IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	
Aleksander KOCOVSKI et al.	Group Art Unit: 2628
Application No.: 16/403,283	Examiner: LAM, VINH TANG
Filing Date.: 05/03/2019	Confirmation No.: 5417
For: TOUCH DEVICE	**VIA EFS-WEB**

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Commissioner:

FEE ADDRESS FOR MAINTENANCE FEE PURPOSES
IN ACCORDANCE WITH 37 C.F.R. 1.363

In accordance with the provisions of 37 C.F.R. 1.363, the fee address set forth below is being supplied for purposes of receiving notices, receipts, and other correspondence relating to the payment of maintenance fees:

CPA Global Limited
3133 West Frye Road, Suite 400,
Chandler, AZ 85226

Payor No.: 0069353

Respectfully submitted,

FINNEGAN, HENDERSON, FARABOW,
GARRETT & DUNNER, L.L.P.

Dated: May 6, 2022

By: / Arpita Bhattacharyya /
Arpita Bhattacharyya
Reg. No. 63,681
(650) 849-6650

Electronic Acknowledgement Receipt

EFS ID:	45649641
Application Number:	16403283
International Application Number:	
Confirmation Number:	5417
Title of Invention:	TOUCH DEVICE
First Named Inventor/Applicant Name:	Aleksander Kocovski
Customer Number:	22852
Filer:	Aaron James Capron/Maria Poulakos
Filer Authorized By:	Aaron James Capron
Attorney Docket Number:	14700.0002-00000
Receipt Date:	06-MAY-2022
Filing Date:	03-MAY-2019
Time Stamp:	10:59:05
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Maintenance Fee Address Change	14700_0002_00_Maintenance_Fee_Address_Change_Form_14700_0002_As_Filed.pdf	13561 903e19b7cdf5ab8d57b5b1325af5d36562009cf8	no	1

Warnings:

Information:	
Total Files Size (in bytes):	13561

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/403,283	03/22/2022	11281335	14700.0002-00000	5417

22852 7590 03/02/2022

FINNEGAN, HENDERSON, FARABOW, GARRETT & DUNNER
LLP
901 NEW YORK AVENUE, NW
WASHINGTON, DC 20001-4413

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 0 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

INVENTOR(s) (Please see PAIR WEB site http://pair.uspto.gov for additional inventors):

Aleksander Kocovski, Malmo, SWEDEN;
Hakan Bergstrom, Torna-Hallestad, SWEDEN;
Jens Thorvinger, Lund, SWEDEN;

APPLICANT(s) (Please see PAIR WEB site http://pair.uspto.gov for additional applicants):

Flatfrog Laboratories AB, Lund, SWEDEN;

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The USA offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to encourage and facilitate business investment. To learn more about why the USA is the best country in the world to develop technology, manufacture products, and grow your business, visit SelectUSA.gov.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

22852 7590 12/08/2021

FINNEGAN, HENDERSON, FARABOW, GARRETT & DUNNER LLP
901 NEW YORK AVENUE, NW
WASHINGTON, DC 20001-4413

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)

(Signature)

(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/403,283	05/03/2019	Aleksander Kocovski	14700.0002-00000	5417

TITLE OF INVENTION: TOUCH DEVICE

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	03/08/2022

EXAMINER	ART UNIT	CLASS-SUBCLASS
LAM, VINH TANG	2628	345-175000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

☒ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-09 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 Finnegan, Henderson,
2 Farabow, Garrett &
3 Dunner, LLP

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE	(B) RESIDENCE: (CITY and STATE OR COUNTRY)
FlatFrog Laboratories AB	Lund, Sweden

Please check the appropriate assignee category or categories (will not be printed on the patent) : ☐ Individual ☒ Corporation or other private group entity ☐ Government

4a. Fees submitted: ☒ Issue Fee ☐ Publication Fee (if required) ☐ Advance Order - # of Copies _____

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

☒ Electronic Payment via EFS-Web ☐ Enclosed check ☐ Non-electronic payment by credit card (Attach form PTO-2038)

☒ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. 06-0916

5. **Change in Entity Status** (from status indicated above)

☐ Applicant certifying micro entity status. See 37 CFR 1.29

☐ Applicant asserting small entity status. See 37 CFR 1.27

☐ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature /Arpita Bhattacharyya/ Date 02/11/2022

Typed or printed name Arpita Bhattacharyya Registration No. 63,681

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 5

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	)	
	)	
Aleksander KOCOVSKI et al.	)	Group Art Unit: 2628
	)	
Application No. 16/403,283	)	Examiner: Vinh Tang LAM
	)	
Filed: May 3, 2019	)	Confirmation No. 5417
	)	
For: TOUCH DEVICE	)	
	)	VIA EFS-WEB
	)	

Mail Stop Issue Fee
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Commissioner:

COMMENTS ON STATEMENT OF REASONS FOR ALLOWANCE

Applicant thanks the Examiner for the Notice of Allowance dated December 8, 2021. Without withdrawing the allowed claims from issue, Applicant submits these comments for the record.

In the Examiner's Statement of Reasons for Allowance, included with the Notice of Allowance, the Examiner made characterizations and assertions regarding the basis for the allowability of the claims and the prior art of record. Although Applicant agrees with the Examiner's ultimate conclusion that the pending claims are patentable, Applicant does not necessarily agree with the characterizations and assertions made in the Examiner's Statement.

Applicant submits that each of the allowed claims is patentable based on the subject matter defined by the claim language and the combination of recitations within the claims, and not based solely on the reasons emphasized in any statement by the Examiner.

Should the Examiner disagree with the Applicant's comments submitted herewith, the Examiner is invited to contact the undersigned to resolve such disagreement.

Please charge any fee due in connection with the filing of these Comments to Deposit Account 06-0916.

Respectfully submitted,

FINNEGAN, HENDERSON, FARABOW,
GARRETT & DUNNER, L.L.P.

Dated: February 11, 2022

By: /Arpita Bhattacharyya/
Arpita Bhattacharyya
Reg. No. 63,681
(650) 849-6650

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 7

Electronic Patent Application Fee Transmittal

Application Number:	16403283
Filing Date:	03-May-2019
Title of Invention:	TOUCH DEVICE
First Named Inventor/Applicant Name:	Aleksander Kocovski
Filer:	Aaron James Capron/Maria Poulakos
Attorney Docket Number:	14700.0002-00000

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
UTILITY APPL ISSUE FEE	1501	1	1200	1200

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**1200**

Electronic Acknowledgement Receipt

EFS ID:	44979467
Application Number:	16403283
International Application Number:	
Confirmation Number:	5417
Title of Invention:	TOUCH DEVICE
First Named Inventor/Applicant Name:	Aleksander Kocovski
Customer Number:	22852
Filer:	Aaron James Capron/Maria Poulakos
Filer Authorized By:	Aaron James Capron
Attorney Docket Number:	14700.0002-00000
Receipt Date:	11-FEB-2022
Filing Date:	03-MAY-2019
Time Stamp:	16:20:44
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$1200
RAM confirmation Number	E20222AG21210976
Deposit Account	
Authorized User	

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Issue Fee Payment (PTO-85B)	14700_0002_Issue_Fee_Transmittal_signed.pdf	100727 cf46c519ba43411f3506effa4688ff4fb393697e	no	1
Warnings:					
Information:					
2	Post Allowance Communication - Incoming	14700_0002_00000_Comments_on_Statement_of_Reasons_for_Allowance_signed.pdf	22042 9b593f86116581b76e361c45fb7c88a666285a6d	no	2
Warnings:					
Information:					
3	Fee Worksheet (SB06)	fee-info.pdf	37898 7b5b7c13e5a69ac581ea0b9a707a9ff7fb124c05	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	160667		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

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New International Application Filed with the USPTO as a Receiving Office

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UNITED STATES PATENT AND TRADEMARK OFFICE
COMMISSIONER FOR PATENTS
P.O.BOX 1450
ALEXANDRIA VA 22313-1451

PRESORTED
FIRST-CLASS MAIL
U.S. POSTAGE PAID
POSTEDIGITAL
NNNNN

FINNEGAN, HENDERSON, FARABOW,
GARRETT & DUNNER
LLP
901 NEW YORK AVENUE, NW
WASHINGTON, DC 20001-4413

Courtesy Reminder for
Application Serial No: 16/403,283

Attorney Docket No: 14700.0002-00000
Customer Number: 22852
Date of Electronic Notification: 12/08/2021

This is a courtesy reminder that new correspondence is available for this application. If you have not done so already, please review the correspondence. The official date of notification of the outgoing correspondence will be indicated on the form PTOL-90 accompanying the correspondence.

An email notification regarding the correspondence was sent to the following email address(es) associated with your customer number:
regional-desk@finnegan.com

To view your correspondence online or update your email addresses, please visit us anytime at **https://ppair-my.uspto.gov/pair/PrivatePair.**
If you have any questions, please email the Electronic Business Center (EBC) at EBC@uspto.gov or call 1-866-217-9197.

PATENT ASSIGNMENT COVER SHEET

Electronic Version v1.1
Stylesheet Version v1.2

EPAS ID: PAT7073115

SUBMISSION TYPE:	NEW ASSIGNMENT
NATURE OF CONVEYANCE:	ASSIGNMENT

CONVEYING PARTY DATA

Name	Execution Date
ALEKSANDER KOCOVSKI	02/21/2019
HAKAN BERGSTROM	02/21/2019
JENS THORVINGER	02/25/2019

RECEIVING PARTY DATA

Name:	FLATFROG LABORATORIES AB
Street Address:	SCHEELEVAGEN 15
City:	LUND
State/Country:	SWEDEN
Postal Code:	223 63

PROPERTY NUMBERS Total: 1

Property Type	Number
Application Number:	16403283

CORRESPONDENCE DATA

Fax Number: (202)408-4400

Correspondence will be sent to the e-mail address first; if that is unsuccessful, it will be sent using a fax number, if provided; if that is unsuccessful, it will be sent via US Mail.

Phone: 2024084000
Email: faxserve@finnegan.com
Correspondent Name: FINNEGAN HENDERSON FARABOW GARRETT & DUNNER
Address Line 1: 901 NEW YORK AVENUE, NW
Address Line 4: WASHINGTON, D.C. 20001-4413

ATTORNEY DOCKET NUMBER:	14700.0002-00000
NAME OF SUBMITTER:	MARIA POULAKOS
SIGNATURE:	/Maria Poulakos/
DATE SIGNED:	12/14/2021
	This document serves as an Oath/Declaration (37 CFR 1.63).

Total Attachments: 5
source=14700_0002_00_Combined_Dec_Assignment (2)#page1.tif
source=14700_0002_00_Combined_Dec_Assignment (2)#page2.tif
source=14700_0002_00_Combined_Dec_Assignment (2)#page3.tif

source=14700_0002_00_Combined_Dec_Assignment (2)#page4.tif
source=14700_0002_00_Combined_Dec_Assignment (2)#page5.tif

COMBINED DECLARATION & ASSIGNMENT (37 CFR 1.63(e))

Application Data Sheet filed previously or concurrently

Docket No.: FFOG.053C1

Title: TOUCH DEVICE

Inventors: Aleksander Kocovski, Hakan Bergstrom, Jens Thorvinger

Declaration

This Declaration is directed to U.S. or International Application No. **16/190907**, filed November 14, 2018 and incorporating any amendments made thereto prior to the signature date of this Declaration.

As a named inventor, I declare that:

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 USC 1001 by fine or imprisonment of not more than five (5) years, or both.

I have reviewed and understand the contents of the above-identified application, including the claims, as amended by any amendment.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56.

Assignment from Inventors

WHEREAS, **above-identified inventors** (individual(s) hereinafter "ASSIGNOR") invented certain new and useful improvements, technology, inventions, developments, ideas, ornamental designs, or discoveries, and hereby assign or are under an obligation to assign to the below identified Assignee the above-titled application (collectively hereinafter referred to as the "Work") for which an application for Letters Patent in the United States (identified above) has been prepared for filing with the United States Patent and Trademark Office (hereinafter the "Application").

AND WHEREAS, **FlatFrog Laboratories AB,** with its principal place of business at Scheelevagen 15, 223 63 Lund, Sweden (hereinafter the "ASSIGNEE"), desires to acquire the entire right, title, and interest in and to the Application and the Work.

NOW, THEREFORE, for good and valuable consideration of which receipt is hereby acknowledged, ASSIGNOR hereby acknowledges that ASSIGNOR has sold, assigned, transferred and set over, and by these presents does hereby sell, assign, transfer and set over, unto said ASSIGNEE, its successors, legal representatives and assigns, the entire right, title, and interest throughout the world in the Application and the Work, including all Patent Properties filed or issued upon the Application and the Work; where "Patent Properties" include, but are not limited to:

all provisional applications relating thereto (including but not limited to U.S. Provisional Application No(s). , filed (respectively if plural applications));

all nonprovisional applications claiming priority to aforementioned provisional(s) and/or the present Application, including, all divisions, continuations, continuations-in-part, and reissues, and all Letters Patent of the United States which may be granted thereon and all reissues and extensions thereof; and

all rights of priority under International Conventions and any related Letters Patent which may hereafter be granted or filed in any country or countries foreign to the United States, all extensions, renewals and reissues thereof.

ASSIGNOR hereby acknowledges the ASSIGNEE as the Applicant for all aforementioned Patent Properties, and authorizes and requests the Commissioner of Patents of the United States, and any

Official of any country or countries foreign to the United States, whose duty it is to issue patents on applications as aforesaid, to issue all related Letters Patent to the ASSIGNEE, its successors, legal representatives and assigns, in accordance with the terms of this instrument.

AND ASSIGNOR DOES HEREBY sell, assign, transfer, and convey to ASSIGNEE, its successors, legal representatives, and assigns all claims for damages and all remedies arising out of any violation of the rights assigned hereby that may have accrued prior to the date of assignment to ASSIGNEE, or may accrue hereafter, including, but not limited to, the right to sue for, collect, and retain damages for past infringements of said Letters Patent before or after issuance.

AND ASSIGNOR DOES HEREBY covenant and agree that ASSIGNOR will communicate to said ASSIGNEE, its successors, legal representatives and assigns, any facts known to ASSIGNOR respecting the Work, and testify in any legal proceeding, assist in the preparation of any other Patent Property relating to the Application and the Work or any improvements made thereto, sign/execute all lawful papers, authorize the filing of and execute and make all rightful oaths and/or declarations in connection with the Application and the Work including any improvements made thereto, any patent applications filed therefrom, and any continuing application filed from any of the aforementioned applications, and generally do everything possible to aid the ASSIGNEE, its successors, legal representatives and assigns, to obtain and enforce proper patent protection for the Work in all countries.

COMBINED DECLARATION & ASSIGNMENT (37 CFR 1.63(e))

Application Data Sheet filed previously or concurrently

Docket No.: FFOG.053C1

Title: TOUCH DEVICE

Inventors: Aleksander Kocovski, Hakan Bergstrom, Jens Thorvinger

Legal Name of inventor: Aleksander Kocovski

Signature: Aleksander Kocovski
Aleksander Kocovski (Feb 21, 2019)

Date: Feb 21, 2019

Witnessed by: _____

Witness Name (printed): _____

Legal Name of inventor: Hakan Bergstrom

Signature: Håkan Bergström
Håkan Bergström (Feb 21, 2019) Date: Feb 21, 2019

Witnessed by: _____

Witness Name (printed): _____

COMBINED DECLARATION & ASSIGNMENT (37 CFR 1.63(e))

Application Data Sheet filed previously or concurrently

Docket No.: FFOG.053C1

Title: TOUCH DEVICE

Inventors: Aleksander Kocovski, Hakan Bergstrom, Jens Thorvinger

Legal Name of inventor: Jens Thorvinger

Signature: Jens Thorvinger
Jens Thorvinger (Feb 25, 2019)

Date: Feb 25, 2019

Witnessed by: _____

Witness Name (printed): _____

29688161

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

22852 7590 12/08/2021

FINNEGAN, HENDERSON, FARABOW, GARRETT & DUNNER LLP
901 NEW YORK AVENUE, NW
WASHINGTON, DC 20001-4413

EXAMINER
LAM, VINH TANG

ART UNIT	PAPER NUMBER
2628	

DATE MAILED: 12/08/2021

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/403,283	05/03/2019	Aleksander Kocovski	14700.0002-00000	5417

TITLE OF INVENTION: TOUCH DEVICE

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	03/08/2022

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Maintenance fees are due in utility patents issuing on applications filed on or after Dec. 12, 1980. It is patentee's responsibility to ensure timely payment of maintenance fees when due. More information is available at www.uspto.gov/PatentMaintenanceFees.

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 20

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

22852 7590 12/08/2021

FINNEGAN, HENDERSON, FARABOW, GARRETT & DUNNER LLP
901 NEW YORK AVENUE, NW
WASHINGTON, DC 20001-4413

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/403,283	05/03/2019	Aleksander Kocovski	14700.0002-00000	5417

TITLE OF INVENTION: TOUCH DEVICE

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	03/08/2022

EXAMINER	ART UNIT	CLASS-SUBCLASS
LAM, VINH TANG	2628	345-175000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-09 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 _____
2 _____
3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. Fees submitted: ❑ Issue Fee ❑ Publication Fee (if required) ❑ Advance Order - # of Copies _____

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

❑ Electronic Payment via EFS-Web ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. _____

5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29

❑ Applicant asserting small entity status. See 37 CFR 1.27

❑ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/403,283	05/03/2019	Aleksander Kocovski	14700.0002-00000	5417

22852 7590 12/08/2021

FINNEGAN, HENDERSON, FARABOW, GARRETT & DUNNER LLP
901 NEW YORK AVENUE, NW
WASHINGTON, DC 20001-4413

EXAMINER	
LAM, VINH TANG	

ART UNIT	PAPER NUMBER
2628	

DATE MAILED: 12/08/2021

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 22

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	Application No. 16/403,283	Applicant(s) Kocovski et al.	
	Examiner VINH T LAM	Art Unit 2628	AIA (FITF) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to 09/27/2021.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☑ The allowed claim(s) is/are 2-5 and 10 . As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information , please see **http://www.uspto.gov/patents/init_events/pph/index.jsp** or send an inquiry to **PPHfeedback@uspto.gov.**

4. ☑ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☐ All b) ☐ Some* c) ☑ None of the:

   1. ☑ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☑ Notice of References Cited (PTO-892)
2. ☑ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☐ Examiner's Amendment/Comment
6. ☑ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/VINH T LAM/
Primary Examiner, Art Unit 2628

EXAMINER'S STATEMENT OF REASONS FOR ALLOWANCE

Notice of Pre-AIA or AIA Status

1. The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Priority

2. Acknowledgment is made of applicant's claim for foreign priority based on an application filed in **SE** on **12/07/2016**. It is noted, however, that applicant has not filed a certified copy of the 16302945 application as required by 37 CFR 1.55.

Response to Arguments

3. Applicant's arguments, see P. **4**, filed **09/27/2021**, with respect to **Rejections** under **35 U.S.C. § 103** have been fully considered and are persuasive. The **Rejections** under **35 U.S.C. § 103** have been withdrawn.

Allowable Subject Matter

4. Claims **2-5** and **10** are allowed.

5. The following is an examiner's statement of reasons for allowance:

Kukulj (US PGPub./Pat. 20120223916) teaches infrared-style touch screens are described having light emission means and light detection means along only two opposing sides of a touch input area, which are nevertheless able to detect and locate a touch object in two dimensions. Certain embodiments use an edge-blurring algorithm to determine the second coordinate, while other embodiments use a form of stereo-scopic vision to determine both coordinates by triangulation. These touch screens have minimal bezel width along two opposing sides of the touch input area, and also offer cost reductions associated with components and product assembly and manufacturing.

KWON et al. (US PGPub./Pat. 20170147105) teach the touch input device comprises a base including a metal composite; a first pattern groove formed concavely in one surface of the base, a second pattern groove formed concavely in the other surface of the base; a first sensing pattern disposed in the first pattern groove and including a conductive material; a second sensing pattern disposed in the second pattern groove and including a conductive material; and a wire connecting the first sensing pattern and the second sensing pattern to an integrated circuit.

The subject matter of the independent claims could either not be found or was not suggested in the prior art of record. The subject matter not found was a touch device including

"…the second frame element includes a first surface portion extending over an edge portion of the plate and a second surface portion arranged substantially parallel to a surface of the plate that defines the plate thickness…

…wherein a distance between a first curved line drawn on the touch surface and a second straight line drawn on the flat plane varies according to a concave curve function; and

wherein all of the edges of the top surface of the plate are curved." (Claim **1**),

in combination with the other elements (or steps) of the device or apparatus and method recited in the claims.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to VINH TANG LAM whose telephone number is (571) 270-3704. The examiner can normally be reached Monday to Friday 8:00 AM to 5:00 PM.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nitin K Patel can be reached on (571) 272-7677. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of published or unpublished applications may be obtained from Patent Center. Unpublished application information in Patent Center is available to registered users. To file and manage patent submissions in Patent Center, visit: https://patentcenter.uspto.gov. Visit https://www.uspto.gov/patents/apply/patent-center for more information about Patent Center and https://www.uspto.gov/patents/docx for information about filing in DOCX format. For additional questions, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/VINH T LAM/
Primary Examiner, Art Unit 2628

Notice of References Cited	Application/Control No. 16/403,283	Applicant(s)/Patent Under Reexamination Kocovski et al.	
	Examiner VINH T LAM	Art Unit 2628	Page 1 of 2

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-10642386-B2	05-2020	Makelainen; Esa	G06F3/04164	1/1
*	B	US-10126897-B2	11-2018	Kwon; Gideok	B60K37/06	1/1
*	C	US-20170308236-A1	10-2017	LEE; Jun Goo	G06F3/04182	1/1
*	D	US-20170147105-A1	05-2017	KWON; Gideok	G06F3/0445	1/1
*	E	US-20170075494-A1	03-2017	Kwon; Gideok	G06F3/0446	1/1
*	F	US-20170075476-A1	03-2017	KWON; Gideok	G06F3/04883	1/1
*	G	US-9563298-B2	02-2017	Sakashita; Asako	G06F3/041	1/1
*	H	US-20160334942-A1	11-2016	Wassvik; Ola	G06F3/0428	1/1
*	I	US-20160295711-A1	10-2016	RYU; Hyunjong	H05K5/03	1/1
*	J	US-20160147375-A1	05-2016	BOK; Seung Lyong	G06F3/04166	345/175
*	K	US-20150331546-A1	11-2015	CRAVEN-BARTLE; Thomas	G02B6/0038	345/175
*	L	US-9063614-B2	06-2015	Pettersson; Robert	G06F3/0421	1/1
*	M	US-20120223916-A1	09-2012	Kukulj; Dax	G06F3/0428	345/175

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Notice of References Cited	Application/Control No. 16/403,283	Applicant(s)/Patent Under Reexamination Kocovski et al.	
	Examiner VINH T LAM	Art Unit 2628	Page 2 of 2

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-20120089348-A1	04-2012	Perlin; Kenneth	G06F3/04144	702/41
	B					
	C					
	D					
	E					
	F					
	G					
	H					
	I					
	J					
	K					
	L					
	M					

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/403,283	Kocovski et al.
	Examiner	Art Unit
	VINH T LAM	2628

CPC - Searched*		
Symbol	Date	Examiner
G06F3/0421 G06F2203/04103	11/15/2021	vl

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
Search inventor'(s)' name(s). No ODP.	02/13/2020	vl
Search technical terms and synonyms.	11/15/2021	vl
Search IDS.	11/15/2021	vl
Search Foreign Patent Literature(s) and NPL (IP.com).	11/15/2021	vl
Search CPC.	11/15/2021	vl
Search PE2E.	11/15/2021	vl
Review amendment and argument.	11/15/2021	vl

/VINH T LAM/ Primary Examiner, Art Unit 2628	

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/403,283	Kocovski et al.
	Examiner	Art Unit
	VINH T LAM	2628

Interference Search			
US Class/CPC Symbol	**US Subclass/CPC Group**	**Date**	**Examiner**
Search all of the above.	Search all of the above.	11/15/2021	vl

/VINH T LAM/ Primary Examiner, Art Unit 2628	

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	16/403,283	Kocovski et al.
	Examiner	**Art Unit**
	VINH T LAM	2628

CPC								
Symbol							**Type**	**Version**
G06F	/	3	/	0421			F	2013-01-01
G06F	/	1	/	1652			I	2013-01-01
G06F	/	1	/	16			I	2013-01-01
G06F	/	3	/	041			I	2013-01-01
G06F	/	2203	/	04102			A	2013-01-01
G06F	/	2203	/	04103			A	2013-01-01

CPC Combination Sets								
Symbol							**Type**	**Set**	**Ranking**	**Version**
	/		/							

None		Total Claims Allowed:	
(Assistant Examiner)	(Date)	5	
/VINH T LAM/ Primary Examiner, Art Unit 2628	15 November 2021	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/403,283	Kocovski et al.
	Examiner	**Art Unit**
	VINH T LAM	2628

INTERNATIONAL CLASSIFICATION				
CLAIMED				
G06F	/	3	/	042
G06F	/	1	/	16
G06F	/	3	/	041

NON-CLAIMED				
	/		/	

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**

CROSS REFERENCES(S)						
CLASS	**SUBCLASS (ONE SUBCLASS PER BLOCK)**					

None (Assistant Examiner)	(Date)	**Total Claims Allowed:** 5	
/VINH T LAM/ Primary Examiner, Art Unit 2628 (Primary Examiner)	15 November 2021 (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 1

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/403,283	Kocovski et al.
	Examiner	Art Unit
	VINH T LAM	2628

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIMS

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
-	1	5	10	-	19										
1	2	-	11	-	20										
2	3	-	12	-	21										
3	4	-	13	-	22										
4	5	-	14	-	23										
-	6	-	15												
-	7	-	16												
-	8	-	17												
-	9	-	18												

None		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	5	
/VINH T LAM/ Primary Examiner, Art Unit 2628	15 November 2021	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office

Part of Paper No.: 20211115

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Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
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	Examiner	**Art Unit**
	VINH T LAM	2628

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	02/13/2020	10/05/2020	03/17/2021	06/30/2021	08/17/2021	11/15/2021			
-	1	-	-	-	-	-	-			
1	2	=	=	✓	✓	=	=			
2	3	=	=	✓	✓	=	=			
3	4	=	=	✓	✓	=	=			
4	5	=	=	✓	✓	=	=			
-	6	=	=	✓	✓	=	-			
-	7	=	=	✓	✓	=	-			
-	8	=	=	✓	✓	=	-			
-	9	=	=	✓	✓	=	-			
5	10	=	=	✓	✓	=	=			
-	11	=	=	✓	✓	=	-			
-	12	=	=	✓	✓	=	-			
-	13	✓	✓	✓	✓	=	-			
-	14	✓	✓	✓	✓	=	-			
-	15	✓	✓	✓	✓	=	-			
-	16	✓	✓	✓	✓	=	-			
-	17	✓	✓	✓	✓	=	-			
-	18	✓	✓	✓	✓	=	-			
-	19	✓	✓	✓	✓	=	-			
-	20	✓	✓	✓	✓	=	-			
-	21	✓	✓	✓	✓	-	-			
-	22		✓	✓	✓	-	-			
-	23		✓	✓	✓	-	-			

PE2E SEARCH - Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
L1	1	16/403283.app.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/11/15 11:32 AM
L2	96	((("FLATFROG") near3 ("LABORATORIES") near3 ("AB"))).AS,AANM.	(USPAT)	OR	ON	ON	2021/11/15 11:35 AM
L3	68	((("KOCOVSKI") near3 ("Aleksander")) OR (("BERGSTROM") near3 ("Hakan")) OR (("THORVINGER") near3 ("Jens"))).INV.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2021/11/15 11:35 AM
L4	4	2 AND 3 AND ((short long) SAME edge$1).clm.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/11/15 11:40 AM
L5	250	("10282035" OR "10649585" OR "20080080811" OR "20100073327" OR "20110141062" OR "20110205189" OR "20120056807" OR "20120170056" OR "20120212457" OR	(US-PGPUB; USPAT)	OR	ON	ON	2021/11/15 11:44 AM

		"20120242622" OR "20130155655" OR "20130222344" OR "20130257810" OR "20130300714" OR "20140015803" OR "20140152624" OR "20140210793" OR "20140226084" OR "20150131010" OR "20150199071" OR "20150256658" OR "20150261323" OR "20150339000" OR "20160041629" OR "20160062549" OR "20160092021" OR "20160103026" OR "20160154533" OR "20160306501" OR "20170031516" OR "20170075484" OR "20170160871" OR "20170220204" OR "20180107373" OR "20180136788" OR "20180149792" OR "20180314206" OR "20190004668" OR "20190025984" OR "20190107923" OR "20190146630" OR "20190196657" OR "20190196658" OR "20190196659" OR "20190227670" OR "20190258353" OR "20190324570" OR "20190377431" OR "20190377435" OR "20200073509" OR "20200098147" OR "20200125189" OR "20200159382" OR "20200167033" OR "20200249777" OR "20200310621" OR "20200341587" OR "20200348473" OR "20200387237" OR "4868550" OR "5729250" OR "8319729" OR "9001086" OR "9207800" OR "9291845" OR "9366802" OR "9983626" OR					

		"20120223916" OR "20110080361" OR "20130234991" OR "20130321740" OR "20150373864" OR "20190235701" OR "4751379" OR "9024896" OR "20100103133" OR "20120062492" OR "20160026297" OR "20160209886" OR "20160255713" OR "20160295711" OR "6031524" OR "10013107" OR "10019113" OR "20010002694" OR "20010005004" OR "20010005308" OR "20010030642" OR "20020067348" OR "20020075243" OR "20020118177" OR "20020158823" OR "20020158853" OR "20020163505" OR "20030016450" OR "20030034439" OR "20030034935" OR "20030048257" OR "20030052257" OR "20030095399" OR "20030107748" OR "20030137494" OR "20030156100" OR "20030160155" OR "20030210537" OR "20030214486" OR "20040027339" OR "20040032401" OR "20040090432" OR "20040130338" OR "20040174541" OR "20040201579" OR "20040212603" OR "20040238627" OR "20040239702" OR "20040245438" OR "20040252091" OR "20040252867" OR "20050012714" OR "20050041013" OR "20050057903" OR "20050073508" OR "20050083293" OR "20050128190" OR "20050143923" OR					

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		"20080150848" OR "20080151126" OR "20080158176" OR "20080189046" OR "20080192025" OR "20080238433" OR "20080246388" OR "20080252619" OR "20080266266" OR "20080278460" OR "20080284925" OR "20080291668" OR "20080297482" OR "20090000831" OR "20090002340" OR "20090006292" OR "20090040786" OR "20090066647" OR "20090067178" OR "20090073142" OR "20090077501" OR "20090085894" OR "20090091554" OR "20090115919" OR "20090122020" OR "20090122027" OR "20090128508" OR "20090135162" OR "20090143141" OR "20090153519" OR "20090161026" OR "20090168459" OR "20090187842" OR "20090189857" OR "20090189874" OR "20090189878" OR "20090219256" OR "20090229892" OR "20090251439" OR "20090256817" OR "20090259967" OR "20090267919" OR "20090273794" OR "20090278816" OR "20090297009" OR "20100033444" OR "20100045629" OR "20100060896" OR "20100066016" OR "20100066704" OR "20100073318" OR "20100078545" OR "20100079407" OR "20100079408" OR "20100097345" OR "20100097348" OR "20100097353" OR "20100125438" OR					

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L6	250	("20100277436" OR "20100283785" OR "20100284596" OR "20100289754" OR "20100295821" OR "20100302196" OR "20100302209" OR "20100302210" OR "20100302240" OR "20100315379" OR "20100321328" OR "20100322550" OR "20110043490" OR "20110049388" OR "20110050649" OR "20110051394" OR "20110068256" OR "20110069039" OR "20110069807" OR "20110074725" OR "20110074734" OR "20110074735" OR "20110084939" OR "20110090176" OR "20110102374" OR "20110115748" OR "20110121323" OR "20110122075" OR "20110122091" OR "20110122094" OR "20110134079" OR "20110147569" OR "20110157095" OR "20110157096" OR "20110163996" OR "20110163997" OR "20110163998" OR "20110169780" OR "20110175852" OR "20110205186" OR "20110216042" OR "20110221705" OR "20110221997" OR "20110227036" OR "20110227874" OR "20110234537" OR "20110254864" OR "20110261020" OR	(US-PGPUB; USPAT)	OR	ON	ON	2021/11/15 11:44 AM

		"20110267296" OR "20110291989" OR "20110298743" OR "20110309325" OR "20110310045" OR "20120019448" OR "20120026408" OR "20120038593" OR "20120062474" OR "20120068973" OR "20120086673" OR "20120089348" OR "20120110447" OR "20120131490" OR "20120141001" OR "20120146930" OR "20120153134" OR "20120154338" OR "20120162142" OR "20120162144" OR "20120169672" OR "20120181419" OR "20120182266" OR "20120188206" OR "20120191993" OR "20120200532" OR "20120200538" OR "20120212441" OR "20120217882" OR "20120218229" OR "20120249478" OR "20120256882" OR "20120268403" OR "20120268427" OR "20120274559" OR "20120305755" OR "20120313865" OR "20130021300" OR "20130021302" OR "20130027404" OR "20130044073" OR "20130055080" OR "20130076697" OR "20130082980" OR "20130106709" OR "20130107569" OR "20130113715" OR "20130120320" OR "20130125016" OR "20130127790" OR "20130135258" OR "20130135259" OR "20130141388" OR "20130141395" OR "20130154983" OR "20130155027" OR "20130158504" OR "20130181896" OR					

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		"3440426" OR "3553680" OR "3673327" OR "4129384" OR "4180702" OR "4209255" OR "4213707" OR "4254333" OR "4254407" OR "4294543" OR "4346376" OR "4420261" OR "4484179" OR "4507557" OR "4521112" OR "4542375" OR "4550250" OR "4593191" OR "4673918" OR "4688933" OR "4688993" OR "4692809" OR "4710760" OR "4736191" OR "4737626" OR "4746770" OR "4752655" OR "4772763").pn.					
L7	182	("4782328" OR "4812833" OR "4837430" OR "4868912" OR "4891829" OR "4916712" OR "4933544" OR "4949079" OR "4986662" OR "4988983" OR "5065185" OR "5073770" OR "5105186" OR "5159322" OR "5166668" OR "5227622" OR "5248856" OR "5254407" OR "5345490" OR "5383022" OR "5483261" OR "5484966" OR "5499098" OR "5502568" OR "5525764" OR "5526422" OR "5539514" OR "5570181" OR "5572251" OR	(US-PGPUB; USPAT)	OR	ON	ON	2021/11/15 11:44 AM

		"5577501" OR "5600105" OR "5608550" OR "5672852" OR "5679930" OR "5686942" OR "5688933" OR "5729249" OR "5736686" OR "5740224" OR "5764223" OR "5767517" OR "5775792" OR "5945980" OR "5945981" OR "5959617" OR "6061177" OR "6067079" OR "6122394" OR "6141104" OR "6172667" OR "6175999" OR "6227667" OR "6229529" OR "6333735" OR "6366276" OR "6380732" OR "6380740" OR "6390370" OR "6429857" OR "6452996" OR "6476797" OR "6492633" OR "6495832" OR "6504143" OR "6529327" OR "6538644" OR "6587099" OR "6648485" OR "6660964" OR "6664498" OR "6664952" OR "6690363" OR "6707027" OR "6738051" OR "6748098" OR "6784948" OR "6799141" OR "6806871" OR "6927384" OR "6940286" OR "6965836" OR "6972753" OR "6985137" OR "7042444" OR "7084859" OR "7087907" OR "7133031" OR					

		"7176904" OR "7199932" OR "7359041" OR "7397418" OR "7432893" OR "7435940" OR "7436443" OR "7442914" OR "7465914" OR "7613375" OR "7629968" OR "7646833" OR "7653883" OR "7655901" OR "7705835" OR "7729056" OR "7847789" OR "7855716" OR "7859519" OR "7924272" OR "7932899" OR "7969410" OR "7995039" OR "8013845" OR "8031186" OR "8077147" OR "8093545" OR "8094136" OR "8094910" OR "8149211" OR "8218154" OR "8274495" OR "8325158" OR "8339379" OR "8350827" OR "8384010" OR "8407606" OR "8441467" OR "8445834" OR "8466901" OR "8482547" OR "8542217" OR "8567257" OR "8581884" OR "8624858" OR "8686974" OR "8692807" OR "8716614" OR "8727581" OR "8745514" OR "8780066" OR "8830181" OR "8860696" OR "8872098" OR "8872801" OR "8884900" OR "8890843" OR "8890849" OR					

		"8928590" OR "8963886" OR "8982084" OR "9024916" OR "9035909" OR "9063614" OR "9063617" OR "9086763" OR "9134854" OR "9158401" OR "9158415" OR "9201520" OR "9213445" OR "9274645" OR "9280237" OR "9317168" OR "9323396" OR "9366565" OR "9377884" OR "9389732" OR "9411444" OR "9411464" OR "9430079" OR "9442574" OR "9547393" OR "9552103" OR "9557846" OR "9588619" OR "9594467" OR "9618682" OR "9626018" OR "9626040" OR "9639210" OR "9678602" OR "9684414" OR "9710101" OR "9874978").pn.					
L8	146417	first SAME second SAME third SAME fourth SAME (edge boundary perimeter periphery) SAME (curv$3 concave convex)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/11/15 11:54 AM
L9	112619	8 AND @ad<"20161207"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU,	OR	ON	ON	2021/11/15 11:55 AM

			CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L10	90	9 AND (G06F3/0421 G06F2203/04103)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/11/15 11:55 AM
L11	2028	"20200064966" "20200110508" "20210173514" "10775935" "20190079637" "20190079638" "10282035" "20190092411" "2020512607" "112740158" "20210263603" "10845923" "20190196657" "20190196659" "20190196658" "20190196660" "110114737" "10739916" "110663015" "208506715" "20210041970" "10437389" "111868672" "20200225807" "20210173515" "20210096691" "10606416" "20200401270" "20210286464"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/11/15 12:10 PM

		"20200310592" "10963104" "201411455" "11029783" "201416936" "20200201479" "10496227" "20180267672" "20150331547" "20150205441" "20160026337" "9857917" "9857916" "8963886" "110300950" "20130127790" "20150138161" "20160009073" "10268319" "101709889" "20200257405" "8884900" "20130021300" "2014513375" "5593006" "20210349569" "9164625" "8872801" "5821125" "2014222539" "20120154338" "9785287" "20150331544" "20140364218" "20110227874" "10004985" "8581884" "20120068973" "20180296915" "101685220" "20190094990" "9442574" "20160067602" "201430655" "20150331545" "20200150823" "10474249" "20140125633" "20100040277" "10534479" "10048773" "20170010688" "20110096061" "2015505117" "201025102" "11073948" "10318074" "20160224144" "2745422" "101502295" "20140105872" "20150248796" "9741184" "4818859" "20210255662" "20150324028"	ip.com top 200				

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L12	1669	11 AND @ad<"20161207"	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/11/15 12:10 PM
L13	182	12 AND (G06F3/0421 G06F2203/04103)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU,	OR	ON	ON	2021/11/15 12:10 PM

			CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L14	243	"20120223916" "20150331546" "9063614" "20120089348" "20160334942" "4986662" "20160295711" "20170308236" "10860142" "9563298" "20170147105" "20170075494" "20170075476" "20160147375" "10642386" "10126897"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2021/11/15 12:19 PM
L15	125	"20120223916" "20150331546" "9063614" "20120089348" "20160334942" "4986662" "20160295711" "20170308236" "10860142" "9563298" "20170147105" "20170075494" "20170075476" "20160147375" "10642386" "10126897"	(US-PGPUB; USPAT)	OR	ON	ON	2021/11/15 12:19 PM
L16	14	((US-10642386-B2 OR US-10126897-B2 OR US-9563298-B2 OR US-9063614-B2).did. AND USPT.dbnm.) OR ((US-20170308236-A1 OR US-20170147105-A1 OR US-20170075494-A1 OR US-20170075476-A1 OR US-20160334942-A1 OR US-20160295711-A1 OR US-20160147375-A1 OR US-20150331546-	(USPAT; US-PGPUB; FPRS; USOCR; IBM_TDB; EPO; JPO; DERWENT; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW,	OR	ON	ON	2021/11/15 12:32 PM

		A1 OR US-20120223916-A1 OR US-20120089348-A1).did. AND PGPB.dbnm.)	UA, VN))				

PE2E SEARCH - Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
N1	11653	first SAME second SAME third SAME fourth SAME (edge boundary perimeter periphery) SAME (curv$3 concave convex)	(US-PGPUB; USPAT)	OR	ON	ON	2021/11/15 12:00 PM
N4	8265	1 AND @ad<"20161207"	(US-PGPUB; USPAT)	OR	ON	ON	2021/11/15 12:01 PM
N5	17	4 AND (G06F3/0421 G06F2203/04103)	(US-PGPUB; USPAT)	OR	ON	ON	2021/11/15 12:02 PM

PTO/SB/08 Equivalent

INFORMATION DISCLOSURE STATEMENT BY APPLICANT	Application No.	16/403283
	Filing Date	May 3, 2019
	First Named Inventor	Aleksander Kocovski
	Art Unit	2628
(Multiple sheets used when necessary)	Examiner	Lam, Vinh Tang
SHEET 1 OF 7	Attorney Docket No.	FFOG.053C3

U.S. PATENT DOCUMENTS

Examiner Initials	Cite No.	Document Number *Number - Kind Code (if known)* Example: 1,234,567 B1	Publication Date MM-DD-YYYY	Name	Pages, Columns, Lines Where Relevant Passages or Relevant Figures Appear
	1	2020/0387237	12-10-2020	Drumm, Owen	
	2	2019/0377435	12-12-2019	Piot et al.	
	3	2019/0377431	12-12-2019	Drumm, Owen	
	4	2020/0348473	11-05-2020	Drumm, Owen	
	5	2020/0341587	10-29-2020	Drumm, Owen	
	6	2015/0339000	11-26-2014	Lee et al.	
	7	2019/0324570	10-24-2019	Kolundzjia et al.	
	8	2018/0314206	11-01-2018	Lee et al.	
	9	2020/0310621	10-01-2020	Piot et al.	
	10	2016/0306501	10-20-2016	Drumm et al.	
	11	2013/0300714	11-14-2013	Goh et al.	
	12	2015/0261323	09-17-2015	Cui et al.	
	13	2013/0257810	10-03-2013	Niu et al.	
	14	2019/0258353	08-22-2019	Drumm et al.	
	15	2015/0256658	09-10-2015	Shin et al.	
	16	2020/0249777	08-06-2020	Hou et al.	
	17	2012/0242622	09-27-2012	Tseng et al.	
	18	2019/0227670	07-25-2019	O'Cleirigh et al.	
	19	2014/0226084	08-14-2014	Utukuri et al.	
	20	2013/0222344	08-29-2013	Lu et al.	
	21	2017/0220204	08-03-2017	Huang et al.	
	22	2012/0212457	08-23-2012	Drumm, Owen	
	23	2014/0210793	07-31-2014	Eriksson et al.	
	24	2011/0205189	08-25-2011	Newton, John David	
	25	2015/0199071	07-16-2015	Hou	
	26	2015/0199071	07-16-2015	Hou	
	27	2019/0196659	06-27-2019	Skagmo et al.	
	28	2019/0196658	06-27-2019	Skagmo et al.	
	29	2019/0196657	10-08-2019	Skagmo et al.	

Examiner Signature	/VINH T LAM/	Date Considered	11/29/2021

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PTO/SB/08 Equivalent

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	First Named Inventor	Aleksander Kocovski
	Art Unit	2628
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SHEET 2 OF 7	Attorney Docket No.	FFOG.053C3

U.S. PATENT DOCUMENTS

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	30	2016/0179261	06-23-2016	Drumm, Owen	
	31	2012/0170056	07-05-2012	Jakobsen et al.	
	32	2020/0167033	05-28-2020	Kim et al.	
	33	2017/0160871	06-08-2017	Drumm, Owen	
	34	2020/0159382	05-21-2020	Drumm, Owen	
	35	2013/0155655	06-20-2013	Lee et al.	
	36	2016/0154533	06-02-2016	Eriksson et al.	
	37	2014/0152624	06-05-2014	Piot et al.	
	38	2018/0149792	05-31-2018	Lee et al.	
	39	2019/0146630	05-16-2019	Chen et al.	
	40	2011/0141062	06-16-2011	Yu et al.	
	41	2018/0136788	05-17-2018	He et al.	
	42	2015/0131010	05-14-2015	Sugiyama, Koichi	
	43	2020/0125189	04-23-2020	Kim et al.	
	44	2019/0107923	04-11-2019	Drumm, Owen	
	45	2018/0107373	04-19-2018	Cheng, Kai-Yu	
	46	2016/0103026	04-14-2016	Povazay et al.	
	47	2020/0098147	03-26-2020	Ha et al.	
	48	2016/0092021	03-31-2016	Tu et al.	
	49	2008/0080811	04-03-2008	Deane, Peter	
	50	2017/0075484	03-16-2017	Kali et al.	
	51	2010/0073327	03-25-2010	Mau et al.	
	52	2020/0073509	03-05-2020	Shih et al.	
	53	2016/0062549	03-03-2016	Drumm et al.	
	54	2012/0056807	03-08-2012	Chapman et al.	
	55	2016/0041629	02-11-2016	Rao et al.	
	56	2017/0031516	02-02-2017	Sugiyama et al.	
	57	2019/0025984	01-24-2019	Weilbacher et al.	
	58	2014/0015803	01-16-2014	Drumm, Owen	

Examiner Signature	/VINH T LAM/	Date Considered	11/29/2021

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	First Named Inventor	Aleksander Kocovski
	Art Unit	2628
(Multiple sheets used when necessary)	Examiner	Lam, Vinh Tang
SHEET 3 OF 7	Attorney Docket No.	FFOG.053C3

U.S. PATENT DOCUMENTS

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	59	2020/0012408	01-09-2020	Drumm et al.	
	60	2019/0004668	01-03-2019	Jeong et al.	
	61	4,868,550	09-19-1989	Hiroaki et al.	
	62	5,729,250	03-17-1998	Bishop et al.	
	63	8,319,729	11-27-2012	Choi et al.	
	64	9,001,086	04-07-2015	Saini, Amrinder Pal Singh	
	65	9,207,800	12-08-2015	Eriksson et al.	
	66	9,291,845	03-22-2016	Shin et al.	
	67	9,366,802	06-14-2016	Lee et al.	
	68	9,983,626	05-29-2018	Cao et al.	
	69	10,282,035	05-07-2019	Kocovksi et al.	
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Examiner Initials	Cite No.	Foreign Patent Document *Country Code-Number-Kind Code* Example: JP 1234567 A1	Publication Date MM-DD-YYYY	Name	Pages, Columns, Lines Where Relevant Passages or Relevant Figures Appear	T[1]
	71	CN 102117155A	07-06-2011	Guangzhou Shirui Electronics Co Ltd		
	72	CN 103123556 A	05-29-2013	SHENZHEN TIANSHITONG TECHNOLOGY CO LTD		
	73	CN 104391611 A	09-29-2017	SHENZHEN IBOARD TECHNOLOGY Co Ltd		X-Abs
	74	CN 104808843A	07-29-2015	Interface Optoelectronics Shenzhen Co Ltd., Cheng Cheng Technology Chengdu Co Ltd.		
	75	CN 203720812 U	07-16-2014	CHEN YUNHUA; LI RUILIANG		
	76	CN 203786707 U	08-20-2014	SHENZHEN TIMELINK ECHNOLOGY CO., LTD.		X-Abs

Examiner Signature	/VINH T LAM/	Date Considered	11/29/2021

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SHEET 4 OF 7	Attorney Docket No.	FFOG.053C3

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	77	CN 203786708 U	08-20-2014	GUANGZHOU SHIRUI ELECTRICAL TECHNOLOGY CO., LTD.		
	78	CN 203825586 U	09-10-2014	SHENZHEN TIMELINK TECHNOLOGY CO., LTD		
	79	CN202887145U	04-17-2013	HANGZHOU WANIN EDUCATION MULTIMEDIA TECHNOLOGY CO LTD		
	80	CN204288179U	04-22-2015	BEIJING DONVIEW EDUCATION & TECHNOLOGY CO., LTD.		
	81	DE 10025175 A1	12-06-2001	FRIENDLYWAY AKTIENGESELLSCHAFT FUER ANWENDERFREUNDLICHE SYSTEME		
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	83	EP 2325735 A2	05-25-2011	SAMSUNG ELECTRONICS CO LTD		
	84	JP2015158831A	02-07-2018	TAKEUCHI YOSHIFUMI; YANO HISAAKI		
	85	JPS62159213A	07-15-1987	ALPS ELECTRIC CO LTD		
	86	KR 20150125374A	11-09-2015	LG ELECTRONICS INC.		
	87	KR101081586B1	11-08-2011	SAMSUNG ELECTRO-MECHANICS CO., LTD.		
	88	TW M517370U	02-11-2016	TEKQ TECHNOLOGY CO., LTD.		
	89	WO 2014/098742	06-26-2014	FLATFROG LABORATORIES AB		
	90	WO 2014/130515	08-28-2014	CORNING INC		
	91	WO 2014/131221	09-04-2014	SHENZHEN TIMELINK TECHNOLOGY CO LT		X-Abs

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SHEET 5 OF 7	Attorney Docket No.	FFOG.053C3

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Examiner Initials	Cite No.	Foreign Patent Document *Country Code-Number-Kind Code* Example: JP 1234567 A1	Publication Date MM-DD-YYYY	Name	Pages, Columns, Lines Where Relevant Passages or Relevant Figures Appear	T[1]
	92	WO 2016/130074 A1	08-18-2016	FLATFROG LABORATORIES AB		

NON PATENT LITERATURE DOCUMENTS			
Examiner Initials	Cite No.	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T[1]
	93	Defendants' Initial Invalidity Contentions, FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated April 23, 2021, in 26 pages.	
	94	Exhibit 1: Invalidity Claim Chart Against U.S. Patent No. 10,775,935 Based on Prior Public Use and/or Commercial Offer for Sale of Defendant Promethean Inc.'s ActivPanel 4.5 Product, FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated April 23, 2021, in 26 pages.	
	95	Exhibit 2: Invalidity Claim Chart Against U.S. Patent No. 10,775,935 Based on U.S. Patent No. U.S. Pre-Grant Pub. No. 2019/0235701 to Han et al., FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated April 23, 2021, in 26 pages.	
	96	Exhibit 3A: Invalidity Claim Chart Against U.S. Patent No. 10,775,935 Based on U.S. Patent No. 4,751,379 to Sasaki et al., FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated April 23, 2021, in 26 pages.	
	97	Exhibit 3B: Invalidity Claim Chart Against U.S. Patent No. 10,775,935 Based on U.S. Patent No. 4,751,379 to Sasaki et al., FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated April 23, 2021, in 26 pages.	
	98	Exhibit 3C: Invalidity Claim Chart Against U.S. Patent No. 10,775,935 Based on U.S. Patent No. 4,751,379 to Sasaki et al., FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated April 23, 2021, in 26 pages.	
	99	Exhibit 4A: Invalidity Claim Chart Against U.S. Patent No. 10,775,935 Based on U.S. Pre-Grant Pub. No. 2019/0004668 to Jeong et al., FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated April 23, 2021, in 26 pages.	
	100	Exhibit 4B: Invalidity Claim Chart Against U.S. Patent No. 10,775,935 Based on U.S. Pre-Grant Pub. No. 2019/0004668 to Jeong et al., FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated April 23, 2021, in 26 pages.	
	101	Exhibit 4C: Invalidity Claim Chart Against U.S. Patent No. 10,775,935 Based on U.S. Pre-Grant Pub. No. 2019/0004668 to Jeong et al., FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated April 23, 2021, in 26 pages.	
	102	Exhibit 5A: Invalidity Claim Chart Against U.S. Patent No. 10,775,935 Based on U.S. Patent No. 9,983,626 to Cao et al., FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated April 23, 2021, in 26 pages.	
	103	Exhibit 5B: Invalidity Claim Chart Against U.S. Patent No. 10,775,935 Based on U.S. Patent No. 9,983,626 to Cao et al., FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated April 23, 2021, in 26 pages.	
	104	Exhibit 5C: Invalidity Claim Chart Against U.S. Patent No. 10,775,935 Based on U.S. Patent No. 9,983,626 to Cao et al., FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated April 23, 2021, in 26 pages.	

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	105	Exhibit 6A: Invalidity Claim Chart Against U.S. Patent No. 10,775,935 Based on U.S. Pre-Grant Pub. No. 2019/0025984 to Weilbacher et al., FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated April 23, 2021, in 26 pages.	
	106	Exhibit 6B: Invalidity Claim Chart Against U.S. Patent No. 10,775,935 Based on U.S. Pre-Grant Pub. No. 2019/0025984 to Weilbacher et al., FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated April 23, 2021, in 26 pages.	
	107	Exhibit 6C: Invalidity Claim Chart Against U.S. Patent No. 10,775,935 Based on U.S. Pre-Grant Pub. No. 2019/0025984 to Weilbacher et al., FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated April 23, 2021, in 26 pages.	
	108	Exhibit 7A: Invalidity Claim Chart Against U.S. Patent No. 10,775,935 Based on U.S. Patent No. 9,207,800 to Eriksson et al., FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated April 23, 2021, in 26 pages.	
	109	Exhibit 7B: Invalidity Claim Chart Against U.S. Patent No. 10,775,935 Based on U.S. Patent No. 9,207,800 to Eriksson et al., FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated April 23, 2021, in 26 pages.	
	110	Exhibit 7C: Invalidity Claim Chart Against U.S. Patent No. 10,775,935 Based on U.S. Patent No. 9,207,800 to Eriksson et al., FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated April 23, 2021, in 26 pages.	
	111	Exhibit 8: Invalidity Claim Chart Against U.S. Patent No. 10,739,916 Based on Prior Public Use and/or Commercial Offer for Sale of Defendant Promethean Inc.'s ActivPanel 4.5 Product, FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated April 23, 2021, in 26 pages.	
	112	Exhibit 9: Invalidity Claim Chart Against U.S. Patent No. 10,739,916 Based on Chinese Utility Model No. CN 203786707 U to Chen et al., FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated April 23, 2021, in 26 pages.	
	113	Exhibit 10: Invalidity Claim Chart Against U.S. Patent No. 10,739,916 Based on International App. Pub. No. WO2014131221 to Chen et al., FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated April 23, 2021, in 26 pages.	
	114	Exhibit 11: Invalidity Claim Chart Against U.S. Patent No. 10,739,916 Based on Chinese Pub. App. No. 104391611 A to Hu et al., FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated April 23, 2021, in 26 pages.	
	115	Exhibit 12: Invalidity Claim Chart Against U.S. Patent No. 10,739,916 Based on Chinese Utility Model No. 203786708 U to Cao, FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated April 23, 2021, in 26 pages.	
	116	Exhibit 13: Invalidity Claim Chart Against U.S. Patent No. 10,739,916 Based on Chinese Utility Model No. 204288179 U to Mo et al., FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated April 23, 2021, in 26 pages.	
	117	Defendants Promethean Ltd. and Promethean Inc.'s Preliminary Proposed Claim Constructions, FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated May 24, 2021, in 8 pages.	
	118	Defendants' Sur-Reply Claim Construction Brief, FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated September 13, 2021, in 24 pages.	
	119	Notice of Service, FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated April 23, 2021, in 2 pages.	
	120	Extended European Search Report in European Application number 16873465.5, date June 25, 2019 in 9 pages.	

Examiner Signature	/VINH T LAM/	Date Considered	11/29/2021

***Examiner:** Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

T[1] - Place a check mark in this area when an English language Translation is attached.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /V.T.L/

PTO/SB/08 Equivalent

INFORMATION DISCLOSURE STATEMENT BY APPLICANT	Application No.	16/403283
	Filing Date	May 3, 2019
	First Named Inventor	Aleksander Kocovski
	Art Unit	2628
(Multiple sheets used when necessary)	Examiner	Lam, Vinh Tang
SHEET 7 OF 7	Attorney Docket No.	FFOG.053C3

NON PATENT LITERATURE DOCUMENTS			
Examiner Initials	Cite No.	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T[1]
	121	Extended European Search Report for European App. No. 18772370.5, dated December 9, 2020, in 8 pages.	
	122	Extended European Search Report for European App. No. 18772178.2, dated December 10, 2020, in 8 pages.	
	123	ASTM International, "Standard Specification for Heat-Treated Flat Glass-Kind HS, Kind FT Coated and Uncoated Glass," Designation: C 1048-04, in 7 pages.	
	124	British Standard, "Glass in building - Thermally toughened soda lime silicate safety glass," EN 12150-1:2000, ISBN 0 580 36171 3, August 15, 2000, in 28 pages.	
	125	Joint Claim Construction Brief, FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated September 20, 2021, in 92 pages.	
	126	Joint Appendix of Exhibits to Joint Claim Construction Brief, FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated September 20, 2021, in 383 pages, (uploaded in 4 parts, part 1 of 4).	
	127	Joint Appendix of Exhibits to Joint Claim Construction Brief, FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated September 20, 2021, in 383 pages, (uploaded in 4 parts, part 2 of 4).	
	128	Joint Appendix of Exhibits to Joint Claim Construction Brief, FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated September 20, 2021, in 383 pages, (uploaded in 4 parts, part 3 of 4).	
	129	Joint Appendix of Exhibits to Joint Claim Construction Brief, FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated September 20, 2021, in 383 pages, (uploaded in 4 parts, part 4 of 4).	

54161654

Examiner Signature	/VINH T LAM/	Date Considered	11/29/2021

*__Examiner:__ Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

T[1] - Place a check mark in this area when an English language Translation is attached.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /V.T.L/

Bibliographic Data

Application No: 16/403,283

Foreign Priority claimed: (•) Yes ( ) No

35 USC 119 (a-d) conditions met: [ ] Yes [✓] No [ ] Met After Allowance

Verified and Acknowledged: /VINH T LAM/ [ ]

Examiner's Signature | Initials

Title: TOUCH DEVICE

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
05/03/2019	345	2628	14700.0002-00000
RULE			

APPLICANTS

Flatfrog Laboratories AB, Lund, SWEDEN

INVENTORS

Aleksander Kocovski, Malmo, SWEDEN

Hakan Bergstrom, Torna-Hallestad, SWEDEN

Jens Thorvinger, Lund, SWEDEN

CONTINUING DATA

This application is a CON of 16190907 11/14/2018 PAT 10282035

16190907 is a CON of PCT/SE2017/051233 12/07/2017

FOREIGN APPLICATIONS

SWEDEN SE1630294-5 12/07/2016

IF REQUIRED, FOREIGN LICENSE GRANTED**

05/17/2019

STATE OR COUNTRY

SWEDEN

ADDRESS

FINNEGAN, HENDERSON, FARABOW, GARRETT & DUNNER
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901 NEW YORK AVENUE, NW
WASHINGTON, DC 20001-4413
UNITED STATES

FILING FEE RECEIVED

$4,080

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
16/403,283	05/03/2019	Aleksander Kocovski	14700.0002-00000

CONFIRMATION NO. 5417

POA ACCEPTANCE LETTER

22852
FINNEGAN, HENDERSON, FARABOW, GARRETT & DUNNER LLP
901 NEW YORK AVENUE, NW
WASHINGTON, DC 20001-4413

OC00000129191144

Date Mailed: 10/20/2021

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 10/15/2021.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/ytdemisse/

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 63

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UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
16/403,283	05/03/2019	Aleksander Kocovski	FFOG.053C3

CONFIRMATION NO. 5417

POWER OF ATTORNEY NOTICE

20995
KNOBBE MARTENS OLSON & BEAR LLP
2040 MAIN STREET
FOURTEENTH FLOOR
IRVINE, CA 92614

OC000000129191120

Date Mailed: 10/20/2021

NOTICE REGARDING CHANGE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 10/15/2021.

- The Power of Attorney to you in this application has been revoked by the applicant. Future correspondence will be mailed to the new address of record(37 CFR 1.33).

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/ytdemisse/

Doc Code: PA..
Document Description: Power of Attorney

PTO/AIA/82A (07-13)
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Application Number	16/403,283
Filing Date	May 3, 2019
First Named Inventor	Aleksander Kocovski
Title	TOUCH DEVICE
Art Unit	2628
Examiner Name	Vinh Tang LAM
Attorney Docket Number	14700.0002-00000

SIGNATURE of Applicant or Patent Practitioner

Signature	/Arpita Bhattacharyya/	Date (Optional)	
Name	Arpita Bhattacharyya	Registration Number	63,681
Title (if Applicant is a juristic entity)			
Applicant Name (if Applicant is a juristic entity)			

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. If more than one applicant, use multiple forms.

☑ *Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Doc Code: PA..
Document Description: Power of Attorney

PTO/AIA/82B (07-13)
Approved for use through 03/31/2021. OMB 0651-0035
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POWER OF ATTORNEY BY APPLICANT

I hereby revoke all previous powers of attorney given in the application identified in either the attached transmittal letter or the boxes below.

Application Number	Filing Date

(Note: The boxes above may be left blank if information is provided on form PTO/AIA/82A.)

☑ I hereby appoint the Patent Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above: 22852

OR

I hereby appoint Practitioner(s) named in the attached list (form PTO/AIA/82C) as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the patent application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above. (Note: Complete form PTO/AIA/82C.)

Please recognize or change the correspondence address for the application identified in the attached transmittal letter or the boxes above to:

☑ The address associated with the above-mentioned Customer Number

OR

The address associated with Customer Number:

OR

Firm or Individual Name					
Address					
City		State		Zip	
Country					
Telephone		Email			

I am the Applicant (if the Applicant is a juristic entity, list the Applicant name in the box):

FlatFrog Laboratories AB

Inventor or Joint Inventor (title not required below)

Legal Representative of a Deceased or Legally Incapacitated Inventor (title not required below)

☑ Assignee or Person to Whom the Inventor is Under an Obligation to Assign (provide signer's title if applicant is a juristic entity)

Person Who Otherwise Shows Sufficient Proprietary Interest (e.g., a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document) (provide signer's title if applicant is a juristic entity)

SIGNATURE of Applicant for Patent

The undersigned (whose title is supplied below) is authorized to act on behalf of the applicant (e.g., where the applicant is a juristic entity).

Signature	Dhwani Vyas	Date (Optional)	
Name	Dhwani Vyas		
Title	CEO, FlatFrog Laboratories AB		

NOTE: Signature - This form must be signed by the applicant in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. If more than one applicant, use multiple forms.

☑ Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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Electronic Acknowledgement Receipt

EFS ID:	44041030
Application Number:	16403283
International Application Number:	
Confirmation Number:	5417
Title of Invention:	TOUCH DEVICE
First Named Inventor/Applicant Name:	Aleksander Kocovski
Customer Number:	20995
Filer:	Elizabeth Diane Ferrill/Maria Poulakos
Filer Authorized By:	Elizabeth Diane Ferrill
Attorney Docket Number:	FFOG.053C3
Receipt Date:	15-OCT-2021
Filing Date:	03-MAY-2019
Time Stamp:	13:20:09
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Power of Attorney	AS_FILED_POA_with_POA_Transmittal_14700_0002.pdf	226395 214a9e6051624b3b8c64782f4b4edc6b49eea0eb	no	2

Warnings:

Information:	
Total Files Size (in bytes):	226395

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Electronic Acknowledgement Receipt

EFS ID:	43880128
Application Number:	16403283
International Application Number:	
Confirmation Number:	5417
Title of Invention:	TOUCH DEVICE
First Named Inventor/Applicant Name:	Aleksander Kocovski
Customer Number:	20995
Filer:	Harnik Shukla/Jennifer Neat
Filer Authorized By:	Harnik Shukla
Attorney Docket Number:	FFOG.053C3
Receipt Date:	27-SEP-2021
Filing Date:	03-MAY-2019
Time Stamp:	21:26:20
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Non Patent Literature	Defendants_Initial_Invalidity_Contentions_April_23_2021.pdf	231286 9192b3978357031b265c0357ad5768d7bdcc4b1a	no	26

Warnings:

Information:					
2	Non Patent Literature	EXHIBIT_1_04-23-2021.pdf	6985579 9e21a187bb26a80aa58484c9a2d522980b516411	no	43
Warnings:					
Information:					
3	Non Patent Literature	EXHIBIT_2_04-23-2021.pdf	162354 f73f0d6a8fb7f776f696e4004285b81fa2e91f43	no	16
Warnings:					
Information:					
4	Non Patent Literature	EXHIBIT_3A_04-23-2021.pdf	140152 791198dcc193a42379bb37ef9e7db70100e40c9b	no	13
Warnings:					
Information:					
5	Non Patent Literature	EXHIBIT_3B_04-23-2021.pdf	148435 af10a1a6a0ad8707a0721badf79bffe44bc7428a	no	14
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Information:					
6	Non Patent Literature	EXHIBIT_3C_04-23-2021.pdf	141278 3ff6920451e974deb5b0b52731e9e6b59be91fcb	no	13
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Information:					
7	Non Patent Literature	EXHIBIT_4A_04-23-2021.pdf	142045 90a6caaada92a9bb4cd6ec3451e1de97b41e9993	no	14
Warnings:					
Information:					
8	Non Patent Literature	EXHIBIT_4B_04-23-2021.pdf	150819 ad22132f72928d5d9fe6f56307bd36c32374d223	no	15
Warnings:					
Information:					

9	Non Patent Literature	EXHIBIT_4C_04-23-2021.pdf	143253 5ceaa6e67c55db1fcc1fbd3bc7b45892f70f2921	no	14
Warnings:					
Information:					
10	Non Patent Literature	EXHIBIT_5A_04-23-2021.pdf	140577 3a1ebe5c6374b59c69d6c54a5202b5f2d62f1248	no	13
Warnings:					
Information:					
11	Non Patent Literature	EXHIBIT_5B_04-23-2021.pdf	150428 7c7c5be40a86d8920e886db0dd357fcb60f97a93	no	15
Warnings:					
Information:					
12	Non Patent Literature	EXHIBIT_5C_04-23-2021.pdf	141418 8db349f4f5575e9ddd8635a1083a7dbd180570d4	no	13
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Information:					
13	Non Patent Literature	EXHIBIT_6A_04-23-2021.pdf	107634 80de8ce6bb3e8267e190e366ba2456f0f1b7fe37	no	9
Warnings:					
Information:					
14	Non Patent Literature	EXHIBIT_6B_04-23-2021.pdf	109730 74a7ffdeca2563d2d5f592f21c405d7fb5263820	no	9
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Information:					
15	Non Patent Literature	EXHIBIT_6C_04-23-2021.pdf	106881 fa9abb9cdda4384c2ed51faa44dca91c83257b26	no	9
Warnings:					
Information:					

16	Non Patent Literature	EXHIBIT_7A_04-23-2021.pdf	107134 2d21c11550c0c3147728052091 1b791ef740637c	no	9
Warnings:					
Information:					
17	Non Patent Literature	EXHIBIT_7B_04-23-2021.pdf	108770 c9efdce173a5e999b79aff35f9bd2062f2d78371	no	9
Warnings:					
Information:					
18	Non Patent Literature	EXHIBIT_7C_04-23-2021.pdf	106634 4971f9908fff62bd0779d0c6b6c61c44b92e181d	no	9
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Information:					
19	Non Patent Literature	EXHIBIT_8_04-23-2021.pdf	3556301 736a1c2f65c869946e4e1f4227be7402d4e9fdc9	no	21
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Information:					
20	Non Patent Literature	EXHIBIT_9_04-23-2021.pdf	79591 496d73e0f1d498ad8f158aebf30f732f0cb58f37	no	4
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Information:					
21	Non Patent Literature	EXHIBIT_10_04-23-2021.pdf	81918 16a8454858231ccea8e5433ab928e8d57673713f	no	4
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Information:					
22	Non Patent Literature	EXHIBIT_11_04-23-2021.pdf	80336 7969a4b693eb9f9187f2664e2218773fdce7d1b3	no	4
Warnings:					
Information:					

23	Non Patent Literature	EXHIBIT_12_04-23-2021.pdf	80473 7202274bccf93b97f43727904367a434ea2a2416	no	4
Warnings:					
Information:					
24	Non Patent Literature	EXHIBIT_13_04-23-2021.pdf	80479 b4ea596253055be54d87e998a5a07140ee86fd99	no	4
Warnings:					
Information:					
25	Non Patent Literature	05-24-2021_Promethean_Prelim_Claim_Constructions.pdf	114012 3cf23f2ee800c534e879b27c57c6c9caf6ec291f	no	8
Warnings:					
Information:					
26	Non Patent Literature	09-13-2021_Defendant_Sur-Reply_Claim_Const_Brief.pdf	814016 03a497fe87313b20013ae3a6a1db7d6f67e7af4a	no	24
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Information:					
27	Non Patent Literature	ASTM_Standard_Specification_Heat-Treated_Flat_Glass.pdf	1705275 2073a038b17e58b8b36aaf6f0577cbfbd9970f2f	no	7
Warnings:					
Information:					
28	Non Patent Literature	BritishStandard_Glass_in_building_Thermally_toughened.pdf	2542131 f9099257aed70aa2a6eea02255595c9ded8ec041	no	28
Warnings:					
Information:					
29	Non Patent Literature	Notice_of_Service_Contentions_April_23_2021.pdf	74226 b6eab6a62a5e15c56ed3e686c7575486f856414	no	2
Warnings:					
Information:					

30	Non Patent Literature	Joint_Claim_Construction_Brief.pdf	14169124 22119f2bbdc3e9730d4927cf43451581380 7f152	no	92
Warnings:					
Information:					
31	Non Patent Literature	Joint_Appendix_Exhibits_Joint_Claim_Construction_Brief_PT 1.pdf	13229894 1a30b51924963c0f9ba601ccc59d36ff9aca 0777	no	127
Warnings:					
Information:					
32	Non Patent Literature	Joint_Appendix_Exhibits_Joint_Claim_Construction_Brief_PT 2.pdf	14436364 ff405e21bbea4eebf9940f9ec36e5ba973c9 abae	no	63
Warnings:					
Information:					
33	Non Patent Literature	Joint_Appendix_Exhibits_Joint_Claim_Construction_Brief_PT 3.pdf	16881050 b3a010740e0e756aac2c30661d3a5a095a3 68c25	no	65
Warnings:					
Information:					
34	Non Patent Literature	Joint_Appendix_Exhibits_Joint_Claim_Construction_Brief_PT 4.pdf	9376565 ee32ab8f40a42555911caf63eb2a826a1f3f7 ed2	no	128
Warnings:					
Information:					
35	Non Patent Literature	SuppESR_EP16873465_06-25-2019.pdf	1584654 24e75515b6455e55d281041eeb730632ff1 7fce6	no	9
Warnings:					
Information:					
36	Non Patent Literature	2020-12-09_ESR_EP18772370.pdf	1959421 c97445d2502f7fa40718b9a547d665340d0 2b43d	no	8
Warnings:					
Information:					

37	Non Patent Literature	EESR_EP18772178_Dec-10-2020.pdf	1823696 1866c02c9b315718cd624fc7e12418217e807f48	no	8

Warnings:	
Information:	
Total Files Size (in bytes):	91993933

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT	Application No.	16/403283
	Filing Date	May 3, 2019
	First Named Inventor	Aleksander Kocovski
	Art Unit	2628
(Multiple sheets used when necessary)	Examiner	Lam, Vinh Tang
SHEET 1 OF 7	Attorney Docket No.	FFOG.053C3

U.S. PATENT DOCUMENTS

Examiner Initials	Cite No.	Document Number *Number - Kind Code (if known)* Example: 1,234,567 B1	Publication Date MM-DD-YYYY	Name	Pages, Columns, Lines Where Relevant Passages or Relevant Figures Appear
	1	2020/0387237	12-10-2020	Drumm, Owen	
	2	2019/0377435	12-12-2019	Piot et al.	
	3	2019/0377431	12-12-2019	Drumm, Owen	
	4	2020/0348473	11-05-2020	Drumm, Owen	
	5	2020/0341587	10-29-2020	Drumm, Owen	
	6	2015/0339000	11-26-2014	Lee et al.	
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	29	2019/0196657	10-08-2019	Skagmo et al.	

Examiner Signature	Date Considered

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT	Application No.	16/403283
	Filing Date	May 3, 2019
	First Named Inventor	Aleksander Kocovski
	Art Unit	2628
(Multiple sheets used when necessary)	Examiner	Lam, Vinh Tang
SHEET 2 OF 7	Attorney Docket No.	FFOG.053C3

U.S. PATENT DOCUMENTS					
Examiner Initials	Cite No.	Document Number *Number - Kind Code (if known)* Example: 1,234,567 B1	Publication Date MM-DD-YYYY	Name	Pages, Columns, Lines Where Relevant Passages or Relevant Figures Appear
	30	2016/0179261	06-23-2016	Drumm, Owen	
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	32	2020/0167033	05-28-2020	Kim et al.	
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Examiner Signature	Date Considered

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	First Named Inventor	Aleksander Kocovski
	Art Unit	2628
(Multiple sheets used when necessary)	Examiner	Lam, Vinh Tang
SHEET 3 OF 7	Attorney Docket No.	FFOG.053C3

U.S. PATENT DOCUMENTS					
Examiner Initials	Cite No.	Document Number *Number - Kind Code (if known)* Example: 1,234,567 B1	Publication Date MM-DD-YYYY	Name	Pages, Columns, Lines Where Relevant Passages or Relevant Figures Appear
	59	2020/0012408	01-09-2020	Drumm et al.	
	60	2019/0004668	01-03-2019	Jeong et al.	
	61	4,868,550	09-19-1989	Hiroaki et al.	
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	67	9,366,802	06-14-2016	Lee et al.	
	68	9,983,626	05-29-2018	Cao et al.	
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FOREIGN PATENT DOCUMENTS						
Examiner Initials	Cite No.	Foreign Patent Document *Country Code-Number-Kind Code* Example: JP 1234567 A1	Publication Date MM-DD-YYYY	Name	Pages, Columns, Lines Where Relevant Passages or Relevant Figures Appear	**T[1]**
	71	CN 102117155A	07-06-2011	Guangzhou Shirui Electronics Co Ltd		
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Examiner Signature	Date Considered

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SHEET 4 OF 7	Attorney Docket No.	FFOG.053C3

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Examiner Initials	Cite No.	Foreign Patent Document *Country Code-Number-Kind Code* Example: JP 1234567 A1	Publication Date MM-DD-YYYY	Name	Pages, Columns, Lines Where Relevant Passages or Relevant Figures Appear	T[1]
	77	CN 203786708 U	08-20-2014	GUANGZHOU SHIRUI ELECTRICAL TECHNOLOGY CO., LTD.		
	78	CN 203825586 U	09-10-2014	SHENZHEN TIMELINK TECHNOLOGY CO., LTD		
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	89	WO 2014/098742	06-26-2014	FLATFROG LABORATORIES AB		
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	92	WO 2016/130074 A1	08-18-2016	FLATFROG LABORATORIES AB		

NON PATENT LITERATURE DOCUMENTS			
Examiner Initials	Cite No.	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T[1]
	93	Defendants' Initial Invalidity Contentions, FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated April 23, 2021, in 26 pages.	
	94	Exhibit 1: Invalidity Claim Chart Against U.S. Patent No. 10,775,935 Based on Prior Public Use and/or Commercial Offer for Sale of Defendant Promethean Inc.'s ActivPanel 4.5 Product, FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated April 23, 2021, in 26 pages.	
	95	Exhibit 2: Invalidity Claim Chart Against U.S. Patent No. 10,775,935 Based on U.S. Patent No. U.S. Pre-Grant Pub. No. 2019/0235701 to Han et al., FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated April 23, 2021, in 26 pages.	
	96	Exhibit 3A: Invalidity Claim Chart Against U.S. Patent No. 10,775,935 Based on U.S. Patent No. 4,751,379 to Sasaki et al., FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated April 23, 2021, in 26 pages.	
	97	Exhibit 3B: Invalidity Claim Chart Against U.S. Patent No. 10,775,935 Based on U.S. Patent No. 4,751,379 to Sasaki et al., FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated April 23, 2021, in 26 pages.	
	98	Exhibit 3C: Invalidity Claim Chart Against U.S. Patent No. 10,775,935 Based on U.S. Patent No. 4,751,379 to Sasaki et al., FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated April 23, 2021, in 26 pages.	
	99	Exhibit 4A: Invalidity Claim Chart Against U.S. Patent No. 10,775,935 Based on U.S. Pre-Grant Pub. No. 2019/0004668 to Jeong et al., FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated April 23, 2021, in 26 pages.	
	100	Exhibit 4B: Invalidity Claim Chart Against U.S. Patent No. 10,775,935 Based on U.S. Pre-Grant Pub. No. 2019/0004668 to Jeong et al., FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated April 23, 2021, in 26 pages.	
	101	Exhibit 4C: Invalidity Claim Chart Against U.S. Patent No. 10,775,935 Based on U.S. Pre-Grant Pub. No. 2019/0004668 to Jeong et al., FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated April 23, 2021, in 26 pages.	
	102	Exhibit 5A: Invalidity Claim Chart Against U.S. Patent No. 10,775,935 Based on U.S. Patent No. 9,983,626 to Cao et al., FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated April 23, 2021, in 26 pages.	
	103	Exhibit 5B: Invalidity Claim Chart Against U.S. Patent No. 10,775,935 Based on U.S. Patent No. 9,983,626 to Cao et al., FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated April 23, 2021, in 26 pages.	
	104	Exhibit 5C: Invalidity Claim Chart Against U.S. Patent No. 10,775,935 Based on U.S. Patent No. 9,983,626 to Cao et al., FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated April 23, 2021, in 26 pages.	

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	Filing Date	May 3, 2019
	First Named Inventor	Aleksander Kocovski
	Art Unit	2628
(Multiple sheets used when necessary)	Examiner	Lam, Vinh Tang
SHEET 6 OF 7	Attorney Docket No.	FFOG.053C3

NON PATENT LITERATURE DOCUMENTS			
Examiner Initials	Cite No.	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T[1]
	105	Exhibit 6A: Invalidity Claim Chart Against U.S. Patent No. 10,775,935 Based on U.S. Pre-Grant Pub. No. 2019/0025984 to Weilbacher et al., FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated April 23, 2021, in 26 pages.	
	106	Exhibit 6B: Invalidity Claim Chart Against U.S. Patent No. 10,775,935 Based on U.S. Pre-Grant Pub. No. 2019/0025984 to Weilbacher et al., FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated April 23, 2021, in 26 pages.	
	107	Exhibit 6C: Invalidity Claim Chart Against U.S. Patent No. 10,775,935 Based on U.S. Pre-Grant Pub. No. 2019/0025984 to Weilbacher et al., FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated April 23, 2021, in 26 pages.	
	108	Exhibit 7A: Invalidity Claim Chart Against U.S. Patent No. 10,775,935 Based on U.S. Patent No. 9,207,800 to Eriksson et al., FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated April 23, 2021, in 26 pages.	
	109	Exhibit 7B: Invalidity Claim Chart Against U.S. Patent No. 10,775,935 Based on U.S. Patent No. 9,207,800 to Eriksson et al., FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated April 23, 2021, in 26 pages.	
	110	Exhibit 7C: Invalidity Claim Chart Against U.S. Patent No. 10,775,935 Based on U.S. Patent No. 9,207,800 to Eriksson et al., FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated April 23, 2021, in 26 pages.	
	111	Exhibit 8: Invalidity Claim Chart Against U.S. Patent No. 10,739,916 Based on Prior Public Use and/or Commercial Offer for Sale of Defendant Promethean Inc.'s ActivPanel 4.5 Product, FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated April 23, 2021, in 26 pages.	
	112	Exhibit 9: Invalidity Claim Chart Against U.S. Patent No. 10,739,916 Based on Chinese Utility Model No. CN 203786707 U to Chen et al., FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated April 23, 2021, in 26 pages.	
	113	Exhibit 10: Invalidity Claim Chart Against U.S. Patent No. 10,739,916 Based on International App. Pub. No. WO2014131221 to Chen et al., FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated April 23, 2021, in 26 pages.	
	114	Exhibit 11: Invalidity Claim Chart Against U.S. Patent No. 10,739,916 Based on Chinese Pub. App. No. 104391611 A to Hu et al., FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated April 23, 2021, in 26 pages.	
	115	Exhibit 12: Invalidity Claim Chart Against U.S. Patent No. 10,739,916 Based on Chinese Utility Model No. 203786708 U to Cao, FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated April 23, 2021, in 26 pages.	
	116	Exhibit 13: Invalidity Claim Chart Against U.S. Patent No. 10,739,916 Based on Chinese Utility Model No. 204288179 U to Mo et al., FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated April 23, 2021, in 26 pages.	
	117	Defendants Promethean Ltd. and Promethean Inc.'s Preliminary Proposed Claim Constructions, FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated May 24, 2021, in 8 pages.	
	118	Defendants' Sur-Reply Claim Construction Brief, FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated September 13, 2021, in 24 pages.	
	119	Notice of Service, FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated April 23, 2021, in 2 pages.	
	120	Extended European Search Report in European Application number 16873465.5, date June 25, 2019 in 9 pages.	

Examiner Signature	Date Considered

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	Art Unit	2628
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SHEET 7 OF 7	Attorney Docket No.	FFOG.053C3

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	121	Extended European Search Report for European App. No. 18772370.5, dated December 9, 2020, in 8 pages.	
	122	Extended European Search Report for European App. No. 18772178.2, dated December 10, 2020, in 8 pages.	
	123	ASTM International, "Standard Specification for Heat-Treated Flat Glass-Kind HS, Kind FT Coated and Uncoated Glass," Designation: C 1048-04, in 7 pages.	
	124	British Standard, "Glass in building - Thermally toughened soda lime silicate safety glass," EN 12150-1:2000, ISBN 0 580 36171 3, August 15, 2000, in 28 pages.	
	125	Joint Claim Construction Brief, FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated September 20, 2021, in 92 pages.	
	126	Joint Appendix of Exhibits to Joint Claim Construction Brief, FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated September 20, 2021, in 383 pages, (uploaded in 4 parts, part 1 of 4).	
	127	Joint Appendix of Exhibits to Joint Claim Construction Brief, FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated September 20, 2021, in 383 pages, (uploaded in 4 parts, part 2 of 4).	
	128	Joint Appendix of Exhibits to Joint Claim Construction Brief, FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated September 20, 2021, in 383 pages, (uploaded in 4 parts, part 3 of 4).	
	129	Joint Appendix of Exhibits to Joint Claim Construction Brief, FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 1:19-cv-02246-MN, dated September 20, 2021, in 383 pages, (uploaded in 4 parts, part 4 of 4).	

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Electronic Patent Application Fee Transmittal

Application Number:	16403283
Filing Date:	03-May-2019
Title of Invention:	TOUCH DEVICE
First Named Inventor/Applicant Name:	Aleksander Kocovski
Filer:	Harnik Shukla/Jenny Kim
Attorney Docket Number:	FFOG.053C3

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
RCE- 2ND AND SUBSEQUENT REQUEST	1820	1	2000	2000
		Total in USD ($)		**2000**

Electronic Acknowledgement Receipt

EFS ID:	43880090
Application Number:	16403283
International Application Number:	
Confirmation Number:	5417
Title of Invention:	TOUCH DEVICE
First Named Inventor/Applicant Name:	Aleksander Kocovski
Customer Number:	20995
Filer:	Harnik Shukla/Jennifer Neat
Filer Authorized By:	Harnik Shukla
Attorney Docket Number:	FFOG.053C3
Receipt Date:	27-SEP-2021
Filing Date:	03-MAY-2019
Time Stamp:	21:24:34
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$2000
RAM confirmation Number	E20219QL25152182
Deposit Account	111410
Authorized User	Jennifer Neat

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

37 CFR 1.16 (National application filing, search, and examination fees)

37 CFR 1.17 (Patent application and reexamination processing fees)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		FFOG053C3_Amend.pdf	32027 093e05c29f1dc829e2299014628c60419e7ce8a2	yes	5
	Multipart Description/PDF files in .zip description				
	Document Description		**Start**	**End**	
	Amendment Submitted/Entered with Filing of CPA/RCE		1	1	
	Claims		2	3	
	Applicant Arguments/Remarks Made in an Amendment		4	5	
Warnings:					
Information:					
2	Request for Continued Examination (RCE)	FFOG053C3_RCE.pdf	1349958 89977a77df5f55d80486cd86fc4303603e0aded3	no	3
Warnings:					
Information:					
3	Foreign Reference	CN_102117155.pdf	942481 c235aa3f851819117f7504f9c5af5822340a1e35	no	8
Warnings:					
Information:					
4	Foreign Reference	CN103123556A.pdf	918979 7ea63bef02ede0ba8ec5fb794be55728a7d26667	no	10
Warnings:					
Information:					
5	Foreign Reference	CN_104391611A_Abs.pdf	1337097 2f2a501766c99c0989efbfe6ba1d0c7f53aa9d60	no	11

Warnings:					
Information:					
6	Foreign Reference	CN_104808843A.pdf	1279490 c1c5f0023a6415a79e2eb5b707ee89fb9c136704	no	19
Warnings:					
Information:					
7	Foreign Reference	CN_203720812U.pdf	930551 4f27e9c3613c18ff30f66534fbc309e59f3146fc	no	7
Warnings:					
Information:					
8	Foreign Reference	CN_203786707U_wAbs.pdf	1389171 d43daa97196e8b3cc61e808f6a53776d366f687c	no	14
Warnings:					
Information:					
9	Foreign Reference	CN_203786708U.pdf	1042141 135325edbb8063ebe1ad6987d3c2ef80cc23ad06	no	7
Warnings:					
Information:					
10	Foreign Reference	CN_203825586U.pdf	1167513 4a8bc6659d57687eeac33186f0019b38bfc1ece0	no	9
Warnings:					
Information:					
11	Foreign Reference	CN_202887145U.pdf	350341 e85f7d11eca062614731d893c90d4638adc933c8	no	5
Warnings:					
Information:					
12	Foreign Reference	CN_204288179U_Abs.pdf	576006 0d87328799dbbbd7b6c53cdf4b62f31c26c5059a	no	7
Warnings:					
Information:					

13	Foreign Reference	DE_10025175A1.pdf	946646 f2768b6b4c7b61e7cc653bf80a259de1fc6a1208	no	6
Warnings:					
Information:					
14	Foreign Reference	DE_102009003990A1.pdf	3030969 50af069d1588cf38a0a205885415a733deee8ddc	no	23
Warnings:					
Information:					
15	Foreign Reference	EP_2325735.pdf	295875 da8ffa43ed759f63ae5c37de928200f438139ef4	no	16
Warnings:					
Information:					
16	Foreign Reference	JP_2015158831A.pdf	1980518 8560f0877d42bd077121d5e74b0949825b376bda	no	12
Warnings:					
Information:					
17	Foreign Reference	JPS62159213A.pdf	676942 fc610e2f86819a69213f0d24d505494da54409c3	no	6
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18	Foreign Reference	KR_20150125374A.pdf	2634379 1fa5adb7fe1d9d84ebf1f2dd503ead6c429f6d8f	no	23
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19	Foreign Reference	KR_101081586B1.pdf	2283071 b7f435c6fc8c14c27f19e14ba091e0da363c2267	no	23
Warnings:					
Information:					

20	Foreign Reference	TW_M517370U.pdf	2647157 25f58212da7f49d9e9e7529c45caa72b70589a15	no	23
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21	Foreign Reference	WO_2014098742.pdf	4300153 93d6be96ee62608bb284c08dd4f43c4e773593bb	no	30
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22	Foreign Reference	WO_2014130515.pdf	4883168 78fcea966687acd05797c8573bc421c7b50f5900	no	35
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23	Foreign Reference	WO_2014131221A1_Abs.pdf	641886 e14ebd115b5ca829ee13609dbfa904ac6da1cb4e	no	18
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24	Foreign Reference	WO_2016130074.pdf	745074 371fb4f6e9c3438939feda510e26496ace7f0404	no	29
Warnings:					
Information:					
25		FFOG053C3_IDS.pdf	92069 5f220ce816f4273a45710f0282d18768ac902270	yes	9

Multipart Description/PDF files in .zip description

Document Description	Start	End
Transmittal Letter	1	2
Information Disclosure Statement (IDS) Form (SB08)	3	9

Warnings:

Information:

26	Fee Worksheet (SB06)	fee-info.pdf	38128 ee92ebc7b703aef4d5bcf0e91f08550fe345136a	no	2

Warnings:	
Information:	
Total Files Size (in bytes):	36511790

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

AMENDMENT SUBMITTED IN CONJUCTION WITH REQUEST FOR CONTINUED EXAMINATION (RCE)

First Inventor: Aleksander Kocovski	**Conf. No.:** 5417
App. No.: 16/403283	**Filed:** May 3, 2019
Examiner: Lam, Vinh Tang	**Art Unit:** 2628
Title: TOUCH DEVICE	

Mail Stop RCE
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Commissioner:

The Applicant respectfully requests the above-identified application be amended as follows:

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AMENDMENTS TO THE CLAIMS

The following listing of claims replaces all prior versions thereof. Changes are shown below in highlighted form, where insertions appear as underlined text (e.g., insertions) while deletions appear as strikethrough text (e.g., ~~deletions~~) or double brackets (e.g., [[deletions]]).

1. (Canceled)

2. (Currently Amended) A touch sensing apparatus having a long edge and a short edge, the touch sensing apparatus comprising:

a display panel;

a plate including a top surface that comprises a touch surface;

a plurality of emitters arranged around a portion of the periphery of theplate and configured to emit light across the touch surface of the plate,

a plurality of detectors arranged around a portion of the periphery of theplate and configured to receive light from the plurality of emitters, and

a frame assembly, the frame assembly comprising;

a first frame element configured to support the display panel;

a second frame element arranged around the periphery of the plate and configured to support the plurality of emitters and plurality of detectors,

wherein the second frame element ~~including~~ includes a first surface portion ~~arranged against~~ extending over an edge portion of the plate and a second surface portion arranged substantially parallel to a surface of the plate that defines the plate thickness, ~~the touch surface,~~

~~the touch surface including:~~

~~a first edge and a second edge adjacent to the short edge; and a third edge and a fourth edge adjacent to the long edge;~~

wherein the touch surface is curved relative to a flat plane defined in part by the short edge and the long edge;

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wherein a distance between a first curved line drawn on the touch surface and a second straight line drawn on the flat plane varies according to a concave curve function; and

wherein all of the ~~first, second, third, and fourth~~ edges of the top surface of the plate are curved.

3. (Previously Presented) The touch sensing apparatus of claim 2, wherein the plurality of emitters is configured to emit light to propagate over the touch surface.

4. (Previously Presented) The touch sensing apparatus of claim 2, wherein the plurality of emitters is configured to emit light through the plate by total internal reflection.

5. (Previously Presented) The touch sensing apparatus of claim 2, further comprising a processing element configured to determine, based on output signals of the plurality of detectors, a position of an object on the touch surface.

6. - 9. (CANCELED)

10. (Currently Amended) The touch sensing apparatus of claim 2, further comprising a gasket, wherein the plate is supported by the gasket along the surface of the plate that defines the plate thickness~~an edge of the plate~~.

11. - 23. (CANCELED)

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REMARKS

In the present amendment, Applicant has canceled Claims 6-9 and 11-20, and has amended Claims 2 and 10 without prejudice or disclaimer. Accordingly, Claims 2 – 5 and 10 remain pending.

No Disclaimers or Disavowals

Although the present communication may include alterations to the application or claims, or characterizations of claim scope or referenced art, Applicant is not conceding in this application that previously pending claims are not patentable over the cited references. Rather, any alterations or characterizations are being made to facilitate expeditious prosecution of this application. Applicant reserves the right to pursue at a later date any previously pending or other broader or narrower claims that capture any subject matter supported by the present disclosure, including subject matter found to be specifically disclaimed herein or by any prior prosecution. Accordingly, reviewers of this or any parent, child or related prosecution history shall not reasonably infer that Applicant has made any disclaimers or disavowals of any subject matter supported by the present application. Further, Applicant's arguments in favor of one independent claim should not be imputed to any other independent claim.

Conclusion

In view of the foregoing amendments and remarks, Applicant respectfully requests that the Examiner withdraw the outstanding rejections and allow the present application. If any issues arise during examination, the Examiner is invited to call the undersigned representative at his direct dial number listed below.

By focusing on specific claims and claim recitations in the discussion above, Applicant does not intend to imply that other claim recitations are disclosed or rendered obvious by the art of record.

Please charge any additional fees, including any fees for additional extension of time, or credit overpayment to Deposit Account No. 11-1410.

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Respectfully submitted,

KNOBBE, MARTENS, OLSON & BEAR, LLP

Dated: September 27, 2021

By: /Harnik Shukla/
Harnik Shukla
Registration No. 73,097
Registered Practitioner
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54285858

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PTO/SB/30EFS (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

REQUEST FOR CONTINUED EXAMINATION(RCE)TRANSMITTAL
(Submitted Only via EFS-Web)

Application Number	16403283	Filing Date	2019-05-03	Docket Number (if applicable)	FFOG.053C3	Art Unit	2628
First Named Inventor	Kocovski, Aleksander			Examiner Name	Lam, Vinh Tang		

This is a Request for Continued Examination (RCE) under 37 CFR 1.114 of the above-identified application.
Request for Continued Examination (RCE) practice under 37 CFR 1.114 does not apply to any utility or plant application filed prior to June 8, 1995, or to any design application. The Instruction Sheet for this form is located at WWW.USPTO.GOV

SUBMISSION REQUIRED UNDER 37 CFR 1.114

Note: If the RCE is proper, any previously filed unentered amendments and amendments enclosed with the RCE will be entered in the order in which they were filed unless applicant instructs otherwise. If applicant does not wish to have any previously filed unentered amendment(s) entered, applicant must request non-entry of such amendment(s).

☐ Previously submitted. If a final Office action is outstanding, any amendments filed after the final Office action may be considered as a submission even if this box is not checked.

- ☐ Consider the arguments in the Appeal Brief or Reply Brief previously filed on _____
- ☐ Other _____

☒ Enclosed

- ☒ Amendment/Reply
- ☒ Information Disclosure Statement (IDS)
- ☐ Affidavit(s)/ Declaration(s)
- ☐ Other _____

MISCELLANEOUS

☐ Suspension of action on the above-identified application is requested under 37 CFR 1.103(c) for a period of months _____ (Period of suspension shall not exceed 3 months; Fee under 37 CFR 1.17(i) required)

☐ Other _____

FEES

☒ **The RCE fee under 37 CFR 1.17(e) is required by 37 CFR 1.114 when the RCE is filed.**
The Director is hereby authorized to charge any underpayment of fees, or credit any overpayments, to Deposit Account No 111410

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED

☒ Patent Practitioner Signature

Applicant Signature

PTO/SB/30EFS (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Signature of Registered U.S. Patent Practitioner			
Signature	/Harnik Shukla/	Date (YYYY-MM-DD)	2021-09-27
Name	HARNIK SHUKLA	Registration Number	73097

This collection of information is required by 37 CFR 1.114. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

(19)中华人民共和国国家知识产权局

(12)发明专利申请

(10)申请公布号 CN 102117155 A
(43)申请公布日 2011.07.06

(21)申请号 201110049536.9

(22)申请日 2011.03.02

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地址 510663 广东省广州市广州科学城科珠路 192 号

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代理人 郝传鑫

(51)Int.Cl.
G06F 3/042(2006.01)

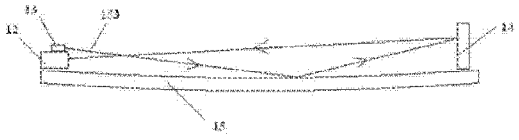
权利要求书 1 页 说明书 3 页 附图 3 页

(54)发明名称

凹面光学触摸屏

(57)摘要

本发明公开了一种凹面光学触摸屏，包括框架、光学传感器、光源、回归反射条及触摸面板，其中，所述触摸面板的表面是向下凹陷的。本发明的凹面光学触摸屏与现有技术相比，具有如下有益效果：由于安装了表面向下凹陷的触摸面板，部分光线被所述触摸面板反射到回归反射条，增强了回归反射的光的能量，使得本发明的凹面光学触摸屏具有更高的灵敏度和检测精度。



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1. 一种凹面光学触摸屏，包括框架、光学传感器、光源、回归反射条及触摸面板，其特征在于，所述触摸面板的表面是向下凹陷的。

2. 根据权利要求 1 所述的凹面光学触摸屏，其特征在于：所述触摸面板的表面中心向下凹陷，边缘水平，其余部位从所述中心向所述边缘均匀拉升。

3. 根据权利要求 2 所述的凹面光学触摸屏，其特征在于：所述触摸面板表面的中心位置比边缘位置低 0.5mm 至 5mm。

4. 根据权利要求 2 所述的凹面光学触摸屏，其特征在于：所述触摸面板是由蜂窝铝板材料制作而成的。

5. 根据权利要求 2 所述的凹面光学触摸屏，其特征在于：所述触摸面板是由亚克力板材料制作而成的。

6. 根据权利要求 2 所述的凹面光学触摸屏，其特征在于：所述触摸面板是由钢化玻璃材料制作而成的。

7. 根据权利要求 6 所述的凹面光学触摸屏，其特征在于：所述钢化玻璃的触摸面板，在制作过程钢化冷却时，所述钢化玻璃的上表面气压为 920±10MP，下表面气压为 880±10MP。

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凹面光学触摸屏

技术领域

[0001] 本发明涉及一种触摸屏，尤其涉及一种凹面光学触摸屏。

背景技术

[0002] 随着多媒体技术的发展，用于实现人机交互的触摸屏得到越来越广泛的应用。当前国内主流的触摸技术当以红外、表面声波和电阻屏为主，但这几种技术也都存在着瑕疵，如声波屏点击需要力度，电阻屏性能不稳定等等。近年来，凹面光学触摸屏的出现基本解决了众多触摸屏的难题，其反应速度快，灵敏度高，所需触摸力度小。图 1 为现有一种凹面光学触摸屏的结构示意图，所述凹面光学触摸屏包括框架 101、光学传感器 102、光源 103、回归反射条 104 及触摸面板 105，所述框架 101 为矩形框架，由第一边缘 1011、第二边缘 1012、第三边缘 1013 以及第四边缘 1014 依次连接而成。当触摸物 106 在触摸面板 105 上发生触击时，就会阻挡光源 103 所发出的光线 107，在回归反射条 104 上产生阴影 108，光学传感器 102 分析阴影 108 就可以计算出触摸物 106 所在的位置。在理想状态下，所述触摸面板 105 是水平的，但是在实际情况下，所述触摸面板 105 一般都有凹凸不平，难以达到理想的水平状态。请参加图 4a，当所述触摸面板 105 表面外凸时，部分光线 109 被反射到回归反射条 104 之外，有效反射回归的光能量就很弱。反射回归的光能量低，信号就弱，使得触摸屏灵敏度不高，检测精度低。

发明内容

[0003] 本发明实施例所要解决的技术问题在于，提供一种灵敏、检测精度高的凹面光学触摸屏。

[0004] 为了解决上述技术问题，本发明实施例提供了一种凹面光学触摸屏，包括框架、光学传感器、光源、回归反射条及触摸面板，其中，所述触摸面板的表面是向下凹陷的。

[0005] 进一步的，所述触摸面板的表面中心向下凹陷，边缘水平，其余部位从所述中心向所述边缘均匀拉升。

[0006] 进一步的，所述触摸面板表面的中心位置比边缘位置低 0.5mm 至 5mm。

[0007] 进一步的，所述触摸面板是由蜂窝铝板材料制作而成的。

[0008] 进一步的，所述触摸面板是由亚克力板材料制作而成的。

[0009] 进一步的，所述触摸面板是由钢化玻璃材料制作而成的。

[0010] 进一步的，所述钢化玻璃的触摸面板，在制作过程钢化冷却时，所述钢化玻璃的上表面气压为 920±10MP，下表面气压为 880±10MP。

[0011] 实施本发明实施例，具有如下有益效果：由于安装了表面向下凹陷的触摸面板，部分光线被所述触摸面板反射到回归反射条，增强了回归反射的光的能量，使得本发明的光学触摸屏具有更高的灵敏度和检测精度。相比其他的在回归反射条上设置特殊物质或者设置特殊结构以提高回归反射的光的能量的技术方案，本实施例的方案简单易行，取得了预料不到的技术效果。

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附图说明

[0012] 为了更清楚地说明本发明实施例中的技术方案，下面将对实施例描述中所需要使用的附图作简单地介绍，显而易见地，下面描述中的附图仅仅是本发明的一个实施例，对于本领域普通技术人员来讲，在不付出创造性劳动性的前提下，还可以根据这些附图获得其他的附图。

[0013] 图 1 是现有凹面光学触摸屏的结构示意图；

图 2 是本发明凹面光学触摸屏的一实施例结构示意图；

图 3 是图 2 所述凹面光学触摸屏的触摸面板的结构示意图；

图 4a 是现有凹面光学触摸屏在实际应用中的光线反射回归示意图；

图 4b 是本发明凹面光学触摸屏在实际应用中的光线反射回归示意图。

具体实施方式

[0014] 下面将结合本发明实施例中的附图，对本发明实施例中的技术方案进行清楚、完整地描述，显然，所描述的实施例仅仅是本发明一个实施例，而不是全部的实施例。基于本发明中的实施例，本领域普通技术人员在没有做出创造性劳动前提下所获得的所有其他实施例，都属于本发明保护的范围。

[0015] 本发明实施例提供了一种凹面光学触摸屏，下面结合图 2 至图 4b 对本凹面光学触摸屏的实施例进行说明。

[0016] 图 2 为本发明凹面光学触摸屏的第一实施例结构示意图。如图 2 所示，本实施例的凹面光学触摸屏 1 的结构包括：

框架 11、光学传感器 12、光源 13、回归反射条 14 及触摸面板 15。所述框架 11 包围所述触摸面板 15。所述光学传感器 12 和光源 13 置于所述框架 11 上，具体的，可以置于所述框架 11 的左上角和右上角，或者置于所述框架 11 的上边框中央位置。所述回归反射条 14 置于所述框架 11 的边缘。其中，所述触摸面板 15 的表面是向下凹陷的。

[0017] 具体的，请参见图 3，为本发明凹面光学触摸屏的触摸面板 15 的结构示意图。如图 3 所示，所述触摸面板 15 的表面中心 151 向下凹陷，边缘 152 水平，其余部位从所述中心 151 向所述边缘 152 均匀拉升。优选的，所述触摸面板 15 表面的中心 151 位置比边缘位置 152 低 0.5mm 至 5mm，以取得较好的反射效果。

[0018] 请结合参见图 4a 和图 4b，图 4a 为现有凹面光学触摸屏在实际应用中的光线反射回归示意图；图 4b 为本发明所述凹面光学触摸屏在实际应用中的光线反射回归示意图。

[0019] 如图 4a 所示，当所述触摸面板 105 表面外凸时，光源 103 发出的部分光线 109 被所述触摸面板 105 反射到回归反射条 104 之外，有效反射回归所述光学传感器 102 的光能量就很弱。反射回归的光能量低，信号就弱，使得触摸屏灵敏度不高，检测精度低。

[0020] 如图 4b 所示，由于安装了表面向下凹陷的触摸面板 15，光源 13 发出的部分光线 153 被所述触摸面板 15 反射到所述回归反射条 14，再由所述回归反射条 14 反射回所述光学传感器 12，增强了回归反射的光的能量。反射回归的光能量高，信号就强，使得触摸屏灵敏度提高，检测精度提高。

[0021] 具体的，所述触摸面板 15 是由蜂窝铝板材料或者亚克力板材料制作而成的。

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[0022] 优选的，所述触摸面板 15 是由钢化玻璃材料制作而成的。所述钢化玻璃并非平常正常工艺，生产时需注意控制工艺，使其中心部位向下凹陷。控制方法是：在所述钢化玻璃钢化冷却时，上下两表面对吹的风压压力设置不同，控制其上表面气压为 920±10MP，下表面气压为 880±10MP，则所述钢化玻璃向下凹陷。

[0023] 实施本发明实施例，具有如下有益效果：由于安装了表面向下凹陷的触摸面板，部分光线被所述触摸面板反射到回归反射条，增强了回归反射的光的能量，使得本发明的光学触摸屏具有更高的灵敏度和检测精度。相比其他的在回归反射条上设置特殊物质或者设置特殊结构以提高回归反射的光的能量的技术方案，本实施例的方案简单易行，取得了预料不到的技术效果。

[0024] 以上所揭露的仅为本发明较佳实施例而已，当然不能以此来限定本发明之权利范围，因此依本发明权利要求所作的等同变化，仍属本发明所涵盖的范围。

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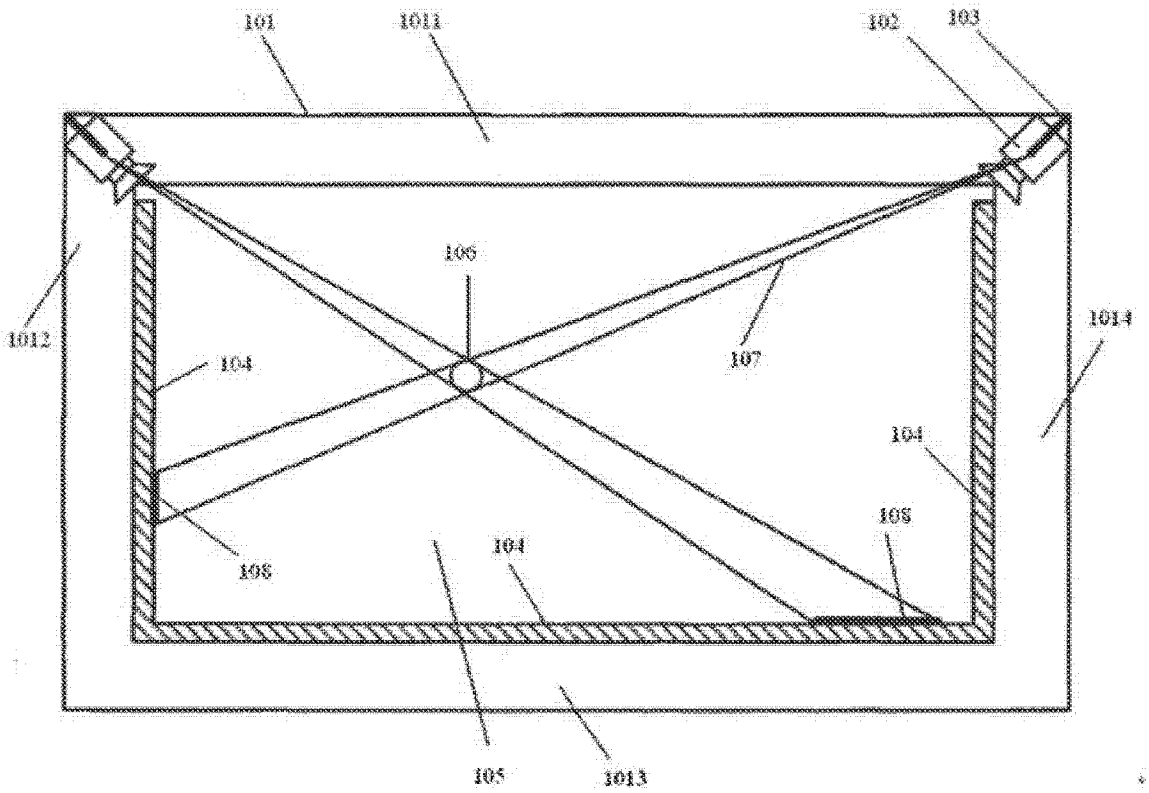


图 1

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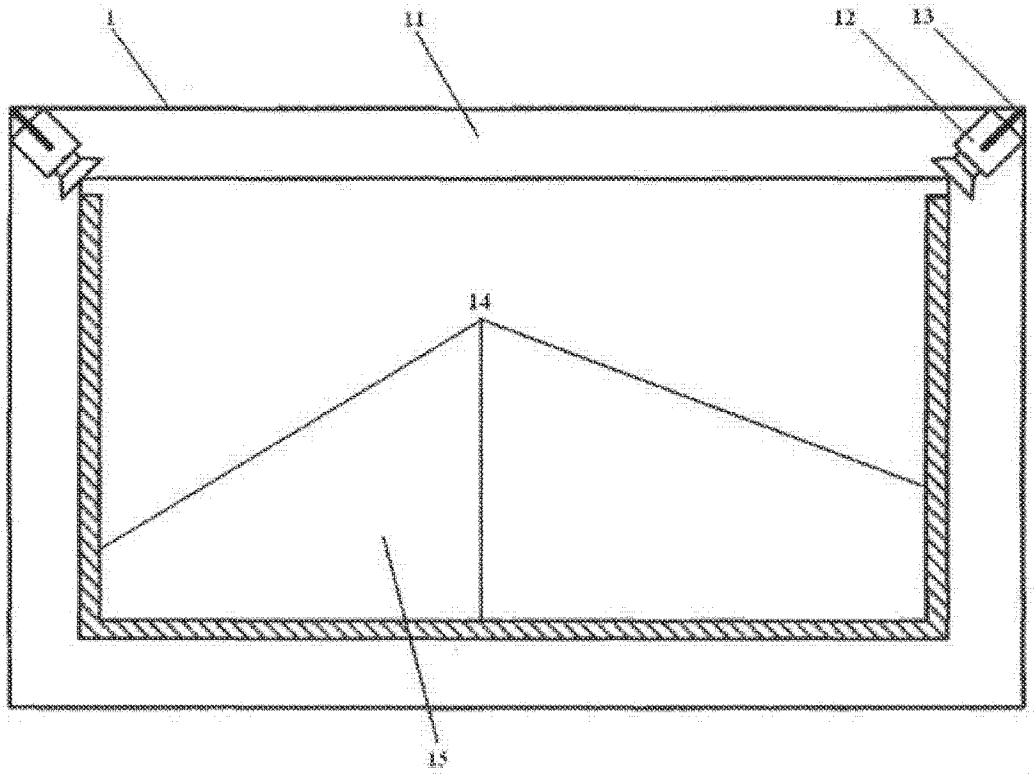


图 2

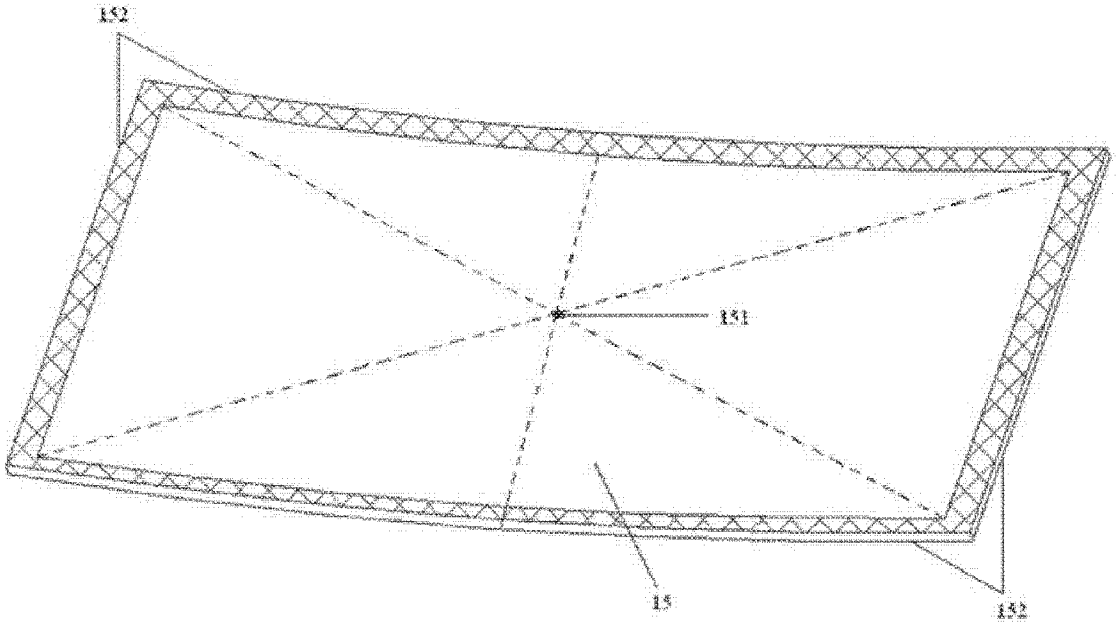


图 3

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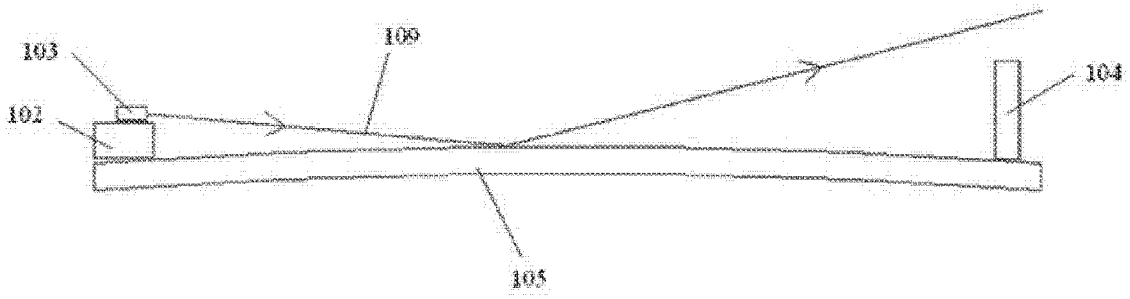


图 4a

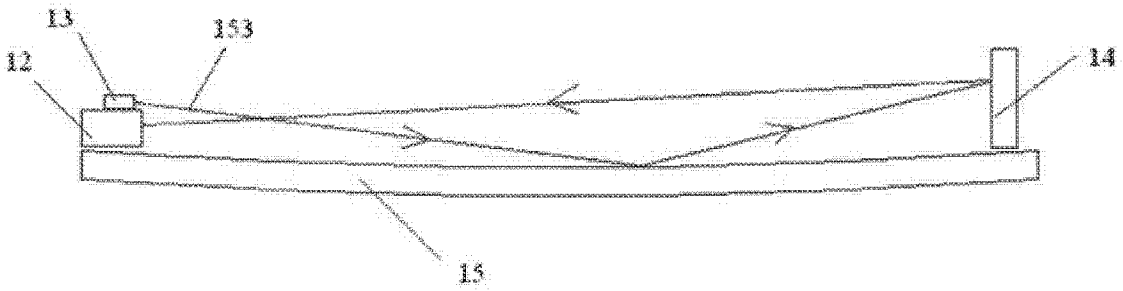


图 4b

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Espacenet

CN103123556A Projection type touch-control electronic whiteboard and frame structure thereof

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Classifications:
IPC ***G06F3/042;***

CPC **G06F3/0428 (EP);**

Priorities: CN201310066663A 2013-03-01

Application: CN103123556A·2013-03-01

Publication: CN103123556A·2013-05-29

Published as: CN103123556A;**WO2014131221A1**

Projection type touch-control electronic whiteboard and frame structure thereof

Abstract

The invention discloses a frame structure of a projection type touch-control electronic whiteboard. The frame structure is used for being arranged on the edge portion of a screen of the electronic whiteboard. The frame structure comprises a frame, a light source component and a light filter. The light source component is arranged in the frame, and the light filter is arranged on the side opening portion of the frame. The side opening of the frame extends along the edge of the electronic whiteboard. Sensors of the light source component are vertically arranged on a circuit board of the light source component, and the circuit board extends along the edge of the electronic whiteboard. The vertically arranged sensors provide touch-control locating through the light filter. The invention further discloses the electronic whiteboard provided with the frame structure. The electronic whiteboard and the frame structure of the electronic whiteboard enable the electronic whiteboard to have a narrow frame and to be easy to install and maintain, a beautiful light electronic whiteboard can be designed conveniently.

(19)中华人民共和国国家知识产权局

(12)发明专利申请

(10)申请公布号 CN 103123556 A
(43)申请公布日 2013.05.29

(21)申请号 201310066663.9

(22)申请日 2013.03.01

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(51)Int.Cl.
G06F 3/042(2006.01)

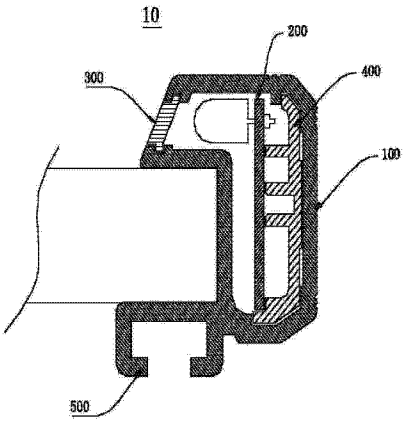
权利要求书1页 说明书3页 附图4页

(54)发明名称

投影式触控电子白板及其边框结构

(57)摘要

本发明公开一种投影式触控电子白板的边框结构，用于设置在电子白板的屏幕的边缘处，包括边框、设置在所述边框内的光源组件和设于所述边框侧边开口处的滤光片，所述边框的侧边开口沿电子白板的边缘延伸，所述光源组件的传感器竖排在所述光源组件的电路板上，且所述电路板沿电子白板的边缘延伸，所述竖排的传感器透过所述滤光片提供触控定位。还公开一种具有上述边框结构的电子白板。上述电子白板及其边框结构使得电子白板具有窄边框，易安装，易维护，方便设计更加美观的轻薄电子白板。



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1. 一种投影式电子白板的边框结构，用于设置在电子白板的显示区域的边缘处，包括边框、设置在所述边框内的传感器组件和设于所述边框侧边开口处的滤光片，所述边框的侧边开口沿电子白板的边缘延伸，其特征在于，所述传感器组件的传感器竖排在所述传感器组件的电路板上，且所述电路板沿显示区域的边缘延伸，所述竖排的传感器透过所述滤光片提供触控定位。

2. 根据权利要求 1 所述的投影式电子白板的边框结构，其特征在于，所述边框整体为条柱状，并具有截面为 L 型的容置腔，用于容置所述传感器组件，所述传感器组件的电路板和传感器相互垂直地设置并置于所述截面为 L 型的容置腔中。

3. 根据权利要求 1 所述的投影式电子白板的边框结构，其特征在于，还包括托板，所述电路板固定在所述托板上，并与托板一起活动地容置于所述边框内。

4. 根据权利要求 1 所述的投影式电子白板的边框结构，其特征在于，还包括设于所述边框上且与设有滤光片的开口相对的边框连接结构，多个边框可通过所述边框连接结构相互连接。

5. 根据权利要求 4 所述的投影式电子白板的边框结构，其特征在于，所述边框连接结构为与角铁配合的框架。

6. 一种投影式电子白板，包括触控板和设于所述触控板四个边缘的边框结构，所述边框结构包括边框、设置在所述边框内的传感器组件和设于所述边框侧边开口处的滤光片，所述边框的侧边开口沿触控板的边缘延伸，其特征在于，所述传感器组件的传感器竖排在所述光源组件的电路板上，且所述电路板沿触控板的边缘延伸，所述竖排的传感器透过所述滤光片提供触控定位。

7. 根据权利要求 6 所述的投影式电子白板，其特征在于，所述边框整体为条柱状，并具有截面为 L 型的容置腔，用于容置所述光源组件，所述光源组件的电路板和传感器相互垂直地设置并置于所述截面为 L 型的容置腔中。

8. 根据权利要求 6 所述的投影式电子白板，其特征在于，还包括托板，所述电路板固定在所述托板上，并与托板一起活动地容置于所述边框内。

9. 根据权利要求 6 所述的投影式电子白板，其特征在于，还包括设于所述边框上且与设有滤光片的开口相对的边框连接结构，相邻的边框通过所述边框连接结构相互连接。

10. 根据权利要求 9 所述的投影式电子白板，其特征在于，所述边框连接结构包括为与角铁配合的框架，相邻边框通过角铁连接，且相邻的边框连接处设有与所述角铁固定连接且覆盖边框端部的角件。

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投影式触控电子白板及其边框结构

技术领域

[0001] 本发明涉及电子白板技术领域，特别是涉及一种投影式触控电子白板和一种投影式触控电子白板的边框结构。

背景技术

[0002] 在电子白板技术领域，特别是采用投影显示的大型电子白板中(参考图 1)，多采用红外传感技术为电子白板提供触控定位。红外传感器一般都设置在电子白板的边框中。如图 2 所示，是一种传统的电子白板的横向剖视图。该电子白板包括基板 1、设置在基板 1 四个边缘的边框 2、设置在边框 2 中的传感器组件 3 和设置在边框 2 侧边开口处的滤光片 4。其中传感器组件 3 发射出信号并经过滤光片 4 滤光后为触控区域另一侧的传感器接收。参考图 3a 和图 3b，传感器组件 3 包括电路板 31、插设在电路板 31 上的传感器 32 和驱动传感器 32 的电路芯片 33。在传统的电子白板中，传感器组件 3 中的传感器 32 的管脚是与传感器主体部分垂直的，也即传感器 32 主体部分是卧排在电路板 31 上的，这样就需要将整个电路板 31 以平行于基板 1 的方式放置在基板 1 的边缘，这样整个电子白板的边框就会太宽，无法形成窄边框设计。

发明内容

[0003] 基于此，有必要提供一种用于窄边框的投影式电子白板的边框结构。

[0004] 此外，还提供一种投影式电子白板。

[0005] 一种投影式电子白板的边框结构，用于设置在电子白板的显示区域的边缘处，包括边框、设置在所述边框内的传感器组件和设于所述边框侧边开口处的滤光片，所述边框的侧边开口沿电子白板的边缘延伸，所述传感器组件的传感器竖排在所述传感器组件的电路板上，且所述电路板沿显示区域的边缘延伸，所述竖排的传感器透过所述滤光片提供触控定位。

[0006] 在其中一个实施例中，所述边框整体为条柱状，并具有截面为 L 型的容置腔，用于容置所述传感器组件，所述传感器组件的电路板和传感器相互垂直地设置并置于所述截面为 L 型的容置腔中。

[0007] 在其中一个实施例中，还包括托板，所述电路板固定在所述托板上，并与托板一起活动地容置于所述边框内。

[0008] 在其中一个实施例中，还包括设于所述边框上且与设有滤光片的开口相对的边框连接结构，多个边框可通过所述边框连接结构相互连接。

[0009] 在其中一个实施例中，所述边框连接结构为与角铁配合的框架。

[0010] 一种投影式电子白板，包括触控板和设于所述触控板四个边缘的边框结构，所述边框结构包括边框、设置在所述边框内的传感器组件和设于所述边框侧边开口处的滤光片，所述边框的侧边开口沿触控板的边缘延伸，所述传感器组件的传感器竖排在所述光源组件的电路板上，且所述电路板沿触控板的边缘延伸，所述竖排的传感器透过所述滤光片

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提供触控定位。

[0011] 在其中一个实施例中，所述边框整体为条柱状，并具有截面为 L 型的容置腔，用于容置所述光源组件，所述光源组件的电路板和传感器相互垂直地设置并置于所述截面为 L 型的容置腔中。

[0012] 在其中一个实施例中，还包括托板，所述电路板固定在所述托板上，并与托板一起活动地容置于所述边框内。

[0013] 在其中一个实施例中，还包括设于所述边框上且与设有滤光片的开口相对的边框连接结构，相邻的边框通过所述边框连接结构相互连接。

[0014] 在其中一个实施例中，所述边框连接结构包括为与角铁配合的框架，相邻边框通过角铁连接，且相邻的边框连接处设有与所述角铁固定连接且覆盖边框端部的角件。

[0015] 上述投影式电子白板及其边框结构，通过将红外 LED 光源的发光灯体与电路板垂直设置，使得电路板可以采用沿屏幕边缘延伸的方向设置，相比于传统的设置方式，可以将显示屏的边框部分变窄，便于设计更美观的显示屏。

附图说明

[0016] 图 1 为触摸电子白板用于投影的示意图；

[0017] 图 2 为一种传统的显示屏的横向剖视图；

[0018] 图 3a 和图 3b 为图 2 中的触控组件结构示意图；

[0019] 图 4 为一实施例的显示屏的边框结构示意图；

[0020] 图 5 为图 4 所述边框结构的横向剖视图；

[0021] 图 6 为图 5 中的触控组件结构示意图；

[0022] 图 7 为一实施例的显示屏的横向剖视图；

[0023] 图 8 为相邻的边框结构相接处带角件的示意图；

[0024] 图 9 为相邻的边框结构相接处不带角件的示意图。

具体实施方式

[0025] 如图 4 所示，为一实施例的投影式电子白板的边框结构示意图，图 5 为图 4 所示的边框结构的横向剖视图。结合图 4 和图 5，该边框结构 10 包括边框 100、设置在边框 100 内的传感器组件 200 和设于边框 100 侧边开口处的滤光片 300（参考图 5）。

[0026] 边框 100 整体为条柱状，并具有截面为 L 型的容置腔。边框 100 侧边开设沿电子白板的屏幕的边缘延伸的开口，滤光片 300 设于该开口处。

[0027] 如图 6 所示，传感器组件 200 包括传感器 210 和电路板 220。在电子白板相对的边缘上设置的边框结构 10 中，对应设置发送传感器和接收传感器。这样，从电子白板一侧边缘发送的传感器信号能够被另一对侧的传感器接收。传感器 210 竖排在电路板 220 上，也即传感器 210 的管脚与传感器轴向相同，使得传感器 210 与电路板 220 相互垂直。电路板 220 沿电子白板的边缘延伸，多个传感器 210 即沿该延伸方向顺序排列，并且传感器信号的发射或接收方向朝向滤光片 300，透过滤光片 300 提供触控定位。相互垂直的传感器 210 和电路板 220 容置于上述的具有 L 型截面的容置腔中。

[0028] 进一步地，如图 4~ 图 6 所示，本实施例的边框结构 10 还包括托板 400。电路 220

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固定在托板 400 上，并与托板 400 一起活动地容置于边框 100 内。

[0029] 在传统的电子白板边框结构中，一旦传感器出现故障，就要更换传感器组件中的部分电路板，此时需要将电子白板四个边框全部拆除以取出电路板。本实施例的边框结构 10 中，传感器组件 200 则可以随托板 400 一起整体地在边框 100 的容置腔中移动，在电路出现故障时，从边框 100 的一端拉动托板 400，即可将传感器组件 200 整体取出。因此可以方便地维护。

[0030] 进一步地，如图 5 所示，本实施例的边框结构 10 还包括设于边框 100 上的边框连接结构 500。在边框 100 的位置上，边框连接结构 500 与设有滤光片 300 的开口相对，在边框 100 与电子白板边缘连接时，边框连接结构 500 和滤光片 300 分别位于电子白板的正面和背面。相邻的边框 100 可通过边框连接结构 500 相互连接，以形成紧凑的边框整体。

[0031] 本实施例中，边框连接结构 500 为与角铁配合的框架。

[0032] 上述实施例中，通过将传感器 210 的传感器主体与电路板 220 垂直设置，使得电路板 210 可以采用沿电子白板边缘延伸的方向设置，相比于传统的设置方式，可以将电子白板的边框部分变窄，便于设计更美观的电子白板。同时，传感器组件 200 作为一个整体可以随托板 400 活动地进出边框 100 的容置腔，便于在传感器故障时进行维护。

[0033] 可以理解，在不同的实施例中，托板 400 和边框连接结构 500 根据成本或便利性等需求增减，且具体结构也不限于上述实施例的结构。

[0034] 如图 7 所示，为一实施例的电子白板的横向剖视图。该电子白板包括触控板 20 和设于触控板 20 四个边缘的如上述实施例的边框结构 10（图 7 中仅显示两个边缘的边框结构）。

[0035] 参考图 8，边框结构 10 在相邻处通过角件 30 连接。参考图 9，边框结构 10 的相邻处设置角铁 40，相邻边框 10 的边框连接结构 500 通过角铁 40 连接，角件 30 与角铁 40 固定连接并覆盖在边框 10 的相邻的端部。当光源组件 200 出现故障时，只需要将角件 30 拆卸，然后通过托板 400 将光源组件 200 整体拉出，即可方便地维修。

[0036] 以上所述实施例仅表达了本发明的几种实施方式，其描述较为具体和详细，但并不能因此而理解为对本发明专利范围的限制。应当指出的是，对于本领域的普通技术人员来说，在不脱离本发明构思的前提下，还可以做出若干变形和改进，这些都属于本发明的保护范围。因此，本发明专利的保护范围应以所附权利要求为准。

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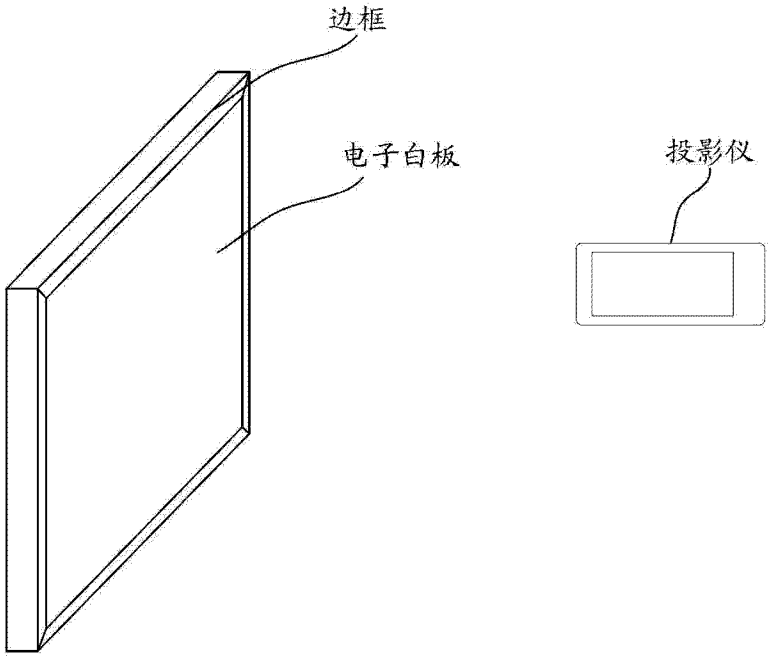


图 1

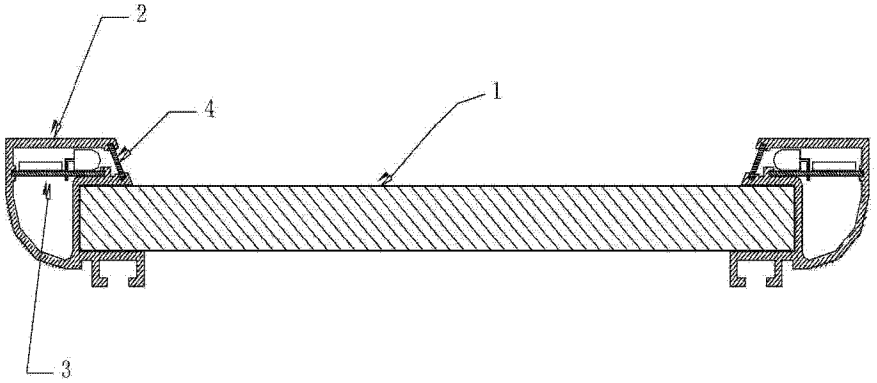


图 2

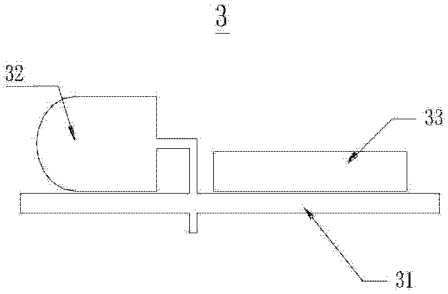


图 3a

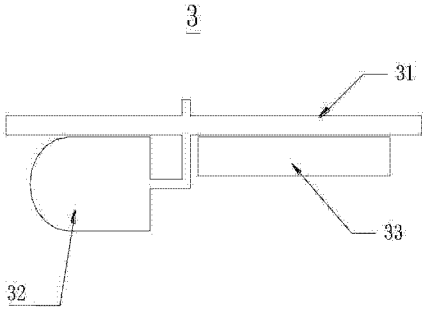


图 3b

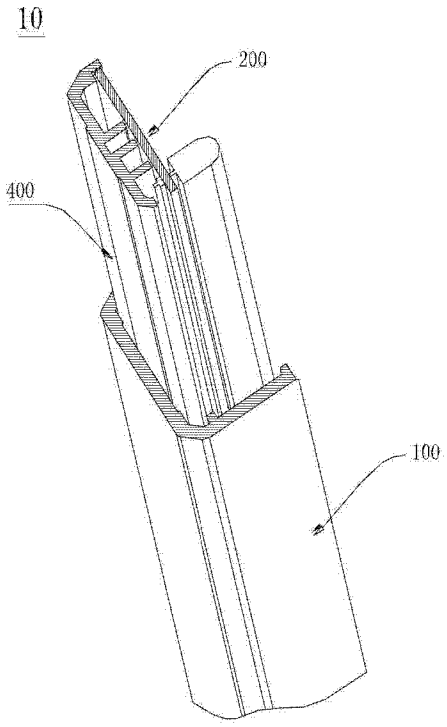


图 4

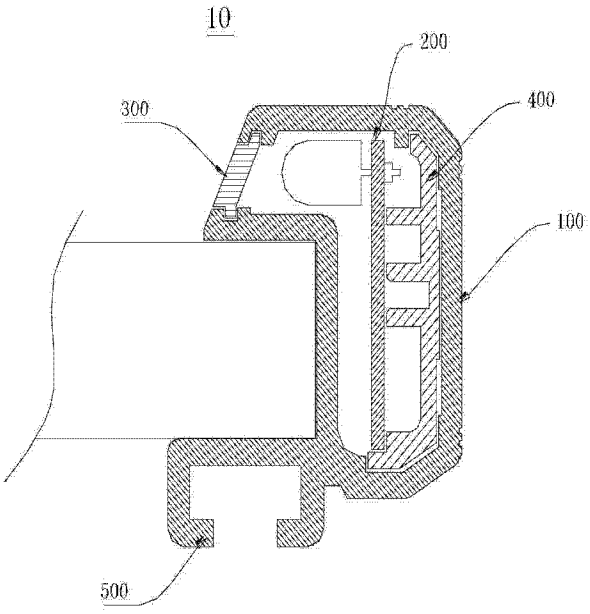


图 5

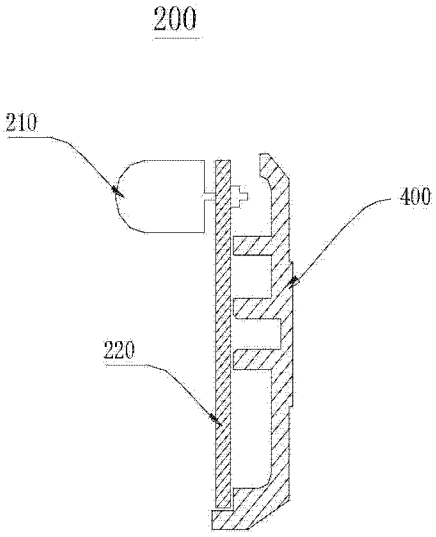


图 6

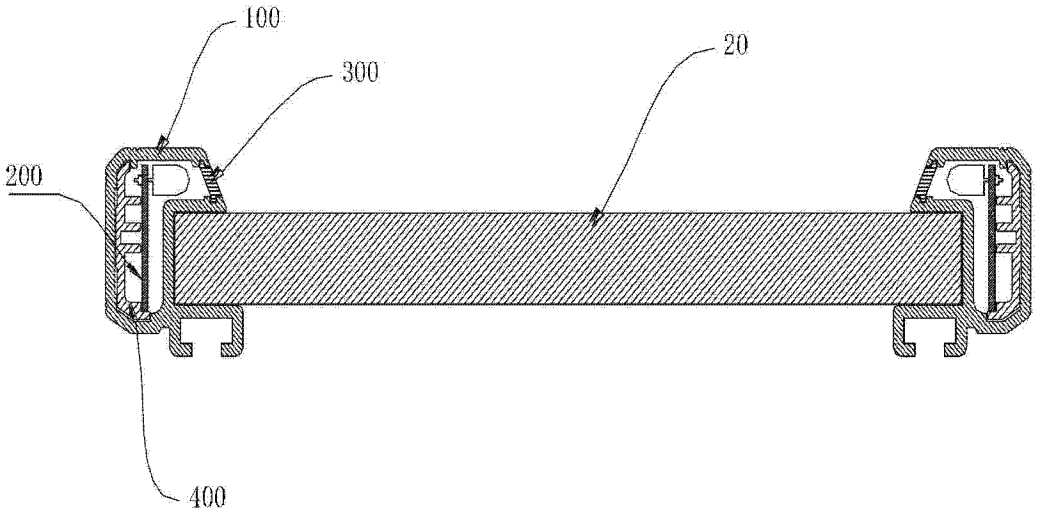


图 7

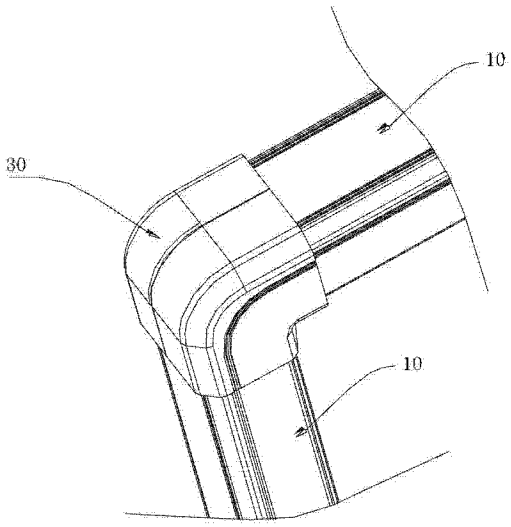


图 8

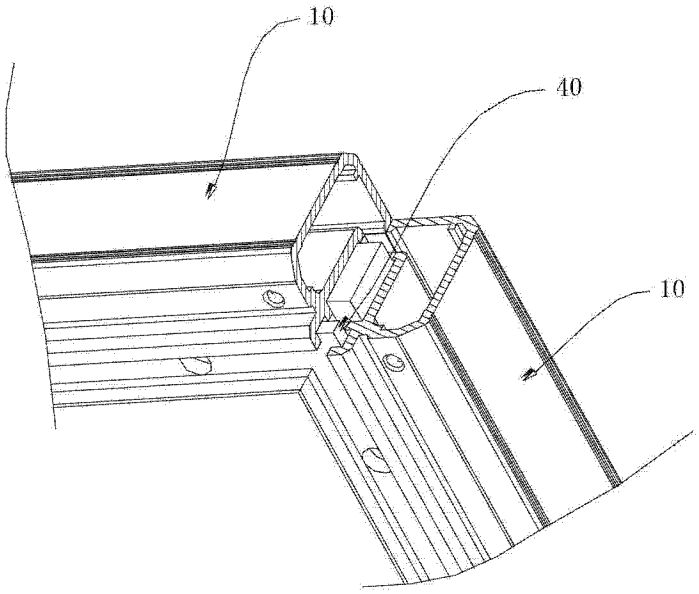


图 9

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Espacenet

CN104391611A Infrared touch equipment with high light resistance and touch detection unit thereof

Applicants: SHENZHEN IBOARD TECHNOLOGY CO LTD

Inventors: HU LONG

Classifications:
IPC ***G06F3/042;***

CPC **G06F3/0421 (CN)**; G06F2203/04109 (CN);

Priorities: CN201410528713A 2014-10-09

Application: CN104391611A·2014-10-09

Publication: CN104391611A·2015-03-04

Published as: CN104391611A;**CN104391611B**

Infrared touch equipment with high light resistance and touch detection unit thereof

Abstract

The invention relates to infrared touch equipment with high light resistance, which comprises a touch screen, a first group of infrared transmitters, a first group of infrared receivers and a first infrared optical filter. The touch screen is provided with a first edge and a second edge which are opposite. The first group of infrared transmitters is arranged at the first edge of the touch screen. The first group of infrared receivers is arranged at the second edge of the touch screen. The first group of infrared receivers corresponds to the first group of infrared transmitters one to one and is used for receiving infrared rays transmitted by the corresponding first group of infrared transmitters. The first infrared optical filter is arranged at a light inlet at the second edge. A tunnel structure is formed between the first infrared optical filter and the first group of infrared receivers; the tunnel structure is constructed to be used for weakening intensity of environmental light which passes through the first infrared optical filter and reaches the first group of infrared receivers.

(19)中华人民共和国国家知识产权局

(12)发明专利申请

(10)申请公布号 CN 104391611 A
(43)申请公布日 2015.03.04

(21)申请号 201410528713.5

(22)申请日 2014.10.09

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(51)Int.Cl.
G06F 3/042(2006.01)

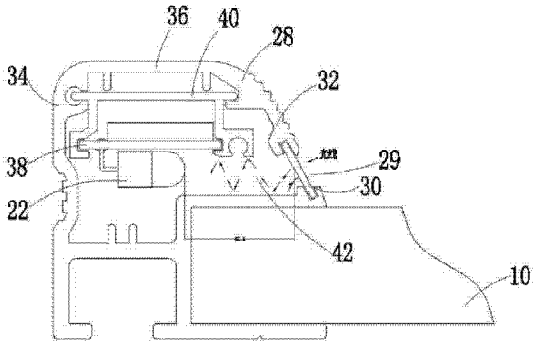
权利要求书2页 说明书4页 附图3页

(54)发明名称

具有高抗光性能的红外触摸设备及其触摸检测单元

(57)摘要

一种具有高抗光性能的红外触摸设备，包括：触摸屏、第一组多个红外发射器、第一组多个红外接收器以及第一红外滤光片。触摸屏具有相对的第一边缘和第二边缘。第一组多个红外发射器设置在触摸屏的第一边缘。第一组多个红外接收器设置在触摸屏的第二边缘。第一组多个红外接收器与第一组多个红外发射器一一对应，用以接收对应的第一组红外发射器发出的红外线。第一红外滤光片设置在位于第二边缘的光线入口处。在第一红外滤光片与第一组红外接收器之间形成隧道结构，该隧道结构构造成用以减弱穿过第一红外滤光片并到达第一组多个红外接收器的环境光线的强度。



CN 104391611 A

1. 一种具有高抗光性能的红外触摸设备，包括：

触摸屏，所述触摸屏具有相对的第一边缘和第二边缘；

第一组多个红外发射器，设置在所述触摸屏的第一边缘；

第一组多个红外接收器，设置在所述触摸屏的第二边缘，所述第一组多个红外接收器与所述第一组多个红外发射器一一对应，用以接收对应的第一组红外发射器发出的红外线；以及

第一红外滤光片，设置在位于所述第二边缘的光线入口处；

其特征在于：

在所述第一红外滤光片与所述第一组红外接收器之间形成隧道结构，所述隧道结构构造成用以减弱穿过所述第一红外滤光片并到达所述第一组多个红外接收器的环境光线的强度。

2. 如权利要求 1 所述的具有高抗光性能的红外触摸设备，其特征在于，所述红外触摸设备包括沿所述第二边缘设置的边框，所述第一组红外接收器安装在电路板上，所述电路板固定在所述边框上并与所述触摸屏平行，所述第一组红外接收器安装在所述电路板上的远离所述触摸屏的一端。

3. 如权利要求 1 所述的具有高抗光性能的红外触摸设备，其特征在于，所述红外触摸设备包括沿所述第二边缘设置的边框，所述第一组红外接收器安装在电路板上，所述电路板固定在所述边框上并与所述触摸屏垂直。

4. 如权利要求 1 所述的具有高抗光性能的红外触摸设备，其特征在于，所述第一红外滤光片倾斜设置。

5. 如权利要求 4 所述的具有高抗光性能的红外触摸设备，其特征在于，所述第一红外滤光片的倾斜角度在 45 至 60 度之间。

6. 如权利要求 4 所述的具有高抗光性能的红外触摸设备，其特征在于，所述红外触摸设备包括沿所述第二边缘设置的边框，所述第一组红外接收器安装在电路板上，所述电路板固定在所述边框上，所述边框包括面对所述第一组红外发射器的内侧框部、远离所述第一组红外发射器的外侧框部以及连接所述内侧框部和外侧框部的边框正面连接部，所述内侧框部自所述边框正面连接部沿远离所述第一组红外接收器并朝向所述触摸屏的方向倾斜延伸，所述第一红外滤光片位于所述内侧框部上。

7. 如权利要求 1 所述的具有高抗光性能的红外触摸设备，其特征在于，所述第一组红外接收器与所述光线入口的距离不小于 11 毫米。

8. 如权利要求 1 所述的具有高抗光性能的红外触摸设备，其特征在于，所述红外触摸设备包括沿所述第二边缘设置的边框，所述隧道结构由所述边框的结构形成或由所述边框的结构与所述触摸屏共同形成。

9. 如权利要求 1-8 中任意一项所述的具有高抗光性能的红外触摸设备，其特征在于，所述触摸屏具有相对的第三边缘和第四边缘，所述第三边缘和第四边缘与所述第一边缘和第二边缘不同，所述红外触摸设备还包括：

第二组多个红外发射器，设置在所述触摸屏的第三边缘；

第二组多个红外接收器，设置在所述触摸屏的第四边缘，所述第二组多个红外接收器与所述第二组多个红外发射器一一对应，用以接收对应的第二组红外发射器发出的红外

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线；以及

第二红外滤光片，设置在位于所述第四边缘的光线入口处；

其中，在所述第二红外滤光片与所述第二组红外接收器之间形成隧道结构，所述隧道结构构造成用以降低穿过所述第二红外滤光片并到达所述第二组多个红外接收器的环境光线的强度。

10. 一种具有高抗光性能的红外触摸设备的触摸检测单元，包括：

相对设置的第一组多个红外发射器和第一组多个红外接收器，所述第一组多个红外接收器与所述第一组多个红外发射器一一对应，用以接收对应的第一组红外发射器发出的红外线；

第一红外滤光片，设置在所述第一组红外发射器发出的红外线的光路上并靠近所述第一组红外接收器；

相对设置的第二组多个红外发射器和第二组多个红外接收器，所述第二组多个红外接收器与所述第二组多个红外发射器一一对应，用以接收对应的第二组红外发射器发出的红外线；

第二红外滤光片，设置在所述第二组红外发射器发出的红外线的光路上并靠近所述第二组红外接收器；

其特征在于：

至少在所述第一红外滤光片和第二红外滤光片其中之一与其对应的第一组或第二组红外接收器之间形成隧道结构，所述隧道结构构造成用以减弱穿过与所述隧道结构对应的那一红外滤光片的环境光线的强度。

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具有高抗光性能的红外触摸设备及其触摸检测单元

技术领域

[0001] 本发明涉及红外触摸领域，特别是具有高抗光性能的红外触摸设备及其触摸检测单元。

背景技术

[0002] 红外触摸的原理是由发射灯发射红外线到接收灯，形成一张由红外线布成的光网，当有物体进入红外光网阻挡住某处的红外线发射接收时，控制器就能知道何处进行了触摸。目前，红外触摸产品大多使用红外滤光片来过滤掉不需要的光线，对使用的环境要求比较高，不能有太强的光线照射，否则影响产品的使用效果或者直接无法使用。

[0003] 但是作为触摸设备却不能限制使用范围，从室内使用到室外高强度阳光下的户外使用，作为产品，它必须适应。因此，提高红外设备的抗光性是本领域技术人员的不懈追求。

发明内容

[0004] 有鉴于此，本发明所要解决的技术问题是提供一种具有改进抗光性能的红外触摸设备。

[0005] 本发明所要解决的另一技术问题是提供一种具有改进抗光性能的红外触摸设备的触摸检测单元。

[0006] 本发明提供了一种具有高抗光性能的红外触摸设备，包括：触摸屏，所述触摸屏具有相对的第一边缘和第二边缘；第一组多个红外发射器，设置在所述触摸屏的第一边缘；第一组多个红外接收器，设置在所述触摸屏的第二边缘，所述第一组多个红外接收器与所述第一组多个红外发射器一一对应，用以接收对应的第一组红外发射器发出的红外线；以及第一红外滤光片，设置在位于所述第二边缘的光线入口处。在所述第一红外滤光片与所述第一组红外接收器之间形成隧道结构，所述隧道结构构造成用以减弱穿过所述第一红外滤光片并到达所述第一组多个红外接收器的环境光线的强度。

[0007] 在一实施例中，所述红外触摸设备包括沿所述第二边缘设置的边框，所述第一组红外接收器安装在电路板上，所述电路板固定在所述边框上并与所述触摸屏平行，所述第一组红外接收器安装在所述电路板上的远离所述触摸屏的一端。

[0008] 在一实施例中，所述红外触摸设备包括沿所述第二边缘设置的边框，所述第一组红外接收器安装在电路板上，所述电路板固定在所述边框上并与所述触摸屏垂直。

[0009] 在一实施例中，所述第一红外滤光片倾斜设置。

[0010] 在一实施例中，所述第一红外滤光片的倾斜角度在 45 至 60 度之间。

[0011] 在一实施例中，所述红外触摸设备包括沿所述第二边缘设置的边框，所述第一组红外接收器安装在电路板上，所述电路板固定在所述边框上，所述边框包括面对所述第一组红外发射器的内侧框部、远离所述第一组红外发射器的外侧框部以及连接所述内侧框部和外侧框部的边框正面连接部，所述内侧框部自所述边框正面连接部沿远离所述第一组红外接收器并朝向所述触摸屏的方向倾斜延伸，所述第一红外滤光片位于所述内侧框部上。

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[0012] 在一实施例中，所述第一组红外接收器与所述光线入口的距离不小于 11 毫米。

[0013] 在一实施例中，所述红外触摸设备包括沿所述第二边缘设置的边框，所述隧道结构由所述边框的结构形成或由所述边框的结构与所述触摸屏共同形成。

[0014] 在一实施例中，所述触摸屏具有相对的第三边缘和第四边缘，所述第三边缘和第四边缘与所述第一边缘和第二边缘不同。所述红外触摸设备还包括：第二组多个红外发射器，设置在所述触摸屏的第三边缘；第二组多个红外接收器，设置在所述触摸屏的第四边缘，所述第二组多个红外接收器与所述第二组多个红外发射器一一对应，用以接收对应的第二组红外发射器发出的红外线；以及第二红外滤光片，设置在位于所述第四边缘的光线入口处。其中，在所述第二红外滤光片与所述第二组红外接收器之间形成隧道结构，所述隧道结构构造成用以降低穿过所述第二红外滤光片并到达所述第二组多个红外接收器的环境光线的强度。

[0015] 本发明还提供了一种具有高抗光性能的红外触摸设备的触摸检测单元，包括：相对设置的第一组多个红外发射器和第一组多个红外接收器，所述第一组多个红外接收器与所述第一组多个红外发射器一一对应，用以接收对应的第一组红外发射器发出的红外线；第一红外滤光片，设置在所述第一组红外发射器发出的红外线的光路上并靠近所述第一组红外接收器；相对设置的第二组多个红外发射器和第二组多个红外接收器，所述第二组多个红外接收器与所述第二组多个红外发射器一一对应，用以接收对应的第二组红外发射器发出的红外线；第二红外滤光片，设置在所述第二组红外发射器发出的红外线的光路上并靠近所述第二组红外接收器。至少在所述第一红外滤光片和第二红外滤光片其中之一与其对应的第一组或第二组红外接收器之间形成隧道结构，所述隧道结构构造成用以减弱穿过与所述隧道结构对应的那一红外滤光片的环境光线的强度。

[0016] 综上所述，在上述红外触摸设备及其触摸检测单元中，红外接收器与对应的红外滤光片之间形成隧道结构，通过隧道结构对环境光线的多次反射，减弱环境光线至不影响红外接收的程度，从而提高红外触摸设备的抗光性。

附图说明

[0017] 图 1 是红外触摸设备的原理示意图。

[0018] 图 2 是红外触摸设备的一个实施例的剖视图。

[0019] 图 3 是图 2 的红外触摸设备的触摸检测单元的结构示意图。

[0020] 图 4 是红外触摸设备的另一个实施例的剖视图。

[0021] 图 5 是图 4 的红外触摸设备的触摸检测单元的结构示意图。

具体实施方式

[0022] 为了使本发明要解决的技术问题、技术方案及有益效果更加清楚明白，以下结合附图及实施例，对本发明进行进一步详细说明。应当理解，此处所描述的具体实施例仅仅作为例示用途，并不用于限定本发明。

[0023] 参考图 1，为红外触摸设备的原理示意图。红外触摸设备包括触摸检测单元，围绕触摸屏 10 设置，并且设置在触摸屏 10 相对的边缘上。在所示的实施例中，触摸屏 10 为长方形，具有相对的第一边缘 12 和第二边缘 14，以及相对的第三边缘 16 和第四边缘 18。触

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摸检测单元包括第一组多个红外发射器 20 和第一组多个红外接收器 22，其中第一组多个红外发射器 20 设置在触摸屏 10 的第一边缘 12，而第一组多个红外接收器 22 设置在触摸屏 10 的第二边缘 14。第一组多个红外接收器 22 与第一组多个红外发射器 20 一一对应，用以接收对应的第一组红外发射器 20 发出的红外线。

[0024] 同样，触摸检测单元还包括第二组多个红外发射器 24 和第二组多个红外接收器 26，其中第二组多个红外发射器 24 设置在触摸屏 10 的第三边缘 16，而第二组多个红外接收器 26 设置在触摸屏 10 的第四边缘 18。第二组多个红外接收器 26 与第一组多个红外发射器 24 一一对应，用以接收对应的第二组红外发射器 24 发出的红外线。

[0025] 不同组的红外发射器发射的红外线相互交叉，在此实施例中是正交设置。如果某处（例如图 1 触摸屏中的黑点处）发生触摸事件，则对应位置的红外线无法被接收，因此可以根据红外接收器的接收情况确定发生触摸事件的位置。

[0026] 红外接收器接收正对的红外发射器发射的红外线时，也同时会接收环境光线。一般会在红外发射器发出的红外线的光路上并靠近红外接收器的位置设置红外滤光片，以滤除环境光线。但在环境光线很强的情况下，还是会有部分环境光穿过红外滤光片并到达对应的红外接收器。这部分穿过红外滤光片的环境光需要被减弱，否则会影响红外接收。

[0027] 图 2 和图 3 是红外触摸设备的一个实施例的示意图。

[0028] 红外触摸设备包括沿触摸屏 10 的第二边缘 14 设置的边框 28。边框 28 设有光线入口 29，此光线入口 29 位于红外线的光路上。在光线入口 29 处设置第一红外滤光片 30，以滤除环境光线。

[0029] 边框 28 包括面对第一组红外发射器 20 的内侧框部 32、远离第一组红外发射器 20 的外侧框部 34 以及连接内侧框部 32 和外侧框部 34 的边框正面连接部 36。内侧框部 32 自边框正面连接部 36 沿远离第一组红外接收器 22 并朝向触摸屏 10 的方向倾斜延伸。第一红外滤光片 30 位于内侧框部 32 上，因此也呈倾斜设置。第一红外滤光片 30 的倾斜角度在 45 至 60 度范围内，在本实施例中，其倾斜角度为 59 度。

[0030] 第一组红外接收器 22 安装在电路板 38 上，电路板 38 固定在边框 28 上。在所示的实施例中，电路板 38 是利用一个分离的安装件 40 安装在边框 28 上的。整体来看，此安装件 40 可视为边框 28 的一部分。在其他实施例中，电路板 38 也可以直接安装在边框 28 上，而不需要设置上述分离的安装件 40。

[0031] 在所示的实施例中，电路板 38 与触摸屏 10 平行。第一组红外接收器 22 安装在电路板 38 上的远离触摸屏 10 的一端。

[0032] 在第一红外滤光片 30 与第一组红外接收器 22 之间形成隧道结构 42。隧道结构 42 构造成用以降低穿过第一红外滤光片 30 并到达第一组多个红外接收器 22 的环境光线的强度。环境光线穿过第一红外滤光片 30 后，在隧道结构 42 中多次反射，逐渐降低环境光的强度，使其减弱到不影响红外接收的程度。由于第一组红外接收器 22 安装在电路板 38 上的远离触摸屏 10 的一端，而且边框 28 的内侧框部 32 沿远离第一组红外接收器 22 的方向倾斜延伸，这样设计可以增加上述隧道结构 42 的长度，进而增加环境光的反射次数，更大程度地减弱环境光线的强度。第一组红外接收器 22 与光线入口 29 之间的距离不小于 11 毫米。在本实施例中，第一组红外接收器 22 与光线入口 29 之间的距离为 14.3 毫米。

[0033] 在此实施例中，隧道结构 42 由边框 28 的结构形成。具体而言，其由内侧框部 32

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的部分结构、安装件 40 的部分结构以及夹持触摸屏 10 的部分边框结构共同形成。为此，边框 28 的上述部位可以形成各种有利于增加光线反射的结构。进一步地，这些部位上还可以设置吸光结构或材料，进一步减弱环境光线。

[0034] 图 4 和图 5 是红外触摸设备的另一个实施例。

[0035] 下面主要针对与前述是实施例不同之处进行描述。电路板 138 利用安装件 140 安装在边框 28 上，且电路板 138 与触摸屏 10 垂直。电路板 138 位置尽量靠近外侧框部 34。内侧框部 32 自边框正面连接部 36 沿远离第一组红外接收器 22 并朝向触摸屏 10 的方向倾斜延伸。第一红外滤光片 130 位于内侧框部 32 上，因此也呈倾斜设置。在本实施例中，其倾斜角度为 55 度。

[0036] 在第一红外滤光片 130 与第一组红外接收器 22 之间形成隧道结构 142。隧道结构 142 构造成用以降低穿过第一红外滤光片 130 并到达第一组多个红外接收器 22 的环境光线的强度。环境光线穿过第一红外滤光片 130 后，在隧道结构 142 中多次反射，逐渐降低环境光的强度，使其减弱到不影响红外接收的程度。

[0037] 由于电路板 38 位置尽量靠近外侧框部 34，而且边框 28 的内侧框部 32 沿远离第一组红外接收器 22 的方向倾斜延伸，这样设计可以增加上述隧道结构 42 的长度，进而增加环境光的反射次数，更大程度地减弱环境光线的强度。在本实施例中，第一组红外接收器 22 与光线入口 129 之间的距离为 14.3 毫米。

[0038] 在此实施例中，隧道结构 42 由边框 28 与触摸屏 10 的结构共同形成。具体而言，其由内侧框部 32 的部分结构、第一滤光片 130 的部分结构以及触摸屏 10 的部分表面共同形成。为此，边框 28 和触摸屏 10 的上述部位可以形成各种有利于增加光线反射的结构。同样，这些部位上还可以设置吸光结构或材料，进一步减弱环境光线。

[0039] 在本实施例中，内侧框部 32 末端沿远离第一组红外发射器 20 的方向反折而形成翻折部 33，第一滤光片 130 末端沿远离第一组红外发射器 20 的方向反折而形成翻折部 131。这些翻折部 33，131 都是形成上述隧道结构 142 的结构。

[0040] 上述是以第一组红外发射器和接收器为例，说明了触摸检测单元的滤光片和隧道结构的构造。应当理解的是，针对第二组红外发射器和接收器也可以按照相同的方式设置类似的滤光片和隧道结构，即在位于第四边缘 18 的光线入口设置第二红外滤光片，在第二红外滤光片与第二组红外接收器 26 之间形成隧道结构，该隧道结构构造成用以降低穿过第二红外滤光片并到达第二组多个红外接收器 26 的环境光线的强度。当然，针对第二组红外发射器和接收器也可以不同的方式设置滤光片，可以设置或不设置隧道结构。

[0041] 在第一组红外发射器 20 和第二组红外发射器 24 的一侧，理论上是不用抗光设计的。但从产品外观的角度看，发射器这一侧也可以设置相同或类似的边框结构以形成统一的外观。本说明书附图所示的实施例中，发射器这一侧设置了相同的边框结构。

[0042] 综上所述，在上述介绍的红外触摸设备及其触摸检测单元中，红外接收器与对应的红外滤光片之间形成隧道结构，通过隧道结构对环境光线的多次反射，减弱环境光线至不影响红外接收的程度，从而提高红外触摸设备的抗光性。

[0043] 以上所述仅为本发明的实施例而已，并不用以限制本发明，凡在本发明的精神和原则之内所作的任何修改、等同替换和改进等，均应包含在本发明的保护范围之内。

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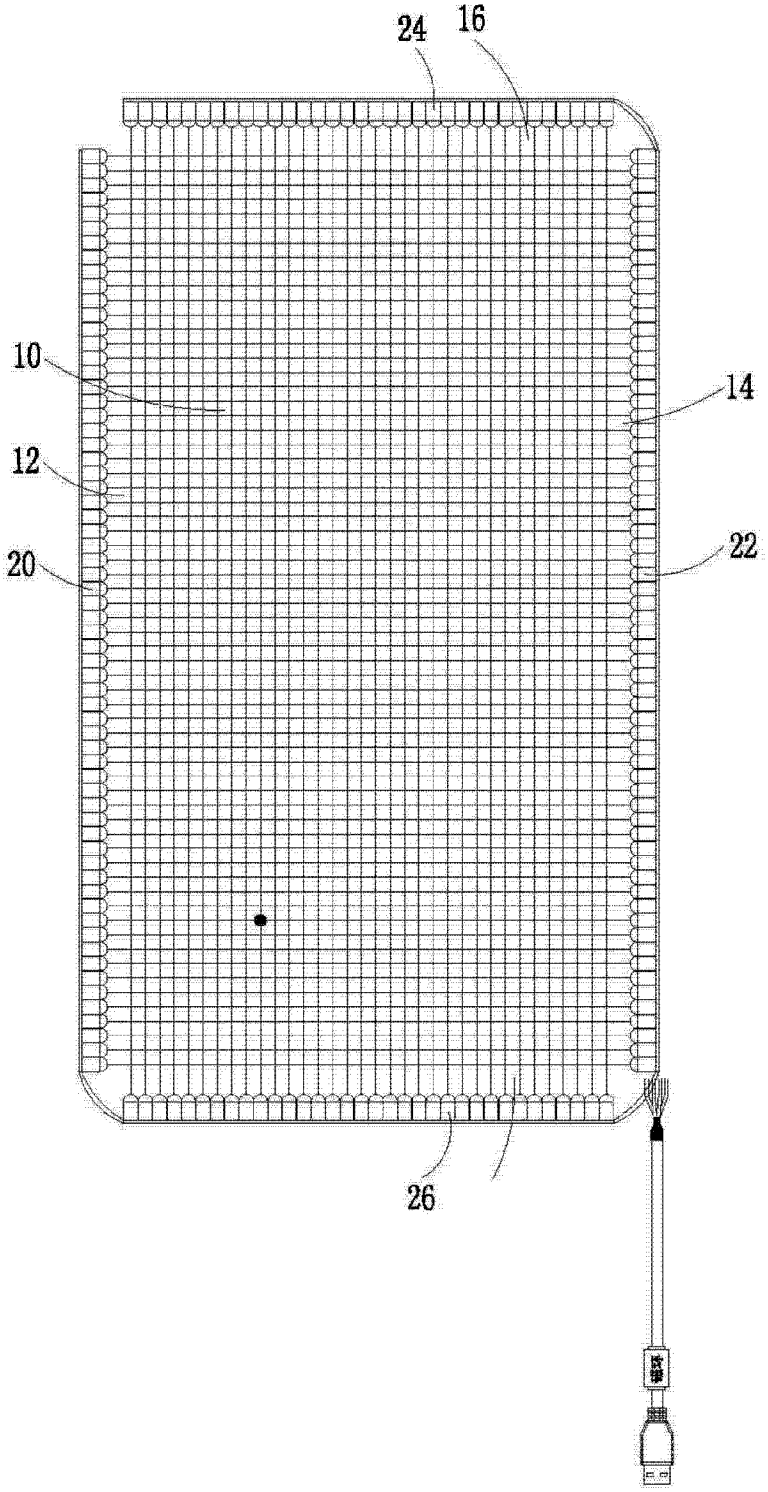


图 1

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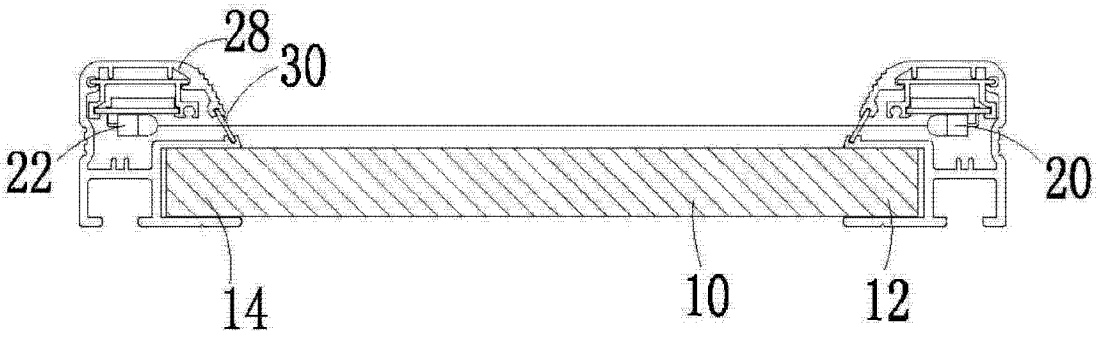


图 2

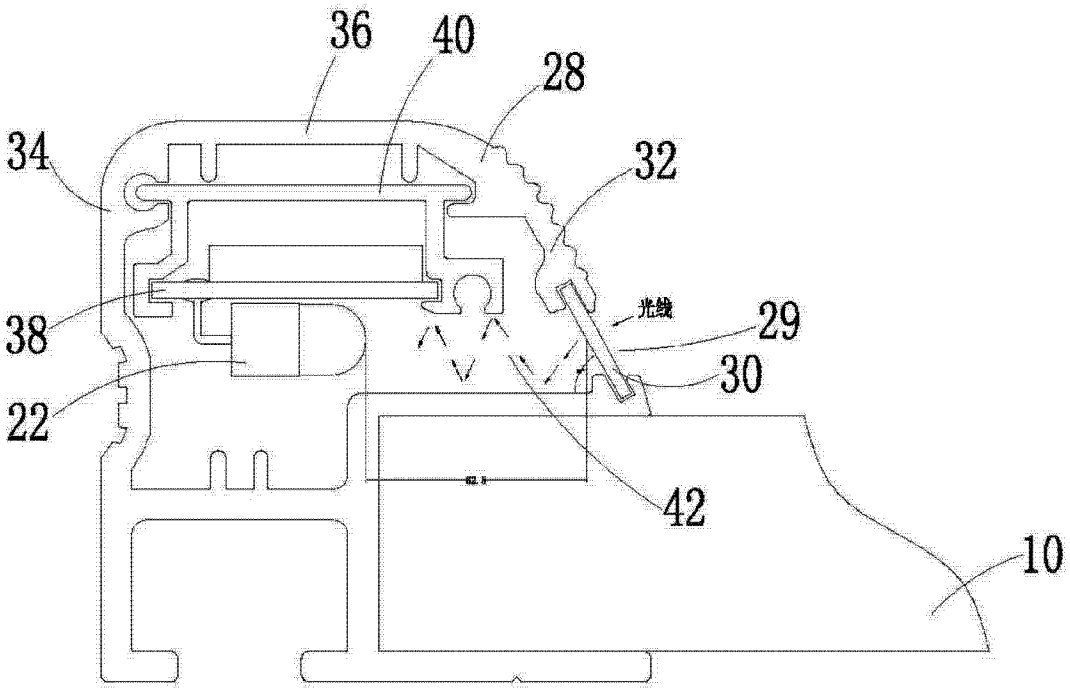


图 3

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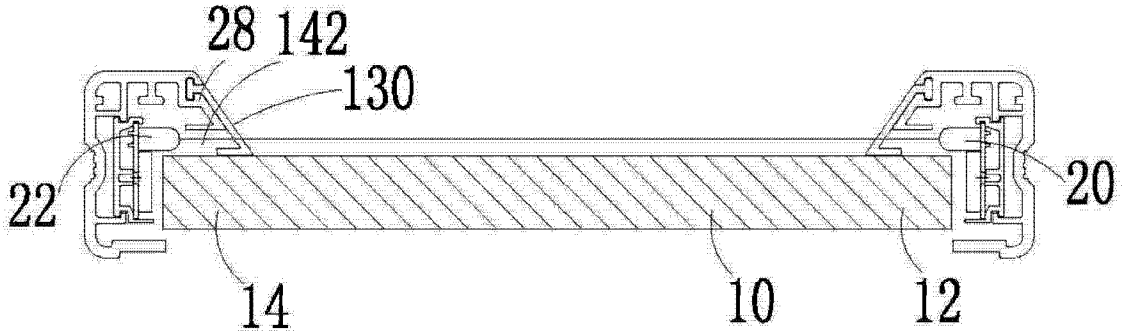


图 4

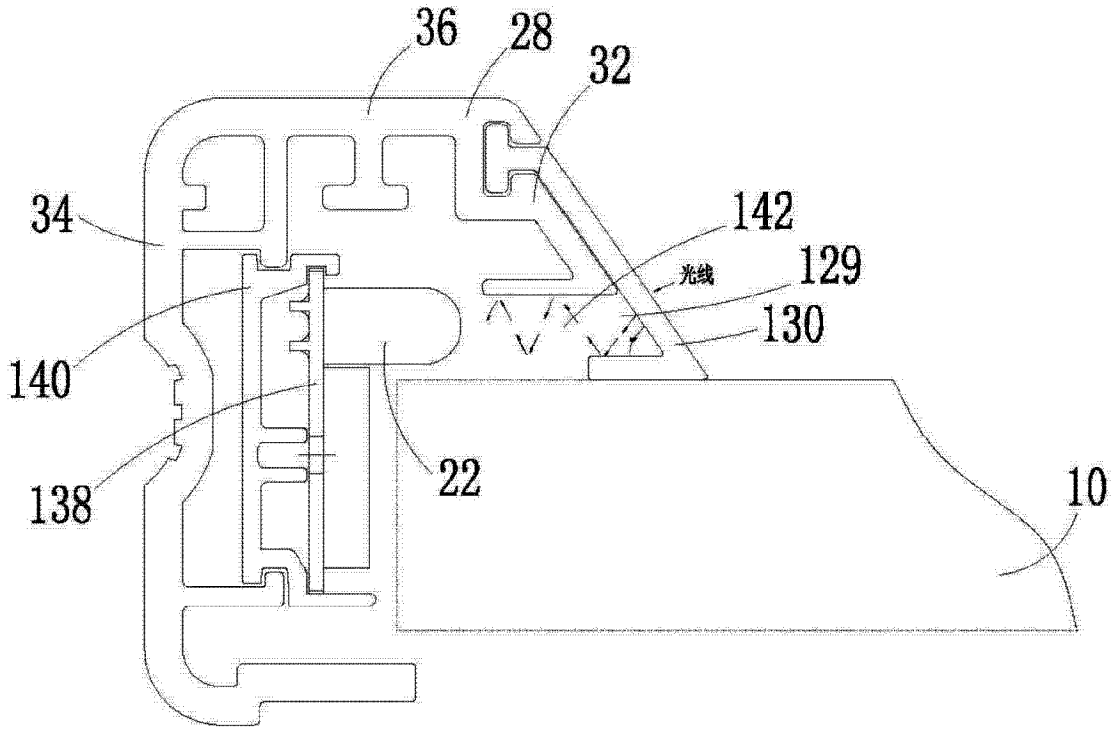


图 5

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(19)中华人民共和国国家知识产权局

(12)发明专利申请

(10)申请公布号 CN 104808843 A
(43)申请公布日 2015.07.29

(21)申请号 201510156560.0

(22)申请日 2015.04.03

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(51)Int.Cl.
G06F 3/041(2006.01)

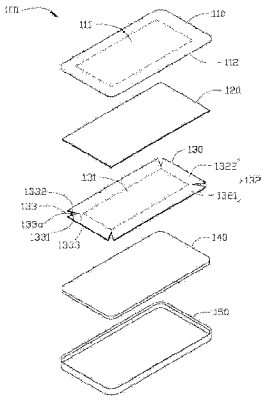
权利要求书1页 说明书5页 附图12页

(54)发明名称

触控面板及触控显示面板

(57)摘要

一种触控面板及触控显示装置。该触控显示装置包括触控面板及显示面板，该触控面板包括盖板及光学膜片组，该盖板包括触控表面及与该触控表面相对的内表面，该内表面为三维曲面，该光学膜片组固定于该内表面上，该光学膜片组包括触控区及围绕该触控区的周边区，该周边区包括至少一缺口。本发明的触控面板及触控显示面板，在光学膜片组上设置缺口，可有效解决光学膜片组与曲面盖板贴合导致的不良现象。



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1. 一种触控面板，光学膜片组该触控面板包括盖板及光学膜片组，该盖板包括触控表面及与该触控表面相对的内表面，该内表面为三维曲面，该光学膜片组固定于该内表面上，该光学膜片组包括触控区及围绕该触控区的周边区，其特征在于，该周边区包括至少一缺口。

2. 如权利要求 1 所述的触控面板，其特征在于，该缺口为开放型缺口。

3. 如权利要求 1 所述的触控面板，其特征在于，该缺口与该触控区互相不临接。

4. 如权利要求 1 所述的触控面板，其特征在于，该触控表面与该内表面形状相同且相互平行。

5. 如权利要求 4 所述的触控面板，其特征在于，该内表面为朝向触控表面一侧凹陷的弯曲表面。

6. 如权利要求 4 所述的触控面板，其特征在于，该内表面为朝向远离该触控表面一侧凸出的弯曲表面。

7. 如权利要求 1 所述的触控面板，其特征在于，该缺口呈扇形并位于该光学膜片组的周边区的拐角处。

8. 如权利要求 5 所述的触控面板，其特征在于，该顶点处具有圆弧形倒角。

9. 如权利要求 1 所述的触控面板，其特征在于，该缺口位于该光学膜片组的周边区的相邻两个拐角之间。

10. 如权利要求 1 所述的触控面板，其特征在于，该缺口设置于该光学膜片组的周边区的拐角及相邻两个拐角之间。

11. 如权利要求 1 所述的触控面板，其特征在于，该光学膜片组为触控感应电极层、抗反射膜、防爆膜或其他功能性膜片中至少一者。

12. 一种触控显示装置，该触控显示装置包括层叠设置的触控面板及显示面板，其特征在于，该触控面板采用权利要求 1-11 所述的触控面板。

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触控面板及触控显示面板

技术领域

[0001] 本发明涉及一种触控面板及触控显示装置，尤其是触控面为三维曲面的触控面板及触控显示面板。

背景技术

[0002] 触控显示装置因其功耗小、成本低、无辐射和易操作等特点，近年来得到了广泛的应用，已越来越多的走进人们的生活、工作中。触控显示装置通常包括层叠设置的触控面板及显示模组。触控面板用于接收并识别用户的触摸操作，显示模组用于显示图像。随着科技的不断发展，三维曲面的触控屏越来越多的使用在触控显示装置中。

[0003] 然而，在三维曲面的触控模组中，盖板为三维曲面，而传统的触控感应电极层及各种光学膜片是平面的，在贴合的过程中会产生许多不良现象。

发明内容

[0004] 鉴于以上内容，有必要提供一种触控面板及具有此触控面板的触控显示装置。

[0005] 一种触控面板，该触控面板包括盖板及光学膜片组，该盖板包括触控表面及与该触控表面相对的内表面，该内表面为三维曲面，该光学膜片组固定于该内表面上，该光学膜片组包括触控区及围绕该触控区的周边区，该周边区包括至少一缺口。

[0006] 一种触控显示装置，该触控显示装置包括层叠设置的触控面板及显示面板，该触控面板采用上述的触控面板。

[0007] 相较于现有技术，本发明所提供的触控面板及触控显示装置，在光学膜片组的周边区设置缺口，减小贴合时光学膜片组周边区的面积，有效解决光学膜片组与曲面盖板贴合导致的不良现象。

附图说明

[0008] 图 1 为本发明一较佳实施方式所提供的触控显示装置 100 的立体组装示意图。

[0009] 图 2 为图 1 中所示的触控显示装置的正向分解示意图。

[0010] 图 3 为图 1 中沿 III-III 所示的剖面示意图。

[0011] 图 4 为图 1 中沿 IV-IV 所示的剖面示意图。

[0012] 图 5 为图 2 中盖板及光学膜片组粘结后的反向示意图。

[0013] 图 6 为本发明第二实施方式提供的光学膜片组的示意图。

[0014] 图 7 为本发明第三实施方式提供的光学膜片组的示意图。

[0015] 图 8 为本发明第四实施方式提供的光学膜片组的示意图。

[0016] 图 9 为本发明第五实施方式提供的光学膜片组的示意图。

[0017] 图 10 为本发明第六实施方式提供的光学膜片组的示意图。

[0018] 图 11 为本发明第七实施方式提供的光学膜片组的示意图。

[0019] 图 12 为本发明第八实施方式提供的光学膜片组的示意图。

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[0020] 图 13 为本发明第九实施方式提供的光学膜片组的示意图。

[0021] 图 14 为本发明第十实施方式提供的光学膜片组的示意图。

[0022] 图 15 为本发明第十一实施方式提供的光学膜片组的示意图。

[0023] 图 16 为本发明第十二实施方式提供的触控显示装置的一侧剖面示意图。

[0024] 主要元件符号说明

触控显示装置	100、600
触控显示区	101
非触控显示区	102
盖板	110、610
胶体层	120、620
光学膜片组	130、230、330、430、530、630
显示模组	140、640
框架	150、650
触控表面	111、611
内表面	112、612
侧壁	151
触控区	131、231、331、431、531
周边区	132、232、332、432、532
缺口	133、233、333、433、533
第一侧边	1321、2321、3321、4321、5321
第二侧边	1322、2322、3322、4322、5322
第一边	1331、2331
第二边	1332、2332
顶点	1333、2333
夹角	133a、233a、333a
圆弧形倒角	2334、5334

如下具体实施方式将结合上述附图进一步说明本发明。

具体实施方式

[0025] 请参阅图 1，图 1 为本发明一较佳实施方式所提供的触控显示装置 100 的立体组装示意图。该触控显示装置 100 可用于游戏娱乐、多媒体互动、移动设备显示与交互、仿真模拟、模拟教学等领域的触屏式显示装置。该触控显示装置 100 包括触控显示区 101 及包围该触控显示区 101 的非触控显示区 102。

[0026] 请参阅图 2，图 2 为图 1 所示触控显示装置 100 的立体分解示意图。该触控显示装置 100 包括盖板 110、胶体层 120、光学膜片组 130、显示模组 140 及框架 150。该盖板 110、该胶体层 120、该光学膜片组 130、该显示模组 140 依序层叠设置。具体地，该光学膜片组 130 用于通过胶体层 120 粘接于该盖板 110 上，该显示模组 140 设置于该光学膜片组 130 远离该盖板 110 的一侧。该盖板 110 设置于该框架 150 上方，该盖板 110 用于与该框架 150 共同围成收容空间以收容该光学膜片组 130 及该显示模组 140。该盖板 110、该胶体层 120 及该光学膜片组 130 共同构成一触控面板。该光学膜片组 130 为触控感应电极层、抗反射膜、防爆膜或其他功能膜片中至少一者，本实施方式中，该光学膜片组 130 以触控感应电极层为例进行说明。

[0027] 该盖板 110 包括触控表面 111 及与该触控表面 111 相对设置的内表面 112。该内表面 112 为一光滑的三维曲面，该触控表面 111 与该内表面 112 的形状相同且相互平行。该

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触控表面 111 用于使用者对该触控触控显示装置 100 进行触控操作。

[0028] 进一步的，请同时参阅图 3 及图 4，图 3 为图 1 中沿 III-III 所示的剖面示意图，图 4 为图 1 中沿 IV-IV 所示的剖面示意图。不管从 X 轴方向或是 Y 轴方向观看，该内表面 112 的剖面均呈一抛物线形的曲面，该内表面 112 的中心点为抛物线的焦点，且该内表面 112 为朝向该触控表面 111 一侧凹陷的弯曲表面。本实施方式中，该内表面 112 的中心点与该内表面 112 的两侧边缘的高度差不大于 1mm。

[0029] 该框架 150 包括首尾相接的四侧壁 151，该盖板 110 设置于该框架 150 的侧壁 151 的上方，且与该框架 150 形成收容该光学膜片组 130 及显示模组 140 的收容空间。该光学膜片组 130 通过该胶体层 120 粘接于该盖板 110 的内表面 112 上，该显示模组 140 固定于该框架 150 的侧壁 151 的内侧，且位于该光学膜片组 130 远离该盖板 110 的一侧。

[0030] 该光学膜片组 130 包括触控区 131、周边区 132 及缺口 133。该触控区 131 呈一矩形，位于该光学膜片组 130 的中央并与该触控显示区 101 对应设置，该周边区 132 包括两条平行设置的第一侧边 1321 及两条平行设置的第二侧边 1322，该第一侧边 1321 及该第二侧边 1322 彼此首尾连接共同围成一环形框，该周边区 132 围绕该触控区 131 并与该非触控显示区 102 对应设置。该缺口 133 为开放型缺口，设置于该周边区 132 内，并位于该光学膜片组 130 的周边区 132 的拐角处，该缺口 133 呈扇形设置，该缺口 133 包括第一边 1331、第二边 1332 及顶点 1333，该第一边 1331、该第二边 1332 及该顶点 1333 共同围成呈扇形状的该缺口 133，该缺口 133 具有夹角 133a。该第一边 1331 及该第二边 1332 的长度相同，该顶点 1333 由该第一边 1331 及该第二边 1332 交叉处定义得来，该顶点 1333 位于该周边区 132 中，并与该触控区 131 不接触，该顶点 1333 与该触控区 131 之间具有一定距离，也就是说，该缺口 133 与该触控区 131 互相不邻接。本实施方式中，该顶点 1333 与该触控区 131 之间的距离为 0.15-0.3mm，该夹角 133a 小于 90 度。本实施方式中，该缺口的数量为 4 个，且均位于该光学膜片组 130 的周边区 132 的拐角处。

[0031] 传统的触控显示面板，其触控面板及显示面板皆为平面的，所以其触控面板的光学膜片组与盖板贴合时一般不会存在不良现象，而本实施方式中的盖板 110 为一三维曲面的盖板，所以将传统的光学膜片组与之贴合时，光学膜片组的边缘由于应力无法释放，会出现皱褶、与盖板之间产生间隙、胶层中存在气泡等不良现象，从而影响触控显示装置的性能。

[0032] 请参阅图 5，图 5 为图 2 中盖板 110 及光学膜片组 130 粘结后的仰视图。本实施方式中，该光学膜片组 130 的拐角处设置有缺口 133，该周边区 132 的面积减小。当将该光学膜片组 130 通过该胶体层 120 与该盖板 110 进行粘结固定时，该触控区 131 与该触控显示区 101 对应贴合后，无任何影响，当该周边区 132 与该非触控显示区 102 对应贴合时，该第一边 1331 及该第二边 1332 收缩重合，该夹角 133a 变为 0 度，该缺口 133 可释放由于贴合所导致的该光学膜片组 130 在边缘拐角处产生的应力，从而使该光学膜片组 130 与该盖板 110 完全贴合，不会因应力问题与该盖板 110 之间产生间隙，导致胶层中产生气泡，又由于缺口 133 的设置，该周边区 132 的面积减小，不会在边缘拐角处产生皱褶。

[0033] 本实施方式中，虽然已限定该缺口 133 的夹角 133a 小于 90 度，该触控表面 111 的中心点与该触控表面 111 的两侧边缘的高度差不大于 1mm，但并不局限于此，如在其他实施方式中，光学膜片组上缺口的夹角也可以为 90 度或大于 90 度，其角度的大小需根据盖板的

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曲率大小进行调整，而盖板的曲率可通过盖板的触控表面中心点与盖板的触控表面两侧边缘的高度差进行调整。可以预知，盖板的触控表面中心点与盖板的触控表面两侧边缘的高度差进行调整高度差越大，盖板的曲率也相应越大，当盖板的曲率越大，则光学膜片组上缺口的夹角则需相应的越大，即缺口越大，缺口的数量越多，反之，则光学膜片组上缺口越小，数量越少。

[0034] 本实施方式中，该触控显示装置 100 是由三维曲面的触控面板与传统的平面形的显示面板组成的，但并不局限于此，在其他实施方式中，也可采用具有柔性的显示面板。

[0035] 请参阅图 6，图 6 为本发明第二实施方式提供的光学膜片组 230 的示意图。该光学膜片组 230 包括触控区 231、周边区 232 及缺口 233。该触控区 231 呈一矩形，并位于该光学膜片组 230 的中央位置，该周边区 232 包括两条平行设置的第一侧边 2321 及两条平行设置的第二侧边 2322，该第一侧边 2321 及该第二侧边 2322 彼此收尾连接共同围成一环形框，并围绕该触控区 231 设置。该缺口 233 为开放型缺口，设置于该周边区 232 内，并位于该光学膜片组 230 的周边区 232 的拐角处，该缺口 233 呈类似扇形设置，该缺口 233 包括第一边 2331、第二边 2332 及顶点 2333，该第一边 2331、该第二边 2332 及该顶点 2333 共同围成呈扇形状的该缺口 233，该缺口 233 具有夹角 233a。该第一边 2331 及该第二边 2332 的长度相同，该顶点 2333 由该第一边 2331 及该第二边 2332 交叉处定义得来，该顶点 2333 位于该周边区 232 中，并与该触控区 231 不接触，该顶点 2333 与该触控区 231 之间具有一定距离，也就是说，该缺口 133 与该触控区 131 互相不临接。与触控显示装置 100 中光学膜片组 130 不同的是，该光学膜片组 230 的顶点 2333 处具有圆弧形倒角 2334 设置。本实施方式中，该顶点 2333 与该触控区 231 之间的距离为 0.15-0.3mm，该夹角 233a 小于 90 度。本实施方式中，该缺口的数量为 4 个，且均位于该光学膜片组 130 的周边区 132 的拐角处，但并不局限于此，该缺口 233 的数量及该缺口 233 的大小的大小可根据盖板的曲率进行调整。

[0036] 请参阅图 7，图 7 为本发明第三实施方式提供的光学膜片组 330 的示意图。该光学膜片组 330 包括触控区 331、周边区 332 及缺口 333。该触控区 331 呈一矩形，位于该光学膜片组 330 的中央位置，该周边区 332 包括两条平行设置的第一侧边 3321 及两条平行设置的第二侧边 3322，该第一侧边 3321 及该第二侧边 3322 彼此收尾连接共同围成一环形框，并围绕该触控区 331 设置。与光学膜片组 130 不同的是，本发明第三实施方式的该光学膜片组 330 的缺口 333 设置于该周边区 332 内，并位于该光学膜片组 330 的周边区 332 的相邻两个拐角之间，即该第一侧边 3321 及该第二侧边 3322 上。本实施方式中，每一该第一侧边 3321 上设置有 3 个该缺口 333，每一该第二侧边 3322 上设置有 2 个该缺口 333，但并不局限于此，该缺口 333 的数量及该缺口 333 的夹角 333a 的大小可根据盖板的曲率进行调整。本实施方式中，该缺口 333 为等腰三角形，但并不局限于此，在其他实施方式中，该缺口 333 的形状还可以为圆弧形或方形，如图 8 及图 9 中所示，图 8 为本发明第四实施方式提供的光学膜片组的示意图，图 9 为本发明第五实施方式提供的光学膜片组的示意图。

[0037] 请参阅图 10，图 10 为本发明第六实施方式提供的光学膜片组 430 的示意图。该光学膜片组 430 包括触控区 431、周边区 432 及缺口 433。该触控区 431 呈一矩形，位于该光学膜片组 430 的中央位置，该周边区 432 包括两条平行设置的第一侧边 4321 及两条平行设置的第二侧边 4322，该第一侧边 4321 及该第二侧边 4322 彼此收尾连接共同围成一环形框，该周边区 432 围绕该触控区 431 设置。该缺口 433 设置于该周边区 432 内。与光学膜

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片组 130 不同的是，该缺口 433 不仅设置于该光学膜片组 430 的周边区 432 的拐角处，还设置于该光学膜片组 430 的周边区 432 的相邻两个拐角之间，即该第一侧边 4321 及该第二侧边 4322 上均设置有该缺口 433，该缺口 433 与该触控区 431 互相不邻接。本实施方式中，除了在该光学膜片组 430 的周边区 432 的每一个拐角处设置有一缺口 433，每一该第一侧边 4321 上设置有 3 个该缺口 433，每一该第二侧边 4322 上设置有 2 个该缺口 433，但并不局限于此，该缺口 433 的数量及该缺口 433 的大小可根据盖板的曲率进行调整。本实施方式中，位于该第一侧边 4321 及该第二侧边 4322 上的该缺口 433 为等腰三角形，但并不局限于此，在其他实施方式中，该第一侧边 4321 及该第二侧边 4322 上的该缺口 433 的形状还可以为圆弧形或方形，如图 11 及图 12 中所示，图 11 为本发明第七实施方式提供的光学膜片组的示意图，图 12 为本发明第八实施方式提供的光学膜片组的示意图。

[0038] 请参阅图 13，图 13 为本发明第九实施方式提供的光学膜片组 530 的示意图。该光学膜片组 530 包括触控区 531、周边区 532 及缺口 533。该触控区 531 呈一矩形，位于该光学膜片组 530 的中央位置，该周边区 532 包括两条平行设置的第一侧边 5321 及两条平行设置的第二侧边 5322，该第一侧边 5321 及该第二侧边 5322 彼此收尾连接共同围成一环形框，该周边区 532 围绕该触控区 531 设置。该缺口 533 设置于该周边区 532 内。与第六实施方式的光学膜片组 430 不同的是，该光学膜片组 530 的位于拐角处的该缺口 533 的顶点处圆弧形倒角 5334 设置。本实施方式中，位于该第一侧边 5321 及该第二侧边 5322 上的该缺口 533 为等腰三角形，但并不局限于此，在其他实施方式中，该缺口 533 的形状还可以为圆弧形或方形，如图 14 及图 15 中所示，图 14 为本发明第十实施方式提供的光学膜片组的示意图，图 15 为本发明第十一实施方式提供的光学膜片组的示意图。

[0039] 以上所述的实施方式中，均是以触控表面为一外凸面为例，即内表面为朝向触控表面一侧凹陷的弯曲表面为例进行说明的，但并不局限于此，当触控显示装置的触控表面为一内凹面，即内表面为远离触控表面一侧突出的弯曲表面的情况，同样适用于本发明的结构。如图 16 所示，图 16 为本发明第十二实施方式提供的触控显示装置 600 的一侧剖面示意图。

[0040] 该触控显示装置 600 包括盖板 610、胶体层 620、光学膜片组 630、显示模组 640 及框架 650。该盖板 610、该胶体层 620、该光学膜片组 630、该显示模组 640 依序层叠设置。具体地，该光学膜片组 630 用于通过胶体层 620 粘接于该盖板 610 上，该显示模组 640 设置于该光学膜片组 630 远离该盖板 610 的一侧。该盖板 610 设置于该框架 650 上方，该盖板 610 用于与该框架 650 共同围成收容空间以收容该光学膜片组 630 及该显示模组 640。该盖板 610、该胶体层 620 及该光学膜片组 630 共同构成一触控面板。该盖板 610 包括触控表面 611 及与该触控表面 611 相对设置的内表面 112。该内表面 612 的剖面同样为一呈抛物线形的曲面，与触控显示装置 100 不同的是，该内表面 612 为朝向远离该触控表面 611 一侧凸出的弯曲表面。

[0041] 以上实施例仅用以说明本发明的技术方案而非限制，尽管参照较佳实施例对本发明进行了详细说明，本领域的普通技术人员应当理解，可以对本发明的技术方案进行修改或等同替换，而不脱离本发明技术方案的精神和范围。

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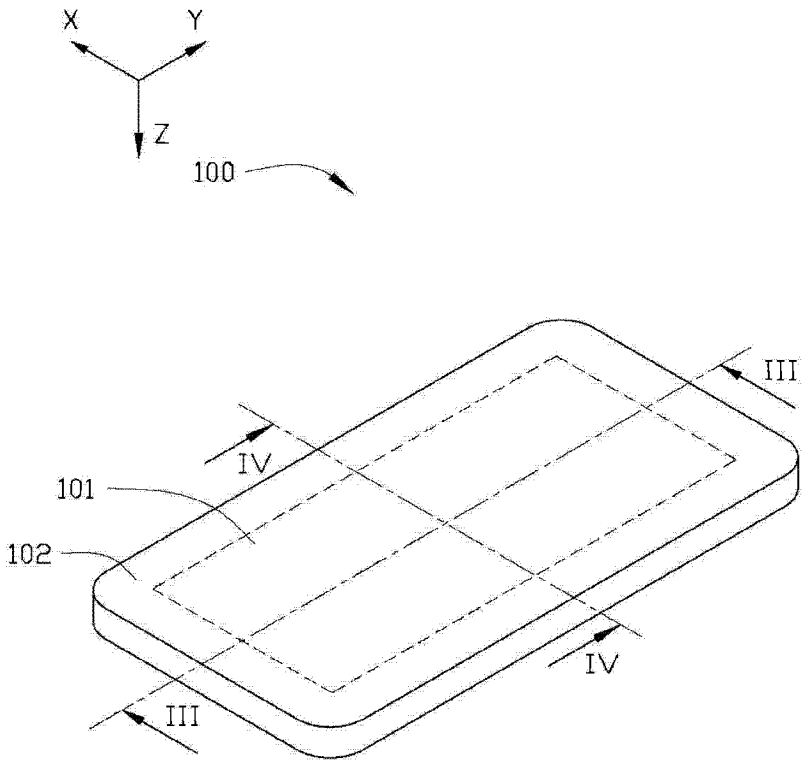


图 1

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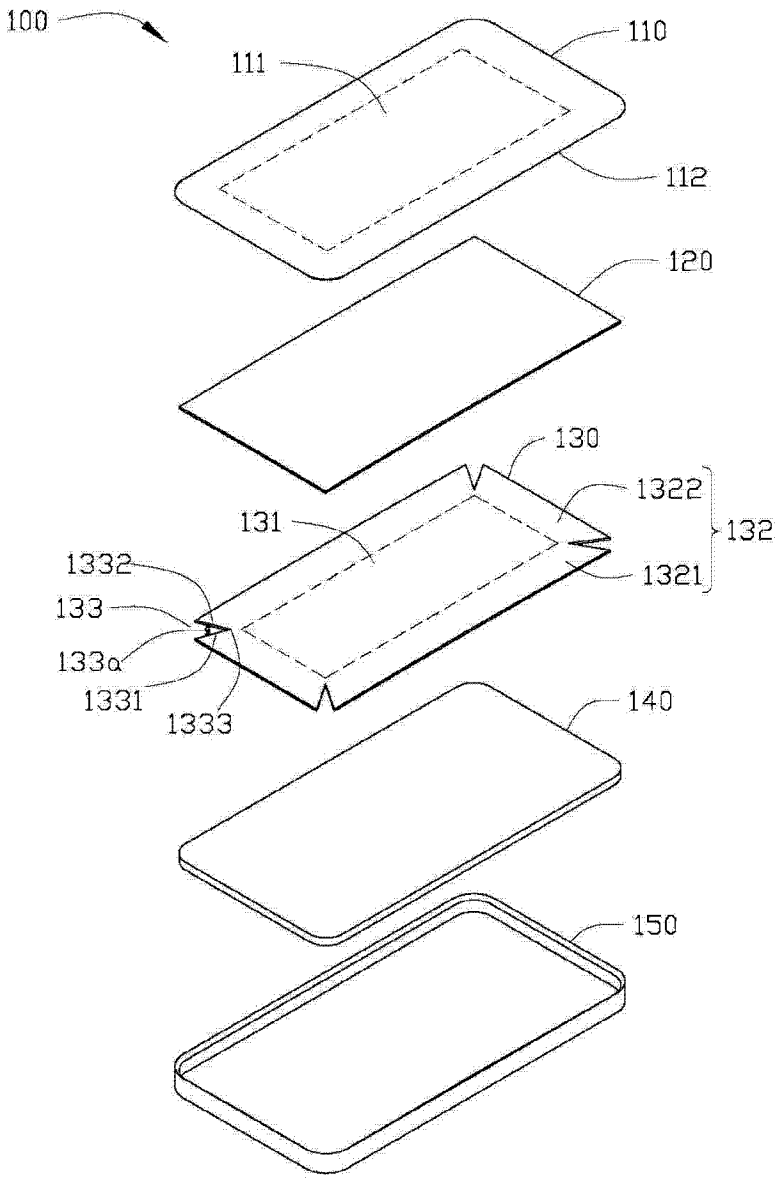


图 2

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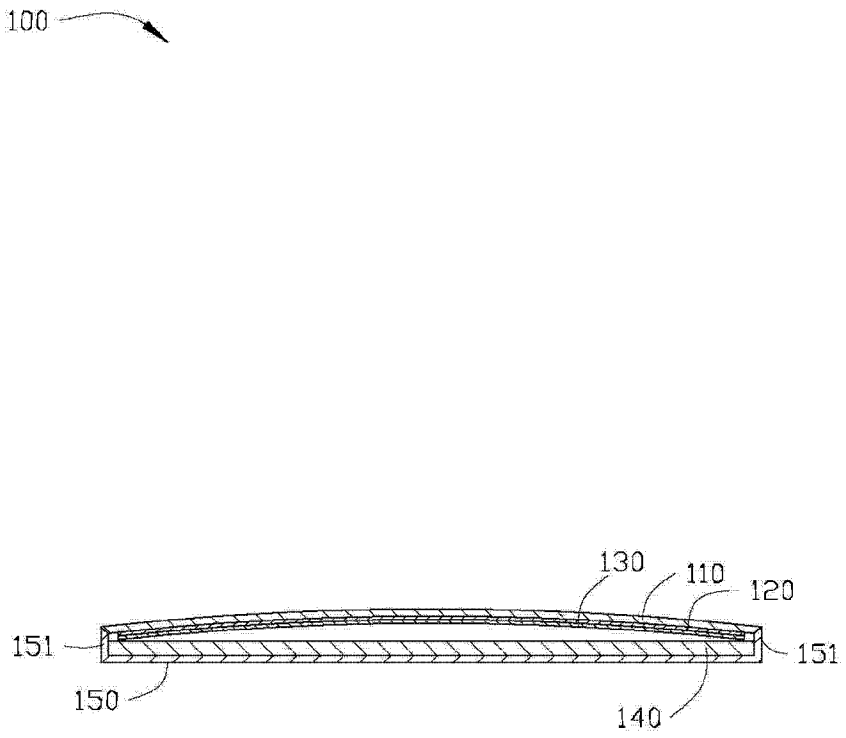


图 3

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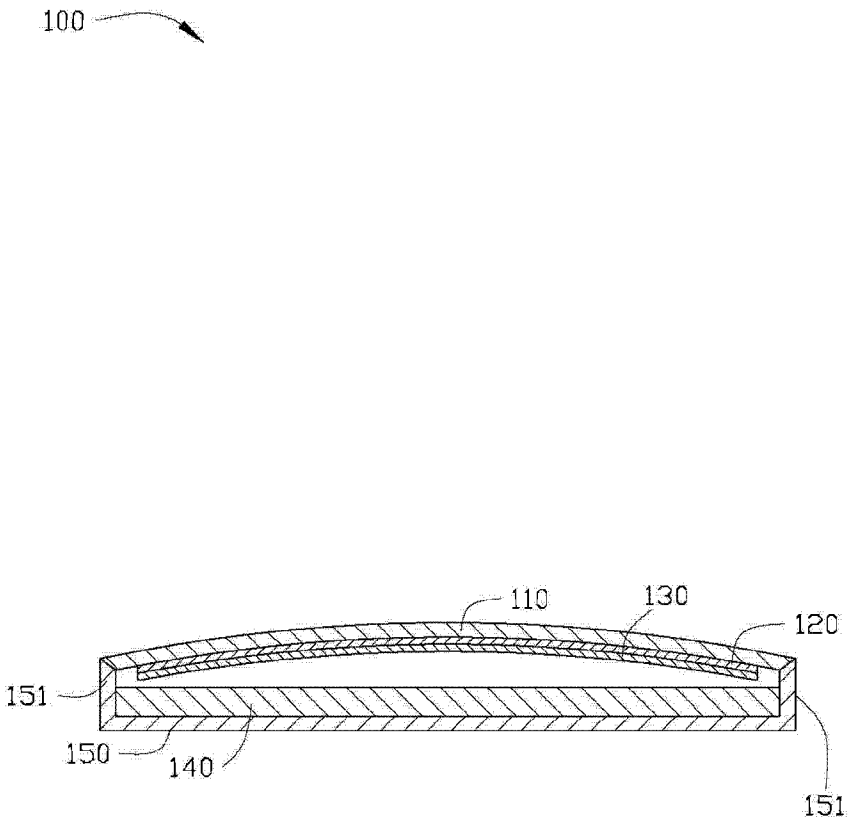


图 4

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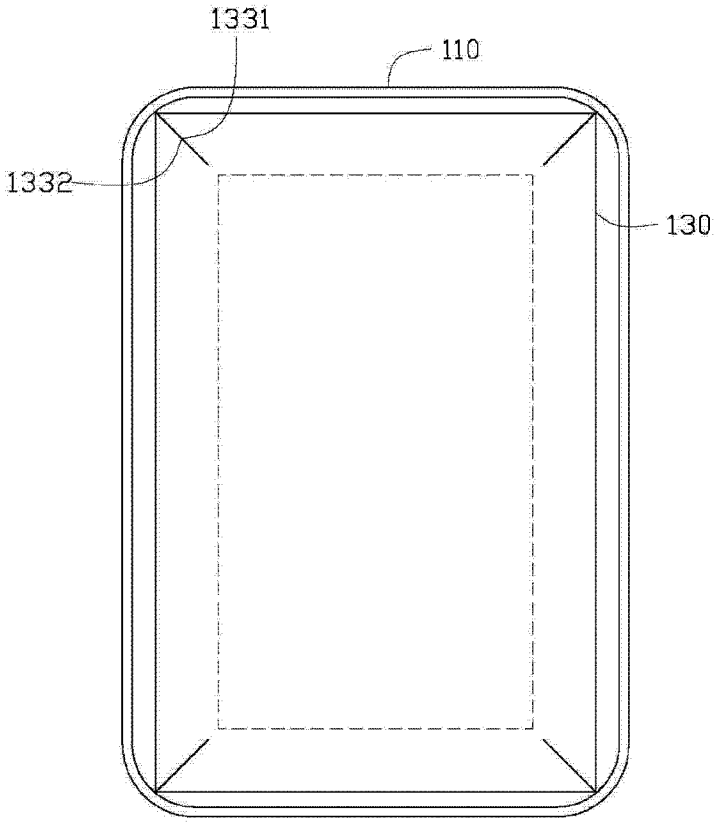


图 5

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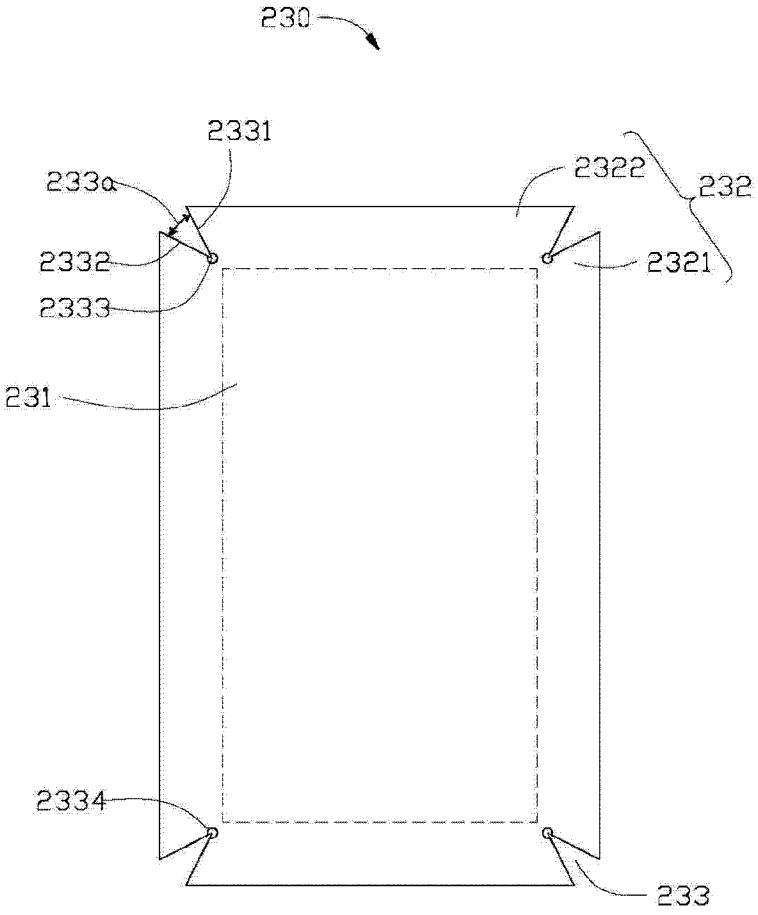


图 6

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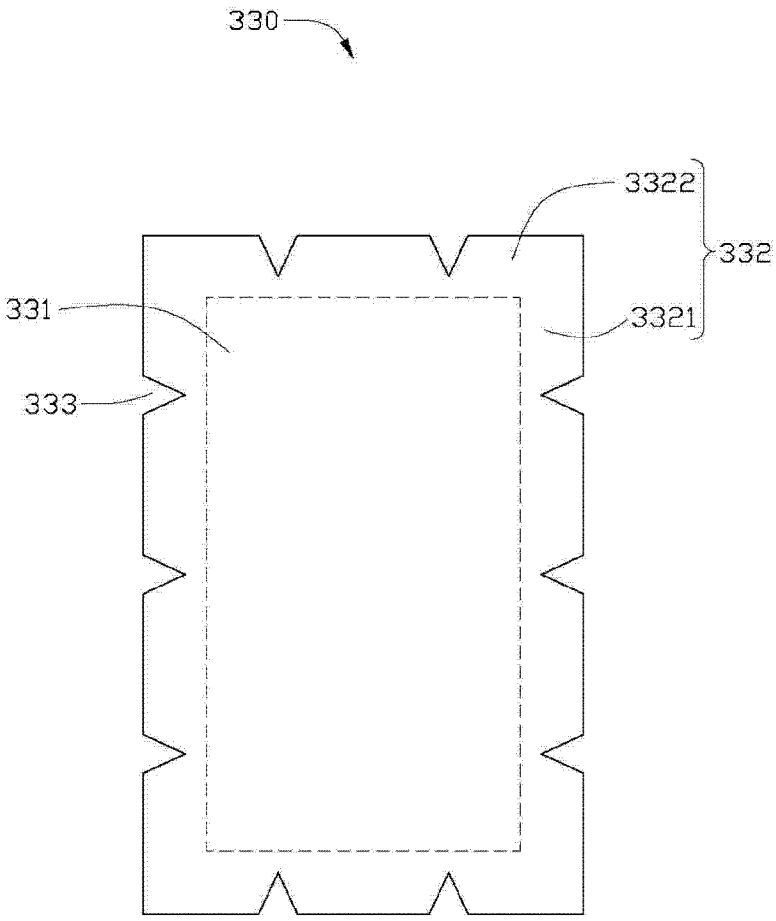


图 7

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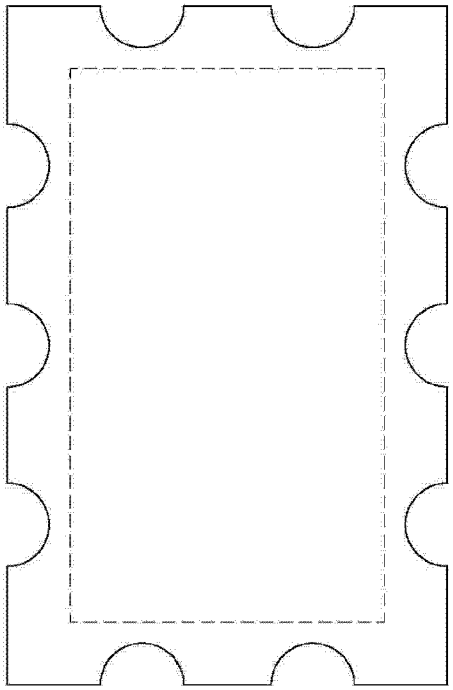


图 8

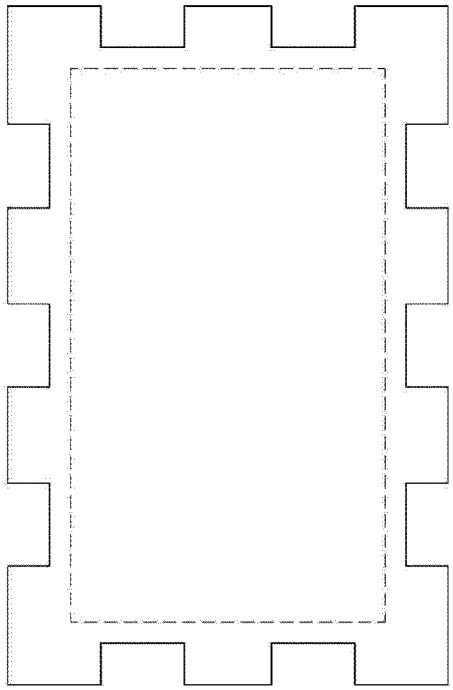


图 9

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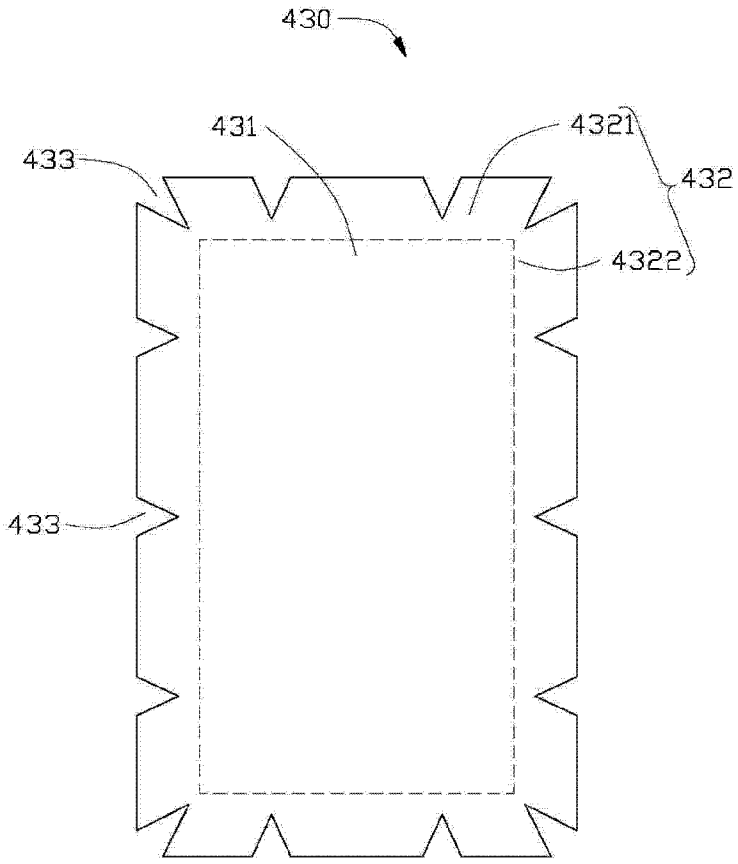


图 10

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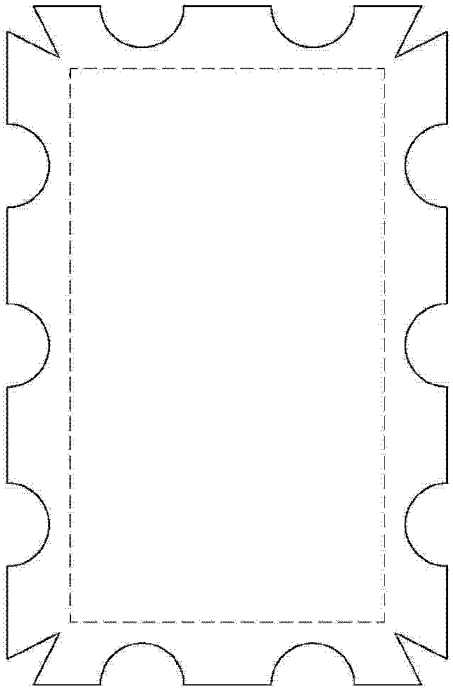


图 11

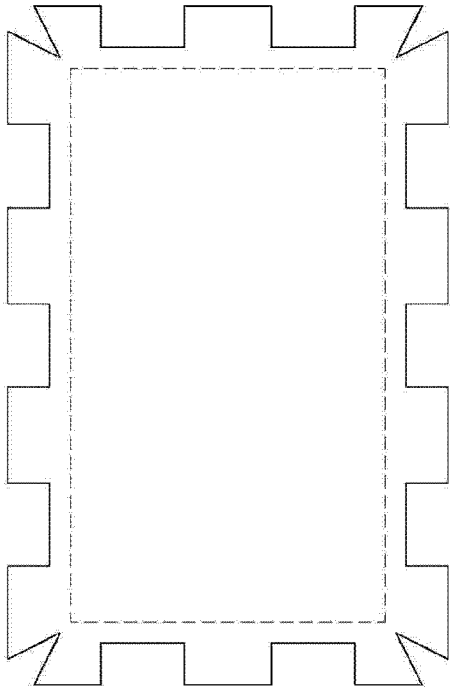


图 12

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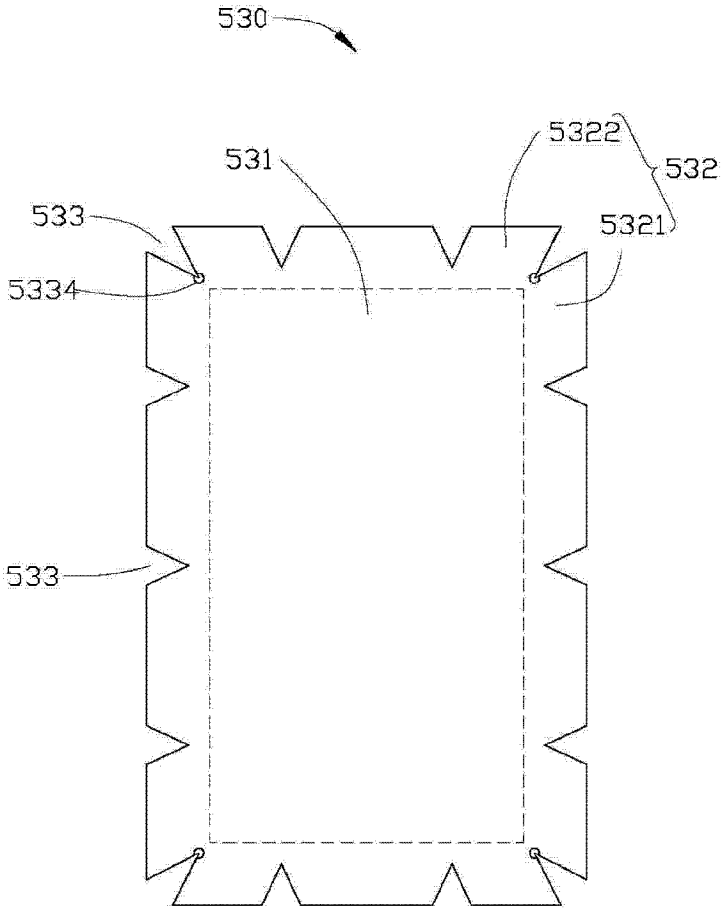


图 13

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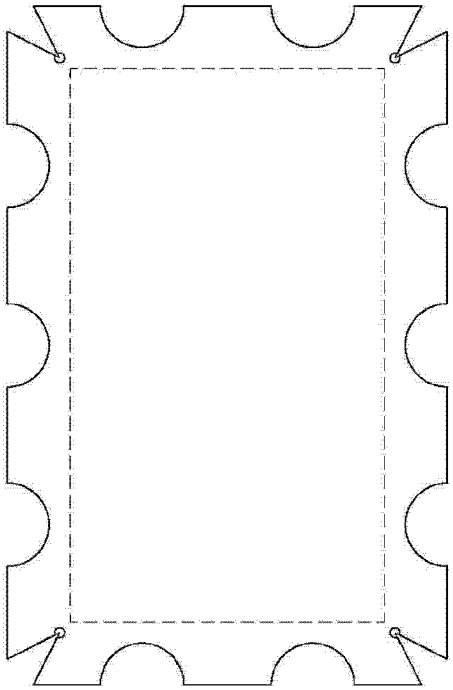


图 14

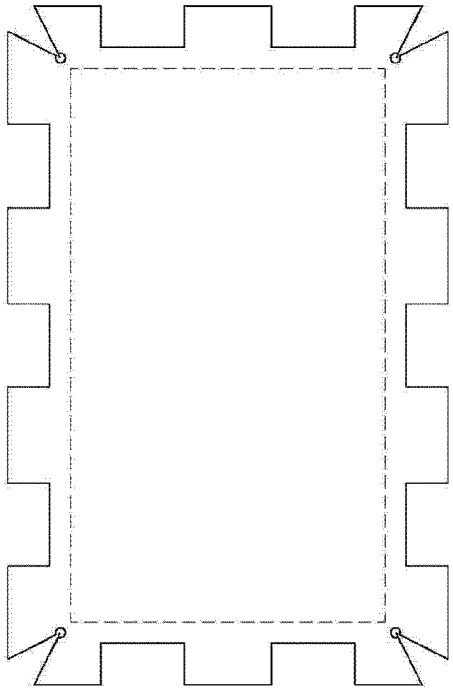


图 15

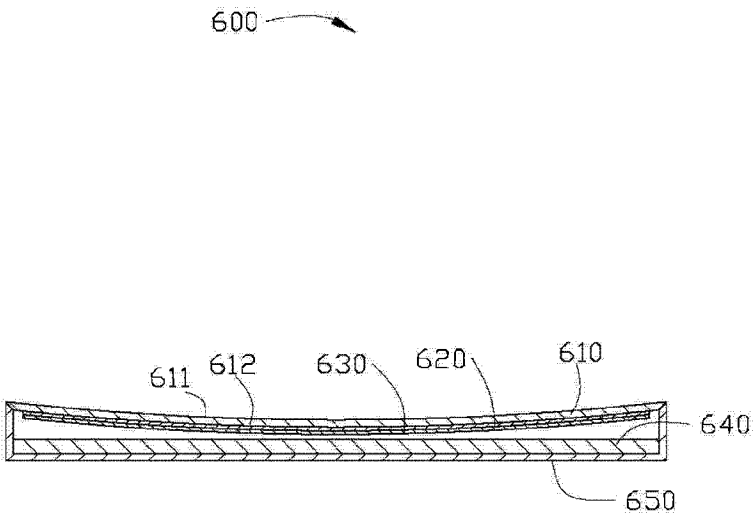


图 16

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(19)中华人民共和国国家知识产权局

(12)实用新型专利

(10)授权公告号 CN 203720812 U
(45)授权公告日 2014.07.16

(21)申请号 201420017359.5

(22)申请日 2014.01.10

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(51)Int.Cl.
G06F 3/042(2006.01)

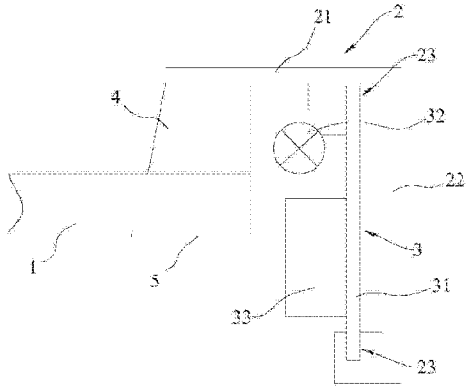
权利要求书1页 说明书3页 附图2页

(54)实用新型名称

一种新型红外触摸屏

(57)摘要

本实用新型公开了一种新型红外触摸屏，包括屏体、装嵌屏体的矩形边框以及位于矩形边框内且围绕屏体设置的红外触控组件，矩形边框包括平行于屏体的前壁和垂直于屏体的侧壁，前壁探至屏体边沿的前方并通过滤光条与屏体连接，红外触控组件包括平行于侧壁设在矩形边框内的PCB板以及若干设在PCB板上、位于滤光条外侧且紧贴屏体前表面所在平面的红外管，红外管包括分别位于矩形边框的左边框和下边框的红外发射管，以及分别位于右边框和上边框的红外接收管。本实用新型通过上述设计使得PCB板上的电子元器件位于屏体前表面的后方，克服现有红外触摸屏框体过宽、框体前壁与触摸屏外表面距离过大，在改善产品外观的同时，降低误触摸的发生。



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1. 一种新型红外触摸屏，其特征在于：包括屏体、装嵌屏体的矩形边框以及位于所述矩形边框内且围绕屏体设置的红外触控组件，所述矩形边框包括平行于屏体的前壁和垂直于屏体的侧壁，所述前壁探至屏体边沿的前方并通过滤光条与屏体连接，所述红外触控组件包括平行于侧壁设在矩形边框内的 PCB 板以及若干设在所述 PCB 板上、位于滤光条外侧且紧贴屏体前表面所在平面的红外管，所述红外管包括分别位于矩形边框的左边框和下边框的红外发射管，以及分别位于右边框和上边框的红外接收管。

2. 根据权利要求 1 所述的新型红外触摸屏，其特征在于：围绕所述屏体后表面的四周边沿设有遮光层。

3. 根据权利要求 1 或 2 所述的新型红外触摸屏，其特征在于：所述滤光条包括设在红外发射管内侧的聚光滤光条和设在红外接收管内侧的非聚光滤光条。

4. 根据权利要求 1 或 2 所述的新型红外触摸屏，其特征在于：所述矩形边框在侧壁的内侧形成装嵌所述 PCB 板的卡槽。

5. 根据权利要求 1 或 2 所述的新型红外触摸屏，其特征在于：所述滤光条的前、后表面分别与矩形边框的前壁和屏体的前表面粘附连接。

6. 根据权利要求 5 所述的新型红外触摸屏，其特征在于：所述矩形边框的前壁内侧形成嵌入所述滤光条内的凸棱。

7. 根据权利要求 1 或 2 所述的新型红外触摸屏，其特征在于：所述矩形边框还包括夹紧屏体后表面四周边沿的底框，所述底框与侧壁形成将所述红外触控组件封装在矩形边框内的内腔。

8. 根据权利要求 7 所述的新型红外触摸屏，其特征在于：所述底框与侧壁固定连接或采用一体成型工艺形成整体。

9. 根据权利要求 7 所述的新型红外触摸屏，其特征在于：所述矩形边框为铝合金构件或塑胶构件。

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一种新型红外触摸屏

技术领域

[0001] 本实用新型涉及一种触摸屏，特别是涉及一种新型红外触摸屏。

背景技术

[0002] 当前触摸屏主要有表面声波、红外、电阻、电容等类型。表面声波触摸屏具分辨率高、响应时间短、不宜实现多点触摸、稳定性很好、防暴性好、透光性好、实现大尺寸困难等特点；红外屏触摸屏分辨率较好、响应时间快、容易实现多点触摸、稳定性较好、防暴性好、透光性好、容易实现大尺寸等特点；电阻触摸屏具分辨率高、响应时间短、不宜实现多点触摸、稳定性好、透光性差、防暴性差、实现大尺寸困难等特点；电容触摸屏具分辨率高、响应时间短、容易实现多点触摸、稳定性一般、透光性一般、防暴性较好、容易漂移、实现大尺寸困难等特点。综上所述，红外触摸屏由于其具有红外屏触摸屏分辨率较好、响应时间快、容易实现多点触摸、稳定性较好、防暴性好、透光性好、容易实现大尺寸等优点，特别是现在触摸需要用户体念好、触感好，是几种主流触摸屏大尺寸中最具推广使用价值的触摸屏。

[0003] 现有红外触摸屏一般由框体、滤光条、玻璃、PCB 板及焊装在 PCB 板上的电子元器件、红外发射管及红外接收管等组成，并且一般来说 PCB 板、焊接在 PCB 板上的红外发射管发出的红外光中心线以及红外接收管接收红外光的中心线均与触摸屏触摸面平行，触摸屏的所有电子部件都封装在框体与滤光条组成的封装内，存在触摸屏框体过宽、触摸屏框体表面至显示器外加装的玻璃表面距离过大的缺点，影响产品的外观。此外，由于红外发射管发出的红外光悬浮过高，也容易引起误触摸的发生。

实用新型内容

[0004] 为解决上述问题，本实用新型提供一种克服现有红外触摸屏框体过宽、框体上表面与触摸屏外表面距离过大，改善产品外观，降低误触摸发生的新型红外触摸屏。

[0005] 本实用新型解决其技术问题所采用的技术方案是：一种新型红外触摸屏，包括屏体、装嵌屏体的矩形边框以及位于矩形边框内且围绕屏体设置的红外触控组件，矩形边框包括平行于屏体的前壁和垂直于屏体的侧壁，前壁探至屏体边沿的前方并通过滤光条与屏体连接，红外触控组件包括平行于侧壁设在矩形边框内的 PCB 板以及若干设在 PCB 板上、位于滤光条外侧且紧贴屏体前表面所在平面的红外管，红外管包括分别位于矩形边框的左边框和下边框的红外发射管，以及分别位于右边框和上边框的红外接收管。

[0006] 进一步作为本实用新型技术方案的改进，围绕所述屏体后表面的四周边沿设有遮光层。

[0007] 进一步作为本实用新型技术方案的改进，滤光条包括设在红外发射管内侧的聚光滤光条和设在红外接收管内侧的非聚光滤光条。

[0008] 进一步作为本实用新型技术方案的改进，矩形边框在侧壁的内侧形成装嵌 PCB 板的卡槽。

[0009] 进一步作为本实用新型技术方案的改进，滤光条的前、后表面分别与矩形边框的

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前壁和屏体的前表面粘附连接。

[0010] 进一步作为本实用新型技术方案的改进，矩形边框的前壁内侧形成嵌入滤光条内的凸棱。

[0011] 进一步作为本实用新型技术方案的改进，矩形边框还包括夹紧屏体后表面四周边沿的底框，底框与侧壁形成将所述红外触控组件封装在矩形边框内的内腔。

[0012] 进一步作为本实用新型技术方案的改进，底框与侧壁固定连接或采用一体成型工艺形成整体。

[0013] 进一步作为本实用新型技术方案的改进，矩形边框为铝合金构件或塑胶构件。

[0014] 本实用新型的有益效果：本新型红外触摸屏中，位于矩形边框内的 PCB 板平行于侧壁设置，使得 PCB 板上的电子元器件能够位于屏体前表面的后方，使得红外管在紧贴屏体前表面所在平面的同时，能够避免 PCB 板上电子元器件对于矩形边框前壁到屏体前表面距离的限制。本实用新型通过上述设计克服了现有红外触摸屏框体过宽、框体上表面与触摸屏外表面距离过大，在改善产品外观的同时，触摸悬浮更低，触摸精度、可靠性更高，能够有效降低误触摸的发生。

附图说明

[0015] 下面结合附图对本实用新型作进一步说明：

[0016] 图 1 是本实用新型第一实施例结构示意图；

[0017] 图 2 是本实用新型第二实施例结构示意图；

[0018] 图 3 是本实用新型第三实施例结构示意图。

具体实施方式

[0019] 参照图 1 ～图 3，本实用新型提供了一种新型红外触摸屏，包括屏体 1、装嵌屏体 1 的矩形边框 2 以及位于矩形边框 2 内且围绕屏体 1 设置的红外触控组件 3，屏体 1 是红外触摸屏的一部分，一般由玻璃构成，包括前表面和后表面。矩形边框 2 包括平行于屏体 1 的前壁 21 和垂直于屏体 1 的侧壁 22，前壁 21 探至屏体 1 边沿的前方并通过滤光条 4 与屏体 1 连接，红外触控组件 3 包括平行于侧壁 22 设在矩形边框 2 内的 PCB 板 31 以及若干设在 PCB 板 31 上、位于滤光条 4 外侧且紧贴屏体 1 前表面所在平面的红外管 32，红外管 32 包括分别位于矩形边框 2 的左边框和下边框的红外发射管，以及分别位于右边框和上边框的红外接收管。

[0020] 本新型红外触摸屏中，位于矩形边框 2 内的 PCB 板 31 平行于侧壁 22 设置，使得 PCB 板 31 上的电子元器件 33 能够位于屏体 1 前表面的后方，使得红外管 32 在紧贴屏体 1 前表面所在平面的同时，能够避免 PCB 板 31 上电子元器件 33 对于矩形边框 2 前壁到屏体 1 前表面距离的限制。本实用新型通过上述设计克服了现有红外触摸屏框体过宽、框体上表面与触摸屏外表面距离过大，在改善产品外观的同时，触摸悬浮更低，触摸精度、可靠性更高，能够有效降低误触摸的发生。

[0021] 作为本实用新型优选的实施方式，围绕屏体 1 后表面的四周边沿设有遮光层 5，遮光层 5 可采用印刷或粘贴的黑色薄膜，以使产品更加美观、耐用。

[0022] 作为本实用新型优选的实施方式，滤光条 4 包括设在红外发射管内侧的聚光滤光

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条和设在红外接收管内侧的非聚光滤光条。一方面能实现红外接收管通过聚光结构接收到更强信号以触摸更可靠、触摸效果更好；另方面达到一个红外发射管发射，多个红外接收管接收的效果，以实现多点触摸。

[0023] 作为本实用新型优选的实施方式，矩形边框 2 在侧壁 22 的内侧形成装嵌 PCB 板 31 的卡槽 23，红外触控组件 3 在矩形边框 2 内安装时，红外触控组件 3 在 PCB 板 31 上形成一个整体结构，配合侧壁 22 内侧的卡槽 23 实现快速安装调试。

[0024] 作为本实用新型优选的实施方式，滤光条 4 的前、后表面分别与矩形边框 2 的前壁 21 和屏体 1 的前表面粘附连接。

[0025] 作为本实用新型优选的实施方式，矩形边框 2 的前壁 21 内侧形成嵌入滤光条 4 内的凸棱 24。

[0026] 作为本实用新型优选的实施方式，矩形边框 2 还包括夹紧屏体 1 后表面四周边沿的底框 25，底框 25 与侧壁 22 固定连接或采用一体成型工艺形成整体。底框 25 与侧壁 22 形成将红外触控组件 3 封装在矩形边框 2 内的内腔，在保证屏体 1 在矩形边框 2 上安装牢固的同时，保障内部红外触控组件 3 的安全，避免损坏。

[0027] 作为本实用新型优选的实施方式，矩形边框 2 为铝合金构件或塑胶构件，以使得触摸屏重量更轻、成本更低。

[0028] 当然，本发明创造并不局限于上述实施方式，熟悉本领域的技术人员在不违背本实用新型精神的前提下还可作出等同变形或替换，这些等同的变型或替换均包含在本申请权利要求所限定的范围内。

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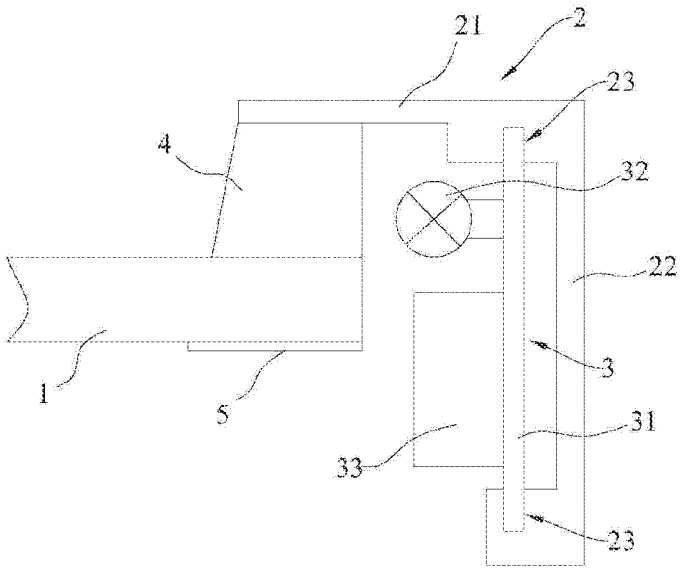


图 1

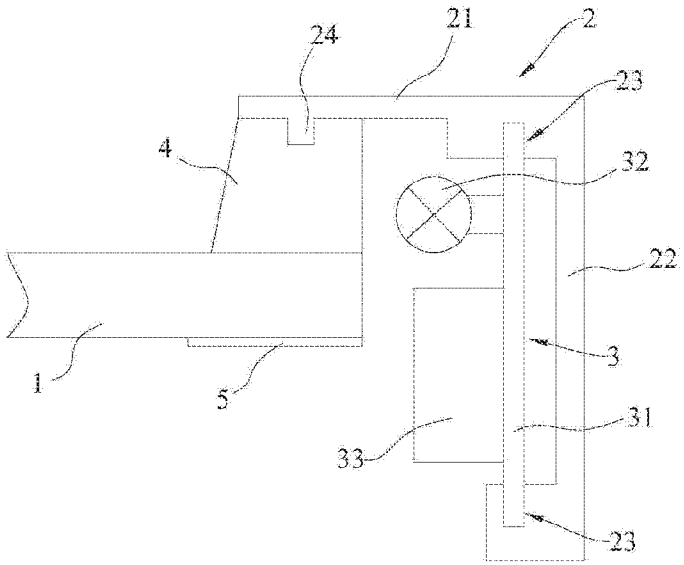


图 2

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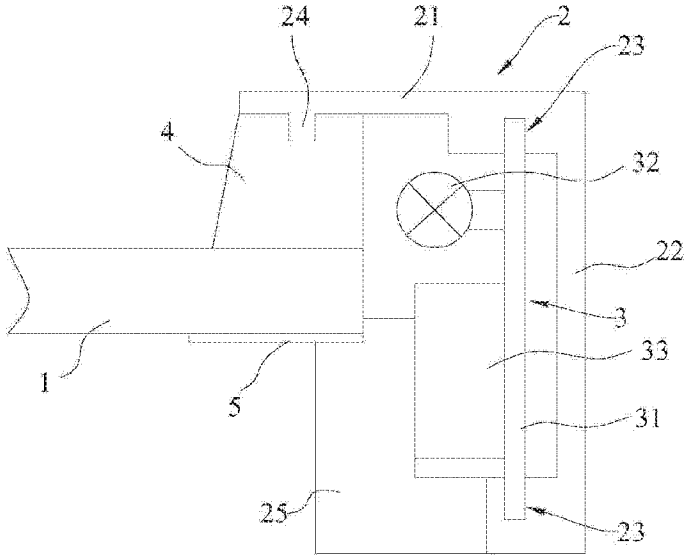


图 3

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Espacenet

WO2014131221A1 PROJECTION-TYPE TOUCH CONTROL ELECTRONIC WHITEBOARD AND FRAME STRUCTURE THEREOF

Applicants: SHENZHEN TIMELINK TECHNOLOGY CO LTD [CN]

Inventors: CHEN WEISHAN [CN],DENG HUAQIN [CN],FENG GUANGLUN [CN],GU HONGLIN [CN],LI YONG [CN],YAN GUANGLIN [CN]

Classifications:
IPC ***G06F3/042;***

CPC **G06F3/0428 (EP);**

Priorities: CN201310066663A 2013-03-01

Application: WO2014131221A1·2013-04-07

Publication: WO2014131221A1·2014-09-04

Published as: **CN103123556A;** WO2014131221A1

PROJECTION-TYPE TOUCH CONTROL ELECTRONIC WHITEBOARD AND FRAME STRUCTURE THEREOF

Abstract

Disclosed is a frame structure of a projection-type touch control electronic whiteboard to be arranged on the edge of an electronic whiteboard screen, comprising a frame, a light source assembly arranged inside the frame, and an optical filter arranged on the side opening of the frame; the side opening of the frame extends along the edge of the electronic whiteboard; a sensor of the light source assembly is vertically arranged on the circuit board of the light source assembly; the circuit board extends along the edge of the electronic whiteboard; and the vertically arranged sensor provides touch control positioning through the filter. Also disclosed is an electronic whiteboard with the frame structure. The electronic whiteboard and the frame structure thereof enable the electronic whiteboard to have a narrow frame, and are easy to install and maintain, thus facilitating the designing of a light and thin electronic whiteboard having a more attractive appearance.

Espacenet

CN203786707U Frame structure of front-disassembly electronic whiteboard

Applicants: SHENZHEN TIMELINK TECHNOLOGY CO LTD

Inventors: CHEN WEISHAN,FENG GUANGLUN,YAN GUANGLIN

Classifications:
IPC ***G06F3/042;***

Priorities: CN201320893621U 2013-12-31

Application: CN203786707U·2013-12-31

Publication: CN203786707U·2014-08-20

Published as: CN203786707U

Frame structure of front-disassembly electronic whiteboard

Abstract

The utility model relates to a frame structure of a front-disassembly electronic whiteboard. A light filtering strip is relatively movably fixed by using a first clamping strip groove body of an upper cover and a holding groove of a lower shell. The light filtering strip can slide in parallel in the holding groove relative to the first clamping strip groove body. Meanwhile, the locking part of the upper cover and the fixing part of the lower shell are movably connected and fixedly in a clamped mode. In the disassembly process, the locking part is pulled by external force to be away from the fixing part, and then the upper cover and the lower shell can be separated. The edge of the lower shell and the edge of a display area are movably fixed through a second clamping strip groove body which can slide in parallel relative to the edge of the display area. In this way, in the maintenance process, the light filtering strip slides in parallel along the first clamping strip groove body and the holding groove, and then the light filtering strip can be disassembled; afterwards, the locking part is pulled by the external force to be away from the fixing part, and therefore the upper cover and the lower shell can be separated. Accordingly, a light tube and a PCB can be maintained; as the situation that the whole electronic whiteboard is disassembled is avoided, the maintenance process becomes simple and easy to implement.

