



US006456477B1

(12) **United States Patent**
McIntosh et al.

(10) **Patent No.:** **US 6,456,477 B1**
(45) **Date of Patent:** **Sep. 24, 2002**

(54) **LINEAR CAPACITANCE DETECTION
CIRCUIT**

(76) Inventors: **Robert B. McIntosh**, 309 Vassar Rd.,
Alexandria, VA (US) 22314; **Winfield
Hill**, 36 Hall Rd., Stoncham, MA (US)
02180

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/482,119**

(22) Filed: **Jan. 13, 2000**

Related U.S. Application Data

(62) Division of application No. 09/037,733, filed on Mar. 10,
1998, now Pat. No. 6,151,967.

(51) **Int. Cl.**⁷ **H01H 73/00**

(52) **U.S. Cl.** **361/115; 301/15; 301/278;**
301/283.4

(58) **Field of Search** 361/15, 115, 18,
361/278, 280, 283.4

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,646,433	A	*	2/1972	Eilersen	.....	324/60
3,863,147	A	*	1/1975	Erath	.....	324/60
4,563,634	A	*	1/1986	Lehle	.....	324/61 R
4,634,965	A	*	1/1987	Foote	.....	324/60
4,785,664	A	*	11/1988	Reebs	.....	73/290
5,019,783	A	*	5/1991	Cadwell	.....	324/662
5,294,889	A	*	3/1994	Heep et al.	.....	324/678
5,399,980	A	*	3/1995	Rashford	.....	324/678
5,406,137	A	*	4/1995	Scheler et al.	.....	327/509
5,428,352	A	*	6/1995	Bennett	.....	340/870.37

