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United States Patent [19]

[11] Patent Number: **5,708,460**

Young et al.

[45] Date of Patent: **Jan. 13, 1998**

[54] TOUCH SCREEN

[57] ABSTRACT

[75] Inventors: **Thomas M. Young**, Oakland; **William Martin Becker**, San Carlos; **Joseph Shamash**, Orinda, all of Calif.

A touch screen or touch panel wherein there is a monitoring of relative distribution of force via one or more, preferably symmetrically positioned, sensors such as strain gage sensors. The strain gage sensors are positioned such that bending strain on the touch screen, engendered by touch, is detected by the one or more strain gages and accurately measured by an electronic controller, connected to the strain gage(s). The electronic controller, or associated hardware, is programmed to relate relative bending force to a unique position on the screen and is a charge balancing and multiplying analog-to-digital converter which provides accurate position determination, even with very low forces and with very minor differentiation in position related forces. A sum and divide analog-to-digital converter uses charge balancing and integration, with the balance charge coming from the plus and minus sum of the corners (wherein four sensors are positioned at the corners of a square or rectangular display), and the input signal is the difference between two sides of the display panel. This, in effect, results in the input signal being divided by the sum signal and the sum of charge counts over a fixed interval, resulting in the output value and unique position determination. A unique mounting structure for flat panel displays includes using the flat panel as the bending beam and wherein a circuit board mounted behind the flat panel transmits forces to sensors mounted on the circuit board.

[73] Assignee: **AVI Systems, Inc.**, Oakland, Calif.

[21] Appl. No.: **460,647**

[22] Filed: **Jun. 2, 1995**

[51] Int. Cl.⁶ **G09G 5/00**

[52] U.S. Cl. **345/173; 345/174; 178/18**

[58] Field of Search **345/173, 174; 178/18, 19**

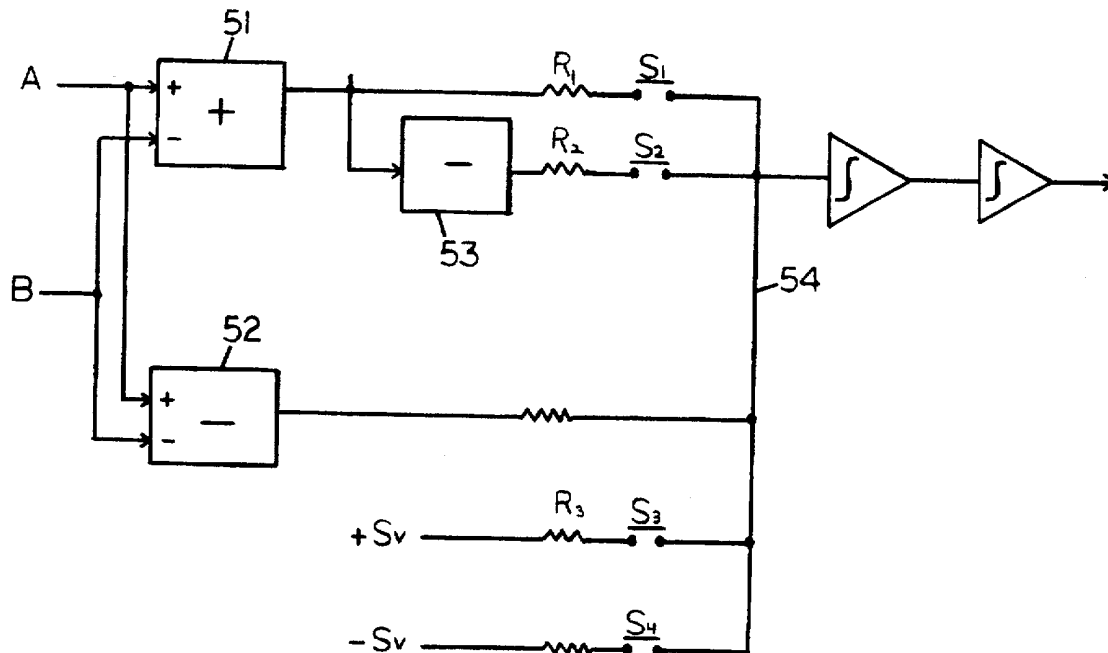
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18 Claims, 5 Drawing Sheets



