Aug. 5, 1952 P. R. J. COURT 2,606,301

MAGNETIC FOCUSING DEVICE FOR CATHODE-RAY TUBES

Filed Feb. 23, 1950

Fig.1.

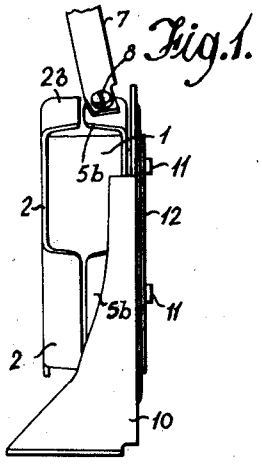


Fig.2.

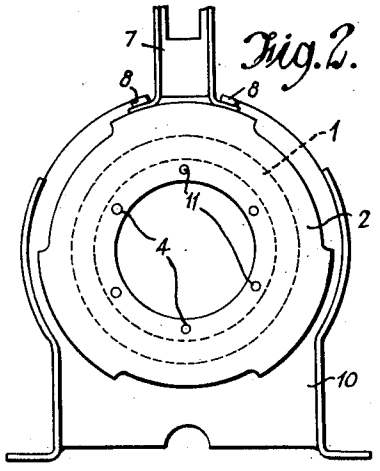


Fig.3.

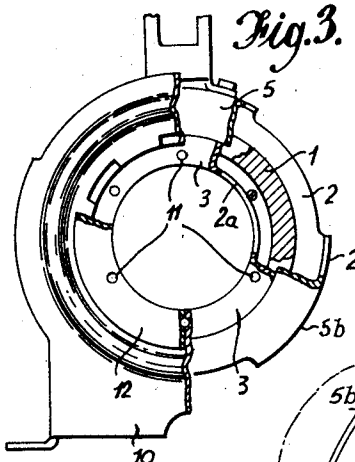


Fig.4.

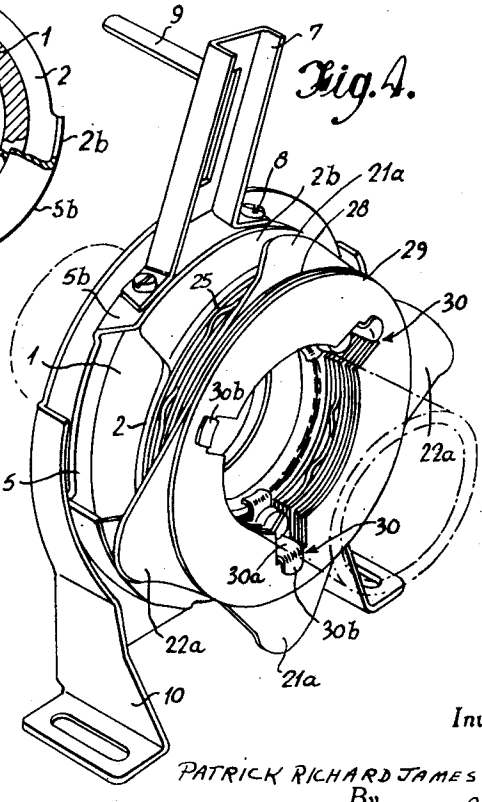
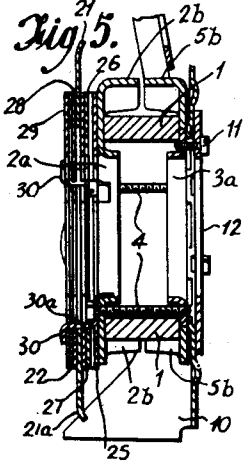


Fig.5.



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MAGNETIC FOCUSING DEVICE FOR CATHODE-RAY TUBES

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12 Claims. (Cl. 313—84)

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The present invention relates to a magnetic focussing device for use on cathode ray tubes, and is particularly suitable for focussing cathode ray tubes as used in television apparatus. With magnetic focussing devices, the magnetic focussing field may be produced either by a permanent magnet or an electromagnet.

With permanent magnet focussing devices, the magnet is generally arranged to produce a field across a magnetic gap surrounding the neck of the cathode ray tube, the focussing being effected by varying the width of the gap. One such focussing arrangement is described in the specification of co-pending application Serial No. 73,347 filed January 28, 1949, now Patent No. 2,591,820.

