

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In the *Inter Partes* Review of U.S. Patent No. 10,775,935

Trial No.: Not Yet Assigned

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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 – 14 of U.S. Patent No. 10,775,935 (“the ’935 Patent”) (Ex. 1001).

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.

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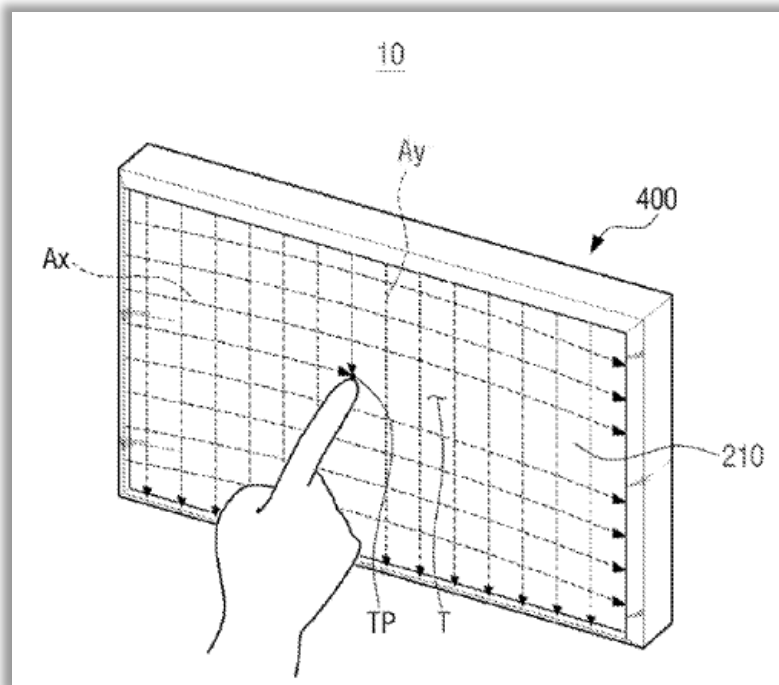
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I. INTRODUCTION

The '935 Patent claims elements, configurations, and methods related to infrared touch screen display devices that were known in the art. *See* Ex. 1002, ¶¶28-39. 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., Fig. 2 (prior art).

The '935 Patent purports to improve touch detection by claiming a concave, parabolically curved touch surface. But concave, parabolically curved touch surfaces were already known in the art, and for the same reasons. The '935 Patent claims a touch

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screen device having a frame with curved edges. But touch screen device frames with curved edges were already known in the art. Further, the '935 Patent claims inducing curvature into the cover plate and touch surface via frame elements. But such curvature-inducing frame functionality was already known in the art. Ex. 1002, ¶¶28-39.

As detailed below, the evidence shows that the apparatuses and techniques claimed in the '935 Patent were known before its priority date. Claims 1-14 of the '935 Patent should be deemed unpatentable.

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

Petitioner certifies the '935 Patent is available for IPR and Petitioner is not barred or estopped from requesting IPR challenging the patent claims on the grounds identified herein.

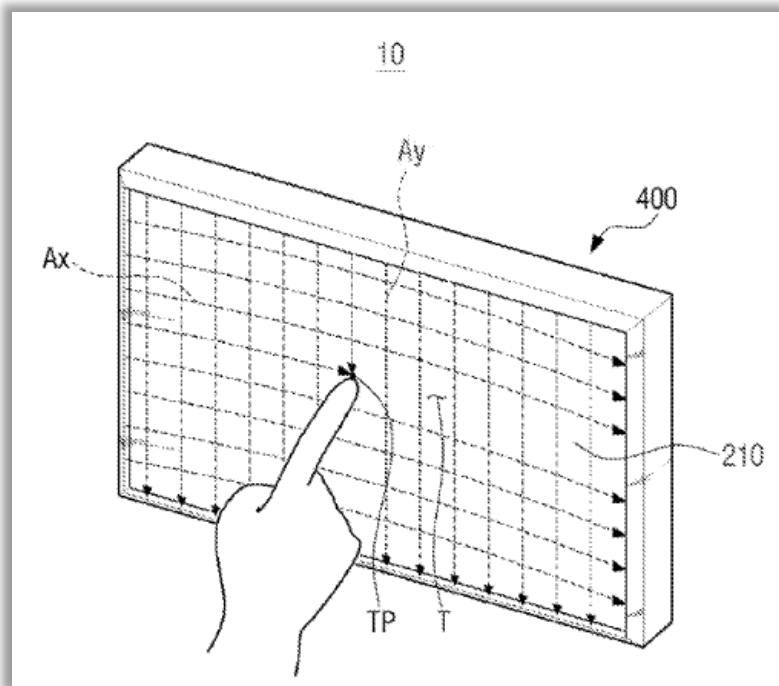
III. BACKGROUND INFORMATION FOR THE '935 PATENT

A. Technology Overview And The '935 Patent

Prior to the '935 Patent, it was known that a plurality of light emitters and corresponding detectors could be utilized to achieve touch-sensing functionality. See Ex. 1002, ¶¶28-39. For example, a plurality of infrared light emitters and opposing detectors could be arranged around the edges of a cover plate or display. *Id.*; See Ex. 1005, [0040-46]. Taught by Han, as 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

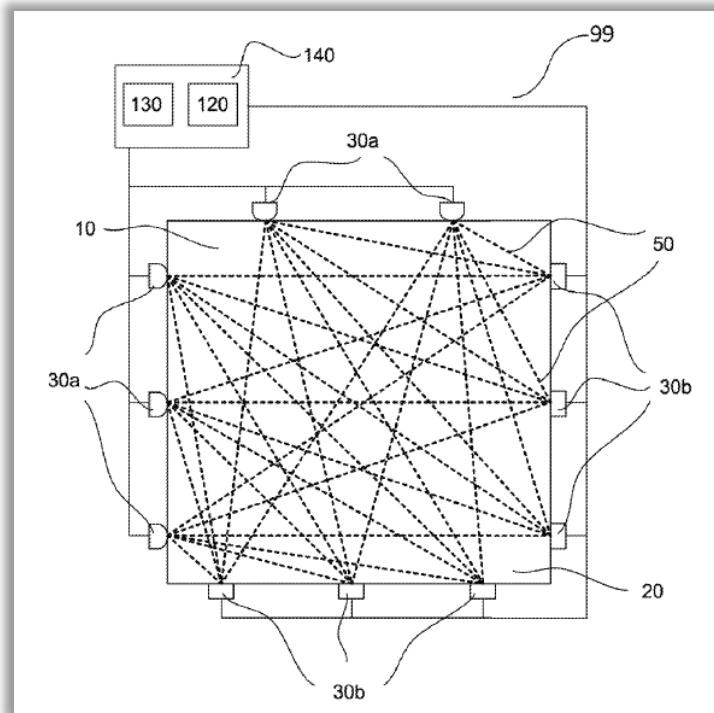
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emitters from being detected by certain detectors. Ex. 1005, [0048-49]. A processor can then determine the coordinate of the user touch based on which light emitters' light was blocked. *Id.* Ex. 1002, ¶29.



Id., Fig. 2 (prior art).

The '935 Patent claims the same light detection methodology. Ex. 1002, ¶30. “Emitters 30a are distributed around the periphery of touch plate 10, to propagating light across touch surface 20.” Ex. 1001, 14:10-17. “Detectors 30b are distributed around the periphery of touch surface 20, to receive part of the propagating light.” *Id.*

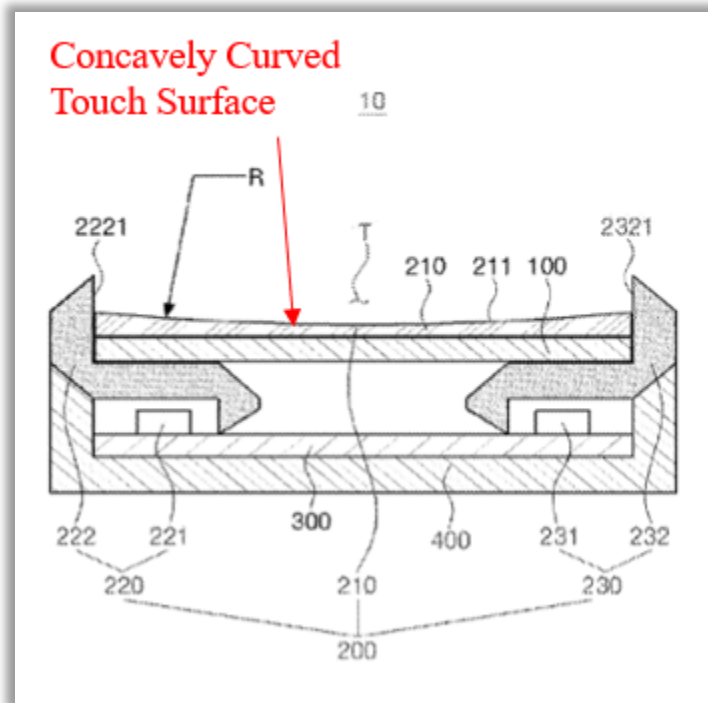


Ex. 1001, Fig. 9.

“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 '935 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. Ex. 1002, ¶32. 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. 1002, ¶32.

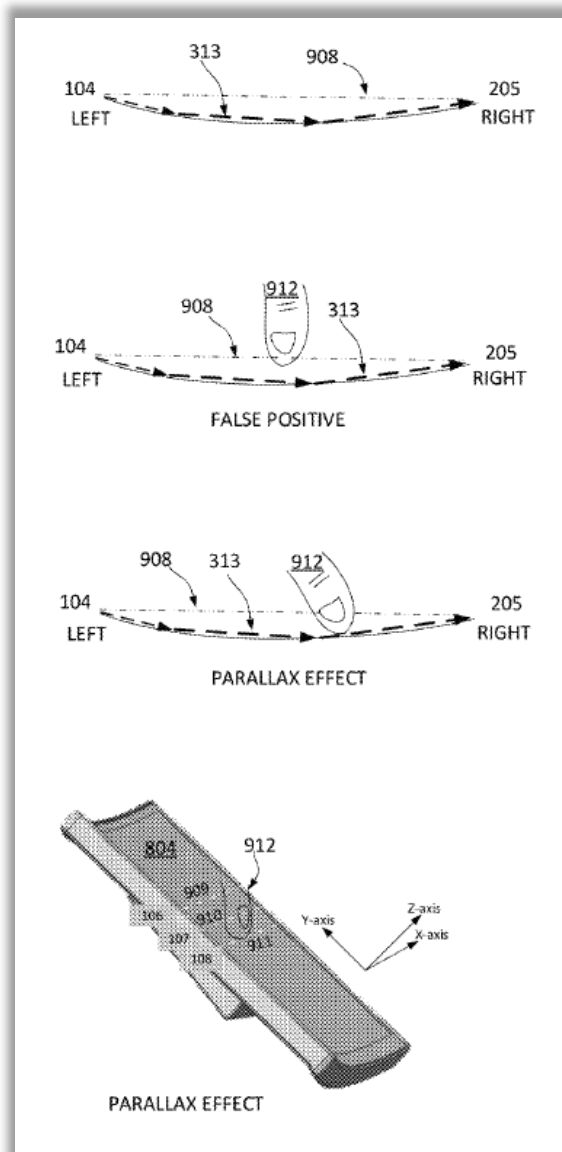


Ex. 1005, Fig. 3 (prior art).

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; Ex. 1002, ¶33. As described in detail below, Han teaches that a parabolic curvature is one advantageous shape of a touch surface. Ex. 1002, ¶33. 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

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at [0047], [0049], Fig. 9; Ex. 1029, [0028], [0040]; Ex. 1016, [0071]; Ex. 1030, 3:6-46, Figs. 29-31; Ex. 1002, ¶34.

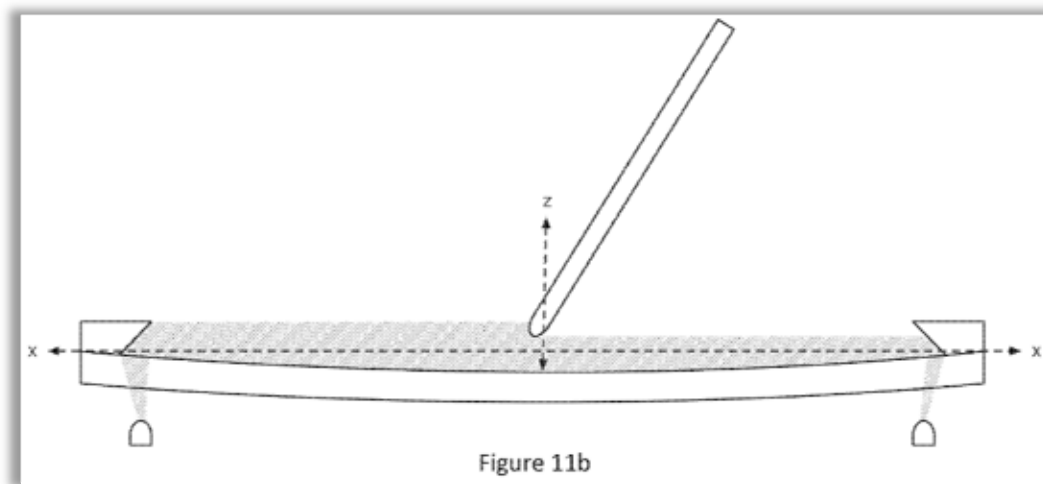


Ex. 1030, Fig. 31.

The '935 Patent claims the same parabolic, concave curvature in the cover plate of a touch sensing method and apparatus. Ex. 1002, ¶35. According to the '935 Patent,

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a plate having a parabolic curvature increases the amount of light transmitted from the emitters that is received at the detectors (rather than being “lost” above or below the detectors), resulting in a “signal boost” that improves touch recognition. See Ex. 1001, Figs. 13a-17b; 17:48-18:44. In one embodiment, the '935 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. 1002, ¶35.



Ex. 1001, Fig. 11b.

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; Ex. 1002, ¶36. 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,

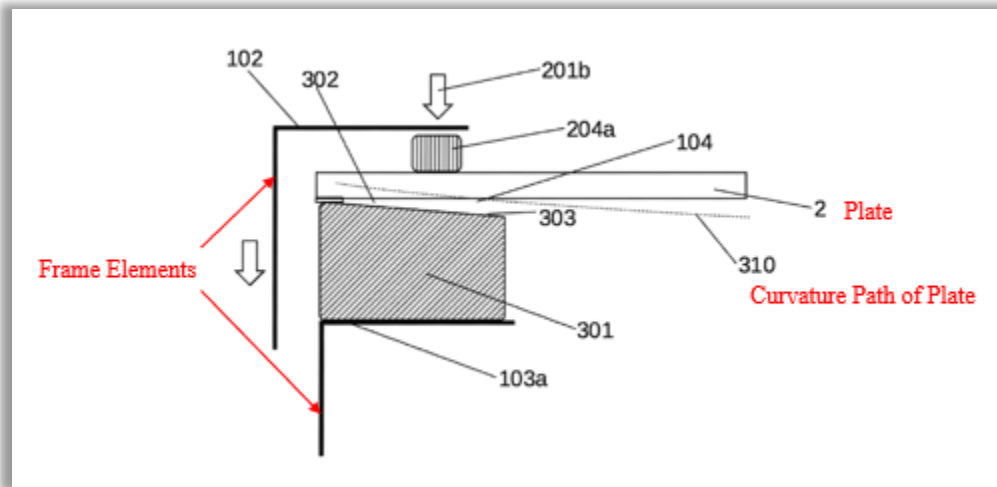
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e.g., Ex. 1011, 18:40-64, Fig. 4; Ex. 1002, ¶36. Other references, such as Zhao, provide the same teaching in the context of large format displays having a cover glass. *See, e.g.*, Ex. 1012, [0045], [0048], [0050], Figs. 1, 3; Ex. 1002, ¶36. In both 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. 1002, ¶36.

The '935 Patent claims the same control of a touch plate curvature using a frame assembly. Ex. 1002, ¶36. Just as in Shin and Zhao, the '935 Patent contemplates that a frame assembly component having a tapered edge can be used in inducing concavity. Ex. 1001, 13:29-42, Fig. 7.

[S]upport block 301 is arranged to support glass plate 2. Support block 301 has a surface portion comprising a tapered edge 303 at an angle from second frame element 103A, Plate 2 is pressed against the top surface of support block 301 from pressure 201b from first frame element 102 and sealing 204a. Pressure 201b causes plate 2 to follow the contour of the top surface of block 301 and plate 2 is forced into a curving plane at an angle to the plane of second frame element 103A. The resulting path of plate 2 is shown by curvature path 310.

Ex. 1001, 13:29-42.



Ex. 1001, Fig. 7.

The '935 Patent claims "...configuring the frame assembly to support the plate includes inducing a parabolic curvature in the touch surface relative to a first axis and relative to a second axis perpendicular to the first axis..." and "the plate has a first curvature in the touch surface when not installed in the frame assembly, and wherein the plate has a second curvature along the width and along the length in the touch surface when the plate is installed in the frame assembly..." *Id.*, Claims 1, 7; Ex. 1002, ¶38.

As described in specificity below, the '935 Patent claims known structures and methods to provide solutions to problems that were already well understood in the art. Ex. 1002, ¶39.

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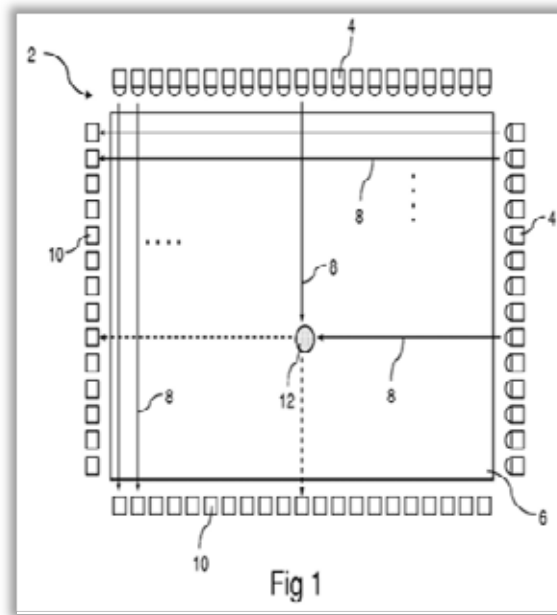
B. Related And Priority Applications

The '935 Patent issued from U.S. Application No. 16/706,438 (“the '438 Application”) on September 15, 2020. The '438 Application was filed December 5, 2019, as a continuation of US. Application No. 16/403,283 (“the '283 Application”). The '283 Application was filed May 3, 2019, as a continuation of US. Application No. 16/190,907 (“the '907 Application”). The '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. 1002, ¶40.

C. Overview Of The Prosecution History

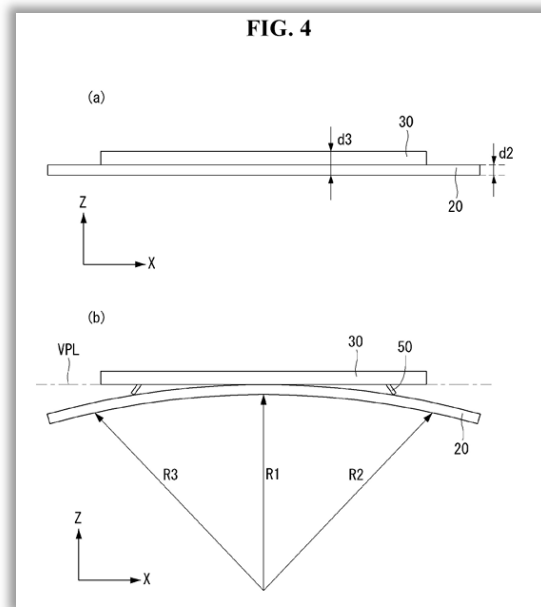
Prosecution of the '935 Patent traversed two Office Actions that each relied on US Patent Pub. No. 20120223916 (“Kukulj”), U.S. Patent Pub. No. 20160295711 (“Ryu”), and U.S. Patent Pub. No. 20130044073 (“Christiansson”). Ex. 1002, ¶41.

On January 28, 2020, the Examiner issued a non-final Office Action, rejecting claims 1 – 20 based on Kukulj, Ryu, and Christiansson. Ex. 1013, 623. Kukulj disclosed an infrared-style touchscreen with light emission and detection means along sides of a touch input area. Ex. 1014, Abstract, Fig. 1; Ex. 1002, ¶42.



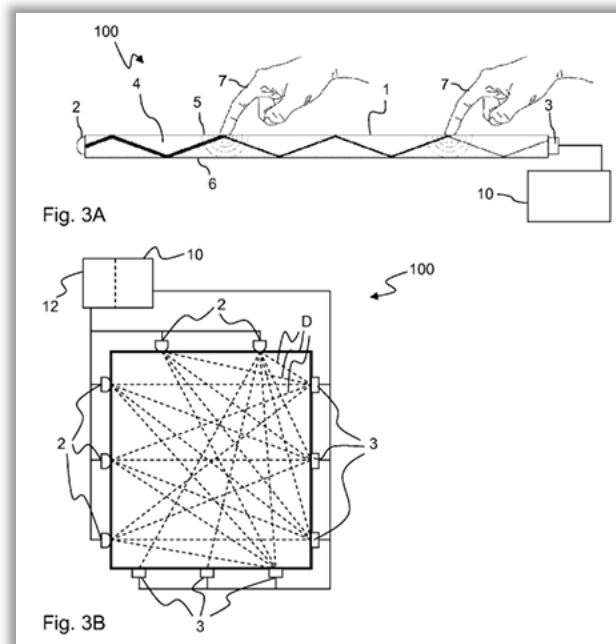
Ex. 1014, Fig. 1.

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. 1002, ¶43.



Ex. 1015, Fig. 4.

Christiansson disclosed a panel configured to conduct light signals between a plurality of incoupling and outcoupling points for the detection of touch points along the panel via internal refraction. Ex. 1016, Abstract, Figs. 3A-B; Ex. 1002, ¶44.



Ex. 1016, Figs. 3A, 3B.

In differentiating the claims, the Applicant amended the independent claims to specify elements of the frame assembly, arrangements of emitters and detectors in relation to a plate having a touch surface, and inducing a curvature in the touch surface. Ex. 1013, 601; Ex. 1002, ¶45.

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1. (Currently Amended) A method for assembling a touch sensing apparatus, the touch sensing apparatus comprising a display panel, a plate including a touch surface, and a frame assembly,
wherein the frame assembly includes:
 a first edge;
 a second edge perpendicular to the first edge; and
 a flat plane defined by the first edge and the second edge; and
wherein the touch surface includes a center point,
the method comprising:
 configuring the frame assembly to support the display panel;
 arranging a plurality of emitters adjacent to a periphery of the plate, said plurality of emitters configured to emit light to propagate over the touch surface;
 arranging a plurality of detectors arranged adjacent to the periphery of the plate, said plurality of detectors configured to receive light from the set of emitters; and
 configuring the frame assembly to support the plate;
 wherein configuring the frame assembly to support the plate includes inducing a curvature in the touch surface such that the center point moves further away from the flat plane.

Ex. 1013, 601.

10. (Currently Amended) A touch sensing apparatus comprising:
a display panel;
a plate having a width, a length and a periphery, the plate further including a touch surface having a center point;
a flat plane defined by a first edge of the touch surface and a second edge of the touch surface perpendicular to the first edge;
one or more emitters arranged adjacent to the periphery of the plate and configured to emit light across the touch surface of the plate;
a set of detectors arranged adjacent to the periphery of the plate and configured to receive light from the set of emitters, and
a frame assembly, the frame assembly comprising [[:]] :
a first frame element configured to support the display panel; and
wherein the plate has a first curvature in the touch surface when not installed in the frame assembly, and wherein the plate has a second curvature in the touch surface greater than the first curvature when the plate is installed in the frame assembly;
wherein the frame assembly is arranged to induce the second curvature such that the center point of the touch surface causes the center point to move further away from the flat plane, and
wherein the first curvature is concave.

Ex. 1013, 601.

The Examiner was unconvinced and issued a Final Office Action on April 7, 2020, based on the same references. *Id.*, 502; Ex. 1002, ¶46. In response, the Applicant further amended independent claims 1 and 10 on June 18, 2020, this time specifying a geometric “parabolic” profile of the induced curvature in the touch surface. Ex. 1013, 150-51; Ex. 1002, ¶46.

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1. (Currently Amended) A method for assembling a touch sensing apparatus, the touch sensing apparatus comprising a display panel, a plate including a touch surface, and a frame assembly, wherein the frame assembly includes:

- a first edge; and
- a second edge perpendicular to the first edge; and
- ~~a flat plane defined by the first edge and the second edge; and~~
- ~~wherein the touch surface includes a center point,~~

the method comprising:

- configuring the frame assembly to support the display panel;
- arranging a plurality of emitters adjacent to a periphery of the plate, said plurality of emitters configured to emit light to propagate over the touch surface;
- arranging a plurality of detectors ~~arranged~~ adjacent to the periphery of the plate, said plurality of detectors configured to receive light from the set of emitters; and
- configuring the frame assembly to support the plate;
- wherein configuring the frame assembly to support the plate includes inducing a parabolic curvature in the touch surface ~~such that the center point moves further away from the flat plane.~~

Ex. 1013, 150.

10. (Currently Amended) A touch sensing apparatus comprising:

- a display panel;
- a plate having a width, a length and a periphery, the plate further including a touch surface having a center point;
- a flat plane defined by a first edge of the touch surface and a second edge of the touch surface perpendicular to the first edge, wherein the center point is separated from the flat plane by a distance;
- one or more emitters arranged adjacent to the periphery of the plate and configured to emit light across the touch surface of the plate;
- a set of detectors arranged adjacent to the periphery of the plate and configured to receive light from the set of emitters, and
- a frame assembly, the frame assembly comprising:
 - a first frame element configured to support the display panel; and
 - a second frame element arranged around at least a portion of the periphery of the plate, the second frame element having a first portion extending along an edge of the plate and a second portion opposed to the touch surface;

wherein the plate has a first curvature in the touch surface when not installed in the frame assembly, and wherein the plate has a second curvature in the touch surface ~~greater than the first curvature~~ when the plate is installed in the frame assembly, said second curvature is parabolic and induced to change the distance of the center point with respect the flat plane when the plate is installed in the frame assembly;

~~wherein the frame assembly is arranged to induce the second curvature such that the center point of the touch surface causes the center point to move further away from the flat plane, and~~

wherein the first curvature is concave.

Ex. 1013, 151.

On July 8, 2020, the Examiner issued a Notice of Allowance for the '935 Patent's application. *Id.*, 91.

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Han was included in an IDS but was not cited by the Examiner. None of the Shin, Cao, Zhao, or Cheng references herein were considered during prosecution. *See* Ex. 1013. Cheng, Han, Zhao, Cao, and Shin—in obvious combinations described herein—disclose a touch sensing apparatus and method of assembling thereof embodying each of the limitations found in claims 1 – 14 of the '935 Patent. Thus, the Office has not previously considered the same prior art or substantially the same arguments. Further, in view of Patent Owner's Infringement Contentions (Exs. 1018, 1019) which have not previously been before the Office and illustrate Patent Owner's broad read of the '935 Patent claims, this Petition does not provide cause for a § 325(d) discretionary denial. Ex. 1002, ¶48.

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. Ex. 1002, ¶¶23-24. 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.*

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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 – 14 of the '935 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 '935 patent are unpatentable as follows:

Ground 1: Claims 1-14 are obvious under 35 U.S.C. § 103 based on Cheng in view of Han and Zhao.

Ground 2: Claims 1-11, 14 are obvious under 35 U.S.C. § 103 based on Cao 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 the '935 Patent. *See* Exs. 1017, 1018, 1019. Petitioner does not waive, and expressly reserves, the claim scope arguments, constructions, and evidence it may raise in other proceedings.

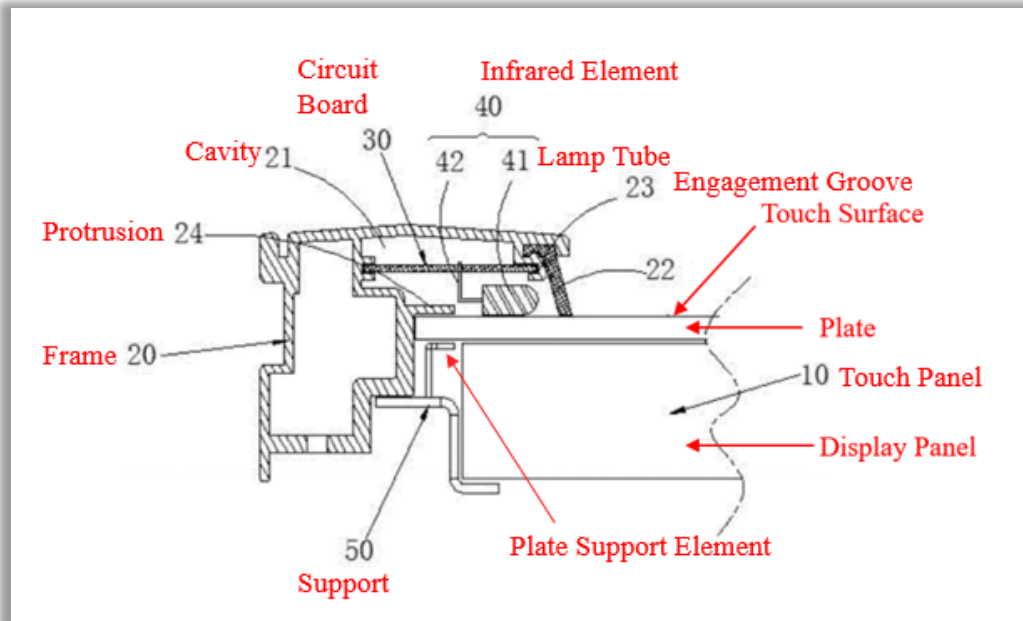
V. CLAIMS 1-14 OF THE '935 PATENT ARE UNPATENTABLE

A. Brief Overview Of The Prior Art

1. Cheng (Chinese Patent No. 203386188)

Cheng is a Chinese Patent titled “Frame Structure of Infrared Touch Screen” having a publication date of January 8, 2014. Cheng claims priority to Chinese Application CN201320390996.2, filed July 2, 2013. Cheng is prior art against the '935 Patent under 35 U.S.C. § 102. Ex. 1002, ¶49.

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. 1002, ¶50.



Ex. 1004, Fig. 1.

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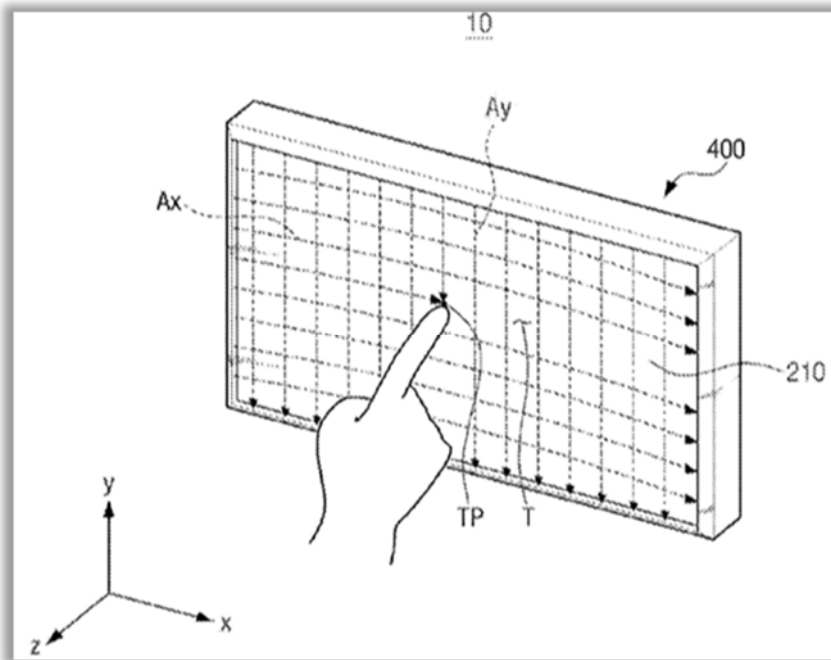
Cheng teaches improving the accuracy of touch detection by configuring the frame 20 and infrared element 40 in relation to the plate of the touch panel 10 to project light across the plate. *See* Ex. 1004, [0002], [0005-10], [0014-17], Fig. 1; Ex. 1002, ¶50-53.

