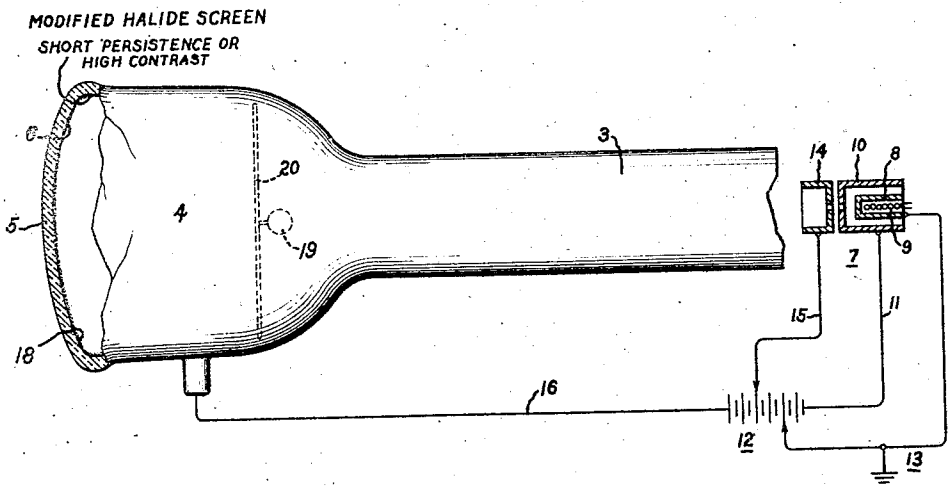
Feb. 3, 1948. G. R. FONDA 2,435,435

CATHODE RAY SCREEN

Filed April 6, 1943



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Patented Feb. 3, 1948

2,435,435

UNITED STATES PATENT OFFICE

2,435,435

CATHODE-RAY SCREEN

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Application April 6, 1943, Serial No. 482,025

10 Claims. (Cl. 250—164)

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The present invention relates to cathode ray devices of the type having screens which respond to excitation by cathode rays; i. e., a beam of electrons, and, in particular, to screens in which a marked darkening is produced by the impact of electrons. These devices are sometimes referred to as "dark trace" tubes because the path of the cathode ray beam is reproduced in the form of a dark trace, the intensity of which varies with alterations in the intensity of the cathode ray beam. They are also known as skiatrons. The screens of such devices commonly consist of an alkali metal halide, for example potassium chloride.

It is the object of my present invention to improve and extend the applications to which skiatrons can be put, this result being attained by alteration of the composition and characteristics of the electron-sensitive screen.

In skiatron tubes, such as used for example in range-finding and direction-finding equipment, a beam of electrons or cathode rays moves over the screen in response to an externally applied deflecting force, such as the variation of an electromagnetic field. Reception of electromagnetic radiations which are reflected from an object to be located results in appropriate current variations in the control field of the equipment. As a result the cathode beam is caused to travel over the screen of the skiatron, thereby producing a dark image or trace. This image or "dark trace" may be viewed by light which falls on the screen from an external source. If desired, the image may be projected on a distant viewing surface. The external illumination of the screen not only permits the "dark trace" to be viewed, but also has the important function of causing the dark trace to decay and disappear, thus restoring the original condition of the screen. In other words, impinging light wipes out the dark trace after it has served its purpose.

For some purposes it is desirable that the life or persistence of such trace should be reduced. Commonly, the dark trace remains visible for about a minute, or even longer, depending upon the intensity of the illumination. For some purposes it is desirable that the dark trace should disappear in about five seconds. For still other purposes, a decay period of no longer than one second is needed.

It is also desirable that the contrast intensity between the dark trace and the lighter background should be as marked as possible to permit ready recognition of the trace or image.

It is the primary object of my invention to

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reduce the decay period of "traces" or images on skiatron films. Such a reduction not only widens the field of usefulness in range-finding and direction-finding equipment, but also renders it adaptable for use in other fields. An important field, for instance, would be television. A dark trace screen having a sufficiently short persistence offers the noteworthy advantage over the present fluorescent screen that it need not be viewed in a darkened room, as is necessary for the latter type of screen, but may be observed equally well in a well-lighted room.

