UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG ELECTRONICS CO., LTD.;
SAMSUNG ELECTRONICS AMERICA, INC.; AND HP INC.
Petitioners

v.

NEODRON LTD,
Patent Owner.

PETITION FOR INTER PARTES REVIEW OF U.S. PATENT NO. 7,821,502

TABLE OF CONTENTS

I. INTRODUCTION 1
II. GROUNDS FOR STANDING, MANDATORY NOTICES, AND FEE AUTHORIZATION 2
III. PRECISE RELIEF REQUESTED 4
IV. OVERVIEW OF THE '502 Patent 4
A. Overview of the '502 Patent 4
B. Prosecution History 8
C. Level of Ordinary Skill in the Art 10
V. CLAIM CONSTRUCTION 10
VI. OVERVIEW OF THE INVALIDATING PRIOR ART 11
A. U.S. Patent No. 3,757,322 ("Barkan") 11
B. U.S. Patent Publication No. 2006/0007701 ("Marten") 13
C. U.S. Patent No. 5,463,388 ("Boie") 16
D. U.S. Patent Publication No. 2003/0067451 ("Tagg") 18
VII. SPECIFIC EXPLANATION OF GROUNDS 20
A. Ground 1: Claims 1-4 and 9-18 of the '502 Patent Are Rendered Obvious by Barkan, Either Alone or in Combination with Tagg 20
1. Motivation to Combine 20
2. Independent Claim 1 22
3. Dependent Claim 2 31
4. Dependent Claim 3 31
5. Dependent Claim 4 32
6. Dependent Claims 9 and 10 37
7. Dependent Claim 11 39
8. Dependent Claim 12 40
9. Dependent Claim 13 40
10. Dependent Claim 14 41

11. Dependent Claim 15 42
12. Dependent Claim 16 43
13. Independent Claim 17 43
14. Dependent Claim 18 54

B. Ground 2: Claims 5-7 and 20 of the ’502 Patent Are Rendered Obvious by Barkan, Either Alone or in Combination with Tagg or Marten 56

1. Motivation to Combine 56
2. Dependent Claim 5 59
3. Dependent Claim 6 64
4. Dependent Claim 7 68
5. Dependent Claim 20 69

C. Ground 3: Claim 8 and 21of the ’502 Patent Are Rendered Obvious by Barkan in Combination with Marten or with Marten and Boie....73

1. Motivation to Combine 73
2. Dependent Claims 8 and 21 76

D. Ground 4: Claim 19 of the ’502 Patent Is Rendered Obvious by Barkan in Combination with Boie....79

1. Motivation to Combine 79
2. Dependent Claim 19 80

VIII. CONCLUSION....82

LIST OF EXHIBITS

Exhibit No.	Description
1001	U.S. Patent No. 7,821,502
1002	Declaration of Dr. Andrew Wolfe
1003	Curriculum Vitae of Dr. Andrew Wolfe
1004	U.S. Patent No. 3,757,322 ("Barkan")
1005	U.S. Patent Publication No. 2006/0017701 ("Marten")
1006	U.S. Patent No. 5,463,388 ("Boie")
1007	U.S. Patent Publication No. 2003/0067451 ("Tagg")
1008	Prosecution History for U.S. Patent Application No. 11/428,670

I. INTRODUCTION

Pursuant to 37 C.F.R. § 42.100, et seq., Samsung Electronics Co., Ltd., Samsung Electronics America, Inc. and HP Inc. ("Petitioners") hereby petition the United States Patent and Trademark Office (the "Office") to institute an inter partes review of claims 1-21 of U.S. Patent No. 7,821,502 ("the '502 Patent"). The '502 Patent, attached as Exhibit 1001, is assigned to Neodron Ltd. ("Patent Owner").

The '502 Patent relates to touch sensors and, more specifically, the electrical connection of the electrodes within a touch sensor. The '502 Patent acknowledges "[t]here exist[ed] a large body of art involving 2D touch panels and screens" prior to July 8, 2005, the earliest priority date of the '502 Patent. E.g., Ex.-1001, 1:27-30. This expansive body of prior art included touch panels that could determine the position of a touch along the X and Y axes. E.g., id. It was well-known, for example, that these touch panels could be configured with a plurality of electrodes composed of a transparent conductive material deposited on a single surface of a substrate. E.g., id., 1:63-65, 7:44-46, Figs. 1-2. The '502 Patent further acknowledges that it was known to arrange these electrodes into separate column and row sensing electrodes and interleave them with one another, for example, in the manner taught by U.S. Patent No. 5,463,388 ("Boie"). Id., 3:52-59; see also Ex.-1006, Fig. 2. The '502 Patent further teaches that these electrodes may be

connected via traces or free wires using conventional techniques. E.g., Ex.-1001, 7:20-26. The only claimed feature alleged to not be included in the admitted prior art is the specific routing of these connections in a manner that wraps-around, i.e., lies outside, the sensing area to connect electrodes or segments at opposite ends of a column or row.

As discussed in greater detail below, these wrap-around connections are not novel and are disclosed, for example, by U.S. Patent No. 3,757,322 ("Barkan"), which issued 46 years ago. Ex.-1004, cover. The prior art presented in this Petition thus discloses or renders obvious all elements of Claims 1-21 of the '502 Patent. This petition presents non-cumulative grounds of invalidity based on prior art and combinations thereof that were not relied upon by the Office during prosecution. Each ground presented is reasonably likely to prevail, and this petition should be granted on all grounds.

II. GROUNDS FOR STANDING, MANDATORY NOTICES, AND FEE AUTHORIZATION

Grounds for Standing: Petitioners certify that the '502 Patent is available for inter partes review and that Petitioners are not barred or estopped from requesting an inter partes review challenging the patent claims on the grounds identified in this petition.

Real Parties-In-Interest: The real parties-in-interest are Samsung

Electronics Co., Ltd., Samsung Electronics America, Inc. and Samsung Display Co., Ltd.

Notice of Related Matters: Patent Owner has asserted the '502 Patent against Petitioners in Neodron Ltd. v. Samsung Elecs. Co., Ltd., et al., No. 6:19-cv-00903-ADA (W.D. Tex.).

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Service Information: Petitioners consent to electronic service by email to

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Fee Authorization: The Office is authorized to charge an amount in the sum of $34,400 to Deposit Account No. 50-2862 for the fee set forth in 37 C.F.R. § 42.15(a), and any additional fees that might be due in connection with this petition.

III. PRECISE RELIEF REQUESTED

Petitioners respectfully request cancellation of claims 1-21 of the '502 Patent under 35 U.S.C. § 103 based on the following grounds:

- **Ground 1:** Claims 1-4 and 9-18 of the '502 Patent are obvious over Barkan (Ex.-1004), either alone or in combination with Tagg (Ex.-1007).
- **Ground 2:** Claims 5-7 and 20 of the '502 Patent are obvious over Barkan, either alone or in view of Tagg or Marten (Ex.-1005).
- **Ground 3:** Claims 8 and 21 of the '502 Patent are obvious over Barkan in view of Marten or in view of Marten and Boie (Ex.-1006).
- **Ground 4:** Claim 19 of the '502 Patent is obvious over Barkan in view of Boie.

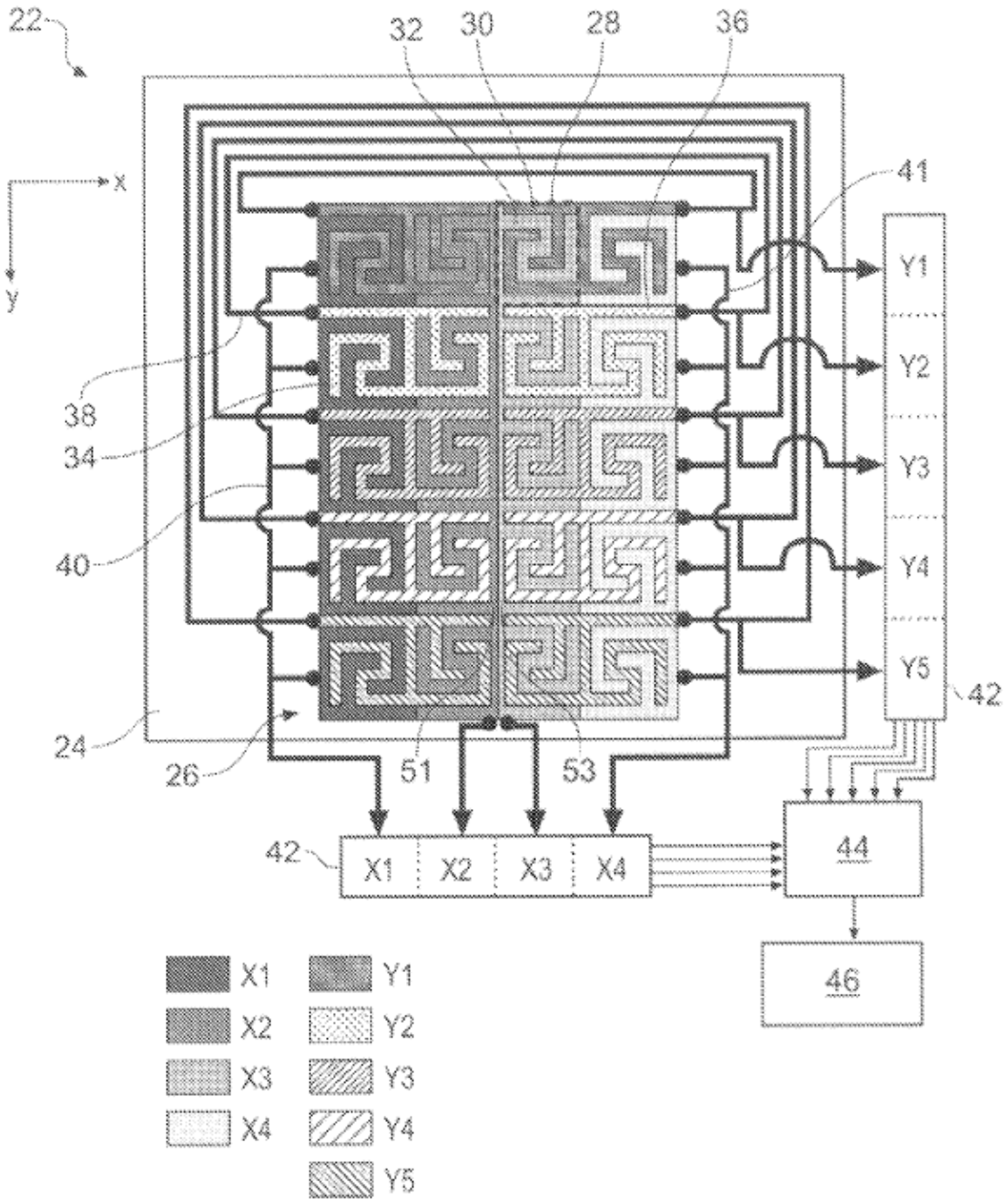
IV. OVERVIEW OF THE '502 PATENT

A. Overview of the '502 Patent

The '502 Patent issued from U.S. Patent Application No. 11/428,670 ("the '670 Application"), which was filed on July 5, 2006. Ex.-1001, cover. The '502 Patent claims priority to U.S. Provisional Patent Application No. 60/697,613 ("the '613 Application"), which was filed on July 8, 2005. Id. The '502 Patent is directed to a capacitive sensor for determining the position of a touch or contact by an object along a first (x) and second (y) direction. See, e.g., id., Abstract, 5:37-42. The sensor comprises a plurality of electrodes disposed on the surface of a substrate. E.g., id., 5:42-44, Figs. 3, 7-8. The electrodes define a sensing area in which the position of a finger or other object can be determined. E.g., id., 5:44-47.

As shown in Figure 3 below, the electrodes form an array of sensing cells (28) arranged in rows and columns. E.g., id., 5:58:60, Fig. 3. In this embodiment, each sensing cell includes a column sensing electrode (32) and a row sensing electrode (30). Id., 6:8-13, Fig. 3. The column sensing electrodes in each column are electrically coupled together and the row sensing electrodes in each row are electrically coupled together, either by connections within the sensing area or outside the sensing area. E.g., id., 6:29-7:10, Fig. 3. For example, the row sensing electrodes at opposite ends of the rows are connected by wrap-around connections (38) that lie outside the sensing area. Id., 6:59-7:3, Fig. 3. Similarly, column

sensing electrodes in columns X1 an X4 are connected by connections (40 and 41) that lie outside the sensing area. Id., 7:11-16, Fig. 3.



Ex.-1001, Figure 3

The specification explains that the sensing area may include a single layer of

sensing electrodes, meaning that the sensing electrodes are disposed on only one side of the substrate. Id., 11:28-32. Both the substrate and the electrodes may be formed from transparent materials. E.g., id., 3:65-4:2, 5:47-52. As shown in the embodiment depicted in Figure 3 above, the column and row sensing electrodes in each sensing cell may be interleaved with one another in a spiral, interlaced, intertwined, or other pattern such that there exists a portion of a column sensing electrode and a row sensing electrode in each sensing cell. Id., 3:52-55, 11:8-13, Figs. 3, 8.

The position sensor also includes a series of capacitive measurement channels coupled to the respective rows and columns of sensing electrodes. E.g., id., 7:59-62, Fig. 3. These capacitive measurement channels (42) are shown as two separate banks in Figure 3 above. Id., 7:65-8:6, Fig. 3. The specification does not provide any detail concerning the components that form the capacitance measurement channels or the manner in which they measure capacitance in the rows and columns, but generally indicates that the channels generate signals indicative of the capacitive values for each row and column. E.g., id., 7:62-65

The signals from the capacitive measurement channels are provided to processing circuitry configured to determine the interpolated position of the capacitive load along the x-direction from the signals associated with the columns and the interpolated position of the capacitive load along the y-direction from the

signals associated with the rows. Id., 7:62-65, 8:30-44. The '502 Patent does not specify how this is achieved, but indicates that the determination of the position of a touch is to be made using otherwise conventional circuitry connected to the sensing elements. Id., 3:28-36. In addition, the '502 Patent explains that all of the rows and columns of the array may be driven in a phase-synchronous manner as taught by Boie and two other U.S. patents. Id., 8:11-20.

B. Prosecution History

During the prosecution of the '502 Patent, the Examiner issued two office actions. In the first office action dated June 24, 2009, the Examiner rejected Claims 1-4, 6-15, and 19-24 (which ultimately issued as Claims 1-13 and 16-21 of the '502 Patent) as anticipated by U.S. Patent No. 4,550,221 ("Mabusth") and Claims 17 and 18 (which ultimately issued as Claims 14 and 15 of the '502 Patent) as obvious in view of Mabusth and Boie. Ex.-1008, 104-09.[1] With respect to dependent Claim 17, the Examiner found that "Mabusth does not teach a graphical display wherein the electrodes in the sensing area are disposed over the graphical display to provide a touch screen." Id., 108-09. Similarly, with respect to Claim 18, the Examiner found that "Mabusth does not teach an insulating panel wherein

[1] For ease of reference, the pages of Exhibit 1008 have been numbered consecutively from 1 to 209.

the electrodes in the sensing area are disposed beneath the insulating panel to provide a keypad." Id. The Examiner explained that it would have been obvious to combine Mabusth with the disclosures of Boie that address both limitations. Id.

The applicant argued the rejection of Claims 1-13 and 16-21 was improper because Mabusth does not show or teach "electrodes of sensing cells at opposing ends of a row (or column) connected using a wrap-around connection" as recited by independent Claim 1 or "connecting the broken segments together with an electrical conductor, wherein the conductor is made to lie outside of the active sensing region" as recited by independent Claim 20. Id., 85-86. The applicant argued that the rejection of dependent Claims 17 and 18 was improper because those claims depend from Claim 1, which was improperly rejected for the foregoing reason. Id.

In the second office action dated February 19, 2010, the Examiner repeated the rejection of Claims 1-4, 6-15, and 19-24 as anticipated by Mabusth, and Claims 17 and 18 as obvious in view of Mabusth and Boie for the same reasons cited in the earlier office action. Id., 73-78. The applicant argued the rejection of the claims was improper for the same reasons cited in response to the earlier office action. Id., 59-61. On May 19, 2010, the applicant submitted a supplemental response to the second office action amending independent Claims 20 to recite "connecting a first broken segment at a first end of second end of the one of the at

least one row or column using a wrap-around connection lying outside of the active sensing region." Id., 38-39. The Examiner issued a notice of allowance on June 18, 2010, and the '502 Patent issued on October 26, 2010. Id., 27-30.

C. Level of Ordinary Skill in the Art

As discussed above, Claims 1-21 of the '502 Patent are directed to a capacitive position sensor for determining the position of an object within a two-dimensional sensing area. See, e.g., Exhibit 1001, Abstract, 1:5-7. Accordingly, as of July 2005, a person of ordinary skill in the art ("POSITA") would have had a bachelor's degree in electrical engineering, computer science, physics, or the equivalent, plus at least two years of experience in the field of touch sensors or a related field, where additional education could substitute for work experience and vice versa. Ex.-1002, ¶ 33, Ex.-1003.

V. CLAIM CONSTRUCTION

Petitioners interpret the claims of the '502 Patent according to the Phillips claim construction standard. 83 Fed. Reg. 51340, 51340-44 (Oct. 11, 2018); Phillips v. AWH Corp., 415 F.3d 1303 (Fed. Cir. 2005). To resolve the particular grounds presented in this Petition, however, Petitioners do not believe any term

requires explicit construction.[2]

VI. OVERVIEW OF THE INVALIDATING PRIOR ART

The prior art references relied upon in this petition are briefly summarized below along with the reasons that a POSITA would have been motivated to combine their teachings on or before July 8, 2005. Neither Barkan nor Marten were before the Examiner during prosecution of the '502 Patent. See generally Ex.-1008. The examiner cited Boie only for its disclosure of "a graphical display wherein the electrodes in the sensing area are disposed over the graphical display to provide a touch screen" (issued Claim 14) and "an insulating panel wherein the electrodes in the sensing area are disposed beneath the insulating panel to provide a keypad" (issued Claim 15). Id., 108-09; see also Section IV.B above. The following grounds do not rely on Boie for its disclosure of those limitations.

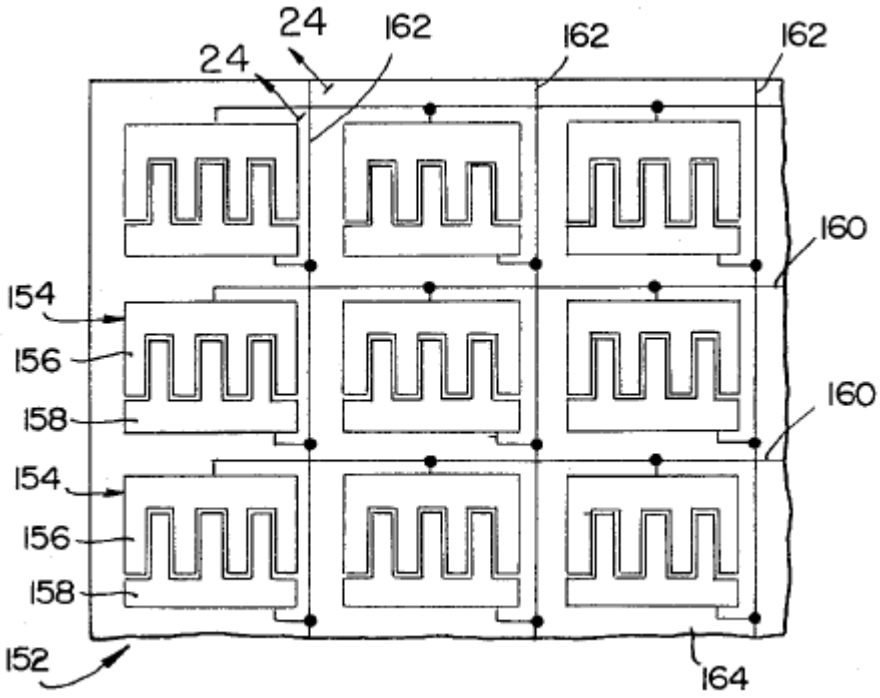
A. U.S. Patent No. 3,757,322 ("Barkan")

Barkan was filed on February 3, 1971 and issued on September 4, 1973. Ex.-1004, cover. Barkan qualifies as prior art under pre-AIA U.S.C. § 102(b). Barkan is directed to a transparent touch actuated interface that overlies a display

[2] Because no claim construction issues are believed to be dispositive as to grounds presented here, Petitioners reserve their rights to assert in litigation claim constructions not asserted here and to assert that certain terms are indefinite.

to form a keyboard or touch screen. See, e.g., id., Abstract, 4:37-50, 7:43-52, Figs. 5, 9, 23. The touch actuated interface includes a plurality of contact areas deposited on a transparent substrate such as a sheet of glass or plastic. E.g., id., 4:59-62, Figs. 3, 9, 23. The contact areas may comprise thin films of electrically conductive transparent material deposited in a single layer on a surface of the substrate via well-known techniques such as sputtering, stencil deposition, or etching. E.g., id., 4:59-62, 12:47-48, 15:39-61.