The present invention has for an object to provide a method of and apparatus for controlling the focussing without varying the width of the focussing gap, or, in the case of an electrically energised magnet, without varying the energising current. To this end the flux in the focussing gap is controlled by adjusting an external magnetic path arranged in shunt or in series with the focussing gap.

The invention also consists in a focussing device for a cathode ray tube, comprising a pair of magnetic members of annular form which are spaced apart to form a focussing gap surrounding the neck of the cathode ray tube or the electron beam to be focussed, means for magnetising said magnetic members to produce a magnetic flux across said gap, and a variable magnetic path for varying the flux in said focussing gap.

In order that the invention may be more clearly understood, reference will now be made to the accompanying drawings, in which:

Fig. 1 shows a side elevation of one embodiment according to the invention.

Fig. 2 shows a front elevation.

Fig. 3 shows a rear elevation with one half of the supporting bracket removed.

Fig. 4 shows a perspective view of the device with a beam centering arrangement mounted thereon.

Fig. 5 is a longitudinal section of the device shown in Fig. 4.

Referring to the drawings, an annular permanent magnet 1 is clamped between two end rings 2, 3 of magnetic material by longitudinally extending bolts 4, the internal peripheries of the end rings being flanged or extended inwardly at 2*a*, 3*a* to form an annular focussing gap within the bore of the magnet.

One of the end rings 2 is made of such a diameter that its outer periphery extends beyond the outer periphery of the annular permanent magnet 1 and is formed at said outer periphery with inwardly and axially directed teeth 2*b*, preferably substantially rectangular in shape.

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The other ring 3 is of smaller diameter than the outer periphery of the permanent magnet 1, and surrounding the external periphery of the end ring 3 is a further control ring member 5 of magnetic material, the internal diameter of which is approximately the same as the external diameter of the ring 3 whereby the control ring 5 is rotatable about the ring 3. The ring 5 is held in position surrounding the ring 3 by the pull of the magnet thereon, the ring 5 being in magnetic contact with the magnet 1. The external periphery of the control ring 5 is of approximately the same diameter as the external diameter of the end ring 2 and is formed at its external periphery with teeth 5*b*, preferably substantially rectangular teeth, directed towards the teeth 2*b* projecting from the ring 2. Each of the rings 2, 3 and 5 may be made from sheet metal, the flanges 2*a*, 3*a* and the teeth 2*b*, 5*b* being formed by a suitable pressing operation.

As shown in the drawings, the ring 2 is formed with three rectangular teeth 2*b* each extending for a distance of about one sixth of the periphery of the ring with gaps therebetween of similar length. Three similar rectangular teeth 5*b* are formed on the control ring 5, the gap between the two sets of teeth, when they lie opposite to one another, being less than the width of the focussing gap between the flanges 2*a*, 3*a* within the bore of the magnet. The gap between the teeth forms a magnetic path in shunt with the focussing gap, and by rotating the control ring 5 of the teeth 5*b* carried thereby can be shifted from the position in which they lie opposite the teeth 2*b* on the end ring 2 (position of maximum shunt) to a position in which they lie opposite to the gaps between the teeth 2*b* (position of minimum shunt). The flux in the inner focussing gap varies in accordance with the adjustment of the control ring and thus adjusts the focussing of the beam of the cathode ray tube, of which the neck 6 (Fig. 4) extends through the bore of the focussing assembly.

The corners of the rectangular teeth can be rounded and the end walls of each tooth can be inclined to the axis of the assembly to increase the range of adjustment. The adjustment may be effected by means of a lever 7 of non-magnetic material secured by screws 8 to one of the teeth of the control ring. This lever 7 may be

provided with an arm 9 adapted to extend through the rear of the television receiver cabinet to enable the focus control to be manually adjusted. Alternatively, it may be actuated from a remote point by a control knob or lever, for example, through a suitable link mechanism or by a gear wheel which may, for example mesh with teeth carried by, or formed on, the control ring 5.

