

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

GOOGLE LLC

Petitioner

v.

DDC TECHNOLOGY, LLC,

Patent Owner

U.S. Patent No. 9,420,075

Case No.: IPR2023-00707

DECLARATION OF KURTIS P. KELLER

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I, Kurtis P. Keller, of Hillsborough, North Carolina, declare as follows:

I. INTRODUCTION AND SCOPE OF WORK

1. I have been retained by Google LLC (“Google” or “Petitioner”) in the above-captioned *Inter Partes* Review (IPR) as an independent expert in the fields of head-mounted displays and touchscreen technology.

2. I have been asked to provide my independent analysis regarding U.S. Patent No. 9,420,075 (“the ’075 patent”), which I understand is assigned to DDC Technology, LLC (“Patent Owner”). I have been asked to consider what one of ordinary skill in the art before the priority date would have understood, including scientific and technical knowledge related to the subject matter of the ’075 patent.

3. I have also been asked to provide my opinions regarding whether claims 1-12, 14, and 18-20 of the ’075 patent (“challenged claims”) are rendered obvious to a person having ordinary skill in the art at the time of the alleged invention (“POSA”) in view of Kondo (JP3176588) and Chu (US 2013/0082963), provided to me by Google LLC.

4. My analysis is directed by my education, training, and experience as a POSA at the time of the alleged invention of each claim.

5. For the purposes of my engagement, I have been asked to assume that the date of the alleged invention is July 16, 2014. However, I have not considered,

nor have I been asked to consider, whether this priority date is correct with respect to any claims.

6. I am being compensated for my work in connection with this IPR at my standard hourly rate. My compensation is not in any way contingent on the substance of my opinions or the outcome of these proceedings.

II. SUMMARY OF OPINIONS

7. Based on my experience and expertise, discussed below, and my review of the references provided to me, it is my opinion that all challenged claims are invalid as obvious in view of Kondo and Chu.

III. BACKGROUND AND QUALIFICATIONS

8. I am a Research Engineer for the Computer Science Department at the University of North Carolina at Chapel Hill where I have worked for over 25 years, primarily in the mechanical/optical design of Head-Mounted Displays and other Virtual and Augmented Reality hardware/systems. I have designed or co-designed at least twelve Head-Mounted Displays (“HMDs”), evaluated many and modified many more, and purchased/commercial or military ones for special applications. I am currently part-time at the University of North Carolina.

9. I am one of three founders of a 3D computer-assisted medical device company, InnerOptic Technology, Inc., located in Hillsborough, NC and am the COO and mechanical engineer for the company. Our first products designed and

sold were Augmented Reality Head Mounted Displays for medical research use. We currently are developing software and hardware for HMDs to assist in direct human surgery.

10. My C.V. is attached as Appendix A hereto. My educational background includes an M.S. in Integrated Manufacturing Systems Engineering from North Carolina State University and a B.S. in Mechanical Engineering, from North Carolina State University. I have been involved in designing and implementing advanced electro-mechanical systems since 1988 and Head-Mounted Displays (“HMDs”) since 1992. Most of the HMD designs were at UNC Chapel Hill’s Computer Science Department in the effort to advance the art and provide innovative hardware for the graduate students and researchers to support their research efforts in Virtual and Augmented Reality. This development also included assisting designing and building of associated custom tracker systems and custom graphic computers.

11. Head-Mounted Display development includes Narrow Field of View (medical and detail work), Wide Field of View (full immersion), and augmented reality video and optical see-through systems. Particular systems include a very wide field of view HMD unit with six tiled displays per eye, a \$1.4 million one-off design, simple two and three-per-eye tiled displays, gesture tracking HMDs, integrated tracker HMDs, and medical and surgical HMDs, including the HMD

used for the very first augmented reality surgery. I have been directly involved in the conception, specifications, design, build, and manufacture of HMDs since 1992. This includes the mechanical, electrical, optical and integration aspects. I have been continuously designing or customizing HMDs and optical systems since 1992 and personally have multiple HMDs of my own at home.

12. I have been directly involved in the marketing and sales of commercial Head-Mounted Displays.

13. I have been an expert witness on ten different patents previously, including writing expert declarations and being deposed for testimony.

14. I am an inventor on at least twelve issued U.S. patents. Most of them deal with integration of computer-assisted augmented reality surgery displays, content and other 3D-tracked display modalities, some with Head-Mounted Displays.

- 9,792,715, “Methods, systems, and computer readable media for utilizing synthetic animatronics”
- 9,675,319, “Loupe Display”
- 9,659,345, “System and method of providing real-time dynamic imagery of a medical procedure site using multiple modalities”
- 9,282,947, “Imager focusing based on intraoperative data”

- 8,690,776, “Systems, methods, apparatuses, and computer-readable media for image guided surgery”
- 8,585,598, “Systems, methods, apparatuses, and computer-readable media for image guided surgery”
- 8,482,606, “System and method of providing real-time dynamic imagery of a medical procedure site using multiple modalities”
- 8,350,902, “System and method of providing real-time dynamic imagery of a medical procedure site using multiple modalities”
- 8,152,305, “Methods, systems, and computer program products for full spectrum projection”
- 7,728,868, “System and method of providing real-time dynamic imagery of a medical procedure site using multiple modalities”
- 7,385,708, “Methods and systems for laser based real-time structured light depth extraction”
- 6,503,195, “Methods and systems for real-time structured Light”

I also have several currently pending patent applications.

IV. LEGAL STANDARDS

15. In preparing my analysis, I have applied the legal standards described below, which were provided to me by counsel for the Petitioner. I have been

provided with an understanding of the legal standards sufficient to conduct the analysis given in this declaration.

16. It is my understanding that assessing the validity of a U.S. patent based on a prior art analysis requires two steps. First, one must construe the terms of the patent claims to understand what meaning one of ordinary skill in the art would give the terms. Second, after the claim terms have been construed, one may then assess validity by comparing a patent claim to the “prior art.” I understand that the teaching of the prior art is viewed through the eyes of a person of ordinary skill in the art at the time the invention was made. My opinion as to what constitutes a relevant person of ordinary skill in the art is set forth below.

A. CLAIM INTERPRETATION

17. In the present proceeding, I have been advised that the claims are to be construed in the same way they would be in district court, which I understand is called the *Phillips* standard. I have been informed as follows about the standard:

Claim construction begins with the language of the claims. The words of a claim are generally given their ordinary and customary meaning, which is the meaning that the term would have to a person of ordinary skill in the art in question at the time of the invention, i.e., as of the effective filing date of the patent application. The specification is the single best guide to the meaning of a disputed term and acts as a dictionary when it expressly defines terms used in the claims or when it defines terms by implication. Although the prosecution history often

lacks the clarity of the specification and thus is less useful for claim construction purposes, it is another source of intrinsic evidence that can inform the meaning of the claim language by demonstrating how the inventor understood the invention and whether the inventor limited the invention in the course of prosecution, making the claim scope narrower than it would otherwise be. Extrinsic evidence, such as expert testimony and dictionaries, may be useful regarding the field of the invention or helping determine what a person of ordinary skill in the art would understand claim terms to mean. However, extrinsic evidence in general is viewed as less reliable than intrinsic evidence.

Additionally, there is a doctrine of construing claims to preserve their validity, but it should only be applied in rare circumstances in AIA proceedings. This doctrine is of limited utility and has been limited to cases in which after applying all the available tools of claim construction, that the claim is still ambiguous.

I will use this standard in my analysis below. I note that there is no ambiguity in the terms that I discuss below, and therefore, I do not believe that the doctrine of construing claims to preserve their validity is applicable here.

18. Below, I set forth what I believe to be the meaning of certain claim terms as well as the factual basis for those claim constructions. As to the other terms that I do not address, I will simply apply the ordinary and customary meaning of those terms. In arriving at the claim constructions shown below, I

carefully considered the '075 patent and its prosecution history, including the prosecution history of the related patents. In the chart below, I provide a summary of the construction for certain terms that are relevant to the challenged claims. Following the chart, I provide my reasoning and the factual basis in support of my proposed interpretation for each term.

Claim Term	Meaning
Virtual Reality Viewer	“A viewer of an artificial environment,” where “viewer” includes both handheld devices and headsets.
Electrical Shield/Electric Shield	“A material configured to induce a touch event that is electrically detectable by a touchscreen/device when at least a portion of the shield contacts or is in proximity to a touchscreen.”
Lever	“A projecting piece by which a mechanism is operated or adjusted.”

Below I provide support for the terms that I have construed above.

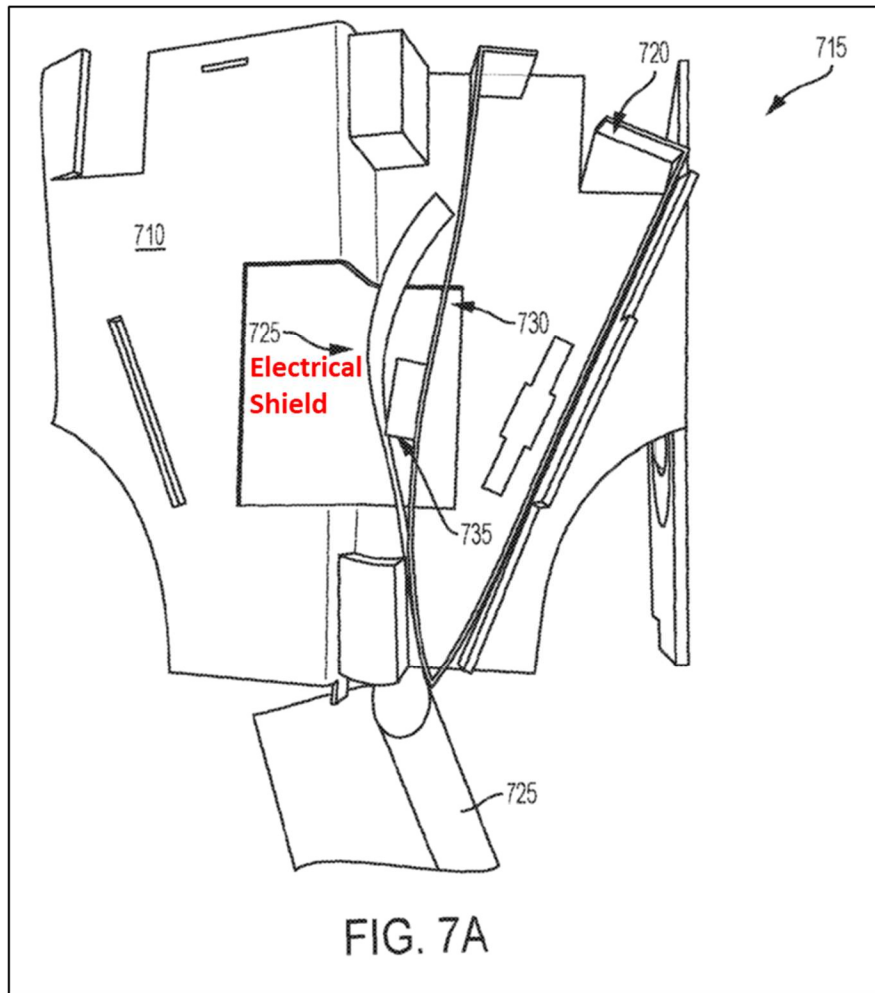
Virtual Reality Viewer – This term appears in all claims and is not defined in the '075 patent other than to state “[v]irtual reality viewers and headsets (collectively referred to as viewers) are becoming an increasingly popular way of viewing digital media, gaming and the like.” EX1001, 1:30-32. The patent also states that “[v]iewers can be hand-held devices that a user holds up to the users [sic] face/eyes, for example, like a user would hold a pair of binoculars.” EX1001, 1:39-41. And the patent states that “[v]iewers can also be worn on a user’s head....” EX1001, 1:41-43. So, the patent is using the term “virtual reality viewer” to include both handheld devices and headsets. Beyond describing some typical features of virtual reality viewers (see 1:30-2:15), the '075 patent does not provide any definition or place any limitations on this term. I therefore considered some definitions for the term “virtual reality”:

an artificial environment which is experienced through sensory stimuli (such as sights and sounds) provided by a computer and in which one's actions partially determine what happens in the environment. Merriam-Webster Online Dictionary, <https://www.merriam-webster.com/dictionary/virtual%20reality>.

A realistic simulation of an environment, including three-dimensional graphics, by a computer system using interactive software and hardware. EX1006, pg. 4 (Random House Webster’s College Dictionary, pg. 1459 (2000)).

These definitions suggest that Virtual Reality is an artificial environment. These definitions are consistent with my understanding as a POSA. To further support this analysis, I note the difference between Augmented Reality, which is when computer-generated images are superimposed on a user's real-world field of vision (see §VI(A) below), and Virtual Reality, which is an artificial environment. It should be noted that there are a variety of Virtual Reality viewer sub categories, some are not tracked, like a Viewmaster, which is static, and others are tracked in order to present the image from the users point of view, even during head movement. However, in light of the term's usage and well-known meaning to a POSA, I will use its ordinary meaning, which is "a viewer of an artificial environment" where "viewer" includes both handheld devices and headsets.

Electrical Shield/Electric Shield – The term "electrical shield" appears in claims 1-17 and 20, and the term "electric shield" appears in claims 18-19. These terms appear to be used synonymously. I will therefore treat them as the same term. This term does not have an ordinary meaning to a POSA. I therefore look to the '075 patent to discern its meaning. The '075 patent discusses electrical shield at 7:13-11:4. The electrical shield 725 is shown in Fig. 7A:



EX1001, Fig. 7A (annotation added).

In my opinion, a POSA would understand the following two quotes as defining the term because they state that the “electrical shield *is*....”

The electric shield is arranged such that at least a portion of the electric shield is configured to contact the touch-screen of the mobile electronic device when the input mechanism is in the extended position. *The electrical shield is a material configured to, when brought in proximity to and/or touches the touchscreen, induce a touch event that is electrically detectable by the touchscreen/device.* In some

implementations the electrical shield material can be a metallized textile/fabric or films, e.g., polymer film coated with a thin layer of metal, for example PET (Polyethylene terephthalate) films and Mylar (BoPET Biaxially-oriented polyethylene terephthalate). Such metalized materials are commonly used in anti-static bags. Moreover, the electrical shield can be comprised of other metallic conductors, non-metallic conductors, metallized fabrics, metallized polymers, conductive polymers, conductive fabrics, flexographic inks, rigid flex printed circuit board (PCB) and the like. EX1001, 7:18-35 (emphasis added).

The viewer further comprises an electrical shield, wherein *the electrical shield is a material configured to induce a touch event that is electrically detectable by a touchscreen/device when at least a portion of the shield contacts or is in proximity to a touchscreen.* In addition, the portion of the electrical shield is positioned between the coupling and the touchscreen such that movement of the coupling advances at least the portion of the electrical shield material toward the touchscreen so as to induce the touch event. EX1001, 10:31-40 (emphasis added).

Some other relevant quotes about this term can be found at EX1001, 7:52-61, 7:62-8:5, 8:27-39, 8:40-45. In light of the specification's express definition of what "electrical shield" "is," I have interpreted "electrical shield/electric shield" to mean "a material configured to induce a touch event that is electrically detectable

by a touchscreen/device when at least a portion of the shield contacts or is in proximity to a touchscreen.”

Lever — The term “lever” appears in claims 12, 15, and 20. The ’075 patent does not define the term, but merely refers to the externally accessible portion of the input device as a “lever” and describes how it interacts with the coupling. See EX1001, 7:13-15, 7:62-64, 8:5-10, 9:10-21, 9:32-46, 10:13-31. I therefore considered some dictionary definitions to determine its ordinary meaning:

1 a: a bar used for prying or dislodging something

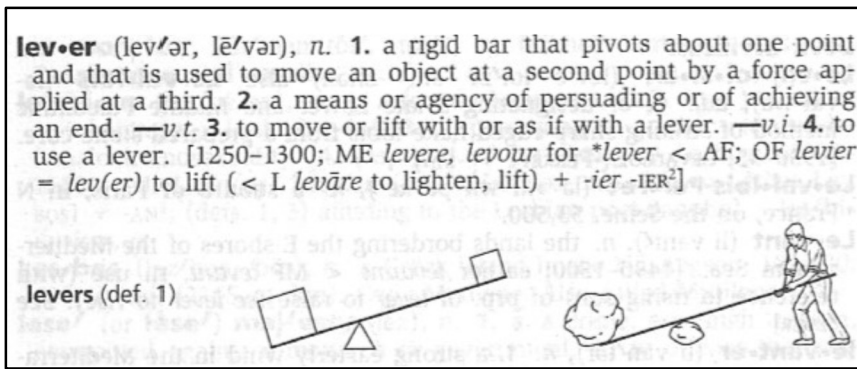
b: an inducing or compelling force : TOOL

use food as a political lever

—Time

2 a: a rigid piece that transmits and modifies force or motion when forces are applied at two points and it turns about a third
specifically : a rigid bar used to exert a pressure or sustain a weight at one point of its length by the application of a force at a second and turning at a third on a fulcrum

b: *a projecting piece by which a mechanism (see MECHANISM sense 1) is operated or adjusted.* Merriam-Webster Online Dictionary, [Lever Definition & Meaning - Merriam-Webster](#) (emphasis added).



EX1006, pg. 3 (Random House Webster's College Dictionary, pg. 764 (2000)).

These definitions encompass a long plank or bar that lifts heavy objects, which a POSA would understand is not relevant to how the term is used in the '075 patent. There is one definition above that is relevant because it relates to how the term lever is used in a device: “a projecting piece by which a mechanism is operated or adjusted.” It is this definition that a POSA would consider to be the ordinary and customary meaning for the term “lever” when used in conjunction with a consumer device.

B. OBVIOUSNESS

19. I understand that prior art can render a patent claim obvious to a person of skill in the art if the differences between the subject matter set forth in the patent claim and the prior art are such that the subject matter of the claim would have been obvious to a person of ordinary skill in the art at the time the claimed invention was made. I understand that obviousness is a legal conclusion,

but I am not offering a legal conclusion. I am testifying regarding the relevant facts that underlie the legal conclusion: the level of skill in the relevant art, the scope and content of the prior art, the differences between the prior art and the claims, and any secondary considerations.

20. I understand that when the claimed subject matter involves combining pre-existing elements to yield no more than one would expect from such an arrangement, the combination is obvious. I understand that, in assessing whether a claim is obvious, one must consider whether the claimed improvement is more than the predictable use of prior art elements according to their established functions. I understand that there need not be a precise teaching in the prior art directed to the specific subject matter of a claim because one can take account of the inferences and creative steps that a person of ordinary skill in the art would employ. I understand that a person of ordinary skill is a person of ordinary creativity, not an automaton.

21. I understand that obviousness cannot be based on the hindsight combination of components from the prior art. I understand that in an obviousness analysis, neither the motivation nor the avowed purpose of the inventors controls the inquiry. Any need or problem known in the field at the time of the invention and addressed by the patent can provide a reason for combining elements. For example, I understand that it is important to consider whether there existed at the

time of the invention a known problem for which there was an obvious solution encompassed by the patent's claims. I understand that known techniques can have obvious uses beyond their primary purposes, and that in many cases a person of ordinary skill can fit the teachings of multiple pieces of prior art together like pieces of a puzzle.

22. I understand that, when there is a reason to solve a problem and there are a finite number of identified, predictable solutions, a person of ordinary skill has good reason to pursue the known options within his or her technical grasp. I understand that, if this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense, which bears on whether the claim would have been obvious.

23. I understand that secondary considerations can include, for example, evidence of commercial success of the invention, evidence of a long-felt need that was solved by an invention, evidence that others copied an invention, or evidence that an invention achieved a surprising result. I understand that such evidence must have a nexus, or causal relationship to the elements of a claim, in order to be relevant.

24. I am not aware of any secondary considerations applicable to the subject matter of the '075 patent, and I have not considered nor provided any

opinions related to the secondary considerations at this time. If the Patent Owner provides any evidence of secondary considerations, I will evaluate it at that time.

V. A PERSON OF ORDINARY SKILL IN THE ART

25. I understand that the teaching of the prior art is viewed through the eyes of a person of ordinary skill in the art at the time of the invention (“POSA” or “person of skill in the art”). To assess the level of ordinary skill in the art, I understand that one can consider the types of problems encountered in the art, the prior solutions to those problems found in prior art references, the speed with which innovations were made at that time, the sophistication of the technology, and the level of education of active workers in the field.

26. Based upon my knowledge and experience in this field and my review of the '075 patent and the prior art, I believe that a POSA at the time of the alleged invention was a person having a minimum of an undergraduate degree (or equivalent) in mechanical engineering or a related field, with knowledge of mechanical actuation systems, basic optical design with lenses, head-mounted displays, a basic understanding of touchscreen technology, and at least two years of experience of professional work experience in mechanical and basic optical design or engineering. At the time of the alleged invention, I was such a person and continue to be. I have also supervised and worked with many such people

over my career and am therefore well aware of a POSA's knowledge, skill, and level of understanding.

VI. THE '075 PATENT

A. State of the Technology at the Time of the Alleged Invention

27. Virtual reality headsets, such as the viewer described in the '075 patent, are based on a long-established, three-dimensional viewing technology called stereoscopy. Stereoscopy uses a pair of separate, distinct images presenting a left-eye and right-eye view with the views being captured or geometrically generated at unique left and right locations; the scene is interpreted by the viewer as a single, three-dimensional image of the scene. Stereoscopy can be traced back to the 1820s. One example of a well-known stereoscopic device is the View-Master, first produced in the 1930s. Shown on the right is a version from the 1960s.



28. Advancements in computers and computing technology led in the late 1960s to development of head-mounted displays (“HMD”) for Augmented Reality (“AR”) and Virtual Reality (“VR”) applications. AR describes superimposing or layering computer-generated images or data in a user’s “real world” field of vision—such as a heads-up display in a fighter pilot’s helmet. VR is similar, but

the user only sees computer-generated images. Both AR and VR require software and multiple hardware devices or systems to be effective. This includes, for example, a tracker to determine the view orientation and position of the user, a real-time graphics processor capable of stereo display generation, and an HMD worn on the user's head.

29. Virtual Reality headsets were originally called “Head-Mounted Displays,” HMDs, before Jarret Lanier coined the term “Virtual Reality.” HMDs were first created in 1968 by Ivan Southerland and his students; it was an ungainly device but demonstrated the concept. In the mid 1980's and especially the early 1990's, significant advances were made in tracking, optics, and computer graphics to allow for the HMDs to become practical. UNC Chapel Hill's Computer Science department was at the forefront of this advancement and much of the technology we developed there has made its way into the consumer market over time.

30. While most head-mounted displays through 2014 used integrated display screens such as in the Rift, the idea of using a mobile device display in a headset was known at least as early as 2008. For example, U.S. Patent No. 8,957,835, assigned to Apple, Inc. and filed in September 2008, discloses a “[h]ead-mounted display systems and methods of operation that allow users to

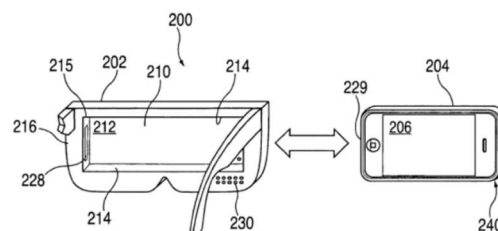


FIG. 2B

couple and decouple a portable electronic device such as a handheld portable electronic device with a separate head-mounted device....” Although not shown in this image, the Apple patent discloses an embodiment using a left and right optical lens “so that the user is given the illusion of viewing image based content in three dimensions.” EX1005, 3:20-23, 23:34-39, Fig. 2B.

31. Prior to 2014 and still through today, there were multiple types of touchscreens that were integrated into mobile electronic devices; these include infrared, pressure, resistive, and capacitive. In order to be able to have as much consumer appeal as possible for a VR headset, one would want to accommodate as many current and legacy devices as possible. As of 2012, the filing date of Chu (EX1004), the most common types of touchscreens used by handheld devices, like smartphones, were resistive and capacitive touchscreens. EX1004, ¶0003.

Resistive screens: These screens are made up of two layers of conductive material, typically polymer coated glass and a polymer coated plastic, and have the ability to take direct input by touch including a gloved finger or stylus. They are also resistant to water and dust. Resistive screens are now more common on legacy and lower-priced smartphones. Physical pressure is needed to make resistive screens function.

A resistive touch screen includes a glass sheet coated with a thin conductive layer and a metallic layer. The two layers are separated by

a spacer. When a user makes contact with the touch screen, the two layers touch each other at the same location. The change in electric current will be identified and computed to a set of coordinates on the touch screen display. A resistive touch screen can be operated by fingers or by many types of object as long as it can provide pin point compression on the touch screen. EX1004, ¶0004.

Capacitive screens: These screens use the electrical properties of the body to create a change of charge at a location on a polymer coated touchscreen. They require a finger or conductive path to a body but are able to detect lighter touches. Their biggest advantages are that one can use multi-touch instead of a single finger-tip only and have more robust screens since the two perpendicular conductive layers are behind the glass screen. Capacitive screens are more costly than resistive screens.

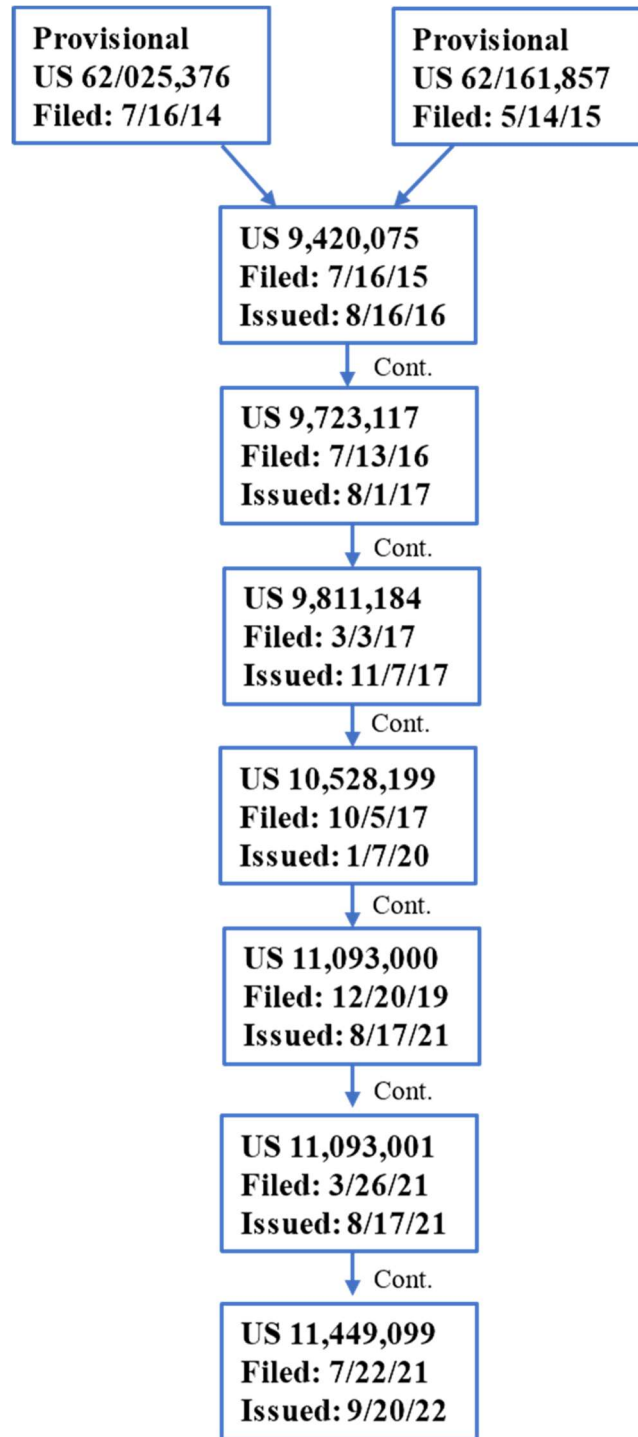
A capacitive touch screen includes a thin conductive layer such as Indium Tin Oxide, which is visually transparent. It stores electric charge and is positioned on a glass layer of the display. When a user makes contact with the touch screen, usually with a bare finger, small quantity of electric charge is transmitted to or from the user's finger. The quantity of electric charge on the touch screen at the designated position is reduced or increased. This change in electric charge is detected and computed to a set of coordinates on the display. A finger usually works well with capacitive touch screen. A human body is a good transferor and transferee of electric charge because of the electromagnetic field around the human body at all times. A device

composed of compatible materials with good conductivity of electric charge can perform the function. However, a pencil or stylus which is workable on a resistive touch screen is not workable on a capacitive touch screen. EX1004, ¶0005.

32. One well-known goal for devices that encompass a smartphone (*e.g.*, VR viewers) at the time of the '075 patent's alleged invention was to accommodate as many different types of touchscreens as possible (both current and legacy), thus appealing to a wide range of consumers.

B. The '075 Patent

33. The '075 patent is one of a family of related patents, all continuations, which I understand means that the patent specifications are all claimed to basically be the same with only the claims changing. This family stems from two provisionals, which I understand serve as priority documents but are not substantively examined. A diagram of this family follows:



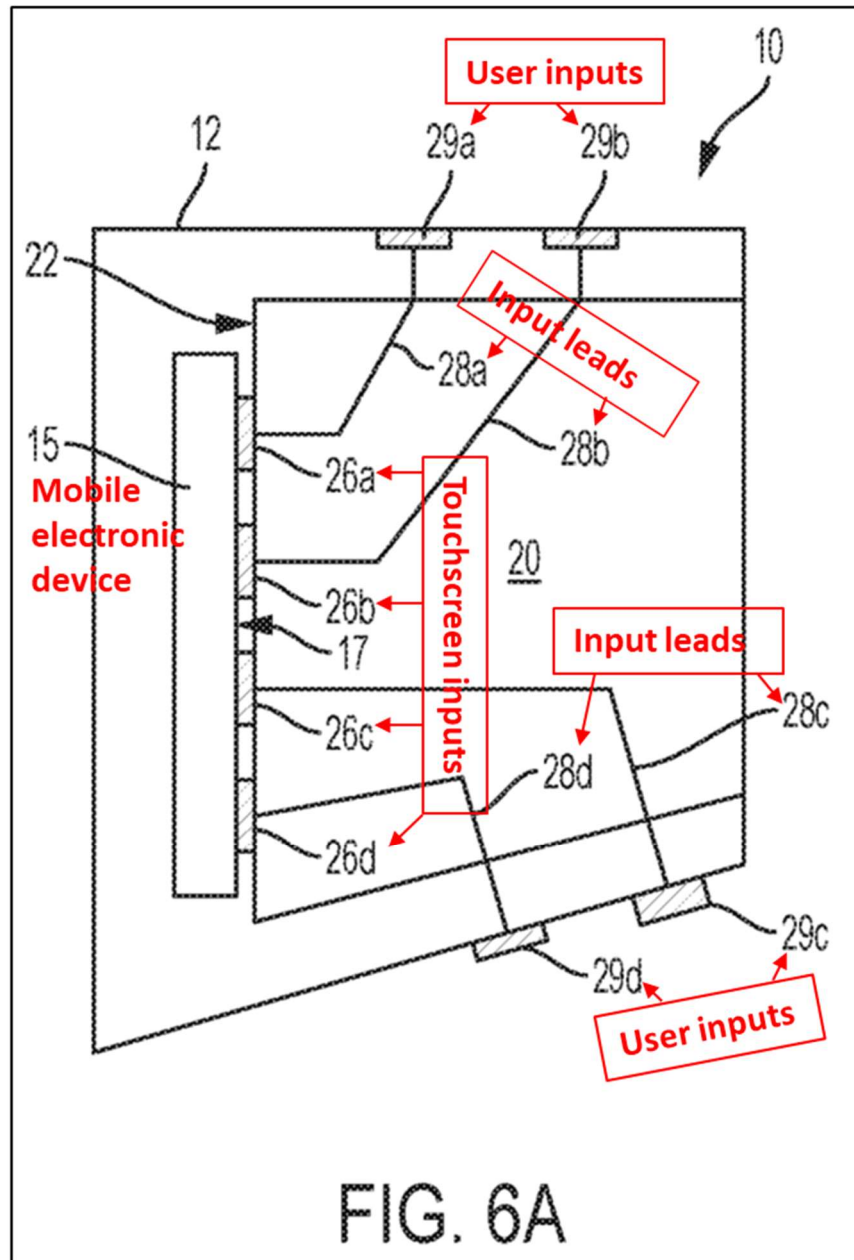
34. The '075 patent purports to invent a virtual reality viewer with “an input mechanism that can be used with [a] mobile electronic device having a touchscreen contained within the viewer.” EX1001, 2:19-22. However, the '075

patent admits that VR viewers with input devices were well-known at the time of the alleged invention. For example, in the Background of the Invention section, the patent admits that “[w]ith the widespread distribution of powerful and capable smartphone devices, many VR viewers are designed to use such smartphone devices as the visual display device, instead of having dedicated displays and electronics.” EX1001, 1:30-36.

35. The Background continues by admitting that “[t]ypically the viewers have a housing that a user looks into in order to view the video display device contained within the housing” and that “[v]iewers can be hand-held devices that a user holds up to the users [sic] face/eyes....” EX1001, 1:37-43.

36. The Background mentions that since a smartphone is enclosed within the viewer, “[o]ne challenge ... is that the touch sensitive display is concealed within the viewer housing, thereby making it difficult for a user to interact with the touch sensitive display....” EX1001, 1:56-59. Additionally, the Background admits that some VR viewers use magnets as input devices and “[o]ther VR viewers utilize dedicated input devices, like video game controllers....” EX1001, 1:59-2:10.

37. The ’075 patent is directed to two embodiments of input mechanisms: one is an electrical connection, referred to in the patent as “passive,” as shown in Figure 6A:

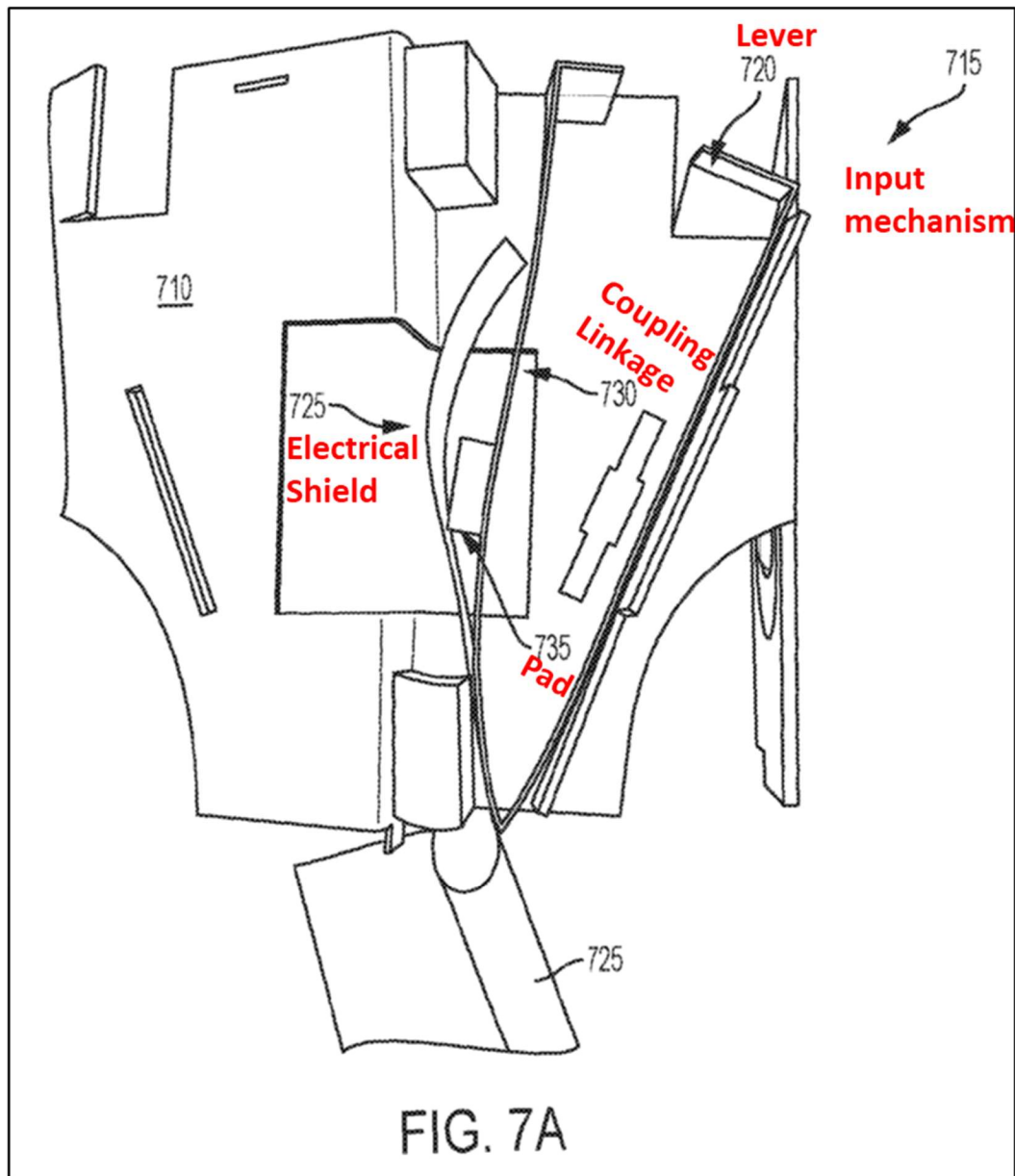


EX1001, Fig. 6A (annotations added).

