# United States Patent [19]

## Mead et al.

[11] **Patent Number:** **5,488,204**

[45] **Date of Patent:** **Jan. 30, 1996**

[54] **PAINTBRUSH STYLUS FOR CAPACITIVE TOUCH SENSOR PAD**

[75] Inventors: **Carver A. Mead**, Pasadena; **Ralph Wolf**, Palo Alto; **Timothy P. Allen**, Los Gatos, all of Calif.

[73] Assignee: **Synaptics, Incorporated**, San Jose, Calif.

[21] Appl. No.: **324,438**

[22] Filed: **Oct. 17, 1994**

### Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 300,630, Sep. 2, 1994, which is a continuation-in-part of Ser. No. 300,387, Sep. 2, 1994, which is a continuation-in-part of Ser. No. 115,743, Aug. 31, 1993, Pat. No. 5,374,787, which is a continuation-in-part of Ser. No. 895,934, Jun. 8, 1992, abandoned.

[51] **Int. Cl.$^6$** ..................................................... **G08C 21/00**

[52] **U.S. Cl.** ............................................... **178/18**; 345/179

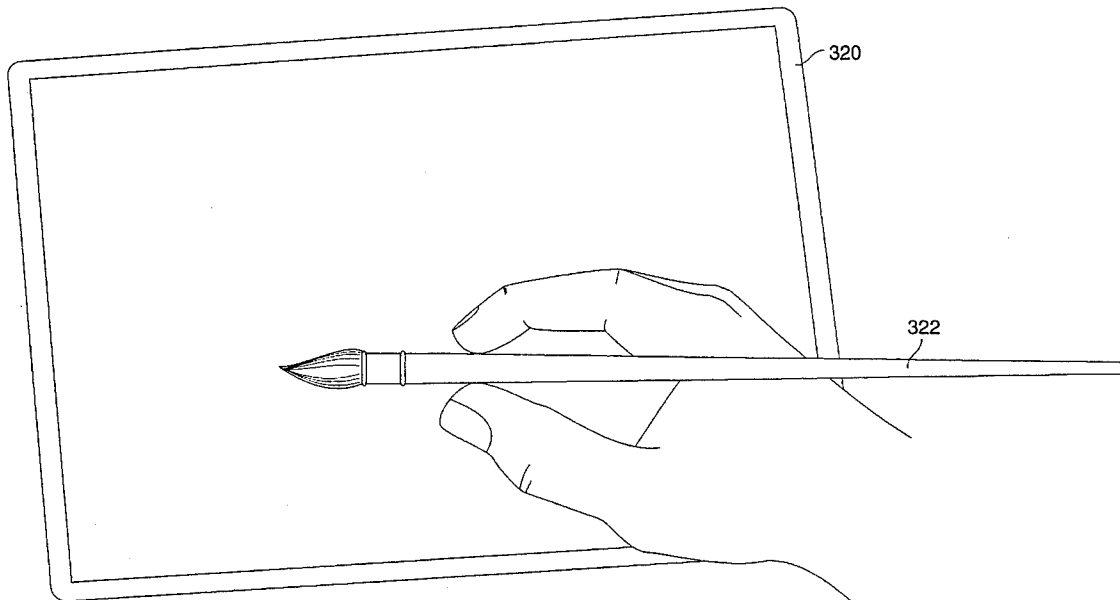[58] **Field of Search** ................................. 178/12, 19, 20, 178/87; 345/173, 174, 175, 179, 180, 181; 341/5; 382/3, 13; 355/27, 266; 395/117, 118, 122

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[57] **ABSTRACT**

A proximity sensor system includes a touch-sensor pad with a sensor matrix array having a characteristic capacitance on horizontal and vertical conductors connected to sensor pads. The capacitance changes as a function of the proximity of an object or objects to the sensor matrix. The change in capacitance of each node in both the X and Y directions of the matrix due to the approach of an object is converted to a set of voltages in the X and Y directions. These voltages are processed by circuitry to develop electrical signals representative of the centroid of the profile of the object, i.e, its position in the X and Y dimensions. Noise reduction and background level setting techniques inherently available in the architecture are employed. A conductive paintbrush-type stylus is used to produce paint-like strokes on a display associated with the touch-sensor pad.

