

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In the *Inter Partes* Review of U.S. Patent No. 11,281,335

Trial No.: Not Yet Assigned

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Inventor: Aleksander Kocovski, Hakan Bergstrom, Jens Thorvinger

Assignee: FlatFrog Laboratories AB

Title: TOUCH DEVICE

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PETITION FOR *INTER PARTES* REVIEW
UNDER 37 C.F.R. § 42.100

On behalf of Chemtronics USA, Inc. (“Chemtronics” or “Petitioner”) and in accordance with 35 U.S.C. § 311 and 37 C.F.R. § 42.100, *inter partes* review (“IPR”) is respectfully requested for claims 1 – 5 of U.S. Patent No. 11,281,335 (“the ’335 Patent”) (Ex. 1031).

The undersigned representative of Petitioner authorizes the Office to charge the \$41,500 Petition and Post-Institution Fees, and any additional fees, to Deposit Account 503013, ref: 034712-635004.

PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 11,281,335

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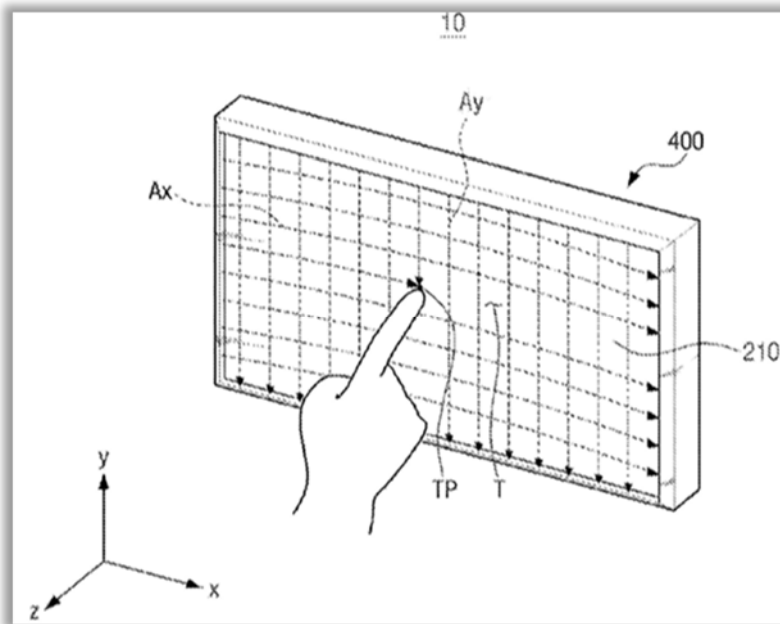
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I. INTRODUCTION

The '335 Patent claims elements, configurations, and methods related to infrared touch screen display devices that were known in the art. *See* Ex. 1033, ¶¶28-41 (Cairns Declaration). Such devices utilize infrared light beam occlusion techniques to determine a relative position of an object, such as a stylus or a user's touch, on a touch surface of a cover plate. Ex. 1005, Fig. 2 (Han).



Id. (prior art)

The '335 Patent purports to improve touch detection by claiming a concavely curved touch surface. But concavely curved touch surfaces were already known in the art, and for the same reasons. The '335 Patent discloses supporting and inducing curvature into the cover plate and touch surface via frame elements. But such support and curvature-inducing frame functionality was already known in the art. The '335

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Patent additionally claims total internal reflection of light through the cover plate. But total internal reflection of light through touch screen device cover plates was also already known in the art. Ex. 1033, ¶¶28-41.

The evidence shows that the apparatuses and techniques claimed in the '335 Patent were known before its priority date. Claims 1-5 of the '335 Patent should be deemed unpatentable.

II. GROUNDS FOR STANDING PURSUANT TO 37 C.F.R. § 42.104(A)

Petitioner certifies the '335 Patent is available for IPR and Petitioner is not barred or estopped from requesting IPR challenging the patent claims on the grounds identified herein.

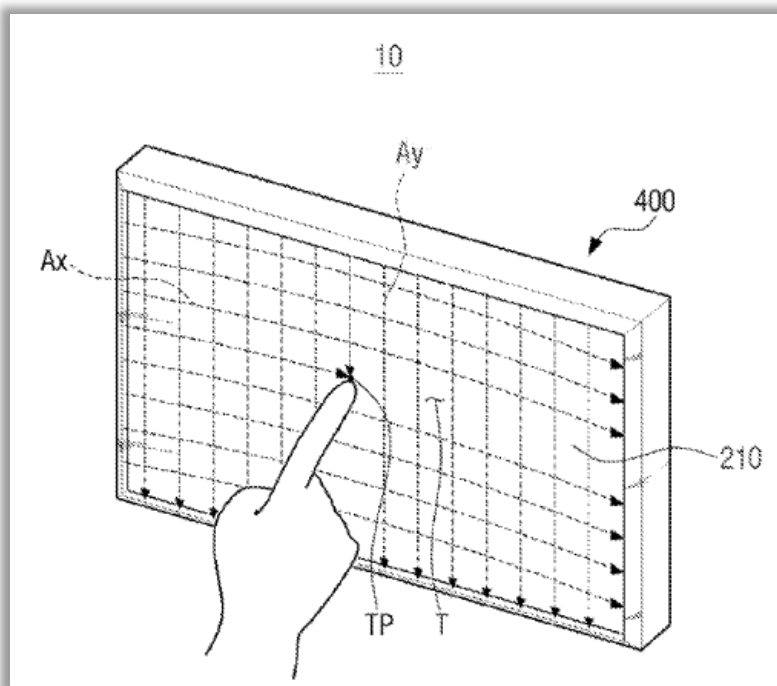
III. BACKGROUND INFORMATION FOR THE '335 PATENT

A. Technology Overview And The '335 Patent

Prior to the '335 Patent, it was known that a plurality of light emitters and corresponding detectors could be utilized to achieve touch-sensing functionality. For example, a plurality of infrared light emitters and opposing detectors could be arranged around the edges of a cover plate or display. See Ex. 1005, [0040-46]. Taught by Han, as infrared light is emitted, it passes over a touch surface before being received by a detector. *Id.* When a user touches an area of the touch surface, the touch blocks specific light pathways, preventing light emitted from certain emitters from being detected by

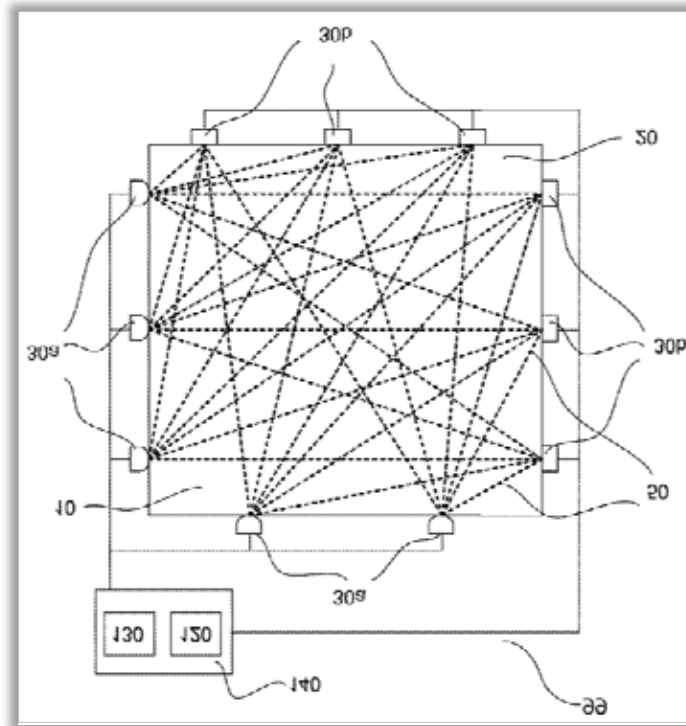
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certain detectors. Ex. 1005, [0048-49]. A processor can then determine the coordinate of the user touch based on which light emitters' light was blocked. *Id.*; Ex. 1033, ¶29.



Id., Fig. 2 (prior art).

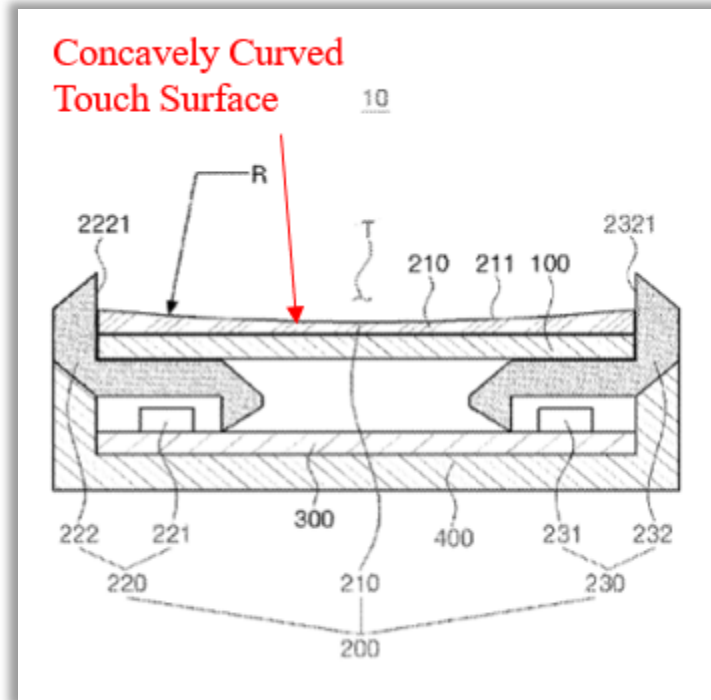
The '335 Patent claims the same light detection methodology. “Emitters 30a are distributed around the periphery of touch plate 10, to propagating light across touch surface 20.” Ex. 1031, 14:10-17. “Detectors 30b are distributed around the periphery of touch surface 20, to receive part of the propagating light.” *Id.*; Ex. 1033, ¶30.



Ex. 1031, Fig. 9.

“The emitters 30a and detectors 30b collectively define a grid of detection lines 50 (“detection grid”) on the touch surface 20.” *Id.*, 14:24-26, Claims 1, 7.

Further, it was known before the ’335 Patent that if the touch surface of the cover plate is concavely curved, rather than being flat, then the amount of light transmitted from the emitters that is received at the detectors will increase, thereby improving the functionality of touch detection. For example, Han discloses that a cover plate of a touch screen display apparatus can be concavely curved according to a radius, i.e., so that the touch surface curves along a portion of a circle, along either or both of the directions in which light moves. Ex. 1005, Fig. 3; [0074-78], [0082-83], [0085-0088]; Ex. 1033, ¶32.



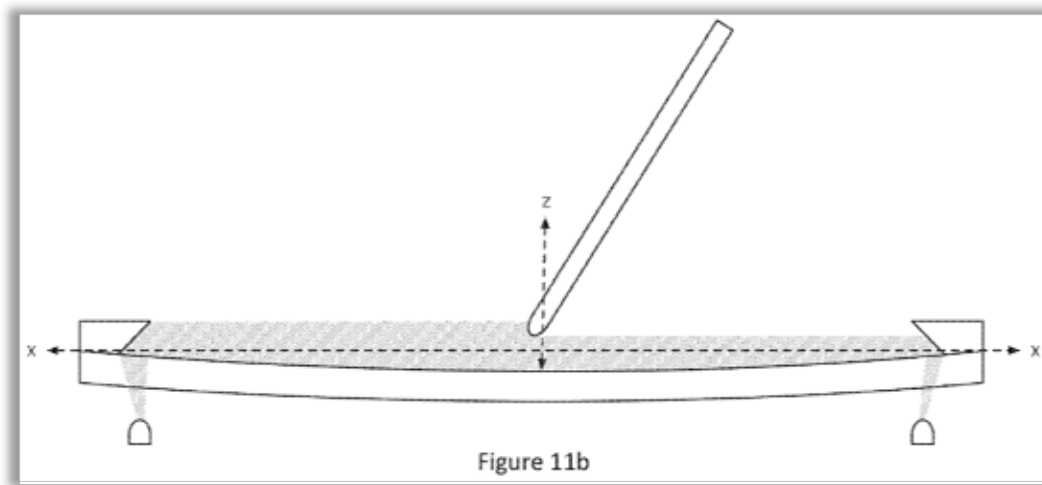
Ex. 1005, Fig. 3 (prior art).

Han teaches, among other things, that this configuration can increase the light efficiency of a touch detector and, correspondingly, the accuracy of touch recognition. *Id.*, [0082-0086], [0091-0095], Fig. 5. Han teaches that a parabolic curvature is one advantageous shape of a touch surface. Further, other references, such as Miller, Kang, Christiansson, and Eriksson, also expressly teach that touch surfaces may be curved or parabolic in shape. See Ex. 1027, [0047], [0049], Fig. 9; Ex. 1029, [0028], [0040]; Ex. 1016, [0071]; Ex. 1030, 3:6-46, Figs. 29-31; Ex. 1033, ¶¶33-34.

The '335 Patent claims the same parabolic, concave curvature in the cover plate of a touch sensing method and apparatus. According to the '335 Patent, a plate having a parabolic curvature increases the amount of light transmitted from the emitters that is

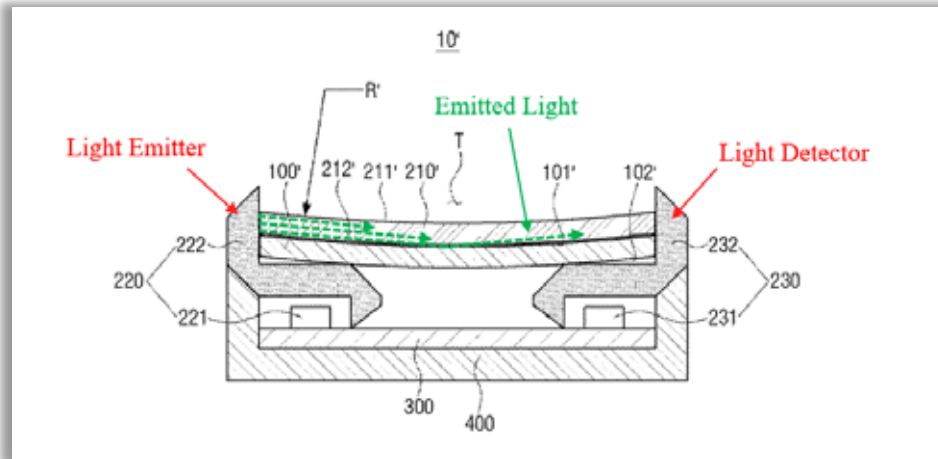
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received at the detectors (rather than being “lost” above or below the detectors), resulting in a “signal boost” that improves touch recognition. *See id.*, Figs. 13a-17b; 17:48-18:44. In one embodiment, the ’335 Patent contemplates that the touch plate 10 could be curved in two axes, rather than one. *Id.*, 16:63-17:47 & Figs. 12a-12b. Ex. 1033, ¶35.



Ex. 1031, Fig. 11b.

In addition to light transmission above or near a cover glass, Han teaches transmitting light through the cover glass via total internal reflection. Ex. 1005, [0115-16]. Han explains that the inside surface of the cover glass may have the same concave curvature as the outside surface, thus “light [emitted from light emission guide member 222] passing through the inside of the cover glass 210’ may be guided to the incidence surface 2321 of the light reception guide member 232.” *Id.*; Ex. 1033, ¶36.



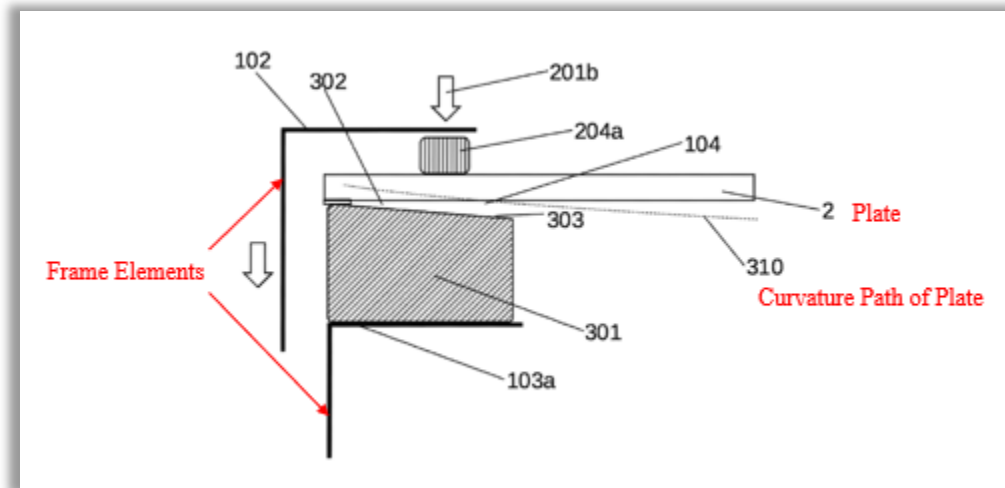
Ex. 1005, Fig. 7.

The '335 Patent claims the same total internal reflection through the cover glass, claiming “wherein the plurality of emitters is configured to emit light through the plate by total internal reflection.” Ex. 1031, claim 3; Ex. 1033, ¶37.

Further, the prior art teaches that a frame assembly can be used to control curvature of a glass plate in an optical touch sensing apparatus. Ex. 1011, 18:47-64; Ex. 1010, 4:13-26. For instance, Shin teaches that, as an alternative to pre-curving a plate touch surface, a frame assembly can be configured to induce a curvature in the touch surface of an initially flat plate, such that, when the plate is installed in the frame assembly, the touch surface of the plate becomes curved. *See, e.g.*, Ex. 1011, 18:40-64, Fig. 4. Other references, such as Zhao, provide the same teaching in the context of large format displays having a cover glass. *See, e.g.*, Ex. 1012, [0045], [0048], [0050], Figs. 1, 3. In both Shin and Zhao, a tapered surface is used in inducing the curvature. *See, e.g.*, Ex. 1011, 20:53-21:55, Fig. 5; Ex. 1012, [0051-52], Fig. 1; Ex. 1033, ¶38.

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The '335 Patent describes the same control of a touch plate curvature using a frame assembly. Just as in Shin and Zhao, the '335 Patent contemplates that a frame assembly component having a tapered edge can be used in inducing concavity. Ex. 1031, 13:29-42, Fig. 7; Ex. 1033, ¶39.



Ex. 1031, Fig. 7.

The '335 Patent claims “...a gasket, wherein the plate is supported by the gasket along the surface of the plate that defines the plate thickness. *Id.*, Claim 5.

As described below, the '335 Patent claims known structures and methods to provide solutions to problems that were already well understood in the art. Ex. 1033, ¶40-41.

B. Related And Priority Applications

The '335 Patent issued from U.S. Application No. 16/403,283 (“the '283 Application”) on March 22, 2022. The '283 Application was filed May 3, 2019, as a continuation of US. Application No. 16/190,907 (“the '907 Application”). The

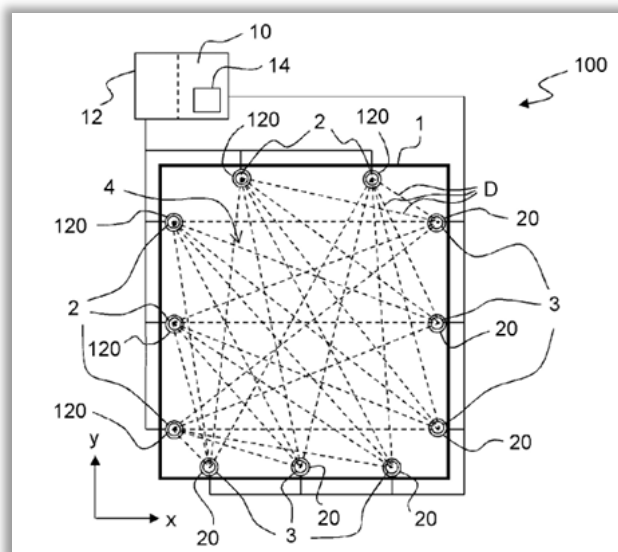
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'907 Application was filed November 14, 2018, as a national stage entry from PCT Application PCT/SE2017/051233 (“the ’233 PCT”). The ’233 PCT was filed December 7, 2017 and claimed priority to Swedish Application SE1630294, filed December 7, 2016. Ex. 1033, ¶42.

C. Overview Of The Prosecution History

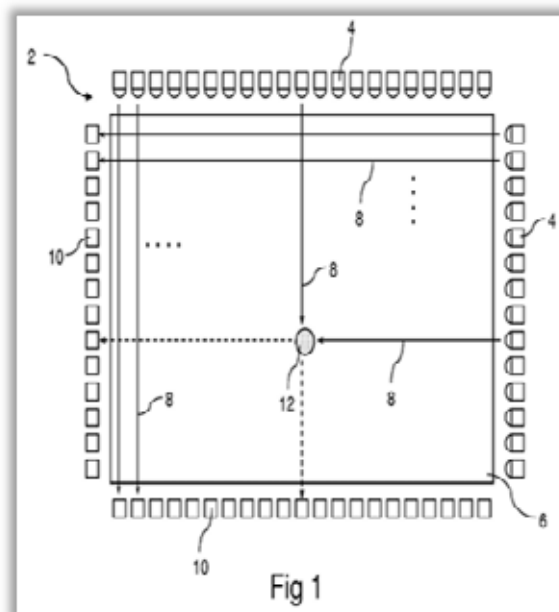
Prosecution of the ’335 Patent traversed multiple Office Actions that relied on combinations of U.S. Patent Pub. No. 20160334942 (“Wassvik”), U.S. Patent Pub. No. 20120223916 (“Kukulj”), U.S. Patent Pub. No. 20160295711 (“Ryu”), U.S. Patent Pub. No. 10860142 (“Northcott”), U.S. Patent Pub. No. 20170308236 (“Lee”), and Chinese Application No. CN102117155 (“Liu”). *See generally*, Ex. 1032; Ex. 1033, ¶43.

Wassvik disclosed an infrared-style touch screen with emission and detection means along sides of a touch input area and including internal light refraction in a glass plate. Ex. 1034, Abstract; Ex. 1033, ¶44.



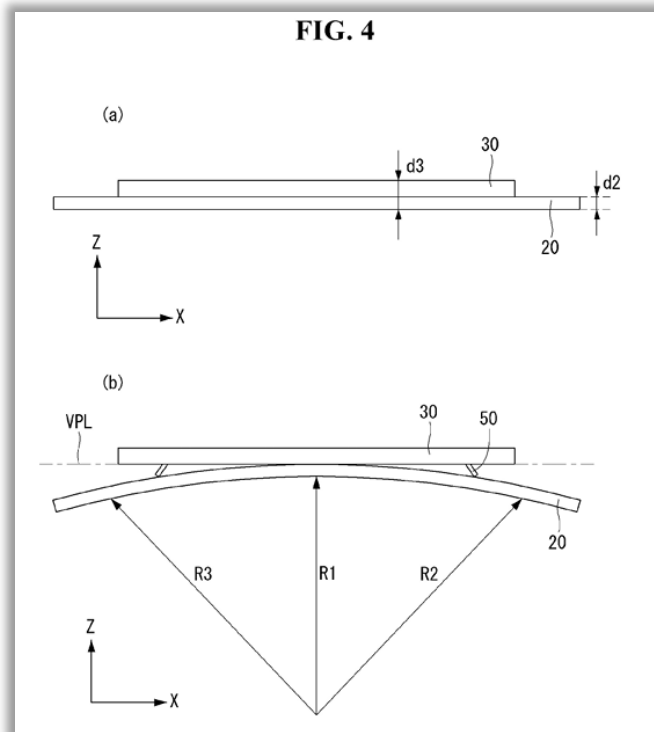
Ex. 1034, Fig. 2A

Kukulj disclosed an infrared-style touchscreen with light emission and detection means along multiple sides of a touch input area. Ex. 1014, Abstract, Fig. 1; Ex. 1033, ¶45.



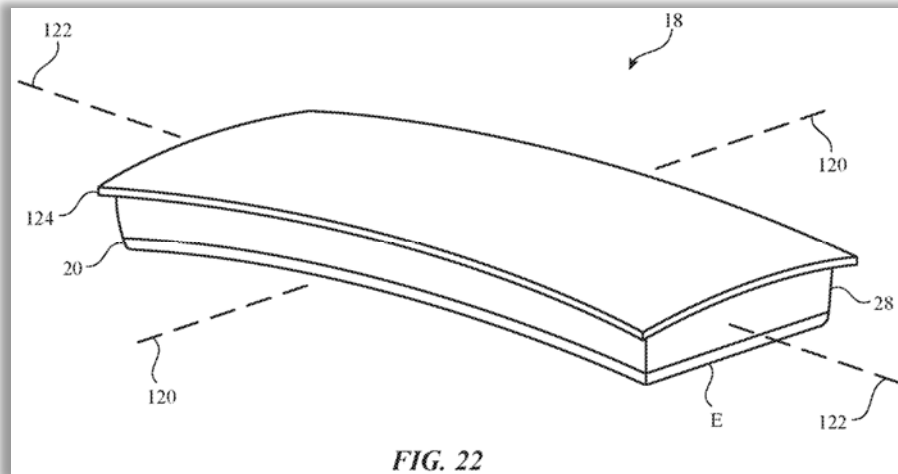
Ex. 1014, Fig. 1

Ryu disclosed a display panel having a first and second state, wherein the display panel is straight in a first state and curved in a second state. Ex. 1015, Abstract, Fig. 4; Ex. 1033, ¶46.



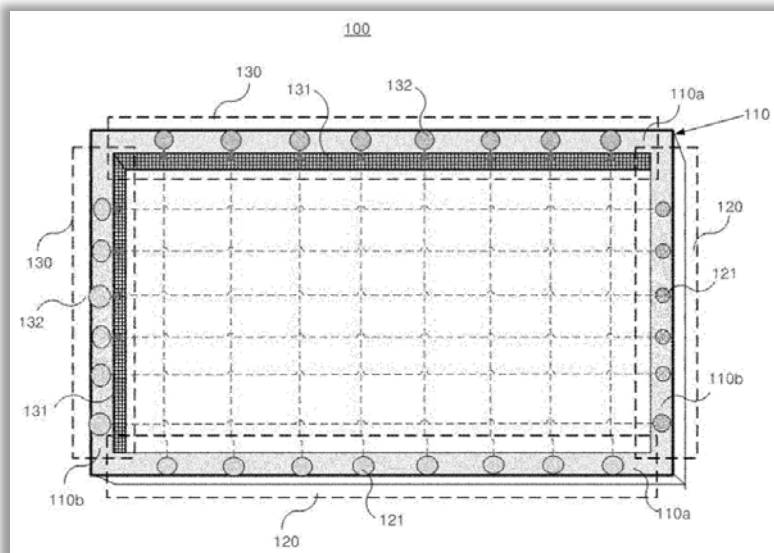
Ex. 1015, Fig. 4.

Northcott disclosed a light-based device with light guide arrays having light emitting diodes and a compound curvature. Ex. 1035, Abstract; Ex. 1033, ¶47.



Ex. 1035, Fig. 22.

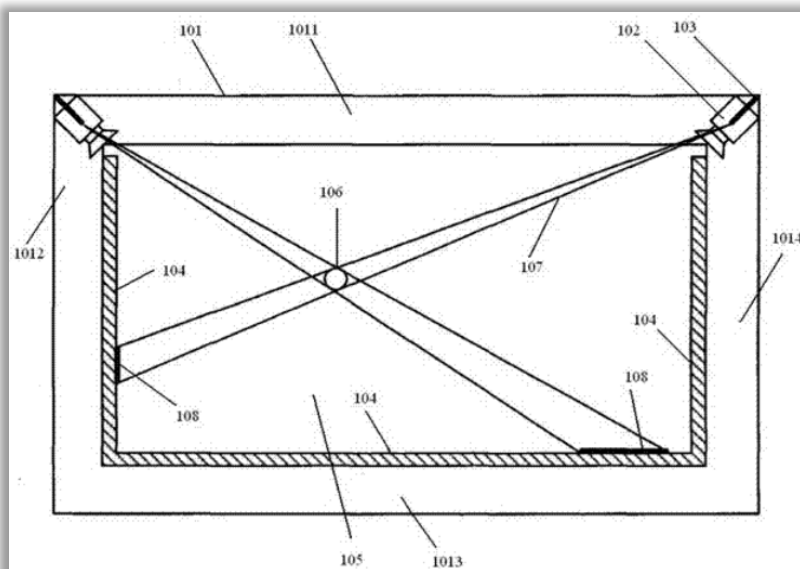
Lee disclosed an infrared touch screen device with multiple light transmitting elements installed along a vertical and horizontal bezel. Ex. 1036, Abstract; Ex. 1033, ¶48.



Ex. 1036, Fig. 1.

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Liu disclosed an optical touch screen comprising a frame, optical sensor, light source, retroreflective bar and touch panel. Ex. 1032, 496-515. The touch panel included a concave curvature. *Id.*; Ex. 1033, ¶49.



Ex. 1032, 104.

On March 26, 2020, the Examiner issued a Non-Final Office Action for the '283 Application. Ex. 1032, 1034-35. Claims 2 – 12 were noted as allowable, claims 13 - 16 and 21 were rejected as anticipated and claim 17 – 20 were rejected as obvious. Ex. 1033, ¶50.

On September 24, 2020, the Applicant amended the claims, primarily focusing on limitations related to the configuration of the plate curvature and frame elements. Ex. 1032, 669-72; Ex. 1033, ¶51.

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.

Ex. 1032, 669.

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 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.

Id., 670-71.

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.

Id., 672.

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On October 9, 2020, a Final Office Action was issued for the '283 Application. *Id.*, 630-44. Claims 2 – 12 were noted as allowable, claims 13-14, 16, 21 and 23 were rejected as being anticipated, and claims 15, 17-20 and 22 were rejected as obvious. *Id.*, 632-41; Ex. 1033, ¶52.

On March 9, 2021, the Applicant amended the claims, arguing that the prior art did not disclose frame elements allowing for curvature of the plate or implementing such elements for “large screen sizes” such as 55 inches. Ex. 1032, 622; Ex. 1033, ¶53.

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 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.

Ex. 1032, 618.

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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.

Ex. 1032, 620.

On March 22, 2021, a Non-Final Office Action was entered for the '283 Application, rejecting claims 2 – 12 under §112(b) and rejecting claims 2-23 as obvious. *Id.*, 569-89; Ex. 1033, ¶54.

On June 3, 2021, an Applicant-Initiated Interview was conducted, after which a proposed amendment to independent claim 2 to overcome the March 22, 2021 rejections was summarized. *Id.*, 563.

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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.

Ex. 1032, 563.

On June 22, 2021, the Applicant amended the '283 Application's claims reflecting the substance of the June 3, 2021 interview. *Id.*, 551-54; Ex. 1033, ¶¶55-56.

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.

Ex. 1032, 551.

On July 6, 2021, a Final Office Action was entered for the '283 Application, rejecting claims 2-20 as obvious. *Id.*, 497- 516; Ex. 1033, ¶57.

On August 9, 2021, the Applicant argued that Liu taught neither i) both long and short edges of the plate being curved or ii) using a curved “rectangular plate” where curvature is induced in the rectangular plate by a “curved edge portion.” *Id.*, 492.

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On August 24, 2021, a Notice of Allowance was issued for the '283 Application. *Id.*, 448.

However, on September 27, 2021, the Applicant submitted a Request for Continued Examination and further amended the claims to specify limitations related to the frame assembly element. *Id.*, 85; Ex. 1033, ¶¶58-60.

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 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~~ 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;

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.

Ex. 1032, 93.

On December 8, 2021, a Notice of Allowance was again issued for the '283 Application, and the '335 Patent issued on March 22, 2022. *See Id.*, 4.

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Han, Cao, and Shin were included in an IDS by the Applicant, however, the Examiner failed to cite the references in any office action. *See* Ex. 1032, 76. Neither Cheng nor Zhao were considered during prosecution. *See generally*, Ex. 1032. Cheng, Han, Zhao, Cao, and Shin—in various obvious combinations—disclose a touch sensing apparatus and method of assembling thereof embodying each of the limitations found in claims 1– 5 of the '335 Patent. Ex. 1033, ¶¶62.

D. Level Of Skill In The Art

A relevant person of ordinary skill in the art (“POSA”) is someone having at least a bachelor-of-science or comparable degree in mechanical engineering or an equivalent discipline and at least five years of experience designing touch sensors, provided that the educational level can offset the experience level, and vice versa. For example, a POSA includes a person with at least a master’s degree in those disciplines and at least two years of design experience in the field. (*Id.*). Ex. 1033, ¶¶23-25.

IV. IDENTIFICATION OF CHALLENGE PURSUANT TO 37 C.F.R. § 42.104(B)

A. 37 C.F.R. § 42.104(b)(1): Claims For Which IPR Is Requested

IPR is requested for claims 1 – 5 of the '335 Patent.

B. 37 C.F.R. § 42.104(b)(2): The Prior Art And Specific Grounds On Which The Challenge To The Claims Is Based

Chemtronics asserts that the claims of the '335 patent are unpatentable as follows:

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Ground 1: Claims 1-5 are obvious under 35 U.S.C. § 103 based on Cheng in view of Han and Zhao.

Ground 2: Claims 1-5 are obvious under 35 U.S.C. § 103 based on Cao in view of Han and Zhao.

Ground 3: Claims 1-4 are obvious under 35 U.S.C. § 103 based on Cheng in view of Han and Shin.

C. 37 C.F.R. § 42.104(b)(3): Claim Construction

The Board gives claims their ordinary and customary meaning, or “the meaning that the term would have to a [POSA] at the time of the invention.” *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–13 (Fed. Cir. 2005) (en banc). Petitioner interprets the meaning of the claims herein based on Petitioner’s understanding of Patent Owner’s construction of the claims as informed by its allegation in co-pending litigation with Chemtronics as well as prior litigation involving continuation patents citing priority to the ’335 Patent. *See* Exs. 1017, 1018, 1038. Petitioner does not waive, and expressly reserves, the claim scope arguments, constructions, and evidence it may raise in other proceedings. Ex. 1033, ¶¶26-27.