38. This embodiment includes touchscreen inputs 26a–26d electrically coupled to user inputs 29a–29d via input leads 28a–28d. User inputs 29a–29d are exposed on the outer surfaces of the housing so that the user can interact with them

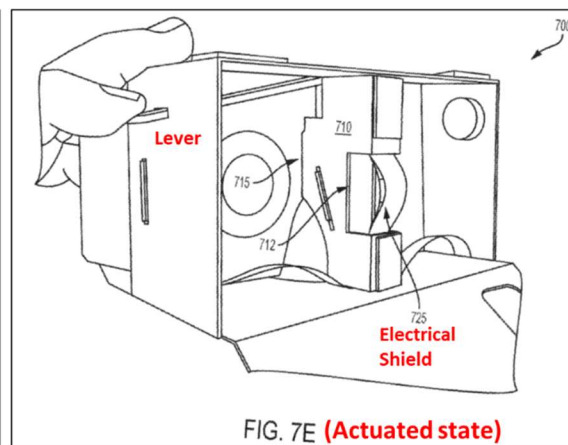
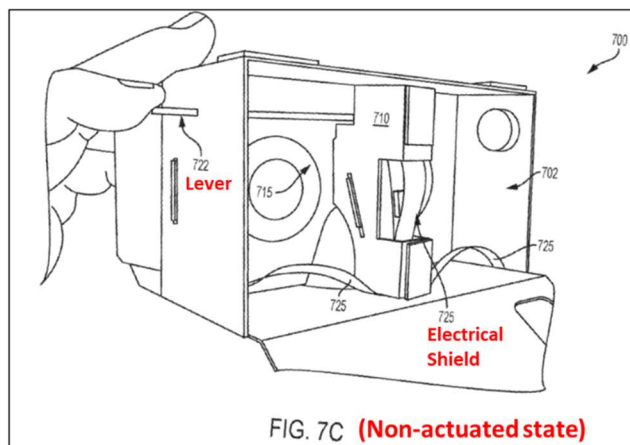
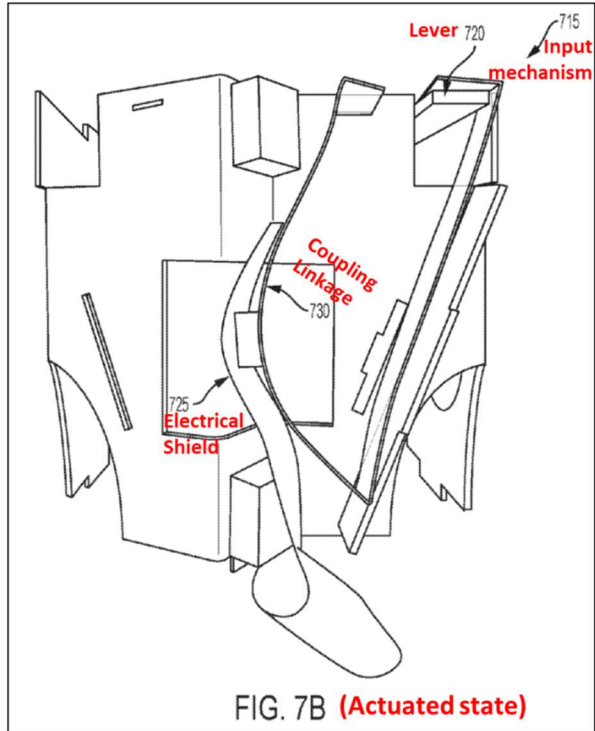
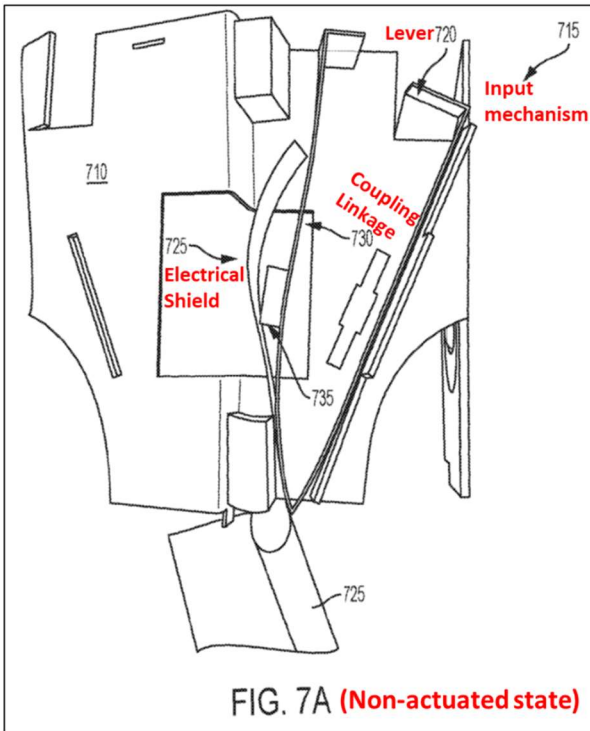
to provide input to the mobile electronic device 15. EX1001, 3:25-6:50, 5:24-40, Figs. 6A–B. In this way, the user inputs 29a-29d transfer a capacitive touch to touchscreen inputs 26a–26d.

39. The other embodiment is a mechanical embodiment, which the patent refers to as “active,” as shown in Figures 7A-F. Figure 7A is reproduced below:



EX1001, Fig. 7A (annotations added).

40. In this embodiment, the input mechanism 715 is moveable within the housing/enclosure. EX1001, 7:13–10:8, Figs. 7A–F. In particular, the viewer 700 (not shown) includes a lever 720 that is accessible from an exterior of a housing/enclosure to bring the electrical shield 725 into an actuated state where a contact event is transferred to a touchscreen and a non-actuated state where a contact event is not transferred to the touchscreen inside the housing/enclosure. A coupling linkage 730 extends between the lever 720 and the electrical shield 725. EX1001, 7:13–10:8. A pad 735 sits between the coupling linkage 730 and electrical shield 725. “[A]ctuation of the lever causes the coupling to deform and extend in a direction towards the touchscreen, which in turn moves a portion of the electrical shield towards the touchscreen.” EX1001, 8:7-10. Figures 7A and 7C below show the non-actuated state, and Figures 7B and 7E below show the actuated state.



EX1001, Figs. 7A, 7B, 7C, 7E (annotations added).

C. The '075 Patent's Prosecution History

41. The '075 patent received one substantive office action in which all claims were rejected under §102 in view of Compton et al. (US 2013/0141360).

See EX1008, pps. 38-50. In response, the Patent Owner amended its claims, including claim 1 as follows:

1. (Currently Amended) A virtual reality viewer for use with a mobile electronic device having a touch-screen, the viewer comprising:

a housing configured to receive ~~a~~the mobile electronic device within ~~an~~a generally hollow interior of the housing, wherein the housing is configured to hold the touch-screen such that it is generally centered in a horizontal direction and directly in a user's field of view when looking into the interior of the housing through a side opposite the touch-screen;

an input mechanism that is accessible from an exterior of the housing and is moveable within the interior between at least a first position and an extended position, the input mechanism comprising:

an electrical shield having a surface, wherein only a portion of a~~the~~ surface of the input mechanism the electrical shield is configured to contact a central region of the touch-screen of the mobile electronic device when the input mechanism is in the extended position.

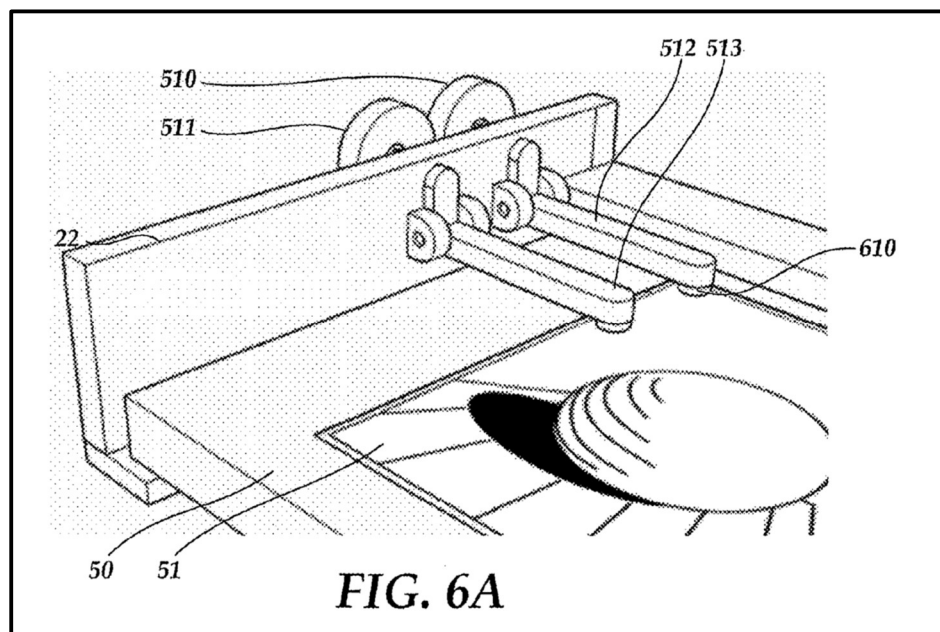
EX1008, p. 22.

42. The Patent Owner held an interview, and noted in its response that the “undersigned believes that the Examiner also appreciated additional distinctions” including “that Compton fails to disclose an input mechanism including an electric shield wherein only a portion of a surface of the electric shield material is configured to contact the touch-screen when the input mechanism is actuated.”

EX1008, p. 30. In the remarks section, the Patent Owner argued that claim 1 had

been amended to clarify that “only a portion of the surface of the electrical shield is configured to contact a central region of the touch-screen...” EX1008, p. 31(emphasis in original).

43. The Patent Owner then argued that Compton failed to disclose the electrical shield limitation because it consists of “a rigid rocker arm (e.g., 512, 513) that is pivotably mounted to the mobile device holder 22 and has a ‘special tip 610’ at the end of the rocker arm that makes contact with *the edge* of screen 51” and then referred to the following Figure from Compton:



EX1008, pps. 32-33 (emphasis in original).

44. The Patent Owner emphasized that the claimed input mechanism provides input to “*the central region of the touch-screen....*” EX1008, p. 33 (emphasis in original). The Patent Owner contrasted Compton because “the

surface of the *entire tip* is configured to touch the screen” and that “Compton fails to describe the special tip and its configuration with particularity.” EX1008, p. 33 (emphasis in original).

45. The Examiner then issued a notice of allowance. His reasons for allowance referred to the electrical shield limitation and stated the following about the prior art: “[t]here is no discussion of an electrical shield, where only a portion of the surface of the electrical shield contacts a central region of the mobile device.” EX1008, p. 17. This statement is ambiguous. While it is clear from Compton’s Figure 6A above that the rocker arm’s tip contacts only the edge of the touchscreen, and not the center, it is unclear whether the Examiner agreed with Patent Owner’s additional argument that all of Compton’s tip’s surface (i.e., “entire tip”) contacts the touchscreen. In effect, the Patent Owner was arguing that the sides of Compton’s tip did not constitute part of the surface, and it is on this point that the prosecution history is unclear.

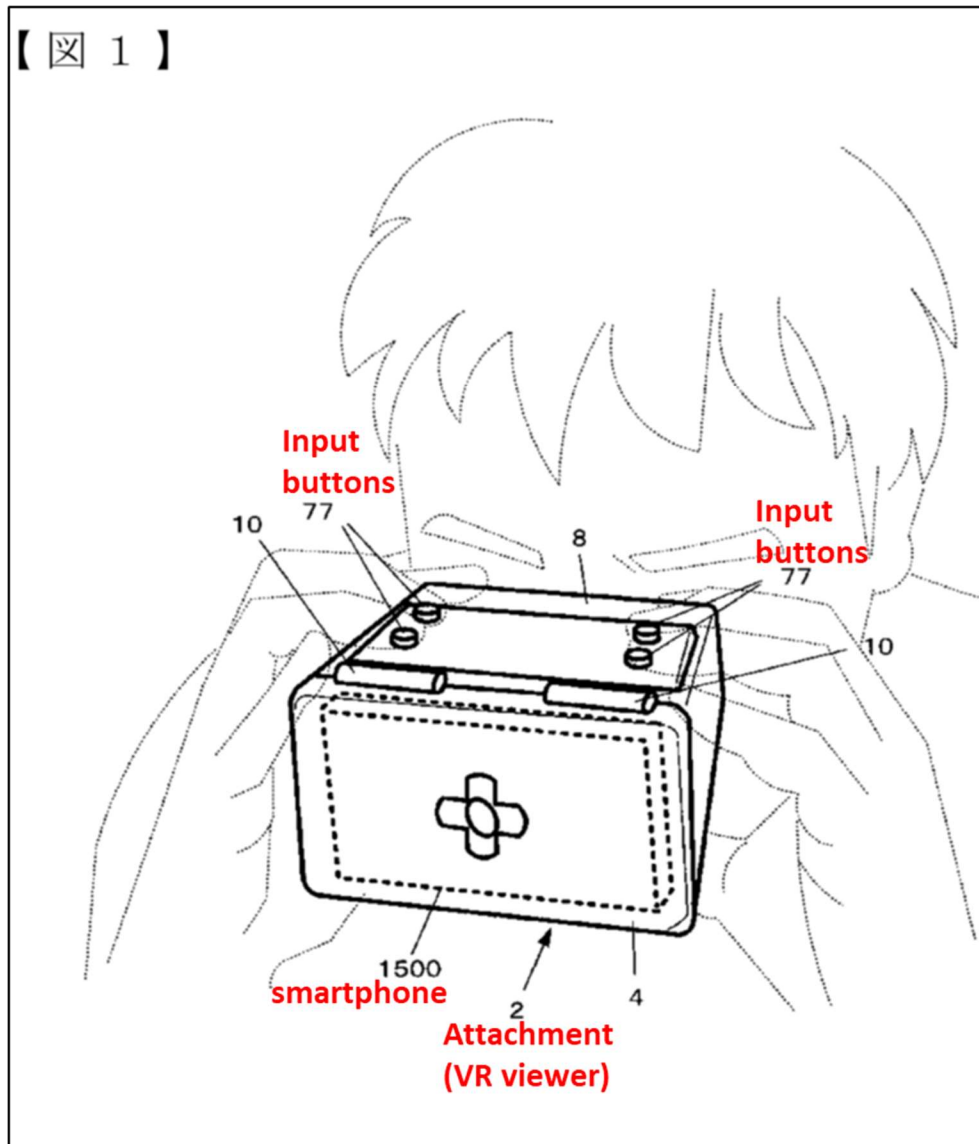
46. Regardless, as I discuss with respect to claim 1(d) below, in past and present district court litigations, the Patent Owner has accused devices of infringement and alleged that the sides of the mechanism that contacts the touchscreen constitute part of the surface of the electrical shield.

VII. PRIOR ART

A. Kondo – JP3176588

47. Kondo is a Japanese patent entitled “Remote Touch Circuit and Attachment,” issued on June 28, 2012, which provides a VR viewer so the user can enjoy “three-dimensional stereoscopic images.” EX1003, ¶0021; *see also* Fig. 3, ¶0027. Kondo refers to its VR viewer as an “attachment” using reference numeral “2.” I will therefore use “VR viewer” and “attachment” interchangeably when describing Kondo.

48. Kondo is directed to the same problem as the '075 patent, namely, “[t]o provide an attachment that achieves remote control input to a touch panel mounted on an electronic device.” EX1003, p. 2; *see also*, ¶4. Kondo’s solution is to equip the VR viewer “with a remote touch circuit that enables remote operation input to the touch panel from the outside using the fingers gripping the attachment.” EX1003, p. 2. Kondo’s input mechanism is electrical or passive. EX1003, ¶0005. Kondo’s Figure 1 below shows this input mechanism (buttons 77) on a VR viewer 2 with a smartphone 1500 mounted therein. EX1003, Fig. 1; ¶0022.



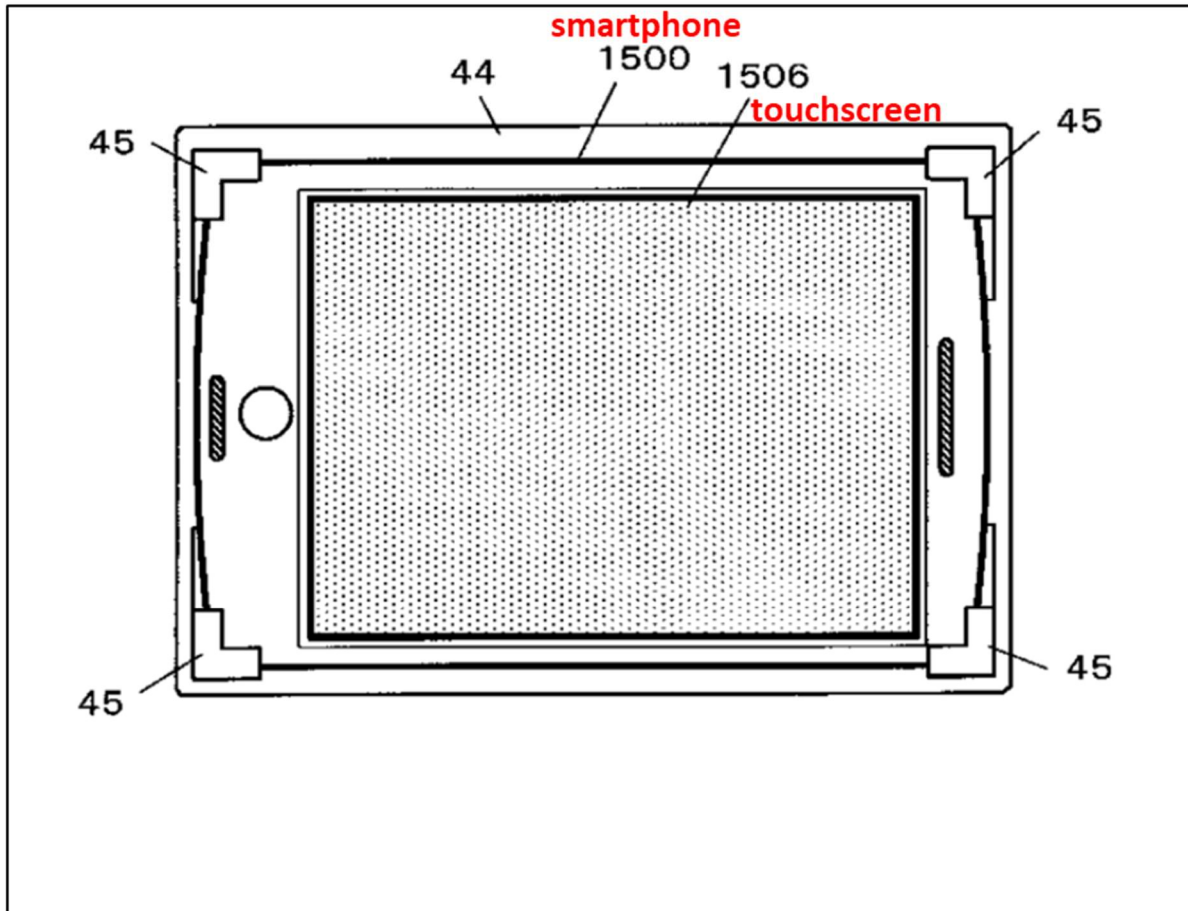
EX1003, Fig. 1 (annotations added).

49. Kondo describes how the remote touch circuit is mounted and utilized, and the benefits of having externally available buttons 77. The basic concept is to have one or more electrically conductive pads 76 placed over the smartphone screen and electrically in contact by wire with the external buttons 77. These external buttons are placed on the outer shell of the virtual reality viewer

EX1003, Fig. 7 (annotations added).

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touch panel shown as 1506 in Fig. 8, see below) via electrical wire 72 and touch pads 76. EX1003, Fig. 7; ¶¶0043-0048.

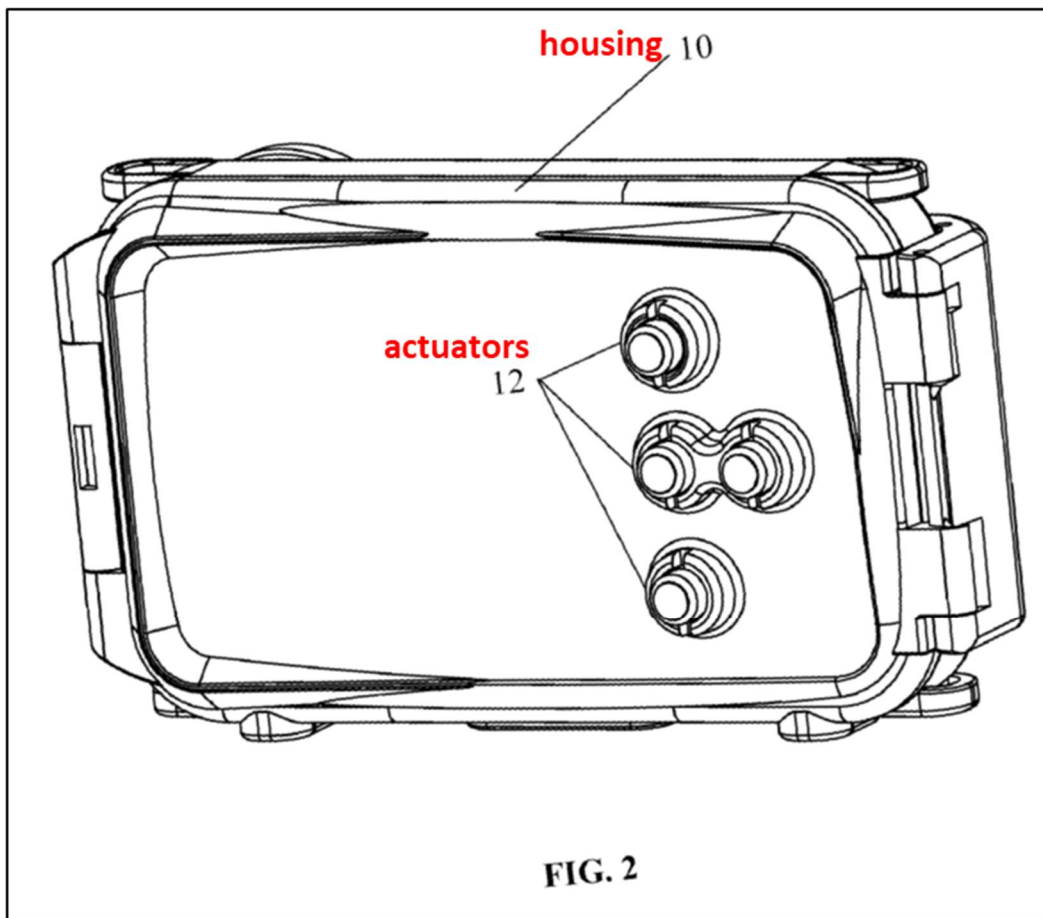


EX1003, Fig. 8(2) (annotations added).

51. Kondo discloses alternative embodiments, such as button 77 connecting to a different capacitive element other than the human body (Fig. 12, ¶0054) and using a game controller to operate the smartphone (Fig. 13, ¶0055). Kondo also specifically contemplates alternatives to button 77, including “a cross-shaped directional input key, a joystick, and the like.” EX1003, ¶0057.

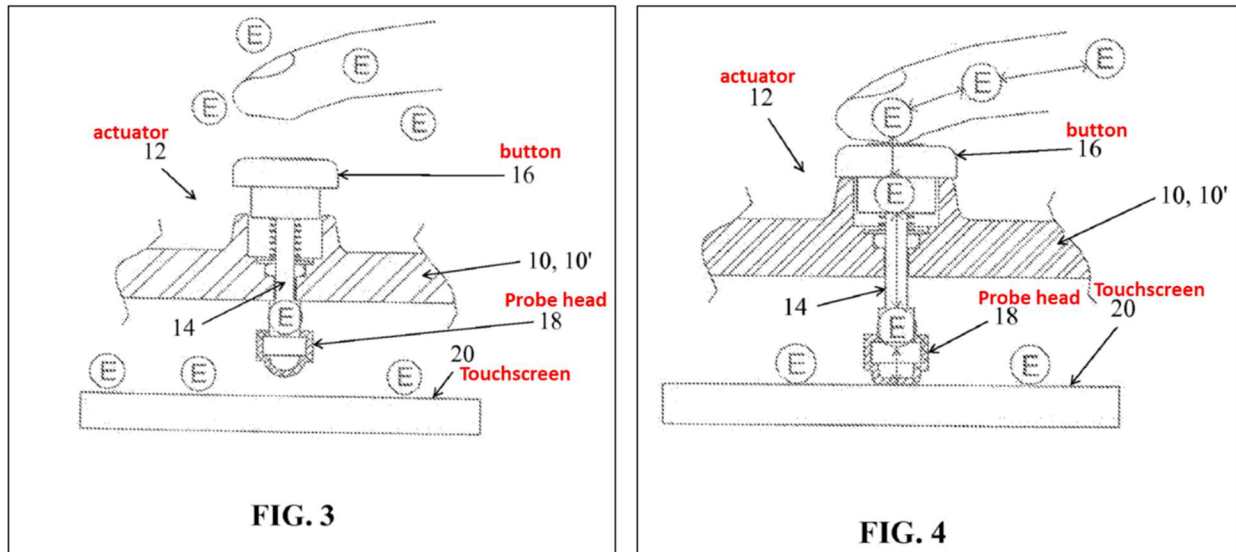
B. Chu – U.S. 2013/0082963

52. Chu is a U.S. patent publication dated April 4, 2013. It is directed to actuating a capacitive touchscreen of a smartphone held within a waterproof housing. EX1004, Abstract. Fig. 2 below shows the housing 10 enclosing a smartphone as well as the actuators 12, or input mechanisms, that are capable of actuating the touchscreen on the smartphone through physical contact:



EX1004, Fig. 2 (annotations added).

53. Figure 3 shows actuator 12 at rest, and Figure 4 shows the actuator 12 in an actuation position where probe head 18 is touching the capacitive touchscreen 20 to create a touch event. EX1004 ¶¶0040-0041.

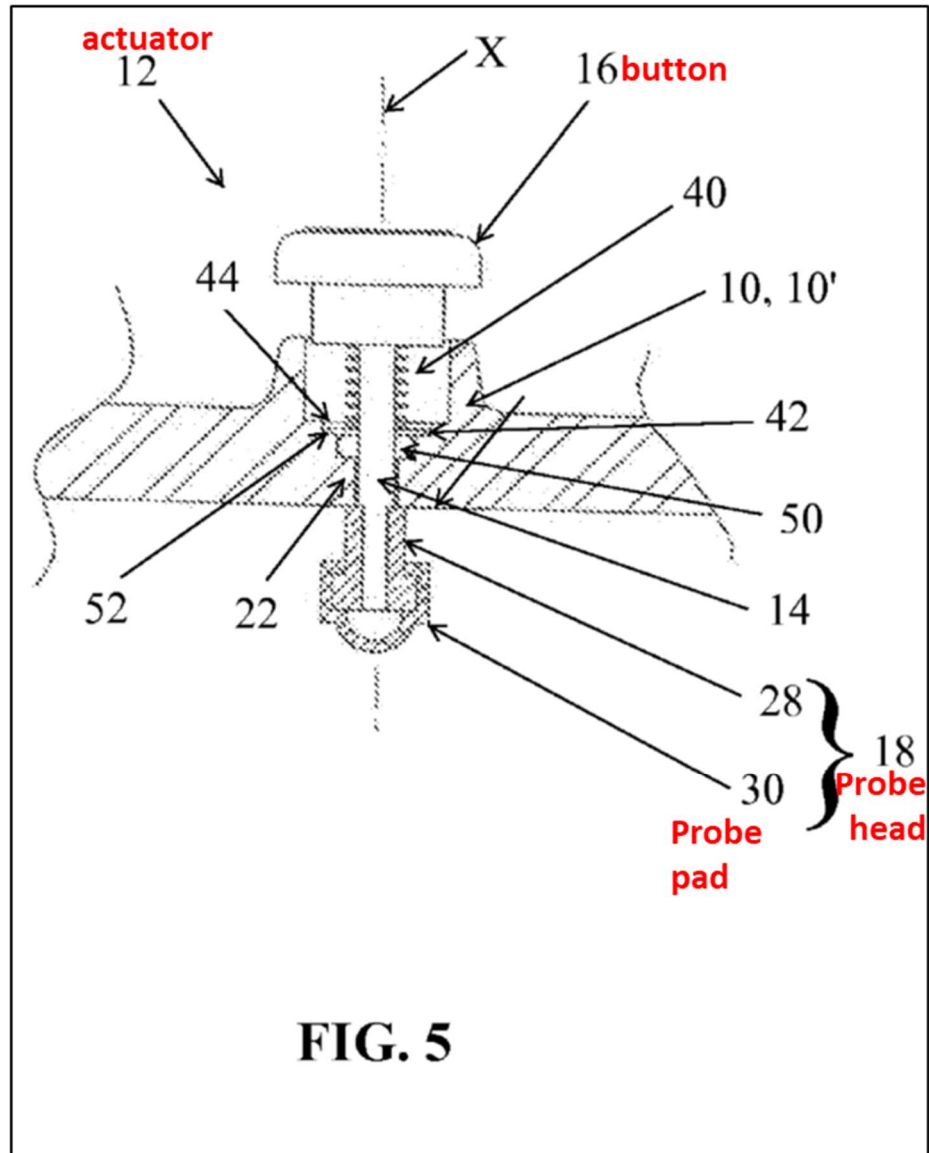


EX1004, Figs. 3, 4 (annotations added).

54. Chu explains that when the user presses down on button 16, the contact area with button 16 increases, and since button 16 is metal, the user's finger is electric charge connected. If the user continues to press down, the probe head will contact the touchscreen (see Figure 4 above) and the electric charge conductivity between the user, conductive shaft 14, and button 16 improves. EX1004, ¶0054-0055.

55. Figure 5 shows a more detailed view of probe head 18, which includes probe pad 30 for direct contact with the touchscreen 20. The probe pad 30 may be

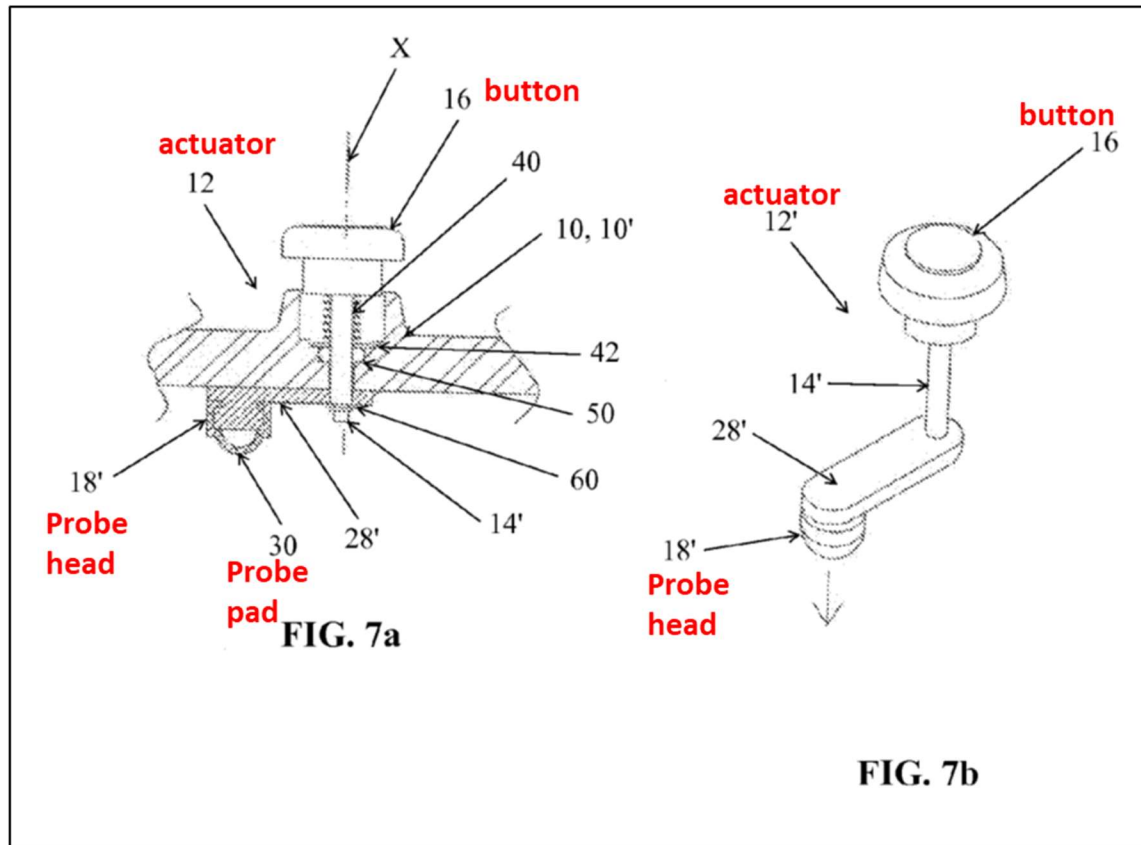
made of rubber with an additive to “enhance its electric charge transfer performance.” EX1004, ¶¶0048-0049.



EX1004, Fig. 5 (annotations added).

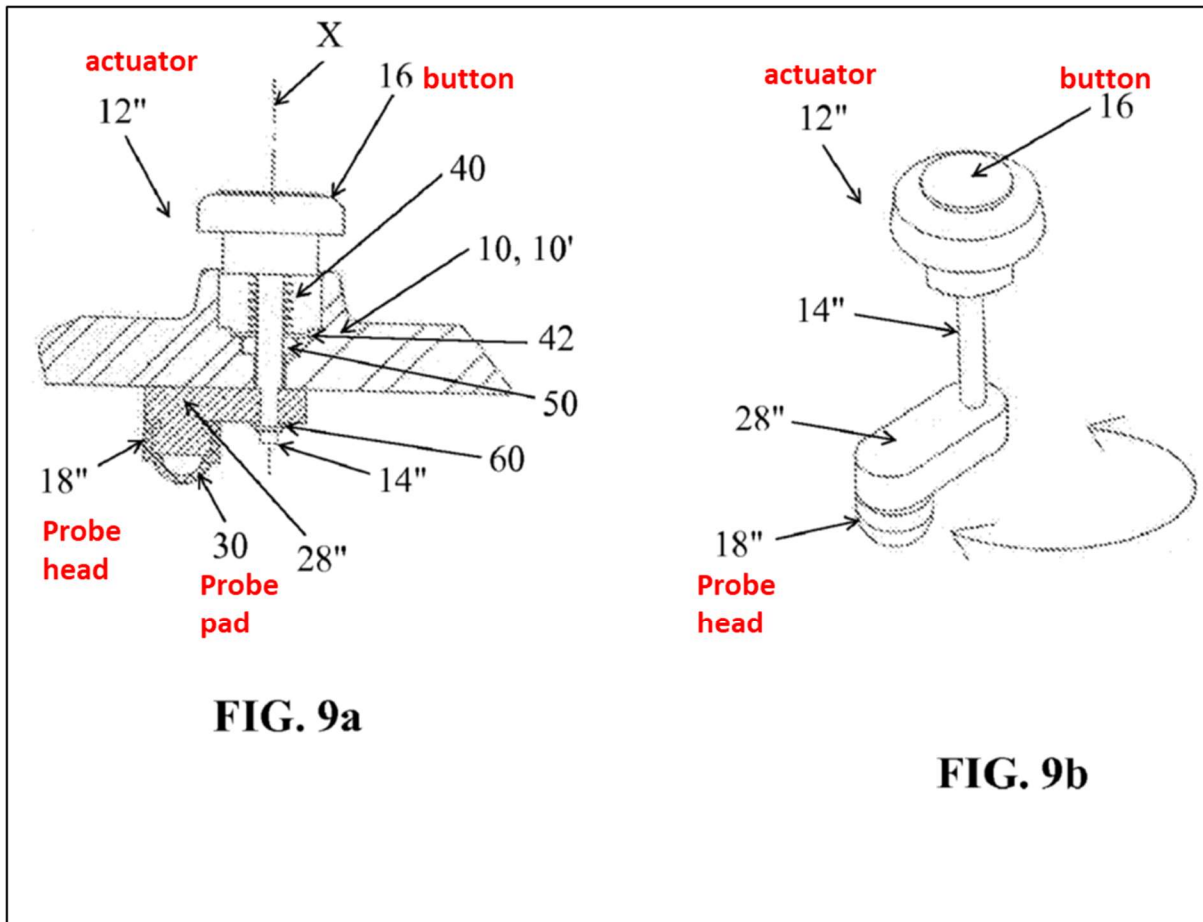
56. Figures 7a and 7b below show an alternative embodiment that operates similarly to the first embodiment in that when the user presses button 16,

the probe head 18 (and probe pad 30) comes into contact with touchscreen 20 (see ¶¶0058-0059):



EX1004, Figs. 7a, 7b (annotations added).

