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SIGNAL STORAGE TUBES

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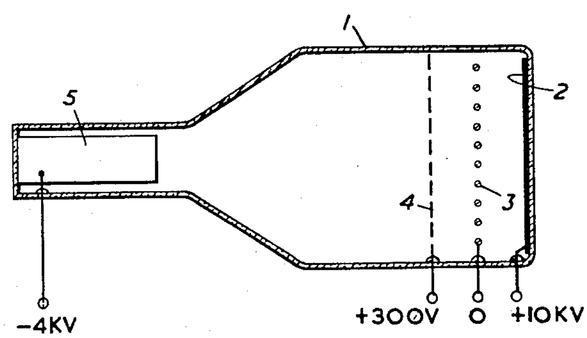

Inventor:
Ian Robertson Sinclair
BY Baldwin & Wight
Attorneys

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SIGNAL STORAGE TUBES

Ian Robertson Sinclair, Chelmsford, England, assignor to English Electric Valve Company Limited, London, England, a British company

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This invention relates to signal storage tubes and more particularly to such tubes of the so-called "black and white" kind, i.e., tubes in which the stored information is representative only of "signal" and "no signal" states and is not representative of other signal variations such as signal amplitude.

This invention relies on the use of material exhibiting the so-called "Malter Effect" or "Thin Film Field Emission." Such a material exhibits the property that under the influence of a bombarding electron beam and an external electric field its surface becomes highly positively charged due to secondary electron emission, the intense potential gradient thereby established through the material causing further electrons to be expelled therefrom. For further information on "Malter Effect" reference may be made to a paper entitled, "Thin Film Field Emission," by Louis Malter in the "Psyhical Review" for July 1, 1936, volume 50, at pages 48–58.

According to this invention a signal storage tube has an electron source, a storage electrode positioned in the path of electrons from said source and comprising a metallic mesh or grid having deposited on the side thereof towards the electron source a thin insulating layer of material exhibiting the so-called "Malter Effect," a collector electrode closely adjacent but spaced from said storage electrode on the side thereof nearer the electron source, and a further electrode closely adjacent but spaced from said storage electrode on the side thereof remote from the electron source.

Preferably the signal storage tube is of the direct viewing kind having a fluorescent screen on the same side of the storage electrode as said further electrode. Preferably the further electrode constitutes a metallic backing film for the fluorescent screen.

The electron source may be a photo-electric cathode or it may be an electron gun having means adapted to switch the beam from said gun on and off in accordance with signals to be stored.

Preferably the storage electrode is coated on the side nearer said further electrode with a substance which tends to suppress electron emission. One such substance is gold.

Preferably the thin insulating layer of the storage electrode is of magnesium oxide, and preferably also the material of said metallic mesh or grid is nickel.

The invention is illustrated in and further described with reference to the accompanying drawing, the single figure of which shows in simplified diagrammatic form one embodiment thereof.

Referring to the drawing, the envelope **1** of the tube therein shown has a fluorescent screen **2**, shown as a thickened line, on its flat end face. The fluorescent screen is backed by a thin aluminium film (not separately shown) in well-known manner. Parallel to the screen **2** and spaced a short distance from it is mounted the storage electrode **3**.

The storage electrode **3** comprises a mesh or grid of nickel having deposited on the side farther from the screen **2** a layer of magnesium oxide of such purity that it acts as a good insulator and secondary electron emitter and exhibits the so-called "Malter Effect." The other side of the nickel mesh or grid, i.e., the side nearer the screen **2**, is coated with gold, the arrangement of the storage electrode being such that the interstices of the grid or mesh are not filled by the coatings on each side but are left open so that the storage electrode as a whole is foraminous.

On the side of the storage electrode remote from the fluorescent screen is a collector electrode **4** in the form of a coarse metal mesh which is parallel to, and spaced a small distance from, the storage electrode.

An electron gun **5**, which is as well known per se and requires no further description here, is arranged to produce an electron beam which is focussed on and deflected across the storage electrode **3** by means (not shown) but which are also well known and require no further description.

In operation if the storage electrode be run at substantially zero volts, the fluorescent screen is at a positive potential of several thousand volts, the collector electrode **4** at a positive potential of several hundred volts and the electron gun cathode at a negative potential of several thousand volts. Typical figures, which are by way of example only and are in no sense limiting, are shown in the drawing.