(19)中华人民共和国国家知识产权局

(12)实用新型专利

(10)授权公告号 CN 203786707 U
(45)授权公告日 2014.08.20

(21)申请号 201320893621.8

(22)申请日 2013.12.31

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(51)Int.Cl.
G06F 3/042(2006.01)

(ESM)同样的发明创造已同日申请发明专利

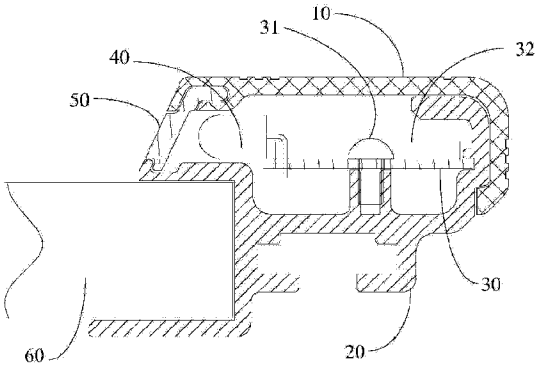
权利要求书1页 说明书5页 附图5页

(54)实用新型名称

前拆式电子白板的边框结构

(57)摘要

前拆式电子白板的边框结构使用上盖的第一卡条槽体与下壳的托持槽相对活动固定滤光条。滤光条能够相对第一卡条槽体与托持槽平行滑动。同时，上盖的锁固部与下壳的固定部活动卡接固定。拆除时，使用外力拉动固定部远离固定部就能够使上盖与下壳分开。下壳与显示区域的边缘通过第二卡条槽体活动固定，第二卡条槽体能够相对显示区域的边缘平行滑动。因而在检修过程中，使滤光条沿第一卡条槽体及托持槽平行滑动，就能够将滤光条拆除，然后将锁固部使用外力拉开，使其远离固定部，从而使得上盖与下壳分开。进而可以对灯管及印刷电路板进行检修，避免了拆除整个电子白板，使检修过程变的简便易操作。



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1. 一种前拆式电子白板的边框结构，用于设置在电子白板的显示区域的边缘处，包括印刷电路板、固定于所述印刷电路板上的灯管、设置在所述灯管出光面的滤光条，其特征在于，还包括上盖和下壳；

所述上盖和所述下壳配合形成空腔，所述空腔用于收容所述灯管及所述印刷电路板；所述上盖包括锁固部并设有第一卡条槽体；所述下壳包括固定部并设有第二卡条槽体、托持槽及螺接槽；

所述第一卡条槽体用于收容所述滤光条的一端，所述滤光条的一端滑入所述第一卡条槽体内；所述托持槽用于收容所述滤光条背离所述上盖的一端，所述滤光条背离所述上盖的一端滑入所述托持槽内；所述第一卡条槽体及所述托持槽沿所述滤光条的长度方向延伸；所述第二卡条槽体用于收容显示区域的边缘，所述显示区域的边缘滑入所述第二卡条槽体内；所述第二卡条槽体沿所述显示区域的边缘长度方向延伸；所述螺接槽与所述印刷电路板的中央位置螺接；所述锁固部与所述固定部配合固定，所述锁固部卡扣于所述固定部上，使所述上盖和所述下壳固定连接。

2. 根据权利要求 1 所述的前拆式电子白板的边框结构，其特征在于，所述上盖大体呈 L 形，所述上盖的长边设置所述第一卡条槽体，所述上盖的短边设置所述锁固部；所述第一卡条槽体的形状与所述滤光条的一端配合，所述滤光条的一端可相对所述第一卡条槽体平行滑动；所述锁固部设有突起，所述突起卡扣于所述固定部上，使所述上盖与所述下壳相对固定。

3. 根据权利要求 1 所述的前拆式电子白板的边框结构，其特征在于，所述下壳还设有侧边卡槽，所述印刷电路板远离所述滤光条的一端与所述侧边卡槽卡合连接；所述侧边卡槽沿所述印刷电路板边缘长度方向上延伸。

4. 根据权利要求 3 所述的前拆式电子白板的边框结构，其特征在于，所述下壳沿所述侧边卡槽的短边方向延伸并弯折呈直角。

5. 根据权利要求 1 所述的前拆式电子白板的边框结构，其特征在于，所述托持槽设于所述第二卡条槽体的一侧；所述托持槽与所述滤光条背离所述第一卡条槽体的一端抵持连接，所述滤光条背离所述第一卡条槽体的一端可相对所述托持槽平行滑动。

6. 根据权利要求 1 所述的前拆式电子白板的边框结构，其特征在于，所述下壳设有多个螺接槽，所述螺接槽通过螺钉与所述印刷电路板螺接，使所述印刷电路板相对所述下壳固定。

7. 根据权利要求 6 所述的前拆式电子白板的边框结构，其特征在于，所述螺接槽均匀分布于所述下壳相对固定所述印刷电路板的部分。

8. 根据权利要求 1 所述的前拆式电子白板的边框结构，其特征在于，所述下壳背离所述螺接槽的一面设有卡持部，所述卡持部用于将所述下壳固定于支架上。

9. 根据权利要求 1 所述的前拆式电子白板的边框结构，其特征在于，所述第一卡条槽体及所述锁固部一体成型。

10. 根据权利要求 1 所述的前拆式电子白板的边框结构，其特征在于，所述第二卡条槽体、所述托持槽、所述螺接槽及所述固定部一体成型。

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前拆式电子白板的边框结构

技术领域

[0001] 本实用新型涉及电子白板技术领域，特别是涉及一种可活动拆卸的前拆式电子白板的边框结构。

背景技术

[0002] 在电子白板技术领域，特别是采用投影显示的大型电子白板中，多采用红外传感技术为电子白板提供触控定位。红外传感器一般都设置在电子白板的边框中。电子白板包括基板、设置在基板四个边缘的边框、设置在边框中印刷电路板、灯管和设置在边框侧边开口处的滤光条。其中灯管发射出信号并经过滤光条滤光后为触控区域另一侧的信号接收器接收。在传统的电子白板中，灯管、印刷电路板及滤光条是固定于边框中。当灯管或者滤光条出现异常时，对电子白板进行检修，需将整个电子白板拆除，进而对边框内部元件进行检修，这样不仅检修过程复杂，而且还给增加了工作人员的检修难度。

实用新型内容

[0003] 基于此，有必要提供一种简便的、可活动拆卸的前拆式电子白板的边框结构。

[0004] 一种前拆式电子白板的边框结构，用于设置在电子白板的显示区域的边缘处，包括印刷电路板、固定于所述印刷电路板上的灯管、设置在所述灯管出光面的滤光条，还包括上盖和下壳；

[0005] 所述上盖和所述下壳配合形成空腔，所述空腔用于收容所述灯管及所述印刷电路板；所述上盖包括锁固部并设有第一卡条槽体；所述下壳包括固定部并设有第二卡条槽体、托持槽及螺接槽；

[0006] 所述第一卡条槽体用于收容所述滤光条的一端，所述滤光条的一端滑入所述第一卡条槽体内；所述托持槽用于收容所述滤光条背离所述上盖的一端，所述滤光条背离所述上盖的一端滑入所述托持槽内；所述第一卡条槽体及所述托持槽沿所述滤光条的长度方向延伸；所述第二卡条槽体用于收容显示区域的边缘，所述显示区域的边缘滑入所述第二卡条槽体内；所述第二卡条槽体沿所述显示区域的边缘长度方向延伸；所述螺接槽与所述印刷电路板的中央位置螺接；所述锁固部与所述固定部配合固定，所述锁固部卡扣于所述固定部上，使所述上盖和所述下壳固定连接。

[0007] 在其中一个实施例中，所述上盖大体呈 L 形，所述上盖的长边设置所述第一卡条槽体，所述上盖的短边设置所述锁固部；所述第一卡条槽体的形状与所述滤光条的一端配合，所述滤光条的一端可相对所述第一卡条槽体平行滑动；所述锁固部设有突起，所述突起卡扣于所述固定部上，使所述上盖与所述下壳相对固定。

[0008] 在其中一个实施例中，所述下壳还设有侧边卡槽，所述印刷电路板远离所述滤光条的一端与所述侧边卡槽卡合连接；所述侧边卡槽沿所述印刷电路板边缘长度方向上延伸。

[0009] 在其中一个实施例中，所述下壳沿所述侧边卡槽的短边方向延伸并弯折呈直角。

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[0010] 在其中一个实施例中，所述托持槽设于所述第二卡条槽体的一侧；所述托持槽与所述滤光条背离所述第一卡条槽体的一端抵持连接，所述滤光条背离所述第一卡条槽体的一端可相对所述托持槽平行滑动。

[0011] 在其中一个实施例中，所述下壳设有多个螺接槽，所述螺接槽通过螺钉与所述印刷电路板螺接，使所述印刷电路板相对所述下壳固定。

[0012] 在其中一个实施例中，所述螺接槽均匀分布于所述下壳相对固定所述印刷电路板的部分。

[0013] 在其中一个实施例中，所述下壳背离所述螺接槽的一面设有卡持部，所述卡持部用于将所述下壳固定于支架上。

[0014] 在其中一个实施例中，所述第一卡条槽体及所述锁固部一体成型。

[0015] 在其中一个实施例中，所述第二卡条槽体、所述托持槽、所述螺接槽及所述固定部一体成型。

[0016] 上述前拆式电子白板的边框结构使用上盖的第一卡条槽体与下壳的托持槽相对活动固定滤光条。滤光条能够相对第一卡条槽体与托持槽平行滑动。同时，上盖的锁固部与下壳的固定部活动卡接固定。拆除时，使用外力拉动固定部远离固定部就能够使上盖与下壳分开。下壳与显示区域的边缘通过第二卡条槽体活动固定，第二卡条槽体能够相对显示区域的边缘平行滑动。因而在检修过程中，使滤光条沿第一卡条槽体及托持槽平行滑动，就能够将滤光条拆除，然后将锁固部使用外力拉开，使其远离固定部，从而使得上盖与下壳分开。进而可以对灯管及印刷电路板进行检修，避免了拆除整个电子白板，使检修过程变的简便易操作。

附图说明

[0017] 图 1 为前拆式电子白板的边框结构示意图之一；

[0018] 图 2 为前拆式电子白板的边框结构示意图之一；

[0019] 图 3 为前拆式电子白板的边框结构示意图之一；

[0020] 图 4 为前拆式电子白板的边框结构的爆炸图；

[0021] 图 5 为前拆式电子白板的边框结构的应用示意图之一；

[0022] 图 6 为前拆式电子白板的边框结构的应用示意图之一；

[0023] 图 7 为前拆式电子白板的边框结构的应用示意图之一。

具体实施方式

[0024] 一种前拆式电子白板的边框结构，用于设置在电子白板的显示区域的边缘处，包括印刷电路板、固定于所述印刷电路上的灯管、设置在所述灯管出光面的滤光条，还包括上盖和下壳。上盖和下壳配合形成空腔，空腔用于收容灯管及印刷电路板；上盖包括锁固部并设有第一卡条槽体；下壳包括固定部并设有第二卡条槽体、托持槽及螺接槽。第一卡条槽体用于收容滤光条的一端，滤光条的一端滑入第一卡条槽体内；托持槽用于收容滤光条背离上盖的一端，滤光条背离上盖的一端滑入托持槽内；第一卡条槽体及托持槽沿滤光条的长度方向延伸；第二卡条槽体用于收容显示区域的边缘，显示区域的边缘滑入第二卡条槽体内；第二卡条槽体沿显示区域的边缘长度方向延伸；螺接槽与印刷电路板的中央位置螺

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接；锁固部与固定部配合固定，锁固部卡扣于所述固定部上，使上盖和下壳固定连接。

[0025] 使用上盖的第一卡条槽体与下壳的托持槽相对活动固定滤光条。滤光条能够相对第一卡条槽体与托持槽平行滑动。同时，上盖的锁固部与下壳的固定部活动卡接固定。拆除时，使用外力拉动固定部远离固定部就能够使上盖与下壳分开。下壳与显示区域的边缘通过第二卡条槽体活动固定，第二卡条槽体能够相对显示区域的边缘平行滑动。因而在检修过程中，使滤光条沿第一卡条槽体及托持槽平行滑动，就能够将滤光条拆除，然后将锁固部使用外力拉开，使其远离固定部，从而使得上盖与下壳分开。进而可以对灯管及印刷电路板进行检修，避免了拆除整个电子白板，使检修过程变的简便易操作。

[0026] 为了使本实用新型的目的、技术方案及优点更清楚，以下结合附图及实施例，对实用新型进行进一步详细说明。

[0027] 如图 1 所示，为前拆式电子白板的边框结构示意图之一。

[0028] 请结合图 4。

[0029] 一种前拆式电子白板的边框结构，用于设置在电子白板的显示区域的边缘处，包括印刷电路板 30、固定于所述印刷电路板 30 上的灯管 40、设置在所述灯管 40 出光面的滤光条 50，还包括上盖 10 和下壳 20。

[0030] 所述上盖 10 和所述下壳 20 配合形成空腔，所述空腔用于收容所述灯管 40 及所述印刷电路板 50；所述上盖 10 包括锁固部 102 并设有第一卡条槽体 101；所述下壳 20 包括固定部 205 并设有第二卡条槽体 202、托持槽 201 及螺接槽 203。

[0031] 所述第一卡条槽体 101 用于收容所述滤光条 50 的一端 501，所述滤光条 50 的一端 501 滑入所述第一卡条槽体 101 内；所述托持槽 201 用于收容所述滤光条 50 背离所述上盖 10 的一端 502，所述滤光条 50 背离所述上盖 10 的一端 502 滑入所述托持槽 201 内；所述第一卡条槽体 101 及所述托持槽 201 沿所述滤光条 50 的长度方向延伸；所述第二卡条槽体 202 用于收容显示区域的边缘，所述显示区域的边缘滑入所述第二卡条槽体 202 内；所述第二卡条槽体 202 沿所述显示区域的边缘长度方向延伸；所述螺接槽 203 与所述印刷电路板 30 的中央位置螺接；所述锁固部 102 与所述固定部 205 配合固定，所述锁固部 102 卡扣于所述固定部 205 上，使所述上盖 10 和所述下壳 20 固定连接。

[0032] 上盖 10 大体呈 L 形，所述上盖 10 的长边设置所述第一卡条槽体 101，所述上盖 10 的短边设置所述锁固部 102；所述第一卡条槽体 101 的形状与所述滤光条 50 的一端 501 配合，所述滤光条 50 的一端 501 可相对所述第一卡条槽体 101 平行滑动；所述锁固部 102 设有突起，所述突起卡扣于所述固定部 205 上，使所述上盖 10 与所述下壳 20 相对固定。

[0033] 下壳 20 还设有侧边卡槽 204，所述印刷电路板 30 远离所述滤光条 50 的一端与所述侧边卡槽 204 卡合连接；所述侧边卡槽 204 沿所述印刷电路板 30 边缘长度方向上延伸。

[0034] 下壳 20 沿所述侧边卡槽 204 的短边方向延伸并弯折呈直角。

[0035] 托持槽 201 设于所述第二卡条槽体 202 的一侧；所述托持槽 201 与所述滤光条 50 背离所述第一卡条槽体 101 的一端 502 抵持连接，所述滤光条 50 背离所述第一卡条槽体 101 的一端 502 可相对所述托持槽 201 平行滑动。

[0036] 下壳 20 设有多个螺接槽 203，所述螺接槽 203 通过螺钉 31 与所述印刷电路板 30 螺接，使所述印刷电路板 30 相对所述下壳 20 固定。

[0037] 螺接槽 203 均匀分布于所述下壳 10 相对固定所述印刷电路板 30 的部分。

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[0038] 下壳 20 背离所述螺接槽 203 的一面设有卡持部 206，所述卡持部 206 用于将所述下壳 20 固定于支架上。

[0039] 第一卡条槽体 101 及所述锁固部 102 一体成型。

[0040] 第二卡条槽体 202、所述托持槽 201、所述螺接槽 203 及所述固定部 205 一体成型。

[0041] 滤光条 50 的一端 501 与上盖 10 的第一卡条槽体 101 配合，即滤光条 50 的一端 501 滑动卡入第一卡条槽体 101 内。滤光条 50 背离第一卡条槽体 101 的一端 502 与下壳 20 的托持槽 201 配合，即滤光条 50 背离第一卡条槽体 101 的一端 502 与下壳 20 的托持槽 201 抵持固定。因此，滤光条 50 固定于上盖 10 与下壳 20 之间。而上盖 10 与下壳 20 之间通过锁固部 102 卡扣于固定部 205 上来固定。

[0042] 上盖 10 与下壳 20 相对固定后形成空腔。灯管 40 与印刷电路板 30 设置于空腔内。具体的，灯管 30 设置于印刷电路板 30 上，且出光面靠近滤光条。印刷电路板 30 通过螺钉 31 与下壳 20 的螺接槽 203 固定连接。印刷电路板 30 远离灯管 30 的一端与侧边卡槽 204 卡接。从而将印刷电路板 30 固定在下壳上。

[0043] 下壳 20 的第二卡条槽体 202 用于活动固定显示区域的边缘。具体地，第二卡条槽体 202 于挤塑板 60 的边缘活动固定，即挤塑板 60 的边缘沿第二卡条槽体 202 的长度方向滑入第二卡条槽体 202 内。挤塑板 60 的边缘与第二卡条槽体 202 沿长度方向可平行滑动。

[0044] 如图 5 所示，为前拆式电子白板的边框结构应用示意图之一。

[0045] 在本实施例中，挤塑板 60 的两个边缘设置有前拆式电子白板的边框结构。电子白板通过印刷电路 30 控制灯管 40 的发光情况，滤光条 50 对灯管 40 发出光进行滤光处理。在电子白板需要检修时，通过外力拉动锁固部 102 使其远离固定部 205，从而能够使上盖 10 与下壳 20 分开。沿第一卡条槽体 101 的长度方向滑动使滤光条 50 的一端 501 不再与第一卡条槽体 101 卡合，从而能够分开上盖 10 与滤光条 50。此时，灯管 40 与印刷电路板 30 完全裸露，方便检修人员对灯管 40 及印刷电路板 30 进行检修，整个拆卸过程简便，提高了检修效率，降低检修难度。

[0046] 请结合图 2。

[0047] 在一个实施例中，上盖 10 的第一卡条槽体 101 与滤光条 50 的一端 501 抵持固定，下壳 20 的托持槽 201 与滤光条 50 背离第一卡条槽体 101 的一端 502 卡合，即滤光条 50 背离第一卡条槽体 101 的一端 502 可滑动卡入托持槽 201 内。

[0048] 如图 6 所示，为前拆式电子白板的边框结构应用示意图之一。

[0049] 在本实施例中，挤塑板 60 的两个边缘设置有前拆式电子白板的边框结构。电子白板通过印刷电路 30 控制灯管 40 的发光情况，滤光条 50 对灯管 40 发出光进行滤光处理。在电子白板需要检修时，通过外力拉动锁固部 102 使其远离固定部 205，从而能够使上盖 10 与下壳 20 分开。沿第一卡条槽体 101 的长度方向滑动使滤光条 50 的一端 501 不再与第一卡条槽体 101 抵持，从而能够分开上盖 10 与滤光条 50。此时，灯管 40 与印刷电路板 30 完全裸露，方便检修人员对灯管 40 及印刷电路板 30 进行检修，整个拆卸过程简便，提高了检修效率，降低检修难度。

[0050] 请结合图 3。

[0051] 在一个实施例中，上盖 10 的锁固部 102 可设置为卡合突起；下壳 20 的固定部 205 设为卡合槽，卡合突起与卡合槽配合使上盖 10 与下壳 20 固定。即将卡合突起卡入卡合槽

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内。

[0052] 如图 7 所示，为前拆式电子白板的边框结构应用示意图。

[0053] 在本实施例中，挤塑板 60 的两个边缘设置有前拆式电子白板的边框结构。电子白板通过印刷电路 30 控制灯管 40 的发光情况，滤光条 50 对灯管 40 发出光进行滤光处理。在电子白板需要检修时，通过外力拉动锁固部 102 使其远离固定部 205，使锁固部 102 不再与固定部 205 卡合，从而能够使上盖 10 与下壳 20 分开。沿第一卡条槽体 101 的长度方向滑动使滤光条 50 的一端 501 不再与第一卡条槽体 101 抵持，从而能够分开上盖 10 与滤光条 50。此时，灯管 40 与印刷电路板 30 完全裸露，方便检修人员对灯管 40 及印刷电路板 30 进行检修，整个拆卸过程简便，提高了检修效率，降低检修难度。

[0054] 以上所述实施例仅表达了本实用新型的几种实施方式，其描述较为具体和详细，但并不能因此而理解为对本实用新型专利范围的限制。应当指出的是，对于本领域的普通技术人员来说，在不脱离本实用新型构思的前提下，还可以做出若干变形和改进，这些都属于本实用新型的保护范围。因此，本实用新型专利的保护范围应以所附权利要求为准。

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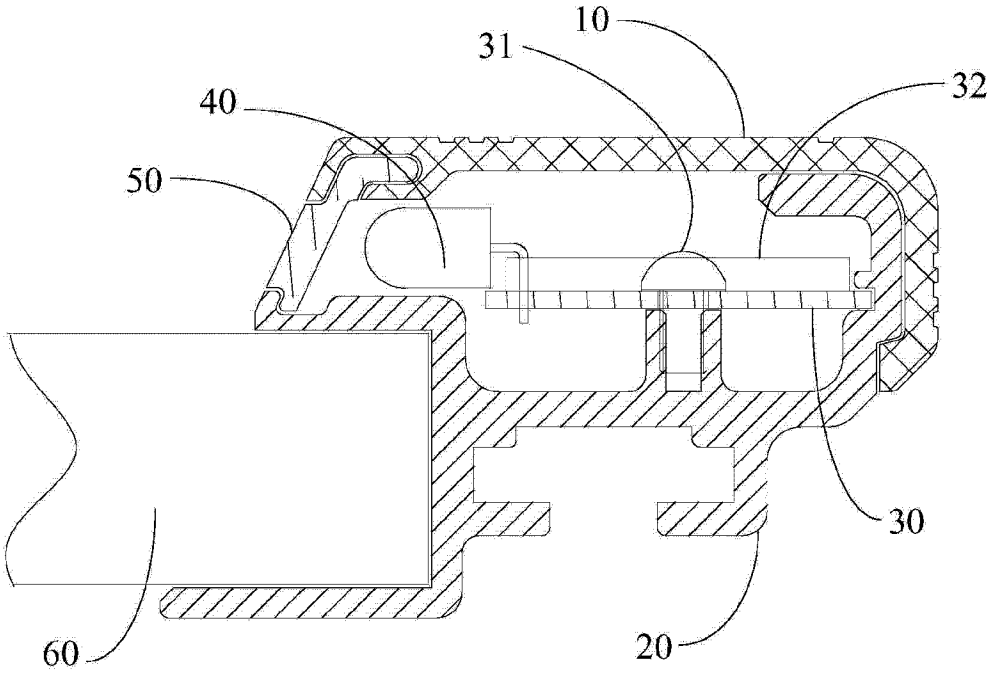


图 1

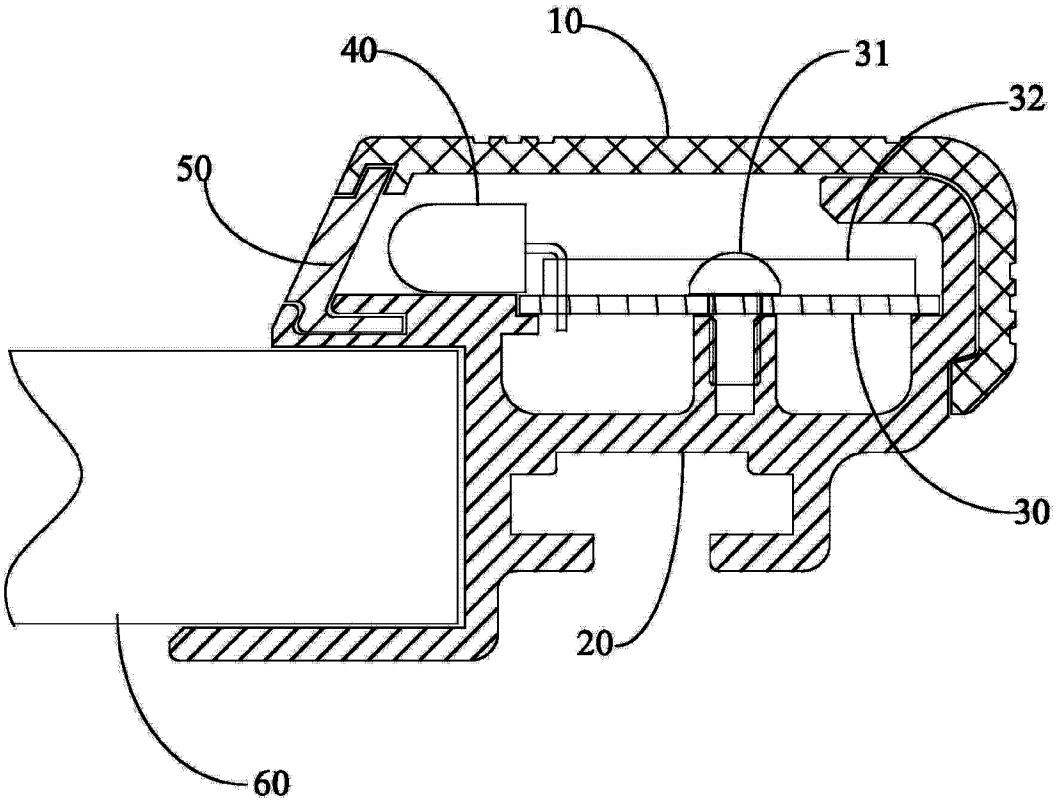


图 2

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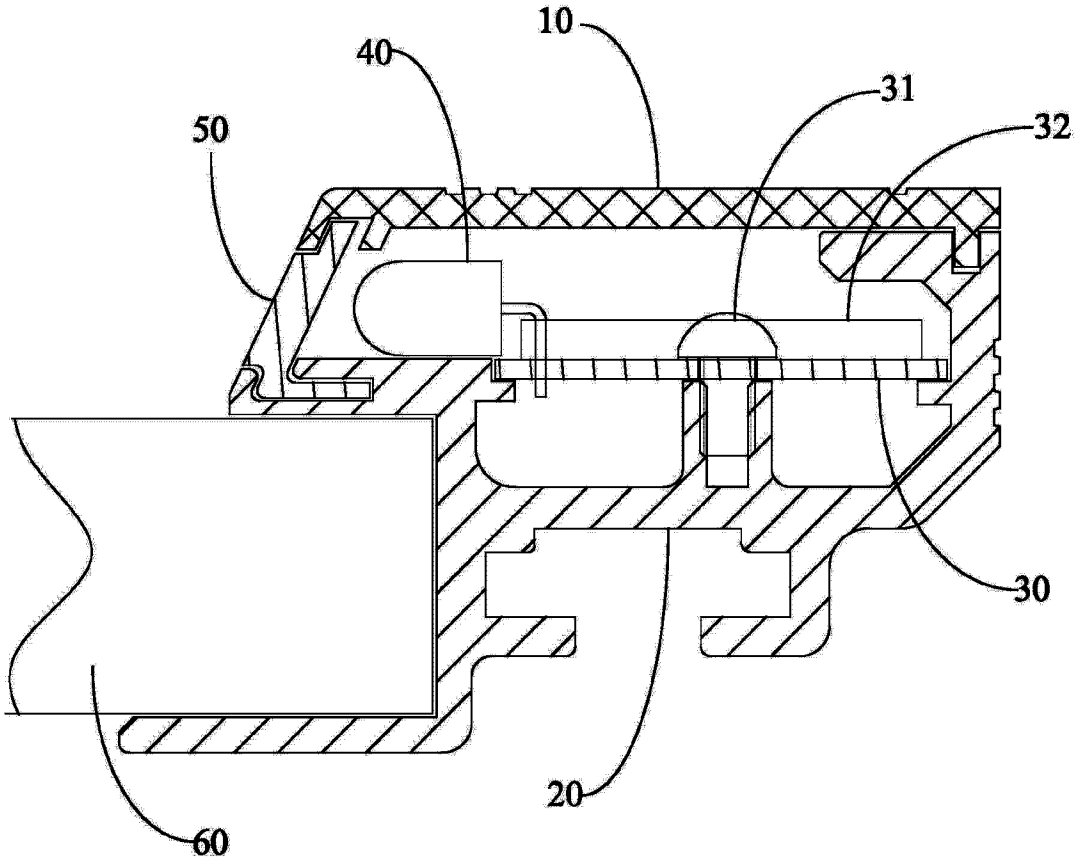


图 3

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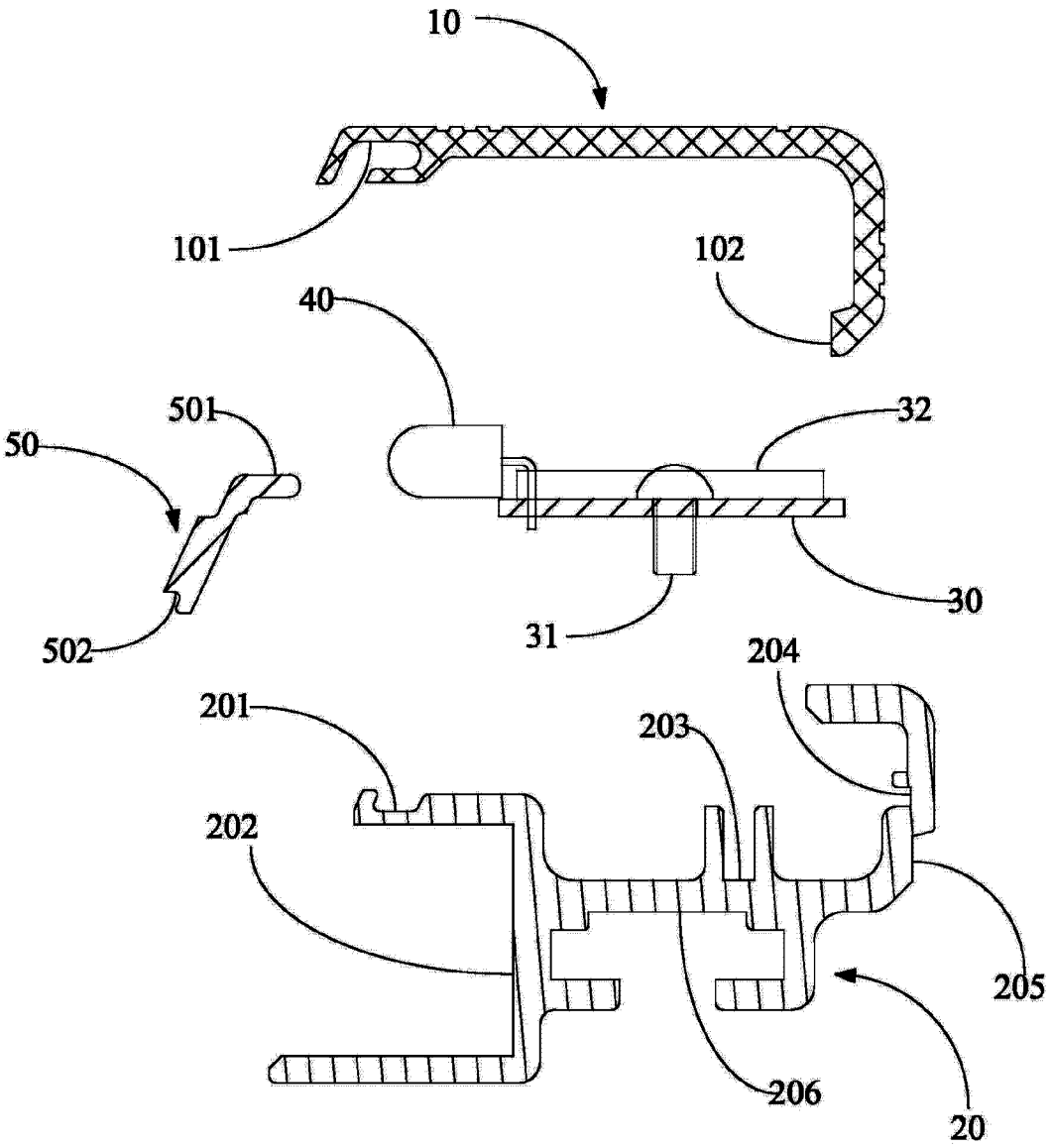


图 4

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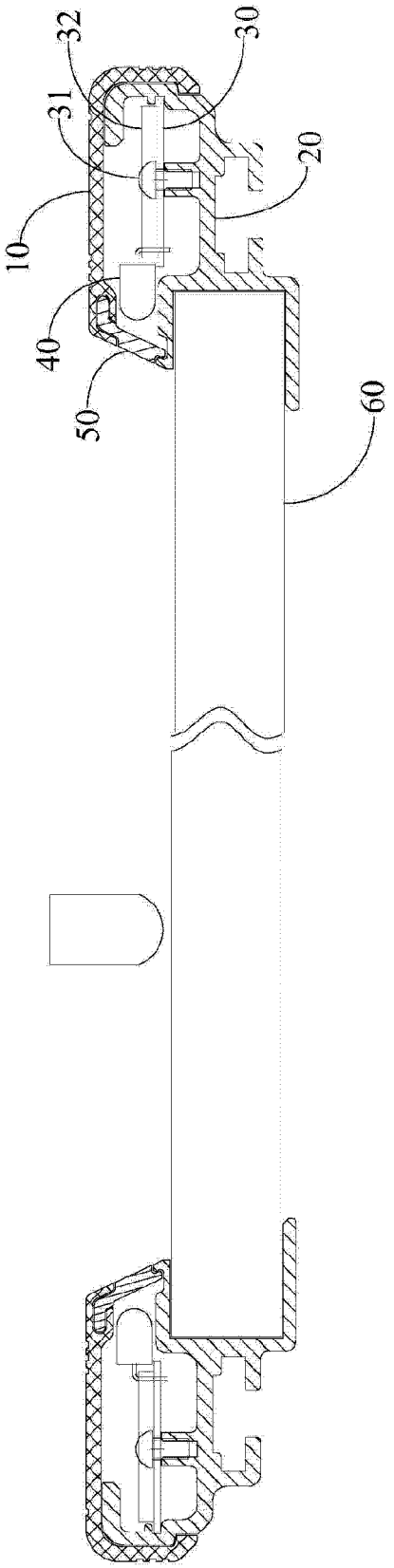


图 5

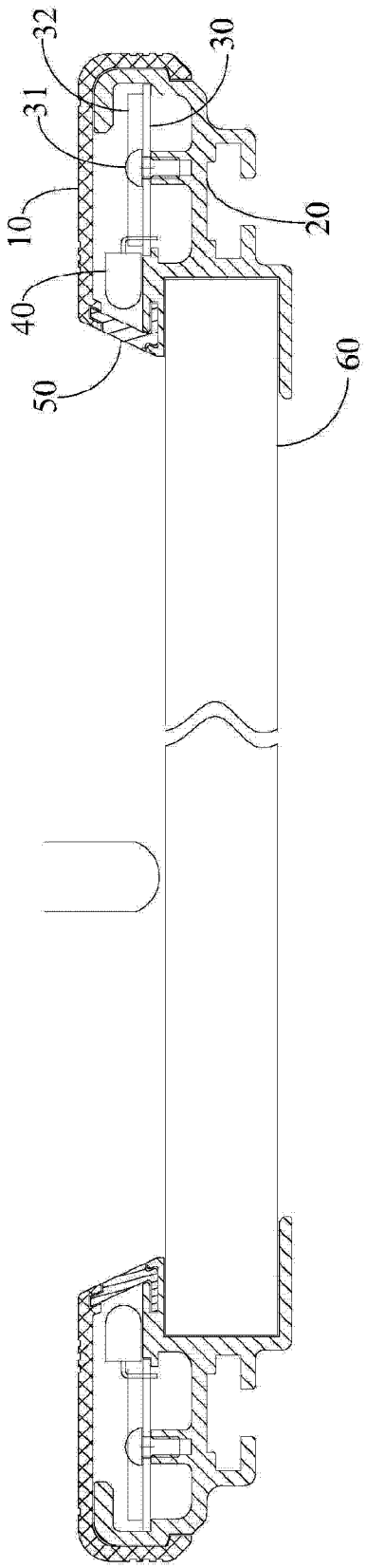


图 6

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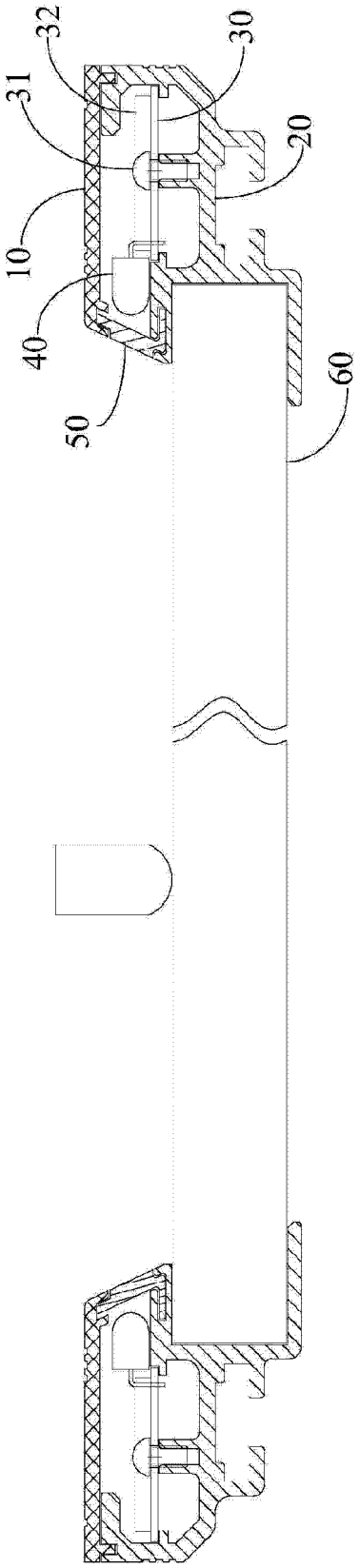


图 7

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(19)中华人民共和国国家知识产权局

(12)实用新型专利

(10)授权公告号 CN 203786708 U
(45)授权公告日 2014.08.20

(21)申请号 201420057402.0

(22)申请日 2014.01.29

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(51)Int.Cl.
G06F 3/042(2006.01)

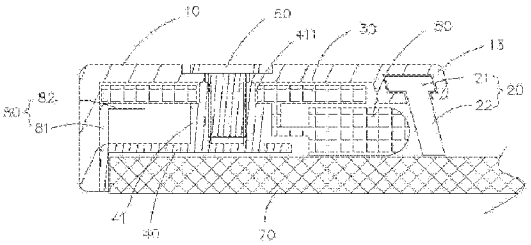
权利要求书1页 说明书3页 附图2页

(54)实用新型名称

拆装式红外触摸装置及红外触摸屏

(57)摘要

本实用新型公开了一种拆装式红外触摸装置及红外触摸屏，其中外框架包括面板及与面板相连的侧板，面板与侧板垂直设置，面板上间隔开设有卡孔，面板远离侧板一侧设有卡持部，滤光条卡持在卡持部内；支架置于外框架下方，支架匹配卡孔处设有卡杆，卡孔与卡柱通过螺丝件进行固接；电路板卡持在外框架与支架之间，红外装置电性连接在电路板上并匹配滤光条设置。本实用新型通过将滤光条卡持在外框架的卡槽内，滤光条与外框架分离设置，降低了一体成型式生产的难度，同时也降低生产成本；同时，配合设置支架，通过螺丝件将卡孔与卡柱进行固接，使得电路板能稳定固接在外框架与支架之间；并在对装置进行维修时，拆下螺丝件即能让电路板裸露在装置外侧，方便取出维护。



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1. 一种拆装式红外触摸装置，其特征在于：包括外框架、滤光条、电路板、支架及红外装置，所述外框架包括面板及与面板相连的侧板，所述面板与所述侧板垂直设置，所述面板上间隔开设有卡孔，所述面板远离侧板一侧设有卡持部，所述滤光条卡持在卡持部内；所述支架置于所述外框架下方，所述支架匹配卡孔处设有卡柱，所述卡孔与卡柱通过螺丝件进行固接；所述电路板卡持在所述外框架与支架之间，所述红外装置电性连接在电路板上并匹配所述滤光条设置。

2. 根据权利要求 1 所述的拆装式红外触摸装置，其特征在于：所述支架下表面贴合触摸显示屏设置。

3. 根据权利要求 2 所述的拆装式红外触摸装置，其特征在于：所述触摸显示屏一侧与支架之间设有双面胶，所述双面胶用于将所述支架与触摸显示屏固定粘合。

4. 根据权利要求 1 所述的拆装式红外触摸装置，其特征在于：所述卡持部横向开设有卡槽，所述滤光条卡持在卡槽内。

5. 根据权利要求 1 所述的拆装式红外触摸装置，其特征在于：所述电路板上匹配所述卡孔处开设有开孔，所述卡柱贯穿所述电路板设置；所述卡柱上端部周侧设置有支撑部，所述支撑部用于对电路板支撑固定。

6. 根据权利要求 5 所述的拆装式红外触摸装置，其特征在于：所述支撑部为 L 型构造。

7. 根据权利要求 1 所述的拆装式红外触摸装置，其特征在于：所述外框架内侧部贴合设置有支撑条，所述支撑条设置有一体成型的侧片及支撑片，所述侧片贴合所述外框架设置，所述支撑片与所述侧片垂直设置，所述支撑片用于支撑所述电路板一端部。

8. 根据权利要求 1 所述的拆装式红外触摸装置，其特征在于：所述滤光条包括一体成型的基部及滤光部，所述基部与滤光部呈 T 型构造，所述基部卡持容置在卡槽内。

9. 根据权利要求 1 所述的拆装式红外触摸装置，其特征在于：所述外框架采用不锈钢材质制造。

10. 一种红外触摸屏，其特征在于：包括如权利要求 1 ～ 9 任一项所述的拆装式红外触摸装置及其贴合的触摸显示屏。

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拆装式红外触摸装置及红外触摸屏

技术领域

[0001] 本实用新型涉及触控设备技术领域，尤其是涉及一种拆装式红外触摸装置及红外触摸屏。

背景技术

[0002] 红外触摸屏是利用 X、Y 方向上密布的红外线矩阵来检测并定位用户的触摸，包括滤光条、电路板、外框、显示屏玻璃、红外发射管和红外接收器等，红外发射管和红外接收器交叉安装在高度集成的电路板上的两个相对的方向，形成一个不可见的红外线光栅，滤光条通过外框固定在红外发射管和红外接收器前方。电路板上的控制电路持续地对二极管发出脉冲形成红外线偏震光束格栅，当用户在触摸显示屏玻璃时，手指或其它物体就会挡住经过该位置上方的横竖两条红外线，阻断了光束，由控制器判断出触摸点在显示屏玻璃的位置，从而达到触摸和手写效果。

[0003] 红外触摸屏不受电流电压和静电干扰，适宜恶劣的环境条件，所以普遍认为红外线技术是触摸屏产品最终的发展趋势，如果为了美观而减少红外触摸屏的组装结构，将更多的结构进行一体成型，而当结构中存在部分瑕疵时，会将整体结构进行统一替换，无形中增加了维护成本，同时，进行一体成型化生产也会增大生产的难度，不利于生产效率的有效提高。

实用新型内容

[0004] 基于此，有必要针对现有技术的不足，提供一种生产容易、维护方便，降低成本的拆装式红外触摸装置及红外触摸屏。

[0005] 为解决上述技术问题，本实用新型所采用的技术方案是：一种拆装式红外触摸装置，其包括外框架、滤光条、电路板、支架及红外装置，所述外框架包括面板及与面板相连的侧板，所述面板与所述侧板垂直设置，所述面板上间隔开设有卡孔，所述面板远离侧板一侧设有卡持部，所述滤光条卡持在卡持部内；所述支架置于所述外框架下方，所述支架匹配卡孔处设有卡柱，所述卡孔与卡柱通过螺丝件进行固接；所述电路板卡持在所述外框架与支架之间，所述红外装置电性连接在电路板上并匹配所述滤光条设置。

[0006] 在其中一个实施例中，所述支架下表面贴合触摸显示屏设置。

[0007] 在其中一个实施例中，所述触摸显示屏一侧与支架之间设有双面胶，所述双面胶用于将所述支架与触摸显示屏固定粘合。

[0008] 在其中一个实施例中，所述卡持部横向开设有卡槽，所述滤光条卡持在卡槽内。

[0009] 在其中一个实施例中，所述电路板上匹配所述卡孔处开设有开孔，所述卡柱贯穿所述电路板设置；所述卡柱上端部周侧设置有支撑部，所述支撑部用于对电路板支撑固定。

[0010] 在其中一个实施例中，所述支撑部为 L 型构造。

[0011] 在其中一个实施例中，所述外框架内侧部贴合设置有支撑条，所述支撑条设置有一体成型的侧片及支撑片，所述侧片贴合所述外框架设置，所述支撑片与所述侧片垂直设

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置，所述支撑片用于支撑所述电路板一端部。

[0012] 在其中一个实施例中，所述滤光条包括一体成型的基部及滤光部，所述基部与滤光部呈 T 型构造，所述基部卡持容置在卡槽内。

[0013] 在其中一个实施例中，所述外框架采用不锈钢材质制造。

[0014] 一种红外触摸屏，其包括上述述的拆装式红外触摸装置及其贴合的触摸显示屏。

[0015] 综上所述，本实用新型拆装式红外触摸装置及红外触摸屏通过将滤光条卡持在外框架的卡槽内，滤光条与外框架分离设置，降低了一体成型式生产的难度，同时也降低生产成本；同时，配合设置支架，通过螺丝件将卡孔与卡柱进行固接，使得电路板能稳定固接在外框架与支架之间；并在对装置进行维修时，拆下螺丝件即能让电路板裸露在装置外侧，方便取出维护。

附图说明

[0016] 图 1 为本实用新型拆装式红外触摸装置的结构示意图；

[0017] 图 2 为图 1 本实用新型拆装式红外触摸装置的截面示意图；

[0018] 图 3 为图 1 本实用新型拆装式红外触摸装置隐藏部分结构的截面示意图。

具体实施方式

[0019] 为能进一步了解本实用新型的特征、技术手段以及所达到的具体目的、功能，下面结合附图与具体实施方式对本实用新型作进一步详细描述。

[0020] 如图 1 至图 3 所示，本实用新型拆装式红外触摸装置包括外框架 10、滤光条 20、电路板 30、支架 40 及红外装置 50，所述外框架 10 采用不锈钢材质制造，所述外框架 10 包括面板 11 及与面板 11 相连的侧板 12，所述面板 11 与所述侧板 12 垂直设置，所述面板 11 上间隔开设有卡孔 111，所述面板 11 远离侧板 12 一侧设有卡持部 13，所述卡持部 13 横向开设有卡槽 131，所述滤光条 20 卡持在卡槽 131 内，将外框架 10 与滤光条 20 组装设置，降低了一体成型式生产的难度，同时也降低生产成本；所述支架 40 置于所述外框架 10 下方，所述支架 40 匹配卡孔 111 处设有卡柱 41，所述卡孔 111 与卡柱 41 通过螺丝件 60 进行固接，使得外框架 10 与支架 40 稳定固接；所述支架 40 下表面贴合触摸显示屏 70 设置，进一步地，所述触摸显示屏 70 一侧与支架 40 之间设有双面胶，所述双面胶用以将所述支架 40 与触摸显示屏 70 固定粘合。

[0021] 所述电路板 30 卡持在所述外框架 10 与支架 40 之间，所述红外装置 50 电性连接在电路板 30 上并匹配所述滤光条 20 设置；在其中一个实施例中，所述红外装置 50 为红外发射管或红外接收器，所述红外接收器用以接收从红外发射管发出的红外光线信号。

[0022] 进一步地，所述电路板 30 上匹配所述卡孔 111 处开设有开孔，所述卡柱 41 贯穿所述电路板 30 设置；所述卡柱 41 上端部周侧设置有 L 型支撑部 411，所述支撑部 411 用于对电路板 30 支撑固定，以保证电路板 30 能稳固装置在所述外框架 10 与支架 40 之间。

[0023] 在其中一个实施例中，所述外框架 10 内侧部贴合设置有支撑条 80，所述支撑条 80 设置有一体成型的侧片 81 及支撑片 82，所述侧片 81 贴合所述外框架 10 设置，所述支撑片 82 与所述侧片 81 垂直设置，所述支撑片 82 用于支撑所述电路板 30 一端部，与卡柱 41 的支撑部 411 共同对电路板 30 进行支撑固定，使得电路板 30 能更稳固地装设在所述外框架 10

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与支架 40 之间。

[0024] 在其中一个实施例中，所述滤光条 20 包括一体成型的基部 21 及滤光部 22，所述基部 21 与滤光部 22 呈 T 型构造，所述基部 21 卡持容置在卡槽 131 内，所述滤光部 22 斜向下设置，所述滤光部 22 用以过滤经过其内部的光线，以保证红外接收器能准确识别红外发射管发出的红外光线。

[0025] 本实用新型还提供了一种红外触摸屏，包括上述一种拆装式红外触摸装置的外框架 10、滤光条 20、支架 40、电路板 30 及红外装置 50，还包括与拆装式红外触摸装置贴合的触摸显示屏 70。

[0026] 上述一种红外触摸屏的其他技术特征与上述一种红外触摸装置相同，此处不予赘述。

[0027] 本实用新型具体组装时，首先通过双面胶将支架 40 与触摸显示屏 70 进行粘合，将组装好红外装置 50 的电路板 30 安设在卡柱 41 上，此时，卡柱 41 贯穿电路板 30 上开设的开孔，支撑部 411 对电路板 30 起到支撑作用，使得电路板 30 能稳固地进行安设；然后，将组装好滤光条 20 的外框架 10 安设在支架 40 上方，此时，外框架 10 的卡孔 111 匹配卡柱 41 设置，通过螺丝件 60 使得卡孔 111 和卡柱 41 对接，完成对外框接与支架 40 的固接，同时也使得电路板 30 稳定固定在外框架 10 与支架 40 之间；本实用新型进行拆装时，直接将螺丝件 60 拆下，将外框架 10 与支架 40 分离，此时，电路板 30 即可裸露在装置外侧，方便取出进行维护。

[0028] 综上所述，本实用新型拆装式红外触摸装置及红外触摸屏通过将滤光条 20 卡持在外框架 10 的卡槽 131 内，滤光条 20 与外框架 10 分离设置，降低了一体成型式生产的难度，同时也降低生产成本；同时，配合设置支架 40，通过螺丝件 60 将卡孔 111 与卡柱 41 进行固接，使得电路板 30 能稳定固接在外框架 10 与支架 40 之间；并在对装置进行维修时，拆下螺丝件 60 即能让电路板 30 裸露在装置外侧，方便取出维护。

[0029] 以上所述实施例仅表达了本实用新型的几种实施方式，其描述较为具体和详细，但并不能因此而理解为对本实用新型范围的限制。应当指出的是，对于本领域的普通技术人员来说，在不脱离本实用新型构思的前提下，还可以做出若干变形和改进，这些都属于本实用新型的保护范围。因此，本实用新型的保护范围应以所附权利要求为准。

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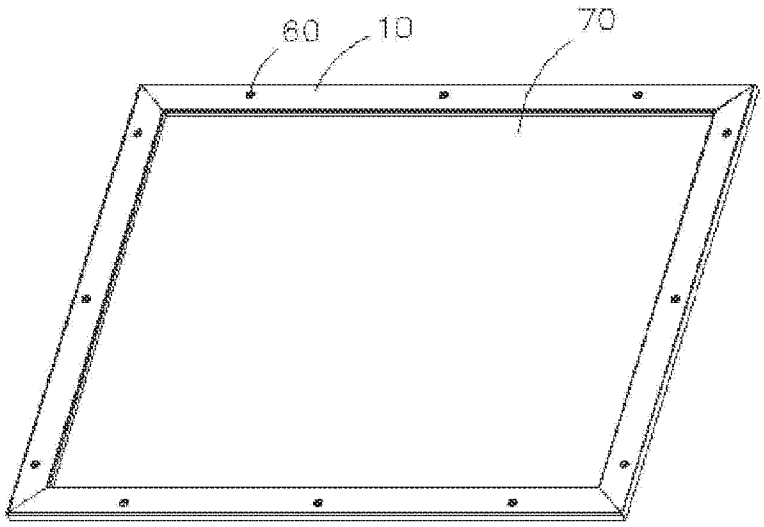


图 1

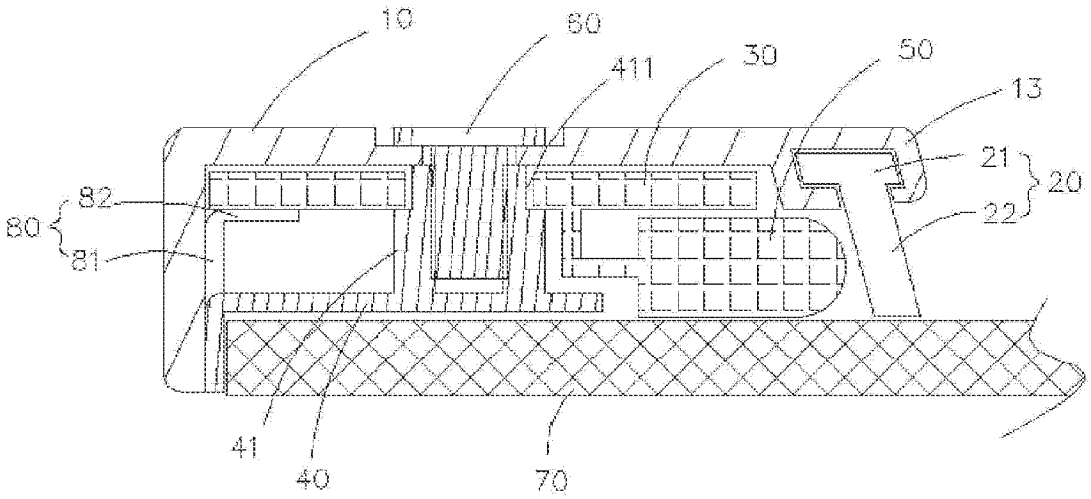


图 2

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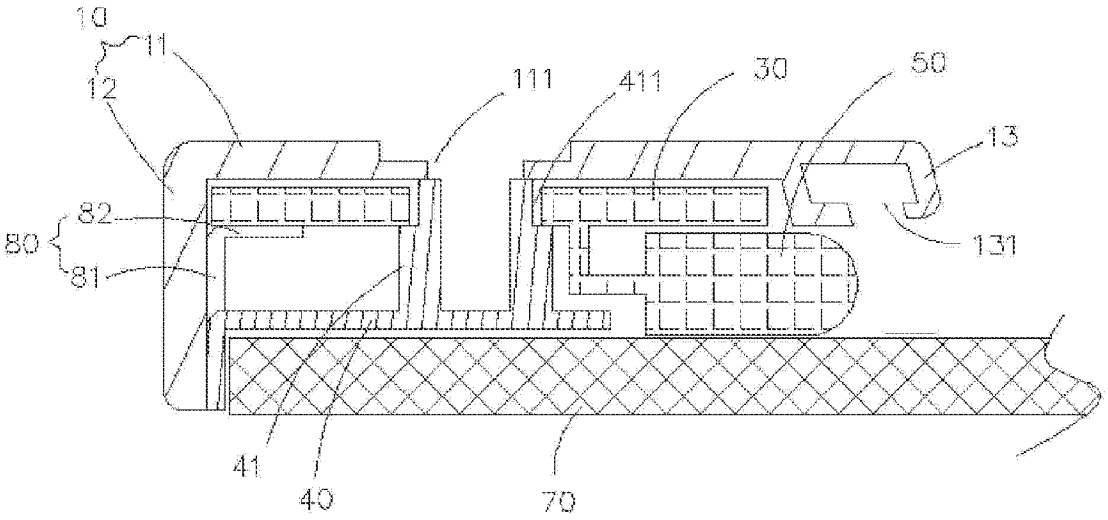


图 3

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(19)中华人民共和国国家知识产权局

(12)实用新型专利

(10)授权公告号 CN 203825586 U
(45)授权公告日 2014.09.10

(21)申请号 201420096500.5

(22)申请日 2014.03.04

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(51)Int.Cl.
G06F 3/041(2006.01)
G06F 3/042(2006.01)

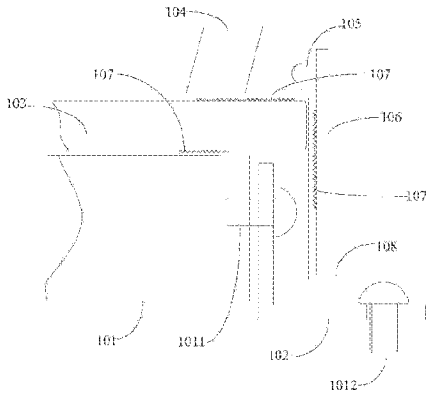
权利要求书1页 说明书4页 附图3页

(54)实用新型名称

显示器边框结构

(57)摘要

一种显示器边框结构，包括：滤光条、玻璃盖板、灯管、印刷电路板，其还包括印刷电路板支撑板和第一双面胶；显示器边框结构采用第一双面胶将印刷电路板与印刷电路板支撑板的主体板固定，再将印刷电路板支撑板的第一板固定于玻璃盖板上，从而将印刷电路板相对显示器及玻璃盖板固定。再将滤光条及灯管依次安装即完成显示器边框结构的安装，由于印刷电路板沿长度方向安装，减小了显示器的边缘宽度，同时使得Z轴高度降低。



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1. 一种显示器边框结构，包括：滤光条、玻璃盖板、灯管、印刷电路板，其特征在于，还包括印刷电路板支撑板和第一双面胶；

玻璃盖板，用于盖设在所述显示器的显示面；

印刷电路板支撑架，用于设于所述显示器的侧边，所述印刷电路板支撑架具有固定印刷电路板的主体板和自所述主体板两端分别向相反的方向垂直延伸的第一挡板和第二挡板，其中所述第一挡板向玻璃盖板延伸并固定于所述玻璃盖板上，所述第二挡板背向玻璃盖板延伸并与所述印刷电路板一端抵接；所述主体板通过所述第一双面胶与所述印刷电路板固定，所述第一挡板通过所述第一双面胶与所述玻璃盖板固定；

印刷电路板，通过所述第一双面胶固定于所述印刷电路板支撑架的主体板上；

灯管，设于所述印刷电路板上并突出于所述主体板；

滤光条，置于所述灯管的出光面并与所述玻璃盖板所在的平面平行。

2. 根据权利要求 1 所述的显示器边框结构，其特征在于，所述印刷电路板支撑板的第一挡板覆盖于所述玻璃盖板靠近显示器的一面。

3. 根据权利要求 1 所述的显示器边框结构，其特征在于，所述玻璃盖板与所述显示器通过第一双面胶固定连接。

4. 根据权利要求 1 所述的显示器边框结构，其特征在于，所述印刷电路板支撑板的第一挡板覆盖于所述玻璃盖板远离显示器的一面。

5. 根据权利要求 1-4 任意一项所述的显示器边框结构，其特征在于，所述第一双面胶为 0.3 厚 3M 双面胶。

6. 根据权利要求 1 所述的显示器边框结构，其特征在于，所述滤光条置于所述玻璃盖板上，并与所述玻璃盖板通过第二双面胶连接。

7. 根据权利要求 1 所述的显示器边框结构，其特征在于，所述滤光条置于所述印刷电路板支撑板的第一挡板上，并与所述印刷电路板支撑板的第一挡板通过第二双面胶连接。

8. 根据权利要求 6 或 7 所述的显示器边框结构，其特征在于，所述第二双面胶为 0.1 厚 3M 双面胶。

9. 根据权利要求 1 所述的显示器边框结构，其特征在于，还包括显示器支撑板，所述显示器支撑板靠近所述显示器的一端与所述显示器螺接，所述显示器支撑板远离所述显示器的一端与外部设备采用螺接。

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显示器边框结构

技术领域

[0001] 本实用新型涉及显示器边框结构，特别是涉及一种安装简便、边框窄的显示器边框结构。

背景技术

[0002] 显示器的黑边为屏幕中显示的内容除了正常显示区域外，两侧或四周多出来的不能显示的区域，因该区域为黑色，故称之为黑边。传统的触控模组，由于 PCB 的宽度较宽，导致边缘较宽，使得安装后的显示器边缘较宽，Z 轴触控太高，从而影响用户体验。

实用新型内容

[0003] 基于此，有必要提供一种安装简便、显示边缘窄、低 Z 轴触控的显示器边框结构。

[0004] 一种显示器边框结构，包括：滤光条、玻璃盖板、灯管、印刷电路板，还包括印刷电路板支撑板和第一双面胶；

[0005] 玻璃盖板，用于盖设在所述显示器的显示面；

[0006] 印刷电路板支撑架，用于设于所述显示器的侧边，所述印刷电路板支撑架具有固定印刷电路板的主体板和自所述主体板两端分别向相反的方向垂直延伸的第一挡板和第二挡板，其中所述第一挡板向玻璃盖板延伸并固定于所述玻璃盖板上，所述第二挡板背向玻璃盖板延伸并与所述印刷电路板一端抵接；所述主体板通过所述第一双面胶与所述印刷电路板固定，所述第一挡板通过所述第一双面胶与所述玻璃盖板固定；

[0007] 印刷电路板，通过所述第一双面胶固定于所述印刷电路板支撑架的主体板上；

[0008] 灯管，设于所述印刷电路板上并突出于所述主体板；

[0009] 滤光条，置于所述灯管的出光面并与所述玻璃盖板所在的平面平行。

[0010] 在其中一个实施例中，所述印刷电路板支撑板的第一挡板覆盖于所述玻璃盖板靠近显示器的一面。

[0011] 在其中一个实施例中，所述玻璃盖板与所述显示器通过第一双面胶固定连接。

[0012] 在其中一个实施例中，所述印刷电路板支撑板的第一挡板覆盖于所述玻璃盖板远离显示器的一面。

[0013] 在其中一个实施例中，所述第一双面胶为 0.3 厚 3M 双面胶。

[0014] 在其中一个实施例中，所述滤光条置于所述玻璃盖板上，并与所述玻璃盖板通过第二双面胶连接。

[0015] 在其中一个实施例中，所述滤光条置于所述印刷电路板支撑板的第一挡板上，并与所述印刷电路板支撑板的第一挡板通过第二双面胶连接。

[0016] 在其中一个实施例中，所述第二双面胶为 0.1 厚 3M 双面胶。

[0017] 在其中一个实施例中，还包括显示器支撑板，所述显示器支撑板靠近所述显示器的一端与所述显示器螺接，所述显示器支撑板远离所述显示器的一端与外部设备采用螺接。

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[0018] 上述显示器边框结构采用第一双面胶将印刷电路板与印刷电路板支撑板的主体板固定，再将印刷电路板支撑板的第一板固定于玻璃盖板上，从而将印刷电路板相对显示器及玻璃盖板固定。再将滤光条及灯管依次安装即完成显示器边框结构的安装，由于印刷电路板沿长度方向安装，减小了显示器的边缘宽度，同时使得 Z 轴高度降低。

附图说明

[0019] 图 1 为显示器边框结构的示意图；

[0020] 图 2 为一个实施例中显示器边框结构的示意图；

[0021] 图 3 为又一个实施例中显示器边框结构的示意图；

[0022] 图 4 为另一个实施例中显示器边框结构的示意图。

具体实施方式

[0023] 一种显示器边框结构，用于设置在显示器的四周以提供基于红外线探测的触控操作组件，包括：玻璃盖板、灯管、印刷电路板，其特征在于，还包括印刷电路板支撑板和第一双面胶。

[0024] 玻璃盖板，用于盖设在所述显示器的显示面。

[0025] 印刷电路板支撑架，用于设于所述显示器的侧边，所述印刷电路板支撑架具有固定印刷电路板的主体板和自所述主体板两端分别向相反的方向垂直延伸的第一挡板和第二挡板，其中所述第一挡板向玻璃盖板延伸并固定于所述玻璃盖板上，所述第二挡板背向玻璃盖板延伸并与所述印刷电路板一端抵接；所述主体板通过所述第一双面胶与所述印刷电路板固定，所述第一挡板通过所述第一双面胶与所述玻璃盖板固定。

[0026] 印刷电路板，通过所述第一双面胶固定于所述印刷电路板支撑架的主体板上。

[0027] 灯管，设于所述印刷电路板上并突出于所述主体板。

[0028] 滤光条，置于所述灯管的出光面并与所述玻璃盖板所在的平面平行。

[0029] 印刷电路板支撑板通过第一双面胶与玻璃盖板固定，然后沿主体板的长度方向通过第一双面胶与印刷电路板平行固定。玻璃盖板与显示器之间也采用第一双面胶固定。因而显示器、玻璃盖板、印刷电路板支撑板及印刷电路板相对固定。再将灯管与印刷电路板电连接，滤光条设置于灯管的出光面。显示器与显示器支架之间采用螺接。因而，显示器的边框结构能够快速简便的安装完毕，同时，将印刷电路板沿长度方向固定，使得显示器边框结构占用面积变小，减小了显示器的边缘宽度，同时也降低了 Z 轴触控高度。

[0030] 为了使本实用新型的目的、技术方案及优点更清楚，以下结合附图及实施例，对本实用新型进行进一步详细说明。

[0031] 如图 1 所示，为一个实施例中的显示器边框结构示意图。

[0032] 一种显示器边框结构，包括：玻璃盖板 103、灯管 105、印刷电路板 106，还包括印刷电路板支撑板 108 和第一双面胶 107。

[0033] 玻璃盖板 103，用于盖设在显示器 101 的显示面。

[0034] 印刷电路板支撑架 108，用于设于显示器 101 的侧边，所述印刷电路板支撑架 108 具有固定印刷电路板 106 的主体板和自所述主体板两端分别向相反的方向垂直延伸的第一挡板和第二挡板，其中所述第一挡板向玻璃盖板 103 延伸并固定于所述玻璃盖板 103 上，

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所述第二挡板背向玻璃盖板 103 延伸并与所述印刷电路板 106 一端抵接；所述主体板通过所述第一双面胶 107 与所述印刷电路板 106 固定，所述第一挡板通过所述第一双面胶 107 与所述玻璃盖板 103 固定。

[0035] 印刷电路板 106，通过所述第一双面胶 107 固定于所述印刷电路板支撑架 108 的主体板上。

[0036] 灯管 105，设于所述印刷电路板 106 上并突出于所述主体板。

[0037] 滤光条 104，置于所述灯管 105 的出光面并与所述玻璃盖板 103 所在的平面平行。

[0038] 显示器边框结构还包括显示器支撑板 102，所述显示器支撑板 102 靠近所述显示器 101 的一端通过螺钉 1011 与所述显示器 101 螺接，所述显示器支撑板 102 远离所述显示器 101 的一端与外部设备通过螺钉 1012 螺接。

[0039] 显示器 101 与显示器支撑板 102 通过螺钉 1011 固定，因而，显示器支撑板 102 背离显示器 101 的一端自由延伸并通过螺接将显示器 101 固定于外部设备上。

[0040] 在一个实施例中，玻璃盖板 103 与所述显示器 101 的接触部分通过第一双面胶 107 连接。

[0041] 在一个实施例中，印刷电路板支撑板 108 的第一挡板覆盖于所述玻璃盖板 103 远离显示器 101 的一面。

[0042] 在另一个实施例中，印刷电路板支撑板 108 的第一挡板覆盖于所述玻璃盖板 103 靠近显示器 101 的一面

[0043] 玻璃盖板 103 与显示器 101 通过第一双面胶 107 固定连接。

[0044] 如图 2 所示，为显示器边框结构的示意图。在本实施例中，印刷电路板支撑板 108 的第一挡板覆盖于玻璃盖板 103 远离显示器 101 的一面，印刷电路板支撑板 108 的第一挡板沿玻璃盖板 103 长度方向延伸，并与玻璃盖板 103 固定连接。滤光条 104 置于印刷电路板支撑板 108 的第一挡板上，并与印刷电路板支撑板 108 的第一挡板所在的平面及玻璃盖板 103 所在的平面平行设置。

[0045] 滤光条 104 置于所述印刷电路板支撑板 108 的第一挡板上，并与所述印刷电路板支撑板 108 的第一挡板通过第二双面胶连接。

[0046] 如图 3 所示，为显示器边框结构的示意图。在本实施例中，印刷电路板支撑板 108 的第一挡板覆盖于玻璃盖板 103 远离显示器 101 的一面。印刷电路板支撑板 108 沿玻璃盖板 103 长度方向延伸的第一挡板与滤光条 104 的边缘对齐，即滤光条 104 置于玻璃盖板 103 上，且滤光条 104 所在的平面与玻璃盖板 103 所在的平面平行，并采用第二双面胶 109 与玻璃盖板 103 固定连接。

[0047] 如图 4 所示，为显示器边框结构的示意图。印刷电路板支撑板 108 的第一挡板覆盖于显示器 101 上，印刷电路板支撑板 108 沿显示器 101 长度方向延伸的第一挡板与滤光条 104 固定。印刷电路板支撑板 108 与显示器 101 及玻璃盖板 103 接触的部分采用第一双面胶 107 固定连接。滤光条 104 置于灯管 105 的出光面，同时与玻璃盖板 103 通过第二双面胶 109 固定连接。

[0048] 上述实施例中，印刷电路板支撑板 108 与所述玻璃盖板 103 的接触部分均采用第一双面胶 107 连接。

[0049] 上述实施例中，第一双面胶 107 为 0.3 厚 3M 双面胶。

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[0050] 上述实施例中，第一双面胶 109 为 0.1 厚 3M 双面胶。

[0051] 显示器支撑板 102 远离所述显示器 101 的一端与外部设备采用螺接。

[0052] 上述显示器边框结构采用第一双面胶 107 将印刷电路板 106 与印刷电路板支撑板 108 的主体板固定，再将印刷电路板支撑板 108 的第一挡板端固定于玻璃盖板 103 上，从而将印刷电路板 106 相对显示器 101 及玻璃盖板 103 固定。再将滤光条 104 及灯管 105 依次安装即完成显示器边框结构的安装，由于印刷电路板 106 沿长度方向安装，减小了显示器的边缘宽度，同时使得 Z 轴高度降低。

[0053] 以上所述实施例仅表达了本实用新型的几种实施方式，其描述较为具体和详细，但并不能因此而理解为对本实用新型专利范围的限制。应当指出的是，对于本领域的普通技术人员来说，在不脱离本实用新型构思的前提下，还可以做出若干变形和改进，这些都属于本实用新型的保护范围。因此，本实用新型专利的保护范围应以所附权利要求为准。

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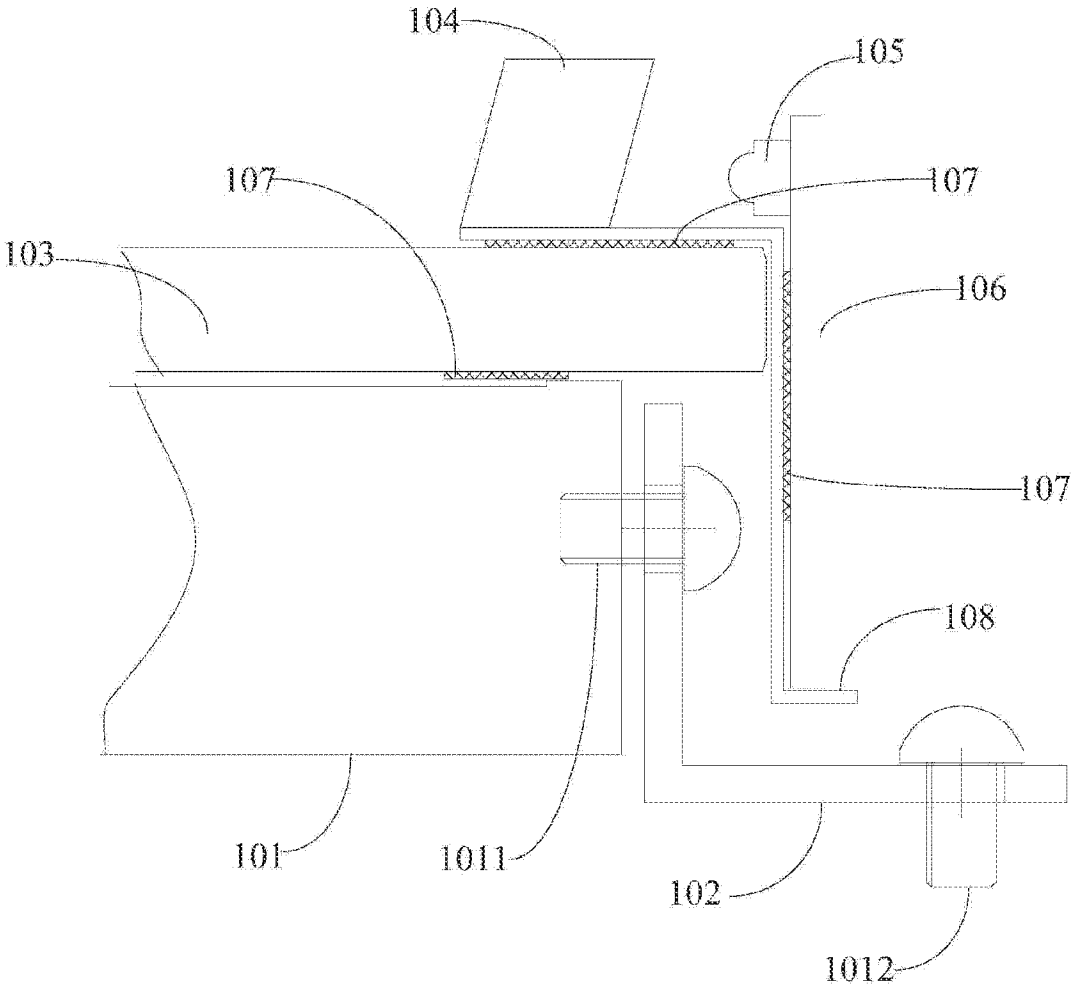


图 1

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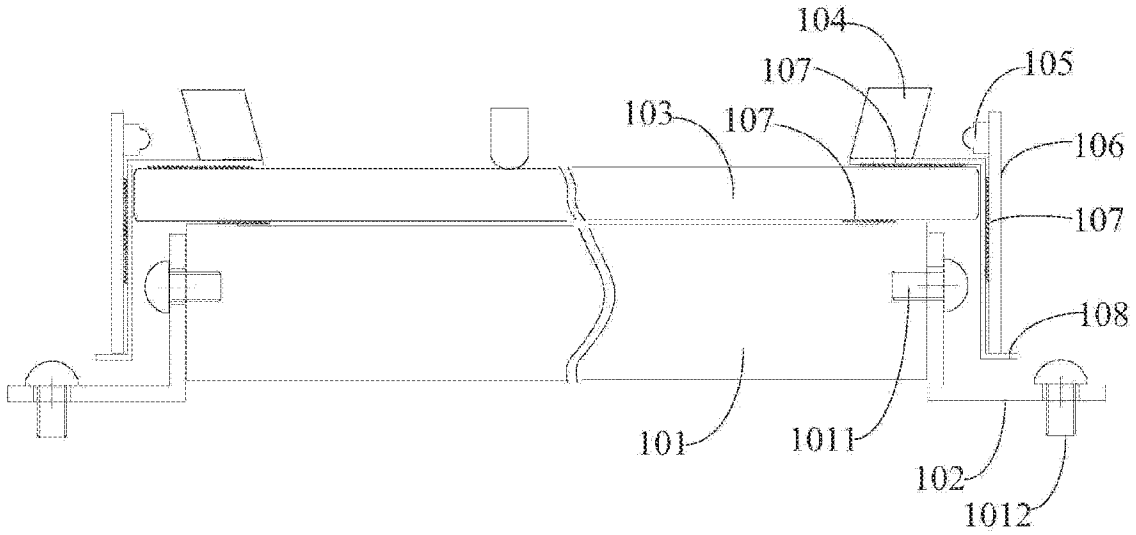


图 2

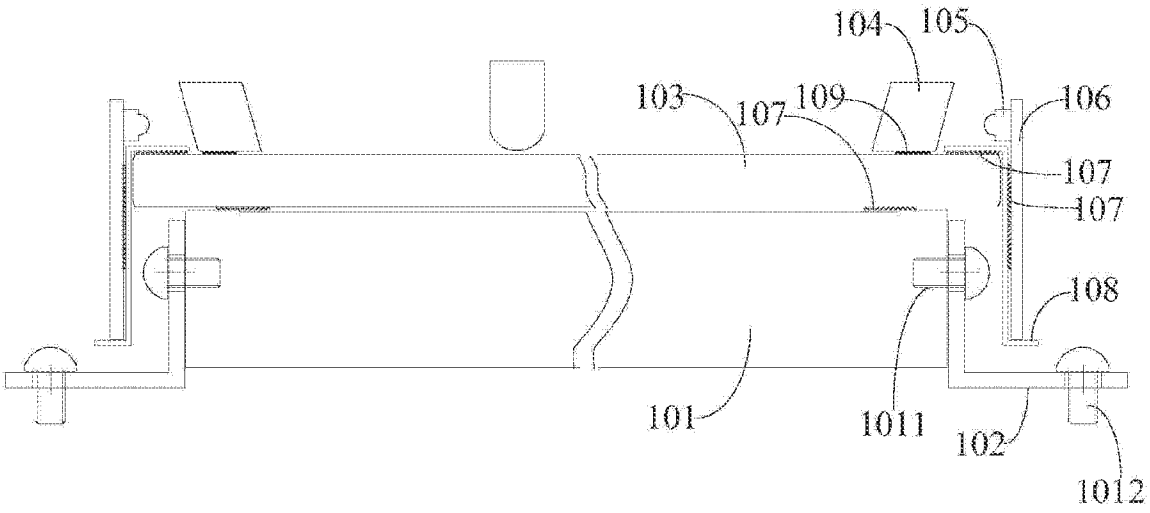


图 3

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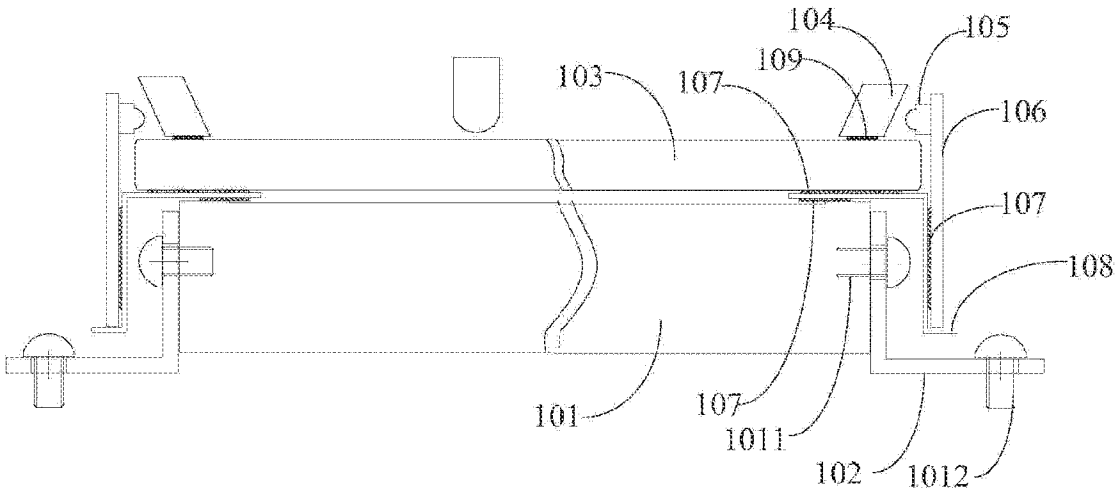


图 4

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(19)中华人民共和国国家知识产权局

(12)实用新型专利

(10)授权公告号 CN 202887145 U
(45)授权公告日 2013.04.17

(21)申请号 201220507418.8

(22)申请日 2012.09.29

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(51)Int.Cl.
G06F 3/042(2006.01)

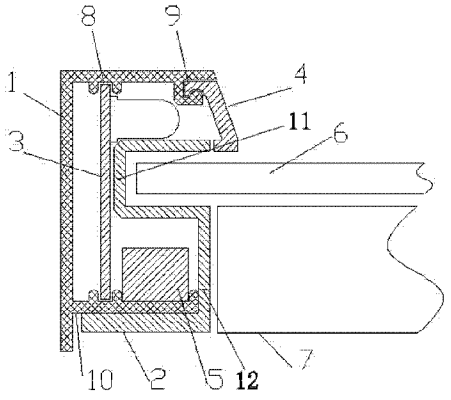
权利要求书 1 页 说明书 2 页 附图 1 页

(54)实用新型名称

新型触摸屏框架

(57)摘要

本实用新型提供一种易于拆卸和维修的新型触摸屏框架，所述触摸屏框架包括方形的外边框 1 和内边框 2，所述内边框 2 套在外边框 1 内，所述外边框 1 包括边 10，所述边 10 与内边框 2 相互贴合且相对可拆式固定，所述外边框 1 内侧设有电路板固定凹槽 8 和红外条固定凹槽 9，所述内边框 2 上设有玻璃 6 的夹持凹槽 11 和显示器 7 的安装位 12。本实用新型在使用的时候，如果出现故障，可以将其外边框直接从内边框上拆离，因为电路板设于外边框内，所以维修起来较为方便。



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1. 新型触摸屏框架，其特征在于所述触摸屏框架包括方形的外边框（1）和内边框（2），所述内边框（2）套在外边框（1）内，所述外边框（1）包括边（10），所述边（10）与内边框（2）相互贴合且相对可拆式固定，所述外边框（1）内侧设有电路板固定凹槽（8）和红外条固定凹槽（9），所述内边框（2）上设有玻璃（6）的夹持凹槽（11）和显示器（7）的安装位（12）。

2. 如权利要求 1 所述新型触摸屏框架，其特征在于所述玻璃（6）的夹持凹槽（11）设置在内边框（2）上的两条对边上或是四条边上。

3. 如权利要求 1 所述新型触摸屏框架，其特征在于所述外框（1）的边（10）直接固定或通过固定零件（5）间接固定在内边框（2）上。

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新型触摸屏框架

技术领域

[0001] 本实用新型涉及触摸屏框架。

背景技术

[0002] 因为触摸屏白板的体积和重量较大，电路板有故障时需要将其整体取下拆卸，拆卸和维修都较为麻烦。

发明内容

[0003] 本实用新型所要解决的技术问题是提供一种易于拆卸和维修的新型触摸屏框架，为此，本实用新型采用以下技术方案：

[0004] 所述触摸屏框架包括方形的外边框 1 和内边框 2，所述内边框 2 套在外边框 1 内，所述外边框 1 包括边 10，所述边 10 与内边框 2 相互贴合且相对可拆式固定，所述外边框 1 内侧设有电路板固定凹槽 8 和红外条固定凹槽 9，所述内边框 2 上设有玻璃 6 的夹持凹槽 11 和显示器 7 的安装位 12。

[0005] 通过以上技术方案，本实用新型在使用的时候，如果出现故障，可以将其外边框直接从内边框上拆离，因为电路板设于外边框内，所以维修起来较为方便。

附图说明

[0006] 图 1 是本实用新型在安装上电路板、玻璃和显示器后的单边的横截面剖视图。

具体实施方式

[0007] 参照附图。本实用新型提供一种触摸屏框架，所述触摸屏框架包括方形的外边框 1 和内边框 2，所述内边框 2 套在外边框 1 内，所述外边框 1 包括边 10，所述边 10 与内边框 2 相互贴合且相对可拆式固定，所述外边框内侧设有电路板固定凹槽 8 和红外条固定凹槽 9，所述内边框 2 上设有玻璃 6 的夹持凹槽 11 和显示器 7 的安装位 12。

[0008] 如图所示，电路板固定凹槽 8 内设有电路板 3 并将其固定。红外条固定凹槽 9 内设有红外条 4 并将其固定。

[0009] 所述玻璃 6 的夹持凹槽 11 设置在内边框 2 上的两条对边上或是四条边上，将玻璃 6 安装在凹槽内，整个触摸屏框架夹持在玻璃 6 上。

[0010] 所述玻璃 6 放置平行于显示器 7。显示器 7 包括液晶屏及其它平板屏。

[0011] 电路板 3 固定在外边框 1 内，电路板的放置和玻璃 6 及显示器（触摸屏）7 的平面呈垂直状态，接收和发射的 LED 灯管和玻璃 6 及显示器（触摸屏）7 的平面呈平行状态。

[0012] 所述外框 1 的边 10 直接固定或通过固定零件 5 间接固定在内边框 2 上，固定方式为触摸屏在外边框 1 的 4 个转角处正面固定。

[0013] 综上所述，本实用新型所述的触摸屏框架，有效解决了下列问题：

[0014] 1、能够将外边框 1 和内边框 2 的宽度缩小，使得边框变窄，更为美观；

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[0015] 2、将固定零件 5 拆卸便可将外边框 1 拆卸，且电路板 3 设于外边框 1 内，方便维修电路板 3。

[0016] 3、LED 组装简易，可以组装测试好，触摸框之后装入整机。

[0017] 4、容易贴平整，提高触摸准度，LED 直接选用直插方式，比传统的折弯 90 度焊接方式更有利于控制 LED 灯管与触控平面的平行度，再一个就是，可以更好让 LED 贴近触控表面（玻璃 6）达到手指更贴近表面才产生有效触摸。

[0018] 红外触摸原理是通过阻挡发射管到接收管之间的光线来计算触摸位置从而达到触控效果，故光线越贴近玻璃触控效果越好。

[0019] 上述具体实施方式用来解释说明本实用新型，而不是对本实用新型进行限制，在本实用新型的精神和权利要求的保护范围内，对本实用新型作出的任何修改和改变，都落入本实用新型的保护范围。

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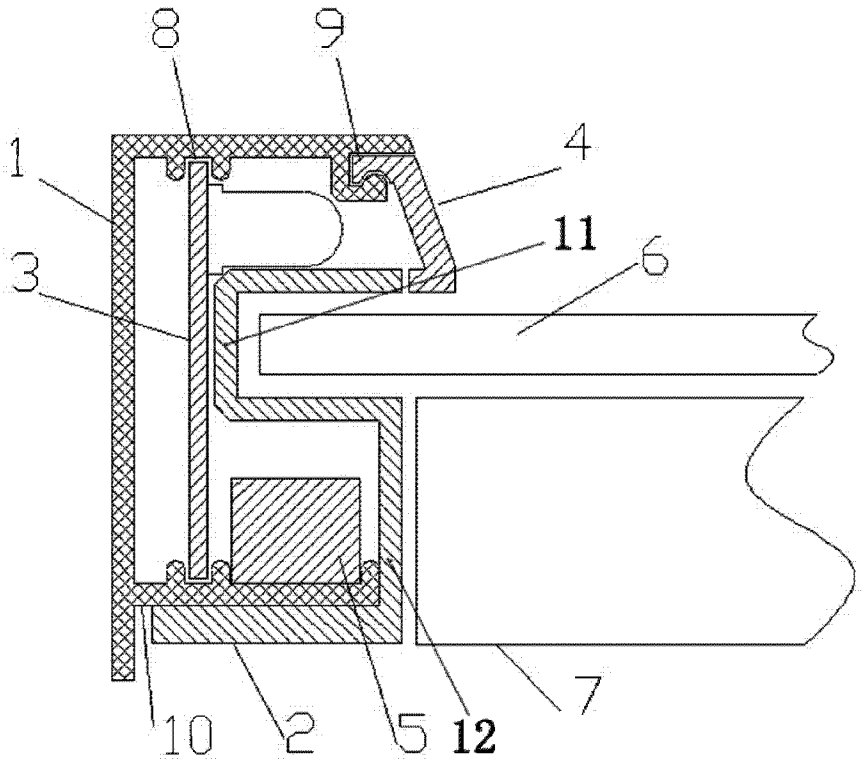


图 1

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Espacenet

CN204288179U TB infrared white board frame structure and TB infrared white board structure thereof

Applicants: BEIJING DONVIEW EDUCATION & TECHNOLOGY CO LTD

Inventors: MO SHAODONG,ZHOU JIANGHONG

Classifications:
IPC ***G06F3/042;***

Priorities: CN201420703165U 2014-11-20

Application: CN204288179U·2014-11-20

Publication: CN204288179U·2015-04-22

Published as: CN204288179U

TB infrared white board frame structure and TB infrared white board structure thereof

Abstract

The utility model provides a TB infrared white board frame structure, which comprises a light filter bar, an infrared screen PCB (Printed Circuit Board), a PCB fixed strip and a frame, wherein the infrared screen PCB is fixed on the PCB fixed strip through screws; the infrared screen PCB and the PCB fixed strip are assembled to form a single infrared frame; a clamping position, a slot position and a socket are arranged on the frame; the single infrared frame is plugged in the clamping position of the frame; the light filter bar is plugged in the slot position of the frame; the socket of the frame is used for a white board body to plug in. The TB infrared white board frame structure is firm and reliable in structure, easy to disassemble and assemble, and convenient to maintain.

(19)中华人民共和国国家知识产权局

(12)实用新型专利

(10)授权公告号 CN 204288179 U
(45)授权公告日 2015.04.22

(21)申请号 201420703165.0

(22)申请日 2014.11.20

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(51)Int.Cl.
G06F 3/042(2006.01)

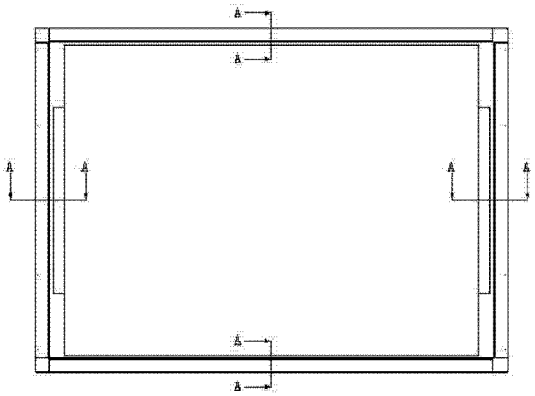
权利要求书1页 说明书2页 附图2页

(54)实用新型名称

一种 TB 红外白板边框结构及其 TB 红外白板结构

(57)摘要

本实用新型提出了一种 TB 红外白板边框结构，包括滤光条、红外屏 PCB 线路板、PCB 固定条、边框，所述红外屏 PCB 线路板通过螺丝固定在所述 PCB 固定条上，所述红外屏 PCB 线路板与所述 PCB 固定条组装成单根红外框；所述边框上设有一卡位和一槽位以及一插口，所述单根红外框插接于所述边框的卡位中；所述滤光条插接于所述边框的槽位中；所述边框的插口用于插接白板板体。所述 TB 红外白板边框结构牢固可靠、拆装容易、维护方便。



CN 204288179 U

1. 一种 TB 红外白板边框结构，其特征在于：包括滤光条、红外屏 PCB 线路板、PCB 固定条、边框，所述红外屏 PCB 线路板通过螺丝固定在所述 PCB 固定条上，所述红外屏 PCB 线路板与所述 PCB 固定条组装成单根红外框；所述边框上设有一卡位和一槽位以及一插口，所述单根红外框插接于所述边框的卡位中；所述滤光条插接于所述边框的槽位中；所述边框的插口用于插接白板板体。

2. 如权利要求 1 所述的 TB 红外白板边框结构，其特征在于：所述滤光条为塑胶滤光条。

3. 如权利要求 1 所述的 TB 红外白板边框结构，其特征在于：所述边框为铝合金材质。

4. 如权利要求 1 所述的 TB 红外白板边框结构，其特征在于：所述 PCB 固定条为铝合金材质。

5. 如权利要求 1 所述的 TB 红外白板边框结构，其特征在于：所述边框内设有若干条加强筋。

6. 如权利要求 1 所述的 TB 红外白板边框结构，其特征在于：所述卡位呈 T 型。

7. 如权利要求 1 所述的 TB 红外白板边框结构，其特征在于：所述槽位呈球型。

8. 如权利要求 1 所述的 TB 红外白板边框结构，其特征在于：所述边框内部设有空腔。

9. 一种 TB 红外白板结构，其特征在于：由权利要求 1-8 任一所述的 TB 红外白板边框结构连接而成。

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一种 TB 红外白板边框结构及其 TB 红外白板结构

技术领域

[0001] 本实用新型涉及电子白板领域，特别是指一种 TB 红外白板边框结构。

背景技术

[0002] 红外电子白板是现在最受教学、会议等场合十分适用的一种工具，它可以与电脑进行信息通讯，将电子白板连接到 PC，并利用投影机将 PC 上的内容投影到电子白板屏幕上，在专门的应用程序的支持下，可以构造一个大屏幕、交互式的协作会议或教学环境。利用特定的定位笔代替鼠标在白板上进行操作，可以运行任何应用程序，可以对文件进行编辑、注释、保存等在计算机上利用键盘及鼠标可以实现的任何操作。

[0003] 目前，已有技术的红外电子白板存在以下不足：1、结构稳定性差，白板板体与边框之间以及相邻两个边框之间的连接不牢固，使用中容易出现松脱现象，给用户现场带来麻烦。2、维护时，需要把电子白板从墙上抬下来，然后拆下四个铝合金边框，才能拆下 PCB 线路板进行维护，因而操作不便。3、外形单调，缺乏美感。

实用新型内容

[0004] 本实用新型提出一种 TB 红外白板边框结构，该结构牢固可靠、拆装容易、维护方便、外形美观。

[0005] 本实用新型的技术方案是这样实现的：一种 TB 红外白板边框结构，包括滤光条、红外屏 PCB 线路板、PCB 固定条、边框，所述红外屏 PCB 线路板通过螺丝固定在所述 PCB 固定条上，所述红外屏 PCB 线路板与所述 PCB 固定条组装成单根红外框；所述边框上设有一卡位和一槽位以及一插口，所述单根红外框插接于所述边框的卡位中；所述滤光条插接于所述边框的槽位中；所述边框的插口用于插接白板板体。

[0006] 优选的，所述滤光条为塑胶滤光条。

[0007] 优选的，所述边框为铝合金材质。

[0008] 优选的，所述 PCB 固定条为铝合金材质。

[0009] 优选的，所述边框内设有若干条加强筋。

[0010] 优选的，所述卡位呈 T 型。

[0011] 优选的，所述槽位呈球型。

[0012] 优选的，所述边框内部设有空腔。

[0013] 一种 TB 红外白板结构，由所述 TB 红外白板边框结构连接而成。

[0014] 本实用新型的有益效果是：所述 TB 红外白板边框结构采用铝合金型材组合而成，铝合金型材采用铝合金挤出模具制作而成，表面能做喷粉、氧化、拉丝等多种外观，具有产品精度高，外形光滑，生产制造简便，周期短，利于大批量生产等优点，所述 TB 红外白板边框结构还具备结构牢固可靠、拆装容易、维护方便的特点。

附图说明

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[0015] 为了更清楚地说明本实用新型实施例或现有技术中的技术方案，下面将对实施例或现有技术描述中所需要使用的附图作简单地介绍，显而易见地，下面描述中的附图仅仅是本实用新型的一些实施例，对于本领域普通技术人员来讲，在不付出创造性劳动性的前提下，还可以根据这些附图获得其他的附图。

[0016] 图 1 为本实用新型一种 TB 红外白板结构的主视示意图；

[0017] 图 2 为图 1 所示 TB 红外白板边框结构 A-A 面剖视图；

[0018] 图 3 为图 2 所示 TB 红外白板边框结构插入单根红外框的结构示意图；

[0019] 图 4 为图 2 所示 TB 红外白板边框结构插入白板的结构示意图。

[0020] 附图中，1- 白板板体，2- 滤光条，3- 红外屏 PCB 线路板，4-PCB 固定条，5- 边框，6- 槽位，7- 卡位。

具体实施方式

[0021] 下面将结合本实用新型实施例中的附图，对本实用新型实施例中的技术方案进行清楚、完整地描述，显然，所描述的实施例仅仅是本实用新型一部分实施例，而不是全部的实施例。基于本实用新型中的实施例，本领域普通技术人员在没有作出创造性劳动前提下所获得的所有其他实施例，都属于本实用新型保护的范围。

[0022] 如图 2、3、4 所示，一种 TB 红外白板边框结构，包括滤光条 2、红外屏 PCB 线路板 3、PCB 固定条 4、边框 5，所述红外屏 PCB 线路板 3 通过螺丝固定在所述 PCB 固定条 4 上，所述红外屏 PCB 线路板 3 与所述 PCB 固定条 4 组装成单根红外框；所述边框 5 上设有一卡位 7 和一槽位 6 以及一插口，所述单根红外框插接于所述边框的卡位 7 中；所述滤光条 2 插接于所述边框的槽位 6 中；所述边框的插口用于插接白板板体。

[0023] 优选的，所述滤光条 2 为塑胶滤光条。

[0024] 优选的，所述边框 5 为铝合金材质。

[0025] 优选的，所述 PCB 固定条 4 为铝合金材质。

[0026] 优选的，所述边框 5 内设有若干条加强筋。

[0027] 优选的，所述卡位 7 呈 T 型。

[0028] 优选的，所述槽位 6 呈球型。

[0029] 优选的，所述边框 5 内部设有空腔。

[0030] 如图 1 所示，一种 TB 红外白板结构，由上下左右四个所述 TB 红外白板边框结构连接而成。

[0031] 如图 1、2、3、4 所示，所述 TB 红外白板边框结构的一种组装方式：

[0032] 红外屏 PCB 线路板 3 通过螺丝固定在 PCB 固定条 4 上，组装成单根红外框，所述单根红外框插接于所述边框的 T 型卡位 7 中；所述滤光条 2 插接于所述边框的槽位 6 中；白板板体 1 插接于所述边框 5 的插口中；

[0033] 所述白板板体 1 呈矩形，白板板体 1 的四边各插接一个 TB 红外白板边框结构，四个 TB 红外白板边框结构通过连接件可拆卸连接。结构简单，安装方便，维修方便快捷。

[0034] 以上所述仅为本实用新型的较佳实施例而已，并不用以限制本实用新型，凡在本实用新型的精神和原则之内，所作的任何修改、等同替换、改进等，均应包含在本实用新型的保护范围之内。

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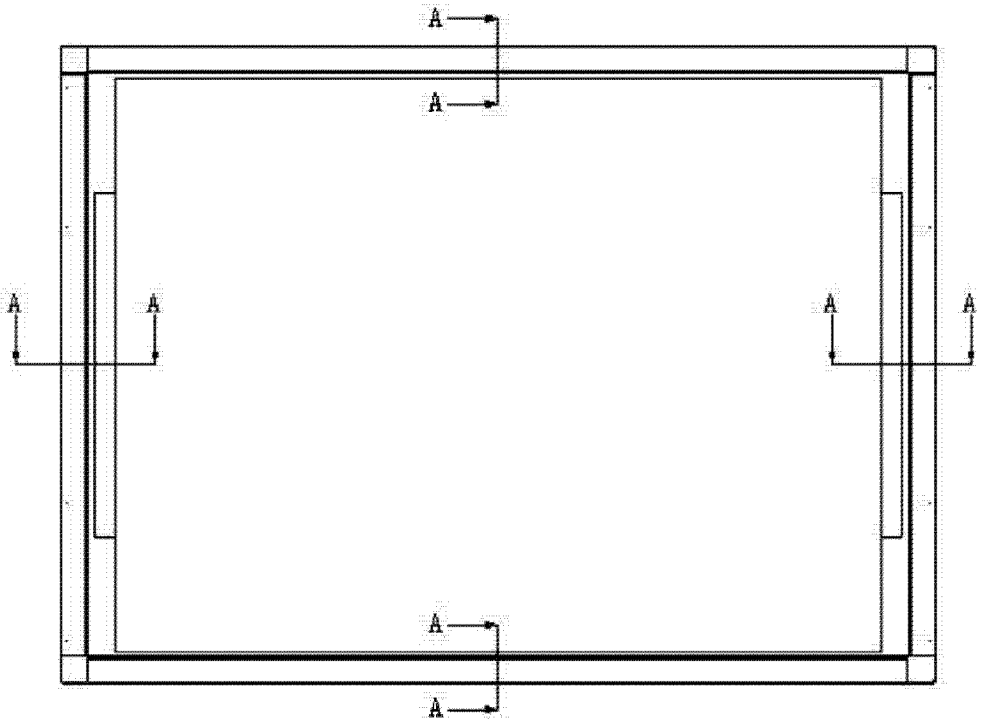


图 1

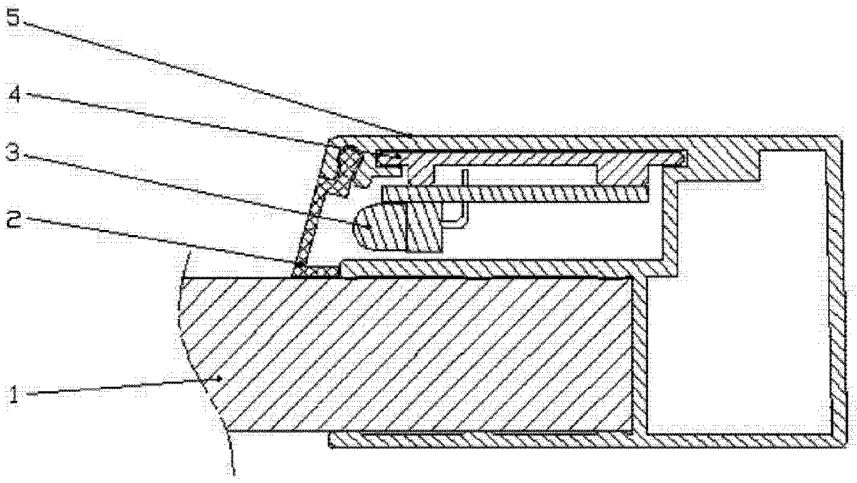


图 2

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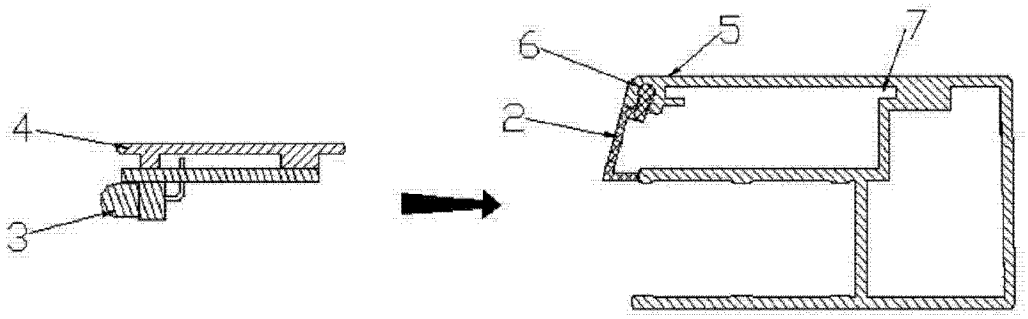


图 3

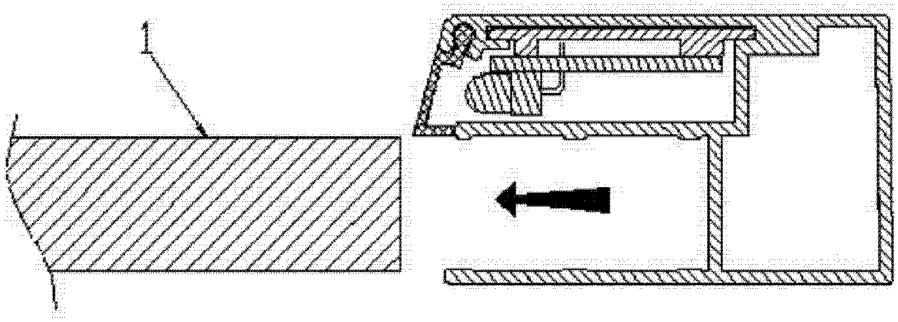


图 4

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(19) BUNDESREPUBLIK DEUTSCHLAND

DEUTSCHES PATENT- UND MARKENAMT

(12) **Offenlegungsschrift**

(10) **DE 100 25 175 A 1**

(51) Int. Cl.[7]:
G 06 K 11/06
G 06 K 11/14

(21) Aktenzeichen: 100 25 175.7
(22) Anmeldetag: 24. 5. 2000
(43) Offenlegungstag: 6. 12. 2001

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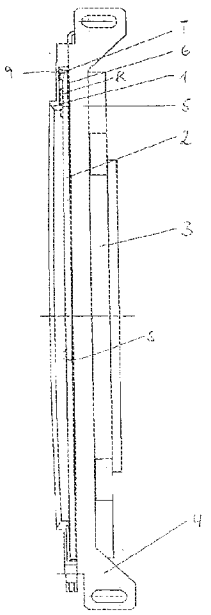
(56) Entgegenhaltungen:
DE 37 14 535 C2
US 53 32 238 A
US 5 79 250 A

Die folgenden Angaben sind den vom Anmelder eingereichten Unterlagen entnommen

Prüfungsantrag gem. § 44 PatG ist gestellt

(54) Einbaurahmen für einen berührungssensitiven Schirm

(57) Zum schnellen und einfachen Einbau eines berührungssensitiven, im wesentlichen transparenten Schirms (2) in ein Terminalgehäuse ist ein Einbaurahmen (1) mit einer darin ausgebildeten Öffnung (12) vorgesehen, wobei wenigstens ein Teil der berührungssensitiven Oberfläche (S) des Schirms (2) freiliegt, wobei der Einbaurahmen (1) wenigstens einen Teil des Außenumfangs des Schirms (2) abdeckt, und wobei der Einbaurahmen (1) Mittel zur Anbringung des Rahmens (1) an weiteren Elementen aufweist.



DE 100 25 175 A 1

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DEF_00004650

Beschreibung

[0001] Die vorliegende Erfindung betrifft einen Einbaurahmen für einen berührungssensitiven, im wesentlichen transparenten Schirm gemäß Patentanspruch 1. Ferner betrifft die vorliegende Erfindung eine eigenständig handhabbare Montageeinheit gemäß Patentanspruch 17.

[0002] Im Stand der Technik sind sogenannte Touchscreens bekannt. Als Beispiel sei hier auf das US-Patent US-A-5,591,945 hingewiesen, aus welchem ein akustischer Berührungspositionssensor bekannt ist, welcher die Ausbreitung von horizontal polarisierten Scherwellen höherer Ordnung zur Lokalisierung verwendet. Dieser Touchscreen weist einen Wandler auf, welcher eine Welle generiert, die sich auf der Oberfläche des Touchscreens ausbreitet. Eine reflektierende Anordnung ist zur Reflexion der Welle umfangsmäßig um die Oberfläche vorgesehen. Die durch die Reflexion entstandenen Wellen werden durch einen Gegenstand, z. B. ein Finger, der das Substrat berührt teilweise absorbiert, abgeschwächt oder gestört, um eine modifizierte Wellenform zu erzeugen. Aus der Wellenperturbation kann der Ort und/oder weitere Kontaktzustände des Gegenstandes bestimmt werden.

[0003] Bei einem derartigen Touchscreen, insbesondere basierend auf der Oberflächenwellentechnologie, stellt der Einbau in ein Gehäuse eines Terminals ein besonderes Problem dar. Dies beruht darauf, daß die aktive Seite keinen Kontaktierungen ausgesetzt sein darf, welche lediglich durch die Montage und nicht durch den Betrieb verursacht sind. Ferner befinden sich um einen derartigen Schirm Reflektoren und Wandler bzw. Transducer, welche ebenfalls für einen Anwender des Terminals nicht zugänglich sein dürfen. Weitere Probleme des Einbaus eines derartigen Touchscreens in ein Terminal ist die Abdichtung, z. B. gegenüber Feuchtigkeit oder Staub, der Schutz gegen Manipulationen und die Robustheit im Hinblick auf Vandalismus.

[0004] Insbesondere aufgrund der inhärenten Druckempfindlichkeit der Touchscreenoberfläche hat es sich als besonders schwierig herausgestellt, derartige Touchscreens in Terminals einzubauen, da der Einbau individualisiert, d. h. für jedes Terminal speziell, vorgenommen werden mußte. Die durch die Befestigung auftretenden Drücke wurden mechanisch, d. h. durch Anbringung von den der Polsterung dienenden Schaumstoffmaterialien, und elektronisch bzw. durch Software d. h durch Herausrechnen des durch die Befestigung entstandenen Beitrags aus den Signalen durch Computerverarbeitung, korrigiert.

[0005] Die Aufgabe der vorliegenden Erfindung besteht daher darin, die Nachteile des Standes der Technik zu vermeiden, und insbesondere auf einfache, kostengünstige, betriebssichere, reproduzierbare und für eine Serienfertigung geeignete Art und Weise den Einbau eines Touchscreens in ein Terminal sicherzustellen.

[0006] Vorteilhafterweise ist der Einbaurahmen aus einem harten Kunststoffmaterial. Dabei ist insbesondere ein mit Glasfasern verstärktes Polyamidmaterial bevorzugt. Ein hartes Material ist deshalb bevorzugt, da die Steuereinrichtung für den Touchscreen die sich durch den Kontakt ergebenden Dämpfungen genau berechnen kann. Bei dem bisher im Stand der Technik eingesetzten weicheren Schaumstoffmaterial besteht die Gefahr, das die Dämpfung zu hoch ist, und damit zu indifferent wird.

[0007] Zur Fixierung des in dem Einbaurahmen aufgenommenen Schirms ist vorzugsweise der Einbaurahmen mit einer Halteplatte derart verbunden, daß der Schirm zwischen der Halteplatte und dem Einbaurahmen angeordnet ist. Der Touchscreen ist daher in dem Einbaurahmen aufgenommen und wird von hinten von der Halteplatte in diesem gehalten.

Die Halteplatte, die vorzugsweise aus Metall hergestellt ist, drückt den Schirm gleichmäßig an den Einbaurahmen, weshalb die eingangs erwähnte Beeinträchtigung der Funktion des Touchscreens durch die Befestigung vermindert wird.

[0008] Eine besonders günstige Realisierung ergibt sich dadurch, daß die Halteplatte als Rahmen mit einer Öffnung ausgebildet ist, wobei in der Öffnung eine Anzeigeeinrichtung aufgenommen ist. Auf diese Weise sind sowohl der Einbaurahmen als auch die Halteplatten als Rahmen ausgebildet und die Anzeigeeinrichtung, insbesondere ein Computerdisplay, ist vollständig hinter dem Schirm angeordnet. Somit lassen sich lediglich durch eine Berührung des Schirms mit dem Finger oder einem Stift oder dergleichen Eingaben an einer auf dem Computermonitor dargestellten Menüsteuerung realisieren.

[0009] Eine besonders einfache Befestigungsmethode ergibt sich dadurch, daß der Halterahmen an dem Einbaurahmen durch eine lösbare Verbindung, insbesondere eine Klemmverbindung befestigt ist. Vorzugsweise erfolgt eine derartige Klemmverbindung über den Außenumfang der beiden Bauteile.

[0010] Vorteilhafterweise sind zur Erfassung der Position einer Berührung dienende Elemente auf der Außenseite des Schirms von dem Einbaurahmen verdeckt. Somit können insbesondere die an der Vorderseite vorstehenden Transducer, welche sehr empfindlich sind und nicht beschädigt werden dürfen, geschützt werden.

[0011] Bevorzugt weist der Einbaurahmen an seiner, der Außenseite des Schirms zugewandten Innenseite eine Umfangsnut zur Freilegung der Sensorik-Elemente auf. Die Freilegung der Elemente, ist insbesondere deshalb bevorzugt, um Beschädigungen zu vermeiden, und um insbesondere einen direkten Druck auf diese Elemente zu verhindern. Die eingangs beschriebene Touchscreeneinrichtung basiert zwar auf der Oberflächenwellentechnologie, die vorliegende Erfindung ist aber ebenfalls auf Touchscreens anderer Technologien, wie z. B. durch optische Erfassung, anwendbar. Auch bei diesen ist besonders vorteilhaft, wenn z. B. die Infrarotsignale ausstrahlenden und empfangenden Sende- bzw. Empfangsmittel für einen Anwender verdeckt sind.

[0012] Weiter ist bevorzugt, daß der Einbaurahmen an seiner, der Außenseite des Schirms zugewandten Innenseite eine nach innen ragende Dichtkante aufweist. Die Dichtkante ist das einzige direkt auf die aktive Außenseite des Schirms direkt drückende Element und sieht einen umfangsmäßigen gleichen Druck auf die aktive Fläche des Touchscreens, d. h. bereits innerhalb der am Außenumfang angeordneten Transducer bzw. Reflektoren, vor. Deshalb ist die Dichtkante vorzugsweise radial innerhalb der Umfangsnut, welche die Transducer aufnimmt, angeordnet.

[0013] Um besonders Schmutz am Eintritt in ein Terminalgehäuse zu hindern, ist die Dichtkante derart ausgebildet, daß sie den berührungssensitive Bereich des Schirms vollständig abdichtet.

[0014] Um einen besonders leichten Einbau in ein Terminalgehäuse, welches eine entsprechende Ausnehmung aufweist zu ermöglichen, steht die Dichtkante auf der Außenseite des Einbaurahmens nach außen vor, wobei die freiliegende Stirnfläche nach innen abgeschrägt ist. Durch das Vorstehen nach außen ergibt sich zum einen eine Montagehilfe, da ein Einsetzen des Einbaurahmens somit möglich wird, und zum anderen hast sich die nach innen abgeschrägte Kante ebenfalls aus Abdichtgründen bewährt.

[0015] Vorteilhafterweise sind der Einbaurahmen und der Halterahmen umfangsmäßig außerhalb des Schirms miteinander verbunden. Auf dieses Weise wird eine gleichmäßige Druckverteilung der Befestigungsmittel für den Touchscreen sichergestellt.

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[0016] Die Erfindung, sowie weitere Merkmale, Ziele, Vorteile und Anwendungsmöglichkeiten derselben wird bzw. werden nachfolgend unter Bezugnahme auf die beigefügten Zeichnungen näher erläutert. Dabei bilden alle beschriebenen und/oder bildlich dargestellten Elemente für sich oder in beliebiger sinnvoller Kombination den Gegenstand der vorliegenden Erfindung, und zwar unabhängig von ihrer Zusammenfassung in den Patentansprüchen oder deren Rückbeziehung. Sofern zum Zwecke der vorliegenden Beschreibung die Ausdrücke "außen", "innen", "oben" und "unten" verwendet werden, so dienen diese zum Zwecke einer einfachen Beschreibung der Erfindung und beziehen sich auf den eingebauten Teil des Einbaurahmens in einem Terminal gemäß **Fig.** 1. Überall in den Zeichnungen bezeichnen die selben Bezugszeichen dieselben oder entsprechenden Elemente. In den Zeichnungen zeigen:

[0017] **Fig.** 1 eine schematische Querschnittsansicht des erfindungsgemäßen Einbaurahmens, welcher mit weiteren Komponenten eine eigenständig handhabbare Montageeinheit bildet;

[0018] **Fig.** 2 eine schematische Ansicht von oben auf den erfindungsgemäßen Einbaurahmen;

[0019] **Fig.** 3 eine schematische Seitenansicht des erfindungsgemäßen Einbaurahmens; und

[0020] **Fig.** 4 eine schematische Ansicht von unten auf den erfindungsgemäßen Einbaurahmen.

[0021] In **Fig.** 1 ist der Einbaurahmen **1** gezeigt, in welchem ein Schirm oder Touchscreen **2** aufgenommen ist. Vom Standpunkt eines Betrachters (in **Fig.** 1 auf der linken Seite) ist hinter dem Touchscreen **2** eine Anzeigeeinrichtung oder Display **3** angeordnet, welche in einem Halte- oder Klemmrahmen **4** befestigt ist. Der Halterahmen **4** ist an dem Einbaurahmen **1** durch eine Klemmverbindung befestigt. Der Schirm **2** ist aus Glas hergestellt und ist in etwa rechteckig. Entlang seinem Umfang weist er eine Vielzahl von Transducern, d. h. piezoelektrische Wandler, und Reflektoren auf. Der Ansicht der **Fig.** 1 entnimmt man, daß die Transducer außerhalb einer Dichtkante **5** des Einbaurahmens **1** angeordnet sind. Nur der innere Bereich des Schirms **2**, d. h. im eingebauten Zustand der Bereich innerhalb der Dichtkante **5**, also der Öffnung **12** des Einbaurahmens **1**, ist für einen Anwender zugänglich. Über die Dichtkante **5** wird auf dem Schirm **2** ein gleichmäßiger Druck aufgebracht, welcher insbesondere durch ein geeignetes Software-Programm zur Auswertung der gewandelten Signale einfach herausgerechnet werden kann. Die Dichtkante **5** steht ebenfalls nach außen vor und besitzt eine abgeschrägte Innenseite, was den Einbau in Montageöffnungen, z. B. zum Einbau in ein (nicht dargestelltes) Terminal, erleichtert. Das Display **3** ist über vier (nicht gezeigte) Drehbolzen in dem Halterahmen **4** aufgenommen. Der aus Metall hergestellte Halterahmen **4** preßt den Schirm **2** über ein Druckband **6** auf die Dichtkante **5**.

[0022] In **Fig.** 1 ist daher eine eigenständig handhabbare Montageeinheit dargestellt, welche kombiniert einen vor einem Display **3** angeordnete Touchscreen **1** aufweist, und welche einen unmittelbaren Einbau in ein Terminalgehäuse gestattet.

[0023] In den **Fig.** 2 bis 4 ist der Einbaurahmen **1** in verschiedenen Ansichten dargestellt. Zur Aufnahme des Schirms **2** weist der Einbaurahmen **1** umfangsmäßig eine Nut **9** auf, in welcher die Transducer **8** kontaktlos aufgenommen sind, wobei an der Stelle der Nut **9** über das Druckband **6** der Druck vom Halterahmen **4** auf den Schirm **2** auf der, der aktivierten Seite gegenüberliegenden Innenseite ausgeübt wird. Zur Befestigung des Halterahmens **4** an dem Einbaurahmen **1** ist eine Vielzahl von umfangsmäßig angeordneten Schraubverbindungen vorgesehen. Die entsprechenden Bohrungen sind in den Zeichnung klar ersichtlich und mit dem Bezugszeichen **10** angezeigt. Eine entsprechende Nut **11** ist zur Zu- und Abführung von elektrischen Kabeln vorgesehen.

[0024] Die Erfindung wurde zuvor anhand eines bevorzugten Ausführungsbeispiels derselben näher erläutert. Für einen Fachmann ist es jedoch offensichtlich, daß unterschiedliche Abwandlungen und Modifikationen gemacht werden können, ohne den der Erfindung zugrundeliegenden Gedanken zu verlassen.

Bezugszeichenliste

1 Einbaurahmen
2 Touchscreen oder Schirm
3 Anzeigeeinrichtung oder Display
4 Halte- oder Klemmrahmen
5 Dichtkante
6 Druckband
9 Nut
10 Gewindebohrung
11 Nut
12 Öffnung
S berührungssensitive Oberfläche
T Transducer
R Reflexionselement

Patentansprüche

1. Einbaurahmen (**1**) für einen berührungssensitiven, im wesentlichen transparenten Schirm (**2**), mit einer derart ausgebildeten Öffnung (**12**), daß wenigstens ein Teil der berührungssensitiven Oberfläche (S) des Schirms (**2**) freiliegt, wobei der Einbaurahmen (**1**) wenigstens einen Teil des Außenumfangs des Schirms (**2**) abdeckt, und wobei der Einbaurahmen (**1**) Mittel zur Anbringung des Rahmens (**1**) an weiteren Elementen aufweist.

2. Einbaurahmen (**1**) nach Anspruch 1, dadurch gekennzeichnet, daß der Einbaurahmen aus einem hartem Kunststoffmaterial ist.

3. Einbaurahmen (**1**) nach Anspruch 2, dadurch gekennzeichnet, daß der Einbaurahmen (**1**) aus einem mit Glasfaser verstärktem Polyamidmaterial ist.

4. Einbaurahmen (**1**) nach einem der Ansprüche 1 bis 3, dadurch gekennzeichnet, daß zur Fixierung des in dem Einbaurahmen (**1**) aufgenommenen Schirms (**2**), der Einbaurahmen (**1**) mit einer Halteplatte (**4**) derart verbunden ist, daß der Schirm (**2**) zwischen der Halteplatte (**4**) und dem Einbaurahmen (**1**) angeordnet ist.

5. Einbaurahmen (**1**) nach Anspruch 4, dadurch gekennzeichnet, daß die Halteplatte (**4**) aus Metall hergestellt ist.

6. Einbaurahmen (**1**) nach Anspruch 4 oder 5, dadurch gekennzeichnet, daß die Halteplatte (**4**) als Rahmen mit einer Öffnung ausgebildet ist, wobei in der Öffnung eine Anzeigeeinrichtung (**3**) aufgenommen ist.

7. Einbaurahmen (**1**) nach einem der Ansprüche 4 bis 6, dadurch gekennzeichnet, daß der Halterahmen (**4**) mit dem Einbaurahmen (**1**) durch eine lösbare Verbindung, insbesondere eine Klemmverbindung, befestigt ist.

8. Einbaurahmen (**1**) nach einem der Ansprüche 4 bis 7, dadurch gekennzeichnet, daß die Anzeigeeinrichtung vollständig hinter dem Schirm (**2**) angeordnet ist.

9. Einbaurahmen (**1**) nach einem der Ansprüche 1 bis 8, dadurch gekennzeichnet, daß zur Erfassung der Position einer Berührung dienende Elemente (T, R) auf der

Außenseite des Schirms (2) von dem Einbaurahmen (1) verdeckt sind.

10. Einbaurahmen (1) nach Anspruch 9, dadurch gekennzeichnet, daß der Einbaurahmen (1) an seiner, der Außenseite des Schirms (2) zugewandten Innenseite eine Umfangsnut (9) zur Freilegung der Elemente (T, R) aufweist.

11. Einbaurahmen (1) nach einem der Ansprüche 1 bis 10, dadurch gekennzeichnet, daß der Einbaurahmen (1) an seiner, der Außenseite des Schirms (2) zugewandten Innenseite eine nach innen ragende Dichtkante (5) aufweist.

12. Einbaurahmen (1) nach Anspruch 11, dadurch gekennzeichnet, daß die Dichtkante (5) radial innerhalb der Umfangsnut (9) angeordnet ist.

13. Einbaurahmen (1) nach Anspruch 12, dadurch gekennzeichnet, daß die Dichtkante (5) einen berührungssensitiven Bereich des Schirms (2) vollständig abdichtet.

14. Einbaurahmen (1) nach einem der Ansprüche 11 bis 13, dadurch gekennzeichnet, daß die Dichtkante (5) die Umfangsnut (9) einseitig begrenzt.

15. Einbaurahmen (1) nach einem der Ansprüche 11 bis 13, dadurch gekennzeichnet, daß die Dichtkante (5) auf der Außenseite des Einbaurahmens (1) nach außen vorsteht, wobei die freiliegende Stirnfläche nach innen abgeschrägt ist.

16. Einbaurahmen (1) nach einem der Ansprüche 4 bis 15, dadurch gekennzeichnet, daß der Einbaurahmen (1) und der Halterahmen (4) umfangsmäßig außerhalb des Schirms (2) miteinander verbunden sind.

17. Eigenständig handhabbare Montageeinheit, welche einen Einbaurahmen (1) nach einem der vorhergehenden Ansprüche, eine Halterahmen (4), einen berührungssensitiven Schirm (2) und eine Anzeigeeinrichtung (3) aufweist.

Hierzu 2 Seite(n) Zeichnungen

Nummer: DE 100 25 175 A1
Int. Cl.[7]: G 06 K 11/06
Offenlegungstag: 6. Dezember 2001

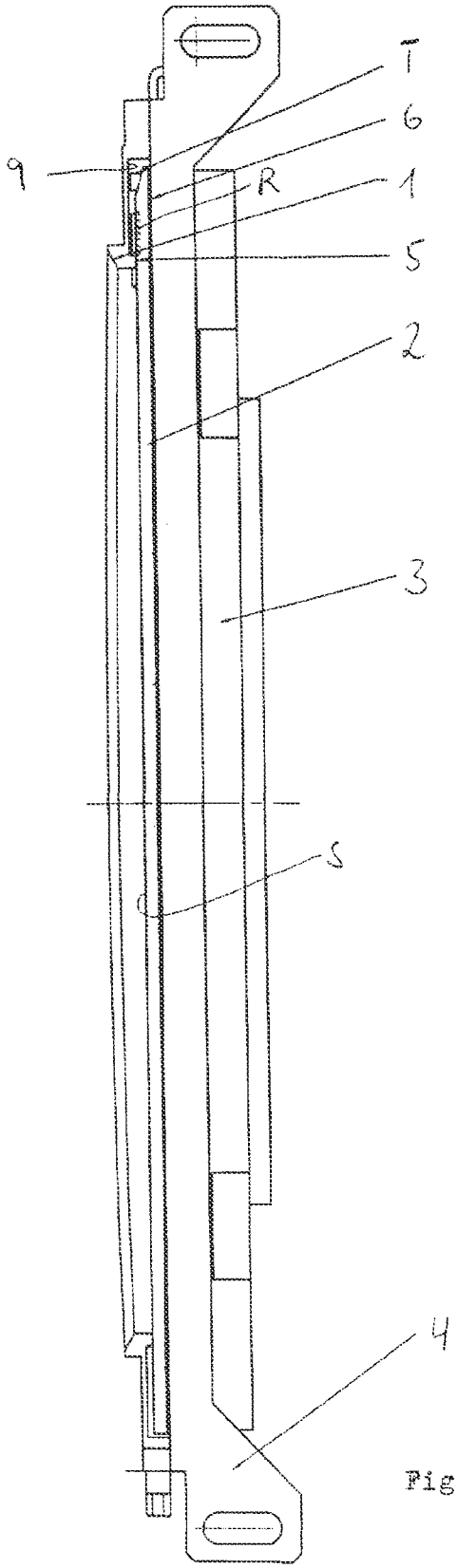


Fig. 1

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Nummer: DE 100 25 175 A1
Int. Cl.[7]: G 06 K 11/06
Offenlegungstag: 6. Dezember 2001

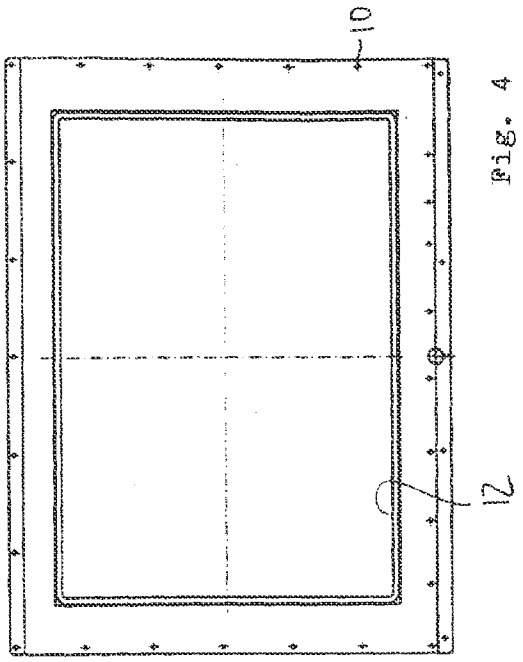


Fig. 4

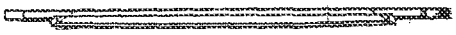


Fig. 3

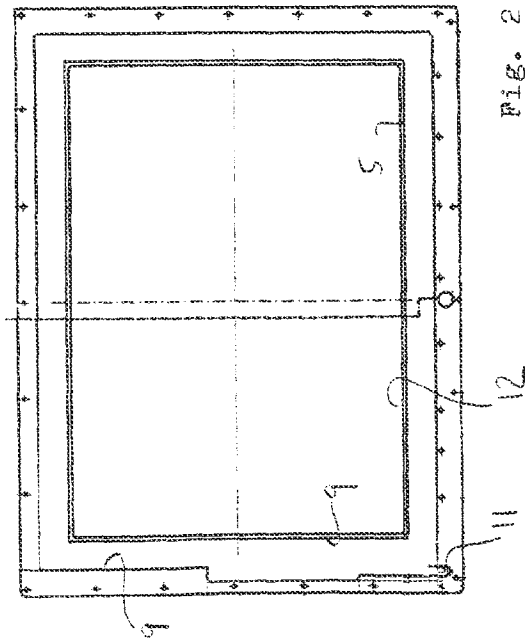


Fig. 2

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(19) Bundesrepublik Deutschland
Deutsches Patent- und Markenamt

(10) **DE 10 2009 003 990 A1** 2010.07.08

(12) **Offenlegungsschrift**

(21) Aktenzeichen: **10 2009 003 990.2**
(22) Anmeldetag: **07.01.2009**
(43) Offenlegungstag: **08.07.2010**

(51) Int Cl.[8]: ***H03K 17/96*** (2006.01)

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(56) Für die Beurteilung der Patentfähigkeit in Betracht zu ziehende Druckschriften:

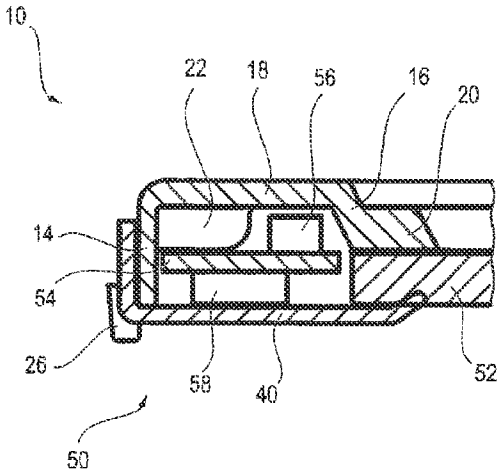
US	66 77 934	B1
DE	603 17 988	T2
DE	36 25 444	A1
DE	697 29 317	T2
US	2002/01 49 572	A1
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DE	10 2007 021537	A1
US	2007/02 36 465	A1
DE	100 25 175	A1

Die folgenden Angaben sind den vom Anmelder eingereichten Unterlagen entnommen

Rechercheantrag gemäß § 43 Abs. 1 Satz 1 PatG ist gestellt.

(54) Bezeichnung: **Berührungssensitive Eingabevorrichtung**

(57) Zusammenfassung: Die Erfindung betrifft eine berührungssensitive Eingabevorrichtung (30, 50, 60, 70, 80) mit einem eine Öffnung (12) aufweisenden Rahmen (10) und mit einer Scheibe (32, 52, 62, 72). Ferner umfasst die Eingabevorrichtung (30, 50, 60, 70, 80) eine Sensoranordnung zur Ermittlung der Position einer Berührung der Scheibe (32, 52, 62, 72). Der Rahmen (10) hat ein Profil mit einem der Öffnung (12) zugewandten Schenkel (16), einem der Öffnung (12) abgewandten Schenkel (14) und einem die beiden Schenkel (14, 16) verbindenden Grundsegment (18). Zumindest ein Teil der Sensoranordnung ist innerhalb der durch den der Öffnung (12) zugewandten Schenkel (16) den der Öffnung (12) abgewandten Schenkel (14) und das Grundsegment (18) gebildeten Vertiefung angeordnet.



Beschreibung

[0001] Die Erfindung betrifft eine berührungssensitive Eingabevorrichtung mit einer Sensoranordnung zur Ermittlung der Position einer Berührung einer Scheibe.

[0002] Die erfindungsgemäße berührungssensitive Eingabevorrichtung wird insbesondere in Verbindung mit Selbstbedienterminals, Kassen und Geldautomaten verwendet und auch als Touchmodul bezeichnet. Ein solches Touchmodul umfasst zumindest eine transparente Scheibe und eine Sensoranordnung zur Ermittlung einer Berührung dieser Scheibe. Zusammen mit einer Anzeigeeinheit, insbesondere einem Bildschirm, bildet ein solches Touchmodul einen Touchscreen. Mit Hilfe eines solchen Touchscreens können Eingaben von einer Bedienperson für ein Computersystem, insbesondere für das Computersystem eines Selbstbedienungsgerätes, erfasst und das Selbstbedienungsgerät auf einfache Weise intuitiv gesteuert werden. Die Eingabe von Informationen und Befehlen erfolgt durch Berührung der Schreibe des Touchmoduls. Die Position der Berührung wird erfasst. Die Anzeigeeinheit ist hinter der Scheibe des Touchmoduls angeordnet und zeigt auswählbare Felder, denen Eingabefelder zugeordnet sind. Liegt die erfasste Position in einem solchen Eingabefeld wird eine dem Eingabefeld zugeordnete Funktion aktiviert. Die eingegebene Information bzw. der eingegebene Befehl kann dadurch eingegeben bzw. aktiviert werden.

[0003] Als Sensoranordnung zur Ermittlung der Position der Berührung der Scheibe des Touchmoduls können verschiedene Technologien zum Einsatz kommen. Eine der Technologien ist die sogenannte kapazitive Touchtechnologie. Bei ihr wird die Scheibe des Touchmoduls beispielweise mit einer durchsichtigen Metalloxydschicht beschichtet. Eine an den Ecken der Beschichtung angelegte Spannung erzeugt ein exakt gleichmäßiges elektrisches Feld. Es entsteht ein geringer Ladungstransport der in einem Entladezyklus in Form eines Stroms an den Ecken der Scheibe gemessen wird. Die resultierenden Ströme aus den Ecken stehen im direkten Verhältnis zu der Position, an der die Scheibe des Touchmoduls durch eine Bedienperson berührt wird.

[0004] Eine weitere Technologie zur Ermittlung der Position einer Berührung der Scheibe des Touchmoduls durch eine Bedienperson ist die sogenannte Infrarottouchtechnologie. Bei dieser Technologie wird mit Hilfe von Infrarotlicht sendenden Dioden ein Netz aus Infrarotstrahlen über der Scheibe des Touchmoduls erzeugt. Den Infrarotlicht sendenden Dioden gegenüberliegend sind Infrarotlicht detektierende Fotodioden vorgesehen, die ohne Unterbrechung der ausgesandten Infrarotstrahlen diese empfangen. Bei einer Berührung der Scheibe wird zumindest ein Teil der ausgesandten Infrarotstrahlen unterbrochen, so dass ein Teil der Fotodioden keine oder eine wesentlich geringere Infrarotstrahlung erfassen. Die Infrarotdioden und die Fotodioden sind in X-Richtung und in Y-Richtung der X-Y-Ebene der auf Berührung zu überwachenden Scheibenoberfläche angeordnet. Auf diese Weise können die X- und V-Position der Berührung der Scheibe durch eine Bedienperson ermittelt werden.

[0005] Das Touchmodul kann einen Rahmen umfassen, der die Scheibe und die Sensoranordnung umschließt. Je nach verwendeter Touchtechnologie unterscheidet sich zwangsläufig auch der verwendete Rahmen. Nachteilig hieran ist, dass hierdurch zum Einen der logistische Aufwand zur Bereitstellung unterschiedlicher Rahmen erhöht wird und zum Anderen je nach verwendeten Rahmen das Touchmodul andere Maße und Anschlüsse aufweisen muss, so dass beispielweise bei Wartungsarbeiten beispielsweise an einem Selbstbedienungsterminal, wie einem Geldautomaten, ein Touchmodul mit einer Touchtechnologie nicht auf einfache Weise gegen ein Touchmodul mit einer anderen Touchtechnologie ausgetauscht werden kann.

[0006] Ein Einbaurahmen ist beispielsweise aus dem Dokument DE10025175A1 bekannt. Der dort beschriebene Einbaurahmen hat eine im Rahmen ausgebildete Öffnung, wobei wenigstens ein Teil einer berührungssensitiven Oberfläche eines Schirms freiliegt und der Einbaurahmen wenigstens einen Teil des Außenumfangs des Schirms abdeckt.

[0007] Aufgabe der Erfindung ist es, eine berührungssensitive Eingabevorrichtung anzugeben, die einfach und kompakt aufgebaut ist und die für mehrere Sensortechnologien zur berührungssensitiven Eingabe geeignet ist.

[0008] Die Aufgabe wird durch die Eingabevorrichtung mit den Merkmalen des Patentanspruches 1 gelöst. Vorteilhafte Weiterbildungen der Erfindung sind in den abhängigen Patentansprüchen angegeben.

[0009] Gemäß der Erfindung umfasst die berührungssensitive Eingabevorrichtung einen eine Öffnung aufweisenden Rahmen, eine Scheibe und eine Sensoranordnung zur Ermittlung einer Berührung der Scheibe durch eine Bedienperson. Der Rahmen hat ein Profil mit einem der Öffnung zugewandten Schenkel, einen der Öffnung abgewandten Schenkel und einem die beiden Schenkel verbindenden Grundsegment. Die Scheibe kontaktiert den der Öffnung zugewandten Schenkel. Durch den der Öffnung zugewandten Schenkel, den der Öffnung abgewandten Schenkel und das Grundsegment wird eine Vertiefung, insbesondere eine nutförmige Vertiefung, gebildet, in der zumindest ein Teil der Sensoranordnung anordenbar ist. Hierdurch wird erreicht, dass in ein

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und demselben Rahmen verschiedene Sensoranordnungen und auch Scheiben mit unterschiedlichen Abmessungen anordenbar sind. Auf diese Weise kann der Rahmen unabhängig von der verwendeten Sensoranordnung verwendet werden. Hierdurch kann die Anzahl der vorzuhaltenden Bauteile, insbesondere der vorzuhaltenden Rahmen und der vorzuhaltenden Touchmodule, reduziert werden, wodurch der logistische Aufwand und die hiermit verbundenen Kosten gesenkt werden. Da keine konstruktiven Änderungen an dem Rahmen vorzunehmen sind, werden auch die Bearbeitungszeit und die Werkzeugkosten verringert. Darüber hinaus wird erreicht, dass die berührungssensitive Eingabevorrichtung unabhängig von der verwendeten Sensoranordnung immer in etwa die gleichen Abmessungen hat, so dass sie auf einfache Weise in die verschiedensten Geräte integriert werden kann. Des Weiteren können in ein Gerät alternativ mit verschiedenen Sensoranordnungen ausgestatteten berührungssensitiven Eingabevorrichtungen integriert werden, ohne dass konstruktive Änderungen an dem Gerät notwendig sind.

[0010] Vorzugsweise ist der Rahmen umlaufend ausgebildet. Auf diese Weise kann die berührungssensitive Eingabevorrichtung auf einfache Weise eigenständig gehandhabt werden. Dies ermöglicht eine vielseitige Verwendung der berührungssensitiven Eingabevorrichtung. Es ist besonders vorteilhaft, wenn der Rahmen ein Gehäuse für die Scheibe und die Sensoranordnung bildet oder mit einem Blendenrahmen verbindbar ist.

[0011] Darüber hinaus ist es vorteilhaft, wenn zwischen dem der Öffnung zugewandten Schenkel und dem Grundsegment ein stumpfer Winkel ist. Es ist besonders vorteilhaft, wenn der der Öffnung zugewandte Schenkel kürzer ist als der der Öffnung abgewandte Schenkel und an dem dem Grundsegment entgegengesetzten Ende des der Öffnung zugewandten Schenkels ein parallel zum Grundsegment angeordnetes Kontaktsegment vorgesehen ist. Dieses Kontaktsegment kontaktiert die Scheibe. Durch das Kontaktsegment wird eine größere Kontaktfläche zwischen dem Rahmen und der Scheibe erzeugt. Hierdurch wird die Verwendung unterschiedlich großer Scheiben ermöglicht. Des Weiteren wird durch eine solche große Kontaktfläche das Eindringen von Staub und/oder Feuchtigkeit erschwert. Bei einer besonders vorteilhaften Ausführungsform der Erfindung ist der Abstand des dem Grundsegment entgegengesetzten Endes des der Öffnung abgewandten Schenkels zum Grundsegment und der Abstand der dem Kontaktsegment abgewandten Oberfläche der Scheibe zu dem Grundsegment identisch. Auf diese Weise wird ein glatter Abschluss der Eingabevorrichtung erreicht, so dass an der dem Grundsegment abgewandten Seite auf einfache Weise mindestens eine weitere Baugruppe, insbesondere ein Bildschirm, anordenbar ist.

[0012] Des Weiteren ist es vorteilhaft, wenn die Sensoranordnung mindestens eine Infrarotsensoranordnung umfasst und zumindest ein Teil der von einem Infrarotlichtsender der Infrarotsensoranordnung ausgesandten und einem Infrarotlichtempfänger der Infrarotsensoranordnung empfangenen Infrarotstrahlung bei Berühren einer Berührungsoberfläche der Scheibe unterbrochen wird. Die Berührungsoberfläche ist diejenige Oberfläche der Scheibe, an der der Öffnung zugewandte Schenkel des Rahmens die Scheibe kontaktiert und die einem Benutzer der berührungssensitiven Eingabevorrichtung zugewandt ist. Mit Hilfe einer solchen Infrarotsensoranordnung kann die Position der Berührung der Scheibe auf einfache Weise ermittelt werden. Hierzu sind die Infrarotlichtsender derart angeordnet, dass über der Scheibe ein Netz aus Infrarotstrahlen erzeugt wird, wobei die Infrarotstrahlen von Infrarotlichtempfängern empfangen werden. Je nach Position der Berührung der Berührungsoberfläche der Scheibe wird zumindest ein Teil der Infrarotstrahlen unterbrochen und abhängig hiervon die Position der Berührung der Scheibe ermittelt. Die Infrarotlichtsender und die Infrarotlichtempfänger sind vorzugsweise in X-Richtung und in Y-Richtung der X-Y-Ebene der auf Berührung zu überwachenden Scheibenoberfläche angeordnet. Auf diese Weise können die X- und Y-Position der Berührung der Scheibe durch eine Bedienperson ermittelt werden.

[0013] Vorzugsweise umfasst die Sensoranordnung eine Vielzahl von Infrarotsensorelementen. Die Infrarotsensorelemente sind auf einem Sensorträgerrahmen angeordnet. Zumindest die Infrarotsensorelemente sind innerhalb der Vertiefung des Rahmens angeordnet. Auf diese Weise wird eine kompakte Bauform der berührungssensitiven Eingabevorrichtung erreicht. Bei dem Sensorträgerrahmen handelt es sich insbesondere um einen Leiterplattenrahmen. Die Infrarotsensorelemente können beispielweise die Infrarotlichtsender und Infrarotlichtempfänger, insbesondere Infrarotdioden und Fotodioden, sein.

[0014] Der Sensorträgerrahmen ist vorteilhafterweise zwischen dem der Öffnung abgewandten Schenkels des Rahmens und der Scheibe angeordnet. Auf diese Weise wird die Scheibe positioniert und ein Verrutschen der Scheibe innerhalb der durch die Scheibe gebildeten Ebene verhindert bzw. minimiert.

[0015] Es ist vorteilhaft, wenn zumindest der der Öffnung zugewandte Schenkel des Rahmens, vorzugsweise der gesamte Rahmen, aus einem infrarotstrahlendurchlässigen Material, insbesondere einem infrarotstrahlendurchlässigen Kunststoff, gefertigt ist. Auf diese Weise kann die von den in der Vertiefung des Rahmens angeordneten Infrarotlichtsendern ausgestrahlte Infrarotstrahlung durch den der Öffnung zugewandten Schenkel und auf der gegenüberliegenden Seite durch den gegenüberliegenden der

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Öffnung zugewandten Schenkel des Rahmens hindurchstrahlen und die dort angeordneten Infrarotlichtempfänger erreichen und somit das Netz aus Infrarotstrahlung über der Berührungsoberfläche der Scheibe herstellen. Es ist besonders vorteilhaft, den gesamten Rahmen aus einem infrarotstrahlungsdurchlässigen Material zu fertigen, da auf diese Weise der Fertigungsprozess vereinfacht wird und die Kosten reduziert werden. Ferner wird das Recycling des Rahmens vereinfacht.

[0016] Alternativ kann der Rahmen auch aus einem nicht infrarotstrahlungsdurchlässigen Material gefertigt werden und der der Öffnung zugewandte Schenkel an den Stellen, an denen die Infrarotlichtsender und Infrarotlichtempfänger innerhalb der Vertiefung angeordnet sind, Durchlassöffnungen aufweisen, durch die die Infrarotstrahlung durch den der Öffnung zugewandten Schenkel hindurchgehen kann.

[0017] Bei einer alternativen Ausführungsform der Erfindung umfasst die Sensoranordnung mindestens ein Piezoelement zur Erfassung von durch eine Berührung der Scheibe erzeugten Schallwellen. Vorzugsweise ist eine Vielzahl von Piezoelementen vorgesehen, die an der dem der Öffnung abgewandten Schenkel zugewandten Seite der Scheibe angeordnet sind. Bei einer Berührung der Scheibe wird eine Schallwelle erzeugt. Abhängig von der Position der Berührung der Scheibe wird von den verschiedenen Piezoelementen der Schall nach unterschiedlichen Zeitspannen nach der Berührung empfangen, und hieraus die Position der Berührung der Scheibe durch eine Bedienperson bestimmt.

[0018] Bei einer weiteren alternativen Ausführungsform der Erfindung hat die Sensoranordnung mehrere auf der Scheibe aufgedampfte Elektroden oder eine auf der Scheibe aufgebrachte Metalloxydschicht. Bei Berührung der Berührungsoberfläche der Scheibe wird ein elektrisches Signal ausgesandt. Abhängig von der Position der Berührung der Scheibe wird an den Ecken der Scheibe ein unterschiedlich starker Stromfluss gemessen.

[0019] Es ist besonders vorteilhaft, wenn innerhalb der Vertiefung des Rahmens zumindest auf einem Sensorträgerrahmen angeordnete Infrarotsensorelemente anordenbar sind und mindestens ein Piezoelement zwischen dem der Öffnung abgewandten Schenkel des Rahmens und der diesem Schenkel zugewandten Seite der Scheibe anordenbar ist und eine Scheibe, auf der Elektroden oder eine Metalloxydschicht aufgebracht sind, derart anordenbar ist, dass diese Scheibe zumindest den der Öffnung zugewandten Schenkel kontaktiert. Auf diese Weise wird erreicht, dass in ein und demselben Rahmen zumindest eine Infrarottouchtechnologie, eine kapazitive Touchtechnologie und eine akustische Touchtechnologie integrierbar sind. Bei ein besonders vorteilhaften Ausführungsform der Erfindung ist zusätzlich auch eine resistive Touchtechnologie integrierbar.

[0020] Darüber hinaus ist es vorteilhaft, wenn eine Dichtung vorgesehen ist, die zumindest die Scheibe und den der Öffnung abgewandten Schenkel kontaktiert und die Öffnung der Vertiefung zumindest staub- und/oder feuchtigkeitsdicht verschließt. Auf diese Weise kann auf weitere Dichtungselemente verzichtet werden und die Montage des Touchmoduls wird vereinfacht.

[0021] Es ist vorteilhaft, wenn der Rahmen mindestens ein Positionierelement zur Positionierung und/oder Befestigung der Scheibe umfasst. Bei diesen Positionierelementen handelt es sich vorzugsweise um eine umlaufende oder einseitige Erhebung auf der der Scheibe zugewandten Seite des Kontaktsegments. Hierdurch wird trotz der Verwendung von Scheiben unterschiedlicher Abmessungen eine genaue Positionierung der Scheibe erreicht.

[0022] Bei einer vorteilhaften Ausführungsform der Erfindung sind innerhalb der Vertiefung des Rahmens mehrere Erhebungen ausgebildet, mit deren Hilfe die Scheibe und/oder die Sensoranordnung auf Abstand zum Grundsegment gehalten werden. Mit Hilfe dieser Erhebungen wird insbesondere der Sensorträgerrahmen einer Infrarotsensoranordnung auf Abstand zum Grundsegment gehalten, so dass die Infrarotsensorelemente, die auf dem Sensorträgerrahmen angeordnet sind, in der Vertiefung anordenbar sind, ohne mit dem Grundsegment in Kontakt zu kommen. Dadurch ist eine einfache Positionierung und Fixierung von weiteren Bauelementen und Baugruppen möglich. Bei der Verwendung einer Scheibe mit einer Metalloxidschicht bzw. aufgedampften Elektroden wird durch die Erhebungen eine zusätzliche Kontaktfläche neben der durch das Kontaktsegment gebildeten Kontaktfläche erreicht, wodurch eine noch stabilere Positionierung der Scheibe möglich ist.

[0023] Weitere Merkmale und Vorteile der Erfindung ergeben sich aus der folgenden Beschreibung, welche in Verbindung mit den beigefügten Figuren die Erfindung anhand von Ausführungsbeispielen näher erläutert.

[0024] Es zeigen:

[0025] Fig. 1 eine schematische perspektivische Darstellung der Innenseite eines Rahmens einer berührungssensitiven Eingabevorrichtung;

[0026] Fig. 2 eine schematische perspektivische Darstellung der Innenseite einer berührungssensitiven Eingabevorrichtung mit einer kapazitiven Sensoranordnung;

[0027] Fig. 3 einen Ausschnitt eines Schnittes

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durch die berührungssensitive Eingabevorrichtung nach Fig. 2;

[0028] Fig. 4 eine schematische perspektivische Darstellung der Innenseite einer berührungssensitiven Eingabevorrichtung mit einer Infrarotsensoranordnung;

[0029] Fig. 5 einen Ausschnitt eines Schnittes durch die berührungssensitive Eingabevorrichtung nach Fig. 4;

[0030] Fig. 6 eine schematische perspektivische Darstellung der Innenseite einer berührungssensitiven Vorrichtung mit einer akustischen Sensoranordnung;

[0031] Fig. 7 eine schematische perspektivische Ansicht der Innenseite einer berührungssensitiven Vorrichtung mit einer Dichtung;

[0032] Fig. 8 eine weitere schematische perspektivische Darstellung der Innenseite der berührungssensitiven Vorrichtung nach Fig. 7;

[0033] Fig. 9 eine schematische perspektivische Darstellung der Außenseite einer berührungssensitiven Eingabevorrichtung nach den Fig. 7 und Fig. 8;

[0034] Fig. 10 eine schematische perspektivische Darstellung der Außenseite und der Innenseite einer berührungssensitiven Eingabevorrichtung nach den Fig. 7 bis Fig. 9 mit einer Frontblende; und

[0035] Fig. 11 eine schematische perspektivische Darstellung einer berührungssensitiven Eingabevorrichtung und einer mit der berührungssensitiven Eingabevorrichtung verbundenen Anzeigeeinheit.

[0036] In Fig. 1 ist eine perspektivische schematische Darstellung der Innenseite eines Rahmens **10** einer berührungssensitiven Eingabevorrichtung gemäß einer ersten Ausführungsform der Erfindung gezeigt. Die berührungssensitive Eingabevorrichtung wird im Folgenden auch als Touchmodul bezeichnet. Neben dem Rahmen **10** umfasst das Touchmodul zumindest eine nicht dargestellte Scheibe und eine ebenfalls nicht dargestellte Sensoranordnung. Die Innenseite des Touchmoduls ist diejenige Seite, die beim Einbau des Touchmoduls in ein Gerät, insbesondere ein Selbstbedienungsterminal, eine Kasse oder einen Geldautomaten, vom Benutzer abgewandt ist, und somit dem Inneren des Gerätes zugewandt ist.

[0037] Der Rahmen **10** hat ein Profil mit einer im Wesentlichen U-förmigen Grundform. Der Rahmen ist umlaufend ausgebildet und somit geschlossen. Ferner hat der Rahmen **10** eine Öffnung **12**. Das Profil des Rahmens **10** umfasst einen der Öffnung **12** abgewandten Schenkel **14** und einen der Öffnung **12** zugewandten Schenkel **16**. Der der Öffnung **12** abgewandte Schenkel **14** und der der Öffnung **12** zugewandte Schenkel **16** sind über ein Grundsegment **18** miteinander verbunden. Ferner ist an dem dem Grundsegment **18** abgewandten Ende des der Öffnung **12** zugewandten Schenkels **16** ein Kontaktsegment **20** angeordnet. Das Kontaktsegment **20** ist vorzugsweise parallel zum Grundsegment **18** angeordnet. Der der Öffnung **12** abgewandte Schenkel **14** und das Grundsegment **18** sind orthogonal zueinander angeordnet. Alternativ kann zwischen dem der Öffnung **12** abgewandten Schenkel **14** und dem Grundsegment **18** auch ein spitzer oder stumpfer Winkel sein. Zwischen dem der Öffnung **12** zugewandten Schenkel **16** des Rahmens **10** und dem Grundsegment **18** ist vorzugsweise ein stumpfer Winkel. Alternativ kann zwischen dem der Öffnung **12** zugewandten Schenkel **16** und dem Grundsegment **18** auch ein spitzer oder rechter Winkel sein. Der Rahmen **10** ist derart ausgebildet, dass der Abstand des von dem Grundsegment **18** abgewandten Endes des der Öffnung **12** abgewandten Schenkels **14** zum Grundsegment **18** größer ist als der Abstand der dem Grundsegment **18** abgewandten Seite des Kontaktsegmentes **20** zum Grundsegment **18**.

[0038] Durch die beiden Schenkel **14**, **16**, das Grundsegment **18** und das Kontaktsegment **20** wird eine Vertiefung gebildet. Diese Vertiefung wird im Folgenden auch als Nut bezeichnet. Innerhalb dieser Nut ist eine Vielzahl von Erhebungen vorgesehen. Eine dieser Erhebungen ist beispielhaft mit dem Bezugszeichen **22** bezeichnet. Der Abstand jeweils zweier benachbarter Erhebungen **22** ist vorzugsweise jeweils gleich. Insbesondere ist die Länge einer Erhebung **22** genauso groß wie der Abstand zwischen zwei benachbarten Erhebungen **22**. Die Erhebungen **22** sind vorzugsweise derart ausgebildet, dass ihre Höhe gleich dem Abstand zwischen der dem Grundsegment **18** abgewandten Seite des Kontaktsegments **20** und dem Grundsegment **18** ist.

[0039] Der der Öffnung **12** abgewandte Schenkel **14** hat zwei Aussparungen **24a**, **24b**, über die Anschlüsse einer innerhalb der Nut und/oder auf einer mit dem Rahmen **12** in Kontakt stehenden Scheibe angeordneten Sensoranordnung nach außen geführt werden können.

[0040] Des Weiteren sind an der der Öffnung **12** abgewandten Seite des der Öffnung **12** abgewandten Schenkels **14** eine Vielzahl kleiner Klemmelemente und einige größere Klemmelemente angeordnet. Eines der kleinen Klemmelemente ist beispielhaft mit dem Bezugszeichen **26** bezeichnet, eines der großen Klemmelemente ist beispielhaft mit dem Bezugszeichen **28** bezeichnet. Die kleinen Klemmelemente **26** und die großen Klemmelemente **28** sind derart ausgebildet, dass zumindest ein Teil eines jeden kleinen

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Klemmelements **26** und ein Teil jedes größeren Klemmelements **28** über das dem Grundsegment **18** abgewandte Ende des der Öffnung **12** abgewandten Schenkels **14** hinausragt.

[0041] Der Rahmen **10** ist derart ausgebildet, dass in ihm, wie im Folgenden beschrieben, zumindest eine kapazitive Sensoranordnung, eine Infrarotsensoranordnung und eine akustische Sensoranordnung anordenbar ist.

[0042] In Fig. 2 ist eine schematische perspektivische Darstellung der Innenseite eines Touchmoduls **30** mit einer kapazitiven Sensoranordnung gezeigt. Elemente mit gleichem Aufbau oder gleicher Funktion haben dieselben Bezugszeichen.

[0043] Innerhalb des Rahmens **10** ist eine Scheibe **32** derart angeordnet, dass durch sie die gesamte Öffnung **12** verdeckt wird und die Scheibe **32** mit einer Berührungsoberfläche das Kontaktsegment **20** kontaktiert. Die Berührungsoberfläche ist einem Benutzer des Touchmoduls **30** zugewandt und in Richtung der Außenseite des Rahmens **10** gerichtet. Die Scheibe **32** ist zumindest teilweise, vorzugsweise vollständig, transparent. Die Scheibe **32** ist insbesondere aus Glas oder Kunststoff gefertigt.

[0044] Die Scheibe **32** ist derart innerhalb des Rahmens **10** positioniert, dass die Scheibe **32** an der die Aussparungen **24a**, **24b** aufweisenden Seite des Rahmens **10** bündig an die der Öffnung **12** zugewandten Seite des der Öffnung **12** abgewandten Schenkels **14** anliegt und an der der die Aussparung **24a**, **24b** aufweisenden Seite des Rahmens **10** entgegengesetzten Seite des Rahmens **10** die Erhebungen **22** nicht kontaktiert. An der die Aussparung **24a**, **24b** aufweisenden Seite des Rahmens **10** kontaktiert die Scheibe **32** mit ihrer Berührungsoberfläche sowohl das Kontaktsegment **20** als auch die an dieser Seite des Rahmens **10** angeordneten Erhebungen **22**.

[0045] Die Positionierung der Scheibe **32** in Bezug auf die anderen beiden Seiten des Rahmens **10** wird durch zwei Positionierelemente **34**, **36** erreicht. Die Positionierelemente **34**, **36** sind derart angeordnet, dass der Abstand der Positionierelemente **34**, **36** und somit auch der an den Positionierelementen **34**, **36** anliegenden Kanten der Scheibe **32** zu dem der Öffnung **12** abgewandten Schenkel **14** des Rahmens **10** gleich ist. Ferner verhindern die Positionierelemente **34**, **36** ein Verschieben der Scheibe **32**.

[0046] Auf der Berührungsoberfläche der Scheibe **32** sind eine Vielzahl Elektroden und/oder eine durchsichtige Metalloxydschicht aufgebracht, insbesondere aufgedampft. Eine an den Ecken der Beschichtung angelegte Spannung erzeugt ein exaktes, gleichmäßiges elektrisches Feld. Es besteht ein geringer Ladungstransport, der in Form eines Stroms an den Kanten der Scheibe **32** gemessen wird. Die an den Kanten gemessenen Ströme stehen im direkten Verhältnis zu der Position an der die Berührungsoberfläche der Scheibe **32** von einer Bedienperson mit einem Finger oder einer Eingabehilfe berührt wird. Auf diese Weise kann die Position der durch die Bedienperson vollzogenen Berührung der Berührungsoberfläche der Scheibe **32** auf einfache Weise ermittelt werden. Mit Hilfe des Anschlusselements **38** werden diese Ströme bzw. aus diesen Strömen gewonnenen Informationen an eine Verarbeitungseinheit übertragen. Das Anschlusselement **38** ist fest mit der Scheibe **32** verbunden, und derart an der dem der Öffnung **12** abgewandten Schenkels **14** zugewandten Seite der Scheibe **12** angeordnet, dass das Anschlusselement **38** zumindest teilweise innerhalb der Aussparung **24b** angeordnet ist. Die Verarbeitungseinheit ermittelt aus den Strömen bzw. den aus den Strömen gewonnen Informationen die Position der Berührung der Scheibe **32**.

[0047] In Fig. 3 ist einen Schnitt durch einen Ausschnitts des Touchmoduls **30** nach Fig. 2 entlang der Schnittlinie A-A gezeigt. Der Rahmen **10** und die Scheibe **32** sind vorteilhafterweise derart ausgebildet, dass der Abstand des dem Grundsegment **18** entgegengesetzten Endes des der Öffnung **12** abgewandten Schenkels **14** zum Grundsegment **18** und der Abstand der der Berührungsoberfläche entgegengesetzten Oberfläche der Scheibe **32** zum Grundsegment **18** gleich sind. Auf diese Weise wird ein ebener Abschluss der Innenseite gebildet, so dass auf einfache Weise weitere Bauteile auf der Innenseite des Tochmoduls **30** anordenbar sind. Ein solches Bauteil kann beispielsweise eine Dichtung **40** sein.

[0048] Die der Nut zugewandte Seite des der Öffnung **12** zugewandten Schenkels **16** und des Kontaktsegments **20** sind parallel zu der der Nut abgewandten Seite des der Öffnung **12** zugewandten Schenkels **16** und des Kontaktsegments **20**.

[0049] In Fig. 4 ist eine perspektivische schematische Darstellung der Innenseite eines Touchmoduls **50** mit einer Infrarotsensoranordnung gemäß einer zweiten Ausführungsform der Erfindung dargestellt. In den Rahmen **10** ist mittig eine Scheibe **52** eingesetzt, die die Öffnung **12** des Rahmens **10** vollständig bedeckt. Die Scheibe **52** ist vorzugsweise aus Glas oder Kunststoff hergestellt und dient hauptsächlich dem Schutz von hinter der der Berührungsoberfläche entgegengesetzten Oberfläche der Scheibe **52** angeordneten Bauteilen, insbesondere einer hinter der Scheibe **52** angeordneten Anzeigeeinheit.

[0050] Die Infrarotsensoranordnung umfasst einen Sensorträgerrahmen **54**. Der Sensorträgerrahmen **54** ist vorzugsweise eine Leiteplatte mit einer rah-

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menförmigen Form oder mehrerer Leiterplattensegmente, die als im Wesentlichen umlaufender Rahmen angeordnet sind. Der Sensorträgerrahmen **54** ist derart dimensioniert, dass seine äußere Kante an allen vier Seiten die der Öffnung **12** zugewandte Seite des der Öffnung **12** abgewandten Schenkels **14** kontaktiert oder zwischen dem Schenkel **14** und der äußeren Kante des Sensorträgerrahmens **54** nur ein kleiner Spalt verbleibt. Die Scheibe **52** ist derart dimensioniert, dass sie bündig in der Öffnung des Sensorträgerrahmens **54** anordenbar ist. Auf diese Weise dient der Sensorträgerrahmen **54** als Positionierhilfe und Aufnahmeelement für die Scheibe **52**. Der Sensorträgerrahmen **54** kontaktiert mit der dem Grundsegment **18** zugewandten Seite die Erhebungen **22** des Rahmens **10**.

[0051] In Fig. 5 ist ein Ausschnitt eines Schnitts durch das Touchmodul **50** nach Fig. 4 entlang der Schnittlinie B-B gezeigt. Die Scheibe **52** ist derart dimensioniert, dass ihre Kante bündig mit der dem der Öffnung **12** abgewandten Schenkel **14** zugewandten Seite des Kontaktsegments **20** abschließt.

[0052] Ferner ist die Scheibe **52** derart ausgebildet, dass der Abstand der vom Grundsegment **18** abgewandten Seite der Scheibe **52** zum Grundsegment **18** und der Abstand des dem Grundsegment **18** abgewandten Endes des der Öffnung **12** abgewandten Schenkels **14** zum Grundsegment **18** gleich sind.

[0053] Die dem Grundsegment **18** zugewandte Oberfläche des Sensorträgerrahmens **54** und die Berührungsoberfläche der Scheibe **52** liegen näherungsweise in einer Ebene. Auf der dem Grundsegment **18** zugewandten Oberfläche des Sensorträgerrahmens **54** sind eine Vielzahl von Infrarotsende- und Infrarotempfangsdioden angeordnet, die im Folgenden kurz als Infrarotdioden bezeichnet werden. Eine dieser Infrarotdioden ist beispielhaft mit dem Bezugszeichen **56** bezeichnet. Die Infrarotdioden **56** sind elektrisch leitend mit den Leiterbahnen des Sensorträgerrahmens **54** verbunden.

[0054] Die Infrarotdioden **56** sind somit innerhalb der Nut des Rahmens **10** angeordnet und somit durch den Rahmen **10** vor Vandalismus und Verschmutzungen, insbesondere vor Staub, geschützt. Der Rahmen **10** ist aus einem infrarotstrahlungsdurchlässigen Material, insbesondere einem infrarotstrahlungsdurchlässigen Kunststoff, gefertigt. In einer alternativen Ausführungsform der Erfindung kann auch nur der der Öffnung **12** zugewandte Schenkel **16** und das Kontaktsegment **20** aus einem infrarotstrahlungsdurchlässigen Material gefertigt sein.

[0055] Von den Infrarotdioden **56** werden Infrarotstrahlen in Richtung des der Öffnung **12** zugewandten Schenkels **16** emittiert.

[0056] Die Infrarotstrahlen treten durch den infrarotstrahlungsdurchlässigen, der Öffnung **12** zugewandten Schenkel **16** und durch das Kontaktsegment **20** durch. Die durch die Infrarotsendedioden ausgesandten Infrarotstrahlen werden mit Hilfe von Infrarotempfangsdioden, insbesondere von infrarotstrahlungsempfindlichen Fotodioden, empfangen. Die Infrarotsende- und die Infrarotempfangsdioden können einteilig ausgebildet sein. Eine Infrarotempfangsdiode und eine Infrarotsendediode werden zusammen auch als Infrarotsensor bezeichnet. Mit Hilfe der Infrarotdioden wird ein Netz aus Infrarotstrahlen über der Berührungsoberfläche der Scheibe **52** gebildet. Berührt ein Benutzer die Berührungsoberfläche der Scheibe **52** so wird zumindest ein Teil der durch die Infrarotdioden **56** ausgesandten und zumindest ohne Berührung der Scheibe durch die Infrarotempfangsdioden empfangenen Infrarotstrahlen unterbrochen. Welcher Teil der Infrarotstrahlen unterbrochen wird, hängt von der Position ab, an der die Scheibe **52** berührt wird. Auf diese Weise kann die Position der Berührung der Scheibe **52** bestimmt werden. Zum Unterbrechen der Infrarotstrahlung ist es nicht notwendig, die Scheibe **52** tatsächlich zu berühren oder gar Druck auf die Scheibe auszuüben. Somit können auch nur annähernde Berührungen der Scheibe **52** durch das Touchmodul **50** ermittelt werden, wenn dadurch zumindest ein Teil der ausgesandten Infrarotstrahlen unterbrochen wird und vom den Infrarotempfangsdioden nicht mehr empfangen wird. Das durch die Infrarotdioden **56** erzeugte Netz aus Infrarotstrahlenüber der Scheibe **52** hat vorzugsweise eine matrixförmige Struktur in X-Richtung und in Y-Richtung einer zur Scheibe **52** parallelen X-Y-Ebene.

[0057] Auf der dem Grundsegment **18** abgewandten Oberfläche des Sensorträgerrahmens **54** sind mehrere elektrische Bauelemente angeordnet, die mit den Leiterbahnen des Sensorträgerrahmens **54** elektrisch leitend verbunden sind. Eines dieser Bauelemente ist beispielhaft mit dem Bezugszeichen **58** bezeichnet. Die elektrischen Bauelemente **58** sind derart dimensioniert, dass die den Sensorträgerrahmen **54** abgewandte Oberfläche der elektrischen Bauelemente **58** näherungsweise in einer Ebene mit der dem Grundsegment **18** abgewandten Oberfläche der Scheibe **52** liegt.

[0058] Bei einer alternativen Ausführungsform der Erfindung kann der der Öffnung **12** zugewandte Schenkel **16** und das Kontaktsegment **20** an den Stellen, an denen die Infrarotdioden **56** angeordnet sind, Aussparungen aufweisen, durch die die von den Infrarotdioden **56** ausgesandten und empfangenen Infrarotstrahlen hindurchtreten können. Bei dieser Ausführungsform muss der Rahmen **10** dann nicht unbedingt aus einem infrarotstrahlungsdurchlässigen Material gefertigt sein.

[0059] In Fig. 6 ist eine schematische perspektivi-

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sche Darstellung der Innenseite eines Touchmoduls **60** mit einer akustischen Sensoranordnung gemäß einer dritten Ausführungsform der Erfindung gezeigt. Die akustische Sensoranordnung umfasst eine Vielzahl von Piezoelementen, die vorzugsweise an der dem der Öffnung **12** abgewandten Schenkel **14** zugewandten Seite einer Scheibe **62** angeordnet sind. Bei einer Berührung der Berührungsoberfläche der Scheibe **62** durch einen Benutzer werden Schallwellen erzeugt, die über die Piezoelemente erfasst werden. In Abhängigkeit von der Stärke der von einzelnen Piezoelementen erfassten Schallwellen und/oder in Abgängigkeit von der Zeit die zwischen der Berührung der Scheibe **62** und dem erfassen der Schallwelle durch die Piezoelemente vergeht, kann die Position der Berührung der Scheibe **62** ermittelt werden. Die Scheibe **62** ist derart angeordnet, dass sie mit ihrer Berührungsoberfläche zumindest die Kontaktsegmente **20** des Rahmens **10** kontaktiert. Die Piezoelemente liegen somit geschützt zwischen der Scheibe **62** und dem der Öffnung **12** abgewandten Schenkel **16** des Rahmens **10**.

[0060] In Fig. 7 ist eine schematische perspektivische Darstellung der Innenseite eines Touchmoduls **70** mit einer Dichtung **40** gemäß einer vierten Ausführungsform der Erfindung gezeigt. Innerhalb des Rahmens **10** ist eine Scheibe **72** derart angeordnet, dass die Öffnung **12** vollständig von der Scheibe **72** bedeckt und die Scheibe **72** zumindest von dem Kontaktsegment **20** des Rahmens **10** kontaktiert wird. Auf der Innenseite des Touchmoduls **70** ist eine Dichtung **40** angeordnet. Die Dichtung **40** kontaktiert zumindest die Innenseite der Scheibe **72** und das dem Grundsegment **18** abgewandte Ende des der Öffnung **12** abgewandten Schenkels **14**. Mit Hilfe der Dichtung **40** wird die Nut des Rahmens **10** und die innerhalb dieser Nut bzw. der an der dem der Öffnung **12** abgewandten Schenkel **14** zugewandten Seite der Scheibe **72** angeordneten Teil einer Sensoranordnung zumindest staub- und/oder feuchtigkeitsdicht verschlossen. Die Dichtung **40** ist über die kleinen Klemmelemente **26** fest mit dem Rahmen **10** des Touchmoduls **70** verbunden. Auf diese Weise wird erreicht, dass die Dichtung **40** zusammen mit dem Touchmodul **70** auf einfache Art und Weise handhabbar ist.

[0061] In Fig. 8 ist eine weitere perspektivische schematische Darstellung der Innenseite des Touchmoduls **70** nach Fig. 7 gezeigt. In Fig. 9 ist eine schematische perspektivische Darstellung der Außenseite des Touchmoduls **70** nach den Fig. 7 und Fig. 8 gezeigt. Im eingebauten Zustand sind für den Benutzer von dem Touchmodul **70** lediglich die Berührungsoberfläche der Scheibe **72** und zumindest ein Teil des Rahmens **10** sichtbar.

[0062] In Fig. 10 ist eine schematische perspektivische Darstellung der Innenseite und der Außenseite des Touchmoduls **70** nach den Fig. 7 bis Fig. 9 und eine mit dem Touchmodul **70** verbundene Frontblende **74** gezeigt. Im linken Teil der Fig. 10 ist eine Sicht auf die Außenseite des Touchmoduls **70** und in der rechten Figur von Fig. 10 eine Sicht auf die Innenseite des Touchmoduls **70** gezeigt. Die Frontblende **74** ist an der Außenseite des Touchmoduls **70** derart angeordnet, dass die Außenseite des Rahmens **10** nahezu vollständig von der Frontlende **74** verdeckt wird. Die Position der Frontblende **74** zu dem Touchmodul **70** wird über mehrere an der dem Touchmodul **70** zugewandten Seite der Frontblende **74** angeordnete Positionierelemente festgelegt. Eines dieser Positionierelemente ist beispielhaft mit dem Bezugszeichen **76** bezeichnet.

[0063] In Fig. 11 ist eine schematische perspektivische Darstellung eines Touchmoduls **80** und einer fest mit dem Touchmodul **80** verbundenen Anzeigeeinheit **82** gemäß einer fünften Ausführungsform der Erfindung gezeigt. Die Anzeigeeinheit **82** ist derart an der Innenseite des Touchmoduls **80** angeordnet, dass ein in Fig. 11 nicht sichtbarer Bildschirm der Anzeigeeinheit **82** derart angeordnet ist, dass er an der der Berührungsoberfläche entgegengesetzten Oberfläche einer Scheibe des Touchmoduls **80** angeordnet ist. Mit Hilfe der Dichtung **40** wird ein zwischen dem Rahmen **10** des Touchmoduls **80** und der Anzeigeeinheit **82** verbleibender Spalt verschlossen. Bei der Anzeigeeinheit **82** handelt es sich vorteilhafterweise um ein Display, insbesondere ein LCD-Display, wie beispielweise ein TFT-Display. Das Touchmodul **80** und die Anzeigeeinheit **82** bilden zusammen einen sogenannten Touchscreen **84**.

[0064] Solche Touchscreens **84** können zum Einen als alleinstehende Geräte, z. B. auf oder neben einem Selbstbedienterminal oder einer Registrierkasse, verwendet werden. Solche alleinstehenden Touchscreengeräte werden auch als stand-alone-Touchscreens bezeichnet. Bei einem alleinstehenden Touchscreengerätes wird ein Touchmodul **80** in die Frontblende **74** des Touchscreens **84** integriert.

[0065] Im Fall der Integration des Touchscreens **84** in das Gehäuse eines Selbstbedienterminals, wie beispielsweise in das Gehäuse eines Geldautomaten, wird das Touchmodul **80** mit dem Display **82** verbunden. Die Blende für den Touchscreen **84** wird in diesem Fall von dem Gehäuse des Selbstbedienterminals gebildet, das eine Aussparung für den Touchscreen **84** aufweist. Bei der Integration des Touchscreens **84** in ein Selbstbedienterminal wird ein Displaymodul **82** verwendet, das kein Gehäuse aufweist. Ein solches Displaymodul **82** wird auch als Barebone-Displaymodul bezeichnet.

[0066] Bei einer alternativen Ausführungsform der Erfindung kann als Sensoranordnung eine resistive Sensoranordnung verwendet werden.

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Bezugszeichenliste

10	Rahmen
12	Öffnung
14, 16	Schenkel
18	Grundsegment
20	Kontaktsegment
22	Erhebung
24a, 24b	Aussparung
26	kleines Klemmelement
28	großes Klemmelement
30, 50, 60, 70, 80	Touchmodul
32, 52, 62, 72	Scheibe
34, 36	Positionierelement
38	Anschlusselement
40	Dichtung
54	Sensorträgerrahmen
56	Infrarotdiode
58	elektrisches Bauelement
74	Frontblende
76	Positionierelemente
82	Anzeigeeinheit
84	Touchscreen

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ZITATE ENTHALTEN IN DER BESCHREIBUNG

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Zitierte Patentliteratur

- DE 10025175 A1 [0006]

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Patentansprüche

1. Berührungssensitive Eingabevorrichtung,
mit einem eine Öffnung (**12**) aufweisenden Rahmen (**10**),
mit einer Scheibe (**32**, **52**, **62**, **72**), und
mit einer Sensoranordnung zur Ermittlung der Position einer Berührung der Scheibe (**32**, **52**, **62**, **72**),
wobei der Rahmen (**10**) ein Profil mit einem der Öffnung (**12**) zuwandten Schenkel (**16**), einem der Öffnung (**12**) abgewandten Schenkel (**14**) und einem die beiden Schenkel (**14**, **16**) verbindenden Grundsegment (**18**) hat,
die Scheibe (**32**, **52**, **62**, **72**) den der Öffnung (**12**) zugewandten Schenkel (**16**) des Profils kontaktiert, und
wobei zumindest ein Teil der Sensoranordnung innerhalb einer durch den der Öffnung (**12**) zugewandten Schenkel (**16**), den der Öffnung (**12**) abgewandten Schenkel (**14**) und das Grundsegment (**18**) ausgebildeten Vertiefung anordenbar ist.

2. Eingabevorrichtung nach Anspruch 1, dadurch gekennzeichnet, dass der Rahmen (**10**) umlaufend ist.

3. Eingabevorrichtung nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, dass zwischen dem der Öffnung (**12**) zugewandten Schenkel (**16**) und dem Grundsegment (**18**) ein stumpfer Winkel ist.

4. Eingabevorrichtung nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, dass der der Öffnung (**12**) zugewandte Schenkel (**16**) kürzer ist als der der Öffnung (**12**) abgewandte Schenkel (**14**), und dass an dem dem Grundsegment (**18**) entgegengesetzten Ende des der Öffnung (**12**) zugewandten Schenkels (**16**) ein parallel zum Grundsegment (**18**) angeordnetes Kontaktsegment (**20**) vorgesehen ist, das die Scheibe (**32**, **52**, **62**, **72**) kontaktiert.

5. Eingabevorrichtung nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, dass die Sensoranordnung mindestens eine Infrarotsensoranordnung umfasst, und dass zumindest ein Teil der von mindestens einem Infrarotlichtsender der Infrarotsensoranordnung ausgesandten und von mindestens einem Infrarotlichtempfänger der Infrarotsensoranordnung empfangenen Infrarotstrahlen bei Berührung einer Berührungsoberfläche der Scheibe (**52**) unterbrochen wird.

6. Eingabevorrichtung nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, dass die Sensoranordnung eine Vielzahl von Infrarotsensorelementen umfasst, und dass die Infrarotsensorelemente auf einem Sensorträgerrahmen (**54**) angeordnet sind und zumindest die Infrarotsensorelemente innerhalb der Vertiefung des Rahmens (**10**) angeordnet sind.

7. Eingabevorrichtung nach Anspruch 6, dadurch gekennzeichnet, dass der Sensorträgerrahmen (**54**) zwischen dem der Öffnung (**12**) abgewandten Schenkel (**14**) des Rahmens (**10**) und der Scheibe (**52**) angeordnet ist.

8. Eingabevorrichtung nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, dass zumindest der der Öffnung (**12**) zugewandte Schenkel (**16**) des Rahmens (**10**), vorzugsweise der gesamte Rahmen (**10**), aus einem infrarotstrahlungsdurchlässigen Material, insbesondere einem infrarotstrahlungsdurchlässigen Kunststoff, gefertigt ist.

9. Eingabevorrichtung nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, dass die Sensoranordnung mindestens ein Piezoelement zum Erfassen von durch eine Berührung der Scheibe (**62**) erzeugten Schallwellen umfasst.

10. Eingabevorrichtung nach Anspruch 9, dadurch gekennzeichnet, dass eine Vielzahl von Piezoelementen vorgesehen ist und die Piezoelemente an der dem der Öffnung (**12**) abwandten Schenkel (**14**) zugewandten Seite der Scheibe (**62**) angeordnet sind.

11. Eingabevorrichtung nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, dass die Sensoranordnung mehrere auf der Scheibe (**32**) aufgedampfte Elektroden oder eine Metalloxidschicht hat, die bei Berührung einer Berührungsoberfläche der Scheibe (**32**) ein elektrisches Signal aussenden bzw. aussendet.

12. Vorrichtung nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, dass innerhalb der Vertiefung des Rahmens (**10**) zumindest auf einem Sensorträgerrahmen (**54**) angeordnete Infrarotsensorelemente anordenbar sind und mindestens ein Piezoelement zwischen dem der Öffnung (**12**) abgewandten Schenkel (**14**) des Rahmens (**10**) und der diesem Schenkel (**14**) zugewandten Seite der Scheibe (**32**, **52**, **62**, **72**) anordenbar ist und eine Scheibe (**32**, **52**, **62**, **72**), auf der Elektroden aufgedampft sind, derart anordenbar ist, dass diese Scheibe (**32**, **52**, **62**, **72**) zumindest den der Öffnung (**12**) zugewandten Schenkel (**16**) kontaktiert.

13. Vorrichtung nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, dass eine Dichtung (**40**) vorgesehen ist, die zumindest die Scheibe (**32**, **52**, **62**, **72**) und den der Öffnung (**12**) abgewandten Schenkel (**14**) kontaktiert und die Öffnung der Vertiefung zumindest staub- und/oder feuchtigkeitsdicht verschließt.

14. Vorrichtung nach einem der vorhergehenden

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Ansprüche, dadurch gekennzeichnet, dass der Rahmen (**10**) mindestens ein Positionierelement (**34**, **36**) zur Positionierung und/oder Befestigung der Scheibe (**32**, **52**, **62**, **72**) umfasst.

15. Vorrichtung nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, dass innerhalb der Vertiefung des Rahmens (**10**) mehrere Erhebungen (**22**) ausgebildet sind, mit deren Hilfe die Scheibe (**32**, **52**, **62**, **72**) und/oder die Sensoranordnung auf Abstand zum Grundsegment (**18**) gehalten werden.

Es folgen 11 Blatt Zeichnungen

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Anhängende Zeichnungen

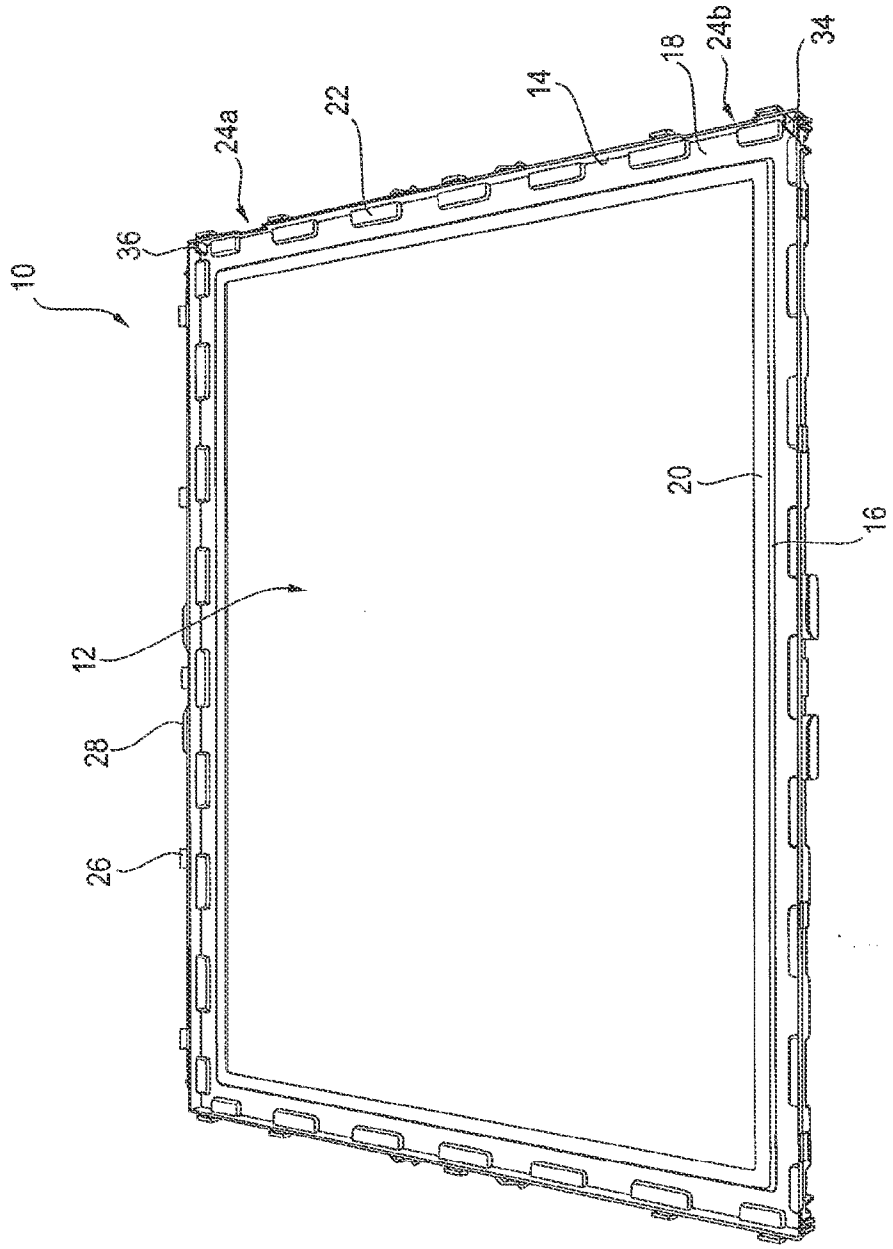


FIG. 1

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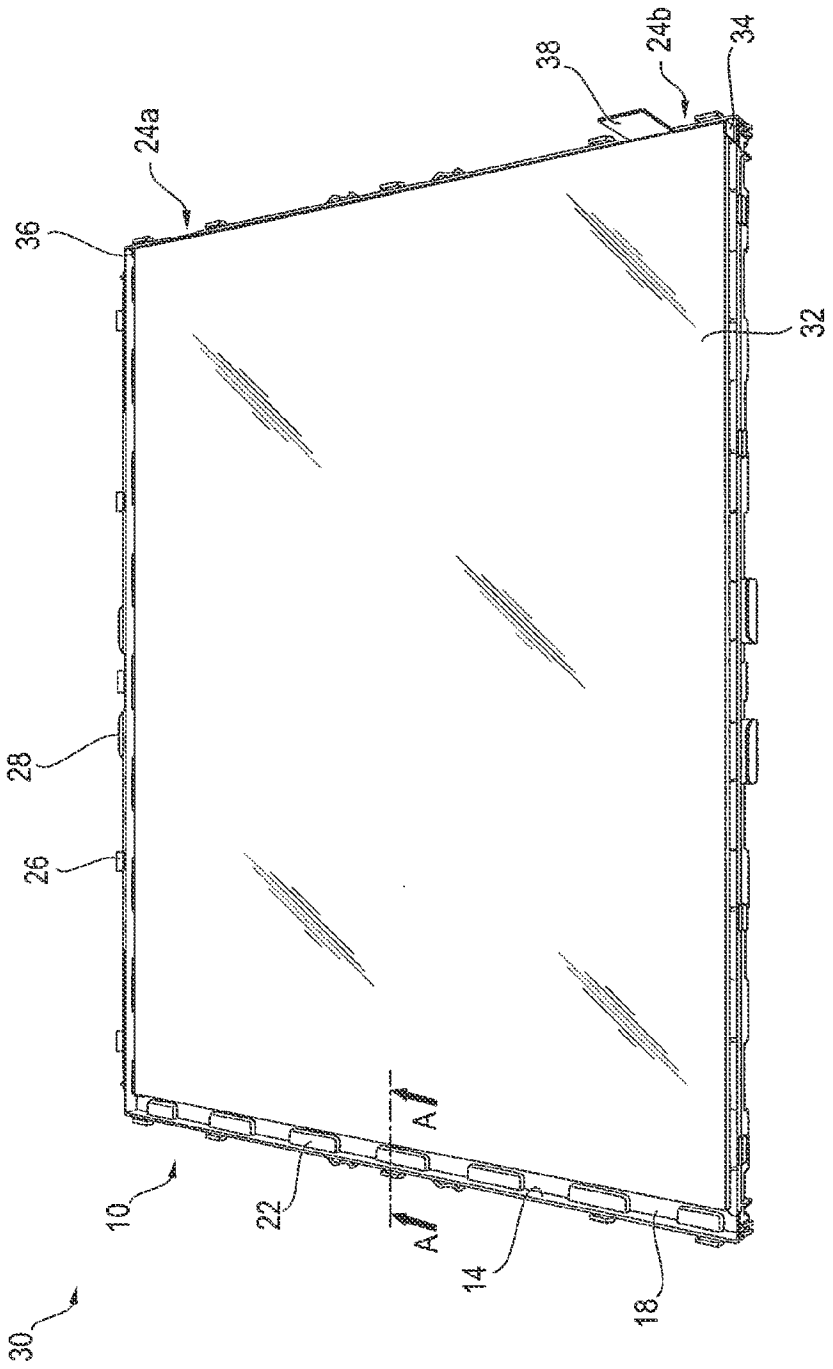


FIG. 2

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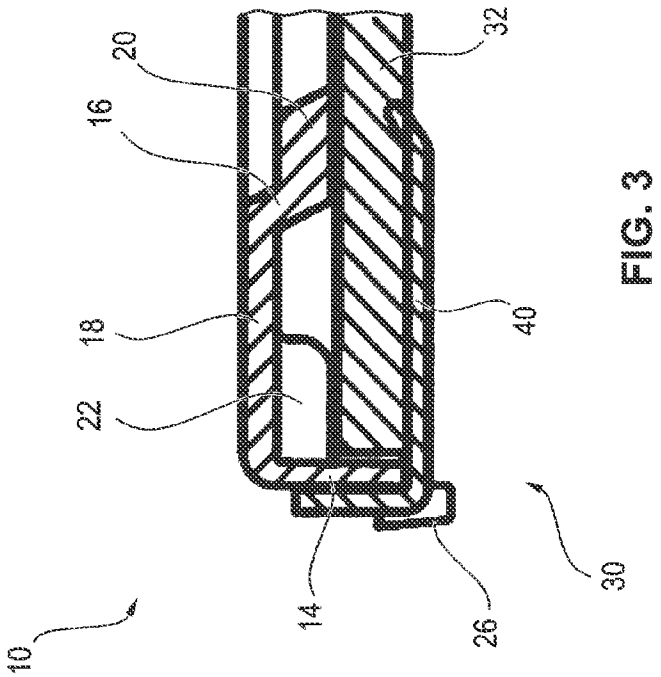


FIG. 3

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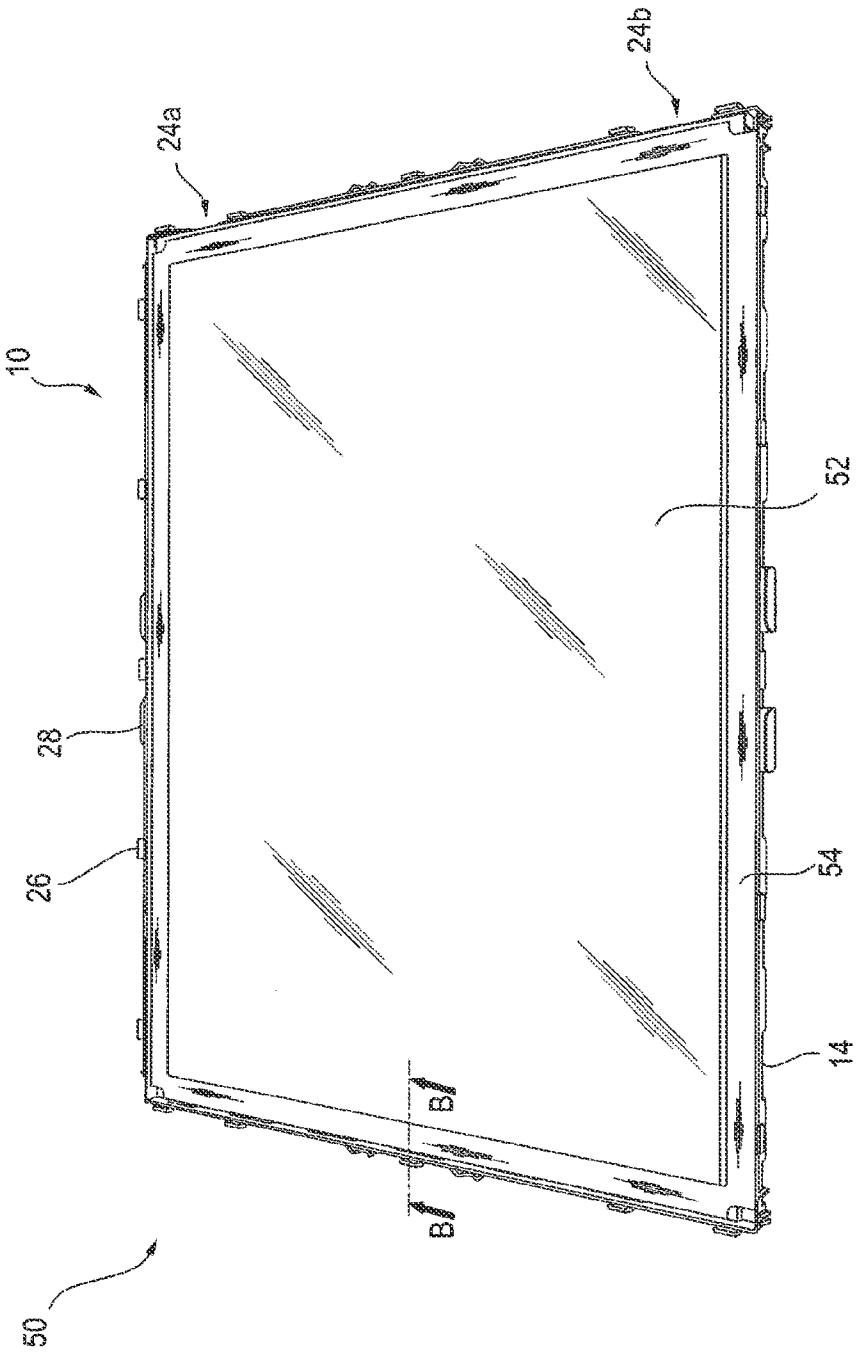


FIG. 4

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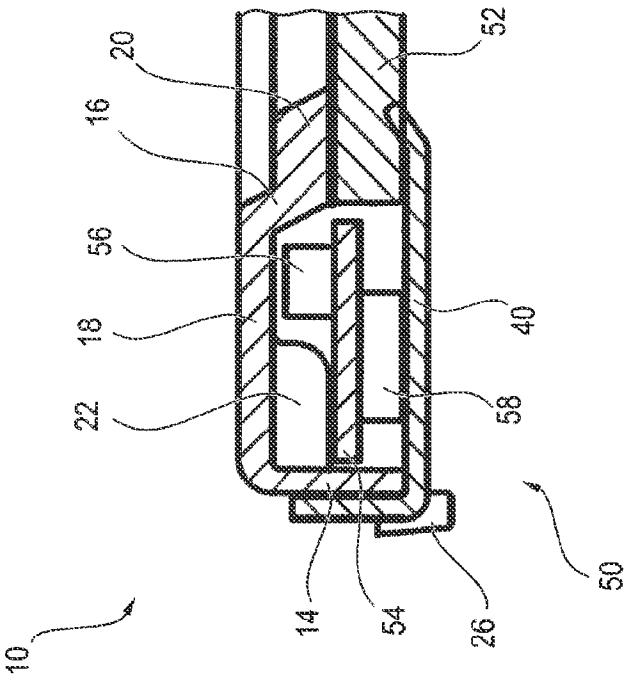


FIG. 5

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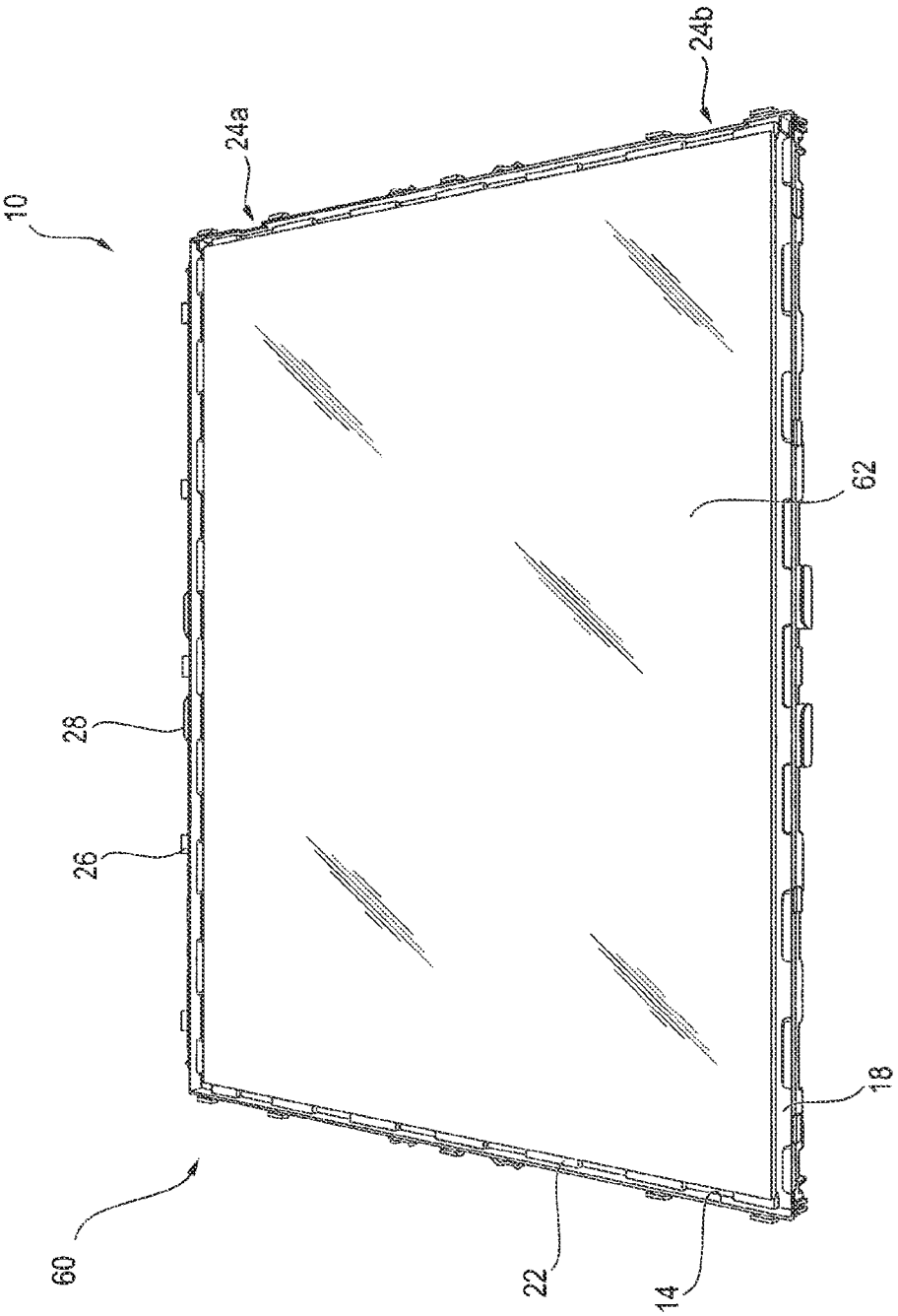


FIG. 6

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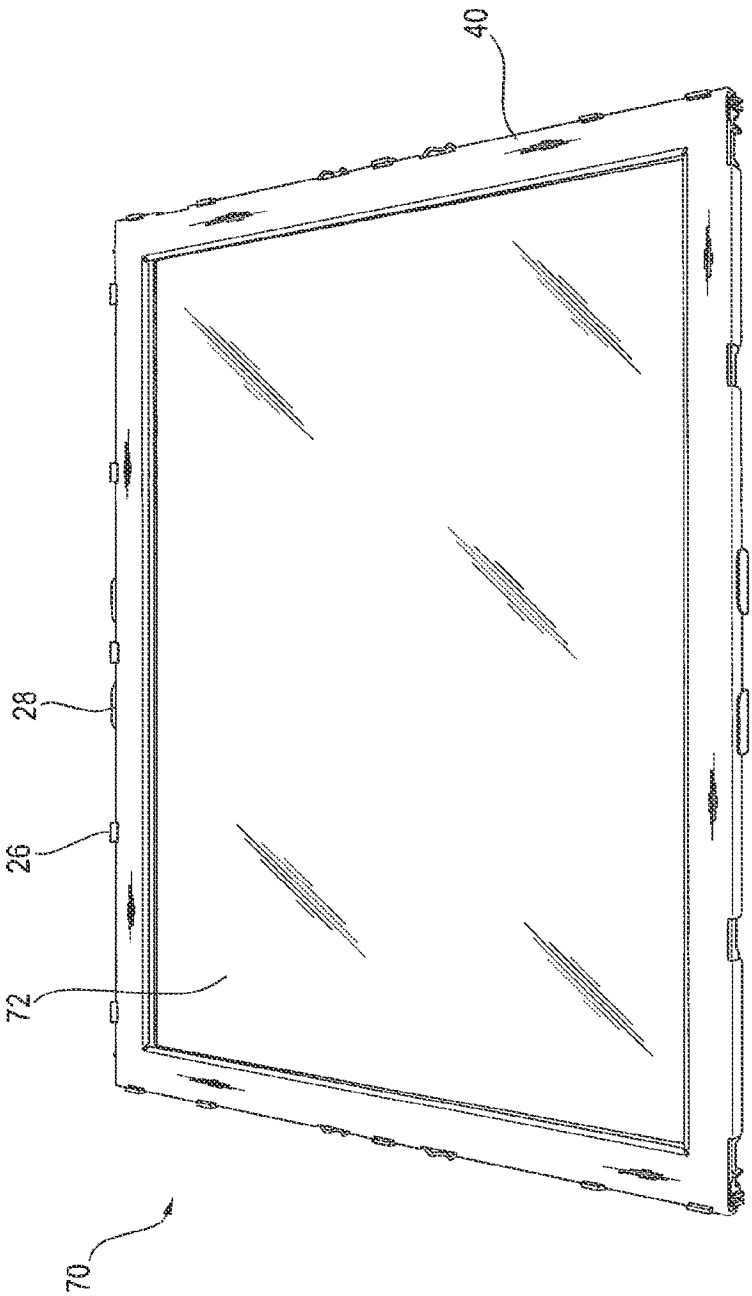


FIG. 7

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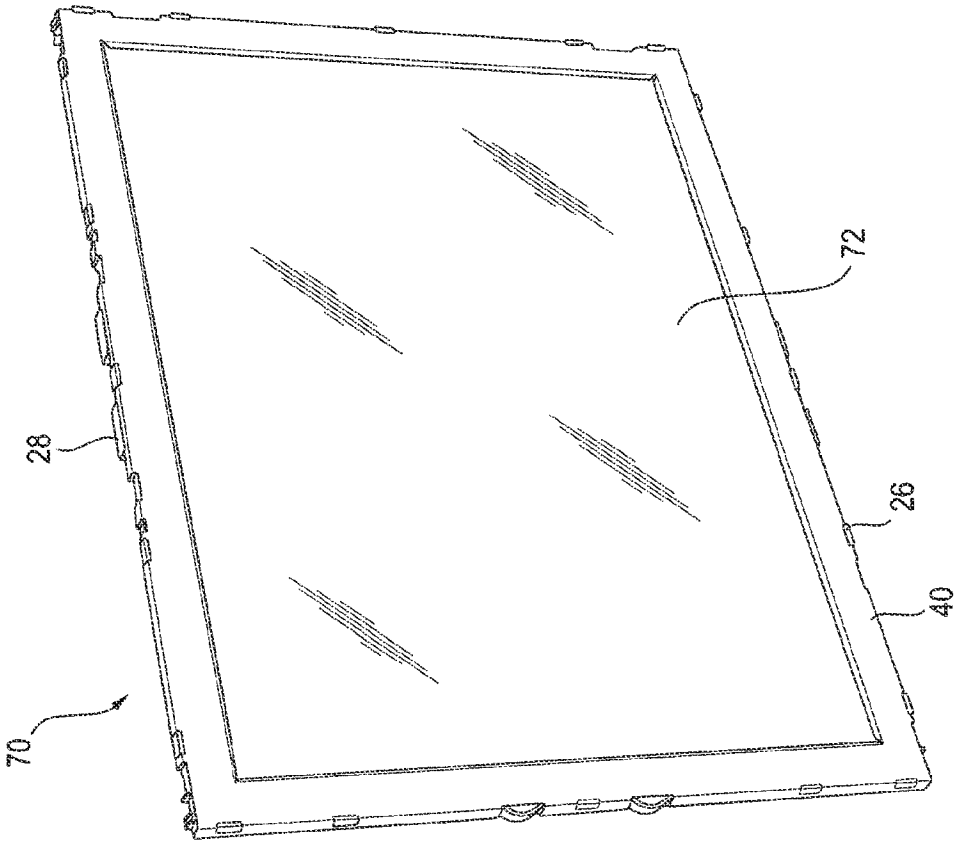


FIG. 8

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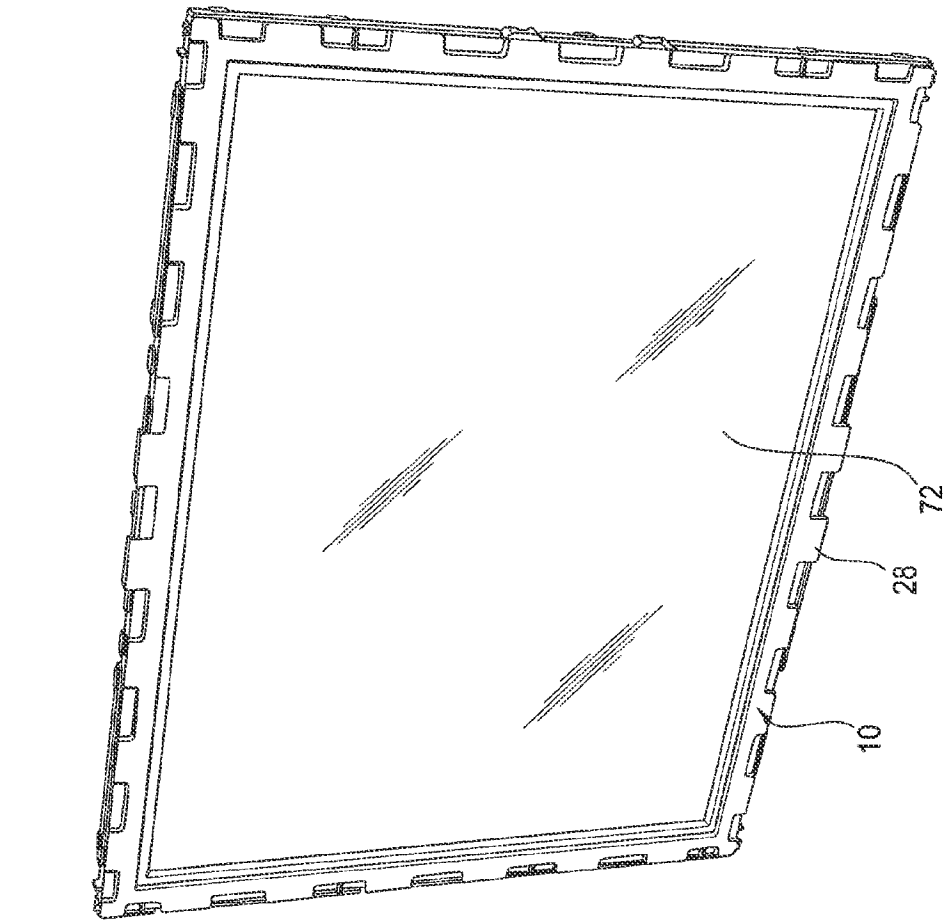


FIG. 9

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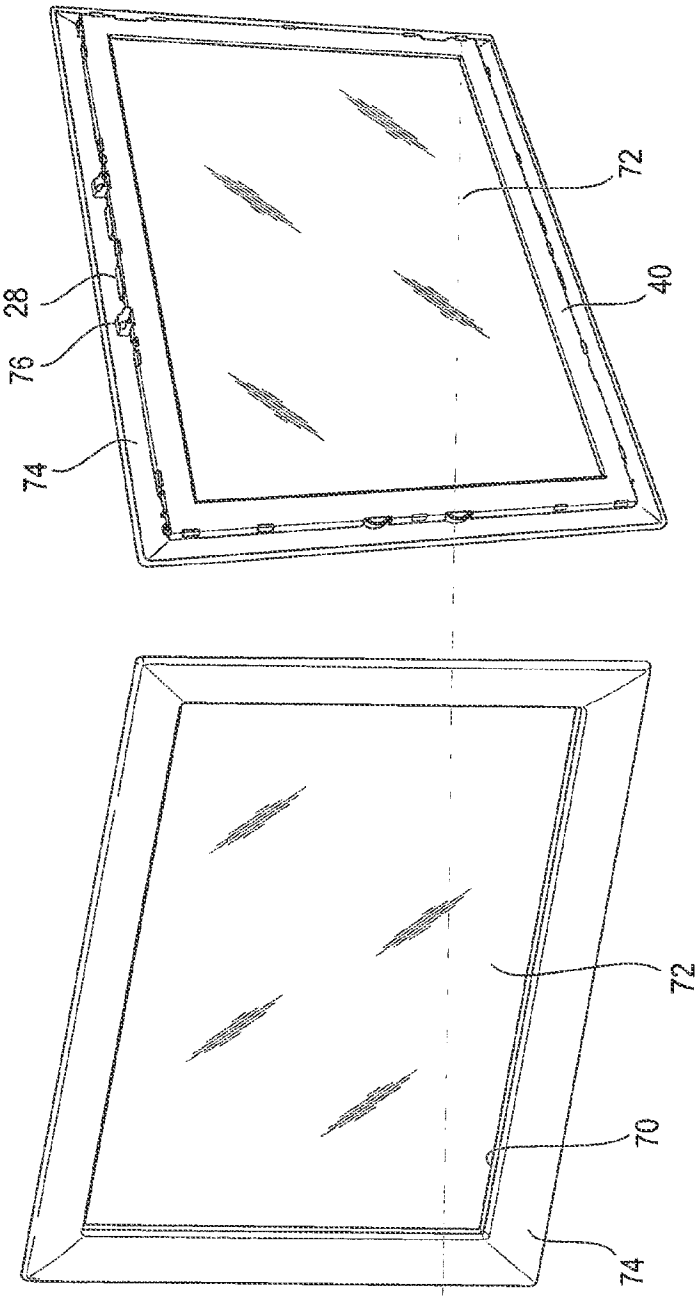


FIG.10

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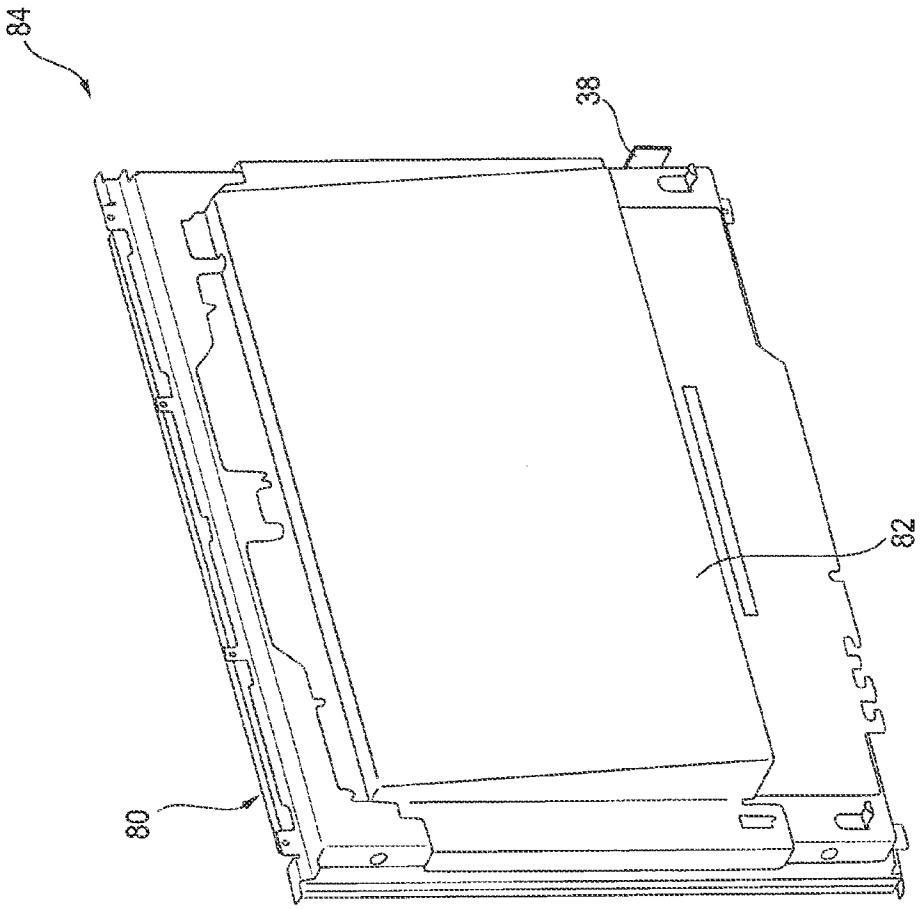


FIG. 11

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(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 325 735 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
25.05.2011 Bulletin 2011/21

(51) Int Cl.:
G06F 3/042 *(2006.01)*

(21) Application number: **10189924.3**

(22) Date of filing: **04.11.2010**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(30) Priority: **23.11.2009 KR 20090113392**

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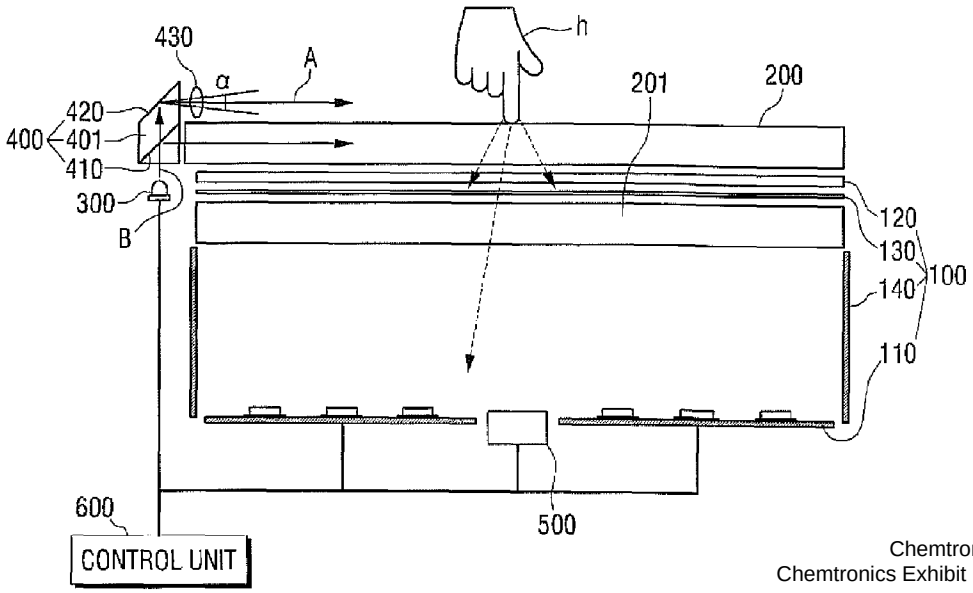
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(54) Multi-touch detecting apparatus and method for LCD display apparatus

(57) A multi-touch detecting apparatus includes a liquid crystal display (LCD) module which includes an LCD panel and a backlight unit (BLU), a plurality of infrared light sources which emits infrared light toward the LCD module, an infrared light detecting camera which is disposed proximate a rear surface of the LCD panel, and detects infrared light reflected from an object on the LCD panel, and a control unit which turns off the BLU when the infrared light detecting camera is turned on.

FIG. 1



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Description

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority from Korean Patent Application No. 10-2009-0113392, filed November 23, 2009 in the Korean Intellectual Property Office, the disclosure of which is incorporated herein by reference in its entirety.

BACKGROUND

1. Field

[0002] Apparatuses and methods consistent with exemplary embodiments relate to a multi-touch detecting of two or more touched positions, for example, on touch screens and electronic blackboards, and more particularly, to a multi-touch detecting applicable to a liquid crystal display (LCD) apparatus.

2. Description of the Related Art

[0003] Touch screen displays are used in portable electronic devices, such as mobile phones, portable multimedia players (PMPs), personal digital assistants (PDAs), and the like. In general, the touch screen technology detects change in voltage or electrical resistance at a point touched by a finger or an object using a single point detecting method. However, the single point detection technology cannot be used with the display apparatuses which detect various inputs at the same time, such as with the electronic blackboards.

[0004] Recently, in order to overcome this shortcoming, multi-touch screen technology to detect the multi-inputs in the projection devices has been developed. The related art multi-touch screen technology methods include a Fourier transform infrared spectroscopy (FTIR) scheme using an infrared light source and an infrared light detecting camera, a Rear Diffused Illumination (Rear-DI) scheme, and an LED-Light Plane (LED-LP) scheme.

[0005] In the FTIR scheme, a plurality of infrared light sources is disposed on the edge of a touch screen. Infrared light emitted from the infrared light sources moves within the interior of a transparent panel which is in contact with a finger of a user. When the infrared light is scattered at a point touched by the finger, an infrared light detecting camera disposed under the transparent panel detects the scattered and reflected infrared light, so that the presence of the touch can be detected. The amount of scattered infrared light correlates with an area touched by the finger.

[0006] In the FTIR scheme, an area touched by the finger is comparatively easily detected since the infrared light is scattered around the center of the area touched by the finger. Accordingly, the center of the touched area can be measured easily and quickly. However, if the finger which is in contact with the transparent panel drags itself on the transparent panel, an area touched by the finger is altered. Accordingly, the amount of scattered infrared light detected by the infrared light detecting camera may be reduced, and the detection capability of the infrared light detecting camera may be diminished. Therefore, it may be difficult to track points touched by the finger through the camera vision processing. In order to solve this problem, a compliant layer may be disposed on the front surface of a transparent panel. However, to have such layer added to the LCD apparatuses is not desirable and difficult to implement.

[0007] In the Rear-DI scheme, an infrared light source and an infrared light detecting camera to detect infrared light emitted from the infrared light source are disposed on the same plane. The infrared light detecting camera detects infrared light reflected by a touch by a finger or an object and detects a touched point. However, in an LCD apparatus, a plurality of optical sheets is piled in an LCD module, so that the infrared light is attenuated while going through the optical sheets. Thus, the detection capability of the infrared light detecting camera may be diminished unless the optical sheets are modified. This makes it difficult to apply the Rear-DI structure to LCD apparatuses.

[0008] The LED-LP scheme is a modification of the FTIR scheme. In LED-LP scheme, the infrared light moves along the front surface of the transparent panel. Under this structure, the shortcoming of the FTIR scheme in tracking the points touched by the finger can be overcome, but it is difficult to detect the center of a point touched by the finger, similar to the Rear-DI scheme.

[0009] As described above, the FTIR, Rear-DI, and LED-LP schemes are technologies related to a multi-touch detecting apparatus which can be applied to a projection system. However, it is difficult to apply these schemes to an LCD system in the same manner.

[0010] Further, in the LCD system, an LCD panel does not have a light emitting function, so a backlight unit (BLU) using cold cathode fluorescent lamps (CCFLs) or light emitting diodes (LEDs) is used. However, since the BLU has an invisible IR band which overlaps with a near IR band of 650nm or more and an IR band 800nm or more, the BLU may operate as a background noise for an infrared light detecting camera. Furthermore, the camera contrast ratio of the infrared light detecting camera may be reduced due to the light emitted by the BLU.

[0011] Therefore, there is a need for a multi-touch detecting apparatus and method which can be applied to an LCD apparatus and avoid influence of a BLU.

SUMMARY

[0012] Exemplary embodiments address at least the above problems and/or disadvantages and other disadvantages not described above. Also, an exemplary embodiment is not required to overcome the disadvantages described above, and an exemplary embodiment may

not overcome any of the problems described above.

[0013] An aspect of an exemplary embodiment provides a multi-touch detecting apparatus and method which can be applied to an LCD apparatus and avoid influence of a BLU.

[0014] According to an aspect of an exemplary embodiment, there is provided a multi-touch detecting apparatus including an LCD module which includes an LCD panel and a BLU, a plurality of infrared light sources which emit infrared light toward the LCD module, an infrared light detecting camera which is disposed under the LCD panel, and detects infrared light reflected from an object on the LCD panel, and a control unit which turns off the BLU when the infrared light detecting camera is turned on.

[0015] The multi control unit may control on-timing of the BLU using an off signal of the infrared light detecting camera as a trigger signal.

[0016] The LCD module may include a transparent panel, which is touched by a user, at an uppermost surface thereof, and the infrared light sources may emit the infrared light parallel to an inside and a surface of the transparent panel.

[0017] The multi-touch detecting apparatus may further include an optical unit which is disposed on a light path of the infrared light sources and moves the infrared light emitted from the infrared light sources so as to be parallel to an inside and a surface of the transparent panel.

[0018] The optical unit may include a beam splitter which reflects the infrared light incident from the infrared light sources so as to separately go through the inside and the surface of the transparent panel, and a collimate member which is disposed on one of a light incident surface and a light emergent of the beam splitter so as to secure straightness of the infrared light.

[0019] There is at least one infrared light detecting camera at the BLU, and the at least one infrared light detecting camera is disposed in the center of the BLU. As the case may be, two or three infrared light detecting cameras may be disposed at the BLU at regular intervals.

[0020] According to an aspect of an exemplary embodiment, the beam splitter may include a first surface which reflects infrared light having a first wavelength and transmits infrared light having the remaining wavelength, and a second surface which reflects all incident light, and the beam splitter may allow the infrared light having the first wavelength to go through the inside of the transparent panel and allow the infrared light having the remaining wavelength to move parallel along the surface of the transparent panel.

[0021] According to an aspect of another exemplary embodiment, the beam splitter may include a first surface which transmits infrared light having a first wavelength and reflects infrared light having the remaining wavelength, and a second surface which reflects all incident light, and the beam splitter may allow the infrared light having the first wavelength to go through the inside of the transparent panel and allow the infrared light having the remaining wavelength to move parallel along the surface of the transparent panel.

[0022] According to an aspect of another exemplary embodiment, the infrared light sources may be arranged around the transparent panel on a plurality of lines. The infrared light sources include a first line to move the infrared light in the inside of the transparent panel, and a second line to move the infrared light on the surface of the transparent panel.

[0023] According to an aspect of another exemplary embodiment, the BLU may use a direct-type lighting method, and the infrared light sources may be disposed on the same plane as the BLU and be formed in two-dimensional arrays so as to have regular intervals with light sources of the BLU.

[0024] According to an aspect of another exemplary embodiment, the BLU may use an edge-type lighting method, and the multi-touch detecting apparatus may further include a reflection unit which reflects infrared light reflected from the object toward the infrared light detecting camera.

[0025] The reflection unit may include a first reflection mirror which reflects infrared light which penetrates the backlight units and is reflected from the object, and a second reflection mirror which reflects the infrared light reflected from the first reflection mirror toward the infrared light detecting camera.

[0026] The infrared light detecting camera may be disposed separately from the BLU.

[0027] The infrared light sources, according to exemplary embodiments, may be disposed on a single side of the transparent panel, on two sides of the transparent panel facing each other, or on four sides of the transparent panel.

[0028] The infrared light sources may be turned on or off concurrently in association with the infrared light detecting camera.

[0029] The infrared light sources may have a horizontal light angle of the infrared light larger than a vertical light angle with respect to the transparent panel.

[0030] The transparent panel may be a transparent acrylic material or a hardened protection glass, and the LCD module may include a white reflector which is disposed at a wall thereof and focuses light of the BLU.

[0031] According to an aspect of another exemplary embodiment, there is provided a multi-touch detecting method including emitting infrared light from an infrared light source toward an LCD module including a BLU, turning on an infrared light detecting camera and turning off the BLU, detecting infrared light reflected from an object on the LCD module, and turning off the infrared light detecting camera and turning on the BLU.

[0032] The emitting the infrared light may include guiding the emitted infrared light to an inside and a surface of a transparent panel which is disposed on the LCD module including the BLU, and in the emitting the infrared light, when the infrared light detecting camera is turned

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on, the infrared light source may be turned on.

[0033] When the infrared light detecting camera is turned off, the infrared light source may be turned off.

[0034] The timing when the infrared light detecting camera is turned on may depend on an amount of infrared light which is scattered and incident from the infrared light source, and an amount of adjacent noise, and an on-off period of the BLU may be greater than at least 30Hz.

[0035] According to one or more exemplary embodiments, the multi-touch detecting apparatus can provide optical design capable of supporting both the FTIR scheme and the LED-LP scheme, and thus support dynamic finger movement detection as well as static finger movement detection.

[0036] In addition, the multi-touch detecting apparatus can detect an infrared light detecting signal without interference with an optical sheet, a transparent panel, a backlight unit, and a white reflector which are installed in the LCD module.

[0037] Furthermore, the period in which the infrared light detecting camera is exposed changes in association with on-off operation of the BLU, so the multi-touch detecting apparatus does not receive influence by the BLU. Therefore, precise position tracking of a touch point can be enabled.

BRIEF DESCRIPTION OF THE DRAWINGS

[0038] The above and/or other aspects will be more apparent by describing certain exemplary embodiments with reference to the accompanying drawings, in which:

FIG. 1 is a schematic perspective view of a multi-touch detecting apparatus according to an exemplary embodiment;

FIG. 2 is a schematic perspective view of a multi-touch detecting apparatus according to an exemplary embodiment;

FIG. 3 is a schematic perspective view of a multi-touch detecting apparatus according to an exemplary embodiment;

FIG. 4 is a schematic perspective view of a multi-touch detecting apparatus according to an exemplary embodiment;

FIG. 5 is a schematic perspective view of a multi-touch detecting apparatus according to an exemplary embodiment;

FIG. 6 is a graph illustrating on-off control of an infrared light source, an infrared light detecting apparatus, and a BLU of the multi-touch detecting apparatuses according to an exemplary embodiment; and

FIG. 7 is a flow chart illustrating a multi-touch detecting method according to an exemplary embodiment.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0039] Certain exemplary embodiments are described in greater detail below with reference to the accompanying drawings.

[0040] In the following description, like drawing reference numerals are used for the like elements, even in different drawings. The matters defined in the description, such as detailed construction and elements, are provided to assist in a comprehensive understanding of exemplary embodiments. However, exemplary embodiments can be practiced without those specifically defined matters.

[0041] FIG. 1 illustrates an example of a multi-touch detecting apparatus according to an exemplary embodiment.

[0042] As illustrated in FIG. 1, the multi-touch detecting apparatus may include an LCD module 100, a transparent panel 200, an infrared light source 300, an optical unit 400, an infrared light detecting camera 500, and a control unit 600. Although the multi-touch detecting apparatus illustrated in a horizontal position for convenience of explanation, it should understood that the multi-touch detecting apparatus may be disposed in a vertical position.

[0043] The LCD module 100 may include a BLU 110, an LCD panel 120, a filter layer 130, and a white reflector 140. The BLU 110 may use a direct-type lighting method using a CCFL or a plurality of LEDs, as illustrated in FIGS. 1 to 3, or may use an edge-type lighting method using a plurality of LEDs disposed at the edge-type of a light guide plate, as illustrated in FIG. 5. The filter layer 130 is interposed between the LCD panel 120 and the BLU 110 to transmit light emitted from the BLU 110 toward the LCD panel 120 uniformly. The white reflector 140 is used for the LCDy module 100 having the direct-type light BLU 110, as illustrated in FIGS. 1 to 3, to guide the light emitted from the BLU 110 to the LCD panel 120. If there is no white reflector 140, some or most of the emitted light, which is not transmitted directly to the LCD panel 120, may become a light loss and, thus, the brightness of the display apparatus may decrease. Therefore, the white reflector 140 is installed when the direct-type light BLUs are used.

[0044] The transparent panel 200 is disposed on the front surface of the LCD module 100 to prevent damage of the LCD module 100 and enable a user to touch a screen displayed on the LCD module 100. The transparent panel 200 may be formed of a transparent acrylic material, or of a material such as a hardened protection glass. The transparent panel 200 may be spaced a predetermined distance apart from the LCD panel 120 to be prevented from being deformed by heat of the LCD panel 120. In addition, if the transparent panel 200 is spaced a predetermined distance apart from the LCD panel 120, the problem of damaging the LCD panel 120 caused when the transparent panel 200 is touched by a finger and becomes in contact with the LCD panel 120, can be prevented.

[0045] A lower transparent panel 201 formed of the same material as the transparent panel 200 may be

formed proximate a rear surface of the LCD panel 120 to be spaced a predetermined distance apart from the LCD panel 120. The lower transparent panel 201 supports the LCD panel 120 and the filter layer 130 disposed proximate the rear surface of the LCD panel 120, and may be formed of a hardened protection glass. For example, the lower transparent panel 201 may be formed of a transparent material.

[0046] A plurality of infrared light sources 300 may be arranged at regular intervals along a single line or two lines. Since the LCD module 100 has a square shape in general, the infrared light sources 300 may be disposed around the transparent panel 200 on the LCD module 100 or proximate the LCD module 100. The infrared light sources 300 may be disposed at one side of the transparent panel 200, at two opposite sides facing each other, or at four sides.

[0047] The direction in which the infrared light sources 300 emit the infrared light can be implemented in various ways according to an exemplary embodiment. Design and presence of the optical unit 400 depend on the infrared light emitting direction and arrangement of the infrared light sources 300. Detailed description is provided below.

[0048] The infrared light sources 300 may have a horizontal light angle greater than a vertical light angle(α) with respect to the direction of the infrared light shown by an arrow A moving along a lengthwise direction of the transparent panel 200 in FIG. 1. With this structure, the infrared light which propagates in the interior of the transparent panel 200 or along the front surface of the transparent panel 200 may be substantially parallel to the lengthwise direction of the transparent panel 200, so that the detection of an object (h), such as the finger of the user, which is in contact with the transparent panel 200 can be effectively performed. The greater the horizontal light angle, the fewer the number of infrared light sources 300 may be used. However, if the horizontal light angle is excessively large, the detection capability may be reduced. Therefore, the horizontal light angle may be smaller and the appropriate number of infrared light sources 300 may be used.

[0049] The optical unit 400 directs the infrared light emitted from the infrared light sources 300 to propagate through the interior of the transparent panel 200 and along the front surface of the transparent panel 200 at the same time. While the infrared light propagates through the interior of the transparent panel 200 and along the front surface of the transparent panel 200 in this manner at the same time, the infrared light propagating through the interior of the transparent panel 200 is scattered around a touch point of an object touching the transparent panel 200 and is used to detect the static movement caused by the finger. The infrared light propagating in parallel along the front surface of the transparent panel 200 is scattered at the contour line of the touch point of an object touching the transparent panel 200 and is used to detect tracking of the dynamic movement caused by the finger.

[0050] A reflection surface of the optical unit 400 is set according to the direction and arrangement of the infrared light sources 300. If the infrared light sources 300 are arranged on a plurality of lines, the optical unit 400 may be omitted. However, the optical unit 400 may be provided to reduce the number of infrared light sources 300. If the optical unit 400 is used, the number of infrared light sources 300 may be reduced approximately in half as compared with the case that the optical unit 400 is not used.

[0051] The optical unit 400 may include a beam splitter 401 and a collimating member 430. The collimating member 430 may include a collimating function sheet, or may be implemented as a collimating lens. The beam splitter 401 may include a first surface 410 and a second surface 420. The reflection and penetration properties of the first and second surfaces 410 and 420 depend on the arrangement and emitting direction of the infrared light sources 300.

[0052] For example, in an exemplary embodiment shown in FIG. 1, the infrared light sources 300 emit infrared light upwards in a direction of an arrow B. In this case, the first surface 410 reflects infrared light having a first wavelength of the infrared light emitted from the infrared light sources 300 so that the infrared light having the first wavelength propagates in the interior of the transparent panel 200 and the remaining infrared light penetrates the first surface 410 and propagates toward the second surface 420. The second surface 420 reflects the infrared light incident to the second surface 420 so that the infrared light propagates along the front surface of the transparent panel 200. The infrared light reflected by the second surface 420 passes through the collimating member 430 to become parallel light, and propagates along the front surface of the transparent panel 200, maintaining substantial straightness.

[0053] In an exemplary embodiment shown in FIG. 2, the infrared light sources 300 emit infrared light substantially parallel to the lengthwise direction of the transparent panel 200. In this case, the first surface 410' transmits infrared light having a first wavelength of the infrared light emitted from the infrared light sources 300 so that the infrared light having the first wavelength propagates through the interior of the transparent panel 200. The first surface 410' reflects the remaining infrared light so that the remaining infrared light propagates toward the second surface 420', is reflected by the second surface 420', and propagates along the front surface of the transparent panel 200. The infrared light reflected by the second surface 420' passes through the collimating member 430 to become parallel light, and propagates along the front surface of the transparent panel 200, maintaining substantial straightness.

[0054] For example, the wavelength of the infrared light distinguished by the first surfaces 410 and 410' may be one of 850nm, 880nm, and 940nm.

[0055] If the infrared light sources 300 are arranged

on a plurality of lines or are disposed on the same plane as the BLU 110, the optical unit 400 may be omitted.

[0056] According to exemplary embodiments shown in FIGS. 3 to 5, infrared light sources 300 emit infrared light toward a transparent panel 200 without a separate carrier.

[0057] For example, as shown in FIGS. 3 and 5, infrared light emitted from a first light source array 310 propagates in the interior of the transparent panel 200, and infrared light emitted from a second light source array 320 propagates along the front surface of the transparent panel 200. In this case, an optical unit may be omitted.

[0058] According to an exemplary embodiment shown in FIG. 4, the infrared light sources 300 may be arranged in two-dimensional arrays. In this case, since the infrared light sources 300 and an infrared light detecting camera 500 are disposed on the same plane, an optical unit may be omitted.

[0059] In exemplary embodiments shown in FIGS. 1 to 3, there is a single infrared light detecting camera 500 disposed in the center of the BLU 110 to sense infrared light reflected from an object which is in contact with the surface of the transparent panel 200. Alternatively, two or more infrared light detecting cameras 500 may be disposed behind the transparent panel 200 at regular intervals.

[0060] In an exemplary embodiment of FIG. 5, an infrared light detecting camera 500 installed in an LCD module 100 having edge-type light BLU 110' is disposed on an external wall of the LCD module 100. The BLU 110' uses first and second reflection mirrors 510 and 520, and the thickness of the display apparatus can be reduced. The edge-type light BLU 110' may be slimmer than the direct-type light BLU 110. The infrared light detecting camera 500 may be disposed at a position capable of reducing the thickness of the display apparatus. In an exemplary embodiment, a light path is formed using the first and second reflection mirrors 510 and 520, but this is merely an example. Three or more reflection mirrors may be used, or just a single reflection mirror may be used.

[0061] The control unit 600 concurrently turns on or off the BLU 110, 110', the infrared light sources 300, and the infrared light detecting camera 500, and optimizes the signal-to-noise ratio (SNR) performance.

[0062] That is, at an exposed timing at which the infrared light detecting camera 500 is turned on and detects the infrared light, the control unit 600 turns off the BLU 110, 110'. Accordingly, when the BLU 110, 110' is turned off, the infrared light detecting camera 500 detects infrared light reflected from an object which is in contact with the transparent panel 200. If the infrared light detecting camera 500 is turned off, the control unit 600 turns on the BLU 110, 110'.

[0063] An on-off control trigger signal of the control unit 600 may use an external trigger signal which uses a microcontroller, or may use a signal which is transmitted to the components, such as the infrared light sources 300, the infrared light detecting camera 500, or the BLU 110, 110'.

[0064] The operation of the control unit 600 is described in detail with reference to FIGS. 6 and 7.

[0065] At time sections and shown in the graph 610 of FIG. 6, the BLU 110, 110' is turned on. The infrared light sources 300 and the infrared light detecting camera 500 are turned off as shown in graphs 620 and 630, respectively.

[0066] When the display apparatus starts operating, the control unit 600 turns on the infrared light sources 300 (S10).

[0067] Subsequently, infrared light emitted from the infrared light sources 300 is guided to propagate in the interior of the transparent panel 200 and along the front surface of the transparent panel 200. There are various methods for guiding the infrared light to propagate in the interior of the transparent panel 200 and along the front surface of the transparent panel 200 as described above (S20).

[0068] Using the on-signal of the infrared light sources 300 as a trigger signal, the control unit 600 turns off the BLU 110, 110' and turns on the infrared light detecting camera 500 (S30) as illustrated by the graph 630 at time section , thereby making an exposed state. Accordingly, since the BLU 110, 110' is turned off, infrared light reflected from a finger or an object (h) which is in contact with the surface of the transparent panel 200, can be input to the infrared light detecting camera 500 without interference and disturbance with the infrared band of the BLU 110, 110'.

[0069] If the BLU 110, 110' is turned on and the infrared light detecting camera 500 is turned on, the noise of the near IR band and the IR band included in the light of the BLU 110, 110' may be mixed with the infrared light reflected from the object (h), so that the infrared light detecting camera 500 may not detect a touch point of the object (h) with precision. However, if the BLU 110, 110' is turned off and the infrared light detecting camera 500 is turned on, the noise interference may be mitigated or eliminated.

[0070] In particular, if the infrared light sources 300 are turned on at time section as shown in the graph 620 of FIG. 6, it is possible to emit infrared light having high peak strength, so that the SNR of the infrared light detecting camera 500 can be enhanced during the detection of the touch of the finger or object (h) at time section .

[0071] The length of time section for detecting the finger or the object (h) depends on the amount of infrared light reflected from the finger or the object (h) which is touching the surface of the transparent panel 200, and the amount of noise. The stronger the reflected infrared light, the shorter the detecting time. However, if excessively strong infrared light is used, the infrared light may affect other electronic devices. Therefore, the strength of infrared light may be set appropriately. At time section, since the BLU 110, 110' is turned off, the display apparatus may look dark, so the time section may be set to

be short. Therefore, the strength of infrared light should not be excessively low. The infrared peak strength of the infrared light sources 300 varies according to the system.

[0072] Reiteration of on-off time section may be considered according to the optical-electrical circuit property of the infrared light sources 300, the infrared light detecting camera 500, and the BLU 110, 110'.

[0073] At time section in FIG. 6, if the detection of the infrared light is complete, the control unit 600 turns on the BLU 110, 110' and turns off the infrared light detecting camera 500 (S40).

[0074] Subsequently, the control unit 600 turns off the infrared light sources 300 (S50). The infrared light sources 300 can be controlled to be in a continuous-wave mode in which the infrared light sources 300 are always turned on, but it is not appropriate for the infrared light sources 300 to always emit infrared light. Infrared light is generally used for remote controllers for controlling electronic devices, so if the infrared light sources 300 always emit infrared light, the infrared light may be confused with control signals of other electronic devices and may cause malfunction.

[0075] Subsequently, the infrared light sources 300 are turned on when the infrared light detecting camera 500 is turned on and the BLU 110, 110' is turned off.

[0076] As described above, the BLU 110, 110' is turned on and off periodically. If the on-off period of the BLU 110 is slow, the user may feel the flicker of the screen of the display apparatus. Therefore, the on-off period of the BLU 110 may be set to be fast. For example, the on-off period of the BLU 110, 110' may be set to be faster than 30Hz.

[0077] The foregoing exemplary embodiments and advantages are merely exemplary and are not to be construed as limiting. The present teaching can be readily applied to other types of apparatuses. Also, the description of the exemplary embodiments is intended to be illustrative, and not to limit the scope of the claims, and many alternatives, modifications, and variations will be apparent to those skilled in the art.

Claims

1. A multi-touch detecting apparatus comprising:

   a liquid crystal display (LCD) module which comprises an LCD panel and a backlight unit (BLU);
   a plurality of infrared light sources which emits infrared light toward the LCD module;
   an infrared light detecting camera which is disposed behind the LCD panel and detects infrared light reflected from an object on the LCD panel; and
   a control unit which turns off the BLU when the infrared light detecting camera is turned on.

2. The multi-touch detecting apparatus according to claim 1, wherein the control unit controls on-timing of the BLU using an off signal of the infrared light detecting camera as a trigger signal.

3. The multi-touch detecting apparatus according to claim 1, wherein the LCD module comprises a transparent panel, which is touched by a user, at an uppermost surface thereof.

4. The multi-touch detecting apparatus according to claim 3, wherein the plurality of infrared light sources emits the infrared light parallel to an interior surface and the uppermost surface of the transparent panel.

5. The multi-touch detecting apparatus according to claim 3, further comprising:

   an optical unit which is disposed on a light path of the plurality of infrared light sources and directs the infrared light emitted from the plurality of infrared light sources to be parallel to an interior surface and to the uppermost surface of the transparent panel.

6. The multi-touch detecting apparatus according to claim 5, wherein the optical unit comprises:

   a beam splitter which reflects the infrared light incident from the plurality of infrared light sources so as to separately propagate inside and along the uppermost surface of the transparent panel; and
   a collimating member which is disposed on one of light incident surfaces of the beam splitter so as to secure straightness of the infrared light.

7. The multi-touch detecting apparatus according to claim 6, wherein the beam splitter comprises a first surface which reflects infrared light having a first wavelength and transmits infrared light having remaining wavelengths, and a second surface which reflects all incident light, and allows the infrared light having the first wavelength to propagate through the inside of the transparent panel and allows the infrared light having the remaining wavelengths to propagate parallel along the uppermost surface of the transparent panel.

8. The multi-touch detecting apparatus according to claim 6, wherein the beam splitter comprises a first surface which transmits infrared light having a first wavelength and reflects infrared light having remaining wavelengths, and a second surface which reflects all incident light, and allows the infrared light having the first wavelength to propagate through the inside of the transparent panel and allows the infrared light having the remaining wavelengths to propagate parallel along the uppermost surface of the

transparent panel.

9. The multi-touch detecting apparatus according to claim 1, wherein the infrared light detecting camera is disposed at the BLU.

10. The multi-touch detecting apparatus according to claim 9, wherein the infrared light detecting camera is disposed in a center of the BLU.

11. The multi-touch detecting apparatus according to claim 9, further comprising a plurality of infrared light detecting cameras disposed at the BLU.

12. The multi-touch detecting apparatus according to claim 3, wherein the plurality of infrared light sources comprises a first light source array which emits infrared light parallel along an interior surface of the transparent panel, and a second light source array which is disposed above the first light source array and emits infrared light parallel to the uppermost surface of the transparent panel.

13. The multi-touch detecting apparatus according to claim 1, wherein the BLU uses an edge lighting method, the multi-touch detecting apparatus further comprises a reflection unit which reflects infrared light reflected from the object toward the infrared light detecting camera, the reflection unit comprising:

a first reflection mirror which reflects infrared light which penetrates the backlight unit and is reflected from the object; and
a second reflection mirror which reflects the infrared light reflected from the first reflection mirror toward the infrared light detecting camera, wherein
the infrared light detecting camera is disposed outside the BLU.

14. The multi-touch detecting apparatus according to claim 3, wherein the plurality of infrared light sources is disposed on a single side of the transparent panel.

15. A multi-touch detecting method comprising:

emitting infrared light from an infrared light source toward a liquid crystal display (LCD) module comprising a backlight unit (BLU);
turning on an infrared light detecting camera and turning off the BLU;
detecting infrared light reflected from an object on the LCD module; and
turning off the infrared light detecting camera and turning on the BLU,
wherein the emitting the infrared light comprises guiding the emitted infrared light to an inside and along a surface of a transparent panel which is disposed on the LCD module comprising the BLU, and
wherein in the emitting the infrared light, when the infrared light detecting camera is turned on, the infrared light source is turned on.