57. Chu recognizes that in some situations, the touchscreen may require a “touch-swipe” or “touch-circle” motion where the probe head needs to move in a swiping or circular motion. Chu therefore describes another embodiment for just this situation where the user presses down on button 16 and can turn the button so that probe head 18” touches touchscreen 20 and can move along a circular path, causing a swipe. EX1004, ¶¶0060-0062.



EX1004, Figs. 9a, 9b (annotations added).

58. A POSA would understand Chu as a conductive extension actuator from the interior to the exterior location of the device. The exterior location is accessible by the user and can be pressed by a user to create the capacitive or electrically conductive touch with the mobile device display within the housing. A POSA would understand that Chu would work not only with capacitive touchscreens, but also with resistive touchscreens. As to resistive touchscreens, Chu's mechanical input device applies pressure to the touchscreen, thus providing

a touch input for a resistive touchscreen. At ¶0004, Chu explains how such pressure will provide a touch input to a resistive screen.

C. Motivation to Combine Kondo and Chu and Reasonable Expectation of Success

59. As I mentioned above in §VI(A), the most common touchscreens on the market as of the time of the '075 patent's alleged invention were capacitive and resistive. A mechanical input mechanism, like Chu's, can work with both types of screens, whereas an electrical input mechanism, like Kondo's, can only work with capacitive screens. One goal of device designers is always to increase the usability and consumer appeal for their product where possible, allowing many different types of smartphones and touchscreens to be used. In this situation, a VR designer looking at Kondo would readily realize and be motivated to increase the usability and consumer appeal for their device by making it work with both capacitive and resistive screens and therefore would be led to Chu. Chu's input mechanism works with both types of screens.

60. Moreover, both Kondo and Chu deal with a smartphone enclosed in a housing or device and both references face a similar problem, the external activation of the touchscreen of the smartphone enclosed in that device. *See e.g.*, EX1003, pg. 2 ("PROBLEM To provide an attachment that achieves remote control input to a touch panel mounted on an electronic device"), EX1004, ¶0009

(“Therefore, there is a need to provide a specially designed actuator mechanism for actuating a capacitive touch screen of a digital device inside a waterproof housing.”). Therefore, a POSA that is designing a VR viewer by using Kondo would look to other available input mechanisms, thus leading the POSA to Chu.

61. There are additional reasons why a POSA would combine Kondo/Chu. First, because Chu’s input mechanism is mechanical, the user can press the button using different levels of pressure, increasing not only the area in which contact is made but also the conductivity. Touchscreens can interpret this as differing inputs, based on the size of touch-screen contact, the level of pressure, and the level of conductivity. In other words, Chu provides a wider range of input at a single location on the touchscreen rather than just binary input (i.e., on or off).

62. Second, Chu’s “swipe” embodiment provides additional input to Kondo’s device. Not only can Chu provide a “touch” with different amounts of pressure and conductivity, but it also enables a whole new form of input, the swipe. A POSA would understand that having additional inputs beyond a mere binary touch, such as differing pressures, conductivity, and swipes, would allow the VR viewer to provide more functionality. The Kondo/Chu combination would therefore allow the resulting VR viewer to be used for more applications, increasing the desirability of the device.

63. Third, Chu's input mechanism is not only a mechanical mechanism, but it is designed to be waterproof, and thus, adding Chu's input mechanism to Kondo has advantages.

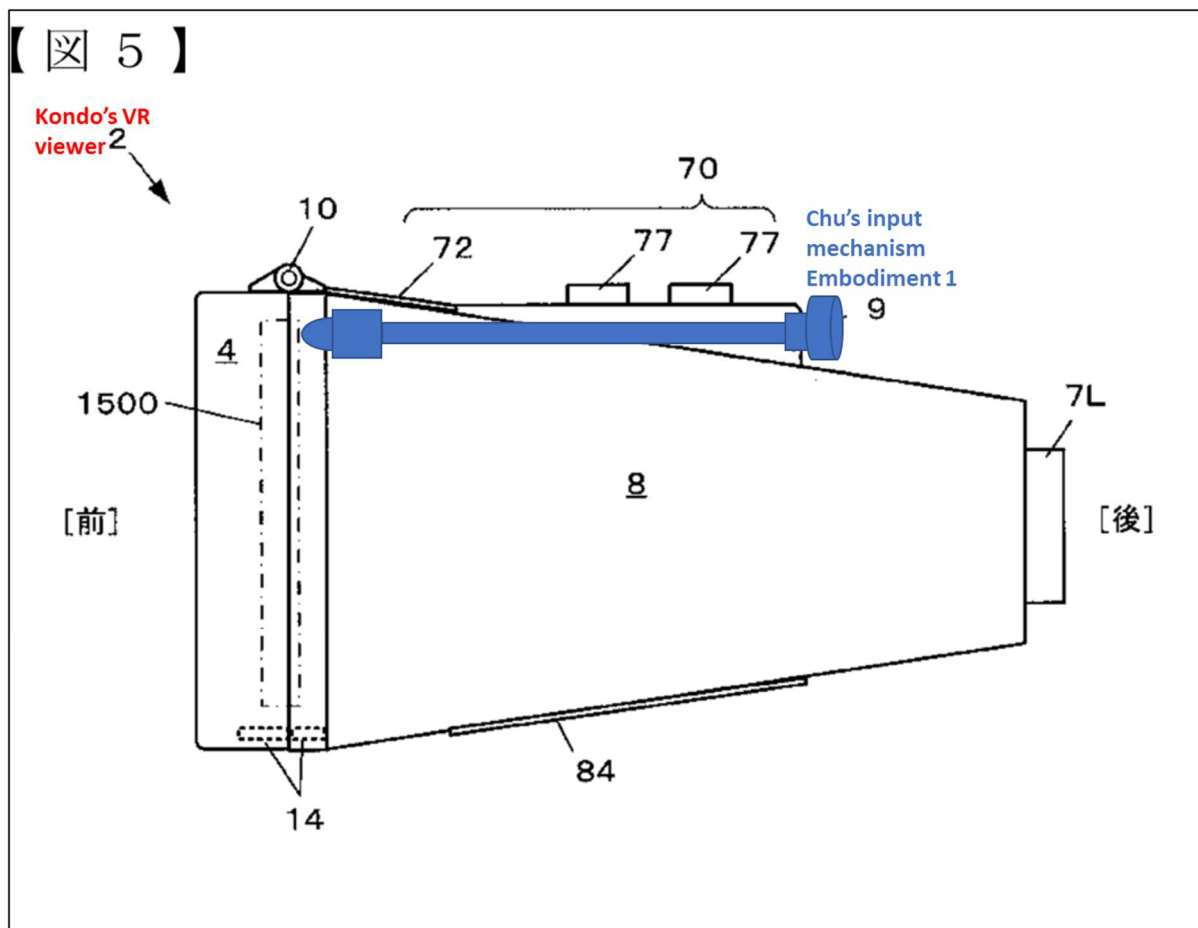
64. In particular, this combination of Kondo and Chu would be less susceptible to damage from water and other environmental factors, like dirt and dust. Handheld devices are often subjected to such conditions if they are used outdoors or even indoors if dropped in some liquid or splashed by accident for example. Of course, this combination would also allow the resulting device to be used underwater.

65. Fourth, this combination would allow the device to be cleaned without fear of cleaning fluid reaching the inner parts of the device. This can be important if the VR viewer is being used in a sanitary environment, such as during a medical procedure or in a manufacturing facility, like a semiconductor fabrication facility. For these reasons, a POSA would be motivated to combine Kondo/Chu.

66. Both Kondo and Chu are simple mechanical devices. Thus, a POSA would have a reasonable expectation of success in combining Chu's input mechanism with Kondo. In fact, a POSA would consider the formation of this combination to be merely routine, requiring little skill.

67. The following diagram shows how a POSA could easily combine Chu's first embodiment (depicted in **blue**), found in Figs. 3-6, with Kondo's Fig. 5.

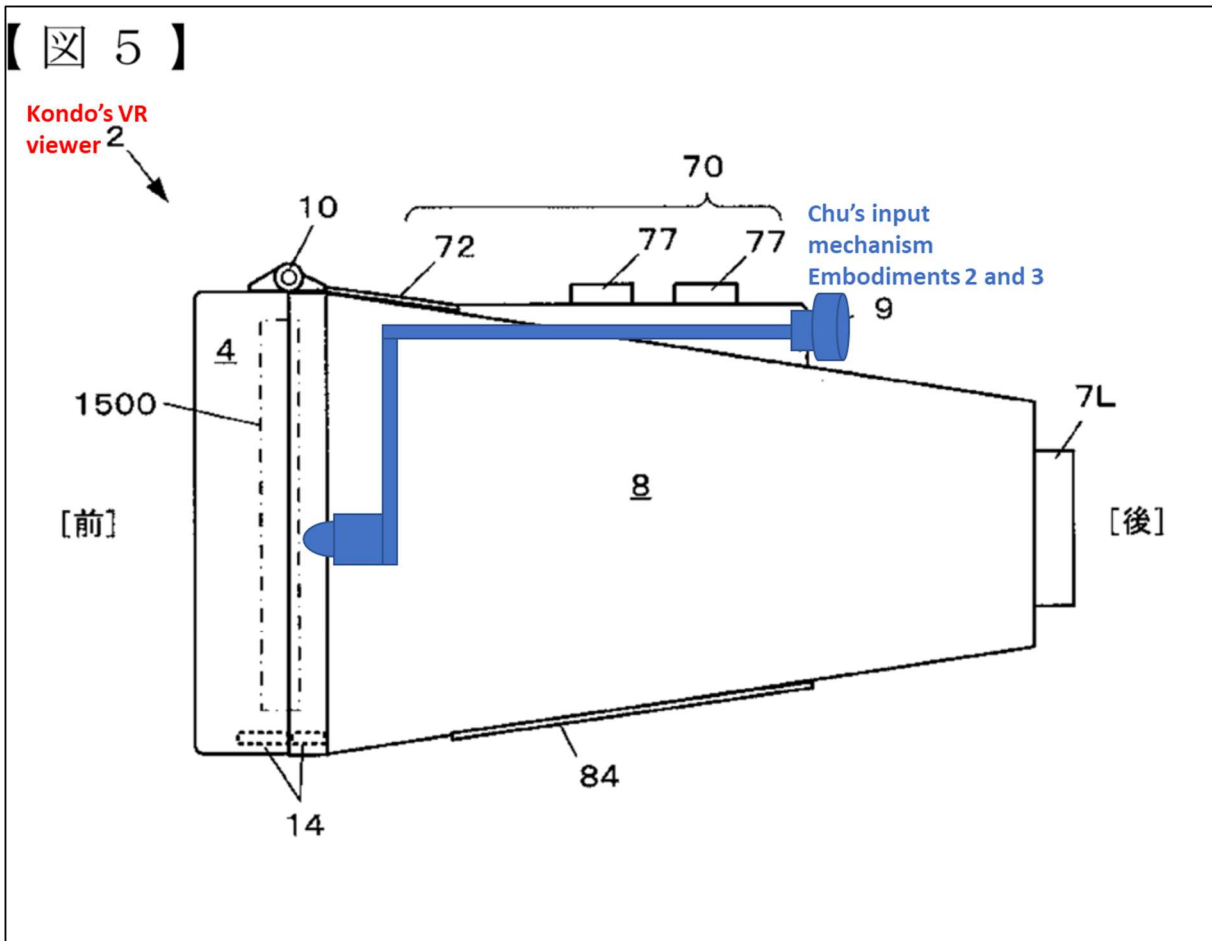
Of course, inputs 77 and electrical wire 72 would be removed. To do so would require little effort and skill, and a POSA would have a reasonable expectation of success. This figure is not to scale and is only illustrative. A POSA would recognize that minor adjustments might need to be made, like elongating the stem of Chu's input device, and possibly providing supportive structure inside of Kondo's device to accommodate Chu's input device. In fact, Chu contemplates such structure as "one or more posts or guides" and shows supportive structure in its figures. EX1004, ¶0059, Figs. 3-10. All such modifications are well within the skill of a POSA, requiring little ingenuity.



EX1003, Fig. 5 (annotated to include Chu's input device).

68. In the above diagram, Chu's input mechanism could be smaller and take a variety of sizes. Additionally, the outer shell of Kondo's device through which Chu operates could easily be extended to accommodate more input devices if desired.

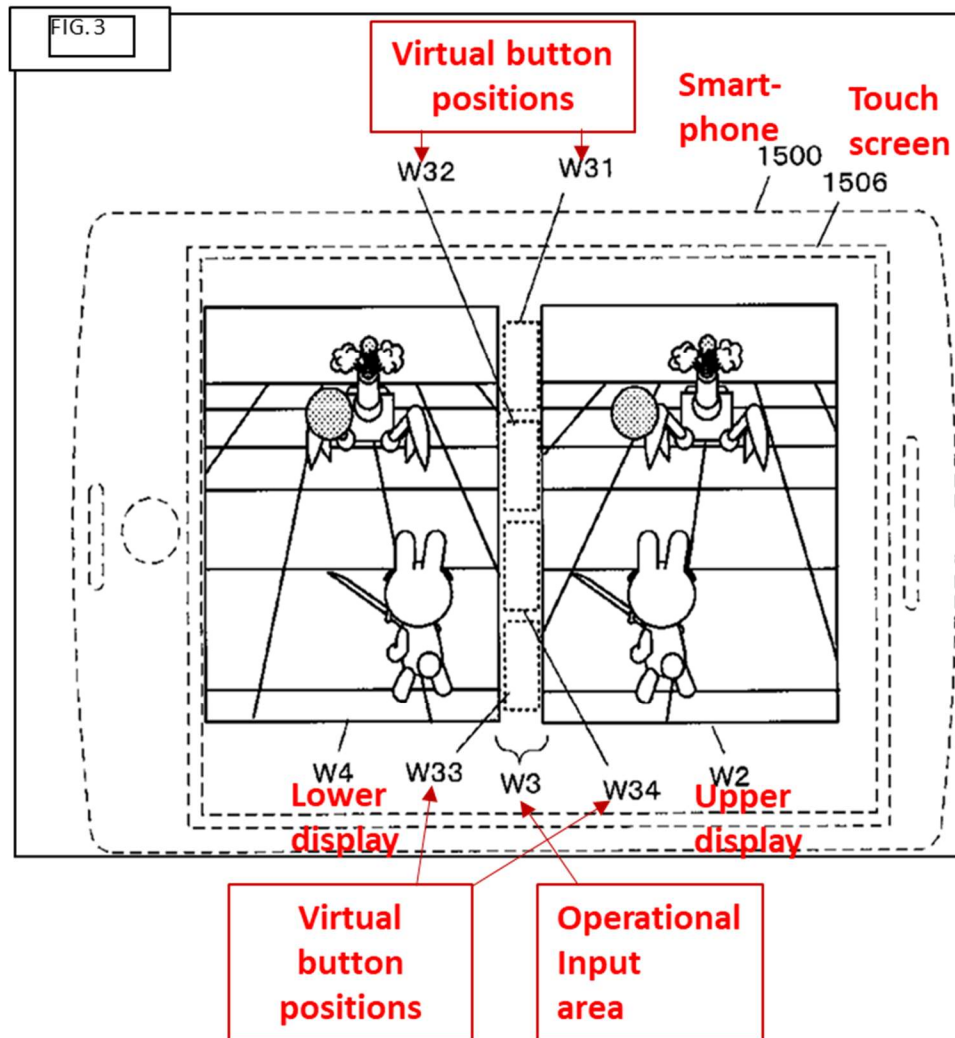
69. The following diagram shows how a POSA could easily combine Chu's second embodiment, found in Figs. 7a, 7b, and 8, and third embodiment, found in Figs. 9a, 9b, and 10, in Kondo's Fig. 5. Chu's input mechanism reflecting both the second and third embodiments is depicted in **blue**. Again, inputs 77 and electrical wire 72 would be removed. This would require little effort and skill, and a POSA would have a reasonable expectation of success.



EX1003, Fig. 5 (annotated to include Chu's input device).

70. Again, minor adjustments might need to be made, including adding supportive structure. But those modifications would be well within the skill of a POSA, and as I said with respect to my discussion of Chu's first-embodiment combination, Chu contemplates such supportive structure. Additionally, Chu's input mechanism could be smaller and take a variety of sizes. And, the outer shell of Kondo's device through which Chu operates could easily be extended to accommodate more input devices if desired.

71. Both combinations shown above would contact the central region of the smartphone's touchscreen because Kondo shows that its operational input area is at the center of the touchscreen and this operational input area contains virtual button positions for operating the smartphone.



EX1003, Fig. 3 (annotations added), ¶¶0027-0028.

VIII. VALIDITY ANALYSIS

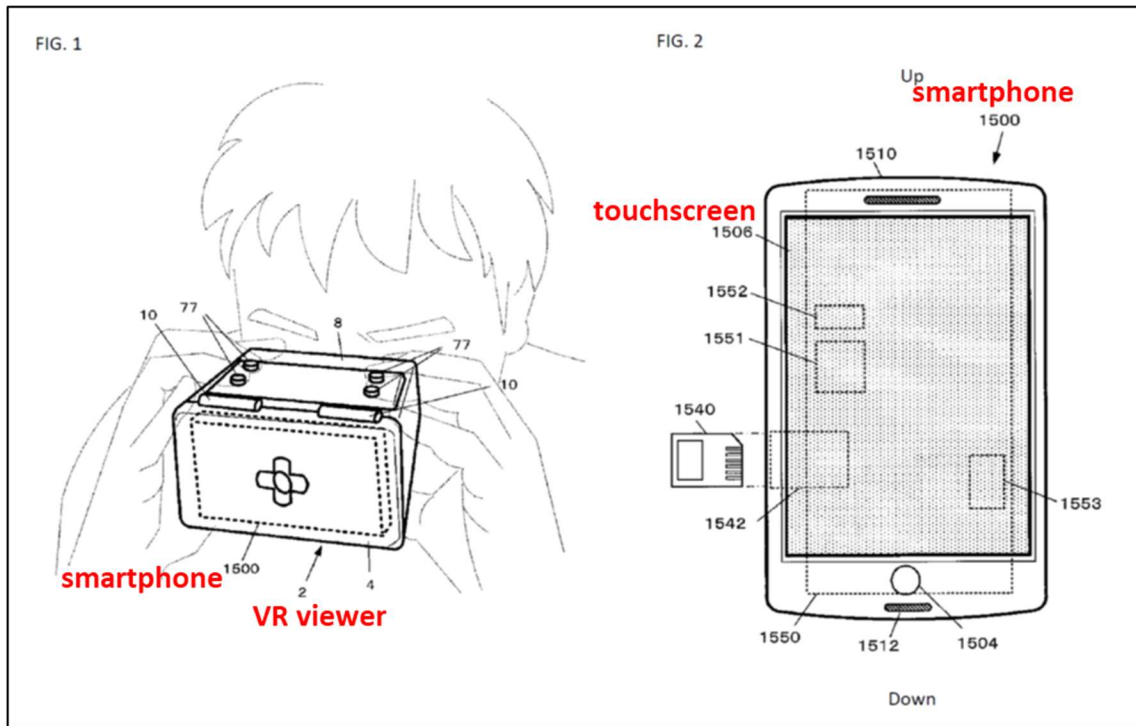
72. In the following paragraphs, I identify specific claim elements and provide an explanation of obviousness. Additional supporting disclosures and reasons for combining Kondo and Chu are included below.

A. Claim 1:

73. Please see my proposed combinations of Kondo/Chu discussed in §VII(C) and my descriptions of Kondo and Chu in §§VII(A) and (B).

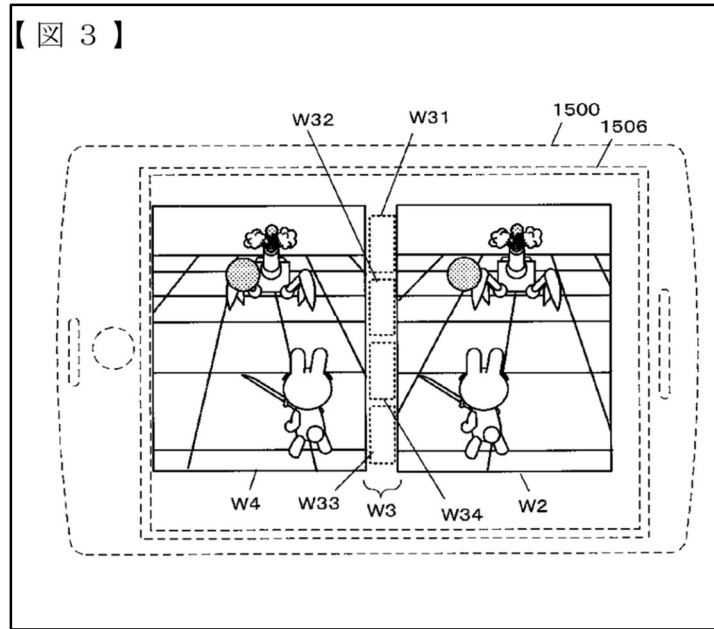
1. Claim 1(a): A virtual reality viewer for use with a mobile electronic device having a touch-screen, the viewer comprising:

74. In my opinion, Kondo shows a virtual reality viewer that uses a mobile phone with a touchscreen display. I have defined a virtual reality viewer above to mean “a viewer of an artificial environment,” where “viewer” includes both handheld devices and headsets. See §IV(A) above. Figures 1 and 2 of Kondo below show a VR viewer 2 that encloses a smartphone 1500 with a touch-screen display 1506. As I mentioned above in §VII(A), Kondo refers to its VR viewer as an “attachment.” I will use the terms VR viewer and attachment interchangeably in my analysis of Kondo.



EX1003, Figs. 1, 2 (annotations added). Kondo's Figure 3 below shows the touchscreen 1506 depicting an artificial environment, a stereoscopic video.

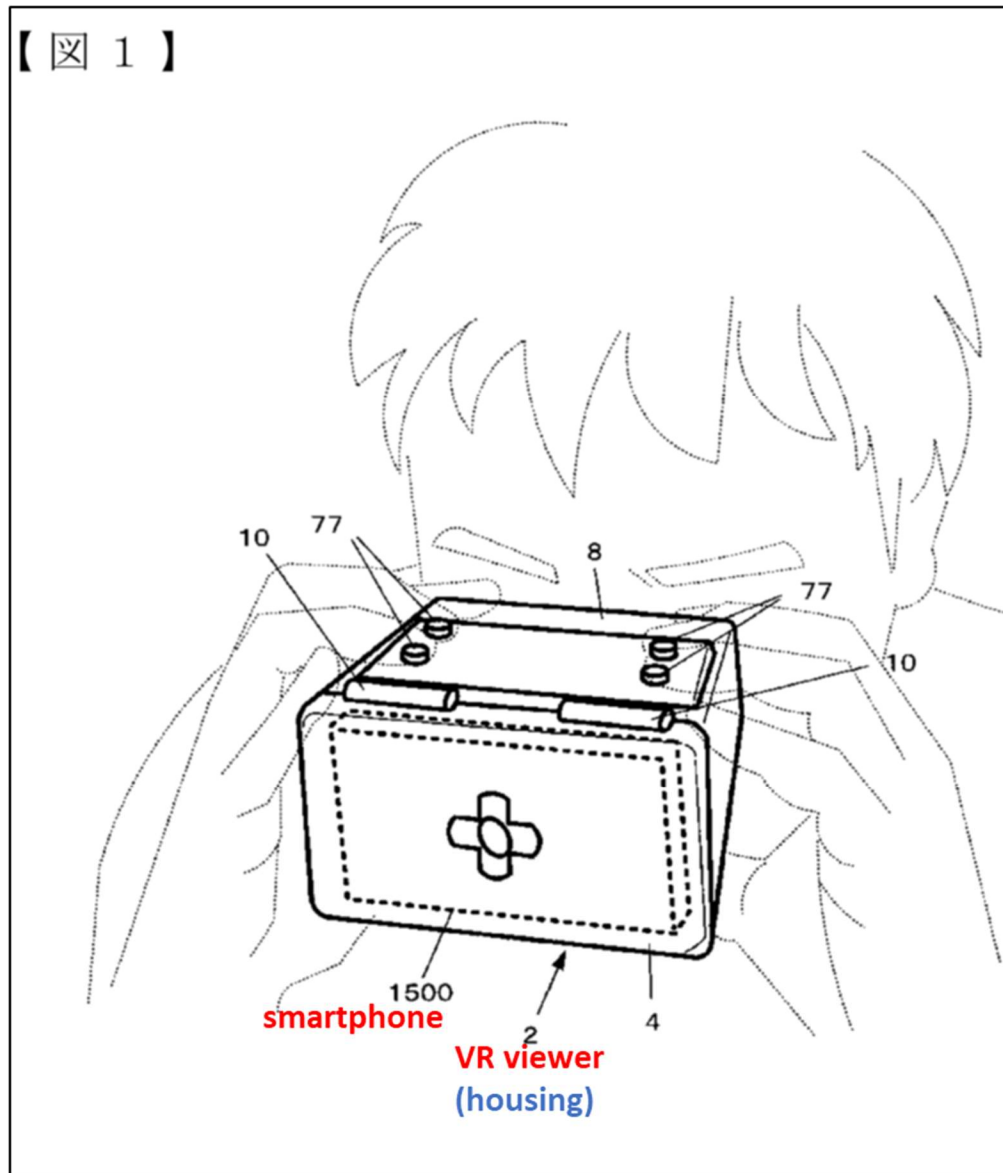
EX1003, ¶0027. The touchscreen is a capacitive touchscreen. EX1003, cls. 1, 4, ¶¶0005, 0009, 0023, 0024.



EX1003, Fig. 3.

2. Claim 1(b): a housing configured to receive the mobile electronic device, wherein the housing is configured to hold the mobile electronic device such that the touch-screen is generally centered in a horizontal direction and directly in a user's field of view when looking into a generally hollow interior of the housing through a side opposite the touch-screen;

75. In Figure 1 below, Kondo shows the VR viewer, the housing of which is the claimed “housing” (labeled in blue), holding the smartphone 1500 horizontally centered and directly within the user’s view. Also, the user looks through a side opposite the touch-screen of the smartphone.

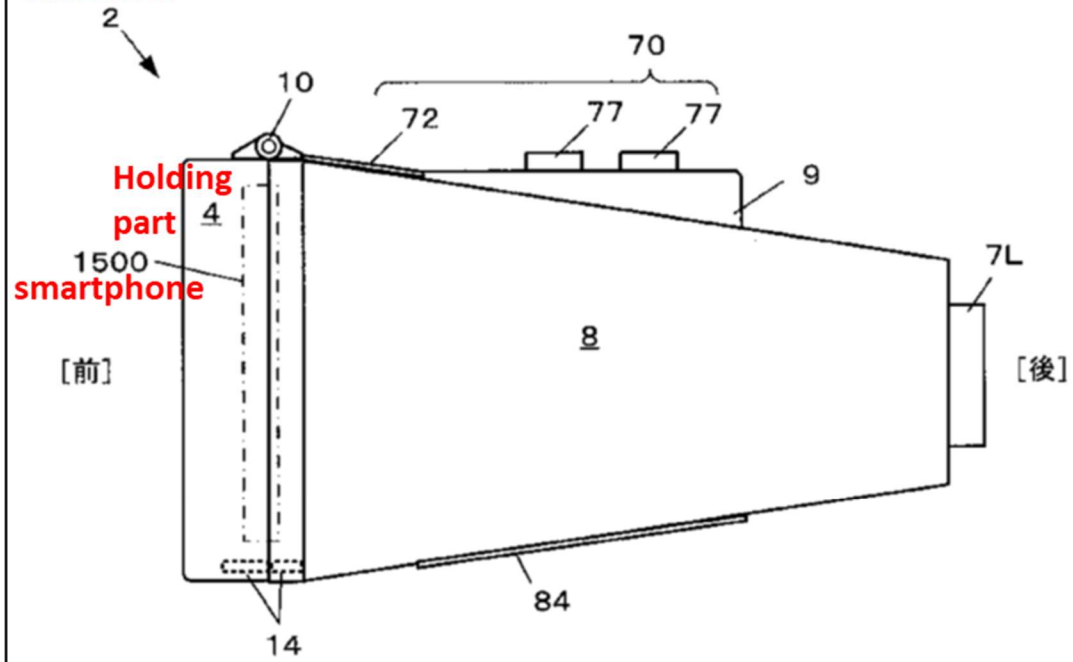


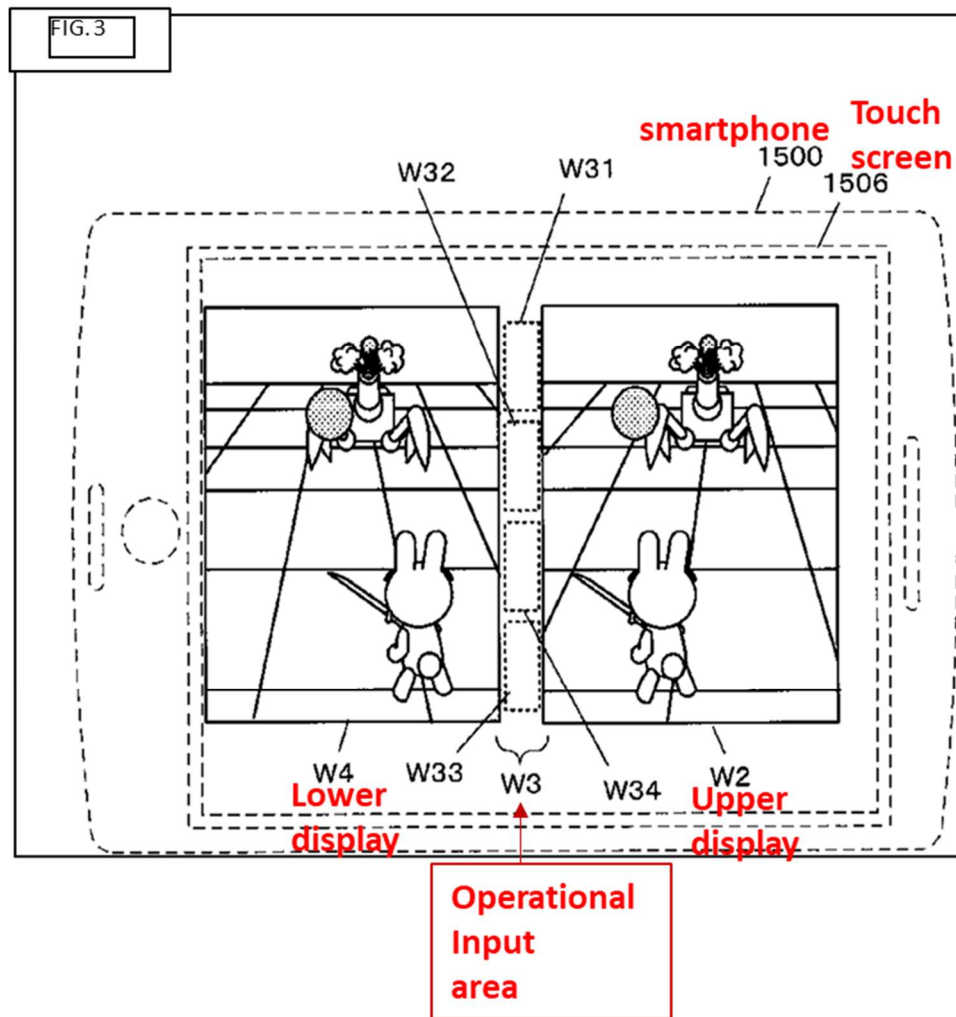
EX1003, Fig. 1 (annotations added).

76. Kondo Figure 5 below shows the smartphone 1500 inside the VR viewer, and Kondo Figure 3 below (as well as Figure 1 above) show that the phone is centered in a horizontal position.

【図 5】

VR viewer



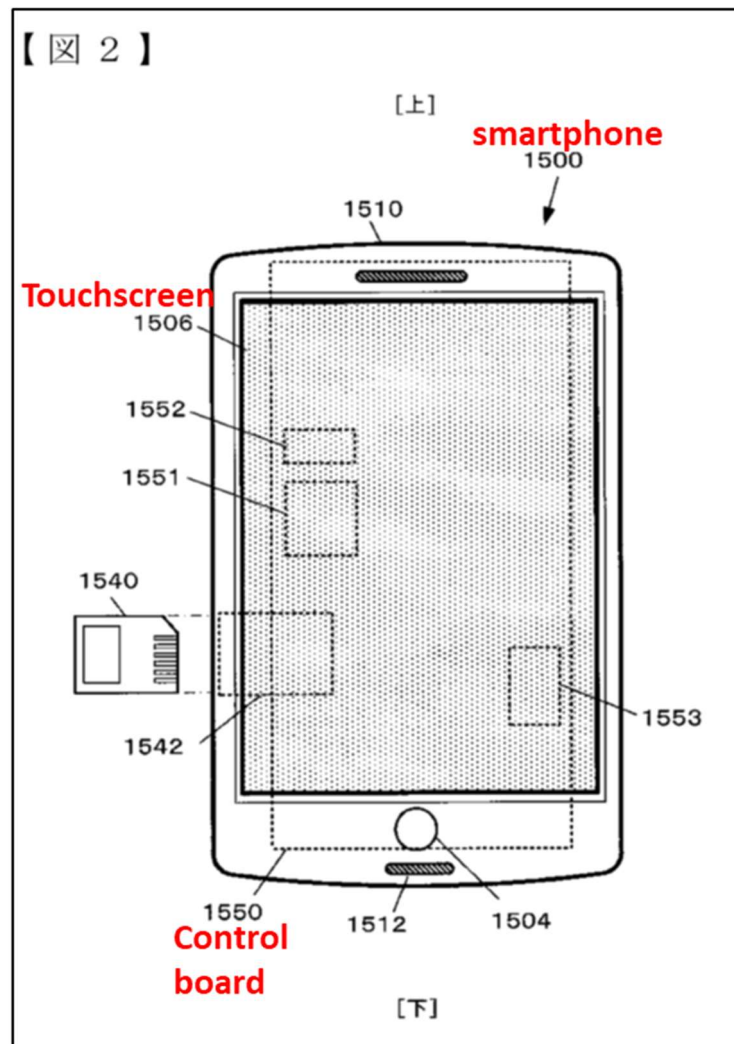


EX1003, Figs. 3, 5 (annotations added).

77. Kondo Figure 3 (above) is a diagram illustrating an example of a display screen of a three-dimensional stereoscopic video. The smartphone 1500 is mounted to the holding part 4 (shown in Figure 5) with the smartphone 1500 turned sideways. Figure 3 shows an upper display area W2 and lower display area W4 on the screen of the touch panel 1506, and an operational input area W3 is between these display areas. The upper display area W2 and lower display area

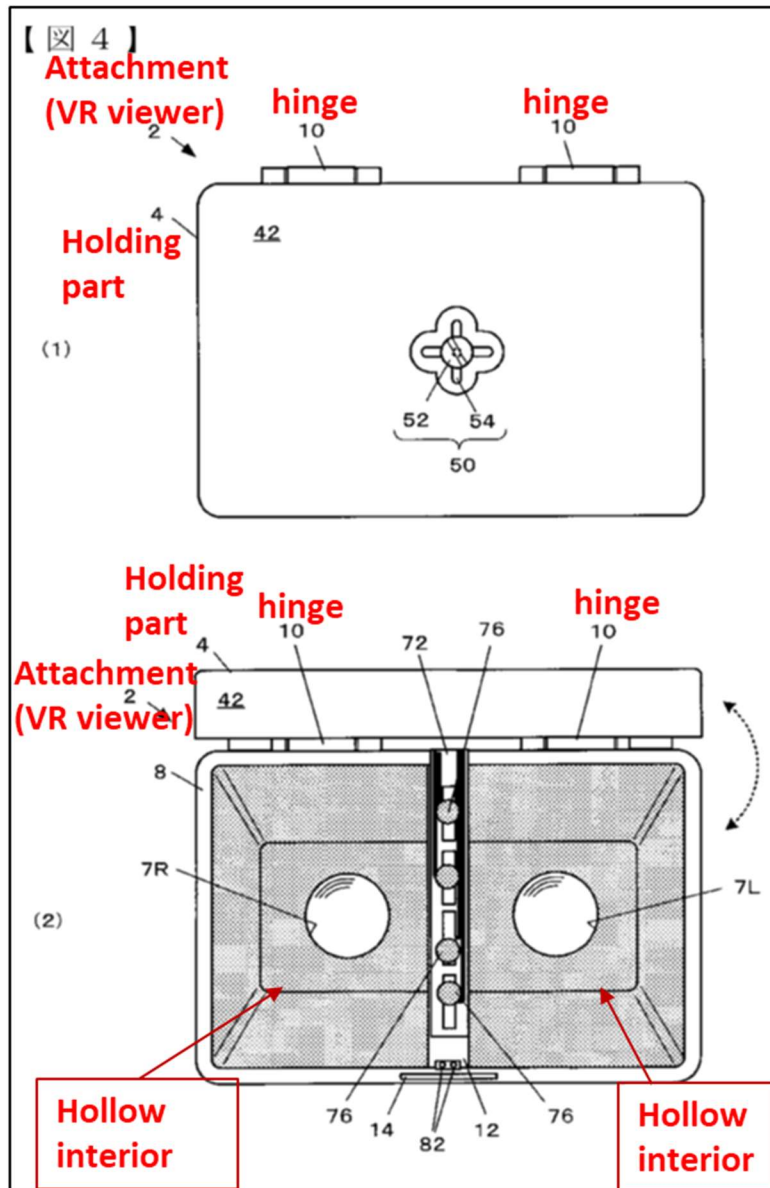
W4 are on the right and left sides of the VR viewer 2, respectively, when the smartphone 1500 is mounted to the VR viewer. Therefore, the control board 1550 (shown in Figure 2 below) of the smartphone 1500 displays a right-eye image on the upper display area W2, and a left eye image on the lower display area W4.

