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2,907,914

ELECTRICALLY ENERGIZED MAGNETIC SHIELD

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FIG. 1.

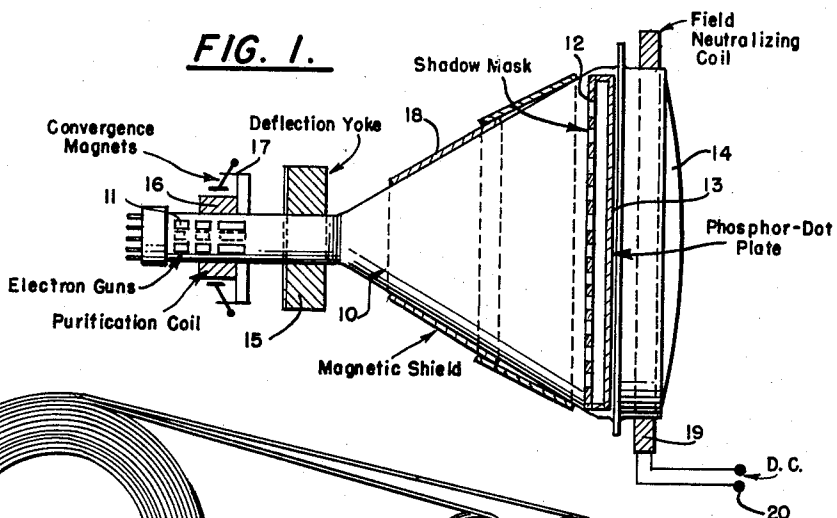


FIG. 2A.

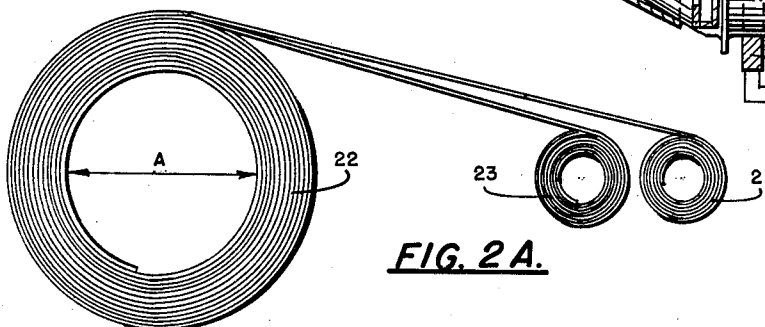


FIG. 2B.

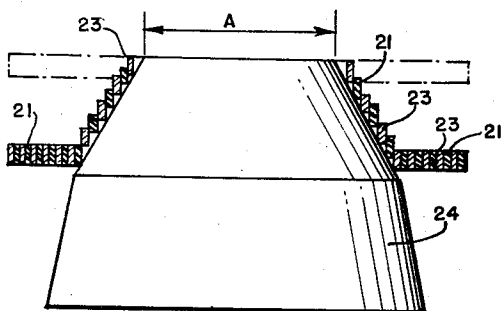


FIG. 2C.

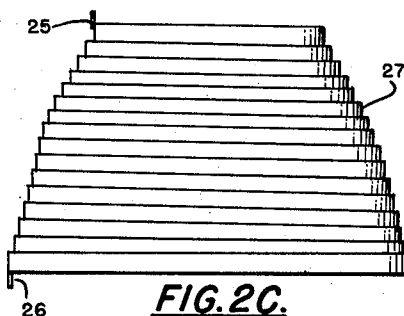
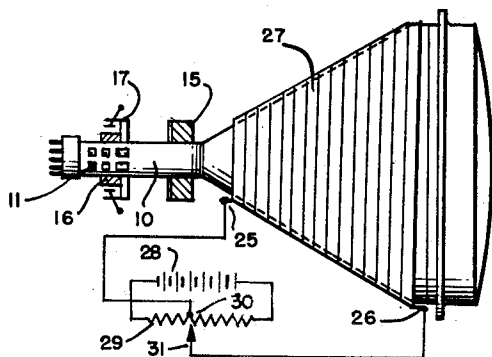


FIG. 3.