FIG. 1

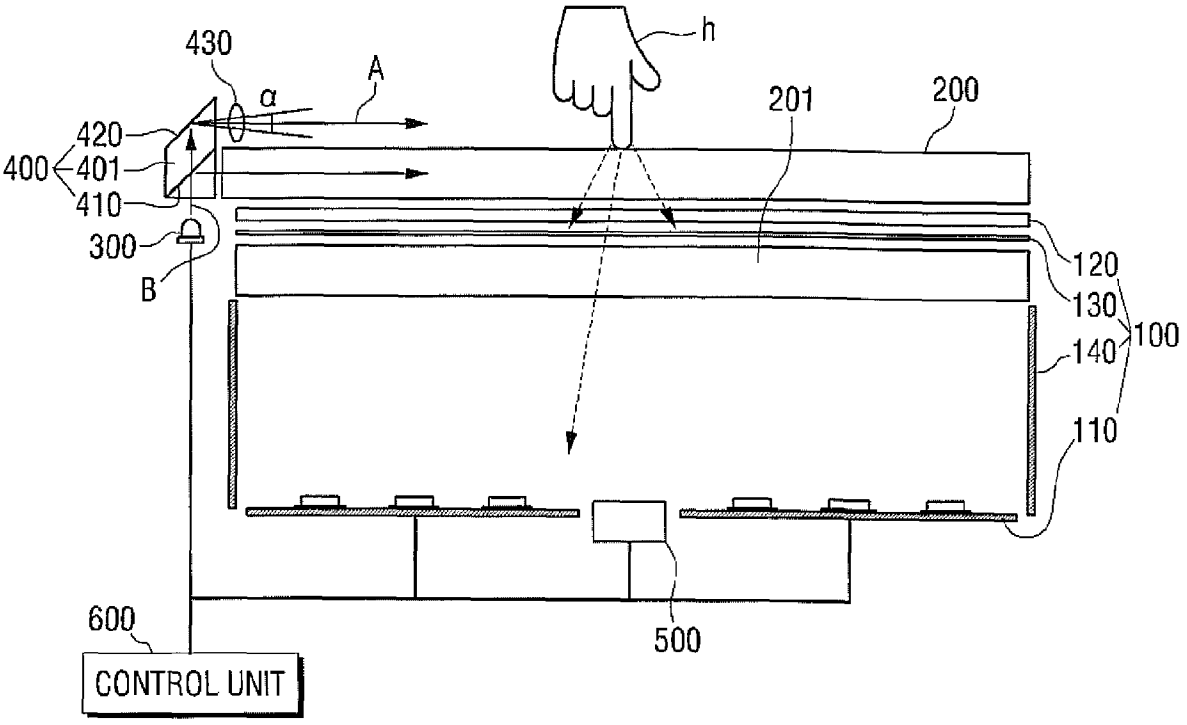

h
430
A
α
201
200
420
400
401
410
300
B
120
130
100
140
110
500
600
CONTROL UNIT

FIG. 2

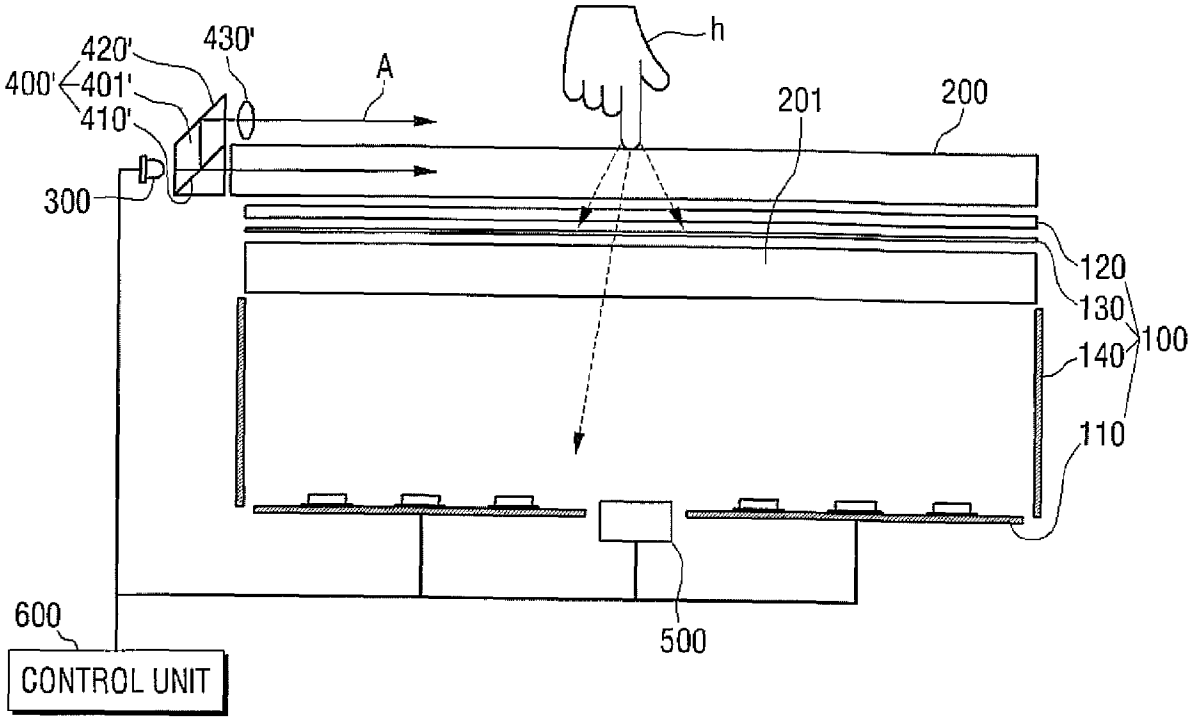

h
420'
430'
400'
401'
410'
A
201
200
300
120
130
140
100
110
600
500
CONTROL UNIT

FIG. 3

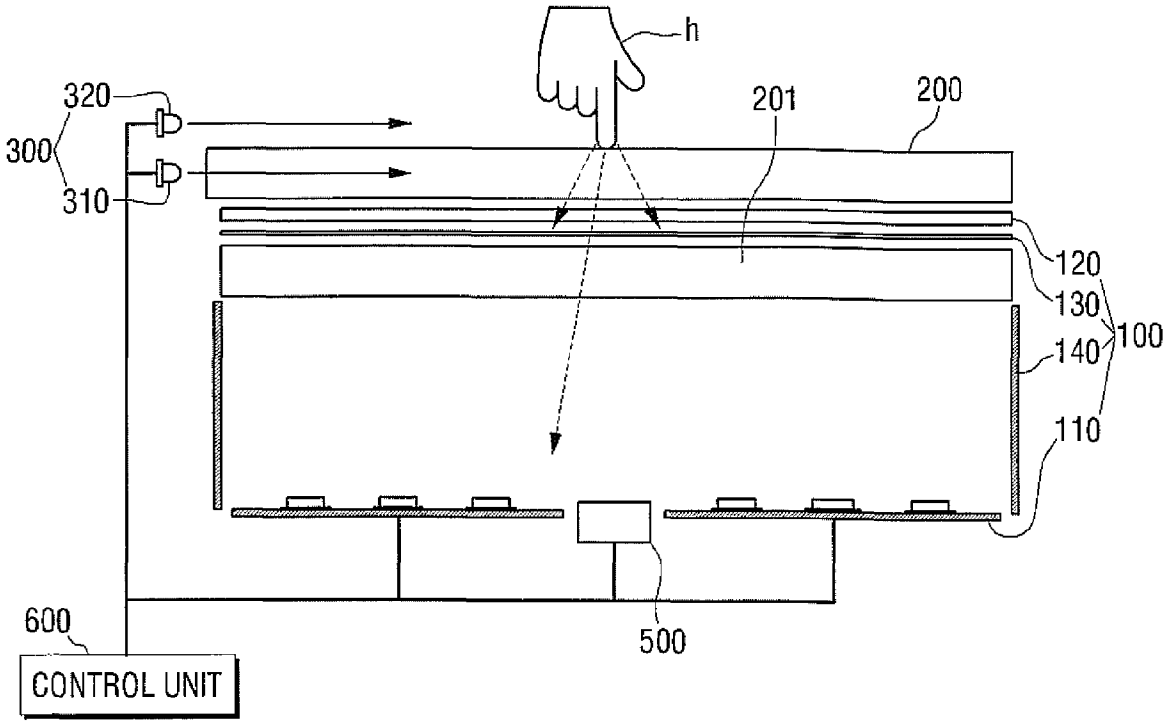


FIG. 4

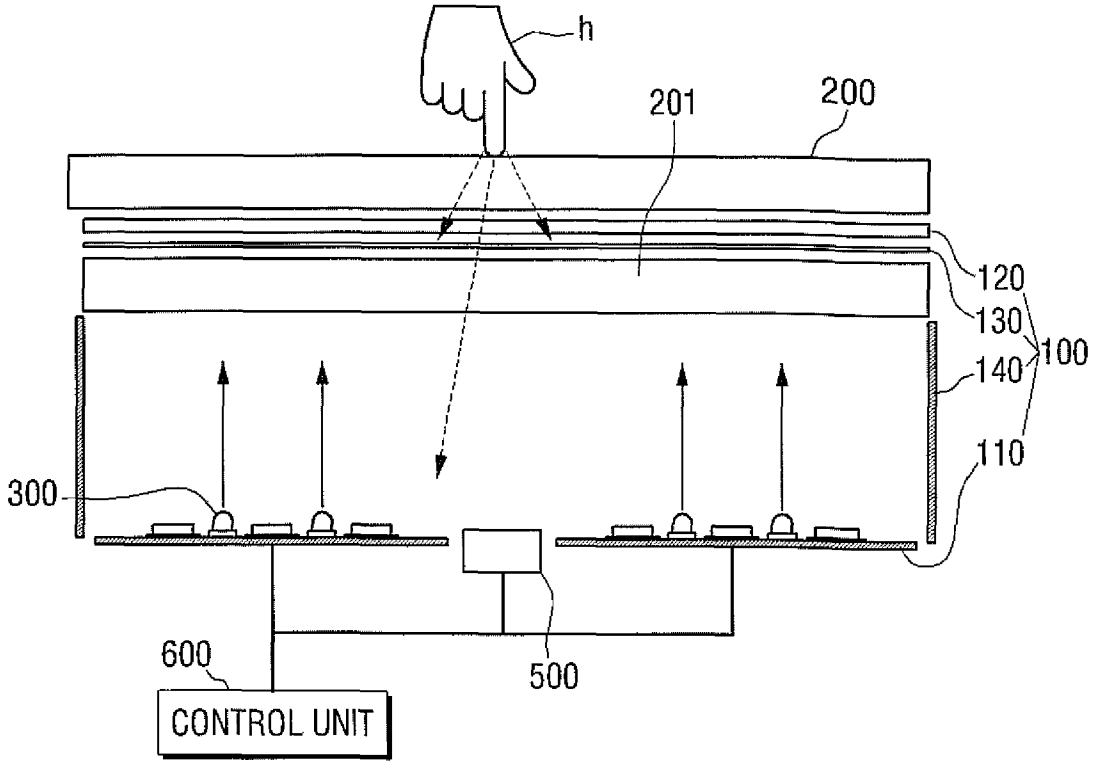


FIG. 5

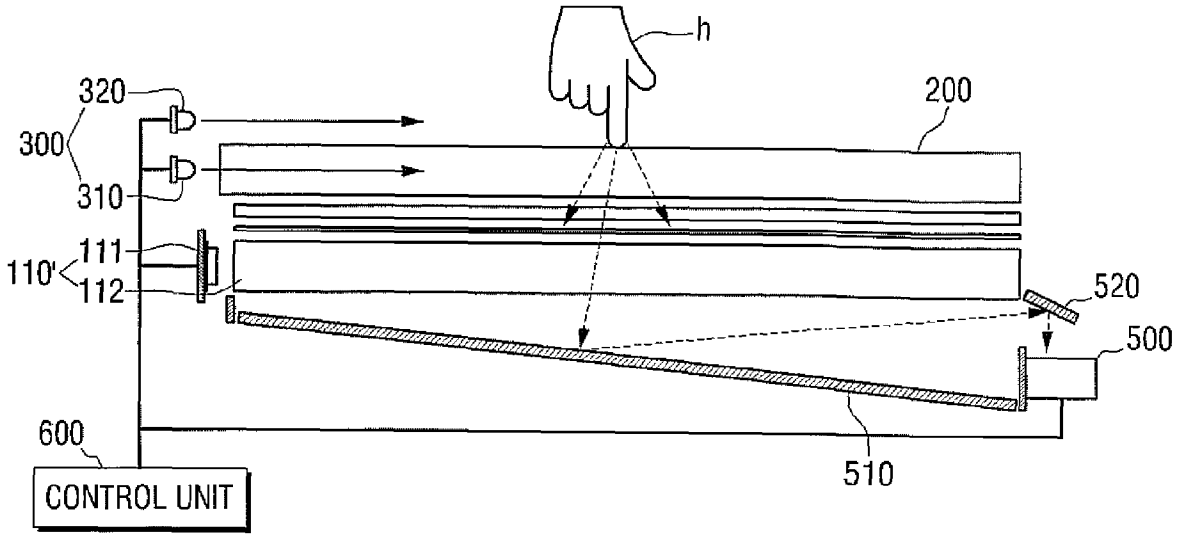


FIG. 6

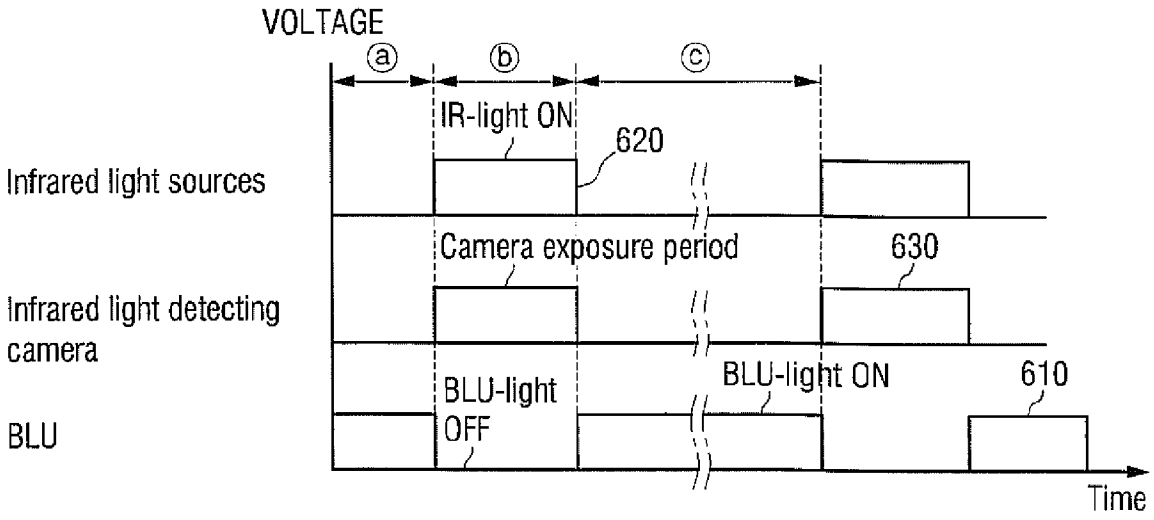
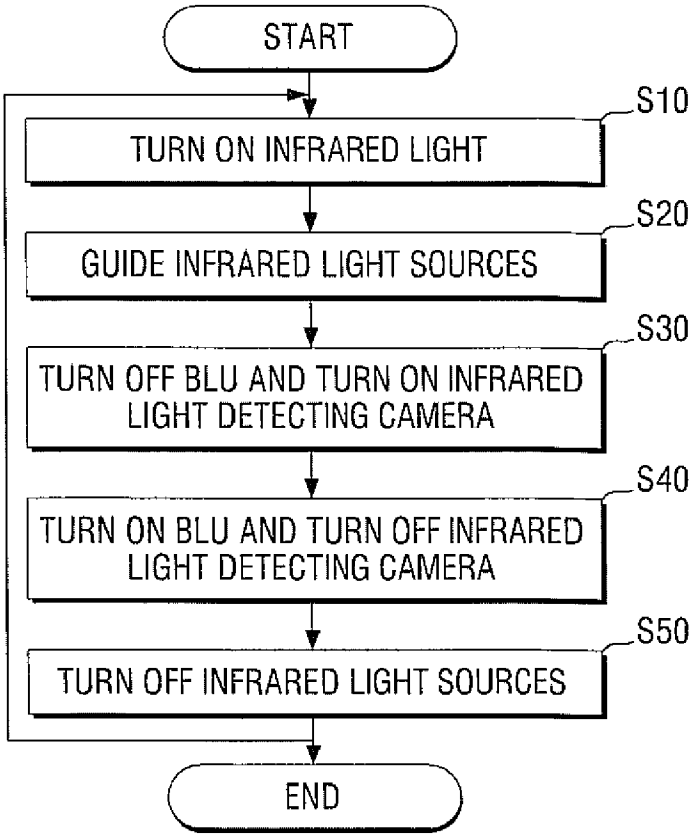

VOLTAGE
ⓐ
ⓑ
ⓒ
IR-light ON
620
Infrared light sources
Camera exposure period
630
Infrared light detecting camera
BLU-light OFF
BLU-light ON
610
BLU
Time

FIG. 7


START
S10
TURN ON INFRARED LIGHT
S20
GUIDE INFRARED LIGHT SOURCES
S30
TURN OFF BLU AND TURN ON INFRARED LIGHT DETECTING CAMERA
S40
TURN ON BLU AND TURN OFF INFRARED LIGHT DETECTING CAMERA
S50
TURN OFF INFRARED LIGHT SOURCES
END

REFERENCES CITED IN THE DESCRIPTION

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(19)日本国特許庁(JP)　(12)公開特許公報(A)　(11)特許出願公開番号
特開2015-158831
(P2015-158831A)
(43)公開日　平成27年9月3日(2015.9.3)

(51)Int.Cl.			F I			テーマコード（参考）
G06F	3/042	(2006.01)	G06F	3/042	484	5G435
G06F	3/041	(2006.01)	G06F	3/041	400	
G09F	9/00	(2006.01)	G09F	9/00	350Z	
H04N	5/64	(2006.01)	G09F	9/00	366A	
			H04N	5/64	571A	

審査請求 未請求　請求項の数 5　OL　（全 12 頁）

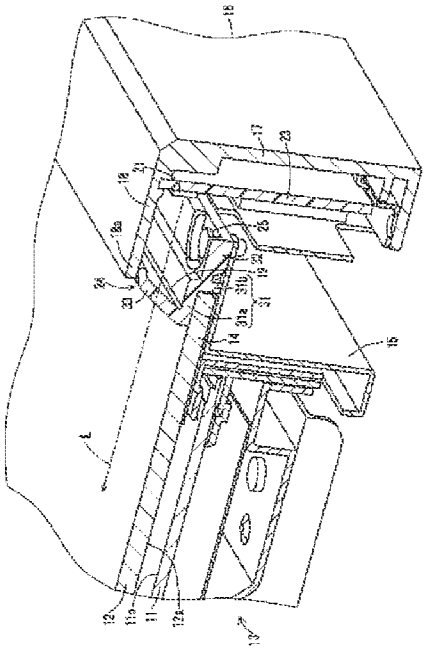
(21)出願番号　特願2014-33820(P2014-33820)
(22)出願日　平成26年2月25日(2014.2.25)

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Ｆターム(参考)　5G435 AA17　AA18　BB05　BB12　BE02
BE05　GG43　HH02　KK03

(54)【発明の名称】座標入力装置および画像表示装置

(57)【要約】
【課題】　装置全体の重量を低減し、部品点数を削減し、赤外線の透過率を場所に依らずに安定させることができる座標入力装置を提供する。
【解決手段】　タッチパネル装置１０は、液晶パネル１１と、保護ガラス１２と、液晶パネル１１および保護ガラス１２を外囲する外観ベゼル１６と、保護ガラス１２の周縁部分１４を液晶パネル１１側から支持するモジュール金属ベゼル１５とを含み、外観ベゼル１６が、保護ガラス１２の厚み方向に、周縁部分１４から離間して配置される額縁部分１８を有する液晶表示装置１に搭載され、外観ベゼル１６内に設けられ、周縁部分１４と額縁部分１８との間の間隙１９を介して赤外線Ｌを受光する複数の受光素子２２と、赤外線Ｌを透過し、間隙１９を閉塞するＩＲフィルタ２４とを含み、ＩＲフィルタ２４が、モジュール金属ベゼル１５と協働して保護ガラス１２の周縁部分１４を挟持することで、保護ガラス１２を固定する。
【選択図】　図２



【特許請求の範囲】
【請求項１】
画像を表示する表示面を有する表示部と、前記表示面に対向して配設される透明の板状部材と、前記表示部および前記板状部材を外囲するフレーム部材と、前記板状部材の周縁部分を前記表示部側から支持する支持部材とを含み、前記フレーム部材が、前記板状部材の厚み方向に、前記周縁部分から離間して配置される枠状部分を有する画像表示装置に搭載され、前記板状部材における、指示体によって指示された指示位置を検出する座標入力装置であって、
前記フレーム部材の内部に設けられ、前記板状部材の周縁部分と前記枠状部分との間の間隙を介して、前記指示位置を検出するために用いられる検出光を受光する複数の受光部と、
前記検出光を透過する材料から成り、前記間隙を閉塞する閉塞部材とを含み、
前記閉塞部材が、前記支持部材と協働して前記板状部材の周縁部分を挟持することにより、該板状部材を固定するように構成されていることを特徴とする座標入力装置。
【請求項２】
前記閉塞部材は、
前記板状部材の周縁部分における、前記表示部側とは反対側の表面に面接触する挟持部分と、
前記挟持部分における、前記厚み方向に垂直な面方向の外方側の端部に連なり、前記支持部材に固定される固定部分と、
前記挟持部分における、前記面方向の内方側の端部に連なり、前記間隙を閉塞する閉塞部分とを含むことを特徴とする請求項１に記載の座標入力装置。
【請求項３】
前記固定部分は、長尺の板状に形成され、前記支持部材に対向する側の対向面には、前記支持部材に対する位置決めのための複数の位置決め部が、長手方向に沿って間を空けて形成され、前記対向面とは反対側の面には、前記位置決め部が形成されている位置に対応して、リブが形成されていることを特徴とする請求項２に記載の座標入力装置。
【請求項４】
前記フレーム部材の内部に前記複数の受光部に個別に対応して設けられ、対応する前記受光部に向けて、赤外線を前記検出光として出射する複数の発光部をさらに含むことを特徴とする請求項１～３のいずれか１つに記載の座標入力装置。
【請求項５】
請求項１～４のいずれか１つに記載の座標入力装置が搭載されることを特徴とする画像表示装置。
【発明の詳細な説明】
【技術分野】
【０００１】
本発明は、液晶表示装置などの画像表示装置に搭載される座標入力装置およびそれを備える画像表示装置に関する。
【背景技術】
【０００２】
従来から、液晶表示装置などの画像表示装置に搭載される座標入力装置として、赤外線遮断方式による座標入力装置が提案されている（たとえば、特許文献１参照）。
【０００３】
図５は、従来技術に係る赤外線遮断方式による座標入力装置１１０を搭載した液晶表示装置１００の構成を示す部分断面図である。液晶表示装置１００は、図５に示すように、画像を表示する表示面を一方側の主面１１１ａに有する矩形板状に構成された液晶パネル１１１と、液晶パネル１１１の表示面に対向して配置される、無色透明で矩形板状の保護ガラス１１２と、液晶パネル１１１を含む液晶モジュール１１３を四方から外囲するとともに、保護ガラス１１２の周縁部分１１４を液晶パネル１１１側から支持するモジュール

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金属ベゼル１１５と、モジュール金属ベゼル１１５と協働して、保護ガラス１１２の周縁部分１１４を挟持することにより、保護ガラス１１２を固定する金属製のガラス押えアングル１１６と、保護ガラス１１２の周縁部分１１４の損傷を防止するために、ガラス押えアングル１１６と保護ガラス１１２の周縁部分１１４との間に配設されるガラス押えクッション１１７と、液晶モジュール１１３および保護ガラス１１２を四方から外囲する、外観フレームとして機能する矩形枠状のアルミベゼル１１８とを含んで構成される。

【０００４】

アルミベゼル１１８は、液晶モジュール１１３および保護ガラス１１２の外周に沿って設けられる、該外周よりも一回り大きな大略的に矩形筒状の側壁部分１１９と、側壁部分１１９における、保護ガラス１１２の厚み方向一方側の端部であって、液晶表示装置１００の正面側に配置される端部に一体的に連なり、側壁部分１１９から内方側へ略直角に屈曲する矩形枠状の額縁部分１２０とを含み、額縁部分１２０は、保護ガラス１１２の周縁部分１１４に対し、保護ガラス１１２の厚み方向に離間して配置される。これにより、図５に示すように、アルミベゼル１１８の額縁部分１２０における内方側端部１２０ａと、保護ガラス１１２の周縁部分１１４との間には間隙１２１が形成される。

【０００５】

一方、座標入力装置１１０は、赤外線Ｌを出射する複数の発光素子１２２と、複数の発光素子１２２に個別に対応して設けられ、対応する発光素子１２２から出射された赤外線Ｌをそれぞれ受光する複数の受光素子（図示せず）と、アルミベゼル１１８内に保持され、複数の発光素子１２２および受光素子が搭載されるセンサ基板１２３とを含み、アルミベゼル１１８内に配置される発光素子１２２から出射された赤外線Ｌが、額縁部分１２０における内方側端部１２０ａと保護ガラス１１２の周縁部分１１４との間の間隙１２１を通過し、保護ガラス１１２の表面に沿って進行し、再度、額縁部分１２０における内方側端部１２０ａと保護ガラス１１２の周縁部分１１４との間の間隙１２１を通過して、アルミベゼル１１８内に配置される、対応する受光素子によって受光されるように構成される。座標入力装置１１０は、各受光素子において、対応する発光素子１２２から出射された赤外線Ｌが検出されたか否かに基づいて、ユーザが保護ガラス１２の表面を指またはスタイラスなどの指示体によって指示した指示位置の座標を検出する。

【０００６】

従来から、このように構成される座標入力装置１１０においては、アルミベゼル１１８内に設けられた発光素子１２２および受光素子やセンサ基板１２３が外部から視認されることにより、外観が損なわれることを防止するために、また、アルミベゼル１１８内に塵埃が侵入し、発光素子１２２および受光素子に付着することにより、発光素子１２２から出射された赤外線Ｌが受光素子において検出されるときの検出レベルが低下することで、保護ガラス１１２の表面における指示位置を誤検出してしまうことを防止するために、図５に示すように、アルミベゼル１１８の額縁部分１２０における内方側端部１２０ａと保護ガラス１１２の周縁部分１１４との間に形成された間隙１２１を閉塞するように、可視光を吸収し、赤外線Ｌを透過する赤外線透過フィルタ（以下、「ＩＲフィルタ」と称する）１２４がさらに組み付けられて構成されている。

【先行技術文献】

【特許文献】

【０００７】

【特許文献１】特開平１１－４５１５５号公報

【発明の概要】

【発明が解決しようとする課題】

【０００８】

従来から、このＩＲフィルタ１２４は、可視光を吸収し、赤外線Ｌを透過するＩＲインクをシルク印刷した、たとえばポリカーボネート（ＰＣ）から成る長尺の板状体によって構成され、図５に示すように、その幅方向の一方側の端部１２４ａが、保護ガラス１１２の周縁部分１１４に対して接触するように、その幅方向の他方側の端部１２４ｂが、アル

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ミベゼル１１８の額縁部分１２０における内方側端部１２０ａに、両面テープなどで固定されている。

【０００９】

しかしながら、かかる構造では、ＩＲフィルタ１２４の一方側の端部１２４ａが固定されていないため、たとえば装置を運搬する際の揺れなどに起因して、その一方側の端部１２４ａが振動すると、一方側の端部１２４ａと保護ガラス１１２の周縁部分１１４とが擦れ、保護ガラス１１２の周縁部分１１４の表面を傷つけてしまうという問題がある。

【００１０】

また、かかる構造では、両面テープの劣化などに起因して、ＩＲフィルタ１２４が、額縁部分１２０における内方側端部１２０ａから剥離してしまうおそれがあるという問題もある。さらには、一方側の端部１２４ａが振動することで、該一方側の端部１２４ａと保護ガラス１１２の周縁部分１１４とが離間してしまうと、その間隙からアルミベゼル１１８内に塵埃が侵入し、発光素子１２２および受光素子に付着することで、発光素子１２２から出射された赤外線Ｌが受光素子において検出されるときの検出レベルが低下してしまうという問題もある。

【００１１】

また、前記のように、従来のＩＲフィルタ１２４は、ＩＲインクをシルク印刷することによって構成されているので、シルク印刷の印刷精度にばらつきが生じてしまうおそれがある。このように印刷精度にばらつきが生じると、赤外線Ｌの透過率が場所に依ってばらつくことにより、発光素子１２２から出射された赤外線Ｌが受光素子において検出されるときの検出レベルも場所によって異なってしまい、保護ガラス１１２の表面における指示位置の誤検出につながるおそれがあるという問題もある。

【００１２】

さらに、従来の液晶表示装置１００では、赤外線遮断方式による座標入力装置１１０を搭載するために、アルミベゼル１１８の額縁部分１２０における内方側端部１２０ａと保護ガラス１１２の周縁部分１１４との間に間隙１２１が形成されるので、保護ガラス１１２を固定するために、図５に示すように、板金部品であるガラス押えアングル１１６とガラス押えクッション１１７とを別途取り付ける必要がある。このため、装置全体の重量が増大し、また、部品点数も多くなっているという問題がある。さらに、これにより、製造コストが増大しているという問題もある。

【００１３】

引用文献１には、額縁部分における内方側端部に相当する部分と、保護ガラスに相当するアクリル板との間にＩＲフィルタを配置することについては開示されているが、アクリル板の固定方法については記載されていない。

【００１４】

本発明の目的は、装置全体の重量を低減し、部品点数を削減し、赤外線の透過率を場所に依らずに安定させることができる座標入力装置およびそれを備える画像表示装置を提供することである。

【課題を解決するための手段】

【００１５】

本発明は、画像を表示する表示面を有する表示部と、前記表示面に対向して配設される透明の板状部材と、前記表示部および前記板状部材を外囲するフレーム部材と、前記板状部材の周縁部分を前記表示部側から支持する支持部材とを含み、前記フレーム部材が、前記板状部材の厚み方向に、前記周縁部分から離間して配置される枠状部分を有する画像表示装置に搭載され、前記板状部材における、指示体によって指示された指示位置を検出する座標入力装置であって、

前記フレーム部材の内部に設けられ、前記板状部材の周縁部分と前記枠状部分との間の間隙を介して、前記指示位置を検出するために用いられる検出光を受光する複数の受光部と、

前記検出光を透過する材料から成り、前記間隙を閉塞する閉塞部材とを含み、

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前記閉塞部材が、前記支持部材と協働して前記板状部材の周縁部分を挟持することにより、該板状部材を固定するように構成されていることを特徴とする座標入力装置である。

【００１６】

また本発明は、前記閉塞部材は、

前記板状部材の周縁部分における、前記表示部側とは反対側の表面に面接触する挟持部分と、

前記挟持部分における、前記厚み方向に垂直な面方向の外方側の端部に連なり、前記支持部材に固定される固定部分と、

前記挟持部分における、前記面方向の内方側の端部に連なり、前記間隙を閉塞する閉塞部分とを含むことを特徴とする。

【００１７】

また本発明は、前記固定部分は、長尺の板状に形成され、前記支持部材に対向する側の対向面には、前記支持部材に対する位置決めのための複数の位置決め部が、長手方向に沿って間を空けて形成され、前記対向面とは反対側の面には、前記位置決め部が形成されている位置に対応して、リブが形成されていることを特徴とする。

【００１８】

また本発明は、前記フレーム部材の内部に前記複数の受光部に個別に対応して設けられ、対応する前記受光部に向けて、赤外線を前記検出光として出射する複数の発光部をさらに含むことを特徴とする。

また本発明は、前記座標入力装置が搭載されることを特徴とする画像表示装置である。

【発明の効果】

【００１９】

本発明によれば、フレーム部材の枠状部分と板状部材の周縁部分との間に間隙が形成され、その間隙を介して、板状部材における指示位置を検出するために用いられる検出光を受光して、指示位置の座標を検出するように構成された座標入力装置が搭載される画像表示装置において、板状部材を固定するための部材を、閉塞部材と別途に設ける必要がなくなるので、装置全体の重量を低減することができ、また部品点数を削減することができる。さらに、閉塞部材が、検出光を透過する材料から成るので、赤外線の透過率を場所に依らずに安定させることができる。

【図面の簡単な説明】

【００２０】

【図１】本発明の第１の実施形態に係るタッチパネル装置１０を搭載した液晶表示装置１の構成を概略的に示す正面図である。

【図２】図１における切断面線ＩＩ－ＩＩから見た断面を示す斜視図である。

【図３】液晶表示装置１の左上の角部を拡大して示す図であり、図３（ａ）は外観ベゼル１６が装着された状態を示し、図３（ｂ）は外観ベゼル１６が取り外された状態を示している。

【図４】本発明の第２の実施形態に係るタッチパネル装置を構成するＩＲフィルタ４０の長手方向の一方側の構成を概略的に示す斜視図であり、図４（ａ）はＩＲフィルタ４０を上方から見た斜視図であり、図４（ｂ）はＩＲフィルタ４０を下方から見た斜視図である。

【図５】従来技術に係る赤外線遮断方式による座標入力装置１１０を搭載した液晶表示装置１００の構成を示す部分断面図である。

【発明を実施するための形態】

【００２１】

（第１の実施形態）

図１は、本発明の第１の実施形態に係るタッチパネル装置１０を搭載した液晶表示装置１の構成を概略的に示す正面図である。図２は、図１における切断面線ＩＩ－ＩＩから見た断面を示す斜視図である。本実施形態に係るタッチパネル装置１０は、赤外線遮断方式による座標入力装置である。

【００２２】
先ず、液晶表示装置１の構成について説明する。液晶表示装置１は、図２に示すように、画像を表示する表示面を一方側の主面１１ａに有する矩形板状に構成された液晶パネル１１（表示部）と、液晶パネル１１の表示面に対向して配置される、無色透明で矩形板状の保護ガラス１２（板状部材）と、液晶パネル１１を含む液晶モジュール１３を四方から外囲するとともに、保護ガラス１２の周縁部分１４を液晶パネル１１側から支持するモジュール金属ベゼル１５（支持部材）と、液晶モジュール１３および保護ガラス１２を四方から外囲する、外観フレームとして機能する矩形枠状の外観ベゼル１６（フレーム部材）とを含んで構成される。

【００２３】
外観ベゼル１６は、液晶モジュール１３および保護ガラス１２の外周に沿って設けられる、該外周よりも一回り大きな大略的に矩形筒状の側壁部分１７と、側壁部分１７における、保護ガラス１２の厚み方向の一方側の端部であって、液晶表示装置１の正面側に配置される端部に一体的に連なり、側壁部分１７から内方側へ略直角に屈曲する矩形枠状の額縁部分１８（枠状部分）とを含み、額縁部分１８は、保護ガラス１２の周縁部分１４に対し、保護ガラス１２の厚み方向に離間して配置される。これにより、図２に示すように、外観ベゼル１６の額縁部分１８における内方側端部１８ａと、保護ガラス１２の周縁部分１４との間には間隙１９が形成される。外観ベゼル１６は、たとえばアルミ押出材によって構成される。

【００２４】
一方、タッチパネル装置１０は、赤外線Ｌ（検出光）を出射する複数の発光素子２１（発光部）と、複数の発光素子２１に個別に対応して設けられ、対応する発光素子２１から出射された赤外線Ｌをそれぞれ受光する複数の受光素子２２（受光部）と、外観ベゼル１６内に保持され、複数の発光素子２１および受光素子２２が搭載されるセンサ基板２３とを含んで構成される。

【００２５】
本実施形態では、図１に示すように、液晶パネル１１の一方の長辺に沿って、複数の発光素子２１が、液晶パネル１１の短辺に平行に赤外線Ｌを出射するように、等間隔で一列に並べて配設されるとともに、液晶パネル１１の一方の短辺に沿って、複数の発光素子２１が、液晶パネル１１の長辺に平行に赤外線Ｌを出射するように、等間隔で一列に並べて配設され、各発光部２２から出射された赤外線Ｌが受光されるように、液晶パネル１１の他方の長辺および短辺に沿って、複数の受光素子２２が、等間隔で一列に並べて配設されている。これにより、複数の発光素子２１からは、格子を形成するように、赤外線Ｌが出射される。

【００２６】
本実施形態では、図２に示すように、複数の発光素子２１および受光素子２２は、保護ガラス１２の厚み方向に関して、間隙１９が形成される位置に対応して配設されるように、センサ基板２３にそれぞれ搭載される。これにより、外観ベゼル１６内に配置される発光素子２１から出射された赤外線Ｌは、間隙１９を通過し、保護ガラス１２の表面に沿って進行し、再度、間隙１９を通過して、外観ベゼル１６内に配置される、対応する受光素子２２によって受光される。なお、発光素子２１および受光素子２２は、たとえばＬＥＤ（Light Emitting Diode）によって実現される。

【００２７】
タッチパネル装置１０は、各受光素子２２において、対応する発光素子２１から出射された赤外線Ｌが検出されたか否かに基づいて、ユーザが保護ガラス１２の表面を指またはスタイラスなどの指示体によって指示した指示位置の座標を検出する。

【００２８】
本実施形態に係るタッチパネル装置１０は、外観ベゼル１６内に設けられた複数の発光素子２１および受光素子２２ならびにセンサ基板２３が外部から視認されることにより、外観が損なわれることを防止するために、また、外観ベゼル１６内に塵埃が侵入し、塵埃

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が発光素子２１および受光素子２２に付着することにより、発光素子２１から出射された赤外線Ｌが受光素子２２において検出されるときの検出レベルが低下することで、保護ガラス１２の表面における指示位置を誤検出してしまうことを防止するために、図１に示すように、外観ベゼル１６の額縁部分１８における内方側端部１８ａと保護ガラス１２の周縁部分１４との間に形成された間隙１９を閉塞するように、可視光を吸収し、赤外線Ｌを透過する赤外線透過フィルタ（以下、「ＩＲフィルタ」と称する）２４がさらに組み付けられて構成されている。

【００２９】

ＩＲフィルタ２４は、本実施形態では、液晶パネル１１の各長辺および各短辺に沿ってそれぞれ設けられる長尺の棒状部材であり、可視光を吸収し、赤外線Ｌを透過する赤外線透過樹脂で射出成型されることによって製造される。

【００３０】

ＩＲフィルタ２４は、図２に示すように、保護ガラス１２の周縁部分１４における、液晶パネル１１側とは反対側の表面に面接触する挟持部分３１と、挟持部分３１における、保護ガラス１２の厚み方向に垂直な面方向の外方側の端部に一体的に連なり、モジュール金属ベゼル１５に固定される板状の固定部分３２と、挟持部分３１における、前記面方向の内方側の端部に一体的に連なり、間隙１９を閉塞する板状の閉塞部分３３とを含んで構成される。

【００３１】

本実施形態では、図２に示すように、固定部分３２とモジュール金属ベゼル１５とは、締結具であるねじ２５によって締結固定される。これにより、挟持部分３１は、モジュール金属ベゼル１５と協働して、保護ガラス１２の周縁部分１４を挟持する。保護ガラス１２は、各長辺および各短辺に対応する周縁部分１４が、ＩＲフィルタ２４の挟持部分３１とモジュール金属ベゼル１５とによって挟持されることにより、液晶パネル１１に対向する位置に固定される。

【００３２】

また、挟持部分３１は、図２に示すように、その断面が大略的にＬ字形状を成しており、前記のように保護ガラス１２の周縁部分１４に面接触する第１部分３１ａと、その第１部分３１ａの前記面方向の外方側の端部に連なり、第１部分３１ａからモジュール金属ベゼル１５側へ略直角に屈曲する第２部分３１ｂとから成り、この第２部分３１ｂは、ＩＲフィルタ２４がモジュール金属ベゼル１５に締結固定されたときに、保護ガラス１２の外周面を前記面方向の外方から被覆するように構成されている。

【００３３】

空中を浮遊する塵埃は、静電気力等によって保護ガラス１２の表面に引き寄せられ、その後、重力によって落下することにより、保護ガラス１２とＩＲフィルタ２４との境目の部分に溜まり易い。図５に示す従来技術によれば、振動によって保護ガラス１１２とＩＲフィルタ１２４との間に間隙が形成されてしまうと、境目の部分に溜まった塵埃がその間隙から外観ベゼル１１８内へ侵入してしまう。

【００３４】

しかしながら、本実施形態によれば、ＩＲフィルタ２４が前記のように構成されているので、境目の部分に溜まった塵埃が、保護ガラス１２と挟持部分３１との間に侵入したとしても、塵埃は保護ガラス１２と挟持部分３１との間に閉じ込め、外観ベゼル１６内へ侵入することを防止することができる。したがって、発光素子２１および受光素子２２に塵埃が付着することに起因して、発光素子２１から出射された赤外線Ｌが受光素子２２において検出されるときの検出レベルが低下してしまうことが防止され、これにより、保護ガラス１２の表面における指示位置を誤検出してしまうことを防止することができる。

【００３５】

なお、ＩＲフィルタ２４の閉塞部分３３は、本実施形態では、保護ガラス１２から離反するにつれて前記面方向の外方側へ傾斜するように形成され、挟持部分３１とは反対側の端部が、外観ベゼル１６の額縁部分１８における内方側端部１８ａと接触することで、間

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隙１９を閉塞している。

【００３６】

本実施形態では、図２に示すように、閉塞部分３３の挟持部分３１とは反対側の端部と内方側端部１８ａとが直接接触しているが、該端部と内方側端部１８ａとの間から外観ベゼル１６内への塵埃の侵入を確実に防止するために、該端部と内方側端部１８ａとの間にクッション材を設けて、該端部と内方側端部１８ａとの間を確実に封止するように構成してもよい。

【００３７】

図３は、液晶表示装置１の左上の角部を拡大して示す図であり、図３（ａ）は外観ベゼル１６が装着された状態を示し、図３（ｂ）は外観ベゼル１６が取り外された状態を示している。

【００３８】

図３に示すように、本実施形態に係るタッチパネル装置１０は、液晶パネル１１の長辺に沿って配置されるＩＲフィルタ２４Ａが、保護ガラス１２の角部において、短辺側の周縁部分１４を部分的に覆い、ＩＲフィルタ２４Ａと、液晶パネル１１の短辺に沿って配置されるＩＲフィルタ２４Ｂとの接合部が、長辺に沿って延びるように構成されている。

【００３９】

そして、その接合部において、ＩＲフィルタ２４Ａの閉塞部分３３に形成された、断面がＬ字形状の段差部３４に、ＩＲフィルタ２４Ｂの閉塞部分３３が係合するように構成されている。これにより、塵埃が、ＩＲフィルタ２４ＡとＩＲフィルタ２４Ｂとの接合部を介して、外観ベゼル１６内へ侵入してしまうことを防止している。

【００４０】

以上のように、本実施形態によれば、ＩＲフィルタ２４は、赤外線透過樹脂で射出成型によって製造されているので、従来技術のように、ＩＲインクをシルク印刷する場合と比較して、赤外線Ｌの透過率を場所に依らずに安定させることができる。

【００４１】

また、本実施形態によれば、ＩＲフィルタ２４は、外観ベゼル１６の額縁部分１８における内方側端部１８ａと保護ガラス１２の周縁部分１４との間に形成された間隙１９を閉塞するとともに、モジュール金属ベゼル１５と協働して、保護ガラス１２の周縁部分１４を挟持することにより、保護ガラス１２を固定する機能を有しているので、保護ガラス１２を固定するための、板金部品などの部材を別途に設ける必要がない。したがって、装置全体の重量を低減し、部品点数を削減し、製造コストを低減することができる。

【００４２】

また、本実施形態によれば、装置を運搬する際に揺れなどが生じたとしても、ＩＲフィルタ２４と保護ガラス１２とが擦れることがないので、保護ガラス１２の周縁部分１４の表面の損傷を防止することができる。

【００４３】

また、本実施形態によれば、ＩＲフィルタ２４は、モジュール金属ベゼル１５に締結固定されたときに、挟持部分３１における第１部分３１ａが、保護ガラス１２の周縁部分１４に面接触し、挟持部分３１における第２部分３１ｂが、保護ガラス１２の外周面を前記面方向の外方から被覆するように構成されているので、塵埃が、保護ガラス１２と挟持部分３１との間に侵入したとしても、外観ベゼル１６内へ侵入することを防止することができる。

【００４４】

なお、本実施形態では、画像表示装置として液晶表示装置１を例示しているが、これに限らず、タッチパネル装置１０は、プラズマディスプレイ装置や有機ＥＬ（Electro-Luminescence）ディスプレイ装置などに搭載されてもよい。

【００４５】

（第２の実施形態）

図４は、本発明の第２の実施形態に係るタッチパネル装置を構成するＩＲフィルタ４０

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の長手方向の一方側の構成を概略的に示す斜視図であり、図４（ａ）はＩＲフィルタ４０を上方から見た斜視図であり、図４（ｂ）はＩＲフィルタ４０を下方から見た斜視図である。図４では、液晶パネル１１の短辺に沿って配置されるＩＲフィルタ４０を示している。本実施形態に係るタッチパネル装置は、ＩＲフィルタ４０の構成が、第１の実施形態に係るＩＲフィルタ２４と異なっている。なお、ＩＲフィルタ４０において、第１の実施形態に係るＩＲフィルタ２４と同一の構成については、同一の参照符を付し、重複する説明を省略する。

【００４６】

本実施形態に係るＩＲフィルタ４０は、固定部分３２における、モジュール金属ベゼル１５に対向する側の対向面３２ａに、モジュール金属ベゼル１５に対する位置決めのための複数の突起３６（位置決め部）が、長手方向に沿って間を空けて形成されている。

【００４７】

一方、図示しないが、モジュール金属ベゼル１５には、このＩＲフィルタ４０に形成された各突起３６がそれぞれ嵌合可能な複数の凹所が形成されており、ＩＲフィルタ４０の各突起３６とモジュール金属ベゼル１５の各凹所とをそれぞれ嵌合させることにより、ＩＲフィルタ４０が、モジュール金属ベゼル１５に対して適所に配置されるように構成されている。

【００４８】

また、ＩＲフィルタ４０の固定部分３２における、対向面３２ａとは反対側の面３２ｂには、ＩＲフィルタ４０の長手方向に関して、各突起３６が形成されている位置に対応した位置に、リブ３５がそれぞれ形成されている。

【００４９】

なお、固定部分３２には、締結具としてのねじ２５（図２参照）の軸が挿通可能な孔部３７が形成され、また、ＩＲフィルタ４０の長手方向の端部には、液晶パネル１１の長辺に沿って配置されるＩＲフィルタ４０の長手方向の端部に形成された段差部３４（図３（ｂ）参照）に係合するように、閉塞部分３３を、挟持部分３１および固定部分３２よりも長手方向に突出させた突出部分３８が形成されている。

【００５０】

以上のように、本実施形態によれば、固定部分３２に設けられたリブ３５によって、長尺の部材であるＩＲフィルタ４０を補強することができ、さらに、ＩＲフィルタ４０をモジュール金属ベゼル１５に組み付ける際、このリブ３５を視認することで、各突起３６が形成されている位置を把握することができるので、各突起３６をモジュール金属ベゼル１５の各凹所に対して容易に嵌合させることができ、ＩＲフィルタ４０のモジュール金属ベゼル１５への組付け作業の作業性を向上させることができる。

【００５１】

なお、本実施形態では、ＩＲフィルタ４０の固定部分３２には、位置決め部として突起３６が形成されているが、他の実施形態では、位置決め部として凹所が形成されてもよい。この場合には、モジュール金属ベゼル１５側に、該凹所に嵌合可能な突起が形成される。

【００５２】

（第３の実施形態）

上記の実施形態では、タッチパネル装置１０は、赤外線遮断方式による座標入力装置によって実現されていたが、第３の実施形態では、赤外線カメラ方式による座標入力装置が、タッチパネル装置として液晶表示装置１に搭載される。

【００５３】

この場合のタッチパネル装置は、たとえば、赤外線Ｌを出射する、ＬＥＤなどによって実現される赤外線投光器（発光部）と、赤外線投光器から出射された赤外線Ｌを受光するＣＣＤ（Charge Coupled Device）カメラ（受光部）とを含んで構成される。赤外線投光器およびＣＣＤカメラは、液晶表示装置１の上段における左右両側の各角部において、液晶表示装置１の外観ベゼル１６内に設置され、保護ガラス１２の表面における指示位置の

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座標は、ＣＣＤカメラによって撮像された映像に基づいて、三角測量方式により検出される。

【００５４】

このようなタッチパネル装置においても、外観ベゼル１６内に設置された赤外線投光器およびＣＣＤカメラが外部から視認されることにより、外観が損なわれることを防止するために、また、外観ベゼル１６内に塵埃が侵入し、塵埃が赤外線投光器およびＣＣＤカメラに付着することにより、ＣＣＤカメラにおける検出レベルが低下することで、保護ガラス１２の表面における指示位置を誤検出してしまうことを防止するために、外観ベゼル１６の額縁部分１８における内方側端部１８ａと保護ガラス１２の周縁部分１４との間に形成された間隙１９を閉塞するように、第１の実施形態で説明した赤外線透過フィルタ２４を設けることで、第１の実施形態と同様の効果を奏することができる。

【００５５】

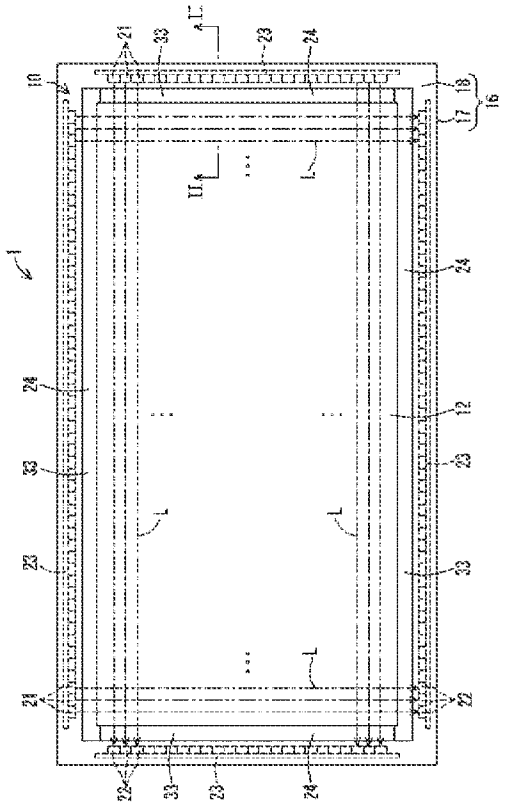
なお、赤外線カメラ方式による座標入力装置としては、外観ベゼル１６内に赤外線投光器およびＣＣＤカメラを設けるものに限らず、たとえば、外観ベゼル１６内には赤外線投光器を設けずに、保護ガラス１２の表面を指示するためのスタイラスの先端部に、赤外線Ｌを出射する発光部を設けたものによって実現されてもよい。

【符号の説明】

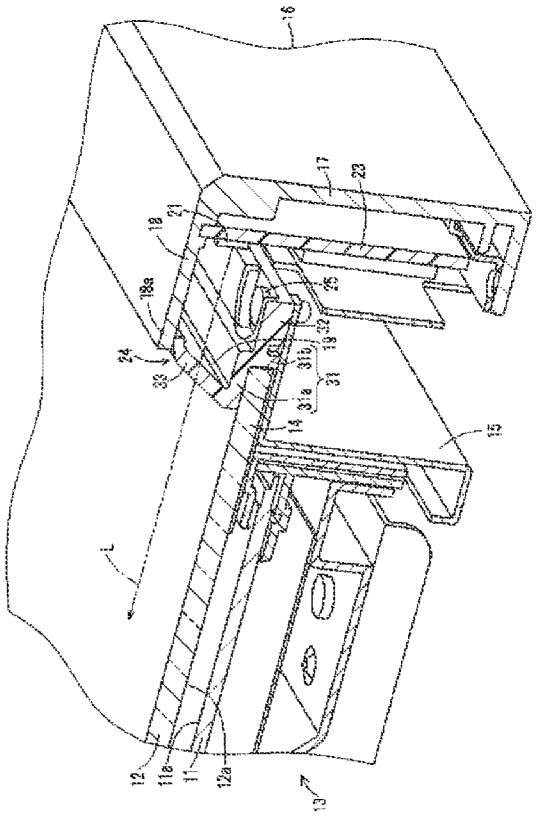
【００５６】

１　液晶表示装置
１０　タッチパネル装置
１１　液晶パネル
１２　保護ガラス
１３　液晶モジュール
１４　周縁部分
１５　モジュール金属ベゼル
１６　外観ベゼル
１７　側壁部分
１８　額縁部分
１９　間隙
２１　発光部
２２　受光部
２４　ＩＲフィルタ
３１　挟持部分
３２　固定部分
３３　閉塞部分

【図１】

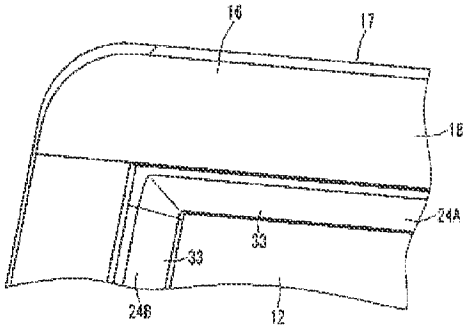


【図２】

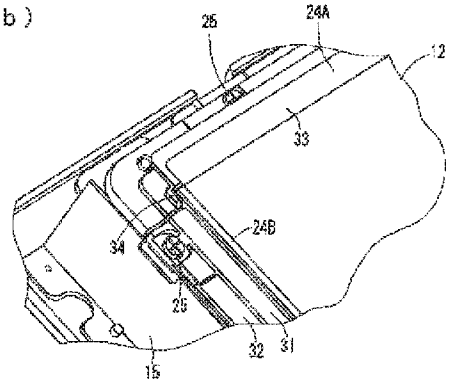


【図３】

（ａ）

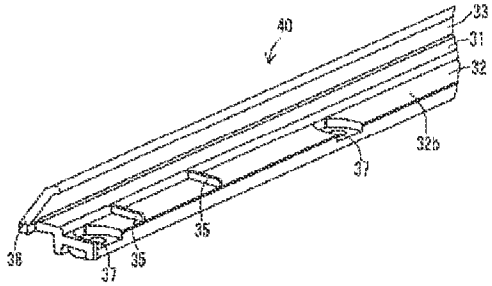


（ｂ）

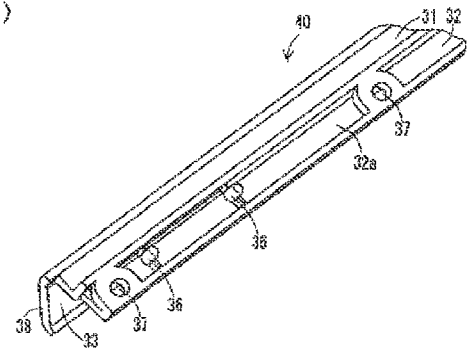


【図４】

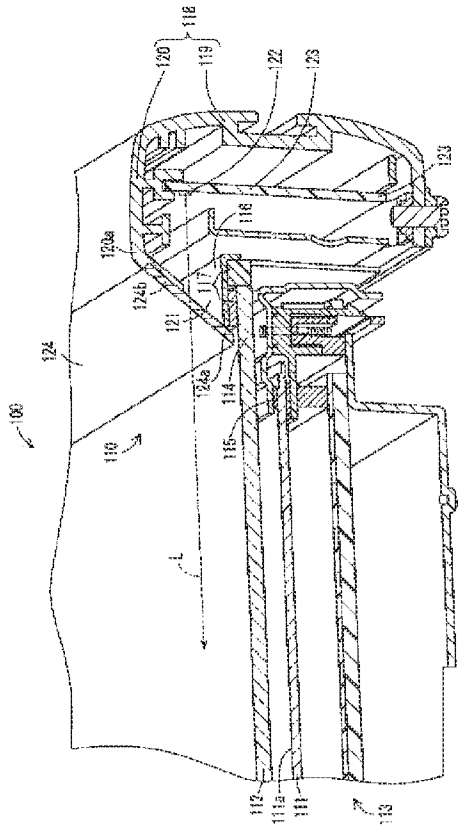
（ａ）



（ｂ）



【図５】


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124b
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124a
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Espacenet

JPS62159213A COORDINATES INPUT DEVICE

Applicants: ALPS ELECTRIC CO LTD

Inventors: HASEGAWA KAZUO,OUCHI JUNICHI,SASAKI HIROAKI

Classifications:
IPC ***G06F3/03; G06F3/042;*** (IPC1-7): G06F3/03;

Priorities: JP21886A 1986-01-07

Application: JPS62159213A·1986-01-07

Publication: JPS62159213A·1987-07-15

Published as: JPS62159213A

COORDINATES INPUT DEVICE

Abstract

PURPOSE:To prevent the mixture of dust that affects the light transmittance by providing an airtight room to seal up a space formed between a variable light eliminating filter and an optical conductor element set opposite to said filter. CONSTITUTION:A light emitting part 4a of a light emitting element 4 is set opposite to a filter part 12a of an infrared filter 12. While the tip of a dust preventing wall 12b protruded inside the filter 12 has a contact with a base board 7 which fixes the element 4. The element 4 is stored in an airtight room 13 formed by the filter 12 and the board 7. Therefore the space within the room 13 including a space B formed between both parts 12a and 4a is shielded from the space outside a coordinate input device. As a result, the outside dust or the dust on a display surface 3 is never mixed into the space B by the flow of air. This always secures the satisfactory light transmittance.

⑲日本国特許庁（JP）　⑪特許出願公開

⑫公開特許公報（A）　昭62－159213

⑤1Int.Cl.⁴	識別記号	庁内整理番号	⑬公開　昭和62年(1987)7月15日
G 06 F 3/03	330	F－7165－5B	

審査請求　未請求　発明の数 1　（全5頁）

⑤4発明の名称　座標入力装置

⑳特　願　昭61－218
㉒出　願　昭61(1986)1月7日

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明　細　書

1．発明の名称

座標入力装置

2．特許請求の範囲

発光素子とこれに対応する受光素子とからなる多数の光半導体素子と、これら光半導体素子に対向して設けられた可視光除外フイルタとを備え、この可視光除外フイルタを介して前記発光素子と受光素子間で表示装置の表示面の前面側に光路を形成し、この光路が遮断された位置を検出して表示面上の座標位置を入力する光検出方式の座標入力装置において、前記可視光除外フイルタとこれに対向する前記光半導体素子との間の空間を密閉する気密室を設けたことを特徴とする座標入力装置。

3．発明の詳細な説明

〔産業上の利用分野〕

本発明は、表示装置の前面に取り付けられ、この表示装置の表示面上の座標位置を検出してコンピュータに入力する光検出方式の座標入力装置に係り、特にその防塵対策に関するものである。

〔従来の技術〕

コンピュータに手入力する座標入力装置としては、電磁誘導方式、静電容量方式、透明電極方式、光検出方式等の種々の方式がある。この中で、表示装置の前面に取り付けられ、単に指などで、表示装置の表示面上の任意個所を押えて光路を遮断することにより、検出装置には非接触で座標位置を特定できる光検出方式のものが、信頼性と操作性の面から注目を浴びている。

この光検出方式の座標入力装置の従来例を第8図ないし第10図に示す。第8図は座標入力装置を表示装置の前面に装着した状態を示す斜視図、第9図はこの座標入力装置の受光素子側の要部断面図、第10図は裏板を取り外して座標入力装置の内部構造を示す背面図である。

これらの図において、座標入力装置は、略長方形状に成形されて中央部に開口2を有する枠体1と、この枠体1の裏面側、すなわちCRT（カソード・レイ・チューブ）等を用いた表示装置3の

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表示面３ａに対面する側の各対辺に複数個並設されたＬＥＤなどの発光素子４とフオトトランジスタなどの受光素子５の組と、これらの発光素子４と受光素子５の組み合わせの中から光路１０が遮断された位置を検出し、その位置を入力する演算部６とから主に構成されている。

前記発光素子４および受光素子５は、互いの発光部４ａと受光部５ａとが各組ごとに対向するように、前記枠体１の内部に設けられた基板７に固設されており、また、受光素子５の受光部５ａの前面には、対となる発光素子４からの入射光のみ受光可能なように、所定の面積の光透過孔８ａが形成された遮光板８が配設されている。さらに、この遮光板８の前面と発光素子４の前面、つまり操作領域Ａの周縁部には、可視光除外フイルタとして赤外線フイルタ９が全周にわたつて装着されている。したがつて、表示面３ａの前面側の操作領域Ａ内には、赤外線フイルタ９を介して目に見えない光路１０が形成されることになる。

次に、上記構成からなる座標入力装置の入力原理を説明する。いま、例えば第８図に示すように、表示面３ａ上の入力したい位置に指１１等を接触させると、その位置を通過するはずの光路１０が遮断されることから、座標位置を特定することが可能となる。すなわち、発光素子４を順に発光させてスキヤンさせることにより、ｘ方向、ｙ方向のそれぞれにおいて、遮光された光路１０を受光素子５によつて検出することができ、この光路を演算部６により特定し、図示しないホストコンピュータ側にその座標位置が入力されるようになつている。

〔発明が解決しようとする問題点〕

ところで、かかる従来の座標入力装置にあつては、大気中の塵や、静電気により表示面３ａ上に付着した埃などが、第９図の矢印に示す空気の流動によつて赤外線フイルタ９と受光素子５との間の空間Ｂに侵入し、このため赤外線フイルタ９の内面や受光素子５の受光部５ａに塵埃が付着しやすいという問題があつた。これは発光素子４側についても同様であつて発光部４ａに塵埃が付着しやすく、このように赤外線フイルタ９の内面や発光部４ａ、受光部５ａなどに塵埃が付着すると、光透過効率が著しく低下して誤動作を引き起こす危険性があり、また、かかる誤動作発生を防止するためには塵埃を除去する清掃作業を頻繁に行わねばならなくなるので、メンテナンスが煩雑になつてしまう。特に、表示装置３に冷却フアンが内蔵されている場合、第９図の矢印方向に強制的に気流が発生するため、赤外線フイルタ９の内面や発光部４ａ、受光部５ａ等への塵埃の付着が一層顕著となる。

したがつて本発明の目的とするところは、上記従来技術の問題点を解消し、光透過効率に悪影響を及ぼす塵埃の侵入を防止した座標入力装置を提供することにある。

〔問題点を解決するための手段〕

上記目的を達成するために、本発明は、発光素子とこれに対応する受光素子とからなる多数の光半導体素子と、これら光半導体素子に対向して設けられた可視光除外フイルタとを備え、この可視光除外フイルタを介して前記発光素子と受光素子間で表示装置の表示面の前面側に光路を形成し、この光路が遮断された位置を検出して表示面上の座標位置を入力する光検出方式の座標入力装置において、前記可視光除外フイルタとこれに対向する前記光半導体素子との間の空間を密閉する気密室を設けた構成とした。

〔作用〕

すなわち、本発明は、気密室を設けることによつて、可視光除外フイルタと光半導体素子との間の空間が外部空間と連通しないように図り、この外部空間内に含まれる塵埃の侵入を防止しようというものである。

〔実施例〕

以下、本発明の実施例を図面について説明する。

第１図および第２図は本発明の一実施例を説明するためのもので、第１図は座標入力装置の発光素子側の要部断面図、第２図は第１図に示す赤外線フイルタの斜視図である。また、これらの図において、従来例と同等の構成要素には同一符号を

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付すことによりその説明は省略する。

第1図、第2図において、符号12は、アクリルを断面略コ字形に成形してフイルタ部12aと防塵壁12bとを設けた赤外線フイルタであり、可視光を除外して赤外線を選択的に透過させる機能を有する。そして、この赤外線フイルタ12のフイルタ部12aには発光素子4の発光部4aが対向し、また、赤外線フイルタ12の内側に突設された防塵壁12bの先端は発光素子4を固設している基板7に当接しており、このため発光素子4は、赤外線フイルタ12と基板7とにより画成される気密室13内に収納された形になつている。つまり、フイルタ部12aと発光部4aとの間の空間Bを包含する気密室13内の空間は、座標入力装置の外部の空間から遮断されていて、第1図の矢印に示すように、冷却フアン等により発生する気流もこの気密室13内には影響を及ぼさない。このように、気密室13を画成したことにより、外部空間に含まれる塵埃、例えば大気中の塵や表示面3a上の埃などが、空気の流動に伴つてフイルタ部12aと発光部4a間の空間B内へ侵入してくるということがなくなり、フイルタ部12aの内面や発光部4aの表面への塵埃の付着が確実に防止できて常に良好な光透過効率を維持することが可能となつている。しかも、気密室13は、従来品における赤外線フイルタの形状に若干の変更を加えるだけで実現できるものであつて、コストアツプを招く心配もない。

なお、上記実施例の入力原理は従来例と同様であるので、その説明は省略する。また、赤外線フイルタ12をアクリル以外の材料、例えば塩化ビニルの成形体とすることも可能である。

第3図ないし第5図は本発明の他の実施例を説明するためのもので、第3図は座標入力装置の受光素子側の要部断面図、第4図は第3図に示す赤外線フイルタの斜視図、第5図は第3図に示す遮光ホルダの斜視図であり、第1図と同等の構成要素には同一符号を付けてある。

この実施例は、フイルタ部14aおよび嵌合部14bを備えた赤外線フイルタ14と、受光素子5を収納して散乱光の入射を規制する遮光ホルダ15とを組み合わせることによつて、防塵対策を講じたものである。つまり、遮光ホルダ15の前面をフイルタ部14aの内面に密着させた状態で、この遮光ホルダ15の前部を嵌合部14b間に嵌め込むことによつて、遮光ホルダ15内の受光素子5の前方に気密室13が画成されており、フイルタ部14aと受光部5aとの間の空間Bはこの気密室13内に包含されて外部空間から遮断されている。したがつて、外部空間に含まれる塵埃が空気の流動に伴つて座標入力装置の内部に侵入したとしても、かかる塵埃はフイルタ部14aと受光部5aとの間の空間B内に侵入することはできず、光透過効率は常に良好に保たれる。

なお、上記実施例における遮光ホルダ15は光透過光15aを有するものであるため、従来例において用いられていた遮光板は不要となつている。

第6図および第7図は本発明のさらに他の実施例を説明するためのもので、第6図は座標入力装置の受光素子側の要部断面図、第7図は第6図に示す遮光ホルダの内部形状を示す斜視図であり、第3図と同等の構成要素には同一符号を付けてある。

この実施例は、フイルタ部16aおよび嵌合部16bを備えた断面略コ字形の赤外線フイルタ16と、上型17aおよび下型17bからなり複数の受光素子5を形状に収納可能な遮光ホルダ17とを組み合わせることによつて防塵対策を講じたものであり、前記第2の実施例に比して部品点数の削減が図られている。なお、図中の符号17cは光透過孔であり、その他特に説明しない部分の構成は、基本的に前記第2の実施例と同様である。

〔発明の効果〕

以上説明したように、本発明によれば、赤外線フイルタ等の可視光除外フイルタと、発光素子もしくは受光素子からなる光半導体素子との間の空間が、気密室により密閉されているので、この空間内に外部から塵埃が侵入する虞れがなくなつて常に良好な光透過効率を維持することができ、よつて塵埃の付着に起因する誤動作の発生が防止で

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きるとともにメンテナンスの改善が図れる。

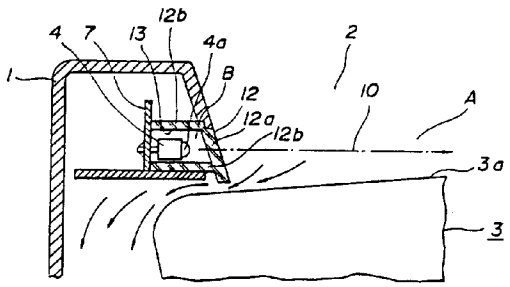
4．図面の簡単な説明

第1図および第2図は本発明の一実施例を説明するためのもので、第1図は座標入力装置の発光素子側の要部断面図、第2図は第1図に示す赤外線フイルタの斜視図、第3図ないし第5図は本発明の他の実施例を説明するためのもので、第3図は座標入力装置の受光素子側の要部断面図、第4図は第3図に示す赤外線フイルタの斜視図、第5図は第3図に示す遮光ホルダの斜視図、第6図および第7図は本発明のさらに他の実施例を説明するためのもので、第6図は座標入力装置の受光素子側の要部断面図、第7図は第6図に示す遮光ホルダの内部形状を示す斜視図、第8図ないし第10図は従来例を説明するためのもので、第8図は座標入力装置を表示装置の前面に装着した状態を示す斜視図、第9図はこの座標入力装置の受光素子側の要部断面図、第10図はこの座標入力装置の内部構造を示す背面図である。

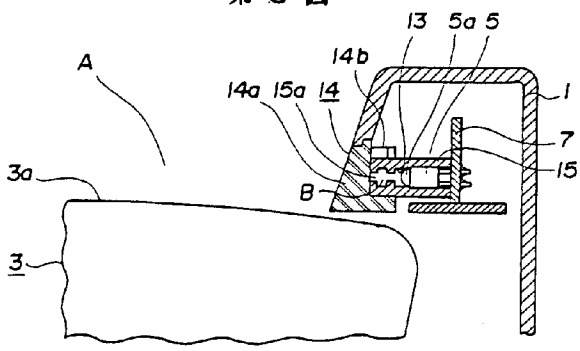
3……表示装置、3a……表示面、4……発光素子、4a……発光部、5……受光素子、5a……受光部、7……基板、10……光路、12，14，16……赤外線フイルタ（可視光除外フイルタ）、12a，14a，16a……フイルタ部、12b……防塵壁、13……気密室、14b，16b……嵌合部、15，17……遮光ホルダ、A……操作領域、B……空間。

代理人　弁理士　武　　顕次郎

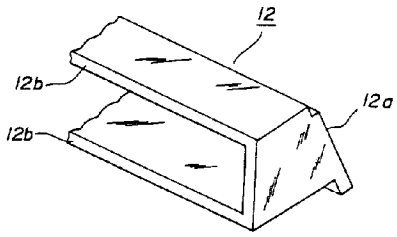
第1図



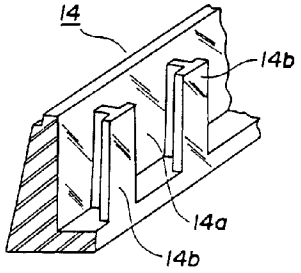
第3図



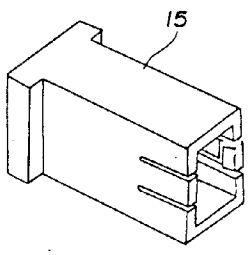
第2図



第4図

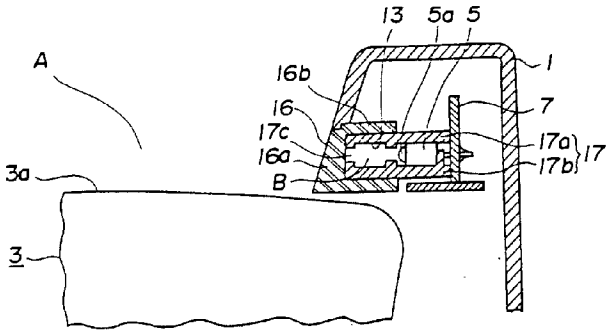


第5図

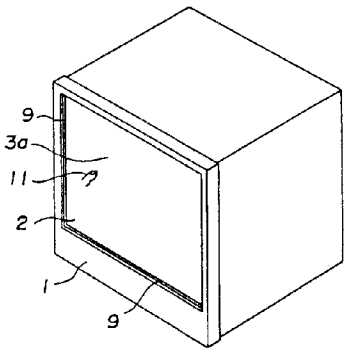


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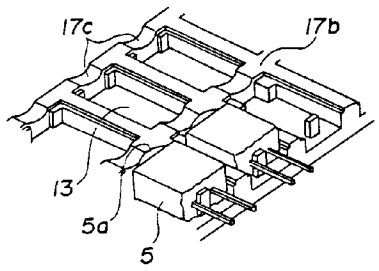
第 6 図



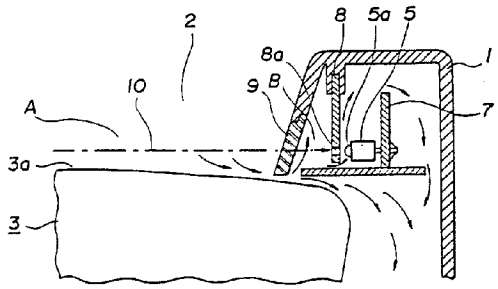
第 8 図



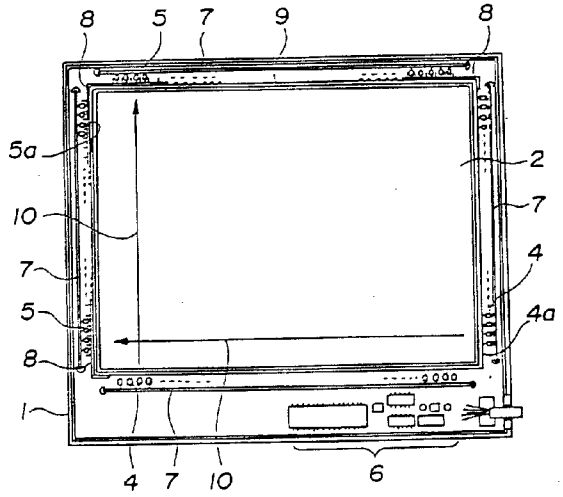
第 7 図



第 9 図



第 10 図



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(19) 대한민국특허청(KR)
(12) 공개특허공보(A)

(11) 공개번호 10-2015-0125374
(43) 공개일자 2015년11월09일

(51) 국제특허분류(Int. Cl.)
H04B 1/38 (2015.01) *H04M 1/02* (2006.01)
(21) 출원번호 10-2014-0052656
(22) 출원일자 2014년04월30일
심사청구일자 없음

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전체 청구항 수 : 총 10 항

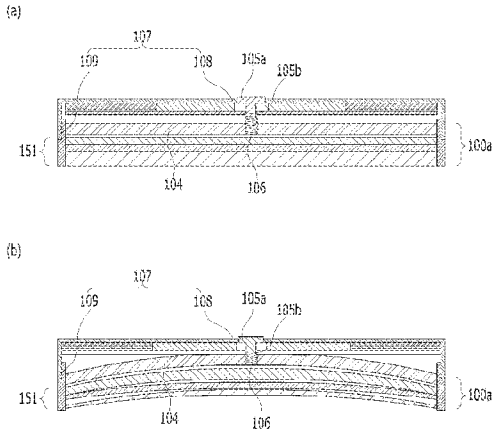
(54) 발명의 명칭 **이동 단말기**

(57) 요 약

상기 또는 다른 목적을 달성하기 위해 본 발명의 일 측면에 따르면, 액정 디스플레이 및 액정 디스플레이와 결합하는 미들 프레임을 구비하고 휘어질 수 있는 소재를 포함하는 전면부, 그리고 이 전면부의 배면 방향에 위치하고, 잘 휘어지지 않고 무재의 일부가 전면부 방향으로 돌출되어 전면부 등의 부재를 휘어질 수 있도록 받쳐주는 지지부, 상기 미들 프레임에 구비되어 스크루가 지나갈 수 있도록 하는 나사홈, 나사선은 상기 나사홈에 맞물려 인입출되며, 나사머리는 상기 지지부의 일 영역에 회전가능하게 결합되어 상기 전면부에 인장력을 인가하는 스크루를 제공하여 휨 운동시 스크루와 무재가 이격된 상태로 거동하는 일이 없도록 하고, 상기 스크루가 상기 전면부에 인장력을 인가시, 상기 지지부의 또 다른 영역을 받침점으로 상기 전면부의 곡률이 변화한다.

따라서 가변적으로 일정 범위내의 이동 단말기의 곡률을 변화시킬 수 있다는 장점이 있다.

대 표 도 - 도3



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명 세 서

청구범위

청구항 1

액정 디스플레이 및 상기 액정 디스플레이와 결합하는 미들 프레임을 구비하고, 휘어질 수 있는 소재를 포함하는 전면부;

상기 전면부의 배면 방향에 위치하고, 상기 전면부 보다 높은 강성의 소재를 포함하며, 상기 전면부와 이격된 제1 영역과, 상기 전면부 방향으로 돌출된 제2 영역을 포함하는 지지부;

상기 미들 프레임에 구비된 나사홈;

나사선은 상기 나사홈에 맞물려 인입출되며, 나사머리는 상기 지지부의 제 1 영역에 회전가능하게 결합되어 상기 전면부에 인장력을 인가하는 스크루를 포함하고,

상기 스크루가 상기 전면부에 인장력을 인가시, 상기 지지부의 제 2 영역을 받침점으로 상기 전면부의 곡률이 변화하는 가변형 이동 단말기.

청구항 2

제 1 항에 있어서,

상기 스크루는 시계 또는 반시계 방향 중 어느 한 방향으로 회전시 상기 전면부의 곡률을 증가시키며,

상기 어느 한 방향의 반대 방향으로 회전시 상기 전면부의 곡률을 감소시키는 것을 특징으로 하는 가변형 이동 단말기.

청구항 3

제 1 항에 있어서,

휘어질 수 있는 소재를 포함하고, 상기 지지부의 배면방향에 위치하는 후면부를 더 포함하고,

상기 전면부의 곡률이 증가시 상기 후면부의 곡률도 함께 증가하고, 상기 전면부의 곡률이 감소시 상기 후면부의 곡률도 함께 감소하는 것을 특징으로 하는 가변형 이동 단말기.

청구항 4

제 1 항에 있어서,

상기 전면부는 제1 방향으로 휘어지며,

상기 전면부와 상기 후면부 사이에 위치하는 피씨비를 더욱 포함하고,

상기 피씨비의 상기 전면부와 대향하는 면에 실장된 복수개의 부품은 상기 나사홈이 위치한 부분에서 제1 방향의 바깥쪽으로 갈수록 더 두꺼운 것을 특징으로 하는 가변형 이동 단말기.

청구항 5

제 1 항에 있어서,

상기 스크루에 결합되어 상기 지지부 후면에 노출되어 사용자가 잡고 상기 스크루를 회전시키는 손잡이를 더 포함하는 것을 특징으로 하는 가변형 이동 단말기.

청구항 6

제 5 항에 있어서,

상기 손잡이는 상기 이동 단말기에 전원을 공급하는 배터리를 포함하는 것을 특징으로 하는 가변형 이동 단말기.

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청구항 7

제 6 항에 있어서,

상기 배터리를 상기 배터리의 회전축에 대한 수직 방향으로 자른 단면은 원형인 것을 포함하는 것을 특징으로 하는 가변형 이동 단말기.

청구항 8

제 7 항에 있어서,

상기 배터리는 호 형상의 전원 단자를 포함하는 것을 특징으로 하는 가변형 이동 단말기.

청구항 9

제 3 항에 있어서,

상기 후면부와 착탈되는 후크를 포함하는 배터리커버; 및

상기 후면부의 외측면에 상기 후크와 체결되는 복수개의 후크홈을 더 포함하고,

상기 후크홈은 두 개 이상의 홈이 중첩되어 배치된 것을 특징으로 하는 가변형 이동 단말기.

청구항 10

액정 디스플레이 및 상기 액정 디스플레이와 결합하는 더블 프레임을 구비하고, 휘어질 수 있는 소재를 포함하는 전면부;

상기 전면부의 배면 방향에 위치하고, 상기 전면부 보다 높은 강성의 소재를 포함하며, 상기 전면부와 이격된 제 1 영역과, 상기 전면부 방향으로 돌출된 제 2 영역을 포함하는 지지부;

상기 지지부의 배면방향에 위치하고, 휘어질 수 있는 소재를 포함하는 후면부;

상기 지지부에 구비된 나사홈;

나사선은 상기 나사홈에 맞물려 인입출되며, 상기 나사선의 양 끝단은 상기 나사홈을 통해 상기 지지부의 제 1 영역을 관통하여 연장되어 상기 더블 프레임과 상기 후면부에 회전가능하게 결합되어 상기 전면부와 상기 후면부에 인장력을 인가하는 스크루를 포함하고,

상기 스크루가 상기 전면부와 상기 후면부에 인장력을 인가시, 상기 지지부의 제 2 영역을 받침점으로 상기 전면부와 상기 후면부의 곡률이 변화하는 이동 단말기.

발명의 상세

기 술 분 야

[0001] 본 발명은 단말기의 휘어짐 정도를 조절할 수 있는 이동 단말기에 관한 것이다.

배 경 기 술

[0002] 단말기는 이동 가능여부에 따라 이동 단말기(mobile/portable terminal) 및 고정 단말기(stationary terminal)으로 나뉠 수 있다. 다시 이동 단말기는 사용자의 직접 휴대 가능 여부에 따라 휴대(형) 단말기(handheld terminal) 및 거치형 단말기(vehicle mounted terminal)로 나뉠 수 있다.

[0003] 이동 단말기의 기능은 다양화 되고 있다. 예를 들면, 데이터와 음성통신, 카메라를 통한 사진촬영 및 비디오 촬영, 음성녹음, 스피커 시스템을 통한 음악파일 재생 그리고 디스플레이부에 이미지나 비디오를 출력하는 기능이 있다. 일부 단말기는 전자게임 플레이 기능이 추가되거나, 멀티미디어 플레이어 기능을 수행한다. 특히 최근의 이동 단말기는 방송과 비디오나 텔레비전 프로그램과 같은 시각적 컨텐츠를 제공하는 멀티캐스트 신호를 수신할 수 있다.

[0004] 이와 같은 단말기(terminal)는 기능이 다양화됨에 따라 예를 들어, 사진이나 동영상의 촬영, 음악이나 동영상 파일의 재생, 게임, 방송의 수신 등의 복합적인 기능들을 갖춘 멀티미디어 기기(Multimedia player) 형태로 구

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휘되고 있다.

[0005] 이러한 단말기의 기능 지지 및 증대를 위해, 단말기의 구조적인 부분 및/또는 소프트웨어적인 부분을 개량하는 것이 고려될 수 있다.

[0006] 최근에는 휘어질 수 있는 플렉서블 디스플레이가 개발되었고, 이에 따라 휘어진 이동 단말기가 구현되었다.

발명의 내용

해결하려는 과제

[0007] 종래에는 디스플레이가 가변적으로 휘어질 수 있는 플렉서블 디스플레이가 존재했음에도, 이동 단말기의 나머지 부재 또는 부품의 물성의 제약으로 인해 휨의 상태가 고정된 상태의 휘어진 이동 단말기 밖에 존재하지 않으며, 이 이동 단말기에 힘을 가해 휘어지더라도 일시적일 뿐 힘을 빼는 경우 본 형상으로 되, 휘어질 수 있는 디스플레이의 특성을 전제로 스크루와 휘어질 수 있는 부재들을 받침점을 통해 지탱할 수 있도록 하여 수시로 이동 단말기의 곡률을 변화시켜 사용할 수 돌아와 가변적인 곡률의 조정, 유지가 불가능 하였다. 이를 해결하기 위해 본 발명은 있는 이동 단말기를 제공하고, 배터리 커버가 존재하는 이동 단말기를 전제로 이렇게 곡률이 변화된 이동 단말기에 따라 배터리 커버가 벗겨지기 쉬운 문제를 해결하는데 그 목적이 있다.

과제의 해결 수단

[0008] 상기 목적을 달성하기 위해 본 발명의 일 측면에 따르면, 액정 디스플레이 및 액정 디스플레이와 결합하는 미들 프레임을 구비하고 휘어질 수 있는 소재를 포함하는 전면부, 그리고 이 전면부의 배면 방향에 위치하고, 잘 휘어지지 않고 부재의 일부가 전면부 방향으로 돌출되어 전면부 등의 부재를 휘어질 수 있도록 반쳐주는 지지부, 상기 미들 프레임에 구비되어 스크루가 지나갈 수 있도록 하는 나사홈, 나사선은 상기 나사홈에 맞물려 인입출되며, 나사머리는 상기 지지부의 일 영역에 회전가능하게 결합되어 상기 전면부에 인상력을 인가하는 스크루를 제공하여 휨 운동시 스크루와 부재가 이격된 상태로 거동하는 일이 없도록 하고, 상기 스크루가 상기 전면부에 인장력을 인가시, 상기 지지부의 또 다른 영역을 받침점으로 상기 전면부의 곡률이 변화하는 이동 단말기를 제공한다.

[0009] 또한 휘어질 수 잇는 소재를 포함하고, 상기 지지부의 배면방향에 위치하는 후면부를 더 포함하고, 상기 전면부의 곡률이 증가시 상기 후면부의 곡률도 함께 증가하고, 상기 전면부의 곡률이 감소시 상기 후면부의 곡률도 함께 감소하는 것을 특징으로 하는 가변형 이동 단말기를 제공한다.

[0010] 나아가, 전면부와 후면부 사이에 위치하는 피씨비를 더 포함하고, 피씨비의 전면부와 대향하는 면에 실장된 복수개의 부품은 나사홈이 위치한 부분에서 휘어지는 방향으로 이격될수록 더 두꺼운 이동 단말기를 제공한다.

[0011] 한편, 스크루를 회전하는 손잡이를 더 구비하고, 이러한 손잡이는 단말기에 전원을 공급하는 배터리가 될 수 있으며, 이 배터리를 회전축에 대한 수직방향으로 자른 단면은 원형이 되는 이동 단말기를 제공한다.

[0012] 또 후면부와 착탈되는 후크를 포함하는 배터리커버와 후면부의 외측면에 상기 후크와 체결되는 복수개의 후크홈을 포함하고, 후크홈은 두 개의 홈이 중첩되어 배치된 이동 단말기를 제공한다.

발명의 효과

[0013] 본 발명에 따른 이동 단말기의 효과에 대해 설명하면 다음과 같다.

[0014] 본 발명의 실시 예들 중 적어도 하나에 의하면, 기존의 플렉서블 디스플레이가 존재함에도 불구하고 나머지 부재 또는 부품들의 이유로 가변적으로 휘어서 쓸 수 없고 휘어짐이 고정된 상태로 써야 했으나, 본 발명의 경우에는 가변적으로 일정 범위내의 이동 단말기의 곡률을 변화시킬 수 있다는 장점이 있다.

[0015] 본 발명의 적용 가능성의 추가적인 범위는 이하의 상세한 설명으로부터 명백해질 것이다. 그러나 본 발명의 사상 및 범위 내에서 다양한 변경 및 수정은 당업자에게 명확하게 이해될 수 있으므로, 상세한 설명 및 본 발명의 바람직한 실시 예와 같은 특정 실시 예는 단지 예시로 주어진 것으로 이해되어야 한다.

도면의 간단한 설명

[0016] 도 1a 는 본 발명과 관련된 이동 단말기를 설명하기 위한 블록도이다.

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도 1b 는 본 발명과 관련된 변형되지 않은 상태의 이동 단말기의 일 예를 서로 다른 방향에서 바라본 개념도이다.

도 1c 는 본 발명과 관련된 변형된 상태의 이동 단말기의 일 예를 서로 다른 방향에서 바라본 개념도이다.

도 2 는 본 발명과 관련된 이동 단말기의 A-A' 방향에 대한 종단면도 이다.

도 3 내지 5 는 본 발명과 관련된 변형된 상태와 변형되지 않은 상태의 이동 단말기의 A-A' 방향에 대한 종단면도 이다.

도 6 은 본 발명과 관련된 이동 단말기의 배터리 커버를 제외한 구성에 대한 배면도이다.

도 7 은 본 발명과 관련된 이동 단말기의 A-A' 방향에 대한 종단면도 이다.

도 8 은 본 발명과 관련된 배터리 내장형 또는 교체 가능형 이동 단말기의 배면도와 이동 단말기의 A-A' 방향에 대한 종단면도이다.

도 9 는 본 발명과 관련된 이동 단말기의 배터리 커버를 제외한 구성에 대한 배면도이다.

도 10 은 본 발명과 관련된 이동 단말기의 원형 배터리에 대한 종 단면도, 선면 사시도, 원형 배터리에 의해 휜 상태와 평평한 상태가 된 이동 단말기의 종 단면도를 도시한 것이다.

도 11 은 본 발명과 관련된 실시 예 중 하나인 교체 가능형 배터리를 가진 가변형 이동 단말기의 전원 집촉 구조를 도시한 도면이다.

도 12 는 본 발명과 관련된 배터리 교체가능형 이동 단말기의 A-A' 방향에 대한 종단면도이다.

발명을 실시하기 위한 구체적인 내용

[0017] 이하, 첨부된 도면을 참조하여 본 명세서에 개시된 실시 예를 상세히 설명하되, 도면 부호에 관계없이 동일하거나 유사한 구성요소는 동일한 참조 번호를 부여하고 이에 대한 중복되는 설명은 생략하기로 한다. 이하의 설명에서 사용되는 구성요소에 대한 접미사 "모듈" 및 "부"는 명세서 작성의 용이함만이 고려되어 부여되거나 혼용되는 것으로서, 그 자체로 서로 구별되는 의미 또는 역할을 갖는 것은 아니다. 또한, 본 명세서에 개시된 실시 예를 설명함에 있어서 관련된 공지 기술에 대한 구체적인 설명이 본 명세서에 개시된 실시 예의 요지를 흐릴 수 있다고 판단되는 경우 그 상세한 설명을 생략한다. 또한, 첨부된 도면은 본 명세서에 개시된 실시 예를 쉽게 이해할 수 있도록 하기 위한 것일 뿐, 첨부된 도면에 의해 본 명세서에 개시된 기술적 사상이 제한되지 않으며, 본 발명의 사상 및 기술 범위에 포함되는 모든 변경, 균등물 내지 대체물을 포함하는 것으로 이해되어야 한다.

[0018] 본 명세서에서 설명되는 이동 단말기에는 휴대폰, 스마트 폰(smart phone), 노트북 컴퓨터(laptop computer), 디지털방송용 단말기, PDA(personal digital assistants), PMP(portable multimedia player), 네비게이션, 슬레이트 PC(slate PC), 태블릿 PC(tablet PC), 울트라북(ultrabook), 웨어러블 디바이스(wearable device, 예를 들어, 워치형 단말기 (smartwatch), 글래스형 단말기 (smart glass), HMD(head mounted display)) 등이 포함될 수 있다.

[0019] 그러나, 본 명세서에 기재된 실시 예에 따른 구성은 이동 단말기에만 적용 가능한 경우를 제외하면, 디지털 TV, 데스크탑 컴퓨터, 디지털 사이니지 등과 같은 고정 단말기에도 적용될 수도 있음을 본 기술분야의 당업자라면 쉽게 알 수 있을 것이다.

[0020] 도 1a 내지 도 1c 를 참조하면, 도 1a 는 본 발명과 관련된 이동 단말기를 설명하기 위한 블록도이고, 도 1b 및 1c 는 본 발명과 관련된 이동 단말기의 일 예를 서로 다른 방향에서 바라본 개념도이다.

[0021] 상기 이동 단말기(100)는 무선 통신부(110), 입력부(120), 감지부(140), 출력부(150), 인터페이스부(160), 메모리(170), 제어부(180) 및 전원 공급부(190) 등을 포함할 수 있다. 도 1a 에 도시된 구성요소들은 이동 단말기를 구현하는데 있어서 필수적인 것은 아니어서, 본 명세서 상에서 설명되는 이동 단말기는 위에서 열거된 구성요소들 보다 많거나, 또는 적은 구성요소들을 가질 수 있다.

[0022] 보다 구체적으로, 상기 구성요소들 중 무선 통신부(110)는, 이동 단말기(100)와 무선 통신 시스템 사이, 이동 단말기(100)와 다른 이동 단말기(100) 사이, 또는 이동 단말기(100)와 외부서버 사이의 무선 통신을 가능하게 하는 하나 이상의 모듈을 포함할 수 있다. 또한, 상기 무선 통신부(110)는, 이동 단말기(100)를 하나 이상의 네트워크에 연결하는 하나 이상의 모듈을 포함할 수 있다.

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[0023] 이러한 무선 통신부(110)는, 방송 수신 모듈(111), 이동통신 모듈(112), 무선 인터넷 모듈(113), 근거리 통신 모듈(114), 위치정보 모듈(115) 중 적어도 하나를 포함할 수 있다.

[0024] 입력부(120)는, 영상 신호 입력을 위한 카메라(121) 또는 영상 입력부, 오디오 신호 입력을 위한 마이크로폰(microphone, 122), 또는 오디오 입력부, 사용자로부터 정보를 입력받기 위한 사용자 입력부(123, 예를 들어, 터치키(touch key), 푸시키(mechanical key) 등)를 포함할 수 있다. 입력부(120)에서 수집한 음성 데이터나 이미지 데이터는 분석되어 사용자의 제어명령으로 처리될 수 있다.

[0025] 센싱부(140)는 이동 단말기 내 정보, 이동 단말기를 둘러싼 주변 환경 정보 및 사용자 정보 중 적어도 하나를 센싱하기 위한 하나 이상의 센서를 포함할 수 있다. 예를 들어, 센싱부(140)는 근접센서(141, proximity sensor), 조도 센서(142, illumination sensor), 터치 센서(touch sensor), 가속도 센서(acceleration sensor), 자기 센서(magnetic sensor), 중력 센서(G-sensor), 자이로스코프 센서(gyroscope sensor), 모션 센서(motion sensor), RGB 센서, 적외선 센서(IR 센서: infrared sensor), 지문인식 센서(finger scan sensor), 초음파 센서(ultrasonic sensor), 광 센서(optical sensor, 예를 들어, 카메라(121 참조)), 마이크로폰(microphone, 122 참조), 배터리 게이지(battery gauge), 환경 센서(예를 들어, 기압계, 습도계, 온도계, 방사능 감지 센서, 열 감지 센서, 가스 감지 센서 등), 화학 센서(예를 들어, 전자 코, 헬스케어 센서, 생체 인식 센서 등) 중 적어도 하나를 포함할 수 있다. 한편, 본 명세서에 개시된 이동 단말기는, 이러한 센서들 중 적어도 둘 이상의 센서에서 센싱되는 정보들을 조합하여 활용할 수 있다.

[0026] 출력부(150)는 시각, 청각 또는 촉각 등과 관련된 출력을 발생시키기 위한 것으로, 디스플레이부(151), 음향 출력부(152), 햅팁 모듈(153), 광 출력부(154) 중 적어도 하나를 포함할 수 있다. 디스플레이부(151)는 터치 센서와 상호 레이어 구조를 이루거나 일체형으로 형성됨으로써, 터치 스크린을 구현할 수 있다. 이러한 터치 스크린은, 이동 단말기(100)와 사용자 사이의 입력 인터페이스를 제공하는 사용자 입력부(123)로써 기능함과 동시에, 이동 단말기(100)와 사용자 사이의 출력 인터페이스를 제공할 수 있다. 본 발명에서는 이동 단말기에서 처리되는 정보를 플렉서블 디스플레이(flexible display)를 이용하여 표시할 수 있다. 디스플레이부(151)는 외력에 의하여 변형 가능하게 구성될 수 있다. 상기 변형은 디스플레이부(151)의 휘어짐, 구부러짐, 접힘, 비틀림, 말림 중 적어도 하나일 수 있다. 이러한 변형 가능한 디스플레이부(151)는 '플렉서블 디스플레이부'로 명명될 수 있다. 여기에서, 플렉서블 디스플레이부(151)는 일반적인 플렉서블 디스플레이와 전자 종이(e-paper) 및 그 조합을 모두 포함할 수 있다.

[0027] 일반적인 플렉서블 디스플레이는 기존의 평판 디스플레이의 특성을 유지하면서, 종이와 같이 휘어짐, 구부러짐, 접힘, 비틀림 또는 말림이 가능한 얇고 유연한 기판 위에 제작되어, 가볍고 쉽게 깨지지 않는 튼튼한 디스플레이를 말한다.

[0028] 또한, 전자 종이는 일반적인 잉크의 특징을 적용한 디스플레이 기술로서, 반사광을 사용하는 점이 기존의 평판 디스플레이와 다른 점일 수 있다. 전자 종이는 트위스트 볼을 이용하거나, 캡슐을 이용한 전기영동(電氣泳動, electrophoresis)을 이용하여, 정보를 변경할 수 있다.

[0029] 플렉서블 디스플레이부(151)가 변형되지 않는 상태(예를 들어, 무한대의 곡률반경을 가지는 상태, 이하 제 1 상태(도 1b)라 한다)에서, 플렉서블 디스플레이부(151)의 디스플레이 영역은 평면이 된다. 상기 제 1 상태에서 외력에 의하여 변형된 상태(예를 들어, 유한의 곡률반경을 가지는 상태, 이하, 제 2 상태(도 1c)라 한다)에서는 상기 디스플레이 영역이 곡면이 될 수 있다. 도시된 바와 같이, 상기 제 2 상태에서 표시되는 정보는 곡면상에 출력되는 시각 정보가 될 수 있다. 이러한 시각 정보는 매트릭스 형태로 배치되는 단위 화소(sub-pixel)의 발광이 독자적으로 제어됨에 의하여 구현된다. 상기 단위 화소는 하나의 색을 구현하기 위한 최소 단위를 의미한다.

[0030] 플렉서블 디스플레이부(151)는 상기 평평한 상태인 제 1 상태(도 1b)가 아닌, 휘어진 상태(예를 들어, A-A'또는 B-B'방향으로 휘어진 상태)인 제 2 상태(도 1c)에 놓일 수 있다. 이 경우, 플렉서블 디스플레이부(151)에 외력이 가해지면, 플렉서블 디스플레이부(151)는 평평한 상태(혹은 보다 덜 휘어진 상태) 또는 보다 많이 휘어진 상태로 변형될 수 있다.

[0031] 플렉서블 디스플레이부(151)의 상태 변형은 외력에 의한 것으로만 국한되지는 않는다. 예를 들어, 플렉서블 디스플레이부(151)가 제 1 상태를 가지고 있을 때, 사용자 혹은 애플리케이션의 명령에 의해서, 제 2 상태로 변형될 수도 있다.

[0032] 한편, 플렉서블 디스플레이부(151)는 터치센서와 조합되어 플렉서블 터치 스크린을 구현할 수 있다. 플렉서블 터치 스크린에 대하여 터치가 이루어지면, 제어부(180, 도 1a 참조)는 이러한 터치입력에 상응하는 제어를 수행

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할 수 있다. 플렉서블 터치 스크린은 상기 제1 상태뿐만 아니라 상기 제 2 상태에서도 터치입력을 감지하도록 이루어질 수 있다.

[0033] 한편, 본 변형 예에 따른 이동 단말기(100)에는 플렉시블 디스플레이부(151)의 변형을 감지할 수 있는 변형감지수단이 구비될 수 있다. 이러한 변형감지수단은 센싱부(140, 도 1a 참조)에 포함될 수 있다.

[0034] 상기 변형감지수단은 플렉서블 디스플레이부(151) 또는 케이스(201)(처리 요)에 구비되어, 플렉서블 디스플레이부(151)의 변형과 관련된 정보를 감지할 수 있다. 여기에서, 변형과 관련된 정보는, 플렉시블 디스플레이부(151)가 변형된 방향, 변형된 정도, 변형된 위치, 변형된 시간 및 변형된 플렉서블 디스플레이부(151)가 복원되는 가속도 등이 될 수 있으며, 이 밖에도 플렉서블 디스플레이부(151)의 휘어짐으로 인하여 감지 가능한 다양한 정보일 수 있다.

[0035] 인터페이스부(160)는 이동 단말기(100)에 연결되는 다양한 종류의 외부 기기와의 통로 역할을 수행한다. 이러한 인터페이스부(160)는, 유/무선 헤드셋 포드(port), 외부 충전기 포드(port), 유/무선 데이터 포드(port), 메모리 카드(memory card) 포트, 식별 모듈이 구비된 장치를 연결하는 포트(port), 오디오 I/O(Input/Output) 포트(port), 비디오 I/O(Input/Output) 포트(port), 이어폰 포트(port) 중 적어도 하나를 포함할 수 있다. 이동 단말기(100)에서는, 상기 인터페이스부(160)에 외부 기기가 연결되는 것에 대응하여, 연결된 외부 기기와 관련된 적절할 제어를 수행할 수 있다.

[0036] 또한, 메모리(170)는 이동 단말기(100)의 다양한 기능을 지원하는 데이터를 저장한다. 메모리(170)는 이동 단말기(100)에서 구동되는 다수의 응용 프로그램(application program 또는 애플리케이션(application)), 이동 단말기(100)의 동작을 위한 데이터들, 명령어들을 저장할 수 있다. 이러한 응용 프로그램 중 적어도 일부는, 무선 통신을 통해 외부 서버로부터 다운로드 될 수 있다. 또한 이러한 응용 프로그램 중 적어도 일부는, 이동 단말기(100)의 기본적인 기능(예를 들어, 전화 착신, 발신 기능, 메시지 수신, 발신 기능)을 위하여 출고 당시부터 이동 단말기(100)상에 존재할 수 있다. 한편, 응용 프로그램은, 메모리(170)에 저장되고, 이동 단말기(100) 상에 설치되어, 제어부(180)에 의하여 상기 이동 단말기의 동작(또는 기능)을 수행하도록 구동될 수 있다.

[0037] 제어부(180)는 상기 응용 프로그램과 관련된 동작 외에도, 통상적으로 이동 단말기(100)의 전반적인 동작을 제어한다. 제어부(180)는 위에서 살펴본 구성요소들을 통해 입력 또는 출력되는 신호, 데이터, 정보 등을 처리하거나 메모리(170)에 저장된 응용 프로그램을 구동함으로써, 사용자에게 적절한 정보 또는 기능을 제공 또는 처리할 수 있다.

[0038] 또한, 제어부(180)는 메모리(170)에 저장된 응용 프로그램을 구동하기 위하여, 도 1a와 함께 살펴본 구성요소들 중 적어도 일부를 제어할 수 있다. 나아가, 제어부(180)는 상기 응용 프로그램의 구동을 위하여, 이동 단말기(100)에 포함된 구성요소들 중 적어도 둘 이상을 서로 조합하여 동작시킬 수 있다.

[0039] 또한, 제어부(180)는 상기 변형감지수단에 의하여 감지되는 플렉서블 디스플레이부(151)의 변형과 관련된 정보에 근거하여, 플렉서블 디스플레이부(151) 상에 표시되는 정보를 변경하거나, 이동 단말기(100)의 기능을 제어하기 위한 제어신호를 생성할 수 있다.

[0040] 전원공급부(190)는 제어부(180)의 제어 하에서, 외부의 전원, 내부의 전원을 인가 받아 이동 단말기(100)에 포함된 각 구성요소들에 전원을 공급한다. 이러한 전원공급부(190)는 배터리를 포함하며, 상기 배터리는 내장형 배터리 또는 교체가능한 형태의 배터리가 될 수 있다.

[0041] 아울러, 이동 단말기(100)에 구비되는 배터리(미도시) 또한 플렉서블 디스플레이부(151)의 특성을 고려하여, 외력에 의하여 플렉서블 디스플레이부(151)와 함께 변형 가능하도록 구성될 수 있다. 상기 배터리를 구현하기 위하여, 배터리 셀을 위로 쌓은 스택앤폴딩(stack and folding) 방식이 적용될 수 있다.

[0042] 상기 각 구성요소들 중 적어도 일부는, 이하에서 설명되는 다양한 실시 예들에 따른 이동 단말기의 동작, 제어, 또는 제어방법을 구현하기 위하여 서로 협력하여 동작할 수 있다. 또한, 상기 이동 단말기의 동작, 제어, 또는 제어방법은 상기 메모리(170)에 저장된 적어도 하나의 응용 프로그램의 구동에 의하여 이동 단말기 상에서 구현될 수 있다.

[0043] 도 1b 및 1c 를 참조하면, 개시된 이동 단말기(100)는 바 형태의 단말기 바디를 구비하고 있다. 다만, 본 발명은 여기에 한정되지 않고 와치 타입, 클립 타입, 글래스 타입 또는 2 이상의 바디들이 상대 이동 가능하게 결합되는 폴더 타입, 플립 타입, 슬라이드 타입, 스윙 타입, 스위블 타입 등 다양한 구조에 적용될 수 있다. 이동 단말기의 특정 유형에 관련될 것이나, 이동 단말기의 특정유형에 관한 설명은 다른 타입의 이동 단말기에 일반

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적으로 적용될 수 있다.

[0044] 여기에서, 단말기 바디는 이동 단말기(100)를 적어도 하나의 집합체로 보아 이를 지칭하는 개념으로 이해될 수 있다.

[0045] 이동 단말기(100)는 외관을 이루는 케이스(예를 들면, 프레임, 하우징, 커버 등)를 포함한다. 도시된 바와 같이, 이동 단말기(100)는 프론트 케이스(101)와 리어 케이스(102)를 포함할 수 있다. 프론트 케이스(101)와 리어 케이스(102)의 결합에 의해 형성되는 내부공간에는 각종 전자부품들이 배치된다. 프론트 케이스(101)와 리어 케이스(102) 사이에는 적어도 하나의 미들 케이스가 추가로 배치될 수 있다.

[0046] 단말기 바디의 전면에는 디스플레이부(151)가 배치되어 정보를 출력할 수 있다. 도시된 바와 같이, 디스플레이부(151)의 윈도우(151a)는 프론트 케이스(101)에 장착되어 프론트 케이스(101)와 함께 단말기 바디의 전면을 형성할 수 있다.

[0047] 경우에 따라서, 리어 케이스(102)에도 전자부품이 장착될 수 있다. 리어 케이스(102)에 장착 가능한 전자부품은 착탈 가능한 배터리, 식별 모듈, 메모리 카드 등이 있다. 이 경우, 리어 케이스(102)에는 장착된 전자부품을 덮기 위한 배터리 커버(103)가 착탈 가능하게 결합될 수 있다. 따라서, 배터리 커버(103)가 리어 케이스(102)로부터 분리되면, 리어 케이스(102)에 장착된 전자부품은 외부로 노출된다.

[0048] 도시된 바와 같이, 후면커버(103)가 리어 케이스(102)에 결합되면, 리어 케이스(102)의 측면 일부가 노출될 수 있다. 경우에 따라서, 상기 결합시 리어 케이스(102)는 후면커버(103)에 의해 완전히 가려질 수도 있다. 한편, 후면커버(103)에는 카메라(121b)나 음향 출력부(152b)를 외부로 노출시키기 위한 개구부가 구비될 수 있다.

[0049] 이러한 케이스들(101, 102, 103)은 합성수지를 사출하여 형성되거나 금속, 예를 들어 스테인레스 스틸(STS), 알루미늄(Al), 티타늄(Ti) 등으로 형성될 수도 있다.

[0050] 이동 단말기(100)는, 복수의 케이스가 각종 전자부품들을 수용하는 내부 공간을 마련하는 위의 예와 달리, 하나의 케이스가 상기 내부 공간을 마련하도록 구성될 수도 있다. 이 경우, 합성수지 또는 금속이 측면에서 후면으로 이어지는 유니 바디의 이동 단말기(100)가 구현될 수 있다.

[0051] 한편, 이동 단말기(100)는 단말기 바디 내부로 물이 스며들지 않도록 하는 방수부(미도시)를 구비할 수 있다. 예를 들어, 방수부는 윈도우(151a)와 프론트 케이스(101) 사이, 프론트 케이스(101)와 리어 케이스(102) 사이 또는 리어 케이스(102)와 배터리 커버(103) 사이에 구비되어, 이들의 결합 시 내부 공간을 밀폐하는 방수부재를 포함할 수 있다.

[0052] 이동 단말기(100)에는 디스플레이부(151), 제1 및 제2 음향 출력부(152a, 152b), 근접 센서(141), 조도 센서(142), 광 출력부(154), 제1 및 제2 카메라(121a, 121b), 제1 및 제2 조작유닛(123a, 123b), 마이크로폰(122), 인터페이스부(160) 등이 구비될 수 있다.

[0053] 이하에서는, 도 1b 및 도 1c 에 도시된 바와 같이, 단말기 바디의 전면에 디스플레이부(151), 제1 음향 출력부(152a), 근접 센서(141), 조도 센서(142), 광 출력부(154), 제1 카메라(121a) 및 제1 조작유닛(123a)이 배치되고, 단말기 바디의 측면에 제2 조작유닛(123b), 마이크로폰(122) 및 인터페이스부(160)이 배치되며, 단말기 바디의 후면에 제2 음향 출력부(152b) 및 제2 카메라(121b)가 배치된 이동 단말기(100)를 일 예로 들어 설명한다.

[0054] 다만, 이들 구성은 이러한 배치에 한정되는 것은 아니다. 이들 구성은 필요에 따라 제외 또는 대체되거나, 다른 면에 배치될 수 있다. 예를 들어, 단말기 바디의 전면에는 제1 조작유닛(123a)이 구비되지 않을 수 있으며, 제2 음향 출력부(152b)는 단말기 바디의 후면이 아닌 단말기 바디의 측면에 구비될 수 있다.

[0055] 디스플레이부(151)는 이동 단말기(100)에서 처리되는 정보를 표시(출력)한다. 예를 들어, 디스플레이부(151)는 이동 단말기(100)에서 구동되는 응용 프로그램의 실행화면 정보, 또는 이러한 실행화면 정보에 따른 UI(User Interface), GUI(Graphic User Interface) 정보를 표시할 수 있다.

[0056] 디스플레이부(151)는 액정 디스플레이(liquid crystal display, LCD), 박막 트랜지스터 액정 디스플레이(thin film transistor-liquid crystal display, TFT LCD), 유기 발광 다이오드(organic light-emitting diode, OLED), 플렉서블 디스플레이(flexible display), 3차원 디스플레이(3D display), 전자잉크 디스플레이(e-ink display) 중에서 적어도 하나를 포함할 수 있다.

[0057] 또한, 디스플레이부(151)는 이동 단말기(100)의 구현 형태에 따라 2개 이상 존재할 수 있다. 이 경우, 이동 단말기(100)에는 복수의 디스플레이부들이 하나의 면에 이격되거나 일체로 배치될 수 있고, 또한 서로 다른 면에

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각각 배치될 수도 있다.

[0058] 디스플레이부(151)는 터치 방식에 의하여 제어 명령을 입력 받을 수 있도록, 디스플레이부(151)에 대한 터치를 감지하는 터치센서를 포함할 수 있다. 이를 이용하여, 디스플레이부(151)에 대하여 터치가 이루어지면, 터치센서는 상기 터치를 감지하고, 제어부(180)는 이에 근거하여 상기 터치에 대응하는 제어명령을 발생시키도록 이루어질 수 있다. 터치 방식에 의하여 입력되는 내용은 문자 또는 숫자이거나, 각종 모드에서의 지시 또는 지정 가능한 메뉴항목 등일 수 있다.

[0059] 한편, 터치센서는, 터치패턴을 구비하는 필름 형태로 구성되어 윈도우(151a)와 윈도우(151a)의 배면 상의 디스플레이(미도시) 사이에 배치되거나, 윈도우(151a)의 배면에 직접 패터닝되는 메탈 와이어가 될 수도 있다. 또는, 터치센서는 디스플레이와 일체로 형성될 수 있다. 예를 들어, 터치센서는, 디스플레이의 기판 상에 배치되거나, 디스플레이의 내부에 구비될 수 있다.

[0060] 이처럼, 디스플레이부(151)는 터치센서와 함께 터치 스크린을 형성할 수 있으며, 이 경우에 터치 스크린은 사용자 입력부(123, 도 1a 참조)로 기능할 수 있다. 경우에 따라, 터치 스크린은 제1조작유닛(123a)의 적어도 일부 기능을 대체할 수 있다.

[0061] 제1 음향 출력부(152a)는 통화음을 사용자의 귀에 전달시키는 리시버(receiver)로 구현될 수 있으며, 제2 음향 출력부(152b)는 각종 알람음이나 멀티미디어의 재생음을 출력하는 라우드 스피커(loud speaker)의 형태로 구현될 수 있다.

[0062] 디스플레이부(151)의 윈도우(151a)에는 제1 음향 출력부(152a)로부터 발생되는 사운드의 방출을 위한 음향홀이 형성될 수 있다. 다만, 본 발명은 이에 한정되는 것은 아니고, 상기 사운드는 구조물 간의 조립틈(예를 들어, 윈도우(151a)와 프론트 케이스(101) 간의 틈)을 따라 방출되도록 구성될 수 있다. 이 경우, 외관상 음향 출력을 위하여 독립적으로 형성되는 홀이 보이지 않거나 숨겨져 이동 단말기(100)의 외관이 보다 심플해질 수 있다.

[0063] 광 출력부(154)는 이벤트의 발생시 이를 알리기 위한 빛을 출력하도록 이루어진다. 상기 이벤트의 예로는 메시지 수신, 호 신호 수신, 부재중 전화, 알람, 일정 알림, 이메일 수신, 애플리케이션을 통한 정보 수신 등을 들 수 있다. 제어부(180)는 사용자의 이벤트 확인이 감지되면, 빛의 출력이 종료되도록 광 출력부(154)를 제어할 수 있다.

[0064] 제1 카메라(121a)는 촬영 모드 또는 화상통화 모드에서 이미지 센서에 의해 얻어지는 정지영상 또는 동영상의 화상 프레임을 처리한다. 처리된 화상 프레임은 디스플레이부(151)에 표시될 수 있으며, 메모리(170)에 저장될 수 있다.

[0065] 제1 및 제2 조작유닛(123a, 123b)은 이동 단말기(100)의 동작을 제어하기 위한 명령을 입력 받기 위해 조작되는 사용자 입력부(123)의 일 예로서, 조작부(manipulating portion)로도 통칭될 수 있다. 제1 및 제2 조작유닛(123a, 123b)은 터치, 푸시, 스크롤 등 사용자가 촉각적인 느낌을 받으면서 조작하게 되는 방식(tactile manner)이라면 어떤 방식이든 채용될 수 있다. 또한, 제1 및 제2 조작유닛(123a, 123b)은 근접 터치(proximity touch), 호버링(hovering) 터치 등을 통해서 사용자의 촉각적인 느낌이 없이 조작하게 되는 방식으로도 채용될 수 있다.

[0066] 본 도면에서는 제1 조작유닛(123a)이 터치키(touch key)인 것으로 예시하나, 본 발명이 이에 한정되는 것은 아니다. 예를 들어, 제1 조작유닛(123a)은 푸시키(mechanical key)가 되거나, 터치키와 푸시키의 조합으로 구성될 수 있다.

[0067] 제1 및 제2 조작유닛(123a, 123b)에 의하여 입력되는 내용은 다양하게 설정될 수 있다. 예를 들어, 제1 조작유닛(123a)은 메뉴, 홈키, 취소, 검색 등의 명령을 입력 받고, 제2 조작유닛(123b)은 제1 또는 제2 음향 출력부(152a, 152b)에서 출력되는 음향의 크기 조절, 디스플레이부(151)의 터치 인식 모드로의 전환 등의 명령을 입력 받을 수 있다.

[0068] 한편, 단말기 바디의 후면에는 사용자 입력부(123)의 다른 일 예로서, 후면 입력부(미도시)가 구비될 수 있다. 이러한 후면 입력부는 이동 단말기(100)의 동작을 제어하기 위한 명령을 입력 받기 위해 조작되는 것으로서, 입력되는 내용은 다양하게 설정될 수 있다. 예를 들어, 전원의 온/오프, 시작, 종료, 스크롤 등과 같은 명령, 제1 및 제2 음향 출력부(152a, 152b)에서 출력되는 음향의 크기 조절, 디스플레이부(151)의 터치 인식 모드로의 전환 등과 같은 명령을 입력 받을 수 있다. 후면 입력부는 터치입력, 푸시입력 또는 이들의 조합에 의한 입력이 가능한 형태로 구현될 수 있다.

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[0069] 후면 입력부는 단말기 바디의 두께방향으로 전면의 디스플레이부(151)와 중첩되게 배치될 수 있다. 일 예로, 사용자가 단말기 바디를 한 손으로 쥐었을 때 검지를 이용하여 용이하게 조작 가능하도록, 후면 입력부는 단말기 바디의 후면 상단부에 배치될 수 있다. 다만, 본 발명은 반드시 이에 한정되는 것은 아니며, 후면 입력부의 위치는 변경될 수 있다.

[0070] 이처럼 단말기 바디의 후면에 후면 입력부가 구비되는 경우, 이를 이용한 새로운 형태의 유저 인터페이스가 구현될 수 있다. 또한, 앞서 설명한 터치 스크린 또는 후면 입력부가 단말기 바디의 전면에 구비되는 제1 조작유닛(123a)의 적어도 일부 기능을 대체하여, 단말기 바디의 전면에 제1 조작유닛(123a)이 미배치되는 경우, 디스플레이부(151)가 보다 대화면(大畵面)으로 구성될 수 있다.

[0071] 한편, 이동 단말기(100)에는 사용자의 지문을 인식하는 지문인식센서가 구비될 수 있으며, 제어부(180)는 지문인식센서를 통하여 감지되는 지문정보를 인증수단으로 이용할 수 있다. 상기 지문인식센서는 디스플레이부(151) 또는 사용자 입력부(123)에 내장될 수 있다.

[0072] 마이크로폰(122)은 사용자의 음성, 기타 소리 등을 입력 받도록 이루어진다. 마이크로폰(122)은 복수의 개소에 구비되어 스테레오 음향을 입력 받도록 구성될 수 있다.

[0073] 인터페이스부(160)는 이동 단말기(100)를 외부기기와 연결시킬 수 있는 통로가 된다. 예를 들어, 인터페이스부(160)는 다른 장치(예를 들어, 이어폰, 외장 스피커)와의 연결을 위한 접속단자, 근거리 통신을 위한 포트[예를 들어, 적외선 포트(IrDA Port), 블루투스 포트(Bluetooth Port), 무선 랜 포트(Wireless LAN Port) 등], 또는 이동 단말기(100)에 전원을 공급하기 위한 전원공급단자 중 적어도 하나일 수 있다. 이러한 인터페이스부(160)는 SIM(Subscriber Identification Module) 또는 UIM(User Identity Module), 정보 저장을 위한 메모리 카드 등의 외장형 카드를 수용하는 소켓의 형태로 구현될 수도 있다.

[0074] 단말기 바디의 후면에는 제2카메라(121b)가 배치될 수 있다. 이 경우, 제2카메라(121b)는 제1카메라(121a)와 실질적으로 반대되는 촬영 방향을 가지게 된다.

[0075] 제2카메라(121b)는 적어도 하나의 라인을 따라 배열되는 복수의 렌즈를 포함할 수 있다. 복수의 렌즈는 행렬(matrix) 형식으로 배열될 수도 있다. 이러한 카메라는, '어레이(array) 카메라'로 명명될 수 있다. 제2카메라(121b)가 어레이 카메라로 구성되는 경우, 복수의 렌즈를 이용하여 다양한 방식으로 영상을 촬영할 수 있으며, 보다 나은 품질의 영상을 획득할 수 있다.

[0076] 플래시(124)는 제2카메라(121b)에 인접하게 배치될 수 있다. 플래시(124)는 제2카메라(121b)로 피사체를 촬영하는 경우에 피사체를 향하여 빛을 비추게 된다.

[0077] 단말기 바디에는 제2 음향 출력부(152b)가 추가로 배치될 수 있다. 제2 음향 출력부(152b)는 제1 음향 출력부(152a)와 함께 스테레오 기능을 구현할 수 있으며, 통화시 스피커폰 모드의 구현을 위하여 사용될 수도 있다.

[0078] 단말기 바디에는 무선 통신을 위한 적어도 하나의 안테나가 구비될 수 있다. 안테나는 단말기 바디에 내장되거나, 케이스에 형성될 수 있다. 예를 들어, 방송 수신 모듈(111, 도 1a 참조)의 일부를 이루는 안테나는 단말기 바디에서 인출 가능하게 구성될 수 있다. 또는, 안테나는 필름 타입으로 형성되어 배터리 커버(103)의 내측면에 부착될 수도 있고, 도전성 재질을 포함하는 케이스가 안테나로서 기능하도록 구성될 수도 있다.

[0079] 단말기 바디에는 이동 단말기(100)에 전원을 공급하기 위한 전원 공급부(190, 도 1a 참조)가 구비된다. 전원 공급부(190)는 단말기 바디에 내장되거나, 단말기 바디의 외부에서 착탈 가능하게 구성되는 배터리(191)를 포함할 수 있다.

[0080] 배터리(191)는 인터페이스부(160)에 연결되는 전원 케이블을 통하여 전원을 공급받도록 구성될 수 있다. 또한, 배터리(191)는 무선충전기기를 통하여 무선충전 가능하도록 구성될 수도 있다. 상기 무선충전은 자기유도방식 또는 공진방식(자기공명방식)에 의하여 구현될 수 있다.

[0081] 한편, 본 도면에서는 배터리 커버(103)가 배터리(191)를 덮도록 리어 케이스(102)에 결합되어 배터리(191)의 이탈을 제한하고, 배터리(191)를 외부 충격과 이물질로부터 보호하도록 구성된 것을 예시하고 있다. 배터리(191)가 단말기 바디에 착탈 가능하게 구성되는 경우, 배터리 커버(103)는 리어 케이스(102)에 착탈 가능하게 결합될 수 있다.

[0082] 이동 단말기(100)에는 외관을 보호하거나, 이동 단말기(100)의 기능을 보조 또는 확장시키는 액세서리가 추가될 수 있다. 이러한 액세서리의 일 예로, 이동 단말기(100)의 적어도 일면을 덮거나 수용하는 커버 또는 파우치를

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들 수 있다. 커버 또는 파우치는 디스플레이부(151)와 연동되어 이동 단말기(100)의 기능을 확장시키도록 구성될 수 있다. 액세서리의 다른 일 예로, 터치 스크린에 대한 터치입력을 보조 또는 확장하기 위한 터치펜을 들 수 있다.

[0083] 도 2 는 이동 단말기의 A-A' 방향에 대한 종단면을 도시한 것이다.

[0084] 본 발명에서 언급하고 있는 전면부(100a)는 디스플레이부(151)(윈도우, ITO필름, LCD Panel, BLU(back light unit)), 미들 프레임(104, 여기서는LCD plate가 될 수 있다.)와 프론트 케이스(101)를 포함할 수 있다. 한편, 후면부(100b)는 리어케이스(102) 또는 리어케이스(102)및 배터리 커버(103)를 지칭할 수 있다.

[0085] 도3은 배터리 내장형 가변형 이동 단말기에 대한 실시 예 중 하나를 도시한 것이다. 본 실시 예는 이동 단말기의 후면부(100b)가 지지부(107)의 역할을 동시에 할 수 있다. 도3a는 전면부(100a)가 휘어지지 않은 상태를, 도3b는 전면부(100a)가 휘어진 상태를 도시한 도면이다.

[0086] 전면부(100a)는 이동 단말기(100)의 A-A' 방향으로 휘어질 수 있다. 전면부의 디스플레이부(151)는 전면부의 미들 프레임(104)과 끝단이 고정되어 있어 전면부의 미들 프레임(104)이 휘어지는 경우 전면부의 디스플레이부(151)도 휘어지게 될 수 있다. 여기서 전면부의 미들 프레임(104)은 액정 디스플레이 배면을 지지하는 금속판(LCD plate)이 될 수 있다. 한편 전면부(100a)는 휘어질 수 있는 소재로 된 것일 수 있다. 전면부의 모양은 전체적으로 직사각형의 형태를 띨 수 있다.

[0087] 스크루(105)의 나사선(105b)은 전면부의 미들 프레임(104)의 나사홈(106)과 맞물려 인입출 된다. 한편 스크루(105)는 스크루(105)가 전면부에 인장력을 인가하여 곡률이 변화하도록 받쳐주는 역할을 하는 지지부(107)에 회전 가능하도록 고정되어있을 수 있다. 한편, 이러한 지지부(107)는 이동 단말기(100)의 후면부(100b)로의 역할을 동시에 할 수 있다.

[0088] 스크루의 나사머리(105a)를 시계방향으로 회전 시키는 경우 스크루의 나사선(105b)은 전면부의 나사홈(106)을 따라 이동하며 나사홈(106)에 삽입되어 나사홈(106) 부근의 전면부(100a)는 스크루(105)가 고정된 지지부(107)와 가까워 질 수 있다.

[0089] 반대로 스크루의 나사머리(105a)를 반시계방향으로 회전시키는 경우 전면부의 나사홈(106)은 전면부의 나사홈(106)스크루(105)의 나사선을 이동하여 나사홈(105) 부근의 전면부(100a)는 스크루(105)와 상대적으로 멀어질 수 있다. 물론 상기 방향과 상대적 거리관계는 반대가 될 수도 있다.

[0090] 디스플레이부(151)와 전면부(100a)의 미들 프레임(104)의 측면은 프론트케이스(101)에 결합해 있을 수 있다. 이 전면부(100a)는 지지부(107)의 중심부인 제 1 영역(108)과는 이격된 상태로 존재하고, 한편 지지부(107)의 양 끝단인 제 2영역(109)과는 접촉되거나 제 1 영역(108)보다 가까운 상태로 존재한다. 이 경우 지지부(107)는 전면부(100a)의 곡률이 변화하는데 받쳐주는 역할을 할 수 있도록 한다. 전면부(100a)가 휘어지기 위해서는 전면부(100a)에 토크(torque)가 필요한데, 이 때 프론트 케이스(101)와 결합하는 면의 지지부의 제 2 영역(109)이 전면부(100a)의 측면을 잡아주고 나사홈(106)이 있는 곳에서 윗방향으로의 인력이 작용하여 토크(torque)를 발생시켜 전면부(100a)의 곡률을 변화 시킬 수 있다.

[0091] 이 경우 지지부(107)는 전면부(100a)보다 강성이 크거나, 일반적인 힘으로 휘어지지 않는 소재를 사용할 수 있다.

[0092] 나아가 전면부(100a)가 휘어질 수 있는 공간이 필요하므로 전면부(100a)의 곡률이 변하기 전에는 도3 (a)와 같이 전면부(100a)와 지지부(107)의 일부는 이격되어 있을 수 있다.

[0093] 도 4 는 전면부(100a)와 후면부(100b)가 모두 휘어지는 가변형 이동 단말기(100)의 A-A' 방향에 대한 종단면을 도시한 것이다.

[0094] 상기 도 3 의 실시 예와 달리 후면부(100b)와 별도로 지지부(107)가 존재 하고 후면부(100b)는 전면부(100a)와 마찬가지로 휘어질 수 있는 소재로 구성되어 휘어질 수 있다.

[0095] 스크루(105)의 나사선(105b)은 상기 실시 예와 마찬가지로 전면부(100a)의 미들 프레임(104)에 존재하는 나사홈(106)과 결합할 수 있다. 한편 스크루(105)의 나사머리(105a)는 지지부의 미들 프레임(104)상에 존재할 수 있다.

[0096] 이 때, 지지부(107)는 휘어지는 방향을 기준으로 양 끝단의 제2 영역(109)이 지지부의 중앙부 제 1 영역(108)보다 상대적으로 전면부(100a) 방향으로 돌출되어 있을 수 있다. 지지부(107)의 전면은 돌출된 제2영역(109)에서

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중앙부 제 1영역(108)로 갈수록 배면 방향으로 움푹 패여있어서 휘어지지 않은 제 1 상태(도 1b)에서는 지지부(107)의 제1 영역(108)과 전면부(100a)가 충분히 이격되어 있을 수 있다. 한편, 전면부(100a)가 최대로 휘어지는 제 2 상태(도 1c)의 경우에는 전면부(100a)는 지지부(107)의 중앙부 제 1 영역(108)에 가까워 지거나 접촉될 수 있다.

[0097] 전면부(100a)가 지지부(107)에 의해 곡면을 이루며 휘어지는 경우 전면부(100a)의 측면과 결합한 후면부(100b)의 측면부가 전면부(100a)와 함께 전면 방향으로 이동하게 된다. 이 때, 후면부(100b)는 휘어질 수 있는 소재로 되어 있으므로, 전면부(100a)과 유사한 형상으로 휘어져, 전면부(100a)의 곡률이 증가하는 경우 후면부(100b)의 곡률도 함께 증가하고, 전면부(100a)의 곡률이 감소하는 경우 후면부(100b)의 곡률도 함께 감소할 수 있다.

[0098] 도 5 는 지지부(107)에 대한 스크루(105)의 상대적 운동을 통해서 전면부(100a)와 후면부(100b)가 휘어지는 가변형 이동 단말기(100)의 단면의 실시 예를 도시한 것이다. 전면부(100a)와 후면부(100b) 사이에 존재하는 지지부(107)의 중앙의 나사홈(106)과 스크루의 나사선(105b)은 맞물려 상하 운동을 할 수 있다. 한편 스크루(105)의 양 끝단은 나사홈을 통해 지지부의 제 1 영역(108)을 관통하여 연장되어 각각 전면부의 미들 프레임(104)과 후면부(100b)에 회전 가능하게 결합되어 있을 수 있다. 나아가, 전면부(100a) 또는 후면부(100b) 각각을 밀어주는 장력이나 당겨주는 인력을 모두 작용할 수 있도록 해야 하므로 회전은 가능하나 전면부 및 후면부와 위치는 변화하지 않도록 고정될 수 있다. 이를 통해 스크루(105)가 상하운동을 하는 경우 스크루(105)의 각 끝단이 결합된 전면부(100a)와 후면부(100b)에 인장력이 인가되어, 지지부의 제 2 영역(109)을 받침점으로 작용하여 토크(torque)를 발생시켜 전면부(100a)와 후면부(100b)의 곡률이 변화하게 된다. 이 경우, 스크루(105)의 상하운동이 전면부(100a)와 후면부(100b)에 대해 동일한 방향으로 작용하므로, 결과적으로 전면부(100a)의 곡률이 증가하는 경우 후면부(100b)의 곡률도 증가하고, 전면부(100a)의 곡률이 감소하는 경우 후면부(100b)의 곡률도 감소할 수 있다.

[0099] 도 6 은 본 발명과 관련된 실시 예 중 하나인 배터리 내장형 가변형 이동 단말기에서 배터리 커버를 제외한 구성 배면도를 도시한 것이다.

[0100] 스크루(105)는 후면부(100b) 배면에 노출되어야 하고, 동시에 전면부의 미들 프레임(104)의 나사홈에 맞물려 있어야 한다. 따라서 이 때 배터리(191)는 스크루(105)와 겹치지 않도록 설계 되어야 할 수 있고, 이 경우 'ㄴ'자 모양의 배터리(191)가 될 수 있다.

[0101] 도 7 은 본 발명과 관련된 실시 예 중 하나인 피씨비(181)가 결합된 가변형 이동 단말기(100)의 A-A' 방향의 단면을 도시한 것이다.

[0102] 전면부(100a)와 지지부(107) 사이에는 이동 단말기(100)의 각종 성능 구현에 필요한 전자 부품(182)들이 피씨비(181)위에 결합되어 있을 수 있다. 이러한 부품(182)들은 피씨비(181)상에 안착되므로 전면부(100a) 또는 후면부(100b)와 달리 상대적으로 높은 강성을 지녀 휘어지지 않거나 휘어지더라도 그 정도가 매우 미약할 수 있다. 이 경우, 휘어지는 전면부(100a) 또는 후면부(100b)의 사이에서 부품(182)이 차지할 공간이 전면부(100a)가 평평한 제 1 상태(도 1b)와 달라질 수 있다.

[0103] 전면부(100a)가 휘는 경우 전면부(100a)의 이동 단말기 내측은 공간은 스쿠루에 인접한 부분이 좁은 반면, 끝단 쪽으로 이동할수록 넓어질 수 있다. 따라서 이러한 공간상의 제약 또는 특성을 이용하여 전면부(100a)와 대향하는 면에 실장된 복수개의 부품(181)은 나사홈(106)이 위치한 부분에서 이동 단말기(100)의 휘어지는 방향의 바깥쪽으로 갈수록 더 두꺼운 부품(181)이 될 수 있다.

[0104] 한편, 후면부(100b)도 전면부(100a)와 함께 휘어지는 경우, 전면부의 경우와 반대로 후면부(100b)는 휘어지는 방향을 기준으로 나사홈(106)이 위치한 부분에서 이동 단말기(100)의 휘어지는 방향의 바깥쪽으로 갈수록 더 공간이 좁아지므로, 더 얇은 부품(182)을 구비 할 수 있다.

[0105] 도 8 은 본 발명과 관련된 실시 예 중 하나인 배터리 내장형 이동 단말기의 배면도와 이동 단말기의 A-A' 방향에 대한 종단면도이다.

[0106] 스크루(105)의 경우 사용자로 하여금 회전시키기 용이하도록 하기 위해서 손잡이가 존재할 수 있다. 이러한 손잡이는 배터리 내장형 이동 단말기인 경우 후면부(100b)상에 노출되어 이동 단말기(100)의 뒷면에서 사용자에 의해 조작이 가능하게 할 수 있고, 또는 후면부(100b)에 추가로 배터리 커버(103)가 있는 배터리 교체가능형 이동 단말기(100)인 경우(미도시)에는 배터리 커버(103)를 관통하여 사용자에게 노출되어 구비 될 수도 있고, 배터리 커버(103)를 열면 손잡이가 사용자에게 노출되어 구비 될 수도 있다.

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[0107] 도 9 는 본 배터리 교체가능형 가변형 이동 단말기(100)에서 배터리 커버(103)를 제외한 배면도와 세로방향에 대한 종단면을 도시한 것이다.

[0108] 이동 단말기(100)의 전원을 공급하는 배터리(191)는 이동단말기 내장형과 교체가능형 배터리가 존재 할 수 있다. 이 때 교체가능형 배터리는 상기 스크루(105)의 손잡이 역할을 하여, 별도의 손잡이 없이 배터리(191)를 회전시키는 것만으로 스크루(105)를 회전시킬 수 있다. 이 때 배터리(191)와 스크루(105)는 인서트 사출을 통해 제작될 수 있다.

[0109] 나아가 배터리(191)는 회전 가능한 모양을 띨 수 있으며 특히 배터리(191)의 회전축에 대한 수직 방향으로 자른 단면은 원형의 모양이 될 수 있다.

[0110] 도 10 은 본 발명과 관련된 실시 예 중 하나인 원형 배터리의 종 단면, 전면, 원형 배터리에 의해 휜 상태와 평평한 상태가 된 이동 단말기의 종 단면도를 도시한 것이다.

[0111] 배터리(191)의 전면은 지지부의 역할을 하거나 도와줄 수 있도록 일정한 곡률 형상을 가질 수 있다.

[0112] 다만 배터리(191) 자체가 지지부의 역할을 하는 경우, 전면부가 평평한 상태인 제 1 상태(도 1b)와 전면부가 휘어진 상태인 제 2 상태(도 1c)를 모두 지지할 수 있도록 배터리 전면 곡면부(191a)를 가질 수 있으며, 그 중 한 쪽 방향인 C-C' 방향의 양 끝단 부분만 배터리 전면 평면부(191b)를 가질 수 있다. 이동 단말기(100)가 A-A' 방향으로 휘어지는 경우를 전제로, 배터리(191)의 C-C' 방향이 이동 단말기(100)의 A-A' 방향에 위치하는 경우 이동 단말기(100)의 전면부(100a)와 배터리 전면 곡면부 (191a)와 접하여 제 2 상태(도 1c)와 같이 휘어질 수 있고(도 10 의 (c)), 반대로 배터리(191)의 C-C' 방향이 이동 단말기(100)의 B-B' 방향에 위치하는 경우 이동 단말기(100)의 전면부(100a)는 배터리 전면 평면부(191b)에 접하여 제 1 상태(도 1b)와 같이 평평해 질 수 있다(도 10 의 (b)).

[0113] 도 11 은 본 발명과 관련된 실시 예 중 하나인 교체 가능형 배터리를 가진 가변형 이동 단말기의 전원 접촉 구조를 도시한 도면이다.

[0114] 배터리(191)의 전원을 이동 단말기(100)에 공급해주기 위해 배터리 전원 단자(192)와 이동 단말기(100)상의 전원 단자인 씨-클립(C-clip, 193)이 필요하게 되는데, 앞의 실시 예 중 배터리(191)가 회전하게 되는 경우 이동 단말기의 후면부(100b)와 상대적 위치관계가 변화하게 될 수 있으며, 따라서 이 때 배터리의 전원 단자(192)와 이동 단말기(100)의 씨-클립(C-clip, 193)의 접촉이 유지되어야 한다. 이에 따라 배터리(191) 상의 전원 단자(192)는 호 형상을 가져 배터리(191)가 회전하더라도 각 전원 단자의 접촉을 유지하여 전원을 계속 하여 공급할 수 있다.

[0115] 한편 이 경우 전원을 공급받는 이동 단말기에 존재하는 전원 단자인 씨-클립(C-clip, 193)은 이동 단말기(100)의 분리된 피씨비(181)를 연결하는 휘어지는 추가 플렉서블 피씨비(SUB FPCB, 183)위에 위치할 수 있다.

[0116] 도 12 는 본 발명과 관련된 실시 예 중 하나인 배터리 커버가 있는 이동 단말기의 A-A' 방향의 종단면 중 후크와 후크홈을 포함하는 단면을 도시한 것이다.

[0117] 휘어질 수 있는 소재의 경우라도, 소재의 특성상 원래 모양대로 돌아가려는 복원력을 가질 수 있으며, 따라서 휘어진 상태인 제 2 상태(도 1c)의 경우 스크루(105)에 의해 고정이 되어 있을 뿐, 다시 펴지기 위한 복원력을 가지고 있을 수 있다. 앞선 실시 예 중 도 4의 경우 배터리 커버(103)가 휘어지는 것은 전면부(100a)에 의해 종속적으로 좇아가는 것이므로 이러한 상태에 있을 경우 배터리 커버(103)와 후면부(100b)의 외측면의 결합 상태가 불안해 질 수 있다. 이러한 경우, 낙하 기타 외부 충격에 의해 펴진 경우인 제 1 상태(도 1b)보다 쉽게 배터리 커버(100b)가 분리될 수 있다. 따라서 배터리 커버의 후크(194)와 결합하기 위해 존재하는 후면부 외측면에 위치하는 후크홈(195)은 두 개 이상이 중첩되도록 배치하여 제 2 상태(도 1c)로 휘어져 배터리 커버(103)와 이동 단말기(100)가 이격되는 경우에도 상단에 존재하는 후크홈(195)중 상단의 후크홈에 결합하여 배터리 커버(103)가 쉽게 분리되는 것을 방지할 수 있다.

[0118] 상기의 상세한 설명은 모든 면에서 제한적으로 해석되어서는 아니되고 예시적인 것으로 고려되어야 한다. 본 발명의 범위는 첨부된 청구항의 합리적 해석에 의해 결정되어야 하고, 본 발명의 등가적 범위 내에서의 모든 변경은 본 발명의 범위에 포함된다.

부호의 설명

[0119] 100: 이동단말기 100a: 전면부

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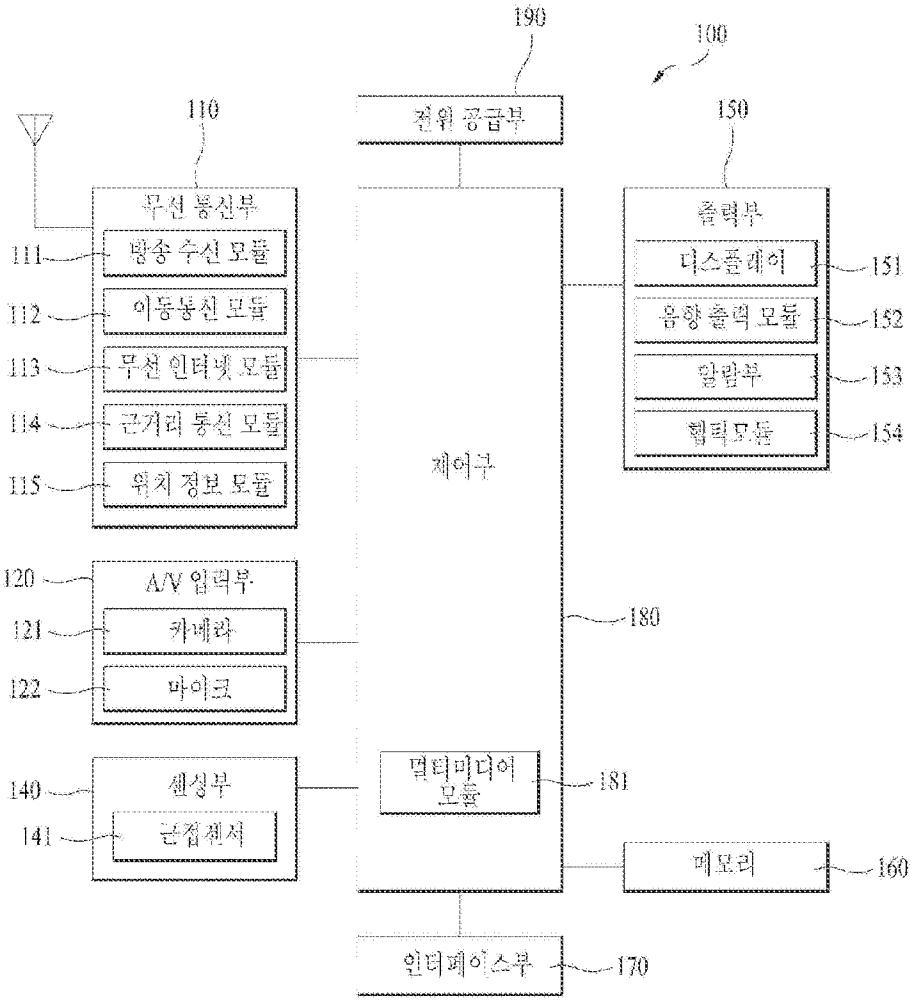
100b: 후면부
101: 프론트 케이스
102: 리어 케이스
103: 배터리 커버
104: 전면부의 배면
105: 스크루
105a: 스크루 나사머리
105b: 스크루 나사산
106: 나사홈
107: 지지부
108: 지지부의 중앙부 제 1 영역
109: 지지부의 돌출부 제 2 영역
110: 무선통신부
120: 입력부
140: 센싱부
150: 출력부
160: 인터페이스부
170: 메모리
180: 제어부
181: 피씨비
182: 부품
183: 추가 플렉서블 피씨비
190: 전원공급부
191: 배터리
191a: 배터리 전면 곡면부
191b: 배터리 전면 평면부
192: 배터리 전원 단자
193: 씨-클립(C-clip)
194: 후크
195: 후크홈

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도면

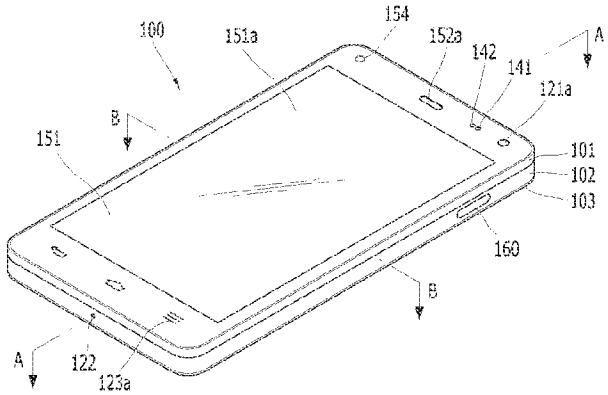
도면1a



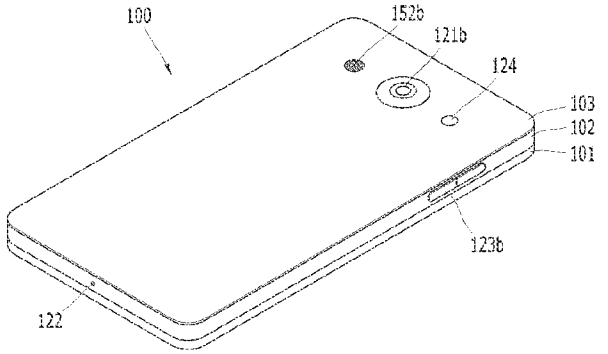
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DEF_00004733

도면7b

(a)



(b)

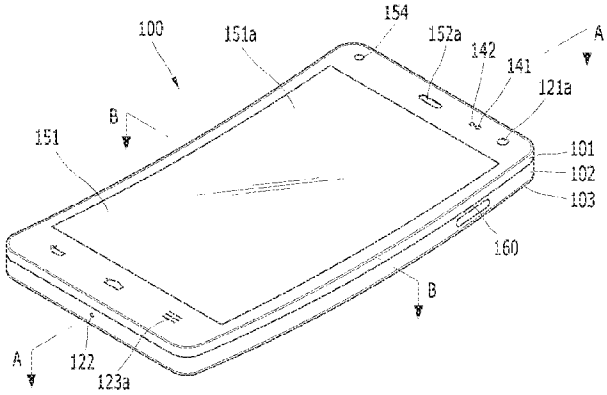


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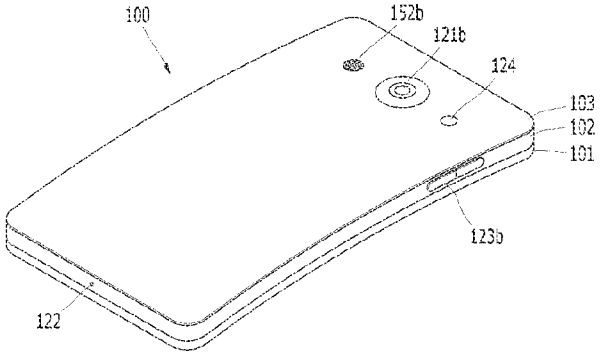
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도면1c

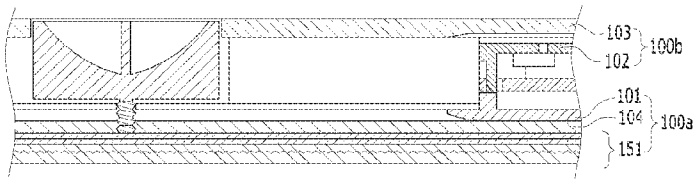
(c)



(d)



도면2

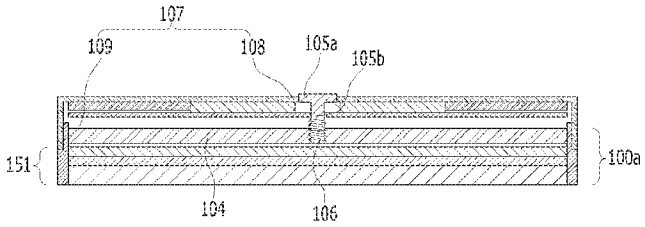


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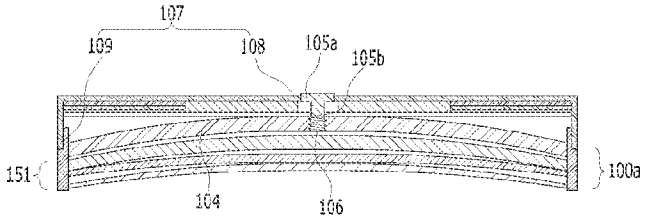
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도면3

(a)

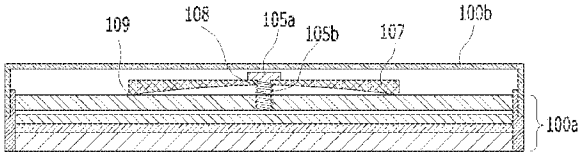


(b)

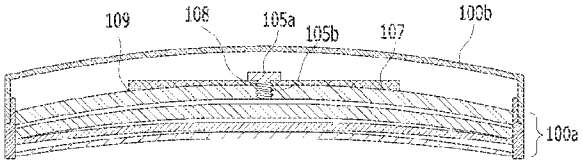


도면4

(a)



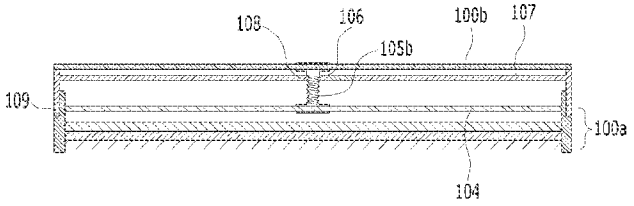
(b)



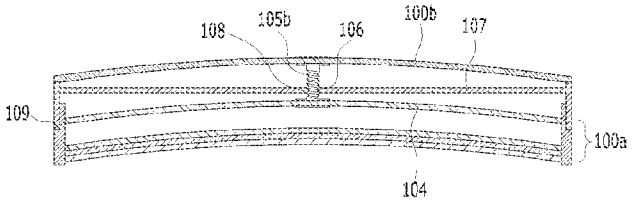
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도면5

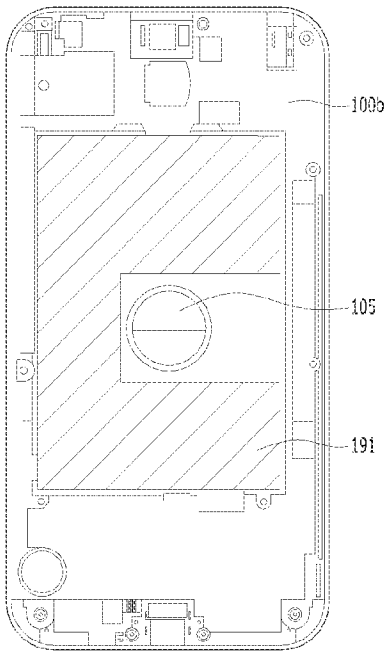
(a)



(b)



도면6

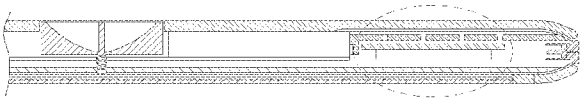


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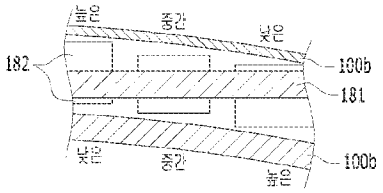
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도면7

(a)

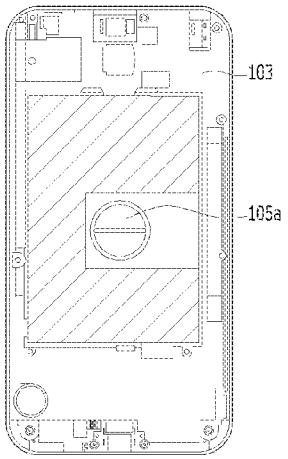


(b)

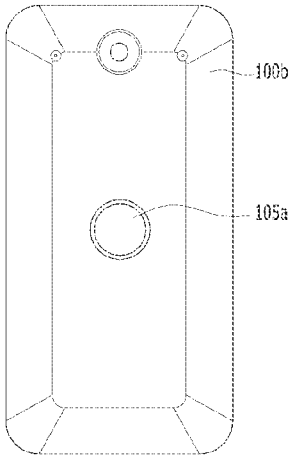


도면8

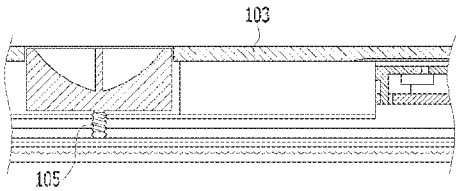
(a)



(b)



(c)

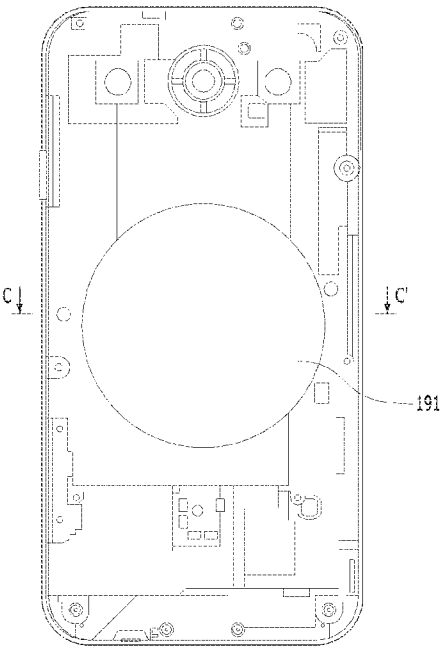


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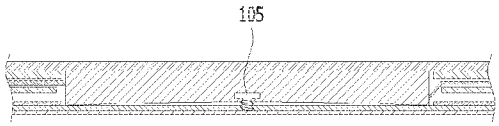
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도면9

(a)



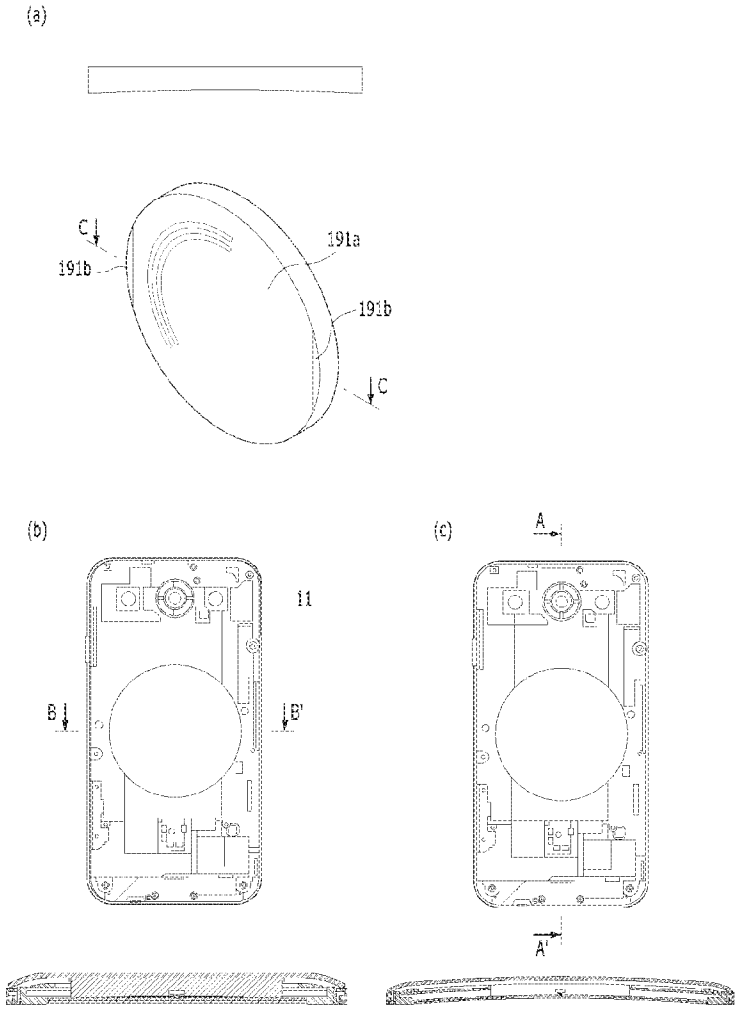
(b)



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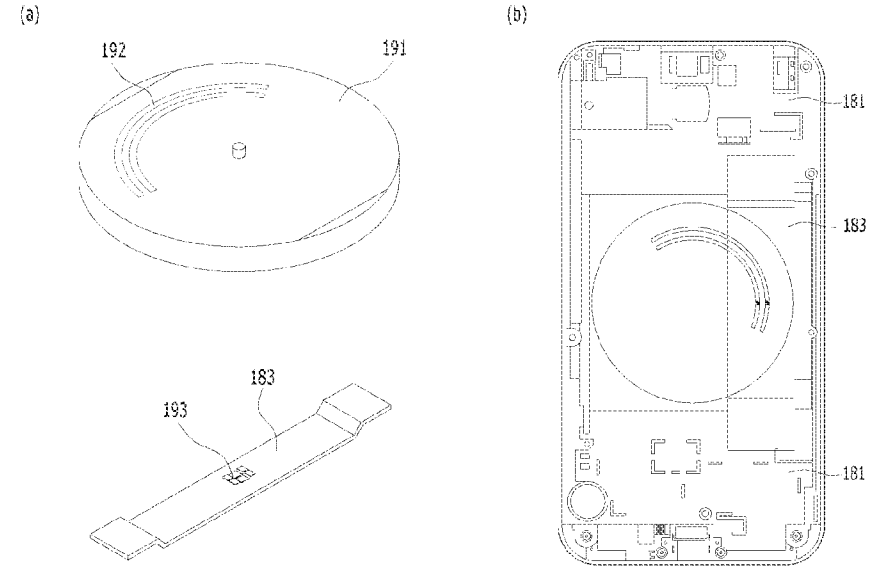
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도면10

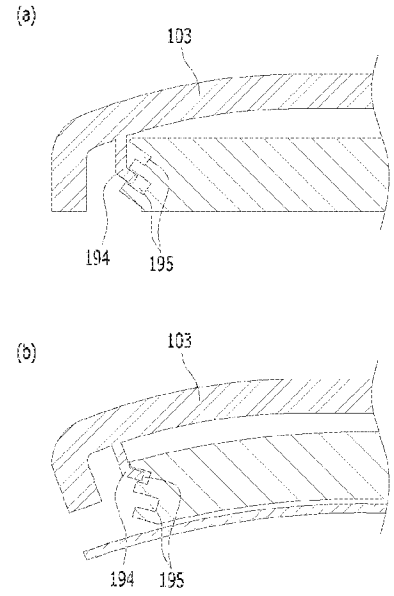


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도면11



도면12



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(19) 대한민국특허청(KR)
(12) 등록특허공보(B1)

(45) 공고일자 2011년11월08일
(11) 등록번호 10-1081586
(24) 등록일자 2011년11월02일

(51) Int. Cl.
G06F 3/041 (2006.01) *G06F 3/048* (2006.01)
G06F 3/01 (2006.01)
(21) 출원번호 10-2009-0015243
(22) 출원일자 2009년02월24일
심사청구일자 2009년02월24일
(65) 공개번호 10-2010-0096390
(43) 공개일자 2010년09월02일
(56) 선행기술조사문헌
KR1020030049646 A*
KR1020070045954 A*
*는 심사관에 의하여 인용된 문헌

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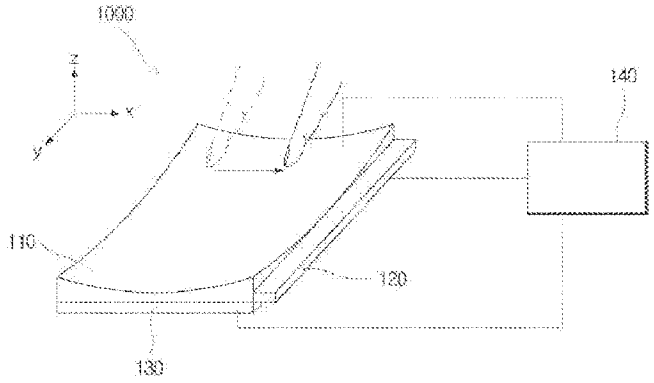
전체 청구항 수 : 총 23 항 심사관 : 최정권

(54) 촉감제시 인터페이스 장치

(57) 요 약

촉감제시 인터페이스 장치가 개시된다. 터치스크린부, 터치스크린부의 일면의 촉감이 변화되도록 터치스크린부를 수평방향으로 진동시키는 구동부 및 구동부의 동작 주파수를 조절하는 제어부를 포함하는 촉감제시 인터페이스 장치는, 터치스크린부를 그 일면과 평행한 방향으로 진동시켜, 사용자가 접촉하는 부분의 촉감이 변화하는 조작감을 제공 할 수 있다.

대 표 도 - 도1



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특허청구의 범위

청구항 1

일면이 경사지게 형성되는 터치스크린부;

사용자와 상기 터치스크린부 표면 사이의 수평 및 수직 방향으로 상대운동으로 인해 상기 터치스크린부의 일면의 촉감이 변화되도록, 상기 터치스크린부를 수평 방향으로 진동시키는 구동부; 및

상기 구동부의 동작 주파수를 조절하는 제어부를 포함하는 촉감제시 인터페이스 장치.

청구항 2

제1항에 있어서,

상기 구동부의 동작 주파수는 1kHz이상인 것을 특징으로 하는 촉감제시 인터페이스 장치.

청구항 3

제2항에 있어서,

상기 구동부의 동작 주파수는 가청 주파수 이상인 것을 특징으로 하는 촉감제시 인터페이스 장치.

청구항 4

제1항에 있어서,

상기 구동부는 압전소자를 포함하여 이루어지는 것을 특징으로 하는 촉감제시 인터페이스 장치.

청구항 5

제1항에 있어서,

상기 구동부는 복수 개인 것을 특징으로 하는 촉감제시 인터페이스 장치.

청구항 6

제5항에 있어서,

상기 구동부는 상기 터치스크린의 양측에 결합되는 것을 특징으로 하는 촉감제시 인터페이스 장치.

청구항 7

제1항에 있어서,

상기 구동부는 상기 터치스크린의 일면의 사장자리의 일측에 결합되는 것을 특징으로 하는 촉감제시 인터페이스 장치.

청구항 8

제1항에 있어서,

상기 터치스크린부의 일면에 결합되는 보호패널부를 더 포함하며,

상기 구동부는 상기 보호패널부의 표면의 촉감이 변화되도록, 상기 보호패널부의 일측에 결합되는 것을 특징으

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로 하는 촉감제시 인터페이스 장치.

청구항 9

제1항에 있어서,

상기 터치스크린부의 일면은,

상기 터치스크린부의 일단에서 타단으로 경사지게 형성되는 것을 특징으로 하는 촉감제시 인터페이스 장치.

청구항 10

제1항에 있어서,

상기 터치스크린부의 일면은,

상기 터치스크린의 양단에서 상기 터치스크린부를 양분하는 중심선을 향해 경사지는 것을 특징으로 하는 촉감제시 인터페이스 장치.

청구항 11

제1항에 있어서,

상기 터치스크린부의 일면은,

상기 터치스크린부의 양단에서 상기 터치스크린부를 양분하는 중심선을 향해 볼록하게 형성되는 것을 특징으로 하는 촉감제시 인터페이스 장치.

청구항 12

제1항에 있어서,

상기 터치스크린부의 일면은,

상기 터치스크린부의 양단에서 상기 터치스크린부를 양분하는 중심선을 향해 오목하게 형성되는 것을 특징으로 하는 촉감제시 인터페이스 장치.

청구항 13

제1항에 있어서,

상기 터치스크린부의 일면은,

상기 터치스크린부의 일단에서 타단으로 형성되는 물결모양을 이루는 것을 특징으로 하는 촉감제시 인터페이스 장치.

청구항 14

제1항에 있어서,

상기 터치스크린부의 일면은,

상기 터치스크린부의 가장자리에서 상기 터치스크린부의 중심을 향해 오목하게 형성되는 것을 특징으로 하는 촉감제시 인터페이스 장치.

청구항 15

제1항에 있어서,

상기 제어부는

상기 터치스크린부의 가압 위치에 따라 상기 구동부가 상기 터치스크린부를 상이한 주파수로 진동시키도록 상기 구동부를 제어하는 것을 특징으로 하는 촉감제시 인터페이스 장치.

청구항 16

제15항에 있어서,

상기 제어부는

상기 터치스크린부의 일부는 가상의 촉감제시영역으로 구획하며,

상기 터치스크린부의 가압 위치가 상기 촉감제시영역 내인지 여부에 따라 상기 구동부가 상이한 주파수로 상기 터치스크린부를 진동시키도록 상기 구동부를 제어하는 것을 특징으로 하는 촉감제시 인터페이스 장치.

청구항 17

제16항에 있어서,

상기 터치스크린부의 타면에 결합되는 영상표시패널부를 더 포함하는 촉감제시 인터페이스장치.

청구항 18

제17항에 있어서,

상기 구동부는 상기 영상표시패널부의 일측에 결합되는 것을 특징으로 하는 촉감제시 인터페이스 장치.

청구항 19

제17항에 있어서,

상기 영상표시패널부에는 아이콘이 표시되며,

상기 촉감제시영역은 상기 아이콘의 위치와 형상에 따라 형성되는 것을 특징으로 하는 촉감제시 인터페이스 장치.

청구항 20

제17항에 있어서,

상기 영상표시패널부에는 복수의 아이콘이 표시되며,

상기 촉감제시영역은 인접한 상기 복수의 아이콘 사이에 형성되는 것을 특징으로 하는 촉감제시 인터페이스 장치.

청구항 21

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제17항에 있어서,

상기 영상표시패널부에는 아이콘이 표시되며,

상기 촉감제시영역은 상기 아이콘의 가장자리를 따라 환형으로 형성되는 것을 특징으로 하는 촉감제시 인터페이스 장치.

청구항 22

제17항에 있어서,

상기 영상표시패널부에는 스크롤바가 표시되며,

상기 촉감제시영역은 상기 스크롤바가 연장되는 방향으로 불연속적으로 형성되는 것을 특징으로 하는 촉감제시 인터페이스 장치.

청구항 23

제22항에 있어서,

상기 스크롤바는 환형의 형태를 가지며,

상기 촉감제시영역은 상기 스크롤바 상에 방사상으로 형성되는 것을 특징으로 하는 촉감제시 인터페이스 장치.

명 세 서

발명의 상세한 설명

기 술 분 야

[0001] 본 발명은 촉감제시 인터페이스 장치에 관한 것이다.

배 경 기 술

[0002] 터치스크린은 stylus pen이나 사용자의 손으로 특정 영역을 가압하면, 그 터치스크린이 장착된 전자기기에 그 가압된 위치에 해당하는 입력신호를 전달할 수 있는 일종의 입력장치이다.

[0003] 그러나, 터치스크린의 경우 사용자가 터치스크린의 특정 영역을 가압할 때, 사용자에게 전해지는 피드백이 없이 사용자는 터치스크린에 올바르게 입력이 이루어 졌는지에 대해 알 수 없는 어려움이 있었다.

[0004] 최근에는 이에 대응하기 위해 터치패널이 장착되는 전자기기에 진동모터 등을 구비하여 사용자가 터치패널을 조작하면, 진동모터가 동작하여 전자기기 전체를 진동시키는 장치가 개발되었다. 그러나, 이 또한 사용자는 직접 가압한 영역에 대한 피드백인지는 알 수 없어, 터치스크린의 조작감이 떨어지는 문제가 있었다.

발명의 내용

해결 하고자하는 과제

[0005] 본 발명은 사용자의 터치스크린부의 조작에 대해 촉감의 형태를 가지는 피드백을 제공할 수 있는 촉감제시 인터페이스 장치를 제공하는 것이다.

과제 해결수단

[0006] 본 발명의 일 측면에 따르면, 일면이 경사지게 형성되는 터치스크린부, 터치스크린부의 일면의 촉감이 변화되도

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록 터치스크린부를 수평 방향으로 진동시키는 구동부 및 구동부의 동작 주파수를 조절하는 제어부를 포함하는 촉감제시 인터페이스 장치가 제공된다.

[0007] 여기서, 구동부의 동작 주파수는 1kHz이상일 수 있으며, 구동부의 동작 주파수는 가청 주파수 이상일 수도 있다. 그리고, 구동부는 압전소자를 포함하여 이루어질 수 있다.

[0008] 한편, 구동부는 복수 개일 수 있으며, 구동부는 터치스크린의 양측에 결합될 수 있으며, 구동부는 터치스크린의 일면의 가장자리의 일측에 결합될 수 있다.

[0009] 한편, 촉감제시 인터페이스 장치는 터치스크린부의 일면에 결합되는 보호패널부를 더 포함하며, 구동부는 보호패널부의 표면의 촉감이 변화되도록, 보호패널부의 일측에 결합될 수 있다.

[0010] 한편, 터치스크린부의 일면은 터치스크린부의 일단에서 타단으로 경사지게 형성될 수 있으며, 터치스크린부의 일면은 터치스크린의 양단에서 터치스크린부를 양분하는 중심선을 향해 경사지게 형성될 수 있으며, 터치스크린부의 일면은 터치스크린부의 양단에서 터치스크린부를 양분하는 중심선을 향해 볼록하게 형성될 수 있다.

[0011] 그리고, 터치스크린부의 일면은 터치스크린부의 양단에서 터치스크린부를 양분하는 중심선을 향해 오목하게 형성될 수 있다. 또한, 터치스크린부의 일면은 터치스크린부의 일단에서 타단으로 형성되는 물결모양을 이루어 지거나, 터치스크린부의 가장자리에서 터치스크린부의 중심을 향해 오목하게 형성될 수 있다.

[0012] 한편, 제어부는 터치스크린부의 가압 위치에 따라 구동부가 터치스크린부를 상이한 주파수로 진동시키도록 구동부를 제어할 수 있으며, 이 때, 제어부는 터치스크린부의 일부는 가상의 촉감제시영역으로 구획하며, 터치스크린부의 가압 위치가 촉감제시영역 내인지 여부에 따라 구동부가 상이한 주파수로 터치스크린부를 진동시키도록 구동부를 제어할 수 있다.

[0013] 그리고, 촉감제시 인터페이스 장치는 터치스크린부의 타면이 결합되는 영상표시패널부를 더 포함할 수 있으며, 구동부는 영상표시패널부의 일측에 결합될 수 있다.

[0014] 한편, 영상표시패널부이는 복수의 아이콘이 표시되며, 촉감제시영역은 인접한 복수의 아이콘 사이에 형성될 수 있으며, 촉감제시영역은 아이콘의 가장자리를 따라 환형으로 형성될 수도 있다. 그리고, 촉감제시영역은 아이콘의 위치와 형상에 따라 형성될 수도 있다.

[0015] 그리고, 영상표시패널부에는 스크롤바가 표시되며, 촉감제시영역은 스크롤바가 연장되는 방향으로 불연속적으로 형성될 수 있으며, 스크롤바가 환형의 형태를 가지는 경우, 촉감제시영역은 스크롤바 상에 방사상으로 형성될 수 있다.

효 과

[0016] 상술한 바와 같이 본 발명의 실시예에 따르면, 터치스크린부를 그 일면과 평행한 방향으로 진동시켜, 사용자가 접촉하는 부분의 촉감이 변화하는 조작감을 제공 할 수 있다.

발명의 실시를 위한 구체적인 내용

[0017] 본 발명의 특징, 이점이 이하의 도면과 발명의 상세한 설명으로부터 명확해질 것이다.

[0018] 이하, 본 발명에 따른 촉감제시 인터페이스 장치의 실시예를 첨부도면을 참조하여 상세히 설명하기로 하며, 첨부 도면을 참조하여 설명함에 있어, 동일하거나 대응하는 구성 요소는 동일한 도면번호를 부여하고 이에 대한 중복되는 설명은 생략하기로 한다.

[0019] 도 1은 본 발명의 제1 실시예에 따른 촉감제시 인터페이스 장치(1000)를 나타낸 사시도이다. 도 1에 도시된 바와 같이, 본 발명의 제1 실시예에 따른 촉감제시 인터페이스 장치(1000)는, 터치스크린부(110), 터치스크린부(110)의 표면의 촉감이 변화되도록 터치스크린부(110)를 수평 방향으로 진동시키는 구동부(120), 구동부(120)의 동작 주파수를 조절하는 제어부(140) 및 터치스크린부(110)의 타면에 결합되는 영상표시패널부(130)를 포함함으로써, 사용자가 접촉하는 부분의 촉감이 변화하는 조작감을 제공할 수 있다.

[0020] 촉감제시 인터페이스 장치(1000)는 사용자의 터치에 의해 정보를 입력 받을 수 있으며, 그에 대한 피드백으로

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사용자가 접촉하는 부분의 촉감이 변화하는 조작감을 제공할 수 있는 정보입력장치일 수 있다.

[0021] 촉감제시 인터페이스 장치(1000)는 예를 들어 휴대전화(400), PDA(Personal Digital Assistants), PMP(Portable Multimedia Player), MP3(MPEG Audio Layer-3) player등과 같은 휴대용 전자기기, 네비게이션, 도너터, ATM(Auto Teller Machine), 게임기, Kiosk 등과 같은 전자기기에 있어서, 사용자가 터치스크린부(110)의 특정 위치를 가압하면, 그 가압위치에 대한 정보를 제어부(140)이 전달할 수 있는 입력부로 적용될 수 있다.

[0022] 여기서, 촉감제시 인터페이스 장치(1000)에 영상표시패널부(130)를 더 포함하는 경우, 촉감제시 인터페이스 장치(1000)가 적용된 전자기기의 출력부와 입력부의 기능을 동시에 수행할 수 있음은 물론이다.

[0023] 터치스크린부(110)의 일면에는 영상표시패널부(130)가 결합된다. 영상표시패널부(130)는 예를 들어 LCD패널과 같이 영상을 표시할 수 있는 부분으로, 촉감제시 인터페이스 장치(1000)가 장착되는 전자기기의 출력부로서의 기능을 수행할 수 있다.

[0024] 영상표시패널부(130)는 후술한 제어부(140)와 전기적으로 연결될 수 있으며, 제어부(140)에 의해 촉감제시 인터페이스 장치(1000)가 장착된 전자기기의 동작 상태에 따른 다양한 형태의 영상을 표시할 수 있다. 영상표시패널부(130)는, 예를 들어 아이콘(410), 스크롤바(415) 등과 같이 사용자의 메뉴선택의 대상이 되는 대상물을 표시할 수 있다.

[0025] 구동부(120)는 터치스크린부(110)의 표면의 촉감이 변화되도록 터치스크린부(110)를 수평 방향으로 진동시킬 수 있다. 즉, 터치스크린부(110)의 일면이 경사지게 형성되고, 그 타면은 일면에 비해 상대적으로 기울어 지지 않게 형성될 수 있으며, 이 때의 수평 방향은 터치스크린부(110)의 타면과 평행한 방향일 수 있다. 다시 말해, 터치스크린부(110)의 일면이 Z축에 대해 90도 이외의 각도를 가지며, 이 때, 터치스크린부(110)의 운동 방향은 X축 또는 Y축임을 의미할 수 있다.

[0026] 구동부(120)는 예를 들어 압전소자가 사용될 수 있으며, 바 형태로 형성되어, 터치스크린부(110)의 일측에 결합될 수 있다. 압전소자는 그 분극 방향에 따라 다양한 형태의 고주파 진동을 구현할 수 있으며, 도 1에서는 x방향으로 터치스크린부(110)를 진동시킬 수 있다.

[0027] 도 2 내지 도 4는 본 발명의 제1 실시예에 따른 촉감제시 인터페이스 장치(1000)의 동작원리를 나타낸 도면이다. 도 2에 도시된 바와 같이, 사용자가 터치스크린부(110)의 표면에 접촉하여 그 표면 상을 이동하는 경우, 터치스크린부(110)가 사용자의 손가락이 이동하는 속도(Vm) 보다 느린 속도(Vv)로 진동한다면, 사용자는 터치스크린부(110)의 표면의 질감에 따른 촉감과 함께 손가락의 이동 방향과 반대 방향의 마찰력(F)을 느낄 수 있다.

[0028] 그러나, 도 3에 도시된 바와 같이, 터치스크린부(110)가 사용자의 손가락이 이동하는 속도(Vm') 보다 터치스크린부(110)가 더 빠른 속도(Vv')로 진동하는 경우, 사용자는 손가락이 이동하는 방향과 동일한 방향의 마찰력(F')을 느낄 수 있다. 다시 말해, 터치스크린부(110)의 표면의 마찰력이 감소한 것과 같은 촉감을 느낄 수 있다.

[0029] 한편, 사람의 피부에는 여러 수용기들이 존재하며, 각각의 수용기들은 주파수 범위에 따라 서로 다른 정보를 뇌로 전달할 수 있다. 그 가운데 진동을 수용하는 파시니 소체(Pacinian corpuscule)는 10 ~ 500 Hz범위에서 진동을 감지할 수 있다.

[0030] 따라서, 구동부(120)는 500 Hz이상으로 터치스크린부(110)를 진동시킴으로써, 사용자에게 진동이 아닌 터치스크린부(110)의 표면의 마찰력의 감소로 인한 촉감이 변화된 것으로 인식될 수 있는 정보를 사용자에게 제공할 수 있다.

[0031] 사용자에 따라 진동으로 인식할 수 있는 범위의 주파수는 조금씩 상이할 수 있고, 예를 들어 1kHz이상의 주파수로 터치스크린부(110)가 진동하는 경우 대부분의 사용자가 터치스크린부(110)의 표면의 촉감이 변화된 것으로 인식할 수 있다.

[0032] 또한, 가청주파수인 20kHz이상에서 구동부(120)의 현재 진동수, 예를 들어 압전소자를 이용하는 경우 600kHz이하의 범위에서는 터치스크린부(110)의 진동으로 인한 소음을 사용자가 인식할 수 없어, 사용자는 터치스크린부(110)의 표면의 촉감이 변화된 정보만을 인식할 수 있다.

[0033] 한편, 도 4에 도시된 바와 같이, 터치스크린부(110)의 일면은, 가장자리에서 터치스크린부(110)의 중심을 향해

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오목하게 형성되어 있는 상태 즉, 터치스크린부(110)의 일면이 경사지게 형성되어 있는 상태에서, 터치스크린부(110)가 수평방향(도 4의 A 방향)으로 진동하면, 터치스크린부(110)의 일면의 터치 위치는 사용자의 손가락에 대해, X축과 Z축 방향으로 각각, Vx, Vz의 상대속도를 가지게 된다.

[0034] 그리고, 이러한 상대속도(Vz)로 인해, 터치스크린부(110)의 일면과 손가락 사이에 개재되는 공기는 압축될 수 있다. 특히, 터치스크린부(110)의 일면의 Z방향의 진동 주파수가 20kHz 이상인 경우, 터치스크린부(110)의 일면과 손가락 사이에 발생하는 공기의 압축은 터치스크린부(110)의 일면과 손가락 사이의 마찰력을 감소시키게 되어, 사용자는 터치스크린부(110)의 일면의 촉감이 변화되는 것으로 느끼게 된다. 이것을 일명 air squeeze effect라고 한다.

[0035] 결국, 터치스크린부(110)의 일면이 경사지게 형성됨으로 인해, 터치스크린부(110)의 일면과 손가락 사이에 Z방향과 X방향의 상대운동을 구현할 수 있게 되고, 상술한 수평방향의 상대운동으로 인한 마찰력 감소의 효과와, air squeeze effect로 인한 마찰력 감소의 효과를 동시에 얻을 수 있게 된다. 따라서, 사용자는 이로 인한 터치스크린부(110)의 일면의 촉감의 변화를 보다 확실하게 느낄 수 있게 된다.

[0036] 도 5 내지 도 9는 본 발명의 제1 실시예에 따른 촉감제시 인터페이스 장치의 적용 가능한 터치스크린부의 변형예를 나타낸 사시도이다. 도 5 내지 도 9에 도시된 바와 같이, 터치스크린부(110)의 일면은 다양한 형태를 가지며 경사지게 형성될 수 있다.

[0037] 먼저, 도 5에 도시된 바와 같이, 터치스크린부(110a)는 전체적으로 직사각형의 형태를 가지며, 터치스크린부(110a)의 양단에서, 터치스크린부(110a)를 길이 방향으로 이분하는 중심선(도 5의 C)을 향해 부드러운 곡선의 형태를 가지며 오목하게 형성될 수 있다. 도 5의 터치스크린부(110a)는 중심선(도 5의 C)을 기준으로 좌우 대칭인 형태를 가지게 된다.

[0038] 다음으로, 도 6에 도시된 바와 같이, 터치스크린부(110b)는, 터치스크린부(110b)의 양단에서 터치스크린부(110b)를 양분하는 중심선(도 6의 C)을 향해 볼록하게 형성될 수 있다. 터치스크린부(110b)는 중심선을 기준으로 부드러운 곡선의 형태를 가지며 좌우 대칭되게 돌출되는 형태를 가지게 된다.

[0039] 다음으로, 도 7에 도시된 바와 같이, 터치스크린부(110c)의 일면은 일단에서 타단으로 경사지게 형성될 수 있다. 터치스크린부(110c)는 전체적으로 직사각형의 형태를 가지며, 일측의 장변의 높이가 타측의 장변의 높이보다 높으며, 전체적으로 터치스크린부(110c)의 일면의 일단에서 타단으로 기울어진 형태를 가지게 된다.

[0040] 다음으로, 도 8에 도시된 바와 같이, 터치스크린부(110d)의 일면은, 그 양단에서 터치스크린부(110d)를 양분하는 중심선(도 8의 C)을 향해 경사지게 형성될 수 있다. 터치스크린부(110d)의 양단의 높이는 중심선(도 8의 C)이 지나는 부분 보다 높으며, 전체적으로 터치스크린부(110d)의 양단에서 중심선(도 8의 C)을 향해 좌우 대칭되게 기울어지는 형태를 가진다.

[0041] 다음으로, 도 9에 도시된 바와 같이, 터치스크린부(110e)의 일면은, 그 일단에서 타단으로 형성되는 물결모양을 이룰 수 있다. 터치스크린부(110e)는 볼록한 부분과 오목한 부분이 부드러운 곡선을 이루며 반복적으로 형성되며, 이러한 물결무늬는 터치스크린부(110e)의 일단에서 타단을 향해 터치스크린부(110e)의 일면 전체에 걸쳐 형성된다.

[0042] 제어부(140)는 구동부(120)와 전기적으로 연결될 수 있으며, 구동부(120)의 동작 주파수를 조절할 수 있다. 제어부(140)는 구동부(120)뿐만 아니라 터치스크린부(110) 및 영상표시패널부(130)와도 전기적으로 연결될 수 있으며, 그들의 동작을 제어할 수 있다.

[0043] 제어부(140)는 촉감제시 인터페이스 장치(1000)의 동작을 제어하기 위해 별도의 회로물로 구현될 수 있으며, 촉감제시 인터페이스 장치(1000)가 장착되는 전자기기의 동작을 제어하는 장치의 일부로 구현될 수도 있다.

[0044] 도 10은 본 발명의 제1 실시예에 따른 촉감제시 인터페이스 장치 제어방법을 나타낸 순서도이고, 도 11은 본 발명의 제1 실시예에 따른 촉감제시 인터페이스 장치 제어방법의 제1 동작을 나타낸 평면도이다. 도 5에 도시된 바와 같이, 본 발명의 일 실시예에 따른 촉감제시 인터페이스 장치(1000) 제어방법은, 촉감제시 인터페이스 장치(1000)가 휴대전화(400)에 적용된 경우를 예로 들어 설명한다.

[0045] 촉감제시 인터페이스 장치(1000)는, 휴대전화(400)이 적용되어, 사용자의 조작에 의해 정보를 입력받고, 영상표시패널을 통해 휴대전화(400)의 동작 상태를 출력하며, 터치스크린부(110)의 진동에 의해 촉감이 변화하는 조작감을 사용자에게 제공할 수 있다.

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[0046] 최초, 대기 상태(S100)에서, 터치스크린부(110)는 사용자에 의해 터치스크린부(110)에 터치가 있는지 여부를 감지한다. (S200) 이 때, 터치스크린부(110)는 사용자의 터치 위치에 대한 정보를 제어부(140)에 전달한다. 만약, 사용자의 터치가 감지되지 않는 경우, 제어부(140)는 대기 상태(S100)을 유지한다.

[0047] 다음으로, 제어부(140)는 영상표시패널부(130)에 아이콘(410)과 같은 입력마크가 표시되어 있는지를 판단하고, (S300) 아이콘(410)이 영상표시패널부(130)에 표시되어 있는 경우, 아이콘(410)의 위치와 형상에 따라 터치스크린부(110)의 일부를 구획하여 촉감제시영역(420)을 설정한다. (S400)

[0048] 여기서, 입력마크는 사용자의 조작에 의해 정보를 입력 받기 위해 영상표시패널부(130)에 표시되는 대상물로, 예를 들어 아이콘(410) 또는 스크롤바(415)와 같은 것일 수 있다.

[0049] 촉감제시영역(420)은 터치스크린부(110)의 일부를 구획하여 형성되는 영역으로, 촉감제시영역(420) 내에 사용자의 터치가 있는 경우, 구동부(120)의 구동에 의해 터치스크린부(110)의 표면의 촉감이 변화되어, 사용자는 촉감제시영역(420) 내에서 그 외의 영역과 상이한 촉감을 느끼게 되는 터치스크린부(110)의 일부를 말할 수 있다.

[0050] 촉감제시영역(420)은 입력마크의 종류와 형태에 따라 다양한 형태로 설정될 수 있으며, 예를 들어, 도 5에 도시된 바와 같이, 아이콘(410)의 위치 및 형상과 일치하게 터치스크린부(110) 상에 형성될 수 있다.

[0051] 한편, 영상표시패널부(130)에 아이콘(410)과 같은 입력마크가 표시되지 않는 경우, 제어부(140)는 다시 대기 상태(S100)로 돌아가서, 사용자의 터치를 기다리게 된다.

[0052] 한편, 촉감제시영역(420)은 사용자의 조작에 의해 또는 설계자의 설계에 의해 미리 설정되어 있을 수 있으며, 이 때, 영상표시패널부(130)에 입력마크가 표시되었는지 여부를 판단하는 단계(S300)과 입력마크에 따라 촉감제시영역(420)을 설정하는 단계(S400)은 생략될 수 있다.

[0053] 이 경우, 터치스크린부(110)의 터치 위치에 대한 정보를 입력 받은 제어부(140)는, 미리 설정된 촉감제시영역(420)에 따라 후술할 터치 위치가 촉감제시영역(420) 이내인지 여부를 판단하는 단계(S500)를 수행할 수 있다.

[0054] 다음으로, 터치스크린부(110)로부터 터치 위치에 대한 정보를 수신한 제어부(140)는, 그 위치가 상술한 단계에서 설정된 촉감제시영역(420) 이내 인지를 판단하고, (S500) 터치 위치가 촉감제시영역(420) 이내인 경우, 터치스크린부(110)의 일면에 촉감이 변화되도록 동작신호를 구동부(120)에 인가한다. (S600)

[0055] 동작신호는 사용자의 조작 또는 설계자의 설계에 의해 미리 설정될 수 있으며, 입력마크의 종류에 따라 상이하게 설정될 수 있다. 예를 들어, 영상표시패널부(130)에 상이한 종류의 아이콘(410)이 표시되고 있는 경우, 각각의 아이콘(410) 마다 상이한 동작신호가 인가되도록 설정될 수 있다.

[0056] 이 때, 제어부(140)는 각각의 아이콘(410) 마다 형성되는 촉감제시영역(420)에 터치가 이루어지는 경우, 미리 설정된 서로 상이한 동작신호를 인가할 수 있다.

[0057] 아이콘(410)과 스크롤바(415)는 서로 상이한 동작신호가 설정될 수 있으며, 이 때, 서로 상이한 동작신호가 인가될 수 있음은 물론이다.

[0058] 도 12는 본 발명의 일 실시예에 따른 촉감제시 인터페이스 장치(1000) 제어방법의 동작신호 패턴을 나타낸 그래프이다. 도 12에 도시된 바와 같이, 동작신호는, 동작신호가 가지는 파형(S)의 진폭(A), 주파수(f) 및 지속시간(Tt)으로 정의될 수 있으며, 진폭, 주파수 및 지속시간 중 어느 하나 이상이 상이하게 설정되어, 다양한 형태로 변형될 수 있다.

[0059] 그리고, 하나의 동작신호는 동일한 파형(S)이 반복되는 형태를 가질 수 있으며, 이 때는 진폭, 주파수 및 지속시간뿐만 아니라, 각각의 파형(S)간에 간격시간(D)에 따라 상이한 동작신호로 구분될 수 있다.

[0060] 이렇게 동작신호는 다양한 형태의 패턴을 가질 수 있으며, 제어부(140)는 구동부(120)에 미리 설정된 다양한 형태의 동작신호를 인가함으로써, 사용자에게 다양한 형태의 촉감을 제공할 수 있다.

[0061] 한편, 사용자의 터치 위치가 촉감제시영역(420)이 아닌 경우, 제어부(140)는 대기 상태(S100)로 돌아가게 된다. 즉, 사용자가 촉감제시영역(420) 이외의 영역의 터치스크린부(110)를 터치한 경우, 터치스크린부(110)의 표면의 촉감의 변화를 느낄 수 없게 되고, 사용자는 시각뿐만 아니라 촉각에 의해서도 도 5에 도시된 아이콘(410)의 위치와 형상을 인식할 수 있게 된다.

[0062] 다음으로, 제어부(140)는 구동부(120)에 동작신호를 인가한 이후에, 동작신호가 인가되고 경과된 경과시간을 측정 한다. (S700) 제어부(140)는 측정된 경고시간이 미리 설정된 지속시간 보다 크거나 같은지 여부를 판단하고,

(S800) 미리 설정된 동작신호의 지속시간이 경과하지 않은 경우, 계속적으로 동작신호의 경과시간을 측정하고, 측정된 동작신호의 지속시간이 미리 설정된 지속시간 보다 크거나 같아지는 경우, 상술한 터치 여부를 감지하는 단계(S200)를 수행할 수 있다.

[0063] 즉, 사용자는 미리 설정된 지속시간 동안 터치스크린부(110)의 촉감제시영역(420) 내에서 촉감의 변화를 느끼게 된다. 그리고, 촉감제시 인터페이스 장치(1000)는, 지속시간 이후에, 사용자의 터치가 유지되지 않는 경우 대기 상태로 돌아가게 되고, 사용자의 터치가 유지되고 있거나, 다른 위치에 터치가 이루어지고 있는 경우, 계속적으로 터치스크린부(110) 표면의 촉감의 변화를 제공함으로써, 사용자의 터치 위치를 추적하며 계속적인 촉감의 변화를 제공할 수 있게 된다.

[0064] 이후, 촉감제시영역(420)의 설정 형태에 따라 사용자가 느끼게 되는 촉감의 차이를 중심으로 설명한다. 후술하는 부분에 있어서, 본 발명의 일 실시예에 따른 촉감제시 인터페이스 장치(1000) 제어방법은 상술한 도 4에 따라 이루어 질 수 있으며, 이에 대한 설명은 생략한다.

[0065] 도 13 내지 도 14는 본 발명의 일 실시예에 따른 촉감제시 인터페이스 장치 제어방법의 제2 동작을 나타낸 평면도이다. 도 13에 도시된 바와 같이, 영상표시패널부(110)에 복수의 아이콘(410)이 표시되면, 촉감제시영역(420)은 아이콘(410)이 표시되는 영역과 그 외의 영역을 구분하기 위해, 인접하는 아이콘(410) 사이에 형성될 수 있다.

[0066] 이 때, 제어부(140)는, 터치 위치가 촉감제시영역(420) 외에 있는 경우, 구동부(120)에 동작신호를 인가하지 않아, 사용자가 터치스크린부(110)의 표면의 원래의 촉감을 느끼게 할 수 있다.

[0067] 따라서, 사용자의 손가락이 복수의 아이콘(410)을 드래그하면, 사용자는 복수의 아이콘(410) 사이에서는 아이콘(410)이 형성된 부분과 상이한 촉감을 느끼게 되어, 터치스크린부(110)의 표면이 촉감이 상이한 가상의 영역으로 구획된 것과 같은 느낌을 받을 수 있다.

[0068] 도 14에 도시된 바와 같이, 영상표시패널부(130)는 휴대전화(400)에 저장된 사진을 표시할 수 있으며, 그 일측에 사진을 선택할 수 있는 복수의 아이콘(410)을 길이 방향으로 표시할 수 있다.

[0069] 복수의 아이콘(410) 사이에는 촉감제시영역(420)으로 구획될 수 있으며, 터치스크린부(110)의 터치 위치가 촉감제시영역(420) 내에 있는 경우, 제어부(140)는 구동부(120)에 동작신호를 인가하여, 사용자가 터치스크린부(110)의 표면의 촉감이 변화된 것과 같은 조작감을 제공할 수 있다.

[0070] 도 15에 도시된 바와 같이, 영상표시패널부(130)에는 가로로 연장된 형태의 복수의 아이콘(410)이 세로 방향으로 표시될 수 있다. 이 때, 촉감제시영역(420)은 복수의 아이콘(410)이 인접하고 있는 부분에, 아이콘(410)이 가로로 연장된 방향으로 형성될 수 있다.

[0071] 따라서, 사용자는 터치스크린부(110)의 표면을 상하로 드래그하면, 아이콘(410)이 표시되는 영역과, 아이콘(410) 사이의 영역에서 상이한 촉감을 느낄 수 있어, 영상표시패널부(130)에 표시되는 영상과 일체감을 가지는 조작감을 제공받을 수 있게 된다.

[0072] 도 16는 본 발명의 제1 실시예에 따른 촉감제시 인터페이스 장치 제어방법의 제3 동작을 나타낸 평면도이다. 도 16에 도시된 바와 같이, 영상표시패널부(130)에는 복수의 아이콘(410)이 표시될 수 있으며, 촉감제시영역(420)은 아이콘(410)의 가장자리를 따라 환형의 형태로 터치스크린부(110)의 일부를 구획할 수 있다.

[0073] 터치스크린부(110)의 터치 위치가 촉감제시영역(420) 내에 있는 경우, 터치스크린부(110)가 진동되어, 사용자는 아이콘(410)의 가장자리의 경계 부분의 촉감을 상이하게 인식할 수 있으며, 이로 인해 사용자는 시각적으로 아이콘(410)을 인식할 수 있을 뿐만 아니라 촉감으로 아이콘(410)을 인식할 수 있게 된다.

[0074] 도 17는 본 발명의 제1 실시예에 따른 촉감제시 인터페이스 장치 제어방법의 제4 동작을 나타낸 평면도이다. 도 17에 도시된 바와 같이, 휴대전화(400)에 저장된 음원 파일을 재생하는 경우, 영상표시패널부(130)에는 볼륨을 조절할 수 있는 스크롤바(415)가 가로로 표시될 수 있다.

[0075] 이 때, 촉감제시영역(420)은 스크롤바(415)가 연장되는 길이 방향으로 나란히 이격되어 불연속적으로 형성될 수 있다. 각각의 촉감제시영역(420)은 스크롤바(415)를 따라 서로 이격되며 배치되어, 터치스크린부(110)의 일부를 구획할 수 있다.

[0076] 따라서, 사용자가 볼륨을 조절하기 위해 스크롤바(415)를 드래그 하면, 사용자의 손가락이 스크롤바(415)를 따라 가는 동안 상이한 촉감을 계속적으로 느낄 수 있어, 촉감이 변화하는 조작감을 느낄 수 있게 된다.

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[0077] 도 18은 본 발명의 제1 실시예에 따른 촉감제시 인터페이스 장치 제어방법의 제5 동작을 나타낸 평면도이다. 도 18에 도시된 바와 같이, 휴대전화(100)에 저장된 음원파일을 저장할 때, 환형의 형태를 가지는 스크롤바(415)가 영상표시패널부(130)에 표시될 수 있다.

[0078] 이 때, 상술한 바와 같이, 촉감제시영역(420)은 스크롤바(415)가 표시되는 터치스크린부(110) 상에 스크롤바(415)가 연결되는 원형의 방향을 따라 방사상으로 배치되며, 불연속적으로 서로 이격되며 형성되며, 사용자의 손가락이 환형의 스크롤바(415)를 따라 이동하는 동안 상이한 촉감을 느끼게 되어, 사용자는 촉감이 변화하는 조작감을 느낄 수 있게 된다.

[0079] 도 19는 본 발명의 제2 실시예에 따른 촉감제시 인터페이스 장치(2000)를 나타낸 사시도이다. 도 19에 도시된 바와 같이, 본 발명의 제2 실시예에 따른 촉감제시 인터페이스 장치(2000)의 구동부(120)는 터치스크린부(110)와 영상표시패널부(130)의 일측에 함께 결합되어 있다.

[0080] 따라서, 구동부(120)가 일체화된 터치스크린부(110)와 영상표시패널부(130)를 함께 x방향으로 진동시킬 수 있어, 구동부(120)가 터치스크린부(110)에 진동을 전달하는 과정에서 발생할 수 있는 진동의 손실을 방지하여, 보다 충분한 진동을 터치스크린부(110)에 전달할 수 있다.

[0081] 도 20는 본 발명의 제3 실시예에 따른 촉감제시 인터페이스 장치(3000)를 나타낸 사시도이다. 도 20에 도시된 바와 같이, 본 발명의 제3 실시예에 따른 촉감제시 인터페이스 장치(3000)는, 터치스크린부(110)를 보호하기 위해 터치스크린부(110)의 일면에 결합되는 보호패널부(150)를 더 포함할 수 있다.

[0082] 보호패널부(150)는 터치스크린부(110)의 표면을 외부로부터 보호할 수 있으며, 사용자가 직접적으로 접촉하는 부분일 수 있다. 이 때, 보호패널부(150)의 일측에 구동부(120)가 결합되어, x방향으로 진동을 제공함으로써, 사용자는 직접 접촉하는 부분의 진동으로 인해 촉감의 변화를 직접적으로 전달 받을 수 있게 된다.

[0083] 도 21은 본 발명의 제4 실시예에 따른 촉감제시 인터페이스 장치(4000)를 나타낸 사시도이다. 도 21에 도시된 바와 같이, 본 발명의 제4 실시예에 따른 촉감제시 인터페이스 장치(4000)의 구동부(122)는, 터치스크린부(110)의 일면의 가장자리의 일측과, 그와 마주보는 타측에 결합될 수 있다.

[0084] 이 때, 구동부(122)는 압전소자로 구현될 수 있으며, 압전소자의 분극 방향은 x방향으로 진동이 가능하도록 형성될 수 있다. 본 실시예의 구동부(122)는 터치스크린부(110)의 양측에 결합되어, 터치스크린부(110)에 충분한 진동을 제공할 수 있다.

[0085] 한편, 구동부(122)는 영상표시패널부(130)의 영상이 표시되는 영역의 이외에 결합될 수 있다.

[0086] 도 22는 본 발명의 제5 실시예에 따른 촉감제시 인터페이스 장치(5000)를 나타낸 사시도이다. 도 22에 도시된 바와 같이, 본 발명의 제5 실시예에 따른 촉감제시 인터페이스 장치(5000)의 구동부(120)는 터치스크린부(110)의 양측에 각각 결합될 수 있다. 따라서, 구동부(120)는 터치스크린부(110)에 x방향으로 충분한 진동을 제공할 수 있다.

[0087] 도 23은 본 발명의 제6 실시예에 따른 촉감제시 인터페이스 장치(6000)를 나타낸 사시도이다. 도 23에 도시된 바와 같이, 본 발명의 제6 실시예에 따른 촉감제시 인터페이스 장치(6000)의 구동부(122)는 터치스크린부(110)의 일면의 가장자리에 결합될 수 있다.

[0088] 이 때, 구동부(122)인 압전소자의 분극 방향이 따라 다양한 방향으로 터치스크린부(110)가 진동될 수 있으며, 예를 들어, x방향과 y방향으로 진동될 수 있다. 따라서, 사용자의 손가락이 터치스크린부(110)의 표면을 x방향으로 이동하는 경우 터치스크린부(110)를 x방향으로 진동시키고, 사용자의 손가락이 y방향으로 터치스크린부(110)의 표면을 이동하는 경우 y방향으로 터치스크린부(110)를 진동시킴으로써, 사용자가 어떤 방향으로 드래그하는 경우라도, 동일한 촉감의 차이를 제공할 수 있다.

[0089] 상기에서는 본 발명의 바람직한 실시예를 참조하여 설명하였지만, 해당 기술 분야에서 통상의 지식을 가진 자라면 하기의 특허 청구의 범위에 기재된 본 발명의 사상 및 영역으로부터 벗어나지 않는 범위 내에서 본 발명을 다양하게 수정 및 변경시킬 수 있음을 이해할 수 있을 것이다.

도면의 간단한 설명

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[0090] 도 1은 본 발명의 제1 실시예에 따른 촉감제시 인터페이스 장치를 나타낸 사시도.

[0091] 도 2 내지 도 4는 본 발명의 제1 실시예에 따른 촉감제시 인터페이스 장치의 동작원리를 나타낸 도면.

[0092] 도 5 내지 도 9는 본 발명의 제1 실시예에 따른 촉감제시 인터페이스 장치의 적용 가능한 터치스크린부의 변형예를 나타낸 사시도.

[0093] 도 10은 본 발명의 제1 실시예에 따른 촉감제시 인터페이스 장치 제어방법을 나타낸 순서도.

[0094] 도 11은 본 발명의 제1 실시예에 따른 촉감제시 인터페이스 장치의 제1 동작을 나타낸 평면도.

[0095] 도 12는 본 발명의 제1 실시예에 따른 촉감제시 인터페이스 장치의 동작신호 패턴을 나타낸 그래프.

[0096] 도 13 내지 도 15는 본 발명의 제1 실시예에 따른 촉감제시 인터페이스 장치 의 제2 동작을 나타낸 평면도.

[0097] 도 16은 본 발명의 제1 실시예에 따른 촉감제시 인터페이스 장치의 제3 동작을 나타낸 평면도.

[0098] 도 17은 본 발명의 제1 실시예에 따른 촉감제시 인터페이스 장치의 제4 동작을 나타낸 평면도.

[0099] 도 18은 본 발명의 제1 실시예에 따른 촉감제시 인터페이스 장치의 제5 동작을 나타낸 평면도.

[0100] 도 19는 본 발명의 제2 실시예에 따른 촉감제시 인터페이스 장치를 나타낸 사시도.

[0101] 도 20은 본 발명의 제3 실시예에 따른 촉감제시 인터페이스 장치를 나타낸 사시도.

[0102] 도 21는 본 발명의 제4 실시예에 따른 촉감제시 인터페이스 장치를 나타낸 사시도.

[0103] 도 22은 본 발명의 제5 실시예에 따른 촉감제시 인터페이스 장치를 나타낸 사시도.

[0104] 도 23은 본 발명의 제6 실시예에 따른 촉감제시 인터페이스 장치를 나타낸 사시도.

[0105] <도면의 주요부분에 대한 부호의 설명>

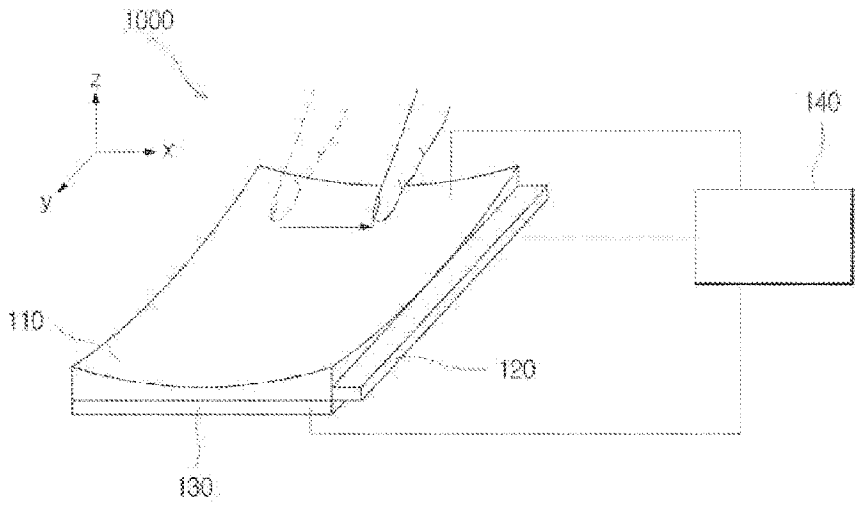
[0106] 110: 터치스크린부 120: 구동부

[0107] 130: 영상표시패널부 140: 제어부

[0108] 1000: 촉감제시 인터페이스 장치

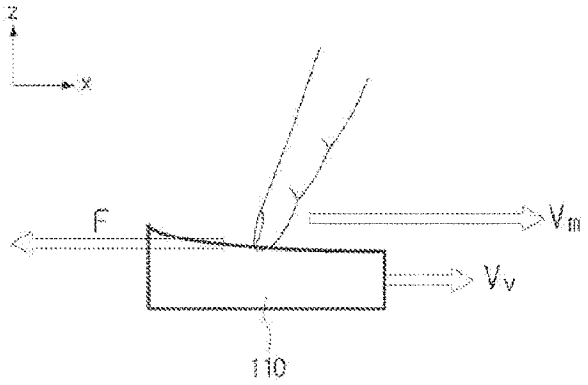
도면

도면1

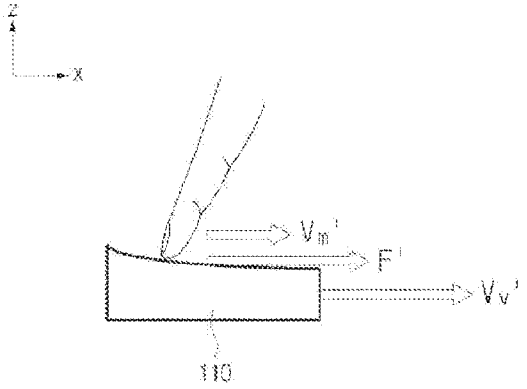


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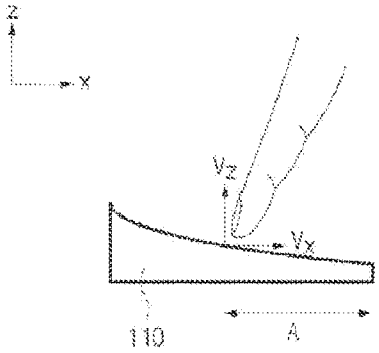
도면2



도면3

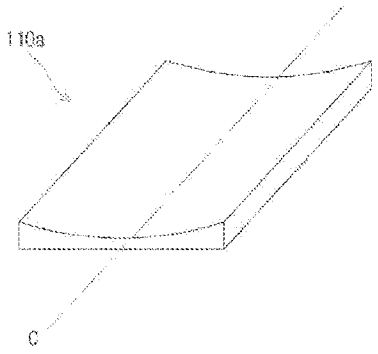


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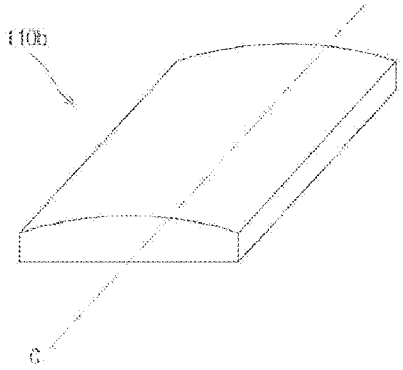


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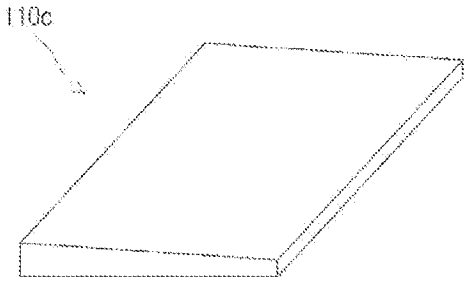
도면5



도면6



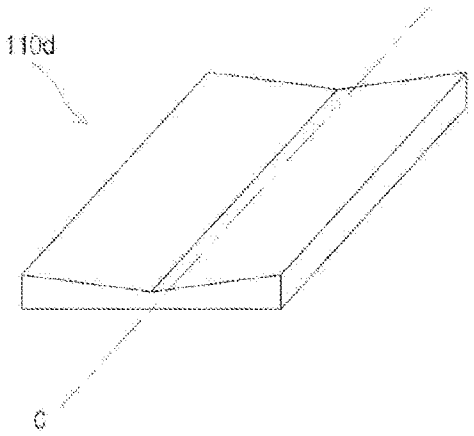
도면7



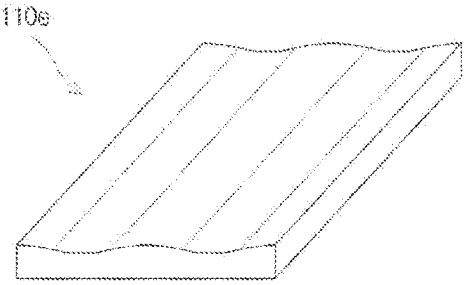
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DEF_00004709

도면8



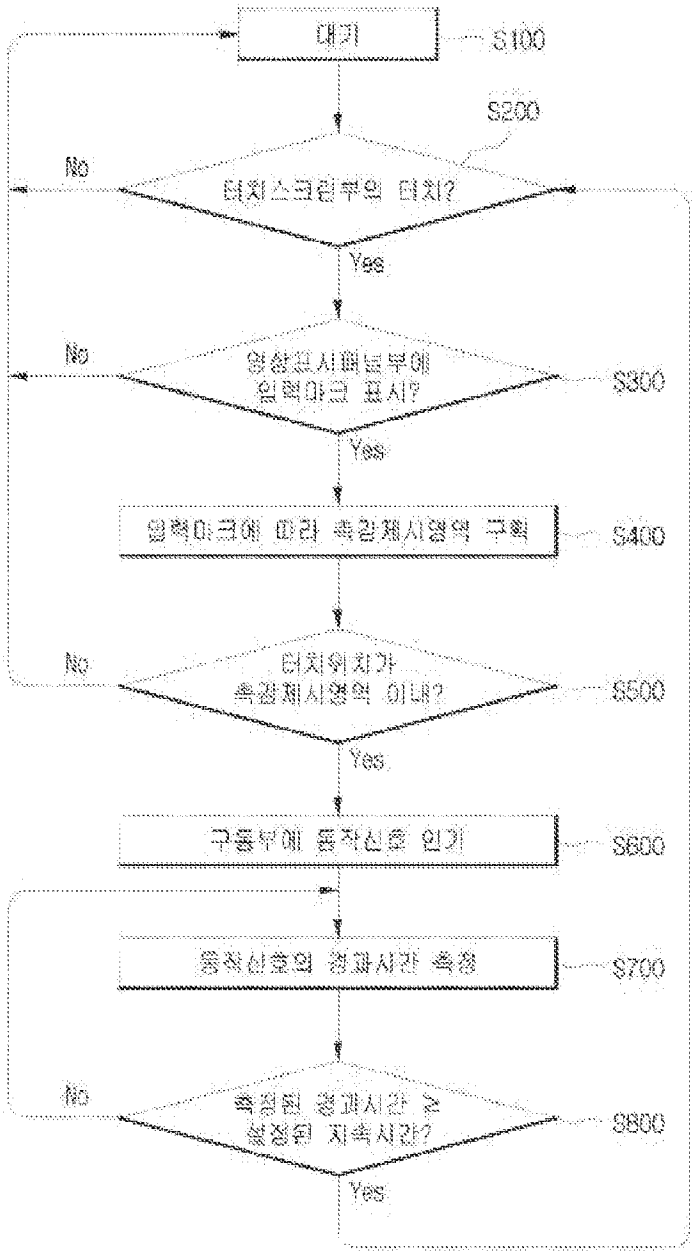
도면9



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DEF_00004710

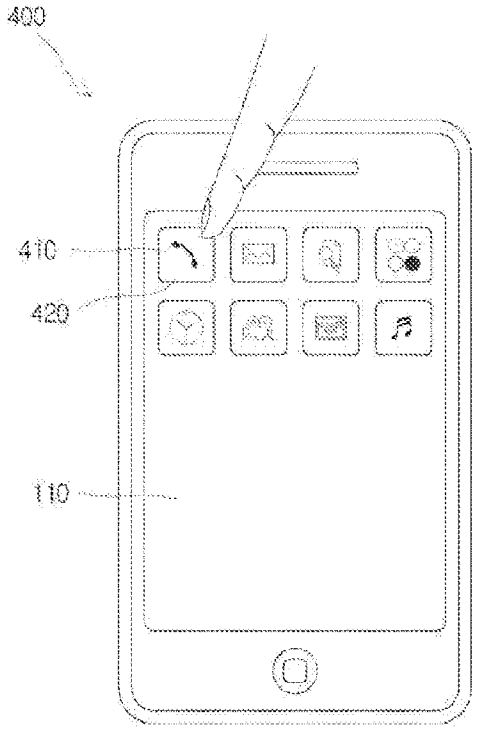
도면10



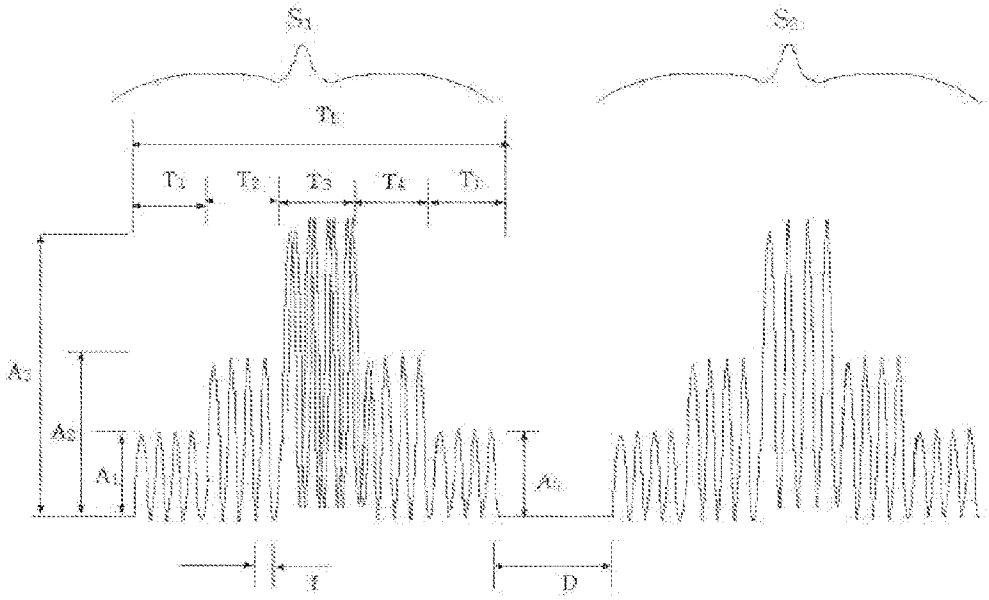
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DEF_00004711

도면11

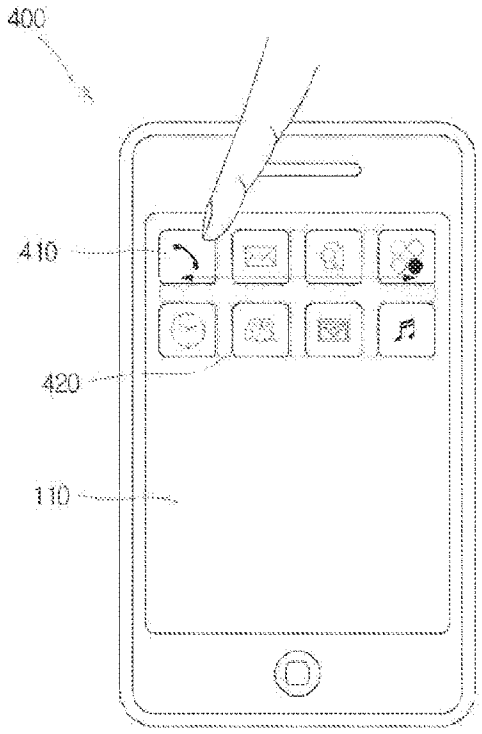


도면12

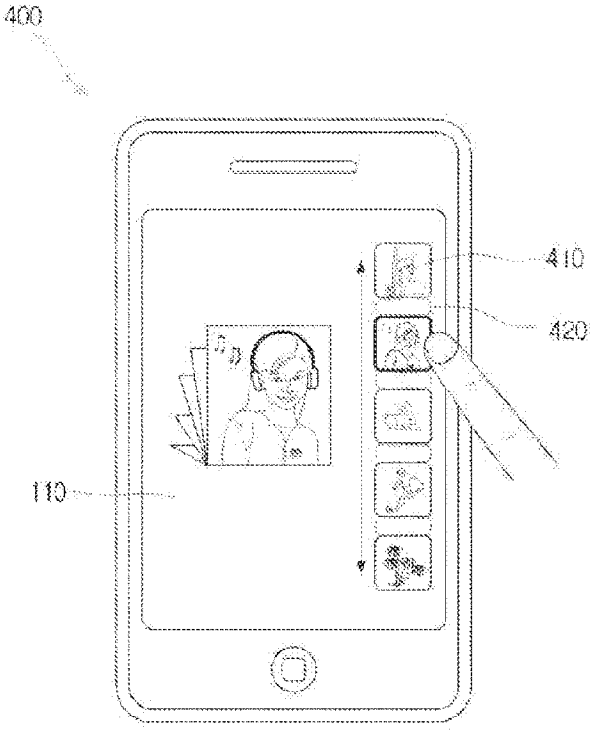


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도면13

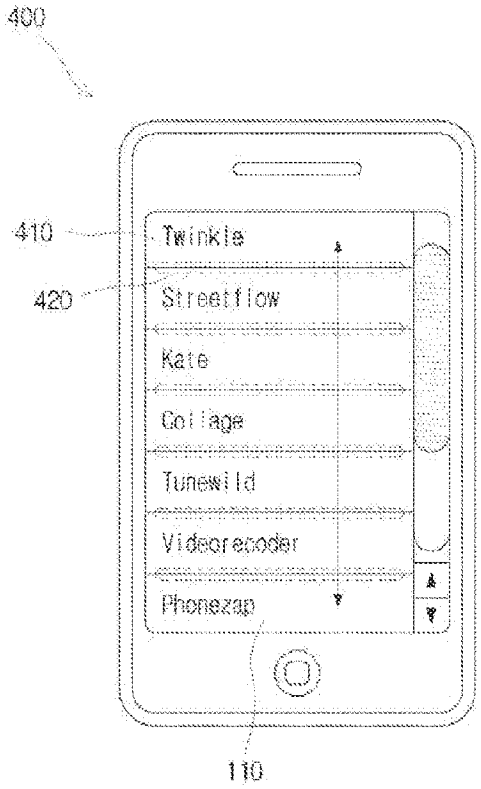


도면14



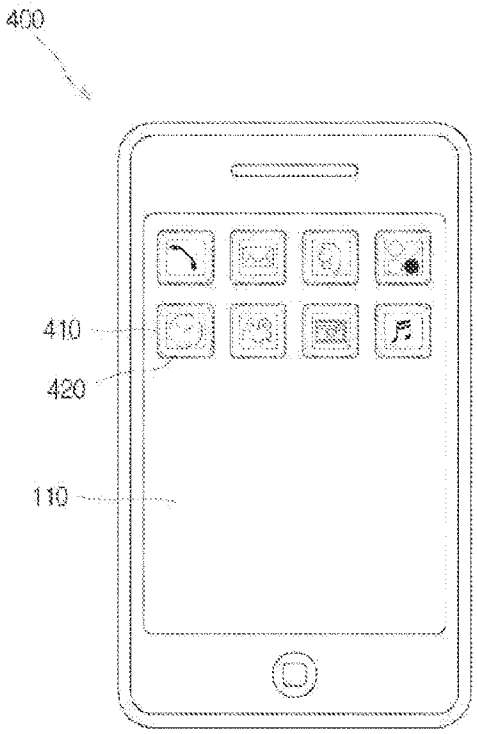
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도면16

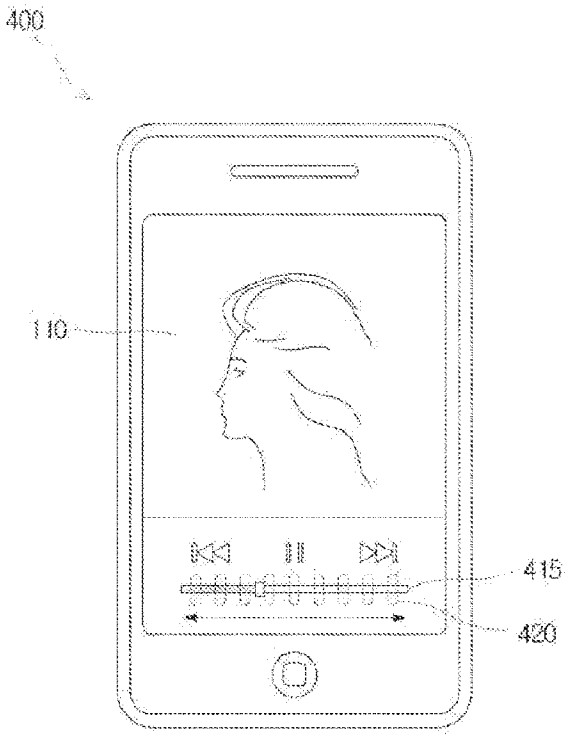


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도면16

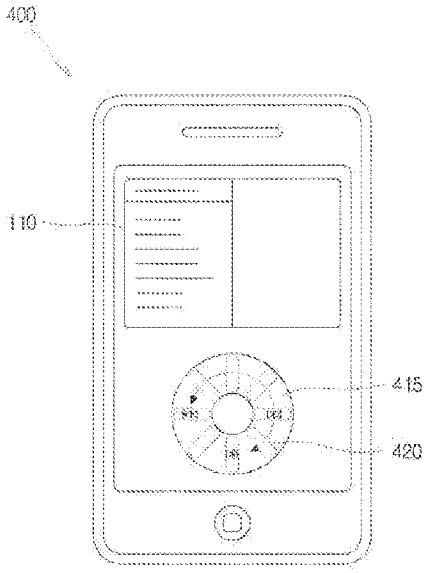


도면17

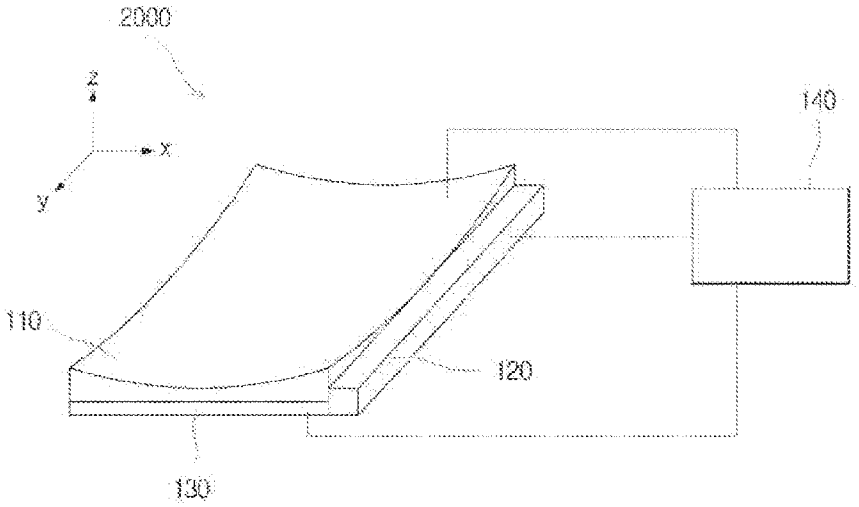


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도면18

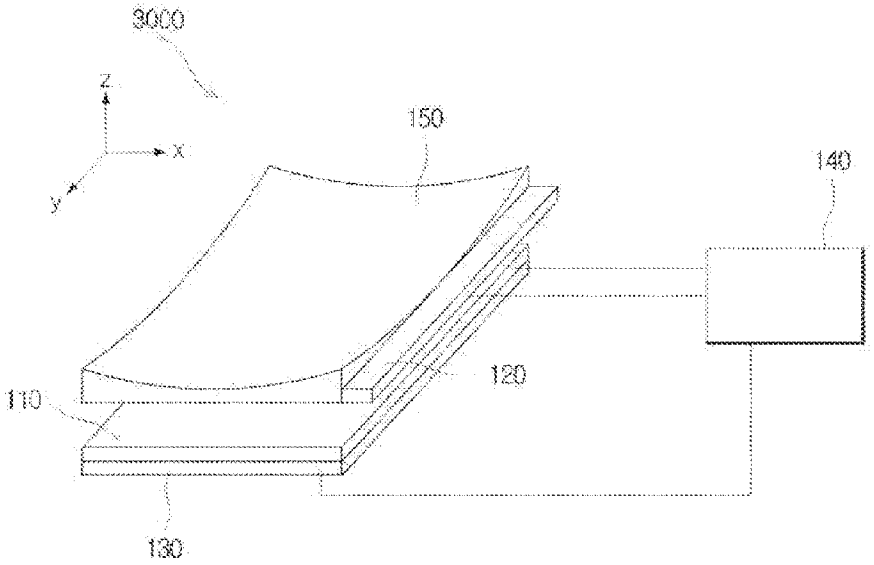


도면19

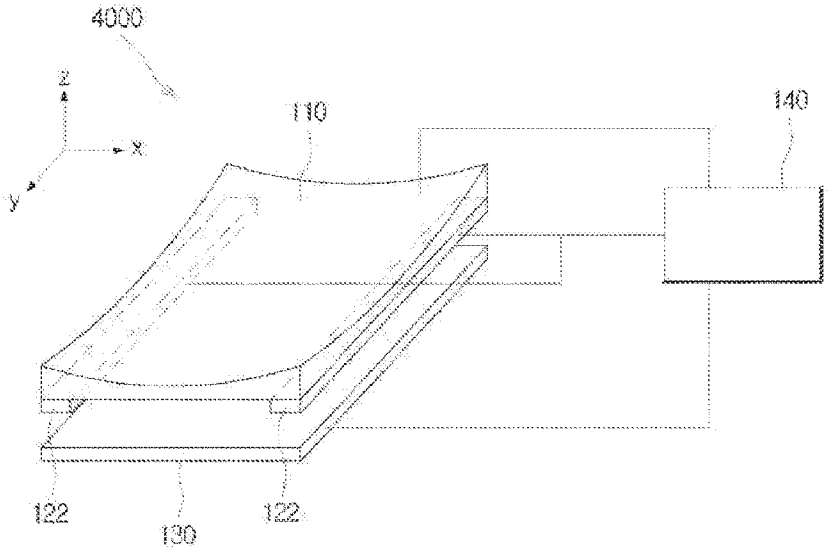


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도면20

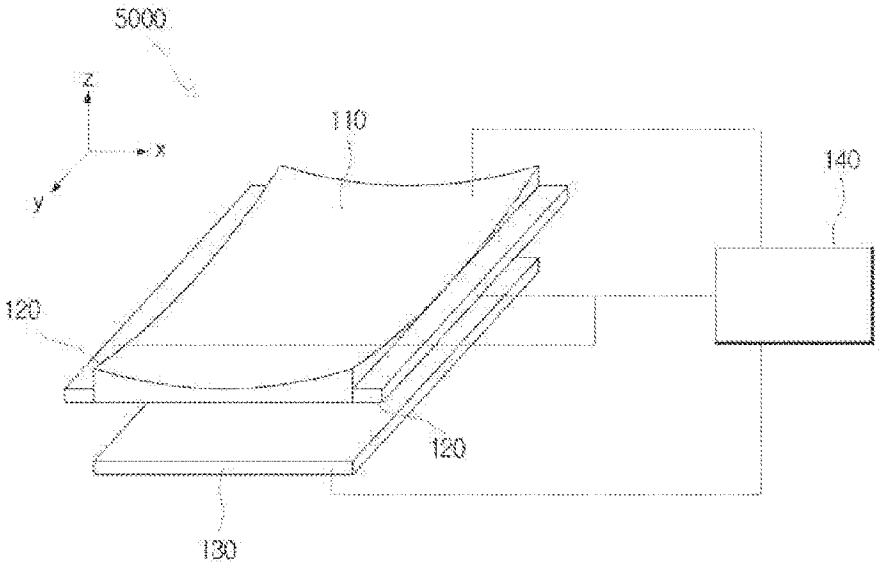


도면21

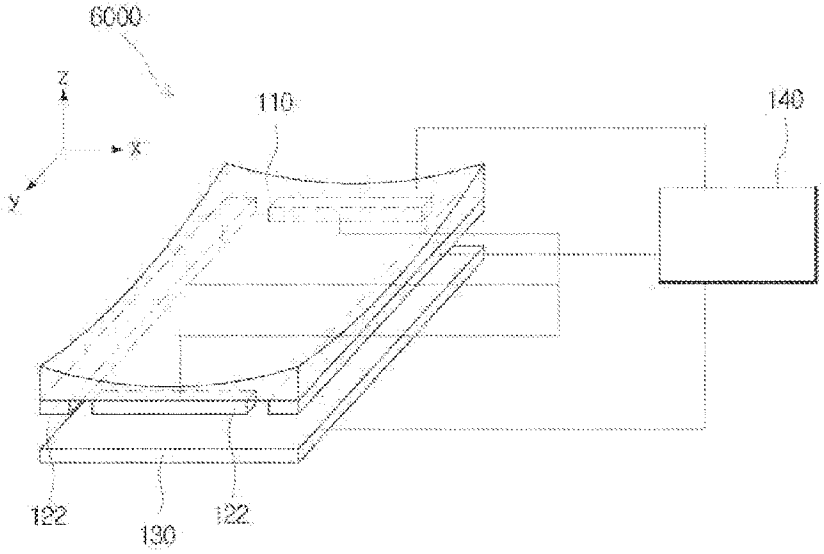


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도면22



도면23



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M517370

(19)中華民國智慧財產局

(12)新型說明書公告本 (11)證書號數：TW M517370 U

(45)公告日： 中華民國 105 (2016) 年 02 月 11 日

(21)申請案號：104211723 (22)申請日： 中華民國 104 (2015) 年 07 月 21 日

(51)Int. Cl.： *G06F3/042 (2006.01)*

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(NOTE)備註： 相同的創作已於同日申請發明專利(Another patent application for invention in respect of the same creation has been filed on the same date)

申請專利範圍項數：10 項 圖式數：8 共 21 頁

(54)名稱

光學觸控裝置

(57)摘要

一種適用於一顯示器的光學觸控裝置，包含一透明板體、一反光層、至少二光源、至少二鄰近該等光源的光感測模組及一處理單元。透明板體設在顯示器的顯示面上，包括一頂面、一貼近顯示面的底面、一上側面、一與上側面相對的下側面、一連接於上側面與下側面的左側面及一與左側面相對的右側面。該反光層包括一設置在透明板體的周緣的主層部，及一設置在該透明板體之底面的鄰近下側面、左側面及右側面的周緣並連接主層部的延伸層部。該延伸層部設置的位置不僅可避免該光學觸控裝置堆積灰塵，更有助於使該光學觸控裝置達到全平面的架構。

指定代表圖：

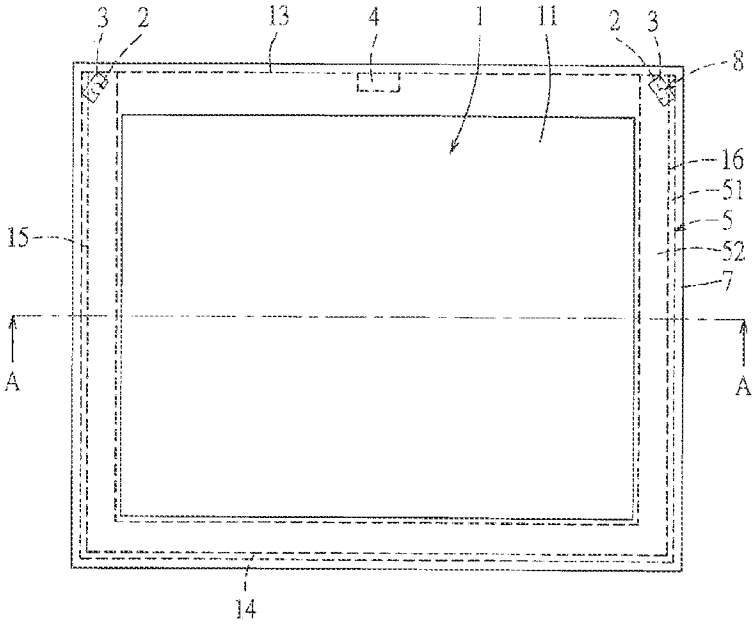


圖 1

符號簡單說明：

1・・・透明板體

11・・・頂面

13・・・上側面

14・・・下側面

15・・・左側面

16・・・右側面

2・・・光源

3・・・光感測模組

4・・・處理單元

5・・・反光層

51・・・主層部

52・・・延伸層部

7・・・框體

8・・・發光單元

新型專利說明書

（本說明書格式、順序，請勿任意更動）

【新型名稱】 光學觸控裝置

【技術領域】

【0001】 本新型是有關於一種光學觸控裝置，特別是指一種能達到全平面式的光學觸控裝置。

【先前技術】

【0002】 觸控裝置具有使設備簡潔、操作介面人性化等優點，故觸控裝置逐漸取代傳統的按鍵。近年來，隨著智慧型手機、平板電腦、電子書及觸控式提款機、公共事務機等電子化設備的普及，觸控裝置被應用的範圍也越來越廣泛。其中，光學觸控裝置因具備了低成本的優勢，因此在各種觸控面板的競爭市場中更備受關注。

【0003】 現有的光學觸控裝置通常包含一觸控板、二裝設於該觸控板頂面上端的攝影機、二分別位於鄰近該等攝影機的光發射器及一設於該觸控板的頂面的周緣的反光層。在使用時，該等光發射器發出光線，該光線碰到反光層並被該反光層反射後的影像被攝影機所擷取。當有一觸碰物接觸到該觸控板的頂面時，該觸碰物會阻擋住由反光層反射的部分光線，使該被反光層所反射的光線產生遮斷。藉由分析該等攝影機所記錄到光線產生遮斷的位置，來判斷該觸碰物所接觸到該觸控板頂面的位置。

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【0004】 然而，在現有的光學觸控裝置中，反光層設置於觸控板的頂面以增加光線反射的效果，但此種設置方式限制了觸控板的頂面可被使用的面積，也無法如期他觸控技術般做到窄邊框甚至是全平面的觸控板，故在美觀上仍需改善。此外，設置於該觸控板頂面的反光層在與該觸控板的接合處容易有卡積灰塵或被異物遮蔽之問題。

【0005】 此外，爲了擴大光線穿透該觸控板的面積範圍，往往會以加高攝影機與該觸控板頂面間的距離來達成此目的，但使得整體裝置的厚度增加，造成使用上較爲厚重不方便的問題。

【新型內容】

【0006】 因此，本新型之目的，即在提供一種不易累積灰塵的光學觸控裝置。

【0007】 本新型之另一目的，即在提供一種全平面式的光學觸控裝置。

【0008】 本新型之再一目的，即在提供一種不需增加整體觸控裝置的厚度也能擴大感應區域的光學觸控裝置。

【0009】 於是，本新型光學觸控裝置適用於一顯示器，該光學觸控裝置包含一透明板體、一發光單元、至少二光感測模組及一處理單元。

【0010】 該透明板體適於設在該顯示器的一顯示面上，且包括一頂面、一貼近該顯示面的底面、一上側面、一與該上側面相對的下側面、一連接於該上側面與該下側面的左側面及一與該左側面相對的右側面。

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【0011】 該發光單元設置於該透明板體，能產生遍佈該透明板體的光線。

【0012】 該等光感測模組分別設於靠近該等光源處，每一光感測模組用於感測當一物體接觸到該透明板體的該頂面時的光線以產生一感測信號。

【0013】 該處理單元，耦接於該等光感測模組，並接收來自於該等光感測模組之該等感測信號並據以產生一控制信號。

【0014】 在一些實施態樣中，該發光單元包括一反光層及至少二光源。該反光層包括一環繞設置在該透明板體的該下側面、該左側面及該右側面上的主層部、及一設置在該透明板體之該底面的一鄰近該下側面、該左側面及該右側面的周緣並連接該主層部的延伸層部。該等光源分別設置在該透明板體的該頂面的任兩相鄰兩角落處，該等光源分別發出紅外光。

【0015】 在一些實施態樣中，該發光單元包括至少一導光條，設置於該透明板體之任一側，並能發出紅外光。

【0016】 在一些實施態樣中，該發光單元包括一導光條，環繞設置於該透明板體之左側面、右側面及下側面。

【0017】 在一些實施態樣中，該透明板體具有兩彼此相對且逐漸朝一遠離該顯示面之方向延伸的左、右端部。

【0018】 在一些實施態樣中，該反光層的延伸層部的寬度配合該透明板體的該頂面的面積增加而增加。

【0019】 在一些實施態樣中，該反光層以反光布及反光

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條其中之一者所構成。

【0020】 在一些實施態樣中，該反光層具有至少一波浪狀的表面。

【0021】 在一些實施態樣中，該光學觸控裝置還包含一設在該反光層的該延伸層部與該透明板體的該底面之間的光學濾件(IR PASS)。

【0022】 在一些實施態樣中，光學觸控裝置還包含一框體，設在該透明板體的該頂面上用於覆蓋該等光源、該等光感測模組。

【0023】 本新型之功效在於利用設置在該透明板體的底面的反光層來加強反光效果，以補強在穿透該透明板體時因反射與折射而衰減的光線，而少了該反光層遮蔽的該透明板體的頂面不僅在外觀上能夠達成全平面的美觀，也避免灰塵卡積在該反光層與該透明板體頂面的交界處。此外，呈微凹面狀的透明板體，左、右兩端遠離該顯示器，使該透明板體能被該等光源照射到的面積增加。

【圖式簡單說明】

【0024】 本新型之其他的特徵及功效，將於參照圖式的實施方式中清楚地呈現，其中：

圖 1 是一上視圖，說明在一第一實施例中，一光學觸控裝置的元件安排；

圖 2 是一示意圖，說明該第一實施例中，該光學觸控裝置中的一反光層及二光感測模組設置的位置；

圖 3 是一剖面示意圖，說明圖 1 中的一透明板體爲一

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平面時，沿 A-A 剖線切割，該透明板體的情形；

圖 4 是一剖面示意圖，說明圖 1 中的該透明板體爲一曲面時，沿 A-A 剖線切割，該透明板體的情形；

圖 5 是一圖 3 的局部放大示意圖，說明一光學濾件設於該透明板體的底面與該反光層間之情形；

圖 6 是一流程圖，說明該光學觸控裝置處理一訊號源的流程；

圖 7 是一上視圖，說明在一第二實施例中，一光學觸控裝置的發光單元爲一導光條時，該等導光條設置在該透明板體的三側邊之情形；及

圖 8 是沿圖 7 的 B-B 剖線切割的剖面示意圖，說明該導光條位於該透明板體與一框體間。

【實施方式】

【0025】 參閱圖 1 至圖 5，本新型光學觸控裝置的第一實施例包含一透明板體 1、一發光單元 8、二光感測模組 3、一處理單元 4、一光學濾件(IR PASS)6 及一框體 7。

【0026】 該透明板體 1 適於設在一顯示器 9 的一顯示面 91 上，且包括一頂面 11、一貼近該顯示面 91 的底面 12、一上側面 13、一與該上側面 13 相對的下側面 14、一連接於該上側面 13 與該下側面 14 的左側面 15 及一與該左側面 15 相對的右側面 16。

【0027】 該發光單元 8 包括二光源 2 及一反光層 5。如圖 2 所示，該等光源 2 在本實施例中分別設置在該透明板體 1 的該頂面 11 的右上方與左上方兩角落處，且該等光源 2 分

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別發出遠紅外光。該等光源 2 的數量可為二以上，且光源 2 設置的位置可以是位在該透明板體 1 的該頂面 11 的任意兩相鄰的角落處，不以本實施例中之舉例為限。

【0028】 用以反射該等光源 2 發出的光線的該反光層 5 包括一設置在該透明板體 1 的該下側面 14、該左側面 15 及該右側面 16 上的主層部 51、及一設置在該透明板體 1 之該底面 12 的一鄰近該下側面 14、該左側面 15 及該右側面 16 的周緣並連接該主層部 51 的延伸層部 52。在此實施例中，該反光層 5 的延伸部層 52 的寬度隨該透明板體 1 的該頂面 11 的面積增加而增加，如此可加強光線的反射，以彌補光線穿透玻璃時因反射、折射而減弱的能量。此外，本新型中在該透明板體 1 的周緣設置用以反射光線的反光層 5 的成本低於配置多個光學鏡頭的成本，具有降低成本的優點。

【0029】 其中，該反光層 5 可以是反光布或是反光條其中之一種形式。值得一提的是，如圖 5 所示，該反光層 5 的主層部 51 及延伸層部 52 皆具有一波浪狀的表面，能增加該反光層 5 與光線接觸的面積，進而加強光線被反射的效果。此實施例中的反光層 5 雖以反光布或是反光條為例，但不限制使用其他具有反光效果的材料作為反光層 5。

【0030】 參閱圖 5，該光學觸控裝置還包含一設在該反光層 5 的該延伸層部 52 與該透明板體 1 的該底面 12 之間的光學濾件 6。該光學濾件 6 供遠紅外線通過，以避免其他波長的光線穿透，而干擾反光的效果。

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【0031】 參閱圖 2 及圖 6，該等光感測模組 3 分別設於靠近該等光源 2 處，每一光感測模組 3 具有一感光耦合元件(CCD)，用於感測當一物體接觸到該透明板體 1 的該頂面 11 的光線時產生一觸碰點，以發出一感測信號 31。當該物體觸碰至該透明板體 1 的該頂面 11 時，該物體不僅會阻擋來自該等光源 2 的光線，也會阻擋從該反光層 5 反射的光線路徑，使該觸碰點爲一較暗區域，當該等光感測模組 3 擷取到具有該觸碰點的影像時，傳送一感測信號 41。此外，本實施例中的該等光感測模組 3 的數量雖以二爲例，但其數量可爲二以上。再者，該等光感測模組 3 設置的位置可以是位在該透明板體 1 的該頂面 11 的任意兩相鄰的角落處，不以本實施例中之舉例爲限。

【0032】 如圖 6 所示，該處理單元 4 耦接於該等光感測模組 3，接收來自於該等光感測模組 3 之該等感測信號 31，利用已知光感測模組 3 的位置與該觸碰點所投影在該反光層 5 的位置，運算出該觸碰點的位置，並據以產生一控制信號 41。

【0033】 從圖 1 及圖 3 皆可看出，該光學觸控裝置還包含一框體 7。該框體 7 設在該透明板體 1 的該頂面 11 上並包覆該透明板體 1 的周緣，用於覆蓋該等光源 2、該等光感測模組 3，使該光學觸控裝置整體視覺更加美觀。

【0034】 值得一提的是，本實施例中的透明板體 1 不限於只有平板狀的實施態樣。如圖 4 所示，該透明板體 1 具有兩彼此相對且逐漸朝一遠離該顯示面 91 之方向延伸的左

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、右端部。該左、右端部提高了該等光源 2 及該等光感測模組 3 能照射到該透明板體 1 的高度，亦增加了光線能穿透該透明板體 1 的面積，進而達到增加反射光線的效果。如此，該光學裝置不需架高該等光源 2 及該光感測模組 3 的位置，保持整體既有的厚度，就能提升光線的反射量，來增加其與該透明板體 1 間的距離，反而使該光學觸控裝置整體厚度的增加，造成使用上的厚重和不方便。

【0035】 參閱圖 7 及圖 8，本新型光學觸控裝置的一第二實施例大致上與前述的第一實施例相似，不同的地方在於，該第二實施例中的發光單元 8 爲一導光條 81，該導光條 81 環繞設置於該透明板體 1 的左側面 15、右側面 16 及下側面 14 並發出遍佈於該透明板體 1 的遠紅外光。當物體觸碰至該透明板體 1 的該頂面 11 時，會阻擋來自該等導光條 81 的光線，使該觸碰點爲一較暗區域，當該等光感測模組 3 擷取到具有該觸碰點的影像時，傳送一感測信號 41。值得注意的是，該導光條 81 至少設置於該透明板體 1 的某一側邊使光線分佈於透明板體 1 上即可，並不一定要在該透明板體 1 的左側面 15、右側面 16 及下側面 14 皆設置該導光條 81。

【0036】 綜上所述，在該第一實施例中，本新型利用設置在該透明板體 1 底面 12 的發光單元 8 使光線能分佈在該透明板體 1。該發光單元 8 可爲至少二光源 2 及一加強反光效果的反光層 5。該反光層 5 能補強光線穿透該透明板體 1 時因反射與折射而耗損的能量。此外，該透明板體 1 的頂

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面 11 少了該反光層 5 的遮蔽，不僅在外觀上更能貼近窄邊框或是全平面的設計，也克服了灰塵堆積在該反光層 5 與該透明板體 1 頂面 11 交界處的問題。而在該第二實施例中，該發光單元 8 爲能發出紅外光源的導光條 81 來產生分佈於該透明板體 1 的光線。最後，該透明板體 1 的型態能夠呈微凹面狀，即該透明板體 1 的左、右兩端遠離該顯示器 9，使該透明板體 1 能被該等光源 2 照射到的面積增加，故確實能達成本新型之目的。

【0037】 惟以上所述者，僅爲本新型之實施例而已，當不能以此限定本新型實施之範圍，凡是依本新型申請專利範圍及專利說明書內容所作之簡單的等效變化與修飾，皆仍屬本新型專利涵蓋之範圍內。

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【符號說明】

【0038】

1 ····· 透明板體

11 ····· 頂面

12 ····· 底面

13 ····· 上側面

14 ····· 下側面

15 ····· 左側面

16 ····· 右側面

2 ····· 光源

3 ····· 光感測模組

31 ····· 感測信號

4 ····· 處理單元

41 ····· 控制信號

5 ····· 反光層

51 ····· 主層部

52 ····· 延伸層部

6 ····· 光學濾件

7 ····· 框體

8 ····· 發光單元

81 ····· 導光條

9 ····· 顯示器

91 ····· 顯示面

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M517370

新型摘要

公告本

※ 申請案號：104211773

※ 申請日：104. 7. 21

※IPC 分類：G06F3/042 (2006.01)

【新型名稱】 光學觸控裝置

【中文】

一種適用於一顯示器的光學觸控裝置，包含一透明板體、一反光層、至少二光源、至少二鄰近該等光源的光感測模組及一處理單元。透明板體設在顯示器的顯示面上，包括一頂面、一貼近顯示面的底面、一上側面、一與上側面相對的下側面、一連接於上側面與下側面的左側面及一與左側面相對的右側面。該反光層包括一設置在透明板體的周緣的主層部，及一設置在該透明板體之底面的鄰近下側面、左側面及右側面的周緣並連接主層部的延伸層部。該延伸層部設置的位置不僅可避免該光學觸控裝置堆積灰塵，更有助於使該光學觸控裝置達到全平面的架構。

【英文】

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申請專利範圍

1. 一種光學觸控裝置，適用於一顯示器，該光學觸控裝置包含：

一透明板體，適於設在該顯示器的一顯示面上，且包括一頂面、一貼近該顯示面的底面、一上側面、一與該上側面相對的下側面、一連接於該上側面與該下側面的左側面及一與該左側面相對的右側面；

一發光單元，設置於該透明板體，能產生遍佈該透明板體的光線；

至少二光感測模組，分別設於靠近該等光源處，每一光感測模組用於感測當一物體接觸到該透明板體的該頂面時的光線，以產生一感測信號；及

一處理單元，耦接於該等光感測模組，並接收來自於該等光感測模組之該等感測信號並據以產生一控制信號。

2. 如請求項1所述的光學觸控裝置，其中，該發光單元包括一反光層及至少二光源，該反光層具有一環繞設置在該透明板體的該下側面、該左側面及該右側面上的主層部、及一設置在該透明板體之該底面的一鄰近該下側面、該左側面及該右側面的周緣並連接該主層部的延伸層部；該等光源分別設置在該透明板體的該頂面的任兩相鄰兩角落處，且分別發出紅外光。

3. 如請求項1所述的光學觸控裝置，其中，該發光單元包括至少一導光條，設置於該透明板體之任一側，並能發

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出紅外光。

4. 如請求項 3 所述的光學觸控裝置，其中，該發光單元包括一導光條，環繞設置於該透明板體之左側面、右側面及下側面。

5. 如請求項 2 所述的光學觸控裝置，其中，該透明板體具有兩彼此相對且逐漸朝一遠離該顯示面之方向延伸的左、右端部。

6. 如請求項 2 所述的光學觸控裝置，其中，該反光層的延伸層部的寬度配合該透明板體的該頂面的面積增加而增加。

7. 如請求項 2 所述的光學觸控裝置，其中，該反光層以反光布及反光條其中之一者所構成。

8. 如請求項 2 所述的光學觸控裝置，其中，該反光層具有至少一波浪狀的表面。

9. 如請求項 2 所述的光學觸控裝置，還包含一設在該反光層的該延伸層部與該透明板體的該底面之間的光學濾件(IR PASS)。

10. 如請求項 1 至 9 其中任一項所述的光學觸控裝置，還包含一框體，設在該透明板體的該頂面上用於覆蓋該等光源、該等光感測模組。

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圖式

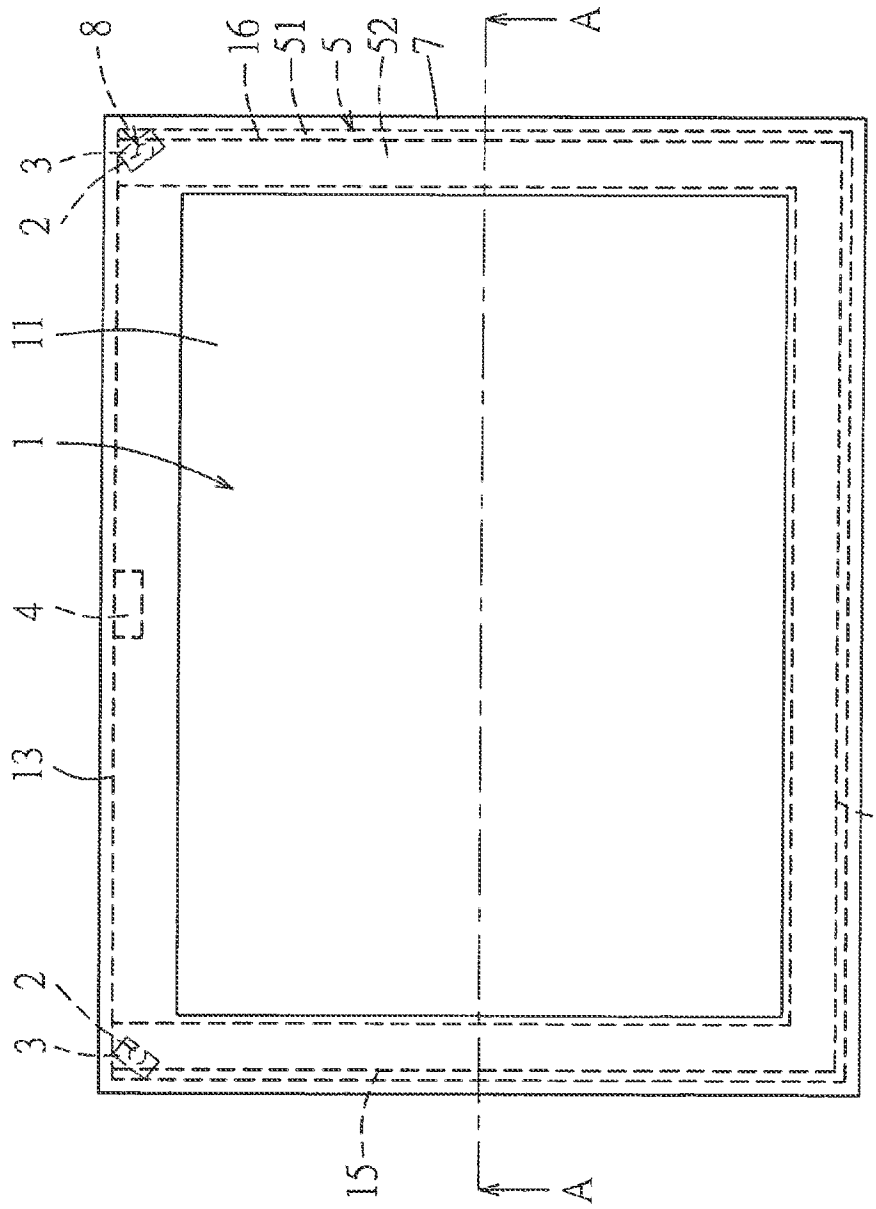


圖 1

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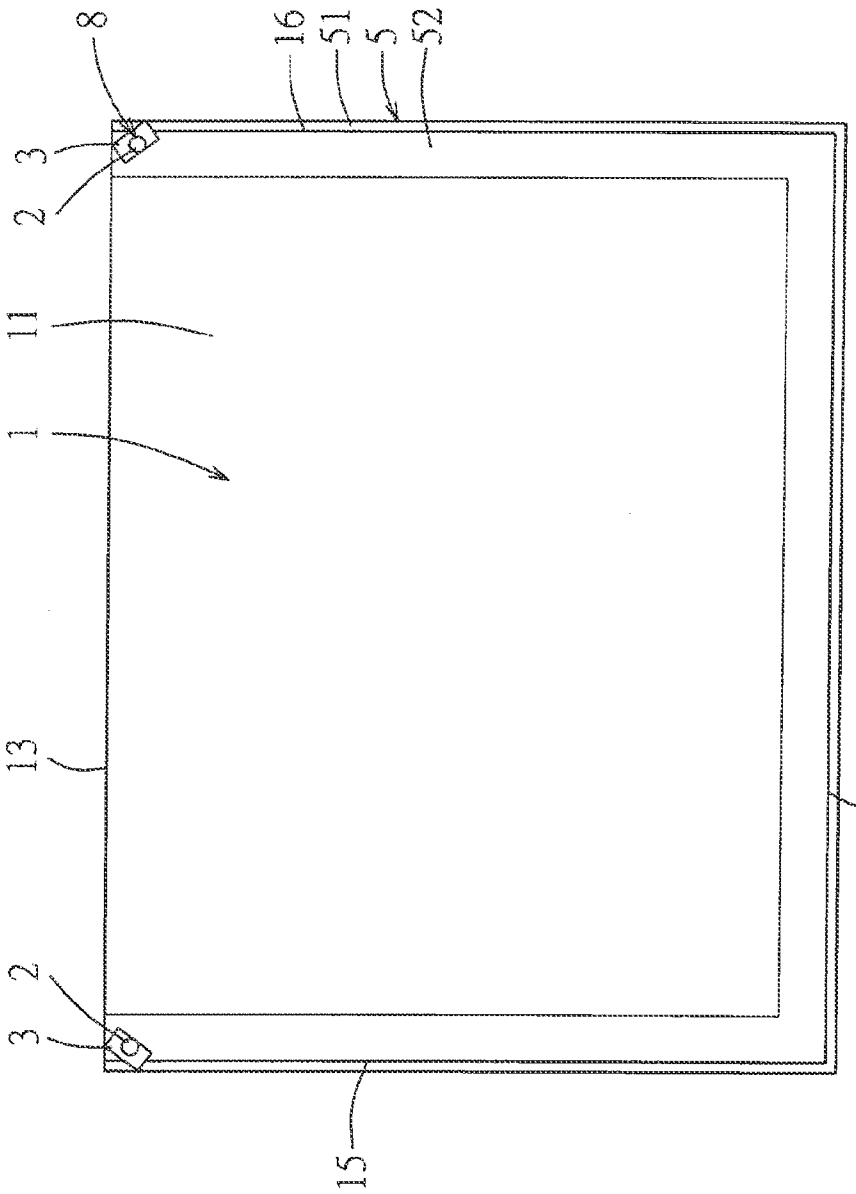


圖 2

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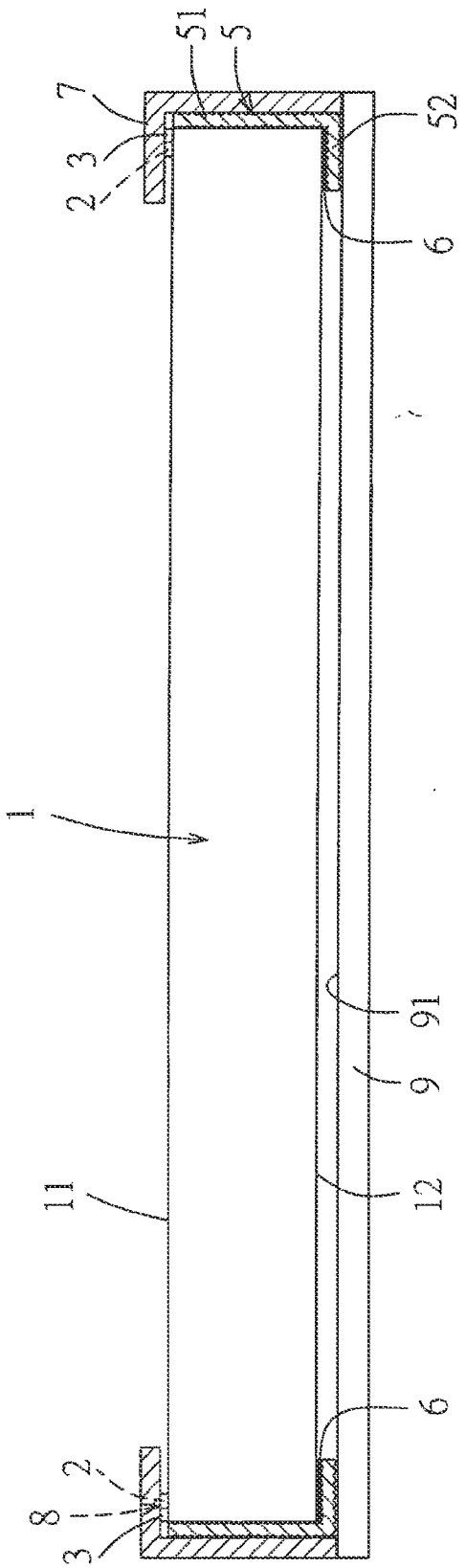


圖 3

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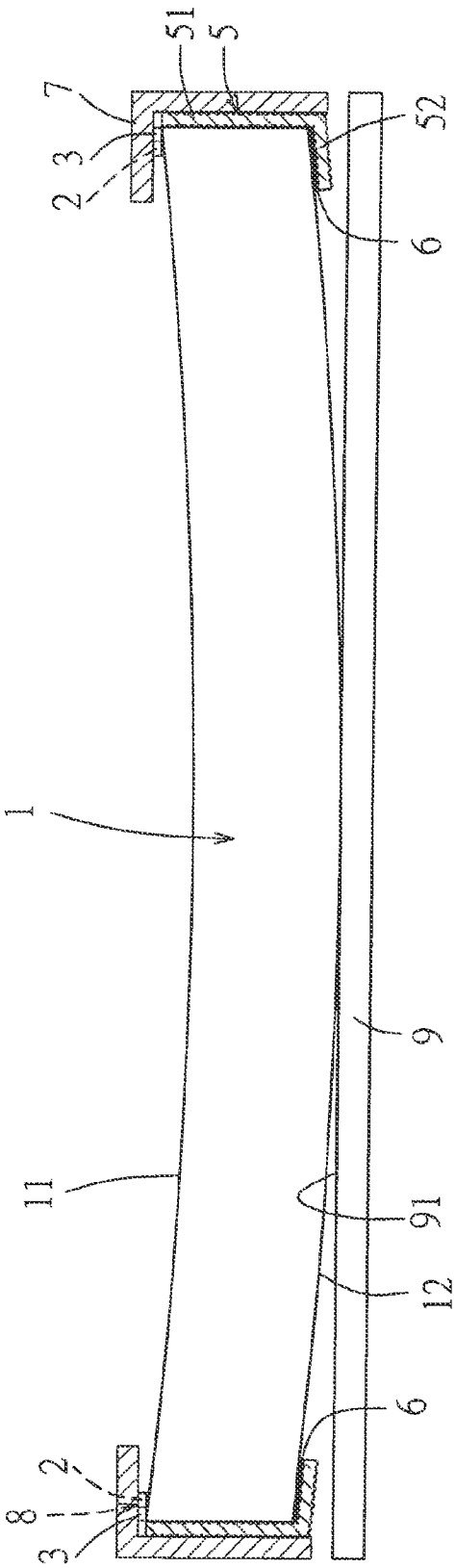


圖 4

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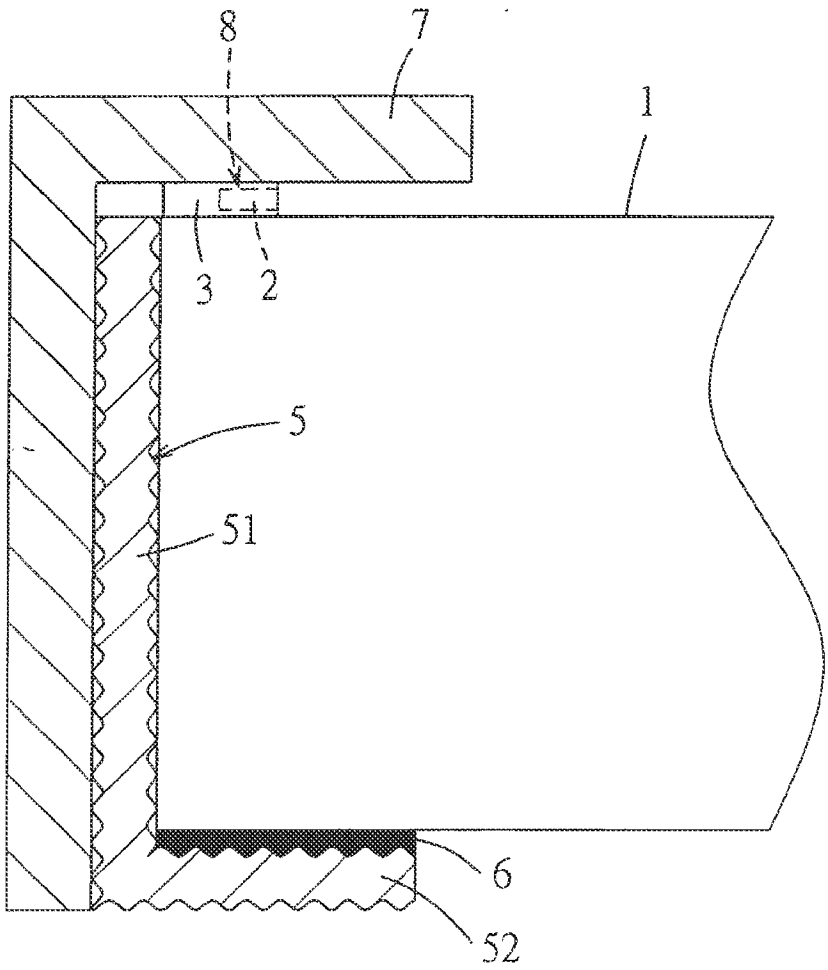


圖 5

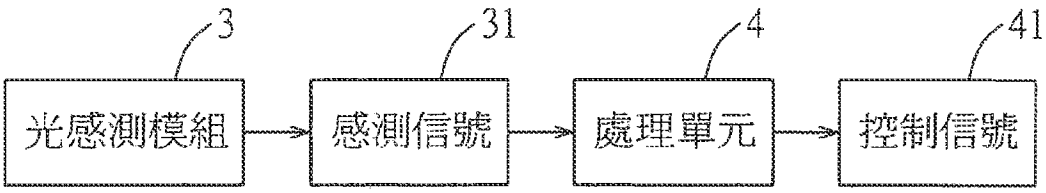


圖 6

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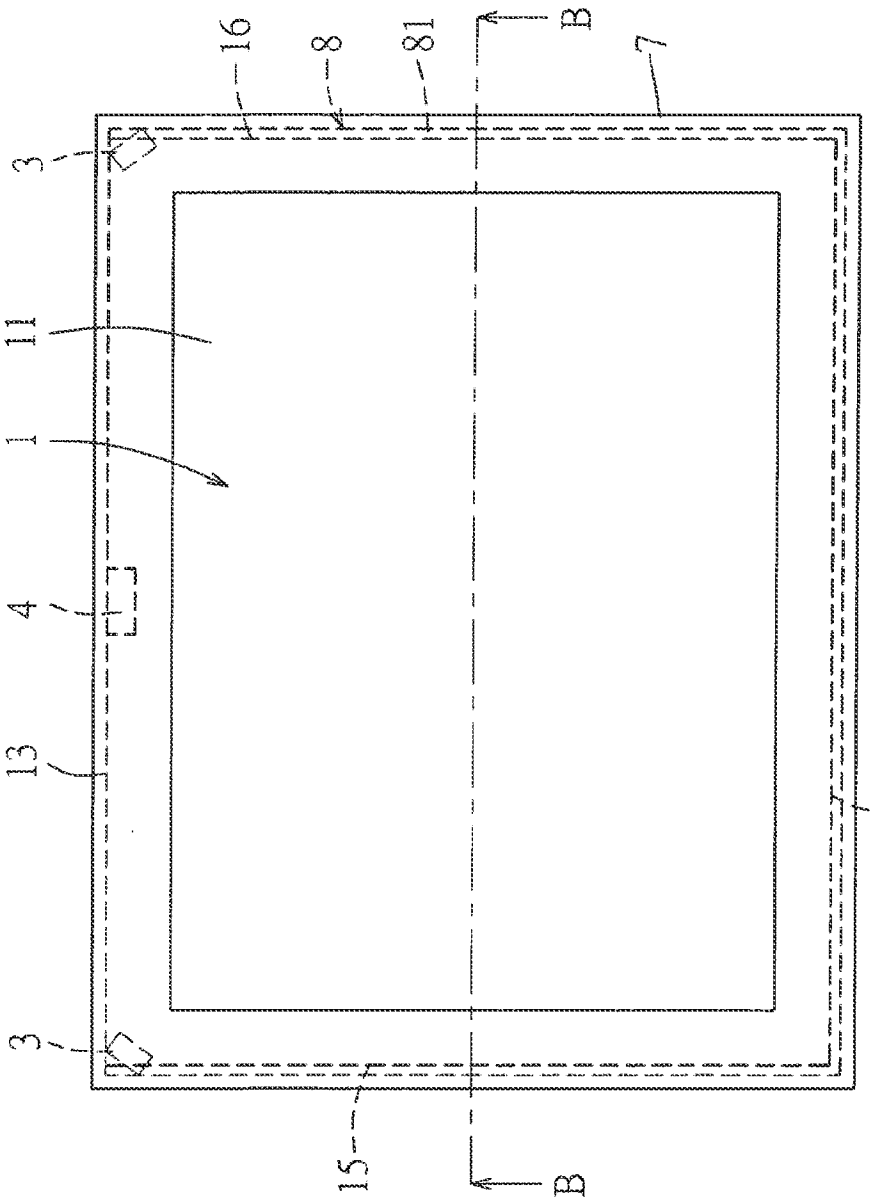


圖 7

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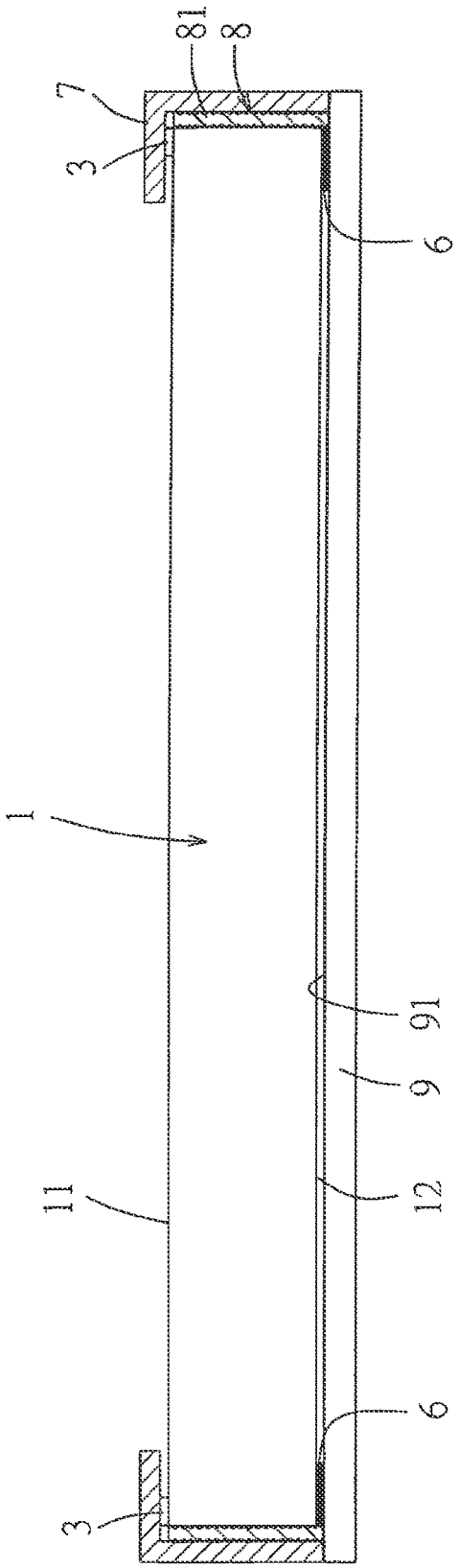


圖 8

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【代表圖】

【本案指定代表圖】：圖（ 1 ）。

【本代表圖之符號簡單說明】：

1 ..... 透明板體

11 ..... 頂面

13 ..... 上側面

14 ..... 下側面

15 ..... 左側面

16 ..... 右側面

2 ..... 光源

3 ..... 光感測模組

4 ..... 處理單元

5 ..... 反光層

51 ..... 主層部

52 ..... 延伸層部

7 ..... 框體

8 ..... 發光單元

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(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
26 June 2014 (26.06.2014)

WIPO | PCT

(10) International Publication Number
WO 2014/098742 A1

(51) International Patent Classification:
G06F 3/042 (2006.01)

(21) International Application Number:
PCT/SE2013/051534

(22) International Filing Date:
17 December 2013 (17.12.2013)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
1251438-6 17 December 2012 (17.12.2012) SE
61/738,022 17 December 2012 (17.12.2012) US

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— *of inventorship (Rule 4.17(iv))*

Published:

— *with international search report (Art. 21(3))*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

(54) Title: EDGE-COUPLED TOUCH-SENSITIVE APPARATUS

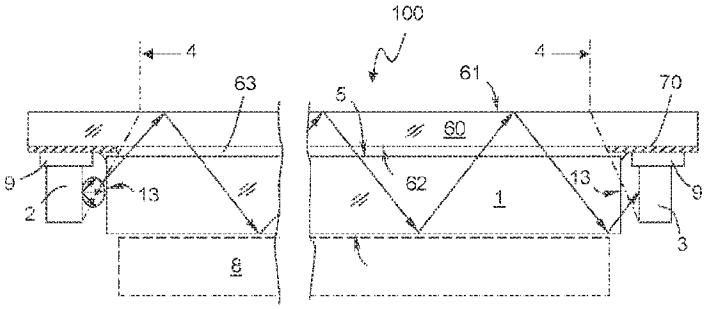


Fig. 4

(57) Abstract: A touch-sensitive FTIR apparatus (100), comprising a light-transmissive panel (1) having a front surface (5), an opposite rear surface (6), and a side edge (13) connecting the front and rear surfaces. A light emitter (2) is connected to input light at a first side edge portion and a detector (3) is connected to receive light output at a second side edge portion. A light-transmissive sheet (60) is laminated over the front surface of the panel and extends beyond the side edge of the panel to cover the emitter and the detector; wherein a lower surface (62) of the light-transmissive sheet is in optical contact with the front surface of the panel, so as to allow input light to propagate between the emitter and the detector through the panel and the light-transmissive sheet via total internal reflection in an upper surface (61) of the light-transmissive sheet.