EX1003, ¶0027.



EX1003, Fig. 2 (annotations added).

78. As illustrated in Kondo Figure 4 below (as well as Figures 5-7), the VR viewer 2 has a hinge 10 on the upper front end of a hollow attachment main body 8, and the hinge supports the holding part 4 so as to swing freely. The holding part 4 is opened to mount and dismount the smartphone 1500 to the VR viewer 2, and the holding part 4 is closed for use as a stereoscope. Figure 4 also shows that the VR viewer's interior is hollow, that the smartphone is held in a centered, horizontal position, and that the user looks through the side opposite of the smartphone. EX1003, ¶0030; *see also*, ¶0022.



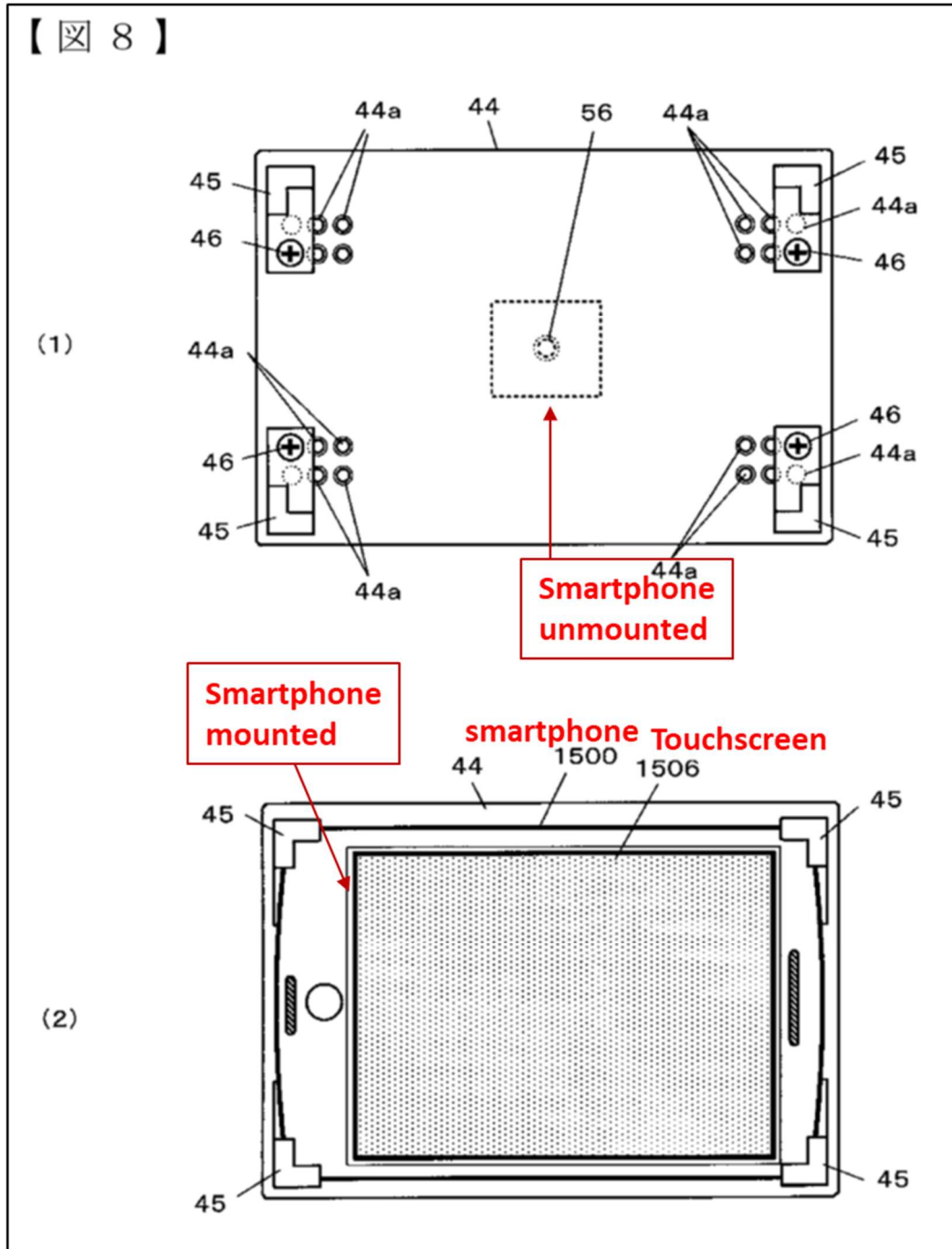
EX1003, Fig. 4 (annotations added).

79. Kondo Figure 7 below shows a pair of magnets 14 embedded in the mating surfaces of the lower end of the holding part 4 and the lower end of the VR viewer's main body 8, and when the holding part 4 is closed, the magnets attract

EX1003, Fig. 7 (annotations added).

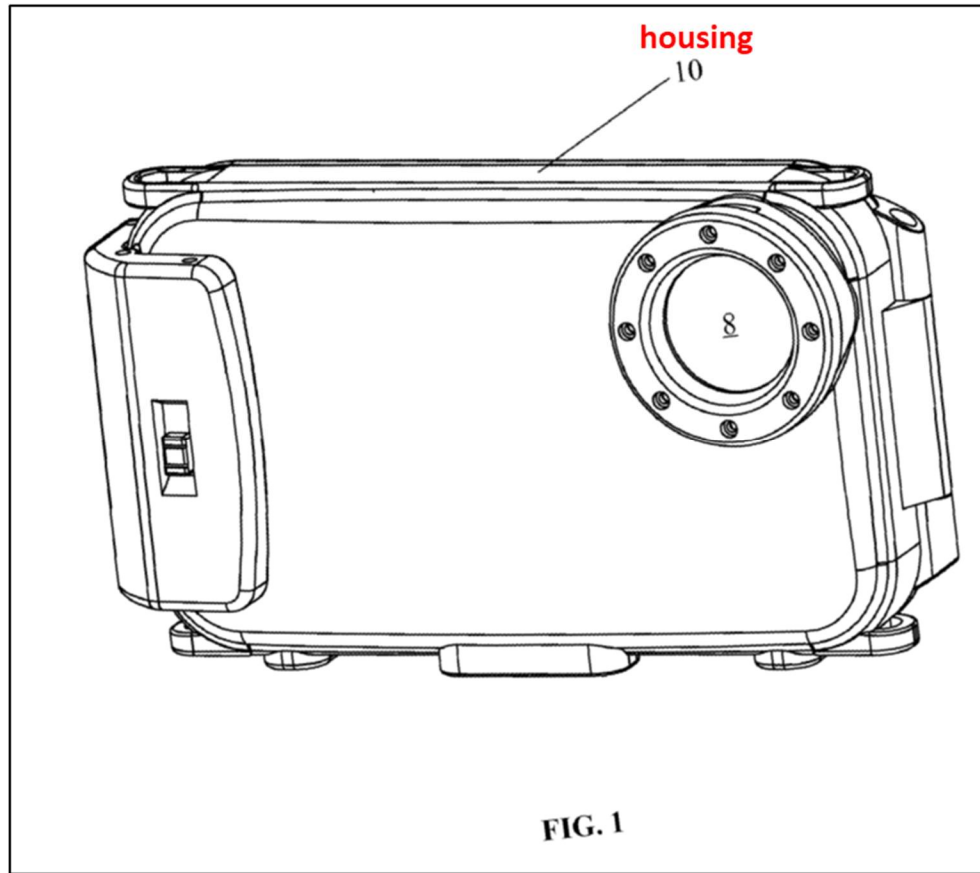


80. In Figure 8 below, Kondo shows both when the mobile phone is mounted and when it is not.



EX1003, Fig. 8 (annotations added).

81. Chu shows a housing that holds a mobile phone in Figure 1 below:



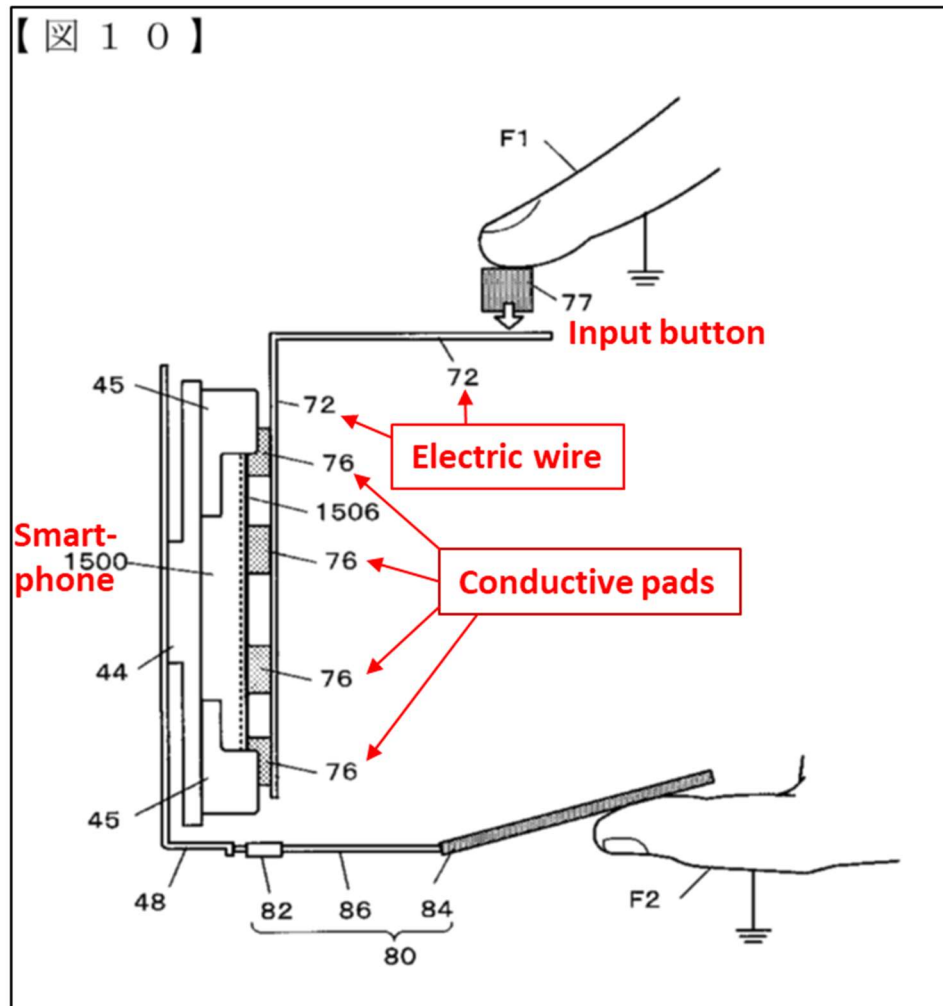
EX1004, Fig. 1 (annotation added); *see also* ¶0038.

3. Claim 1(c): an input mechanism that is accessible from an exterior of the housing and is moveable within the interior between at least a first position and an extended position,

82. Kondo discloses an input mechanism on the exterior of the housing (button 77) that is movable between a first position and an extended position:

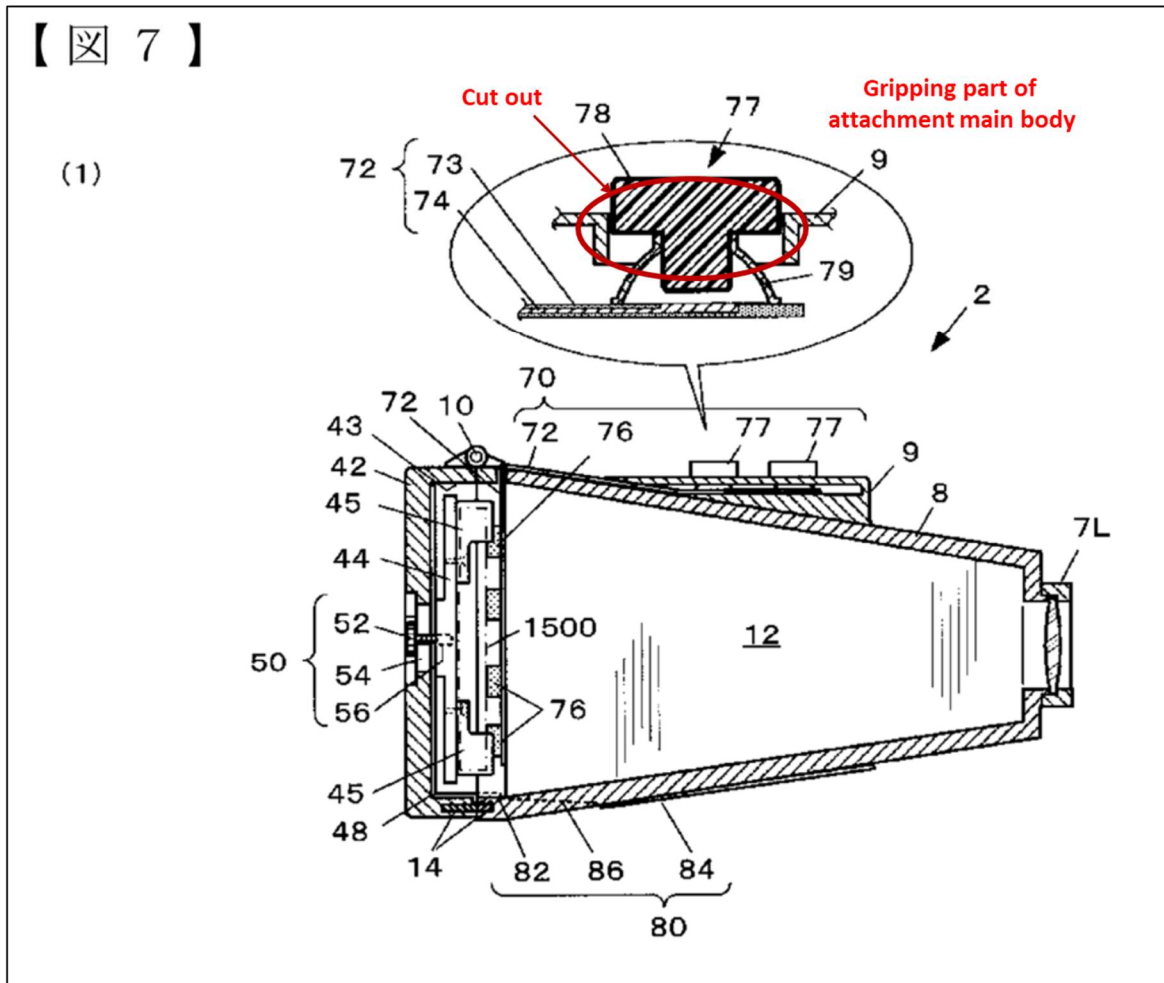
PROBLEM

To provide an attachment that achieves remote control input to a touch panel mounted on an electronic device. EX1003, p. 1.



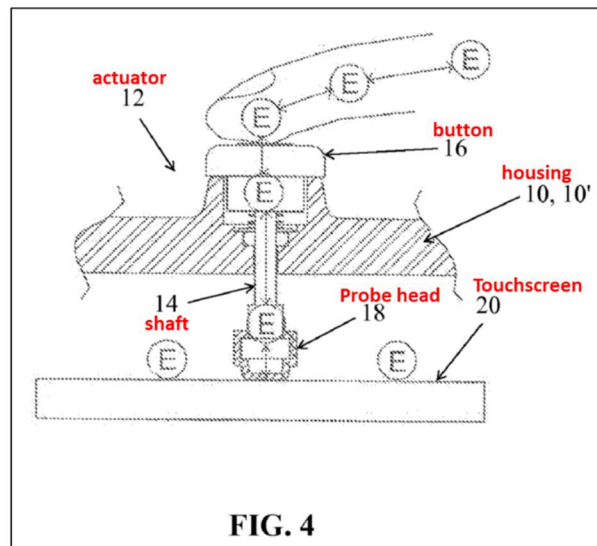
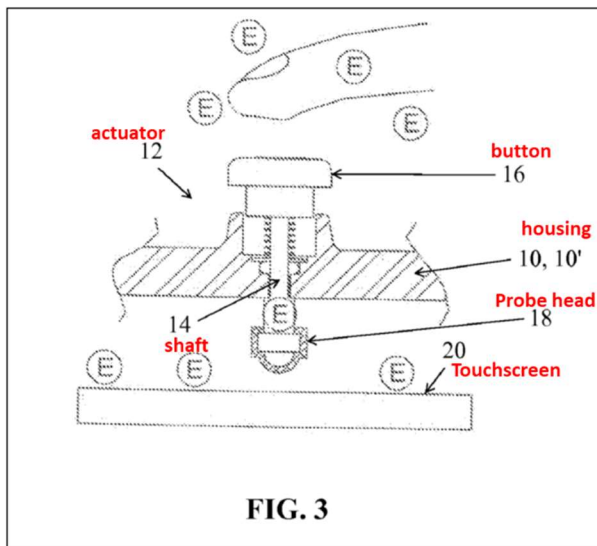
EX1003, Fig. 10 (annotations added).

83. In Figure 10 above, Kondo shows the user depressing input button 77, which then provides input to mobile phone 1500 via electric wire 72 and conductive pads 76. Figure 7 below shows that button 77 is accessible from the exterior of the housing and that this button moves in the interior from a first position to an extended position through a cut out in the main body of the attachment, called the gripping part 9:



EX1003, Fig. 7 (annotations added); *see also*, ¶¶0042, 0043, 0047, 0048, 0049, 0052.

84. Chu discloses (in Figures 3 and 4 below) an exterior input mechanism that moves in the interior of the housing from a first position to an extended position:



EX1004, Figs. 3, 4 (annotations added).

[0053] At an initial state, as illustrated in FIG. 3, the press button 16 is at its highest position when the press button 16 is released and the biasing member 40 is urging the press button 16 upwards. The biasing member 40 pushes the washer 42 downwards thereby holding the 0-ring 50 inside the circular recess 52 formed on waterproof housing 10. Since the press button 16 is at its highest position, the probe head 18 being connected to the shaft 14 is also at its highest position. ***Therefore, the probe head 18 is not touching the capacitive touch screen 20 of the digital device inside the waterproof housing 10.*** The electric charge E on the capacitive touch screen 20 does not change.

EX1004, ¶0053 (emphasis added).

[0054] When a user's finger or body part starts to touch the press button 16 and begins to press downwards, the user's finger or body part gets intimate with the press button 16 and the contact area with the press button 16 increases. ***Since the press button 16 is metal or metalized,***

the user's finger or body part is electric charge connected. EX1004, ¶0054 (emphasis added).

[0055] *When the user's finger or body part continues to press downwards, the electric charge conductivity between the press button 16 and the user's finger or body part further improves. The press button 16 together with the actuator shaft 14 starts to move downwards.* The biasing member 40 supporting the press button 16 is compressed. Since an O-ring 50 is installed on the actuator shaft 14 with a water-sealing compound, it can prevent water outside the waterproof housing 10, 10 from entering into the waterproof housing 10, 10 and damaging the digital device held therein. *The probe head 18 carried by the actuator shaft 14 starts touching the touch screen 20. When the probe pad 30 is further pressed onto the touch screen 20, the probe pad 30 starts to deform and form a larger contact area with the touch screen 20, as depicted in FIG. 4, thereby enhancing the electric charge conductivity.* Through the large flat or mushroom-shaped surface of the press button 16, the actuator shaft 14 and the probe head 18, it starts to transfer or receive electric charge to or from human body. This results in change of electric charge on the touch screen 20. The digital device can then compute a set of coordinates on the touch screen display. EX1004, ¶0055 (emphasis added).

[0056] *When the press button 16 is released, the biasing member 40 then pushes the press button 16 upwards. The actuator shaft 14 and the probe head 18 also move upwards thereby separating the probe head 18 from the touch screen 20 and stopping the interaction with*

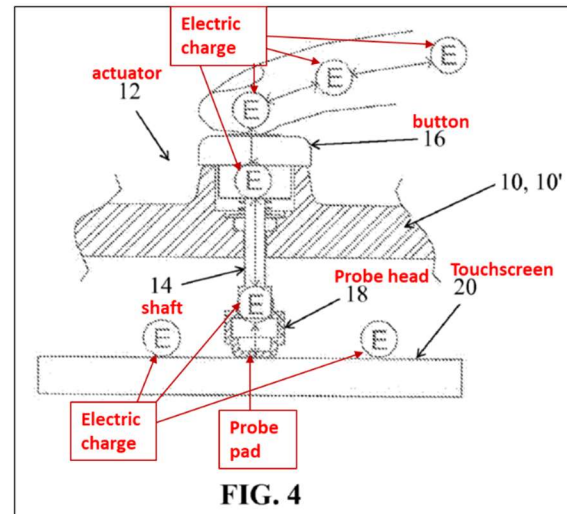
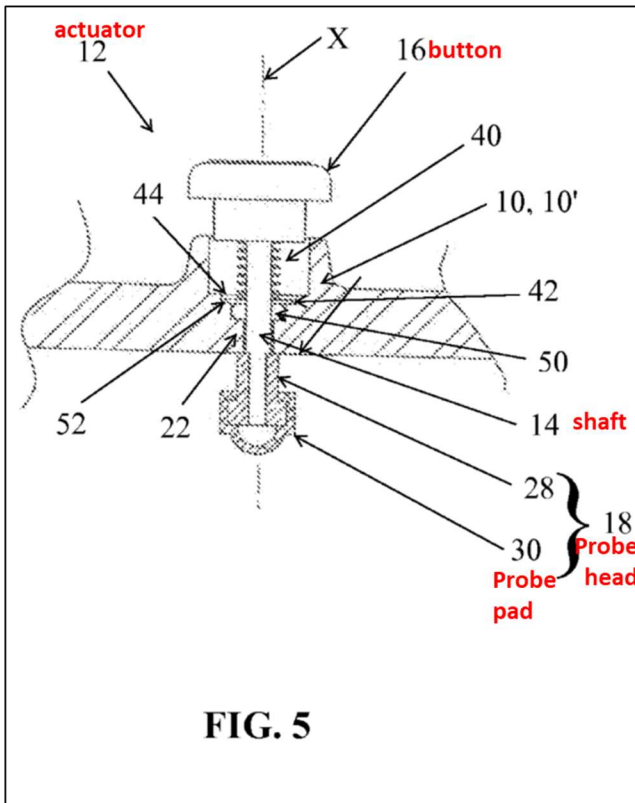
the touch screen 20. The operation of the actuator mechanism 12 is then completed. EX1004, ¶¶0056 (emphasis added); *see also* ¶¶0011, 0038.

85. Chu explains that its second and third embodiments operate in the same way in that pressing button 16 causes the probe head (18' in embodiment two and 18" in embodiment 3) to contact the touchscreen 20 and cause a touch event. EX1004, ¶¶0058-0062.

4. Claim 1(d): the input mechanism comprising: an electrical shield having a surface, wherein only a portion of the surface of the electrical shield is configured to contact a central region of the touch-screen of the mobile electronic device when the input mechanism is in the extended position.

86. See my analysis of claim 1(c) concerning “input mechanism.”

87. As discussed, I have interpreted the term “electrical shield” to mean “a material configured to induce a touch event that is electrically detectable by a touchscreen/device when at least a portion of the shield contacts or is in proximity to a touchscreen.” See §IV(A). In Figure 5 below, Chu shows the electrical shield (probe pad 30), which has a surface that is made of material capable of conducting electric charge to a touchscreen. EX1004, ¶0011. And Figure 4 below shows that only a portion of the probe pad’s surface contacts the touchscreen 20 of the smartphone when the input mechanism is extended.



EX1004, Figs. 4, 5 (annotations added).

88. Chu explains how the actuator mechanism moves to an extended position to cause a touch event:

FIG. 4 shows the actuator mechanism 12 at an actuation position when the press button 16 is pushed downwards/inwards by a finger of a user, and the probe head 18 is touching the capacitive touch screen 20. At this actuation position, electric charge E can be transferred between the finger of the user and the capacitive touch screen 20 through the press button 16, the actuator shaft 14 and the probe head 18, as shown by the arrows. EX1004, ¶0041 (emphasis added).

89. The probe pad 30 is made of conductive material, such as metal or rubber with a conductive additive.

The press button, the shaft and *the probe head may be made of a material capable of conducting electric charge.* EX1004, ¶ 0011(emphasis added).

The press button, the shaft, the adaptor, and the probe head may be made of metal. EX1004, ¶0014.

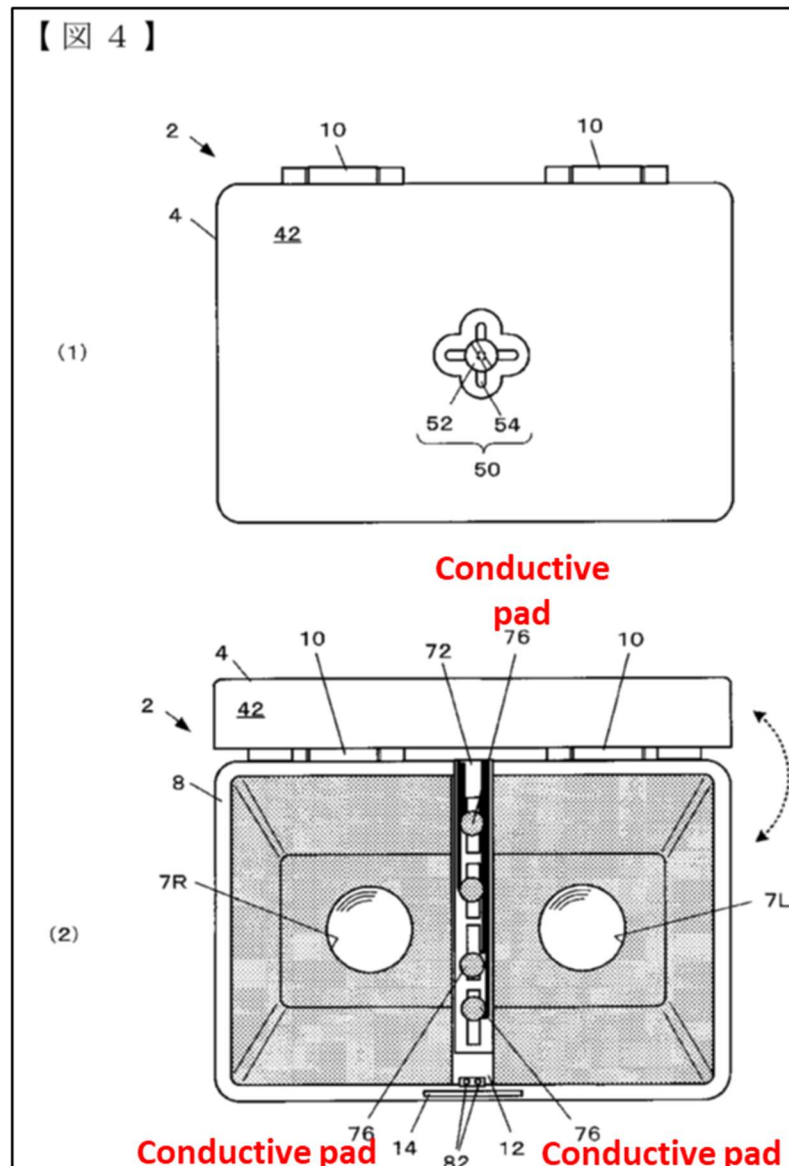
The actuator mechanism may further include a retaining ring fastened at the inner end of the shaft for retaining the adaptor at a position abutting against an inner surface of the housing. The press button, the shaft, the adaptor and the probe head may be made of metal. EX1004, ¶0019; *see also*, ¶0049.

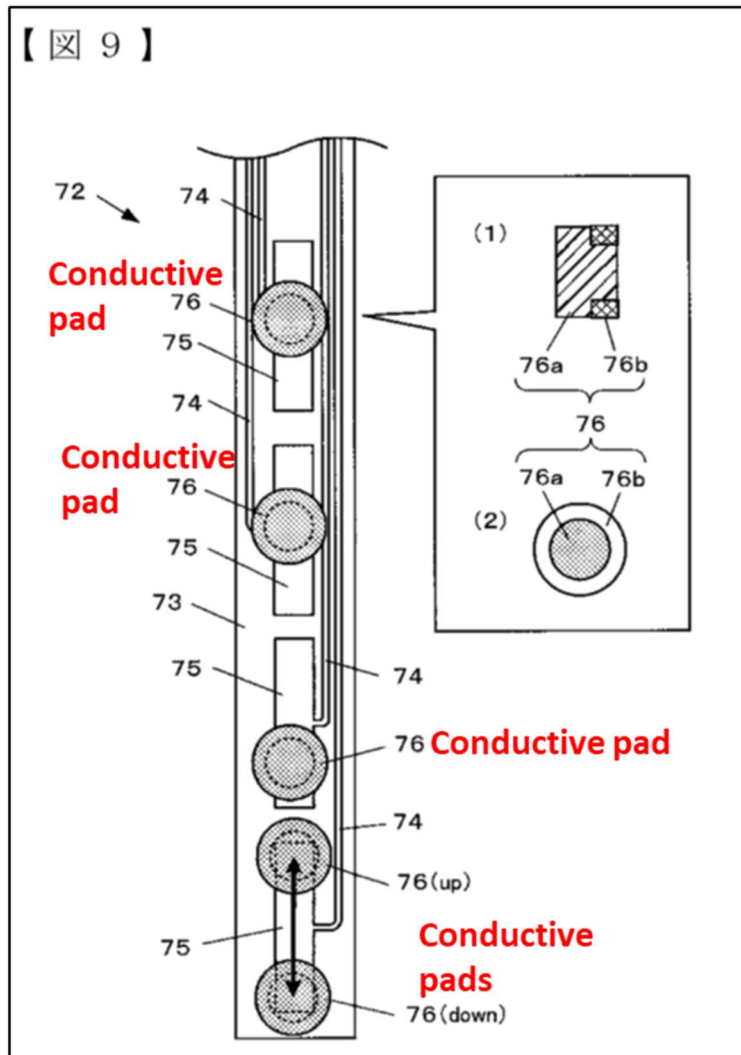
The probe pad 30 may be made of soft material such as rubber. Additive may be added to the rubber in order to enhance its electric charge transfer performance. Soft material is used because it can minimize possible scratch or damage on the touchscreen 20. EX1004, ¶0049 (emphasis added).

90. As I mentioned with respect to claim 1(c), all three embodiments of Chu operate in this same way. See EX1004, ¶¶0053-0062.

91. Kondo shows that the conductive pads 76, activated by pushing button 77 on the exterior of the housing, contact the central region of the smartphone. Figure 4 below shows that the conductive pads contact the central region of the

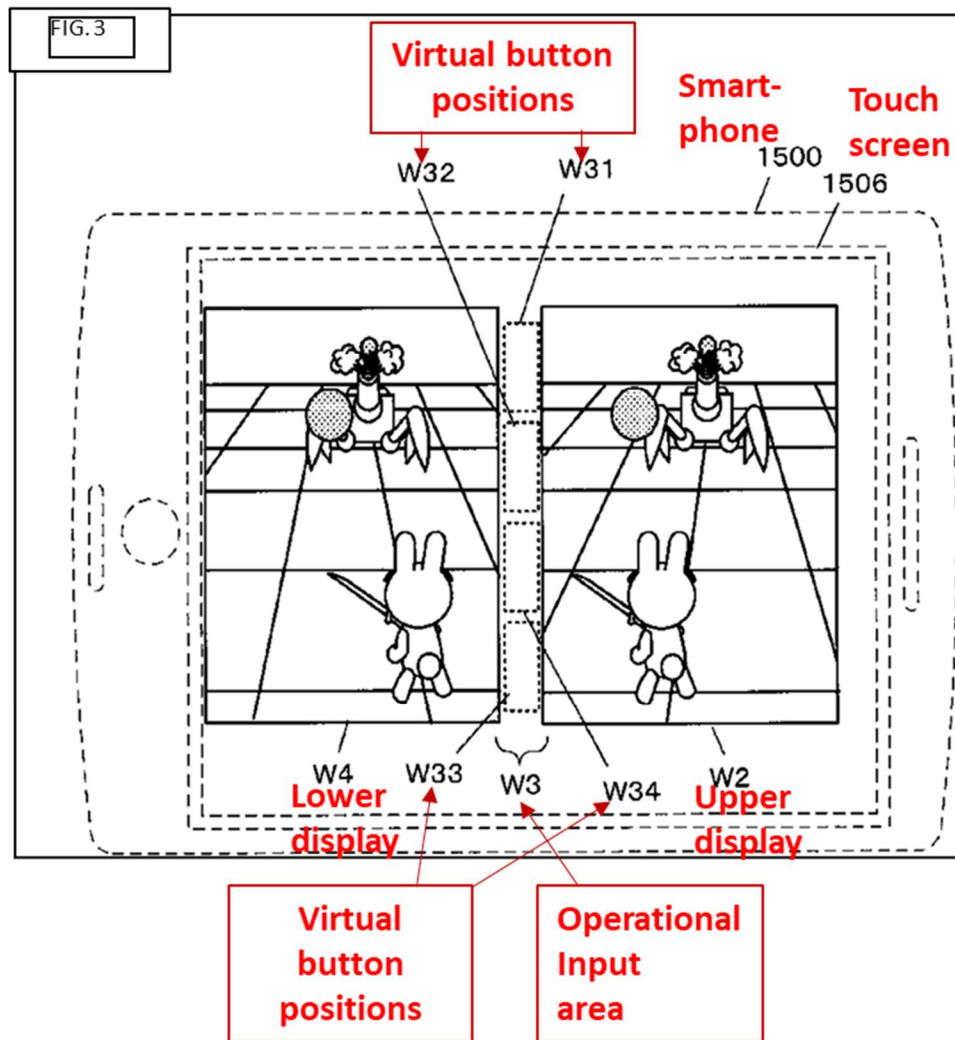
smartphone, and Figure 9 below shows the conductive pads in more detail. Since Kondo's touchscreen operational input area is centered, the combinations of Kondo/Chu I proposed above in §VII(C) would use Chu's input mechanism to contact the central region of Kondo's touchscreen.





EX1003, Figs. 4, 9 (annotations added).

92. Kondo's Figure 3 below shows operational input area W3 centered on the touchscreen that the conductive pads align against:



EX1003, Fig. 3 (annotations added).

93. Kondo explains that when holding part 4 is closed, the conductive pads 76 (shown in Figures 4 and 9 above) come into contact (as shown in Figure 3 above) with the operational input area W3 and, specifically, virtual button positions W31-W34:

The blown-up portion of FIG. 9 is a diagram illustrating a (1) vertical cross-sectional view and (2) bottom view (attachment surface side) of

the conductive pad 76. *When the holding part 4 is closed, the conductive pad 76 comes into contact with the virtual button positions W31 to W34 set on the touch panel 1506 of the smartphone 1500 held by the holding part 4.* The conductive pad 76 of the present Embodiment is a disk-shaped pad, and includes a conductive core section 76a exposed on both end surfaces and adhesive section 76b provided on the outer periphery of the end portion of the side in contact with the widened section 75. The adhesive section 76b is an elastic resin that can be removed and re-adhered to the flexible sheet 73 and the conductive lines 74. In other words, the attachment position of the conductive pads 76 relative to the widened section 73 [sic] of the conductive lines 74 can be changed, and this functions as the position adjusting mechanism for adjusting the position at which the conductive pad 76 contacts the touch panel 1506 (adjustable in the range of 76 (up) and 76 (down) as seen in FIG. 9). EX1003, ¶0041 (emphasis added).