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ELECTRICALLY ENERGIZED MAGNETIC SHIELD 5

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8 Claims. (Cl. 315—8)

The present invention relates to magnetic shield structures and more particularly to magnetic shields for color television tubes.

As is well known, it is sometimes necessary to shield cathode ray and television tubes from undesired magnetic fields. Color television tubes, in particular, require proper shielding to prevent pattern distortion, to increase sharpness of focus and to prevent color fringing and off-color effects. The color purity of a television tube depends upon the effective magnetic shielding of the tube envelope against stray magnetic fields whether fixed or variable in direction and intensity.

In the case of color television installations, it is therefore known that much care must be taken in shielding the color television tube in order that acceptable color purity will be achieved. For instance, reference is made to the RCA Developmental Booklet (Form No. 1CE-111), published by the tube department of Radio Corporation of America, Harrison, New Jersey, in October 1953. This publication, in discussing the three gun tri-color kinescope designated therein as Developmental No. C-73599, indicates at pages 33 and 34 that shielding of the tube is preferably effected by the use of two shields and two coils. The two shields comprise a substantially conical shield placed in close proximity to the bulbous body of the tube, and a further, preferably cylindrical, shield placed about a portion of the neck of the tube. The two coils in turn comprise a purifying coil placed about the neck of the tube, and a "field neutralizing coil" which is placed adjacent the face of the tube. Desired color purity is effected by adjustment of the purifying coil, the axial position of the deflecting yoke, and the magnitude and direction of current in the field neutralizing coil. This system of magnetic shielding and field neutralization has been used in conjunction with the RCA tri-color kinescope, type 15GP22. This particular tri-color kinescope is now in public use.

In practice, the field neutralizing coil, wound, as it is, adjacent the face of the tube and substantially coaxial with the longitudinal axis of the tube, produces a D.C. field of selective magnitude and direction substantially parallel to the axis of the picture tube. However, it should be noted that inasmuch as this field neutralizing coil is in fact a single bunched coil, the axial magnetic field produced thereby is somewhat less uniform than may be desired to provide proper color purity. In addition, the provision of such a field neutralizing coil as a distinct component in a color television installation, increases the necessary cost thereof and further requires careful consideration to be given to physical disposition of components.

Prior to my invention, an improved form of shield was produced by David C. Langworthy as described in his prior copending application Serial No. 392,925, filed November 18, 1953, now Patent No. 2,860,328, issued November 11, 1958, and entitled: Shield for Cathode Ray Tubes and Process of Making the Same. The Langworthy disclosure points out that a shield may be made

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of inexpensive strip silicon steel by winding the same in the form of a spiral and then annealing it. The spiral is then modified by moving some of the turns parallel to the axis of the spiral whereby a shield having the shape of a frustum of a cone results. That disclosure also contemplates that during the winding of the spiral a strip of insulating material may be wound between the layers of the spiral. This insulation remains in the final shield and improves the shielding properties of the shield.

While the device shown in the aforesaid Langworthy application discloses an improved shield, it does not take the place of the "field neutralizing coil," much less produce an improved field neutralizing means as is contemplated by the present invention.

The primary object of the present invention is to improve the shielding properties of shields of the character disclosed in the aforesaid Langworthy disclosure.

Another object of the invention is to provide a shield for color television tubes which not only performs a shielding function but also performs the function of the prior art "field neutralizing coil."

Still another object of the invention is to provide a color television tube with improved field neutralizing means therefor.

In addition, it is an object of the invention to provide a simple and effective shield for cathode ray tubes.

It is still another object of the invention to provide a color television tube having improved means, which not only shields the tube but provides field neutralization therefor, and which is lower in cost than the means heretofore employed to perform these two functions.

It is another object of the invention to improve the shielding efficiency of magnetic shields.

The aforesaid Langworthy application discloses a strip of silicon steel wound in the shape of a frustum of a cone, with the several turns of the spiral insulated from each other. The present invention contemplates passing a direct current through the silicon steel strip of that prior shielding device. This current will cause the silicon steel strip to operate at a higher point on its magnetization curve and thus effectively increase the permeability of the shielding material. In the case of color television tubes, the D.C. field set up due to current flow through the shield aids in achieving color purity in the same way as that result was achieved by the aforesaid prior art "field neutralizing coil." However, the shield of the present invention is much longer than the bunched coil previously used as a field neutralizing coil. Hence, the field produced by the shield of this invention much more nearly approaches that of an infinitely long solenoid than has heretofore been the practice. It follows that the shield of the present invention not only eliminates the necessity for the bunched "field neutralizing coil" of the prior art but gives an improved neutralization field. Moreover, it also effects better shielding than the shield that it replaces.

