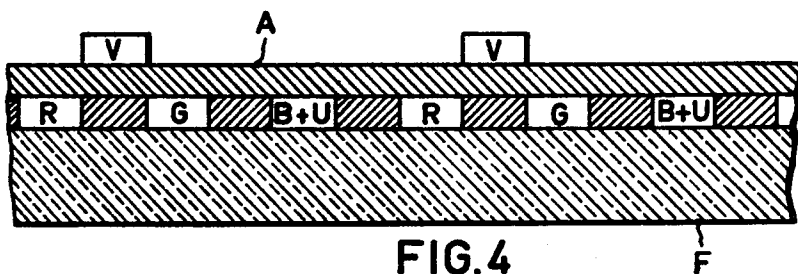
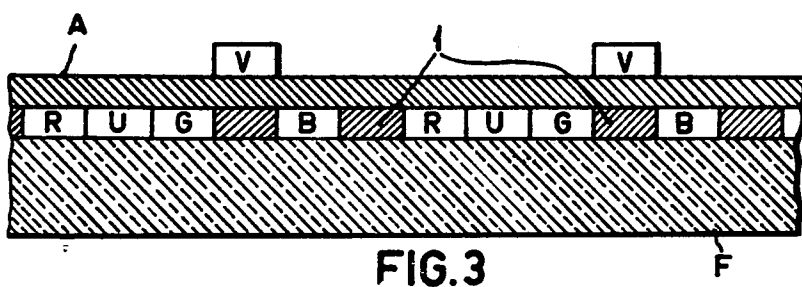
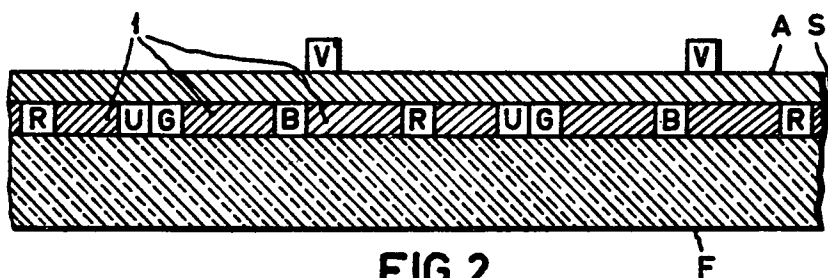
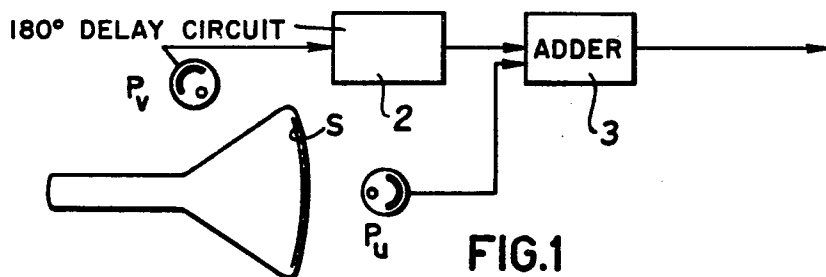


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BEAM-INDEXING PICTURE DISPLAY SYSTEM WITH TWO
SETS OF INDEXING STRIPES

