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CATHODE-RAY TUBE

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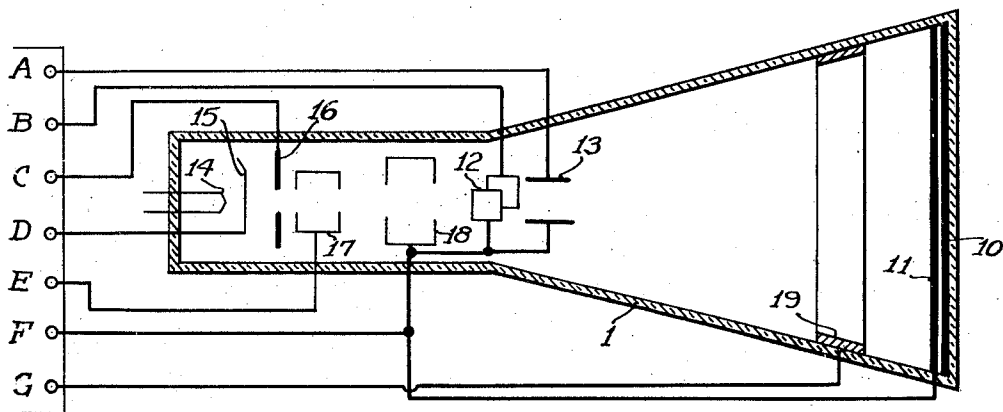


Fig. 1

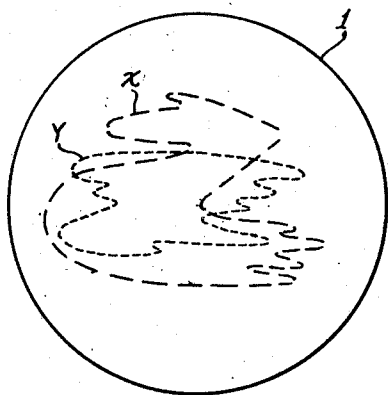


Fig. 3

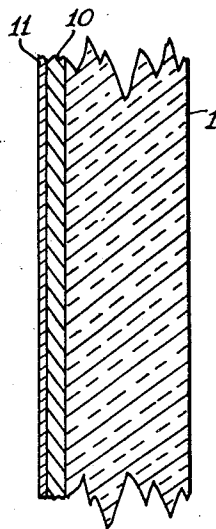


Fig. 2

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CATHODE-RAY TUBE

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13 Claims. (Cl. 250-164)

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This invention relates to a cathode ray tube, or similar device, having an impressionable screen which is capable of substantially permanent alteration when impinged in selectable areas by an electron beam of predetermined intensity, but which is substantially unalterable by a beam of predetermined lower intensity; moreover, which lower intensity beam by tracing areas thus altered may produce detectable screen reactions which differ from those produced in tracing unaltered areas.

The invention relates, in one specific form, to a cathode ray tube, or its equivalent, the screen whereof is susceptible of substantially permanent alteration in its secondary emissive properties along a characteristic trace or path when bombarded by an electron beam of selected (usually high) intensity—the trace configuration being characteristic of a particular signal impulse or input stimulus impressed upon the tube's deflecting plates or coils, and of the frequency or similar identifying effect arbitrarily imparted to the beam, such as by its intensity modulation, which effect persists in the trace pattern associated with that signal impulse—but which screen is substantially unalterable by a beam of different (usually low) intensity. Hence, should a beam of low intensity retrace the path, by reason of subsequently impressing that particular signal impulse upon the tube's deflecting plates, the beam at low or normal intensity will produce secondary emissions which differ in effect from those produced by traversing other (previously unaltered) portions of the screen. Thus, where originally the high-intensity beam was intensity modulated, secondary emissions will now be produced which pulsate at a frequency corresponding to the initial modulation of such high intensity beam. Generally, in one practical application of such a tube, by collecting the resultant secondarily emitted electrons, and impressing the resulting current or voltage on a detecting circuit, a selected result may be produced which is identical with or related to the stimulus then causing the beam to regenerate a permanent trace on the screen. Contrariwise, no beam of any intensity which does not retrace the path of the original trace will produce the same result. Furthermore, several traces may be impressed permanently upon a single screen, whereby the beam, in regenerating at low intensity any one of these trace patterns, will produce a secondary emission result characteristic of that trace only, whereupon detecting devices sensitive to and selective of the several possible secondary emission results will produce an end result which alone, of all the possible end results, corresponds to the input stimulus which originally produced that particular trace. My copending application Serial No. 639,616, filed January 7, 1946, and

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entitled Translating device and method, from which this application is divided, discloses such a practical application of the tube.

