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Bert et al.

[11] **3,886,503**

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[54] **DEVICE FOR STORING HIGH FREQUENCY SIGNALS**

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[52] **U.S. Cl.**..... **333/30 R;** 310/8; 315/39.3; 340/173 R

[51] **Int. Cl.**... **H03h 9/30;** G11c 21/02; G11c 27/00

[58] **Field of Search** ..... 333/30 R; 330/42, 43, 44; 315/39.3, 3, 8.5; 340/173 R, 173 CR; 310/8, 8.1, 8.2, 8.3

[56] **References Cited**

UNITED STATES PATENTS

2,941,110	6/1960	Yando	315/3
3,750,043	7/1971	Epsztein	330/43
3,753,029	8/1973	Kantorowicz	315/3

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[57] **ABSTRACT**

A memory device including a piezoelectric delay line along the surface of which travels acoustic waves to be put into memory; an electron gun which sweeps the work surface of the line with a beam of electrons for recording or reading out the wave; and in which this work surface is covered at least in part by a layer of a highly resistive material.

2 Claims, 3 Drawing Figures

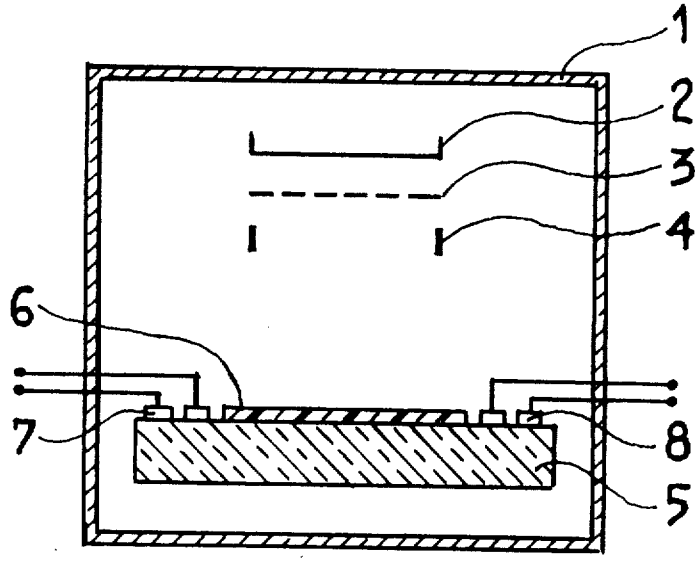


FIG. 1

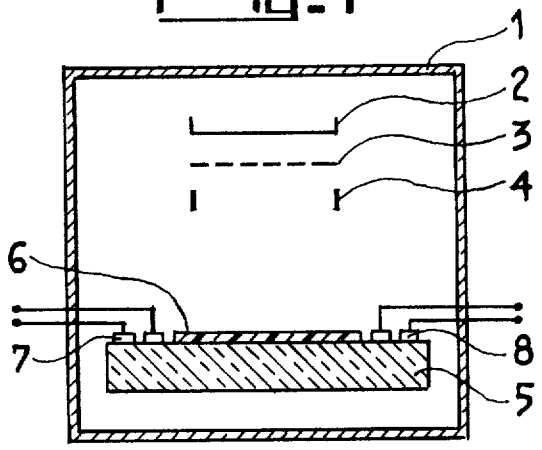


FIG. 2

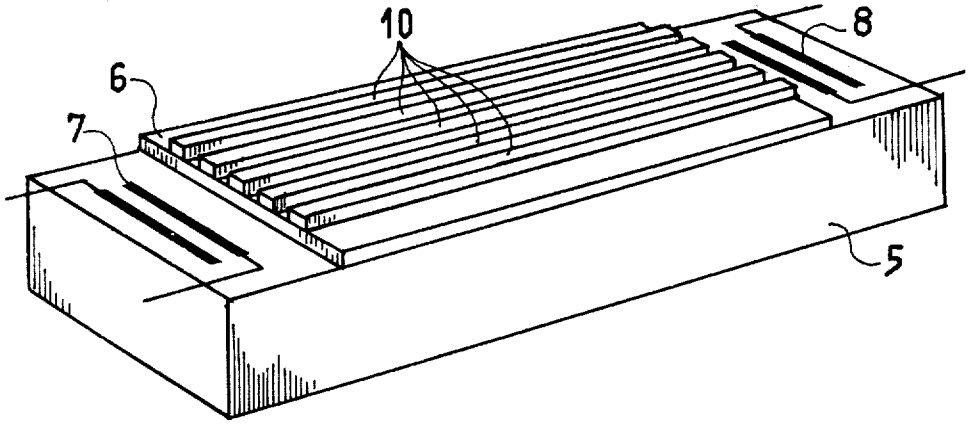
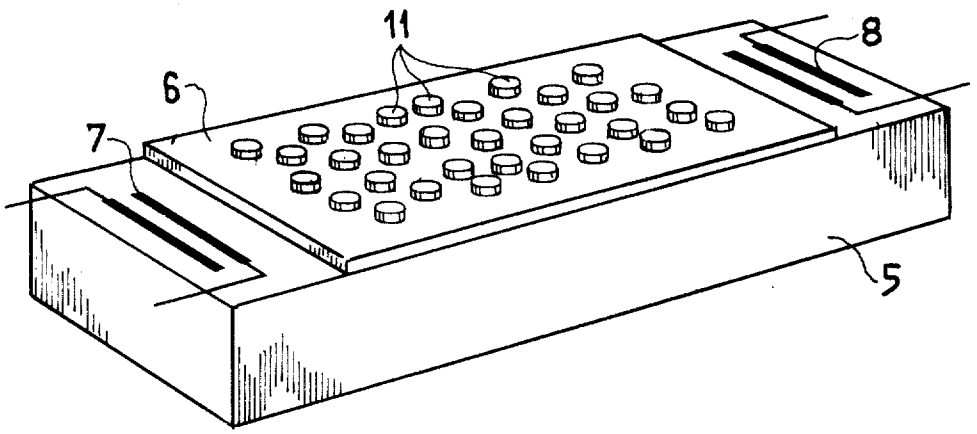


FIG. 3



DEVICE FOR STORING HIGH FREQUENCY SIGNALS

The invention relates to memory devices which record high frequency signals through the use of acoustic waves traveling along a work surface.

Devices of this type are described in applicants' U.S. Pat. No. 3,750,043 filed in the U.S. on July 13, 1971 and in U.S. Pat. Application Ser. No. 427,572, filed on Dec. 26, 1973, both of which are assigned to the same assignee as the present application.

The memory devices described in these patents have vacuum-tight enclosures, each containing (1) a delaying structure, such as a piezoelectric delay line, along which travel the acoustic waves which are to be stored in memory; and (2) an electron gun which produces a beam of electrons that strikes the surface of the line along which the waves travel.

The delay line typically is an elongated block of an insulating piezoelectric material capable of emitting a relatively large number of secondary electrons when struck by primary electrons from the electron gun. Transducers at each end of the delay line convert high frequency electric signals into the acoustic surface waves and vice-versa.

