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Stein et al.

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[54] **POSITION SENSING COMPUTER INPUT DEVICE**

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[73] Assignee: **MicroTouch Systems, Inc.**, Wilmington, Mass.

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[22] Filed: **Apr. 30, 1992**

[51] **Int. Cl.**[5] **G01B 7/00**

[52] **U.S. Cl.** **364/550**

[58] **Field of Search** 364/550; 178/19

[56] **References Cited**

U.S. PATENT DOCUMENTS

4,659,874	4/1987	Landmeier	178/19
4,680,429	7/1987	Murdock et al.	178/19
4,686,332	8/1987	Greanias et al.	178/19
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4,795,858	1/1989	Yamazaki	178/19
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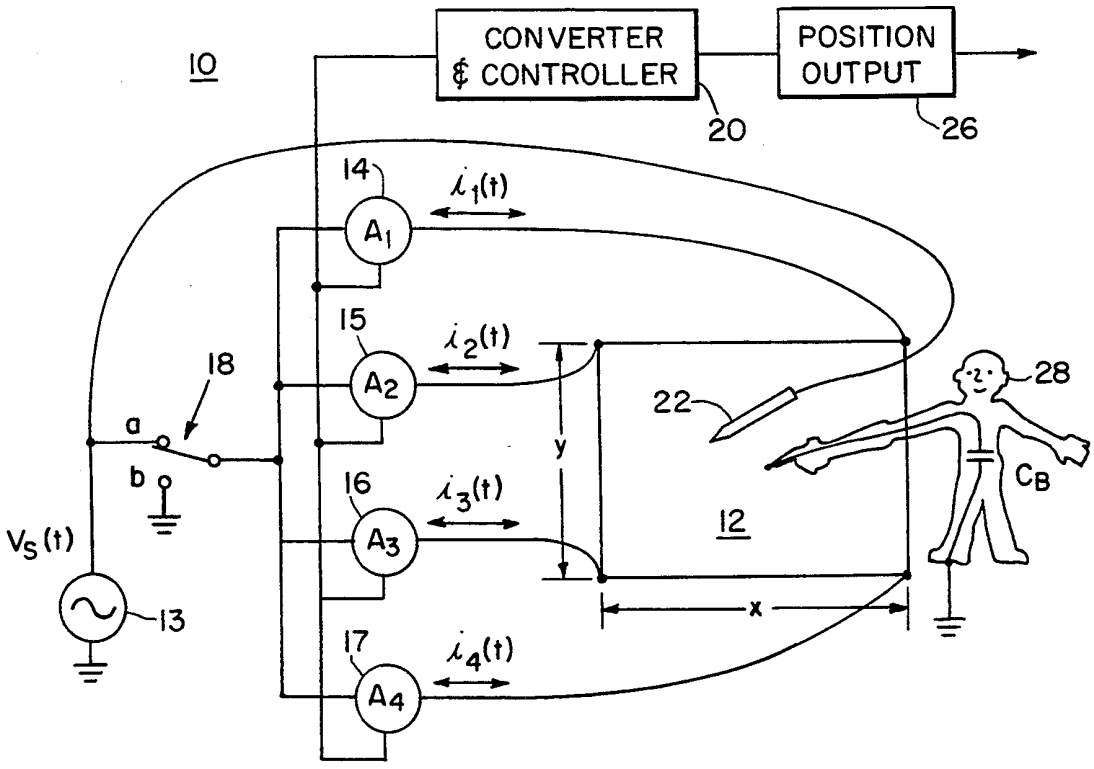
Primary Examiner—Jack B. Harvey
Assistant Examiner—Thomas Peeso
Attorney, Agent, or Firm—Kirk Teska; Joseph S. Iandiorio

[57] **ABSTRACT**

A position sensing computer input device including a sensor with a sensing surface including a conductive sheet on which a human touch and the touch of an inanimate object may both be sensed. The device is able to discriminate between the two types of touch for allowing input with at least one of an inanimate object and a human touch.

