Aug. 11, 1970 G. A. BURDICK ET AL 3,524,093
TIME DEPENDENT COLOR PURITY CORRECTION FOR A COLOR CATHODE RAY TUBE
Filed April 24, 1968 3 Sheets-Sheet 1

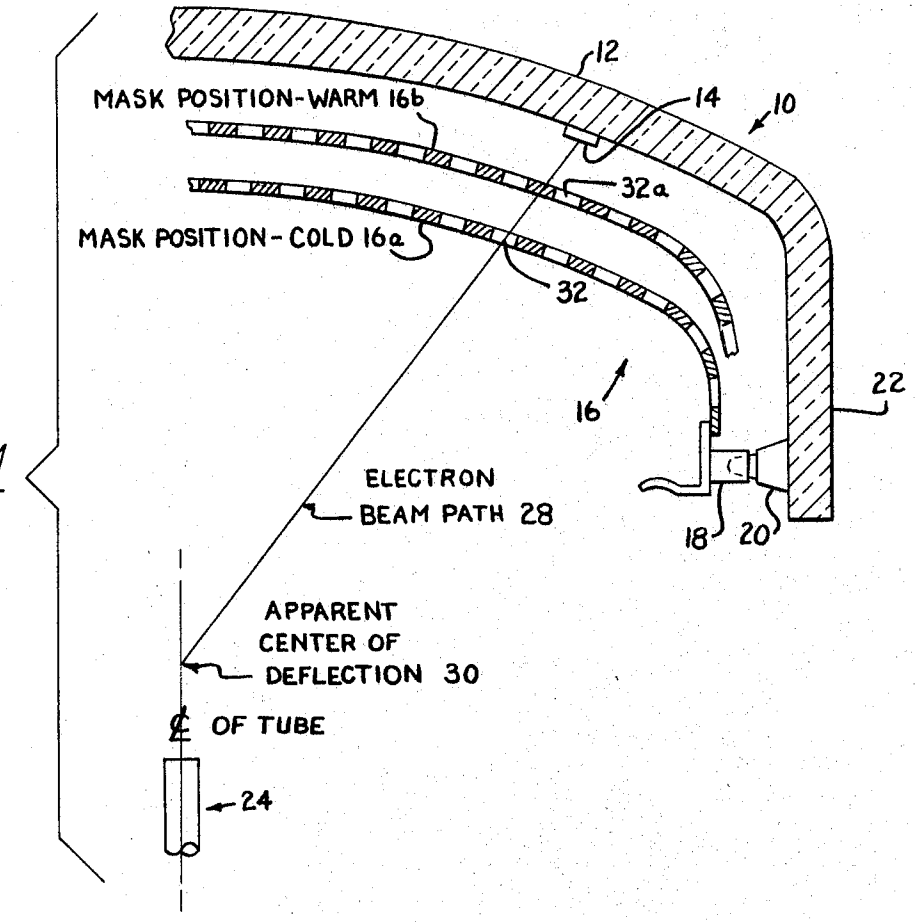


Fig. 1
PRIOR ART

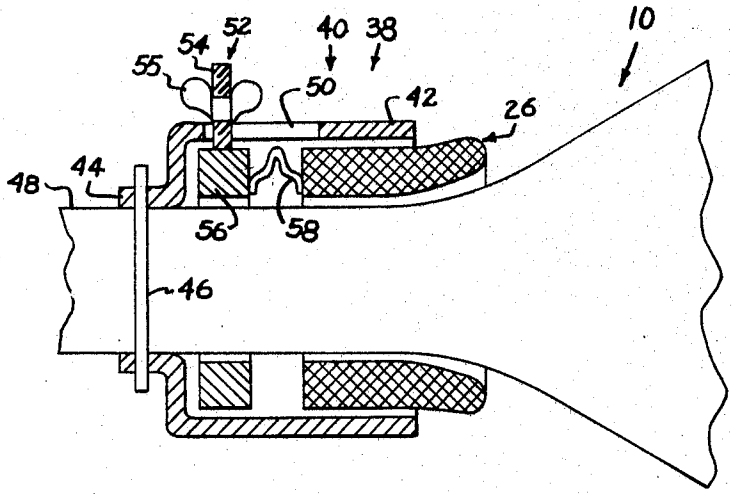
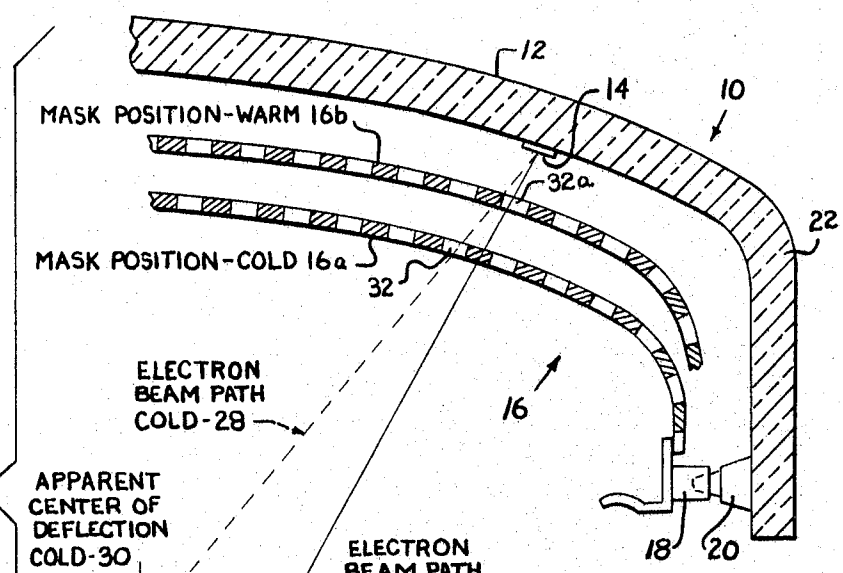


Fig. 3

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Aug. 11, 1970 G. A. BURDICK ET AL 3,524,093
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Fig. 2