V. CLAIMS 1-5 OF THE ’335 PATENT ARE UNPATENTABLE

A. Brief Overview Of The Prior Art

1. Cheng

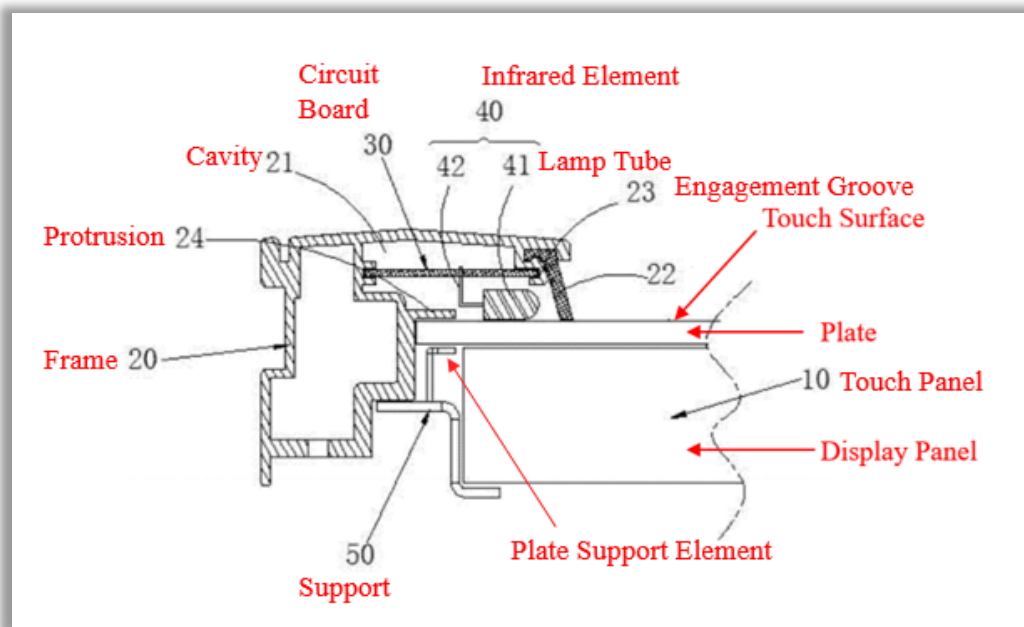
Cheng (Chinese Patent No. 203386188) is a Chinese Patent titled “Frame Structure of Infrared Touch Screen” having a publication date of January 8, 2014.

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Cheng claims priority to Chinese Application CN201320390996.2, filed July 2, 2013.

Cheng is prior art against the '335 Patent under 35 U.S.C. § 102.

Cheng discloses an infrared touch screen device including a frame 20, a touch panel 10 (comprising a display panel and plate), a circuit board 30, and an infrared element 40. Ex. 1004, [0013], Fig. 1.



Ex. 1004, Fig. 1.

Cheng teaches improving the accuracy of touch detection by configuring the frame 20 and infrared element 40 in relation to the plate of the touch panel 10 to project light across the plate. See Ex. 1004, [0002], [0005-10], [0014-17], Fig. 1; Ex. 1033, ¶¶63-67.

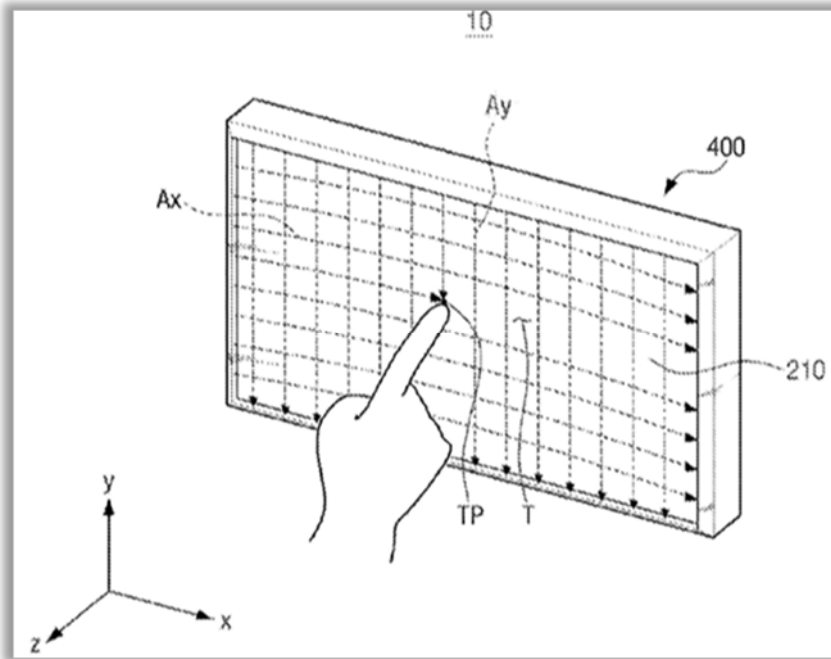
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2. Han

Han (U.S. Patent Publication No. 2019/0235701) titled “Display Apparatus,” is a continuation of PCT Application No. PCT/KR2017/000004, which was filed on January 2, 2017 and which claims priority to Korean Patent Application No. 10-2016-0128325, filed on October 5, 2016.¹ Han is prior art against the ’335 Patent under 35 U.S.C. § 102.

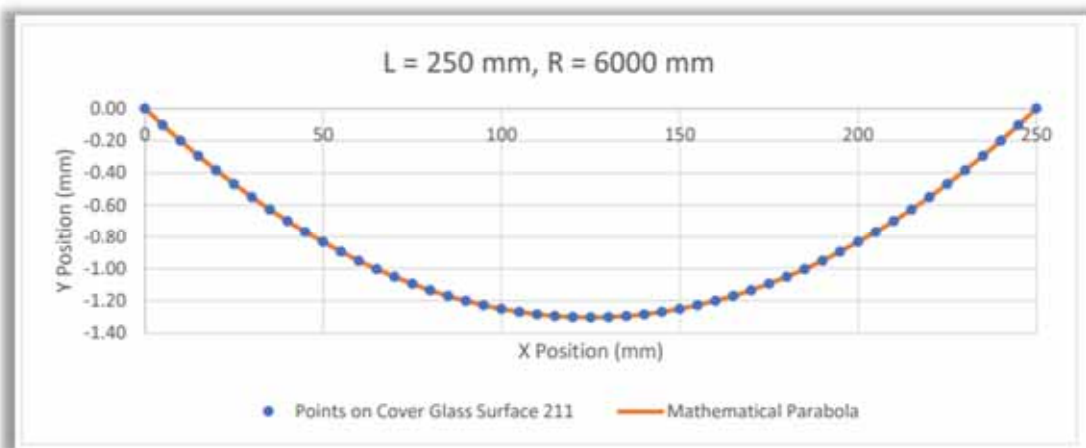
Han discloses an infrared touch sensitive device with a cover glass 210, a display panel 100, and light emissive and receptive elements 222, 232 which project light across a surface 211 of the cover glass 210. *See* Ex. 1005, [0031-32], [0034], [0037 0042], [0057-59], [0062-63], Figs. 2-3. Han’s surface 211 of cover glass 210 may be curved along both the first direction Ax and the second direction Ay. *Id.*, [0067-69], [0074-77].

¹ Han’s priority claims to Korean Patent Application No. 10-2016-0128325 (October 5, 2016) predates the ’335 Patent’s earliest priority date of December 7, 2016. Dr. Cairns has compared the translations of the Korean Application (Ex-1009) and the PCT Application (Ex-1007) and has determined that Han’s substantive disclosure in Ex-1005 is fully supported by both the Korean application and the PCT application, thus attributing an effective filing date for Han under 35 U.S.C. § 102(d) as October 5, 2016. 35 U.S.C. §§ 102(a)(2); § 122(b); § 374; § 102(d).



Ex. 1005, Fig. 2.

The curvature of Han's touch surface 211 is parabolic and reduces the amount of light lost by reflection and increases an amount of light received at light reception guide member 232, which enhances the accuracy of touch recognition. *See id.*, [0082-83].



Ex. 1033, ¶74.

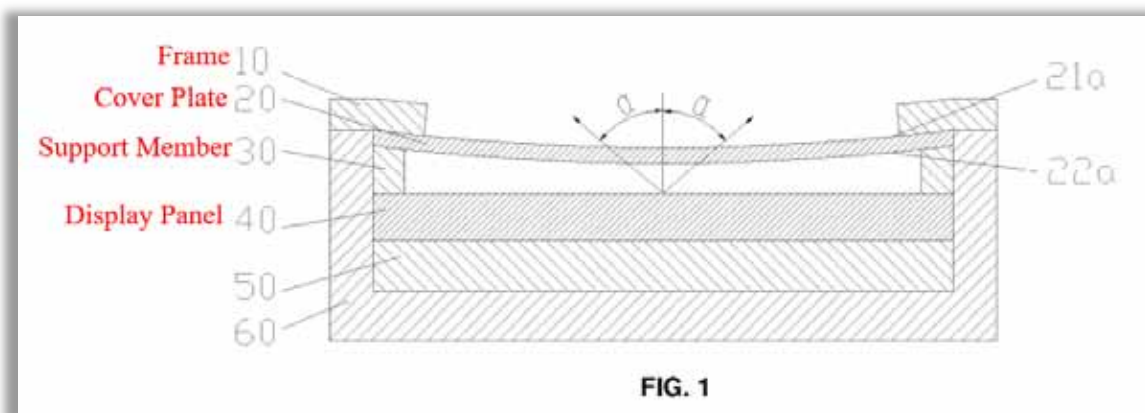
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Han further discloses conveying emitted light through the curved cover glass 210 via total internal reflection. Ex. 1005, [0115-116]; Ex. 1033, ¶¶68-107.

3. Zhao

Zhao (U.S. Patent Application Publication No. 2017/0123257) is a U.S. Patent Application titled “Curved-Surface Liquid Crystal Display.” Zhao claims priority to Chinese Application 201510727484.4 which has a publication date of December 15, 2015. Zhao is prior art against the ’335 Patent under 35 U.S.C. § 102.

Zhao discloses a display device with a display (liquid crystal display panel 40) and a transparent plate (cover plate 20) having a concave curvature. Ex. 1012, Abstract, Fig. 1. Zhao teaches a simplified process of inducing curvature in the plate, explaining that “[t]he cover plate 20 also may be a flat plate, and is forced to bend by squeezing the cover plate 20 [against a support member 30] in the installation process, so that its first surface 21a is concave.” *Id.*, [0050], [0055]; Ex. 1033, ¶¶108-12.

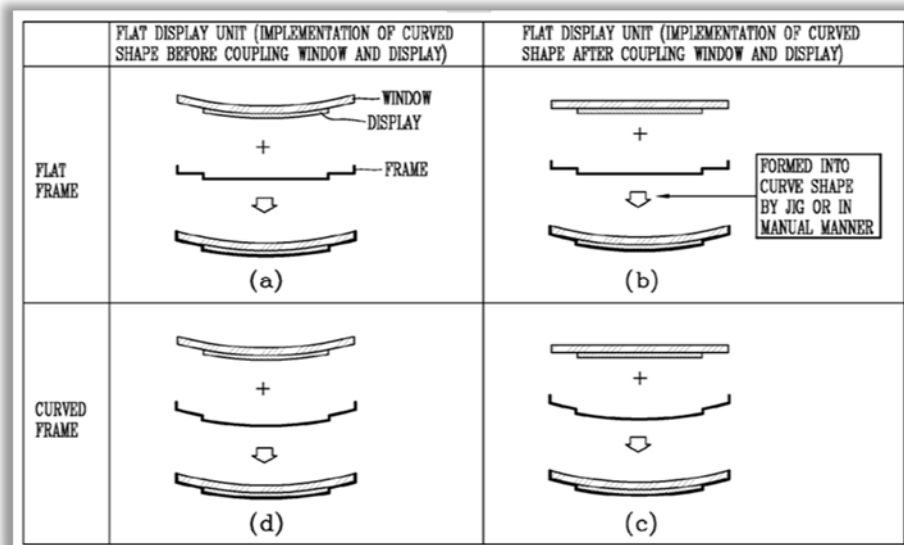


Ex. 1012, Fig. 1.

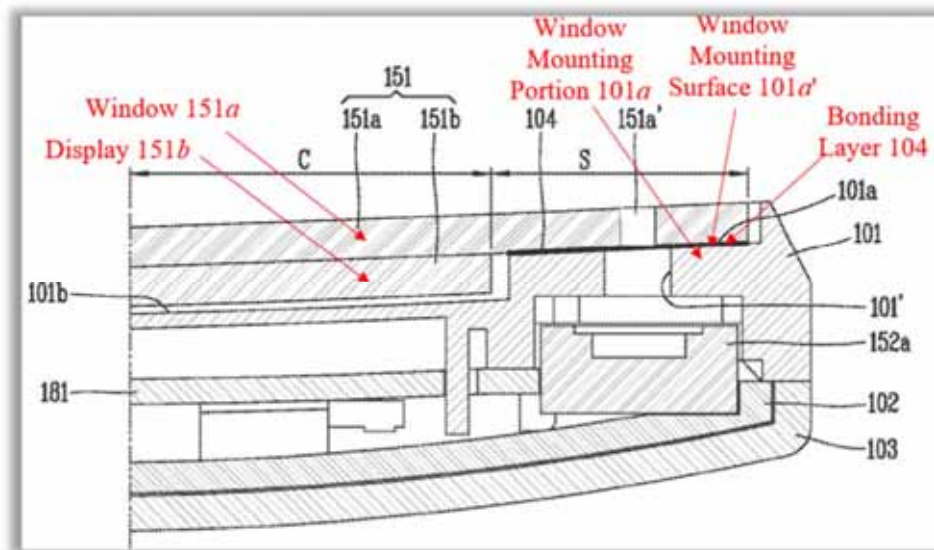
4. Shin

Shin (U.S. Patent No. 9,291,845) is a U.S. Patent titled “Mobile Terminal and Method for Manufacturing the Same” which issued from U.S. Patent Application 14/487,996 (“’996 Application”). The ’996 application has a publication date of September 17, 2015. Shin is prior art against the ’335 Patent under 35 U.S.C. § 102.

Shin discloses an infrared touch-sensitive device configured to induce a curvature into an initially flat cover glass and display using a frame with curved mounted surfaces. See Ex. 1011, 1:52-2:22, 3:4058, 10:45-49, 20:9-14, 20:66-21:6, Fig. 4. Shin teaches a simplified process of achieving a curved cover glass by inducing a [parabolic] curvature in the glass via a curved frame. *Id.*, 20:9-14, 20:66-21:6. Ex. 1033, ¶¶113-26.



Ex. 1011, Fig. 4.

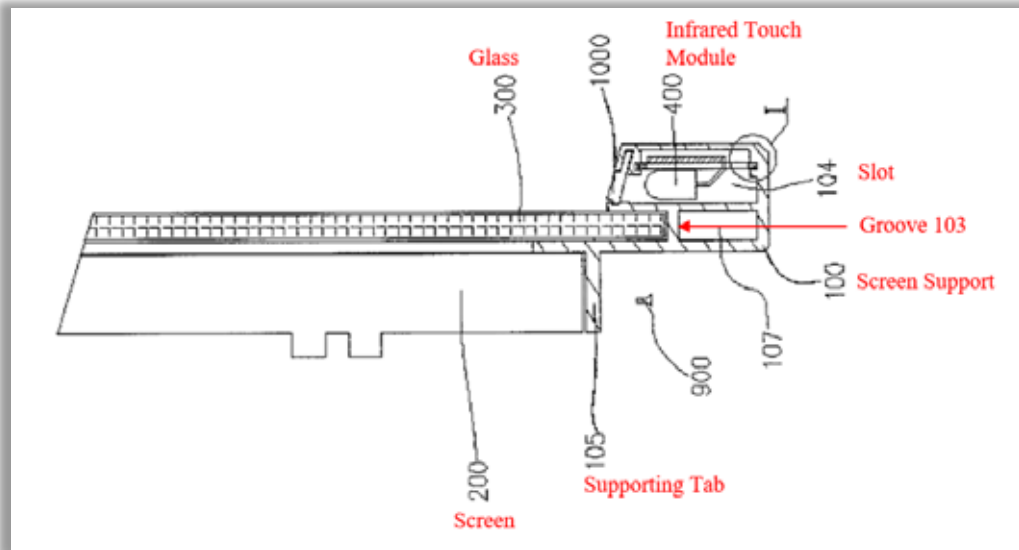


Id., Fig. 5.

5. Cao

Cao (U.S. Patent No. 9,983,626) is a U.S. Patent titled “All-in-One Smart Tablet PC and the Assembly Method Thereof” which issued from U.S. Application 14/888,331 (“’331 Application”). The ’331 Application is a continuation of PCT Application PCT/CN2014/092348 which has a publication date of June 4, 2015. Cao is prior art against the ’335 Patent under 35 U.S.C. § 102.

Cao discloses an infrared touch device including a screen support 100, an infrared touch module 400, a screen 200, and a glass 300. *See* Ex. 1010, 4:1-26, Fig. 9.



Ex. 1010, Fig. 9.

As shown in Figs. 1, 9, and 16 of Cao, the Cao device has four screen supports 100, and each screen support 100 has a groove 103 and groove wall 112 to receive an edge of the plate (glass 300). Cao’s discloses preventing “oversized gap between the glass 300 and the front frame caused by the four rising corners of the glass 300, which improves the quality and the qualified rate of the product.” *Id.*, 4:2-19; Ex. 1033, ¶¶127-31.

B. Ground 1 - Claims 1 - 5 Are Obvious Under 35 U.S.C. § 103 Based On Cheng In View Of Han And Zhao.

Cheng in view of Han and Zhao renders claims 1-5 obvious. It would have been obvious for a POSA to combine the touch screen display device and frame elements of Cheng, with the parabolically curved touch screen elements of Han and the curvature-inducing frame elements of Zhao. A POSA would have expected a resulting touch

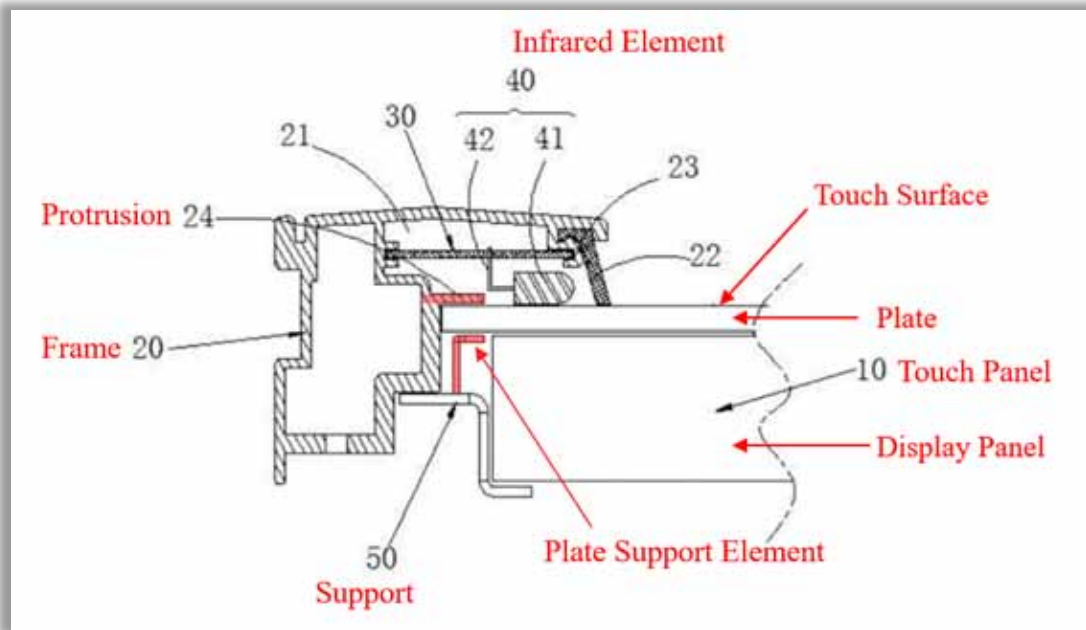
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screen display device with improved touch performance, achieved through a simplified manufacturing process. Ex. 1033, ¶132.

Motivation to Combine

A POSA would have been motivated to modify the Cheng device using the teachings of Zhao to obtain the technical advantages disclosed in Han. Cheng, Han, and Zhao each relate to similar devices including a display, a covering panel, and a supporting frame assembly. See Ex. 1004, Abstract, Fig. 1; Ex. 1005, Abstract; Ex. 1012, Abstract; Ex. 1033, ¶133.

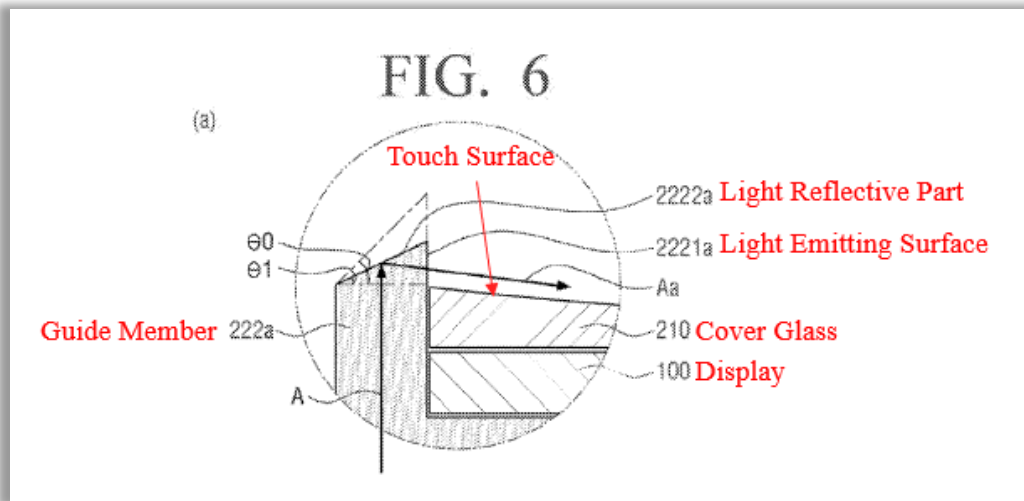
Cheng discloses an infrared touch device including plate with touch surface, a display, and a frame with a reduced thickness. Ex. 1004, [0001], Fig. 1. Cheng teaches utilizing infrared receivers and transmitters distributed densely around a display region to form a scanning network in both a horizontal and vertical direction. *Id.*, [0002]. Infrared light is emitted and received across a touch surface of a plate. *Id.*, [0010], Fig. 1. Cheng's frame 20 includes a protrusion 24 and plate support element for supporting a plate with a touch surface. *Id.*, Fig. 1; Ex. 1033, ¶134.



Ex. 1004, Fig. 1.

Cheng's frame 20 improves touch detection accuracy by orienting the lamp tube 41 of an infrared element 40 to transmit and receive infrared light closely along the touch surface of the plate. *Id.*, [0013]. Cheng additionally teaches reducing material costs by reducing material requirements of the frame. *Id.*, Abstract, [0018]; Ex. 1033, ¶135.

Han, like Cheng, teaches improving touch detection accuracy in infrared touch devices. In Han, the front surface of a flat cover glass 210 (plate) is configured to have a concave parabolic curvature. Ex. 1005, [0077-80]. Further, Han teaches tuning the direction of emitted infrared light to travel along the surface of the curved touch surface of cover glass 210 by tilting a light reflective part 222a of the guide member 222. Ex. 1005, [106]; Ex. 1033, ¶136.

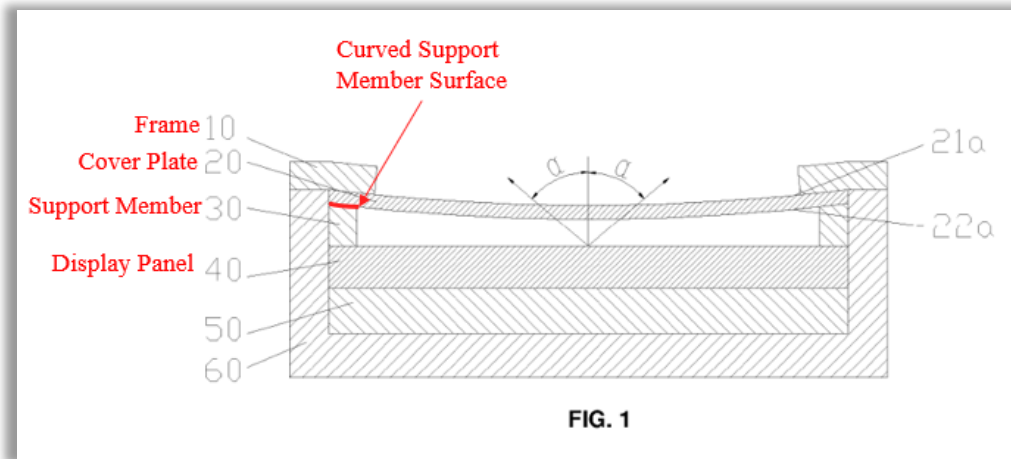


Ex. 1005, Fig. 6(a).

Han teaches that by utilizing a parabolic curvature of front surface 211 of cover glass 210 and tuning the travel direction of emitted light across the front surface, the amount of light lost by reflection is reduced, the amount of light received at light reception guide member 232, and corresponding detection accuracy, is increased. *Id.*, [0086]. Further, Han teaches reducing the thickness of the bezel (frame) of the infrared touch device 10 using light emission and reception guide members 222, 232. *Id.*, [0058]. Thus, Han discloses improvements of the same objectives (improved touch detection accuracy and frame size reduction) in the same technological field (infrared touch devices) as Cheng. Ex. 1033, ¶137.

Similar to Han, Zhao discloses a device having a display 40 (Han's display 100) and a cover plate 20 (Han's cover glass 210) having a concave curvature. Ex. 1012, [0045-48]. Like Cheng, Zhao teaches supporting the cover plate 20 with the frame 10

(Cheng's frame 20 with protrusion 24) and a support member 30 (Cheng's plate support element). Ex. 1033, ¶138.



Id., Fig. 1.

Zhao teaches inducing curvature in the cover plate 20, explaining that “[t]he cover plate 20 also may be a flat plate, and is forced to bend by squeezing the cover plate 20 in the installation process, so that its first surface 21a is concave.” *See id.*, [0050]. Zhao explains that the shape of the surface of the support member 30 in contact with the cover plate 20 matches that of the cover plate. *Id.*, [0055]. A POSA would have understood inducing the curvature of the cover plate 20 to include forcing the cover plate 20 against the curved top side of the support member 30. As the cover plate 20 is bent under force against the curved surface of the support member 30, its shape (curvature) would match that of the curved surface of the support member 30. *See* Ex. 1012, [0050-55]. Zhao teaches that the curved cover panel 20 improves the optical

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performance of emitted light by reducing the amount of light leak. *See Id.*, Abstract; Ex. 1033, ¶139.

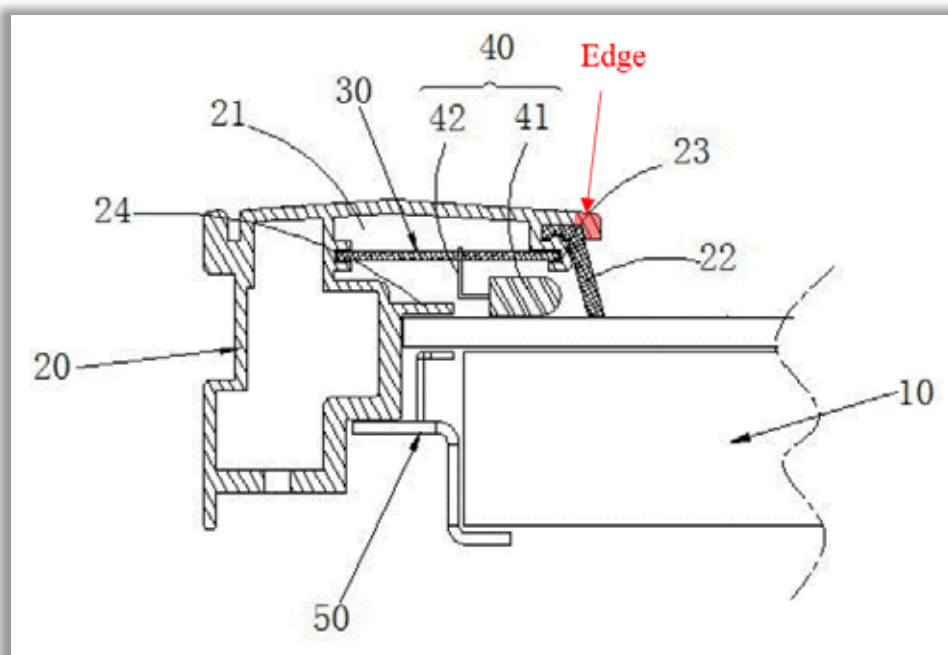
To achieve Han's parabolic plate curvature in Cheng, a POSA would have been motivated to implement Zhao's teaching of inducing curvature in the plate via a curved support member 30 during plate installation. As the frame in Cheng already includes a protrusion 24 and frame support element supporting the plate, it would have been obvious for POSA to modify Cheng's protrusion and frame support element according to the curved support member 30 of Zhao. A POSA would have expected such modification to achieve the same simplified curvature-inducing functionality in the modified Cheng device. Further, a POSA would have appreciated Zhao's curved support member 30 to deliver a simplified manufacturing process with reduced cost. Ex. 1033, ¶140.

Thus, a POSA combining the teachings of Han and Zhao into the device of Cheng would have expected to achieve the predictable result of a high touch accuracy (Han) infrared touch device (Cheng, Han) and manufacturing method (Cheng, Han, Zhao), meeting the limitations of the '335 Patent. Such modifications would have merely embodied implementing known techniques to improve a similar device in a similar way. Ex. 1033, ¶141.

1. Claim 1

(a) Preamble: “A touch sensing apparatus having a long edge and a short edge,”

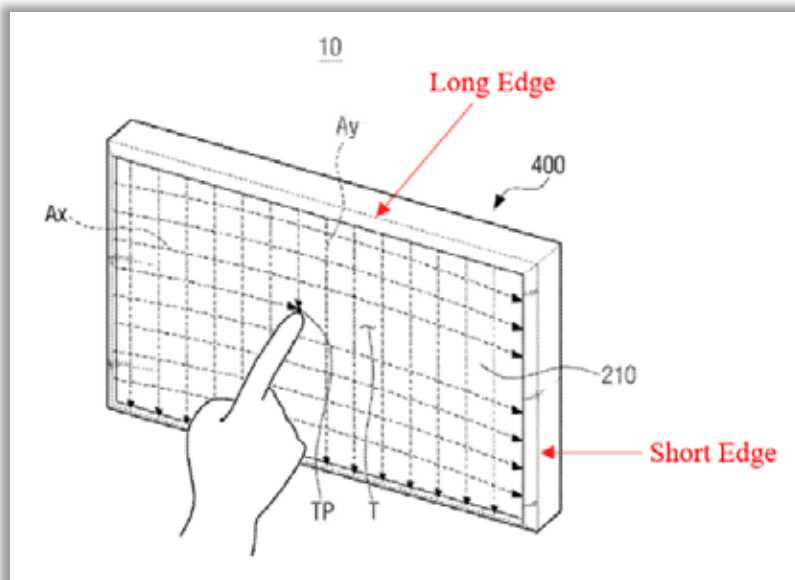
Cheng and Han disclose this element. A POSA would have understood Cheng’s frame 20 to disclose a frame assembly with a first and second edge. Ex. 1033, ¶142.



Ex. 1004, Fig. 1.

A POSA would have further understood Cheng’s frame 20 to disclose a frame assembly configured in the common rectangular geometry of infrared touch screen devices, thus including a first long edge and second short edge. Ex. 1004, [0002]; Ex. 1033, ¶143.

Further, Han's frame assembly (including rear cover 400 and guide members 222, 232) depicts a rectangular frame geometry including a first long edge, and a second short edge. Ex. 1005, Fig. 2; Ex. 1033, ¶144.

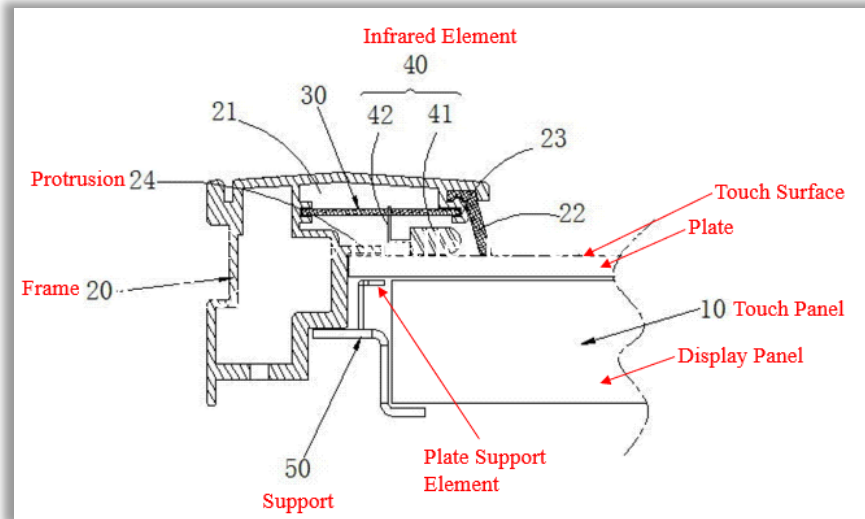


Ex. 1005, Fig. 2.

Thus, Cheng and Han disclose claim 1's preamble. Ex. 1033, ¶145.

(b) “a display panel;”

Cheng, Han, and Zhao disclose this element. Cheng discloses a touch panel 10. Ex. 1004, [0005], Fig.1. A POSA would have understood Cheng's touch panel 10 to include a display panel. *See id.*, Fig. 1, [0002-3]; Ex. 1033, ¶146.



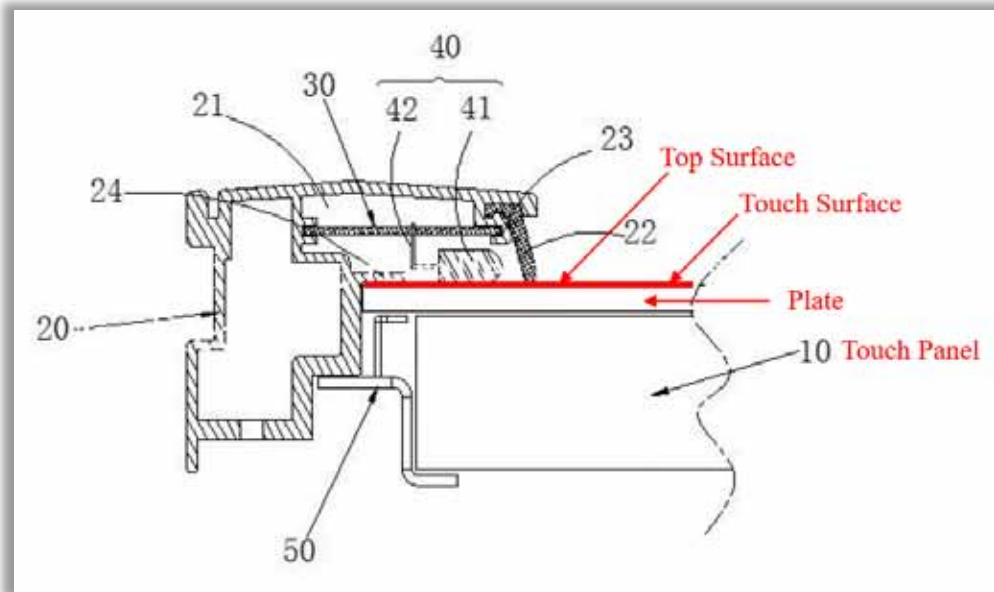
Ex. 1004, Fig. 1.

Further, both Han and Zhao also disclose a display panel. Ex. 1005, Abstract; Ex. 1012, Abstract; Ex. 1033, ¶147.

Thus, Cheng, Han, and Zhao disclose claim 1(b). *Id.*, ¶148.

(c) “a plate including a top surface that comprises a touch surface;”

Cheng and Han disclose this element. A POSA would have understood the touch panel 10 of touch screen device disclosed in Cheng to include a plate including a top surface that comprises a touch surface. Ex. 1033, ¶149.