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EDGE-COUPLED TOUCH-SENSITIVE APPARATUS

Cross-reference to Related Applications

The present application claims the benefit of Swedish patent application No. 1251438-6, filed 17 December 2012, and US provisional application No. 61/738022, filed 17 December 2012, both of which are incorporated herein by reference.

Technical Field

The present invention relates to the field of touch-sensing systems that operate by propagating light by internal reflections along well-defined light paths inside a thin light-transmissive panel, and in particular to edge-coupled solutions for providing a robust and user friendly touch-sensitive apparatus.

Background Art

This type of touch-sensing system is known as an FTIR-based system (FTIR, Frustrated Total Internal Reflection). It may be implemented to operate by transmitting light inside a solid light-transmissive panel, which defines two parallel boundary surfaces connected by a peripheral edge surface. Light generated by a plurality of emitters is coupled into the panel so as to propagate by total internal reflection (TIR) between the boundary surfaces to a plurality of detectors. The light thereby defines propagation paths across the panel, between pairs of emitters and detectors. The emitters and detectors are arranged such that the propagation paths define a grid on the panel. An object that touches one of the boundary surfaces ("the touch surface") will attenuate ("frustrate") the light on one or more propagation paths and cause a change in the light received by one or more of the detectors. The location (coordinates), shape or area of the object may be determined by analyzing the received light at the detectors. This type of apparatus has an ability to detect plural objects in simultaneous contact with the touch surface, known as "multi-touch" in the art.

There are different ways of coupling light into and out from the panel. One way is to attach prisms or wedges to the bottom surface of the panel. Such solutions have the benefit that light may be coupled within controllable angles, and it also allows a flush, edge-to-edge solution, for the top surface. However, the prisms or wedges may add significant thickness and weight to the system.

In another configuration, e.g. disclosed in US2006/0114237, the light is coupled into the panel directly through a peripheral side edge surface. Such an approach allows the light to be simply and efficiently injected into the panel. Also, such an in-coupling does not add significantly to the thickness of the touch system. On the other hand, in-

coupling via the edge surface may add to the footprint of the touch system. Furthermore, mounting and calibration of light emitters and detectors with respect to the side edge may be difficult in order to obtain an acceptable production yield.

Summary

It is an objective of the invention to at least partly overcome one or more of limitations of prior art FTIR-based touch systems.

More specifically, it is an objective to provide an FTIR-based touch-sensitive apparatus which is comparatively robust and compact.

One or more of these objectives, and other objectives that may appear from the description below, are at least partly achieved by means of touch-sensitive apparatuses according to the independent claims, embodiments thereof being defined by the dependent claims.

In accordance with one aspect, the invention relates to a touch-sensitive apparatus, comprising: a light-transmissive panel having a front surface, an opposite rear surface, and a side edge connecting the front and rear surfaces; a light emitter connected to input light at a first side edge portion; a detector connected to receive light output at a second side edge portion; and a light-transmissive sheet laminated over the front surface of the panel and having a portion extending beyond the side edge of the panel to cover the emitter and the detector; wherein a lower surface of the light-transmissive sheet is in optical contact with the front surface of the panel, so as to allow input light to propagate between the emitter and the detector through the panel and the light-transmissive sheet via total internal reflection in an upper surface of the light-transmissive sheet.

In one embodiment, the touch-sensitive apparatus comprises a support element carrying at least one of said emitter and said detector, which support element is secured towards the lower surface of the light-transmissive sheet.

In one embodiment, the touch-sensitive apparatus comprises support element carrying at least one of said emitter and said detector, which support element is secured towards the rear surface of the panel.

In one embodiment, said support element is a printed circuit board.

In one embodiment, said support element is a flex film.

In one embodiment, said support element is an elongate strip, provided along an extended portion of the side edge, and carrying a plurality of emitters and/or detectors.

In one embodiment, the touch-sensitive apparatus comprises a side connecting element, configured to secure at least one of said emitter and detector towards the side edge of the panel.

In one embodiment, the touch-sensitive apparatus said side connecting element comprises a transparent adhesive or silicon, and provides optical matching to the panel.

In one embodiment, the touch-sensitive apparatus comprises a shielding element applied along a perimeter of the panel and under the light-transmissive sheet, covering at least said emitter and detector;

In one embodiment, the shielding element is formed on the lower surface of the light-transmissive sheet.

In one embodiment, the shielding element is a rigid metal sheet member configured to reinforce the portion of the light-transmissive sheet extending beyond the side edge of the panel.

In one embodiment, the shielding element is partly sandwiched between the panel and the light-transmissive sheet.

In one embodiment, the shielding element covers an outer region of the front surface to prevent ambient light incident on the upper surface, within a predetermined wavelength range of use, from specularly reaching at least said detector.

In one embodiment, the shielding element is non-transmissive to visible light.

In one embodiment, a lower surface of the shielding element which faces said outer region of the front surface of the panel is specularly reflective within the predetermined wavelength range of use.

In one embodiment, the touch-sensitive apparatus comprises a shielding element applied along a perimeter of the panel and under the light-transmissive sheet, covering at least said emitter and detector, and a support element carrying at least one of said emitter and said detector, which support element is secured towards the lower surface of the light-transmissive sheet.

In one embodiment, the light-transmissive sheet includes a rigid layer.

In one embodiment, at least one rigid layer of the light-transmissive sheet is made from the same material as the light-transmissive panel.

In one embodiment, the touch-sensitive apparatus comprises a light coupling member, arranged at the side edge to optically connect at least one of the emitter and the detector to the panel.

In one embodiment, the light coupling member includes at least one non-imaging, diffusively transmitting optical element arranged on the side edge of the panel; wherein the emitter is arranged to emit a beam of light onto the non-imaging optical element; and wherein the detector is arranged to receive detection light generated, by diffuse transmission, as propagating light from within the panel impinges on the non-imaging optical element.

Brief Description of Drawings

Embodiments of the invention will now be described in more detail with reference to the accompanying schematic drawings.

Fig. 1A is a section view of a light transmissive panel using FTIR for touch detection, and Fig. 1B is a top plan view of an FTIR-based touch-sensitive apparatus.

Fig. 2 is a 3D plot of an attenuation pattern generated based on energy signals from an FTIR-based touch-sensitive apparatus.

Fig. 3 is a section view of an example of a touch-sensitive apparatus.

Fig. 4 is a section view of an edge-coupled laminated touch-sensitive apparatus according to an embodiment of the invention.

Fig. 5 is a bottom plan view of a touch-sensitive apparatus according to one embodiment.

Fig. 6 is a section view of a portion of an edge-coupled laminated touch-sensitive apparatus according to an embodiment of the invention.

Fig. 7 shows a perspective view of a touch-sensitive apparatus according to one embodiment.

Figs 8-11 show section views of a portions of alternative embodiments of an edge-coupled laminated touch-sensitive apparatus according to the invention.

Figs 12-14 show details related to a shielding element in various embodiments of an edge-coupled laminated touch-sensitive apparatus according to the invention.

Detailed Description of Example Embodiments

In the following, embodiments of the present invention will be presented for a touch-sensitive apparatus incorporating a laminated optical element. Throughout the description, the same reference numerals are used to identify corresponding elements.

Fig. 1A illustrates the concept of touch detection based on attenuation by FTIR (Frustrated Total Internal Reflection) of propagating light. According to this concept, light is transmitted inside a panel 1 along a plurality of well-defined propagation paths. The panel 1 is made of a solid material in one or more layers and may have any shape. The panel 1 defines an internal radiation propagation channel, in which light propagates by internal reflections. In the example of Fig. 1A, the propagation channel is defined between the boundary surfaces 5, 6 of the panel 1, and the front (top) surface 5 allows the propagating light to interact with touching objects 7 and thereby defines a touch-sensitive region 4. The interaction is enabled by injecting the light into the panel 1 such that the light is reflected by total internal reflection (TIR) in the front surface 5 as it propagates through the panel 1. The light may be reflected by TIR in the rear (bottom) surface 6 or against a reflective coating thereon. It is also conceivable that the

propagation channel is spaced from the rear surface 6, e.g. if the panel comprises multiple layers of different materials. The panel 1 may thus be made of any solid material (or combination of materials) that transmits a sufficient amount of light in the relevant wavelength range to permit a sensible measurement of transmitted energy. Such material includes glass, poly(methyl methacrylate) (PMMA) and polycarbonates (PC). The panel 1 may be designed to be overlaid on or integrated into a display device or monitor (not shown in Fig. 1A).

As shown in Fig. 1A, an object 7 that is brought into close vicinity of, or in contact with, the touch-sensitive region 4 may interact with the propagating light at the point of touch. In this interaction, part of the light may be scattered by the object 7, part of the light may be absorbed by the object 7, and part of the light may continue to propagate in its original direction across the panel 1. Thus, the touching object 7 causes a local frustration of the total internal reflection, which leads to a decrease in the energy (or equivalently, the power or intensity) of the transmitted light, as indicated by the thinned lines downstream of the touching objects 7 in Fig. 1A.

Fig. 1B illustrates an example embodiment of a touch-sensitive apparatus 100 that is based on the concept of FTIR. Emitters 2 (indicated by open circles throughout the description) are distributed along the perimeter of the touch-sensitive region 4, around the panel 1, to project light onto the panel 1 such that at least part of the light is captured inside the panel 1 for propagation by internal reflections in the propagation channel. Detectors 3 (indicated by open squares throughout the description) are distributed along the perimeter of the touch-sensitive region 4, around the panel 1, to receive part of the propagating light. The light from each emitter 2 will thereby propagate inside the panel 1 to a number of different detectors 3 on a plurality of light propagation paths D. Even if the light propagation paths D correspond to light that propagates by internal reflections inside the panel 1, the light propagation paths D may conceptually be represented as "detection lines" that extend across the touch-sensitive region 4 between pairs of emitters 2 and detectors 3, as shown in Fig. 1B. Thus, the detection lines correspond to a projection of the propagation paths D onto the touch-sensitive region 4. Thereby, the emitters 2 and detectors 3 collectively define a grid of detection lines D ("detection grid") on the touch-sensitive region 4, as seen in a top plan view. The spacing of intersections in the detection grid defines the spatial resolution of the apparatus 100, i.e. the smallest object that can be detected on the touch-sensitive region 4.

As used herein, the emitters 2 may be any type of device capable of emitting radiation in a desired wavelength range, for example a diode laser, a VCSEL (vertical-cavity surface-emitting laser), an LED (light-emitting diode), an incandescent lamp, a

halogen lamp, etc. The emitter 2 may also be formed by the end of an optical fiber. The emitters 2 may generate light in any wavelength range. The following examples presume that the light is generated in the infrared (IR), i.e. at wavelengths above about 750 nm. Analogously, the detectors 3 may be any device capable of converting light (in the same wavelength range) into an electrical signal, such as a photo-detector, a CCD device, a CMOS device, etc.

The detectors 3 collectively provide an output signal, which is received and sampled by a signal processor 10. The output signal contains a number of sub-signals, also denoted "projection signals", each representing the energy of light received by a certain light detector 3 from a certain light emitter 2. Depending on implementation, the signal processor 10 may need to process the output signal for separation of the individual projection signals. The projection signals represent the received energy, intensity or power of light received by the detectors 3 on the individual detection lines D. Whenever an object touches a detection line, the received energy on this detection line is decreased or "attenuated".

The signal processor 10 may be configured to process the projection signals so as to determine a property of the touching objects, such as a position (e g. in the x,y coordinate system shown in Fig. 1B), a shape, or an area. This determination may involve a straight-forward triangulation based on the attenuated detection lines, e.g. as disclosed in US7432893 and WO2010/015408, or a more advanced processing to recreate a distribution of attenuation values (for simplicity, referred to as an "attenuation pattern") across the touch surface 1, where each attenuation value represents a local degree of light attenuation. An example of such an attenuation pattern is given in the 3D plot of Fig. 2, where the peaks of increased attenuation represent touching objects. The attenuation pattern may be further processed by the signal processor 10 or by a separate device (not shown) for determination of a position, shape or area of touching objects. The attenuation pattern may be generated e.g. by any available algorithm for image reconstruction based on projection signal values, including tomographic reconstruction methods such as Filtered Back Projection, FFT-based algorithms, ART (Algebraic Reconstruction Technique), SART (Simultaneous Algebraic Reconstruction Technique), etc. Alternatively, the attenuation pattern may be generated by adapting one or more basis functions and/or by statistical methods such as Bayesian inversion. Examples of such reconstruction functions designed for use in touch determination are found in WO2009/077962, WO2011/049511, WO2011/139213, WO2012/050510, and WO2013/062471, all of which are incorporated herein by reference.

In the illustrated example, the apparatus 100 also includes a controller 12 which is connected to selectively control the activation of the emitters 2 and, possibly, the

readout of data from the detectors 3. Depending on implementation, the emitters 2 and/or detectors 3 may be activated in sequence or concurrently, e.g. as disclosed in WO2010/064983. The signal processor 10 and the controller 12 may be configured as separate units, or they may be incorporated in a single unit. One or both of the signal processor 10 and the controller 12 may be at least partially implemented by software executed by a processing unit 14.

Fig. 3 is a section view of an example of an FTIR-based touch-sensitive apparatus 100, which makes use of an edge-coupled mechanism for light coupling. Emitters 2 (one shown) and detectors 3 (one shown) are provided at different side edge portions of a side edge 13 of a light-transmissive panel 1. The emitter 2 may emit light within a wide cone angle, and is preferably placed near the side edge 13 such that a major part of the emitter light is coupled into the panel 1. Typically, some form of arrangement would also be employed for connecting light from the emitter 2 into the panel 1, such as an optical matching or an optical coupling element. For the sake of simplicity, such elements have been left out in this drawing. It should be noted that the drawings are all schematic, which is why refraction in the side edges is not indicated. Entered light will at least partly propagate by TIR in the panel 1, of which some light will reach the side edge portion at the detector 3, and be coupled out to the detector 3. Total Internal Reflection (TIR) in the panel 1 is represented by a set of arrows from emitter 2 to detector 3, and θ_{c1} represents the critical angle for internal reflection as given by Snell's law. As is well known to the skilled person, also light impinging on the surfaces 5 and 6 from within the panel 1 at angles that are wider than the critical angle θ_{c1} will propagate by TIR. A light coupling mechanism (not shown) may be provided for controlling the input and/or output of light, such as a lens arrangement at the side edge 13 of the panel 1. For one thing, such a light coupling mechanism may comprise a refractive element, or alternatively a light blocker or absorber, arranged between the emitter 2 and the adjacent side edge portion, to prevent light from being coupled in to the panel 1 that would reach the detector without any reflection in the front surface 5. Such un-reflected light would only add to the background noise level at the detector 3, and would not be usable for detecting touch input. The emitter 2 is carried on a support element 22, such as a PCB (Printed Circuit Board) which is designed to supply power and transmit control signals to the emitter 2. Correspondingly, the detector 3 is carried on a support element 32, which may also be a PCB, designed to supply power to and transmit measurement data from the detector 3. A backside panel 8 may be provided under the touch-sensitive apparatus 100, such as a display device 8 having a display surface facing rear side 6 so as to be visible through the touch-sensitive apparatus 100.

An arrangement in accordance with Fig. 3 places high requirements on assembly. In order to provide a reliable and robust touch-sensing system, the emitter(s) 2 and detector(s) 3 need to be consistently and securely attached with respect to the panel 1. Environmental factors, such as temperature and humidity, will affect the alignment of the emitters 2 and detectors 3 with respect to the panel 1, and proper assembly may also be affected by mechanical stress from mounting structures and by subsequent use of the touch-sensitive apparatus 100. From another aspect, there is a risk that ambient light, or light from the emitter 2 scattered or reflected within the apparatus 100, will reach the detector 3 without passing through the panel 1. In the drawing, this is illustrated by an arrow impinging from above on the detector 3. Any such light will have nothing but negative effect on the performance of the apparatus, since it will increase the noise level at the detector 3. Therefore, a light screen will often have to be employed above the side edge 13.

Figs 4-7 illustrate an embodiment of the invention, in which a laminated structure is employed to provide an improved touch-sensitive apparatus 100, which is set to alleviate at least some of the deficiencies associated with arrangements in accordance with prior art designs such as the one in Fig. 3. While Fig. 4 only depicts one emitter 2 and one detector 3, it should be understood that a plurality of emitters 2 and detectors 3 are normally included. These may be arranged with several emitters arranged next to each other along one side of the panel 1, and several detectors arranged next to each other along another side, corresponding to the embodiment of Fig. 1B. Alternatively, several emitters 2 and detectors 3 may be alternately arranged along at least two sides, as shown in Fig. 5.

In the embodiment of Fig. 4, a light-transmissive sheet 60 is laminated over the front surface 5 of the panel 1. This light-transmissive sheet 60 preferably covers the entire front surface 5, and also extends beyond the side edge 13. The light-transmissive sheet 60 is made from a material selected to optically comply with the panel 1. That way, the lower surface 62 of the light-transmissive sheet 60 is in optical connection with the front surface 5 of the panel 1, so as to allow input light to propagate between an emitter 2 and a detector 3 through the panel 1 and through the light-transmissive sheet 60, via total internal reflection in an upper surface 61 of the light-transmissive sheet 60, as indicated by the arrows in the drawing. Preferably, optical matching is obtained by selecting materials such that the refractive indices of the light-transmissive sheet 60 and the panel 1 are close. In one embodiment, the light-transmissive sheet 60 may be connected to the panel 1 by means of an optical bonding element 63. Such a bonding element 63 may be a film which is sandwiched between the panel 1 and the light-transmissive sheet 60 to act as an adhesive. Examples of such films are Optically Clear

Adhesive (OCA) and Contrast Enhancement Film (CEF), both provided by 3M™, which are usable for both flexible-to-rigid and rigid-to-rigid lamination. In other embodiments, the bonding element 63 may be provided in liquid form which is subsequently cured, in either a wet bonding process or a dry bonding process, both of which are well known in the art of lamination. In one embodiment, silicon may be used as a bonding element 63.

Whereas the panel 1, in one embodiment, is in the range of 500-1000 µm thick, the light-transmissive sheet 60 is preferably thinner, e.g. in the range of 50-500 µm. In a preferred embodiment, the panel 1 is made of a substantially rigid material, e.g. glass, PMMA, PC or other material, as already outlined with reference to Fig. 1A. In embodiments where the panel is substantially thicker than the light-transmissive sheet 60, the panel will act as the bulk layer for the entire sandwiched laminated optical element due to its relative thickness. The light-transmissive sheet 60 may be made from the same material as the panel 1. In another embodiment, the light-transmissive sheet 60 is a film made of or comprising a layer of PET (poly(ethylene terephthalate)). PET films may be provided with very small thicknesses, in the range of tens of µm. However, the thinner the PET film is made, the more birefringent it gets. PET in sheet form typically has distinct refractive indices in all 3 dimensions, and the in-plane indices normally increase as the film thickness decreases while the out-of-plane index decreases. In yet another embodiment, the light-transmissive sheet 60 comprises at least a layer of a comparatively rigid material, and preferably the same material as in the panel 1. The light-transmissive sheet 60 may also comprise further layers of different materials, in order to provide certain benefits, such as an anti-fingerprint coating and scratch resistance.

In accordance with the shown embodiments of the invention, touch-sensitivity is thus obtained in the upper surface 61, in which frustration may occur. However, it is only a touch-sensitive region 4 of the upper surface 61 that can be used for input. This region 4 is determined by the optical geometry of the apparatus 100. Light emitted to propagate by TIR cannot hit the upper surface 61 at any steeper angle than the critical angle. Thus, the placement and size of the emitter, and the vertical distance from the emitter 2 to the upper surface 61 may affect how far into the upper surface 61 the perimeter of the touch sensitive region 4 is located.

By providing the light-transmissive sheet 60 such that it extends outside the touch-sensitive region 4 and beyond to cover the emitters 2 and detectors 3, a top surface 61 of the apparatus is obtained which is flush. This may be beneficial in systems utilizing touch sensitivity, which are used not only for pointing input, but also for swiping gestures. Particularly, many graphical user interface operated by touch input

involve gestures starting from within the touch-sensitive region 4 and ending at the perimeter of or outside the touch sensitive region 4, to indicate scrolling, sending, flipping, page turning or other functions. When making a gesture with an object 7, particularly when using the tip of your finger, the edge of a mounting frame or housing provided just outside the touch-sensitive region may be sensed by a user. A result thereof may be a negative effect on the user experience, due to the discomfort of swiping your finger over an edge. Another problem may be that grease and dirt may stick to the front surface 5 at the edge of such a mounting frame, which may increase the leakage of ambient light into the panel 1, reduce the overall signal level of the light to be detected, and negatively influence the touch sensitivity at the perimeter. The flush surface 61, which extends over the emitters 2 and detectors 3, may alleviate this problem.

In accordance with the embodiment shown in Fig. 4, a shielding element 70 may also be provided along the perimeter of the front surface 5 of the panel 1. The shielding element 70 is arranged to cover the emitters 2 and detectors 3, and also any light-coupling mechanism and support elements for the emitters 2 or detectors 3. The purpose of the shielding element 70 is two-fold. For one thing, it minimizes the risk of ambient light reaching the detectors 3 from above. This is specifically relevant for light within a predetermined wavelength range of use, in which the touch-sensitive apparatus 100 operates. In other words, a wavelength range in which the emitter 2 outputs light, and the detector 3 is sensitive to. This may be light within the visible range, but is preferably within the infrared region. In one embodiment the predetermined wavelength range of use is in the region of 750 to 1000 nm, in which detectors are readily available at reasonable cost. At higher wavelengths, though, suppression of ambient light may be easier. Secondly, unless shielded the emitters 2 and detectors 3, as well as support elements 22, 32 and any light-coupling mechanism, will be visible around the panel 1. These visible structures may clutter the appearance of the touch-sensitive apparatus 100 and may cause information shown by a display 8 close to its perimeter to be difficult to distinguish. For these reasons, the shielding element 70 is also opaque to visible light. As indicated in Fig. 4, the shielding element 70 is preferably substantially flat, and configured to block IR light and visible light. In embodiments incorporating a shielding element 70, the inner edge thereof may also limit the size of the touch-sensitive region 4 through mechanical vignetting. As shown in Fig. 4, the shielding element 70 preferably extends a portion into an outer region of the front surface 5 so as to protect the detector from angled incident light. In such an embodiment, a lower surface of the shielding element, which faces the outer region of the front surface 5 of the panel, may be specularly reflective with no or only a very small amount of absorption within the

predetermined wavelength range of use, in order to minimize reflection losses of light that impinges thereon.

Providing the panel 1 with the shielding element 70 alone, without the light transmissive sheet 60 laminated above, would at least alleviate the mentioned optical issues of ambient light input and visibility of the light-coupling mechanism. However, it would also introduce an edge at the perimeter of the touch-sensitive region 4, and such an edge may be felt during finger swiping, which may have the afore-mentioned drawbacks. By providing the shielding element 70 underneath the light-transmissive sheet 60, this problem is avoided.

In the embodiment of Figs 4-7, the emitters 2 and detectors 3 are carried on a support element 9. The support element 9 may be one single structure, or a series of separate structures. More specifically, the support element 9 may be one or more PCB:s, one or more flex films, or similar, each carrying one or more emitters 2 and/or detectors. For the sake of simplicity, the same reference numeral 9 is used for all these variants.

In one embodiment of the invention, the support element 9 carrying at least one of said emitter 2 and said detector 3, is secured towards the lower surface 62 of the light-transmissive sheet. The support element 9 may be an elongate strip, provided along an extended portion of the side edge 13 of the panel 1. The "hanging" adhesion of the emitters 2 and detectors 3 to the upper light-transmissive sheet 60 provides a convenient and robust attachment. In one embodiment, the support element 9 is a flex film which is provided with an extended connector tongue (not shown) to be connected to further circuitry. Compared to a PCB, a flex film has the advantage of a very low profile.

In an embodiment incorporating a shielding element 70 as outlined above, the support member 9 may be secured towards the lower surface 62 of the light-transmissive sheet with the shielding element 70 in between, as seen in Figs 4-7. The shielding element 70 may be adhered by gluing to the lower surface 62 of the light-transmissive sheet 60, and also to the front surface 5 of the panel 1. The support element 9 may correspondingly be glued to the lower face of the shielding element 70.

In one embodiment, the shielding element may e.g. be a cut out metal sheet, shaped as a frame, which has a certain degree of rigidity. A benefit of such a design is that the shielding element 70 will provide reinforcement to the lip of the light-transmissive sheet 60 which extends beyond the edge of the panel 1. This, in turn, may increase the strength and durability of the sandwich structure, and may also decrease its sensitivity to pressure applied to the touch-sensitive surface 4. Such a shielding element may e.g. be made from stainless steel with a thickness in the range of 0.2 to 1 mm, but preferably less than 0.5 mm, e.g. 0.4 mm. Other types of metal, or even plastic

materials, are also plausible, and the thickness of the sheet may be tailored to the targeted use and size of the touch-sensing system.

In another embodiment, the shielding element 70 is formed directly on the lower surface 62 of the light-transmissive sheet 60, before assembly with the panel. From a production perspective, this may be beneficial. Also, since the upper surface of the shielding element 70 may be seen through the light-transmissive sheet 60, it may be desirable not to have glue in this interface, since bubbles, dust or other artifacts, if caught, will become visible. Forming of the shielding element directly on the lower surface 62 of the light-transmissive sheet 60 may be accomplished by spray painting, screen printing, or any known deposition method, such as by PVD or CVD (Chemical Vapor Deposition) of a suitable metal, e.g. silver, copper or chromium. In addition to the shielding element 70, a layer may be formed directly on the front surface 5 of the panel 1, e.g. by means of a chromium PVD coating of the perimeter of the panel 1. This yields a metalized bottom side reflective coating facing the body of the panel 1.

Figs 5-7 show an embodiment of the invention from different perspectives. Fig. 5 illustrates a bottom plan view of a touch-sensitive apparatus 100, i.e. from the side at which a display 8 (not shown) may be provided. The support element 9 for the emitters 2 and detectors 3 is provided by means of two separate strips, arranged along each one side edge 13 of the panel 1. These two strips 9 are attached to the shielding element 70 , e.g. by gluing. Fig. 5 also shows, by partial transparency of the panel 1, that the shielding element 70 extends over (under in the drawing) the front surface 5 of the panel 1. The support element 9 may include two PCB:s or flex films, and include wiring and potentially also other electric components functionally associated with the emitters 2 or detectors 3. In an alternative embodiment (not shown), a single strip is instead provided, extending around the upper left corner of the panel 1 in the drawing. In yet another embodiment (not shown), separate support elements 9 are provide for each emitter 2 and each detector 3.

The embodiments of Figs 5-7 also include the feature of a side connecting element 11 for each one of the emitters 2 and detectors 3. Fig. 6 shows how only one such side connecting element 11 links an emitter 2 to the side edge portion at which it couples light into the panel 1. The side connecting element 11 may be a transparent adhesive, such as a glue or silicon, which adheres the emitter 2 to the side edge 13, and which provides optical matching between the emitter 2 and the panel 1. In a corresponding manner, each detector 3 is secured to the side edge 13 by means of a side connecting element 11, which provides optical matching between the emitter 2 and the panel 1. With the provision of the side connecting element 11, each emitter 2 and detector 3 will be secured to the laminated panel 1 in two directions, upwards to the

light-transmissive sheet 60, and sideways to the side edge 13. This is also evident from the perspective view of Fig. 7. In an alternative embodiment (not shown), a string of adhesive, silicon or the like, will act as a side connecting element 11 for a plurality of emitters 2 or detectors 3, or at least one emitter 2 and one detector 3.

The result of the implementation of the side connecting element 11 is that the robustness of the touch-sensitive apparatus 100 may be improved. Also, the two-dimensional attachment of the emitters 2 and detectors 3 can make it possible to use a thinner light-transmissive sheet 60 than otherwise would have been possible, since flexing of the portion of the light-transmissive sheet 60 extending beyond the side edge 13 of the panel 1 will be damped by the securing of the side connecting element 11 to the side edge 13 of the panel, which will function as a securing lever. This, in turn, means that the overall thickness of the touch-sensitive apparatus may be decreased.

Fig. 8 shows an alternative embodiment, in which a light coupling member 15 is employed instead of a side connecting element 11 that provides optical matching. This light coupling member 15 may include e.g. a lens, a diffraction lattice, a prism, a blocker for light aimed straight through the panel 1, etc. In one embodiment a structured layer is applied to the side edge 13, so as to provide an enhanced light coupling effect at least for input. One example of such a structured layer may be Uniformity Tape by 3M™, which has a rib-like structure provided on a PET film that is adhered to side edge 13. A light coupling member 15 with such a structured layer will thus act as a series of lenses or lattices for a number of emitters 2 and/or detectors 3.

In one embodiment, the light coupling member 15 may include a diffuser, attached to side edge portion adjacent to the emitter 2. The diffuser is configured as a non-imaging component that diffusely transmits a portion of the incoming light into the panel 1. As is well-known to the skilled person, a non-imaging, diffusively transmitting surface will, when illuminated, emit light over a large solid angle at each location on the surface. The diffuse transmission is governed by "scattering" (also known as a combination of "diffuse reflection" and "diffuse transmission") which refers to reflection, refraction and interference (diffraction) of light at a surface as well as by particles dispersed in the bulk beneath the surface, such that an incident ray is scattered at many angles rather than being reflected at just one angle as in "specular reflection" or "specular transmission". Thus, part of the incoming light from the emitter 2 will be scattered by the diffuser, and a portion of this light will be transmitted into the panel 1. A "non-imaging" optical component is, in contrast to an imaging optical component, not designed with respect to the phase of the incoming light e.g. for the purpose of forming an image of a light source in a focal plane or generating a highly collimated beam of light, but is instead designed to achieve a dedicated optical radiative transfer of light

from a source onto a target regardless of the phase of the light. Accordingly, when illuminated, the diffuser will act as a light source which is located in contact with the propagation channel inside the panel 1 to emit diffuse light. The light source realized by the diffuser thereby defines the actual origin of the detection lines that are generated by the light from the respective emitter 2. Since the diffuser more or less randomly re-distributes the incoming light, the importance of the luminance profile of the emitter 2 as well as the requirement on index matching and on the quality of the side edge 13 is reduced or even eliminated. This means that the diffuser has the ability to act as a light source for many different types of emitters 2 and for many different relative orientations between the emitter 2 and the diffuser, as long as the light from the emitter 2 hits the diffuser with a proper extent and at a proper location. Thus, compared to conventional coupling elements that operate by optical imaging, the sensitivity to manufacturing and mounting tolerances is reduced and assembly of the apparatus 100 is facilitated. This makes this embodiment better suited for mass production. The diffuser may e.g. be a coating, layer or film, or be realized by structuring of the edge by blasting, grinding, etching. In one embodiment the diffuser may be provided by means of a matte white paint or ink, applied to he side edge 13. Furthermore, the paint may be optimized to obtain a desired diffusive transmission ratio, e.g. by including pigments with low refractive index or spherical objects of different materials. One such pigment is SiO_2, which has a refractive index n=1.6. There are many dedicated materials that are commercially available, e.g. the fluoropolymer Spectralon, barium-sulphate-based paints or solutions, granular PTFE, microporous polyester, Makrofol® polycarbonate films provided by the company Bayer AG, etc.

In a corresponding manner, each detector 3 is arranged to optically face a light coupling member 15 comprising a diffuser, at the side edge 13 of the panel 1. The diffuser diffusely transmits a portion of the incoming propagating light, whereby at least part of the diffusively transmitted light reaches the detector 3. Accordingly, each diffuser such will act as a light source that diffusively emits "detection light" for receipt by the detector 3. The diffusers for the emitters 2 and the diffusers for the detectors 3 may be configured in the same way, to attain corresponding advantages. Further details with regard to diffusive coupling in an FTIR system can be found in applicants prior U.S. provisional application 61/675032 and Swedish patent application SE1250890-9, both filed on July 24, 2012, (equivalent to PCT/SE2013/050922, filed on July 22, 2013) which are hereby incorporated by reference.

Alternative embodiments for mounting of emitters 2 at the side edge 13 of the panel 1 will now be described with reference to Figs 9-11. It should be noted that for each embodiment, a corresponding arrangement may be employed for the detectors 3.

Common for the embodiments shown in these drawings, is that a shielding element 70 preferably is included at the lower face of the light-transmissive sheet 60, which may be configured in any of the ways disclosed above. Furthermore, a mounting frame 91 is disclosed, which as such does not form part of the invention, in which the sandwiched element of the panel 1 and light-transmissive sheet 60 is suspended. A gasket or adhesive 92 may also be arranged between the light-transmissive sheet 60 and the mounting frame 91.

In Fig. 9 an emitter 2 is used, which is mounted to a support structure 9, such as a PCB or flex film as discussed for previous embodiments. The emitter 2 in this embodiment is of a type which primarily emits light from its top, i.e. the side of the emitter 2 opposite to the base which attaches to the support structure 9. For this reason, the support structure 9 is arranged at angle, typically about 90°, to the front surface 5 of the panel 1, such that the emitter 2 is directed to emit light towards the side edge 13. In this embodiment, optical silicon 90 is used as a side connecting element, so as to attach the emitter 2 towards the side edge 13 of the panel 1 and provide optical matching. Preferably, and as shown in Fig. 9, optical silicon 90 is applied not only between the emitting end of the emitter 2 and the side edge 13, but also between the side of the emitter 2 facing upwards and the light-transmissive sheet 60. This way, the emitter 2 is secured in two directions, which renders a strong attachment. The support structure 9 may furthermore be suspended in the frame 91 by adhesion or other means, even though it is illustrated as unattached in the drawing.

Fig. 10 shows another embodiment, in which an emitter 2 is mounted to a support structure 9. The emitter 2 in this embodiment may be of the same type as in Fig. 6, configured to primarily emit light from its side. However, the support structure, which extends in the same general plane as the panel 1, is attached underneath the panel 1, to its rear surface 6. Attachment to the panel 1 may e.g. be accomplished by means of an adhesive or tape 93. Optical silicon 90 may also be provided, as illustrated, as a side connecting element, so as to attach the emitter 2 towards the side edge 13 of the panel 1 and provide optical matching. The optical silicon 90 may be applied not only between the emitting end of the emitter 2 and the side edge 13, but also between the side of the emitter 2 facing upwards and the light-transmissive sheet 60.

Fig. 11 shows an embodiment which is similar to the embodiment of Fig. 10. The difference is that instead of optical matching provided by means of silicon 90, a light coupling member 15 is provided between the emitter 2 and the side edge 13 of the panel 1. Functionally, this embodiment is therefore similar to the embodiment disclosed with reference to Fig. 8.

All embodiments disclosed above have been described as optionally including a shielding element 70. Also the benefits of such an arrangement have been outlined. Where such a shielding element 70 is provided by means of a thin metal layer of paint or metal coating deposited on the lower surface of the light-transmissive sheet 60, it may be configured with a very low profile, down to single microns or even less than one micron. In such cases, there may be no reason to make any special arrangement to accommodate for the difference in the gap between the light-transmissive sheet 60 and the panel 1. However, if a substantially rigid shielding element 70 is used, such as a cutout metal sheet, its thickness may be up to several hundred microns as previously outlined. For such an embodiment, it may be suitable to make arrangements to adapt to the mechanical threshold rendered by the shielding element 70. Figs 12-14 provide different ways of solving that particular problem. For the sake of simplicity, emitters 2 and detectors 3 are left out in these drawings, and so are any side connecting elements 11 or light coupling members 15 for coupling emitters 2 and detectors 3 to the panel 1. In fact, any one of the embodiments already described with reference to Figs 4 to 11 may be combined with any one of the embodiments of Figs 12 to 14.

Fig. 12 illustrates an embodiment, in which an adapter sheet 64 is provided between the panel 1 and the light-transmissive sheet 60, so as to even out the gap there between. Consequently, an adapter sheet 64 which has a thickness equal, or as close as possible, to the thickness of the shielding element 70 should be used. The adapter sheet 64 shall of course also be light-transmissive in at least the wavelength range of use for the apparatus, normally in the NIR, and also to visible light. Examples of transmissive films usable for the adapter sheet 64 are the aforementioned OCA and CEF, which are available in many different thicknesses. In other embodiments, the adapter sheet 64 may be provided in liquid form which is subsequently cured, in either a wet bonding process or a dry bonding process, both of which are well known in the art of lamination. In another embodiment, silicon may be used as a material for filing up the space, so as to act as an adapter sheet 64.

Fig. 13 shows another embodiment, in which the height difference is adjusted by providing a recess 65 in the lower surface 62 of the light-transmissive sheet 60. The recess 65 should preferably be as deep as the shielding element 70 is thick, so as to more or less completely even out the gap size.

Fig. 14 shows a variant of the preceding embodiment, in which the height difference is instead adjusted by providing a recess 66 in the front surface 5 of the panel 1. The recess 66 should preferably be as deep as the shielding element 70 is thick, so as to more or less completely even out the gap size.

As the skilled person will realize, any combination of two or all of the

embodiments of Figs 12-14 are also possible, even though the drawings do not show such combinations. In other words, a combination of a recess 65 and a recess 66 can be provided, where the added depth of those recesses are as close as possible to the thickness of the shielding element 70. Also, an adapter sheet 64 may be employed in addition to either a recess 65 or a recess 66, or both. It should also be noted that any known method may be used for laminating the light-transmissive sheet 60 to the panel 1, as discussed already with reference to Fig. 4, but that no remaining gap or separate bonding element is shown between the light-transmissive sheet 60 and the panel 1 for the sake of simplicity in Figs 12-14.

The invention has mainly been described above with reference to a few embodiments. However, as is readily appreciated by a person skilled in the art, other embodiments than the ones disclosed above are equally possible within the scope and spirit of the invention, which is defined and limited only by the appended patent claims.

For example, the specific arrangement of emitters and detectors as illustrated and discussed in the foregoing, as well as the specific examples of the light-coupling mechanism for input and output of light, are merely given as examples. Also, additional transmissive layers may be provided over the upper surface 61. The inventive coupling structure is useful in any touch-sensing system that operates by transmitting light, generated by a number of emitters, inside a light-transmissive panel and detecting, at a number of detectors, the decrease in propagating light caused by the frustration at the point of touch.

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CLAIMS

1. A touch-sensitive apparatus (100), comprising:

a light-transmissive panel (1) having a front surface (5), an opposite rear surface (6), and a side edge (13) connecting the front and rear surfaces;

a light emitter (2) connected to input light at a first side edge portion;

a detector (3) connected to receive light output at a second side edge portion;

a light-transmissive sheet (60) laminated over the front surface of the panel and having a portion extending beyond the side edge of the panel to cover the emitter and the detector;

wherein a lower surface (62) of the light-transmissive sheet is in optical contact with the front surface of the panel, so as to allow input light to propagate between the emitter and the detector through the panel and the light-transmissive sheet via total internal reflection in an upper surface (61) of the light-transmissive sheet.

2. The touch-sensitive apparatus of claim 1, comprising

a support element (9) carrying at least one of said emitter and said detector, which support element is secured towards the lower surface of the light-transmissive sheet.

3. The touch-sensitive apparatus of claim 1, comprising

a support element (9) carrying at least one of said emitter and said detector, which support element is secured towards the rear surface of the panel.

4. The touch-sensitive apparatus of claim 2 or 3, wherein said support element is a printed circuit board.

5. The touch-sensitive apparatus of claim 2 or 3, wherein said support element is a flex film.

6. The touch-sensitive apparatus of claim 2 or 3, wherein said support element is an elongate strip, provided along an extended portion of the side edge, and carrying a plurality of emitters and/or detectors.

7. The touch-sensitive apparatus of any of the preceding claims, comprising

a side connecting element (11), configured to secure at least one of said emitter and detector towards the side edge of the panel.

8. The touch-sensitive apparatus of claim 7, wherein said side connecting element comprises a transparent adhesive or silicon, and provides optical matching to the panel.

9. The touch-sensitive apparatus of any of the preceding claims, comprising a shielding element (70) applied along a perimeter of the panel and under the light-transmissive sheet, covering at least said emitter and detector.

10. The touch-sensitive apparatus of claim 9, wherein the shielding element is formed on the lower surface of the light-transmissive sheet.

11. The touch-sensitive apparatus of claim 9, wherein the shielding element is a rigid metal sheet member configured to reinforce the portion of the light-transmissive sheet extending beyond the side edge of the panel.

12. The touch-sensitive apparatus of any of the preceding claims 9-11, wherein the shielding element is partly sandwiched between the panel and the light-transmissive sheet.

13. The touch-sensitive apparatus of any of the preceding claims 9-12, wherein the shielding element covers an outer region of the front surface to prevent ambient light incident on the upper surface, within a predetermined wavelength range of use, from specularly reaching at least said detector.

14. The touch-sensitive apparatus of any of the preceding claims 9-13, wherein the shielding element is non-transmissive to visible light.

15. The touch-sensitive apparatus of claim 13, wherein a lower surface of the shielding element which faces said outer region of the front surface of the panel is specularly reflective within the predetermined wavelength range of use.

16. The touch-sensitive apparatus of claim 2 and any of claims 9-15, wherein said support element is attached to a lower surface of the shielding element.

17. The touch-sensitive apparatus of any of the preceding claims, wherein the light-transmissive sheet includes a rigid layer.

18. The touch-sensitive apparatus of claim 17, wherein at least one rigid layer of the light-transmissive sheet is made from the same material as the light-transmissive panel.

19. The touch-sensitive apparatus of any of the preceding claims 1-6, comprising a light coupling member (15), arranged at the side edge to optically connect at least one of the emitter and the detector to the panel.

20. The touch-sensitive apparatus of claim 19, wherein the light coupling member includes at least one non-imaging, diffusively transmitting optical element arranged on the side edge of the panel;

wherein the emitter is arranged to emit a beam of light onto the non-imaging optical element; and

wherein the detector is arranged to receive detection light generated, by diffuse transmission, as propagating light from within the panel impinges on the non-imaging optical element.

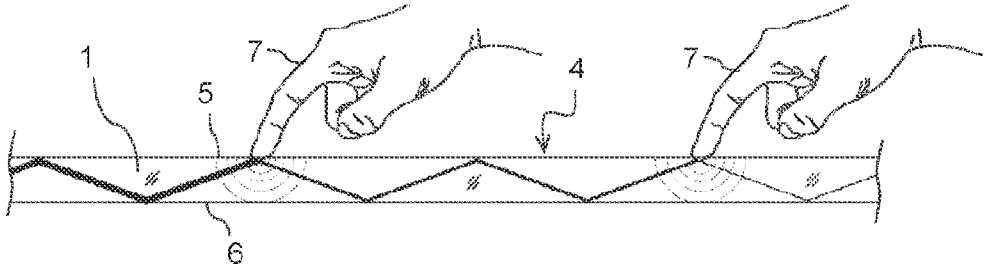


Fig. 1A (Prior Art)

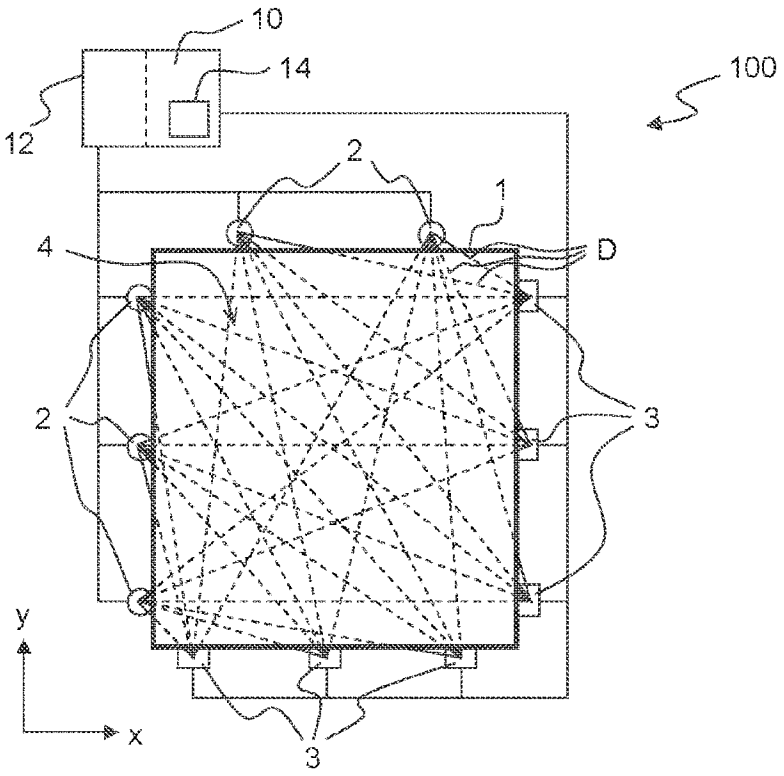


Fig. 1B

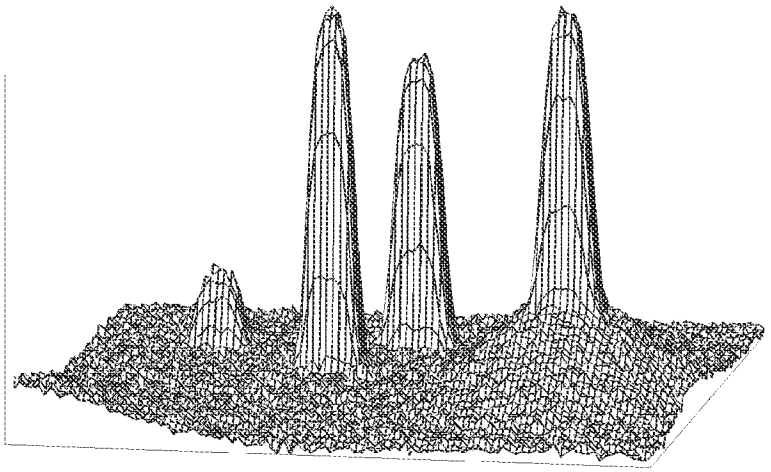


Fig. 2

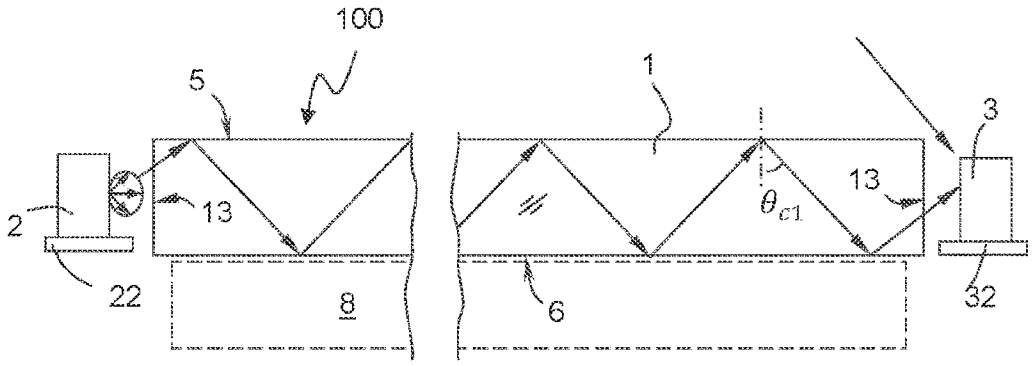


Fig. 3 (Prior art)

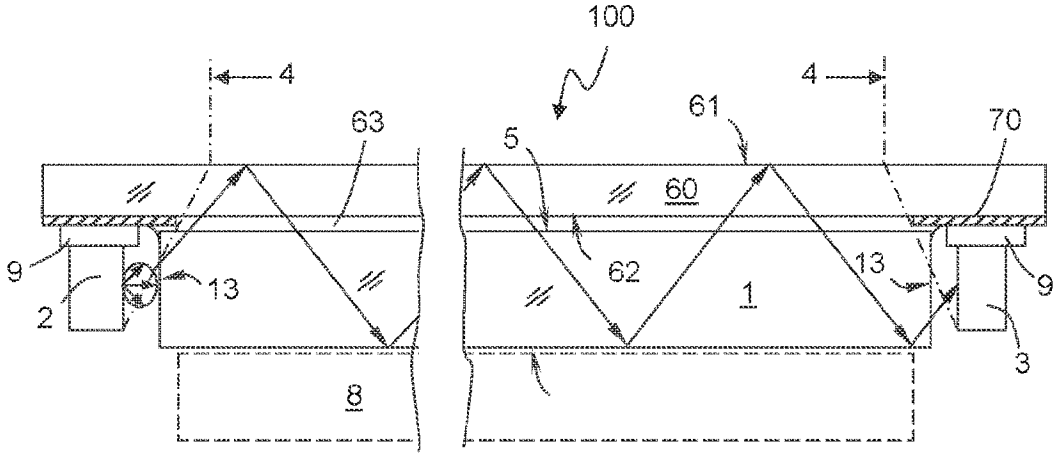


Fig. 4

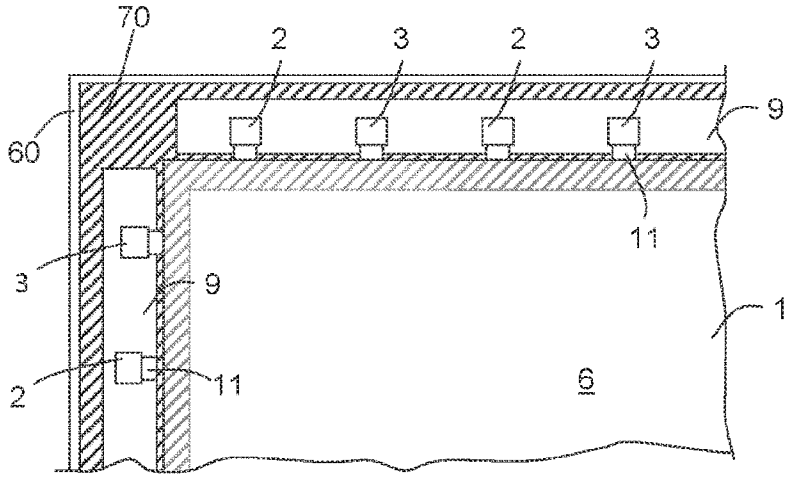


Fig. 5

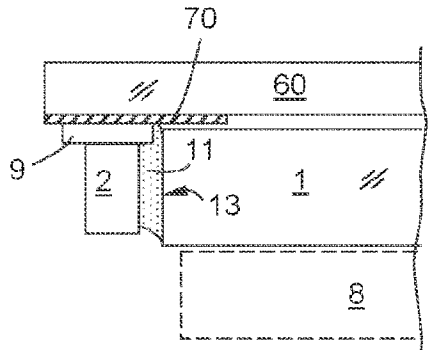


Fig. 6

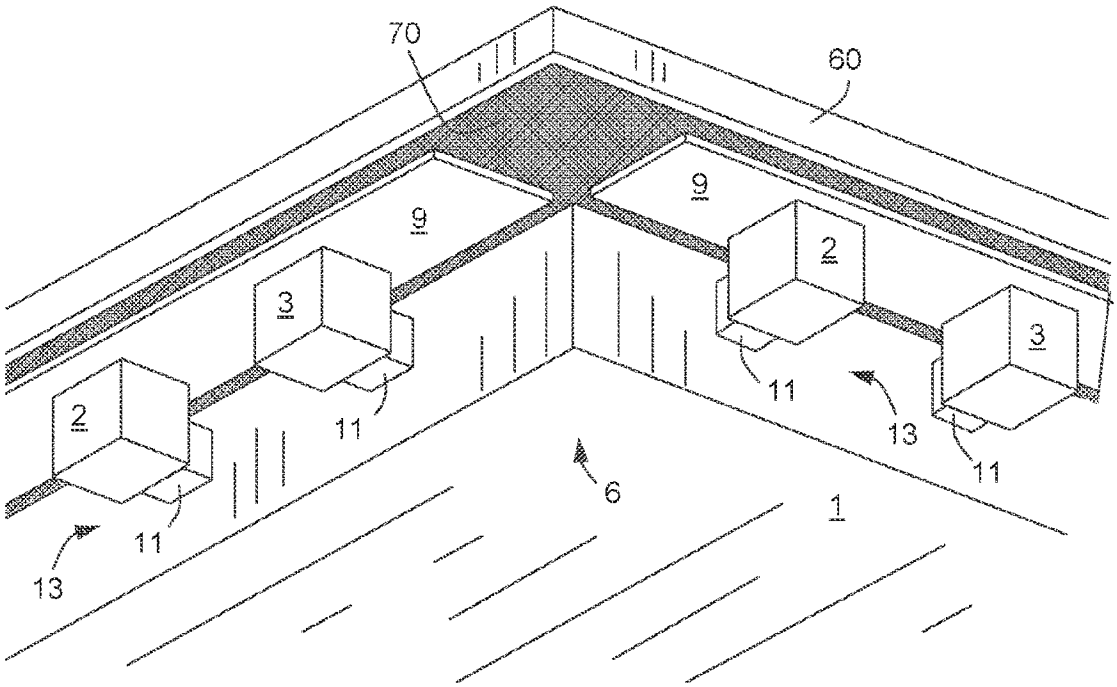


Fig. 7

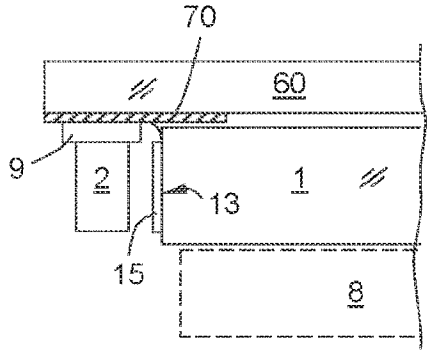


Fig. 8

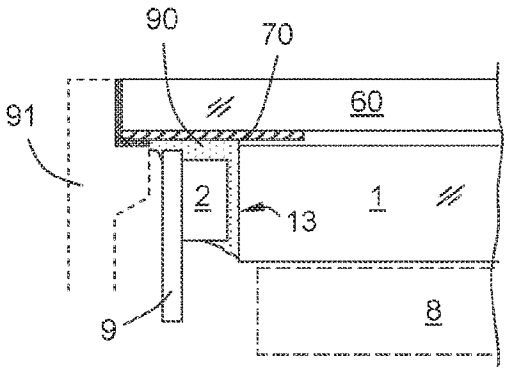


Fig. 9

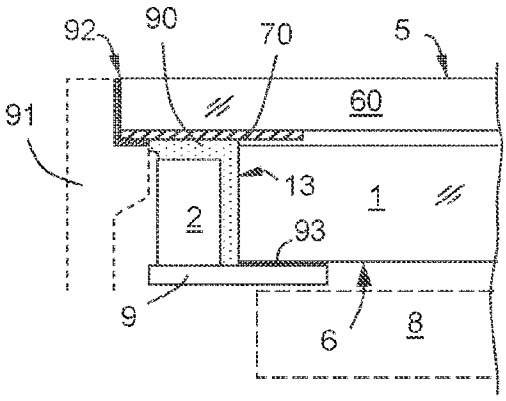


Fig. 10

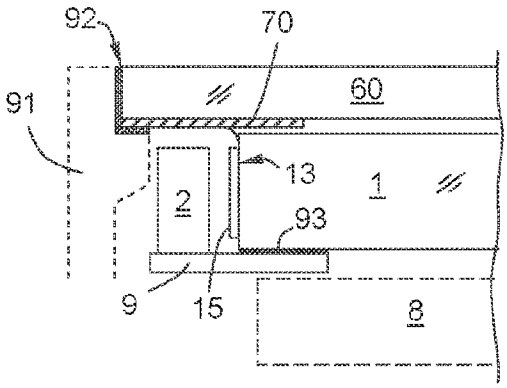


Fig. 11

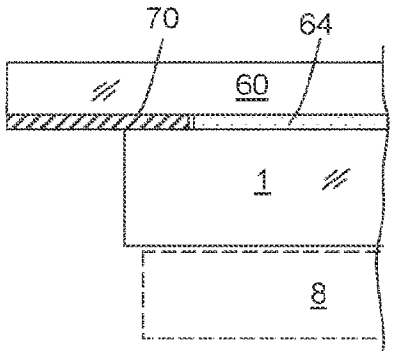


Fig. 12

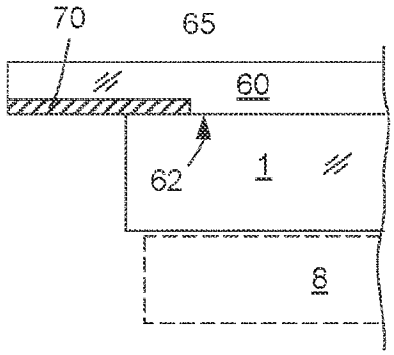


Fig. 13

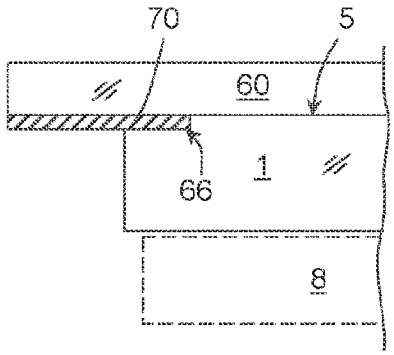


Fig. 14

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2013/051534

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: G06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE, DK, FI, NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, PAJ, WPI data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 20060114237 A1 (CROCKETT TIMOTHY W ET AL), 1 June 2006 (2006-06-01); paragraphs [0024]-[0041]; figures 1 7	1-20
Y	US 20080007541 A1 (ELIASSON JONAS OVE PHILIP ET AL), 10 January 2008 (2008-01-10); figures 3A 3B	1-20
A	US 20110043490 A1 (POWELL KARLTON ET AL), 24 February 2011 (2011-02-24); paragraph [0044]; figures 2 11	1-20
A	WO 2012105893 A1 (FLATFROG LAB AB ET AL), 9 August 2012 (2012-08-09); figure 2	19, 20

☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
06-05-2014	06-05-2014

Name and mailing address of the ISA/SE	Authorized officer
Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. + 46 8 666 02 86	Patrik Rydman Telephone No. + 46 8 782 25 00

Form PCT/ISA/210 (second sheet) (July 2009)

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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International application No.
PCT/SE2013/051534

Continuation of: second sheet

International Patent Classification (IPC)

G06F 3/042 (2006.01)

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				WO	2011022632	A3	21/07/2011
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				WO	2013165749	A1	07/11/2013

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DEF_00004396

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
28 August 2014 (28.08.2014)

WIPO | PCT

(10) International Publication Number
WO 2014/130515 A1

(51) International Patent Classification:
G01B 21/20 (2006.01) *C03C 21/00* (2006.01)

(21) International Application Number:
PCT/US2014/017062

(22) International Filing Date:
19 February 2014 (19.02.2014)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/768,822 25 February 2013 (25.02.2013) US

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(74) Agent: **SCHAEBERLE, Timothy M**; Corning Incorporated, Intellectual Property Department, SP-Ti-03-01, Corning, New York 14831 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

(54) Title: METHODS FOR MEASURING THE ASYMMETRY OF A GLASS-SHEET MANUFACTURING PROCESS

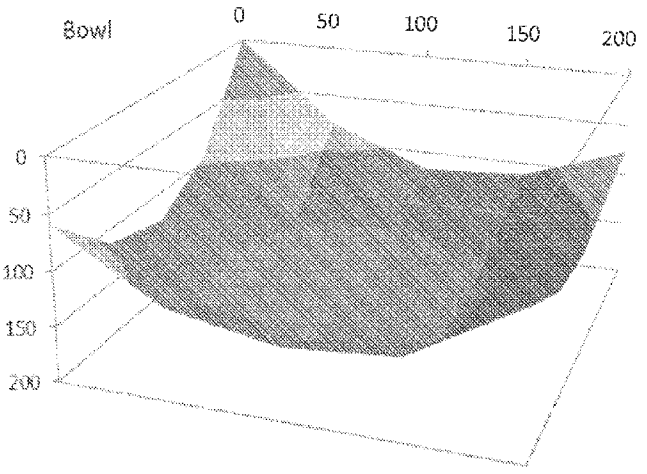


FIG. 1

(57) Abstract: Methods are provided for measuring the asymmetry of glass-sheet manufacturing processes. The methods include subjecting glass sheets or test samples taken from glass sheets to an ion-exchange process and measuring warp values. Metrics for the asymmetry of the glass-sheet manufacturing process are then obtained from the warp values. In one embodiment, the metric is independent of the geometry of the glass sheets or the test samples (the EM_I metric); in another embodiment, the metric is independent of the geometry of the glass sheets or the test samples and substantially independent of the ion-exchange process used in the testing (the *ASYM* metric).

WO 2014/130515 A1

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METHODS FOR MEASURING THE ASYMMETRY OF A GLASS-SHEET MANUFACTURING PROCESS

[0001] This application claims the benefit of priority under 35 U.S.C. § 119 of U.S. Provisional Application Serial No. 61/768822 filed on February 25, 2013 the content of which is relied upon and incorporated herein by reference in its entirety.

FIELD

[0002] This disclosure relates to processes for manufacturing glass sheets and, in particular, to processes for manufacturing glass sheets that will subsequently be subjected to ion-exchange strengthening. Even more particularly, the disclosure relates to methods for measuring (quantifying) the asymmetry, specifically, the front/back (Z-axis) asymmetry, of such a manufacturing process. Among other things, the disclosed measuring techniques can be used to control (reduce) the magnitude of warp that glass sheets produced by the manufacturing process exhibit after undergoing ion-exchange strengthening.

DEFINITIONS

[0003] As used herein, the phrase "process for manufacturing glass sheets" and similar phrases, e.g., "glass-sheet manufacturing process," "sheet manufacturing process," "manufacturing process," etc., refer to the steps performed to convert batch materials into glass sheets, as well as any subsequent steps performed on the glass sheets prior to their being subjected to an ion-exchange process.

[0004] As used herein, the phrases "two major surfaces of a glass sheet," "front and back surfaces," "front and back sides," and "first and second sides" are used interchangeably and refer to the two surfaces of a glass sheet that have the largest areas. The phrases are used without regard to the orientation of the glass sheet relative to vertical.

[0005] As used herein, the phrase "Z-axis asymmetry" (also referred to herein as "front/back asymmetry" or simply as "asymmetry") of a process for manufacturing glass sheets refers to an asymmetry in the conditions to which the two major surfaces of the glass sheet are exposed during the manufacturing process, where the conditions are

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capable of affecting ion-exchange through the surfaces during an ion-exchange process (hereinafter referred to as "ion-exchange-affecting conditions"). The converse of Z-axis asymmetry is referred to herein as "Z-axis symmetry" or simply as "symmetry". A manufacturing process with perfect Z-axis symmetry (zero Z-axis asymmetry) would expose both major surfaces of the glass sheets to the identical conditions during manufacture. As discussed below, although low levels of Z-axis asymmetry are achievable in practice, zero Z-axis asymmetry is not achievable because of, among other things, random variations in process conditions, which are inevitable. As will be evident, the conditions to which a glass sheet is exposed includes, but is not limited to, the conditions to which the sheet's parent glass ribbon is exposed.

[0006] As used herein, the phrase "warp as a number" means the maximum out-of-plane displacement from highest to lowest on a glass sheet or glass sample that was nominally flat prior to ion exchange. If the sheet or sample possessed some warp prior to ion exchange, then the pre-existing warp is subtracted off to obtain the net warp resulting from ion exchange, and the numerical value of the warp, i.e., the "warp as a number" for the sheet or sample, is the net warp thus obtained. The letter "W" is used herein to represent "warp as a number."

BACKGROUND

[0007] Ion-exchanged glass sheets, also known as chemically-strengthened or ion-strengthened glass sheets, are used in a variety of applications. For example, ion-exchanged glass sheets are widely used as touch screens for hand-held consumer electronics such as smart phones and tablets. Perhaps the best-known example of an ion-exchanged glass sheet is the scratch-resistant faceplate of the iPhone® made from Corning Incorporated's Gorilla® Glass.

[0008] In broad overview, ion-exchanged glass sheets are made by forming a glass having a composition suitable for chemical strengthening into a glass ribbon from which individual glass sheets are cut, and then subjecting the glass sheets to chemical strengthening through an ion-exchange (IOX) process, e.g., a treatment in which the glass sheet is submersed in a salt bath at an elevated temperature for a predetermined period of time.

[0009] The IOX process causes ions from the salt bath, e.g., potassium ions, to diffuse into the glass while ions from the glass, e.g., sodium ions, diffuse out of the glass.

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Because of their different ionic radii, this exchange of ions between the glass and the salt bath results in the formation of a compressive layer at the surface of the glass which enhances the glass's mechanical properties, e.g., its surface hardness. The effects of the ion exchange process are typically characterized in terms of two parameters: (1) the depth of layer (DOL) produced by the process and (2) the final maximum surface compressive stress (CS). Values for these parameters are most conveniently determined using optical measurements, and commercial equipment is available for this purpose, e.g., instruments sold by Frontier Semiconductor and Orihara Industrial Company, Ltd.

[0010] Although glass sheets can be produced by a variety of glass-sheet manufacturing processes, the two main processes that are currently in commercial use to produce glass sheets that are to be subjected to an IOX process are the float process and the overflow downdraw fusion process (hereinafter referred to as the "fusion process"). The present disclosure will thus focus on these processes, it being understood that the methods for quantifying Z-axis asymmetries disclosed herein are also applicable to other glass-sheet manufacturing processes now known or subsequently developed.

[0011] In the case of the fusion process, a glass ribbon is formed by passing molten glass around the outside of a forming structure (known in the art as an "isopipe") to produce two layers of glass that fuse together at the bottom of the forming structure (the root of the isopipe) to form the glass ribbon. The glass ribbon is pulled away from the isopipe by pulling rollers and cooled as it moves vertically downward through a temperature-controlled housing. At, for example, the bottom of the housing (bottom of the draw), individual glass sheets are cut from the ribbon. In the case of the float process, a glass ribbon is formed on the surface of a molten metal bath, e.g., a molten tin bath, and after being removed from the bath is passed through an annealing lehr before being cut into individual sheets.

[0012] In both processes, the glass ribbon and/or the glass sheets cut from the ribbon are exposed to conditions that may be asymmetric with respect to the front and back sides of the glass and thus may affect the results of an ion-exchange process subsequently applied to the glass sheets. For example, the process of removing glass sheets from a glass ribbon is normally asymmetric, with scoring taking place on only one side of the ribbon followed by separation of the glass sheet by rotation in a direction which opens the score line (i.e., if the score line is formed in the front surface of the glass ribbon, then the rotation takes

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place towards the back surface as seen from the side of the ribbon). See, for example, Andrewlavage, Jr., U.S. Patent No. 6,616,025.

[0013] Because sheet removal in the float process normally occurs after the ribbon has passed through an annealing lehr and because sheets are cut from the ribbon while the ribbon is supported horizontally, the conditions associated with sheet removal normally do not constitute ion-exchange-affecting conditions for the float process. However, for the fusion process, the glass ribbon hangs vertically and forces applied to the ribbon during the sheet removal process can propagate upward through the ribbon thus affecting the ribbon's position and shape at locations where, for example, the glass is passing through its glass transition temperature range. Consequently, conditions associated with sheet removal can constitute asymmetric ion-exchange-affecting conditions for the fusion process.

[0014] Various approaches have been disclosed for reducing movement of a glass ribbon and/or changes in the ribbon's shape during sheet removal in the fusion process. See, for example, Chalk et al., U.S. Patent No. 7,895,861; Abbott, III et al., U.S. Patent Application Publication No. 2006/0042314; Kirby et al., U.S. Patent Application Publication No. 2007/0095108; and Kirby et al., U.S. Patent Application Publication No. 2010/0043495. Moreover, in some situations, especially when dealing with thin and/or wide glass ribbons, it may be desirable to intentionally introduce a bow into the glass ribbon. See, for example, Burdette et al., U.S. Patent Application Publication No. 2008/0131651; and Burdette, U.S. Patent No. 8,113,015. Such bowing can cause the concave and convex sides of the ribbon to experience somewhat different thermal conditions as the ribbon moves through the fusion draw machine. Such different thermal histories for the two major surfaces of a glass sheet can constitute asymmetric ion-exchange-affecting conditions for a fusion process.

[0015] As noted above, the float process does not normally suffer from asymmetries associated with sheet removal. However, the float process has a basic asymmetry that arises from the fact that only one surface of the glass ribbon contacts the molten metal bath. This asymmetry is known to result in different ion-exchange properties for the two sides of the sheet. In particular, after undergoing an IOX process, glass sheets produced by the float process exhibit warp, with the surface that was not in contact with the molten metal bath becoming a convex surface. See, for example, U.S. Patent No. 4,859,636.

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[0016] Various process steps have been added to the basic float process so that the ion-exchange-affecting conditions for the overall glass-sheet manufacturing process are less asymmetric. For example, the above-referenced U.S. Patent No. 4,859,636 adds the step of contacting the surface of the glass sheet that was in contact with the molten metal with a source of sodium ions prior to ion-exchange strengthening, while PCT Patent Publication No. WO 2012/005307 and U.S. Patent Application Publication No. US 2012/0196110 respectively describe plasma treating and forming a film of SiO_2, TiO_2, NESA, ITO, AR, or the like on one of the surfaces of the glass sheet prior to ion exchange strengthening. In addition to adding process steps, changes to the basic float process with or without additional process steps, have also been disclosed. See International Publication Numbers WO 2013/005588 and WO 2013/005608.

[0017] A common characteristic of the approaches used to deal with asymmetric ion-exchange-affecting conditions of a glass-sheet manufacturing process, whether it be a float process or a fusion process, has been their ad hoc nature. Put simply, other than through trial and error or complex and difficult measurements performed on glass samples (see, for example, International Publication Number WO 2013/005588), there has been no way to quantify whether a particular manufacturing process has or does not have sufficient Z-axis symmetry to be suitable for producing glass sheets that are to be subjected to an IOX process.

[0018] This is especially so when it is considered that IOX processes in and of themselves have numerous variables (e.g., time-temperature profiles, bath compositions, use of multiple ion-exchange stages each with its own time-temperature profile and bath composition, etc.). The ad hoc process is thus even more challenging when trying to determine if a particular manufacturing process or particular additions to a basic manufacturing process (e.g., the addition of a plasma treatment) will provide a sufficiently low level of Z-axis asymmetry for more than one possible IOX treatment of the glass sheets produced by the process. Along these same lines, it has not been possible to predict whether a particular manufacturing process or particular additions to a basic manufacturing process provide sufficient Z-axis symmetry to be used in producing a specified product, e.g., glass sheets having a specified size/thinness combination.

[0019] As discussed fully below, in accordance with certain of its aspects, the present disclosure addresses the above-described deficiencies in the art by providing methods for

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measuring (quantifying) the intrinsic (native) Z-axis asymmetry of a glass-sheet manufacturing process. The quantification is in terms of an asymmetry value, i.e., an "*ASYM*" value, which is a dimensionless number, or a BM_1 value, which has the dimensions of distance. Using either or both of these asymmetry values, comparisons can be made between a given glass-sheet manufacturing process operated under various conditions or between glass-sheet manufacturing processes of various types.

SUMMARY

[0020] In accordance with a first aspect, a method is disclosed for measuring the asymmetry of a glass-sheet manufacturing process which includes:

(I) producing a glass sheet using the glass-sheet manufacturing process;

(II) measuring the mass M_0 of the glass sheet or a test sample from the glass sheet;

(III) subjecting the glass sheet or the test sample to an ion-exchange process;

(IV) measuring the change in mass ΔM of the glass sheet or the test sample as a result of step (III);

(V) measuring a warp value W for the glass sheet or the test sample after step (III); and

(VI) computing an *ASYM* value for the glass sheet or the test sample using an equation of the form:

$$ASYM = \frac{2R^2}{3}\left(\frac{2}{L_x}+\frac{2}{L_y}+\frac{2}{L_z}\right)\frac{W}{\Delta M}\frac{2M_0\left(W_{in}-W_{out}\right)}{W_{Glass}}$$

where W_{Glass} is the molecular weight in grams/mole of the glass making up the glass sheet or the test sample prior to step (III), W_{in} and W_{out} are, respectively, the molecular weights in grams/mole of the ions being exchanged into and out of the glass in step (III), taken singly, such as K and Na, and not taken as oxides, such as K_2O and Na_2O, R is the glass sheet's or the test sample's thickness-to-diagonal ratio, and L_x, L_y, and L_z are, respectively, the length, width, and thickness of the glass sheet or the test sample in the same units as the warp value W;

where the *ASYM* value calculated in step (VI) is a measure of the asymmetry of the glass-sheet manufacturing process.

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[0021] In accordance with a second aspect, a method is disclosed for measuring the asymmetry of a glass-sheet manufacturing process which includes:

(I) producing a glass sheet using the glass-sheet manufacturing process;

(II) subjecting the glass sheet or a test sample from the glass sheet to an ion-exchange process;

(III) measuring a warp value W for the glass sheet or the test sample after step (II); and

(IV) computing a BM_1 value for the glass sheet or the test sample using an equation of the form:

$$BM_1 = K \cdot W \cdot R^2$$

where K is a constant (e.g., $K = 2/3$) and R is the glass sheet's or the test sample's thickness-to-diagonal ratio;

where the BM_1 value calculated in step (IV) is a measure of the asymmetry of the glass-sheet manufacturing process.

[0022] The asymmetric metrics determined by the above methods (i.e., the *ASYM* and/or BM_1 values) can be used to identify glass-sheet manufacturing processes having sufficient Z-axis symmetry for use in producing particular products. For example, in accordance with an embodiment, glass-sheet manufacturing processes having *ASYM* values less than or equal to 1,500 ppm and/or BM_1 values ($K = 2/3$) less than or equal to 0.002 microns can be used to produce ion-exchange strengthened glass sheets having R values less than or equal to 2.5×10^{-4}. The *ASYM* metric is particularly valuable in this regard because it is predictive of the warp that will be exhibited by ion-exchange strengthened glass sheets not only for the IOX process used in measuring the *ASYM* value, but also for other IOX processes applied to glass sheets of similar composition produced by the glass-sheet manufacturing process.

[0023] The above summaries of the various aspects of the disclosure are not intended to and should not be interpreted as limiting the scope of the invention. More generally, it is to be understood that both the foregoing general description and the following detailed description are merely exemplary of the invention and are intended to provide an overview or framework for understanding the nature and character of the invention.

[0024] Additional features and advantages of the invention are set forth in the detailed description which follows, and in part will be readily apparent to those skilled in the art

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from that description or recognized by practicing the invention as exemplified by the description herein. The accompanying drawings are included to provide a further understanding of the invention, and are incorporated in and constitute a part of this specification. It is to be understood that the various features of the invention disclosed in this specification, the drawings, and the claims can be used in any and all combinations.

Brief Description of the Drawings

[0025] FIG. 1 is a graph illustrating the type of warp observed after ion exchange of a glass sheet (glass plate) produced by a manufacturing process, e.g., a float process, having a high level of Z-axis asymmetry.

[0026] FIG. 2 is a graph showing concentration versus distance-from-surface after ion exchange for a glass sheet produced by a float process. The upper curve is for the air side of the sheet and the lower curve is for the tin side.

[0027] FIG. 3 is a plot of warp in millimeters predicted by Eq. (5) for a representative BM_1 value of 0.003 microns and a sheet thickness of 0.5 mm.

[0028] FIG. 4 is a plot of warp in millimeters predicted by Eq. (5) for a representative BM_1 value of 0.003 microns and a sheet size of 2000 mm x 1500 mm.

Detailed Description

[0029] As discussed above, the present disclosure relates to quantifying intrinsic asymmetry (Z-axis asymmetry) in the manufacture of ion-exchangeable glass which results in warping or curvature of a glass sheet as a consequence of asymmetric ion distribution through the thickness of the sheet after ion exchange. The quantification provided herein serves as a guide to the manufacture of low-warp, ion-exchangeable glass through the creation and/or maintenance of low asymmetry in the manufacturing process.

[0030] The warp resulting from performing ion exchange on a glass sheet produced by a manufacturing process having a high level of Z-axis asymmetry is more severe when the glass sheets are larger in length and width and/or when thinner. As the marketplace evolves toward larger displays that use cover glass (such as pad sizes, notebook sizes, laptop, and TV cover glass) and as the marketplace evolves toward thinner cover glass thicknesses, the problem of warping becomes aggravated.

[0031] Glass sheets that develop warp through ion exchange are difficult to handle on removal from a salt bath and difficult to transport within a manufacturing plant, as warp

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can cause glass sheets to touch each other or to touch parts of cassettes or transport devices with consequent damage to the glass. Thus, even if the warp in a final product might be small due to small product dimensions, when large glass sheets are being processed prior to cutting into small individual products, warp can still be a problem because it can interfere with the overall process for making the product. Processing of larger sheets is a commercial trend and thus the need to control (reduce) warp is an ever pressing problem in the art.

[0032] FIGS. 1 and 2 provide background for the analysis presented below. FIG. 1 shows an example of the warp observed for a typical glass plate produced by a manufacturing process, e.g., a float process, having a high level of Z-axis asymmetry and subsequently ion exchanged. For a float process, the sense of warp is concave towards the side of the sheet that was exposed to the molten metal bath (molten tin bath) and persists even when the metal (tin) is removed by grinding and polishing or by etching. The bowl shape seen in FIG. 1 is the shape predicted by the gravity-free analysis used in the equations presented below.

[0033] FIG. 2 shows an example of the asymmetry in potassium concentration that can be observed after Na/K ion exchange performed on a glass sheet produced by a manufacturing process having a high level of Z-axis asymmetry, specifically, in this figure, a float process. As can be seen, the difference in ion penetration is rather small, i.e., about 1 micron, with the air side of the glass sheet exhibiting a slightly greater diffusivity. The non-zero asymmetry seen in FIG. 2 creates a non-zero value for the intrinsic asymmetry integral of Eq. (1) discussed below.

[0034] It should be noted that the asymmetry shown in FIG. 2 is not always detectable even when warp in a full size sheet is clearly present. This is so because the magnitude of the asymmetry in concentration can be so small that it is nearly within the noise of the measurement. A benefit of the quantification (measurement) techniques of the present disclosure is that they do not depend on the direct measurement of such small concentration differences, but rather employ warp and overall weight change measurements that can be readily and accurately performed using commonly-available laboratory equipment. These easily-performed measurements are in direct comparison to the complex measurement techniques used in, for example, the above-referenced International Publication Number WO 2013/005588.

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[0035] With the foregoing as background, we now turn to the problem of identifying and quantifying asymmetries of physical properties that give rise to warp after ion exchange. To simplify the analysis, we focus on nominally flat glass sheets of rectangular shape and uniform thickness, it being understood that the processing of other shapes can also have trouble with systematic warp from ion exchange.

[0036] The asymmetry of interest is intrinsic (native) asymmetry of physical properties through the thickness dimension of the glass sheet as a result of Z-axis asymmetries in the glass-sheet manufacturing process. We identify two main sources of warp from asymmetric physical properties: (1) asymmetry of the diffusivity (such as can arise from asymmetry of the thermal history of the glass) and (2) asymmetry of the surface chemistry of the glass. The former influences how far and how many ions enter each surface during ion exchange, while the latter affects both how many ions enter and the magnitude of exchanged ion concentration at each surface. Warp results when either or both of these quantities are asymmetric. Other sources of asymmetry of physical properties, such as asymmetry of lattice dilation coefficient (discussed below), asymmetry of Young's modulus, or asymmetry of the Poisson ratio, are also included as these also induce warp during ion exchange.

[0037] We denote the concentration of the exchanged ion (e.g., the concentration of K_2O that replaces Na_2O in a K/Na ion exchange) by $C(z)$ where z is the dimension through the thickness. This can be expressed in concentration units such as mole%. In accordance with an embodiment, we represent the intrinsic asymmetry by a concentration integral of the following form, which can be thought of as a "bending moment per unit length" concentration integral in view of the multiplication of the concentration difference by z:

$$M_1 = \frac{1}{L_z}\int_{-L_z/2}^{L_z/2}\left(C(z)-C_{base}\right)z\,dz \qquad (1)$$

[0038] In this expression L_z is the thickness of the glass sheet, $C(z)$ is the concentration of the larger ion after ion exchange, and C_{base} is the concentration of the larger ion in the base glass prior to ion exchange. The bottom surface is at $z = -L_z/2$ and the top surface is at $z = L_z/2$. The M_1 integral has dimensions of mole% times distance. Thus, the M_1 intrinsic asymmetry value can be thought of as a measure of the asymmetry of the concentration through the thickness times the asymmetry of the ion penetration depth through the

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thickness, giving rise to concentration times thickness. This integral would be zero if the concentration profile were perfectly symmetric because the value of z would take on equal but opposite values between the center and each respective surface while the concentrations above baseline would be the same.

[0039] We denote the top and bottom *surface* concentration values above baseline by:

$$\Delta C_t = C_{surf,t} - C_{base} \tag{2}$$

and

$$\Delta C_b = C_{surf,b} - C_{base} \tag{3}$$

[0040] These two values may or may not be identical; when they differ they constitute another source of intrinsic asymmetry of the glass sheet. This intrinsic asymmetry is only revealed by performing ion exchange but it is intrinsic to the glass because the surface concentration is the result of a dynamic equilibrium between the salt bath and the glass, so when the two surfaces reach a different equilibrium it reflects a fundamental difference of the glasses near the top and bottom surfaces.

[0041] We denote the surface compressive stress, as measured by, for example, a FSM instrument such as that manufactured by Orihara Industrial Company, by *CS*. Since this will differ on the top and bottom surfaces in the presence of intrinsic asymmetry, we denote the top and bottom surface values by CS_t and CS_b respectively. As shown below, a surprisingly small difference in *CS* values can give rise to substantial warp. Because small differences are difficult to determine accurately, in accordance with the present disclosure, intrinsic asymmetry is quantified using a warp measurement rather than by trying to measure a difference in *CS*.

[0042] In accordance with the present disclosure, the difference in *CS* from the top to bottom surfaces, where each is taken as a positive number representing the magnitude of compressive stress, is related to the M_1 intrinsic asymmetry value by the following equation:

$$CS_t - CS_b = \frac{BE}{1-\nu}\left[\Delta C_t - \Delta C_b - \frac{12M_1}{L_z}\right] \tag{4}$$

[0043] In Eq. (4), B represents the "lattice dilation coefficient", E is Young's modulus, ν is the Poisson ratio of the glass, and L_z is again the glass thickness. As used herein, the lattice dilation coefficient is defined as a coefficient that converts concentration above

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baseline into strain, i.e., $B\Delta C_t$ gives the ion exchange-induced free strain on the top surface and $B\Delta C_b$ gives the ion exchange-induced free strain on the bottom surface. As shown in Eq. (4), when these differ, their difference contributes directly to a difference in CS between top and bottom surfaces.

[0044] The other term in Eq. (4) involves the bending moment integral of Eq. (1), i.e., the M_1 asymmetry value. When more ions enter say the top surface than the bottom surface, then $M_1>0$. This contributes to CS_b being larger than CS_t from Eq. (4). Physically, added strain in the top half of a glass plate bends the plate in a concave sense toward the bottom half; this introduces increased compressive stress (higher CS_b) on the bottom surface and reduced compressive stress (lower CS_t) on the top surface. Thus warp and differences in CS are correlated.

[0045] Using the above definition of warp as a number, the overall warp W in terms of the bending moment integral M_1 can be written as:

$$W = -\frac{6}{L_z^2}\left(\left(\frac{L_x}{2}\right)^2+\left(\frac{L_y}{2}\right)^2\right)BM_1 \tag{5}$$

where the sheet length and width are L_x and L_y, the thickness is still L_z, and B is again the lattice dilation coefficient.

[0046] Because M_1 has units of concentration times distance, BM_1 is dimensionless strain times distance, so overall W has the dimension of distance as it should. Like M_1, BM_1 constitutes an intrinsic asymmetry value in accordance with the present disclosure.

[0047] As can be seen from Eq. (5), for a given intrinsic asymmetry expressed as a M_1 value or a BM_1 value, the warp is worse for a larger sheet size (larger L_x and/or L_y value) and for a thinner sheet (smaller L_z value). FIGS. 3 and 4 illustrate the rapid rise in gravity-free warp values with sheet size and sheet thickness as predicted by Eq. (5) for a BM_1 value of 0.003 microns, a typical value for a float process. In FIG. 3, sheet thickness is held constant at 0.5 mm, while in FIG. 4, sheet size is held fixed at 2000 mm x 1500 mm. Table 1 tabulates typical warp values for a few representative sheets sizes and thicknesses. The connection between (1) sheet size and thickness and (2) resulting warp that is illustrated in these figures and table is critical for controlling warp for larger and thinner parts.

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[0048] To simplify the analysis, the warp of Eq. (5) is gravity-free warp. Gravity will tend to flatten a warped glass sheet that is laid out horizontally but the underlying warp of the sheet is still problematic due to the possibility of edge curl or other warp-induced effects such as ripple in the sheet. As discussed below, gravity-free warp values can be obtained from warp values measured under gravity conditions by multiplying the measured value by a correction factor, e.g., by 1.13 if the warp is measured with the sheet in a dome orientation (i.e., concave down) and 1.07 if the warp is measured with the sheet in a bowl orientation (i.e., concave up), which makes the latter configuration the preferred orientation for the warp measurement.

[0049] It should be noted that when the lattice dilation coefficient is not known, Eq. (4) can be used to estimate B from an equation of the form

$$B = \frac{1-\nu}{E}\frac{\left(CS_t - CS_b\right)}{\left[\Delta C_t - \Delta C_b - \frac{12M_1}{L_z}\right]} \tag{6}$$

[0050] This equation allows us to relate warp directly to the difference in CS values by substituting Eq. (6) in Eq. (5) to get

$$W = -\frac{6}{L_z^2}\left(\left(\frac{L_x}{2}\right)^2 + \left(\frac{L_y}{2}\right)^2\right)M_1\frac{1-\nu}{E}\frac{\left(CS_t - CS_b\right)}{\left[\Delta C_t - \Delta C_b - \frac{12M_1}{L_z}\right]} \tag{7}$$

When the surface concentrations are symmetric, this expression simplifies to

$$W = \frac{1}{2L_z}\left(\left(\frac{L_x}{2}\right)^2 + \left(\frac{L_y}{2}\right)^2\right)\frac{1-\nu}{E}\left(CS_t - CS_b\right) \tag{8}$$

[0051] This last equation is convenient because M_1 divides out and we have a simple way to relate CS differences to warp. To provide a specific example, we assume that the glass sheet is produced by a float glass process for which a typical observed warp after ion-exchange is approximately –0.63 mm for a part with L_x=182 mm, L_y=237 mm, and L_z=0.8 mm. The negative sign indicates that the warp is concave "down" or concave toward the tin side of the glass. The Young's modulus for such a glass is roughly 70 GPa and the Poisson ratio roughly 0.2.

[0052] Using these values, Eq. (8) gives an estimate for CS_t–CS_b of 3.95 MPa. This shows that a surprisingly small difference in surface compressive stress, generally too low

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to measure accurately, results in a substantial degree of warp that is readily observed. From Eq. (5), we can estimate BM_1 for such a glass sheet to be approximately $3.0\text{x}10^{-6}$ mm. Taking the lattice dilation coefficient to be approximately 0.001/mole%, we can then estimate M_1 to be approximately 0.0030 mm mole%.

[0053] In terms of average diffusivities D_t and D_b of the top and bottom halves of the plate, M_1 can be expressed by integrating an erfc-shaped concentration profile to get

$$M_1 \approx \Delta C_t\left(\sqrt{\frac{D_t t}{\pi}}\right) - \Delta C_b\left(\sqrt{\frac{D_b t}{\pi}}\right) \tag{9}$$

where t is the time of diffusion. When characterizing the depth of penetration of ions using for example a FSM instrument manufactured by Orihara, this expression, when written in terms of FSM DOL values for the sheet's top and bottom surfaces, takes the form

$$M_1 \approx \frac{1}{2.8\sqrt{\pi}}\left[\Delta C_t\left(DOL_t\right) - \Delta C_b\left(DOL_b\right)\right] \tag{10}$$

where DOL_t is the DOL measured for the top half and DOL_b is the DOL measured for the bottom half.

[0054] If the surface concentrations above baseline are the same for top and bottom, and are equal to about 12 mole%, we can estimate the difference in penetration depths DOL for the above M_1 value of approximately 0.0030 mm mole% to be about 1.2 μm. This is again a barely measureable difference in diffusivity or ion penetration depth, but it gives rise to readily observable warp.

[0055] The above analysis illustrates 1) the substantial amount of warp that can be observed on larger and thinner parts and 2) the difficulties associated with directly measuring the asymmetry of the physical properties that gives rise to warp after ion exchange. In view of these considerations, in accordance with the present disclosure, direct measurement of warp is used as the experimental starting point for characterizing intrinsic asymmetry of the glass-sheet manufacturing process that produced the warped glass sheet. In some cases, when intrinsic asymmetry is large enough, the integral of Eq. (1) can be evaluated using directly measured concentration profiles from, for example, an electron probe micro-analyzer (EPMA) measurement. However, even in these cases, direct experimental observation of warp is generally more sensitive.

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[0056] By choosing a piece size (L_x,L_y) that is large enough and a thickness L_z that is thin enough, a consistently large warp value can be observed after ion exchange when a glass manufacturing process produces glass with intrinsic asymmetry. Equation (5) is then the primary equation for transforming such measured values of warp into an asymmetry value (asymmetry metric) for the glass-sheet manufacturing process. In particular, the glass' intrinsic asymmetry (native asymmetry) as revealed by a given ion exchange process can be characterized by the BM_1 value of Eq. (5), independent of the length and width of a given glass plate.

[0057] Once a BM_1 value is known for a given glass produced by a given glass-sheet manufacturing process and a given ion exchange process (e.g., time, temperature, and salt quality), the expected gravity-free warp for any glass geometry produced by that manufacturing process can be estimated by Eq. (5) for the same or substantially the same ion exchange process. BM_1 is thus a valuable measure of the intrinsic (native) asymmetry of a glass-sheet manufacturing process and when coupled with a defined ion exchange process, provides a useful method for comparing sheet manufacturing processes and for tracking the effects on warp of changes to such processes.

[0058] From the above, it can be seen that the BM_1 metric is of the form:

$$BM_1 = \mathrm{K} \cdot W \cdot R^2$$

where R is the ratio of the glass sheet's thickness to its diagonal given by:

$$R = \frac{L_z}{\sqrt{L_x^2 + L_y^2}} \qquad (11)$$

In Eq. (5) above, K equals 2/3.

[0059] Although a single test sample can be used, the final result is normally obtained by averaging BM_1 values for a plurality of test samples, e.g., four or more samples. As a general guide, a BM_1 value (e.g., an average BM_1 value) less than or equal to 0.002 microns, (for example, $BM_1 \leq 0.001$ microns or $BM_1 \leq 0.0005$ microns), obtained using a commercially viable ion-exchange process and calculated for K equal to 2/3, is indicative of a glass-sheet manufacturing process that has intrinsic (native) symmetry, and thus glass sheets produced by the process can be expected not to encounter warp problems. In particular, these values are applicable to glass sheets having R values that are less than or equal to $2.5\text{x}10^{-4}$ (for example, $R \leq 2.0\text{x}10^{-4}$ or $R \leq 1.5\text{x}10^{-4}$).

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[0060] As indicated above BM_1 values depend on the ion exchange conditions used in the measurement process. Specifically, ion exchange conditions can make the warp more or less severe depending on the resulting surface boundary concentrations above baseline, i.e., ΔC_t and ΔC_b, and the depth of penetration of the concentration profile that occurs in Eq. (1).

[0061] In accordance with a further embodiment, the effects of ion exchange conditions on the measurement of Z-axis asymmetry for a glass-sheet manufacturing process are minimized through the evaluation of the process' $ASYM$ value. That is, while both BM_1 and $ASYM$ values measure the intrinsic (native) asymmetry of a glass-sheet manufacturing process, $ASYM$ values have the advantage of being substantially independent of ion exchange conditions, provided the ion exchange conditions are sufficient to produce ion exchange strengthening of glass sheets, i.e., although not wedded to any particular ion exchange conditions, an $ASYM$ measurement does assume the use of ion exchange conditions that are reasonable, e.g., ion exchange conditions suitable for use commercially for the glass sheets of interest.

[0062] In general terms, an $ASYM$ value is a normalization of a BM_1 value by the number of atoms exchanged. The normalization is achieved by a measurement of fractional mass difference before and after ion exchange, with the fractional mass difference being itself normalized using molecular weights and sample size. While BM_1 values have the units of length, e.g., microns or nanometers, $ASYM$ values are dimensionless, e.g., of the order of a few hundred to a few thousand ppm.

[0063] In particular, in accordance with an embodiment, $ASYM$ values are determined using an equation of the form:

$$ASYM \equiv BM_1\left(\frac{2}{L_x}+\frac{2}{L_y}+\frac{2}{L_z}\right)\frac{M_0}{\Delta M}\frac{2\left(W_{in}-W_{out}\right)}{W_{Glass}} \qquad (12)$$

or upon using Eq. (5) for BM_1 and Eq. (11) for R:

$$ASYM = \frac{2R^2}{3}\left(\frac{2}{L_x}+\frac{2}{L_y}+\frac{2}{L_z}\right)\frac{W}{\Delta M}\frac{2M_0\left(W_{in}-W_{out}\right)}{W_{Glass}} \qquad (13)$$

where W, BM_1, L_x, L_y, and L_z are as defined above and are all expressed in the same units, e.g., microns, M_0 is the mass of the sample (i.e., the sample whose warp was measured) just before ion exchange, ΔM is the change in sample mass as a result of the ion exchange

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and is obtained by using the mass just after ion exchange and cleaning minus M_0, W_{Glass} is the molecular weight of the base glass prior to ion exchange in grams/mole, W_{in} represents the molecular weight of the ion (e.g., K^+, not K_2O) being exchanged into the glass in grams/mole, and W_{out} represents the molecular weight of the ion (e.g., Na^+, not Na_2O) being exchanged out of the glass in grams/mole. The molecular weight of the base glass is obtained by taking the molecular weights of the components of the glass (e.g., SiO_2, Al_2O_3, etc.), multiplying each molecular weight by the component's mole fraction in the glass, and then summing the results.

[0064] Although a single test sample can be used, the final result is normally obtained by averaging *ASYM* values for a plurality of test samples, e.g., four or more samples. As a general guide, an *ASYM* value (e.g., an average *ASYM* value) less than or equal to 1,500 ppm, (for example, $ASYM \leq 1{,}000$ ppm or $ASYM \leq 500$ ppm), obtained using a commercially viable ion-exchange process and evaluated for K equal to 2/3 in the BM_1 calculation if Eq. (12) is used, is indicative of a glass-sheet manufacturing process that has intrinsic (native) symmetry, and thus glass sheets produced by the process can be expected not to encounter warp problems. This is especially so for glass sheets having R values that are less than or equal to $2.5\text{x}10^{-4}$ (for example, $R \leq 2.0\text{x}10^{-4}$ or $R \leq 1.5\text{x}10^{-4}$).

[0065] Eqs. (12) and (13) are based on the observation that the measured native asymmetry grows in proportion to the number of ions exchanged. Accordingly, normalization can be performed using the number of ions exchanged, i.e., by the fractional mass increase produced by an ion exchange process, a readily measurable value. Fractional mass increase is proportional to the average of the top and bottom depths of layer (*DOL*s), while the native asymmetry is proportional to the difference in the depths of layer. Since both grow with sqrt(time), there is no need to explicitly divide by sqrt(t).

[0066] Accordingly, in general terms, based on the above observation, the *ASYM* value can be expressed as:

$$ASYM = B\frac{\Delta C_t\left(\sqrt{D_t t}\right) - \Delta C_b\left(\sqrt{D_b t}\right)}{\Delta C_t\left(\sqrt{D_t t}\right) + \Delta C_b\left(\sqrt{D_b t}\right)} \qquad (14)$$

where D_t and D_b are the diffusivities for the top and bottom of the glass sheet. This equation shows how *ASYM* is a measure of the difference in number of ions that have crossed the two surfaces normalized by the total number of ions that have crossed the two

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surfaces. This equation includes the glass' lattice dilation coefficient B since larger B gives larger warp in proportion and thus plays a role in the asymmetry of strain and thus warp, but, as will now be shown, its effects are automatically included in the warp measurement and thus a value for B is not needed to evaluate $ASYM$.

[0067] We begin by assuming a single erfc concentration profile on each side of the glass so that warp can be expressed as

$$W = -\frac{3B\sqrt{t}}{2\sqrt{\pi}}\left[\Delta C_t\left(\sqrt{D_t}\right) - \Delta C_b\left(\sqrt{D_b}\right)\right]\frac{\left(L_x^2 + L_y^2\right)}{L_z^2} \tag{15}$$

We also have from Eq. (5) above

$$W = -\frac{3}{2}\frac{\left(L_x^2 + L_y^2\right)}{L_z^2}BM_1 \tag{16}$$

which implies

$$BM_1 = -\frac{B}{\sqrt{\pi}}\left[\Delta C_t\left(\sqrt{D_t t}\right) - \Delta C_b\left(\sqrt{D_b t}\right)\right] \tag{17}$$

which corresponds to Eq. (9) above.

[0068] Again assuming a single erfc concentration profile, an analysis of mass difference during ion exchange gives the following relationship:

$$\frac{\Delta M(t)}{M_0} = \left(\frac{2}{\sqrt{\pi}}\right)\left(\frac{1}{L_x} + \frac{1}{L_y} + \frac{1}{L_z}\right)\left[\Delta C_t\left(\sqrt{D_t t}\right) + \Delta C_b\left(\sqrt{D_b t}\right)\right]\left[\frac{2\left(W_{in} - W_{out}\right)}{W_{Glass}}\right] \tag{18}$$

[0069] Substituting Eqs. (17) and (18) into Eq. (14) then gives Eq. (13), with the dependence on B removed and the resulting asymmetry value (asymmetry metric) normalized by the molecular weight of the glass, the masses of exchanging atoms, and the sample geometry.

[0070] To summarize, in outline, $ASYM$ values are obtained by:

[0071] (A) Measuring fractional mass difference on a plurality of samples before and after ion exchange and calculating for each sample

$$\frac{\frac{\Delta M(t)}{M_0}}{\left(\frac{2}{L_x} + \frac{2}{L_y} + \frac{2}{L_z}\right)\left[\frac{\left(W_{K_2O} - W_{Na_2O}\right)}{W_{Glass}}\right]} = \left(\frac{1}{\sqrt{\pi}}\right)\left[\Delta C_t\left(\sqrt{D_t t}\right) + \Delta C_b\left(\sqrt{D_b t}\right)\right] \tag{19}$$

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(Note that the samples' edges may need to be polished prior to testing to avoid errors due to edge chipping.)

[0072] (B) On the same samples, measuring warp magnitudes W, including correction for gravity, and calculate for each sample

$$BM_1 = \frac{2}{3}\frac{L_z^2}{\left(L_x^2+L_y^2\right)}W = \frac{B}{\sqrt{\pi}}\left[\Delta C_t\left(\sqrt{D_t t}\right) - \Delta C_b\left(\sqrt{D_b t}\right)\right] \tag{20}$$

[0073] (C) Forming the ratio

$$\frac{B\left[\Delta C_t\left(\sqrt{D_t t}\right) - \Delta C_b\left(\sqrt{D_b t}\right)\right]}{\Delta C_t\left(\sqrt{D_t t}\right) + \Delta C_b\left(\sqrt{D_b t}\right)} = \frac{\frac{2}{3}\frac{L_z^2}{\left(L_x^2+L_y^2\right)}W}{\frac{\Delta M(t)}{M_0}} = \frac{\frac{2}{3}\frac{L_z^2}{\left(L_x^2+L_y^2\right)}W}{\left(\frac{2}{L_x}+\frac{2}{L_y}+\frac{2}{L_z}\right)\left[\frac{2\left(W_{in}-W_{out}\right)}{W_{Glass}}\right]} \tag{21}$$

$$= \frac{2}{3}\frac{L_z^2}{\left(L_x^2+L_y^2\right)}\left(\frac{2}{L_x}+\frac{2}{L_y}+\frac{2}{L_z}\right)\frac{W}{\Delta M}\frac{2M_0\left(W_{in}-W_{out}\right)}{W_{Glass}}$$

the last expression in Eq. (21) being the *ASYM* value of Eq. (13).

[0074] As a more specific, non-limiting, example, BM_1 and *ASYM* values are determined by the following procedure:

[0075] (1) From one or more glass sheets manufactured using the glass-sheet manufacturing process whose asymmetry is to be measured, cut or extract at least 4 square test samples (test pieces) of size 100mm on each edge. The thickness is set by the target thickness of the glass sheet to be tested.

[0076] (2) Accurately measure the initial mass M_0 of each test sample just before ion exchange in preparation for tracking the change in mass that occurs as a result of ion exchange. Also measure the sample dimensions L_x, L_y, and thickness L_z for later use in calculations.

[0077] (3) Subject the test samples to an ion exchange process that is identical to or at least similar to that which is to be used on parts manufactured using the glass-sheet manufacturing process whose asymmetry is being measured.

[0078] As used in this step, a "similar" ion exchange process means subjecting the test samples to similar conditions of time in the salt bath, temperature of the salt bath, and purity or composition of the salt bath, with the same heating up and cooling down before

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and after immersion in the salt bath. If any polishing or etching is done before or after ion exchange in the manufactured part, the same should be done to the test sample. The resulting surface compressive stress CS, which can be measured by the optical measurement instrument FSM-6000 by Orihara, or measured by any other means, is preferably within 10% of the highest CS observed on manufactured parts. This implies that the salt bath should be "fresh", i.e. relatively pure, and not contaminated by the exchanged ion. High CS is a sensitive measure of the purity of the salt bath. In order to partly remove the influence of asymmetry of the salt bath itself, half the test samples are preferably placed in one orientation of the salt bath relative to the glass manufacturing orientation and half placed in the opposite orientation (see discussion of extrinsic asymmetry below).

[0079] Note that if only *ASYM* values are of interest, the ion-exchange conditions need not be based on those used or to be used on parts manufactured using the glass-sheet manufacturing process of interest, but can be based on other considerations, e.g., easy of use in a testing setting.

[0080] (4) Accurately measure the mass just after ion exchange and after cleaning the sample so that only glass remains in the mass measurement.

[0081] (5) After all steps of the ion exchange process are completed, including any cleaning and polishing that is intended for the commercial object of interest, measure the maximum warp of the test sample using any of several instruments capable of measuring surface profiles. An example of one such instrument is the KLA Tencor P16 Profilometer, which uses a stylus. Another example is the Tropel Flatmaster MSP-150, which is a non-contact interferometer. Measure the maximum vertical difference from center to edge or corner. Perform the measurement with the part held horizontally.

[0082] If there is a detectable curvature to the part, measure it in the "bowl" orientation (see FIG. 1), i.e. with the center lower than the edges, in order to minimize the influence of gravity. If curvature is not readily detectable then measure both bowl and "dome" (center higher than edges) orientations. If those measurements reveal which orientation corresponds with the bowl shape then use the maximum vertical difference from that measurement, otherwise use the smaller of the two maximum vertical differences for the two orientations. Express the result in, for example, microns.

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[0083] (6) Apply a correction for the influence of gravity by taking each warp value from the previous step and multiplying by a correction factor of 1.07. This correction factor approximately accounts for the flattening influence of gravity on a bowl-shaped piece of glass of the chosen size.

[0084] The correction factor of 1.07 (a 7% increase in warp) has been found to be appropriate over the full range of thicknesses from 1 mm to 0.2 mm for square plates of 100mm on an edge. Density and Young's modulus also affect the gravity correction but these influences are approximately at the 1% level so they can be ignored. In the dome orientation the correction factor is about 1.13 (a 13% increase in warp). The bowl orientation has less impact from gravity and thus is preferred, although the dome orientation and its correction factor can be used if desired.

[0085] (7) For each test sample, calculate the value of BM_1 by using a ratio R of thickness to diagonal given by $R = \frac{L_z}{\sqrt{L_x^2 + L_y^2}}$ where L_z is the thickness in the expression

$$BM_1 = 2/3\ W \cdot R^2$$

where W (the warp in microns) is the warp corrected for gravity of step 6. (Note that if only $ASYM$ values are desired, Eq. (13) can be used and a separate calculation of BM_1 values need not be performed.)

[0086] (8) For each test sample, calculate a native (intrinsic) asymmetry $ASYM$ value using Eq. (12) or Eq. (13) above. The final result is obtained by averaging the $ASYM$ values (and BM_1 values, if determined) for the various test samples.

[0087] With regard to step (6) of the above procedure, i.e., correction for gravity, it should be noted that there is a trade-off between the sheet size (where larger sheets have more warp) and the impact of gravity on sheet shape (where larger sheets have their shape more influenced by gravity). By keeping the size of the sheet smaller, one also has recourse to various commercial instruments that are capable of highly accurate measurements of the sheet shape. These include the use of interferometry such as the Tropel Flatmaster referred to above. A part size of up to about 200 mm on a side should have an easily detectable warp if there is intrinsic asymmetry in the manufacturing process used to produce the part, and should have little influence of gravity on its shape. Smaller sizes can also be used if the measurement equipment is sensitive enough.

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[0088] Instead of measuring warp, it may be more convenient to measure an average radius of curvature near the center of the sheet. This radius of curvature C is related to the warp W discussed above by the relation

$$W = \frac{1}{2C}\left(\left(\frac{L_x}{2}\right)^2 + \left(\frac{L_y}{2}\right)^2\right) \tag{22}$$

[0089] If it is desired to measure the warp or radius of curvature of a larger sheet and obtain the gravity-free result, then an apparatus such as is described in U.S. Patent No. 7,225,665, entitled "Process and apparatus for measuring the shape of an article", which describes a measurement method that incorporates immersing the sheet in a fluid to approximate neutral buoyancy, may be used.

[0090] It should be noted that even a glass sheet manufactured to have no intrinsic asymmetry of its physical properties through the thickness of the sheet will generally have some nonzero warp after being ion exchanged. This can occur through either slight variations in the manufacturing process or slight asymmetry of the ion exchange process itself. Fortunately, intrinsic (native) asymmetry can be separated from extrinsic (random) asymmetry by performing repeated measurements and averaging.

[0091] In particular, extrinsic asymmetry produced by the ion exchange process itself can be eliminated by varying the orientation of the glass sheets within the salt bath relative to their orientation during manufacturing. Using "top" and "bottom" to denote the two sides of the manufactured sheet, and "left" and "right" to denote the two possible orientations in a salt bath, ion exchanges can be performed both with the top side facing left and also with the top side facing right. When these are compared, extrinsic asymmetry from the salt bath will tend to make the warp have the same orientation relative to the salt bath (left and right) but it will have a different orientation relative to the manufacturing process (top and bottom). Intrinsic asymmetry from the manufacturing process will always have the same warp orientation relative to the manufacturing process (top and bottom), but as a result of flipping, it will have different orientations relative to the salt bath (left and right). Random warp will have values (typically small) that are random relative to the manufacturing process orientation. Accordingly, when multiple sheets are ion exchanged with both orientations of top and bottom relative to left and right of the salt bath, the sign of the observed warp will flip when the top and bottom sides are exchanged, but not when left

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and right are exchanged. Averaging will then tie any remaining nonzero value to systematic warp that is intrinsic to the glass prior to ion exchange. That is, averaging will help remove extrinsic warp from the ion exchange process itself and will average over random warp that could arise from the warp measurement gauge or from random (small) variations in the manufacturing process. The choice of how many sheets to average depends on how sensitively the warp can be measured.

[0092] Using an eight-step measurement procedure of the type described above with flipping and a typical, commercially-acceptable ion exchange process, BM_1 and *ASYM* values were determined for glass sheets produced by a fusion process and glass sheets produced by a float process. The results are shown in Table 2, where samples 1-9 are fusion glass samples and samples 10-22 are float glass samples. W_{Glass} for the fusion and float samples were 63.88 grams/mole and 63.18 grams/mole, respectively; W_{in} (K^+) was 39.09831 grams/mole and W_{out} (Na^+) was 22.98977 grams/mole. The column labeled "Corrected Warp" in Table 2 refers to measured warp values corrected for the effects of gravity as described above.

[0093] As can be seen in Table 2, the fusion glass had substantially smaller BM_1 and *ASYM* values than the float glass, the average over all of the samples of the BM_1 values being ~0.0005 microns for the fusion process and ~0.003 microns for the float process, and the average over all of the samples of the *ASYM* values being ~240 ppm for the fusion process and ~2080 ppm for the float process. Consequently, the float glass can be expected to exhibit warp problems when used in various applications for chemically-strengthened glass sheets.

[0094] Using BM_1 and/or *ASYM* values as a guide, the intrinsic (native) asymmetry of the float process can be reduced so as to minimize its warp problems. Likewise, one or both of these values can be used as a guide to maintain the high level of symmetry of the fusion process. In connection with both processes, the techniques disclosed herein can be used to monitor Z-axis asymmetry during on-going production and/or to track changes in Z-axis asymmetry associated with changes to existing processes. In these ways, thin and large glass sheets with low warp after ion exchange can be produced by achieving and/or maintaining the intrinsic symmetry of the physical properties of the glass through the thickness direction, including its thermal history.

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[0095] In particular, based on the *ASYM* and the BM_1 metrics disclosed herein, as well as the analysis of the physical processes underlying warp discussed above, novel, low-warp, glass sheets are produced which, in an embodiment, have *R* values that are less than or equal to $2.5x10^{-4}$ and have *ASYM* values that are less than or equal to 1,500 ppm (BM_1 values ($K = 2/3$) that are less than or equal to 0.002 microns). In other embodiments, the glass sheets have *R* values that are less than or equal to $2.0x10^{-4}$ and *ASYM* values that are less than or equal to 1,000 ppm (BM_1 values ($K = 2/3$) that are less than or equal to 0.001 microns), while in still further embodiments, the glass sheets have *R* values that are less than or equal to $1.5x10^{-4}$ and *ASYM* values that are less than or equal to 500 ppm (BM_1 values ($K = 2/3$) that are less than or equal to 0.0005 microns).

[0096] For these novel glass sheets, the *ASYM* and the BM_1 values are determined for the sheets in question or test samples taken from the sheets in question, while the *R* values are for the full sheets. For example, for a glass sheet having a thickness of 0.5 mm, an *R* value of $2.5x10^{-4}$ corresponds to a sheet diagonal of 2000 mm, an *R* value of $2.0x10^{-4}$ corresponds to a sheet diagonal of 2500 mm, and an *R* value of $1.5x10^{-4}$ corresponds to a sheet diagonal of 3333 mm. For a sheet thickness of 0.7 mm, the diagonals are larger, being 2800 mm, 3500 mm, and 4667 mm for *R* values of $2.5x10^{-4}$, $2.0x10^{-4}$, and $1.5x10^{-4}$, respectively.

[0097] In view of their low *ASYM* (BM_1) values, the full sheets exhibit gravity-free warp values (*W* values) that are less than or equal to 48 mm for the $R = 2.5x10^{-4}$, $ASYM = 1{,}500$ ppm (or $BM_1 = 0.002$ microns) combination, full sheet *W* values that are less than or equal to 37.5 mm for the $R = 2.0x10^{-4}$, $ASYM = 1{,}000$ ppm (or $BM_1 = 0.001$ microns) combination, and full sheet *W* values that are less than or equal to 33 mm for the $R = 1.5x10^{-4}$, $ASYM = 500$ ppm (or $BM_1 = 0.0005$ microns) combination. Full sheets having such low warp values facilitate handling of the sheets during manufacture and use. The ultimate product also benefits from such reduced warp, especially where the chemically-strengthened glass incorporated in the ultimate product has a large surface area.

[0098] A variety of modifications that do not depart from the scope and spirit of the invention will be evident to persons of ordinary skill in the art from the foregoing disclosure. The following claims are intended to cover the specific embodiments set forth herein as well as modifications, variations, and equivalents of those embodiments.

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Table 1

Representative Calculated Gravity-Free Warp Values for Float Glass

Lx(mm)	Ly(mm)	Lz(mm)	(Lx^2+Ly^2)/Lz^2	R x 10^3	Warp(mm)
60	44	0.5	22144	6.71	0.10
1910	1575	1.1	5065062	0.44	22.79
136	170	0.8	74056	3.68	0.33
182	237	0.8	139520	2.67	0.63
500	500	0.5	2000000	0.71	9.00
2000	1500	3	694444	1.20	3.13
2000	1500	1	6250000	0.40	28.13

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Table 2

Representative *ASYM* and BM_1 Values
For Glasses With and Without Intrinsic (Native) Asymmetry

Sample Number	Thickness (mm)	ΔM/M0	Warp (mm)	Corrected Warp (microns)	R	BM_1 (microns)	ASYM (ppm)
1	0.55	0.00393	0.0485	51.895	0.003889	0.000523	247
2	0.55	0.00308	0.048	51.36	0.003889	0.000518	312
3	0.55	0.00461	0.059	63.13	0.003889	0.000637	256
4	0.55	0.00381	0.033	35.31	0.003889	0.000356	173
						Average	247
5	1	0.00202	0.014	14.98	0.007071	0.000499	254
6	1	0.00195	0.013	13.91	0.007071	0.000464	245
7	1	0.00197	0.0125	13.375	0.007071	0.000446	233
8	1	0.00197	0.014	14.98	0.007071	0.000499	261
9	1	0.00201	0.0115	12.305	0.007071	0.00041	210
						Average	241
10	0.55	0.00264	0.2245	240.215	0.003889	0.002422	1722
11	0.55	0.00279	0.2855	305.485	0.003889	0.00308	2070
12	0.55	0.00287	0.2705	289.435	0.003889	0.002918	1908
13	0.55	0.00292	0.242	258.94	0.003889	0.002611	1676
14	0.55	0.00288	0.304	325.28	0.003889	0.00328	2137
15	0.55	0.00308	0.2715	290.505	0.003889	0.002929	1784
16	0.55	0.00278	0.2515	269.105	0.003889	0.002713	1828
						Average	1875
17	1.1	0.001194	0.072	77.04	0.007778	0.003107	2467
18	1.1	0.001383	0.0845	90.415	0.007778	0.003647	2499
19	1.1	0.001414	0.081	86.67	0.007778	0.003496	2343
20	1.1	0.001459	0.0785	83.995	0.007778	0.003388	2200
21	1.1	0.001305	0.0765	81.855	0.007778	0.003301	2397
22	1.1	0.001386	0.067	71.69	0.007778	0.002891	1976
						Average	2314

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What is claimed is:

1. A method for measuring the asymmetry of a glass-sheet manufacturing process comprising:

(I) producing a glass sheet using the glass-sheet manufacturing process;

(II) measuring the mass M_0 of the glass sheet or a test sample from the glass sheet;

(III) subjecting the glass sheet or the test sample to an ion-exchange process;

(IV) measuring the change in mass ΔM of the glass sheet or the test sample as a result of step (III);

(V) measuring a warp value W for the glass sheet or the test sample after step (III); and

(VI) computing an $ASYM$ value for the glass sheet or the test sample using an equation of the form:

$$ASYM = \frac{2R^2}{3}\left(\frac{2}{L_x}+\frac{2}{L_y}+\frac{2}{L_z}\right)\frac{W}{\Delta M}\frac{2M_0\left(W_{in}-W_{out}\right)}{W_{Glass}}$$

where W_{Glass} is the molecular weight in grams/mole of the glass making up the glass sheet or the test sample prior to step (III), W_{in} and W_{out} are, respectively, the molecular weights in grams/mole of the ions being exchanged into and out of the glass in step (III), taken singly and not as oxides, R is the glass sheet's or the test sample's thickness-to-diagonal ratio, and L_x, L_y, and L_z are, respectively, the length, width, and thickness of the glass sheet or the test sample in the same units as the warp value W;

wherein the $ASYM$ value calculated in step (VI) is a measure of the asymmetry of the glass-sheet manufacturing process.

2. The method of Claim 1 wherein the warp value of step (V) is determined for the glass sheet or the test sample in a bowl configuration.

3. The method of Claim 1 wherein the warp value of step (V) is corrected for the effects of gravity.

4. The method of Claim 1 wherein the $ASYM$ value computed in step (VI) is an average value based on measurements made on multiple glass sheets or multiple test samples.

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5. The method of Claim 4 wherein:

(a) step (III) comprises submerging multiple glass sheets or multiple test samples in a salt bath;

(b) each glass sheet or each test sample has a first side and a second side;

(c) the multiple glass sheets or multiple test samples are submerged in the salt bath with some of the first sides oriented in a first direction and some of the first sides oriented in a second direction, which is opposite to the first direction; and

(d) the average value computed in step (VI) includes *ASYM* values for glass sheets or test samples oriented in the first direction and glass sheets or test samples oriented in the second direction.

6. A method for producing low warp, ion-exchanged, glass sheets comprising:

(a) producing a population of glass sheets using a glass-sheet manufacturing process, each glass sheet in the population having an *R* value that is less than or equal to 2.5×10^{-4}, where the *R* value is the ratio of the thickness of the glass sheet to the length of the glass sheet's diagonal; and

(b) ion exchange strengthening the population of glass sheets produced in step (a);

wherein the glass-sheet manufacturing process has an *ASYM* value that is less than or equal to 1,500 ppm, where the *ASYM* value is determined using the method of Claim 4.

7. The method of Claim 6 wherein:

(a) the *R* value of the glass sheets is less than or equal 2.0×10^{-4} and the *ASYM* value of the glass-sheet manufacturing process is less than or equal to 1,000 ppm; or

(b) the *R* value of the glass sheets is less than or equal 1.5×10^{-4} and the *ASYM* value of the glass-sheet manufacturing process is less than or equal to 500 ppm.

8. A low warp, ion-exchanged glass sheet produced by the process of Claim 6.

9. A low warp, ion-exchanged glass sheet produced by the process of Claim 7.

10. A method for measuring the asymmetry of a glass-sheet manufacturing process comprising:

(I) producing a glass sheet using the glass-sheet manufacturing process;

(II) subjecting the glass sheet or a test sample from the glass sheet to an ion-exchange process;

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(III) measuring a warp value W for the glass sheet or the test sample after step (II); and

(IV) computing a BM_1 value for the glass sheet or the test sample using an equation of the form:

$$BM_1 = K \cdot W \cdot R^2$$

where K is a constant and R is the glass sheet's or the test sample's thickness-to-diagonal ratio;

wherein the BM_1 value calculated in step (IV) is a measure of the asymmetry of the glass-sheet manufacturing process.

11. The method of Claim 10 wherein the warp value of step (III) is determined for the glass sheet or the test sample in a bowl configuration.

12. The method of Claim 10 wherein the warp value of step (III) is corrected for the effects of gravity.

13. The method of Claim 10 wherein the BM_1 value computed in step (IV) is an average value based on measurements made on multiple glass sheets or multiple test samples.

14. The method of Claim 13 wherein:

(a) step (II) comprises submerging multiple glass sheets or multiple test samples in a salt bath;

(b) each glass sheet or each test sample has a first side and a second side;

(c) the multiple glass sheets or multiple test samples are submerged in the salt bath with some of the first sides oriented in a first direction and some of the first sides oriented in a second direction, which is opposite to the first direction; and

(d) the average value computed in step (IV) includes BM_1 values for glass sheets or test samples oriented in the first direction and glass sheets or test samples oriented in the second direction.

15. The method of Claim 13 where $K = 2/3$.

16. A method for producing low warp, ion-exchanged, glass sheets comprising:

(a) producing a population of glass sheets using a glass-sheet manufacturing process, each glass sheet in the population having an R value that is less than or equal to 2.5×10^{-4}, where the R value is the ratio of the thickness of the glass sheet to the length of the glass sheet's diagonal; and

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(b) ion exchange strengthening the population of glass sheets produced in step (a);

wherein the glass-sheet manufacturing process has a BM_1 value that is less than or equal to 0.002 microns, where the BM_1 value is determined using the method of Claim 15.

17. The method of Claim 16 wherein:

(a) the R value of the glass sheets is less than or equal 2.0×10^{-4} and the BM_1 value of the glass-sheet manufacturing process is less than or equal to 0.001 microns; or

(b) the R value of the glass sheets is less than or equal 1.5×10^{-4} and the BM_1 value of the glass-sheet manufacturing process is less than or equal to 0.0005 microns.

18. A low warp, ion-exchanged glass sheet produced by the process of Claim 16.

19. A low warp, ion-exchanged glass sheet produced by the process of Claim 17.

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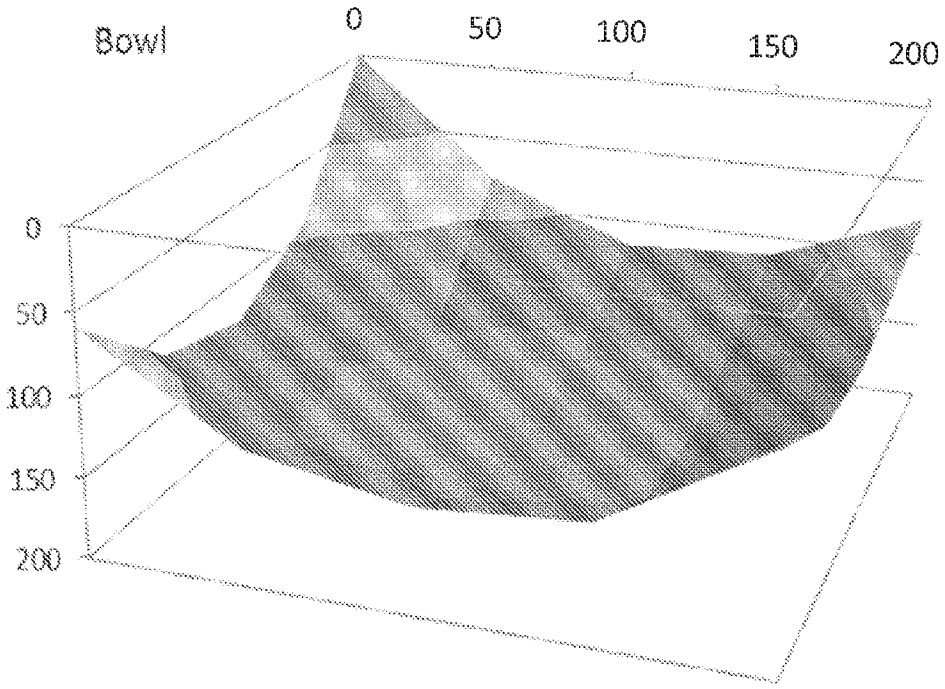


FIG. 1

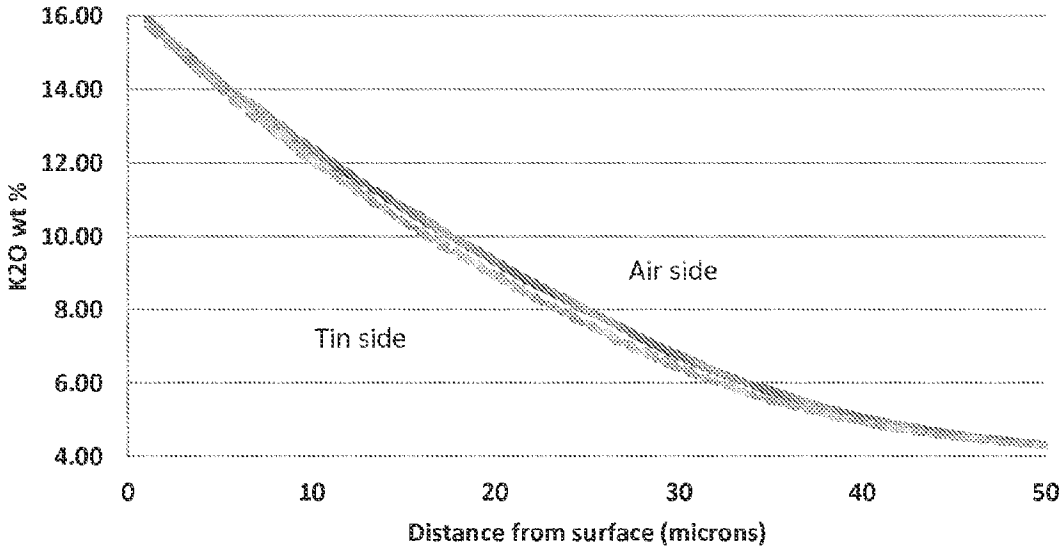


FIG. 2

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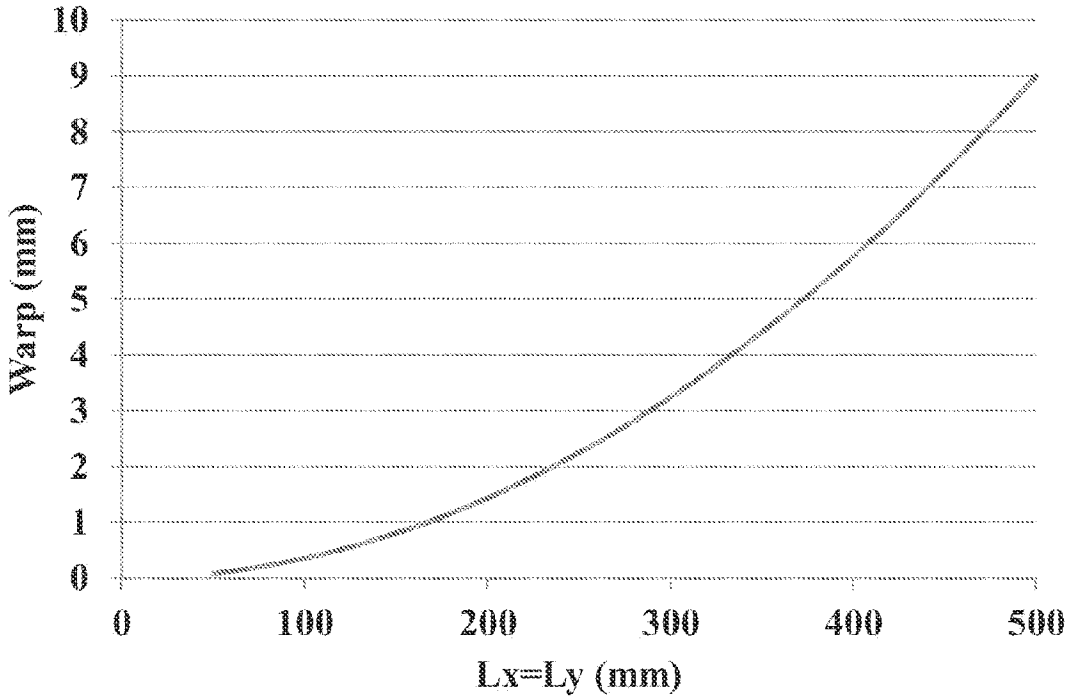


FIG. 3

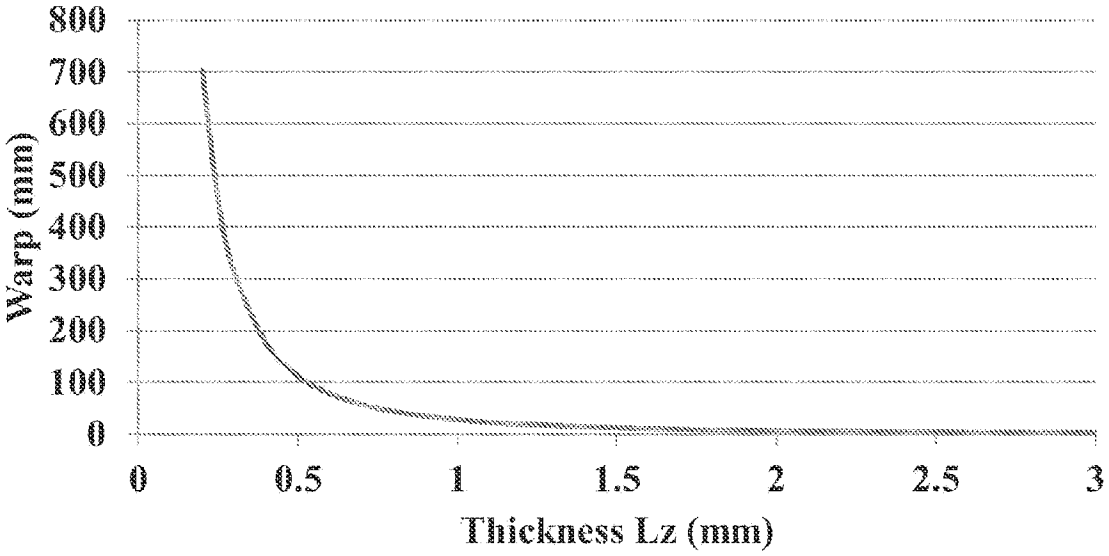


FIG. 4

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INTERNATIONAL SEARCH REPORT

International application No
PCT/US2014/017062

A. CLASSIFICATION OF SUBJECT MATTER
INV. G01B21/20 C03C21/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G01B C03C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2002/135281 A1 (GODA TAKUJI [JP] ET AL) 26 September 2002 (2002-09-26)	10-19
A	paragraphs [0011] - [0020]; figure 1	1-9
A	JP 2000 264681 A (ASAHI TECHNO GLASS CORP) 26 September 2000 (2000-09-26) abstract	1,6,10, 16
A	US 2012/134025 A1 (HART SHANDON DEE [US]) 31 May 2012 (2012-05-31) paragraphs [0016], [0033], [0070] - [0072]; figure 1	1,6,10, 16
A	US 2007/028681 A1 (GOFORTH DOUGLAS E [US] ET AL GOFORTH DOUGLAS EDMON [US] ET AL) 8 February 2007 (2007-02-08) cited in the application paragraphs [0032] - [0035]; figure 2	1,6,10, 16

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
22 May 2014	30/05/2014

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Trique, Michael

1

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

Information on patent family members

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WO2014131221A1 PROJECTION-TYPE TOUCH CONTROL ELECTRONIC WHITEBOARD AND FRAME STRUCTURE THEREOF

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Inventors: CHEN WEISHAN [CN],DENG HUAQIN [CN],FENG GUANGLUN [CN],GU HONGLIN [CN],LI YONG [CN],YAN GUANGLIN [CN]

Classifications:
IPC ***G06F3/042;***

CPC **G06F3/0428 (EP);**

Priorities: CN201310066663A 2013-03-01

Application: WO2014131221A1·2013-04-07

Publication: WO2014131221A1·2014-09-04

Published as: **CN103123556A;** WO2014131221A1

PROJECTION-TYPE TOUCH CONTROL ELECTRONIC WHITEBOARD AND FRAME STRUCTURE THEREOF

Abstract

Disclosed is a frame structure of a projection-type touch control electronic whiteboard to be arranged on the edge of an electronic whiteboard screen, comprising a frame, a light source assembly arranged inside the frame, and an optical filter arranged on the side opening of the frame; the side opening of the frame extends along the edge of the electronic whiteboard; a sensor of the light source assembly is vertically arranged on the circuit board of the light source assembly; the circuit board extends along the edge of the electronic whiteboard; and the vertically arranged sensor provides touch control positioning through the filter. Also disclosed is an electronic whiteboard with the frame structure. The electronic whiteboard and the frame structure thereof enable the electronic whiteboard to have a narrow frame, and are easy to install and maintain, thus facilitating the designing of a light and thin electronic whiteboard having a more attractive appearance.

(12) 按照专利合作条约所公布的国际申请

(19) 世界知识产权组织
国际局

(43) 国际公布日
2014 年 9 月 4 日 (04.09.2014)

WIPO PCT

(10) 国际公布号
WO 2014/131221 A1

(51) 国转 利分类号：
G06F 3/042 (2006.01)

(21) 国际申请号： PCT/CN2013/073781

(22) 国际申请日： 2013 年 4 月 7 日 (07.04.2013)

(25) 申飾 言： 中文

(26) 公布语言： 中文

(30) 优先权：
2013 10066663. 9 2013 年 3 月 1 日 (01.03.2013) CN

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(81) 指定国 (除另有指明，要求每一种可提供的国家保护)：AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, ML, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW。

(84) 指定国 (除另有指明，要求每一种可提供的地区保护)：ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), 喊亚 (AM, AZ,

[见续页]

(54) Title: PROJECTION-TYPE TOUCH CONTROL ELECTRONIC WHITEBOARD AND FRAME STRUCTURE THEREOF

(54) 发明名称 投影式触控电子白板及其边框结构

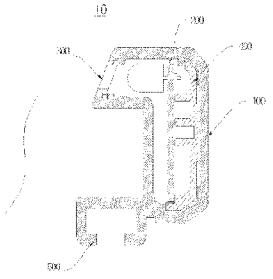


图 5/Fig.5

(57) Abstract: Disclosed is a frame structure of a projection-type touch control electronic whiteboard to be arranged on the edge of an electronic whiteboard screen, comprising a frame, a light source assembly arranged inside the frame, and an optical filter arranged on the side opening of the frame; the side opening of the frame extends along the edge of the electronic whiteboard; a sensor of the light source assembly is vertically arranged on the circuit board of the light source assembly; the circuit board extends along the edge of the electronic whiteboard; and the vertically arranged sensor provides touch control positioning through the filter. Also disclosed is an electronic whiteboard with the frame structure. The electronic whiteboard and the frame structure thereof enable the electronic whiteboard to have a narrow frame, and are easy to install and maintain, thus facilitating the designing of a light and thin electronic whiteboard having a more attractive appearance.

(57) 摘要：

[见续页]

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Chemtronics Exhibit 1032 Page 394

BY, KG, KZ, RU, TJ, TM), 欧洲 (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TG)。

本国际公布：

- 包括国际检索报告(条约第21条(3))。

本发明公开一种投影式触控电子白板的边框结构，用于设置在电子白板的屏幕的边缘处，包括边框、设置在所述边框内的光源组件和设于所述边框侧边开口处的滤光片，所述边框的侧边开口沿电子白板的边缘延伸，所述光源组件的传感器竖排在所述光源组件的电路板上，且所述电路板沿电子白板的边缘延伸，所述竖排的传感器透过所述滤光片提供触控定位。还公开一种具有上述边框结构的电子白板。上述电子白板及其边框结构使得电子白板具有窄边框，易安装，易维护，方便设计更加美观的轻薄电子白板。

说 明 书

发 明 名 称 : 投 影 式 触 控 电 子 白板 及 其 边 框 结 构

[1] 【技术领域】

[2] 本发明涉及电子白板技术领域，特别是涉及一种投影式触控电子白板和一种投影式触控电子白板的边框结构。

[3] 【背景技术】

[4] 在电子白板技术领域，特别是采用投影显示的大型电子白板中（参考图1），多采用红外传感技术为电子白板提供触控定位。红外传感器一般都设置在电子白板的边框中。如图2所示，是一种传统的电子白板的横向剖视图。该电子白板包括基板1、设置在基板1四个边缘的边框2、设置在边框2中的传感器组件3和设置在边框2侧边开口处的滤光片4。其中传感器组件3发射出信号并经过滤光片4滤光后为触控区域另一侧的传感器接收。参考图3a和图3b，传感器组件3包括电路板31、插设在电路板31上的传感器32和驱动传感器32的电路芯片33。在传统的电子白板中，传感器组件3中的传感器32的管脚是与传感器主体部分垂直的，也即传感器32主体部分是卧排在电路板31上的，这样就需要将整个电路板31以平行于基板1的方式放置在基板1的边缘，这样整个电子白板的边框就会太宽，无法形成窄边框设计。

[5] 【发明内容】

[6] 基于此，有必要提供一种用于窄边框的投影式电子白板的边框结构。

[7] 此外，还提供一种投影式电子白板。

[8] 一种投影式电子白板的边框结构，用于设置在电子白板的显示区域的边缘处，包括边框、设置在所述边框内的传感器组件和设于所述边框侧边开口处的滤光片，所述边框的侧边开口沿电子白板的边缘延伸，所述传感器组件的传感器竖排在所述传感器组件的电路板上，且所述电路板沿显示区域的边缘延伸，所述竖排的传感器透过所述滤光片提供触控定位。

[9] 在其中一个实施例中，所述边框整体为条柱状，并具有截面为L型的容置腔，用于容置所述传感器组件，所述传感器组件的电路板和传感器相互垂直地设置

并置于所述截面为L型的容置腔中。

[10] 在其中一个实施例中，还包括托板，所述电路板固定在所述托板上，并与托板一起活动地容置于所述边框内。

[11] 在其中一个实施例中，还包括设于所述边框上且与设有滤光片的开口相对的边框连接结构，多个边框可通过所述边框连接结构相互连接。

[12] 在其中一个实施例中，所述边框连接结构为与角铁配合的框架。

[13] 一种投影式电子白板，包括触控板和设于所述触控板四个边缘的边框结构，所述边框结构包括边框、设置在所述边框内的传感器组件和设于所述边框侧边开口处的滤光片，所述边框的侧边开口沿触控板的边缘延伸，所述传感器组件的传感器竖排在所述光源组件的电路板上，且所述电路板沿触控板的边缘延伸，所述竖排的传感器透过所述滤光片提供触控定位。

[14] 在其中一个实施例中，所述边框整体为条柱状，并具有截面为L型的容置腔，用于容置所述光源组件，所述光源组件的电路板和传感器相互垂直地设置并置于所述截面为L型的容置腔中。

[15] 在其中一个实施例中，还包括托板，所述电路板固定在所述托板上，并与托板一起活动地容置于所述边框内。

[16] 在其中一个实施例中，还包括设于所述边框上且与设有滤光片的开口相对的边框连接结构，相邻的边框通过所述边框连接结构相互连接。

[17] 在其中一个实施例中，所述边框连接结构包括为与角铁配合的框架，相邻边框通过角铁连接，且相邻的边框连接处设有与所述角铁固定连接且覆盖边框端部的角件。

[18] 上述投影式电子白板及其边框结构，通过将红外LED光源的发光灯体与电路板垂直设置，使得电路板可以采用沿屏幕边缘延伸的方向设置，相比于传统的设置方式，可以将显示屏的边框部分变窄，便于设计更美观的显示屏。

[19] 【附图说明】

[20] 图1为触摸电子白板用于投影的示意图；

[21] 图2为一种传统的显示屏的横向剖视图；

[22] 图3a和图3b为图2中的触控组件结构示意图；

[23] 图4为一实施例的显示屏的边框结构示意图；

[24] 图5为图4所述边框结构的横向剖视图；

[25] 图6为图5中的触控组件结构示意图；

[26] 图7为一实施例的显示屏的横向剖视图；

[27] 图8为相邻的边框结构相接处带角件的示意图；

[28] 图9为相邻的边框结构相接处不带角件的示意图。

[29] 具体实施方式】

[30] 如图4所示，为一实施例的投影式电子白板的边框结构示意图，图5为图4所示的边框结构的横向剖视图。结合图4和图5，该边框结构10包括边框100、设置在边框100内的传感器组件200和设于边框100侧边开口处的滤光片300 (参考图5)。

[31] 边框100整体为条柱状，并具有截面为L型的容置腔。边框100侧边开设沿电子白板的屏幕的边缘延伸的开口，滤光片300设于该开口处。

[32] 如图6所示，传感器组件200包括传感器210和电路板220。在电子白板相对的边缘上设置的边框结构10中，对应设置发送传感器和接收传感器。这样，从电子白板一侧边缘发送的传感器信号能够被另一对侧的传感器接收。传感器210竖排在电路板220上，也即传感器210的管脚与传感器轴向相同，使得传感器210与电路板220相互垂直。电路板220沿电子白板的边缘延伸，多个传感器210即沿该延伸方向顺序排列，并且传感器信号的发射或接收方向朝向滤光片300，透过滤光片300提供触控定位。相互垂直的传感器210和电路板220容置于上述的具有L型截面的容置腔中。

[33] 进一步地，如图4~图6所示，本实施例的边框结构10还包括托板400。电路220固定在托板400上，并与托板400—起活动地容置于边框100内。

[34] 在传统的电子白板边框结构中，一旦传感器出现故障，就要更换传感器组件中的部分电路板，此吋需要将电子白板四个边框全部拆除以取出电路板。本实施例的边框结构10中，传感器组件200则可以随托板400—起整体地在边框100的容置腔中移动，在电路出现故障吋，从边框100的一端拉动托板400，即可将传感器组件200整体取出。因此可以方便地维护。

[35] 进一步地，如图5所示，本实施例的边框结构10还包括设于边框100上的边框连接结构500。在边框100的位置上，边框连接结构500与设有滤光片300的开口相对，在边框100与电子白板边缘连接时，边框连接结构500和滤光片300分别位于电子白板的正面和背面。相邻的边框100可通过边框连接结构500相互连接，以形成紧凑的边框整体。

[36] 本实施例中，边框连接结构500为与角铁配合的框架。

[37] 上述实施例中，通过将传感器210的传感器主体与电路板220垂直设置，使得电路板210可以采用沿电子白板边缘延伸的方向设置，相比于传统的设置方式，可以将电子白板的边框部分变窄，便于设计更美观的电子白板。同时，传感器组件200作为一个整体可以随托板400活动地进出边框100的容置腔，便于在传感器故障时进行维护。

[38] 可以理解，在不同的实施例中，托板400和边框连接结构500根据成本或便利性等需求增减，且具体结构也不限于上述实施例的结构。

[39] 如图7所示，为一实施例的电子白板的横向剖视图。该电子白板包括触控板20和设于触控板20四个边缘的如上述实施例的边框结构10（图7中仅显示两个边缘的边框结构）。

[40] 参考图8，边框结构10在相邻处通过角件30连接。参考图9，边框结构10的相邻处设置角铁40，相邻边框10的边框连接结构500通过角铁40连接，角件30与角铁40固定连接并覆盖在边框10的相邻的端部。当光源组件200出现故障时，只需要将角件30拆卸，然后通过托板400将光源组件200整体拉出，即可方便地维修。

[41] 以上所述实施例仅表达了本发明的几种实施方式，其描述较为具体和详细，但并不能因此而理解为对本发明专利范围的限制。应当指出的是，对于本领域的普通技术人员来说，在不脱离本发明构思的前提下，还可以做出若干变形和改进，这些都属于本发明的保护范围。因此，本发明专利的保护范围应以所附权利要求为准。

权利要求书

[权利要求 1] 一种投影式电子白板的边框结构，用于设置在电子白板的显示区域的边缘处，包括边框、设置在所述边框内的传感器组件和设于所述边框侧边开口处的滤光片，所述边框的侧边开口沿电子白板的边缘延伸，其特征在于，所述传感器组件的传感器竖排在所述传感器组件的电路板上，且所述电路板沿显示区域的边缘延伸，所述竖排的传感器透过所述滤光片提供触控定位。

[权利要求 2] 根据权利要求1所述的投影式电子白板的边框结构，其特征在于，所述边框整体为条柱状，并具有截面为L型的容置腔，用于容置所述传感器组件，所述传感器组件的电路板和传感器相互垂直地设置并置于所述截面为L型的容置腔中。

[权利要求 3] 根据权利要求1所述的投影式电子白板的边框结构，其特征在于，还包括托板，所述电路板固定在所述托板上，并与托板一起活动地容置于所述边框内。

[权利要求 4] 根据权利要求1所述的投影式电子白板的边框结构，其特征在于，还包括设于所述边框上且与设有滤光片的开口相对的边框连接结构，多个边框可通过所述边框连接结构相互连接。

[权利要求 5] 根据权利要求4所述的投影式电子白板的边框结构，其特征在于，所述边框连接结构为与角铁配合的框架。

[权利要求 6] 一种投影式电子白板，包括触控板和设于所述触控板四个边缘的边框结构，所述边框结构包括边框、设置在所述边框内的传感器组件和设于所述边框侧边开口处的滤光片，所述边框的侧边开口沿触控板的边缘延伸，其特征在于，所述传感器组件的传感器竖排在所述光源组件的电路板上，且所述电路板沿触控板的边缘延伸，所述竖排的传感器透过所述滤光片提供触控定位。

[权利要求 7] 根据权利要求6所述的投影式电子白板，其特征在于，所述边框整体为条柱状，并具有截面为L型的容置腔，用于容置所述光源组件，所述光源组件的电路板和传感器相互垂直地设置并置于所述截

面为L型的容置腔中。

[权利要求 8] 根据权利要求6所述的投影式电子白板，其特征在于，还包括托板，所述电路板固定在所述托板上，并与托板一起活动地容置于所述边框内。

[权利要求 9] 根据权利要求6所述的投影式电子白板，其特征在于，还包括设于所述边框上且与设有滤光片的开口相对的边框连接结构，相邻的边框通过所述边框连接结构相互连接。

[权利要求 10] 根据权利要求9所述的投影式电子白板，其特征在于，所述边框连接结构包括为与角铁配合的框架，相邻边框通过角铁连接，且相邻的边框连接处设有与所述角铁固定连接且覆盖边框端部的角件。

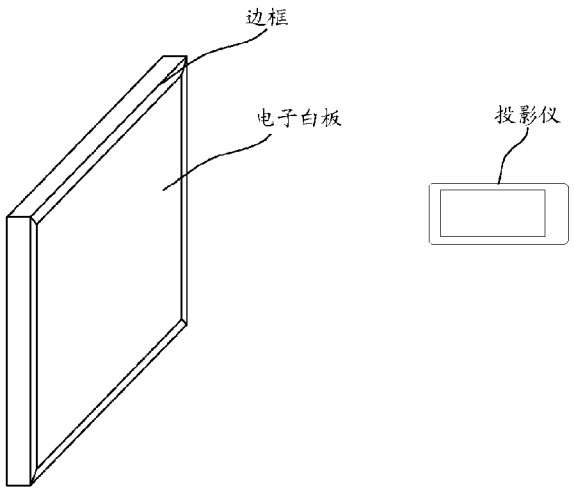


图 1

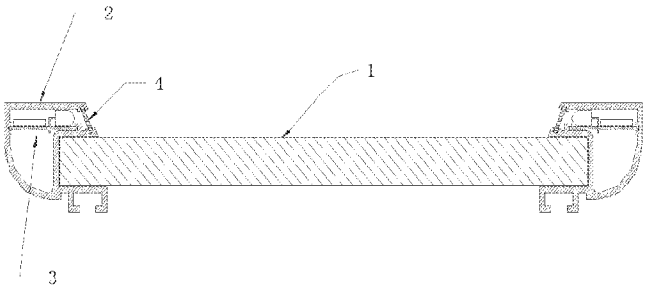


图 2

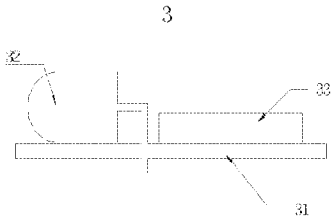


图 3a

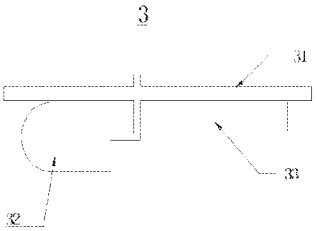


图 3b

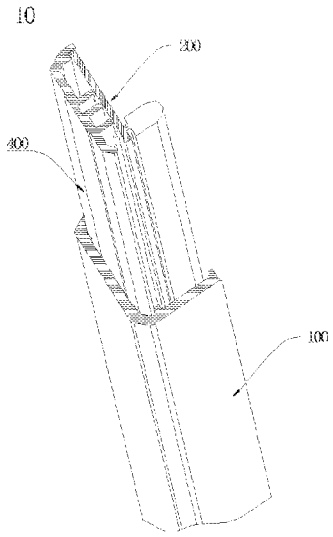


图 4

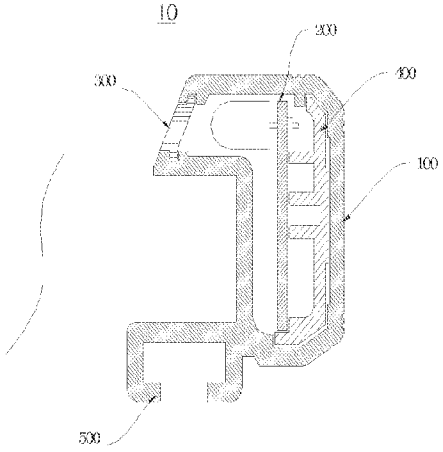


图 5

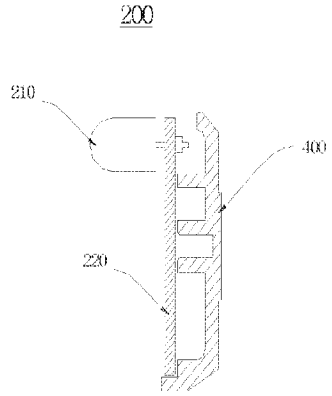


图 6

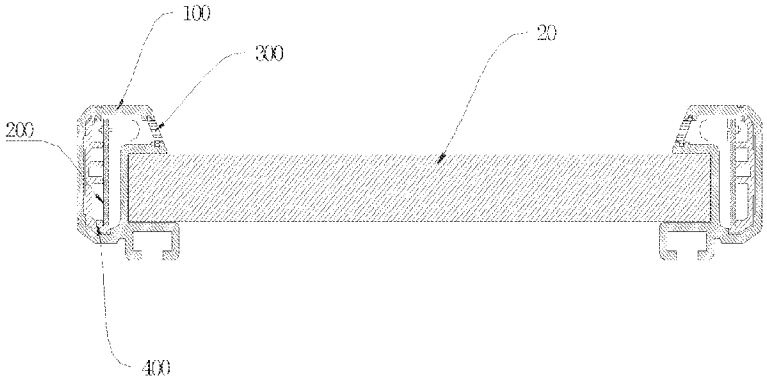


图 7

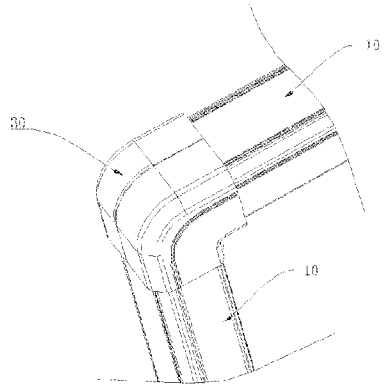


图 8

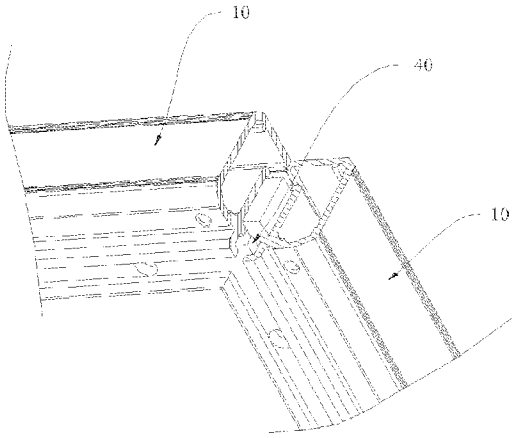


图 9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2013/073781

A. CLASSIFICATION OF SUBJECT MATTER

G06F 3/042 (2006.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: G06F 3/-

Documentetion searched other than minimum documentetion to the extent that such documents are included in the fields searched

Electronic date base consulted during the international search (name of data base and, where practicable, search terms used)
CNPAT, CNKI, DWPI, EPODOC: touch, frame, size, width, narrow, sensor, sensing, infrared, circuit board, vertical, perpendicular, white board, print circuit board, optics

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citetion of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 201917889 U (ZHEJIANG RUNZHI ELECTRONIC TECHNOLOGY CO., LTD.) 03 August 2011 (03.08.2011) description, paragraphs [0029]-[0031], [0071] and [0075], and figures 1 and 7	1-10
X	CN 102662534 A (SHENZHEN TIMELINK SCI&TECHNOLOGY CO.) 12 September 2012 (12.09.2012) description, paragraphs [0021]-[0024], and figure 1	1-10
X	CN 202661975 U (SHENZHEN TIMELINK SCI&TECHNOLOGY CO.) 09 January 2013 (09.01.2013) description paragraphs [0021]-[0024], and figure 1,	1-10
E	CN 203178984 U (SHENZHEN TIMELINK SCI & TECHNOLOGY CO.) 04 September 2013 (04.09.2013) claims 1-10	1-10
A	CN 202171790 U (IRICO GROUP CO., LTD.) 21 March 2012 (21.03.2012) the whole document	1-10

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
28 November 2013 (28.11.2013)	05 Decamber 2013 (05.12.2013)
Name and mailing address of the ISA State Intellectual Property Offica of the P.R. China No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088, China Facsimile No. (86-10) 62019451	Authorized officar ZENG, Wei Telephone No. (86-10) 62411695

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/CN2013/073781

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN 201917889 U	03.08.2011	None	
CN 1026625 34 A	12.09.2012	W O 2013159472 A l	31.10.2013
CN 202661975 U	09.01.2013	None	
CN 203178984 U	04.09.2013	None	
CN 202171790 U	2 1.03.2012	None	

国际检索报告

国际申请号
PCT/CN20 13/073781

A. 主题的分类

G06F 3/042 (2006.01) i

按照国际专利分类(IPC) 或者同时按照国家分类和 IPC 两种分类

B. 检索领域

检索的最低限度文献(标明分类系统和分类号)

IPC: G06F3/-

包含在检索领域中的除最低限度文献以外的检索文献

在国际检索时查阅的电子数据库(数据库的名称，和使用的检索词 (如使用))

CNPAT, CNKI, DWPI, EPODOC: 触摸，触敏，触控，边框，宽度，窄，感应，感测，传感，光学，红外，白板，电路，电路板，印刷电路板，印制电路板，垂直，竖直，竖排，外框，框架, touch, frame, size, sensor, sensing, infrared circuit board, vertical, perpendicular

C. 相关文件

类 型*	引用文件，必要时，指明相关段落	相关的权利要求
X	CN 201917889 U (浙江润智电子科技有限公司)03. 8 月 201 1 (03.08.201 1) 附图 1, 7，说明书 0029-0031, 0071, 0075 段	1-10
X	CN 102662534 A (深圳市天时通科技有限公司)12. 9 月 2012 (12.09.2012) 附图 1，说明书 0021-0024 段	1-10
X	CN 202661975 U (深圳市天时通科技有限公司)09. 1 月 2013 (09.01.2013) 附图 1，说明书 0021-0024 段	1-10
E	CN 203 178984 U (深圳市天时通科技有限公司)04. 9 月 2013 (04.09.2013) 权利要求 1-10	1-10
A	CN 202171790 U (彩虹集团公司)21. 3 月 2012 (21.03.2012) 全文	1-10

☐ 其余文件在 C 栏的续页中列出。

☒ 见同族专利附件。

* 引用文件的具体类型：

"A" 认为不特别相关的表示了现有技术一般状态的文件

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"&" 同族专利的文件

国际检索实际完成的日期	国际检索报告邮寄日期
28. 11 月 2013 (28. 11.2013)	05.12 月 2013 (05.12.2013)

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Chemtronics Exhibit 1032 Page 409

国际检索报告

关于同族专利的信息

国际申请号
PCT/CN2013/073781

检索报告中引用的专利文件	公布日期	同族专利	公布日期
CN 201917889 U	03.08.201 1	无	
CN 102662534 A	12.09.2012	WO 2013 159472 A I	31.10.2013
CN 202661975 U	09.01.2013	无	
CN 203 178984 U	04.09.2013	无	
CN 202171790 U	21.03.2012	无	

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
18 August 2016 (18.08.2016)

WIPO | PCT

(10) International Publication Number
WO 2016/130074 A1

(51) International Patent Classification:
G06F 3/042 (2006.01)

(21) International Application Number:
PCT/SE20 16/050098

(22) International Filing Date:
9 February 2016 (09.02.2016)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
1550145-5 9 February 2015 (09.02.2015) SE

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available):* AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available):* ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

(54) **Title:** OPTICAL TOUCH SYSTEM COMPRISING MEANS FOR PROJECTING AND DETECTING LIGHT BEAMS ABOVE AND INSIDE A TRANSMISSIVE PANEL

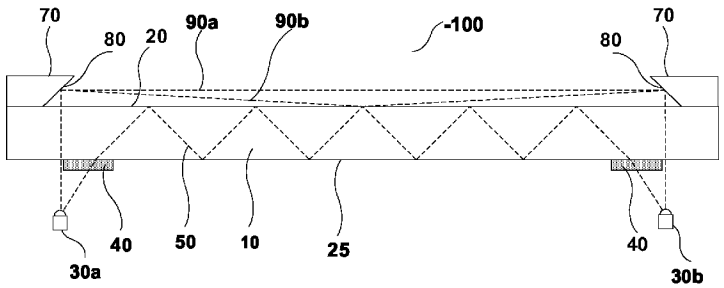


Figure 3

(57) **Abstract:** An embodiment of the invention provides a touch sensing apparatus, comprising: a light transmissive element (10) that defines a touch surface; a set of emitters (30a) arranged around the periphery of the touch surface to emit beams of light into the light transmissive element, wherein a first portion of the beams (50) of light propagate inside the light transmissive element while illuminating the touch surface such that an object touching the touch surface causes an attenuation of the propagating light, and wherein a second portion of the beams (90) of light pass out of the light transmissive element and are reflected to travel above the touch surface, a set of light detectors (30b) arranged around the periphery of the touch surface to receive light from the set of emitters from the transmissive element and from above the touch surface, wherein each light detector is arranged to receive light from more than one emitter.

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WO 2016/130074 A1

Optical touch system comprising means for projecting and detecting light beams above and inside a transmissive panel

Technical Field

[0001] The present invention generally relates to improved touch determination on touch surfaces of optical touch-sensing systems, and in particular in relation to FTIR-based (frustrated total internal reflection) touch systems.

Background Art

[0002] In one category of touch-sensitive panels known as 'above surface optical touch systems' and known from e.g. US4459476, a plurality of optical emitters and optical receivers are arranged around the periphery of a touch surface to create a grid of intersecting light paths above the touch surface. Each light path extends between a respective emitter/receiver pair. An object that touches the touch surface will block certain ones of the light paths. Based on the identity of the receivers detecting a blocked light path, a processor can determine the location of the intercept between the blocked light paths. This type of system is only capable of detecting the location of one object (single-touch detection). Further, the required number of emitters and receivers, and thus cost and complexity, increases rapidly with increasing surface area and/or spatial resolution of the touch panel.

[0003] In a variant, e.g. shown in WO2006/095320, each optical emitter emits a beam of light that diverges across the touch surface, and each beam is detected by more than one optical receiver positioned around the periphery of the touch surface. Thus, each emitter creates more than one light path across the touch surface. A large number of light paths are created by sequentially activating different emitters around the periphery of the touch surface, and detecting the light received from each emitter by a plurality of optical receivers. Thereby, it is possible to reduce the number of emitters and receivers for a given surface area or spatial resolution, or to enable simultaneous location detection of more than one touching object (multi-touch detection).

[0004] If the display screen is contaminated by e.g. fingerprints, the optical transmission path may become unintentionally interrupted and the information retrieved from the system erroneous or incomplete as the contaminated surface becomes insensitive to touches. If contaminants are collected in front of one of the emitters or detectors there will always be blocked or occluded light paths.

[0005] Another category of touch-sensitive panels known as 'in-glass optical systems' is now described and is also known from e.g. US8581884.

[0006] Figure 1 illustrates an example of a touch-sensitive apparatus 100 that is based on the concept of FTIR (Frustrated Total Internal Reflection), also denoted "FTIR system". The apparatus operates by transmitting light inside a transmissive panel 10, from light emitters 30a to light sensors or detectors

30b, so as to illuminate a touch surface 20 from within the transmissive panel 10. The transmissive panel 10 is made of solid material in one or more layers and may have any shape. The transmissive panel 10 defines an internal radiation propagation channel, in which light propagates by internal reflections.

[0007] In the example of figure 1, the propagation channel is defined between the touch surface 20 and bottom surface 25 of the transmissive panel 10, where the touch surface 20 allows the propagating light to interact with touching object 60 and thereby defines the touch surface 20. This is achieved by injecting the light into the transmissive panel 10 via coupling element 40 such that the light is reflected by total internal reflection (TIR) in the touch surface 20 as it propagates through the transmissive panel 10. The light may be reflected by TIR on the bottom surface 25 or against a reflective coating thereon. Upon reaching coupling element 40 on a far side of the panel, the light is coupled out of transmissive panel 10 and onto detectors 30b. The touch-sensitive apparatus 100 may be designed to be overlaid on or integrated into a display device or monitor.

[0008] US8553014 describes an attempt to combine the above surface and in-glass optical systems described above. US8553014 describes an optical coupling technique for introducing light into a transmissive panel and above a transmissive panel simultaneously. However, the in-coupling component shown in figure 126 of US8553014 is a complex prism and appears to rely on total internal reflection and diffraction to couple the light above the touch surface. Such an arrangement would be highly tolerance sensitive, making the optical signal highly sensitive to, for example, the load on the touch surface, the tolerances of process used to mount the prism to the transmissive panel, and the manufacturing of both the transmissive panel and the prism. Furthermore, the spread of the light in a plane parallel to the transmissive panel is limited to a range of less than 80 degrees as light outside this range will be diffracted up and away from the panel. Such a system is best suited to a rectangular grid of detection lines, such as described in US4459476 above. Furthermore, a complex prism as described in US8553014 would be both expensive to manufacture and bulky, taking up valuable space underneath and to the side of the transmissive panel.

Summary of invention

[0009] It is an objective of the invention to at least partly overcome one or more of the above-identified limitations of the prior art.

[001 0] One or more of these objectives, as well as further objectives that may appear from the description below, are at least partly achieved by means of a method for data processing, a computer readable medium, devices for data processing, and a touch-sensing apparatus according to the

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independent claims, embodiments thereof being defined by the dependent claims.

[001 1] An embodiment of the invention provides a touch sensing apparatus, comprising: a light transmissive element that defines a touch surface; a set of emitters arranged around the periphery of the touch surface to emit beams of light into the light transmissive element, wherein a first portion of the beams of light propagate inside the light transmissive element while illuminating the touch surface such that an object touching the touch surface causes an attenuation of the propagating light, and wherein a second portion of the beams of light pass out of the light transmissive element and are reflected to travel above the touch surface, a set of light detectors arranged around the periphery of the touch surface to receive light from the set of emitters from the transmissive element and from above the touch surface, wherein each light detector is arranged to receive light from more than one emitter; a processing element configured to determine, based on output signals of the light detectors, a light energy value for each light path; to generate a transmission value for each light path based on the light energy value; and to operate an image reconstruction algorithm on at least part of the thus-generated transmission values so as to determine the position of the object on the touch surface.

Brief description of drawings

[0012] Embodiments of the invention will now be described in more detail with reference to the accompanying schematic drawings.

[0013] Figure 1 shows a cross section of an FTIR-based touch-sensitive apparatus according to the prior art.

[0014] Figure 2 is a top plan view of an FTIR-based touch-sensitive apparatus.

[001 5] Figure 3 shows a section view of an extended FTI R touch system according to an embodiment of the present invention.

[0016] Figure 4 shows a top plan view of an extended FTIR touch system according to an embodiment of the present invention.

[0017] Figure 5 shows the narrow detection lines within transmissive panel 10.

[0018] Figure 6 shows the broad detection lines above transmissive panel 10.

[001 9] Figure 7 shows the signal profile of detection lines 95 and detection lines 96.

[0020] Figure 8 shows an embodiment of the present invention in which the touch surface is curved.

[0021] Figure 9 shows an embodiment of the present invention with deflectors set back from the edge of the active area.

[0022] Figure 10 shows an embodiment of the present invention having a dust shield.

[0023] Figure 11 shows an embodiment of the present invention having a first set of emitters and detectors for projecting light above transmissive panel 10

and a second set of emitters and detectors for projecting light into transmissive panel 10.

[0024] Figure 12 shows a top plan view of the Figure 11.

[0025] Figure 13 shows a variation of figure 11 wherein the emitters are configured to simultaneously project light above and into transmissive panel 10.

[0026] Figure 14 shows a variation of figure 11 wherein the detectors are configured to simultaneously receive light from above and from within transmissive panel 10.

Description of embodiments

[0027] Before describing embodiments of the invention, a few definitions will be given.

[0028] A "touch object" or "touching object" is a physical object that touches, or is brought in sufficient proximity to, a touch surface so as to be detected by one or more sensors in the touch system. The physical object may be animate or inanimate.

[0029] An "interaction" occurs when the touch object affects a parameter measured by the sensor.

[0030] A "touch" denotes a point of interaction as seen in the interaction pattern.

[0031] Throughout the following description, the same reference numerals are used to identify corresponding elements.

Main Embodiment

[0032] Figure 2 illustrates a top plan view of figure 1 in an example of a touch-sensitive apparatus 100 that is based on the concept of FTIR. Emitters 30a are distributed around the periphery of touch surface 20, to project light into the transmissive panel 10 such that at least part of the light is captured inside the transmissive panel 10 for propagation by internal reflection in the propagation channel. Detectors 30b are distributed around the periphery of touch surface 20, to receive part of the propagating light. The light from each of emitters 30a will thereby propagate inside the transmissive panel 10 to a number of different detectors 30b on a plurality of light paths D.

[0033] Even if the light paths D correspond to light that propagates by internal reflections inside the panel 1, the light paths D may conceptually be represented as "detection lines" that extend across the touch surface 20 to the periphery of touch surface 20 between pairs of emitters 30a and detectors 30b, as shown in figure 2. Thus, the detection lines D correspond to a projection of the light paths D onto the touch surface 20. Thereby, the emitters 30a and detectors 30b collectively define a grid of detection lines D ("detection grid") on the touch surface 20, as seen in a top plan view. The spacing of intersections in the detection grid defines the spatial resolution of the touch-sensitive apparatus 100, i.e. the smallest object that can be detected on the touch surface 20. The width of the detection line is a

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function of the width of the emitters and corresponding detectors. A wide detector detecting light from a wide emitter provides a wide detection line with a broader surface coverage, minimising the space in between detection lines which provide no touch coverage. A disadvantage of broad detection lines may be the reduced touch precision and lower signal to noise ratio.

[0034] As used herein, the emitters 30a may be any type of device capable of emitting radiation in a desired wavelength range, for example a diode laser, a VCSEL (vertical-cavity surface-emitting laser), an LED (light-emitting diode), an incandescent lamp, a halogen lamp, etc. The emitters 30a may also be formed by the end of an optical fiber. The emitters 30a may generate light in any wavelength range. The following examples presume that the light is generated in the infrared (IR), i.e. at wavelengths above about 750 nm. Analogously, the detectors 30b may be any device capable of converting light (in the same wavelength range) into an electrical signal, such as a photo-detector, a CCD device, a CMOS device, etc.

[0035] The detectors 30b collectively provide an output signal, which is received and sampled by a signal processor 130. The output signal contains a number of sub-signals, also denoted "projection signals", each representing the energy of light received by one of light detectors 30b from one of light emitters 30a. Depending on implementation, the signal processor 130 may need to process the output signal for separation of the individual projection signals. The projection signals represent the received energy, intensity or power of light received by the detectors 30b on the individual detection lines D. Whenever an object touches a detection line D, the received energy on this detection line is decreased or "attenuated".

[0036] The signal processor 130 may be configured to process the projection signals so as to determine a property of the touching objects, such as a position (e.g. in a x,y coordinate system), a shape, or an area. This determination may involve a straight-forward triangulation based on the attenuated detection lines, e.g. as disclosed in US7432893 and WO201 0/01 5408, or a more advanced processing to recreate a distribution of attenuation values (for simplicity, referred to as an "attenuation pattern") across the touch surface 20, where each attenuation value represents a local degree of light attenuation. The attenuation pattern may be further processed by the signal processor 130 or by a separate device (not shown) for determination of a position, shape or area of touching objects. The attenuation pattern may be generated e.g. by any available algorithm for image reconstruction based on projection signal values, including tomographic reconstruction methods such as Filtered Back Projection, FFT-based algorithms, ART (Algebraic Reconstruction Technique), SART (Simultaneous Algebraic Reconstruction Technique), etc. Alternatively, the attenuation pattern may be generated by adapting one or more basis functions and/or by statistical methods such as Bayesian inversion.

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Examples of such reconstruction functions designed for use in touch determination are found in WO2009/077962, WO201 1/04951 1, WO201 1/139213, WO201 2/050510, and WO201 3/062471 , all of which are incorporated herein by reference.

[0037] In the illustrated example, the apparatus 100 also includes a controller 120 which is connected to selectively control the activation of the emitters 30a and, possibly, the readout of data from the detectors 30b. Depending on implementation, the emitters 30a and/or detectors 30b may be activated in sequence or concurrently, e.g. as disclosed in US8581884. The signal processor 130 and the controller 120 may be configured as separate units, or they may be incorporated in a single unit. One or both of the signal processor 130 and the controller 120 may be at least partially implemented by software executed by a processing unit 140.

[0038] Figure 3 illustrates an embodiment of the invention extending the FTIR system of figure 1 to include touch detection lines above touch surface 20.

[0039] As with figure 1, figure 3 shows an embodiment of the invention in which light travels inside a transmissive panel 10, from light emitters 30a to detectors 30b, so as to illuminate a touch surface 20 from within the transmissive panel 10. The transmissive panel 10 is made of solid material in one or more layers and may have any shape. The transmissive panel 10 defines an internal radiation propagation channel, in which light beam 50 propagates by internal reflections. In figure 3, the propagation channel is defined between the touch surface 20 and bottom surface 25 of the transmissive panel 10, where the touch surface 20 allows the propagating light beam 50 to interact with touching object 60 and thereby defines the touch surface 20. This is achieved by injecting the light into the transmissive panel 10 via coupling element 40 such that the light is reflected by total internal reflection (TIR) in the touch surface 20 as it propagates through the transmissive panel 10. The light beam 50 may be reflected by TIR on the bottom surface 25 or against a reflective coating thereon. Upon reaching coupling element 40 on a far side of the panel, the light is coupled out of transmissive panel 10 and onto detectors 30b. The touch-sensitive apparatus 100 may be designed to be overlaid on or integrated into a display device or monitor.

[0040] Figure 3 further illustrates that a portion of the light emitted by emitters 30a is transmitted through transmissive panel 10 in a manner that does not cause the light to TIR within transmissive panel 10. Instead, the light the light exits transmissive panel 10 through touch surface 20 and is reflected by reflector surface 80 of edge reflector 70 to travel along path 90a in a plane parallel with touch surface 20. The light will then continue until deflected by reflector surface 80 of the edge reflector 70 at an opposing edge of the transmissive panel 10, wherein the light will be deflected back down through transmissive panel 10 and onto detectors 30b. The feature of

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the transmitting the light from the emitters 30a to reflector surface 80 via transmissive panel 10 has a number of advantages over the solutions presented by the prior art. In particular, manufacture of touch-sensitive apparatus 100 becomes significantly less expensive. This feature allows an arrangement where nothing is in contact with the edges of the transmissive panel 10, allowing expensive finishing (where the transmissive panel 10 is formed from glass) to regulate the edges of the glass to be avoided. Furthermore, fastening of the components to the transmissive panel 10 is simplified and optical tolerances are improved.

[0041] Figure 4 shows a top plan view of the embodiment of figure 3. As viewed from above, light beam 50 travelling through transmissive panel 10 originates from where the light is coupled into the transmissive panel 10 by coupling element 40 at in-coupling point 45. Light beam 90 travelling above touch surface 20 (along path 90a, path 90b) originates from reflector surface focal point 80a of reflector surface 80 where the light emitted from emitters 30a and having passed through transmissive panel 10 is reflected across touch surface 20. The distance travelled by the (un-collimated) light from emitters 30a to reflector surface focal point 80a is greater than the distance travelled by the light from emitters 30a to in-coupling point 45. Consequently, the spread of light reflected from the reflector surface focal point 80a is broader than the spread of light entering the transmissive panel 10 at in-coupling point 45. The resulting effect is equivalent to that of using a wider emitter for emitting the above surface light beam 90 than that of light beam 50, travelling inside the glass. A corresponding effect occurs at the detector end, wherein the light arriving at detectors 30b via the above surface route is reflected onto detectors 30b from a broader area than the area of in-coupling point 45, providing the equivalent effect of broader detectors 30b.

[0042] The result is that detection lines derived from light beam 90 are broader than detection lines derived from light beam 50. Figure 5 and figure 6 show the difference in detection lines 95 derived from the light travelling within the glass and detection lines 96 derived from light travelling above the touch surface. In figure 5, detection lines 95 have a width corresponding to the short distance travelled to the in-coupling point 45 from emitters 30a. In figure 6, detection lines 96 have a width corresponding to the extra distance travelled to reflector surface focal point 80a from emitters 30a.

[0043] A stylus and a finger may have very large differences in size (or width as viewed from the perspective of a detection line). A stylus may typically provide a width of 2mm to 5mm, whereas a finger may provide a width of 5mm to 15mm. However, the size of a decoded touch will depend on the convolution of the detection line and the object. It is preferable to have wider detection lines above the glass, both in order to provide better cover the touch surface 20 and to get a broadened stylus interaction, since this may

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increase the resolution. However, broadening of detection lines will reduce the ability to separate two closely spaced touch objects, potentially a key requirement for multi-touch systems.

[0044] Therefore, a solution with different detection line widths above and within the glass is required. Figure 7 shows a signal profile of a narrow detection line overlaid on a wide detection line. Narrow detection lines 95 have a signal profile corresponding to signal profile 150 and wide detection lines 96 have a signal profile corresponding to signal profile 160.

[0045] Since a stylus will usually be used as a single touch object, broader detection lines are possible. Wide detection lines 96 with a width larger than 4 mm and possibly up to 20 mm are advantageous, although 4mm-6mm is preferred.

[0046] For narrow detection lines 95 designed to resolved multiple touching objects such as fingers, broadening must be kept down to a size less than or comparable to the touching objects. The width of narrow detection lines 95 is also usually limited by the width of emitters 30a and detectors 30b. Narrow detection lines 95 should be less than 5mm in width. In a preferred embodiment, detection lines 95 are between 2mm and 3mm wide.

[0047] In one embodiment, reflector surface 80 is a diffusive reflecting surface. In a preferred embodiment, reflector surface 80 is a lambertian diffusive reflecting surface preferably providing a scattering of greater than 90%. Suitable materials for reflector surface 80 may include Titanium oxide paint or Microcellular foamed reflector MCPET. The advantage of using a diffusive reflecting surface is that it makes the optical system less sensitive to production, mounting and load tolerances than a specular reflector or lens. This allows the touch-sensitive apparatus 100 to be cheaper and simpler to produce. Furthermore, a diffusive reflector surface 80 also allows broader and overlapping detection lines.

[0048] The amount of light reflected by reflector surface 80 may be controlled by adjusting the size of reflector surface 80. A reflector surface 80 having a smaller surface area will reflect a small amount of light. Alternatively, paint or spray coatings may be selected to reduce the reflection, and may be applied in a specific pattern to the surface for accurate control of reflectivity.

[0049] In one embodiment, the amount of light received at each of detectors 30b via the in-glass route (shown in the figures as light beam 50) is greater than or equal to the amount of light received at each of detectors 30b via the above surface route (shown in the figures as light beam 90). In a preferred embodiment, the ratio of light received at each of detectors 30b via the in-glass route is ten times greater than the amount of light received at each of detectors 30b via the above surface route. This feature is advantageous as it allows the attenuation of the optical signal resulting from FTIR to be easily compared at the reconstruction phase to the attenuation of the optical

signal resulting from occlusion of the above surface light, even though the latter is usually significantly larger than the former.

[0050] In the embodiment shown in figure 3, reflector surface 80 is configured to reflect a portion of light beam 90 to travel along path 90a and a portion of light beam 90 to travel along path 90b, by reflecting off touch surface 20 and coupling out to the detector. This advantageously results in a larger portion of light beam 90 being detected by detectors 30b. Furthermore, the use of path 90b allows load tolerances of the touch-sensitive apparatus 100 to be improved. A heavy load on touch surface 20 may deform the panel and bring path 90a out of alignment. However, path 90b would likely be less affected by said deformation, allowing sufficient signal to continue to be received by detectors 30b.

[0051] In an embodiment of the invention shown in figure 8, transmissive panel 10 is curved to form a concave surface. In this embodiment, reflector surface 80 is configured to cause a portion of light beam 90 to reflect a plurality of times off touch surface 20 to follow a path 90c shown in figure 8. Similarly to the above embodiment, this feature allows a further enhancement of the signal to noise ratio, even for a curved panel.

[0052] In an embodiment of the invention shown in figure 9, edge reflector 70 is set further back from the periphery of touch surface 20 than in the previous embodiments. The positioning of the edge reflector 70 further back from the periphery of touch surface 20 provides a longer distance from emitters 30a to reflector surface 80, allowing the above surface detection lines to be broader. Furthermore, the extra distance that the edge reflector 70 is set back provides larger overlap between wide detection lines 96 in the peripheral regions of touch surface 20 resulting in improved accuracy in areas. This is especially advantageous where narrow detection lines 95 provide limited coverage. In a preferred embodiment, the edge reflector 70 is positioned so that reflector surface 80 is set 10 mm back from in-coupling point 45.

[0053] Figure 10 shows an embodiment of the invention featuring dust shield 110. A known problem with above-surface touch systems is the accumulation of dust and contamination around the sensor area or the area in which the light signal is emitted to travel across the touch panel. Dust or other contamination accumulating at this point will block the light signal and seriously degrade the ability of the touch system to determine a touch. For a system such as the embodiment presented in figure 3, the accumulation of contamination may be increased where reflector surface 80 is angled to form an overhang. This overhang forms a natural shelter for accumulating contamination, resulting in further touch signal degradation. A solution presented in figure 10 is that of a dust shield 110 forming a physical barrier preventing the dust from reaching reflector surface 80 and comprising transparent window 115 through which the light signal may pass.

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unhindered. Preferably, dust shield 110 forms a sloping edge, sloping from the inside edge in contact with touch surface 20 outwardly to the top surface of edge reflector 70. This allows dust shield 110 to be effectively wiped clean.

[0054] In a preferred embodiment, transparent window 115 comprises a material of coating configured to allow only IR or Near-IR light to pass through. This feature provides improved ambient light noise reduction as light from artificial lighting or sun light is filtered before reaching detectors 30b.

[0055] In a preferred embodiment, dust shield 110 is configured with a longer dimension extending from edge reflector 70 towards touch surface 20 and with an internal top surface providing a light baffle effect so as to provide an angular filter for light entering through transparent window 115. This is advantageous for reducing ambient noise as light entering at the wrong angle is absorbed into the roof of the dust shield 110. Furthermore, when combined with the embodiment from figure 8, the angle of light paths travelling above the panel may be limited so that that detection lines very high above the glass 90a may be supressed.

[0056] Figure 11 shows an alternative embodiment to the embodiment shown in figure 3. In figure 11, apparatus 100 is configured to transmit light from a first set of emitters 31a to a first set of detectors 31b inside a transmissive panel 10 so as to illuminate a touch surface 20 from within the transmissive panel 10. Apparatus 100 is also configured to transmit light from a second set of emitters 32a to a second set of detectors 32b such that the light is emitted by emitters 32a, exits transmissive panel 10 through touch surface 20 and is reflected by reflector surface 80 of edge reflector 70 to travel along path 90a in a plane parallel with touch surface 20. The light will then continue until deflected by reflector surface 80 of the edge reflector 70 at an opposing edge of the transmissive panel 10, wherein the light will be deflected back down through transmissive panel 10 and onto detectors 32b. Significant advantages may be obtained from using two separate emitting and detecting systems rather than a single set of emitters and detectors for both the above-surface and FTIR light paths. A significant problem with trying to differentiate between the attenuation of the light travelling along a path above the touch surface from the attenuation of light travelling along a path within the panel via FTIR is that a typical finger touch is likely to produce an attenuation of the light above the panel is greater than the attenuation of the light travelling within the panel via FTIR by as much as a factor of 50. This results in an attenuation signal of the light travelling in the panel which is difficult to differentiate from noise relative to the attenuation signal of the light travelling above the panel. For objects such as stylus tips, this relative difference in signal strength can be even greater. Therefore, the use of separate emitting and detecting systems for light paths above (above-surface system) and within the panel via FTIR (FTIR system) allows

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each system to be configured appropriately for the respective signal-to-noise ratios. The separate resulting signals can then be combined to provide a system that provides the following features:

[0057] - Oil or water contamination on the touch surface may appear to the FTIR system as an attenuation surface area and generate a false touch. However, in the above embodiment, the touch output of the FTIR system may be compared to the touch output of the above-surface system to identify touches of the FTIR system which do not appear in the touch output of the above-surface system. This would indicate that the identified touches do not correspond to actual objects above the touch surface but mere contamination on the surface. The output of the identified touches can then be suppressed.

[0058] - Similarly to the above, when a user raises their finger from the touch surface, a previously identified touch should be removed from the touch output. However, on occasion, finger grease from the skin is left on the touch surface and an FTIR system continues to detect and report a touch. In the above embodiment, the output of the above-surface system may be used to identify touches of the FTIR system where the touching object has now been removed. The output of the identified touches can then be suppressed.

[0059] - Certain object types produce very little attenuation of the FTIR light when in contact with the touch surface e.g. Hard objects such as stylus tips. Where the above-surface system registers an object but the FTIR system does not, it can be determined that the object is likely to be a 'hard object' as opposed to a normal touch from a finger. Differentiation between hard and soft surfaced objects may allow differentiation between e.g. a pen and a finger. A touch system configured to differentiate between a stylus and a fingertip may generate a different UI output in dependence on the identified object touching the touch surface.

[0060] - One problem with above-surface systems is that the object touching the touch surface may completely occlude one or more light paths of the above-surface system. Where a large number of touches are simultaneously applied to the touch surface, portions of the touch surface may become significantly shielded from the light paths of the above-surface system, resulting in little or no touch signal in the shielded portion. In the above embodiment, the FTIR may continue to provide a touch signal within the occluded areas, as the attenuation of the FTIR light paths resulting from a touch is relatively small and non-occluding.

[0061] In the embodiment of figure 11, a first wavelength of light emitted by first set of emitters 31a and detected by first set of detectors 31b may be different to a second wavelength of light emitted by second set of emitters 32a and detected by second set of detectors 32b. This allows light to be emitted from one of the first set of emitters 31a and one of the second set of emitters 32a

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simultaneously and detected by the first set of detectors 31b and second set of detectors 32b without co-interference. This may also allow improved ambient light noise reduction in environments where ambient light comprises more light with a first wavelength than light with a second wavelength or vice versa. E.g. Wherein the first and second wavelengths are both near IR wavelengths.

[0062] In the embodiment of figure 11, the timing sequence used to activate emitters of the first and second set of emitters may be chosen to ensure that activation of the emitters of the first set of emitters does not chronologically overlap with activation of emitters of the second set of emitters. This allows potential co-interference to be minimized.

[0063] Figure 12 shows a top plan view of the Figure 11. In this embodiment, emitters 31a are spatially interlaced with emitters 32a around the peripheral edge of transmissive panel 10 so that emitters of first set 31a are positioned between adjacent emitters of second set 32a. Similarly, detectors 31b are spatially interlaced with detectors 32b around the peripheral edge of transmissive panel 10 so that detectors of first set 31b are positioned between adjacent emitters of second set 32b. This has the advantage of improving coverage of the touch surface where detection paths of the above-surface system cover gaps between detection paths of the FTIR system and vice versa.

[0064] In one embodiment, emitters 31a and detectors 31b are only positioned along sub-portions of the periphery of the touch surface. In this embodiment, the portion of the periphery of the touch surface along which emitters 31a and detectors 31b are positioned is smaller than the portion of the periphery of the touch surface along which emitters 31a and detectors 31b are positioned. In one example, emitters 31a and detectors 31b are only located along two opposing edges of a rectangular touch surface. In an alternative embodiment, emitters 31a are placed along one edge of the rectangular touch surface and detectors 31b are positioned along an opposing edge of the touch surface. Alternatively, emitters 31a and detectors 31b may be positioned along L-shaped portions of the periphery of the rectangular touch surface at the corners. In one embodiment, the number of emitters 31a and detectors 31b are fewer than the number of emitters 32a and detectors 32b respectively. This may result in an FTIR system with a lower resolution than the above-surface system. Alternatively, for all of the above arrangements, emitters 31a and detectors 31b may be swapped for emitters 32a and detectors 32b so that the FTIR system has a higher resolution and/or coverage than the above-surface system. These arrangements allow the advantages of a complete above-surface system or FTIR system to be supplemented with the advantages of a limited FTIR system or limited above-surface system respectively without the need for a complete version of both systems. This would allow a significant reduction

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in manufacturing cost, power usage, and even physical size of the touch frame. E.g. Where high accuracy pressure detection needed to be added to an above-surface system, a limited FTIR type system configured to detect pressure (as is known in the art) may be added to the above-surface system with only as many emitters and detectors needed to accurately detect pressure. In one example, the limited system comprises only 25% of the number of emitters and detectors of the complete system.

[0065] In one embodiment, a low-power mode is provided wherein only the above-surface system is powered. When a touch is detected by the above-surface system, a full-power mode is activated and power is provided to the FTIR system. This has the advantage of preserving energy during periods that the above-surface system detects no touches whilst enabling the features of the FTIR system once it is required. Alternatively, an embodiment is provided wherein only the FTIR system is powered in a low-power mode and the above-surface system is only powered on when required. This may include a system wherein the above-surface system is only activated periodically or in response to a determination that a touch detected by the FTIR system is possibly a false touch caused by contamination.

[0066] Figure 13 shows a variation of figure 11 wherein emitters 31a are configured to simultaneously project light above and into transmissive panel 10 but wherein separate detectors 31b and 32b are used to provide separate above-surface and FTIR type touch signals. This advantageously allows simultaneous emission of both signals using a single emitter, allowing low energy consumption and cheaper manufacturing costs, whilst the above features.

[0067] Figure 14 shows an alternative to figure 13 wherein the detectors 31b are configured to simultaneously receive light from above and from within transmissive panel 10 but wherein separate emitters 31a and 32a are used to provide separate above-surface and FTIR type touch signals. This configuration advantageously allows separate control of the light intensity of the light emitted from emitters 31a and 32a to account for environmental light noise or other situations in which light levels need to be separately altered, whilst also allowing low energy consumption and cheaper manufacturing costs.

[0068] For all of the above embodiments, alternative in-coupling and out-coupling solutions used for coupling the light into and out of transmissive panel 10 may be employed according to techniques known in the prior art. E.g. Coupling the light into the edge of the panel rather than from below.

[0069] Furthermore, alternative waveguide, lens, and reflective surface configurations to convey light from emitters 32a to a plane parallel with touch surface 20 and back to detectors 32b may be employed according to

techniques known in the prior art. E.g. Configurations for conveying the light around the edge of the panel rather than through it.

Reference signs list

A. touch-sensitive apparatus 100
B. transmissive panel 10
C. touch surface 20
D. bottom surface 25
E. emitters 30a
F. detectors 30b
G. coupling element 40
H. in-coupling point 45
I. light beam 50
J. touching object 60
K. edge reflector 70
L. reflector surface 80
M. reflector surface focal point 80a
N. light beam 90
O. path 90a
P. path 90b
Q. path 90c
R. detection lines 95
S. detection lines 96
T. dust shield 110
U. transparent window 115
V. light paths D
W. controller 120
X. signal processor 130
Y. processing unit 140
Z. signal profile 150
AA. signal profile 160

CLAIMS

1. A touch sensing apparatus, comprising:

a light transmissive element that defines a touch surface;

a first set of emitters arranged around a first portion of the periphery of the touch surface to emit first beams of light into the light transmissive element, wherein the first beams of light propagate inside the light transmissive element while illuminating the touch surface,

a second set of emitters arranged around a second portion of the periphery of the touch surface to emit second beams of light, wherein the second beams of light are reflected to travel above the touch surface,

a first set of light detectors arranged around a third portion of the periphery of the touch surface to receive light from the first set of emitters from the transmissive element

a second set of light detectors arranged around a fourth portion of the periphery of the touch surface to receive light from the second set of emitters from above the touch surface,

wherein each light detector is arranged to receive light from more than one emitter;

a processing element configured to determine, based on output signals of the first and second set of light detectors, the position of an object on the touch surface.

2. The touch sensing apparatus of claim 1, wherein the first and second set of emitters comprise at least one common emitter.

3. The touch sensing apparatus of claim 1, wherein the first and second set of detectors comprise at least one common detector.

4. The touch sensing system of any preceding claim wherein the processing element is configured to perform a first touch determination based on signals of the first set of light detectors and a second touch determination based on signals of the second set of light detectors, and wherein the the position of an object on the touch surface is determined in dependence on the first touch determination and second touch determination.

5. The touch sensing system of claim 4, wherein the processing element is configured to determine that the object is not touching the touch surface when the first touch determination indicates the presence of the object but the second touch determination indicates the absence of the object.

6. The touch sensing system of claim 4, wherein the processing element is configured to determine that the object is of a first object type when the first touch

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determination indicates the absence of the object but the second touch determination indicates the presence of the object.

7. The touch sensing system of claim 4, wherein the processing element is configured to determine the position of an object on the touch surface in dependence on just the first touch determination when the object is occluded from the second beams of light.

8. The touch sensing system of any preceding claim wherein the first set of emitters is configured to emit light at a first wavelength and the first set of emitters is configured to detect light at the first wavelength, and wherein the second set of emitters is configured to emit light at a second wavelength and the second set of emitters is configured to detect light at the second wavelength.

9. The touch sensing system of any preceding claim wherein the touch sensing system is configured to activate the first set of emitters and the second set of emitters at non-overlapping times.

10. The touch sensing apparatus of any preceding claim, wherein the touch sensing system is configured to operate in a low-power mode wherein just the second set of emitters are powered, and wherein when the processing element determines the presence of an object on the touch surface from the second set of light detectors, entering a higher-power mode wherein the first and second set of emitters are powered.

11. The touch sensing apparatus of claims 1-9, wherein the touch sensing system is configured to operate in a low-power mode wherein just the first set of emitters are powered, and wherein when the processing element determines the presence of an object on the touch surface from the first set of light detectors, entering a higher-power mode wherein the first set of emitters are powered and the second set of emitters are at least intermittently powered.

12. The touch sensing apparatus of any preceding claim, wherein the first and/or third portion is larger than the second and/or fourth portion.

13. The touch sensing apparatus of any preceding claim, wherein the number of the first set of emitters and/or first set of detectors is larger than the number of the second set of emitters and/or second set of detectors.

14. The touch sensing apparatus of claim 11, wherein the ratio of the first set of emitters and/or first set of detectors to the number of the second set of emitters and/or second set of detectors is 4:1 .

15. The touch sensing apparatus of any preceding claim, wherein the first and second set of emitters are spatially interleaved along the periphery of the touch surface.

DRAWINGS

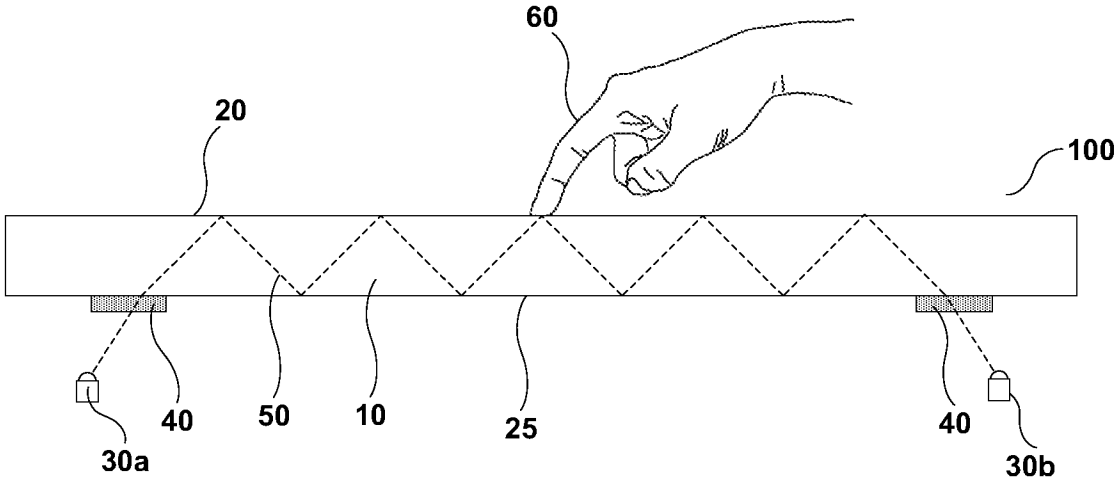


Figure 1

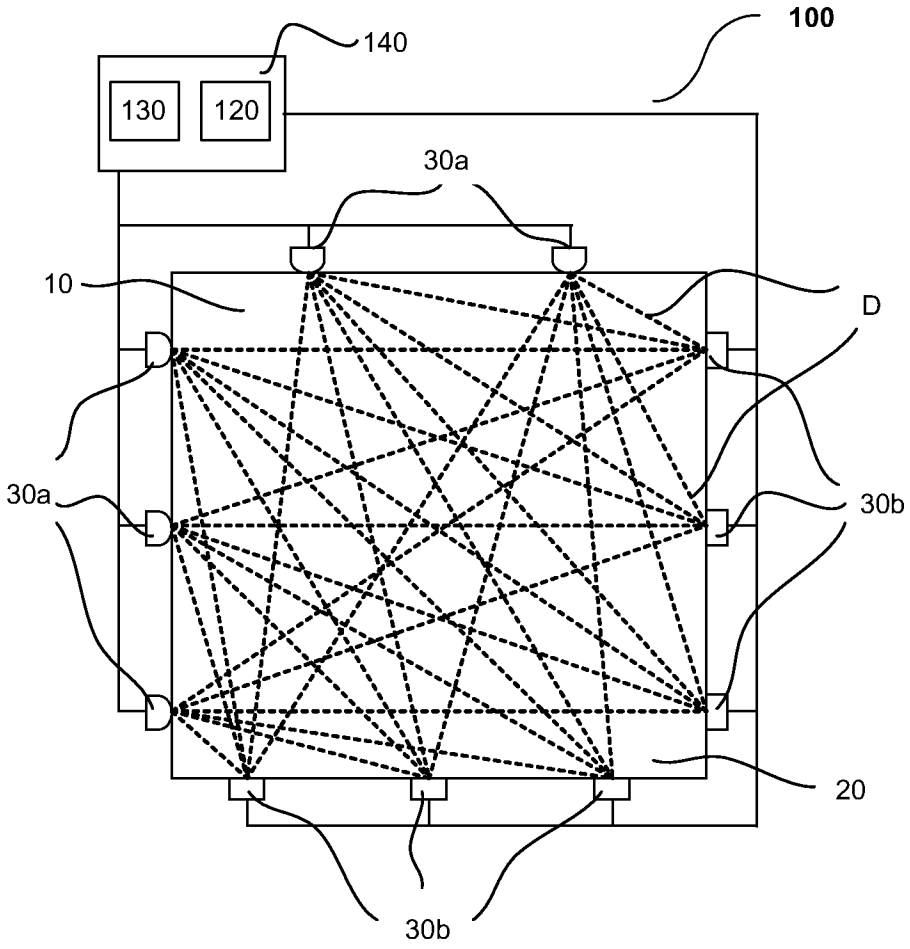


Figure 2

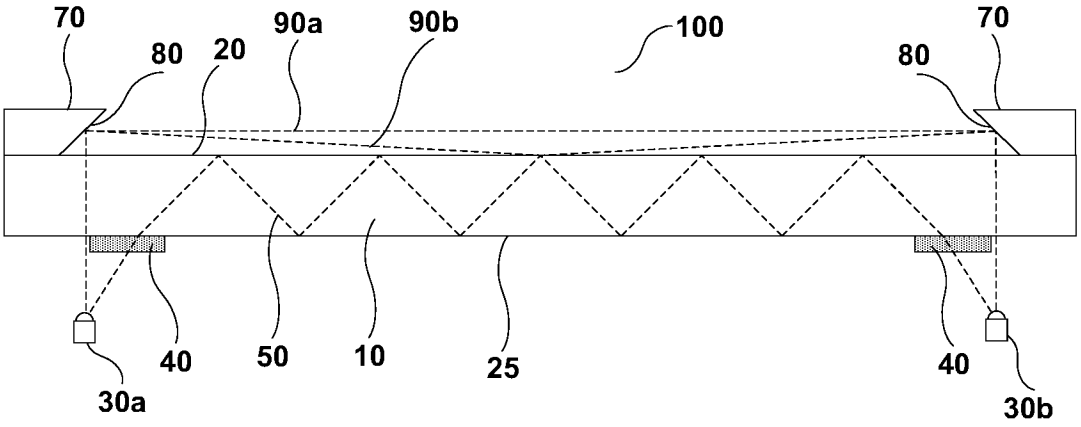


Figure 3

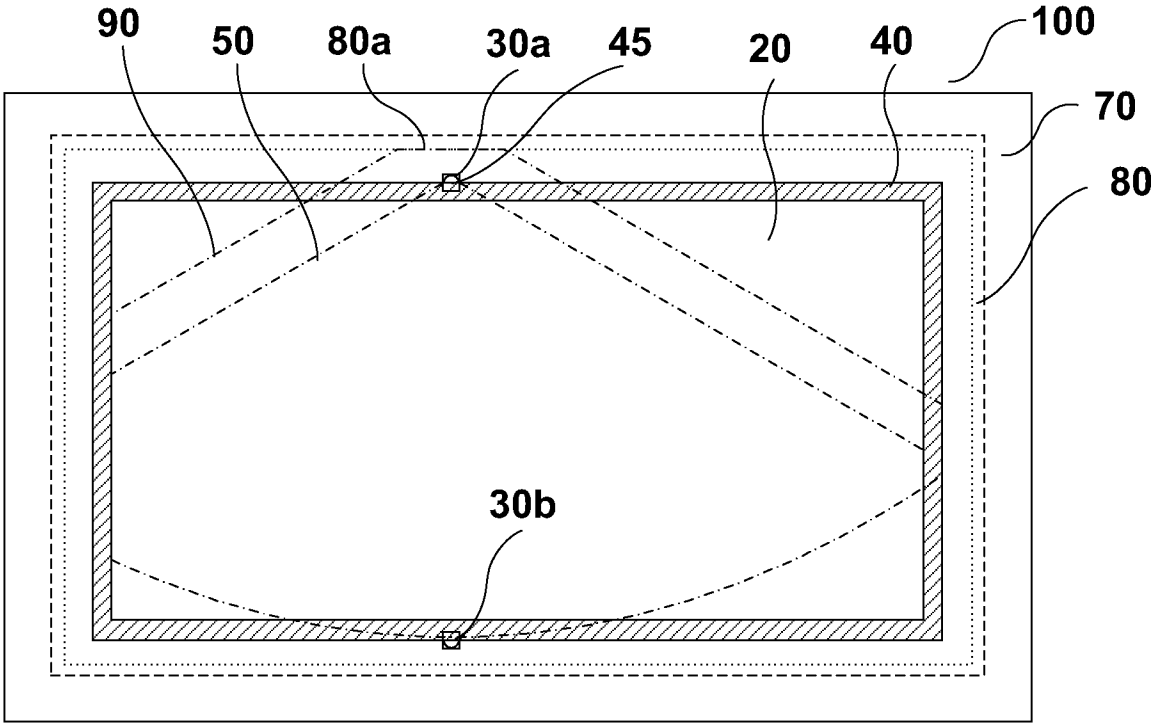


Figure 4

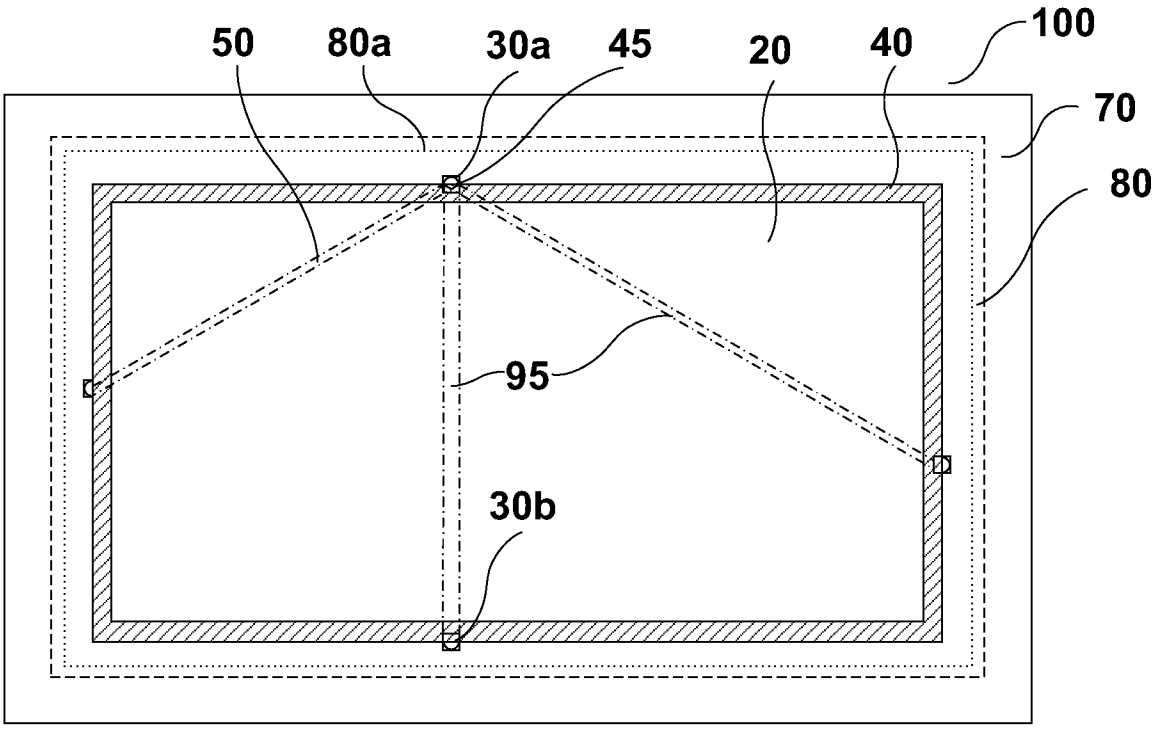


Figure 5

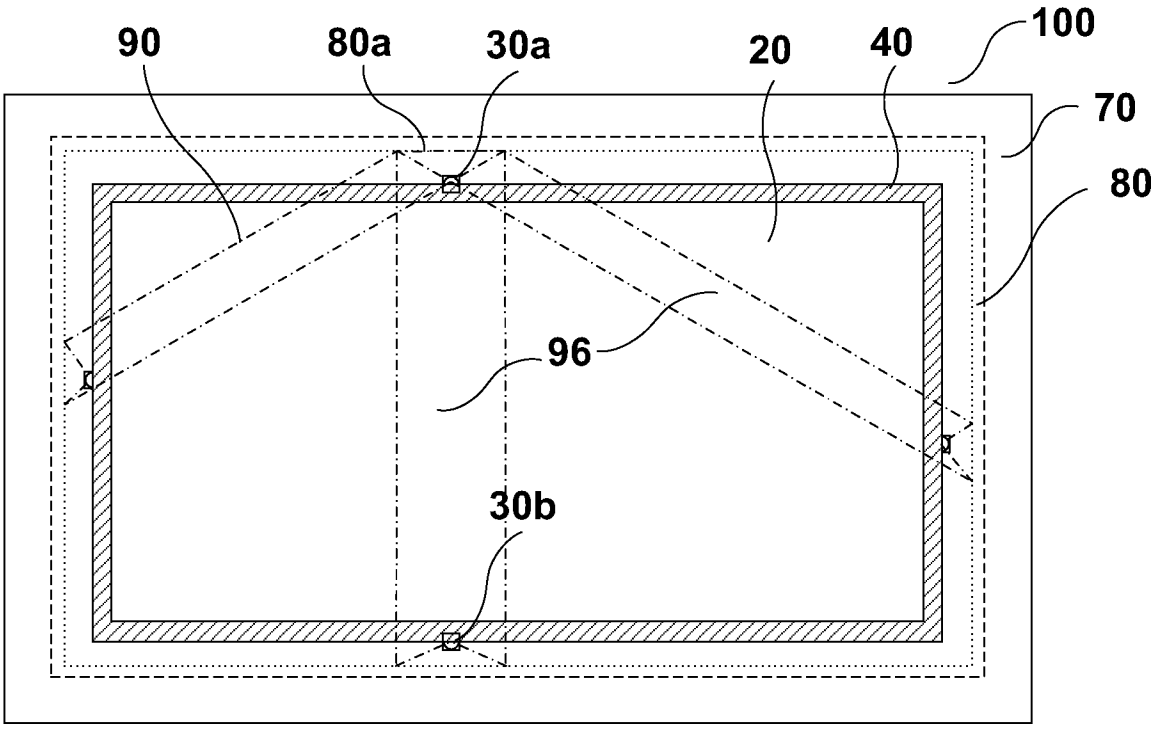


Figure 6

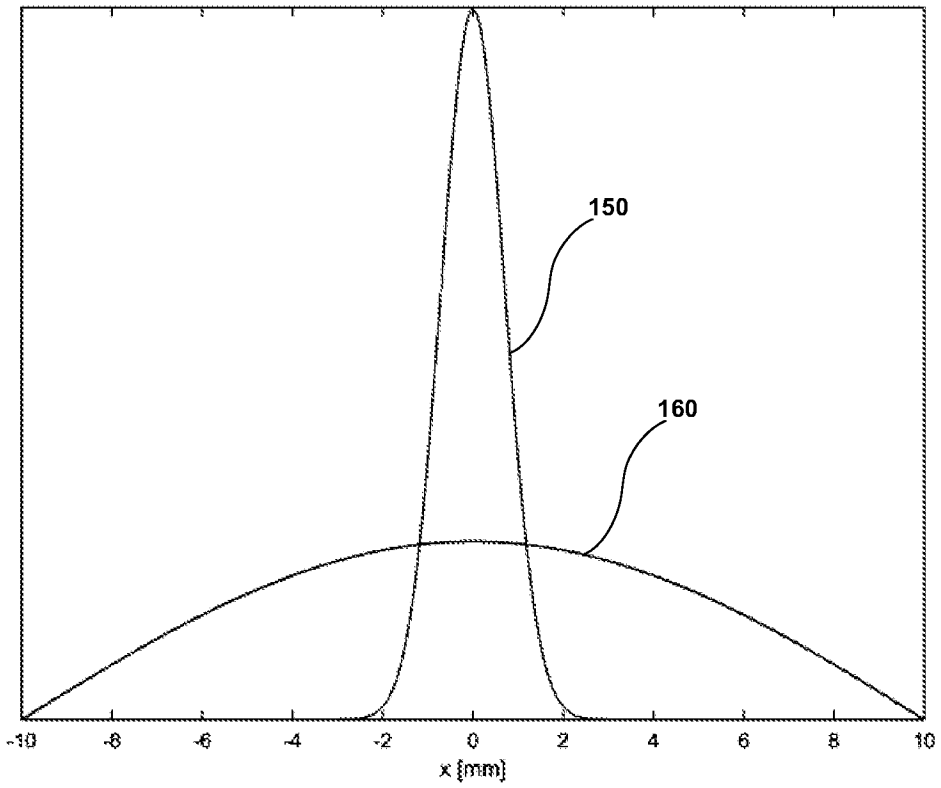


Figure 7

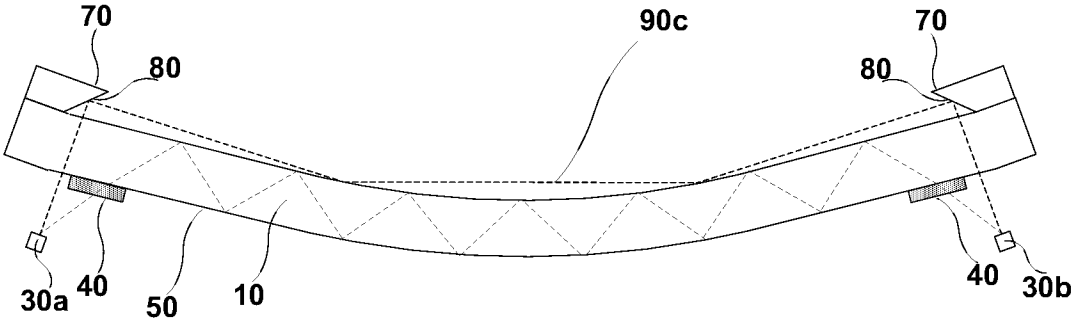


Figure 8

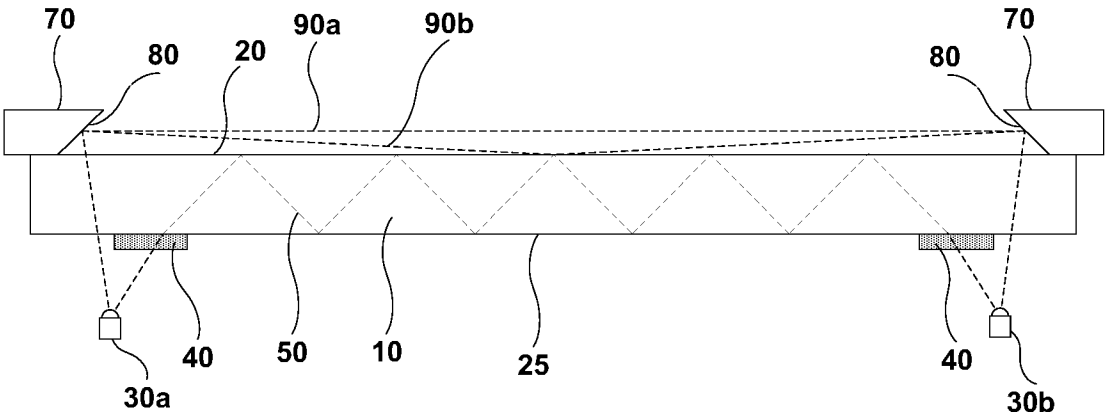


Figure 9

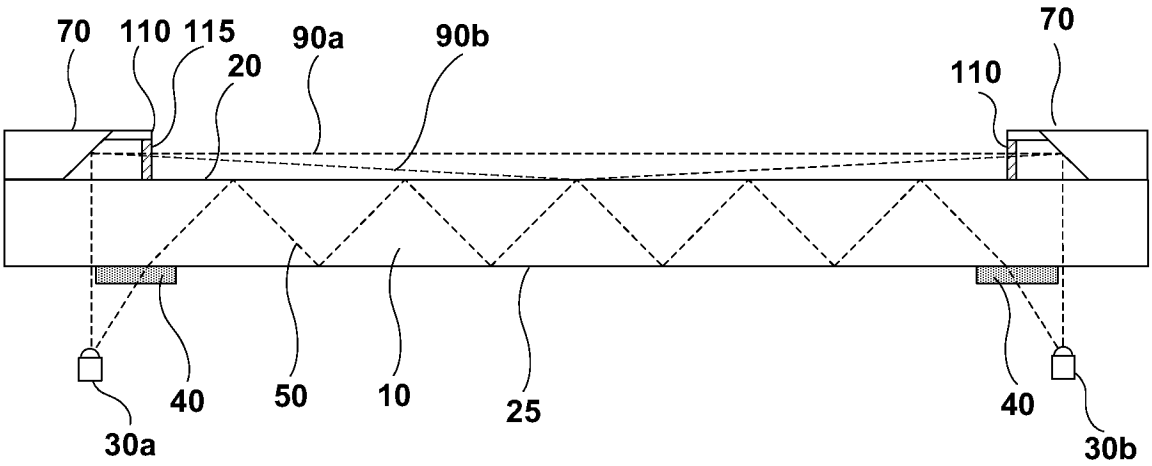


Figure 10

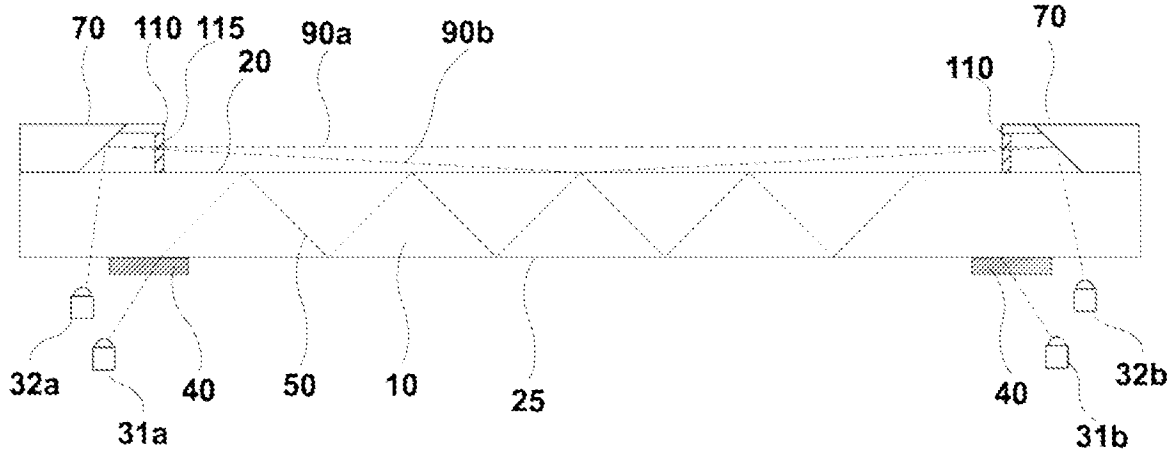


Figure 11

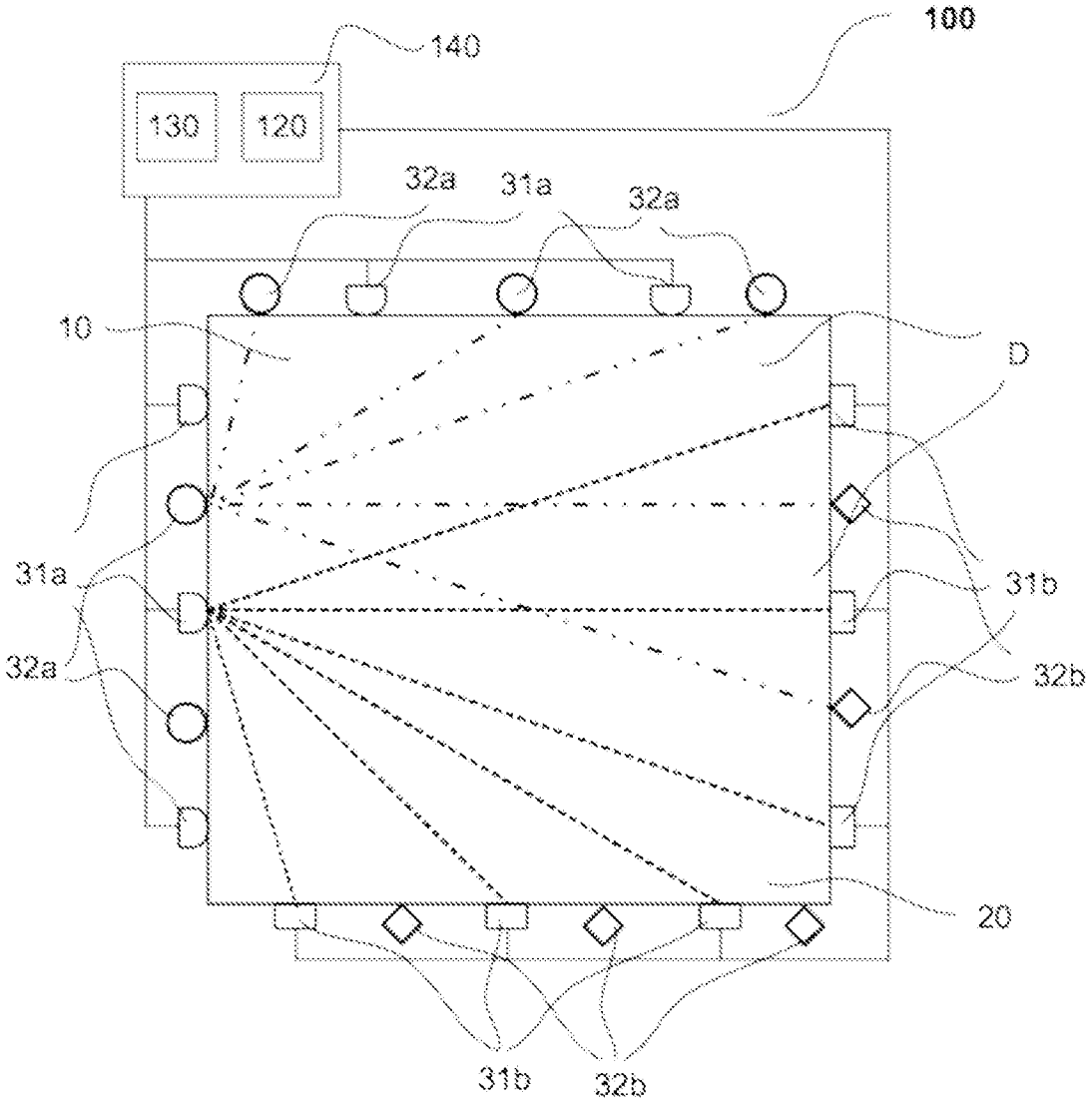


Figure 12

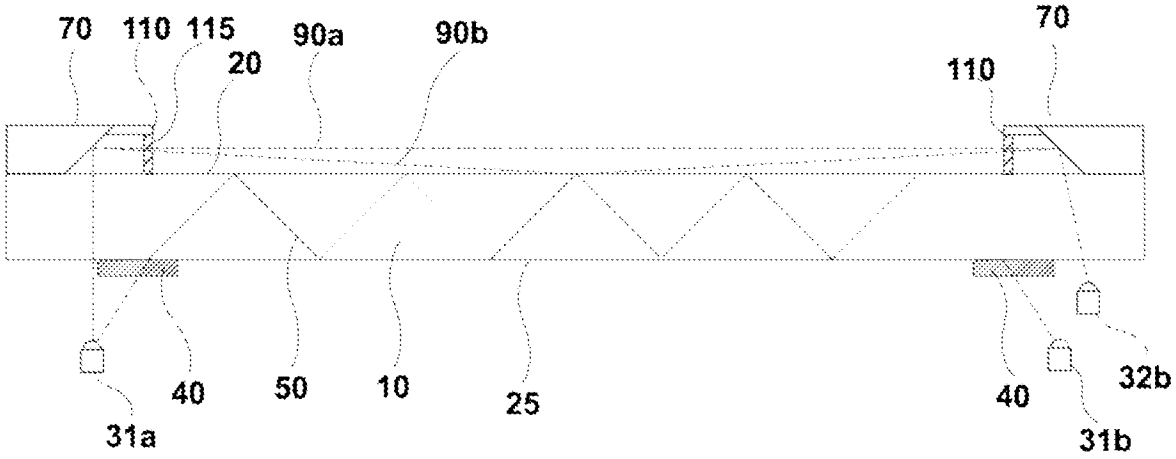


Figure 13

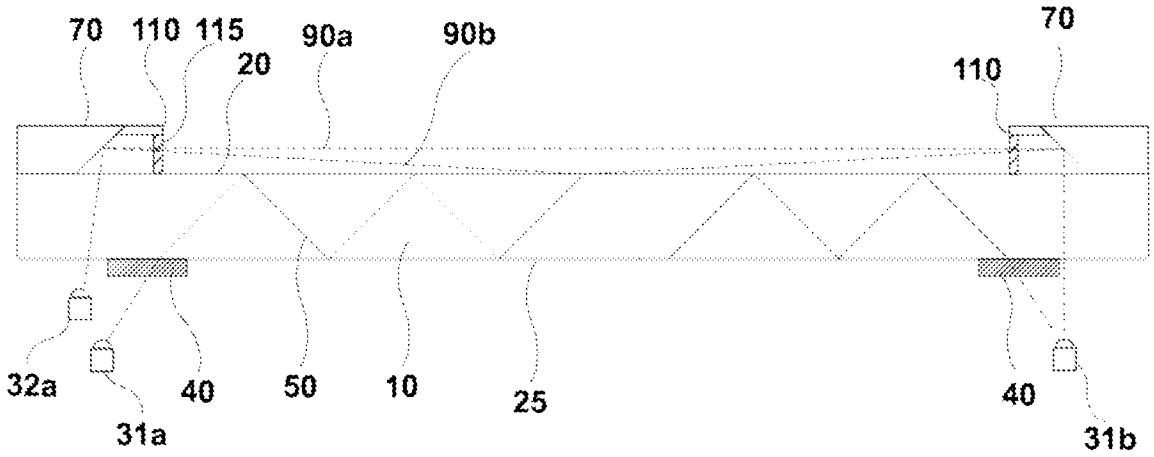


Figure 14

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE201 6/050098

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: G06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE, DK, FI, NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, PAJ, WPI data, COMPENDEX, INSPEC, IBM-TDB

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category' *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 201 301 55027 A 1 (HOLMGREN STEFAN ET AL), 20 June 2013 (201 3-06-20); paragraphs [021 2], [0246], [031 1], [0374], [0388], [041 5]-[041 9]; figures 18,31 ,1 26 --	1-15
A	US 201 401 92023 A 1 (HOFFMAN DAVID), 10 July 201 4 (201 4-07-1 0); paragraphs [0008]-[001 1], [0026]-[0028], [0045]-[0048], [0050], [0057], [0070], [0072]; figure 1 --	1-15
A	US 201 10221 705 A 1 (YI KWON JU ET AL), 15 January 201 4 (2014-01 -15); paragraphs [0008]-[0009], [001 2], [001 8]-[001 9], [0037]-[0038], [0047], [0049], [0063]-[0069], [0078]-[0089]; figures 1,7-1 0 --	1-15

☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
28-06-201 6	29-06-201 6

Name and mailing address of the ISA/SE	Authorized officer
Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM	Alexander Lakic

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Chemtronics Exhibit 1032 Page 436

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 201 10122075 A1 (SEO YOUNG-KWANG ET AL), 26 May 201 1 (201 1-05-26); paragraphs [0065], [0069]; figures 3,5 --	1-15
A	YOUNGSEOK AHN et al. "A slim and wide multi-touch tabletop interface and its applications", 2014 International Conference on Big Data and Smart Computing (BIGCOMP), 2014-01-15, IEEE, p. 276-281 , ISSN: 2375-933X; whole document --	1-15

International application No.
PCT/SE201 6/050098

Continuation of: second sheet

International Patent Classification (IPC)

G06F 3/042 (2006.01)

US	201301 55027	A 1	20/06/201 3	US	20140071 094	A 1	13/03/2014
				US	8553014	B2	08/1 0/201 3
us	201401 92023	A 1	10/07/2014	US	9223442	B2	29/1 2/201 5
us	201 10221 705	A 1	15/01/2014	CN	1021 93686	B	17/02/201 6
				EP	2365423	A2	14/09/201 1
				KR	201 10103140	A	20/09/201 1
us	201 1 0 122075	A 1	26/05/201 1	EP	2325735	A2	25/05/201 1
				KR	201 10056892	A	31/05/201 1

INFORMATION DISCLOSURE STATEMENT

First Inventor: Aleksander Kocovski	**Conf. No.:** 5417
App. No.: 16/403283	**Filed:** May 3, 2019
Examiner: Lam, Vinh Tang	**Art Unit:** 2628
Title: TOUCH DEVICE	

Mail Stop RCE
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

References and Listing

Pursuant to 37 CFR 1.56, an Information Disclosure Statement listing references is provided herewith. Copies of any listed foreign and non-patent literature references are being submitted.

No Disclaimers

To the extent that anything in the Information Disclosure Statement or the listed references could be construed as a disclaimer of any subject matter supported by the present application, Applicant hereby rescinds and retracts such disclaimer.

Notification of Related Litigation Filing

Submitted herewith in the above-identified application is an Information Disclosure Statement listing references for consideration. These references are being submitted pursuant to MPEP § 2001.06(c) in that U.S. Patent Nos. 10,282,035, 10,606,414, and 10,606,416, are currently or have been involved in litigation, namely, *FLATFROG LABORATORIES AB vs. PROMETHEAN LTD. AND PROMETHEAN INC.*, (C.A. No. 19-2246-MN). One or more of these patents may be related, or claimed as part of the priority claim of the present application, or may claim a priority benefit of applications and patents that are part of the present application's claim for priority under 35 U.S.C. § 120.

To the best of the undersigned's understanding, the references submitted herewith represent documents or document portions that are non-confidential as defined by any protective order governing information exchanged between the parties to the litigation mentioned above.

Timing of Disclosure

This Information Disclosure Statement is being filed within three months of the filing date or date of national phase entry, with an RCE or before receipt of a First Office Action after an RCE, and no fee is believed to be required.

The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment, to Account No. 11-1410.

Respectfully submitted,

KNOBBE, MARTENS, OLSON & BEAR, LLP

Dated: September 27, 2021

By: /Harnik Shukla/
Harnik Shukla
Registration No. 73,097
Registered Practitioner
(949) 760-0404

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Chemtronics Exhibit 1032 Page 441

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 16/403,283	Filing Date 05/03/2019	☐ To be Mailed

ENTITY: ☑ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $100 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $460 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	09/27/2021	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 6	Minus	** 22	= 0		x $100 =	0
	Independent (37 CFR 1.16(h))	* 1	Minus	*** 3	= 0		x $480 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	0

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	LIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/ANTHONY TYSON/
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".	
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.	

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/403,283	05/03/2019	Aleksander Kocovski	FFOG.053C3	5417

7590 08/30/2021

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2040 MAIN STREET
FOURTEENTH FLOOR
IRVINE, CA 92614

EXAMINER	
LAM, VINH TANG	
ART UNIT	PAPER NUMBER
2628	

DATE MAILED: 08/30/2021

PRIORITY ACKNOWLEDGMENT

☐ 1. Receipt is acknowledged of priority papers submitted under 35 U.S.C. 119. The papers have been placed of record in the file.

☑ 2. Applicant's claim for priority, based on papers filed in parent Application Number PCT/SE2017/051233 submitted under 35 U.S.C. 119, is acknowledged.

☐ 3. The priority papers, submitted _____, after payment of the issue fee are

- ☐ acknowledged
  While the priority claim or certified copy filed will be placed in the file record, neither will be reviewed and the patent when published will not include the priority claim.
  See 37 CFR 1.55(a)(2).
- ☐ not acknowledged since the processing fee in 37 CFR 1.17(i) has not been received.

☐ 4. For utility and plant applications filed on or after November 29, 2000, the priority claim is not entered because the claim was not presented within the time limit required by 37 CFR 1.55(a)(1). A petition to accept a delayed claim for priority under 35 U.S.C. 119(a) - (d) or (f), or 365(a) may be filed. See 37 CFR 1.55(c) and MPEP 201.14(a).

/M.G./ for:
571-272-4200 or 1-888-786-0101
Application Assistance Unit
Office of Data Management

PTOL-147 (Rev. 03/08)

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 443

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
16/403,283	05/03/2019	2628	2080	FFOG.053C3	1	1

CONFIRMATION NO. 5417

CORRECTED FILING RECEIPT

20995
KNOBBE MARTENS OLSON & BEAR LLP
2040 MAIN STREET
FOURTEENTH FLOOR
IRVINE, CA 92614

OC000000128019597

Date Mailed: 08/27/2021

Receipt is acknowledged of this non-provisional utility patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF FIRST INVENTOR, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection.

Please verify the accuracy of the data presented on this receipt. If an error is noted on this Filing Receipt, please submit a written request for a corrected Filing Receipt, including a properly marked-up ADS showing the changes with strike-through for deletions and underlining for additions. If you received a "Notice to File Missing Parts" or other Notice requiring a response for this application, please submit any request for correction to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections provided that the request is grantable.

Inventor(s)

Aleksander Kocovski, Malmo, SWEDEN;
Hakan Bergstrom, Torna-Hallestad, SWEDEN;
Jens Thorvinger, Lund, SWEDEN;

Applicant(s)

Flatfrog Laboratories AB, Lund, SWEDEN;

Power of Attorney: The patent practitioners associated with Customer Number 20995

Domestic Priority data as claimed by applicant

This application is a CON of 16/190,907 11/14/2018 PAT 10282035
which is a CON of PCT/SE2017/051233 12/07/2017

Foreign Applications (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.)
SWEDEN 1630294-5 12/07/2016 Access Code Provided

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

Chemtronics v. FlatFrog
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Request to Retrieve - This application either claims priority to one or more applications filed in an intellectual property Office that participates in the Priority Document Exchange (PDX) program or contains a proper **Request to Retrieve Electronic Priority Application(s)** (PTO/SB/38 or its equivalent). Consequently, the USPTO will attempt to electronically retrieve these priority documents.

If Required, Foreign Filing License Granted: 05/17/2019
The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 16/403,283**
Projected Publication Date: Not Applicable
Non-Publication Request: No
Early Publication Request: No
Title

TOUCH DEVICE

Preliminary Class

345

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific

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countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign AssetsControl, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

SelectUSA

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The U.S. offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to promote and facilitate business investment. SelectUSA provides information assistance to the international investor community; serves as an ombudsman for existing and potential investors; advocates on behalf of U.S. cities, states, and regions competing for global investment; and counsels U.S. economic development organizations on investment attraction best practices. To learn more about why the United States is the best country in the world to develop

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UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
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Alexandria, Virginia 22313-1450
www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

20995 7590 08/24/2021

KNOBBE MARTENS OLSON & BEAR LLP
2040 MAIN STREET
FOURTEENTH FLOOR
IRVINE, CA 92614

EXAMINER
LAM, VINH TANG

ART UNIT	PAPER NUMBER
2628	

DATE MAILED: 08/24/2021

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/403,283	05/03/2019	Aleksander Kocovski	FFOG.053C3	5417

TITLE OF INVENTION: TOUCH DEVICE

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	11/24/2021

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Maintenance fees are due in utility patents issuing on applications filed on or after Dec. 12, 1980. It is patentee's responsibility to ensure timely payment of maintenance fees when due. More information is available at www.uspto.gov/PatentMaintenanceFees.

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PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

20995 7590 08/24/2021

KNOBBE MARTENS OLSON & BEAR LLP
2040 MAIN STREET
FOURTEENTH FLOOR
IRVINE, CA 92614

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/403,283	05/03/2019	Aleksander Kocovski	FFOG.053C3	5417

TITLE OF INVENTION: TOUCH DEVICE

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	11/24/2021

EXAMINER	ART UNIT	CLASS-SUBCLASS
LAM, VINH TANG	2628	345-175000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-09 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list

(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,

(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 _____

2 _____

3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

(B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. Fees submitted: ❑ Issue Fee ❑ Publication Fee (if required) ❑ Advance Order - # of Copies _____

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

❑ Electronic Payment via EFS-Web ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. _____

5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29

❑ Applicant asserting small entity status. See 37 CFR 1.27

❑ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 1 of 3

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/403,283	05/03/2019	Aleksander Kocovski	FFOG.053C3	5417

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KNOBBE MARTENS OLSON & BEAR LLP
2040 MAIN STREET
FOURTEENTH FLOOR
IRVINE, CA 92614

EXAMINER	
LAM, VINH TANG	

ART UNIT	PAPER NUMBER
2628	

DATE MAILED: 08/24/2021

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

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Chemtronics Exhibit 1032 Page 450

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	Application No. 16/403,283	Applicant(s) Kocovski et al.	
	Examiner VINH T LAM	Art Unit 2628	AIA (FITF) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to 08/09/2021.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☑ The allowed claim(s) is/are 2-20 . As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see **http://www.uspto.gov/patents/init_events/pph/index.jsp** or send an inquiry to **PPHfeedback@uspto.gov.**

4. ☑ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☐ All b) ☐ Some* c) ☑ None of the:

   1. ☑ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☑ Notice of References Cited (PTO-892)
2. ☐ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☐ Examiner's Amendment/Comment
6. ☑ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/VINH T LAM/
Primary Examiner, Art Unit 2628

EXAMINER'S STATEMENT OF REASONS FOR ALLOWANCE

Notice of Pre-AIA or AIA Status

1. The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Priority

2. Acknowledgment is made of applicant's claim for foreign priority based on an application filed in **SE** on **12/07/2016**. It is noted, however, that applicant has not filed a certified copy of the 16302945 application as required by 37 CFR 1.55.

Response to Arguments

3. Applicant's arguments, see P. **6**, filed **08/09/2021**, with respect to **Rejections** under **35 U.S.C. § 103** have been fully considered and are persuasive. The **Rejections** under **35 U.S.C. § 103** have been withdrawn.

Allowable Subject Matter

4. Claims **2-20** are allowed.

5. The following is an examiner's statement of reasons for allowance:

Kukulj (US PGPub./Pat. 20120223916) teaches infrared-style touch screens are described having light emission means and light detection means along only two opposing sides of a touch input area, which are nevertheless able to detect and locate a touch object in two dimensions. Certain embodiments use an edge-blurring algorithm to determine the second coordinate, while other embodiments use a form of stereo-scopic vision to determine both coordinates by triangulation. These touch screens have minimal bezel width along two opposing sides of the touch input area, and also offer cost reductions associated with components and product assembly and manufacturing.

KWON et al. (US PGPub./Pat. 20170147105) teach the touch input device comprises a base including a metal composite; a first pattern groove formed concavely in one surface of the base, a second pattern groove formed concavely in the other surface of the base; a first sensing pattern disposed in the first pattern groove and including a conductive material; a second sensing pattern disposed in the second pattern groove and including a conductive material; and a wire connecting the first sensing pattern and the second sensing pattern to an integrated circuit.

