June 23, 1964 C. H. HEUER ETAL 3,138,730

CONVERGENCE DEVICE FOR COLOR TELEVISION

Filed May 19, 1960

FIG. 3

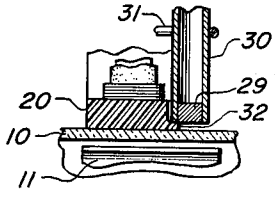


FIG. 5

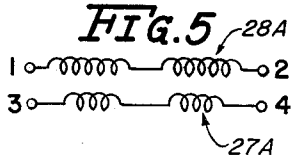


FIG. 1

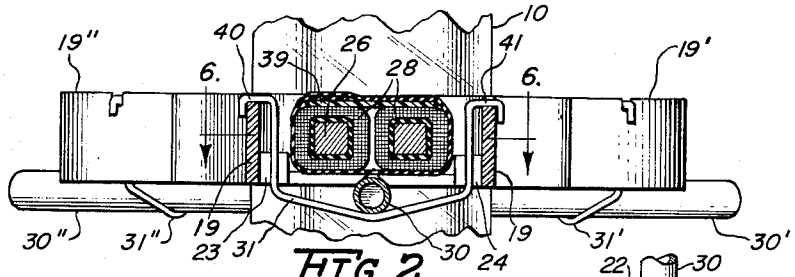
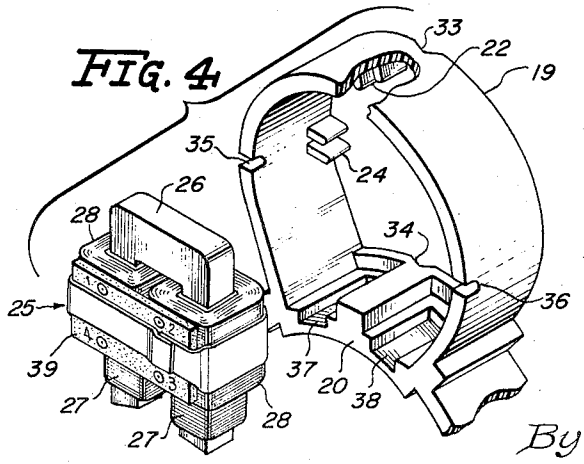


FIG. 2

FIG. 4



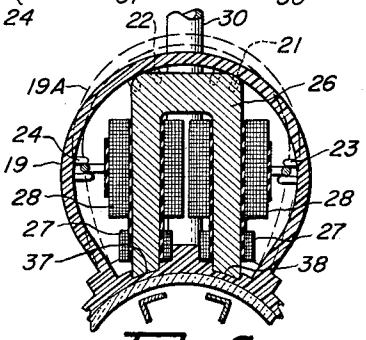


FIG. 6

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CONVERGENCE DEVICE FOR COLOR TELEVISION

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The present invention relates to color television and more particularly to magnetic convergence devices for use with multi-beam color kinescopes.

In color television receivers and other systems using multi-beam cathode-ray tubes, proper operation requires that the several beams be converged to a common point on the luminescent screen. Both static and dynamic convergence are normally required. Static convergence is customarily accomplished through the use of permanent magnets, which cooperate with suitable internal pole pieces in the color kinescope and are so adjusted that the resulting static magnetic fields converge the electron beams, in the absence of scanning fields, at the center of the luminescent screen. Dynamic convergence fields are conventionally established by electromagnets which also cooperate with the internal pole pieces and are responsive to applied convergence signals which vary as a function of scanning deflection. The required magnets are usually assembled to form a common convergence yoke which is adapted for both rotational and longitudinal adjustment on the neck of the color kinescope.

Typical of the prior convergence yoke assemblies is one comprising a plurality of interlocking peripheral sections held together by springs to permit the required longitudinal and rotational adjustment after fitting to the color kinescope neck. In order to provide for firm frictional retention on tube necks of varying diameters within the range of manufacturing tolerances, the construction of such devices has been undesirably complex.