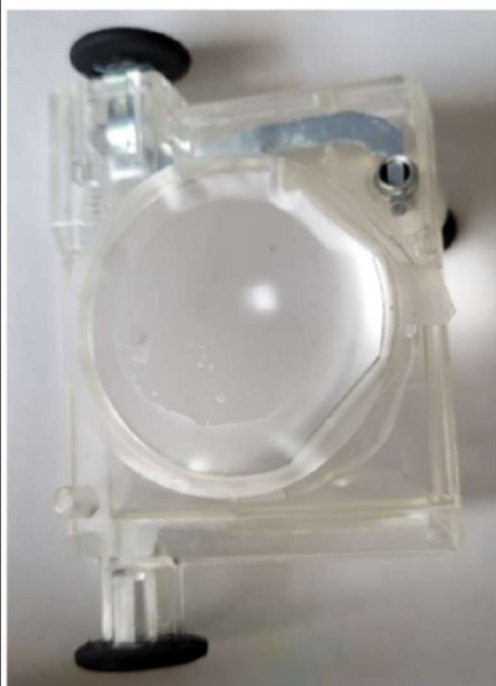
94. As a result, the electrical shield (Chu's probe pad 30) in the Kondo/Chu combination would contact the central region of the smartphone's touchscreen when the input mechanism is in an extended position.

95. The prosecution history does not influence my analysis of this claim element because it is ambiguous. I noted above that the Patent Owner argued over the prior art because it did not teach only a portion of the surface of the electrical shield contacting the central region of the touchscreen. See §VI(C). As I mentioned above, it is clear that the prior art's input device only contacted the edge of the touchscreen, and not the center. What is unclear is whether the Examiner

agreed with the Patent Owner's additional argument about Compton's tip's entire surface contacting the touchscreen. In other words, the Patent Owner was arguing that the sides of Compton's tip cannot constitute part of the tip's surface and that only the portion of the tip's surface that physically contacted the touchscreen could be the "electrical shield." On this point, a POSA would not consider the prosecution history to be helpful.

96. Regardless and despite its remarks to the Patent Office, in district court, Patent Owner charged a company with infringement based on a viewer with an input device that is almost exactly the same as Chu's. The Patent Owner alleged that a rubberized nub is the "electric shield" and that only a portion of its surface touches the touchscreen. Notably, that surface extends up the sides of the input mechanism which must therefore constitute part of the electric shield's surface.

38. These unsupported assertions are incorrect. The Accused Products do include an electrical shield, which (although not required by Claim 1) comprises a conductive material. As evidenced below, the Accused Products include an electric shield comprised of a rubberized conductive nub affixed to a metal arm that extends through the interior housing:



Rubberized
nub

39. The Accused Products are also configured to have a portion of the surface of the electric shield contact the screen of a mobile electronic device and the electric shield does not, as

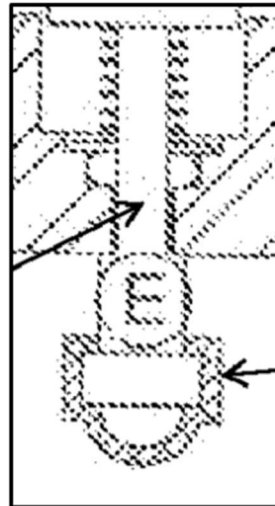
Merge counsel contends, have “maximum surface contact.” Instead, as shown immediately above, only a portion of the electric shield (*i.e.*, only a portion of the rubberized conductive nub) is configured to make contact with the touchscreen.

DDC Technology v. Merge Labs, Inc., Complaint, Case No.: 6:21-cv-000850, WDTX (EX1009, pps. 12-13 (highlighting and annotation added)).

97. A side-by-side comparison between the accused “rubberized nub” and Chu’s probe pad demonstrates the similarity. Indeed, compared to the accused rubberized nub on the left, a smaller portion of Chu’s probe pad surface contacts the touchscreen.



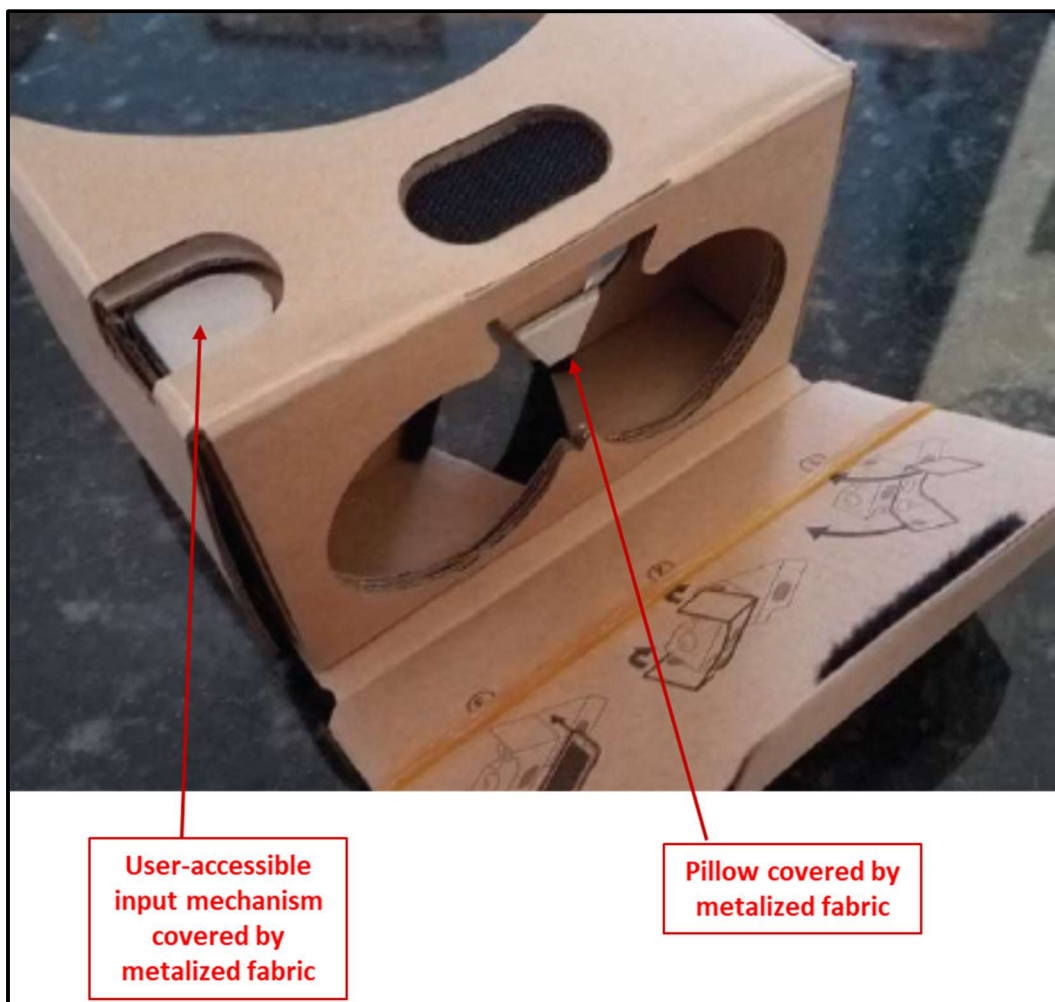
**DDC v. Merge Labs
Complaint**



Chu Fig. 3

EX1009, p. 12 (cropped and rotated); EX1004, Fig. 3 (cropped).

98. The Patent Owner also accuses Google’s Cardboard Viewer of infringement. Google’s accused device has what is known as a “pillow” that contacts the touchscreen. The touchscreen-facing side of the pillow is covered by a silver-colored, metalized fabric that wraps around the bottom of the pillow and continues along a “conductive strip” all the way to the user-accessible input mechanism, as shown below.



DDC v. Google et al. Supplemental Annotated Infringement Contentions (EX1011, p. 9 (annotations added)).

99. DDC accuses the metalized fabric that is on the pillow and the conductive strip as constituting the claimed “electrical shield.”

The input mechanism of the Cardboard Viewers comprises an electrical shield having a surface.



GCV2 Physical Unit.

The electrical shield of the Cardboard Viewers is the portion of the Cardboard Viewers comprising the metalized fabric (polyester nickle/copper) that encases the "pillow" and the "conductive strip." See also annotated supplement.

3.3. Button Specifications: Conductive Strip and Pillow

Google Cardboard (I/O 2015) button consists of two conductive parts ("pillow" and "strip"), glued to a cardboard-based "hammer".

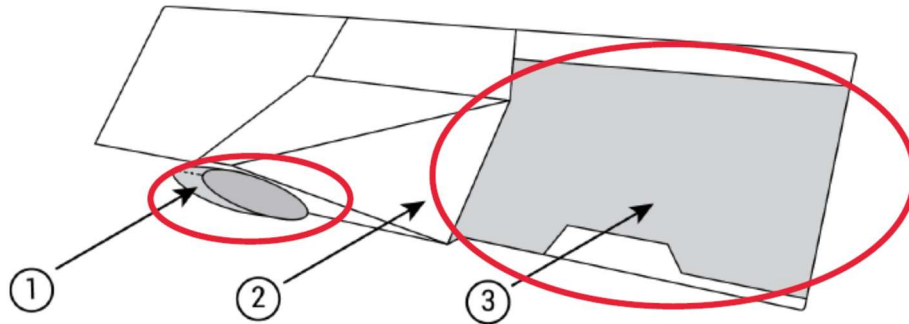
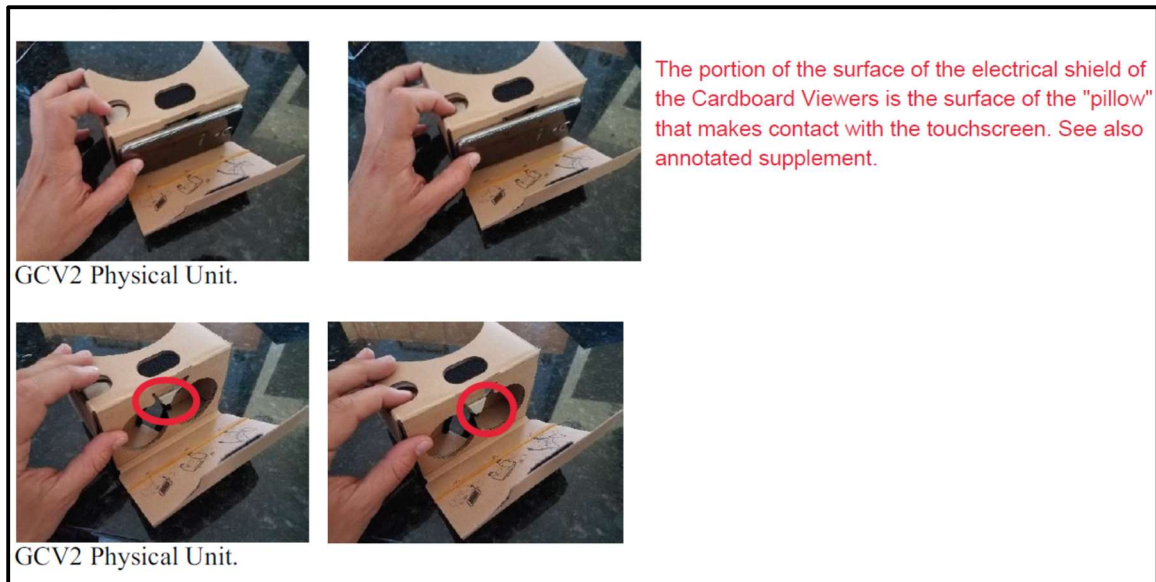


Figure 7. Cardboard button parts: (1) - "pillow", (2) - "hammer", (3) - "conductive strip"

EX1011, p. 40 (annotations in original).

100. The Patent Owner alleges that the claimed “only a portion of the surface of the electrical shield” is the surface of the pillow that contacts the touchscreen:



EX1011, p. 42 (annotations in original).

101. The portion of the metalized fabric that wraps around the pillow's sides which do not contact the touchscreen are not accused of being the claimed "only a portion of the surface of the electrical shield" but are claimed to be part of the electrical shield's surface. In this respect, Chu is the same. As explained above, Chu's probe pad's end contacts the touchscreen, but the probe pad extends up Chu's input device along the sides.

102. The Patent Owner's infringement positions in district court litigations only confirm that Chu's probe pad constitutes the claimed electrical shield in a manner consistent with how the Patent Owner is interpreting its claims.

B. Claim 2:

103. See my analysis of claim 1 above.

1. Claim 2(a): The virtual reality viewer of claim 1, wherein input mechanism is configured to provide a capacitive touch input to the touch-screen when the input mechanism is in the extended position, and

104. See claim 1 and, in particular, 1(c) and (d). *See also*, Chu's Figure 4 and ¶0041, where Chu explains that, when the actuator mechanism is actuated (extended), an electric charge is transferred between the user's finger and the capacitive touchscreen. EX1004, Fig. 4, ¶0041; *see also*, ¶¶0053-0062.

2. Claim 2(b): wherein at least a portion of the input mechanism is moveable between the first position and the extended position and is located within a central region of the interior that is between a left and a right region of the interior and the field of view such that only the portion of the surface of the electrical shield contacts the central area of the touch-screen of the mobile electronic device.

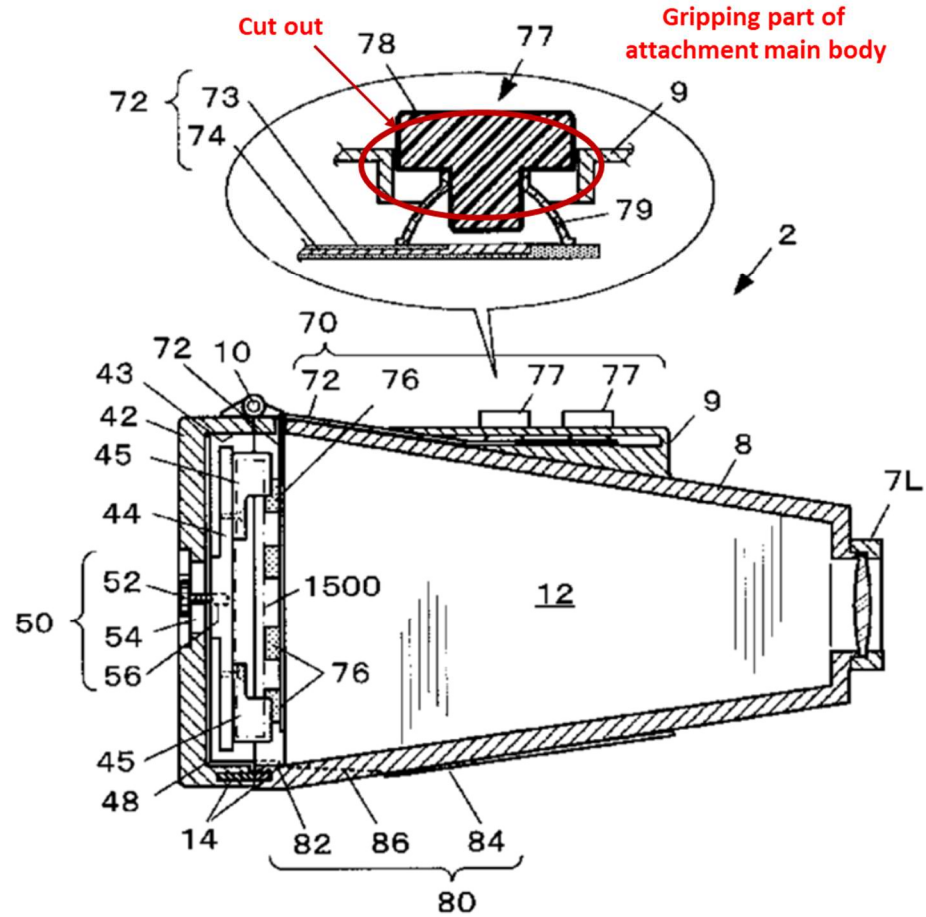
105. See my analysis in claim 1, and in particular, 1(c) and (d). *See also* Chu's Figures 3-5 and Kondo's Figure 4.

C. Claim 3: The virtual reality viewer of claim 1, wherein an exterior wall of the housing is shaped to define a cut-out, and wherein at least a first portion of the input mechanism is accessible to the user through the cut-out.

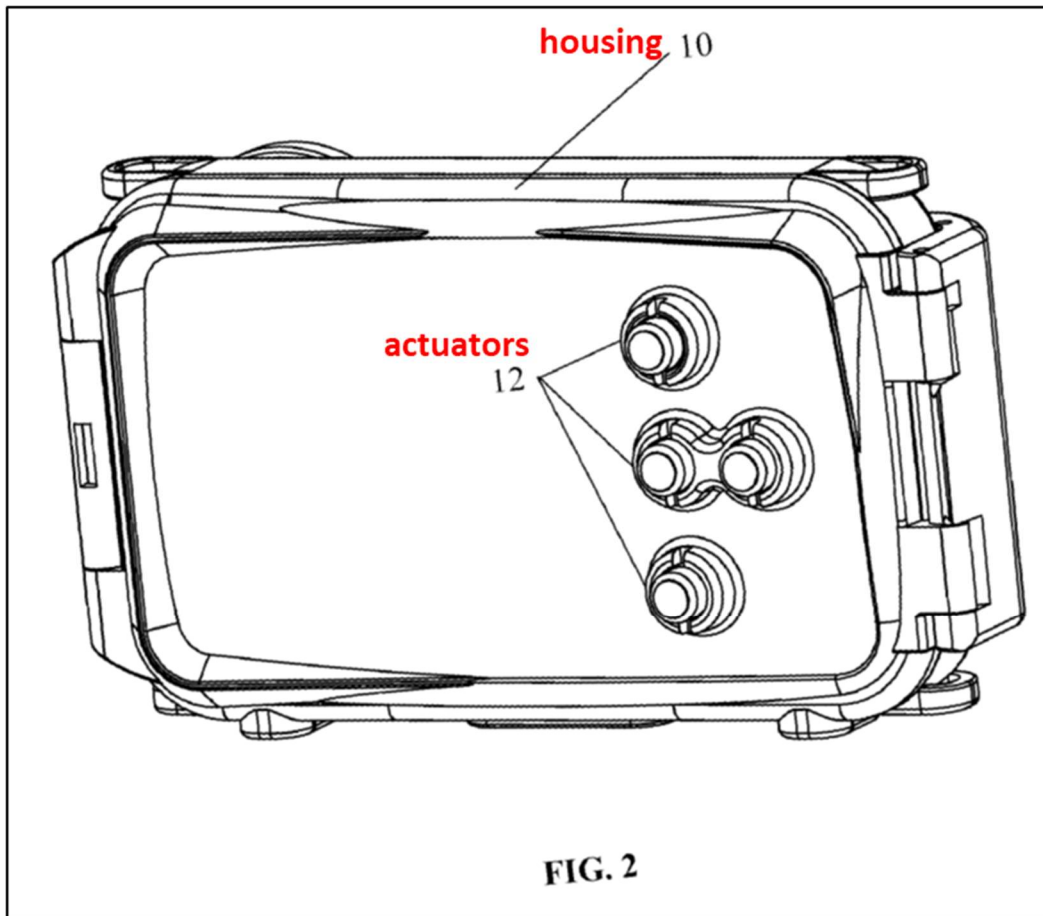
106. See my analysis of claim 1 above. Kondo shows in Figure 7 a cut-out in the gripping part 9 of the main body of the attachment where a first portion of the input mechanism 77 is accessible to the user.

【 図 7 】

(1)



107. Chu shows in Figure 2 below that a portion of the actuator 12 is accessible to the user through a cut-out.



EX1004, Fig. 1 (annotations added).

108. Chu also shows this in Figures 3-5, 7a, and 9a because button 16 is accessible to the user on the outside of housing 10. Also, my proposed combinations of Kondo/Chu shows a portion of the actuator 12 accessible through a cut-out. See §VII(C).

D. Claim 4:

109. See my analysis of claims 1 and 3 above.

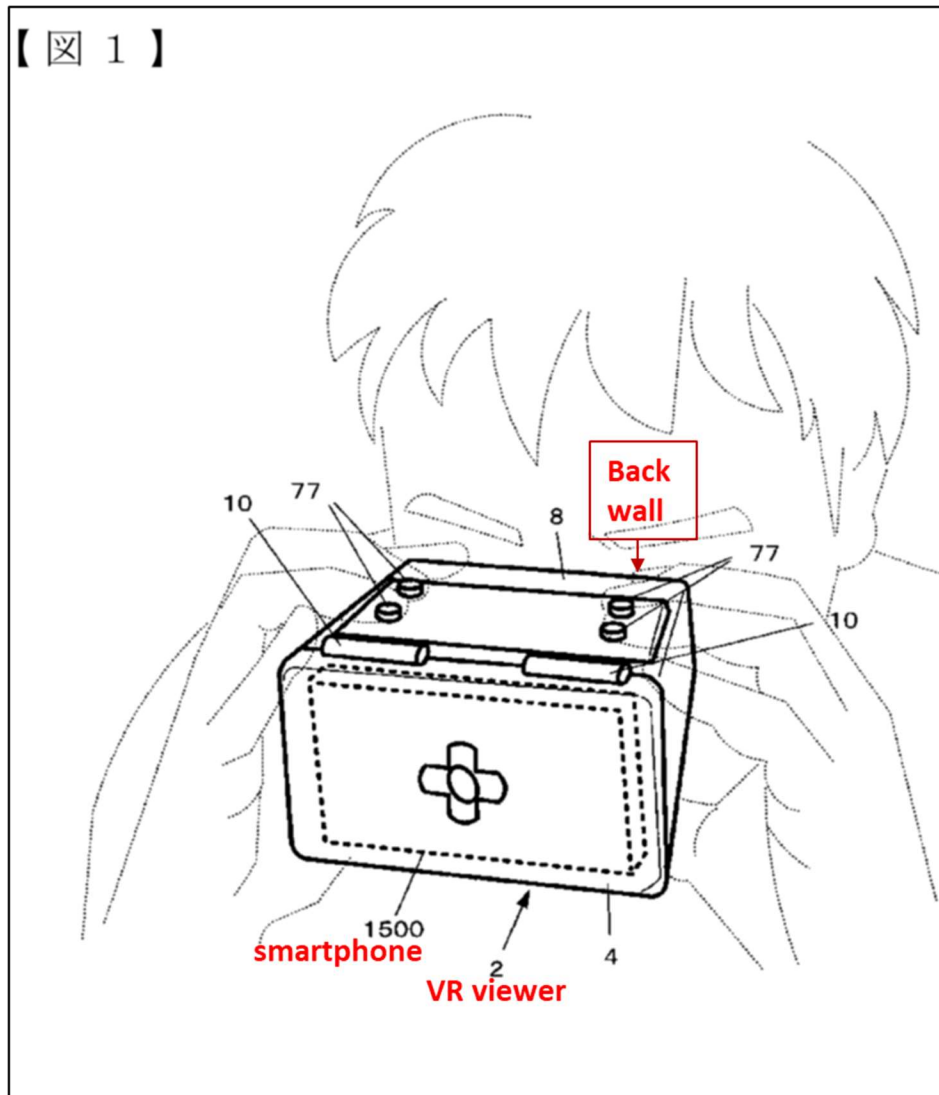
1. Claim 4(a): The virtual reality viewer of claim 3, wherein the housing substantially encloses the touch-screen within the interior, and further comprising:

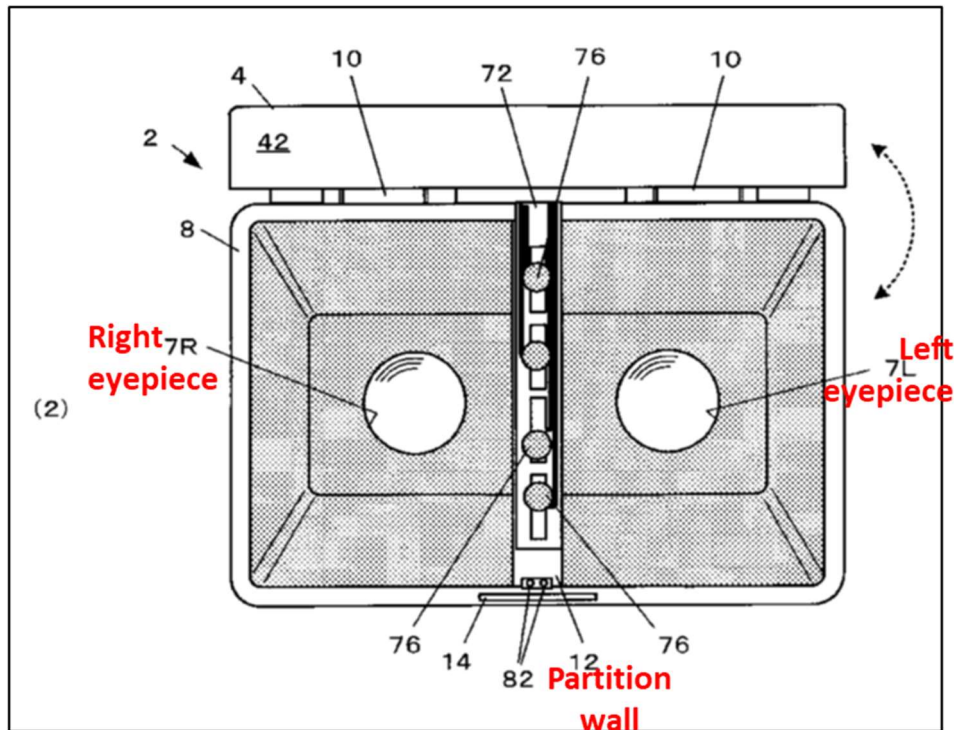
110. See my analysis of claim 1 above, including 1(b), where both Kondo and Chu show the VR viewer's housing enclosing the touchscreen within the interior. *See also*, EX1003, Figs. 1, 5, 6, 7; EX1004, Figs. 1, 2, ¶0011.

2. Claim 4(b): a back wall opposite the touch-screen, wherein the back-wall includes a left and a right lens for viewing a left and a right region of the interior and the touch-screen within the housing;

111. Please see my analysis of claim 1, including 1(b). Kondo's Figure 1 below shows a back wall opposite the touchscreen of the smartphone 1500 and Figure 4(2) below shows a left and right lens on that back wall for viewing the left and right region of the touchscreen, which is on the opposite side.

【 図 1 】





EX1003, Figs. 1, 4(2) (annotations added).

112. Kondo explains that 7R is the right eyepiece and 7L is the left eyepiece. A POSA would recognize these eyepieces are lenses. This is also bolstered by the shadings on the upper left portion of the eyepieces 7R and 7L on Figure 4(2) indicating a curved glass-like lens. Kondo’s eyepieces are the same as the ’075 patent’s lenses because they perform the same function. The ’075 patent explains that “[t]hese viewers also typically include one or more optical lenses within the housing so as to facilitate a three-dimensional viewing experience despite the two-dimensional display of the smartphone.” EX1001, 1:47-51. Kondo’s eyepieces serve the exact same purpose: “By looking into the inside of

the attachment 2 with the eyepieces placed on both eyes as if using binoculars, the user can enjoy a three-dimensional stereoscopic image.” EX1003, pg. 2.

113. Not only does Kondo disclose the claimed lenses, but the '075 patent's admissions also render them obvious. The '075 patent states that VR viewers typically have lenses.

These viewers also typically include one or more optical lenses within the housing so as to facilitate a three-dimensional viewing experience despite the two-dimensional display of the smartphone. EX1001, 1:47-51 (emphasis added).

114. The '075 patent also admits that the configuration, construction, and placement of lenses in VR viewers is well-known:

The configuration, construction and placement of a lens or lenses 70 for use in virtual reality viewers are generally known and understood by those skilled in the art. EX1001, 4:4-7.

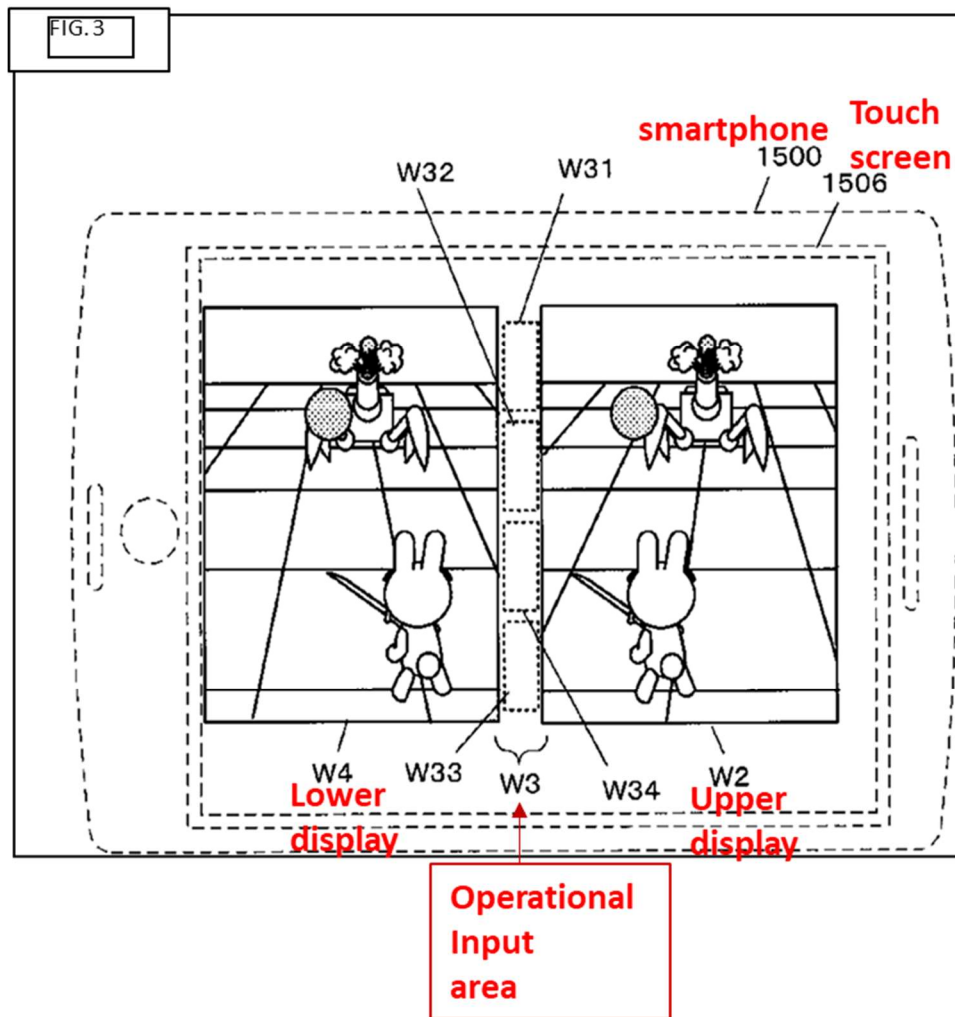
115. These admissions demonstrate that the claimed lenses were well-known and that a POSA would be motivated to use the claimed lenses to facilitate a three-dimensional viewing experience. I note that Kondo states the same motivation. EX1003, pg. 2. These admissions also demonstrate that a POSA would know how to configure, construct, and locate those lenses in a VR viewer

and thus have a reasonable expectation of success, including focusing of the images.

116. Figure 4(2) also shows a partition wall 12, separating the interior to a left and right region. Thus, 7R views a right region of the interior and 7L views a left region of the interior.

A partition wall 12 is provided in the center side-to-side of the attachment main body 8, separating into a tubular part communicating with the right eyepiece 7R and a tubular part communicating with the left eyepiece 7L. The smartphone 1500 is supported and secured to the holding part 4 such that when the holding part 4 is closed, the operation input area W3 is positioned facing the front end part of the partition wall 12. EX1003, ¶0037 (emphasis added).

117. Figure 3 shows that, when mounted, the user will see region W2 as the right side, region W4 as the left side, and region W3 is used for input.



EX1003, Fig. 3 (annotations added).

118. Kondo explains Figure 3's regions of the smartphone:

FIG. 3 is a diagram illustrating an example of a display screen of a three-dimensional stereoscopic video. The smartphone 1500 is mounted to the holding part 4 with the smartphone 1500 turned sideways. An upper display area W2 and lower display area W4 are set on the screen of the touch panel 1506, and an operation input area W3 is further set between these display areas. *The upper display area W2*

and lower display area W4 are on the right and left sides of the attachment 2 when the smartphone 1500 is mounted to the attachment 2. Therefore, the control board 1550 of the smartphone 1500 provides control so as to display a right eye image on the former, and a left eye image on the latter. EX1003, ¶0027 (emphasis added).

3. Claim 4(c): wherein at least a second portion of the input mechanism is generally centered in the horizontal direction within the interior and is configured to move in a direction toward the touch-screen when the first portion of the input mechanism is actuated; and

119. See my analysis of claim elements 1(b)-(d) and §VII(C).

4. Claim 4(d): wherein the portion of the surface of the electrical shield is disposed on the second portion of the input mechanism and is generally centered within the interior in the horizontal direction whereby the portion is generally located between the left and right regions and is moveable between the first position and the extended position.

120. See my analysis of claim 1, including 1(c) and (d).

E. Claim 5: The virtual reality viewer of claim 1, wherein at least a portion of the input mechanism defines at least a portion of a view divider within the interior of the housing, wherein the view divider is a structure that is generally centered within the interior and at least partially separates a left and a right region of the interior.

121. See my analysis of claims 1 and 4. In my proposed combination,

Chu's input mechanism would operate within the partition wall 12 of Kondo's

Figure 4(2), thereby defining a portion of the view divider. EX1003, Fig. 4(2), ¶0037.

F. Claim 6: The virtual reality viewer of claim 1, wherein the electrical shield comprises one or more of: a metallized fabric, a metallized polymer; a conductive polymer, a conductive fabric, a rigid flex printed circuit board and a flexographic ink.

122. Chu explains that the probe head is “made of material capable of conducting electric charge” and may be made of “rubber” with an additive “to enhance its electric charge transfer performance.” Also, the probe head may be made of metal, which a POSA would understand is electrically conductive.

The press button, the shaft and the probe head may be made of a material capable of conducting electric charge. EX1004, ¶0011.

The press button, the shaft, the adaptor and the probe head may be made of metal. EX1004, ¶0019.

The probe pad 30 may be made of soft material such as rubber. Additive may be added to the rubber in order to enhance its electric charge transfer performance. Soft material is used because it can minimize possible scratch or damage on the touchscreen 20. EX1004, ¶0049 (emphasis added).

123. A POSA understands that rubber is a polymer:

Rubber (cis-1,4-polyisoprene) is one of the most important polymers naturally produced by plants because it is a strategic raw material used in more than 40,000 products, including more than 400 medical

devices. EX1007, p. 1 (Mooibroek and Cornish, *Alternative Sources of Natural Rubber*, Appl Microbiol Biotechnol (2000) 53: 355-65) (emphasis added).

A polymeric substance obtained from the sap of the tree *Hevea brasiliensis*. Crude natural rubber is obtained by coagulating and drying the sap (latex), and is then modified by vulcanization and compounding with fillers. *It is a polymer of isoprene* containing the unit – CH₂C(CH₃):CHCH₂–. Oxford Reference On line <https://www.oxfordreference.com/display/10.1093/oi/authority.20110803100432119;jsessionid=3431CAADF7C05265E60C052BF4E2FF6> D (emphasis added).

A highly elastic solid substance, light cream or dark amber in color, **polymerized** by the drying and coagulation of the latex or milky juice of rubber trees and plants, exp. of the *Hevea* and *Ficus* species. EX1006, p. 3 (Random House Webster's College Dictionary (2000), p. 3) (bold emphasis added, italics in original).

124. A POSA would have known that a rubber capable of conducting electric charge with an additive to improve electric charge transfer performance is, therefore, a conductive polymer.

G. Claim 7: The virtual reality viewer of claim 6, wherein the surface of the electrical shield is sized to have electrical properties that are sufficient to be detected by the touch-screen based on capacitance when the input mechanism is in the extended position and only the portion of the surface is contacting the touch-screen.

125. See my analysis of claims 1, 1(c), 1(d), 2, and 6.

H. Claim 8: The virtual reality viewer of claim 6, wherein the surface of the electric shield is sized to have sufficient capacitive properties such that contact between only the portion of the surface and the touch-screen can be detected by a capacitive touch-screen when the input mechanism is in the extended position and in the absence of human contact with the electric shield.

126. See my analysis of claims 1, 2, and 6, and in particular, my discussion of the input mechanism in claims 1(c) and 1(d).

