United States Patent [19]

Yamada

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[45] **June 26, 1973**

[54] **COLOUR DISPLAY TUBES**

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[73] Assignee: **Ise Electronics Corporation**, Mil Prefecture, Japan

[22] Filed: **Aug. 3, 1971**

[21] Appl. No.: **168,682**

[30] **Foreign Application Priority Data**

Aug. 4, 1970 Japan 45/67896
Aug. 4, 1970 Japan 45/67897

[52] **U.S. Cl.** ..... **315/30**, 313/92 PH
[51] **Int. Cl.** **H01j 29/52**
[58] **Field of Search** ..... 313/92 PH, 42 P; 315/30

[56] **References Cited**

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Assistant Examiner—E. E. Lehmann
Attorney—Chittick, Pfund, Birch, Samuels & Gauthier

[57] **ABSTRACT**

In a colour display tube of the type wherein a fluorescent screen is caused to luminesce by irradiating it with an electron beam, the flourescent screen is coated with at least one phosphor having at least two discrete spectral peaks of different excitation and photo-persistence characteristics and there is provided means for varying the interval during which the electron beam is permitted to impinge upon the fluorescent screen whereby to cause it to luminesce at the selected one of the spectral peaks.

6 Claims, 9 Drawing Figures

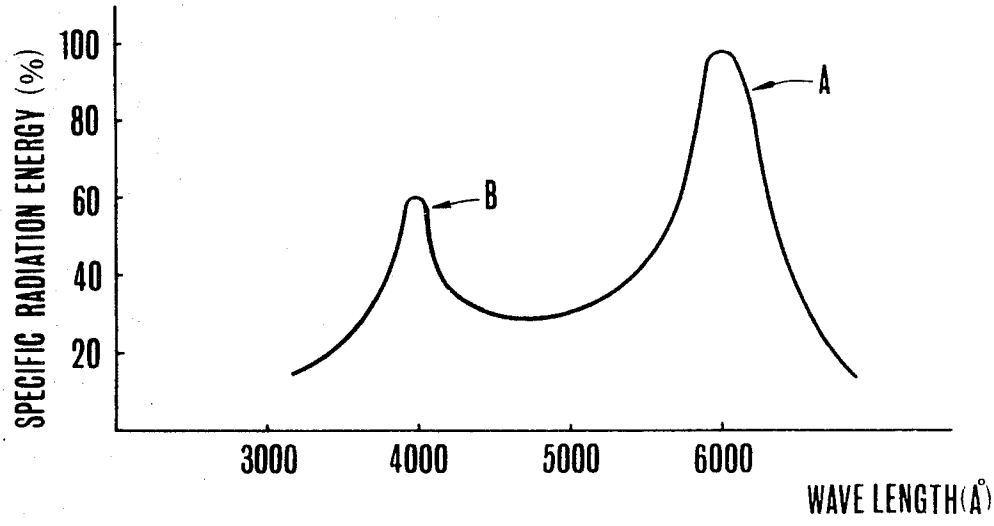

FIG. 1
PRIOR ART

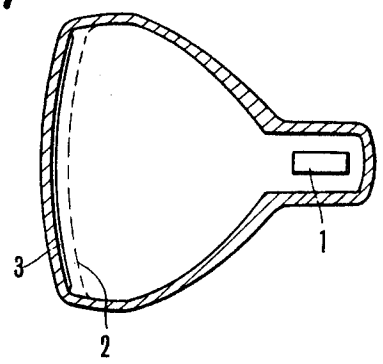

FIG. 2

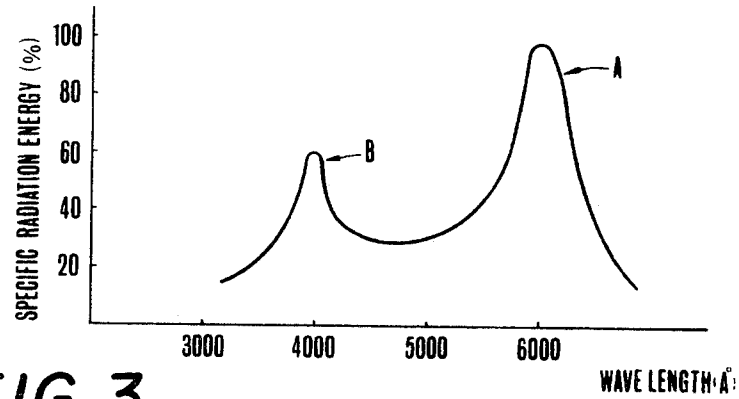

FIG. 3

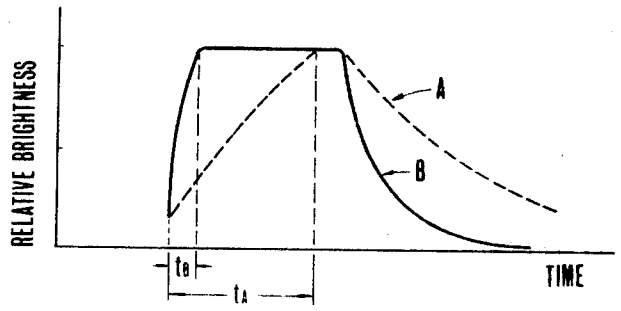

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FIG. 4

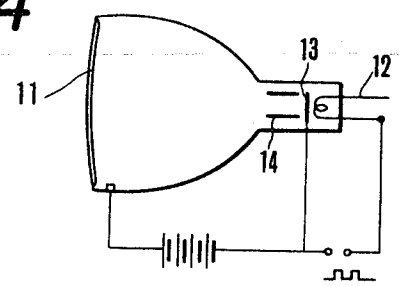

FIG. 5