In addition to the required longitudinal and rotational adjustability of the yoke assembly, the permanent magnets must be adjustable so as to obtain proper static convergence of the electron beams. This adjustment has been made previously by individually rotating the permanent magnets within the cores of the electromagnets or by changing the spacing relative to the associated internal pole piece. Both of these arrangements lead to undesirable structural complication, and neither utilizes the magnetic components to full advantage.

The principal object of this invention is to provide a new and improved magnetic convergence device for use with a multi-beam cathode-ray tube.

Another object is to provide such a convergence device of greatly simplified construction.

It is a still further object of this invention to provide such a device with which both installation and adjustment are substantially facilitated.

It is also an object of the invention to provide a new and improved convergence yoke assembly in which adjustment of the permanent magnets to obtain static convergence is greatly facilitated.

In accordance with the invention, a new and improved convergence device for use with a multi-beam cathode-ray tube comprises a plurality of electromagnets and a plurality of permanent magnets. The convergence device further includes a unitary resilient support member of non-magnetic material, including means consisting of resilient retaining members substantially encompassing the electromagnets for positioning and retaining them and for indexing the permanent magnets. Also included in the convergence device are additional resilient means coupled to the aforementioned support member for adjustably retaining the permanent magnets in predetermined cooperative relation with the electromagnets.

The features of this 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, however, by reference to the following description taken in conjunction with the accompanying drawings, in the several figures of which like reference numerals identify like elements, and in which:

FIGURE 1 is an elevational view, partly in section, of a preferred embodiment of the invention in its position about the neck of a multi-beam cathode-ray tube;

FIGURE 2 is a cross-sectional view taken across line 2—2 of FIGURE 1;

FIGURE 3 is a cross-sectional view taken across line 3—3 of FIGURE 1;

FIGURE 4 is a fragmentary exploded perspective view of a portion of the embodiment shown in FIGURE 1;

FIGURE 5 is a schematic circuit diagram showing the electrical circuitry of the convergence coils of the embodiment shown in FIGURES 1–4; and

FIGURE 6 is a fragmentary cross-sectional view taken across line 6—6 of FIGURE 2 illustrating the manner of assembling the device of FIGURES 1–4.

Referring to FIGURE 1, a preferred embodiment of the invention is shown mounted on the neck **10** of a multi-beam cathode-ray tube such as a conventional tri-beam color kinescope. In cathode-ray tubes of this type the cylindrical axis of the neck of the tube is generally coincident with the geometric axis of symmetry of the entire tube. Within the neck portion of the cathode-ray tube, pairs of metallic pole pieces **11**, **11'** and **11''** are spaced symmetrically about the aforementioned cylindrical axis. Electron beams, **12**, **12'** and **12''** are emitted from respective electron guns (not shown) and are directed in such a manner so as to pass between the respective pairs of internal pole pieces **11**, **11'** and **11''**. A magnetic shield **13** is employed to prevent interaction of the magnetic fields created in the respective pairs of pole pieces. This magnetic shield is constructed of ferromagnetic members **14**, **14'** and **14''** radially extending from the tube axis, between adjacent pairs of internal pole pieces **11**, **11'** and **11''** in conventional fashion.

The embodiment of FIGURE 1 comprises a molded one-piece yoke or support member **16** comprising a collar **17**, three resilient bight portions **18**, **18'** and **18''** and three resilient retaining members in the form of arcuate lobes **19**, **19'** and **19''**. Collar portion **17** of support member **16** is constructed of three identical segments **20**, **20'** and **20''** each of a curvature conforming to that of neck **10** and symmetrically interspaced with the resilient bight portions **18**, **18'** and **18''**. Integral with collar segments **20**, **20'** and **20''** are respective retaining members constructed as arcuate lobes **19**, **19'** and **19''** which extend outwardly from the collar. Integral with and extending inwardly from lobe **19** are two pairs of indexing projections **21** and **22** as well as guide channels **23** and **24** which may for convenience be constructed as similar pairs of projections. The unitary support member complete with collar, bight portions, lobes, projections, and guide channels is preferably molded of a suitable plastic material such as nylon.