127. This claim requires “in the absence of human contact with the electric shield.” An ordinary reading of this claim excludes direct human contact with the electric shield but does not exclude indirect contact, i.e., electrical connection between the electric shield and a user that is remote with respect to the electric shield. If the claim were intended to exclude indirect human contact with the electric shield, it should have said so, but it does not. The proposed combination of Kondo/Chu does not allow for direct human contact with the electric shield (Chu’s probe pad 30). See §VII(C); EX1003, Figs. 1-11; EX1004, Figs. 1-10.

128. Nevertheless, even if no human contact (direct or indirect) were permitted by the claim, and it were required that no electric charge is transferred from the user to the electric shield, Kondo explicitly teaches this alternative interpretation of the claim:

[0007]

Here, the remote touch circuit according to the first aspect can be configured in which the user is the impedance imparting body and the button part is composed of a conductive member that can be touched by a finger of the user (second aspect).

[0008]

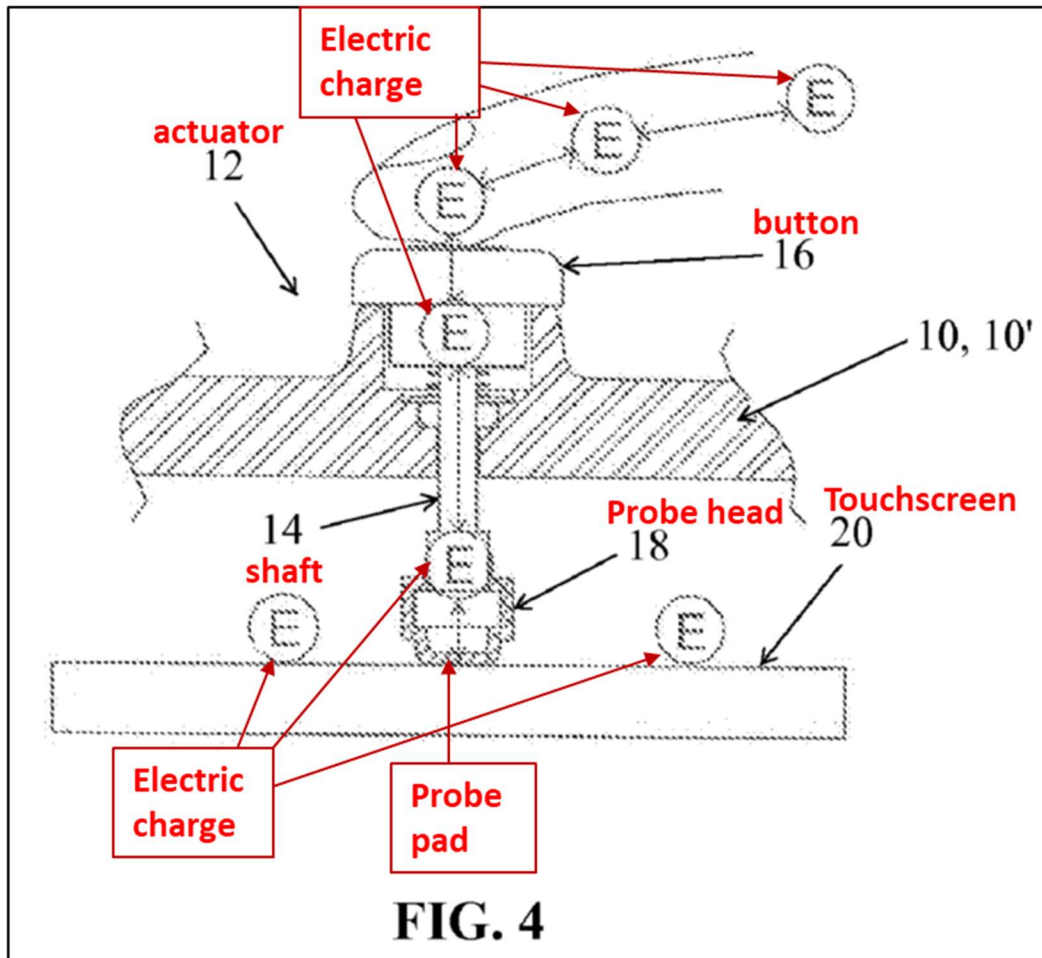
Alternatively, the remote touch circuit according to the first aspect can be configured such that the impedance imparting body is composed of a particular capacitor element, and the button part is configured such that pressing thereof enables a second end to electrically contact/release the impedance imparting body (third aspect). EX1003, ¶¶0007-0008 (emphasis added).

For example, the button part 77 has the function of connecting the impedance imparting body, which is the human body, to the remote touch circuit 70; *however, the button can be configured to connect to a capacitive element instead of the human body. For example, a capacitive element 11 like attachment 2B illustrated in FIG. 11 can be equipped. Connect a first terminal of the capacitive element 11 to the attachment main body side ground circuit 80, and connect the*

second terminal to the button part 77. Furthermore, the button part 77 can be configured to connect the second terminal of the capacitive element 11 to the conductive line 74 when the button part is pressed. In this case, even if the user is wearing gloves or the like and capacitance is not appropriately formed between the button part 77 and the user, remote operation to the touch panel 1506 can be achieved. EX1003, ¶0052 (emphasis added); see also Fig. 11.

129. A POSA would be motivated to use this alternative to the user being the impedance imparting body so that the user could operate the VR viewer while wearing gloves. Also, there would be a reasonable expectation of success as it was well known at the time, and in fact, it is described by Kondo. A POSA would have knowledge of capacitors.

130. Also, as shown below, Kondo's electrical shield, touch pad 76, is sized to have sufficient capacitive properties such that contact between only a portion of its surface and the touchscreen can be detected by a capacitive touchscreen.

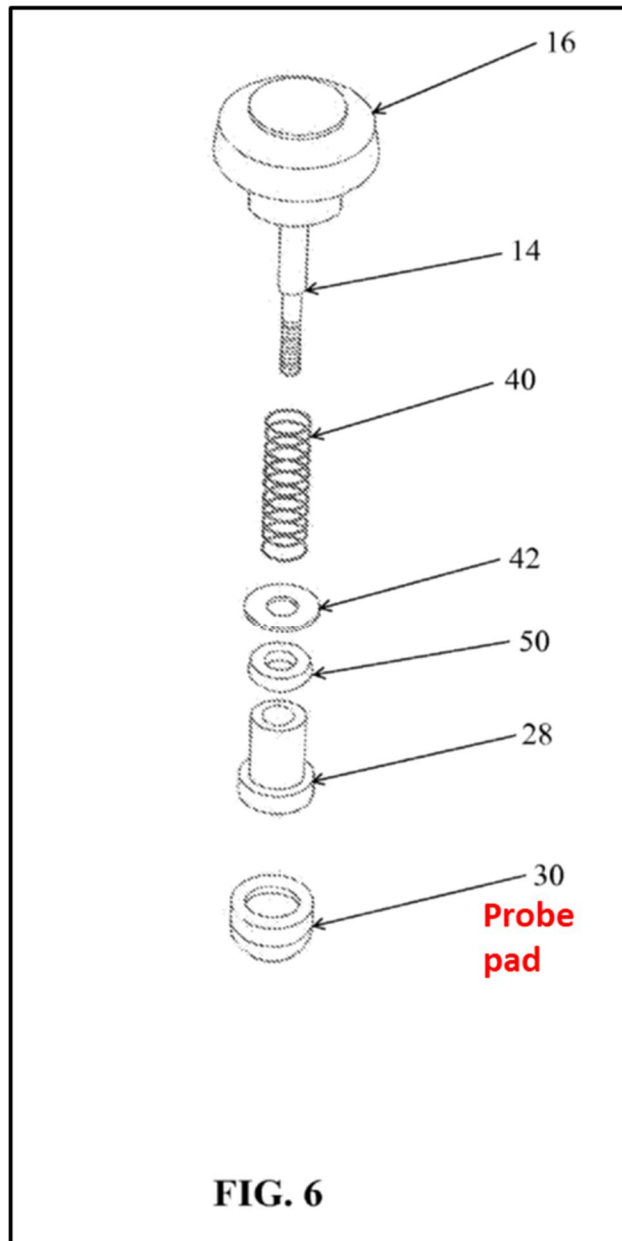


EX1004, Fig. 4 (annotations added); *see also* ¶¶0053-0062.

- I. **Claim 9:** The virtual reality viewer of claim 8, wherein the only portion of the surface that is configured to contact the touch-screen when the input mechanism is in the extended position is substantially smaller in size than the remaining portion of the surface of electric shield that is not configured to contact the touch-screen.

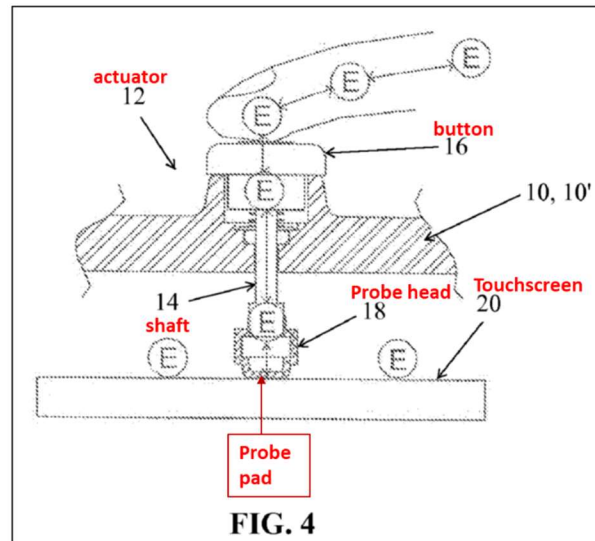
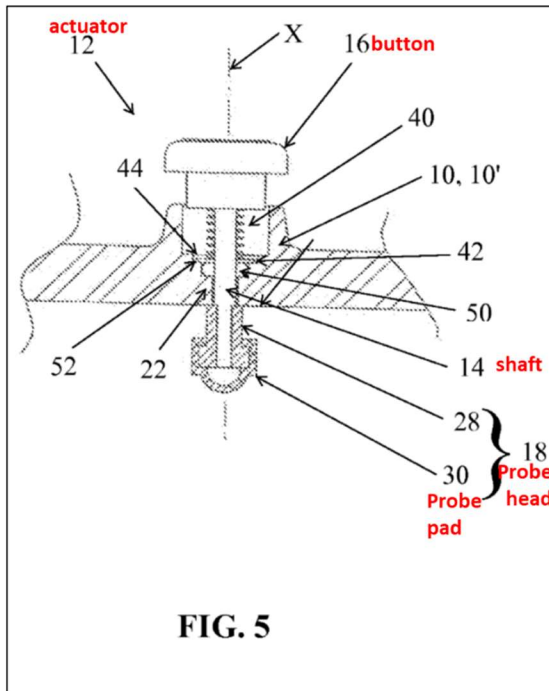
132. See my analysis of claims 1, 6, and 8.

133. Chu's Fig. 6 shows the probe pad 30, which is the claimed electric shield:



EX1004, Fig. 6 (annotation added); *see also* Figs. 8 and 10.

134. Chu's Figures 4 and 5 show that the portion of the probe pad 30 that contacts the touchscreen is substantially smaller than the remaining portion of the probe pad:



EX1004, Figs. 4, 5 (annotations added).

J. Claim 10: The virtual reality viewer of claim 6, further comprising a compressible pad disposed between the second portion of the input mechanism and the portion of the surface of the electric shield, wherein the pad is configured to create a sufficiently sized area of contact between the portion of the surface and the touch-screen when the input mechanism is in the extended position.

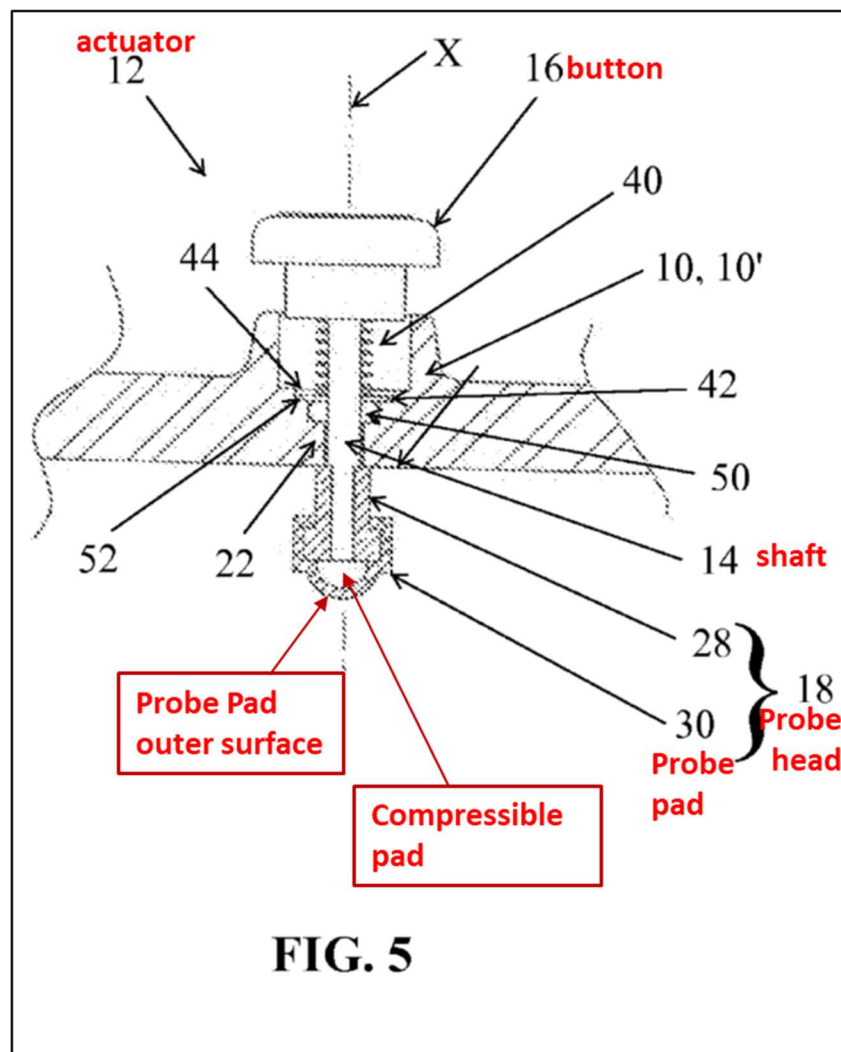
135. See my analysis of claims 1, 6, 8, and 9.

136. Chu's Figure 5 below shows probe pad 30 at the end of shaft 14.

Chu's shaft 14 constitutes the claimed "second portion of the input mechanism."

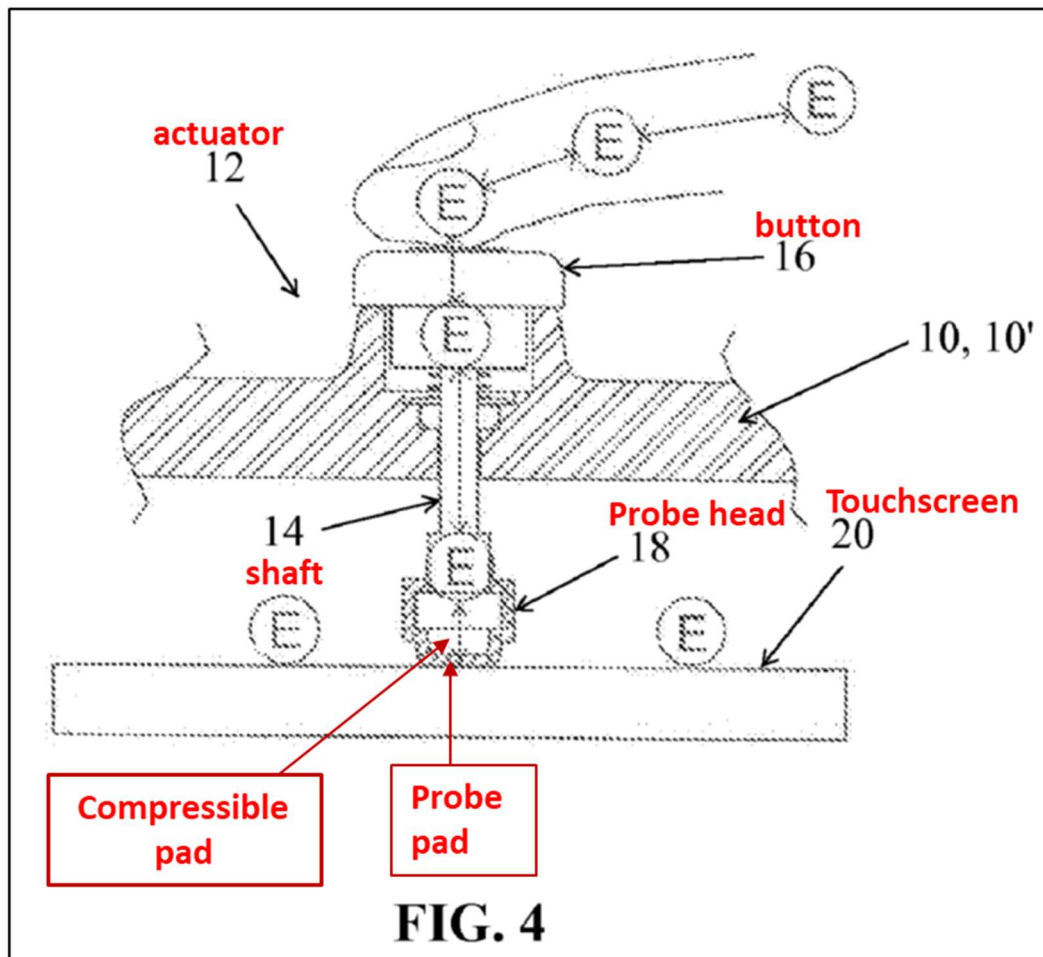
Probe pad 30 (the claimed electric shield) has an outer surface (the claimed "surface of the electric shield").

137. Of course, the probe pad has a pad (the claimed “compressible pad”) within the outer surface, hence the name “probe *pad*.” I will refer to this padding within the probe pad as the compressible pad. This Figure below shows the input mechanism in an unactuated state with the probe pad, probe pad outer surface, and compressible pad.



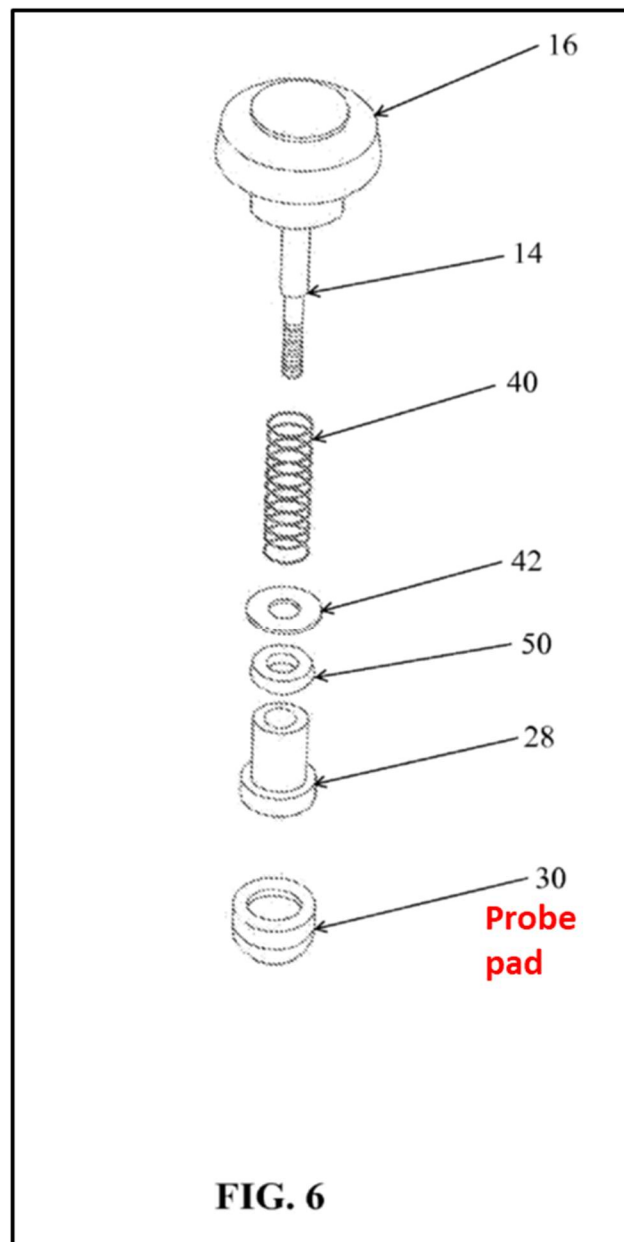
EX1004, Fig. 5 (annotations added).

138. Chu's Figure 4 below shows the input mechanism in an activated state, creating a sufficiently sized area of contact between the probe pad's surface and the touchscreen. The probe pad is made of rubber. EX1004, ¶0012, 0017, 0048, 0049. This figure shows an electric charge flowing through the probe pad when it is in an extended position and deformed (i.e., compressed), which indicates to a POSA that there is a substantial thickness to the probe pad and it is not empty. In other words, this Figure shows that there is padding within the probe pad (the "compressible pad").



EX1004, Fig. 4 (annotations added); *see also* ¶¶0053-0056.

139. Chu's Figure 6 shows that the probe pad 30 is substantially thick and it is this padding within the probe pad that constitutes the claimed "compressible pad."



EX1004, Fig. 6 (annotation added); *see also* Fig. 8.

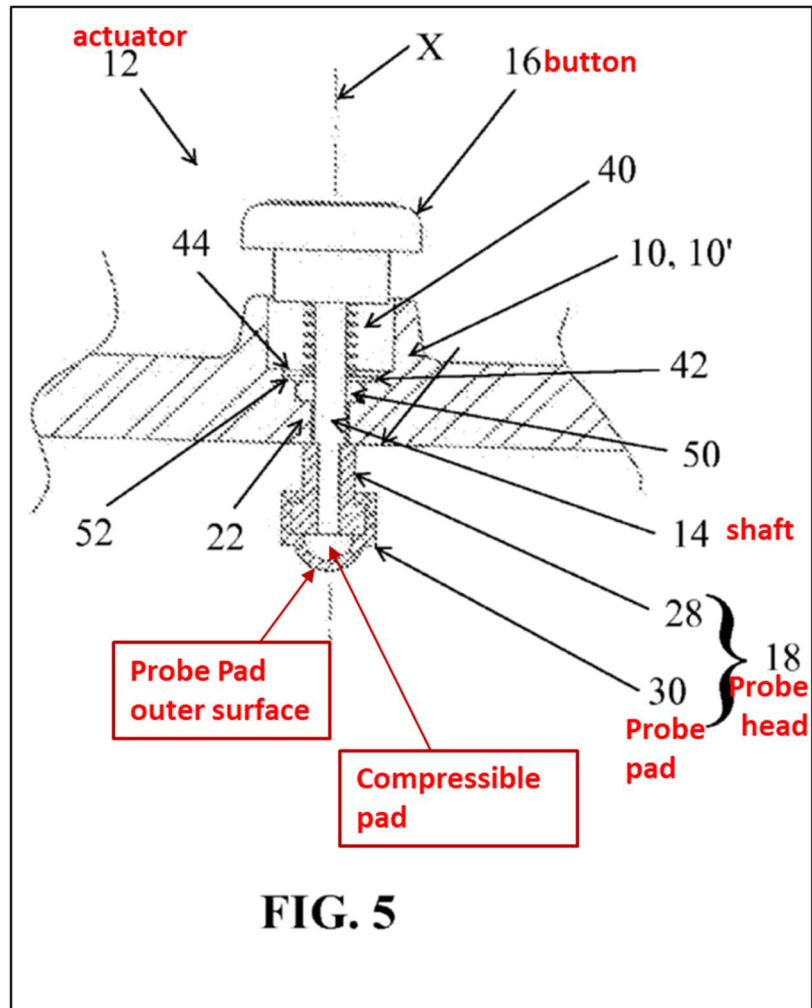
140. A POSA would recognize that there is padding within the probe pad, and it is this padding that would constitute the claimed compressible pad.

However, even if there weren't such padding, a POSA would be motivated to add it for more of a cushioning effect against the touchscreen and increased conductivity because it would be made of conductive rubber. EX1004, ¶0049. A POSA would have a reasonable expectation of success because they would simply be adding more conductive rubber to the probe pad.

K. Claim 11: The virtual reality viewer of claim 10, wherein the pad is configured to vary the size of the area of contact between the portion of the surface of the electric shield and the touch-screen as a function of a force applied to the input mechanism from the exterior of the housing.

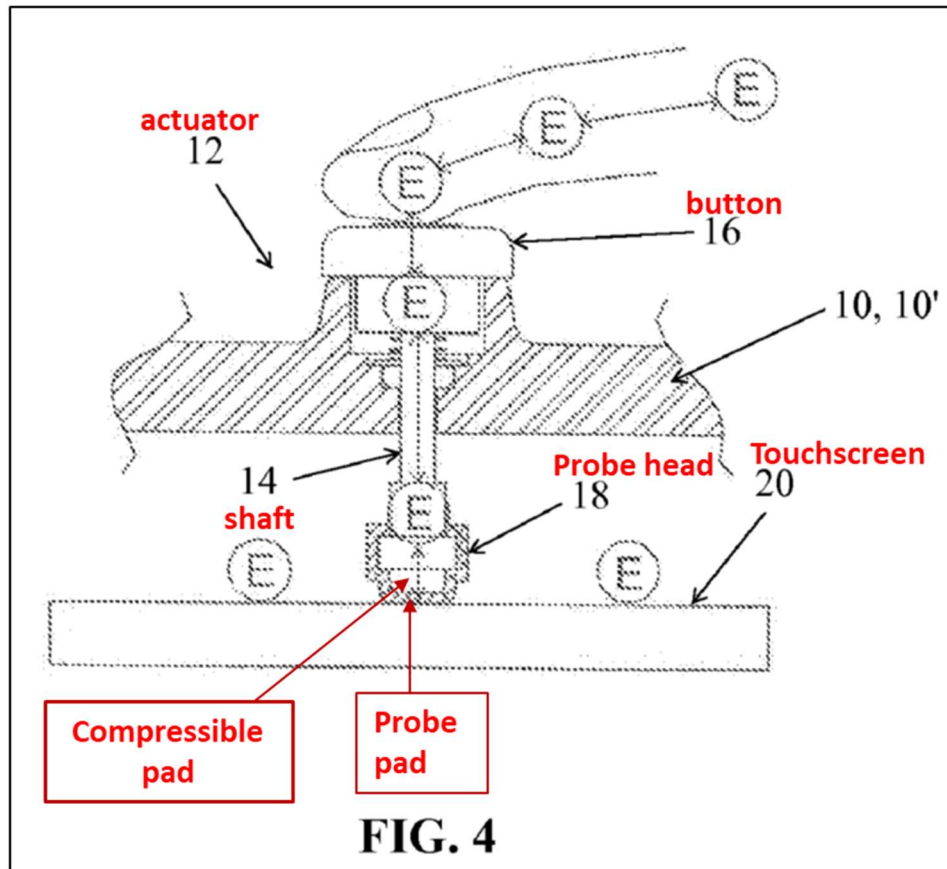
141. See my analysis of claims 1, 2, 6, 7, 8, and 10.

142. Chu's Figure 5 shows the probe pad 30 (the claimed electric shield) in an unactuated state, where its tip is spherical. The probe pad's outer surface is the claimed surface of the electric shield, and the padding or thickness within the probe pad is the claimed "pad" or "compressible pad":



EX1004, Fig. 5 (annotations added).

143. Chu's Figure 4 discloses the probe pad (the claimed electric shield) when activated. The probe pad 30 flattens out, including the padding within it, which varies the size of the area of contact between the probe pad and the touchscreen:



EX1004, Fig. 4 (annotations added).

144. Chu explains that the size of the contact area of the probe pad 30 with the touchscreen increases as more force is applied.

When the user's finger or body part continues to press downwards, the electric charge conductivity between the press button 16 and the user's finger or body part further improves. The press button 16 together with the actuator shaft 14 starts to move downwards. The biasing member 40 supporting the press button 16 is compressed. Since an O-ring 50 is installed on the actuator shaft 14 with a water-sealing compound, it can prevent water outside the waterproof housing 10, 10 from entering into the waterproof housing 10, 10 and damaging the

digital device held therein. *The probe head 18 carried by the actuator shaft 14 starts touching the touch screen 20. When the probe pad 30 is further pressed onto the touch screen 20, the probe pad 30 starts to deform and form a larger contact area with the touch screen 20, as depicted in FIG. 4, thereby enhancing the electric charge conductivity.*

See EX1004, ¶0055; *see also* ¶¶0053-0057.

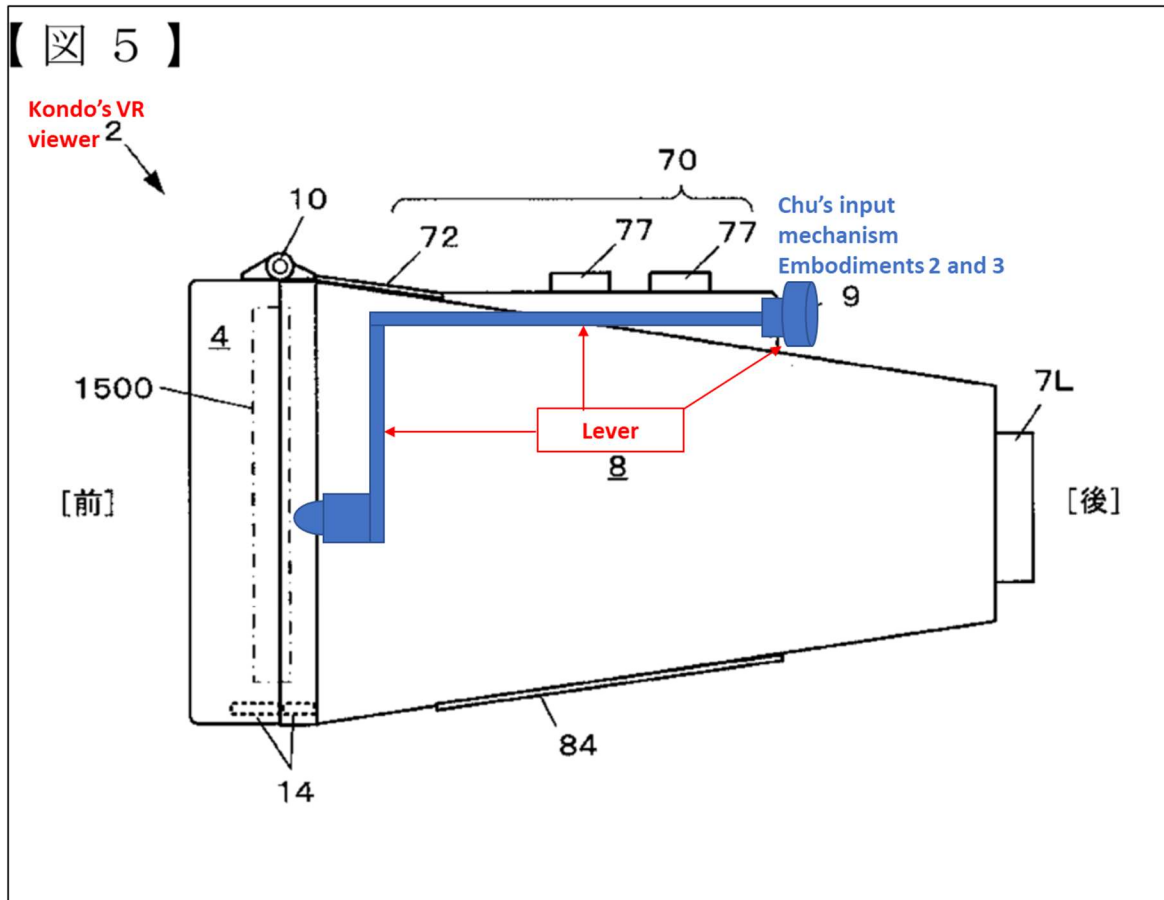
145. As I mentioned for claim 10, a POSA would recognize that the probe pad has padding within it, and even if it didn't, it would be obvious to add such padding for the reasons I already stated. This padding would vary the size of the contact area between the surface of the probe pad and the touch screen as a function of the force applied by the user because it is made of rubber. EX1004, ¶0049.

L. Claim 12: The virtual reality viewer of claim 1, wherein the input mechanism includes a lever and a flexible linkage coupled to the housing, wherein the flexible linkage is configured to deform when the lever is actuated and thereby guide at least the portion of the surface between the first position and the extended position.

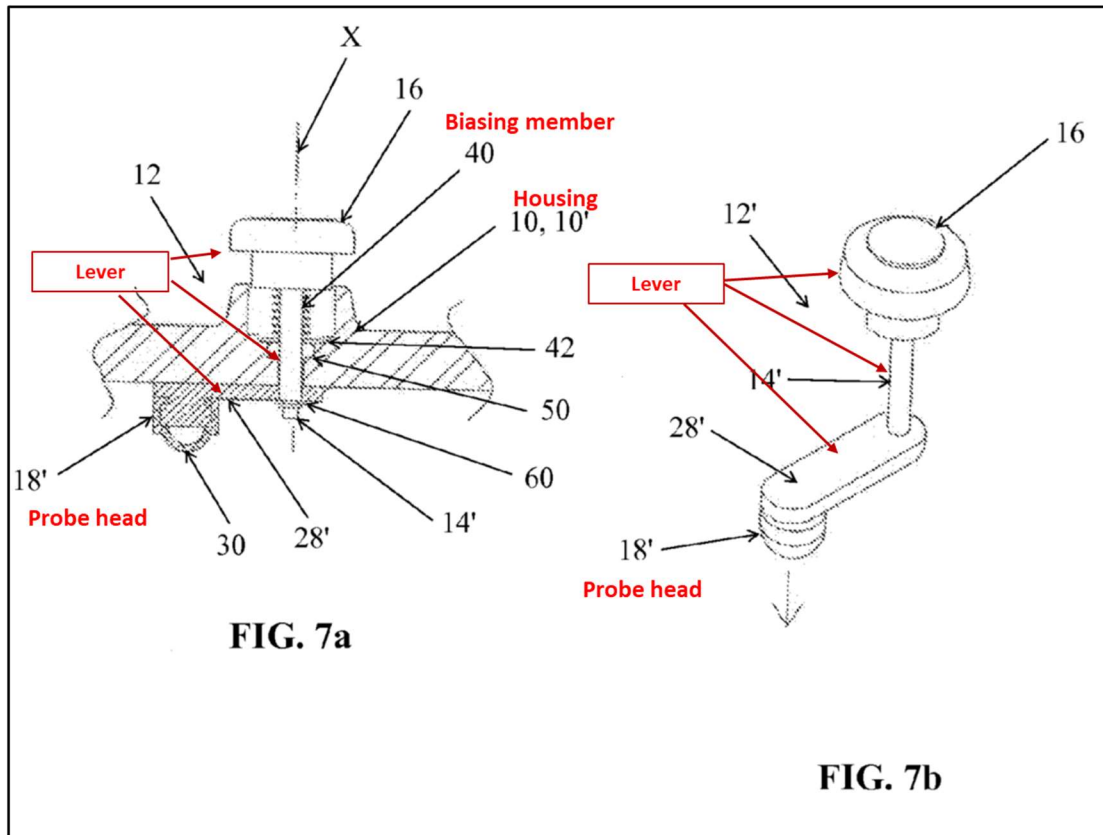
146. Please see my analysis of claim 1.

147. As discussed in §IV(A), I have construed “lever” to mean “A projecting piece by which a mechanism is operated or adjusted.” For this claim, my proposed combinations include Chu’s second and third embodiments, as I

explained above in §VII(C). Here is my figure from that section with additional annotations to show the claimed lever:



148. A POSA would recognize Chu's button 16, shaft 14 and extension arm 28' as the claimed "lever" because it projects from housing 10 and operates the VR viewer as shown below in Figures 7a and 7b:



EX1004, Figs. 7a, 7b; *see also* Figs. 9a, 9b, ¶¶0058-0062.

149. It is worth noting that Chu's lever (button 16, shaft 14, and extension arm 28') in Chu's second and third embodiments moves about a fixed position, including the biasing member 40, the center of shaft 14, as well as the housing 10.

150. As an alternative, a POSA would consider Chu's shaft 14 and extension arm 28' (without button 16) as also constituting the claimed lever.

151. The biasing member 40 is a spring/coil structure that constitutes the claimed flexible linkage because it is coupled to housing 10 (as shown in Figure 7a

above) and deforms when the lever is actuated, thereby guiding the surface of the electric shield (probe pad 30) between an unactuated and actuated position.

When the user's finger or body part continues to press downwards, the electric charge conductivity between the press button 16 and the user's finger or body part further improves. The press button 16 together with the actuator shaft 14 starts to move downwards. *The biasing member 40 supporting the press button 16 is compressed.* EX1004, ¶0055.

