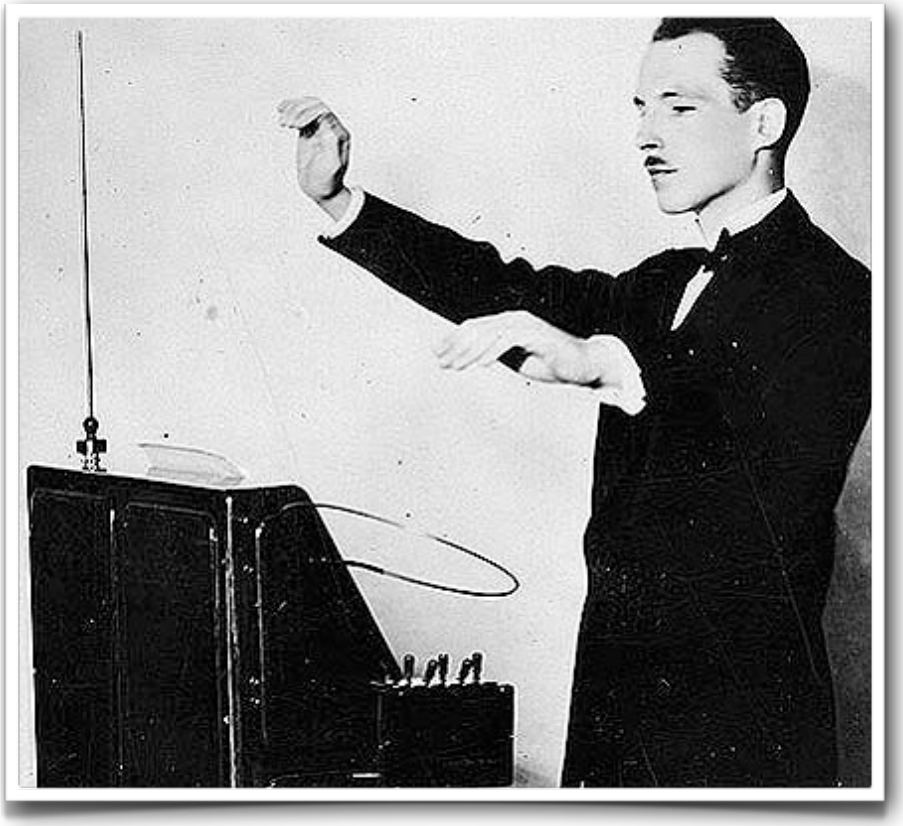
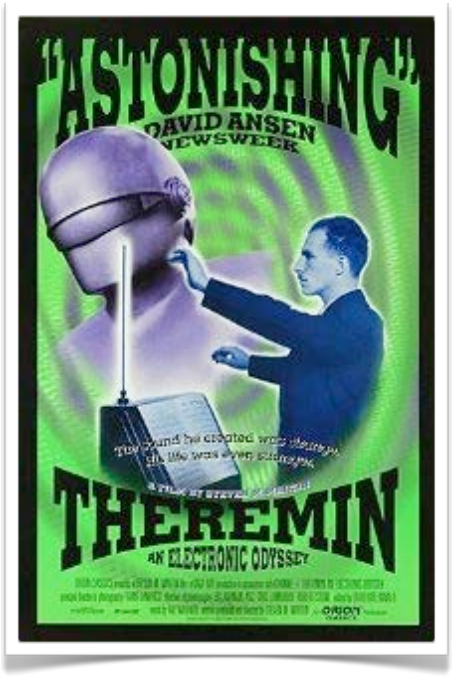
The Great Seal Bug

How does it work?

