

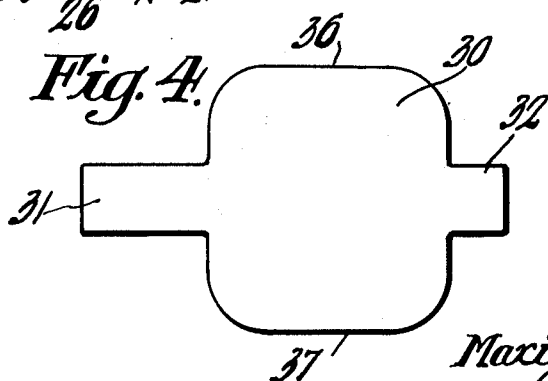
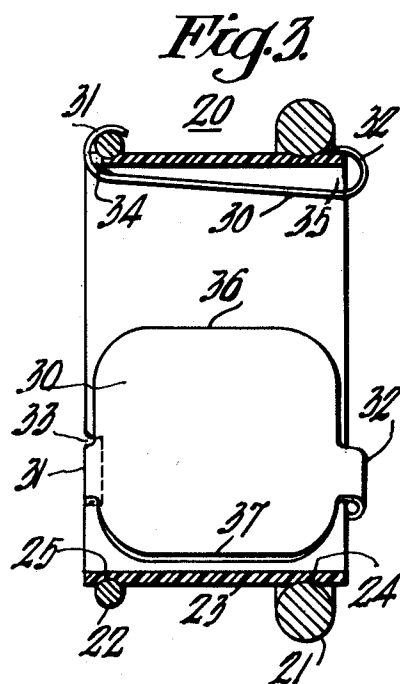
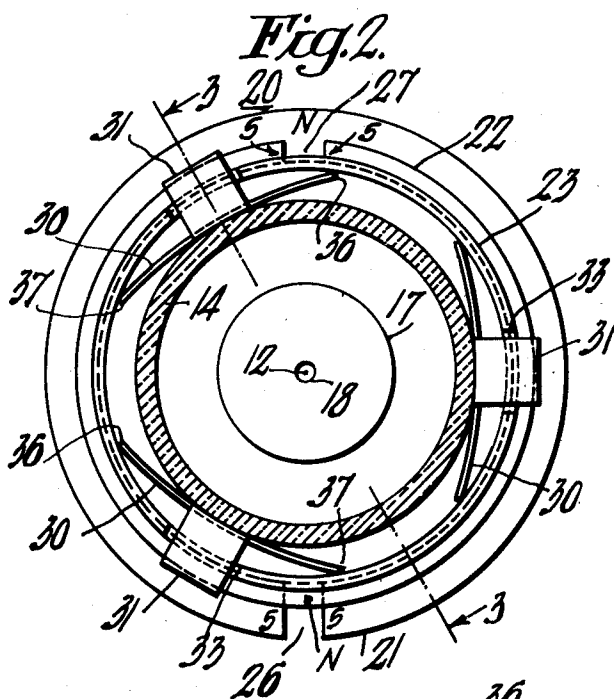
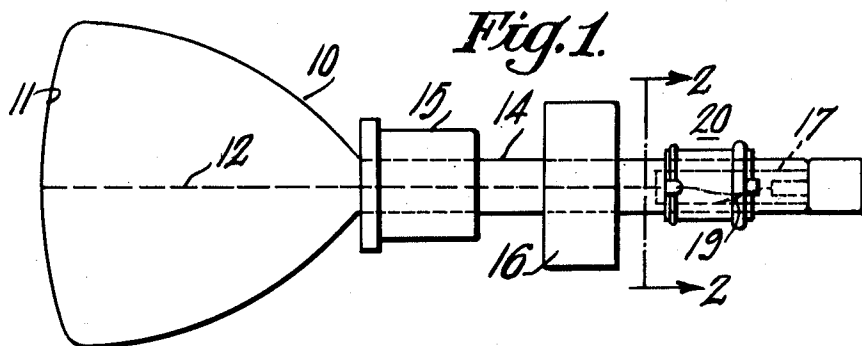
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ELECTRON BEAM BENDER

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ELECTRON BEAM BENDER

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The present invention relates to devices for bending an electron beam and is especially useful in connection with "ion traps" in cathode ray tubes. More particularly, the invention relates to magnetic devices for centering a cathode ray beam after it has been deflected or otherwise operated upon to separate the electrons from heavier negative particles (or ions). The destructive effects of the latter when they strike a sensitized screen are well known and various methods and devices, such as ion traps, have been disclosed to prevent such effects. In an ion trap the entire beam from the cathode region of the electron gun is deflected sufficiently to make the heavy negative particles strike the neck of the tube (or a barrier therein). A magnetic field then re-directs the electrons before they strike any solid part of the tube. Such devices operate on the principle that an electrostatic field or a tilted electron lens causes substantially similar deflections of electrons and negative particles, whereas a magnetic field deflects electrons but has relatively little effect on the heavier ion particles.