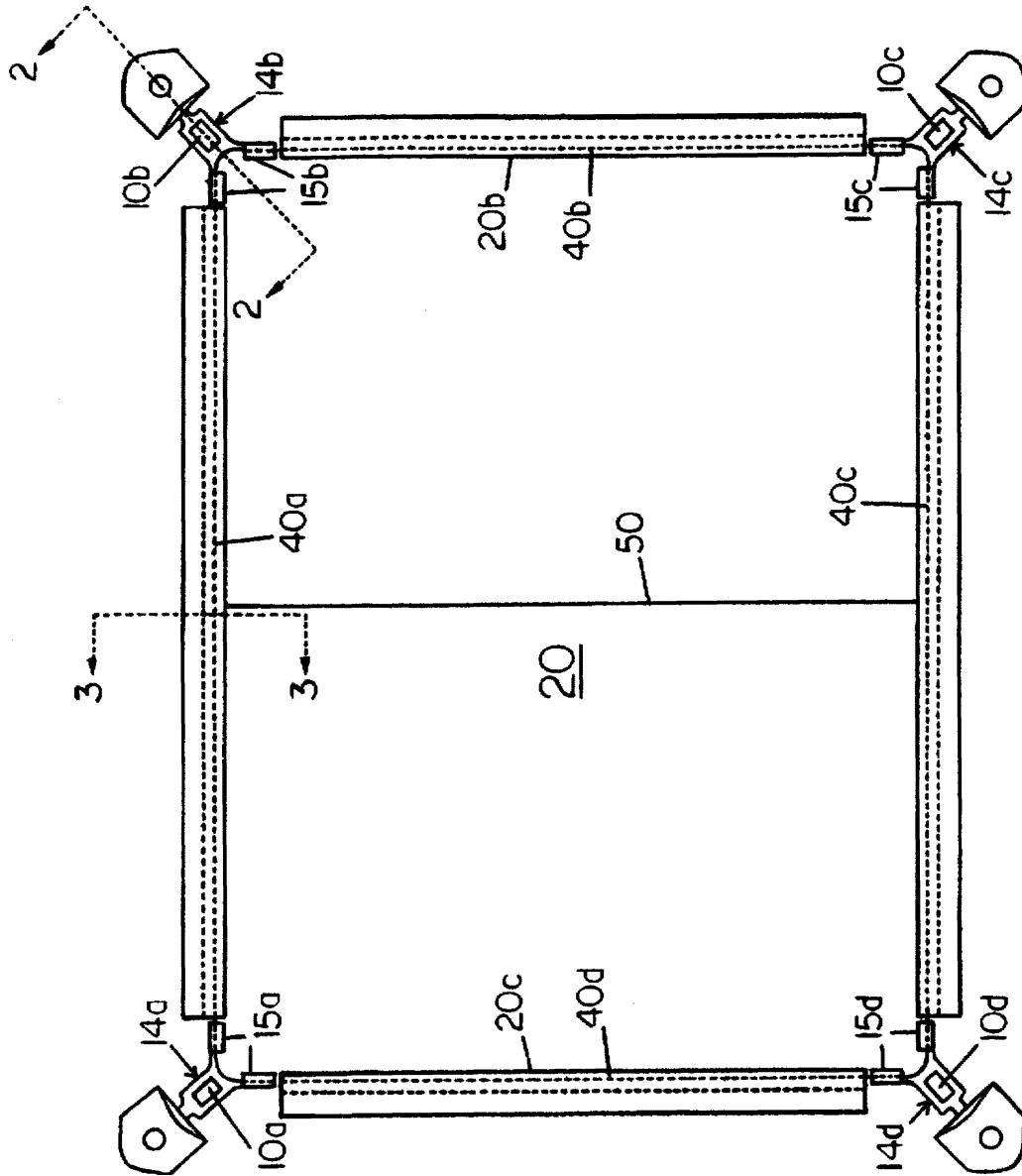


FIGURE 1

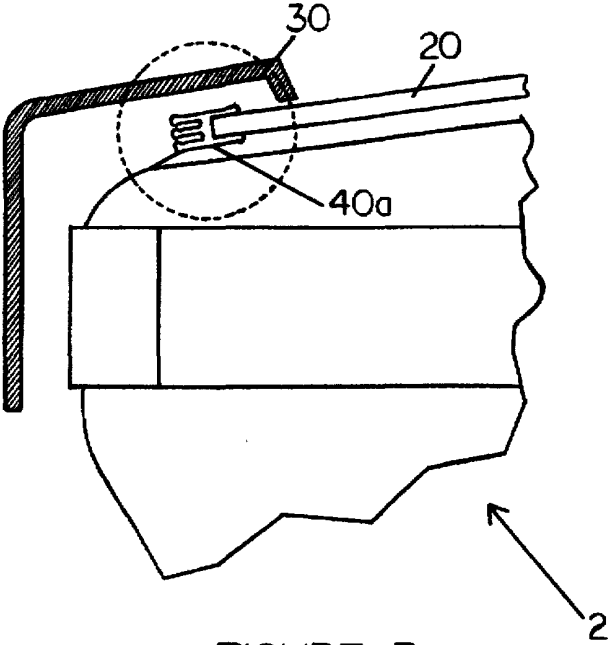


FIGURE 3