As shown in Figure 23 below, the contact areas are arranged in columns and rows to form a capacitive sensing area. Each contact area (154) includes an X contact sub-area (156) and a Y contact sub-area (158). Id., 27:1-18-63, Fig. 23. The X contact sub-areas in each row are connected by transparent electrically conductive leads (160) and the Y contact sub-areas in each column are similarly connected by transparent electrical conductive leads (162). Id., 27:52-56, Fig. 23. The leads connecting the contact sub-areas may be thin opaque wires (i.e., free wires) or conductive traces deposited on the substrate. E.g., id., 5:23-28, 13:17-29, 19:56-62, 23:3-19, Fig. 23.



Ex.-1004, Figure 23

Each row and column of contact areas is connected to its own dedicated matrix circuitry that includes a switch and one or more "and gates." E.g., id., 26:26-59. The matrix circuitry receives signals from the various rows and columns in the sensing area and the touch-activated switches are activated when a touch alters the capacitance of a contact area within a particular row and column associated with the switches. E.g., id., 7:49-52, 26:43-48. After the location of the touch is recognized by the interface through its touch-activated switches and "and gates," the location recognition is translated via the programming of the machine into the desired input for a utilization mechanism such as a computer that performs an action or function in response to the touch. E.g., id., 7:49-52, 11:29-56, 12:47-

52, 16:53-61, Fig. 2.

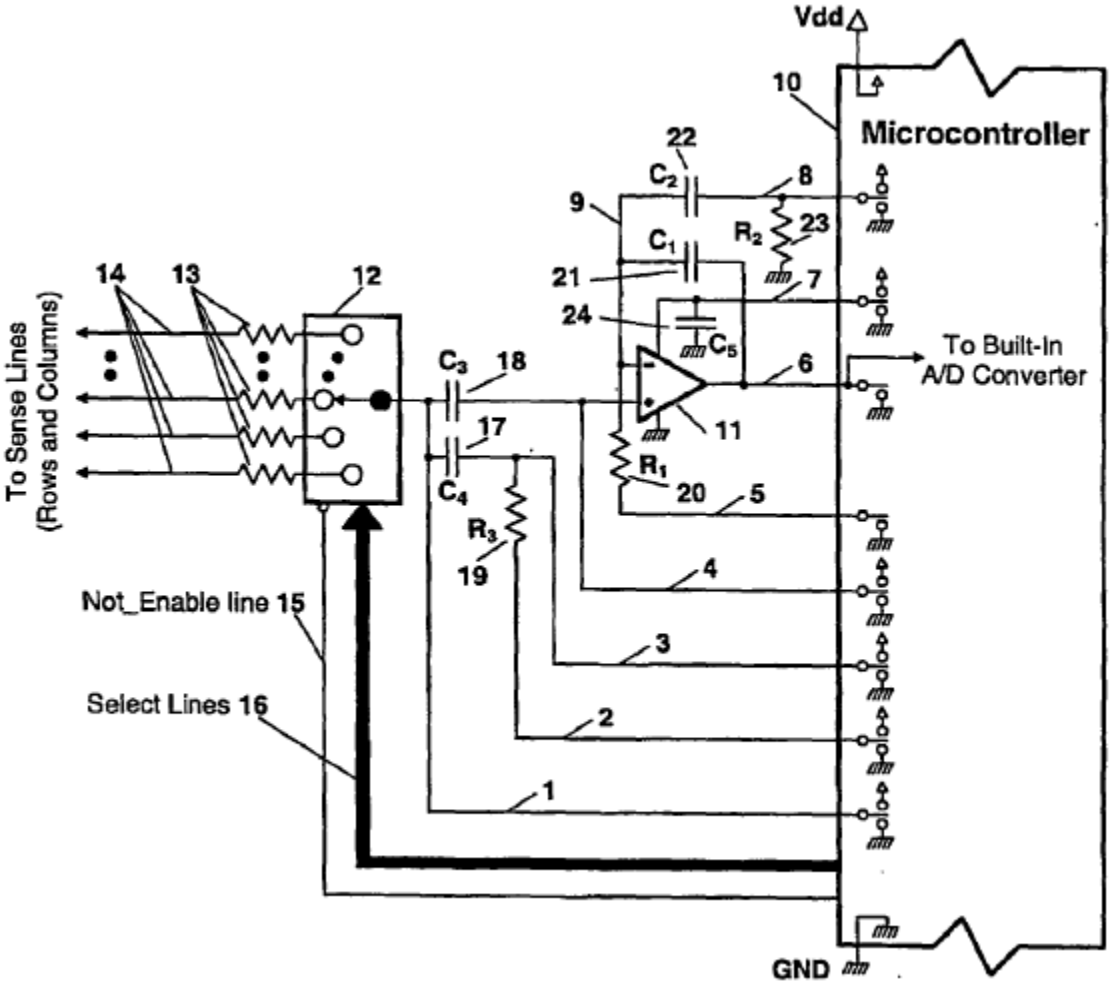
B. U.S. Patent Publication No. 2006/0007701 ("Marten")

Marten was filed as International Patent Application No. PCT/US03/3372 on October 28, 2003 and was published as International Publication No. WO2004/040538 on May 13, 2004 and as U.S. Patent Publication No. 2006/0017701 on January 26, 2006. Ex.-1005, cover. International Publication No. WO2004/040538 was published in English and designated the United States. Marten qualifies as prior art under at least pre-AIA 35 U.S.C. § 102(e).

Marten is directed to processing circuitry for a capacitive touch pad sensor. E.g., id., Abstract, [0022], [0058]-[0067]. The circuitry utilizes charge transfer to sense capacitance and can be implemented using general purpose "off the shelf" components and a programmable microcontroller. Id. Marten explains that this is advantageous, because it makes the processing circuitry resistant to the effects of noise from internal sources such as CPU clocks and memory signals as well external sources such as cellular phones operated in close proximity to the capacitive touch pad sensor, power lines, etc. Id., [0004], [0058].

As shown in Figure 1 below, the circuit includes a single voltage source (Vdd) that drives all of the rows and columns of electrodes in the capacitive touch pad sensor. E.g., id., [0058], Figs. 1, 4. The circuit also includes a synchronous detector capable of further suppression of noise and unwanted signals due to their

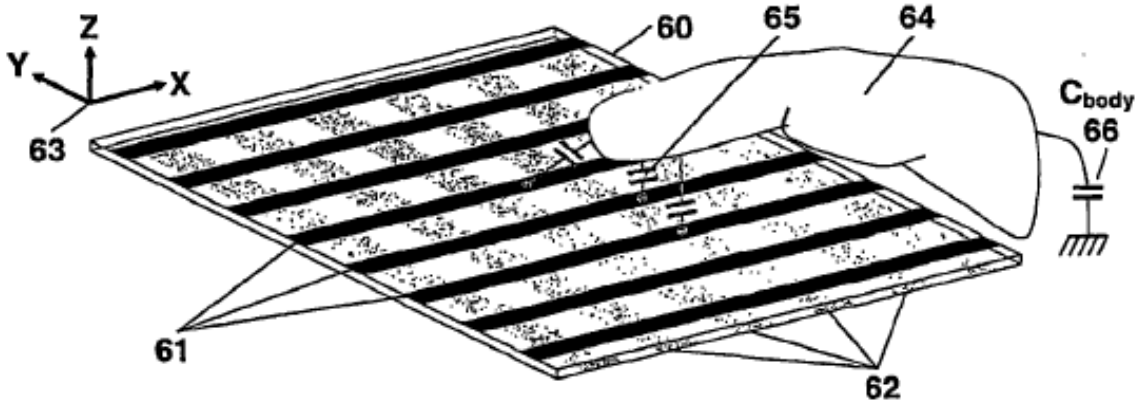
phase difference or non-synchronicity to the drive signal. Id., [0014].



Ex.-1005, Figure 1

The processing circuitry can be coupled with a capacitive touch pad such as that shown in Figure 6 below. The touch pad (60) includes a first group of electrodes parallel to the X-axis (61) for determining the Y coordinate of a touch and a second group of electrodes (62) parallel to the Y-axis for determining the X coordinate of a touch. E.g., id., [0053], [0007]-[0011], Fig. 6. When a person

touches the touch panel, the circuitry determines the position of the touch by measuring the changes in capacitance to ground for all of the electrodes in the first and second groups, followed by extrapolation of the position between the electrodes. Id., [0054, [0010], Fig. 6.

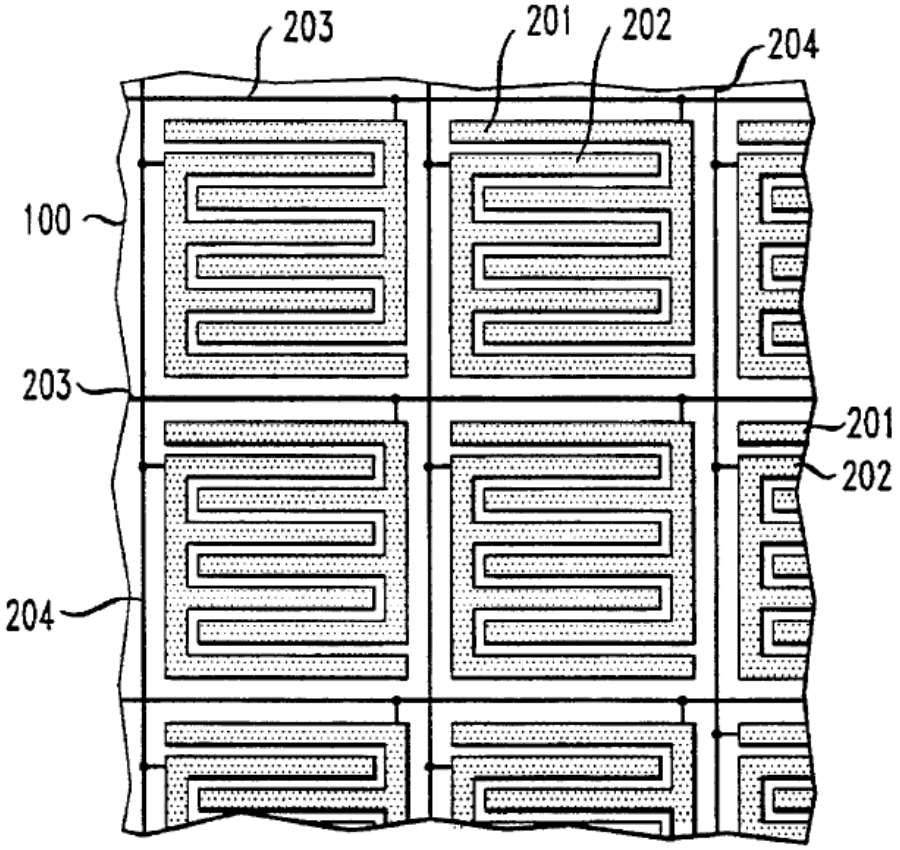


Ex.-1005, Figure 6

C. U.S. Patent No. 5,463,388 ("Boie")

Boie was filed on January 29, 1993 and issued on October 31, 1995. Ex.-1006, cover. Boie qualifies as prior art under pre-AIA 35 U.S.C. § 102(b). Boie is directed to a capacitive sensor with a plurality of electrodes disposed on an insulating surface (i.e., substrate). E.g., id., Abstract, 1:61-2:11. As shown in Figure 2 below, the array of electrodes (100) is arranged in a grid of columns and rows and each electrode (101) may be subdivided into a horizontal element (201) and a vertical element (202). Id., 3:13-22, Fig. 2. The horizontal elements in each row are interconnected by leads (203) and the vertical elements in each column are

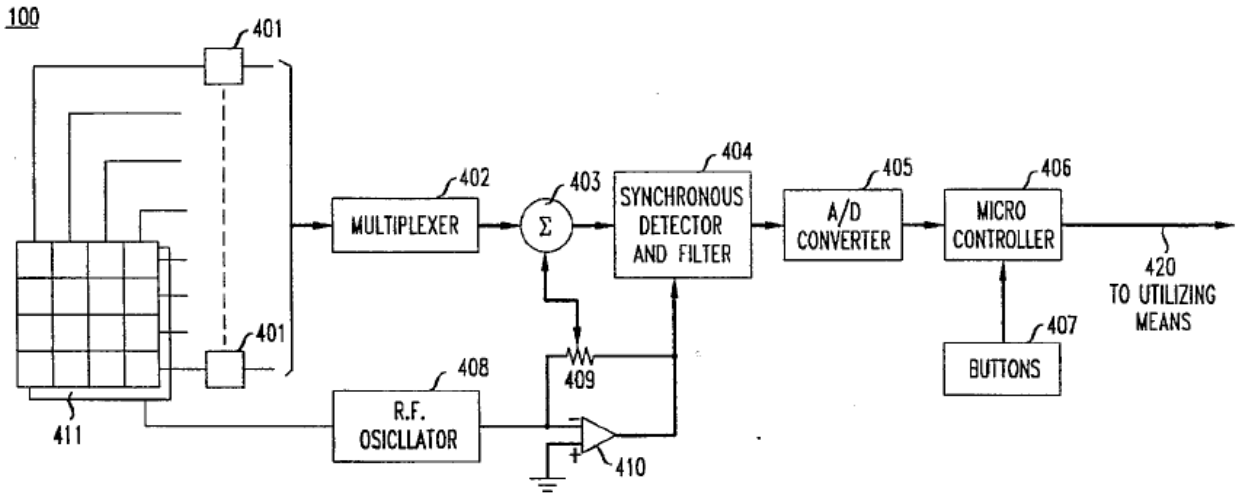
connected by leads (204). Id. The horizontal and vertical elements within each electrodes may be interdigitated (i.e., interleaved) as shown in Figure 6. Id., 3:22-29, Fig. 2.



Ex.-1006, Figure 2

Each column and row of the array is connected to circuitry for measuring capacitance. E.g., id., Abstract. As shown in Figure 4 below, the circuitry includes a single RF oscillator (408) that drives all of the columns and rows in unison and a synchronous detector and filter (404). E.g., id., 3:67-4:13, 4:58-66, Fig. 4. The processing circuitry also includes a microcontroller that determines the

position of a finger or other object in contact with the touch pad by calculating the centroid of measured capacitance across the rows and columns of electrodes. E.g., id., Abstract, 5:10-49.



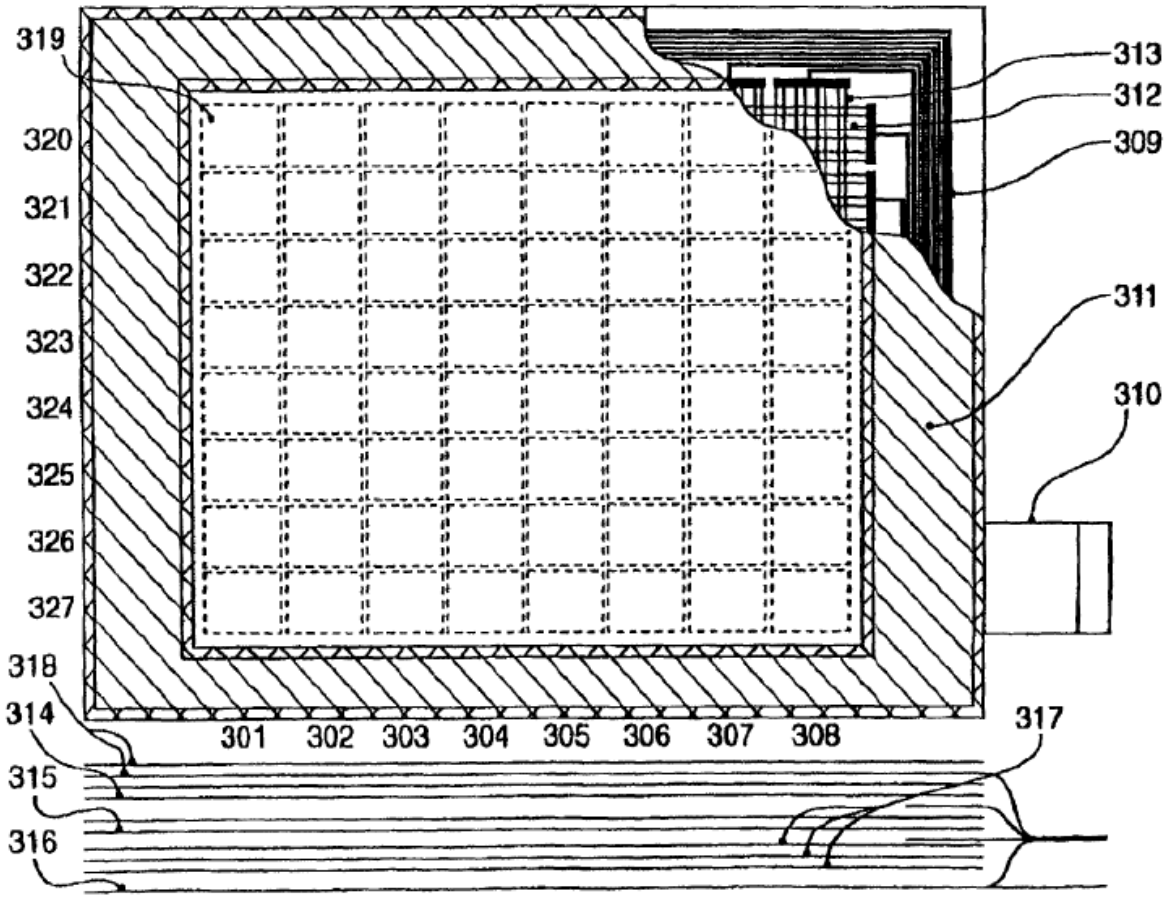
Ex.-1006, Figure 4

D. U.S. Patent Publication No. 2003/0067451 ("Tagg")

Tagg was filed as International Patent Application No. PCT/GB95/02678 on November 14, 1995 and was published as U.S. Patent Publication No. 2003/0067451 on April 10, 2003. Ex.-1007, cover. Tagg qualifies as prior art under pre-AIA 35 U.S.C. § 102(b).

Tagg is directed to a touch screen with two sets of orthogonally arranged linear electrodes forming rows and columns. Id., [0201]-[0202], Figs. 23-24. As shown in Figure 23 below, the touch screen includes a row layer (314) and a column layer (315). Id. Each layer includes a plurality of parallel linear electrodes comprised of thin strips (312 and 313). Id. The opposing ends of the electrodes

are coupled via external wires (309) that are routed outside the sensing area of the touch screen. Id. The wires, which may be formed from a conductive silver track, are connected to an edge connector and a channel capacitance measuring device (not shown in Figure 23). Id.



Ex.-1007, Figure 23

The sensing area of the touch screen is defined by an array of capacitive sensor zones (e.g., 319). Id. An associated processor can be configured to interpolate the position of a finger in contact with the surface of the touch screen.

Id., [0084]-[0085].

VII. SPECIFIC EXPLANATION OF GROUNDS

A. Ground 1: Claims 1-4 and 9-18 of the '502 Patent Are Rendered Obvious by Barkan, Either Alone or in Combination with Tagg

1. Motivation to Combine

A POSITA would have been motivated to combine the disclosures and teaching of Barkan and Tagg as they are directed to common subject matter within the same field. Ex.-1002, ¶¶ 36-38, 49-51. Both references disclose capacitive touch sensors and associated processing circuitry for determining the position of a touch on a touch panel. See, e.g., Ex.-1004, Abstract; Ex.-1007, Abstract, [0201]-[0211], Figs. 23-24. In addition, the references disclose common components, including an array of electrodes aligned with the X and Y axes that signal the position of a touch based on changes in capacitance. See, e.g., Ex.-1004, Abstract, 27:1-63, Fig. 23; Ex.-1007, Abstract, [0178], [0201]-[0211], Figs. 10, 23-24.