An object of the present invention is to provide an electronic tube, such as a cathode ray tube, having a screen comprising material capable of permanent alteration in its reacting properties by the effect of a high intensity beam initially impinging the screen in selected areas and thereafter of producing different detectable reactions to a lower intensity beam when it impinges such altered and unaltered areas.

A more specific object of my invention is to provide a cathode ray tube having a screen, the secondary emission properties of which are permanently alterable in selected areas only by a relatively high intensity beam impinging such areas.

In achieving the objects of my invention I provide a cathode ray tube screen consisting of a plurality of layers, the outermost of which, away from the glass or other screen backing material, will serve effectively as a shield for, or barrier to secondary emissions from, an underlying layer when the screen is impinged by a relatively low intensity electron beam, but which shield or barrier layer may be permanently destroyed, or altered in its properties, in selected areas, by impingement in such areas of a relatively high intensity beam, with the result that the reaction of the screen to subsequent impingement in such areas of a lower intensity beam will differ from its reaction to impingement in unaltered areas of the screen. In a preferred case, the shielding layer prevents or subdues secondary emissions from an underlying conductive layer by preventing it from reacting to a beam of normal or low intensity, but the shielding effect may be destroyed by the point impact of an intense beam, whereafter secondary emissions will be produced in relatively greater degree when a normal beam strikes that point. Alternatively, the overlying layer may not be destroyed strictly, but may be caused to merge or combine with the underlying layer when impinged by an intense beam to the same end. Other objects of my invention are hereinafter set forth in greater detail by reference to the accompanying drawings.

Figure 1 is a side view in section of a cathode ray tube structure suitably adapted to the practice of my invention.

Figure 2 is a greatly enlarged fragmentary sectional view of my novel cathode ray tube screen.

Figure 3 is a front view of the screen of the cathode ray tube, showing arbitrary trace patterns permanently impressed in the screen.

The tube of Figure 1 includes a special metallic coating upon the interior of the glass envelope, together with a very thin layer of material,

capable of permanent change under the influence of a beam of great intensity, overlying the metallic coating, and consonant with the latter. By way of example a satisfactory coating consists of a thin film or undercoating of metallic potassium 10 on the interior of the glass 1, and overlying this metallic film a very thin layer or overcoating 11 of potassium hydroxide with adsorbed hydrogen, to comprise a sensitive composite coating. In Figures 1 and 2 the actual layers are greatly exaggerated as to thickness. The metallic potassium layer 10 need only be thick enough to offer a continuous surface, and a single molecular layer 11 of potassium hydroxide with adsorbed hydrogen is sufficient. As one of many alternative forms, a metallic sodium film at 10 is covered by a very thin film 11 (ideally approaching molecular thickness) of paraffine, volatilizable by the intensified cathode ray.

In all forms, dependence is placed on fact that when a cathode ray strikes a metallic surface, electrons are emitted therefrom, but an unimpaired thin nonmetallic coating 11 on such a metallic surface as 10 alters the freedom of electronic emissions. The coating ceases to be unimpaired when broken by impact of an intensified cathode ray during the time a signal selected for future recognition is being impressed upon the screen. The overcoating 11 may be converted from potassium hydroxide to metallic potassium, in the first instance above, merging with the potassium of the undercoating 10; in the case of the paraffine overcoating, it may simply be volatilized by the beam to leave exposed the metallic sodium. In any case, the beam effects a permanent change in the nature of the composite screen coating, whenever the beam's trace bombards the screen at high intensity, and that permanent change alters the capability of emission of electrons from the changed portions of the screen, when subsequently bombarded, at lesser intensity.

Other metals may be used as the undercoating, such as other alkali metals, or caesium, or selenium. The overcoating 11 should be compatible with or consonant to the undercoating 10, in each case.