Lev (Léon) Theremin

b. 1896 Saint Petersburg
d. 1993 Moscow



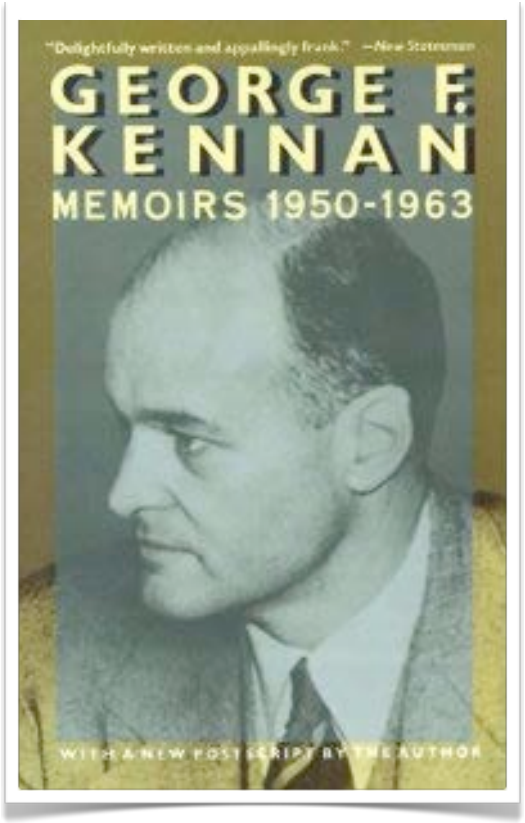


http://www.youtube.com/watch?v=w5qf9O6c20o

http://en.wikipedia.org/wiki/Good_Vibrations

http://www.imdb.com/title/tt0108323/

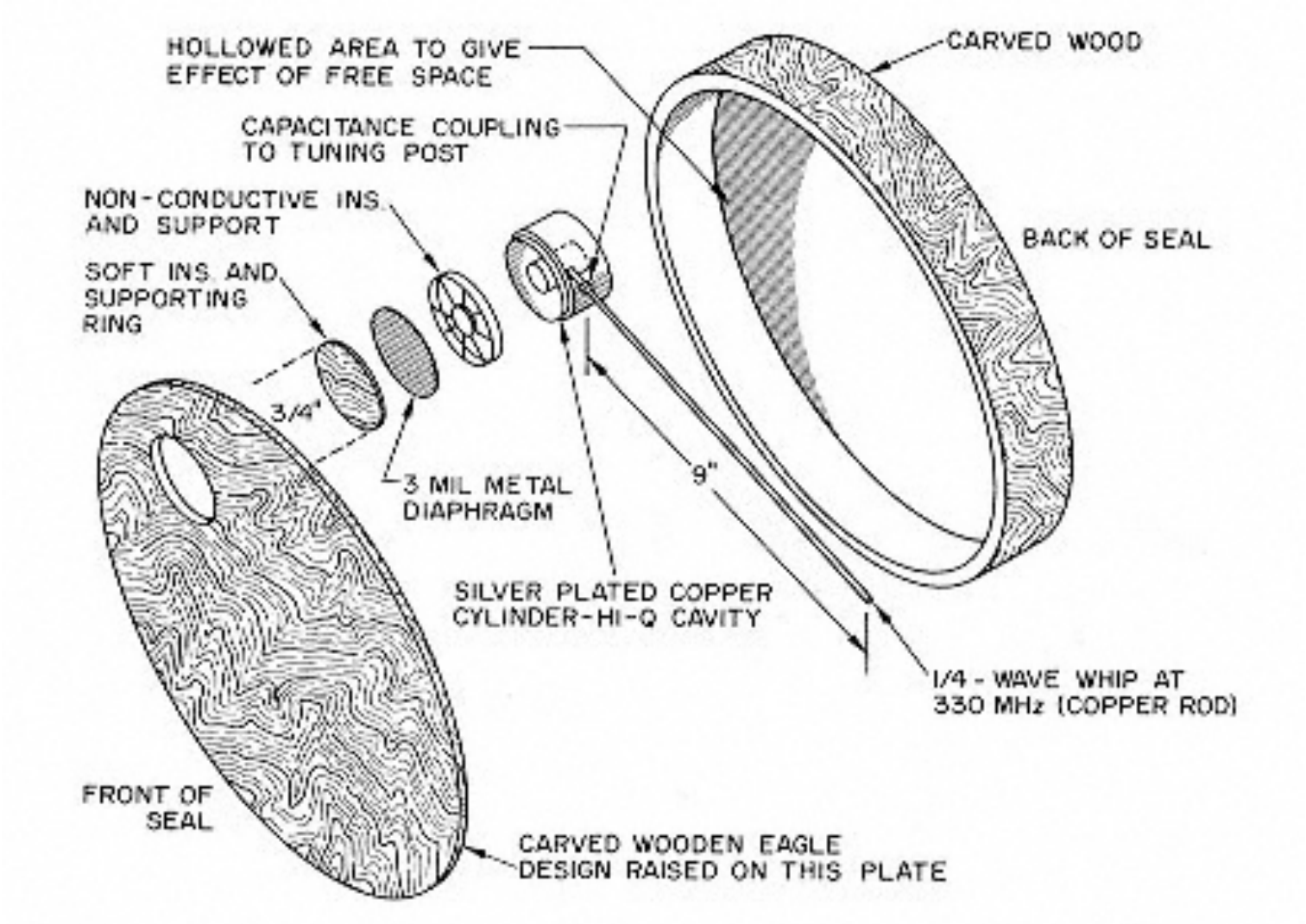
THE GREAT SEAL BUG STORY
Part III - George F. Kennan
U.S. Ambassador to the U.S.S.R.