SETS OF INDEXING STRIPES

2 Sheets-Sheet 1



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3,154,715

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2 Sheets-Sheet 2

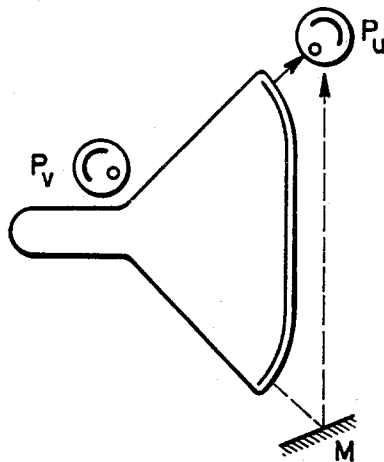


FIG. 5

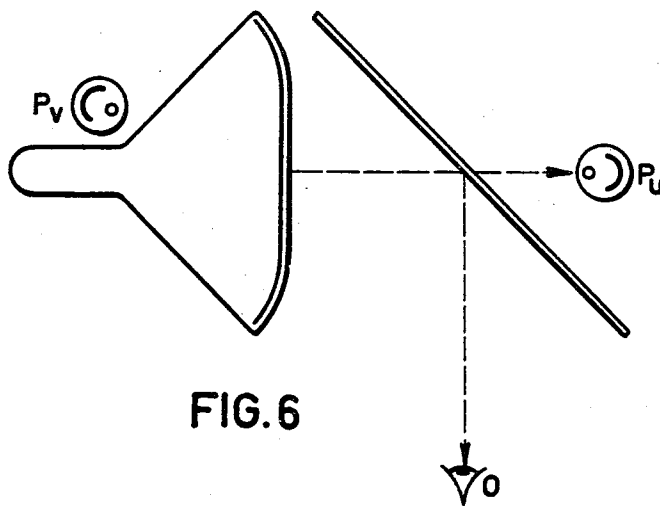


FIG. 6

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BEAM-INDEXING PICTURE DISPLAY SYSTEM WITH TWO SETS OF INDEXING STRIPES

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This invention relates to a beam-indexing picture tube for colour television display systems.

This invention relates to a beam-indexing picture tube for colour television display comprising a display screen formed as an iterative pattern of groups of two or more luminescent display stripes with each stripe of a group adapted to produce light in a differing colour, a backing layer formed on the electron-gun side of said screen, a first set of ultra-violet photo-emissive indexing stripes parallel to said display stripes which set has the same pitch as that of said pattern, and a second set of ultra-violet photo-emissive indexing stripes of the same pitch parallel to those of the first set and interleaved therebetween.

In such beam-indexing picture tubes, information is derived either continuously or periodically about the position of the light spot relative to the array of phosphors on the tube screen. This information is used either to maintain the correct positional relationship between the spot and the phosphor array, or to maintain the correct time relationship between the colour signal which is applied to the beam intensity control electrode and the spot position.

It has been proposed to use two or more interleaved sets of indexing stripes to obtain a corresponding number of partial indexing signals of substantially sinusoidal form having differing phases, together with means for combining said partial indexing signals so as to produce a single final indexing signal. One such system is described in copending patent application Serial No. 43,814, filed July 19, 1960, which discloses the manner in which two or more partial indexing signals are derived from the picture tube, from which signals the desired beam-positional information can be derived substantially free from colour cross-talk.

In the latter arrangement, luminescent colour stripes of the display system may be associated with photo-cells so as to act also as indexing stripes. Alternatively the indexing stripes may all be stripes other than the visibly luminescent display stripes, for example secondary-emissive or ultra-violet emissive stripes provided solely for indexing purposes. As a third alternative, a combination of visibly and non-visibly emissive stripes may be used for indexing purposes. However, all these solutions present practical difficulties. The use of secondary emission has well-known disadvantages of its own, and these may be aggravated if a set of secondary-emissive stripes for a first partial indexing signal is combined with a second system having very different characteristics, e.g. a set of phosphor stripes acting on a photo-cell to provide a further partial signal. On the other hand, the use of the colour phosphor display stripes for indexing purposes is liable to impose limitations, e.g. in respect of the number of picture elements that is scanned per unit time and the noise levels that can be tolerated. This applies more particularly to red and green phosphors because of the relatively poor response of photo-cells to red light and the relatively long decay characteristics of practical red and green phosphors.

The use of phosphors radiating in the ultra-violet, violet or blue part of the spectrum can overcome these problems

for one signal since these phosphors can have a relatively short decay time and photo-cells can be found having a good sensitivity to ultra-violet, violet or blue radiation. However, when more than one indexing signal is required, a further difficulty arises inasmuch as it is not readily possible to differentiate between two or more sets of ultra-violet, violet and/or blue emitting stripes. Even if the radiations are of differing wavelengths, effective separation filters for the photo-cells cannot be obtained in practice.