Ex. 1004, Fig. 1.

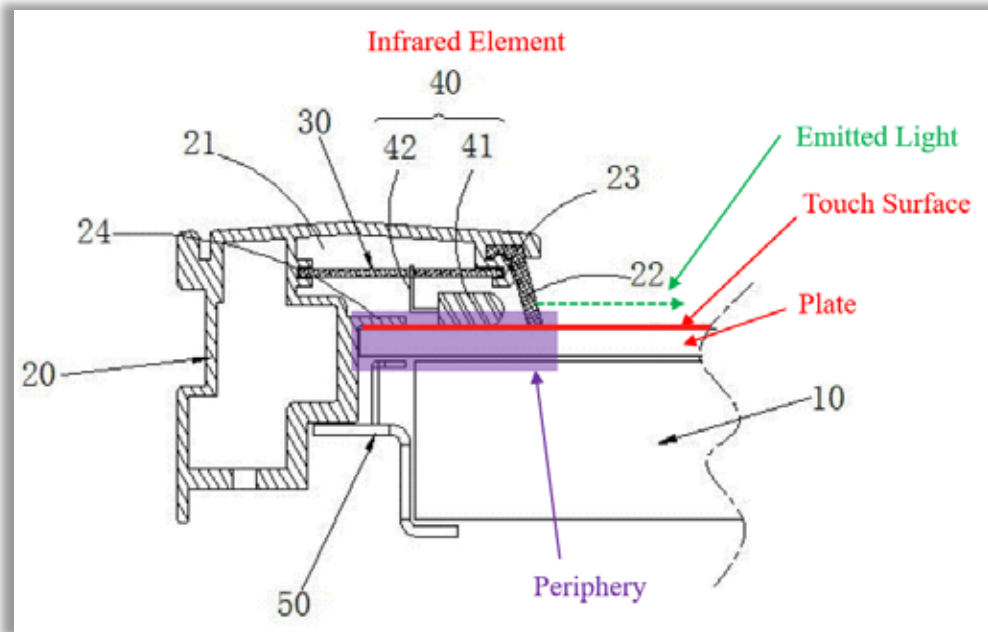
Further, Han discloses a cover glass 210 with a touch surface. Ex. 1005, [0019], [0038], Fig. 2; Ex. 1033, ¶150.

Thus, Cheng and Han disclose claim 1(c). *Id.*, ¶151.

(d) “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,”

Cheng and Han disclose this element. Cheng discloses arranging “infrared receivers and **transmitters** [emitters] distributed densely around a display region [to] form a scanning network in horizontal and vertical directions...” Ex. 1004, [0002] (emphasis added). The infrared element 40 is arranged around a portion of the periphery of the plate. *Id.*, Fig. 1. To achieve touch sensing functionality, a POSA

would have understood Cheng's lamp tube 41 of infrared element 40 to emit light across the touch surface of the plate. Ex. 1033, ¶152.



Ex. 1004, Fig. 1.

Further, Han discloses a plurality of emitters configured to emit across the touch surface of the plate. See Ex. 1005, [0040-43]; Ex. 1033, ¶153.

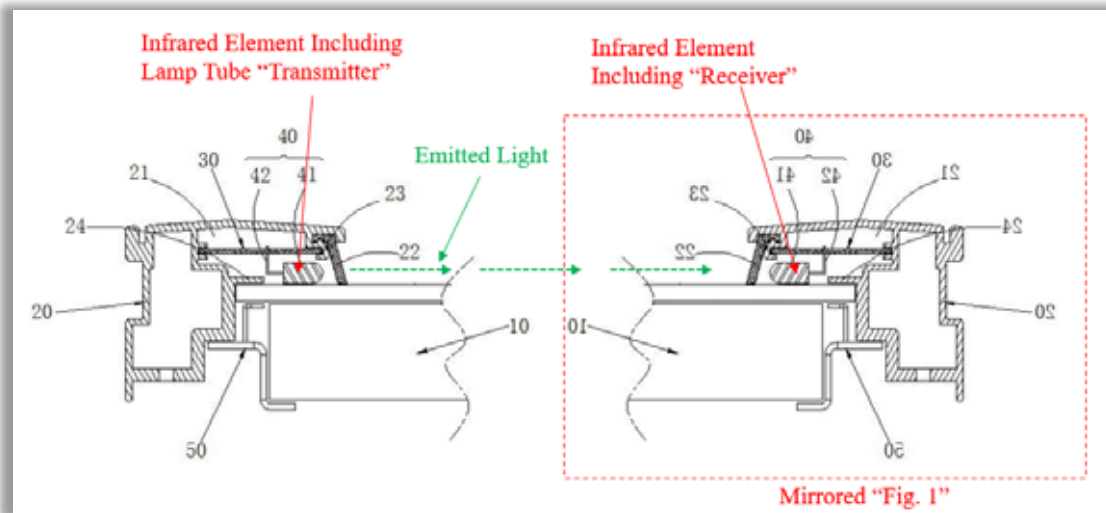
Thus, Cheng and Han disclose claim 1(d). Ex. 1033, ¶¶154.

- (e) **“a plurality of detectors arranged around a portion of the periphery of the plate and configured to receive light from the plurality of emitters,”**

Cheng and Han disclose this element. Cheng discloses “infrared **receivers** and transmitters distributed densely around a display region [to] form a scanning network in horizontal and vertical directions...” Ex. 1004, [0002] (emphasis added). Cheng's infrared element 40 is arranged around a portion of the periphery of the plate. *Id.*, Fig.

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1. To achieve touch sensing functionality, a POSA would have understood Cheng's infrared element 40 to also disclose a corresponding infrared element 40 with a receiver (detector) to receive light from lamp tube 41. Ex. 1033, ¶155.



Ex. 1004, Fig. 1.

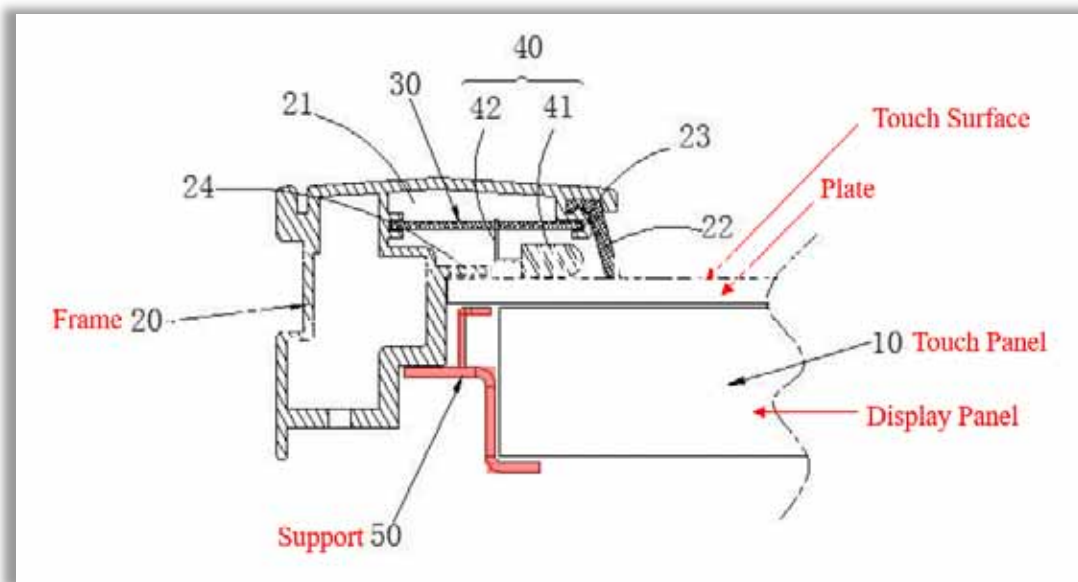
Further, Han discloses a plurality of detectors configured around a portion of the periphery of the plate and configured to receive light from the plurality of emitter. See Ex. 1005, [0040-43]. Ex. 1033, ¶156.

Thus, Cheng and Han disclose claim 1(e). *Id.*, ¶157.

- (f) “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.”

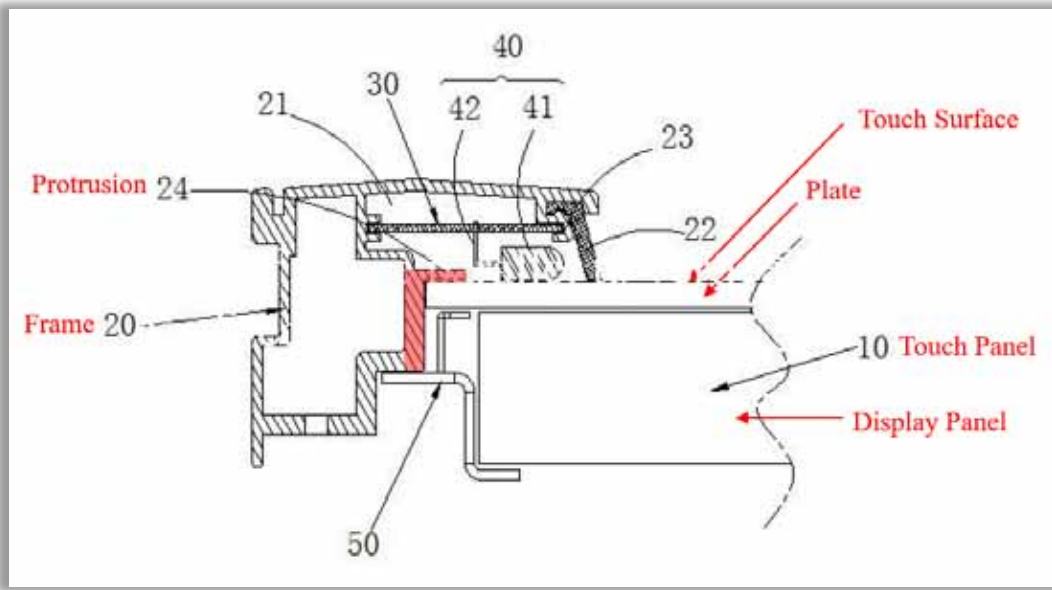
Cheng discloses this element. For a first frame element, Cheng discloses a frame 20 with protrusion 24 and a support 50. Ex. 1004, [0007-8]. As depicted in Fig. 1 of

Cheng, the support 50 supports the display panel of the touch panel 10. *Id.*, Fig. 1; Ex. 1033, ¶158.



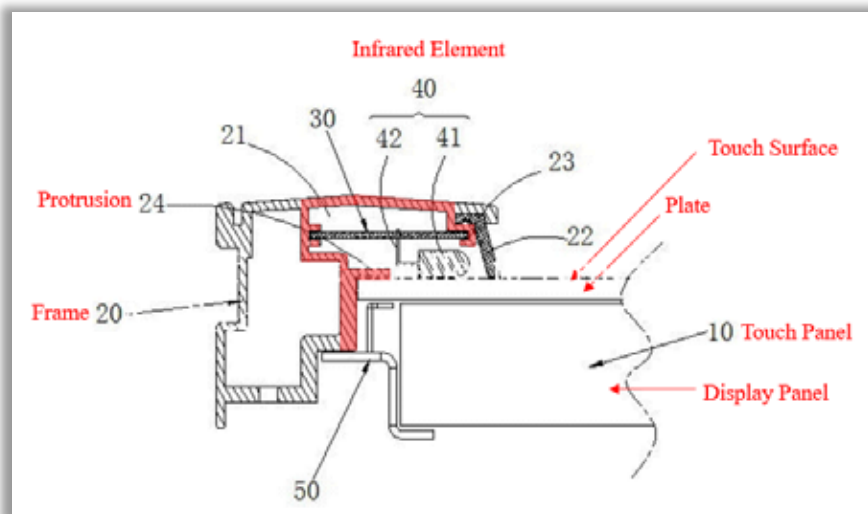
Ex. 1004, Fig. 1.

For a second frame element, Cheng’s frame 20 is arranged around a portion of the periphery of the plate and extends along an edge of the plate. Ex. 1004, Fig. 1. The frame 20 further includes a protrusion 24 that “is placed on an upper surface [touch surface] of the touch panel.” *Id.*, [0007]. Depicted in Fig. 1, Cheng’s protrusion 24 is placed on the touch surface of the plate. *Id.*, Fig. 1; Ex. 1033, ¶159.



Ex. 1004, Fig. 1.

Cheng's infrared element 40 (comprising emitters 41 or detectors) is supported by the frame 20 via grooves 23. The grooves 23 are structurally connected to the frame 20 and the protrusion 24, wherein the protrusion 24 rests on the touch surface of the plate. Ex. 1033, ¶160.



Ex. 1004, Fig. 1.

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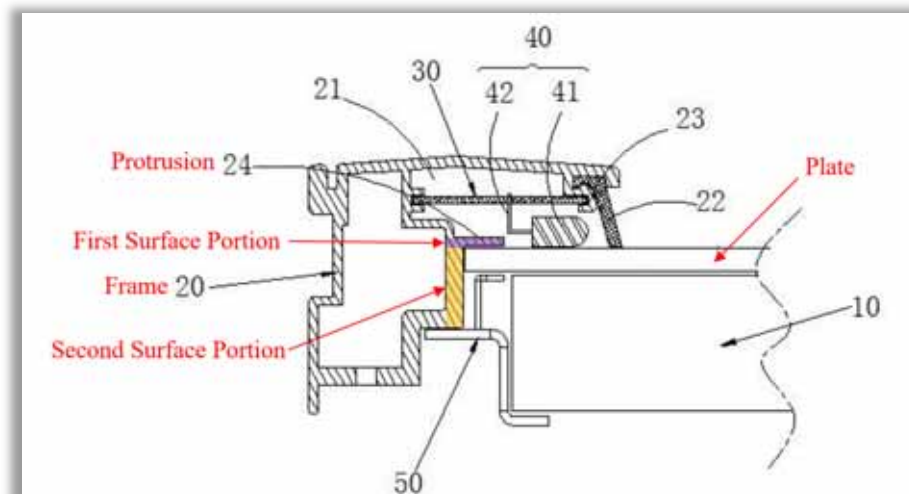
A POSA would have understood the frame 20 and protrusion 24 (second frame element) to support the infrared element 40 (emitters and transmitters) by the protrusion 24 resting on the touch surface of the plate and being structurally connected to the grooves 23. Ex. 1033, ¶161.

Thus, Cheng discloses claim 1(f). *Id.*, ¶162.

(g) “wherein 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.”

Cheng discloses this element. Cheng’s protrusion 24 (first surface portion) extends over an edge portion of the plate. Ex. 1004, Fig. 1. While the term “surface of the plate that defines the plate thickness” is ambiguous, a POSA would understand that Cheng’s frame 20 (second surface portion) is arranged substantially parallel to the surface of the plate that defines the plate thickness.² *Id.*; Ex. 1033, ¶163.

² Petitioner does not waive alternative construction or indefiniteness arguments related to “surface of the plate that defines the plate thickness” as applied throughout this Petition.

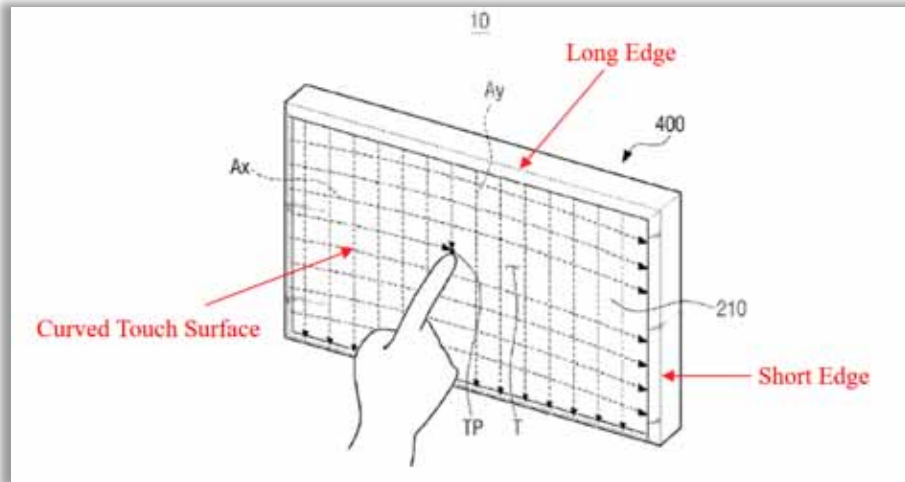


Ex. 1004, Fig. 1.

Thus, Cheng discloses claim 1(g). Ex. 1033, ¶164.

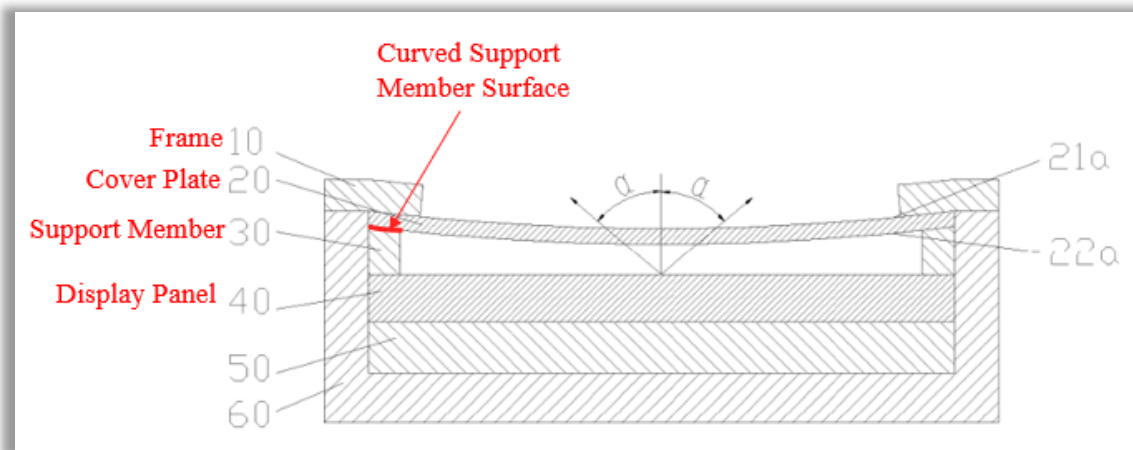
- (h) “wherein the touch surface is curved relative to a flat plane defined in part by the short edge and the long edge.”

Cheng in view of Han and Zhao discloses this element. It would have been obvious to a POSA to modify Cheng’s plate to incorporate Han’s parabolic touch screen curvature along Ax and Ay directions to improve touch detection accuracy. Ex. 1033, ¶165.



Ex. 1005, Fig. 2.

To reach Han's touch screen curvature, it would have been obvious to a POSA to modify Cheng's frame 20 with protrusions 24 and plate support elements of supports 50 according to Zhao's curved mounting surfaces 30 and frame 10. Ex. 1033, ¶166.

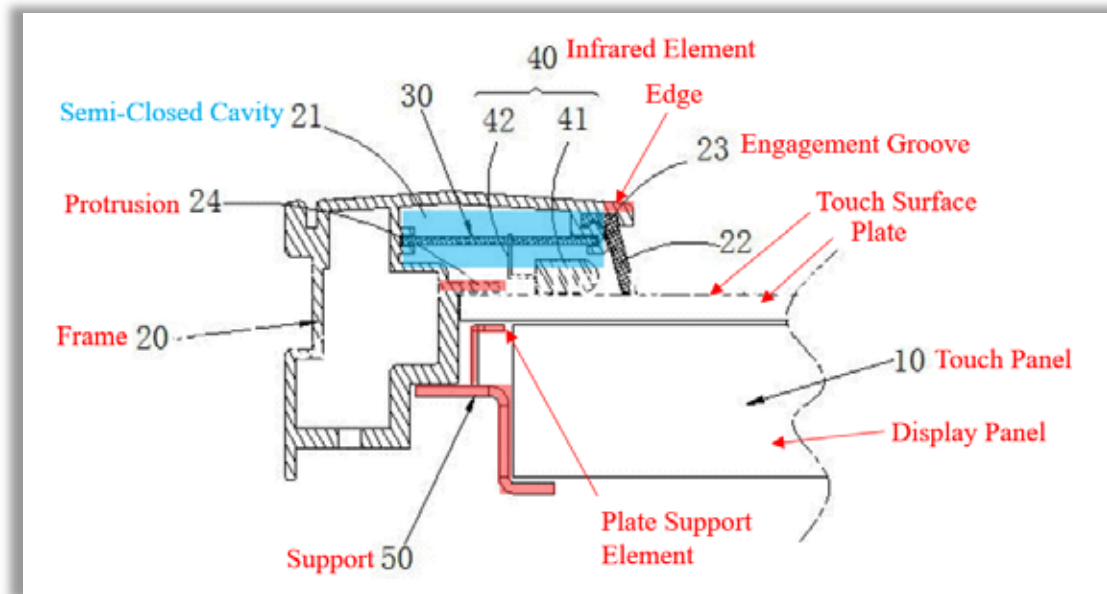


Ex. 1012, Fig. 1.

Like in Zhao, the curved modified plate support elements of Cheng would induce curvature into the plate in a simplified manufacturing step, and the curved modified

frame 20 with protrusions 24 of Cheng would secure the curved touch surface side of the curved plate. Ex. 1033, ¶167.

The modified Cheng device has curved short and long edges. Cheng's frame 20 includes semi-enclosed cavity 21 and engagement groove 23 for supporting the circuit board 30 and infrared element 40. *Id.*, ¶168; Ex. 1004, [0013].



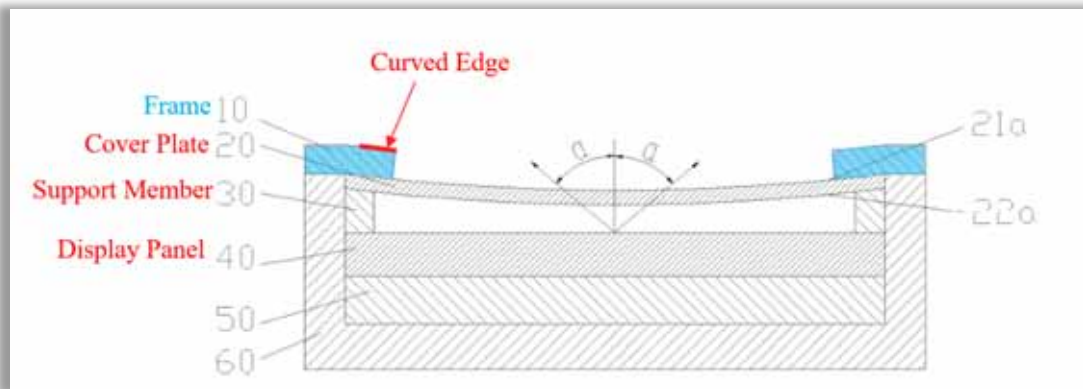
Ex. 1004, Fig. 1.

Cheng teaches that “the lamp tube 41 [of infrared element 40] extends out of the semi-closed cavity 21 and lies against a surface of the touch panel 10.” *Id.*, [0013], [0018]. From this lamp tube 41-to-surface-of-panel configuration, Cheng explains “this reduces the distance from the center of the lamp tube 41 to the touch panel 10, and avoids the phenomenon whereby a touch object triggers a touch operation when it has not yet touched the touch panel...” *Id.* In the modified Cheng device, wherein the

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protrusion 24 and plate support element are curved according to Zhao, Cheng's modified semi-closed cavity 21 and engagement groove 23 would also be curved. As a result, the respective first and second (short and long) edges of Cheng's modified frame 20 would also be curved. *Id.* In this configuration, a POSA would have expected Cheng's lamp tube 41 to remain in contact with the curved touch surface of the plate and provide the same touch detection performance by emitting light in close proximity to the surface of the plate disclosed in the unmodified Cheng device. Ex. 1033, ¶169.

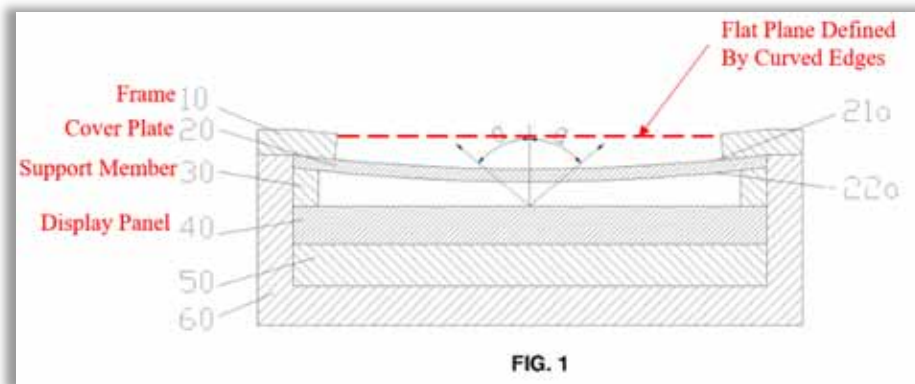
Additionally, curved first and second edges in the modified Cheng device would have been obvious based on Zhao's curved frame 10. *Id.*, ¶¶170-71.



Ex. 1012, Fig. 1.

A POSA would have been motivated to implement Zhao's curved frame 10 into Cheng's frame 20 with protrusion 24 and would have expected such a modification to achieve Zhao's structural loosening prevention in the modified Cheng device. As a result, the curved frame 20 of the modified Cheng device would thus also have a curved first and second (long and short) edge. Ex. 1033, ¶172.

Cheng's modified curved plate touch surface would be curved relative to a flat plane defined in part by the short and long edges of frame 20. Cheng's modified long and short edges would be curved according to Zhao. A flat plane would be defined (at least in part) by Cheng's modified curved edges. Given that the modified edges would be curved, the flat plane would intersect the edges at least at the extremum of the edges, such as the corners of the edges or the slope inflection regions of the edges. *Id.*, ¶173.



Ex. 1012, Fig. 1.

Cheng's modified curved plate would be curved relative to the flat plane formed in part by the long and short edges of frame 20. Ex. 1033, ¶174.

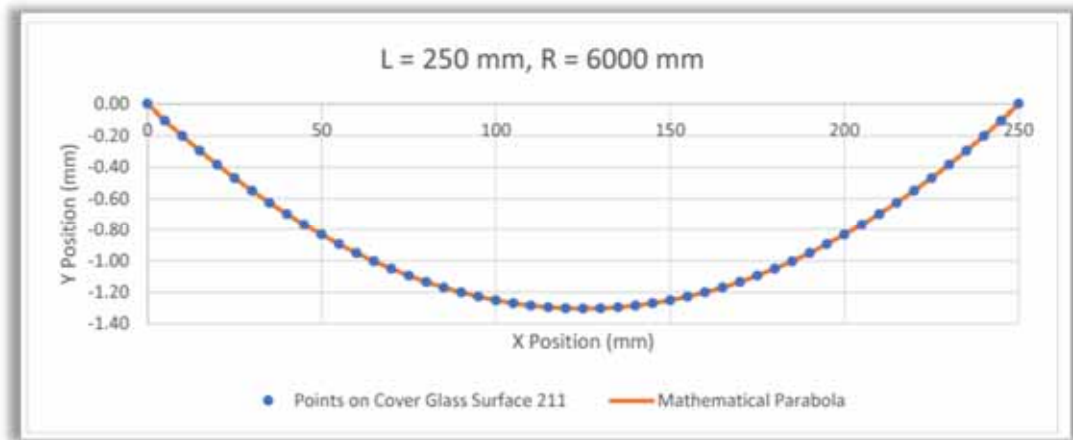
Thus, Cheng in view of Han and Zhao discloses claim 1(g). *Id.*, ¶175.

- (i) **“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.”**

Cheng in view of Han and Zhao discloses this element. Han discloses a parabolically curved touch surface on cover glass 210. Ex. 1005, [0074-77], [0093-95].

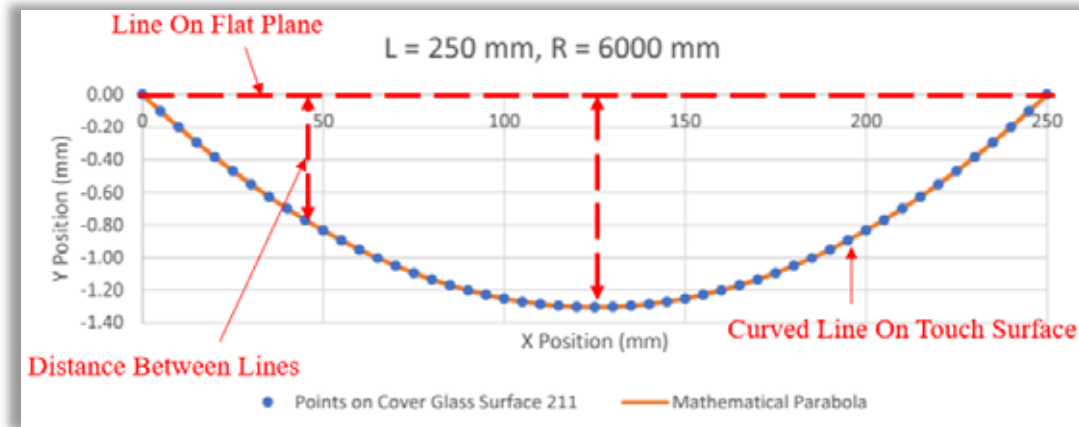
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Plotting Han's disclosed curvature yields a curve described by a parabolic function. A POSA would have been motivated to adopt the same parabolic (concave) curvature of Han in Cheng's modified plate to achieve improved touch performance. Ex. 1033, ¶176.



Ex. 1033, ¶176.

A flat plane can be established across the long and short edges of the modified Cheng frame 20 (according to Zhao). A line can be drawn along Cheng's flat plane and a line may be drawn along the concavely curved touch surface of Cheng's modified plate. *Id.*, ¶177.



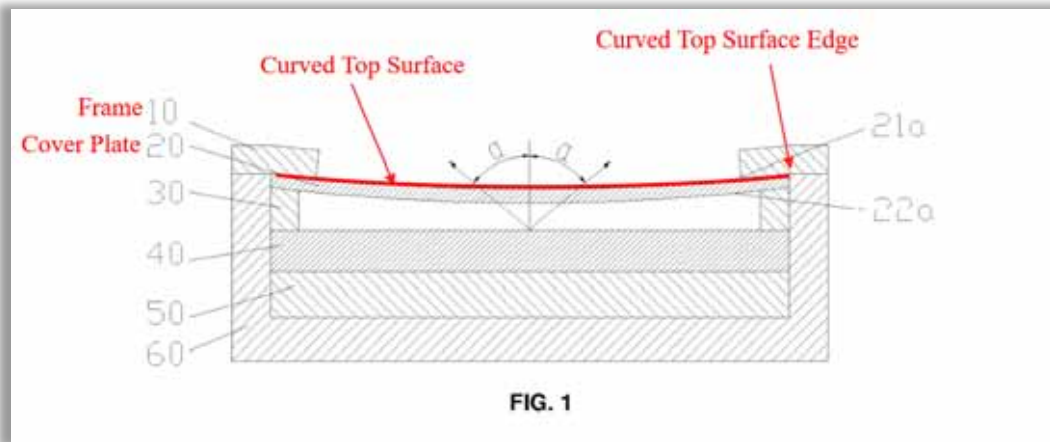
Id.

The distance between the lines drawn on the flat plane line and the curved line on Cheng’s modified concave touch surface vary according to a parabolic function that a POSA would have understood as equating to a “concave function.” Ex. 1033, ¶178.

Thus, Cheng in view of Han and discloses claim 1(i). *Id.*, ¶179.

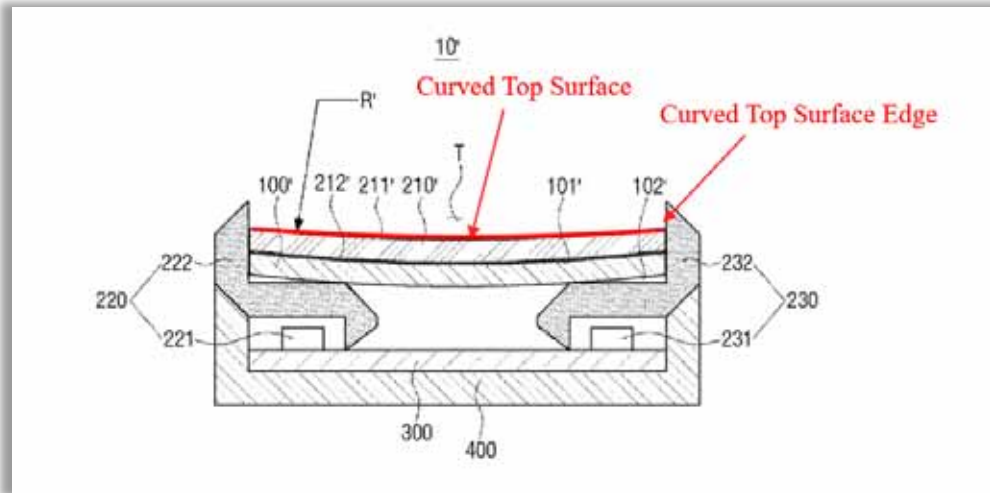
(j) “wherein all of the edges of the top surface of the plate are curved.”

Cheng in view of Han and Zhao disclose this element. Han and Zhao each disclose a plate having a top surface with curved edges. Ex. 1005, Fig. 7, Ex. 1012, Fig. 1; Ex. 1033, ¶180.

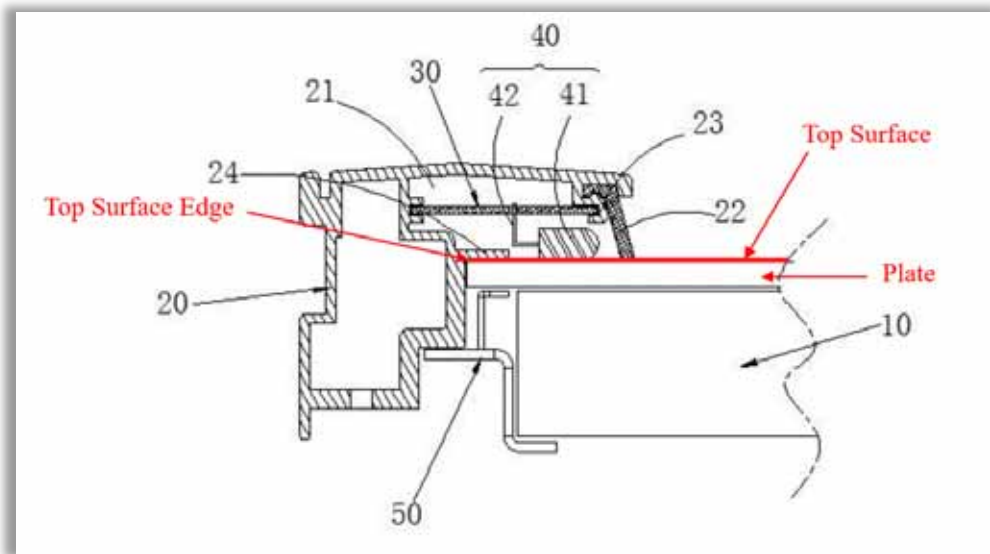


Ex. 1012, Fig. 1.