31 Claims, 3 Drawing Sheets



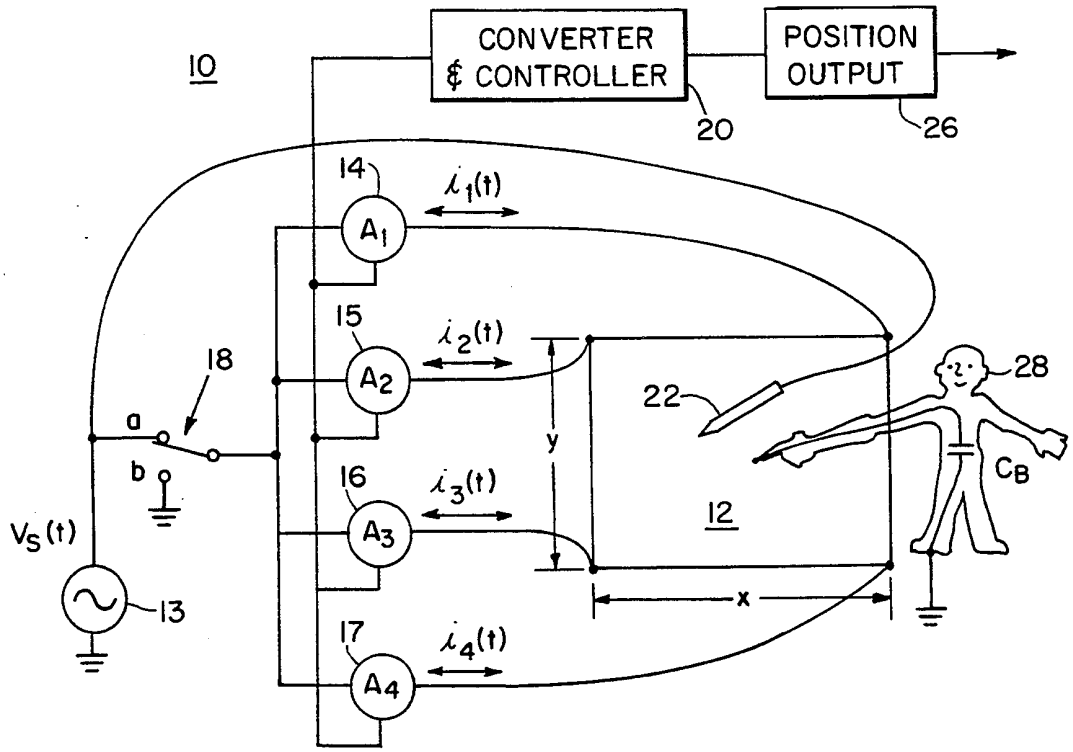


FIG. 1

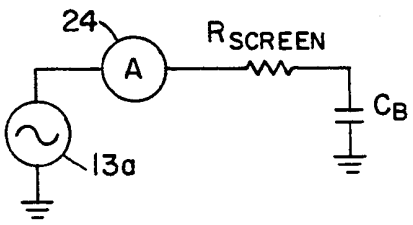


FIG. 2A