2. Han (U.S. Patent Publication No. 2019/0235701)

Han, 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 ’935 Patent under 35 U.S.C. § 102. Ex. 1002, ¶54.

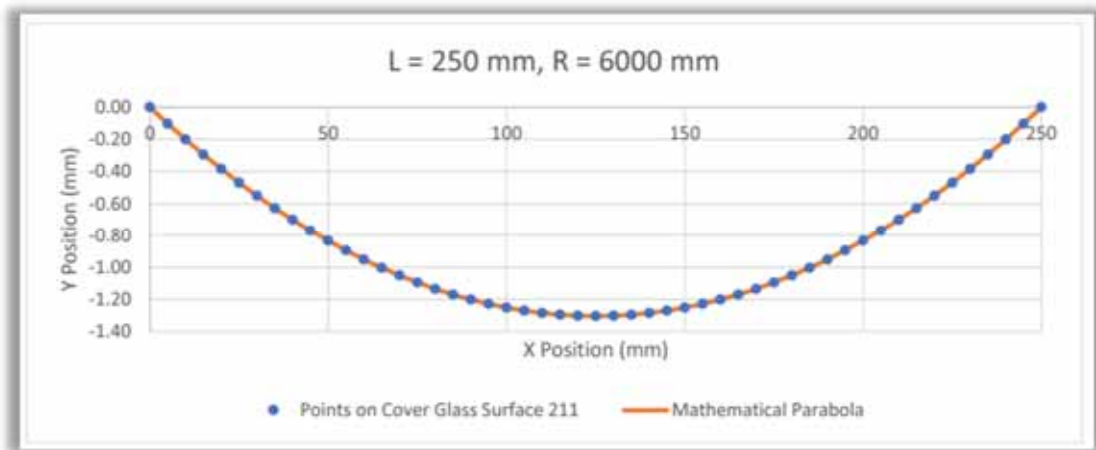
¹ Han’s priority claims to Korean Patent Application No. 10-2016-0128325 (October 5, 2016) predates the ’935 Patent’s earliest priority date of December 7, 2016. Dr. Cairns has compared the translations of the Korean Application (Ex-1009) and the PCT Application (Ex-1007) and has determined that Han’s 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).

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; Ex. 1002, ¶¶55-60. Han's surface 211 of cover glass 210 may be curved along both the first direction Ax and the second direction Ay shown below. *Id.*, [0067-69], [0074-77]; Ex. 1002, ¶¶61-64.



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. 1002, ¶¶65,67-92.

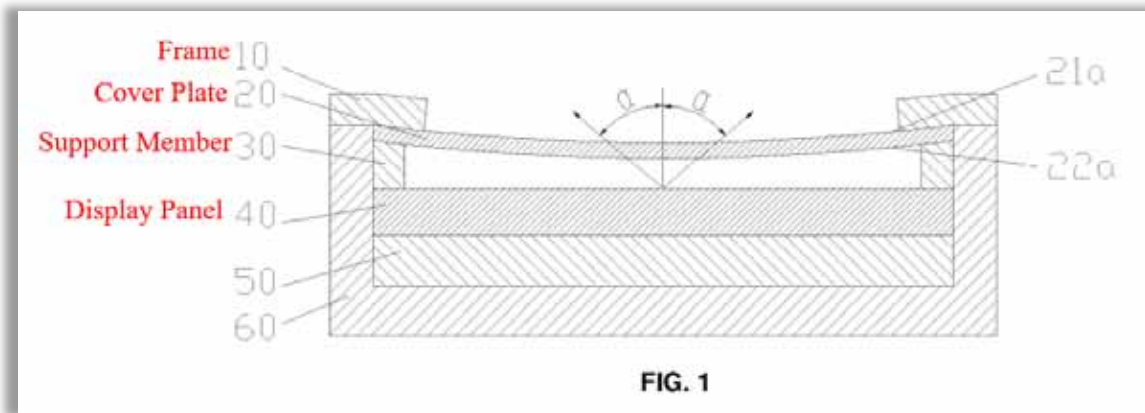


Ex. 1002, ¶74.

3. Zhao (U.S. Patent Application Publication No. 2017/0123257)

Zhao 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 ’935 Patent under 35 U.S.C. § 102. Ex. 1002, ¶94.

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. 1002, ¶¶95-98, 127.



Ex. 1012, Fig. 1.

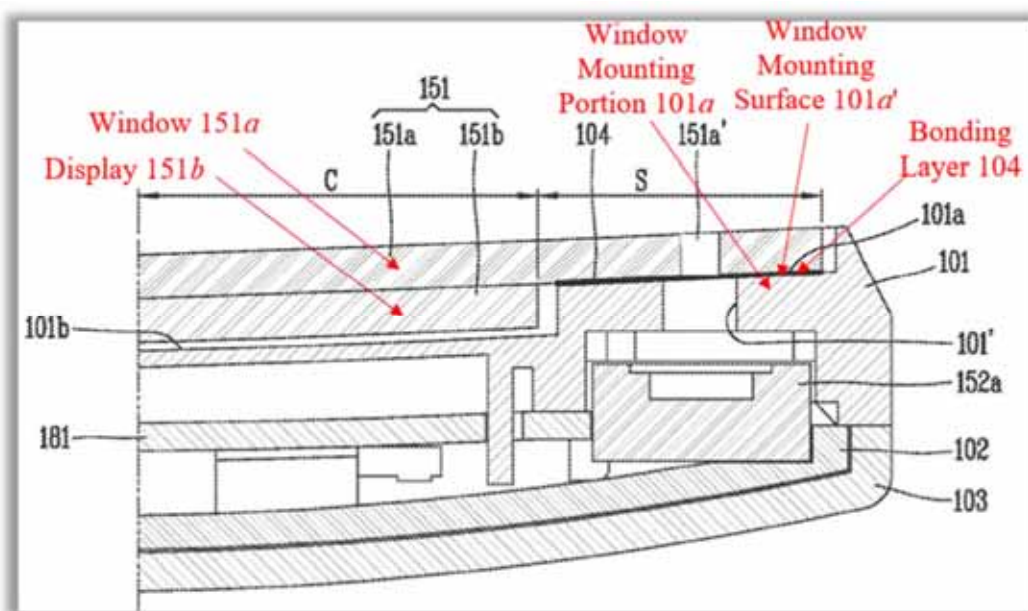
4. Shin (U.S. Patent No. 9,291,845)

Shin 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 ’935 Patent under 35 U.S.C. § 102. Ex. 1002, ¶¶99.

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; Ex. 1002, ¶¶100-04, 107-11. Shin teaches a simplified process of achieving a curved cover glass by inducing a [parabolic] curvature in the glass via a curved frame. *Id.* at 20:9-14, 20:66-21:6; Ex. 1002, ¶¶105-11.

	FLAT DISPLAY UNIT (IMPLEMENTATION OF CURVED SHAPE BEFORE COUPLING WINDOW AND DISPLAY)	FLAT DISPLAY UNIT (IMPLEMENTATION OF CURVED SHAPE AFTER COUPLING WINDOW AND DISPLAY)
FLAT FRAME	(a)	(b)
CURVED FRAME	(d)	(c)

Ex. 1011, Fig. 4.

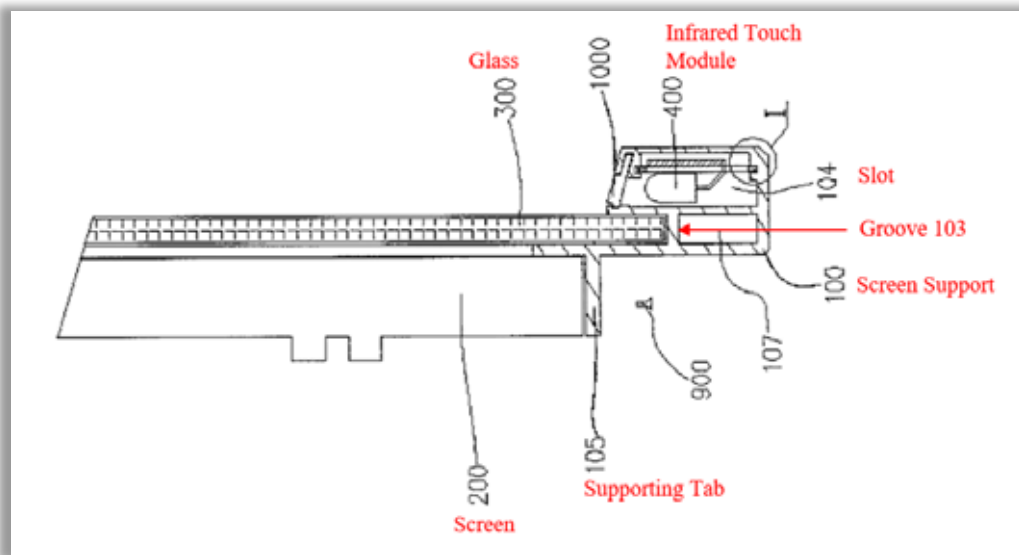


Id., Fig. 5.

5. Cao (U.S. Patent No. 9,983,626)

Cao 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 ’935 Patent under 35 U.S.C. § 102. Ex. 1002, ¶113.

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. 1002, ¶¶114-17.



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

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edge of the plate (glass 300) and modify incoming curvature the edges of glass 300. Ex. 1010, 4:2-14, 7:16-21. Cao's screen support 100 and associated elements prevents "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.*, 4:16-19; Ex. 1002, ¶116.

B. Ground 1 - Claims 1 - 14 Are Obvious Under 35 U.S.C. § 103 Based On Cheng In View Of Han And Zhao.

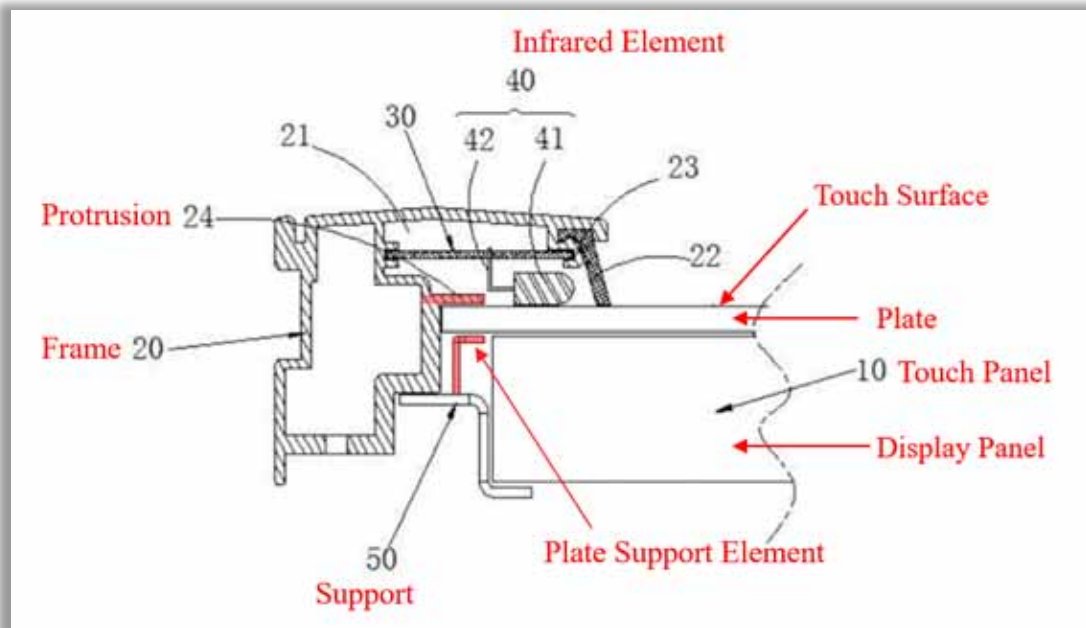
Cheng in view of Han and Zhao renders claims 1-11 and 14 obvious. Ex. 1002, ¶118. Specifically, and as detailed below, it would have been obvious for a POSA to combine the touch screen display device and frame elements of Cheng, with the parabolically curved touch screen elements of Han and the curvature-inducing frame elements of Zhao. *Id.* A POSA would have expected a resulting touch screen display device having improved touch performance, achieved through a simplified manufacturing process. *Id.*

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. Ex. 1002, ¶119. Cheng, Han, and Zhao each relate to similar devices including a display, a covering panel, and a supporting frame assembly. *Id.*; Ex. 1004, Abstract, Fig. 1; Ex. 1005, Abstract; Ex. 1012, Abstract.

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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. 1002, ¶120.

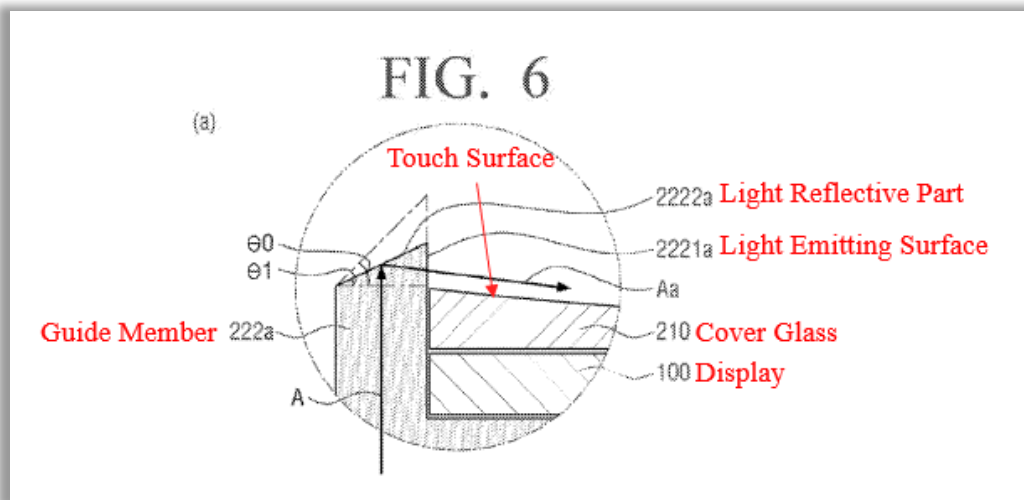


Ex. 1004, Fig. 1.

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. Ex. 1002, ¶121. Cheng additionally teaches reducing material costs by reducing material requirements of the frame. *Id.*; Abstract, [0018].

Han, like Cheng, teaches improving touch detection accuracy in infrared touch devices. Ex. 1002, ¶121. 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. 1002, ¶122.



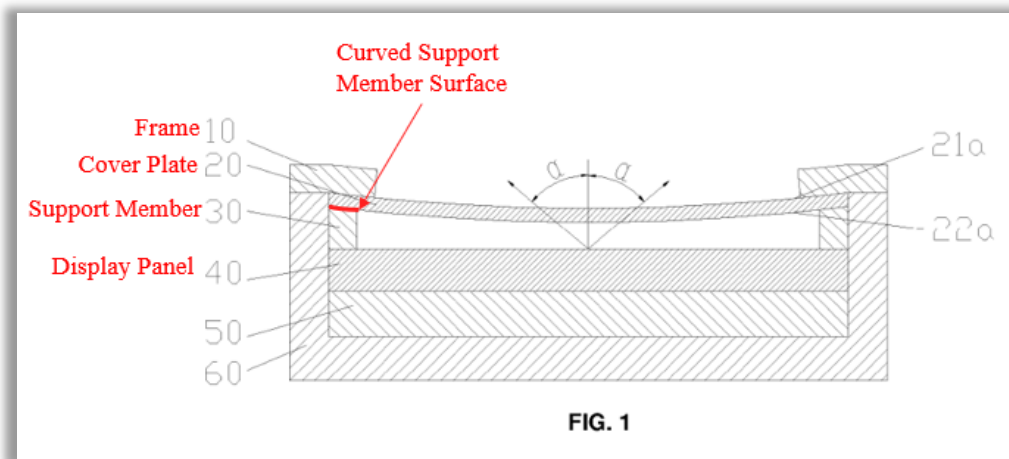
Ex. 1004, Fig. 6(a).

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

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reception guide member 232, and corresponding detection accuracy, is increased. Ex. 1005, [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. 1002, ¶123.

In order to achieve Han's advantageous plate curvature, a POSA would have been motivated to modify Cheng according to Zhao's simplified manufacturing process of inducing curvature into the plate via a frame assembly. *Id.*, ¶124. 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. *Id.* 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). *Id.*



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 cover plate 20 against the curved top side of the support member 30. Ex. 1002, ¶125. 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]; Ex. 1002, ¶125. Zhao teaches that the curved cover panel 20 improves the optical performance of emitted light by reducing the amount of light leak. *See* Ex. 1012, Abstract.

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Thus, a POSA would have been motivated to combine Cheng, Han, and Zhao to meet the claim limitations of the '935 Patent. Ex. 1002, ¶126. Starting with the increased accuracy infrared touch device of Cheng, a POSA would have expected that touch accuracy could be further increased by implementing the parabolically curved touch surface of Han into the touch surface of Cheng. *Id.* Indeed, Han's teachings would have been obvious for POSA to incorporate into Cheng, as both disclose improving touch accuracy by tuning the travel direction of infrared light across the touch surface of a plate using a frame assembly. *Id.*; Ex. 1004, [0010], Fig. 1; Ex. 1005, [106].

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. Ex. 1002, ¶127. As the frame in Cheng already includes a frame support element supporting the plate, it would have been obvious for POSA to modify Cheng's support element according to the curved support member 30 of Zhao. *Id.* A POSA would have expected such modification to achieve the same simplified curvature-inducing functionality in the modified Cheng device. *Id.* Further, a POSA would have appreciated Zhao's curved support member 30 to deliver a simplified manufacturing process with reduced cost. *Id.* Thus, a POSA combining the teachings of Han and Zhao into the device of Cheng would have expected to achieve

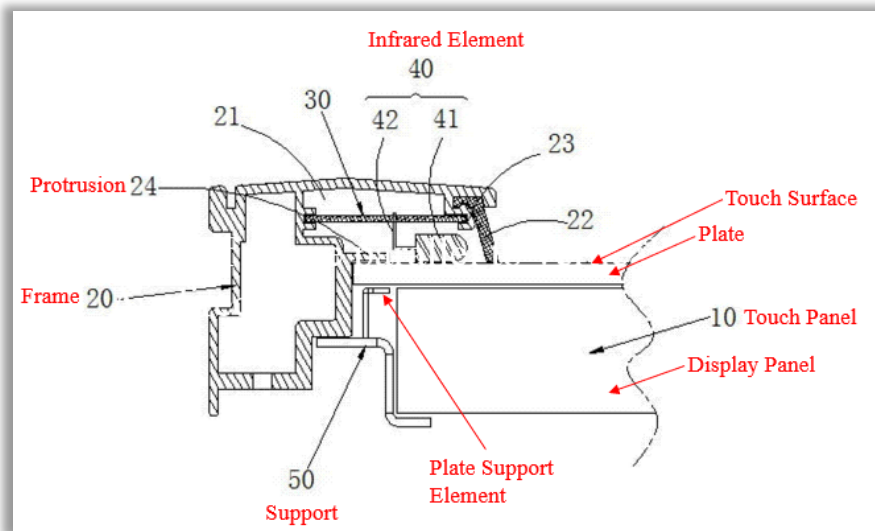
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the predictable result of a high touch accuracy (Han) infrared touch device (Cheng, Han) and manufacturing method (Cheng, Han, Zhao), meeting the limitations of the '935 Patent. Such modifications would have merely embodied implementing known techniques to improve a similar device in a similar way. *Id.*

1. Claim 1

- (a) Preamble: “A method for assembling a touch sensing apparatus, the touch sensing apparatus comprising a display panel, a plate including a touch surface, and a frame assembly,”**

Cheng discloses this element. Ex. 1002, ¶128. Cheng discloses a method for assembling touch sensing apparatus that includes a touch panel 10. *See* Ex. 1004, [0013]. A POSA would have understood Cheng’s touch panel 10 to include a display panel and a plate including a touch surface. *See id.*, Fig. 1, [0002-3]; Ex. 1002, ¶128. Cheng further discloses a frame 20 and a support 50 having a plate support element. Ex. 1004, [0013-0016]; Ex. 1002, ¶128.

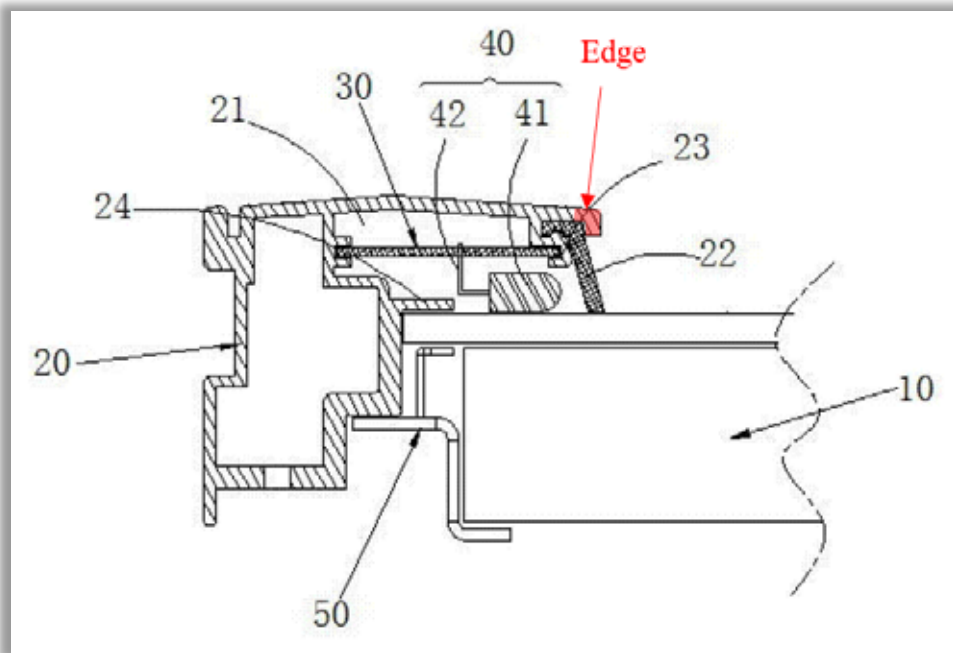


Ex. 1004, Fig. 1.

Thus, Cheng discloses claim's 1 preamble. Ex. 1002, ¶129.

- (b) “wherein the frame assembly includes: a first edge extending between a first end point and an opposite second end point; and a second edge extending between the second end point and a third end point;”

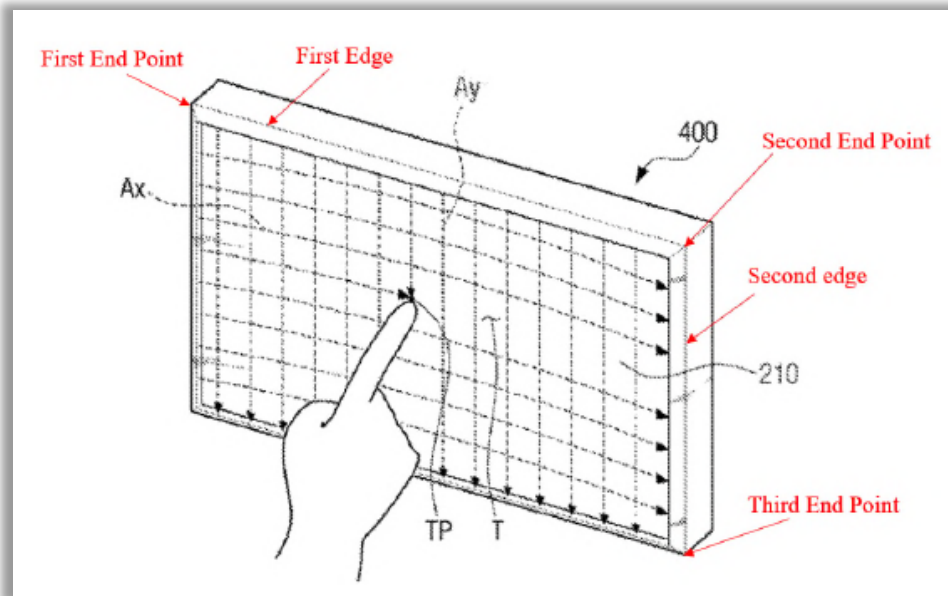
Cheng and Han disclose this element. Ex. 1002, ¶130. A POSA would have understood Cheng's frame 20 to disclose a frame assembly with a first and second edge.
Id.



Ex. 1004, Fig. 1.

A POSA would have further understood Cheng’s frame 20 to disclose a frame assembly configured in the common rectangular (quadrilateral) geometry of infrared touch screen devices, thus including a first and second edge as defined between endpoints. Ex. 1002, ¶¶131-32. For example, Cheng discloses “a scanning network in horizontal and vertical directions, and it is thus possible to determine X and Y coordinates by means of the position of infrared rays in the horizontal and vertical directions.” Ex. 1004, [0002]. Thus, Cheng discloses frames 20 with edges in both a horizontal (first edge) and vertical (second edge) direction. Ex. 1002, ¶132. Further, Han’s frame assembly (including rear cover 400 and guide members 222, 232) depicts a quadrilateral frame geometry

including a first edge extending between a first end point and an opposite second end point, and a second edge extending between the second end point and a third end point.



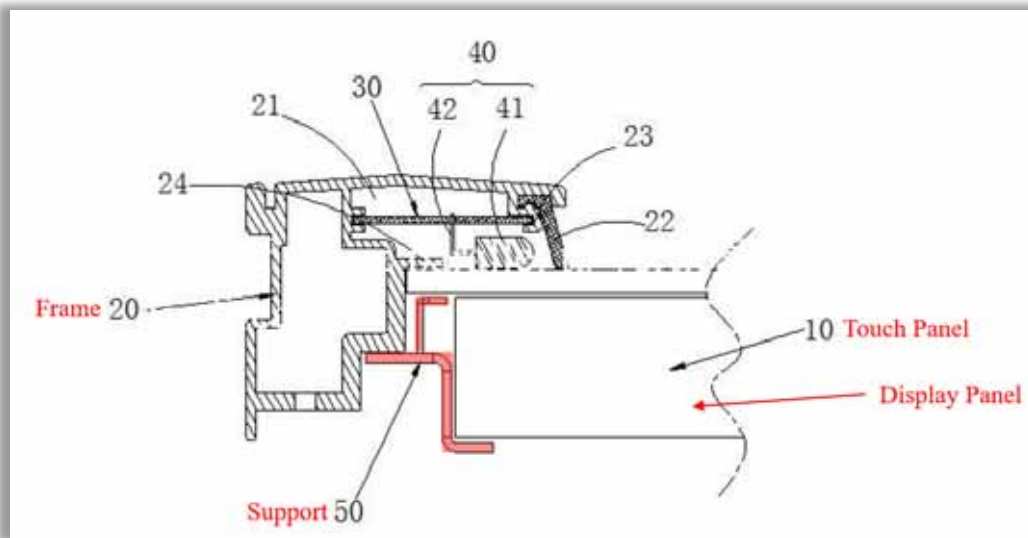
Ex. 1005, Fig. 2.

Thus, Cheng and Han disclose claim 1(b). Ex. 1002, ¶135.

(c) “the method comprising: configuring the frame assembly to support the display panel;”

Cheng discloses this element. Ex. 1002, ¶136. Cheng discloses “a protrusion 24 is provided on the frame 20; the protrusion 24 is placed on an upper surface of touch panel 10” (touch surface of the plate). Ex. 1004, [0015]. Further, “[a] support 50 is provided below the protrusion 24; the support 50 and the protrusion 24 together clamp the touch panel 10.” *Id.*, [0015]. A POSA would have understood Cheng’s frame 20

and support 50 to cooperatively function as a “frame assembly” to support the display panel. Ex. 1002, ¶136.



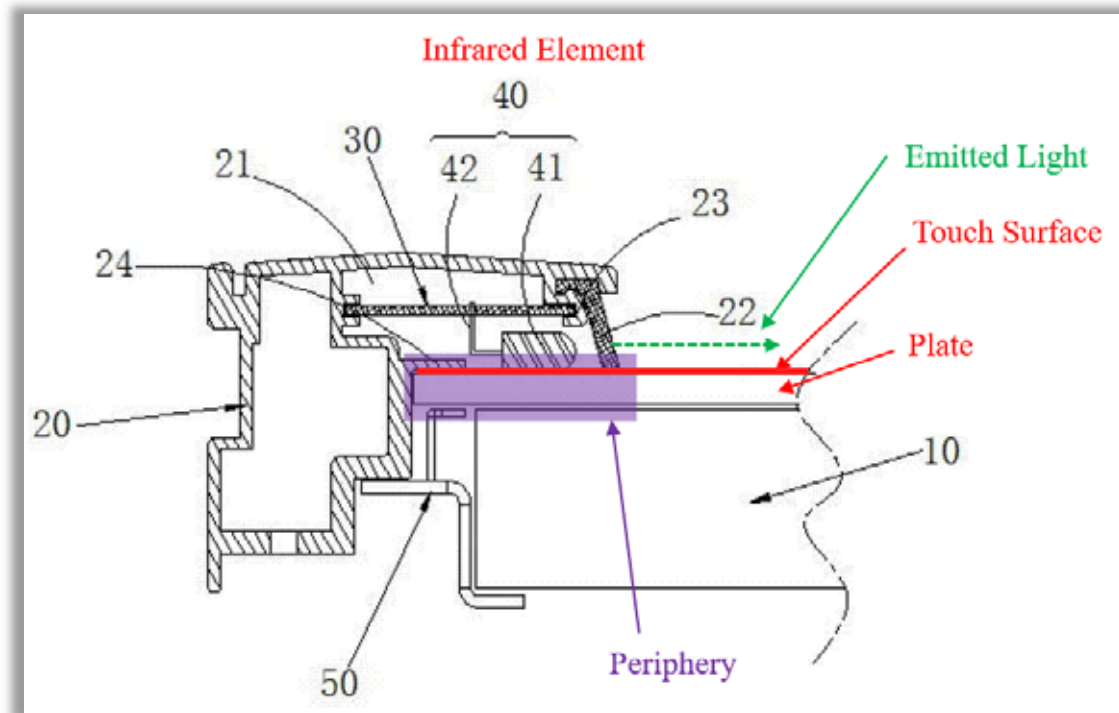
Ex. 1004, Fig. 1.

Thus, Cheng discloses claim 1(c). Ex. 1002, ¶137.

(d) “arranging a plurality of emitters adjacent to a periphery of the plate, said plurality of emitters configured to emit light to propagate over the touch surface;”

Cheng discloses this element. Ex. 1002, ¶138. 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. 1002, ¶138.