During a read-in or a write-out, the electron gun produces a narrow beam of primary electrons of high intensity and short duration. In one type of memory device, the beam strikes the entire work surface of the delay line simultaneously (i.e., all of the surface included between the two transducers). In another device a very narrow beam sweeps the work surface of the line.

In both cases, when the work surface of the line having the acoustic wave traveling thereon, is swept by a beam of primary electrons; then an electric surface field produced by the wave acts on the distribution of secondary electrons produced on the work surface. This results in a modulation of the density of the charges deposited on the work surface, thereby creating an electrostatic image of the wave. It can be read-out (and erased) with a subsequent sweep of the work surface with a beam of primary electrons. A more detailed description can be found by referring to the patents cited above.

It appears to be desirable for the delay line to have the following characteristics:

it should be strongly piezoelectric, in order for the wave to store a high level of electrical energy.

it should have a weak dielectric constant, so that the number of charges which must be deposited to register a given signal can be kept as low as possible.

it should have a high coefficient of secondary emissions, in order to minimize the density required for the initial current.

it should have a very high surface resistivity, in order to store the recorded signal for as long as possible.

Generally speaking, no single material will fulfill all these requirements. Quartz, for example, has a high resistivity and a low piezoelectricity. On the other hand, lithium niobate is highly piezoelectric but not as insulating as quartz.

One of the objectives of this invention is to produce memory devices with good characteristics, most notably the ability to store information over a long period of time without affecting the quality of the information

recorded. This can be accomplished by the use of particular types of delay lines.

