# United States Patent [19]

**Brown**

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[54] **TEMPERATURE COMPENSATED ELECTRON BEAM CONVERGENCE APPARATUS**


[75] Inventor: **Maurice H. Brown,** Palos Heights, Ill.

[73] Assignee: **Pemcor, Inc.,** Westchester, Ill.



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[52] **U.S. Cl.** ..... **335/211,** 335/217

[51] **Int. Cl.** ..... **H01f 3/12**

[58] **Field of Search** ..... 335/210, 211, 217



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*Primary Examiner*—George Harris

*Attorney, Agent, or Firm*—Wallenstein, Spangenberg, Hattis & Strampel



[57] **ABSTRACT**

The gap of a pair of core members of a convergence unit for a color producing cathode ray tube is provided with a U-shaped, flux permeable, temperature compensating, magnetic member extending part way around the core members. The U-shaped compensating magnetic member has a bridging portion extending across the gap of the core members on the side thereof opposite the side on which a manually adjustable magnetic flux-producing member is located, and a pair of opposite legs extending across the gap on the adjacent sides of the core members.


**4 Claims, 6 Drawing Figures**

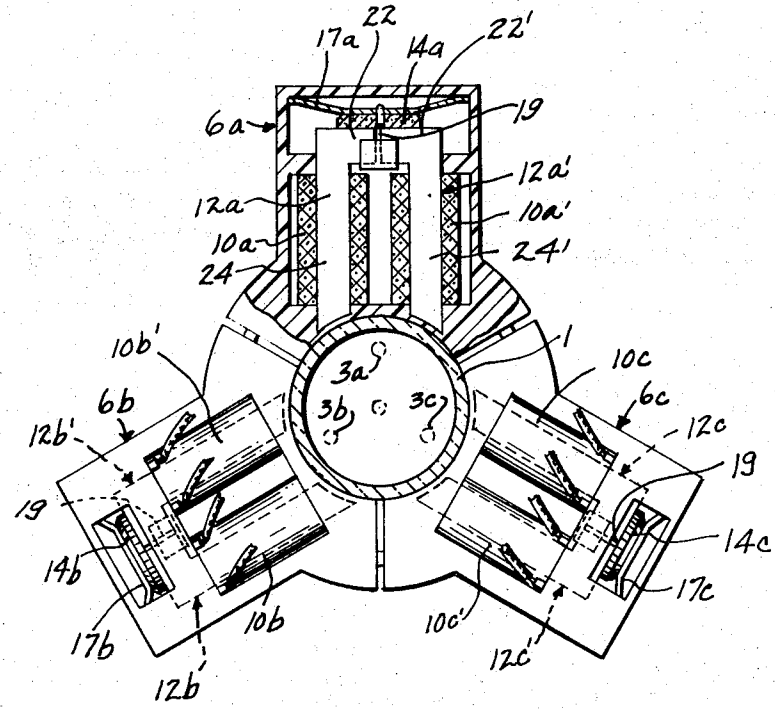


FIG. 1

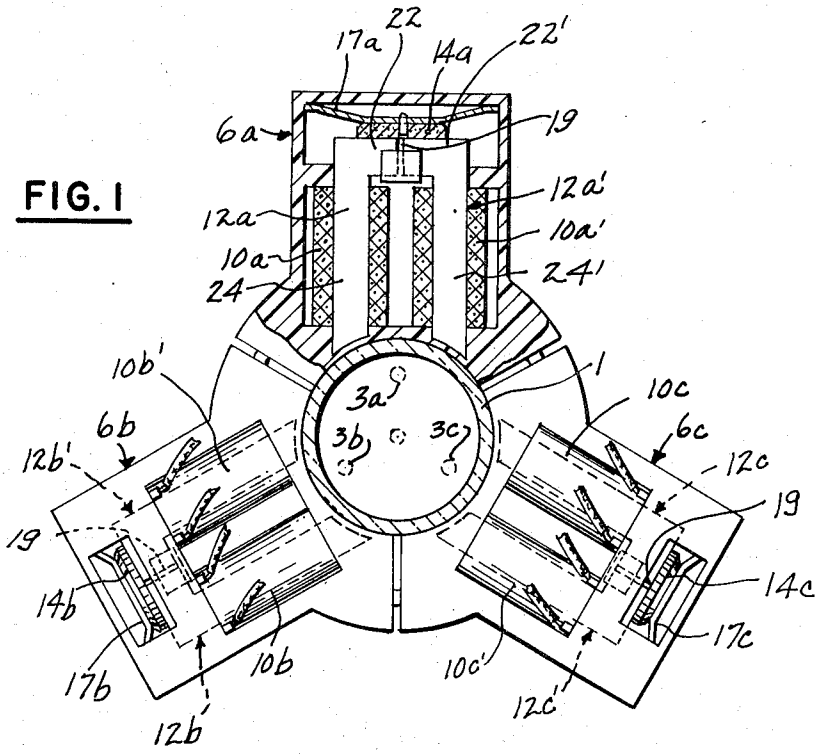
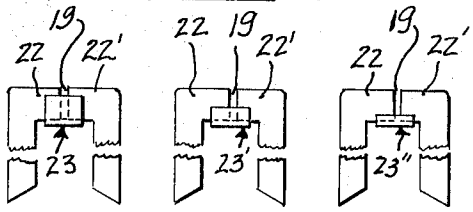