To the extent it is not already disclosed by Barkan, it would have been obvious to a POSITA to incorporate processing elements from Tagg, including a 16 channel capacitance measurement device and a microprocessor that compares signals from the capacitance measurement channels in order to interpolate the position of a finger in contact with the touch screen. Eg., Ex.-1007, [0084]-[0085], [0201]; Ex.-1002, ¶ 50-51. Tagg teaches that these functions can be achieved using well-known universal components such as "a small (i.e. low cost)

microprocessor)." E.g., Ex.-1007, [0113]. Accordingly, a POSITA would have been motivated to incorporate these elements with the touch sensor of Barkan to achieve a low-cost means of determining the position of a touch with improved accuracy. Ex.-1002, ¶ 50-51. A POSITA would have understood that this would involve the combination of known elements (i.e., a general-purpose microprocessor and a known configuration of electrodes arranged in rows and columns) to yield predictable results. Id.

A POSITA would have also found it obvious to incorporate external wires connecting electrodes at opposing ends of each column and row of electrodes as taught by Tagg. Id., ¶ 51. As a POSITA would have appreciated, these connections would be beneficial in minimizing RC delay, and would thereby enable the use of lengthier columns and rows of electrodes. Id. Accordingly, a POSITA would have been motivated to achieve this benefit. Id. Furthermore, because Tagg teaches that the external wires are formed from conductive silver track, a POSITA would have understood that this could be accomplished using known materials and techniques. Id.; see also Ex.-1007, [0201]. For these reasons, along with those discussed below, a POSITA would have found it obvious to incorporate these elements with the touch interface of Barkan and would have understood how to do so. Ex.-1002, ¶¶ 49-51.

2. Independent Claim 1

a. [1Pre]: "a position sensor comprising"

To the extent the preamble of Claim 1 is limiting, Barkan discloses "[a] transparent touch actuated interface with an interactively related display." Ex.-1004, Abstract. Barkan teaches that "the operator responds to [] data presented on the [display] screen in the simplest way imaginable that is, by touching the selected portion of the display [at which point] [t]he location of the touch is recognized by the interface through its touch-activated switches." Id., 7:43-52.

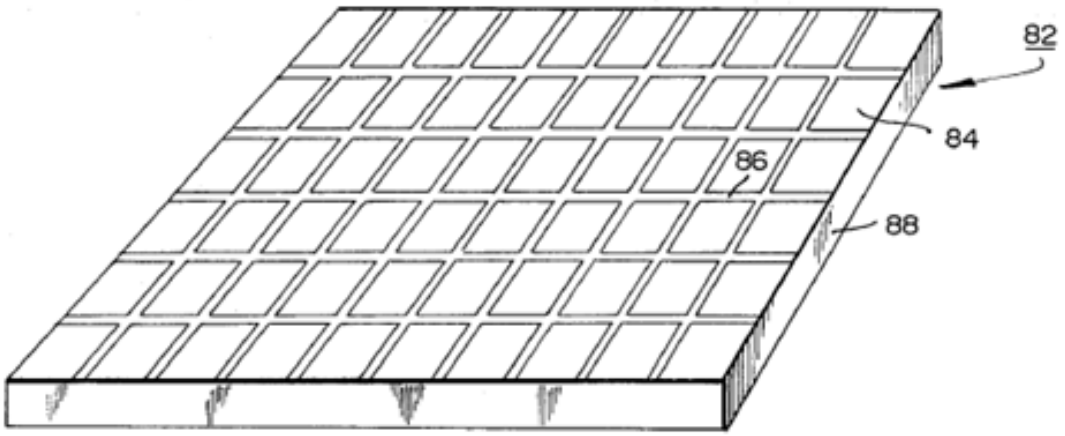
Based on the foregoing disclosures, a POSITA would have understood that Barkan discloses or renders obvious the Preamble of Claim 1. Ex.-1002, ¶¶ 52-53.

b. [1A]: "a substrate having a surface with an arrangement of electrodes mounted thereon"

Barkan discloses a touch actuated interface that includes "one or more to-be-touched contact areas of electrically conductive transparent material electrically isolated from one another by transparent means." Ex.-1004, Abstract. Barkan teaches that "the contact areas may be thin electrically conductive transparent films supported by an electrically non-conductive substrate such as a pane of clear glass or clear plastic." Id., 4:59-62, Figs. 3, 9, 23. The contact areas may be mounted on the substrate via well-known techniques such as sputtering, stencil deposition, or etching. Id., 15:39-61. As a POSITA would have appreciated, the contact areas composed of electrically conductive material are electrodes mounted on the

substrate. Ex.-1002, ¶ 54.

Barkan further teaches that the contact areas are preferably disposed on a single surface of the substrate. Ex.-1004, 12:47-48 ("The contact areas preferably are flat and their contact surfaces are coplanar."). In the exemplary embodiment shown in Figure 9 below, the contact areas (84) are disposed on the upper surface of a substrate (88). Id., 18:64-19:15, Figs. 9, 23.



Ex.-1004, Figure 9

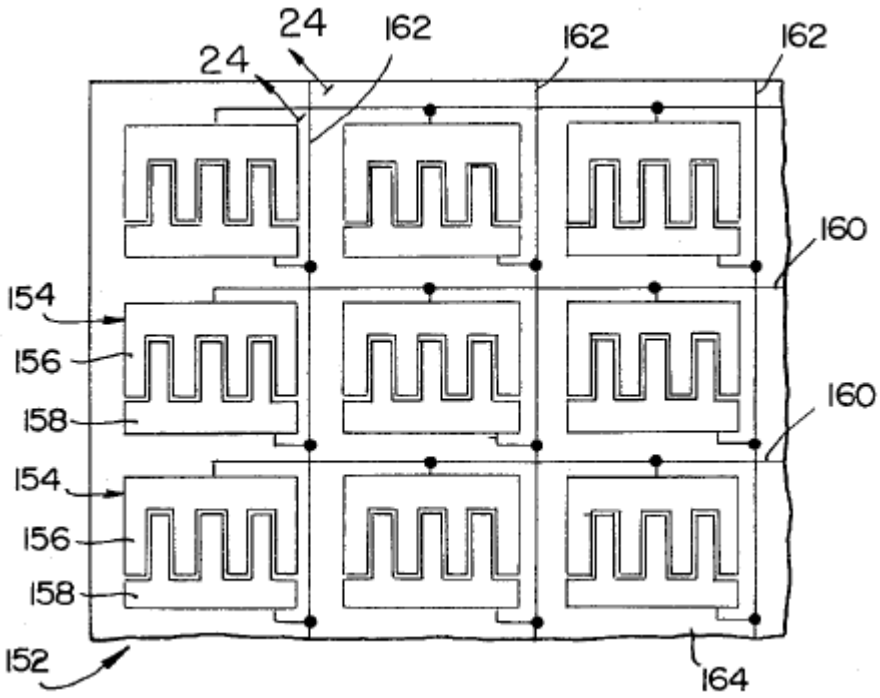
Based on these disclosures, a POSITA would have understood that Barkan discloses or renders obvious Element A of Claim 1. Ex.-1002, ¶¶ 54-56.

c. [1B]: "wherein the electrodes define an array of sensing cells arranged in columns and rows to form a capacitive sensing area of the sensor, each sensing cell including a column sensing electrode and a row sensing electrode, the column sensing electrodes of sensing cells in the same column being electrically coupled together and the row sensing electrodes of sensing cells in the same row being electrically coupled together"

Barkan discloses a touch actuated interface with an array of electrically conductive contact areas (i.e., "sensing cells"). Barkan teaches that the contact areas are arranged in columns and rows to form a capacitive sensing area. Ex.-1004, 26:10-15, 26:26-59, Figs. 3, 5-9, 23; see also 12:47-52, 13:46-50 ("The conductive areas are designed to be touched and their associated switch circuits energized thereby, the touch being that of a human finger or an element having a capacitance in the order of that of a human being or an element having a resistance in the order of that of a human finger.").

With reference to Figure 23 below, Barkan further teaches that each contact area (154) may include an X contact sub-area (156) and a Y contact sub-area (158). Id., 27:1-18-63, Fig. 23. In this configuration, "[a]ll of the X contact sub-areas in any given X row are connected by a transparent electrically conductive lead 160, and, similarly, all of the Y column contact subareas in any given Y column are connected by a transparent electrical conductive lead 162." Id., 27:52-56, Fig. 23. A POSITA would have thus appreciated that the Y contact sub-areas are "column

sensing electrodes" and the X contact sub-areas are "row sensing electrodes." Ex.-1002, ¶¶ 57-59.



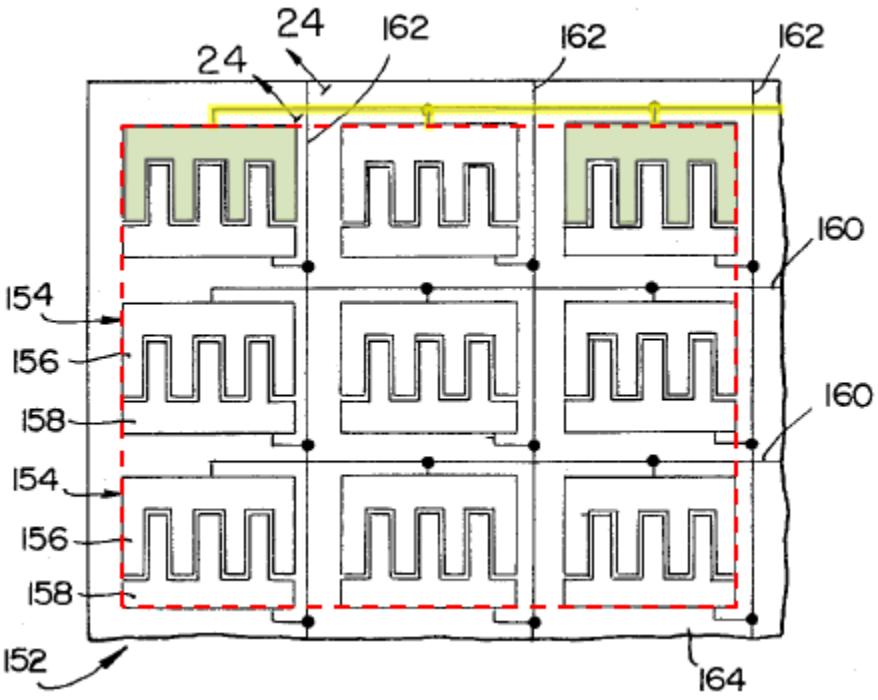
Ex.-1004, Figure 23

On the basis of the foregoing disclosures, a POSITA would have understood that Barkan discloses or renders obvious Element B of Claim 1. Id.

d. [1C]: "wherein row sensing electrodes of sensing cells at opposing ends of at least one of the rows are electrically coupled to one another by respective row wrap-around connections made outside of the sensing area"

As previously discussed in connection with Element B of Claim 1 (Section VII.A.2.c), Barkan discloses an array of contact areas (i.e., "sensing cells") wherein each contact area includes an X contact sub-area (i.e., "row sensing

electrode") and a Y contact sub-area (i.e., "column sensing electrode"). See, e.g., Ex.-1004, 27:1-18, 27:49-56, Fig. 23. Barkan teaches that the X contact sub-areas (156) in each row are electrically coupled by a lead (160) as shown in annotated Figure 23 below. Id., 27:52-56, Fig. 23. The X contact sub-areas (highlighted in green) on the left and right ends of the uppermost row are electrically coupled via a lead (highlighted in yellow) that lies outside the sensing area (indicated by a red dashed line) containing the contact areas that sense touch. Id.; see also Ex.-1001, 5:44-47 (explaining that "[t]he sensing electrodes 26 define a sensing area within which the position of an object (e.g. a finger or stylus) adjacent the sensor may be determined").



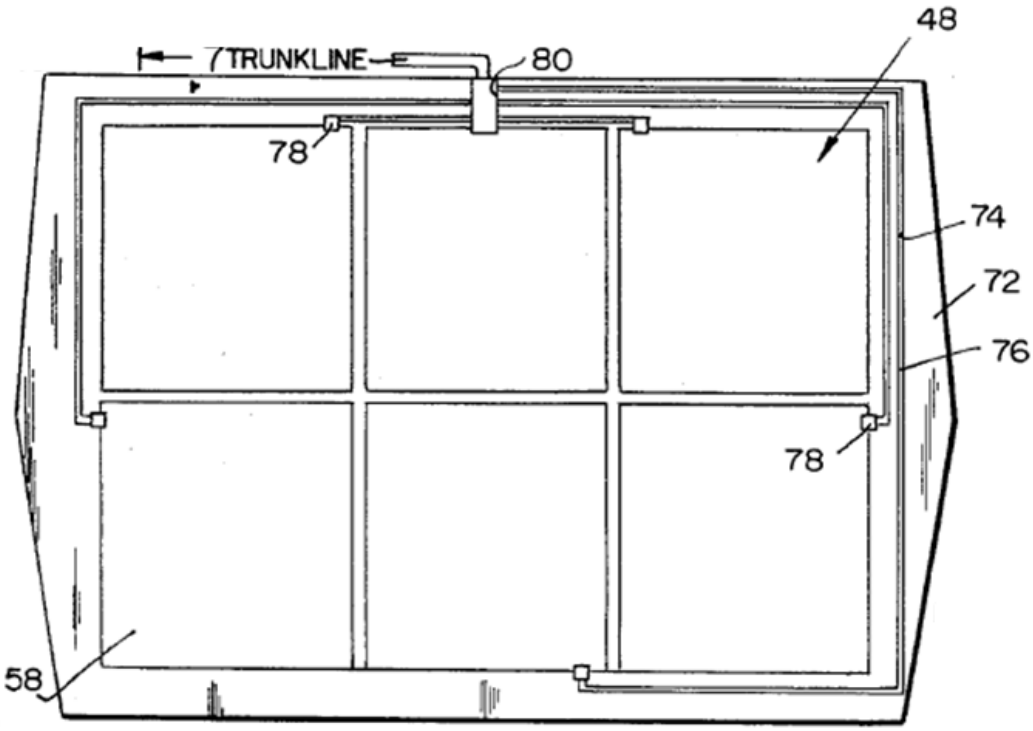
Ex.-1004, Figure 23 (Annotated)

Although the right and bottom edges of the illustration in Figure 23 are uneven, indicating that the touch sensor extends to the right and down, the left and top edges are straight and solid, which would indicate to a POSITA that these are the left and top edges of the touch sensor overlay. Ex.-1002, ¶ 61. Further, while the uneven edge on the right indicates that the touch sensor extends to the right, possibly with additional contact areas (154), a POSITA would have understood that any additional contact areas (154) in the top row, including the right-most one, would be connected to the highlighted lead exactly as those pictured in Fig. 23. Id.

Accordingly, a POSITA would have understood that the highlighted lead connecting these X contact sub-areas connects the X contact areas on the left and right ends of the uppermost row, and thus is a "wrap around connection" as recited in Claims 1 and 17 of the '502 Patent. Id.

Barkan also teaches that the lead connecting the X contact sub-areas in the uppermost row could be positioned even further outside the sensing area. With reference to the embodiment shown in Figure 8 below, Barkan explains that the leads (74 and 76) connecting the contact areas to the processing circuitry may be routed through a series of channels formed in a supporting frame (72) surrounding the contact areas (58). Ex.-1004, 18:22-49, Fig. 8. In this configuration, the leads run through the channels in the frame to an exit channel (80) and then to the processing circuitry. Id. A POSITA would have recognized that the uppermost

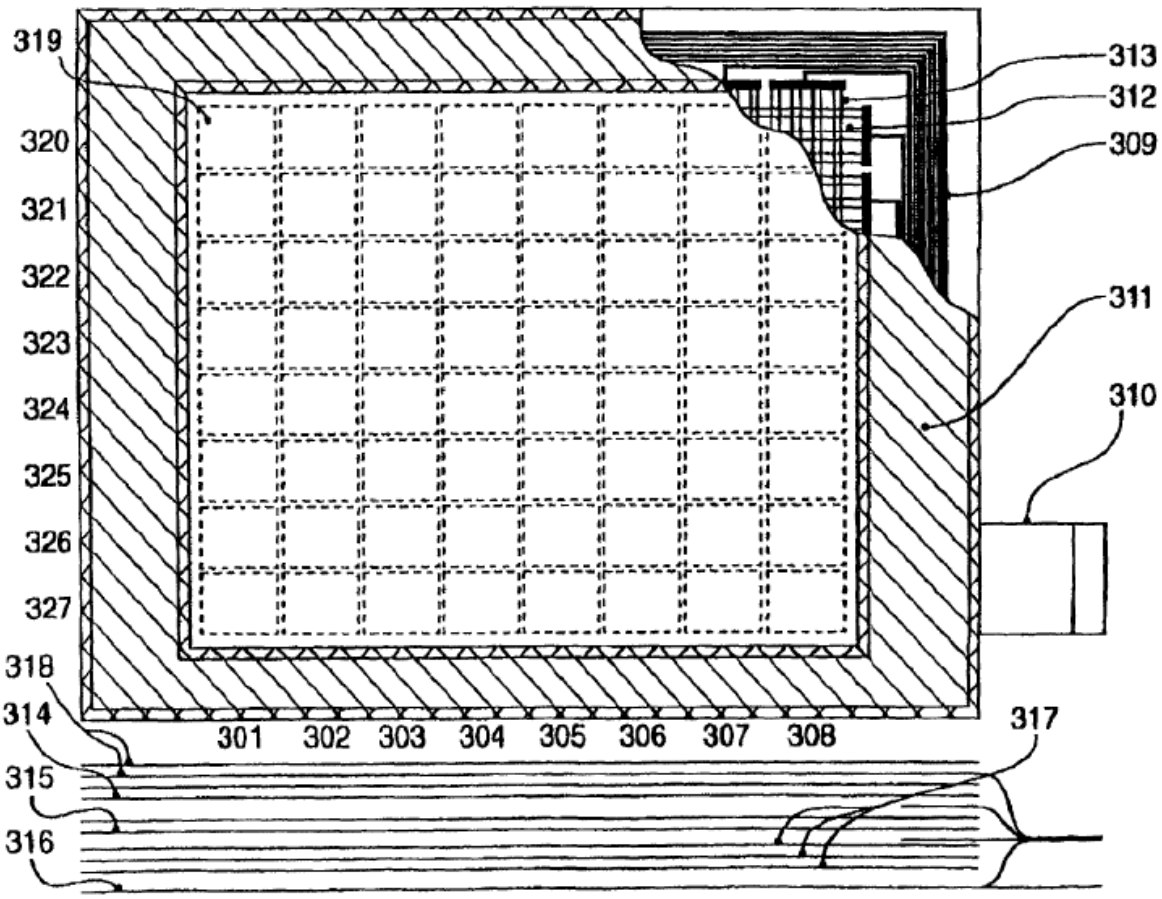
lead in the embodiment of Figure 23 could likewise be routed through a surrounding frame, which would offer numerous advantages, including enhanced protection of the delicate lead and the avoidance of any visual interference with the underlying display. Ex.-1002, ¶ 62.



Ex.-1004, Figure 8

To the extent Barkan does not explicitly disclose "row wrap-around connections made outside the sensing area," Tagg discloses a touch screen with external wires that connect row sensing electrodes at opposing ends of each row. Ex.-1007, [0201], Fig. 23. As shown in Figure 23 below, the touch screen includes a row layer (314) and a column layer (315). Id. The row layer includes a plurality of electrodes structured as thin strips (312). See id. The opposing ends of the row

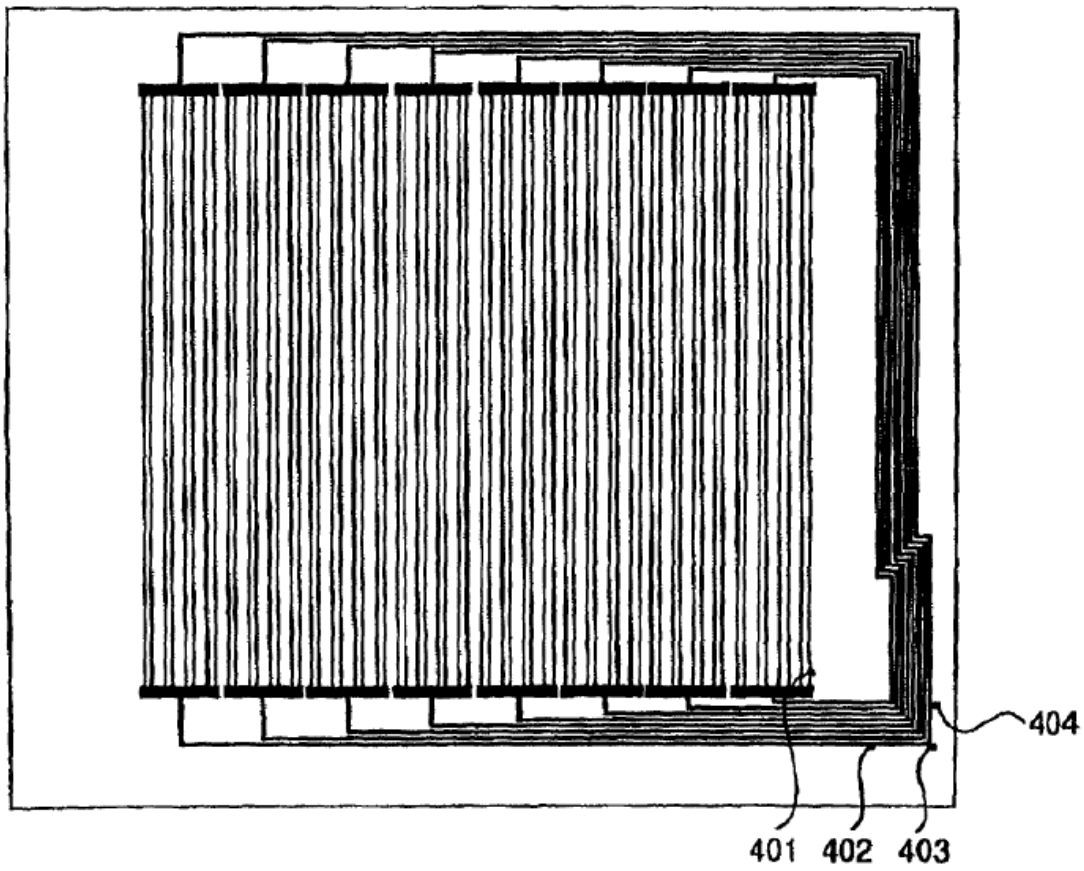
electrodes are coupled via wires (309) that are routed outside the sensing area under the frame of the touch screen. See id.