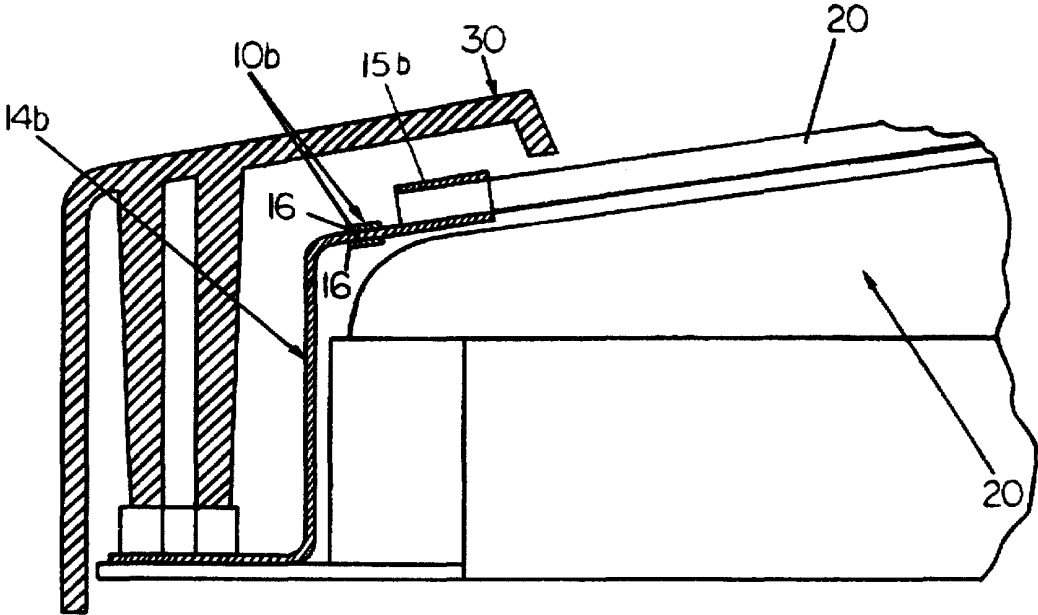


FIGURE 2

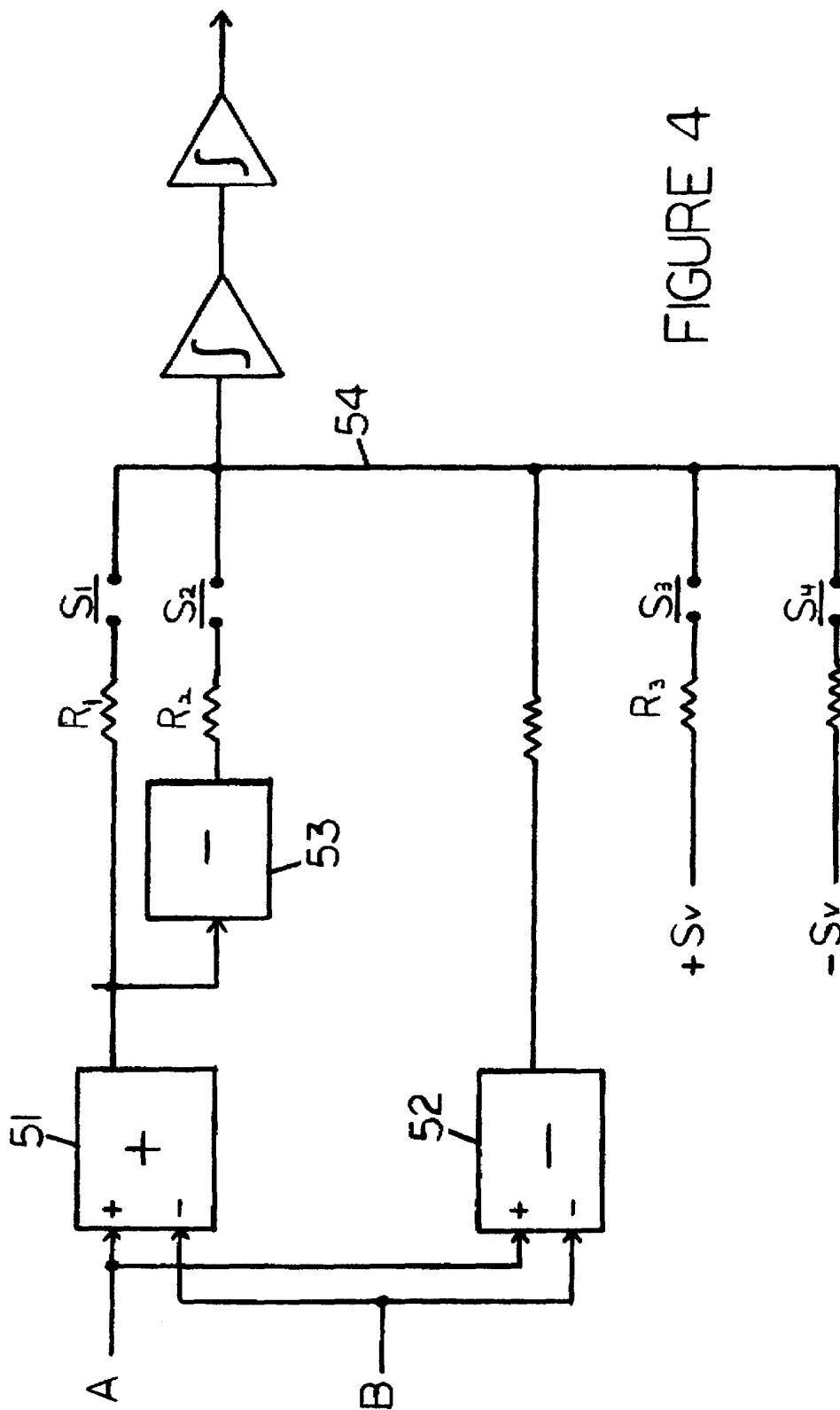


FIGURE 4