FIG. 4A FIG. 4B FIG. 4C



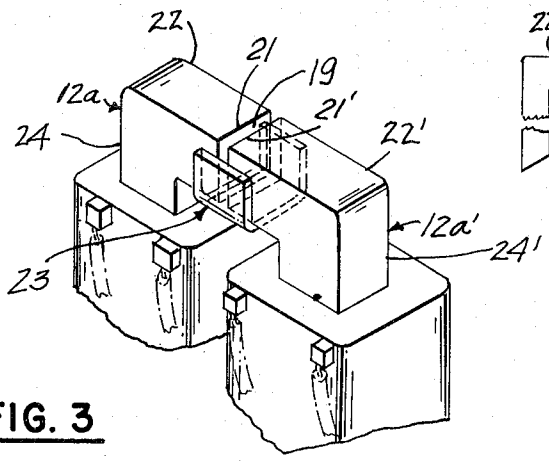
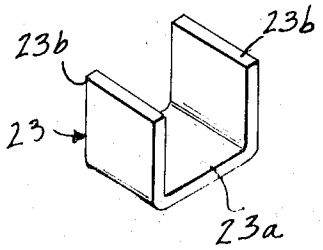




FIG. 3

FIG. 2



# TEMPERATURE COMPENSATED ELECTRON BEAM CONVERGENCE APPARATUS

The present invention relates to apparatus for controlling the position of electron beams in cathode ray tubes used in television receivers. More particularly, the present invention relates to beam convergence apparatus for controlling the deflections of the various electron beams used in color television tubes and the like to converge the beams onto a limited portion of a luminescent screen on the tube face.

As is well known, the conventional color television tube used today has three electron guns mounted in the neck of the tube, which electron guns direct electron beams at three equally spaced points longitudinally in the tube neck. The beams are deflected by a number of different beam deflection means on their way to the luminescent screen on the face of the television tube. The screen is provided with a multiplicity of groups of phosphor areas or spots, there being three such areas or spots in each group capable respectively of producing light of the different primary colors, blue, green and red, in response to electron impingement thereon. The intensity and deflection of the three electron beams of the television tube are controlled in such a way that the picture produced on the screen approximates fairly closely the form and color of the particular scene recorded by the picture taking equipment involved.

One of the beam deflection means mounted on the neck of a color television tube is a deflection yoke having both horizontal and vertical beam deflection coils for moving the three beams as a unit in both horizontal and vertical directions across the entire extent of the screen of the television tube. The present invention relates to other beam deflection means carried on the neck of the color television tube behind the deflection yoke, such means being sometimes referred to as beam convergence apparatus.

The beam convergence apparatus generally comprises a number of independently adjustable disc magnets carried on a common frame, each disc magnet being mounted for rotation opposite a gap in a pair of core members or pole pieces located adjacent one of the electron beams. Adjustment of each disc magnet varies the flux directed into the neck of the tube to vary the deflection of the associated electron beam. The adjustment is made so that the three beams are made to converge on the respective phosphor areas or spots of a selected group thereof. When the beams are of equal intensity and each beam impinges upon the particular phosphor area or spot of a group assigned to the particular beam involved, due to the additive effect of the primary colors on the region of the screen occupied by the group of phosphor areas or spots involved, the resultant color is white. This adjustment is made prior to the application of the sweep and picture forming signals to the signal input terminals of the color television tube. (These sweep signals cause the converged beams to sweep across the entire useful area of the tube screen and the picture forming signals vary the relative intensities of the various electron beams to produce the desired color at each region of the screen occupied by each group of phosphor areas or spots.)

