Nov. 14, 1967 N. PAPPADIS 3,353,049

DYNAMIC CONVERGENCE ASSEMBLY SHIELDING AND MOUNTING STRUCTURE

Filed June 18, 1965

FIG. 1

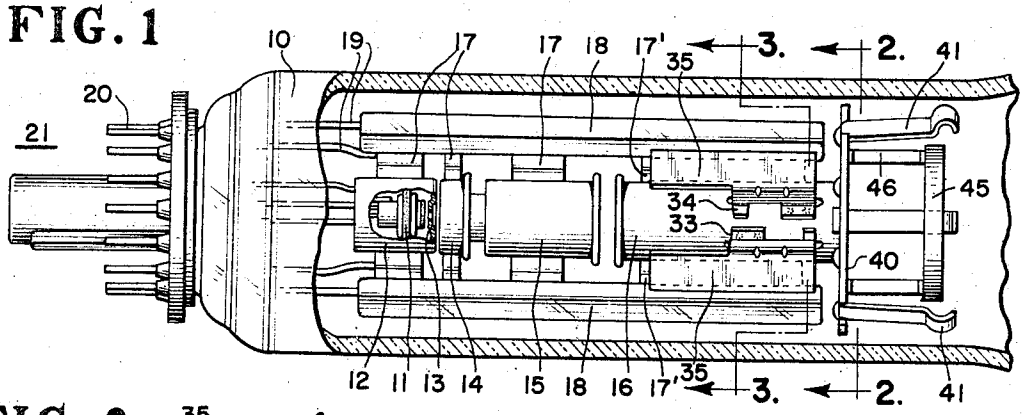


FIG. 2

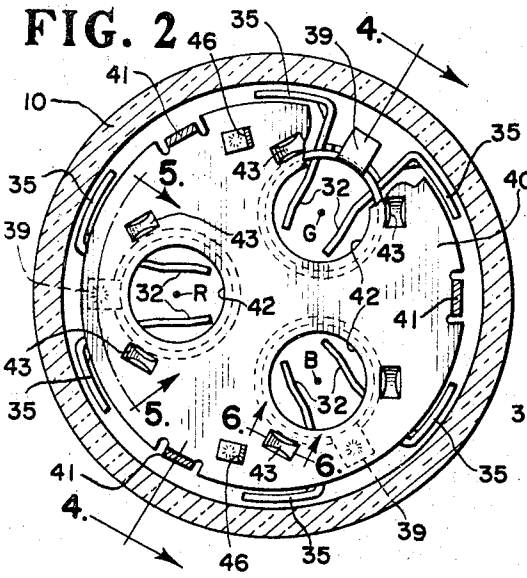


FIG. 3

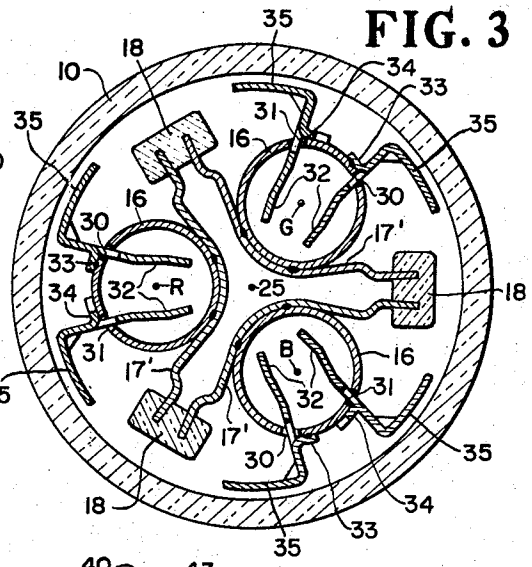
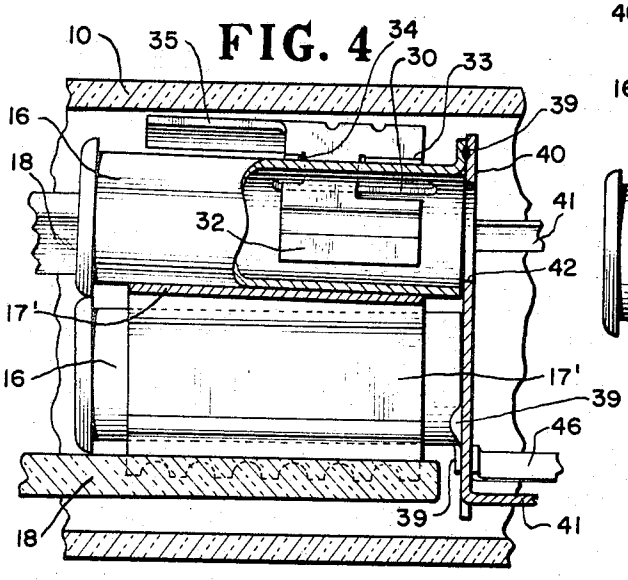