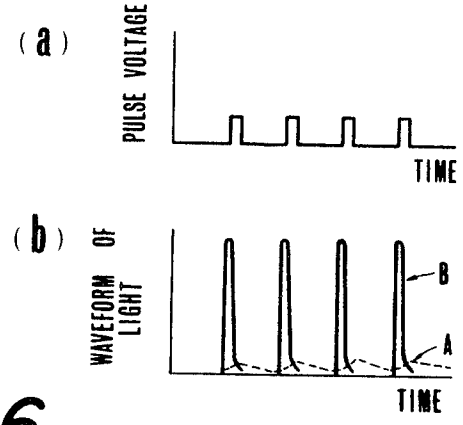

FIG. 6

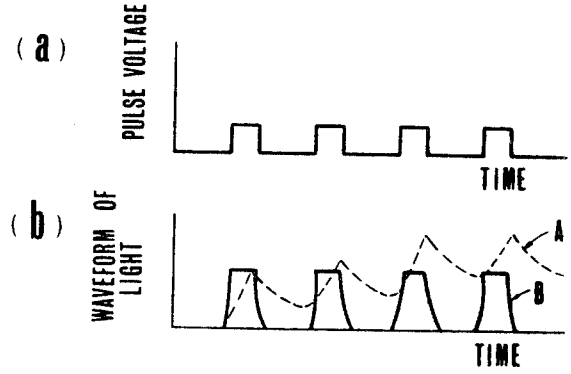

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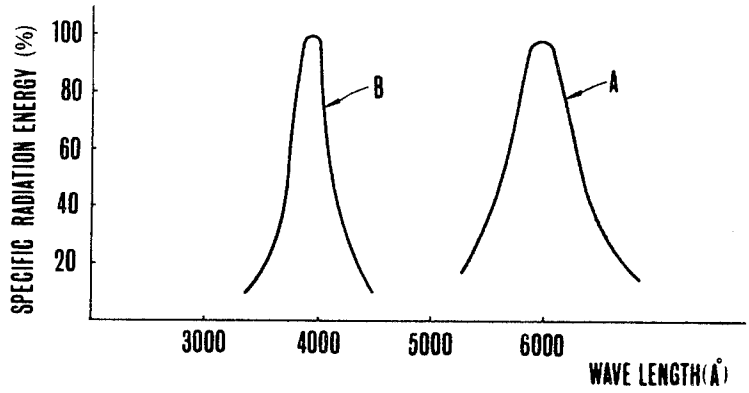
FIG. 7



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COLOUR DISPLAY TUBES

BACKGROUND OF THE INVENTION

This invention relates to a colour display tube, more particularly to a colour display tube such as a colour cathode ray tube, colour fluorescent display tube or the like which displays desired colour patterns.

Various types of colour display tubes have been developed including shadow mask type, Chromatron type, Zebra type, Andromeda type, Sun Flower type, etc.

However, each one of these prior colour cathode ray tubes is difficult to manufacture owing to its complicated operating circuit and it was difficult to provide colour cathode ray tubes of desired characteristics.

For this reason, only few of them are now being used. Taking a shadow mask type colour cathode ray tube as an example, as shown in FIG. **1**, it utilizes three electron guns **1** of red (R), green (G) and blue (B) colours and after being accelerated and focused, three electron beams emanated from these guns, are caused to impinge upon phosphor dots of R, G and B on the face plate **3** through a shadow mask **2** thus causing the dots to luminesce. Such a shadow mask type colour cathode ray tube, however, requires use of three electron guns as well as the shadow mask thus complicating the construction. In other types, for example, Colour Netron and chromatron type colour cathode ray tubes, it is necessary to use colour switching grids.