The focussing assembly may be carried from the chassis of the receiver by a bracket 10 clamped to the ring 3 by means of screws 11 passing through holes in a clamping ring 12 and threaded into threaded apertures in the ring 3. The bracket 10 is so shaped that when it is clamped between the ring 12 and the ring 3 it only bears firmly on the ring 3, clearance being allowed for free rotation of the control ring 5. With this method of mounting the focussing assembly, by loosening the clamping ring 12 the complete magnet assembly can be rotated around the axis of the cathode ray tube to compensate for any irregularities in the field produced by the permanent magnet 1 due either to its magnetisation or to slight variations in the position in which it is clamped by the screws 4 between the end rings 2 and 3. The complete assembly is locked in the desired adjusted position by tightening the screws 11.

In the perspective view of the device shown in Fig. 4 there is fitted to the front of the focussing assembly means for centering the electron beam on the screen of the cathode ray tube as described in the specification of co-pending application Serial No. 144,688 filed February 17, 1950, now Patent No. 2,597,298.

The centering device comprises two annular permanent magnets 21, 22 magnetised across their diameters. These magnets may be made of thin sheet metal and are mounted at the front of the focussing magnet so as to be rotatable around the axis of this magnet and thus around the axis of the neck of the cathode ray tube 6, extending through the centre of the assembly. Positioned between the focussing magnet and the magnet 21 are three annular spacers of sheet non-magnetic material 25, 26 and 27, between the two magnets 21 and 22 is a further annular spacer of sheet insulating non-magnetic material 28 and in front of the magnet 22 is another annular spacer of sheet non-magnetic material 29, the whole assembly being held in position to the front of the focus magnet by means of three clips 30 secured to the magnet by the screws 34. The longitudinally extending limbs 30*a* of these clips are positioned on a circle corresponding approximately to the internal diameter of the magnets 21 and 22 so that the latter are guidingly rotatable therearound. The internal diameters of the spacers are smaller than the internal diameter of the magnets 21 and 22, recesses 32 being formed in the internal peripheries of the spacers to accommodate the clips 30 whereby rotation of the spacers is prevented. The whole assembly is held against the focus magnet by the outwardly turned ends 30*b* of the clips bearing on the outer surface of the spacer 29. The spacer 26 is of wavy or corrugated form so as to exert a slight axial pressure on the elements of the assembly and create friction between the magnets 21 and 22 and the adjacent spacers so that the magnets will remain in the adjusted position to which they are turned. To facilitate turning the magnets are provided with ears 21*a*, 22*a* extending beyond the external periphery of the spacers.

By making the centering assembly narrow in the axial direction can be disposed between the focus magnet and the deflector coils.

Centering of the cathode ray beam is achieved by simply rotating the two annular magnets independently around the neck of the cathode ray tube.

Whilst a particular embodiment has been described, it will be understood that various modifications may be made without departing from the scope of the invention. Thus, the field produced in the focussing gap may be produced by an electrically energised coil instead of by a permanent magnet. In this embodiment the permanent magnet 1 would be replaced by a focussing coil, the construction otherwise being similar to that illustrated in the drawing. In this embodiment, however, the external magnetic path between the teeth 2*a* and 5*a* would be in series with the focussing gap so that when the teeth are most widely spaced the reluctance of the magnetic circuit is a maximum and there will be a minimum flux in the focussing gap, the reluctance decreasing as the teeth are moved opposite to one another with consequential increase of the flux in the focussing gap.

I claim:

1. A focussing device for a cathode ray tube, comprising a pair of magnetic members of annular form which are spaced to form a focussing gap adapted to surround the neck of a cathode ray tube, an annular permanent magnet positioned between and in magnetic contact with said magnetic members to produce a magnetic flux across said gap, and a variable magnetic shunt for varying the flux in said focussing gap, said variable magnetic shunt comprising two sets of teeth of magnetic material which are arranged and directed towards one another externally of the magnet, the sets being in magnetic contact with opposite ends of the magnet respectively and one set of teeth being movable relative to the other set from a position in which its teeth lie opposite the teeth of the other set to a position in which its teeth lie opposite the spaces between the teeth of the other set.

