The exciter, mounted closely behind the deflection yoke on the neck of the tube, has three pairs of external coils which are respectively associated with three pairs of internal pole pieces and are enveloped by a ferromagnetic core.
BACKGROUND OF THE INVENTION

In the design of television receivers the trend has been toward shallower cabinets which require shorter picture tubes. In order to produce suitably sized pictures on such tubes it is necessary that the electron beams thereof be deflected through a relatively wide angle. Also some allowance must be made for a longitudinal adjustment of the deflection yoke so that the effective deflection center thereof can be made to coincide substantially with the color center of the tube. In addition, the electron guns, mounted in the tube neck, should be placed as close to the deflection yoke as is consistent with its adjustment allowance, thereby minimizing the length of the tube neck.

In effecting such arrangements there is encountered a substantial coupling of the deflection field into prior art types of beam convergence apparatus. Theoretically, this field which is undesirably coupled into the convergence apparatus could be cancelled by an opposing field generated by the convergence energizing current. Practically, however, such cancellation is difficult to achieve, particularly in tubes requiring wide angle beam deflection. In a picture tube having a 110° deflection system, for example, the deflection field requires a relatively large amount of modulation for the correction of pincushion distortion of the electron scans at the viewing screen. Such modulation also occurs in that portion of the deflection field which is coupled into the convergence apparatus. Because convergence currents are adjusted to effect on-axis beam convergence at the horizontal and vertical axes of the viewing screen, cancellation of the interacting deflection field component may be effected on axis but such cancellation is incorrect for off-axis deflection field components. Any attempt to alter the field distribution of the yoke to compensate for such a dynamic off-axis error would result in other undesirable effects such as greater astigmatism.

It, therefore, is an object of this invention to shield the convergence apparatus from extraneous fields in a novel manner and, at the same time, to so concentrate the convergence fields for the respective electron beams that interaction between the separate convergence fields is minimized.

SUMMARY OF THE INVENTION

The beam convergence exciter of this invention comprises a pair of coils, external of the picture tube neck, associated with each pair of converging pole pieces, internal of the tube neck, and through each of which an electron beam passes. The coils are enveloped by a ferromagnetic core which shields the electron beams from extraneous magnetic fields and so concentrates the convergence fields for the respective beams between the associated pole pieces that interaction between the different convergence fields is minimized.

For a more specific disclosure of the invention reference may be had to the following detailed description of an illustrative embodiment thereof which is given in conjunction with the accompanying drawing, of which:

FIG. 1 is a diagrammatic view of a shadow mask color picture tube showing the general positions of the beam convergence exciter of this invention in relation to other Adjuncts used in the operation of the tube;

FIG. 2 is a sectional view of the neck section of the picture tube taken on the line 2—2 of FIG. 1 and showing the general structure of the exciter;

FIGS. 3 and 4 are plan and side views respectively of one of the coils included in the exciter; and

FIG. 5 is a schematic diagram showing the electrical connections of the excitor coils.

DESCRIPTION OF THE INVENTION

In FIG. 1 the three beam shadow mask type of color picture tube 11, with which the beam convergence exciter is used, has a relatively large flared front section 12 and a relatively small cylindrical rear neck section 13. The face plate 14 at the front of the flared section 12 has formed on its rear surface a fluorescent screen 15 comprising a plurality of triads of phosphor dots which are excitable by respective electron beams to produce light of three different colors such as red, green and blue. A shadow mask 16 having a plurality of apertures aligned with the triads of phosphor dots of the screen 15 is mounted in back of the screen and functions, in cooperation with other elements of the tube, to direct the three electron beams to their respective phosphor dots. Three electron beams of which only the blue gun 17 and the red gun 18 are visible, are mounted in the neck section 13 of the picture tube 11 to produce, when suitably energized, the three electron beams for excitation of the screen 15. The green electron gun is mounted directly on the same horizontal line with the red electron gun so that it is not visible in this figure.

A deflection yoke 19 is mounted externally of the tube 11 in the region in which the neck section 13 merges with the flared section 12. The beam convergence exciter 21, comprising this invention, is indicated diagrammatically as surrounding the neck section 13 and is connected only to the rear of the deflection yoke 19. Still further to the rear of the neck section 13 there are located a color purity device 22 and a lateral magnet 23 behind it. The color picture tube 11 and the various adjuncts referred to are generally known and used and hence, except for the convergence exciter 21, need no additional description or explanation.

In FIG. 2 the beam convergence exciter 21 is shown in its relation to the neck section 13 of the picture tube 11 and to the blue, red and green electron beams 17a, 18a and 24a respectively emanating from the blue and red electron guns 17 and 18 and from the green gun (not shown). The three beams are symmetrically disposed about the longitudinal axis 25 of the picture tube 11. In the convergence region of the tube shown in this figure the blue, red and green electron beams 17a, 18a and 24a pass respectively between the internal pole pieces 26a—26b, 27a—27b and 28a—28b which are suitably mounted on the inside of the neck section 13.