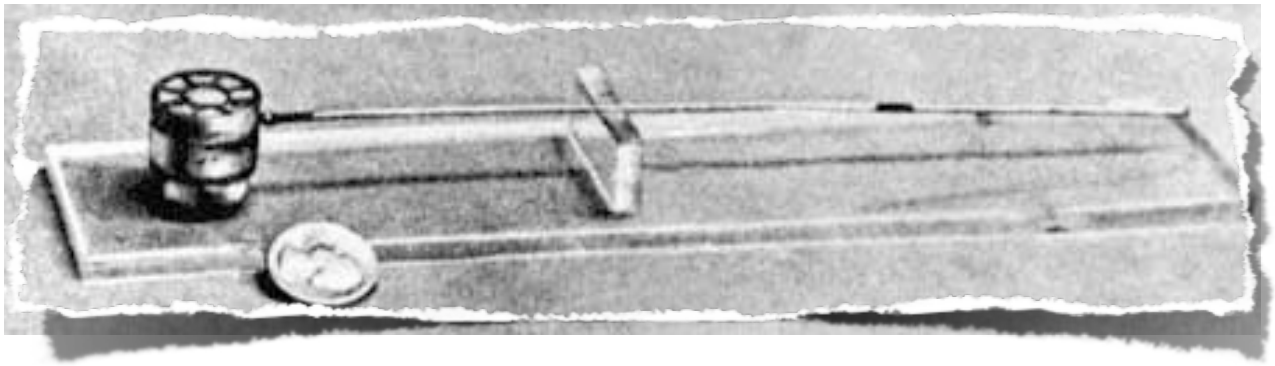
The political sky, in any case, as I left Russia for the conference in London, was dark and menacing.

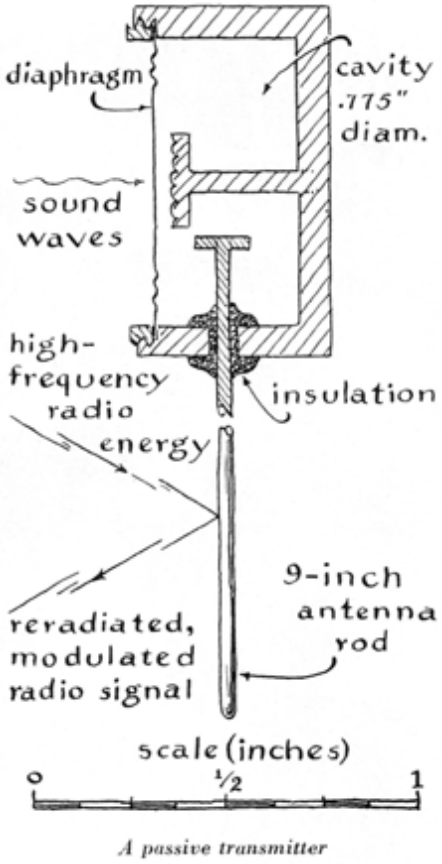
http://www.spybusters.com/Great_Seal_Bug_Part_III.html

Great Seal Bug



"The Thing"