FIG. 4



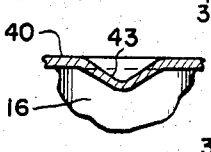


FIG. 6

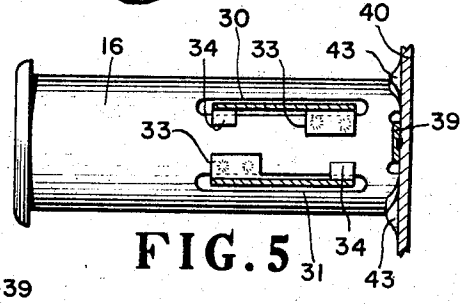


FIG. 5

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DYNAMIC CONVERGENCE ASSEMBLY SHIELDING AND MOUNTING STRUCTURE

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ABSTRACT OF THE DISCLOSURE

The disclosure is of a three-gun color cathode-ray tube with a dynamic convergence structure incorporated within the final electrode of each gun. Each such final electrode has a pair of parallel slots into which convergence pole pieces are threaded to be disposed on opposite sides of the path of the beam traversing that electrode. Each such electrode is secured to a strap of ferromagnetic material engaging the electrode at a place diametrically opposed to the location of the slots accommodating the pole pieces. These straps are received by the usual beading elements and secure the electrodes with their convergence pole pieces into the gun assembly.

The present invention is directed to the structure of an electron gun mount for a multibeam cathode-ray tube. The mount to be described is especially attractive for a three-beam color cathode-ray tube of the shadow mask type and, for convenience, it will be disclosed in that environment.

In the operation of such a multibeam color tube a single deflection system causes the three beams to scan the image screen through an apertured shadow mask. The screen has a multiplicity of phosphor dot triads with the dots of each triad emitting red, blue and green light, respectively, in response to electron excitation. Color selection or the assigning of a particular color beam to one dot of every triad is accomplished by the geometry of the tube structure including the location of the three electron guns within a common mount and the pattern of apertures in the shadow mask through which the beams are permitted to impinge upon the image area. Ideally, the structure is arranged to the end that each beam lands fully on the dot of each triad to which it has been assigned and does not impinge upon any of the other dots of the triads but this ideal is difficult to maintain with increasing angles of beam deflection.

Even though it is convenient to mechanically converge the three beams at the central portion of the image area through proper relative orientations of the guns in the mount, there is a distinct tendency of misconvergence as the family of beams sweep away from the center toward the edges or corners of the raster. To compensate this tendency, it is now the practice to include in the amount a dynamic convergence subassembly. While the convergence may be accomplished electrically, it is more customary to utilize magnetic forces and the structure of the present invention applies particularly well to this approach.