Ex. 1004, Fig. 1.

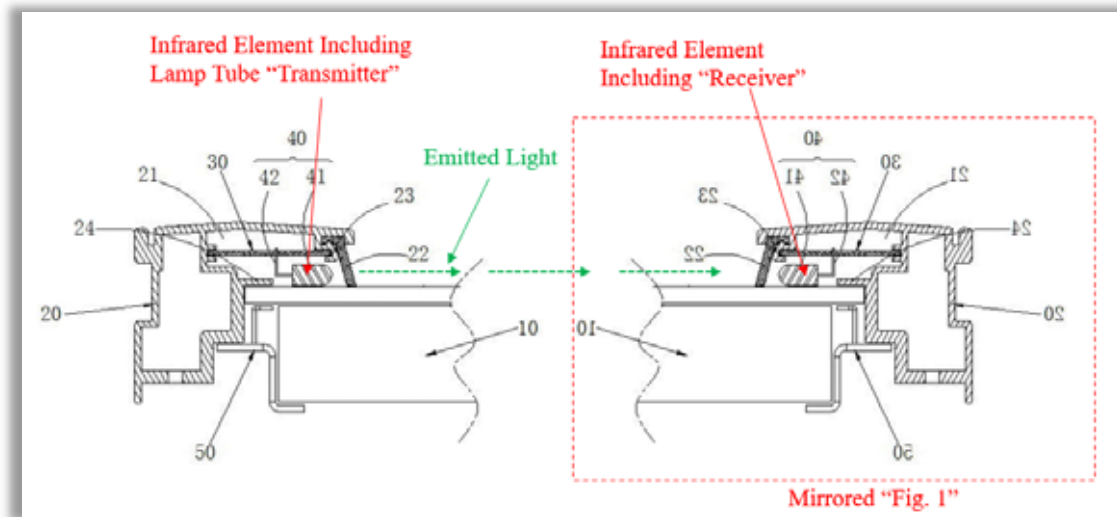
Thus, Cheng discloses claim 1(d). Ex. 1002, ¶139.

- (e) “arranging a plurality of detectors arranged adjacent to the periphery of the plate, said plurality of detectors configured to receive light from the set of emitters; and”

Cheng discloses this element. Ex. 1002, ¶140. As discussed above, 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 adjacent to the plate

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periphery. *Id.*, Fig. 1; Ex. 1002, ¶140. 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. 1002, ¶140.

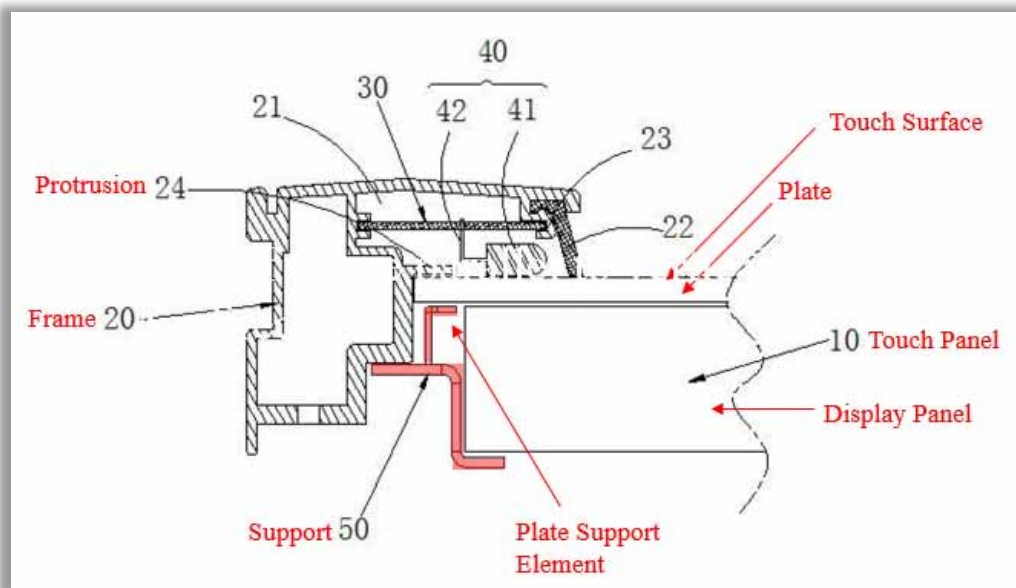


Ex. 1004, Fig. 1.

Thus, Cheng discloses claim 1(e). Ex. 1002, ¶141.

- (f) “configuring the frame assembly to support the plate; wherein configuring the frame assembly to support the plate includes inducing a parabolic curvature in the touch surface relative to a first axis and relative to a second axis perpendicular to the first axis, said first axis is parallel to a line between the first end point and the second end point and said second axis is parallel to a line between the second end point and the third end point.”

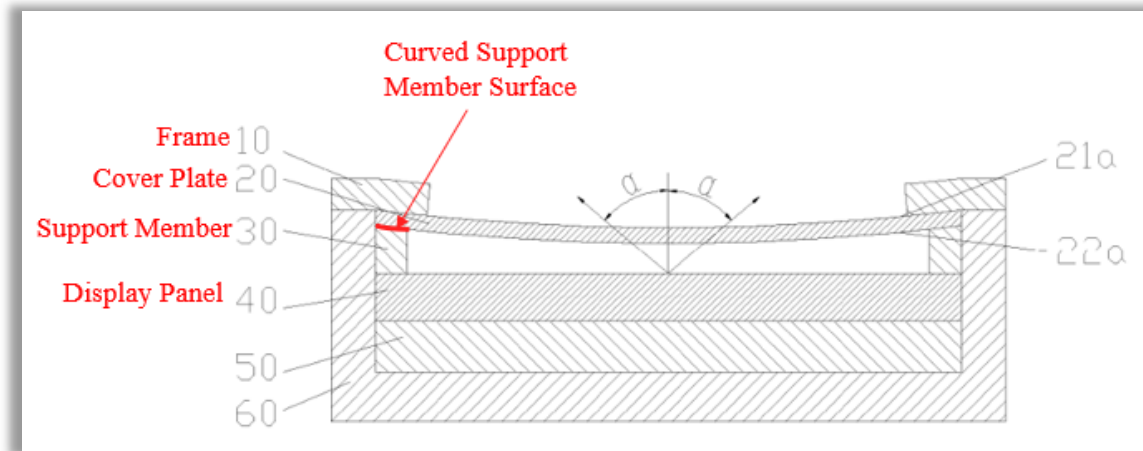
Cheng in view of Han and Zhao discloses this element. Ex. 1002, ¶142. Cheng’s frame assembly comprises frame 20 and support 50. Ex. 1004, Fig. 1. The support 50 includes a plate support element that supports the plate. *Id.*; Ex. 1002, 142.



Ex. 1004, Fig. 1.

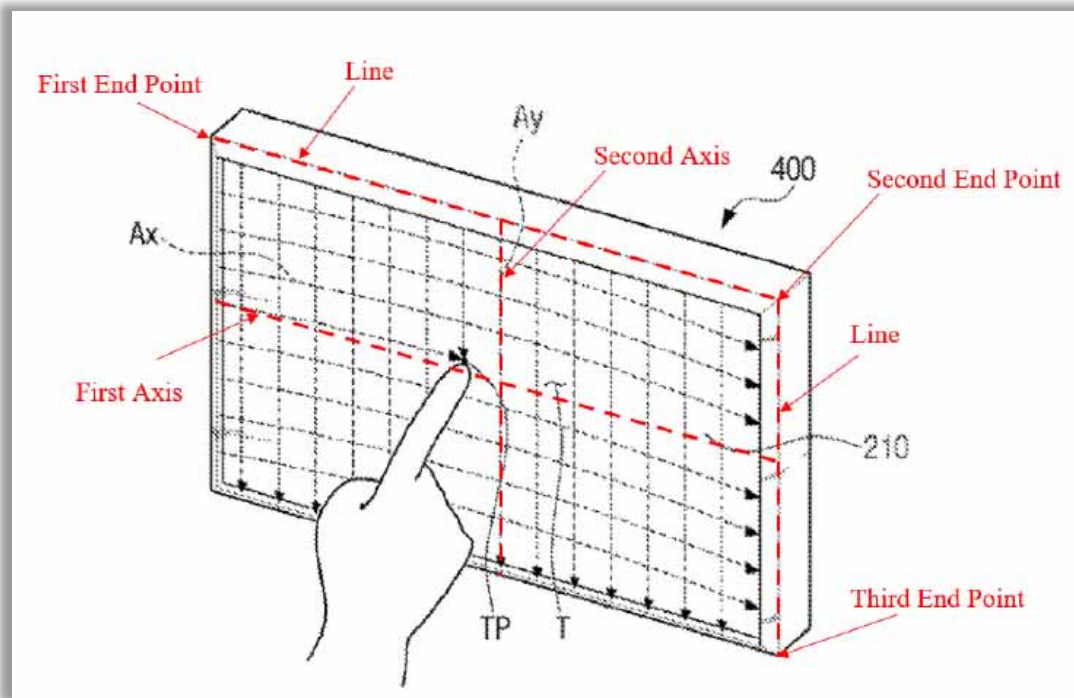
As discussed above, it would have been obvious to a POSA to modify Cheng’s plate to incorporate Han’s parabolic touch screen curvature along Ax and Ay directions

to improve touch detection accuracy. Ex. 1002, ¶143. To reach Han's touch screen curvature, it would have been obvious to a POSA to modify Cheng's frame protrusions 24 and plate support elements of supports 50 according to Zhao's curved mounting surfaces 30. *Id.*



Ex. 1012, Fig. 1.

Like in Zhao, the modified plate support elements of Cheng would induce curvature into the plate in a simplified manufacturing step, and the modified protrusions 24 of Cheng would secure the curved touch surface side of the curved plate. Ex. 1002, ¶144. According to Han, Cheng's modified plate would be parabolically curved along a first axis (A_x) and a second axis (A_y) perpendicular to the first to achieve improve touch detection accuracy. *Id.* Further according to Han, the first axis would be parallel to a line between the first and second endpoints and the second axis would be parallel to a line between the second and third endpoints. *Id.*



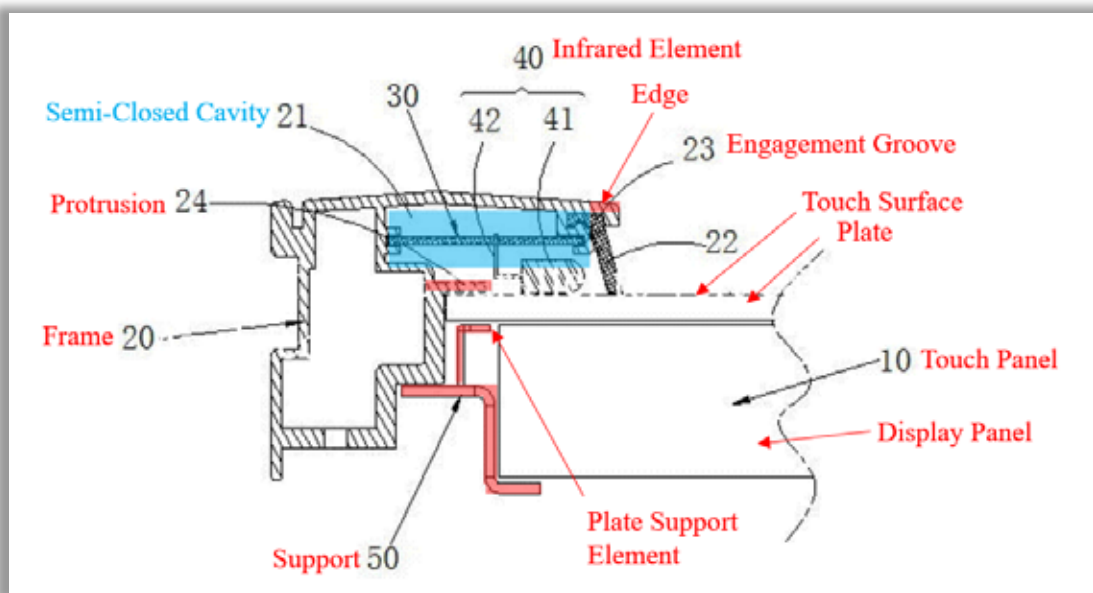
Ex. 1005, Fig. 2.

In an example of the modified Cheng device, each side of an initially flat panel is inserted onto respective modified curved plate support element of supports 50 according to Zhao. Ex. 1002, ¶145. Like in Zhao, the modified curved plate support elements would apply a bending force to the periphery of the plate, inducing a curvature into the plate (including the touch surface of the plate). *Id.* The plate support elements parallel to the plate's Ax axis would induce curvature along the plate's Ay axis, and the plate support elements parallel to the plate's Ay axis would induce curvature along the plate's Ax axis, according to the accuracy improving plate curvature of Han *Id.*

Thus, Cheng in view of Han and Zhao discloses claim 1(f). Ex. 1002, ¶146.

2. **Claim 2: “The method of claim 1, wherein the first edge is curved and the second edge is curved.”**

Cheng in view of Zhao discloses this element. Ex. 1002, ¶147. The modified Cheng device has a curved first edge and a curved second edge. *Id.* As discussed above, the modified Cheng device has curved plate support elements and curved protrusions 24 connected to the frame 20. 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, [0013-17].



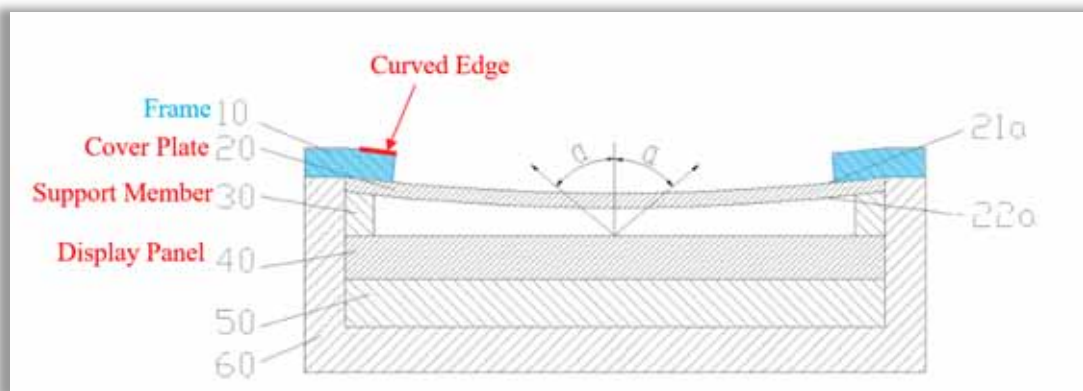
Ex. 1004, Fig. 1.

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

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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 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. Ex. 1002, ¶148. As a result, the respective first and second edges of Cheng’s frame 20 (which are connected to semi-closed cavity 21 and engagement groove 23) would thus 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. *Id.*

Additionally, curved first and second edges in the modified Cheng device would have been obvious based on Zhao’s curved frame 10. *Id.*, ¶149.



Ex. 1012, Fig. 1.

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Zhao discloses an embodiment having a frame with “curved sides.” Ex. 1012, [0051-52]. The radius of curvature of the curved frame 10 is “the same as that of the first surface 21a [surface of curved cover plate 20], and specifically, the shape of the frame 10 mates with that of the edges of the first surface where the frame is located, such that frame 10 fits the cover plate 20 better, to prevent structure loosening.” *Id.*

A POSA would have been motivated to implement Zhao’s curved frame 10 into Cheng’s frame 20 with protrusion 24. Ex. 1002, ¶151. A POSA would have expected such a modification to achieve Zhao’s structural loosening prevention in the modified Cheng device. *Id.* As a result, the curved frame 20 of the modified Cheng device would thus also have a curved first and second edge. *Id.*

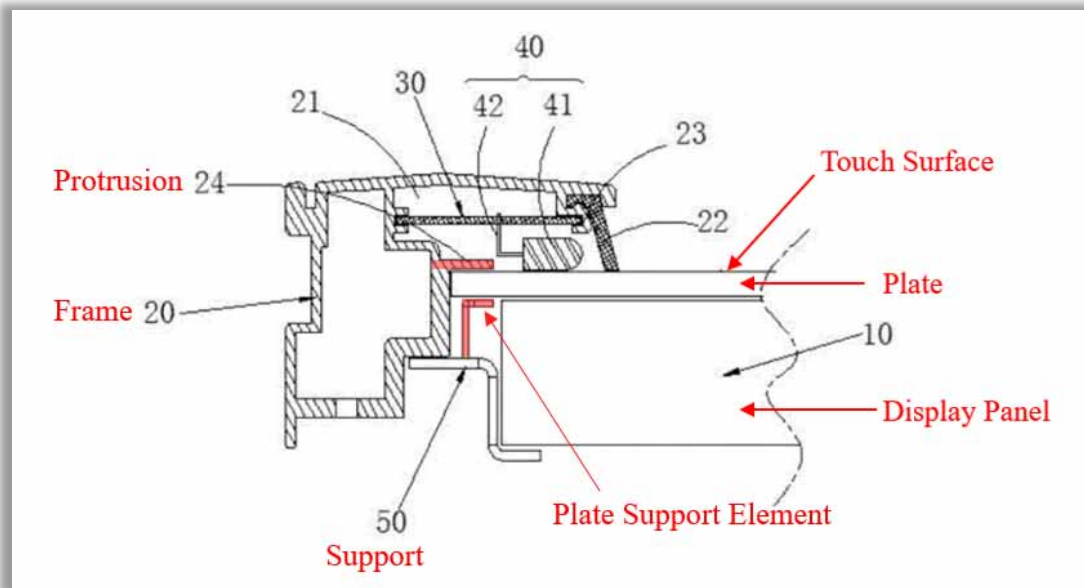
Thus, Cheng in view of Zhao discloses claim 2. Ex. 1002, ¶152.

3. Claim 3: “The method of claim 1, wherein the plate has a first curvature when not configured in the frame assembly, and wherein the plate has a second curvature greater than the first curvature after the plate is configured in the frame assembly.”

Cheng in view of Han and Zhao discloses this element. Ex. 1002, ¶153. In an embodiment of the modified Cheng device, the plate has an initial, pre-installed curvature according to the well-known material property of pre-installed stock tempered glass. *See* Exs. 1023, 1024, 1025, 1026; Ex. 1002, ¶¶154-56; *see also* Ex. 1001, 2:5-9. Each side of the plate is then inserted onto Cheng’s modified curved

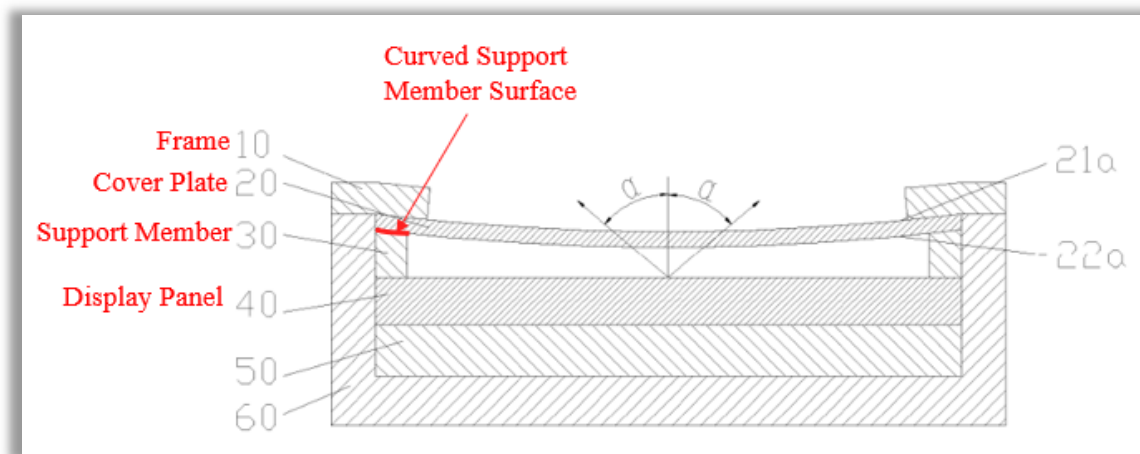
plate support elements of each support 50 and enclosed by curved protrusions 24 .

Ex. 1002, ¶157.



Ex. 1004, Fig. 1.

As the plate is assembled onto and between the curved plate support elements and protrusions 24, they apply a bending force to the panel. Like in Zhao, the bending force induces Cheng's modified plate to curve according to the corresponding curvature of the Cheng's modified plate support elements and protrusions 24.



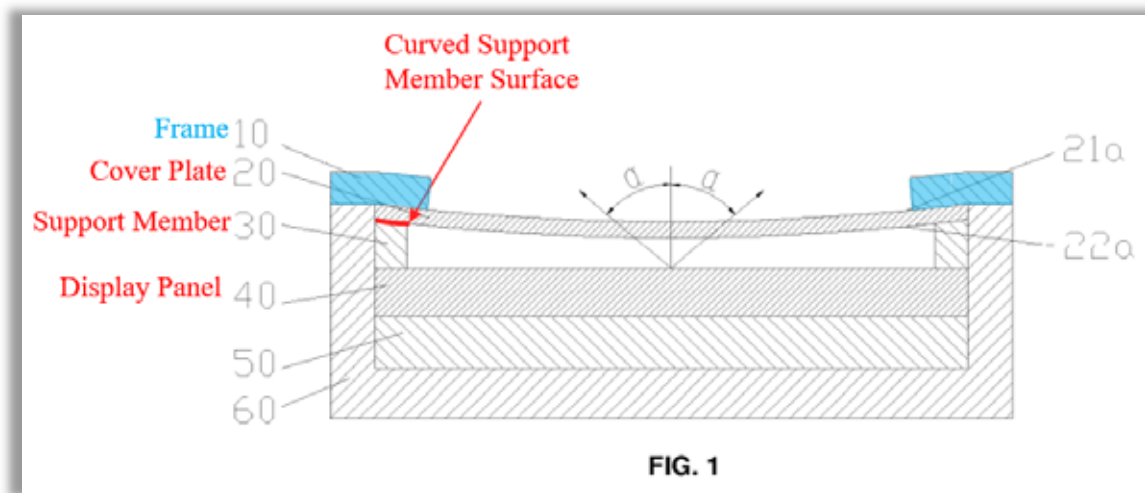
Ex. 1012, Fig. 1.

The induced curvature (second) in Cheng's modified plate is greater than the first curvature based on the curvature of the modified plate support elements and protrusions 24 along both the Ax and Ay directions. Ex. 1002, ¶¶159-61.

Thus, Cheng in view of Han and Zhao discloses claim 3. Ex. 1002, ¶162.

4. Claim 4: The touch sensing apparatus of claim 3, wherein the first curvature and second curvature are defined along an edge of the plate.

Cheng in view of Han and Zhao discloses this element. Ex. 1002, ¶163. In the modified Cheng device, the first and second curvatures are defined along an edge of the plate. *Id.* A POSA would have understood pre-installed plate curvature (bow) to be defined along an edge of the plate. *Id.* As taught by Zhao, 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].



Ex. 1012, Fig. 1.

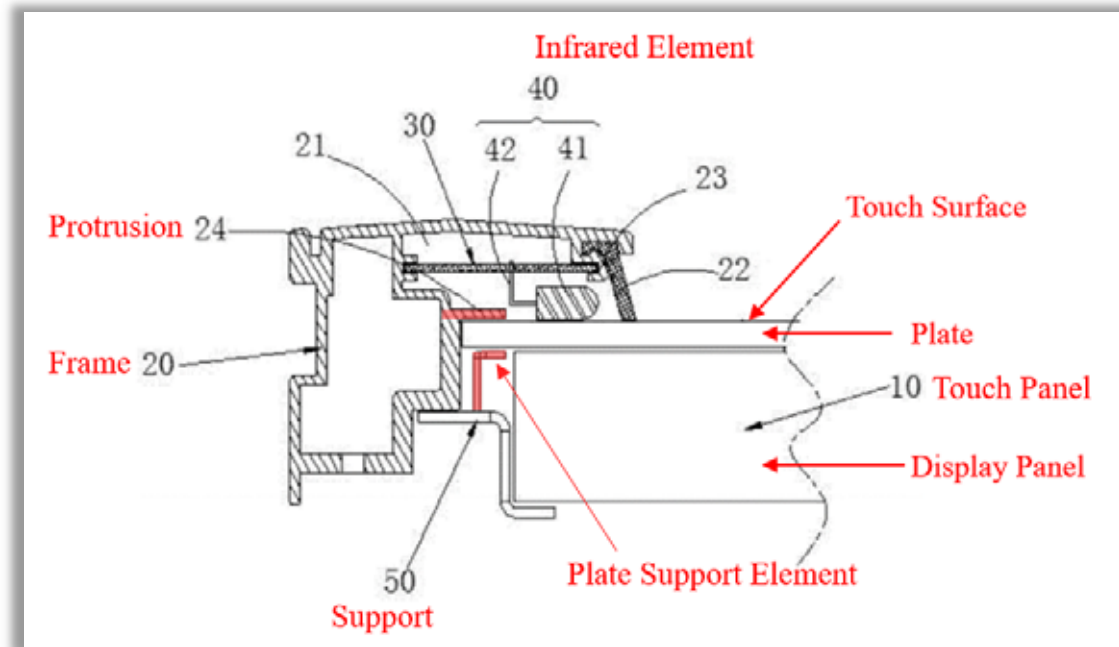
Thus, during installation of Zhao’s cover plate 20, the curved support member 30 and frame 10 induce curvature up to the edge of cover plate 20. *Id.*; Ex. 1002, ¶164. Specifically, Zhao teaches that “the curvature radius of the two curved sides 12 of the frame 10 is the same as that of the first surface 21a [top of the cover plate 20], and specifically, the shape of the frame 10 mates with that of **edges** of the first surface where the frame is located, such that the frame 10 fits the cover plate 20 better, to prevent loosening.” Ex. 1012, [0052] (emphasis added). Zhao further teaches that “the shape of the surface of the support member 30 in contact with the cover plate 20 matches with that of the cover plate.” *Id.*, [0055]; Ex. 1002, ¶164.

In the modified Cheng device according to Zhao, Cheng’s curved plate support elements and protrusions 24 would also induce curvature up to the edges of the plate

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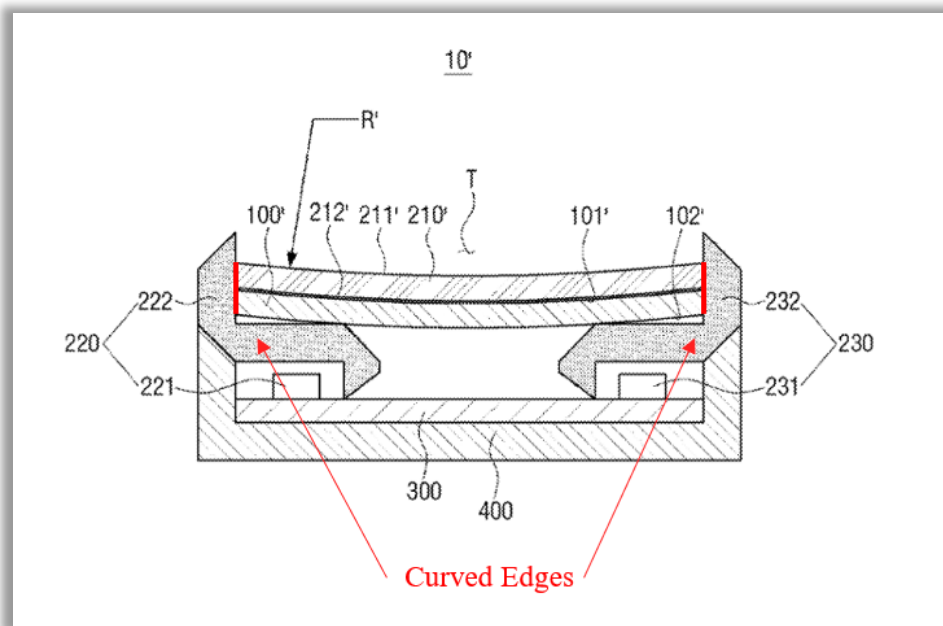
during installation, as each would also contact the plate up to its respective edges.

Ex. 1002, ¶165.



Ex. 1004, Fig. 1.

Further, Han teaches curvature along both an Ax and Ay direction, up to and including the edges of its front cover glass 210 to improve touch accuracy. Ex. 1005, [0077], [0085-86], Fig. 7.



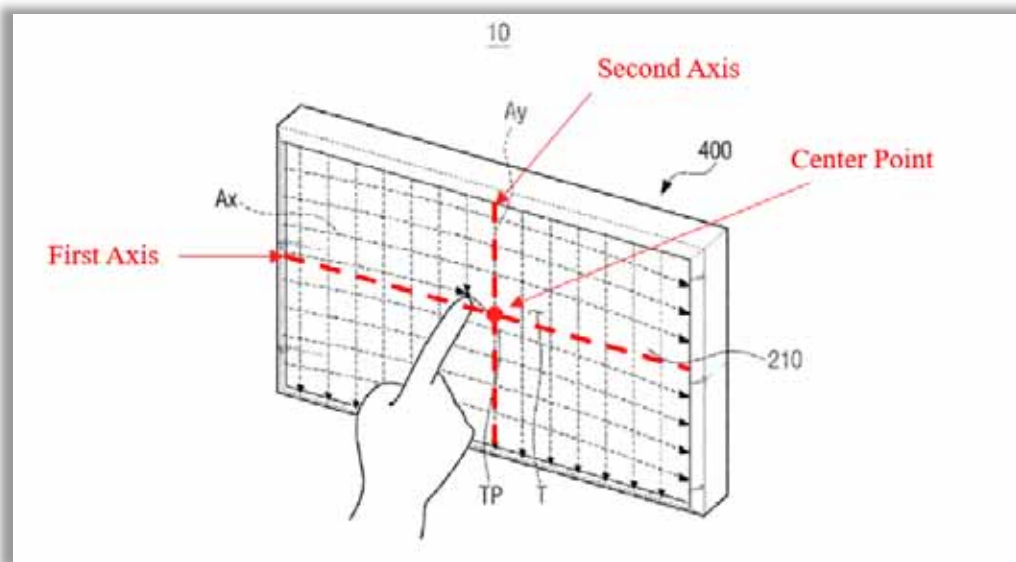
Ex. 1005, Fig. 7.

A POSA would have expected to reach the same accuracy improving plate curvature of Han in the modified Cheng device by implementing Zhao's curved frame 10 and curved support member 30 teachings into the modified Cheng's protrusion 24 and plate support elements along both the horizontal (A_x) and vertical directions (A_y).
Ex. 1002, ¶167.

Thus, Cheng in view of Han and Zhao discloses claim 4. *Id.* ¶168.

