United States Patent

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[54] **TEMPERATURE COMPENSATED CONVERGENCE COIL FOR CATHODE RAY TUBES**
8 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** **313/77,** 317/132, 335/212, 335/217
[51] **Int. Cl.** **H01f 1/10,** H01f 7/06, H01j 29/80
[50] **Field of Search** 313/75, 76, 77; 335/217, 212, 213; 317/132

[56] **References Cited**
UNITED STATES PATENTS

3,002,120	9/1961	Clay	313/77
3,325,758	6/1967	Cook	335/217

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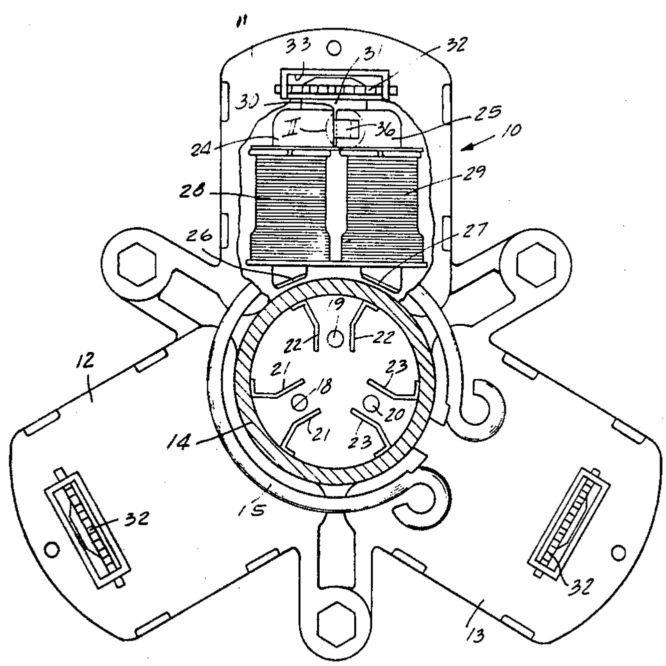
ABSTRACT: Convergence coil assembly for multigun cathode ray tubes in which changes in magnetic permeability due to changes in temperature are compensated by the provision of a temperature compensating shunting element in the core structure whose change in permeability upon temperature change tends to keep the available flux density affecting the electron beam at a constant value.