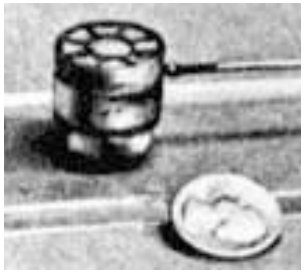




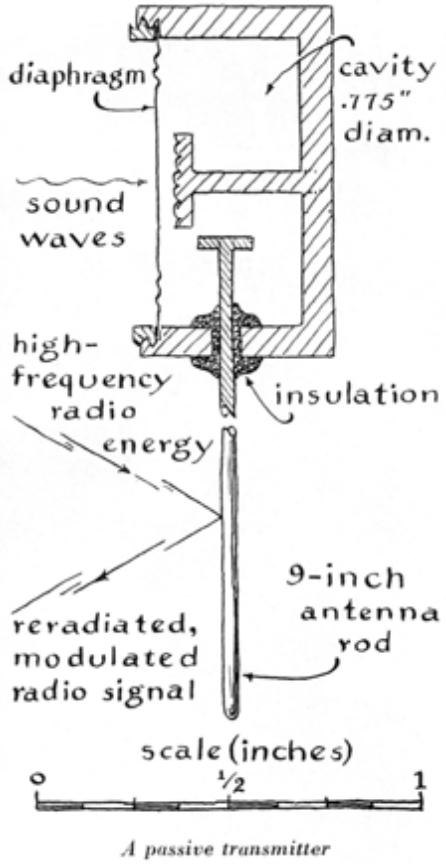
A passive transmitter

(from Scientific American, 1968)

What are the Resonant Frequencies of the Great Bug Cavity?



Reentrant Cavity
Transmission Line Modes
Electric Field Mode Structure
Antenna Coupling



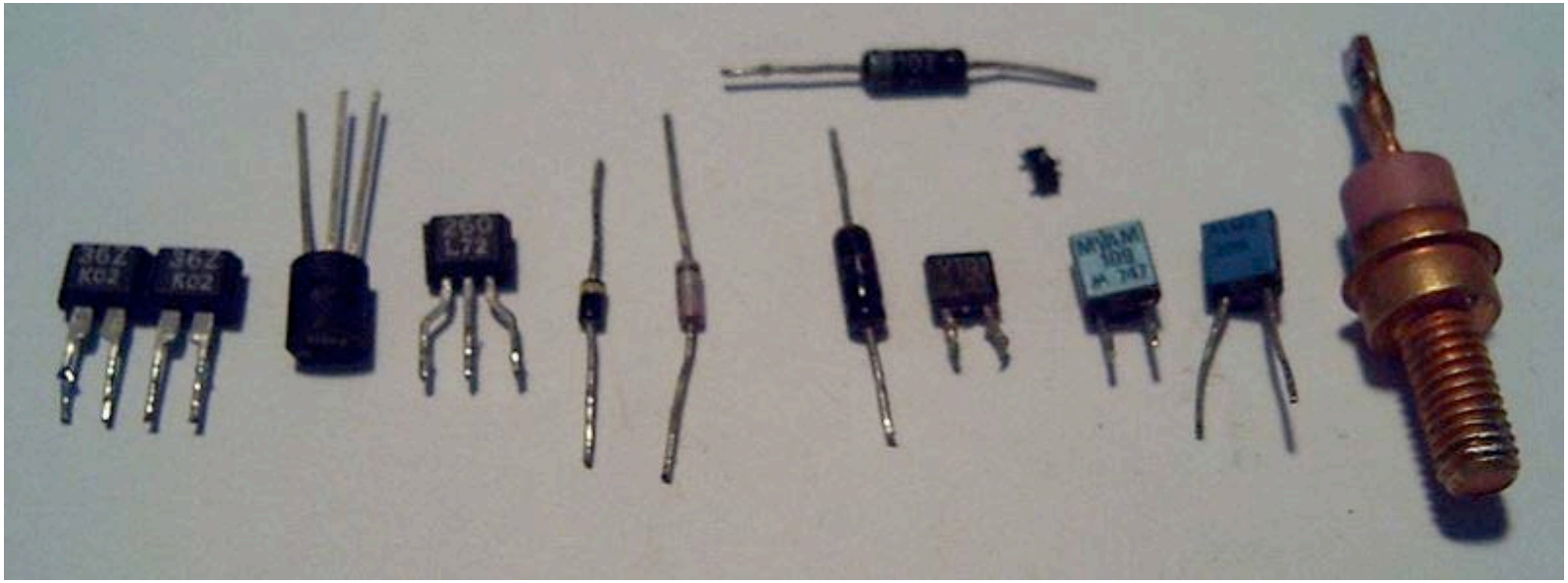
A passive transmitter

How Does it Work?