**11 Claims, 17 Drawing Sheets**

ΔX

ΔY

VIRTUAL BUTTON

18

MOTION UNIT

20

GESTURE UNIT

16

ARITH. UNIT

X

Y

Z

6

12

X INPUT PROCESSING

14

Y INPUT PROCESSING

10

8

*FIG. 1*

30 30 30 30 30 30 30 30 30 30 30 30 30 30 30
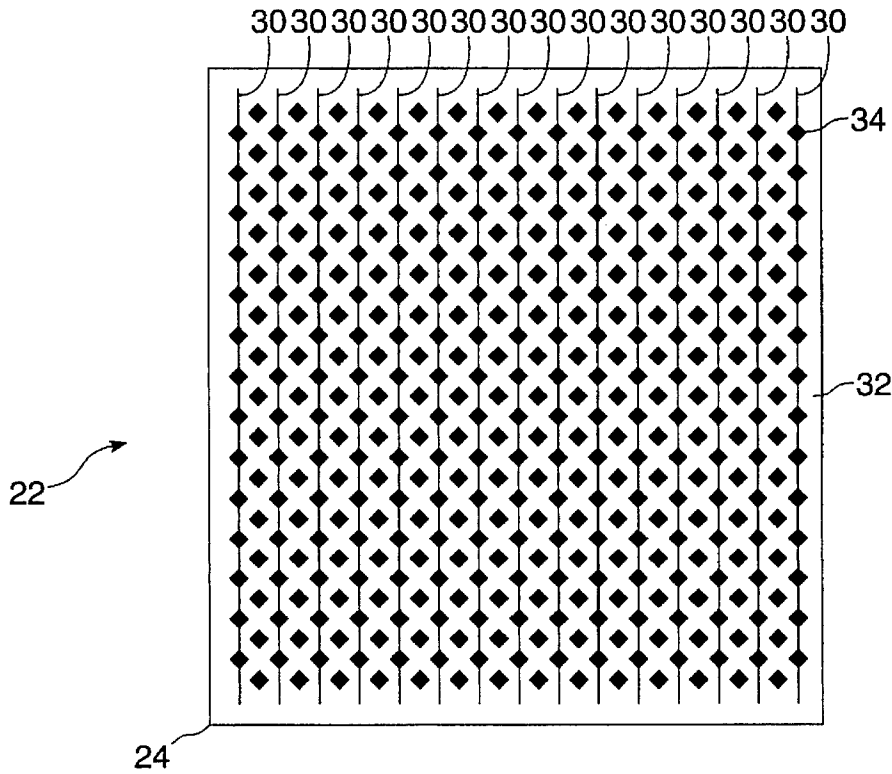
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*FIG. 2A*