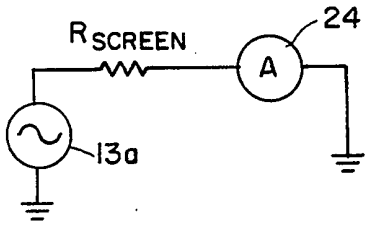


FIG. 2B

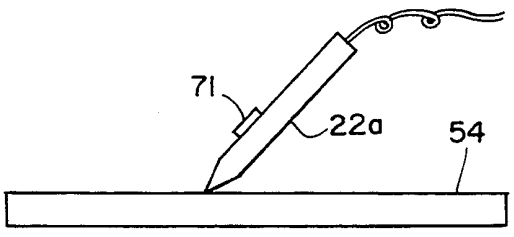


FIG. 5A

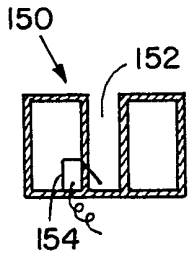


FIG. 5B

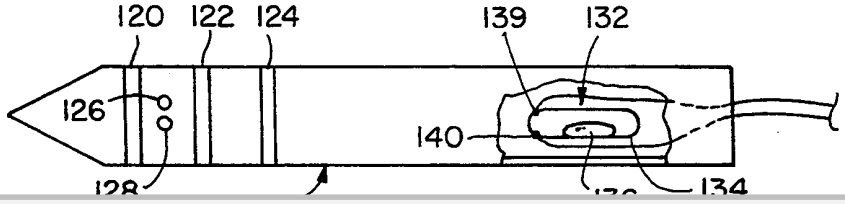


FIG. 5C

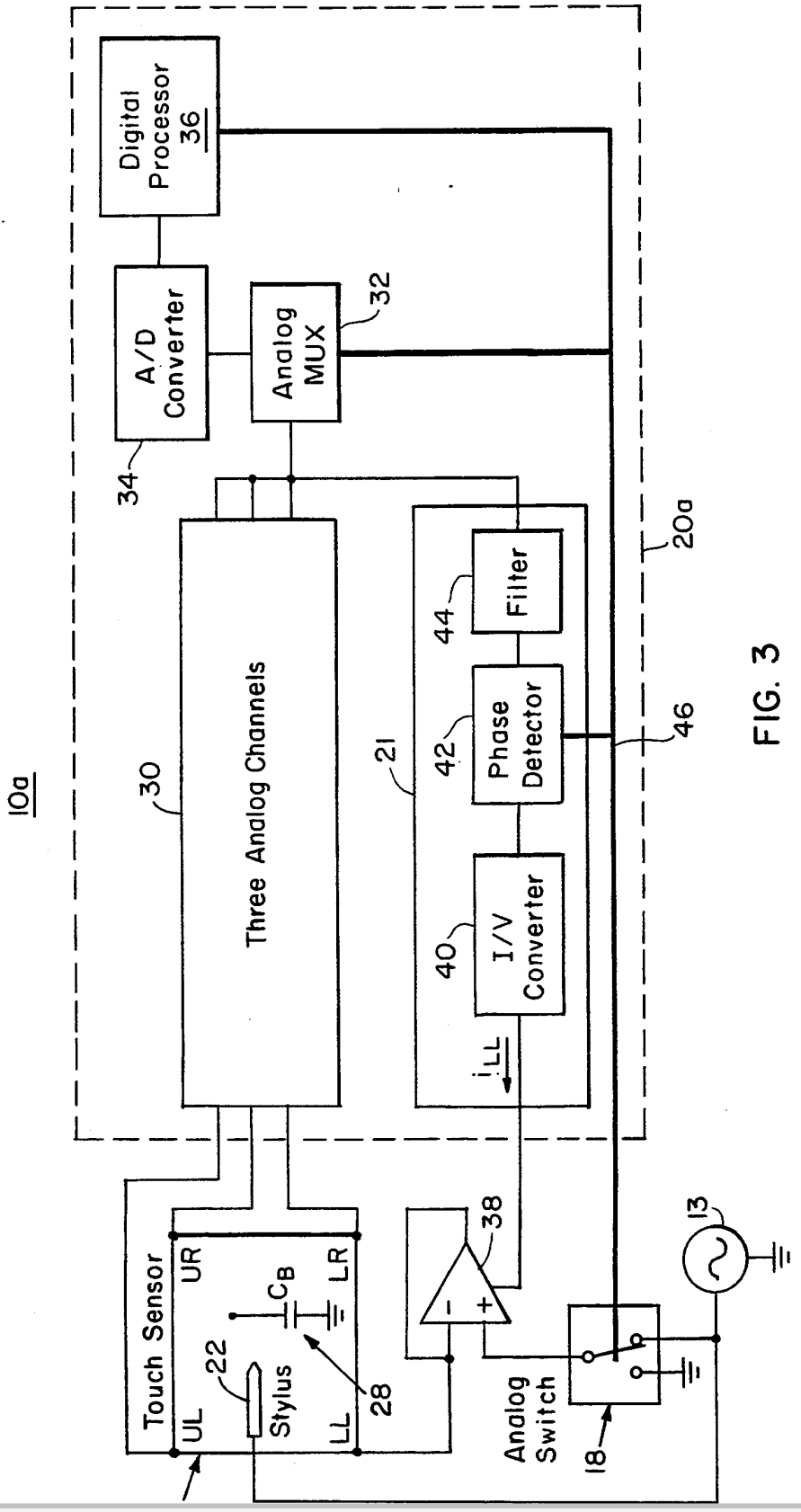
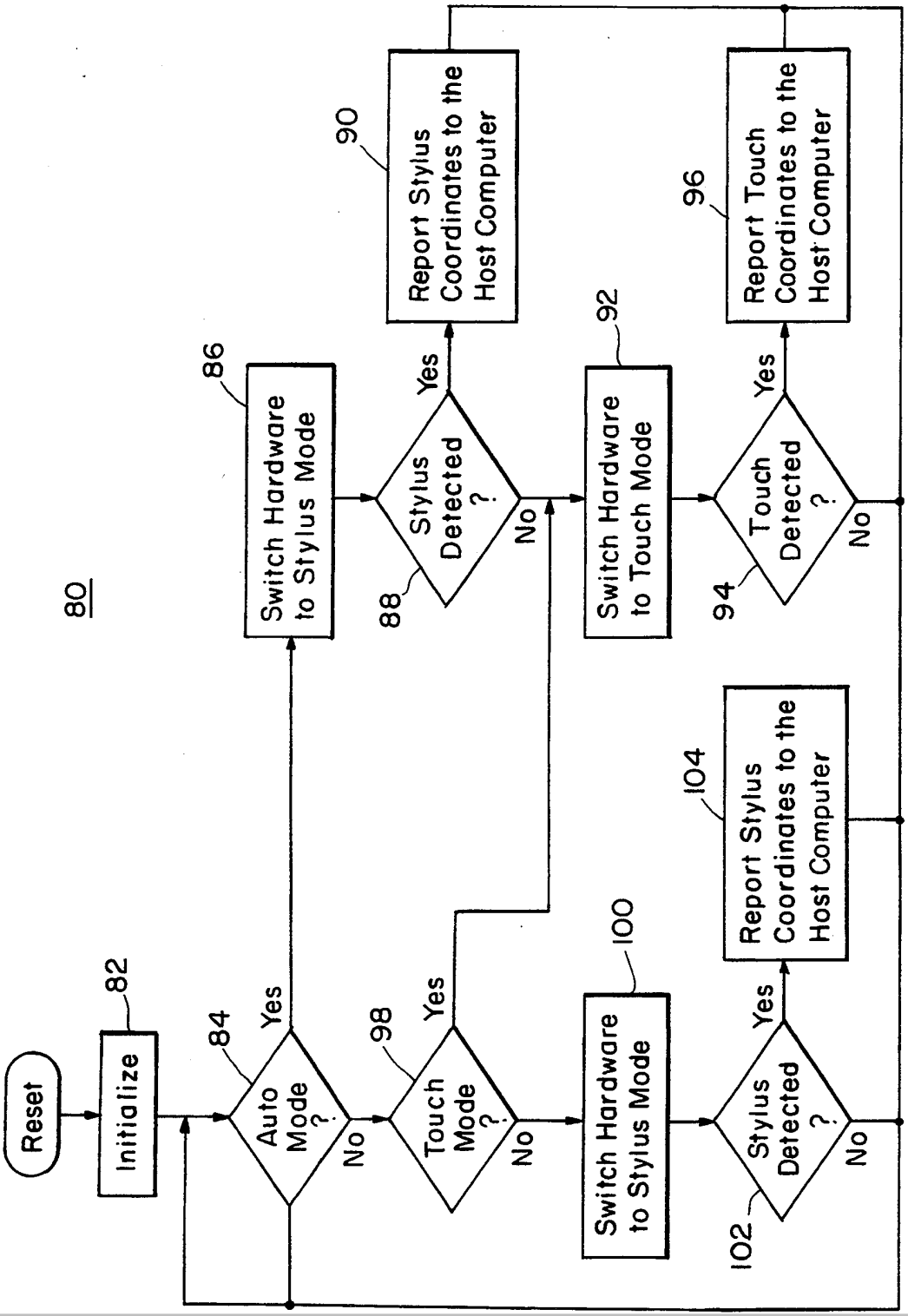


