



US005572205A

United States Patent [19]

Caldwell et al.

[11] Patent Number: **5,572,205**

[45] Date of Patent: **Nov. 5, 1996**

[54] **TOUCH CONTROL SYSTEM**

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[73] Assignee: **Donnelly Technology, Inc.**, Holland, Mich.

[21] Appl. No.: **40,188**

[22] Filed: **Mar. 29, 1993**

[51] Int. Cl.⁶ **H03K 17/955**

[52] U.S. Cl. **341/33; 341/26; 345/168; 200/600; 361/181; 219/451**

[58] Field of Search **341/20, 22, 26, 341/33; 200/600; 345/168, 173; 331/65; 361/181; 291/451, 464**

4,405,918	9/1983	Wall et al.	340/365 C
4,413,252	11/1983	Tyler et al.	341/33
4,439,647	3/1984	Calandrello et al.	200/5 A
4,446,350	5/1984	Mizukawa et al.	219/10.77
4,495,485	1/1985	Smith	341/33
4,527,049	7/1985	Thomas et al.	219/449
4,529,968	7/1985	Hilsum et al.	340/365 C
4,550,310	10/1985	Yamaguchi et al.	341/33
4,561,002	12/1985	Chiu	341/33
4,567,470	1/1986	Yoshikawa et al.	341/33
4,614,937	9/1986	Poujois	341/33
4,651,133	3/1987	Ganesan et al.	341/33
4,665,324	5/1987	Ogino et al.	307/126
4,709,228	11/1987	Hucking et al.	340/365 E

(List continued on next page.)

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[56] **References Cited**

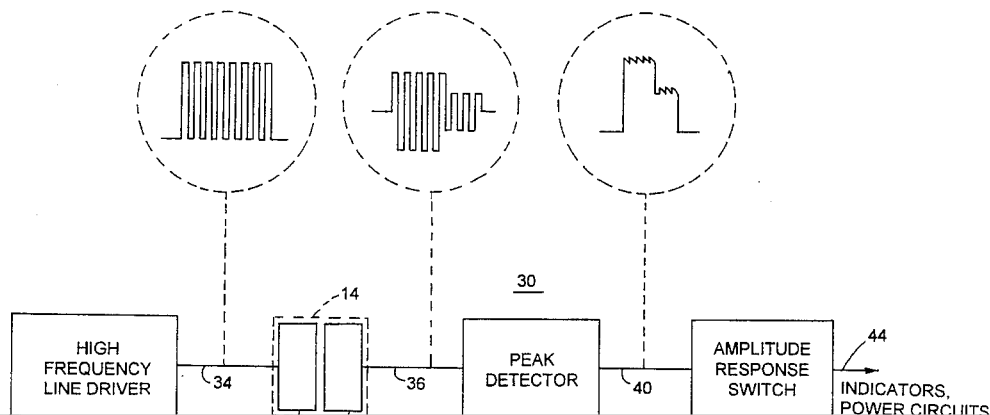
U.S. PATENT DOCUMENTS

3,846,791	11/1974	Foster	340/365 C
3,971,013	7/1976	Challoner et al.	340/337
3,974,472	8/1976	Gould et al.	341/33
4,056,699	11/1977	Jordan	341/33
4,090,092	5/1978	Serrano	307/116
4,119,864	10/1978	Petrazio	307/116
4,123,631	10/1978	Lewis	341/33
4,136,291	1/1979	Waldron	307/308
4,145,748	3/1979	Eichelberger et al.	364/862
4,159,473	6/1979	Senk	340/565
4,161,766	7/1979	Castleberry et al.	361/281
4,175,239	11/1979	Sandler	307/116
4,203,280	5/1980	Ziegler et al.	368/187
4,211,915	7/1980	Miller et al.	371/15
4,237,421	12/1980	Waldron	307/116
4,246,533	1/1981	Chiang	323/349
4,263,659	4/1981	Hirata et al.	341/33
4,290,052	9/1981	Eichelberger et al.	341/33
4,291,303	9/1981	Cutler et al.	341/33
4,304,976	12/1981	Gottbreht et al.	341/33
4,308,443	12/1981	Tucker et al.	219/10.49 R
4,323,829	4/1982	Witney et al.	341/33
4,380,040	4/1983	Posset	361/280
4,394,643	7/1983	Williams	341/33
4,400,758	8/1983	Frame	361/290
4,405,917	9/1983	Chai	340/365 C