Dynamic convergence arrangements of the prior art generally comprise three pairs of ferromagnetic pole pieces each assigned to a respective one of the electron beams. Physically, the pairs of pole pieces are supported from a convergence cylinder or structure which is common to all three beams in that it mechanically supports all of the pairs of pole pieces. Each such pair is located on opposite sides of the path of the beam which it is intended to control and the portion of the pole pieces remote from the tips extends very close to the neck of the tube to facilitate coupling to an electromagnetic source physically located outside of the tube envelope. Energization of the electromagnetic drive with signals properly shaped and related to the scanning frequencies causes the beams to be controlled as required to preserve convergence over substantially the entire image area. The electrical properties of the dynamic convergence signals, that is to say their waveform and frequency, are well known and constitute no part of this invention which addresses itself more particularly to the structural features of the convergence subassembly.

While the subassemblies used heretofore have operated successfully in maintaining beam convergence, they have posed difficult problems in production. Since obviously it is essential that the beam controlling pole pieces be carefully oriented relative to the three beam paths of the tube, their location with prior art structures has required the use of complicated and expensive jigs and difficult fabricating techniques.

Accordingly, it is an object of the present invention to provide an electron gun mount for a multibeam cathode-ray tube which avoids or minimizes such deficiencies of prior structures.

It is a specific object of the invention to provide a gun mount for a multibeam cathode-ray tube having a simplified and more easily fabricated convergence subassembly.

An electron gun mount for a multibeam cathode-ray tube, constructed in accordance with the invention, comprises a plurality of electron guns arranged in a predetermined array, such as a delta array. The guns individually include a cathode subassembly and a series of conductive electrodes aligned along a path for developing, accelerating and focusing a beam of electrons along that path.

At least one of these electrodes is a cylinder disposed coaxially of the beam path and having a pair of longitudinally extending side-by-side slots. A plurality of beading elements are secured to electrodes of the guns to integrate the guns into a gun cluster. There are shielding means for magnetically shielding the slotted electrodes of the guns from one another comprising a plurality of straps of ferromagnetic material individually having end portions secured to the beading elements and an intermediate section enveloping and secured to the outer periphery of the slotted electrode of an assigned one of the guns on the portion thereof that faces the center of the gun cluster and is diametrically opposed to the slots. Additionally, there are a plurality of pairs of convergence magnet pole pieces of ferromagnetic material, individually threaded through the slots of the slotted electrode of an assigned one of the guns and welded thereto and comprising pole tips disposed within its assigned electrode on opposite sides of the beam path extending therethrough.

The features of the present invention which are believed to be novel are set forth with particularity in the appended claims. The invention, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawing, in the several figures of which like reference numerals identify like elements, and in which:

FIGURE 1 is a fragmentary view, partially in cross section, of an electron gun mount embodying the invention and installed within the neck portion of a multibeam cathode-ray tube;

FIGURES 2 and 3 are sectional views taken along section lines 2—2 and 3—3 of FIGURE 1;

FIGURE 4 is a fragmentary sectional view taken along section lines 4—4 of FIGURE 2;

FIGURE 5 is a view taken as indicated by section lines 5—5 of FIGURE 2, showing one of the lens electrodes and the manner in which it supports convergence magnet pole pieces; and

FIGURE 6 is a detail of a self-aligning feature of the gun mount and taken as indicated along section line 6—6 of FIGURE 2.

A multibeam cathode-ray tube employed for color television, especially if it is of the shadow mask type as assumed for convenience, has an envelope with two principal parts. There is a cap section which is similar to a flanged dish and the area surrounded by the flange comprises the screen or image area. It also bears the triads of phosphor dots. Mounting studs projecting inwardly from the flange of the cap permit installing the shadow mask in proper orientation with respect to the triads of the screen, and the cap with the shadow mask constitutes a subassembly.

The remaining portion of the envelope is a funnel or conical shaped glass structure which is dimensioned at its large end to correspond with the dimensions and configuration of the flange of the cap whether the tube be round or rectangular. A neck portion extends from the smaller end of the funnel and houses the electron gun mount. Since the invention under consideration concerns only the mount, FIGURE 1 represents merely so much of the neck portion **10** of the envelope as required for an understanding of the association of the gun mount therewith.