The subject matter of the independent claims could either not be found or was not suggested in the prior art of record. The subject matter not found was a touch device including

"…a first edge and a second edge adjacent to the short edge; and a third edge and a fourth edge adjacent to the long edge;

wherein the touch surface is curved relative to a flat plane defined in part by the short edge and the long edge;

wherein a distance between a first curved line drawn on the touch surface and a second straight line drawn on the flat plane varies according to a concave curve function; wherein the first, second, third, and fourth edges are curved." (Claim **1**),

"…a longitudinal edge portion configured to contact at least a first corner and a second corner of the rectangular plate, wherein the longitudinal edge portion is curved such that a distance in a vertical plane between the longitudinal edge portion and a straight line between the first corner and the second corner varies according to a concave curve function and wherein the curved edge portion is configured to enable curvature in the rectangular plate..." (Claim **13**),

in combination with the other elements (or steps) of the device or apparatus and method recited in the claims.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably

accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to VINH TANG LAM whose telephone number is (571) 270-3704. The examiner can normally be reached on Monday to Friday 8:00 AM to 5:00 PM.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nitin K Patel can be reached on (571) 272-7677. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see https://ppair-

my.uspto.gov/pair/PrivatePair. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/VINH T LAM/
Primary Examiner, Art Unit 2628

Notice of References Cited	Application/Control No. 16/403,283	Applicant(s)/Patent Under Reexamination Kocovski et al.	
	Examiner VINH T LAM	Art Unit 2628	Page 1 of 2

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-9280237-B2	03-2016	Kukulj; Dax	G06F3/0428	1/1
*	B	US-20150331546-A1	11-2015	CRAVEN-BARTLE; Thomas	G02B6/0038	345/175
*	C	US-9063614-B2	06-2015	Pettersson; Robert	G06F3/0421	1/1
*	D	US-20120089348-A1	04-2012	Perlin; Kenneth	G06F3/04144	702/41
*	E	US-20160334942-A1	11-2016	Wassvik; Ola	G06F3/0428	1/1
*	F	US-4986662-A	01-1991	Bures; Milan	G06F3/0421	250/221
*	G	US-20120223916-A1	09-2012	Kukulj; Dax	G06F3/0428	345/175
*	H	US-20160295711-A1	10-2016	RYU; Hyunjong	H05K5/03	1/1
*	I	US-20170308236-A1	10-2017	LEE; Jun Goo	G06F3/04182	1/1
*	J	US-10860142-B1	12-2020	Northcott; Malcolm J.	G02B6/04	1/1
*	K	US-9563298-B2	02-2017	Sakashita; Asako	G06F3/041	1/1
*	L	US-20170147105-A1	05-2017	KWON; Gideok	G06F3/0445	1/1
*	M	US-20170075494-A1	03-2017	Kwon; Gideok	C23C18/1603	1/1

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	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Notice of References Cited	Application/Control No. 16/403,283	Applicant(s)/Patent Under Reexamination Kocovski et al.	
	Examiner VINH T LAM	Art Unit 2628	Page 2 of 2

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-20170075476-A1	03-2017	KWON; Gideok	G06F3/04883	1/1
*	B	US-20160147375-A1	05-2016	BOK; Seung Lyong	G06F3/0421	345/175
*	C	US-10642386-B2	05-2020	Makelainen; Esa	G06F3/04164	1/1
*	D	US-10126897-B2	11-2018	Kwon; Gideok	B60K37/06	1/1
	E					
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	I					
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	K					
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FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
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	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/403,283	Kocovski et al.
	Examiner	**Art Unit**
	VINH T LAM	2628

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
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2	3	=	=	✓	✓	=				
3	4	=	=	✓	✓	=				
4	5	=	=	✓	✓	=				
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-	22		✓	✓	✓	-				
-	23		✓	✓	✓	-				

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Chemtronics Exhibit 1032 Page 460

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/403,283	Kocovski et al.
	Examiner	**Art Unit**
	VINH T LAM	2628

CPC								
Symbol							**Type**	**Version**
G06F	/	3	/	0421			F	2013-01-01
G06F	/	1	/	1652			I	2013-01-01
G06F	/	1	/	16			I	2013-01-01
G06F	/	3	/	041			I	2013-01-01
G06F	/	2203	/	04102			A	2013-01-01
G06F	/	2203	/	04103			A	2013-01-01

CPC Combination Sets								
Symbol							**Type**	**Set**	**Ranking**	**Version**
	/		/							

None		Total Claims Allowed:	
(Assistant Examiner)	(Date)	19	
/VINH T LAM/ Primary Examiner, Art Unit 2628	17 August 2021	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office

Part of Paper No.: 20210816

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Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/403,283	Kocovski et al.
	Examiner	**Art Unit**
	VINH T LAM	2628

INTERNATIONAL CLASSIFICATION				
CLAIMED				
G06F	/	3	/	042
G06F	/	1	/	16
G06F	/	3	/	041

NON-CLAIMED				
	/		/	

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**

CROSS REFERENCES(S)						
CLASS	**SUBCLASS (ONE SUBCLASS PER BLOCK)**					

None (Assistant Examiner) (Date)		**Total Claims Allowed:** 19	
/VINH T LAM/ Primary Examiner, Art Unit 2628 (Primary Examiner)	17 August 2021 (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 1

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Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/403,283	Kocovski et al.
	Examiner	Art Unit
	VINH T LAM	2628

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIMS

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
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3	4	12	13	-	22										
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None (Assistant Examiner)	(Date)	**Total Claims Allowed:** 19	
/VINH T LAM/ Primary Examiner, Art Unit 2628 (Primary Examiner)	17 August 2021 (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 1

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/403,283	Kocovski et al.
	Examiner	Art Unit
	VINH T LAM	2628

CPC - Searched*		
Symbol	Date	Examiner
G06F3/0421 G06F2203/04103	08/17/2021	vl

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
Search inventor'(s)' name(s). No ODP.	02/13/2020	vl
Search technical terms and synonyms.	08/17/2021	vl
Search IDS.	03/17/2021	vl
Search Foreign Patent Literature(s) and NPL (IP.com).	08/17/2021	vl
Search CPC.	08/17/2021	vl
Search EAST.	08/17/2021	vl
Review amendment and argument.	08/17/2021	vl

/VINH T LAM/ Primary Examiner, Art Unit 2628	

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Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/403,283	Kocovski et al.
	Examiner	Art Unit
	VINH T LAM	2628

Interference Search			
US Class/CPC Symbol	**US Subclass/CPC Group**	**Date**	**Examiner**
Search all of the above.	Search all of the above.	08/17/2021	vl

/VINH T LAM/ Primary Examiner, Art Unit 2628	

Chemtronics v. FlatFrog
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Bibliographic Data

Application No: 16/403,283

Foreign Priority claimed: (•) Yes ( ) No

35 USC 119 (a-d) conditions met: ( ) Yes (•) No | ( ) Met After Allowance

Verified and Acknowledged: /VINH T LAM/ | Examiner's Signature | Initials

Title: TOUCH DEVICE

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
05/03/2019	345	2628	FFOG.053C3
RULE			

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Hakan Bergstrom, Torna-Hallestad, SWEDEN

Jens Thorvinger, Lund, SWEDEN

CONTINUING DATA

This application is a CON of 16190907 11/14/2018 PAT 10282035

This application is a CON of PCT/SE2017/051233 12/07/2017

FOREIGN APPLICATIONS

SWEDEN SE1630294-5 12/07/2016

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EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
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EAST Search History (Prior Art)

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S12	58	((parabol$3) same (optic$3 light$3) same touch$3 same (sens$3 detect$3) same (surface fac$3))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/02/01 09:45
S13	43	S12 and @ad<"20161207"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/02/01 09:45
S14	5	S13 and (G06F3/0421 G06F2203/04103)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/02/01 09:46
S15	284	((parabol$3) same (optic$3 light$3) same touch$3 same (surface fac$3))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/02/01 10:06

EAST Search History (Prior Art)

S16	208	S15 and @ad<"20161207"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/02/01 10:07
S17	29	S16 and (G06F3/0421 G06F2203/04103)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/02/01 10:07

EAST Search History (Prior Art)

S19	128	("20160077625" "9524067" "4986662" "8350828" "20170351324" "20130147711" "20100259506" "20030210483" "8587562" "20110175852" "4467193" "20060188196" "7352940" "20090251811" "9128250" "20130156376" "5736688" "8847900" "7553035" "20120044206" "20050225885" "8730179" "9280237" "20050041018" "20100079387" "8692802" "20120223916" "20110169782" "8403203" "9195344" "20110167628" "20110043482" "8896575" "20110181552" "8049738" "6559835" "20060207806" "7825905" "5796368" "8902196" "9471170" "20110163998" "20150277663" "20110169780" "20100277436" "9075477" "9389730" "20110169781" "20140225874" "9052771" "20110210946" "20190025984" "5220409" "8760416" "20110080360" "9658705" "20140071070" "20130135255" "8390576" "20100053090" "20110080344" "20120327039" "20030231169" "7952567" "20060119587" "4387961" "8816991" "4878296" "20120218215" "7274358" "8704822" "20050146514" "20110080361" "20180067292" "20040175677" "10088952" "20180292945" "20120098794" "20180292946" "20100149182" "8842366" "20160188112" "7391410" "20050259074" "20130135359" "20080278460" "8665244" "9958996" "20170220146" "20120212451" "10126854" "20110032214" "20170031569" "2584697" "4880969" "20180040239" "20150029131" "4825212" "20120262580" "20100103140" "9411481" "20070247443" "20180136769" "8929697" "3365720" "5969823" "20150261339" "9063614" "5661561" "20120146957" "20140320459" "20020001091" "6177999" "20120275167" "8905592" "8810549" "20170038896" "20130027352" "6775012" "9678601" "7845827" "20080278946" "20130092154" "9335525" "20140225868" "20130222301" "9560293" "20160156857").pn.	US-PGPUB; USPAT	OR	OFF	2019/02/01 10:33
S20	120	S19 and @ad<"20161207"	US-PGPUB; USPAT	OR	OFF	2019/02/01 10:34
S21	12	S20 and (G06F3/0421 G06F2203/04103)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/02/01 10:34

EAST Search History (Prior Art)

S22	350	("9006560" "6412961" "6775012" "20150029131" "20180335919" "3354343" "8824051" "8896747" "9019238" "20120120496" "4105429" "9679413" "20170046875" "20140132791" "20110234537" "5235470" "9317243" "20150287866" "5077644" "20060238897" "20150184895" "8462437" "20110044056" "6819687" "8029181" "20110050580" "20060263035" "20050084212" "20130321923" "7127141" "20130135255" "7369742" "8430523" "20120014006" "7688522" "20110220092" "9441808" "8282493" "10140791" "8210164" "20130235579" "20160377259" "20170309096" "8511298" "8791959" "9215357" "4363113" "20120046100" "20120037206" "9741184" "4672389" "20150248796" "2000526" "7815335" "20150184894" "5967653" "4297690" "5941648" "20130135359" "20120143018" "20150042841" "6885965" "20090207615" "4683526" "9594347" "20120242690" "5764219" "9541901" "10120335" "8500284" "6945881" "20040029654" "20110128555" "20160133156" "20130293939" "20170090420" "9342187" "4643545" "20170242172" "2970518" "20040111232" "4195620" "8460119" "20140033052" "20160077489" "20110025620" "9754511" "6639733" "20030016539" "5162811" "20110281660" "4028542" "20090056704" "5782553" "3283331" "7453419" "8345255" "6438238" "20100163014" "9706975" "20060109199" "20050154539" "20120275040").pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/02/01 10:46
S23	95	S22 and @ad<"20161207"	US-PGPUB; USPAT	OR	OFF	2019/02/01 10:46
S24	3	S23 and (G06F3/0421 G06F2203/04103)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/02/01 10:46

EAST Search History (Prior Art)

S25	390	("5471574" "4174533" "20160380583" "5023440" "2801363" "20150029092" "3553705" "5727108" "9855019" "9414155" "20060125713" "20100002237" "9698726" "20160109684" "20040233122" "20120086295" "4359041" "20110188138" "2657577" "20180173296" "9388961" "9405091" "6977624" "7245266" "9740336" "7084836" "20110037674" "9511290" "7233299" "9268069" "20020051303" "20040165821" "4506185" "20140331991" "20130235580" "20150370054" "6566853" "20130064468" "20120092775" "6985658" "6091825" "4059094" "8130120" "20030185506" "9806206" "7068880" "2821813" "9766040" "4530348" "20160259484" "20090193627" "20160202021" "20130083558" "7689054" "20150301267" "6832031" "20100019935" "20120320586" "4951180" "7770265" "2965899" "20170370618" "9110224" "20100006139" "20160322513" "5016995" "6023133" "20160337750" "8450597" "20010035747" "20170082322" "5939726" "20110265249" "9602917" "9390072" "5515255" "9039905" "20130276775" "20130192226" "8413266" "20140321151" "2368019" "4972127" "20130220312" "20130220307" "20160201947" "7086746" "9404675" "8978642" "20170284771" "2825063" "20050281017" "20100201977" "20150145869" "20130213929" "20130213387" "20090168446" "8632235" "20130000356" "3443086").pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/02/01 10:48
S26	88	S25 and @ad<"20161207"	US-PGPUB; USPAT	OR	OFF	2019/02/01 10:48
S27	2	S26 and (G06F3/0421 G06F2203/04103)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/02/01 10:48

EAST Search History (Prior Art)

S28	200	("10013107"|"10019113"|"20010002694"|"20010005004"|"20010005308"|"20010030642"|"20020067348"|"20020075243"|"20020118177"|"20020158823"|"20020158853"|"20020163505"|"20030016450"|"20030034439"|"20030034935"|"20030048257"|"20030052257"|"20030095399"|"20030107748"|"20030137494"|"20030156100"|"20030160155"|"20030210537"|"20030214486"|"20040027339"|"20040032401"|"20040090432"|"20040130338"|"20040174541"|"20040201579"|"20040212603"|"20040238627"|"20040239702"|"20040245438"|"20040252091"|"20040252867"|"20050012714"|"20050041013"|"20050057903"|"20050073508"|"20050083293"|"20050128190"|"20050143923"|"20050156914"|"20050162398"|"20050179977"|"20050200613"|"20050212774"|"20050248540"|"20050253834"|"20050276053"|"20060001650"|"20060001653"|"20060007185"|"20060008164"|"20060017706"|"20060017709"|"20060033725"|"20060038698"|"20060061861"|"20060114237"|"20060132454"|"20060139340"|"20060158437"|"20060170658"|"20060202974"|"20060227120"|"20060255248"|"20060256092"|"20060279558"|"20060281543"|"20060290684"|"20070014486"|"20070024598"|"20070034783"|"20070038691"|"20070052684"|"20070070056"|"20070075648"|"20070120833"|"20070125937"|"20070152985"|"20070201042"|"20070296688"|"20080006766"|"20080007540"|"20080007541"|"20080007542"|"20080011944"|"20080029691"|"20080036743"|"20080062150"|"20080068691"|"20080074401"|"20080088603"|"20080121442"|"20080122792"|"20080122803"|"20080130979"|"20080133265"|"20080150846"|"20080150848"|"20080151126"|"20080158176"|"20080189046"|"20080192025"|"20080238433"|"20080246388"|"20080252619"|"20080266266"|"20080278460"|"20080284925"|"20080291668"|"20080297482"|"20090002340"|"20090006292"|"20090040786"|"20090066647"|"20090067178"|"20090073142"|"20090077501"|"20090085894"|"20090091554"|"20090115919"|"20090122020"|"20090122027"|"20090128508"|"20090135162"|"20090143141"|"20090153519"|"20090161026"|"20090168459"|"20090187842"|"20090189857"|"20090189874"|"20090189878"|"20090219256"|"20090229892"|"20090251439"|"20090256817"|"20090259967"|"20090267919"|"20090273794"|"20090278816"|"20090297009"|"20100033444"|"20100045629"|"20100060896"|"20100066016"|"20100066704"|"20100073318"|"20100078545"|"20100079407"|"20100079408"|"20100097345"|"20100097348"|"20100097353"|"20100125438"|"20100127975"|"20100134435"|"20100142823"|"20100187422"|"20100	US-PGPUB; USPAT	OR	OFF	2019/02/01 10:56

EAST Search History (Prior Art)

S29	210	("20110163996"|"20110163997"|"20110163998"|"20110169780"|"20110175852"|"20110205186"|"20110216042"|"20110221705"|"20110221997"|"20110227036"|"20110227874"|"20110234537"|"20110254864"|"20110261020"|"20110267296"|"20110291989"|"20110298743"|"20110309325"|"20110310045"|"20120019448"|"20120026408"|"20120038593"|"20120062474"|"20120068973"|"20120086673"|"20120089348"|"20120110447"|"20120131490"|"20120141001"|"20120146930"|"20120153134"|"20120154338"|"20120162142"|"20120162144"|"20120169672"|"20120181419"|"20120182266"|"20120188206"|"20120191993"|"20120200532"|"20120200538"|"20120212441"|"20120217882"|"20120249478"|"20120256882"|"20120268403"|"20120268427"|"20120274559"|"20120305755"|"20130021300"|"20130021302"|"20130027404"|"20130044073"|"20130055080"|"20130076697"|"20130082980"|"20130107569"|"20130113715"|"20130120320"|"20130125016"|"20130127790"|"20130135258"|"20130135259"|"20130141388"|"20130154983"|"20130155027"|"20130158504"|"20130181896"|"20130187891"|"20130201142"|"20130222346"|"20130241887"|"20130249833"|"20130269867"|"20130275082"|"20130285920"|"20130285968"|"20130300716"|"20130307795"|"20130342490"|"20140002400"|"20140028575"|"20140028604"|"20140028629"|"20140036203"|"20140055421"|"20140063853"|"20140071653"|"20140085241"|"20140092052"|"20140098032"|"20140098058"|"20140109219"|"20140125633"|"20140139467"|"20140160762"|"20140192023"|"20140232669"|"20140237401"|"20140237408"|"20140237422"|"20140253831"|"20140267124"|"20140292701"|"20140300572"|"20140320460"|"20140347325"|"20140362046"|"20140368471"|"20140375607"|"20150002386"|"20150009687"|"20150015497"|"20150035774"|"20150035803"|"20150053850"|"20150054759"|"20150083891"|"20150103013"|"20150130769"|"20150138105"|"20150138158"|"20150138161"|"20150205441"|"20150215450"|"20150242055"|"20150271481"|"20150286698"|"20150317036"|"20150324028"|"20150331544"|"20150331545"|"20150331546"|"20150331547"|"20150332655"|"20150346856"|"20150346911"|"20150363042"|"20160026337"|"20160034099"|"20160050746"|"20160070415"|"20160070416"|"20160124546"|"20160124551"|"20160154531"|"20160154532"|"20160202841"|"20160216844"|"20160224144"|"20160299593"|"20160328090"|"20160328091"|"20160334942"|"20160342282"|"20160357348"|"20170010688"|"20170090090"|"20170102827"|"20170115235"|"20170115823"|"20170139541"	US-PGPUB; USPAT	OR	OFF	2019/02/01 10:56

EAST Search History (Prior Art)

S30	175	("4986662"|"4988983"|"5065185"|"5073770"|"5105186"|"5159322"|"5166668"|"5227622"|"5248856"|"5254407"|"5345490"|"5383022"|"5483261"|"5484966"|"5499098"|"5502568"|"5525764"|"5526422"|"5539514"|"5570181"|"5572251"|"5577501"|"5600105"|"5608550"|"5672852"|"5679930"|"5686942"|"5688933"|"5729249"|"5736686"|"5740224"|"5764223"|"5767517"|"5775792"|"5945980"|"5945981"|"5959617"|"6061177"|"6067079"|"6122394"|"6141104"|"6172667"|"6175999"|"6227667"|"6229529"|"6333735"|"6366276"|"6380732"|"6380740"|"6390370"|"6429857"|"6452996"|"6476797"|"6492633"|"6495832"|"6504143"|"6529327"|"6538644"|"6587099"|"6648485"|"6660964"|"6664498"|"6664952"|"6690363"|"6707027"|"6738051"|"6748098"|"6784948"|"6799141"|"6806871"|"6927384"|"6940286"|"6965836"|"6972753"|"6985137"|"7042444"|"7084859"|"7087907"|"7133031"|"7176904"|"7199932"|"7359041"|"7397418"|"7432893"|"7435940"|"7436443"|"7442914"|"7465914"|"7613375"|"7629968"|"7646833"|"7653883"|"7655901"|"7705835"|"7729056"|"7847789"|"7855716"|"7859519"|"7924272"|"7932899"|"7969410"|"7995039"|"8013845"|"8031186"|"8077147"|"8093545"|"8094136"|"8094910"|"8149211"|"8218154"|"8274495"|"8325158"|"8339379"|"8350827"|"8384010"|"8407606"|"8441467"|"8445834"|"8466901"|"8482547"|"8542217"|"8567257"|"8581884"|"8624858"|"8686974"|"8692807"|"8716614"|"8727581"|"8745514"|"8780066"|"8830181"|"8860696"|"8872098"|"8872801"|"8884900"|"8890843"|"8890849"|"8928590"|"8963886"|"8982084"|"9024916"|"9035909"|"9063617"|"9086763"|"9134854"|"9158401"|"9158415"|"9213445"|"9274645"|"9317168"|"9323396"|"9366565"|"9377884"|"9389732"|"9411444"|"9411464"|"9430079"|"9442574"|"9547393"|"9552103"|"9557846"|"9588619"|"9594467"|"9618682"|"9626018"|"9626040"|"9639210"|"9678602"|"9684414"|"9710101"|"9874978"|"20120045170"|"20120062492"|"20160295711"|"6031524").PN.	US-PGPUB; USPAT	OR	OFF	2019/02/01 10:56
S31	50	(S28 S29 S30) and (parabol$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/02/01 10:58
S36	0	16/403283.app.	US-PGPUB	OR	OFF	2020/02/13 11:23

EAST Search History (Prior Art)

S37	49	((("KOCOVSKI") near3 ("Aleksander")) OR (("BERGSTROM") near3 ("Hakan")) OR (("THORVINGER") near3 ("Jens"))).INV.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	OR	OFF	2020/02/13 11:23
S38	3	S37 and ((first second) same (plane$1 surface$1 frame$1 edge$1) same (parabolic)).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/02/13 11:26

EAST Search History (Prior Art)

S39	201	("10282035"|"20100103133"|"20120062492"|"20150373864"|"20160026297"|"20160209886"|"20160255713"|"20160295711"|"6031524"|"10013107"|"10019113"|"20010002694"|"20010005004"|"20010005308"|"20010030642"|"20020067348"|"20020075243"|"20020118177"|"20020158823"|"20020158853"|"20020163505"|"20030016450"|"20030034439"|"20030034935"|"20030048257"|"20030052257"|"20030095399"|"20030107748"|"20030137494"|"20030156100"|"20030160155"|"20030210537"|"20030214486"|"20040027339"|"20040032401"|"20040090432"|"20040130338"|"20040174541"|"20040201579"|"20040212603"|"20040238627"|"20040239702"|"20040245438"|"20040252091"|"20040252867"|"20050012714"|"20050041013"|"20050057903"|"20050073508"|"20050083293"|"20050128190"|"20050143923"|"20050156914"|"20050162398"|"20050179977"|"20050200613"|"20050212774"|"20050248540"|"20050253834"|"20050276053"|"20060001650"|"20060001653"|"20060007185"|"20060008164"|"20060017706"|"20060017709"|"20060033725"|"20060038698"|"20060061861"|"20060114237"|"20060132454"|"20060139340"|"20060158437"|"20060170658"|"20060202974"|"20060227120"|"20060255248"|"20060256092"|"20060279558"|"20060281543"|"20060290684"|"20070014486"|"20070024598"|"20070034783"|"20070038691"|"20070052684"|"20070070056"|"20070075648"|"20070120833"|"20070125937"|"20070152985"|"20070201042"|"20070296688"|"20080006766"|"20080007540"|"20080007541"|"20080007542"|"20080011944"|"20080029691"|"20080036743"|"20080062150"|"20080068691"|"20080074401"|"20080088603"|"20080121442"|"20080122792"|"20080122803"|"20080130979"|"20080133265"|"20080150846"|"20080150848"|"20080151126"|"20080158176"|"20080189046"|"20080192025"|"20080238433"|"20080246388"|"20080252619"|"20080266266"|"20080278460"|"20080284925"|"20080291668"|"20080297482"|"20090000831"|"20090002340"|"20090006292"|"20090040786"|"20090066647"|"20090067178"|"20090073142"|"20090077501"|"20090085894"|"20090091554"|"20090115919"|"20090122020"|"20090122027"|"20090128508"|"20090135162"|"20090143141"|"20090153519"|"20090161026"|"20090168459"|"20090187842"|"20090189857"|"20090189874"|"20090189878"|"20090219256"|"20090229892"|"20090251439"|"20090256817"|"20090259967"|"20090267919"|"20090273794"|"20090278816"|"20090297009"|"20100033444"|"20100045629"|"20100060896"|"20100066016"|"20100066704"|"20100073318"|"20100078545"|"20100079407"	US-PGPUB; USPAT	OR	OFF	2020/02/13 11:41

EAST Search History (Prior Art)

S40	201	("20110102374"|"20110115748"|"20110121323"|"20110122075"|"20110122091"|"20110122094"|"20110134079"|"20110147569"|"20110157095"|"20110157096"|"20110163996"|"20110163997"|"20110163998"|"20110169780"|"20110175852"|"20110205186"|"20110216042"|"20110221705"|"20110221997"|"20110227036"|"20110227874"|"20110234537"|"20110254864"|"20110261020"|"20110267296"|"20110291989"|"20110298743"|"20110309325"|"20110310045"|"20120019448"|"20120026408"|"20120038593"|"20120062474"|"20120068973"|"20120086673"|"20120089348"|"20120110447"|"20120131490"|"20120141001"|"20120146930"|"20120153134"|"20120154338"|"20120162142"|"20120162144"|"20120169672"|"20120181419"|"20120182266"|"20120188206"|"20120191993"|"20120200532"|"20120200538"|"20120212441"|"20120217882"|"20120218229"|"20120249478"|"20120256882"|"20120268403"|"20120268427"|"20120274559"|"20120305755"|"20120313865"|"20130021300"|"20130021302"|"20130027404"|"20130044073"|"20130055080"|"20130076697"|"20130082980"|"20130106709"|"20130107569"|"20130113715"|"20130120320"|"20130125016"|"20130127790"|"20130135258"|"20130135259"|"20130141388"|"20130141395"|"20130154983"|"20130155027"|"20130158504"|"20130181896"|"20130181953"|"20130187891"|"20130201142"|"20130222346"|"20130241887"|"20130249833"|"20130269867"|"20130275082"|"20130285920"|"20130285968"|"20130300716"|"20130307795"|"20130342490"|"20140002400"|"20140028575"|"20140028604"|"20140028629"|"20140036203"|"20140055421"|"20140063853"|"20140071653"|"20140085241"|"20140092052"|"20140098032"|"20140098058"|"20140109219"|"20140125633"|"20140139467"|"20140160762"|"20140192023"|"20140232669"|"20140237401"|"20140237408"|"20140237422"|"20140253520"|"20140253831"|"20140259029"|"20140267124"|"20140292701"|"20140300572"|"20140320460"|"20140347325"|"20140362046"|"20140368471"|"20140375607"|"20150002386"|"20150009687"|"20150015497"|"20150035774"|"20150035803"|"20150053850"|"20150054759"|"20150083891"|"20150103013"|"20150121691"|"20150130769"|"20150138105"|"20150138158"|"20150138161"|"20150205441"|"20150215450"|"20150242055"|"20150271481"|"20150286698"|"20150317036"|"20150324028"|"20150331544"|"20150331545"|"20150331546"|"20150331547"|"20150332655"|"20150346856"|"20150346911"|"20150363042"|"20160004898"|"20160026337"|"20160034099"|"20160050746"|"20160070415"|"20160070416"	US-PGPUB; USPAT	OR	OFF	2020/02/13 11:41

EAST Search History (Prior Art)

S41	207	("4129384"|"4180702"|"4209255"|"4213707"|"4254333"|"4254407"|"4294543"|"4346376"|"4420261"|"4484179"|"4507557"|"4521112"|"4542375"|"4550250"|"4593191"|"4673918"|"4688933"|"4688993"|"4692809"|"4710760"|"4736191"|"4737626"|"4746770"|"4752655"|"4772763"|"4782328"|"4812833"|"4837430"|"4868912"|"4891829"|"4916712"|"4933544"|"4949079"|"4986662"|"4988983"|"5065185"|"5073770"|"5105186"|"5159322"|"5166668"|"5227622"|"5248856"|"5254407"|"5345490"|"5383022"|"5483261"|"5484966"|"5499098"|"5502568"|"5525764"|"5526422"|"5539514"|"5570181"|"5572251"|"5577501"|"5600105"|"5608550"|"5672852"|"5679930"|"5686942"|"5688933"|"5729249"|"5736686"|"5740224"|"5764223"|"5767517"|"5775792"|"5945980"|"5945981"|"5959617"|"6061177"|"6067079"|"6122394"|"6141104"|"6172667"|"6175999"|"6227667"|"6229529"|"6333735"|"6366276"|"6380732"|"6380740"|"6390370"|"6429857"|"6452996"|"6476797"|"6492633"|"6495832"|"6504143"|"6529327"|"6538644"|"6587099"|"6648485"|"6660964"|"6664498"|"6664952"|"6690363"|"6707027"|"6738051"|"6748098"|"6784948"|"6799141"|"6806871"|"6927384"|"6940286"|"6965836"|"6972753"|"6985137"|"7042444"|"7084859"|"7087907"|"7133031"|"7176904"|"7199932"|"7359041"|"7397418"|"7432893"|"7435940"|"7436443"|"7442914"|"7465914"|"7613375"|"7629968"|"7646833"|"7653883"|"7655901"|"7705835"|"7729056"|"7847789"|"7855716"|"7859519"|"7924272"|"7932899"|"7969410"|"7995039"|"8013845"|"8031186"|"8077147"|"8093545"|"8094136"|"8094910"|"8149211"|"8218154"|"8274495"|"8325158"|"8339379"|"8350827"|"8384010"|"8407606"|"8441467"|"8445834"|"8466901"|"8482547"|"8542217"|"8567257"|"8581884"|"8624858"|"8686974"|"8692807"|"8716614"|"8727581"|"8745514"|"8780066"|"8830181"|"8860696"|"8872098"|"8872801"|"8884900"|"8890843"|"8890849"|"8928590"|"8963886"|"8982084"|"9024916"|"9035909"|"9063614"|"9063617"|"9086763"|"9134854"|"9158401"|"9158415"|"9201520"|"9213445"|"9274645"|"9280237"|"9317168"|"9323396"|"9366565"|"9377884"|"9389732"|"9411444"|"9411464"|"9430079"|"9442574"|"9547393"|"9552103"|"9557846"|"9588619"|"9594467"|"9618682"|"9626018"|"9626040"|"9639210"|"9678602"|"9684414"|"9710101"|"9874978").PN.	US-PGPUB; USPAT	OR	OFF	2020/02/13 11:41

EAST Search History (Prior Art)

S42	55	(S39 S40 S41) and (parabol$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/02/13 11:43
S43	1	"20120223916".pn.	US-PGPUB	OR	OFF	2020/02/13 17:27
S44	1	"20160295711".pn.	US-PGPUB	OR	OFF	2020/02/13 17:30

EAST Search History (Prior Art)

S45	464	("20190079638" "20190079637" "10282035" "20190092411" "20120068973" "20190196659" "20190196657" "20190196658" "20190196660" "2015505117" "8989536" "10437389" "20140362053" "20140098791" "2014513375" "5593006" "2014222539" "5821125" "101491430" "101502295" "20140105872" "201329822" "5764266" "20150331547" "2862819" "2862819" "2013212634" "2013212634" "2793524" "2011229745" "20130135255" "2011229745" "2014233573" "20130133307" "2014233573" "2011229745" "10268319" "101399142" "2013522801" "9335867" "20100040277" "2825175" "8676007" "2015503157" "20110175852" "20130141395" "8587562" "20140146249" "5876587" "20150145834" "20110163998" "5853016" "9471170" "2825175" "8837882" "8553014" "20130155027" "20130135359" "20110074734" "2728034" "20110167628" "20160239153" "8902196" "8403203" "2009272923" "8890843" "20110169780" "2856992" "20110032214" "20190272052" "10496227" "2013207572" "9389730" "20180267672" "2012346379" "20110210946" "20150277663" "9411430" "2012346379" "201007530" "20140071094" "2013207572" "2014201966" "8896575" "9811163" "9052777" "20120176343" "20110181552" "9195344" "20160026337" "20110169781" "9164625" "9857917" "2688065" "2008280797" "8434909" "9052771" "9158416" "8950902" "20110169782" "20130250618" "20160026250" "20110227487" "20140364218" "20150277636" "20180296915" "9741184" "20150248796" "201416936" "20130187891" "8905610" "20130155723" "20120098794" "20120188206" "20150205441" "9063614" "20140320459" "2013525955" "9857916" "20160067602" "9110200" "2010236331" "2796519" I497358 "201411455" "2728030" "20170262134" "10140791" "20110255303" "20170309096" "20150261339" "2749584" "10282034" "10534479" "20140160081" "20110074735" "9035917" "2848650" "20160009073").pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/02/13 18:22

EAST Search History (Prior Art)

S46	409	S45 and @ad<"20161207"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/02/13 18:23
S47	64	S46 and (G06F3/0421 G06F2203/04103)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/02/13 18:23
S48	16	("10282035"|"20080080811"|"20110141062"|"20120170056"|"20120223916"|"20130155655"|"20130300714"|"20150131010"|"20150339000"|"20160306501"|"20190025984"|"20190196657"|"20190196658"|"20190196659"|"9001086"|"9207800").PN.	US-PGPUB; USPAT	OR	OFF	2020/10/05 14:12
S49	3	(parabol$3) and S48	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/10/05 14:13
S50	8	("20110080361"|"20130234991"|"20130321740"|"20150373864"|"20160154533"|"20190235701"|"4751379"|"9024896").PN.	US-PGPUB; USPAT	OR	OFF	2020/10/05 14:59
S51	1	(parabol$3) and S50	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/10/05 15:00
S52	9,977,497	((curv$3 arc$3 arch$3 bend$3 bent curvature bow$3 circl$3 circul$3 ellipse helix hyperbol$3 parabol$3 round$3 whorl) (optic$3 light$3) same touch$3 same (sens$3 detect$3) same (surface fac$3)).ab.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/03/16 15:05
S53	6,745,912	S52 and @ad<"20161207"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/03/16 15:07

EAST Search History (Prior Art)

S54	773	S53 and (G06F3/0421 G06F2203/04103)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/03/16 15:09
S55	843	((curv$3 arc$3 arch$3 bend$3 bent curvature bow$3 circl$3 circul$3 ellipse helix hyperbol$3 parabol$3 round$3 whorl) same (optic$3 light$3) same touch$3 same (sens$3 detect$3) same (surface fac$3)).ab.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/03/16 15:10
S56	541	S55 and @ad<"20161207"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/03/16 15:13
S57	19	S56 and (G06F3/0421 G06F2203/04103)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/03/16 15:13
S58	24	("2015/0331546").URPN.	USPAT	OR	OFF	2021/03/16 16:22
S59	1	15/547587.app.	US-PGPUB	OR	OFF	2021/03/16 16:25
S60	0	15/248405.app.	US-PGPUB	OR	OFF	2021/03/16 16:35
S61	2	S54 and (frame hous$3 chassis) same (touch$3 sens$3 detect$3) same ("in." inch$2)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/03/16 17:16
S62	29,804	(frame hous$3 chassis) same (touch$3 sens$3 detect$3) same ("in." inch$2)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/03/16 17:17
S63	16,671	S62 and @ad<"20161207"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/03/16 17:17

EAST Search History (Prior Art)

S64	22	S63 and (G06F3/0421 G06F2203/04103)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/03/16 17:18
S65	112	(concave same (optic$3 light$3) same touch$3 same (sens$3 detect$3) same (surface fac$3)).ab.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/06/30 10:06
S66	64	S65 and @ad<"20161207"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/06/30 10:06
S67	0	S66 and (G06F3/0421 G06F2203/04103)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/06/30 10:07

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L6	10,180	first same second same third same fourth same (edge boundary perimeter periphery) same (curv$3 concave convex)	US-PGPUB; USPAT	OR	OFF	2021/08/17 10:16
L7	7,326	6 and @ad<"20161207"	US-PGPUB; USPAT	OR	OFF	2021/08/17 10:16
L8	10	7 and (G06F3/0421 G06F2203/04103)	US-PGPUB; USPAT	OR	OFF	2021/08/17 10:16
S32	193	((parabol$3) same (optic$3 light$3) same touch$3 same (surface fac$3))	US-PGPUB; USPAT	OR	OFF	2019/02/01 10:20
S33	181	S32 and @ad<"20161207"	US-PGPUB; USPAT	OR	OFF	2019/02/01 10:21
S34	29	S33 and (G06F3/0421 G06F2203/04103)	US-PGPUB; USPAT	OR	OFF	2019/02/01 10:22

RESPONSE TO FINAL OFFICE ACTION DATED JULY 6, 2021

First Inventor: Aleksander Kocovski	**Conf. No.:** 5417
App. No.: 16/403283	**Filed:** May 3, 2019
Examiner: Lam, Vinh Tang	**Art Unit:** 2628
Title: TOUCH DEVICE	

Mail Stop AF
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Commissioner:

In response to the Office Action mailed July 6, 2021, the Applicant respectfully submits the following:

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 490

REMARKS

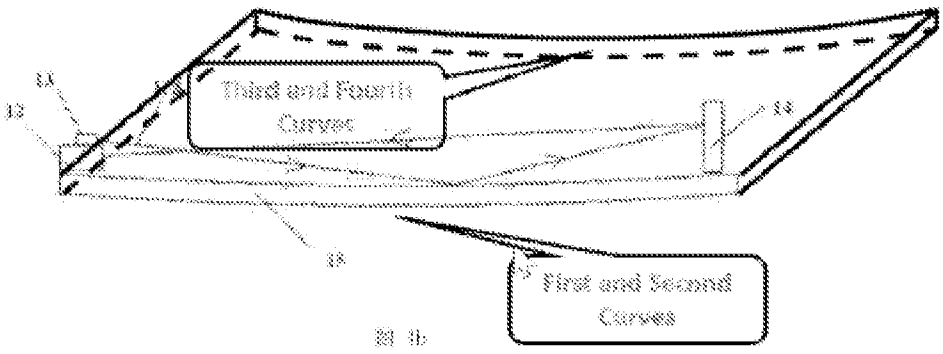
By way of summary, Claims 2-20 remain pending in this application.

Art Based Rejections

Applicant respectfully traverses the art-based rejections, the characterizations of the pending claims and the cited references and each and every implicit and explicit potential for reliance on Official Notice.

Independent Claim 2

The Office Action reproduced Figure 4b of Liu and makes annotations on it as shown below.



Claim 2 recites, "[a] touch sensing apparatus having a *long edge* and a *short edge*, the touch sensing apparatus comprising:

. . .

a first edge and a second edge adjacent to the short edge; and

a third edge and a fourth edge adjacent to the long edge;

. . .

wherein *the first, second, third, and fourth edges are curved*.

According to the Examiner's interpretation of "third and fourth curves" in his annotation, Liu only shows that its long edges are curved. In contrast, Claim 2 teaches that the "first edge" and the "second edge" which are adjacent to the "short edge" are "curved." Liu does not teach or suggest that its short edges are curved.

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 491

Claim 13

Claim 13 recites, among other things, "wherein the curved edge portion is configured to enable curvature in the rectangular plate." In contrast, Liu teaches a "concave surface optical touch screen." Liu does not teach or suggest using a "rectangular plate" where a curvature is induced or "enabled" in the rectangular plate by the "curved edge portion."

Dependent Claims

The dependent claims are patentable for the same reasons articulated above with respect to their independent claims. The dependent claims are also patentable because of the additional features recited therein.

No Disclaimers or Disavowals

Although the present communication may include alterations to the application or claims, or characterizations of claim scope or referenced art, Applicant is not conceding in this application that previously pending claims are not patentable over the cited references. Rather, any alterations or characterizations are being made to facilitate expeditious prosecution of this application. Applicant reserves the right to pursue at a later date any previously pending or other broader or narrower claims that capture any subject matter supported by the present disclosure, including subject matter found to be specifically disclaimed herein or by any prior prosecution. Accordingly, reviewers of this or any parent, child or related prosecution history shall not reasonably infer that Applicant has made any disclaimers or disavowals of any subject matter supported by the present application. Further, Applicant's arguments in favor of one independent claim should not be imputed to any other independent claim.

Conclusion

In view of the foregoing amendments and remarks, Applicant respectfully requests that the Examiner withdraw the outstanding rejections and allow the present application. If any issues arise during examination, the Examiner is invited to call the undersigned representative at his direct dial number listed below.

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 492

By focusing on specific claims and claim recitations in the discussion above, Applicant does not intend to imply that other claim recitations are disclosed or rendered obvious by the art of record.

Please charge any additional fees, including any fees for additional extension of time, or credit overpayment to Deposit Account No. 11-1410.

Respectfully submitted,

KNOBBE, MARTENS, OLSON & BEAR, LLP

Dated: August 9, 2021

By:/Harnik Shukla/_____
Harnik Shukla
Registration No. 73,097
Registered Practitioner
(949) 721-5278

53873512

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 493

Electronic Acknowledgement Receipt

EFS ID:	43463755
Application Number:	16403283
International Application Number:	
Confirmation Number:	5417
Title of Invention:	TOUCH DEVICE
First Named Inventor/Applicant Name:	Aleksander Kocovski
Customer Number:	20995
Filer:	Harnik Shukla/Wendy Castorena
Filer Authorized By:	Harnik Shukla
Attorney Docket Number:	FFOG.053C3
Receipt Date:	09-AUG-2021
Filing Date:	03-MAY-2019
Time Stamp:	19:39:55
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		FFOG053C3_OAR.pdf	43114 cc056dc3d57034ca4628420347913eac1bfb06a1	yes	4

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Response After Final Action	1	1
	Applicant Arguments/Remarks Made in an Amendment	2	4
Warnings:			
Information:			
	Total Files Size (in bytes):	43114	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/403,283	05/03/2019	Aleksander Kocovski	FFOG.053C3	5417

20995 7590 07/06/2021

KNOBBE MARTENS OLSON & BEAR LLP
2040 MAIN STREET
FOURTEENTH FLOOR
IRVINE, CA 92614

EXAMINER	
LAM, VINH TANG	

ART UNIT	PAPER NUMBER
2628	

NOTIFICATION DATE	DELIVERY MODE
07/06/2021	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

efiling@knobbe.com
jayna.cartee@knobbe.com

Office Action Summary	Application No. 16/403,283	Applicant(s) Kocovski et al.	
	Examiner VINH T LAM	Art Unit 2628	AIA (FITF) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 06/22/2021.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☑ This action is **FINAL.** 2b) ☐ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 1-23 is/are pending in the application.

5a) Of the above claim(s) 1 and 21-23 is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☑ Claim(s) 2-20 is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☑ The specification is objected to by the Examiner.

11)☑ The drawing(s) filed on 05/03/2019 is/are: a)☑ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☑ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☑ All b)☐ Some** c)☐ None of the:

1.☑ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☑ Notice of References Cited (PTO-892)

2) ☐ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

DETAILED ACTION

Notice of Pre-AIA or AIA Status

1. The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Priority

2. Acknowledgment is made of applicant's claim for foreign priority based on an application filed in **SE** on **12/07/2016**. It is noted, however, that applicant has not filed a certified copy of the 16302945 application as required by 37 CFR 1.55.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103 which forms the basis for all obviousness rejections set forth in this Office action:

> A patent for a claimed invention may not be obtained, notwithstanding that the claimed invention is not identically disclosed as set forth in section 102 of this title, if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claim(s) **2-3**, **5**, and **12** is/are rejected under 35 U.S.C. 103 as being unpatentable over **Kukulj (US Patent/PGPub. No. 20120223916)** in view of **LIU et al. (No. CN102117155).**

Regarding Claim **2, (Currently Amended)** **Kukulj** teaches **a touch sensing apparatus** *([0007], FIG. **3**, i.e. **touch screen 31**)* **having a long edge** *([0007], FIG. **3**, i.e. **horizontal edge**)* **and a short edge** *([0007], FIG. **3**, i.e. **horizontal edge**)*, **the touch sensing apparatus** *(i.e. please see above citation(s))* **comprising:**

a display panel *([0007], FIG. **3**, i.e. **an underlying display**)*;

a plate *([0007], FIG. **3**, i.e. **shape** of **touch screen 31**; **[0101]**, FIG. **4**, i.e. **shape** of **touch screen 54**)* **including a touch surface** *([0007], FIG. **3**, i.e. **touch screen 31**)*;

a plurality of emitters *([0007], FIG. **3**, i.e. **optical sources 4**)* **arranged around a portion** *([0007], FIG. **3**, i.e. **left portion**)* **of the periphery of the plate** *(i.e. please see above citation(s))* **and configured to emit light across** *([0007], FIG. **3**, i.e. **launched into the light guide plate**)* **the touch surface of the plate** *(i.e. please see above citation(s))*,

a plurality of detectors *([0006], [0007], FIG. **2-3**, i.e. **waveguides 22**)* **arranged around a portion of the periphery of the plate** *(i.e. please see above citation(s))* **and configured to receive light** *([0006], [0007], FIG. **2-3**, i.e. **detected**)* **from the plurality of emitters** *(i.e. please see above citation(s))*, **and**

a frame assembly *([0006], FIG. **3**, i.e. **L-shaped substrate 24**)*, **the frame assembly comprising:**

a first frame element *([0007], FIG. **3**, i.e. **frame** of **31**)* **configured to support** *(FIG. **2-3**, i.e. as **shown** by the **figure(s)**)* **the display panel** *(i.e. please see above citation(s))*;

a second frame element *([0006], FIG. **3**, i.e. **L-shaped substrate 24**)* **arranged around** *(FIG. **2-3**, i.e. as **shown** by the **figure(s)**)* **the periphery of the plate** *(i.e. please see above citation(s))* **and configured to support** *(FIG. **2-3**, i.e. as **shown** by the **figure(s)**)* **the plurality of emitters and plurality of detectors,**

wherein the second frame element *(i.e. please see above citation(s))* **including a first surface** *([0006], FIG. **3**, i.e. **vertical surface between 24 and 34**)* **arranged against an edge** *([0006], FIG. **3**, i.e. **left***

vertical edge 34) **of the plate** *(i.e. please see above citation(s))* **and a second surface** *([0006], [0007], FIG. **3**, i.e. **surface of the figure**)* **arranged parallel to** *(FIG. **3**, i.e. as **shown** by the **figure(s)**)* **the touch surface,**

the touch surface *(i.e. please see above citation(s))* **including:**

a first edge *([0007], FIG. **3**, i.e. **lower horizontal edge**)* **and a second edge** *([0007], FIG. **3**, i.e. **right vertical edge**)* **adjacent to** *(FIG. **3**, i.e. as **shown** by the **figure(s)**)* **the short edge** *(i.e. please see above citation(s))*; **and**

a third edge and a fourth edge adjacent to *(FIG. **3**, i.e. as **shown** by the **figure(s)**)* **the long edge** *(i.e. please see above citation(s))*.

However, **Kukulj** does not explicitly teach

the touch surface is curved relative to a flat plane defined in part by the short edge and the long edge;

wherein a distance between a first curved line drawn on the first plane the touch surface and a second straight line drawn on the flat plane varies according to a concave curve function;

wherein the first, second, third, and fourth edges are curved.

In the same field of endeavor, **LIU et al.** teach

the touch surface *([0026], FIG. **1-4**, i.e. **touch panel 15**)* **is curved** *(FIG. **1-4**, i.e. as **shown** by the **figure(s)**)* **relative to a flat plane** *([0026], FIG. **1-4**, i.e. **retro-reflective strip 14's top plane**)* **defined in part by the short**

edge *([0026], FIG. **1-4**, i.e. **14's vertical edge**)* **and the long edge** *([0026], FIG. **1-4**, i.e. **14's horizontal edge**)*;

wherein a distance *([0026], FIG. **4b**, i.e. **distance between 14's top surface and 15's top surface**)* **between a first curved line** *([0026], FIG. **4b**, i.e. **15's top curve**)* **drawn on the touch surface** *(i.e. please see above citation(s))* **and a second straight line** *([0026], FIG. **1-4**, i.e. **line on 14's top plane**)* **drawn on the flat plane** *(i.e. please see above citation(s))* **varies according to a concave curve function** *([0024]-[0026], FIG. **1-4**, i.e. **concave; downward**)*;

wherein the first, second *(FIG. **2**, i.e. **top horizontal;** FIG. **4b**, i.e. **front on page**)*, **third, and fourth edges** *(FIG. **2**, i.e. **bottom horizontal;** FIG. **4b**, i.e. **parallel to page**)* **are curved** *(FIG. **2 & 4b**, i.e. as **shown** by the **figure(s)**)*.

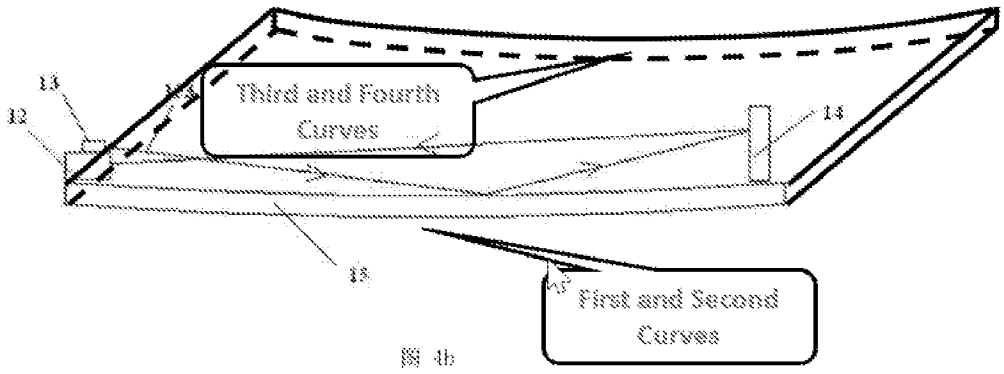


Fig. 4b

It would have been obvious to a person having ordinary skill in the art at the time the invention's effective date was filed to modify **Kukulj** teaching of an optical sensing device having a flat surface with **LIU et al.** teaching of teaching of an optical sensing device having a curved surface *to effectively enhance sensitivity and detection accuracy by designing curved surface (LIU et al.'s [0014]).*

Regarding Claim **3, (Previously Presented) the touch sensing apparatus of claim 2, wherein**

Kukulj teaches

the plurality of emitters *(i.e. please see above citation(s))* **is configured to emit light to propagate** *([0007], FIG. **3**, i.e. **launched into the light guide plate**)* **over the touch surface** *(i.e. please see above citation(s))*.

Regarding Claim **5, (Previously Presented) the touch sensing apparatus of claim 2,**

Kukulj teaches

further comprising a processing element *([0101], FIG. **5**, i.e. **controller 60**)* **configured to determine, based on output signals** *([0103], FIG. **5**, i.e. **intensity profile**)* **of the plurality of detectors** *(i.e. please see above citation(s))*, **a position** *([0103], FIG. **5**, i.e. **X/Y-axis coordinate**)*

of an object *([0103], FIG. **5**, i.e. **object 12**)* **on the touch surface** *(i.e. please see above citation(s))*.

Regarding Claim **12, (Previously Presented) the apparatus of claim 2, wherein**

LIU et al. teach

the second frame element *([0026], FIG. **4b**, i.e. **touch panel 15**)* **is curved** *(FIG. **1-4**, i.e. as **shown** by the **figure(s)**)*.

4. Claim(s) **4** is/are rejected under 35 U.S.C. 103 as being unpatentable over **Kukulj (US Patent/PGPub. No. 20120223916)** in view of **LIU et al. (No. CN102117155)** and **Wassvik (US Patent/PGPub. No. 20160334942).**

Regarding Claim **4, (Previously Presented)** **Kukulj** and **LIU et al.** teach **the touch sensing apparatus of claim 2.**

However, **Kukulj** and **LIU et al.** do not explicitly teach

the plurality of emitters is configured to emit light through the plate by total internal reflection.

In the same field of endeavor, **Wassvik** teaches

the plurality of emitters *([0052], FIG. **2A**, i.e. **Emitters 2**)* **is configured to emit light** *([0052], FIG. **2A**, i.e. **propagating light**)* **through**

the plate *([0103], FIG. **10G**, i.e. **filter 20**)* **by total internal reflection** *([0051], FIG. **1**, i.e. **total internal reflection**)*.

It would have been obvious to a person having ordinary skill in the art at the time the invention's effective date was filed to realize **Kukulj** and **LIU et al.** teaching of optical touch sensing device propagating light with **Wassvik** teaching of optical touch sensing device propagating light via total internal reflection *to accurately identify touch point (Wassvik's [0051])*.

5. Claim(s) **6-9** is/are rejected under 35 U.S.C. 103 as being unpatentable over **Kukulj (US Patent/PGPub. No. 20120223916)** in view of **Northcott et al. (US Patent/PGPub. No. 10860142)** and **RYU et al. (US Patent/PGPub. No. 20160295711).**

Regarding Claim **6, (Previously Presented)** **Kukulj** and **LIU et al.** teach **the touch sensing apparatus of claim 2.**

However, **Kukulj** and **LIU et al.** do not explicitly teach

the plate has a first curvature prior to installation and a second curvature greater than the first curvature when assembled.

the first curvature when assembled.

In the same field of endeavor, **RYU et al.** teach

the plate *([0063], FIG. **4(a) & 4(b)**, i.e. **display unit 20**)* **has a first curvature** *([0070], FIG. **4(a)**, i.e. **flat** surface **display unit 20** which would be*

***curvature** with **infinite radius**)* **prior to installation** *([0072], FIG. **4(a)**, i.e. **prior to** links 50 are pushed up)* **and a second curvature** *([0072], FIG. **4(a)**, i.e. **after** links **50** are **pushed up**)* **greater than** *([0072], FIG. **4(a)**, i.e. **flat > curve up**)* **the first curvature when assembled** *(i.e. please see above citation(s))*.

It would have been obvious to a person having ordinary skill in the art at the time the invention's effective date was filed to combine **Kukulj** and **LIU et al.** teaching touch display device comprising frame and curved display surface with **RYU et al.** teaching of touch display device comprising frame and curved/flat display surface *to effectively adjust field of views by providing both curved or flat surface of display (RYU et al.'s [0071])*.

Regarding Claim **7, (Previously Presented) the touch sensing apparatus of claim 6, wherein**

RYU et al. teach

the first curvature and second curvature *(i.e. please see above citation(s))* **are measured along an edge** *([0072], FIG. **4(a) & 4(b)**, i.e. **vertical edge**)* **of the plate** *([0072], FIG. **4(a) & 4(b)**, i.e. **housing 30**)*.

Regarding Claim **8, (Previously Presented) the touch sensing apparatus of claim 6, wherein**

RYU et al. teach

the first curvature and second curvature *(i.e. please see above citation(s))* **are measured along a line drawn** *([0072], FIG. **4(a) & 4(b)**, i.e. **R1)*** **on the plate passing through a center point** *([0072], FIG. **4(a) & 4(b)**, i.e. **point intersected by R1 and 30)*** **of the plate** *(i.e. please see above citation(s))*.

Regarding Claim **9, (Previously Presented) the touch sensing apparatus of claim 6, wherein**

RYU et al. teach

the first curvature and second curvature *(i.e. please see above citation(s))* **are measured along a line drawn** *([0073], FIG. **4(a) & 4(b)**, i.e. **VPL)*** **on the plate passing through any position on the plate** *(i.e. please see above citation(s))*.

6. Claim(s) **10-11** is/are rejected under 35 U.S.C. 103 as being unpatentable over **Kukulj (US Patent/PGPub. No. 20120223916)** in view of **LIU et al. (No. CN102117155)** and **Northcott et al. (US Patent/PGPub. No. 10860142).**

Regarding Claim **10, (Previously Presented)** **Kukulj** and **LIU et al.** teach **the touch sensing apparatus of claim 2.**

However, **Kukulj** and **LIU et al.** do not explicitly teach

a gasket, wherein the plate is supported by the gasket along an edge of the plate.

In the same field of endeavor, **Northcott et al.** teach

a gasket *(Col. **8**, Ln. **23-28**, FIG. **18**, i.e. **light guide array 28**)*, **wherein the plate** *(Col. **8**, Ln. **23-28**, FIG. **18**, i.e. **display 20**)* **is supported by** *(Col. **8**, Ln. **23-28**, FIG. **18**, i.e. **interposing**)* **the gasket** *(i.e. please see above citation(s))* **along an edge** *(Col. **8**, Ln. **23-28**, FIG. **18**, i.e. **top edge**)* **of the plate** *(i.e. please see above citation(s))*.

It would have been obvious to a person having ordinary skill in the art at the time the invention's effective date was filed to combine **Kukulj** and **LIU et al.** teaching of an optical sensing device having a curved surface with **Northcott et al.** teaching of teaching of an optical sensing device comprising light guide *to effectively operate optical touch display (Northcott et al.'s Col. 1, Ln. 18-22).*

Regarding Claim **11, (Previously Presented) the apparatus of claim 10, wherein**

Northcott et al. teach

the gasket *(i.e. please see above citation(s))* **is configured to have varying thickness** *(Col. **8**, Ln. **23-28**, FIG. **18**, i.e. **may be curved**)* **to match**

a curvature *(Col. **8**, Ln. **23-28**, FIG. **18**, i.e. **curvature**)* **of the plate along the edge** *(i.e. please see above citation(s))*.

7. Claim(s) **13-14** and **16** is/are rejected under 35 U.S.C. 103 as being unpatentable over **Kukulj (US Patent/PGPub. No. 20120223916)** in view of **LIU et al. (No. CN102117155)** and **LEE (US Patent/PGPub. No. 20170308236).**

Regarding Claim **13, (Currently Amended)** **Kukulj** teaches **a touch sensing apparatus** *([0007], FIG. **3**, i.e. **touch screen 31**)* **comprising:**

a display panel *([0007], FIG. **3**, i.e. **an underlying display**)*;

a rectangular plate *([0007], FIG. **3**, i.e. **rectangular shape** of **touch screen 31**; [0100], FIG. **4**, i.e. **rectangular shape** of **touch screen 46**)* **including a touch surface** *([0007], FIG. **3**, i.e. **touch screen 31**)*;

a plurality of emitters *([0007], FIG. **3**, i.e. **optical sources 4**)* **configured to emit light across** *([0007], FIG. **3**, i.e. **launched into the light guide plate**)* **the touch surface of the rectangular plate** *(i.e. please see above citation(s))*, **and**

a frame *([0006], FIG. **3**, i.e. **L-shaped substrate 24**)* **configured to support the display panel, the rectangular plate, and the plurality of emitters, said frame** *(i.e. please see above citation(s))* **comprising:**

a longitudinal edge portion *([0101], FIG. **5**, i.e. **upper horizontal edge of 36**)* **configured to contact** *(FIG. **4**, i.e. as **shown** by the **figure(s)**)* **at least a first corner and a second corner** *([0100], FIG. **4**, i.e. **upper left and right left corners**)* **of the rectangular plate** *(i.e. please see above citation(s))*.

However, **Kukulj** does not explicitly teach

the longitudinal edge portion is curved such that a distance in a vertical plane between the longitudinal edge portion and a straight line between the first corner and the second corner varies according to a concave curve function and wherein the curved edge portion is configured to enable curvature in the rectangular plate,

wherein the rectangular plate is at least 55" wide along an axis.

In the same field of endeavor, **LIU et al.** teach

the longitudinal edge portion *([0026], FIG. **4b**, i.e. **15's horizontal edge**)* **is curved** *(FIG. **1-4**, i.e. as **shown** by the **figure(s)**)* **such that a distance in a vertical plane** *([0026], FIG. **4b**, i.e. **14's vertical plane**)*

between the longitudinal edge portion *(i.e. please see above citation(s))* **and a straight line** *([0026], FIG. **4b**, i.e. **14's vertical line**)* **between the first corner and the second corner** *([0026], FIG. **4b**, i.e. **14's top and bottom corners**)* **varies according to a concave curve function** *([0024]-[0026], FIG. **1-4**, i.e. **concave; downward**)* **and wherein the curved edge portion** *(i.e. please see above citation(s))* **is configured to enable curvature** *([0024]-[0026], FIG. **1-4**, i.e. **concave; downward**)* **in the rectangular plate** *([0026], FIG. **1-4**, i.e. **frame 11**)*.

It would have been obvious to a person having ordinary skill in the art at the time the invention's effective date was filed to modify **Kukulj** teaching of an optical sensing device having a flat surface with **LIU et al.** teaching of teaching of an optical sensing device having a curved surface *to effectively enhance sensitivity and detection accuracy by designing curved surface (LIU et al.'s [0014])*.

However, **Kukulj** and **LIU et al.** do not explicitly teach

the rectangular plate is at least 55" wide along an axis.

In the same field of endeavor, **LEE** teaches

the rectangular plate *([0061], FIG. **6**, i.e. **touch screen device with large size**)* **is at least 55" wide** *([0061], FIG. **6**, i.e. **60 inch**)* **along an axis** *([0061], FIG. **6**, i.e. **width axis**)*.

It would have been obvious to a person having ordinary skill in the art at the time the invention's effective date was filed to modify **Kukulj** and **LIU et al.** teaching of an optical sensing device having a general size with **LEE** teaching of teaching of a large size optical sensing device *effectively transmit power transmission for a large size optical sensing device (LEE's [0061]).*

Regarding Claim **14, (Previously Presented) the touch sensing apparatus of claim 13, wherein**

Kukulj teaches

plurality of emitters *(i.e. please see above citation(s))* **is configured to emit light to propagate over** *([**0007**], FIG. **3**, i.e. **launched into the light guide plate**)* **the touch surface** *(i.e. please see above citation(s))***.**

Regarding Claim **16, (Previously Presented) the touch sensing apparatus of claim 13,**

Kukulj teaches

further comprising a processing element *([**0101**], FIG. **5**, i.e. **controller 60**)* **configured to determine, based on output signals** *([**0103**], FIG. **5**, i.e. **intensity profile**)* **of the plurality of detectors** *(i.e. please see above citation(s))***, a position** *([**0103**], FIG. **5**, i.e. **X/Y-axis coordinate**)*

of an object *([0103], FIG. **5**, i.e. **object 12**)* **adjacent to the touch surface** *(i.e. please see above citation(s))*.

8. Claim(s) **15** is/are rejected under 35 U.S.C. 103 as being unpatentable over **Kukulj (US Patent/PGPub. No. 20120223916)** in view of **LIU et al. (No. CN102117155)**, **LEE (US Patent/PGPub. No. 20170308236),** and **Wassvik (US Patent/PGPub. No. 20160334942).**

Regarding Claim **15, (Previously Presented)** **Kukulj, LIU et al.,** and **LEE** teach **the touch sensing apparatus of claim 13.**

However, **Kukulj, LIU et al.,** and **LEE** do not explicitly teach

the plurality of emitters is configured to emit light through the plate by total internal reflection.

In the same field of endeavor, **Wassvik** teaches

the plurality of emitters *([0052], FIG. **2A**, i.e. **Emitters 2**)* **is configured to emit light** *([0052], FIG. **2A**, i.e. **propagating light**)* **through the plate** *([0103], FIG. **10G**, i.e. **filter 20**)* **by total internal reflection** *([0051], FIG. **1**, i.e. **total internal reflection**)*.

It would have been obvious to a person having ordinary skill in the art at the time the invention's effective date was filed to realize **Kukulj, LIU et al.,** and **LEE** teaching of

optical touch sensing device propagating light with **Wassvik** teaching of optical touch sensing device propagating light via total internal reflection *to accurately identify touch point (Wassvik's [0051])*.

9. Claim(s) **17-20** is/are rejected under 35 U.S.C. 103 as being unpatentable over **Kukulj (US Patent/PGPub. No. 20120223916)** in view of **LIU et al. (No. CN102117155)**, **LEE (US Patent/PGPub. No. 20170308236),** and **RYU et al. (US Patent/PGPub. No. 20160295711).**

Regarding Claim **17, (Previously Presented)** **Kukulj, LIU et al.,** and **LEE** teach **the touch sensing apparatus of claim 13.**

However, **Kukulj, LIU et al.,** and **LEE** do not explicitly teach

the plate has a first curvature prior to installation and, a second curvature greater than the first curvature when assembled.

In the same field of endeavor, **RYU et al.** teach

the plate *([0063], FIG. **4(a) & 4(b)**, i.e. **display unit 20**)* **has a first curvature** *([0070], FIG. **4(a)**, i.e. **flat** surface **display unit 20** which would be **curvature** with **infinite radius**)* **prior to installation** *([0072], FIG. **4(a)**, i.e. **prior to** links 50 are pushed up)* **and a second curvature** *([0072], FIG. **4(a)**, i.e. **after** links **50** are **pushed up**)* **greater than** *([0072], FIG. **4(a)**, i.e. **flat > curve up**)* **the first curvature when assembled** *(i.e. please see above citation(s))*.

It would have been obvious to a person having ordinary skill in the art at the time the invention's effective date was filed to combine **Kukulj, LIU et al.,** and **LEE** teaching touch display device comprising frame and curved display surface with **RYU et al.** teaching of touch display device comprising frame and curved/flat display surface *to effectively adjust field of views by providing both curved or flat surface of display (RYU et al.'s [0071]).*

Regarding Claim **18, (Previously Presented) the touch sensing apparatus of claim 17, wherein**

RYU et al. teach

the first curvature and second curvature *(i.e. please see above citation(s))* **are measured along an edge** *([0072], FIG. **4(a) & 4(b)**, i.e. **vertical edge**)* **of the plate** *([0072], FIG. **4(a) & 4(b)**, i.e. **housing 30**)*.

Regarding Claim **19, (Previously Presented) the touch sensing apparatus of claim 17, wherein**

RYU et al. teach

the first curvature and second curvature *(i.e. please see above citation(s))* **are measured along a line drawn** *([0072], FIG. **4(a) & 4(b)**, i.e. **R1**)* **on the plate passing through a center point** *([0072], FIG. **4(a) & 4(b)**, i.e. **point intersected by R1 and 30**)* **of the plate** *(i.e. please see above citation(s))*.

Regarding Claim **20, (Previously Presented) the touch sensing apparatus of claim 17, wherein**

RYU et al. teach

the first curvature and second curvature *(i.e. please see above citation(s))* **are measured along a line drawn** *([0073], FIG. **4(a) & 4(b)**, i.e. **VPL**)* **on the plate passing through any position on the plate** *(i.e. please see above citation(s))*.

Response to Argument

10. Applicant's arguments with respect to Claim(s) **2 and 13** has/have been considered but are moot because the arguments do not apply to the newly added reference being used in the current rejection.

11. All dependent claims are properly rejected or objected as shown above.

12. Applicants' Response to the Non-Final Office action, **03/22/2021**, has been entered and made of record. Claim(s) **2** and **13** is/are amended, Claim(s) **1** and **21-23** is/are cancelled. Thus, Claim(s) **2-20** is/are pending in this application.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to VINH TANG LAM whose telephone number is (571) 270-3704. The examiner can normally be reached on Monday to Friday 8:00 AM to 5:00 PM.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nitin K Patel can be reached on (571) 272-7677. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see https://ppair-my.uspto.gov/pair/PrivatePair. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/VINH T LAM/
Primary Examiner, Art Unit 2628

Notice of References Cited	Application/Control No. 16/403,283	Applicant(s)/Patent Under Reexamination Kocovski et al.	
	Examiner VINH T LAM	Art Unit 2628	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-9280237-B2	03-2016	Kukulj; Dax	G06F3/0428	1/1
*	B	US-20150331546-A1	11-2015	CRAVEN-BARTLE; Thomas	G02B6/0038	345/175
*	C	US-9063614-B2	06-2015	Pettersson; Robert	G06F3/0421	1/1
*	D	US-20120089348-A1	04-2012	Perlin; Kenneth	G06F3/04144	702/41
*	E	US-20160334942-A1	11-2016	Wassvik; Ola	G06F3/0428	1/1
*	F	US-4986662-A	01-1991	Bures; Milan	G06F3/0421	250/221
*	G	US-20120223916-A1	09-2012	Kukulj; Dax	G06F3/0428	345/175
*	H	US-20160295711-A1	10-2016	RYU; Hyunjong	H05K5/03	1/1
*	I	US-20170308236-A1	10-2017	LEE; Jun Goo	G06F3/04182	1/1
*	J	US-10860142-B1	12-2020	Northcott; Malcolm J.	G02B6/04	1/1
	K					
	L					
	M					

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*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N	CN102117155	07-2011	China	LIU et al.	G06F3/042
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	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/403,283	Kocovski et al.
	Examiner	Art Unit
	VINH T LAM	2628

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	02/13/2020	10/05/2020	03/17/2021	06/30/2021					
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	22		✓	✓	✓					
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Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/403,283	Kocovski et al.
	Examiner	Art Unit
	VINH T LAM	2628

CPC - Searched*		
Symbol	Date	Examiner
G06F3/0421 G06F2203/04103	06/30/2021	vl

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
Search inventor'(s)' name(s). No ODP.	02/13/2020	vl
Search technical terms and synonyms.	06/30/2021	vl
Search IDS.	06/30/2021	vl
Search Foreign Patent Literature(s) and NPL (IP.com).	03/17/2021	vl
Search CPC.	06/30/2021	vl
Search EAST.	06/30/2021	vl
Review amendment and argument.	06/30/2021	vl

/VINH T LAM/ Primary Examiner, Art Unit 2628	

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Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/403,283	Kocovski et al.
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Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
Search all of the above.	Search all of the above.	02/13/2020	vl

/VINH T LAM/ Primary Examiner, Art Unit 2628	

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EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
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S7	35	((("KOCOVSKI") near3 ("Aleksander")) OR (("BERGSTROM") near3 ("Hakan")) OR (("THORVINGER") near3 ("Jens"))).INV.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	OR	OFF	2019/01/31 16:47
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EAST Search History (Prior Art)

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EAST Search History (Prior Art)

S29	210	("20110163996"|"20110163997"|"20110163998"|"20110169780"|"20110175852"|"20110205186"|"20110216042"|"20110221705"|"20110221997"|"20110227036"|"20110227874"|"20110234537"|"20110254864"|"20110261020"|"20110267296"|"20110291989"|"20110298743"|"20110309325"|"20110310045"|"20120019448"|"20120026408"|"20120038593"|"20120062474"|"20120068973"|"20120086673"|"20120089348"|"20120110447"|"20120131490"|"20120141001"|"20120146930"|"20120153134"|"20120154338"|"20120162142"|"20120162144"|"20120169672"|"20120181419"|"20120182266"|"20120188206"|"20120191993"|"20120200532"|"20120200538"|"20120212441"|"20120217882"|"20120249478"|"20120256882"|"20120268403"|"20120268427"|"20120274559"|"20120305755"|"20130021300"|"20130021302"|"20130027404"|"20130044073"|"20130055080"|"20130076697"|"20130082980"|"20130107569"|"20130113715"|"20130120320"|"20130125016"|"20130127790"|"20130135258"|"20130135259"|"20130141388"|"20130154983"|"20130155027"|"20130158504"|"20130181896"|"20130187891"|"20130201142"|"20130222346"|"20130241887"|"20130249833"|"20130269867"|"20130275082"|"20130285920"|"20130285968"|"20130300716"|"20130307795"|"20130342490"|"20140002400"|"20140028575"|"20140028604"|"20140028629"|"20140036203"|"20140055421"|"20140063853"|"20140071653"|"20140085241"|"20140092052"|"20140098032"|"20140098058"|"20140109219"|"20140125633"|"20140139467"|"20140160762"|"20140192023"|"20140232669"|"20140237401"|"20140237408"|"20140237422"|"20140253831"|"20140267124"|"20140292701"|"20140300572"|"20140320460"|"20140347325"|"20140362046"|"20140368471"|"20140375607"|"20150002386"|"20150009687"|"20150015497"|"20150035774"|"20150035803"|"20150053850"|"20150054759"|"20150083891"|"20150103013"|"20150130769"|"20150138105"|"20150138158"|"20150138161"|"20150205441"|"20150215450"|"20150242055"|"20150271481"|"20150286698"|"20150317036"|"20150324028"|"20150331544"|"20150331545"|"20150331546"|"20150331547"|"20150332655"|"20150346856"|"20150346911"|"20150363042"|"20160026337"|"20160034099"|"20160050746"|"20160070415"|"20160070416"|"20160124546"|"20160124551"|"20160154531"|"20160154532"|"20160202841"|"20160216844"|"20160224144"|"20160299593"|"20160328090"|"20160328091"|"20160334942"|"20160342282"|"20160357348"|"20170010688"|"20170090090"|"20170102827"|"20170115235"|"20170115823"|"20170139541"	US-PGPUB; USPAT	OR	OFF	2019/02/01 10:56

EAST Search History (Prior Art)

S30	175	("4986662"|"4988983"|"5065185"|"5073770"|"5105186"|"5159322"|"5166668"|"5227622"|"5248856"|"5254407"|"5345490"|"5383022"|"5483261"|"5484966"|"5499098"|"5502568"|"5525764"|"5526422"|"5539514"|"5570181"|"5572251"|"5577501"|"5600105"|"5608550"|"5672852"|"5679930"|"5686942"|"5688933"|"5729249"|"5736686"|"5740224"|"5764223"|"5767517"|"5775792"|"5945980"|"5945981"|"5959617"|"6061177"|"6067079"|"6122394"|"6141104"|"6172667"|"6175999"|"6227667"|"6229529"|"6333735"|"6366276"|"6380732"|"6380740"|"6390370"|"6429857"|"6452996"|"6476797"|"6492633"|"6495832"|"6504143"|"6529327"|"6538644"|"6587099"|"6648485"|"6660964"|"6664498"|"6664952"|"6690363"|"6707027"|"6738051"|"6748098"|"6784948"|"6799141"|"6806871"|"6927384"|"6940286"|"6965836"|"6972753"|"6985137"|"7042444"|"7084859"|"7087907"|"7133031"|"7176904"|"7199932"|"7359041"|"7397418"|"7432893"|"7435940"|"7436443"|"7442914"|"7465914"|"7613375"|"7629968"|"7646833"|"7653883"|"7655901"|"7705835"|"7729056"|"7847789"|"7855716"|"7859519"|"7924272"|"7932899"|"7969410"|"7995039"|"8013845"|"8031186"|"8077147"|"8093545"|"8094136"|"8094910"|"8149211"|"8218154"|"8274495"|"8325158"|"8339379"|"8350827"|"8384010"|"8407606"|"8441467"|"8445834"|"8466901"|"8482547"|"8542217"|"8567257"|"8581884"|"8624858"|"8686974"|"8692807"|"8716614"|"8727581"|"8745514"|"8780066"|"8830181"|"8860696"|"8872098"|"8872801"|"8884900"|"8890843"|"8890849"|"8928590"|"8963886"|"8982084"|"9024916"|"9035909"|"9063617"|"9086763"|"9134854"|"9158401"|"9158415"|"9213445"|"9274645"|"9317168"|"9323396"|"9366565"|"9377884"|"9389732"|"9411444"|"9411464"|"9430079"|"9442574"|"9547393"|"9552103"|"9557846"|"9588619"|"9594467"|"9618682"|"9626018"|"9626040"|"9639210"|"9678602"|"9684414"|"9710101"|"9874978"|"20120045170"|"20120062492"|"20160295711"|"6031524").PN.	US-PGPUB; USPAT	OR	OFF	2019/02/01 10:56
S31	50	(S28 S29 S30) and (parabol$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/02/01 10:58
S36	0	16/403283.app.	US-PGPUB	OR	OFF	2020/02/13 11:23

EAST Search History (Prior Art)

S37	49	((("KOCOVSKI") near3 ("Aleksander")) OR (("BERGSTROM") near3 ("Hakan")) OR (("THORVINGER") near3 ("Jens"))).INV.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	OR	OFF	2020/02/13 11:23
S38	3	S37 and ((first second) same (plane$1 surface$1 frame$1 edge$1) same (parabolic)).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/02/13 11:26

EAST Search History (Prior Art)

S39	201	("10282035"|"20100103133"|"20120062492"|"20150373864"|"20160026297"|"20160209886"|"20160255713"|"20160295711"|"6031524"|"10013107"|"10019113"|"20010002694"|"20010005004"|"20010005308"|"20010030642"|"20020067348"|"20020075243"|"20020118177"|"20020158823"|"20020158853"|"20020163505"|"20030016450"|"20030034439"|"20030034935"|"20030048257"|"20030052257"|"20030095399"|"20030107748"|"20030137494"|"20030156100"|"20030160155"|"20030210537"|"20030214486"|"20040027339"|"20040032401"|"20040090432"|"20040130338"|"20040174541"|"20040201579"|"20040212603"|"20040238627"|"20040239702"|"20040245438"|"20040252091"|"20040252867"|"20050012714"|"20050041013"|"20050057903"|"20050073508"|"20050083293"|"20050128190"|"20050143923"|"20050156914"|"20050162398"|"20050179977"|"20050200613"|"20050212774"|"20050248540"|"20050253834"|"20050276053"|"20060001650"|"20060001653"|"20060007185"|"20060008164"|"20060017706"|"20060017709"|"20060033725"|"20060038698"|"20060061861"|"20060114237"|"20060132454"|"20060139340"|"20060158437"|"20060170658"|"20060202974"|"20060227120"|"20060255248"|"20060256092"|"20060279558"|"20060281543"|"20060290684"|"20070014486"|"20070024598"|"20070034783"|"20070038691"|"20070052684"|"20070070056"|"20070075648"|"20070120833"|"20070125937"|"20070152985"|"20070201042"|"20070296688"|"20080006766"|"20080007540"|"20080007541"|"20080007542"|"20080011944"|"20080029691"|"20080036743"|"20080062150"|"20080068691"|"20080074401"|"20080088603"|"20080121442"|"20080122792"|"20080122803"|"20080130979"|"20080133265"|"20080150846"|"20080150848"|"20080151126"|"20080158176"|"20080189046"|"20080192025"|"20080238433"|"20080246388"|"20080252619"|"20080266266"|"20080278460"|"20080284925"|"20080291668"|"20080297482"|"20090000831"|"20090002340"|"20090006292"|"20090040786"|"20090066647"|"20090067178"|"20090073142"|"20090077501"|"20090085894"|"20090091554"|"20090115919"|"20090122020"|"20090122027"|"20090128508"|"20090135162"|"20090143141"|"20090153519"|"20090161026"|"20090168459"|"20090187842"|"20090189857"|"20090189874"|"20090189878"|"20090219256"|"20090229892"|"20090251439"|"20090256817"|"20090259967"|"20090267919"|"20090273794"|"20090278816"|"20090297009"|"20100033444"|"20100045629"|"20100060896"|"20100066016"|"20100066704"|"20100073318"|"20100078545"|"20100079407"	US-PGPUB; USPAT	OR	OFF	2020/02/13 11:41

EAST Search History (Prior Art)

S40	201	("20110102374"|"20110115748"|"20110121323"|"20110122075"|"20110122091"|"20110122094"|"20110134079"|"20110147569"|"20110157095"|"20110157096"|"20110163996"|"20110163997"|"20110163998"|"20110169780"|"20110175852"|"20110205186"|"20110216042"|"20110221705"|"20110221997"|"20110227036"|"20110227874"|"20110234537"|"20110254864"|"20110261020"|"20110267296"|"20110291989"|"20110298743"|"20110309325"|"20110310045"|"20120019448"|"20120026408"|"20120038593"|"20120062474"|"20120068973"|"20120086673"|"20120089348"|"20120110447"|"20120131490"|"20120141001"|"20120146930"|"20120153134"|"20120154338"|"20120162142"|"20120162144"|"20120169672"|"20120181419"|"20120182266"|"20120188206"|"20120191993"|"20120200532"|"20120200538"|"20120212441"|"20120217882"|"20120218229"|"20120249478"|"20120256882"|"20120268403"|"20120268427"|"20120274559"|"20120305755"|"20120313865"|"20130021300"|"20130021302"|"20130027404"|"20130044073"|"20130055080"|"20130076697"|"20130082980"|"20130106709"|"20130107569"|"20130113715"|"20130120320"|"20130125016"|"20130127790"|"20130135258"|"20130135259"|"20130141388"|"20130141395"|"20130154983"|"20130155027"|"20130158504"|"20130181896"|"20130181953"|"20130187891"|"20130201142"|"20130222346"|"20130241887"|"20130249833"|"20130269867"|"20130275082"|"20130285920"|"20130285968"|"20130300716"|"20130307795"|"20130342490"|"20140002400"|"20140028575"|"20140028604"|"20140028629"|"20140036203"|"20140055421"|"20140063853"|"20140071653"|"20140085241"|"20140092052"|"20140098032"|"20140098058"|"20140109219"|"20140125633"|"20140139467"|"20140160762"|"20140192023"|"20140232669"|"20140237401"|"20140237408"|"20140237422"|"20140253520"|"20140253831"|"20140259029"|"20140267124"|"20140292701"|"20140300572"|"20140320460"|"20140347325"|"20140362046"|"20140368471"|"20140375607"|"20150002386"|"20150009687"|"20150015497"|"20150035774"|"20150035803"|"20150053850"|"20150054759"|"20150083891"|"20150103013"|"20150121691"|"20150130769"|"20150138105"|"20150138158"|"20150138161"|"20150205441"|"20150215450"|"20150242055"|"20150271481"|"20150286698"|"20150317036"|"20150324028"|"20150331544"|"20150331545"|"20150331546"|"20150331547"|"20150332655"|"20150346856"|"20150346911"|"20150363042"|"20160004898"|"20160026337"|"20160034099"|"20160050746"|"20160070415"|"20160070416"	US-PGPUB; USPAT	OR	OFF	2020/02/13 11:41

EAST Search History (Prior Art)

S41	207	("4129384"|"4180702"|"4209255"|"4213707"|"4254333"|"4254407"|"4294543"|"4346376"|"4420261"|"4484179"|"4507557"|"4521112"|"4542375"|"4550250"|"4593191"|"4673918"|"4688933"|"4688993"|"4692809"|"4710760"|"4736191"|"4737626"|"4746770"|"4752655"|"4772763"|"4782328"|"4812833"|"4837430"|"4868912"|"4891829"|"4916712"|"4933544"|"4949079"|"4986662"|"4988983"|"5065185"|"5073770"|"5105186"|"5159322"|"5166668"|"5227622"|"5248856"|"5254407"|"5345490"|"5383022"|"5483261"|"5484966"|"5499098"|"5502568"|"5525764"|"5526422"|"5539514"|"5570181"|"5572251"|"5577501"|"5600105"|"5608550"|"5672852"|"5679930"|"5686942"|"5688933"|"5729249"|"5736686"|"5740224"|"5764223"|"5767517"|"5775792"|"5945980"|"5945981"|"5959617"|"6061177"|"6067079"|"6122394"|"6141104"|"6172667"|"6175999"|"6227667"|"6229529"|"6333735"|"6366276"|"6380732"|"6380740"|"6390370"|"6429857"|"6452996"|"6476797"|"6492633"|"6495832"|"6504143"|"6529327"|"6538644"|"6587099"|"6648485"|"6660964"|"6664498"|"6664952"|"6690363"|"6707027"|"6738051"|"6748098"|"6784948"|"6799141"|"6806871"|"6927384"|"6940286"|"6965836"|"6972753"|"6985137"|"7042444"|"7084859"|"7087907"|"7133031"|"7176904"|"7199932"|"7359041"|"7397418"|"7432893"|"7435940"|"7436443"|"7442914"|"7465914"|"7613375"|"7629968"|"7646833"|"7653883"|"7655901"|"7705835"|"7729056"|"7847789"|"7855716"|"7859519"|"7924272"|"7932899"|"7969410"|"7995039"|"8013845"|"8031186"|"8077147"|"8093545"|"8094136"|"8094910"|"8149211"|"8218154"|"8274495"|"8325158"|"8339379"|"8350827"|"8384010"|"8407606"|"8441467"|"8445834"|"8466901"|"8482547"|"8542217"|"8567257"|"8581884"|"8624858"|"8686974"|"8692807"|"8716614"|"8727581"|"8745514"|"8780066"|"8830181"|"8860696"|"8872098"|"8872801"|"8884900"|"8890843"|"8890849"|"8928590"|"8963886"|"8982084"|"9024916"|"9035909"|"9063614"|"9063617"|"9086763"|"9134854"|"9158401"|"9158415"|"9201520"|"9213445"|"9274645"|"9280237"|"9317168"|"9323396"|"9366565"|"9377884"|"9389732"|"9411444"|"9411464"|"9430079"|"9442574"|"9547393"|"9552103"|"9557846"|"9588619"|"9594467"|"9618682"|"9626018"|"9626040"|"9639210"|"9678602"|"9684414"|"9710101"|"9874978").PN.	US-PGPUB; USPAT	OR	OFF	2020/02/13 11:41

EAST Search History (Prior Art)

S42	55	(S39 S40 S41) and (parabol$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/02/13 11:43
S43	1	"20120223916".pn.	US-PGPUB	OR	OFF	2020/02/13 17:27
S44	1	"20160295711".pn.	US-PGPUB	OR	OFF	2020/02/13 17:30

EAST Search History (Prior Art)

S45	464	("20190079638" "20190079637" "10282035" "20190092411" "20120068973" "20190196659" "20190196657" "20190196658" "20190196660" "2015505117" "8989536" "10437389" "20140362053" "20140098791" "2014513375" "5593006" "2014222539" "5821125" "101491430" "101502295" "20140105872" "201329822" "5764266" "20150331547" "2862819" "2862819" "2013212634" "2013212634" "2793524" "2011229745" "20130135255" "2011229745" "2014233573" "20130133307" "2014233573" "2011229745" "10268319" "101399142" "2013522801" "9335867" "20100040277" "2825175" "8676007" "2015503157" "20110175852" "20130141395" "8587562" "20140146249" "5876587" "20150145834" "20110163998" "5853016" "9471170" "2825175" "8837882" "8553014" "20130155027" "20130135359" "20110074734" "2728034" "20110167628" "20160239153" "8902196" "8403203" "2009272923" "8890843" "20110169780" "2856992" "20110032214" "20190272052" "10496227" "2013207572" "9389730" "20180267672" "2012346379" "20110210946" "20150277663" "9411430" "2012346379" "201007530" "20140071094" "2013207572" "2014201966" "8896575" "9811163" "9052777" "20120176343" "20110181552" "9195344" "20160026337" "20110169781" "9164625" "9857917" "2688065" "2008280797" "8434909" "9052771" "9158416" "8950902" "20110169782" "20130250618" "20160026250" "20110227487" "20140364218" "20150277636" "20180296915" "9741184" "20150248796" "201416936" "20130187891" "8905610" "20130155723" "20120098794" "20120188206" "20150205441" "9063614" "20140320459" "2013525955" "9857916" "20160067602" "9110200" "2010236331" "2796519" I497358 "201411455" "2728030" "20170262134" "10140791" "20110255303" "20170309096" "20150261339" "2749584" "10282034" "10534479" "20140160081" "20110074735" "9035917" "2848650" "20160009073").pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/02/13 18:22

EAST Search History (Prior Art)

S46	409	S45 and @ad<"20161207"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/02/13 18:23
S47	64	S46 and (G06F3/0421 G06F2203/04103)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/02/13 18:23
S48	16	("10282035"|"20080080811"|"20110141062"|"20120170056"|"20120223916"|"20130155655"|"20130300714"|"20150131010"|"20150339000"|"20160306501"|"20190025984"|"20190196657"|"20190196658"|"20190196659"|"9001086"|"9207800").PN.	US-PGPUB; USPAT	OR	OFF	2020/10/05 14:12
S49	3	(parabol$3) and S48	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/10/05 14:13
S50	8	("20110080361"|"20130234991"|"20130321740"|"20150373864"|"20160154533"|"20190235701"|"4751379"|"9024896").PN.	US-PGPUB; USPAT	OR	OFF	2020/10/05 14:59
S51	1	(parabol$3) and S50	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/10/05 15:00
S52	9,977,497	((curv$3 arc$3 arch$3 bend$3 bent curvature bow$3 circl$3 circul$3 ellipse helix hyperbol$3 parabol$3 round$3 whorl) (optic$3 light$3) same touch$3 same (sens$3 detect$3) same (surface fac$3)).ab.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/03/16 15:05
S53	6,745,912	S52 and @ad<"20161207"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/03/16 15:07

EAST Search History (Prior Art)

S54	773	S53 and (G06F3/0421 G06F2203/04103)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/03/16 15:09
S55	843	((curv$3 arc$3 arch$3 bend$3 bent curvature bow$3 circl$3 circul$3 ellipse helix hyperbol$3 parabol$3 round$3 whorl) same (optic$3 light$3) same touch$3 same (sens$3 detect$3) same (surface fac$3)).ab.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/03/16 15:10
S56	541	S55 and @ad<"20161207"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/03/16 15:13
S57	19	S56 and (G06F3/0421 G06F2203/04103)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/03/16 15:13
S58	24	("2015/0331546").URPN.	USPAT	OR	OFF	2021/03/16 16:22
S59	1	15/547587.app.	US-PGPUB	OR	OFF	2021/03/16 16:25
S60	0	15/248405.app.	US-PGPUB	OR	OFF	2021/03/16 16:35
S61	2	S54 and (frame hous$3 chassis) same (touch$3 sens$3 detect$3) same ("in." inch$2)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/03/16 17:16
S62	29,804	(frame hous$3 chassis) same (touch$3 sens$3 detect$3) same ("in." inch$2)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/03/16 17:17
S63	16,671	S62 and @ad<"20161207"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/03/16 17:17

EAST Search History (Prior Art)

S64	22	S63 and (G06F3/0421 G06F2203/04103)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/03/16 17:18
S65	112	(concave same (optic$3 light$3) same touch$3 same (sens$3 detect$3) same (surface fac$3)).ab.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/06/30 10:06
S66	64	S65 and @ad<"20161207"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/06/30 10:06
S67	0	S66 and (G06F3/0421 G06F2203/04103)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/06/30 10:07

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S32	193	((parabol$3) same (optic$3 light$3) same touch$3 same (surface fac$3))	US-PGPUB; USPAT	OR	OFF	2019/02/01 10:20
S33	181	S32 and @ad<"20161207"	US-PGPUB; USPAT	OR	OFF	2019/02/01 10:21
S34	29	S33 and (G06F3/0421 G06F2203/04103)	US-PGPUB; USPAT	OR	OFF	2019/02/01 10:22

Espacenet

Bibliographic data: CN102117155 (A) — 2011-07-06

Optical touch screen with concave surface

Inventor(s): HUIWU LIU; GONGZHE CHENG; JUNPENG HU ± (LIU HUIWU, ; CHENG GONGZHE, ; HU JUNPENG)

Applicant(s): GUANGZHOU SHIRUI ELECTRONICS CO LTD ± (GUANGZHOU SHIRUI ELECTRONICS CO.,LTD)

Classification: **- international:** ***G06F3/042***
- cooperative:

Application number: CN20111049536 20110302 Global Dossier

Priority number (s): CN20111049536 20110302

Abstract of CN102117155 (A)

The invention discloses an optical touch screen with one concave surface, which comprises a frame, an optical sensor, a light source, a retroreflective bar and a touch panel, wherein the surface of the touch control surface is downward-convex. Compared with the prior art, the optical touch screen has the following benefits that as the touch panel with one downward-convex surface is mounted, a part of light rays is reflected to the retroreflective bar by the touch panel, so that the energy of retroreflective light is enhanced. Therefore, the optical touch screen with one concave surface has higher sensibility and detection precision.

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DESCRIPTION CN102117155A

Concave optical touch screen

[0001]

Technical field

[0002]

The invention relates to a touch screen, in particular to a concave optical touch screen.

[0003]

Background technique

[0004]

With the development of multimedia technology, touch screens for realizing human-computer interaction have become more and more widely used.

At present, the mainstream touch technology in China is mainly infrared, surface acoustic wave and resistive screen, but these technologies also have flaws, such as the need for force to click on the acoustic wave screen, and the performance of the resistive screen is unstable. In recent years, the emergence of concave optical touch screens has basically solved the problems of many touch screens, with fast response speed, high sensitivity, and low touch force required. 1 is a schematic diagram of the structure of a conventional concave optical touch screen. The concave optical touch screen includes a frame 101, an optical sensor 102, a light source 103, a retro-reflective strip 104, and a touch panel 105. The frame 101 is a rectangular frame with a first edge 1011, the second edge 1012, the third edge 1013, and the fourth edge 1014 are connected in sequence. When the touch object 106 is touched on the touch panel 105, the light 107 emitted by the light source 103 will be blocked, and a shadow 108 will be generated on the retro-reflective strip 104. The optical sensor 102 can calculate the location of the touch object 106 by analyzing the shadow 108. position. In an ideal state, the touch panel 105 is horizontal, but in actual situations, the touch panel 105 generally has unevenness, which makes it difficult to achieve an ideal horizontal state. Please refer to FIG. 4a. When the surface of the touch panel 105 is convex, part of the light 109 is reflected out of the retro-reflective strip 104, and the effective reflected and returned light energy is very weak. The light energy of the reflected return is low, and the signal is weak, which makes the sensitivity of the touch screen low and the detection accuracy is low.

[0005]

Summary of the invention

[0006]

The technical problem to be solved by the embodiments of the present invention is to provide a concave optical touch screen with sensitivity and high detection accuracy.

[0007]

In order to solve the above technical problems, an embodiment of the present invention provides a concave optical touch screen, including a frame, an optical sensor, a light source, a retro-reflective strip, and a touch panel, wherein the surface of the touch panel is recessed downward.

[0008]

Further, the center of the surface of the touch panel is recessed downward, the edges are horizontal, and the remaining parts are evenly pulled up from the center to the edges.

[0009]

Further, the center position of the surface of the touch panel is 0.5 mm to 5 mm lower than the edge position.

[0010]

Further, the touch panel is made of honeycomb aluminum plate material.

[0011]

Further, the touch panel is made of acrylic board material.

[0012]

Further, the touch panel is made of tempered glass material.

[0013]

Further, when the tempered glass touch panel is tempered and cooled during the manufacturing process, the air pressure on the upper surface of the tempered glass is 920±10MP, and the air pressure on the lower surface is 860±10MP.

[0014]

The implementation of the embodiments of the present invention has the following beneficial effects: due to the installation of a touch panel with a downwardly recessed surface, part of the light is reflected by the touch panel to the retro-reflective strip, which enhances the energy of the retro-reflected light, making the optical touch screen of the present invention Has higher sensitivity and detection accuracy.

Compared with other technical solutions in which special materials or special structures are arranged on the retro-reflective strip to increase the energy of the retro-reflected light, the solution of this embodiment is simple and easy to implement, and achieves unexpected technical effects.

[0015]

Description of the drawings

[0016]

In order to explain the technical solutions in the embodiments of the present invention more clearly, the following will briefly introduce the drawings used in the description of the embodiments. Obviously, the drawings in the following description are only

one embodiment of the present invention. For those of ordinary skill in the art, without creative labor, other drawings can be obtained based on these drawings.

[0017]

FIG. 1 is a schematic diagram of the structure of a conventional concave optical touch screen;

[0018]

2 is a schematic structural diagram of an embodiment of the concave optical touch screen of the present invention;

[0019]

3 is a schematic diagram of the structure of the touch panel of the concave optical touch screen of FIG. 2;

[0020]

Fig. 4a is a schematic diagram of light reflection regression of a conventional concave optical touch screen in practical application;

[0021]

Fig. 4b is a schematic diagram of light reflection regression of the concave optical touch screen of the present invention in practical application.

[0022]

Detailed ways

[0023]

The technical solutions in the embodiments of the present invention will be clearly and completely described below in conjunction with the accompanying drawings in the embodiments of the present invention. Obviously, the described embodiment is only one embodiment of the present invention, not all embodiments.

Based on the embodiments of the present invention, all other embodiments obtained by those of ordinary skill in the art without creative work shall fall within the protection scope of the present invention.

[0024]

The embodiment of the present invention provides a concave optical touch screen. The embodiment of the concave optical touch screen will be described below with reference to FIGS. 2 to 4b.

[0025]

2 is a schematic structural diagram of the first embodiment of the concave optical touch screen of the present invention. As shown in FIG. 2, the structure of the concave optical touch screen 1 of this embodiment includes:

[0026]

Frame 11, optical sensor 12, light source 13, retro-reflective strip 14 and touch panel 15.

The frame 11 surrounds the touch panel 15. The optical sensor 12 and the light source 13 are placed on the frame 11, specifically, they can be placed on the upper left corner and the upper right corner of the frame 11, or placed at the center of the upper frame of the frame 11. The retro-reflective strip 14 is placed on the edge of the frame 11. Wherein, the surface of the touch panel 15 is recessed downward.

[0027]

Specifically, please refer to FIG. 3, which is a schematic diagram of the structure of the touch panel 15 of the concave optical touch screen of the present invention.

As shown in FIG. 3, the surface center 151 of the touch panel 15 is recessed downward, the edge 152 is horizontal, and the remaining parts are pulled up uniformly from the center 151 to the edge 152. Preferably, the position of the center 151 of the surface of the touch panel 15 is 0.5 mm to 5 mm lower than the edge position 152 to achieve a better reflection effect.

[0028]

Please refer to FIGS. 4a and 4b in combination. FIG. 4a is a schematic diagram of light reflection regression of the existing concave optical touch screen in practical application; FIG. 4b is a schematic diagram of light reflection regression of the concave optical touch screen of the present invention in practical application.

[0029]

As shown in FIG. 4a, when the surface of the touch panel 105 is convex, part of the light 109 emitted by the light source 103 is reflected by the touch panel 105 outside the retro-reflective strip 104, effectively reflecting the light energy returning to the optical sensor 102 It's very weak.

The light energy of the reflected return is low, and the signal is weak, which makes the sensitivity of the touch screen low and the detection accuracy is low.

[0030]

As shown in Figure 4b, due to the installation of the touch panel 15 with a downwardly recessed surface, part of the light 153 emitted by the light source 13 is reflected by the touch panel 15 to the retro-reflective strip 14 and then reflected back by the retro-reflective strip 14 The optical sensor 12 enhances the energy of retro-reflected light.

The high light energy of the reflected return means the strong signal, which improves the sensitivity of the touch screen and the detection accuracy.

[0031]

Specifically, the touch panel 15 is made of honeycomb aluminum plate material or acrylic plate material.

[0032]

Preferably, the touch panel 15 is made of tempered glass material.

The tempered glass is not a normal process, and it is necessary to pay attention to the control process during production, so that the center part is recessed downward.

The control method is: when the tempered glass is tempered and cooled, the upper and lower surfaces have different wind pressure settings, and the upper surface pressure is controlled to be 920±10MP, and the lower surface pressure is 880±10MP, then the tempered glass is downward Sunken.

[0033]

The implementation of the embodiments of the present invention has the following beneficial effects: due to the installation of a touch panel with a downwardly recessed surface, part of the light is reflected by the touch panel to the retro-reflective strip, which enhances the energy of the retro-reflected light, making the optical touch screen of the present invention Has higher sensitivity and detection accuracy.

Compared with other technical solutions in which special materials or special structures are arranged on the retro-reflective strip to increase the energy of the retro-reflected light, the solution of this embodiment is simple and easy to implement, and achieves unexpected technical effects.

[0034]

The above-disclosed are only the preferred embodiments of the present invention, which of course cannot be used to limit the scope of the present invention. Therefore, equivalent changes made according to the claims of the present invention still fall within the scope of the present invention.

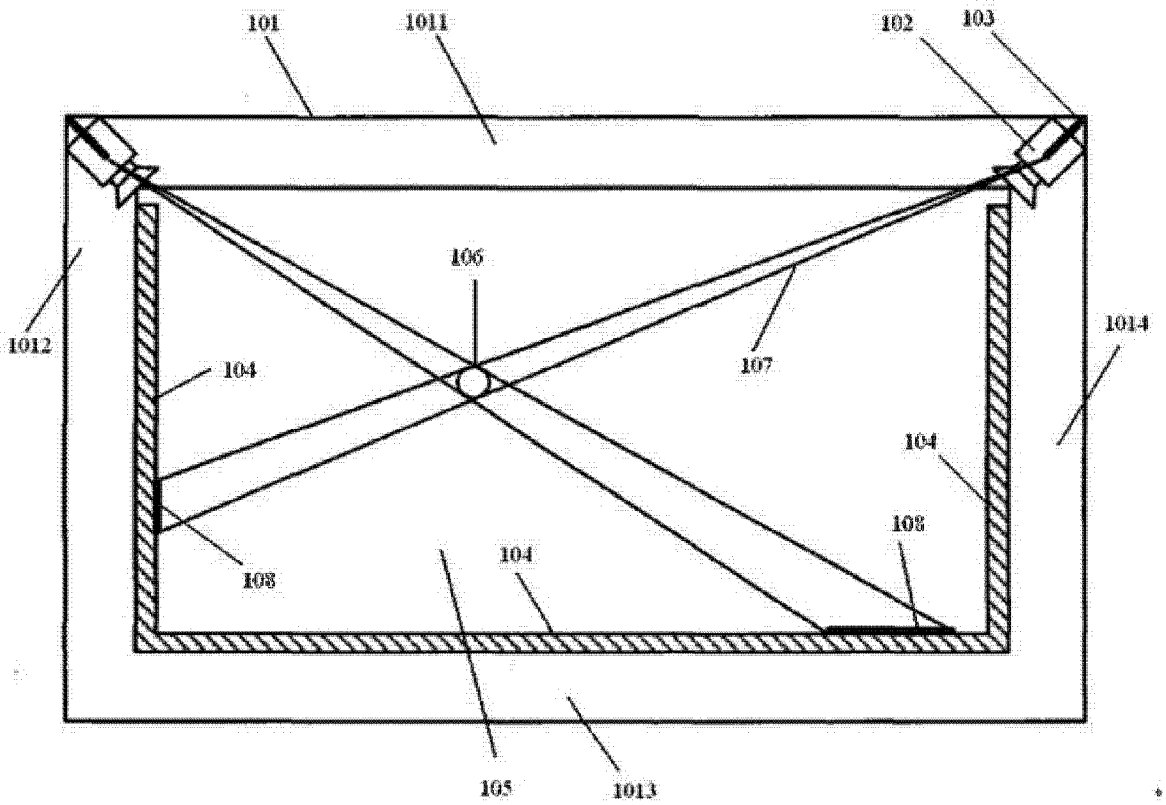


图 1

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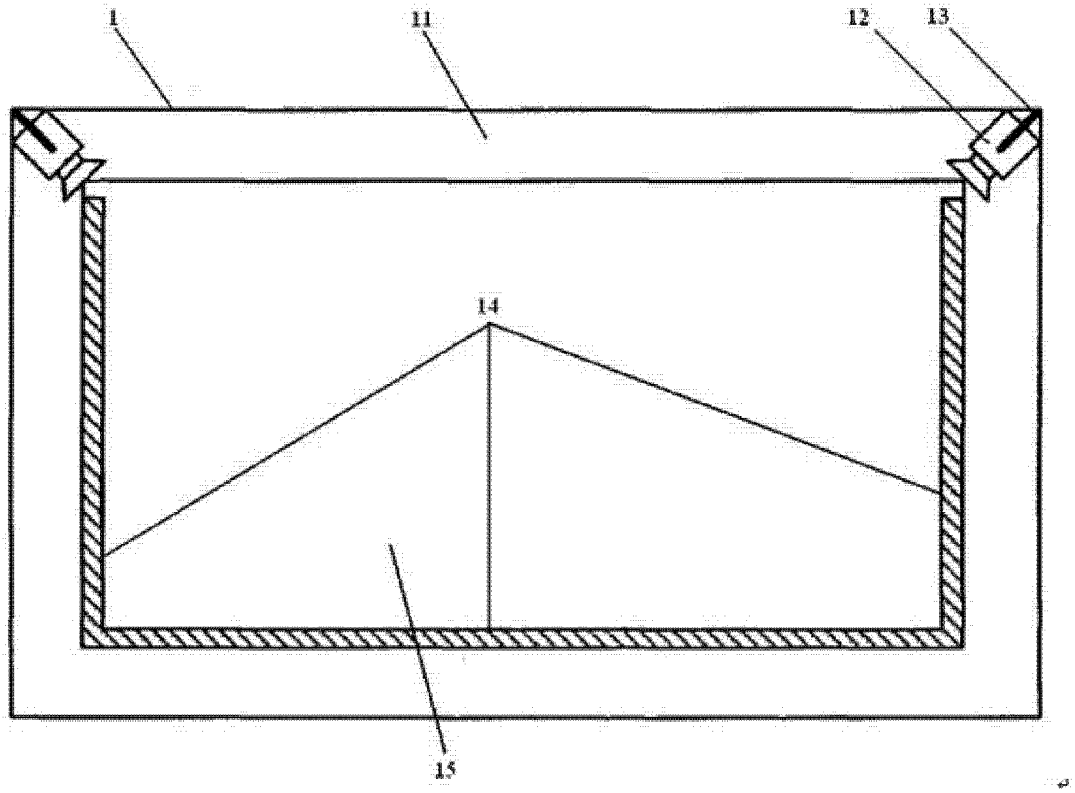


图 2

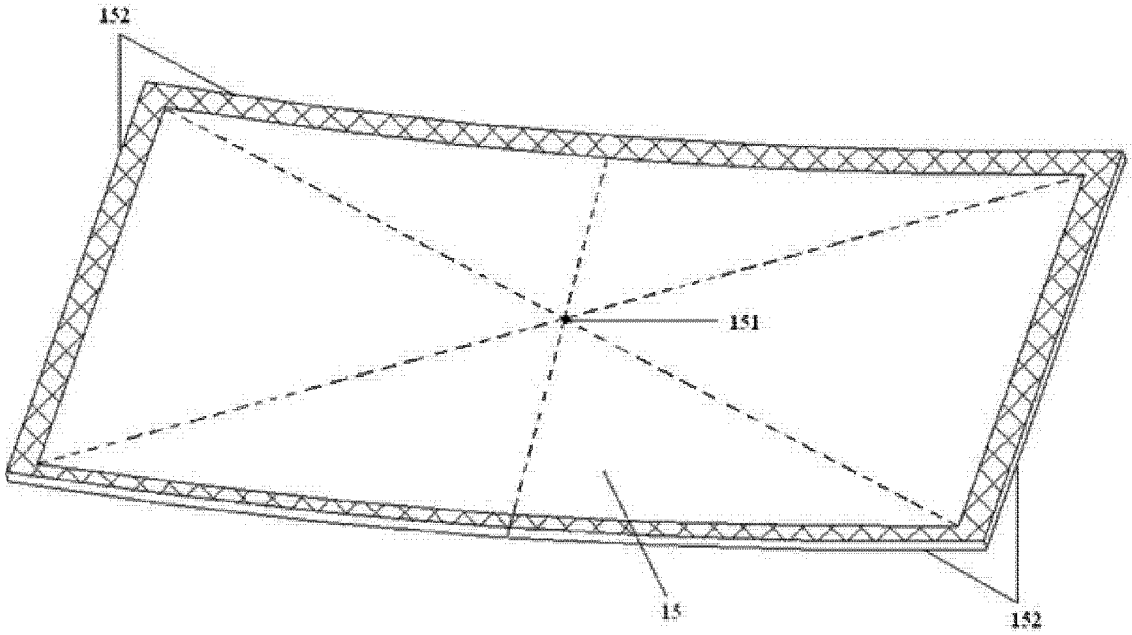


图 3

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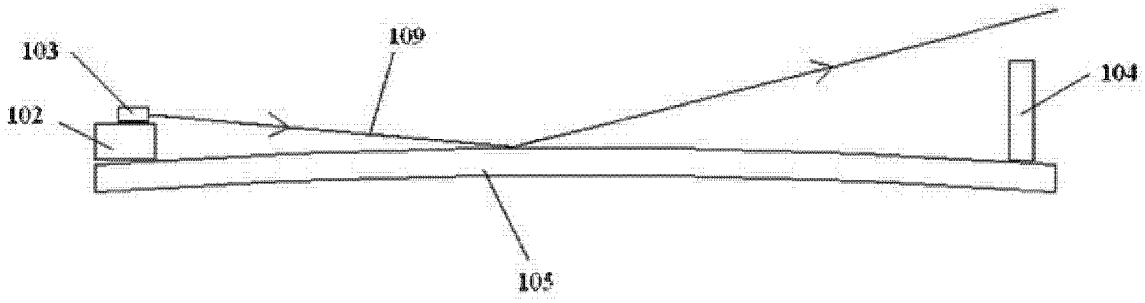


图 4a

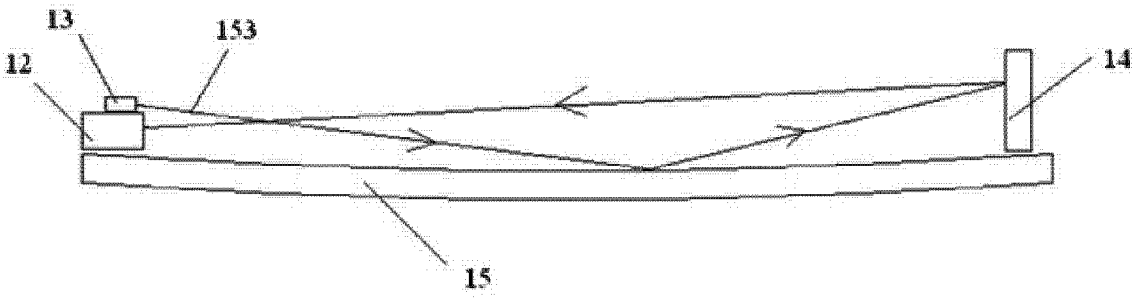


图 4b

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PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 16/403,283	Filing Date 05/03/2019	☐ To be Mailed

ENTITY: ☑ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $100 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $460 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	06/22/2021	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 19	Minus	** 22	= 0		x $100 =	0
	Independent (37 CFR 1.16(h))	* 2	Minus	*** 3	= 0		x $480 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	0

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	LIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/TRINA RIDDICK/
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".	
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.	

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

RESPONSE TO OFFICE ACTION DATED MARCH, 22, 2021

First Inventor: Aleksander Kocovski	**Conf. No.:** 5417
App. No.: 16/403283	**Filed:** May 3, 2019
Examiner: Lam, Vinh Tang	**Art Unit:** 2628
Title: TOUCH DEVICE	

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Commissioner:

In response to the Office Action mailed March 22, 2021, the Applicant respectfully requests the above-identified application be amended as follows:

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AMENDMENTS TO THE CLAIMS

The following listing of claims replaces all prior versions thereof. Changes are shown below in highlighted form, where insertions appear as underlined text (e.g., insertions) while deletions appear as strikethrough text (e.g., ~~deletions~~) or double brackets (e.g., [[deletions]]).

1. (Canceled)

2. (Currently Amended) A touch sensing apparatus having a long edge and a short edge, the touch sensing apparatus comprising:

a display panel;

a plate including a touch surface;

a plurality of emitters arranged around a portion of the periphery of the plate and configured to emit light across the touch surface of the plate,

a plurality of detectors arranged around a portion of the periphery of the plate and configured to receive light from the plurality of emitters, and

a frame assembly, the frame assembly comprising;

a first frame element configured to support the display panel;

a second frame element arranged around the periphery of the plate and configured to support the plurality of emitters and plurality of detectors,

wherein the second frame element including a first surface arranged against an edge of the plate and a second surface arranged parallel to the touch surface,

the touch surface including:

a first edge and a second edge adjacent to the short edge; and

a third edge and a fourth edge adjacent to the long edge;

wherein the touch surface is curved relative to a ~~second~~ flat plane defined in part by the short edge and the long edge;

wherein a distance between a first curved line drawn on ~~the first plane~~ the touch surface and a second straight line drawn on the ~~second~~ flat plane varies according to a concave curve function;

wherein the first, second, third, and fourth edges are curved.

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3. (Previously Presented) The touch sensing apparatus of claim 2, wherein the plurality of emitters is configured to emit light to propagate over the touch surface.

4. (Previously Presented) The touch sensing apparatus of claim 2, wherein the plurality of emitters is configured to emit light through the plate by total internal reflection.

5. (Previously Presented) The touch sensing apparatus of claim 2, further comprising a processing element configured to determine, based on output signals of the plurality of detectors, a position of an object on the touch surface.

6. (Previously Presented) The touch sensing apparatus of claim 2, wherein the plate has a first curvature prior to installation and a second curvature greater than the first curvature when assembled.

7. (Previously Presented) The touch sensing apparatus of claim 6, wherein the first curvature and second curvature are measured along an edge of the plate.

8. (Previously Presented) The touch sensing apparatus of claim 6, wherein the first curvature and second curvature are measured along a line drawn on the plate passing through a center point of the plate.

9. (Previously Presented) The touch sensing apparatus of claim 6, wherein the first curvature and second curvature are measured along a line drawn on the plate passing through any position on the plate.

10. (Previously Presented) The touch sensing apparatus of claim 2, further comprising a gasket, wherein the plate is supported by the gasket along an edge of the plate.

11. (Previously Presented) The apparatus of claim 10, wherein the gasket is configured to have varying thickness to match a curvature of the plate along the edge.

12. (Previously Presented) The apparatus of claim 2, wherein the second frame element is curved.

13. (Currently Amended) A touch sensing apparatus comprising:

a display panel;

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a rectangular plate including a touch surface;

a plurality of emitters configured to emit light across the touch surface of the rectangular plate, and

a frame configured to support the display panel, the rectangular plate, and the plurality of emitters, said frame comprising:

a longitudinal edge portion configured to contact at least a first corner and a second corner of the rectangular plate,

wherein the longitudinal edge portion is curved such that a distance in a vertical plane between the longitudinal edge portion and a straight line between the first corner and the second corner varies according to a concave curve function and wherein the curved edge portion is configured to enable curvature in the rectangular plate,

wherein the rectangular plate is at least 55" wide along an axis.

14. (Previously Presented) The touch sensing apparatus of claim 13, wherein the plurality of emitters is configured to emit light to propagate over the touch surface.

15. (Previously Presented) The touch sensing apparatus of claim 13, wherein the plurality of emitters is configured to emit light through the plate by total internal reflection.

16. (Previously Presented) The touch sensing apparatus of claim 13, further comprising a processing element configured to determine, based on output signals of the plurality of detectors, a position of an object adjacent to the touch surface.

17. (Previously Presented) The touch sensing apparatus of claim 13, wherein the plate has a first curvature prior to installation and, a second curvature greater than the first curvature when assembled.

18. (Previously Presented) The touch sensing apparatus of claim 17, wherein the first curvature and second curvature are measured along an edge of the plate.

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19. (Previously Presented) The touch sensing apparatus of claim 17, wherein the first curvature and second curvature are measured along a line drawn on the plate passing through a center point of the plate.

20. (Previously Presented) The touch sensing apparatus of claim 17, wherein the first curvature and second curvature are measured along a line drawn on the plate passing through any position on the plate.

21. – 23. (CANCELED)

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SUMMARY OF INTERVIEW

Applicant's representatives, Harnik Shukla and Dominic Davies, conducted a telephonic interview with Examiner Vinh Lam on June 3, 2021. The Applicant's representatives proposed amendments to Claim 2 and discussed the claims in view of cited art, Kukulj. The Examiner indicated that the amendments overcome the existing rejections. No agreement was reached as to allowance.

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REMARKS

By way of summary, Claims 2-23 were pending in this application. In the present amendment, Applicant has canceled Claims 21-23, and has amended Claims 2 and 13 without prejudice or disclaimer. Accordingly, Claims 2-23 remain pending.

Rejections of Claims Under 35 U.S.C. § 112

The Office Action rejected Claim 2 and its dependent claims under 35 U.S.C. § 112, second paragraph as being indefinite with respect to the "first plane." Applicant has clarified the claim as shown above. Based on the amendment, Applicant respectfully requests withdrawal of the rejections.

Rejections of Claims Under 35 U.S.C. § 103

The Office Action rejected independent Claim 2 under 35 U.S.C. § 103 as being unpatentable over unpatentable over Kukulj (US Patent/PGPub. No. 20120223916) in view of Northcott et al. (US Patent/PGPub. No. 10860142). Furthermore, independent Claims 13 and 21 were rejected under § 103 as being unpatentable over Kukulj (US Patent/PGPub. No. 20120223916) in view of LEE (US Patent/PGPub. No. 20170308236). The Office Action rejected the dependent claims based at least on the above cited references. Applicant respectfully traverses these rejections, the characterizations of the pending claims and the cited references and each and every implicit and explicit potential for reliance on Official Notice. However, in the interest of expediting prosecution, Applicant has amended the independent claims as shown above. The dependent claims are addressed in the "Dependent Claims" section below.

Independent Claim 2

As discussed and agreed by the Examiner, the proposed amendments to Claim 2 overcome the existing art based rejections. Applicant has amended Claim 2 in line with the proposed amendments. Thus, at least based on the discussions during the Interview, Applicant respectfully requests withdrawal of the rejections.

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Independent Claim 13

Claim 13 recites a "frame comprising . . . a longitudinal edge portion . . . wherein the longitudinal edge portion is curved."

Figure 5 of Kukulj including "parabolic reflectors" 38 are shown below.

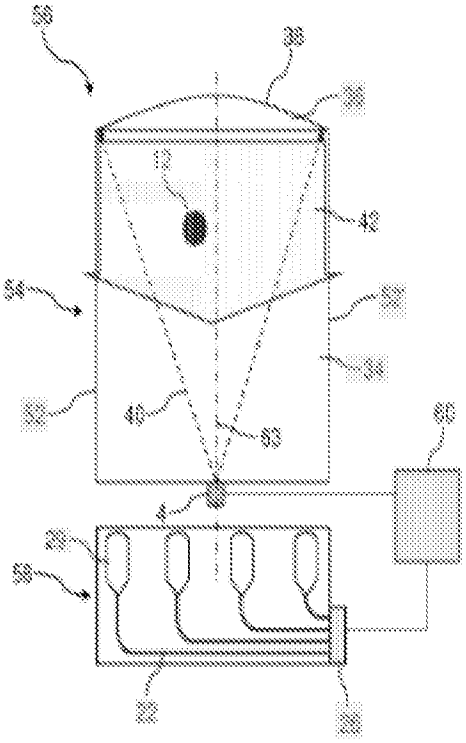


Fig 5A

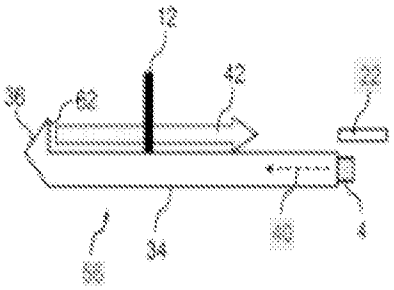


Fig 5B

The sides 52 of Kukulj are not curved, particularly in a "vertical plane" (coming out of the page). In contrast, the "longitudinal edge portion" as recited in claim 13 "is curved such that a distance in a vertical plane between the longitudinal edge portion and a straight line between the first corner and the second corner varies according to a concave curve function."

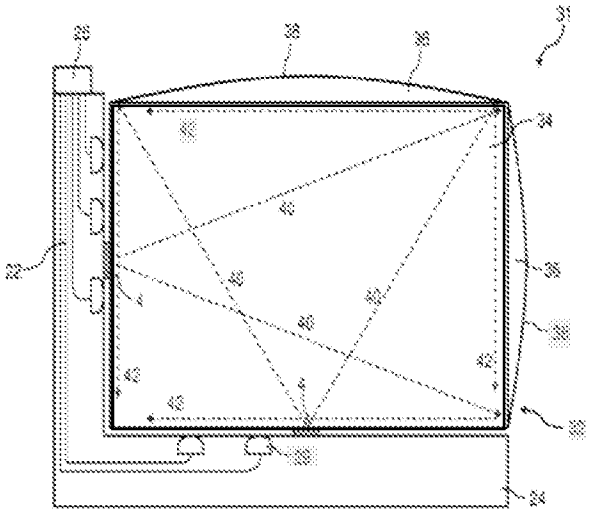


Fig 3

Furthermore, Claim 13 recites "wherein the curved edge portion is configured to enable curvature in the rectangular plate." In Kukulj, the touch surface area which is illustrated by the yellow rectangle in Figure 3 reproduced above is **not** curved.

For at least these reasons and for those discussed during the Interview, amended Claim 13 is patentable over the cited references.

Dependent Claims

The dependent claims are patentable for the same reasons articulated above with respect to their independent claims. The dependent claims are also patentable because of the additional features recited therein.

No Disclaimers or Disavowals

Although the present communication may include alterations to the application or claims, or characterizations of claim scope or referenced art, Applicant is not conceding in this application that previously pending claims are not patentable over the cited references. Rather, any alterations or characterizations are being made to facilitate expeditious prosecution of this application. Applicant reserves the right to pursue at a later date any previously pending or other broader or narrower claims that capture any subject matter supported by the present disclosure, including subject matter found to be specifically disclaimed herein or by any prior prosecution. Accordingly, reviewers of this

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or any parent, child or related prosecution history shall not reasonably infer that Applicant has made any disclaimers or disavowals of any subject matter supported by the present application. Further, Applicant's arguments in favor of one independent claim should not be imputed to any other independent claim.

Conclusion

In view of the foregoing amendments and remarks, Applicant respectfully requests that the Examiner withdraw the outstanding rejections and allow the present application. If any issues arise during examination, the Examiner is invited to call the undersigned representative at his direct dial number listed below.

By focusing on specific claims and claim recitations in the discussion above, Applicant does not intend to imply that other claim recitations are disclosed or rendered obvious by the art of record.

Please charge any additional fees, including any fees for additional extension of time, or credit overpayment to Deposit Account No. 11-1410.

Respectfully submitted,

KNOBBE, MARTENS, OLSON & BEAR, LLP

Dated: June 22, 2021

By:/Harnik Shukla/_____
Harnik Shukla
Registration No. 73,097
Registered Practitioner
(949) 721-5278

35188528

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Electronic Acknowledgement Receipt

EFS ID:	43055492
Application Number:	16403283
International Application Number:	
Confirmation Number:	5417
Title of Invention:	TOUCH DEVICE
First Named Inventor/Applicant Name:	Aleksander Kocovski
Customer Number:	20995
Filer:	Harnik Shukla/Daniela Lopez
Filer Authorized By:	Harnik Shukla
Attorney Docket Number:	FFOG.053C3
Receipt Date:	22-JUN-2021
Filing Date:	03-MAY-2019
Time Stamp:	16:07:28
Application Type:	Utility under 35 USC 111(a)

Payment information:

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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		FFOG053C3_OAR.pdf	122701 29271d833ab10da4b551c52bef839f598eea8975	yes	10

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Amendment/Req. Reconsideration-After Non-Final Reject	1	1
	Claims	2	5
	Applicant summary of interview with examiner	6	6
	Applicant Arguments/Remarks Made in an Amendment	7	10
Warnings:			
Information:			
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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/403,283	05/03/2019	Aleksander Kocovski	FFOG.053C3	5417

20995 7590 06/11/2021

KNOBBE MARTENS OLSON & BEAR LLP
2040 MAIN STREET
FOURTEENTH FLOOR
IRVINE, CA 92614

EXAMINER	
LAM, VINH TANG	

ART UNIT	PAPER NUMBER
2628	

NOTIFICATION DATE	DELIVERY MODE
06/11/2021	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

efiling@knobbe.com
jayna.cartee@knobbe.com

Applicant-Initiated Interview Summary	**Application No.** 16/403,283	**Applicant(s)** Kocovski et al.		
	Examiner VINH T LAM	**Art Unit** 2628	**AIA (First Inventor to File) Status** Yes	**Page** 1 of 1

All Participants (applicant, applicants representative, PTO personnel)	**Title**	**Type**
VINH T LAM	Examiner	Telephonic
Hamik Shukla	Attorney of Record	
Dominic	Flatfrog	

Date of Interview: 03 June 2021

Issues Discussed:

35 U.S.C. 103

Kukulj (US Patent/PGPub. No. 20120223916) in view of Northcott et al. (US Patent/PGPub. No. 10860142)

Proposed Amendment(s)

"a distance between a first curved line drawn on THE TOUCH SURFACE and a second straight line drawn on the second flat plane varies according to a concave curve function" WOULD OVERCOME MOST RECENT REJECTION.

/VINH T LAM/ Primary Examiner, Art Unit 2628	

Applicant is reminded that a complete written statement as to the substance of the interview must be made of record in the application file. It is the applicants responsibility to provide the written statement, unless the interview was initiated by the Examiner and the Examiner has indicated that a written summary will be provided. See MPEP 713.04
Please further see:
MPEP 713.04
Title 37 Code of Federal Regulations (CFR) § 1.133 Interviews, paragraph (b)
37 CFR § 1.2 Business to be transacted in writing

Applicant recordation instructions: The formal written reply to the last Office action must include the substance of the interview. (See MPEP section 713.04). If a reply to the last Office action has already been filed, applicant is given a non-extendable period of the longer of one month or thirty days from this interview date, or the mailing date of this interview summary form, whichever is later, to file a statement of the substance of the interview.

Examiner recordation instructions: Examiners must summarize the substance of any interview of record. A complete and proper recordation of the substance of an interview should include the items listed in MPEP 713.04 for complete and proper recordation including the identification of the general thrust of each argument or issue discussed, a general indication of any other pertinent matters discussed regarding patentability and the general results or outcome of the interview, to include an indication as to whether or not agreement was reached on the issues raised.

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 563

UNITED STATES PATENT AND TRADEMARK OFFICE

USPTO Automated Interview Request (AIR)

May 20 2021

This paper requesting to schedule and/or conduct an interview is appropriate because:

This submission is requested to be accepted as an authorization for this interview to communicate via the internet. Recognizing that Internet communications are not secure, I hereby authorize the USPTO to communicate with the undersigned concerning scheduling of the interview via video conference, instant messaging, or electronic mail, and to conduct the interview in accordance with office practice including video conferencing.

Name(s):
Harnik Shukla

S-signature:
/Harnik Shukla/

Registration Number:
73097

U.S. Application Number:
16403283

Confirmation Number:
5417

E-mail Address:
2hzs@knobbe.com

Phone Number:
+1 9497215278

Proposed Time of Interview:
6-3-2021 12:00 PM ET

Prefered Interview Type:
Telephonic

I am the applicant or applicant's representative for this application.

Topic for Discussion:

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Courtesy Reminder for
Application Serial No: 16/403,283

Attorney Docket No: FFOG.053C3
Customer Number: 20995
Date of Electronic Notification: 03/22/2021

This is a courtesy reminder that new correspondence is available for this application. If you have not done so already, please review the correspondence. The official date of notification of the outgoing correspondence will be indicated on the form PTOL-90 accompanying the correspondence.

An email notification regarding the correspondence was sent to the following email address(es) associated with your customer number:

jayna.cartee@knobbe.com
efiling@knobbe.com

To view your correspondence online or update your email addresses, please visit us anytime at **https://ppair-my.uspto.gov/pair/PrivatePair.**
If you have any questions, please email the Electronic Business Center (EBC) at EBC@uspto.gov or call 1-866-217-9197.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER	
LAM, VINH TANG	

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03/22/2021	ELECTRONIC

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The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

efiling@knobbe.com
jayna.cartee@knobbe.com

Office Action Summary	Application No. 16/403,283	Applicant(s) Kocovski et al.	
	Examiner VINH T LAM	Art Unit 2628	AIA (FITF) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 03/09/2021.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL.** 2b) ☑ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 1-23 is/are pending in the application.

5a) Of the above claim(s) 1 is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☑ Claim(s) 2-23 is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☑ The drawing(s) filed on 05/03/2019 is/are: a)☑ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☑ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☑ All b)☐ Some** c)☐ None of the:

1.☑ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☑ Notice of References Cited (PTO-892)

2) ☐ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

DETAILED ACTION

Notice of Pre-AIA or AIA Status

1. The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Priority

2. Acknowledgment is made of applicant's claim for foreign priority based on an application filed in **SE** on **12/07/2016**. It is noted, however, that applicant has not filed a certified copy of the 16302945 application as required by 37 CFR 1.55.

Claim Objections

3. Claim **2** is objected to because of the following informalities: Typo error.

*"**the** periphery … configured to emit …"* should be *"**a** periphery … configured to emit …"*.

Appropriate correction is required.

Claim Rejections - 35 USC § 112

The following is a quotation of 35 U.S.C. 112(b):

(b) CONCLUSION.—The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the inventor or a joint inventor regards as the invention.

The following is a quotation of 35 U.S.C. 112 (pre-AIA), second paragraph:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

4. Claim(s) **2-12** is/are rejected under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which the inventor or a joint inventor, or for pre-AIA the applicant regards as the invention.

Regarding Claim **2's** limitation, "***the first plane***" is ***not defined*** by any conventional definition.

To further advance prosecution, the Examiner assumes "***the first plane***" is ***defined as a vertical plane perpendicular to the figure***.

Appropriate action is required.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103 which forms the basis for all obviousness rejections set forth in this Office action:

> A patent for a claimed invention may not be obtained, notwithstanding that the claimed invention is not identically disclosed as set forth in section 102 of this title, if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claim(s) **2-3**, **5**, and **10-12** is/are rejected under 35 U.S.C. 103 as being unpatentable over **Kukulj (US Patent/PGPub. No. 20120223916)** in view of **Northcott et al. (US Patent/PGPub. No. 10860142).**

Regarding Claim **2, (Currently Amended)** **Kukulj** teaches **a touch sensing apparatus** *([0007], FIG. **3**, i.e. **touch screen 31**)* **having a long edge** *([0007], FIG. **3**, i.e. **horizontal edge**)* **and a short edge** *([0007], FIG. **3**, i.e. **horizontal edge**)*, **the touch sensing apparatus** *(i.e. please see above citation(s))* **comprising:**

a display panel *([0007], FIG. **3**, i.e. **an underlying display**)*;

a plate *([0007], FIG. **3**, i.e. **shape** of **touch screen 31**; **[0101]**, FIG. **4**, i.e. **shape** of **touch screen 54**)* **including a touch surface** *([0007], FIG. **3**, i.e. **touch screen 31**)*;

a plurality of emitters *([0007], FIG. **3**, i.e. **optical sources 4**)* **arranged around a portion** *([0007], FIG. **3**, i.e. **left portion**)* **of the periphery of the plate** *(i.e. please see above citation(s))* **and configured to emit light across** *([0007], FIG. **3**, i.e. **launched into the light guide plate**)* **the touch surface of the plate** *(i.e. please see above citation(s))*,

a plurality of detectors *([0006], [0007], FIG. **2-3**, i.e. **waveguides 22**)* **arranged around a portion of the periphery of the plate** *(i.e. please see above citation(s))* **and configured to receive light** *([0006], [0007], FIG. **2-3**, i.e. **detected**)* **from the plurality of emitters** *(i.e. please see above citation(s))*, **and**

a frame assembly *([0006], FIG. **3**, i.e. **L-shaped substrate 24**)*, **the frame assembly comprising:**

a first frame element *([0007], FIG. **3**, i.e. **frame** of **31**)* **configured to support** *(FIG. **2-3**, i.e. as **shown** by the **figure(s)**)* **the display panel** *(i.e. please see above citation(s))*;

a second frame element *([0006], FIG. **3**, i.e. **L-shaped substrate 24**)* **arranged around** *(FIG. **2-3**, i.e. as **shown** by the **figure(s)**)* **the periphery of the plate** *(i.e. please see above citation(s))* **and configured to**

support *(FIG. **2-3**, i.e. as **shown** by the **figure(s)**)* **the plurality of emitters and plurality of detectors,**

wherein the second frame element *(i.e. please see above citation(s))* **including a first surface** *([**0006**], FIG. **3**, i.e. **vertical surface between 24 and 34**)* **arranged against an edge** *([**0006**], FIG. **3**, i.e. **left vertical edge 34**)* **of the plate** *(i.e. please see above citation(s))* **and a second surface** *([**0006**], [**0007**], FIG. **3**, i.e. **surface of the figure**)* **arranged parallel to** *(FIG. **3**, i.e. as **shown** by the **figure(s)**)* **the touch surface,**

the touch surface *(i.e. please see above citation(s))* **including:**

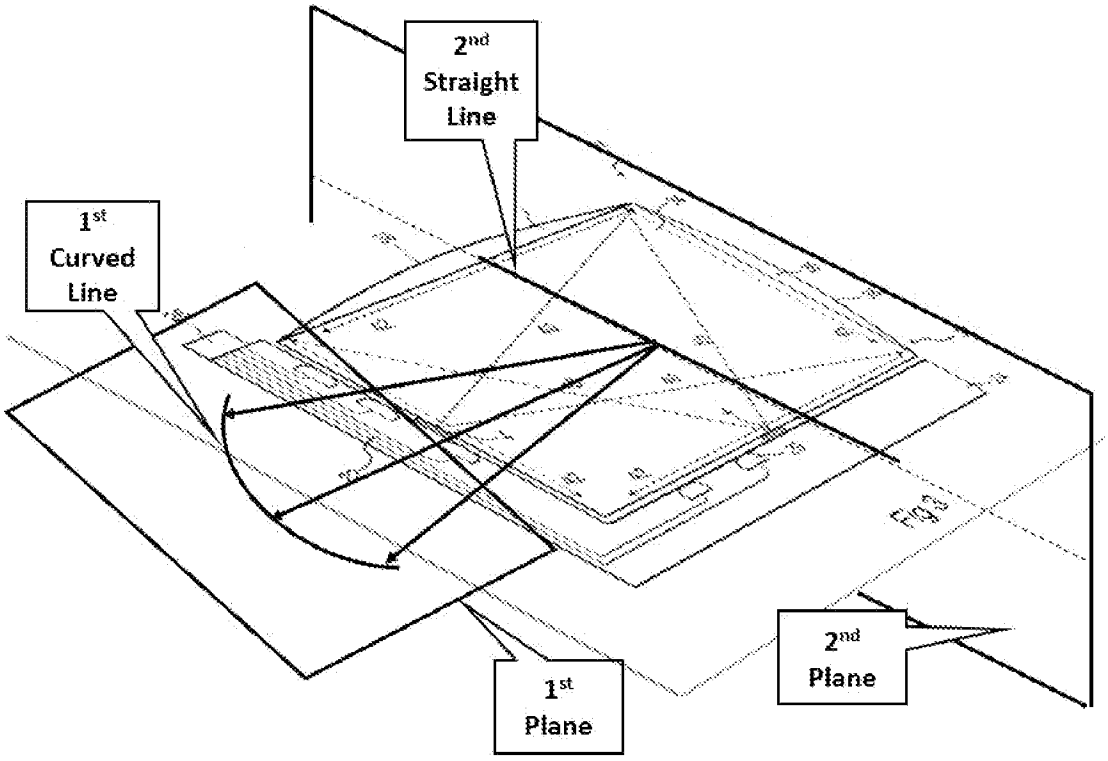
a first edge *([**0007**], FIG. **3**, i.e. **lower horizontal edge**)* **and a second edge** *([**0007**], FIG. **3**, i.e. **right vertical edge**)* **adjacent to** *(FIG. **3**, i.e. as **shown** by the **figure(s)**)* **the short edge** *(i.e. please see above citation(s))***; and**

a third edge and a fourth edge adjacent to *(FIG. **3**, i.e. as **shown** by the **figure(s)**)* **the long edge;**

wherein the touch surface *(i.e. please see above citation(s))* **is curved** *([**0007**], FIG. **3**, i.e. **parabolic reflectors 38**)* **relative to** *(FIG. **3**, i.e. as **shown** by the **figure(s)**)* **a second flat plane** *([**0006**], [**0007**], FIG. **3**, i.e. **plane***

of the figure) **defined in part by** *(FIG. **3**, i.e. as **shown** by the **figure(s))* **the short edge and the long edge** *(i.e. please see above citation(s))*;

wherein a distance *(**[0007]**, FIG. **3**, i.e. **distance**)* **between a first curved line** *(**[0007]**, FIG. **3**, i.e. **curve on vertical plane perpendicular to figure**)* **drawn on the first plane** *(**[0007]**, FIG. **3**, i.e. **vertical plane perpendicular to figure**)* **and a second straight line** *(**[0007]**, FIG. **3**, i.e. **horizontal line on figure**)* **drawn on the second flat plane** *(i.e. please see above citation(s))* **varies according to a concave curve function** *(i.e. please see below illustration)*.



However, **Kukulj** does not explicitly teach

the first, second, third, and fourth edges are curved.

In the same field of endeavor, **Northcott et al.** teach

the first, second, third, and fourth edges *(Col. **6**, Ln. **16-22**, FIG. **10**, i.e. **each 1/4 of a circle intersected by a lateral plane and the "hemispherical surface 24"**)* **are curved** *(Col. **6**, Ln. **16-22**, FIG. **10**, i.e. **90^0 arc**)*.

It would have been obvious to a person having ordinary skill in the art at the time the invention's effective date was filed to modify **Kukulj** teaching of an optical sensing device having a flat surface with **Northcott et al.** teaching of teaching of an optical sensing device having a curved surface *to effectively select different desired touch screen by designing curved surface (Northcott et al.'s Col. 6, Ln. 16-22).*

Regarding Claim **3, (Previously Presented) the touch sensing apparatus of claim 2, wherein**

Kukulj teaches

the plurality of emitters *(i.e. please see above citation(s))* **is configured to emit light to propagate** *([**0007**], FIG. **3**, i.e. **launched into the light guide plate**)* **over the touch surface** *(i.e. please see above citation(s))*.

Regarding Claim **5, (Previously Presented) the touch sensing apparatus of claim 2,**

Kukulj teaches

further comprising a processing element *([0101], FIG. **5**, i.e. **controller 60**)* **configured to determine, based on output signals** *([0103], FIG. **5**, i.e. **intensity profile**)* **of the plurality of detectors** *(i.e. please see above citation(s))*, **a position** *([0103], FIG. **5**, i.e. **X/Y-axis coordinate**)* **of an object** *([0103], FIG. **5**, i.e. **object 12**)* **on the touch surface** *(i.e. please see above citation(s))*.

Regarding Claim **10, (Previously Presented) the touch sensing apparatus of claim 2,**

Northcott et al. teach

further comprising a gasket *(Col. **8**, Ln. **23-28**, FIG. **18**, i.e. **light guide array 28**)*, **wherein the plate** *(Col. **8**, Ln. **23-28**, FIG. **18**, i.e. **display 20**)* **is supported by** *(Col. **8**, Ln. **23-28**, FIG. **18**, i.e. **interposing**)* **the gasket** *(i.e. please see above citation(s))* **along an edge** *(Col. **8**, Ln. **23-28**, FIG. **18**, i.e. **top edge**)* **of the plate** *(i.e. please see above citation(s))*.

Regarding Claim **11, (Previously Presented) the apparatus of claim 10, wherein**

Northcott et al. teach

the gasket *(i.e. please see above citation(s))* **is configured to have varying thickness** *(Col. **8**, Ln. **23-28**, FIG. **18**, i.e. **may be curved**)* **to match a curvature** *(Col. **8**, Ln. **23-28**, FIG. **18**, i.e. **curvature**)* **of the plate along the edge** *(i.e. please see above citation(s))*.

Regarding Claim **12, (Previously Presented) the apparatus of claim 2, wherein**

Northcott et al. teach

the second frame element *(Col. **8**, Ln. **23-28**, FIG. **18**, i.e. **light guide array 28**)* **is curved** *(Col. **8**, Ln. **23-28**, FIG. **18**, i.e. **may be curved**)*.

6. Claim(s) **4** is/are rejected under 35 U.S.C. 103 as being unpatentable over **Kukulj (US Patent/PGPub. No. 20120223916)** in view of **Northcott et al. (US Patent/PGPub. No. 10860142)** and **Wassvik (US Patent/PGPub. No. 20160334942).**

Regarding Claim **4, (Previously Presented)** **Kukulj** and **Northcott et al.** teach **the touch sensing apparatus of claim 2.**

However, **Kukulj** and **Northcott et al.** do not explicitly teach

the plurality of emitters is configured to emit light through the plate by total internal reflection.

In the same field of endeavor, **Wassvik** teaches

the plurality of emitters *([0052], FIG. **2A**, i.e. **Emitters 2**)* **is configured to emit light** *([0052], FIG. **2A**, i.e. **propagating light**)* **through the plate** *([0103], FIG. **10G**, i.e. **filter 20**)* **by total internal reflection** *([0051], FIG. **1**, i.e. **total internal reflection**)*.

It would have been obvious to a person having ordinary skill in the art at the time the invention's effective date was filed to realize **Kukulj** and **Northcott et al.** teaching of optical touch sensing device propagating light with **Wassvik** teaching of optical touch sensing device propagating light via total internal reflection *to accurately identify touch point (Wassvik's [0051])*.

7. Claim(s) **6-9** is/are rejected under 35 U.S.C. 103 as being unpatentable over **Kukulj (US Patent/PGPub. No. 20120223916)** in view of **Northcott et al. (US Patent/PGPub. No. 10860142)** and **RYU et al. (US Patent/PGPub. No. 20160295711).**

Regarding Claim **6, (Currently Amended)** **Kukulj** and **Northcott et al.** teach **the touch sensing apparatus of claim 2.**

However, **Kukulj** and **Northcott et al.** do not explicitly teach

the plate has a first curvature prior to installation and a second curvature greater than the first curvature when assembled.

In the same field of endeavor, **RYU et al.** teach

the plate *([0063], FIG. **4(a) & 4(b)**, i.e. **display unit 20**)* **has a first curvature** *([0070], FIG. **4(a)**, i.e. **flat** surface **display unit 20** which would be **curvature** with **infinite radius**)* **prior to installation** *([0072], FIG. **4(a)**, i.e. **prior to** links 50 are pushed up)* **and a second curvature** *([0072], FIG. **4(a)**, i.e. **after** links **50** are **pushed up**)* **greater than** *([0072], FIG. **4(a)**, i.e. **flat > curve up**)* **the first curvature when assembled** *(i.e. please see above citation(s))*.

It would have been obvious to a person having ordinary skill in the art at the time the invention's effective date was filed to combine **Kukulj** and **Northcott et al.** teaching touch display device comprising frame and curved display surface with **RYU et al.** teaching of touch display device comprising frame and curved/flat display surface *to effectively adjust field of views by providing both curved or flat surface of display (RYU et al.'s [0071])*.

Regarding Claim **7, (Previously Presented) the touch sensing apparatus of claim 6, wherein**

RYU et al. teach

the first curvature and second curvature *(i.e. please see above citation(s))* **are measured along an edge** *([0072], FIG. **4(a) & 4(b)**, i.e. **vertical edge**)* **of the plate** *([0072], FIG. **4(a) & 4(b)**, i.e. **housing 30**)*.

Regarding Claim **8, (Currently Amended) the touch sensing apparatus of claim 6, wherein**

RYU et al. teach

the first curvature and second curvature *(i.e. please see above citation(s))* **are measured along a line drawn** *([0072], FIG. **4(a) & 4(b)**, i.e. **R1**)* **on the plate passing through a center point** *([0072], FIG. **4(a) & 4(b)**, i.e. **point intersected by R1 and 30**)* **of the plate** *(i.e. please see above citation(s))*.

Regarding Claim **9, (Currently Amended) the touch sensing apparatus of claim 6, wherein**

RYU et al. teach

the first curvature and second curvature *(i.e. please see above citation(s))* **are measured along a line drawn** *([0073], FIG. **4(a) & 4(b)**, i.e. **VPL**)* **on the plate passing through any position on the plate** *(i.e. please see above citation(s))*.

8. Claim(s) **13-14**, **16**, **21**, and **23** is/are rejected under 35 U.S.C. 103 as being unpatentable over **Kukulj (US Patent/PGPub. No. 20120223916)** in view of **LEE (US Patent/PGPub. No. 20170308236).**

Regarding Claim **13, (Currently Amended)** **Kukulj** teaches **a touch sensing apparatus** *([0007], FIG. **3**, i.e. **touch screen 31**)* **comprising:**

a display panel *([0007], FIG. **3**, i.e. **an underlying display**)*;

a rectangular plate *([0007], FIG. **3**, i.e. **rectangular shape** of **touch screen 31**; [0100], FIG. **4**, i.e. **rectangular shape** of **touch screen 46**)* **including a touch surface** *([0007], FIG. **3**, i.e. **touch screen 31**)*;

a plurality of emitters *([0007], FIG. **3**, i.e. **optical sources 4**)* **configured to emit light across** *([0007], FIG. **3**, i.e. **launched into the light guide plate**)* **the touch surface of the rectangular plate** *(i.e. please see above citation(s))*, **and**

a frame *([0006], FIG. **3**, i.e. **L-shaped substrate 24**)* **configured to support the display panel, the rectangular plate, and the plurality of emitters, said frame** *(i.e. please see above citation(s))* **comprising:**

a longitudinal edge portion *([0101], FIG. **5**, i.e. **upper horizontal edge of 36**)* **configured to contact** *(FIG. **4**, i.e. as **shown** by the **figure(s)**)* **at**

least a first corner and a second corner *([0100], FIG. **4**, i.e. **upper left and right left corners**)* **of the rectangular plate** *(i.e. please see above citation(s))*,

wherein the edge portion *(i.e. please see above citation(s))* **is curved** *([0101], FIG. **5**, i.e. **parabolic reflector 38**)* **such that a distance** *([0101], FIG. **5**, i.e. **distance**)* **between the edge portion** *(i.e. please see above citation(s))* **and a straight line between** *([0101], FIG. **5**, i.e. **horizontal line between upper left and right corners**)* **the first corner and the second corner varies according to a concave curve function** *([0101], FIG. **5**, i.e. **parabolic**)* **and wherein the curved edge portion** *(i.e. please see above citation(s))* **is configured to enable curvature** *(FIG. **5**, i.e. as **shown** by the **figure(s)**)* **in the rectangular plate** *(i.e. please see above citation(s))*.

However, **Kukulj** does not explicitly teach

the rectangular plate is at least 55" wide along an axis.

In the same field of endeavor, **LEE** teaches

the rectangular plate *([0061], FIG. **6**, i.e. **touch screen device with large size**)* **is at least 55" wide** *([0061], FIG. **6**, i.e. **60 inch**)* **along an axis** *([0061], FIG. **6**, i.e. **width axis**)*.

It would have been obvious to a person having ordinary skill in the art at the time the invention's effective date was filed to modify **Kukulj** teaching of an optical sensing device having a general size with **LEE** teaching of teaching of a large size optical sensing device *effectively transmit power transmission for a large size optical sensing device (LEE's [0061]).*

Regarding Claim **14, (Previously Presented) the touch sensing apparatus of claim 13, wherein**

Kukulj teaches

plurality of emitters *(i.e. please see above citation(s))* **is configured to emit light to propagate over** *([0007], FIG. **3**, i.e. **launched into the light guide plate**)* **the touch surface** *(i.e. please see above citation(s))*.

Regarding Claim **16, (Previously Presented) the touch sensing apparatus of claim 13,**

Kukulj teaches

further comprising a processing element *([0101], FIG. **5**, i.e. **controller 60**)* **configured to determine, based on output signals** *([0103], FIG. **5**, i.e. **intensity profile**)* **of the plurality of detectors** *(i.e. please see above citation(s))*, **a position** *([0103], FIG. **5**, i.e. **X/Y-axis coordinate**)* **of an object** *([0103], FIG. **5**, i.e. **object 12**)* **adjacent to the touch surface** *(i.e. please see above citation(s))*.

Regarding Claim **21, (Currently Amended)** **Kukulj** teaches **a touch sensing apparatus** *([0007], FIG. **3**, i.e. **touch screen 31**)* **comprising:**

a frame element *([0006], FIG. **3**, i.e. **L-shaped substrate 24**)* **configured to contact at least a portion** *([0007], FIG. **3**, i.e. **contact portion** at optical sources **4**)* **of an edge** *(FIG. **3**, i.e. **lower edge** as **shown** by the **figure(s)**)* **of a rectangular plate** *([0007], FIG. **3**, i.e. **rectangular shape** of **31**)*, **said rectangular plate** *(i.e. please see above citation(s))* **including a touch surface** *([0007], FIG. **3**, i.e. **touch screen 31/34**)*;

wherein the frame element *(i.e. please see above citation(s))* **includes a curvature** *([0007], FIG. **3**, i.e. **upper curvature of parabolic***

reflectors 38) **along a longitudinal axis** *([0007], FIG. **3**, i.e. **vertical axis**)* **of the frame element,**

wherein the curvature of the frame element *(i.e. please see above citation(s))* **is configured to induce a corresponding curvature** *([0007], FIG. **3**, i.e. **right curvature of parabolic reflectors 38**)* **in the plate.**

However, **Kukulj** does not explicitly teach

the rectangular plate is at least 55" wide along an axis.

In the same field of endeavor, **LEE** teaches

the rectangular plate *([0061], FIG. **6**, i.e. **touch screen device with large size**)* **is at least 55" wide** *([0061], FIG. **6**, i.e. **60 inch**)* **along an axis** *([0061], FIG. **6**, i.e. **width axis**)*.

It would have been obvious to a person having ordinary skill in the art at the time the invention's effective date was filed to modify **Kukulj** teaching of an optical sensing device having a general size with **LEE** teaching of teaching of a large size optical sensing device *effectively transmit power transmission for a large size optical sensing device (LEE's [0061]).*

Regarding Claim **23, (Currently Amended) the touch sensing apparatus of claim 21, wherein a distance** *(FIG. **3**, i.e. **upper vertical distance** as **shown** by the **figure(s)**)* **between the touch**

surface *(i.e. please see above citation(s))* **and a straight line parallel to** *(FIG. **3**, i.e. **horizontal line** as **shown** by the **figure(s)**)* **the edge of the plate** *(i.e. please see above citation(s))* **varies according to a concave curve function** *([**0007**], FIG. **3**, i.e. **parabolic reflectors 38**)*.

9. Claim(s) **15** is/are rejected under 35 U.S.C. 103 as being unpatentable over **Kukulj (US Patent/PGPub. No. 20120223916)** in view of **LEE (US Patent/PGPub. No. 20170308236)** and **Wassvik (US Patent/PGPub. No. 20160334942).**

Regarding Claim **15, (Previously Presented)** **Kukulj** and **LEE** teach **the touch sensing apparatus of claim 13.**

However, **Kukulj** and **LEE** do not explicitly teach

the plurality of emitters is configured to emit light through the plate by total internal reflection.

the plurality of emitters *([**0052**], FIG. **2A**, i.e. **Emitters 2**)* **is configured to emit light** *([**0052**], FIG. **2A**, i.e. **propagating light**)* **through the plate** *([**0103**], FIG. **10G**, i.e. **filter 20**)* **by total internal reflection** *([**0051**], FIG. **1**, i.e. **total internal reflection**)*.

It would have been obvious to a person having ordinary skill in the art at the time the invention's effective date was filed to realize **Kukulj** and **LEE** teaching of optical touch sensing device propagating light with **Wassvik** teaching of optical touch sensing device propagating light via total internal reflection *to accurately identify touch point (Wassvik's [0051])*.

10. Claim(s) **17-20** and **22** is/are rejected under 35 U.S.C. 103 as being unpatentable over **Kukulj (US Patent/PGPub. No. 20120223916)** in view of **LEE (US Patent/PGPub. No. 20170308236)** and **RYU et al. (US Patent/PGPub. No. 20160295711).**

Regarding Claim **17, (Currently Amended)** **Kukulj** and **LEE** teach **the touch sensing apparatus of claim 13.**

However, **Kukulj** and **LEE** do not explicitly teach

the plate has a first curvature prior to installation and a second curvature greater than the first curvature when assembled.

In the same field of endeavor, **RYU et al.** teach

the plate *([0063], FIG. **4(a) & 4(b)**, i.e. **display unit 20**)* **has a first curvature** *([0070], FIG. **4(a)**, i.e. **flat** surface **display unit 20** which would be **curvature** with **infinite radius**)* **prior to installation** *([0072], FIG. **4(a)**, i.e. **prior to** links 50 are pushed up)* **and a second curvature** *([0072], FIG. **4(a)**, i.e.*

***after** links **50** are **pushed up**)* **greater than** *([0072], FIG. **4(a)**, i.e. **flat > curve up**)* **the first curvature when assembled** *(i.e. please see above citation(s))*.

It would have been obvious to a person having ordinary skill in the art at the time the invention's effective date was filed to combine **Kukulj** and **LEE** teaching touch display device comprising frame and curved display surface with **RYU et al.** teaching of touch display device comprising frame and curved/flat display surface *to effectively adjust field of views by providing both curved or flat surface of display (RYU et al.'s [0071])*.

Regarding Claim **18, (Previously Presented) the touch sensing apparatus of claim 17, wherein**

RYU et al. teach

the first curvature and second curvature *(i.e. please see above citation(s))* **are measured along an edge** *([0072], FIG. **4(a) & 4(b)**, i.e. **vertical edge**)* **of the plate** *([0072], FIG. **4(a) & 4(b)**, i.e. **housing 30**)*.

Regarding Claim **19, (Currently Amended) the touch sensing apparatus of claim 17, wherein**

RYU et al. teach

the first curvature and second curvature *(i.e. please see above citation(s))* **are measured along a line drawn** *([0072], FIG. **4(a) & 4(b)**, i.e. **R1**)* **on the plate passing through a center point** *([0072], FIG. **4(a) &***

***4(b)**, i.e. **point intersected by R1 and 30**)* **of the plate** *(i.e. please see above citation(s))*.

Regarding Claim **20, (Currently Amended) the touch sensing apparatus of claim 17, wherein**

RYU et al. teach

the first curvature and second curvature *(i.e. please see above citation(s))* **are measured along a line drawn** *([0073], FIG. **4(a) & 4(b)**, i.e. **VPL**)* **on the plate passing through any position on the plate** *(i.e. please see above citation(s))*.

Regarding Claim **22, (Previously Presented)** **Kukulj** and **LEE** teach **the touch sensing apparatus of claim 21.**

However, **Kukulj** and **LEE** do not explicitly teach

the plate has a first curvature prior to installation and, when assembled, the frame element induces the plate into having a second curvature greater than the first curvature.

In the same field of endeavor, **RYU et al.** teach

the plate *([0063], FIG. **4(a) & 4(b)**, i.e. **display unit 20**)* **has a first curvature** *([0070], FIG. **4(a)**, i.e. **flat** surface **display unit 20** which would be **curvature** with **infinite radius**)* **prior to installation** *([0072], FIG. **4(a)**, i.e. **prior***

***to** links 50 are pushed up)* **and, when assembled** *([**0072**], FIG. **4(a)**, i.e. **after** links **50** are **pushed up**)*, **the frame element** *([**0063**], FIG. **4(a) & 4(b)**, i.e. **housing 30**)* **induces the plate into having a second curvature greater than** *([**0072**], FIG. **4(a) & 4(b)**, i.e. **more curved** after links 50 are pushed up)* **the first curvature** *(i.e. please see above citation(s))*.

It would have been obvious to a person having ordinary skill in the art at the time the invention's effective date was filed to combine **Kukulj** teaching touch display device comprising frame and curved display surface with **RYU et al.** teaching of touch display device comprising frame and curved/flat display surface *to effectively adjust field of views by providing both curved or flat surface of display (RYU et al.'s [0071])*.

Response to Argument

11. Applicant's arguments filed **03/09/2021** have been fully considered but they are not persuasive.

On P. **8** concerning Claims **13** and **21**, applicant argues that **Kukulj** does not teach ***"the "light guide plate" is curved"***. However, the Examiner respectfully disagrees because:

In response to applicant's argument that the references fail to show certain features of applicant's invention, it is noted that the features upon which applicant relies

(i.e., ***"the "light guide plate" is curved"***) are not recited in the rejected claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993).

12. Applicant's arguments with respect to **amended features** of Claim(s) **13** and **21** has/have been considered but are moot because the arguments do not apply to the newly added reference being used in the current rejection.

13. All dependent claims are properly rejected or objected as shown above.

14. Applicants' Response to the **Final Office Action**, **10/09/2020**, has been entered and made of record. Claim(s) **2**, **6**, **8-9**, **13**, **17**, **19-21**, and **23** is/are amended, and Claim(s) **1** is/are cancelled. Thus, Claim(s) **2-23** is/are pending in this application.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to VINH TANG LAM whose telephone number is (571) 270-3704. The examiner can normally be reached on Monday to Friday 8:00 AM to 5:00 PM.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nitin K Patel can be reached on (571) 272-7677. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see https://ppair-my.uspto.gov/pair/PrivatePair. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/VINH T LAM/
Primary Examiner, Art Unit 2628

Notice of References Cited	Application/Control No. 16/403,283	Applicant(s)/Patent Under Reexamination Kocovski et al.	
	Examiner VINH T LAM	Art Unit 2628	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-9280237-B2	03-2016	Kukulj; Dax	G06F3/0428	1/1
*	B	US-20150331546-A1	11-2015	CRAVEN-BARTLE; Thomas	G02B6/0038	345/175
*	C	US-9063614-B2	06-2015	Pettersson; Robert	G06F3/0421	1/1
*	D	US-20120089348-A1	04-2012	Perlin; Kenneth	G06F3/04144	702/41
*	E	US-20160334942-A1	11-2016	Wassvik; Ola	G06F3/0428	1/1
*	F	US-4986662-A	01-1991	Bures; Milan	G06F3/0421	250/221
*	G	US-20120223916-A1	09-2012	Kukulj; Dax	G06F3/0428	345/175
*	H	US-20160295711-A1	10-2016	RYU; Hyunjong	H05K5/03	1/1
*	I	US-20170308236-A1	10-2017	LEE; Jun Goo	G06F3/04182	1/1
*	J	US-10860142-B1	12-2020	Northcott; Malcolm J.	G02B6/04	1/1
	K					
	L					
	M					

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/403,283	Kocovski et al.
	Examiner	Art Unit
	VINH T LAM	2628

CPC - Searched*		
Symbol	Date	Examiner
G06F3/0421 G06F2203/04103	03/17/2021	vl

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
Search inventor'(s)' name(s). No ODP.	02/13/2020	vl
Search technical terms and synonyms.	03/17/2021	vl
Search IDS.	03/17/2021	vl
Search Foreign Patent Literature(s) and NPL (IP.com).	03/17/2021	vl
Search CPC.	03/17/2021	vl
Search EAST.	03/17/2021	vl
Review amendment and argument.	03/17/2021	vl

/VINH T LAM/ Primary Examiner, Art Unit 2628	

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Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/403,283	Kocovski et al.
	Examiner	Art Unit
	VINH T LAM	2628

Interference Search			
US Class/CPC Symbol	**US Subclass/CPC Group**	**Date**	**Examiner**
Search all of the above.	Search all of the above.	02/13/2020	vl

/VINH T LAM/ Primary Examiner, Art Unit 2628	

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Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/403,283	Kocovski et al.
	Examiner	**Art Unit**
	VINH T LAM	2628

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	02/13/2020	10/05/2020	03/17/2021						
	1	-	-	-						
	2	=	=	✓						
	3	=	=	✓						
	4	=	=	✓						
	5	=	=	✓						
	6	=	=	✓						
	7	=	=	✓						
	8	=	=	✓						
	9	=	=	✓						
	10	=	=	✓						
	11	=	=	✓						
	12	=	=	✓						
	13	✓	✓	✓						
	14	✓	✓	✓						
	15	✓	✓	✓						
	16	✓	✓	✓						
	17	✓	✓	✓						
	18	✓	✓	✓						
	19	✓	✓	✓						
	20	✓	✓	✓						
	21	✓	✓	✓						
	22		✓	✓						
	23		✓	✓						

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S1	0	16/190907.app.	US-PGPUB	OR	OFF	2019/01/31 16:20
S2	47,226	((optic$3 light$3) same (sens$3 detect$3) same (warp$3 twist$3 curv$3 bend$3 bent distort$3)).ab.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/01/31 16:40
S3	41,872	S2 and @ad<"20161207"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/01/31 16:41
S4	108	S3 and (G06F3/0421 G06F2203/04103)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/01/31 16:43
S5	4	S4 and ((line$1 plane$1) same (parabol$3))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/01/31 16:45
S6	72	((("FLATFROG") near3 ("LABORATORIES") near3 ("AB"))).AS,AANM.	USPAT	OR	OFF	2019/01/31 16:46
S7	35	((("KOCOVSKI") near3 ("Aleksander")) OR (("BERGSTROM") near3 ("Hakan")) OR (("THORVINGER") near3 ("Jens"))).INV.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	OR	OFF	2019/01/31 16:47
S8	17	S7 and @pd<"20151207"	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	OR	OFF	2019/01/31 16:48
S9	10	((parabol$3) same (optic$3 light$3) same touch$3 same (sens$3 detect$3) same (surface fac$3)).ab.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/01/31 17:58

EAST Search History (Prior Art)

S10	8	S9 and @ad<"20161207"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/01/31 17:59
S11	1	"20120112541".pn.	US-PGPUB	OR	OFF	2019/01/31 18:05
S12	58	((parabol$3) same (optic$3 light$3) same touch$3 same (sens$3 detect$3) same (surface fac$3))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/02/01 09:45
S13	43	S12 and @ad<"20161207"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/02/01 09:45
S14	5	S13 and (G06F3/0421 G06F2203/04103)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/02/01 09:46
S15	284	((parabol$3) same (optic$3 light$3) same touch$3 same (surface fac$3))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/02/01 10:06
S16	208	S15 and @ad<"20161207"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/02/01 10:07
S17	29	S16 and (G06F3/0421 G06F2203/04103)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/02/01 10:07

EAST Search History (Prior Art)

S19	128	("20160077625" "9524067" "4986662" "8350828" "20170351324" "20130147711" "20100259506" "20030210483" "8587562" "20110175852" "4467193" "20060188196" "7352940" "20090251811" "9128250" "20130156376" "5736688" "8847900" "7553035" "20120044206" "20050225885" "8730179" "9280237" "20050041018" "20100079387" "8692802" "20120223916" "20110169782" "8403203" "9195344" "20110167628" "20110043482" "8896575" "20110181552" "8049738" "6559835" "20060207806" "7825905" "5796368" "8902196" "9471170" "20110163998" "20150277663" "20110169780" "20100277436" "9075477" "9389730" "20110169781" "20140225874" "9052771" "20110210946" "20190025984" "5220409" "8760416" "20110080360" "9658705" "20140071070" "20130135255" "8390576" "20100053090" "20110080344" "20120327039" "20030231169" "7952567" "20060119587" "4387961" "8816991" "4878296" "20120218215" "7274358" "8704822" "20050146514" "20110080361" "20180067292" "20040175677" "10088952" "20180292945" "20120098794" "20180292946" "20100149182" "8842366" "20160188112" "7391410" "20050259074" "20130135359" "20080278460" "8665244" "9958996" "20170220146" "20120212451" "10126854" "20110032214" "20170031569" "2584697" "4880969" "20180040239" "20150029131" "4825212" "20120262580" "20100103140" "9411481" "20070247443" "20180136769" "8929697" "3365720" "5969823" "20150261339" "9063614" "5661561" "20120146957" "20140320459" "20020001091" "6177999" "20120275167" "8905592" "8810549" "20170038896" "20130027352" "6775012" "9678601" "7845827" "20080278946" "20130092154" "9335525" "20140225868" "20130222301" "9560293" "20160156857").pn.	US-PGPUB; USPAT	OR	OFF	2019/02/01 10:33
S20	120	S19 and @ad<"20161207"	US-PGPUB; USPAT	OR	OFF	2019/02/01 10:34
S21	12	S20 and (G06F3/0421 G06F2203/04103)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/02/01 10:34

EAST Search History (Prior Art)

S22	350	("9006560" "6412961" "6775012" "20150029131" "20180335919" "3354343" "8824051" "8896747" "9019238" "20120120496" "4105429" "9679413" "20170046875" "20140132791" "20110234537" "5235470" "9317243" "20150287866" "5077644" "20060238897" "20150184895" "8462437" "20110044056" "6819687" "8029181" "20110050580" "20060263035" "20050084212" "20130321923" "7127141" "20130135255" "7369742" "8430523" "20120014006" "7688522" "20110220092" "9441808" "8282493" "10140791" "8210164" "20130235579" "20160377259" "20170309096" "8511298" "8791959" "9215357" "4363113" "20120046100" "20120037206" "9741184" "4672389" "20150248796" "2000526" "7815335" "20150184894" "5967653" "4297690" "5941648" "20130135359" "20120143018" "20150042841" "6885965" "20090207615" "4683526" "9594347" "20120242690" "5764219" "9541901" "10120335" "8500284" "6945881" "20040029654" "20110128555" "20160133156" "20130293939" "20170090420" "9342187" "4643545" "20170242172" "2970518" "20040111232" "4195620" "8460119" "20140033052" "20160077489" "20110025620" "9754511" "6639733" "20030016539" "5162811" "20110281660" "4028542" "20090056704" "5782553" "3283331" "7453419" "8345255" "6438238" "20100163014" "9706975" "20060109199" "20050154539" "20120275040").pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/02/01 10:46
S23	95	S22 and @ad<"20161207"	US-PGPUB; USPAT	OR	OFF	2019/02/01 10:46
S24	3	S23 and (G06F3/0421 G06F2203/04103)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/02/01 10:46

EAST Search History (Prior Art)

S25	390	("5471574" "4174533" "20160380583" "5023440" "2801363" "20150029092" "3553705" "5727108" "9855019" "9414155" "20060125713" "20100002237" "9698726" "20160109684" "20040233122" "20120086295" "4359041" "20110188138" "2657577" "20180173296" "9388961" "9405091" "6977624" "7245266" "9740336" "7084836" "20110037674" "9511290" "7233299" "9268069" "20020051303" "20040165821" "4506185" "20140331991" "20130235580" "20150370054" "6566853" "20130064468" "20120092775" "6985658" "6091825" "4059094" "8130120" "20030185506" "9806206" "7068880" "2821813" "9766040" "4530348" "20160259484" "20090193627" "20160202021" "20130083558" "7689054" "20150301267" "6832031" "20100019935" "20120320586" "4951180" "7770265" "2965899" "20170370618" "9110224" "20100006139" "20160322513" "5016995" "6023133" "20160337750" "8450597" "20010035747" "20170082322" "5939726" "20110265249" "9602917" "9390072" "5515255" "9039905" "20130276775" "20130192226" "8413266" "20140321151" "2368019" "4972127" "20130220312" "20130220307" "20160201947" "7086746" "9404675" "8978642" "20170284771" "2825063" "20050281017" "20100201977" "20150145869" "20130213929" "20130213387" "20090168446" "8632235" "20130000356" "3443086").pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/02/01 10:48
S26	88	S25 and @ad<"20161207"	US-PGPUB; USPAT	OR	OFF	2019/02/01 10:48
S27	2	S26 and (G06F3/0421 G06F2203/04103)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/02/01 10:48

EAST Search History (Prior Art)

S28	200	("10013107"|"10019113"|"20010002694"|"20010005004"|"20010005308"|"20010030642"|"20020067348"|"20020075243"|"20020118177"|"20020158823"|"20020158853"|"20020163505"|"20030016450"|"20030034439"|"20030034935"|"20030048257"|"20030052257"|"20030095399"|"20030107748"|"20030137494"|"20030156100"|"20030160155"|"20030210537"|"20030214486"|"20040027339"|"20040032401"|"20040090432"|"20040130338"|"20040174541"|"20040201579"|"20040212603"|"20040238627"|"20040239702"|"20040245438"|"20040252091"|"20040252867"|"20050012714"|"20050041013"|"20050057903"|"20050073508"|"20050083293"|"20050128190"|"20050143923"|"20050156914"|"20050162398"|"20050179977"|"20050200613"|"20050212774"|"20050248540"|"20050253834"|"20050276053"|"20060001650"|"20060001653"|"20060007185"|"20060008164"|"20060017706"|"20060017709"|"20060033725"|"20060038698"|"20060061861"|"20060114237"|"20060132454"|"20060139340"|"20060158437"|"20060170658"|"20060202974"|"20060227120"|"20060255248"|"20060256092"|"20060279558"|"20060281543"|"20060290684"|"20070014486"|"20070024598"|"20070034783"|"20070038691"|"20070052684"|"20070070056"|"20070075648"|"20070120833"|"20070125937"|"20070152985"|"20070201042"|"20070296688"|"20080006766"|"20080007540"|"20080007541"|"20080007542"|"20080011944"|"20080029691"|"20080036743"|"20080062150"|"20080068691"|"20080074401"|"20080088603"|"20080121442"|"20080122792"|"20080122803"|"20080130979"|"20080133265"|"20080150846"|"20080150848"|"20080151126"|"20080158176"|"20080189046"|"20080192025"|"20080238433"|"20080246388"|"20080252619"|"20080266266"|"20080278460"|"20080284925"|"20080291668"|"20080297482"|"20090002340"|"20090006292"|"20090040786"|"20090066647"|"20090067178"|"20090073142"|"20090077501"|"20090085894"|"20090091554"|"20090115919"|"20090122020"|"20090122027"|"20090128508"|"20090135162"|"20090143141"|"20090153519"|"20090161026"|"20090168459"|"20090187842"|"20090189857"|"20090189874"|"20090189878"|"20090219256"|"20090229892"|"20090251439"|"20090256817"|"20090259967"|"20090267919"|"20090273794"|"20090278816"|"20090297009"|"20100033444"|"20100045629"|"20100060896"|"20100066016"|"20100066704"|"20100073318"|"20100078545"|"20100079407"|"20100079408"|"20100097345"|"20100097348"|"20100097353"|"20100125438"|"20100127975"|"20100134435"|"20100142823"|"20100187422"|"20100	US-PGPUB; USPAT	OR	OFF	2019/02/01 10:56

EAST Search History (Prior Art)

S29	210	("20110163996"|"20110163997"|"20110163998"|"20110169780"|"20110175852"|"20110205186"|"20110216042"|"20110221705"|"20110221997"|"20110227036"|"20110227874"|"20110234537"|"20110254864"|"20110261020"|"20110267296"|"20110291989"|"20110298743"|"20110309325"|"20110310045"|"20120019448"|"20120026408"|"20120038593"|"20120062474"|"20120068973"|"20120086673"|"20120089348"|"20120110447"|"20120131490"|"20120141001"|"20120146930"|"20120153134"|"20120154338"|"20120162142"|"20120162144"|"20120169672"|"20120181419"|"20120182266"|"20120188206"|"20120191993"|"20120200532"|"20120200538"|"20120212441"|"20120217882"|"20120249478"|"20120256882"|"20120268403"|"20120268427"|"20120274559"|"20120305755"|"20130021300"|"20130021302"|"20130027404"|"20130044073"|"20130055080"|"20130076697"|"20130082980"|"20130107569"|"20130113715"|"20130120320"|"20130125016"|"20130127790"|"20130135258"|"20130135259"|"20130141388"|"20130154983"|"20130155027"|"20130158504"|"20130181896"|"20130187891"|"20130201142"|"20130222346"|"20130241887"|"20130249833"|"20130269867"|"20130275082"|"20130285920"|"20130285968"|"20130300716"|"20130307795"|"20130342490"|"20140002400"|"20140028575"|"20140028604"|"20140028629"|"20140036203"|"20140055421"|"20140063853"|"20140071653"|"20140085241"|"20140092052"|"20140098032"|"20140098058"|"20140109219"|"20140125633"|"20140139467"|"20140160762"|"20140192023"|"20140232669"|"20140237401"|"20140237408"|"20140237422"|"20140253831"|"20140267124"|"20140292701"|"20140300572"|"20140320460"|"20140347325"|"20140362046"|"20140368471"|"20140375607"|"20150002386"|"20150009687"|"20150015497"|"20150035774"|"20150035803"|"20150053850"|"20150054759"|"20150083891"|"20150103013"|"20150130769"|"20150138105"|"20150138158"|"20150138161"|"20150205441"|"20150215450"|"20150242055"|"20150271481"|"20150286698"|"20150317036"|"20150324028"|"20150331544"|"20150331545"|"20150331546"|"20150331547"|"20150332655"|"20150346856"|"20150346911"|"20150363042"|"20160026337"|"20160034099"|"20160050746"|"20160070415"|"20160070416"|"20160124546"|"20160124551"|"20160154531"|"20160154532"|"20160202841"|"20160216844"|"20160224144"|"20160299593"|"20160328090"|"20160328091"|"20160334942"|"20160342282"|"20160357348"|"20170010688"|"20170090090"|"20170102827"|"20170115235"|"20170115823"|"20170139541"	US-PGPUB; USPAT	OR	OFF	2019/02/01 10:56

EAST Search History (Prior Art)

S30	175	("4986662"|"4988983"|"5065185"|"5073770"|"5105186"|"5159322"|"5166668"|"5227622"|"5248856"|"5254407"|"5345490"|"5383022"|"5483261"|"5484966"|"5499098"|"5502568"|"5525764"|"5526422"|"5539514"|"5570181"|"5572251"|"5577501"|"5600105"|"5608550"|"5672852"|"5679930"|"5686942"|"5688933"|"5729249"|"5736686"|"5740224"|"5764223"|"5767517"|"5775792"|"5945980"|"5945981"|"5959617"|"6061177"|"6067079"|"6122394"|"6141104"|"6172667"|"6175999"|"6227667"|"6229529"|"6333735"|"6366276"|"6380732"|"6380740"|"6390370"|"6429857"|"6452996"|"6476797"|"6492633"|"6495832"|"6504143"|"6529327"|"6538644"|"6587099"|"6648485"|"6660964"|"6664498"|"6664952"|"6690363"|"6707027"|"6738051"|"6748098"|"6784948"|"6799141"|"6806871"|"6927384"|"6940286"|"6965836"|"6972753"|"6985137"|"7042444"|"7084859"|"7087907"|"7133031"|"7176904"|"7199932"|"7359041"|"7397418"|"7432893"|"7435940"|"7436443"|"7442914"|"7465914"|"7613375"|"7629968"|"7646833"|"7653883"|"7655901"|"7705835"|"7729056"|"7847789"|"7855716"|"7859519"|"7924272"|"7932899"|"7969410"|"7995039"|"8013845"|"8031186"|"8077147"|"8093545"|"8094136"|"8094910"|"8149211"|"8218154"|"8274495"|"8325158"|"8339379"|"8350827"|"8384010"|"8407606"|"8441467"|"8445834"|"8466901"|"8482547"|"8542217"|"8567257"|"8581884"|"8624858"|"8686974"|"8692807"|"8716614"|"8727581"|"8745514"|"8780066"|"8830181"|"8860696"|"8872098"|"8872801"|"8884900"|"8890843"|"8890849"|"8928590"|"8963886"|"8982084"|"9024916"|"9035909"|"9063617"|"9086763"|"9134854"|"9158401"|"9158415"|"9213445"|"9274645"|"9317168"|"9323396"|"9366565"|"9377884"|"9389732"|"9411444"|"9411464"|"9430079"|"9442574"|"9547393"|"9552103"|"9557846"|"9588619"|"9594467"|"9618682"|"9626018"|"9626040"|"9639210"|"9678602"|"9684414"|"9710101"|"9874978"|"20120045170"|"20120062492"|"20160295711"|"6031524").PN.	US-PGPUB; USPAT	OR	OFF	2019/02/01 10:56
S31	50	(S28 S29 S30) and (parabol$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/02/01 10:58
S36	0	16/403283.app.	US-PGPUB	OR	OFF	2020/02/13 11:23

EAST Search History (Prior Art)

S37	49	((("KOCOVSKI") near3 ("Aleksander")) OR (("BERGSTROM") near3 ("Hakan")) OR (("THORVINGER") near3 ("Jens"))).INV.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	OR	OFF	2020/02/13 11:23
S38	3	S37 and ((first second) same (plane$1 surface$1 frame$1 edge$1) same (parabolic)).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/02/13 11:26

EAST Search History (Prior Art)

S39	201	("10282035"|"20100103133"|"20120062492"|"20150373864"|"20160026297"|"20160209886"|"20160255713"|"20160295711"|"6031524"|"10013107"|"10019113"|"20010002694"|"20010005004"|"20010005308"|"20010030642"|"20020067348"|"20020075243"|"20020118177"|"20020158823"|"20020158853"|"20020163505"|"20030016450"|"20030034439"|"20030034935"|"20030048257"|"20030052257"|"20030095399"|"20030107748"|"20030137494"|"20030156100"|"20030160155"|"20030210537"|"20030214486"|"20040027339"|"20040032401"|"20040090432"|"20040130338"|"20040174541"|"20040201579"|"20040212603"|"20040238627"|"20040239702"|"20040245438"|"20040252091"|"20040252867"|"20050012714"|"20050041013"|"20050057903"|"20050073508"|"20050083293"|"20050128190"|"20050143923"|"20050156914"|"20050162398"|"20050179977"|"20050200613"|"20050212774"|"20050248540"|"20050253834"|"20050276053"|"20060001650"|"20060001653"|"20060007185"|"20060008164"|"20060017706"|"20060017709"|"20060033725"|"20060038698"|"20060061861"|"20060114237"|"20060132454"|"20060139340"|"20060158437"|"20060170658"|"20060202974"|"20060227120"|"20060255248"|"20060256092"|"20060279558"|"20060281543"|"20060290684"|"20070014486"|"20070024598"|"20070034783"|"20070038691"|"20070052684"|"20070070056"|"20070075648"|"20070120833"|"20070125937"|"20070152985"|"20070201042"|"20070296688"|"20080006766"|"20080007540"|"20080007541"|"20080007542"|"20080011944"|"20080029691"|"20080036743"|"20080062150"|"20080068691"|"20080074401"|"20080088603"|"20080121442"|"20080122792"|"20080122803"|"20080130979"|"20080133265"|"20080150846"|"20080150848"|"20080151126"|"20080158176"|"20080189046"|"20080192025"|"20080238433"|"20080246388"|"20080252619"|"20080266266"|"20080278460"|"20080284925"|"20080291668"|"20080297482"|"20090000831"|"20090002340"|"20090006292"|"20090040786"|"20090066647"|"20090067178"|"20090073142"|"20090077501"|"20090085894"|"20090091554"|"20090115919"|"20090122020"|"20090122027"|"20090128508"|"20090135162"|"20090143141"|"20090153519"|"20090161026"|"20090168459"|"20090187842"|"20090189857"|"20090189874"|"20090189878"|"20090219256"|"20090229892"|"20090251439"|"20090256817"|"20090259967"|"20090267919"|"20090273794"|"20090278816"|"20090297009"|"20100033444"|"20100045629"|"20100060896"|"20100066016"|"20100066704"|"20100073318"|"20100078545"|"20100079407"	US-PGPUB; USPAT	OR	OFF	2020/02/13 11:41

EAST Search History (Prior Art)

S40	201	("20110102374"|"20110115748"|"20110121323"|"20110122075"|"20110122091"|"20110122094"|"20110134079"|"20110147569"|"20110157095"|"20110157096"|"20110163996"|"20110163997"|"20110163998"|"20110169780"|"20110175852"|"20110205186"|"20110216042"|"20110221705"|"20110221997"|"20110227036"|"20110227874"|"20110234537"|"20110254864"|"20110261020"|"20110267296"|"20110291989"|"20110298743"|"20110309325"|"20110310045"|"20120019448"|"20120026408"|"20120038593"|"20120062474"|"20120068973"|"20120086673"|"20120089348"|"20120110447"|"20120131490"|"20120141001"|"20120146930"|"20120153134"|"20120154338"|"20120162142"|"20120162144"|"20120169672"|"20120181419"|"20120182266"|"20120188206"|"20120191993"|"20120200532"|"20120200538"|"20120212441"|"20120217882"|"20120218229"|"20120249478"|"20120256882"|"20120268403"|"20120268427"|"20120274559"|"20120305755"|"20120313865"|"20130021300"|"20130021302"|"20130027404"|"20130044073"|"20130055080"|"20130076697"|"20130082980"|"20130106709"|"20130107569"|"20130113715"|"20130120320"|"20130125016"|"20130127790"|"20130135258"|"20130135259"|"20130141388"|"20130141395"|"20130154983"|"20130155027"|"20130158504"|"20130181896"|"20130181953"|"20130187891"|"20130201142"|"20130222346"|"20130241887"|"20130249833"|"20130269867"|"20130275082"|"20130285920"|"20130285968"|"20130300716"|"20130307795"|"20130342490"|"20140002400"|"20140028575"|"20140028604"|"20140028629"|"20140036203"|"20140055421"|"20140063853"|"20140071653"|"20140085241"|"20140092052"|"20140098032"|"20140098058"|"20140109219"|"20140125633"|"20140139467"|"20140160762"|"20140192023"|"20140232669"|"20140237401"|"20140237408"|"20140237422"|"20140253520"|"20140253831"|"20140259029"|"20140267124"|"20140292701"|"20140300572"|"20140320460"|"20140347325"|"20140362046"|"20140368471"|"20140375607"|"20150002386"|"20150009687"|"20150015497"|"20150035774"|"20150035803"|"20150053850"|"20150054759"|"20150083891"|"20150103013"|"20150121691"|"20150130769"|"20150138105"|"20150138158"|"20150138161"|"20150205441"|"20150215450"|"20150242055"|"20150271481"|"20150286698"|"20150317036"|"20150324028"|"20150331544"|"20150331545"|"20150331546"|"20150331547"|"20150332655"|"20150346856"|"20150346911"|"20150363042"|"20160004898"|"20160026337"|"20160034099"|"20160050746"|"20160070415"|"20160070416"	US-PGPUB; USPAT	OR	OFF	2020/02/13 11:41

EAST Search History (Prior Art)

S41	207	("4129384"|"4180702"|"4209255"|"4213707"|"4254333"|"4254407"|"4294543"|"4346376"|"4420261"|"4484179"|"4507557"|"4521112"|"4542375"|"4550250"|"4593191"|"4673918"|"4688933"|"4688993"|"4692809"|"4710760"|"4736191"|"4737626"|"4746770"|"4752655"|"4772763"|"4782328"|"4812833"|"4837430"|"4868912"|"4891829"|"4916712"|"4933544"|"4949079"|"4986662"|"4988983"|"5065185"|"5073770"|"5105186"|"5159322"|"5166668"|"5227622"|"5248856"|"5254407"|"5345490"|"5383022"|"5483261"|"5484966"|"5499098"|"5502568"|"5525764"|"5526422"|"5539514"|"5570181"|"5572251"|"5577501"|"5600105"|"5608550"|"5672852"|"5679930"|"5686942"|"5688933"|"5729249"|"5736686"|"5740224"|"5764223"|"5767517"|"5775792"|"5945980"|"5945981"|"5959617"|"6061177"|"6067079"|"6122394"|"6141104"|"6172667"|"6175999"|"6227667"|"6229529"|"6333735"|"6366276"|"6380732"|"6380740"|"6390370"|"6429857"|"6452996"|"6476797"|"6492633"|"6495832"|"6504143"|"6529327"|"6538644"|"6587099"|"6648485"|"6660964"|"6664498"|"6664952"|"6690363"|"6707027"|"6738051"|"6748098"|"6784948"|"6799141"|"6806871"|"6927384"|"6940286"|"6965836"|"6972753"|"6985137"|"7042444"|"7084859"|"7087907"|"7133031"|"7176904"|"7199932"|"7359041"|"7397418"|"7432893"|"7435940"|"7436443"|"7442914"|"7465914"|"7613375"|"7629968"|"7646833"|"7653883"|"7655901"|"7705835"|"7729056"|"7847789"|"7855716"|"7859519"|"7924272"|"7932899"|"7969410"|"7995039"|"8013845"|"8031186"|"8077147"|"8093545"|"8094136"|"8094910"|"8149211"|"8218154"|"8274495"|"8325158"|"8339379"|"8350827"|"8384010"|"8407606"|"8441467"|"8445834"|"8466901"|"8482547"|"8542217"|"8567257"|"8581884"|"8624858"|"8686974"|"8692807"|"8716614"|"8727581"|"8745514"|"8780066"|"8830181"|"8860696"|"8872098"|"8872801"|"8884900"|"8890843"|"8890849"|"8928590"|"8963886"|"8982084"|"9024916"|"9035909"|"9063614"|"9063617"|"9086763"|"9134854"|"9158401"|"9158415"|"9201520"|"9213445"|"9274645"|"9280237"|"9317168"|"9323396"|"9366565"|"9377884"|"9389732"|"9411444"|"9411464"|"9430079"|"9442574"|"9547393"|"9552103"|"9557846"|"9588619"|"9594467"|"9618682"|"9626018"|"9626040"|"9639210"|"9678602"|"9684414"|"9710101"|"9874978").PN.	US-PGPUB; USPAT	OR	OFF	2020/02/13 11:41

EAST Search History (Prior Art)

S42	55	(S39 S40 S41) and (parabol$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/02/13 11:43
S43	1	"20120223916".pn.	US-PGPUB	OR	OFF	2020/02/13 17:27
S44	1	"20160295711".pn.	US-PGPUB	OR	OFF	2020/02/13 17:30

EAST Search History (Prior Art)

S45	464	("20190079638" "20190079637" "10282035" "20190092411" "20120068973" "20190196659" "20190196657" "20190196658" "20190196660" "2015505117" "8989536" "10437389" "20140362053" "20140098791" "2014513375" "5593006" "2014222539" "5821125" "101491430" "101502295" "20140105872" "201329822" "5764266" "20150331547" "2862819" "2862819" "2013212634" "2013212634" "2793524" "2011229745" "20130135255" "2011229745" "2014233573" "20130133307" "2014233573" "2011229745" "10268319" "101399142" "2013522801" "9335867" "20100040277" "2825175" "8676007" "2015503157" "20110175852" "20130141395" "8587562" "20140146249" "5876587" "20150145834" "20110163998" "5853016" "9471170" "2825175" "8837882" "8553014" "20130155027" "20130135359" "20110074734" "2728034" "20110167628" "20160239153" "8902196" "8403203" "2009272923" "8890843" "20110169780" "2856992" "20110032214" "20190272052" "10496227" "2013207572" "9389730" "20180267672" "2012346379" "20110210946" "20150277663" "9411430" "2012346379" "201007530" "20140071094" "2013207572" "2014201966" "8896575" "9811163" "9052777" "20120176343" "20110181552" "9195344" "20160026337" "20110169781" "9164625" "9857917" "2688065" "2008280797" "8434909" "9052771" "9158416" "8950902" "20110169782" "20130250618" "20160026250" "20110227487" "20140364218" "20150277636" "20180296915" "9741184" "20150248796" "201416936" "20130187891" "8905610" "20130155723" "20120098794" "20120188206" "20150205441" "9063614" "20140320459" "2013525955" "9857916" "20160067602" "9110200" "2010236331" "2796519" I497358 "201411455" "2728030" "20170262134" "10140791" "20110255303" "20170309096" "20150261339" "2749584" "10282034" "10534479" "20140160081" "20110074735" "9035917" "2848650" "20160009073").pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/02/13 18:22

EAST Search History (Prior Art)

S46	409	S45 and @ad<"20161207"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/02/13 18:23
S47	64	S46 and (G06F3/0421 G06F2203/04103)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/02/13 18:23
S48	16	("10282035"|"20080080811"|"20110141062"|"20120170056"|"20120223916"|"20130155655"|"20130300714"|"20150131010"|"20150339000"|"20160306501"|"20190025984"|"20190196657"|"20190196658"|"20190196659"|"9001086"|"9207800").PN.	US-PGPUB; USPAT	OR	OFF	2020/10/05 14:12
S49	3	(parabol$3) and S48	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/10/05 14:13
S50	8	("20110080361"|"20130234991"|"20130321740"|"20150373864"|"20160154533"|"20190235701"|"4751379"|"9024896").PN.	US-PGPUB; USPAT	OR	OFF	2020/10/05 14:59
S51	1	(parabol$3) and S50	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/10/05 15:00
S52	9,977,497	((curv$3 arc$3 arch$3 bend$3 bent curvature bow$3 circl$3 circul$3 ellipse helix hyperbol$3 parabol$3 round$3 whorl) (optic$3 light$3) same touch$3 same (sens$3 detect$3) same (surface fac$3)).ab.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/03/16 15:05
S53	6,745,912	S52 and @ad<"20161207"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/03/16 15:07

EAST Search History (Prior Art)

S54	773	S53 and (G06F3/0421 G06F2203/04103)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/03/16 15:09
S55	843	((curv$3 arc$3 arch$3 bend$3 bent curvature bow$3 circl$3 circul$3 ellipse helix hyperbol$3 parabol$3 round$3 whorl) same (optic$3 light$3) same touch$3 same (sens$3 detect$3) same (surface fac$3)).ab.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/03/16 15:10
S56	541	S55 and @ad<"20161207"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/03/16 15:13
S57	19	S56 and (G06F3/0421 G06F2203/04103)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/03/16 15:13
S58	24	("2015/0331546").URPN.	USPAT	OR	OFF	2021/03/16 16:22
S59	1	15/547587.app.	US-PGPUB	OR	OFF	2021/03/16 16:25
S60	0	15/248405.app.	US-PGPUB	OR	OFF	2021/03/16 16:35
S61	2	S54 and (frame hous$3 chassis) same (touch$3 sens$3 detect$3) same ("in." inch$2)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/03/16 17:16
S62	29,804	(frame hous$3 chassis) same (touch$3 sens$3 detect$3) same ("in." inch$2)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/03/16 17:17
S63	16,671	S62 and @ad<"20161207"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/03/16 17:17

EAST Search History (Prior Art)

S64	22	S63 and (G06F3/0421 G06F2203/04103)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/03/16 17:18

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S32	193	((parabol$3) same (optic$3 light$3) same touch$3 same (surface fac$3))	US-PGPUB; USPAT	OR	OFF	2019/02/01 10:20
S33	181	S32 and @ad<"20161207"	US-PGPUB; USPAT	OR	OFF	2019/02/01 10:21
S34	29	S33 and (G06F3/0421 G06F2203/04103)	US-PGPUB; USPAT	OR	OFF	2019/02/01 10:22

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 16/403,283	Filing Date 05/03/2019	☐ To be Mailed

ENTITY: ☑ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $100 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $460 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	03/09/2021	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 22	Minus	** 20	= 2		x $100 =	200
	Independent (37 CFR 1.16(h))	* 3	Minus	*** 3	= 0		x $480 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	200

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	LIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/MONICA D FRANCIS/
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".	
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.	

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Doc code: RCEX
Doc description: Request for Continued Examination (RCE)

PTO/SB/30EFS (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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REQUEST FOR CONTINUED EXAMINATION(RCE)TRANSMITTAL
(Submitted Only via EFS-Web)

Application Number	16403283	Filing Date	2019-05-03	Docket Number (if applicable)	FFOG.053C3	Art Unit	2628
First Named Inventor	Aleksander Kocovski			Examiner Name	Vinh Tang Lam		

This is a Request for Continued Examination (RCE) under 37 CFR 1.114 of the above-identified application.
Request for Continued Examination (RCE) practice under 37 CFR 1.114 does not apply to any utility or plant application filed prior to June 8, 1995, or to any design application. The Instruction Sheet for this form is located at WWW.USPTO.GOV

SUBMISSION REQUIRED UNDER 37 CFR 1.114

Note: If the RCE is proper, any previously filed unentered amendments and amendments enclosed with the RCE will be entered in the order in which they were filed unless applicant instructs otherwise. If applicant does not wish to have any previously filed unentered amendment(s) entered, applicant must request non-entry of such amendment(s).

☐ Previously submitted. If a final Office action is outstanding, any amendments filed after the final Office action may be considered as a submission even if this box is not checked.

- ☐ Consider the arguments in the Appeal Brief or Reply Brief previously filed on _____
- ☐ Other _____

☒ Enclosed

- ☒ Amendment/Reply
- ☐ Information Disclosure Statement (IDS)
- ☐ Affidavit(s)/ Declaration(s)
- ☐ Other _____

MISCELLANEOUS

☐ Suspension of action on the above-identified application is requested under 37 CFR 1.103(c) for a period of months _____ (Period of suspension shall not exceed 3 months; Fee under 37 CFR 1.17(i) required)

☐ Other _____

FEES

☒ **The RCE fee under 37 CFR 1.17(e) is required by 37 CFR 1.114 when the RCE is filed.**
The Director is hereby authorized to charge any underpayment of fees, or credit any overpayments, to Deposit Account No 111410

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED

☒ Patent Practitioner Signature

Applicant Signature

PTO/SB/30EFS (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Signature of Registered U.S. Patent Practitioner			
Signature	/Harnik Shukla/	Date (YYYY-MM-DD)	2021-03-09
Name	HARNIK SHUKLA	Registration Number	73097

This collection of information is required by 37 CFR 1.114. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Inventor	:	Aleksander Kocovski
App. No.	:	16/403283
Filed	:	May 3, 2019
For	:	TOUCH DEVICE
Examiner	:	Lam, Vinh Tang
Art Unit	:	2628
Conf. No.	:	5417

AMENDMENT SUBMITTED WITH REQUEST FOR CONTINUTED EXAMINATION (RCE)

Mail Stop RCE
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Commissioner:

In response to the Office Action mailed October 9, 2020, the Applicant respectfully requests the above-identified application be amended as follows:

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AMENDMENTS TO THE CLAIMS

The following listing of claims replaces all prior versions thereof. Changes are shown below in highlighted form, where insertions appear as underlined text (e.g., insertions) while deletions appear as strikethrough text (e.g., ~~deletions~~) or double brackets (e.g., [[deletions]]).

1. (Canceled)

2. (Currently Amended) A touch sensing apparatus having a long edge and a short edge, the touch sensing apparatus comprising:

a display panel;

a plate including a touch surface;

a plurality of emitters arranged around a portion of the periphery of the plate and configured to emit light across the touch surface of the plate,

a plurality of detectors arranged around a portion of the periphery of the plate and configured to receive light from the plurality of emitters, and

a frame assembly, the frame assembly comprising;

a first frame element configured to support the display panel;

a second frame element arranged around the periphery of the plate and configured to support the plurality of emitters and plurality of detectors,

wherein the second frame element including a first surface arranged against an edge of the plate and a second surface arranged parallel to the touch surface,

the touch surface including:

a first edge and a second edge ~~parallel~~ adjacent to the short edge; and

a third edge and a fourth edge ~~parallel~~ adjacent to the long edge;

wherein the touch surface is curved relative to ~~with respect to~~ a second flat plane defined in part by the short edge and the long edge; [[and]]

~~wherein a distance between a first line in the touch surface and the second plane varies according to a parabolic function~~ wherein a distance

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between a first curved line drawn on the first plane and a second straight line drawn on the second flat plane varies according to a concave curve function;

wherein the first , second, third, and fourth edges are curved.

3. (Previously Presented) The touch sensing apparatus of claim 2, wherein the plurality of emitters is configured to emit light to propagate over the touch surface.

4. (Previously Presented) The touch sensing apparatus of claim 2, wherein the plurality of emitters is configured to emit light through the plate by total internal reflection.

5. (Previously Presented) The touch sensing apparatus of claim 2, further comprising a processing element configured to determine, based on output signals of the plurality of detectors, a position of an object on the touch surface.

6. (Currently Amended) The touch sensing apparatus of claim 2, wherein the plate has a first curvature prior to installation and~~, when assembled, the plate is induced into having~~ a second curvature greater than the first curvature when assembled.

7. (Previously Presented) The touch sensing apparatus of claim 6, wherein the first curvature and second curvature are measured along an edge of the plate.

8. (Currently Amended) The touch sensing apparatus of claim 6, wherein the first curvature and second curvature are measured along a line drawn on the plate ~~an axis~~ passing through a center point of the plate.

9. (Currently Amended) The touch sensing apparatus of claim 6, wherein the first curvature and second curvature are measured along a line drawn on the plate ~~an axis~~ passing through any position on the plate.

10. (Previously Presented) The touch sensing apparatus of claim 2, further comprising a gasket, wherein the plate is supported by the gasket along an edge of the plate.

11. (Previously Presented) The apparatus of claim 10, wherein the gasket is configured to have varying thickness to match a curvature of the plate along the edge.

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12. (Previously Presented) The apparatus of claim 2, wherein the second frame element is curved.

13. (Currently Amended) A touch sensing apparatus comprising:

a display panel;

a rectangular plate including a touch surface;

a plurality of emitters configured to emit light across the touch surface of the rectangular plate, and

a frame configured to support the display panel, the rectangular plate, and the plurality of emitters, said frame comprising:

a[[n]] longitudinal edge portion configured to contact at least a first corner and a second corner of the rectangular plate,

wherein the edge portion is curved such that a distance between the edge portion and a straight line between the first corner and the second corner varies according to a ~~parabolic~~ concave curve function and wherein the curved edge portion is configured to enable curvature in the rectangular plate,

wherein the rectangular plate is at least 55" wide along an axis.

14. (Previously Presented) The touch sensing apparatus of claim 13, wherein the plurality of emitters is configured to emit light to propagate over the touch surface.

15. (Previously Presented) The touch sensing apparatus of claim 13, wherein the plurality of emitters is configured to emit light through the plate by total internal reflection.

16. (Previously Presented) The touch sensing apparatus of claim 13, further comprising a processing element configured to determine, based on output signals of the plurality of detectors, a position of an object adjacent to the touch surface.

17. (Currently Amended) The touch sensing apparatus of claim 13, wherein the plate has a first curvature prior to installation and, ~~when assembled, the frame assembly induces the plate into having~~ a second curvature greater than the first curvature when assembled.

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18. (Previously Presented) The touch sensing apparatus of claim 17, wherein the first curvature and second curvature are measured along an edge of the plate.

19. (Currently Amended) The touch sensing apparatus of claim 17, wherein the first curvature and second curvature are measured along a line drawn on the plate ~~an axis~~ passing through a center point of the plate.

20. (Currently Amended) The touch sensing apparatus of claim 17, wherein the first curvature and second curvature are measured along a line drawn on the plate ~~an axis~~ passing through any position on the plate.

21. (Currently Amended) A touch sensing apparatus comprising:

a frame element configured to contact at least a portion of an edge of a rectangular plate, said rectangular plate including a touch surface;

wherein the frame element includes a curvature along a longitudinal axis of the frame element, [[and]]

wherein the curvature of the frame element is configured to induce a corresponding curvature in the plate, and

wherein the rectangular plate is at least 55" wide along an axis.

22. (Previously Presented) The touch sensing apparatus of claim 21, wherein the plate has a first curvature prior to installation and, when assembled, the frame element induces the plate into having a second curvature greater than the first curvature.

23. (Currently Amended) The touch sensing apparatus of claim 21, wherein a distance between the touch surface and a straight line parallel to the edge of the plate varies according to a ~~parabolic~~ concave curve function.

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REMARKS

By way of summary, Claims 2 - 23 were pending in this application. In the present amendment, Applicant has amended the claims as shown above without prejudice or disclaimer to previously pending versions thereof. Accordingly, Claims 2 - 23 remain pending.

Allowable Subject Matter

Applicant thanks the Examiner for the allowable subject matter in Claims 2 -12. Applicant has amended independent Claim 2 as shown above and respectfully request reconsideration.

Art Based Rejections

The Office Action rejected independent Claim 13 and 21 under 35 U.S.C. § 102(a) as being anticipated by Kukulj (U.S. Pub. No. 2012/0223916). The Office Action rejected the dependent claims based at least on the above cited references. Applicant respectfully traverses these rejections, the characterizations of the pending claims and the cited references and each and every implicit and explicit potential for reliance on Official Notice. However, in the interest of expediting prosecution, Applicant has amended the independent claims as shown above. The dependent claims are addressed in the "Dependent Claims" section below.

The Office Action is citing to the “parabolic reflectors” of Kukulj for teaching “wherein the curved edge portion is configured to enable curvature in the rectangular plate.” *Office Action*, 4. Applicant respectfully disagrees. For example, Kukulj does not teach or suggest that its “light guide plate” is curved. *Kukulj*, [0101]. Furthermore, Kukulj also does not teach or suggest its system can be expanded to large screen sizes as recited in the claims (“wherein the rectangular plate is at least 55” wide along an axis”). For at least these reasons, Kukulj does not anticipate claim 13.

Amended Independent Claim 21 recites among other things, “wherein the rectangular plate is at least 55” wide along an axis.” For at least the reasons discussed above with

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respect to deficiencies in Kukulj and for the additional features recited therein, amended Claim 21 is also not anticipated by Kukulj.

Dependent Claims

The dependent claims are patentable for the same reasons articulated above with respect to their independent claims. The dependent claims are also patentable because of the additional features recited therein.

No Disclaimers or Disavowals

Although the present communication may include alterations to the application or claims, or characterizations of claim scope or referenced art, Applicant is not conceding in this application that previously pending claims are not patentable over the cited references. Rather, any alterations or characterizations are being made to facilitate expeditious prosecution of this application. Applicant reserves the right to pursue at a later date any previously pending or other broader or narrower claims that capture any subject matter supported by the present disclosure, including subject matter found to be specifically disclaimed herein or by any prior prosecution. Accordingly, reviewers of this or any parent, child or related prosecution history shall not reasonably infer that Applicant has made any disclaimers or disavowals of any subject matter supported by the present application. Further, Applicant's arguments in favor of one independent claim should not be imputed to any other independent claim.

Conclusion

In view of the foregoing amendments and remarks, Applicant respectfully requests that the Examiner withdraw the outstanding rejections and allow the present application. If any issues arise during examination, the Examiner is invited to call the undersigned representative at his direct dial number listed below.

By focusing on specific claims and claim recitations in the discussion above, Applicant does not intend to imply that other claim recitations are disclosed or rendered obvious by the art of record.

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 623

Please charge any additional fees, including any fees for additional extension of time, or credit overpayment to Deposit Account No. 11-1410.

Respectfully submitted,

KNOBBE, MARTENS, OLSON & BEAR, LLP

Dated: March 9, 2021

By:/Harnik Shukla/_____
Harnik Shukla
Registration No. 73,097
Registered Practitioner
(949) 721-5278

34566964

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 624

Electronic Patent Application Fee Transmittal

Application Number:	16403283
Filing Date:	03-May-2019
Title of Invention:	TOUCH DEVICE
First Named Inventor/Applicant Name:	Aleksander Kocovski
Filer:	Harnik Shukla/Jenny Kim
Attorney Docket Number:	FFOG.053C3

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension - 2 months with $0 paid	1252	1	640	640
Miscellaneous:				
RCE- 1ST REQUEST	1801	1	1360	1360
		Total in USD ($)		**2000**

Electronic Acknowledgement Receipt

EFS ID:	42134964
Application Number:	16403283
International Application Number:	
Confirmation Number:	5417
Title of Invention:	TOUCH DEVICE
First Named Inventor/Applicant Name:	Aleksander Kocovski
Customer Number:	20995
Filer:	Harnik Shukla/Melanie Terrazas
Filer Authorized By:	Harnik Shukla
Attorney Docket Number:	FFOG.053C3
Receipt Date:	09-MAR-2021
Filing Date:	03-MAY-2019
Time Stamp:	19:27:07
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$2000
RAM confirmation Number	E202139J27284283
Deposit Account	111410
Authorized User	Melanie Terrazas

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

37 CFR 1.16 (National application filing, search, and examination fees)

37 CFR 1.17 (Patent application and reexamination processing fees)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Request for Continued Examination (RCE)	FFOG053C3_RCE.pdf	1349947 38b746f39d2c00611e275e3db7293199cb741159	no	3
Warnings:					
Information:					
2		FFOG053C3_OAR.pdf	47365 81cbf6f98bdc1e9d28631a1c76c8ed97aa970203	yes	8

Multipart Description/PDF files in .zip description

Document Description	Start	End
Amendment Submitted/Entered with Filing of CPA/RCE	1	1
Claims	2	5
Applicant Arguments/Remarks Made in an Amendment	6	8

Warnings:					
Information:					
3	Fee Worksheet (SB06)	fee-info.pdf	32425 4ceabdb2ccb0a36cebeecc5054914401bcd8c7c1	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	1429737		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/403,283	05/03/2019	Aleksander Kocovski	FFOG.053C3	5417

20995 7590 10/09/2020

KNOBBE MARTENS OLSON & BEAR LLP
2040 MAIN STREET
FOURTEENTH FLOOR
IRVINE, CA 92614

EXAMINER	
LAM, VINH TANG	

ART UNIT	PAPER NUMBER
2628	

NOTIFICATION DATE	DELIVERY MODE
10/09/2020	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

efiling@knobbe.com
jayna.cartee@knobbe.com

Office Action Summary	Application No. 16/403,283	Applicant(s) Kocovski et al.	
	Examiner VINH T LAM	Art Unit 2628	AIA (FITF) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 09/24/2020.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☑ This action is **FINAL.** 2b) ☐ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 1-23 is/are pending in the application.

5a) Of the above claim(s) 1 is/are withdrawn from consideration.

6) ☑ Claim(s) 2-12 is/are allowed.

7) ☑ Claim(s) 13-23 is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☑ The drawing(s) filed on 05/03/2019 is/are: a)☑ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☑ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☑ None of the:

1.☑ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☑ Notice of References Cited (PTO-892)

2) ☑ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

DETAILED ACTION

Notice of Pre-AIA or AIA Status

1. The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Priority

2. Acknowledgment is made of applicant's claim for foreign priority based on an application filed in **SE** on **12/07/2016**. It is noted, however, that applicant has not filed a certified copy of the 16302945 application as required by 37 CFR 1.55.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (a)(1) the claimed invention was patented, described in a printed publication, or in public use, on sale or otherwise available to the public before the effective filing date of the claimed invention.

3. Claim(s) **13-14, 16, 21,** and **23** is/are rejected under 35 U.S.C. 102(a)(1) as being anticipated by **Kukulj (US Patent/PGPub. No. 20120223916)**.

Regarding Claim **13, (Currently Amended)** **Kukulj** teaches **a touch sensing apparatus** *([0007], FIG. **3**, i.e. **touch screen 31**)* **comprising:**

a display panel *([0007], FIG. **3**, i.e. **an underlying display**)*;

a rectangular plate *([0007], FIG. **3**, i.e. **rectangular shape** of **touch screen 31**)* **including a touch surface** *([0007], FIG. **3**, i.e. **touch screen 31**)*;

a plurality of emitters *([0007], FIG. **3**, i.e. **optical sources 4**)* **configured to emit light across** *([0007], FIG. **3**, i.e. **launched into the light guide plate**)* **the touch surface of the rectangular plate** *(i.e. please see above citation(s))*, **and**

a frame *([0006], FIG. **3**, i.e. **L-shaped substrate 24**)* **configured to support** *(FIG. **3**, i.e. as **shown** by the **figure(s)**)* **the display panel, the rectangular plate, and the plurality of emitters, said frame** *(i.e. please see above citation(s))* **comprising:**

an edge portion *([0007], FIG. **3**, i.e. **parabolic reflectors 38**)* **configured to contact** *(FIG. **3**, i.e. as **shown** by the **figure(s)**)* **at least a first corner** *(FIG. **3**, i.e. **upper left corner** as **shown** by the **figure(s)**)* **and a**

second corner *(FIG. **3**, i.e. **upper right corner** as **shown** by the **figure(s))* **of the rectangular plate,**

wherein the edge portion *(i.e. please see above citation(s))* **is curved** *(FIG. **3**, i.e. as **shown** by the **figure(s))* **such that a distance** *(FIG. **3**, i.e. **upper vertical distance** as **shown** by the **figure(s))* **between the edge portion and a straight line** *(FIG. **3**, i.e. **upper horizontal line** as **shown** by the **figure(s))* **between the first corner and the second corner** *(i.e. please see above citation(s))* **varies according to a parabolic function** *([**0007**], FIG. **3**, i.e. **parabolic**)* **and wherein the curved edge portion** *(i.e. please see above citation(s))* **is configured to enable curvature** *([**0007**], FIG. **3**, i.e. **parabolic**)* **in the rectangular plate** *(i.e. please see above citation(s))***.**

Regarding Claim **14, (Previously Presented)** **Kukulj** teaches **the touch sensing apparatus of claim 13, wherein the plurality of emitters** *(i.e. please see above citation(s))* **is configured to emit light to propagate over** *([**0007**], FIG. **3**, i.e. **launched into the light guide plate**)* **the touch surface** *(i.e. please see above citation(s))***.**

Regarding Claim **16, (Previously Presented)** **Kukulj** teaches **the touch sensing apparatus of claim 13, further comprising a processing element** *([0007], FIG. **3**, i.e. **computers** would have **processing element**)* **configured to determine, based on output signals** *([0005], FIG. **3**, i.e. **blocks** a substantial portion of at least **one beam**)* **of the plurality of detectors** *(i.e. please see above citation(s))*, **a position of an object** *([0005], FIG. **3**, i.e. **its location** can be readily determined)* **adjacent to the touch surface** *(i.e. please see above citation(s))*.

Regarding Claim **21, (Currently Amended)** **Kukulj** teaches **a touch sensing apparatus** *([0007], FIG. **3**, i.e. **touch screen 31**)* **comprising:**

a frame element *([0006], FIG. **3**, i.e. **L-shaped substrate 24**)* **configured to be contact at least a portion** *([0007], FIG. **3**, i.e. **contact portion** at optical sources **4**)* **of an edge** *(FIG. **3**, i.e. **lower edge** as **shown** by the **figure(s)**)* **of a plate** *([0007], FIG. **3**, i.e. **touch screen 31**)*, **said plate** *(i.e. please see above citation(s))* **including a touch surface** *([0007], FIG. **3**, i.e. **touch screen 31/34**)*;

wherein the frame element *(i.e. please see above citation(s))* **includes a curvature** *([0007], FIG. **3**, i.e. **upper curvature of parabolic reflectors 38**)* **along a longitudinal axis** *([0007], FIG. **3**, i.e. **vertical axis**)* **of the frame element** *(i.e. please see above citation(s))*, **and**

wherein the curvature of the frame element *(i.e. please see above citation(s))* **is configured to induce a corresponding curvature** *([0007], FIG. **3**, i.e. **right curvature of parabolic reflectors 38**)* **in the plate** *(i.e. please see above citation(s))*.

Regarding Claim **23, (New)** **Kukulj** teaches **the touch sensing apparatus of claim 21, wherein a distance** *(FIG. **3**, i.e. **upper vertical distance** as **shown** by the **figure(s)**)* **between the touch surface** *(i.e. please see above citation(s))* **and a straight line parallel to** *(FIG. **3**, i.e. **horizontal line** as **shown** by the **figure(s)**)* **the edge of the plate** *(i.e. please see above citation(s))* **varies according to a parabolic function** *([0007], FIG. **3**, i.e. **parabolic reflectors 38**)*.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103 which forms the basis for all obviousness rejections set forth in this Office action:

> A patent for a claimed invention may not be obtained, notwithstanding that the claimed invention is not identically disclosed as set forth in section 102 of this title, if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claim(s) **15** is/are rejected under 35 U.S.C. 103 as being unpatentable over **Kukulj (US Patent/PGPub. No. 20120223916)** in view of **Wassvik (US Patent/PGPub. No. 20160334942).**

Regarding Claim **15, (Previously Presented)** **Kukulj** teaches **the touch sensing apparatus of claim 13.**

However, **Kukulj** does not explicitly teach the plurality of emitters is configured to emit light through the plate by total internal reflection.

In the same field of endeavor, **Wassvik** teaches **the plurality of emitters** *([0052], FIG. **2A**, i.e. **Emitters 2**)* **is configured to emit light** *([0052], FIG. **2A**, i.e. **propagating light**)* **through the plate** *([0103], FIG. **10G**, i.e. **filter 20**)* **by total internal reflection** *([0051], FIG. **1**, i.e. **total internal reflection**)*.

It would have been obvious to a person having ordinary skill in the art at the time the invention's effective date was filed to realize **Kukulj** teaching of optical touch sensing device propagating light with **Wassvik** teaching of optical touch sensing device propagating light via total internal reflection *to accurately identify touch point (Wassvik's [0051])*.

5. Claim(s) **17-20** and **22** is/are rejected under 35 U.S.C. 103 as being unpatentable over **Kukulj (US Patent/PGPub. No. 20120223916)** in view of **RYU et al. (US Patent/PGPub. No. 20160295711).**

Regarding Claim **17, (Previously Presented)** **Kukulj** teaches **the touch sensing apparatus of claim 13.**

However, **Kukulj** does not explicitly teach the plate has a first curvature prior to installation and, when assembled, the frame assembly induces the plate into having a second curvature greater than the first curvature.

In the same field of endeavor, **RYU et al.** teach

the plate *([0063], FIG. **4(a) & 4(b)**, i.e. **display unit 20**)* **has a first curvature** *([0070], FIG. **4(a)**, i.e. **flat** surface **display unit 20** which would be **curvature** with **infinite radius**)* **prior to installation** *([0072], FIG. **4(a)**, i.e. **prior to** links 50 are pushed up)* **and, when assembled** *([0072], FIG. **4(a)**, i.e. **after** links **50** are **pushed up**)*, **the frame assembly** *([0063], FIG. **4(a) & 4(b)**, i.e.*

housing 30) **induces the plate into having a second curvature greater than** *([0072], FIG.* ***4(a) & 4(b)****, i.e.* ***more curved*** *after links 50 are pushed up)* **the first curvature** *(i.e. please see above citation(s))***.**

It would have been obvious to a person having ordinary skill in the art at the time the invention's effective date was filed to combine **Kukulj** teaching touch display device comprising frame and curved display surface with **RYU et al.** teaching of touch display device comprising frame and curved/flat display surface *to effectively adjust field of views by providing both curved or flat surface of display (RYU et al.'s [0071]).*

Regarding Claim **18, (Previously Presented) the touch sensing apparatus of claim 17, wherein**

RYU et al. teach **the first curvature and second curvature** *(i.e. please see above citation(s))* **are measured along an edge of the plate** *([0072], FIG.* ***4(a) & 4(b)****, i.e.* ***vertical edge*** *of* ***housing 30)*****.**

Regarding Claim **19, (Previously Presented) the touch sensing apparatus of claim 17, wherein**

RYU et al. teach **the first curvature and second curvature** *(i.e. please see above citation(s))* **are measured along an axis passing through a center point** *([0072], FIG.* ***4(a) & 4(b)****, i.e.* ***vertical axis*** *through* ***center point*** *of* ***20)*** **of the plate** *(i.e. please see above citation(s))***.**

Regarding Claim **20, (Previously Presented) the touch sensing apparatus of claim 17, wherein**

RYU et al. teach **the first curvature and second curvature** *(i.e. please see above citation(s))* **are measured along an axis passing through any position** *([0072], FIG. **4(a) & 4(b)**, i.e. **vertical axis** through **any point** of **20**)* **on the plate** *(i.e. please see above citation(s))*.

Regarding Claim **22, (New)** **Kukulj** teaches **the touch sensing apparatus of claim 21.**

However, **Kukulj** does not explicitly teach the plate has a first curvature prior to installation and, when assembled, the frame element induces the plate into having a second curvature greater than the first curvature.

In the same field of endeavor, **RYU et al.** teach

the plate *([0063], FIG. **4(a) & 4(b)**, i.e. **display unit 20**)* **has a first curvature** *([0070], FIG. **4(a)**, i.e. **flat** surface **display unit 20** which would be **curvature** with **infinite radius**)* **prior to installation** *([0072], FIG. **4(a)**, i.e. **prior to** links 50 are pushed up)* **and, when assembled** *([0072], FIG. **4(a)**, i.e. **after** links **50** are **pushed up**)*, **the frame element** *([0063], FIG. **4(a) & 4(b)**, i.e. **housing 30**)* **induces the plate into having a second curvature**

greater than *([0072], FIG. **4(a) & 4(b)**, i.e. **more curved** after links 50 are pushed up)* **the first curvature** *(i.e. please see above citation(s))*.

It would have been obvious to a person having ordinary skill in the art at the time the invention's effective date was filed to combine **Kukulj** teaching touch display device comprising frame and curved display surface with **RYU et al.** teaching of touch display device comprising frame and curved/flat display surface *to effectively adjust field of views by providing both curved or flat surface of display (RYU et al.'s [0071])*.

Allowable Subject Matter

6. Claim(s) 2-12 is/are allowed.

7. The following is an examiner's statement of reasons for allowance:

The reasons for allowance have been set forth in the **Non-Final Office Action** dated **03/26/2020**.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Response to Argument

8. Applicant's arguments with respect to Claim(s) **13** and **21** has/have been considered but are moot because the arguments do not apply to any of the references being used in the current rejection.

9. All dependent claims are properly rejected or objected as shown above.

10. Applicants' Response to the Non-Final Office Action, **03/26/2020**, has been entered and made of record. Claim(s) **2**, **13**, and **21** is/are amended, Claim(s) **1** is/are cancelled, and Claim(s) **22-23** is/are new. Thus, Claim(s) **2-23** is/are pending in this application.

11. Applicant's arguments, see P. 6, filed **09/24/2020**, with respect to **Claim Objections** have been fully considered and are persuasive. The **Claim Objections** has/have been withdrawn.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to VINH TANG LAM whose telephone number is (571) 270-3704. The examiner can normally be reached on Monday to Friday 8:00 AM to 5:00 PM.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nitin K Patel can be reached on (571) 272-7677. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see https://ppair-my.uspto.gov/pair/PrivatePair. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/VINH T LAM/
Primary Examiner, Art Unit 2628

Notice of References Cited	Application/Control No. 16/403,283	Applicant(s)/Patent Under Reexamination Kocovski et al.	
	Examiner VINH T LAM	Art Unit 2628	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-9280237-B2	03-2016	Kukulj; Dax	G06F3/0428	1/1
*	B	US-20150331546-A1	11-2015	CRAVEN-BARTLE; Thomas	G02B5/005	345/175
*	C	US-9063614-B2	06-2015	Pettersson; Robert	G06F3/03547	1/1
*	D	US-20120089348-A1	04-2012	Perlin; Kenneth	G06F3/04144	702/41
*	E	US-20160334942-A1	11-2016	Wassvik; Ola	G06F3/0428	1/1
*	F	US-4986662-A	01-1991	Bures; Milan	G06F3/0421	250/221
*	G	US-20120223916-A1	09-2012	Kukulj; Dax	G06F3/0428	345/175
*	H	US-20160295711-A1	10-2016	RYU; Hyunjong	H05K5/03	1/1
	I					
	J					
	K					
	L					
	M					

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/403,283	Kocovski et al.
	Examiner	Art Unit
	VINH T LAM	2628

CPC - Searched*		
Symbol	Date	Examiner
G06F3/0421 G06F2203/04103	02/13/2020	vl

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
Search inventor'(s)' name(s). No ODP.	02/13/2020	vl
Search technical terms and synonyms.	10/05/2020	vl
Search IDS.	10/05/2020	vl
Search Foreign Patent Literature(s) and NPL (IP.com).	02/13/2020	vl
Search CPC.	02/13/2020	vl
Search EAST.	10/05/2020	vl

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
Search all of the above.	Search all of the above.	02/13/2020	vl

/VINH T LAM/ Primary Examiner, Art Unit 2628	

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 646

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/403,283	Kocovski et al.
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/VINH T LAM/
Primary Examiner, Art Unit 2628

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Chemtronics Exhibit 1032 Page 647

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/403,283	Kocovski et al.
	Examiner	**Art Unit**
	VINH T LAM	2628

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	02/13/2020	10/05/2020							
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	2	=	=							
	3	=	=							
	4	=	=							
	5	=	=							
	6	=	=							
	7	=	=							
	8	=	=							
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	13	✓	✓							
	14	✓	✓							
	15	✓	✓							
	16	✓	✓							
	17	✓	✓							
	18	✓	✓							
	19	✓	✓							
	20	✓	✓							
	21	✓	✓							
	22		✓							
	23		✓							

PTO/SB/08 Equivalent

INFORMATION DISCLOSURE STATEMENT BY APPLICANT	Application No.	16/403283
	Filing Date	May 3, 2019
	First Named Inventor	Aleksander Kocovski
	Art Unit	2621
(Multiple sheets used when necessary)	Examiner	Lam, Vinh Tang
SHEET 1 OF 2	Attorney Docket No.	FFOG.053C3

U.S. PATENT DOCUMENTS

Examiner Initials	Cite No.	Document Number *Number - Kind Code (if known)* Example: 1,234,567 B1	Publication Date MM-DD-YYYY	Name	Pages, Columns, Lines Where Relevant Passages or Relevant Figures Appear
	1	2015/0373864 A1	12-24-2015	Jung	
	2	2013/0321740 A1	12-5-2013	An et al.	
	3	2016/0154533 A1	06-02-2016	Eriksson et al.	
	4	2011/0080361 A1	04-07-2011	Miller et al.	
	5	2019/0235701 A1	08-01-2019	Han et al.	
	6	9,024,896 B2	05-05-2015	Chen	
	7	4,751,379	06-14-1988	Sasaki et al.	
	8	2013/0234991 A1	09-12-2013	Sparf	

FOREIGN PATENT DOCUMENTS

Examiner Initials	Cite No.	Foreign Patent Document *Country Code-Number-Kind Code* Example: JP 1234567 A1	Publication Date MM-DD-YYYY	Name	Pages, Columns, Lines Where Relevant Passages or Relevant Figures Appear	T[1]
	9	WO 2014/065601	05-01-2014	LG Electronics Inc.		
	10	WO 2018/106176	06-14-2018	FlatFrog Laboratories AB		
	11	EP 3535640 A1	09-11-2019	FlatFrog Laboratories AB		
	12	EP 2765622 A2	08-13-2014	LG Electronics Inc.		
	13	WO 2013/159472	10-31-2013	Shenzhen Timelink Technology Co., LTD.		X

NON PATENT LITERATURE DOCUMENTS

Examiner Initials	Cite No.	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T[1]
	14	Report on the Filing or Determination of an Action Regarding a Patent or Trademark. For U.S. Patent No. 10,282,035, U.S. District of Delaware, dated December 10, 2019, in 1 page.	
	15	Civil Cover Sheet FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., dated December 10, 2019, in 1 page.	
	16	Complaint for Patent Infringement, FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 19-2246, dated December 10, 2019, in 83 pages.	
	17	Executed Summons in a Civil Action to PROMETHEAN INC., C.A. No. 19-2246, dated December 10, 2019 in 2 pages.	
	18	Summons in a Civil Action to PROMETHEAN INC., C.A. No. 19-2246, dated December 10, 2019 in 2 pages.	

Examiner Signature	/VINH T LAM/	Date Considered	10/05/2020

*__Examiner:__ Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

T[1] - Place a check mark in this area when an English language Translation is attached.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /V.T.L/

PTO/SB/08 Equivalent

INFORMATION DISCLOSURE STATEMENT BY APPLICANT	Application No.	16/403283
	Filing Date	May 3, 2019
	First Named Inventor	Aleksander Kocovski
	Art Unit	2621
(Multiple sheets used when necessary)	Examiner	Lam, Vinh Tang
SHEET 2 OF 2	Attorney Docket No.	FFOG.053C3

NON PATENT LITERATURE DOCUMENTS			
Examiner Initials	Cite No.	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T[1]
	19	Summons in a Civil Action to Promethean Ltd., C.A. No. 19-2246, dated December 10, 2019 in 2 pages.	
	20	Defendants' Answer to Second Amended Complaint and Defendant Promethean Inc.'s Counterclaims Against FlatFrog Laboratories AB., C.A. No. 19-2246, dated May 22, 2020, in 29 pages.	

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U.S. PATENT DOCUMENTS

Examiner Initials	Cite No.	Document Number *Number - Kind Code (if known)* Example: 1,234,567 B1	Publication Date MM-DD-YYYY	Name	Pages, Columns, Lines Where Relevant Passages or Relevant Figures Appear
	1	9,001,086	04-07-2015	Saini, Amrinder Pal Singh	
	2	10,282,035	05-07-2019	Kocovksi et al.	
	3	2008/0080811	04-03-2008	Deane, Peter	
	4	2011/0141062	06-16-2011	Yu et al.	
	5	2012/0170056	07-05-2012	Jakobsen et al.	
	6	2012/0223916	09-06-2012	Kukulj, Dax	
	7	2013/0300714	11-14-2013	Goh et al.	
	8	2015/0131010	05-14-2015	Sugiyama, Koichi	
	9	2019/0196657	10-08-2019	Skagmo et al.	
	10	2019/0196658	06-27-2019	Skagmo et al.	
	11	2019/0196659	06-27-2019	Skagmo et al.	
	12	2019/0025984	01-24-2019	Weilbacher et al.	
	13	9,207,800	12-08-2015	Eriksson et al.	
	14	2015/0339000	11-26-2014	Lee et al.	
	15	2016/0306501	10-20-2016	Drumm et al.	
	16	2013/0155655	06-20-2013	Lee et al.	

FOREIGN PATENT DOCUMENTS

Examiner Initials	Cite No.	Foreign Patent Document *Country Code-Number-Kind Code* Example: JP 1234567 A1	Publication Date MM-DD-YYYY	Name	Pages, Columns, Lines Where Relevant Passages or Relevant Figures Appear	T[1]
	17	EP 2325735 A2	05-25-2011	SAMSUNG ELECTRONICS CO LTD		
	18	WO 2016/130074 A1	08-18-2016	FLATFROG LABORATORIES AB		

NON PATENT LITERATURE DOCUMENTS

Examiner Initials	Cite No.	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T[1]
	19	Extended European Search Report in European Application number 16873465.5, date June 25, 2019 in 9 pages.	

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Examiner Signature	/VINH T LAM/	Date Considered	10/05/2020

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	1	9,001,086	04-07-2015	Saini, Amrinder Pal Singh	
	2	10,282,035	05-07-2019	Kocovksi et al.	
	3	2008/0080811	04-03-2008	Deane, Peter	
	4	2011/0141062	06-16-2011	Yu et al.	
	5	2012/0170056	07-05-2012	Jakobsen et al.	
	6	2012/0223916	09-06-2012	Kukulj, Dax	
	7	2013/0300714	11-14-2013	Goh et al.	
	8	2015/0131010	05-14-2015	Sugiyama, Koichi	
	9	2019/0196657	10-08-2019	Skagmo et al.	
	10	2019/0196658	06-27-2019	Skagmo et al.	
	11	2019/0196659	06-27-2019	Skagmo et al.	
	12	2019/0025984	01-24-2019	Weilbacher et al.	
	13	9,207,800	12-08-2015	Eriksson et al.	
	14	2015/0339000	11-26-2014	Lee et al.	
	15	2016/0306501	10-20-2016	Drumm et al.	
	16	2013/0155655	06-20-2013	Lee et al.	

FOREIGN PATENT DOCUMENTS

Examiner Initials	Cite No.	Foreign Patent Document *Country Code-Number-Kind Code* Example: JP 1234567 A1	Publication Date MM-DD-YYYY	Name	Pages, Columns, Lines Where Relevant Passages or Relevant Figures Appear	T[1]
	17	EP 2325735 A2	05-25-2011	SAMSUNG ELECTRONICS CO LTD		
	18	WO 2016/130074 A1	08-18-2016	FLATFROG LABORATORIES AB		

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	19	Extended European Search Report in European Application number 16873465.5, date June 25, 2019 in 9 pages.	

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ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /V.T.L/

EAST Search History (Prior Art)

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S4	108	S3 and (G06F3/0421 G06F2203/04103)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/01/31 16:43
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S6	72	((("FLATFROG") near3 ("LABORATORIES") near3 ("AB"))).AS,AANM.	USPAT	OR	OFF	2019/01/31 16:46
S7	35	((("KOCOVSKI") near3 ("Aleksander")) OR (("BERGSTROM") near3 ("Hakan")) OR (("THORVINGER") near3 ("Jens"))).INV.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	OR	OFF	2019/01/31 16:47
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EAST Search History (Prior Art)

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EAST Search History (Prior Art)

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EAST Search History (Prior Art)

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S26	88	S25 and @ad<"20161207"	US-PGPUB; USPAT	OR	OFF	2019/02/01 10:48
S27	2	S26 and (G06F3/0421 G06F2203/04103)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/02/01 10:48

EAST Search History (Prior Art)

S28	200	("10013107"|"10019113"|"20010002694"|"20010005004"|"20010005308"|"20010030642"|"20020067348"|"20020075243"|"20020118177"|"20020158823"|"20020158853"|"20020163505"|"20030016450"|"20030034439"|"20030034935"|"20030048257"|"20030052257"|"20030095399"|"20030107748"|"20030137494"|"20030156100"|"20030160155"|"20030210537"|"20030214486"|"20040027339"|"20040032401"|"20040090432"|"20040130338"|"20040174541"|"20040201579"|"20040212603"|"20040238627"|"20040239702"|"20040245438"|"20040252091"|"20040252867"|"20050012714"|"20050041013"|"20050057903"|"20050073508"|"20050083293"|"20050128190"|"20050143923"|"20050156914"|"20050162398"|"20050179977"|"20050200613"|"20050212774"|"20050248540"|"20050253834"|"20050276053"|"20060001650"|"20060001653"|"20060007185"|"20060008164"|"20060017706"|"20060017709"|"20060033725"|"20060038698"|"20060061861"|"20060114237"|"20060132454"|"20060139340"|"20060158437"|"20060170658"|"20060202974"|"20060227120"|"20060255248"|"20060256092"|"20060279558"|"20060281543"|"20060290684"|"20070014486"|"20070024598"|"20070034783"|"20070038691"|"20070052684"|"20070070056"|"20070075648"|"20070120833"|"20070125937"|"20070152985"|"20070201042"|"20070296688"|"20080006766"|"20080007540"|"20080007541"|"20080007542"|"20080011944"|"20080029691"|"20080036743"|"20080062150"|"20080068691"|"20080074401"|"20080088603"|"20080121442"|"20080122792"|"20080122803"|"20080130979"|"20080133265"|"20080150846"|"20080150848"|"20080151126"|"20080158176"|"20080189046"|"20080192025"|"20080238433"|"20080246388"|"20080252619"|"20080266266"|"20080278460"|"20080284925"|"20080291668"|"20080297482"|"20090002340"|"20090006292"|"20090040786"|"20090066647"|"20090067178"|"20090073142"|"20090077501"|"20090085894"|"20090091554"|"20090115919"|"20090122020"|"20090122027"|"20090128508"|"20090135162"|"20090143141"|"20090153519"|"20090161026"|"20090168459"|"20090187842"|"20090189857"|"20090189874"|"20090189878"|"20090219256"|"20090229892"|"20090251439"|"20090256817"|"20090259967"|"20090267919"|"20090273794"|"20090278816"|"20090297009"|"20100033444"|"20100045629"|"20100060896"|"20100066016"|"20100066704"|"20100073318"|"20100078545"|"20100079407"|"20100079408"|"20100097345"|"20100097348"|"20100097353"|"20100125438"|"20100127975"|"20100134435"|"20100142823"|"20100187422"|"20100	US-PGPUB; USPAT	OR	OFF	2019/02/01 10:56

EAST Search History (Prior Art)

S29	210	("20110163996"|"20110163997"|"20110163998"|"20110169780"|"20110175852"|"20110205186"|"20110216042"|"20110221705"|"20110221997"|"20110227036"|"20110227874"|"20110234537"|"20110254864"|"20110261020"|"20110267296"|"20110291989"|"20110298743"|"20110309325"|"20110310045"|"20120019448"|"20120026408"|"20120038593"|"20120062474"|"20120068973"|"20120086673"|"20120089348"|"20120110447"|"20120131490"|"20120141001"|"20120146930"|"20120153134"|"20120154338"|"20120162142"|"20120162144"|"20120169672"|"20120181419"|"20120182266"|"20120188206"|"20120191993"|"20120200532"|"20120200538"|"20120212441"|"20120217882"|"20120249478"|"20120256882"|"20120268403"|"20120268427"|"20120274559"|"20120305755"|"20130021300"|"20130021302"|"20130027404"|"20130044073"|"20130055080"|"20130076697"|"20130082980"|"20130107569"|"20130113715"|"20130120320"|"20130125016"|"20130127790"|"20130135258"|"20130135259"|"20130141388"|"20130154983"|"20130155027"|"20130158504"|"20130181896"|"20130187891"|"20130201142"|"20130222346"|"20130241887"|"20130249833"|"20130269867"|"20130275082"|"20130285920"|"20130285968"|"20130300716"|"20130307795"|"20130342490"|"20140002400"|"20140028575"|"20140028604"|"20140028629"|"20140036203"|"20140055421"|"20140063853"|"20140071653"|"20140085241"|"20140092052"|"20140098032"|"20140098058"|"20140109219"|"20140125633"|"20140139467"|"20140160762"|"20140192023"|"20140232669"|"20140237401"|"20140237408"|"20140237422"|"20140253831"|"20140267124"|"20140292701"|"20140300572"|"20140320460"|"20140347325"|"20140362046"|"20140368471"|"20140375607"|"20150002386"|"20150009687"|"20150015497"|"20150035774"|"20150035803"|"20150053850"|"20150054759"|"20150083891"|"201501030 13"|"20150130769"|"20150138105"|"20150138158"|"20150138161"|"20150205441"|"20150215450"|"20150242055"|"201502714 81"|"20150286698"|"20150317036"|"20150324028"|"20150331544"|"20150331545"|"20150331546"|"20150331547"|"20150332655"|"20150346856"|"20150346911"|"20150363042"|"20160026337"|"20160034099"|"20160050746"|"20160070415"|"20160070416"|"20160124546"|"20160124551"|"20160154531"|"20160154532"|"20160202841"|"20160216844"|"20160224144"|"20160299593"|"20160328090"|"20160328091"|"20160334942"|"20160342282"|"20160357348"|"20170010688"|"20170090090"|"20170102827"|"20170115235"|"20170115823"|"20170139541"	US-PGPUB; USPAT	OR	OFF	2019/02/01 10:56

EAST Search History (Prior Art)

S30	175	("4986662"|"4988983"|"5065185"|"5073770"|"5105186"|"5159322"|"5166668"|"5227622"|"5248856"|"5254407"|"5345490"|"5383022"|"5483261"|"5484966"|"5499098"|"5502568"|"5525764"|"5526422"|"5539514"|"5570181"|"5572251"|"5577501"|"5600105"|"5608550"|"5672852"|"5679930"|"5686942"|"5688933"|"5729249"|"5736686"|"5740224"|"5764223"|"5767517"|"5775792"|"5945980"|"5945981"|"5959617"|"6061177"|"6067079"|"6122394"|"6141104"|"6172667"|"6175999"|"6227667"|"6229529"|"6333735"|"6366276"|"6380732"|"6380740"|"6390370"|"6429857"|"6452996"|"6476797"|"6492633"|"6495832"|"6504143"|"6529327"|"6538644"|"6587099"|"6648485"|"6660964"|"6664498"|"6664952"|"6690363"|"6707027"|"6738051"|"6748098"|"6784948"|"6799141"|"6806871"|"6927384"|"6940286"|"6965836"|"6972753"|"6985137"|"7042444"|"7084859"|"7087907"|"7133031"|"7176904"|"7199932"|"7359041"|"7397418"|"7432893"|"7435940"|"7436443"|"7442914"|"7465914"|"7613375"|"7629968"|"7646833"|"7653883"|"7655901"|"7705835"|"7729056"|"7847789"|"7855716"|"7859519"|"7924272"|"7932899"|"7969410"|"7995039"|"8013845"|"8031186"|"8077147"|"8093545"|"8094136"|"8094910"|"8149211"|"8218154"|"8274495"|"8325158"|"8339379"|"8350827"|"8384010"|"8407606"|"8441467"|"8445834"|"8466901"|"8482547"|"8542217"|"8567257"|"8581884"|"8624858"|"8686974"|"8692807"|"8716614"|"8727581"|"8745514"|"8780066"|"8830181"|"8860696"|"8872098"|"8872801"|"8884900"|"8890843"|"8890849"|"8928590"|"8963886"|"8982084"|"9024916"|"9035909"|"9063617"|"9086763"|"9134854"|"9158401"|"9158415"|"9213445"|"9274645"|"9317168"|"9323396"|"9366565"|"9377884"|"9389732"|"9411444"|"9411464"|"9430079"|"9442574"|"9547393"|"9552103"|"9557846"|"9588619"|"9594467"|"9618682"|"9626018"|"9626040"|"9639210"|"9678602"|"9684414"|"9710101"|"9874978"|"20120045170"|"20120062492"|"20160295711"|"6031524").PN.	US-PGPUB; USPAT	OR	OFF	2019/02/01 10:56
S31	50	(S28 S29 S30) and (parabol$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/02/01 10:58
S36	0	16/403283.app.	US-PGPUB	OR	OFF	2020/02/13 11:23

EAST Search History (Prior Art)

S37	49	((("KOCOVSKI") near3 ("Aleksander")) OR (("BERGSTROM") near3 ("Hakan")) OR (("THORVINGER") near3 ("Jens"))).INV.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	OR	OFF	2020/02/13 11:23
S38	3	S37 and ((first second) same (plane$1 surface$1 frame$1 edge$1) same (parabolic)).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/02/13 11:26

EAST Search History (Prior Art)

S39	201	("10282035"|"20100103133"|"20120062492"|"20150373864"|"20160026297"|"20160209886"|"20160255713"|"20160295711"|"6031524"|"10013107"|"10019113"|"20010002694"|"20010005004"|"20010005308"|"20010030642"|"20020067348"|"20020075243"|"20020118177"|"20020158823"|"20020158853"|"20020163505"|"20030016450"|"20030034439"|"20030034935"|"20030048257"|"20030052257"|"20030095399"|"20030107748"|"20030137494"|"20030156100"|"20030160155"|"20030210537"|"20030214486"|"20040027339"|"20040032401"|"20040090432"|"20040130338"|"20040174541"|"20040201579"|"20040212603"|"20040238627"|"20040239702"|"20040245438"|"20040252091"|"20040252867"|"20050012714"|"20050041013"|"20050057903"|"20050073508"|"20050083293"|"20050128190"|"20050143923"|"20050156914"|"20050162398"|"20050179977"|"20050200613"|"20050212774"|"20050248540"|"20050253834"|"20050276053"|"20060001650"|"20060001653"|"20060007185"|"20060008164"|"20060017706"|"20060017709"|"20060033725"|"20060038698"|"20060061861"|"20060114237"|"20060132454"|"20060139340"|"20060158437"|"20060170658"|"20060202974"|"20060227120"|"20060255248"|"20060256092"|"20060279558"|"20060281543"|"20060290684"|"20070014486"|"20070024598"|"20070034783"|"20070038691"|"20070052684"|"20070070056"|"20070075648"|"20070120833"|"20070125937"|"20070152985"|"20070201042"|"20070296688"|"20080006766"|"20080007540"|"20080007541"|"20080007542"|"20080011944"|"20080029691"|"20080036743"|"20080062150"|"20080068691"|"20080074401"|"20080088603"|"20080121442"|"20080122792"|"20080122803"|"20080130979"|"20080133265"|"20080150846"|"20080150848"|"20080151126"|"20080158176"|"20080189046"|"20080192025"|"20080238433"|"20080246388"|"20080252619"|"20080266266"|"20080278460"|"20080284925"|"20080291668"|"20080297482"|"20090000831"|"20090002340"|"20090006292"|"20090040786"|"20090066647"|"20090067178"|"20090073142"|"20090077501"|"20090085894"|"20090091554"|"20090115919"|"20090122020"|"20090122027"|"20090128508"|"20090135162"|"20090143141"|"20090153519"|"20090161026"|"20090168459"|"20090187842"|"20090189857"|"20090189874"|"20090189878"|"20090219256"|"20090229892"|"20090251439"|"20090256817"|"20090259967"|"20090267919"|"20090273794"|"20090278816"|"20090297009"|"20100033444"|"20100045629"|"20100060896"|"20100066016"|"20100066704"|"20100073318"|"20100078545"|"20100079407"	US-PGPUB; USPAT	OR	OFF	2020/02/13 11:41

EAST Search History (Prior Art)

S40	201	("20110102374"|"20110115748"|"20110121323"|"20110122075"|"20110122091"|"20110122094"|"20110134079"|"20110147569"|"20110157095"|"20110157096"|"20110163996"|"20110163997"|"20110163998"|"20110169780"|"20110175852"|"20110205186"|"20110216042"|"20110221705"|"20110221997"|"20110227036"|"20110227874"|"20110234537"|"20110254864"|"20110261020"|"20110267296"|"20110291989"|"20110298743"|"20110309325"|"20110310045"|"20120019448"|"20120026408"|"20120038593"|"20120062474"|"20120068973"|"20120086673"|"20120089348"|"20120110447"|"20120131490"|"20120141001"|"20120146930"|"20120153134"|"20120154338"|"20120162142"|"20120162144"|"20120169672"|"20120181419"|"20120182266"|"20120188206"|"20120191993"|"20120200532"|"20120200538"|"20120212441"|"20120217882"|"20120218229"|"20120249478"|"20120256882"|"20120268403"|"20120268427"|"20120274559"|"20120305755"|"20120313865"|"20130021300"|"20130021302"|"20130027404"|"20130044073"|"20130055080"|"20130076697"|"20130082980"|"20130106709"|"20130107569"|"20130113715"|"20130120320"|"20130125016"|"20130127790"|"20130135258"|"20130135259"|"20130141388"|"20130141395"|"20130154983"|"20130155027"|"20130158504"|"20130181896"|"20130181953"|"20130187891"|"20130201142"|"20130222346"|"20130241887"|"20130249833"|"20130269867"|"20130275082"|"20130285920"|"20130285968"|"20130300716"|"20130307795"|"20130342490"|"20140002400"|"20140028575"|"20140028604"|"20140028629"|"20140036203"|"20140055421"|"20140063853"|"20140071653"|"20140085241"|"20140092052"|"20140098032"|"20140098058"|"20140109219"|"20140125633"|"20140139467"|"20140160762"|"20140192023"|"20140232669"|"20140237401"|"20140237408"|"20140237422"|"20140253520"|"20140253831"|"20140259029"|"20140267124"|"20140292701"|"20140300572"|"20140320460"|"20140347325"|"20140362046"|"20140368471"|"20140375607"|"20150002386"|"20150009687"|"20150015497"|"20150035774"|"20150035803"|"20150053850"|"20150054759"|"20150083891"|"20150103013"|"20150121691"|"20150130769"|"20150138105"|"20150138158"|"20150138161"|"20150205441"|"20150215450"|"20150242055"|"20150271481"|"20150286698"|"20150317036"|"20150324028"|"20150331544"|"20150331545"|"20150331546"|"20150331547"|"20150332655"|"20150346856"|"20150346911"|"20150363042"|"20160004898"|"20160026337"|"20160034099"|"20160050746"|"20160070415"|"20160070416"	US-PGPUB; USPAT	OR	OFF	2020/02/13 11:41

EAST Search History (Prior Art)

S41	207	("4129384"|"4180702"|"4209255"|"4213707"|"4254333"|"4254407"|"4294543"|"4346376"|"4420261"|"4484179"|"4507557"|"4521112"|"4542375"|"4550250"|"4593191"|"4673918"|"4688933"|"4688993"|"4692809"|"4710760"|"4736191"|"4737626"|"4746770"|"4752655"|"4772763"|"4782328"|"4812833"|"4837430"|"4868912"|"4891829"|"4916712"|"4933544"|"4949079"|"4986662"|"4988983"|"5065185"|"5073770"|"5105186"|"5159322"|"5166668"|"5227622"|"5248856"|"5254407"|"5345490"|"5383022"|"5483261"|"5484966"|"5499098"|"5502568"|"5525764"|"5526422"|"5539514"|"5570181"|"5572251"|"5577501"|"5600105"|"5608550"|"5672852"|"5679930"|"5686942"|"5688933"|"5729249"|"5736686"|"5740224"|"5764223"|"5767517"|"5775792"|"5945980"|"5945981"|"5959617"|"6061177"|"6067079"|"6122394"|"6141104"|"6172667"|"6175999"|"6227667"|"6229529"|"6333735"|"6366276"|"6380732"|"6380740"|"6390370"|"6429857"|"6452996"|"6476797"|"6492633"|"6495832"|"6504143"|"6529327"|"6538644"|"6587099"|"6648485"|"6660964"|"6664498"|"6664952"|"6690363"|"6707027"|"6738051"|"6748098"|"6784948"|"6799141"|"6806871"|"6927384"|"6940286"|"6965836"|"6972753"|"6985137"|"7042444"|"7084859"|"7087907"|"7133031"|"7176904"|"7199932"|"7359041"|"7397418"|"7432893"|"7435940"|"7436443"|"7442914"|"7465914"|"7613375"|"7629968"|"7646833"|"7653883"|"7655901"|"7705835"|"7729056"|"7847789"|"7855716"|"7859519"|"7924272"|"7932899"|"7969410"|"7995039"|"8013845"|"8031186"|"8077147"|"8093545"|"8094136"|"8094910"|"8149211"|"8218154"|"8274495"|"8325158"|"8339379"|"8350827"|"8384010"|"8407606"|"8441467"|"8445834"|"8466901"|"8482547"|"8542217"|"8567257"|"8581884"|"8624858"|"8686974"|"8692807"|"8716614"|"8727581"|"8745514"|"8780066"|"8830181"|"8860696"|"8872098"|"8872801"|"8884900"|"8890843"|"8890849"|"8928590"|"8963886"|"8982084"|"9024916"|"9035909"|"9063614"|"9063617"|"9086763"|"9134854"|"9158401"|"9158415"|"9201520"|"9213445"|"9274645"|"9280237"|"9317168"|"9323396"|"9366565"|"9377884"|"9389732"|"9411444"|"9411464"|"9430079"|"9442574"|"9547393"|"9552103"|"9557846"|"9588619"|"9594467"|"9618682"|"9626018"|"9626040"|"9639210"|"9678602"|"9684414"|"9710101"|"9874978").PN.	US-PGPUB; USPAT	OR	OFF	2020/02/13 11:41

EAST Search History (Prior Art)

S42	55	(S39 S40 S41) and (parabol$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/02/13 11:43
S43	1	"20120223916".pn.	US-PGPUB	OR	OFF	2020/02/13 17:27
S44	1	"20160295711".pn.	US-PGPUB	OR	OFF	2020/02/13 17:30

EAST Search History (Prior Art)

S45	464	("20190079638" "20190079637" "10282035" "20190092411" "20120068973" "20190196659" "20190196657" "20190196658" "20190196660" "2015505117" "8989536" "10437389" "20140362053" "20140098791" "2014513375" "5593006" "2014222539" "5821125" "101491430" "101502295" "20140105872" "201329822" "5764266" "20150331547" "2862819" "2862819" "2013212634" "2013212634" "2793524" "2011229745" "20130135255" "2011229745" "2014233573" "20130133307" "2014233573" "2011229745" "10268319" "101399142" "2013522801" "9335867" "20100040277" "2825175" "8676007" "2015503157" "20110175852" "20130141395" "8587562" "20140146249" "5876587" "20150145834" "20110163998" "5853016" "9471170" "2825175" "8837882" "8553014" "20130155027" "20130135359" "20110074734" "2728034" "20110167628" "20160239153" "8902196" "8403203" "2009272923" "8890843" "20110169780" "2856992" "20110032214" "20190272052" "10496227" "2013207572" "9389730" "20180267672" "2012346379" "20110210946" "20150277663" "9411430" "2012346379" "201007530" "20140071094" "2013207572" "2014201966" "8896575" "9811163" "9052777" "20120176343" "20110181552" "9195344" "20160026337" "20110169781" "9164625" "9857917" "2688065" "2008280797" "8434909" "9052771" "9158416" "8950902" "20110169782" "20130250618" "20160026250" "20110227487" "20140364218" "20150277636" "20180296915" "9741184" "20150248796" "201416936" "20130187891" "8905610" "20130155723" "20120098794" "20120188206" "20150205441" "9063614" "20140320459" "2013525955" "9857916" "20160067602" "9110200" "2010236331" "2796519" I497358 "201411455" "2728030" "20170262134" "10140791" "20110255303" "20170309096" "20150261339" "2749584" "10282034" "10534479" "20140160081" "20110074735" "9035917" "2848650" "20160009073").pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/02/13 18:22

EAST Search History (Prior Art)

S46	409	S45 and @ad<"20161207"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/02/13 18:23
S47	64	S46 and (G06F3/0421 G06F2203/04103)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/02/13 18:23
S48	16	("10282035"|"20080080811"|"20110141062"|"20120170056"|"20120223916"|"20130155655"|"20130300714"|"20150131010"|"20150339000"|"20160306501"|"20190025984"|"20190196657"|"20190196658"|"20190196659"|"9001086"|"9207800").PN.	US-PGPUB; USPAT	OR	OFF	2020/10/05 14:12
S49	3	(parabol$3) and S48	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/10/05 14:13
S50	8	("20110080361"|"20130234991"|"20130321740"|"20150373864"|"20160154533"|"20190235701"|"4751379"|"9024896").PN.	US-PGPUB; USPAT	OR	OFF	2020/10/05 14:59
S51	1	(parabol$3) and S50	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/10/05 15:00

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S32	193	((parabol$3) same (optic$3 light$3) same touch$3 same (surface fac$3))	US-PGPUB; USPAT	OR	OFF	2019/02/01 10:20
S33	181	S32 and @ad<"20161207"	US-PGPUB; USPAT	OR	OFF	2019/02/01 10:21
S34	29	S33 and (G06F3/0421 G06F2203/04103)	US-PGPUB; USPAT	OR	OFF	2019/02/01 10:22

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Inventor	:	Aleksander Kocovski
App. No.	:	16/403283
Filed	:	May 3, 2019
For	:	TOUCH DEVICE
Examiner	:	Lam, Vinh Tang
Art Unit	:	2621
Conf. No.	:	5417

RESPONSE TO OFFICE ACTION DATED MARCH 26, 2020

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Commissioner:

In response to the Office Action mailed March 26, 2020, the Applicant respectfully requests the above-identified application be amended as follows:

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AMENDMENTS TO THE CLAIMS

The following listing of claims replaces all prior versions thereof. Changes are shown below in highlighted form, where insertions appear as underlined text (e.g., insertions) while deletions appear as strikethrough text (e.g., ~~deletions~~) or double brackets (e.g., [[deletions]]).

1. (Canceled)

2. (Currently Amended) A touch sensing apparatus having a long edge and a short edge, the touch sensing apparatus comprising:

a display panel;

a plate including a touch surface;

a plurality of emitters arranged around a portion of the periphery of the plate and configured to emit light across the touch surface of the plate,

a plurality of detectors arranged around a portion of the periphery of the plate and configured to receive light from the plurality of emitters, and

a frame assembly, the frame assembly comprising;

a first frame element configured to support the display panel;

a second frame element arranged around the periphery of the plate and configured to support the plurality of emitters and plurality of detectors,

wherein the second frame element including a first surface arranged against an edge of the plate and a second surface arranged parallel to the touch surface,

the touch surface including:

a first edge and a second edge parallel to the short edge; and

a third edge and a fourth edge parallel to the long edge;

wherein ~~a first plane defined by~~ the touch surface is curved with respect to a second plane defined by the short edge and the long edge; and

wherein a distance between a first line in the ~~first plane~~ touch surface and the second plane varies according to a parabolic function.

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3. (Previously Presented) The touch sensing apparatus of claim 2, wherein the plurality of emitters is configured to emit light to propagate over the touch surface.

4. (Previously Presented) The touch sensing apparatus of claim 2, wherein the plurality of emitters is configured to emit light through the plate by total internal reflection.

5. (Previously Presented) The touch sensing apparatus of claim 2, further comprising a processing element configured to determine, based on output signals of the plurality of detectors, a position of an object on the touch surface.

6. (Previously Presented) The touch sensing apparatus of claim 2, wherein the plate has a first curvature prior to installation and, when assembled, the plate is induced into having a second curvature greater than the first curvature.

7. (Previously Presented) The touch sensing apparatus of claim 6, wherein the first curvature and second curvature are measured along an edge of the plate.

8. (Previously Presented) The touch sensing apparatus of claim 6, wherein the first curvature and second curvature are measured along an axis passing through a center point of the plate.

9. (Previously Presented) The touch sensing apparatus of claim 6, wherein the first curvature and second curvature are measured along an axis passing through any position on the plate.

10. (Previously Presented) The touch sensing apparatus of claim 2, further comprising a gasket, wherein the plate is supported by the gasket along an edge of the plate.

11. (Previously Presented) The apparatus of claim 10, wherein the gasket is configured to have varying thickness to match a curvature of the plate along the edge.

12. (Previously Presented) The apparatus of claim 2, wherein the second frame element is curved.

13. (Currently Amended) A touch sensing apparatus comprising:

a display panel;

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a rectangular plate including a touch surface;

a plurality of emitters configured to emit light across the touch surface of the rectangular plate, and

a frame ~~element~~ configured to support the display panel, the rectangular plate, and the plurality of emitters, said frame ~~element~~ comprising:

an edge portion ~~including a longitudinal axis and being~~ configured to contact at least ~~arranged along an edge of the plate between~~ a first corner and a second corner of the rectangular plate,

wherein the edge portion is curved such that a distance between ~~the longitudinal axis of~~ the edge portion and a straight line between the first corner and the second corner varies according to a parabolic function and wherein the curved edge portion is configured to enable curvature in the rectangular plate.

14. (Previously Presented) The touch sensing apparatus of claim 13, wherein the plurality of emitters is configured to emit light to propagate over the touch surface.

15. (Previously Presented) The touch sensing apparatus of claim 13, wherein the plurality of emitters is configured to emit light through the plate by total internal reflection.

16. (Previously Presented) The touch sensing apparatus of claim 13, further comprising a processing element configured to determine, based on output signals of the plurality of detectors, a position of an object adjacent to the touch surface.

17. (Previously Presented) The touch sensing apparatus of claim 13, wherein the plate has a first curvature prior to installation and, when assembled, the frame assembly induces the plate into having a second curvature greater than the first curvature.

18. (Previously Presented) The touch sensing apparatus of claim 17, wherein the first curvature and second curvature are measured along an edge of the plate.

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19. (Previously Presented) The touch sensing apparatus of claim 17, wherein the first curvature and second curvature are measured along an axis passing through a center point of the plate.

20. (Previously Presented) The touch sensing apparatus of claim 17, wherein the first curvature and second curvature are measured along an axis passing through any position on the plate.

21. (Currently Amended) A touch sensing apparatus comprising:

a frame element configured to ~~be arranged along an edge of~~ contact ~~a plate~~ at least a portion of an edge of a plate, said plate including a touch surface;

wherein the frame element includes a curvature along a longitudinal axis of the frame element, and

wherein the curvature of the frame element is configured to induce a corresponding curvature in the plate ~~such that a distance between the touch surface and a straight line parallel to the edge of the plate varies according to a parabolic function~~.

22. (New) The touch sensing apparatus of claim 21, wherein the plate has a first curvature prior to installation and, when assembled, the frame element induces the plate into having a second curvature greater than the first curvature.

23. (New) The touch sensing apparatus of claim 21, wherein a distance between the touch surface and a straight line parallel to the edge of the plate varies according to a parabolic function.

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REMARKS

By way of summary, Claims 2-21 were pending in this application. In the present amendment, Applicant has amended Claims 13 and 21. Applicant thanks the Examiner for the allowable subject matter in Claims 2-12. Claim 2 has been amended solely for the purposes of clarification. Applicant has added Claims 22-23. Accordingly, Claims 2 – 23 remain pending.

Claim Objection

Applicant has amended Claim 13 to resolve the informality as suggested by the Examiner.

Art Based Rejection

The Office Action rejected Claims 13 – 21 as anticipated by Wassvik (2016/0334942). Applicant respectfully disagrees. A non-limiting embodiment corresponding to independent Claim 13 is shown below. Amended Claim 13, recites "an edge portion configured to contact at least a first corner and a second corner of the rectangular plate, wherein the edge portion is curved such that a distance between the edge portion and a straight line between the first corner and the second corner varies according to a parabolic function." As seen in Figure 8 (reproduced below), the "edge portion" 203c is curved with respect to a "straight line" (dotted line in Figure 8).

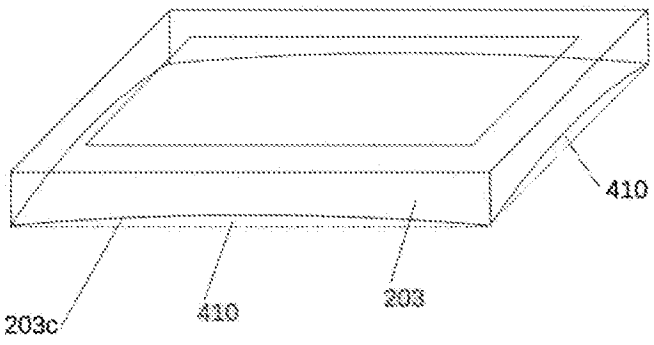


Figure 8

In contrast, Wassvik teaches a filter 20 and a recycler 40 as shown in Figure 10G

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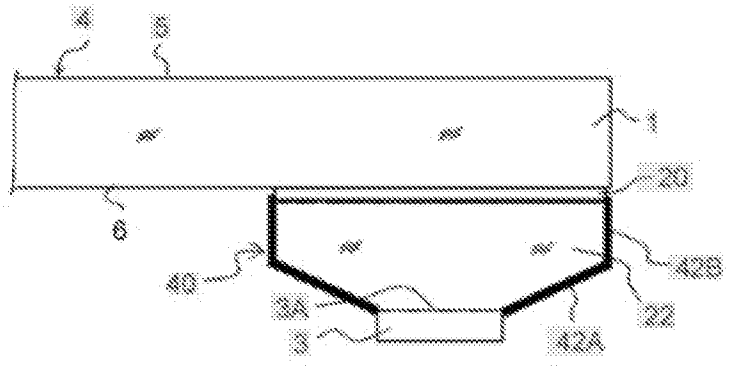


Fig. 10G

Wassvik further mentions that "bottom wall 42A may be parabolic." However, the wall 42A is not "configured to contact at least a first corner and a second corner of the rectangular plate" as recited in Claim 13. Futhermore, the wall 42A is also not "configured to enable curvature in the rectangular plate." Thus, for at least these reasons, Claim 13 is not anticipated by Wassvik.

Independent Claim 21

In contrast to the teachings of Wassvik discussed above, amended Claim 21 recites:

> a frame element configured to contact at least a portion of an edge of a plate, said plate including a touch surface;
> wherein the frame element includes a curvature along a longitudinal axis of the frame element, and
> wherein the curvature of the frame element is configured to induce a corresponding curvature in the plate.

Thus, Claim 21 is not anticipated by Wassvik.

No Disclaimers or Disavowals

Although the present communication may include alterations to the application or claims, or characterizations of claim scope or referenced art, Applicant is not conceding in this application that previously pending claims are not patentable over the cited references. Rather, any alterations or characterizations are being made to facilitate expeditious prosecution of this application. Applicant reserves the right to pursue at a

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later date any previously pending or other broader or narrower claims that capture any subject matter supported by the present disclosure, including subject matter found to be specifically disclaimed herein or by any prior prosecution. Accordingly, reviewers of this or any parent, child or related prosecution history shall not reasonably infer that Applicant has made any disclaimers or disavowals of any subject matter supported by the present application. Further, Applicant's arguments in favor of one independent claim should not be imputed to any other independent claim.

Conclusion

In view of the foregoing amendments and remarks, Applicant respectfully requests that the Examiner withdraw the outstanding rejections and allow the present application. If any issues arise during examination, the Examiner is invited to call the undersigned representative at his direct dial number listed below.

By focusing on specific claims and claim recitations in the discussion above, Applicant does not intend to imply that other claim recitations are disclosed or rendered obvious by the art of record.

Please charge any additional fees, including any fees for additional extension of time, or credit overpayment to Deposit Account No. 11-1410.

Respectfully submitted,

KNOBBE, MARTENS, OLSON & BEAR, LLP

Dated: September 24, 2020

By:/Harnik Shukla/_____
Harnik Shukla
Registration No. 73,097
Registered Practitioner
(949) 760-0404

AMEND

33029766

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Chemtronics Exhibit 1032 Page 675

Electronic Patent Application Fee Transmittal

Application Number:	16403283
Filing Date:	03-May-2019
Title of Invention:	TOUCH DEVICE
First Named Inventor/Applicant Name:	Aleksander Kocovski
Filer:	Harnik Shukla/Jenny Kim
Attorney Docket Number:	FFOG.053C3

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
CLAIMS IN EXCESS OF 20	1202	2	100	200
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Extension - 3 months with $0 paid	1253	1	1400	1400
Miscellaneous:				
			Total in USD ($)	**1600**

Electronic Acknowledgement Receipt

EFS ID:	40660505
Application Number:	16403283
International Application Number:	
Confirmation Number:	5417
Title of Invention:	TOUCH DEVICE
First Named Inventor/Applicant Name:	Aleksander Kocovski
Customer Number:	20995
Filer:	Harnik Shukla/Elizabeth Rutherford
Filer Authorized By:	Harnik Shukla
Attorney Docket Number:	FFOG.053C3
Receipt Date:	24-SEP-2020
Filing Date:	03-MAY-2019
Time Stamp:	17:26:37
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$1600
RAM confirmation Number	E20209NH26566430
Deposit Account	111410
Authorized User	Elizabeth Rutherford

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

37 CFR 1.16 (National application filing, search, and examination fees)

37 CFR 1.17 (Patent application and reexamination processing fees)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		ffog053c3_OAR.pdf	98427 a2656d1f266dca9d050cf6930ee524e72a6eb1d1	yes	8

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Amendment/Req. Reconsideration-After Non-Final Reject	1	1
	Claims	2	5
	Applicant Arguments/Remarks Made in an Amendment	6	8

Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	32428 5ebf2c64a20acb0f49ef2ec4d331269feba00759	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	130855		

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 16/403,283	Filing Date 05/03/2019	☐ To be Mailed

ENTITY: ☑ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $100 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $460 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	09/24/2020	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 22	Minus	** 20	= 2		x $100 =	200
	Independent (37 CFR 1.16(h))	* 3	Minus	*** 3	= 0		x $460 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	200

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	LIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/ALLYSON PURNELL/
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".	
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.	