Where, in this specification, relative intensity of the electron beam is referred to, as "great" or "high" intensity, or "lesser" or lower" intensity, it is scarcely possible to define these terms in absolute quantitative units, for the reason that these values will necessarily vary in accordance with the characteristics of the tube and the nature of the screen coating employed. In general, "great" intensity refers to an intensity such that, under the conditions present, the beam produces an irreversible chemical or microphysical change in the screen, whereas a beam of "lesser" intensity is one which produces only a reversible or electronic reaction upon the screen, secondarily emitting such electrons as bombard the screen, without permanent change in the nature of the screen itself. If the screen is of metallic potassium coated with potassium hydroxide, the beam of great intensity produces a chemical change; if the screen is of a metal coated with paraffine, such a beam produces a microphysical change. In either case, a beam of lesser intensity produces only an electronic effect, receiving and emitting electrons without change in the chemical or physical properties of the screen itself.

As is well known, the cathode ray tube may have horizontal deflecting plates or coils 12, and vertical deflecting plates or coils 13 between which may be passed, generally axially of the tube, a

narrow beam of electrons directed against the screen which is disposed transversely of the beam at the enlarged end of the tube. For beam-forming purposes the tube may incorporate a conventional cathode-heater element 14, cathode 15, control grid 16, coacting to produce a stream of electrodes which is accelerated and focused by anodes 17 and 18.

The tube may also incorporate an electron collector ring 19 located near the screen, which collects electrons emitted by the screen when bombarded by the cathode ray or beam. For convenience, the several tube components have been shown connected to leads extending to a terminal strip having terminals labeled A, B, C . . . G. Terminal F, connected to the anode 18, to the screen, and to one of each of the deflecting plates 12, 13, may be grounded, and terminal E connected to the anode 17, at a potential below ground potential. Terminal D, connected to the cathode 15, may be placed at a still greater potential below ground, whereas terminal C, connected to the control grid, may be connected to a source of potential which is adjustable relative to the potential of the cathode, in order to vary or control the intensity of the beam in any selected manner. Terminals A and B, which are connected respectively to the ungrounded vertical and horizontal deflecting plates, are free to be impressed with selected voltage stimuli to deflect the beam and produce corresponding traces on the screen in the customary manner. Secondarily emitted electrons drawn to the collector ring 19 pass from the tube to terminal F from whence they may be impressed on a suitable receiving circuit.

In the device of my copending above-cited application, referring to the use therein of a cathode ray tube of the type of present concern, the sound of the human voice or other initial stimulus may be detected electrically, separated into two component signal voltages, for instance, voltages comprising high and low frequency harmonic components of the stimulus, and then separately applied to the horizontal and vertical plates of the cathode ray tube to trace on its screen a pattern uniquely related to the original sound or stimulus. The present invention contemplates an electronic tube for recording a plurality of such stimuli permanently on the screen of the tube, in such a way that repetition of the same signals applied to the tube's deflecting plates will create a detectable reaction, such as in terms of secondary electron emission, which may be identified with such signals. In a preferred manner of using the tube, as in my copending application, a trace pattern or record is created by a pulsating high-intensity electron beam bombarding the screen during the application to the tube's deflecting plate of the signal voltages representing the stimulus to be recorded. The resulting reaction of the screen to the intense bombardment at points of impact of the beam, comprises a permanent alteration in the secondary emission properties of the screen at such points, but not in others, with the result that the trace pattern will have been impressed upon the screen permanently in the form of a broken line of alternately altered and unaltered segments. Lowering the beam intensity and retracing the same path results, therefore, in a series of time-separated impulses of secondary emission electrons emanating from the screen and collected by the collector ring 19. By employing different beam-pulsation frequencies for different stimuli during their recording,

frequency sensitive apparatus responsive to the secondary emission impulses will thereby be enabled to distinguish or identify a recorded stimulus when it is repeated to the apparatus, and to perform a selected related operation or create a related effect. In Figure 3, two purely arbitrary trace patterns *x* and *y* are shown as they might be impressed on the screen, representing different stimulus records.