The gun mount comprises a plurality of electron guns arranged in a predetermined array, usually in a delta arrangement. Preferably, the guns are identical in construction and, except for the structural arrangement of the convergence subassembly and a particular lens electrode with which that subassembly is mechanically associated, are of conventional design. Accordingly, it is sufficient to describe a single one of the guns.

As shown in FIGURE 1, each gun includes a cathode subassembly **11** which is mechanically supported within but electrically insulated from a cylindrical, conductive electrode **12** usually referred to as grid **1**. Electrode **12** is open at one end but is closed at its far end by a coined and centrally apertured disk **13**. The cathode subassembly **11** has a cathode cylinder which terminates in a closed end treated with an electron emitting coating and it is open at the other end in order to receive the usual filament or heater. The cathode cylinder is mechanically supported within a wafer of insulating material proportioned to have an external diameter approximately equal to the internal diameter of grid cylinder **12**. Locating washers or the like (not shown) accurately position cathode subassembly **11** within cylinder **12** so that the emitting surface is properly positioned and spaced relative to the aperture of closure plate **13** through which the emitted electrons pass in forming an electron beam.

In addition to grid **12**, there are other conductive electrodes which, along with grid **12**, form a series of electrodes aligned along a beam path for cooperating with the cathode subassembly in developing, accelerating and focusing a beam of electrons along that path. Usually, the beam path is the axis of the cathode subassembly and its coaxially aligned series of conductive electrodes. These other electrodes include a cylinder **14** referred to as grid **2** or the first anode, and a pair of lens electrodes **15** and **16**. As illustrated, the first lens electrode **15** has a leading portion of reduced diameter which projects into anode cylinder **14**. Electrodes **15** and **16** constitute a two-element lens although it is, of course, just as expedient to employ a unipotential lens should that be desired. Many structural features of lens electrode **16** have to do with the convergence subassembly and will be considered hereafter.

The cathode subassembly **11** is mechanically supported within cylinder **12** of grid **1** as explained but the other electrodes are provided with mounting members which are designated by numeral **17** in FIGURE 1. They are generally formed of steel straps which partially encircle each electrode being welded to their outer periphery. The strap **17'** for lens electrode **16** is specifically different because it has additional functions to be outlined in the material to follow. The free ends of mounting straps **17**, **17'** are embedded in beading elements **18** which, by their mechanical integration with the mounting tabs, integrate the elements of all three guns into a gun cluster. The three guns are arranged in a delta array and they are mechanically supported so that their axes converge at the center of the image screen in a manner well understood in the art. The general configuration of the delta array is apparent in FIGURE 2, for example, where the designations R, G and B denote the three electron beams of the tube which traverse the central axes of the three guns, respectively.

The gun cluster is positioned within neck **10** of the tube envelope as shown in FIGURE 1 and electrode leads **19** connect the various electrodes and heater elements to terminal pins **20** of the customary tube base **21** which is secured to the envelope when the tubulation is sealed off. As thus far described, the gun cluster is conventional and the three beams thereof in response to energization of the heaters and the electrode systems develop three electron beams R, G and B which are accelerated and focused along the respective beam paths for scanning of the image area in response to the deflection system which has not been shown. As explained, it is essential in the operation of this type of tube to provide dynamic convergence so that the three beams are properly converged throughout the scanned raster. The details of the convergence subassembly are as follows:

Referring now to FIGURE 3, it is apparent that the final lens electrode **16** of each of the three electron guns is offset from the central axis **25** of the tube but at the same time each lens electrode is coaxially disposed along an assigned beam path to accomplish focusing of the beam traversing that path. Since these final lens electrodes are integrally associated with the convergence subassembly, they are formed of material which is nonmagnetic as well as conductive, for example, stainless steel. Each electrode **16** has two longitudinally extending side by side slots **30**, **31** on the portion thereof which is disposed radially outward of both the beam path of the gun including that electrode and tube axis **25**.