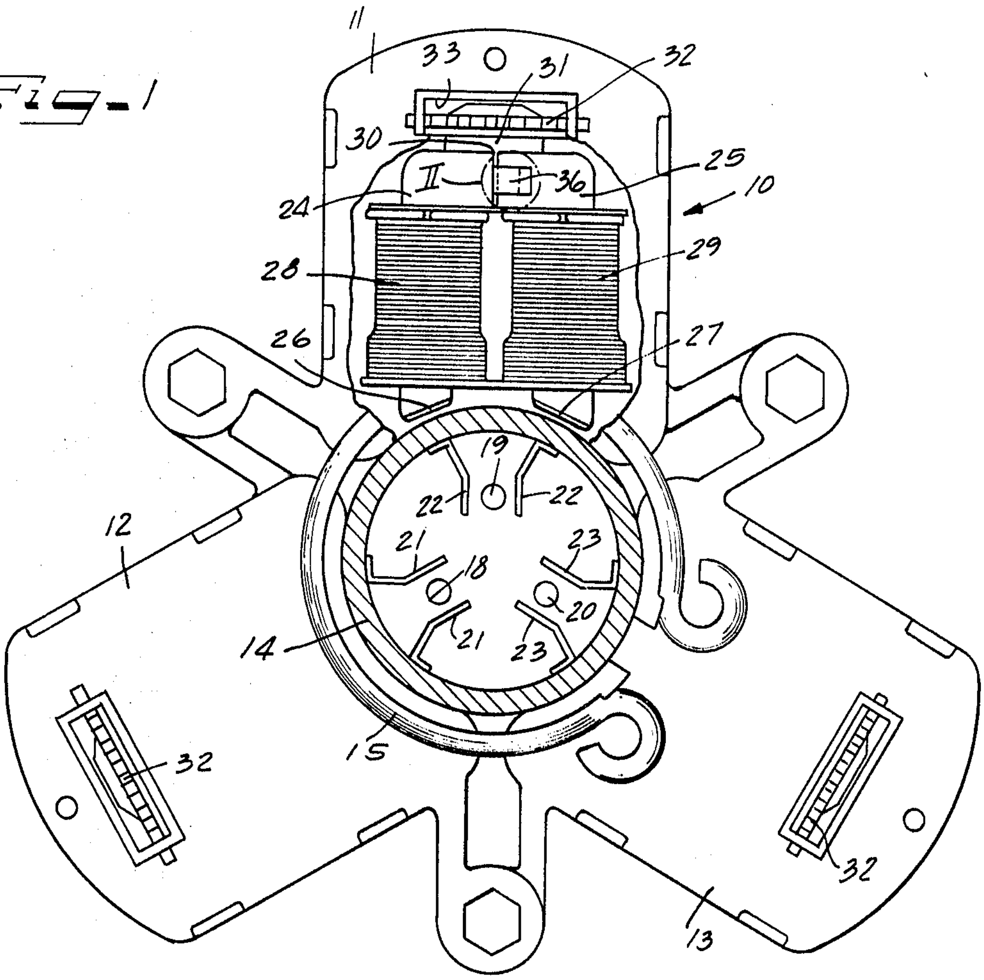


Fig. 1

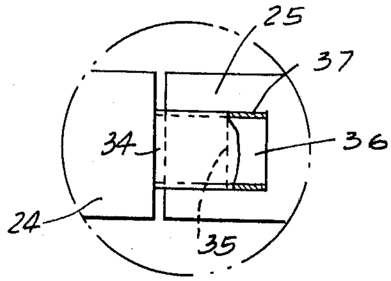


Fig. 2

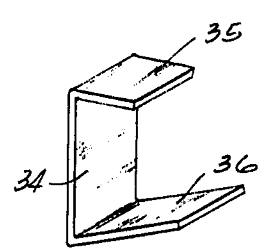


Fig. 3

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TEMPERATURE COMPENSATED CONVERGENCE COIL FOR CATHODE RAY TUBES

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention is in the field of convergence coil assemblies for multigun cathode-ray tubes, such as color television tubes and provides a means for adjusting static conversion of the three electron beams of such a tube, which convergence is rendered independent of temperature changes.

2. Description of the Prior Art

Color television picture tubes of the type employing a shadow mask are all provided with convergence circuits by means of which the three electron beams are caused to pass through the same hole in the shadow mask at the same time. When the beams do this, they emerge from the mask at the correct angle to strike the appropriate dot in the triad of color dots on the face of the tube. Static convergence, that is, adjustment of the beam convergence at the center of the screen is unusually accomplished by a magnetic means which bends the individual beam to convergence. Dynamic convergence, that is, maintaining the beams in proper convergence at points away from the center is accomplished by introducing additional voltages which change the convergence point of the beams as they sweep over the face of the screen, both from side to side and up and down. Dynamic convergence is necessary because the shadow mask surface is not completely spherical and therefore does not follow the curve necessary to keep the beams converged at all points.

Convergence coil assemblies usually consist of three magnetic circuits spaced 120° apart about the neck of the tube, with one magnetic circuit being associated with one of the three electron beams. Typically, the static convergence is controlled through the adjustment of the magnetic force supplied by a permanent magnet in the convergence coil assembly. The flux of each magnet is conducted through magnetic circuits to the neck of the picture tube and across the path of the electron beam. An electron beam entering a magnetic field is deflected in a direction normal to the flux line in an amount determined by the velocity of the beam and the strength of the field.

In many convergence assemblies, permanent magnets of the barium ferrite-type are employed. These magnets are relatively inexpensive and provide relatively strong field strength for unit of mass. Typically, the residual flux density of a barium ferrite magnet is about 2200 gauss and its coercive force is about 1800 oersteds. The maximum energy product of such magnets is usually about 1,000,000 gauss-oersteds. However, such magnets have a negative temperature coefficient of magnetic permeability, that is, as temperature increases, the magnetic field strength provided by the magnet decreases. The result is that the amount of deflection of a given beam decreases as temperature increases, and the beam moves along a line which is radial to the tube axis away from the converged position. Since all beams are effected, there is a definite tendency toward losing convergence as the temperature of the television receiver increases.