The delay lines used in the devices of this invention are composed of substrates chosen for their strong piezoelectric properties, the work surfaces of which are covered by a layer of material having good insulating properties but no piezoelectricity.

In order further to increase the capacity of these devices, the coefficient of the secondary emission of the outer surface of the layer of insulating material can be raised by adding to this surface another layer, which may or may not be continuous, and which is composed of a material with a high secondary emission coefficient.

Other objectives, charateristics and results of this invention will become clear from the following description offered as a non-limiting example and illustrated by the accompanying figures:

FIG. **1**, is a schematic diagram of a section of an improved memory device according to the invention.

FIGS. **2** and **3**, are schematic diagrams in perspective of different delay lines used in memory devices according to the invention.

FIG. **1** is a schematic representation of a memory device having a metallic vacuum-tight enclosure **1** containing an electron gun which is shown schematically having a cathode **2**, for emitting electrons, an electrode **3** which controls the intensity of the electron current emitted by the cathode, and an accelerating electrode **4**.

During read-in or write-out, this electron gun sweeps a delay line, which includes a substrate **5**, chosen for its strong piezoelectric properties. The material for this substrate can be niobate of lithium or a strongly piezoelectric semiconductor such as a cadmium sulphur compound. These semiconductors have an advantage over lithium niobate of having a weaker dielectric constant. On the other hand, the strongly piezoelectric substrates such as lithium niobate are generally not good insulators.

A thin layer **6** of a highly resistive non-piezoelectric material, such as silicon, covers a work surface of substrate **5**; this is the surface between transducers **7** and **8** along which the acoustic waves travel, and which is swept by primary electrons from the electron gun. The electrostatic image of the wave produced during a read-in can be retained for a much longer period of time, because the insulating layer **6** prevents the migration of charges along the work surface of the line.

In order to improve even further the qualities of the delay line in this device, insulating layer **6** can be covered with a thin layer (not shown in FIG. **1**) of material having a high coefficient of secondary emissions, such as magnesium oxide.

This layer with this high secondary emission coefficient can be continuous, thereby completely covering layer **6**. In that case, it should be made of a material having good insulating properties. This additional layer may also, be discontinuous as shown in FIGS. **2** and **3**. These figures represent, in schematic fashion, delay lines that can be used in memory devices such as the one described in FIG. **1**.

In FIG. **2**, insulating layer **6**, which covers the work surface of substrate **5**, is itself covered in part with bands **10** parallel to the direction of wave travel, and of a material having a high coefficient of secondary emissions, e.g. magnesium oxide. If the material of

these bands **10** is also a good insulator, then the electrostatic image of the acoustic wave will cover the entire work surface of the line. If the material is not a very good insulator, then the electrostatic image will be recorded only along those areas of insulating surface **6** not covered by bands **10.**

In FIG. **3,** the layer of material with a high coefficient of secondary emissions is composed of disks **11** arranged along the insulating layer **6.** The advantage of the disks is that, so long as these disks are smaller than the wave length of the acoustic wave, the charges will remain on the work surface where they were produced and the electrostatic image of the wave will remain along the entire work surface of the delay line, even if the material composing the disks is not a good insulator.

We claim:

1. A device for storing travelling surface waves comprising, inside a vacuum tight enclosure; a delay line of strongly piezoelectric material having transducers mounted thereon and separated from one another, for transducing high frequency electric signals into acoustic waves and vice-versa, said acoustic waves propagating along a work surface of said line between said transducers; and an electron gun for directing a beam of primary electrons toward said work surface; said work surface of said delay line being covered with a thin layer of electrically insulating material; and said thin layer having deposited on it a plurality of bands parallel to the direction of acoustic wave travel along said line, said bands being made of a material having a high coefficient of secondary emission.

2. A device fo storing travelling surface waves comprising, inside a vacuum tight enclosure; a delay line of strongly piezoelectric material having transducers mounted thereon and separated from one another, for transducing high-frequency-electric signals into acoustic waves and vice-versa, said acoustic waves propagating along a work surface of said line between said transducers; and an electron gun for directing a beam of primary electrons toward said work surface; said work surface of said delay line being covered with a thin layer of electrically insulating material; and said thin layer having deposited on it a plurality of disks made of a material having a high coefficient of secondary emission.

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