This objection can be eliminated if in accordance with the present invention a beam-indexing picture tube for colour television is characterized in that the first set of indexing stripes is provided on the inner side or rear of the backing layer and the second set of indexing stripes is provided on the outer side or front of the backing layer whereas said backing layer is substantially opaque to radiation emitted by any of said indexing stripes.

This arrangement permits one ultra-violet photo-sensitive pick-up device to be located so as to view the set of indexing stripes on the inner or gun side of the luminescent screen and another pick-up device to view the other set on the outer side or front of the screen, the arrangement being such that the radiation from the one set is substantially excluded from being received by the pick-up device pertaining to the other set and vice versa, due to the fact that the backing layer is opaque to radiation from any of the indexing stripes.

Indexing stripes forming a third set may be added but, if it relies on radiation, its radiation will have to be distinguished from that of the other set located on its side of the backing layer by means (e.g. filters) other than the backing layer. In this case the indexing stripes of the three sets will preferably be disposed at equal distances along the screen so as to produce three partial signals 120° out of phase with each other. However, it is preferred to employ a beam-indexing tube having three stripes in each group of luminescent stripes for display in three colours, and only two indexing stripes for each group of three luminescent stripes, the indexing stripes of one set being symmetrically interleaved between those of the other set. Such a tube permits two partial indexing signals to be obtained which signals are 180° apart.

The backing layer may be a metallic layer having the same functions as a conductive layer usually provided in picture tubes.

Since the backing layer is substantially opaque to radiation from the indexing stripes, it permits two photo-cells to be placed in such positions that each receives substantially only radiation from one set of indexing stripes, and the two sets may employ phosphors of the same composition.

Specific embodiments of the invention will now be described by way of example with reference to the accompanying diagrammatic drawings in which:

FIGURE 1 shows a picture tube and block-schematic circuit elements for producing an indexing signal substantially free from cross-talk,

FIGURE 2 is a horizontal cross-section of part of the display screen of a colour tube suitable for the circuit of FIGURE 1,

FIGURES 3 and 4 are cross-sections of alternative screen arrangements, and

FIGURES 5 and 6 show how two pick-up devices can be situated at the rear and at the front side of the picture screen.

Referring now to FIGURES 1 and 2, and first more particularly to FIGURE 2, F is the glass screen support (which is preferably the face of the tube), S is the phosphor screen, and A is a backing layer which may be of aluminium. The phosphor screen comprises triplets

of stripes of the three colour phosphors red (R), green (G) and blue (B) between which guard-bands 1 are provided and a first set (U) of indexing phosphor stripes adapted to emit ultraviolet radiation forwardly. A further set (V) of stripes of ultraviolet emissive phosphor is deposited on the rear or electron-gun side of the backing layer A. The disposition of these phosphors will be discussed later, but it will be noted here that each (U) stripe forms part of a guard-band 1 between the red (R) and green (G) phosphor stripes.

In FIGURE 1, *Pu* and *Pv* are photo-cells sensitive substantially only to ultra-violet radiation. By virtue of their physical positions, cell *Pu* will receive radiation substantially only from stripes (U) and *Pv* substantially only from stripes (V). This is because the density of the backing layer A is such that substantially no radiation from stripes (U) can pass through the layer to cell *Pv* and vice versa. Thus two independent partial indexing signals are obtained and the phases of one or both may be shifted so that they coincide and can be added together to form the desired final indexing signal as previously described in the aforesaid patent application Serial No. 43,814. In the circuit shown, this is achieved by delaying the phase of the *Pv* signal by 180° in device 2. Thereafter it is applied to a device 3 to which also the signal from the cell *Pu* is applied. Both signals are added together in the device 3 so that at the output thereof the final indexing signal is attained.

The actual disposition of the stripes in FIGURE 2 is intended to fulfil simultaneously two conditions which, however, do not always have to be adhered to, these being:

- (a) That the sets of indexing stripes be spaced apart uniformly, and
- (b) That no phosphor stripe (whether for display or indexing) should overlap any other phosphor stripe.