The present invention provides an improved device for creating such a magnetic field and also provides an improved form of magnetic field for bending and centering an electron beam.

In addition to the above, an object of the invention is to make a simple, cheap beam bender that is well adapted for quantity production.

Another object is to provide a mounting for ring-shaped magnets which is self-centering and adjustable on the necks of cathode ray tubes and accommodates itself to variations in diameter of said necks.

A further object is to make a universal beam bender, that is, one that can be used on kinescopes having screen diameters from 7 to 16 inches and employing second-anode voltages from 4 to 15 kilovolts, by way of example.

Other objects and advantages of the invention will become apparent from the following description in connection with the accompanying drawing in which:

Figure 1 illustrates a cathode ray tube with a beam bender of the present invention applied thereto;

Figure 2 is a cross section on a larger scale taken on line 2—2 of Figure 1;

Figure 3 is a cross section taken on line 3—3 of Figure 2; and

Figure 4 is a developed view of one of the clips shown in Figures 2 and 3.

Referring to Figures 1 and 2 reference char-

acter 10 indicates a cathode ray tube, such as a kinescope, the large end 11 of which is sensitized to provide the usual screen which becomes luminous at the spot where an electron beam 12 impinges thereon. Upon the neck 14 of tube 10 there may be mounted a deflection yoke 15 and focus coil 16 in the usual manner. Tube 10 is also provided with an electron gun 17 having a small hole 18 in the end thereof from which the electron beam 12 emerges. Details of the electron gun are not shown because it forms no part of the present invention, but it should be understood that the gun 17 contains a cathode and some means, such as an electrostatic field, which deflects both the electrons and negative particles (or ions) as indicated by dotted line 19 in Figure 1. Further details of the gun structure are to be found, for example, in Kelar U. S. Patent 2,496,127, filed February 5, 1947, issued January 31, 1950 and Patent No. 2,515,305, filed January 24, 1946, issued July 18, 1950. The apparatus thus far described is conventional and may have many forms, such as electrostatic deflection arrangements and also means for varying the intensity of the electron beam 12 in accordance with signals.

An electron beam bender according to the present invention is indicated generally at 20 as positioned on neck 14 with respect to gun 17. Details of the beam bender are shown in Figures 2, 3, and 4, wherein reference characters 21 and 22 indicate ring-shaped magnets which are supported on a tubular member 23 of non-magnetic material. Preferably member 23 is provided with grooves 24 and 25 around its outer surface for receiving magnets 21 and 22 respectively. Magnet 21 may be provided with an air gap 26 and magnet 22 with an air gap 27, the lengths of the gaps not being critical. The inside diameters of the magnets are substantially equal and slightly less than the outside diameter of member 23. They are mounted thereon by springing apart the ends forming the air gap and slipping the magnets over the ends of member 23, after which the resilience of the magnets holds them securely in position and spaced a fixed distance apart. A convenient method of making such magnets is to bend rods into almost complete circles and heat-treat them as required by the material employed. One or more such magnets may be mounted as described and they may have the same or different cross sections, depending on the results desired.

Before the magnets are mounted on member 23 it is preferable to magnetize them. In the

example chosen for illustration, it is necessary that magnets 21 and 22 bend the beam 12 in opposite directions, but nevertheless they may be magnetized simultaneously and with the same polarity. For instance, the ends of the rod-like material forming the air gaps 25 and 27, respectively, may both be made south poles and a portion of each magnet diametrically opposite the air gap may be made the north pole. The actual polarity is optional but it is important that the two faces forming the air gap have the same polarity. Such magnetization produces, in effect, two semi-circular magnets having their like poles adjacent, but for ease of construction, only one gap is provided. The magnetic field produced by such a ring-shaped magnet extends across its diameter and therefore extends across the neck 14 when the magnet is placed thereon as shown in Figure 1. With magnets 21 and 22 magnetized as described, they are mounted with their air gaps 180° apart on member 23 and thereby deflect beam 12 in opposite directions.

