May 14, 1968 F. C. ALPERS 3,383,547

COLLIMATED COLOR TELEVISION DISPLAY TUBE

Filed Oct. 15, 1965 2 Sheets-Sheet 1

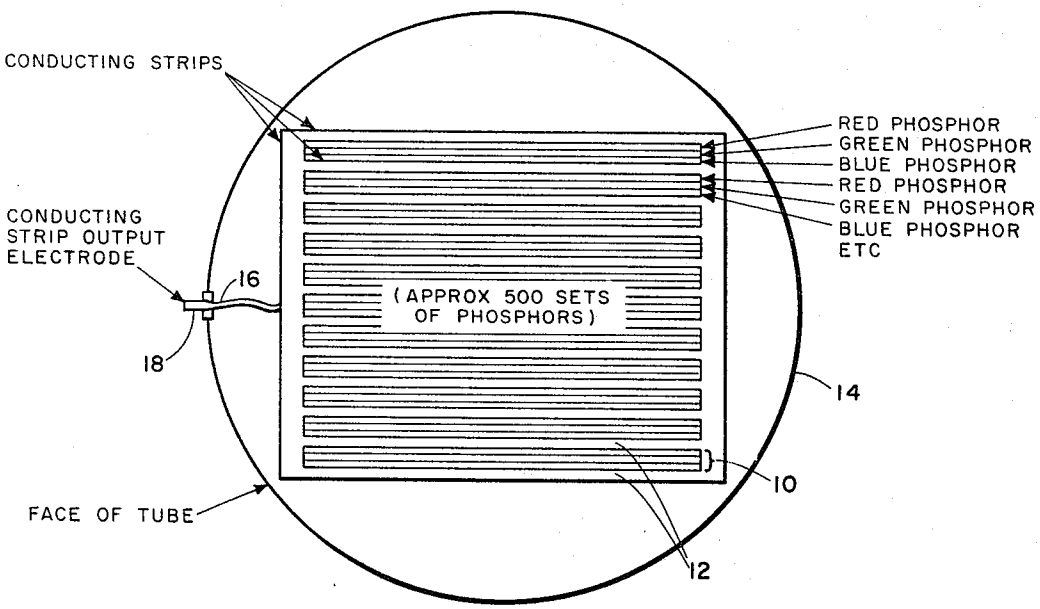


FIG. 1

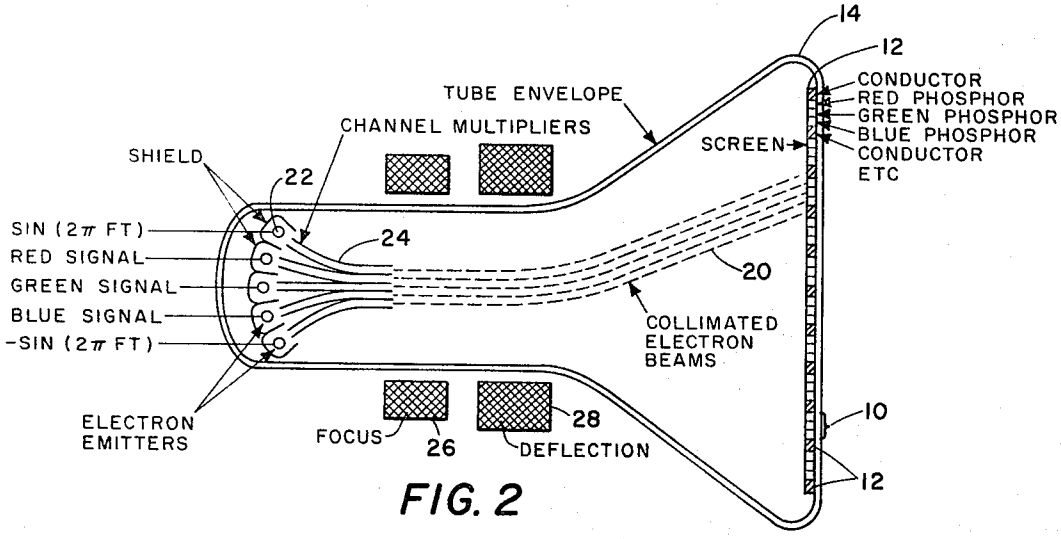


FIG. 2

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COLLIMATED COLOR TELEVISION DISPLAY TUBE

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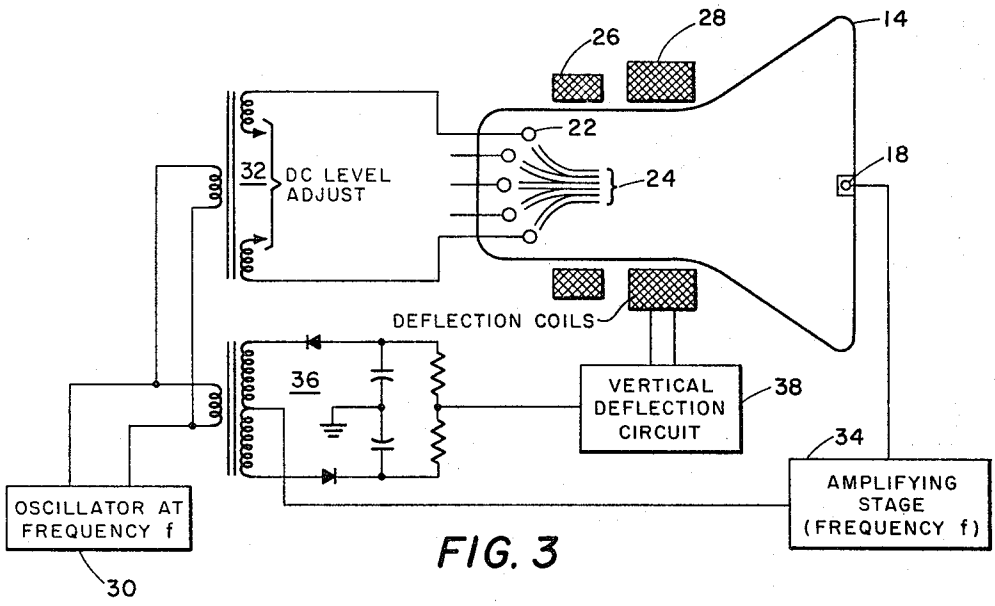


FIG. 3

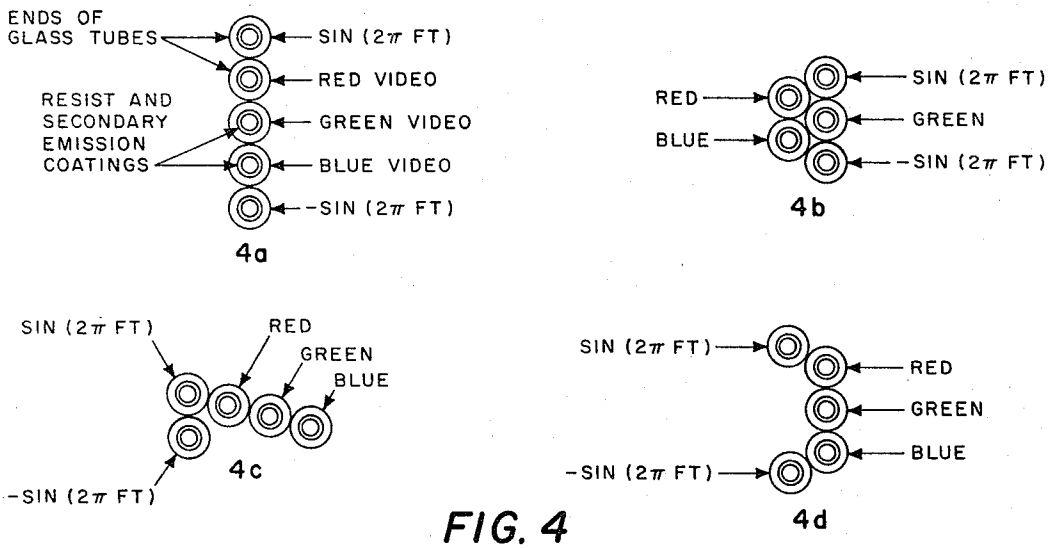


FIG. 4

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COLLIMATED COLOR TELEVISION DISPLAY TUBE

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6 Claims. (Cl. 315—13)

The invention herein described may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

The present invention relates to multiple beam color television display tubes and more particularly to a collimated multiple beam color television display tube wherein a collimated group of five closely spaced electron beams is provided, with the three inner beams carrying color signals and the two outer beams being used for indexing purposes so as to achieve accurate alignment and simplification in circuitry.