The present invention finds particular utility in connection with the so-called RCA color television tube wherein three electrostatic focus guns spaced 120°, with axes parallel to the tube axis, are employed in conjunction with a shadow mask and a phosphor dot plate. Reference is made to the RCA kinescope type 15GP22 as well as to the RCA Developmental Booklet, identified previously, for typical tube structures of this type. It is to be understood, however, that the invention finds further utility in any application wherein it is desired to increase the permeability of a magnetic shield as well as in any system wherein both magnetic shielding and/or an axial magnetic field are desired.

The foregoing objects, advantages and operation of my invention will become more readily apparent from

the following description and accompanying drawings, wherein:

Fig. 1 is a cross-sectional diagram of a prior art color television tube utilizing three guns, a shadow mask and a phosphor dot plate in combination with a single bunched coil adjacent the face of the said tube for field neutralization.

Figures 2A, 2B and 2C represent steps in the manufacture of a multi-layered strip wound shield which may form a part of the present invention; and

Figure 3 depicts a cathode ray tube, such as the color television tube of Figure 1, in combination with a strip wound shield and means for energizing the said shield to increase the shield permeability and to effect an axial neutralization field, all in accordance with the present invention.

Figure 1 shows an RCA type 15GP22 color television tube which is now in wide public use. This tri-color kinescope comprises a cathode ray tube 10 provided with three electrostatic focus guns 11 adjacent one end of the neck thereof, which guns are normally spaced 120° apart with their axes parallel to the tube axis. The tube 10 is further provided with a shadow mask 12 and a substantially planar tri-color phosphor dot plate 13 in proximity to one another and adjacent the face plate 14 of the tube. For proper operation of the tube, a deflection yoke 15 is provided, and a purification coil 16 and convergence magnets 17 are disposed adjacent the three electron guns 11. In addition, a neck shield of magnetic material is also normally provided adjacent the purification coil 16 and convergence magnets 17 to aid in the color purity of the picture. This neck shield has not been shown for purposes of simplicity of representation. A substantially conical shield 18, which may be formed in two sections as shown in Figure 1, is also normally provided between the deflection yoke 15 and the viewing face of the tube 14, which shield extends in close proximity to the tube envelope over a major portion of the said envelope. A field neutralizing coil 19 energized from a direct current source 20 is also placed about the face plate end of the tri-color kinescope as shown, to produce a magnetic field in a direction substantially parallel to the longitudinal axis of the tube 10. This magnetic field aids in the color purity of the picture by neutralization of the extraneous magnetic fields which cause tangential displacement of the three electron beams from their color centers. Inasmuch as the field neutralizing coil 19 takes the form of a single bunched coil adjacent the face plate of the tube, the axial field produced thereby is not as uniform as might be desired to effect necessary field neutralization. In addition, the field neutralizing coil 19 requires special considerations as the provision of adequate high voltage insulation between the said coil 19 and the metal flange of the kinescope as well as considerations of the physical space necessarily required for disposition of the coil 19 as shown.

A brief description of the method of making a shield of strip material, as previously taught in the aforesaid Langworthy application will now be stated. Following such statement my improvement upon the Langworthy invention will also be stated.

Referring to Figure 2A it will be seen that in accordance with one possible method of construction, the shield may be fabricated by employing a strip of high silicon steel 21 (2 to 5% silicon) which is preferably wider than one quarter (1/4th) inch and which is preferably between 0.002 and 0.020 inch in thickness. In a preferred embodiment of the invention, the dimensions of the strip 21 are approximately 0.012 inch in thickness and of a width of substantially five-sixteenth (5/16) inch. The strip 21 is wound in the form of a spiral coil 22 and during the said winding operation a further strip of insulating material 23, which may take the form of an insulating paper, is wound with the strip 21 whereby the spiral coil 22 comprises alternate layers of (a) magnetic and electri-

cally conductive material 21 and (b) insulating material 23. Upon completion of the winding step, illustrated in Figure 2A, the coil 22 or stacks of coils similar to 22, may be annealed under suitable conditions of temperature, pressure and atmosphere for a suitable length of time. The actual anneal conditions will vary with the precise material employed in the formation of the coil 22.