The beam convergence exciter 21, comprising this invention, is mounted on the outside of the picture tube neck section 13. It includes three pairs of coils 29a—29b, 31a—31b and 32a—32b associated respectively with the internal pole pieces 26a—26b, 27a—27b and 28a—28b. A ferromagnetic core 33 envelops the three pairs of excitor coils. The core may be formed of several convolutions of a strip of suitable material such as Allegheny-Ludlum No. 4750 nickel steel having a thickness of approximately 0.003 inches.

Each coil, such as the coil 29a, is fabricated as illustrated in FIGS. 3 and 4 by first winding a suitable number of turns, such as 220 for example, upon a substantially rectangular mandrel. The coils are then assembled in equally spaced positions around a forming tube (not shown) having an outside diameter only slightly greater than the outside diameter of the neck section 13 of the picture tube 11. In this operation each coil, whose thickness is small relative to its length and width, is shaped to conform generally to the curvature of the forming tube and thus to that of the picture tube neck section 13. The coils of each pair are connected electrically as shown in FIG. 5 with the finishing leads F joined together, leaving the starting leads S to be connected suitably to the convergence exciter energizing circuit. The core 33 is then applied and the coils securely affixed thereto by suitable means. The completed assembly is removed from the forming tube and is ready for mounting on the picture tube neck 13.

When the beam convergence exciter as described is mounted on the picture tube neck section 13 closely adjacent the deflection yoke as shown in FIG. 1, the core 33 functions as an effective shield to prevent any substantial component of the deflection field from affecting the electron beams while they are traversing the convergence region including the internal pole pieces 26a—26b, 27a—27b and 28a—28b. At the same time the core 33 also serves to so concentrate the three convergence fields between each pair of pole pieces that there is a minimum of interaction between the convergence fields.
Thus, the beam convergence exciter of this invention enables the convergence region to be close to the deflection yoke, thereby minimizing any degrouping of the three beams when convergence is effected. It also enables the production of a deflection field which is sufficiently long to provide wide angle beam deflection with optimum astigmatism characteristics. These factors contribute to a desired shortening of the neck section 13 of the picture tube 11.

What is claimed is:

1. A beam convergence exciter for mounting on the tubular neck section of a shadow mask color picture tube having three electron beams symmetrically disposed about the longitudinal axis of said tube and traversing a convergence region between three respective pairs of internal pole pieces, said exciter comprising:
   three pairs of coils disposed externally about said tube neck section and respectively associated with said three pairs of pole pieces, each of said coils comprising a plurality of convolutions of a conductor about a central axis, and each of said coils being mounted in close proximity to the curved outer surface of said tube neck section, with each coil axis in alignment with a respectively different one of said internal pole pieces and with the conductor convolutions of each coil arcuately bent relative to the axis thereof in such manner as to present to said neck a curved coil surface substantially conforming in curvature to the proximate neck surface; and
   a ferromagnetic core circumferentially enveloping said coils to concentrate over said pole pieces electromagnetic fields produced by energizing said coils and to shield said electron beams from extraneous magnetic fields.

2. In combination with (a) a color picture tube enclosing three electron beam paths symmetrically disposed about the longitudinal axis of a tubular neck section of said tube, each of said beam paths traversing a convergence region within said neck section between three respective pairs of internal pole pieces of magnetizable material, said color picture tube having a display screen; and (b) a deflection yoke for establishing magnetic fields to deflect electron beams traversing said paths over a wide deflection angle, said magnetic fields being subject to pincushion correcting modulation to ensure development of a substantially undistorted raster of scanning lines on said display screen despite the wide angle said deflection angle, said deflection yoke encircling said picture tube and positioned along the longitudinal axis thereof in such manner as to place the rear of said yoke in the immediate vicinity of said convergence region; (c) a beam convergence exciter, mounted on said neck section, and comprising:
   three pairs of coils disposed externally about said tube neck section and respectively associated with said three pairs of internal pole pieces, each of said coils comprising a plurality of convolutions of a conductor about a central axis, and each of said coils being mounted in close proximity to the curved outer surface of said tube neck section, with each coil axis in alignment with a respectively different one of said internal pole pieces and with the conductor convolutions of each coil arcuately bent relative to the axis thereof in such manner as to present to said neck a curved coil surface substantially conforming in curvature to the proximate neck surface; and
   means, comprising an annular band of ferromagnetic material circumferentially enveloping said arcuately bent coils, for providing said coils with a ferromagnetic core concentrating over each pole piece pair the electromagnetic fields produced by energizing the respectively associated coil pair and for concentrically shielding said coils and the aligned pole pieces in said convergence region from the modulated magnetic fields produced by said deflection yoke.

3. A beam convergence exciter as defined in claim 2, wherein:
   the thickness of said coils is small relative to the arcuate dimensions thereof.

4. A beam convergence exciter as defined in claim 3, wherein:
   said annular ferromagnetic band comprises a plurality of convolutions of a nickel steel strip around the outside of said coils.

5. A beam convergence exciter as defined in claim 4, wherein:
   said coils are affixed to the inside of said annular ferromagnetic band.