The tube and screen structure which I have disclosed herein may be thought of as an electronic impressionable record medium on which may be impressed and preserved various information and data in the form of beam trace patterns. The purposes of forming records may vary. I have indicated the preferred purpose, but by so doing it is not intended that the present invention is to be limited accordingly. In the indicated use, the record is used as a means of identifying particular intelligence or stimuli as they are repeated to the incorporating apparatus, but I may in other cases prefer to use the record impressed on the screen for direct reproduction purposes in the usual sense of the term, that is for play-back or related purposes.

Moreover, I have confined the foregoing description to a cathode ray tube because such tubes are the most common of the beam tubes, but I conceive of other possible tubes one of which may, for example, use ion beams. Consequently, the invention is considered to be of a scope which does not confine itself in unnecessary particulars, such as the general structural details of the tube, but only as I have incorporated them into the following claims.

I claim as my invention:

1. A cathode ray tube having associated therewith a screen structure of a nature susceptible of permanent alteration in its sensitivity to electron bombardment by initial bombardment.

2. A cathode ray tube having associated therewith a screen structure of a nature susceptible of permanent alteration by intense electron bombardment, in its sensitivity to react in electrically detectable manner to subsequent bombardment at lower intensity.

3. A cathode ray tube including a sensitive screen coating of an alkali metal, and an over coating of a compound of such metal, having the property of being reduced to metallic form by initial bombardment by an electron beam of high intensity, but of being unaffected by such a beam of low intensity, said over coating being interposed between the sensitive metallic coating and the electron source.

4. A cathode ray tube including a sensitive screen coating of potassium, and an over coating of a compound of such metal, having the property of being reduced to metallic form by initial bombardment by an electron beam of high intensity, but of being unaffected by such a beam of low intensity, said over coating being interposed between the sensitive metallic coating and the electron source.

5. A cathode ray tube including a sensitive screen coating of potassium, and an over coating of potassium hydroxide, having the property of being reduced to metallic form by initial bombardment by an electron beam of high intensity, but of being unaffected by such a beam of low intensity, said over coating being interposed between the sensitive metallic coating and the electron source.

6. A cathode ray tube including a sensitive screen coating of metallic sodium, and an over

coating of paraffine interposed between said sensitive coating and the electron source.

7. An electronic tube having a sensitive permanent recording screen comprising a metallic undercoating of secondarily emissive material and a nonmetallic overcoating of shielding material effective when unimpaired to shield said undercoating for purposes of secondary emission, from a beam of normal intensity, but capable of impairment by the point impact thereon of a beam of higher intensity to expose permanently said undercoating at the impact points, to the effect of a beam of normal intensity, thereby thereafter to produce greater secondary emission therefrom at such points upon impingement of a normal-intensity beam.

8. An electronic tube having a sensitive permanent recording screen comprising an undercoating of secondarily emissive material and an overcoating of shielding material effective when unimpaired to shield said undercoating for purposes of secondary emission, from a beam of normal intensity, but capable of impairment by the point impact thereon of a beam of higher intensity to expose permanently said undercoating at the impact points, to the effect of a beam of normal intensity, thereby thereafter to produce greater secondary emission therefrom at such points upon impingement of a normal-intensity beam.

9. The electronic tube as defined in claim 8 in which the nonmetallic overcoating comprises a thin layer of paraffine.

10. An electronic tube having a sensitive screen comprising a metallic undercoating and an overlying coating of the hydroxide of said metal with adsorbed hydrogen.

11. The electronic tube of claim 10 in which said metal comprises any base metal, the hydroxide of which in the presence of hydrogen is capable of decomposition into the metallic base by electron bombardment.

12. A cathode ray tube having associated therewith a screen structure of a nature susceptible of permanent alteration in its secondary emission properties by intense electron bombardment, in its sensitivity to produce different amounts of secondary emission in areas initially bombarded than in other areas, when such areas are subsequently impinged by a beam of lower intensity.

13. A cathode ray tube comprising beam-forming means, beam-scanning means, and a permanent recording screen structure operatively disposed for impingement by the scanning electron beam, said screen structure having the property of permanent alteration of its scanning response quality in areas affected by an electron beam of high intensity, rendering said screen structure responsive differently in intensely bombarded areas than in areas unaffected by such high intensity beam, said cathode ray tube and screen structure being adapted to retain such difference permanently.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,116,901	Knoll	May 10, 1938
2,180,710	Knoll et al.	Nov. 21, 1939
2,319,195	Morton	May 11, 1943