24  28  34

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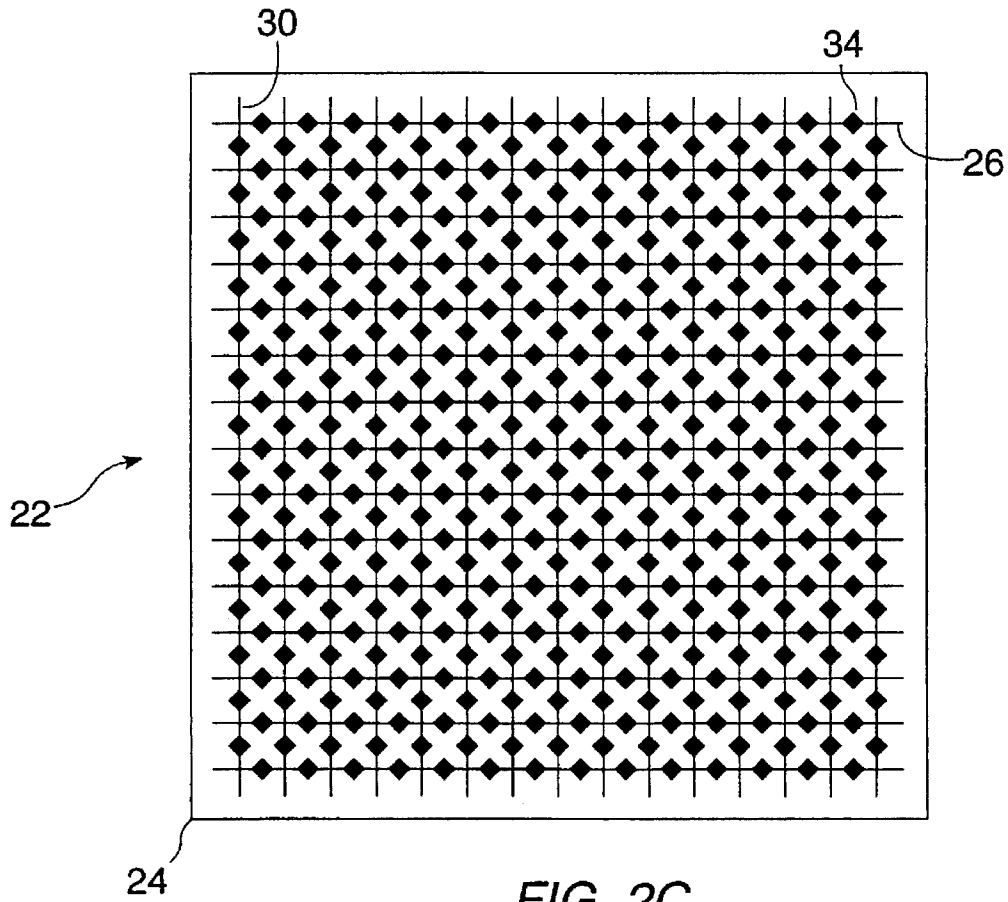26