If the coil 22 includes the insulating strip material 23 at the time of the anneal, a special grade of paper, such as asbestos paper, is preferably employed to prevent the insulation from being destroyed by the high annealing temperatures. It is possible to wind the spiral coil without the paper layer therein and to slip the paper in the spiral coil after the latter has been wound and annealed. If this manufacturing process is employed, ordinary paper may be used.

Upon completion of the winding of the coil 22, as shown and discussed with reference to Figure 2A, the said coil 22 is placed on a form 24 (see Figure 2B) which form 24 is fabricated of a rigid solid material having an external configuration similar to that of the final magnetic shield desired. The coil 22 is formed so as to have an inside diameter A which fits snugly over one end of the form 24; and the successive turns of the coil 22 are pressed downwardly to lower and lower levels as shown in Figure 2B, until the strip takes the shape of a helix having plural wraps of magnetic material 21 overlapping one another and in contact with the external surface of the form 24; the said overlapping turns of magnetic material 21 are, of course, mutually separated by further overlapping turns of insulating material 23. The innermost turns of the coil 22 are pressed downwardly at first, and then the larger and larger turns are successively pressed downwardly as shown, until finally a helix is formed which fits accurately over the outside of the form 24. The helical coils of alternate magnetic and insulating material are then coated with a penetrating adhesive such as silicone varnish by dipping, spraying, brushing, etc., and upon removal from the said form 24 the shield is self-supporting and has the configuration shown in Figure 2C.

Terminals 25 and 26 are then affixed to the opposite ends of the shield 27 formed by the foregoing process, these terminals 25 and 26 being fastened to the metal strip 21 by riveting, for example. Inasmuch as the shield shown in Figure 2C now defines an elongated strip of material helically wound about an elongated longitudinal axis, the silicon steel strips being insulated by adjacent wraps of insulating material 23, the shield 27 not only provides excellent magnetic shielding properties but also affords a path of electrical continuity between the terminals 25 and 26. It will be readily seen from an examination of Figure 2C that, in effect, the shield is a helix of electrical conducting material which, when energized by passing a direct current from one of terminals 25 and 26 to the other, acts as an electrical coil of extended length approaching the ideal of an infinitely long solenoid.

Such a shield structure can be placed upon a cathode ray tube such as the RCA tri-color kinescope 15GP22 referred to previously; and when so placed the shield not only performs the magnetic shielding function of the shield 18, shown in Figure 1, but also produces the axial field necessary for color purity and previously provided by the field neutralizing coil 19 of Figure 1.

This preferred embodiment of my invention is shown in Figure 3 and it will be seen that the shield 27 comprising the plural overlapping wraps of magnetic and electrically conductive material separated from one another by the plural wraps of electrically insulating material, as described previously, may be placed on the color television tube 10 as shown. A source of direct current may then be applied between the terminals 25 and 26 and this source is so designed that both the magnitude and direction of direct current applied between the terminals 25 and 26 may be varied as desired. The arrange-

ment shown in Figure 3 comprises a source of direct current 28 such as a battery or an appropriate portion of the main power supply of a television system employing the present invention, which source 28 is connected across an impedance such as a potentiometer 29. Potentiometer 29 may be center tapped as at 30 and the shield terminal 25 can be connected to the said center tap 30. Terminal 26 is in turn connected to a variable contact 31 movable upon the resistance 29, as shown. By varying the position of contact 31 with respect to the fixed contact 30, it will thus be seen that both the magnitude and direction of the direct current flowing through the spiral wraps of the shield 27 may be selectively varied. It will, of course, be understood that the precise interconnection between the shield 27 and the direct current source employed as well as the details of the source itself, is merely illustrative and many other arrangements will also suggest themselves to those skilled in the art.