An electromagnet **25** which forms a part of the magnetic convergence device is resiliently retained by the unitary support member **16** within arcuate lobe **19**. Electromagnet **25** is constructed of a U-shaped ferromagnetic core **26** on which is wound a set of horizontal dynamic convergence coils **27** and a set of vertical dynamic convergence coils **28**. Associated with electromagnet **25** is a diametrically polarized cylindrical permanent magnet **29** housed in a tubular retainer **30** of cardboard or the like. A generally U-shaped wire spring **31** secures tubular retainer **30** and its magnet **29** against

lobe 19 and collar segment 20 in predetermined spatial relation relative to electromagnet 25, while allowing for rotational adjustment thereof. The aforementioned spatial relation is such that the flux created by magnets 29 and 25 traverses the internal pole pieces 11 when the convergence yoke assembly is mounted on neck 10.

As better shown in FIGURE 2, wire spring 31 is of generally U-shaped configuration and is provided with hook-like end portions 40 and 41 which engage arcuate lobe 19 to resiliently retain tubular magnet retainer 30 in place.

To properly position the tubular retainer 30 and its permanent magnet with respect to internal pole pieces 11, an indexing tab 32 is used as shown in FIGURE 3. This tab is an integral part of the collar segment 20. Permanent magnet assembly 29, 30 bottoms on tab 32 to establish magnet 29 at a predetermined spacing from pole pieces 11 when the yoke assembly is mounted on neck 10.

As shown more clearly in FIGURE 4, guide channels in the form of notches 33 and 34 in lobe 19 and collar segment 20 cooperate with tab 32 is positioning permanent magnet assembly 29, 30. These two guide channels radially align the tubular retainer 30 which is not shown in this view. FIGURE 4 also assists in visualizing the engagement of hook-like end portions 40 and 41 of the U-shaped spring 31 (see FIGURE 2) with respective indexing slots 35 and 36 of lobe 19, and the stabilization of spring 31 by engagement with guide channels 23 and 24.

Electromagnet 25 is mounted into lobe member 19 by the use of stepped paraxial guide channels 37 and 38 in collar segment 20. The lower portions of guide channels 37 and 38 are formed to receive the end portions of electromagnet core 26. The upper portions of channels 37 and 38 each of which utilizes opposite segments of the arcuate lobe 19 as one side of the channel are enlarged to provide clearance for horizontal dynamic convergence coils 27 which are wound around core 26. A terminal board 39, also shown in FIGURE 4, is firmly attached to the electromagnet through the use of tape. This board provides terminals for electrically connecting the conductors carrying dynamic convergence signals to the dynamic convergence coils.

The schematic diagram of FIGURE 5 shows the manner in which the two vertical dynamic convergence coils and the two horizontal dynamic convergence coils are respectively connected to the terminal board 39 shown in FIGURE 4. As can be seen, the two vertical dynamic convergence coils 28A are connected in series between terminals 1 and 2 of board 39, while the horizontal dynamic convergence coils 27A are connected in series between terminals 3 and 4.

Each of the remaining lobe assemblies is constructed similarly to the one previously described. Corresponding parts are designated by the use of corresponding reference numerals which are singly and doubly primed respectively.

In assembling this embodiment of the invention, the initial step is performed by inserting the three electromagnets into their respective yoke-mounting elements or arcuate lobes. Channels 37 and 38 and projections 21 and 22 place electromagnet 25 in a position so that the axis of symmetry of the electromagnet lies on a radial line stemming from the geometric center of the convergence device. Lobe 19 is manually compressed in the vicinity of guide channels 23 and 24 to facilitate the insertion of electromagnet 25. Once the electromagnet is in place within the arcuate lobe, the pressure is released and the lobe springs back toward its undeformed position and thus it resiliently retains the electromagnet. This is clearly shown in FIGURE 6, in which the broken lines 19A show lobe 19 in its deformed condition while the solid lines show the lobe retaining the electromagnet after the pressure has been released.