[57] **ABSTRACT**

A touch control system that is responsive to a user input selection includes an electrically non-conducting substrate, such as glass ceramic, and at least one capacitive-responsive touch pad on the substrate. A source signal having a primary frequency that is greater than 150 kHz, and preferably in the range of between 150 kHz and 500 kHz, is applied to one portion of the touch pad. The touch pad couples the electrical signal to another portion of the touch pad in order to develop a detection signal, which is decoded in order to determine the presence of the capacitance of a user. The decoder preferably includes a peak detector composed of a low gain circuit in order to avoid distortion of the detection signal. Greatly improved performance in the presence of liquids, such as water, on the touch pad is provided. This is especially useful when the touch pad is applied to a horizontal surface, such as a cook top, upon which liquid spills may occur. A display is juxtaposed with the glass ceramic substrate and an optical correction material is provided between the display and the underlying modulated surface that imparts mechanical strength to the substrate. The optical correction material corrects optical distortion of the visual indications of the display caused by the modulated surface.

60 Claims, 4 Drawing Sheets



U.S. PATENT DOCUMENTS

4,712,163	12/1987	Oxley	362/29	4,920,343	4/1990	Schwartz	341/33
4,731,694	3/1988	Grabner et al.	361/280	4,924,222	5/1990	Antikidis et al.	341/33
4,736,190	4/1988	Fiorella	341/32	4,954,823	9/1990	Binstead	341/26
4,740,781	4/1988	Brown	341/33	4,983,812	1/1991	Worrall et al.	219/451
4,743,895	5/1988	Alexander	341/33	5,012,124	4/1991	Hollaway	341/22
4,794,233	12/1988	Goessler et al.	219/464	5,153,572	10/1992	Caldwell et al.	341/24
4,855,550	8/1989	Schultz, Jr.	280/600	5,155,338	10/1992	Hoffmann	219/451
4,894,493	1/1990	Smith et al.	200/600	5,157,273	10/1992	Medendorp et al.	307/147
4,901,074	2/1990	Sinn et al.	341/22	5,183,996	2/1993	Hazan et al.	219/452
4,914,553	4/1990	Hamada et al.	362/32	5,189,417	2/1993	Caldwell et al.	341/26
				5,270,710	12/1993	Gaultier et al.	741/33