Zhao's support member 30 and frame 10 are curved along the full length of contact with Zhao's curved cover plate 20, up to and including the cover plate 20's edge. *Id.*; Ex. 1012, [0055]. Accordingly, the edges of Zhao's cover plate 20 (including a top surface) are curved. In the modified Cheng device, Cheng's frame protrusions 24 and plate support elements of supports 50 along both the long and short sides would be curved according to Zhao, resulting in Cheng's modified plate also being curved up to edges along both long and short edges. Cheng's curved plate up to its edges would match the edges of Han's plate curved along both Ax and Ay directions. See Ex. 1005, [0087-89]; Ex. 1033, ¶181.



Ex. 1005, Fig. 7.

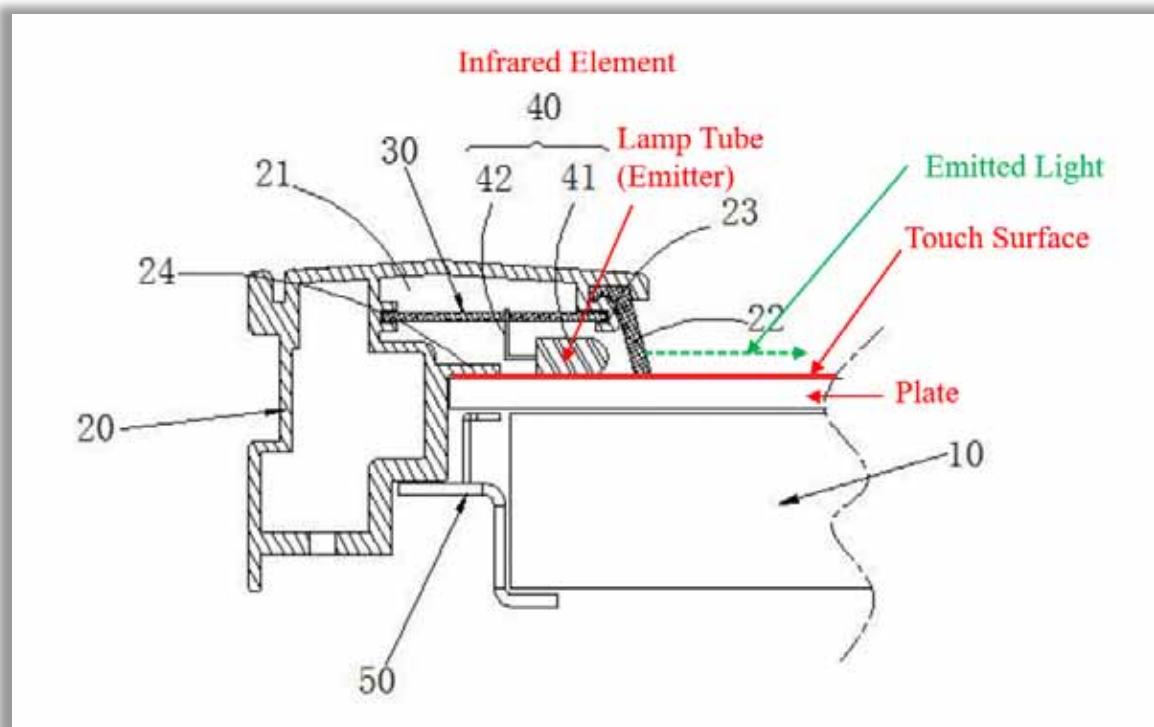


Ex. 1004, Fig. 1.

Thus, Cheng in view of Han and Zhao discloses claim 1(j). Ex. 1033, ¶182.

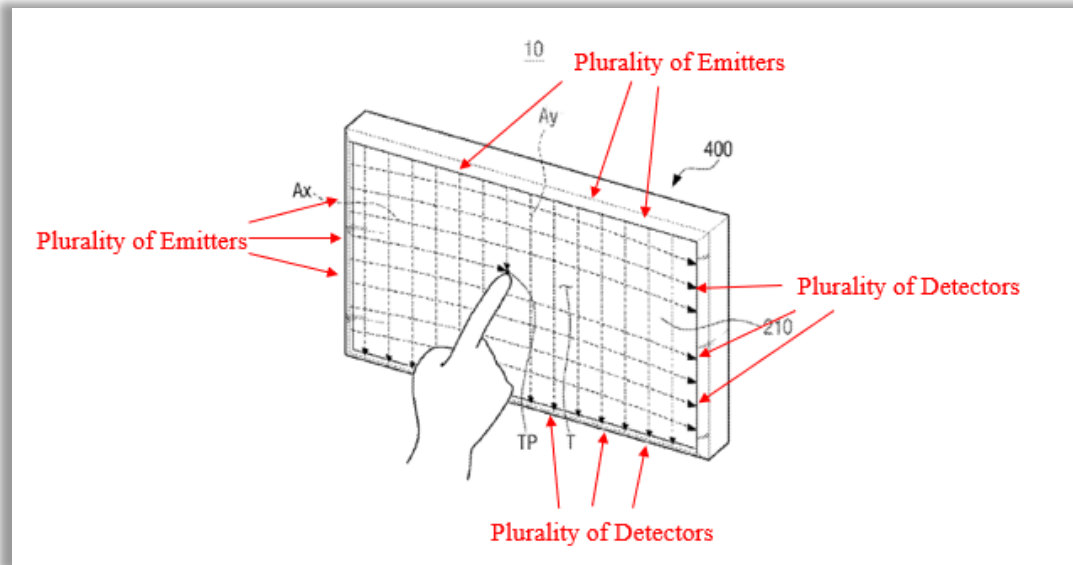
2. **Claim 2: The touch sensing apparatus of claim 1, wherein the plurality of emitters is configured to emit light to propagate over the touch surface.**

Cheng and Han disclose this element. Cheng discloses arranging “infrared receivers and **transmitters** [emitters] distributed densely around a display region [to] form a scanning network in horizontal and vertical directions...” Ex. 1004, [0002] (emphasis added). The infrared element 40 is arranged adjacent to a periphery of the plate. *Id.*, Fig. 1. To achieve touch sensing functionality, a POSA would have understood Cheng’s lamp tube 41 of infrared element 40 to emit light to propagate over the touch surface of the plate. Ex. 1033, ¶183.



Ex. 1004, Fig. 1.

Further, Han discloses a plurality of emitters (light emitting parts 220) configured to emit light across a touch surface. *See* Ex. 1005, [0040]; Ex. 1033, ¶184.



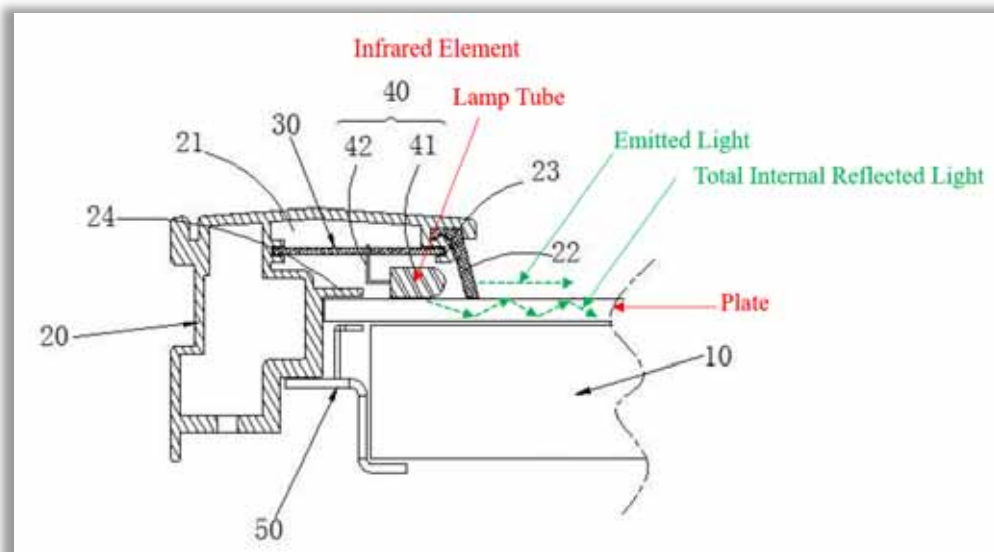
Ex. 1005, Fig. 2.

Thus, Cheng and Han disclose claim 2. Ex. 1033, ¶185.

3. Claim 3: The touch sensing apparatus of claim 1, wherein the plurality of emitters is configured to emit light through the plate by total internal reflection.

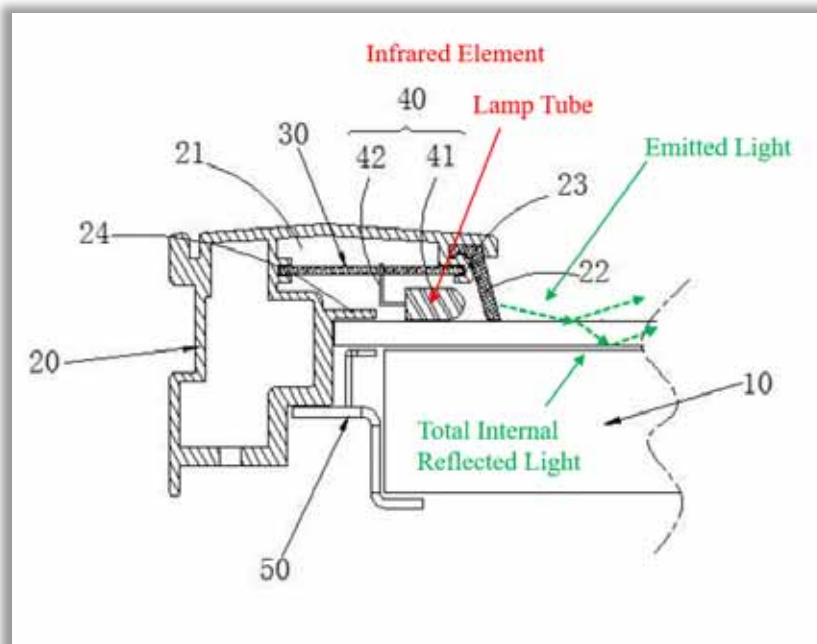
Cheng in view of Han discloses this element. A POSA would have understood Cheng's infrared element 40 with lamp tube 41 (emitter) to emit light through Cheng's plate by total internal reflection ("TIR") via several modes. Ex. 1033, ¶186.

First, a POSA would have understood TIR to have occurred in Cheng from light emitting from the lamp tube 41 (in contact with the plate) and passing directly into the plate. *See* Ex. 1004, [0005-0010], Fig. 1; Ex. 1033, ¶187.



Ex. 1004, Fig. 1.

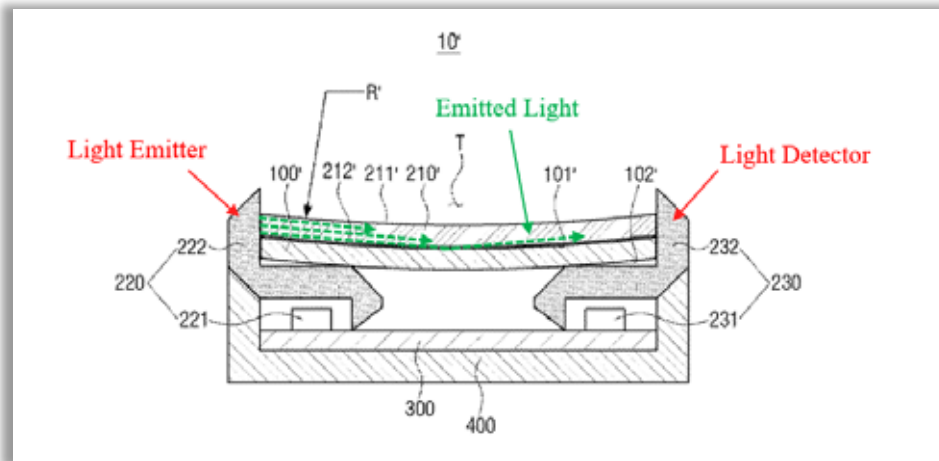
Second, a POSA would have understood TIR to have occurred from light emitted from the lamp tube 41 in a non-parallel vector with the surface of the plate such that the emitted light would intersect the plate. At the intersection point, a POSA would have understood light to both reflect away from and enter the plate. *Id.* A POSA would have further understood light entering the plate to subsequently travel along the plate via TIR. Ex. 1033, ¶188.



Ex. 1004, Fig. 1.

Further, Han discloses TIR in a touch accuracy improving touch device. Ex. 1005, [0115-116]; Ex. 1033, ¶189.

A POSA would have understood Han to describe a plurality of emitters (light emitting surface 2221 of the light emission guide member 222) emitting light through the plate (cover glass 210') by TIR. Ex. 1033, ¶190.



Ex. 1005, Fig. 7.

The inside surface of Han’s cover glass 210 is curved to facilitate TIR. *Id.*, [0116]. A POSA would have understood that Han teaches improving touch detection accuracy by utilizing TIR to deliver light—that would otherwise escape and be undetected—to the light detection guide member 232. Additionally, a POSA would have understood Han’s TIR of emitted light to limit interference between the light emitters and the display, as light would be conveyed (via TIR in the cover glass 210) substantially orthogonal to the display as opposed to intersecting the display and resulting in a “washing out” effect. Further, a POSA would have appreciated TIR within Han’s cover glass 210 to increase the total light signal detected by Han’s detector in the absence of a touch. This increase in “base” light signal would proportionally increase the amount of signal attenuated during a touch, as well as increase the “signal-to-noise” ratio of the detector, thus increasing overall touch detection sensitivity. Still further, a POSA would have appreciated an increased base signal and “signal-to-noise”

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the modified Cheng device implementing TIR to result in limited emitter-to-display interference, increased touch accuracy thanks in part to increased base light signal and “signal-to-noise” ratio, and reduced detector sensitivity and cost requirements. Ex. 1033, ¶193.

Thus, Cheng in view of Han discloses claim 3. *Id.*, ¶194.

- 4. Claim 4: The touch sensing apparatus of claim 1, 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.**

Cheng and Han disclose this element. Cheng discloses a circuit board 30 in connection with infrared element 40. Ex. 1004, [0013]. Han further discloses a controller integrated circuit (“IC”) that “performs the role of identifying the location where a signal was generated according to occurrence of contact or change of electrical capacity, and transmitting the information on the location to a controller IC” Ex. 1005, [0012-13]. Further, a POSA would have understood Han’s IC to embody a typical element performing typical functions to enable touch sensing functionality in infrared touch devices, including the infrared touch device of Cheng. Ex. 1033, ¶195.

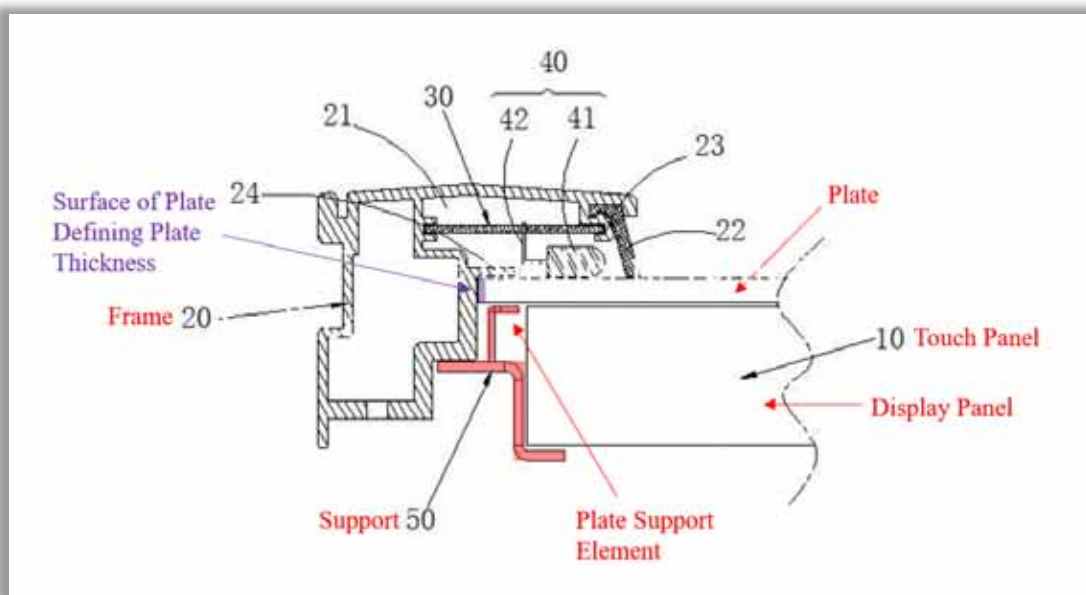
A POSA would have understood Cheng to include a processing element—embodied in Cheng’s circuit board 30 or otherwise—for determining a touch location relative to the touch surface of plate based on output signals of the infrared element 40 (having detectors) as this would embody a typical configuration to enable optical touch

sensing functionality. Han's teaching of the same confirms as much. Ex. 1005, [0012-13]; Ex. 1033, ¶196.

Thus, Cheng and Han discloses claim 4. Ex. 1033, ¶197.

5. **Claim 5: The touch sensing apparatus of claim 1, further comprising a gasket, wherein the plate is supported by the gasket along the surface of the plate that defines the plate thickness.**

Cheng in view of Han and Zhao discloses this element. Cheng's support 50 includes a plate support element. Ex. 1004, Fig. 1. Cheng's plate support element supports the plate along the surface of the plate that defines the plate thickness. Ex. 1033, ¶198.



Ex. 1004, Fig. 1.

In the modified Cheng device according to Zhao, the surface of Cheng's modified plate support element in contact with the plate is curved, like in Zhao, to

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A POSA would have expected to achieve Zhao's curvature-inducing gasket function by modifying Cheng's plate support element according to Zhao's curved support member 30. Like Zhao, Cheng's modified plate support element would support the plate along the surface of the plate that defines the plate thickness. Ex. 1033, ¶201.

Thus, Cheng in view of Han and Zhao discloses claim 5. *Id.*, ¶202.

C. Ground 2 - Claims 1-5 Are Obvious Under 35 U.S.C. § 103 Based On Cao In View Of Han And Zhao.

Cao in view of Han and Zhao renders claims 1-5 obvious as follows. It would have been obvious for a POSA to combine the touch screen display device and frame elements of Cao, with the parabolically curved touch screen elements of Han and the curvature-inducing frame elements of Zhao. A POSA would have expected a resulting touch screen display device having improved touch performance, achieved through a simplified manufacturing process. Ex. 1033, ¶203.

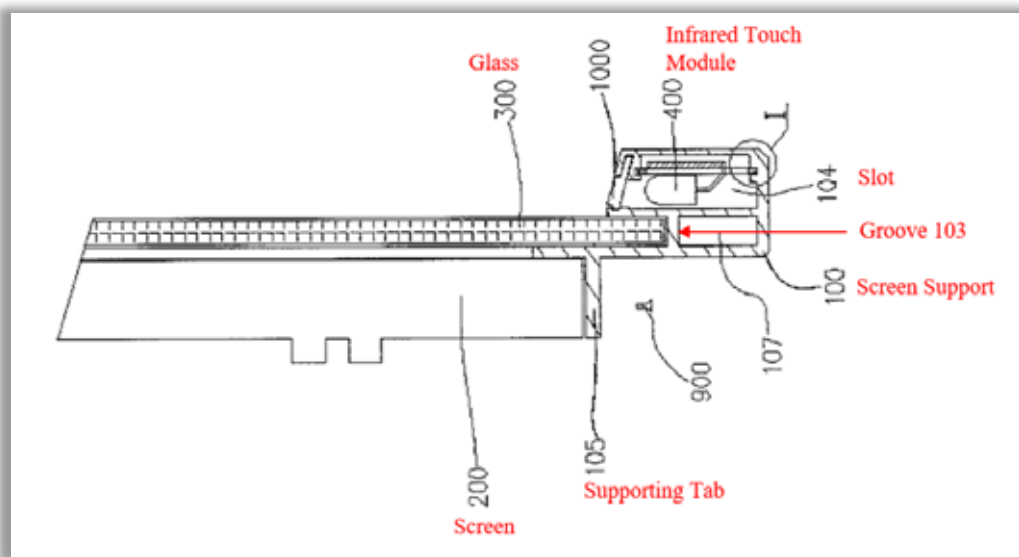
Motivation to Combine

A POSA would have been motivated to modify the Cao device using the teachings of Zhao to obtain the technical advantages disclosed in Han. Cao, Han, and Zhao each relate to similar devices including a display, a covering panel, and a supporting frame assembly. See Ex. 1010, Abstract, Fig. 1; Ex. 1005, Abstract; Ex. 1012, Abstract. Ex. 1033, ¶204.

Cao discloses an "all-in-one smart tablet PC" having an infrared module for touch detection. Ex. 1010, Abstract, 1:17-19. Cao's device includes a display panel

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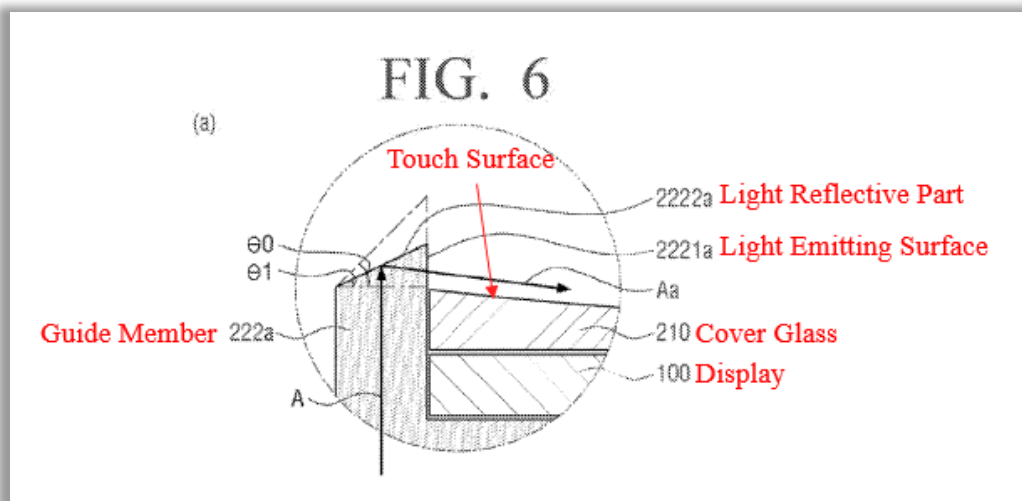
(screen 200), a plate (glass 300) with a touch surface on its upper side, and a frame assembly including four screen supports 100 joined at their ends to form a rectangular shape. *Id.*, 4:1-26, 4:41-42, 5:30-34, 5:47-6:2, 7:16-21, 7:66-67, Figs. 1, 9, 13. Cao discloses infrared light touch detection configurations, while leaving certain implementation details to the reader. Ex. 1033, ¶205.



Ex. 1010, Fig. 9.

For example, where Cao discloses a relatively flat touch surface to improve a glass-to-frame fit (teaching the concept of adjusting glass's incoming inherent curvature with grooves 103), Han teaches increasing the accuracy of touch detection by utilizing a multi-axis (A_x , A_y) parabolic concave curvature of a touch surface to reduce the amount of light lost by reflection and increasing the amount of light received at light reception guide member 232. See Ex. 1005, [0082-83], [0084-86]; Ex. 1033, ¶206.

Han teaches improving touch detection accuracy in infrared touch devices—such as Cao’s device. In Han, the front surface of a flat cover glass 210 (plate) is configured to have a concave parabolic curvature. Further, Han teaches tuning the direction of emitted infrared light to travel along the surface of the curved touch surface of cover glass 210 by tilting a light reflective part 222a of the guide member 222. Ex. 1005, [106]; Ex. 1033, ¶1207.

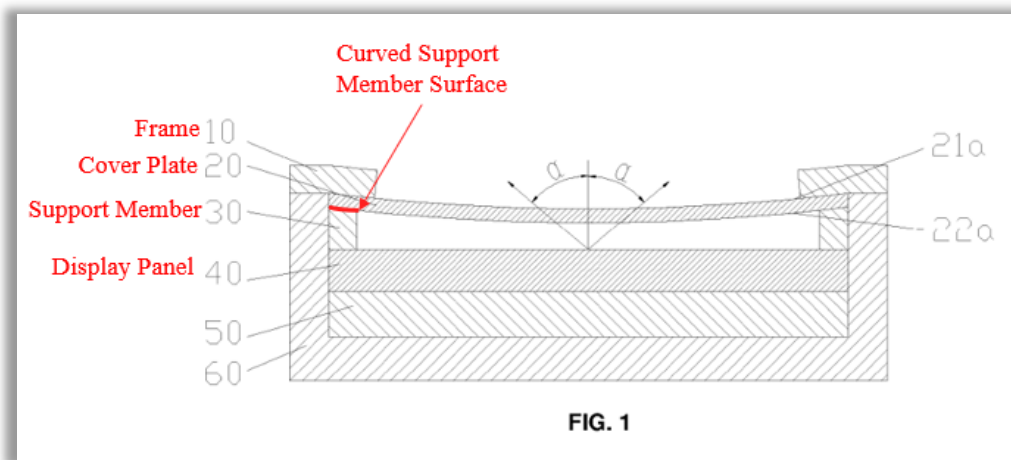


Ex. 1005, Fig. 6(a).

Han teaches that by utilizing a parabolic curvature of front surface 211 of cover glass 210 and tuning the travel direction of emitted light across the front surface, the amount of light lost by reflection is reduced, the amount of light received at light reception guide member 232, and corresponding detection accuracy, is increased. *Id.*, [0086-87]. Further, Han teaches reducing the thickness of the bezel (frame) of the infrared touch device 10 using light emission and reception guide members 222, 232.

Id., [0058]. Thus, Han discloses improvements of the same objectives (improved touch detection accuracy and frame size reduction) in the same technological field (infrared touch devices) as Cao. Ex. 1033, ¶208.

Similar to Han, Zhao discloses a device having a display 40 (Han's display 100) and a cover plate 20 (Han's cover glass 210) having a concave curvature. Like Cao, Zhao teaches supporting its cover plate 20 with a frame 10 (Cao's screen support 100) and a support member 30 (Cao's groove 103 having groove wall 112). *Id.*, ¶209.



Ex. 1012, Fig. 1.

Zhao teaches inducing curvature in the cover plate 20, explaining that “[t]he cover plate 20 also may be a flat plate, and is forced to bend by squeezing the cover plate 20 in the installation process, so that its first surface 21a is concave.” *See id.*, [0050]. Zhao explains that the shape of the surface of the support member 30 in contact with the cover plate 20 matches that of the cover plate. *Id.*, [0055]. A POSA would have understood inducing the curvature of the cover plate 20 to include forcing the

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cover plate 20 against the curved top side of the support member 30. As the cover plate 20 is bent under force against the curved surface of the support member 30, its shape (curvature) would match that of the curved surface of the support member 30. *See* Ex. 1012, [0050-55]. Zhao teaches that the curved cover panel 20 improves the optical performance of emitted light by reducing the amount of light leak. *See id.*, Abstract; Ex. 1033, ¶210.

To achieve Han's parabolic plate curvature in Cao, a POSA would have been motivated to implement Zhao's teaching of inducing curvature in the plate via a curved support member 30 during plate installation. As the frame in Cao already supports the plate via groove 103, it would have been obvious for POSA to modify Cao's groove 103 with groove walls 112 and 113 according to the curved support member 30 of Zhao. A POSA would have expected such modification to achieve the same simplified curvature-inducing functionality of Zhao in the modified Cao device. As Zhao teaches that the surface of the Zhao's support member 30 in contact with Zhao's cover plate 20 matches that of the cover plate, the modified Cao groove 103 would also match the curvature of the resulting curved plate. This modification would agree with the original Cao's configuration improving glass-to-frame fit. Ex. 1033, ¶211.

Thus, a POSA combining the teachings of Han and Zhao into the device of Cao would have expected to achieve the predictable result of a high touch accuracy (Han) infrared touch device (Cao, Han) and simplified manufacturing method (Zhao), meeting

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the limitations of the '335 Patent. Such modifications would have merely embodied implementing known techniques to improve a similar device in a similar way.

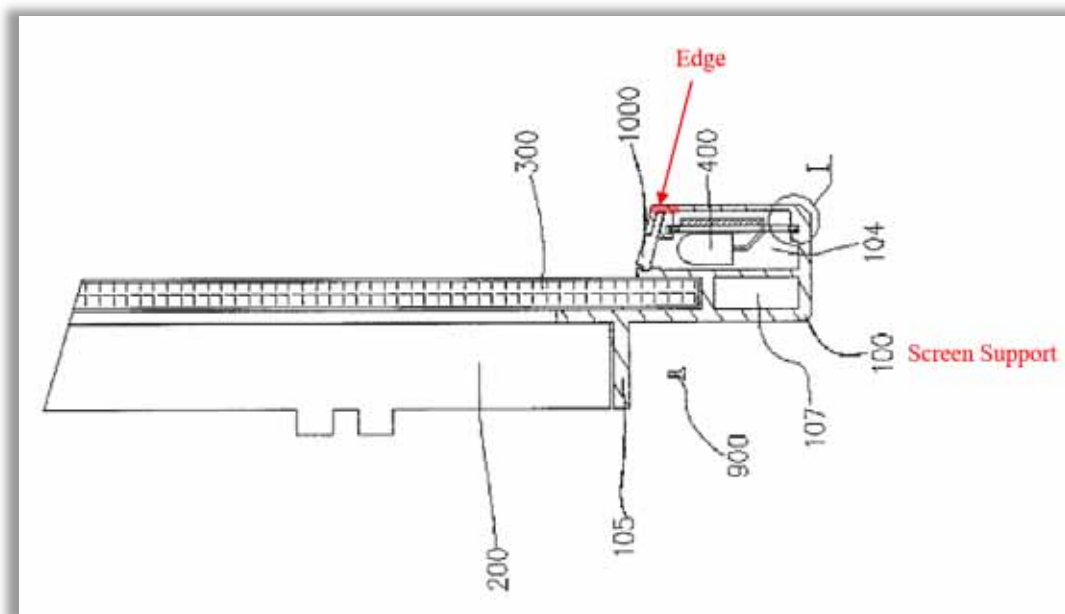
Ex. 1033, ¶212.

1. Claim 1

(a) Preamble

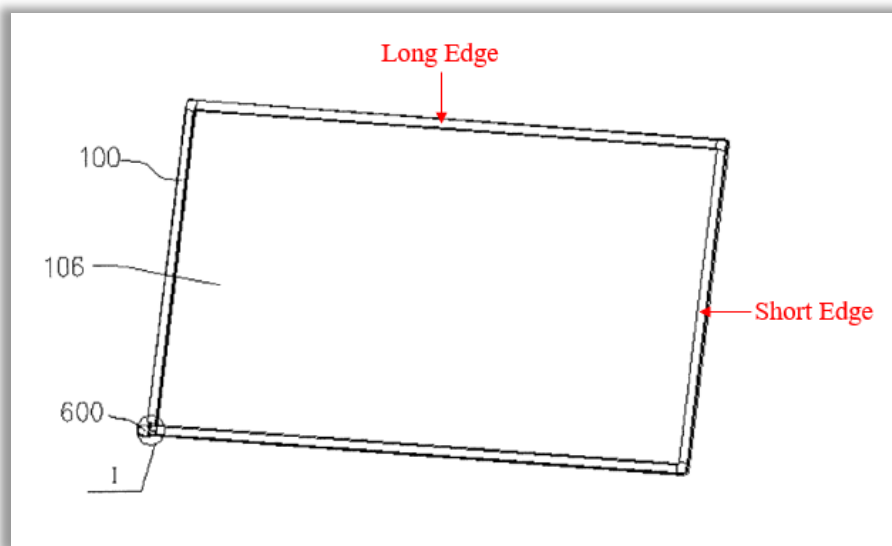
Cao and Han disclose this element. Cao discloses touch sensing device having a long edge and a short edge. Cao's screen support 100 includes an edge portion.

Ex. 1033, ¶213.



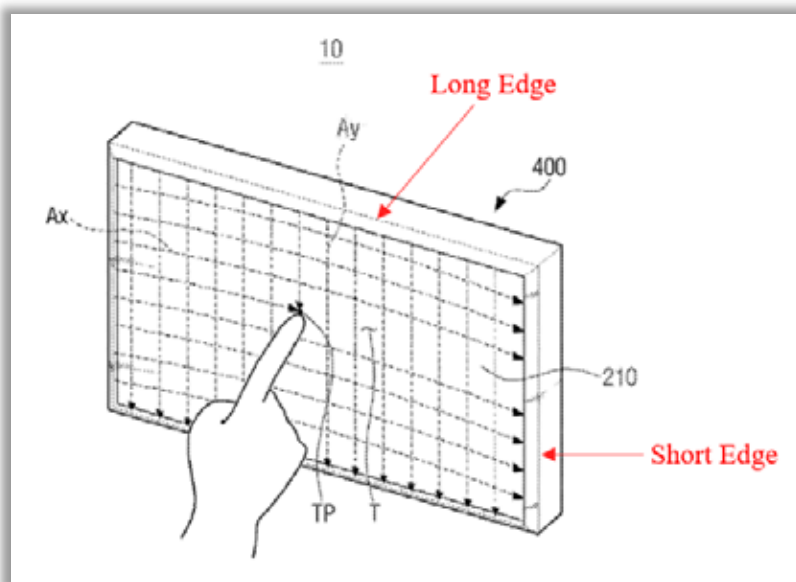
Ex. 1010, Fig. 9.

Cao's screen support 100 makes up a screen frame 106 having a long edge and a short edge.



Ex. 1010, Fig. 14.

Further, Han's frame assembly (including rear cover 400 and guide members 222, 232) includes a first long edge, and a second short edge. See Ex. 1005, Fig. 2.

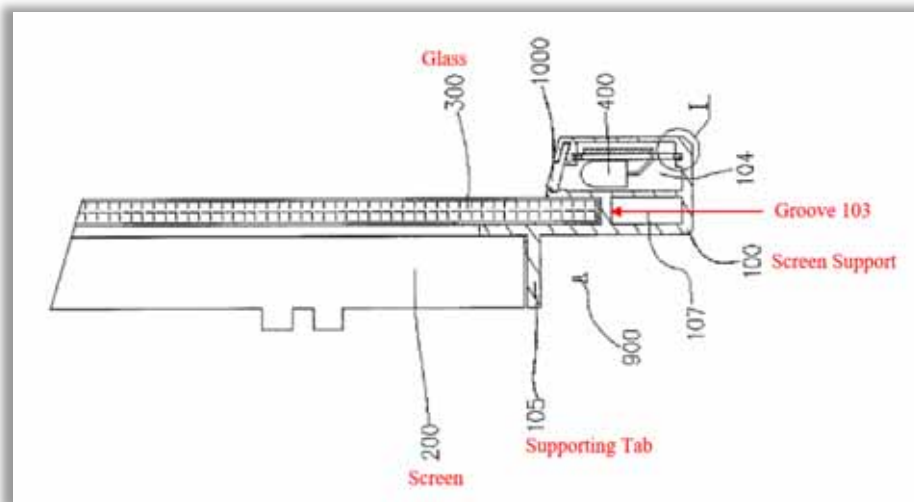


Ex. 1005, Fig. 2.

Thus, Cao and Han disclose claim 1's preamble. Ex. 1033, ¶¶214-16.