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT	Application No.	16/403283
	Filing Date	May 3, 2019
	First Named Inventor	Aleksander Kocovski
	Art Unit	2621
(Multiple sheets used when necessary)	Examiner	Lam, Vinh Tang
SHEET 1 OF 1	Attorney Docket No.	FFOG.053C3

U.S. PATENT DOCUMENTS					
Examiner Initials	Cite No.	Document Number *Number - Kind Code (if known)* Example: 1,234,567 B1	Publication Date MM-DD-YYYY	Name	Pages, Columns, Lines Where Relevant Passages or Relevant Figures Appear
	1	9,001,086	04-07-2015	Saini, Amrinder Pal Singh	
	2	10,282,035	05-07-2019	Kocovksi et al.	
	3	2008/0080811	04-03-2008	Deane, Peter	
	4	2011/0141062	06-16-2011	Yu et al.	
	5	2012/0170056	07-05-2012	Jakobsen et al.	
	6	2012/0223916	09-06-2012	Kukulj, Dax	
	7	2013/0300714	11-14-2013	Goh et al.	
	8	2015/0131010	05-14-2015	Sugiyama, Koichi	
	9	2019/0196657	10-08-2019	Skagmo et al.	
	10	2019/0196658	06-27-2019	Skagmo et al.	
	11	2019/0196659	06-27-2019	Skagmo et al.	
	12	2019/0025984	01-24-2019	Weilbacher et al.	
	13	9,207,800	12-08-2015	Eriksson et al.	
	14	2015/0339000	11-26-2014	Lee et al.	
	15	2016/0306501	10-20-2016	Drumm et al.	
	16	2013/0155655	06-20-2013	Lee et al.	

FOREIGN PATENT DOCUMENTS						
Examiner Initials	Cite No.	Foreign Patent Document *Country Code-Number-Kind Code* Example: JP 1234567 A1	Publication Date MM-DD-YYYY	Name	Pages, Columns, Lines Where Relevant Passages or Relevant Figures Appear	T[1]
	17	EP 2325735 A2	05-25-2011	SAMSUNG ELECTRONICS CO LTD		
	18	WO 2016/130074 A1	08-18-2016	FLATFROG LABORATORIES AB		

NON PATENT LITERATURE DOCUMENTS			
Examiner Initials	Cite No.	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T[1]
	19	Extended European Search Report in European Application number 16873465.5, date June 25, 2019 in 9 pages.	

32980490

Examiner Signature	Date Considered

***Examiner:** Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

T[1] - Place a check mark in this area when an English language Translation is attached.

Electronic Patent Application Fee Transmittal

Application Number:	16403283
Filing Date:	03-May-2019
Title of Invention:	TOUCH DEVICE
First Named Inventor/Applicant Name:	Aleksander Kocovski
Filer:	Harnik Shukla/Jenny Kim
Attorney Docket Number:	FFOG.053C3

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
SUBMISSION- INFORMATION DISCLOSURE STMT	1806	1	240	240
		Total in USD ($)		**240**

Electronic Acknowledgement Receipt

EFS ID:	39723668
Application Number:	16403283
International Application Number:	
Confirmation Number:	5417
Title of Invention:	TOUCH DEVICE
First Named Inventor/Applicant Name:	Aleksander Kocovski
Customer Number:	20995
Filer:	Harnik Shukla/Jenny Kim
Filer Authorized By:	Harnik Shukla
Attorney Docket Number:	FFOG.053C3
Receipt Date:	15-JUN-2020
Filing Date:	03-MAY-2019
Time Stamp:	17:51:43
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$240
RAM confirmation Number	E20206EH52357452
Deposit Account	
Authorized User	

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		FFOG053C3_IDS.pdf	47478 a50824c2cdf59397fb67342efb42364d03bf8dbb	yes	3

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Transmittal Letter	1	2
	Information Disclosure Statement (IDS) Form (SB08)	3	3

Warnings:

Information:

2	Fee Worksheet (SB06)	fee-info.pdf	30584 6955eb984a6ad446fe54d974dce56301bdb03b2c	no	2

Warnings:

Information:

Total Files Size (in bytes):	78062

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INFORMATION DISCLOSURE STATEMENT

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For	:	TOUCH DEVICE
Examiner	:	Lam, Vinh Tang
Art Unit	:	2621
Conf. No.	:	5417

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

References and Listing

Pursuant to 37 CFR 1.56, an Information Disclosure Statement listing references is provided herewith. Copies of any listed foreign and non-patent literature references are being submitted.

No Disclaimers

To the extent that anything in the Information Disclosure Statement or the listed references could be construed as a disclaimer of any subject matter supported by the present application, Applicant hereby rescinds and retracts such disclaimer.

Timing of Disclosure

This Information Disclosure Statement is being filed after receipt of a First Office Action, but before the mailing date of a Final Action and before the mailing date of a Notice of Allowance.

This Statement is accompanied by the fees set forth in 37 CFR 1.17(p). The Commissioner is hereby authorized to charge any additional fees which may be required or to credit any overpayment to Account No. 11-1410.

Respectfully submitted,

KNOBBE, MARTENS, OLSON & BEAR, LLP

Dated: June 15, 2020

By:/Harnik Shukla/_____
Harnik Shukla
Registration No. 73,097
Registered Practitioner
(949) 760-0404

32982531

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 688

INFORMATION DISCLOSURE STATEMENT BY APPLICANT	Application No.	16/403283
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	First Named Inventor	Aleksander Kocovski
	Art Unit	2621
(Multiple sheets used when necessary)	Examiner	Lam, Vinh Tang
SHEET 1 OF 1	Attorney Docket No.	FFOG.053C3

U.S. PATENT DOCUMENTS					
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	3	2008/0080811	04-03-2008	Deane, Peter	
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32980490

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***Examiner:** Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

T[1] - Place a check mark in this area when an English language Translation is attached.

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 325 735 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
25.05.2011 Bulletin 2011/21

(51) Int Cl.:
G06F 3/042 *(2006.01)*

(21) Application number: **10189924.3**

(22) Date of filing: **04.11.2010**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(30) Priority: **23.11.2009 KR 20090113392**

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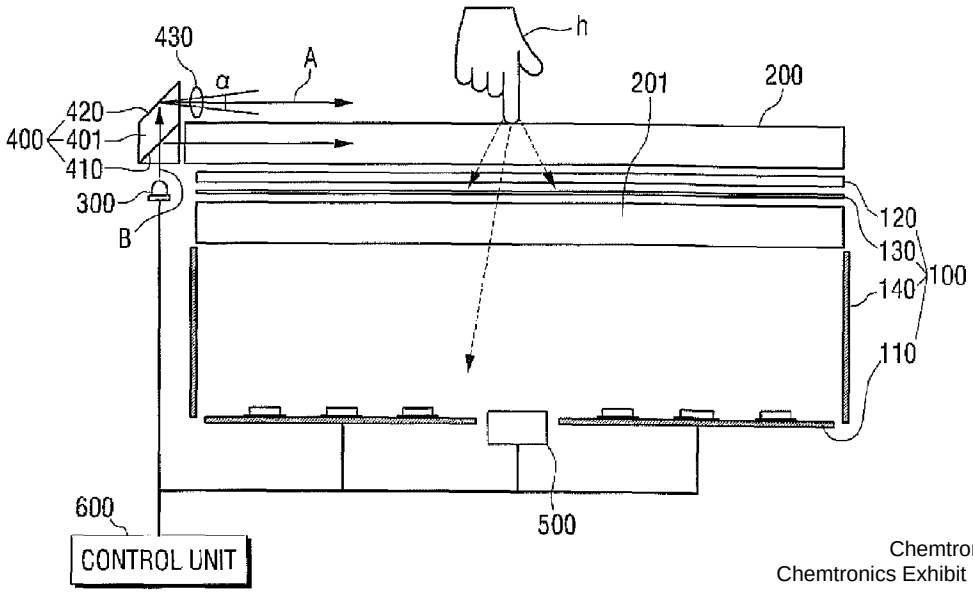
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(54) Multi-touch detecting apparatus and method for LCD display apparatus

(57) A multi-touch detecting apparatus includes a liquid crystal display (LCD) module which includes an LCD panel and a backlight unit (BLU), a plurality of infrared light sources which emits infrared light toward the LCD module, an infrared light detecting camera which is disposed proximate a rear surface of the LCD panel, and detects infrared light reflected from an object on the LCD panel, and a control unit which turns off the BLU when the infrared light detecting camera is turned on.

FIG. 1



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Description

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority from Korean Patent Application No. 10-2009-0113392, filed November 23, 2009 in the Korean Intellectual Property Office, the disclosure of which is incorporated herein by reference in its entirety.

BACKGROUND

1. Field

[0002] Apparatuses and methods consistent with exemplary embodiments relate to a multi-touch detecting of two or more touched positions, for example, on touch screens and electronic blackboards, and more particularly, to a multi-touch detecting applicable to a liquid crystal display (LCD) apparatus.

2. Description of the Related Art

[0003] Touch screen displays are used in portable electronic devices, such as mobile phones, portable multimedia players (PMPs), personal digital assistants (PDAs), and the like. In general, the touch screen technology detects change in voltage or electrical resistance at a point touched by a finger or an object using a single point detecting method. However, the single point detection technology cannot be used with the display apparatuses which detect various inputs at the same time, such as with the electronic blackboards.

[0004] Recently, in order to overcome this shortcoming, multi-touch screen technology to detect the multi-inputs in the projection devices has been developed. The related art multi-touch screen technology methods include a Fourier transform infrared spectroscopy (FTIR) scheme using an infrared light source and an infrared light detecting camera, a Rear Diffused Illumination (Rear-DI) scheme, and an LED-Light Plane (LED-LP) scheme.

[0005] In the FTIR scheme, a plurality of infrared light sources is disposed on the edge of a touch screen. Infrared light emitted from the infrared light sources moves within the interior of a transparent panel which is in contact with a finger of a user. When the infrared light is scattered at a point touched by the finger, an infrared light detecting camera disposed under the transparent panel detects the scattered and reflected infrared light, so that the presence of the touch can be detected. The amount of scattered infrared light correlates with an area touched by the finger.

[0006] In the FTIR scheme, an area touched by the finger is comparatively easily detected since the infrared light is scattered around the center of the area touched by the finger. Accordingly, the center of the touched area can be measured easily and quickly. However, if the finger which is in contact with the transparent panel drags itself on the transparent panel, an area touched by the finger is altered. Accordingly, the amount of scattered infrared light detected by the infrared light detecting camera may be reduced, and the detection capability of the infrared light detecting camera may be diminished. Therefore, it may be difficult to track points touched by the finger through the camera vision processing. In order to solve this problem, a compliant layer may be disposed on the front surface of a transparent panel. However, to have such layer added to the LCD apparatuses is not desirable and difficult to implement.

[0007] In the Rear-DI scheme, an infrared light source and an infrared light detecting camera to detect infrared light emitted from the infrared light source are disposed on the same plane. The infrared light detecting camera detects infrared light reflected by a touch by a finger or an object and detects a touched point. However, in an LCD apparatus, a plurality of optical sheets is piled in an LCD module, so that the infrared light is attenuated while going through the optical sheets. Thus, the detection capability of the infrared light detecting camera may be diminished unless the optical sheets are modified. This makes it difficult to apply the Rear-DI structure to LCD apparatuses.

[0008] The LED-LP scheme is a modification of the FTIR scheme. In LED-LP scheme, the infrared light moves along the front surface of the transparent panel. Under this structure, the shortcoming of the FTIR scheme in tracking the points touched by the finger can be overcome, but it is difficult to detect the center of a point touched by the finger, similar to the Rear-DI scheme.

[0009] As described above, the FTIR, Rear-DI, and LED-LP schemes are technologies related to a multi-touch detecting apparatus which can be applied to a projection system. However, it is difficult to apply these schemes to an LCD system in the same manner.

[0010] Further, in the LCD system, an LCD panel does not have a light emitting function, so a backlight unit (BLU) using cold cathode fluorescent lamps (CCFLs) or light emitting diodes (LEDs) is used. However, since the BLU has an invisible IR band which overlaps with a near IR band of 650nm or more and an IR band 800nm or more, the BLU may operate as a background noise for an infrared light detecting camera. Furthermore, the camera contrast ratio of the infrared light detecting camera may be reduced due to the light emitted by the BLU.

[0011] Therefore, there is a need for a multi-touch detecting apparatus and method which can be applied to an LCD apparatus and avoid influence of a BLU.

SUMMARY

[0012] Exemplary embodiments address at least the above problems and/or disadvantages and other disadvantages not described above. Also, an exemplary embodiment is not required to overcome the disadvantages described above, and an exemplary embodiment may

not overcome any of the problems described above.

[0013] An aspect of an exemplary embodiment provides a multi-touch detecting apparatus and method which can be applied to an LCD apparatus and avoid influence of a BLU.

[0014] According to an aspect of an exemplary embodiment, there is provided a multi-touch detecting apparatus including an LCD module which includes an LCD panel and a BLU, a plurality of infrared light sources which emit infrared light toward the LCD module, an infrared light detecting camera which is disposed under the LCD panel, and detects infrared light reflected from an object on the LCD panel, and a control unit which turns off the BLU when the infrared light detecting camera is turned on.

[0015] The multi control unit may control on-timing of the BLU using an off signal of the infrared light detecting camera as a trigger signal.

[0016] The LCD module may include a transparent panel, which is touched by a user, at an uppermost surface thereof, and the infrared light sources may emit the infrared light parallel to an inside and a surface of the transparent panel.

[0017] The multi-touch detecting apparatus may further include an optical unit which is disposed on a light path of the infrared light sources and moves the infrared light emitted from the infrared light sources so as to be parallel to an inside and a surface of the transparent panel.

[0018] The optical unit may include a beam splitter which reflects the infrared light incident from the infrared light sources so as to separately go through the inside and the surface of the transparent panel, and a collimate member which is disposed on one of a light incident surface and a light emergent of the beam splitter so as to secure straightness of the infrared light.

[0019] There is at least one infrared light detecting camera at the BLU, and the at least one infrared light detecting camera is disposed in the center of the BLU. As the case may be, two or three infrared light detecting cameras may be disposed at the BLU at regular intervals.

[0020] According to an aspect of an exemplary embodiment, the beam splitter may include a first surface which reflects infrared light having a first wavelength and transmits infrared light having the remaining wavelength, and a second surface which reflects all incident light, and the beam splitter may allow the infrared light having the first wavelength to go through the inside of the transparent panel and allow the infrared light having the remaining wavelength to move parallel along the surface of the transparent panel.

[0021] According to an aspect of another exemplary embodiment, the beam splitter may include a first surface which transmits infrared light having a first wavelength and reflects infrared light having the remaining wavelength, and a second surface which reflects all incident light, and the beam splitter may allow the infrared light having the first wavelength to go through the inside of the transparent panel and allow the infrared light having the remaining wavelength to move parallel along the surface of the transparent panel.

[0022] According to an aspect of another exemplary embodiment, the infrared light sources may be arranged around the transparent panel on a plurality of lines. The infrared light sources include a first line to move the infrared light in the inside of the transparent panel, and a second line to move the infrared light on the surface of the transparent panel.

[0023] According to an aspect of another exemplary embodiment, the BLU may use a direct-type lighting method, and the infrared light sources may be disposed on the same plane as the BLU and be formed in two-dimensional arrays so as to have regular intervals with light sources of the BLU.

[0024] According to an aspect of another exemplary embodiment, the BLU may use an edge-type lighting method, and the multi-touch detecting apparatus may further include a reflection unit which reflects infrared light reflected from the object toward the infrared light detecting camera.

[0025] The reflection unit may include a first reflection mirror which reflects infrared light which penetrates the backlight units and is reflected from the object, and a second reflection mirror which reflects the infrared light reflected from the first reflection mirror toward the infrared light detecting camera.

[0026] The infrared light detecting camera may be disposed separately from the BLU.

[0027] The infrared light sources, according to exemplary embodiments, may be disposed on a single side of the transparent panel, on two sides of the transparent panel facing each other, or on four sides of the transparent panel.

[0028] The infrared light sources may be turned on or off concurrently in association with the infrared light detecting camera.

[0029] The infrared light sources may have a horizontal light angle of the infrared light larger than a vertical light angle with respect to the transparent panel.

[0030] The transparent panel may be a transparent acrylic material or a hardened protection glass, and the LCD module may include a white reflector which is disposed at a wall thereof and focuses light of the BLU.

[0031] According to an aspect of another exemplary embodiment, there is provided a multi-touch detecting method including emitting infrared light from an infrared light source toward an LCD module including a BLU, turning on an infrared light detecting camera and turning off the BLU, detecting infrared light reflected from an object on the LCD module, and turning off the infrared light detecting camera and turning on the BLU.

[0032] The emitting the infrared light may include guiding the emitted infrared light to an inside and a surface of a transparent panel which is disposed on the LCD module including the BLU, and in the emitting the infrared light, when the infrared light detecting camera is turned

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on, the infrared light source may be turned on.

[0033] When the infrared light detecting camera is turned off, the infrared light source may be turned off.

[0034] The timing when the infrared light detecting camera is turned on may depend on an amount of infrared light which is scattered and incident from the infrared light source, and an amount of adjacent noise, and an on-off period of the BLU may be greater than at least 30Hz.

[0035] According to one or more exemplary embodiments, the multi-touch detecting apparatus can provide optical design capable of supporting both the FTIR scheme and the LED-LP scheme, and thus support dynamic finger movement detection as well as static finger movement detection.

[0036] In addition, the multi-touch detecting apparatus can detect an infrared light detecting signal without interference with an optical sheet, a transparent panel, a backlight unit, and a white reflector which are installed in the LCD module.

[0037] Furthermore, the period in which the infrared light detecting camera is exposed changes in association with on-off operation of the BLU, so the multi-touch detecting apparatus does not receive influence by the BLU. Therefore, precise position tracking of a touch point can be enabled.

BRIEF DESCRIPTION OF THE DRAWINGS

[0038] The above and/or other aspects will be more apparent by describing certain exemplary embodiments with reference to the accompanying drawings, in which:

FIG. 1 is a schematic perspective view of a multi-touch detecting apparatus according to an exemplary embodiment;

FIG. 2 is a schematic perspective view of a multi-touch detecting apparatus according to an exemplary embodiment;

FIG. 3 is a schematic perspective view of a multi-touch detecting apparatus according to an exemplary embodiment;

FIG. 4 is a schematic perspective view of a multi-touch detecting apparatus according to an exemplary embodiment;

FIG. 5 is a schematic perspective view of a multi-touch detecting apparatus according to an exemplary embodiment;

FIG. 6 is a graph illustrating on-off control of an infrared light source, an infrared light detecting apparatus, and a BLU of the multi-touch detecting apparatuses according to an exemplary embodiment; and

FIG. 7 is a flow chart illustrating a multi-touch detecting method according to an exemplary embodiment.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0039] Certain exemplary embodiments are described in greater detail below with reference to the accompanying drawings.

[0040] In the following description, like drawing reference numerals are used for the like elements, even in different drawings. The matters defined in the description, such as detailed construction and elements, are provided to assist in a comprehensive understanding of exemplary embodiments. However, exemplary embodiments can be practiced without those specifically defined matters.

[0041] FIG. 1 illustrates an example of a multi-touch detecting apparatus according to an exemplary embodiment.

[0042] As illustrated in FIG. 1, the multi-touch detecting apparatus may include an LCD module 100, a transparent panel 200, an infrared light source 300, an optical unit 400, an infrared light detecting camera 500, and a control unit 600. Although the multi-touch detecting apparatus illustrated in a horizontal position for convenience of explanation, it should understood that the multi-touch detecting apparatus may be disposed in a vertical position.

[0043] The LCD module 100 may include a BLU 110, an LCD panel 120, a filter layer 130, and a white reflector 140. The BLU 110 may use a direct-type lighting method using a CCFL or a plurality of LEDs, as illustrated in FIGS. 1 to 3, or may use an edge-type lighting method using a plurality of LEDs disposed at the edge-type of a light guide plate, as illustrated in FIG. 5. The filter layer 130 is interposed between the LCD panel 120 and the BLU 110 to transmit light emitted from the BLU 110 toward the LCD panel 120 uniformly. The white reflector 140 is used for the LCDy module 100 having the direct-type light BLU 110, as illustrated in FIGS. 1 to 3, to guide the light emitted from the BLU 110 to the LCD panel 120. If there is no white reflector 140, some or most of the emitted light, which is not transmitted directly to the LCD panel 120, may become a light loss and, thus, the brightness of the display apparatus may decrease. Therefore, the white reflector 140 is installed when the direct-type light BLUs are used.

[0044] The transparent panel 200 is disposed on the front surface of the LCD module 100 to prevent damage of the LCD module 100 and enable a user to touch a screen displayed on the LCD module 100. The transparent panel 200 may be formed of a transparent acrylic material, or of a material such as a hardened protection glass. The transparent panel 200 may be spaced a predetermined distance apart from the LCD panel 120 to be prevented from being deformed by heat of the LCD panel 120. In addition, if the transparent panel 200 is spaced a predetermined distance apart from the LCD panel 120, the problem of damaging the LCD panel 120 caused when the transparent panel 200 is touched by a finger and becomes in contact with the LCD panel 120, can be prevented.

[0045] A lower transparent panel 201 formed of the same material as the transparent panel 200 may be

formed proximate a rear surface of the LCD panel 120 to be spaced a predetermined distance apart from the LCD panel 120. The lower transparent panel 201 supports the LCD panel 120 and the filter layer 130 disposed proximate the rear surface of the LCD panel 120, and may be formed of a hardened protection glass. For example, the lower transparent panel 201 may be formed of a transparent material.

[0046] A plurality of infrared light sources 300 may be arranged at regular intervals along a single line or two lines. Since the LCD module 100 has a square shape in general, the infrared light sources 300 may be disposed around the transparent panel 200 on the LCD module 100 or proximate the LCD module 100. The infrared light sources 300 may be disposed at one side of the transparent panel 200, at two opposite sides facing each other, or at four sides.

[0047] The direction in which the infrared light sources 300 emit the infrared light can be implemented in various ways according to an exemplary embodiment. Design and presence of the optical unit 400 depend on the infrared light emitting direction and arrangement of the infrared light sources 300. Detailed description is provided below.

[0048] The infrared light sources 300 may have a horizontal light angle greater than a vertical light angle(α) with respect to the direction of the infrared light shown by an arrow A moving along a lengthwise direction of the transparent panel 200 in FIG. 1. With this structure, the infrared light which propagates in the interior of the transparent panel 200 or along the front surface of the transparent panel 200 may be substantially parallel to the lengthwise direction of the transparent panel 200, so that the detection of an object (h), such as the finger of the user, which is in contact with the transparent panel 200 can be effectively performed. The greater the horizontal light angle, the fewer the number of infrared light sources 300 may be used. However, if the horizontal light angle is excessively large, the detection capability may be reduced. Therefore, the horizontal light angle may be smaller and the appropriate number of infrared light sources 300 may be used.

[0049] The optical unit 400 directs the infrared light emitted from the infrared light sources 300 to propagate through the interior of the transparent panel 200 and along the front surface of the transparent panel 200 at the same time. While the infrared light propagates through the interior of the transparent panel 200 and along the front surface of the transparent panel 200 in this manner at the same time, the infrared light propagating through the interior of the transparent panel 200 is scattered around a touch point of an object touching the transparent panel 200 and is used to detect the static movement caused by the finger. The infrared light propagating in parallel along the front surface of the transparent panel 200 is scattered at the contour line of the touch point of an object touching the transparent panel 200 and is used to detect tracking of the dynamic movement caused by the finger.

[0050] A reflection surface of the optical unit 400 is set according to the direction and arrangement of the infrared light sources 300. If the infrared light sources 300 are arranged on a plurality of lines, the optical unit 400 may be omitted. However, the optical unit 400 may be provided to reduce the number of infrared light sources 300. If the optical unit 400 is used, the number of infrared light sources 300 may be reduced approximately in half as compared with the case that the optical unit 400 is not used.

[0051] The optical unit 400 may include a beam splitter 401 and a collimating member 430. The collimating member 430 may include a collimating function sheet, or may be implemented as a collimating lens. The beam splitter 401 may include a first surface 410 and a second surface 420. The reflection and penetration properties of the first and second surfaces 410 and 420 depend on the arrangement and emitting direction of the infrared light sources 300.

[0052] For example, in an exemplary embodiment shown in FIG. 1, the infrared light sources 300 emit infrared light upwards in a direction of an arrow B. In this case, the first surface 410 reflects infrared light having a first wavelength of the infrared light emitted from the infrared light sources 300 so that the infrared light having the first wavelength propagates in the interior of the transparent panel 200 and the remaining infrared light penetrates the first surface 410 and propagates toward the second surface 420. The second surface 420 reflects the infrared light incident to the second surface 420 so that the infrared light propagates along the front surface of the transparent panel 200. The infrared light reflected by the second surface 420 passes through the collimating member 430 to become parallel light, and propagates along the front surface of the transparent panel 200, maintaining substantial straightness.

[0053] In an exemplary embodiment shown in FIG. 2, the infrared light sources 300 emit infrared light substantially parallel to the lengthwise direction of the transparent panel 200. In this case, the first surface 410' transmits infrared light having a first wavelength of the infrared light emitted from the infrared light sources 300 so that the infrared light having the first wavelength propagates through the interior of the transparent panel 200. The first surface 410' reflects the remaining infrared light so that the remaining infrared light propagates toward the second surface 420', is reflected by the second surface 420', and propagates along the front surface of the transparent panel 200. The infrared light reflected by the second surface 420' passes through the collimating member 430 to become parallel light, and propagates along the front surface of the transparent panel 200, maintaining substantial straightness.

[0054] For example, the wavelength of the infrared light distinguished by the first surfaces 410 and 410' may be one of 850nm, 880nm, and 940nm.

[0055] If the infrared light sources 300 are arranged

on a plurality of lines or are disposed on the same plane as the BLU 110, the optical unit 400 may be omitted.

[0056] According to exemplary embodiments shown in FIGS. 3 to 5, infrared light sources 300 emit infrared light toward a transparent panel 200 without a separate carrier.

[0057] For example, as shown in FIGS. 3 and 5, infrared light emitted from a first light source array 310 propagates in the interior of the transparent panel 200, and infrared light emitted from a second light source array 320 propagates along the front surface of the transparent panel 200. In this case, an optical unit may be omitted.

[0058] According to an exemplary embodiment shown in FIG. 4, the infrared light sources 300 may be arranged in two-dimensional arrays. In this case, since the infrared light sources 300 and an infrared light detecting camera 500 are disposed on the same plane, an optical unit may be omitted.

[0059] In exemplary embodiments shown in FIGS. 1 to 3, there is a single infrared light detecting camera 500 disposed in the center of the BLU 110 to sense infrared light reflected from an object which is in contact with the surface of the transparent panel 200. Alternatively, two or more infrared light detecting cameras 500 may be disposed behind the transparent panel 200 at regular intervals.

[0060] In an exemplary embodiment of FIG. 5, an infrared light detecting camera 500 installed in an LCD module 100 having edge-type light BLU 110' is disposed on an external wall of the LCD module 100. The BLU 110' uses first and second reflection mirrors 510 and 520, and the thickness of the display apparatus can be reduced. The edge-type light BLU 110' may be slimmer than the direct-type light BLU 110. The infrared light detecting camera 500 may be disposed at a position capable of reducing the thickness of the display apparatus. In an exemplary embodiment, a light path is formed using the first and second reflection mirrors 510 and 520, but this is merely an example. Three or more reflection mirrors may be used, or just a single reflection mirror may be used.

[0061] The control unit 600 concurrently turns on or off the BLU 110, 110', the infrared light sources 300, and the infrared light detecting camera 500, and optimizes the signal-to-noise ratio (SNR) performance.

[0062] That is, at an exposed timing at which the infrared light detecting camera 500 is turned on and detects the infrared light, the control unit 600 turns off the BLU 110, 110'. Accordingly, when the BLU 110, 110' is turned off, the infrared light detecting camera 500 detects infrared light reflected from an object which is in contact with the transparent panel 200. If the infrared light detecting camera 500 is turned off, the control unit 600 turns on the BLU 110, 110'.

[0063] An on-off control trigger signal of the control unit 600 may use an external trigger signal which uses a microcontroller, or may use a signal which is transmitted to the components, such as the infrared light sources 300, the infrared light detecting camera 500, or the BLU 110, 110'.

[0064] The operation of the control unit 600 is described in detail with reference to FIGS. 6 and 7.

[0065] At time sections and shown in the graph 610 of FIG. 6, the BLU 110, 110' is turned on. The infrared light sources 300 and the infrared light detecting camera 500 are turned off as shown in graphs 620 and 630, respectively.

[0066] When the display apparatus starts operating, the control unit 600 turns on the infrared light sources 300 (S10).

[0067] Subsequently, infrared light emitted from the infrared light sources 300 is guided to propagate in the interior of the transparent panel 200 and along the front surface of the transparent panel 200. There are various methods for guiding the infrared light to propagate in the interior of the transparent panel 200 and along the front surface of the transparent panel 200 as described above (S20).

[0068] Using the on-signal of the infrared light sources 300 as a trigger signal, the control unit 600 turns off the BLU 110, 110' and turns on the infrared light detecting camera 500 (S30) as illustrated by the graph 630 at time section , thereby making an exposed state. Accordingly, since the BLU 110, 110' is turned off, infrared light reflected from a finger or an object (h) which is in contact with the surface of the transparent panel 200, can be input to the infrared light detecting camera 500 without interference and disturbance with the infrared band of the BLU 110, 110'.

[0069] If the BLU 110, 110' is turned on and the infrared light detecting camera 500 is turned on, the noise of the near IR band and the IR band included in the light of the BLU 110, 110' may be mixed with the infrared light reflected from the object (h), so that the infrared light detecting camera 500 may not detect a touch point of the object (h) with precision. However, if the BLU 110, 110' is turned off and the infrared light detecting camera 500 is turned on, the noise interference may be mitigated or eliminated.

[0070] In particular, if the infrared light sources 300 are turned on at time section as shown in the graph 620 of FIG. 6, it is possible to emit infrared light having high peak strength, so that the SNR of the infrared light detecting camera 500 can be enhanced during the detection of the touch of the finger or object (h) at time section .

[0071] The length of time section for detecting the finger or the object (h) depends on the amount of infrared light reflected from the finger or the object (h) which is touching the surface of the transparent panel 200, and the amount of noise. The stronger the reflected infrared light, the shorter the detecting time. However, if excessively strong infrared light is used, the infrared light may affect other electronic devices. Therefore, the strength of infrared light may be set appropriately. At time section, since the BLU 110, 110' is turned off, the display apparatus may look dark, so the time section may be set to

be short. Therefore, the strength of infrared light should not be excessively low. The infrared peak strength of the infrared light sources 300 varies according to the system.

[0072] Reiteration of on-off time section may be considered according to the optical-electrical circuit property of the infrared light sources 300, the infrared light detecting camera 500, and the BLU 110, 110'.

[0073] At time section in FIG. 6, if the detection of the infrared light is complete, the control unit 600 turns on the BLU 110, 110' and turns off the infrared light detecting camera 500 (S40).

[0074] Subsequently, the control unit 600 turns off the infrared light sources 300 (S50). The infrared light sources 300 can be controlled to be in a continuous-wave mode in which the infrared light sources 300 are always turned on, but it is not appropriate for the infrared light sources 300 to always emit infrared light. Infrared light is generally used for remote controllers for controlling electronic devices, so if the infrared light sources 300 always emit infrared light, the infrared light may be confused with control signals of other electronic devices and may cause malfunction.

[0075] Subsequently, the infrared light sources 300 are turned on when the infrared light detecting camera 500 is turned on and the BLU 110, 110' is turned off.

[0076] As described above, the BLU 110, 110' is turned on and off periodically. If the on-off period of the BLU 110 is slow, the user may feel the flicker of the screen of the display apparatus. Therefore, the on-off period of the BLU 110 may be set to be fast. For example, the on-off period of the BLU 110, 110' may be set to be faster than 30Hz.

[0077] The foregoing exemplary embodiments and advantages are merely exemplary and are not to be construed as limiting. The present teaching can be readily applied to other types of apparatuses. Also, the description of the exemplary embodiments is intended to be illustrative, and not to limit the scope of the claims, and many alternatives, modifications, and variations will be apparent to those skilled in the art.

Claims

1. A multi-touch detecting apparatus comprising:

   a liquid crystal display (LCD) module which comprises an LCD panel and a backlight unit (BLU);
   a plurality of infrared light sources which emits infrared light toward the LCD module;
   an infrared light detecting camera which is disposed behind the LCD panel and detects infrared light reflected from an object on the LCD panel; and
   a control unit which turns off the BLU when the infrared light detecting camera is turned on.

2. The multi-touch detecting apparatus according to claim 1, wherein the control unit controls on-timing of the BLU using an off signal of the infrared light detecting camera as a trigger signal.

3. The multi-touch detecting apparatus according to claim 1, wherein the LCD module comprises a transparent panel, which is touched by a user, at an uppermost surface thereof.

4. The multi-touch detecting apparatus according to claim 3, wherein the plurality of infrared light sources emits the infrared light parallel to an interior surface and the uppermost surface of the transparent panel.

5. The multi-touch detecting apparatus according to claim 3, further comprising:

   an optical unit which is disposed on a light path of the plurality of infrared light sources and directs the infrared light emitted from the plurality of infrared light sources to be parallel to an interior surface and to the uppermost surface of the transparent panel.

6. The multi-touch detecting apparatus according to claim 5, wherein the optical unit comprises:

   a beam splitter which reflects the infrared light incident from the plurality of infrared light sources so as to separately propagate inside and along the uppermost surface of the transparent panel; and
   a collimating member which is disposed on one of light incident surfaces of the beam splitter so as to secure straightness of the infrared light.

7. The multi-touch detecting apparatus according to claim 6, wherein the beam splitter comprises a first surface which reflects infrared light having a first wavelength and transmits infrared light having remaining wavelengths, and a second surface which reflects all incident light, and allows the infrared light having the first wavelength to propagate through the inside of the transparent panel and allows the infrared light having the remaining wavelengths to propagate parallel along the uppermost surface of the transparent panel.

8. The multi-touch detecting apparatus according to claim 6, wherein the beam splitter comprises a first surface which transmits infrared light having a first wavelength and reflects infrared light having remaining wavelengths, and a second surface which reflects all incident light, and allows the infrared light having the first wavelength to propagate through the inside of the transparent panel and allows the infrared light having the remaining wavelengths to propagate parallel along the uppermost surface of the

transparent panel.

9. The multi-touch detecting apparatus according to claim 1, wherein the infrared light detecting camera is disposed at the BLU.

10. The multi-touch detecting apparatus according to claim 9, wherein the infrared light detecting camera is disposed in a center of the BLU.

11. The multi-touch detecting apparatus according to claim 9, further comprising a plurality of infrared light detecting cameras disposed at the BLU.

12. The multi-touch detecting apparatus according to claim 3, wherein the plurality of infrared light sources comprises a first light source array which emits infrared light parallel along an interior surface of the transparent panel, and a second light source array which is disposed above the first light source array and emits infrared light parallel to the uppermost surface of the transparent panel.

13. The multi-touch detecting apparatus according to claim 1, wherein the BLU uses an edge lighting method, the multi-touch detecting apparatus further comprises a reflection unit which reflects infrared light reflected from the object toward the infrared light detecting camera, the reflection unit comprising:

a first reflection mirror which reflects infrared light which penetrates the backlight unit and is reflected from the object; and
a second reflection mirror which reflects the infrared light reflected from the first reflection mirror toward the infrared light detecting camera, wherein
the infrared light detecting camera is disposed outside the BLU.

14. The multi-touch detecting apparatus according to claim 3, wherein the plurality of infrared light sources is disposed on a single side of the transparent panel.

15. A multi-touch detecting method comprising:

emitting infrared light from an infrared light source toward a liquid crystal display (LCD) module comprising a backlight unit (BLU);
turning on an infrared light detecting camera and turning off the BLU;
detecting infrared light reflected from an object on the LCD module; and
turning off the infrared light detecting camera and turning on the BLU,
wherein the emitting the infrared light comprises guiding the emitted infrared light to an inside and along a surface of a transparent panel which is disposed on the LCD module comprising the BLU, and
wherein in the emitting the infrared light, when the infrared light detecting camera is turned on, the infrared light source is turned on.

FIG. 1

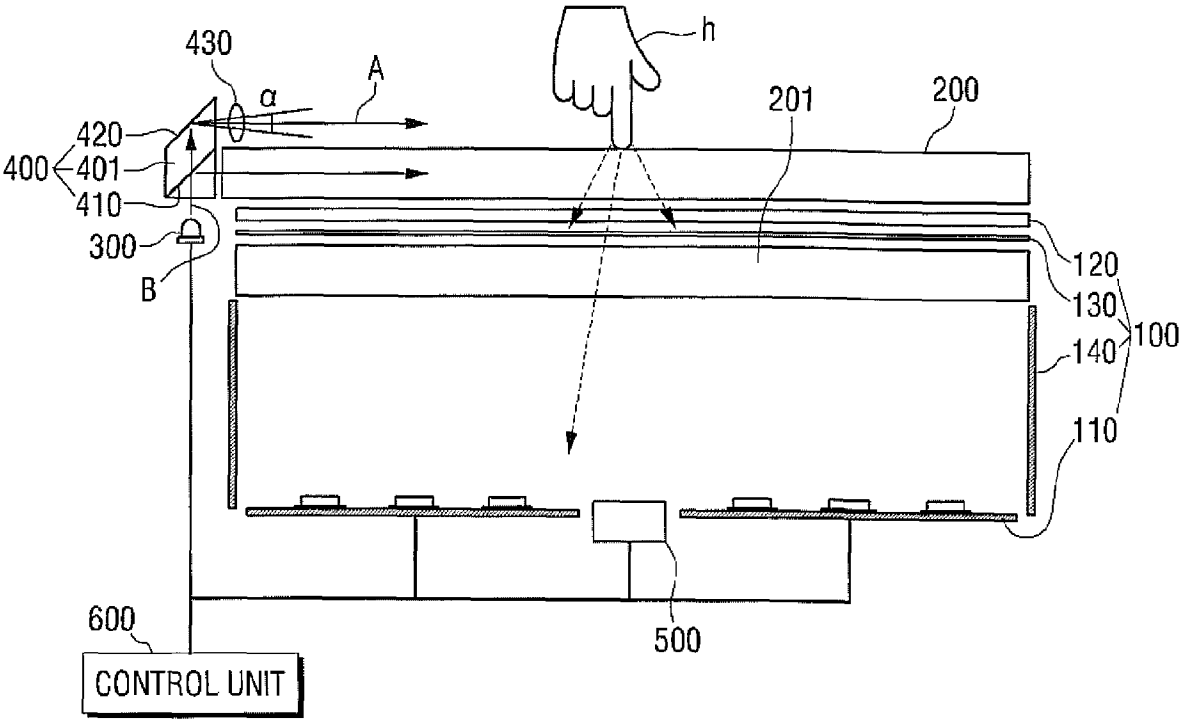

h
430
A
α
201
200
420
400
401
410
300
B
120
130
100
140
110
500
600
CONTROL UNIT

FIG. 2

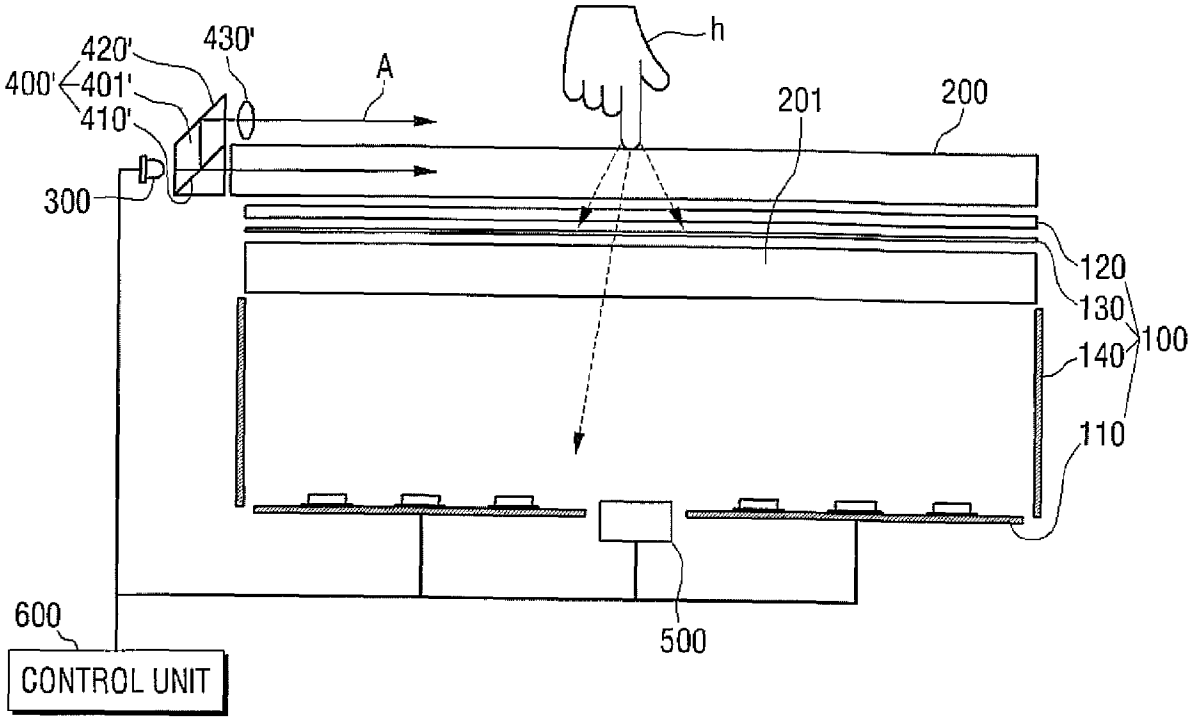

h
420'
430'
400'
401'
410'
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200
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130
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600
500
CONTROL UNIT

FIG. 3

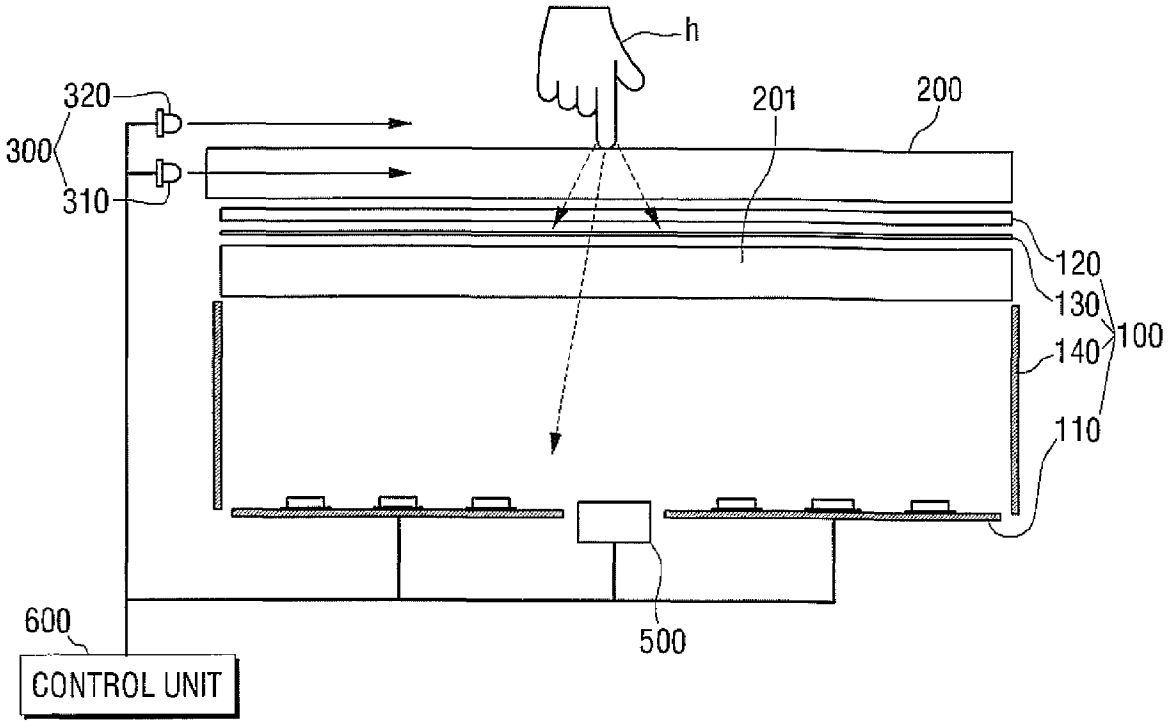


FIG. 4

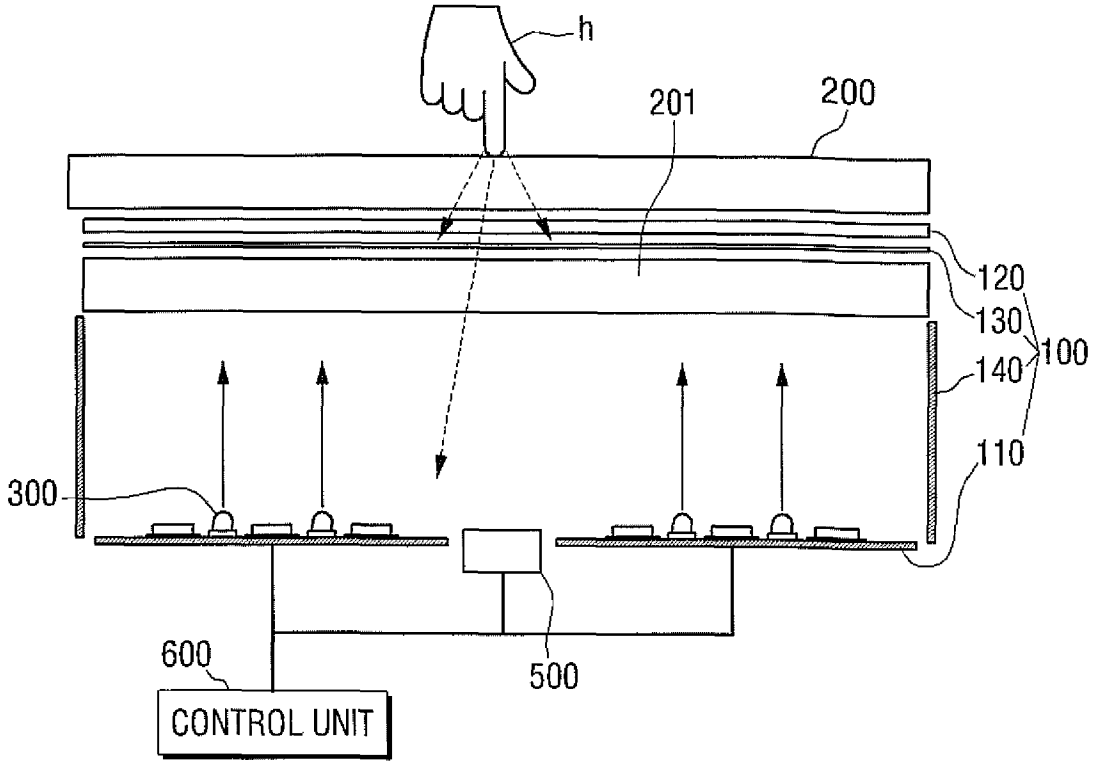


FIG. 5

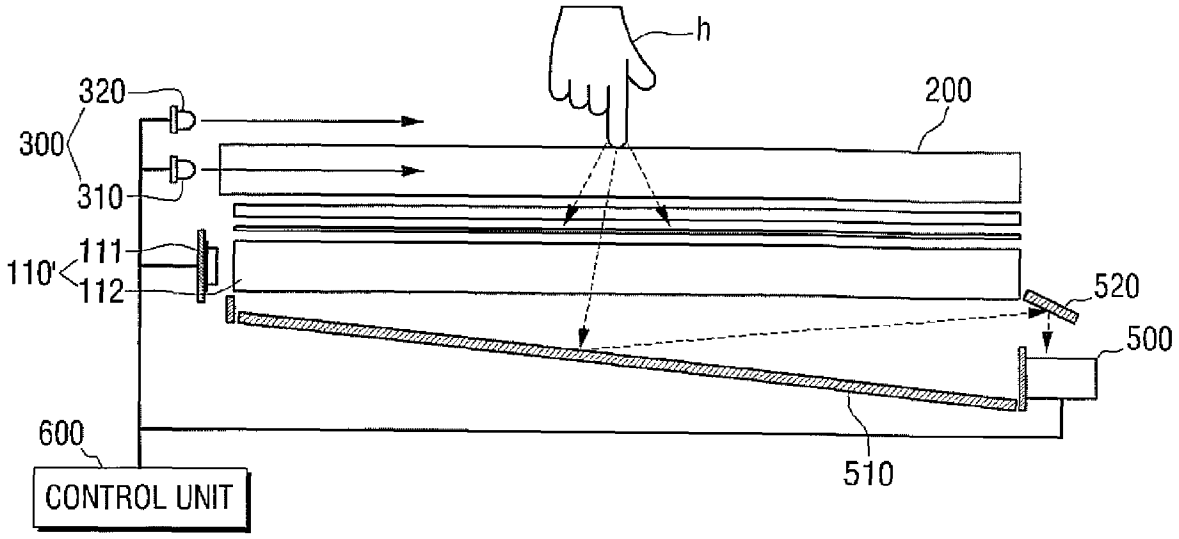


FIG. 6

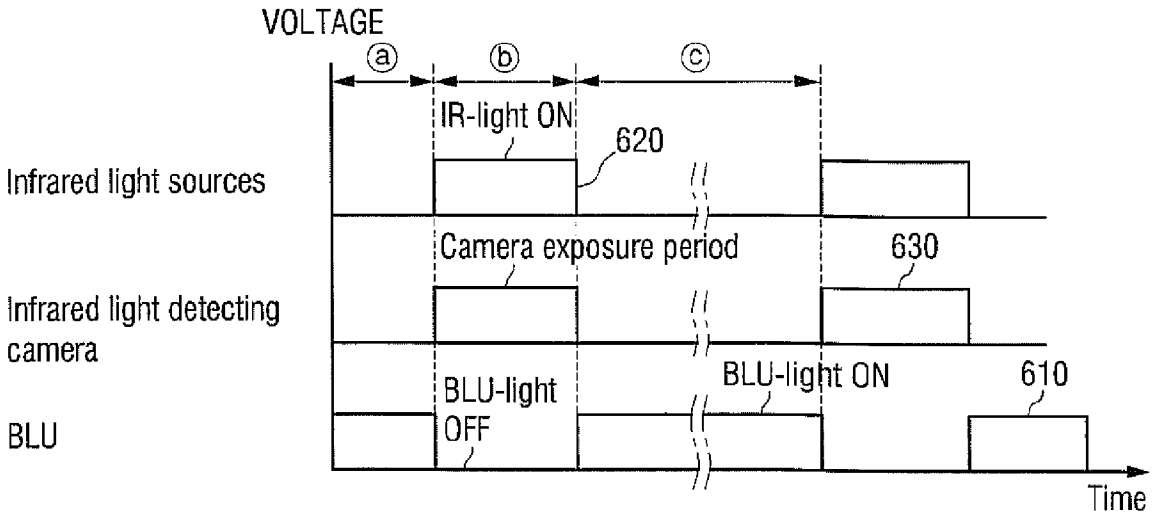
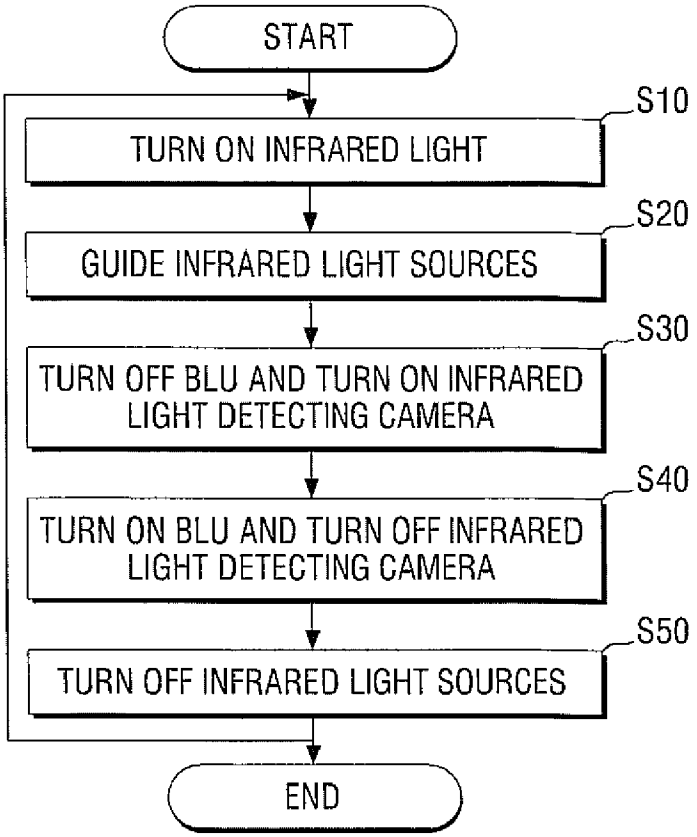

VOLTAGE
ⓐ
ⓑ
ⓒ
IR-light ON
620
Infrared light sources
Camera exposure period
630
Infrared light detecting camera
BLU-light OFF
BLU-light ON
610
BLU
Time

FIG. 7


START
S10
TURN ON INFRARED LIGHT
S20
GUIDE INFRARED LIGHT SOURCES
S30
TURN OFF BLU AND TURN ON INFRARED LIGHT DETECTING CAMERA
S40
TURN ON BLU AND TURN OFF INFRARED LIGHT DETECTING CAMERA
S50
TURN OFF INFRARED LIGHT SOURCES
END

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- KR 1020090113392 **[0001]**

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
18 August 2016 (18.08.2016)

WIPO | PCT

(10) International Publication Number
WO 2016/130074 A1

(51) International Patent Classification:
G06F 3/042 (2006.01)

(21) International Application Number:
PCT/SE20 16/050098

(22) International Filing Date:
9 February 2016 (09.02.2016)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
1550145-5 9 February 2015 (09.02.2015) SE

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available):* AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available):* ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

(54) Title: OPTICAL TOUCH SYSTEM COMPRISING MEANS FOR PROJECTING AND DETECTING LIGHT BEAMS ABOVE AND INSIDE A TRANSMISSIVE PANEL

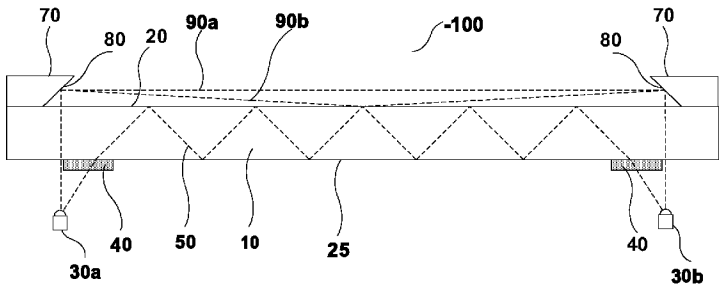


Figure 3

(57) Abstract: An embodiment of the invention provides a touch sensing apparatus, comprising: a light transmissive element (10) that defines a touch surface; a set of emitters (30a) arranged around the periphery of the touch surface to emit beams of light into the light transmissive element, wherein a first portion of the beams (50) of light propagate inside the light transmissive element while illuminating the touch surface such that an object touching the touch surface causes an attenuation of the propagating light, and wherein a second portion of the beams (90) of light pass out of the light transmissive element and are reflected to travel above the touch surface, a set of light detectors (30b) arranged around the periphery of the touch surface to receive light from the set of emitters from the transmissive element and from above the touch surface, wherein each light detector is arranged to receive light from more than one emitter.

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Optical touch system comprising means for projecting and detecting light beams above and inside a transmissive panel

Technical Field

[0001] The present invention generally relates to improved touch determination on touch surfaces of optical touch-sensing systems, and in particular in relation to FTIR-based (frustrated total internal reflection) touch systems.

Background Art

[0002] In one category of touch-sensitive panels known as 'above surface optical touch systems' and known from e.g. US4459476, a plurality of optical emitters and optical receivers are arranged around the periphery of a touch surface to create a grid of intersecting light paths above the touch surface. Each light path extends between a respective emitter/receiver pair. An object that touches the touch surface will block certain ones of the light paths. Based on the identity of the receivers detecting a blocked light path, a processor can determine the location of the intercept between the blocked light paths. This type of system is only capable of detecting the location of one object (single-touch detection). Further, the required number of emitters and receivers, and thus cost and complexity, increases rapidly with increasing surface area and/or spatial resolution of the touch panel.

[0003] In a variant, e.g. shown in WO2006/095320, each optical emitter emits a beam of light that diverges across the touch surface, and each beam is detected by more than one optical receiver positioned around the periphery of the touch surface. Thus, each emitter creates more than one light path across the touch surface. A large number of light paths are created by sequentially activating different emitters around the periphery of the touch surface, and detecting the light received from each emitter by a plurality of optical receivers. Thereby, it is possible to reduce the number of emitters and receivers for a given surface area or spatial resolution, or to enable simultaneous location detection of more than one touching object (multi-touch detection).

[0004] If the display screen is contaminated by e.g. fingerprints, the optical transmission path may become unintentionally interrupted and the information retrieved from the system erroneous or incomplete as the contaminated surface becomes insensitive to touches. If contaminants are collected in front of one of the emitters or detectors there will always be blocked or occluded light paths.

[0005] Another category of touch-sensitive panels known as 'in-glass optical systems' is now described and is also known from e.g. US8581884.

[0006] Figure 1 illustrates an example of a touch-sensitive apparatus 100 that is based on the concept of FTIR (Frustrated Total Internal Reflection), also denoted "FTIR system". The apparatus operates by transmitting light inside a transmissive panel 10, from light emitters 30a to light sensors or detectors

30b, so as to illuminate a touch surface 20 from within the transmissive panel 10. The transmissive panel 10 is made of solid material in one or more layers and may have any shape. The transmissive panel 10 defines an internal radiation propagation channel, in which light propagates by internal reflections.

[0007] In the example of figure 1, the propagation channel is defined between the touch surface 20 and bottom surface 25 of the transmissive panel 10, where the touch surface 20 allows the propagating light to interact with touching object 60 and thereby defines the touch surface 20. This is achieved by injecting the light into the transmissive panel 10 via coupling element 40 such that the light is reflected by total internal reflection (TIR) in the touch surface 20 as it propagates through the transmissive panel 10. The light may be reflected by TIR on the bottom surface 25 or against a reflective coating thereon. Upon reaching coupling element 40 on a far side of the panel, the light is coupled out of transmissive panel 10 and onto detectors 30b. The touch-sensitive apparatus 100 may be designed to be overlaid on or integrated into a display device or monitor.

[0008] US8553014 describes an attempt to combine the above surface and in-glass optical systems described above. US8553014 describes an optical coupling technique for introducing light into a transmissive panel and above a transmissive panel simultaneously. However, the in-coupling component shown in figure 126 of US8553014 is a complex prism and appears to rely on total internal reflection and diffraction to couple the light above the touch surface. Such an arrangement would be highly tolerance sensitive, making the optical signal highly sensitive to, for example, the load on the touch surface, the tolerances of process used to mount the prism to the transmissive panel, and the manufacturing of both the transmissive panel and the prism. Furthermore, the spread of the light in a plane parallel to the transmissive panel is limited to a range of less than 80 degrees as light outside this range will be diffracted up and away from the panel. Such a system is best suited to a rectangular grid of detection lines, such as described in US4459476 above. Furthermore, a complex prism as described in US8553014 would be both expensive to manufacture and bulky, taking up valuable space underneath and to the side of the transmissive panel.

Summary of invention

[0009] It is an objective of the invention to at least partly overcome one or more of the above-identified limitations of the prior art.

[001 0] One or more of these objectives, as well as further objectives that may appear from the description below, are at least partly achieved by means of a method for data processing, a computer readable medium, devices for data processing, and a touch-sensing apparatus according to the

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independent claims, embodiments thereof being defined by the dependent claims.

[001 1] An embodiment of the invention provides a touch sensing apparatus, comprising: a light transmissive element that defines a touch surface; a set of emitters arranged around the periphery of the touch surface to emit beams of light into the light transmissive element, wherein a first portion of the beams of light propagate inside the light transmissive element while illuminating the touch surface such that an object touching the touch surface causes an attenuation of the propagating light, and wherein a second portion of the beams of light pass out of the light transmissive element and are reflected to travel above the touch surface, a set of light detectors arranged around the periphery of the touch surface to receive light from the set of emitters from the transmissive element and from above the touch surface, wherein each light detector is arranged to receive light from more than one emitter; a processing element configured to determine, based on output signals of the light detectors, a light energy value for each light path; to generate a transmission value for each light path based on the light energy value; and to operate an image reconstruction algorithm on at least part of the thus-generated transmission values so as to determine the position of the object on the touch surface.

Brief description of drawings

[0012] Embodiments of the invention will now be described in more detail with reference to the accompanying schematic drawings.

[0013] Figure 1 shows a cross section of an FTIR-based touch-sensitive apparatus according to the prior art.

[0014] Figure 2 is a top plan view of an FTIR-based touch-sensitive apparatus.

[001 5] Figure 3 shows a section view of an extended FTI R touch system according to an embodiment of the present invention.

[0016] Figure 4 shows a top plan view of an extended FTIR touch system according to an embodiment of the present invention.

[0017] Figure 5 shows the narrow detection lines within transmissive panel 10.

[0018] Figure 6 shows the broad detection lines above transmissive panel 10.

[001 9] Figure 7 shows the signal profile of detection lines 95 and detection lines 96.

[0020] Figure 8 shows an embodiment of the present invention in which the touch surface is curved.

[0021] Figure 9 shows an embodiment of the present invention with deflectors set back from the edge of the active area.

[0022] Figure 10 shows an embodiment of the present invention having a dust shield.

[0023] Figure 11 shows an embodiment of the present invention having a first set of emitters and detectors for projecting light above transmissive panel 10

and a second set of emitters and detectors for projecting light into transmissive panel 10.

[0024] Figure 12 shows a top plan view of the Figure 11.

[0025] Figure 13 shows a variation of figure 11 wherein the emitters are configured to simultaneously project light above and into transmissive panel 10.

[0026] Figure 14 shows a variation of figure 11 wherein the detectors are configured to simultaneously receive light from above and from within transmissive panel 10.

Description of embodiments

[0027] Before describing embodiments of the invention, a few definitions will be given.

[0028] A "touch object" or "touching object" is a physical object that touches, or is brought in sufficient proximity to, a touch surface so as to be detected by one or more sensors in the touch system. The physical object may be animate or inanimate.

[0029] An "interaction" occurs when the touch object affects a parameter measured by the sensor.

[0030] A "touch" denotes a point of interaction as seen in the interaction pattern.

[0031] Throughout the following description, the same reference numerals are used to identify corresponding elements.

Main Embodiment

[0032] Figure 2 illustrates a top plan view of figure 1 in an example of a touch-sensitive apparatus 100 that is based on the concept of FTIR. Emitters 30a are distributed around the periphery of touch surface 20, to project light into the transmissive panel 10 such that at least part of the light is captured inside the transmissive panel 10 for propagation by internal reflection in the propagation channel. Detectors 30b are distributed around the periphery of touch surface 20, to receive part of the propagating light. The light from each of emitters 30a will thereby propagate inside the transmissive panel 10 to a number of different detectors 30b on a plurality of light paths D.

[0033] Even if the light paths D correspond to light that propagates by internal reflections inside the panel 1, the light paths D may conceptually be represented as "detection lines" that extend across the touch surface 20 to the periphery of touch surface 20 between pairs of emitters 30a and detectors 30b, as shown in figure 2. Thus, the detection lines D correspond to a projection of the light paths D onto the touch surface 20. Thereby, the emitters 30a and detectors 30b collectively define a grid of detection lines D ("detection grid") on the touch surface 20, as seen in a top plan view. The spacing of intersections in the detection grid defines the spatial resolution of the touch-sensitive apparatus 100, i.e. the smallest object that can be detected on the touch surface 20. The width of the detection line is a

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function of the width of the emitters and corresponding detectors. A wide detector detecting light from a wide emitter provides a wide detection line with a broader surface coverage, minimising the space in between detection lines which provide no touch coverage. A disadvantage of broad detection lines may be the reduced touch precision and lower signal to noise ratio.

[0034] As used herein, the emitters 30a may be any type of device capable of emitting radiation in a desired wavelength range, for example a diode laser, a VCSEL (vertical-cavity surface-emitting laser), an LED (light-emitting diode), an incandescent lamp, a halogen lamp, etc. The emitters 30a may also be formed by the end of an optical fiber. The emitters 30a may generate light in any wavelength range. The following examples presume that the light is generated in the infrared (IR), i.e. at wavelengths above about 750 nm. Analogously, the detectors 30b may be any device capable of converting light (in the same wavelength range) into an electrical signal, such as a photo-detector, a CCD device, a CMOS device, etc.

[0035] The detectors 30b collectively provide an output signal, which is received and sampled by a signal processor 130. The output signal contains a number of sub-signals, also denoted "projection signals", each representing the energy of light received by one of light detectors 30b from one of light emitters 30a. Depending on implementation, the signal processor 130 may need to process the output signal for separation of the individual projection signals. The projection signals represent the received energy, intensity or power of light received by the detectors 30b on the individual detection lines D. Whenever an object touches a detection line D, the received energy on this detection line is decreased or "attenuated".

[0036] The signal processor 130 may be configured to process the projection signals so as to determine a property of the touching objects, such as a position (e.g. in a x,y coordinate system), a shape, or an area. This determination may involve a straight-forward triangulation based on the attenuated detection lines, e.g. as disclosed in US7432893 and WO201 0/01 5408, or a more advanced processing to recreate a distribution of attenuation values (for simplicity, referred to as an "attenuation pattern") across the touch surface 20, where each attenuation value represents a local degree of light attenuation. The attenuation pattern may be further processed by the signal processor 130 or by a separate device (not shown) for determination of a position, shape or area of touching objects. The attenuation pattern may be generated e.g. by any available algorithm for image reconstruction based on projection signal values, including tomographic reconstruction methods such as Filtered Back Projection, FFT-based algorithms, ART (Algebraic Reconstruction Technique), SART (Simultaneous Algebraic Reconstruction Technique), etc. Alternatively, the attenuation pattern may be generated by adapting one or more basis functions and/or by statistical methods such as Bayesian inversion.

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Examples of such reconstruction functions designed for use in touch determination are found in WO2009/077962, WO201 1/04951 1, WO201 1/139213, WO201 2/050510, and WO201 3/062471 , all of which are incorporated herein by reference.

[0037] In the illustrated example, the apparatus 100 also includes a controller 120 which is connected to selectively control the activation of the emitters 30a and, possibly, the readout of data from the detectors 30b. Depending on implementation, the emitters 30a and/or detectors 30b may be activated in sequence or concurrently, e.g. as disclosed in US8581884. The signal processor 130 and the controller 120 may be configured as separate units, or they may be incorporated in a single unit. One or both of the signal processor 130 and the controller 120 may be at least partially implemented by software executed by a processing unit 140.

[0038] Figure 3 illustrates an embodiment of the invention extending the FTIR system of figure 1 to include touch detection lines above touch surface 20.

[0039] As with figure 1, figure 3 shows an embodiment of the invention in which light travels inside a transmissive panel 10, from light emitters 30a to detectors 30b, so as to illuminate a touch surface 20 from within the transmissive panel 10. The transmissive panel 10 is made of solid material in one or more layers and may have any shape. The transmissive panel 10 defines an internal radiation propagation channel, in which light beam 50 propagates by internal reflections. In figure 3, the propagation channel is defined between the touch surface 20 and bottom surface 25 of the transmissive panel 10, where the touch surface 20 allows the propagating light beam 50 to interact with touching object 60 and thereby defines the touch surface 20. This is achieved by injecting the light into the transmissive panel 10 via coupling element 40 such that the light is reflected by total internal reflection (TIR) in the touch surface 20 as it propagates through the transmissive panel 10. The light beam 50 may be reflected by TIR on the bottom surface 25 or against a reflective coating thereon. Upon reaching coupling element 40 on a far side of the panel, the light is coupled out of transmissive panel 10 and onto detectors 30b. The touch-sensitive apparatus 100 may be designed to be overlaid on or integrated into a display device or monitor.

[0040] Figure 3 further illustrates that a portion of the light emitted by emitters 30a is transmitted through transmissive panel 10 in a manner that does not cause the light to TIR within transmissive panel 10. Instead, the light the light exits transmissive panel 10 through touch surface 20 and is reflected by reflector surface 80 of edge reflector 70 to travel along path 90a in a plane parallel with touch surface 20. The light will then continue until deflected by reflector surface 80 of the edge reflector 70 at an opposing edge of the transmissive panel 10, wherein the light will be deflected back down through transmissive panel 10 and onto detectors 30b. The feature of

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the transmitting the light from the emitters 30a to reflector surface 80 via transmissive panel 10 has a number of advantages over the solutions presented by the prior art. In particular, manufacture of touch-sensitive apparatus 100 becomes significantly less expensive. This feature allows an arrangement where nothing is in contact with the edges of the transmissive panel 10, allowing expensive finishing (where the transmissive panel 10 is formed from glass) to regulate the edges of the glass to be avoided. Furthermore, fastening of the components to the transmissive panel 10 is simplified and optical tolerances are improved.

[0041] Figure 4 shows a top plan view of the embodiment of figure 3. As viewed from above, light beam 50 travelling through transmissive panel 10 originates from where the light is coupled into the transmissive panel 10 by coupling element 40 at in-coupling point 45. Light beam 90 travelling above touch surface 20 (along path 90a, path 90b) originates from reflector surface focal point 80a of reflector surface 80 where the light emitted from emitters 30a and having passed through transmissive panel 10 is reflected across touch surface 20. The distance travelled by the (un-collimated) light from emitters 30a to reflector surface focal point 80a is greater than the distance travelled by the light from emitters 30a to in-coupling point 45. Consequently, the spread of light reflected from the reflector surface focal point 80a is broader than the spread of light entering the transmissive panel 10 at in-coupling point 45. The resulting effect is equivalent to that of using a wider emitter for emitting the above surface light beam 90 than that of light beam 50, travelling inside the glass. A corresponding effect occurs at the detector end, wherein the light arriving at detectors 30b via the above surface route is reflected onto detectors 30b from a broader area than the area of in-coupling point 45, providing the equivalent effect of broader detectors 30b.

[0042] The result is that detection lines derived from light beam 90 are broader than detection lines derived from light beam 50. Figure 5 and figure 6 show the difference in detection lines 95 derived from the light travelling within the glass and detection lines 96 derived from light travelling above the touch surface. In figure 5, detection lines 95 have a width corresponding to the short distance travelled to the in-coupling point 45 from emitters 30a. In figure 6, detection lines 96 have a width corresponding to the extra distance travelled to reflector surface focal point 80a from emitters 30a.

[0043] A stylus and a finger may have very large differences in size (or width as viewed from the perspective of a detection line). A stylus may typically provide a width of 2mm to 5mm, whereas a finger may provide a width of 5mm to 15mm. However, the size of a decoded touch will depend on the convolution of the detection line and the object. It is preferable to have wider detection lines above the glass, both in order to provide better cover the touch surface 20 and to get a broadened stylus interaction, since this may

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increase the resolution. However, broadening of detection lines will reduce the ability to separate two closely spaced touch objects, potentially a key requirement for multi-touch systems.

[0044] Therefore, a solution with different detection line widths above and within the glass is required. Figure 7 shows a signal profile of a narrow detection line overlaid on a wide detection line. Narrow detection lines 95 have a signal profile corresponding to signal profile 150 and wide detection lines 96 have a signal profile corresponding to signal profile 160.

[0045] Since a stylus will usually be used as a single touch object, broader detection lines are possible. Wide detection lines 96 with a width larger than 4 mm and possibly up to 20 mm are advantageous, although 4mm-6mm is preferred.

[0046] For narrow detection lines 95 designed to resolved multiple touching objects such as fingers, broadening must be kept down to a size less than or comparable to the touching objects. The width of narrow detection lines 95 is also usually limited by the width of emitters 30a and detectors 30b. Narrow detection lines 95 should be less than 5mm in width. In a preferred embodiment, detection lines 95 are between 2mm and 3mm wide.

[0047] In one embodiment, reflector surface 80 is a diffusive reflecting surface. In a preferred embodiment, reflector surface 80 is a lambertian diffusive reflecting surface preferably providing a scattering of greater than 90%. Suitable materials for reflector surface 80 may include Titanium oxide paint or Microcellular foamed reflector MCPET. The advantage of using a diffusive reflecting surface is that it makes the optical system less sensitive to production, mounting and load tolerances than a specular reflector or lens. This allows the touch-sensitive apparatus 100 to be cheaper and simpler to produce. Furthermore, a diffusive reflector surface 80 also allows broader and overlapping detection lines.

[0048] The amount of light reflected by reflector surface 80 may be controlled by adjusting the size of reflector surface 80. A reflector surface 80 having a smaller surface area will reflect a small amount of light. Alternatively, paint or spray coatings may be selected to reduce the reflection, and may be applied in a specific pattern to the surface for accurate control of reflectivity.

[0049] In one embodiment, the amount of light received at each of detectors 30b via the in-glass route (shown in the figures as light beam 50) is greater than or equal to the amount of light received at each of detectors 30b via the above surface route (shown in the figures as light beam 90). In a preferred embodiment, the ratio of light received at each of detectors 30b via the in-glass route is ten times greater than the amount of light received at each of detectors 30b via the above surface route. This feature is advantageous as it allows the attenuation of the optical signal resulting from FTIR to be easily compared at the reconstruction phase to the attenuation of the optical

signal resulting from occlusion of the above surface light, even though the latter is usually significantly larger than the former.

[0050] In the embodiment shown in figure 3, reflector surface 80 is configured to reflect a portion of light beam 90 to travel along path 90a and a portion of light beam 90 to travel along path 90b, by reflecting off touch surface 20 and coupling out to the detector. This advantageously results in a larger portion of light beam 90 being detected by detectors 30b. Furthermore, the use of path 90b allows load tolerances of the touch-sensitive apparatus 100 to be improved. A heavy load on touch surface 20 may deform the panel and bring path 90a out of alignment. However, path 90b would likely be less affected by said deformation, allowing sufficient signal to continue to be received by detectors 30b.

[0051] In an embodiment of the invention shown in figure 8, transmissive panel 10 is curved to form a concave surface. In this embodiment, reflector surface 80 is configured to cause a portion of light beam 90 to reflect a plurality of times off touch surface 20 to follow a path 90c shown in figure 8. Similarly to the above embodiment, this feature allows a further enhancement of the signal to noise ratio, even for a curved panel.

[0052] In an embodiment of the invention shown in figure 9, edge reflector 70 is set further back from the periphery of touch surface 20 than in the previous embodiments. The positioning of the edge reflector 70 further back from the periphery of touch surface 20 provides a longer distance from emitters 30a to reflector surface 80, allowing the above surface detection lines to be broader. Furthermore, the extra distance that the edge reflector 70 is set back provides larger overlap between wide detection lines 96 in the peripheral regions of touch surface 20 resulting in improved accuracy in areas. This is especially advantageous where narrow detection lines 95 provide limited coverage. In a preferred embodiment, the edge reflector 70 is positioned so that reflector surface 80 is set 10 mm back from in-coupling point 45.

[0053] Figure 10 shows an embodiment of the invention featuring dust shield 110. A known problem with above-surface touch systems is the accumulation of dust and contamination around the sensor area or the area in which the light signal is emitted to travel across the touch panel. Dust or other contamination accumulating at this point will block the light signal and seriously degrade the ability of the touch system to determine a touch. For a system such as the embodiment presented in figure 3, the accumulation of contamination may be increased where reflector surface 80 is angled to form an overhang. This overhang forms a natural shelter for accumulating contamination, resulting in further touch signal degradation. A solution presented in figure 10 is that of a dust shield 110 forming a physical barrier preventing the dust from reaching reflector surface 80 and comprising transparent window 115 through which the light signal may pass.

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unhindered. Preferably, dust shield 110 forms a sloping edge, sloping from the inside edge in contact with touch surface 20 outwardly to the top surface of edge reflector 70. This allows dust shield 110 to be effectively wiped clean.

[0054] In a preferred embodiment, transparent window 115 comprises a material of coating configured to allow only IR or Near-IR light to pass through. This feature provides improved ambient light noise reduction as light from artificial lighting or sun light is filtered before reaching detectors 30b.

[0055] In a preferred embodiment, dust shield 110 is configured with a longer dimension extending from edge reflector 70 towards touch surface 20 and with an internal top surface providing a light baffle effect so as to provide an angular filter for light entering through transparent window 115. This is advantageous for reducing ambient noise as light entering at the wrong angle is absorbed into the roof of the dust shield 110. Furthermore, when combined with the embodiment from figure 8, the angle of light paths travelling above the panel may be limited so that that detection lines very high above the glass 90a may be supressed.

[0056] Figure 11 shows an alternative embodiment to the embodiment shown in figure 3. In figure 11, apparatus 100 is configured to transmit light from a first set of emitters 31a to a first set of detectors 31b inside a transmissive panel 10 so as to illuminate a touch surface 20 from within the transmissive panel 10. Apparatus 100 is also configured to transmit light from a second set of emitters 32a to a second set of detectors 32b such that the light is emitted by emitters 32a, exits transmissive panel 10 through touch surface 20 and is reflected by reflector surface 80 of edge reflector 70 to travel along path 90a in a plane parallel with touch surface 20. The light will then continue until deflected by reflector surface 80 of the edge reflector 70 at an opposing edge of the transmissive panel 10, wherein the light will be deflected back down through transmissive panel 10 and onto detectors 32b. Significant advantages may be obtained from using two separate emitting and detecting systems rather than a single set of emitters and detectors for both the above-surface and FTIR light paths. A significant problem with trying to differentiate between the attenuation of the light travelling along a path above the touch surface from the attenuation of light travelling along a path within the panel via FTIR is that a typical finger touch is likely to produce an attenuation of the light above the panel is greater than the attenuation of the light travelling within the panel via FTIR by as much as a factor of 50. This results in an attenuation signal of the light travelling in the panel which is difficult to differentiate from noise relative to the attenuation signal of the light travelling above the panel. For objects such as stylus tips, this relative difference in signal strength can be even greater. Therefore, the use of separate emitting and detecting systems for light paths above (above-surface system) and within the panel via FTIR (FTIR system) allows

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each system to be configured appropriately for the respective signal-to-noise ratios. The separate resulting signals can then be combined to provide a system that provides the following features:

[0057] - Oil or water contamination on the touch surface may appear to the FTIR system as an attenuation surface area and generate a false touch. However, in the above embodiment, the touch output of the FTIR system may be compared to the touch output of the above-surface system to identify touches of the FTIR system which do not appear in the touch output of the above-surface system. This would indicate that the identified touches do not correspond to actual objects above the touch surface but mere contamination on the surface. The output of the identified touches can then be suppressed.

[0058] - Similarly to the above, when a user raises their finger from the touch surface, a previously identified touch should be removed from the touch output. However, on occasion, finger grease from the skin is left on the touch surface and an FTIR system continues to detect and report a touch. In the above embodiment, the output of the above-surface system may be used to identify touches of the FTIR system where the touching object has now been removed. The output of the identified touches can then be suppressed.

[0059] - Certain object types produce very little attenuation of the FTIR light when in contact with the touch surface e.g. Hard objects such as stylus tips. Where the above-surface system registers an object but the FTIR system does not, it can be determined that the object is likely to be a 'hard object' as opposed to a normal touch from a finger. Differentiation between hard and soft surfaced objects may allow differentiation between e.g. a pen and a finger. A touch system configured to differentiate between a stylus and a fingertip may generate a different UI output in dependence on the identified object touching the touch surface.

[0060] - One problem with above-surface systems is that the object touching the touch surface may completely occlude one or more light paths of the above-surface system. Where a large number of touches are simultaneously applied to the touch surface, portions of the touch surface may become significantly shielded from the light paths of the above-surface system, resulting in little or no touch signal in the shielded portion. In the above embodiment, the FTIR may continue to provide a touch signal within the occluded areas, as the attenuation of the FTIR light paths resulting from a touch is relatively small and non-occluding.

[0061] In the embodiment of figure 11, a first wavelength of light emitted by first set of emitters 31a and detected by first set of detectors 31b may be different to a second wavelength of light emitted by second set of emitters 32a and detected by second set of detectors 32b. This allows light to be emitted from one of the first set of emitters 31a and one of the second set of emitters 32a

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simultaneously and detected by the first set of detectors 31b and second set of detectors 32b without co-interference. This may also allow improved ambient light noise reduction in environments where ambient light comprises more light with a first wavelength than light with a second wavelength or vice versa. E.g. Wherein the first and second wavelengths are both near IR wavelengths.

[0062] In the embodiment of figure 11, the timing sequence used to activate emitters of the first and second set of emitters may be chosen to ensure that activation of the emitters of the first set of emitters does not chronologically overlap with activation of emitters of the second set of emitters. This allows potential co-interference to be minimized.

[0063] Figure 12 shows a top plan view of the Figure 11. In this embodiment, emitters 31a are spatially interlaced with emitters 32a around the peripheral edge of transmissive panel 10 so that emitters of first set 31a are positioned between adjacent emitters of second set 32a. Similarly, detectors 31b are spatially interlaced with detectors 32b around the peripheral edge of transmissive panel 10 so that detectors of first set 31b are positioned between adjacent emitters of second set 32b. This has the advantage of improving coverage of the touch surface where detection paths of the above-surface system cover gaps between detection paths of the FTIR system and vice versa.

[0064] In one embodiment, emitters 31a and detectors 31b are only positioned along sub-portions of the periphery of the touch surface. In this embodiment, the portion of the periphery of the touch surface along which emitters 31a and detectors 31b are positioned is smaller than the portion of the periphery of the touch surface along which emitters 31a and detectors 31b are positioned. In one example, emitters 31a and detectors 31b are only located along two opposing edges of a rectangular touch surface. In an alternative embodiment, emitters 31a are placed along one edge of the rectangular touch surface and detectors 31b are positioned along an opposing edge of the touch surface. Alternatively, emitters 31a and detectors 31b may be positioned along L-shaped portions of the periphery of the rectangular touch surface at the corners. In one embodiment, the number of emitters 31a and detectors 31b are fewer than the number of emitters 32a and detectors 32b respectively. This may result in an FTIR system with a lower resolution than the above-surface system. Alternatively, for all of the above arrangements, emitters 31a and detectors 31b may be swapped for emitters 32a and detectors 32b so that the FTIR system has a higher resolution and/or coverage than the above-surface system. These arrangements allow the advantages of a complete above-surface system or FTIR system to be supplemented with the advantages of a limited FTIR system or limited above-surface system respectively without the need for a complete version of both systems. This would allow a significant reduction

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in manufacturing cost, power usage, and even physical size of the touch frame. E.g. Where high accuracy pressure detection needed to be added to an above-surface system, a limited FTIR type system configured to detect pressure (as is known in the art) may be added to the above-surface system with only as many emitters and detectors needed to accurately detect pressure. In one example, the limited system comprises only 25% of the number of emitters and detectors of the complete system.

[0065] In one embodiment, a low-power mode is provided wherein only the above-surface system is powered. When a touch is detected by the above-surface system, a full-power mode is activated and power is provided to the FTIR system. This has the advantage of preserving energy during periods that the above-surface system detects no touches whilst enabling the features of the FTIR system once it is required. Alternatively, an embodiment is provided wherein only the FTIR system is powered in a low-power mode and the above-surface system is only powered on when required. This may include a system wherein the above-surface system is only activated periodically or in response to a determination that a touch detected by the FTIR system is possibly a false touch caused by contamination.

[0066] Figure 13 shows a variation of figure 11 wherein emitters 31a are configured to simultaneously project light above and into transmissive panel 10 but wherein separate detectors 31b and 32b are used to provide separate above-surface and FTIR type touch signals. This advantageously allows simultaneous emission of both signals using a single emitter, allowing low energy consumption and cheaper manufacturing costs, whilst the above features.

[0067] Figure 14 shows an alternative to figure 13 wherein the detectors 31b are configured to simultaneously receive light from above and from within transmissive panel 10 but wherein separate emitters 31a and 32a are used to provide separate above-surface and FTIR type touch signals. This configuration advantageously allows separate control of the light intensity of the light emitted from emitters 31a and 32a to account for environmental light noise or other situations in which light levels need to be separately altered, whilst also allowing low energy consumption and cheaper manufacturing costs.

[0068] For all of the above embodiments, alternative in-coupling and out-coupling solutions used for coupling the light into and out of transmissive panel 10 may be employed according to techniques known in the prior art. E.g. Coupling the light into the edge of the panel rather than from below.

[0069] Furthermore, alternative waveguide, lens, and reflective surface configurations to convey light from emitters 32a to a plane parallel with touch surface 20 and back to detectors 32b may be employed according to

techniques known in the prior art. E.g. Configurations for conveying the light around the edge of the panel rather than through it.

Reference signs list

A. touch-sensitive apparatus 100
B. transmissive panel 10
C. touch surface 20
D. bottom surface 25
E. emitters 30a
F. detectors 30b
G. coupling element 40
H. in-coupling point 45
I. light beam 50
J. touching object 60
K. edge reflector 70
L. reflector surface 80
M. reflector surface focal point 80a
N. light beam 90
O. path 90a
P. path 90b
Q. path 90c
R. detection lines 95
S. detection lines 96
T. dust shield 110
U. transparent window 115
V. light paths D
W. controller 120
X. signal processor 130
Y. processing unit 140
Z. signal profile 150
AA. signal profile 160

CLAIMS

1. A touch sensing apparatus, comprising:

a light transmissive element that defines a touch surface;

a first set of emitters arranged around a first portion of the periphery of the touch surface to emit first beams of light into the light transmissive element, wherein the first beams of light propagate inside the light transmissive element while illuminating the touch surface,

a second set of emitters arranged around a second portion of the periphery of the touch surface to emit second beams of light, wherein the second beams of light are reflected to travel above the touch surface,

a first set of light detectors arranged around a third portion of the periphery of the touch surface to receive light from the first set of emitters from the transmissive element

a second set of light detectors arranged around a fourth portion of the periphery of the touch surface to receive light from the second set of emitters from above the touch surface,

wherein each light detector is arranged to receive light from more than one emitter;

a processing element configured to determine, based on output signals of the first and second set of light detectors, the position of an object on the touch surface.

2. The touch sensing apparatus of claim 1, wherein the first and second set of emitters comprise at least one common emitter.

3. The touch sensing apparatus of claim 1, wherein the first and second set of detectors comprise at least one common detector.

4. The touch sensing system of any preceding claim wherein the processing element is configured to perform a first touch determination based on signals of the first set of light detectors and a second touch determination based on signals of the second set of light detectors, and wherein the the position of an object on the touch surface is determined in dependence on the first touch determination and second touch determination.

5. The touch sensing system of claim 4, wherein the processing element is configured to determine that the object is not touching the touch surface when the first touch determination indicates the presence of the object but the second touch determination indicates the absence of the object.

6. The touch sensing system of claim 4, wherein the processing element is configured to determine that the object is of a first object type when the first touch

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determination indicates the absence of the object but the second touch determination indicates the presence of the object.

7. The touch sensing system of claim 4, wherein the processing element is configured to determine the position of an object on the touch surface in dependence on just the first touch determination when the object is occluded from the second beams of light.

8. The touch sensing system of any preceding claim wherein the first set of emitters is configured to emit light at a first wavelength and the first set of emitters is configured to detect light at the first wavelength, and wherein the second set of emitters is configured to emit light at a second wavelength and the second set of emitters is configured to detect light at the second wavelength.

9. The touch sensing system of any preceding claim wherein the touch sensing system is configured to activate the first set of emitters and the second set of emitters at non-overlapping times.

10. The touch sensing apparatus of any preceding claim, wherein the touch sensing system is configured to operate in a low-power mode wherein just the second set of emitters are powered, and wherein when the processing element determines the presence of an object on the touch surface from the second set of light detectors, entering a higher-power mode wherein the first and second set of emitters are powered.

11. The touch sensing apparatus of claims 1-9, wherein the touch sensing system is configured to operate in a low-power mode wherein just the first set of emitters are powered, and wherein when the processing element determines the presence of an object on the touch surface from the first set of light detectors, entering a higher-power mode wherein the first set of emitters are powered and the second set of emitters are at least intermittently powered.

12. The touch sensing apparatus of any preceding claim, wherein the first and/or third portion is larger than the second and/or fourth portion.

13. The touch sensing apparatus of any preceding claim, wherein the number of the first set of emitters and/or first set of detectors is larger than the number of the second set of emitters and/or second set of detectors.

14. The touch sensing apparatus of claim 11, wherein the ratio of the first set of emitters and/or first set of detectors to the number of the second set of emitters and/or second set of detectors is 4:1 .

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15. The touch sensing apparatus of any preceding claim, wherein the first and second set of emitters are spatially interleaved along the periphery of the touch surface.

DRAWINGS

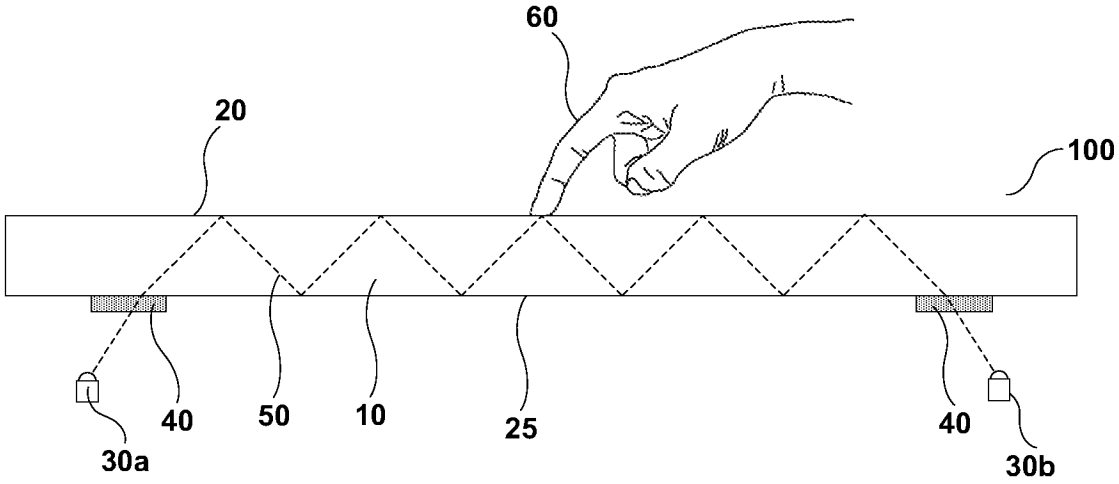


Figure 1

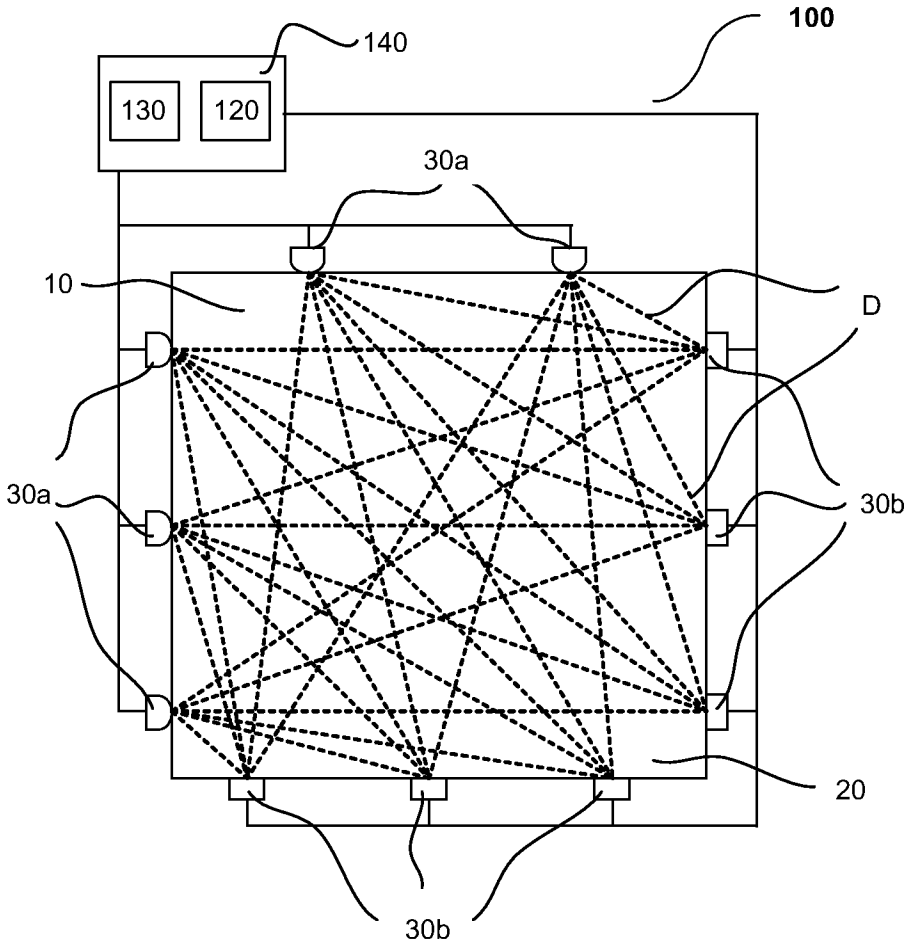


Figure 2

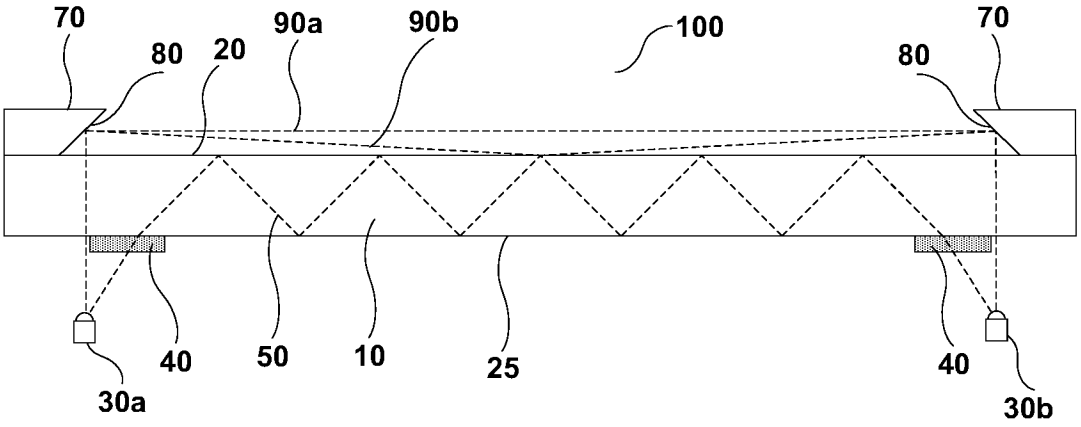


Figure 3

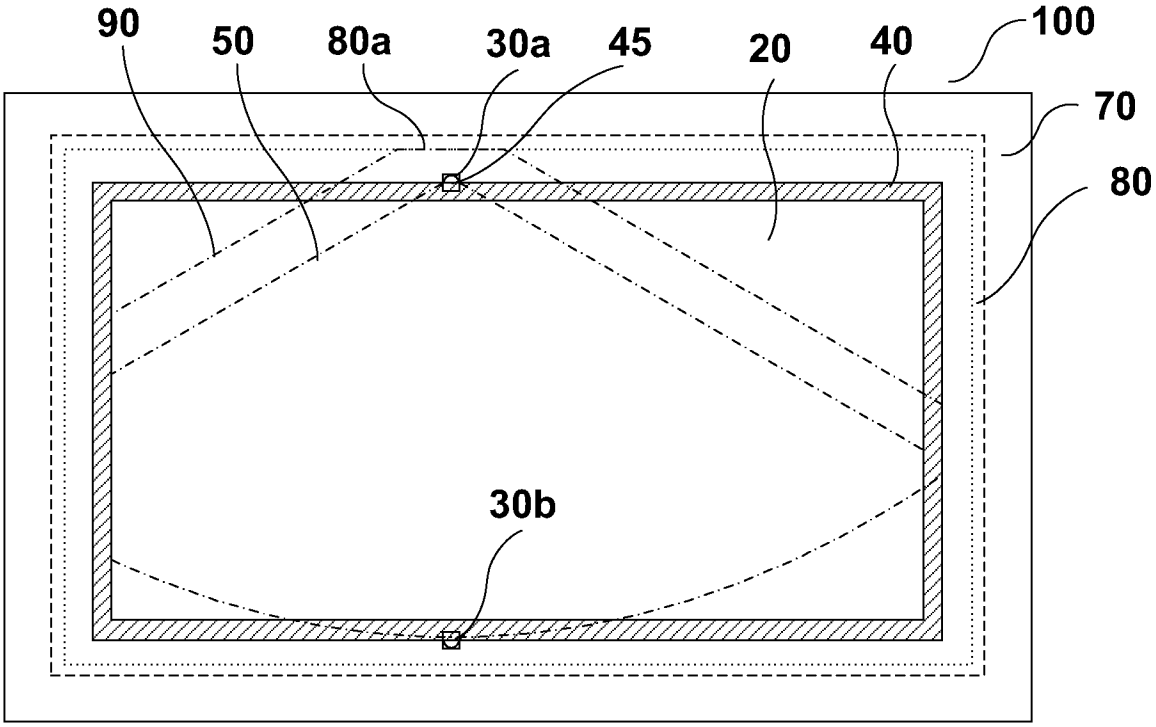


Figure 4

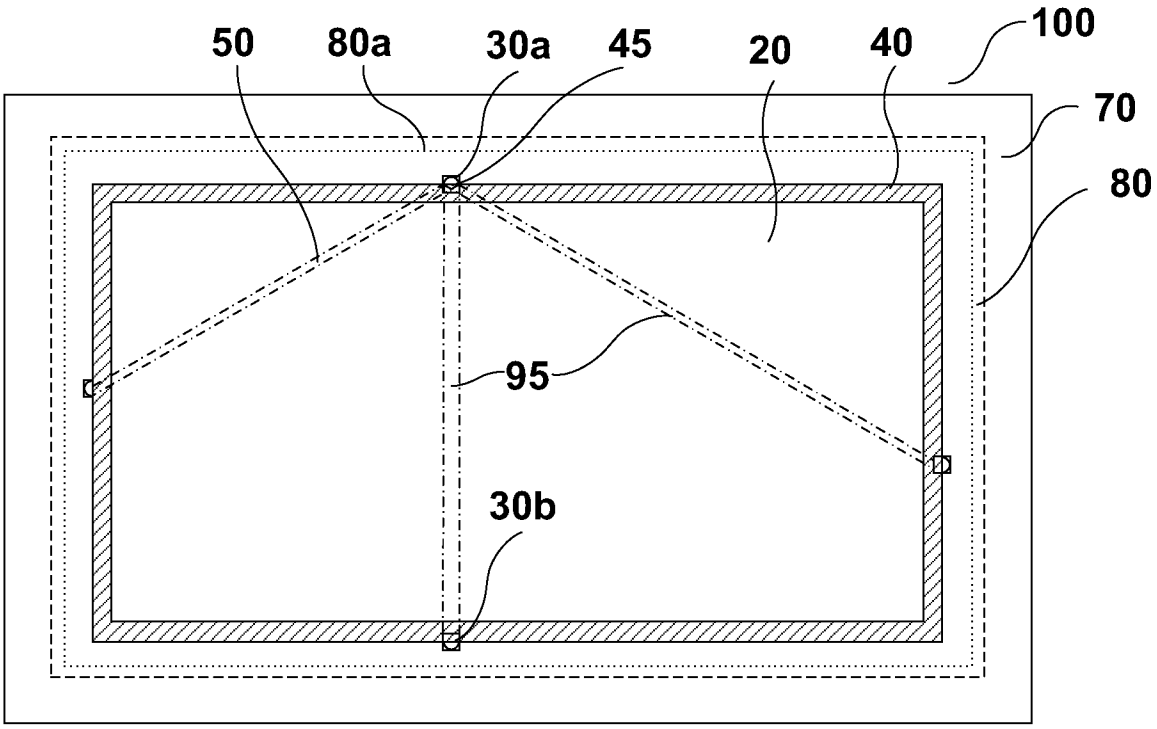


Figure 5

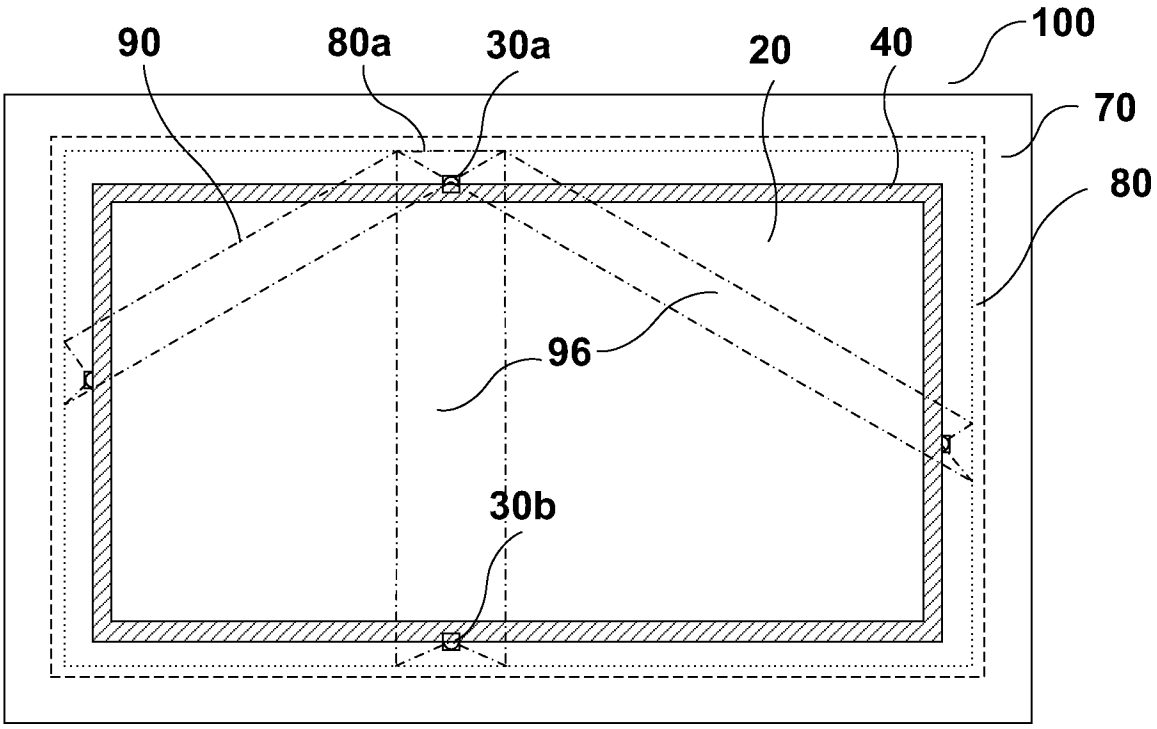


Figure 6

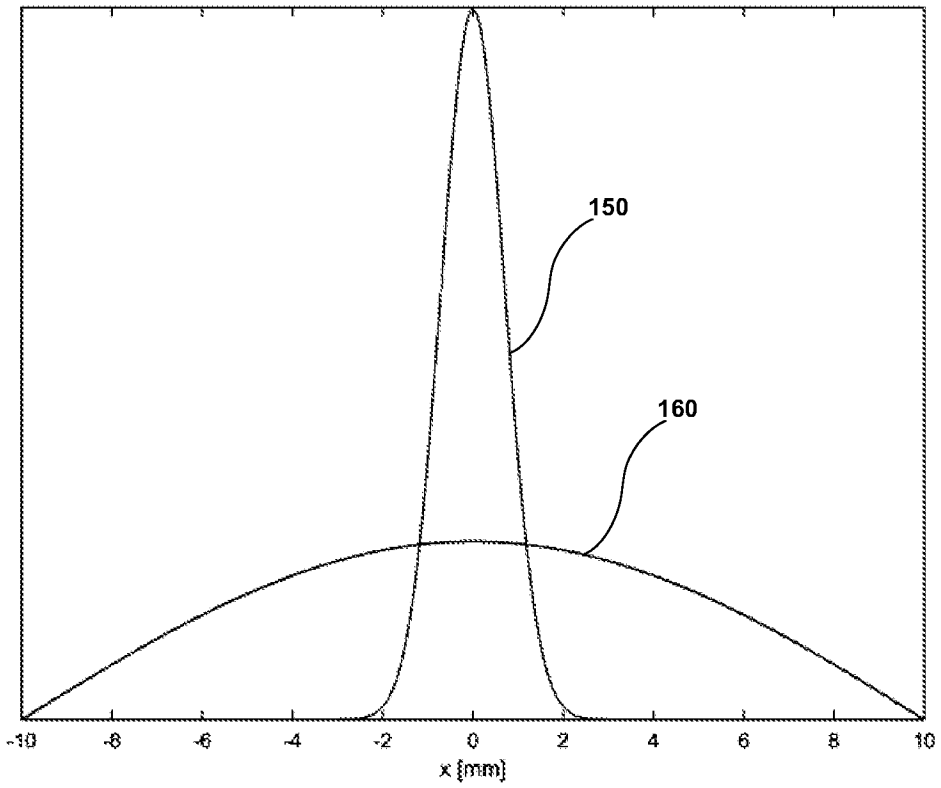


Figure 7

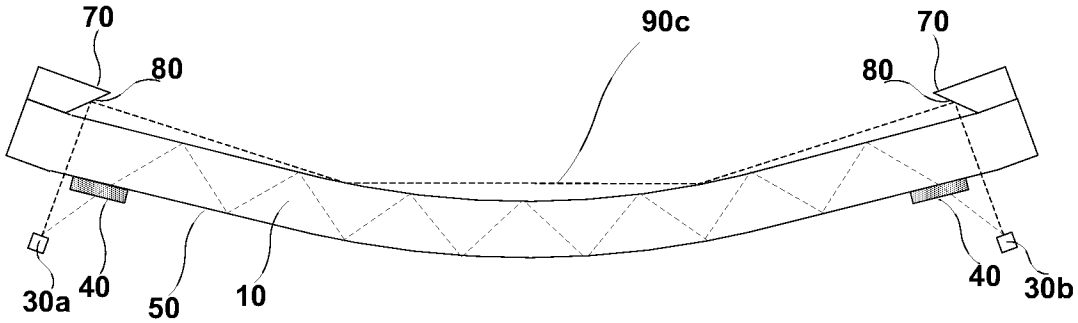


Figure 8

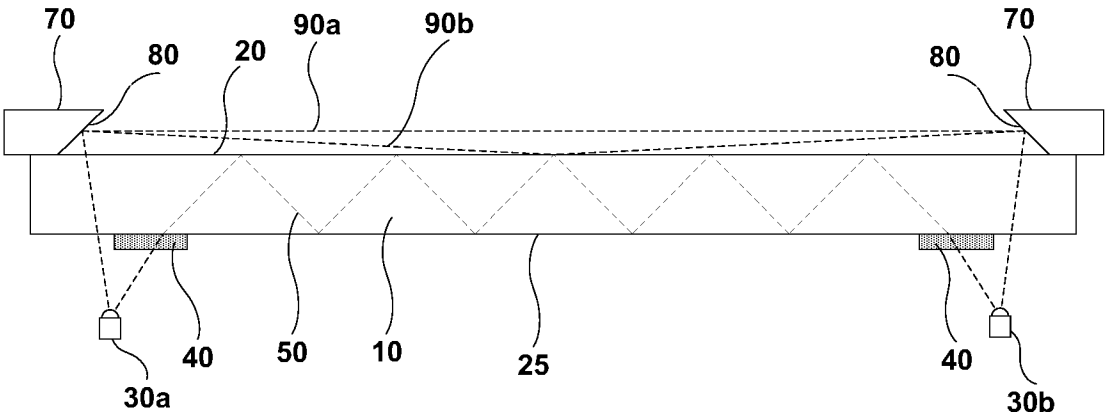


Figure 9

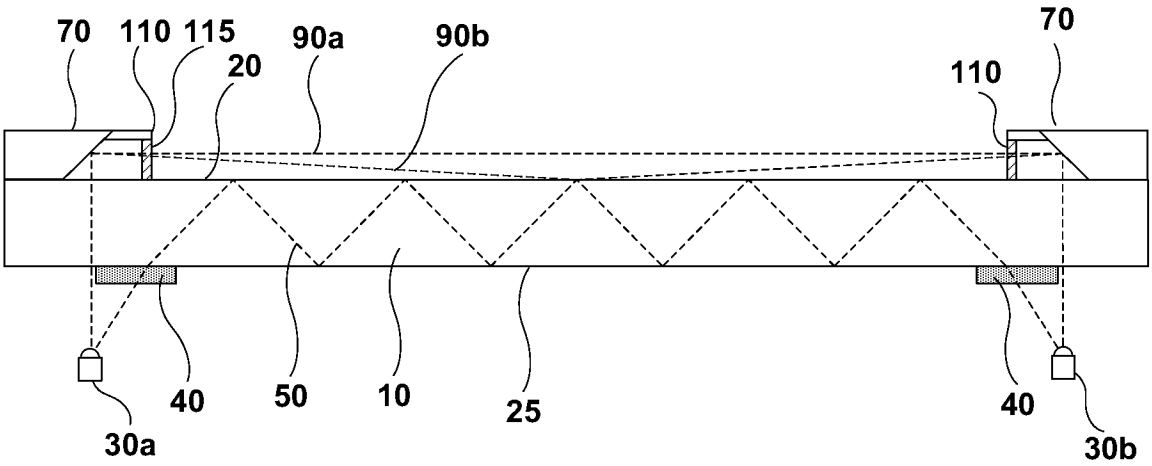


Figure 10

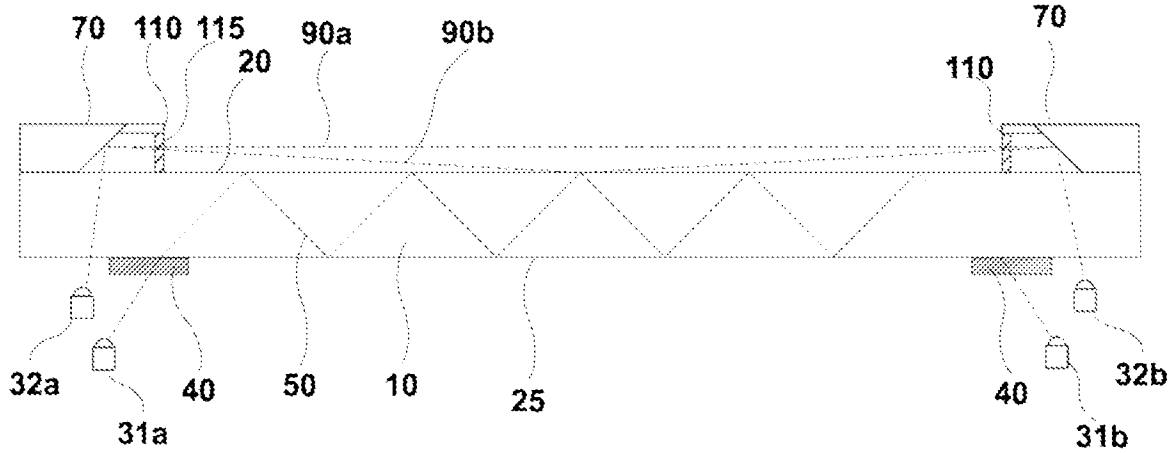


Figure 11

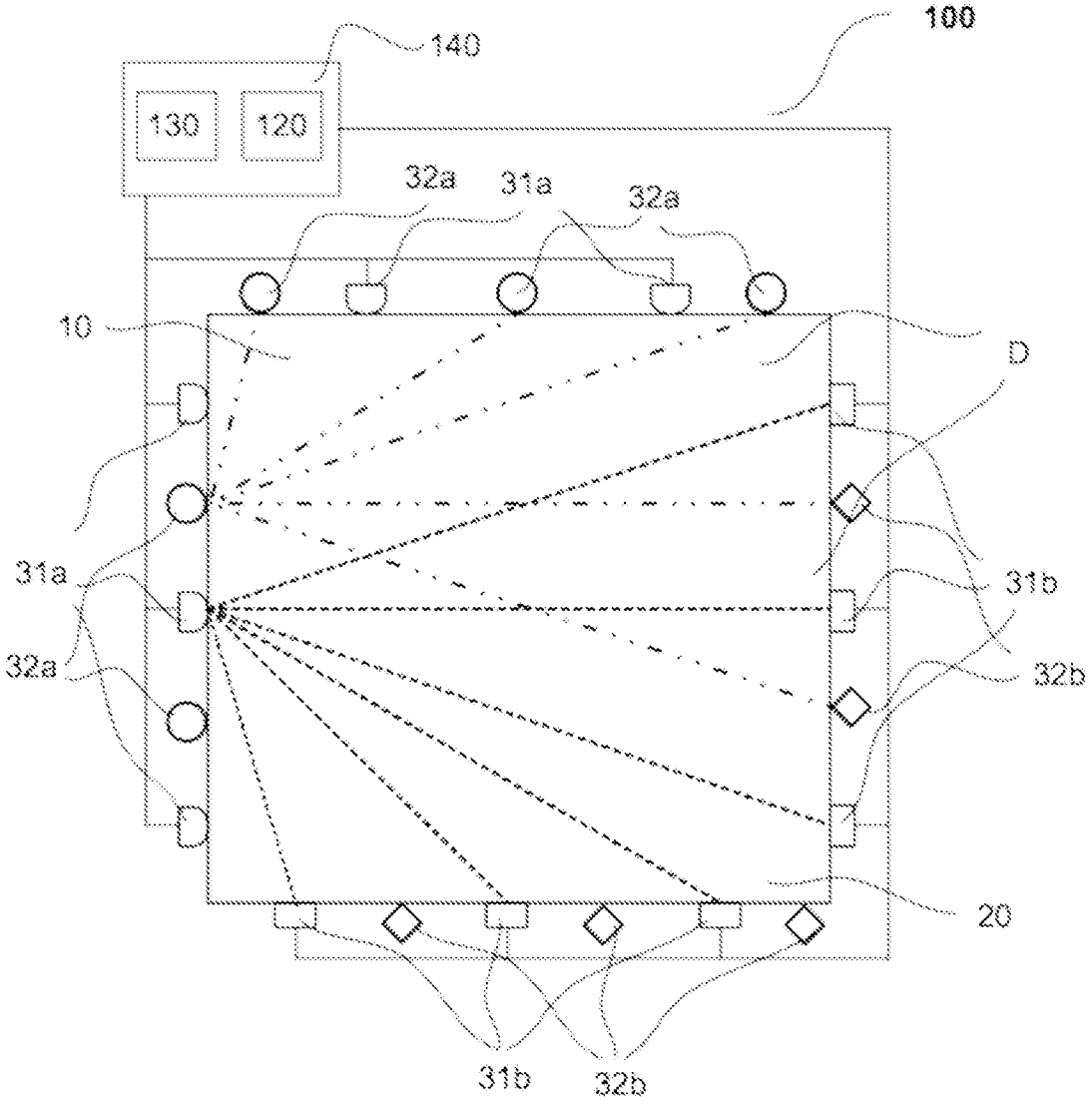


Figure 12

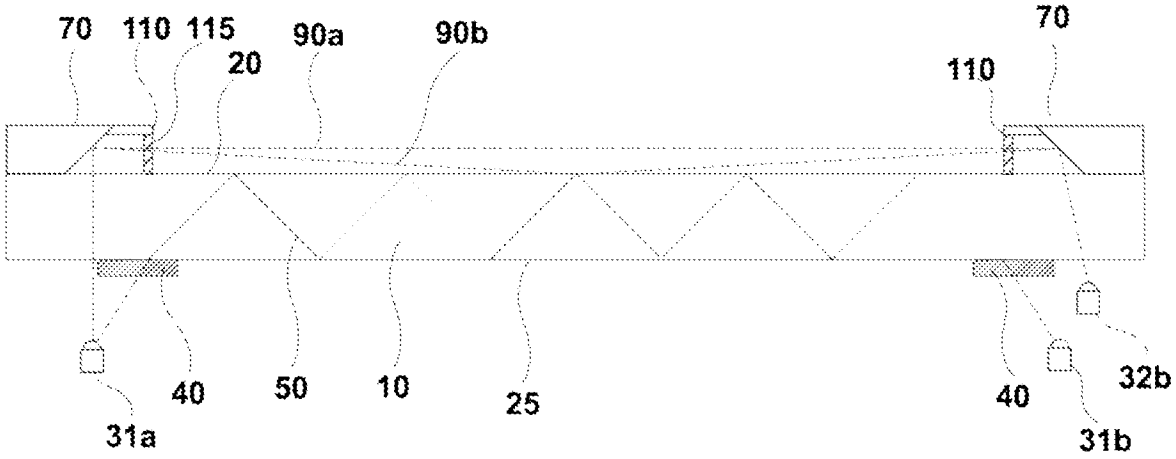


Figure 13

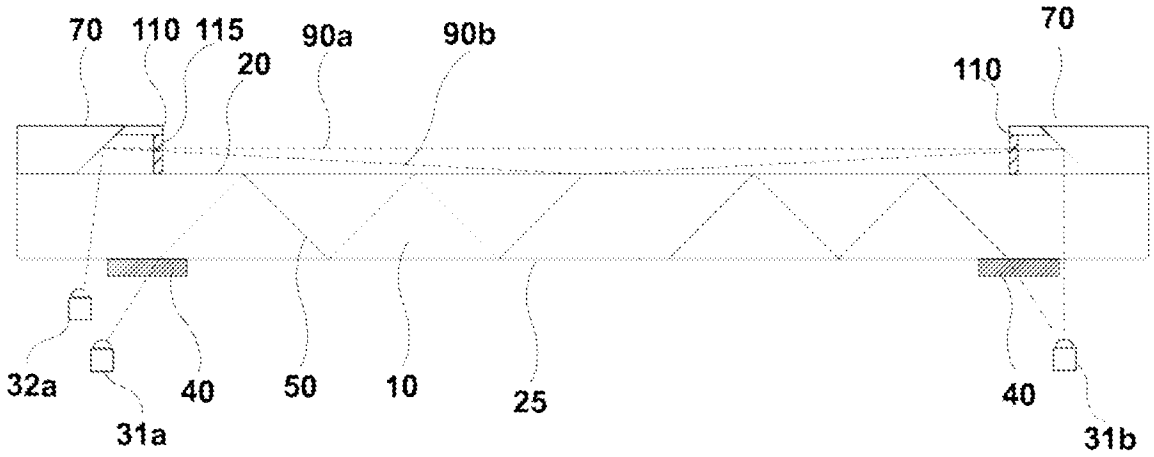


Figure 14

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE201 6/050098

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: G06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE, DK, FI, NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, PAJ, WPI data, COMPENDEX, INSPEC, IBM-TDB

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category' *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 201 301 55027 A 1 (HOLMGREN STEFAN ET AL), 20 June 2013 (201 3-06-20); paragraphs [021 2], [0246], [031 1], [0374], [0388], [041 5]-[041 9]; figures 18,31 ,1 26 --	1-15
A	US 201 401 92023 A 1 (HOFFMAN DAVID), 10 July 201 4 (201 4-07-1 0); paragraphs [0008]-[001 1], [0026]-[0028], [0045]-[0048], [0050], [0057], [0070], [0072]; figure 1 --	1-15
A	US 201 10221 705 A 1 (YI KWON JU ET AL), 15 January 201 4 (2014-01 -15); paragraphs [0008]-[0009], [001 2], [001 8]-[001 9], [0037]-[0038], [0047], [0049], [0063]-[0069], [0078]-[0089]; figures 1,7-1 0 --	1-15

☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
28-06-201 6	29-06-201 6

Name and mailing address of the ISA/SE	Authorized officer
Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM	Alexander Lakic

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 731

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 201 10122075 A1 (SEO YOUNG-KWANG ET AL), 26 May 201 1 (201 1-05-26); paragraphs [0065], [0069]; figures 3,5 --	1-15
A	YOUNGSEOK AHN et al. "A slim and wide multi-touch tabletop interface and its applications", 2014 International Conference on Big Data and Smart Computing (BIGCOMP), 2014-01-15, IEEE, p. 276-281 , ISSN: 2375-933X; whole document --	1-15

International application No.
PCT/SE201 6/050098

Continuation of: second sheet

International Patent Classification (IPC)

G06F 3/042 (2006.01)

US	201301 55027	A 1	20/06/201 3	US	20140071 094	A 1	13/03/2014
				US	8553014	B2	08/1 0/201 3
us	201401 92023	A 1	10/07/2014	US	9223442	B2	29/1 2/201 5
us	201 10221 705	A 1	15/01/2014	CN	1021 93686	B	17/02/201 6
				EP	2365423	A2	14/09/201 1
				KR	201 10103140	A	20/09/201 1
us	201 1o 122075	A 1	26/05/201 1	EP	2325735	A2	25/05/201 1
				KR	201 10056892	A	31/05/201 1

Electronic Acknowledgement Receipt

EFS ID:	39722012
Application Number:	16403283
International Application Number:	
Confirmation Number:	5417
Title of Invention:	TOUCH DEVICE
First Named Inventor/Applicant Name:	Aleksander Kocovski
Customer Number:	20995
Filer:	Harnik Shukla/Jenny Kim
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Attorney Docket Number:	FFOG.053C3
Receipt Date:	15-JUN-2020
Filing Date:	03-MAY-2019
Time Stamp:	16:32:10
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		FFOG053C3_IDS.pdf	47478 a50824c2cdf59397fb67342efb42364d03bf8dbb	yes	3

	Multipart Description/PDF files in .zip description		
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	Information Disclosure Statement (IDS) Form (SB08)	3	3

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Warnings:					
Information:					
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Warnings:					
Information:					
4	Non Patent Literature	SuppESR_EP16873465_06-25-2019.pdf	1584654 24e75515b6455e55d281041eeb730632ff17fce6	no	9
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INFORMATION DISCLOSURE STATEMENT

First Inventor	:	Aleksander Kocovski
App. No.	:	16/403283
Filed	:	May 3, 2019
For	:	TOUCH DEVICE
Examiner	:	Lam, Vinh Tang
Art Unit	:	2621
Conf. No.	:	5417

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

References and Listing

Pursuant to 37 CFR 1.56, an Information Disclosure Statement listing references is provided herewith. Copies of any listed foreign and non-patent literature references are being submitted.

No Disclaimers

To the extent that anything in the Information Disclosure Statement or the listed references could be construed as a disclaimer of any subject matter supported by the present application, Applicant hereby rescinds and retracts such disclaimer.

Timing of Disclosure

This Information Disclosure Statement is being filed after receipt of a First Office Action, but before the mailing date of a Final Action and before the mailing date of a Notice of Allowance.

This Statement is accompanied by the fees set forth in 37 CFR 1.17(p). The Commissioner is hereby authorized to charge any additional fees which may be required or to credit any overpayment to Account No. 11-1410.

Respectfully submitted,

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Dated: June 15, 2020

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Chemtronics Exhibit 1032 Page 738

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Notification of Related Litigation Filing

Submitted herewith in the above-identified application is an Information Disclosure Statement listing references for consideration. These references are being submitted pursuant to MPEP § 2001.06(c) in that U.S. Patent Nos. 10,282,035, 10,606,414, and 10,606,416, are currently involved in litigation, namely, *FLATFROG LABORATORIES AB vs. PROMETHEAN LTD. AND PROMETHEAN INC.*, (C.A. No. 19-2246-MN). One or more of these patents may be related, or claimed as part of the priority claim of the present application, or may claim a priority benefit of applications

and patents that are part of the present application's claim for priority under 35 U.S.C. § 120.

To the best of the undersigned's understanding, the references submitted herewith represent documents or document portions that are non-confidential as defined by any protective order governing information exchanged between the parties to the litigation mentioned above.

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Respectfully submitted,
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Chemtronics Exhibit 1032 Page 740

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 765 622 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
13.08.2014 Bulletin 2014/33

(21) Application number: **13004816.8**

(22) Date of filing: **07.10.2013**

(51) Int Cl.:
H01L 51/00 *(2006.01)* ***G02F 1/1333*** *(2006.01)*
G02F 1/139 *(2006.01)* ***G06F 1/16*** *(2006.01)*
H01L 27/32 *(2006.01)* ***H04M 1/02*** *(2006.01)*

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(30) Priority: **08.02.2013 KR 20130014478**

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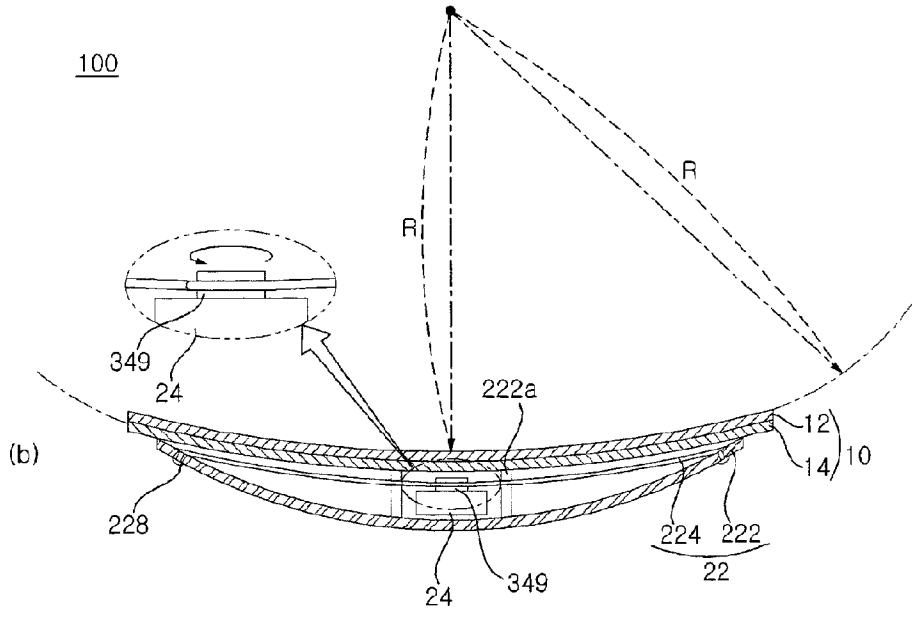
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(54) Display apparatus

(57) A display apparatus includes a display module including a flexible display panel for displaying an image, and a variable member for varying a shape of the flexible display panel. The variable member includes a variable section capable of bending in shape. The variable member also includes a driver for supplying mechanical energy to bend the shape of the variable section, where the flexible display panel is varied in shape by the bending in shape of the variable section.

FIG. 5



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Description

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the priority benefit of Korean Patent Application No. 10-2013-0014478 filed on February 8, 2013 in the Korean Intellectual Property Office, the disclosure of which is incorporated herein by reference.

BACKGROUND

1. Field of the disclosure

[0002] The present disclosure relates to a display apparatus, and more particularly to a display apparatus with an improved structure.

2. Description of the Related Art

[0003] Various types of display apparatuses are used to display images. For example, there are various displays such as a liquid crystal display panel, a plasma display panel, and an organic light emitting diode display panel.

[0004] In accordance with recent expansion of application fields of display apparatuses, diverse characteristics of display apparatuses are now required in the application fields. In particular, such requirements have been increased in association with characteristics related not only to simple display of images, but also to display of images taking into consideration three-dimensional effects and sensory immersion. In order to meet such various requirements, research is being conducted to provide various display apparatuses having improved structures.

SUMMARY

[0005] Therefore, one object is to provide a display apparatus having an improved structure capable of achieving an enhancement in sensory immersion of a user.

[0006] In accordance with one aspect, the above and other objects may be accomplished by the provision of a display apparatus including a display module including a flexible display panel for displaying an image, and a variable member for varying a shape of the flexible display panel, wherein the variable member includes at least one variable section capable of varying in shape, and at least one driver for supplying mechanical energy to bend the shape of the variable section, where the flexible display panel is varied in shape by the bending in shape of the variable section.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] The above and other objects, features and other advantages will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a front perspective view of a display apparatus according to an exemplary embodiment of the present invention;

FIG. 2 is an exploded rear perspective view of the display apparatus according to an exemplary embodiment of the present invention;

FIG. 3 is a perspective view illustrating a driver of the display apparatus according to an exemplary embodiment of the present invention;

FIG. 4 is a cross-sectional perspective view of the driver corresponding to FIG. 3;

FIGS. 5(a) and 5(b) are views explaining shape variation of the display apparatus according to an exemplary embodiment of the present invention; and

FIG. 6 is an exploded perspective view of a display apparatus according to another exemplary embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0008] Reference will now be made in detail to preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings. These embodiments are not intended to limit the present invention. Other embodiments may also be provided.

[0009] Constituent elements other than elements constituting essential features of the present invention may be omitted from the drawings, for clarity of description. Like reference numerals refer to like elements throughout. In the drawings, the widths, thicknesses, and etc., of constituent elements may be exaggerated or reduced for clarity and convenience of illustration. The present invention is not limited to the illustrated thicknesses, widths, and etc.

[0010] It will be further understood that the terms "comprises" and/or "comprising," when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof. In addition, in the description of the embodiments, it will be understood that when a layer (or film), a region, a pad, a pattern or a structure is referred to as being disposed 'on/above/over' another layer, region, pad, pattern or structure, it can be directly in contact with another layer, region, pad, pattern or structure, or one or more intervening layers, regions, pads, patterns or structures may also be present. In addition, it will also be understood that when a layer (or

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film), a region, a pad, a pattern or a structure are referred to as being disposed 'between' two layers, two regions, two pads, two patterns or two structures, it can be the only layer, region, pad, pattern or structure between the two layers, the two regions, the two pads, the two patterns and the two structures or one or more intervening layers, regions, pads, patterns or structures may also be present.

[0011] Hereinafter, a display apparatus according to an exemplary embodiment of the present invention will be described in detail with reference to the accompanying drawings.

[0012] FIG. 1 is a front perspective view of a display apparatus according to an exemplary embodiment of the present invention. FIG. 2 is an exploded rear perspective view of the display apparatus according to an exemplary embodiment of the present invention.

[0013] Referring to FIGS. 1 and 2, the display apparatus of the illustrated embodiment, which is designated by reference numeral "100", includes a display module 10 for displaying an image, and a variable member 20 for varying the shape of the display module 10. The display apparatus 100 also includes a rear cover 30 for covering a rear surface of the display module 10. This will be described in more detail.

[0014] The display module 10 may include a display panel 12 for displaying an image, a support member 14 disposed at a rear surface of the display panel 12, to support the display panel 12, and a panel driver (not shown) fixed to the support member 14, to provide signals for driving of the display panel 12. Although not shown, the display module 10 may further include frames for enclosing edges of the display panel 12 and support member 14.

[0015] In an exemplary embodiment, the display panel 12 may be a panel not only having various structures and types capable of displaying an image, but also having flexibility, to be varied in shape by the variable member 20.

[0016] For example, the display panel 12 may be an organic light emitting display panel using organic light emitting diodes (OLEDs). Such an organic light emitting display panel is a self-luminous display panel in which electrons and holes are combined in a fluorescent or phosphorescent organic thin film when current flows through the organic thin film, thereby generating light. The organic light emitting display panel has various advantages such as excellent picture quality capable of providing bright and crisp images, no restriction as to viewing angle, and low power consumption. In particular, the organic light emitting display panel exhibits excellent flexibility in that it can be manufactured through lamination of organic thin films. Of course, the present invention is not limited to such a display panel. For the display panel 12, various display panels having various structures and types may be employed.

[0017] The support member 14, which is disposed at the rear surface of the display panel 12, supports the display panel 12. The panel driver and variable member 20 may be fixed to a rear surface of the support member 14. As described above, the panel driver drives the display panel 12. To this end, the support member 14 not only has strength to firmly support the display panel 12, panel driver and variable member 20, but also has flexibility and elasticity to be varied in shape in accordance with variation in the shape of the display panel 12. In order to avoid thermal stress, the support member 14 may have a coefficient of thermal expansion similar to that of the display panel 12.

[0018] For example, in an exemplary embodiment, the support member 14 may include a composite material such as reinforced plastic. Here, the composite material is a material obtained by artificially combining two or more kinds of materials, to exhibit excellent characteristics. For example, the support member 14 may include carbon fiber reinforced plastic (CFRP), glass fiber reinforced plastic (GFRP) or the like. In this case, the support member 14 may exhibit not only characteristics of lightness and flexibility by virtue of the plastic, but also high strength, high elasticity and excellent wear resistance by virtue of the fiber type reinforcing material. The support member 14 may be constituted by a single composite material layer or may be constituted by a plurality composite material layers, to exhibit excellent strength.

[0019] The support member 14 may be fixed to the rear surface of the display panel 12 by an adhesive (for example, a double-sided tape). Of course, the present invention is not limited to such a fixing method. The display panel 12 and support member 14 may be fixed to each other, using various fixing methods.

[0020] The panel driver fixed to the rear surface of the support member 14 includes a circuit board (not shown) including various wirings and elements to provide signals for driving the display panel 12. The panel driver may be fixed to the support member 14 by a bracket (not shown) or the like. For example, the bracket may be fixed to the support member 14 at a middle portion thereof in order to minimize force required to vary the shape of the display panel 12. Of course, the present invention is not limited to such a structure, and various alternatives may be employed. For example, the panel driver may be partially or completely disposed at the outside of the display module 10. In an exemplary embodiment, the panel driver may include wirings, elements, and etc., for driving the variable member 20.

[0021] In addition, frames may be provided to protect the edges of the display panel 12 and support member 14. Such frames not only protect the display panel 12 and support member 14, but also support the rear cover 30. That is, the rear cover 30 may be fastened to the frames by fastening members (not shown). The frames may have various shapes, and various fastening structures and methods may be employed to fasten the rear cover to the frames and, as such, no detailed description thereof will be given.

[0022] The variable member 20 is disposed at the dis-

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play module 10 (in this embodiment, the variable member 20 is disposed at the rear surface of the support member 14), to vary the shape of the display panel 12. The variable member 20 may include a variable section 22, and a driver 24 for supplying mechanical energy to vary the shape of the variable section 22. For example, the driver 24 varies the shape of the variable section 22 by bending in shape the variable section 22.

[0023] In an exemplary embodiment, the variable section 22 may be elongated in one direction (for example, a lateral direction of the display apparatus 100). Upon receiving mechanical energy from the driver 24, the variable section 22 may be varied in shape such that opposite end portions thereof protrude forward with respect to the middle portion(comment: since the middle portion is fixed to the display panel, see Figs. 2 and 5, it does not appear to retract rearward). As a result, the display module 10 may be bent throughout the entirety thereof, to have a predetermined radius of curvature (for example, "R" in FIG. 5(b)) in a lateral direction of the display module 10. In this state in FIG. 5(b), there is no difference in the distance from the eyes of the user to the display panel 12 between the middle and lateral end portions of the display panel 12. Even if there is a distance difference, such difference may be minute. Thus, it is possible to achieve an enhancement in sensory immersion of the user. Of course, the present invention is not limited to the above-described embodiment. For example, the varied shape of the variable section 22 may be different from the above-described shape and, as such, the varied shape of the display module 10 may also be different from the above-described shape.

[0024] In the illustrated embodiment, two variable sections 22 are provided such that one variable section 22 is disposed at an upper portion of the display module 10, and the other variable section 22 is disposed at a lower portion of the display module 10. While two or more variable section 22 are preferred, a single variable section 22 may be disposed at an intermediate portion of the display module 10, although insufficient shape variation may occur at lateral edge portions of the display module 10. Taking into such consideration, in this embodiment, two variable sections 22 are implemented. When a plurality of variable sections 22 are provided, it is possible to achieve uniform shape variation throughout the entirety of the display module 10. Of course, the present invention is not limited to the two variable sections 22, and various alternatives may be employed. For example, only one variable section 22 is provided for cost reduction and structure simplification.

[0025] Each variable section 22 may include a first portion 222 fixed to the support member 14 of the display module 10, and a second portion 224 disposed between the support member 14 and the first portion 222. The second portion 224 is fixed, at opposite ends thereof, to opposite ends of the first portion 222, respectively.

[0026] The second portion 224 is fixed, at a certain region thereof, for example, a central region, to the driver 24 and, as such, the second portion 224 has a connection length (that is, a rectilinear length between the opposite ends of the first portion 222 connected with the second portion 224) variable by mechanical energy supplied from the driver 24. When the connection length of the second portion 224 varies, the shape of the first portion 222 is varied. This will be described in more detail later with reference to FIGS. 5(a) and 5(b). When the shape of the first portion 222 varies, the first portion 222 applies force to the display module 10, thereby causing the shape of the display module 10 to be correspondingly varied.

[0027] Thus, the first portion 222 is a portion which is varied in shape by force received from the second portion 224, thereby varying the shape of the display module 10. In this regard, the first portion 222 may include a material having flexibility and excellent strength. In addition, the material of the first portion 222 may be light in weight in order to reduce the weight of the display apparatus 100.

[0028] For example, the first portion 222 may include a single layer structure or a multilayer structure, which includes a composite material, for example, reinforced plastic (CFRP, GFRP or the like). Of course, the present invention is not limited to such materials, and the first portion 222 may be made of various materials. The first portion 222 may have an elongated band shape having a certain width W. Accordingly, it is possible to more effectively apply force to the display module 10. Of course, the present invention is not limited to such a shape, and the first portion 222 may have various shapes.

[0029] The first portion 222 is fixed, at a central region thereof, to the display module 10 (in this embodiment, the support member 14) such that it cannot move at the central region. In this case, the first portion 222 is movable at opposite end regions thereof. Since the first portion 222 is movable (in this case, forward and rearward) at the opposite end regions thereof while being fixed at the central region thereof, the shape of the first portion 222 is variable.

[0030] The first portion 222 is fixed at the central region thereof by fixing members 222a such that it cannot move. The distance between the central region of the first portion 222 and the support member 14 may be greater than the distance between each end region of the first portion 222 and the support member 14. For example, the first portion 222 may be disposed on the support member 14 such that the central region of the first portion 222 is further protruded rearward from the display module 10, as compared to other regions of the first portion 222 and, as such, the first portion 222 has a curved structure. Then, as an example in accordance with FIG. 5(b), when the display module 10 is varied in shape to have a predetermined radius of curvature R throughout the entirety thereof in accordance with variation in the length of the second portion 224 by the driver 24, the shape variation can be more easily achieved. Each fixing member 222a may be constituted by a fastener such as a PEM nut or a screw. Using a PEM nut or a screw, it is possible to achieve simple and easy fastening. Of course, the

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present invention is not limited to the above-described structures, and various fixing methods and structures may be employed for fixing of the first portion 222 to the support member 14.

[0031] The opposite end regions of the first portion 222 may be movably held by guide members 226 fixed to the support member 14, respectively. Accordingly, it is possible to movably hold the first portion 222 while preventing the first portion 222 from being downwardly bent at the opposite end regions thereof.

[0032] Each guide member 226 includes an upper portion 226a spaced from the support member 14, to form a predetermined space therebetween, and side portions 226b bent from the upper portion 226a, to be disposed adjacent to the support member 14. The side portions 226b are fixed to the support member 14 by fastening members 226c. For example, fixing of each guide member 226 to the support member 14 may be achieved by mounting PEM nuts 142 to the support member 14, and fastening the fastening members 226c, which may be screws, to the PEM nuts 142 through fastening holes formed at the side portions 226b. Using the PEM nuts and screws as described above, it is possible to easily and simply achieve fastening. Of course, the present invention is not limited to the above-described structures, and various fixing methods and structures may be employed for fixing of the side portions 226b to the support member 14.

[0033] The second portion 224 may have a wire structure, and may be fixed, at opposite ends thereof, to the opposite ends of the first portion 222, respectively. The second portion 224 is coupled to a rotating shaft 349 of the driver 24, and a portion of the second portion 224 can be wound on or unwound from the rotating shaft 349, to vary the connection length of the second portion 224. This will be described in more detail later.

[0034] Each end of the second portion 224 may be fixed to the first portion 222 by a fixing member 228 such as an adhesive or a seal after extending through a hole 222b formed at the corresponding end of the first portion 222. Of course, the present invention is not limited to the above-described method, and various fixing methods may be employed for fixing of the second portion 224 to the first portion 222.

[0035] The second portion 224 may be made of a material exhibiting little or no stretchability even under diverse conditions while having high yield strength. When the second portion 224 is stretchable, it is difficult to accurately vary the connection length of the second portion 224. In addition, it may be necessary to provide increased mechanical energy. For example, the second portion 224 may include a metal steel wire (for example, a stainless wire), an aramid fiber, a carbon steel wire or the like. The second portion 224 may have a diameter of 0.5 to 10mm. When the diameter of the second portion 224 is less than 0.5mm, there may be a problem in that the second portion 224 may snap or deform upon receiving energy from the driver 24. On the other hand, when the diameter of the second portion 224 exceeds 10mm, there may be problems of increased costs and complicated configurations because mechanical energy required to vary the connection length of the second portion 224 should be increased. Of course, the present invention is not limited to the above-described embodiment, and the second portion 224 may include various materials and may have various diameters. Although only one second portion 224 is provided in association with the first portion 222 in the illustrated embodiment, a plurality of second portions 224 may be provided. That is, various alternatives may be employed.

[0036] The driver 24 which supplies mechanical energy may have various configurations capable of varying the shape of the variable section 22. Since the driver 24 varies the shape of the variable section 22, using mechanical energy, it is possible to easily vary the shape of the variable section 22 while accurately controlling the variation degree and variation time of the variable section 22. The driver 24 will be described in more detail with reference to FIGS. 3 and 4.

[0037] FIG. 3 is a perspective view illustrating a configuration of the driver of the display apparatus according to an exemplary embodiment of the present invention. FIG. 4 is a cross-sectional perspective view of the driver corresponding to FIG. 3.

[0038] In the illustrated embodiment, the driver 24 may include a motor 242 for supplying rotational energy. As the motor 242, an ultrasonic motor may be employed. The ultrasonic motor is a motor in which frictional force generated between a vibration body vibrating using ultrasonic vibration and a mover is converted into rotational force. This motor is also called a "piezoelectric motor" in that it utilizes piezoelectric effects of piezoelectric ceramics.

[0039] The ultrasonic motor may generate great force while exhibiting a rapid response rate that is 10 times or more than that of existing electromagnetic motors. The ultrasonic motor does not generate noise during operation because it employs ultrasonic waves within an inaudible range. In addition, the ultrasonic motor may have a small size because the structure thereof is simple. The ultrasonic motor has no adverse influence on the display module 10 during operation of the display apparatus 100 because it does not include a magnet. The holding torque of the ultrasonic motor, namely, the torque to stop the ultrasonic motor, is great and, as such, no reverse rotation is generated even when no voltage is applied. Accordingly, it is possible to maintain the display module 10 in a shape-varied state without supplying separate electric power or the like. Thus, it is possible to achieve an enhancement in stability during shape variation of the display module 10. In addition, it is possible to achieve a simplified configuration because it is unnecessary to provide a separate configuration for maintaining the shape-varied state.

[0040] The driver 24 may further include a reducer 244 for reducing the speed of the motor 242, for example,

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using reduction ratios, thereby increasing rotational energy supplied by the motor 242. Using the reducer 244, it is also possible to greatly reduce the size of the motor 242. The reduction ratios may be performed using gears. The reduction ratio of the reducer 244 may be 1:2 to 1:300. This range is a range within which the motor 242 can supply mechanical energy capable of sufficiently varying the shape of the variable section 22 while having a minimum size. Of course, the reduction ratio of the reducer 244 may be varied in accordance with the kind of the motor 242, the structure and system of the variable section 22, or the like.

[0041] In the illustrated embodiment, the motor 242 and reducer 244 are disposed within a housing 246.

[0042] When the housing 246 is employed, it is possible to simplify the structure of the driver 24. Fixing of the driver 24 can be easily achieved by coupling fastening members 246b into fastening holes 246a of the housing 246, thereby fastening the housing 246 to the support member 14. In this case, PEM nuts (not shown), to which the fastening members 246b will be fastened, may be provided at the support member 14. In the illustrated case, the housing 246 includes a first housing section 247, in which the motor 242 is disposed, and a second housing section 248, in which the reducer 244 is disposed. Accordingly, the motor 242 and reducer 244 are prevented from interfering with each other. Of course, the present invention is not limited to the illustrated embodiment, and various alternatives may be employed. For example, both the motor 242 and the reducer 244 may be accommodated within a single housing section.

[0043] It is possible to reduce the thickness of the driver 24 by arranging the motor 242 and reducer 244 in parallel in the housing 246. In this case, accordingly, it is possible to install the driver 24 without increasing the thickness of the display apparatus 100. For example, in an exemplary embodiment, a part of the housing 246, in particular, the housing section accommodating the reducer 244, may be interposed between the display module 10 and the first portion 222 of the corresponding variable section 22. In this case, the second portion 224 of the variable section 22 is coupled to the rotating shaft 349 of the reducer 244 and, as such, it is possible to adjust the connection length of the second portion 224 by winding or unwinding a portion of the second portion 224 on or from the rotating shaft 349. In this arrangement, there is also an advantage in terms of space. Of course, the present invention is not limited to such an arrangement. For example, the driver 24 may be spaced from the variable section 22. This will be described in more detail later.

[0044] The motor 242 includes a motor gear 341. The reducer 246 includes a ring gear 343 engaged with the motor gear 341, a plurality of planetary gears 345 engaged with the ring gear 343 within the ring gear 343, and a sun gear 347 engaged with the planetary gears 345. The rotating shaft 349, which is also included in the reducer 246, is coupled to the sun gear 347. The rotating shaft 349 includes a fixing portion 349a to which the second portion 224 is fixed. When the motor gear 341 of the motor 24 rotates, the ring gear 343 engaged with the motor gear 341 rotates, thereby rotating the planetary gears 345 and sun gear 347. Accordingly, the rotating shaft 349 is rotated. The planetary gears 345 may be arranged in multi-layers so as to achieve an increase in reduction ratio.

[0045] The rotating shaft 349 is protruded outwards of the housing 246 toward the display module 10. A recessed fixing portion 349a is formed at a protruded end of the rotating shaft 349. The second portion 224 is engaged, at a central region thereof, in the recessed fixing portion 349a. Accordingly, the second portion 224 is coupled to the rotating shaft 349. Thus, it is possible to easily couple the second portion 224 to the rotating shaft 349 without a separate configuration by forming the recessed fixing portion 349a at the rotating shaft 349. Of course, the present invention is not limited to the above-described embodiment, and various alternatives may be employed. For example, the fixing portion 349a may have various structures. The fixing portion 349a may also be provided separately from the rotating shaft 349.

[0046] Although not shown, a guide path to guide winding of the second portion 224 may be formed on an outer surface of the rotating shaft 349. In this case, the second section 224 can be more stably wound on the rotating shaft 349 using the guide path.

[0047] Although one driver 24 is provided for each of the plural variable sections 22 in the illustrated embodiment, the present invention is not limited thereto. Alternatively, the plural variable sections 22 may be driven by one driver 24. This will be described in more detail later with reference to FIG. 6. Although a planetary gear reducer is employed as the reducer 244 in the illustrated embodiment, various structure and systems may be employed for the reducer 244.

[0048] The rear cover 30 is disposed in rear of the display module 10 and variable member 20. The rear cover 30 protects the display module 10, panel driver, and etc., from external impact while providing a space where the panel driver, and etc., are disposed. The rear cover 30 also covers the panel driver, and etc., to prevent an inner configuration of the display module 10 from being outwardly exposed, and thus to achieve an enhancement in appearance. For example, the rear cover 30 has a surface gently curved throughout the rear cover 30, to secure a sufficient space and to achieve an enhancement in appearance. In an exemplary embodiment, the rear cover 30 includes a material, a structure, or the like capable of coping with a variation in shape of the display module 10.

[0049] The above-described shape variation of the display apparatus 100 will be described in more detail with reference to FIGS. 5(a) and 5(b). FIGS. 5(a) and 5(b) are views explaining shape variation of the display apparatus 100 according to an exemplary embodiment of the present invention. For reference, FIGS. 5(a) and 5(b) are cross-sectional views taken along the line V -V of FIG. 2. For simplicity and convenience of description, illustra-

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tion of the guide member 226 and rear cover 30 is omitted from FIGS. 5(a) and 5(b). For convenience of description, the following description will be given in conjunction with one variable section 22.

[0050] The display module 10 is kept in a flat state, as shown in FIG. 5(a), when there is no force applied to the display module 10.

[0051] The first portion 222 of the variable section 22 is fixed at the central region thereof by the fixing members 222a such that it cannot move. The first portion 222 is also disposed such that the central region of the first portion 222 is further protruded rearward from the display module 10, as compared to other regions of the first portion 222. In accordance with this structure, shape variation of the display module 10 can be more easily achieved. The opposite end regions of the first portion 222 are movably held by the guide members ("226" in FIG. 2), respectively. The second portion 224 is fixed to the fixing portion ("349a" in FIG. 2) of the rotating shaft 349 in the driver 24.

[0052] When the user inputs a command to vary the shape of the display apparatus 100, the driver 24 is driven by an element, for example, included in the panel driver to drive the driver 24. For example, the motor 242 rotates to rotate the rotating shaft 349 of the reducer 244. Accordingly, the second portion 224 fixed to the rotating shaft 349 is rotated together with the rotating shaft 349 and, as such, a portion of the second portion 224 is wound on the rotating shaft 349. As a result, the connection length of the second portion 224 is reduced, thereby reducing the rectilinear distance between the opposite ends of the first portion 222. Thus, the first portion 222 is bent throughout the entirety thereof such that the opposite end regions thereof protrude forward and, as such, the shape of the display module 10 is also varied. For example, the display module 10 is varied into a curved structure having a uniform radius of curvature R in the lateral direction of the display module 10, as shown in FIG. 5(b). Thus, the display module 10 provides an enhancement in sensory immersion of the user.

[0053] When the user inputs a command again to revert the shape of the display module 10 back to its the original shape, the portion of the second portion 224 wound on the rotating shaft 349 is unwound. As such, the length of the second portion 224 is increased to its original length, and the display module 10 reverts to a flat state, as shown in FIG. 5(a). Accordingly, the variable section 22 is returned to an original state thereof.

[0054] Thus, in the illustrated embodiment, it is possible to vary the shape of the display module 10 in order to achieve an enhancement in sensory immersion of the user. Using the driver 24 which supplies mechanical energy for shape variation of the display module 10, it is possible to easily vary the shape of the variable section 22 while accurately controlling the shape variation degree and time of the variable section 22. In addition, since the motor 242 (in particular, the ultrasonic motor) and reducer 244 are employed for the driver 24, the driver 24 can have a small size. It is also possible to vary the shape of the display module 10 without generation of noise.

[0055] For reference, the command to vary the shape of the display apparatus 100 may be input to the display apparatus 100 by various methods. For example, the user may input the comment by pushing or pressing a button of the display apparatus, by using a device for a remote control (for example, a remote controller of the display apparatus 100), by moving a body of the user (such as, moving eyes of the user or applauding), and so on.

[0056] Hereinafter, a display apparatus according to another exemplary embodiment of the present invention will be described with reference to FIG. 6. With regard to the following embodiment, no description will be given of matters identical or very similar to those of the above-described embodiments, and only the different matters will be described in detail.

[0057] FIG. 6 is an exploded perspective view of a display apparatus according to another exemplary embodiment of the present invention.

[0058] Referring to FIG. 6, in this embodiment, a plurality of variable sections 22 are provided, and one driver 24 drives the plural variable sections 22. For example, in this embodiment, the driver 24 is disposed to be spaced from the plural variable sections 22. A path change member 28 is disposed between each variable section 22 and the display module 10, to change a movement path of the second section 224 toward the driver 24. In the illustrated embodiment, the path change member 28 protrudes from the support member 14. The path change member 28 has a cylindrical shape, and does not rotate. The path change member 28 may be mounted to the support member 14, using a PEM nut, a screw or the like. Of course, the path change member 28 may be mounted to the support member 14 in accordance with various methods.

[0059] The path change member 28 may be formed with a first guide 282 to guide movement of one part of the second portion 224 extending between one end region of the first portion 222 and the driver 24, and a second guide 284 to guide movement of the other part of the second portion 224 extending between the other end region of the first portion 222 and the driver 24. Accordingly, the two parts of the second portion 224 do not interfere with each other during movement thereof. The first and second guides 282 and 284 may be grooves formed on an outer surface of the path change member 28, as shown in an enlarged circle of FIG. 6. Each second portions 224 of the variable sections 22 may be fixed to the rotating shaft ("349" in FIG. 2) of the driver 24 under the condition that they are connected together. Thus, the connection lengths of each second portions 224 are simultaneously reduced or increased in accordance with rotation of the rotating shaft 349. Of course, the present invention is not limited to the above-described arrangement. In another exemplary embodiment, the second portions 224 of a plurality of the variable sections 22 may be connected together. In this instance, the second por-

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tions 224 connected together may be connected to the driver 24 under the condition that only the movement paths thereof are guided by the path change members 28. Alternatively, each path change member 28 may be rotatably mounted to the support member 14. Of course, various alternatives may be employed.

[0060] When a plurality of variable sections 22 are driven by one driver 24, as described above, it is possible to easily vary the shape of the display module 10 while achieving structure simplification.

[0061] As apparent from the above description, in the display apparatus according to the above-described embodiment, it is possible to vary the shape of the display module so as to achieve an enhancement in sensory immersion of the user. Using the driver which supplies mechanical energy for shape variation of the display module, it is possible to easily vary the shape of the variable section while accurately controlling the shape variation degree and time of the variable section. In addition, since the motor (in particular, the ultrasonic motor) and reducer are employed for the driver, the driver can have a small size. It is also possible to vary the shape of the display module without generation of noise.

[0062] Although the preferred embodiments of the present invention have been disclosed for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as disclosed in the accompanying claims.

Claims

1. A display apparatus comprising:

   a display module including a flexible display panel to display an image; and
   a variable member to vary a shape of the flexible display panel,
   wherein the variable member comprises
   at least one variable section capable of bending in shape, and
   at least one driver to supply mechanical energy to bend the shape of the variable section,
   wherein, the flexible display panel is varied in shape by the bending in shape of the variable section.

2. The display apparatus according to claim 1, wherein the flexible display panel is varied by the variable member to correspond to the shape of the variable section.

3. The display apparatus according to claim 1, wherein the variable section comprises a first portion located at the display module, and a second portion located at the first portion, the second portion having a connection length variable by the driver to thereby bend a shape of the first portion.

4. The display apparatus according to claim 3, wherein:

   the first portion has a band shape;
   the second portion has a wire shape; and
   the second portion is fixed, at opposite ends thereof, to opposite ends of the first portion, respectively.

5. The display apparatus according to claim 3, wherein:

   the first portion comprises a composite material; and
   the second portion comprises one of a metal wire, a non-metal wire, or a composite wire.

6. The display apparatus according to claim 1, wherein:

   the variable section is elongated in one direction; and
   the variable section is fixed, at a central region thereof, at the display module such that the variable section does not move at the central region.

7. The display apparatus according to claim 6, wherein the variable section is movably fixed, at end regions thereof, by guide members fixed at the display module, respectively.

8. The display apparatus according to claim 1, wherein the driver comprises a motor.

9. The display apparatus according to claim 8, wherein the motor comprises an ultrasonic motor.

10. The display apparatus according to claim 8, wherein:

    the variable section comprises a first portion located at the display module, and a second portion located at the first portion;
    the driver comprises a rotating shaft rotatable by a rotating force from the motor;
    the second portion is fixed on the rotating shaft, and has a connection length variable in accordance with winding or unwinding of a portion of the second portion on or from the rotating shaft.

11. The display apparatus according to claim 10, wherein:

    the rotating shaft is formed with a fixing portion at an end of the rotating shaft disposed toward the display module; and
    the second portion is fixed on the fixing portion.

12. The display apparatus according to claim 8,

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wherein the driver further comprises a reducer connected to the motor.

13. The display apparatus according to claim 12, wherein the motor and the reducer are disposed in parallel at the display module.

14. The display apparatus according to claim 1, wherein:

the at least one variable section comprises a plurality of variable sections and the at least one driver comprises a plurality of drivers respectively corresponding to the plurality of variable sections, and/or
wherein:

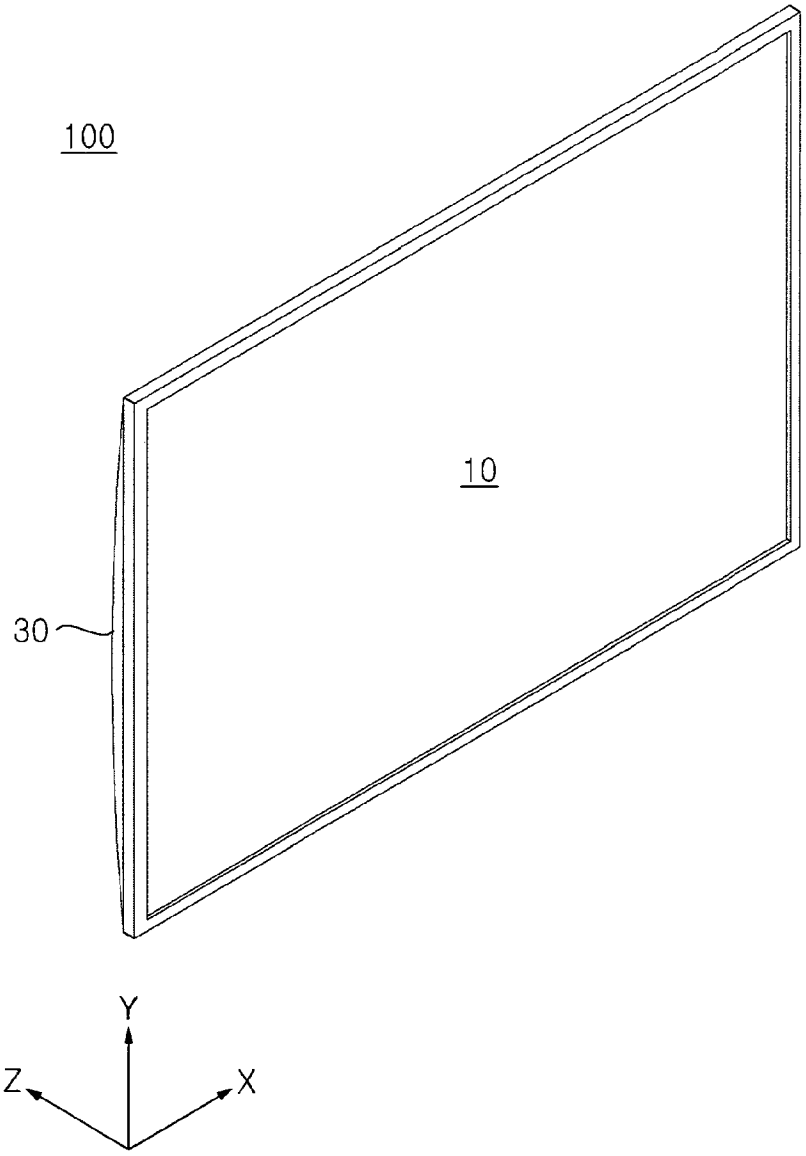
the at least one variable section comprises a plurality of variable sections, and the at least one driver comprises a driver to drive the plurality of variable sections.

15. The display apparatus according to claim 1, wherein:

the at least one variable section comprises a plurality of variable sections;
the at least one driver comprises a driver to drive the plurality of variable sections;
the at least one variable section comprises a first portion fixed on the display module, and a second portion disposed between the display module and the first portion, and fixed on the first portion;
the driver is spaced from the variable section; and
a path change member is disposed between the at least one variable section and the display module, to change a movement path of the second portion toward the driver.

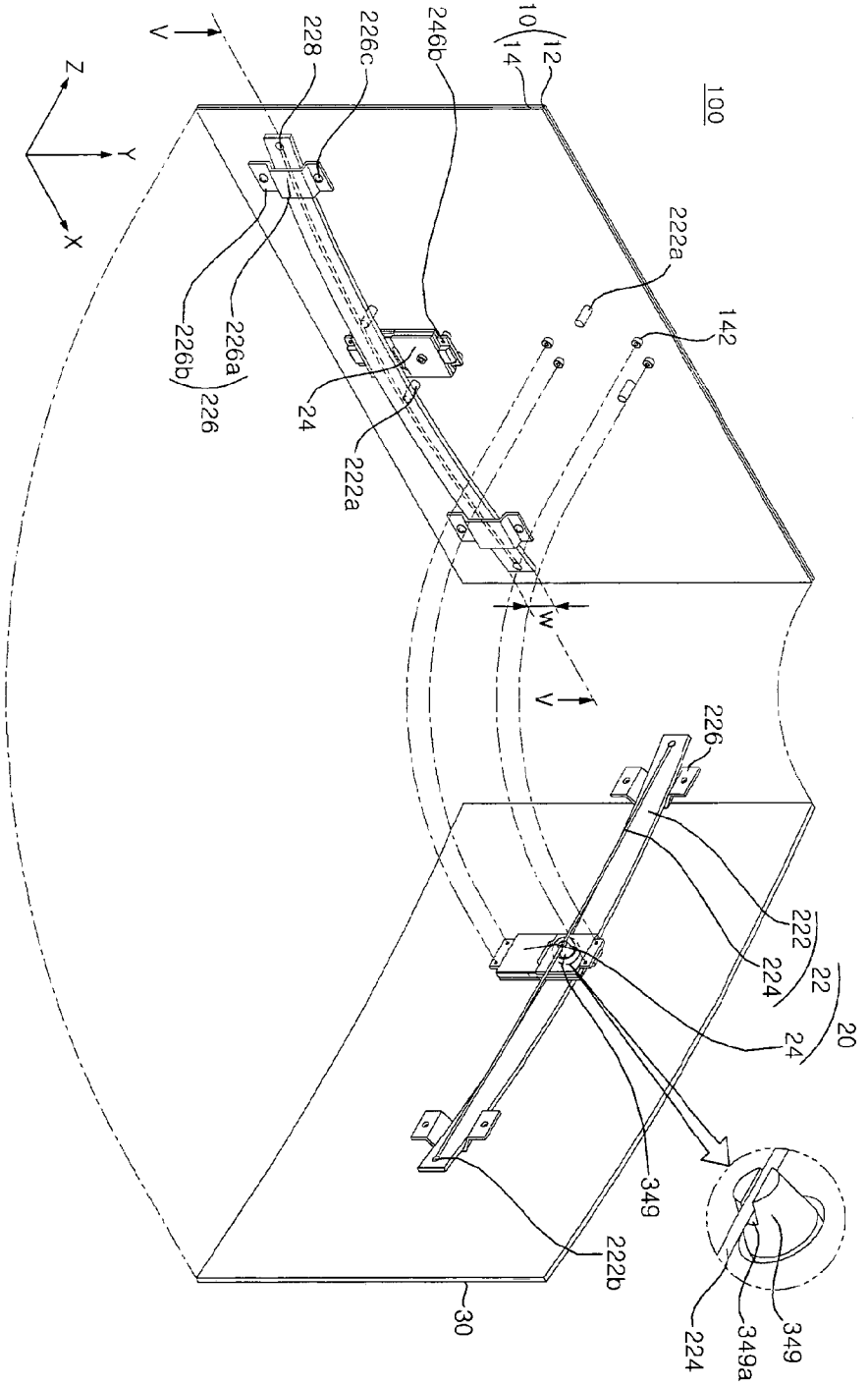
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FIG. 1



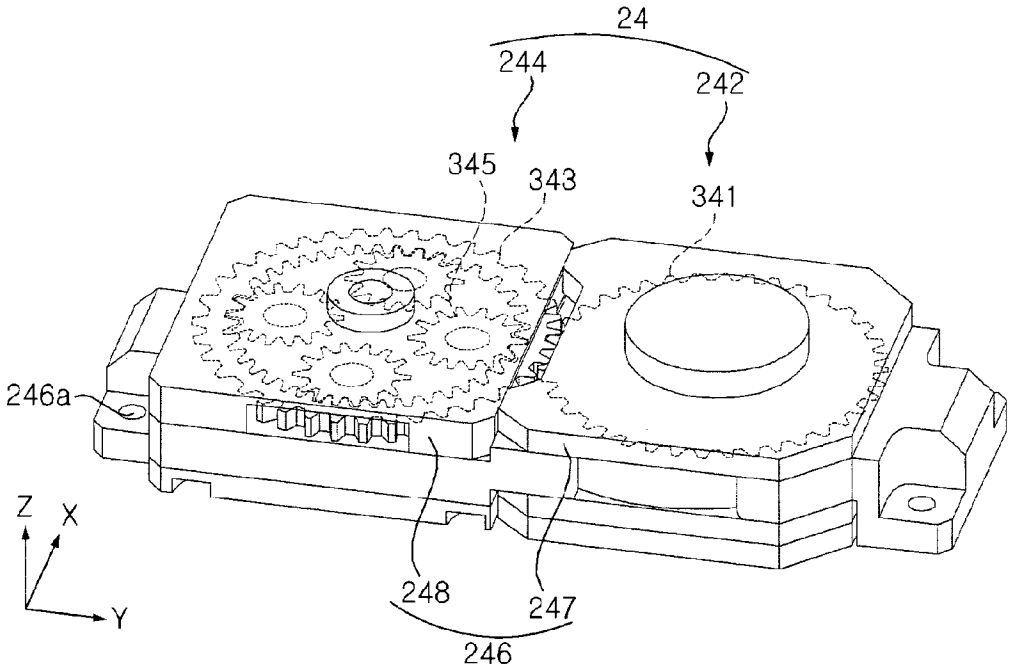
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FIG. 2



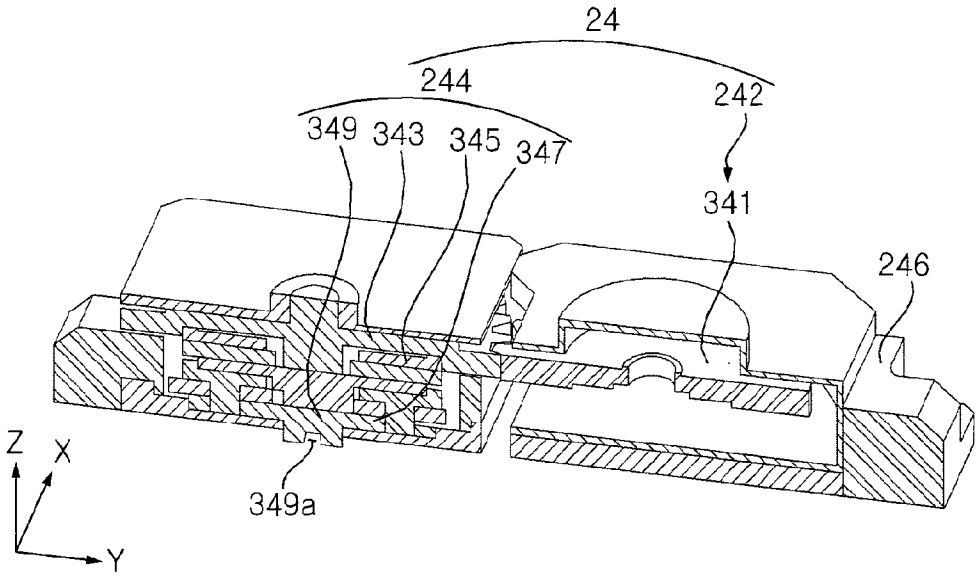
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FIG. 3



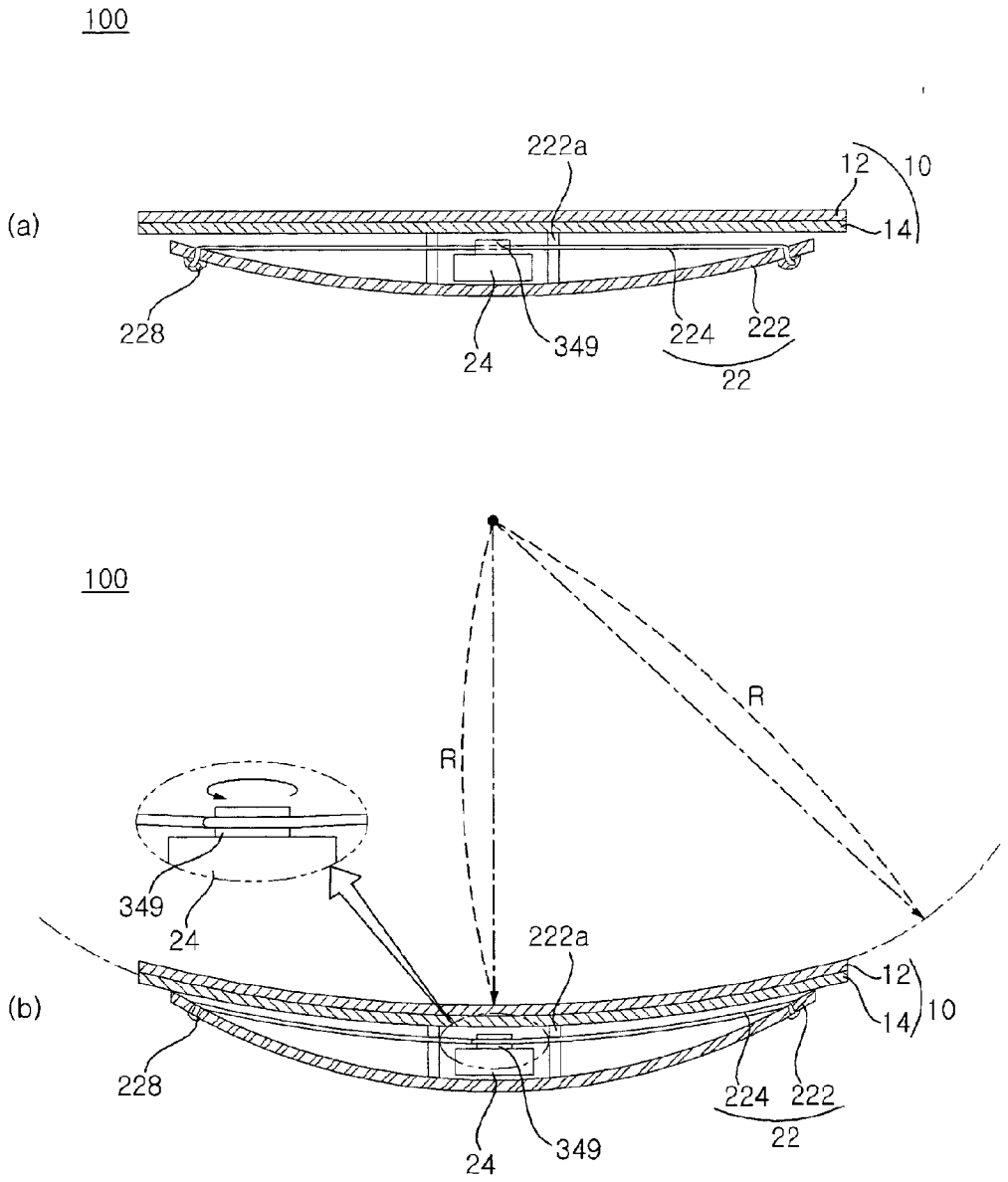
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FIG. 4



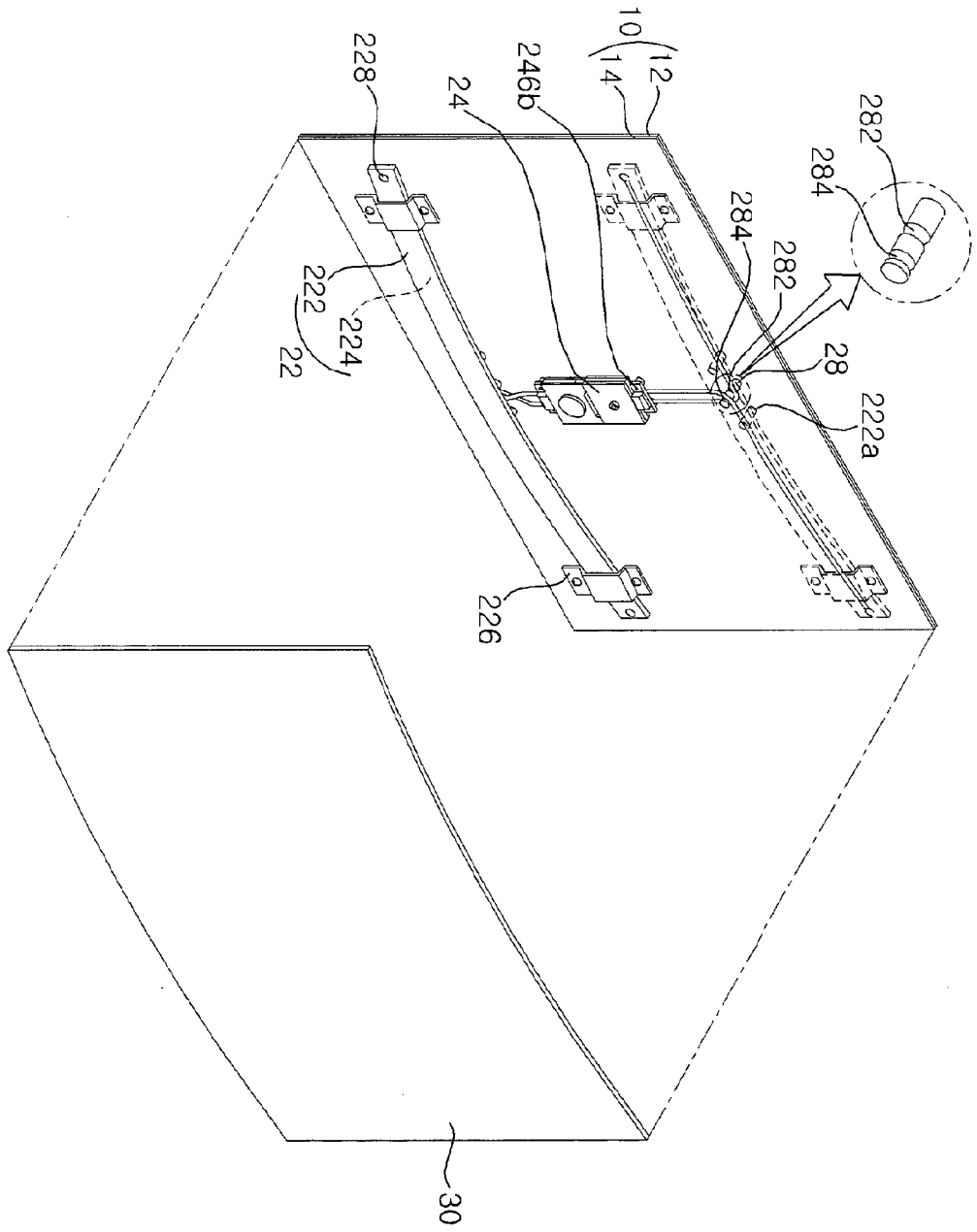
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FIG. 5



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FIG. 6



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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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Chemtronics Exhibit 1032 Page 756

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Veröffentlichungsnummer:
(11) Publication number: **EP 3 535 640 A0**
(11) Numéro de publication:

Internationale Anmeldung veröffentlicht durch die Weltorganisation für geistiges Eigentum unter der Nummer:

WO 2018/106176 (Art. 153(3) EPÜ).

International application published by the World Intellectual Property Organization under number:

WO 2018/106176 (Art. 153(3) EPC).

Demande internationale publiée par l'Organisation Mondiale de la Propriété Intellectuelle sous le numéro:

WO 2018/106176 (art. 153(3) CBE).

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
14 June 2018 (14.06.2018)

WIPO | PCT

(10) International Publication Number
WO 2018/106176 A1

(51) International Patent Classification:
G06F 1/16 (2006.01) *G06F 3/03* (2006.01)
G06F 3/01 (2006.01) *G06F 3/041* (2006.01)

(21) International Application Number:
PCT/SE2017/051233

(22) International Filing Date:
07 December 2017 (07.12.2017)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
1630294-5 07 December 2016 (07.12.2016) SE

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(54) Title: AN IMPROVED TOUCH DEVICE

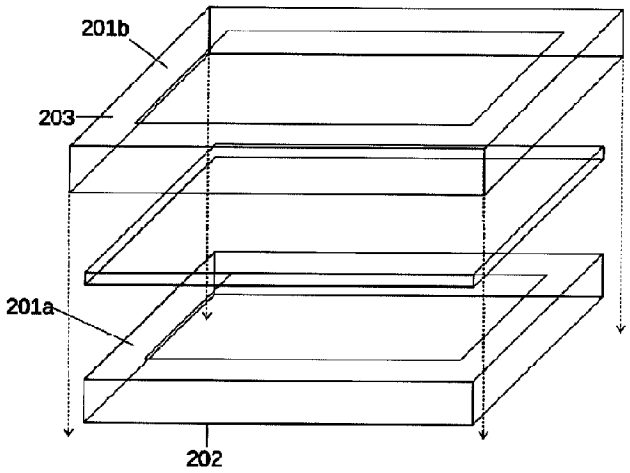


Figure 5b

(57) Abstract: An assembly for holding and controlling curvature of a glass plate for an optical touch sensitive system is described. The assembly comprising a first frame element extending in a first plane and configured to extend at least partially around a panel; at least one second frame element extending in a second plane and forming a support portion for the plate, and at least one spacing element positioned at least partially between the support portion and the first frame element. The spacing element us configured to control a curvature of the first frame element and wherein the at least one second frame element is configured to engage the plate at the support portion, is attached to the first frame element, and is tiltable, by controlling the curvature of the first frame element with said spacing element, to control a curvature of the plate.

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[Continued on next page]

(84) **Designated States** *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*
— *with amended claims (Art. 19(1))*
— *in black and white; the international application as filed contained color or greyscale and is available for download from PATENTSCOPE*

AN IMPROVED TOUCH DEVICE

Field of the Invention

This invention relates in general to the field of optical touch sensitive systems. More particularly, the invention relates to a curved plate and an assembly for holding a plate of the system, such as a glass plate, relative to a panel such that curvature of the plate is controlled. The invention also relates to a method for assembling a plate of an optical touch sensitive system with a panel (such as a display panel) in such a way that curvature is controlled.

Background of the Invention

In one category of touch sensitive panels known as above surface optical touch systems and known from e.g. US4459476, a plurality of optical emitters and optical receivers are arranged around the periphery of a touch surface to create a grid of intersecting light paths above the touch surface. Each light path extends between a respective emitter/receiver pair. An object that touches the touch surface will block certain ones of the light paths. Based on the identity of the receivers detecting a blocked light path, a processor can determine the location of the intercept between the blocked light paths. This type of system is only capable of reliably detecting the location of one object (single-touch detection). Further, the required number of emitters and receivers, and thus cost and complexity, increases rapidly with increasing surface area and/or spatial resolution of the touch panel.

In a variant, e.g. shown in WO2006/095320, each optical emitter emits a beam of light that diverges across the touch surface, and each beam is detected by more than one optical receiver positioned around the periphery of the touch surface.

These systems typically direct light to travel across the surface of the touch surface at a height of up to 5 mm.

Other above surface touch sensitive systems use tomographic touch imaging for sensing a touch, e.g. as described in WO2016/130074. Such systems allow for directing the light much closer to the touch surface, which in turn allows for significant improvements in accuracy and requires a lower light budget. The light is typically directed at a height of up to about 1 mm above the plate.

Typically, the touch surface is a glass plate. In systems where the light is directed closer to the touch surface, distortions in the plate have a disproportionally large effect on the light signal. Therefore, glass plates as used in previously known above surface optical touch systems are unsuitable when the light is transmitted closer to the plate, since the accuracy of the system is impaired by the distortions in the plate.

Additionally, a frame for assembly of the plate of the optical touch sensitive system and a panel, such as an LCD panel, may introduce distortion in the form of uncontrolled warpage, i.e. a twist or curve in the plate is introduced even if it is usually flat. The uncontrolled warpage may even block the light transmitted across the plate. This is due to uncontrolled twisting of the frame as such when it is attached to the panel.

Although not described in relation to touch systems, methods of minimizing glass warpage are known from the window industry and from the display panel industry. Such solutions include pre-bent glass in order to control warpage. However, such solutions are unsuitable/insufficient for touch sensitive systems since they typically require bulky frames at the border of the glass and/or pressure points closer to the center of the panel where force may be applied to control the shape of the glass. These solutions are unsuitable where a minimal/lightweight border bezel is required, and no supporting objects may touch the glass further in than at the borders. Additionally, pre-bent glass is expensive and fragile to transport.

Therefore, an improved frame assembly for holding a plate of an optical touch sensitive system relative to a panel would be advantageous and in particular allowing for improved precision, increased compactness, cost-effectiveness, and/or controlled curvature would be advantageous. Further, a touch panel having a shape conducive to transmitting as much light from the emitters as possible to the detectors is needed.

Summary of the Invention

Accordingly, embodiments of the present invention preferably seek to mitigate, alleviate or eliminate one or more deficiencies, disadvantages or issues in the art, such as the above-identified, singly or in any combination by providing an assembly, a method for assembling, and a kit of frame elements according to the appended patent claims.

A first embodiment of the invention describes an assembly for holding and controlling curvature of a plate for an optical touch sensitive system, comprising a first frame element extending in a first plane and configured to extend at least partially around a panel; at least one second frame element extending in a second plane and forming a support portion for the plate, and at least one spacing element positioned at least partially between the support portion and the first frame element, the spacing element being configured to control a curvature of the first frame element, and wherein the at least one second frame element is configured to engage the plate at the support portion, is attached to the first frame element, and wherein the shape and/or position of the second frame element is controlled by the curvature of the first frame element with said spacing element, to control a curvature of the plate.

A second embodiment of the invention describes a method for assembling a panel and a plate for an optical touch sensitive system, comprising: providing a first frame element extending in a first plane and configured to extend at least partially around a panel; providing at least one second frame element forming a support portion for the plate; supporting the plate by the support portion; attaching the second frame element to the first frame element such that the support portion extends at least partially in a second plane generally opposite at least a portion of the first frame element and is spaced apart from the first plane; and controlling a curvature of the first frame element with a spacing element attached to the first frame element and thereby tilting the support portion to control a curvature of the plate.

A third embodiment of the invention describes a kit of frame elements for assembling a panel and a plate for a touch sensitive system, comprising: a first frame element extending in a first plane; at least one second frame element forming a support portion for the plate and being attachable to the first frame element, and a spacing element adjustably attachable to the first frame element; wherein at least a portion of the support portion is tiltable, by the spacing element, relative to the first frame element to extend in the second plane, which is curved.

Some embodiments of the invention provide for controlling curvature of a plate for an optical touch sensitive system such that it does not occur when the plate is assembled with a panel. This prevents distortion in the plate from affecting a light signal transmitted across the plate, which in turn allows improvements in accuracy and lower light budget of the system. Additionally, or alternatively, embodiments provide for controlling curvature such that the field of view, for a detector receiving light from a light emitter of the touch sensitive system, is increased compared to a substantially flat plate. Again, the improved field of view provides for improved accuracy of the touch sensitive system and allows for a better light budget. Furthermore, embodiments provide for an assembly that is compact at the same time as curvature may be controlled. Also, the curvature may be controlled without contacting the center of the plate.

A fourth embodiment of the invention describes a touch sensing apparatus, comprising a touch surface; a set of emitters arranged around the touch surface to emit first beams of light to propagate across the touch surface, a set of light detectors arranged around the touch surface to receive light from the first set of emitters, wherein each light detector is arranged to receive light from more than one emitter; a processing element configured to determine, based on output signals of the set of light detectors, the position of an object on the touch surface, wherein the touch surface is curved in a first axis according to a first parabola.

It should be emphasized that the term "comprises/comprising" when used in this specification is taken to specify the presence of stated features, integers, steps or components but does not preclude the presence or addition of one or more other features, integers, steps, components or groups thereof.

Brief Description of the Drawings

These and other aspects, features and advantages of which embodiments of the invention are capable of will be apparent and elucidated from the following description of embodiments of the present invention, reference being made to the accompanying drawings, in which:

Figure 1 is a top view of the first frame element showing cross-sectional axes A-A and B-B;

Figures 2a-2d are cross-sectional views of embodiments of assemblies;

Figure 3a is a schematic illustration showing the cross-section axis B-B of figure 1 of the assembly with the second frame element relative to the first frame element and holding the plate in a flat plane;

Figure 3b is a schematic illustration showing the cross-section axis A-A of figure 1 of the assembly with the second frame element relative to the first frame element and holding the plate in a flat plane;

Figure 3c is a schematic view (cross section) showing the cross-section axis B-B of figure 1 of the assembly with the second frame element warped relative to the first frame element and holding the plate in a curved plane that is concave;

Figure 3d is a schematic view (cross section) showing the cross-section axis A-A of figure 1 of the assembly with the second frame element warped relative to the first frame element and holding the plate in a curved plane that is concave;

Figure 4a is a perspective view of the first frame element;

Figure 4b is a schematic illustration of the panel in a convex shape and the frame of the first frame element in a concave shape, including plate 2 also controlled into a concave shape;

Figure 4c is a side view showing screws 116a and 116b;

Figures 5a-5h are side views and perspective views of an embodiment of the assembly comprising a screw arrangement for configuring frame shape; and

Figures 6 is a schematic cross section from a first direction of an embodiment of the assembly;

Figure 7 is a schematic side-view of another embodiment for providing curvature of plate 2;

Figure 8 shows an isometric view of a variation of the embodiment of figures 5a-5g;

Figure 9 is a diagram showing a top down view of an optical touch system and corresponding detection lines;

Figure 10a shows an isometric view of a flat touch surface of an optical touch system;

Figure 10b shows a section view of an optical touch system with a flat touch surface;

Figure 11a shows an isometric view of a touch surface of an optical touch system having a curved profile in the x-axis;

Figure 11b shows a section view along the x-axis of an optical touch system with a touch surface having a curved profile in the x-axis;

Figure 11c shows a section view along the x-axis of an optical touch system with a touch surface having a curved profile in the x-axis;

Figure 11d shows an example of types of warpage that a touch panel may exhibit.

Figure 12a shows top view of a touch surface of an optical touch system;

Figure 12b shows an isometric view of a touch surface of an optical touch system having a curved profile in the x-axis and a curved profile in the y-axis;

Figure 12c shows a section view along the x-axis of an optical touch system with a touch surface having a curved profile in the x-axis and a curved profile in the y-axis;

Figure 12d shows a section view along the y-axis of an optical touch system with a touch surface having a curved profile in the x-axis and a curved profile in the y-axis;

Figure 13a shows a section render of light emitted from a point at an edge of a curved touch surface and propagating across the curved touch surface to be received at a detector at an opposite edge of the touch surface;

Figure 13b shows a graph of light emitted from a point at an edge of a curved touch surface and received at a detector at an opposite edge of the touch surface with respect to the angle of the emitter light;

Figure 14a shows a section render of light emitted from a point at an edge of a curved touch surface and propagating across the curved touch surface to be received at a detector at an opposite edge of the touch surface;

Figure 14b shows a graph of light emitted from a point at an edge of a curved touch surface and received at a detector at an opposite edge of the touch surface with respect to the angle of the emitter light;

Figure 15a shows a section render of light emitted from a point at an edge of a curved touch surface and propagating across the curved touch surface to be received at a detector at an opposite edge of the touch surface;

Figure 15b shows a graph of light emitted from a point at an edge of a curved touch surface and received at a detector at an opposite edge of the touch surface with respect to the angle of the emitter light;

Figure 16a shows a section render of light emitted from a point at an edge of a curved touch surface and propagating across the curved touch surface to be received at a detector at an opposite edge of the touch surface;

Figure 16b shows a graph of light emitted from a point at an edge of a curved touch surface and received at a detector at an opposite edge of the touch surface with respect to the angle of the emitter light;

Figure 17a shows a section render of light emitted from a point at an edge of a curved touch surface and propagating across the curved touch surface to be received at a detector at an opposite edge of the touch surface;

Figure 17b shows a graph of light emitted from a point at an edge of a curved touch surface and received at a detector at an opposite edge of the touch surface with respect to the angle of the emitter light;

Figure 18a shows a curvature of a real touch surface vs a parabolic curved surface along an x-axis;

Figure 18b shows a deviation between a real touch surface vs a parabolic curved surface along an x-axis;

Figure 19a shows a curvature of a real touch surface vs a parabolic curved surface along an x-axis;

Figure 19b shows a deviation between a real touch surface vs a parabolic curved surface along an x-axis;

Figure 20a shows top view of displacement contours for a touch surface according to an embodiment;

Figure 20b shows curvature of a touch surface along an x-axis according to the embodiment of figure 20a;

Figure 20c shows curvature of a touch surface along a y-axis according to the embodiment of figure 20a;

Figure 20d shows curvature of a touch surface along a diagonal line according to the embodiment of figure 20a;

Figure 21a shows top view of displacement contours for a touch surface according to another embodiment;

Figure 21b shows curvature of a touch surface along an x-axis line according to the embodiment of figure 21a;

Figure 21c shows curvature of a touch surface along a y-axis line according to the embodiment of figure 21a;

Figure 21d shows curvature of a touch surface along a diagonal line according to the embodiment of figure 21a.

Description of Embodiments

Specific embodiments of the invention will now be described with reference to the accompanying drawings. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. The terminology used in the detailed description of the embodiments illustrated in the accompanying drawings is not intended to be limiting of the invention. In the drawings, like numbers refer to like elements.

In optical touch sensitive systems, a plate 2 of the system, such as a glass plate may be arranged opposite a panel 1, such as an LCD panel or additional frame. The plate 2 is normally substantially flat. The perimeter of the plate 2 after integration is a concern: the four sides/edges of the plate 2 must all be plane or slightly concave as seen from the touch surface, i.e. the side of the plate 2 above which light is transmitted. An aspect of this is to ensure that the mechanical parts that hold or support the perimeter of the plate 2 are free from convexity. Sometimes, there are several components that are involved in holding the plate 2 (back cover, carriers, edge cover, screw bosses etc.) The stiffer component of the assembly, the more it will govern the final shape of the plate 2.

In prior art solutions, the frame that holds the plate 2 at the edge/perimeter may introduce some twist (the corners will not lay perfectly on a flat plane) to the plate. Twist may induce convexity along the plate diagonals and should thus be minimized or avoided. The twist tolerance depends, e.g., on glass specification, product, size, shape of integrated glass perimeter, and on how a VESA mount is attached.

Figure 1 shows an embodiment of a frame assembly 100, 200 that prevents inducement of convexity along the plate, such as along the plate edges and/or diagonals. Some embodiments avoid convexity and may even induce concavity to further improve the touch system. Frame 109 is formed from first frame element 102. Attachment element 112 and spacing element 116 are described in the embodiments below.

According to some embodiments of the invention, an assembly 100, 200, which is configured to hold or support the plate 2 and the panel 1, applies a controlled force to the plate 2 such that curvature of the plate 2 is controlled. In the embodiments illustrated in figures 2a-2c and 3a-3d, the force applies a torque to a support portion 101a, 101b for the plate 2. In the embodiments of figures 4a-4c, the force is substantially straight and perpendicular to the plate 2. In the following, the embodiments of figures 2a-2c, 3a-3d, 4a-4c, and 5a-5g will be described separately. However, these embodiments may be combined to provide further embodiments, such as the combination illustrated in figures 6a-6c.

Figures 2a-2d illustrate embodiments wherein the frame assembly 100 comprises a first frame element 102 and at least one second frame element 103a, 103b. The first frame element 102 may form a rear bracket frame that extends at least partially over the backside of the panel 1. The second frame element 103a, 103b may form a holder or support bracket. Furthermore, second frame element 103a, 103b may extend along at least a portion of a perimeter of the plate 2 and/or the panel 1. Separate second frame elements 103a, 103b may extend at least partially along the perimeter of different sides of the plate 2 and/or panel 1. For example, two second frame elements 103a, 103b may extend along opposing perimeters of the plate 2 and/or panel 1. Alternatively, four second frame elements 103a, 103b may extend along the perimeter of the plate 2 and/or panel 1, i.e. one along each side of a rectangular plate 2 and/or panel 1.

As is illustrated in figures 4a-4c, the panel 1 may be held between the first frame element 102 and the second frame element 103a, 103b. The plate 2 may be supported or held at a first side of a portion of the second frame element 103a, 103b forming the support portion 101a, 101b. The panel 1 may be held or supported by a second side of the support portion 101a, 101b, which forms a support portion for the panel 1. An adhesive 104, such as an adhesive tape, may be arranged between the support portion 101a, 101b and the plate 2. A gasket 105 may be arranged between the support portion 101a, 101b and the panel 1.

In one embodiment, elements 102, 103 (shown in the figure as comprising elements 103a and 103b) are formed from a single piece.

The second frame element 103a, 103b may be attached to the first frame element 102.

In the embodiments of figures 2a-2c and 3a-3d, the second frame element 103a, 103b, is attached to the first frame element 102 by at least one attachment member 106a, 106b, such as a screw, a weld, a rivet etc. Therefore, the second frame element 103a, 103b may be rigidly attached to the first frame element 102.

The first frame element 102 may comprise a flange 107a, 107b that extends at the perimeter of the first frame element 102. Similarly, the second frame element 103a, 103b may comprise a flange 108a, 108b. When assembled, the flange 107a, 107b of the first frame element 102 may be arranged in abutment with the flange 108a, 108b of the second frame element 103a, 103b. The flange 107a, 107b of the first frame element 102 may be held together with the flange 108a, 108b of the second frame element 103a, 103b by the attachment member 106a, 106b.

The first frame element 102 may form a frame 109 (shown in figure 1) that extends in a first plane. The frame 109 is configured to extend at least partially around a first side of a panel 1. The first side of the panel 1 may be the backside of the panel 1. In some embodiments, the frame 109 has a width, such as 3-10 cm. The frame 109 may extend from the edges of the first side towards the center of the first side of the panel 1. Therefore, the frame 109 may be rectangular, and made from a single piece of material.

As is illustrated in figures 3a and 3b, the assembly 100 may comprise at least one support area 110a, 110b for supporting a back cover 111. The support area 110a, 110b may extend in a plane that is substantially parallel to the first plane, in which the frame 109 extends. The support area 110a, 110b may be located further away from the support portion 101a, 101b of the second frame element 103a, 103b than the frame 109, such that the frame 109 and the back cover 111 are spaced apart. In the illustrated embodiment, the support area 110a, 110b is provided between the flange 107a, 107b and the frame 109 of the first frame element 102. The back cover 111 may be attached to the support area 110a, 110b, e.g. by attachment elements, such as screws.

In other embodiments, the support area 110a, 110b is provided by the flange 108a, 108b of the second frame element 103a, 103b. The flange 107a, 107b of the first frame element 102 may be connected to the second frame element 103a, 103b between the flange 108a, 108b and the support portion 101a, 101b of the second frame element 103a, 103b.

The second frame element 103a, 103b may form the support portion 101a, 101b. For example, the second frame element 103a, 103b may form an elongated member that is at least partly L-shaped in cross-section. When assembled, the second frame element 103a, 103b may extend along the perimeter of the panel 1, and wrap around the perimeter of the panel such that the support portion 101a, 101b extends at least partially in a second plane generally opposite the frame 109 and spaced apart from the first plane. Thereby the second frame element 103a, 103b is configured to extend at least partially at a second side of the panel 1, e.g. at a front side of the panel 1.

In some embodiments, the second frame element 103a, 103b has a first portion and a second portion. The first portion may be provided at an angle relative to the second portion. The second portion may form the support portion 101a, 101b and be configured to extend in the second plane opposite the frame 109. The first portion may extend between the second portion and the first frame element 102. Also, the first portion may extend along the edge or side surface of the plate 2 when assembled. The first frame element 102 may be connected to the first portion of the second frame element 103a, 103b. The first portion may be substantially perpendicular to the second portion.

As is illustrated in figures 3a-3d, the first frame element 102 may be attached to the first portion of the second frame element 103a, 103b such they are fixed relative to each other. Furthermore, the second frame element 103 is tiltable relative to the first frame element 102. A force applied to the first frame element 102 is transferred to the second frame element 103 such that the support portion 101a, 101b is tilted towards the first frame element 102. Thus, a torque may control tilt of the second portion of the second frame element 103a, 103b, i.e. the support portion 101a, 101b that supports the plate 2, relative to the first frame element 102, which is illustrated with a curved arrow in figure 3c and 3d. In some embodiments, the angle of tilt of the support portion 101a, 101b is controlled to be neutral, i.e. the angle of tilt of the support portion 101a, 101b is controlled such that it is substantially parallel with the panel 1 and/or controls the plate 2 to be in a flat plane, as is illustrated in figures 3a and 3b. In other embodiments, the angle of tilt of the support portion 101a, 101b is controlled to be negative relative to the touch surface, i.e. the angle of tilt of the support portion 101a, 101b is controlled such that the free end of the support portion 101a, 101b is tilted towards the frame 109, as is illustrated in figure 3c and 3d. In the latter case, the plate 2 is given a slightly concave shape, i.e. in the direction from the touch surface of the plate 2 towards the panel 1. In each of these cases curvature is controlled such that the field of view, for a detector receiving light from a light emitter of the touch sensitive system, is improved since convexity in the plate is avoided. Again, improved field of view provides for improved accuracy of the touch sensitive system and allows for lower light budget. Furthermore, since the support portion 101a, 101b only needs to extend a short distance over the plate 2 at the perimeter the assembly is compact at the same time as curvature may be controlled. Also, curvature may be controlled without contacting the center of the plate. When the concavity is applied, the sensitivity of the system may be even further improved.

Figures 2a-2d and 3a-3d illustrate embodiments of an attachment element 112 for attaching the first frame element 102 to the panel. A plurality of attachment elements 112 (e.g. as shown in triplicate as elements 112a, 112b, and 112c) may be arranged around

the frame 109, such as at each corner of the frame 109, which is illustrated as circles in figure 4a. Each attachment element may comprise a group of screws 112a, 112b, 112c, 113a, 113b. Each screw may be arranged in a hole of the frame 109, which may be threaded. Each attachment element may comprise at least two screws 112a, 112b, 112c, 113a, 113b. At least one of the screws 112a, 113a may be arranged to displace the frame 109 away from panel 1, which is indicated with an arrow in figure 2d e.g. by having a thread in the frame 109 and pushing on the panel 1. At least one other of the screws 112b, 112c, 113b may be arranged to displace the frame 109 towards the panel 1, which is also indicated with an arrow in figure 2d. e.g. by having a thread in the panel and a hole in frame 109.

Figure 2a illustrates an embodiment wherein each attachment element comprises at least three screws 112a, 112b, 112c. All three screws 112a, 112b, 112c are arranged closer to a center of the first frame element 102 than a perimeter of the support portion 101a, 101b, i.e. an imaginary extension 114a, 114b, 114c of the longitudinal axis of each screw 112a, 112b, 112c passes outside the support portion 101a, 101b when viewed in cross-section, as is illustrated in figure 2a. In the illustrated embodiment, a first screw 112a is arranged between a second screw 112b and a third screw 112c. Figure 2a only illustrates one group of screws. However, a group of screws may be arranged at any location around the frame 109 to attach the first frame element 102 to the panel 1.

Figure 2b illustrates an embodiment wherein each group of screws consists of only two screws 113a, 113b. A first screw 113a is arranged opposing the support portion 101a, 101b, i.e. an imaginary extension 115a of the longitudinal axis of the first screw 113a passes through the support portion 101b when viewed in cross-section, such as through the center thereof, as is illustrated in figure 2b. A second screw 113b of the two screws is arranged closer to a center of the first frame element 102 than a perimeter of the support portion 101b, i.e. an imaginary extension 115b of the longitudinal axis of the first screw 113b passes outside the support portion 101b when viewed in cross-section, as is illustrated in figure 2b.

As shown in figure 2d, the first screw 112a is arranged to displace the frame 109 away from panel 1. This may be enabled by a threaded hole 112i in the frame 102 which the first screw engages while a head of the screw abuts the panel 1. The second screw 112b is arranged to displace the frame 109 towards the panel. This may be enabled by a threaded hole 112f in the panel 1, which the second screw 112b engages while the head of the second screw 112b abuts the surface of the frame. By using screw 112a and/or 112b, forces may be applied to frame 102 and/or panel 2 to control bending or rotation of the frame/panel.

Since the first screw 113b is aligned over the support portion 101a, 101b in the embodiment of figure 2b, only two screws are required to control bending or rotation of the frame.

In figures 2a-2b, only one group of screws is illustrated. However, a group of screws may be arranged at any location around the frame 109 to support the plate 2 and the panel 1.

figure 2c illustrates that a combination the embodiment of figures 2a and 2b, i.e. groups of screws with two as well as three screws may be arranged around the frame 109. Therefore, flexibility is provided for.

As is illustrated in figures 2a-2c and 3c and 3d, each group of screws 112a, 112b, 112c, 113a, 113b may apply a force to the frame 109. Therefore, a torque may be applied at the second frame element 103a, 103b via controlling the curvature of the frame 109 such that tilt of the support portion 101a, 101b, and thereby curvature of the plate, is controlled. In the assembly illustrated in figure 3a, a net force is applied such that the frame is substantially flat and parallel with the panel 1. In the assembly illustrated in figure 3c and 3d, a net force away from the support portion 101a, 101b is provided to the frame 109, which will be slightly concave when viewed from the touch surface of the plate 2. As a consequence, a torque will be provided at to the second frame element 103a, 103b, which will tilt the support portion 101a, 101b along the edge or perimeter of the plate 2. Therefore, controlling the curvature of the first frame element 109 may control curvature of the plate. The plate 2 may become concave as viewed from the touch surface of the plate 2.

Figures 4a-4c, 5a-5g and 6a-6c illustrate embodiments wherein an alternative or additional control of the shape of the frame 109 may be introduced. As shown in figure 4a, attachment elements 112 may be arranged at the corners of the frame 109. The attachment elements 112 may comprise the group of screws 112a, 112b, 112c, 113a, 113b as described above with regard to figures 2a-2c and 3a-3d. The attachment elements 112 may be arranged to pull the panel 1 towards the frame 109. This may be done with or without tilting the support portion 101a, 101b as described above. At least one spacing element 116 (where spacing element 116 may comprise screw 112 and a separate spacing component) may be arranged along the perimeter of the frame 109 between two attachment elements 112. The spacing element 116 is arranged in the assembly to apply a force to the frame 109 directed away from the panel 1. Thereby, a force applied by the spacing element 112 may be transferred to the second frame element 103a, 103b such that the support 101a, 101b is tilted as described above, whereby curvature of the plate 2 is controlled.

As is illustrated in figure 4b, the general shape of the frame 109 will be concave, whereas the general shape of the panel 1 may be convex. The panel may also remain substantially plane depending on its rigidity. The resulting shape of the plate 2 will be concave. Therefore, each side of the frame 109 may be controlled to follow a curved path. The curvature may be controlled by adjusting the force applied by each spacing element 116 and/or via the number of spacing elements 116 along each side of the frame 109. As a result, the support portion 101a, 101b, at least at the free end of the support portion 101a, 101b, may also follow a curved path. Therefore, at least a portion of the support portion 101a, 101b may extend in a plane that is curved.

When the second frame element 103a, 103b is disassembled or only attached to the first frame element 102, it may have a relaxed state. In the relaxed state, the support portion 101a, 101b extends in a plane that is substantially flat. The second frame element 103a, 103b may be deflectable from the relaxed state to a deflected state or stressed state, such as by the attachment elements 112 and spacing elements 116. The level of tilt at the opposing ends of the support 101a, 101b where the attachment elements 112 are provided may be less than the level of tilt between the ends where spacing element(s) 116 is/are provided. As consequence, the second frame element 103a, 103b may be deflected to the deflected or stressed state. In the deflected or stressed state, the support portion 101a, 101b extends, along its length, in a plane that is curved. A cross section of this plane taken along the support portion 101a, 101b, such as at the free end or tip of the support portion 101a, 101b may form a parabolic concave curve along at least a portion of the length of the support portion 101a, 101b. A combination of the attachment element 112 and the spacing element 116, that together may form a screw arrangement, may hold the second frame element 103a, 103b in the deflected or stressed state when assembled with the first frame element 102.

The spacing element 116 may be provided by a single screw that engages a thread in the frame 109 while its tip engages or abuts a surface on panel 1. Alternatively, panel 1 comprises a threaded hole into which spacing element 116 is threaded so that spacing element 116 can be used to displace the frame 109 towards panel 11. Additionally, element 116 may comprise a spacer component such as a washer, spacer, etc. In figure 3a and 3b and figure 6a, two spacing elements 116a, 116b are shown for illustrative purposes and may form separate embodiments. A single-spacing element 116a, 116b may be used in other embodiments. The head of the spacing element 116a, 116b may abut the back cover 111 while the spacing element 116a, 116b may engage the frame 109, wherein the frame 109 may be pulled towards the back cover 111. As a result, the frame 109 becomes concave. In some embodiments, the spacing element 116a does not abut or engage the

panel 1, wherein the panel 1 may be unaffected by the force applied to the frame 109. In other embodiments, the spacing element 116b is sufficiently long such that a tip of the spacing element 116b abuts a surface of the panel 1. This adds further control of the shape of the plate 2.

In some of the embodiments, the frame assembly 100 comprises a plurality of spacing elements 116 arranged spaced apart from corners of the frame 109. One or several spacing elements 116 may be arranged along each perimeter or side of the frame 109. If a single spacing element 116 is arranged along each side, it is preferably centered between the corners of the frame 109.

Each spacing element 116 may comprise a screw with a predefined length. This means that the screw can be fully seated such that the head and tip abut respective surfaces, whereby a predefined curvature of the plate 2 is obtained. The level of curvature may be adjusted by one or several spacers arranged between the head and the surface which the head engages. This is particularly useful if multiple spacing elements 116 are arranged along a single side, or if different sides have different lengths. The more spacers provided, the less force will be applied to the frame 109. Alternatively, as shown in figure 5h, predefined height differences may be generated via other methods, e.g. by milling the frame to the predefined heights, allowing a more continuous support structure.

Figures 5a-5h illustrate embodiments of an assembly 200, which may be combined with the first frame element 102 described above. The embodiments shown in figures 5a-5h are shown inverted relative to the embodiments shown previously, with the plate 2 at the top.

As shown in figures 5a and 5b, the frame assembly 200 may comprise a first frame element 202, and a second frame element 203. The first frame element 202 and the second frame element 203 may be elongated members, each having a support portion 201a, 201b. The first frame element 202 and the second frame element 203 may e.g. be L-shaped in cross section. A first portion of each of the first frame element 202 and the second frame element 203 may be configured to extend along the edge of the panel 1. A second portion of each of the first frame element 202 and the second element 203 forms the support portion 201a, 201b, and may be configured to extend from the perimeter of the plate 2 a short distance, such as a 1-3 cm, over the surface of the plate 2 when assembled. Furthermore, the second frame element 203 may be arranged on top of the first frame element 202 and such that the perimeter of the plate 2 is arranged between the second portion of each of the frame elements 202, 203 when assembled. Therefore, each support portion 201a, 201b may support or engage opposing surfaces of the plate 2, such as is illustrated in figure 5g.

In some embodiments, such as illustrated in figures 5c-5d, a gasket 205 (e.g. gaskets 205a, 205b, 205c, 205d, 205e) is arranged between the first frame element 202 and the second frame element 203. The gasket may e.g. be arranged on the support portion 201a of the first frame element 202. Also, a sealing 204a may be arranged on the support portion 201b of the second frame element 203.

The gasket 205 may have a varying thickness along its length, i.e. also along the length of the first frame element 202. This provides for obtaining a desired curved shape of the perimeter of the plate 2 when captured between the first frame element 202 and the second frame element 203, as is illustrated in figures 5f-5g. For example, the gasket 205 has opposing ends and may be thinner between the opposing ends than at said ends. This provides for obtaining a predefined concavity of the perimeter of the plate 2. The gasket is sufficiently stiff that it is thicker at the ends even when compressed. The gasket 205 may be about 1.5-2.0mm at the ends and about 1 mm thinner at the center.

In some embodiments, the gasket 205 has a plurality of sections along its length. The thickness of each section may vary. For example, a first section 205a of the gasket is provided at one of its ends and a second section 205b of the gasket at the other of its ends. The first section 205a and the second section 205b may have a first thickness that may be equal at each section. At least a third section 205c of the gasket is arranged between the first section 205a and the second section 205b. The third section 205c has a second thickness. The first thickness is thicker than the second thickness. For example, difference in thickness is about 0.5-2mm, preferably about 1.0mm. The difference in thickness may vary depending on the length of the gasket 205 and the edge of the plate 2 at which the concavity is to be introduced. In some embodiments, fourth and fifth sections 205d, 205e may be provided between the first and second sections 205a, 205b and the third section 205c, respectively. The fourth and fifth sections 205d, 205e may add further control of the shape of the concave curve provided by the arrangement 200. The length of each the first and second sections 205a, 205b may be about 2-20% of the total length of the gasket 205. The length of the third section may be about 60-96% of the total length of the gasket 205. The length of each of the fourth and fifth sections 205d, 205e may be about 10-20% of the total length of the gasket 205. In some embodiments the total length of the fourth and fifth sections 205d, 205e is shorter than the length of the third section 205c, and the total length of the first and second sections 205a, 205a is shorter than total length of the fourth and fifth sections 205d, 205e. This provides for a parabolic concave curve along the length of the frame assembly 200.

A distance between the support portion 201a of the first frame element 202 and the support portion 201b of the second frame element 203 may be discontinuous in an assembled state, as can be seen in figure 5e.

In order to maintain the concavity of the plate 2, the first frame element 202 and the second frame element 203 may be held together such that the distance between the support portions 201a, 201b is maintained in the assembled state. The first frame element 202 has a first hole 217a and a second hole 217b arranged at opposing ends of the first frame element 202, such as at the second portion of the first frame element 202. The first and the second hole 217a, 217b are arranged in a first plane. A third hole 217c is arranged between the first hole 217a and the second hole, such as centered between the first hole 217a and the second hole 217b. The third hole 217c is provided in a plane that is different from the first plane. The distance or offset between the plane in which the first and second holes 217a, 217b are arranged and the plane in which the third hole 217c is arranged may be substantially the same as the difference in thickness between the first and second sections 205a, 205b and the third section 205c, i.e. about 0.5-2mm. In some embodiments the first and second holes 217a, 217b are centered in each of the first and second sections 205a, 205b of the gasket 205 along the length of the first frame element 202.

Similarly, the second frame element 203 may comprise a first hole 218a and a second hole 218b arranged at opposing ends of the second frame element 203. A third hole 218c may be arranged between the first hole 218a and the second hole 218b of the second frame element 203. The first hole 218a, the second hole 218b, and the third hole 218c of the second frame element 203 is generally arranged in the same plane when the second frame element 203 is disconnected from the first frame element 202. The second frame element 203 may be less stiff or weaker than the first frame element 202 and be deflectable such that each hole 218a, 218b, 218c of the second frame element 203 is aligned with the holes 217a, 217b, 217c of first frame element 202. Therefore, the support portion 201b of the second frame element 203 may be deflected such that it extends in plane, which is curved in the assembled state of the frame assembly 200. Screws 219a, 219b, 219c may be inserted through the aligned holes 217a, 217b, 217c; 218a, 218b, 218c and may directly engage the panel or engage a threaded hole in the panel 1, which will hold the frame elements 202, 203 in the assembled state. Other relative arrangements of the holes 217a, 217b, 217c; 218a, 218b, 218c are foreseen, wherein the center holes 217c, 218c of each frame element 202, 203 are misaligned in the relaxed state of the second frame element 203 but aligned in the deflected or stressed state of the second frame element 203.

In some embodiments, the first frame element 202 forms a frame side, and the second frame element 203 forms an edge cover. If used together with the frame 109 discussed with regard to figures 4a-4c, the frame side may replace the second frame element of the embodiments of figures 4a-4c. Therefore, the frame side comprises the support portion 201a with a support surface generally opposing the frame 109 and is configured to support the gasket 205.

As illustrated in figure 6, a component (e.g. a sealing component 204a) may be provided between the support portion 201a and the plate 2. Figure 6 illustrates the resulting forces and torque generated when a force 220 is applied to second frame element 203a. A second force 221 is applied to support portion 201. Therefore, a net torque 222 is generated, i.e. counter-clockwise in the illustrated arrangement. The plate 2 will assume a curved path, as is illustrated with dotted line 223.

In an embodiment shown in figure 7, an alternative arrangement is provided for providing curvature of plate 2. In this embodiment, support block 301 is arranged to support glass plate 2. Support block 301 has a surface portion comprising a tapered edge 303 at an angle from second frame element 103A. Plate 2 is pressed against the top surface of support block 301 from pressure 201b from first frame element 102 and sealing 204a. Pressure 201b causes plate 2 to follow the contour of the top surface of block 301 and plate 2 is forced into a curving plane at an angle to the plane of second frame element 103A. The resulting path of plate 2 is shown by curvature path 310. Tapered surface portion 303 is angled between 0.5 degrees and 3 degrees from second frame element 103A.

In an embodiment shown in figure 8, a variation of the embodiment shown in figures 5a-5g is provided. In this embodiment, second frame element 203 has been modified, such that a portion 410 has been removed from the edge portion 203c of second frame element 203. This reduces the force required to bend second frame element 203 in a manner that results in a curvature of plate 2. Portion 410 may be removed by a milling process, by a carving or cutting process, or second frame element 203 may be formed without portion 410 via a molding process or similar. Portion 410 preferably reduces the depth of second frame element 203 at the narrowest point by between 5-20%.

The frame elements of the embodiments of the assembly may be made from sheet metal and given a desired design, thickness, and/or be made from different materials such that the forces, shapes, torques, etc. discussed above are obtained.

Embodiments comprise a method for assembling the panel 1 and the plate 2 for the optical touch sensitive system. The method may comprise providing the frame elements according to the embodiments presented herein. The method further comprises

attaching the first frame element to the second frame element, supporting the plate at a support portion of the assembly, and attaching at least one of the first frame assembly and the second frame assembly to the panel such that the support portion extends in flat or curved plane. Also, the method comprises attaching the second frame element to the first frame element such that the support portion extends at least partially in a second plane generally opposite at least a portion of the first frame element and is spaced apart from the first plane. A curvature of the first frame element may be controlled with a spacing element attached to the first frame element and may thereby tilt the support portion to control a curvature of the plate.

Figure 9 illustrates a top plan view of an example of a touch-sensitive apparatus 99. Emitters 30a are distributed around the periphery of touch plate 10, to propagating light across touch surface 20. Detectors 30b are distributed around the periphery of touch surface 20, to receive part of the propagating light. The light from each of emitters 30a will propagate to a number of different detectors 30b on a plurality of light paths 50.

The embodiments above describe methods of achieving control of plate shape and curvature. The following embodiments describe desirable shapes of the plate for achieving improved performance of a touch sensor system. Light paths 50 may conceptually be represented as "detection lines" that extend across the touch surface 20 between pairs of emitters 30a and detectors 30b. The emitters 30a and detectors 30b collectively define a grid of detection lines 50 ("detection grid") on the touch surface 20, as seen in a top plan view. The spacing of intersections in the detection grid define the spatial resolution of the touch-sensitive apparatus 99, i.e. the smallest object that can be detected on the touch surface 20. The width of the detection line is a function of the width of the emitters and corresponding detectors. A wide detector detecting light from a wide emitter provides a wide detection line with a broader surface coverage, minimizing the space in between detection lines which provide no touch coverage. A disadvantage of broad detection lines may be a reduced ability to differentiate between separate objects and a lower signal to noise ratio.

As used herein, the emitters 30a may be any type of device capable of emitting radiation in a desired wavelength range, for example a diode laser, a VCSEL (vertical-cavity surface-emitting laser), an LED (light-emitting diode), an incandescent lamp, a halogen lamp, etc. The emitters 30a may also be formed by the end of an optical fiber. The emitters 30a may generate light in any wavelength range. The following examples presume that the light is generated in the infrared (IR), i.e. at wavelengths above about 750 nm. Analogously, the detectors 30b may be any device capable of converting light (in the same wavelength range) into an electrical signal, such as a photo-detector, a CCD device, a CMOS device, etc.

The detectors 30b collectively provide an output signal, which is received and sampled by a signal processor 130. The output signal contains a number of sub-signals, also denoted "projection signals", each representing the energy of light received by one of light detectors 30b from one of light emitters 30a. Depending on implementation, the signal processor 130 may need to process the output signal for separation of the individual projection signals. The projection signals represent the received energy, intensity or power of light received by the detectors 30b on the individual detection lines 50. Whenever an object partially or completely occludes detection line 50, the received energy on this detection line is decreased or "attenuated".

The signal processor 130 may be configured to process the projection signals so as to determine a property of the touching objects, such as a position (e.g. in a x, y coordinate system), a shape, or an area. This determination may involve a straight-forward triangulation based on the attenuated detection lines, e.g. as disclosed in US7432893 and WO2010/015408, or a more advanced processing to recreate a distribution of attenuation values (for simplicity, referred to as an "attenuation pattern") across the touch surface 20, where each attenuation value represents a local degree of light attenuation. The attenuation pattern may be further processed by the signal processor 130 or by a separate device (not shown) for determination of a position, shape or area of touching objects. The attenuation pattern may be generated e.g. by any available algorithm for image reconstruction based on projection signal values, including tomographic reconstruction methods such as Filtered Back Projection, FFT-based algorithms, ART (Algebraic Reconstruction Technique), SART (Simultaneous Algebraic Reconstruction Technique), etc. Alternatively, the attenuation pattern may be generated by adapting one or more basis functions and/or by statistical methods such as Bayesian inversion. Examples of such reconstruction functions designed for use in touch determination are found in WO2009/077962, WO2011/049511, WO2011/139213, WO2012/050510, and WO2013/062471, all of which are incorporated herein by reference.

In the illustrated example, the apparatus 99 also includes a controller 120 which is connected to selectively control the activation of the emitters 30a and, possibly, the readout of data from the detectors 30b. Depending on implementation, the emitters 30a and/or detectors 30b may be activated in sequence or concurrently, e.g. as disclosed in US8581884. The signal processor 130 and the controller 120 may be configured as separate units, or they may be incorporated in a single unit. One or both of the signal processor 130 and the controller 120 may be at least partially implemented by software executed by a processing unit 140.

Figure 10a illustrates a substantially flat rectangular touch plate 10 according to the prior art. In this example, the touch plate is made of glass, plastic, or any other materials such as PMMA (Poly(methyl methacrylate)). Two axes are defined in figure 10a. The x-axis is defined as the axis running parallel to and equidistant from the pair of long edges of the rectangle and along the flat surface of the touch surface. The y-axis is defined as the axis running parallel to and equidistant from the pair of short edges of the rectangle and along the flat surface of the touch surface. At least a portion of the top surface of touch plate 10 comprises touch surface 20.

Figure 10b illustrates an example of a touch apparatus according to the prior art. Figure 10b shows the touch apparatus in cross section wherein the cross section runs along the x-axis of the plate 10. Light is emitted by emitter 30a, passes through transmissive plate 10 through touch surface 20 and is reflected by reflector surface 80 of edge reflector 70 to travel in a plane substantially parallel with touch surface 20. The light will then continue until deflected by reflector surface 80 of the edge reflector 70 at an opposing edge of the transmissive plate 10, wherein the light will be deflected back down through transmissive plate 10 and onto detectors 30b. Where an object is applied to touch surface 20, some of the light above the touch surface 20 is occluded. This occlusion is detected by the touch apparatus and used to determine the presence, size, and/or shape of the object. The emitters and detectors may be arranged in a number of other configurations such that the light from the emitters is delivered to the touch surface and delivered from the touch surface to the detectors. Other known arrangements are that of arranging the emitters and detectors above the touch surface and transmitting and receiving the light directly without the use of reflecting surfaces. The light may also be delivered to the touch surface by means of a wave guide, fiber optic cable, or other optical component.

Figure 11a illustrates an embodiment of touch plate 10 similar to that shown in figure 10a but wherein the touch plate 10 is curved. In this embodiment, the plate remains substantially flat in the direction of the y-axis but is curved in a concave direction relative to the x-axis. In this embodiment, the x-axis is defined as the axis running parallel to and equidistant from the pair of long edges of the rectangle. The vertex of the parabola or paraboloid of the touch surface is where the touch surface is deepest relative to the edges of the touch plate. Where the x-axis is positioned at the height of the edge of the touch plate, the curvature of the plate can be measured using the distance of the touch surface from the x-axis. Figure 11b shows a cross-section view along the x-axis of the touch plate 10 of figure 11a.

Figure 11c shows an example embodiment of a curved touch plate 10. The touch plate 10 has a width of 1900 mm along the x-axis and a height of 1070 mm along the y-axis. In this example embodiment, the glass is shaped such that the touch surface follows a parabolic curve relative to the x-axis. The midpoint O of touch surface 20 is the center of the touch surface and the midpoint of the x-axis. Where the curvature of the touch surface 20 is parabolic, the maximum distance a between the touch surface and the x-axis is at the center point O of the touch surface.

Figure 11d shows the maximum allowed concave distance a and maximum allowed convexity b. The maximum allowed convexity b may be a significant consideration as a portion of the touch surface that is substantially convex may result in occlusion of the light between the emitters and detectors and significant loss of touch signal. The maximum allowed convexity b is a negative number in the present examples.

In one embodiment, the range of the distance a for vertically orientated touch plate is limited in order to improve the yield and performance of touch systems. The range is set dependent on the size of the touch system. A smallest value is needed to assure that non-parabolic deviations in the glass shape and convexity in the integration doesn't result in a convex integrated touch surface. A largest value is needed in order to assure that the height of the light field for the final touch system is kept reasonably low in order to enable better contact detection and lift-off detection for touch objects. Preferably, range of the distance a is 0-2.5 mm.

The maximum distance a is a positive number for a concave glass in the present examples. The curvature of the touch surface may therefore be modelled as:

$$\mathrm{F(x)} = -\mathrm{a} + \mathrm{cx}^2$$

In the present example embodiment, a maximum distance a between the 1900 mm long cross section of the touch surface in figure 11c and the x-axis is 2.0 mm. Therefore, an ideal parabolic curve for touch surface 20 may be:

$$\mathrm{F(x)} = 5.5 * 10^{-6} * \mathrm{x}^2 - 2.0$$

where $\mathrm{F(x)}$ is the distance between the x-axis and the touch surface at position x wherein $\mathrm{F(x)}$ is zero at the mid points of the edges. i.e. where the x-axis intersects the perimeter.

Figures 12a and 12b illustrates an embodiment of touch plate 10 similar to that shown in figure 11a but wherein the touch plate 10 is curved in two axes. Figure 12a shows a top plan view and figure 12b shows an isometric view of touch plate 10. In this embodiment, the plate is curved in a concave direction relative to the x-axis and is also curved in a concave direction relative to the y-axis. As with the embodiment shown in figure 11a, the x-axis is defined as the axis running parallel to and equidistant from the pair of long edges of the rectangle and passing over the center point 0 on the touch surface. Therefore, the curvature of the plate can be measured from the distance of the touch surface from the x-axis. Similarly, the y-axis is defined as the axis running parallel to and equidistant from the pair of short edges of the rectangle and passing over the center point 0 on the touch surface. Therefore, the curvature of the plate along this axis can be measured from the distance of the touch surface from the y-axis.

Figure 12c and 12d shows respective section views along the x-axis and y-axis of the touch plate 10 of figure 12a and 12b. In an example embodiment of a curved touch plate 10. The touch plate 10 has a width of 1900 mm along the x-axis and a height of 1070 mm along the y-axis. In this example embodiment, the glass is shaped such that the touch surface follows a parabolic curve relative to the x-axis. The center point O of touch surface 10 is the center of the touch surface and parallel with midpoint of the x-axis. Where the curvature of the touch surface 10 is parabolic, the maximum distance a between the touch surface and the x-axis is at the center point O. The maximum distance a is a positive number for a concave glass in the present examples. The curvature of the touch surface may therefore be modelled as:

$$z(x,y) = -a + b * x^2 + c * x^2y^2 + d * y^2$$

where z is the distance between the plane defined by the x-axis and y-axis and the touch surface, and x and y are co-ordinates in the plane of the glass.

In an example embodiment having a flat perimeter around the plate with a max distance of 2.0 mm measured along the x-direction for y = 0 (i.e. middle of plate):

$$z(x,y) = -2 + 5.56e-06 * x^2 - 4.74e-11 * x^2y2 + 1.7e-05 * y^2$$

In another example embodiment having a concave perimeter around the plate with a max distance of 2.0 mm measured along the x-direction for y = 0 (mid short to short of screen) and with a max distance of 1.5 mm measured along the y-direction for x = 0 (mid

long to long of screen). Where the top and bottom edges have 1.0 mm max distance and the left and right edges have 0.5 mm max distance:

$$z(x,y) = -2.5 + 5.56e-06 * x^2 - 2.37e-11 * x^2 * y^2 + 1.28e-05 * y^2$$

Figure 13a shows a section view along the x-axis of light propagating across an example embodiment of a curved touch plate 10 touch surface having a curved profile in the x-axis. In the section view, the propagation paths of light from a point light source 1310 are shown. Dotted lines 1320 show propagation paths of light emitted from point light source 1310a that are not received by detector surface 1340. Solid lines 1330 show propagation paths of light emitted form point light source 1310 that are received by detector surface 1340. As shown in the figure, a portion of the light is lost above the detector, a portion is lost below the detector, and a portion of the light is received at the detector surface. A person looking from the emitter point towards the mirror image of the detector (mirrored in the touch surface) will perceive the detector size as 2.2 times larger than the real detector. This magnification effect is an effect of using an off axis parabolic mirror. In the specific case of touch systems, this results in a detection signal boost of a factor of 2.2, when comparing to a flat touch surface. This boost applies only to the signal and not significantly to the ambient light otherwise received by the detectors. In a preferred embodiment, the detectors and emitters of the touch system are 3 mm or less above the touch surface (either directly or indirectly) and the length of the detection lines being in the range from 100 to 2500 mm, the angle of incidence is extremely close to 90 degrees. With this, gracing incidence, dirt or anti-glare coatings on the touch surface have no practical impact of the reflection, so it is practically a mirror.

Figure 13b provides a graph of the angle of the emitted light from the point light source 1310 with respect to the z-coordinate of the light path at the edge of the model of figure 13a. The detector surface z-coordinate range is shown by the vertical axis. Light emitted by point light source 1310 received at a z-coordinate within that range is received by the detector.

Figure 14a shows a section view of the embodiment of figure 13a. In the section view, the propagation paths of light from a second point light source 1410 are shown. In this example, the detection signal boost is approximately 3.3. Figure 14b shows the corresponding graph of figure 13b for the second point light source 1410.

Figure 15a shows a section view of the embodiment of figure 13a. In the section view, the propagation paths of light from a third point light source 1510 are shown. Figure

15b shows the corresponding graph of figure 13b for the third point light source 1510. In this example, the detection signal boost is approximately 3.03.

Figure 16a shows a section view of the embodiment of figure 13a. In the section view, the propagation paths of light from a fourth point light source 1610 are shown. Figure 16b shows the corresponding graph of figure 13b for the fourth point light source 1610. In this example, the detection signal boost is approximately 2.71.

Figure 17a shows a section view of the embodiment of figure 13a. In the section view, the propagation paths of light from a fifth point light source 1710 are shown. Figure 17b shows the corresponding graph of figure 13b for the fifth point light source 1710. In this example, the detection signal boost is approximately 2.19.

Figures 13a-17b demonstrate that different emitter positions utilize different parts of the touch surface. The parts of the touch surface that work as reflectors will depend on the actual shape of the glass and the placement and sizes of the emitter and detector apertures surface 1340.

However, the touch plate 10 cannot be manufactured, positioned, or held in shape perfectly. Consequently, a certain amount of deviation can be expected between the curve followed by the touch surface and an ideal parabolic curve.

Figure 18a shows a graph of a mathematically defined parabolic curve and a real-world parabolic touch surface. In the example embodiment of figure 18a, a curved touch plate 10 has a width of 1900 mm along the x-axis and a height of 1070mm along the y-axis (wherein the x-axis and y-axis are defined as in the embodiment shown in figure 12a,4b). In this example embodiment, the glass is shaped such that the touch surface follows parabolic curve 1810 relative to the x-axis. The maximum distance a between the touch surface and the x-axis is 10mm. The mathematically defined parabolic curve is defined as 1820. The graph shows the deviation between the mathematically defined parabolic curve represented by dotted line 1820 and real touch surface 1810. Here, the real touch surface is asymmetrically warped. Fig 10b shows the short to short mid cross section of a 2180 mm diagonal, 16:9 ratio, thermally tempered glass that is just within or at the maximum limit of concave distance < 6 mm as well as |parabolic deviation| < 0.5 mm.

The parabolic fit of the touch surface 1810 has an s-shaped residual. Such asymmetrical warping may be the result of problems with transport rollers or an uneven temperature distribution during the rapid cooling phase of tempering process during manufacture.

Figure 18b shows a graph of the deviation between the mathematically defined parabolic curve and a real-world parabolic touch surface of figure 18a.

The following table defines a preferred set of restrictions on the shape of the touch surface in order to achieve an optimal touch surface shape. The term 'warp' defines the distance of the touch surface from the respective axis intersecting the center point O in the direction of the z-axis.

Glass size	Min x-axis warp (mm)	Max x-axis warp (mm)	Min y-axis warp (mm)	Max y-axis warp (mm)	Max convexity* (mm)	Max parabolic deviation (mm)
55"	1.0	3.50	0.0	1.35	0.1	0.5
65"	1.0	4.50	0.0	1.65	0.1	0.5
70"	1.0	5.10	0.0	1.85	0.1	0.5
75"	1.0	5.70	0.0	2.00	0.1	0.5
84"-86"	1.0	6.00	0.0	2.00	0.1	0.5

Convexity b is shown in figure 18a. Parabolic deviation is shown in figure 18b.

Figure 19a shows another graph of a mathematically defined parabolic curve and a similar glass to that of figure 18a but wherein the glass of figure 19a is out of range and not recommended for touch system production. One reason for the large concavity shown in figure 19a may be that the tempering process has been run with too large differences between bottom and top cooling parameters in a quenching process during manufacturing. The mathematically defined parabolic curve is defined as 1920. The graph shows the deviation between the mathematically defined parabolic curve and real touch surface 1910.

Figure 19b shows a graph of the deviation between the mathematically defined parabolic curve and a real-world parabolic touch surface of figure 19a. The real-world parabolic touch surface of figure 19a is an example of a symmetrical but higher order warping (e.g. W shaped). Such warping may significantly reduce signal boost and may be caused by symmetrical temperature problems (e.g. too hot in center or edge of glass) during the manufacturing tempering process.

Figure 20a shows an embodiment in which the touch surface forms a paraboloid. In figure 20a, a top plan view of the touch surface is shown with contour lines showing the depth of the touch surface relative to a flat plane intersecting the four corners of the touch surface. The numbers shown on each contour represents the depth of the contour. The x-axis, y-axis, and diagonal-axis d are all shown. The x-axis is defined as an axis running parallel to and equidistant from the pair of long edges of the rectangle. The y-axis is defined as an axis running parallel to and equidistant from the pair of short edges of the rectangle. Diagonal-axis d is defined as an axis running diagonally from one corner to a

diagonally opposite corner. In this embodiment, the x-axis, y-axis, and diagonal axis d of touch surface 10 each describe a parabola with respect to the depth of the touch surface. In figure 20b, diagonal-axis d is shown running from the bottom left corner to the top right corner. In the example embodiment of figure 20a, the curved touch plate 10 has a width of 1900mm along the x-axis and a height of 1070 mm along the y-axis.

Figures 20b-20d show optional parabola configurations for the embodiment shown in figure 20a. Figure 20b shows a graph of the desired parabola of the touch surface underneath the x-axis and relative to the x-axis. The deviation (bottom axis) from the x-axis is shown relative to the position (left axis) along the x-axis. Figure 20c shows a graph of the desired parabola of the touch surface underneath the y-axis and relative to the y-axis. The deviation (bottom axis) from the x-axis is shown relative to the position (left axis) along the y-axis. Figure 20d shows a graph of the desired parabola of the touch surface underneath the diagonal-axis and relative to the diagonal-axis. The deviation (bottom axis) from the x-axis is shown relative to the position (left axis) along the diagonal-axis.

The embodiments shown in figure 20a-20d describe a touch surface providing substantial signal boost for signals travelling between most emitters and detectors. However, the non-flat perimeter of the touch surface makes manufacture and assembly of such a system more complex.

Figure 21a shows an embodiment in which the touch surface forms an alternative paraboloid to that of the embodiment shown in figure 20a. As with figure 20a, figure 21a provides a top plan view of the touch surface is shown with contour lines showing the depth of the touch surface relative to a flat plane intersecting the four edges of the touch surface 10. The numbers shown on each contour represents the depth of the contour. X-axis, y-axis, and diagonal-axis d are all shown. The x-axis is defined as an axis running parallel to and equidistant from the pair of long edges of the rectangle. In this embodiment, the x-axis of touch surface 10 describes a parabola with respect to the depth of the touch surface. The y-axis is defined as an axis running parallel to and equidistant from the pair of short edges of the rectangle. In this embodiment, the y-axis of touch surface 10 also describes a parabola with respect to the depth of the touch surface. Diagonal-axis d is defined as an axis running diagonally from one corner to a diagonally opposite corner. In figure 21b, diagonal-axis d is shown running from the bottom left corner to the top right corner. In the example embodiment of figure 21a, the curved touch plate 10 has a width of 1900 mm along the x-axis and a height of 1070 mm along the y-axis. The perimeter of the touch surface of this embodiment is flat or close to flat. In embodiments where the perimeter of the touch surface is flat or close to flat, the surface beneath some detection lines will not be perfect parabolas. Even for an almost perfect

integrated glass shape with a warp in the range of 1-2.5 mm some detection lines (a very small portion) will actually have less signal than for a flat glass. This small drawback is counter balanced by the significant overall signal improvements. Furthermore, touch systems where the perimeter of the touch surface is flat or close to flat can be easier to manufacture and assemble.

Figure 21b shows a graph of the desired parabola of the touch surface underneath the x-axis and relative to the x-axis. The deviation (bottom axis) from the x-axis is shown relative to the position (left axis) along the x-axis. Figure 21c shows a graph of the desired parabola of the touch surface underneath the y-axis and relative to the y-axis. The deviation (bottom axis) from the x-axis is shown relative to the position (left axis) along the y-axis. Figure 21d shows a graph of the desired parabola of the touch surface underneath the diagonal-axis and relative to the diagonal-axis. The deviation (bottom axis) from the x-axis is shown relative to the position (left axis) along the diagonal-axis.

As will be apparent, the features and attributes of the specific embodiments disclosed above may be combined in different ways to form additional embodiments, all of which fall within the scope of the present disclosure.

Conditional language used herein, such as, among others, “can,” “could,” “might,” “may,” “e.g.,” and the like, unless specifically stated otherwise, or otherwise understood within the context as used, is generally intended to convey that certain embodiments include, while other embodiments do not include, certain features, elements and/or states. Thus, such conditional language is not generally intended to imply that features, elements and/or states are in any way required for one or more embodiments or that one or more embodiments necessarily include logic for deciding, with or without author input or prompting, whether these features, elements and/or states are included or are to be performed in any particular embodiment.

The present invention has been described above with reference to specific embodiments. However, other embodiments than the above described are equally possible within the scope of the invention. Different method steps than those described above may be provided within the scope of the invention. The different features and steps of the invention may be combined in other combinations than those described. The scope of the invention is only limited by the appended patent claims.

CLAIMS

1. An assembly for holding and controlling curvature of a plate (2) for an optical touch sensitive system, comprising

a first frame element (102; 202) extending in a first plane and configured to extend at least partially around a panel (1);

at least one second frame element (103a, 103b; 203) extending in a second plane and forming a support portion (101a, 101b; 201b) for the plate (2), and

at least one spacing element positioned at least partially between the support portion (101a, 101b; 201b) and the first frame element (102; 202), the spacing element being configured to control a curvature of the first frame element (102; 202), and

wherein the at least one second frame element (103a, 103b; 203) is configured to engage the plate at the support portion (101a, 101b; 201b), is attached to the first frame element (102; 202), and wherein the shape and/or position of the second frame element is controlled by the curvature of the first frame element (102, 202) with said spacing element, to control a curvature of the plate.

2. The assembly of claim 1, wherein the second frame element (103a, 103b; 203) is deflectable from a relaxed state to a deflected state, in which the second plane forms a parabolic concave curve along at least a portion of the length of the support portion (101a, 101b; 201b), and wherein a screw arrangement (112a, 112b, 112c, 113a, 113b; 219a, 219b, 219c) of the assembly holds the second frame element (103a, 103b; 203) in the deflected state when assembled with the first frame element (102; 202).

3. The assembly of any of claims 1 or 2, wherein a frame (109) of the first frame element (102) comprises a plurality of spacing elements arranged spaced apart from corners of the frame (209) of the first frame element (102), wherein the spacing elements are configured to generate a force to the frame (109) away from the support portion (101a, 101b).

4. The assembly of claim 3, wherein each spacing element comprises a screw (116, 116a, 116b) arranged in a hole of the frame (109).

5. The assembly of claim 4, wherein each spacing element (112, 112a, 112b) comprises a screw with a predefined length, and a spacer arranged between a head of the screw and the frame (109).

6. The assembly of any of the previous claims, wherein assembly comprises a plurality of attachment elements (112) arranged around the frame (109) for attaching the first frame element (102) to said panel (1).

7. The assembly of claim 6, wherein each attachment element (112) comprises a plurality of screws (112a, 112b, 112c, 113a, 113b) arranged in holes of the frame (109), wherein at least one of said screws (112a, 113b) is arranged to apply a first force to the frame (109) towards the support portion (101a, 101b), and at least one other of said screws (112b, 112c, 113b) is arranged to apply a second force to the frame (109) away from the support portion (101a, 101b).

8. The assembly of claim 7, wherein each attachment element (112) comprises at least two screws (113a, 113b), wherein a first screw (113a) of said two screws is arranged opposing the support portion (101a, 101b) and to apply said first force to the frame (109) towards the support portion (101a, 101b), and a second screw (113b) of said two screws is arranged closer to a center of the first frame element (102) than a perimeter of the support portion (101a, 101b) and to apply said second force to the frame (109) away from the support portion (101a, 101b).

9. The assembly of claim 7, wherein each attachment element (112) comprises at least three screws (112a, 112b, 112c), wherein all three screws are arranged closer to a center of the first frame element (102) than a perimeter of the support portion (101a, 101b), and wherein a first screw (112a) of said three screws is arranged to apply said first force to the frame (109) towards the support portion (101a, 101b), and a second screw (112b) and a third screw (112c) of said three screws are arranged to apply said second force to the frame (109) away from the support portion (101a, 101b), the first screw (112a) being arranged between the second screw (112b) and the third screw (112c).

10. The assembly of any of the previous claims, wherein a gasket (205) is arranged on another support portion (201a) of the second frame element (202), wherein the gasket (205) has a varying thickness along its length.

11. The assembly of claim 10, wherein the gasket (205) has opposing ends, and is thinner between the opposing ends than at said ends.

12. The assembly of claim 11, wherein a first section (205a) of the gasket (205) at one of said ends and a second section (205b) of the gasket (205) at the other of said ends has a first thickness, and at least a third section (205c) of the gasket between the first section (205a) and the second section (205b) has a second thickness, wherein the first thickness is thicker than the second thickness.

13. The frame assembly of any of claims 10-12, wherein the second frame element (203) comprises a frame side and the third frame element comprises an edge cover, and wherein the edge cover comprises another support portion for said panel (1), wherein a distance between the support portion of the frame side and the support portion of the edge cover is discontinuous in an assembled state.

14. The frame assembly of claim 13, wherein the frame side comprises a first hole (217a) and a second hole (217b) arranged at opposing ends of the frame side and in a first plane, and a third hole (217c) arranged between the first hole (217a) and the second hole (217c) and in a plane that is different from the first plane, and

the edge cover comprises a first hole (218a) and a second hole (218b) arranged at opposing ends of the edge cover, and a third hole (218c) arranged between the first hole (218a) and the second hole (218c) of the edge cover, wherein the first hole (218a), the second hole (218b), and the third hole (218c) of the edge cover are generally arranged in the same plane when the edge cover is disconnected from the frame side, and

wherein the edge cover is less stiff than the frame side and deflectable such that the holes (218a, 218b, 218c) of the edge cover are aligned with the holes (217a, 217b, 217c) of the frame side and such that the support portion of the edge cover extends in a plane, which is curved.

15. A method for assembling a panel and a plate for an optical touch sensitive system, comprising:

providing a first frame element (102; 202) extending in a first plane and configured to extend at least partially around a panel (1);

providing at least one second frame element (103a, 103b; 203) forming a support portion (101a, 101b; 201b) for the plate (2);

supporting the plate (2) by the support portion (101a, 101b, 201b);

attaching the second frame element to the first frame element (102; 202) such that

the support portion (101a, 101b; 201b) extends at least partially in a second plane generally opposite at least a portion of the first frame element (102; 202) and is spaced apart from the first plane; and

controlling a curvature of the first frame element (102; 102) with a spacing element attached to the first frame element (102; 202) and thereby tilting the support portion (101a, 101b, 201b) to control a curvature of the plate (2).

16. A touch sensing apparatus, comprising:

a touch surface;

a set of emitters arranged around the touch surface to emit first beams of light to propagate across the touch surface,

a set of light detectors arranged around the touch surface to receive light from the first set of emitters,

wherein each light detector is arranged to receive light from more than one emitter;

a processing element configured to determine, based on output signals of the set of light detectors, the position of an object on the touch surface,

wherein the touch surface is curved in a first axis according to a first parabola.

17. The touch sensing apparatus of claim 16, wherein the touch surface is curved in a second axis according to a second parabola.

18. The touch sensing apparatus of claim 16, wherein the touch surface forms a paraboloid.

19. The touch sensing apparatus of claim 18, wherein the first parabolic curve paraboloid is an elliptical paraboloid.

20. The touch sensing apparatus of claim 16, wherein each point of the first axis of the touch surface is within 0.5mm of a mathematical parabola.

21. The touch sensing apparatus of claim 16, wherein the mathematical parabola is defined according to $z(x, y)=a+bx^2+cx^2y^2+dy^2$, where z is depth, and x and y are co-ordinates in the plane of the glass.

22. The touch sensing apparatus of claim 16, wherein the touch surface comprises a portion of a surface of a plate.

23. The touch sensing apparatus of claim 22, wherein the plate comprises a glass or plastic sheet.

24. The touch sensing apparatus of claim 16, wherein the touch surface forms a paraboloid.

AMENDED CLAIMS
received by the International Bureau on 09.Apr.2018 (09.04.2018)

[Claim 1] An assembly (100) for holding and controlling curvature of a plate (2) for an optical touch sensitive system, comprising
a first frame element (102; 202) extending in a first plane and configured to extend at least partially around a panel (1);
at least one second frame element (103a, 103b; 203) extending in a second plane and forming a support portion (101a, 101b; 201b) for the plate (2), and
at least one spacing element (116) positioned at least partially between the support portion (101a, 101b; 201b) and the first frame element (102; 202), the spacing element (116) being configured to control a curvature of the first frame element (102; 202), and
wherein the at least one second frame element (103a, 103b; 203) is configured to engage the plate at the support portion (101a, 101b; 201b), is attached to the first frame element (102; 202), and wherein the shape and/or position of the second frame element is controlled by the curvature of the first frame element (102, 202) with said spacing element (116), to control a curvature of the plate.

[Claim 2] The assembly (100) of claim 1, wherein the second frame element (103a, 103b; 203) is deflectable from a relaxed state to a deflected state, in which the second plane forms a parabolic concave curve along at least a portion of the length of the support portion (101a, 101b; 201b), and wherein a screw arrangement (112a, 112b, 112c, 113a, 113b; 219a, 219b, 219c) of the assembly (100) holds the second frame element (103a, 103b; 203) in the deflected state when assembled with the first frame element (102; 202).

[Claim 3] 3. The assembly (100) of any of claims 1 or 2, wherein a frame (109) of the first frame element (102) comprises a plurality of spacing elements (116) arranged spaced apart from corners of the frame (209) of the first frame element (102), wherein the spacing elements are configured to generate a force to the frame (109) away from the support portion (101a, 101b).

[Claim 4] The assembly (100) of claim 3, wherein each spacing element (116) comprises a screw (116, 116a, 116b) arranged in a hole of the frame (109).

[Claim 5] The assembly (100) of claim 4, wherein each spacing element (116) comprises a screw with a predefined length, and a spacer arranged

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between a head of the screw and the frame (109).

[Claim 6] 6. The assembly (100) of any of the previous claims, wherein assembly (100) comprises a plurality of attachment elements (112) arranged around the frame (109) for attaching the first frame element (102) to said panel (1).

[Claim 7] The assembly (100) of claim 6, wherein each attachment element (112) comprises a plurality of screws (112a, 112b, 112c, 113a, 113b) arranged in holes of the frame (109), wherein at least one of said screws (112a, 113b) is arranged to apply a first force to the frame (109) towards the support portion (101a, 101b), and at least one other of said screws (112b, 112c, 113b) is arranged to apply a second force to the frame (109) away from the support portion (101a, 101b).

[Claim 8] 8. The assembly (100) of claim 7, wherein each attachment element (112) comprises at least two screws (113a, 113b), wherein a first screw (113a) of said two screws is arranged opposing the support portion (101a, 101b) and to apply said first force to the frame (109) towards the support portion (101a, 101b), and a second screw (113b) of said two screws is arranged closer to a center of the first frame element (102) than a perimeter of the support portion (101a, 101b) and to apply said second force to the frame (109) away from the support portion (101a, 101b).

[Claim 9] The assembly (100) of claim 7, wherein each attachment element (112) comprises at least three screws (112a, 112b, 112c), wherein all three screws are arranged closer to a center of the first frame element (102) than a perimeter of the support portion (101a, 101b), and wherein a first screw (112a) of said three screws is arranged to apply said first force to the frame (109) towards the support portion (101a, 101b), and a second screw (112b) and a third screw (112c) of said three screws are arranged to apply said second force to the frame (109) away from the support portion (101a, 101b), the first screw (112a) being arranged between the second screw (112b) and the third screw (112c).

[Claim 10] 10. The assembly (100) of any of the previous claims, wherein a gasket (205) is arranged on another support portion (201a) of the second frame element (202), wherein the gasket (205) has a varying thickness along its length.

[Claim 11] The assembly (100) of claim 10, wherein the gasket (205) has opposing ends, and is thinner between the opposing ends than at said ends.

[Claim 12] The assembly (100) of claim 11, wherein a first section (205a) of the

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gasket (205) at one of said ends and a second section (205b) of the gasket (205) at the other of said ends has a first thickness, and at least a third section (205c) of the gasket between the first section (205a) and the second section (205b) has a second thickness, wherein the first thickness is thicker than the second thickness.

[Claim 13] 13. The assembly (100) of any of claims 10-12, wherein the second frame element (203) comprises a frame side and the third frame element comprises an edge cover, and wherein the edge cover comprises another support portion for said panel (1), wherein a distance between the support portion of the frame side and the support portion of the edge cover is discontinuous in an assembled state.

[Claim 14] The assembly (100) of claim 13, wherein the frame side comprises a first hole (217a) and a second hole (217b) arranged at opposing ends of the frame side and in a first plane, and a third hole (217c) arranged between the first hole (217a) and the second hole (217c) and in a plane that is different from the first plane, and

the edge cover comprises a first hole (218a) and a second hole (218b) arranged at opposing ends of the edge cover, and a third hole (218c) arranged between the first hole (218a) and the second hole (218c) of the edge cover, wherein the first hole (218a), the second hole (218b), and the third hole (218c) of the edge cover are generally arranged in the same plane when the edge cover is disconnected from the frame side, and

wherein the edge cover is less stiff than the frame side and deflectable such that the holes (218a, 218b, 218c) of the edge cover are aligned with the holes (217a, 217b, 217c) of the frame side and such that the support portion of the edge cover extends in a plane, which is curved.

[Claim 15] 15. A method for assembling a panel and a plate for an optical touch sensitive system, comprising:

providing a first frame element (102; 202) extending in a first plane and configured to extend at least partially around a panel (1);

providing at least one second frame element (103a, 103b; 203) forming a support portion (101a, 101b; 201b) for the plate (2);

supporting the plate (2) by the support portion (101a, 101b, 201b);

attaching the second frame element to the first frame element (102; 202) such that

the support portion (101a, 101b; 201b) extends at least partially in a second plane generally opposite at least a portion of the first frame

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element (102; 202) and is spaced apart from the first plane; and controlling a curvature of the first frame element (102; 102) with a spacing element (116) attached to the first frame element (102; 202) and thereby tilting the support portion (101a, 101b, 201b) to control a curvature of the plate (2).

[Claim 16] 16. A touch sensing apparatus, comprising:
a touch surface;
a set of emitters arranged around the touch surface to emit first beams of light to propagate across the touch surface,
a set of light detectors arranged around the touch surface to receive light from the first set of emitters,
wherein each light detector is arranged to receive light from more than one emitter;
a processing element configured to determine, based on output signals of the set of light detectors, the position of an object on the touch surface,
wherein the touch surface is curved in a first axis according to a first parabola.

[Claim 17] 17. The touch sensing apparatus of claim 16, wherein the touch surface is curved in a second axis according to a second parabola.

[Claim 18] 18. The touch sensing apparatus of claim 16, wherein the touch surface forms a paraboloid.

[Claim 19] 19. The touch sensing apparatus of claim 18, wherein the first parabolic curve paraboloid is an elliptical paraboloid.