The action of the storage tube is as follows. The electron beam from the gun **5** is deflected across the target electrode **3** in any suitable manner (in accordance with the use to which the storage tube is being put) and the beam is switched on and off in accordance with the signals to be stored and displayed. The parts of the storage electrode **3** which are bombarded by the electron beam give up secondary electrons as a result of this bombardment, the arrangement being such that the ratio of secondary to primary electrons exceeds unity, and the secondary electrons are collected by the positively biased collector grid **4**. As a result the surface of bombarded areas of the insulating layer of storage electrode **3** become positively charged and field emission due to the so-called "Malter Effect" commences, electrons being drawn from the insulating layer of the storage electrode under the influence of the positive charge on the surface and passing to the collector electrode under the influence of the potential gradient between it and the storage electrode. Due to this field emission the surface of the insulating layer charges more positively until an equilibrium state is reached in which the potential of the insulating layer is lower than that of the collector electrode by such a value that the emission from the storage electrode is balanced by the current in the external circuit connected to the metallic grid or mesh of the storage electrode. It should be noted that all the bombarded parts of the storage electrode will reach substantially the same final potential while all the unbombarded parts will remain uncharged.

Due to the high potential on the fluorescent screen **2** some of the electrons emitted by the insulator are drawn through the interstices of the storage electrode and land with high velocity on the screen thus establishing thereon a visible pattern corresponding to the charge pattern on the storage electrode.

As will be apparent once the storage electrode has been bombarded by the electron beam the charge pattern on the storage electrode will remain until such time as the tube electrode potentials are changed in such manner as to erase it. Erasure may be carried out by reducing the potential of the collector grid or by increasing the potential of the storage electrode.

The purpose of the gold deposit on the side of the storage electrode nearer the fluorescent screen is to prevent field emission taking place from the insulating layer due solely to the voltage gradient between the storage electrode and the fluorescent screen.

In one experimentally tested embodiment of the invention the spacing between the storage electrode and the fluorescent screen, on the one hand, and between the storage electrode and the collector grid, on the other, was 0.2" in each case, the operating potentials being as shown in the drawing.

The construction of the storage electrode is not limited to the use of the material specified above. The insulating layer may be made of caesium oxide on alumina, for example, while the metal grid or mesh might of stainless steel. In place of the gold deposit specified above any other material which is of such a nature as to suppress field emission might be used.

The invention is not limited to the particular arrangements so far described and illustrated. For example, the electron gun may be replaced by a photo-cathode which will respond to external light stimulus. In another modification the fluorescent screen is replaced by a simple signal plate thus providing an arrangement in which a large continuous current may be provided from the signal plate in response to a transient signal applied to the electron gun.

I claim:

1. A signal storage tube including an electron source, a storage electrode positioned in the path of electrons from said source and comprising a metallic mesh having deposited on the side thereof towards the electron source a thin insulating layer of material exhibiting the "Malter Effect," a collector electrode closely adjacent but spaced from said storage electrode on the side thereof nearer the electron source, and a further electrode closely adjacent but spaced from said storage electrode on the side thereof remote from the electron source.

2. A direct viewing storage tube in accordance with claim 1 and having a fluorescent screen on the same side of the storage electrode as said further electrode.

3. A tube as claimed in claim 2 wherein the further electrode constitutes a metallic backing film for the fluorescent screen.

4. A tube as claimed in claim 1 wherein the electron source is a photo-electric cathode.

5. A tube as claimed in claim 1 wherein the electron source is an electron gun having means adapted to switch the beam from said gun on and off in accordance with signals to be stored.

6. A tube as claimed in claim 1 wherein the storage electrode is coated on the side nearer said further electrode with a substance which tends to suppress electron emission.

7. A tube as claimed in claim 6 wherein the substance tending to suppress electron emission is gold.

8. A tube as claimed in claim 1 wherein the thin insulating layer of the storage electrode is of magnesium oxide.

9. A tube as claimed in claim 1 wherein the material of the metallic mesh is nickel.

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JOHN W. HUCKERT, *Primary Examiner.*

RALPH G. NILSON, DAVID J. GALVIN, *Examiners.*