A pair of convergence magnet pole pieces of ferromagnetic material are threaded through the slots **30**, **31**. The pole pieces comprise pole tips **32** disposed within slotted electrode **16** on opposite sides of the beam path through that electrode. The pole pieces further comprise supporting tabs **33** which overlie and are welded to the outer periphery of electrode **16** and terminal portions **35** disposed approximately at right angles to the plane of the pole tips for coupling to a magnet source such as an electromagnet. As shown in FIGURE 5, the welding tabs **33** of the pole pieces of one pair are positioned at opposite end portions thereof and there are locating or stabilizing portions **34** at the other ends to engage the electrode and position the pole pieces during the welding operation. As shown in FIGURE 4, terminal portions **35** of the pole pieces extend beyond tip portions **32** thereof in the direction of a cathode subassembly, that is to say, in the direction of the source of the electron beam traversing the path that a given pair of pole pieces straddles. It is preferable that each pole piece be dimensioned so that terminal portion **35** is as close as practicable to the inner wall of tube neck **10** in order to facilitate coupling an electromagnet to the pole pieces when the electromagnet is located externally of the tube. Actually, the gun cluster is arranged preferably to have the radial dimension from the central axis of the cluster to the outer surface of terminal portions **35** of the pole pieces nearly equal to the internal radius of tube neck **10**.

The mounting strap **17'** of each electrode **16** serves a shielding function and to that end, is formed of ferromagnetic material. The strap has a width which exceeds the longitudinal dimension of electrode slots **30**, **31** and preferably it is wider than the length of terminal portions

35 as indicated in FIGURE 4. The intermediate portion of each strap 17' has a curvature closely approximating that of the cylinder 16 to which it is welded. It is located on the peripheral portion of electrode 16 disposed between the beam path encompassed by that electrode and the tube axis in spaced opposed relation to the slots and to the pole piece elements of its assigned electrode. The free end portions of each such strap 17' extend generally radially outward from the tube axis and are secured to beading elements 18.

FIGURES 1 and 3 make clear that the beading elements or insulating pillars 18 extend longitudinally of the neck and are interleaved with the three guns. Since straps 17' are the same for all three guns as to structure and location, they collectively define a Y type shield which shields the three beam paths from one another at least as to those portions thereof which are within the projected areas of shielding straps 17'.

In addition to the various electrode assemblies of the gun mount, it is conventional to use snubber springs to provide an electrical connection between the high voltage final anode represented by a conductive layer in the funnel portion of the tube envelope and the slotted electrode 16. For that purpose, there is an end plate 40, and a series of snubber springs 41 are fixed thereto or formed integral therewith and diverge outwardly from the tube axis to contact the wall of the envelope. This end plate has three apertures 42 arranged in the same array as the three electron guns to be oriented coaxially with the beam paths of the three guns in the gun cluster. For that purpose, a number of locating projections 43, shown in detail in FIGURE 6, are struck from end plate 40 for engaging the outer periphery of the ends of slotted electrodes 16 that face the screen. More particularly, there is a pair of projections 43 struck from plate 40 for each electrode 16. They extend in the opposite direction from snubber springs 41 to seat on electrodes 16. This accurately orients apertures 42 relative to the beam paths. The end plate is secured in position by welds between the end plate and tabs 39 struck from slotted electrodes 16.

FIGURE 1 further shows a getter ring 45 supported on fingers 46 which may also be welded to end plate 40.