Each of the aforesaid disc magnets produces a magnetic flux in a first path which extends through the core members and between the ends thereof positioned adjacent to the neck of the cathode ray tube, so the flux



extending between the ends of said core members extends into the cathode ray tube in the path of the associated electron beam. Each of the disc magnets also produces flux in a shunt leakage flux path passing across the gap between the core members. The magnetic material out of which these disc magnets are generally made is temperature responsive, so that the amount of flux generated thereby varies somewhat with change in temperature. Generally the flux decreases with increases in temperature. To compensate for such flux variation with temperature, it has been common to associate with the gap between the core members a flux-permeable compensating magnetic member whose magnetic reluctance (i.e. resistance to magnetic lines of force) increases with temperature, so that a greater portion of the flux generated by the associated disc magnet will pass through the core members to extend between the ends thereof adjacent the cathode ray tube as the ambient temperature increases, so as to maintain the flux operating on the associated electron beam fairly constant with the variation in ambient temperature of the disc magnet.

Various designs of compensating magnetic members have been heretofore utilized. In some instances, these compensating magnetic members are located directly in the gap between the confronting faces of the core members defining such gap. In other forms of these compensating magnetic members, they extend across the gap at a radially facing side or at the opposite laterally facing sides of the portions of the core members forming the gap. These various forms of compensating magnetic members, while usually effective to achieve their desired result, have various deficiencies or disadvantages. For example, in the case of some of these compensating magnetic members, because of the design and locations thereof, when they are added to an existing previously designed magnetic structure they materially effect the previously designed structure so that the entire system has to be redesigned to accommodate the compensating members. Also, these prior compensating members were not designed so that the degree of effect thereof on a given magnetic circuit could not be readily varied easily to adjust a particular compensating magnetic member to a given magnetic circuit configuration.

It is one of the objects of the present invention to provide in a temperature compensated static convergence apparatus as described a unique compensating magnetic member which can be added to an existing magnetic circuit design with a minimum of difficulty, and also wherein the degree of effect of such compensating member can be initially modified in a simple and easy manner to provide a near perfect compensation at a given preferred temperature.

In accordance with the present invention, the compensating magnetic member is fabricated with a channel or U-shape and is mounted about the gap-forming portions of the core members so that the bridging or web portion of the U-shaped compensating member extends across the gap on the side of the core member opposite the side on which the associated disc magnet is located, and so that the opposite legs of the U-shaped compensating member extend across the gap on the adjacent sides of the core members. (Where the disc magnet is located on the radially outwardly facing side of the gap formed between the core members, the gap is spanned by the member on both the lateral sides and

the radially inwardly facing side of the core members.) In such a relationship between a U-shaped compensating magnetic member and the gap-forming portions of the core members, the compensating member interferes to a minimum extent with the flux from the disc magnet through the portions of the core members excluding the gap, and the effectiveness of the compensating member on the leakage flux can be readily initially adjusted or varied by merely varying the length of the legs of the U-shaped members. Moreover, where the magnetic member extends substantially beyond the gap between the core members, a substantially large confronting surface area is provided between the inner surfaces of the compensating magnetic member and the adjacent outer surfaces of the core members, so that by covering these confronting surface areas with adhesive to secure the compensating magnetic member to the core members, the magnetic member acts as a means which very strongly interconnects the spaced portions of the core members.

The above and other objects, advantages and features of the invention will become apparent upon making reference to the specification to follow, the claims and the drawings wherein:

FIG. 1 is a sectional view through the neck of a color television cathode ray tube showing a temperature compensated static convergence unit mounted around the cathode ray tube neck, with a portion of the apparatus broken away to show the application of the unique compensating magnetic members of the present invention thereto;

FIG. 2 is a perspective view of the compensating magnetic member applied to each section of the static convergence apparatus shown in FIG. 1;

FIG. 3 is a perspective view of the compensating magnetic member shown in FIG. 2 applied to the gap-forming portions of the core member forming one of the sections of the convergence apparatus of FIG. 1; and

FIGS. 4A, 4B and 4C respectively show the manner in which the compensating member shown in FIG. 2 can be progressively cut down in size to vary progressively the effect thereof on the section of the static convergence apparatus involved.