The prior art has numerous examples of convergence assemblies which have been used to secure static and dynamic convergence in color television tubes. Examples of such assemblies will be found in the following U.S. Pat. Nos. which are cited as strictly for purpose of illustration:

2,791,709	2,975,314	3,348,177
2,864,021	3,002,120	3,332,046
2,880,340	3,138,730	3,354,337
2,880,360	3,188,534	3,363,127
2,880,364	3,308,328	3,379,923

All of these structures suffer from the disadvantage that they are temperature sensitive. Consequently, in order to make a convergence adjustment it is common practice to wait until the receiver temperature is stabilized, which usually

takes about 20 minutes after the set is turned on, before initiating the convergence procedure. Subsequent periods of operation of the set require the same length of time before temperature stabilization and a converged condition are reached.

SUMMARY OF THE INVENTION

The present invention provides a convergence assembly which is temperature compensated in that it provides a compensating element which decreases its shunting effect upon changes in temperature. In the preferred form of the present invention, the magnet is a barium ferrite having a negative temperature permeability characteristic and the compensator element is located in a nonmagnetic pole structure and is also characterized by a negative temperature-permeability characteristic. In effect, then, there is a substantially zero change in effective field strength of the magnetic circuit as a whole upon changes in temperature.

Other objects, features and advantages of the invention will be readily apparent from the following description of a preferred embodiment thereof, taken in conjunction with the accompanying drawing although variations and modifications may be effected without departing from the spirit and scope of the novel concepts of the disclosure, and in which:

FIG. 1 is a view partly in elevation and partly in cross section illustrating the manner in which a convergence assembly of the present invention is incorporated on the neck of a cathode-ray tube;

FIG. 2 is an enlarged view of the portion of the compensator assembly which is encircled in FIG. 1; and

FIG. 3 is a view in perspective of the compensating element itself;

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In FIG. 1, reference numeral **10** indicates generally a convergence assembly consisting of three identical housing **11**, **12** and **13**, the housing **11** being broken away for purposes of illustration. The three housings **11**, **12** and **13** are disposed symmetrically around the longitudinal axis of a neck **14** of a three gun cathode-ray tube. A retaining ring **15** serves to hold the housings against the neck of the tube.

The three electron beams generated within the color television tube have been identified at reference numerals **18**, **19** and **20**, respectively. These electron beams are disposed within the confines of internal pole pieces **21**, **22**, and **23**, respectively, made of a suitable ferromagnetic material.

Each of the housing interiors is identical and therefore the description of one will suffice for all. Disposed within the housing **11** is a pair of L-shaped confronting pole pieces **24** and **25** composed of a suitable ferromagnetic material which provides a relatively low reluctance path for the magnetic flux existing in the magnetic circuits. The ends of the pole pieces **24** and **25** are provided with pole shoes **26** and **27** which are in confronting relation to the internal pole pieces **22** within the cathode-ray tube.

Each of the legs **24** and **25** carries a plurality of coils **28** and **29** for securing dynamic convergence of the electron beams. Such coils may include, for example, both a vertical frequency exciter coil and a horizontal frequency exciter coil mounted on each leg.

The confronting ends of the L-shaped pole pieces **24** and **25** are spaced apart to provide a nonmagnetic gap **30** therebetween. Positioned in close proximity to the nonmagnetic gap **30** is a disc-type permanent magnet **31** preferably composed of barium ferrite. The magnet **31** is polarized such that opposite magnetic poles are at diametrically opposed positions on the face of the disc, so that rotation of the magnet **31** is effective not only to change the relative field strength at the nonmagnetic gap **30**, but also the magnetic polarity. The rotation of the magnet **31** from outside the housing is effected by providing a thumb wheel **32** engaging the permanent magnet **30**, and extending through an aperture **33** provided in the housing.

The nonmagnetic gap 30 is employed to offer fixed amount of reluctance to the magnetic flux applied across it. Widening of the nonmagnetic gap causes the reluctance to magnetic flux to increase, and therefore more flux is available at the pole shoes at 26 and 27. The amount of reluctance is determined by the material used in the nonmagnetic gap and its thickness. To put it another way, the nonmagnetic gap 30 shunts a portion of the flux from one pole of the magnet to the other pole, bypassing the magnetic circuit. The amount of flux thus shunted is not available in the circuit to contribute to field strength.