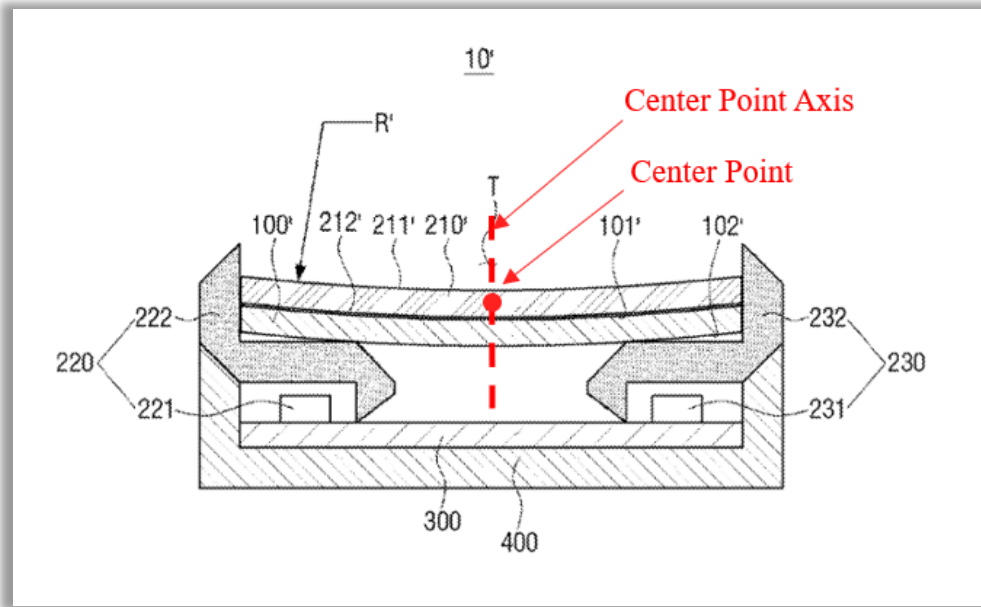
5. **Claim 5: “The touch sensing apparatus of claim 3, wherein the first curvature and second curvature are measured along an axis passing through a center point of the plate.”**

Cheng in view of Han and Zhao discloses this element. Ex. 1002, ¶169. As discussed above, Han teaches a parabolically curved plate (cover glass 210), with curvature relative to both a first (Ax) and second (Ay) axis. Ex. 1005, [0085-87].



Ex. 1005, Fig. 9.

Han further teaches a parabolic curvature as measured along an axis passing through a center point of the plate (cover glass 210). *Id.*, Figs. 7, 9; Ex. 1002, ¶170.



Ex. 1005, Fig. 7.

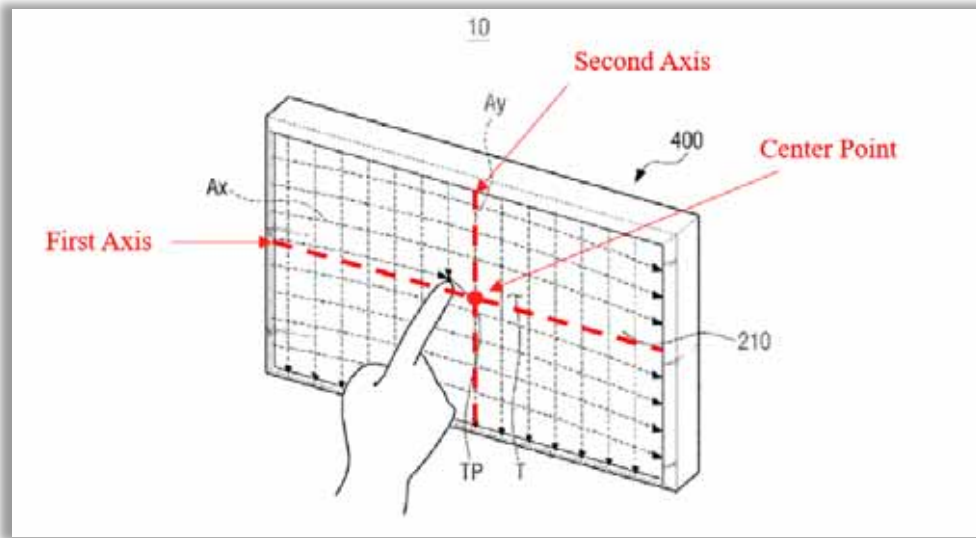
In order to achieve Han's improved touch detection, a POSA would have been motivated to modify Cheng's plate to have the same parabolic curvature as Han's, also as measured along an axis passing through a center point of modified Cheng's plate.

Ex. 1002, ¶171.

Thus, Cheng in view of Han discloses claim 5. *Id.*, ¶172.

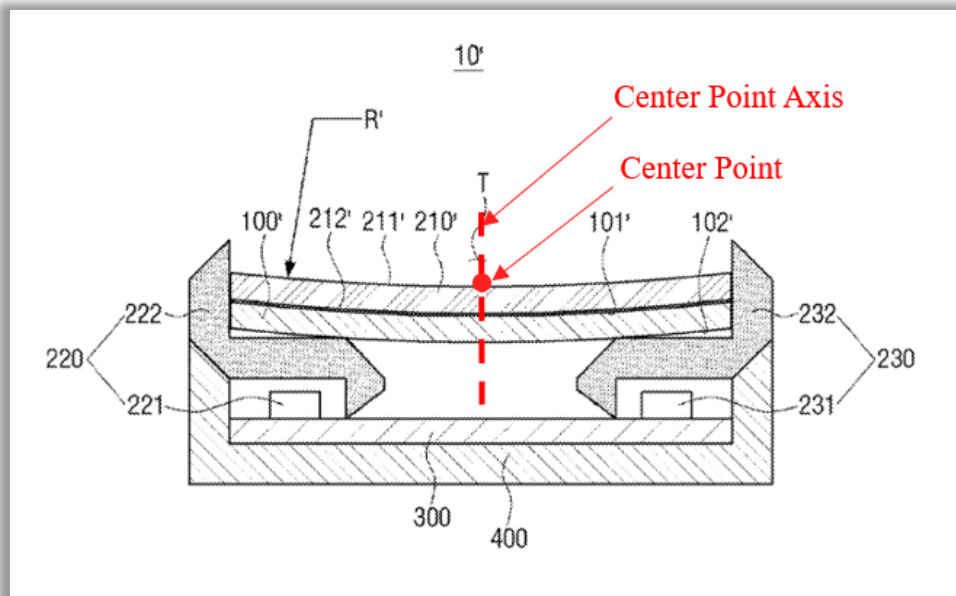
- 6. Claim 6: The touch sensing apparatus of claim 3, wherein the first curvature and second curvature are measured along a line passing through a point on the touch surface.**

Cheng in view of Han and Zhao discloses this element. *Id.*, ¶173. Han teaches a parabolically curved plate (cover glass 210), with curvature relative to both a first (Ax) and second (Ay) axis.



Ex. 1005, Fig. 9.

Han further teaches a parabolic curvature as measured along an axis passing through a point on the touch surface (surface 211). Ex. 1002, ¶172.



Ex. 1005, Fig. 7.

In order to achieve Han's improved touch detection, a POSA would have been motivated to modify Cheng's plate to have the same parabolic curvature as Han's, also as measured along an axis passing through a point on the surface of modified Cheng's plate. Ex. 1002, ¶175.

Thus, Cheng in view of Han discloses claim 6. *Id.*, ¶176.

7. Claim 7

(a) Preamble: "A touch sensing apparatus comprising:"

Cheng and Han discloses this element. Ex. 1002, ¶177. Both Cheng and Han disclose a touch sensing apparatus. Ex. 1004, [0001]; Ex. 1005, Abstract; Ex. 1002, ¶¶177-78.

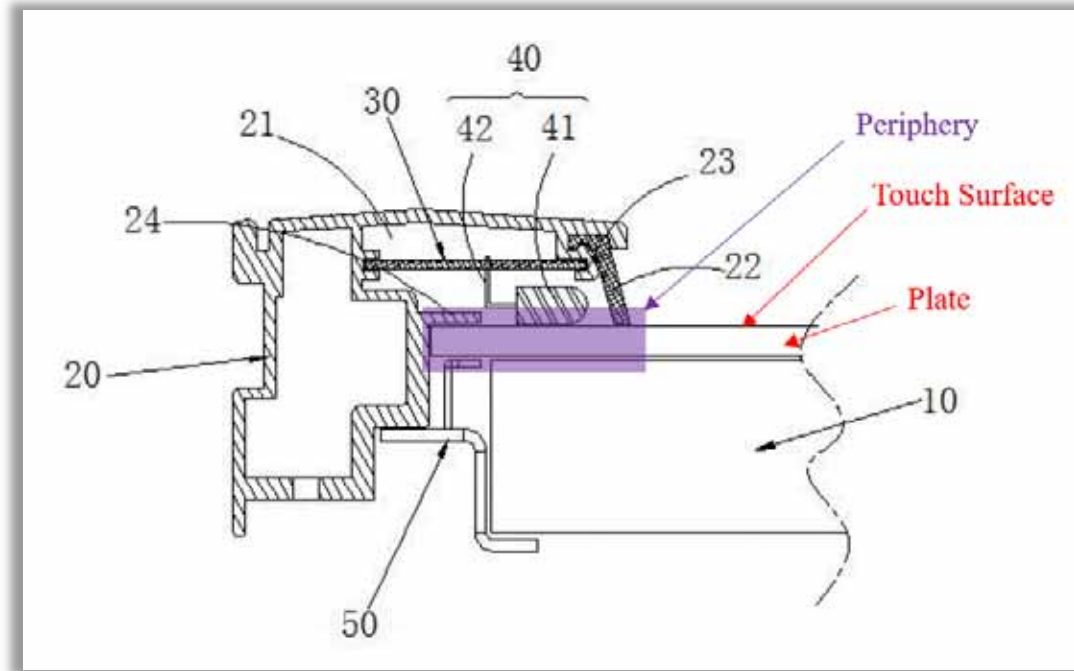
(b) "a display panel;"

Cheng, Han, and Zhao disclose this element. *Id.*, ¶179. Each of Cheng, Han, and Zhao disclose a display panel. Ex. 1004, [0013], Fig. 1; Ex. 1005, Abstract; Ex. 1012, Abstract; Ex. 1002, ¶179.

Thus, Cheng, Han, and Zhao disclose claim 7(b). Ex. 1002, ¶¶179-80.

(c) "a plate having a width, a length and a periphery, the plate further including a touch surface;"

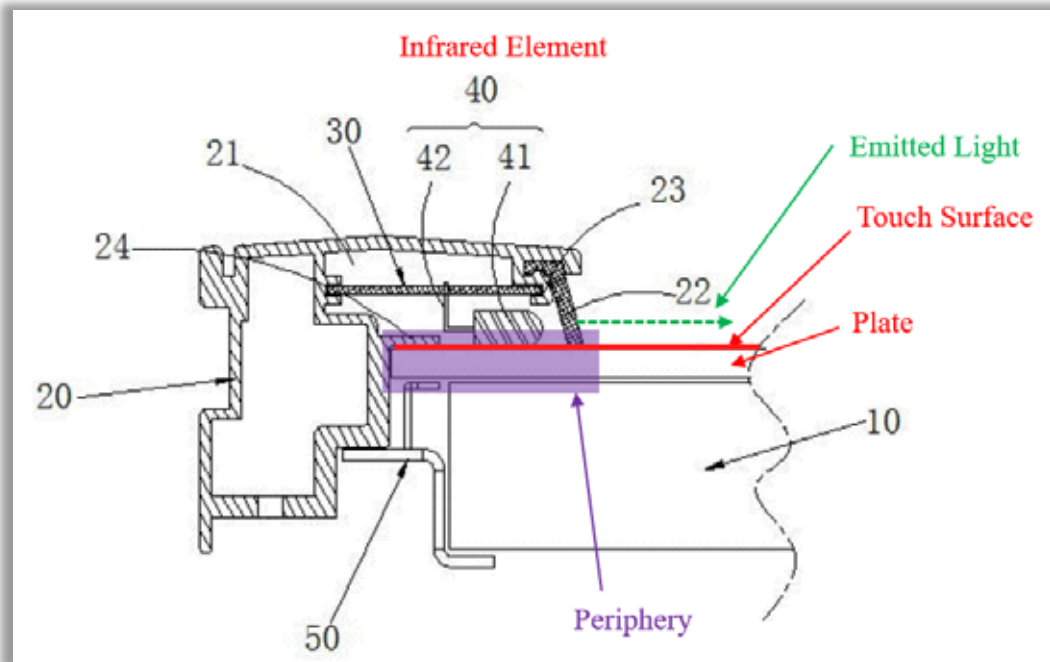
Cheng discloses this element. *Id.*, ¶179. As discussed above, Cheng discloses a touch panel 10 having a plate. Ex. 1004, Fig. 1. A POSA would have understood Cheng's plate to include a width and a length, at least comprising a quadrilateral



Thus, Cheng discloses claim 7(c). Ex. 1002, ¶182.

Cheng discloses this element. *Id.*, ¶183 Cheng discloses “infrared receivers and **transmitters** [emitters] distributed densely around a display region form[ing] a scanning network in horizontal and vertical directions. Ex. 1004, [0002] (emphasis added). Cheng’s emitters, including lamp tube 41 of infrared element 40, are arranged

adjacent to the periphery of the plate and are configured to emit light across the touch surface of the plate. *Id.*, [0018], Fig. 1; Ex. 1002, ¶183.



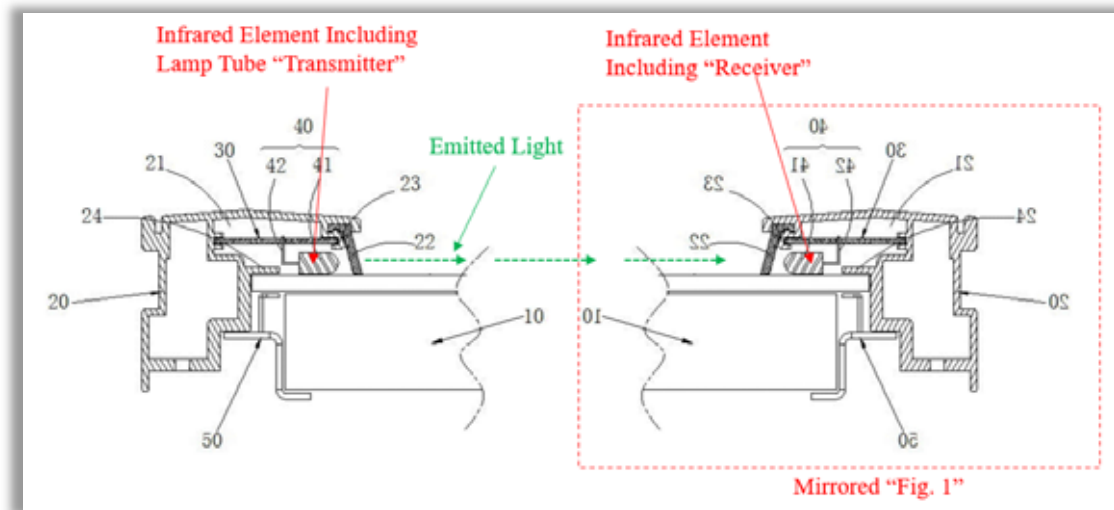
Ex. 1004, Fig. 1.

Thus, Cheng discloses claim 7(d). Ex. 1002, ¶184.

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

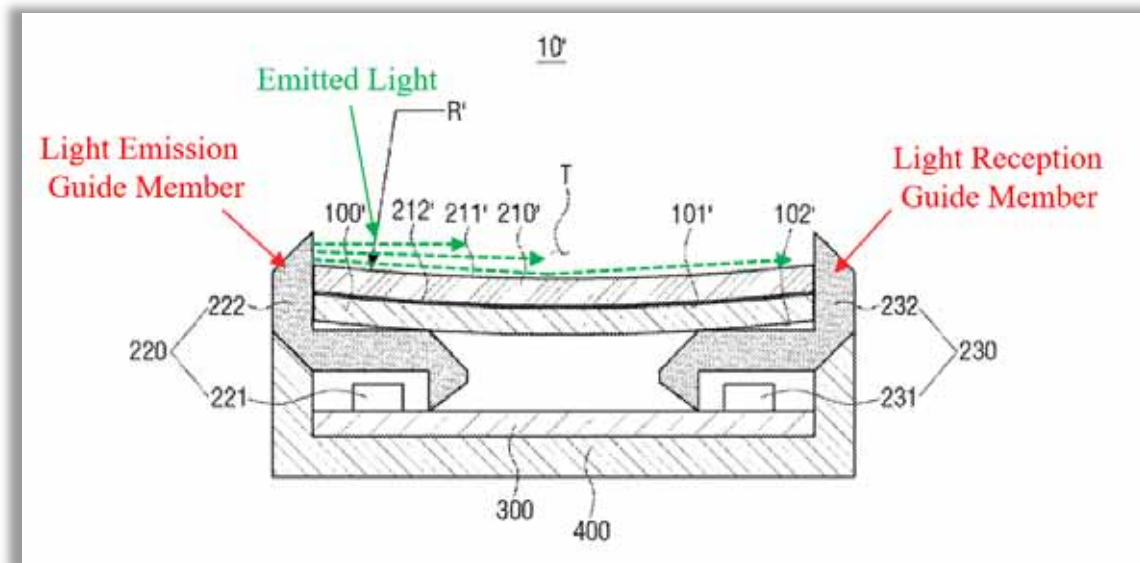
Cheng in view of Han discloses this element. *Id.*, ¶185 Cheng discloses “infrared **receivers** and transmitters distributed densely around a display region form[ing] a scanning network in horizontal and vertical directions.” Ex. 1004, [0002] (emphasis added). The '935 Patent confirms it is well known in the prior art to arrange

a plurality of emitters and detectors around the periphery of the plate in order to enable touch-sensing functionality. *See, e.g.*, Ex. 1001, 1:26-46, 15:62-16:3; Ex. 1002, ¶185. While Cheng identifies a lamp tube 41 in the infrared element 41, a POSA would have understood Cheng’s infrared element to also disclose an infrared receiver (detector) in place of lamp tube 41 to detect emitted light and enable touch sensing functionality. Ex. 1002, ¶185.



Ex. 1004, Fig. 1.

Further, Han teaches that light “irradiated from the light emitting surface 2221 of the light emission guide member 222 [] passes through the touch area T to the incident surface 2321 of the light reception guide member 232.” Ex. 1005, [0087]; Ex. 1002, ¶186.



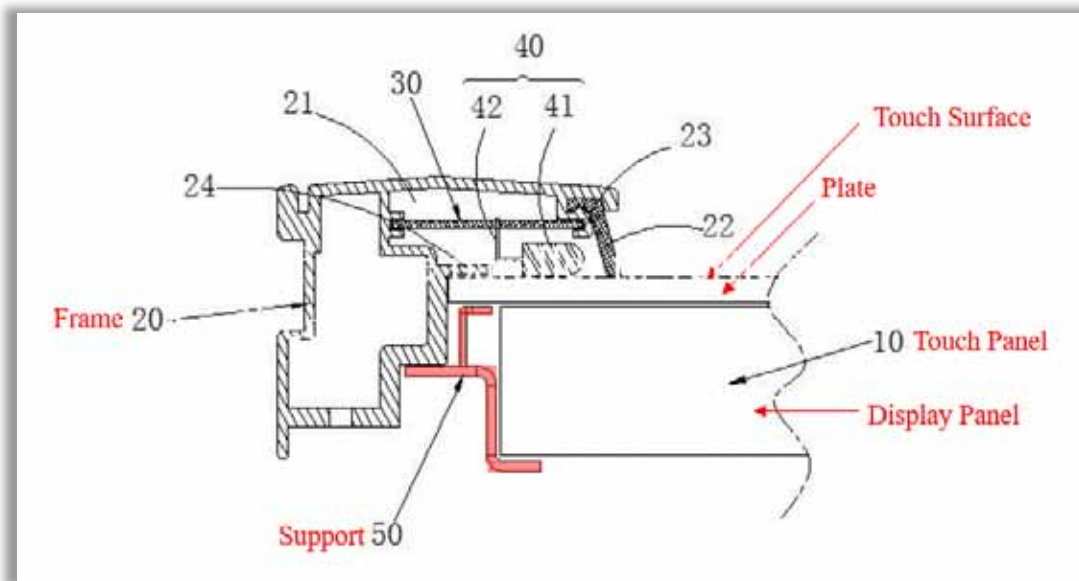
Ex. 1005, Fig. 7.

In modifying Cheng to achieve Han’s improved touch detection accuracy plate curvature, a POSA would have continued to implement detectors adjacent to the periphery of the (curved) plate and configured to receive light from the set of emitters. Ex. 1002, ¶187.

Thus, Cheng in view of Han discloses claim 7(e). *Id.*, ¶188.

- (f) **“a frame assembly, the frame assembly comprising: a first frame element configured to support the display panel; and”**

Cheng discloses this element. *Id.*, ¶189. Cheng discloses a frame 20 with protrusion 24 and a support 50. Ex. 1004, [0007-8]. “[T]he support and the protrusion together clamp the touch panel.” *Id.*, [0008]. As depicted in Fig. 1 of Cheng, the support 50 supports the display panel of the touch panel 10. *Id.*, Fig. 1; Ex. 1002, ¶188.



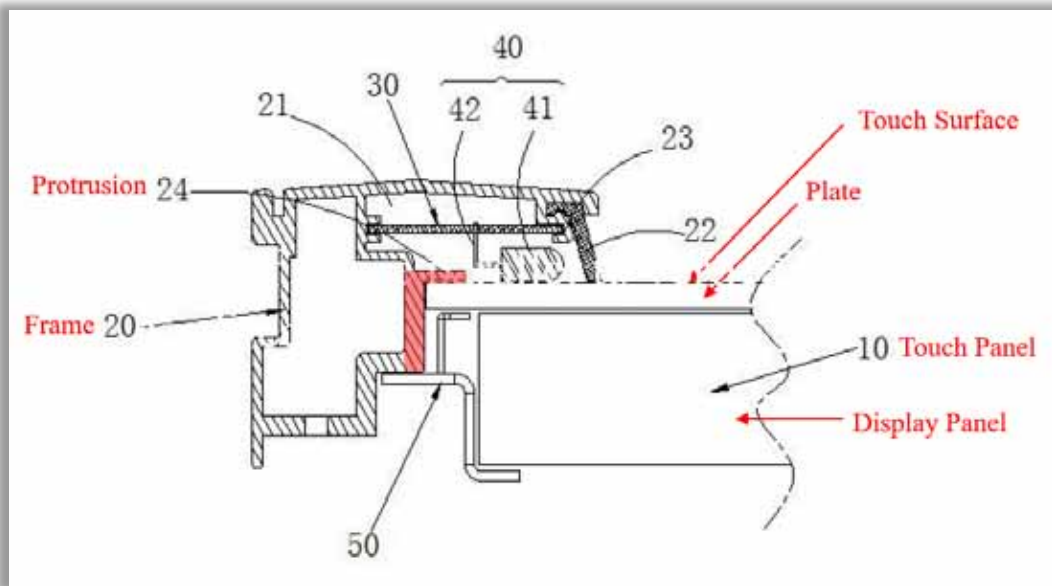
Ex. 1004, Fig. 1.

Thus, Cheng discloses claim 7(f). Ex. 1002, ¶190.

- (g) “a second frame element arranged around at least a portion of the periphery of the plate, the second frame element having a first portion extending along an edge of the plate and a second portion opposed to the touch surface;”

Cheng discloses this element. *Id.*, ¶191. 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 and at least in accordance with Patent Owner’s construction of “opposed” depicted in co-pending

litigation, Cheng's protrusion 24 is opposed to the touch surface of the plate. *Id.*, Fig. 1; see Ex. 1019, 203; Ex. 1002, ¶191.



Ex. 1004, Fig. 1.

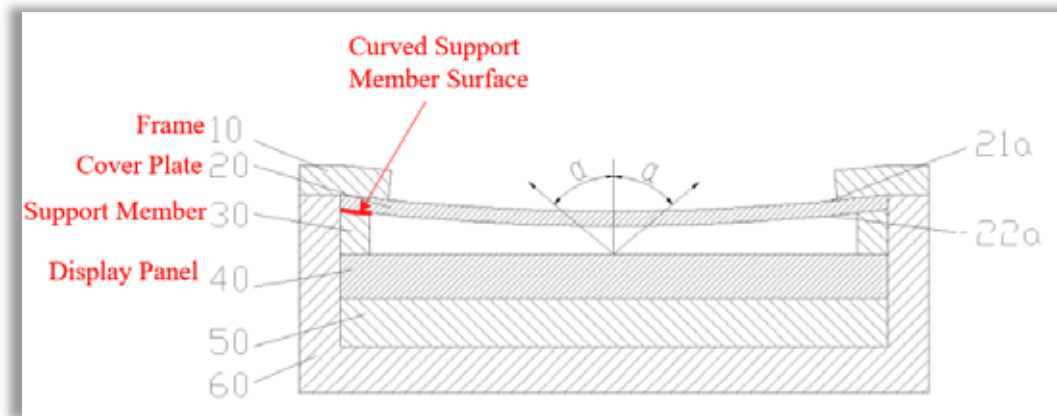
Thus, Cheng discloses claim 7(g). Ex. 1002, ¶192.

- (h) “wherein the plate has a first curvature in the touch surface when not installed in the frame assembly, and wherein the plate has a second curvature along the width and along the length in the touch surface when the plate is installed in the frame assembly, said second curvature is parabolic; and”

Cheng in view of Han and Zhao discloses this element. *Id.*, ¶193. As explained above in an embodiment of the modified Cheng device, the pre-installed plate has an initial curvature according to the well-known material property of pre-installed stock glass. See Exs. 1023, 1024, 1025, 1026; see also., Ex. 1001, 2:5-9; Ex. 1002, ¶193. As

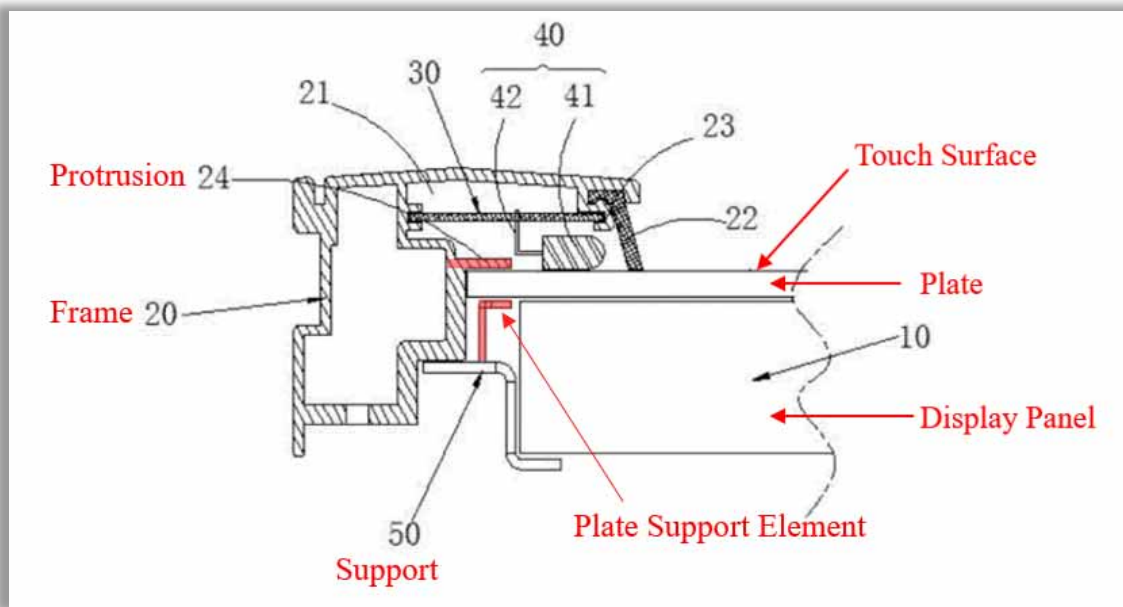
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the plate is assembled into Cheng's modified curved plate support elements and protrusions 24 according to Zhao's simplified configuration for inducing plate curvature, a bending force is applied to the plate. See Ex. 1012, [0050]; Ex. 1002, ¶193.



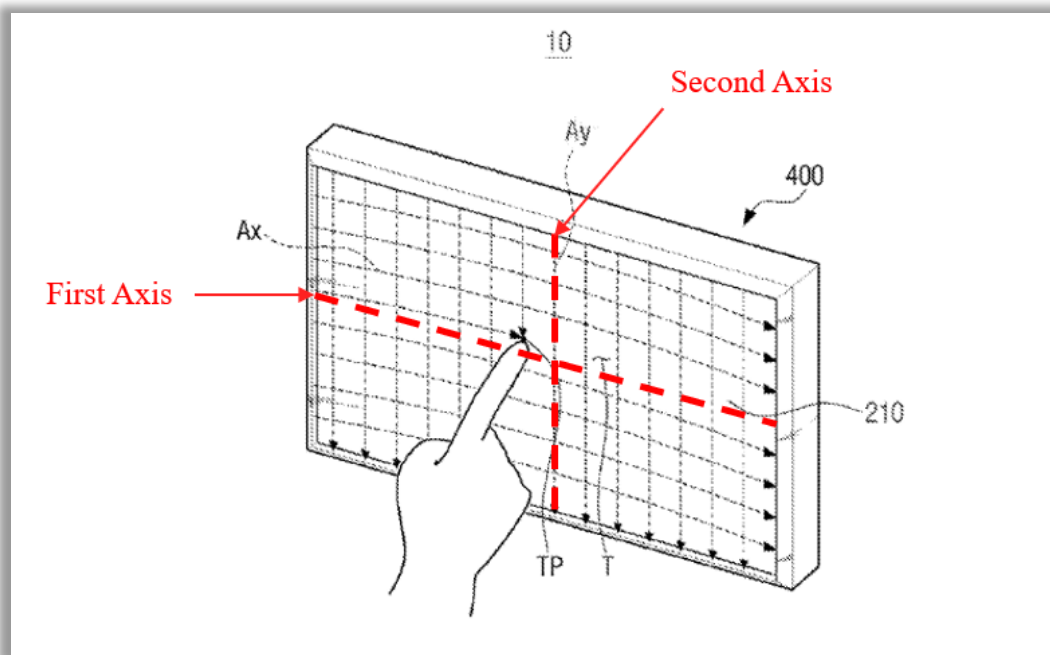
Ex. 1012, Fig. 1.

Cheng's resulting modified plate is curved into a second curvature greater than the first curvature based on the slope of the plate support elements along both Ax and Ay directions. Ex. 1002, ¶194.



Ex. 1004, Fig. 1.

According to Han's touch detection accuracy improving plate curvature, the induced second curvature of Cheng's modified plate would be parabolic and would comprise a first axis component along the length of the plate (A_x) and a second axis component along the width plate (A_y). *Id.*; Ex. 1002, ¶195



Ex. 1005, Fig. 2.

Thus, Cheng in view of Han and Zhao discloses claim 7(h). Ex. 1002, ¶196.

(i) “wherein the first curvature is concave.”

Cheng in view of Han and Zhao discloses this element. *Id.*, ¶197 A POSA would have understood the pre-installed plate to have an initial curvature according to the well-known material property of pre-installed stock glass. See Exs. 1023, 1024, 1025, 1026; *see also*, Ex. 1001, 2:5-9; Ex. 1002, ¶197. A POSA would have further understood this pre-installed curvature to be categorized as “bow,” in which the edges and/or corners of the stock glass curve away from a center point of the glass, equating to a concave (or convex depending on observation orientation) curvature. Ex. 1002, ¶197. Where the edges and/or corners of pre-installed glass curve upwards and away from a center point

relative to a staged Cheng's frame 20, a POSA would have understood the first curvature of the plate to be concave. *Id.*, ¶197.

Thus, Cheng discloses claim 7(i). *Id.*, ¶198.

- 8. Claim 8: “The touch sensing apparatus of claim 7, further comprising a processing element configured to determine, based on output signals of the set of detectors, a position of an object proximate to the touch surface.”**

Cheng in view of Han discloses this element. *Id.*, ¶199. 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]. The IC “modif[ies] an analog signal transmitted from a touch detecting unit into a digital signal and chang[es] the signal to a form of a coordinate which can be displayed on the screen...” *Id.*, [0013]. 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. 1002, ¶199.