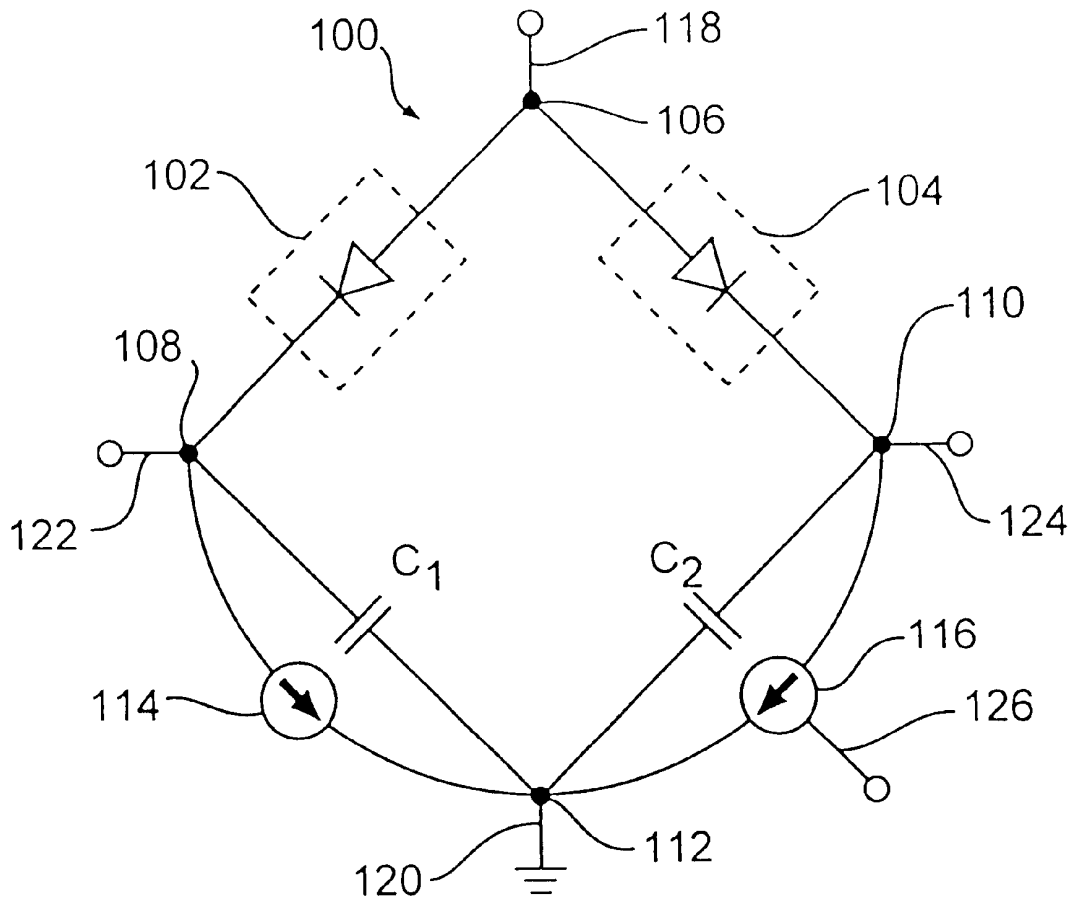
* cited by examiner

Primary Examiner—Stephen W. Jackson

(57) **ABSTRACT**

A differential transconductance amplifier detects changes of
the variable capacitor in a low-impedance, bridge circuit and
feeds back current to balance the bridge. The voltage that
controls the feedback current is proportional to capacitance
over a wide dynamic range.