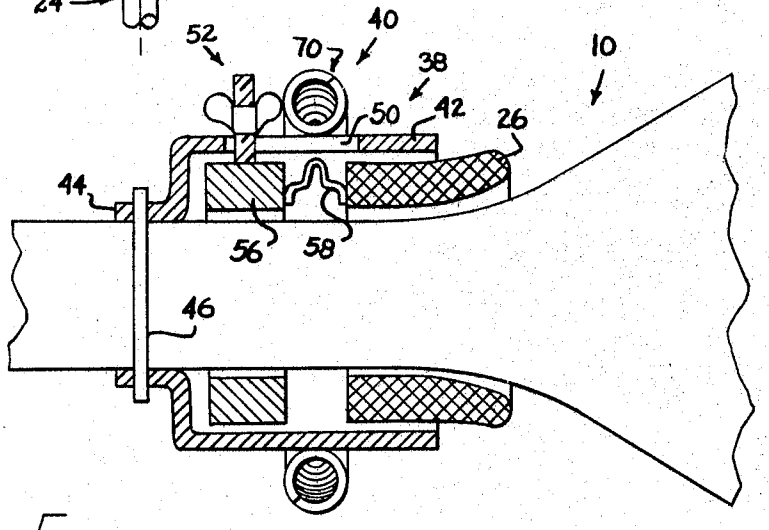


Fig. 5

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TIME DEPENDENT COLOR PURITY CORRECTION FOR A COLOR CATHODE RAY TUBE

Filed April 24, 1968 3 Sheets-Sheet 3

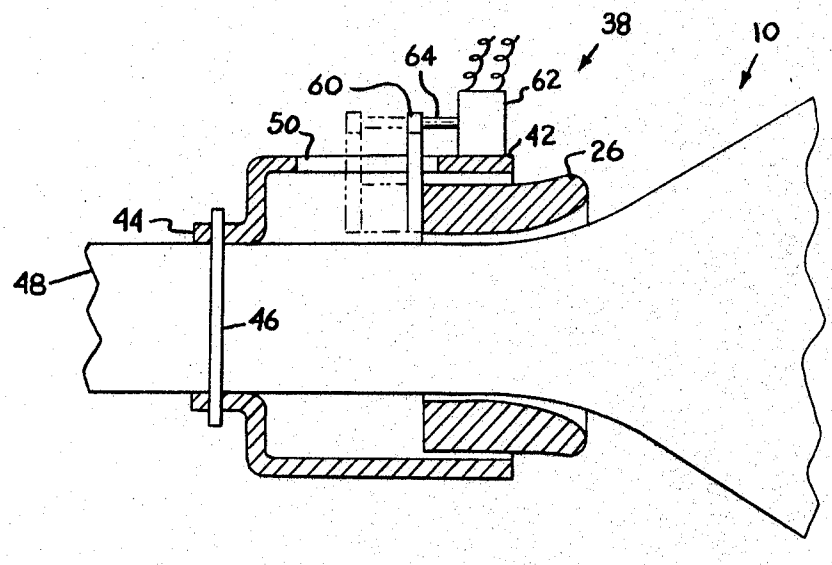


Fig. 4

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3,524,093

TIME DEPENDENT COLOR PURITY CORRECTION FOR A COLOR CATHODE RAY TUBE

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Int. Cl. H01j 29/06, 29/76
U.S. Cl. 313—75 3 Claims