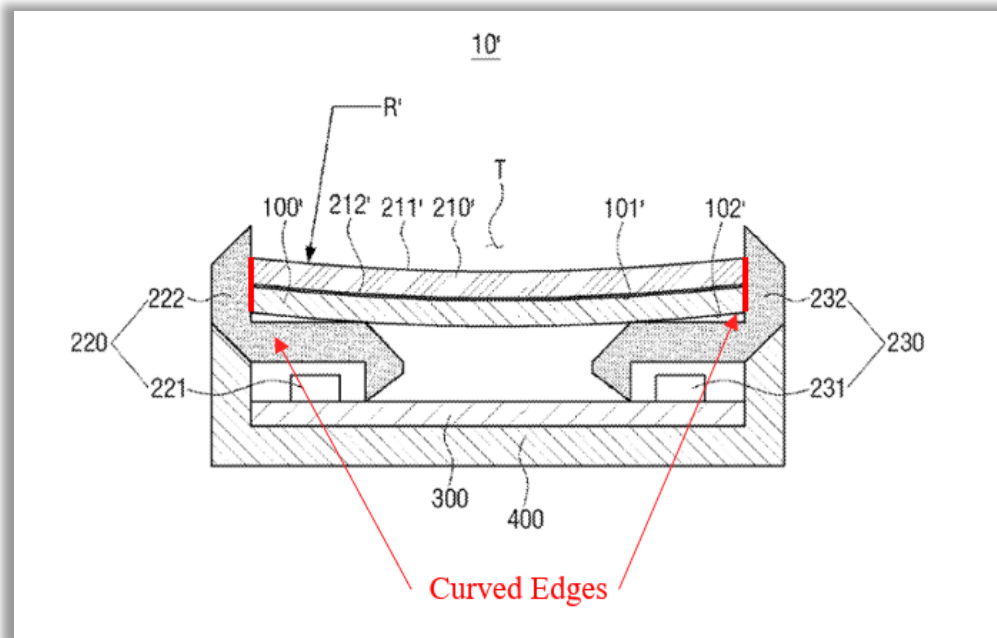
A POSA would have understood Cheng to include a processing element—embodied in Cheng's circuit board 30 or otherwise—for determining a touch location

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. *Id.*, ¶200. Han's teaching of the same confirms as much. *Id.*; Ex. 1005, [0012-13].

Thus, Cheng in view of Han discloses claim 8. Ex. 1002, ¶201.

9. Claim 9: “The touch sensing apparatus of claim 7, wherein the first curvature and second curvature are measured along an edge of the plate.”

Cheng in view of Han and Zhao discloses this element. *Id.*, ¶202.



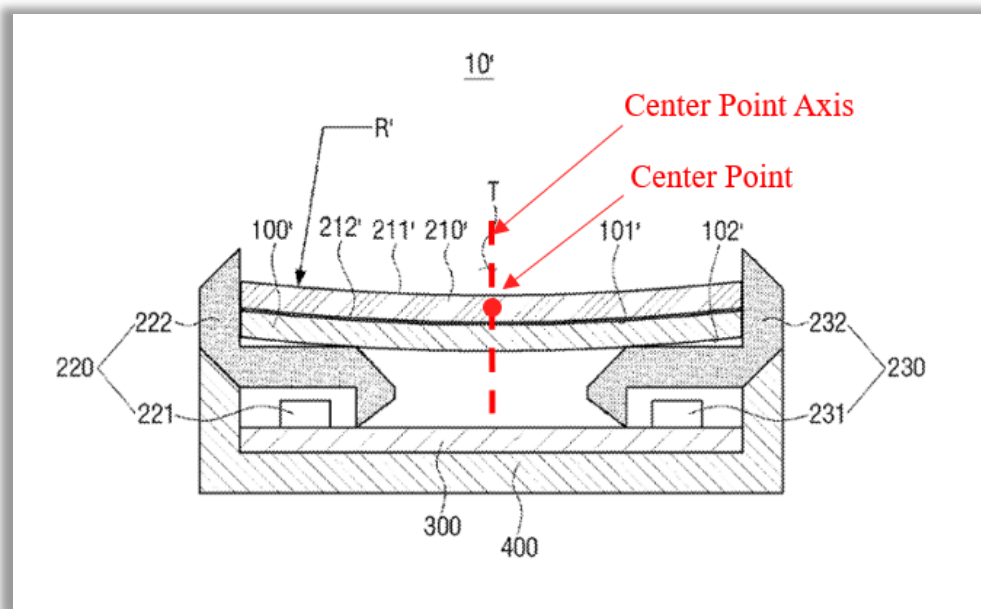
Ex. 1005, Fig. 7.

For at least the same rationale laid out above for Claim 4, Cheng in view of Han and Zhao discloses the first curvature and second curvature are measured along an edge

(edges of Cheng's modified plate curved along Ax and Ay directions according to Han) of the plate (Cheng's plate of touch panel 10). Ex. 1002, ¶203.

- 10. Claim 10: “The touch sensing apparatus of claim 7, wherein the first curvature and second curvature are measured along an axis passing through a center point of the plate.”**

Cheng in view of Han discloses this element. *Id.*, ¶204.

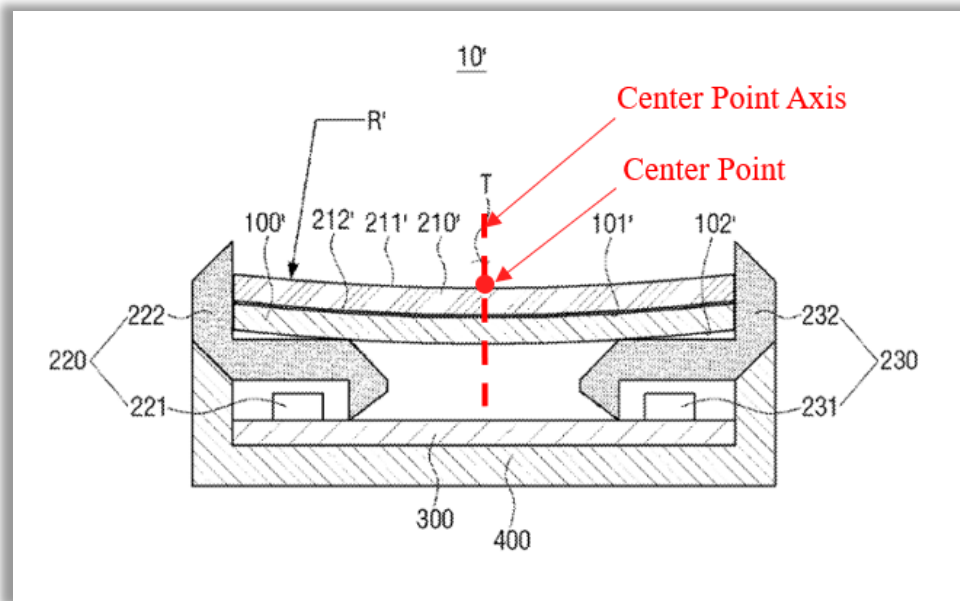


Ex. 1005, Fig. 7.

For at least the same rationale laid out in Claim 5 above, Cheng in view of Han discloses the first curvature and second curvature are measured along an axis (center point axis passing through Cheng's modified plate) passing through a center point (center point of Cheng's modified plate) of the plate. Ex. 1002, ¶205.

11. **Claim 11: “The touch sensing apparatus of claim 7, wherein the first curvature and second curvature are measured along a line passing through a point on the touch surface.”**

Cheng in view of Han and Zhao discloses this element. *Id.*, ¶206.

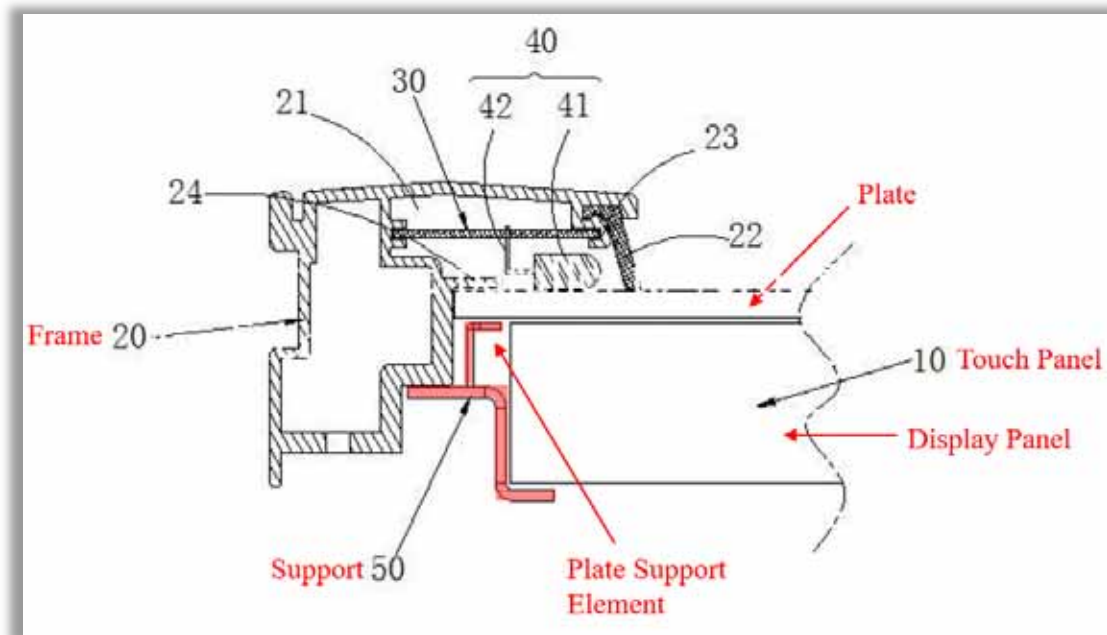


Ex. 1005, Fig. 7.

For at least the same rationale laid out in Claim 6 above, Cheng in view of Han discloses the first curvature and second curvature (Cheng’s modified pre-installed curvature and curved plate in Ax and Ay direction) are measured along a line passing through a point (axis passing through center point of Cheng’s modified plate) on the touch surface (surface of Cheng’s modified plate). Ex. 1002, ¶207.

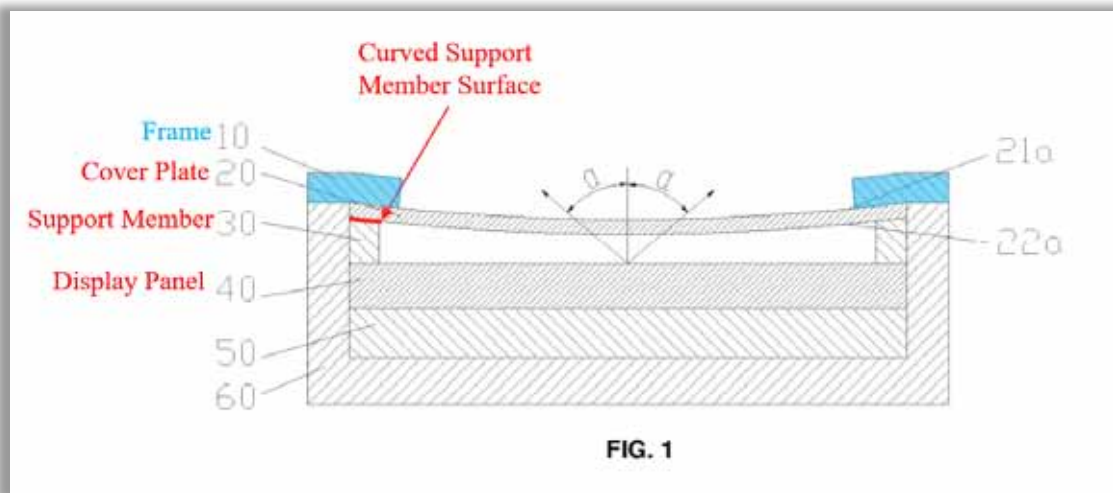
12. **Claim 12: “The touch sensing apparatus of claim 7, further comprising a gasket, wherein the plate is supported by the gasket proximate to an edge of the plate.”**

Cheng in view of Zhao discloses this element. *Id.*, ¶208. Discussed above, Cheng’s support 50 includes a plate support element. Ex. 1004, Fig. 1. The plate support element supports the plate proximate to an edge of the plate. *Id.*



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 induce curvature into the plate with a simplified process by applying a bending force near the edge of the plate during installation. Ex. 1002, ¶209.



Ex. 1012, Fig. 1.

A POSA would have understood Zhao’s support member 30 to have the same function as a “gasket” as described in the ’935 Patent. Ex. 1002, ¶210. As the ’935 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. 1001, 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].

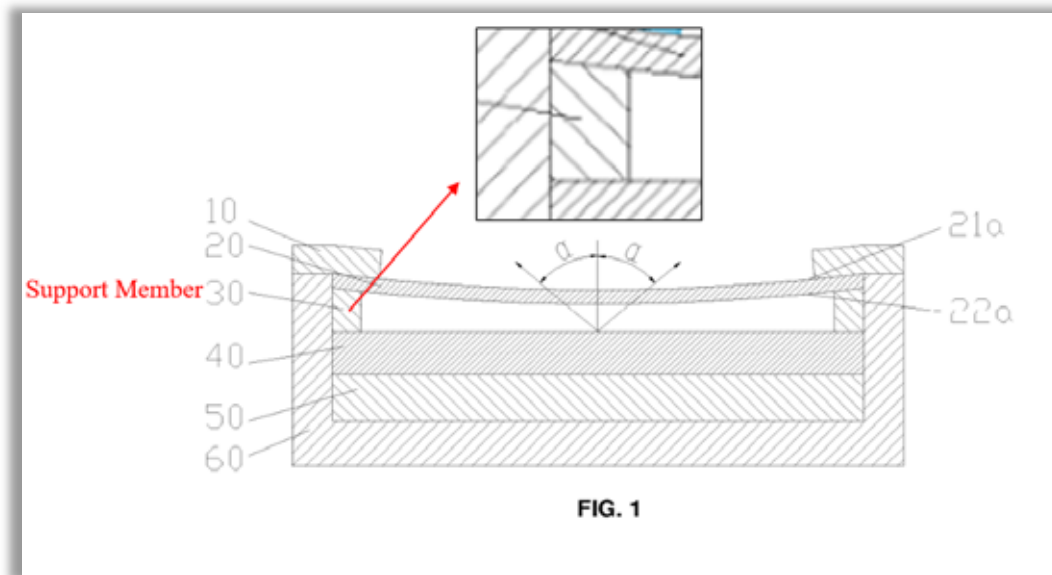
A POSA would have expected to achieve Zhao’s curvature-inducing gasket function by modifying Cheng’s plate support element according to Zhao’s curved

support member 30. Ex. 1002, ¶211. Like Zhao, Cheng's modified plate support element would support the plate proximate to an edge of the plate. *Id.*

Thus, Cheng in view of Zhao discloses claim 12. *Id.*, ¶212.

13. Claim 13: “The apparatus of claim 12, wherein the gasket is configured to have varying thickness to match a curvature of the plate along the edge.”

Cheng in view of Zhao discloses this element. *Id.*, ¶213. Zhao's support member has a varying thickness that matches the curvature of the plate along its edge. Ex. 1012, [0055], Fig. 1.



Ex. 1012, Fig. 1, portion enlarged.

As Zhao explains, “the shape of the surface of the support member 30 in contact with the cover plate 20 matches with that of the cover plate.” *Id.*, [0055]. In other words, the thickness of the support member 30 closest to the edge of the curved cover

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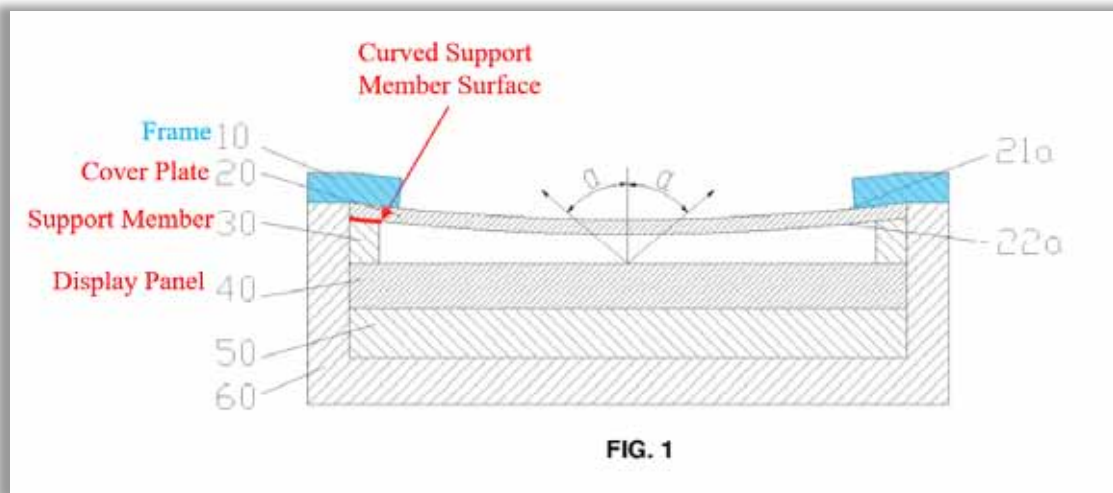
plate 20 is greater than the thickness closest to the center of the curved cover plate 20. *See id.*, at Fig. 1; Ex. 1002, ¶214. Discussed above, the varying thickness of Zhao’s the support member 30 induces curvature in the cover plate in a simplified process during installation. *Id.*; *See* Ex. 1012, [0050].

By modifying Cheng’s plate support element to have Zhao’s support member 30’s thickness variation in relation to the curvature of the plate, a POSA would have expected to achieve the Zhao’s simplified curvature inducing functionality in Cheng’s modified plate support member. Ex. 1002, ¶215.

Thus, Cheng in view of Zhao discloses claim 13. *Id.*, ¶216.

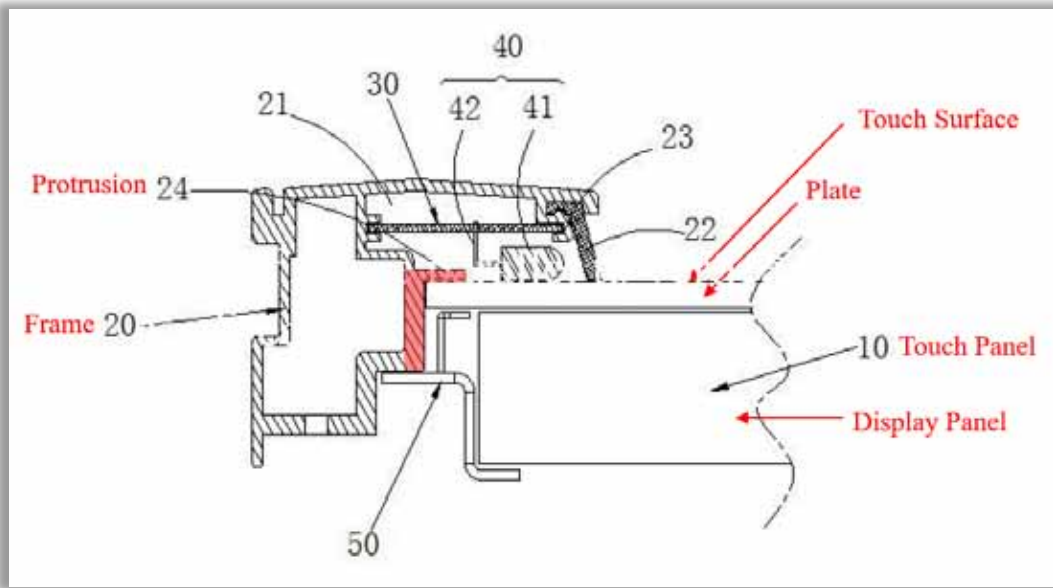
14. Claim 14: “The apparatus of claim 7, wherein the second frame element is curved.”

Cheng in view of Zhao discloses this element. *Id.*, ¶217. As discussed above, the frame 10 of Zhao is curved according to the curvature of the cover plate 20. Ex. 1012, [0052]. A POSA would have understood Zhao’s frame curvature to both “prevent structure loosening” and aid in inducing curvature in the cover plate 20 when the cover plate 20 is “squeezed” during Zhao’s simplified installation process.. *See, id.*, [0050-52]; Ex. 1002, ¶217.



Ex. 1012, Fig. 1.

In the modified Cheng device, the frame 20 with protrusion 24 would also be curved according to Zhao's frame 10. Ex. 1002, ¶218. A POSA would have expected such curvature to achieve the same structure reinforcement and simplified plate curvature inducement function of Zhao's frame 10. *Id.* In other words, the second frame element (Cheng's modified frame 20 with protrusion 24) in the modified Cheng device is curved. *Id.*



Ex. 1004, Fig. 1.

Thus, Cheng in view of Zhao discloses claim 14. Ex. 1002, ¶219.

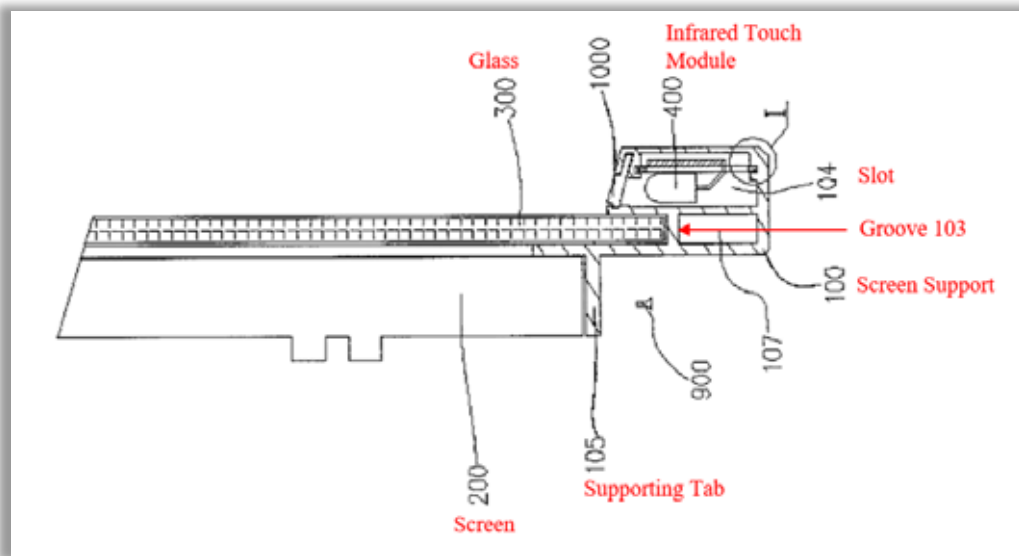
C. Ground 2 – Claims 1-11 and 14 are obvious under 35 U.S.C. § 103 based on Cao in view of Han and Shin.

Cao in view of Han and Shin renders claims 1-11 and 14 obvious. Specifically, and as detailed below, 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 Shin. Ex. 1002, ¶220. A POSA would have expected a resulting improved touch screen display device achieved through a simplified manufacturing process. *Id.*

Motivation to Combine

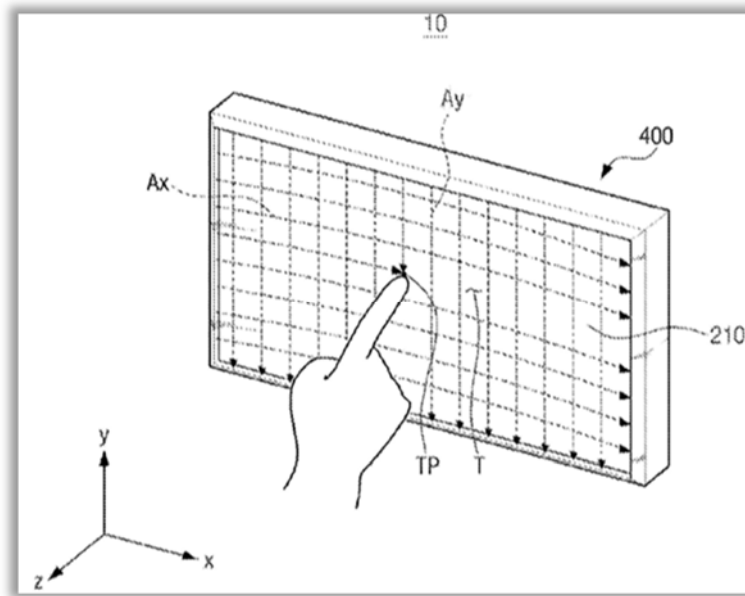
A POSA would have been motivated to modify the touch device of Cao using the glass curvature inducing frame teachings of Shin to obtain the technical advantages of Han's parabolically curved touch surface. Ex. 1002, ¶221. Cao, Han, and Shin each relate to similar touch-sensing devices including a display, a covering panel touch surface, and a supporting frame assembly. *Id.*; See Ex. 1005, Abstract; Ex. 1011, Abstract; Ex. 1010, Abstract.

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 (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 specifically discloses infrared light touch detection configurations, while leaving certain implementation details to the reader. Ex. 1002, ¶222.



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. 1002, ¶223.

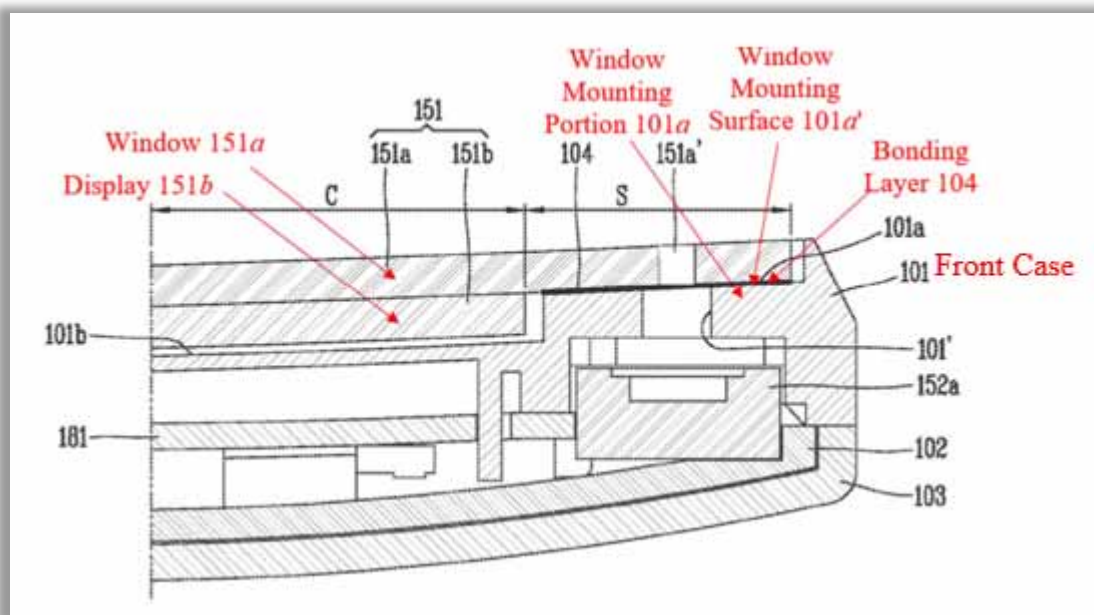


Ex. Han, Fig. 2.

Han teaches that its concave curvature of front surface 211 of cover glass 210 provides advantages over a flat cover glass 210, such as a reduced amount of light lost by reflection and an increased amount of light received at light reception guide member 232, which enhance the accuracy of touch recognition. *See id.*, [0082-83], [0085-86]; Ex. 1002, ¶224.

As another example, where Cao does not explicitly disclose that its infrared touch modules 400 comprise a plurality of infrared emitters and detectors, Han provides details on how a POSA would implement such an touch module 400 using a plurality of LEDs 221 (emitters) and photo diodes 231 (detectors). *Id.*, [0040-43]; Ex. 1002, ¶225.

While Han discloses the advantages of using a curved touch surface compared to a flat surface, Han leaves some details on implementing that curvature to the reader. Shin fills in those details. 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, 3:4058, 10:45-49; Ex. 1002, ¶226.

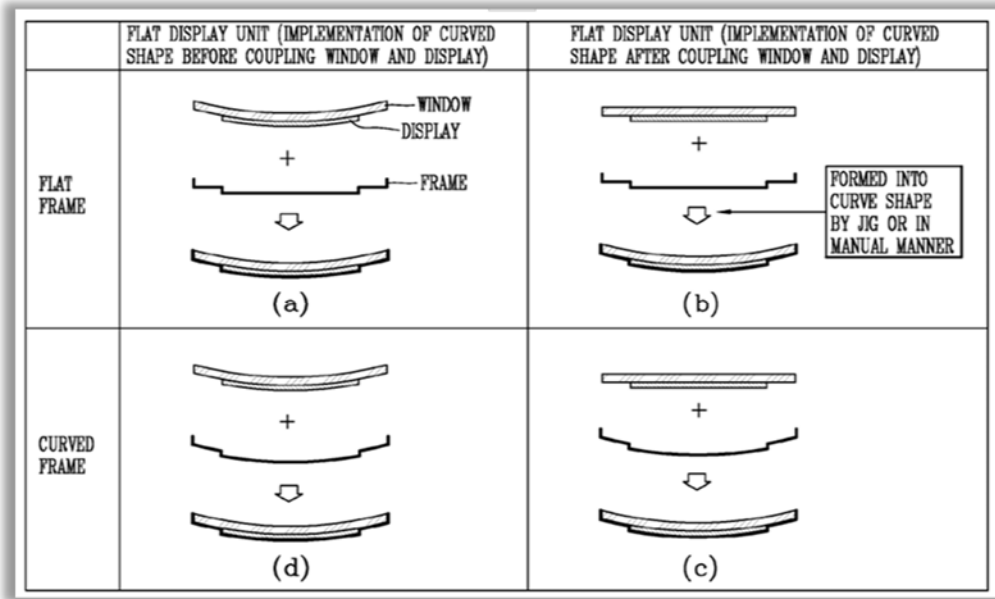


Ex. 1011, Fig. 5.

As shown above, the 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 explains, “when the window 151a is mounted onto the mounting surface, the bending force may be

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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. 1002, ¶228.



Ex. 1011, Fig. 4.

Shin teaches 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. 1002, ¶229.

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A POSA would have been motivated to combine the teachings of Cao and Han for a variety of reasons. Ex. 1002, ¶230. For example, Cao specifically discloses infrared light touch detection configurations, while leaving certain implementation details to the reader. To the extent Cao does not explicitly disclose that its infrared touch modules 400 comprise a plurality of infrared emitters and detectors, it would have been obvious to a POSA to incorporate Han's plurality of LEDs 221 (emitters) and photo diodes 231 (detectors) into Cao's infrared touch module 400. *Id.* Some type of emitter/detector arrangement would be required in Cao to provide its "all-in-one smart tablet PC" having an infrared module for touch detection. *Id.*; Ex. 1010, Abstract, 1:17-19. Implementing that infrared module using "a plurality of infrared emitters and detectors" would have been an obvious design choice, as evidenced by Han. Ex. 1002, ¶230. Such modification of Cao would yield the predictable result of achieving Han's infrared touch-sensing functionality. *Id.* Corroborating this, the '935 Patent acknowledges it is well known in the prior art to arrange a plurality of emitters and detectors around the periphery of the plate in order to enable touch-sensing functionality. *See, e.g.*, Ex. 1001, 1:26-46, 15:62-16:3.