Ex.-1007, Figure 23

The wires can be seen more clearly in Figure 24 below, which depicts the column layer alone. Id., [0202], Figure 24. The opposing ends of each column electrode are coupled via the wires shown to the right of the array of column electrodes. Id. Although the external wires coupling opposing ends of the row electrodes are not shown in their entirety in Figure 23, a POSITA would have

understood that those wires would be configured in the same manner as the wires depicted in Figure 24. Ex.-1002, ¶¶ 63-64. Accordingly, a POSITA would have understood that the wires (309) are "row wrap-around areas made outside the sensing area." Id.



Ex.-1007, Figure 24

In view of the foregoing disclosures, a POSITA would have understood that Barkan discloses or renders obvious Element C of Claim 1, either alone or in combination with Tagg. Id., ¶¶ 60-65.

3. Dependent Claim 2

a. [2]: "The position sensor of 1, wherein the row wrap-around connections comprise a conductive trace deposited on the substrate"

Barkan teaches that the leads may be "deposited films of electrically conductive transparent material" and may be formed via "vacuum evaporation deposition through a stencil." See, e.g., Ex.-1004, 19:56-62, Fig. 23. The leads may also be formed with the use of a resist/etching technique. See, e.g., id., 15:53-61. In either case, a POSITA would have appreciated that the leads would comprise a conductive trace deposited on the substrate. Ex.-1002, ¶¶ 66-67.

In view of the foregoing disclosures, a POSITA would have understood that Barkan discloses or renders obvious Claim 2. Id.

4. Dependent Claim 3

a. [3]: "The position sensor of 1, wherein the row wrap-around connections comprise free wires connected to the respective row sensing electrodes"

Barkan teaches that "the present invention also contemplates the use of opaque leads such, for instance, as wires." See, e.g., Ex.-1004, 23:3-19, 5:23-28, 13:17-29 (explaining that "[i]n an alternate form of the invention very thin opaque wire-type leads are used"). As discussed in connection with Elements [1B] and [1C] of Claim 1 (Sections VII.A.2.c - VII.A.2.d), these leads are connected to the X contact sub-areas (i.e., "row electrodes") in each row of the touch interface. See,

e.g., id., 27:52-56, Fig. 23.

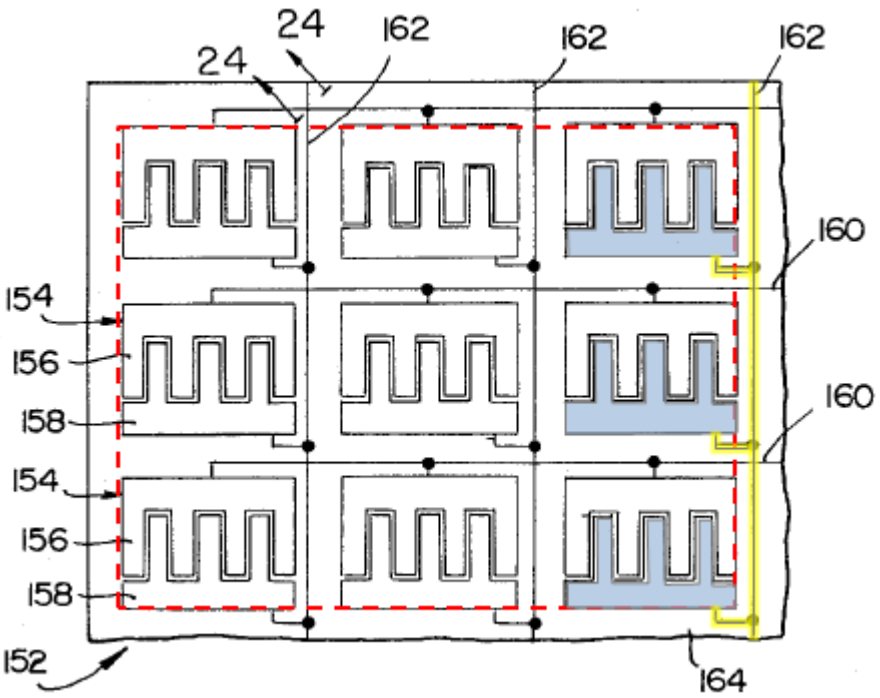
In view of the foregoing disclosures, a POSITA would have understood that Barkan discloses or renders obvious Claim 3. Ex.-1002, ¶¶ 68-69.

5. Dependent Claim 4

a. [4]: "The position sensor of 1, wherein the column sensing electrodes of a column of sensing cells at an edge of the sensing area are electrically coupled to one another by column wrap-around connections made outside of the sensing area"

As previously discussed in connection with Elements [1B] and [1C] (Sections VII.A.2.c - VII.A.2.d), Barkan discloses an array of contact areas (i.e., "sensing cells") wherein each contact area includes an X contact sub-area (i.e., "row sensing electrode") and a Y contact sub-area (i.e., "column sensing electrode"). See, e.g., Ex.-1004, 27:1-18, 27:49-56, Fig. 23. Barkan teaches that the Y contact sub-areas (158) in each column are electrically coupled by a lead (162) as shown in annotated Figure 23 below. Id., 27:52-56, Fig. 23. The Y contact sub-areas (highlighted in blue) in the third column from the left are electrically coupled via a lead (highlighted in yellow). While the uneven edge on the right of the illustration indicates that the touch sensor extends to the right, possibly with additional contact areas (154), a POSITA would have understood that the last column would appear exactly as the right most one in Fig. 23, with a lead (similar to the one highlighted in yellow below) that lies outside the sensing

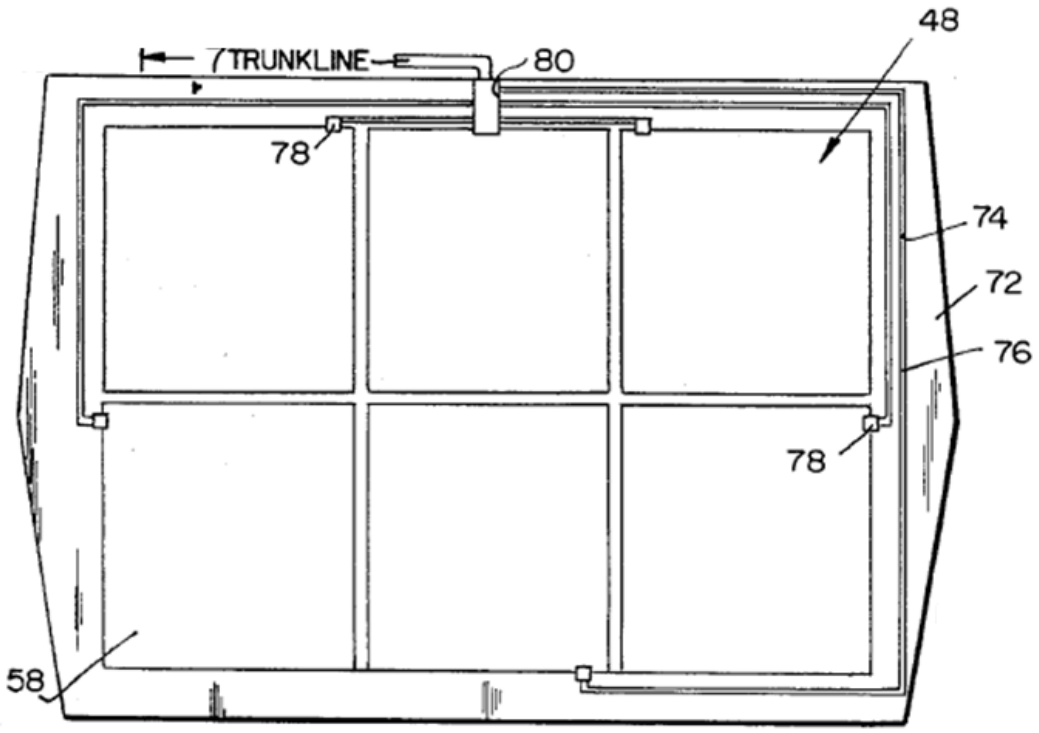
area containing the contact areas that sense touch. Ex.-1002, ¶ 70; see also Ex.-1001, 5:44-47 (explaining that "[t]he sensing electrodes 26 define a sensing area within which the position of an object (e.g. a finger or stylus) adjacent the sensor may be determined"); Ex.-1002, ¶ [_]. A POSITA would also have understood that additional columns are optional in the Barkan disclosure and the system could be implemented exactly as illustrated in Figure 23 with 3 rows and 3 columns. Ex.-1002, ¶ 70. Accordingly, a POSITA would have understood that the lead connecting these Y contact sub-areas is a "wrap around connection" as recited in Claims 1 and 17 of the '502 Patent. Id.



Ex.-1004, Figure 23 (Annotated)

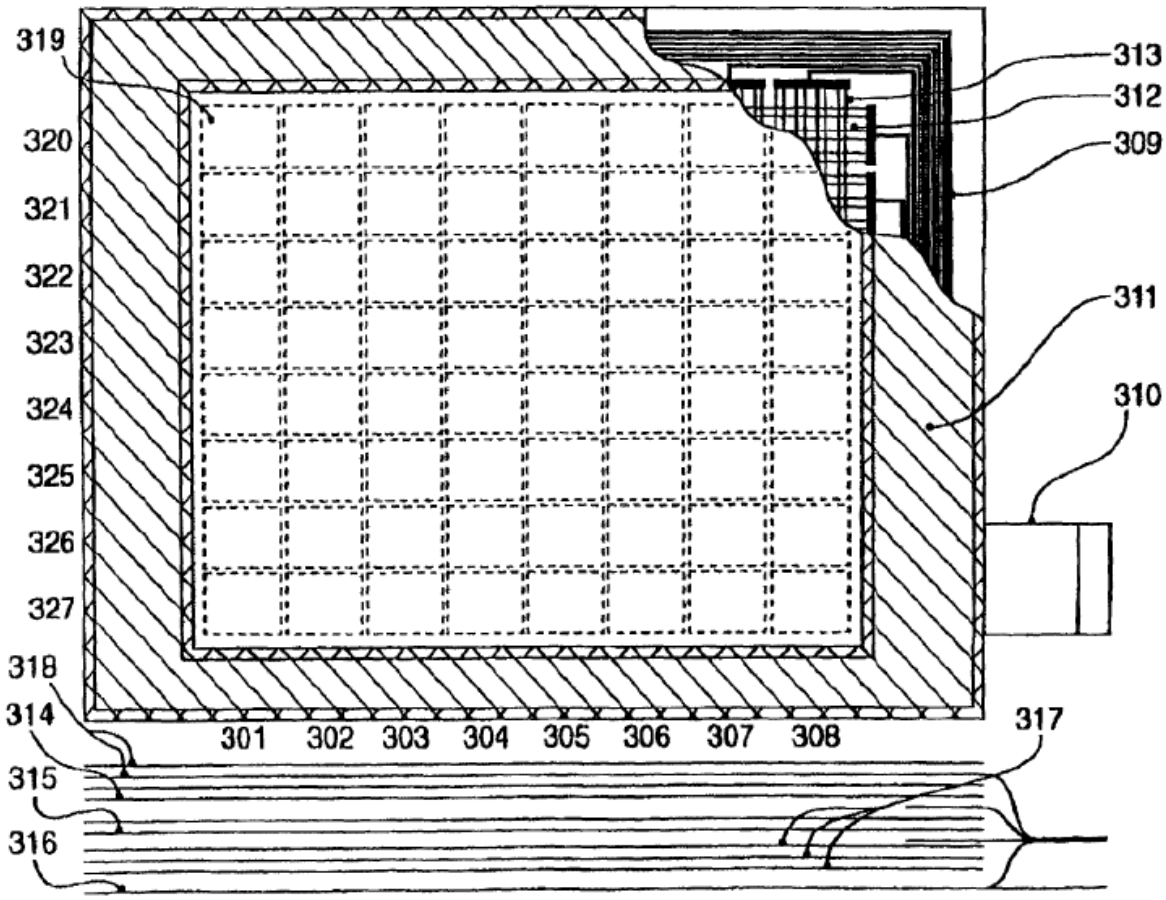
Barkan also teaches that the lead connecting the Y contact sub-areas in the

right edge column could be positioned even further outside the sensing area. With reference to the embodiment shown in Figure 8 below, Barkan explains that the leads (74 and 76) connecting the contact areas to the processing circuitry may be routed through a series of channels formed in a supporting frame (72) surrounding the contact areas (58). Ex.-1004, 18:22-49, Fig. 8. In this configuration, the leads run through the channels in the frame to an exit channel (80) and then to the processing circuitry. Id. A POSITA would have recognized that the right edge lead in the embodiment of Figure 23 could likewise be routed through a surrounding frame, which would offer numerous advantages, including enhanced protection of the delicate lead and the avoidance of any visual interference with the underlying display. Ex.-1002, ¶ 71.



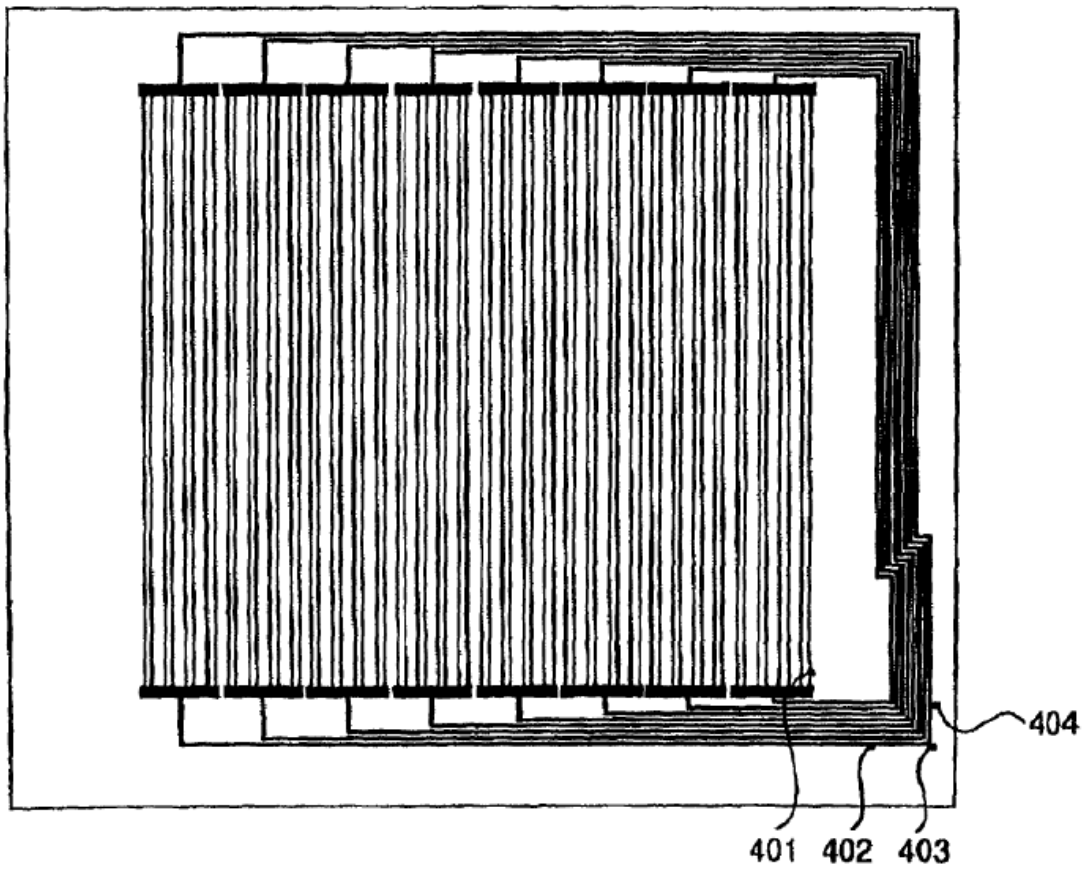
Ex.-1004, Figure 8

To the extent Barkan does not explicitly disclose "column wrap-around connections made outside the sensing area," Tagg discloses a touch screen with external wires that connect column sensing electrodes at opposing ends of each column. Ex.-1007, [0201], Fig. 23. As shown in Figure 23 below, the touch screen includes a row layer (314) and a column layer (315). Id. The column layer includes a plurality electrodes structured as thin strips (313). See id. The opposing ends of the column electrodes are coupled via wires (309) that are routed outside the sensing area under the frame of the touch screen. See id.



Ex.-1007, Figure 23

The wires can be seen more clearly in Figure 24 below, which depicts the column layer alone. Id., [0202], Figure 24. The opposing ends of each column electrode are coupled via the wires shown to the right of the array of column electrodes. Id. Accordingly, a POSITA would have understood that the wires (309) are "column wrap-around connections made outside the sensing area." Ex.-1002, ¶¶ 72-74.



Ex.-1007, Figure 24

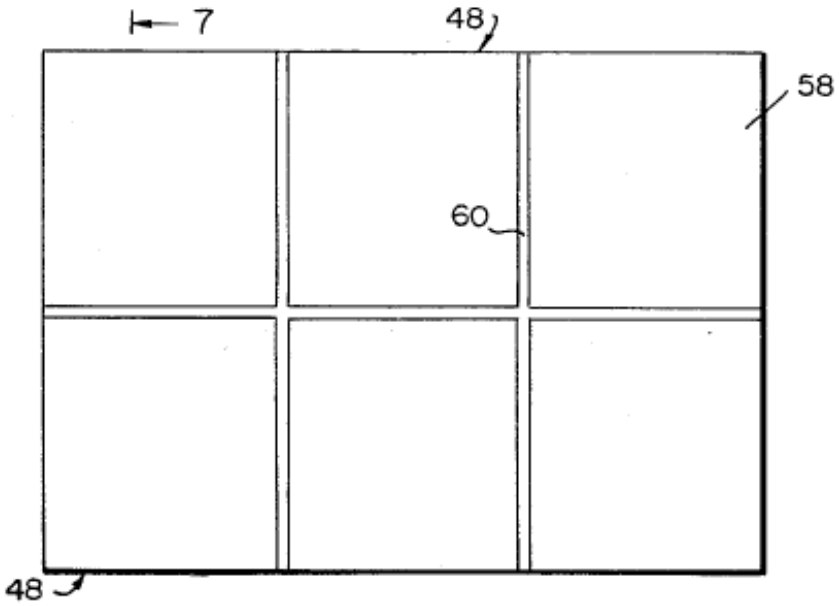
Based on the foregoing disclosures, a POSITA would have understood that Barkan discloses or renders obvious Claim 4, either alone or in combination with Tagg. Id., ¶¶ 70-74,

6. Dependent Claims 9 and 10

a. [9]/[10]: "The position sensor of 1, wherein the sensing cells are arranged into [three/four] columns"

Barkan discloses a touch actuated interface with an array of contact areas (i.e., "sensing cells") that can be arranged in any number of columns and rows. See, e.g., Ex.-1004, 5:3-9 (discussing "more sophisticated forms of matrices such

as 3 x N, up to N x M"). For example, the exemplary array depicted in Figure 6 below includes three columns. See, e.g., id., Figs. 6, 23. 66. A POSITA would have understood that additional columns are optional in the Barkan disclosure and the system can be implemented exactly as illustrated in Figure 23 with 3 rows and 3 columns. Ex.-1002, ¶ 75, 77. Alternatively, a POSITA would have appreciated that the touch interface could be configured with an array of contact areas having four or more columns. Id.