Permanent magnet assembly 29, 30 is positioned in guide channels 33 and 34 and is bottomed on index tab 32, and wire spring 31 is then slipped into engagement with slots 35, 36 and channels 23, 24 to retain magnet assembly 29, 30 in position. Spring 31 frictionally retains the paper tubular housings in such a manner so as to allow the rotation of cylindrical magnet assembly 29, 30, as best shown in FIGURE 2.

After the convergence device has been assembled, it may be easily slid onto the picture tube neck. The bight portions 18, 18′ and 18″ provide sufficient resilience to allow the device to be slid over the tube base and to readily adapt to cathode-ray tube necks of slightly varying diameters within the range of manufacturing tolerances. The device is positioned both rotationally and longitudinally so that the electromagnets are in direct juxtaposition with the respective pairs of internal pole pieces 11, 11′ and 11″; permanent magnets 29, 29′ and 29″ are thus also positioned so as to create a flux in the internal pole pieces.

As previously mentioned, the electron beams pass between the respective pairs of internal pole pieces. Magnetic fields within these pole pieces, being generally perpendicular to the direction of electron motion, cause a resultant lateral deflection of the beam which is proportional to the strength of the impressed magnetic field. By suitably adjusting the impressed magnetic field strengths individually and with respect to each other, the beams can be directed so as to converge at a given point or points on the luminescent screen. With no signal applied to the dynamic convergence coils, the only flux passing through these pole pieces is that created by permanent magnets 29, 29′ and 29″; the permanent magnets may be rotationally adjusted to establish the required condition of static convergence. Each cylindrical magnet establishes a magnetic field having a component normal to the direction of electron beam flow and a component in the direction of electron beam flow. The relative magnitudes of these components vary as the cylindrical magnet is rotated. The physical position of the internal ferromagnetic pole pieces 11 is such that substantially the only magnetic flux in the space between them, through which the beam passes, is the component normal to the direction of electron flow. Thus by rotating cylindrical magnet 29 about its own axis, the strength of the magnetic field normal to the direction of beam flow may be individually adjusted for each electron beam, and the several beams may be statically converged. Stray magnetic fields are of course also substantially compensated by proper adjustment of the cylindrical permanent magnets to obtain static convergence.

The dynamic convergence coils which form a part of the electromagnets are used to provide dynamic convergence in a conventional manner. The two sets of coils 27 and 28 respond to applied dynamic convergence signals which vary as functions of the vertical and horizontal scanning signal respectively to establish an appropriate combined time-varying magnetic field in each set of internal pole pieces.

The invention is of course not limited to devices for use with either three-gun tubes or with cathode-ray tubes having internal pole pieces. Furthermore, the physical configuration of the several components may be varied without departing from the invention. For example, the retaining members may be rectangular or polygonal rather than arcuate, so long as they encompass and resiliently retain and position the dynamic convergence magnet assemblies.

Moreover, permanent magnets of other shapes and orientations may be used with adjustment provided by varying the spacing of the permanent magnets from the pole pieces, by rotational adjustment as in the illustrated embodiment, or by a combination of the two types of adjustment. Static convergence may also be effected in whole or in part by applying a direct current to the electromagnets.

Thus the invention provides a magnetic convergence device of greatly simplified construction, in which the number of components has been reduced to an absolute minimum. The device automatically compensates for size variations of the picture tube within the range of manufacturing tolerances and affords maximum simplicity of manufacture, installation and adjustment. These objectives are achieved while at the same time providing for individual adjustability of static and dynamic convergence fields for each of the electron beams.

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

We claim:

1. A magnetic convergence device adapted for mounting on the circular neck of a multi-beam cathode-ray tube comprising: a plurality of electromagnets; a plurality of permanent magnets; a unitary support member of non-magnetic material including means consisting of a resilient outer portion and a substantially circular resilient inner portion for adjustably positioning and frictionally retaining said electromagnets in predetermined circumferentially spaced relation about said cathode-ray tube neck; and resilient means coupled to said electromagnetic positioning support member for retaining and positioning said permanent magnets while allowing for rotational adjustment thereof.