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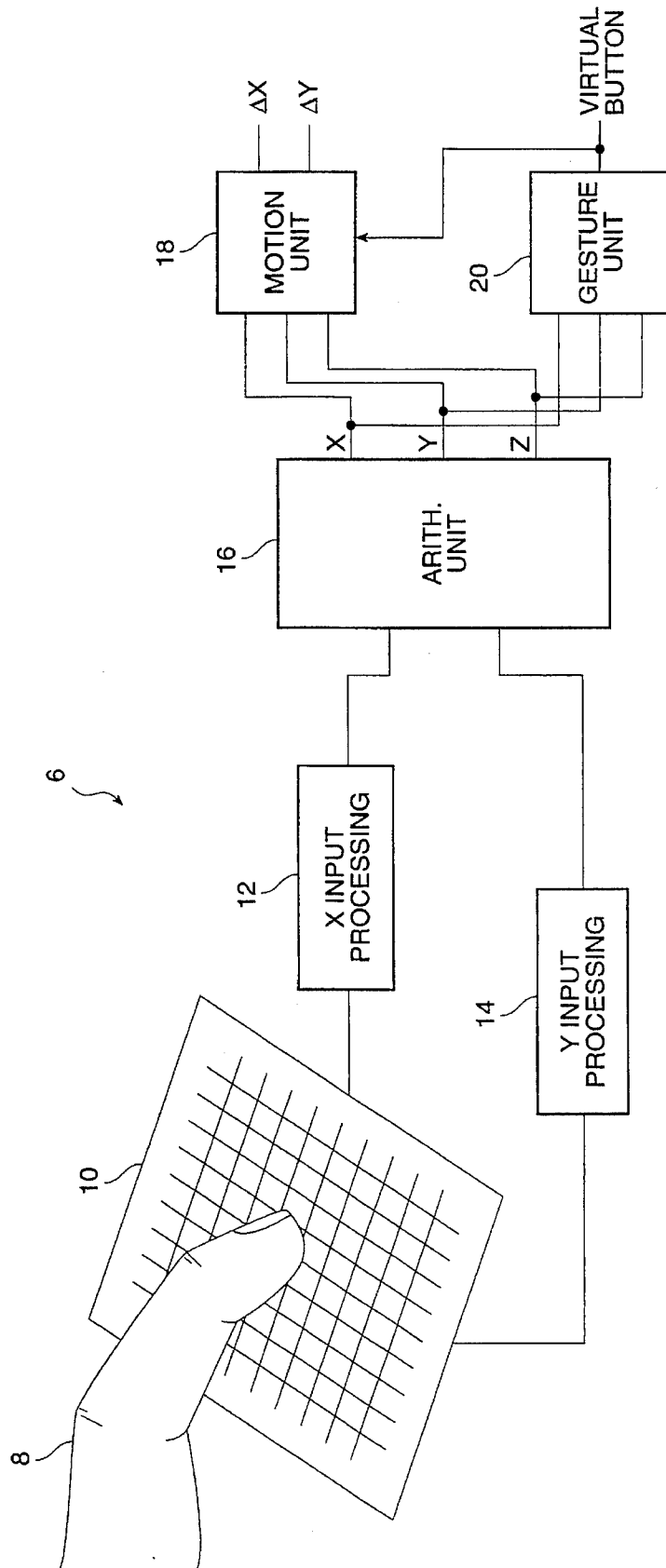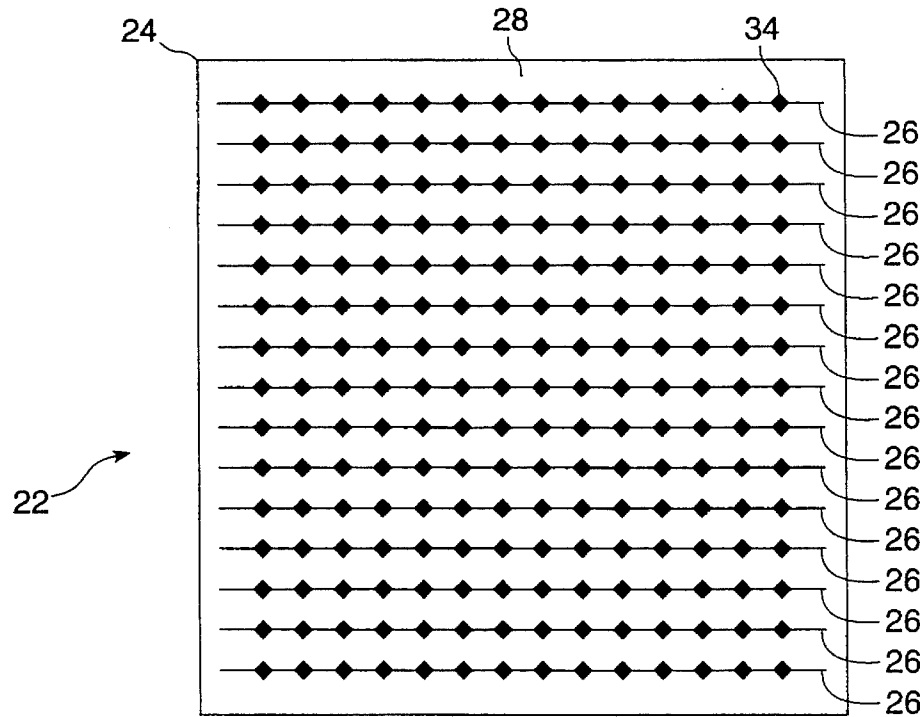
*FIG. 2B*