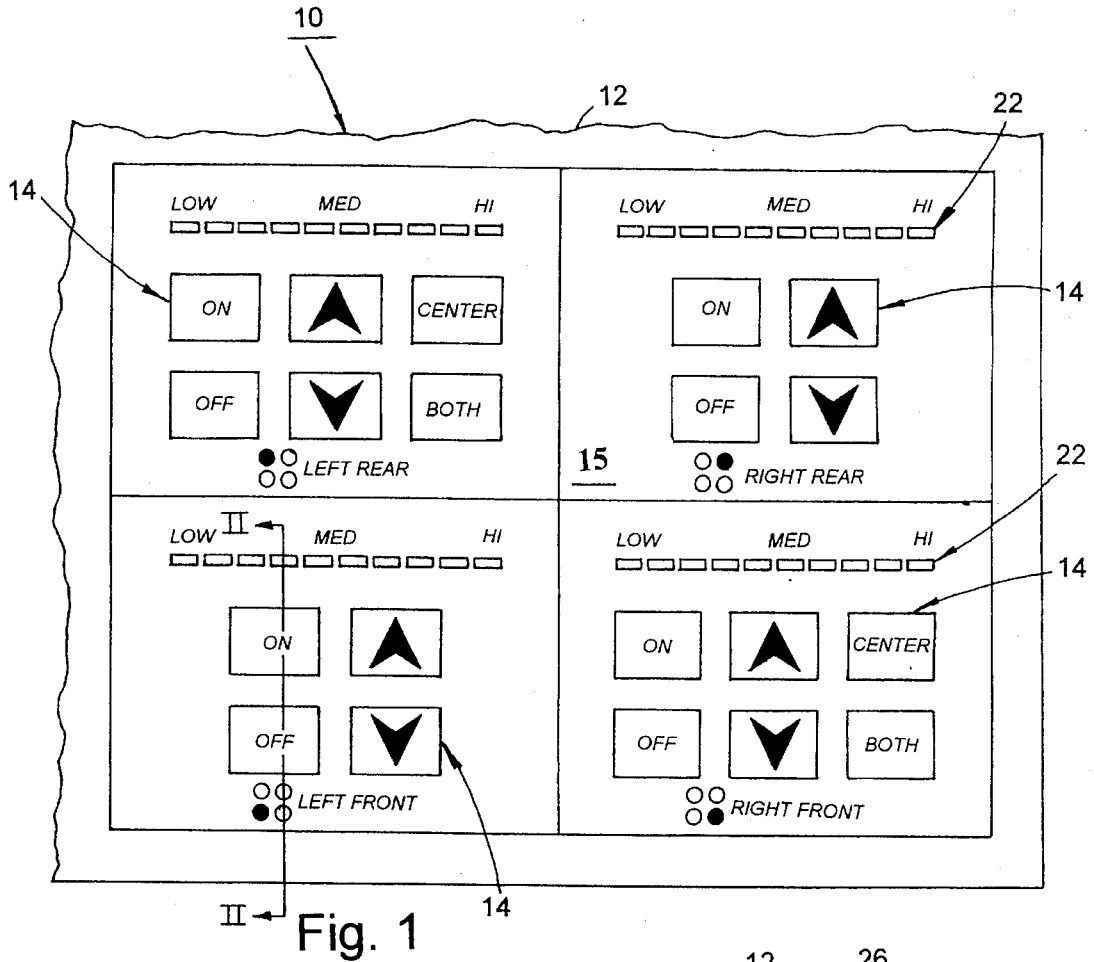


Fig. 1

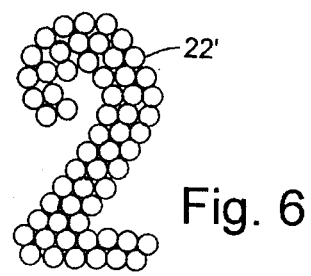


Fig. 6

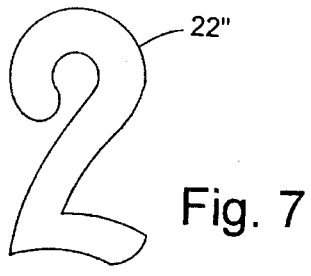