[Claim 20] 20. The touch sensing apparatus of claim 16, wherein each point of the first axis of the touch surface is within 0.5mm of a mathematical parabola.

[Claim 21] 21. The touch sensing apparatus of claim 20, wherein the mathematical parabola is defined according to $z(x, y)=a+bx^2+cx^2y^2+dy^2$, where z is depth, and x and y are co-ordinates in the plane of the glass.

[Claim 22] 22. The touch sensing apparatus of claim 16, wherein the touch surface comprises a portion of a surface of a plate.

[Claim 23] 23. The touch sensing apparatus of claim 22, wherein the plate comprises a glass or plastic sheet.

[Claim 24] 24. The touch sensing apparatus of claim 16, wherein the touch surface forms a paraboloid.

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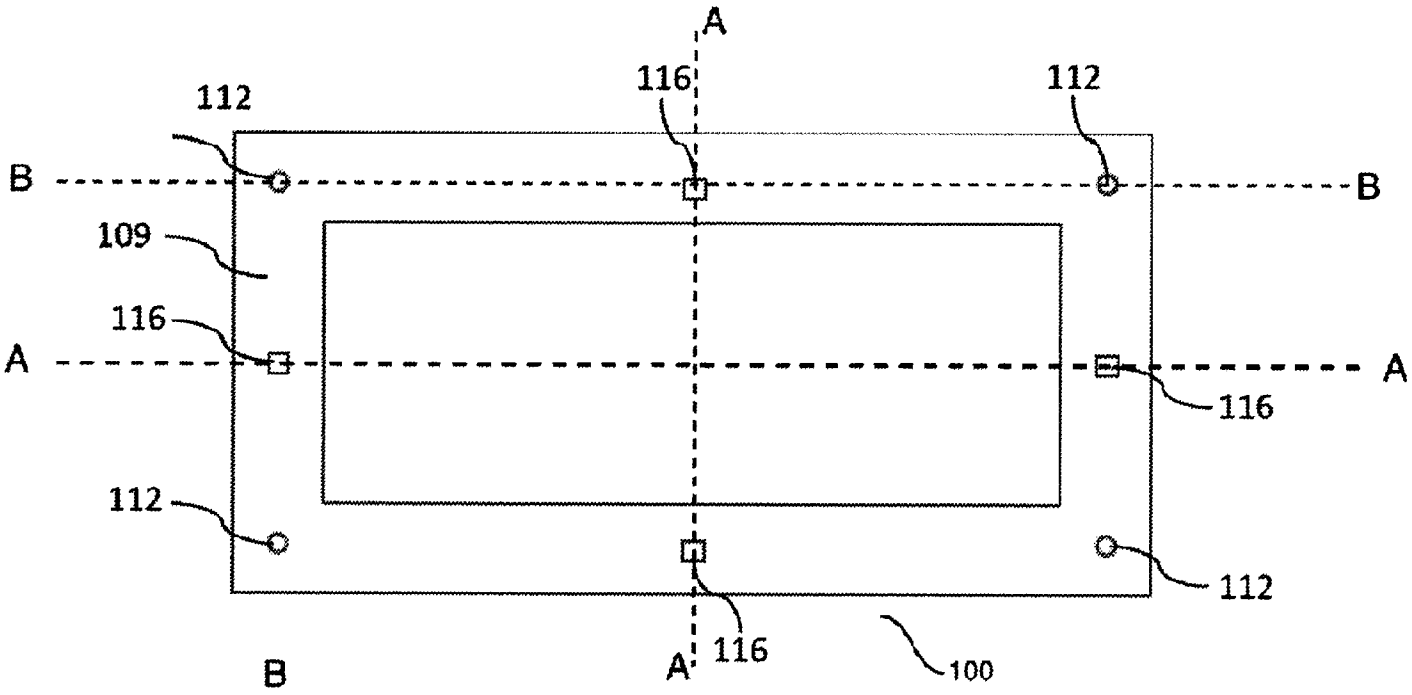


Figure 1

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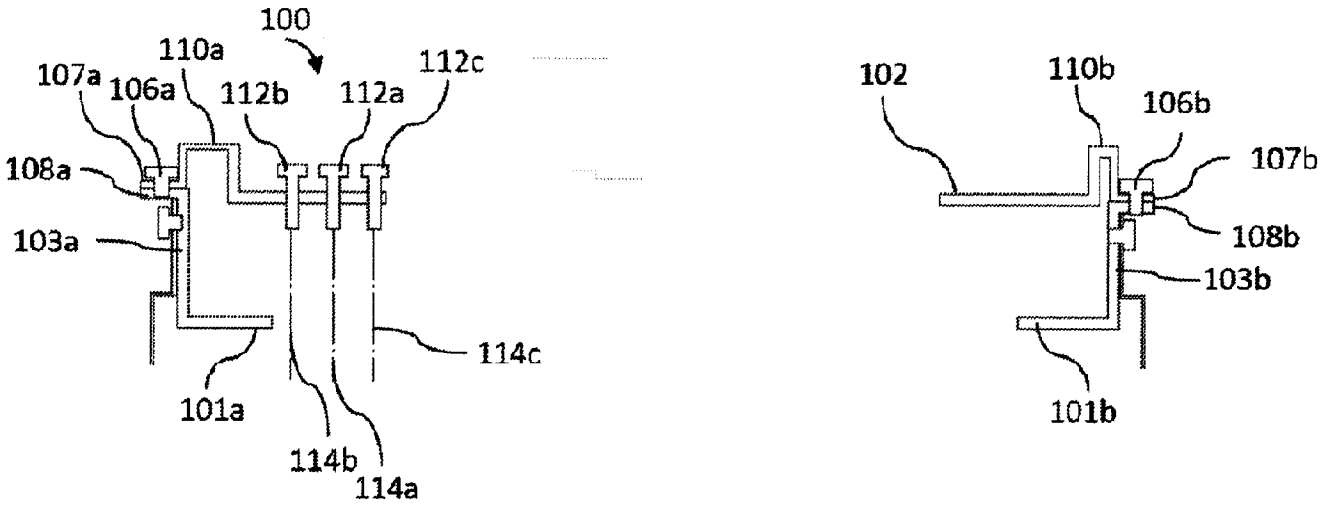

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110a
107a
106a
112b
112a
112c
108a
103a
114c
101a
114b
114a
102
110b
106b
107b
108b
103b
101b

Figure 2a

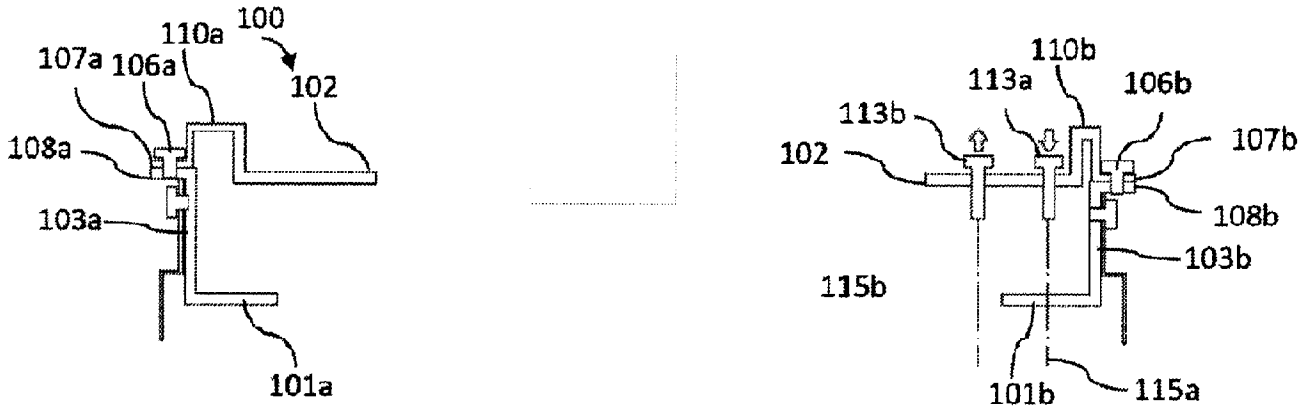

100
110a
107a
106a
102
108a
103a
101a
110b
113a
106b
113b
107b
102
108b
103b
115b
101b
115a

Figure 2b

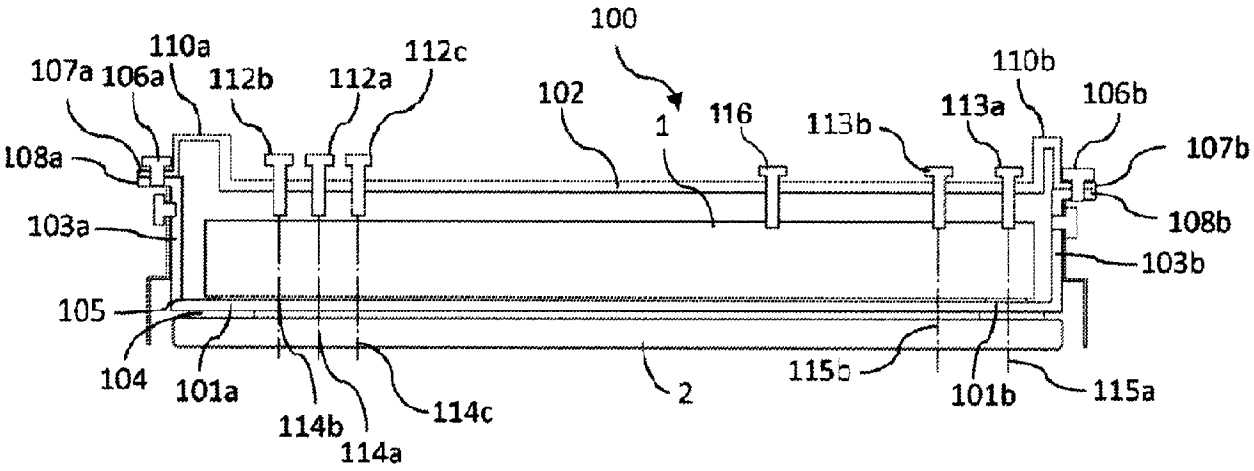

100
110a
107a
106a
112b
112a
112c
102
1
116
113b
113a
110b
106b
107b
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103a
103b
105
104
101a
114b
114a
114c
2
115b
101b
115a

Figure 2c

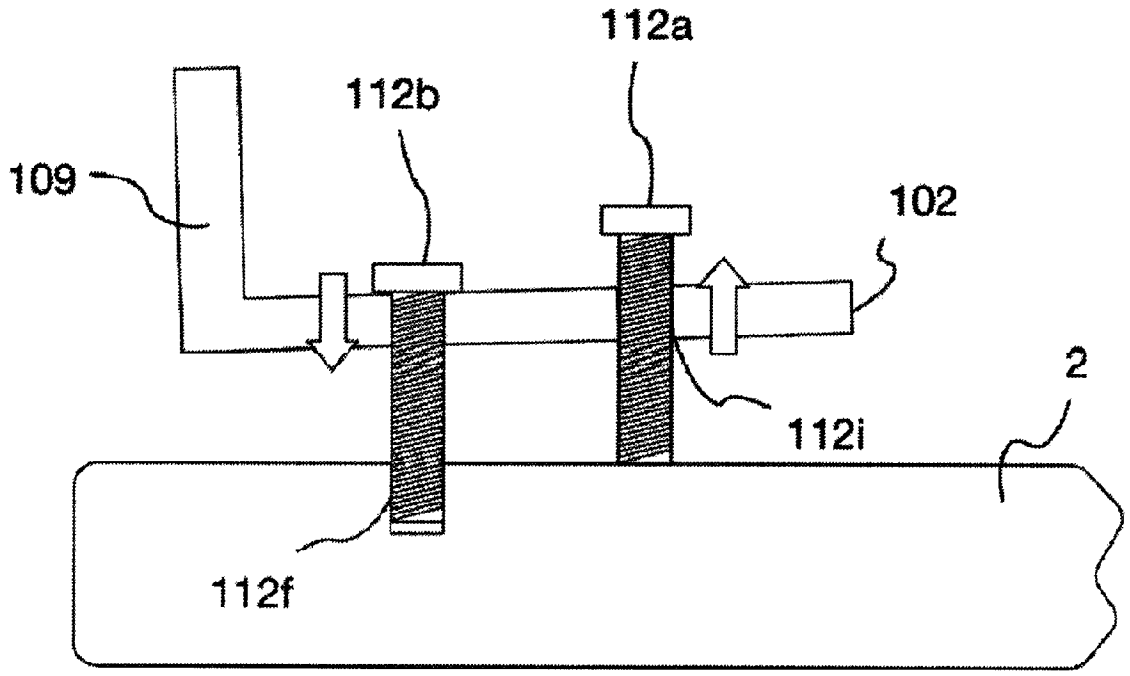


Figure 2d

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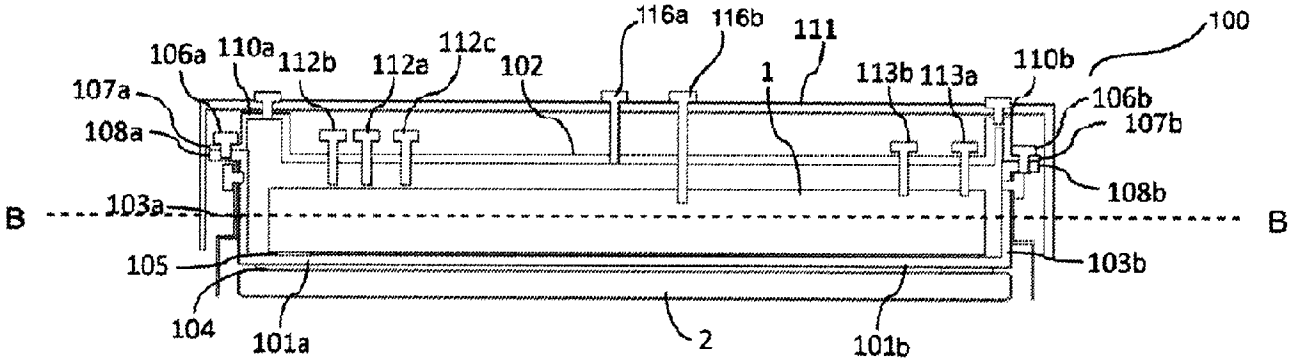


Figure 3a

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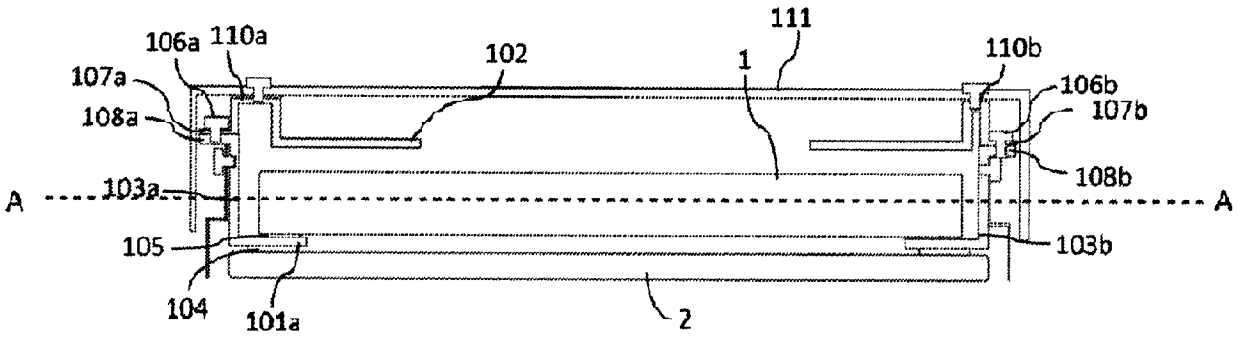

111
106a
110a
102
1
110b
107a
106b
107b
108a
108b
A
103a
A
105
103b
104
101a
2

Figure 3b

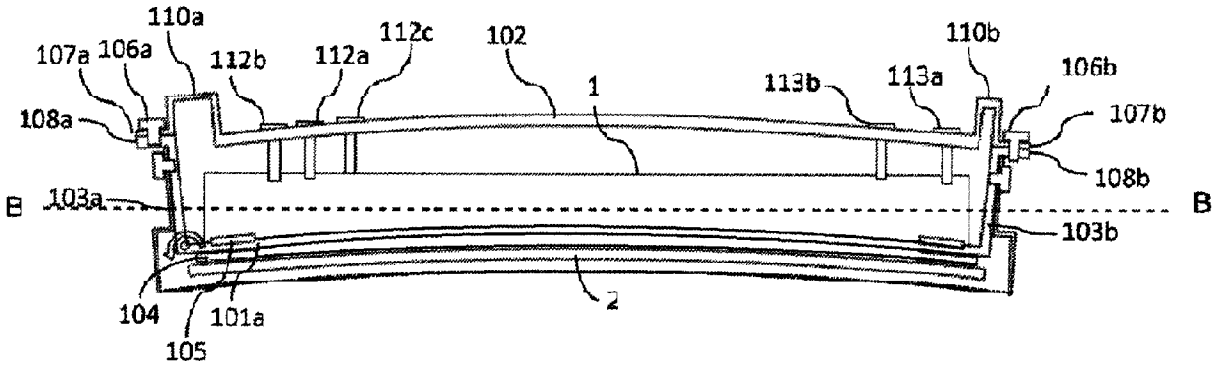


Figure 3c

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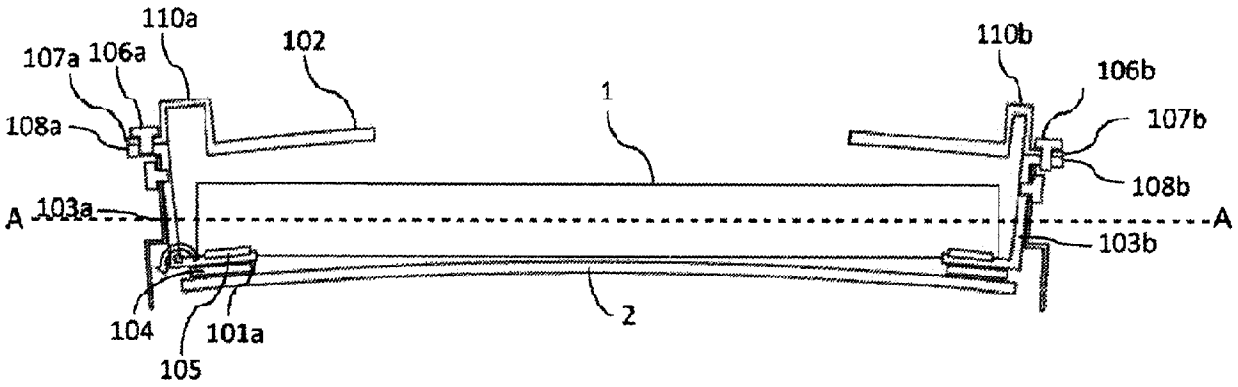


Figure 3d

Chemtronics v. FlatFrog
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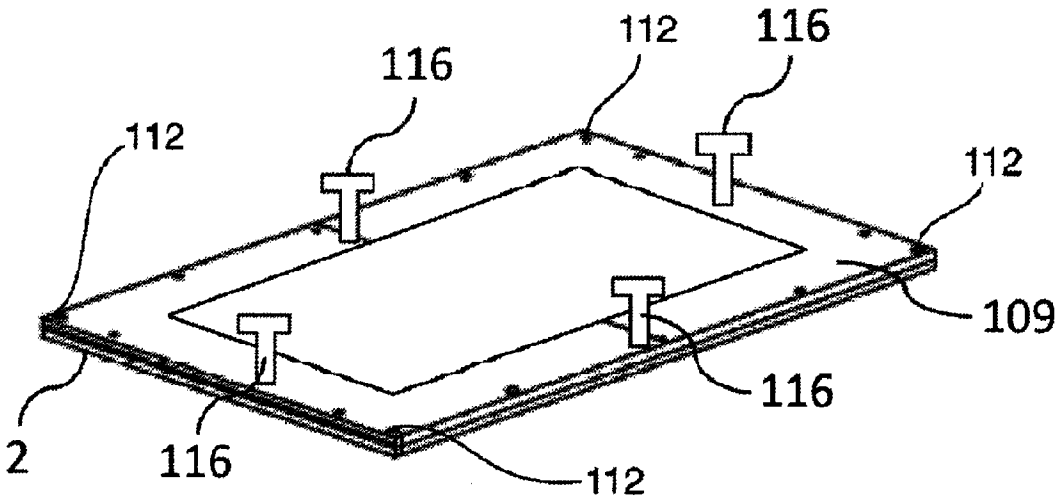


Figure 4a

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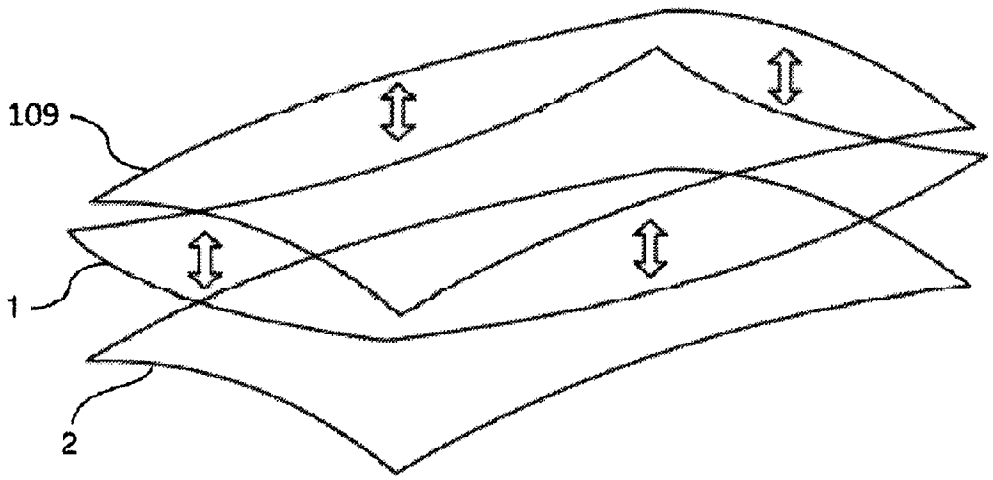


Figure 4b

Chemtronics v. FlatFrog
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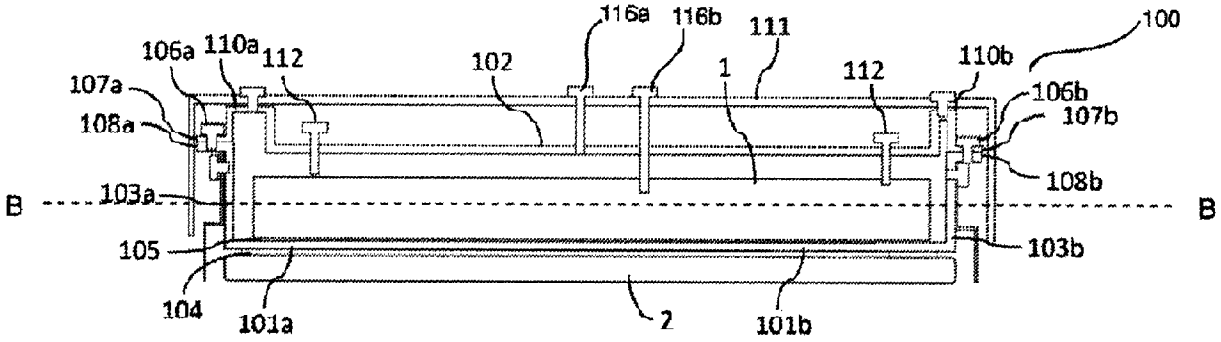


Figure 4c

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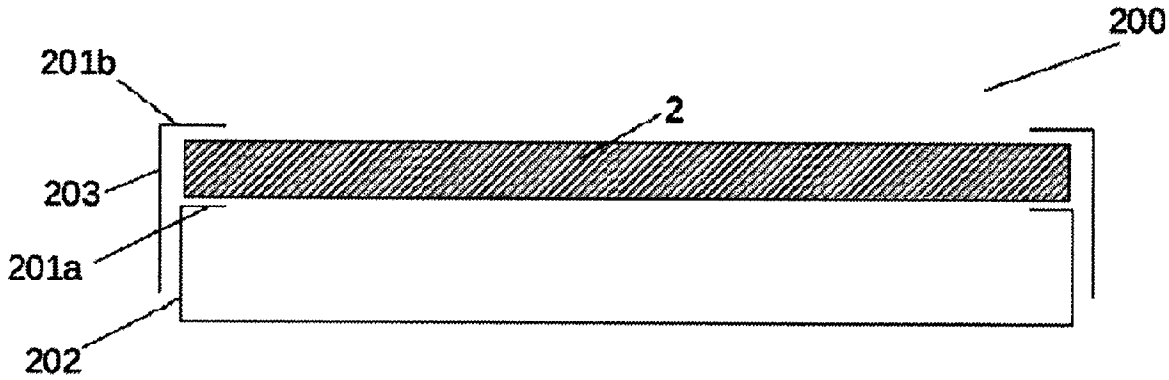


Figure 5a

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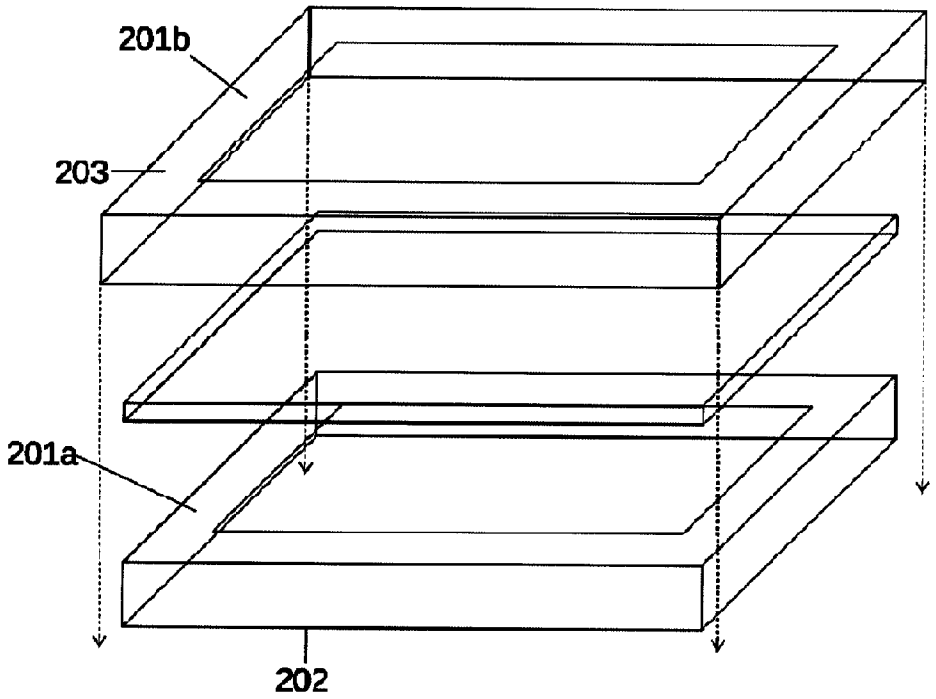


Figure 5b

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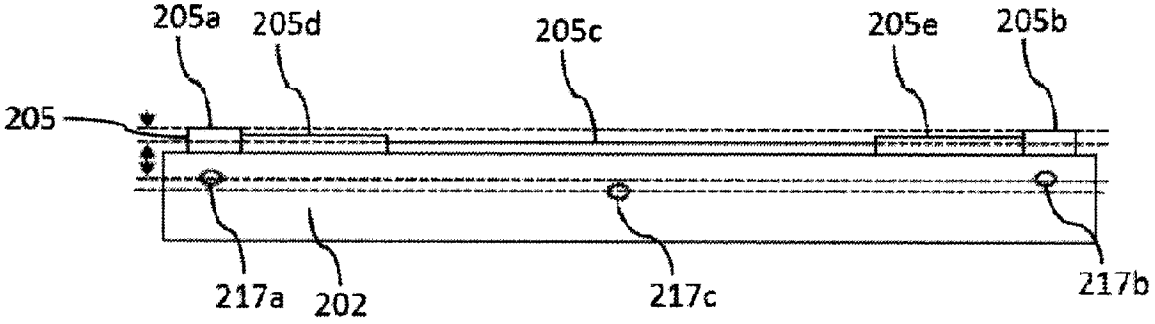


Figure 5c

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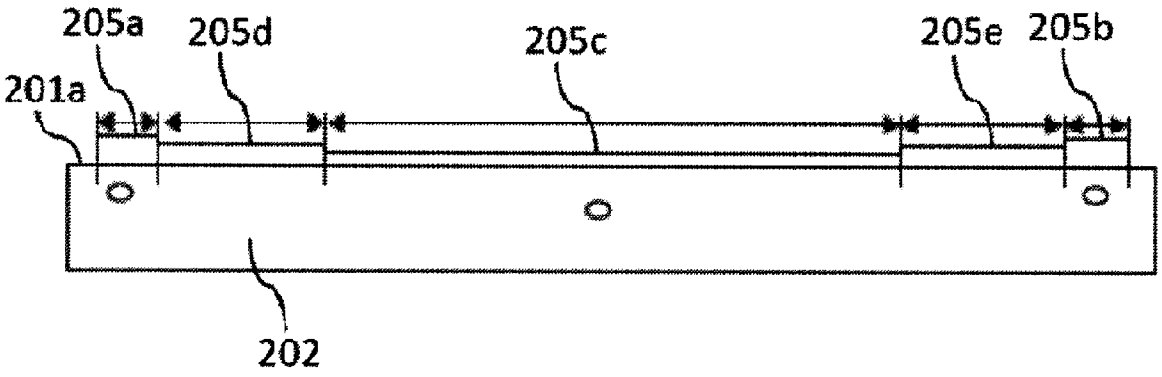


Figure 5d

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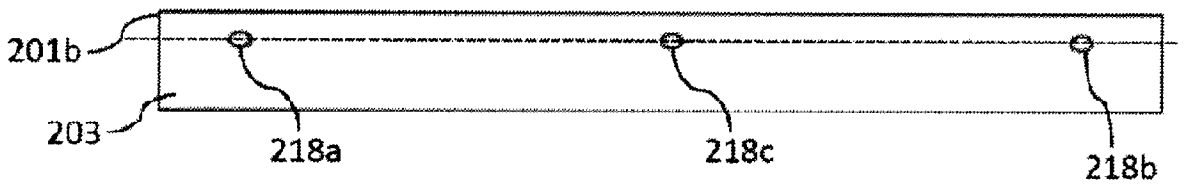


Figure 5e

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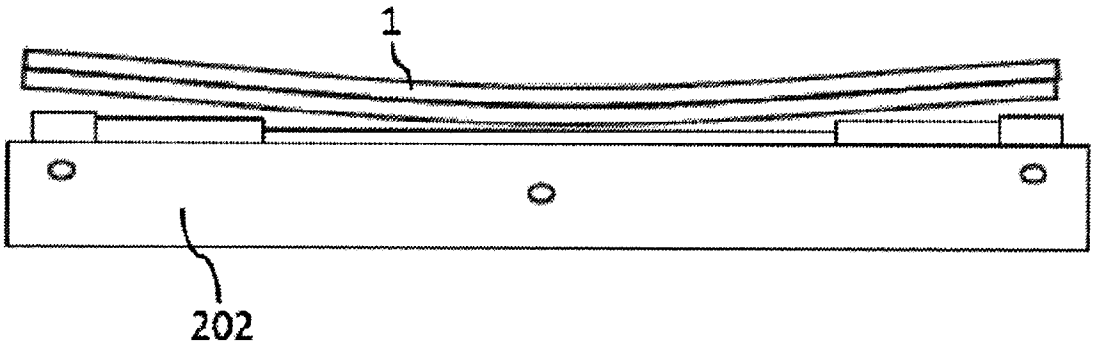


Figure 5f

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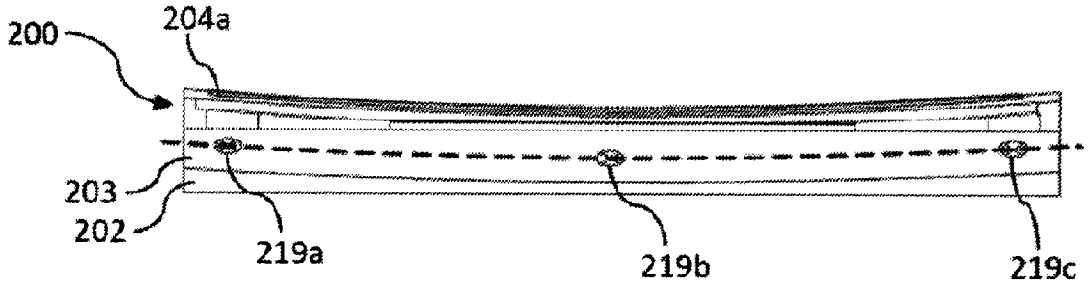


Figure 5g

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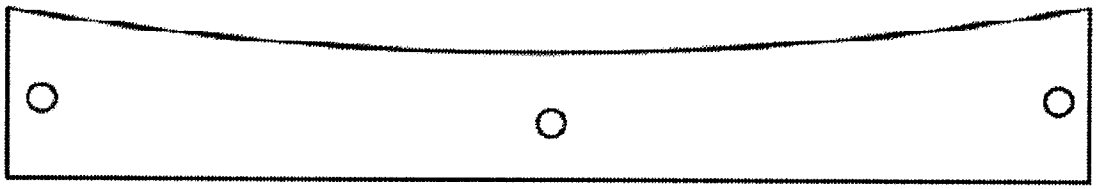


Figure 5h

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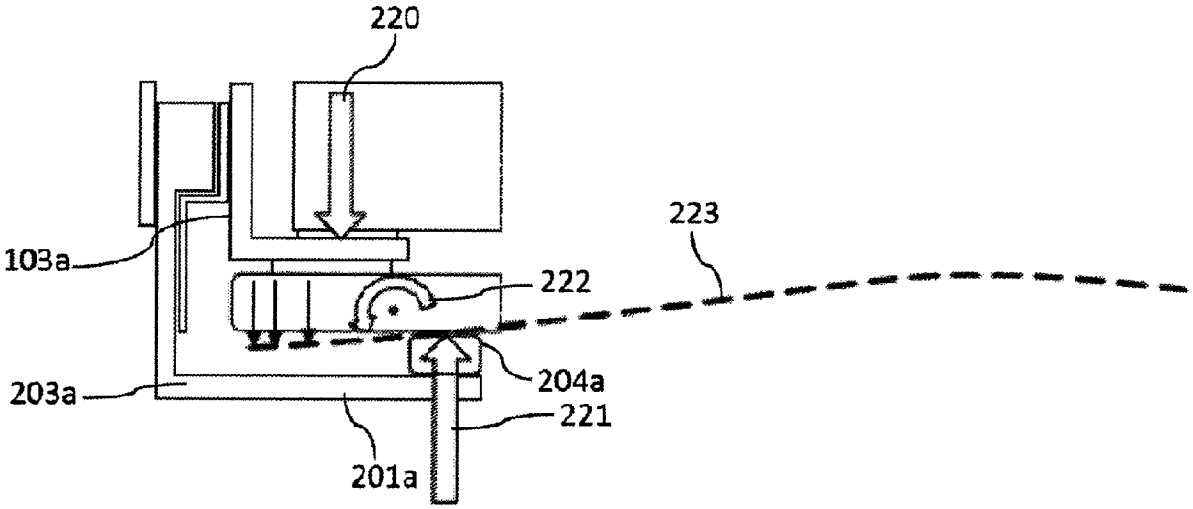


Figure 6

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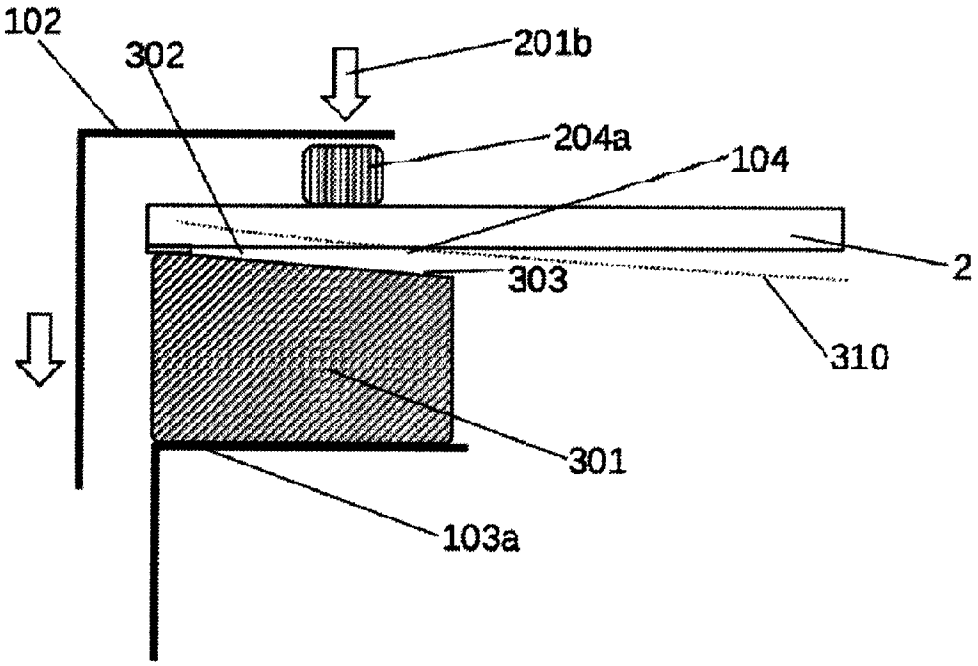


Figure 7

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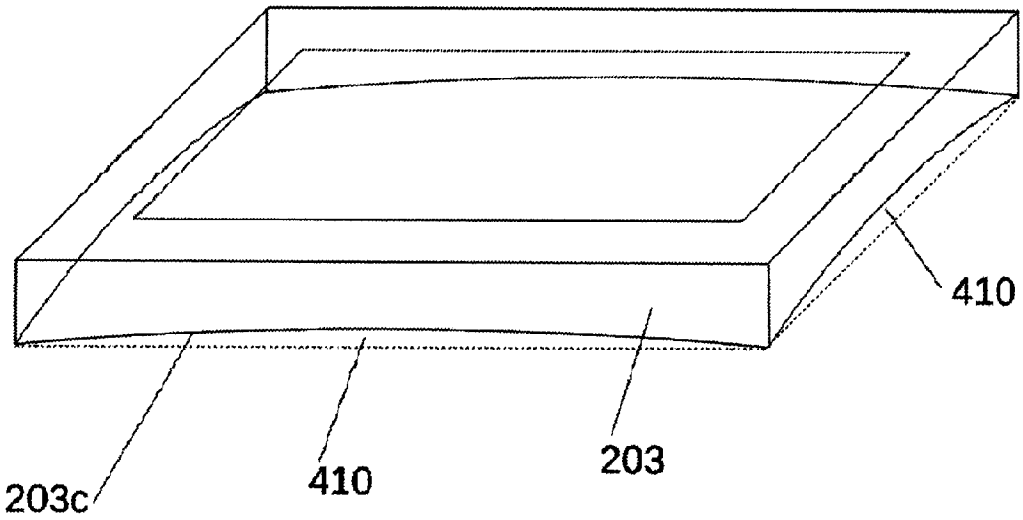


Figure 8

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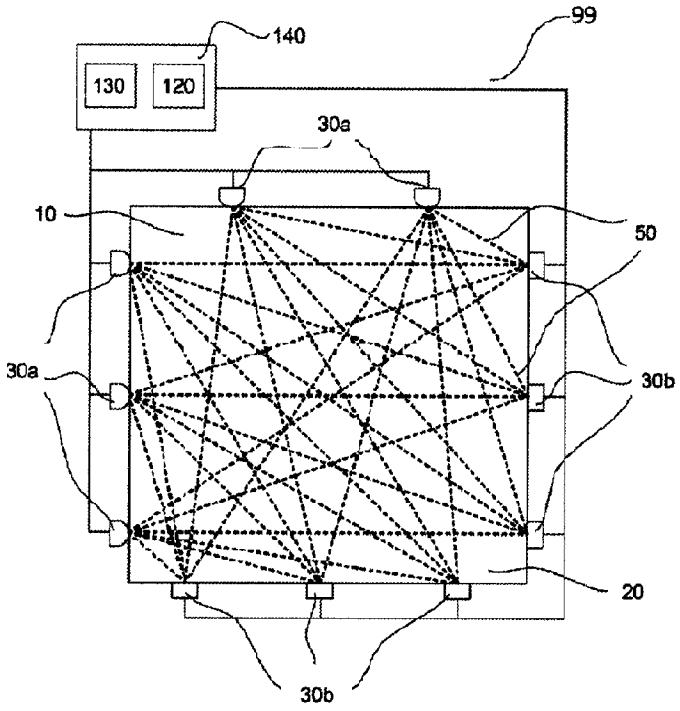


Figure 9

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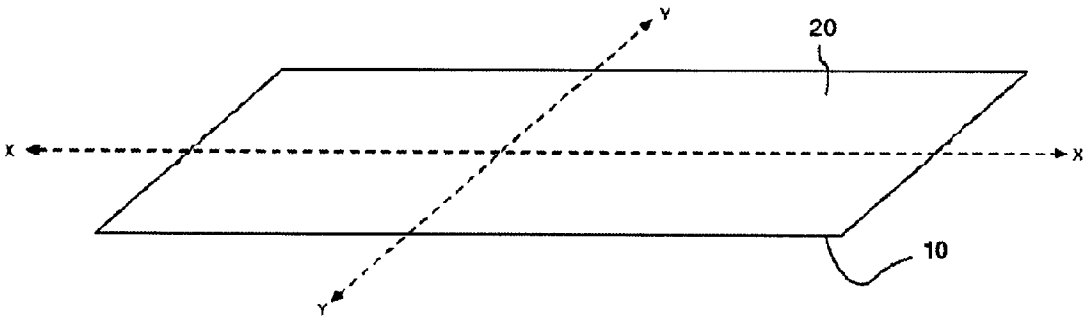


Figure 10a

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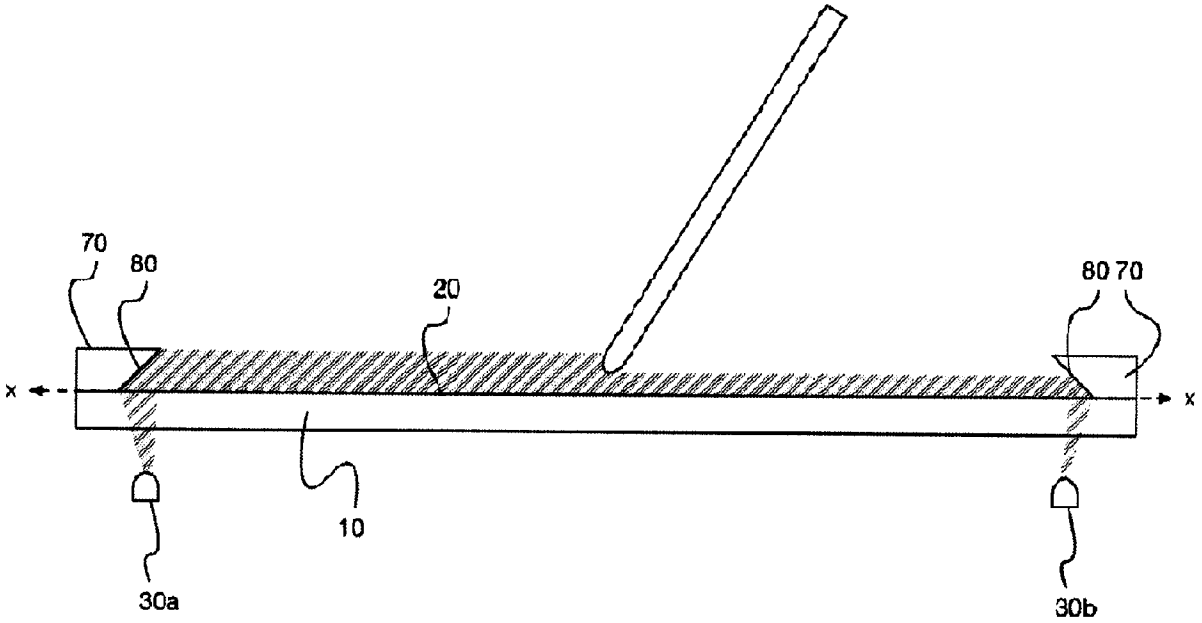


Figure 10b

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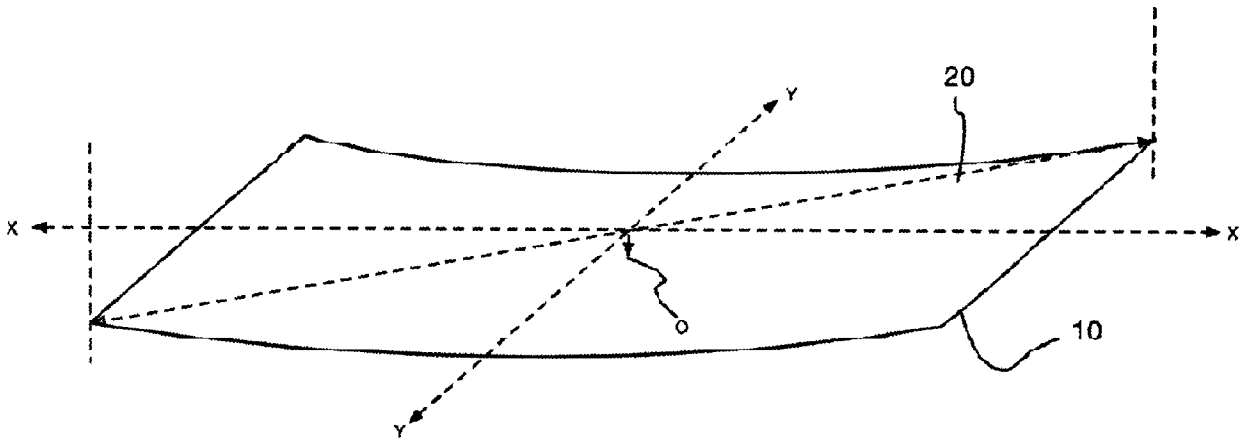


Figure 11a

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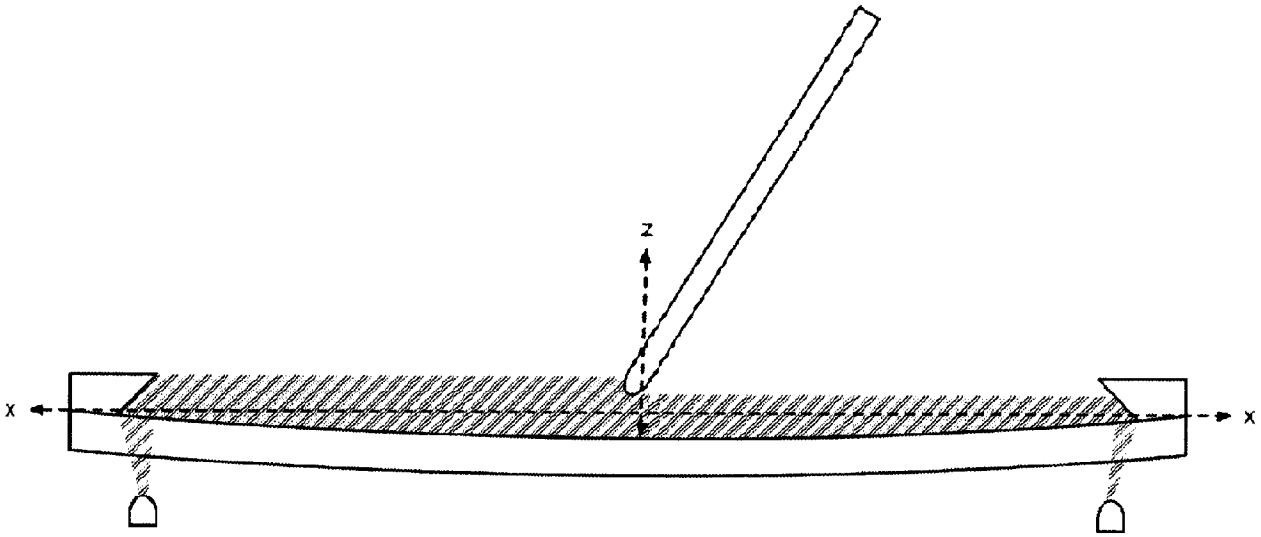


Figure 11b

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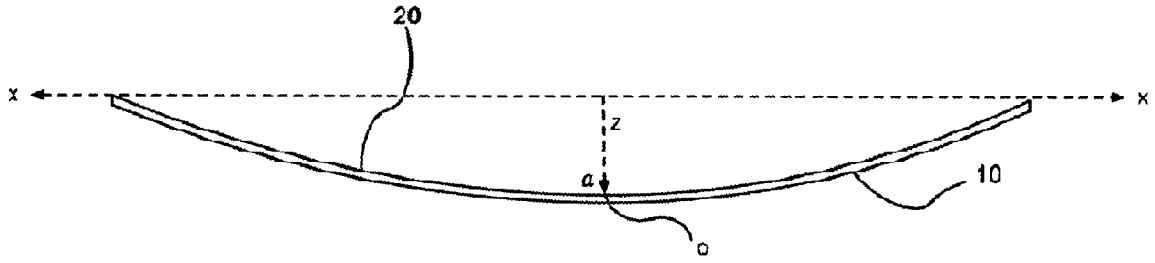


Figure 11c

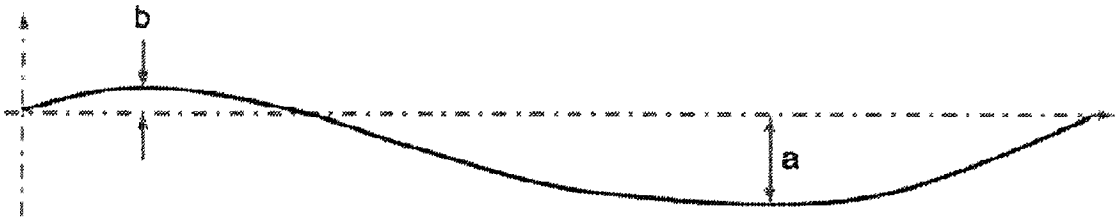


Figure 11d

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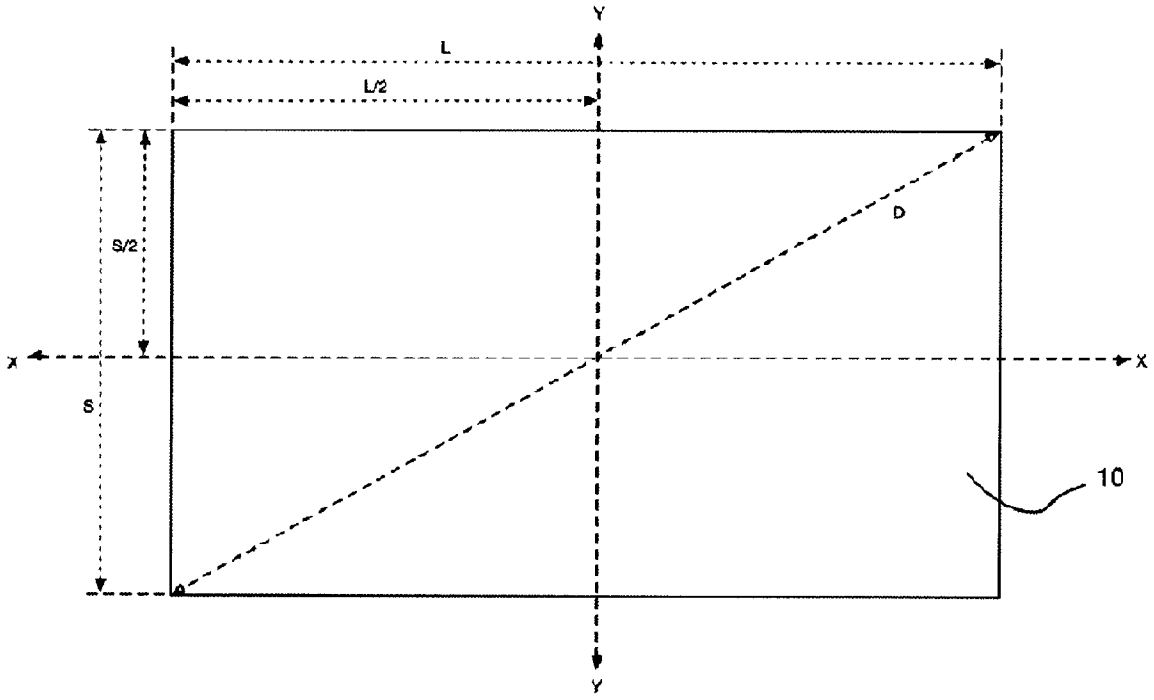


Figure 12a

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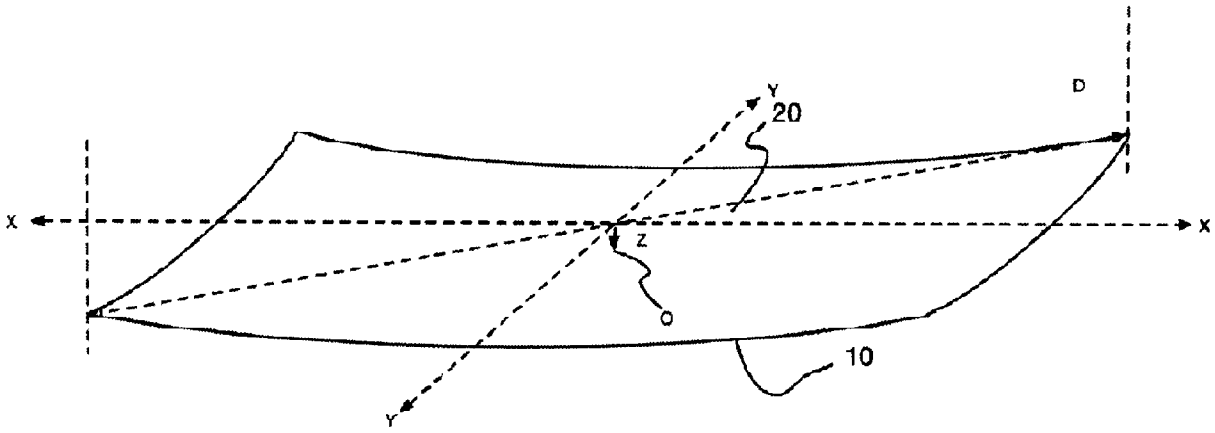


Figure 12b

Chemtronics v. FlatFrog
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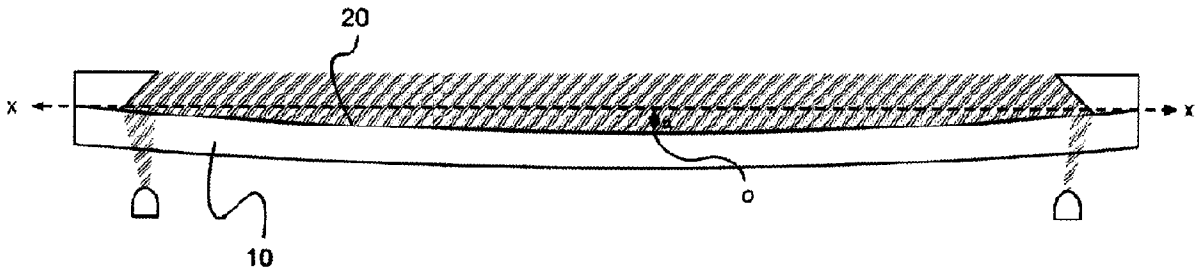


Figure 12c

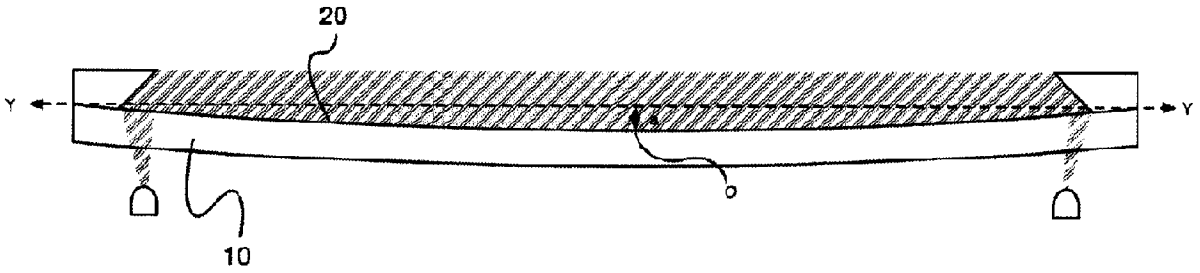


Figure 12d

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 827

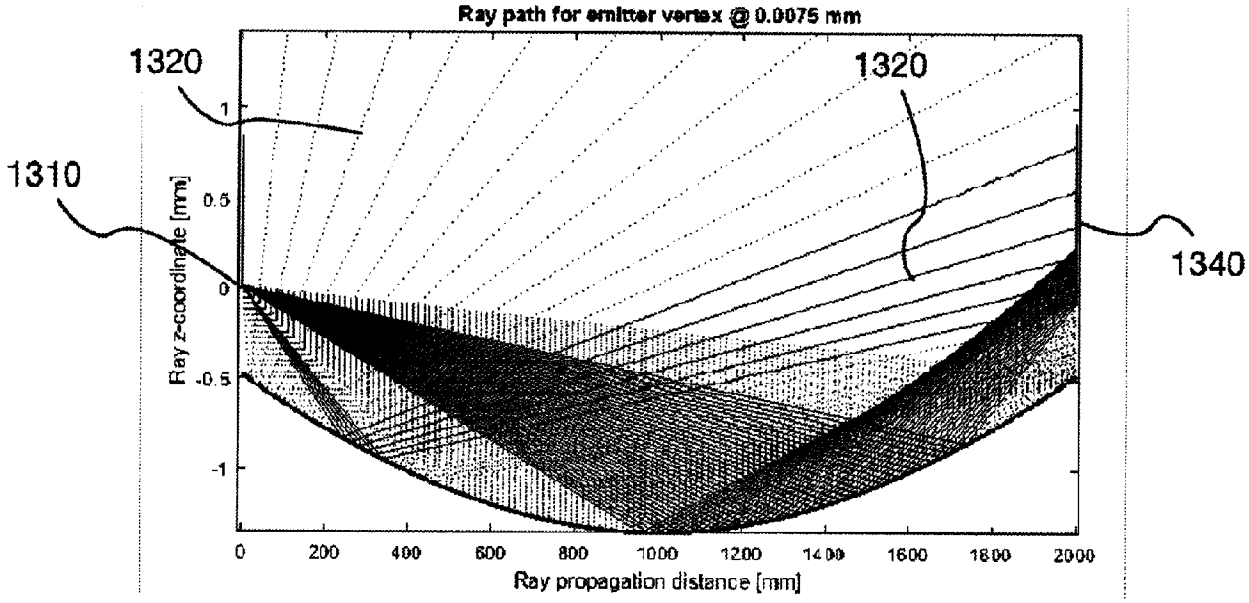


Figure 13a

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 828

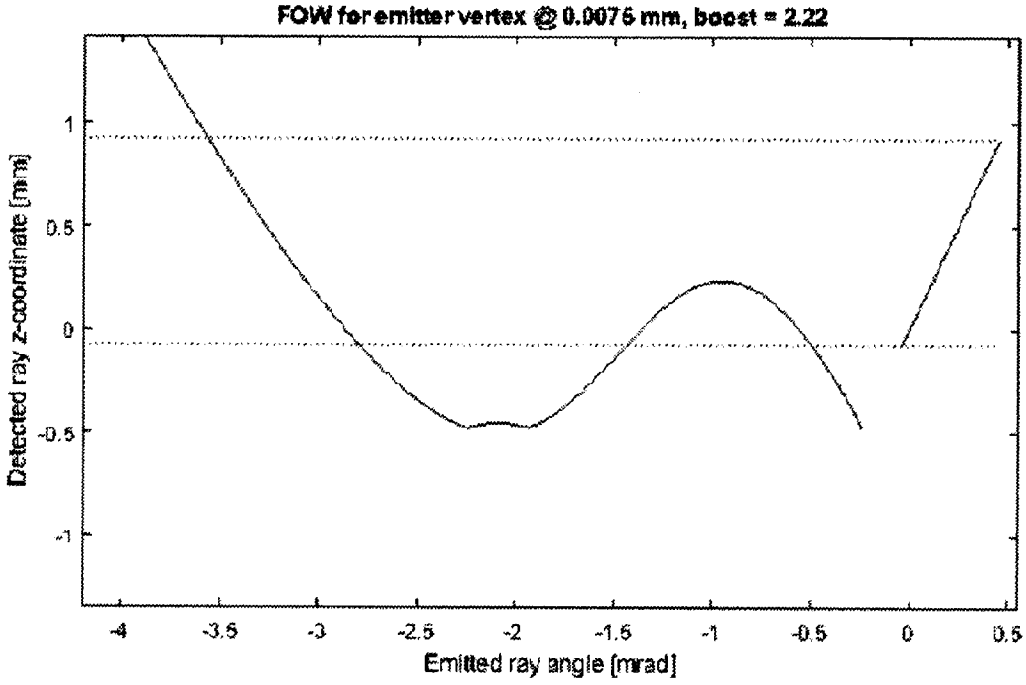


Figure 13b

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 829

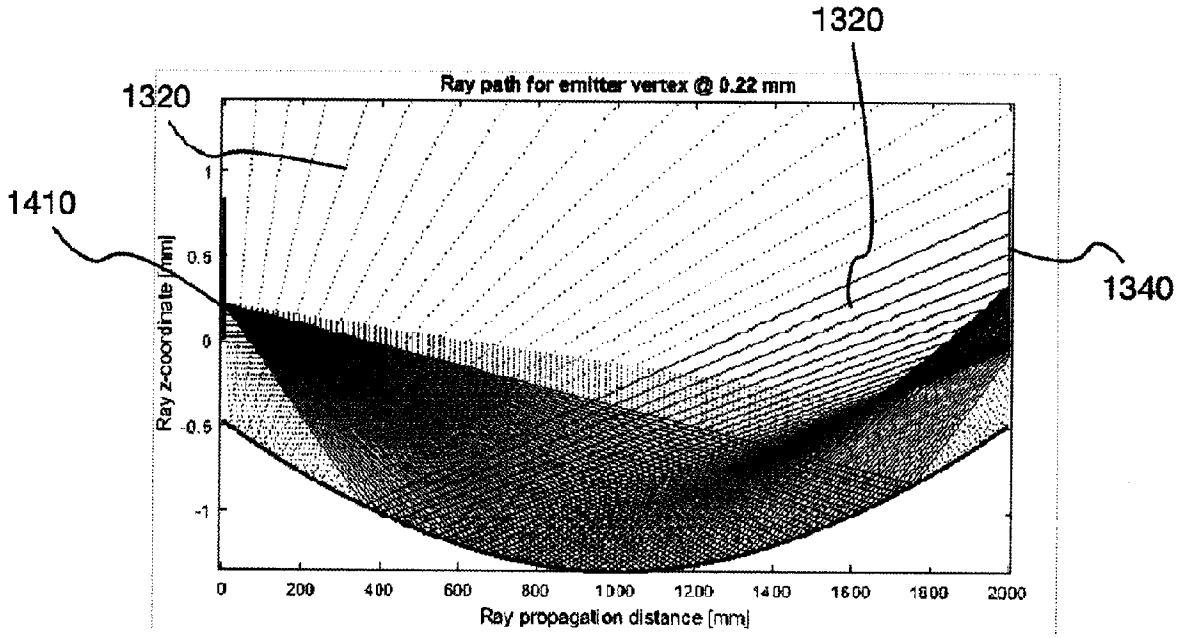


Figure 14a

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 830

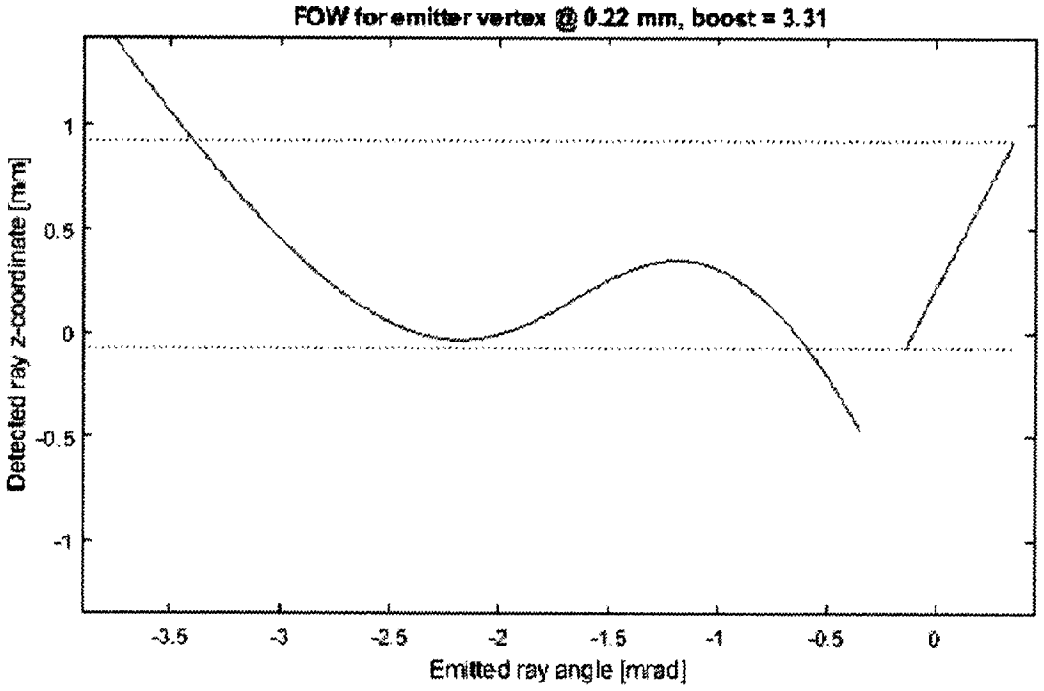


Figure 14b

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 831

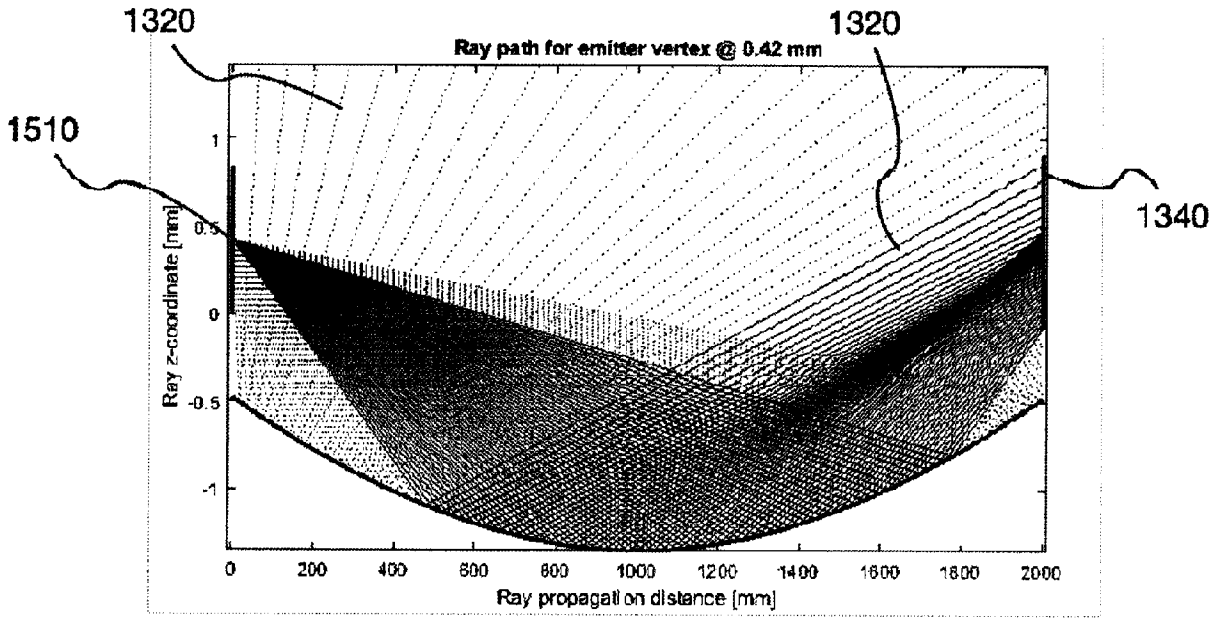


Figure 15a

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 832

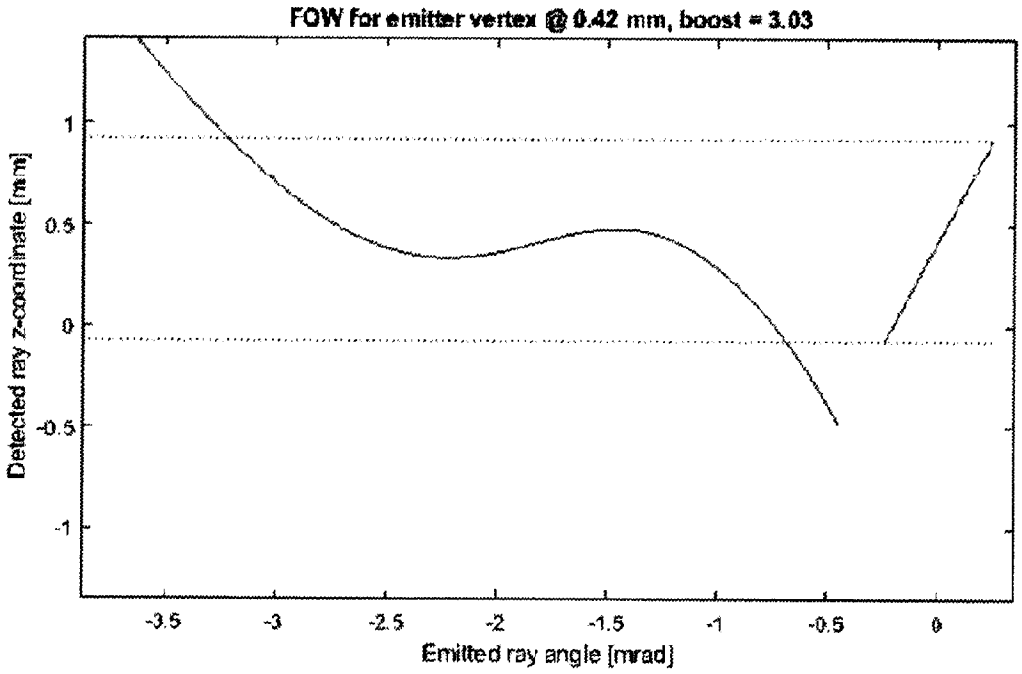


Figure 15b

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 833

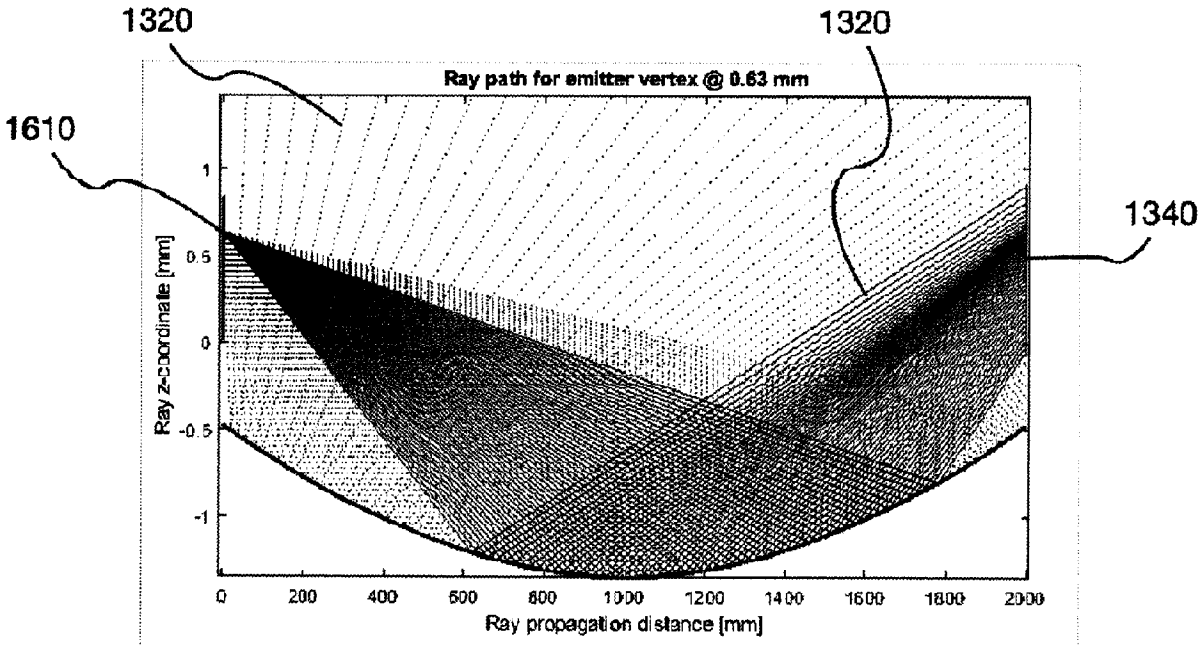


Figure 16a

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 834

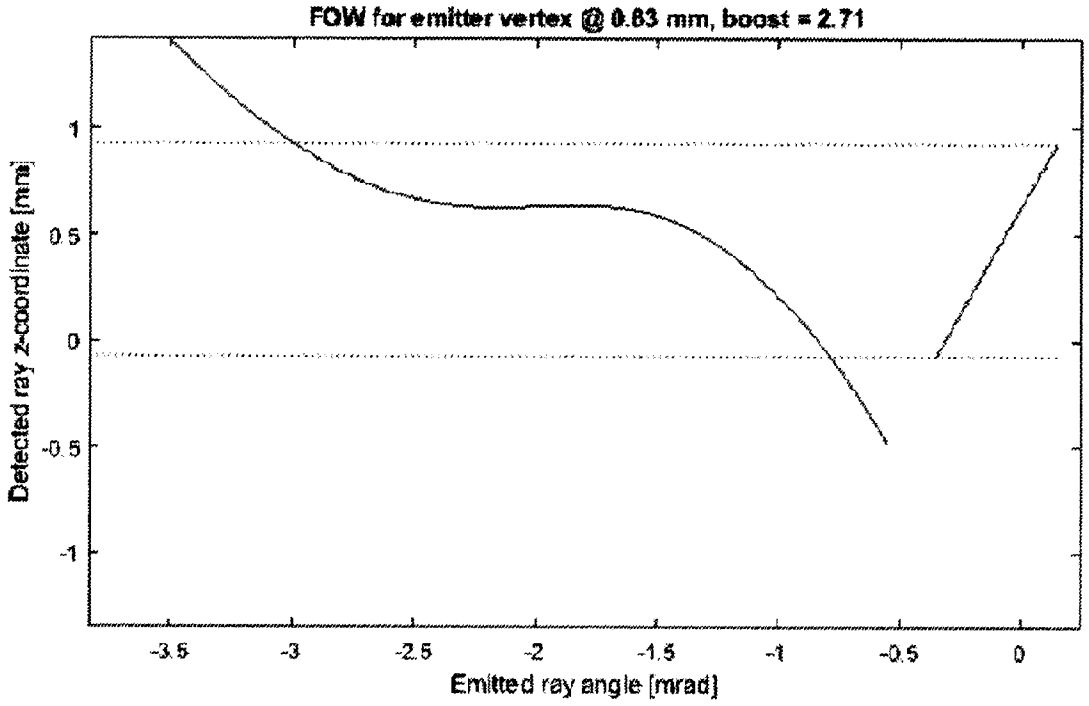


Figure 16b

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 835

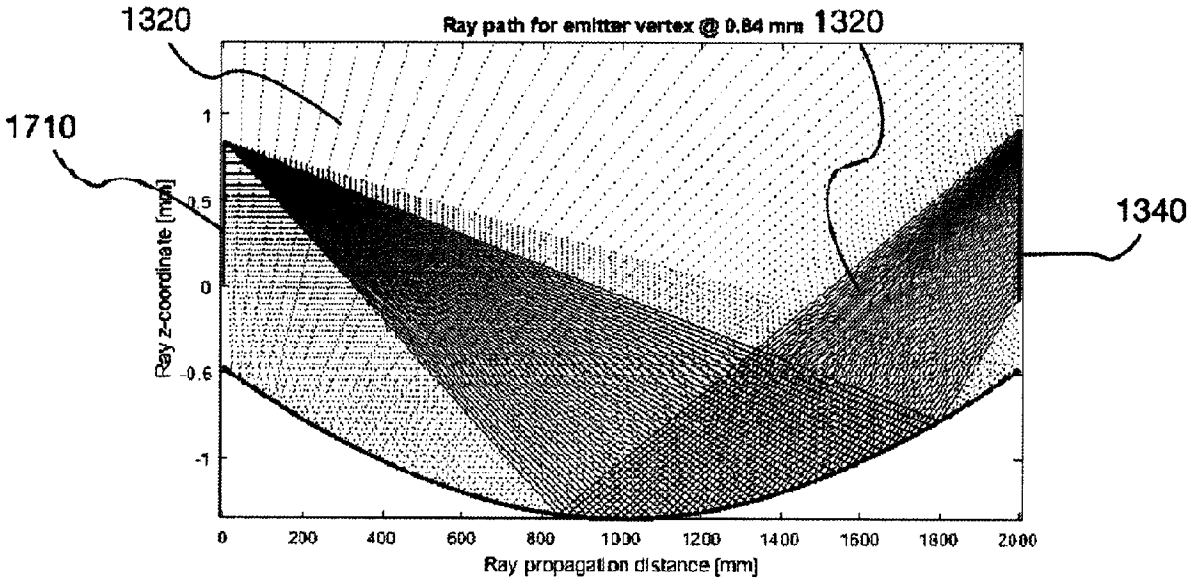


Figure 17a

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 836

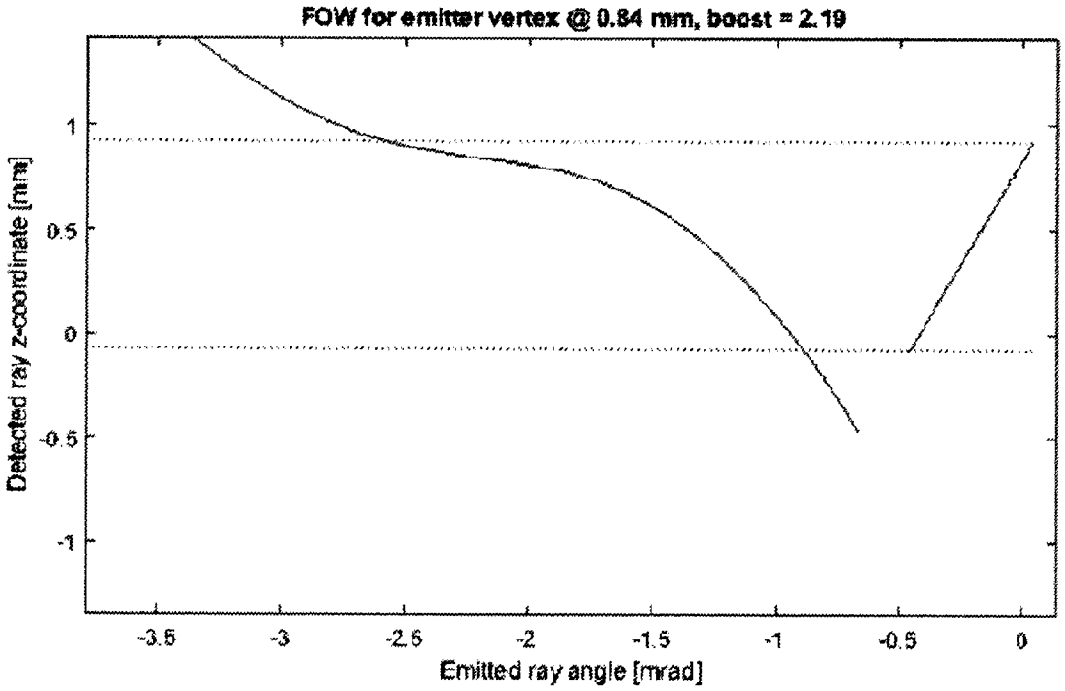


Figure 17b

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 837

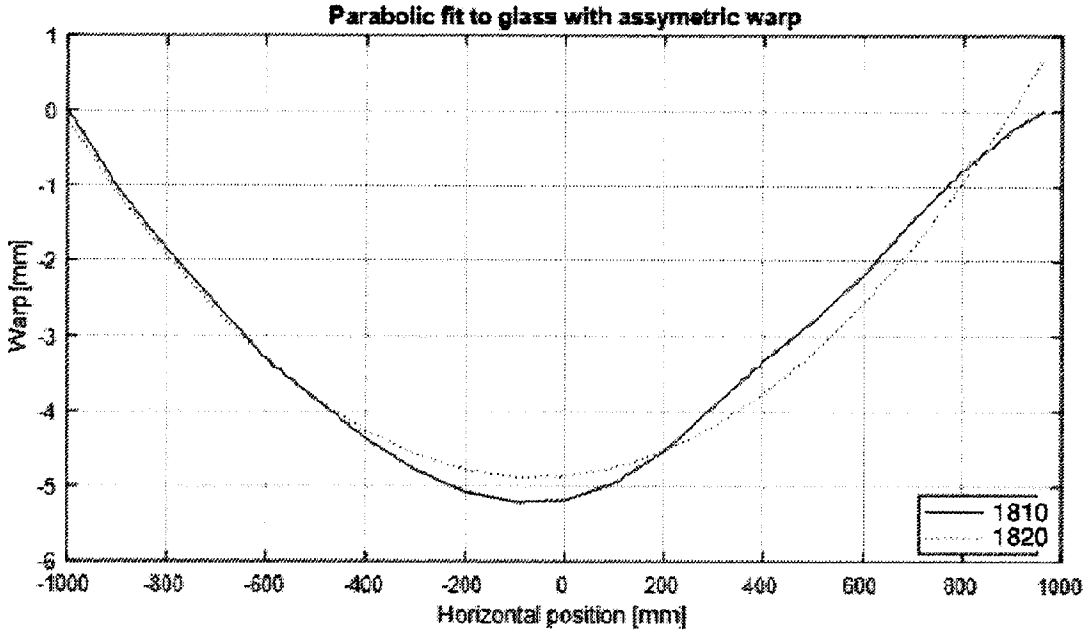


Figure 18a

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 838

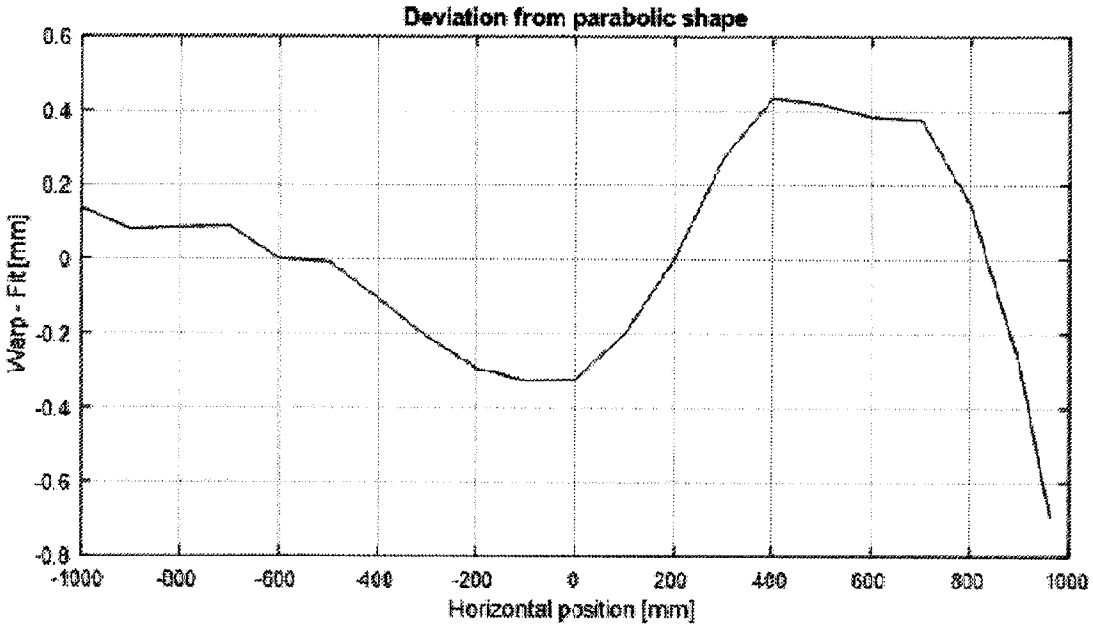


Figure 18b

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 839

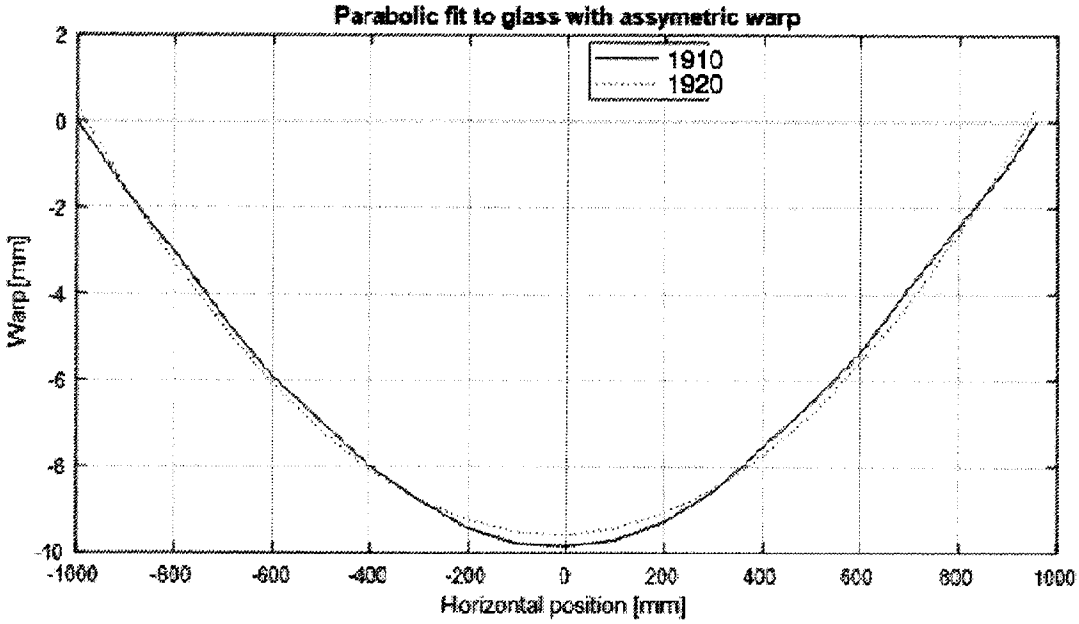


Figure 19a

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 840

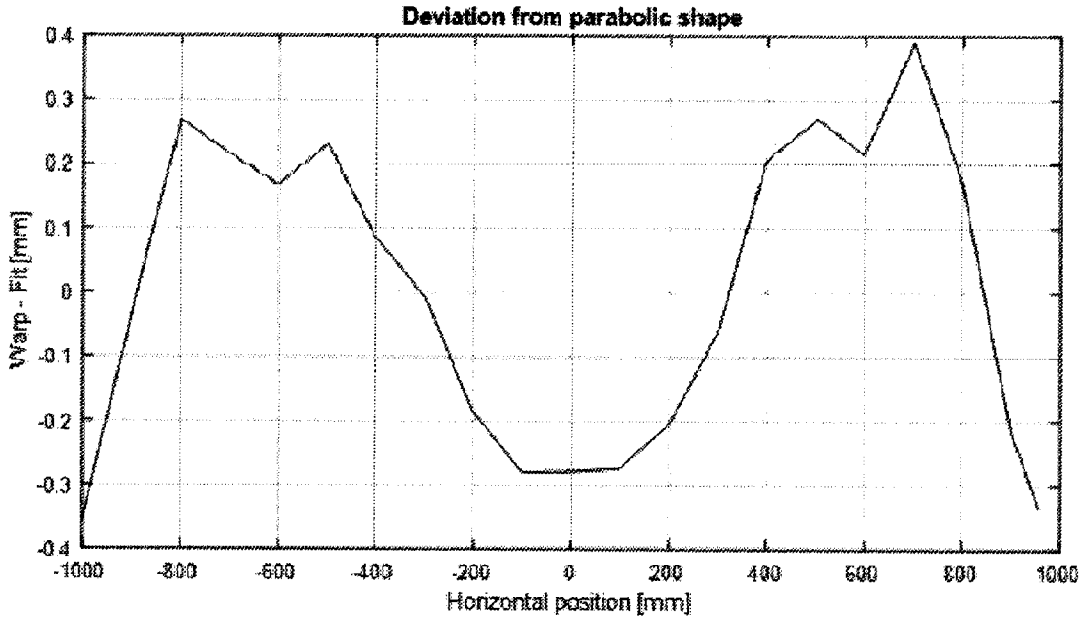


Figure 19b

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 841

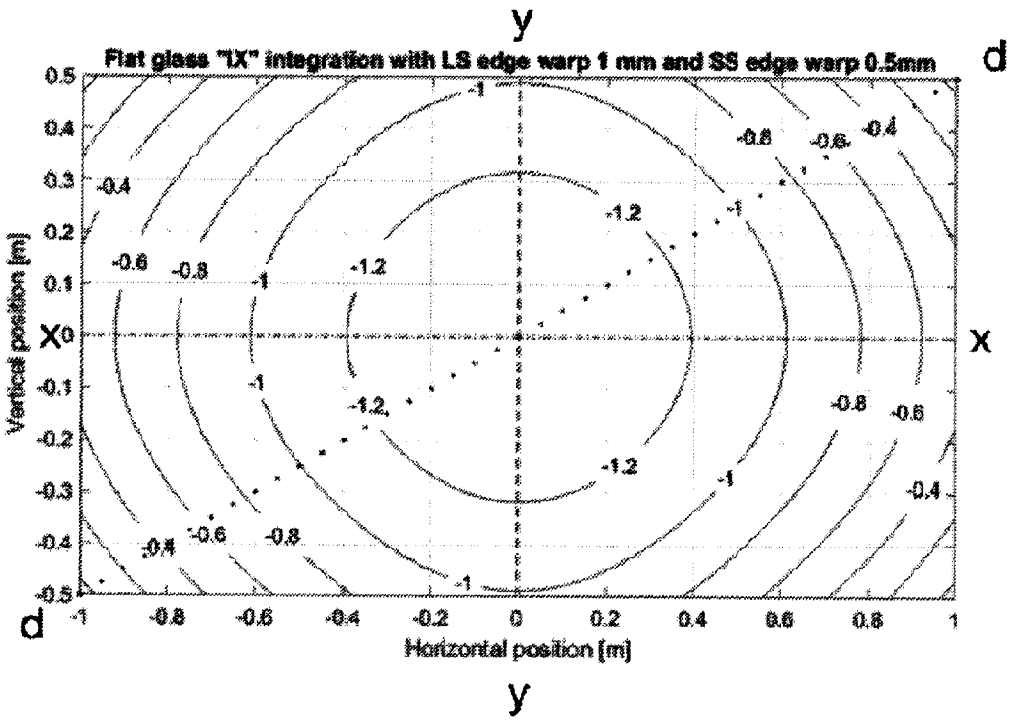

y
Flat glass "IX" integration with LS edge warp 1 mm and SS edge warp 0.5mm
d
Vertical position [m]
Horizontal position [m]
x
d
y

Figure 20a

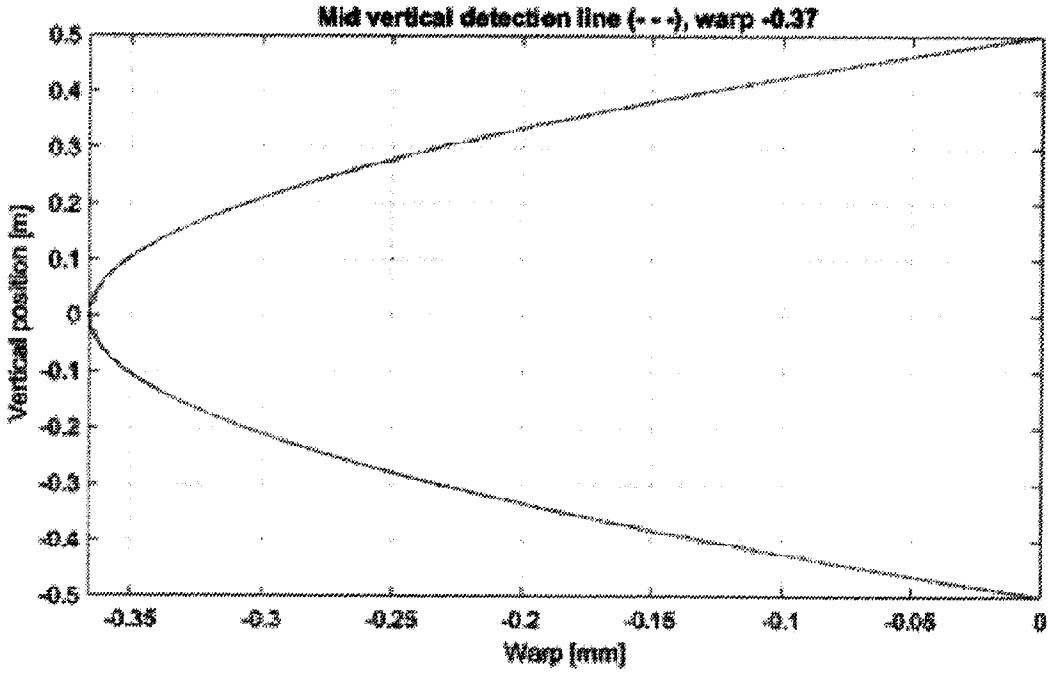


Figure 20b

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 843

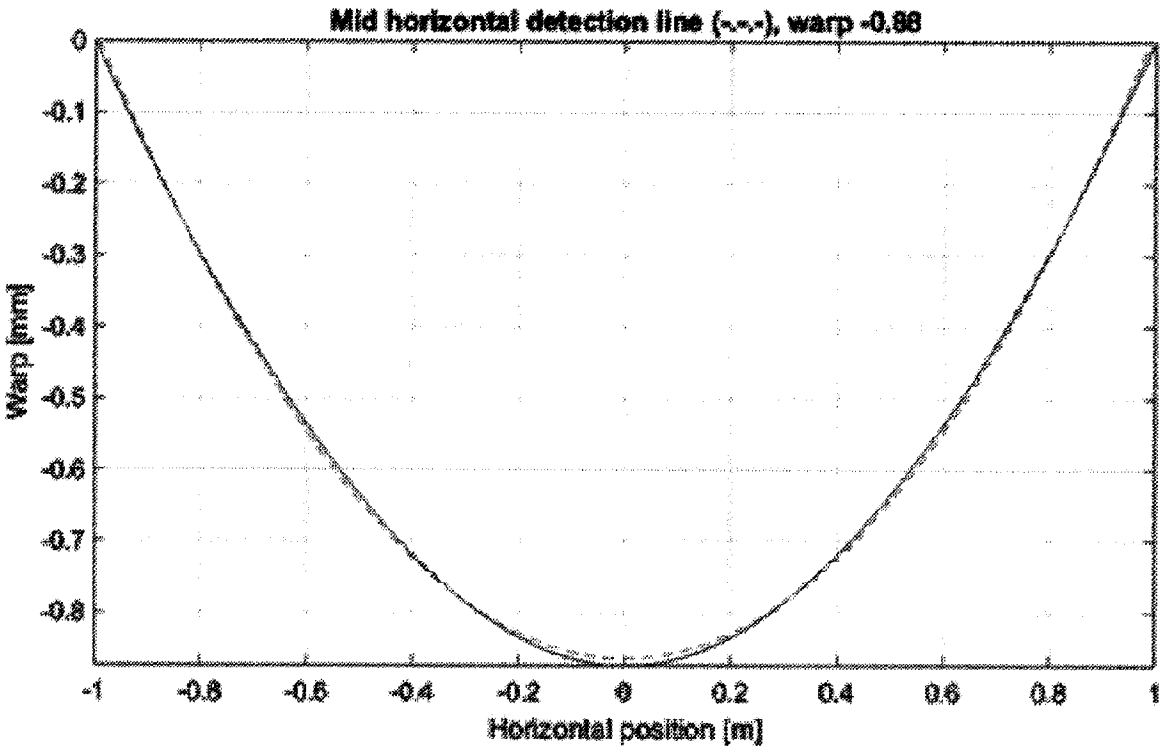


Figure 20c

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 844

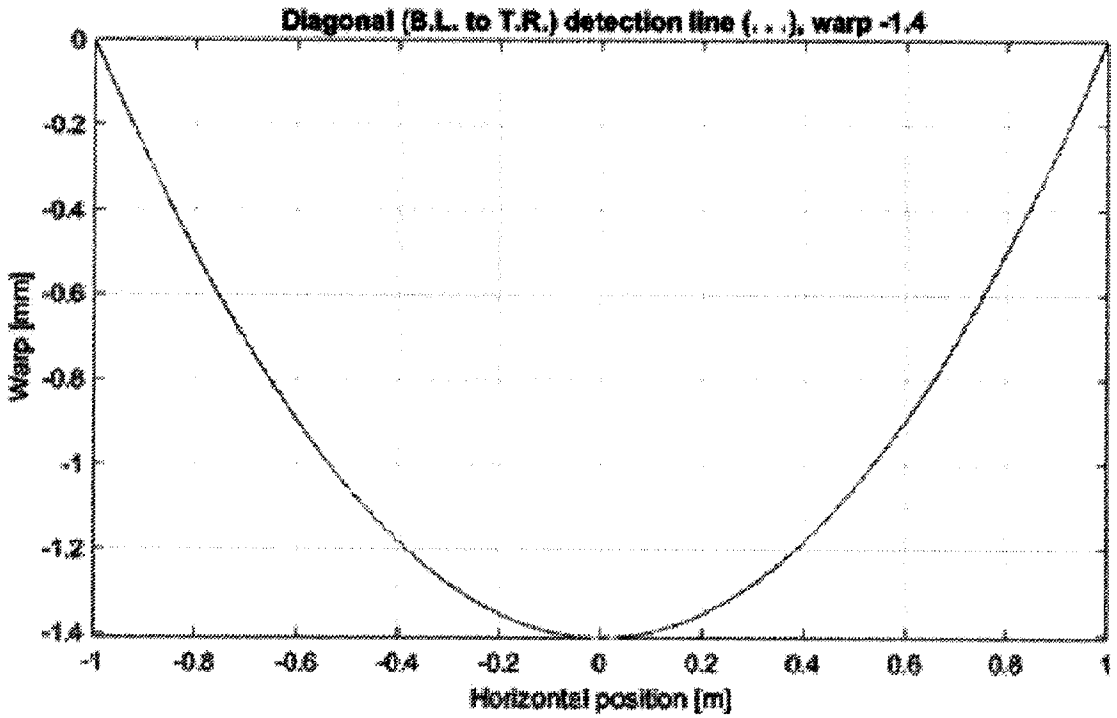


Figure 20d

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 845

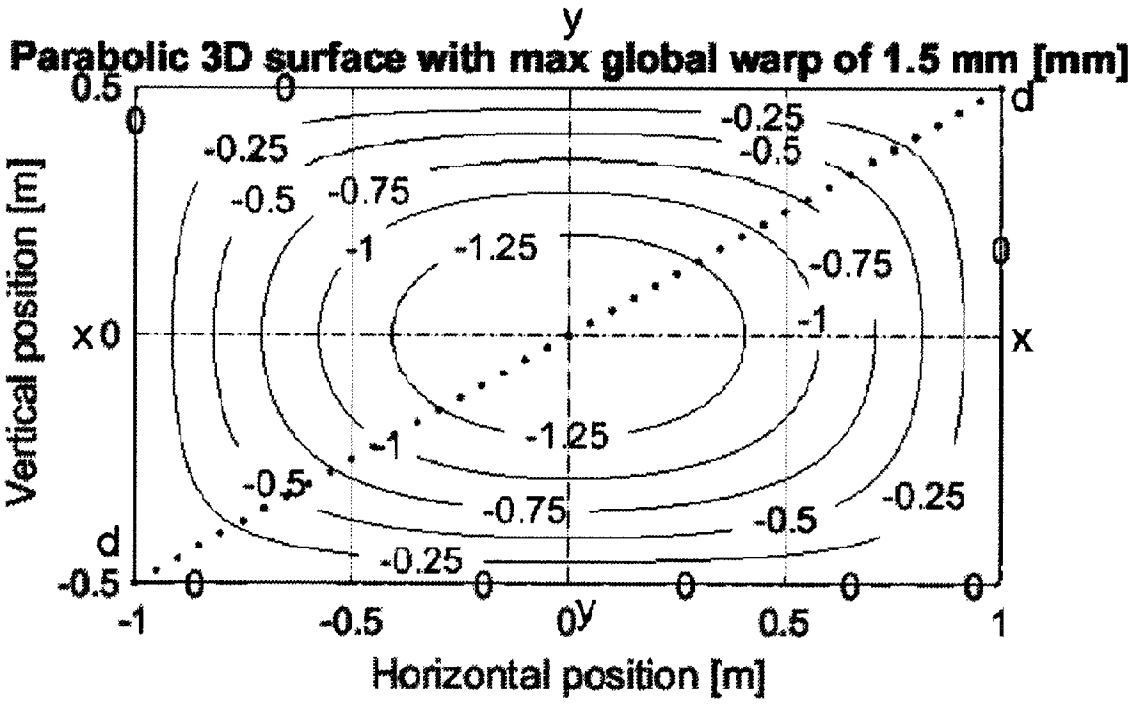


Figure 21a

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 846

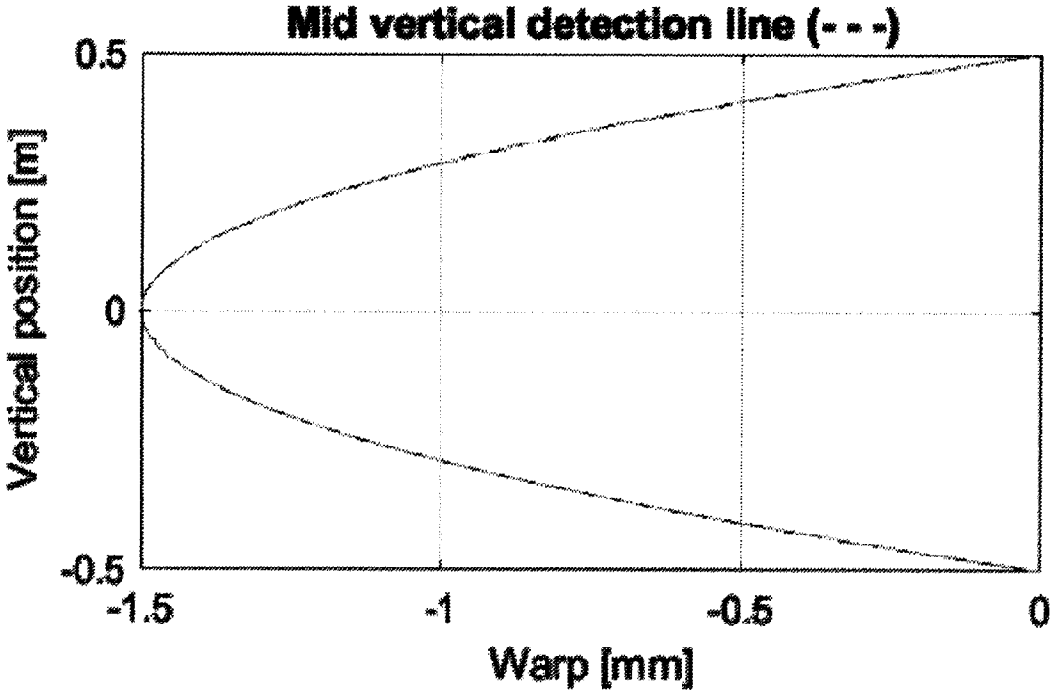


Figure 21b

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 847

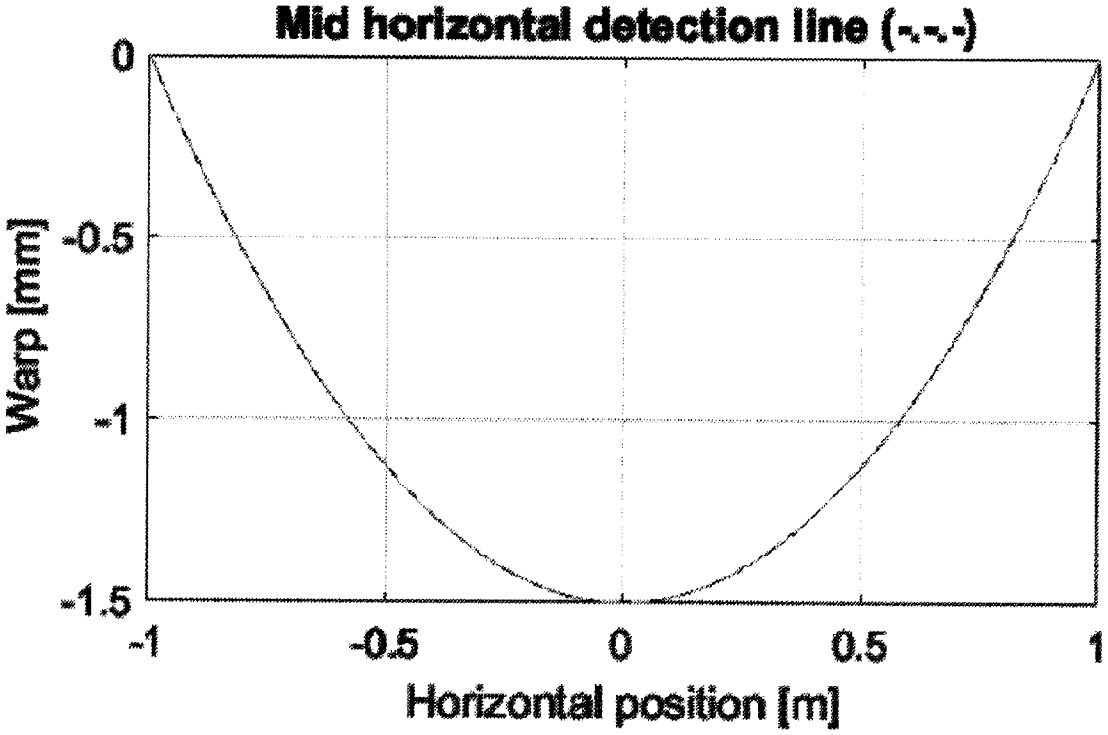


Figure 21c

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 848

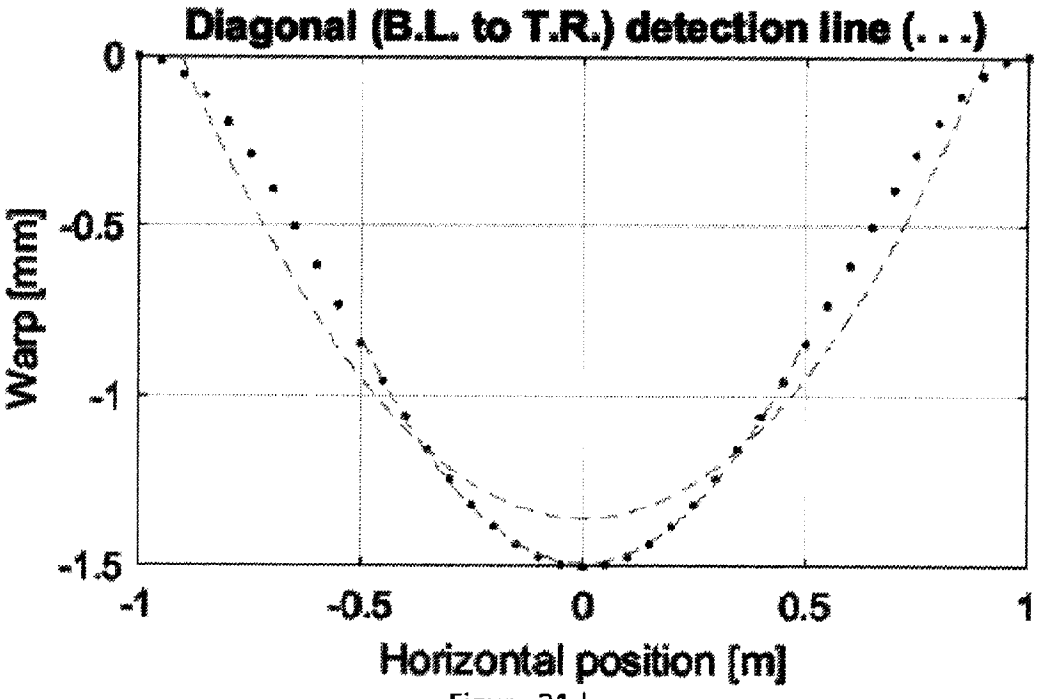


Figure 21d

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 849

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2017/051233

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: G06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE, DK, FI, NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, PAJ, WPI data, COMPENDEX, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6031524 A1 (INTERMEC IP CORP), 29 February 2000 (2000-02-29); column 1, line 60 - column 2, line 20 --	1-24
A	US 20160295711 A1 (RYU HYUNJONG ET AL), 6 October 2016 (2016-10-06); whole document --	1-24
A	EP 3043242 A1 (DEXERIALS CORP), 13 July 2016 (2016-07-13); whole document --	1-24
A	WO 2016177592 A1 (AGC GLASS EUROPE), 10 November 2016 (2016-11-10); whole document --	1-24

☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
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Date of the actual completion of the international search	Date of mailing of the international search report
12-03-2018	12-03-2018
Name and mailing address of the ISA/SE Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. + 46 8 666 02 86	Authorized officer Emil Bäcklund Telephone No. + 46 8 782 28 00

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 20120062492 A1 (KATOH SATOSHI), 15 March 2012 (2012-03-15); paragraphs [0006]-[0010] --	1-24
A	US 20120045170 A1 (SHIBATA NAOKI ET AL), 23 February 2012 (2012-02-23); whole document -- --------	1-24

Continuation of: second sheet

International Patent Classification (IPC)

G06F 1/16 (2006.01)
G06F 3/01 (2006.01)
G06F 3/03 (2006.01)
G06F 3/041 (2006.01)

US	6031524	A1	29/02/2000	NONE			
US	20160295711	A1	06/10/2016	US	9839145	B2	05/12/2017
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EP	3043242	A1	13/07/2016	CN	105518592	A	20/04/2016
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				JP	5848736	B2	27/01/2016
				KR	20160053923	A	13/05/2016
				TW	201523377	A	16/06/2015
				US	20160202801	A1	14/07/2016
				WO	2015033569	A1	12/03/2015
WO	2016177592	A1	10/11/2016	CN	107531547	A	02/01/2018
				KR	20180004141	A	10/01/2018
				TW	201704169	A	01/02/2017
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				WO	2010119882	A1	21/10/2010
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				JP	2012043136	A	01/03/2012
				KR	20120017403	A	28/02/2012
				TW	201219866	A	16/05/2012

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
1 May 2014 (01.05.2014)

WIPO | PCT

(10) International Publication Number
WO 2014/065601 A1

(51) **International Patent Classification:**
G09F 9/00 (2006.01)

(21) **International Application Number:**
PCT/KR20 13/009503

(22) **International Filing Date:**
24 October 2013 (24.10.201 3)

(25) **Filing Language:** English

(26) **Publication Language:** English

(30) **Priority Data:**
10-2012-01 19096 25 October 2012 (25.10.2012) KR
10-2012-01 19976 26 October 2012 (26.10.2012) KR

(71) **Applicant: LG ELECTRONICS INC.** [KR/KR]; 20 Yeouido-dong, Yeongdeungpo-gu, Seoul 150-721 (KR).

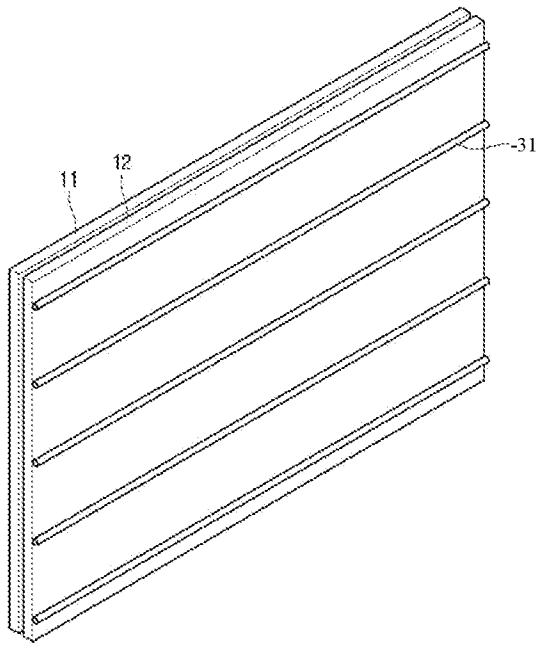
(72) **Inventors: SUNG, Jaehyun;** LG Electronics Inc. IP Group, 16 Umyeon-dong, Seocho-gu, Seoul 137-724 (KR). **KIM, Jinsu;** LG Electronics Inc. IP Group, 16 Umyeon-dong, Seocho-gu, Seoul 137-724 (KR). **LEE, Ahreum;** LG Electronics Inc. IP Group, 16 Umyeon-dong, Seocho-gu, Seoul 137-724 (KR). **SONG, Hyeoncheol;** LG Electronics Inc. IP Group, 16 Umyeon-dong, Seocho-gu, Seoul 137-724 (KR). **PARK, Sangdon;** LG Electronics Inc. IP Group, 16 Umyeon-dong, Seocho-gu, Seoul 137-724 (KR). **LEE, Moungyoub;** LG Electronics Inc. IP Group, 16 Umyeon-dong, Seocho-gu, Seoul 137-724 (KR). **KWON, Heewon;** LG Electronics Inc. IP Group, 16 Umyeon-dong, Seocho-gu, Seoul 137-724 (KR). **LEE, Deogjin;** LG Electronics Inc. IP Group, 16 Umyeon-dong, Seocho-gu, Seoul 137-724 (KR). **RYU, Inkeun;** LG Electronics Inc. IP Group, 16 Umyeon-dong, Seocho-gu, Seoul 137-724 (KR).

(74) **Agent: SEO, Kyo Jun;** 6th FL, Hyun Juk Bldg., 832-41 Yeoksam-dong, Gangnam-gu, Seoul 135-080 (KR).

(81) **Designated States** *(unless otherwise indicated, for every kind of national protection available):* AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC,

[Continued on nextpage]

(54) **Title:** DISPLAY DEVICE



(57) **Abstract:** A display device is provided. The display device may include a display panel for displaying an image and a back cover provided behind the display panel and coupled to the display panel. A bending assembly may be coupled to the back cover to bend the display panel. A controller may be provided that is configured to control the bending assembly to apply a physical force to the back cover to bend the display panel a prescribed amount.

WO 2014/065601 A1

SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) **Designated States** *(unless other-wise indicated, for every kind of regional protection available):* ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

Description

Title of Invention: DISPLAY DEVICE

Technical Field

[I] Provided is a display device and a bending assembly configured to bend the display device.

Background Art

[2] The present disclosure relates to a display device and method of changing a curvature of the display screen to improve user's immersion while viewing the display screen.

[3] A display device may be a Liquid Crystal Display Device (LCD), a Plasma Display Panel (PDP), an Electro Luminescent Display (ELD), and a Vacuum Fluorescent Display (VFD). Display devices may also include 3-D imaging technology. With proliferation and advancement in digital technology, improvements in display technology to provide content to users is needed.

[4]

Disclosure of Invention

Technical Problem

[5] Development of the display device to improve user's immersion while viewing the display screen is required.

Solution to Problem

[6] Embodiments provide a display device having a structure capable of improving user's immersion.

[7] In one embodiment, a display device includes: a display unit displaying an image; and a bending assembly bending the display unit.

[8] The bending assembly may include a bending actuator applying force to the display unit and a bending control unit controlling an operation of the bending actuator.

Advantageous Effects of Invention

[9] According to and embodiment of the present disclosure, user's immersion while viewing the display screen can be improved. In addition, bending amount of the display screen can be easily controlled.

[10]

Brief Description of Drawings

[II] The embodiments will be described in detail with reference to the following drawings in which like reference numerals refer to like elements wherein:

[12] Figure 1 is a view illustrating a shape of a display module according to an embodiment of the present disclosure;

[13] Figure 2 is a view illustrating a shape of a display module and a back cover

according to an embodiment of the present disclosure;

[14] Figures 3A and 3B are views illustrating a portion of a display device according to an embodiment of the present disclosure;

[15] Figures 4 to 6 are cross-sectional views illustrating a portion of a display device according to an embodiment of the present disclosure;

[16] Fig 7 is a plan view illustrating a coupling structure of a back cover and a printed circuit board;

[17] Figures 8A and 8B are sectional views of a second fastener;

[18] Fig 9 is a sectional view of a third fastener;

[19] Fig 10 is a separate perspective view of a third fastener;

[20] Figures 11A and 1IB are views illustrating a partial configuration of a display device according to another embodiment of the present disclosure;

[21] Figure 12 is a cross-sectional view illustrating a partial configuration of a display device according to another embodiment of the present disclosure;

[22] Figures 13 to 15B are views illustrating a partial configuration of a display device according to another embodiment of the present disclosure;

[23] Figures 16 to 17 are views illustrating a partial configuration of a display device according to another embodiment of the present disclosure;

[24] Figure 18 is a view when a sliding member is applied and Figure 19 is a view of an individual sliding member;

[25] Figures 20A and 20B are views illustrating a partial configuration of a display device according to another embodiment of the present disclosure;

[26] Figure 2 1A is a view illustrating a display module, a back cover, and a bending actuator according to an embodiment of the present disclosure;

[27] Figure 21B is a view when Figure 21A is bent;

[28] Figure 22 is a view illustrating a direction of force applied between parallel straight currents;

[29] Figure 23 is a view illustrating a display module, a back cover, and a bending actuator according to another embodiment of the present disclosure;

[30] Figure 24A is a view illustrating a flat cross section of Figure 23;

[31] Figure 24B is a view when Figure 24A is bent;

[32] Figure 25 is a view illustrating a display module, a back cover, and a bending actuator according to another embodiment of the present disclosure;

[33] Figure 26 is a view illustrating a flat cross section of Figure 25;

[34] Figure 27 is a view illustrating a display module, a back cover, and a bending actuator according to another embodiment of the present disclosure;

[35] Figure 28 is a sectional view of a bi-metal;

[36] Figure 29 is a plan view illustrating a back cover and a display module of Figure 27;

[37] Figure 30 is a view illustrating a bending actuator according to another embodiment of the present disclosure;

[38] Figure 31 is a view illustrating a bending actuator according to another embodiment of the present disclosure;

[39] Figure 32 is a view illustrating a bending actuator according to another embodiment of the present disclosure;

[40] Figure 33 is a view illustrating a plan view of Figure 32;

[41] Figures 34 to 36 are views illustrating a bending actuator according to another embodiment of the present disclosure; and

[42] Figure 37 is a sectional view illustrating a coupling structure of a first shaft and a second shaft.

[43]

Best Mode for Carrying out the Invention

[44] The details of one or more embodiments are set forth in the accompanying drawings and the description below. Other features will be apparent from the description and drawings, and from the claims.

[45] Hereinafter a display device according to embodiments of the present disclosure will be described in more detail with reference to the drawings. Hereinafter, each of embodiments described herein may be modified in various forms, and the technical range of the present disclosure is not limited thereto. Moreover, the form and size of each of components shown in the drawings may be exaggerated for clarity of illustration.

[46] Figure 1 is a view illustrating a bending shape of a display module according to the present disclosure. The display module 11 (also display panel) equipped in a display device may bend in a curved shape with a constant curvature R. For example, in relation to the curved shape of the display module 11, the curvature R may be set to allow the distances dl, d2, and d3 between a user's viewing position P and the front side of a panel to have the same or similar value, and the display module 11 may have a shape that is bent depending on the set curvature R.

[47] Accordingly, while viewing an image displayed on a display device, user's immersion in the displayed content may be improved, and especially, when viewing a 3D image, user's immersion may be drastically improved by the curved shape of the display module 11. Moreover, the display module 11 displaying an image may include a self light emitting panel such as an OLED panel, or may include a panel that is not a self light emitting panel such as an LCD panel or a PDP panel and a backlight unit emitting light to the panel.

[48] Hereinafter, merely for ease in description, the display module 11 is depicted as a self light emitting Organic Light Emitting Device (OLED) panel that uses an OLED as

an example. The OLED has a structure in which an organic light emitting layer of a functional thin film form is inserted between an anode electrode and a cathode electrode. Holes are injected from the cathode electrode and electrons are injected from the anode electrode so that the electrons and holes are combined to form excitons in the organic light emitting layer and then, the excitons are recombined to emit light

[49] As a method of realizing a full color organic light emitting display, there are an independent light emitting method, a color filter method, and a color conversion method. The independent light emitting method realizes R, G, and B by thermally depositing a light emitting material of each of R, G, and B with a metal shadow mask having a detailed pattern. The color filter method realizes R, G, and B by forming a white light emitting layer and patterning an R, G, and B color filter. The color conversion method forms a blue light emitting layer and realizing R, G, and B by using a color conversion layer changing blue into green and red. However, it should be appreciated that a display module of the present disclosure is not limited to an OLED panel, and as mentioned above, various flat panel display modules such as an LCD module, a PDP module, an FED module, or another appropriate type of display may be applied to the present disclosure.

[50] The display module 11 may be a flat panel display module 11 having a curvature close to 0°, and the flat panel display module 11 may be bent by a back cover 12. Thus, the display module 11 may have a curved shape having the constant curvature R as shown in Figure 1.

[51] Figure 2 is a sectional view illustrating a configuration of a display device according to the present disclosure. As shown in Figure 2(a), the display module 11 may be the flat panel display module 11. As shown in Figure 2(b), the back cover 12 disposed at the rear of the display module 11 may be bent by applying a force to the display module 11. Therefore, as shown in Figure 2(c), the display module 11 and the back cover 12 may be bent together. While Figure 2 illustrates only the display module 11 and the back cover 12 among components of the display device according to an embodiment of the present disclosure, the display device may further include various components not illustrated.

[52] Here, the back cover 12 may be a single plate-shaped member coupled to the rear of the display module 11 and may be formed of a material having elasticity to be bent forward. For example, the back cover 12 may be formed of Carbon Fiber-reinforced Plastic (CFRP). The back cover 12 may be disposed at the rear of the display module 11 and may serve to protect the display module 11. The back cover 12 may also be used to bend the display module 11 by applying physical force to the display module 11. However, the back cover 12 is not necessarily formed of a single plate-shaped member, and thus, may be formed of a plurality of plate-shaped members or an

assembly in which another configuration is coupled to a plurality of plate-shaped members.

[53] Additionally, in the present disclosure, although the back cover 12 having the approximately same area as the display module 11 is shown in the drawing, this illustrates just a conceptual shape to describe the bending shape of the back cover 12 and the display module 11. The actual back cover 12 may have a vertical or horizontal width that is shorter or longer than that of the display module 11. That is, the shape and size of the back cover 12 is not limited to the drawing.

[54] Moreover, the center of the back cover 12 in the lateral direction and the display module 11 may be fixed, and other parts other than the center may be installed not to restrain movement forward or backward. Therefore, when the back cover 12 and the display module 11 are bent, the left and right edges may move front to back.

[55] However, the back cover 12 and the display module 11 may be installed so that the front to back movements of both lateral ends are restrained and the center of the display in the lateral direction may move front to back. In this case, the back cover 12 and the display module 11 may be bent.

[56] Moreover, a display device according to an embodiment of the present disclosure may include a bending assembly that bends a display unit 10 by applying physical force to the display unit 10. The bending assembly may include a bending actuator and a bending control unit that controls the bending actuator. Here, the display unit 10 may include the above-mentioned display module 11 and back cover 12. Moreover, the display unit 10 may further include a middle cover 13 between the display module 11 and the back cover 12.

[57] In addition, the bending actuator as used herein may also refer to a device that produces mechanical force through use of various types of energy sources such as electricity or hydraulic pressure. The bending actuator may be provided in various shapes as described with various embodiments below.

[58] The bending control unit may control operations of the bending actuator. For example, when the bending actuator is an elastic member, for example being formed of a shape memory alloy, the bending control unit adjusts the amount of current applied to the shape memory alloy to adjust a temperature change of the shape memory alloy, so that a length change of the shape memory alloy may be controlled. Moreover, when the bending actuator is a sensitive heat tube surrounded by conductive wire, electromagnet, bimetal, piezoelectric element, or heat wire, operations of the bending actuator may be controlled. This will be described later in each embodiment.

[59] Hereinafter, with reference to Figures 3A to 37, specific embodiments of a display device including the combined above-mentioned configurations according to the present disclosure will be described in more detail.

[60] Hereinafter, a configuration of a display device according to one embodiment of the present disclosure will be described with reference to Figures 3A to 10. Figures 3A to 10 schematically illustrate only a configuration relating to the bending of the display module 11 merely for ease of description of a structure and principle for bending a display device. However, it should be appreciated that the display device may include various other configurations besides the shown configuration.

[61] First, referring to Figures 3A, 3B, and 4, the display device may include the display module 11, the back cover 12 coupled to the rear of the display module 11, and the bending assembly bending the back cover 12. Here, the bending assembly includes a elastic members. The elastic member may be formed of, for example, a shape memory alloy (SMA).

[62] SMA is an alloy using shape memory and superplastic properties appearing in a metal transformed from austenite to martensite. When a specific shape is memorized in austenite of a high temperature state and then cooled to low temperature, martensite transformation occurs, and residual stress is formed in the tissue. Therefore, the specific shape is transformed. Then, when being heated again at an austenite temperature, the transformed specific shape is restored to its original shape.

[63] Accordingly, when current flows in an SMA set to be restored to an original shape at a predetermined temperature, the SMA serves as resistance and temperature increases. Therefore, the SMA returns to its original shape and size according to temperature increase. At this point, the SMA may be set to increase or decrease its length at an increased predetermined temperature.

[64] Moreover, the bending assembly may include a bending actuator that applies physical force to the back cover 12 and a bending controller (also bending control unit) that controls operations of the bending actuator. Here, the bending actuator may include an SMA 31 and the bending control unit may control a length change of the SMA 31.

[65] The SMA 31 may be provided in a rod shape extending in the left and right directions, and may be attached to the backside of the back cover 12. For reference, the front side of the back cover 12 is a side facing the display module 11 and its backside is the opposite side. The rod shape may have various cross-sections, such as a round or rectangular cross-section. For example, the SMA 31 may have a cylindrical or wire shape.

[66] The SMA 31 may be provided in plurality, horizontally in parallel to each other. The SMA 31 may be provided to maintain a predetermined length at a room temperature and when the temperature rises more than a set temperature, its length extends.

[67] At this point, the rise in the temperature may be achieved by power supply that is controlled by the bending control unit. Accordingly, once power is supplied by the

bending control unit, a resistance of the SMA 31 causes the temperature to rise. As the temperature rises, the length of the SMA 31 extends laterally, in the left and right directions.

[68] When the length of the SMA 31 increases, the back cover 12 may bend and both the left and right ends of the display module 11 may protrude toward the front relative to the center of the display module 11, and its center may have a concave shape. At this point, an angle at which the back cover 12 bends may be adjusted by controlling an amount of current through the SMA 31.

[69] When the back cover 12 is bent, the both left and right ends of the back cover 12 applies pressures to the left and right edge of the backside of the display module 11, and the display module 11 is concavely bent toward the front. Therefore, user's immersion in the viewed image or perception may be enhanced.

[70] Moreover, as shown in Figure 5, a recess may be formed to receive the SMA 31. For example, a groove-shaped receiving unit for receiving the SMA 31 may be formed concave from the backside toward the front at the rear of the back cover 12 and the SMA 31 may be received therein.

[71] Additionally, as shown in Figure 6, the SMA 31 may be buried in or encapsulated in the back cover 12. The depth of the SMA 31 in the back cover 12 may be provided such that it is positioned toward the rear side of the back cover 12 relative to a center depth of the back cover 12, as illustrated. In this case, the SMA receiving unit may be a space where the SMA 31 in the back cover 12 is disposed. The SMA may be insert-molded together with the back cover 31.

[72] A printed circuit board (PCB) may be coupled to the rear of the display module 11 and the back cover 12 having the above configuration. Referring to Figure 7, the back cover 12 may be coupled to the PCB 15 by using a bracket 17.

[73] The plate-shaped bracket 17 may be disposed at the rear of the back cover 12 and the PCB 15 may be disposed at the rear of the bracket 17. At this point, the back cover 12 and the bracket 17 may be coupled by a first fastener 41 at the central part and the bracket 17 and the PCB 15 may be coupled by a second fastener 43 at the left and right direction edges.

[74] Accordingly, the first fastener 41 may be coupled to the backside of the back cover 12 at the center in the lateral direction and the front side of the bracket 17 at the center in the lateral direction, and the second fastener 43 may be coupled to the backside of the bracket 17 near the left and right side edge and the front of the PCB 15 near the left and right side edge.

[75] Figures 8A to 8B are sectional views illustrating a structure of the second fastener 43. The fastener 43 may include a front support part 43a of a roughly cylindrical shape coupled to the rear of the bracket 17, a spring 43c having the rear end supported by the

front support part 43a, and a head part 43b coupled to the rear end of the spring 43c.

[76] The front support unit 43a may be a pern nut whose portion protrudes toward the rear and the head part 43b may be a member of a roughly cylindrical shape. The head part 43b may be coupled to the PCB 15. Here, the spring 43c may be a coil spring. The second fastener 43 maintains a state as show in Figure 8A usually but when external force is applied to the bracket 17 or the PCB 15, as shown in Figure 8B, the spring 42c is compressed so that impact between two members is absorbed.

[77] Moreover, the left and right edges of the back cover 12 and the left and right edges of the bracket 17 may be coupled to each other by a third fastener 45. Figures 9 and 10 illustrate the third fastener 45 in more detail.

[78] The third fastener 45 provides a fastening structure that absorbs the bending of the back cover 12 between the back cover 12 and the bracket 17. The third fastener 45 may include a first member 45a coupled to the backside of the back cover 12 and a second member 45c coupled to the front side of the bracket 17. The backside of the first member 45a may have a rounded shape whose center protrudes convexly, and an opening part 45b extending in the lateral direction may be formed at the center of the rear.

[79] The second member 45c may extend from front to back relative to the display module 11 and may be insertable into the opening part 45b. A long hole 45d may be formed long in the lateral direction in the second member 45c. The long hole 45d may have a rounded shape as may progressively approach the left and right edge. Moreover, a head 45e may be coupled to the rear of the second member 45c.

[80] Accordingly, when the second member 45c is inserted into the opening part 45b of the first member 45a, a coupling protrusion may be inserted into the long hole 45d. Therefore, the second member 45c may be rotatable based on the coupling protrusion and may be movable by the length of the long hole 45d. Accordingly, the back cover 12 in a flat sate or a bending state may be continuously coupled to the back cover 12 and the bracket 17.

[81] Hereinafter, a configuration of a display device according to one embodiment of the present disclosure will be described with reference to Figures 11A and 1IB. Figures 11A and 1IB schematically illustrate only a configuration relating to the bending of the display module 11 merely for ease of description of a structure and principle for bending a display device. However, it should be appreciated that the display device may include various other configurations besides the shown configuration.

[82] The display device includes a display unit bending toward the front and a bending assembly bending the display unit. The display unit includes a display module 11 and a back cover 12 coupled to the rear of the display module 11. The bending assembly bends the back cover 12 so as to bend a display panel.

[83] Moreover, the bending assembly includes a bending actuator applying physical force to the back cover 12 and a bending control unit controlling operations of the bending actuator.

[84] In the embodiment of Figure 3, the SMA 31 configuring the bending actuator extends from the left end part of the back cover 12 to the right end part. However, in this embodiment, a fixing unit 32 (also support bracket) is provided at the rear center of the back cover 12. Accordingly, the bending actuator according to this embodiment includes the SMA 31 and the fixing unit 32 where the SMA 31 is fixed. The bending control unit controls operations of the bending actuator.

[85] The SMA 31 has a rod shape (e.g., cylindrical or wire shape) and extends in the left and right directions. A plurality of SMAs 31 may be attached to the rear of the back cover 12 and extend horizontally, parallel to each other. There may be a group of SMAs 31 that form a left column at the left side of the fixing unit 32 and there may be a group of SMAs 31 that form a right column at the right side of the fixing unit 32. Accordingly, the right end part of the left column and the left end part of the right column may be fixed at the fixing unit 32.

[86] Due to the above configuration, when power is applied to the SMA 31, the wires extend in the left and right directions and the back cover 12 is bent toward the front with a centrally concaved shape. At this point, the control unit may supply power to the left column to allow only a portion where the left column is attached to be bent and on the contrary, may supply power to the right column to allow only a portion where the right column is attached to be bent. Moreover, by differently supplying the amount of current applied to the left column or the right column, the degree of bending may differ.

[87] When the back cover 12 is bent, the both left and right end parts of the back cover 12 forwardly applies pressures around the left and right edges of the display module 11, so that the display module 11 is bent simultaneously. Moreover, when power is cut off by the bending control unit, and thus a temperature of the SMA 31 drops, the length of the SMA 31 is reduced and the display module 11 and the back cover 12 return to their original flat states by the elastic restoring force of the material.

[88] While the SMA 31 is described herein as including only the two columns such as the left column and the right column, the SMA 31 may have other configurations, for example, to have three columns or more.

[89] Furthermore, as shown in Figures 11A and 1IB, the SMA 31 may be attached to the backside of the back cover 12, or like Figures 5 and 6, the SMA 31 may be received in the SMA receiving unit on the inner side of the back cover 12. Like the embodiment of Figures 5, the SMA receiving unit may have a groove shape concave toward the inner side (the front) at the backside of the back cover 12, and when the SMA 31 is buried

inside the back cover 12, the space in which it is buried may be the SMA receiving unit.

[90] Moreover, when the SMA 31 is buried inside the back cover 12, it may be disposed toward the rear of the back cover 12 with respect a depth of the back cover 12. The reason is that the length of the SMA 31 increases at a predetermined temperature in this embodiment. Additionally, when the SMA 31 is received in the SMA receiving unit, a portion of the fixing unit 32 may be buried at the rear of the back cover 12.

[91] Moreover, in the display device according to the present disclosure, the bracket 17, the first fastener 41, and the second fastener 43 shown in Figure 7 to 8B may be applicable for the coupling of the PCB 15. Additionally, as shown in Figures 9 and 10, the third fastener 45 may be applicable.

[92] Hereinafter, a configuration of a display device will be described with reference to Figure 12. Figure 12 schematically illustrates only a configuration relating to the bending of the display module 11 merely to facilitate description of a structure and principle for bending a display device. However, the display may include various other configurations besides the shown configuration.

[93] The SMA 31 may be disposed at position symmetric to the position of Figure 6 toward the front of the back cover 12 toward the display, as illustrated in Figure 12. The display device may include a display unit for displaying an image and a bending assembly for bending the display unit. The display unit may include a display module 11 displaying an image and a back cover 12 coupled to the rear of the display module 11.

[94] Moreover, the bending assembly may include a bending actuator applying physical force to the back cover 12 and a bending control unit controlling operations of the bending actuator. Here, the bending actuator may include the SMA 31 and the bending control unit that controls a length change of the SMA 31.

[95] The SMA 31 may be provided in a rod shape (e.g., cylindrical or wire shape) and extending in the left and right directions, and may be attached to the front of the back cover 12. The SMA 31 maintains a predetermined length at a room temperature and when the temperature rises more than a set temperature, its length is reduced. Here, because the SA 31 is provided toward the front surface of the back cover 12, the length of the SMA 31 is reduced to bend the display forward. At this point, the rise in the temperature may be achieved by power supply that is controlled by the bending control unit.

[96] Accordingly, once power is supplied by the bending control unit, current flows though the SMA and the resistance of the SMA 31 generates heat, thereby raising its temperature. As the temperature rises, the length of the SMA 31 is reduced laterally, i.e., in the left and right directions.

[97] When the length of the SMA 31 is reduced, the back cover 12 becomes bent and both the left and right ends may protrude toward the front relative to its center, and the center may have a concave shape. At this point, an angle at which the back cover 12 bends may be adjusted by controlling the amount of current to the SMA 31. When the back cover 12 is bent, the display module 11 at the front of the back cover 12 is concavely bent toward the front. Due to this, user's immersion or perception while viewing the display may be enhanced.

[98] Moreover, when the SMA 31 is disposed at the front of the back cover 12, like the above embodiment (refer to Figures 11A and 1IB), the SMA 31 may be grouped to form a left column and the right column, or other configurations, for example, three columns or more. Furthermore, the length of each column may be differently controlled. For example, the length of the SMA 31 in the left column may be controlled to have a first prescribed length, and the SMA 31 in the right column may be controlled to have a second prescribed length, such that the curvature of the display may be controlled more precisely.

[99] Moreover, in the display device according to this embodiment, the bracket 17, the first fastener 41, and the second fastener 43 shown in Figure 7 to 8B may be applicable for coupling the PCB 15. Additionally, as shown in Figures 9 and 10, the third fastener 45 may be applicable.

[100] Hereinafter, a configuration of a display device according to another embodiment of the present disclosure will be described with reference to Figures 13 to 15B. Figures 13 to 17 schematically illustrate only a configuration relating to the bending of the display module 11 merely to facilitate description of a structure and principle for bending a display device. However, the display device according to the present embodiment may include various other configurations besides the shown configuration.

[101] Figure 13 is a perspective view illustrating the back cover 12 and the bending assembly of the display device, and Figure 14 is a view illustrating the front side of the back cover 12. Moreover, Figures 15A and 15B are plan views of the display device. The display device may include a display unit and a bending assembly that bends the display unit. The display unit may include a display module 11, a thin plate-shaped middle cover 13 attached to the backside of the display module 11 (or display panel) through a double-sided tape 14 or another appropriate method of connection, and a back cover 12 coupled to the rear of the middle cover 13. The bending assembly may apply force to bend the back cover 12, so that the entire display unit may be bent.

[102] Here, the bending assembly may include a bending actuator applying physical force to the back cover 12 and a bending control unit that controls operations of the bending actuator. The bending actuator may include an SMA 31 and a fixing unit 33 (or support bracket) fixing the SMA 31 to the front of the back cover 12. Also, the bending

actuator may control a length change of the SMA 31.

[103] The fixing unit 33 may include four extension units 38a that extend front to back and protruding toward the front around each edge of the back cover 12. The fixing unit 33 may have a roughly rectangular shape and a vertical extension unit 33b that vertically connects two extension units 38a may be provided around the left and right sides of the back cover 12. The vertical extension unit 33b may be provided to be in one or more pairs. As illustrated, the vertical portions may be provided a prescribed distance from the back cover toward the display panel.

[104] The SMA 31 extends across two vertical extension units 33b. The SMA 31 may be provided to have a rod shape that extends in the left and right directions, and may be provided in plurality to extend horizontally, parallel to each other. The rod shape may have various cross-sections, such as a round shape, square shape or the like. For example, the SMA 31 may have a wire shape.

[105] Accordingly, the SMA 31 may be coupled to a position that is spaced toward the front from the front side of the back cover 12, and extends parallel to the front side of the back cover 12. That is, the left end part of the SMA 31 may be coupled to the vertical extension unit 33b at the left side and the right end part of the SMA 31 may be coupled to the vertical extension unit 33b at the right side. Moreover, the fixing unit 33 and the SMA 31 may be formed as one module. When a module including the fixing unit 33 and the SMA 31 is manufactured separately and is coupled to the front side of the back cover 12, manufacturing efficiency may be improved.

[106] In this embodiment, the SMA 31 may maintain a predetermined length at a room temperature and when the temperature rises more than a set temperature, its length is reduced. At this point, the rise in the temperature may be achieved by a power supply that is controlled by the bending control unit.

[107] Accordingly, once current is supplied to the SMA 31, the resistance of the SMA 31 may produce a prescribed amount of heat causing its temperature to increase. As the temperature increases, the length of the SMA 31 is reduced in the lateral, e.g., left and right, directions.

[108] When the length of the SMA 31 is reduced from Figure 15A to Figure 15B, the back cover 12 becomes bent and the both left and right end parts protrude toward the front relatively, and its center has a concavely retreated shape. At this point, an angle at which the back cover 12 bends may be adjusted by controlling the amount of current through the SMA 31.

[109] When the back cover 12 is bent, pressure is forwardly applied on the both left and right ends of the middle cover 13 from the front of the back cover 12, and due to this, the display module 11 is also concavely bent toward the front. Therefore, user's immersion may be increased. Moreover, when power is cut off by the bending control

unit, and thus a temperature of the SMA 31 drops, the length of the SMA 31 is increased again and the display module 11 and the back cover 12 return to their original flat states by the elastic restoring force of the material.

[110] Moreover, the bracket 17, the first fastener 41, and the second fastener 42 shown in Figures 7 to 8B may be applicable to the display device according to this embodiment. Additionally, as shown in Figures 9 and 10, the third fastener 43 may be also applicable.

[111] Hereinafter, a partial configuration of a display device will be described with reference to Figures 16 to 19. Figures 16 to 19 schematically illustrate only a partial configuration relating to the bending of the display module 11 merely to facilitate description for a structure and principle for bending a display device. However, the display device according to the present embodiment may include various other configurations besides the shown configuration.

[112] Figure 16 illustrates the middle portion of the display module 11, the back cover 12, and the middle cover 13 in the display device. Figure 17 illustrates a portion horizontally deviated from the center of the display module 11, the back cover 12, and the middle cover 13 in the display device. The display device may include a display unit and a bending assembly that bends the display unit. The display unit may include a display module 11, a middle cover 13 located at the rear of the display module 11, and a back cover 12 located at the rear of the middle cover 13. The bending assembly applies physical force to the back cover 12, so that the entire display unit may be bent.

[113] The middle cover 13 may be attached to the backside of the display module 11 by using a double-sided tape 14 or another appropriate method of connection. The back cover 12 may have a shape in which the left and right ends protrude toward the front relative to the center, and the center is curved toward the rear. Accordingly, the central part of the back cover 12 is spaced from the middle cover 13 toward the rear and the left and right end parts of the back cover 12 contact the left and right edge backside of the middle cover 13. At this point, the back cover 12 and the middle cover 13 may contact directly, or may contact through a sliding member 37 as described in more detail hereinafter. Additionally, when the sliding member 37 is provided, the left and right end parts of the back cover 12 and the middle cover 13 may not contact each other, and thus may be spaced apart from each other.

[114] Moreover, the bending assembly may include a bending actuator that applies physical force to the back cover 12 and a bending control unit that controls operations of the bending actuator. The bending actuator may include an SMA 31 (or elastic member) and fixing units 35a and 35b (or support bracket) fixing the SMA 31 to the rear of the back cover 12. The bending control unit may control a length change of the SMA 31.

[115] The fixing units 35a and 35b may include a central fixing unit 35a (or center support) protruding toward the front from the front side at the left and right direction center of the back cover 12 and a side fixing unit 35b (or lateral support) protruding from the front side toward the front around the left and right both end parts of the back cover 12.

[116] The front end of the central fixing unit 35a is coupled to the rear of the left and right direction center of the middle cover 13, and the rear end is coupled to the left and right direction center of the back cover 12. At this point, the central fixing unit 35a may function as a spacer to maintain a predetermined interval between the back cover 12 and the middle cover 13.

[117] The SMA 31 may be attached to the both left and right sides of the central fixing unit 35a, or the central fixing unit 35a may serve as a supporter to allow one SMA 31 to pass through. An end part of the SMA 31 may be fixed at the side fixing unit 35. The SMA 31 may be provided in a wire shape extending in the left and right directions, and is forwardly spaced a predetermined distance apart from the back cover 12.

[118] The SMA 31 may maintain a predetermined length at a room temperature and when the temperature rises more than a set temperature, its length may be reduced. At this point, the rise in the temperature is achieved by power supply that is controlled by the bending control unit. Accordingly, once power is supplied by the bending control unit, the resistance of the SMA 31 causes generation of heat and its temperature rises. As the temperature rises, the length of the SMA 31 is reduced in the lateral, e.g., left and right, directions.

[119] When the length of the SMA 31 is reduced, the both end parts (or lateral sides) of the back cover 12 are pulled toward the center, and as the distance between the both end parts of the back cover 12 becomes narrower, both end parts of the back cover 12 are moved toward the front relative to the center. Then, the both end parts of the back cover 12 forwardly apply pressure to a point horizontally deviated from the center of the mid cover 13, so that the display module 11 becomes bent.

[120] At this point, the back cover 12 may have a curved shape whose center in the lateral direction is curved toward the rear relatively and both lateral ends protrude toward the front relatively. In this case, when the distance between the both end parts of the back cover 12 becomes narrower, the back cover 12 becomes bent with a greater curvature than the original, which then forwardly applies pressure to a point horizontally deviated from the center of the mid cover 13 so that the display module 11 becomes bent. At this point, an angle at which the back cover 12 bends may be adjusted by controlling current flow through the SMA 31.

[121] Since the central fixing unit 35a maintains a predetermined interval laterally between the center of the back cover 12 and the center of the display module 11, when the back cover 12 is bent, forward pressure is applied by both the left and right ends of the back

cover 12 to both the left and right end parts of the display module 11 to simultaneously bend the display module 11. Therefore, user's immersion may be increased.

[122] Moreover, when power is cut off by the bending control unit and thus a temperature of the SMA 31 drops, the length of the SMA 31 is increased and the display module 11 and the back cover 12 return to their original flat states by the elastic restoring force of the material. Moreover, the sliding member 37 shown in Figures 18 and 19 may be additionally included in the above configuration.

[123] The sliding member 37 may be fixed at one of the back cover 12 or the middle cover 13 and may be slidable at the other. That is, the sliding member 37 may be coupled to the front side of the back cover 12 so that it may slide relative to the backside of the middle cover 13, or may be coupled to the rear of the middle cover 13 so that it may slide relative to the front of the back cover 12. Additionally, the sliding member 37 may be coupled to each of the back cover 12 and the middle cover 13, so that sliding may occur between a portion coupled to the back cover 12 and a portion coupled to the middle cover 13.

[124] Hereinafter, a configuration and function of the sliding member 37 according to this embodiment will be described with reference to Figures 18 and 19. The sliding member 37 slide relative to a body 37a fixed at the middle cover 13 and a moving member 37d fixed at the back cover 12 to be movable horizontally.

[125] The body 37a may have a plate-shaped member that extends horizontally, and its center slide relative to a sliding area 37b extending horizontally. Moreover, a fixing unit 37c protruding toward the front side may be provided at the front side of the body 37a. The fixing unit 37c may be fixed by directly contacting the backside of the middle cover 13, and the body 35a may be spaced by the length of the fixing unit 37c apart from the middle cover 13. The moving member 37d may be provided to allow reciprocating sliding in the sliding area 37b, and its flat backside may be coupled to the front side of the back cover 12. Since the sliding member 37 is provided, the back cover 12 and the middle cover 13 may have coherence at a portion horizontally deviated from the center in addition to the center.

[126] Moreover, when the sliding member 37 is provided between the back cover 12 and the middle cover 13, the left and right end parts of the back cover 12 protrude toward the front relatively by the bending assembly. When pressure is applied on the backside of the middle cover 13, the back cover 12 does not directly contact the middle cover 13 and contacts the middle cover 13 through the sliding member 37, allowing the display module 11 to be bent more efficiently. Additionally, when the sliding member 37 is provided, the left and right end parts of the back cover 12 may contact the middle cover 13 so that the back cover 12 applies pressure on the middle cover 13.

[127] Moreover, the bracket 17, the first fastener 41, and the second fastener 43 shown in

Figures 7 to 8B may be applicable to the display device according to this embodiment. Additionally, the third fastener 45 shown in Figures 9 and 10 may be also applicable.

[128] Hereinafter, a configuration of a display device will be described with reference to Figures 20A and 20B. Figure 20A is a view of a flat state before a display unit of the display device is bent. Figure 20B is a view when the display unit is bent. Merely for convenience and to facilitate description, a configuration shown in Figures 20A and 20B does not include all of the features of the display device, and only a partial configuration relating to the bending of the display module 11 is shown while other configurations are omitted.

[129] The display device may include a display unit, a bending assembly bending the display unit, and a lower frame 50 supporting the display unit from the lower part. The display unit may include a display module 11 (or display panel) and a back cover 12 at the rear of the display module 11. The lower frame 50 receives various parts therein such as a control module, and the display module 11 and the back cover 12 are coupled to the top of the lower frame 50. Additionally, a stopper 51 may be provided at the top of the lower frame 50 and may contact the backside of the back cover 12 at the rear of both the left and right ends of the back cover 12.

[130] The bending assembly may include a bending actuator applying physical force to the back cover 12 and a bending control unit controlling operations of the bending actuator. The bending actuator includes an SMA 31, a fixing unit 39 fixing the SMA 31 to the rear of the back cover 12, and a motor 52 rotating the fixing unit 39. The bending control unit controls a length change of the SMA 31 and operations of the motor 52.

[131] The fixing unit 39 (or support bracket) may be provide in a cylindrical shape extending in a vertical direction, and may be backwardly spaced apart from the center of the back cover 12. The SMA 31 (or elastic member) may be provided in a cylindrical or wire shape extending in a lateral direction. Its front end may be coupled to the center laterally at the backside of the back cover 2 and its rear end may be coupled to the fixing unit 39. A plurality of SMA 31 may be provided horizontally, parallel to each other.

[132] The motor 52 may be coupled to the lower part of the fixing unit 39, and the fixing unit 39 may rotate by rotation of the motor 52. The bending control unit may be included in the control module provided at the inner side of the lower frame 50, and may control a current applied to the SMA 31 and rotation of the motor 52.

[133] Accordingly, once current is supplied to the SMA 31 by the bending control unit, resistance of the SMA 31 may cause heat generation and its temperature rises. As the temperature rises, the length of the SMA 31 may be reduced in the lateral, e.g., left and right, directions.

[134] When the length of the SMA 31 is reduced, the both left and right end regions of the back cover 12 are restrained from moving toward the rear, and only the center part is moved toward the rear, so that the back cover 12 has a bending shape that is centrally concaved relative to the front. At this point, an angle at which the back cover 12 is bent may be adjusted by controlling a current applied to the SMA 31.

[135] Moreover, in this embodiment, auxiliary bending is possible by rotation of the motor 52. When the motor 52 rotates, the cylindrical fixing unit 37 rotates to wind the SMA 31 on its outer circumferential surface, so that the center part of the back cover 12 may be further pulled back. Accordingly, when the motor 52 is used sufficient bending effect may be achieved even when the reduced length of the SMA 31 is insufficient for the desired amount of bending.

[136] Additionally, when the length reduction of the SMA 31 is not obtained properly, the bending of the back cover 12 and the display module 11 becomes possible. Also, as the fixing unit 37 rotates, it winds the outer circumference surface with the SMA 31, so that the center part of the back cover may be further retreated.

[137] As mentioned above, when the back cover 12 is bent, the left and right direction center of the back cover 12 is retreated and thus, the left and right direction center part of the display module 11 is pulled toward the rear. Due to this, the display module 11 is bent simultaneously. Therefore, user's immersion may be increased by bending the display unit.

[138] Moreover, when power is cut off by the bending control unit, and thus a temperature of the SMA 31 drops, the length of the SMA 31 is increased and the display module 11 and the back cover 12 return to their original flat states by the elastic restoring force of the material. In this case, if the wire-shaped SMA 31 is wounded on a fixing unit by rotating a motor, the display module 121 returns to a flat state by reversely rotating the fixing unit to unwind the SMA 31.

[139] Hereinafter, a display device will be described with reference to Figures 21A to 22. Figures 21A to 22 schematically illustrate only a configuration relating to the bending of the display module 11 merely to facilitate description of a structure and principle for bending a display device. However, the display device may include various other configurations besides the shown configuration.

[140] The display device may include a display unit displaying an image and a bending assembly bending the display unit. The display unit may include a display module 11 displaying an image and a back cover 12 coupled to the rear of the display module 11.

[141] The bending assembly may include a bending actuator applying physical force to the back cover 12 and a bending control unit controlling operations of the bending actuator. The bending actuator may be a leading wire 34 coupled to the rear of the back cover 12 to flow current.

[142] Figure 21A is a view of a flat state when the display module 11 and the back cover 12 are not bent. Figure 21B is a view when the display unit 11 and the back cover 12 are bent. Figures 21A and 21B are views when a plurality or wires 34 coupled to the rear of the back cover 12 extend vertically. Additionally, Figure 22 is a view illustrating the direction of a current flowing in a wire and the direction of a force acting on between wires.

[143] As shown in Figure 22(a), when the direction of a current flowing in one wire is the same as that in an adjacent wire, gravitation acts on between two wires. As shown in Figure 22(b), when the direction of a current flowing in one wire is different from that in an adjacent wire, repulsion acts on between two wires.

[144] Referring to Figures 21A and 21B, the wire 34 may be provided in plurality vertically in parallel to each other. Each wire 34 extends in parallel to another adjacent wire 34. The wire 34 may be attached to the backside of the back cover 12, or may be built in the back cover 12. The wire 34 may be built in the back cover 12, it needs to be positioned at the rear on the basis of the back and forth direction center of the back cover 12.

[145] Moreover, as shown in Figures 21A and 21B, a groove part 18 formed long vertically may be provided at the front of the back cover 12. The groove part 18 may have a roughly V-shaped shape whose left and right widths become narrower gradually as they approach the rear from the front, and a plurality of groove parts 18 are horizontally arranged in parallel to each other. Each groove part 18 may be disposed parallel to an adjacent groove part 18.

[146] Moreover, the left and right direction central parts of the back cover 12 and the display module 11 may be fixed, and other parts other than the fixed central parts may be installed not to restrain the movement in the front and rear directions. Therefore, when the back cover 12 and the display module 11 are bent, the left and right direction edges may move back and forth.

[147] However, the back cover 12 and the display module 11 may be installed so that the back and forth movements of both end parts are restrained and a central part of the left and right directions may move back and forth. In this case, the back cover 12 and the display module 11 may be bent.

[148] Due to the above configuration, when current is applied to the wire 34 by the bending control unit, it generates a magnetic field. At this point, a current flowing into the wire 34 is controlled so that the direction of a current flowing in one wire 34 is opposite to that in an adjacent wire 34. Therefore, repulsion occurs between the one wire 34 and the adjacent wire 34.

[149] When repulsion acts on between each wire 34, a force in the lateral direction is applied to the rear of the back cover 12 relative to its center. Accordingly, the back

cover 12 and the display module 11 change from a flat shape shown in Figure 2 1A into a shape whose both left and right ends protrude toward the front and the center is pushed back, as illustrated in Figure 2 IB. At this point, since a plurality of groove parts 18 are formed in the front side of the back cover 12, the groove part 18 becomes smaller to aid the bending of the back cover 12, so that the back cover 12 may be bent with a smaller amount of force.

[150] Moreover, the amount of current flowing in the wire 34 may be controlled by the bending control unit and by adjusting the amount of current, the bending degree of the back cover 12 and the display module 11 may be adjusted. Furthermore, the wire 34 may be coupled to the front of the back cover 12. In this case, the wire 34 may be attached to the front side of the back cover 12, or may be built at the front inside the back cover 12 in the front to back direction relative to a thickness of the back cover 12.

[151] When the wire 34 is coupled to the front of the back cover 12, the bending control unit may allow the direction of a current flowing in each wire 34 to be identical. Due to this, gravitation may act on between each wire 34. Once gravitation occurs between each wire 34, since a force to narrow the left and right widths is applied to the front on the basis of the back and forth direction center of the back cover 12, an interval between the groove parts 18 becomes narrower. Due to this, the back cover 12 and the display module 11 may be bent toward the front. In this case, the degree of bending of the back cover 12 and the display module 11 may be controlled when the bending control unit controls current flow through the wires 34.

[152] Moreover, as mentioned above, as the wire 34 serves as a bending actuator, when a current flowing in the wire 34 is cut off the display module 11 and the back cover 12 return to their original flat states by elastic restoring force. If necessary, a current flowing in the wire 34 is applied in an opposite direction, so that this may aid to unbend the display module 11 and the back cover 12 to the original states.

[153] Moreover, a bending actuator configuring a bending assembly may be an electromagnet as shown in Figures 23 to 26. When compared with the configuration of Figures 21A and 21B, all other configurations are the same except that the wire 34 is replaced with an electromagnet 38, and thus repeated description is omitted.

[154] Figures 23 to 25B are views when the electromagnet 38 is coupled to the rear of the back cover 12, and Figures 25 and 26 are views when the electromagnet 38 is coupled to the front of the back cover 12. The electromagnet 38 may extend to have its polarities in the lateral directions. That is, the left end part is an S pole, the right end part is an N pole. When the left end part is an N pole, the right end part is an S pole.

[155] In relation to the electromagnet 38, a plurality of electromagnets which are vertically arranged in parallel to each other may form one electromagnet column 38a. A plurality of columns of electromagnets may be provided horizontally across the back cover 12

and aligned with adjacent electromagnets.

[156] The electromagnet 38 may generate different N and S poles depending on whether the electromagnet 38 is coupled to the front or rear of the back cover 12. Accordingly, as shown in Figure 23, when a plurality of electromagnet columns are coupled to the rear of the back cover 12, the bending control unit controls the current to create repulsion between one electromagnet column and another adjacent electromagnet column.

[157] Once repulsion acts between each electromagnet column, a force to expand the rear in the lateral direction is applied to the back cover 12 as illustrated in Figures 24A and 24B. Due to this, the back cover 12 and the display panel 11 are bent, so that the left and right direction end parts protrude toward the front and the central part is moved toward the rear. The bending of the back cover 12 bends the display module 11 a prescribed amount. At this point, an angle at which the display module 11 and the back cover 12 bend may be adjusted by controlling the amount of current flowing in the electromagnet.

[158] Moreover, as shown in Figures 25 and 26, when a plurality of electromagnet columns are coupled to the front of the back cover 12, the bending control unit controls current to generate gravitation to act between one electromagnet column and another adjacent electromagnet column. Figure 25 is a view when an electromagnet is coupled to the front of the back cover 12 and Figure 26 is a plan view thereof.

[159] Once gravitation is applied to between each electromagnet column, the front of the back cover 12 becomes narrower in the lateral direction. Due to this, the back cover 12 and the display module 11 may be bent. In this case, the amount of current flowing in the electromagnet 38 is controlled by the bending control unit, so that the degree of bending of the display module 11 and the back cover 12 may be adjusted.

[160] Moreover, as mentioned above, as the electromagnet 38 serves as a bending actuator, when a current flowing in the electromagnet 38 is cut off, the display module 11 and the back cover 12 return to their original flat states by elastic restoring force. If necessary, a current flowing in the electromagnet 38 is applied in an opposite direction, so that this may aid to unbend the display module 11 and the back cover 12 to the original states. Additionally, when the electromagnet 38 is used as the bending actuator, the groove part 18 may be provided at the front of the back cover 12.

[161] Moreover, a bending actuator configuring a bending assembly may be an bi-metal or piezoelectric element as shown in Figures 27 to 31. When compared with the configuration of Figures 23 to 25, all other configurations are the same except that the wire 34 is replaced with a bi-metal 36 or a piezoelectric element 36a, and thus repeated description is omitted.

[162] Figures 27 to 29 are views when the bi-metal 36 is attached to the back cover 12. Ac-

cordingly, the bending actuator becomes the bi-metal 36. The bi-metal 36 refers to an object including thin metal plates that have different thermal expansion coefficients and are joined together. When temperature rises, a metal plate having a greater thermal expansion coefficient expands longer so that it is bent toward a metal plate having a less thermal expansion coefficient.

[163] Figure 27 is a view when the bi-metal 36 is attached to the front side of the back cover 12. Figure 28 is a sectional view of the bi-metal 36. Figure 29 is a view when the back cover 12 and the display module 11 are combined. First, referring to Figure 28, the bi-metal 36 includes a first metal 36a having a relatively greater thermal expansion coefficient and a second metal 35a coupled to the front of the first metal 36a. At this point, the first metal 36a may be a piezoelectric element. A voltage applied to the piezoelectric element 36a may be controlled by the bending control unit.

[164] The piezoelectric element 36a is a device having piezoelectric effect (when mechanical pressure is applied, voltage occurs and when voltage is applied, mechanical deformation occurs). When external force is applied, electric polarization occurs to generate potential difference and on the contrary, when voltage is applied, deformation or stress occurs.

[165] The display device according to this embodiment uses the property that when voltage is applied to the piezoelectric element 36a, it expands. The piezoelectric element 36a may be formed of BaTi03, PbZr03 or another appropriate type of material. One bi-metal 36 may have a band shape and extends in the lateral direction. Also, a plurality of the bi-metal 36 may be provided vertically, in parallel to each other.

[166] Moreover, a plurality of groove parts 18 may be provided perpendicular to a direction in which the piezoelectric element 36a extends. A configuration and functions of the groove part 18 are the same as described above.

[167] Due to the above configuration, when power is supplied to the piezoelectric element 36a by the bending control unit, the length of the piezoelectric element 36a is increased and the both end parts of the bi-metal are bent toward the front. As the bi-metal 36 is bent, the back cover 12 is bent with the same curvature radius. Due to this, the display module 11 is bent simultaneously.

[168] Accordingly, the back cover 12 and the display module 11 may have a shape in which the lateral ends protrude toward the front, and the center part is moved toward the rear. That is, the display unit is bent in a shape concaved toward the front.

[169] At this point, when the bending control unit may control a voltage applied to the piezoelectric element 36a, the amount of length change in the piezoelectric element 36a is adjusted so that the bending amount of the back cover 12 may be controlled. Moreover, when the bending control unit cuts off a voltage applied to the piezoelectric device 36a, the piezoelectric device 36a returns to its original length, and also the back

cover 12 and the display module 11 return to their original flat states.

[170] Additionally, as shown in Figure 30, the bi-metal 36 may be coupled to the rear of the back cover 12. In this case, the configuration and operation principle of the bi-metal 30 are the same as those of Figures 9 to 11.

[171] Moreover, the bending actuator may include only a piezoelectric element instead of the bi-metal 36. In Figure 31, only the piezoelectric element 36a is attached to the position where the bi-metal 36 of Figure 30 was attached before. Therefore, the piezoelectric element 36a extends in the left and right directions and is provided in plurality vertically in parallel to each other.

[172] As mentioned above, since the length of the piezoelectric element 36a is increased by applying a predetermined voltage, after the piezoelectric element 36a is coupled to the rear of the back cover 12, when voltage is applied to the piezoelectric element 36a by the bending control unit, the length of the piezoelectric element 36a is increased so that the back cover 12 may be bent toward the front. When the piezoelectric element 36a is bent, the display module 11 is bent simultaneously, so that user's immersion may be improved.

[173] Moreover, when the bending control unit cuts off a voltage applied to the piezoelectric element 36a, the piezoelectric element 36a returns to its original length, and also the back cover 12 and the display module 11 return to their original flat states by the restoring force of the piezoelectric element 36a and the elastic restoring force of the display panel 11 and the back cover 12.

[174] Figures 32-33 illustrates another configuration of the bending actuator according to the present disclosure. The display device may include a display unit displaying an image and a bending assembly bending the display unit. The display unit may include a display module 11 displaying an image and a back cover 12 coupled to the rear of the display module 11. The bending assembly may include a bending actuator applying physical force to the back cover 12 and a bending control unit controlling operations of the bending actuator.

[175] The bending actuator 47 shown in Figure 32 and 33 includes a sensitive heat tube 47a filled with refrigerant gas, a flow path 47b serving as a path through which the refrigerant gas of the sensitive heat tube 47a flows, a cylinder 47c coupled to the end part of the flow path 47b, and a heater 47d surrounding the external of the sensitive heat tube 47a. The heater 47d may be a heating wire.

[176] The flow path 47b has a roughly T-shape as seen from the rear. The flow path 47b may extend from the sensitive heat tube 47a upward, is split into the left and right flow paths 47b at a predetermined position, and then extends at an angle toward the front left and right outer edges. Accordingly, the cylinder 47c coupled to a distal end of the flow path 47b also extends at an angle toward the front left and right outer edges.

[177] Moreover, a stopping part 48 (or stopper) that protrudes toward the rear may be provided at both the left and right edges on the backside of the back cover 12. The stopping part 48 may include a pressing side 48a (or angled surface) toward a direction in which the cylinder 47c extends and the cylinder 47c contacts the pressing side 48a.

[178] When voltage is applied to the heater 47d by the bending control unit and the heater 47d heats the refrigerant, the volume of the refrigerant gas expands and the cylinder 47c is pushed outward. The cylinder 47c applies pressure to the pressing side 48a of the stopping part 48 so that the lateral edges of the back cover 12 are pressed toward the front. Therefore, the back cover 12 is bent toward the front. When the back cover 12 is bent, the display module 11 at the front of the back cover 12 is concavely bent toward the front. Due to this, user's immersion may be increased.

[179] Moreover, when the bending control unit cuts off the power applied to the heater 47d, the display module 11 and the back cover 12 return to their original flat states by the elastic restoring force thereof. Moreover, the bending actuator may have the structure shown in Figures 16 and 19.

[180] Figures 34 to 47 illustrate another configuration of the bending actuator according to the present disclosure. The display device may include a display unit displaying an image and a bending assembly bending the display unit. The display unit may include a display module 11 displaying an image and a back cover 12 coupled to the rear of the display module 11.

[181] The bending assembly may include a bending actuator applying physical force to the back cover 12 and a bending control unit controlling operations of the bending actuator. Here, the bending actuator may include a motor 49a, shafts 49b and 49c, and a speaker 49d.

[182] Figure 34 is a plan view when the speaker 49d is hidden by the rear of the display module 11 and the back cover 12. Figure 35 is a plan view when the speaker 49d is visible at the left and right side of the display unit. Figure 36 is a view when the speaker 49d is further pressed to bend the back cover 12 and the display module 11. Additionally, Figure 47 is a sectional view illustrating a coupling structure of the first shaft 49b and the second shaft 49c.

[183] In the bending assembly applied to the display device according to this embodiment, the bending actuator 49 may include the motor 49a and the shafts 49b and 49c. The shafts 49b and 49c may include a first shaft 49b having a screw gear on the outer circumference thereof and a hollow second shaft 49c having a gear corresponding to the first shaft 49b on the inner circumference thereof. Moreover, the speaker 49 is coupled to the end part of the second shaft 49c to be slidable.

[184] The display module 11, the back cover 12, and the bending actuator 49 may all be provided on the lower frame 50. At this point, the center part of the display module 11

and the back cover 12 may be fixed at the lower frame 50, and both the left and right end parts are not fixed. Accordingly, when external force is applied from the rear to around the both left and right ends of the display module 11 and the back cover 12, the lateral ends may protrude toward the front when the display module is bent.

[185] Moreover, the guide part 53 for guiding the sliding of the speaker 49d may be provided at the lower frame 50. The guide unit 53 protrudes toward the top of the lower frame 40 and extends in a straight line shape, and thus the speaker 49d contacts the backside of the guide unit 53 and is guided. Additionally, the stopping part 48 shown in Figures 34 to 36 is provided at the left and right edges of the back cover 12.

[186] Under the above structure, when the bending control unit rotates the motor 49a, the rotation of the motor 49a rotates the first shaft 49b. At this point, a power transmitting means such as a gear, a chain, and a belt may be provided between the rotational axis of the motor 49a and the first shaft 49b.

[187] The second shaft 49c may be pushed toward the outer edge as the first shaft 49b rotates inside second shaft 49c. At this point, in order for the second shaft 49c to be pushed toward the outer edges a prescribed amount, the rotation of the second shaft 49b needs to be limited. Since the second shaft 49c is coupled to the speaker 49d and the speaker 49d contacts the guide unit 53, the second shaft 49c is pushed toward the outer edge and to the front.

[188] When the second shaft 49c is pushed, and thus the speaker 49d is pressed at an angle toward the edges, the speaker 49d which was hidden from view protrudes at the outer edges of the display module 11 as shown in Figure 35. Accordingly, a user may control a display device to hide a speaker when not in use and show the speaker when in use.

[189] Moreover, the speaker 49d is slid toward the outer edges and contacts the stopping part 48 as shown in Figure 35. During this state, when the motor 49a rotates, the speaker 49d presses against the stopping part 48. Due to this, the lateral edges of the back cover 12 may be pressed toward the front. Therefore, as shown in Figure 36, the lateral edges of the back cover 12 and the display module 11 may protrude toward the front to bend the display module 11 forward. Hence, the user's immersion may be improved. Furthermore, by reversing the rotation direction of the motor 49a, the bending control unit may return the bent display module 11 and back cover 12 to their original flat states.

[190] Moreover, the bracket 17, the first fastener 41, and the second fastener 43 shown in Figures 7 to 8B may be applicable to the display device according to this embodiment. Additionally, the third fastener 45 shown in Figures 9 and 10 may be also applicable.

[191] As broadly described and embodied herein, a display device is provided having a structure capable of improving user's immersion while viewing content. In one embodiment, a display device may include a display unit displaying an image, and a

bending assembly bending the display unit. The bending assembly may include a bending actuator applying force to the display unit and a bending control unit controlling an operation of the bending actuator. According to the present disclosure, since a display module of a display device is bent, user's immersion may be improved. Also, the bending degree of a display module may be easily adjusted.

[192] In one embodiment, a display device may include a display panel for displaying an image, a back cover provided behind the display panel and coupled to the display panel, a bending assembly coupled to the back cover to bend the display panel, and a controller configured to control the bending assembly to apply a physical force to the back cover to bend the display panel a prescribed amount.

[193] The bending assembly may include a plurality of elastic members formed of shape memory alloy that expands or contracts corresponding to a change in temperature of the shape memory alloy. The shape memory alloy may have a cylindrical shape having a prescribed length that changes based on an amount of current that flows through the shape memory alloy.

[194] The elastic members may be provided on the back cover to extend laterally across on the back cover such that the shape memory alloy expands or contracts laterally with respect to the back cover. The elastic members may be provided on a front surface or a rear surface of the back cover. A recess may be formed in the back cover to accommodate the elastic members.

[195] A support bracket may be coupled to the back cover to support the shape memory alloy. A middle cover may be attached to a rear surface of the display panel and provided between the display panel and the back cover, wherein the support bracket is provided on a front surface of the back cover between the back cover and the middle cover, the shape memory alloy extending laterally along the back cover and coupled to the support bracket. The support bracket may include a plurality of vertical portions spaced a prescribed distance from the back cover toward the display panel, the elastic members coupled to the vertical portions to extend laterally across the back cover. Moreover, the support bracket and the elastic members may be modularized for coupling to the back cover.

[196] A support bracket may be coupled to the back cover and may include a center support that extends vertically along a center of the back cover and a plurality of lateral supports provided at lateral regions of the back cover, the support bracket coupling the center and lateral regions of the back cover to the display panel, and the back cover may have a prescribed curvature in a lateral direction and when the shape memory alloy provided laterally along the back cover contracts in length, a center of the display is pulled toward the back cover to bend the display panel. When the shape memory alloy contracts, the prescribed curvature of the back cover may be increased to bend

the display panel. The plurality of lateral supports may be slidable connectors that allow the middle cover to slide laterally relative to the back cover when the display panel is bent. The slidable connectors include a body fixed at one of the back cover or the middle cover and a moving member slidably coupled to the body and fixed to the other one of the back cover or the middle cover.

[197] A support bracket may be provided a prescribed distance behind the back cover, the support bracket extending vertically and positioned to correspond to a center of the back cover, wherein the elastic members extend from the support bracket to the rear cover to pull the center of the rear cover toward the support bracket when the temperature of the shape memory alloy is increased above a prescribed level. A motor may be coupled to the support bracket to rotate the support bracket along a longitudinal axis of the support bracket, wherein the shape memory alloy is wound around an outer surface of the support bracket when the support bracket is rotated to bend the display panel.

[198] The plurality of elastic members may be provided to extend parallel to each other to form a first column corresponding to a left side of the display panel and a second column corresponding to a right side of the display panel. The controller may control a length of the shape memory alloy in the left column to be different than in the right column. The controller may control an amount of current applied to the shape memory alloy to change a length of the shape memory alloy to bend the display panel.

[199] The display device may also include a bracket coupled to a rear of the back cover, a printed circuit board coupled to a rear of the bracket, and a first fastener provided between the bracket and the back cover to couple the back cover to the bracket along a central vertical axis of the display panel. A second fastener may be provided between the bracket and the printed circuit board to couple the printed circuit board to the bracket along a lateral side of the printed circuit board. Another fastener may be provided between the bracket and the back cover to couple a lateral region of the back cover to the bracket, wherein this fastener includes a first portion coupled to the back cover and a second portion coupled to the bracket, the first portion being movably coupled to the second portion to allow lateral movement of the rear cover relative to the bracket.

[200] The bending assembly may include a plurality of wires that extend vertically on the back cover and positioned a prescribed distance from each other in a lateral direction with respect to the display panel, the plurality of wires configured to apply a prescribed amount of force with respect to an adjacent wire to bend the display panel. The plurality of wires may be provided adjacent a front surface of the back cover that faces the display panel or adjacent a rear surface of the back cover opposite the front surface. Here, when the wires are provided adjacent the front surface of the back cover, the

controller controls a direction of current through each wire to be the same to apply a force that pulls each wire toward an adjacent wire. Moreover, when the wires are provided at the rear surface of the back cover, the controller controls the current through each adjacent wire to be opposite to apply a force that pushes each wire away from an adjacent wire.

[201] The bending assembly may include a plurality of electromagnets arranged relative to each other to apply a lateral force to the back cover. The plurality of electromagnets may be provided adjacent a rear surface of the back cover that faces away from the display panel, and the controller controls a direction of current through each electromagnet such that an N pole of one electromagnet faces an N pole of an adjacent electromagnet. Moreover, the plurality electromagnets may be provided adjacent a front surface of the back cover that faces the display panel, and the controller controls a direction of current through each electromagnet such that an N pole of one electromagnet faces an S pole of an adjacent electromagnet.

[202] The bending assembly may include a bi-metal having a first metal provided at a front side that faces the display panel and a second metal provided at a rear side opposite the front side, the first metal having a thermal expansion coefficient that is relatively less than a thermal expansion coefficient of the second metal. The bending assembly may include a bi-metal having a first metal provided at a front side that faces the display panel and a second metal provided at a rear side opposite the front side, the second metal being a piezoelectric element. The bending assembly may also include a piezoelectric element that is coupled to the back cover, a length of the piezoelectric element configured to change in a lateral direction relative to the display panel.

[203] The bending assembly may include a heat sensitive tube, refrigerant provided in the heat sensitive tube, a heater to heat the heat sensitive tube, and a cylinder connected to a distal end of the sensitive heat tube, wherein, when the heater heats the refrigerant, the heat sensitive tube expands to move the cylinder laterally to apply a lateral force to a side edge of the back cover. A stopper may be provided at a rear surface of the back cover that limits a range of movement of the cylinder, the stopper including an angled surface that abuts against the cylinder when the cylinder is moved laterally. The heater may be a heating wire that surrounds an outer surface of the heat sensitive tube.

[204] The bending assembly may include a motor and a shaft provided behind the back cover and extending to a lateral region of the back cover, a length of the shaft being changed by driving the motor, wherein when the shaft is extended, a pressure is applied to a side edge of the back cover to bend the display panel. The shaft may include a first shaft that is rotated by the motor, and a second shaft coupled to the first shaft through a screw gear. Moreover, a speaker may be coupled to a distal end of the shaft. The speaker may be positioned behind the display panel when the length of the

shaft is at a first length. The speaker may be positioned adjacent the display panel when the length of the shaft is at a second length greater than the first length. Moreover, the speaker may be positioned adjacent the display panel and a rear lateral edge of the back cover to apply the pressure to the side edge of the back cover to bend the display panel when the length of the shaft is at a third length greater than the second length. In the various embodiments, the back cover may be formed of a Carbon Fiber-Reinforced Plastic.

[205] Any reference in this specification to "one embodiment," "an embodiment," "example embodiment," etc., means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the disclosure. The appearances of such phrases in various places in the specification are not necessarily all referring to the same embodiment. Further, when a particular feature, structure, or characteristic is described in connection with any embodiment, it is submitted that it is within the purview of one skilled in the art to effect such feature, structure, or characteristic in connection with other ones of the embodiments.

[206] Although embodiments have been described with reference to a number of illustrative embodiments thereof, it should be understood that numerous other modifications and embodiments can be devised by those skilled in the art that will fall within the spirit and scope of the principles of this disclosure. More particularly, various variations and modifications are possible in the component parts and/or arrangements of the subject combination arrangement within the scope of the disclosure, the drawings and the appended claims. In addition to variations and modifications in the component parts and/or arrangements, alternative uses will also be apparent to those skilled in the art.

[207]

Claims

[Claim 1] A display device comprising:
a display panel for displaying an image;
a back cover provided behind the display panel and coupled to the display panel;
a bending assembly coupled to the back cover to bend the display panel; and
a controller configured to control the bending assembly to apply a physical force to the back cover to bend the display panel a prescribed amount.

[Claim 2] The display device according to claim 1, wherein the bending assembly includes a plurality of elastic members formed of shape memory alloy that expands or contracts corresponding to a change in temperature of the shape memory alloy.

[Claim 3] The display device according to claim 2, wherein the shape memory alloy has a cylindrical shape having a prescribed length that changes based on an amount of current that flows through the shape memory alloy.

[Claim 4] The display device according to claim 2, wherein the elastic members are provided on the back cover to extend laterally across on the back cover such that the shape memory alloy expands or contracts laterally with respect to the back cover.

[Claim 5] The display device according to claim 4, wherein the elastic members are provided on a front surface or a rear surface of the back cover.

[Claim 6] The display device according to claim 4, wherein a recess is formed in the back cover to accommodate the elastic members.

[Claim 7] The display device according to claim 2, wherein a support bracket is coupled to the back cover to support the shape memory alloy.

[Claim 8] The display device according to claim 7, further comprising a middle cover attached to a rear surface of the display panel and provided between the display panel and the back cover, wherein the support bracket is provided on a front surface of the back cover between the back cover and the middle cover, the shape memory alloy extending laterally along the back cover and coupled to the support bracket.

[Claim 9] The display device according to claim 8, wherein the support bracket includes a plurality of vertical portions spaced a prescribed distance from the back cover toward the display panel, the elastic members

coupled to the vertical portions to extend laterally across the back cover.

[Claim 10] The display device according to claim 9, wherein the support bracket and the elastic members are modularized for coupling to the back cover.

[Claim 11] The display device according to claim 2, wherein
a support bracket is coupled to the back cover and includes a center support that extends vertically along a center of the back cover and a plurality of lateral supports provided at lateral regions of the back cover, the support bracket coupling the center and lateral regions of the back cover to the display panel, and
the back cover has a prescribed curvature in a lateral direction and when the shape memory alloy provided laterally along the back cover contracts in length, a center of the display is pulled toward the back cover to bend the display panel.

[Claim 12] The display device according to claim 11, wherein, when the shape memory alloy contracts, the prescribed curvature of the back cover is increased to bend the display panel.

[Claim 13] The display device according to claim 12, wherein the plurality of lateral supports are slidable connectors that allow the middle cover to slide laterally relative to the back cover when the display panel is bent.

[Claim 14] The display device according to claim 13, wherein the slidable connectors include a body fixed at one of the back cover or the middle cover and a moving member slidably coupled to the body and fixed to the other one of the back cover or the middle cover.

[Claim 15] The display device according to claim 2, further comprising a support bracket provided a prescribed distance behind the back cover, the support bracket extending vertically and positioned to correspond to a center of the back cover, wherein the elastic members extend from the support bracket to the rear cover to pull the center of the rear cover toward the support bracket when the temperature of the shape memory alloy is increased above a prescribed level.

[Claim 16] The display device according to claim 15, further comprising a motor coupled to the support bracket to rotate the support bracket along a longitudinal axis of the support bracket, wherein the shape memory alloy is wound around an outer surface of the support bracket when the support bracket is rotated to bend the display panel.

[Claim 17] The display device according to claim 2, wherein the plurality of elastic

members are provided to extend parallel to each other to form a first column corresponding to a left side of the display panel and a second column corresponding to a right side of the display panel.

[Claim 18] The display device according to claim 17, wherein the controller controls a length of the shape memory alloy in the left column to be different than in the right column.

[Claim 19] The display device according to claim 2, wherein the controller controls an amount of current applied to the shape memory alloy to change a length of the shape memory alloy to bend the display panel.

[Claim 20] The display device according to claim 1, further comprising
a bracket coupled to a rear of the back cover,
a printed circuit board coupled to a rear of the bracket, and
a first fastener provided between the bracket and the back cover to couple the back cover to the bracket along a central vertical axis of the display panel.

[Claim 21] The display device according to claim 20, further comprising a second fastener provided between the bracket and the printed circuit board to couple the printed circuit board to the bracket along a lateral side of the printed circuit board.

[Claim 22] The display device according to claim 20, further comprising a second fastener provided between the bracket and the back cover to couple a lateral region of the back cover to the bracket, wherein the second fastener includes a first portion coupled to the back cover and a second portion coupled to the bracket, the first portion being movably coupled to the second portion to allow lateral movement of the rear cover relative to the bracket.

[Claim 23] The display device according to claim 1, wherein the bending assembly includes a plurality of wires that extend vertically on the back cover and positioned a prescribed distance from each other in a lateral direction with respect to the display panel, the plurality of wires configured to apply a prescribed amount of force with respect to an adjacent wire to bend the display panel.

[Claim 24] The display device according to claim 23, wherein the plurality of wires are provided adjacent a front surface of the back cover that faces the display panel or adjacent a rear surface of the back cover opposite the front surface, wherein
when the wires are provided adjacent the front surface of the back cover, the controller controls a direction of current through each wire to

be the same to apply a force that pulls each wire toward an adjacent wire, and

when the wires are provided at the rear surface of the back cover, the controller controls the current through each adjacent wire to be opposite to apply a force that pushes each wire away from an adjacent wire.

[Claim 25] The display device according to claim 1, wherein the bending assembly includes a plurality of electromagnets arranged relative to each other to apply a lateral force to the back cover.

[Claim 26] The display device according to claim 25, wherein the plurality of electromagnets are provided adjacent a rear surface of the back cover that faces away from the display panel, and the controller controls a direction of current through each electromagnet such that an N pole of one electromagnet faces an N pole of an adjacent electromagnet.

[Claim 27] The display device according to claim 25, wherein the plurality electromagnets are provided adjacent a front surface of the back cover that faces the display panel, and the controller controls a direction of current through each electromagnet such that an N pole of one electromagnet faces an S pole of an adjacent electromagnet.

[Claim 28] The display device according to claim 1, wherein the bending assembly includes a bi-metal having a first metal provided at a front side that faces the display panel and a second metal provided at a rear side opposite the front side, the first metal having a thermal expansion coefficient that is relatively less than a thermal expansion coefficient of the second metal.

[Claim 29] The display device according to claim 1, wherein the bending assembly includes a bi-metal having a first metal provided at a front side that faces the display panel and a second metal provided at a rear side opposite the front side, the second metal being a piezoelectric element.

[Claim 30] The display device according to claim 1, wherein the bending assembly includes a piezoelectric element that is coupled to the back cover, a length of the piezoelectric element configured to change in a lateral direction relative to the display panel.

[Claim 31] The display device according to claim 1, wherein the bending assembly includes

a heat sensitive tube,

refrigerant provided in the heat sensitive tube,

a heater to heat the heat sensitive tube, and

a cylinder connected to a distal end of the sensitive heat tube,
wherein, when the heater heats the refrigerant, the heat sensitive tube expands to move the cylinder laterally to apply a lateral force to a side edge of the back cover.

[Claim 32] The display device according to claim 31, where a stopper is provided at a rear surface of the back cover that limits a range of movement of the cylinder, the stopper including an angled surface that abuts against the cylinder when the cylinder is moved laterally.

[Claim 33] The display device according to claim 32, wherein the heater is a heating wire that surrounds an outer surface of the heat sensitive tube.

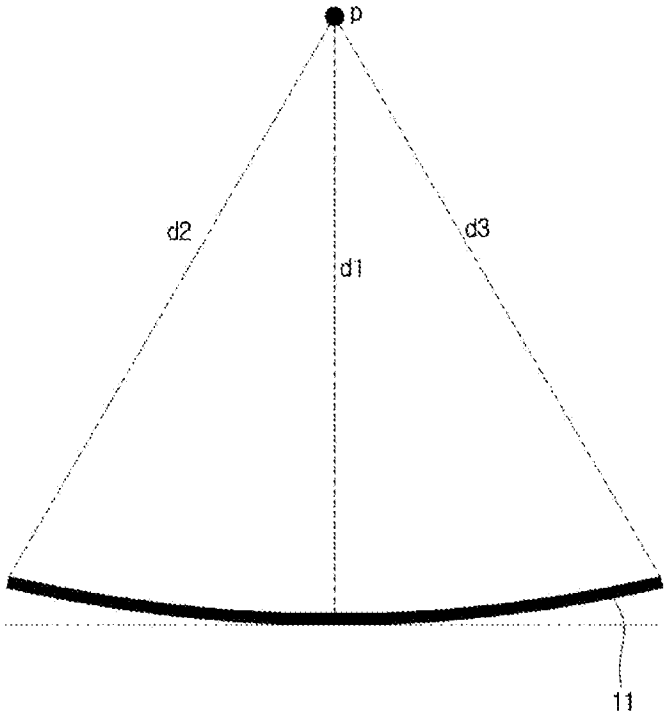
[Claim 34] The display device according to claim 1, wherein the bending assembly includes a motor and a shaft provided behind the back cover and extending to a lateral region of the back cover, a length of the shaft being changed by driving the motor, wherein when the shaft is extended, a pressure is applied to a side edge of the back cover to bend the display panel.

[Claim 35] The display device according to claim 34, wherein the shaft includes
a first shaft that is rotated by the motor, and
a second shaft coupled to the first shaft through a screw gear.

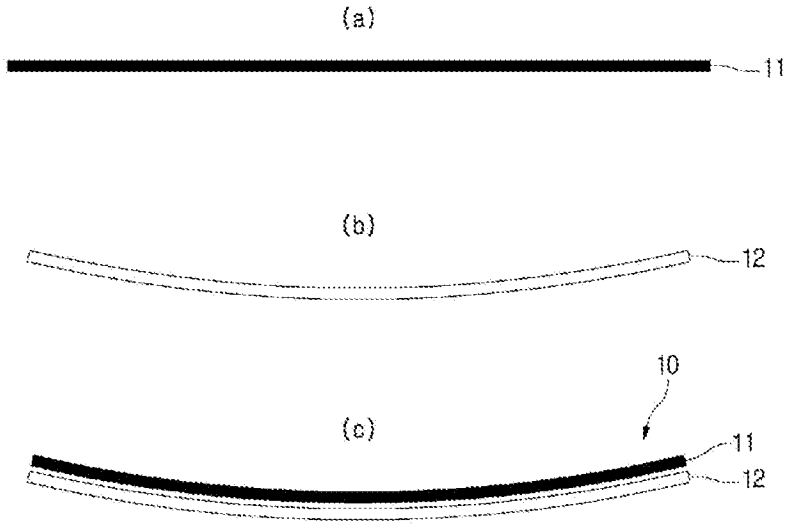
[Claim 36] The display device according to claim 34, wherein a speaker is coupled to a distal end of the shaft, wherein
the speaker is positioned behind the display panel when the length of the shaft is at a first length,
the speaker is positioned adjacent the display panel when the length of the shaft is at a second length greater than the first length, and
the speaker is positioned adjacent the display panel and a rear lateral edge of the back cover to apply the pressure to the side edge of the back cover to bend the display panel when the length of the shaft is at a third length greater than the second length.

[Claim 37] The display device according to claim 1, wherein the back cover comprises Carbon Fiber-Reinforced Plastic.

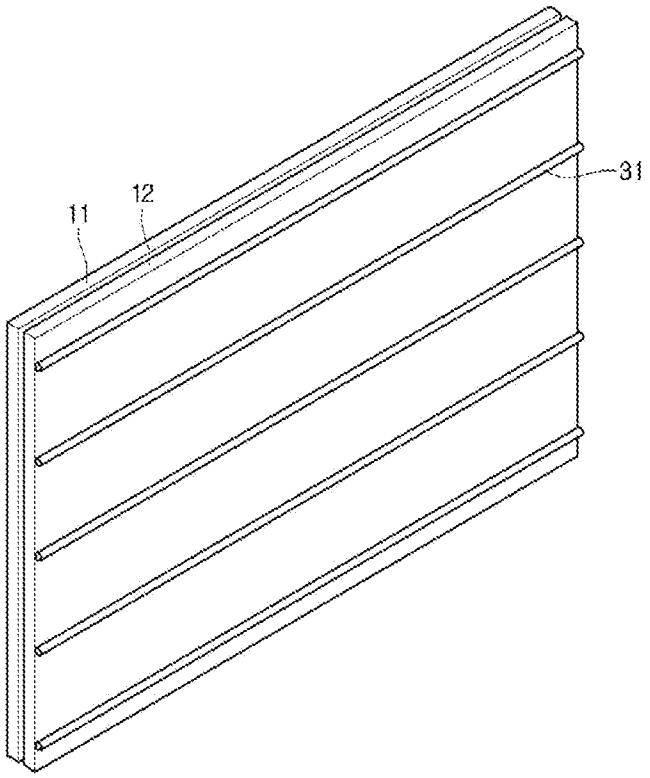
[Fig. 1]



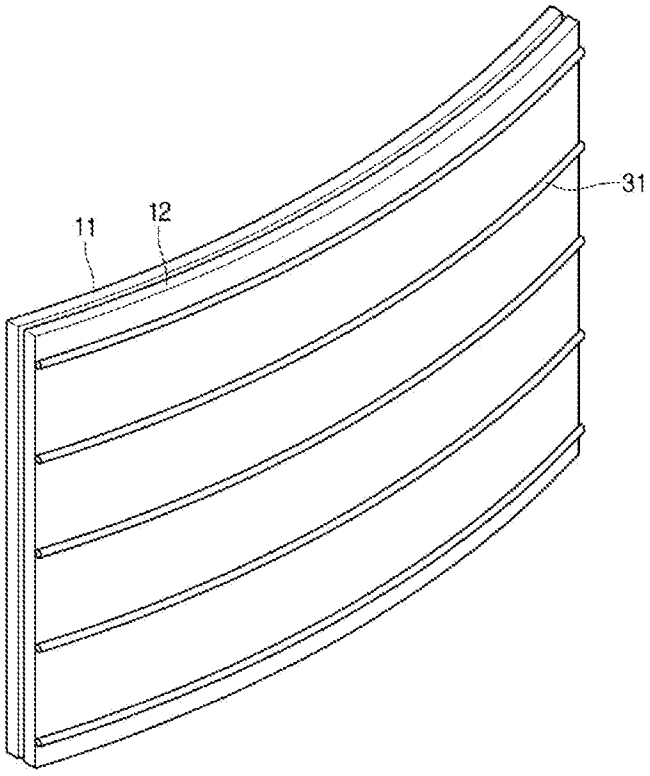
[Fig. 2]



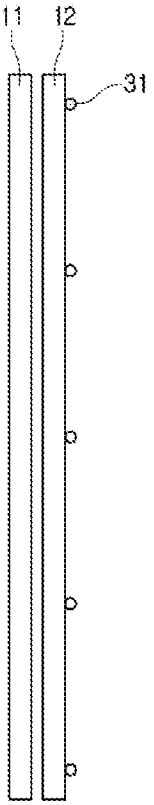
[Fig. 3A]



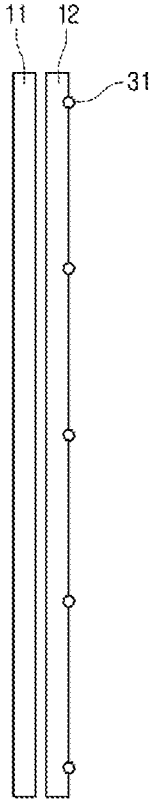
[Fig. 3B]



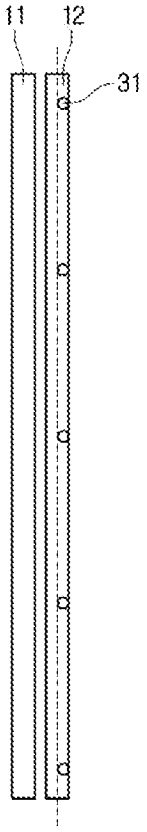
[Fig. 4]



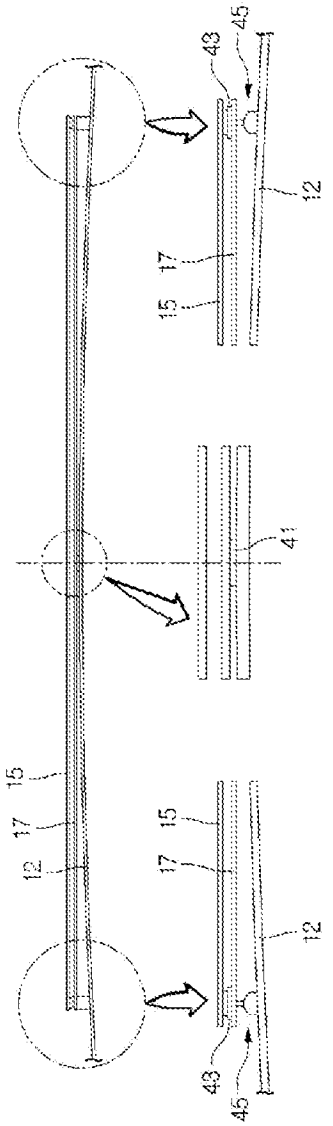
[Fig. 5]



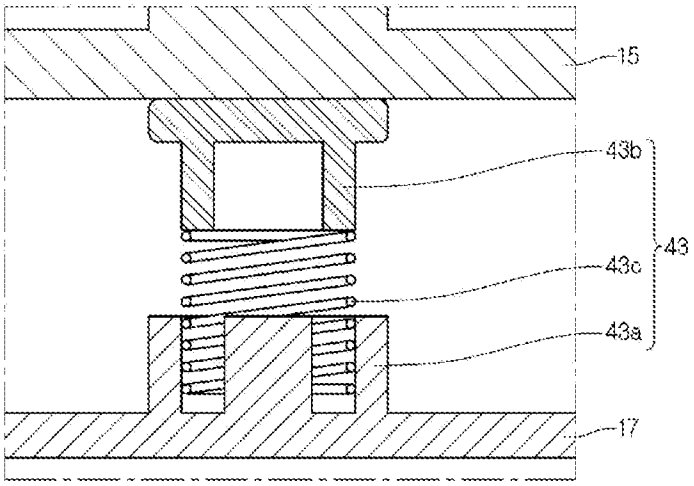
[Fig. 6]



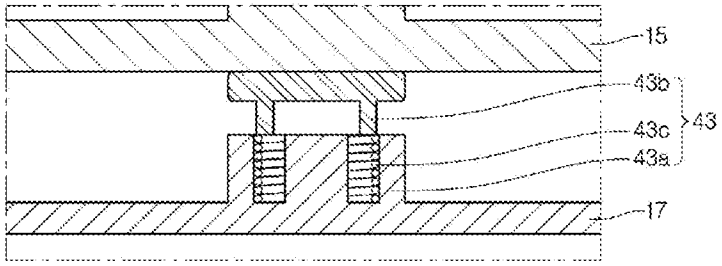
[Fig. 7]



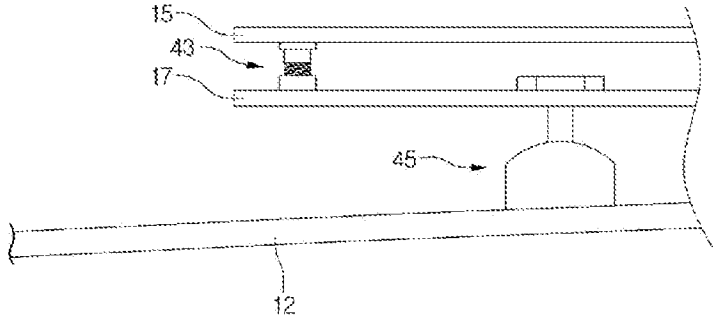
[Fig. 8A]



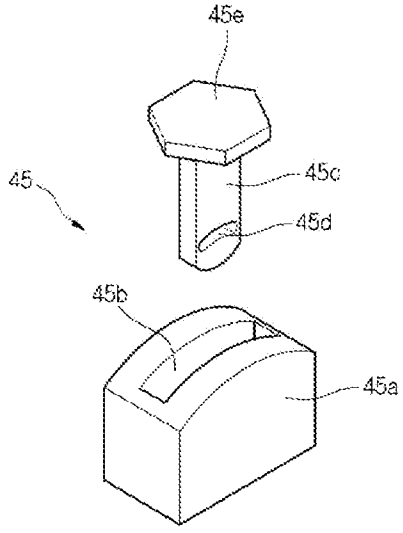
[Fig. 8B]



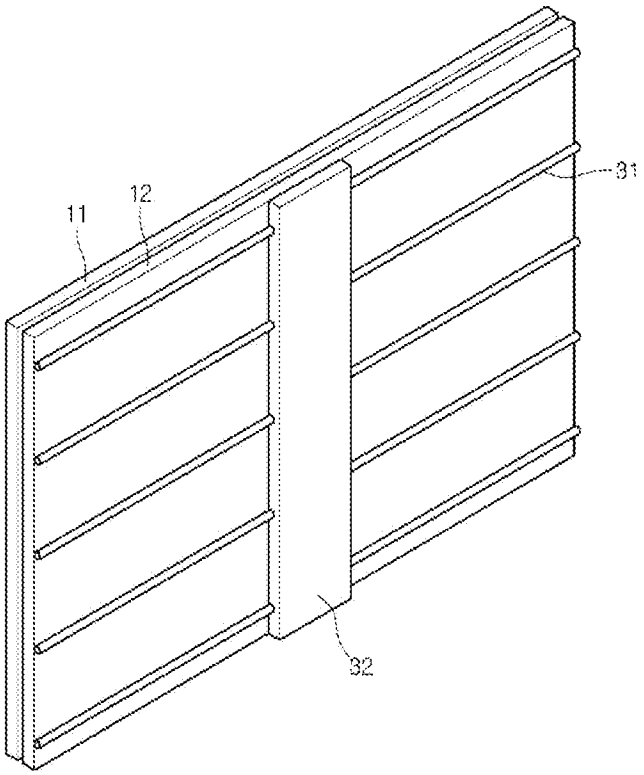
[Fig. 9]



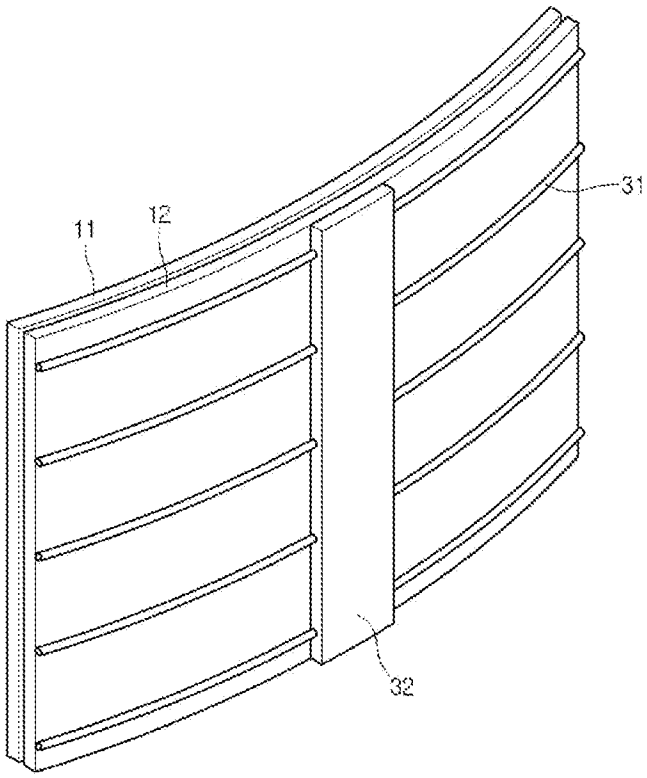
[Fig. 10]



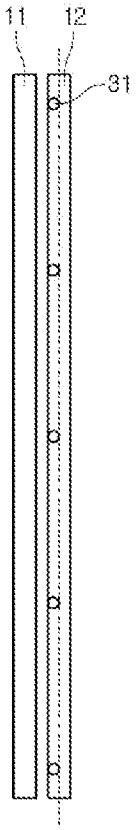
[Fig. 11A]



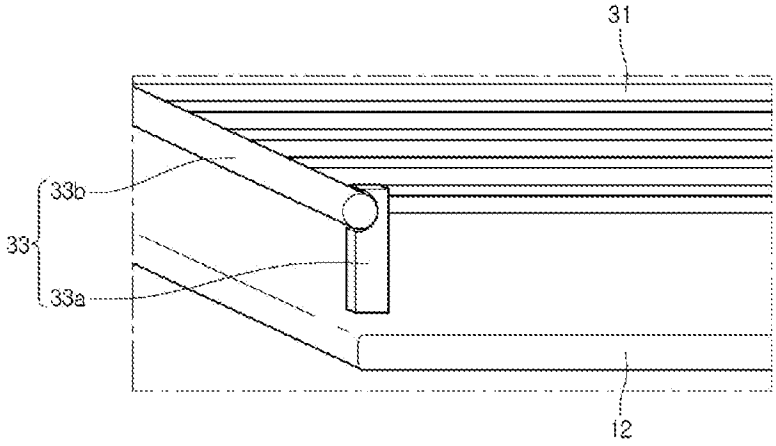
[Fig. 11B]



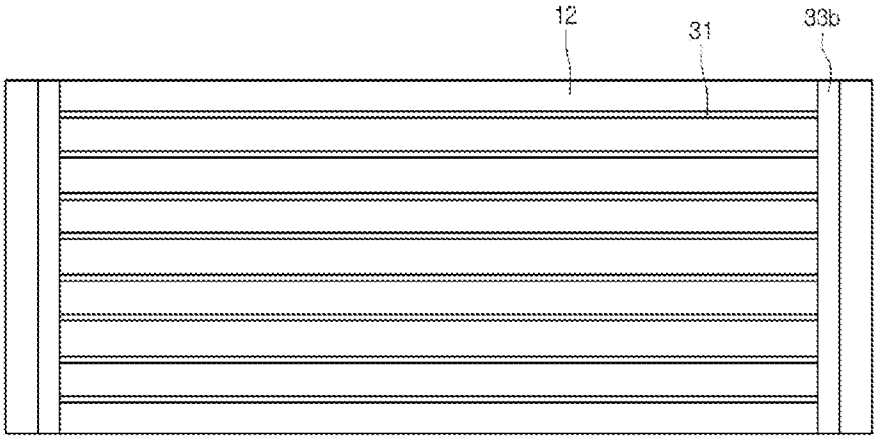
[Fig. 12]



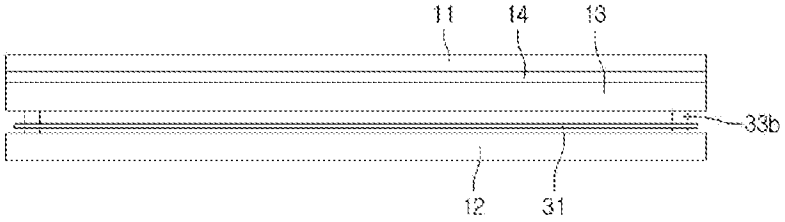
[Fig. 13]



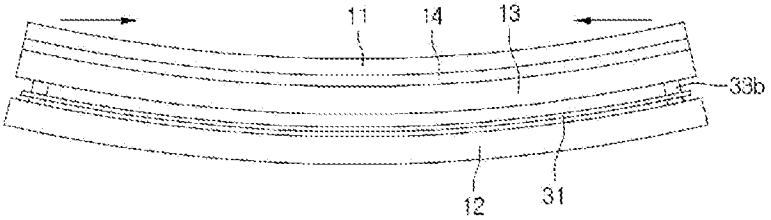
[Fig. 14]



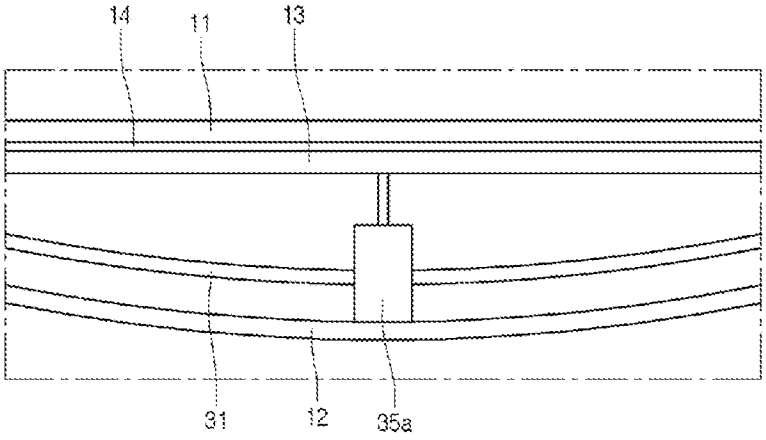
[Fig. 15A]



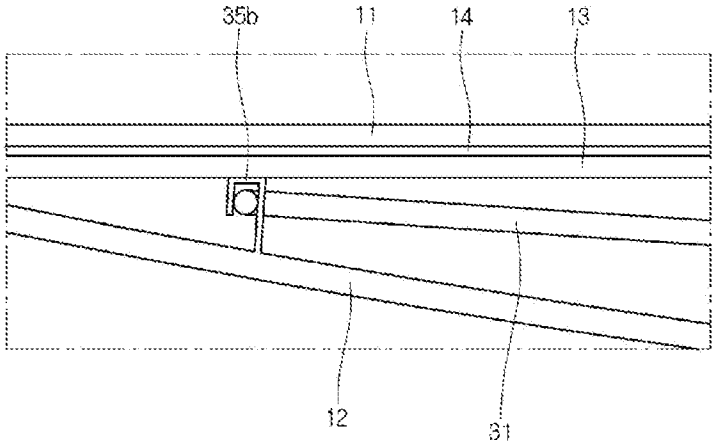
[Fig. 15B]



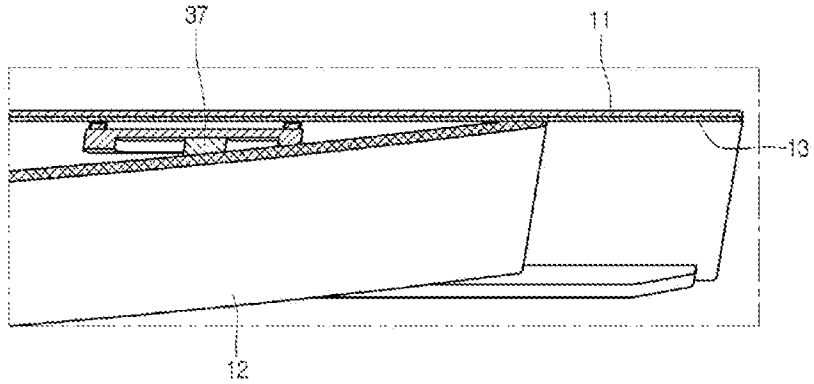
[Fig. 16]



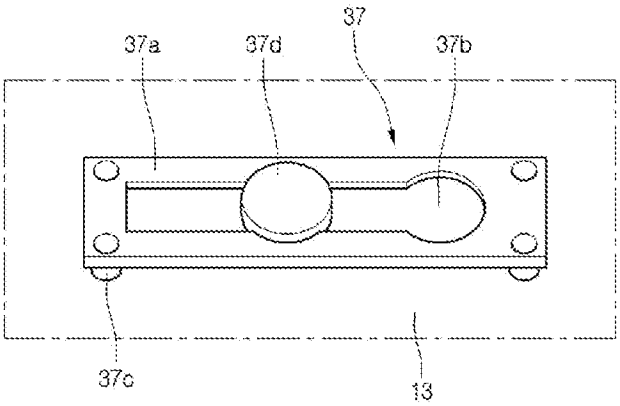
[Fig. 17]



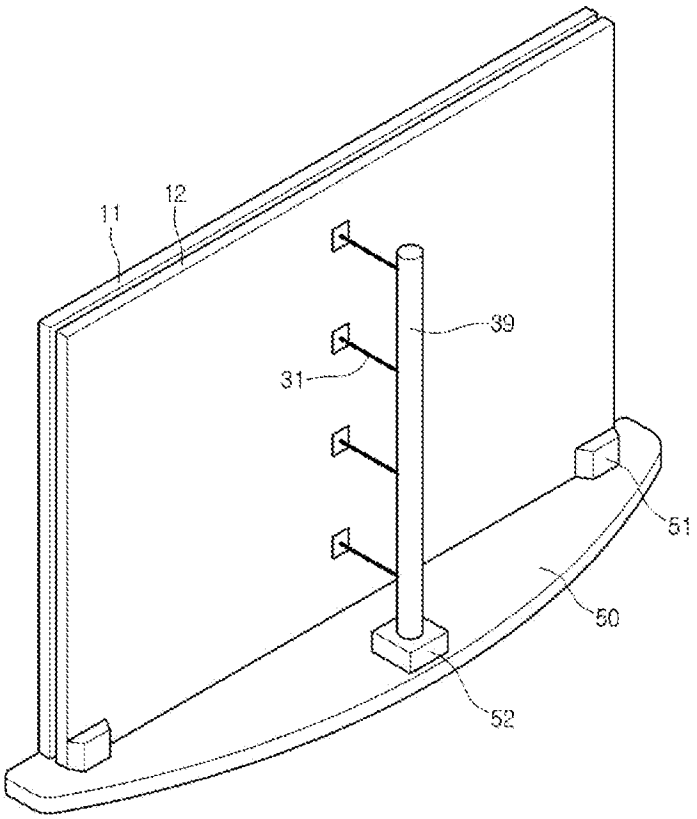
[Fig. 18]



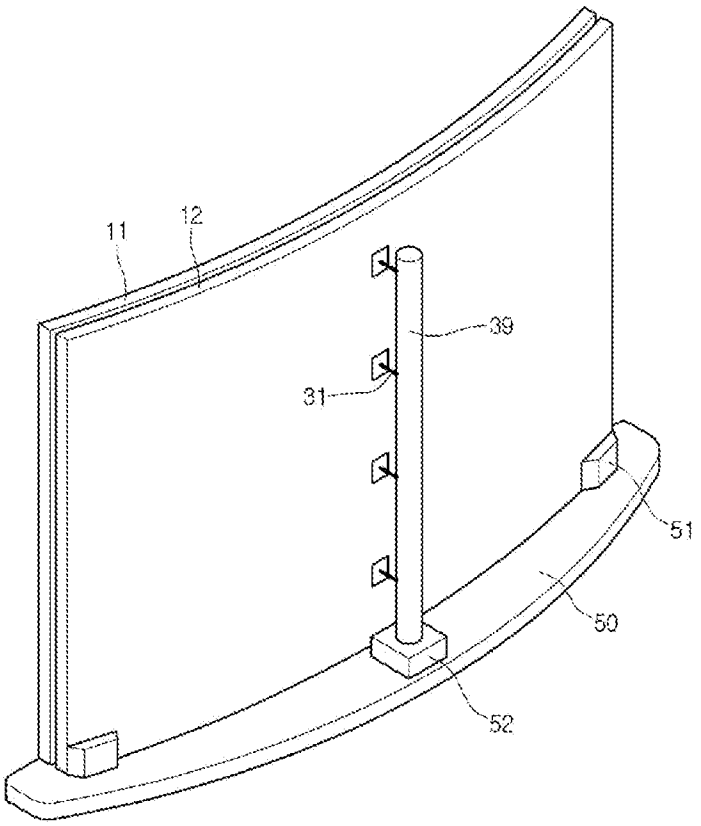
[Fig. 19]



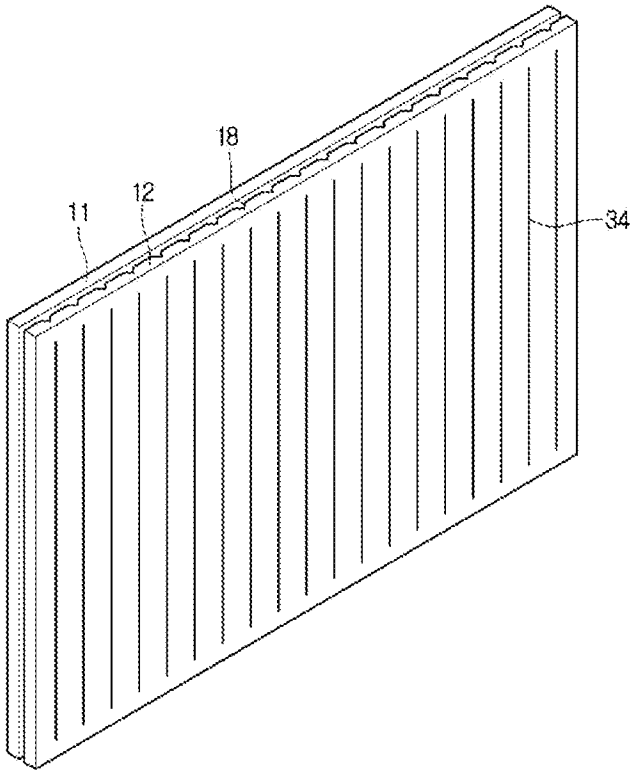
[Fig. 20A]



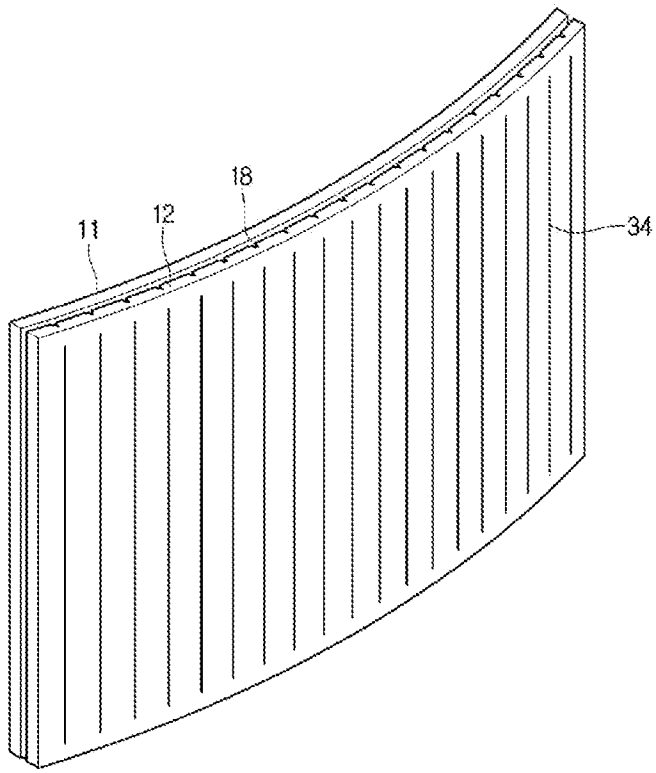
[Fig. 20B]



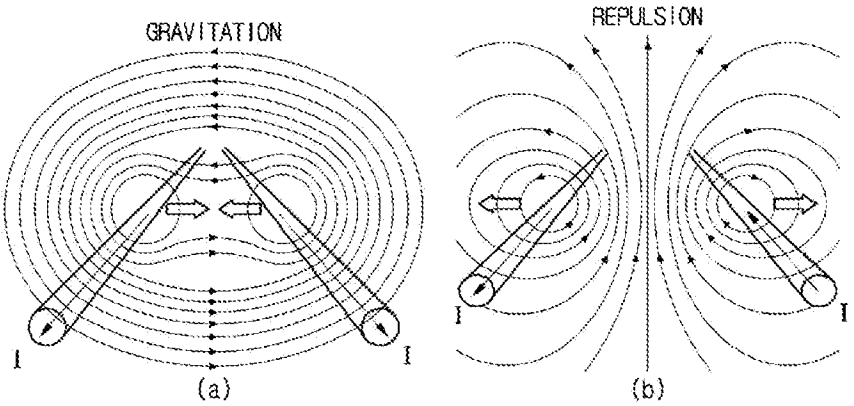
[Fig. 21A]



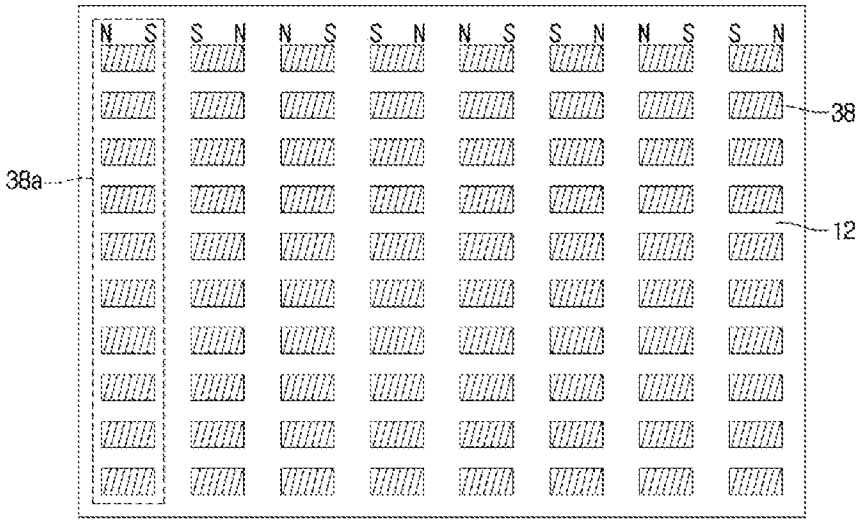
[Fig. 21B]



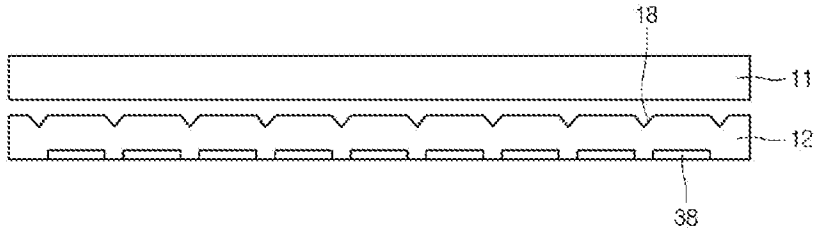
[Fig. 22]



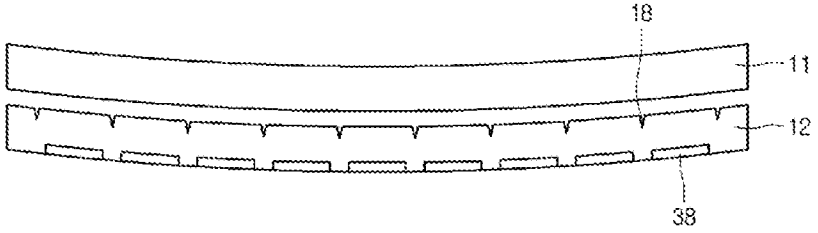
[Fig. 23]



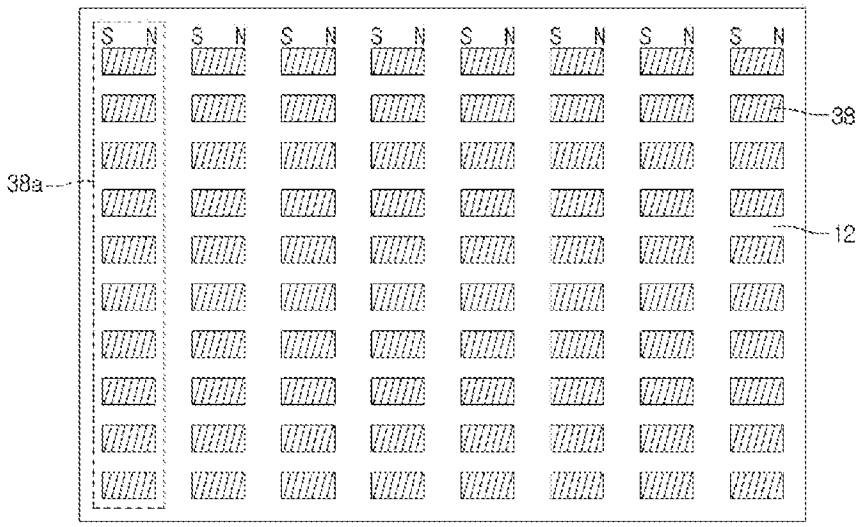
[Fig. 24A]



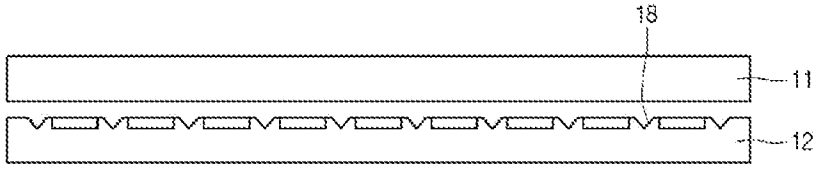
[Fig. 24B]



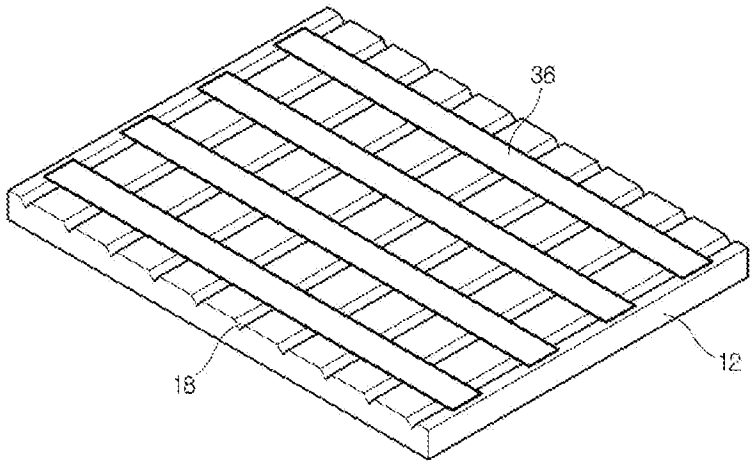
[Fig. 25]



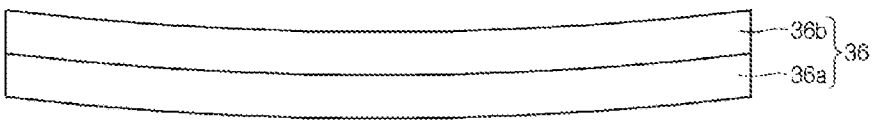
[Fig. 26]



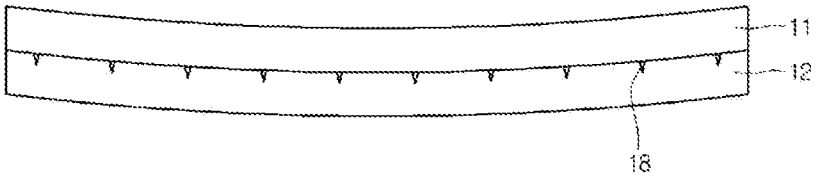
[Fig. 27]



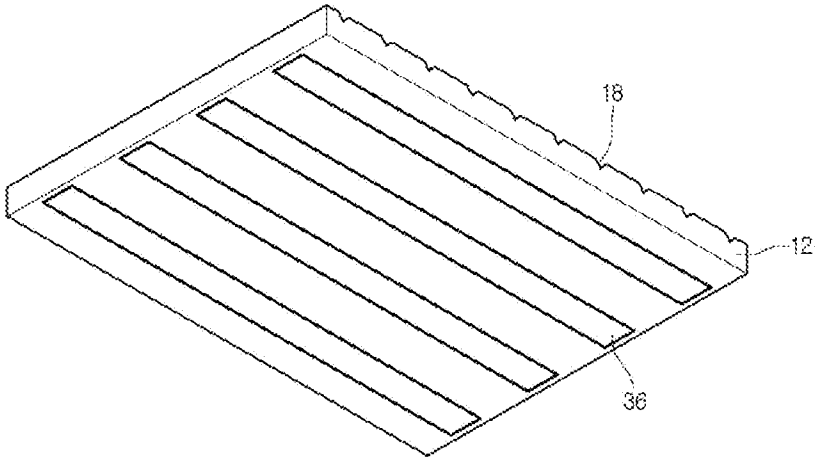
[Fig. 28]



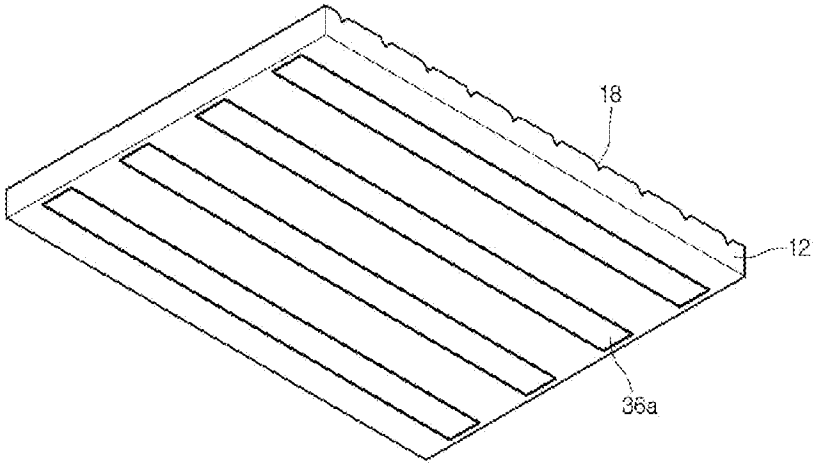
[Fig. 29]



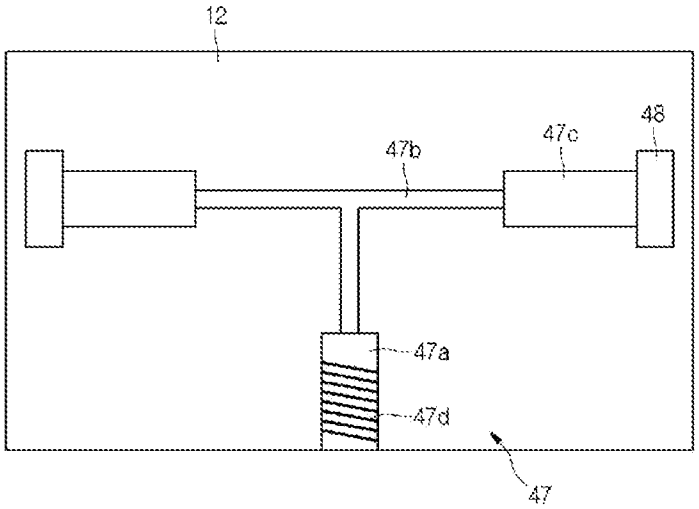
[Fig. 30]



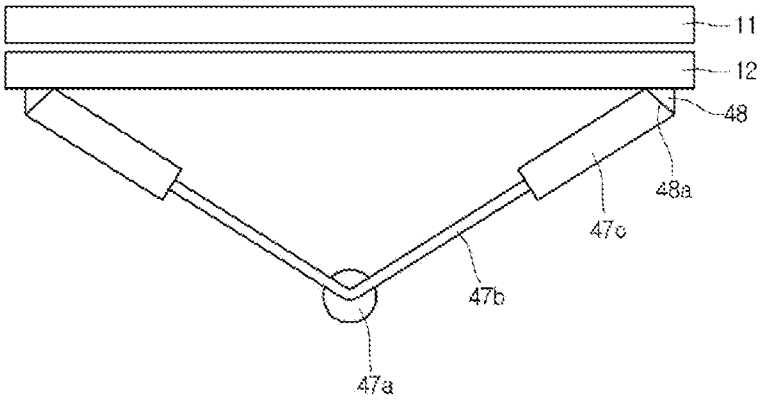
[Fig. 31]



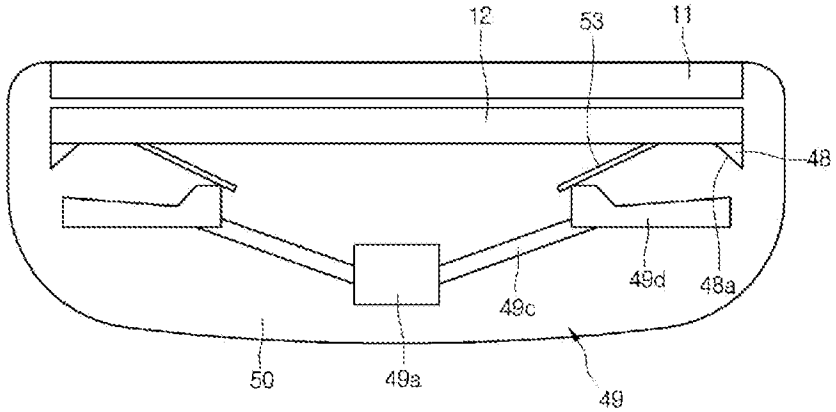
[Fig. 32]



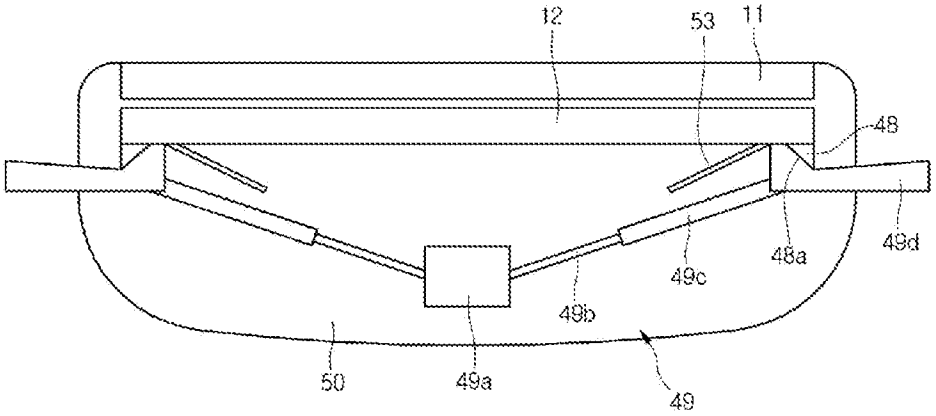
[Fig. 33]



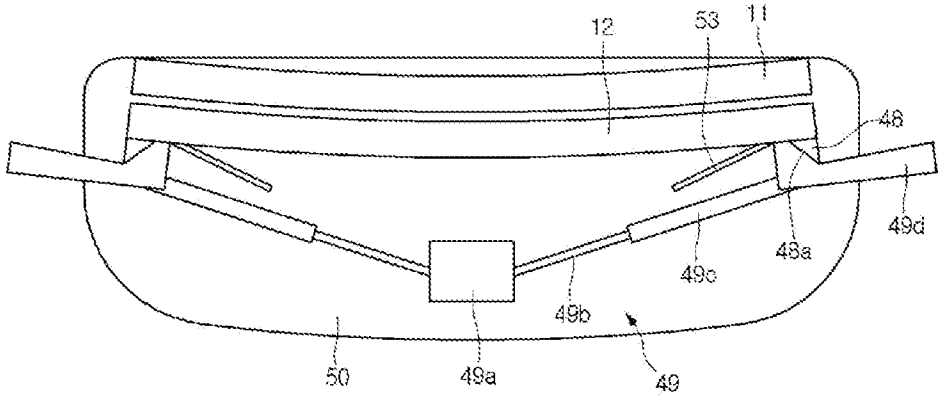
[Fig. 34]



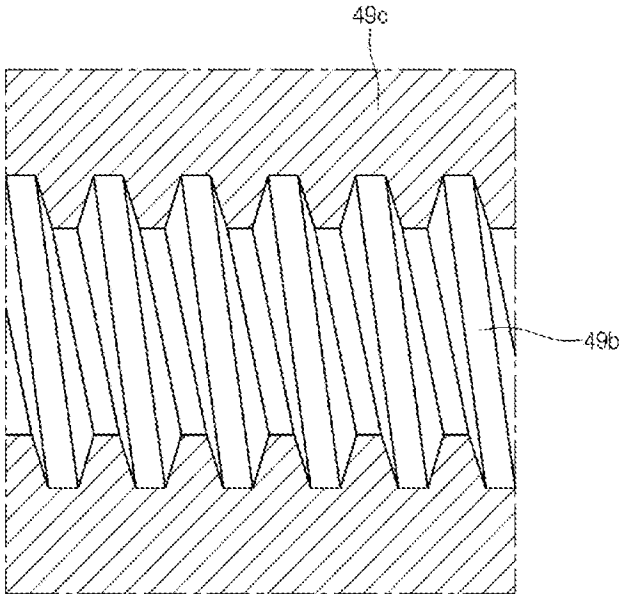
[Fig. 35]



[Fig. 36]



[Fig. 37]



INTERNATIONAL SEARCH REPORT

International application No
PCT/KR2013/009503

A. CLASSIFICATION OF SUBJECT MATTER

G09F 9/00(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G09F 9/00; G02B 27/22; G09F 9/35; G02B 3/08; H05B 33/02; H04N 5/64; G02F 1/1333; G06F 3/041

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & Keywords: display, control, bending, curvature

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2006-023676 A (PIONEER CORP.) 26 January 2006 See paragraphs [0015]- [0024] ; and figures 3.	1,23,24
Y		2-22, 25-37
Y	wo 2010-085575 Al (ARTIFICIAL MUSCLE, INC.) 29 July 2010 See paragraphs [0078] , [0141] ; and figures 1A, IB.	2-19 ,25-30 ,37
Y	JP 2009-109812 A (NEC CORP.) 21 May 2009 See paragraphs [0015]- [0022] ; and figures 1, 3.	9-16
Y	JP 2009-063640 A (SONY CORP.) 26 March 2009 See paragraphs [0022]- [0050] ; and figures 2, 4.	13,14, 20-22 ,31-33 ,36
Y	JP 10-026754 A (NIPPON DENKI IDO TSUSHIN KK.) 27 January 1998 See paragraphs [0011]- [0016] ; and figure 2.	16,34-36

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
06 March 2014 (06.03.2014)	**07 March 2014 (07.03.2014)**

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/KR2013/009503

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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Chemtronics Exhibit 1032 Page 907

(12) 按照专利合作条约所公布的国际申请

(19) 世界知识产权组织
国 际 局

(43) 国际公布日
2013 年 10 月 31 日 (31.10.2013)

WIPO | PCT

(10) 国际公布号
WO 2013/159472 A1

(51) 国转 利分类号：
G06F 3/042 (2006.01)

(21) 国际申请号： PCT/CN20 12/080 153

(22) 国际申请日： 2012 年 8 月 15 日 (15.08.2012)

(25) 申飾 言： 中文

(26) 公布语言： 中文

(30) 优先权：
2012 101274207 2012 年 4 月 27 日 (27.04.2012) CN

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(81) 指定国 (除另有指明，要求每一种可提供的国家保护)：AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW。

(84) 指定国 (除另有指明，要求每一种可提供的地区保护)：ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), 欧亚 (AM, AZ, BY, KG, KZ, RU, TJ, TM), 欧洲 (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)。

本国际公布：
- 包括国际检索报告(条约第 21 条(3))。

(54) Title: TOUCH CONTROL DISPLAY DEVICE

(54) 发明名称 :一种触控显示设备

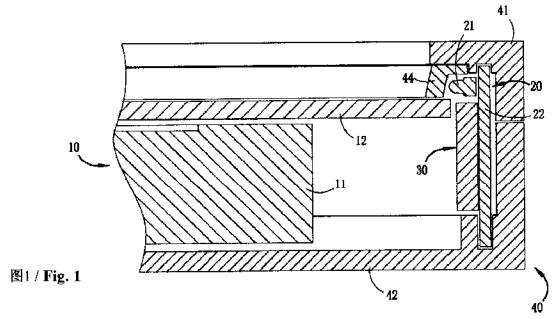


图1 / Fig. 1

(57) Abstract: A touch control display device, comprising a panel display unit, an induction signal receiving and transmitting mod - ule, a control module, and a housing; the induction signal receiving and transmitting module is annularly disposed around the panel display unit; the panel display unit, the induction signal receiving and transmitting module, and the control module are all encapsu - lated in the housing; the panel display unit comprises a liquid crystal display; the induction signal receiving and transmitting module comprises a plurality of induction signal receiving and transmitting geminate transistors and a printed circuit board; the plurality of induction signal receiving and transmitting geminate transistors are all electrically connected to the printed circuit board; each indue - tion signal receiving and transmitting geminate transistor comprises an induction signal transmitting transistor and an induction sig - nal receiving transistor; the printed circuit board is annularly disposed around the liquid crystal display, and is perpendicular to the panel of the liquid crystal display; and the induction signal receiving and transmitting geminate transistors electrically connected to the printed circuit board are disposed on the front side of the display surface of the liquid crystal display.