Reference should now be made to the drawings, more particularly to FIG. 1, where the neck portion 1 of a color television tube is shown. The color television tube is a conventional one having three electron guns (not shown) mounted in the end of the neck 1 of the tube so as to direct three electron beams, 3*a*, 3*b* and 3*c* spaced 120 degrees apart longitudinally thereof.

The three beams are acted upon by a number of beam deflection means mounted around the outside of the neck 1 of the color television tube. These beam deflection means include convergence magnet means supported in three angularly spaced housing sections 6*a*, 6*b* and 6*c*, each of which magnet means controls the deflection of one of the beams 3*a*, 3*b* or 3*c*. Manually and electrically variable convergence magnet means to be described produce a magnetic flux which is directed generally radially into the tube neck 1 where it affects only the associated beam. These magnet means operate so that the three beams are converged upon one group of phosphor spots on the luminescent screen (not shown) of the television tube each beam striking a different spot of the group. This adjustment affects the static or fixed component of the magnetic flux produced by each leg of the convergence apparatus. The screen is provided with a multiplicity of such groups of phosphor spots and the spots in each group respectively produce the three primary colors (blue, green and red) when they are struck by an electron beam. The region encompassed by the phosphor areas or spots in each group is so small that the eye sees only a color which is the resultant of the individual primary colors produced by the three phosphor spots. Thus, if the three electron beams striking the three spots in a group thereof are of equal intensity, the resulting color will be white. The electrically variable convergence magnet means includes means for varying dynamically the magnitude of the magnetic flux produced by the magnet means. The dynamic magnetic field strength variations are made in accordance with a predetermined function of the beam deflection. The signals for producing the dynamic variation in the magnetic field strength are common derived from convergence control circuits (not shown) fed by horizontal and vertical deflection generator circuits (not shown). These signals are fed to windings 10*a*–10*a*′, 10*b*–10*b*′ and 10*c*–10*c*′ wound around respective pairs of core members 12*a*–12*a*′, 12*b*–12*b*′ and 12*c*–12*c*′.

The manually adjustable convergence magnet means most preferably comprise disc magnets 14*a*, 14*b*, and 14*c* mounted for rotation on radial axes within the respective housing sections 6*a*, 6*b* and 6*c*. Each disc magnet projects beyong the outer axially facing surfaces of the associated housing section and is positioned so that it can be readily grasped between the thumb and one of the other fingers of the operator's hand and turned to a desirable angular position. Since only one hand is required for this purpose, two of the disc magnets can be simultaneously adjusted. The resistance offered to the turning of a disc magnet is sufficiently great that the disc magnet remains in any adjusted position in the absence of any severe jarring forces and is sufficiently small that it will not hinder the movement thereof required for the critical convergence adjustment. The disk magnets may be held in place by aby suitable means such as springs 17*a*, 17*b* and 17*c*.

The disc magnets are permanent magnets commonly used in convergence apparatus and are made of a material which generally produces a magnetic flux which decreases with increase in the temperature thereof. Each of these disc magnets are shown located on the radially outwardly facing sides of a gap 19 formed between the closely spaced confronting ends 21–21′ of the transverse legs 22–22′ of the associated core members which are shown having an L-shape. The transverse legs 22–22′ of each pair of core members extends from radially extending longitudinal legs 24–24′ which terminate in ends located contiguous to the neck 1 of the color television tube.

The flux generated in the core members by each of the disc magnets 14*a*, 14*b* and 14*c* varies in direction and intensity in accordance with the angular position thereof. For a given angular position thereof, the magnetic flux produced by each disc magnet flows in two different paths, one of which extends longitudinally through and between the ends of the longitudinal core legs 24–24′ and the other of which is a shunt leakage path between the gap 19 of the associated pair of core members. The relative magnitude of the magnetic flux in these two paths depends upon the magnetic reluctance of the shunt leakage path at the gap 19.