The described structure greatly facilitates the production of the gun mount with a minimum of jigs and fixtures. The various electrodes of the guns may be assembled on mandrels in the usual way but straps 17' and the other mounting straps will first have been secured to the electrodes. The application of pillars or beads 18 integrates the guns along with shields 17' into their cluster after which pole pieces 32 are threaded through slotted apertures 30, 31 and secured in proper position by welding tabs 33 to the electrodes. Thereafter, the self locating indentations 43 permit end plate 40 to be accurately positioned for welding to tabs 39 to complete the assembly, it being understood, of course, that the getter has previously been affixed to the end plate. A particular advantage of this construction is greatly improved mechanical convergence accuracy. Prior constructions required separate jigging and assembly of the principal gun elements and the convergence cage, after which the two subassemblies had to be accurately lined up with each other and integrated. With the described arrangement one jig is employed in making the whole assembly so there is no compounding of tolerances and the assembly operation is greatly simplified.

While a particular embodiment of the invention has been shown and described, it will be obvious to those skilled in the art that changes and modifications may be made without departing from the invention in its broader aspects, and, therefore, the aim in the appended claims is to cover all such changes and modifications as fall within the true spirit and scope of the invention.

I claim:

1. An electron gun mount for a multibeam cathode-ray tube comprising:

a plurality of electron guns arranged in a predetermined array, individually including a cathode subassembly and a series of conductive electrodes aligned along a beam path for collectively developing, accelerating and focusing a beam of electrons along said path, the final electrode of each series being a cylinder disposed coaxially of said beam path and having a pair of longitudinally extending side-by-side slots;

a plurality of beading elements secured to electrodes of said guns to integrate said guns into a gun cluster;

shielding means for magnetically shielding the slotted electrodes of said guns from one another comprising a plurality of straps of ferromagnetic material individually having end portions secured to said beading elements, an intermediate section enveloping and secured to the outer periphery of said slotted electrode of an assigned one of said guns on the portion thereof that faces the center of said gun cluster and is diametrically opposed to said slots and further having a width dimension exceeding the longitudinal dimension of said slots;

a plurality of pairs of convergence magnet pole pieces of ferromagnetic material, individually threaded through the slots of the slotted electrode of an assigned one of said guns and comprising pole tips disposed within its assigned electrode on opposite sides of the beam path extending through its assigned electrode each of said pole pieces further comprising a supporting tab concentric with and welded to its respective cylinder and a coupling portion nearer the neck of said tube than said tab, disposed parallel to said neck for coupling to an external magnetic source and having a length exceeding that of said slots.

2. An electron gun mount for a multibeam cathode-ray tube comprising:

a plurality of electron guns arranged in a predetermined array, individually including a cathode subassembly and a series of conductive electrodes aligned along a beam path for collectively developing, accelerating and focusing a beam of electrons along said path, the final electrode of each series being a cylinder disposed coaxially of said beam path and having a pair of longitudinally extending side-by-side slots;

a plurality of beading elements secured to electrodes of said guns to integrate said guns into a gun cluster;

shielding means for magnetically shielding the slotted electrodes of said guns from one another comprising a plurality of straps of ferromagnetic material individually having end portions secured to said beading elements and an intermediate section enveloping and secured to the outer periphery of said slotted electrode of an assigned one of said guns on the portion thereof that faces the center of said gun cluster and is diametrically opposed to said slots;

a plurality of pairs of convergence magnet pole pieces of ferromagnetic material, individually threaded through the slots of the slotted electrode of an assigned one of said guns and comprising pole tips disposed within its assigned electrode on opposite sides of the beam path extending through its assigned electrode each of said pole pieces further comprising a supporting tab concentric with and welded to its respective cylinder and a coupling portion nearer to the neck of said tube than said tab and parallel to said neck for coupling to an external magnetic source;

and an end plate of conductive nonmagnetic material secured to said guns having a plurality of beam apertures arranged in said predetermined array and having locating projections engaging said final electrodes

of said guns to align the beam apertures thereof coaxial with said beam paths respectively.

References Cited

UNITED STATES PATENTS

2,752,520	6/1956	Morrell	313—92 X
2,806,163	9/1957	Benway	313—92 X
3,128,407	4/1957	Mattson	313—268 X
3,188,507	6/1965	Law et al.	313—84 X
3,268,753	8/1966	Haghes	313—70 X

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