The resonant cavity transmitter is simple technical device called a passive radiator. A layer of thin metalized material is stretched across a closed metal tube. The size of the tube determined its resonant frequency. An antenna, is attached to the base of the cavity. The cavity is irradiated with a beam of radio frequency energy from an external source. The size of the cavity and the length of its antenna are designed so that a harmonic of the inbound radio frequency energy is rebroadcast. The metalized diaphragm acts as a transducer, and the audio range energy modulates the returned radio frequency signal that, in turn, is picked up by a receiver in a nearby listening post. **It is important to note that the microwave signal that "powers up" the device is not the same frequency as the outbound signal.**

http://eetimes.com/design/audio-design/4015284/Eavesdropping-using-microwaves--addendum

Varicap Diodes



In harmonic multiplication, a large signal amplitude A.C. voltage is applied across a varicap to deliberately vary the capacitance at signal rate and generate higher harmonics which are filtered off and used further down the signal chain. This happens because when the capacitance of a charged capacitor is reduced, the voltage across it is increased which, in turn further reduces the capacitance if it is a varicap.

The energy stored on a charged capacitor is given by $E=CV^2/2$ thus if E is constant, but C is reduced then V must increase, thus if a sine wave of sufficient amplitude is applied across a varicap it gets 'peaked' into a **more triangle shape and odd harmonics are generated**. This was one early method used to generate microwave frequencies of moderate power, 1-2 GHz at 1-5 watts, from about 20 watts at a frequency of 3-400 MHz before adequate transistors had been developed to operate at this higher frequency.

US006481286B1

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

(10) **Patent No.: US 6,481,286 B1**
(45) **Date of Patent: Nov. 19, 2002**

(54) **REENTRANT MICROWAVE RESONANT CAVITY ACCELEROMETER**

(75) Inventors: **Jonathan J. Bernstein**, Medfield, MA (US); **Anthony Petrovich**, Tewksbury, MA (US)

(73) Assignee: **The Charles Stark Draper Laboratory, Inc.**, Cambridge, MA (US)