As previously indicated, to maintain the magnetic flux flowing through the longitudinal core legs **24–24′** constant, it has been previously known to provide a flux-permeable compensating magnetic member made of a material whose magnetic reluctance increases with temperature, such as Thermalloy or monel metal. In accordance with the present invention, the compensating magnetic member is a U-shaped member **23** which preferably is sized closely to receive the transverse legs **22–22′** of the associated core members at the gap **19**. Each U-shaped member is positioned so that the web or bridging portion **23*a*** thereof extends across the gap **19** at the side of the transverse core legs **22–22′** opposite the side of which the associated disc magnetic **14*a***, **14*b*** or **14*c*** is located. The bridging portion **23*a*** of each compensating magnetic member **23** terminates in oppositely extending confronting legs **23*b*–23*b*** which extends across the associated gap **19** at the adjacent lateral sides of the transverse core legs **22–22′**. The bridging portion **23*a*** and the opposite legs **23*b*–23*b*** of the compensating magnetic member **23** extends a substantial distance beyond the gap **19** so as to present an appreciable confronting surface area to the adjacent surfaces of the transverse core legs **22–22′**. The compensating magnetic member **23** is secured to the transverse legs of the core members by applying an adhesive to substantially the entire surface area thereof confronting the core members, so that each compensating magnetic member forms rigid interconnection between the core members.

The compensating effect of each compensating magnetic member can be varied by varying the length of the opposite legs **23*b*–23*b*** of the magnetic member as illustrated in FIGS. 4A, 4B and 4C. FIG. 4A illustrates the length of the opposite legs **23*b*–23*b*** of the magnetic member shown in FIGS. **1–3**, and, as thereshown, these legs have a length to extend approximately three-quarters of the thickness of the transverse core legs **22–22′**. FIG. 4B and 4C respectively show the opposite legs of the magnetic member **23** shortened to provide magnetic members **23′** and **23″** which extend respectively one-half and one-quarter of the thickness of the transverse core legs.

The U-shaped compensating magnetic members **23** shown in the drawings have the advantage that they can be adapted to an existing convergence unit in a manner which minimizes modifications which have to be made, if at all, to the design of the basic magnetic structure shown. Also, as indicated, the degree to which the compensating magnetic member effects the magnetic structure shown can be readily varied by varying the length of the opposite legs of the U-shaped compensating magnetic members and they act as structural support members for the core members.

What is claimed is:

**1.** In a static convergence apparatus for establishing a substantially constant magnetic flux field across paths traversed by electron beams in a color producing cathode ray tube, the apparatus including separate sections adapted to be positioned at spaced points about the neck of the tube opposite the respective beams thereof, each section of the apparatus including a pair of core members of a predetermined configuration and having ends adapted to be positioned adjacent to the neck of the cathode ray tube so magnetic flux passing between said ends extends into the tube in the path of the associated electron beam, and portions spaced from said core member ends and in closely spaced confronting relation to one another to provide a small gap therebetween, a manually movable adjustable magnetic flux producing means positioned on one side of said gap of the associated core members for producing magnetic flux in a first path which extends through said core members and between the ends thereof and in a second shunt leakage flux path passing across said air gap, the magnetic flux produced by said movable adjustable magnetic flux producing means having a tendency to vary according to the variation in the ambient temperature thereof, the improvement comprising: a U-shaped flux-permeable compensating magnetic member extending part way around said closely confronting portions of said core members to bridge said gap therebetween and having a magnetic reluctance which varies with temperature so as to vary the amount of leakage flux across said gap to maintain the flux in said first path fiarly constant with variation in the ambient temperature, said U-shaped compensating magnetic member having a bridging portion extending across said gap on the side of said core members opposite the side on which said movable adjustable magnetic flux producing means is located and a pair of opposite legs extending from said bridging portion thereof in the direction of said movable adjustable magnetic flux producing means and passing across the gap along the adjacent sides of said core members so the shunt effect of the compensating member varies with the length of said opposite legs thereof.

**2.** The convergence apparatus of claim **1** wherein said gap of said core members is formed at the radial outermost point of the core members and said movable adjustable magnetic flux producing means is arranged about the gap so the bridging portion of said compensating magnetic member and said movable adjustable magnetic flux producing means are located at opposite radially facing sides of said core members, and said opposite legs of said compensating magnetic member extend radially over the laterally facing sides of the core members.

**3.** The convergence apparatus of claim **2** wherein said opposite legs of said compensating magnetic member extend radially only partway across the core members.

**4.** The apparatus of claim **1** wherein said U-shaped compensating magnetic member extends a substantial distance beyond the gap of said core members to confront appreciable surface areas thereof, and substantially the entire confronting surface areas of said bridging portion and opposite legs of said compensating magnetic member and said core members are adhesively secured together whereby said magnetic member forms a rigid connection between said core members.

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