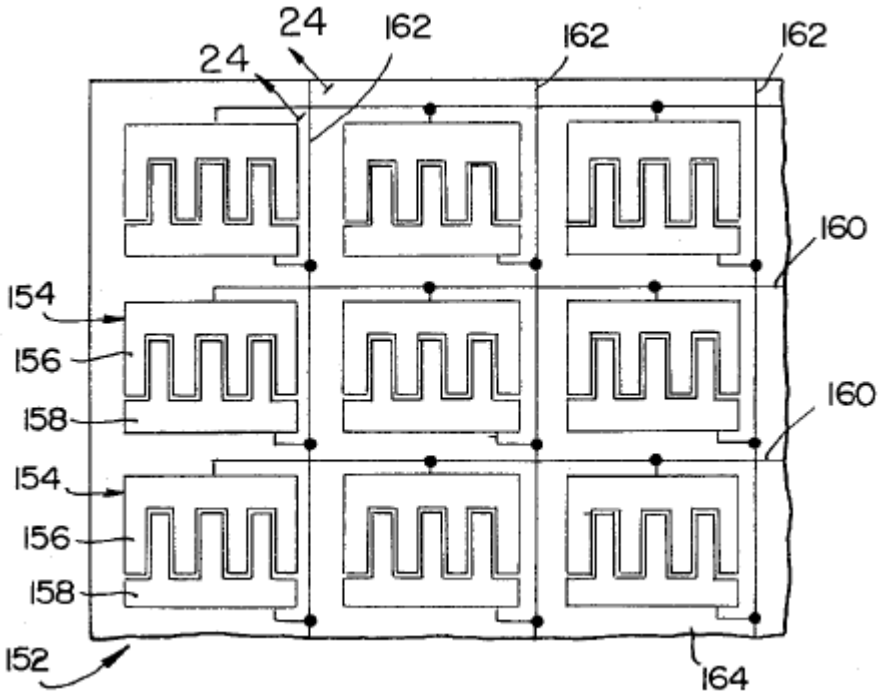
Ex.-1004, Figure 6

In view of the foregoing disclosures, a POSITA would have understood that Barkan discloses or renders obvious Claims 9 and 10. Id., ¶¶ 75-78.

7. Dependent Claim 11

a. [11]: "The position sensor of 1, wherein the column sensing electrode and the row sensing electrode in each sensing cell are interleaved with one another"

Barkan teaches that the Y contact sub-areas (i.e., "column sensing electrodes") and X contact sub-areas (i.e., "row sensing electrodes") in each contact area (i.e., "sensing cell") "are of such configuration and mutual arrangement that they are interleaved, e.g., interdigitated" as shown in Figure 23 below. Ex.-1004, 27:22-35, Fig. 23. Barkan further teaches that "each contact area could be in the form of a flat helix, i.e., spiral, and the associated contact sub-area, likewise in the form of a spiral, the turns of which are interleaved with the turns of the first contact sub-area." Id., 27:31-35.



Ex.-1004, Figure 23

Based on the foregoing disclosures, a POSITA would have understood that Barkan discloses or renders obvious Claim 11. Ex.-1002, ¶¶ 79-80.

8. Dependent Claim 12

a. [12]: "The position sensor of 1, wherein the substrate is formed from a transparent material"

Barkan teaches that "[i]n a preferred form of the invention the contact areas are discrete thin films supported on the electrically non-conductive transparent substrate." E.g., Ex.-1004, Abstract (emphasis added), 15:53-61, 27:52-63. Barkan further teaches that the substrate may comprise an "electrically non-conductive substrate such as a pane of clear glass or clear plastic." Id., 4:59-64.

In view of the foregoing disclosures, a POSITA would have understood that Barkan discloses or renders obvious Claim 12. Ex.-1002, ¶¶ 81-82.

9. Dependent Claim 13

a. [13]: "The position sensor of 1, wherein the electrodes are formed from a transparent electrically conductive material"

Barkan teaches that the contact areas (i.e., "electrodes") are comprised of "electrically conductive transparent material." E.g., Ex.-1004, Abstract (discussing "one or more to-be-touched contact areas of electrically conductive transparent material"), 1:8-14. Barkan further teaches that "the contact areas may be thin electrically conductive transparent films." E.g., id., 4:59-64, 15:39-61 ("The

contact areas 58 are electrically conductive and, since they must also be transparent, are, in the described embodiment of the invention, extremely thin.").

In view of the foregoing disclosures, a POSITA would have understood that Barkan discloses or renders obvious Claim 13. Ex.-1002, ¶¶ 83-84.

10. Dependent Claim 14

a. [14]: "The position sensor of 13, further comprising a graphical display wherein the electrodes in the sensing area are disposed over the graphical display to provide a touch screen"

Barkan discloses "an interreactive [sic] interface in the form of a transparent overlay on a display surface [that is] is clearly visible through the overlay." E.g., Ex.-1004, 7:43-46. The "displays can be static or dynamic and can come from any source known to the visual art." E.g., id., 28:67-29:5. For example, the overlay could be used with a cathode ray tube display. Id., Abstract, 6:32-39. Barkan further teaches that "the operator responds to [] data presented on the screen in the simplest way imaginable—that is, by touching the selected portion of the display." Id., 7:46-48. At that point, "[t]he location of the touch is 'recognized' by the interface through its touch-activated switches, and this location recognition is translated, via the programming of the machine, into the desired input." Id., 7:49-52.

In one example, "[s]uch an overlay might be used [] to cover a radar display at an airport traffic control center, the positions of the airplanes being indicated by

moving spots of light that constitute a visual display and which are disposed immediately beneath the overlay." Id., 19:15-20. In the event that "a controller at the airport tower wants to place himself in voice communication with a particular airplane, he touches his finger to the overlay at the location whereat the blip of light corresponding to the airplane is positioned," and the system will activate a voice channel to that airplane. Id., 19:20-28.

Based on the foregoing disclosures, a POSITA would have understood that Barkan discloses or renders obvious Claim 14. Ex.-1002, ¶¶ 85-87.

11. Dependent Claim 15

a. [15]: "The position sensor of 1, further comprising an insulating panel wherein the electrodes in the sensing area are disposed beneath the insulating panel to provide a keypad"

Barkan discloses "[a] transparent touch actuated interface with an interactively related display, in which the display is substantially fully covered by a solid state overlay, e.g., a keyboard, composed of one or more to-be-touched contact areas." E.g., Ex.-1004, Abstract (emphasis added), 4:39-42 ("By way of analogy, the overlay may be considered to be a transparent fixed keyboard, i.e., a transparent keyboard without movable parts."). Barkan teaches that "for the sake of protecting the contact areas against humidity, chemical deterioration or soil, the exposed surface of the overlay may be covered with a very thin layer of a clear electrically non-conductive material." Id., 5:49-53.

Based on the foregoing disclosures, a POSITA would have understood that Barkan discloses or renders obvious Claim 15. Ex.-1002, ¶¶ 88-89.

12. Dependent Claim 16

a. [16]: "A device comprising the position sensor of 1"

As previously discussed, Barkan discloses "an interreactive [sic] interface in the form of a transparent overlay on a display surface." E.g., Ex.-1004, 7:43-46, 1:8-24. Barkan teaches that "[t]he interface is adapted to be connected to a utilization mechanism including a broad range of electrical devices such as computers, teaching machines, read-outs, illuminating means to light up a selected portion or portions of the display, audio/visual apparatuses and playboard means." E.g., id., Abstract. For example, the interface may be coupled with a wide variety of devices, including election machines, television surveillance systems, vending machines, and visual display toys. E.g., id., 3:41-4:22. In each instance, the overlay of the touch actuated interface would be integrally combined with a display on the device.

Based on the foregoing disclosures, a POSITA would have understood that Barkan discloses or renders obvious Claim 16. Ex.-1002, ¶¶ 90-91.

13. Independent Claim 17

a. [17Pre]: "a method comprising"

To the extent the Preamble of Claim 17 is limiting, Barkan discloses a

method for depositing a single layer of electrically conductive contact areas on a substrate to form an overlay of a touch actuated interface. E.g., Ex.-1004, Abstract. As previously discussed in connection with Claims 1-2, 4, and 12 (Section VII.A), Barkan teaches that the contact areas are connected by leads and that both the leads and the contact areas may be formed from conductive materials such as chromium, tin oxide, or zinc oxide deposited via well-known techniques such as sputtering or vacuum evaporation procedures, deposition through a stencil, or etching. E.g., id., 15:39-61, 15:53-61.

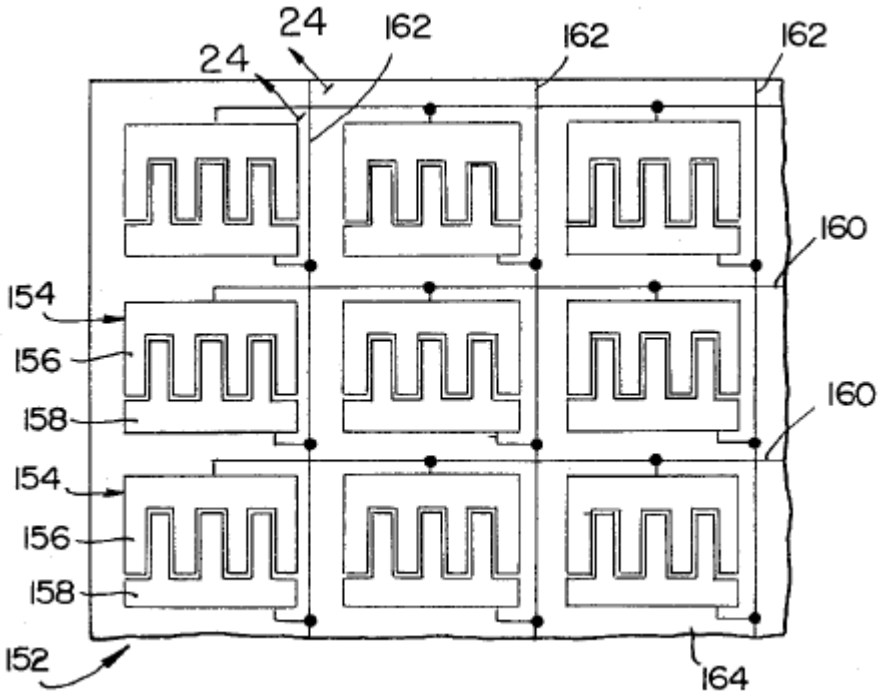
In view of the foregoing disclosures, a POSITA would have understood that Barkan discloses or renders obvious the Preamble of Claim 17. Ex.-1002, ¶¶ 92-93.

b. [17A]: "depositing a single layer of patterned conductive material on a substrate to form an active sensing region of a capacitive sensor, the pattern comprising rows and columns of electrodes connected to individual ones of capacitive sensing channels, and wherein at least one row or column is broken into a plurality of segments within the active sensing region"

As previously discussed in connection with Claims 1 and 12 (Sections VII.A.1 and VII.A.8 above), Barkan teaches that a single layer of patterned electrically conductive transparent films may be deposited on the surface of a substrate to form an array of contact areas (i.e., "electrodes") arranged in rows and columns. Barkan teaches that the contact areas are preferably disposed on a single

surface of the substrate, and may be formed from conductive materials such as chromium, tin oxide, or zinc oxide deposited via well-known techniques such as sputtering or vacuum evaporation procedures, deposition through a stencil, or etching. E.g., Ex.-1004, 12:47-48 ("The contact areas preferably are flat and their contact surfaces are coplanar."), 15:39-61, Fig. 23; see also Sections VII.A.1, VII.A.5, VII.A.8 above.

As shown in Figure 23 below, the contact areas (154) are arranged in a grid with columns and rows. E.g., Ex.-1004, Fig. 23. Each contact sub area includes an X contact sub-area (156) and a Y contact sub-area (158), with the X contact sub-areas in each row connected by an X lead (160) and the Y contact sub-areas in each column connected by a Y lead (162). Id., 27:1-63, Fig. 23; see also Section VII.A.2.c above. Because the X and Y contact areas are deposited in a single layer, it is necessary to prevent short circuiting where the leads cross. Id., 12:47-48, 27:52-28:13, Figs. 23-24. For that purpose, thin layers of insulating material may be deposited over the leads in the spaces between the X and Y contact sub-areas. Id.



Ex.-1004, Figure 23

Barkan teaches that this configuration can be used with a "well known X, Y matrix technique" in which "each X row and each Y column is associated with a different switch" along with other logic circuitry dedicated to each row and column. Ex.-1004, 26:22-59; 26:64-27:2 (explaining that the configuration shown in Figure 23 is suitable for an "X, Y matrix technique"). To illustrate, Barkan explains that "one of the X switches would have as an antenna therefor all of the contact areas in a given X row, another X switch would have associated therewith as an antenna all of the contact areas in another X row, and, similarly, one Y switch would have associated therewith as an antenna all of the contact areas in a given Y column, etc." Id., 26:30-36.

The contact areas in each row and column are connected to the dedicated X, Y matrix circuitry via the X and Y leads. The matrix circuitry is energized when a contact area in a particular column and row is touched. Id., 26:43-48 ("[I]f a contact area in the second X row and fourth Y column were touched, the 2 X switch and the 4 Y switch would be energized and the outputs from these two switches would control an and gate for an output corresponding to the 2 X/4 Y contact area."). Accordingly, a POSITA would have understood that each row and column is connected via an X or Y lead to its own individual matrix circuitry (i.e., "sensing channel"). Ex.-1002, ¶¶ 94-97.

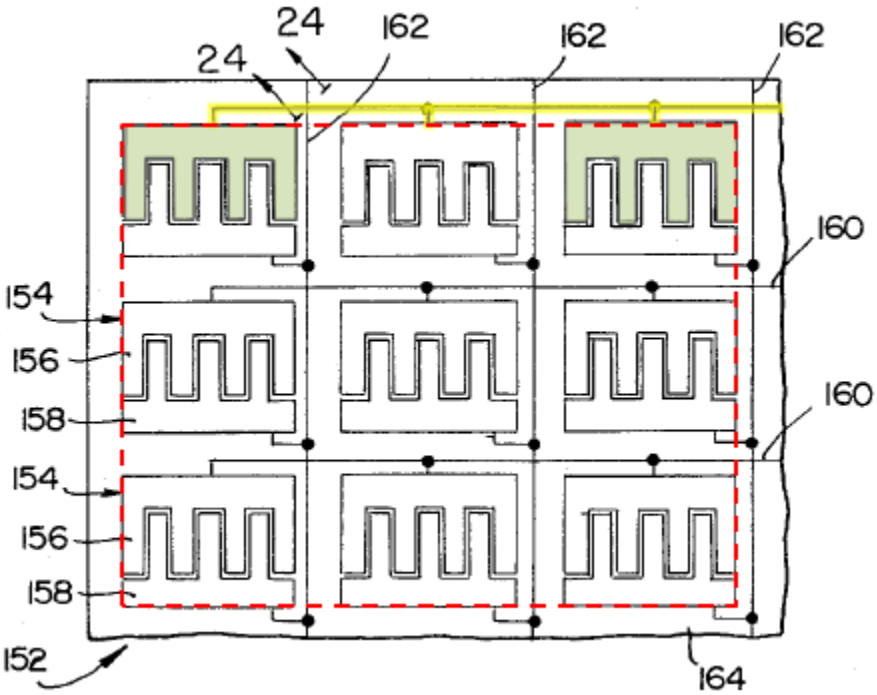
As shown in Figure 23 above, and as previously discussed in connection with Element [1B] (Section VII.A.2.c), each row and column is broken into a plurality of physically discrete X contact sub-areas and Y contact sub-areas. A POSITA would recognize, for example, that the top row of X contact sub-areas and the right-most column of Y contact sub-areas, which are discrete electrodes not electrically connected within the sensing area, are electrodes "broken into a plurality of segments" as recited by Claim 17 of the '502 Patent. See Ex.-1004, Fig. 23, 27:5-6; Ex.-1002, ¶ 97-98; see also Section VII.A.2.c above.

In view of the foregoing disclosures, a POSITA would have understood that Barkan discloses or renders obvious Element A of Claim 17. Ex.-1002, ¶¶ 94-99.

c. [17B]: "connecting a first broken segment at a first end of one of the at least one row or column to a second broken segment at a second end of the one of the at least one row or column using a wrap-around connection lying outside of the active sensing region, the plurality of segments including the first broken segment and the second broken segment"

As previously discussed in connection with Element [1C] and Claim 4 (Sections VII.A.2.d and VII.A.5), Barkan discloses leads lying outside the sensing area that connect the individual X contact sub-areas (i.e., "broken segments") in a row and the individual Y contact sub-areas (i.e., "broken segments") in a column. See Ex.-1004, 27:52-56, Fig. 23. For example, as shown in annotated Figure 23 below, the X contact sub-areas (highlighted in green) on the left and right ends of the uppermost row are connected via a lead (highlighted in yellow) that lies outside the sensing area (bounded by a red dashed line) containing the contact areas that sense touch. Id.; see also Ex.-1001, 5:44-47 (explaining that "[t]he sensing electrodes 26 define a sensing area within which the position of an object (e.g. a finger or stylus) adjacent the sensor may be determined"). As discussed in connection with Element [1C] (Section VII.A.2.d), while the uneven edge on the right indicates that the touch sensor extends to the right, possibly with additional contact areas (154), a POSITA would have understood that any additional contact areas (154) in the top row, including the right-most one, would be connected to the highlighted lead exactly as those pictured in Fig. 23. Ex.-1002, ¶ 100. Thus, a

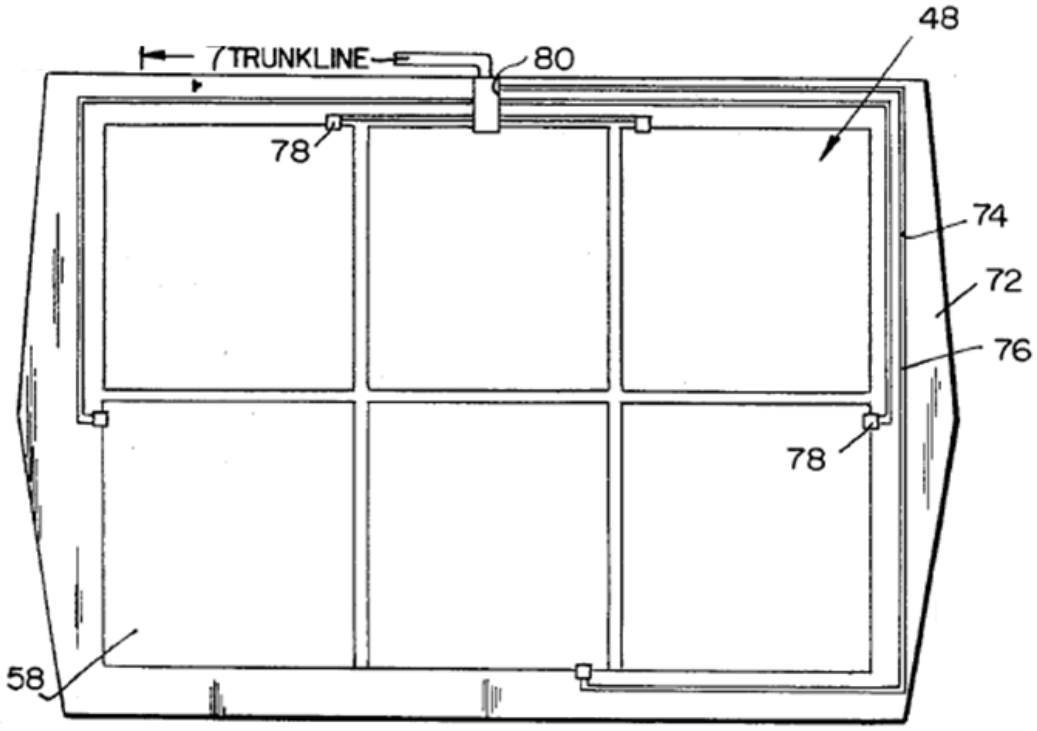
POSITA would have understood that this lead is a "wrap around connection" connecting "a first broken segment at a first end" of the uppermost row with "a second broken segment at a second end" of the uppermost row. Id.