In prior known multiple beam systems, each individual beam has been formed by an electron gun arrangement involving a heater, cathode, control grid, and focusing electrode; and the resulting space requirement has made it impractical to build multiple units sufficiently close together to produce a series of parallel beams which are spaced only one phosphor bar apart and which are all focused and deflected by a single set of focusing and deflection coils or electrodes.

The present invention provides a color television display tube which is better suited for airborne purposes than prior known devices because it leads to an overall system which is simpler in construction, more readily retained in alignment, and more efficient. The tube is of the color-bar-type screen, except that narrow conducting strips are positioned between the separate sets of tri-color phosphors. Five collimated electron beams, spaced only one phosphor width apart, are produced by a stack of five channel multipliers whose output ends are similarly spaced. Signals are fed into the respective channel multipliers as electrons emitted from separate cathodes which may be of a radioactive type. The three central beams are intensity modulated to carry the tri-color display information. The two outside beams carry test signals of opposite phases which impinge on adjacent conducting strips on the screen and cancel each other when the inner color signal beams are aligned with the phosphor color bars, or which impinge by unequal amounts when there is misalignment and produce a sum signal of a phase indicative of the direction of misalignment.

Accordingly, an object of the invention is to provide an improved color television display tube that is simpler in construction, more retentive of alignment, and more efficient than prior known systems.

Other objects and many of the attendant advantages of this invention will become readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

FIG. 1 is a diagram showing the arrangement of phosphors and conducting strips on the screen of a color tube embodying the invention.

FIG. 2 is a cutaway side view of the color tube embodying the invention.

FIG. 3 is a schematic diagram of the modulation-frequency oscillator connections and beam vertical alignment feedback circuit for use with the color tube embodying the invention.

FIG. 4 shows diagrams of various arrangements of output ends of channel multipliers in a color tube embodying the invention.

Referring now to the drawings, wherein like reference characters designate like or corresponding parts throughout the several views, there is shown in FIG. 1 a plurality of sets of red, green, and blue phosphor bars **10** separated by conducting strips **12** forming the screen on the face of a television receiving tube **14**. Conducting strips **12** are connected by lead **16** to an output electrode **18**. Five collimated electron beams **20** for sweeping the screen of tube **14** are generated by five shielded electron emitters **22** stacked in a vertical plane as shown in FIG. 2. Each beam passes through a channel multiplier **24** where it is amplified and brought into a close and even parallel spacing (i.e., is collimated) with the neighboring beams. Simultaneous focusing and deflection of the five beams **20** are accomplished by means of focus coil **26** and deflection coil **28** respectively.

The color display is produced by the middle three electron beams **20** being swept along three phosphor bars **10**, with the sweep continuing until all parallel sets of phosphor bars **10** have been swept to complete a two-dimensional display. Each of the three beams is separately modulated by intelligence signals received at the electron emitters **22**. For a standard television display, bars **10** would run horizontally across the screen or face of tube **14**; would produce red, green, and blue-violet light respectively; and would be very thin in the vertical dimension so that approximately 500 sets (more if a higher-than-standard resolution is desired) could be uniformly spaced within the useful area of the screen.

The adjacent sets of color phosphors **10** are separated by narrow strips of conducting material **12** which may be fabricated by printed circuit techniques. All of strips **12** are connected together and connected by means of a conductor **16** brought out of tube **14** to terminal **18**. The function of conducting strips **12** is to help keep the electron beams **20** modulated by red, green, and blue signals centered respectively on the red, green, and blue phosphor bars **10**.