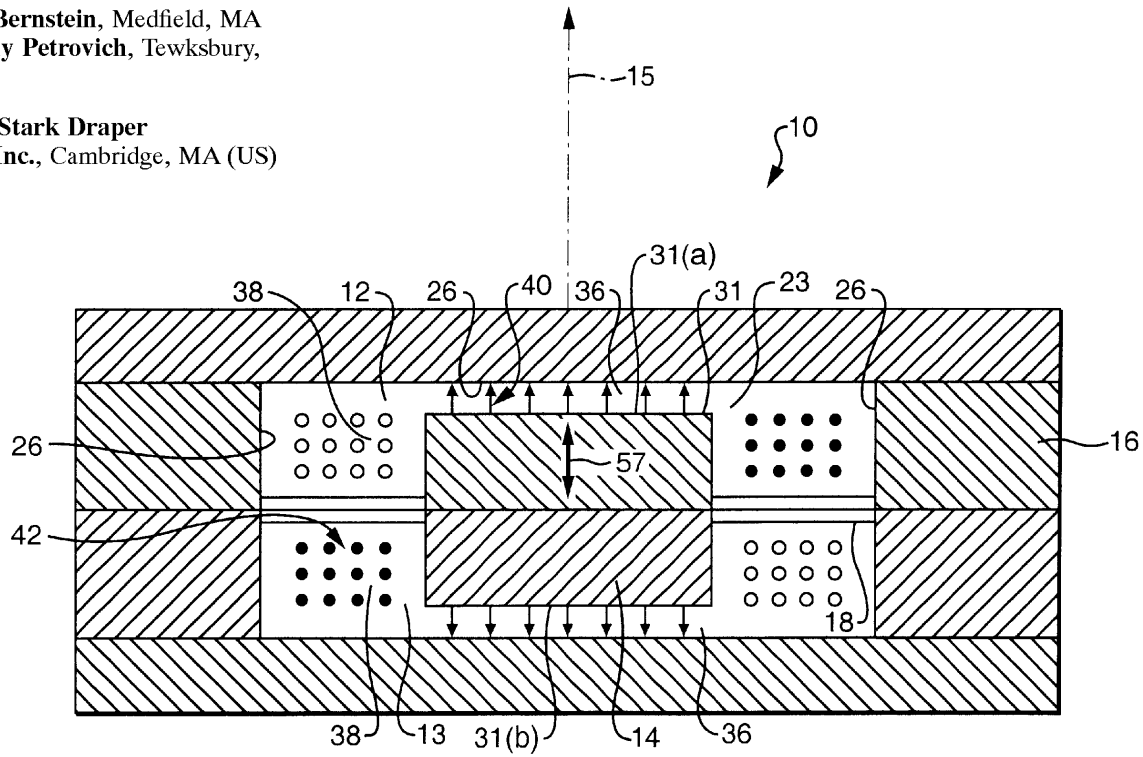


FIG. 4

Patent US6481286

(57) **ABSTRACT**

An improved microwave resonant cavity accelerometer includes a reentrant microwave resonant cavity. Preferably, the accelerometer includes first and second complementary reentrant microwave resonant cavities, each being characterized by a nominal resonant frequency. Each cavity includes a capacitive gap, and an inductive gap surrounding each capacitive gap. A coupler couples to each cavity a microwave signal substantially at the nominal resonant frequency of each cavity. In response to an acceleration force along a sensing axis, a proof mass positioned along the sensing axis differentially changes the dimensions of each cavity and establishes a resonant frequency for each cavity which varies as a function of the acceleration force. The accelerometer includes means for detecting electromagnetic energy in each cavity and determining the frequency of the detected energy. The shift in resonant frequency is used to determine the acceleration of the proof mass. By using-reentrant cavities, the sensitivity of the accelerometer to an acceleration of the proof mass is improved by a factor of about 100 for miniaturized proof masses. The accelerometer may be fabricated using micromachining techniques.

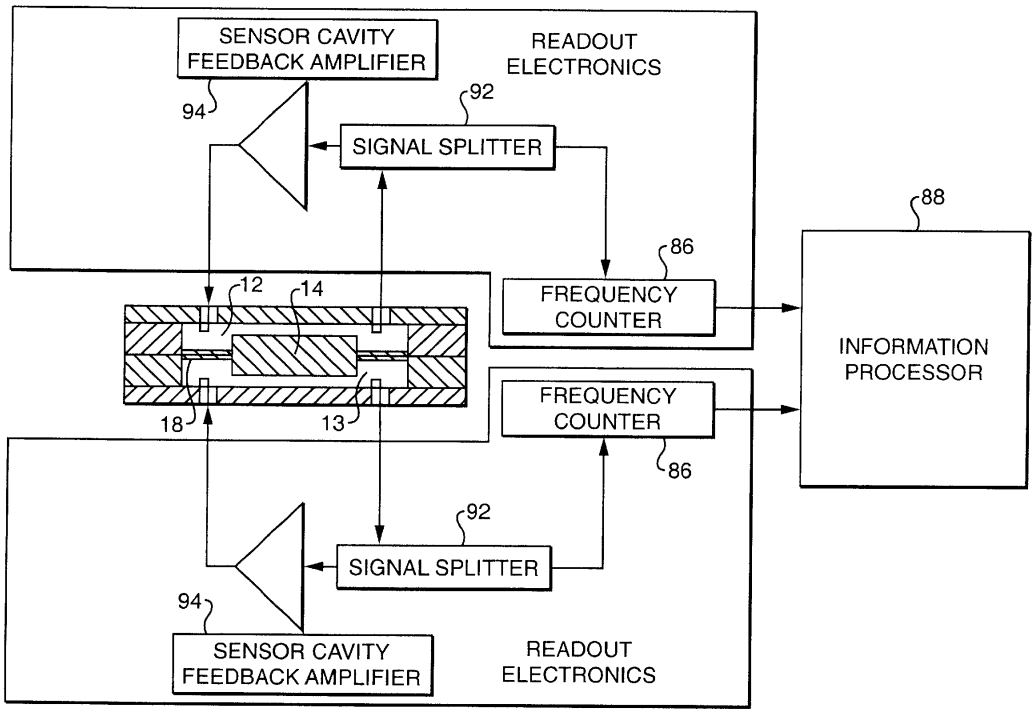


FIG. 6

Next Week: RFID

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