152. As I mentioned above, a POSA would understand that the button 16, shaft 14, and extension arm 28' all combined constitute the claimed lever. The '075 patent mentions the terms "lever" and "button" in the same sentence, but I do not believe that a POSA would read this as meaning that the two terms cannot overlap. They are both actuator mechanisms:

In addition or alternatively the coupling can be a structure that is flexibly coupled to one or more portions of the housing such that it moves in a prescribed manner when a lever is moved or a button is pushed by the user. EX1001, 9:17-21.

153. However, I consider not simply the button, but the button 16 *combined* with shaft 14 and extension arm 28' to constitute the claimed lever. The '075 patent is silent on this.

154. As an alternative combination, as shown below, a POSA would be motivated to replace Chu's button 16 with a handle, but otherwise leave the

【図 5】

Kondo's VR viewer 2

Handle – part of the claimed lever

Chu's input mechanism 9 Embodiments 2 and 3

Lever 8

10, 1500, 4, 72, 77, 7L, 84, 14

[前], [後]

EX1004, ¶0058-0062; Figs. 9a, 9b, 10. A POSA would have a reasonable expectation of success because this is a simple replacement requiring little skill as long as the material was conductive.

M. Claim 14: The virtual reality viewer of claim 12, wherein the flexible linkage is configured to return the portion of the surface from the extended position to the first position in the absence of user interaction with the input mechanism.

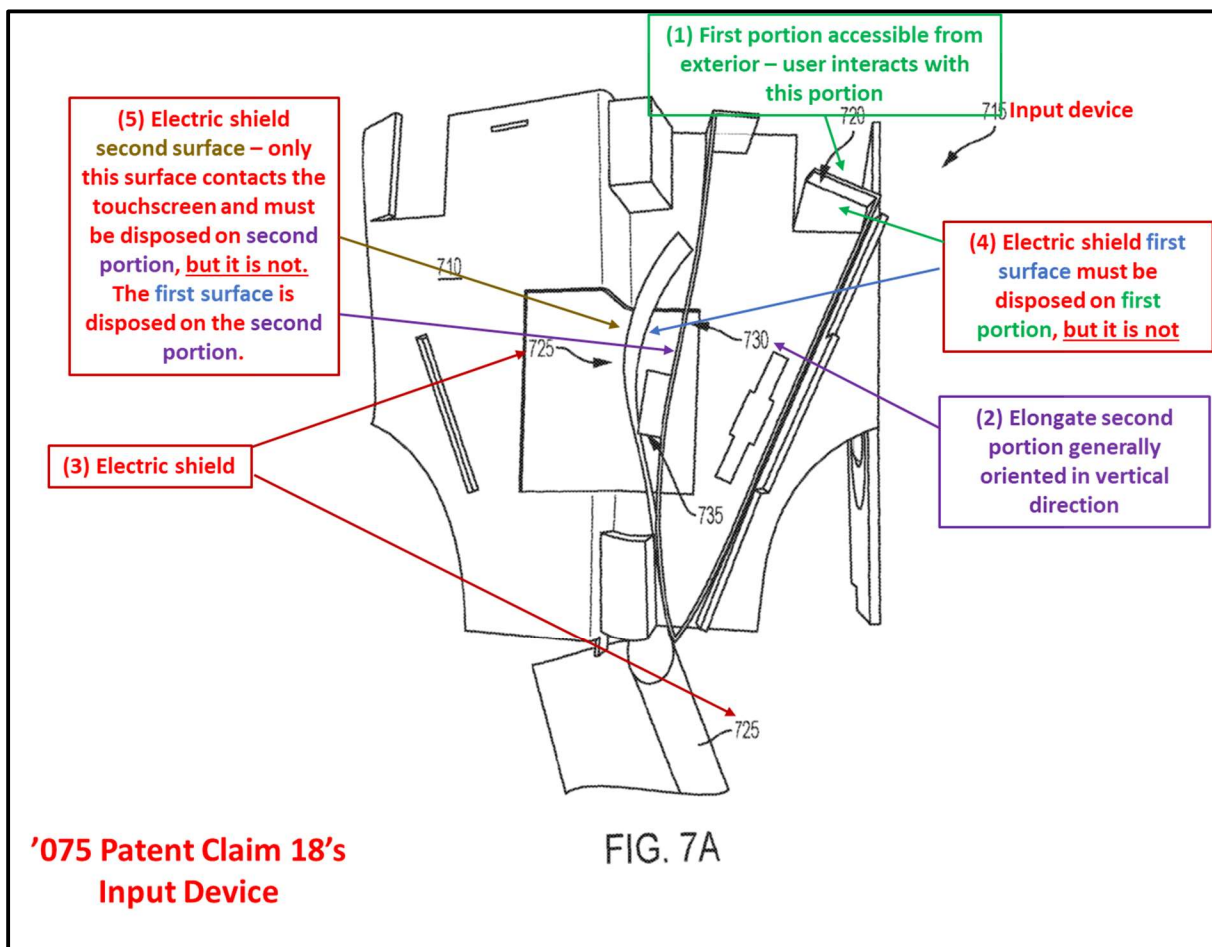
156. See my analysis of claims 1, 6, 10, 11, and 12.

157. Chu's biasing member 40 (the claimed flexible linkage) returns the electric shield to the unactuated position when the user releases the input mechanism, because it is a spring. EX1004, ¶0056 ("When the press button 16 is released, the biasing member 40 then pushes press button 16 upwards.").

N. Claim 18:

158. A POSA would need to review the specification to try to understand this claim for two reasons. First, the claim requires an electric shield with two surfaces. However, "only the second surface of the electric shield is configured to contact ... the touchscreen." But, this second surface "is disposed on the second portion" of the input device. Because the second surface is facing and disposed on the second portion, it does not seem apparent how it could also touch the touchscreen as the claim requires. Second, the claim requires that the first surface of the electric shield is "disposed on the first portion" of the input device which is

“accessible from the interior of the housing.” Therefore, both surfaces of the electric shield are disposed on different parts of the input device, which, from a mechanical perspective, would not seem to allow the electric shield to contact the touchscreen because both of its surfaces are facing and disposed on something else. For these reasons, to understand the claim, I attempted to read the claim in view of the specification to determine the claim’s scope. After doing so, I conclude that a POSA could not understand this claim. I provide below annotations to the ’075 patent’s Figure 7A to demonstrate the problems with this claim:

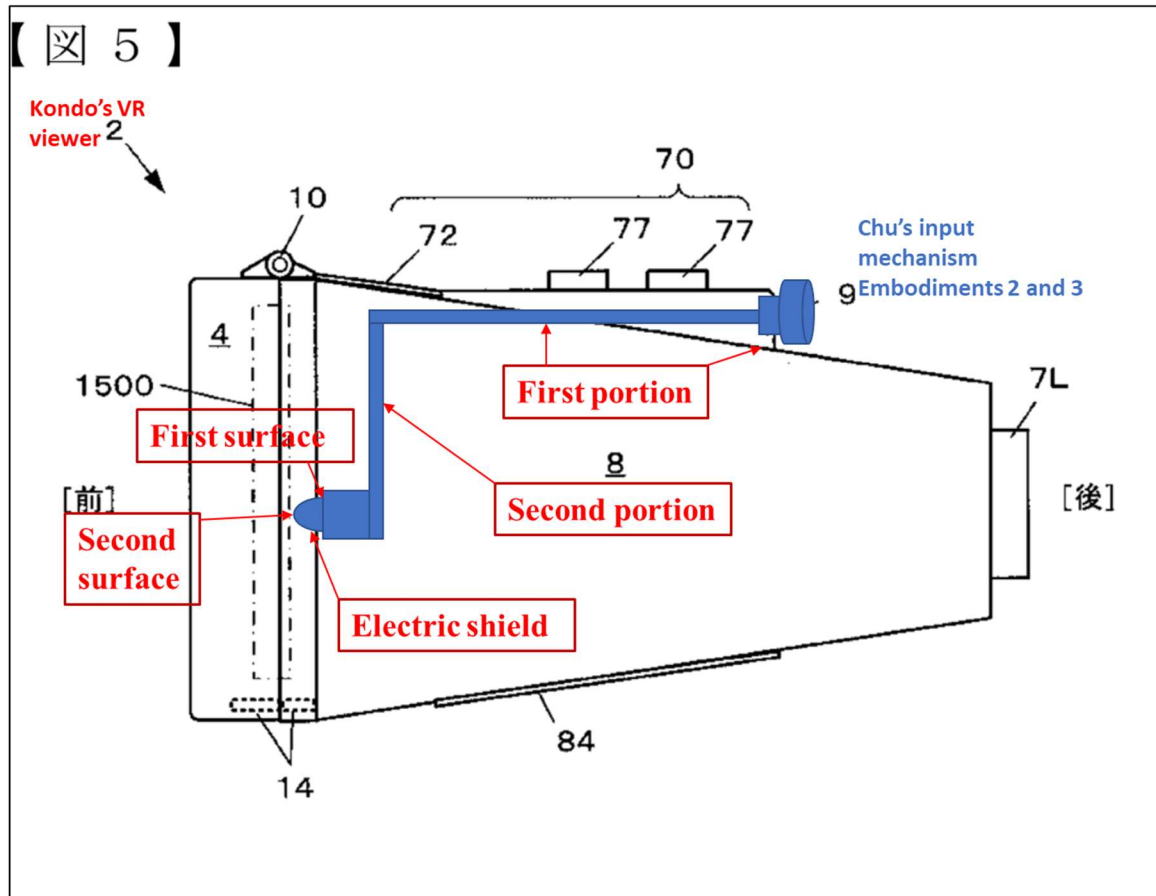


EX1001, Fig. 7A (annotations added).

159. As shown above, claim 18 has 5 limitations for its input device. The input device has two portions: (1) a **first portion** shown in **green** above and (2) a **second portion** shown in **purple** above. The **first portion** is accessible from the exterior so that the user can interact with it, and the **second portion** is generally oriented in a vertical direction. Claim 18's input device also includes (3) an **electric shield** shown above in **red**. The **electric shield** has (4) a **first surface** shown in **blue** and (5) a **second surface** shown in **brown**. As my annotations show and as claim 18 requires, the **electric shield's first surface** must be disposed on the **first portion**. But this claimed **first surface** is not described in the patent's specification; instead, the specification describes that the **first surface** is disposed on the **second portion**. And, in claim 18, the **electric shield's second surface** must contact the touchscreen and must be disposed on the **second portion**. But this claimed **second surface** is not described in the specification; rather, the specification describes that the **first surface** is disposed on the **second portion**.

160. A POSA would not be able to understand this claim based on the specification's inconsistent disclosures. The only way it could possibly make sense is if the words "disposed on" included an indirect connection. For example, in the above diagram, electric shield 725 is far removed from the externally accessible input device (lever 720). If I interpret, "disposed on" in this manner, the

Kondo/Chu combination renders this claim obvious in the following manner,
which I further explain below:



EX1003, Fig. 5 (annotations added).

161. Please see my proposed combinations of Kondo/Chu discussed in §VII(C), my descriptions of Kondo and Chu in §§VII(A) and (B), and my analysis of claim 1.

1. Claim 18(a): A virtual reality viewer for use with a mobile electronic device having a capacitive touch-screen, the viewer comprising:

162. See my analysis of claim 1(a). The touchscreen is a capacitive touchscreen. EX1003, cls. 1, 4; ¶¶0005, 0009, 0023, 0024.

2. Claim 18(b): a housing configured to receive the mobile electronic device and substantially enclose the touch-screen within a generally hollow interior of the housing, wherein the housing holds the touch-screen in a position that is generally centered in a horizontal direction and directly in a user's field of view when viewing the touch-screen through a back wall of the housing, wherein the back-wall is opposite the touch-screen and includes a left and a right lens for viewing a left region and a right region of the interior and the touch-screen;

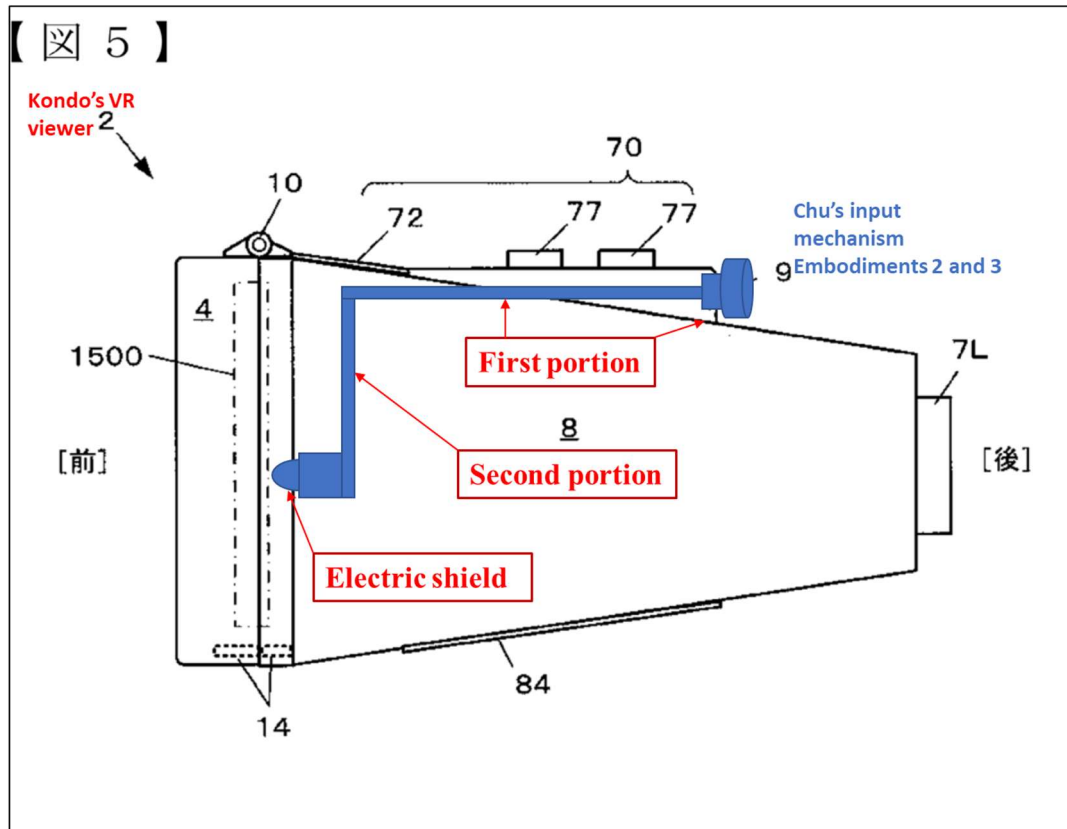
163. See §VII(C) and my analysis of claims 1(b), 1(d), and claim 4.

3. Claim 18(c): an input device including,

164. See my analysis of claim 1(c) and 1(d).

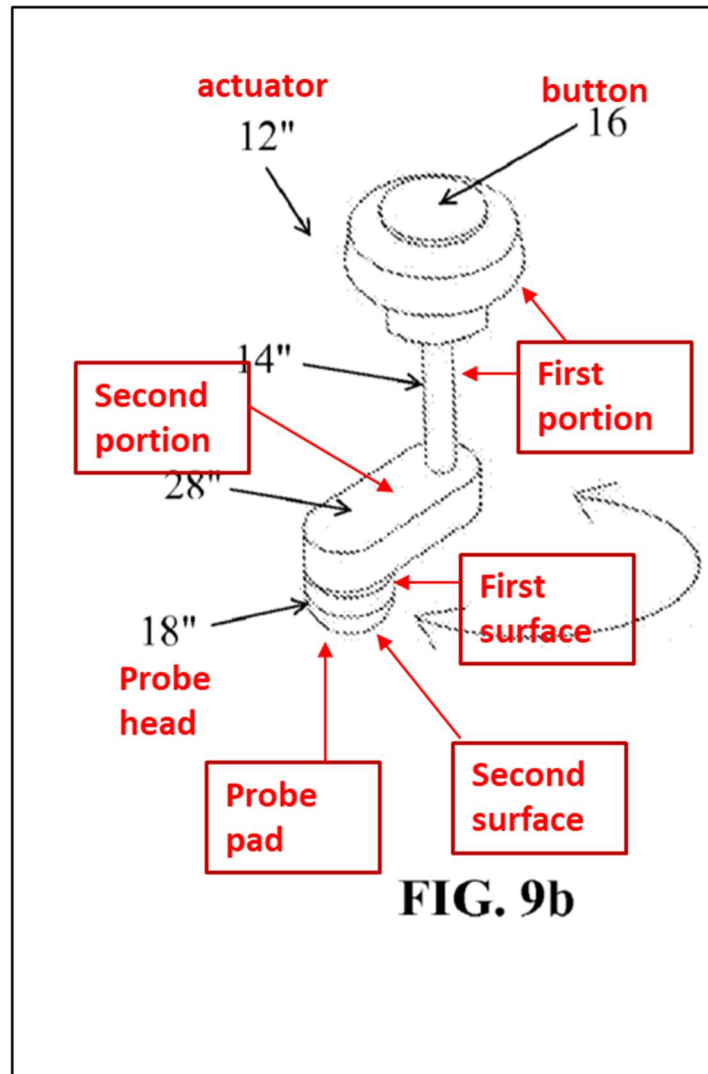
4. Claim 18(d): a first portion that is accessible from an exterior of the housing,

165. I have annotated my proposed combination from §VII(C) for Chu's second and third embodiments to show the first portion, which is accessible from the exterior, as well as the second portion for claim 18(e) and the electric shield of claim 18(f).



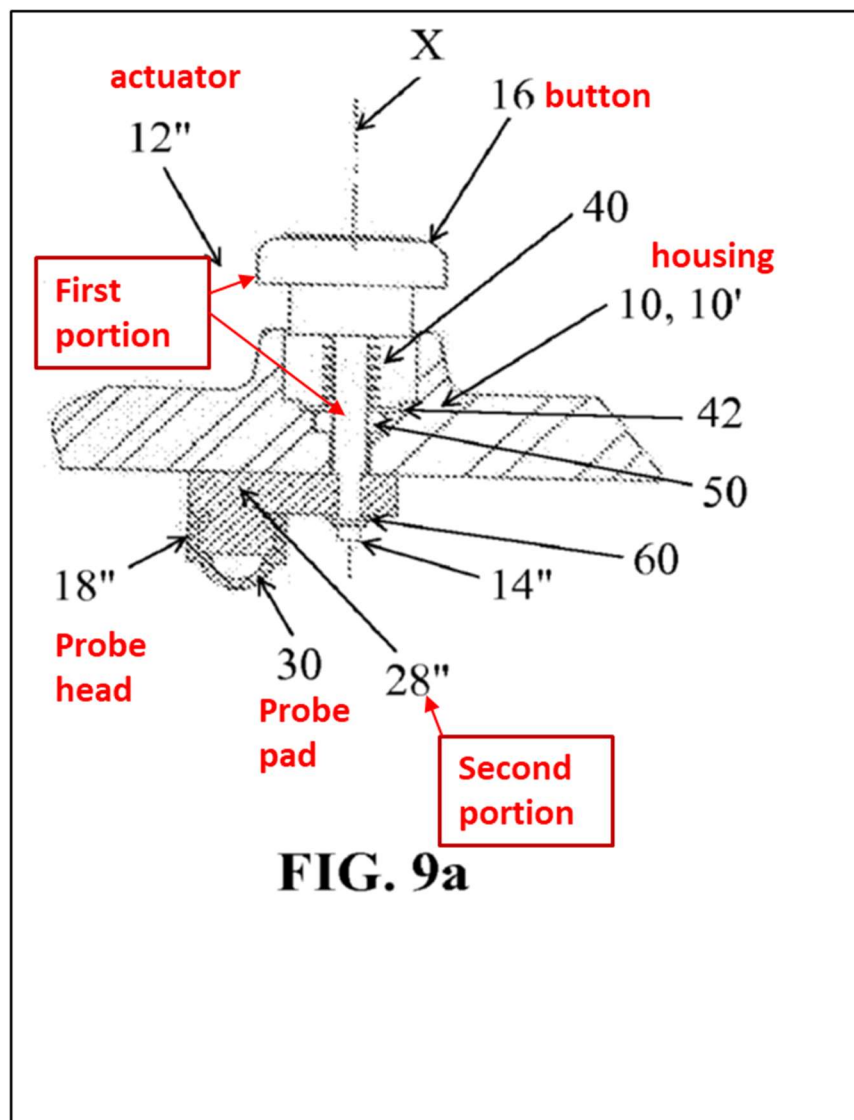
EX1003, Fig. 5 (annotations added); *see also* §VII(C).

166. Chu's Figure 9b below shows the first portion and second portion, as well as the probe pad 30 (the claimed electric shield in claim 18(f)) and the two surfaces of the electric shield.



EX1004, Fig. 9b (annotations added).

167. Chu's Figure 9a shows button 16 is on the exterior of the housing.

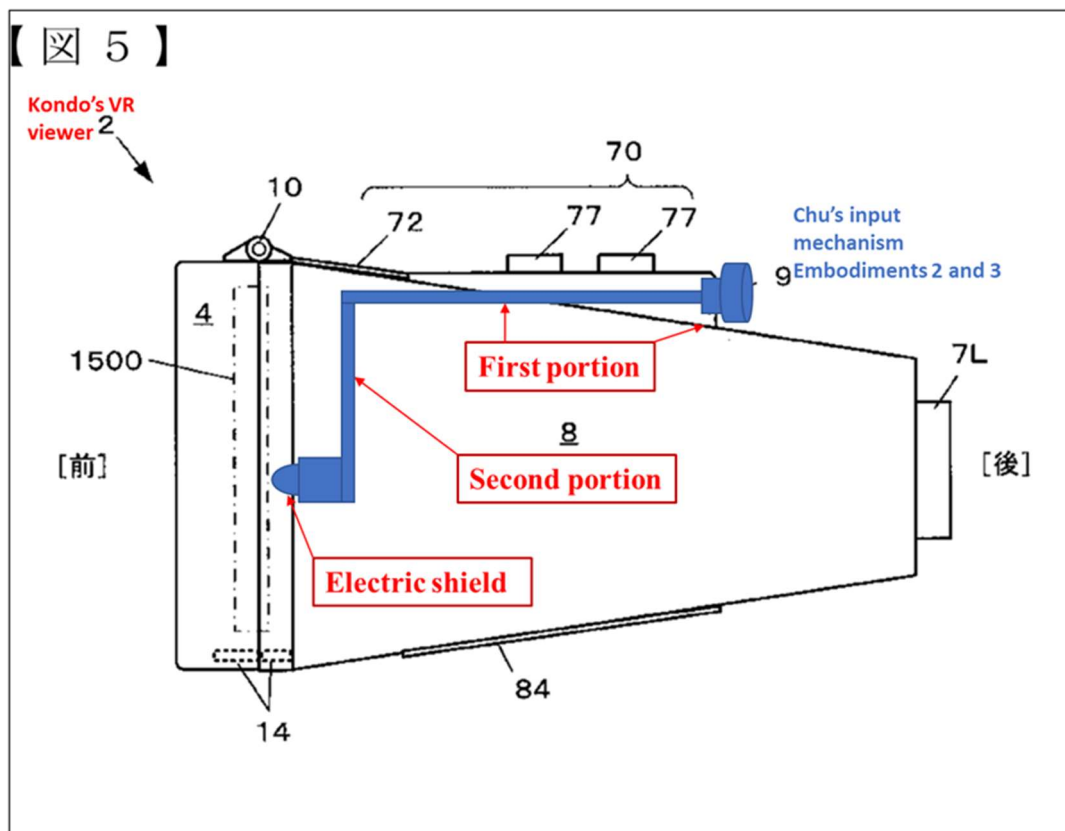


EX1004, Fig. 9a (annotations added).

5. Claim 18(e): and an elongate second portion disposed within the interior of the housing between the left and right regions wherein the second portion is generally oriented in a vertical direction that is perpendicular to the horizontal direction;

168. See my analysis of 18(d).

169. The below figure shows my proposed combination of Kondo/Chu from §VII(C) showing an elongate second portion horizontally centered (see §VII(C) and my analysis from claim 1(d), claim 2, and claim 4) within the interior of the housing and generally oriented in a vertical direction that is perpendicular to the horizontal direction.

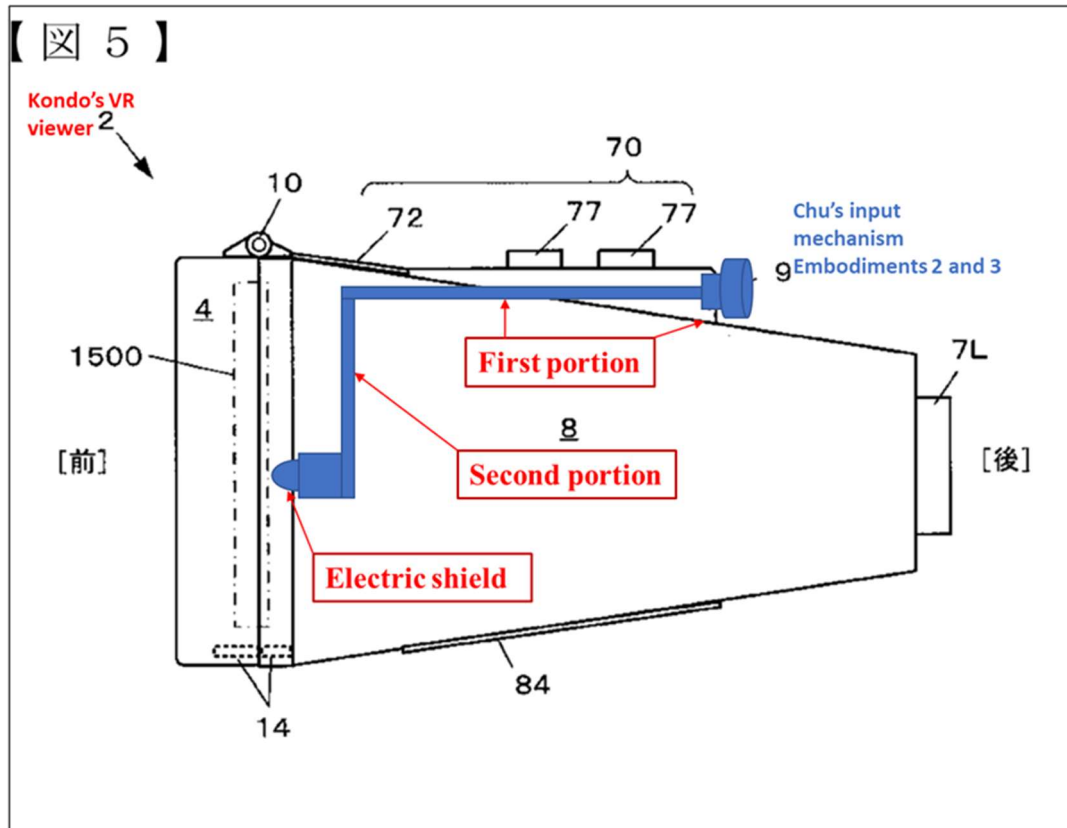


EX1003, Fig. 5 (annotations added); *see also* §VII(C), claim 18(d).

6. Claim 18(f): an electric shield,

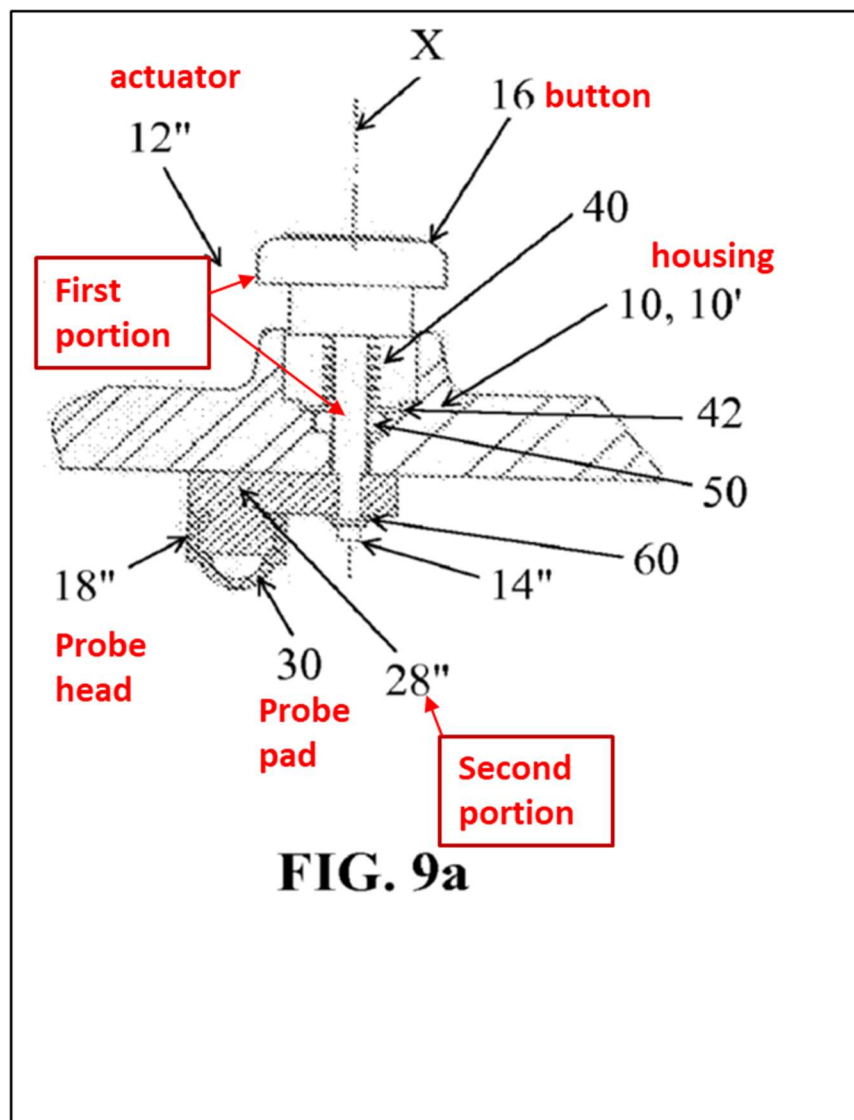
170. See claim 1(d) and claims 18(d) and 18(e).

171. The Figure below shows the electric shield in my proposed combination.



EX1003, Fig. 5 (annotations added); *see also* §VII(C) and claim 1(d).

172. Probe pad 30 is the claimed electric shield and is shown in Chu's Figure 9a below.



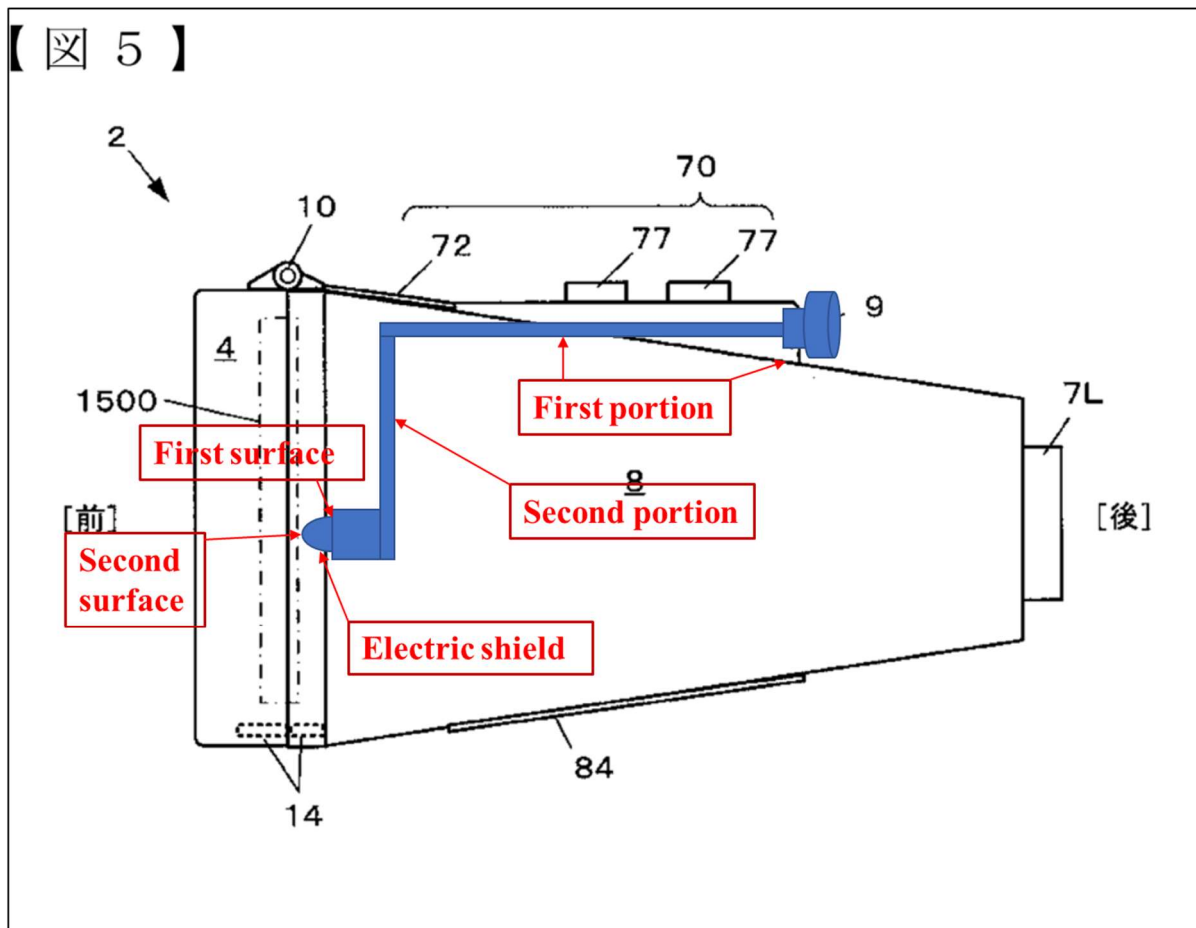
EX1004, Fig. 9a (annotations added).

7. Claim 18(g): wherein a first surface of the electric shield is disposed on the first portion and is electrically coupled to a second surface of the electric shield,

173. See my analysis from claim 1(d) and claims 18(c)-(f). In particular, my analysis of 1(d) explains how electric charge is transferred through Chu's

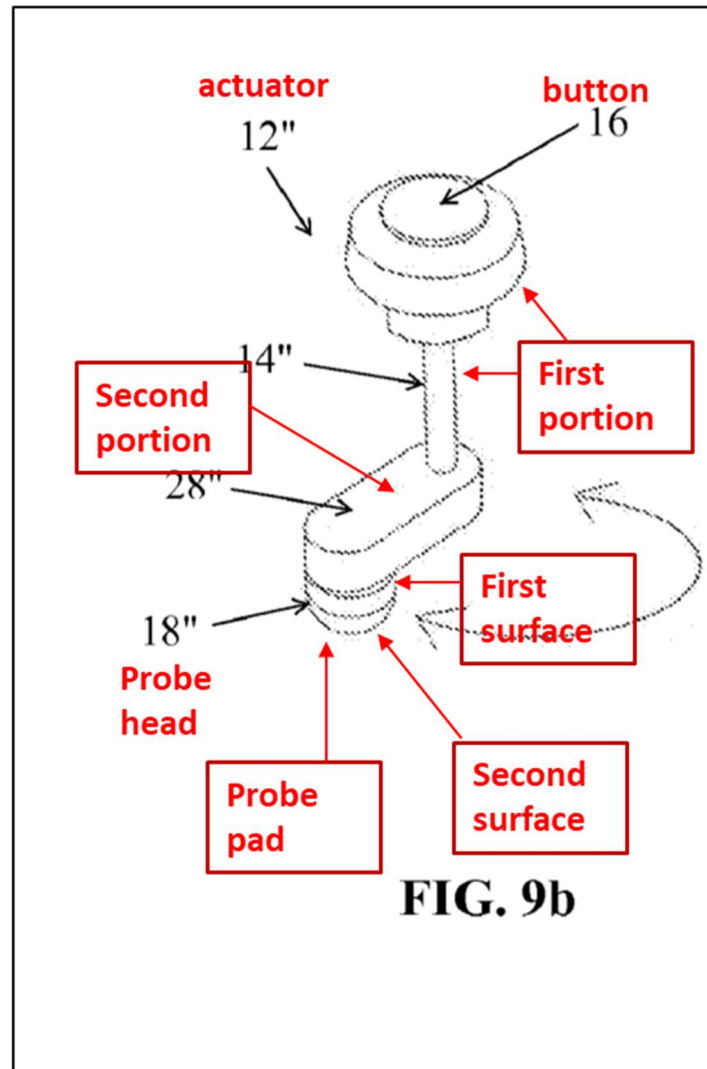
probe pad, indicating that the two surfaces of the probe pad are electrically coupled.

174. Below, I demonstrate that my proposed combination of Kondo/Chu has the electric shield's first surface "disposed on" (as I interpret above to include indirect connection) to the first portion very similar to the '075 patent.