2. Device as claimed in claim 1, wherein the annular member at one end of the magnet extends beyond the outer periphery of the magnet and is formed at its outer periphery with inwardly directed teeth, a magnetic control ring being in contact with the other end of the magnet and rotatable with respect thereto, said control ring having teeth directed inwardly and towards the teeth projecting from the annular member at the opposite end of the magnet.

3. Device as claimed in claim 2, wherein said teeth on said annular member and said control ring are substantially rectangular in shape.

4. Device as claimed in claim 2 which is carried by a supporting bracket in such a manner that the focussing device can be rotated round its axis and clamped to the supporting bracket in any desired adjusted position, the control ring remaining free to rotate when said device is clamped to said bracket.

5. Device as claimed in claim 4, wherein a magnet assembly for centering the electron beam of the cathode ray tube, is attached to said focussing device.

6. Magnetic focussing device for cathode ray tubes, comprising a pair of magnetic members of annular form which are spaced apart to form a focussing gap adapted to surround the neck of a cathode ray tube or the electron beam to be

focussed, means for magnetising said magnetic members to produce a magnetic flux across said gap, and a variable magnetic shunt for varying the flux in said focussing gap said variable magnetic shunt comprising a plurality of magnetic teeth arranged about the two magnetic members and disposed externally at either end of said magnetising means, the teeth at one end being directed towards the teeth at the other end and being movable relative to one another to vary the magnetic shunt.

7. Device as claimed in claim 6, wherein one of said annular magnetic members extends beyond the outer periphery of the annular magnetising means and is formed at its outer periphery with said teeth, a magnetic control ring at the other end of the annular magnetising means being rotatable with respect thereto, said control ring having teeth directed towards the teeth projecting at the opposite end of said annular magnetising means.

8. Device as claimed in claim 7, wherein said teeth are substantially rectangular in shape.

9. Device as claimed in claim 7 which is carried by a supporting bracket in such a manner that the focussing device can be rotated round its axis and clamped to the supporting bracket in any desired position, the control ring remaining free to rotate when said device is clamped to said bracket.

10. Device as claimed in claim 9, wherein a magnet assembly for centering the electron beam of the cathode ray tube is attached to said focussing device.

11. A permanent magnet focussing device for a cathode ray tube, comprising an annular permanent magnet and a pair of complementary soft steel members positioned one on either axial end of said magnet for rotation one relative to the other, each of said members having a collar portion engageable with said magnet, an annular portion extending radially outwardly from said magnet, and a plurality of lip portions equally spaced about each of said members with the lips on one of said members being deflected towards the lips of the other of said members to define a minimum air gap when the lips of one of said members are in alignment with the lips of the other of said members, means for rotating one of said members relative to the other to displace the lips of one of said members from the lips of the other of said members, said magnet and said members constituting a flux path for the flux emanating from said permanent magnet, said flux passing from said magnet through one of said members, through the lips affixed thereon across said air gap into the lips of the second of said members, through said second member into said permanent magnet, said flux path offering a minimum resistance to flux flow when the lips of one of said members are in alignment with the lips of the other of said members, said magnetic path offering a maximum resistance to flux flow when the lips of one of said members are displaced from the lips of the other of said members.

12. A focussing device for a cathode ray tube, comprising a pair of magnetic members of annular form which are spaced to form a focussing gap adapted to surround the neck of a cathode ray tube, an annular permanent magnet positioned between and in magnetic contact with said magnetic members to produce a magnetic flux across said gap, one of said magnetic members extending externally of the magnet and being formed at its periphery with a plurality of teeth, a magnetic control ring surrounding the other of said magnetic members, in magnetic contact with said magnet, the outer periphery of said control ring extending externally of said magnet and being formed at its periphery with a plurality of teeth, the teeth on said control ring being directed towards the teeth on said magnetic member, said teeth forming a variable magnetic shunt to vary the flux in said focussing gap, means for rotating said control ring about said other magnetic member, to move the teeth on said control ring in relation to the teeth on said magnetic member, a bracket for supporting said device in contact with said other magnetic member, an annular clamping ring in contact with said bracket, and means for clamping said bracket between said other magnetic member and said clamping ring.

PATRICK RICHARD JAMES COURT.

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