Additionally, a POSA would have been motivated to incorporate the teachings of Han and Shin into the disclosure of Cao to provide the curved-touch-surface benefits that Han and Shin that can be realized in an infrared touch detection implementation,

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like Cao's. Ex. 1002, ¶231. Starting with the infrared touch device of Cao, a POSA would have expected to improve touch detection accuracy by incorporating the parabolically curved plate teachings of the infrared touch device in Han. *Id.* Incorporating Han's plate curvature into Cao would have been obvious, as Cao discloses—as a baseline—affecting the curvature of the plate (four rising corners) to improve quality. *Id.*; See Ex. 1010, 4:13-19. Thus, Han's parabolic plate curvature would merely be an obvious iterative progression of Cao's plate curvature tuning; affecting curvature of the entire plate (Han), rather than just four rising corners (Cao). Ex. 1002, ¶231.

To achieve Han's parabolic plate curvature in device of Cao, 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'. Ex. 1002, ¶232. As the frame in Cao already includes a groove 103 and groove wall 112 for supporting the plate, it would have been obvious for POSA to modify Cao by curving the groove wall 112 according to the curved frame mounting surface 101a' of Shin. *Id.* A POSA would have expected such modification to achieve the same simplified curvature-inducing functionality of Shin in the modified Cao device. *Id.*

Thus, a POSA combining the teachings of Han and Shin into the device of Cao would have expected to achieve the predictable result of high touch detection accuracy

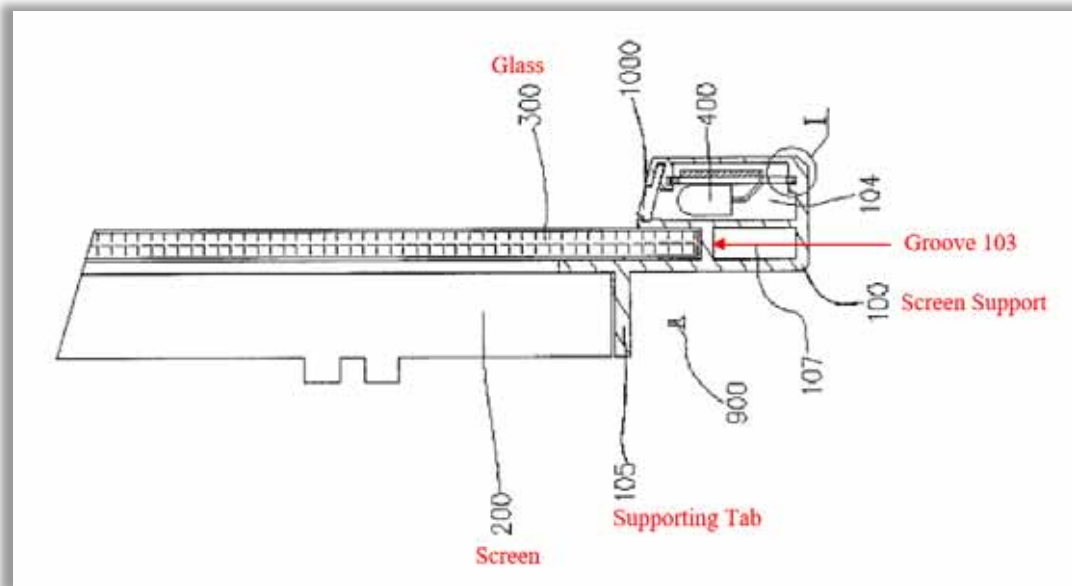
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(Han) infrared touch device (Cao, Han, Shin) and manufacturing method (Cao, Han, Shin) meeting the limitations of the '935 Patent. Such modifications would have merely embodied known techniques to improve a similar device in a similar way. *Id.*, ¶233.

1. Claim 1

(a) Preamble

Cao discloses this element. *Id.*, ¶234. Cao discloses a method of assembling a touch sensing apparatus including a display panel (screen 200), a plate including a touch surface (glass 300) and a frame assembly (screen support 100). *See* Ex. 1010, Abstract.

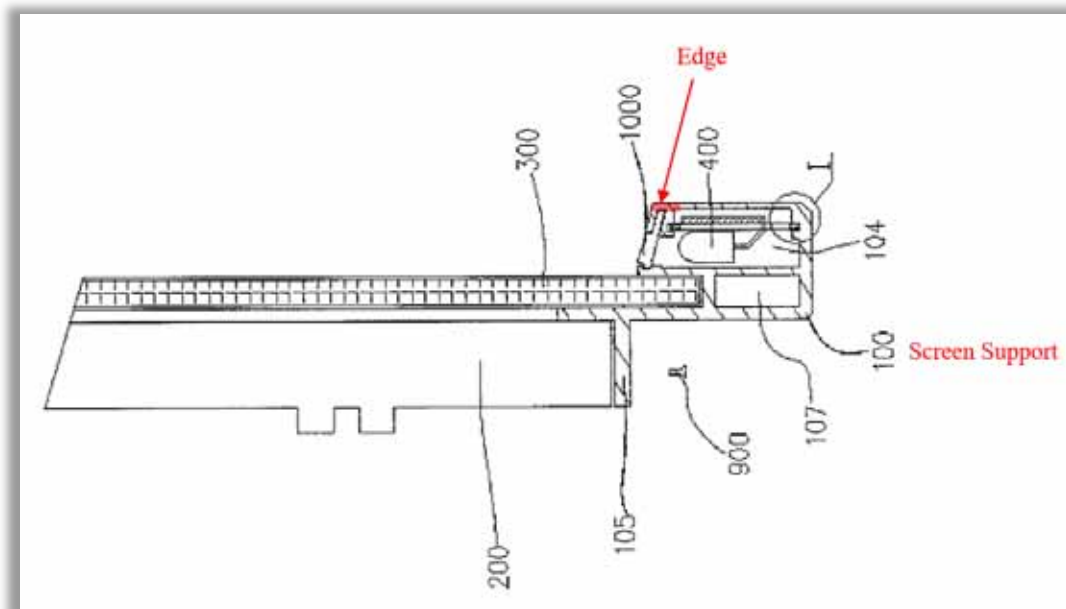


Ex. 1010, Fig. 9.

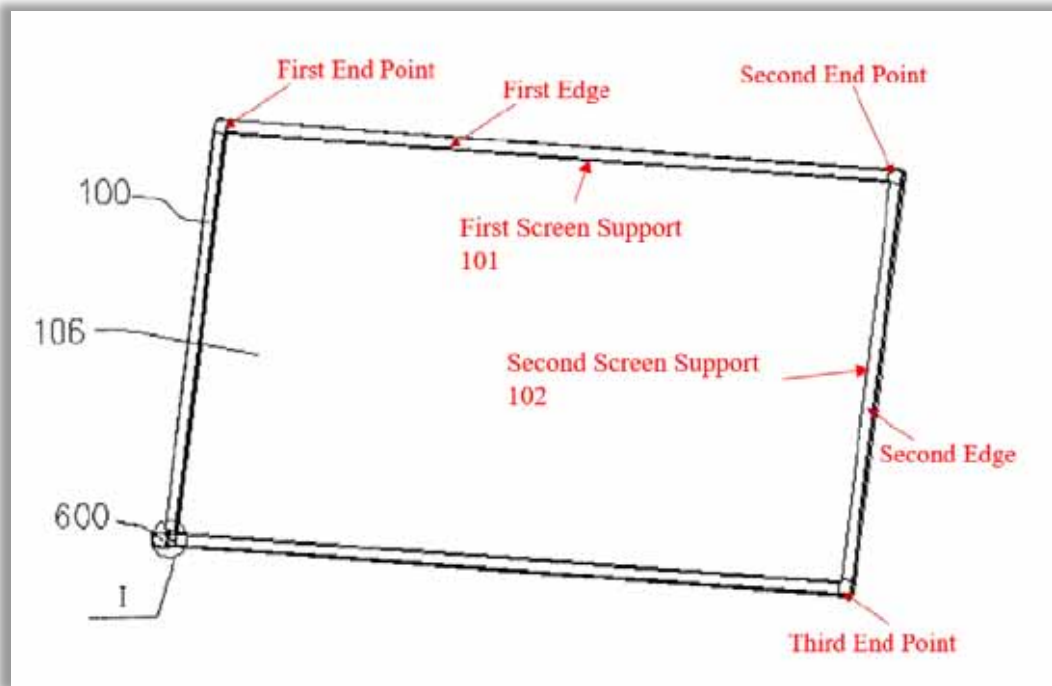
Thus, Cao discloses claim 1's preamble. Ex. 1002, ¶235.

(b) Claim 1(b)

Cao discloses this element. *Id.*, ¶236. Cao's frame assembly 100 includes a first edge extending between a first end point and an opposite second end point and a second edge extending between the second end point and a third end point.



Ex. 1010, Fig. 9.



Ex. 1010, Fig. 14.

Cao explains:

...[T]he screen support 100 may include a first screen support 101 and a second screen support 102. The first screen support 101 is provided on its each end with a corner cover seat 700, the second screen support 102 is provided on its each end with a recess 107, and one end of the corner cover seat 700 is provided with a protrusion 800 matching first fitting opening 120, with the corner cover 600 mounted on the corner cover seat 700. The corner cover seat 700 is

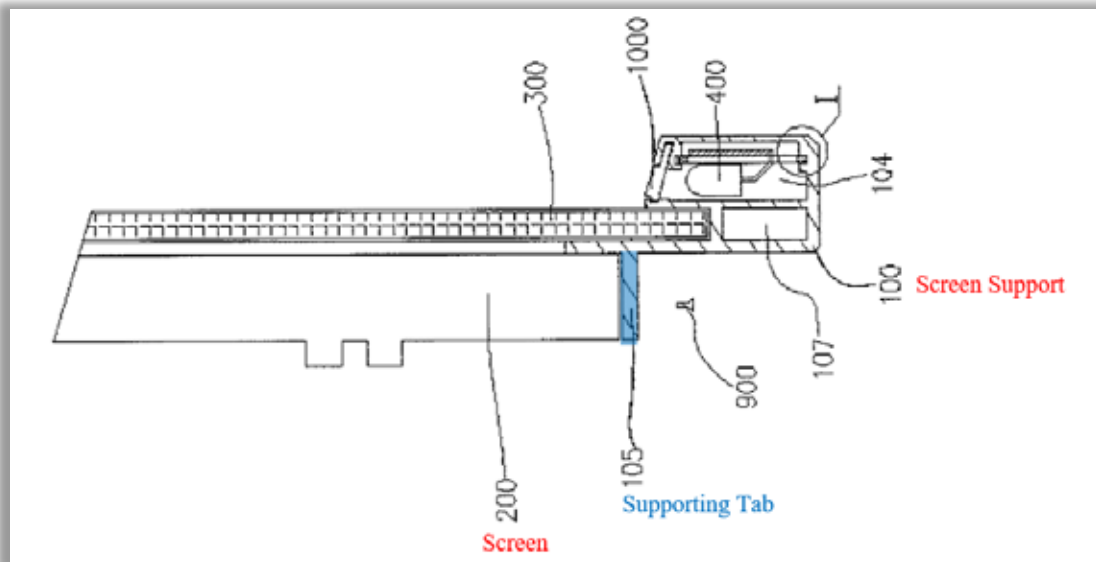
integral with the first screen support 101, which is easy to use with less components, improving the assembly efficiency.

Ex. 1010, 4:41-58.

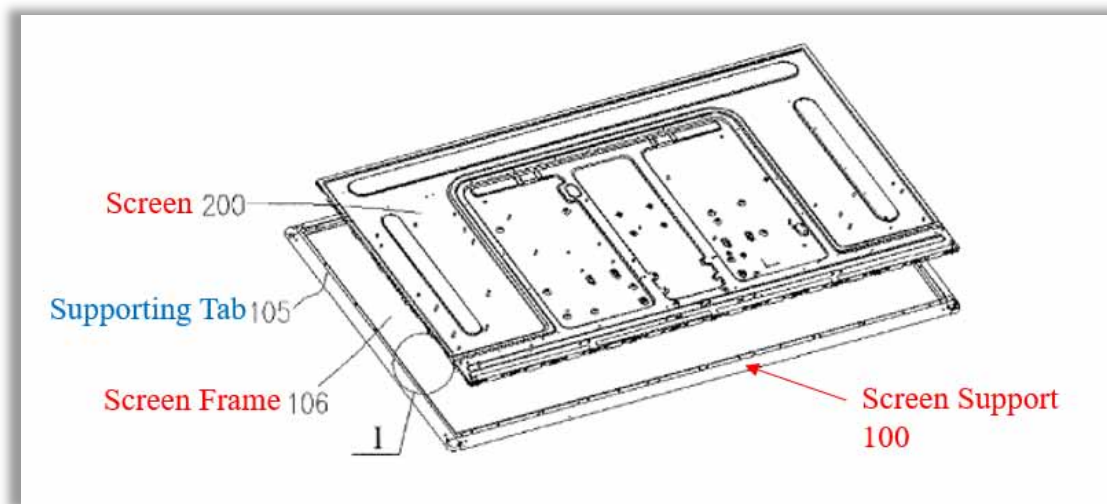
Thus, Cao discloses claim 1(b). Ex. 1002, ¶239.

(c) Claim 1(c)

Cao discloses this element. Ex. 1002, ¶240. Cao's frame assembly comprises four screen supports 100 that each include a supporting tab 105 that together form a screen frame 106. Ex. 1010, 4:7-12. Cao explains that "[t]he screen support 100 is provided on one side with a supporting tab 105, with each supporting tab 105 of the respective screen support 100 forming a screen frame 106 by joining together end to end. The screen 200 is mounted onto the screen frame 106..." Ex. 1010, 4:7-12.



Ex. 1010, Fig. 9.

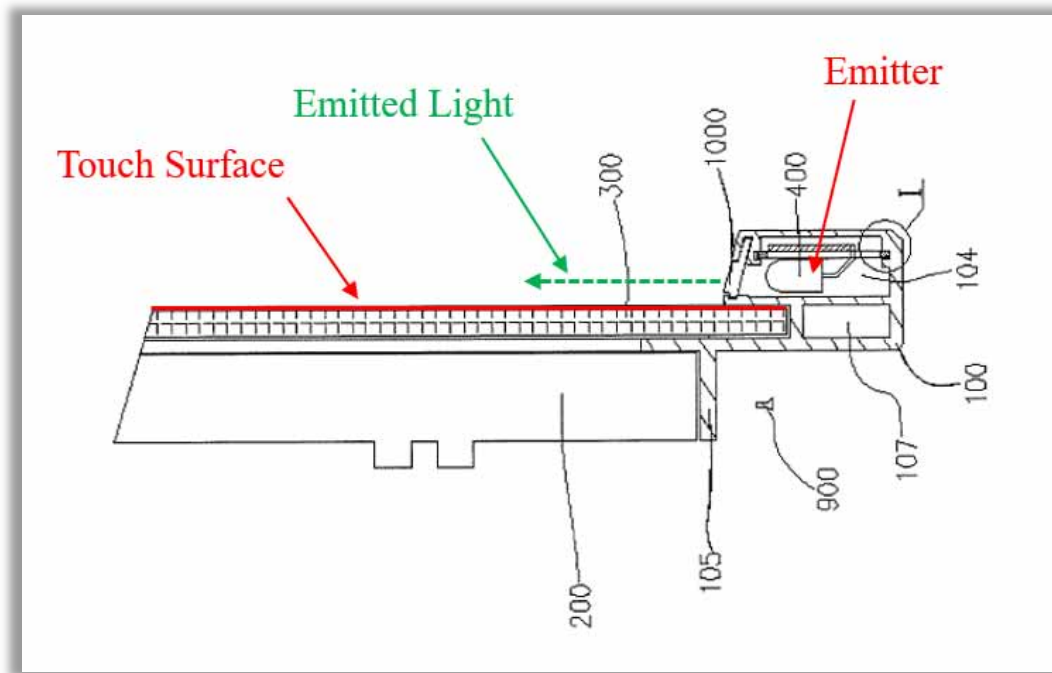


Ex. 1010, Fig. 3.

Thus, Cao discloses claim 1(c). Ex. 1002, ¶241.

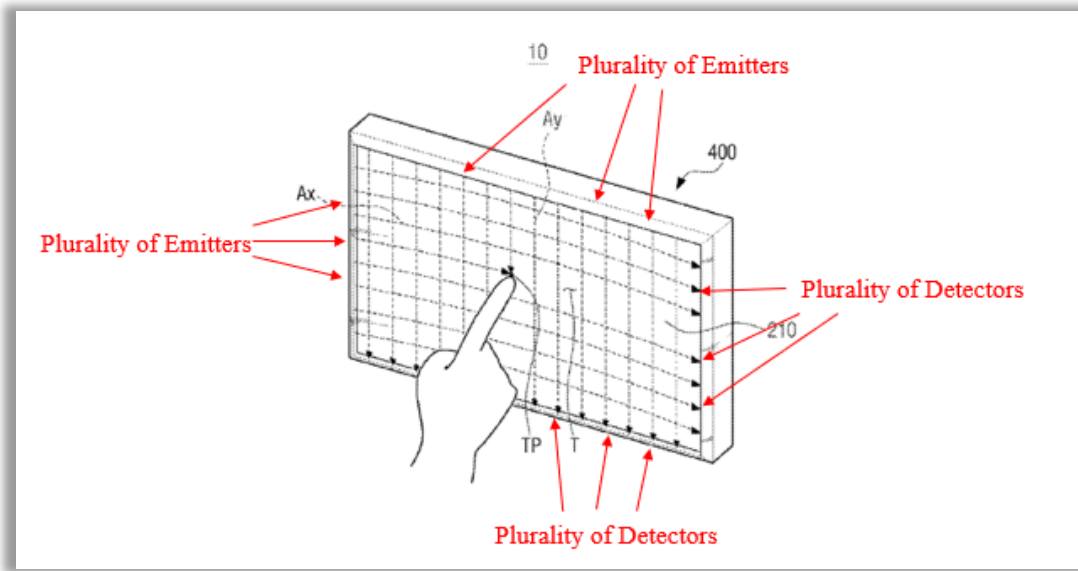
(d) Claim 1(d)

Cao in view of Han discloses this element. Ex. 1002, ¶242. 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 touch modules 400,” a POSA would have understood infrared touch modules to disclose an emitter. Ex. 1002, ¶242.



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. Ex. 1002, ¶243. 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. *Id.*; Ex. 1005, [0040]; Ex. 1001, 1:26-46, 15:62-16:3.



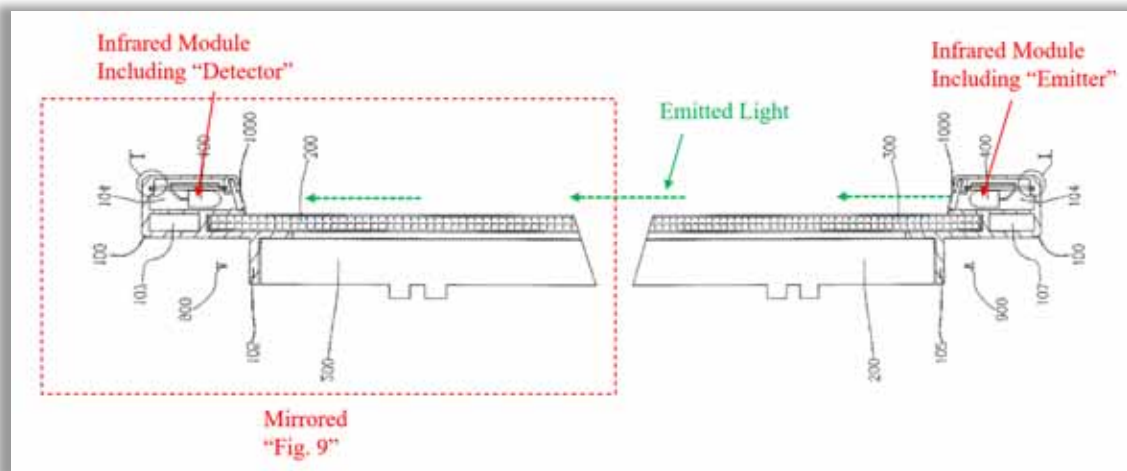
Ex. 1005, Fig. 2.

A POSA would have expected such a modification to Cao to yield the predictable touch-sensing functionality of Han and the similar devices known in the prior art. Ex. 1002, ¶244.

Thus, Cao in view of Han discloses claim 1(f). *Id.*, ¶245.

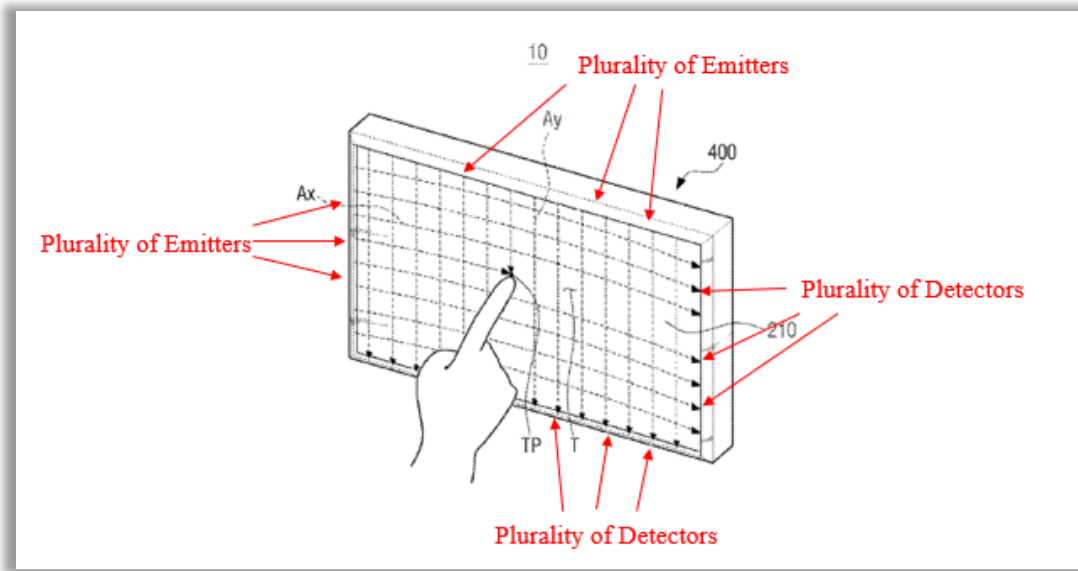
(e) Claim 1(e)

Cao in view of Han discloses this element. *Id.*, ¶246. While Cao only describes “infrared touch modules 400,” a POSA would have understood infrared touch modules 400 to disclose a detector. *Id.* 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. *Id.*



Ex. 1010, Fig. 9.

As discussed above for claim 1(d), it would have been obvious to a POSA to include a plurality of detectors according to Han. Ex. 1002, ¶247. 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. *Id.*; Ex. 1005, [0040]; Ex. 1001, 1:26-46, 15:62-16:3.

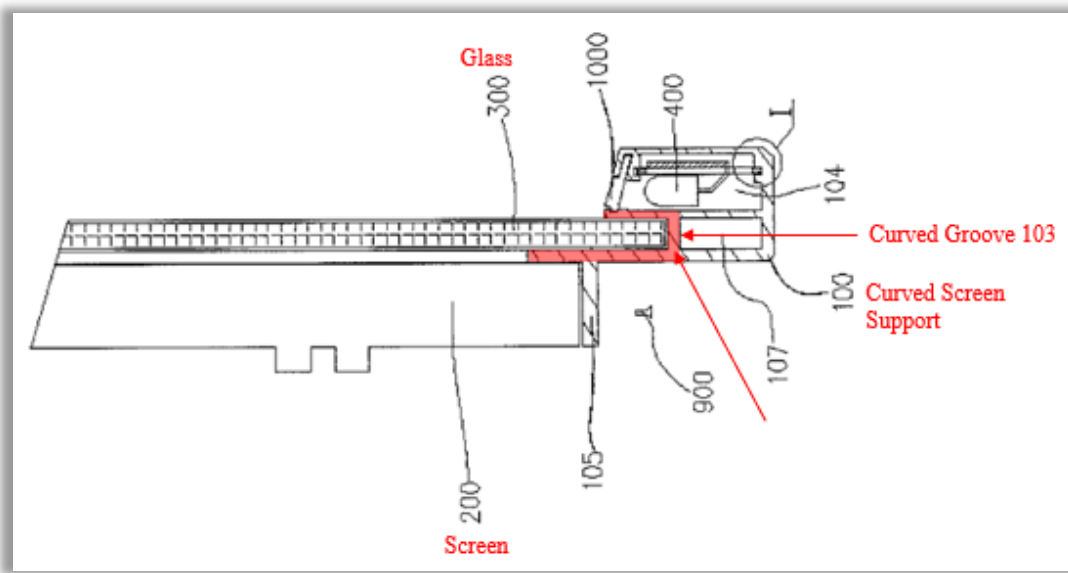


Ex. 1005, Fig. 2.

Thus, Cao in view of Han discloses claim 1(e). Ex. 1002, ¶248.

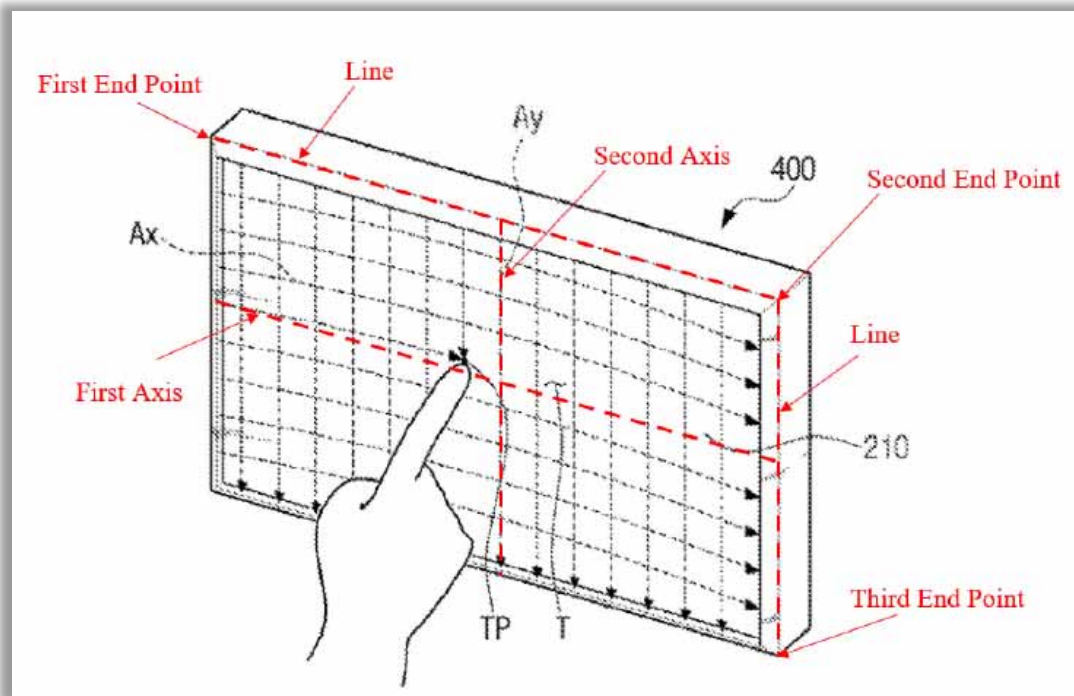
(f) Claim 1(f)

Cao in view of Han and Shin discloses this element. *Id.*, ¶249 Cao's frame assembly with screen supports 100 include a plurality of grooves 103 which position (support) the glass 300. Ex. 1010, 4:13-16. Cao teaches that the grooves 103 of the frame assembly are used to control the curvature of the glass 300. *Id.*, 4:13-19. As discussed above, it would have been obvious to a POSA to modify Cao's glass 300 to incorporate Han's parabolic touch screen curvature along Ax and Ay directions to improve touch detection accuracy. Ex. 1002, ¶249. To reach Han's touch screen curvature, it would have been obvious to a POSA to modify each of Cao's screen supports 100 and grooves 103 according to the curved mounting surfaces 101a' of Shin.



Ex. 1010, Fig. 9.

As the glass 300 is assembled into the screen supports 100, the curved grooves 103 apply a bending force to the glass 300, which induces the glass 300 to curve according to the corresponding curvature of grooves 103 and screen support 100. Curved grooves 103 along the Ax axis would induce curvature along the Ay axis, and vice versa. As in Han, the resulting glass curvatures in the modified Cao glass 300 would be parabolic and would extend from one side of the touch surface of Cao's glass 300 to an opposite side thereof along a first Ax axis and along a second Ay axis perpendicular to the first. Ex. 1002, ¶251. The first axis would be parallel with a line between the first end point and the second end point, and the second axis would be parallel to a line between the second end point and the third end point. *Id.*

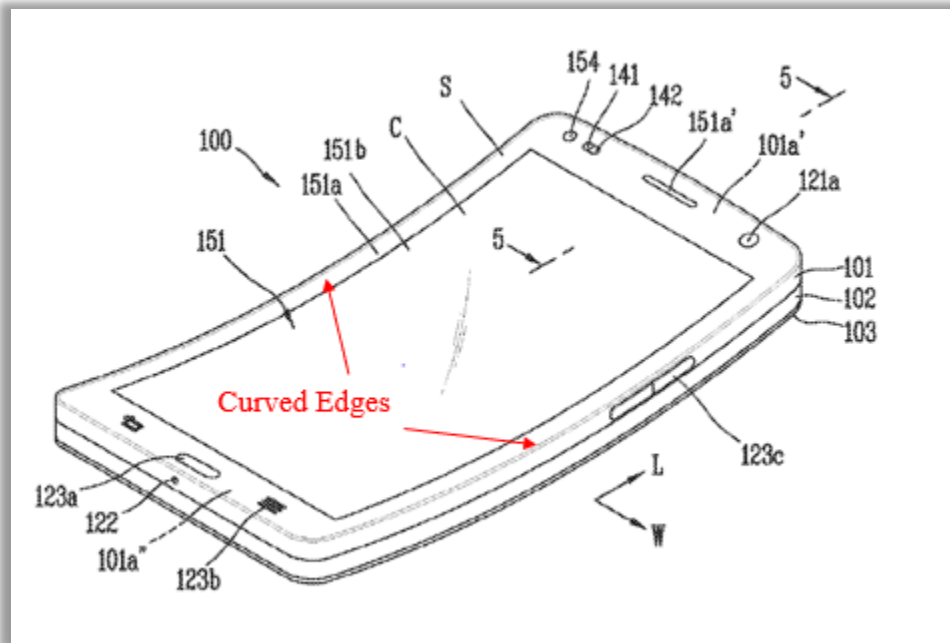


Ex. 1005, Fig. 2.

Thus, Cao in view of Han and Shin discloses claim 1(f). Ex. 1002, ¶252.