ABSTRACT OF THE DISCLOSURE

Continuous color purity correction is provided by means of temperature responsive deflection yoke which is capable of changing the apparent center of deflection in a color tube to compensate for temperature-caused expansion of the shadow mask. The means comprises generally a fixed housing having a deflection yoke slidably mounted therein and a temperature or time dependent element connected thereto for moving the yoke.

BACKGROUND OF THE INVENTION

This invention relates to color cathode ray tubes and more particularly to a means of maintaining color purity by compensating for temperature-caused distortions in the tube.

It is well known that when a shadow mask color tube with a curved mask and phosphor dot screen such, for example, as shown in U.S. Pat. No. 2,986,080, is operated, heat generated within the tube by the electron beam scanning the mask causes the mask to expand. This expansion causes a resulting expansion of the electron beam pattern upon the phosphor dot screen and thus, when a color TV receiver is turned on, there is produced a time dependent mismatch between the beam pattern and the dot pattern with a possible consequent lack of color uniformity in the color picture, either initially during the period of temperature variability or after a rela tively stable thermal condition is reached.

The prior art has proposed many solutions for this problem, none of which to date has been particularly successful. Among those proposed have been methods whereby the mask is mounted on angled rods attached to the face plate of the tube so that when expansion occurs the mask is supposedly directed toward the screen so that particular color dot-mask aperture alignment with respect to the apparent electron source is not disturbed. In other words, since it has not been practical to stop the mask from expanding, the prior art solutions have been to control the direction and extent of movement to maintain registry. Another method utilized has been a hinged mask and still another method has utilized a mask mounting structure which employs bi-metallic devices between a mask frame and the supporting springs.

The principal disadvantage in using a "temperature compensated mask" is that it is incorporated into the sealed and evacuated tube. If it does not perform properly, there is no access available for either correction or control. Specifically, the hinged mask never achieved the theoretical possible motion in practice, while the system employing bi-metallic devices at each spring increases picture tube cost, can cause incorrectable beam dot misregistry if the devices don't expand equally, and causes pivoting of the support springs on the supporting studs which can cause wear, and subsequent misregistration. Also, loose material removed from the springs or studs can cause subsequent screen contamination.

OBJECTS AND SUMMARY OF THE INVENTION

It is, therefore, an object of this invention to obviate the inherent difficulties of the prior art.

It is another object of the invention to enhance color tube operation.

Yet another object of this invention is to provide temperature compensating means to maintain color purity which are external of the tube and thus readily accessible for adjustment purposes.

These objects are accomplished in one aspect of the invention by the provision, in a color cathode ray tube having a patterned screen, a source of electron beam energy, an apertured masking electrode, and yoke means external of the tube for causing an electron beam to scan the screen in a particular manner which provides an apparent center of deflection for the beam (i.e., an apparent source of electrons), of means cooperating with the deflection yoke to provide for substantially continuous compensation for the mask expansion-caused misalignment. The compensation is provided by means for changing the apparent center of deflection of the electron beam as the mask electrode expands, whereby alignment is substantially maintained.

It will be readily apparent that the device here described is a great improvement over the prior art devices and has none of the disadvantages attributable thereto. Namely, it is relatively inexpensive to provide. It is mounted exteriorly of the tube and thus may be easily repaired or corrected. And, since it is external of the tube, it may be saved and reused instead of being discarded when tube replacement becomes necessary.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagrammatic drawing of a typical prior art shadow mask type color tube illustrating the misregistry condition occurring because of mask expansion;

FIG. 2 is a diagrammatic view of a typical shadow mask type color tube illustrating the correction provided by this invention;

FIG. 3 is a diagrammatic sectional view of one means of accomplishing the desired result;

FIG. 4 is a diagrammatic sectional view of an alternate embodiment; and

FIG. 5 is a diagrammatic sectional view of still another embodiment.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

For a better understanding of the present invention together with other and further objects, advantages and capabilities thereof, reference is made to the following disclosure and appended claims in connection with the above-described drawings.