(b) Claim 1(b)

Cao, Han, and Zhao each disclose this element. Cao's touch device includes a screen 200 (display panel).



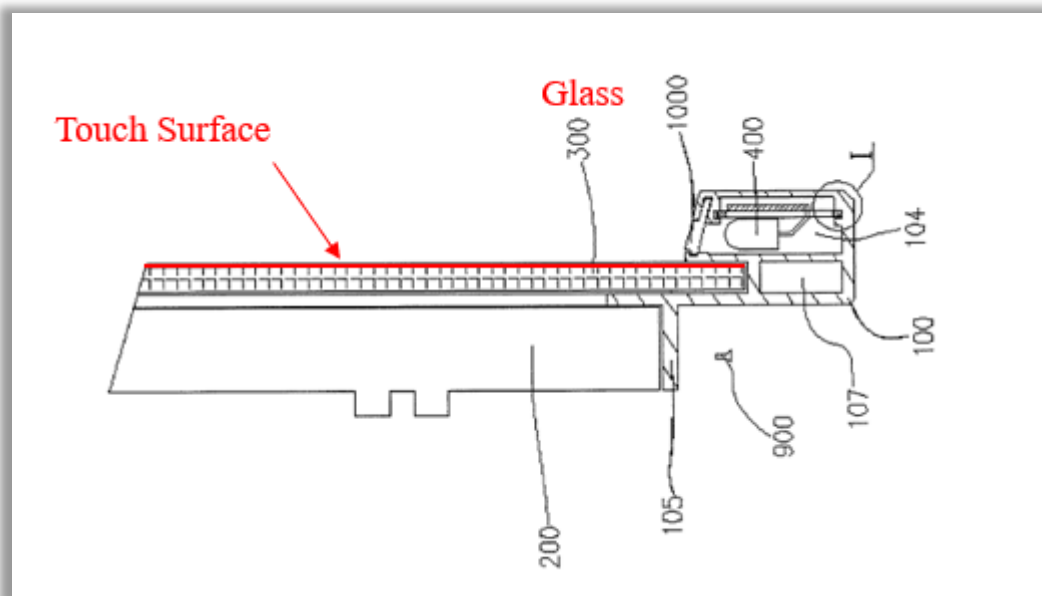
Ex. 1010, Fig. 9.

Further, Han and Zhao also each include a display panel. Ex. 1005, Abstract (Han's display 100); Ex. 1010, Abstract (Zhao's display panel 40).

Thus, Cao, Han and Zhao disclose claim 1 (b). Ex. 1033, ¶¶217-19.

(c) Claim 1(c)

Cao and Han disclose this element. Cao discloses touch device including a glass 300 (plate). Ex. 1010, 3:66-4:12. A POSA would have understood Cao's glass 300 to include a top surface that comprises a touch surface.



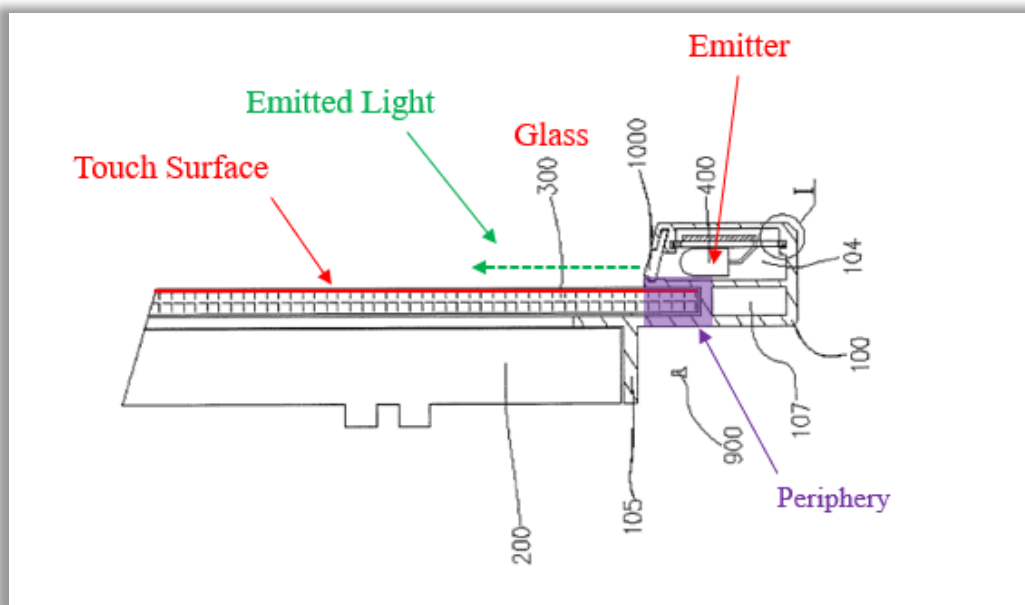
Ex. 1010, Fig. 9.

Further, Han discloses a cover glass 210 with a touch surface. Ex. 1005, [0019], [0038], Fig. 2.

Thus, Cao and Han disclose claim 1(c). Ex. 1033, ¶¶220-22.

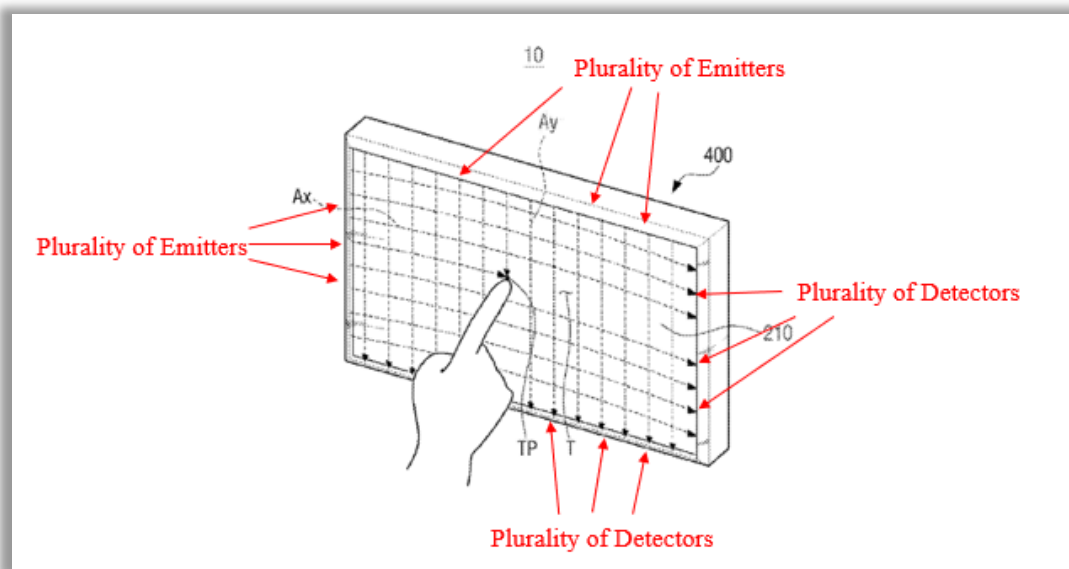
(d) Claim 1(d)

Cao in view of Han discloses this element. Cao's infrared touch modules 400 are arranged adjacent to, or around a portion of, the periphery of the plate 300. See Ex. 1010, Fig. 9. A POSA would have understood infrared modules 400 to disclose an emitter. Ex. 1033, ¶223.



Ex. 1010, Fig. 9.

A POSA would have understood the emitter to emit light across the (touch) surface of the glass 300. Further, it would have been obvious to a POSA to implement a plurality of emitters as taught by Han and as known generally in the prior art. Ex. 1005, [0040]; Ex. 1031, 1:26-46, 15:62-16:3.



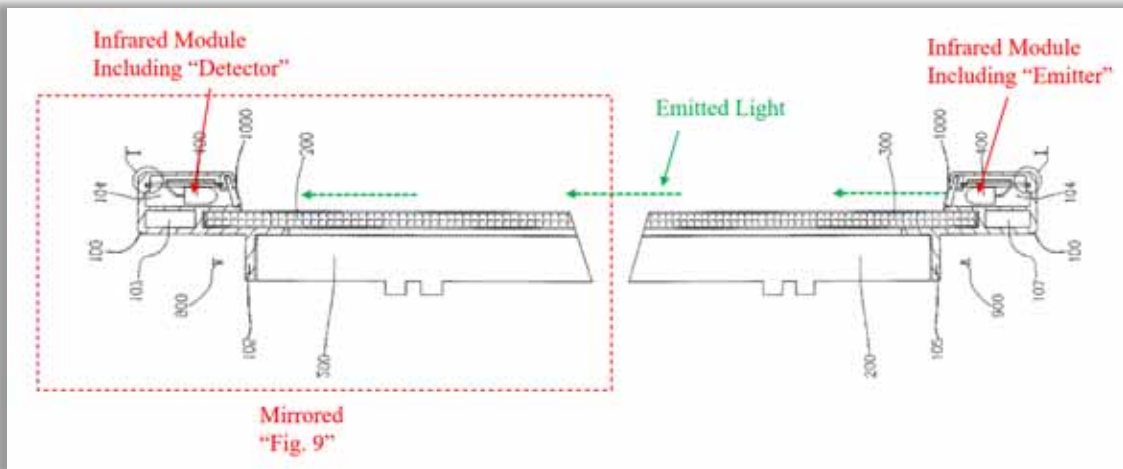
Ex. 1005, Fig. 2.

A POSA would have expected such a modification to Cao to yield the predictable touch-sensing functionality of Han and similar devices known in the prior art.

Thus, Cao in view of Han discloses claim 1(d). Ex. 1033, ¶¶223-26.

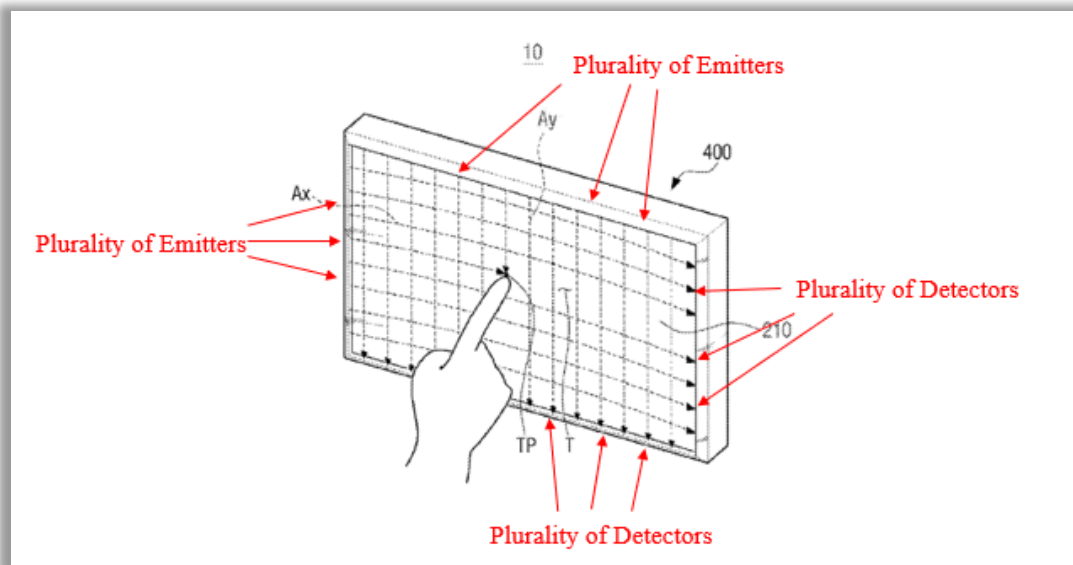
(e) Claim 1(e)

Cao in view of Han discloses this element. A POSA would have understood Cao's infrared modules 400 to disclose a detector. A POSA's understanding would have been supported by the fact that in optical touch sensing devices, such as Cao, infrared emitters require opposing infrared detectors to enable infrared touch sensing functionality. Ex. 1033, ¶227 .



Ex. 1010, Fig. 9.

It would have been obvious to a POSA to include a plurality of detectors in Cao according to Han. A POSA would have expected such a modification to yield the predictable touch-sensing functionality of Han and the similar devices known in the prior art. Ex. 1005, [0040]; Ex. 1031, 1:26-46, 15:62-16:3.

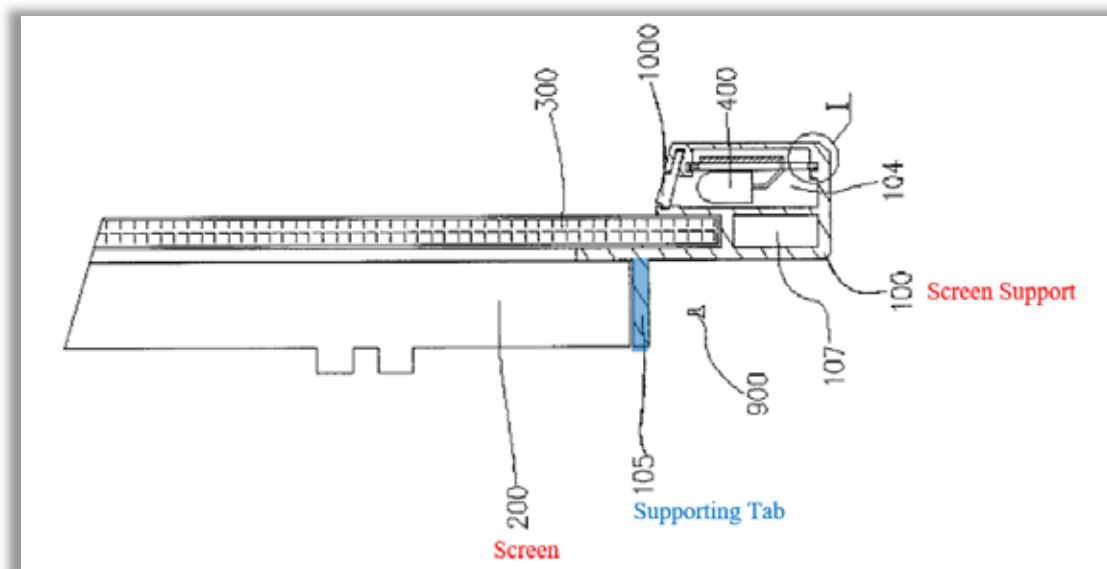


Ex. 1005, Fig. 2.

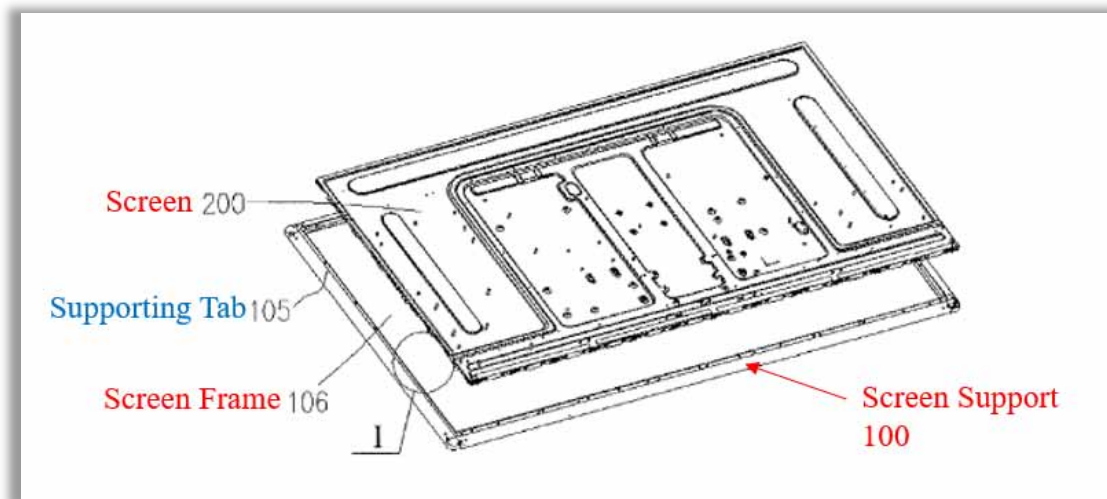
Thus, Cao in view of Han discloses claim 1(e). Ex. 1033, ¶¶227-29.

(f) Claim 1(f)

Cao discloses this element. For a first frame element, each of Cao's screen supports 100 defines a supporting tab 105 that, when four screen supports are joined together, define a screen frame 106 that supports the screen 200. Ex. 1010, 4:7:10, 5:34-36, 7:21-27, Figs. 3, 9, 14; Ex. 1033, ¶230.



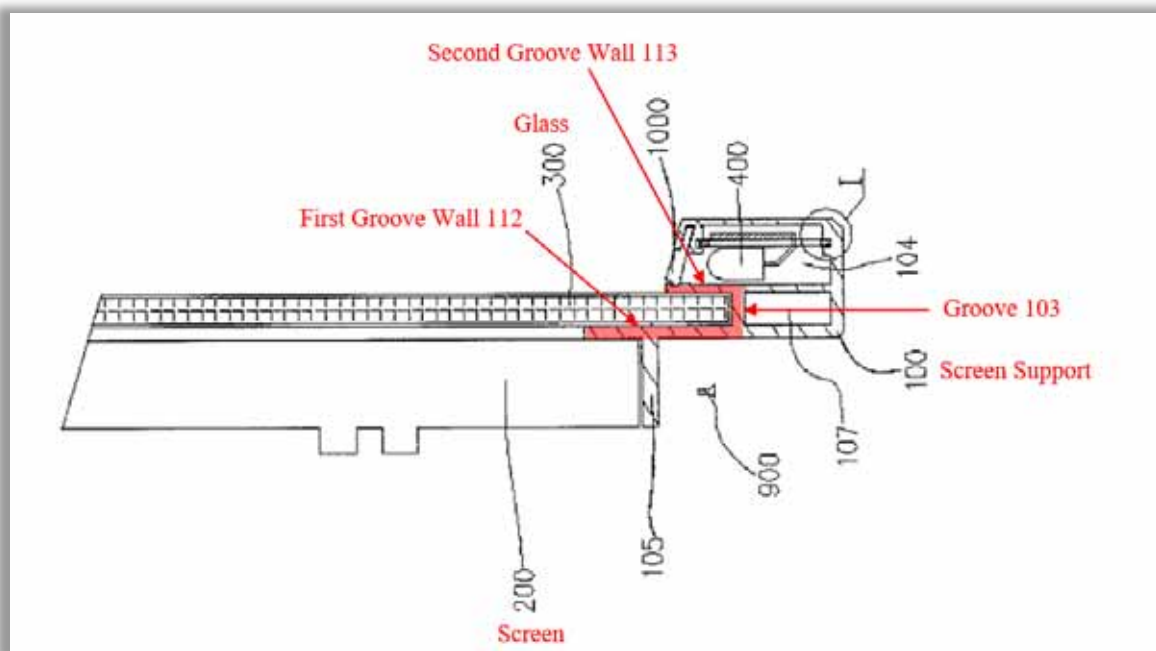
Ex. 1010, Fig. 9.



Ex. 1010, Fig. 3.

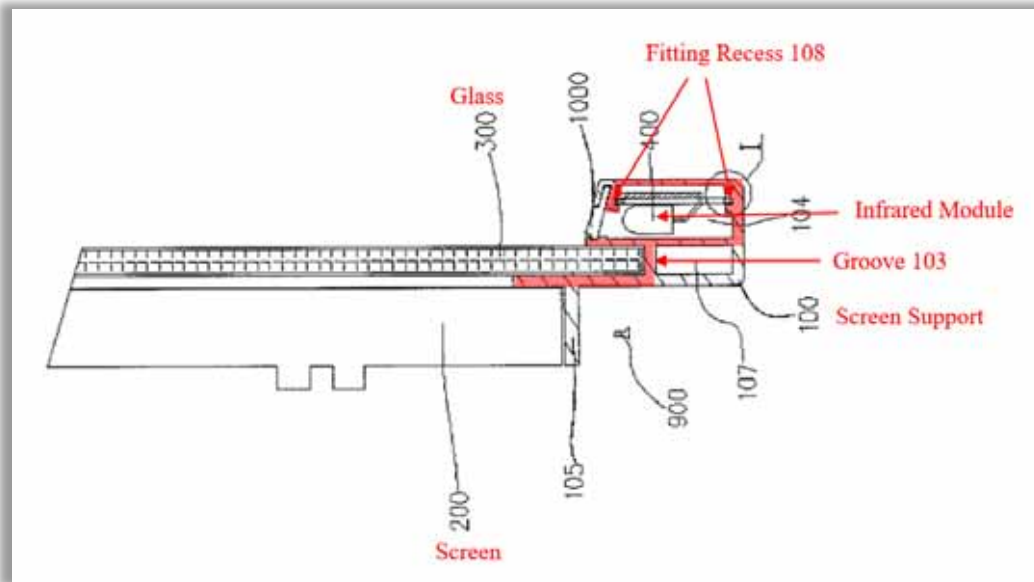
Thus, Cao discloses a frame assembly comprising a first frame element configured to support a display panel. Ex. 1033, ¶231.

For a second frame element, Cao discloses a screen support 100 including a groove 103 having a first groove wall 112 and second groove wall 113, arranged around the periphery of the glass 300. Ex. 1010, 5:47-53, Fig. 9; Ex. 1033, ¶232.



Ex. 1010, Fig. 9.

Cao's infrared module 400—including emitters and detectors—is fitted into fitting recesses 108. *Id.*, 4:59-63. Fitting recesses 108 are structurally connected to Cao's groove 103, first groove wall 112 and second groove wall 113 (together a second frame element) as each are components of Cao's screen support 100. *See id.*, Fig. 9; Ex. 1033, ¶233.



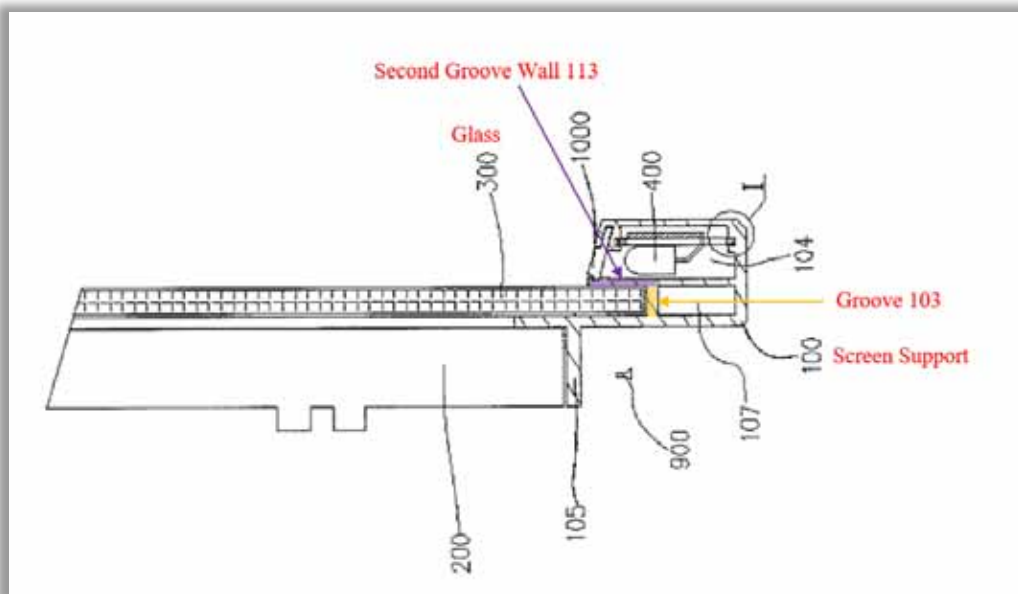
Ex. 1010, Fig. 9.

A POSA would have understood Cao's groove 103, first groove wall 112 and second groove wall 113 to support the emitters and detectors of the infrared module 400 by means of structural connection through screen support 100. Ex. 1033, ¶234.

Thus, Cao discloses claim 1(f). *Id.*, ¶235.

(g) Claim 1(g)

Cao discloses this element. Cao's second groove wall 113 extends over an edge portion of the glass 300 (plate). See Ex. 1010, Fig. 9. Further, a POSA would understand that Cao's groove 103 includes a portion arranged parallel to the surface of Cao's plate that defines its thickness. See Ex. 1010, Fig. 9.

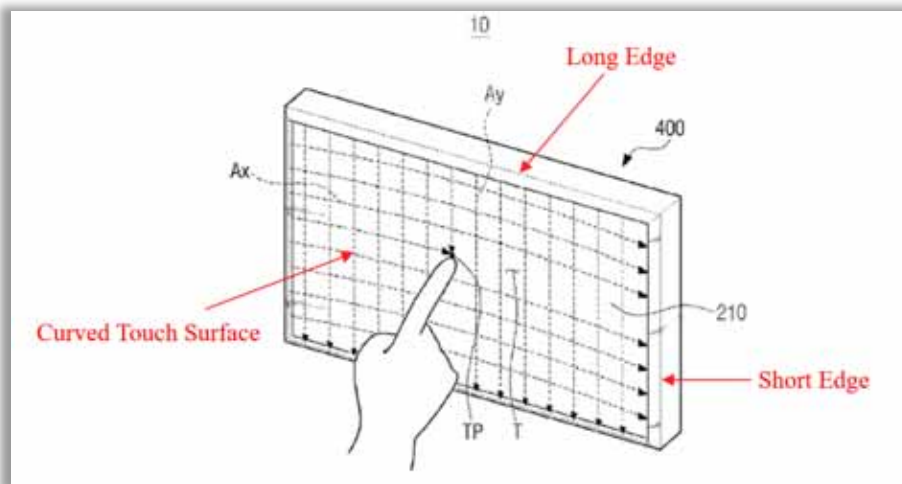


Id.

Thus, Cao discloses claim 1(g). Ex. 1033, ¶¶236-37.

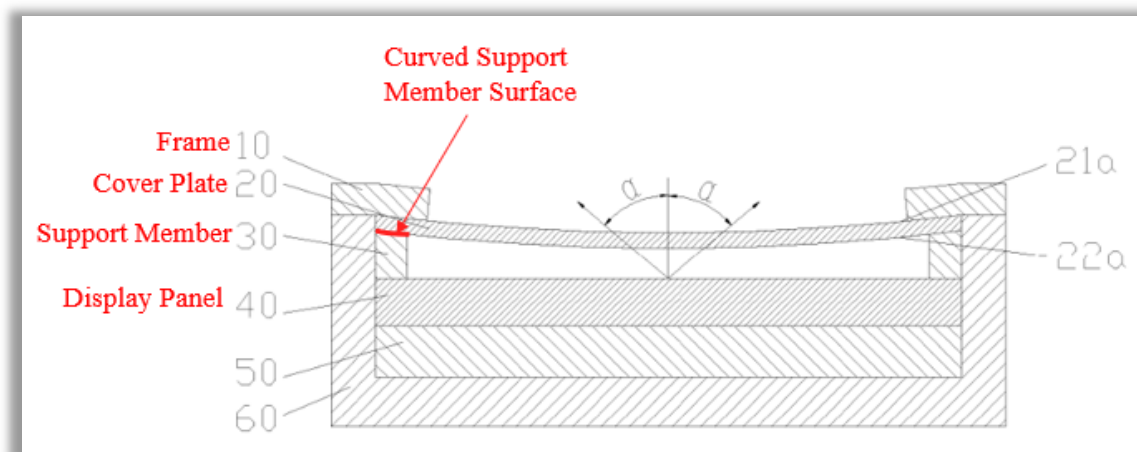
(h) Claim 1(h)

Cao in view of Han and Zhao discloses this element. It would have been obvious to a POSA to modify Cao's glass 300 to incorporate Han's concave touch screen curvature long Ax and Ay directions to improve touch detection accuracy. *Id.*, ¶238.



Ex. 1005, Fig. 2.

To reach Han's touch screen curvature, it would have been obvious to a POSA to modify Cao's groove 103, first groove wall 112 and second groove wall 113 according to Zhao's curved mounting surfaces 30 and frame 10. Ex. 1033, ¶239.



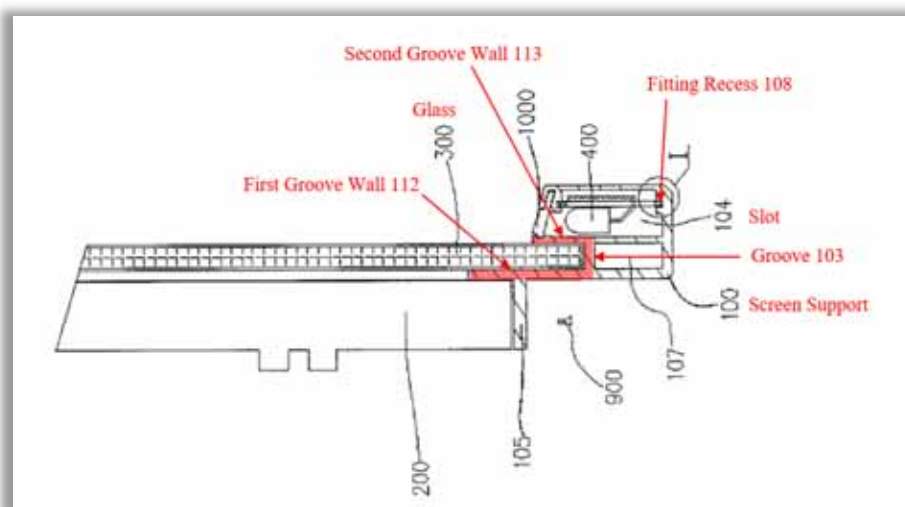
Ex. 1012, Fig. 1.

Like in Zhao, the curved modified groove 103, first groove wall 112 and second groove wall 113 of Cao would induce curvature into Cao's plate in a simplified manufacturing step. Cao's modified curved groove 103 would also secure the curved

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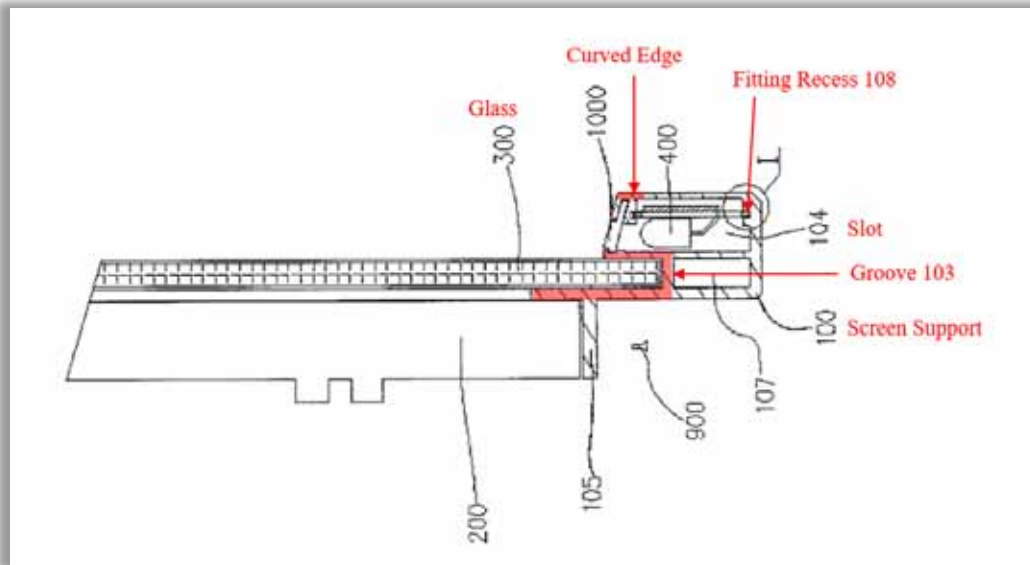
touch surface side of the curved plate similar to Zhao's curved frame 10. Ex. 1033, ¶240.

The modified Cao device has curved short and long edges. Cao's screen support 100 includes a slot 104 and fitting recesses 108 that secure the infrared element 400. Ex. 1010, 4:59-63, Fig. 9. Connected to Cao's fitting recesses 108 via screen support 100 are groove 103, first groove wall 112 and second groove wall 113 which prevent "oversized gap between the glass 300 and the front frame..." *Id.*, 4:13-19. Ex. 1033, ¶241.

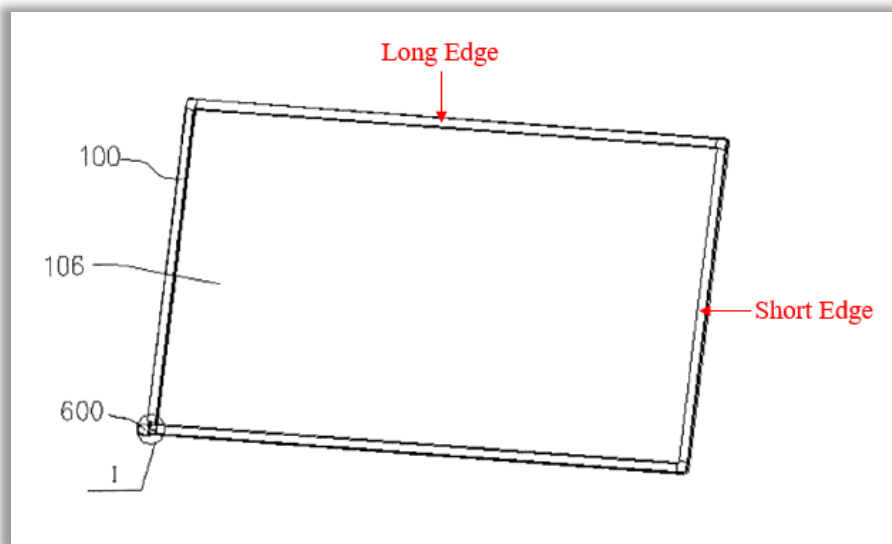


Ex. 1010, Fig. 9.

In the modified Cao device having curved groove 103, first groove wall 112 and second groove wall, the slot 104 and fitting recesses 108 would also be curved. As a result, the long and short edges of Cao's modified screen support 100 would also be curved. Ex. 1033, ¶242.



Ex. 1010, Fig. 9.



Id., Fig. 14.

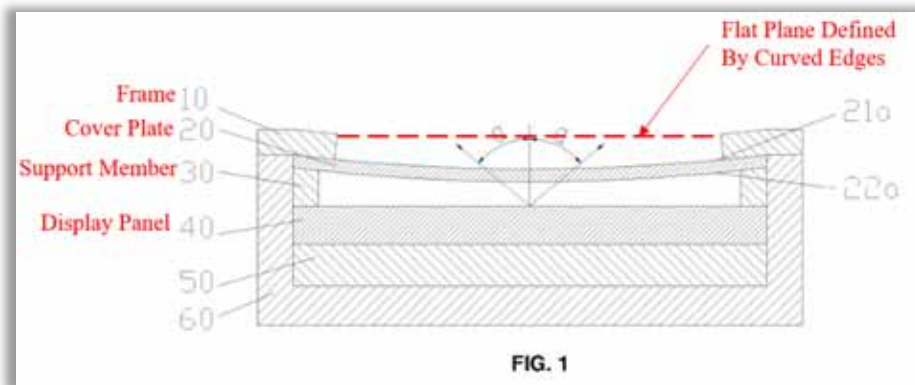
A POSA would have expected Cao’s modified curved edges to contribute to preventing any “oversized gap” between the screen support 100 (frame) and the glass 300 (panel)—such as what would otherwise occur between the curved plate and straight frame. A POSA would further have expected to achieve Zhao’s improved

structural loosening performance from Zhao's curved frame 10 by curving Cao's screen support 100 (having long and short edges). See Ex. 1010, [0051-52].