The current passing between the terminals 25 and 26 through the plural conductive wraps of the shield 27 performs a two-fold function, namely, first it will provide a transverse magnetic field in the strip, which transverse field will allow the strip to operate magnetically at a point on its magnetization curve substantially higher in permeability than would be the case without this current passing through the strip. This increased permeability will, of course, result in improved shielding efficiency and it is to be understood that one of the broad concepts of the present invention resides in so increasing the efficiency of a magnetic shield by the passage of a direct current therethrough. The passage of current between the terminals 25 and 26 also provides the second function, when utilized in conjunction with a cathode ray tube such as tube 10, that inasmuch as the current passes in a plurality of circles about the longitudinal axis of the tube 10, in a manner directly analogous to the passage of current through a coil wound about the tube as shown, a magnetic field is produced in a direction substantially parallel to the longitudinal axis of the tube 10. This field may serve to neutralize any external magnetic fields to which the structure might be subjected. In practice, the current value should be so chosen that the magnetic field produced by passage thereof through the shield 27 has a minimum magnitude of 15 ampere-turns, when the instant invention is to be utilized, for instance, with the RCA tri-color kinescope 15GP22.

While I have described a particular embodiment of my invention, it is to be understood that this description is illustrative only and is not meant to be limitative of my invention.

Having thus described my invention, I claim:

1. In combination, a cathode ray tube, a shield structure adjacent said tube comprising an elongated strip of magnetically permeable and electrically conductive material in the form of a helix, insulating means interposed between adjacent turns of said helix to electrically insulate said turns from each other and a source of direct current connected between spaced points on said elongated strip whereby a current may be passed selectively through said strip to increase the effective permeability thereof.

2. The structure of claim 1 in which said helix has the shape of the frustum of a cone, a pair of terminals respectively affixed to said elongated strip adjacent the opposing ends of said frustum, said source of direct current being operatively connected between said terminals.

3. In combination, a cathode ray tube comprising an elongated neck portion, a bulbous envelope portion, and a viewing face portion at substantially right angles to said

neck portion, an elongated coil of electrically conductive and magnetically permeable material positioned about said bulbous envelope portion and covering a major portion of said envelope portion between said neck portion and said viewing face portion, said elongated coil being placed about said envelope in a plurality of partially superposed wraps, insulating means adjacent said plurality of wraps for electrically insulating said partially superposed wraps from one another, and a source of direct current connected between the opposite ends of said elongated coil.

4. The structure of claim 3 wherein said source of direct current includes means for varying both the magnitude and polarity thereof.

5. In combination, a color television kinescope, a substantially conical magnetic shield comprising an elongated strip of magnetically permeable and electrically conductive material wrapped in a plurality of partially superposed wraps about the major axis of said kinescope and adjacent a substantial portion of the kinescope envelope, and a source of direct current variable in both magnitude and polarity and electrically connected to said elongated strip between substantially opposite ends of said conical shield, whereby passage of current through said elongated strip increases the magnetic permeability thereof and also effects a magnetic field in a direction substantially parallel to the said major axis of the said kinescope.

6. In combination, a cathode ray tube including a bulbous portion, a shield for the tube, said shield comprising a helical coil of spaced turns of magnetic material, said turns being disposed about said bulbous portion of said cathode ray tube in substantially coaxial relation to said tube and means for passing an electrical current through at least a part of said helical coil.

7. The combination of claim 6 wherein said last-named means comprises means for passing a selectively variable electrical current through said coil.

8. In combination, a color television tube comprising an envelope containing a plurality of guns at one end thereof, and a phosphor dot plate adjacent the other end thereof, a deflection yoke supported adjacent said envelope intermediate said guns and said phosphor dot plate, a substantially conical shield of magnetically permeable and electrically conductive material disposed in close proximity to said envelope and adjacent a major portion of the said envelope between said deflection yoke and said phosphor dot plate, said substantially conical shield comprising a coil composed of a strip of magnetic material, the axis of the said coil being substantially colinear with the major axis of said tube, insulating means adjacent said elongated strip for insulating the turns of said coil from one another, and a source of direct current connected substantially between opposite ends of said elongated strip for passing a current through said strip thereby to effect a magnetic field in a direction substantially parallel to said major axis of said tube.

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