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(57) 摘要：

[见续页]

2 13/15 472 1

一种触控显示设备，其包括平板显示部件、感应信号收发模块、控制模组以及外壳体，所述感应信号收发模块环设在所述平板显示部件的四周，所述平板显示部件、感应信号收发模块以及控制模组均封装在所述外壳体中，所述平板显示部件包括液晶显示器，所述感应信号收发模块包括若干感应信号收发对管以及印刷电路板，若干所述感应信号收发对管均电连接在所述印刷电路板上，感应信号收发对管包括感应信号发射管以及感应信号接收管，所述印刷电路板环设在所述液晶显示器的四周，且所述印刷电路板与所述液晶显示器面板垂直，电连接在所述印刷电路板上的感应信号收发对管设置在所述液晶显示器的显示面前侧。

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一种触控显示设备

技术领域

[0001] 本发明涉及显示触控领域，特别是指一种采用触控式的显示设备。

背景技术

[0002] 为了操作上的方便，人们用触摸屏来代替鼠标或键盘工作时，我们必须首先用手指或其它物体触摸安装在显示器前端的触摸屏，然后系统根据手指触摸的图标或菜单位置来定位选择信息输入触摸屏由触摸检测部件和触摸屏控制器组成；触摸检测部件安装在显示器屏幕前面，用于检测¾户触摸位置，接受后送触摸屏控制器；而触摸屏控制器的主要作¾是从触摸点检测装置上接收触摸信息，并将它转换成触点坐标，再送给 CPU, 它同时能接收 CPU 发来的命令并加以执行。

[0003] 对于上述应用触摸屏技术的数码产品而言其优点主要是将控制键盘与显示屏的功能进行集合使显示屏同时具有键盘的功能，这种触摸屏的技术不但可以在有效的面积内尽可能的增大显示屏的面积，同时对于整体数码产品的外观效果也有比较大的提升。通过上述的触摸屏的技术可以在不增大数码产品整体体积的前提下尽可能的增大显示屏的尺寸，从而使通过装置有触摸屏的数码产品播放电视、动画类视频成为可能。而就目前市面上出现的触摸屏而言，红外式触摸屏占据一定的份额，如专利号 200720052423.3 以及专利号 200720051069.2 所公开的两种专利产品即为常见的红外触控显示装置，其主要包括平板显示部件 (包括液晶显示屏)、围绕在平板显示部件四周的四块焊接有红外线发射管以及红外线接收管的印刷电路板、外框，其中，所述红夕线发射管以及红外线接收管均设置在所述平板显示部件的显示面前侧，且所述红外线发射管与红外线接收管分别相对应的设置在平板显示部件四周的左右两侧以及上下两侧，从而使得平板显示部件的显示面前侧形成一个红外线光栅探测网。当使用者用手指或其它物体点触平板状显示部件的显示面上某一点时，便会挡住经过该位置的两条红外线，使红外线接收管不能收到与其相对应的红外线发射管所发射的红外线，该红外触控显示装置的控制系统便能即时计算出触点的位置，再根据触点位置对应的命令运行相应的程序，从而实现平板显示部件上的触控操作。

[0004] 如上所述的这种结构的红外触控显示装置中的印刷电路板按照与平板状显示部件相互平行的方式设置，其结构上存在着一系列的缺陷，具体叙述如下：

第一，由于用于连接红外线发射管以及红外线接收管的印刷电路板嵌设在所述平板显示部件的四周，且所述印刷电路板与平板显示部件成同一平面设置，在封装所述平板显式部件的夕卜

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框时，所述外框需要将所述印刷电路板封装起来，因此造成所述平板显示部件的外框尺寸也相应的更大，从而使红外触控显示装置显得非常厚重；

第二，为使红外线发射管以及红外线接收管所发射以及接收的红外光线与平板显示部件平行，红外线发射管以及红外线接收管需要进行弯胸工序后再焊接安装到印刷线路板上，或者是先焊接安装到印刷电路板上，再进行弯胸，如此不仅工序复杂，增加了制造成本，而且红外线发射管以及红外线接收管在弯脚后可能对其寿命及稳定性产生影响。

[0005] 随着社会的不断发展，目前液晶显示器都向超薄，超窄方向发展，按照传统的红外触摸屏采用边框，一般都需要二十几毫米宽，这主要受限于用于连接上述红外线发射管以及红外线接收管的印刷电路板的排列宽度。因而造成很多超薄、超窄的显示器上难以使¾红外触控的技术。以上为传统红外触控显示装置在具体实施时所存在的主要技术缺陷，即为本发明所要研究解决的主要问题。

发明内容

[0006] 本发明的目的在于提供一种触控显示设备，其是一种与传统的触控显示装置同一性质的产品，其所要解决的主要技术问题在于：传统的触控显示装置受限于用于连接感应信号发射管以及感应信号接收管的印刷电路板的宽度，需要制作相应宽度的外框，从而使得外框一般都需要二十几毫米宽，因此造成很多超薄、超窄的显示器上难以通过采用感应信号收发方式实现触控的技术。以上为本发明所要解决的主要技术问题。

[0007] 为解决上述技术问题，本发明采用的技术方案是：本发明提供一种触控显示设备，其包括平板显示部件、感应信号收发模块、控制模组以及外壳体，其中，所述感应信号收发模块环设在所述平板显示部件的四周，所述平板显示部件、感应信号收发模块以及控制模组均封装在所述外壳体中，所述平板显示部件包括液晶显示器，所述感应信号收发模块包括若干感应信号收发对管以及印刷电路板，若干所述感应信号收发对管均电连接在所述印刷电路板上，感应信号收发对管包括感应信号发射管以及感应信号接收管，所述印刷电路板环设在所述液晶显示器的四周，且所述印刷电路板与所述液晶显示器面板垂直，其特征在于：电连接在所述印剧电路板上的感应信号收发对管设置在所述液晶显示器的显示面前働，且所述感应信号发射管与所述感应信号接收管分别相对应的设置在所述液晶显示器的左右两侧以及上下两侧，若千所述感应信号射管所发射的感应信号在所述液晶显示器的显示面前侧形成一个感应信号探测网。

[0008] 优选方式：所述印刷电路板包括四块或四块以上环设在所述液晶显示器四周的小电路板，各个小电路板之间首尾固定的电连接在一起，所述印刷电路板为硬性 PCB 或柔性

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PCB 板。

[0009] 优选方式：所述控制模组与所述印刷电路板电连接，且所述控制模组固定在所述小电路板上对应所述液晶显示器的一侧或另一侧。

[0010] 优选方式：所述控制模组设置在所述底壳上，所述控制模组与所述印刷电路板之间连接有用于传输电源、数据的软排线。

[0011] 优选方式：所述印刷电路板包括四块或四块以上环设在所述液晶显示器四周的小电路板，各个小电路板之间首尾固定连接在一起，所述印刷电路板为硬性 PCB 或柔性 PCB 板，所述控制模组设置在所述底壳上，所述控制模组与构成所述印刷电路板的各个小电路板之间连接有用于传输电源、数据的软排线。

[0012] 优选方式：所述外壳体包括面壳以及底壳，所述平板显示部件以及感应信号收发模块均设置在所述底壳中，所述面壳为一与所述底壳大小匹配的四方形的框律，四方框形的所述面壳盖设在所述底壳上，所述液晶显示器的显示面对应在四方形框体围绕成的方框内，所述感应信号收发模块收设在所述面壳与所述底壳之间，所述面壳与所述底壳上相对应的设置有卡槽，与所述液晶显示器垂直的所述印剧电路板卡设在所述卡槽中，借助所述卡槽对所述印刷电路板进行固定。

[0013] 优选方式：所述感应信号收发对管为红外收发对管，且所述红外收发对管包括红外线发射管以及红外线接收管，所述红外线发射管为贴片红外 LED 。

[0014] 优选方式：所述面壳与所述液晶显示器的显示面之间预留有出光间隙，所述红外收发对管的红外线发射管以及红外线接收管相对应设置在所述出光间隙中。

[0015] 优选方式：所述面壳与所述液晶显示器之间的出光间隙中设置有滤光条，所述滤光条位于所述红外收发对管的红外线发射管以及红外线接收管前侧。

[0016] 优选方式：所述平板显示部件还包括触摸面板，所述触摸面板盖设在所述液晶显示器的显示面一侧，所述触摸面板采用透明的钢化玻璃板制成。

[0017] 与现有技术相比，本专利申请的技术效果是：本发明提供一种触控显示设备，其将所述平板显示部件以及感应信号收发模块封装在所述外壳体中时，由于所述印刷电路板与所述液晶显示器垂直，因此四方框形的所述面壳边框只需能够封盖所述感应信号收发对管以及板面与所述边框垂直的印刷电路板即可，从而能够很大程度的缩减所述面壳的宽度，进一步实现触控显示设备的边框超窄化，采用本发明的方案所述边框宽度可缩减至 3,6 毫米；而且由于所述印剧电路板与所述液晶显示器垂直，而所述感应信号收发对管与所述液晶显示器平行，因此，当所述感应信号收发对管的引胸焊接在所述印刷电路板上时，无须进行弯脚工

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序，减少了制造工序，同样节约了制造成本，且所述感应信号收发对管的引脚未作折弯加工，其使用寿命更长，稳定性更好。

附图说明

[0018] 图 1 为本发明的一种较佳实施例的局部剖视示意图。

[0019] 图 2 为本发明的一种较佳实施例的局部剖视分解示意图。

[0020] 图 3 为本发明的另一种实施例的局部剖视示意图。

[0021] 图 4 为本发明的第二种较佳实施例的局部剖视示意图。

具体实施方式

[0022] 以下将结合附图 1 至 4 以及较佳实施例对本发明提出的一种触控显示设备作更为详细说明。

[0023] 如图 1 所示，本发明提供一种触控显示设备，其包括平板显示部件 10、感应信号收发模块 20、控制模组 30 以及夕卜壳体 40, 其中，所述感应信号收发模块 20 环设在所述平板显示部件 10 的四周，所述平板显示部件 10、感应信号收发模块 20 以及控制模组 30 均封装在所述外壳体 40 中；

所述平板显示部件 10 包括液晶显示器 11;

所述感应信号收发模块 20 包括若干感应信号收发对管 21 以及印剧电路板 22, 若干所述感应信号收发对管 21 均电连接在所述印剧电路板 22 上，感应信号收发对管 21 包括感应信号发射管以及感应信号接收管；

所述印刷电路板 22 环设在所述液晶显示器 11 的四周，且所述印刷电路板 22 与所述液晶显示器 11 面板垂直；

电连接在所述印刷电路板 22 上的感应信号收发对管 21 设置在所述液晶显示器 11 的显示面前侧，且所述感应信号发射管与所述感应信号接收管分别相对应的设置在所述液晶显示器 II 的左右两侧以及上下两侧，若干所述感应信号射管所发射的感应信号在所述液晶显示器 11 的显示面前侧形成一个感应信号探测网；

所述控制模组 30 与所述印刷电路板 22 电连接，所述控制模组 30 控制所述液晶显示器 11 以及所述感应信号收发对管 21 的工作；

所述外壳体 40 包括面壳 41 以及底壳 42, 所述平板显示部件 10 以及感应信号收发模块 20 均设置在所述底壳 42 中，所述面壳 41 为一与所述底壳 42 大小匹配的四方形的框体，四方框形的所述面壳 4】盖设在所述底壳 42 上，所述液晶显示器 11 的显示面对应在四方形框体围绕成的方框内，所述感应信号收发模块 20 收设在所述面壳 41 与所述底壳 42 之间。

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[0024] 本发明在具体实施时，将所述平板显示部件 10 以及感应信号收发模块 20 封装在所述外壳体 40 中时，由于所述印刷电路板 22 与所述液晶显示器 11 垂直，四方框形的所述面壳 41 边框只需能够收纳所述感应信号收发对管 21 的长度以及与其垂直的印刷电路板 22 即可，从而能够很大程度的缩减所述面壳 41 的宽度，进一步实现触控显示设备的边框超窄化，采用本发明的方案所述边框宽度可缩减至 3.6 毫米，较小地占有现有显示设备表面边框的空间，较小地改变工艺结构，使触控与显示的整体性更强；而且由于所述印刷电路板 22 与所述液晶显示器 11 垂直，而所述感应信号收发对管 21 与所述液晶显示器 11 平行，因此，当所述感应信号收发对管 21 的引脚焊接在所述印刷电路板 22 上时，无须进行弯胸工序，减少了制造工序，同样节约了制造成本，且所述感应信号收发对管 21 的引脚未作折弯加工，其使¾寿命更长，稳定性更好。

[0025] 较佳实施例：如图 1、2、3 所示，所述印剧电路板 22 为硬性 PCB 或柔性 PCB 板，所述印刷电路板 22 包括四块或四块以上环设在所述液晶显示器 11 四周的小电路板，各个小电路板之间首尾固定的电连接在一起，所述控制模组 30 固定连接在小电路板上，通过将所述控制模组 30 固定在小电路板上使本发明的内部结构更加的紧凑，所述控制模组 30 固定在所述小电路板上对应所述液晶显示器 11 的一侧或另一侧。

[0026] 较佳实施例：如图 4 所示，所述印刷电路板 22 包括四块或四块以上环设在所述液晶显示器 !1 四周的小电路板，各个小电路板之间首尾固定的电连接在一起，所述控制模组 30 设置在所述底壳 42 上，所述控制模组 30 与所述印刷电路板 22 之间连接有用于传输电源、数据的软排线，通过使用软排线将所述控制模组 30 与所述感应信号收发模块 20 相连接，通过所述控制模组 30 控制所述感应信号收发模块 20 的正常工作，且通过软排线的连接方式可以方便所述控制模组 30 的拆装、换修。

[0027] 较佳实施例：如图 4 所示，所述印刷电路板 22 为硬性 PCB 或柔性 PCB 板，所述印刷电路板 22 包括四块或四块以上环设在所述液晶显示器 11 四周的小电路板，各个小电路板之间首尾固定连接在一起，所述控制模组 30 设置在所述底壳 42 上，所述控制模组 30 与构成所述印刷电路板 22 的各个小电路板之间连接有用于传输电源、数据的软排线，通过使¾软排线将所述控制模组 30 与各个小电路板之间电连接，从而可以方便所述控制模组 30 以及各个小电路板的拆换、修理，防止因为极个别的感应信号收发对管 21 损坏而影响整个感应信号收发模块 20。

[0028] 较佳实施例：如图 2 所示，所述面壳 4】与所述底壳 42 上相对应的设置有卡槽 411，与所述液晶显示器 11 垂直的所述印刷电路板 22 卡设在所述卡槽 411 中，借助所述卡槽 411

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对所述印剧电路板 22 进行固定。

[0029] 较佳实施例：所述感应信号收发对管 21 为红外收发对管，且所述红夕卜收发对管包括红外线发射管以及红外线接收管，所述红外线发射管为贴片红外 LED 。

[0030] 较佳实施例：如图 2 所示，所述面壳 41 与所述液晶显示器 11 的显示面之间预留有出光间隙 43，所述红外收发对管的红外线发射管以及红外线接收管相对应设置在所述出光间隙 43 中。

[003 1】较佳实施例：如图 1、2、3、4 所示，所述面壳 41 与所述液晶显示器 11 之间的出光间隙 43 中设置有滤光条 44, 所述滤光条 44 位于所述红外收发对管的红外线发射管以及红外线接收管前侧，利用所述滤光条 44 来滤掉外界光线，使所述红外线发射管以及红外线接收管能够选择性的对外发出、接收光。

[0032] 较佳实施例：如图 1、2、3、4 所示，所述平板显示部件 10 还包括触摸面板 12，所述触摸面板 12 盖设在所述液晶显示器 11 的显示面一侧，所述触摸面板 12 采用透明的钢化玻璃板制成，借助采用透明钢化玻璃板制成的触摸面板 】2 为位于所述显示窗口 411 处的所述液晶显示器 11 提供抗外力保护。

[0033] 综合上所述，本发明的技术方案可以充分有效的完成上述发明目的，且本发明的结构原理及功能原理都已经在实施例中得到充分的验证，而能达到预期的功效及目的，且本发明的实施例也可以根据这些原理进行变换，因此，本发明包括一切在申请专利范围中所提到范围内的所有替换内容。任何在本发明申请专利范围内所作的等效变化，皆属本案申请的专利范围之内。

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1. 一种触控显示设备，其包括平板显示部件、感应信号收发模块、控制模组以及外壳体，其中，所述感应信号收发模块环设在所述平板显示部件的四周，所述平板显示部件、感应信号收发模块以及控制模组均封装在所述外壳体中，所述平板显示部件包括液晶显示器，所述感应信号收发模块包括若干感应信号收发对管以及印刷电路板，若干所述感应信号收发对管均电连接在所述印刷电路板上，感应信号收发对管包括感应信号发射管以及感应信号接收管，其特征在于：所述印刷电路板环设在所述液晶显示器的四周，且所述印刷电路板与所述液晶显示器面板垂直，电连接在所述印刷电路板上的感应信号收发对管设置在所述液晶显示器的显示面前侧，且所述感应信号发射管与所述感应信号接收管分别相对应的设置在所述液晶显示器的左右两侧以及上下两侧，若千所述感应信号射管所发射的感应信号在所述液晶显示器的显示面前侧形成一个感应信号探测网。

2. 如权利要求 1 所述的一种触控显示设备，其特征在于：所述印刷电路板包括四块或四块以上环设在所述液晶显示器四周的小电路板，各个小电路板之间首尾固定的电连接在一起，所述印刷电路板为硬性 PCB 或柔性 PCB 板。

3. 如权利要求 2 所述的一种触控显示设备，其特征在于：所述控制模组与所述印刷电路板电连接，且所述控制模组固定在所述小电路板上对应所述液晶显示器的一侧或另一侧。

4. 如权利要求 2 所述的一种触控显示设备，其特征在于：所述控制模组设置在所述底壳上，所述控制模组与所述印剧电路板之间连接有¾于传输电源、数据的软排线。

5. 如权利要求 1 所述的一种触控显示设备，其特征在于：所述印刷电路板包括四块或四块以上环设在所述液晶显示器四周的小电路板，各个小电路板之间首尾固定连接在一起，所述印刷电路板为硬性 PCB 或柔性 PCB 板，所述控制模组设置在所述底壳上，所述控制模组与构成所述印刷电路板的各个小电路板之间连接有用于传输电源、数据的软排线。

6. 如权利要求 2 或 3、4、5 中任意一项所述的一种触控显示设备，其特征在于：所述外壳体包括面壳以及底壳，所述平板显示部件以及感应信号收发模块均设置在所述底壳中，所述面壳为一与所述底壳大小匹配的四方形的框体，四方框形的所述面壳盖设在所述底壳上，所述液晶显示器的显示面对应在四方形框体围绕成的方框内，所述感应信号收发模块收设在所述面壳与所述底壳之间，所述面壳与所述底壳上相对应的设置有卡槽，与所述液晶显示器垂直的所述印刷电路板卡设在所述卡槽中，借助所述卡槽对所述印剧电路板进行固定。

7. 如权利要求 1 所述的一种触控显示设备，其特征在于：所述感应信号收发对管为红外收发对管，且所述红外收发对管包括红外线发射管以及红外线接收管，所述红外线发射管为贴片红外 LED 。

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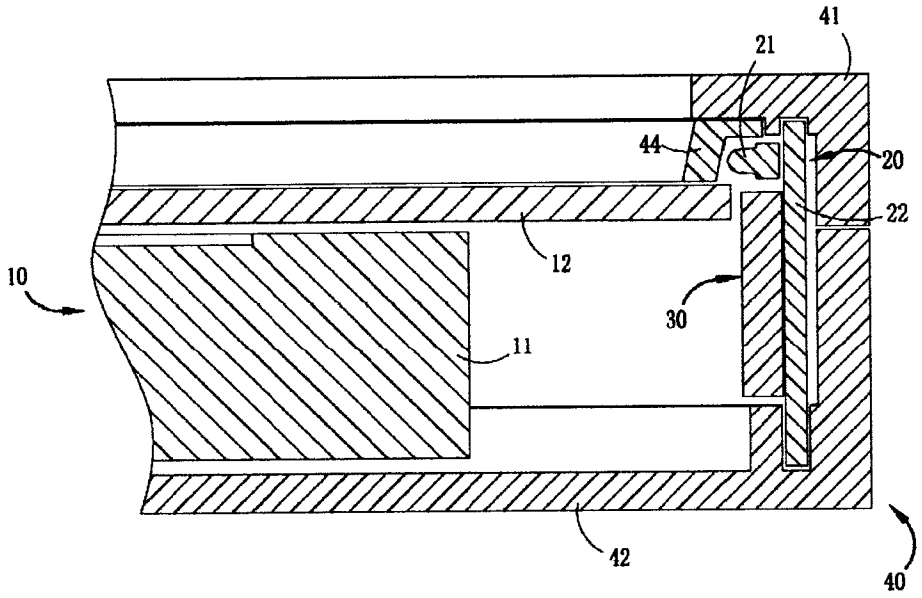
8，如权利要求 1 所述的一种触控显示设备，其特征在于：所述面壳与所述液晶显示器的显示面之间预留有出光间隙，所述红外收发对管的红外线发射管以及红外线接收管相对应设置在所述出光间隙中。

9，如权利要求 8 所述的一种触控显示设备，其特征在于：所述面壳与所述液晶显示器之间的出光间隙中设置有滤光条，所述滤光条位于所述红外收发对管的红外线发射管以及红外线接收管前侧。

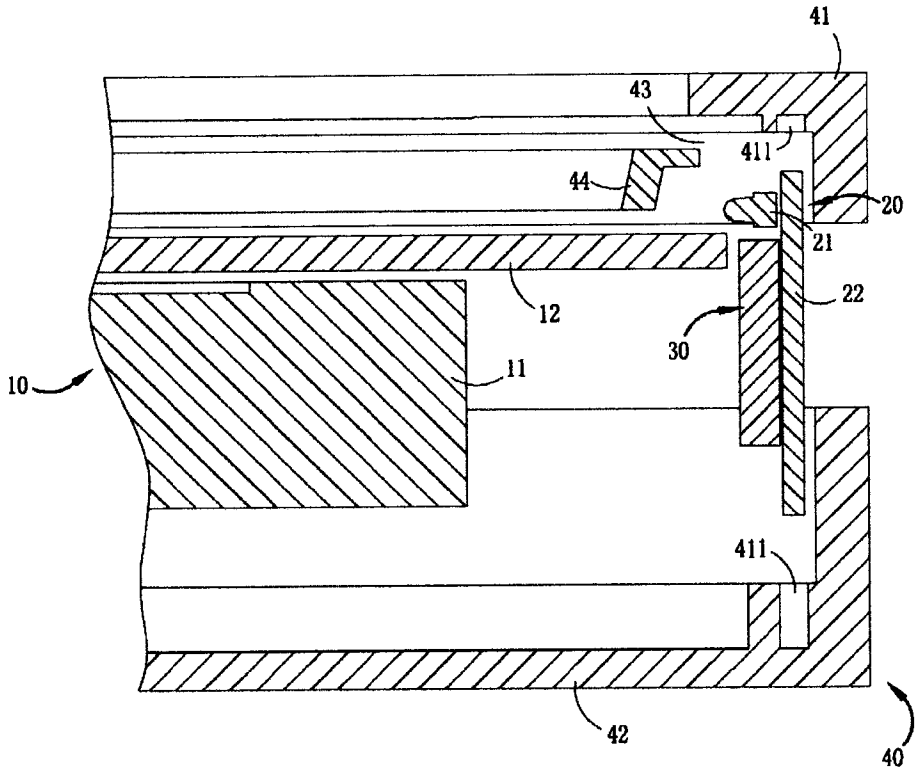
10，如权利要求 9 所述的一种触控显示设备，其特征在于：所述平板显示部件还包括触摸面板，所述触摸面板盖设在所述液晶显示器的显示面一侧，所述触摸面板采用透明的钢化玻璃板制成。

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说 明 书 附 图



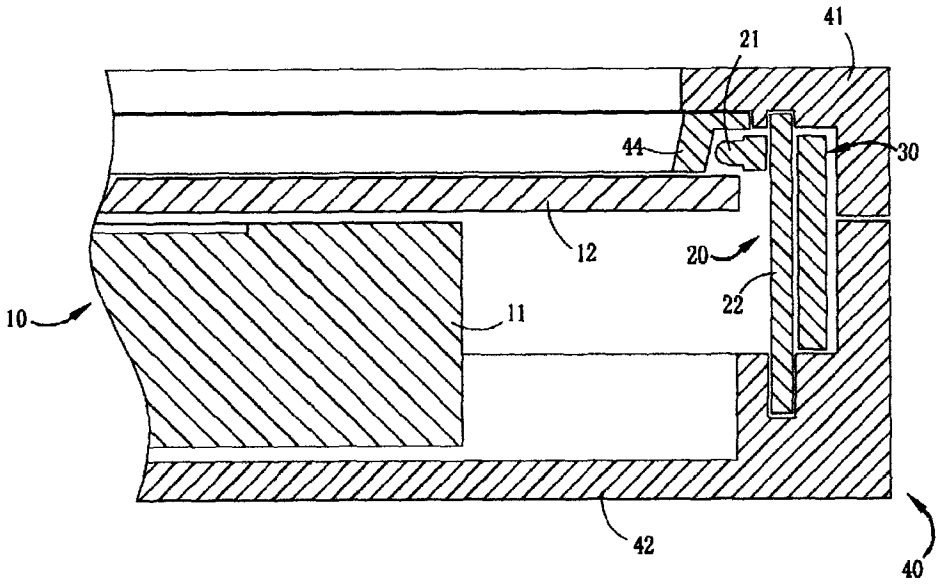
【图号】图1



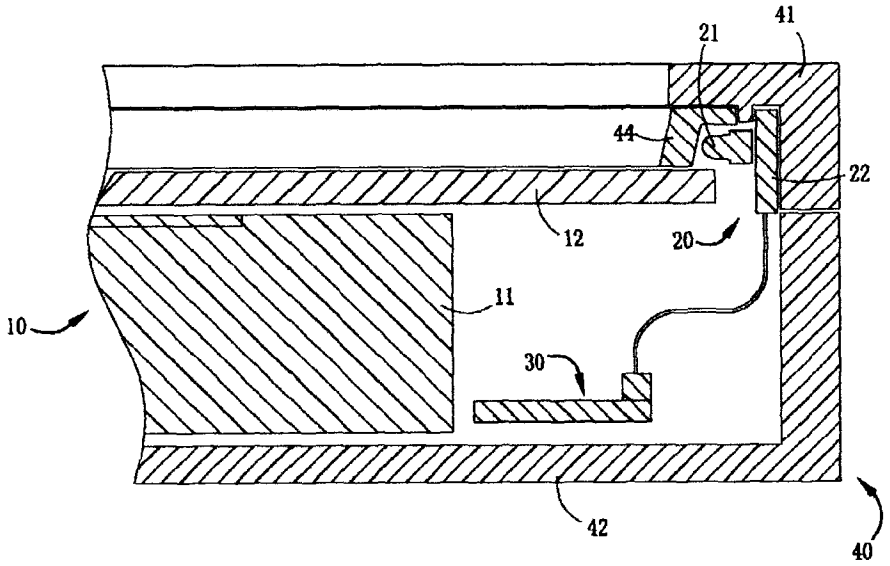
【图号】图2

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说 明 书 附 图



【图号】图3



【图号】图4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2012/080153

A. CLASSIFICATION OF SUBJECT MATTER

G06F 3/042 (2006.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: G06F 3/-

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CPRS, CNKI, WPI, EPODOC: up and down, left and right, display, shell, infrared, touch, receive, transmit, up, down, left, right, front., back, PCB, circuit board, right angle, perpendicular, vertical+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 201917889 U (ZHEJIANG RUNZHI ELECTRONIC TECHNOLOGY CO., LTD.), 03 August 201 1 (03.08.2011), abstract, description, paragraphs 0029 and 0071-0073, and figure 1	1-10
A	CN 2731587 Y (IRTOUCH SYSTEMS CO., LTD.), 05 October 2005 (05.10.2005), the whole document	1-10
A	CN 2731588 Y (IRTOUCH SYSTEMS CO., LTD.), 05 October 2005 (05.10.2005), the whole document	1-10

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search
25 January 2013 (25.01.2013)

Date of mailing of the international search report
07 February 2013 (07.02.2013)

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2012/080153

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN 201917889 U	03.08.2011	None	
CN 2731587 Y	05.10.2005	None	
CN 2731588 Y	05.10.2005	None	

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国际检索报告

国际申请号
PCT/CN2012/080153

A．主题的分类

G06F3/042 （2006.01 ） i

按照国际专利分类(IPC) 或者同时按照国家分类和 IPC 两种分类

B．检索领域

检索的最低限度文献(标明分类系统和分类号)

IPC: G06F3/-

包含在检索领域中的除最低限度文献以外的检索文献

在国际检索时查阅的电子数据库(数据库的名称 ，和使用的检索词 (如使用))

CPRS,CNKI,WPI,EPODOC: 红外,触,收,发,上下,左右,显示,壳,电路板,垂直,infrared, touch, receive, transmit, up, down, left, right, front, back, PCB, circuit board, right angle, perpendicular, vertical+

C．相关文件

类 型*	引用文件，必要时，指明相关段落	相关的权利要求
X	CN201917889U (浙江润智电子科技有限公司)03.8 月 2011 (03.08.201 1) 摘要，说明书 0029 、00714)073 段，附图 1	1-10
A	CN273 1587Y (北京汇冠新技术有限公司)05. 10 月 2005(05. 10.2005) 全文	1-10
A	CN273 1588Y (北京汇冠新技术有限公司)05. 10 月 2005(05. 10.2005) 全文	1-10

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"&" 同族专利的文件

国际检索实际完成的日期	国际检索报告邮寄日期
25. 1 月 2013(25.01.2013)	07.2 月 2013 (07.02.2013)
ISA/CN 的名称和邮寄地址： 中华人民共和国国家知识产权局 中国北京市海淀区蓟门桥西土城路 6 号 100088 传真号： (86-10)62019451	受权官员 刘清泉 电话号码： (86-10) 62411760

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国际检索报告

关于同族专利的信息

国际申请号
PCT/CN2012/080153

检索报告中引用的专利文件	公布日期	同族专利	公布日期
CN201917889U	03.08.201 1	无	
CN273 1587Y	05. 10.2005	无	
CN273 1588Y	05. 10.2005	无	

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Patents WO2013/159472

Touch control display device

Abstract

A touch control display device, comprising a panel display unit, an induction signal receiving and transmitting module, a control module, and a housing; the induction signal receiving and transmitting module is annularly disposed around the panel display unit; the panel display unit, the induction signal receiving and transmitting module, and the control module are all encapsulated in the housing; the panel display unit comprises a liquid crystal display; the induction signal receiving and transmitting module comprises a plurality of induction signal receiving and transmitting geminate transistors and a printed circuit board; the plurality of induction signal receiving and transmitting geminate transistors are all electrically connected to the printed circuit board; each induction signal receiving and transmitting geminate transistor comprises an induction signal transmitting transistor and an induction signal receiving transistor; the printed circuit board is annularly disposed around the liquid crystal display, and is perpendicular to the panel of the liquid crystal display, and the induction signal receiving and transmitting geminate transistors electrically connected to the printed circuit board are disposed on the front side of the display surface of the liquid crystal display.

Classifications

» G06F3/045 Digitisers, e.g. for touch screens or touch pads, characterised by the transducing means by electromagnetic means

WO2013159472A1

WIPO (PCT)

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Other languages: French, Chinese

Inventor: 陈伟山

Worldwide applications

2012 CN WO

Application PCT/CN2012/080153 events

2012-04-27 Priority to CN201210127420.7A

2012-04-27 Priority to CN201210127420.7

2012-08-15 Application filed by 深圳市天时通科技有限公司

2013-10-31 Publication of WO2013159472A1

Info: Patent citations (4), Cited by (6), Legal events, Similar documents, Priority and Related Applications

External links: Espacenet, Global Dossier, PatentScope, Discuss

Claims

Hide Dependent

Claims

A touch display device includes a flat panel display component, a sensing signal transceiver module, a control module, and an outer casing, wherein the sensing signal transceiver module is disposed around the flat panel display component, and the flat panel display component The sensing signal transceiver module and the control module are all packaged in the outer casing, the flat panel display component comprises a liquid crystal display, and the sensing signal transceiver module comprises a plurality of sensing signal transceiver tubes and a printed circuit board, and the plurality of sensing signals The transceiver pair is electrically connected to the printed circuit board, and the sensing signal transceiver tube comprises an inductive signal transmitting tube and an inductive signal receiving tube, wherein: the printed circuit board ring is disposed around the liquid crystal display, Ji The printed circuit board is perpendicular to the liquid crystal display panel, and a sensing signal transceiver tube electrically connected to the printed circuit board is disposed on a front side of the display of the liquid crystal display, and the sensing signal transmitting tube and the sensing The signal receiving tubes are respectively disposed corresponding to the left and right sides of the liquid crystal display And upper and lower sides, one thousand if the sensing signal transmitted ray tube is formed in front side of the detection signal displaying the liquid crystal display of a sensing signal detection network.

2. The touch display device according to claim 1, wherein: the printed circuit board comprises four or more small circuit boards disposed around the liquid crystal display, and each small circuit board The first and last fixed electrical connections are made together, and the printed circuit board is a rigid PCB or a flexible PCB board.

3. The touch display device according to claim 2, wherein: the control module is electrically connected to the printed circuit board, and the control module is fixed on the small circuit board. One side or the other side of the liquid crystal display.

4. The touch display device according to claim 2, wherein: the control module is disposed on the bottom case, and the control module is connected to the printed circuit board ¾ in the transmission of power, data soft # line.

5. The touch display device according to claim 1, wherein: the printed circuit board comprises four or more small circuit boards disposed around the liquid crystal display, and each small circuit board The first and last ends are fixedly connected together, the printed circuit board is a rigid PCB or a flexible PCB board, the control module is disposed on the bottom case, and the control module and each small circuit board constituting the printed circuit board A soft cable for transmitting power and data is connected between them.

The touch display device according to any one of claims 2 to 3, wherein the outer casing comprises a surface shell and a bottom shell, and the flat panel display component and the sensing signal are transmitted and received. The module is disposed in the bottom case, wherein the face shell is a square frame matching the size of the bottom case, and the face plate of the four-box shape is disposed on the bottom case, the liquid crystal The display surface of the display corresponds to a square surrounded by a square frame, and the sensing signal transceiver module is disposed between the face shell and the bottom case, and the face shell and the bottom case are opposite Correspondingly, a card slot is disposed, and the printed circuit board perpendicular to the liquid crystal display is locked in the card slot, and the printed circuit board is fixed by the card slot.

7. The touch display device as claimed in claim 1, wherein: the sensing signal transceiver tube is an infrared transceiver tube, and the infrared transceiver tube comprises an infrared transmitting tube and an infrared receiving tube. The infrared emitting tube is a patch infrared LED.

Claims

8. The touch display device according to claim „ wherein: a light gap is reserved between the face shell and a display surface of the liquid crystal display, and the infrared light is sent to and received from the tube. The launch tube and the red line receiving tube are correspondingly disposed in the light exit gap.

The touch display device of claim 8 , wherein: a light filter strip is disposed in the light exit gap between the face shell and the liquid crystal display, and the filter strip is located in the infrared The infrared transmitting tube of the transmitting and receiving tube and the front side of the infrared receiving tube are provided.

The touch display device of claim 9, wherein the flat panel display component further comprises a touch panel, the touch panel is disposed on a side of the display surface of the liquid crystal display, and the touch The panels are made of transparent tempered glass panels.

Description

Touch display device

[0001] The present invention relates to the field of display touch, and more particularly to a touch display device.

Background technique

[0002] For the convenience of operation, when people use a touch screen instead of a mouse or a keyboard to work, we must first touch the touch screen mounted on the front end of the display with a finger or other object, and then the system locates the selection information according to the icon or menu position touched by the finger. The input touch screen is composed of a touch detection component and a touch screen controller, the touch detection component is installed in front of the display screen for detecting the touch position of the ¾ households, and accepting the touch screen controller, and the main function of the touch screen controller is ¾ is from the touch point The detecting device receives the touch information, converts it into contact coordinates, and sends it to the CPU, which can simultaneously receive and execute the command sent by the CPU.

[0003] For the digital products using the touch screen technology described above, the main advantage is that the functions of the control keyboard and the display screen are combined to make the display screen have the function of the keyboard at the same time. The technology of the touch screen can not only be as effective as possible within an effective area. The area of the display is increased, and the appearance effect of the overall digital product is greatly improved. Through the above-mentioned touch screen technology, it is possible to increase the size of the display screen as much as possible without increasing the overall volume of the digital product, and it is possible to play television and animated video through the digital product having the touch screen. In the current touch screens on the market, the infrared touch screen occupies a certain share. The two patent products disclosed in Patent No. 200720052423.3 and Patent No. 200720051069.2 are common infrared touch display devices, which mainly include a flat panel display. a component (including a liquid crystal display), four printed circuit boards and an outer frame around which the infrared emitting tube and the infrared receiving tube are welded around the flat display member, wherein the red and white emitting tubes and the infrared receiving tube are disposed On the front side of the display of the flat display unit, and the infrared emitting tube and the infrared receiving tube are respectively disposed on the left and right sides and the upper and lower sides of the flat display member, so that the front side of the display of the flat display member is formed. An infrared grating detection network. When the user touches a point on the display surface of the flat display member with a finger or other object, the two infrared rays passing through the position are blocked, so that the infrared receiving tube cannot receive the infrared emitting tube corresponding thereto. Infrared, the control system of the infrared touch display device can instantly calculate the position of the contact, and then run the corresponding program according to the command corresponding to the contact position, thereby realizing the touch operation on the flat display part.

[0004] The printed circuit board in the infrared touch display device of such a structure as described above is disposed in parallel with the flat display member, and has a series of defects in its structure, and is specifically described as T.

First, since a printed circuit board for connecting the infrared emitting tube and the infrared receiving tube is embedded around the flat display member, and the printed circuit board is disposed in the same plane as the flat display member, the flat panel is packaged Part of the When the frame is used, the outer frame needs to package the printed circuit board, so that the outer frame size of the flat display component is correspondingly larger, and the infrared touch display device is very thick;

Secondly, in order to make the infrared light emitted and received by the infrared emitting tube and the infrared receiving tube parallel to the flat display unit, the infrared emitting tube and the infrared receiving tube need to be bent and then soldered to the printed circuit board, or first Soldering is mounted on the printed circuit board and then bending the chest. This not only complicates the process, but also increases the manufacturing cost. The infrared emission tube and the infrared receiving tube may affect the life and stability of the infrared receiving tube after bending.

[0005] With the continuous development of the society, liquid crystal displays are currently developing in an ultra-thin and ultra-narrow direction. According to the conventional infrared touch screen, a frame is generally required to be twenty millimeters wide, which is mainly limited to the connection of the above infrared rays. The arrangement width of the printed circuit board of the transmitting tube and the infrared receiving tube. As a result, many ultra-thin, ultra-narrow displays make it difficult to make ¾ infrared touch technology. The above is the main technical defect of the conventional infrared touch display device in the specific implementation, which is the main problem to be solved by the present invention.

Summary of the invention

[0006] An object of the present invention is to provide a touch display device, which is a product of the same nature as a conventional touch display device, and the main technical problem to be solved is that the conventional touch display device is limited to The width of the printed circuit board used to connect the inductive signal transmitting tube and the inductive signal receiving tube requires the outer frame of the corresponding width, so that the outer frame generally needs to be twenty millimeters wide, thus causing many ultra-thin, ultra-narrow displays. It is difficult to implement touch technology by using an inductive signal transceiving method. The above is the main technical problem to be solved by the present invention.

[0007] In order to solve the above technical problem, the technical solution adopted by the present invention is: The present invention provides a touch display device, which includes a flat panel display component, a sensing signal transceiver module, a control module, and an outer casing, wherein the sensing The signal transceiver module is disposed around the flat panel display component, and the flat panel display component, the sensing signal transceiver module, and the control module are all encapsulated in the outer casing. The flat panel display component includes a liquid crystal display, and the sensing signal is The transceiver module includes a plurality of sensing signal transceiver tubes and a printed circuit board, and the plurality of sensing signal transceiver tubes are electrically connected to the printed circuit board, and the sensing signal transceiver tube includes an inductive signal transmitting tube and an inductive signal receiving tube. The printed circuit board is disposed around the liquid crystal display, and the printed circuit board is perpendicular to the liquid crystal display panel, wherein: the sensing signal transceiver tube electrically connected to the printed circuit board is disposed at Displaying the front side of the liquid crystal display, ü the sensing signal transmitting tube and The sensing signal receiving tubes are respectively disposed on the left and right sides and the upper and lower sides of the liquid crystal display, and if the sensing signal emitted by the sensing signal tube is formed on the front side of the liquid crystal display, an induction is formed. Signal detection network.

[0008] Preferably, the printed circuit board includes four or more small circuit boards disposed around the liquid crystal display, and each of the small circuit boards is electrically connected end to end, and the printed circuit board is electrically connected. Hard PCB or flexible PCB board.

[0009] Preferably, the control module is electrically connected to the printed circuit board, and the control module is fixed on one side or the other side of the small circuit board corresponding to the liquid crystal display.

[0010] Preferably, the control module is disposed on the bottom casing, and a soft cable for transmitting power and data is connected between the control module and the printed circuit board.

[0011] Preferably, the printed circuit board comprises four or more small circuit boards disposed around the liquid crystal display, and the small circuit boards are fixedly connected end to end, and the printed circuit board is rigid. The PCB or the flexible PCB board is disposed on the bottom case, and the control module and the small circuit boards constituting the printed circuit board are connected with a flexible cable for transmitting power and data.

[0012] Preferably, the outer casing includes a surface shell and a bottom shell, and the flat panel display component and the sensing signal transceiver module are disposed in the bottom casing, and the face shell is matched with the size of the bottom casing. a four-square frame, the four-square-shaped cover is disposed on the bottom case, and the display surface of the liquid crystal display corresponds to a square surrounded by a square frame, the sensing signal transceiver module Between the face shell and the bottom case, the face shell is provided with a card slot corresponding to the bottom case, and the printed circuit board perpendicular to the liquid crystal display is clamped in the in the card slot, the printed circuit board is fixed by the card slot.

[0013] Preferably, the sensing signal transceiver tube is an infrared transceiver tube, and the infrared transceiver tube includes an infrared line tube and an infrared receiving tube, and the infrared emitting tube is a patch infrared LED.

[0014] Preferably, a light exit gap is reserved between the face shell and the display surface of the liquid crystal display, and the infrared emitting tube and the infrared receiving tube of the infrared receiving tube are disposed in the light exiting gap.

[0015] Preferably, a light filter strip is disposed in the light exit gap between the surface shell and the liquid crystal display, and the filter strip is located on the front side of the infrared light emitting tube and the infrared receiving tube of the infrared transceiver tube.

[0016] Preferably, the flat panel display component further includes a touch panel, the touch panel is disposed on a display surface side of the liquid crystal display, and the touch panel is made of a transparent tempered glass panel.

[0017] Compared with the prior art, the technical effect of the application of the present invention is: The present invention provides a touch display device, which encapsulates the flat display component and the sensing signal transceiver module in the outer casing Because the printed circuit board is perpendicular to the liquid crystal display, the frame-shaped frame of the square frame only needs to be able to cover the sensing signal transceiver tube and the printed circuit board whose board surface is perpendicular to the frame. Therefore, the width of the face shell can be greatly reduced, and the frame of the touch display device can be further narrowed. The width of the frame can be reduced to 3,6 mm by using the solution of the invention; The circuit board is perpendicular to the liquid crystal display, and the sensing signal transceiver tube is parallel to the liquid crystal display. Therefore, when the sensing signal transceiver tube is soldered to the printed circuit board ff1, there is no need to bend Footwork In order to reduce the manufacturing process, the manufacturing cost is also saved, and the pins of the sensing signal transceiver are not bent, and the service life is longer and the stability is better.

DRAWINGS

1 is a partial cross-sectional view showing a preferred embodiment of the present invention.

2 is a partial cross-sectional exploded view of a preferred embodiment of the present invention.

3 is a partial cross-sectional view showing another embodiment of the present invention.

4 is a partial cross-sectional view showing a first preferred embodiment of the present invention.

detailed description

[0022] A touch display device according to the present invention will be described in more detail below with reference to FIGS. 1 to 4 and preferred embodiments.

As shown in FIG. 1 , the present invention provides a touch display device, which includes a flat panel display component 10, a sensing signal transceiver module 20, a control module 30, and a housing 40, wherein the sensing signal is transmitted and received. The module 20 is disposed around the flat panel display unit 10, and the flat panel display component 10, the sensing signal transceiver module 20, and the control module 30 are all packaged in the outer casing 40;

The flat panel display unit 10 includes a liquid crystal display 11;

The sensing signal transceiver module 20 includes a plurality of sensing signal transceiver tubes 21 and a printed circuit board 22, and a plurality of the sensing signal transceiver tubes 21 are electrically connected to the printed circuit board 22, and the sensing signal transceiver tube 21 is including an inductive signal transmitting tube and an inductive signal receiving tube;

The printed circuit board 22 is disposed around the liquid crystal display 11, and the printed circuit board 22 is perpendicular to the panel of the liquid crystal display 11;

An inductive signal transceiving pair 21 electrically connected to the printed circuit board 22 is disposed on a front side of the display of the liquid crystal display 11, and the sensing signal transmitting tube and the sensing signal receiving tube respectively are disposed at a position The sensing signals emitted by the plurality of sensing signal tubes form an inductive signal detecting network on the display side of the liquid crystal display 11 on the left and right sides and the upper and lower sides of the liquid crystal display II;

The control module 30 is electrically connected to the printed circuit board 22, and the control module 30 controls the operation of the liquid crystal display 11 and the sensing signal transceiver pair 21;

The outer casing 40 includes a face shell 41 and a bottom case 42. The flat panel display unit 10 and the inductive signal transceiver module 20 are disposed in the bottom case 42. The face shell 41 is a size of the bottom case 42. a matching square frame, the square frame 4 is covered on the bottom case 42, and the display surface of the liquid crystal display 11 corresponds to a square surrounded by a square frame. The sensing signal transceiver module 20 is disposed between the face shell 41 and the bottom case 42. [0024] In the specific implementation, when the flat panel display component 10 and the sensing signal transceiver module 20 are packaged in the outer casing 40, since the printed circuit board 22 is perpendicular to the liquid crystal display 11, four squares The frame 41 of the shape of the face can only accommodate the length of the sensing signal transmitting and receiving tube 21 and the printed circuit board 22 perpendicular thereto, and the width of the face 41 can be greatly reduced, further realizing The frame of the touch display device is ultra-narrow, and the width of the frame can be reduced to 3.6 mm by using the solution

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of the invention, which occupies less space of the surface frame of the existing display device, and changes the process structure to make the touch and display smaller. The overall integrity is stronger; and Ji is perpendicular to the liquid crystal display 11 because the printed circuit board 22 is perpendicular to the liquid crystal display 11, and the sensing signal transceiver tube 21 is parallel to the liquid crystal display 11, so that when the sensing signal is transmitted and received to the tube When the lead of 21 is soldered on the printed circuit board 22, the bending process is not required, the manufacturing process is reduced, and the manufacturing cost is also saved, and the sensing letter is saved. Transceiver 21 of pin header is not any bending that causes] % longer life, better stability.

[0025] Preferred embodiment: As shown in FIG. 1, 2, and 3, the printed circuit board 22 is a rigid PCB or a flexible PCB board, and the printed circuit board 22 includes four or more rings. A small circuit board around the liquid crystal display 11, each of the small circuit boards is electrically connected together end to end, and the control module 30 is fixedly connected to the small circuit board by fixing the control module 30 to the small circuit. The internal structure of the present invention is made more compact on the board, and the control module 30 is fixed on one side or the other side of the small circuit board corresponding to the liquid crystal display 11.

[0026] Preferred embodiment: As shown in FIG. 4, the printed circuit board 22 includes four or more small circuit boards disposed around the liquid crystal display 1, and each of the small circuit boards is fixed between the first and the last. The control module 30 is disposed on the bottom case 42. The control module 30 and the printed circuit board 22 are connected with a flexible cable for transmitting power and data. The control module 30 is connected to the sensing signal transceiver module 20, and the control module 30 controls the normal operation of the sensing signal transceiver module 20, and the connection mode of the flexible cable can be conveniently used. The disassembly and replacement of the control module 30 will be described.

[0027] Preferred embodiment: As shown in FIG. 4, the printed circuit board 22 is a rigid PCB or a flexible PCB board, and the printed circuit board 22 includes four or more rings disposed around the liquid crystal display 11. a small circuit board, each small circuit board is fixedly connected end to end, the control module 30 is disposed on the bottom case 42, and the control module 30 and each small circuit constituting the printed circuit board 22 A flexible cable for transmitting power and data is connected between the boards, and the control module 30 is electrically connected to the small circuit boards by means of a flexible cable, so that the control module 30 can be facilitated. The replacement and repair of each small circuit board prevents the entire sensing signal transceiver module 20 from being affected by the damage of the tube 21 due to the transmission of a very small number of sensing signals.

[0028] Preferred embodiment: As shown in FIG. 2, the face shell 4] is provided with a card slot 411 corresponding to the bottom case 42, and the printed circuit board 22 perpendicular to the liquid crystal display 11 a card is disposed in the card slot 411 by means of the card slot 411 The print circuit board 22 is fixed.

[0029] The preferred embodiment: the sensing signal transceiver tube 21 is an infrared transceiver tube, and the red transceiver tube includes an infrared emitting tube and an infrared receiving tube, and the infrared emitting tube is a patch infrared LED .

[0030] Preferred embodiment: as shown in FIG. 2, a light-emitting gap 43 is reserved between the face shell 41 and the display surface of the liquid crystal display 11, and the infrared transmitting and receiving tube of the infrared transmitting and receiving tube and the infrared receiving The tube is correspondingly disposed in the light exit gap 43.

[0031] Preferred embodiment: As shown in FIG. 1, 2, 3, and 4, a filter strip 44 is disposed in the light exit gap 43 between the face shell 41 and the liquid crystal display 11, and the filter strip is disposed. 44 is located on the front side of the infrared transmitting tube and the infrared receiving tube of the infrared transceiver tube, and uses the filter strip 44 to filter out external light, so that the infrared emitting tube and the infrared receiving tube can selectively send and receive externally Light.

[0032] Preferred embodiment: As shown in FIG. 1, 2, 3, and 4, the flat panel display unit 10 further includes a touch panel 12, and the touch panel 12 is disposed on a display surface side of the liquid crystal display 11. The touch panel 12 is made of a transparent tempered glass plate, and the touch panel 2 made of a transparent tempered glass plate provides protection against external force to the liquid crystal display 11 located at the display window 411.

[0033] In summary, the technical solution of the present invention can fully and effectively accomplish the above object, and the structural principle and functional principle of the present invention have been fully verified in the embodiment, and the expected effect and purpose can be achieved. The embodiments of the present invention can also be modified according to these principles, and therefore, the present invention includes all alternatives within the scope of the claims. Any equivalent changes made within the scope of the patent application of the present invention are within the scope of the patent application of the present application.

Patent Citations (4)

Publication number	Priority date	Publication date	Assignee	Title
CN2731587Y *	2004-06-25	2005-10-05	北京汇冠新技术有限公司	Novel infrared touch panel
CN2731588Y *	2004-06-25	2005-10-05	北京汇冠新技术有限公司	Novel infrared touch panel
CN201917889U *	2010-12-26	2011-08-03	浙江润智电子科技有限公司	Side frame structure member of infrared touch display device
Family To Family Citations				
CN202661975U *	2012-04-27	2013-01-09	深圳市天时通科技有限公司	Touch control displaying device

* Cited by examiner, † Cited by third party

Cited By (6)

Publication number	Priority date	Publication date	Assignee	Title
Family To Family Citations				
CN203012682U *	2012-11-30	2013-06-19	北京汇冠新技术股份有限公司	Infrared touch screen

CN103123556A *	2013-03-01	2013-05-29	深圳市天时通科技有限公司	Projection type touch-control electronic whiteboard and frame structure thereof
CN104699326A *	2013-12-06	2015-06-10	深圳市天时通科技有限公司	Novel infrared touch control screen and touch control display device
CN104657005A *	2015-03-24	2015-05-27	北京朔云科技有限公司	Infrared touch frame and infrared touch display screen
CN104867415A *	2015-05-30	2015-08-26	中山市晶艺光电科技有限公司	Shell with touch induction structure and LED digital displayer
CN108259676A *	2018-02-08	2018-07-06	上海摩软通讯技术有限公司	Terminal device and photosensitive control method

* Cited by examiner, † Cited by third party, ‡ Family to family citation

Similar Documents

Publication	Publication Date	Title
US10025411B2	2018-07-17	Touch screen and pressure touch detection method thereof
CN105278788B	2019-03-19	Touch input device
JP2017010542A	2017-01-12	Electrode sheet for detecting pressure and pressure detection module having the same
JP5864741B2	2016-02-17	Touch sensitive display
US20160018922A1	2016-01-21	in-cell touch panel and display device
US9578148B2	2017-02-21	Smartphone capable of detecting touch position and pressure
JP5370944B2	2013-12-18	Touch panel and manufacturing method thereof
JP2018067323A	2018-04-26	Touch input device
CN102133442B	2014-10-22	Display device including optical sensing frame and method of sensing touch
US8139046B2	2012-03-20	Touch screen using infrared camera hardly affected by external disturbance light
CN102053766B	2013-09-11	Electrostatic capacitance-type input device, method of manufacturing electrostatic capacitance-type input device, and electro-optical apparatus provided with input function
JP6510638B2	2019-05-08	Mobile device display module and mobile device
JP5306059B2	2013-10-02	Touch panel, display panel, touch panel substrate, display panel substrate, and display device
US20140111953A1	2014-04-24	Electronic Devices With Components Mounted to Touch Sensor Substrates
KR101837714B1	2018-03-13	Display device
KR100737290B1	2007-07-09	Touch screen panel and manufacturing method thereof
US20120032917A1	2012-02-09	Touch panel, touch panel manufacturing method, and electronic apparatus
US8179383B2	2012-05-15	Touch screen
US20170300142A1	2017-10-19	Display Screen Assembly, Terminal Front Cover, and Terminal
US20070171326A1	2007-07-26	Electro-optical device and electronic equipment
US20100208958A1	2010-08-19	Illuminated Fingerprint Sensor and Method
TWI489336B	2015-06-21	Touch panel and touch display module thereof
JP2006155616A	2006-06-15	Touch input system using light guide
US20200065551A1	2020-02-27	Optical fingerprint recognition assembly, display device, and terminal
TWI494819B	2015-08-01	Touch panel assembly and electronic device

Priority And Related Applications

Priority Applications (2)

Application	Priority date	Filing date	Title
CN201210127420.7A	2012-04-27	2012-04-27	Touch display device
CN201210127420.7		2012-04-27	

Legal Events

Date	Code	Title	Description
2013-12-25	121	Ep: the epo has been informed by wipo that ep was designated in this application	**Ref document number:** 12875319 **Country of ref document:** EP **Kind code of ref document:** A1
2014-10-27	NENP	Non-entry into the national phase in:	**Ref country code:** DE
2015-05-27	122	Ep: pct app. not ent. europ. phase	**Ref document number:** 12875319 **Country of ref document:** EP **Kind code of ref document:** A1
2015-10-21	32PN	Ep: public notification in the ep bulletin as address of the adressee cannot be established	**Free format text:** NOTING OF LOSS OF RIGHTS PURSUANT TO RULE 112(1) EPC (EPO FORM 1205N DATED 11/06/2015)
2015-10-28	122	Ep: pct app. not ent. europ. phase	**Ref document number:** 12875319 **Country of ref document:** EP **Kind code of ref document:** A1

Concepts

machine-extracted

Download Filter table

Name	Image	Sections	Count	Query match
liquid crystal related substances		claims,abstract,description	58	0
inductive effects		claims,abstract,description	23	0
shell materials		claims,description	21	0
corresponding		claims,description	9	0
toughened glasses		claims,description	4	0

Show all concepts from the description section

Data provided by IFI CLAIMS Patent Services

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
14 June 2018 (14.06.2018)

WIPO | PCT

(10) International Publication Number
WO 2018/106176 A1

(51) International Patent Classification:
G06F 1/16 (2006.01) *G06F 3/03* (2006.01)
G06F 3/01 (2006.01) *G06F 3/041* (2006.01)

(21) International Application Number:
PCT/SE2017/051233

(22) International Filing Date:
07 December 2017 (07.12.2017)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
1630294-5 07 December 2016 (07.12.2016) SE

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(54) Title: AN IMPROVED TOUCH DEVICE

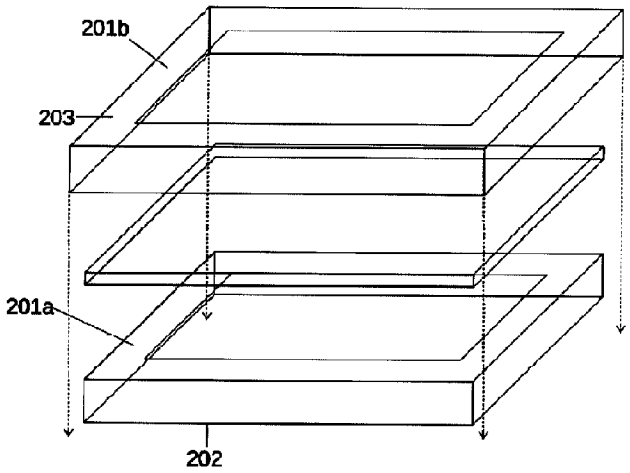


Figure 5b

(57) Abstract: An assembly for holding and controlling curvature of a glass plate for an optical touch sensitive system is described. The assembly comprising a first frame element extending in a first plane and configured to extend at least partially around a panel; at least one second frame element extending in a second plane and forming a support portion for the plate, and at least one spacing element positioned at least partially between the support portion and the first frame element. The spacing element us configured to control a curvature of the first frame element and wherein the at least one second frame element is configured to engage the plate at the support portion, is attached to the first frame element, and is tiltable, by controlling the curvature of the first frame element with said spacing element, to control a curvature of the plate.

WO 2018/106176 A1

[Continued on next page]

(84) **Designated States** *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*
— *with amended claims (Art. 19(1))*
— *in black and white; the international application as filed contained color or greyscale and is available for download from PATENTSCOPE*

AN IMPROVED TOUCH DEVICE

Field of the Invention

This invention relates in general to the field of optical touch sensitive systems. More particularly, the invention relates to a curved plate and an assembly for holding a plate of the system, such as a glass plate, relative to a panel such that curvature of the plate is controlled. The invention also relates to a method for assembling a plate of an optical touch sensitive system with a panel (such as a display panel) in such a way that curvature is controlled.

Background of the Invention

In one category of touch sensitive panels known as above surface optical touch systems and known from e.g. US4459476, a plurality of optical emitters and optical receivers are arranged around the periphery of a touch surface to create a grid of intersecting light paths above the touch surface. Each light path extends between a respective emitter/receiver pair. An object that touches the touch surface will block certain ones of the light paths. Based on the identity of the receivers detecting a blocked light path, a processor can determine the location of the intercept between the blocked light paths. This type of system is only capable of reliably detecting the location of one object (single-touch detection). Further, the required number of emitters and receivers, and thus cost and complexity, increases rapidly with increasing surface area and/or spatial resolution of the touch panel.

In a variant, e.g. shown in WO2006/095320, each optical emitter emits a beam of light that diverges across the touch surface, and each beam is detected by more than one optical receiver positioned around the periphery of the touch surface.

These systems typically direct light to travel across the surface of the touch surface at a height of up to 5 mm.

Other above surface touch sensitive systems use tomographic touch imaging for sensing a touch, e.g. as described in WO2016/130074. Such systems allow for directing the light much closer to the touch surface, which in turn allows for significant improvements in accuracy and requires a lower light budget. The light is typically directed at a height of up to about 1 mm above the plate.

Typically, the touch surface is a glass plate. In systems where the light is directed closer to the touch surface, distortions in the plate have a disproportionally large effect on the light signal. Therefore, glass plates as used in previously known above surface optical touch systems are unsuitable when the light is transmitted closer to the plate, since the accuracy of the system is impaired by the distortions in the plate.

Additionally, a frame for assembly of the plate of the optical touch sensitive system and a panel, such as an LCD panel, may introduce distortion in the form of uncontrolled warpage, i.e. a twist or curve in the plate is introduced even if it is usually flat. The uncontrolled warpage may even block the light transmitted across the plate. This is due to uncontrolled twisting of the frame as such when it is attached to the panel.

Although not described in relation to touch systems, methods of minimizing glass warpage are known from the window industry and from the display panel industry. Such solutions include pre-bent glass in order to control warpage. However, such solutions are unsuitable/insufficient for touch sensitive systems since they typically require bulky frames at the border of the glass and/or pressure points closer to the center of the panel where force may be applied to control the shape of the glass. These solutions are unsuitable where a minimal/lightweight border bezel is required, and no supporting objects may touch the glass further in than at the borders. Additionally, pre-bent glass is expensive and fragile to transport.

Therefore, an improved frame assembly for holding a plate of an optical touch sensitive system relative to a panel would be advantageous and in particular allowing for improved precision, increased compactness, cost-effectiveness, and/or controlled curvature would be advantageous. Further, a touch panel having a shape conducive to transmitting as much light from the emitters as possible to the detectors is needed.

Summary of the Invention

Accordingly, embodiments of the present invention preferably seek to mitigate, alleviate or eliminate one or more deficiencies, disadvantages or issues in the art, such as the above-identified, singly or in any combination by providing an assembly, a method for assembling, and a kit of frame elements according to the appended patent claims.

A first embodiment of the invention describes an assembly for holding and controlling curvature of a plate for an optical touch sensitive system, comprising a first frame element extending in a first plane and configured to extend at least partially around a panel; at least one second frame element extending in a second plane and forming a support portion for the plate, and at least one spacing element positioned at least partially between the support portion and the first frame element, the spacing element being configured to control a curvature of the first frame element, and wherein the at least one second frame element is configured to engage the plate at the support portion, is attached to the first frame element, and wherein the shape and/or position of the second frame element is controlled by the curvature of the first frame element with said spacing element, to control a curvature of the plate.

A second embodiment of the invention describes a method for assembling a panel and a plate for an optical touch sensitive system, comprising: providing a first frame element extending in a first plane and configured to extend at least partially around a panel; providing at least one second frame element forming a support portion for the plate; supporting the plate by the support portion; attaching the second frame element to the first frame element such that the support portion extends at least partially in a second plane generally opposite at least a portion of the first frame element and is spaced apart from the first plane; and controlling a curvature of the first frame element with a spacing element attached to the first frame element and thereby tilting the support portion to control a curvature of the plate.

A third embodiment of the invention describes a kit of frame elements for assembling a panel and a plate for a touch sensitive system, comprising: a first frame element extending in a first plane; at least one second frame element forming a support portion for the plate and being attachable to the first frame element, and a spacing element adjustably attachable to the first frame element; wherein at least a portion of the support portion is tiltable, by the spacing element, relative to the first frame element to extend in the second plane, which is curved.

Some embodiments of the invention provide for controlling curvature of a plate for an optical touch sensitive system such that it does not occur when the plate is assembled with a panel. This prevents distortion in the plate from affecting a light signal transmitted across the plate, which in turn allows improvements in accuracy and lower light budget of the system. Additionally, or alternatively, embodiments provide for controlling curvature such that the field of view, for a detector receiving light from a light emitter of the touch sensitive system, is increased compared to a substantially flat plate. Again, the improved field of view provides for improved accuracy of the touch sensitive system and allows for a better light budget. Furthermore, embodiments provide for an assembly that is compact at the same time as curvature may be controlled. Also, the curvature may be controlled without contacting the center of the plate.

A fourth embodiment of the invention describes a touch sensing apparatus, comprising a touch surface; a set of emitters arranged around the touch surface to emit first beams of light to propagate across the touch surface, a set of light detectors arranged around the touch surface to receive light from the first set of emitters, wherein each light detector is arranged to receive light from more than one emitter; a processing element configured to determine, based on output signals of the set of light detectors, the position of an object on the touch surface, wherein the touch surface is curved in a first axis according to a first parabola.

It should be emphasized that the term "comprises/comprising" when used in this specification is taken to specify the presence of stated features, integers, steps or components but does not preclude the presence or addition of one or more other features, integers, steps, components or groups thereof.

Brief Description of the Drawings

These and other aspects, features and advantages of which embodiments of the invention are capable of will be apparent and elucidated from the following description of embodiments of the present invention, reference being made to the accompanying drawings, in which:

Figure 1 is a top view of the first frame element showing cross-sectional axes A-A and B-B;

Figures 2a-2d are cross-sectional views of embodiments of assemblies;

Figure 3a is a schematic illustration showing the cross-section axis B-B of figure 1 of the assembly with the second frame element relative to the first frame element and holding the plate in a flat plane;

Figure 3b is a schematic illustration showing the cross-section axis A-A of figure 1 of the assembly with the second frame element relative to the first frame element and holding the plate in a flat plane;

Figure 3c is a schematic view (cross section) showing the cross-section axis B-B of figure 1 of the assembly with the second frame element warped relative to the first frame element and holding the plate in a curved plane that is concave;

Figure 3d is a schematic view (cross section) showing the cross-section axis A-A of figure 1 of the assembly with the second frame element warped relative to the first frame element and holding the plate in a curved plane that is concave;

Figure 4a is a perspective view of the first frame element;

Figure 4b is a schematic illustration of the panel in a convex shape and the frame of the first frame element in a concave shape, including plate 2 also controlled into a concave shape;

Figure 4c is a side view showing screws 116a and 116b;

Figures 5a-5h are side views and perspective views of an embodiment of the assembly comprising a screw arrangement for configuring frame shape; and

Figures 6 is a schematic cross section from a first direction of an embodiment of the assembly;

Figure 7 is a schematic side-view of another embodiment for providing curvature of plate 2;

Figure 8 shows an isometric view of a variation of the embodiment of figures 5a-5g;

Figure 9 is a diagram showing a top down view of an optical touch system and corresponding detection lines;

Figure 10a shows an isometric view of a flat touch surface of an optical touch system;

Figure 10b shows a section view of an optical touch system with a flat touch surface;

Figure 11a shows an isometric view of a touch surface of an optical touch system having a curved profile in the x-axis;

Figure 11b shows a section view along the x-axis of an optical touch system with a touch surface having a curved profile in the x-axis;

Figure 11c shows a section view along the x-axis of an optical touch system with a touch surface having a curved profile in the x-axis;

Figure 11d shows an example of types of warpage that a touch panel may exhibit.

Figure 12a shows top view of a touch surface of an optical touch system;

Figure 12b shows an isometric view of a touch surface of an optical touch system having a curved profile in the x-axis and a curved profile in the y-axis;

Figure 12c shows a section view along the x-axis of an optical touch system with a touch surface having a curved profile in the x-axis and a curved profile in the y-axis;

Figure 12d shows a section view along the y-axis of an optical touch system with a touch surface having a curved profile in the x-axis and a curved profile in the y-axis;

Figure 13a shows a section render of light emitted from a point at an edge of a curved touch surface and propagating across the curved touch surface to be received at a detector at an opposite edge of the touch surface;

Figure 13b shows a graph of light emitted from a point at an edge of a curved touch surface and received at a detector at an opposite edge of the touch surface with respect to the angle of the emitter light;

Figure 14a shows a section render of light emitted from a point at an edge of a curved touch surface and propagating across the curved touch surface to be received at a detector at an opposite edge of the touch surface;

Figure 14b shows a graph of light emitted from a point at an edge of a curved touch surface and received at a detector at an opposite edge of the touch surface with respect to the angle of the emitter light;

Figure 15a shows a section render of light emitted from a point at an edge of a curved touch surface and propagating across the curved touch surface to be received at a detector at an opposite edge of the touch surface;

Figure 15b shows a graph of light emitted from a point at an edge of a curved touch surface and received at a detector at an opposite edge of the touch surface with respect to the angle of the emitter light;

Figure 16a shows a section render of light emitted from a point at an edge of a curved touch surface and propagating across the curved touch surface to be received at a detector at an opposite edge of the touch surface;

Figure 16b shows a graph of light emitted from a point at an edge of a curved touch surface and received at a detector at an opposite edge of the touch surface with respect to the angle of the emitter light;

Figure 17a shows a section render of light emitted from a point at an edge of a curved touch surface and propagating across the curved touch surface to be received at a detector at an opposite edge of the touch surface;

Figure 17b shows a graph of light emitted from a point at an edge of a curved touch surface and received at a detector at an opposite edge of the touch surface with respect to the angle of the emitter light;

Figure 18a shows a curvature of a real touch surface vs a parabolic curved surface along an x-axis;

Figure 18b shows a deviation between a real touch surface vs a parabolic curved surface along an x-axis;

Figure 19a shows a curvature of a real touch surface vs a parabolic curved surface along an x-axis;

Figure 19b shows a deviation between a real touch surface vs a parabolic curved surface along an x-axis;

Figure 20a shows top view of displacement contours for a touch surface according to an embodiment;

Figure 20b shows curvature of a touch surface along an x-axis according to the embodiment of figure 20a;

Figure 20c shows curvature of a touch surface along a y-axis according to the embodiment of figure 20a;

Figure 20d shows curvature of a touch surface along a diagonal line according to the embodiment of figure 20a;

Figure 21a shows top view of displacement contours for a touch surface according to another embodiment;

Figure 21b shows curvature of a touch surface along an x-axis line according to the embodiment of figure 21a;

Figure 21c shows curvature of a touch surface along a y-axis line according to the embodiment of figure 21a;

Figure 21d shows curvature of a touch surface along a diagonal line according to the embodiment of figure 21a.

Description of Embodiments

Specific embodiments of the invention will now be described with reference to the accompanying drawings. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. The terminology used in the detailed description of the embodiments illustrated in the accompanying drawings is not intended to be limiting of the invention. In the drawings, like numbers refer to like elements.

In optical touch sensitive systems, a plate 2 of the system, such as a glass plate may be arranged opposite a panel 1, such as an LCD panel or additional frame. The plate 2 is normally substantially flat. The perimeter of the plate 2 after integration is a concern: the four sides/edges of the plate 2 must all be plane or slightly concave as seen from the touch surface, i.e. the side of the plate 2 above which light is transmitted. An aspect of this is to ensure that the mechanical parts that hold or support the perimeter of the plate 2 are free from convexity. Sometimes, there are several components that are involved in holding the plate 2 (back cover, carriers, edge cover, screw bosses etc.) The stiffer component of the assembly, the more it will govern the final shape of the plate 2.

In prior art solutions, the frame that holds the plate 2 at the edge/perimeter may introduce some twist (the corners will not lay perfectly on a flat plane) to the plate. Twist may induce convexity along the plate diagonals and should thus be minimized or avoided. The twist tolerance depends, e.g., on glass specification, product, size, shape of integrated glass perimeter, and on how a VESA mount is attached.

Figure 1 shows an embodiment of a frame assembly 100, 200 that prevents inducement of convexity along the plate, such as along the plate edges and/or diagonals. Some embodiments avoid convexity and may even induce concavity to further improve the touch system. Frame 109 is formed from first frame element 102. Attachment element 112 and spacing element 116 are described in the embodiments below.

According to some embodiments of the invention, an assembly 100, 200, which is configured to hold or support the plate 2 and the panel 1, applies a controlled force to the plate 2 such that curvature of the plate 2 is controlled. In the embodiments illustrated in figures 2a-2c and 3a-3d, the force applies a torque to a support portion 101a, 101b for the plate 2. In the embodiments of figures 4a-4c, the force is substantially straight and perpendicular to the plate 2. In the following, the embodiments of figures 2a-2c, 3a-3d, 4a-4c, and 5a-5g will be described separately. However, these embodiments may be combined to provide further embodiments, such as the combination illustrated in figures 6a-6c.

Figures 2a-2d illustrate embodiments wherein the frame assembly 100 comprises a first frame element 102 and at least one second frame element 103a, 103b. The first frame element 102 may form a rear bracket frame that extends at least partially over the backside of the panel 1. The second frame element 103a, 103b may form a holder or support bracket. Furthermore, second frame element 103a, 103b may extend along at least a portion of a perimeter of the plate 2 and/or the panel 1. Separate second frame elements 103a, 103b may extend at least partially along the perimeter of different sides of the plate 2 and/or panel 1. For example, two second frame elements 103a, 103b may extend along opposing perimeters of the plate 2 and/or panel 1. Alternatively, four second frame elements 103a, 103b may extend along the perimeter of the plate 2 and/or panel 1, i.e. one along each side of a rectangular plate 2 and/or panel 1.

As is illustrated in figures 4a-4c, the panel 1 may be held between the first frame element 102 and the second frame element 103a, 103b. The plate 2 may be supported or held at a first side of a portion of the second frame element 103a, 103b forming the support portion 101a, 101b. The panel 1 may be held or supported by a second side of the support portion 101a, 101b, which forms a support portion for the panel 1. An adhesive 104, such as an adhesive tape, may be arranged between the support portion 101a, 101b and the plate 2. A gasket 105 may be arranged between the support portion 101a, 101b and the panel 1.

In one embodiment, elements 102, 103 (shown in the figure as comprising elements 103a and 103b) are formed from a single piece.

The second frame element 103a, 103b may be attached to the first frame element 102.

In the embodiments of figures 2a-2c and 3a-3d, the second frame element 103a, 103b, is attached to the first frame element 102 by at least one attachment member 106a, 106b, such as a screw, a weld, a rivet etc. Therefore, the second frame element 103a, 103b may be rigidly attached to the first frame element 102.

The first frame element 102 may comprise a flange 107a, 107b that extends at the perimeter of the first frame element 102. Similarly, the second frame element 103a, 103b may comprise a flange 108a, 108b. When assembled, the flange 107a, 107b of the first frame element 102 may be arranged in abutment with the flange 108a, 108b of the second frame element 103a, 103b. The flange 107a, 107b of the first frame element 102 may be held together with the flange 108a, 108b of the second frame element 103a, 103b by the attachment member 106a, 106b.

The first frame element 102 may form a frame 109 (shown in figure 1) that extends in a first plane. The frame 109 is configured to extend at least partially around a first side of a panel 1. The first side of the panel 1 may be the backside of the panel 1. In some embodiments, the frame 109 has a width, such as 3-10 cm. The frame 109 may extend from the edges of the first side towards the center of the first side of the panel 1. Therefore, the frame 109 may be rectangular, and made from a single piece of material.

As is illustrated in figures 3a and 3b, the assembly 100 may comprise at least one support area 110a, 110b for supporting a back cover 111. The support area 110a, 110b may extend in a plane that is substantially parallel to the first plane, in which the frame 109 extends. The support area 110a, 110b may be located further away from the support portion 101a, 101b of the second frame element 103a, 103b than the frame 109, such that the frame 109 and the back cover 111 are spaced apart. In the illustrated embodiment, the support area 110a, 110b is provided between the flange 107a, 107b and the frame 109 of the first frame element 102. The back cover 111 may be attached to the support area 110a, 110b, e.g. by attachment elements, such as screws.

In other embodiments, the support area 110a, 110b is provided by the flange 108a, 108b of the second frame element 103a, 103b. The flange 107a, 107b of the first frame element 102 may be connected to the second frame element 103a, 103b between the flange 108a, 108b and the support portion 101a, 101b of the second frame element 103a, 103b.

The second frame element 103a, 103b may form the support portion 101a, 101b. For example, the second frame element 103a, 103b may form an elongated member that is at least partly L-shaped in cross-section. When assembled, the second frame element 103a, 103b may extend along the perimeter of the panel 1, and wrap around the perimeter of the panel such that the support portion 101a, 101b extends at least partially in a second plane generally opposite the frame 109 and spaced apart from the first plane. Thereby the second frame element 103a, 103b is configured to extend at least partially at a second side of the panel 1, e.g. at a front side of the panel 1.

In some embodiments, the second frame element 103a, 103b has a first portion and a second portion. The first portion may be provided at an angle relative to the second portion. The second portion may form the support portion 101a, 101b and be configured to extend in the second plane opposite the frame 109. The first portion may extend between the second portion and the first frame element 102. Also, the first portion may extend along the edge or side surface of the plate 2 when assembled. The first frame element 102 may be connected to the first portion of the second frame element 103a, 103b. The first portion may be substantially perpendicular to the second portion.

As is illustrated in figures 3a-3d, the first frame element 102 may be attached to the first portion of the second frame element 103a, 103b such they are fixed relative to each other. Furthermore, the second frame element 103 is tiltable relative to the first frame element 102. A force applied to the first frame element 102 is transferred to the second frame element 103 such that the support portion 101a, 101b is tilted towards the first frame element 102. Thus, a torque may control tilt of the second portion of the second frame element 103a, 103b, i.e. the support portion 101a, 101b that supports the plate 2, relative to the first frame element 102, which is illustrated with a curved arrow in figure 3c and 3d. In some embodiments, the angle of tilt of the support portion 101a, 101b is controlled to be neutral, i.e. the angle of tilt of the support portion 101a, 101b is controlled such that it is substantially parallel with the panel 1 and/or controls the plate 2 to be in a flat plane, as is illustrated in figures 3a and 3b. In other embodiments, the angle of tilt of the support portion 101a, 101b is controlled to be negative relative to the touch surface, i.e. the angle of tilt of the support portion 101a, 101b is controlled such that the free end of the support portion 101a, 101b is tilted towards the frame 109, as is illustrated in figure 3c and 3d. In the latter case, the plate 2 is given a slightly concave shape, i.e. in the direction from the touch surface of the plate 2 towards the panel 1. In each of these cases curvature is controlled such that the field of view, for a detector receiving light from a light emitter of the touch sensitive system, is improved since convexity in the plate is avoided. Again, improved field of view provides for improved accuracy of the touch sensitive system and allows for lower light budget. Furthermore, since the support portion 101a, 101b only needs to extend a short distance over the plate 2 at the perimeter the assembly is compact at the same time as curvature may be controlled. Also, curvature may be controlled without contacting the center of the plate. When the concavity is applied, the sensitivity of the system may be even further improved.

Figures 2a-2d and 3a-3d illustrate embodiments of an attachment element 112 for attaching the first frame element 102 to the panel. A plurality of attachment elements 112 (e.g. as shown in triplicate as elements 112a, 112b, and 112c) may be arranged around

the frame 109, such as at each corner of the frame 109, which is illustrated as circles in figure 4a. Each attachment element may comprise a group of screws 112a, 112b, 112c, 113a, 113b. Each screw may be arranged in a hole of the frame 109, which may be threaded. Each attachment element may comprise at least two screws 112a, 112b, 112c, 113a, 113b. At least one of the screws 112a, 113a may be arranged to displace the frame 109 away from panel 1, which is indicated with an arrow in figure 2d e.g. by having a thread in the frame 109 and pushing on the panel 1. At least one other of the screws 112b, 112c, 113b may be arranged to displace the frame 109 towards the panel 1, which is also indicated with an arrow in figure 2d. e.g. by having a thread in the panel and a hole in frame 109.

Figure 2a illustrates an embodiment wherein each attachment element comprises at least three screws 112a, 112b, 112c. All three screws 112a, 112b, 112c are arranged closer to a center of the first frame element 102 than a perimeter of the support portion 101a, 101b, i.e. an imaginary extension 114a, 114b, 114c of the longitudinal axis of each screw 112a, 112b, 112c passes outside the support portion 101a, 101b when viewed in cross-section, as is illustrated in figure 2a. In the illustrated embodiment, a first screw 112a is arranged between a second screw 112b and a third screw 112c. Figure 2a only illustrates one group of screws. However, a group of screws may be arranged at any location around the frame 109 to attach the first frame element 102 to the panel 1.

Figure 2b illustrates an embodiment wherein each group of screws consists of only two screws 113a, 113b. A first screw 113a is arranged opposing the support portion 101a, 101b, i.e. an imaginary extension 115a of the longitudinal axis of the first screw 113a passes through the support portion 101b when viewed in cross-section, such as through the center thereof, as is illustrated in figure 2b. A second screw 113b of the two screws is arranged closer to a center of the first frame element 102 than a perimeter of the support portion 101b, i.e. an imaginary extension 115b of the longitudinal axis of the first screw 113b passes outside the support portion 101b when viewed in cross-section, as is illustrated in figure 2b.

As shown in figure 2d, the first screw 112a is arranged to displace the frame 109 away from panel 1. This may be enabled by a threaded hole 112i in the frame 102 which the first screw engages while a head of the screw abuts the panel 1. The second screw 112b is arranged to displace the frame 109 towards the panel. This may be enabled by a threaded hole 112f in the panel 1, which the second screw 112b engages while the head of the second screw 112b abuts the surface of the frame. By using screw 112a and/or 112b, forces may be applied to frame 102 and/or panel 2 to control bending or rotation of the frame/panel.

Since the first screw 113b is aligned over the support portion 101a, 101b in the embodiment of figure 2b, only two screws are required to control bending or rotation of the frame.

In figures 2a-2b, only one group of screws is illustrated. However, a group of screws may be arranged at any location around the frame 109 to support the plate 2 and the panel 1.

figure 2c illustrates that a combination the embodiment of figures 2a and 2b, i.e. groups of screws with two as well as three screws may be arranged around the frame 109. Therefore, flexibility is provided for.

As is illustrated in figures 2a-2c and 3c and 3d, each group of screws 112a, 112b, 112c, 113a, 113b may apply a force to the frame 109. Therefore, a torque may be applied at the second frame element 103a, 103b via controlling the curvature of the frame 109 such that tilt of the support portion 101a, 101b, and thereby curvature of the plate, is controlled. In the assembly illustrated in figure 3a, a net force is applied such that the frame is substantially flat and parallel with the panel 1. In the assembly illustrated in figure 3c and 3d, a net force away from the support portion 101a, 101b is provided to the frame 109, which will be slightly concave when viewed from the touch surface of the plate 2. As a consequence, a torque will be provided at to the second frame element 103a, 103b, which will tilt the support portion 101a, 101b along the edge or perimeter of the plate 2. Therefore, controlling the curvature of the first frame element 109 may control curvature of the plate. The plate 2 may become concave as viewed from the touch surface of the plate 2.

Figures 4a-4c, 5a-5g and 6a-6c illustrate embodiments wherein an alternative or additional control of the shape of the frame 109 may be introduced. As shown in figure 4a, attachment elements 112 may be arranged at the corners of the frame 109. The attachment elements 112 may comprise the group of screws 112a, 112b, 112c, 113a, 113b as described above with regard to figures 2a-2c and 3a-3d. The attachment elements 112 may be arranged to pull the panel 1 towards the frame 109. This may be done with or without tilting the support portion 101a, 101b as described above. At least one spacing element 116 (where spacing element 116 may comprise screw 112 and a separate spacing component) may be arranged along the perimeter of the frame 109 between two attachment elements 112. The spacing element 116 is arranged in the assembly to apply a force to the frame 109 directed away from the panel 1. Thereby, a force applied by the spacing element 112 may be transferred to the second frame element 103a, 103b such that the support 101a, 101b is tilted as described above, whereby curvature of the plate 2 is controlled.

As is illustrated in figure 4b, the general shape of the frame 109 will be concave, whereas the general shape of the panel 1 may be convex. The panel may also remain substantially plane depending on its rigidity. The resulting shape of the plate 2 will be concave. Therefore, each side of the frame 109 may be controlled to follow a curved path. The curvature may be controlled by adjusting the force applied by each spacing element 116 and/or via the number of spacing elements 116 along each side of the frame 109. As a result, the support portion 101a, 101b, at least at the free end of the support portion 101a, 101b, may also follow a curved path. Therefore, at least a portion of the support portion 101a, 101b may extend in a plane that is curved.

When the second frame element 103a, 103b is disassembled or only attached to the first frame element 102, it may have a relaxed state. In the relaxed state, the support portion 101a, 101b extends in a plane that is substantially flat. The second frame element 103a, 103b may be deflectable from the relaxed state to a deflected state or stressed state, such as by the attachment elements 112 and spacing elements 116. The level of tilt at the opposing ends of the support 101a, 101b where the attachment elements 112 are provided may be less than the level of tilt between the ends where spacing element(s) 116 is/are provided. As consequence, the second frame element 103a, 103b may be deflected to the deflected or stressed state. In the deflected or stressed state, the support portion 101a, 101b extends, along its length, in a plane that is curved. A cross section of this plane taken along the support portion 101a, 101b, such as at the free end or tip of the support portion 101a, 101b may form a parabolic concave curve along at least a portion of the length of the support portion 101a, 101b. A combination of the attachment element 112 and the spacing element 116, that together may form a screw arrangement, may hold the second frame element 103a, 103b in the deflected or stressed state when assembled with the first frame element 102.

The spacing element 116 may be provided by a single screw that engages a thread in the frame 109 while its tip engages or abuts a surface on panel 1. Alternatively, panel 1 comprises a threaded hole into which spacing element 116 is threaded so that spacing element 116 can be used to displace the frame 109 towards panel 11. Additionally, element 116 may comprise a spacer component such as a washer, spacer, etc. In figure 3a and 3b and figure 6a, two spacing elements 116a, 116b are shown for illustrative purposes and may form separate embodiments. A single-spacing element 116a, 116b may be used in other embodiments. The head of the spacing element 116a, 116b may abut the back cover 111 while the spacing element 116a, 116b may engage the frame 109, wherein the frame 109 may be pulled towards the back cover 111. As a result, the frame 109 becomes concave. In some embodiments, the spacing element 116a does not abut or engage the

panel 1, wherein the panel 1 may be unaffected by the force applied to the frame 109. In other embodiments, the spacing element 116b is sufficiently long such that a tip of the spacing element 116b abuts a surface of the panel 1. This adds further control of the shape of the plate 2.

In some of the embodiments, the frame assembly 100 comprises a plurality of spacing elements 116 arranged spaced apart from corners of the frame 109. One or several spacing elements 116 may be arranged along each perimeter or side of the frame 109. If a single spacing element 116 is arranged along each side, it is preferably centered between the corners of the frame 109.

Each spacing element 116 may comprise a screw with a predefined length. This means that the screw can be fully seated such that the head and tip abut respective surfaces, whereby a predefined curvature of the plate 2 is obtained. The level of curvature may be adjusted by one or several spacers arranged between the head and the surface which the head engages. This is particularly useful if multiple spacing elements 116 are arranged along a single side, or if different sides have different lengths. The more spacers provided, the less force will be applied to the frame 109. Alternatively, as shown in figure 5h, predefined height differences may be generated via other methods, e.g. by milling the frame to the predefined heights, allowing a more continuous support structure.

Figures 5a-5h illustrate embodiments of an assembly 200, which may be combined with the first frame element 102 described above. The embodiments shown in figures 5a-5h are shown inverted relative to the embodiments shown previously, with the plate 2 at the top.

As shown in figures 5a and 5b, the frame assembly 200 may comprise a first frame element 202, and a second frame element 203. The first frame element 202 and the second frame element 203 may be elongated members, each having a support portion 201a, 201b. The first frame element 202 and the second frame element 203 may e.g. be L-shaped in cross section. A first portion of each of the first frame element 202 and the second frame element 203 may be configured to extend along the edge of the panel 1. A second portion of each of the first frame element 202 and the second element 203 forms the support portion 201a, 201b, and may be configured to extend from the perimeter of the plate 2 a short distance, such as a 1-3 cm, over the surface of the plate 2 when assembled. Furthermore, the second frame element 203 may be arranged on top of the first frame element 202 and such that the perimeter of the plate 2 is arranged between the second portion of each of the frame elements 202, 203 when assembled. Therefore, each support portion 201a, 201b may support or engage opposing surfaces of the plate 2, such as is illustrated in figure 5g.

In some embodiments, such as illustrated in figures 5c-5d, a gasket 205 (e.g. gaskets 205a, 205b, 205c, 205d, 205e) is arranged between the first frame element 202 and the second frame element 203. The gasket may e.g. be arranged on the support portion 201a of the first frame element 202. Also, a sealing 204a may be arranged on the support portion 201b of the second frame element 203.

The gasket 205 may have a varying thickness along its length, i.e. also along the length of the first frame element 202. This provides for obtaining a desired curved shape of the perimeter of the plate 2 when captured between the first frame element 202 and the second frame element 203, as is illustrated in figures 5f-5g. For example, the gasket 205 has opposing ends and may be thinner between the opposing ends than at said ends. This provides for obtaining a predefined concavity of the perimeter of the plate 2. The gasket is sufficiently stiff that it is thicker at the ends even when compressed. The gasket 205 may be about 1.5-2.0mm at the ends and about 1 mm thinner at the center.

In some embodiments, the gasket 205 has a plurality of sections along its length. The thickness of each section may vary. For example, a first section 205a of the gasket is provided at one of its ends and a second section 205b of the gasket at the other of its ends. The first section 205a and the second section 205b may have a first thickness that may be equal at each section. At least a third section 205c of the gasket is arranged between the first section 205a and the second section 205b. The third section 205c has a second thickness. The first thickness is thicker than the second thickness. For example, difference in thickness is about 0.5-2mm, preferably about 1.0mm. The difference in thickness may vary depending on the length of the gasket 205 and the edge of the plate 2 at which the concavity is to be introduced. In some embodiments, fourth and fifth sections 205d, 205e may be provided between the first and second sections 205a, 205b and the third section 205c, respectively. The fourth and fifth sections 205d, 205e may add further control of the shape of the concave curve provided by the arrangement 200. The length of each the first and second sections 205a, 205b may be about 2-20% of the total length of the gasket 205. The length of the third section may be about 60-96% of the total length of the gasket 205. The length of each of the fourth and fifth sections 205d, 205e may be about 10-20% of the total length of the gasket 205. In some embodiments the total length of the fourth and fifth sections 205d, 205e is shorter than the length of the third section 205c, and the total length of the first and second sections 205a, 205a is shorter than total length of the fourth and fifth sections 205d, 205e. This provides for a parabolic concave curve along the length of the frame assembly 200.

A distance between the support portion 201a of the first frame element 202 and the support portion 201b of the second frame element 203 may be discontinuous in an assembled state, as can be seen in figure 5e.

In order to maintain the concavity of the plate 2, the first frame element 202 and the second frame element 203 may be held together such that the distance between the support portions 201a, 201b is maintained in the assembled state. The first frame element 202 has a first hole 217a and a second hole 217b arranged at opposing ends of the first frame element 202, such as at the second portion of the first frame element 202. The first and the second hole 217a, 217b are arranged in a first plane. A third hole 217c is arranged between the first hole 217a and the second hole, such as centered between the first hole 217a and the second hole 217b. The third hole 217c is provided in a plane that is different from the first plane. The distance or offset between the plane in which the first and second holes 217a, 217b are arranged and the plane in which the third hole 217c is arranged may be substantially the same as the difference in thickness between the first and second sections 205a, 205b and the third section 205c, i.e. about 0.5-2mm. In some embodiments the first and second holes 217a, 217b are centered in each of the first and second sections 205a, 205b of the gasket 205 along the length of the first frame element 202.

Similarly, the second frame element 203 may comprise a first hole 218a and a second hole 218b arranged at opposing ends of the second frame element 203. A third hole 218c may be arranged between the first hole 218a and the second hole 218b of the second frame element 203. The first hole 218a, the second hole 218b, and the third hole 218c of the second frame element 203 is generally arranged in the same plane when the second frame element 203 is disconnected from the first frame element 202. The second frame element 203 may be less stiff or weaker than the first frame element 202 and be deflectable such that each hole 218a, 218b, 218c of the second frame element 203 is aligned with the holes 217a, 217b, 217c of first frame element 202. Therefore, the support portion 201b of the second frame element 203 may be deflected such that it extends in plane, which is curved in the assembled state of the frame assembly 200. Screws 219a, 219b, 219c may be inserted through the aligned holes 217a, 217b, 217c; 218a, 218b, 218c and may directly engage the panel or engage a threaded hole in the panel 1, which will hold the frame elements 202, 203 in the assembled state. Other relative arrangements of the holes 217a, 217b, 217c; 218a, 218b, 218c are foreseen, wherein the center holes 217c, 218c of each frame element 202, 203 are misaligned in the relaxed state of the second frame element 203 but aligned in the deflected or stressed state of the second frame element 203.

In some embodiments, the first frame element 202 forms a frame side, and the second frame element 203 forms an edge cover. If used together with the frame 109 discussed with regard to figures 4a-4c, the frame side may replace the second frame element of the embodiments of figures 4a-4c. Therefore, the frame side comprises the support portion 201a with a support surface generally opposing the frame 109 and is configured to support the gasket 205.

As illustrated in figure 6, a component (e.g. a sealing component 204a) may be provided between the support portion 201a and the plate 2. Figure 6 illustrates the resulting forces and torque generated when a force 220 is applied to second frame element 203a. A second force 221 is applied to support portion 201. Therefore, a net torque 222 is generated, i.e. counter-clockwise in the illustrated arrangement. The plate 2 will assume a curved path, as is illustrated with dotted line 223.

In an embodiment shown in figure 7, an alternative arrangement is provided for providing curvature of plate 2. In this embodiment, support block 301 is arranged to support glass plate 2. Support block 301 has a surface portion comprising a tapered edge 303 at an angle from second frame element 103A. Plate 2 is pressed against the top surface of support block 301 from pressure 201b from first frame element 102 and sealing 204a. Pressure 201b causes plate 2 to follow the contour of the top surface of block 301 and plate 2 is forced into a curving plane at an angle to the plane of second frame element 103A. The resulting path of plate 2 is shown by curvature path 310. Tapered surface portion 303 is angled between 0.5 degrees and 3 degrees from second frame element 103A.

In an embodiment shown in figure 8, a variation of the embodiment shown in figures 5a-5g is provided. In this embodiment, second frame element 203 has been modified, such that a portion 410 has been removed from the edge portion 203c of second frame element 203. This reduces the force required to bend second frame element 203 in a manner that results in a curvature of plate 2. Portion 410 may be removed by a milling process, by a carving or cutting process, or second frame element 203 may be formed without portion 410 via a molding process or similar. Portion 410 preferably reduces the depth of second frame element 203 at the narrowest point by between 5-20%.

The frame elements of the embodiments of the assembly may be made from sheet metal and given a desired design, thickness, and/or be made from different materials such that the forces, shapes, torques, etc. discussed above are obtained.

Embodiments comprise a method for assembling the panel 1 and the plate 2 for the optical touch sensitive system. The method may comprise providing the frame elements according to the embodiments presented herein. The method further comprises

attaching the first frame element to the second frame element, supporting the plate at a support portion of the assembly, and attaching at least one of the first frame assembly and the second frame assembly to the panel such that the support portion extends in flat or curved plane. Also, the method comprises attaching the second frame element to the first frame element such that the support portion extends at least partially in a second plane generally opposite at least a portion of the first frame element and is spaced apart from the first plane. A curvature of the first frame element may be controlled with a spacing element attached to the first frame element and may thereby tilt the support portion to control a curvature of the plate.

Figure 9 illustrates a top plan view of an example of a touch-sensitive apparatus 99. Emitters 30a are distributed around the periphery of touch plate 10, to propagating light across touch surface 20. Detectors 30b are distributed around the periphery of touch surface 20, to receive part of the propagating light. The light from each of emitters 30a will propagate to a number of different detectors 30b on a plurality of light paths 50.

The embodiments above describe methods of achieving control of plate shape and curvature. The following embodiments describe desirable shapes of the plate for achieving improved performance of a touch sensor system. Light paths 50 may conceptually be represented as "detection lines" that extend across the touch surface 20 between pairs of emitters 30a and detectors 30b. The emitters 30a and detectors 30b collectively define a grid of detection lines 50 ("detection grid") on the touch surface 20, as seen in a top plan view. The spacing of intersections in the detection grid define the spatial resolution of the touch-sensitive apparatus 99, i.e. the smallest object that can be detected on the touch surface 20. The width of the detection line is a function of the width of the emitters and corresponding detectors. A wide detector detecting light from a wide emitter provides a wide detection line with a broader surface coverage, minimizing the space in between detection lines which provide no touch coverage. A disadvantage of broad detection lines may be a reduced ability to differentiate between separate objects and a lower signal to noise ratio.

As used herein, the emitters 30a may be any type of device capable of emitting radiation in a desired wavelength range, for example a diode laser, a VCSEL (vertical-cavity surface-emitting laser), an LED (light-emitting diode), an incandescent lamp, a halogen lamp, etc. The emitters 30a may also be formed by the end of an optical fiber. The emitters 30a may generate light in any wavelength range. The following examples presume that the light is generated in the infrared (IR), i.e. at wavelengths above about 750 nm. Analogously, the detectors 30b may be any device capable of converting light (in the same wavelength range) into an electrical signal, such as a photo-detector, a CCD device, a CMOS device, etc.

The detectors 30b collectively provide an output signal, which is received and sampled by a signal processor 130. The output signal contains a number of sub-signals, also denoted "projection signals", each representing the energy of light received by one of light detectors 30b from one of light emitters 30a. Depending on implementation, the signal processor 130 may need to process the output signal for separation of the individual projection signals. The projection signals represent the received energy, intensity or power of light received by the detectors 30b on the individual detection lines 50. Whenever an object partially or completely occludes detection line 50, the received energy on this detection line is decreased or "attenuated".

The signal processor 130 may be configured to process the projection signals so as to determine a property of the touching objects, such as a position (e.g. in a x, y coordinate system), a shape, or an area. This determination may involve a straight-forward triangulation based on the attenuated detection lines, e.g. as disclosed in US7432893 and WO2010/015408, or a more advanced processing to recreate a distribution of attenuation values (for simplicity, referred to as an "attenuation pattern") across the touch surface 20, where each attenuation value represents a local degree of light attenuation. The attenuation pattern may be further processed by the signal processor 130 or by a separate device (not shown) for determination of a position, shape or area of touching objects. The attenuation pattern may be generated e.g. by any available algorithm for image reconstruction based on projection signal values, including tomographic reconstruction methods such as Filtered Back Projection, FFT-based algorithms, ART (Algebraic Reconstruction Technique), SART (Simultaneous Algebraic Reconstruction Technique), etc. Alternatively, the attenuation pattern may be generated by adapting one or more basis functions and/or by statistical methods such as Bayesian inversion. Examples of such reconstruction functions designed for use in touch determination are found in WO2009/077962, WO2011/049511, WO2011/139213, WO2012/050510, and WO2013/062471, all of which are incorporated herein by reference.

In the illustrated example, the apparatus 99 also includes a controller 120 which is connected to selectively control the activation of the emitters 30a and, possibly, the readout of data from the detectors 30b. Depending on implementation, the emitters 30a and/or detectors 30b may be activated in sequence or concurrently, e.g. as disclosed in US8581884. The signal processor 130 and the controller 120 may be configured as separate units, or they may be incorporated in a single unit. One or both of the signal processor 130 and the controller 120 may be at least partially implemented by software executed by a processing unit 140.

Figure 10a illustrates a substantially flat rectangular touch plate 10 according to the prior art. In this example, the touch plate is made of glass, plastic, or any other materials such as PMMA (Poly(methyl methacrylate)). Two axes are defined in figure 10a. The x-axis is defined as the axis running parallel to and equidistant from the pair of long edges of the rectangle and along the flat surface of the touch surface. The y-axis is defined as the axis running parallel to and equidistant from the pair of short edges of the rectangle and along the flat surface of the touch surface. At least a portion of the top surface of touch plate 10 comprises touch surface 20.

Figure 10b illustrates an example of a touch apparatus according to the prior art. Figure 10b shows the touch apparatus in cross section wherein the cross section runs along the x-axis of the plate 10. Light is emitted by emitter 30a, passes through transmissive plate 10 through touch surface 20 and is reflected by reflector surface 80 of edge reflector 70 to travel in a plane substantially parallel with touch surface 20. The light will then continue until deflected by reflector surface 80 of the edge reflector 70 at an opposing edge of the transmissive plate 10, wherein the light will be deflected back down through transmissive plate 10 and onto detectors 30b. Where an object is applied to touch surface 20, some of the light above the touch surface 20 is occluded. This occlusion is detected by the touch apparatus and used to determine the presence, size, and/or shape of the object. The emitters and detectors may be arranged in a number of other configurations such that the light from the emitters is delivered to the touch surface and delivered from the touch surface to the detectors. Other known arrangements are that of arranging the emitters and detectors above the touch surface and transmitting and receiving the light directly without the use of reflecting surfaces. The light may also be delivered to the touch surface by means of a wave guide, fiber optic cable, or other optical component.

Figure 11a illustrates an embodiment of touch plate 10 similar to that shown in figure 10a but wherein the touch plate 10 is curved. In this embodiment, the plate remains substantially flat in the direction of the y-axis but is curved in a concave direction relative to the x-axis. In this embodiment, the x-axis is defined as the axis running parallel to and equidistant from the pair of long edges of the rectangle. The vertex of the parabola or paraboloid of the touch surface is where the touch surface is deepest relative to the edges of the touch plate. Where the x-axis is positioned at the height of the edge of the touch plate, the curvature of the plate can be measured using the distance of the touch surface from the x-axis. Figure 11b shows a cross-section view along the x-axis of the touch plate 10 of figure 11a.

Figure 11c shows an example embodiment of a curved touch plate 10. The touch plate 10 has a width of 1900 mm along the x-axis and a height of 1070 mm along the y-axis. In this example embodiment, the glass is shaped such that the touch surface follows a parabolic curve relative to the x-axis. The midpoint O of touch surface 20 is the center of the touch surface and the midpoint of the x-axis. Where the curvature of the touch surface 20 is parabolic, the maximum distance a between the touch surface and the x-axis is at the center point O of the touch surface.

Figure 11d shows the maximum allowed concave distance a and maximum allowed convexity b. The maximum allowed convexity b may be a significant consideration as a portion of the touch surface that is substantially convex may result in occlusion of the light between the emitters and detectors and significant loss of touch signal. The maximum allowed convexity b is a negative number in the present examples.

In one embodiment, the range of the distance a for vertically orientated touch plate is limited in order to improve the yield and performance of touch systems. The range is set dependent on the size of the touch system. A smallest value is needed to assure that non-parabolic deviations in the glass shape and convexity in the integration doesn't result in a convex integrated touch surface. A largest value is needed in order to assure that the height of the light field for the final touch system is kept reasonably low in order to enable better contact detection and lift-off detection for touch objects. Preferably, range of the distance a is 0-2.5 mm.

The maximum distance a is a positive number for a concave glass in the present examples. The curvature of the touch surface may therefore be modelled as:

$$\mathrm{F(x)} = -\mathrm{a} + \mathrm{cx}^2$$

In the present example embodiment, a maximum distance a between the 1900 mm long cross section of the touch surface in figure 11c and the x-axis is 2.0 mm. Therefore, an ideal parabolic curve for touch surface 20 may be:

$$\mathrm{F(x)} = 5.5 * 10^{-6} * \mathrm{x}^2 - 2.0$$

where $\mathrm{F(x)}$ is the distance between the x-axis and the touch surface at position x wherein $\mathrm{F(x)}$ is zero at the mid points of the edges. i.e. where the x-axis intersects the perimeter.

Figures 12a and 12b illustrates an embodiment of touch plate 10 similar to that shown in figure 11a but wherein the touch plate 10 is curved in two axes. Figure 12a shows a top plan view and figure 12b shows an isometric view of touch plate 10. In this embodiment, the plate is curved in a concave direction relative to the x-axis and is also curved in a concave direction relative to the y-axis. As with the embodiment shown in figure 11a, the x-axis is defined as the axis running parallel to and equidistant from the pair of long edges of the rectangle and passing over the center point 0 on the touch surface. Therefore, the curvature of the plate can be measured from the distance of the touch surface from the x-axis. Similarly, the y-axis is defined as the axis running parallel to and equidistant from the pair of short edges of the rectangle and passing over the center point 0 on the touch surface. Therefore, the curvature of the plate along this axis can be measured from the distance of the touch surface from the y-axis.

Figure 12c and 12d shows respective section views along the x-axis and y-axis of the touch plate 10 of figure 12a and 12b. In an example embodiment of a curved touch plate 10. The touch plate 10 has a width of 1900 mm along the x-axis and a height of 1070 mm along the y-axis. In this example embodiment, the glass is shaped such that the touch surface follows a parabolic curve relative to the x-axis. The center point O of touch surface 10 is the center of the touch surface and parallel with midpoint of the x-axis. Where the curvature of the touch surface 10 is parabolic, the maximum distance a between the touch surface and the x-axis is at the center point O. The maximum distance a is a positive number for a concave glass in the present examples. The curvature of the touch surface may therefore be modelled as:

$$z(x,y) = -a + b * x^2 + c * x^2y^2 + d * y^2$$

where z is the distance between the plane defined by the x-axis and y-axis and the touch surface, and x and y are co-ordinates in the plane of the glass.

In an example embodiment having a flat perimeter around the plate with a max distance of 2.0 mm measured along the x-direction for y = 0 (i.e. middle of plate):

$$z(x,y) = -2 + 5.56e-06 * x^2 - 4.74e-11 * x^2y2 + 1.7e-05 * y^2$$

In another example embodiment having a concave perimeter around the plate with a max distance of 2.0 mm measured along the x-direction for y = 0 (mid short to short of screen) and with a max distance of 1.5 mm measured along the y-direction for x = 0 (mid

long to long of screen). Where the top and bottom edges have 1.0 mm max distance and the left and right edges have 0.5 mm max distance:

$$z(x,y) = -2.5 + 5.56e-06 * x^2 - 2.37e-11 * x^2 * y^2 + 1.28e-05 * y^2$$

Figure 13a shows a section view along the x-axis of light propagating across an example embodiment of a curved touch plate 10 touch surface having a curved profile in the x-axis. In the section view, the propagation paths of light from a point light source 1310 are shown. Dotted lines 1320 show propagation paths of light emitted from point light source 1310a that are not received by detector surface 1340. Solid lines 1330 show propagation paths of light emitted form point light source 1310 that are received by detector surface 1340. As shown in the figure, a portion of the light is lost above the detector, a portion is lost below the detector, and a portion of the light is received at the detector surface. A person looking from the emitter point towards the mirror image of the detector (mirrored in the touch surface) will perceive the detector size as 2.2 times larger than the real detector. This magnification effect is an effect of using an off axis parabolic mirror. In the specific case of touch systems, this results in a detection signal boost of a factor of 2.2, when comparing to a flat touch surface. This boost applies only to the signal and not significantly to the ambient light otherwise received by the detectors. In a preferred embodiment, the detectors and emitters of the touch system are 3 mm or less above the touch surface (either directly or indirectly) and the length of the detection lines being in the range from 100 to 2500 mm, the angle of incidence is extremely close to 90 degrees. With this, gracing incidence, dirt or anti-glare coatings on the touch surface have no practical impact of the reflection, so it is practically a mirror.

Figure 13b provides a graph of the angle of the emitted light from the point light source 1310 with respect to the z-coordinate of the light path at the edge of the model of figure 13a. The detector surface z-coordinate range is shown by the vertical axis. Light emitted by point light source 1310 received at a z-coordinate within that range is received by the detector.

Figure 14a shows a section view of the embodiment of figure 13a. In the section view, the propagation paths of light from a second point light source 1410 are shown. In this example, the detection signal boost is approximately 3.3. Figure 14b shows the corresponding graph of figure 13b for the second point light source 1410.

Figure 15a shows a section view of the embodiment of figure 13a. In the section view, the propagation paths of light from a third point light source 1510 are shown. Figure

15b shows the corresponding graph of figure 13b for the third point light source 1510. In this example, the detection signal boost is approximately 3.03.

Figure 16a shows a section view of the embodiment of figure 13a. In the section view, the propagation paths of light from a fourth point light source 1610 are shown. Figure 16b shows the corresponding graph of figure 13b for the fourth point light source 1610. In this example, the detection signal boost is approximately 2.71.

Figure 17a shows a section view of the embodiment of figure 13a. In the section view, the propagation paths of light from a fifth point light source 1710 are shown. Figure 17b shows the corresponding graph of figure 13b for the fifth point light source 1710. In this example, the detection signal boost is approximately 2.19.

Figures 13a-17b demonstrate that different emitter positions utilize different parts of the touch surface. The parts of the touch surface that work as reflectors will depend on the actual shape of the glass and the placement and sizes of the emitter and detector apertures surface 1340.

However, the touch plate 10 cannot be manufactured, positioned, or held in shape perfectly. Consequently, a certain amount of deviation can be expected between the curve followed by the touch surface and an ideal parabolic curve.

Figure 18a shows a graph of a mathematically defined parabolic curve and a real-world parabolic touch surface. In the example embodiment of figure 18a, a curved touch plate 10 has a width of 1900 mm along the x-axis and a height of 1070mm along the y-axis (wherein the x-axis and y-axis are defined as in the embodiment shown in figure 12a,4b). In this example embodiment, the glass is shaped such that the touch surface follows parabolic curve 1810 relative to the x-axis. The maximum distance a between the touch surface and the x-axis is 10mm. The mathematically defined parabolic curve is defined as 1820. The graph shows the deviation between the mathematically defined parabolic curve represented by dotted line 1820 and real touch surface 1810. Here, the real touch surface is asymmetrically warped. Fig 10b shows the short to short mid cross section of a 2180 mm diagonal, 16:9 ratio, thermally tempered glass that is just within or at the maximum limit of concave distance < 6 mm as well as |parabolic deviation| < 0.5 mm.

The parabolic fit of the touch surface 1810 has an s-shaped residual. Such asymmetrical warping may be the result of problems with transport rollers or an uneven temperature distribution during the rapid cooling phase of tempering process during manufacture.

Figure 18b shows a graph of the deviation between the mathematically defined parabolic curve and a real-world parabolic touch surface of figure 18a.

The following table defines a preferred set of restrictions on the shape of the touch surface in order to achieve an optimal touch surface shape. The term 'warp' defines the distance of the touch surface from the respective axis intersecting the center point O in the direction of the z-axis.

Glass size	Min x-axis warp (mm)	Max x-axis warp (mm)	Min y-axis warp (mm)	Max y-axis warp (mm)	Max convexity* (mm)	Max parabolic deviation (mm)
55"	1.0	3.50	0.0	1.35	0.1	0.5
65"	1.0	4.50	0.0	1.65	0.1	0.5
70"	1.0	5.10	0.0	1.85	0.1	0.5
75"	1.0	5.70	0.0	2.00	0.1	0.5
84"-86"	1.0	6.00	0.0	2.00	0.1	0.5

Convexity b is shown in figure 18a. Parabolic deviation is shown in figure 18b.

Figure 19a shows another graph of a mathematically defined parabolic curve and a similar glass to that of figure 18a but wherein the glass of figure 19a is out of range and not recommended for touch system production. One reason for the large concavity shown in figure 19a may be that the tempering process has been run with too large differences between bottom and top cooling parameters in a quenching process during manufacturing. The mathematically defined parabolic curve is defined as 1920. The graph shows the deviation between the mathematically defined parabolic curve and real touch surface 1910.

Figure 19b shows a graph of the deviation between the mathematically defined parabolic curve and a real-world parabolic touch surface of figure 19a. The real-world parabolic touch surface of figure 19a is an example of a symmetrical but higher order warping (e.g. W shaped). Such warping may significantly reduce signal boost and may be caused by symmetrical temperature problems (e.g. too hot in center or edge of glass) during the manufacturing tempering process.

Figure 20a shows an embodiment in which the touch surface forms a paraboloid. In figure 20a, a top plan view of the touch surface is shown with contour lines showing the depth of the touch surface relative to a flat plane intersecting the four corners of the touch surface. The numbers shown on each contour represents the depth of the contour. The x-axis, y-axis, and diagonal-axis d are all shown. The x-axis is defined as an axis running parallel to and equidistant from the pair of long edges of the rectangle. The y-axis is defined as an axis running parallel to and equidistant from the pair of short edges of the rectangle. Diagonal-axis d is defined as an axis running diagonally from one corner to a

diagonally opposite corner. In this embodiment, the x-axis, y-axis, and diagonal axis d of touch surface 10 each describe a parabola with respect to the depth of the touch surface. In figure 20b, diagonal-axis d is shown running from the bottom left corner to the top right corner. In the example embodiment of figure 20a, the curved touch plate 10 has a width of 1900mm along the x-axis and a height of 1070 mm along the y-axis.

Figures 20b-20d show optional parabola configurations for the embodiment shown in figure 20a. Figure 20b shows a graph of the desired parabola of the touch surface underneath the x-axis and relative to the x-axis. The deviation (bottom axis) from the x-axis is shown relative to the position (left axis) along the x-axis. Figure 20c shows a graph of the desired parabola of the touch surface underneath the y-axis and relative to the y-axis. The deviation (bottom axis) from the x-axis is shown relative to the position (left axis) along the y-axis. Figure 20d shows a graph of the desired parabola of the touch surface underneath the diagonal-axis and relative to the diagonal-axis. The deviation (bottom axis) from the x-axis is shown relative to the position (left axis) along the diagonal-axis.

The embodiments shown in figure 20a-20d describe a touch surface providing substantial signal boost for signals travelling between most emitters and detectors. However, the non-flat perimeter of the touch surface makes manufacture and assembly of such a system more complex.

Figure 21a shows an embodiment in which the touch surface forms an alternative paraboloid to that of the embodiment shown in figure 20a. As with figure 20a, figure 21a provides a top plan view of the touch surface is shown with contour lines showing the depth of the touch surface relative to a flat plane intersecting the four edges of the touch surface 10. The numbers shown on each contour represents the depth of the contour. X-axis, y-axis, and diagonal-axis d are all shown. The x-axis is defined as an axis running parallel to and equidistant from the pair of long edges of the rectangle. In this embodiment, the x-axis of touch surface 10 describes a parabola with respect to the depth of the touch surface. The y-axis is defined as an axis running parallel to and equidistant from the pair of short edges of the rectangle. In this embodiment, the y-axis of touch surface 10 also describes a parabola with respect to the depth of the touch surface. Diagonal-axis d is defined as an axis running diagonally from one corner to a diagonally opposite corner. In figure 21b, diagonal-axis d is shown running from the bottom left corner to the top right corner. In the example embodiment of figure 21a, the curved touch plate 10 has a width of 1900 mm along the x-axis and a height of 1070 mm along the y-axis. The perimeter of the touch surface of this embodiment is flat or close to flat. In embodiments where the perimeter of the touch surface is flat or close to flat, the surface beneath some detection lines will not be perfect parabolas. Even for an almost perfect

integrated glass shape with a warp in the range of 1-2.5 mm some detection lines (a very small portion) will actually have less signal than for a flat glass. This small drawback is counter balanced by the significant overall signal improvements. Furthermore, touch systems where the perimeter of the touch surface is flat or close to flat can be easier to manufacture and assemble.

Figure 21b shows a graph of the desired parabola of the touch surface underneath the x-axis and relative to the x-axis. The deviation (bottom axis) from the x-axis is shown relative to the position (left axis) along the x-axis. Figure 21c shows a graph of the desired parabola of the touch surface underneath the y-axis and relative to the y-axis. The deviation (bottom axis) from the x-axis is shown relative to the position (left axis) along the y-axis. Figure 21d shows a graph of the desired parabola of the touch surface underneath the diagonal-axis and relative to the diagonal-axis. The deviation (bottom axis) from the x-axis is shown relative to the position (left axis) along the diagonal-axis.

As will be apparent, the features and attributes of the specific embodiments disclosed above may be combined in different ways to form additional embodiments, all of which fall within the scope of the present disclosure.

Conditional language used herein, such as, among others, “can,” “could,” “might,” “may,” “e.g.,” and the like, unless specifically stated otherwise, or otherwise understood within the context as used, is generally intended to convey that certain embodiments include, while other embodiments do not include, certain features, elements and/or states. Thus, such conditional language is not generally intended to imply that features, elements and/or states are in any way required for one or more embodiments or that one or more embodiments necessarily include logic for deciding, with or without author input or prompting, whether these features, elements and/or states are included or are to be performed in any particular embodiment.

The present invention has been described above with reference to specific embodiments. However, other embodiments than the above described are equally possible within the scope of the invention. Different method steps than those described above may be provided within the scope of the invention. The different features and steps of the invention may be combined in other combinations than those described. The scope of the invention is only limited by the appended patent claims.

CLAIMS

1. An assembly for holding and controlling curvature of a plate (2) for an optical touch sensitive system, comprising

a first frame element (102; 202) extending in a first plane and configured to extend at least partially around a panel (1);

at least one second frame element (103a, 103b; 203) extending in a second plane and forming a support portion (101a, 101b; 201b) for the plate (2), and

at least one spacing element positioned at least partially between the support portion (101a, 101b; 201b) and the first frame element (102; 202), the spacing element being configured to control a curvature of the first frame element (102; 202), and

wherein the at least one second frame element (103a, 103b; 203) is configured to engage the plate at the support portion (101a, 101b; 201b), is attached to the first frame element (102; 202), and wherein the shape and/or position of the second frame element is controlled by the curvature of the first frame element (102, 202) with said spacing element, to control a curvature of the plate.

2. The assembly of claim 1, wherein the second frame element (103a, 103b; 203) is deflectable from a relaxed state to a deflected state, in which the second plane forms a parabolic concave curve along at least a portion of the length of the support portion (101a, 101b; 201b), and wherein a screw arrangement (112a, 112b, 112c, 113a, 113b; 219a, 219b, 219c) of the assembly holds the second frame element (103a, 103b; 203) in the deflected state when assembled with the first frame element (102; 202).

3. The assembly of any of claims 1 or 2, wherein a frame (109) of the first frame element (102) comprises a plurality of spacing elements arranged spaced apart from corners of the frame (209) of the first frame element (102), wherein the spacing elements are configured to generate a force to the frame (109) away from the support portion (101a, 101b).

4. The assembly of claim 3, wherein each spacing element comprises a screw (116, 116a, 116b) arranged in a hole of the frame (109).

5. The assembly of claim 4, wherein each spacing element (112, 112a, 112b) comprises a screw with a predefined length, and a spacer arranged between a head of the screw and the frame (109).

6. The assembly of any of the previous claims, wherein assembly comprises a plurality of attachment elements (112) arranged around the frame (109) for attaching the first frame element (102) to said panel (1).

7. The assembly of claim 6, wherein each attachment element (112) comprises a plurality of screws (112a, 112b, 112c, 113a, 113b) arranged in holes of the frame (109), wherein at least one of said screws (112a, 113b) is arranged to apply a first force to the frame (109) towards the support portion (101a, 101b), and at least one other of said screws (112b, 112c, 113b) is arranged to apply a second force to the frame (109) away from the support portion (101a, 101b).

8. The assembly of claim 7, wherein each attachment element (112) comprises at least two screws (113a, 113b), wherein a first screw (113a) of said two screws is arranged opposing the support portion (101a, 101b) and to apply said first force to the frame (109) towards the support portion (101a, 101b), and a second screw (113b) of said two screws is arranged closer to a center of the first frame element (102) than a perimeter of the support portion (101a, 101b) and to apply said second force to the frame (109) away from the support portion (101a, 101b).

9. The assembly of claim 7, wherein each attachment element (112) comprises at least three screws (112a, 112b, 112c), wherein all three screws are arranged closer to a center of the first frame element (102) than a perimeter of the support portion (101a, 101b), and wherein a first screw (112a) of said three screws is arranged to apply said first force to the frame (109) towards the support portion (101a, 101b), and a second screw (112b) and a third screw (112c) of said three screws are arranged to apply said second force to the frame (109) away from the support portion (101a, 101b), the first screw (112a) being arranged between the second screw (112b) and the third screw (112c).

10. The assembly of any of the previous claims, wherein a gasket (205) is arranged on another support portion (201a) of the second frame element (202), wherein the gasket (205) has a varying thickness along its length.

11. The assembly of claim 10, wherein the gasket (205) has opposing ends, and is thinner between the opposing ends than at said ends.

12. The assembly of claim 11, wherein a first section (205a) of the gasket (205) at one of said ends and a second section (205b) of the gasket (205) at the other of said ends has a first thickness, and at least a third section (205c) of the gasket between the first section (205a) and the second section (205b) has a second thickness, wherein the first thickness is thicker than the second thickness.

13. The frame assembly of any of claims 10-12, wherein the second frame element (203) comprises a frame side and the third frame element comprises an edge cover, and wherein the edge cover comprises another support portion for said panel (1), wherein a distance between the support portion of the frame side and the support portion of the edge cover is discontinuous in an assembled state.

14. The frame assembly of claim 13, wherein the frame side comprises a first hole (217a) and a second hole (217b) arranged at opposing ends of the frame side and in a first plane, and a third hole (217c) arranged between the first hole (217a) and the second hole (217c) and in a plane that is different from the first plane, and

the edge cover comprises a first hole (218a) and a second hole (218b) arranged at opposing ends of the edge cover, and a third hole (218c) arranged between the first hole (218a) and the second hole (218c) of the edge cover, wherein the first hole (218a), the second hole (218b), and the third hole (218c) of the edge cover are generally arranged in the same plane when the edge cover is disconnected from the frame side, and

wherein the edge cover is less stiff than the frame side and deflectable such that the holes (218a, 218b, 218c) of the edge cover are aligned with the holes (217a, 217b, 217c) of the frame side and such that the support portion of the edge cover extends in a plane, which is curved.

15. A method for assembling a panel and a plate for an optical touch sensitive system, comprising:

providing a first frame element (102; 202) extending in a first plane and configured to extend at least partially around a panel (1);

providing at least one second frame element (103a, 103b; 203) forming a support portion (101a, 101b; 201b) for the plate (2);

supporting the plate (2) by the support portion (101a, 101b, 201b);

attaching the second frame element to the first frame element (102; 202) such that

the support portion (101a, 101b; 201b) extends at least partially in a second plane generally opposite at least a portion of the first frame element (102; 202) and is spaced apart from the first plane; and

controlling a curvature of the first frame element (102; 102) with a spacing element attached to the first frame element (102; 202) and thereby tilting the support portion (101a, 101b, 201b) to control a curvature of the plate (2).

16. A touch sensing apparatus, comprising:

a touch surface;

a set of emitters arranged around the touch surface to emit first beams of light to propagate across the touch surface,

a set of light detectors arranged around the touch surface to receive light from the first set of emitters,

wherein each light detector is arranged to receive light from more than one emitter;

a processing element configured to determine, based on output signals of the set of light detectors, the position of an object on the touch surface,

wherein the touch surface is curved in a first axis according to a first parabola.

17. The touch sensing apparatus of claim 16, wherein the touch surface is curved in a second axis according to a second parabola.

18. The touch sensing apparatus of claim 16, wherein the touch surface forms a paraboloid.

19. The touch sensing apparatus of claim 18, wherein the first parabolic curve paraboloid is an elliptical paraboloid.

20. The touch sensing apparatus of claim 16, wherein each point of the first axis of the touch surface is within 0.5mm of a mathematical parabola.

21. The touch sensing apparatus of claim 16, wherein the mathematical parabola is defined according to $z(x, y)=a+bx^2+cx^2y^2+dy^2$, where z is depth, and x and y are co-ordinates in the plane of the glass.

22. The touch sensing apparatus of claim 16, wherein the touch surface comprises a portion of a surface of a plate.

23. The touch sensing apparatus of claim 22, wherein the plate comprises a glass or plastic sheet.

24. The touch sensing apparatus of claim 16, wherein the touch surface forms a paraboloid.

AMENDED CLAIMS
received by the International Bureau on 09.Apr.2018 (09.04.2018)

[Claim 1] An assembly (100) for holding and controlling curvature of a plate (2) for an optical touch sensitive system, comprising
a first frame element (102; 202) extending in a first plane and configured to extend at least partially around a panel (1);
at least one second frame element (103a, 103b; 203) extending in a second plane and forming a support portion (101a, 101b; 201b) for the plate (2), and
at least one spacing element (116) positioned at least partially between the support portion (101a, 101b; 201b) and the first frame element (102; 202), the spacing element (116) being configured to control a curvature of the first frame element (102; 202), and
wherein the at least one second frame element (103a, 103b; 203) is configured to engage the plate at the support portion (101a, 101b; 201b), is attached to the first frame element (102; 202), and wherein the shape and/or position of the second frame element is controlled by the curvature of the first frame element (102, 202) with said spacing element (116), to control a curvature of the plate.

[Claim 2] The assembly (100) of claim 1, wherein the second frame element (103a, 103b; 203) is deflectable from a relaxed state to a deflected state, in which the second plane forms a parabolic concave curve along at least a portion of the length of the support portion (101a, 101b; 201b), and wherein a screw arrangement (112a, 112b, 112c, 113a, 113b; 219a, 219b, 219c) of the assembly (100) holds the second frame element (103a, 103b; 203) in the deflected state when assembled with the first frame element (102; 202).

[Claim 3] 3. The assembly (100) of any of claims 1 or 2, wherein a frame (109) of the first frame element (102) comprises a plurality of spacing elements (116) arranged spaced apart from corners of the frame (209) of the first frame element (102), wherein the spacing elements are configured to generate a force to the frame (109) away from the support portion (101a, 101b).

[Claim 4] The assembly (100) of claim 3, wherein each spacing element (116) comprises a screw (116, 116a, 116b) arranged in a hole of the frame (109).

[Claim 5] The assembly (100) of claim 4, wherein each spacing element (116) comprises a screw with a predefined length, and a spacer arranged

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between a head of the screw and the frame (109).

[Claim 6] 6. The assembly (100) of any of the previous claims, wherein assembly (100) comprises a plurality of attachment elements (112) arranged around the frame (109) for attaching the first frame element (102) to said panel (1).

[Claim 7] The assembly (100) of claim 6, wherein each attachment element (112) comprises a plurality of screws (112a, 112b, 112c, 113a, 113b) arranged in holes of the frame (109), wherein at least one of said screws (112a, 113b) is arranged to apply a first force to the frame (109) towards the support portion (101a, 101b), and at least one other of said screws (112b, 112c, 113b) is arranged to apply a second force to the frame (109) away from the support portion (101a, 101b).

[Claim 8] 8. The assembly (100) of claim 7, wherein each attachment element (112) comprises at least two screws (113a, 113b), wherein a first screw (113a) of said two screws is arranged opposing the support portion (101a, 101b) and to apply said first force to the frame (109) towards the support portion (101a, 101b), and a second screw (113b) of said two screws is arranged closer to a center of the first frame element (102) than a perimeter of the support portion (101a, 101b) and to apply said second force to the frame (109) away from the support portion (101a, 101b).

[Claim 9] The assembly (100) of claim 7, wherein each attachment element (112) comprises at least three screws (112a, 112b, 112c), wherein all three screws are arranged closer to a center of the first frame element (102) than a perimeter of the support portion (101a, 101b), and wherein a first screw (112a) of said three screws is arranged to apply said first force to the frame (109) towards the support portion (101a, 101b), and a second screw (112b) and a third screw (112c) of said three screws are arranged to apply said second force to the frame (109) away from the support portion (101a, 101b), the first screw (112a) being arranged between the second screw (112b) and the third screw (112c).

[Claim 10] 10. The assembly (100) of any of the previous claims, wherein a gasket (205) is arranged on another support portion (201a) of the second frame element (202), wherein the gasket (205) has a varying thickness along its length.

[Claim 11] The assembly (100) of claim 10, wherein the gasket (205) has opposing ends, and is thinner between the opposing ends than at said ends.

[Claim 12] The assembly (100) of claim 11, wherein a first section (205a) of the

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gasket (205) at one of said ends and a second section (205b) of the gasket (205) at the other of said ends has a first thickness, and at least a third section (205c) of the gasket between the first section (205a) and the second section (205b) has a second thickness, wherein the first thickness is thicker than the second thickness.

[Claim 13] 13. The assembly (100) of any of claims 10-12, wherein the second frame element (203) comprises a frame side and the third frame element comprises an edge cover, and wherein the edge cover comprises another support portion for said panel (1), wherein a distance between the support portion of the frame side and the support portion of the edge cover is discontinuous in an assembled state.

[Claim 14] The assembly (100) of claim 13, wherein the frame side comprises a first hole (217a) and a second hole (217b) arranged at opposing ends of the frame side and in a first plane, and a third hole (217c) arranged between the first hole (217a) and the second hole (217c) and in a plane that is different from the first plane, and

the edge cover comprises a first hole (218a) and a second hole (218b) arranged at opposing ends of the edge cover, and a third hole (218c) arranged between the first hole (218a) and the second hole (218c) of the edge cover, wherein the first hole (218a), the second hole (218b), and the third hole (218c) of the edge cover are generally arranged in the same plane when the edge cover is disconnected from the frame side, and

wherein the edge cover is less stiff than the frame side and deflectable such that the holes (218a, 218b, 218c) of the edge cover are aligned with the holes (217a, 217b, 217c) of the frame side and such that the support portion of the edge cover extends in a plane, which is curved.

[Claim 15] 15. A method for assembling a panel and a plate for an optical touch sensitive system, comprising:

providing a first frame element (102; 202) extending in a first plane and configured to extend at least partially around a panel (1);

providing at least one second frame element (103a, 103b; 203) forming a support portion (101a, 101b; 201b) for the plate (2);

supporting the plate (2) by the support portion (101a, 101b, 201b);

attaching the second frame element to the first frame element (102; 202) such that

the support portion (101a, 101b; 201b) extends at least partially in a second plane generally opposite at least a portion of the first frame

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element (102; 202) and is spaced apart from the first plane; and controlling a curvature of the first frame element (102; 102) with a spacing element (116) attached to the first frame element (102; 202) and thereby tilting the support portion (101a, 101b, 201b) to control a curvature of the plate (2).

[Claim 16] 16. A touch sensing apparatus, comprising:
a touch surface;
a set of emitters arranged around the touch surface to emit first beams of light to propagate across the touch surface,
a set of light detectors arranged around the touch surface to receive light from the first set of emitters,
wherein each light detector is arranged to receive light from more than one emitter;
a processing element configured to determine, based on output signals of the set of light detectors, the position of an object on the touch surface,
wherein the touch surface is curved in a first axis according to a first parabola.

[Claim 17] 17. The touch sensing apparatus of claim 16, wherein the touch surface is curved in a second axis according to a second parabola.

[Claim 18] 18. The touch sensing apparatus of claim 16, wherein the touch surface forms a paraboloid.

[Claim 19] 19. The touch sensing apparatus of claim 18, wherein the first parabolic curve paraboloid is an elliptical paraboloid.

[Claim 20] 20. The touch sensing apparatus of claim 16, wherein each point of the first axis of the touch surface is within 0.5mm of a mathematical parabola.

[Claim 21] 21. The touch sensing apparatus of claim 20, wherein the mathematical parabola is defined according to $z(x, y)=a+bx^2+cx^2y^2+dy^2$, where z is depth, and x and y are co-ordinates in the plane of the glass.

[Claim 22] 22. The touch sensing apparatus of claim 16, wherein the touch surface comprises a portion of a surface of a plate.

[Claim 23] 23. The touch sensing apparatus of claim 22, wherein the plate comprises a glass or plastic sheet.

[Claim 24] 24. The touch sensing apparatus of claim 16, wherein the touch surface forms a paraboloid.

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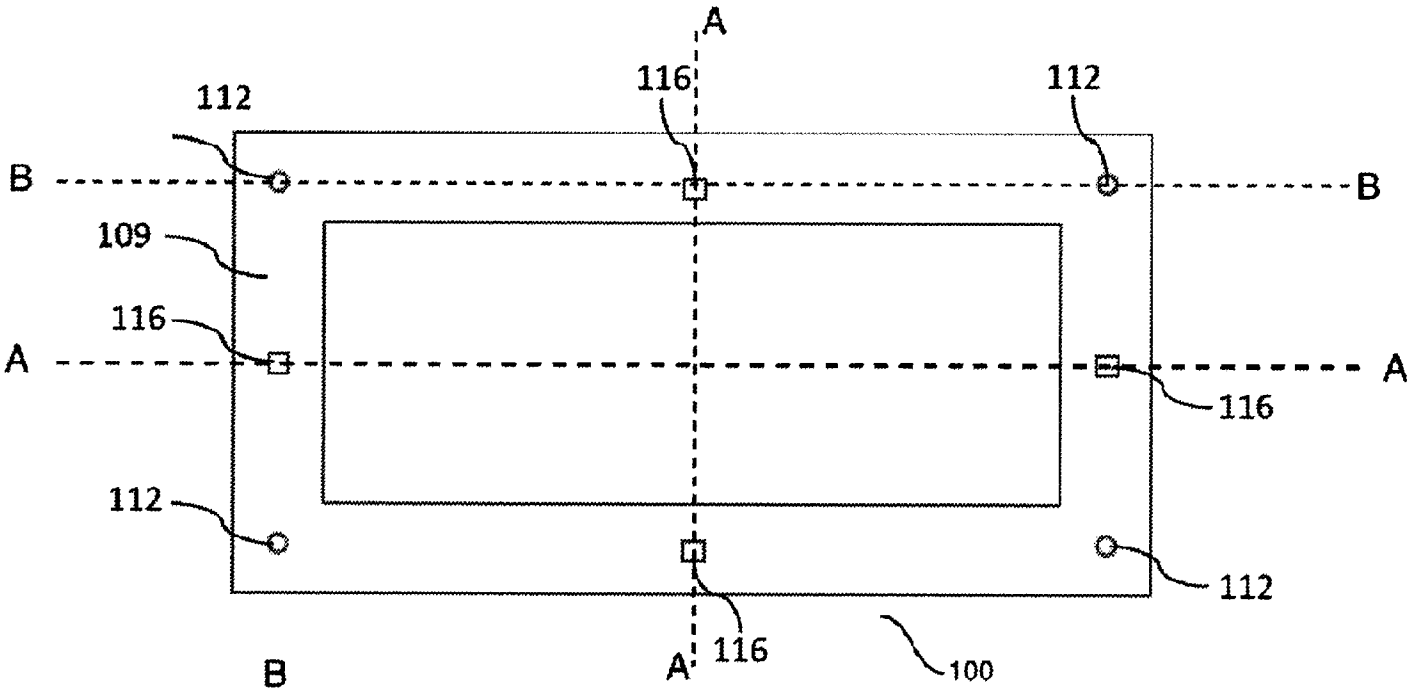


Figure 1

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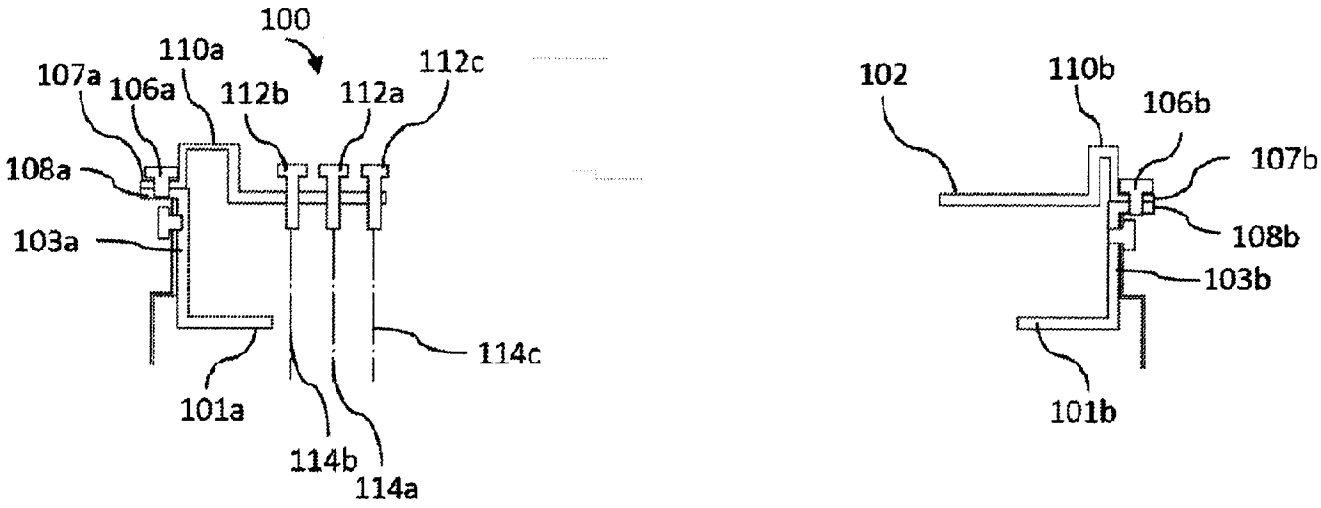

100
110a
107a
106a
112b
112a
112c
108a
103a
114c
101a
114b
114a
102
110b
106b
107b
108b
103b
101b

Figure 2a

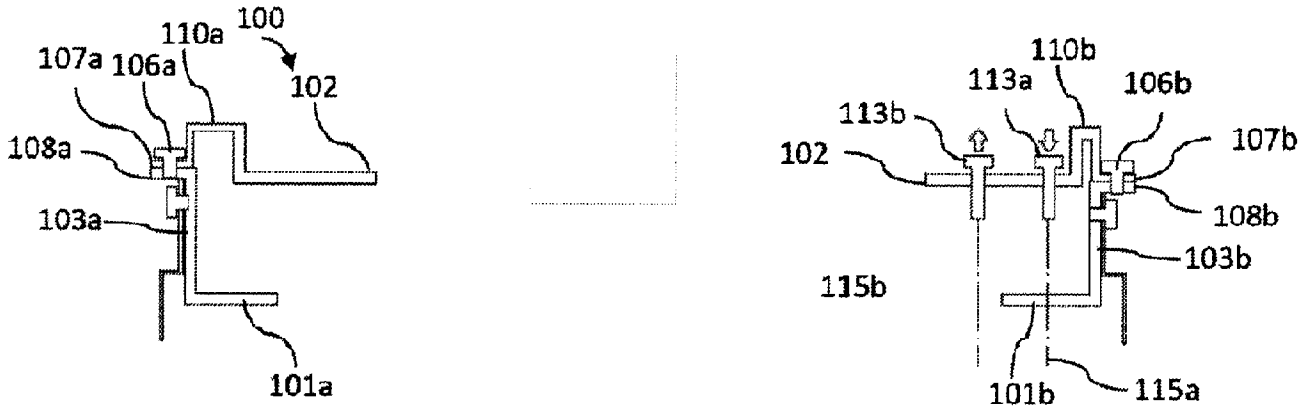

100
110a
107a
106a
102
108a
103a
101a
110b
113a
106b
113b
107b
102
108b
103b
115b
101b
115a

Figure 2b

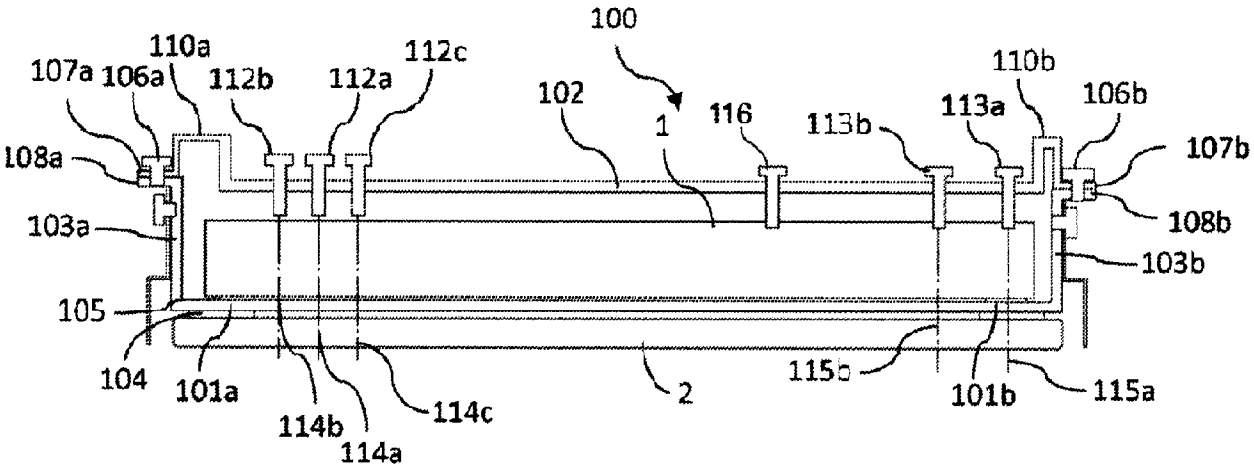


Figure 2c

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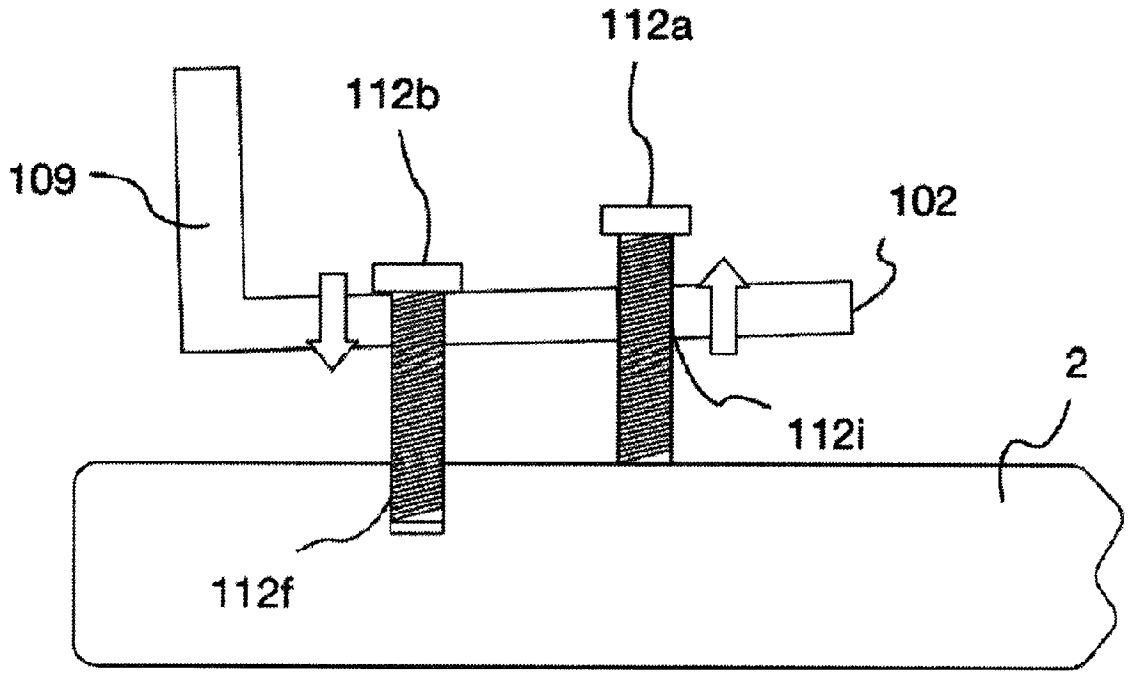


Figure 2d

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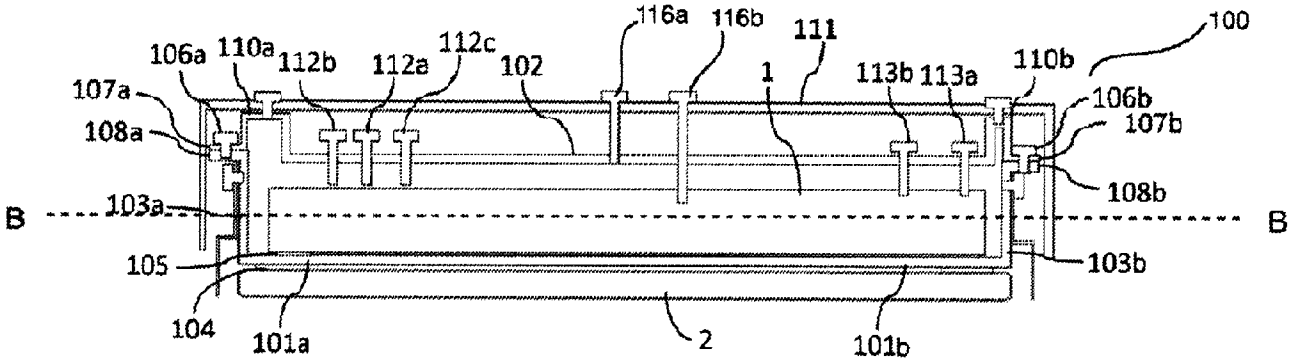


Figure 3a

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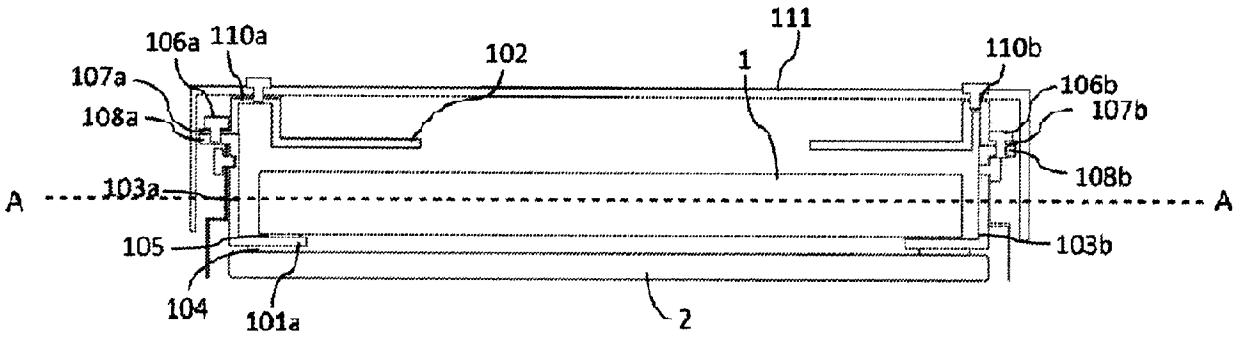

111
106a
110a
102
1
110b
107a
106b
107b
108a
108b
A
103a
A
105
103b
104
101a
2

Figure 3b

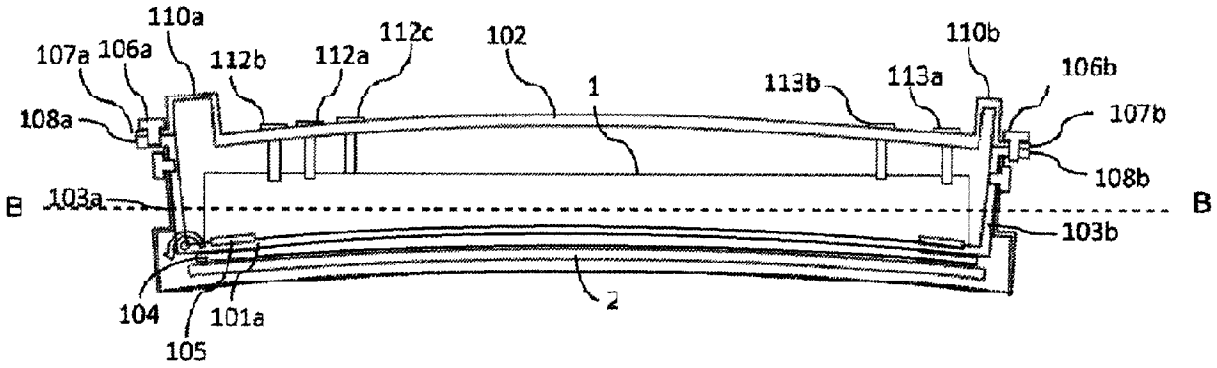

110a
107a
106a
112b
112a
112c
102
1
110b
113b
113a
106b
107b
108a
108b
B
103a
B
103b
104
101a
105
2

Figure 3c

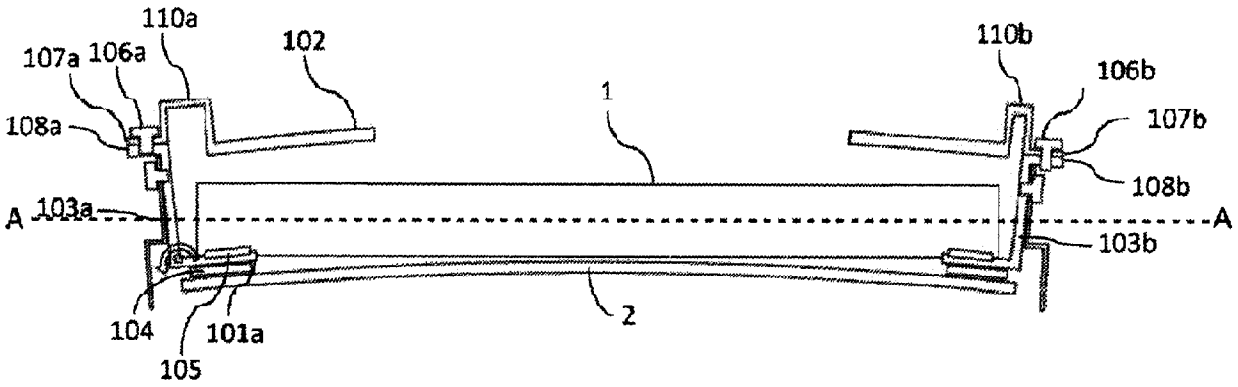


Figure 3d

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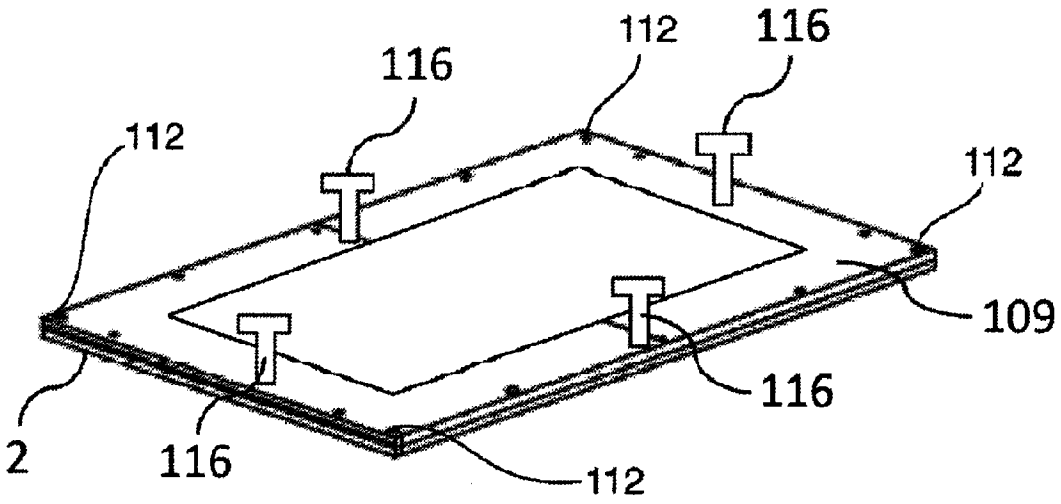


Figure 4a

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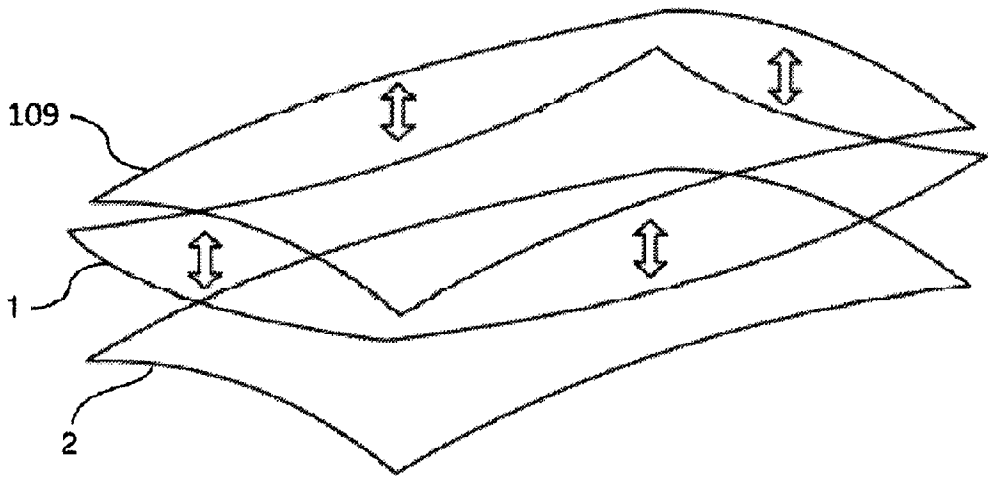


Figure 4b

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 978

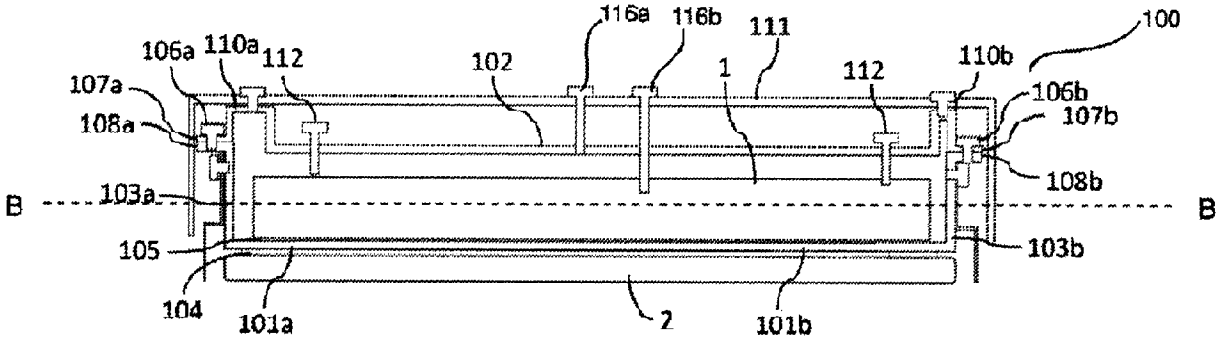


Figure 4c

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 979

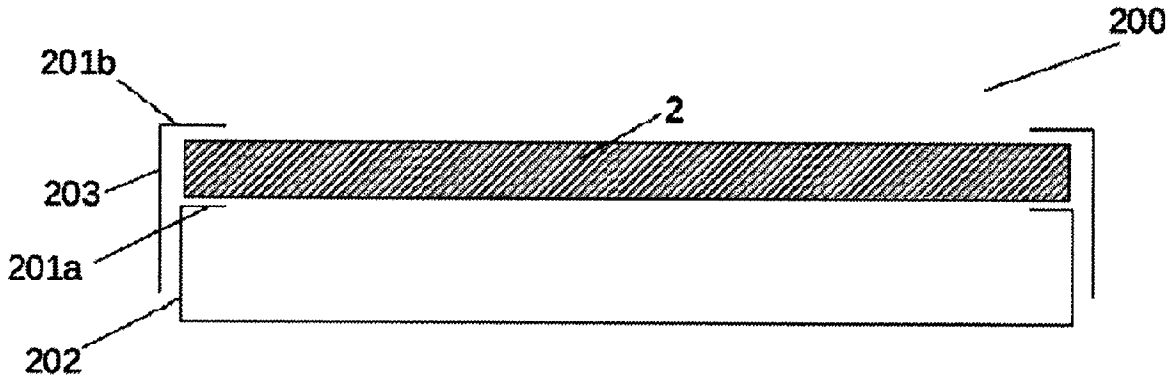


Figure 5a

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 980

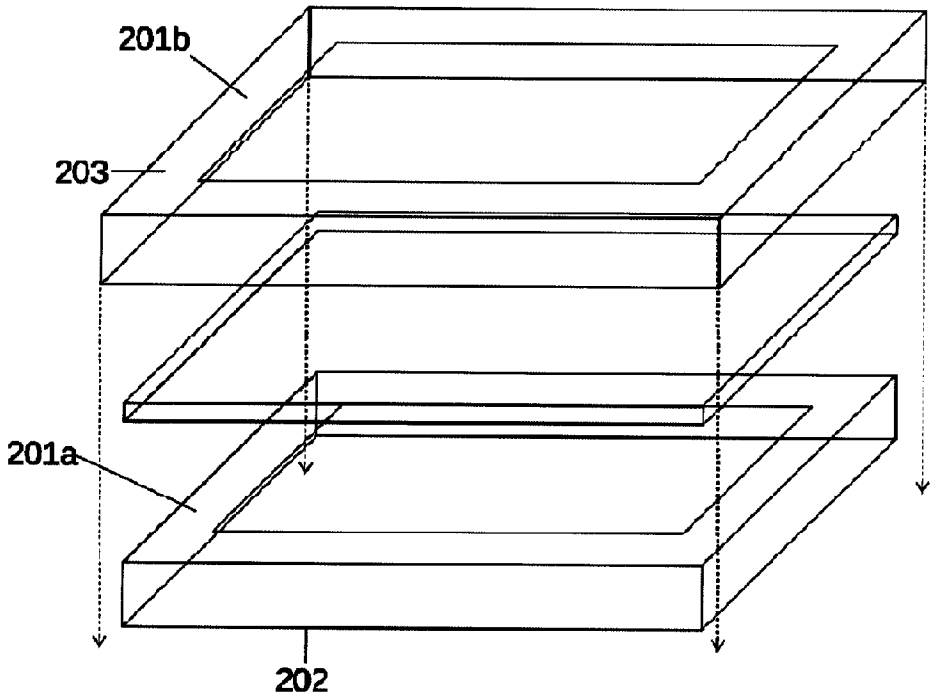


Figure 5b

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 981

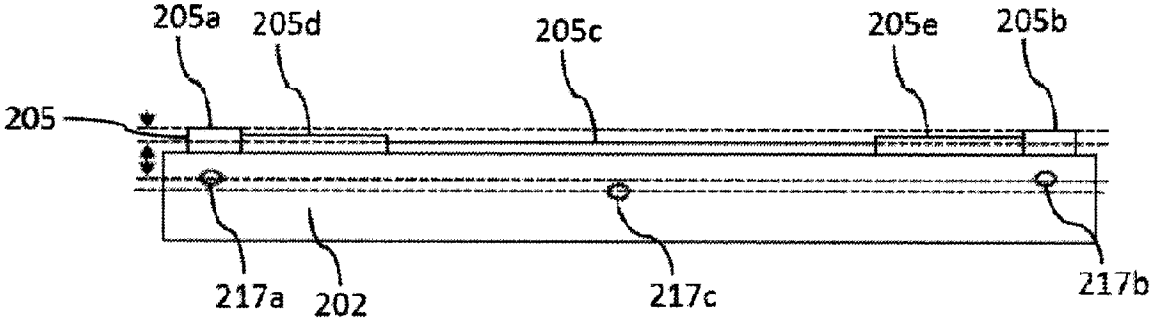


Figure 5c

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 982

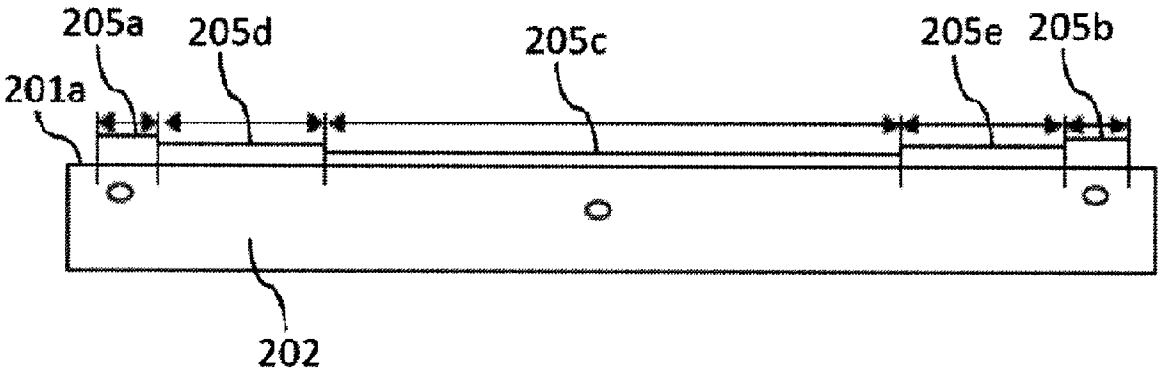


Figure 5d

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 983

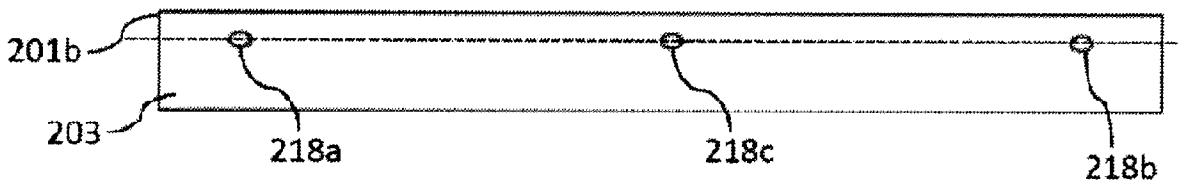


Figure 5e

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 984

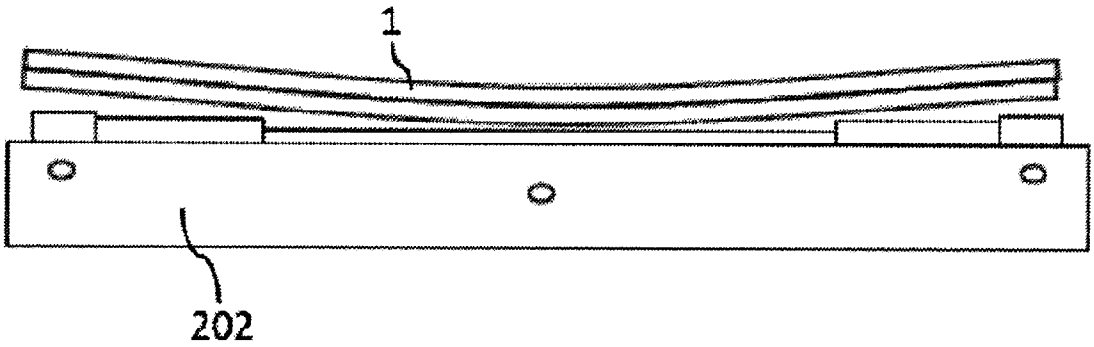


Figure 5f

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 985

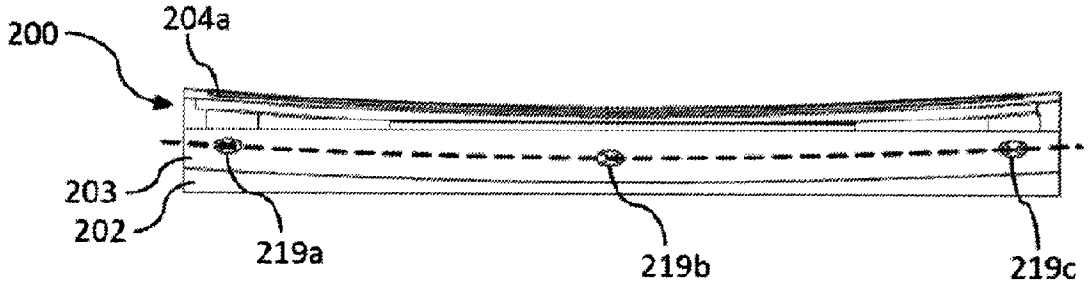


Figure 5g

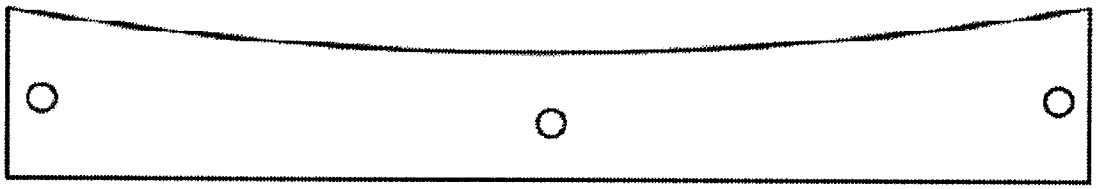


Figure 5h

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 987

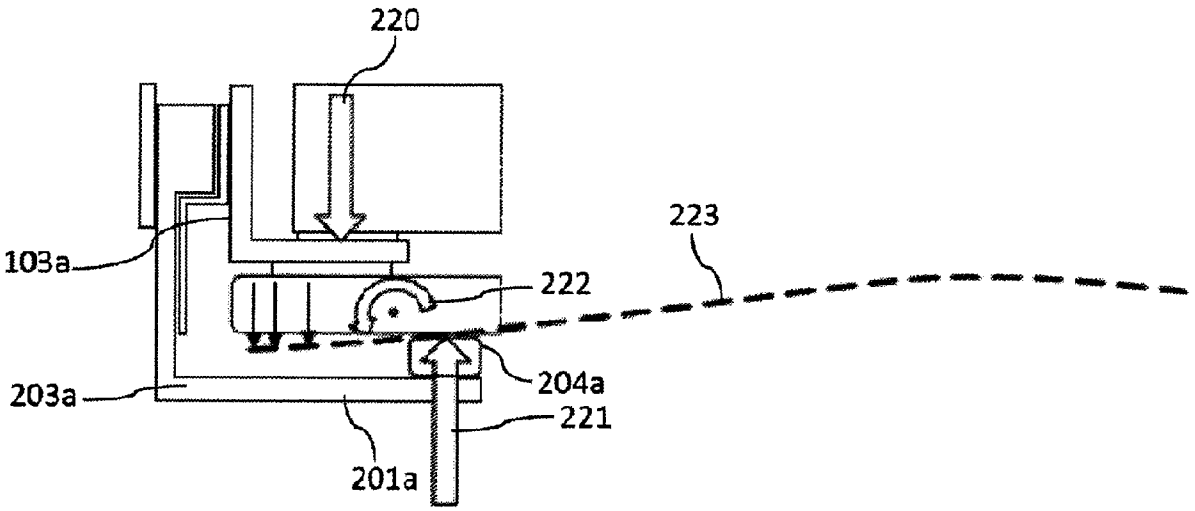


Figure 6

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 988

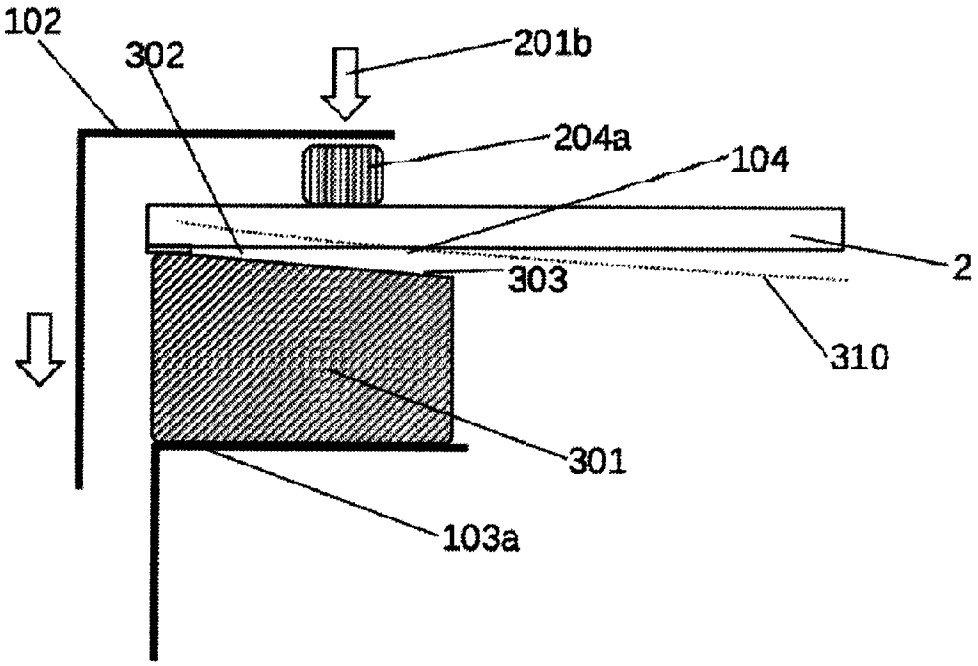


Figure 7

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 989

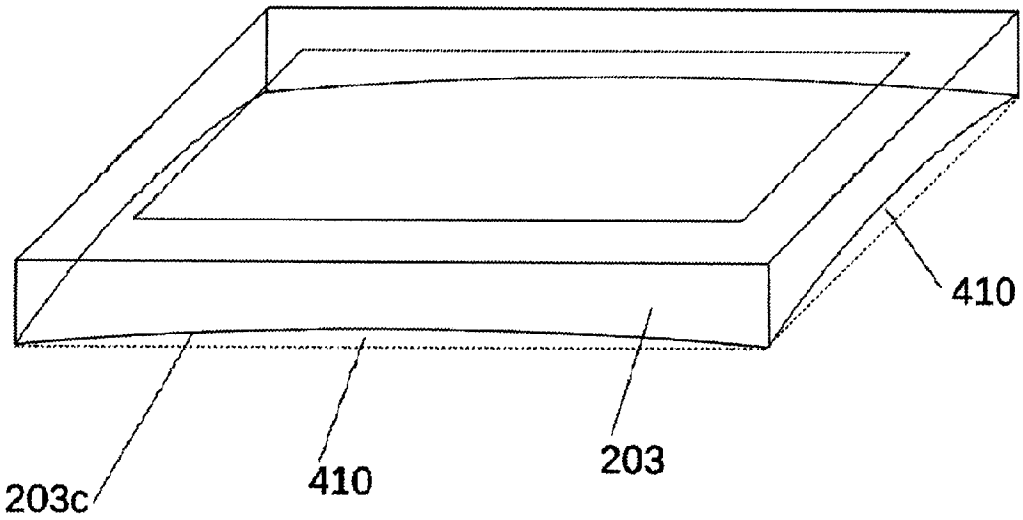


Figure 8

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 990

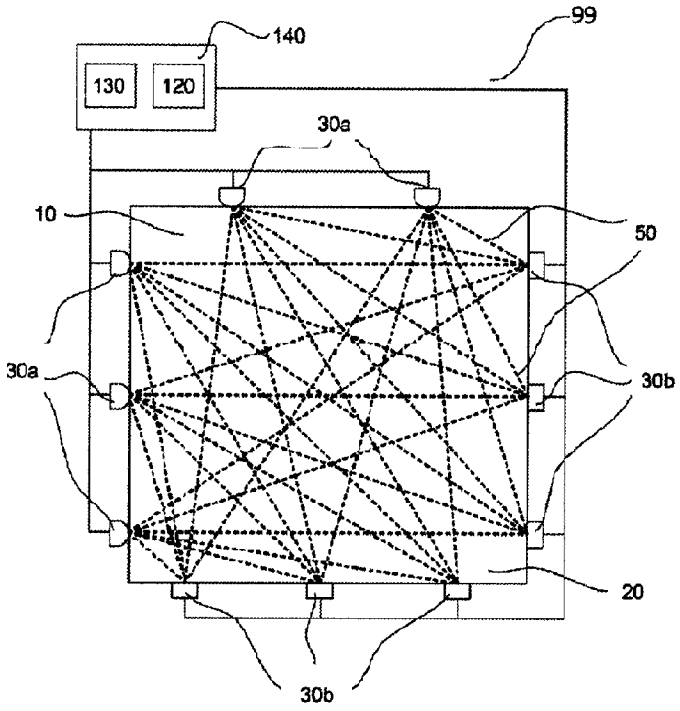


Figure 9

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 991

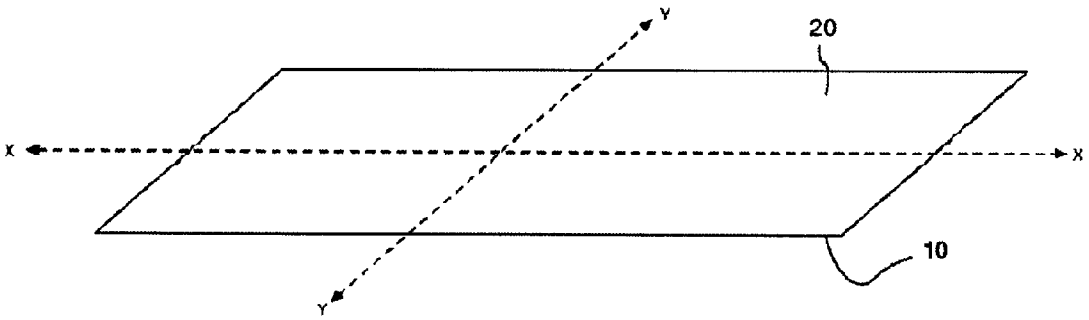


Figure 10a

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 992

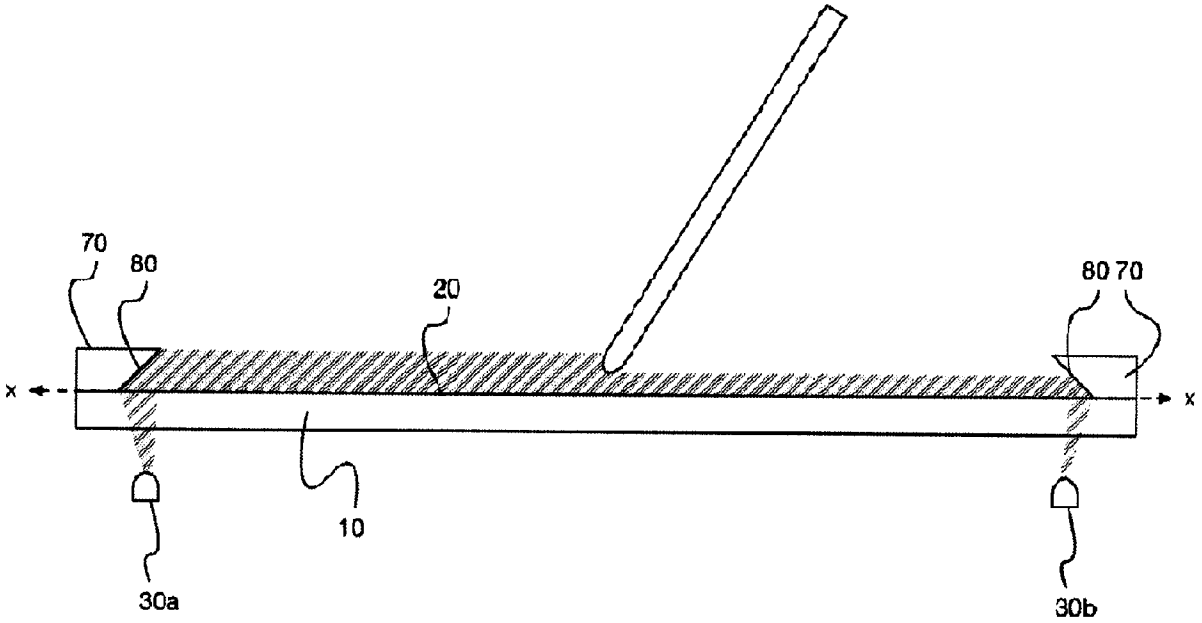


Figure 10b

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 993

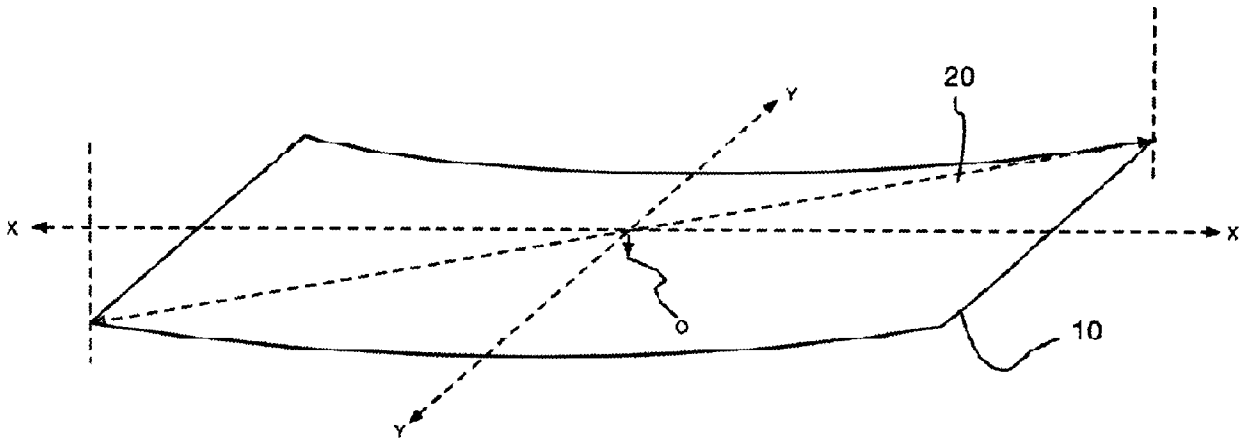


Figure 11a

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 994

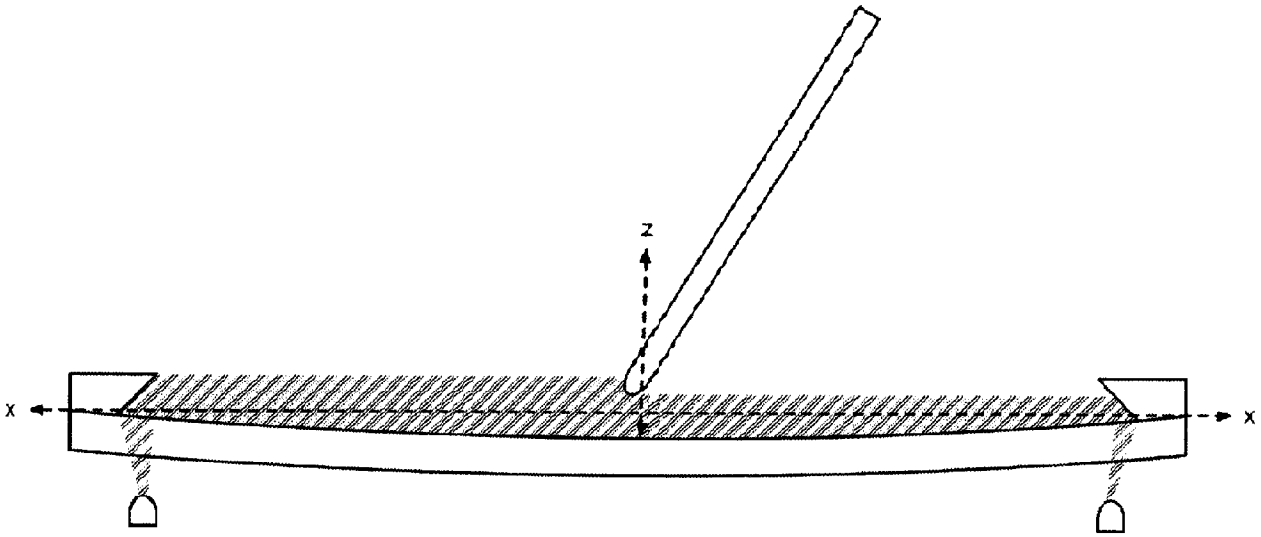


Figure 11b

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 995

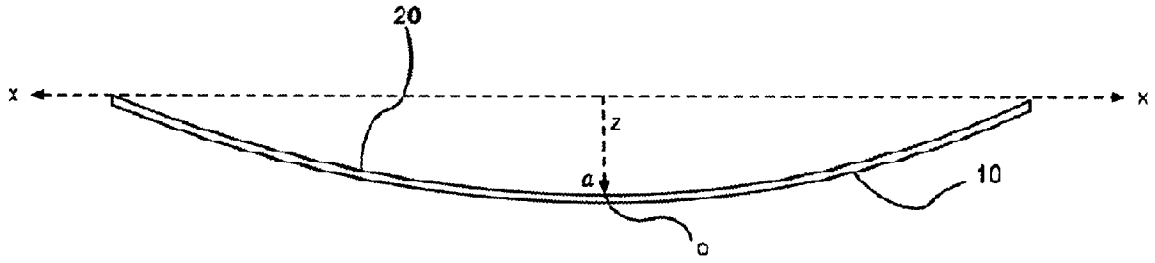


Figure 11c

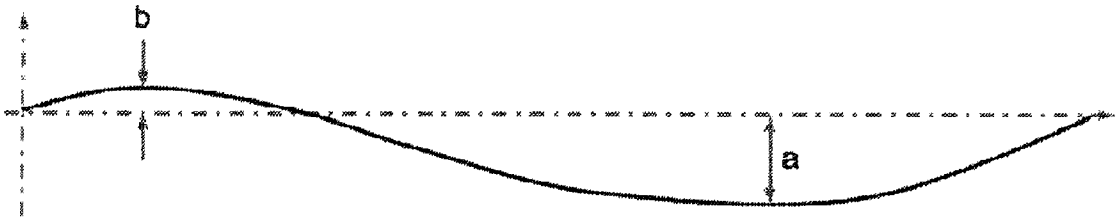


Figure 11d

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 996

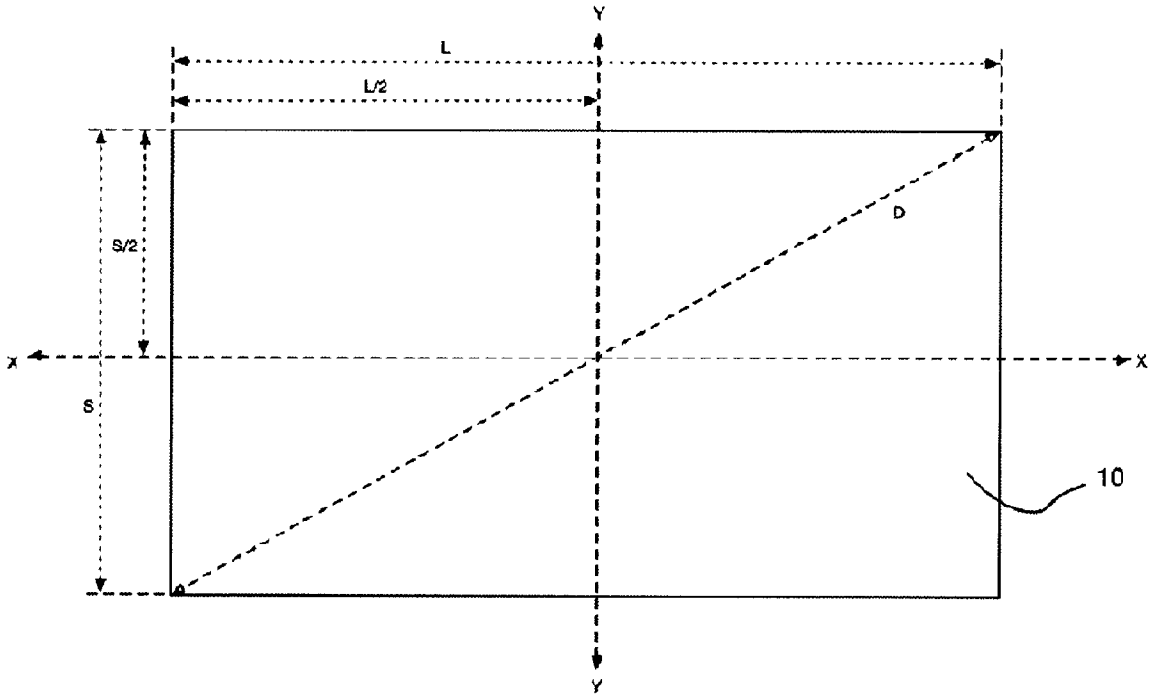


Figure 12a

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 997

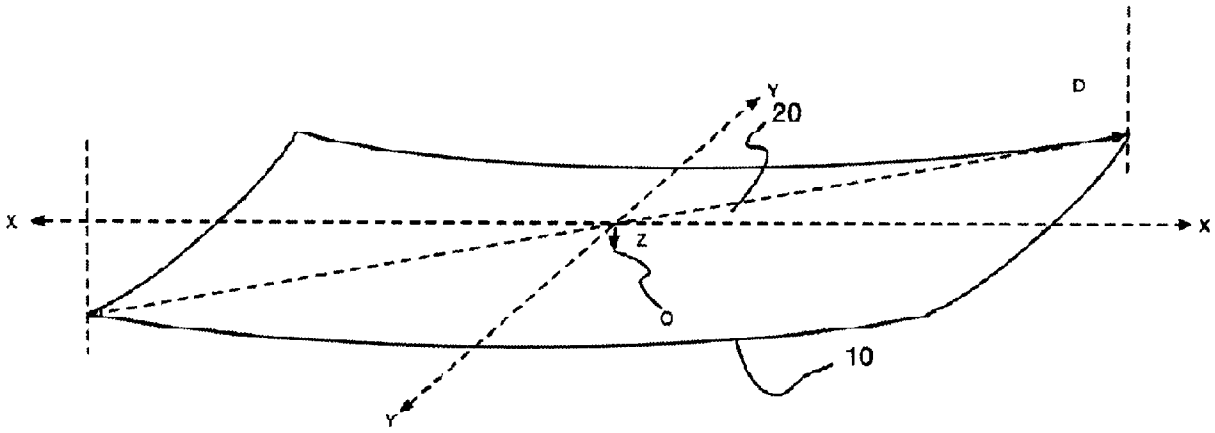


Figure 12b

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 998

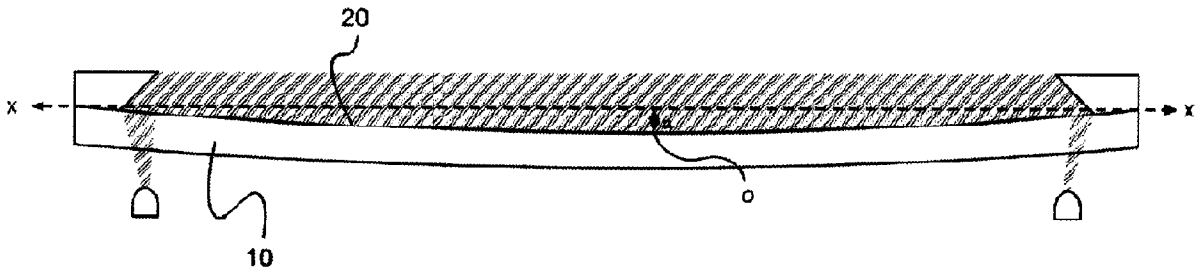


Figure 12c

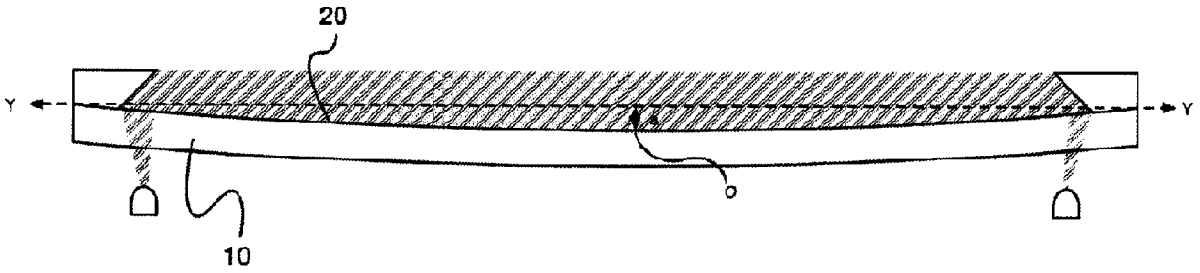


Figure 12d

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 999

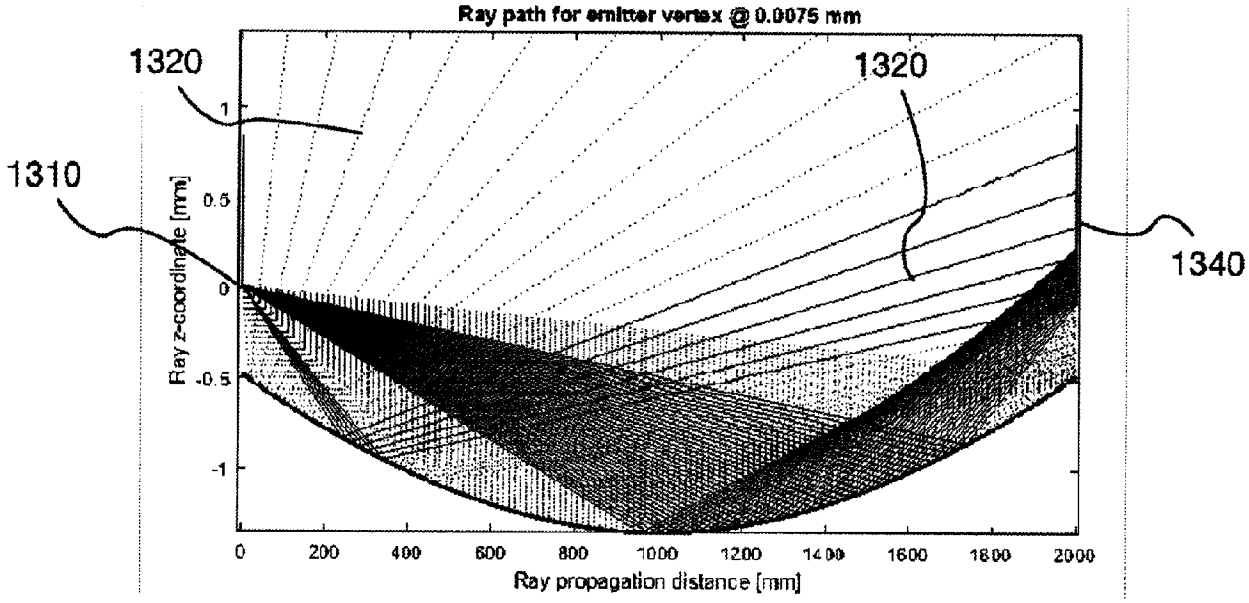


Figure 13a

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 1000

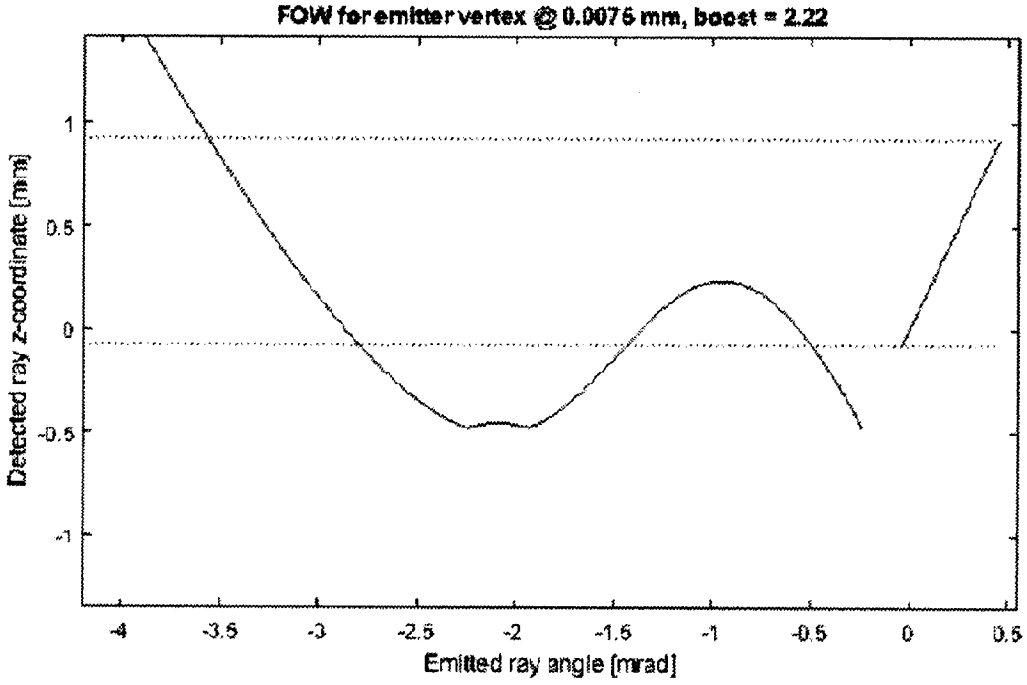


Figure 13b

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 1001

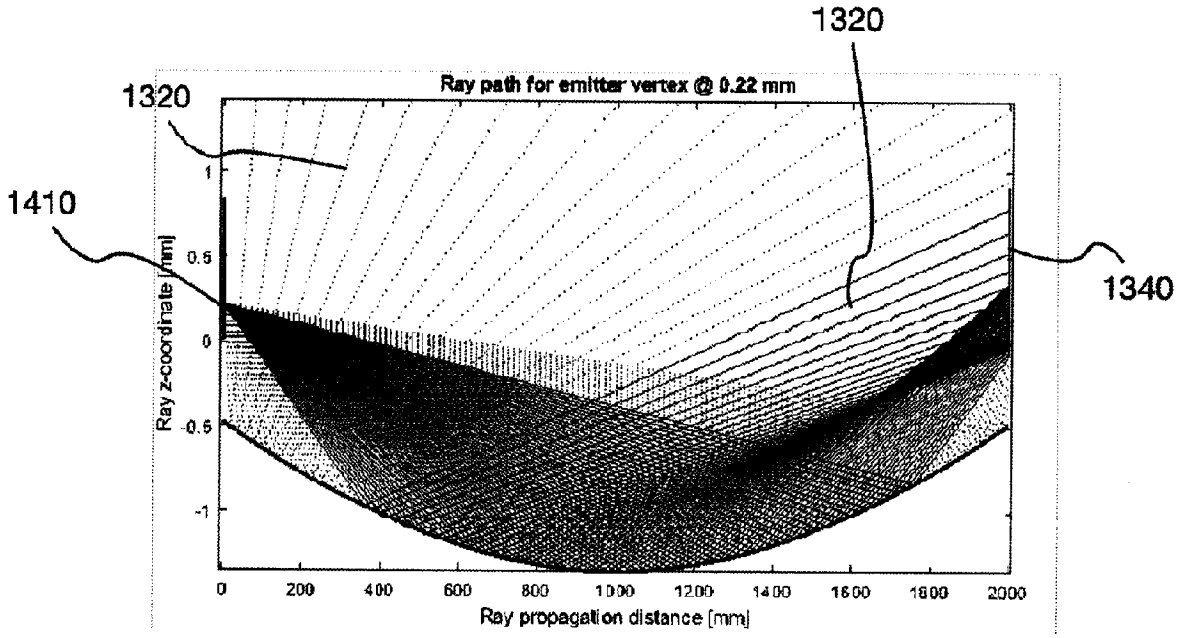


Figure 14a

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 1002

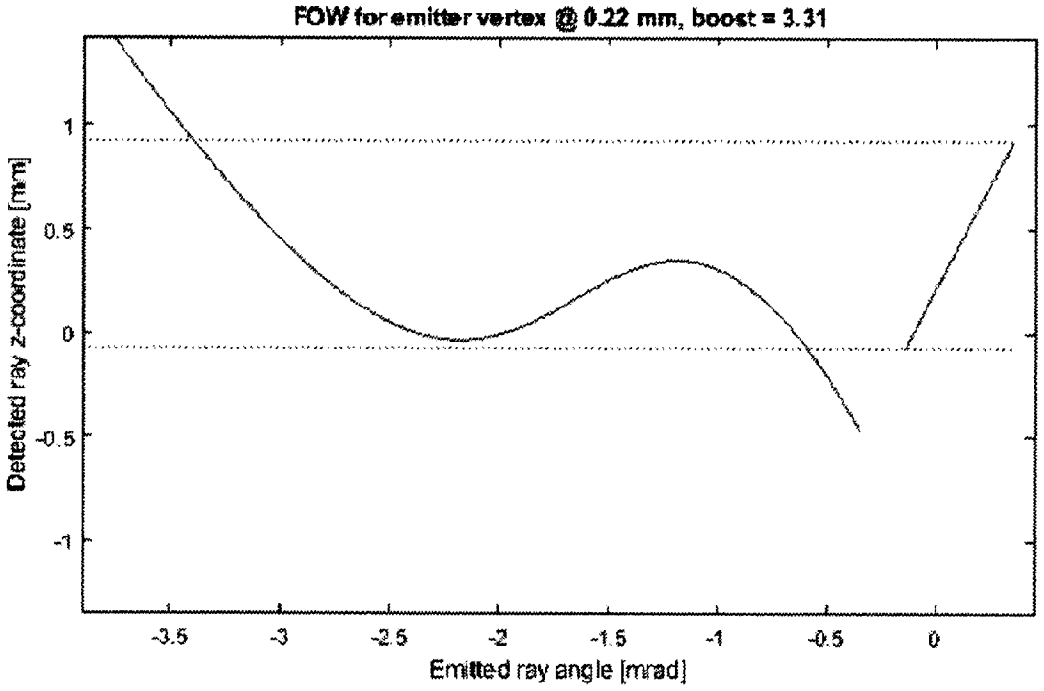


Figure 14b

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 1003

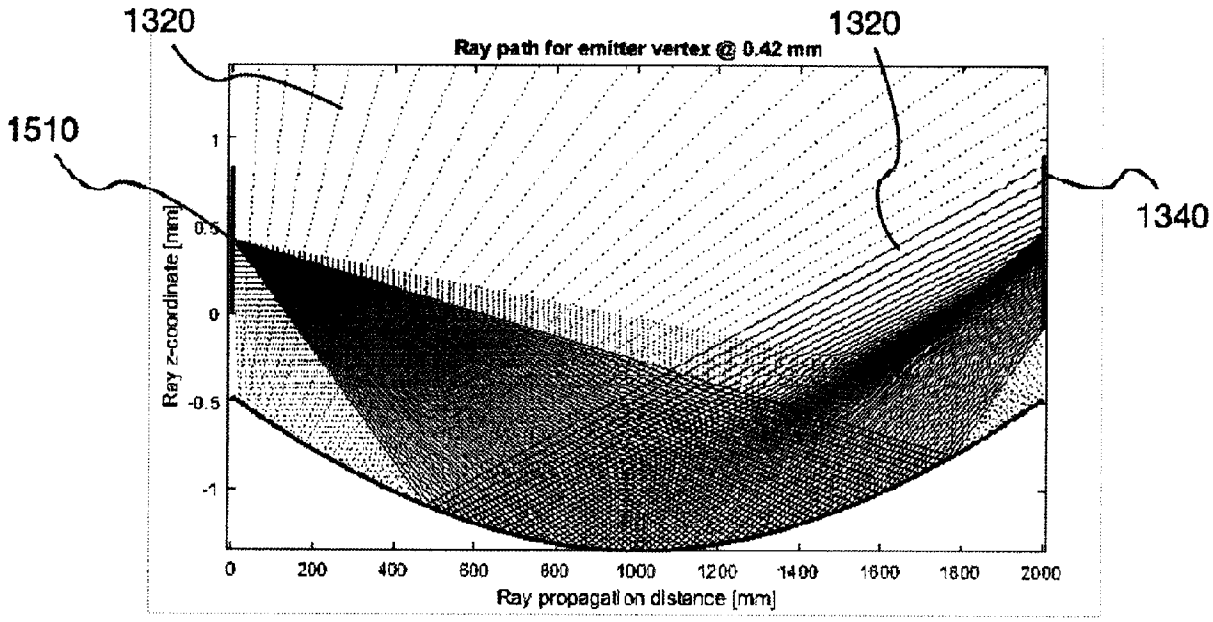


Figure 15a

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 1004

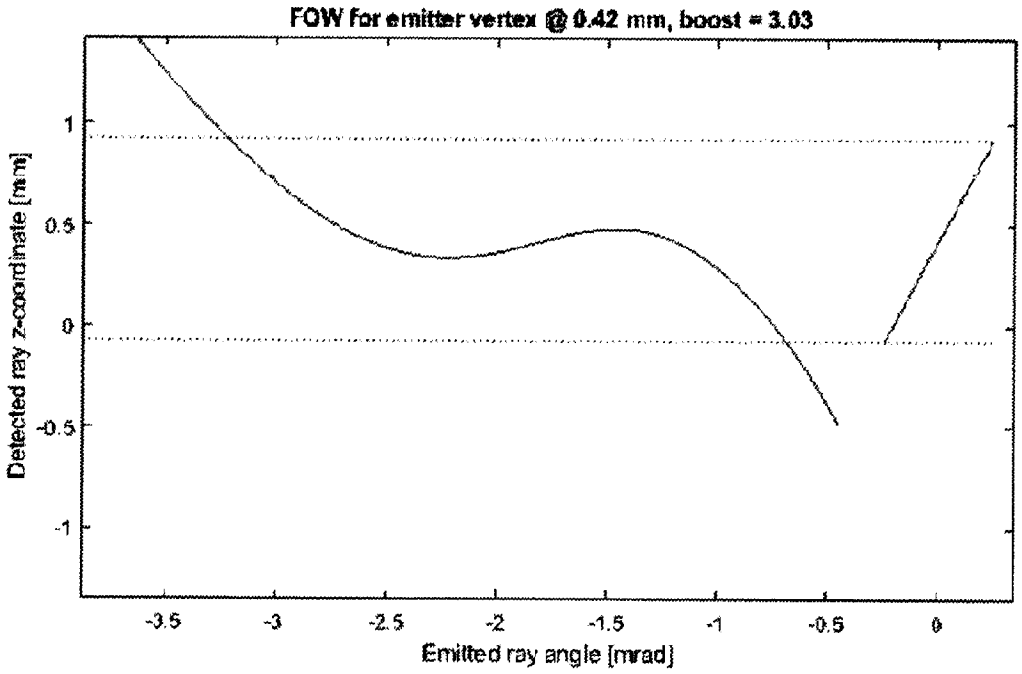


Figure 15b

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 1005

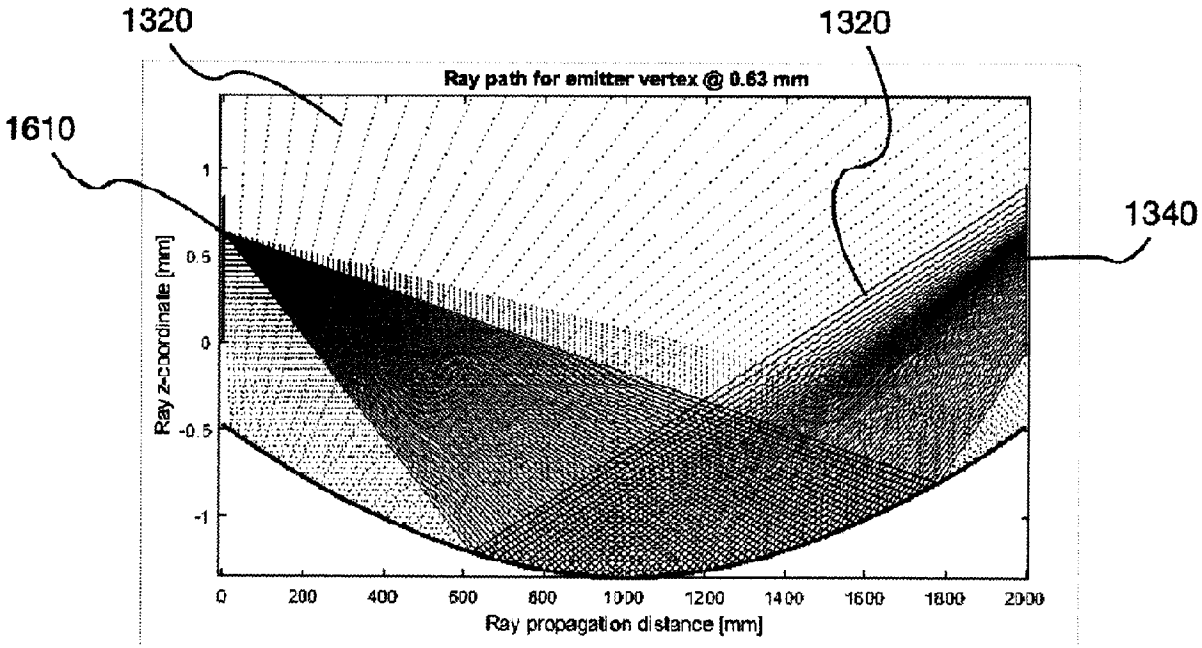


Figure 16a

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 1006

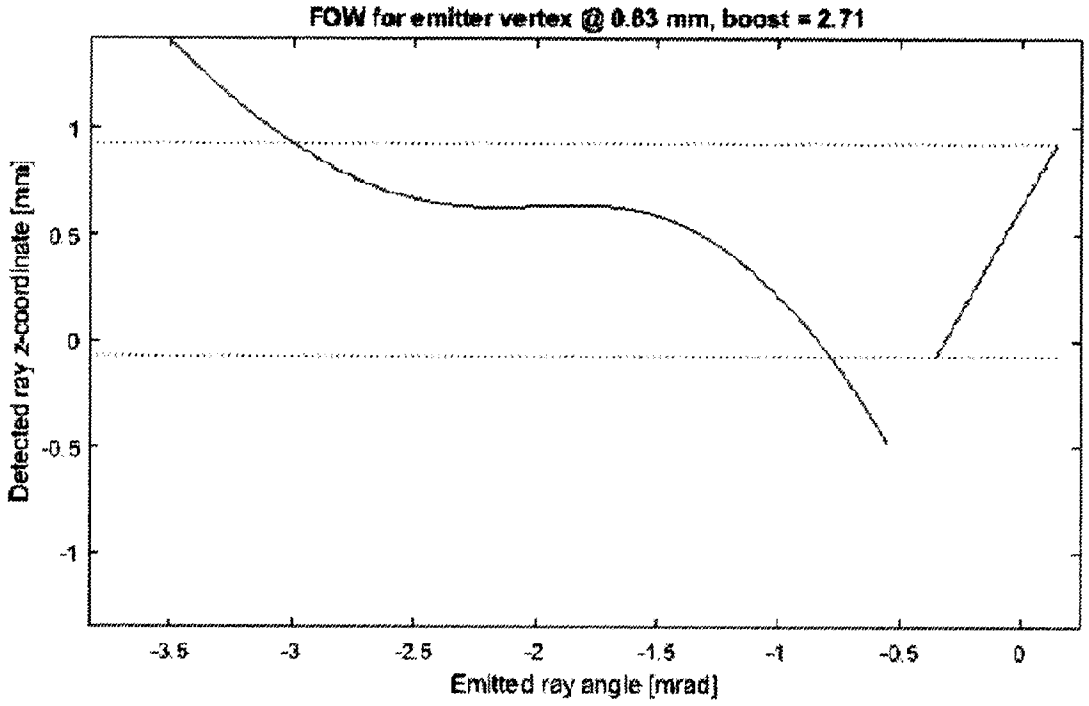


Figure 16b

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 1007

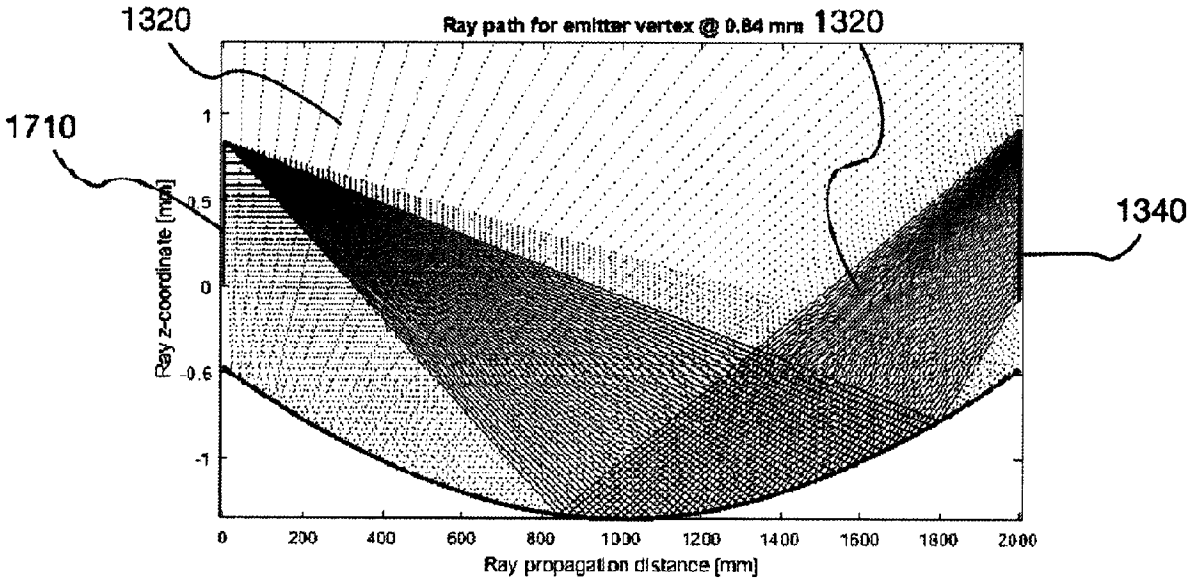


Figure 17a

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 1008

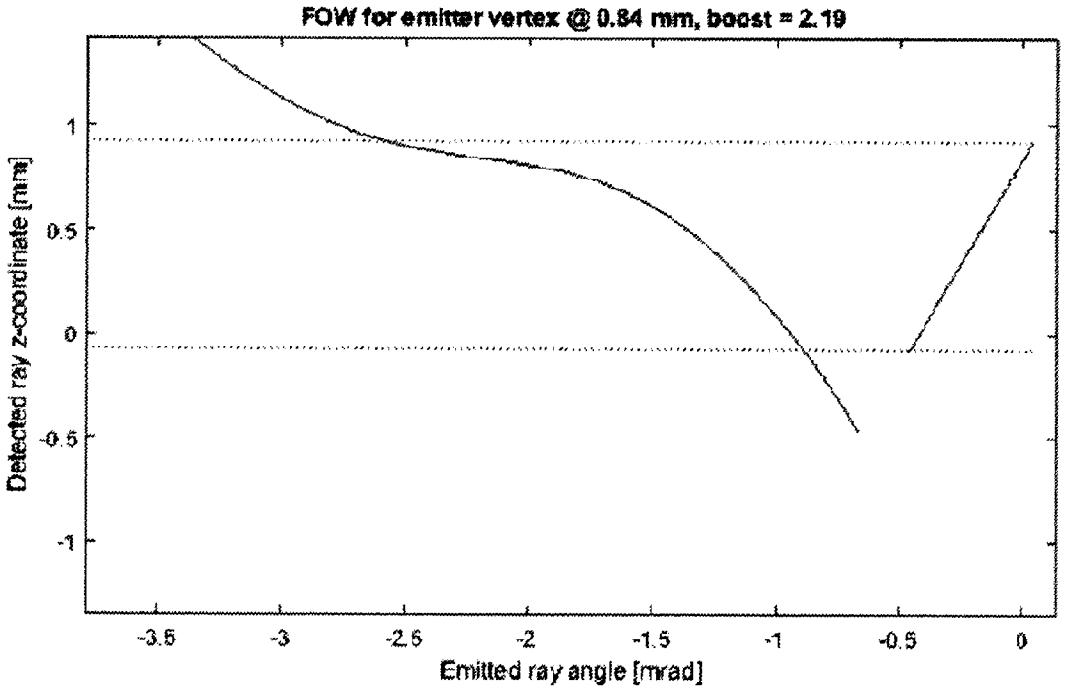


Figure 17b

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 1009

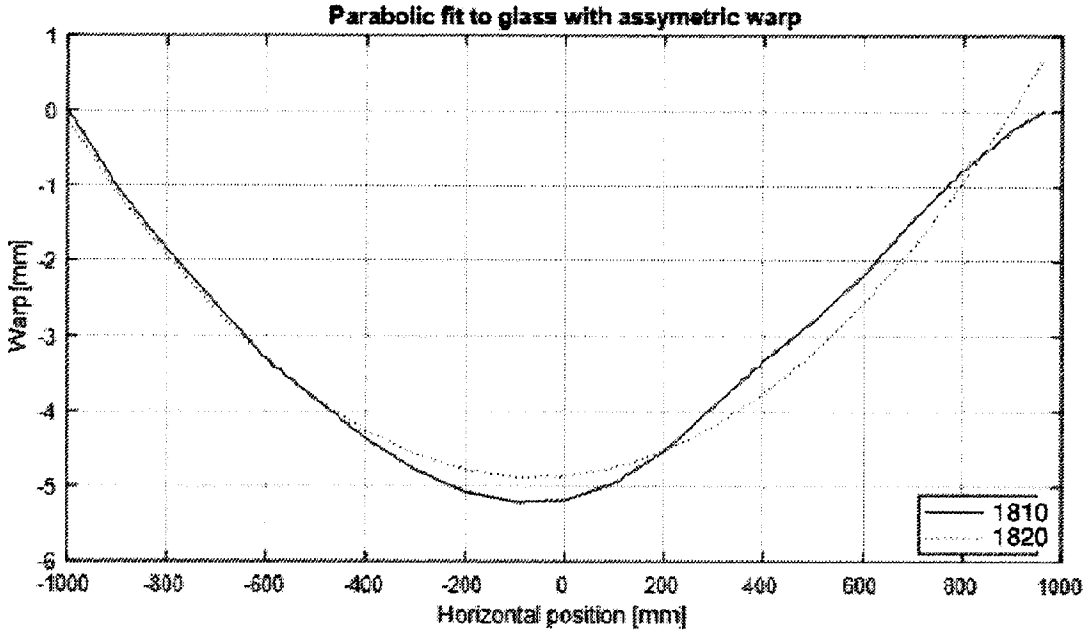


Figure 18a

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 1010

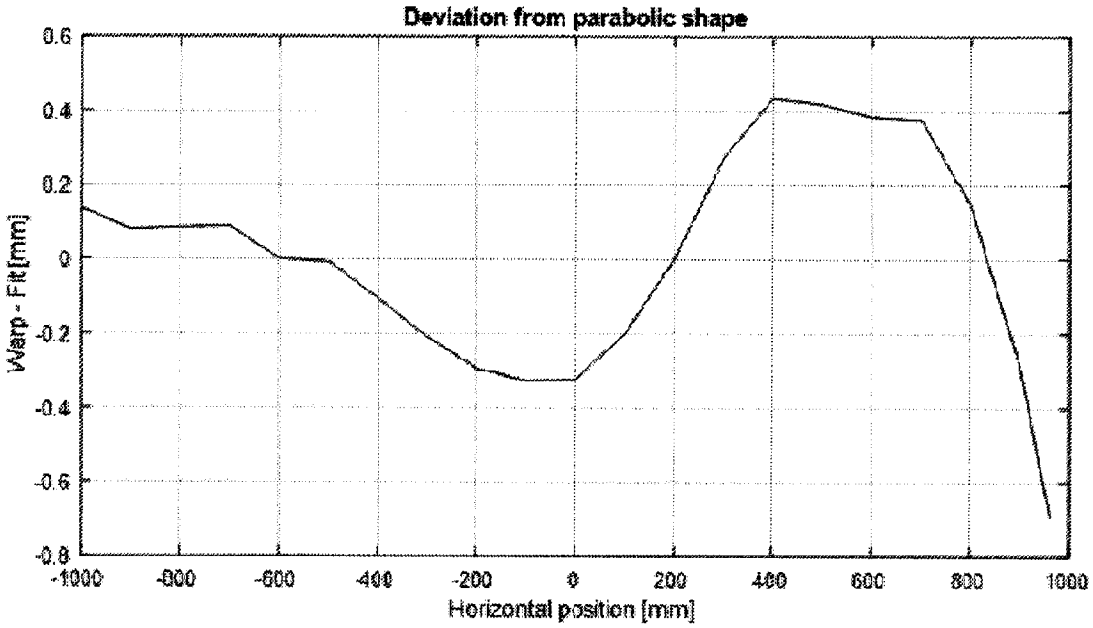


Figure 18b

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 1011

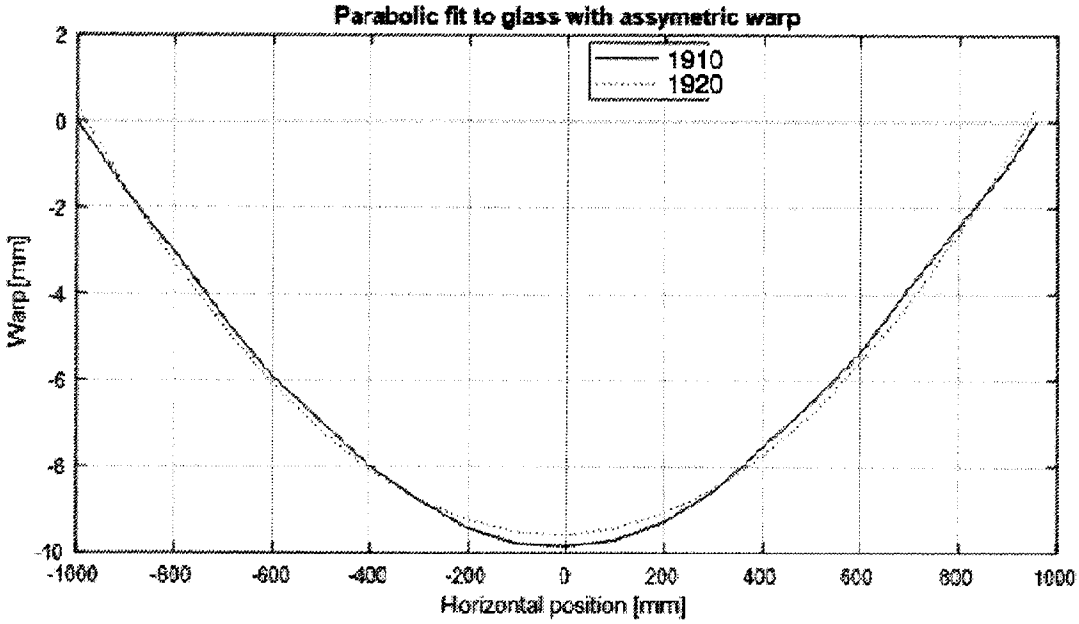


Figure 19a

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 1012

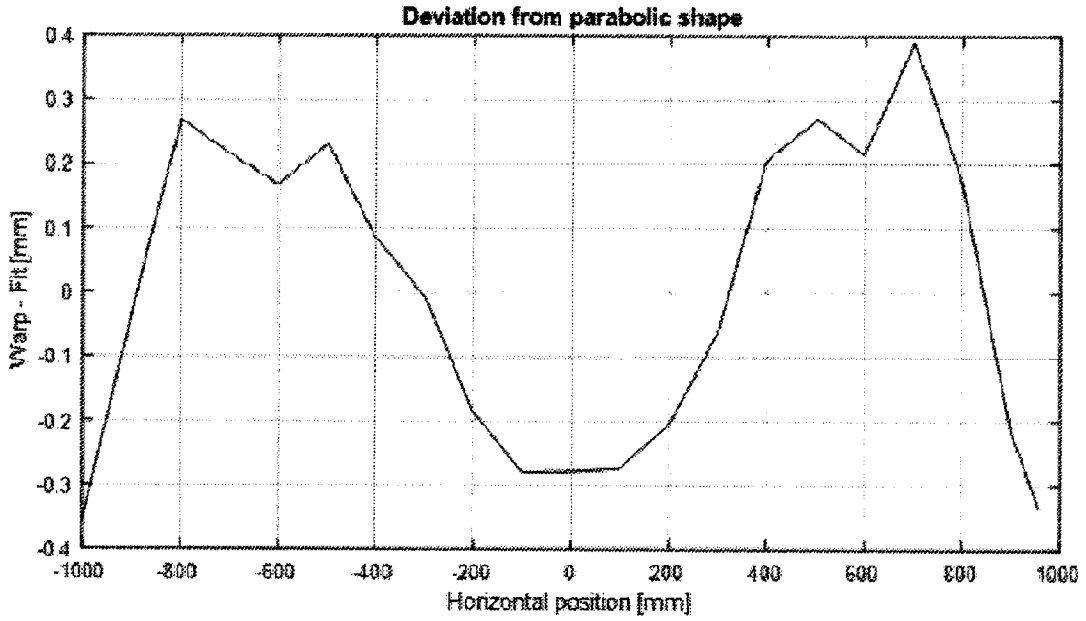


Figure 19b

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 1013

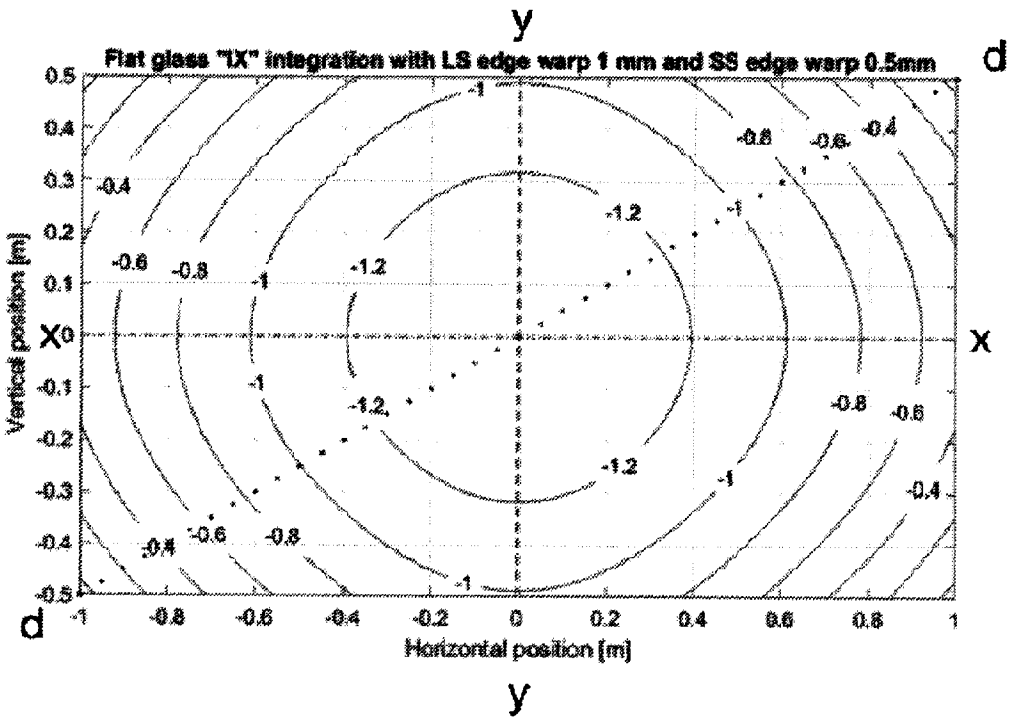


Figure 20a

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 1014

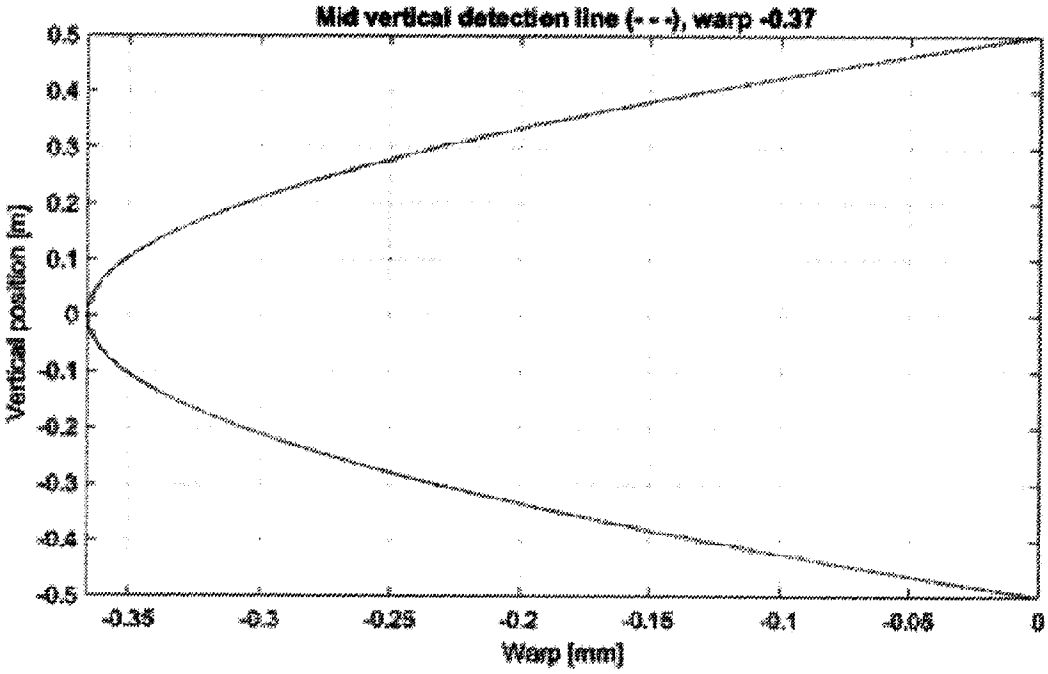


Figure 20b

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 1015

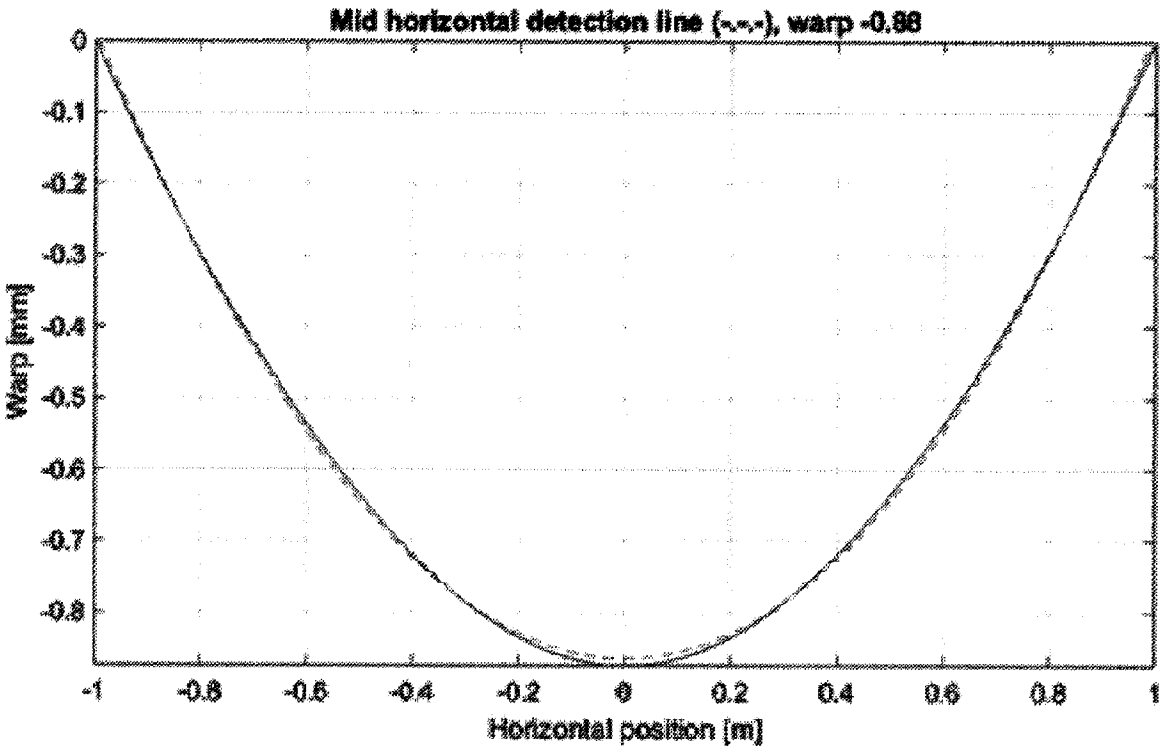


Figure 20c

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 1016

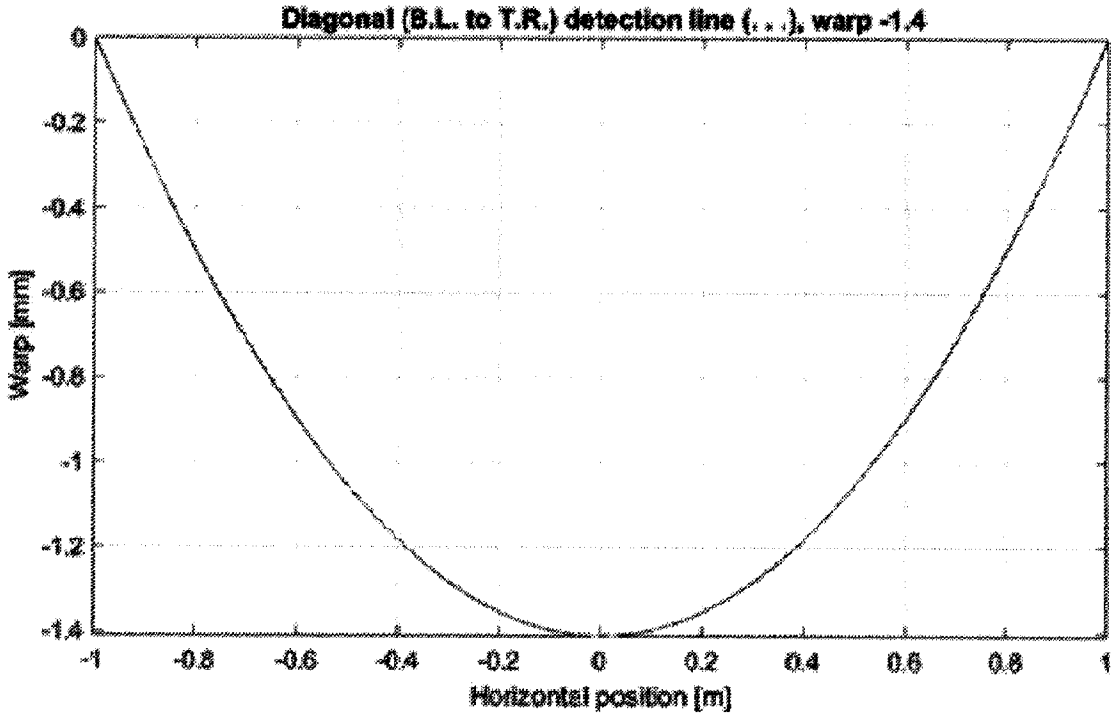


Figure 20d

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 1017

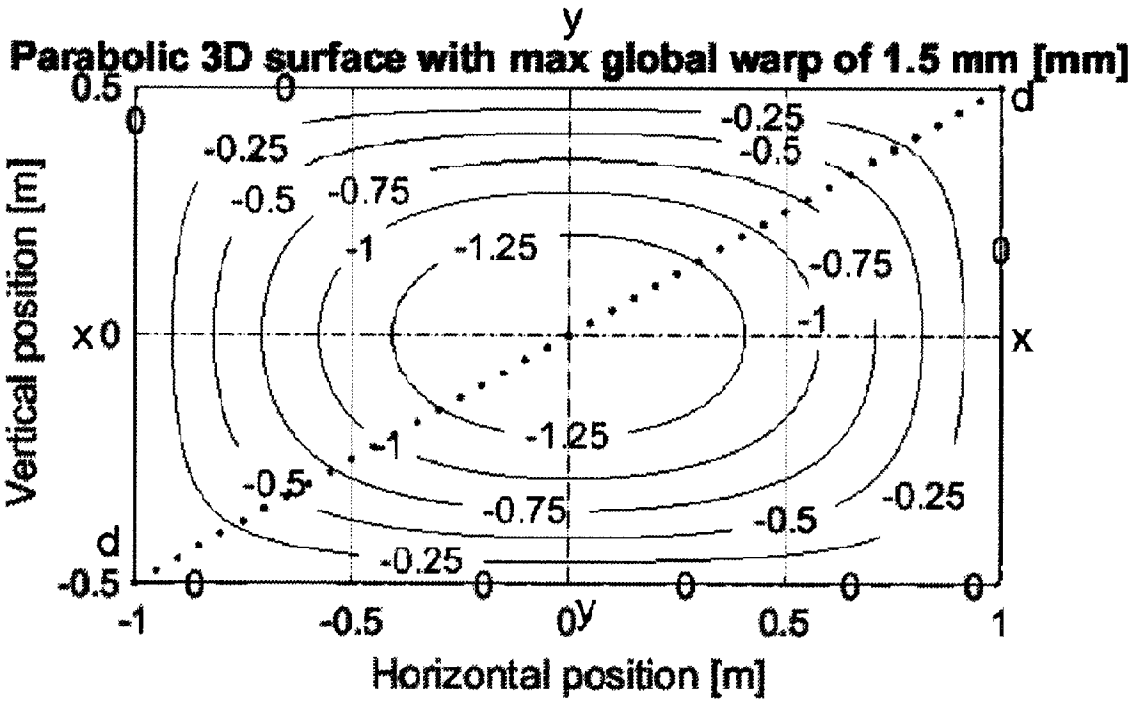


Figure 21a

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 1018

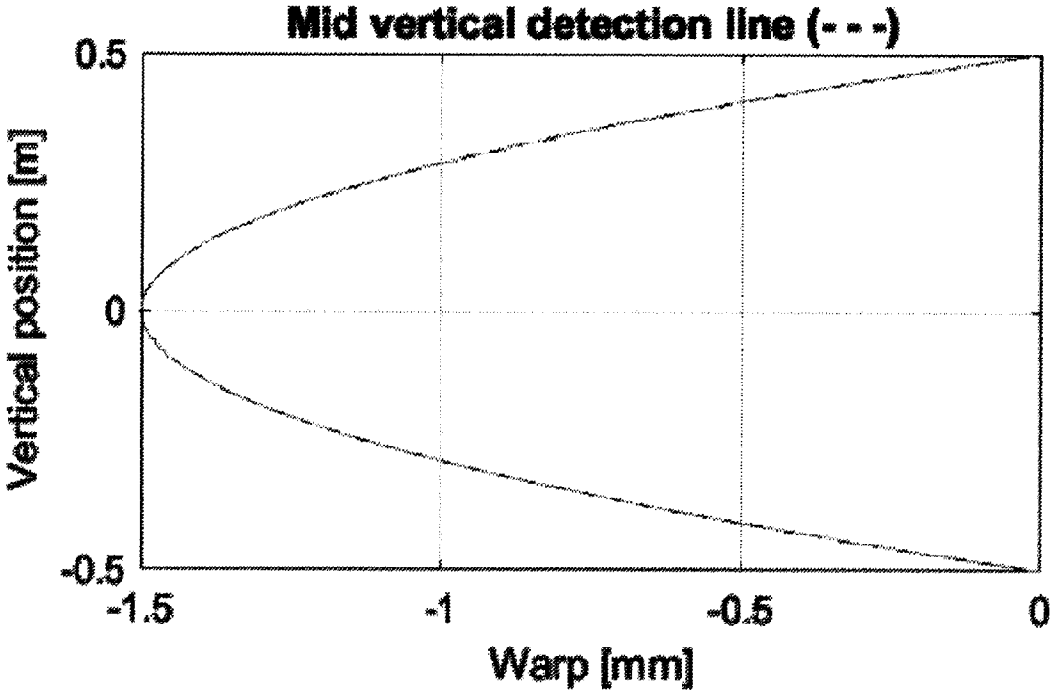


Figure 21b

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 1019

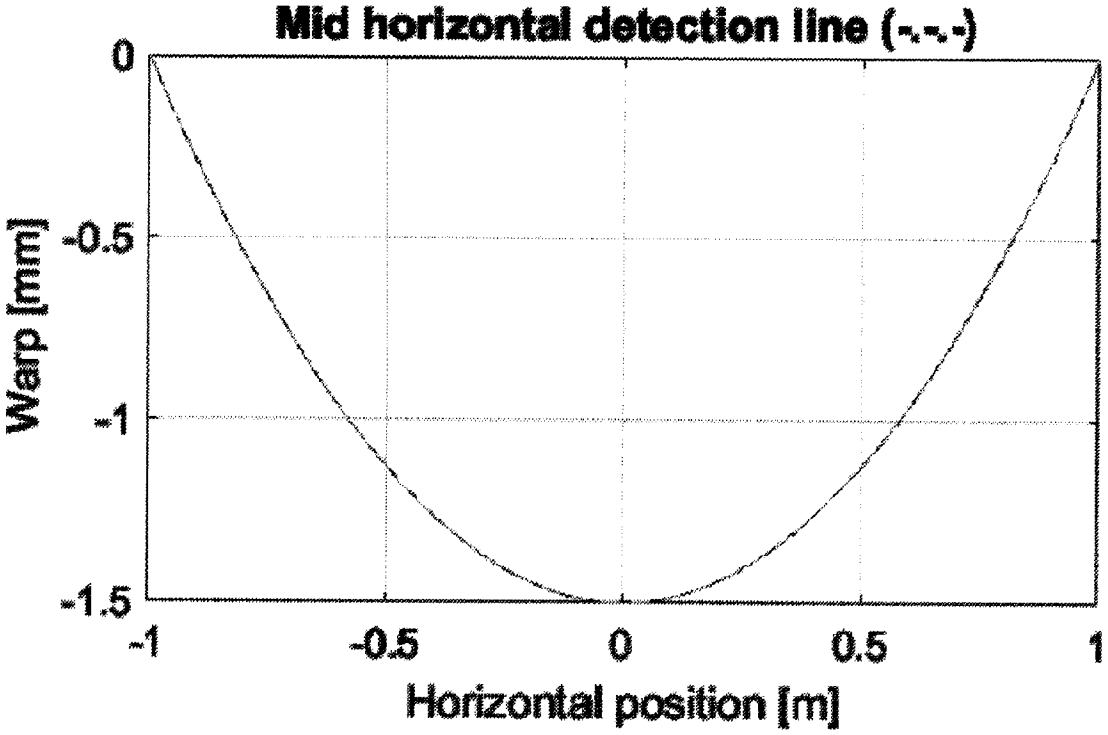


Figure 21c

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 1020

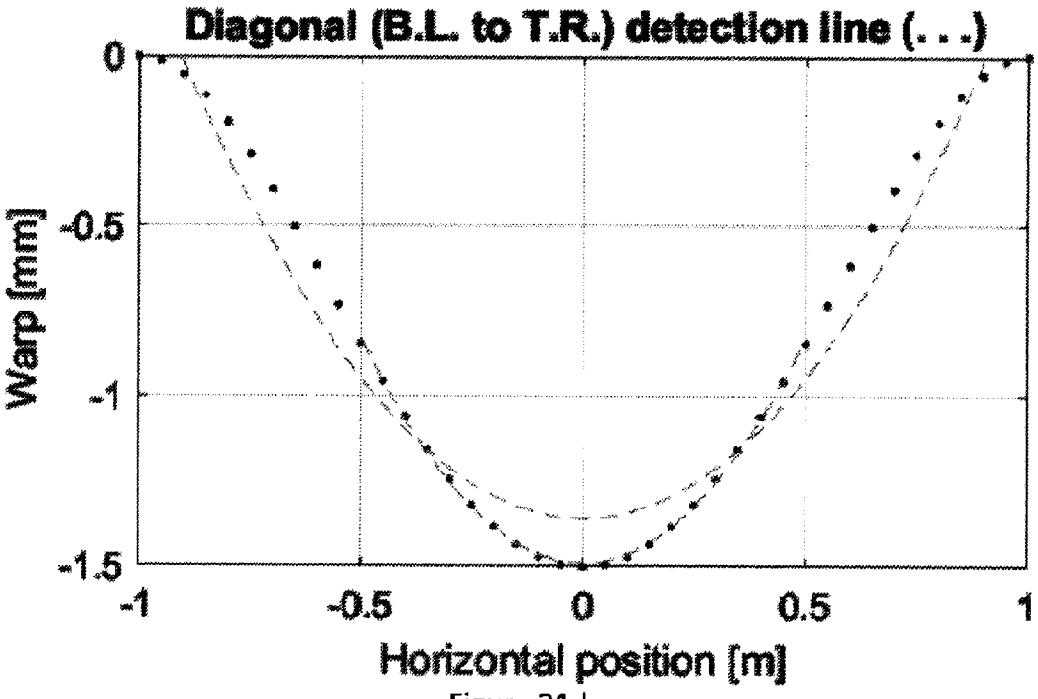


Figure 21d

Chemtronics v. FlatFrog
Chemtronics Exhibit 1032 Page 1021

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2017/051233

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: G06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE, DK, FI, NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, PAJ, WPI data, COMPENDEX, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6031524 A1 (INTERMEC IP CORP), 29 February 2000 (2000-02-29); column 1, line 60 - column 2, line 20 --	1-24
A	US 20160295711 A1 (RYU HYUNJONG ET AL), 6 October 2016 (2016-10-06); whole document --	1-24
A	EP 3043242 A1 (DEXERIALS CORP), 13 July 2016 (2016-07-13); whole document --	1-24
A	WO 2016177592 A1 (AGC GLASS EUROPE), 10 November 2016 (2016-11-10); whole document --	1-24

☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12-03-2018	12-03-2018
Name and mailing address of the ISA/SE Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. + 46 8 666 02 86	Authorized officer Emil Bäcklund Telephone No. + 46 8 782 28 00

Chemtronics v. FlatFrog
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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 20120062492 A1 (KATOH SATOSHI), 15 March 2012 (2012-03-15); paragraphs [0006]-[0010]	1-24
A	US 20120045170 A1 (SHIBATA NAOKI ET AL), 23 February 2012 (2012-02-23); whole document	1-24

Continuation of: second sheet

International Patent Classification (IPC)

G06F 1/16 (2006.01)
G06F 3/01 (2006.01)
G06F 3/03 (2006.01)
G06F 3/041 (2006.01)

US	6031524	A1	29/02/2000	NONE			
US	20160295711	A1	06/10/2016	US	9839145	B2	05/12/2017
				WO	2015111890	A1	30/07/2015
EP	3043242	A1	13/07/2016	CN	105518592	A	20/04/2016
				JP	2015052916	A	19/03/2015
				JP	5848736	B2	27/01/2016
				KR	20160053923	A	13/05/2016
				TW	201523377	A	16/06/2015
				US	20160202801	A1	14/07/2016
				WO	2015033569	A1	12/03/2015
WO	2016177592	A1	10/11/2016	CN	107531547	A	02/01/2018
				KR	20180004141	A	10/01/2018
				TW	201704169	A	01/02/2017
US	20120062492	A1	15/03/2012	US	8648826	B2	11/02/2014
				WO	2010119882	A1	21/10/2010
US	20120045170	A1	23/02/2012	CN	102375179	A	14/03/2012
				JP	2012043136	A	01/03/2012
				KR	20120017403	A	28/02/2012
				TW	201219866	A	16/05/2012

Electronic Patent Application Fee Transmittal

Application Number:	16403283
Filing Date:	03-May-2019
Title of Invention:	TOUCH DEVICE
First Named Inventor/Applicant Name:	Aleksander Kocovski
Filer:	Harnik Shukla/Jenny Kim
Attorney Docket Number:	FFOG.053C3

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
SUBMISSION- INFORMATION DISCLOSURE STMT	1806	1	240	240
		Total in USD ($)		**240**

Electronic Acknowledgement Receipt

EFS ID:	39578589
Application Number:	16403283
International Application Number:	
Confirmation Number:	5417
Title of Invention:	TOUCH DEVICE
First Named Inventor/Applicant Name:	Aleksander Kocovski
Customer Number:	20995
Filer:	Harnik Shukla/Jenny Kim
Filer Authorized By:	Harnik Shukla
Attorney Docket Number:	FFOG.053C3
Receipt Date:	29-MAY-2020
Filing Date:	03-MAY-2019
Time Stamp:	18:04:11
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$240
RAM confirmation Number	E20205SI04375116
Deposit Account	
Authorized User	

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		053C3.pdf	55183 59e34e97bd9d2656313a2cd67bad6e12c3c22a0c	yes	4
	Multipart Description/PDF files in .zip description				
	Document Description		**Start**	**End**	
	Information Disclosure Statement (IDS) Form (SB08)		3	4	
	Information Disclosure Statement (IDS) Form (SB08)		1	2	
Warnings:					
Information:					
2	Non Patent Literature	Civil_Cover_Sheet_12-10-2019.pdf	896949 773f4e80c82a3acd50457340569800fb342d485b	no	1
Warnings:					
Information:					
3	Non Patent Literature	Complaint_Patent_Infringement_12-10-2019.pdf	8421510 a0c527c04d82abffb1ba621897ceb3798db89309	no	83
Warnings:					
Information:					
4	Non Patent Literature	Defendant_Answer_to_Second_Amended_Complaint.pdf	243662 068e7e9778ffb00ea15a167b206033904e97f286	no	29
Warnings:					
Information:					
5	Foreign Reference	EP_2765622A2.pdf	1317864 a4423a5c371d18d46e6371395636e8a70d79241f	no	16
Warnings:					
Information:					

6	Foreign Reference	EP_3535640A1_eq_WO2018_106176.pdf	4694401 4157792d205fd2563da4135d45bf2db141dbc5e4	no	97
Warnings:					
Information:					
7	Non Patent Literature	Executed_Summons_Civil_Action_12-10-2019.pdf	196209 7f4e1552c59e247fb6dd3dadfc0a4e16cbc0f863	no	2
Warnings:					
Information:					
8	Non Patent Literature	Rpt_on_Filing_Pat_10282035_12-10-2019.pdf	449958 c509b1714667a4ee63962c7e952dddab86e29410	no	1
Warnings:					
Information:					
9	Non Patent Literature	Summons_Civil_Action_Promethean_Inc_12-10-2019.pdf	455675 41c8359fcffe458b47baf286c8aab5834214dc48	no	2
Warnings:					
Information:					
10	Non Patent Literature	Summons_Civil_Action_Promethean_Ltd_12-10-2019.pdf	448784 49b0b8722386174655adb944f1b4f5e1fcd59fa7	no	2
Warnings:					
Information:					
11	Foreign Reference	WO_2014065601A1.pdf	10530514 73e7b21a891c3b227398c3dd1ae75e4aca4a7d83	no	54
Warnings:					
Information:					
12	Foreign Reference	WO_2013159472.pdf	836659 b691b0072236ffdc06d1413e7e7367c80cc9ad8c	no	22
Warnings:					
Information:					

13	Foreign Reference	WO_2018106176.pdf	4662685 181b3a8876fa547661e13456f92b6ab702bda68e	no	96
Warnings:					
Information:					
14	Fee Worksheet (SB06)	fee-info.pdf	30584 6ae91cbbfccb6b7f7f9a1d244d2232d395cc3bd6	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	33240637		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT	Application No.	16/403283
	Filing Date	May 3, 2019
	First Named Inventor	Aleksander Kocovski
	Art Unit	2621
(Multiple sheets used when necessary)	Examiner	Lam, Vinh Tang
SHEET 1 OF 2	Attorney Docket No.	FFOG.053C3

U.S. PATENT DOCUMENTS					
Examiner Initials	Cite No.	Document Number *Number - Kind Code (if known)* Example: 1,234,567 B1	Publication Date MM-DD-YYYY	Name	Pages, Columns, Lines Where Relevant Passages or Relevant Figures Appear
	1	2015/0373864 A1	12-24-2015	Jung	
	2	2013/0321740 A1	12-5-2013	An et al.	
	3	2016/0154533 A1	06-02-2016	Eriksson et al.	
	4	2011/0080361 A1	04-07-2011	Miller et al.	
	5	2019/0235701 A1	08-01-2019	Han et al.	
	6	9,024,896 B2	05-05-2015	Chen	
	7	4,751,379	06-14-1988	Sasaki et al.	
	8	2013/0234991 A1	09-12-2013	Sparf	

FOREIGN PATENT DOCUMENTS						
Examiner Initials	Cite No.	Foreign Patent Document *Country Code-Number-Kind Code* Example: JP 1234567 A1	Publication Date MM-DD-YYYY	Name	Pages, Columns, Lines Where Relevant Passages or Relevant Figures Appear	T[1]
	9	WO 2014/065601	05-01-2014	LG Electronics Inc.		
	10	WO 2018/106176	06-14-2018	FlatFrog Laboratories AB		
	11	EP 3535640 A1	09-11-2019	FlatFrog Laboratories AB		
	12	EP 2765622 A2	08-13-2014	LG Electronics Inc.		
	13	WO 2013/159472	10-31-2013	Shenzhen Timelink Technology Co., LTD.		X

NON PATENT LITERATURE DOCUMENTS			
Examiner Initials	Cite No.	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T[1]
	14	Report on the Filing or Determination of an Action Regarding a Patent or Trademark. For U.S. Patent No. 10,282,035, U.S. District of Delaware, dated December 10, 2019, in 1 page.	
	15	Civil Cover Sheet FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., dated December 10, 2019, in 1 page.	
	16	Complaint for Patent Infringement, FLATFROG LABORATORIES AB v. PROMETHEAN LTD. and PROMETHEAN INC., C.A. No. 19-2246, dated December 10, 2019, in 83 pages.	
	17	Executed Summons in a Civil Action to PROMETHEAN INC., C.A. No. 19-2246, dated December 10, 2019 in 2 pages.	
	18	Summons in a Civil Action to PROMETHEAN INC., C.A. No. 19-2246, dated December 10, 2019 in 2 pages.	

Examiner Signature	Date Considered

***Examiner:** Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

T[1] - Place a check mark in this area when an English language Translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT	Application No.	16/403283
	Filing Date	May 3, 2019
	First Named Inventor	Aleksander Kocovski
	Art Unit	2621
(Multiple sheets used when necessary)	Examiner	Lam, Vinh Tang
SHEET 2 OF 2	Attorney Docket No.	FFOG.053C3

NON PATENT LITERATURE DOCUMENTS			
Examiner Initials	Cite No.	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T[1]
	19	Summons in a Civil Action to Promethean Ltd., C.A. No. 19-2246, dated December 10, 2019 in 2 pages.	
	20	Defendants' Answer to Second Amended Complaint and Defendant Promethean Inc.'s Counterclaims Against FlatFrog Laboratories AB., C.A. No. 19-2246, dated May 22, 2020, in 29 pages.	

32775328

Examiner Signature	Date Considered

*__Examiner:__ Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

T[1] - Place a check mark in this area when an English language Translation is attached.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/403,283	05/03/2019	Aleksander Kocovski	FFOG.053C3	5417

20995 7590 03/26/2020

KNOBBE MARTENS OLSON & BEAR LLP
2040 MAIN STREET
FOURTEENTH FLOOR
IRVINE, CA 92614

EXAMINER	
LAM, VINH TANG	

ART UNIT	PAPER NUMBER
2628	

NOTIFICATION DATE	DELIVERY MODE
03/26/2020	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

efiling@knobbe.com
jayna.cartee@knobbe.com

Office Action Summary	Application No. 16/403,283	Applicant(s) Kocovski et al.	
	Examiner VINH T LAM	Art Unit 2628	AIA (FITF) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 11/25/2019.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL.** 2b) ☑ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 1-21 is/are pending in the application.

5a) Of the above claim(s) 1 is/are withdrawn from consideration.

6) ☑ Claim(s) 2-12 is/are allowed.

7) ☑ Claim(s) 13-21 is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☑ The specification is objected to by the Examiner.

11)☑ The drawing(s) filed on 05/03/2019 is/are: a)☑ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☑ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☑ All b)☐ Some** c)☐ None of the:

1.☑ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☑ Notice of References Cited (PTO-892)

2) ☑ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

DETAILED ACTION

Notice of Pre-AIA or AIA Status

1. The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Priority

2. Acknowledgment is made of applicant's claim for foreign priority based on an application filed in **SE** on **12/07/2016**. It is noted, however, that applicant has not filed a certified copy of the **16302945** application as required by 37 CFR 1.55.

Claim Objections

3. Claim **13** is objected to because of the following informalities: Typo error.

"the plate" should be *"the* ***rectangular*** *plate".*

Appropriate correction is required.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(a)(1) the claimed invention was patented, described in a printed publication, or in public use, on sale or otherwise available to the public before the effective filing date of the claimed invention.

4. Claim(s) **13-16** and **21** is/are rejected under 35 U.S.C. 102(a)(1) as being anticipated by **Wassvik (US Patent/PGPub. No. 20160334942)**.

Regarding Claim **13, (NEW)** **Wassvik** teaches **a touch sensing apparatus** *([0052], FIG. **2A**, i.e. **touch-sensitive apparatus 100**)* **comprising:**

a display panel *([0079], FIG. **9**, i.e. **display 34**)*;

a rectangular plate *([0103], FIG. **10G**, i.e. **filter 20**)* **including a touch surface** *([0052], FIG. **2A**, i.e. **touch surface 4**)*;

a plurality of emitters *([0052], FIG. **2A**, i.e. **Emitters 2**)* **configured to emit light across** *([0052], FIG. **2A**, i.e. **propagating light**)* **the touch surface of the rectangular plate** *(i.e. please see above citation(s))*, **and**

a frame element *([0052], FIG. **2A**, i.e. **area surrounding** panel **1**)* **configured to support** *(FIG. **2A**, i.e. as **shown** by the **figure(s)**)* **the**

display panel, the rectangular plate, and the plurality of emitters, said frame element *(i.e. please see above citation(s))* **comprising:**

an edge portion *([0103], FIG. **10G**, i.e. **right side vertical edge portion** of area surrounding panel **1**)* **including a longitudinal axis** *([0052], FIG. **2A & 10G**, i.e. **vertical axis** of FIG. **2** which is an **axis perpendicular** to **plane** of panel **1** in FIG. **10G**)* **and being arranged along an edge** *([0052], FIG. **2A & 10G**, i.e. **right side vertical edge portion** of panel **1**)* **of the plate** *(i.e. please see above citation(s))* **between a first corner** *([0103], FIG. **10G**, i.e. **lower right corner** of filter **20**)* **and a second corner** *([0103], FIG. **10G**, i.e. **lower left corner** of filter **20**)* **of the plate** *(i.e. please see above citation(s))*,

wherein a distance *([0103], FIG. **2A & 10G**, i.e. **distance** the **axis** and **lower horizontal line** of filter **20**)* **between the longitudinal axis of the edge portion** *(i.e. please see above citation(s))* **and a straight line** *([0103], FIG. **10G**, i.e. **lower horizontal line** of filter **20**)* **between the first corner and the second corner** *(i.e. please see above citation(s))* **varies according to a parabolic function** *([0103], FIG. **10G**, i.e. **walls 42A, 42B may be ... parabolic**)*.

Regarding Claim **14, (NEW)** **Wassvik** teaches **the touch sensing apparatus of claim 13, wherein the plurality of emitters** *(i.e. please see above citation(s))* **is configured to emit light to propagate over** *([0052], FIG. 2A, i.e. propagating light)* **the touch surface** *(i.e. please see above citation(s))*.

Regarding Claim **15, (NEW)** **Wassvik** teaches **the touch sensing apparatus of claim 13, wherein the plurality of emitters is configured to emit light through the plate** *(i.e. please see above citation(s))* **by total internal reflection** *([0051], FIG. 1, i.e. total internal reflection)*.

Regarding Claim **16, (NEW)** **Wassvik** teaches **the touch sensing apparatus of claim 13, further comprising a processing element** *([0054], FIG. 2A, i.e. signal processor 10)* **configured to determine, based on output signals** *([0053], FIG. 2A, i.e. output signal)* **of the plurality of detectors** *(i.e. please see above citation(s))*, **a position of an object** *([0053], FIG. 2A, i.e. touching objects, such as a position)* **adjacent to the touch surface** *(i.e. please see above citation(s))*.

Regarding Claim **21, (NEW)** **Wassvik** teaches **a touch sensing apparatus** *([0052], FIG. **2A**, i.e. **touch-sensitive apparatus 100**)* **comprising:**

a frame element *([0103], FIG. **10G**, i.e. **recycler 40**)* **configured to be arranged along an edge** *([0103], FIG. **10G**, i.e. **vertical edge** of filter **20**)* **of a plate** *([0103], FIG. **10G**, i.e. **filter 20**)* **including a touch surface** *([0052], FIG. **2A**, i.e. **touch surface 4**)*;

wherein the frame element *(i.e. please see above citation(s))* **includes a curvature** *([0103], FIG. **10G**, i.e. **curve** of walls 42A, 42B may be … parabolic)* **along a longitudinal axis** *([0103], FIG. **10G**, i.e. **vertical axis** of panel **1**)* **of the frame element** *(i.e. please see above citation(s))*, **and**

wherein the curvature of the frame element *(i.e. please see above citation(s))* **is configured to induce a corresponding curvature function** *([0103], FIG. **10G**, i.e. **curvature function** of walls 42A, 42B may be … parabolic)* **in the plate** *(i.e. please see above citation(s))* **such that a distance** *([0103], FIG. **2A & 10G**, i.e. **distance** from touch surface **4** (**panel 1** in FIG. **10G**) and **lower horizontal line** of filter **20**)* **between the touch surface** *(i.e. please see above citation(s))* **and a straight line** *([0103], FIG. **10G**, i.e. **vertical line** of filter **20**)* **parallel to** *(FIG. **10G**, i.e. as **shown** by the **figure(s)**)* **the**

edge of the plate *(i.e. please see above citation(s))* **varies according to a parabolic function** *([0103], FIG. **10G**, i.e. **walls 42A, 42B may be ... parabolic)*.**

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103 which forms the basis for all obviousness rejections set forth in this Office action:

> A patent for a claimed invention may not be obtained, notwithstanding that the claimed invention is not identically disclosed as set forth in section 102 of this title, if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claim(s) **17-20** is/are rejected under 35 U.S.C. 103 as being unpatentable over **Wassvik (US Patent/PGPub. No. 20160334942)** in view of **RYU et al. (US Patent/PGPub. No. 20160295711).**

Regarding Claim **17, (NEW)** **Wassvik** teaches **the touch sensing apparatus of claim 13.**

However, **Wassvik** does not explicitly teach the plate has a first curvature prior to installation and, when assembled, the frame assembly induces the plate into having a second curvature greater than the first curvature.

In the same field of endeavor, **RYU et al.** teach

the plate *([0063], FIG. **4(a) & 4(b)**, i.e. **display unit 20**)* **has a first curvature** *([0070], FIG. **4(a)**, i.e. **flat** surface **display unit 20** which would be **curvature** with **infinite radius**)* **prior to installation** *([0072], FIG. **4(a)**, i.e. **prior to** links 50 are pushed up)* **and, when assembled** *([0072], FIG. **4(a)**, i.e. **after** links **50** are **pushed up**)*, **the frame assembly** *([0063], FIG. **4(a) & 4(b)**, i.e. **housing 30**)* **induces the plate into having a second curvature greater than** *([0072], FIG. **4(a) & 4(b)**, i.e. **more curved** after links 50 are pushed up)* **the first curvature** *(i.e. please see above citation(s))*.

It would have been obvious to a person having ordinary skill in the art at the time the invention's effective date was filed to combine **Wassvik** teaching touch display device comprising frame and curved display surface with **RYU et al.** teaching of touch display device comprising frame and curved/flat display surface *to effectively adjust field of views by providing both curved or flat surface of display (RYU et al.'s [0071])*.

Regarding Claim **18, (NEW) the touch sensing apparatus of claim 17, wherein**

RYU et al. teach **the first curvature and second curvature** *(i.e. please see above citation(s))* **are measured along an edge of the plate** *([0072], FIG. **4(a) & 4(b)**, i.e. **vertical edge** of **housing 30**)*.

Regarding Claim **19, (NEW) the touch sensing apparatus of claim 17, wherein**

RYU et al. teach **the first curvature and second curvature** *(i.e. please see above citation(s))* **are measured along an axis passing through a center point** *([0072], FIG. **4(a) & 4(b)**, i.e. **vertical axis** through **center point** of **20**)* **of the plate** *(i.e. please see above citation(s))*.

Regarding Claim **20, (NEW) the touch sensing apparatus of claim 17, wherein**

RYU et al. teach **the first curvature and second curvature** *(i.e. please see above citation(s))* **are measured along an axis passing through any position** *([0072], FIG. **4(a) & 4(b)**, i.e. **vertical axis** through **any point** of **20**)* **on the plate** *(i.e. please see above citation(s))*.

Allowable Subject Matter

6. Claim(s) **2-12** is/are allowed.

7. The following is an examiner's statement of reasons for allowance:

Wassvik (US Patent/PGPub. No. 20160334942) teaches a touch-sensitive apparatus operates by light frustration (FTIR) and comprises a light transmissive panel that defines a front surface and a rear surface, light emitters optically connected to the panel so as to generate light that propagates by total internal reflection inside the panel, and light detectors optically connected to the panel so as to define a grid of propagation paths inside the panel between pairs of light emitters and light detectors. Each of said light emitters is a VCSEL array, each said VCSEL array including a plurality of VCSELs driven in parallel to collectively form one light emitter. Preferably, each light detector is optically connected to the panel via an angular filter, tailored to pass light to the detector in an angular range in which the emitters operate.

RYU et al. (US Patent/PGPub. No. 20160295711) teach display device is disclosed. The display device according to the present invention includes a display panel, a module cover coupled to the rear side of the display panel, and a housing coupled to the rear side of the module cover, wherein the housing comprises a driving unit configured to push at least part of the module cover such that the display panel is in at least one of a first state in which the display panel is flat and a second state in which the display panel is curved, wherein the driving unit comprises a motor assembly, at least one link having one side coupled to the motor assembly and the other side coupled to the module cover, and a guide coming into contact with at least one side of the at least one link to enable the at least one link to be pushed up and pulled down according to direction of a driving force transferred from the motor assembly.

The subject matter of the independent claims could either not be found or was not suggested in the prior art of record. The subject matter not found was a touch display device including

"…a first edge and a second edge parallel to the short edge; and

a third edge and a fourth edge parallel to the long edge; wherein a first plane defined by the touch surface is curved with respect to a second plane defined by the short edge and the long edge; and

wherein a distance between a first line in the first plane and the second plane varies according to a parabolic function." (Claim **2**), in combination with the other elements (or steps) of the device or apparatus and method recited in the claims.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to VINH TANG LAM whose telephone number is (571) 270-3704. The examiner can normally be reached on Monday to Friday 8:00 AM to 5:00 PM.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nitin K Patel can be reached on (571) 272-7677. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see https://ppair-my.uspto.gov/pair/PrivatePair. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/VINH T LAM/
Primary Examiner, Art Unit 2628