This shorter persistence is obtained by associating a screen consisting of an alkali halide with a minor amount of a modifier consisting of a foreign halide, for example the halides of alkaline earth metal including magnesium, barium, calcium and others which will be mentioned hereafter.

I find that the presence of the foreign halide in an amount sufficient to reduce the decay period of the dark trace also results in some sacrifice of intensity of the dark trace. A decrease in the amount of foreign halide is accompanied by a lessening of both effects; that is, the decrease in decay period and the decrease of intensity both become less as the amount of modifier is reduced.

Surprisingly, these variations do not change continuously with lessening amounts of foreign additions. The presence of a very small amount of the foreign halide varying from a few hundredths of one per cent to a per cent or more, depending upon the activity of the particular halide used, may result in a marked increase in intensity when the concentration of the foreign halide has been reduced to such a point that it no longer affects the length of the decay period.

These and other features of my invention will be described with greater particularity hereinafter. The accompanying drawing shows conventionally a cathode ray tube containing a screen embodying my invention.

The cathode ray tube here shown has as usual a relatively slender tubular portion 3 which communicates with a bulbous portion 4, one wall 5 of which approximates a flattened shape. The dark trace screen 6, which responds to electron impact, is coated on the inner surface of the wall 5. At the opposite end of the tubular portion remote from the screen 6 is a so-called electron gun 7 for generating a desired cathode ray beam.

This electron gun, which of course is sealed within the enclosing envelope, may comprise an oxide-coated cathode 8 which is shown as a small cylinder receiving heat from an electric heater

9. The cathodes are surrounded by a perforated focusing device 10 which is connected by a conductor 11 to the negative terminal of a source of potential 12. The cathode 8 is connected to an intermediate point on the source 12 by a grounded conductor 13. In front of the device 10 is a perforated electrode 14 which functions as a control grid. It is connected to an intermediate, more positive point of potential of the source 12 by a conductor 15. An electrode which may be a film (not shown) on the interior of the envelope wall is connected by a conductor 16 to the source 12. The device of the drawing is shown only as a schematic representation illustrating generally the type of device in which films embodying my invention are used and, therefore, beam-deflecting means and other auxiliary devices have not been shown.

The composition comprising halide and modifier, the preparaion of which will be described, may be applied as a film 6 on the inside surface of the end wall of the skiatron shown in the drawing by sublimation from a holder 19, indicated schematically as being held by a spring wire support 20. The modifier mixture, after fusion as hereafter described, may conveniently be ground and compressed into a pellet for insertion in the holder 19. At an appropriate point during the exhaust of the device, heat may be applied by high frequency induction to effect the sublimation.

In the preparation of the material to be volatilized and applied as a skiatron or dark trace film an alkali halide is mixed in the finely divided state with a desired amount of chosen finely divided modifier. The mixture is subjected to fusion which is sufficiently prolonged to bring about complete homogeneity. A fusion temperature should be maintained until the melted mass has become clear, transparent, and free from the agitation which occurs when a fusion heat is first applied. However, the fusion should not be prolonged so long as to cause undesired chemical changes, such as oxidation. Also it is undesirable to have the temperature rise much above the melting point of the mixture. Potassium chloride, potassium bromide, rubidium chloride, lithium iodide and sodium chloride may be employed satisfactorily as the main constituent of the screen. I prefer to use potassium chloride because it yields the highest intensiy of dark trace.

The modifying material, particularly when employed with potassium chloride, advantageously may consist of various halides such, for example, as the chlorides of samarium, thallium, manganese, sodium, magnesium, cadmium, lead, chromium, nickel, platinum, caesium, calcium, aluminum, iron thorium, lithium, rubidium, copper, barium, zinc, zirconium or tin. The extent of the activity varies with the metallic element chosen and also with the halogen chosen. Frequently the iodide is more active than the bromide, and the latter more active than the chloride, but this is not invariably so. Because of these variations in activity which increase with concentration over a certain but variable range, it is generally possible to obtain the same shortening of persistence by adding a small amount of an active halide of a foreign metal as by adding a relatively large amount of a less active one. Ordinarily, the addition of such modifier will be less than ten per cent by weight.