Fig. 7

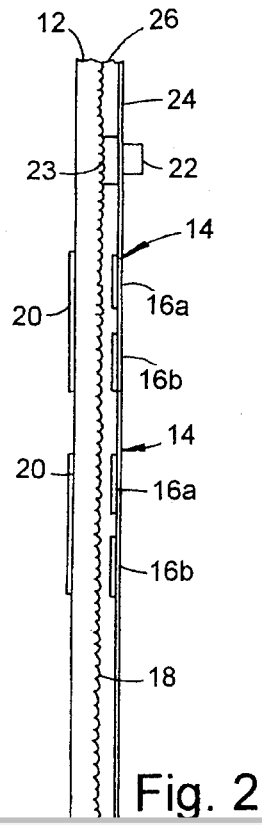


Fig. 2

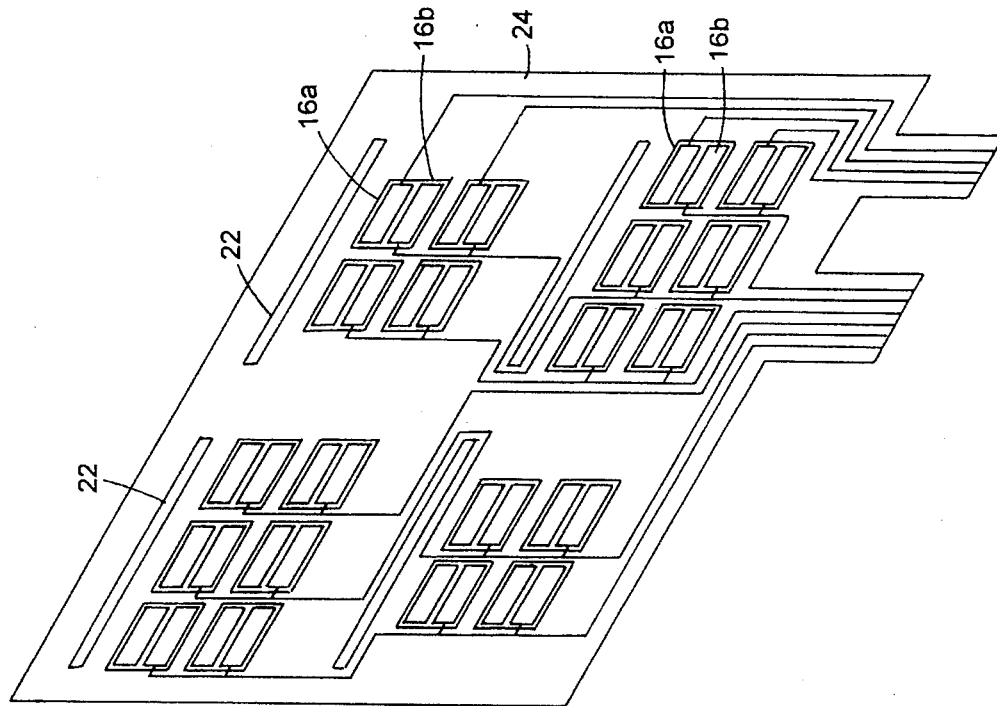
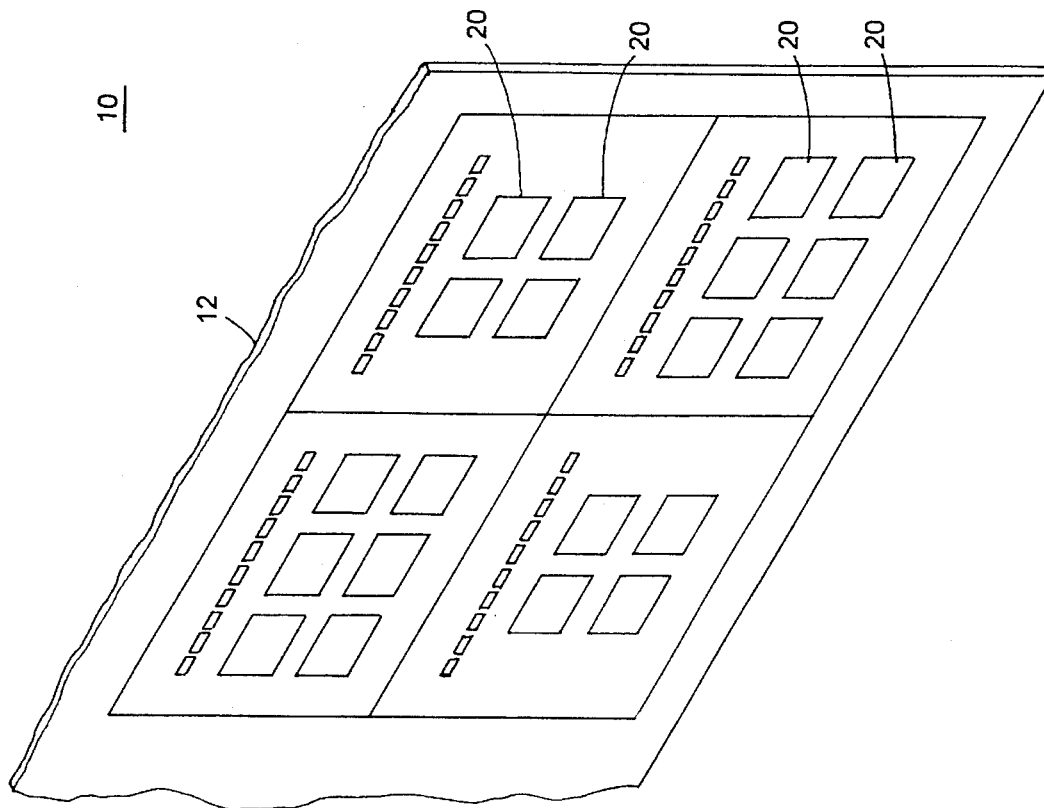