Within the tubular member 23 there are disposed a plurality of spring clips such as 30 which should be made of non-magnetic material having the requisite resilience. Each clip preferably is provided with ears 31 and 32 extending from opposite ends thereof as shown in Figure 4. In the example illustrated in Figures 2 and 3, three clips 30 are disposed symmetrically about the periphery of member 23 with ear 32 of each clip bent over one end of member 23, and with the other ear 31 of each clip preferably bent over both the other end of member 23 and the magnet 22. The bending of the ears as described prevents any substantial longitudinal movement of the clips relative to member 23. Angular or circumferential movement may be prevented by providing notches 33 in one end of member 23 and having the ears 31 at that end engage said notches. The ears 31 and 32 are not crimped tightly around the ends of member 23 but instead have sufficient play at 34 and 35 to permit individual movement of each clip in a radial direction. It is preferable to have the space 35 larger than the space 34 between the respective ends of the clips and the inside surface of member 23. Thus the magnet mounting, comprising member 23 and clips 30, is easily slipped over the end of neck 14 and the clips adjust themselves radially to center the mounting relative to neck 14 and hold it by friction in adjusted position. The side edges 36 and 37 of the clips bear against the inside surface of member 23, the clips having sufficient width to provide the necessary amount of radial movement to accommodate various diameters of glass tubes forming the necks such as 14. A usual tolerance for such a glass tube is plus or minus $\frac{1}{16}$ inch when the neck has a nominal diameter of $1\frac{1}{8}$ inches.

The operation of the beam bender just described is as follows. It was mentioned above that both electrons and negative particles emitted by the cathode, or produced in the vicinity thereof, are deflected as indicated by dotted line 19 in Figure 1. The beam bender 20 is positioned on neck 14 so that the large magnet 21 is in the region of such deflection. It is also rotated so that the field of magnet 21 is in the direction to bend the electron beam 12 back toward the axis of tube 10. The spacing between magnet 21 and magnet 22 is such that magnet 22 is approximately in the plane where the electron beam intersects the tube axis and, inasmuch as the field of magnet 22 is opposite to the field of magnet

21, the beam 12 is caused to proceed along the tube axis. The angular bending required to be produced by magnet 22 is less than that by magnet 21 and therefore magnet 22 is made sufficiently smaller in cross section to give a proportionally weaker field. The beam bender 20 may then be adjusted longitudinally of the neck 14 and in cooperation with the focus coil 16, to give a sharply focused spot at the center of screen 11.

As an example of the universal application of such a beam bender to various sizes of kinescopes, the same beam bender may be used on either 7, 10, 12, or 16 inch kinescopes, all of which have neck diameter varying within the limits of $1\frac{3}{8}$ inches to $1\frac{1}{2}$ inches. The spring clips 30 cause the mounting to be self centering thereon so that the magnets are held substantially concentric with the tube neck. The beam bender can be adjusted at any time and can be transferred from one cathode ray tube to another having approximately the same size neck.

In a specific beam bender for the kinescopes above mentioned, the magnets 21 and 22 are made of rods .200 and .095 inch in diameter respectively and they are spaced $\frac{3}{16}$ inch apart center to center. The inside diameter of both magnets is 1.609 inches and they are sprung into grooves 1.625 inches in diameter. The flux densities at the center are about 55 and 15 gauss, respectively.

While permanent magnets are preferred for devices as above described, electro-magnets of similar shape can be substituted. Other substitutions and modifications may be made to suit particular requirements.

What is claimed is:

1. An electron beam bender comprising a tubular member of non-magnetic material, a plurality of ring-shaped magnets supported in fixed spaced relation on said member, and resilient means extending longitudinally within said member and engaging the ends thereof to prevent longitudinal movement of said means relative to said member.

2. An electron beam bender according to claim 1 wherein said resilient means comprise a plurality of spring clips of non-magnetic material, each clip having ears at opposite ends thereof, at least one ear of each clip being disposed in a notch in one end of said tubular member to hold the clips in angularly spaced relation about the periphery of said member.

3. An electron beam bender according to claim 2 wherein one ear of each clip also engages one of said magnets.

4. A mounting for adjustably positioning and holding a ring-shaped magnet around a glass tube, said mounting comprising a member of non-magnetic material having a larger inside diameter than the outside diameter of the glass tube, the ring-shaped magnet being held in position on the outside of said member by engagement therewith, a plurality of clips of non-magnetic resilient material disposed within said member, means preventing relative movement of said clips longitudinally and circumferentially of said member but permitting individual movement of each clip radially relative to said member for adapting the mounting to various diameters of glass tubes and frictionally holding the mounting in adjusted position thereon, a second ring-shaped magnet held on said member in the same manner as the first magnet and spaced a fixed distance therefrom by said member, and wherein said means comprise an ear extending from

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each end of each of said clips, one ear of each clip engaging both an end of said member and said second magnet, and the other ear of each clip engaging only the other end of said member, the side edges of said clips bearing against the inside surface of said member.

5. A mounting having two magnets thereon according to claim 4, wherein the bodies of said magnets have different cross sectional areas, the smaller of which is said second magnet.

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