FIG. 3

FIG. 4



POSITION SENSING COMPUTER INPUT DEVICE

FIELD OF INVENTION

This invention relates to a position sensing computer input device which is responsive to both human and stylus touch and which discriminates between the two types of touch for allowing input in either manner with a single sensor device.

BACKGROUND OF INVENTION

There are many types of touch sensitive computer input devices currently used for the purpose of digitizing touch on or in conjunction with computer displays. Such devices measure the position of a stylus or finger touch on the sensor surface. The position is used to generate coordinates for the purpose of interacting with the computer, for example in pointing to icons on the display, picking menu items, editing computer generated images, and feedback for input of hand-drawn characters and graphics.

Such devices which sense a human touch may sense using any number of technologies, including capacitive sensing, resistive sensing using a conductive overlay sheet, infrared sensing, acoustic wave sensing, and piezoelectric force sensing. Digitizers which use corded hand held styli such as pens or pucks typically use electromagnetic sensing, electrostatic sensing, resistive sensing, or sonic pulse sensing.

Devices responsive to human touch are typically used for cursor control application, for example pointing to display icons and picking menu items. Devices that are responsive to styli (usually a corded pen) are used to create or trace drawings, blueprints, or original art. These devices are also used for character or handwriting recognition. It is desirable that the device have a pen and paper feel so that it's use is intuitive to most users. It is therefore desirable that the sensor reproduce the trace of the pen below the stylus by some visual means so that the user has visual feedback.

Some of these devices are responsive to both human touch and stylus touch, thereby providing the convenience of stylus-based input, for example when writing on the screen, as well as the ease of human touch input, which does not require the user to find the stylus and pick it up to use it. However, because these sensors cannot distinguish between human and stylus touch, the user may not touch the screen while using the stylus, or vice versa. Accordingly, in the use of these sensors the operator must take great care, which detracts from their desirability.

Some such devices are used as computer input tablets which, rather than being placed on the face of a display, are placed on the desk top next to the computer, similar to a mouse. Such sensor devices are commonly employed for handwriting recognition, in which they are used as a writing tablet. However, when using such tablets, the operator must painstakingly avoid touching the screen with his finger or hand while writing with the stylus. Accordingly, these devices are rather awkward to use.

One system that has the capability of sensing both stylus and human touch is disclosed in U.S. Pat. No. 4,686,332 (Greanias et al., Aug. 11, 1987). The device uses an X-Y array of discrete conductors in spaced planes to electrostatically detect the position of the stylus; finger touch position is determined by detection of a change in capacitance of the conductors closest to the finger. The two large arrays of closely spaced conductors required for good resolution, however, is difficult to fabricate, requiring etching of two layers of conductive material into parallel conductor patterns, and then careful placement of the layers one over the other to accomplish the spaced X-Y conductor array. Having two layers of conductors over the display also interferes significantly with light transmittance, making the device uncomfortable to use. In addition, each conductor or pair of conductors requires discrete electronic components to make the capacitance measurements, making the device complex and costly. Finally, the requirement of driving the conductors individually results in relatively slow digitization response, unless expensive high-speed drive and sensing circuitry is used.

SUMMARY OF INVENTION

It is therefore an object of this invention to provide a position sensing input device which discriminates between a human and inanimate object touch.

It is a further object of this invention to provide such a device which allows the user to place his hand on the input tablet while writing thereon with a stylus.

It is a further object of this invention to provide such a device which allows the display of the stylus trace on the input device.

It is a further object of this invention to provide such a device in which the sensor is virtually transparent.

It is a further object of this invention to provide such a device with relatively simple and inexpensive circuitry.

It is a further object of this invention to provide such a device that has fast response.

It is a further object of this invention to provide such a device that can digitize up to 200 touch points per second.

It is a further object of this invention to provide such a device that does not require discrete drive and sense components for pairs of conductors.

It is a further object of this invention that it provide a pen and paper feel.

This invention results from the realization that a simple to use, intuitive computer input device may be accomplished by sensing both human and inanimate-object touch, and discriminating between the two, so that the user does not have to meticulously avoid touching the screen when using a stylus, or vice versa.

This invention features a position sensing input device which includes a sensor with a sensing surface that includes a conductive sheet, means for detecting both a human touch and the touch of an inanimate object on the surface, and means for discriminating between the two types of touch to allow input with at least one of an inanimate object and a human touch.

The means for detecting a human touch may include means for supplying current, preferably time-varying, to the conductive surface coating, and may further include means for determining the current flow to the conductive surface responsive to the touch. The detected current may be out of phase with the supply voltage. The input device may further include means for determining the human touch location on the surface and means for determining the inanimate touch location on the surface. In one embodiment, the inanimate object is conductive and may be a corded stylus. In that case, the touch of the conductive object may be

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