Ex. 1033, ¶243.

Cao's modified curved plate touch surface would be curved relative to a flat plane defined in part by the short and long edges of screen support 100. Cao's modified long and short edges would be curved according to Zhao. A flat plane would be defined (at least in part) by Cao's modified curved edges. Given that Cao's modified edges would be curved, the flat plane would intersect the edges at least at the extremum of the edges, such as the corners of the edges or the slope inflection regions of the edges.

Ex. 1033, ¶244.



Ex. 1012, Fig. 1.

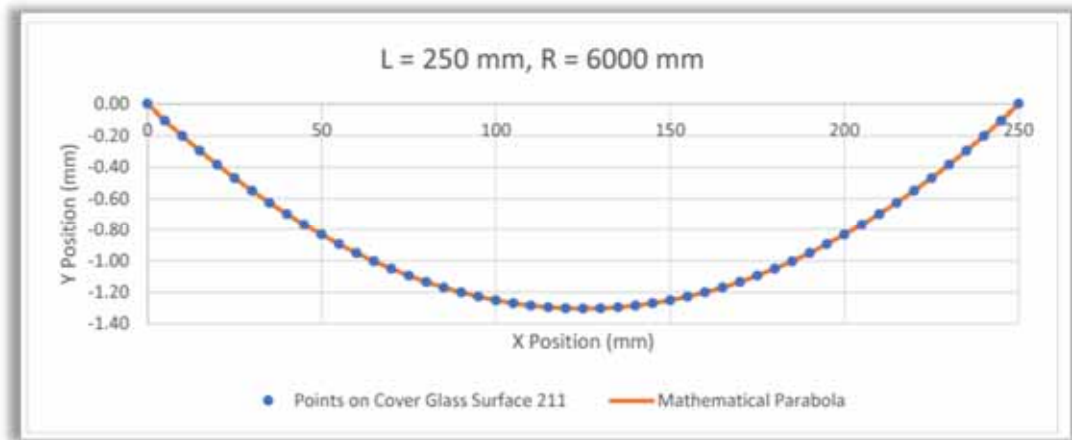
Thus, Cao in view of Han and Zhao discloses claim 1(h). Ex. 1033, ¶245.

(i) Claim 1(i)

Cao in view of Han and Zhao discloses this element. Han discloses a parabolically curved touch surface on cover glass 210. Ex. 1005, [0074-77], [0093-95].

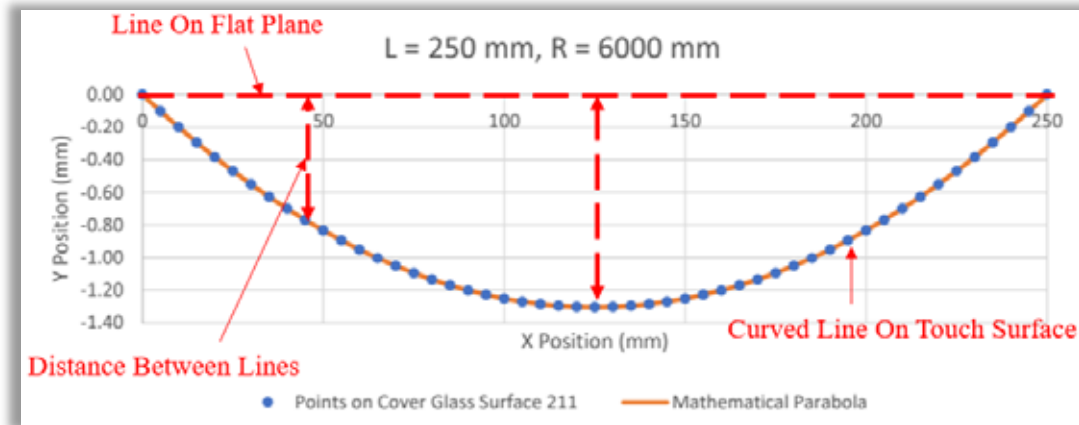
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Plotting Han's disclosed curvature yields a curve described by a parabolic function. A POSA would have been motivated to adopt the same parabolic (concave) curvature of Han into Cao's modified glass 300 to achieve improved touch performance. Ex. 1033, ¶246.



Id.

A flat plane can be established across the long and short edges of the modified Cao screen support 100 (according to Zhao). A line can be drawn along Cao's flat plane and a line can be drawn along the concavely curved touch surface of Cao's modified glass 300. Ex. 1033, ¶247.



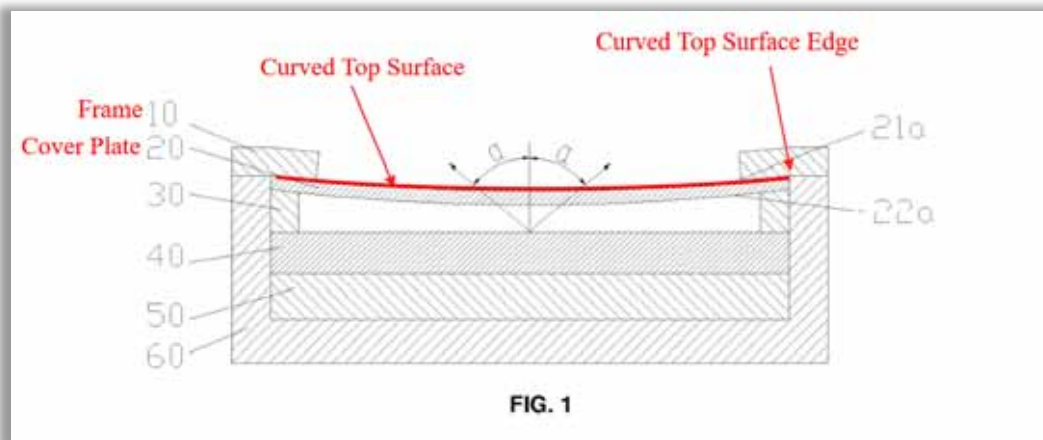
Id.

The distance between the lines drawn on the flat plane line and the curved line on Cao’s modified concave touch surface varies according to a parabolic function that a POSA would have understood as equating to a “concave function.” Ex. 1033, ¶248.

Thus, Cao in view of Han and Zhao discloses claim 1(i). *Id.*, ¶249.

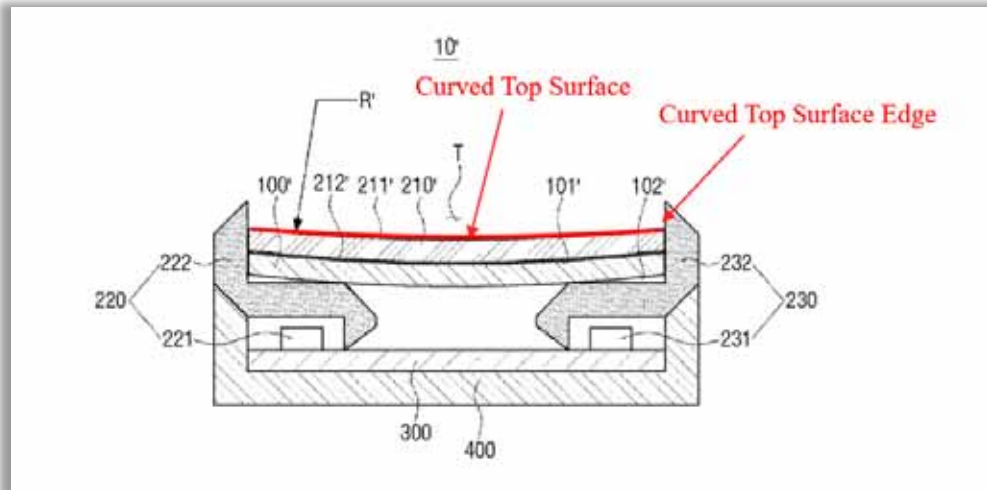
(j) Claim 1(j)

Cao in view of Han and Zhao disclose this element. Han and Zhao each disclose a plate having a top surface with curved edges. Ex. 1005, Fig. 7, Ex. 1012, Fig. 1. Ex. 1033, ¶250.

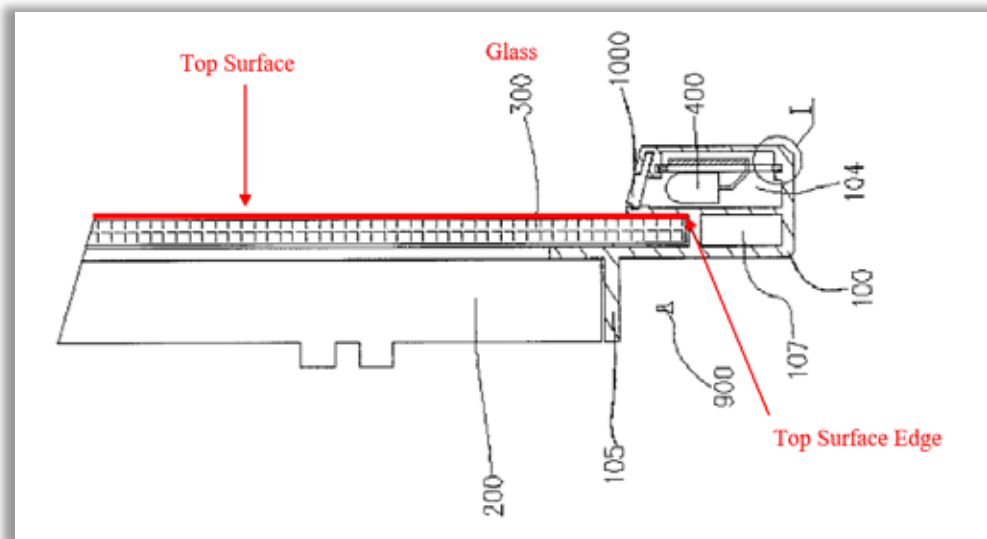


Ex. 1012, Fig. 1.

Zhao's support member 30 and frame 10 are curved along the full length of contact with Zhao's curved cover plate 20, up to and including the cover plate 20's edge. *Id.*; Ex. 1012, [0055]. Accordingly, the edges of Zhao's cover plate 20 (including a top surface) are curved. *Id.* In the modified Cao device, Cao's groove 103 and first and second groove walls 112/113 along both the long and short sides would be curved according to Zhao. This would result in Cao's modified glass 300 being curved up to its edges along both the long and short edges of screen support 100. Cao's curved glass 300 up to its edges would match the edges of Han's cover glass 210 curved along both Ax and Ay directions. See Ex. 1005, [0087-89]; Ex. 1033, ¶251.



Ex. 1005, Fig. 7.



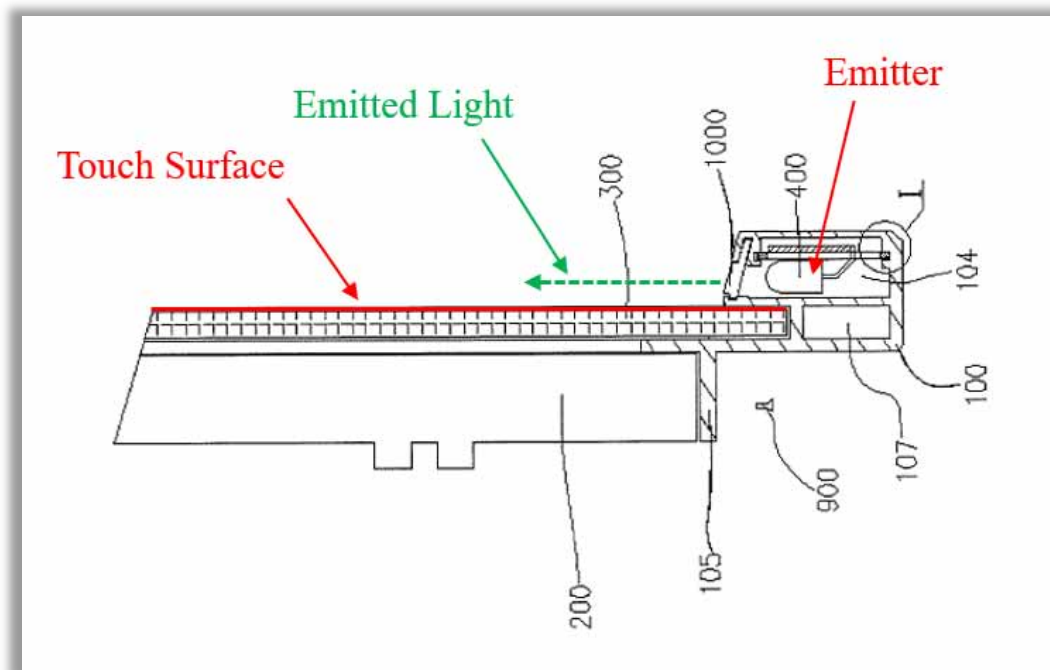
Ex. 1010, Fig. 9.

Thus, Cao in view of Han and Zhao discloses claim 1(j). Ex. 1033, ¶252.

2. Claim 2

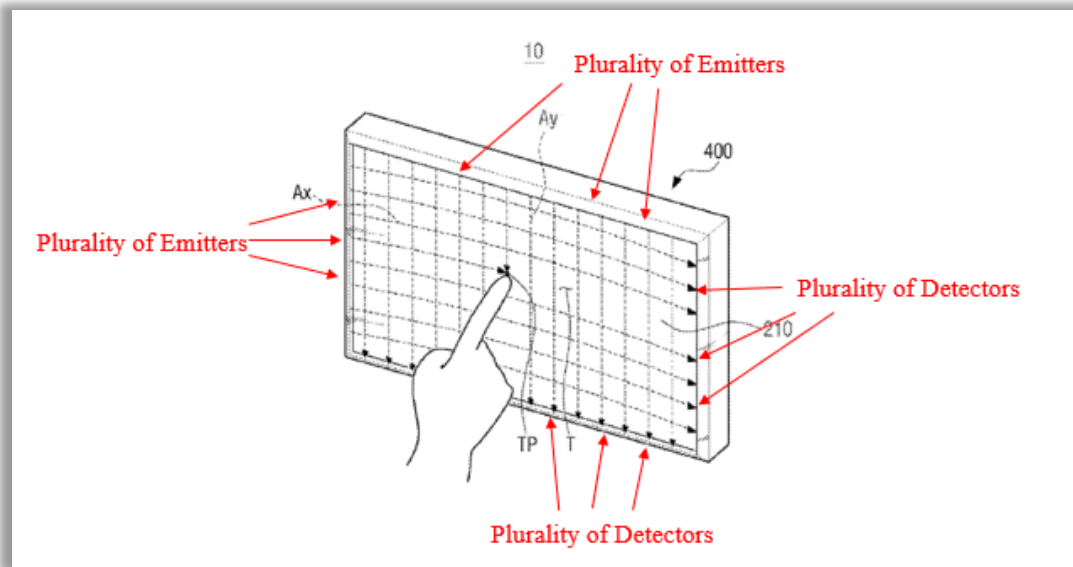
Cao in view of Han discloses this element. In Cao, the infrared touch modules 400 are arranged adjacent to, or near, the periphery of the plate 300. Ex. 1010, Fig. 9.

While Cao only describes “infrared modules 400,” a POSA would have understood infrared modules to disclose an emitter. Ex. 1033, ¶253.



Ex. 1010, Fig. 9.

Based on the orientation of Cao’s emitter in relation to glass 300, a POSA would have understood the emitter to emit light to propagate across the (touch) surface of the glass 300. Further, while Cao does not explicitly describe a plurality of emitters, it would have been obvious to a POSA to implement a plurality of emitters as taught by Han and as known generally in the prior art. Ex. 1005, [0040]; Ex. 1031, 1:26-46, 15:62-16:3; Ex. 1033, ¶254.



Ex. 1005, Fig. 2.

A POSA would have expected such a modification to Cao to yield the predictable touch-sensing functionality of Han and the similar devices known in the prior art. Ex. 1033, ¶255.

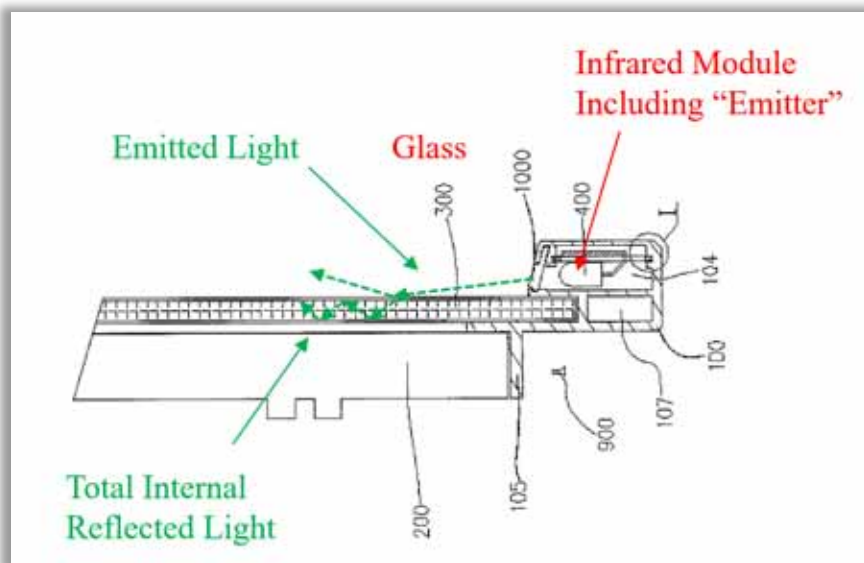
Thus, Cao in view of Han discloses claim 2. *Id.*, ¶256.

3. Claim 3

Cao in view of Han discloses this element. A POSA would have understood Cao's infrared module (with emitter) to emit light through Cao's glass 300 plate by TIR via several modes. *Id.*, ¶257.

First, a POSA would have understood TIR to have occurred from light emitted from Cao's emitter in a non-parallel vector with the surface of the glass 300 such that the emitted light would intersect the plate. At the intersection point, a POSA would have understood light to both reflect away from and enter Cao's glass 300. *Id.* A POSA

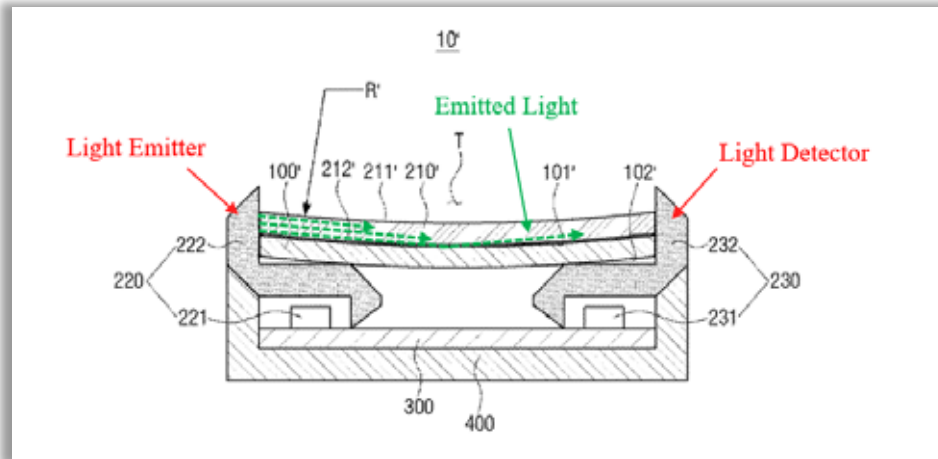
would have further understood light entering the plate to subsequently travel along the plate via TIR. Ex. 1033, ¶258.



Ex. 1010, Fig. 9.

Further, Han discloses TIR in a touch accuracy improving touch device. Ex. 1005, [0115-116]. Ex. 1033, ¶259.

A POSA would have understood Han to describe a plurality of emitters (light emitting surface 2221 of the light emission guide member 222) emitting light through the plate (cover glass 210') by TIR. *Id.*, ¶260.



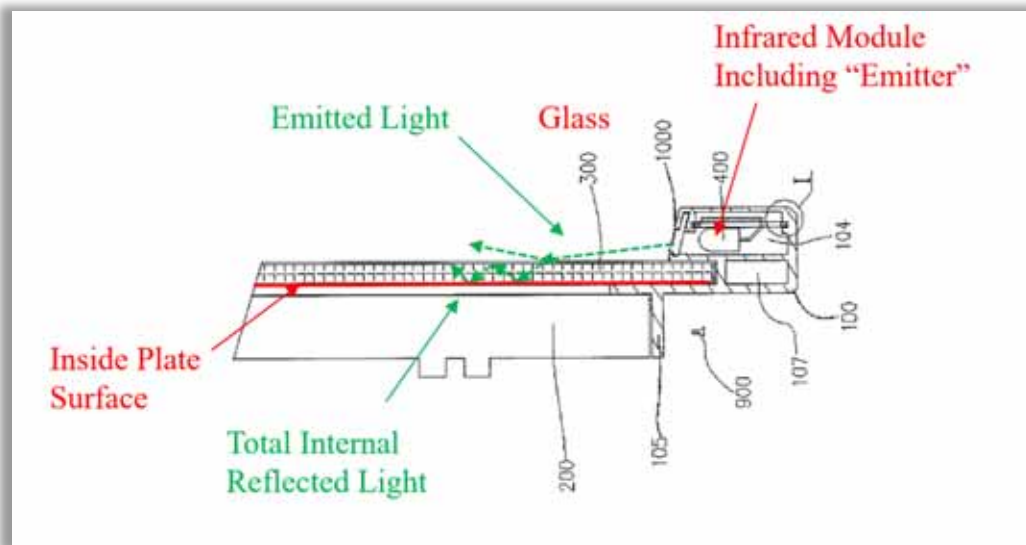
Ex. 1005, Fig. 7.

Further, the inside surface of Han’s cover glass 210 is curved to facilitate TIR. *Id.*, [0116]. Along with Han’s concave touch surface curvature, a POSA would have understood that Han further teaches improving touch detection accuracy by utilizing TIR to deliver light—that would otherwise escape and be undetected—to the light detection guide member 232. Additionally, a POSA would have understood Han’s TIR of emitted light to limit interference between the light emitters and the display, as light would be conveyed (via TIR in the cover glass 210) substantially orthogonal to the display as opposed to intersecting the display and resulting in a “washing out” effect. Further, a POSA would have appreciated TIR within Han’s cover glass 210 to increase the total light signal detected by Han’s detector in the absence of a touch. This increase in “base” light signal would proportionally increase the amount of signal attenuated during a touch, as well as increase the “signal-to-noise” ratio of the detector, thus increasing overall touch detection sensitivity. Still further, a POSA would have

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appreciated an increased base signal and “signal-to-noise” from TIR to allow for comparably less sensitive and costly detector components to achieve the same touch detection performance as more sensitive and expensive detectors without TIR. Ex. 1033, ¶261.

A POSA, implementing the touch accuracy improving *external* cover glass curvature of Han into Cao’s plate, would have similarly been motivated to incorporate Han’s *internal* cover glass curvature into the internal surface of Cao’s modified glass 300. *Id.*, ¶262.



Ex. 1010, Fig. 9.

In the modified Cheng device, the curved back surface of the plate would—like in Han—facilitates “guiding” totally internally reflected light through Cheng’s modified plate. See Ex. 1005, [0115-116]. As Cao’ modified glass 300 would be concavely curved according to Han, additional vectors of emitted light would further

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intersect the glass, increasing the incidence of TIR. *Id.* Like in Han, a POSA would have expected the modified Cao device implementing TIR to result in limited emitter-to-display interference, increased touch accuracy thanks in part to increased base light signal and “signal-to-noise” ratio, and reduced detector sensitivity and cost requirements. Ex. 1033, ¶263.

Thus, Cao in view of Han discloses claim 3. *Id.*, ¶264.

4. Claim 4

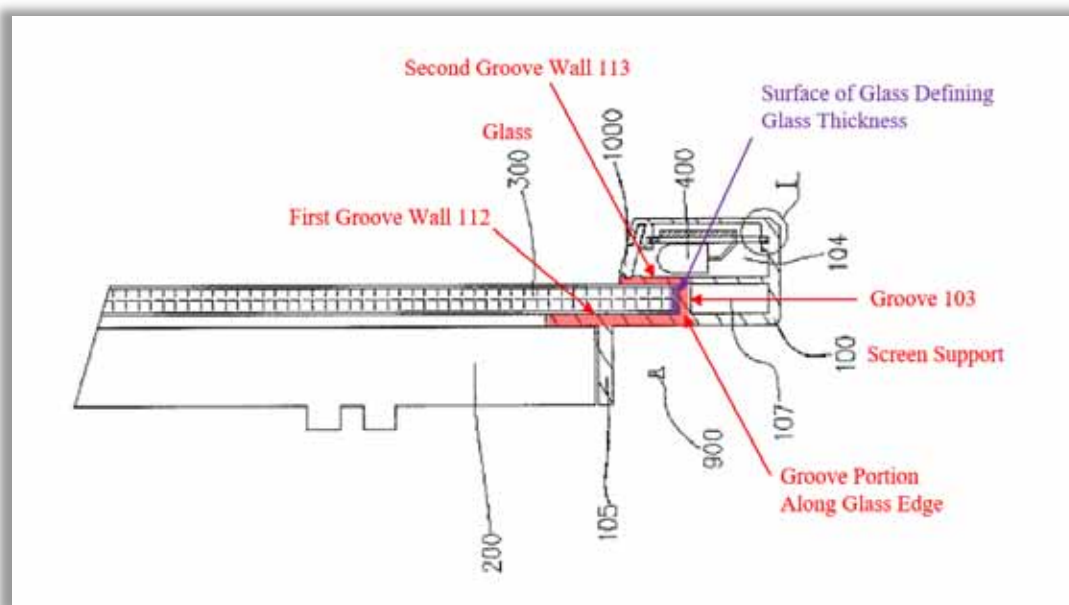
Cao and Han disclose this element. Cao discloses a “smart” tablet PC. Ex. 1010, Abstract. Further, Han discloses a controller integrated circuit (“IC”) that “performs the role of identifying the location where a signal was generated according to occurrence of contact or change of electrical capacity, and transmitting the information on the location to a controller IC” Ex. 1005, [0012-13]. A POSA would have understood Han’s IC to embody a typical element performing typical functions to enable touch sensing functionality in infrared touch devices, including the infrared touch device of Cao. Ex. 1033, ¶265.

A POSA would have understood Cao to include a processing element for determining a touch location relative to the touch surface of the glass 300 based on output signals of the infrared modules 400 (having detectors) as this would embody a typical configuration to enable optical touch sensing functionality. Han’s teaching of the same confirms as much. Ex. 1005, [0012-13].

Thus, Cao in view of Han discloses claim 4. Ex. 1033, ¶266-67.

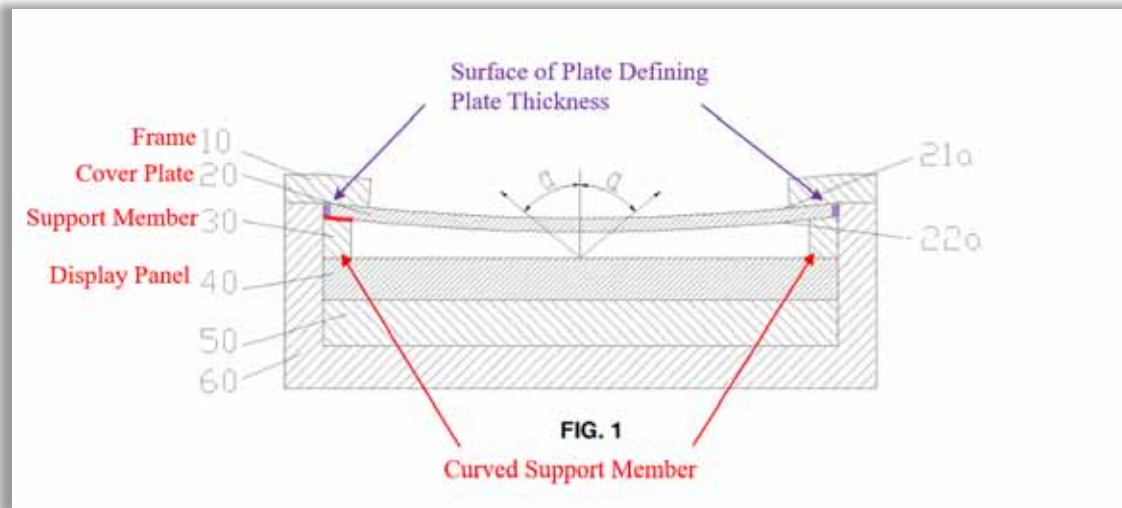
5. Claim 5

Cao in view of Han and Zhao discloses this element. Cao's screen support 100 includes a groove 103 with groove walls 112 and 113. Ex. 1010, 5:47-53, Figs. 9, 12, 13. Cao's groove 103 supports the glass 300 along the surface of the glass that defines the glass thickness. *See id.*; Ex. 1033, ¶268.



Ex. 1010, Fig. 9.

In the modified Cao device according to Zhao, the surfaces of Cao's modified groove 103 with groove walls 112 and 113 in contact with the plate are curved, like in Zhao, to induce curvature into the glass (according to Han) with a simplified process by applying a bending force near the edge of the glass during installation. Ex. 1033, ¶269.



Ex. 1012, Fig. 1.

A POSA would have understood Zhao’s support member 30 to have the same function as a “gasket” in the ’335 Patent. As the ’335 Patent explains “[t]he 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.” Ex. 1031, 11:44-55 (emphasis added). Similarly, Zhao teaches the “the shape of the surface of the support member 30 [gasket] in contact with cover plate [plate] matches with that of the cover plate” and the cover plate “is forced to bend by squeezing the cover plate 20 in the installation process.” Ex. 1012, [0050-55]; Ex. 1033, ¶270.

A POSA would have expected to achieve Zhao’s curvature-inducing gasket function by modifying Cao’s groove 103 with groove walls 112 and 113 according to

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Zhao's curved support member 30. Like Zhao, Cao's modified groove 103 with groove walls 112 and 113 would support the glass along the surface of the glass that defines the glass thickness. Ex. 1033, ¶271.

Thus, Cao in view of Han and Zhao discloses claim 5. *Id.*, ¶272.

D. Ground 3 - Claims 1-4 Are Obvious Under 35 U.S.C. § 103 Based On Cheng In View Of Han And Shin.

Cheng in view of Han and Shin renders claims 1-5 obvious as follows. It would have been obvious for a POSA to combine the touch screen display device and frame elements of Cheng, with the parabolically curved touch screen elements of Han and the curvature-inducing frame elements of Shin. A POSA would have expected a resulting touch screen display device with improved touch performance, achieved through a simplified manufacturing process. Ex. 1033, ¶273.

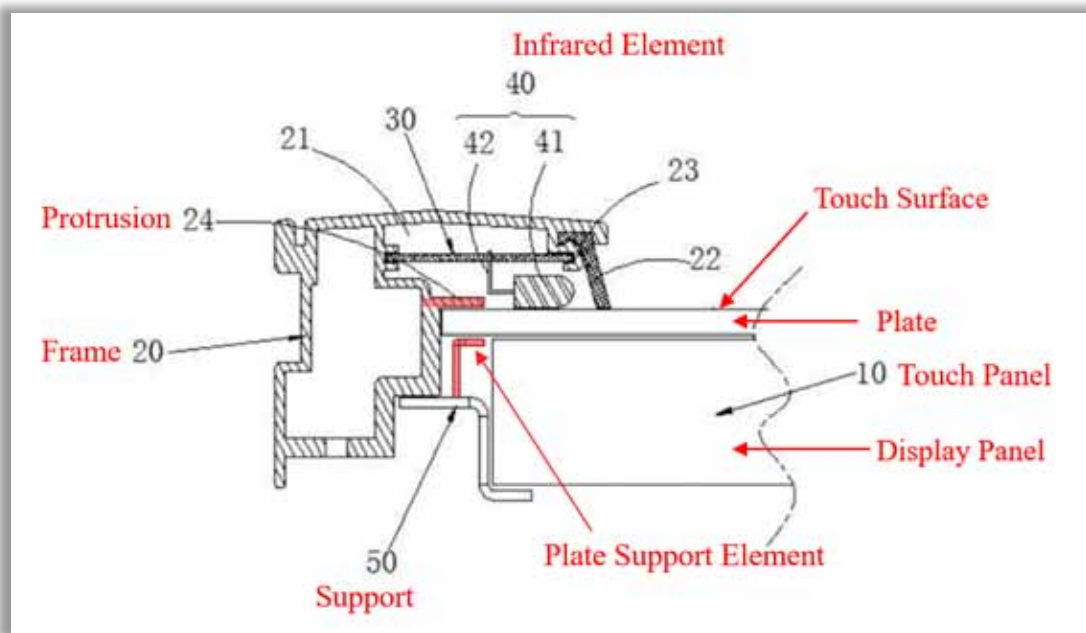
Motivation to Combine

A POSA would have been motivated to modify the touch device of Cheng using the simplified glass curvature inducing frame teachings of Shin to obtain the technical advantages of Han's parabolically curved touch surface. Cheng, Han, and Shin each relate to similar touch-sensing devices including a display, a covering panel touch surface, and a supporting frame assembly. *See* Ex. 1004, Abstract; Ex. 1011, Abstract; Ex. 1005, Abstract. Ex. 1033, ¶274.

Cheng discloses an infrared touch device including plate with touch surface, a display, and a frame with a bezel reduced thickness. Ex. 1004, [0001], Fig. 1. Cheng

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teaches utilizing infrared receivers and transmitters distributed densely around a display region to form a scanning network in both a horizontal and vertical direction. *Id.*, [0002]. Infrared light is emitted and received across a touch surface of a plate. *Id.*, [0010], Fig. 1. Cheng's frame 20 includes a protrusion 24 and plate support element for supporting a plate with a touch surface. *Id.*, Fig. 1; Ex. 1033, ¶275.

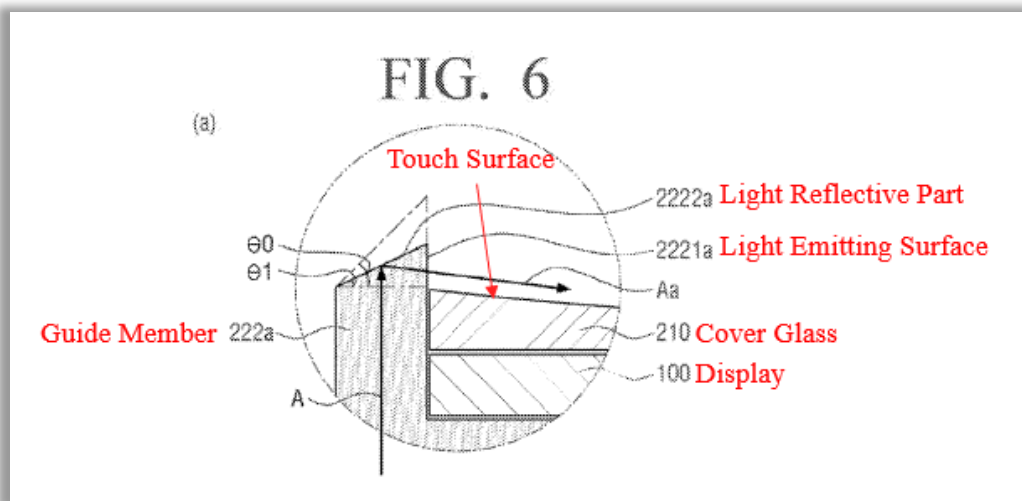


Ex. 1004, Fig. 1.