The upper and lower beams (alignment beams) of collimated beams **20** are positioned in relation to the other beams so that they will strike the conducting strips **12** immediately above and below a set of bars **10**. The alignment beams carry no video information, but a simple modulation signal (e.g., a sine wave) at some frequency f which is high compared to the horizontal scan frequency (i.e., for a standard raster $f>>15$ kc.). The modulation signal is supplied by oscillator **30** and is coupled to the upper and lower electron emitters **22** by means of coupling transformer **32** (FIG. 3). The phase of the modulation signal imposed on the lower beam is the opposite of that on the upper, and when the two beams are both striking a conducting strip, the alternating signal at conducting strip output electrode **18** is zero. Conducting strips **12** should be made wider in the vertical dimension than the individual color beam **10** and the five beams are positioned so that the upper beam impinges on the lower edge of the upper conducting strip and the lower beam impinges on the upper edge of the lower conducting strip when the three color beams are in proper color alignment. When the five beams **20** begin to trace higher than they should on some particular line which would disturb the registration of red video on red phosphor, etc., the upper alignment beam remains in contact with the strip above the set of color phosphors after the lower beam begins to leave its strip and strike the lower (i.e., the blue) phosphor, and this imbalance of alignment beams results in a signal at strip output electrode **18** of frequency, f, and of a phase coincident with that of the upper beam.

The output signal at electrode **18** is fed through an amplifying stage **34** to a balanced sensing circuit **36**

which provides a corrective signal to vertical deflection circuit 38 until vertical alignment is restored.

The five beams arrangement is realized through the use of the five channel multipliers 24. Each multiplier consists of a very small diameter glass tube, normally less than an inch in length, with the inside coated with both a resist and a secondary emission coating. A high voltage of approximately 2000 volts is required across the element so that electrons which enter the input end are accelerated up the center hole, striking the sides and producing electron multiplication as they go. The input ends of channel multipliers 24 receive electrons from electron emitters 22, and the high number of electrons emerging from the output ends form the electron beams which are accelerated toward the very high potential of the screen at the face of tube 14. The same power supply may supply all multipliers. Single focus coil 26 and single deflection coil 28 serve all five beams. The output ends of channel multipliers should extend into the effective region of focusing coil 26 so that as the respective beams are propagated through the channels they are almost completely focused before passing the ends. For a tube where the outside diameter of the channel multipliers are compatible with the desired beam spacing, the multipliers can be stacked in a vertical column with output ends as shown in FIG. 4*a*. For more compact tubes, arrangements can be made as in FIG. 4*b* or 4*c*. The difference in horizontal position of the three center channel multipliers which carry the color signals can be compensated for by the insertion of suitable short delay lines in one or two of the video amplifier channels ahead of the tube. With sharp beam focusing the arrangement of FIG. 4*d* can serve the alignment maintenance function when the conducting strips 12 are no wider, or even narrower, than the individual color bars 10. Horizontal centering and raster alignment may be had by detecting the marked increase in current the strip electrode 18 when all five beams strike the conducting strip 12 around the edge of the raster, and providing suitable feedbacks to control deflection centering and amplitude.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. In a collimated multiple beam color television display tube, the combination comprising:

(a) a display reproducing screen,

(b) groups of parallel bars on said screen, each group including color bars emitting light of different color when impinged upon by radiant energy and arranged in a predetermined pattern between two conducting bars,

(c) beam producing means generating a plurality of radiant energy beams equal to the number of bars in each group of bars and arranged in said predetermined pattern so that a single beam will impinge only on the corresponding bar according to said predetermined pattern,

(d) means for applying a first sine wave modulating signal to the beam impinging on one of said two conducting bars,

(e) means for applying a second sine wave modulating signal of opposite phase to said first sine wave modulating signal to the other of said two conducting bars whereby each sine wave modulated beam impinges the same on its corresponding conducting bar,

(f) means coupled to said conducting bars and being responsive to any signal produced by unequal impingement of said sine wave modulated beams on their corresponding conducting bars to return said modulated beams to equal impingement.

2. The combination of claim 1 wherein said groups of parallel bars include three color bars between two conducting bars.

3. The combination of claim 2 wherein said beam producing means includes five channel multipliers stacked in a vertical plane.

4. The combination of claim 3 wherein said first sine modulated signal is applied to one of the outside channel multipliers and the other of said sine wave modulated signals is applied to the other outside channel multiplier.

5. The combination of claim 3 wherein the two outside channel multipliers produce the beams that impinge on the conducting bars.

6. The combination of claim 5 wherein the upper beam impinges on the lower edge of the upper conducting bar and the lower beam impinges on the upper edge of said lower conducting bar.

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