SUMMARY OF THE INVENTION

It is therefore an object of this invention to provide a new and improved colour display tube having a greatly simplified construction when compared with the prior art colour display tubes.

A more specific object of this invention is to provide an improved colour display tube in which it is not necessary to use three electron guns, a shadow mask of expensive construction and trios of phosphor dots formed on the fluorescent screen as well as colour swithing grids.

According to this invention, these and another objects can be accomplished by providing a colour display tube comprising a source of electron beam, a fluorescent screen coated with at least one phosphor having at least two discrete spectral peaks of different excitation and photopersistency characteristics and means for varying the interval during which the electron beam is permitted to impinge upon the fluorescent screen whereby to cause it to luminesce at the selected one of the spectral peaks.

Where a single phosphor is used, the phosphor is required to have at least two discrete spectral peaks at different wavelengths, whereas when a mixture of phosphors are used such phorphors should have spectral peaks at different wavelengths.

As above described the spectral peaks have different excitation and photopersistancy characteristics, and according to this invention it is possible to cause the display tube to selectively operate at the selected one of the spectral peaks by merely varying the width of the pulse voltage applied upon the control grid. Although it is necessary to use such a source of pulses of variable width it is clear that elimination of the trios of phosphor dots, shadow mask and three electron guns or the colour switching grid electrodes is more advantageous in that elimination of these expensive elements contributes to the simplification of the construction and to the reduction of the manufacturing cost of the display tube.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings

FIG. **1** shows a diagrammatic sectional view of a prior art shadow mask type colour cathode ray tube ;

FIG. **2** shows a luminescence characteristic of a phorphor having two spectral peaks at different colours ;

FIG. **3** is a plot showing the excitation and photopersistency characteristics at two spectral peaks shown in FIG. **2** ;

FIG. **4** is a connection diagram to explain the driving system of a colour display tube having a fluorescent screen coated with a phosphor having two speral peaks;

FIGS. **5***a* and **5***b* show waveforms illustrating the luminescence at two spectral peaks upon application of a pulse voltage of small width ;

FIGS. **6***a* and **6***b* show waveforms illustrating the luminescence at two spectral peaks upon application of a pulse voltage of large width and

FIG. **7** shows luminescence characteristics of two phosphors having discrete spectral peaks.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

First, the excitation and photo-persistence characteristics of the phosphor utilized in this invention will be considered.

As shown by the luminescence characteristic dipicted in FIG. **2**, peak A lies near the wavelength of red whereas peak B near the wavelength of blue. The luminescence used in the present invention is, for example, ZnS : Cu : Mn : Cl or ZnS : Cu : Mn : Ki. The build-up characteristic of the luminescence near peak A is very slow, so that the luminescence does not reach the steady state immediate after excitation . On the other hand, at peak B the build-up is fast and the photopersistency is also short compared to peak A. Further, it is assumed that the intensity of luminescence is lower at peak B than at peak A.

FIG. **3** shows the excitation and the photopersistence charactersistics at these two spectral peaks of different colours in which tB represents the excitation time required for the peak B to reach the steady state which builds-up fast whereas tA the excitation time required for the peak A to reach the steady state which builds-up slowly. The colour display tube embodying the invention comprises a fluorescent screen coated with a phosphor having two spectral peaks of different colours.

FIG. **4** shows a driving circuit of a colour display tube having such a fluorescent screen. The display tube employs a single electron gun of the conventional construction. The colour display tube shown in FIG. **4** comprises a fluorescent screen **11**, a cathode electrode **12**, and first and second electrodes **13** and **14**. A pulse voltage is impressed upon the first grid **13** with one terminal of the cathode electrode **12** grounded. Then an electron beam corresponding to the pulse voltage will be emitted from the electron gun to reach the fluorescent screen **11**.

Where it is desired to luminesce the fluorescent screen with the colour at the spectral peak B of the phosphor, a pulse voltage of small width shown in FIG. **5***a* is applied to the first gride **13** thus causing the electron beam to impinge upon the fluorescent screen.

Then, as shown in FIG. 5*b*, the luminescence exhibits essentially the colour at the peak B and the colour at the peak A of slow build-up does not appear.