Ex.-1004, Figure 23 (Annotated)

Barkan also teaches that the lead connecting the X contact sub-areas in the uppermost row and the lead connecting the Y contact sub-areas in the right edge column could be positioned even further outside the sensing area. With reference to the embodiment shown in Figure 8 below, Barkan explains that the leads (74 and 76) connecting the contact areas to the processing circuitry may be routed through a series of channels formed in a supporting frame (72) surrounding the contact areas (58). Ex.-1004, 18:22-49, Fig. 8. In this configuration, the leads

would run through the channels in the frame to an exit channel (80) and then to the processing circuitry. Id. A POSITA would have recognized that the uppermost lead and the right edge lead in the embodiment of Figure 23 could likewise be routed through a surrounding frame, which would offer numerous advantages, including enhanced protection of the delicate lead and the avoidance of any visual interference with the underlying display. Ex.-1002, ¶ 101.



Ex.-1004, Figure 8

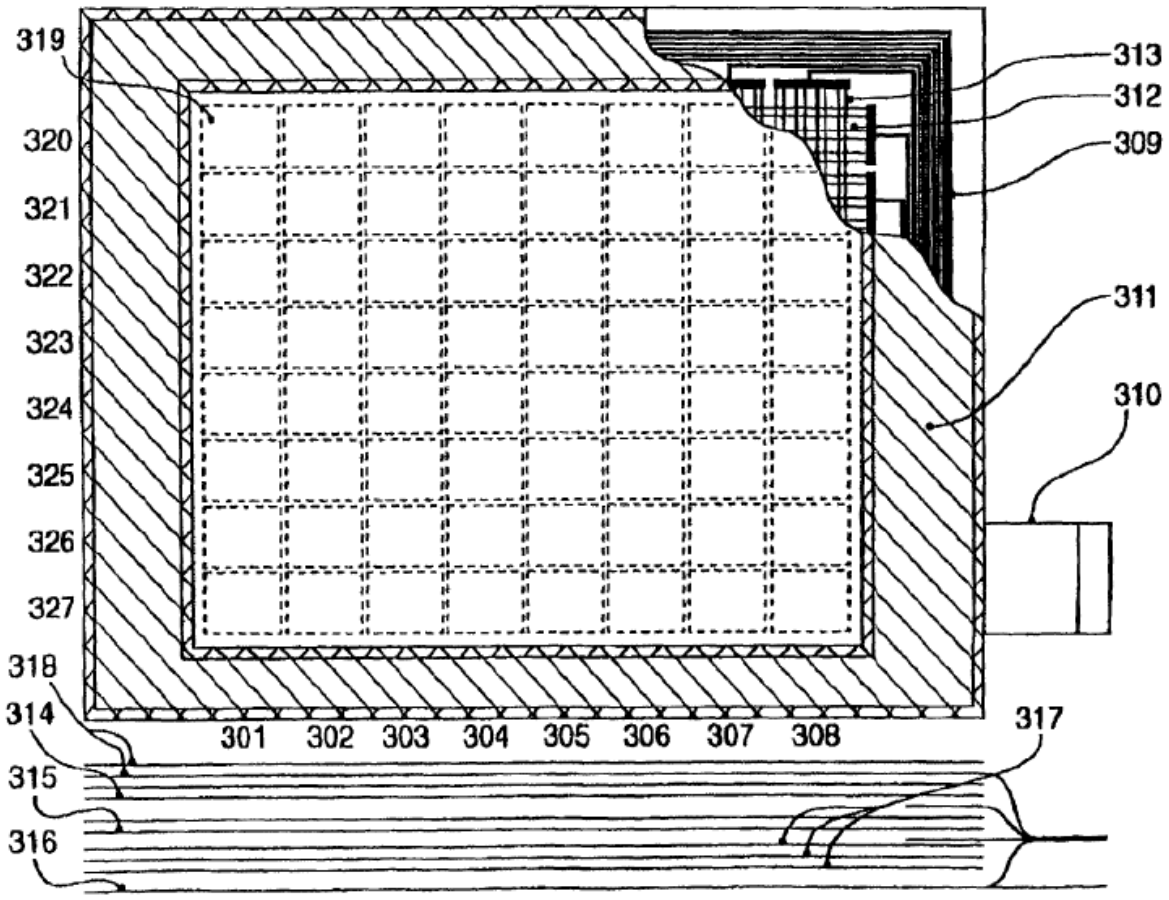
In view of the foregoing disclosures, a POSITA would have understood that Barkan discloses or renders obvious Element B of Claim 17. Id., ¶¶ 100-02.

d. [17C]: "connecting the rows and columns to individual sensing channels of a multi-channel capacitive sensor circuit having multiple outputs representing amplitudes of capacitance on the rows and columns"

As previously discussed in connection with Element [17A] (Section VII.A.13.b), and as shown in Figure 23 below, Barkan teaches that each row and column is connected via a lead to its own dedicated "matrix circuitry," which includes a switch and one or more "and gates." E.g., Ex.-1004, 26:26-59. Barkan further teaches that "[t]he associated circuitry is such that any contact area will, upon touching a human finger or an element having a capacitance in the order of that of a human being, actuate the associated switch, and, through that, a utilization mechanism." E.g., id., 12:47-52, 16:53-61. Thus, a POSITA would have recognized that the circuitry associated with each row and column comprises a sensing channel that receives and outputs signals representing amplitudes of capacitance in response to a touch that alters the capacitance of a contact area associated with a row and a column. See, e.g., id., 26:43-48; Ex.-1002, ¶ 103.

Tagg teaches a similar configuration of orthogonally arranged rows and columns of electrodes that are coupled to a plurality of capacitance measurement channels. Ex.-1007, [0178], [0201]. With reference to Figure 23 below, Tagg explains that the eight rows (320-327) and eight columns (301-308) of electrodes are connected to a "16 channel capacitance measuring device." Id., [0201].

Accordingly, a POSITA would have understood that each row and column is connected to a capacitance measurement channel of the capacitance measuring device. Ex.-1002, ¶ 104. A POSITA would have found it obvious to incorporate a similar capacitance measuring device to measure the capacitance of each row and column of electrodes taught by Barkan for the reasons discussed in Section VII.A.1. Id. at ¶¶ 49-51, 104.



Ex.-1007, Figure 23

In view of the foregoing disclosures, a POSITA would have understood that

Barkan discloses or renders obvious Element C of Claim 17, either alone or in combination with Tagg. Ex.-1002, ¶¶ 103-05.

e. [17D]: "providing a processor operable to process the multiple outputs to determine a XY coordinate position of an object adjacent the active sensing region"

Barkan teaches that the matrix circuitry receives signals from the rows and columns of contact areas and determines the XY coordinate position of a touch within the active sensing region. E.g., Ex.-1004, 26:43-48 ("To elucidate further, if a contact area in the second X row and fourth Y column were touched, the 2 X switch and the 4 Y switch would be energized and the outputs from these two switches would control an and gate for an output corresponding to the 2 X/4 Y contact area."). Barkan further teaches that "[t]he location of the touch is recognized by the interface through its touch-activated switches, and this location recognition is translated, via the programming of the machine, into the desired input." Id., 7:49-52. Thus, as a POSITA would have appreciated, the matrix circuitry that includes switches and "and gates" comprises a processor that determines the position of a touch. Ex.-1002, ¶ 106. Furthermore, the interface of Barkan is "adapted to be connected to a utilization mechanism including a broad range of electrical devices such as computers," which a POSITA would recognize as a further processor programmed to process signals from the array of contact

areas. E.g., Ex.-1004, Abstract, 7:49-52; Ex.-1002, ¶ 106.

Tagg also teaches a microprocessor that can interpolate the position of a touch by comparing signals from the columns and rows of electrodes in a touch screen. E.g. Ex.-1007, [0084]-[0085], [0203]-[0211], Fig. 25; see also Section VII.B.3. To the extent this limitation is not explicitly disclosed by Barkan, a POSITA would have been motivated to incorporate the microprocessor taught by Tagg for the reasons discussed in Section VII.A.1. Ex.-1002, ¶ 107.

Based on the foregoing disclosures, a POSITA would have understood that Barkan discloses or renders obvious Element D of Claim 17, either alone or in combination with Tagg. Ex.-1002, ¶¶ 106-08.

14. Dependent Claim 18

a. [18]: "The method of 17, wherein the processor is operable to compensate for position distortion introduced by the physical geometry of the patterned conductive, material"

Barkan teaches that the touch interface can be configured with contact areas and contact sub-areas of various sizes and shapes. E.g., Ex.-1004, 8:46-54, 27:26-35. Barkan further teaches that accuracy is a key benefit of the touch interface. E.g., id., 8:65-67. Additionally, Barkan provides that "[t]he location of the touch is recognized by the interface through its touch-activated switches, and this location recognition is translated, via the programming of the machine, into the desired input." Id., 7:49-52, Abstract (explaining that the interface is "adapted to be

connected to a utilization mechanism including a broad range of electrical devices such as computers"). A POSITA would have understood that this "recognition" and "translation" would necessarily involve compensating for any position distortion introduced by the physical geometry of the patterned conductive, material. Ex.-1002, ¶ 109.

To the extent Barkan does not explicitly or inherently disclosed this limitation, a POSITA would have found it obvious to modify the programming of the interface or the associated computerized utilization mechanism to compensate for any position distortion introduced by the physical geometry of the contact areas, which could be patterned in various sizes and shapes. See, e.g., id., 27:26-35; Ex.-1002, ¶ [_]. A POSITA would have been motivated to do so in order to ensure accurate touch location that Barkan touts as a key benefit of the touch interface. See, e.g., Ex.-1004, 8:58-67; Ex.-1002, ¶ 110. A POSITA would have further recognized that this could be accomplished using well-known circuit components and programming. Ex.-1002, ¶ 110.

Indeed, the '502 Patent acknowledges that "the determination of the position of a touch [can] be made using otherwise conventional circuitry connected to the sensing elements. Ex.-1001, 3:34-36, 9:19-23 ("The signals provided by the capacitance measurement channels have been processed according to conventional techniques, e.g. background capacitance removal, touch threshold detection,

normalization and filtering have been performed as desired."). Accordingly, to the extent Barkan does not otherwise disclose compensation for position distortion, a POSITA would have recognized that it could be incorporated by applying well-known elements and techniques to a similar item to achieve the benefits taught by Barkan. Ex.-1002, ¶ 111.

In view of the foregoing disclosures, a POSITA would have understood that Barkan discloses or renders obvious Claim 18. Id., ¶¶ 109-12.

B. Ground 2: Claims 5-7 and 20 of the '502 Patent Are Rendered Obvious by Barkan, Either Alone or in Combination with Tagg or Marten

1. Motivation to Combine

To the extent it is not already disclosed by Barkan, it would have been obvious to a POSITA to incorporate processing elements from Marten, including capacitance measurement channels comprising a charge transfer circuit (Claims 5 and 7) and processing circuitry that compares signals from the rows and columns of the sensor and interpolates the position of a touch (Claims 6 and 20). Ex.-1002, ¶¶ 114-17. Indeed, the '502 Patent acknowledges that the claimed processing features and steps can be implemented using conventional processing circuitry and techniques. E.g., Ex.-1001, 3:34-36 (teaching that "the determination of the position of a touch [can] be made using otherwise conventional circuitry connected to the sensing elements"), 9:19-23 (teaching that "the signals provided by the

capacitance measurement channels [are] processed according to conventional techniques"), 9:32-37 ("The determination of the position of point P along the x-direction is thus made by comparing the signals from the different columns of column sensing electrodes, and in particular by determining the interpolation or centroid of the signal values. This can be done using conventional processing techniques.").

A POSITA would have been motivated to consult these references as they both disclose capacitive touch sensors and associated processing circuitry for determining the position of a touch on a touch panel. See, e.g., Ex.-1004, Abstract; Ex.-1005, Abstract, [0053]-[0054]; Ex.-1002, ¶¶ 114-17. Furthermore, the references disclose common components, including an array of electrodes aligned with the X and Y axes and processing circuitry that utilizes switches for controlling and sensing the flow of current through the rows and columns of electrodes. See, e.g., Ex.-1004, Abstract, 27:1-63, Fig. 23; Ex.-1005, Abstract, [0053]-[0054].

A POSITA would have been motivated to incorporate the processing elements from Marten to improve the noise resistance and accuracy of the touch interface taught by Barkan. Ex.-1002, ¶¶ 114-17. Marten teaches that by utilizing the disclosed charge transfer circuit, processing speed can be improved and "the whole circuit can be made quite resistant to the effects of noise currents following [sic] into [the] capacitor." E.g., Ex.-1005, Abstract, [0066], [0059], [0094].

Similarly, a POSITA would have appreciated that the speed and accuracy of the interface could be improved by configuring the processor to determine the position of a touch by comparing and interpolating the signals from the rows and columns of touch sensing contact areas (i.e., electrodes). Ex.-1002, ¶¶ 114-17. A POSITA would have appreciated that this could be achieved by combining the well-known and conventional components and techniques taught by Marten to a similar device to yield predictable results. Id.

Marten likewise teaches that the charge transfer circuit for processing touch signals from the capacitive touch pad "utilizes [] general purpose 'off the shelf' components and [a] programmable microcontroller (element providing flexibility for changes and adjustments without incurring the high costs of a custom IC design)"). Ex.-1005, Abstract, [0025]. A POSITA would have thus understood that like the processing components and techniques disclosed by the '502 Patent, the processing components and techniques taught by Marten are not customized for a specific touch sensor, and could have been incorporated with the interface of Barkan to yield predictable results and improved performance. Ex.-1002, ¶¶ 114-17. For these reasons, along with those discussed below, a POSITA would have been motivated to incorporate the processing elements and techniques taught by Marten with the interface of Barkan and would have understood how to do so. Id.

2. Dependent Claim 5

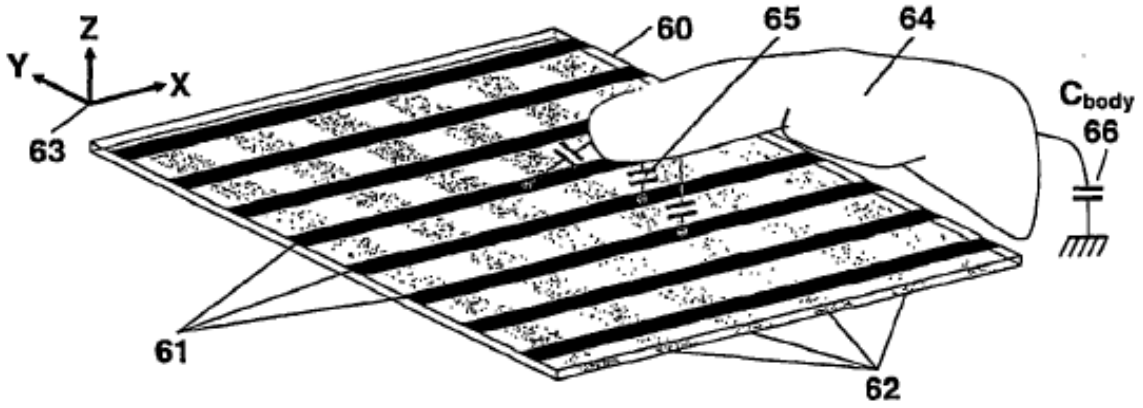
a. [5]: "The position sensor of 1, further comprising a plurality of capacitance measurement channels connected to respective ones of the rows and columns of sensing electrodes, wherein each measurement channel is operable to generate a signal indicative of a capacitance between its associated column or row of sensing electrodes and a system ground"

As previously discussed in connection with Elements [17A] and [17C] (Sections VII.A.13.b, VII.A.13.d), Barkan teaches that each row of X contact sub-areas (i.e., "row sensing electrodes") and each row of Y contact sub-areas (i.e., "column sensing electrodes") is connected to its own dedicated matrix circuitry (i.e., "capacitance measurement channels") that includes a capacitive switch and one or more "and gates." E.g., Ex.-1004 at 26:26-59. As previously discussed in connection with Element [17D] (Section VII.A.13.e), Barkan teaches that the switches associated with a row and a column will output signals to the "and gates" when a contact area in that row and column is touched. E.g., id. at 12:48-52, 26:43-48 ("To elucidate further, if a contact area in the second X row and fourth Y column were touched, the 2 X switch and the 4 Y switch would be energized and the outputs from these two switches would control an and gate for an output corresponding to the 2 X/4 Y contact area.").

As a POSITA would have recognized, these switches would be energized in response to a touch that would alter the capacitance between their associated row

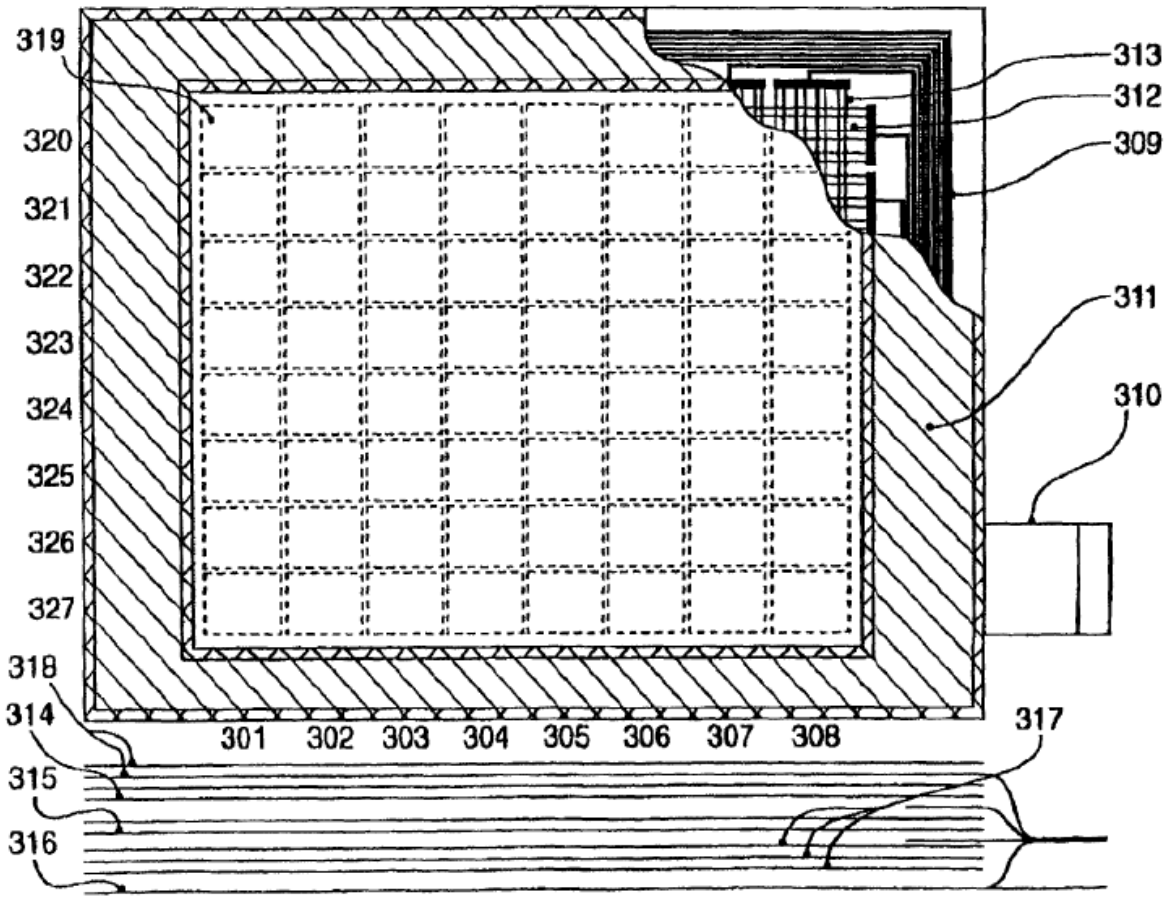
and column electrodes and a system ground. Ex.1002, ¶¶ 118-19. Accordingly, persons of ordinary skill in the art would have also understood that the signals output by the switches would be indicative of a capacitance between the row and column electrodes and a system ground. Id.

To the extent Barkan does not explicitly or inherently disclose this limitation, Marten discloses a similar capacitive touch pad and associated circuitry that determines the X and Y coordinates of a touch. E.g., Ex.-1005, [0007]-[0010], [0013], [0053]. With reference to Figure 6 below, Marten teaches that "[t]he position [of a touch by a grounded human] is determined by measurement of the changes of the capacitances to ground for all the electrodes (belonging to both group 61 and 62), followed by extrapolation of the position between the electrodes." E.g., id., [0054]. A POSITA would have thus understood that the row and column electrodes in groups 61 and 62 are coupled to a plurality of capacitance measurement channels that generate signals indicative of the changes in capacitance to ground for the electrodes. Ex.-1002, ¶ 120.