Referring now to the drawings with greater particularity, in FIG. 1 there is shown a typical prior art type of color cathode ray tube 10 which comprises a face plate portion 12 having on the interior surface thereof a patterned phosphor screen, one element of which is shown at 14. A shadow mask-frame assembly 16 is positioned within the tube and adjacent the screen by means of a plurality of leaf springs 18, only one of which is shown, which are affixed at one end to the frame and at their other end cooperate with supporting studs 20 which are fixedly positioned on an upstanding wall 22 of the face plate. Spaced a further distance away from the screen and located generally on the longitudinal tube axis is an electron beam source shown generally at 24 and which is typically a package of three individual electron guns. A deflection yoke 26 is positioned externally of the tube and substantially adjacent the electron gun area for causing the beam to scan the screen in a desired manner. The

deflection yoke 26 is not shown in FIG. 1 but is shown diagrammatically in FIGS. 3, 4 and 5.

The problem prevalent in this type of prior art tube is diagrammatically illustrated in FIG. 1 wherein a portion of the shadow mask is shown both in its cold position designated 16*a* and in its warm position (i.e., that is, the position it assumes during tube operation) designated 16*b*. It will be apparent from the drawing that when the tube is cold, that is, when it is first turned on, the electron beam or beams emanating from electron source 24 will follow the electron beam path 28 from the apparent center of deflection 30 through an aperture 32 in mask 16*a* and impinge upon phosphor element 14. However, as the tube continues to operate, the shadow mask expands due to the incident electron energy absorbed thereby and thus, after some time period (approximately twenty minutes), the mask will assume the secondary position designated as 16*b*. At this time it will be seen that aperture 32, now designated 32*a*, has changed its relative alignment position because of the mask expansion and thus the electron beam path through the aperture no longer impinges centrally upon the phosphor element 14 and may in extreme cases impinge entirely upon the mask rather than passing through the aperture. To correct this problem, which is manifested to the viewer as a loss in color purity caused by improper beam landings, it becomes necessary to change the apparent center of deflection to a point indicated in FIG. 2 as 34. This may be done by moving the yoke 26 to the rear a sufficient distance to accomplish the result and thus realign the dot 14 with the moved aperture 32*a*. This new apparent center of deflection now provides an electron beam path 36 which is shown in FIG. 2 as a solid line, and it will be seen that the beam-aperture-phosphor element alignment has been re-established. The dashed line on FIG. 2 shows the former electron beam path 28 and shows the consequent misregistry which would occur when the shadow mask assumed its heated position.

It will be apparent from the above description that two alternatives for setting up the color tube exist: namely, the yoke may be positioned while the tube is relatively cold but then it will operate at the expense of color purity as the tube warms up and the mask expands; or the tube may be energized for some period of time and be allowed to warm up and achieve at least some degree of mask expansion before the yoke is adjusted to a final position. It has been the practice in the industry to utilize this latter approach at the expense of color purity during the initial warm-up period. This approach would appear to be more than reasonable if the warm-up time were reasonably short, say from five to fifteen minutes. Recent experiments however have shown that in at least one current 25-inch picture tube the average time required for the mask to reach temperature equilibrium approaches two hours. Thus any of the systems utilized to date have been a compromise at best, set up so that ideal color purity is achieved only at specified periods of time. The disadvantages of some forms of internal correction for this problem have already been discussed above and will not be reiterated here.

The most suitable form of correction, as provided by this invention, is one wherein is provided means 38 for substantially continuously compensating for the mask expansion-caused misalignment which comprises means 40 for changing the apparent center of deflection of the electron beam in substantial synchronism with mask electrode expansion whereby alignment is substantially continuously maintained. Means 40 comprises, generally, a cylindrical housing 42 for yoke 26 and is formed with a reduced diameter portion 44 at one end which in turn is formed to accept a clamp 46 to secure the position of housing 42 on the neck 48 of tube 10. A longitudinal slot 50 is formed in housing 42 to accept a locking mechanism 52 which may comprise a threaded stud-like portion 54 and a wing nut 55. The stud-like portion 54 has one end affixed to a slidable, substantially doughnut-shaped member 56 which is within housing 42 and has its other end projecting through slot 50. A temperature-responsive element 58 which may be in the form of one or more bi-metallic components composed of materials having different coefficients of expansion, is attached to the slidable member 56 and yoke 26. The component 58 is so formed that as the tube operates it changes shape in such a manner that the yoke 26 moves toward the slidable means 56.