In accordance with the present invention, a temperature compensating element is introduced into the nonmagnetic gap 30 to offset the tendency of the magnetic field intensity to decrease upon increase in temperature. While the compensating element may take various geometric forms, a suitable compensator element has been illustrated more particularly in FIGS. 2 and 3 of the drawings. As shown in FIG. 3, the core of the compensating element consists of a strip of metal having a medial portion 34 arranged to be received between the confronting faces of the L-shaped pole pieces 24 and 25 and inclines leg portions 35 and 36 arranged to engage opposed faces of the pole piece 25. The metallic strip is used in conjunction with a nonmagnetic dielectric material such as a paper tape 37 as best illustrated in FIG. 2. As illustrated in FIG. 3, the opposed legs 35 and 36 are inwardly inclined so that they resiliently engage the opposed faces of the pole piece 25.

The metal of the compensator strip has magnetic properties such that its permeability decreases with temperature, as the permeability of the magnet decreases with temperature but usually in a greater amount. Alloys having these properties are commercially available, and one alloy which we have found particularly suitable for use with barium ferrite contains 0.10 percent carbon, 0.40 percent manganese, 0.20 percent silicon, from 29 to 32 percent nickel, and the balance substantially all iron. This material has the following typical magnetic characteristics:

	Flux density kilogauss	Permeability
Temperature, ° C:		
−20	3.32	72.2
+25	1.5	32.6
+50	.69	15.0

In addition to variations in the chemistry of the alloy, the amount of compensation afforded by the compensator strip can be varied by changes in compensator size, thickness, configuration, and the relative amounts of nonmagnetic, dielectric material such as paper or fabric tape and the metallic strip in the nonmagnetic gap.

In use, the composite nonmagnetic gap composed of the metallic strip and the insulating material has a shunting effect which varies with temperature. At lower temperatures, the reluctance to a fixed flux is minimum, while at elevated temperature, the reluctance increases. That effect is a minimum flux change in the entire magnetic circuit due to temperature changes, so that convergence can be adjusted at any time and convergence will be maintained regardless of temperature drifts in a system.

I claim as my invention:

1. A convergence coil assembly for a multibeam cathode ray tube comprising a plurality of magnet assemblies arranged to be positioned on the neck of said tube, one magnet assembly being in proximity to each of the electron beams therein to thereby affect the inclination of its associated beam for convergence of the beams at the face of said tube, each of said magnet assemblies including a permanent magnet composed of a material having a negative temperature coefficient of magnetic permeability and pole pieces disposed in the field of said magnet, said pole pieces being separated by a nonmagnetic gap, and a temperature sensitive spacer within the magnetic field of said magnet assembly and shunting a portion of said magnetic field thereby reducing the deflection of the beams from their converged positions due to temperature changes in the magnet assemblies.

2. The convergence coil assembly of claim 1 in which said permanent magnet is composed of a barium ferrite.

3. The convergence coil assembly of claim 1 in which said spacer includes a strip of metal having a negative temperature coefficient of magnetic permeability associated with a nonmagnetic dielectric material.

4. The convergence coil of claim 3 in which said strip has a medial portion received between confronting faces of said pole pieces and leg portions engaging opposed faces of one of said pole pieces.

5. The convergence coil assembly of claim 3 in which said nonmagnetic dielectric material is paper.

6. The convergence coil assembly of claim 1 in which said permanent magnet is disposed against said nonmagnetic gap and has adjustment means acting on said permanent magnet for varying the magnetic field strength at said gap.

7. The convergence coil assembly of claim 1 in which said pole pieces are L-shaped and said spacer is located in the nonmagnetic gap between said pole pieces.

8. In a convergence coil assembly for cathode ray tubes and the like, having at least one beam path whose position is to be modified, which assembly has a magnet and pole pieces separated by a nonmagnetic gap for controlling the position of a beam path, the improvement of a temperature compensating spacer in said gap effective to offset the effect of temperature changes on the magnet.