Where it is desired to cause the fluroescent screen to luminesce with the colour at the spectral peak A of the phosphor, a pulse voltage of a large width as shown in FIG. 6*a* is impressed. Then, by irradrating the fluorescent screen with the electron beam the peak B luminesces at once with its inherent colour. Peak A is also excited sufficiently to luminesce and, as shown in FIG. 6*b*, increases in intensity as the large width pulses are applied because of its long photo-persistency. If it is designed to cause the intensity of the luminescence at peak B to be larger than that at peak A, a mixed colour corresponding to peaks A and B will be resulted. In this manner, the fluorescent screen coated with a phosphor having two or more spectral peaks can produce variable colours by varying the width of the applied pulse.

Although in the above described embodiment, the invention is applied to a colour cathode ray tube it is to be understood that the invention can also be applied to another type of colour display tube such as a colour fluorescent character display tubes wherein colour patterns are displayed by irradiating a fluorescent screen with an electron beam.

The purpose of the invention can also be accomplished by using two types of phosphors having different spectral peaks thus emanating different colours. More, particularly, the phosphor utilized in the first embodiment can be substituted by a mixture of a first phorphor having a spectral peak A near the wavelength of red and a second phosphor having a spectral peak B near the wavelength of blue, as shown in FIG. 7. The first phosphor may comprise $Zn_3(PO_4)_2$: Mn, MgF_2 : Mn or Mg SiO_3 : M_n whereas the second phosphor may comrpise $(Ca, Mg)_2$ SiO_3 : Ce, ZnS : Ag or ZnO : Zn. Like the phosphor shown FIG. 2, the peak A shown in FIG. 7 has a relatively slow build-up and relatively long decay or photo-persistency, whereas peak B has a relatively fast buid-up and short photo-persistency. In other words the second phosphor has a quick response to the electron beam.

For this reason, the excitation characteristics and the photo-persistency characteristics of the first and second phosphors can also be shown by FIG. 3. For example, the half-period of $Zn(PO_4)_2$: Mn (the first phosphor) equals 10 n_{sec}, whereas that of $(CaMg)_2$ SiO_2 : Ce (the second phosphor) equals 0.03μ_{sec}. It is advantageous to make larger the intensity of luminescence of the second phosphor than that of the first phosphor for the same excitation power. However, it wll be clear that the same result can also be accomplished by varying the ratio of admixture of the two phosphors. It is also possible to admix three of more phosphors having different spectral peaks or emanating different colours.

Thus, the invention provides a colour display tube capable of emanating different colours by merely coating a phosphor having a plurality of spectral peaks or a mixture of phosphors having different peaks upon a fluorescent screen. Thus the construction and the manufacturing of the tube can be greatly simplified. Although, it is necessary to provide a source of pulse voltage to operate the tube, such source is simple and inexpensive.

What is claimed is:

1. A colour display tube comprising a source of electron beam, a fluorescent screen coated with at least one phosphor having at least two discrete spectral peaks of different excitation time and photo-persistency characteristics and means for varying the intervals during which said electron beam is permitted to impinge upon said fluorescent screen whereby to cause it to luminesce at the selected one of said spectral peaks.

2. The colour display tube according to claim 1 wherein said phosphor comprises a single phosphor having at least two discrete spectral peaks at different wavelengths.

3. The colour display tube according to claim 1 wherein said phosphor comprises a mixture of at least two phosphors having spectral peaks at different wavelengths.

4. The colour display tube according to claim 1 wherein one of said phosphor comprises a member selected from the group consisting of $Zn_3(PO_4)_2$: Mn, MgF_2 : Mn and $MgSiO_3$: Mn and the other phosphor comprises a member selected from the group consisting of $(Ca.Mg)_2$ SiO_3 : Ce, ZnS : Ag and ZnO : Zn.

5. The colour cathode ray tube according to claim 1 wherein said means comprises a source of pulse voltage of variable width.

6. The colour display tube according to claim 1 wherein said varying means causes said intervals to be short to cause said screen to luminesce at essentially only that one of said spectral peaks having the shorter excitation time, and said varying means causes said intervals to be long to cause said screen to luminsece at that one of said spectral peaks having the longer photo-persistency.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,742,291 Dated June 26, 1973

Inventor(s) Isao Yamada

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Change "[73] Assignee: Ise Electronics Corporation, Mil Prefecture, Japan"

to -- [73] Assignee: Ise Electronics Corporation, Ise City, Mie Prefecture, Japan --

Signed and sealed this 15th day of January 1974.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

RENE D. TEGTMEYER
Acting Commissioner of Patents

UNITED STATES PATENT OFFICE
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