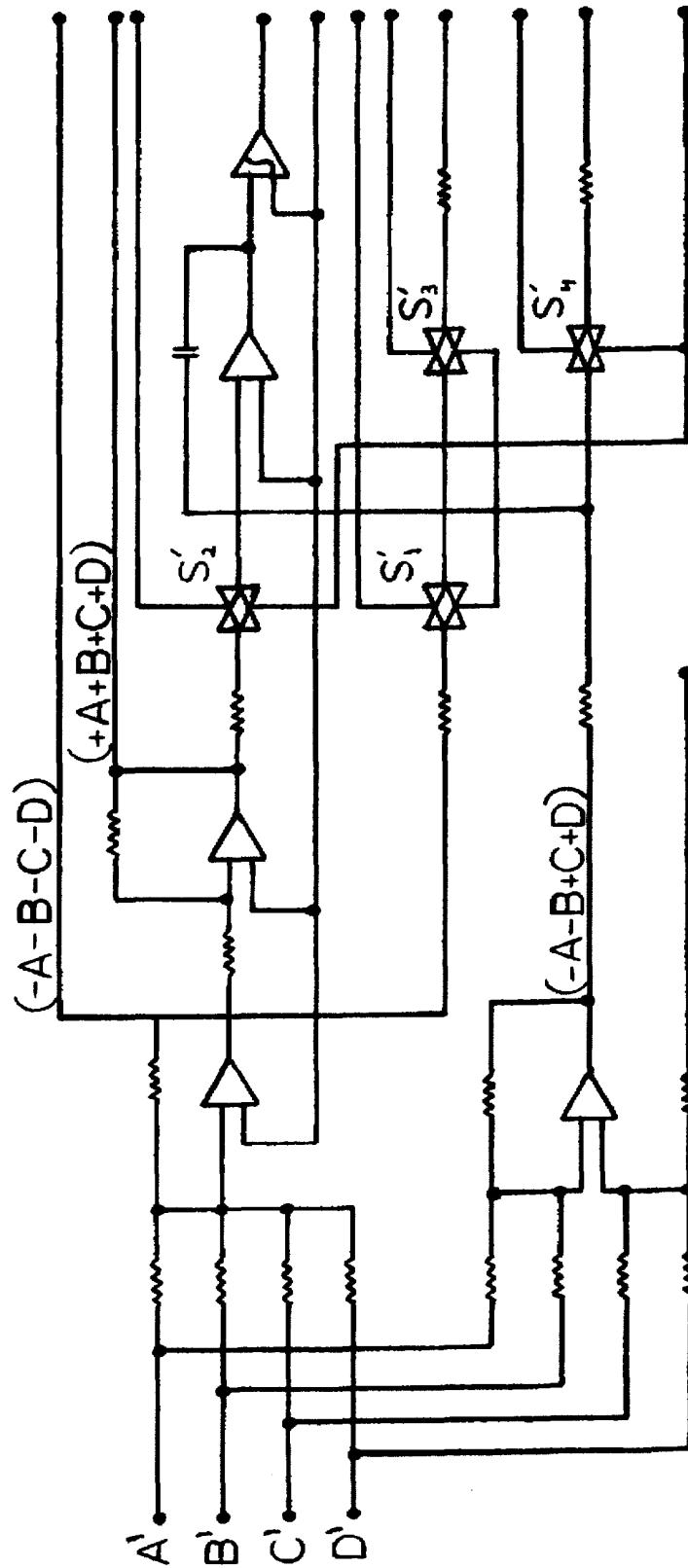


FIGURE 5

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