As regards condition (a), the indexing stripes of sets (U) and (V) of FIGURE 2 have their centres 180° apart on the basis of each colour triplet system representing a 360° cycle.

As for condition (b), this is a beam energy consideration and ensures that a phosphor at the back of the screen does not absorb electrons at the same time as the beam should be exciting a further phosphor located in front of the backing layer.

In the arrangement of FIGURE 2 the guard-bands 1 occupy a relatively large area of the screen with consequent limitation of the efficiency of the system. This is overcome in the arrangement of FIGURE 3 where the width of all the stripes is doubled and the width of the guard-bands 1 is correspondingly reduced while maintaining the conditions (a) and (b).

In a further arrangement, ultra-violet emissive phosphor is mixed together with a colour phosphor to provide, simultaneously from the same stripe, a colour output and an invisible indexing output, the indexing stripe position consequently being coincident with the colour stripe position. Thus each blue (B) stripe may be combined with an ultra-violet (U) stripe to form a single mixed stripe having a width twice that of the stripes of FIGURE 2, and FIGURE 4 shows how such an arrangement can be made to fulfil the condition (a). As for condition (b), it is true that the blue (B) and ultra-violet (U) components of a mixed ("B+U") stripe take energy simultaneously from the electron beam, but this is partly compensated for by the fact that a smaller luminous output is required from the blue phosphor than from the red and green phosphors. The tube screen of FIGURE 4 is suitable for the circuit of FIGURE 1.

Although the screen arrangements of FIGURES 2 to 4 are suitable for circuits in accordance with the aforesaid prior patent specification, they may be applied to other circuits requiring a plurality of partial indexing signals.

A suitable range of ultra-violet wavelengths is 3800–4000 Å., in which case the (U) and (V) phosphors may be of the kind available commercially under the designation P16.

In the special case of mixed phosphor stripes such as the stripes ("B+U") of FIGURE 4, the coincidence of the positions of blue and ultra-violet offers the further advantage that any blue light that may reach and influence the photo-cell *Pu* will reinforce the partial indexing signal thereof in spite of the relatively long decay time of the blue phosphor.

As regards the backing layer, the thickness of the usual aluminium film deposited behind the phosphor layer in television picture tubes is such that the light transmission backwards is only one or two percent of the light output in the forward direction. The high reflectivity of the film (90%) more than compensates for the loss in energy of electrons passing through the film. Aluminium films of this thickness retain their high reflectivity for a wide range of wavelength—in fact down to 2,000 Angstroms, which is well beyond the aforesaid ultra-violet range of 3,800–4,000 Å.

It is desirable to minimize the changes in the amplitudes of the partial indexing signals that occur during scan as a result of changes in the position of the beam in relation to the photo-cell system and consequent variations in the amount of radiation gathered. The main reason is that such amplitude changes can cause unwanted changes in the phasing of the final indexing signal if the changes in amplitude of one partial signal differ from those of the other. The problem is aggravated at the front of the screen by the fact that a photo-cell cannot be located in a central position (such as *Pu* in FIGURE 1) without interfering with the viewing of the screen display. This specific problem can be eased in various ways, as exemplified in FIGURES 5 and 6 of the accompanying diagrammatic drawing.

In FIGURE 5 (which is a side elevation) the system in front of the screen employs a cell *Pu* which gathers direct radiation mainly from the upper half of the screen, radiation from the lower half being largely gathered by reflection from a mirror M extending along the lower edge of the screen. This arrangement leaves a clear field for viewing the screen and also permits the overall depth of the apparatus (in the viewing direction) to be kept compact.

In the alternative arrangement of FIGURE 6 (which is a plan view) the axis of the picture tube is turned through 90° with respect to the observer and the screen is viewed through a vertical mirror M' located at 45° to the tube axis. The mirror M' is semi-transparent and thus provides an unobstructed central view of the screen both to the photo-cell *Pu* and to an observer at O (the positions of the cell and observer can, of course, be exchanged). Instead of lying horizontally, the tube axis of the arrangement of FIGURE 6 may be orientated in the vertical direction so that the cell *Pu* lies above the mirror M' instead of to one side.