Ex.-1005, Figure 6

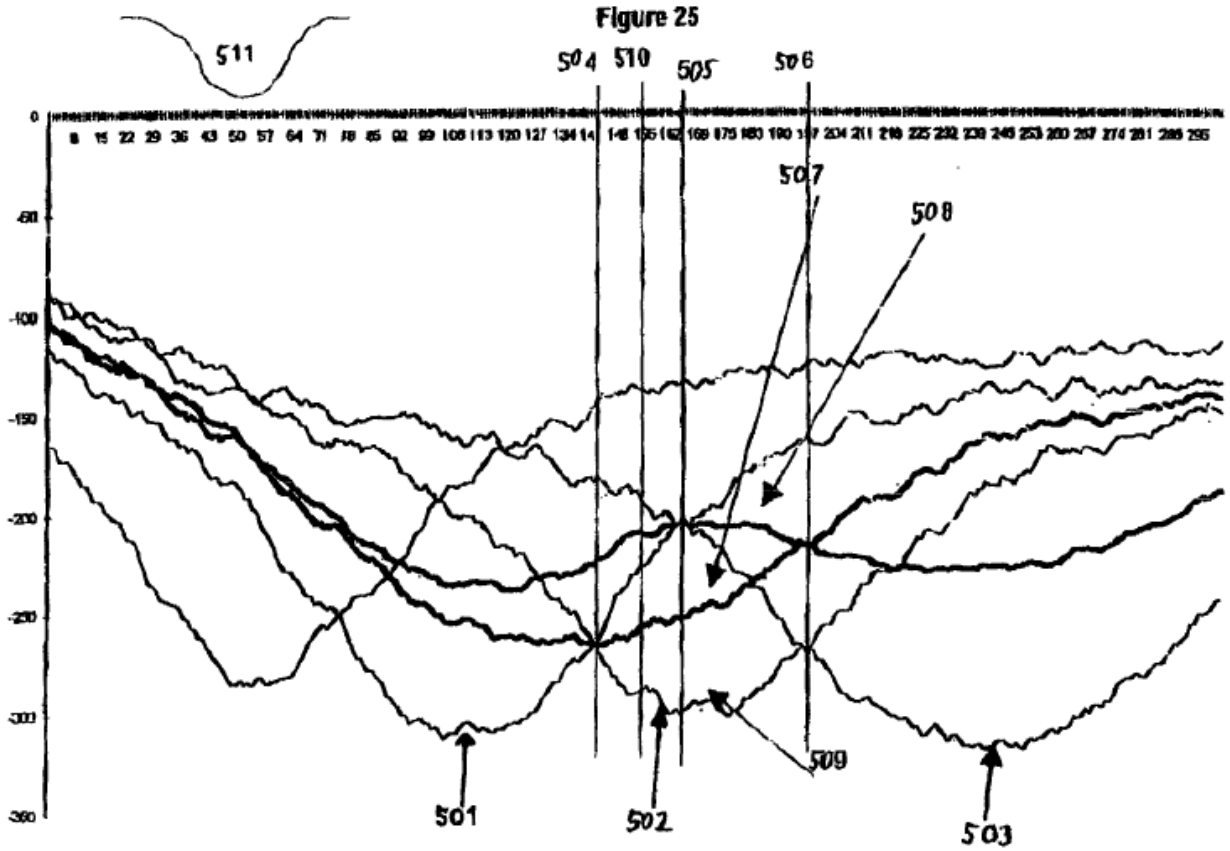
Tagg teaches a similar configuration of orthogonally arranged rows and columns of electrodes that are coupled to a plurality of capacitance measurement channels. Ex.-1007, [0178], [0201]. With reference to Figure 23 below, Tagg explains that the eight rows (320-327) and eight columns (301-308) of electrodes are connected to a "16 channel capacitance measuring device." Id., [0201]. Accordingly, a POSITA would have understood that each row and column is connected to a capacitance measurement channel of the capacitance measuring device. Ex.-1002, ¶ 121.



Ex.-1007, Figure 23

Tagg further teaches that the measurement channels associated with the rows and columns of electrodes output signals indicative of the capacitance of each row and column that can be used to interpolate the position of a touch. Ex.-1007, [0203]-[0211], Fig. 25. For example, Figure 25 below shows the capacitance measured from a series of column electrodes as a finger is moved across the screen from left to right. Id., [0203], Fig. 25. The measured capacitance of each column increases as the finger approaches, then peaks when the finger passes over it, and

finally decreases as the finger moves away, forming bell curves. Id. A microprocessor can interpolate the position of a touch by comparing these signals at a fixed point in time. Id., [0203]-[0211], Fig. 25. A POSITA would have thus understood that the plurality of capacitive measurement channels generate signals indicative of the capacitance between their associate rows and columns of electrodes and a system ground. Ex.-1002, ¶ 122. To the extent this limitation is not explicitly disclosed by Barkan, a POSITA would have been motivated to incorporate the foregoing processing elements of Tagg for the reasons discussed in Section VII.A.1. Ex.-1002, ¶¶ 49-51, 122.



Ex.-1007, Figure 25

In view of the foregoing disclosures, a POSITA would have understood that Barkan discloses or renders obvious Claim 5, either alone or in combination with Marten or Tagg. Id., ¶¶ 118-23.

3. Dependent Claim 6

a. [6]: "The position sensor of 5, further comprising a processor operable to determine the position of the object in the sensing area along a first direction by comparing signals from the different columns with each other and along a second direction by comparing signals from the different rows with each other"

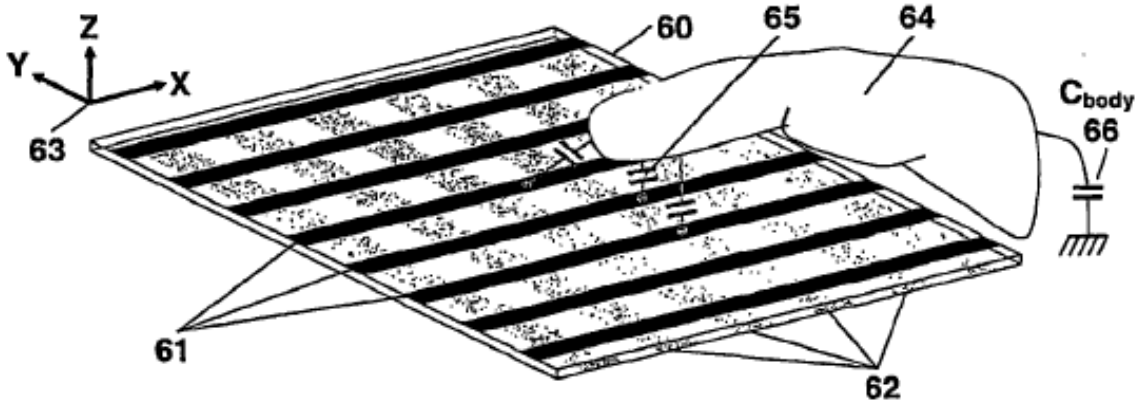
As previously discussed in connection with Claim 5 (Section VII.B.2), Barkan discloses matrix circuitry that receives signals from the various rows and columns of contact areas and determines the X, Y coordinate position of a touch within the in the active sensing region. E.g., Ex.-1004, 26:43-48 ("To elucidate further, if a contact area in the second X row and fourth Y column were touched, the 2 X switch and the 4 Y switch would be energized and the outputs from these two switches would control an and gate for an output corresponding to the 2 X/4 Y contact area."). Barkan teaches that "[t]he location of the touch is recognized by the interface through its touch-activated switches, and this location recognition is translated, via the programming of the machine, into the desired input." Id., 7:49-52. A POSITA would have recognized that this involves a comparison of the different signals from the columns and rows in order to distinguish those that have

energized their associated matrix circuitry from those that have not. Ex.-1002, ¶ 124.

As a POSITA would have appreciated, the matrix circuitry and "the programming of the machine" that translates the signals from the switches comprise a processor that can determine the position of a touch. Ex.-1004, 7:49-52; Ex.-1002, ¶ 125. Furthermore, the interface of Barkan is "adapted to be connected to a utilization mechanism including a broad range of electrical devices such as computers," which a POSITA would have recognized as an additional processor programmed to process signals from the array of contact areas and determine the position of a touch. See, e.g., Ex.-1004, Abstract, 7:49-52; Ex.-1002, ¶ 125.

To the extent Barkan does not explicitly or inherently disclose this limitation, it would be rendered obvious by Marten. Ex.-1002, ¶ [_]. Marten teaches a capacitive touch pad with a first group of electrodes parallel to the X-axis for determining the Y coordinate of a touch and a second group of electrodes parallel to the Y-axis for determining the X coordinate of a touch. E.g., Ex.-1005, [0053], [0007]-[0008], Fig. 6. As shown in Figure 6 below, Marten teaches that "the capacitances 65 between the digit 64 and electrodes belonging to group 61 (as illustrated in FIG. 6) allow for the determination of the position of the digit's tip 64 in the Y-axis [and] [t]he capacitances between the digit 64 and group of electrodes 62 (not shown for clarity) allow the determination of the position in the X-axis."

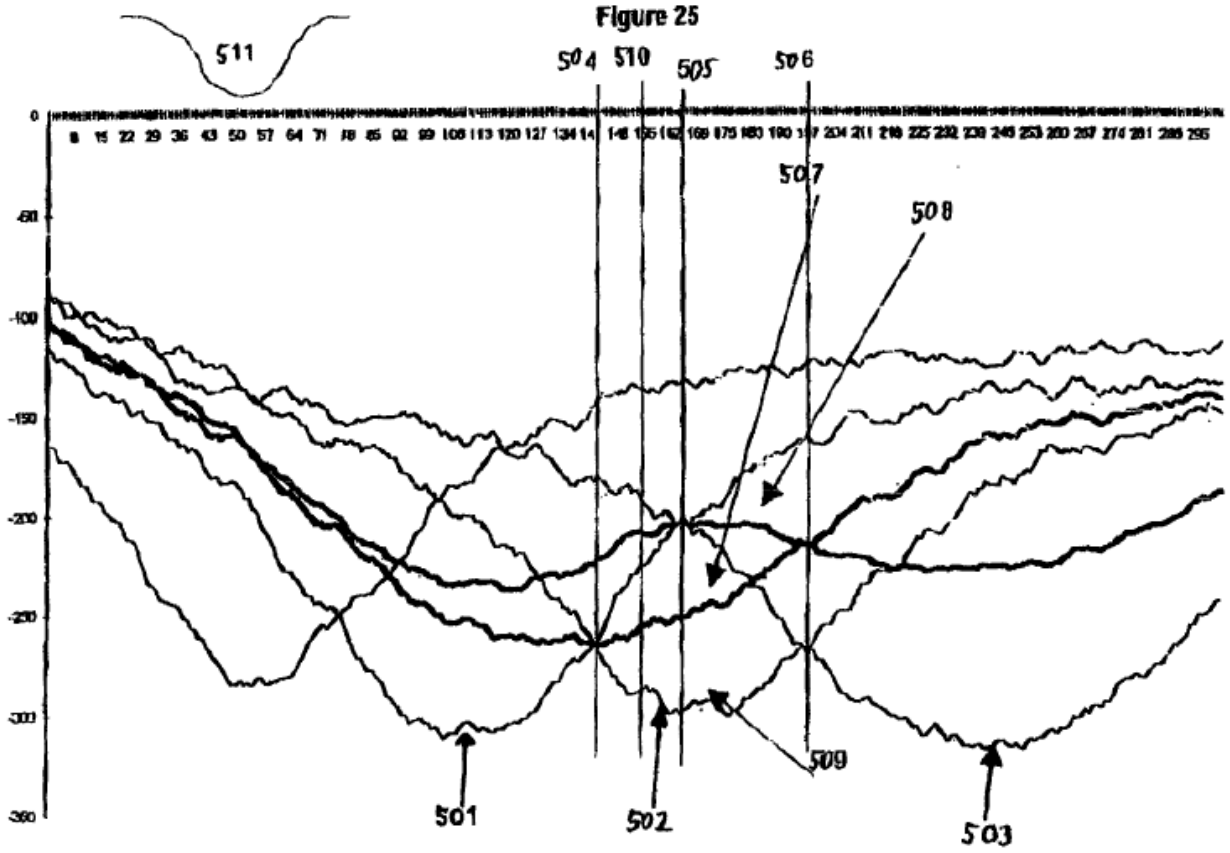
Id. Marten further teaches that "[t]he position is determined by measurement of the changes of the capacitances to ground for all the electrodes (belonging to both group 61 and 62), followed by extrapolation of the position between the electrodes." Id., [0054], [0010]. A POSITA would have understood that this involves a comparison of the signals from the different rows and columns to determine which row and column exhibited the greatest change in capacitance from the touch and thereby extrapolate the position of the touch. Ex.-1002, ¶ 126.



Ex.-1005, Figure 6

Tagg also teaches a microprocessor that can interpolate the position of a touch by comparing signals from the columns and rows of electrodes in a touch screen. E.g. Ex.-1007, [0084]-[0085], [0203]-[0211], Fig. 25. For example, Figure 25 below shows the capacitance measured from a series of column electrodes as a finger is moved across the screen from left to right. Id., [0203], Fig. 25. The measured capacitance of each column increases as the finger approaches, then

peaks when the finger passes over it, and finally decreases as the finger moves away, forming bell curves. Id. A microprocessor can interpolate the position of a touch by comparing these signals at a fixed point in time. Id., [0203]-[0211], Fig. 25. To the extent this limitation is not explicitly disclosed by Barkan, a POSITA would have been motivated to incorporate the foregoing processing elements of Tagg for the reasons discussed in Section VII.A.1. Ex.-1002, ¶¶ 49-51, 127.



Ex.-1007, Figure 25

In view of the foregoing disclosures, a POSITA would have understood that Barkan discloses or renders obvious Claim 6, either alone or in combination with

Marten or Tagg. Ex.-1002, ¶¶ 124-28.

4. Dependent Claim 7

a. [7]: "The position sensor of 5, wherein the capacitance measurement channels comprise a charge transfer circuit"

As previously discussed in connection with Claim 5 (Section VII.B.2), Barkan discloses matrix circuitry associated with each row and column that includes switches and "and gates" that are activated when the contact areas (i.e., "sensing electrodes") in their associated columns and rows are touched by a finger. E.g., Ex.-1004, 12:47-52 ("The associated circuitry is such that any contact area will, upon touching a human finger of an element having a capacitance in the order of that of a human being, actuate the associated switch, and, through that, a utilization mechanism."), 26:43-48. In keeping with basic principles of capacitance, a POSITA would have appreciated that the switches would be actuated in response to some amount of the stored charge in the capacitive contact areas being transferred through the human finger upon contact. Thus, a POSITA would have understood that the capacitive touch interface includes a charge transfer circuit. Ex.-1002, ¶ 129.

This is consistent with the '502 Patent, which does not provide any description of the structure or function of a charge transfer circuit, and instead merely mentions that "[p]referably, the sensing channels 42 are multiple in-phase

charge-transfer sensors of the type described in U.S. Pat. No. 5,730,165 or U.S. Pat. No. 6,466,036." Ex.-1001, 8:16-18.

To the extent Barkan does not explicitly or inherently disclose a charge transfer circuit, however, Marten discloses "[a] Circuit (in FIG. 1) and an Algorithm for Data Acquisition from Capacitive Touch Pad Sensor [that] employs charge transfer to sense capacitance." E.g., Ex.-1005, Abstract, [0059]-[0060].

Based on the foregoing disclosures, a POSITA would have understood that Barkan discloses or renders obvious Claim 7, either alone or in combination with Marten. Ex.-1002, ¶¶ 129-31.

5. Dependent Claim 20

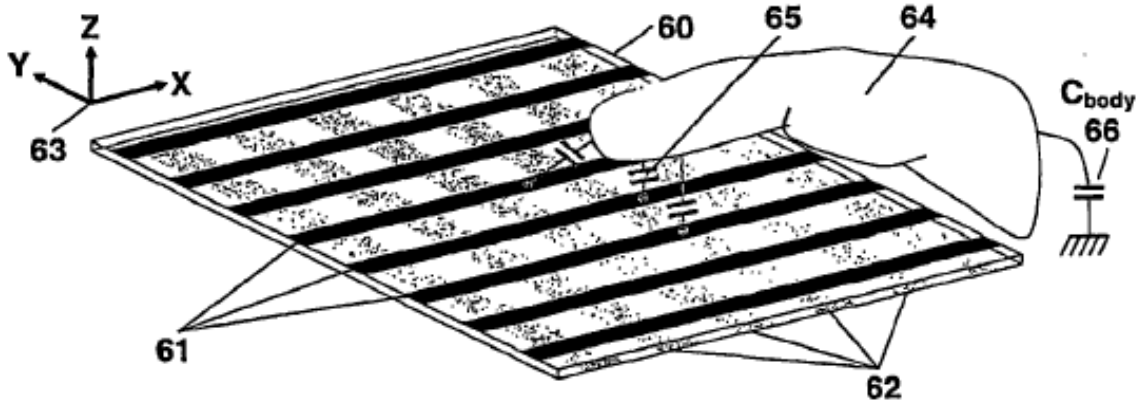
a. [20]: "The method of 17, wherein the processor is operable to calculate an interpolation of the signals across rows and an interpolation of the signals across columns"

As previously discussed in connection with Elements [17A] and [17D] and Claims 5 and 6 (Sections VII.A.13.b, VII.A.13.e, VII.B.2, VII.B.3), Barkan discloses matrix circuitry that receives signals from the various rows and columns of contact areas and determines the X, Y coordinate position of a touch within the in the active sensing region. E.g., id., 26:43-48 ("To elucidate further, if a contact area in the second X row and fourth Y column were touched, the 2 X switch and the 4 Y switch would be energized and the outputs from these two switches would control an and gate for an output corresponding to the 2 X/4 Y contact area.").

Barkan further teaches that "[t]he location of the touch is recognized by the interface through its touch-activated switches, and this location recognition is translated, via the programming of the machine, into the desired input." Id., 7:49-52. A POSITA would have recognized that this involves a comparison and interpolation of the different signals from the columns and rows to distinguish those that have energized their associated matrix circuitry from those that have not and to determine a final position of the touch. Ex.-1002, ¶ 132.