Such mixtures of potassium chloride with magnesium chloride are especially advantageous not only because of the extensive reductions in persistence that are obtainable but also because these reductions are accompanied by smaller losses in the intensity of the dark trace. A further advantage of films prepared from these mixtures with magnesium chloride lies in the speed with which the "after trace" disappears; that is, a long persistent trace of low intensity characteristic of films of potassium chloride alone as well as of films prepared from many of its mixtures with foreign halides.

Because of the variations in activity characteristic of the different modifiers, the proportion of modifier should be chosen to give the results desired, the period of decay (or persistence) becoming progressively shorter (within limits) with increase of modifier. For example, the dark trace formed by a beam of electrons on a film of potassium chloride, unmixed with a modifier, persists, under a certain intensity of illumination, at least about two minutes. The following table shows the effect on persistence, under the same intensity of illumination, of films vaporized from fused mixtures of potassium chloride with progressively larger additions of hydrated magnesium chloride:

Calculated as Per Cent $MgCl_2$ by Weight	Length in Seconds of Decay Period
0.3	15
1.0	5
2.0	3
5.0	0.5

As above stated, the addition of a small amount of platinum halide to potassium chloride results in a composition which, when volatilized, forms a film of shorter persistence than unmodified potassium chloride.

Shorter persistence also is exhibited by films made by volatilizing as described a fusion of a mixture of potassium chloride and potassium hydroxide in a platinum container. The fusion is enveloped either in a hydrogen atmosphere or in air during preparation. The fusion may result in some complex volatile compound of potassium chloride, potassium hydroxide and platinum. Such compound appears to be the active agent in a film prepared by the volatilization of such fusion as above described.

As already observed, the intensity of the initial dark trace may be increased by reducing the concentrations of these foreign halides much below these required for obtaining any notable shortening of persistence. For mixtures of potassium chloride with magnesium chloride, for instance, a decrease in concentration to 0.02 per cent magnesium chloride results in only a normal persistence but the intensity of trace increases 25 per cent.

A still greater intensity or contrast is obtained from mixtures of potassium chloride with barium chloride. Barium chloride is among the weakest of the foreign halides mentioned above in so far as its effect upon shortening of persistence is concerned. A mixture with as much as 5 per cent barium chloride, for instance, gives a barely observable shorening of persistence. When the concentration of barium chloride is still further reduced, for instance to 2 per cent barium chloride, there is no longer any particular effect observable on the persistence but the intensity is increased by about 40 per cent over that obtainable with potassium chloride alone.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A cathode ray device containing a screen consisting of a blend of alkali halide and a halide of alkaline earth metal, the latter halide constituting less than ten per cent of the entire composition.

2. A cathode ray screen consisting mainly of halide of an alkali metal and an associated chloride of the alkali earth metal constituting no more than about five per cent by weight of said alkali halide.

3. A cathode ray screen consisting mainly of potassium chloride and no more than about five per cent of magnesium chloride.

4. A cathode ray screen consisting mainly of potassium chloride and no more than about five per cent of barium chloride.

5. The method of preparing a cathode ray screen which consists in subjecting to fusion a mixture consisting mainly of halide of an alkali metal and up to about ten per cent of an alkaline earth halide, maintaining the temperature adjacent the melting point until agitation ceases and a clear, quiescent fusion results, and subliming the resulting product on a receiving surface in a cathode ray tube.

6. The method of preparing a cathode ray screen which consists in subjecting to fusion a mixture consisting mainly of potassium chloride and up to about five per cent of magnesium chloride, maintaining the temperature adjacent the melting point until agitation ceases and a clear, quiescent fusion results, and subliming the resulting product on a receiving surface in a cathode ray tube.

7. A cathode ray device comprising a glass envelope, a source of cathode rays which are oriented to impinge on a portion of the inner surface of said envelope and a coating on said surface consisting of a pre-fused mixture of alkali halide and alkaline earth metal halide, the latter constituting about 0.3 to 5 per cent by weight of said coating.

8. A cathode ray screen consisting mainly of a mixture of potassium chloride and magnesium chloride, the latter constituting about .3 to 1.0 per cent by weight of said mixture.

9. A cathode ray screen consisting mainly of potassium chloride and approximately five per cent of magnesium chloride.

10. A cathode ray screen consisting mainly of potassium chloride and approximately 5% of a chloride of a member selected from the group consisting of magnesium, zinc, and barium.

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