It will also be clear that instead of using a mixed phosphor B+U as shown in FIGURE 4, a normal phosphor may be used which emits radiation situated in the blue part of the spectrum. The cell *Pu* as shown in FIGURE 5 must then be sensitive to blue radiation only so that the blue (B) phosphor stripes at the same time act as indexing stripes at the front of the screen.

Another possibility is to compose the material of the indexing stripes (V) at the rear of the screen such that these stripes will emit radiation situated in the violet or blue part of the spectrum. The decay time of such stripes is quick enough to let them act as indexing stripes and the radiation, which is now situated in a visible part of the spectrum, is not seen by the observer O due to the opaque backing layer. It will be clear that in this case the cell *Pu* must be sensitive to the said violet or blue radiation from the stripes (V).

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What is claimed is:

1. A display screen for a color television beam-indexing picture tube, said screen comprising an iterative pattern of a plurality of groups of luminescent display stripes with each stripe of a group being adapted to produce light of a different color, a backing layer provided on one side of said stripes, a first set of indexing stripes parallel to said display stripes on the same side of said backing layer, and a second set of indexing stripes parallel to said display stripes on the other side of said backing layer, said first and second sets having the same pitch as that of said iterative pattern of display stripes, said second set being interleaved with said first set, said backing layer being substantially opaque to radiation emitted by the stripes of said first and second sets.

2. In a beam-indexing tube for color television, a display screen comprising a transparent support member, an iterative pattern of a plurality of groups of luminescent display stripes on the electron gun side of said support member, the stripes of each group being adapted to produce light of different colors, a backing layer on the side of said stripes away from said support member, and first and second sets of indexing stripe means parallel to said display stripes on opposite sides of said backing layer, said first and second sets having the same pitch as that of said iterative pattern of display stripes, said first and second sets being interleaved, said backing layer being substantially opaque to radiation emitted by said indexing stripe means.

3. In a beam-indexing tube for color television, a display screen comprising a transparent support member, an iterative pattern of a plurality of parallel groups of parallel stripes on the electron gun side of said support member, a backing layer on the side of said stripes away from said support member, and a set of stripes parallel to the stripes of said groups on the other side of said backing layer, the stripes of said set having the same pitch as that of said pattern, at least two of the stripes of each of said groups being luminescent display stripes adapted to produce light of different colors, at least one

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of the stripes of each of said groups being ultra-violet photo-emissive, the stripes of said set being ultra-violet photo-emissive, the photo-emissive stripes of said groups being interleaved with the stripes of said set, said backing layer being substantially opaque to the ultra-violet radiation emitted by the photo-emissive stripes of said groups and set.

4. The display screen of claim 3, in which said ultra-violet photo-emissive stripes of said groups contain luminescent phosphors for producing light of a different color than the other stripes of the respective group.

5. The display screen of claim 4, in which said luminescent phosphors produce blue light.

6. The display screen of claim 3, in which the stripes of each of said group produce light of three colors and only one stripe of each group is ultra-violet photo-emissive, and the stripes of said set are symmetrically interleaved with said photo-emissive stripes of said groups.

7. A color television system comprising a beam-indexing picture tube having a display screen, said display screen comprising a transparent support member, an iterative pattern of a plurality of groups of luminescent display stripes on the electron gun side of said support member, the stripes of each group being adapted to produce light of different colors, a backing layer on the side of said stripes away from said support member, and first and second sets of indexing stripe means parallel to said display stripes on opposite sides of said backing layer, said first and second sets having the same pitch as that of said iterative pattern of display stripes, said first and second sets being interleaved, said backing layer being substantially opaque to radiation emitted by said indexing stripe means, and first and second photo-cell means positioned to receive radiation from said first and second sets respectively.

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