Cheng's frame 20 improves touch detection accuracy by orienting the lamp tube 41 of an infrared element 40 to transmit and receive infrared light closely along the touch surface of the plate. *Id.* Cheng additionally teaches reducing material costs by reducing material requirements of the frame. *Id.*, Abstract, [0018]; Ex. 1033, ¶276.

Han, like Cheng, teaches improving touch detection accuracy in infrared touch devices. *See* Ex. 1005, [0082-83], [0084-86]. In Han, the front surface of a flat cover

glass 210 (plate) is configured to have a concave parabolic curvature to reduce the amount of light lost by reflection and increasing the amount of light received at light reception guide member 232. *Id.* Further, Han teaches tuning the direction of emitted infrared light to travel along the surface of the curved touch surface of cover glass 210 by tilting a light reflective part 222a of the guide member 222. Ex. 1005, [106]; Ex. 1033, ¶277.

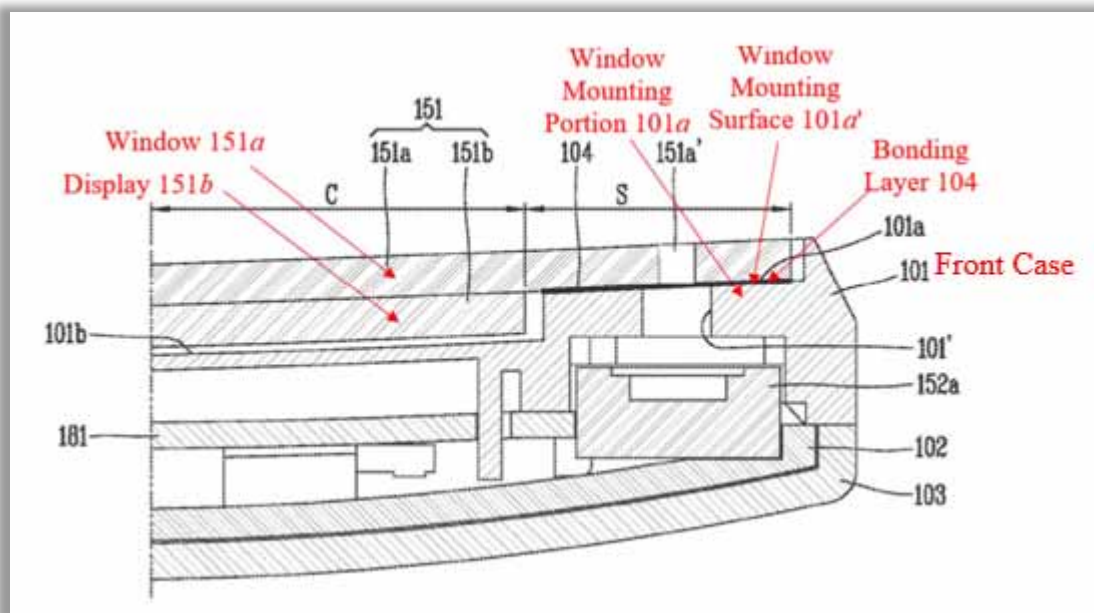


Ex. 1005, Fig. 6(a).

Han teaches that by utilizing a parabolic curvature of front surface 211 of cover glass 210 and tuning the travel direction of emitted light across the front surface, the amount of light lost by reflection is reduced, the amount of light received at light reception guide member 232, and corresponding detection accuracy, is increased. *Id.*, [0086]. Further, Han teaches reducing the thickness of the bezel (frame) of the infrared touch device 10 using light emission and reception guide members 222, 232. *Id.*,

[0058]. Thus, Han discloses improvements of the same objectives (improved touch detection accuracy and frame size reduction) in the same technological field (infrared touch devices) as Cheng. Ex. 1033, ¶278.

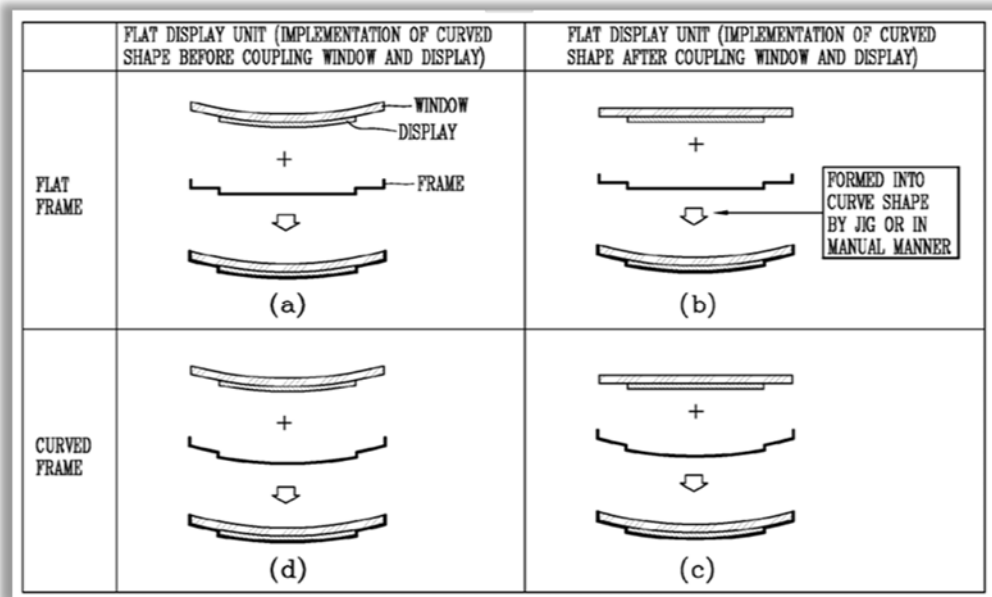
Shin discloses an infrared touch-sensitive device and method of manufacture including inducing a curvature into an initially flat cover glass and display utilizing a curved frame. See Ex. 1011, 1:52-2:22, 3:40-58, 10:45-49; Ex. 1033, ¶279.



Ex. 1011, Fig. 5.

Shin's window mounting portion 101a of a front case 100 is formed in a curved, or inclined, shape so as to generate a bending force (or a curving force) by which window 151a is curved during installation. As Shin discloses, "when the window 151a is mounted onto the mounting surface, the bending force may be applied to the window 151a such that the window 151a can be curved to correspond to the mounting surface."

Id., 20:66-21:6. In other words, Shin's frame assembly, including window mounting portion 101a, induces a curvature in the window 151a when it is installed. Ex. 1033, ¶280.



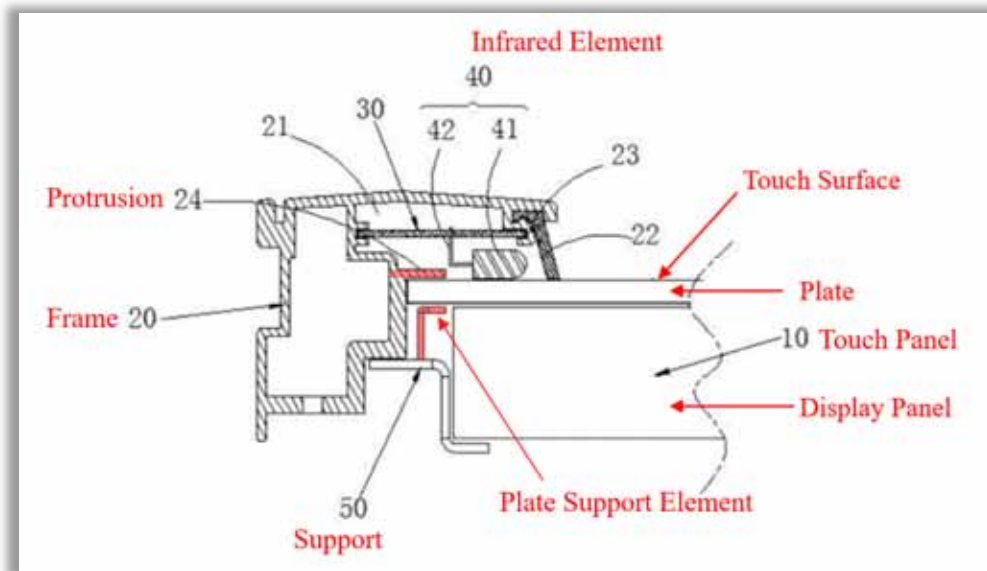
Ex. 1011, Fig. 4.

Shin explains by utilizing the curved mounting portions 101a of the frame to induce curvature in the window 151, the process of manufacturing an infrared touch device is simplified. *Id.*, 18:57-64. For example, the number of steps needed to create a touch device with curved panel is reduced as the step of curving the glass panel is combined with the step of installing the glass panel into the frame. Ex. 1033, ¶281.

To achieve Han's parabolic plate curvature in Cheng's device, a POSA would have been motivated to implement Shin's teaching of inducing curvature in the plate during the installation process via a curved frame mounting surface 101a.' As Cheng

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already includes a frame support 50 with frame support element, it would have been obvious for POSA to modify Cheng by curving the frame support element according to the curved frame mounting surface 101a' of Shin. A POSA would have expected such modification to achieve the same simplified curvature-inducing functionality of Shin in the modified Cheng device. Ex. 1033, ¶282.



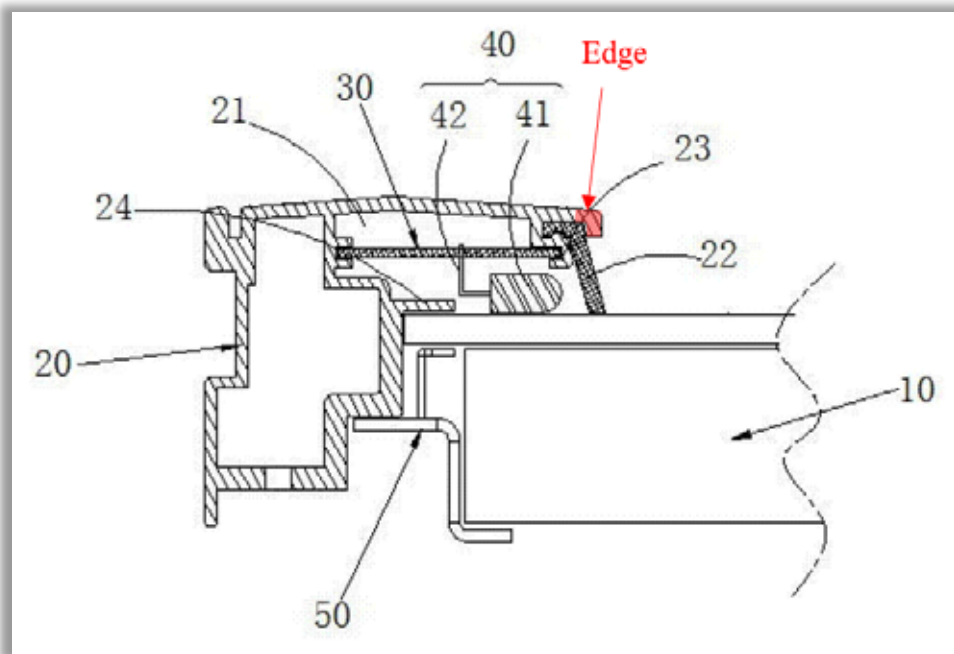
Ex. 1004, Fig. 1.

Thus, a POSA combining the teachings of Han and Shin into the device of Cheng would have expected to achieve the predictable result of high touch detection accuracy (Han) infrared touch device (Cheng, Han, Shin) and manufacturing method (Shin) meeting the limitations of the '335 Patent. Such modifications would have merely embodied known techniques to improve a similar device in a similar way. Ex. 1033, ¶283.

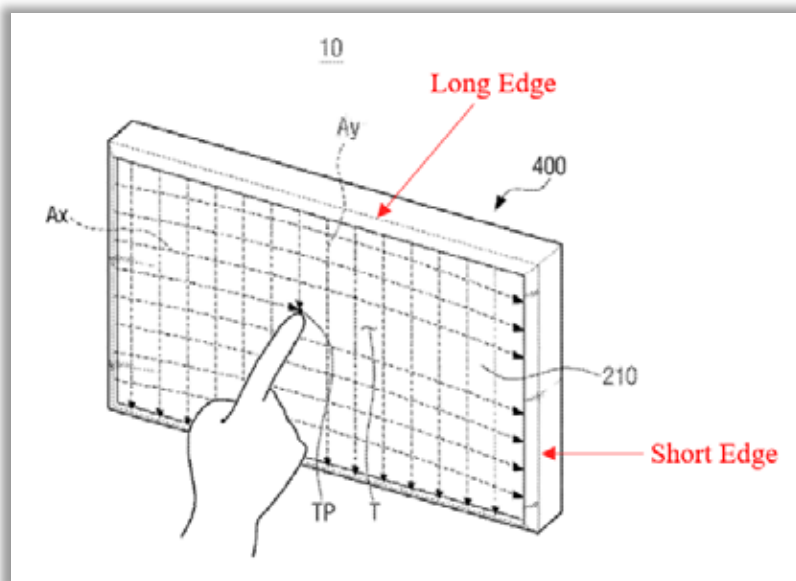
1. Claim 1

(a) Preamble

Cheng in view of Han discloses this element.



Ex. 1004, Fig. 1.

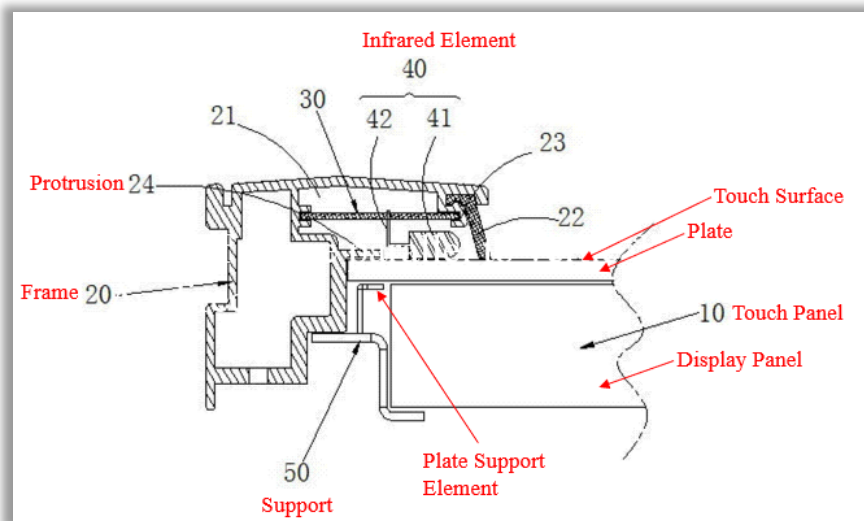


Ex. 1005, Fig. 2.

For at least the reasons discussed in Ground 1, claim 1(a), Cheng in view of Han disclose a touch sensing apparatus having a long edge (Cheng long edge of frame 20, Han frame assembly long edge) and a short edge (Cheng's short edge of frame 20, Han's frame assembly short edge). Ex. 1033, ¶¶284-85.

(b) Claim 1(b)

Cheng, Han, and Shin disclose this element. Cheng discloses a touch panel 10. Ex. 1004, [0005], Fig.1. A POSA would have understood Cheng's touch panel 10 to include a display panel. *See id.*, Fig. 1, [0002-3].



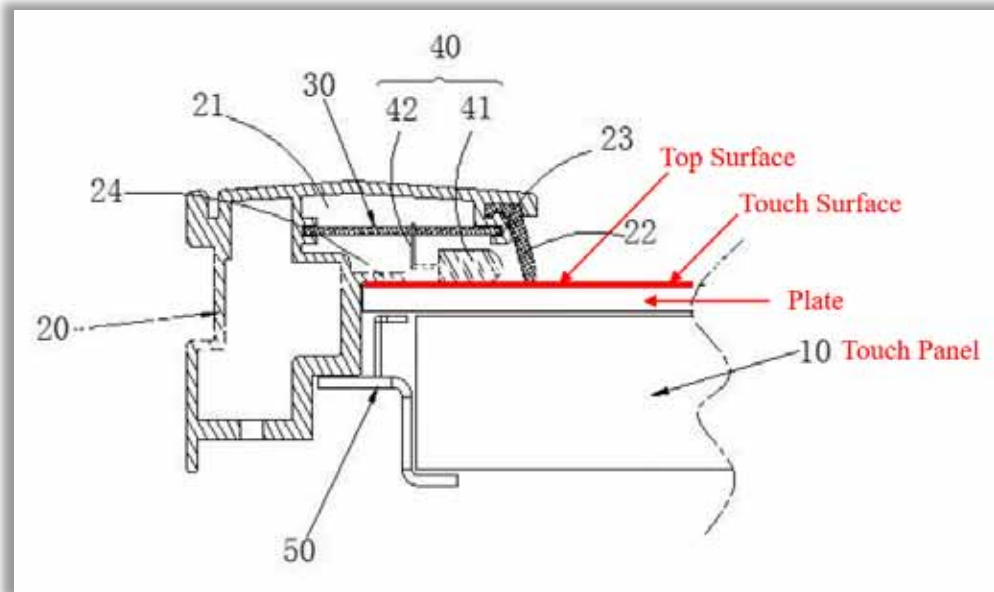
Ex. 1004, Fig. 1.

Further, both Han and Shin also disclose a display panel. Ex. 1005, Abstract; Ex. 1011, Abstract.

Thus, Cheng, Han, and Shin disclose claim 1(b). Ex. 1033, ¶¶286-88.

(c) Claim 1(c)

Cheng and Han disclose this element. A POSA would have understood the touch panel 10 of touch screen device disclosed in Cheng to include a plate including a top surface that comprises a touch surface.



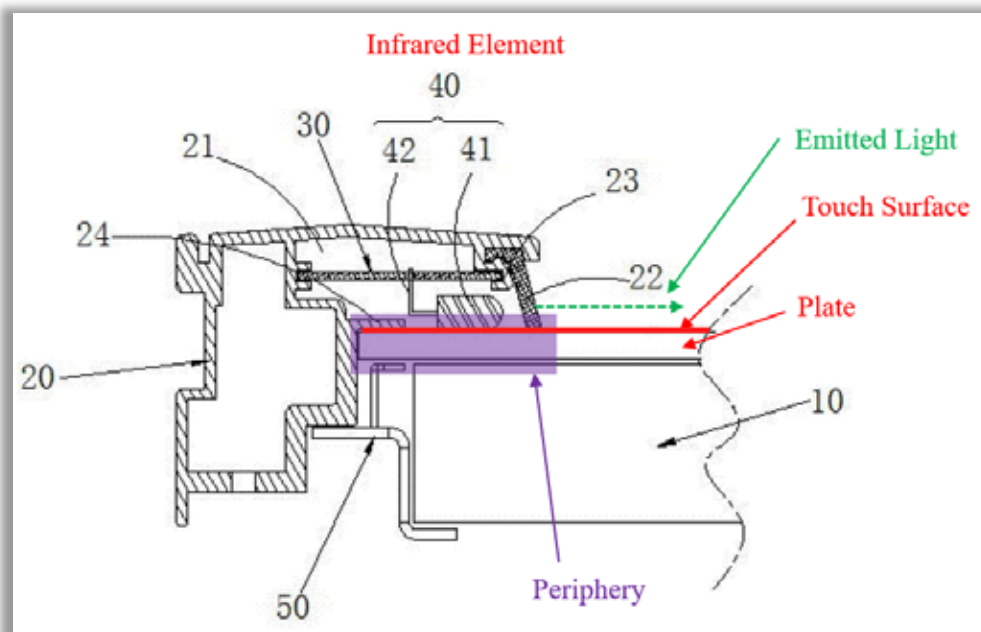
Ex. 1004, Fig. 1.

Further, Han discloses a cover glass 210 with a touch surface. Ex. 1005, [0019], [0038], Fig. 2.

Thus, Cheng and Han disclose claim 1(c). Ex. 1033, ¶¶289-91.

(d) Claim 1(d)

Cheng and Han disclose this element.

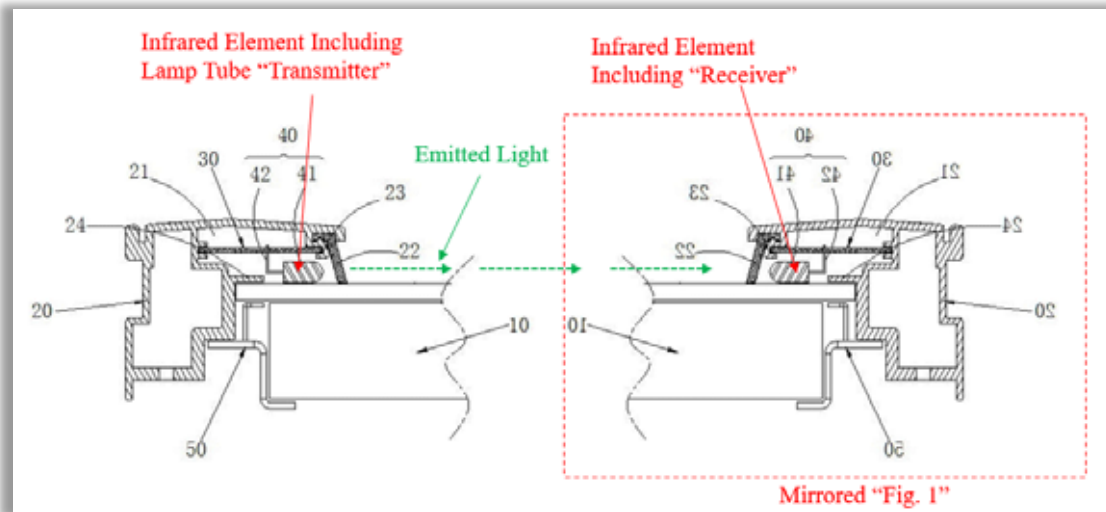


Ex. 1004, Fig. 1.

For at least the reasons discussed for Ground 1, claim 1(d), Cheng and Han disclose a plurality of emitters (Cheng’s infrared element 40 including lamp tubes 41; Han’s LEDs light emitting part 220) arranged around a portion of the periphery of the plate (Cheng’s plate of touch panel 10; Han’s cover glass 210) and configured to emit light across the touch surface of the plate (touch surface of Cheng’s plate; Hans touch surface T). Ex. 1033, ¶¶292-93.

(e) Claim 1(e)

Cheng and Han disclose this element.

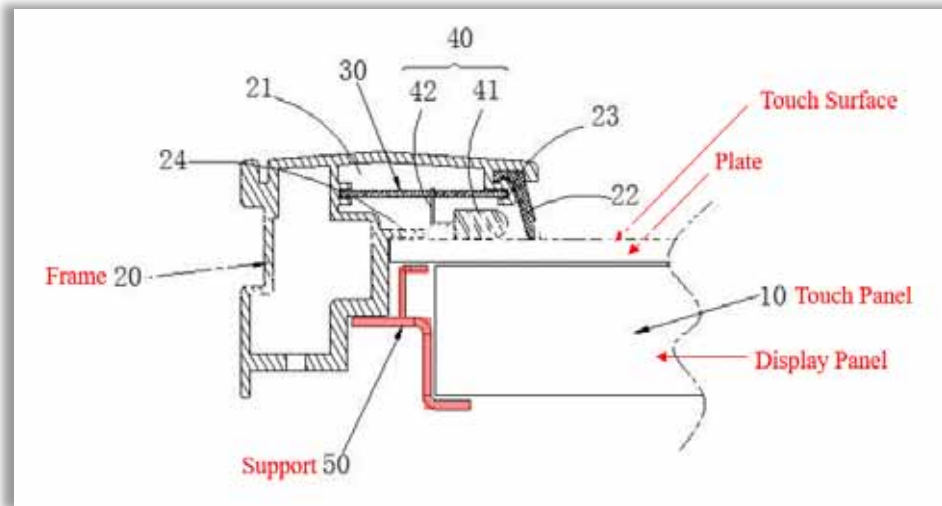


Ex. 1004, Fig. 1.

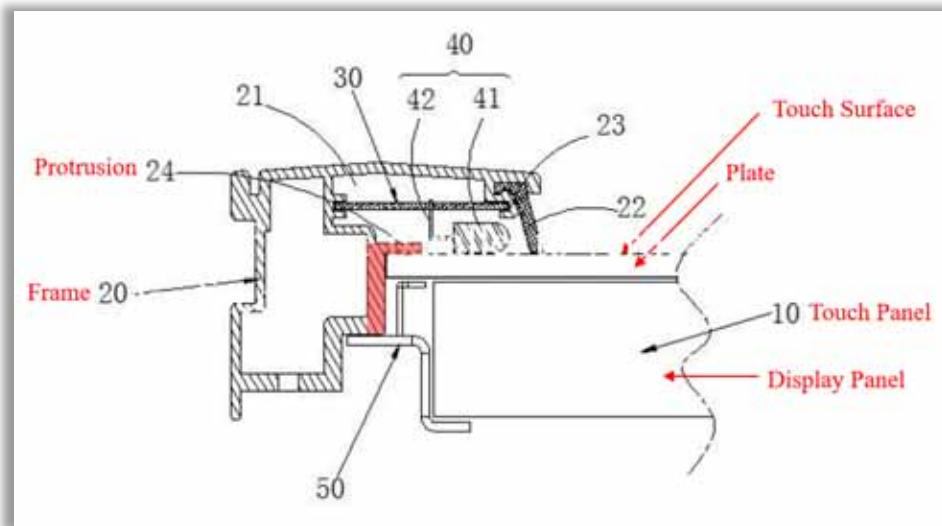
For at least the reasons discussed for Ground 1, claim 1(e), Cheng and Han disclose a plurality of detectors (Cheng's infrared element 40 including a receiver; Han's light receiving part 230) arranged around a portion of the periphery of the plate (Cheng's plate of touch panel 10; Han's cover glass 210) and configured to receive light from the plurality of emitters (Cheng's infrared elements with emitter (transmitter) lamp tube 41; Han's light emitting part 220). Ex. 1033, ¶¶294-95.

(f) Claim 1(f)

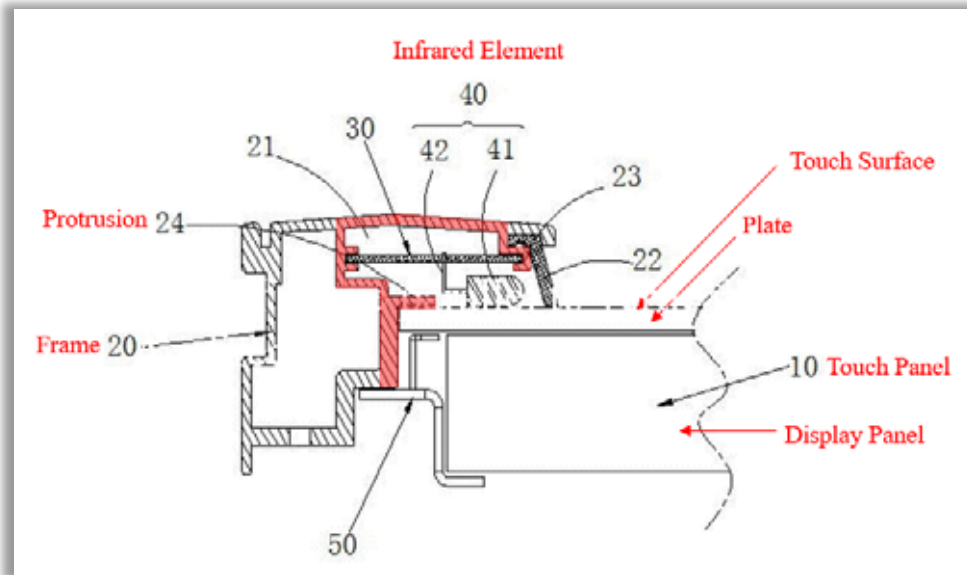
Cheng discloses this element.



Ex. 1004, Fig. 1.



Ex. 1004, Fig. 1.

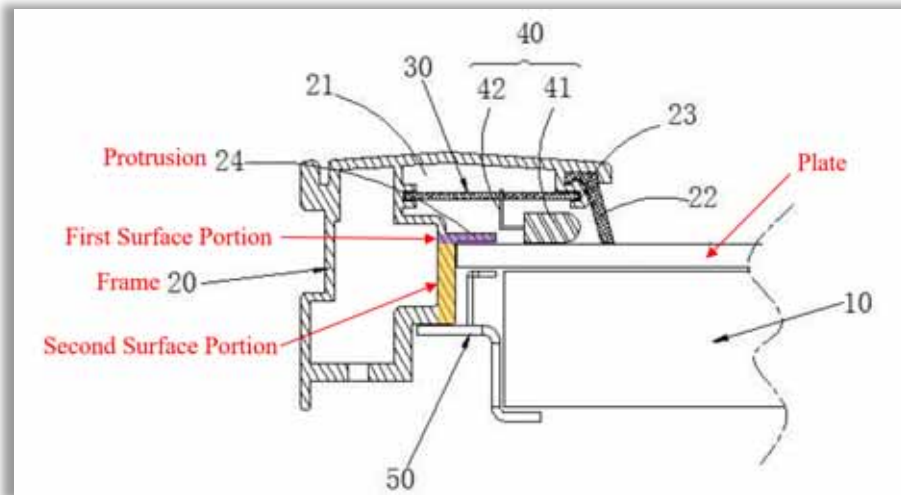


Ex. 1004, Fig. 1

For at least the reasons discussed in Ground 1, claim 1(f), Cheng discloses a frame assembly, the frame assembly comprising; a first frame element (support 50) configured to support the display panel; a second frame element (frame 20 with protrusion 24) arranged around the periphery of the plate and configured to support the plurality of emitters and plurality of detectors (infrared element having emitters and detectors. Ex. 1033, ¶¶296-97.

(g) Claim 1(g)

Cheng discloses this element.

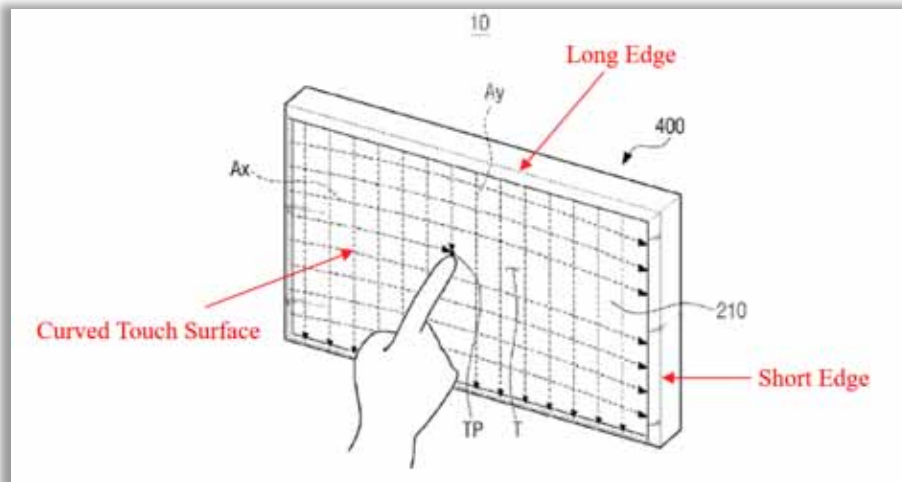


Ex. 1004, Fig. 1.

For at least the reasons discussed in Ground 1, claim 1(g), Cheng discloses wherein the second frame element (frame 20 with protrusion 24) includes a first surface portion (protrusion 24) extending over an edge portion of the plate (plate of touch panel 10) and a second surface portion (frame 20) arranged substantially parallel to a surface of the plate that defines the plate thickness (“thickness” edge of plate). Ex. 1033, ¶¶298-99.

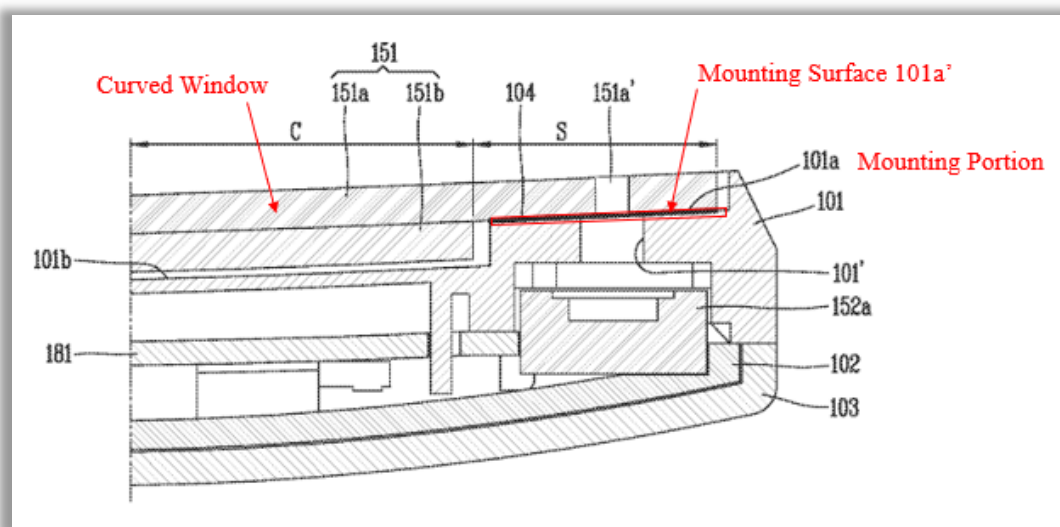
(h) Claim 1(h)

Cheng in view of Han and Shin discloses this element. It would have been obvious to a POSA to modify Cheng’s plate to incorporate Han’s parabolic touch screen curvature along Ax and Ay directions to improve touch detection accuracy. *Id.*, ¶300.



Ex. 1005, Fig. 2.

To reach Han's touch screen curvature, it would have been obvious to a POSA to modify Cheng's protrusion 24 and plate support element according to the curved mounting surfaces 101a' of Shin. By incorporating Shin's curved mounting surface 101a,' a POSA would have expected to achieve a simplified manufacturing process for producing a curved plate, as taught by Shin. See Ex. 1011, 18:57-64; Ex. 1033, ¶301.