22 Claims, 13 Drawing Sheets



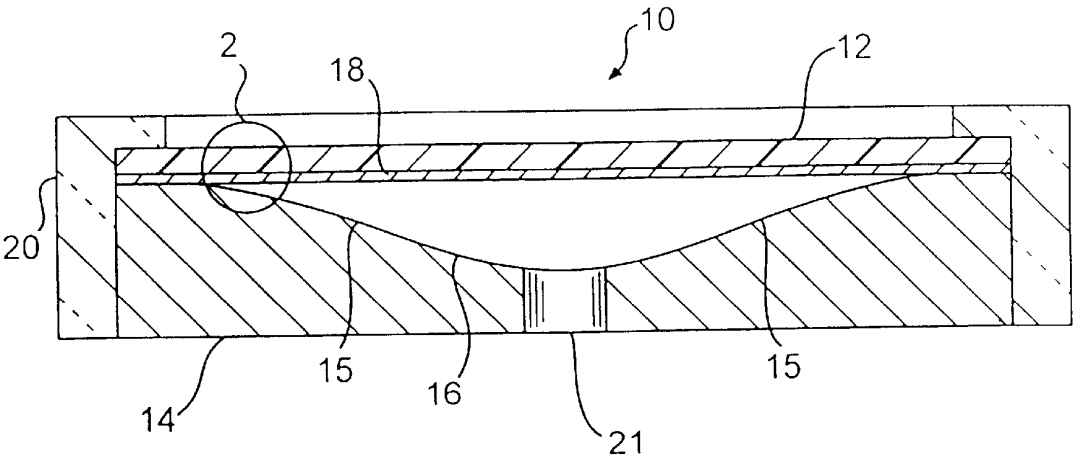


FIG. 1

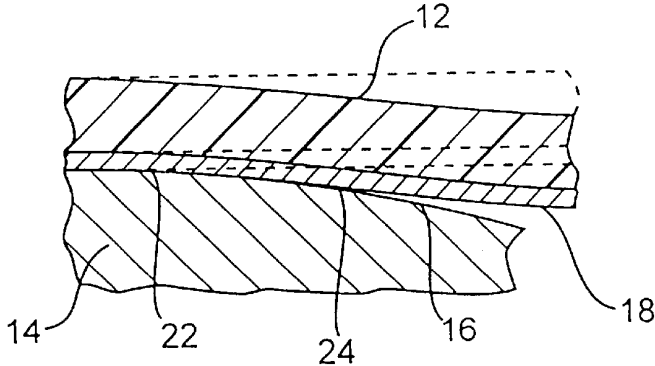


FIG. 2

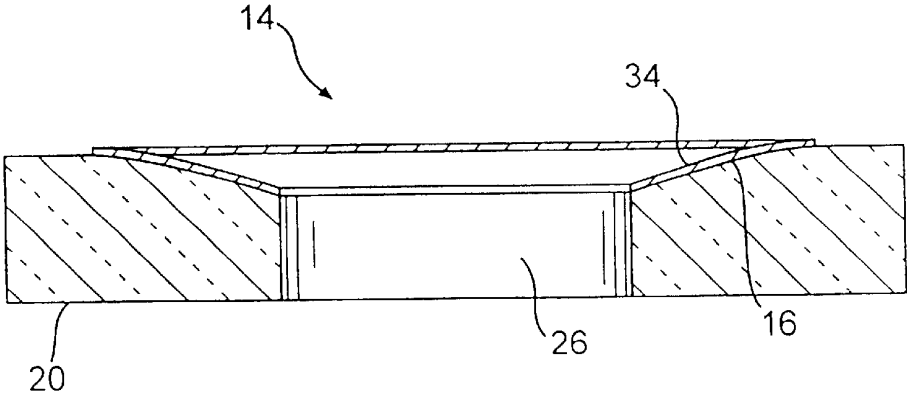


FIG. 3

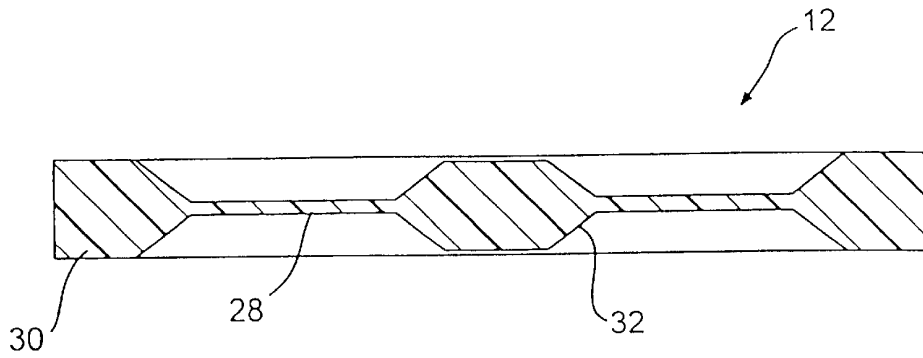


FIG. 4

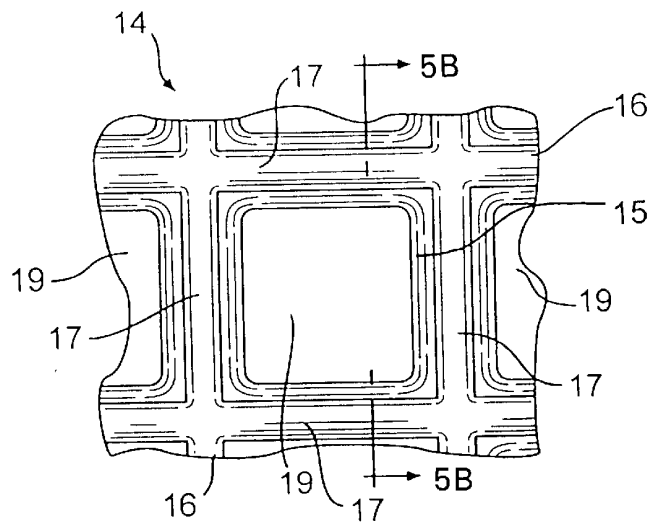


FIG. 5A

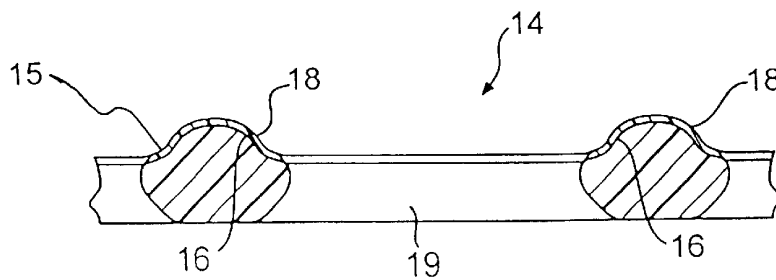


FIG. 5B