FIG. 2C



FIG. 2D

*FIG. 3*

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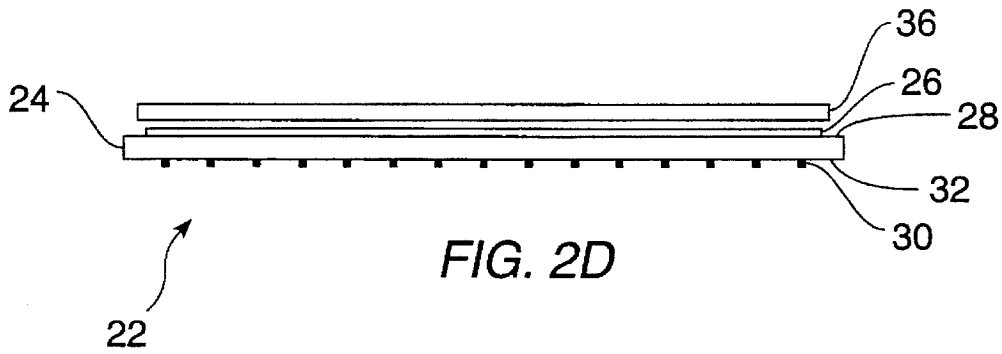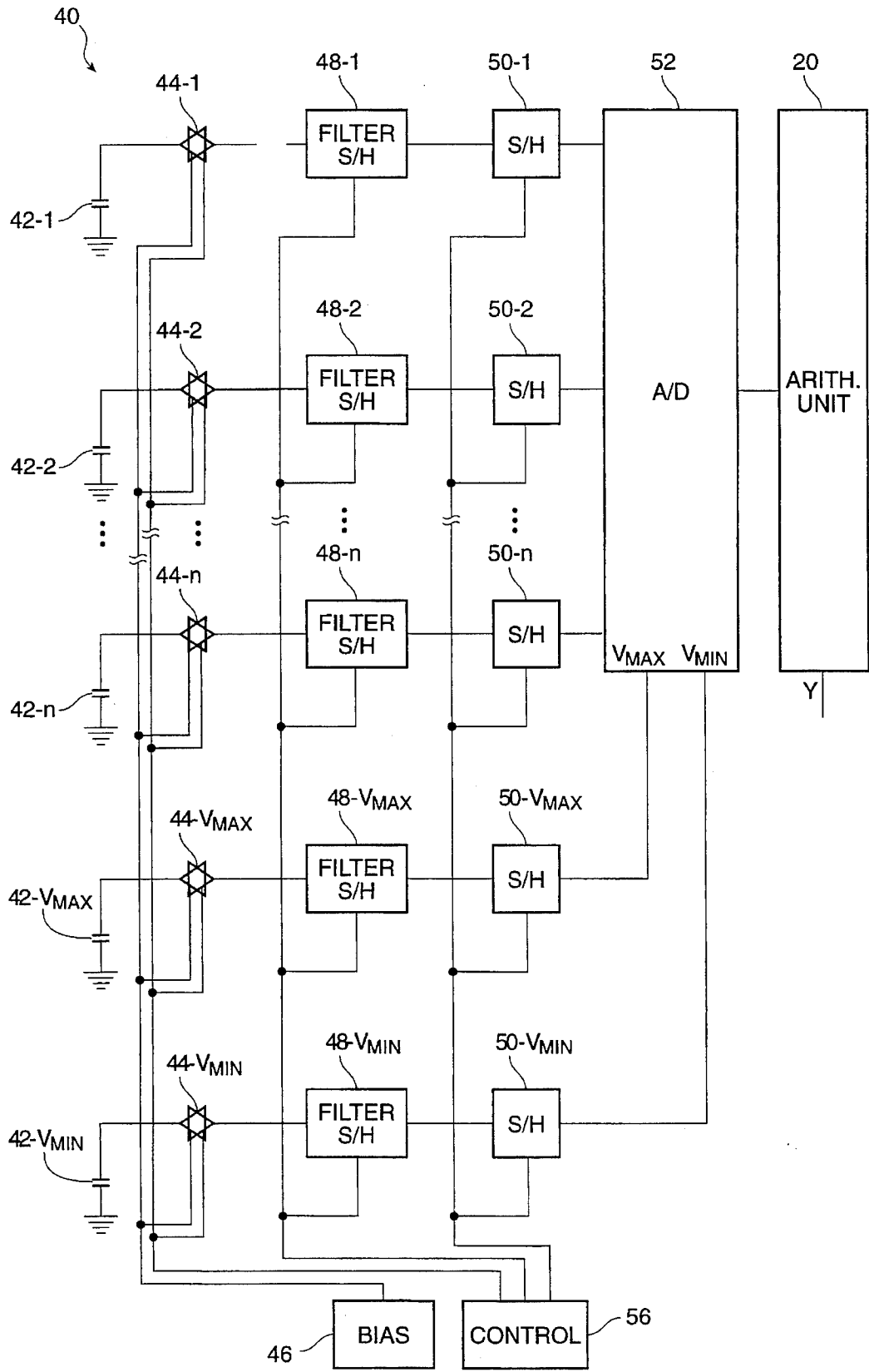
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