Component 58 may be formed in a substantially U-shaped configuration having the lower coefficient material on the inside of the loop so that when heated the loop will contract thus causing yoke 26 to retract. For the lower coefficient material a suitable material is Invar (36% Ni, 64% Fe), which, at the temperature encountered at the yoke area, has a nearly zero thermal coefficient, and the higher coefficient material may be of a metal having the composition: 22% Ni, 3% Cr, and 75% Fe.

More specifically, to prepare the device for operation, housing 42 is clamped to the neck 48 of tube 10 by means of clamp 46 in an approximate location. Thereafter, the integral structure composed of yoke 26, slidable member 56 and connecting temperature-responsive element 58 is moved manually within housing 42 until a desired purity set-up is achieved, whereupon slidable member 56 is locked to housing 42 by means of locking mechanism 52. As the color receiver and, consequently, the deflection yoke and tube neck warm up, the temperature-responsive connecting means 58 changes shape as explained above such that yoke 26 moves toward slidable member 56 thus increasing the distance between the yoke and tube screen, and thus reducing the size of the electron beam pattern on the dotted screen and maintaining substantial alignment between the electron beam pattern and the phosphor dot pattern. A supplementary heating element 70, as seen in FIG. 5, may be added to supplement the normal yoke and neck heating, if desired.

Referring now to FIG. 4, there is shown an alternate embodiment of continuous compensation means 38 wherein the yoke movement is time dependent rather than temperature dependent. Herein the yoke 26 has attached thereto an upright member 60 which projects through the slot 50 in housing 42. Mounted in front of member 60 is a time-controlled device 62 which has a movable shaft 64 connected to member 60. Time-controlled device 62 may comprise, for example, an electric clock function which will cause shaft 64 to move at a timed sequence to substantially synchronize the yoke movement with mask expansion. Obviously, the device should be provided with an automatic stop mechanism timed to approximate mask temperature equilibrium and a reset function timed to the cooling off period of the tube. Such a device has all the advantages of the temperature-responsive devices and none of the disadvantages of the prior art.

There has thus been provided by this invention novel means for substantially continuously compensating for the mask expansion-caused misalignment in a color cathode ray tube. It obviates the disadvantages of the prior art and provides simple and economical solutions to a complex problem that has long plagued the industry.

While there have been shown and described what are at present considered the preferred embodiments of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the scope of the invention as defined by the appended claims.

We claim:

1. A method of maintaining color purity in an operating color cathode ray tube of the shadow mask variety which has a yoke positioned on the neck thereof for controlling the scan of the beam comprising the steps of substantially continuously moving said yoke in a time-

dependent manner to compensate for temperature-caused expansion in said shadow mask.

2. In a color cathode ray tube having a patterned screen comprised of a multiplicity of phosphor dots selectively energizable to provide a gamut of colors, a source of energy in the form of at least one electron gun spaced from said screen which provides a beam of electrons, an apertured masking electrode intermediate said screen and said gun but closer to said screen for cooperating with said gun in the proper selection of colors, yoke means external of said tube for causing said beam to scan said screen in a particular manner which provides an apparent center of deflection for said beams, said proper selection of colors depending, in part, upon alignment between particular ones of said phosphor dots, a particular one of the apertures in said mask, and said electron beam, said tube being subject to operation-caused misalignment due to expansion of the masking electrode from increased temperature generated by the bombardment of the electron beam thereon, the improvement comprising: Means for substantially continuously compensating for said mask expansion-caused misalignment which comprises means for changing said apparent center of deflection, in a time dependent manner, of at least said one electron beam as said mask electrode expands whereby alignment is substantially maintained.

3. The invention of claim 2 wherein said means for changing said apparent center of deflection in a time dependent manner comprises means for moving said yoke, and said means for moving said yoke comprises: a substantially cylindrical external housing for said yoke having a reduced diameter portion at one end formed to accept a clamp to provide positioning means on the neck of the tube; a substantially longitudinal slot formed in said external housing to accept an upright member attached at one end to said yoke and having the other end projecting through said slot; and a time-controlled device mounted on said housing and having a movable shaft fixed at one of its ends to said upright member.

References Cited

UNITED STATES PATENTS

3,408,520 10/1968 Lindeman.

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U.S. Cl. X.R.

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