2. A magnetic convergence device adapted for mounting on a cathode-ray tube comprising: a plurality of electromagnets; a plurality of permanent magnets; a unitary resilient support member of non-magnetic material, including means consisting of resilient retaining members substantially encompassing said electromagnets for positioning and retaining said electromagnets and for indexing said permanent magnets; and additional resilient means coupled to said aforementioned support member for adjustably retaining said permanent magnets in predetermined cooperative relation with said electromagnets.

3. A magnetic convergence device adapted for mounting on a cathode-ray tube coaxially therewith, said device comprising: a plurality of electromagnets; a plurality of permanent magnets each having a predetermined magnetic axis, a unitary resilient support member of non-magnetic material, including means consisting of resilient retaining members substantially encompassing said electromagnets for positioning and retaining said electromagnets in predetermined space relation with each other and with said cathode-ray tube; and additional means coupled to said unitary support member including adjusting means for retaining said permanent magnets with their magnetic axes in respective planes each substantially parallel to the axis of said cathode-ray tube while permitting individual continuous rotational adjustment thereof.

4. A magnetic convergence device adapted for mounting on the neck of a cathode-ray tube comprising: a plurality of electromagnets; a plurality of permanent magnets individually having a predetermined polarization axis; a unitary support member including means consisting of a plurality of arcuate lobes respectively encompassing said electromagnets for resiliently retaining and positioning said electromagnets in predetermined space relation about said neck of said cathode-ray tube; and means coupled to said arcuate lobes including adjusting means for retaining and positioning said perment magnets with their polarization axes respectively oriented in planes parallel to the axis of said cathode-ray tube

while permitting adjustment of said magnets to rotate said polarization axes in said planes.

5. A magnetic convergence device adapted to be mounted about a cathode-ray tube comprising: a plurality of electromagnetic convergence coils; a plurality of permanent magnets; a unitary support member including means consisting of a plurality of arcuate lobes for resiliently retaining and positioning said electromagnetic convergence coils in predetermined space relation with each other, said electromagnetic convergence coil positioning lobes terminating in a collar adapted to fit on said cathode-ray tube, and said collar having a plurality of peripherally spaced outwardly extending bight portions to retain it in resilient frictional engagement with said cathode-ray tube; and means coupled to said electromagnetic convergence coil positioning lobes for retaining and positioning said permanent magnets.

6. A magnetic convergence device adapted for mounting on a cathode-ray tube coaxially therewith, said device comprising: a plurality of electromagnets; a plurality of permanent magnets; a unitary resilient support member comprising a collar adapted for adjustable frictional engagement with said cathode-ray tube and provided with paraxial channels for receiving said electromagnets, and further comprising means consisting of a corresponding plurality of outwardly extending arcuate lobe members respectively encompassing said electromagnets for resiliently retaining them; inwardly extending projections fixed to said lobe members for paraxially indexing said electromagnets; a corresponding plurality of pairs of guide channels, in said collar and lobe members respectively, extending radially relative to the axis of said cathode-ray tube; and a corresponding plurality of spring members adapted to engage said respective lobe members for retaining said permanent magnets in said guide channels while providing for longitudinal and rotational adjustment thereof.

7. A magnetic convergence device for use in conjunction with a multi-beam cathode-ray tube having a plurality of internal ferromagnetic pole pieces symmetrically positioned about the geometric axis of said tube and responsive to impressed magnetic potentials for establishing resultant magnetic fields individually directed generally perpendicularly to said axis, said device comprising: a unitary resilient collar element adapted for longitudinally and rotationally adjustable frictional engagement with said cathode-ray tube; a plurality of resilient lobe-like yoke-mounting elements integral with said collar element and disposed in predetermined symmetrically spaced relation corresponding to that of said pole pieces; dynamic convergence means comprising a corresponding plurality of permanent magnets each adjustably mounted on at least one of said elements for developing an adjustably constant flux in said pole pieces; and indexing elements integral with said aforementioned elements for positioning all of said magnets in predetermined symmetrically spaced relation corresponding to that of said internal pole pieces.

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