Fig. 3



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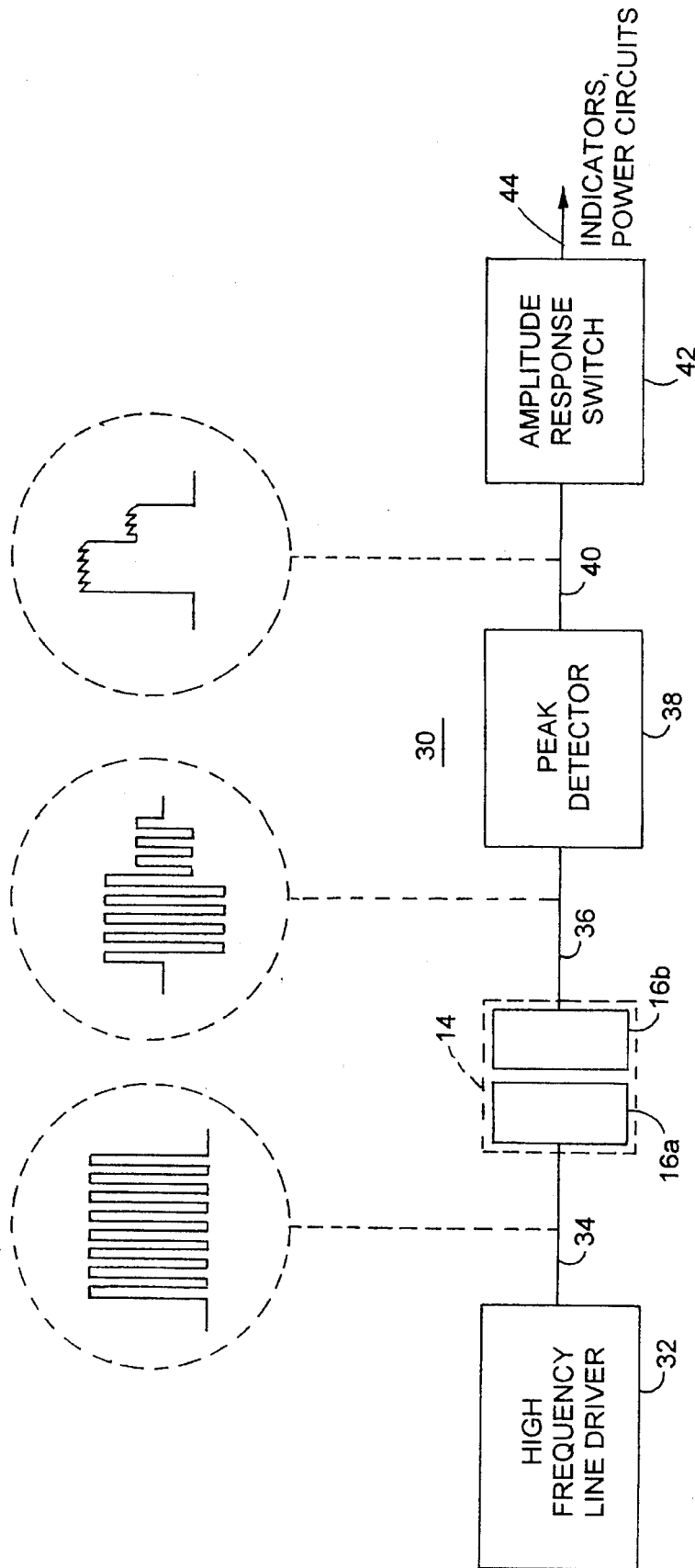


Fig. 4

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