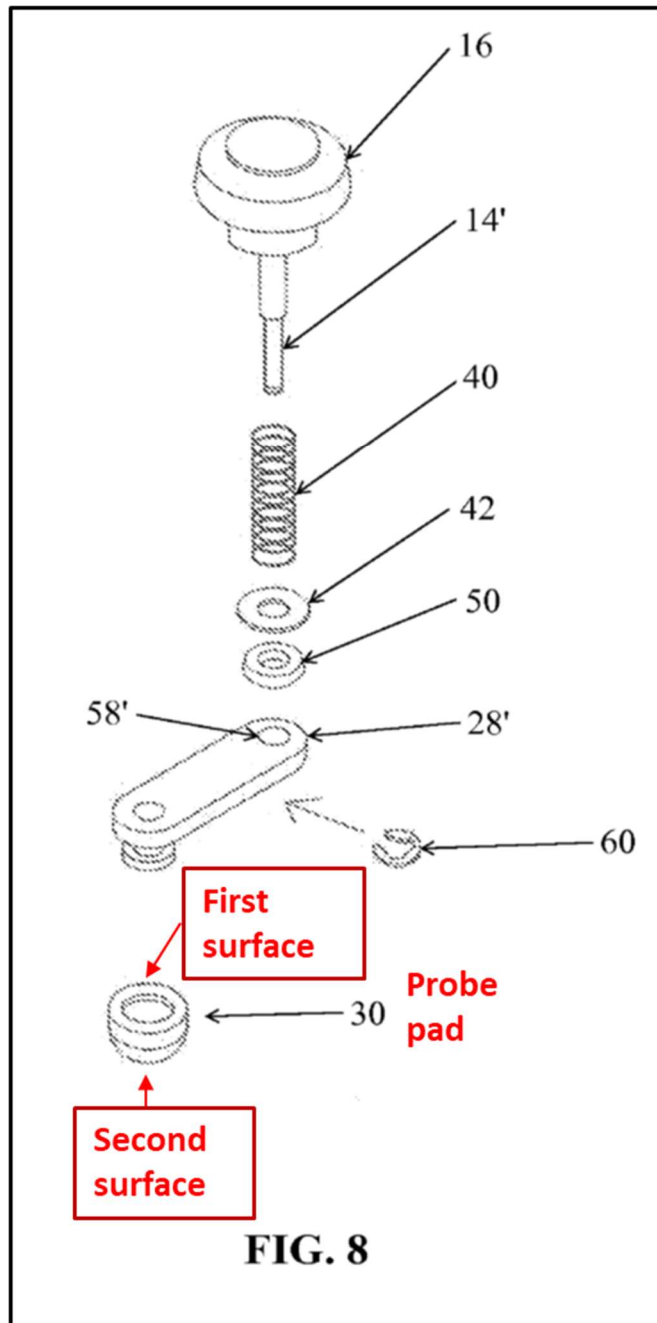
EX1003, Fig. 5 (annotations added).

175. Figure 9b shows the claimed electric shield (probe pad 30) with two surfaces. The “first surface” is that portion of the probe pad that contacts the second portion 28”.



EX1004, Fig. 9b (annotations added).

176. Figure 8 shows the surfaces of the probe pad in greater detail.

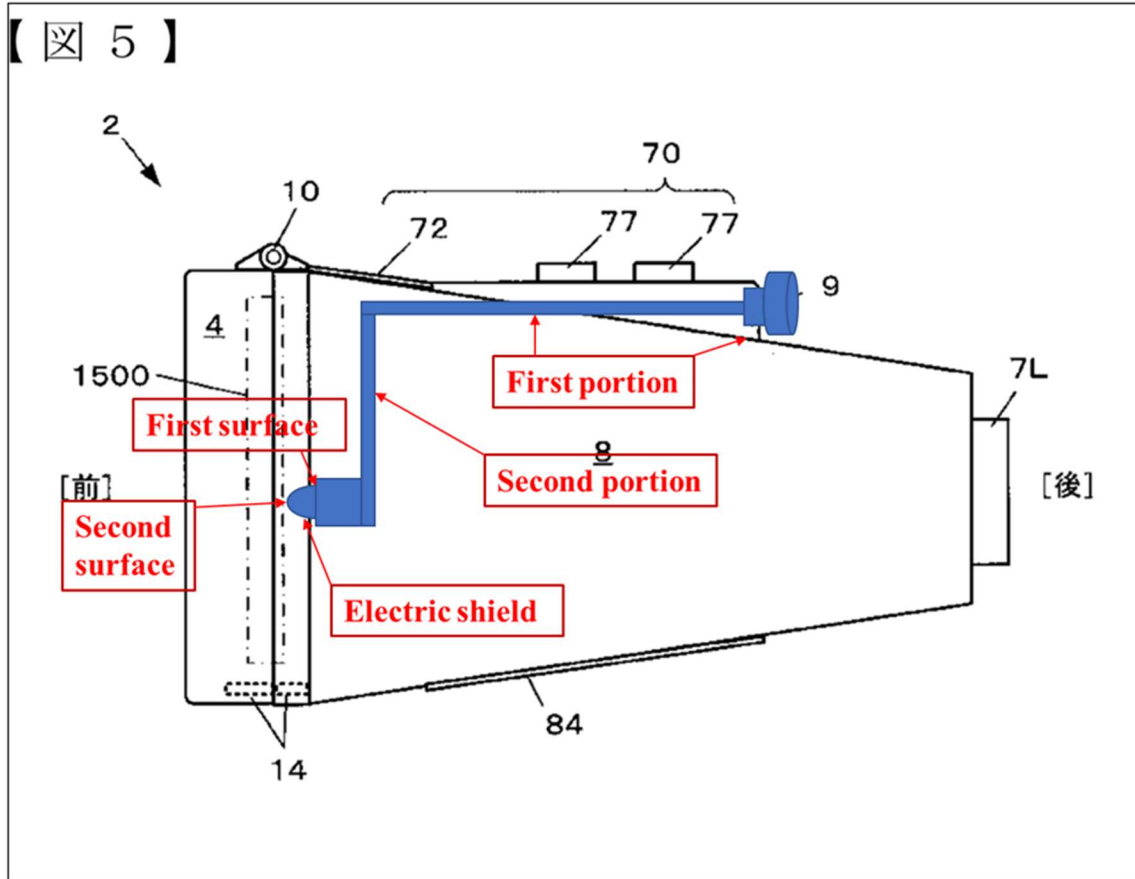


EX1004, Fig. 8 (annotations added).

8. Claim 18(h): wherein the second surface is disposed on the second portion within the interior and is generally centered in the horizontal direction between the left and right regions, and wherein only the second surface of the electric shield is configured to contact a central portion of the touch-screen of the mobile electronic device and selectively transfer a capacitive touch input to the touch-screen in response to a user interaction with the first portion of the input mechanism.

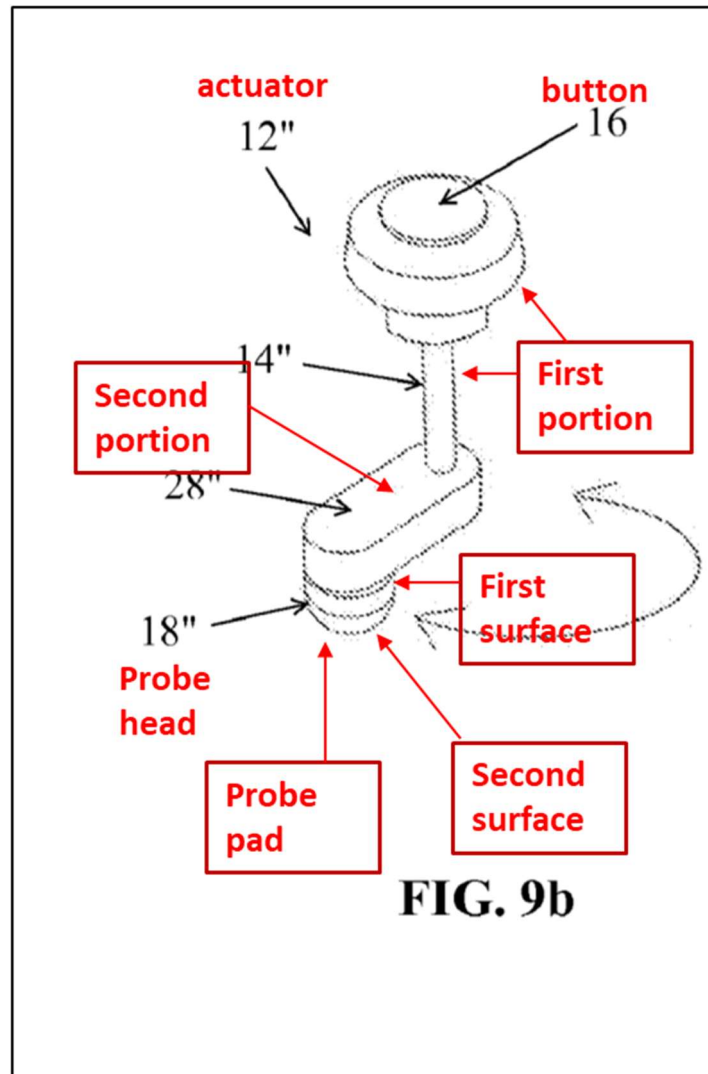
177. See §VII(C) and claims 1(b), 1(c), 1(d), 2(b), and 4 for an explanation of how my proposed combination contacts the central portion of the touchscreen and is generally centered in the horizontal direction. Also, please see my analysis of the other parts of claim 18 for context and explanation.

178. Below, I demonstrate that my proposed combination of Kondo/Chu has the electric shield's second surface "disposed on" the second portion very similar to the '075 patent. Again, I interpret "disposed on" to include indirect connection.



EX1003, Fig. 5 (annotations added).

179. Chu's Figure 9b shows the second portion.



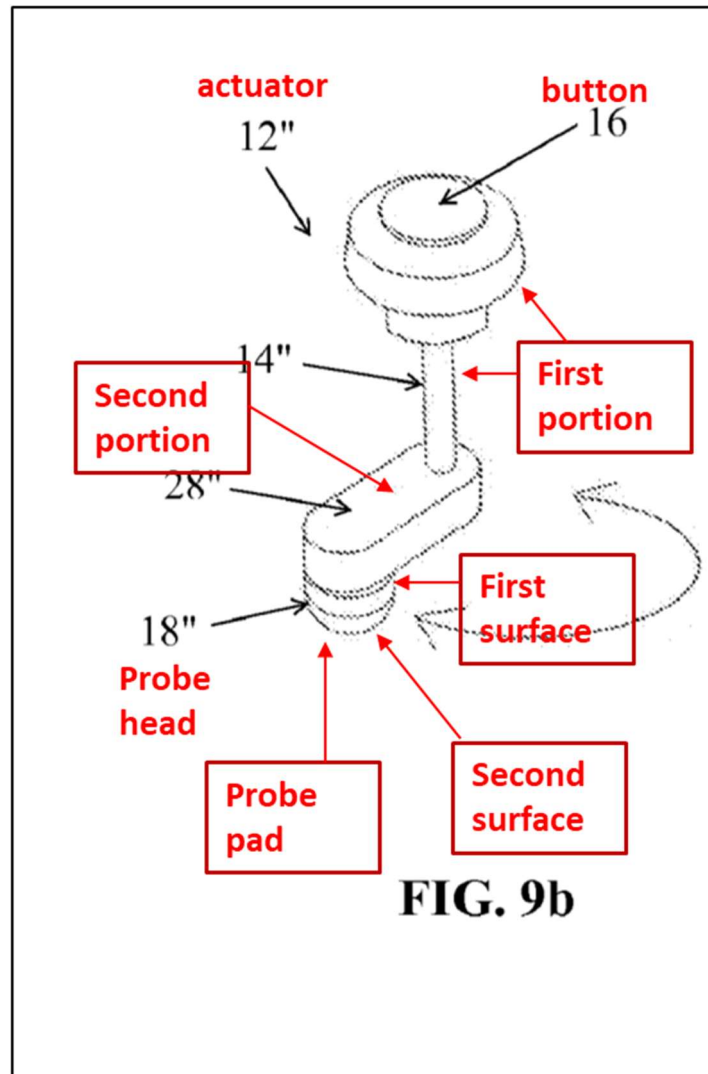
EX1004, Fig. 9b (annotations added).

180. Please see my analysis of claims 1(c) and 1(d) for an explanation for how a user's touch of Chu's button 16 results in a capacitive touch to the touchscreen.

O. Claim 19: The virtual reality viewer of claim 18, further comprising:

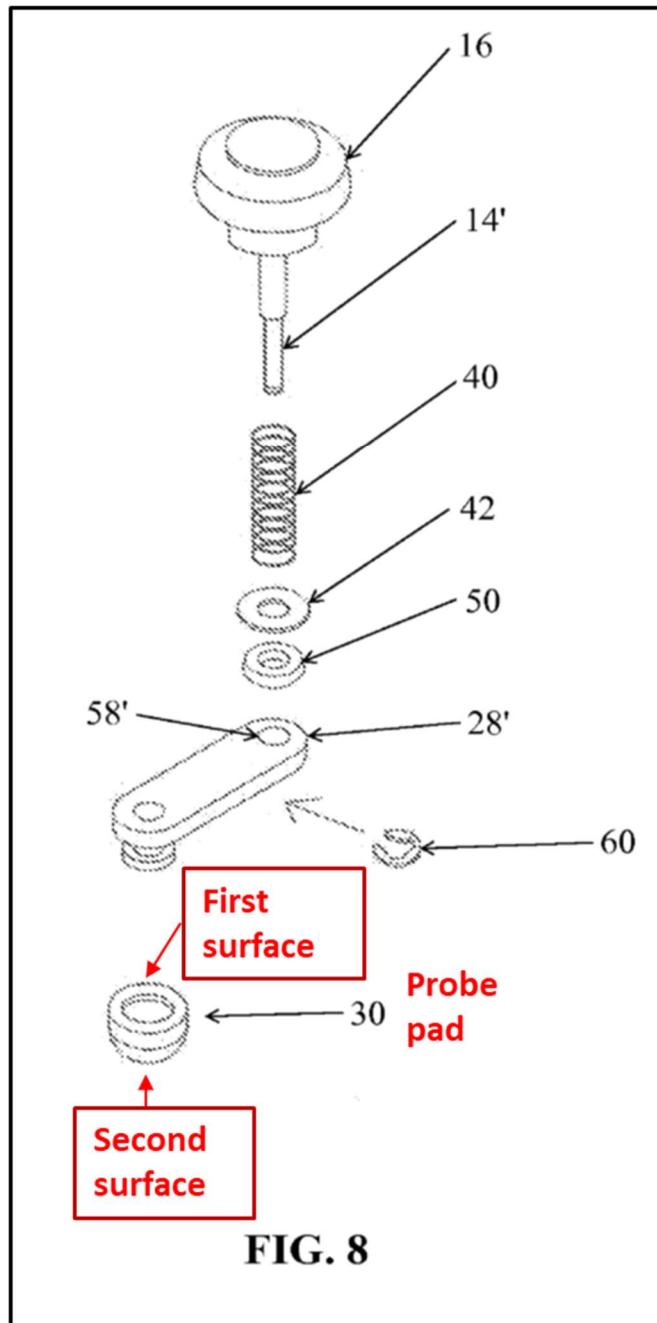
1. Claim 19(a): a compressible pad disposed between the second portion and the second surface to provide an area of contact between the second surface and the touch-screen that is sufficient to transfer the capacitive touch input;

181. See claims 1(c), 1(d), 7, 8, 10, 11, and 18. My analysis for these claims explains how Chu's probe pad 30 constitutes the claimed compressible pad as well as how capacitive touch input is transferred through the probe pad to the touchscreen. The claimed second surface is the outer surface of the probe pad. The probe pad is shown below in Chu's Figure 9b.



EX1004, Fig. 9b (annotations added).

182. Figure 8 discloses the probe pad 30 with its two surfaces in greater detail.



EX1004, Fig. 8 (annotations added).

2. Claim 19(b): wherein at least the electric shield includes a conductive material configured to transfer electrical capacitance between the first surface and the touch-screen via the second surface in response to a user interaction with the first surface; and

183. See claims 1(c), 1(d), 6, 7, 8, 9, 10, and 18.

3. Claim 19(c): wherein the second portion of the input mechanism at least partially divides the left and right regions.

184. See claims 1(c), 1(d), 4, and claim 5.

P. Claim 20:

1. Claim 20(a): A virtual reality viewer for use with a mobile electronic device having a touch-screen, the viewer comprising:

185. See claim 1(a).

2. Claim 20(b): a housing configured to receive a mobile electronic device within an interior of the housing, wherein the housing is formed to define a cut-out through an exterior side of the housing;

186. See claim 1(b) and claim 3.

3. Claim 20(c): an input mechanism that is accessible from an exterior of the housing and is moveable within the interior between at least a first position and an extended position, the input mechanism comprising:

187. See claims 1(c), 1(d), and 18.

4. Claim 20(d): a lever that is accessible through the cut-out;

188. See claims 1(c), 3, and 12.

5. Claim 20(e): an electrical shield, wherein only portion of a surface of the electrical shield is configured to contact the touch-screen of the mobile electronic device when in the extended position,

189. See claim 1(d) and claim 18.

6. Claim 20(f): a flexible linkage coupled to the lever and the housing, wherein the linkage is configured to deform in response to actuation of the lever and thereby guide the portion of the surface between the first position and the extended position, and

190. See claims 12 and 14.

7. Claim 20(g): wherein at least a portion of the input mechanism defines at least a portion of a view divider within the interior of the housing.

191. See claim 5.

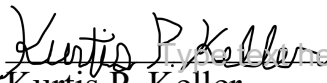
IX. OATH

192. I declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both,

under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the results of these proceedings.

193. I declare under penalty of perjury that the foregoing is true and correct.

Executed on 3/28, 2023.


Kurtis P. Keller

Appendix A

KURTIS KELLER

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Home: 919 732-1371

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<http://www.cs.unc.edu/~keller>

Research Engineer **Mechanical Design of Optical and Electrical Systems**

Medical Equipment design – FDA 510K.
Head Mount Display Design

Virtual/Augmented Reality hardware
Computer interfaces and VR trackers

Education:

1994 M.S. North Carolina State University, Integrated Manufacturing Systems Engineering,

1988 B.S. North Carolina State University, Mechanical Engineering.

Post grad & Business MBA (*27 of 33 credits – started company*): additionally:

Optical Perception, UNC

Patent Law (2 classes), NCSU, UNC

Optical Mounting, U. Arizona.

Business Law, NCSU

Professional:

2003 - Co-founder, Optical/Mechanical Eng. Director & COO, InnerOptic Technology Inc.
Hillsborough, NC (split time with UNC).

1993 - Research Engineer, Microelectronic Systems Laboratory, Department of Computer
Science, University of North Carolina Chapel Hill. (split time with InnerOptic).

2000 – 2001 3rdTech, Senior Mechanical Engineer, Chapel Hill, NC (part time).

Expert witness:

Provided expert witness testimony, declarations and depositions for multiple patents for both prosecution and defense for eight cases involving medical equipment and optical / electro-optical apparatuses and 20+ patents. Depositions were on location or video-taped with court recorder and attorneys; items included invalidity, infringement, claim construction, etc.

Expert witness for projectors and projection systems: Optical and optical electronic packaging and mounting US patents: 6,203,158; 5,297,005; 6,402,324; 6,527,392; 6,558,004; 6,644,817; 6,739,831; and 6,742,899. Seiko Epson Corporation, vs. Coretronic Corporation; Civil Action No. 3:06-cv-06946-MHP, Northern District of California, San Francisco Division; cases settled.

Expert witness for SAIC vs Microsoft. Augmented Reality Head Mounted display tracking technology, multiple patents. Case settled 2020.

Expert witness for MechSource for virtual reality Head Mounted Display (HMD) devices. Investigation, examinations, Infringement, invalidity contentions. Northern District of California. Case settled 2019.

Expert witness for Polycom vs. Fullview. Multi-camera single node camera system for virtual office conferencing. Infringement and invalidity contentions. US patents 5,760,826, 6,128,143, and 6,700,711. Case is ongoing 2022.

Continued

Expert witness for endoscopic medical computer interface / display for Karl Storz - Endoscope. Ongoing, includes declarations and depositions and scheduled in-court appearance, US patent numbers 8,069,420 and 7844,657. Northern District of California, San Francisco Division; Jury. Settled 2019.

Expert witness for Carestream dental scanner. Carestream vs, 3Shape. Dental optical scanning and tracking patent case for IPR. US Patents 10,695,151 and 11,076,146. Case completed 2022.

Expert witness for Axon Enterprises for body mounted cameras, mostly police use. Investigation, Infringement, invalidity contentions. Northern District of California. Case is appears settled.

Expert Witness for GoPro. Thermal and packaging patent issues. Investigation, infringement. Case is settled.

Expert Witness for Samsung, micro camera design, micro lens mounting, multiple patents. Invalidity, Case is settled.

Expert Witness for Polycom, shared optical nodal point teleconferencing camera, versus Fullview, Inc. Patents 6,700,711, 6,128,143. Case ongoing.

Major Projects, abbreviated:

Head Mounted Displays (HMDs). Designer and co-designer of at least 15 HMDs including optical and video see-through systems. Includes designs with LCDs, shutters, projectors and CRTs. 1993 - present UNC & InnerOptic Technology Inc.

Video See through HMD for surgery. First Augmented Reality system to be used for actual surgery in the United States, 1994. Designed AR HMD, surgical tools, calibration mechanisms, and tracker for this innovative project. Custom system design including custom video see-through Head Mounted Display and custom tracked surgical tools. Integrated with live, registered ultrasound. UNC- CS and UNC Hospitals.

HiBall Ceiling Tracker for Virtual and Augmented Reality use. PC design, layout and mechanical design of world's largest & accurate virtual / augmented reality tracker. Six, IR shared path sensors for 5 arc minute rotation accuracy, 1400 updates/sec. Co - designed multi-sensor optical tracker. Commercialized with 3rTech Inc. UNC and 3rdTech Inc.

Wide Field of View See-through Head Mounted Display. Co designer of 60 degree off-axis optical see through HMD design. Full optical mounting, weight and ergonomics. UNC.

Multi Display HMD – 6 display per eye ultra wide field of view full immersion head mount display. Full ergonomic design headset; at the time, both world record pixel count and widest field of view. Kaiser Electro Optics and UNC.

Commercial design and sales of Video see-through HMD. Co-designed, built, patented and commercial sold miniature video see-through HMD. Used from medical procedures, especially surgery. UNC and licensed and commercialized by InnerOptic Technology, Inc.

Pinlight HMD Display. Projector LCD for use as see-through HMD display. Used electronics and display of large cinema projector for source of HMD ultra-wide field of view display and control. UNC and continued at Microsoft.

Virtual Reality welding glasses. Utilized registered cameras and HMD/headset and displayed onto internal screens. Avoided direct intense UV viewing of welding radiation and automatically adjusted brightness levels. UNC.

Virtual Reality hardware and tool design for Virtual Reality golf game where synchronizing swing to “virtual” hit was the difficult issue due to lag; research influenced predictive tracking for future games. UNC-CS.

Virtual Reality safety system – Dual zone system for either XY platform movement or for out of bounds sensing at Virtual Reality stations. Used floor based proximity sensors. UNC.

Scanner System for creating 3D Virtual Reality spaces from real 3D indoor environments. Point clouds were then optimized into 3D textures for tracked HMD registration / display. UNC.

Pixel Flow 8KW Graphics super computer for Virtual Reality (commercialization with Hewlett Packard). Head Mechanical Engineer for \$30 million project. Provided all thermal design, air flow analysis, custom processor heatsink designs, backplane layout (256 bit wide, 12,000 pin, 8 layer), test board designs, co – layout main PC (44 processors, 18 layer board). Hewlett Packard & UNC.

AIM Computer assisted surgical system. Lead Engineer for commercial system that combined tracked ablation needles and ultrasound in a full 3D stereo, real-time display to assist surgeons. From conception to fully FDA approved system. InnerOptic Technology Inc.

Graphic interface review and selection including evaluations of tiled (multiple) projectors systems, flatscreens, virtual touch (3D) and touch screen and other input devices. UNC

Augmented Reality / Virtual Reality hardware – HMDs designs, trackers, interfaces, tools, integration, custom graphic supercomputer team at #1 ranked VR lab in the world, UNC - Computer Science Dept.

Virtual Monticello - Large 3D museum display (about 30 feet) of multiple 3D virtual reality windows to observe Thomas Jefferson's house in tracked stereo. New Orleans Museum of Art and UNC-CH.

Stereo Endoscope Design: Designed patent-pending micro, 5mm diameter dual path endoscope with wide IPD separation, single HD imager, and compact and economical camera interface for surgery use. InnerOptic Technology, Inc.

Projector and 3D display detailed evaluation and analysis. Performed studies on both commercial and UNC's own custom-designed DLP and LCD projectors along with 3D display empirical and user study evaluations. UNC. Also, expert witness for several projector patents.

High-speed optical cancer detection device. Design for a high-speed optical cancer detection apparatus for cancers. Optical design in the visible and IR with multiple, parallel digital cameras and computer. For cervical, prostate and throat cancers. InnerOptic Technology, Inc.

Endoscope camera head for stereo and mono endoscopes: Patent-pending design allows a single camera head to attach to both standard mono- endoscopes and miniature stereo endoscopes providing HD quality imagery. InnerOptic Technology, Inc.

Medical Device FDA and FCC approval process. Worked with team for preparing and submitting 510K of surgical, electronic medical device. Received first clearance Fall 2009. Also included detailed UL 60601-1 and 60601-2 electromagnetic design, test and safety approvals. InnerOptic Technology, Inc.

Magnetic force microscope. Lead mechanical and optical design for real-time magnetic force microscope. Includes design of microscope stages, top and lower optics including dichroic mirrors and custom optics, magnetic coils and circuit boards, optical interfaces, thermal regulation and other. From lab designs to optimized, manufacturable design. UNC.

Multiview. Designed multi-camera 180° FOV shared nodal point camera system. System has six cameras with shared, apparent virtual location by use of use of mirrors and overlapping apertures. Used for effective virtual, wide angle presence and telecollaboration. UNC.

Miniature laser projector design and build. For 3D depth extraction and imaging through an endoscope for surgery. Multiple versions of systems including deployed system and miniature handheld system; laser-based. UNC and licensed to InnerOptic Technology.

Laser projector design humanoid. Design and Implement mini laser projector for rear projection of 3D anatomical mannequins for Office of the future research and eventually incorporated into medical simulations and theatrical use. UNC, U of Florida.

Laser projector design for HMDs. Early attempts at implementing laser projectors on Head Mounted Displays for display engines. Microvision and UNC.

3D Laser range depth finder and imager. Mechanical design of scanning 3D laser scanner for room-sized scans. Commercial product used in crime scene reconstruction. As seen on TV show *CSI*. UNC and Delta Sphere, Inc.

3D laser scanner. Single laser with four planar outputs for very fast scanning of feet for custom orthotics. Multipass system for verification. NCSU, DARPA and NASA.

Dental Implant 3D guidance. Design and build 6DOF magnetic tracker system and mounts with graphic feedback for registration of dental implants across jaw. InnerOptic Technology.

Structured Light projectors, custom projectors for integrating IR projection with standard video for depth extraction. Imperceptible structured light. UNC.

3D depth extraction and imaging endoscope design and build: Real-time 3D depth extraction through an endoscope for medical use. Uses custom structured light projector and camera head to view subject in not only stereo but off-axis in True 3D, not just stereo; imaging-based. 2 patents. UNC and InnerOptic Technology.

Infrared Projectors. Designed and build multiple wideband infrared and laser-based narrowband projectors for imperceptible depth extraction for teleconference and medical use. Includes design of optics, beam splitters, mounts and thermal designs. UNC.

Stereo Projectors. Built and modified projectors with new optics for both passive polarization stereo (Sharp) or active stereo (TI micromirrors). Includes design of custom light wheels, collimators, exit optics, cooling and illuminators. UNC.

Four color IR projector. Uses four color wheel, custom filter design, custom lens, DMD microdisplay and custom source for combined IR and visible projector to allow imperceptible structured light inclusion. UNC and TI.

Frequency doubling, optical. Experiment with using laser to provide multiple wavelength from single laser source; in this case 532nm by using second harmonics. UNC.

High-speed optical cancer detection device. Design for a high-speed optical cancer detection apparatus for cancers. Optical design in the visible and IR using an array of optical filters with multiple, parallel digital cameras and computer. For cervical, prostate and throat cancers. InnerOptic Technology, Inc.

Endoscope camera head for stereo and mono endoscopes: Allows a single camera head to attach to both standard mono- endoscopes and miniature stereo endoscopes providing HD quality imagery. InnerOptic Technology, Inc.

IR camera design. Single element narrowband IR camera for tracking. Uses phosphor filter for visible image detection. Combined into a 6 camera, cross axis WFOV system. UNC.

Stereo Endoscope Design: Designed patent-pending micro, 5mm diameter dual path endoscope with wide IPD separation, single HD imager, and compact and economical camera interface for surgery use. InnerOptic Technology, Inc.

Light amplifier. Using phosphor-based imager, custom camera lens, and image intensifier tube (night vision core), used for tracked scope design for weapon system. UNC & DARPA.

Design of large aperture endoscope: Custom endoscope for very low light environments. InnerOptic.

Design Kinect depth extraction multiple unit environment. Performed laboratory-based reverse engineering of Microsoft's Kinect device by analyzing individual operational wavelengths (to 0.1nm) to allow multiple devices to run overlapping each other. With graduate students. Also built custom mounts and other optical devices for Kinects to expand number to be used. UNC.

Very Large Telescope Optical mounts. Designed & built mechanisms for SOAR telescope, 162" aperture. Co-designed ADC optical system of 12" and 4" optics, in Chile. UNC.

Very Large Telescope spectrum analyzer. Co-designed IFU multi pickup spectrum analyzer. Uses 240 optical fibers and 4 miniature X-Y motion platforms for SOAR telescope. Chile. UNC.

Patents (~6 others pending):

- 9,792,715, "Methods, systems, and computer readable media for utilizing synthetic animatronics"
- 9,675,319, "Loupe Display"
- 9,659,345, "System and method of providing real-time dynamic imagery of a medical procedure site using multiple modalities"
- 9,282,947, "Imager focusing based on intraoperative data"
- 8,690,776, "Systems, methods, apparatuses, and computer-readable media for image guided surgery"
- 8,585,598, "Systems, methods, apparatuses, and computer-readable media for image guided surgery"
- 8,482,606, "System and method of providing real-time dynamic imagery of a medical procedure site using multiple modalities"
- 8,350,902, "System and method of providing real-time dynamic imagery of a medical procedure site using multiple modalities"
- 8,152,305, "Methods, systems, and computer program products for full spectrum projection"
- 7,728,868, "System and method of providing real-time dynamic imagery of a medical procedure site using multiple modalities"
- 7,385,708, "Methods and systems for laser based real-time structured light depth extraction"
- 6,503,195, "Methods and systems for real-time structured Light"

Publications, selected:

- "Single-imager, Stereo Endoscope"; Kurtis Keller & Andrei State. SPIE Medical Imaging 2011,
- "Deployable Integral Field Units, Multislits, and Image Slicer for the Goodman Imaging Spectrograph on the SOAR Telescope"; Cecil, Gerald N.; Moffett, A. J.; Cui, Y.; Eckert, K. D.; McBride, J.; Kannappan, S.; Keller, K.; Barlow, B. N.; Dunlap, B.; Bland-Hawthorn, J.. American Astronomical Society; Bulletin of the American Astronomical Society, Vol. 42, p.403, 2010.
- "Head Mounted Displays for Medical Use"; Kurtis Keller, Andrei State, and Henry Fuchs; Invited Paper; Journal of Display Technology, IEEE and OSA, Vol. 4 Number 4, 2008
- "Thin-foil magnetic force system for high-numerical-aperture microscopy "; Fisher, J. K., L. Vicci, J. Cribb, K. Keller, B. G. Wilde, T. O'Brien, K. Desai, , R. M. Taylor II, R. Superfine; Review of Scientific Instruments; 2006.
- "Simulation-Based Design and Rapid Prototyping of a Parallax-Free, Orthoscopic Video See-Through Head-Mounted Display"; Andrei State, Kurtis P. Keller and Henry Fuchs; *Proc. International Symposium on Mixed and Augmented Reality (ISMAR)* 2005 (Vienna, Austria, Oct 5-8, 2005
- "Towards Tumor Detection through Optical Tomography in a 3D Depth Extraction Endoscope"; Kurtis Keller, Adam Wax, Caroline Green, Andrei State, and Henry Fuchs; MMVR, 2005.
- "3D Force Microscope: a nanometric optical tracking and magnetic manipulation system for the biomedical sciences"; Fisher, J. K., L. Vicci, J. R. Cummings, K. Keller, B. G. Wilde, T. O'Brien, K. Desai, C. Weigle, G. Bishop, R. M. Taylor II, R. Superfine; Review of Scientific Instruments; October 2004.
- "Monticello Through the Window"; 4th Symposium on Virtual Reality, Archaeology and Cultural Heritage 2003, Nathaniel Williams, Chad Hantak, Kom-Lim Low, John Thomas, Kurtis Keller, Lars Nyland, David Luebke and Anselmo Lastra.
- "Mixed Reality HMD Design"; VR2002, Andrei State & Kurtis Keller.

- “Surface Reconstruction of Abdominal organs using Laparoscopic Structured Light for Augmented Reality Applications”; Jeremy Ackerman, Kurtis Keller, Henry Fuchs; Electronic Imaging 2002 – Photonics West.
- “Switched Pattern Laser Projection for Real-time Depth Extraction and Visualization through Endoscopes”; Kurtis Keller, Jeremy Ackerman, and Henry Fuchs; 2002, International Symposium on Optical Science and Technology SPIE's 47th annual meeting.
- “Augmented Reality Guidance for Needle Biopsies: A Randomized, Controlled Trial in Phantoms”; MICCAI 2001”, Rosenthal, M. R., State, A., Lee, J., Hirota, G., Ackerman, J., Keller, K., Pisano, E., Jiroutek, M., Muller, K., & Fuchs, H.
- “High-Performance Wide-Area Optical Tracking: The HiBall Tracking System”; Welch, Greg, Gary Bishop, Leandra Vicci, Stephen Brumback, Kurtis Keller, and D'nardo Colucci; 2001 Presence: Teleoperators and Virtual Environments 10(1): 1-21.
- “Real-time Structured Light Depth Extraction”; Kurtis Keller and Jeremy Ackerman; Photonics West – Electronic Imaging, 2000.
- “The HiBall Tracker: High-Performance Wide-Area Tracking for Virtual and Augmented Environments”; Greg Welch, Leandra Vicci, Stephen Brumback, Kurtis Keller, and D'nardo Colucci; VRST99, 1999.
- “Real-time Anatomical 3D depth Extraction”; Jeremy Ackerman and Kurtis Keller, MMVR, 2001.
- “Augmented Reality Visualization for Laparoscopic Surgery”; Fuchs, Henry, Mark A. Livingston, Ramesh Raskar, D'nardo Colucci, Kurtis Keller, Andrei State, Jessica R. Crawford, Paul Rademacher, Samuel H. Drake, and Anthony A. Meyer; MICCAI '98, 1998.
- “Perception in HMDs, what really makes them all so terrible?”; Kurtis Keller and D'nardo Colucci; Lead conference paper; SPIE Aerosense '98, 1998.
- “Cast 3D Heatsink Design Advantages”; Kurtis Keller; IEEE ITherm '98, 1998. Transactions on Components and Packaging Technologies, IEEE press, 2000.
- “Augmented Reality Assistance for Needle Biopsies: From Early Prototypes to a Controlled User Study”; IMPSE, Andrei State, Michael Rosenthal, Joohi Lee, Gentaro Hirota, Jeremy Ackerman, Kurtis Keller, Etta D Pisano and Henry Fuchs.
- “Efficiency and Cost Tradeoffs Between Aluminum and Zinc Die Cast Heatsinks”; Kurtis Keller; InterPack (International Electronic Packaging conf.), Invited talk, 1997.
- “PXFL Cooling Issues and Solutions for a Graphics Supercomputer”, Kurtis Keller; Colloquium “PXPL at 40”, UNC Chapel Hill, 2022.
- “Video See-through HMD for Surgery Assisted by Augmented Reality”; D. Colucci, G. Hirota, K. Keller, A. State, S. Drake, R. Fish; SPIE - EI'97, 1997.
- “Low Cost, High Performance, High Volume Heatsinks”; Kurtis Keller, 1998 IEMT-Europe Symposium, Berlin, 1998.
- “Commercial Packaging Solutions for a Research Oriented Graphics Supercomputer,” Kurtis Keller and John Poulton; InterPack 1995.
- “Video See-through Design for Merging of Real and Virtual Environments”; Emily K. Edwards, Jannick P. Rolland and Kurtis Keller; VRAIS conference, 1993.