2. Claim 2

Cao in view of Han and Shin discloses this element. *Id.*, ¶253. The modified Cao device has a curved first edge and a curved second edge. *Id.* In an embodiment of the modified Cao device, each of the four screen supports 100 and grooves 103 are curved in the same manner as Shin's mounting surfaces described above. *Id.* Just as the length edges of Shin are curved, both the length and width edges of the modified Cao device would be curved, as each modified Cao support 100—which forms the edges—is curved along with grooved 103 to induce curvature in the plate. *Id.*

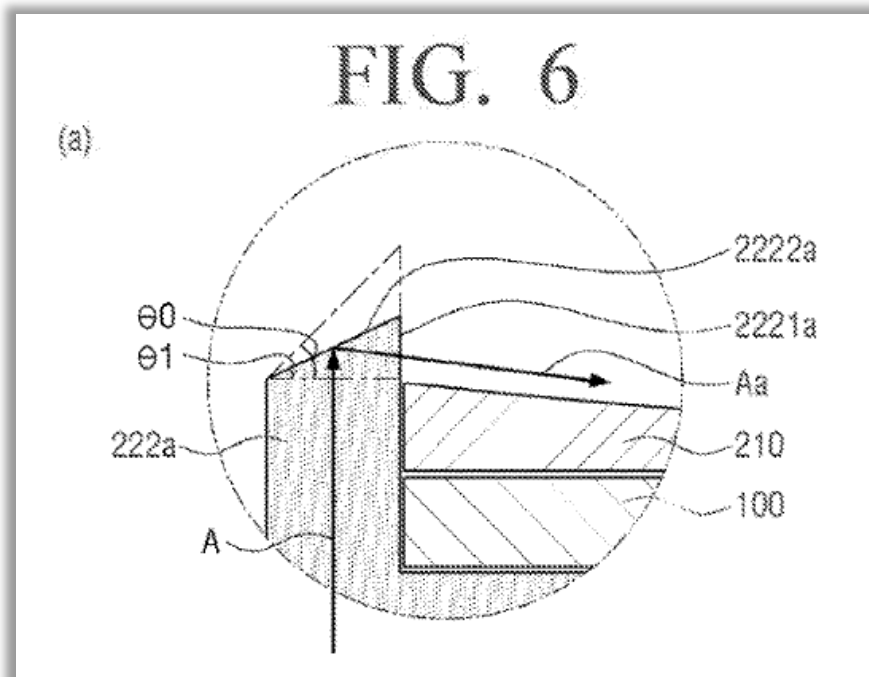


Ex. 1011, Fig. 2.

This modified embodiment would be consistent with Cao’s objective of preventing an “oversized gap between the glass 300 and the front frame cause by [curved glass 300].” See Ex. 1010, 4:16-19; Ex. 1002, ¶254. The curved edges of Cao’s modified screen supports 100 would also help prevent a gap between the frame supports 100 and the glass 300. Ex. 1002, ¶254.

Additionally, a POSA would have appreciated Cao’s infrared modules 400 housed in Cao’s modified curved screen supports 100 (having curved edges) to better project infrared light along the surface of the curved glass 300. *Id.*, ¶255. This configuration would have been obvious based on Han’s teaching of angling infrared light along the surface of Han’s curved screen 210 to reduce light loss and yield

improved touch recognition accuracy. Ex. 1002, ¶255; see Ex. 1005, [0106], Fig. 6; see KSR, 550 U.S., 417 (known techniques to improve a similar device in the same way).



Ex. 1005, Fig 6.

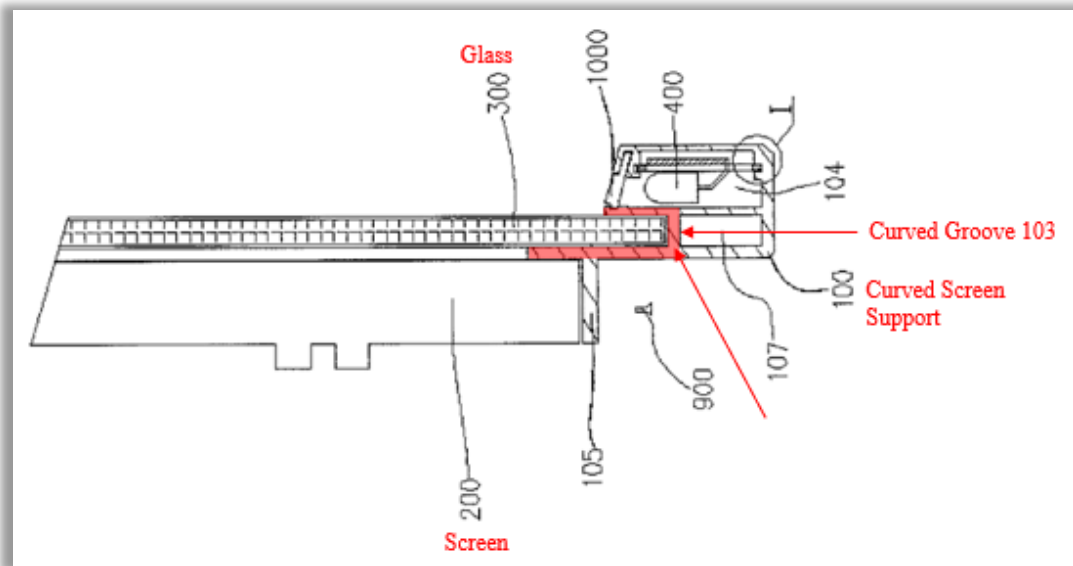
Thus, Cao in view of Han and Shin discloses claim 2. Ex. 1002, ¶256.

3. Claim 3

Cao in view of Han and Shin discloses this element. *Id.*, ¶257. In an embodiment of the modified Cao device according to Han and Shin, Cao's pre-installed glass 300 has an initial (first) curvature according to the well-known material property of pre-installed stock tempered glass. *See* Ex. 1010, 4:13-19; *See also* Exs. 1023, 1024, 1025, 1026; *see also* Ex. 1001, 2:5-9; Ex. 1002, ¶257. Each side of the glass 300 is then

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inserted into respective Cao's modified curved grooves 103 of each screen support 100, and each screen support 100 is coupled together end to end using corner cover seats 700. Ex. 1002, ¶257. As the glass 300 is assembled into the curved grooves 103, they apply a bending force to the glass 300. The bending force induces the glass 300 to curve according to the corresponding curvature of grooves 103 of screen supports 100. The induced curvature (second) is greater than the first curvature based on the slope of the grooves 103 along both the Ax and Ay directions. *Id.*



Ex. 1010, Fig. 9.

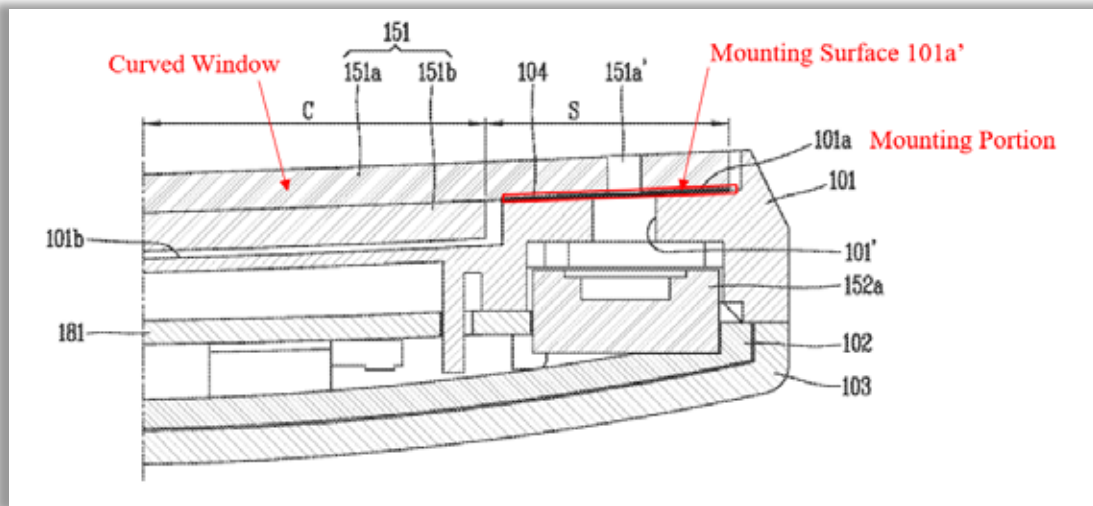
Thus, Cao in view of Han and Shin discloses claim 3. Ex. 1002, ¶258.

4. Claim 4

Cao in view of Han and Shin discloses this element. *Id.*, ¶259 In the modified Cao device, the first and second curvatures are defined along an edge of the plate. *Id.*

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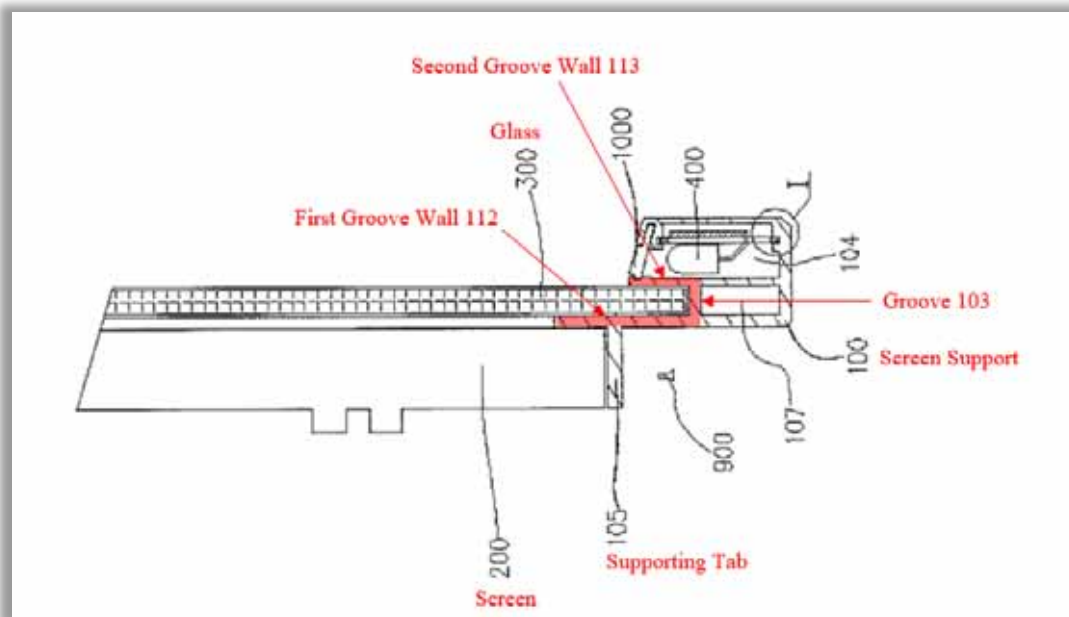
In the modified Cao device, a POSA would have understood pre-installed glass to have (first) curvature defined along the edge of the glass. *Id.* Incorporating Shins' teaching, a POSA would also have expected an induced second curvature of the glass to be defined along its edge. *Id.* As taught by Shin, the mounting surface 101a' is curved along the full length of contact with the curved window 151a up to and including the window edge, "S" length. Ex. 1011, Fig. 5. Thus, during installation of the window 151a in Shin, the curved mounting surface 101a' induces curvature up to the edge of window 151a. *Id.*, Fig. 4; Ex. 1002, ¶259.



Ex. 1011, Fig. 5.

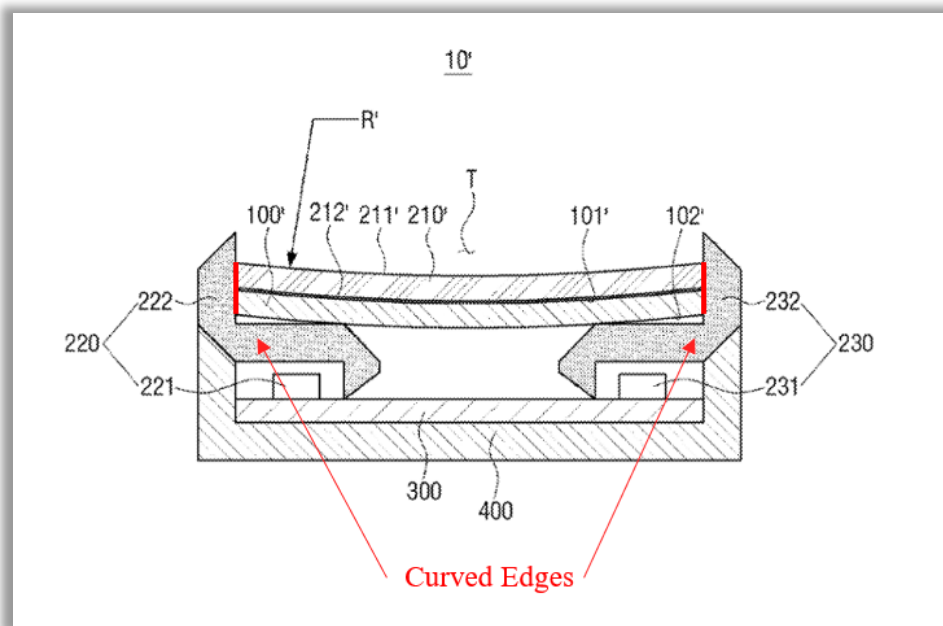
In the modified Cao device according to Shin, Cao's modified first groove walls 112 of the curved grooves 103 would also induce curvature up to the edges of glass 300

during installation as, like in Shin, Cao's first groove walls 112 would also contact glass 300 up to its respective edges. Ex. 1002, ¶260.



Ex. 1010, Fig. 9.

Further, Han teaches curvature along both an Ax and Ay direction, up to and including the edges of its front cover glass 210 in order to improve touch detection accuracy. See Ex. 1005, [0077-89], Fig. 7; Ex. 1002, ¶261. Thus, the glass 300 of the modified Cao device incorporating Han's glass curvature (curved up to glass 210 edges in both an Ax and Ay axis) would also include curvature up to its respective screen 300 edges to achieve Han's improved touch detection accuracy. Ex. 1002, ¶261.

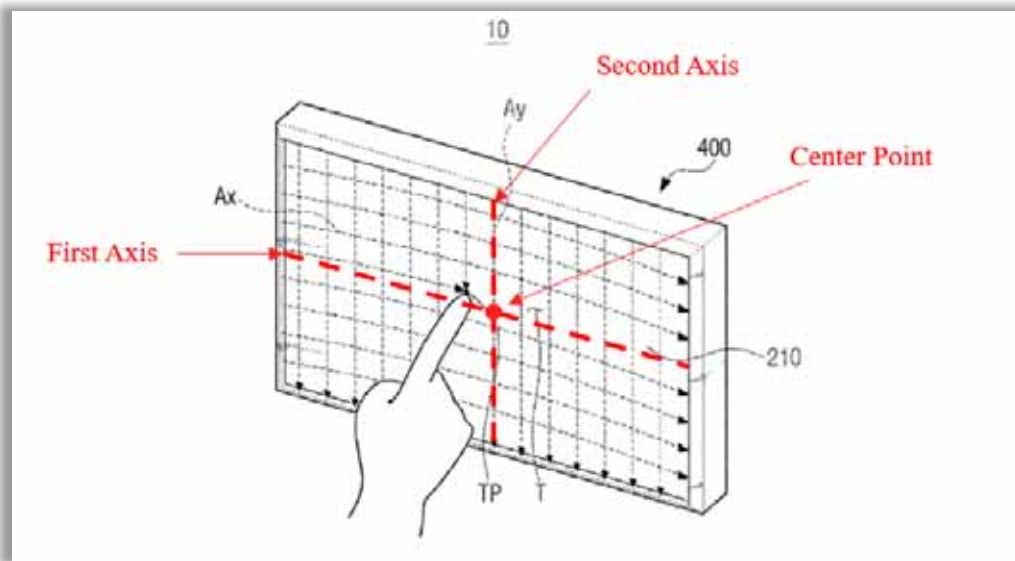


Ex. 1005, Fig. 7.

Thus, Cao in view of Han and Shin discloses claim 4. Ex. 1002, ¶262.

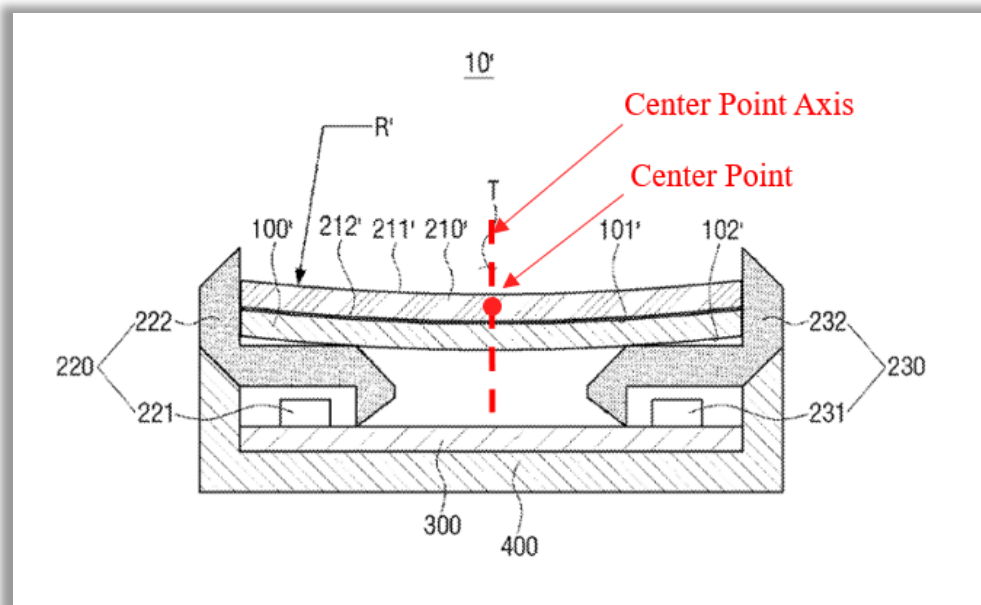
5. Claim 5

Cao in view of Han discloses this element. *Id.*, ¶263. As discussed above, Han teaches a parabolically curved plate (cover glass 210), with curvature relative to both a first (Ax) and second (Ay) axis. *Id.*



Ex. 1005, Fig. 9.

Han further teaches a parabolic curvature as measured along an axis passing through a center point of the plate (cover glass 210). Ex. 1002, ¶264.



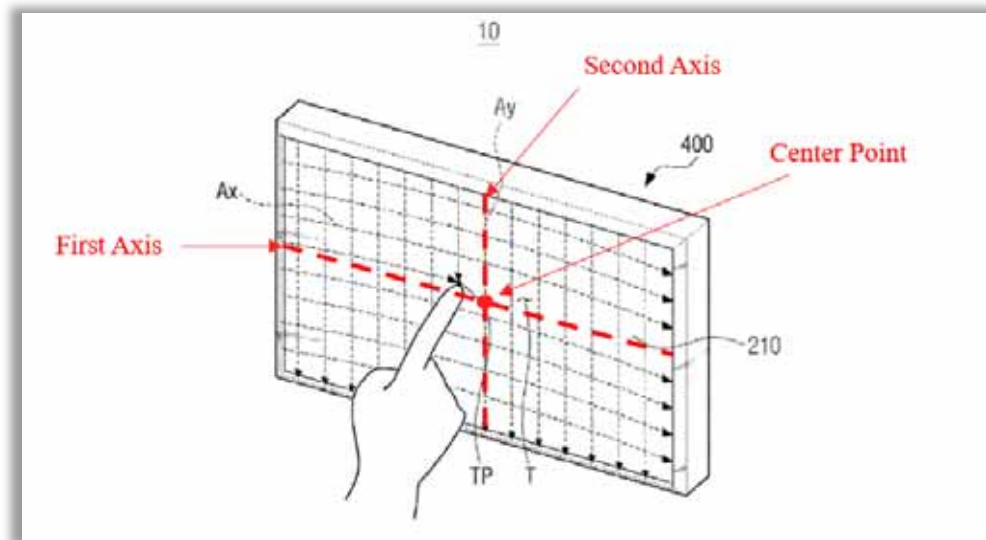
Ex. 1005, Fig. 7.

In order to achieve Han's improved touch detection, a POSA would have been motivated to modify Cao's glass 300 to have the same parabolic curvature as Han's, also as measured along an axis passing through a center point of modified Cao's glass 300. Ex. 1002, ¶265.

Thus, Cao in view of Han discloses claim 5. *Id.*, ¶266.

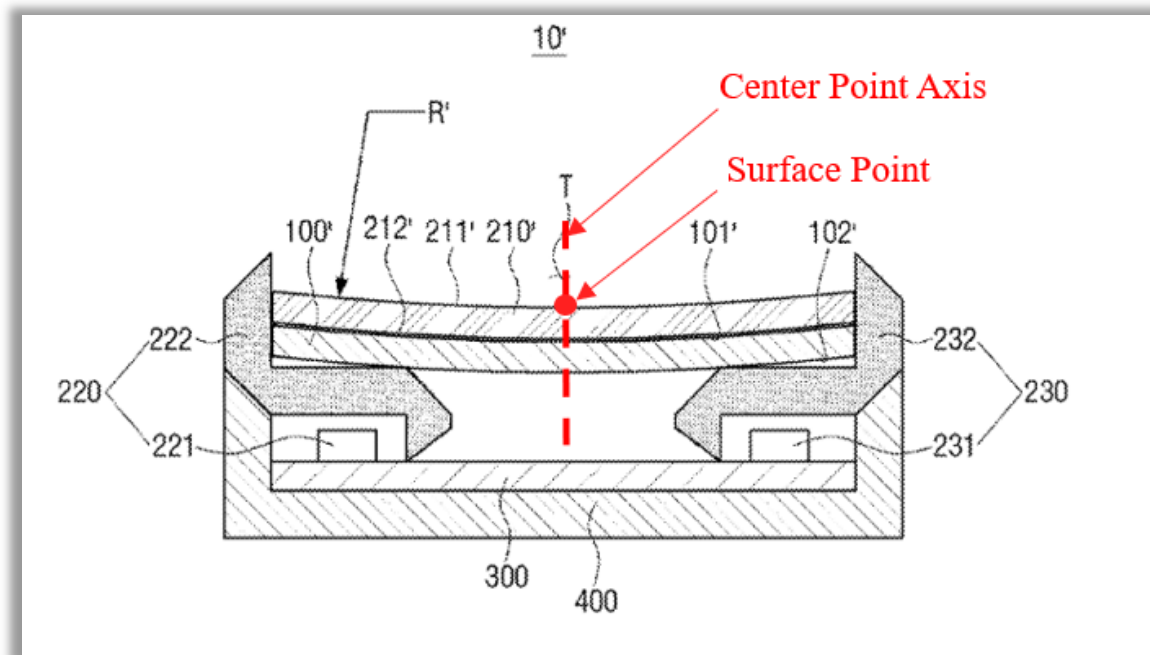
6. Claim 6

Cao in view of Han discloses this element. *Id.*, ¶267 Han teaches a parabolically curved plate (cover glass 210), with curvature relative to both a first (Ax) and second (Ay) axis.



Ex. 1005, Fig. 9.

Han further teaches a parabolic curvature as measured along an axis passing through a point on the touch surface (surface 211). Ex. 1002, ¶268.



Ex. 1005, Fig. 7.

In order to achieve Han's improved touch detection, a POSA would have been motivated to modify Cao's glass 300 to have the same parabolic curvature as Han's, also as measured along an axis passing through a point on the surface of modified Cao's glass 300. Ex. 1002, ¶269.

Thus, Cao in view of Han discloses claim 6. *Id.*, ¶270.

7. Claim 7

(a) Preamble

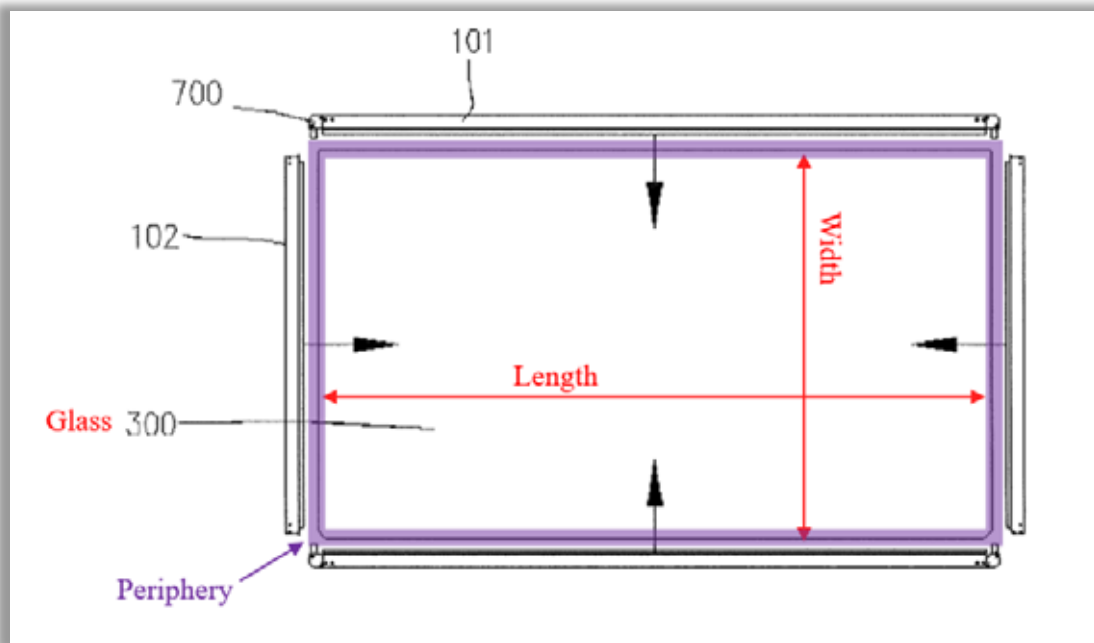
Each of Cao, Han, and Shin disclose this element. *Id.*, ¶271. Cao, Han, and Shin disclose a touch sensing apparatus. *Id.*; Ex. 1010, Abstract, Ex. 1005, Abstract; Ex. 1011, Abstract, 10:45-49.

(b) Claim 7(b)

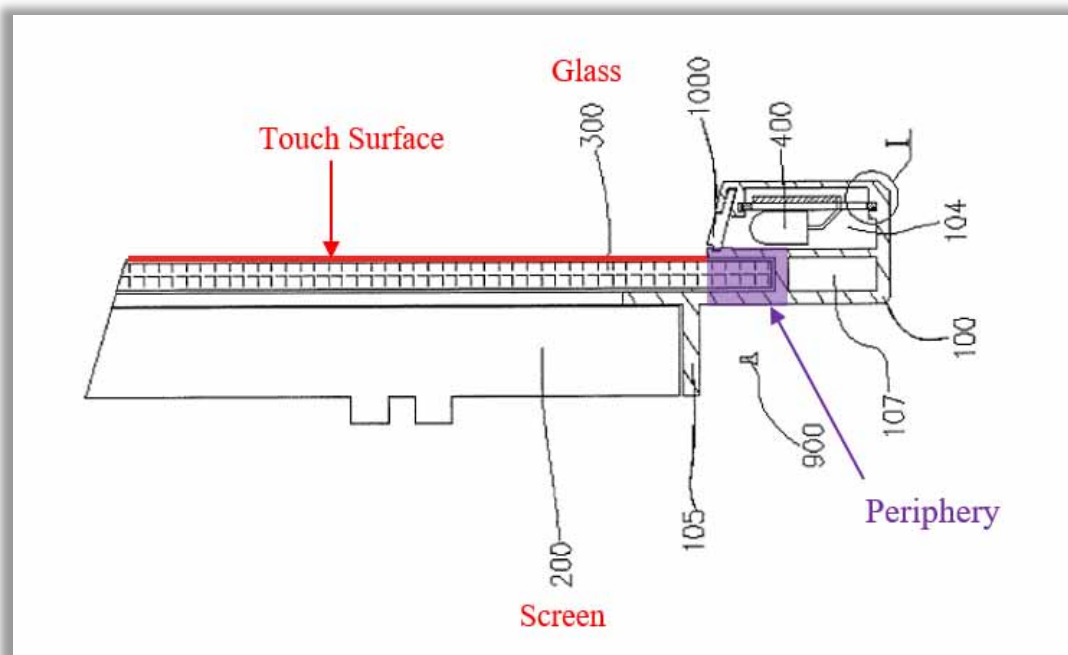
Each of Cao, Han, and Shin disclose this element. Ex. 1002, ¶273. Cao discloses a display panel (screen 200), Han discloses a display panel (display 100), and Shin discloses a display panel (display 151b). *Id.*; Ex. 1010, Abstract; Ex. 1005, Abstract; Ex. 1011, Abstract.

(c) Claim 7(c)

Cao discloses this element. Ex. 1002, ¶275. Cao discloses a plate (glass 300) having a width, a length, a periphery, and touch surface.



Ex. 1010, Fig. 1.

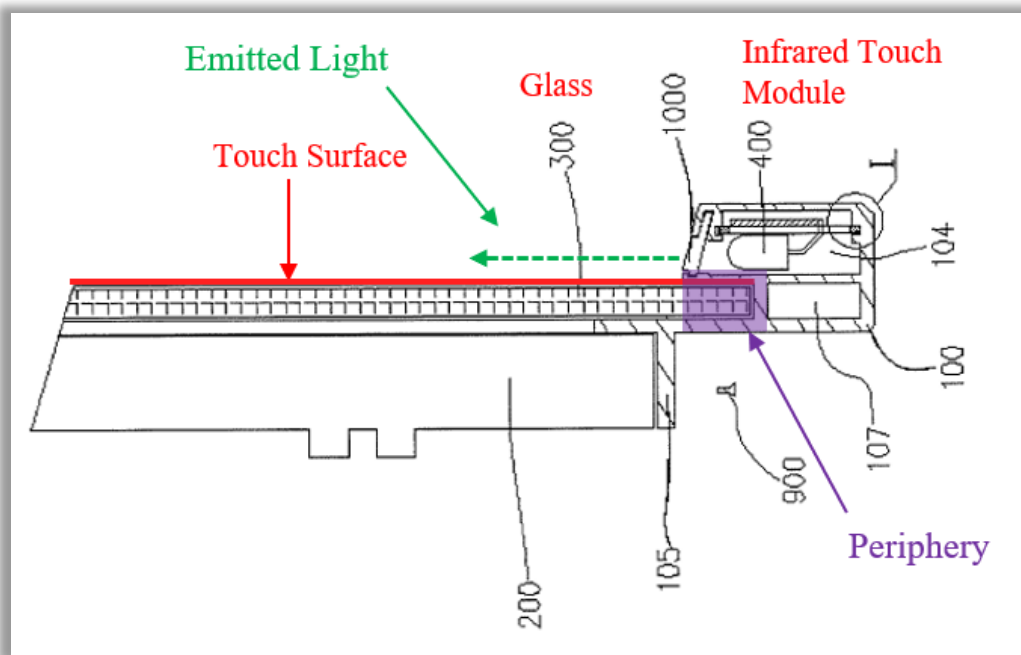


Ex. 1010, Fig. 9.

Thus, Cao discloses claim 7(c). Ex. 1002, ¶276.