To the extent Barkan does not explicitly or inherently disclose this limitation, it would be rendered obvious by Marten. Marten teaches a capacitive touch pad with a first group of electrodes parallel to the X-axis for determining the Y coordinate of a touch and a second group of electrodes parallel to the Y-axis for determining the X coordinate of a touch. E.g., Ex.-1005, [0053], [0007]-[0008], Fig. 6. As shown in Figure 6 below, Marten teaches that "the capacitances 65 between the digit 64 and electrodes belonging to group 61 (as illustrated in FIG. 6) allow for the determination of the position of the digit's tip 64 in the Y-axis [and] [t]he capacitances between the digit 64 and group of electrodes 62 (not shown for clarity) allow the determination of the position in the X-axis." Id. Marten further teaches that "[t]he position is determined by measurement of the changes of the capacitances to ground for all the electrodes (belonging to both group 61 and 62), followed by extrapolation of the position between the electrodes." Id., [0054],

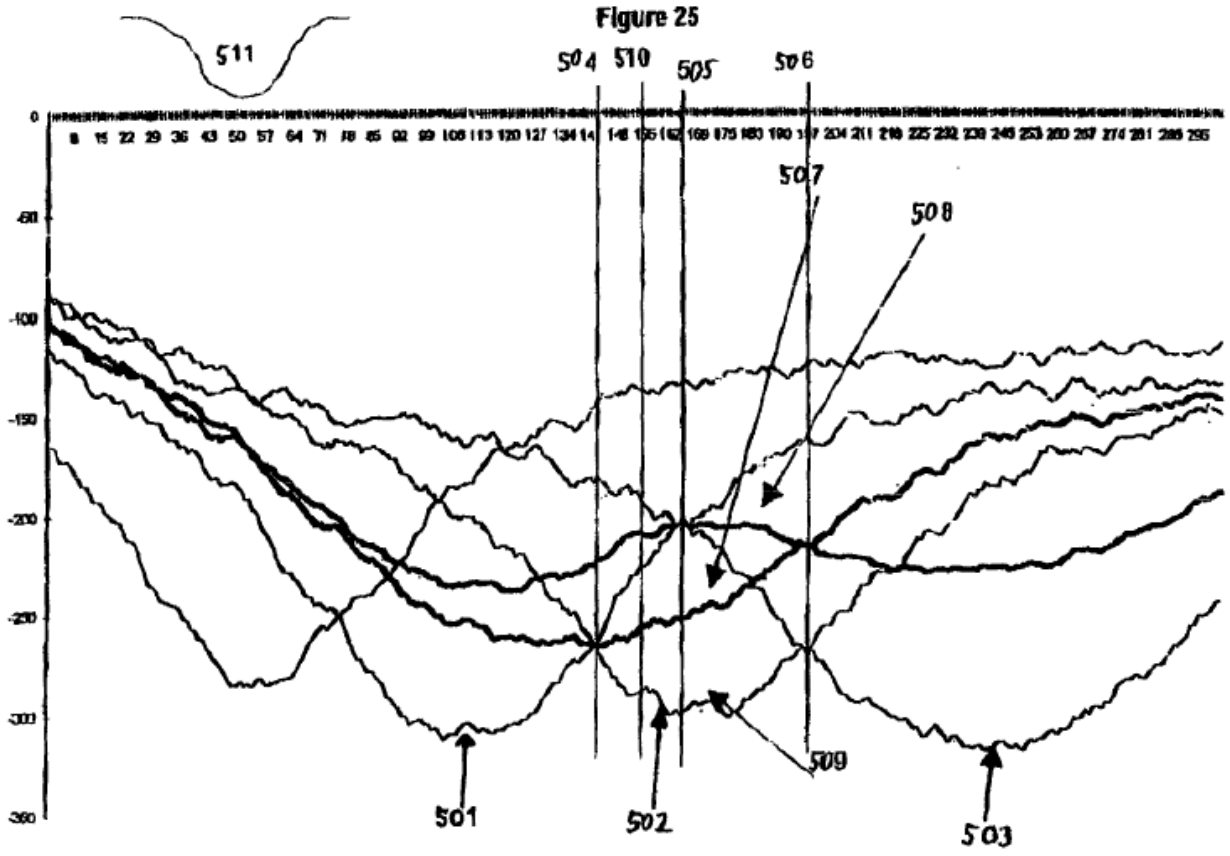
[0010]. A POSITA would have understood that this extrapolation involves a comparison of the signals across the rows and columns to determine the coordinates where the greatest change in capacitance from the touch is exhibited. Ex.-1002, ¶ 133. A POSITA would have thus recognized that this extrapolation process is functionally identical to the interpolation recited in Claim 20 of the '502 Patent. Id.; see also Ex. 1001, 8:32-41 (explaining that "[t]he interpolated position of the capacitive load along the x-direction is determined from the signals from the capacitance measurement channels associated with the columns of column sensing electrodes and the interpolated position of the capacitive load along the y-direction is determined from the signals from the capacitance measurement channels associated with the rows of row sensing electrodes.")



Ex.-1005, Figure 6

Tagg also teaches a microprocessor that can interpolate the position of a touch by comparing signals from the columns and rows of electrodes in a touch

screen. E.g. Ex.-1007, [0084]-[0085], [0203]-[0211], Fig. 25. For example, Figure 25 below shows the capacitance measured from a series of column electrodes as a finger is moved across the screen from left to right. Id., [0203], Fig. 25. The measured capacitance of each column increases as the finger approaches, then peaks when the finger passes over it, and finally decreases as the finger moves away, forming bell curves. Id. A microprocessor can interpolate the position of a touch by comparing these signals at a fixed point in time. Id., [0203]-[0211], Fig. To the extent this limitation is not explicitly disclosed by Barkan, a POSITA would have been motivated to incorporate the foregoing processing elements of Tagg for the reasons discussed in Section VII.A.1. Ex.-1002, ¶ 134.



Ex.-1007, Figure 25

Based on the foregoing disclosures, a POSITA would have understood that Barkan discloses or renders obvious Claim 7, either alone or in combination with Marten or Tagg. Ex.-1002, ¶¶ 132-35.

C. Ground 3: Claim 8 and 21of the '502 Patent Are Rendered Obvious by Barkan in Combination with Marten or with Marten and Boie

1. Motivation to Combine

It would have been obvious to a POSITA to incorporate processor elements from Marten or Boie that drive the sensing electrodes of the touch pad in a substantially phase synchronous manner (Claims 18 and 21). Id., ¶¶ 137-40. Like

Barkan and Marten, Boie is directed to capacitive touch sensors and associated processing circuitry for determining the position of a touch on a touch panel. See, e.g., Ex.-1004, Abstract; Ex.-1005, Abstract, [0053]-[0054]; Ex.-1006, Abstract, Figs. 2-4. Barkan and Boie disclose highly similar touch sensor configurations with interleaved row and column electrodes deposited in a grid on a substrate and connected within each column and row by leads. See, e.g., Ex.-1004, Fig. 23; Ex.-1006, Fig. 2.

As discussed in detail in connection with Claims 1-4 and 9-16 (Section VII.A above), both the '502 Patent and Marten teach that the processing circuitry recited in the challenged claims and the processing circuitry disclosed by Marten is conventional circuitry that utilizes well-known techniques to perform the claimed functions. E.g., Ex.-1001, 3:34-36 (teaching that "the determination of the position of a touch [can] be made using otherwise conventional circuitry connected to the sensing elements"), 9:19-23 (teaching that "the signals provided by the capacitance measurement channels [are] processed according to conventional techniques"), 9:32-37 ("The determination of the position of point P along the x-direction is thus made by comparing the signals from the different columns of column sensing electrodes, and in particular by determining the interpolation or centroid of the signal values. This can be done using conventional processing techniques."); see also Section VII.B.1 above. The '502 Patent further admits that the circuitry

taught by Boie can be used to provide a phase synchronous drive signal. Ex.-1001, 3:40-47, 8:11-16.

As previously discussed in connection with Claims 1-4 and 9-16 (Sections VII.A.2- VII.A.12), a POSITA would have been motivated to combine the processing elements and techniques taught by Marten with the interface of Barkan. See Section VII.B.1 above; Ex.-1002, ¶¶ 137-40. Marten teaches that by driving the electrodes in a phase synchronous manner and using a synchronous detector, the processing circuitry is "capable of suppression of noise and unwanted signals due to their phase difference or non-synchronicity to the excitation signal." E.g., Ex.-1005, [0014]. Boie teaches the same benefit can be achieved by using a phase synchronous drive signal. E.g., Ex.-1006, 4:58-61 ("The effects of electrode-to-electrode capacitances, wiring capacitances and other extraneous capacitances are minimized by driving all electrodes and guard plane 411 in unison with the same RF signal from RF oscillator"). Accordingly, a POSITA would have been motivated to incorporate the single voltage source taught by Marten or the single oscillator taught by Boie to improve the noise resistance of the interface disclosed by Barkan. See Sections VII.B.1 above VII.C.1; Ex.-1002, ¶¶ 137-40.

A POSITA would have thus understood that the well-known and conventional processing components and techniques taught by Marten and Boie are not customized for a specific touch sensor, and could have been incorporated

with the interface of Barkan to yield predictable results and drive the electrodes in a substantially phase synchronous manner. Ex.-1002, ¶¶ 137-40. This could be achieved by simply driving the electrodes with a single signal from a single oscillator or other voltage source as taught by Marten and Boie. Id. For these reasons, along with those discussed below, a POSITA would have been motivated to incorporate the processing elements and techniques taught by Marten or Boie with the interface of Barkan and would have understood how to do so. Id.

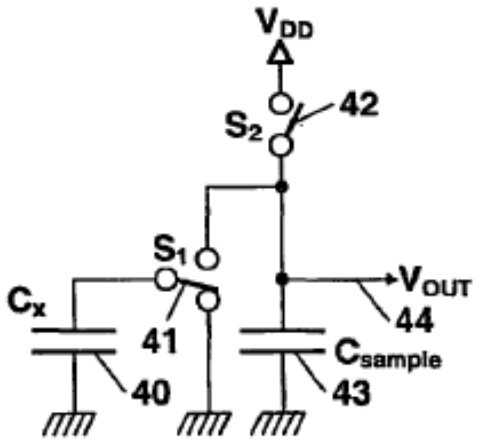
2. Dependent Claims 8 and 21

a. [8]: "The position sensor of 5, wherein the capacitance measurement channels are configured to drive a plurality of sensing electrodes substantially synchronously in phase with one another"
[21]: "The method of 17, wherein the capacitive sensing channels employ driving signals which are substantially phase synchronous with respect to one another"

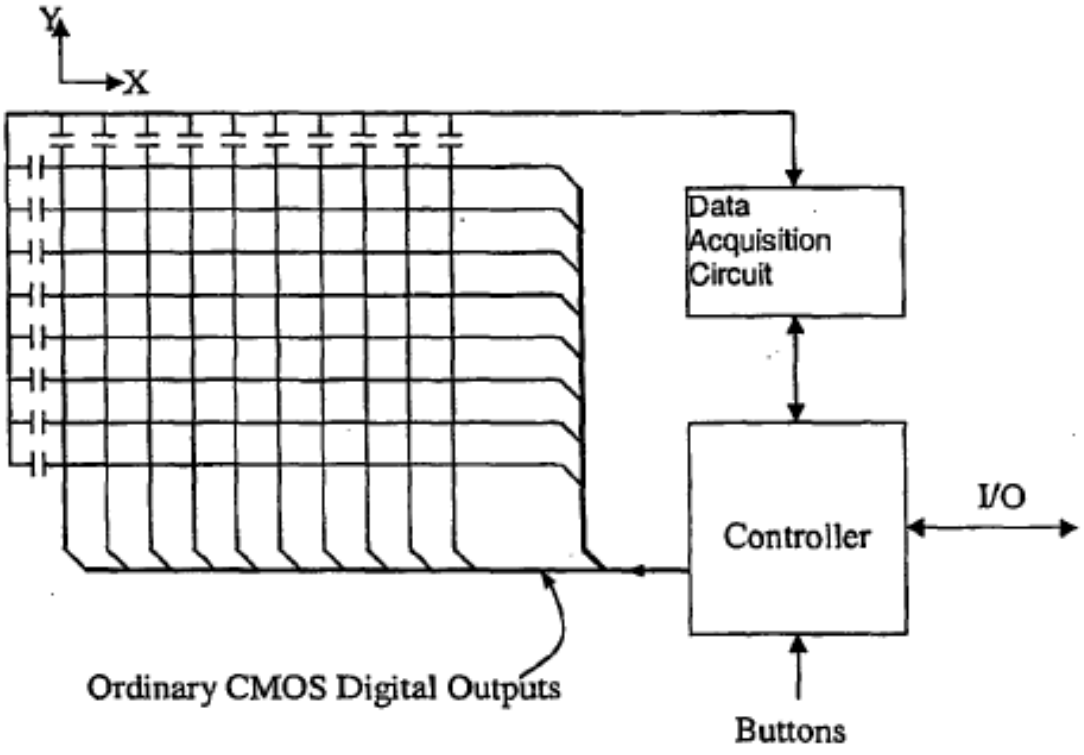
As discussed above, Claim 5 is disclosed or rendered obvious by Barkan, alone or in combination with Marten (Section VII.B.2 above), and Claim 17 is disclosed or rendered obvious by Barkan, either alone or in combination with Tagg (Section VII.A.13).

Marten teaches that "[t]he extraction of the useful signal is typically carried [out] with a synchronous detector, capable of suppression of noise and unwanted signals due to their phase difference or non-synchronicity to the excitation signal." E.g., Ex.-1005, [0014]. In addition, the exemplary processing circuits shown in

Figures 1 and 4 include a single voltage source (Vdd in Figure 4 below). Id., Figs. 1, 4; see also Figs. 11 and 12 (showing an embodiment in which all rows and columns are driven by a common controller with a voltage source). Accordingly, a POSITA would have appreciated that the processing circuitry of Marten is configured to drive the plurality of electrodes substantially synchronously in phase with one another. Ex.-1002, ¶ 142.



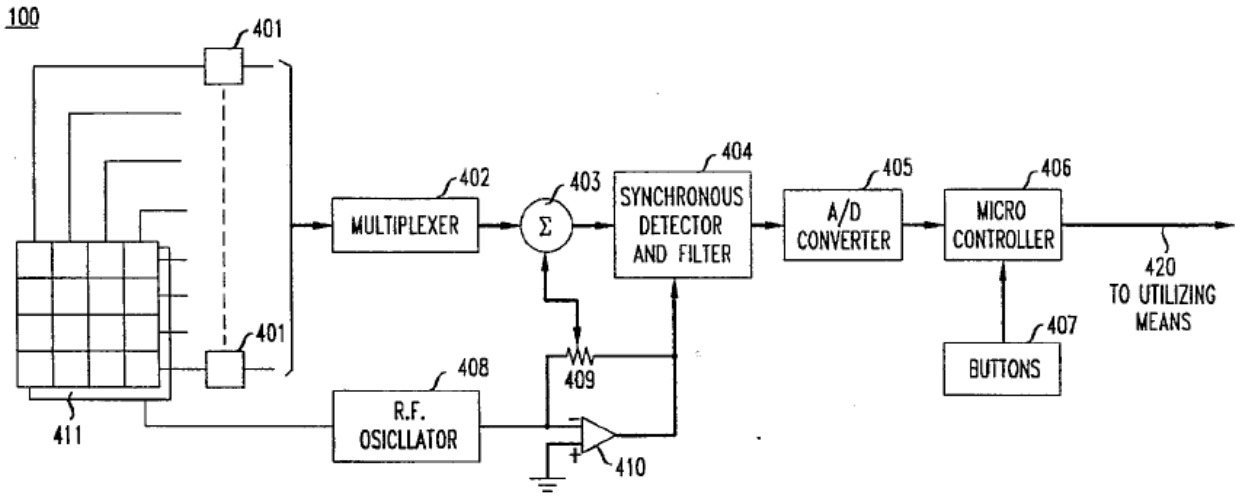
Ex.-1005, Figure 4



Ex.-1005, Figure 11

Alternatively, the '502 Patent acknowledges that the method used to drive a plurality of sensing electrodes substantially synchronously in phase with one another was disclosed in the admitted prior art, such as Boie, which "drive[s] all the rows and columns with a single oscillator simultaneously." Ex.-1001, 8:11-16, 8:16-20 (explaining that" the sensing channels [may be] multiple in-phase charge-transfer sensors of the type described in U.S. Pat. No. 5,730,165 or U.S. Pat. No. 6,466,036"). With reference to Figure 4 below, Boie teaches the use of a synchronous detector (404) and a single RF oscillator that drives the rows and columns of the capacitive sensor (400) in unison with the same RF signal. E.g.,

Ex.-1006, 3:64-4:2, 4:58-61, Fig. 4. A POSITA would have appreciated that Boie discloses a single voltage source for driving the rows and columns of electrodes substantially synchronously in phase with one another. Ex.-1002, ¶ 143.



Ex.-1006, Figure 4

Based on the foregoing disclosures, a POSITA would have understood that the combined disclosures and teaching of Barkan with Marten or Boie render obvious Claims 8 and 21. Id., ¶¶ 141-44.

D. Ground 4: Claim 19 of the '502 Patent Is Rendered Obvious by Barkan in Combination with Boie

1. Motivation to Combine

As previously discussed, in connection with Claims 8 and 21 (Section VII.C.1- VII.C.2), it would have been obvious to a POSITA to incorporate processing elements taught by Boie, including elements or programming that calculate a centroid of touch signals across the rows and columns of the touch pad.

See Sections VII.C.1- VII.C.2; Ex.-1002, ¶¶ 146-47. Boie teaches that the processing circuitry and methods it discloses can be utilized with various touch sensor types and configurations. E.g., Ex.-1006, 2:42-47, 3:37-38, 7:26-44, Figs. 2-4.

A POSITA would have thus understood that the versatile and conventional processing techniques taught by Boie could have been incorporated with the interface of Barkan to yield predictable results and calculate a centroid of capacitance across the rows and columns of the touch sensor. Ex.-1002, ¶¶ 146-47. This could be achieved by simply modifying the programming of the processor in the interface or the utilization mechanism of Barkan to perform a simple calculation of the centroid of capacitance based on signals from the rows and columns of electrodes. Id. This would have been within the knowledge and skills of a POSITA well before July 2005. Id. For these reasons, along with those discussed below, a POSITA would have been motivated to incorporate the processing elements and techniques taught by Boie with the interface of Barkan and would have understood how to do so. Id.

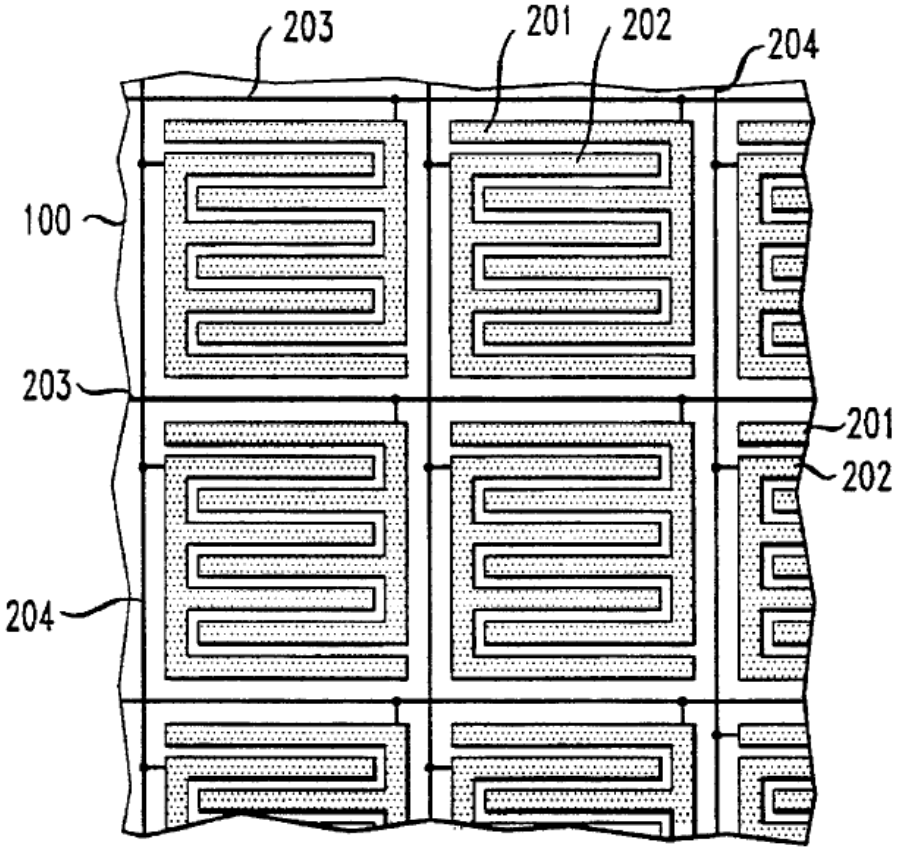
2. Dependent Claim 19

a. [19]: "The method of 17, wherein the processor is operable to calculate a centroid of the signals across rows and a centroid of the signals across columns"

As discussed in Section **Error! Reference source not found.**, Claim 17 is

disclosed or rendered obvious by Barkan, either alone or in combination with Tagg.

Like Barkan, Boie discloses a capacitive sensor with a plurality of electrodes that can be divided into separate horizontal and vertical elements connected in columns and rows as shown in Figure 2 below. E.g., 1006, 1:61-2:5, 3:9-22, Fig. 2. Boie teaches that in this configuration, the capacitances are measured separately for each column and row and the x and y coordinates of the centroid of capacitance are determined in a microcontroller. E.g., id., 1:61-2:5, 3:9-15, 5:10-49 (explaining the method and calculation for determining the centroid of capacitance "[f]or applications in which the electrodes of array 100 are connected in rows and columns, as shown in FIG.2 and FIG. 3"), Figs. 2, 6.



Ex.-1006, Figure 2

Based on the foregoing disclosures, a POSITA would have understood that the combined disclosures and teaching of Barkan and Boie render obvious Claim 19. Ex.-1002, ¶¶ 148-49.

VIII. CONCLUSION

For the reasons set forth above, the invalidity grounds presented above are reasonably likely to prevail, and thus inter partes review should be instituted.

Respectfully Submitted,

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CERTIFICATION OF WORD COUNT

Petitioners certify in reliance on the word count functionality of the word processing system (Microsoft Word 2010) used to prepare this petition, that this petition satisfies the word count requirements of 37 C.F.R. § 42.24(d).

CERTIFICATE OF SERVICE

The undersigned certifies pursuant to 37 C.F.R. § 42.6(e) and § 42.105 that on December 13, 2019, a true and correct copy of this **Petition for Inter Partes Review and Exhibits** was served via express mail on the Patent Owner at the following correspondence address of record:

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