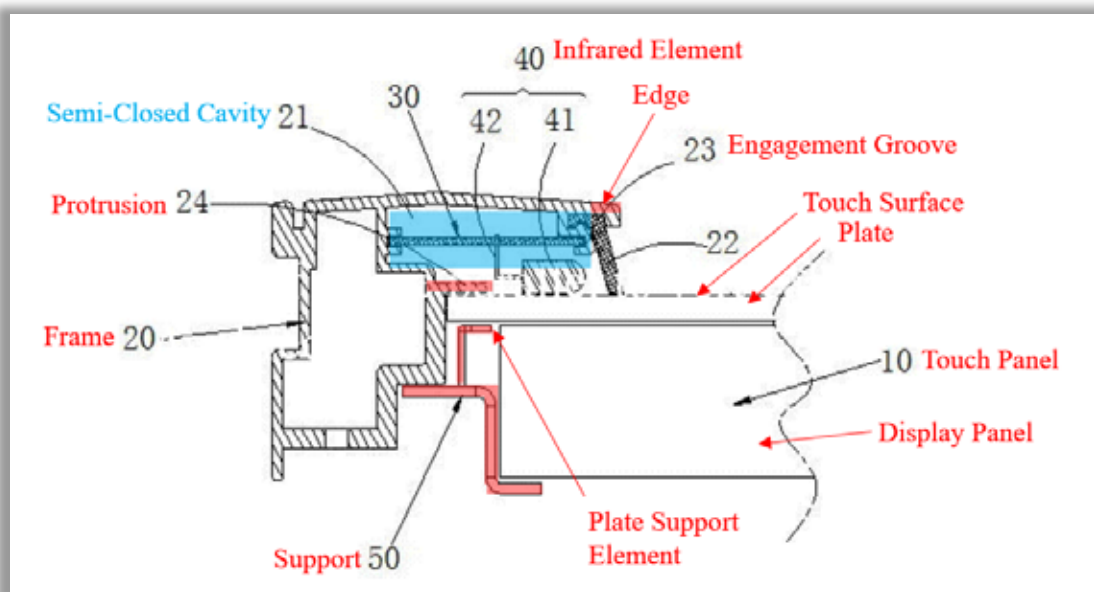


Ex. 1011, Fig. 5.

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Like in Shin, the curved modified plate support elements of Cheng would induce curvature into the plate in a simplified manufacturing step, and the curved modified protrusions 24 of Cheng would secure the curved touch surface side of the curved plate. Ex. 1033, ¶302.

The modified Cheng device has curved short and long edges. Cheng's frame 20 includes semi-enclosed cavity 21 and engagement groove 23 for supporting the circuit board 30 and infrared element 40. Ex. 1004, [0013]; Ex. 1033, ¶303.



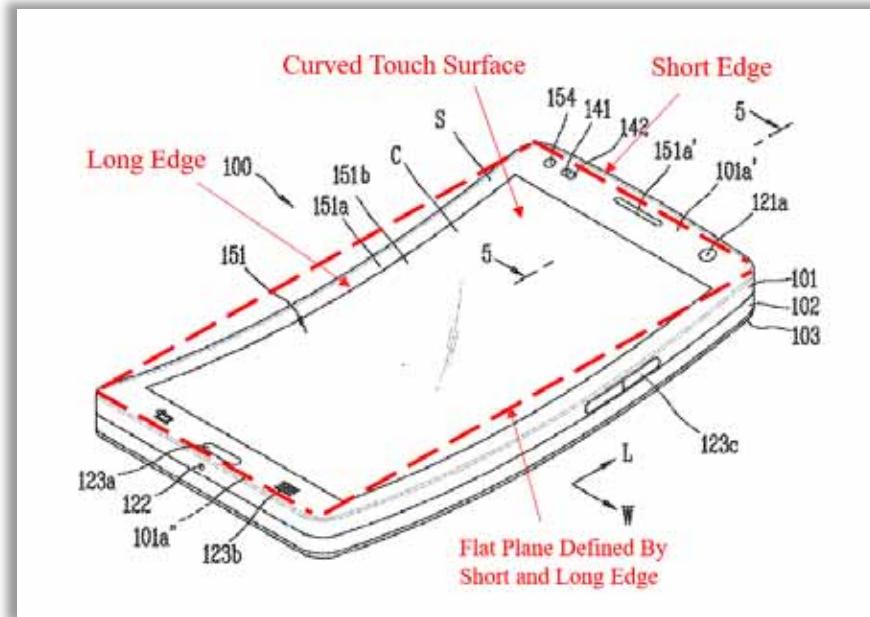
Ex. 1004, Fig. 1.

Cheng teaches that “the lamp tube 41 [of infrared element 40] extends out of the semi-closed cavity 21 and lies against a surface of the touch panel 10.” *Id.*, [0013], [0018]. From this lamp tube 41-to-surface-of-panel configuration, Cheng explains “this reduces the distance from the center of the lamp tube 41 to the touch panel 10, and

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avoids the phenomenon whereby a touch object triggers a touch operation when it has not yet touched the touch panel...” *Id.* In the modified Cheng device, wherein the protrusion 24 and plate support element are curved according to Shin, Cheng’s modified semi-closed cavity 21 and engagement groove 23 would also be curved. As a result, the respective first and second (short and long) edges of Cheng’s modified frame 20 would also be curved. *Id.* In this configuration, a POSA would have expected Cheng’s lamp tube 41 to remain in contact with the curved touch surface of the plate and provide the same touch detection performance by emitting light in close proximity to the surface of the plate disclosed in the unmodified Cheng device. Ex. 1033, ¶304.

Cheng’s modified curved plate touch surface would be curved relative to a flat plane defined in part by the short and long edges of frame 20. Cheng’s modified long and short edges would be curved according to Shin and Han. A flat plane would be defined (at least in part) by Cheng’s modified curved edges. A flat plane would intersect the edges at least at the extremum of the edges, such as the corners of the edges or the slope inflection regions of the edges. Ex. 1033, ¶305.



Ex. 1011, Fig. 2.

Cheng's modified curved plate would be curved relative to the flat plane formed in part by the long and short edges of frame 20. Ex. 1033, ¶306.

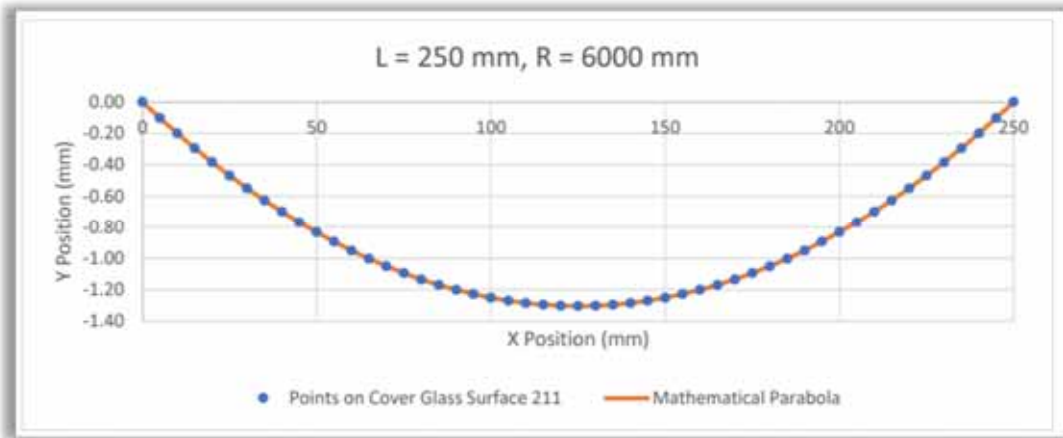
Thus, Cheng in view of Han and Shin discloses claim 1(h). *Id.*, ¶307.

(i) Claim 1(i)

Cheng in view of Han and Shin discloses this element. Han discloses a parabolically curved touch surface on cover glass 210. Ex. 1005, [0074-77]. Han discloses an embodiment in which the radius of the circle that describes the curvature of the cover glass 210 surface 211 is approximately 6000 mm, with the circular curve extending 250 mm across the glass plate's surface. Ex. 1005 [0093], [0095]. Plotting the resulting curvature disclosed by Han yields a curve described by a parabolic function. A POSA would have been motivated to adopt the same parabolic (concave)

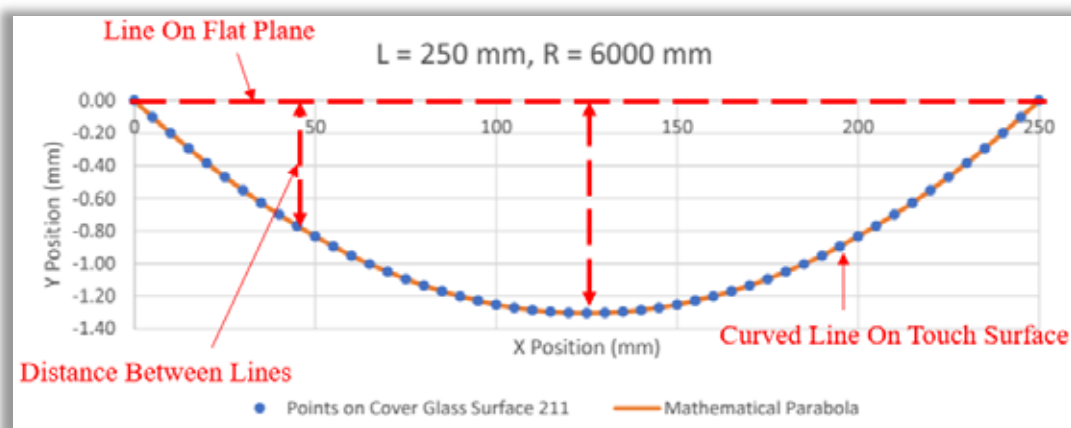
curvature of Han in Cheng's modified plate to achieve improved touch performance.

Ex. 1033, ¶308.



Id.

A flat plane can be established across the (curved) long and short edges of the modified Cheng frame 20 (according to Shin). A line can be drawn along Cheng's flat plane and a line may be drawn along the concavely curved touch surface of Cheng's modified plate. *Id.*, ¶309.



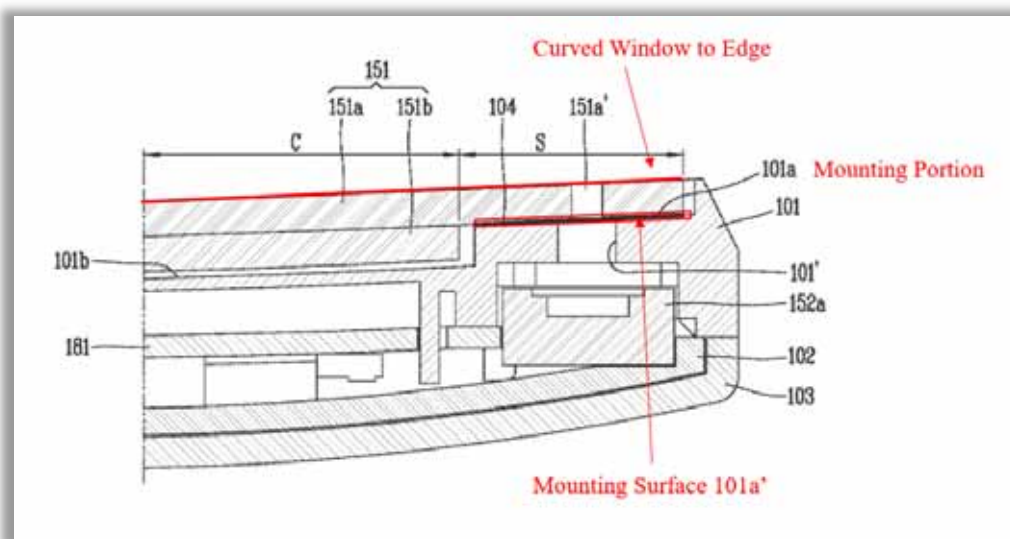
Id.

The distance between the lines drawn on the flat plane line and the curved line on Cheng's modified concave touch surface vary according to a parabolic function that a POSA would have understood as equating to a "concave function." *Id.*, ¶310.

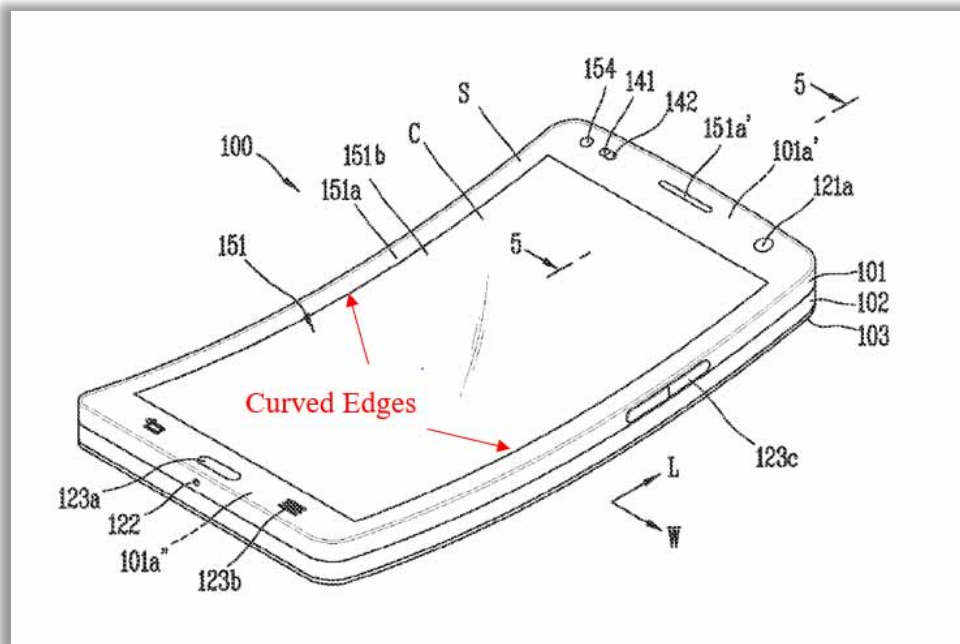
Thus, Cheng in view of Han and Shin discloses claim 1(i). *Id.*, ¶311.

(j) Claim 1(j)

Cheng in view of Han and Shin discloses this element. Han and Shin each disclose a plate having a top surface with curved edges. See Ex. 1005, Fig. 7, Ex. 1011, Figs. 5, 7; Ex. 1033, ¶312.

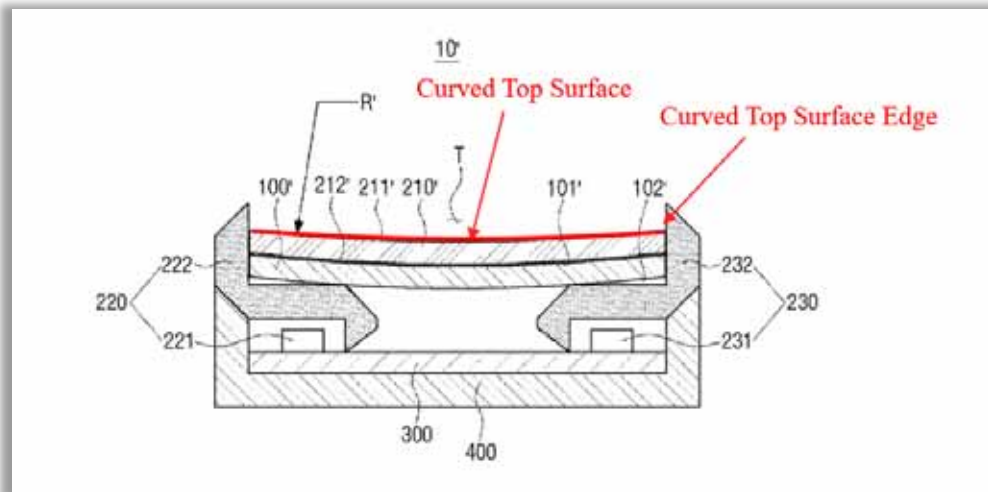


Ex. 1011, Fig. 5.

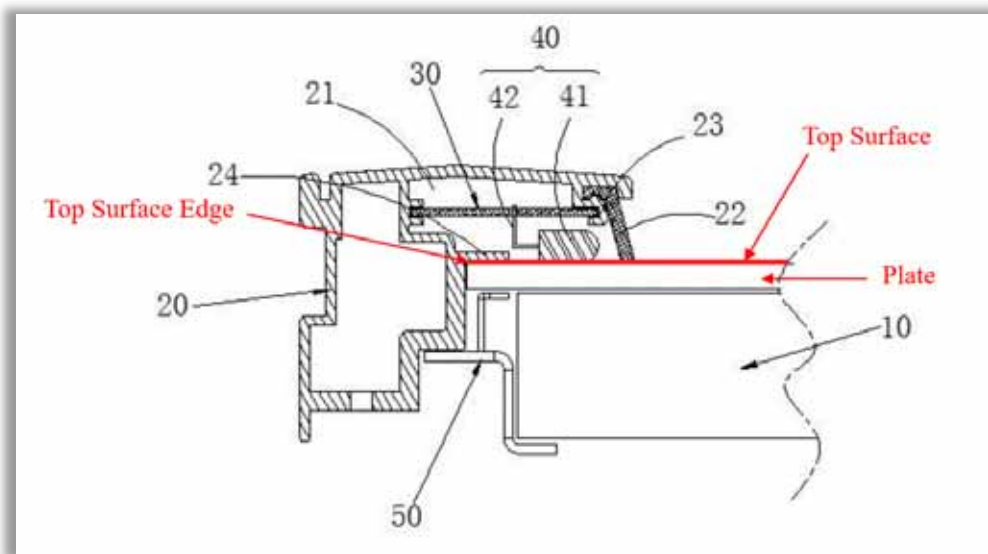


Ex. 1011, Fig. 2.

Shin's mounting surface 101a' is curved along the full length of contact with Shin's curved window 151a, up to and including its edges. Ex. 1011, Fig. 5. Accordingly, the edges of Shin's window 151a (including a top surface) are curved. *Id.* In the modified Cheng device, Cheng's frame protrusions 24 and plate support elements of supports 50 along both the long and short sides would be curved according to Shin, resulting in Cheng's modified plate also being curved up to edges along both long and short edges. Cheng's curved plate up to its edges would match the edges of Han's plate curved along both Ax and Ay directions. See Ex. 1005, [0087-89]; Ex. 1033, ¶313.



Ex. 1005, Fig. 7.



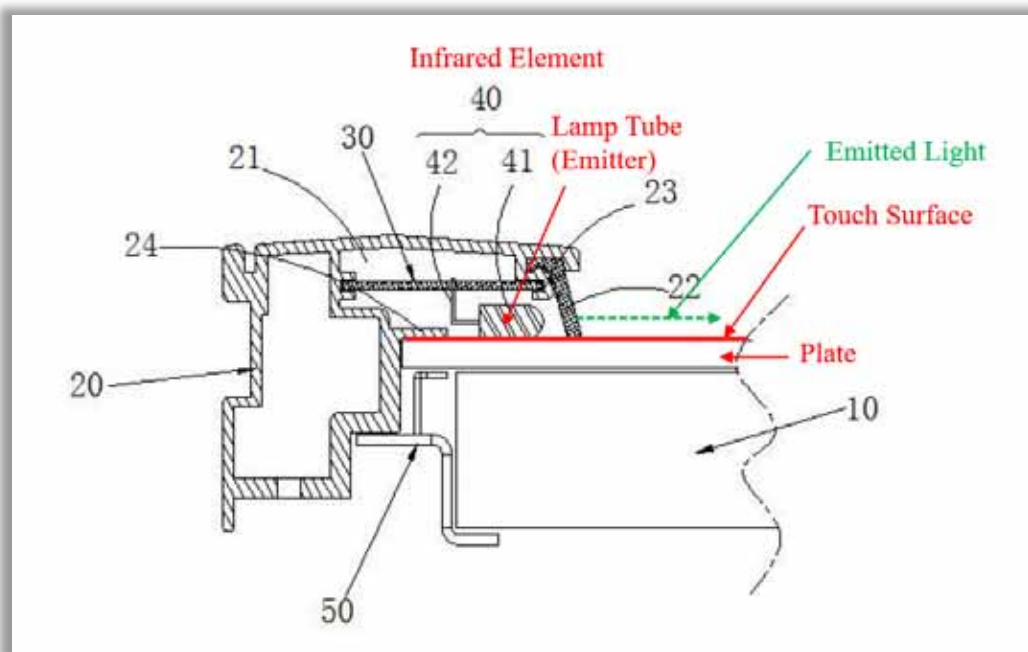
Ex. 1004, Fig. 1.

Thus, Cheng in view of Han and Shin discloses claim 1(j). Ex. 1033, ¶314.

2. Claim 2

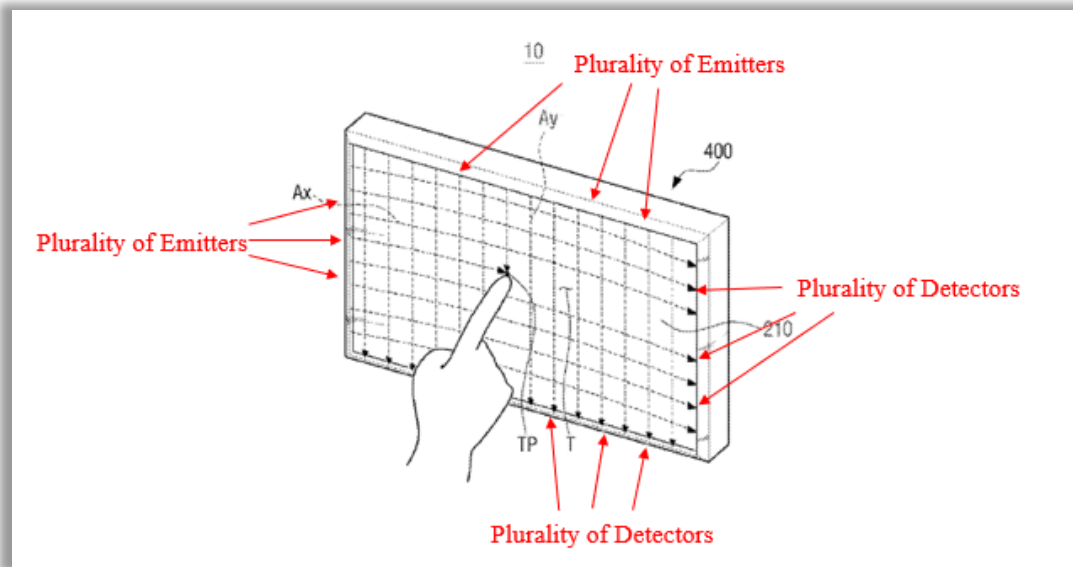
Cheng and Han disclose this element. Cheng discloses arranging “infrared receivers and **transmitters** [emitters] distributed densely around a display region [to]

form a scanning network in horizontal and vertical directions...” Ex. 1004, [0002] (emphasis added). The infrared element 40 is arranged adjacent to a periphery of the plate. *Id*, Fig. 1. To achieve touch sensing functionality, a POSA would have understood Cheng’s lamp tube 41 of infrared element 40 to emit light to propagate over the touch surface of the plate. Ex. 1033, ¶315.



Ex. 1004, Fig. 1.

Further, Han discloses a plurality of emitters (light emitting parts 220) configured to emit light across a touch surface. *See* Ex. 1005, [0040]; Ex. 1033, ¶316.

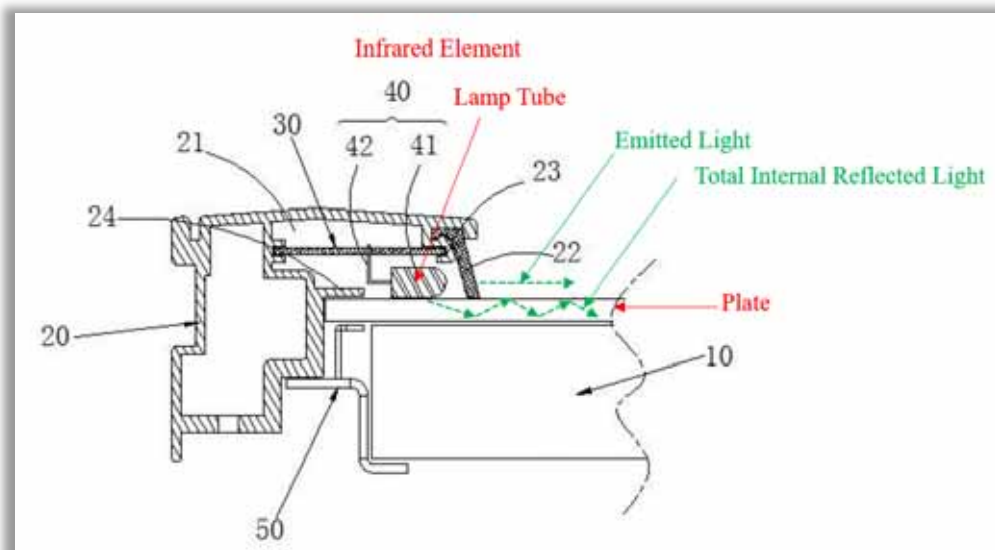


Ex. 1005, Fig. 2.

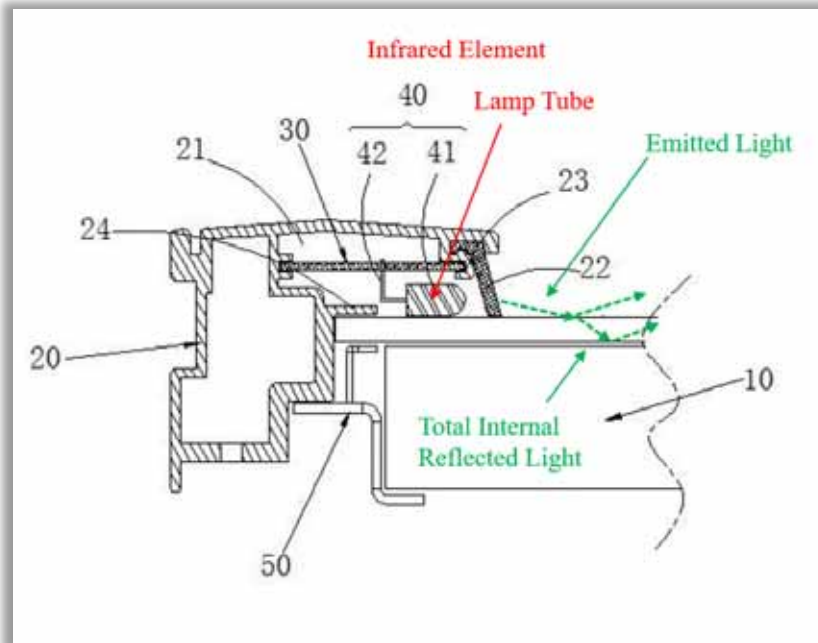
Thus, Cheng and Han disclose claim 2. Ex. 1033, ¶317.

3. Claim 3

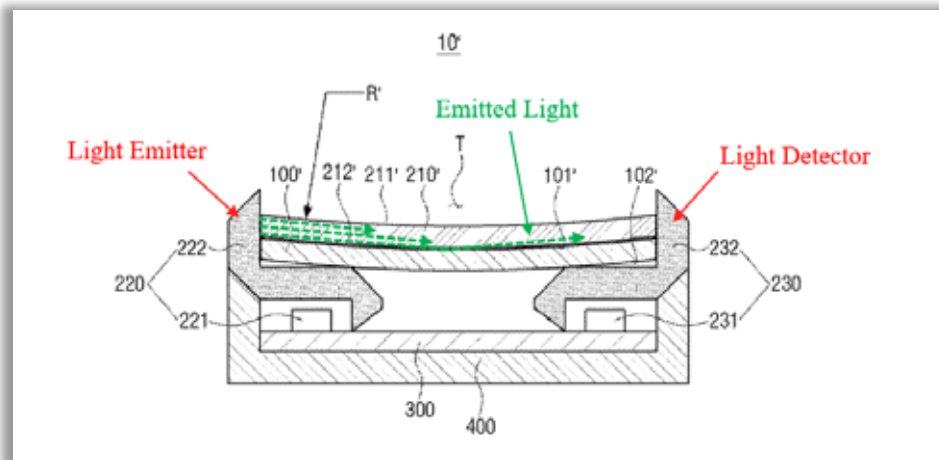
Cheng in view of Han discloses this element.



Ex. 1004, Fig. 1.



Ex. 1004, Fig. 1.



Ex. 1005, Fig. 7.

For at least the reasons discussed in Ground 1, claim 3, Cheng in view of Han discloses wherein the plurality of emitters (Cheng's infrared elements 40 with lamp tube 41; Han's light emitting parts 220) is configured to emit light through the plate

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(Cheng's plate; Han's cover glass 210) by TIR (entered light traveling via TIR).
Ex. 1033, ¶¶318-19.

4. Claim 4

Cheng and Han disclose this element. For at least the reasons discussed for Ground 1, claim 4, Cheng and Han disclose a processing element (Cheng's circuit board 30; Han's integrated circuit IC) configured to determine, based on output signals of the plurality of detectors (Cheng's infrared element 40 with detector; Han's photo diodes 231 and light reception guide members 231), a position of an object (a user touch) on the touch surface (surface of Cheng's plate; Han's front surface 211). *Id.*, ¶320.

VI. MANDATORY NOTICES PURSUANT TO 37 C.F.R. § 42.8(A)(1)

Pursuant to 37 C.F.R. § 42.8(a)(1), the mandatory notices identified in 37 C.F.R. § 42.8(b) are provided below as part of this petition.

A. 37 C.F.R. § 42.8(b)(1): Real Parties-In-Interest

The real parties-in-interest are Chemtronics USA, Inc. and Chemtronics Co. Ltd

B. 37 C.F.R. § 42.8(b)(2): Related Matters

The '335 Patent is currently the subject of litigation in *Flatfrog Laboratories AB v. Chemtronics Co., LTD.*, Case No. 2:23-cv-00306 (E.D. TX), filed on June 26, 2023. Exs. 1018, 1038. The '335 Patent was previously the subject of litigation in *FlatFrog Laboratories AB v. Chemtronics Co. Ltd. et al*, Case No. 3-23-cv-00121 (S.D. Ca), voluntarily dismissed.

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C. 37 C.F.R. § 42.8(b)(3), (4): Lead And Back-Up Counsel And Service Information

Petitioner provides the following designation of counsel:

Lead Counsel	Back-up Counsel
Matthew W. Johnson (Reg. No. 59,108) mwjohnson@jonesday.com JONES DAY 500 Grant Street, Suite 4500 Pittsburgh, PA 15219 T: 412-394-9524	Joshua R. Nightingale (Reg. No. 67,865) jrnightingale@jonesday.com JONES DAY 500 Grant Street, Suite 4500 Pittsburgh, PA 15219 T: 412-394-7950 S. Christian Platt (Reg. No. 46,998) cplatt@jonesday.com JONES DAY 12265 El Camino Real, Suite 200 San Diego, CA 92130 T: 858-314-1200 Christian A. Roberts (Reg. No. 81,158) croberts@jonesday.com JONES DAY 500 Grant Street, Suite 4500 Pittsburgh, PA 15219 T: 412-394-9524 Ashvi S. Patel (Reg. No. 81,156) ashvipatel@jonesday.com JONES DAY 500 Grant Street, Suite 4500 Pittsburgh, PA 15219 T: 412-394-7208

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Pursuant to 37 C.F.R. § 42.10(b), a Power of Attorney accompanies this petition. Please address all correspondence to lead and back-up counsel at the addresses above. Petitioner also consents to electronic service by email at the email addresses listed above.

Dated: 10/6/2023

Respectfully submitted,

/Matthew W. Johnson/

Matthew W. Johnson, Reg. No. 59,108
JONES DAY
500 Grant Street, Suite 4500
Pittsburgh, PA 15219
T: 412-394-9524

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CERTIFICATE OF SERVICE

The undersigned hereby certifies that a copy of the foregoing petition for *Inter Partes* Review of U.S. Patent No. 11,281,335, including all Exhibits, was served on 10/6/2023 via Express Mail delivery directed to the attorney of record for the patent at the following address:

Finnegan, Henderson, Farabow, Garrett & Dunner LLP
901 New York Avenue, NW
Washington, DC 20001-4413

Additionally, a courtesy copy of the foregoing petition for *Inter Partes* Review of U.S. Patent No. 11,281,335, and the accompanying Declaration of Dr. Cairns, was sent on 10/6/2023 to patentee's litigation counsel via email to:

wjohnson@mayerbrown.com
mmolano@mayerbrown.com
cmaier@mayerbrown.com

Date: 10/6/2023

/Matthew W. Johnson/
Matthew W. Johnson
Reg. No. 59,108
JONES DAY
500 Grant Street, Suite 4500
Pittsburgh, PA 15219
mwjohnson@jonesday.com

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CERTIFICATE OF WORD COUNT UNDER 37 C.F.R. § 42.24(a)

I, the undersigned, do hereby certify that the attached petition contains 13,994 words, as measured by the Word Count function of Microsoft Word 2016. This is less than the limit of 14,000 words as specified by 37 C.F.R. § 42.24(a)(i).

Date: 10/6/2023

/Matthew W. Johnson/

Matthew W. Johnson

Reg. No. 59,108

JONES DAY

500 Grant Street, Suite 4500

Pittsburgh, PA 15219

mwjohnson@jonesday.com

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APPENDIX OF EXHIBITS

Exhibit No.	Title
1001-1002	<i>Reserved</i>
1003	Chinese Patent No. CN203386188U to Cheng et al.
1004	Certified Translation of Chinese Patent No. CN203386188U to Cheng et al.
1005	U.S. Patent Publication No. 2019/0235701 to Han et al.
1006	PCT Application No. WO2018066761 to Han et al.
1007	Certified Translation of PCT Application No. WO2018066761 to Han et al.
1008	Korean Pub. App. No. KR2018-0037749 to Han et al.
1009	Certified Translation of Korean Pub. App. No. KR2018-0037749 to Han et al.
1010	U.S. Patent No. 9,98,3626 to Cao et al.
1011	U.S. Patent No. 9,291,845 to Shin et al.
1012	U.S. Patent Application Publication No. 2017/0123257 to Zhao et al.
1013	<i>Reserved</i>
1014	U.S. Patent Application Publication No. 2012/0223916 to Kukulj et al.

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Exhibit No.	Title
1015	U.S. Application Publication No. 2016/0295711 to Ryu et al.
1016	U.S. Application Publication No. 2013/0044073 to Christiansson et al.
1017	Redacted Joint Claim Construction Brief (D.E. 110) FlatFrog v. Promethean C.A. No. 19-2246 (D. Del.)
1018	<i>FlatFrog Laboratories AB v. Chemtronics Co., LTD.</i> , Case No. 2:23-cv-00306 (E.D. TX), filed on June 26, 2023
1019-1026	<i>Reserved</i>
1027	US Patent Application No. 12/893,381 to Miller et al.
1028	Chinese Published Patent Application CN104808843A to Kang
1029	Certified Translation of Chinese Published Patent Application CN104808843A to Kang
1030	U.S. Patent No. 9,207,800 to Eriksson et al.
1031	U.S. Patent No. 11,281,335 to Kocovski et al.
1032	Prosecution History for U.S. Patent No. 11,281,335 to Kocovski et al.
1033	Expert Declaration of Darran R. Cairns, Ph.D., regarding U.S. Patent No. 11,281,335
1034	U.S. Patent Pub. No. 20160334942 to Wassvik et al.

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Exhibit No.	Title
1035	U.S. Patent Pub. No. 10860142 to Northcott et al.
1036	U.S. Patent Pub. No. 2017/0308236 to Lee et al.
1037	<i>Reserved</i>
1038	Claim Chart for US Patent No 11,281,335 (Case No. 2:23-cv-00306) (E.D. TX)
1039	<i>Reserved</i>
1040	Curriculum vitae of Dr. Darran Cairns.