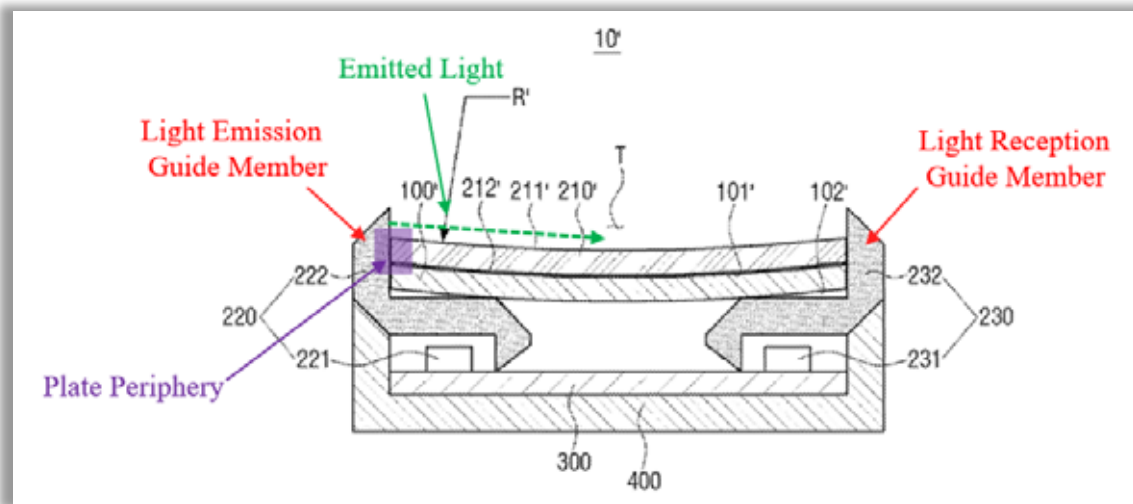
(d) Claim 7(d)

Cao in view of Han discloses this element. *Id.*, ¶277. Cao discloses at least one emitter (infrared touch module 400 with emitter) arranged adjacent to the periphery of a plate (glass 300) and configured to emit light across the touch surface of the plate.



Ex. 1010, Fig. 9.

Further, Han teaches that “light A2 emitted from the light emitting surface 2221 of the light emission guide member 222 is reflected in a curved way along the concavely curved front surface 211 of the cover glass 210...” Ex. 1005, [0085]; Ex. 1002, ¶278.



Ex. 1005, Fig. 7.

In modifying Cao to achieve Han's improve touch detection accuracy, a POSA would have continued to implement an emitter adjacent to the periphery of the (curved) plate and configured to emit light across the surface of the curved glass 300. Ex. 1002, ¶279.

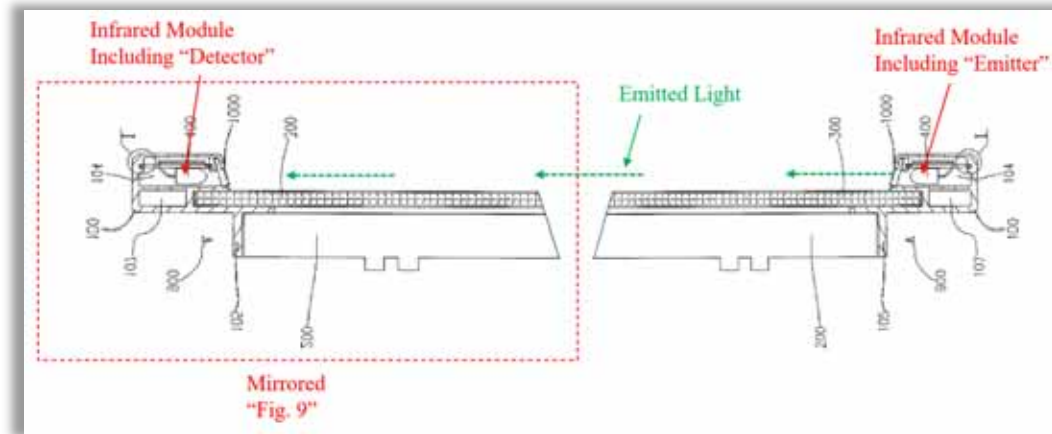
Thus, Cao in view of Han discloses claim 7(f). *Id.*, ¶280.

(e) Claim 7(e)

Cao in view of Han discloses this element. *Id.*, ¶281. A POSA would have understood Cao to disclose at least one detector (infrared touch module 400 with detector) arranged adjacent to the periphery of a plate (glass 300). *Id.*; Ex. 1010, Fig. 9. A POSA would have understood Cao's disclosure of an infrared touch module 400 to teach both an emitter and a detector, as this would have enabled infrared touch functionality (by a touch interrupting light transmission between said emitter and

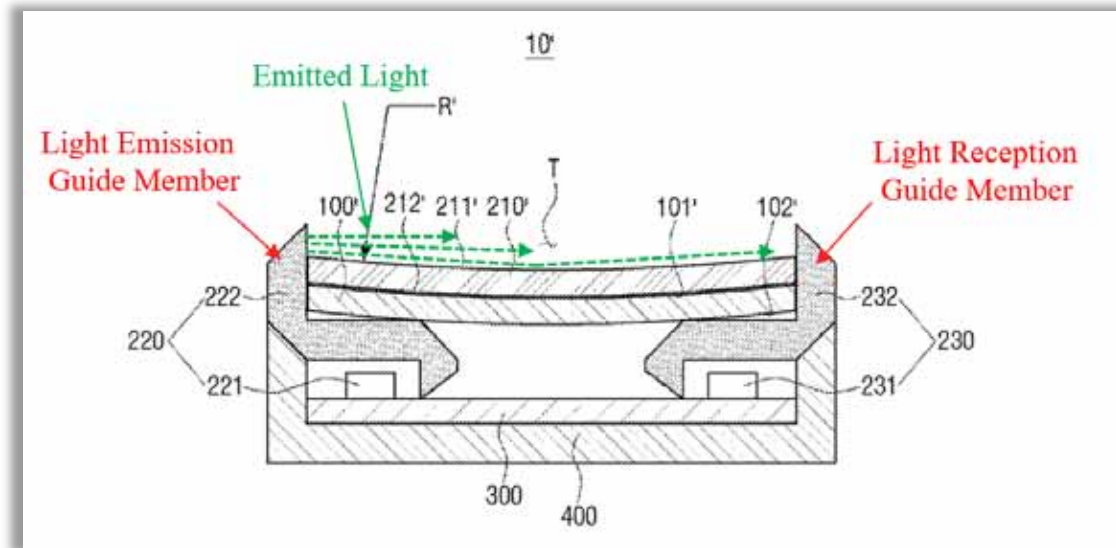
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detector) as widely known in the art. *See, e.g.*, Ex. 1001, 1:26-46, 15:62-16:3; Ex. 1002, ¶281.



Ex. 1010, Fig. 9.

Further, Han teaches that light “irradiated from the light emitting surface 2221 of the light emission guide member 222 [] passes through the touch area T to the incident surface 2321 of the light reception guide member 232. Ex. 1002, ¶282.



Ex. 1005, Fig. 7.

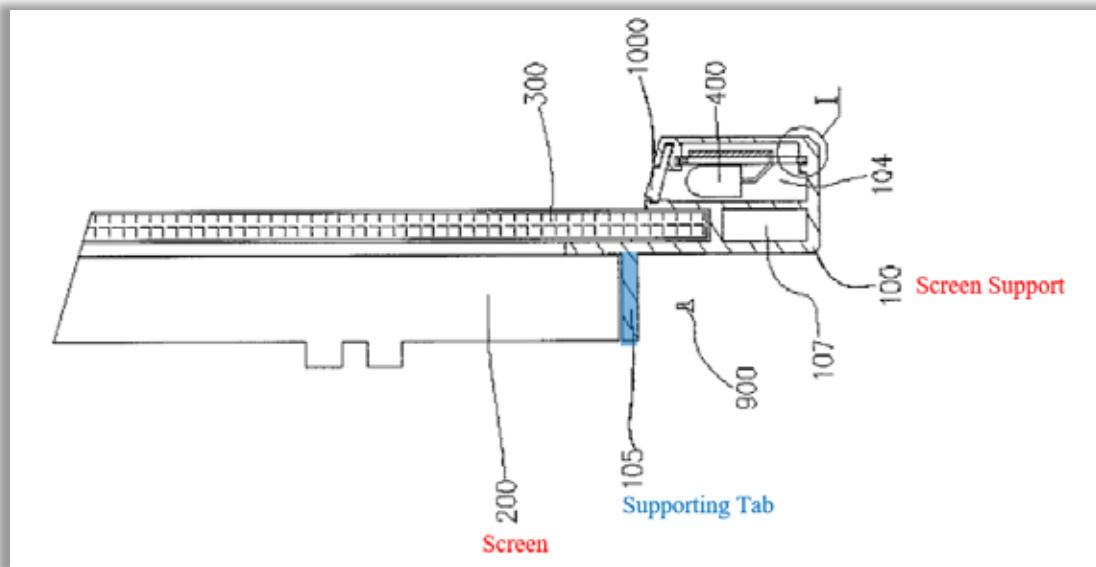
In modifying Cao to achieve Han's improved touch detection accuracy plate curvature, a POSA would have continued to implement a detector adjacent to the periphery of the (curved) plate and configured to receive light from the set of emitters. Ex. 1002, ¶283.

Thus, Cao in view of Han discloses claim 7(e). *Id.*, ¶284.

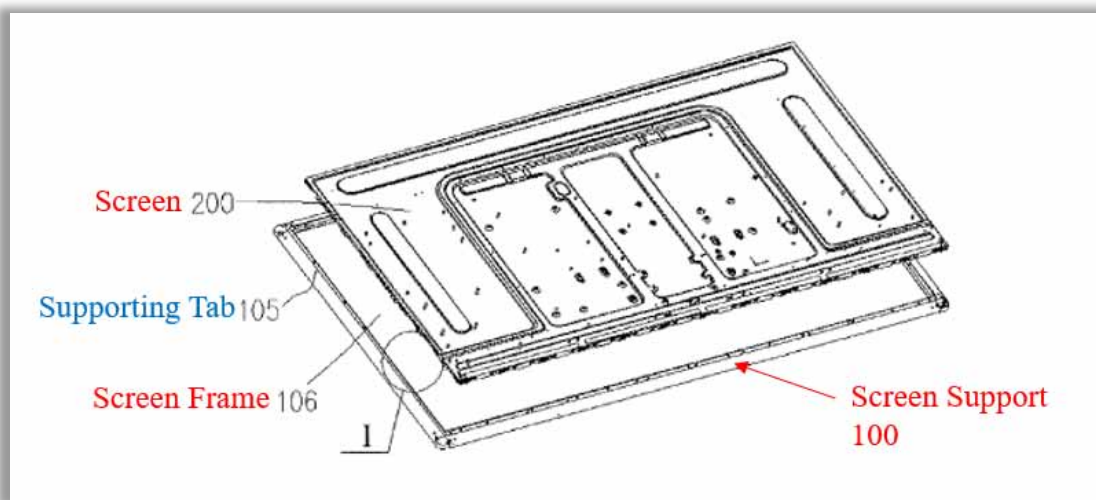
(f) Claim 7(f)

Cao discloses this element. *Id.*, ¶285. Each screen support 100 of Cao defines a supporting tab 105 that, when four screen supports are joined together, define a screen frame 106. Ex. 1010, 4:7:10, 5:34-36, 7:21-27, Figs. 3, 9, 14. A screen 200 (display panel) is positioned into screen frame 106 and fixed by a screw 900 passing through

screw holes defined in supporting tab 105 and screen back plate 203. *Id.*, 7:21-27, Fig. 9. Ex. 1002, ¶285.



Ex. 1010, Fig. 9.

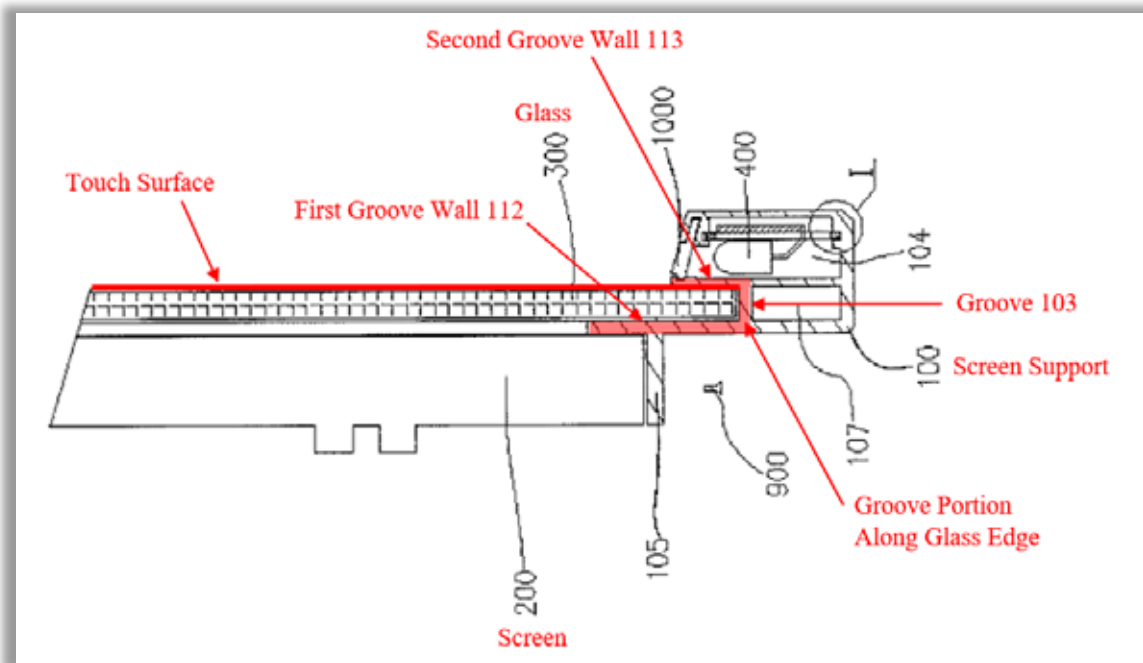


Ex. 1010, Fig. 3.

Thus, Cao discloses claim 7(f). Ex. 1002, ¶286.

(g) Claim 7(g)

Cao discloses this element. *Id.*, ¶287. Cao discloses a screen support 100 including a groove 103 with a first groove wall 112 and second groove wall 113. Ex. 1010, 5:47-53. The groove 103 has a portion extending along the edge of the glass 300. At least in accordance with Patent Owner’s construction of “opposed” depicted in co-pending litigation, the second groove wall 113 is opposed to the touch surface of glass 300. *Id.*, Fig. 9; see Ex. 1019, 203; Ex. 1002, ¶287.

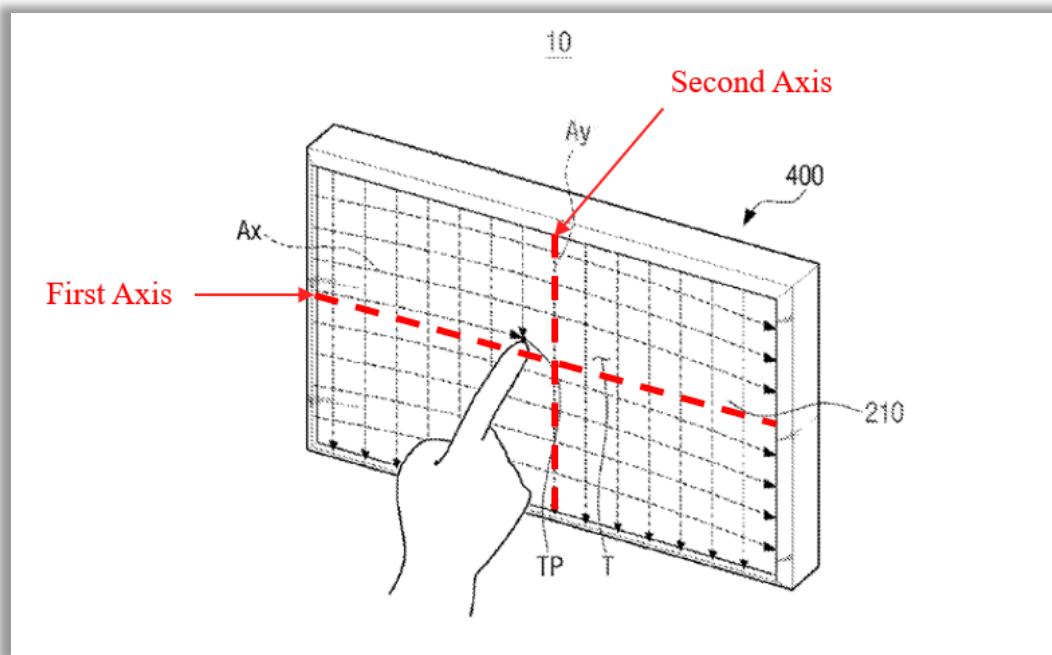


Ex. 1010, Fig. 9.

Thus, Cao discloses claim 7(g). Ex. 1002, ¶288.

(h) Claim 7(h)

Cao in view of Han and Shin discloses this element. *Id.*, ¶289. As explained above in an embodiment of the modified Cao device, the pre-installed glass 300 has an initial curvature according to the well-known material property of pre-installed stock glass. *Id.*; See Exs. 1023, 1024, 1025, 1026; *see also*, Ex. 1001, 2:5-9. As the glass 300 is assembled into the modified Cao curved screen supports 100 and grooves 103 according to Shin, they apply a bending force to Cao's glass 300, which induces glass 300 to curve into a second curvature greater than the first curvature based on the slope of the grooves 103 along both Ax and Ay directions. Ex. 1002, ¶289. According to Han's teaching of improving touch detection accuracy, the induced second curvature of the modified Cao glass 300 would be parabolic and would comprise a first axis component along the length of glass 300 (Ax) and second axis component along the width of glass 300 (Ay). *Id.*



Ex. 1005, Fig. 2.

Thus, Cao in view of Han and Shin discloses claim 7(h). Ex. 1002, ¶290.

(i) Claim 7(i)

Cao discloses this element. *Id.*, ¶291. Cao discloses utilizing a frame assembly 100 to force the “four rising corners of the glass” to “remain flat...” Ex. 1010, 2:20-24, 2:39-44. A POSA would have understood Cao’s glass 300 outside of the frame assembly 100 (i.e. before installation) to have unrestrained “four rising corners.” Ex. 1002, ¶¶291-92. A POSA would have further understood the “four rising corners” of Cao’s pre-installed glass 300 to equate to either a “concave” first curvature and “convex” first curvature, depending on the orientation of the pre-installed glass 300 relative to the frame assembly 100. *Id.* Cao discloses a concave first curvature where

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the rising corners of the pre-installed glass 300 lift upward and away from the screen supports 100. *Id.* Further, a POSA would otherwise understand stock glass to have a concave curvature.

Thus, Cao discloses claim 7(i). Ex. 1002, ¶293.

8. Claim 8

Cao in view of Han discloses this element. *Id.*, ¶294. 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]. The IC “modif[ies] an analog signal transmitted from a touch detecting unit into a digital signal and chang[es] the signal to a form of a coordinate which can be displayed on the screen...” *Id.*, [0013]. 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. 1002, ¶294.

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

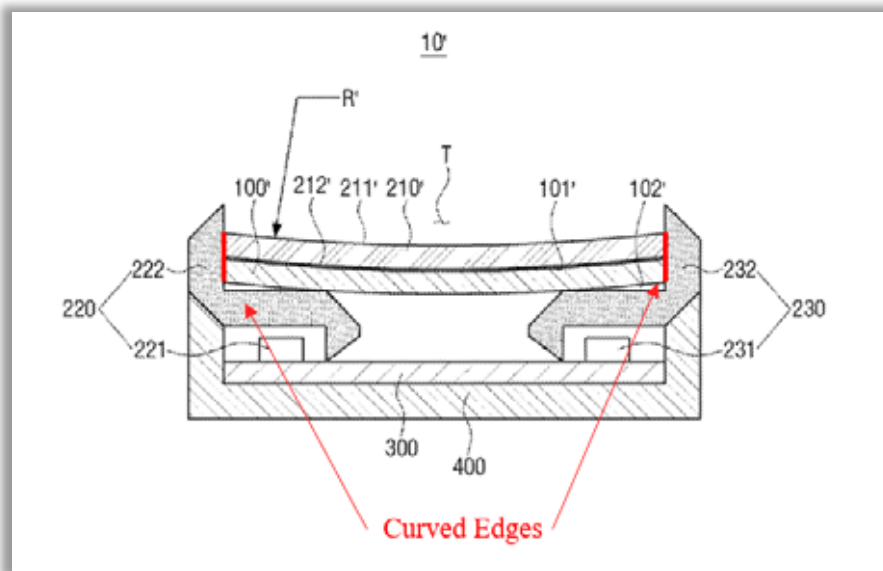
typical configuration to enable optical touch sensing functionality. Ex. 1002, ¶295.

Han's teaching of the same confirms as much. See Ex. 1005, [0012-13].

Thus, Cao in view of Han discloses claim 8. Ex. 1002, ¶296.

9. Claim 9

Cao in view of Han and Shin discloses this element. *Id.*, ¶297.

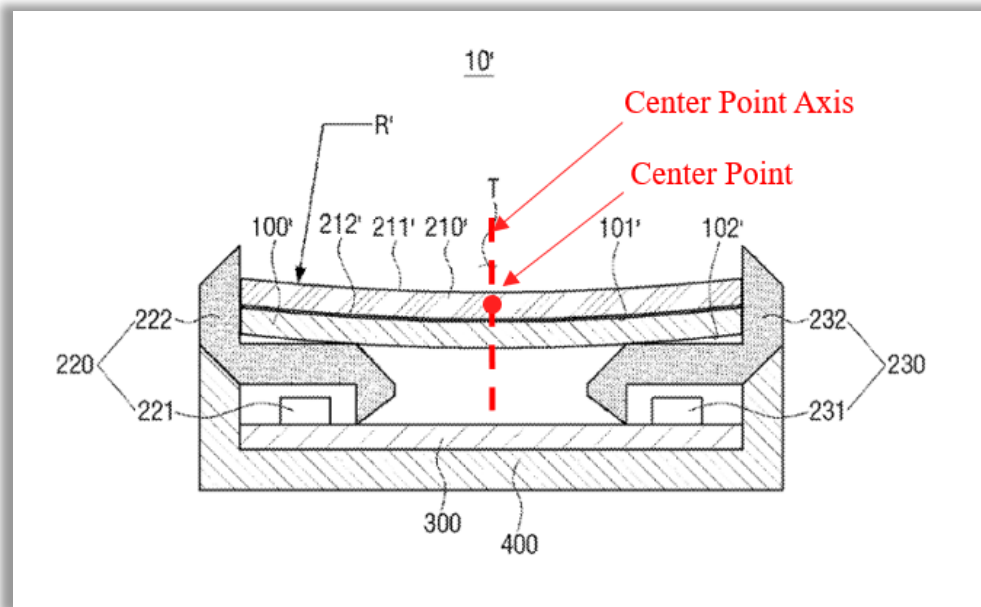


Ex. 1005, Fig. 7.

For at least the same rationale laid out for claim 4, above, Cao in view of Han and Shin discloses the first curvature and second curvature are measured along an edge (edges of Cao's modified screen 300 curved along Ax and Ay directions according to Han) of the plate (Cao's modified screen 300). Ex. 1002, ¶298.

10. Claim 10

Cao in view of Han discloses this element. *Id.*, ¶299.

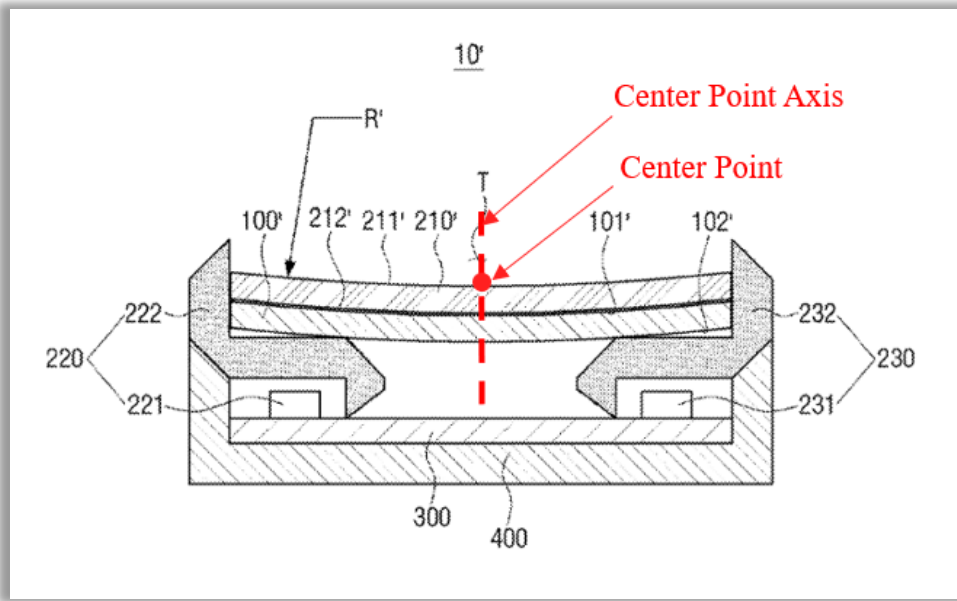


Ex. 1005, Fig. 7.

For at least the same rationale laid out in claim 5 above, Cao in view of Han discloses the first curvature and second curvature are measured along an axis (center point axis passing through Cao's modified glass 300) passing through a center point (center point of Cao's modified glass 300) of the plate. Ex. 1002, ¶300.

11. Claim 11

Cao in view of Han discloses this element. *Id.*, ¶301

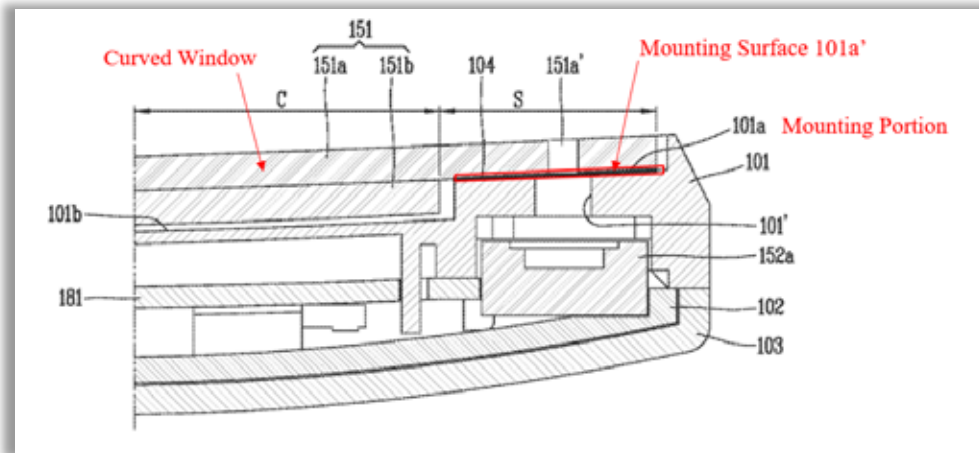


Ex. 1005, Fig. 7.

For at least the same rationale laid out in claim 6 above, Cao in view of Han discloses the first curvature and second curvature (curved pre-installed screen and curved screen 300 in Ax and Ay directions) are measured along a line passing through a point (axis passing through center point of Cao's glass 300) on the touch surface (surface of Cao's glass 300). Ex. 1002, ¶302.

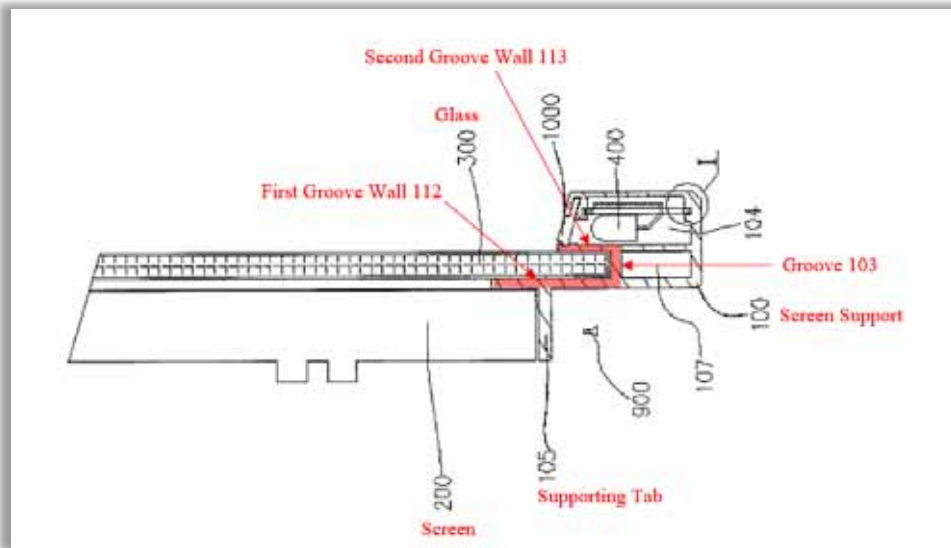
12. Claim 14

Cao in view of Shin discloses this element. *Id.*, ¶303. As discussed above, the curved mounting surface 101a' in Shin induces curvature in the window 151a. Ex. 1011, 22:53-63.



Ex. 1011, Fig. 5.

In the modified Cao device according to Shin, Cao's groove 103 including first and second groove walls 112, 113 would also be curved to induce curvature in Cao's glass 300. In other words, the second frame element (groove 103) in the modified Cao element would be curved. Ex. 1002, ¶304. A POSA would have expected such a modification to result in a simplified manufacturing process of achieving a curved glass 300, as taught by Shin. *Id.*; See Ex. 1011, 18:57-64.



Ex. 1010, Fig. 9.

Thus, Cao in view of Shin discloses claim 14. Ex. 1002, ¶305.

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 '935 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, 1019. The '935 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.

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Ca), voluntarily dismissed. The '935 Patent was previously the subject of litigation in *FlatFrog Laboratories AB v. Promethean Limited et al*, Case No. 1-19-cv-02246 (D. De.), dismissed with prejudice. Ex. 1020. As part of that dispute, an IPR Petition was filed (IPR2022-00065), but that PTAB matter was settled pre-institution. Exs. 1021, 1022.

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:

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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.

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Date: 10/6/2023

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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. 10,775,935, 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. 10,775,935, and the accompanying Declaration of Dr. Cairns, was sent on 10/6/2023 to patentee's litigation counsel via email to:

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Date: 10/6/2023

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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 13,991 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

By: /Matthew W. Johnson/

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APPENDIX OF EXHIBITS

Exhibit No.	Title
1001	U.S. Patent No. 10,775,935 to Kocovski et al.
1002	Expert Declaration of Darran R. Cairns, Ph.D., regarding U.S. Patent No. 10,775,935
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.

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Exhibit No.	Title
1013	Prosecution History for U.S. Patent No. 10,775,935 to Kocovski et al.
1014	U.S. Patent Application Publication No. 2012/0223916 to Kukulj et al.
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	Claim Chart for US Patent No 10,775,935 (Case No. 2:23-cv-00306 (E.D. TX))
1020	<i>FlatFrog Laboratories AB v. Promethean Limited et al</i> , Case No. 1-19-cv-02246 (D. De), filed on December 10, 2019
1021	<i>FlatFrog Laboratories AB v. Promethean Limited et al</i> , IPR2022-00065 (filed October 16, 2021) (Petition for Inter Partes Review of US Patent 10,775,935)
1022	<i>FlatFrog Laboratories AB v. Promethean Limited et al</i> , IPR2022-00065 Paper No. 12 (PTAB April 18, 2022) (Decision)
1023	ASTM C1048-18, Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass (2018)

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Exhibit No.	Title
1024	ASTM C1048-12, Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass (2012)
1025	Jonathan Barr, <i>The Glass Tempering Handbook</i> (2015)
1026	EN 12150-1:2015, Glass in Building – Thermally toughened soda lime silicate safety glass
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 – 1038	<i>Reserved</i>
1039	Declaration by Christian A. Roberts, Dated October 4, 2023
1040	Curriculum vitae of Dr. Darran Cairns.