Oct. 4, 1949. J. H. FREMLIN 2,483,407

FOCUSING ARRANGEMENT FOR ELECTRON DISCHARGE DEVICES OF ELECTRON VELOCITY MODULATION TYPE

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FIG. 1.

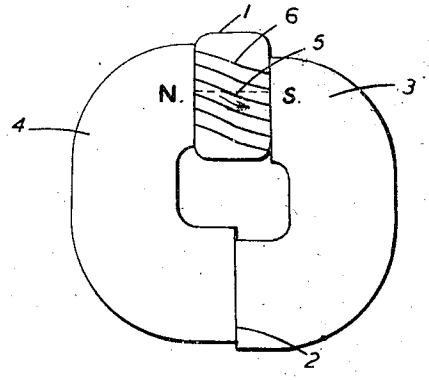


FIG. 2.

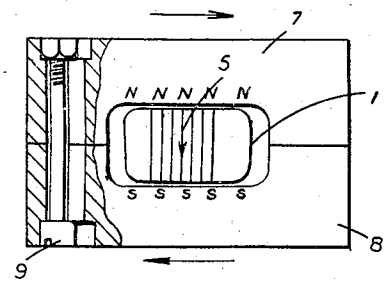
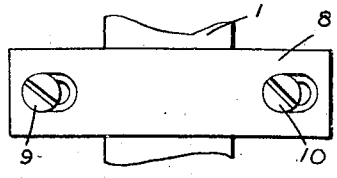


FIG. 3.



Inventor
J. H. FREMLIN

By Robert Harding Jr.
Attorney

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FOCUSING ARRANGEMENT FOR ELECTRON DISCHARGE DEVICES OF ELECTRON VELOCITY MODULATION TYPE

John Heaver Fremlin, London, England, assignor to International Standard Electric Corporation, New York, N. Y.

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2 Claims. (Cl. 250—161)

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The present invention relates to improvements in magnetic focussing arrangements for electron discharge devices of the electron velocity modulation type.

In order to obtain satisfactory operation of such devices with low operating voltages it is necessary to employ a high current density in the electron beam, and for this purpose it is common practice to focus the beam magnetically by means of a strong and preferably small permanent magnet. Some trouble has been experienced in the past in assuring that the magnetic lines of force (which determine the paths of the electrons in the beam) will be in exactly the proper direction with respect to the device, since manufacturing variations cause differences in different samples of the same design of magnet and of the electron discharge device itself which render some adjustment essential.

In the copending U. S. application of S. G. Tomlin, Serial No. 584,903, filed March 26, 1945, there is described one method of dealing with this difficulty. However, when the electron discharge device is enclosed in a cylindrical glass envelope, it is impracticable to manufacture the envelope to close tolerances in diameter, and so rather large clearances must be allowed between the envelope and the poles of the magnet to allow the device to be rotated in order to make the adjustment in the manner described in the above-quoted application. This means that the gap between the poles has to be inconveniently large, and the magnet has to be much larger than is desirable in order to obtain the necessary field strength.

If, however, the envelope of the device be made of metal such as copper, it need no longer be made circular in section, but can be rectangular, and can be manufactured to close limits. This will allow the gap in the focussing magnet to be considerably reduced, and it need only be made just large enough to accommodate the envelope. This will, however, prevent any rotation for adjustment of the direction of the magnetic field, and it is therefore the principal object of the present invention to provide means for making the adjustment when relative rotation of the device and the magnet is not possible. According to the invention, therefore, the focussing magnet is divided into two similar portions or halves which are slidable one with respect to the other in such manner as to vary the direction of the lines of force which pass between the pole pieces.

The invention will be described with reference to the accompanying drawing, in which

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Fig. 1 shows a view of an electron discharge device together with the focussing magnet according to the invention;

Fig. 2 shows a partly sectional view of another form of focussing magnet according to the invention; and

Fig. 3 shows a side view of the arrangement of Fig. 2.

Referring to Fig. 1, a section of the envelope of the electron discharge device is shown in outline at 1, but no internal details are shown. The focussing magnet is cut along the line 2 into two similar halves 3 and 4. The electron beam is intended to be projected across the envelope 1 perpendicular to the pole surfaces of the magnet halves, but owing to manufacturing variations, the direction of the beam may be at a small angle to the intended direction as indicated, for example, by the arrow 5. Assuming that before the magnet was cut, the lines of force would run symmetrically across the gap, when the halves are displaced in the manner shown, the field will be slightly distorted so that its general direction is inclined in the manner indicated by the lines 6. It will be evident that the magnetic field may in this way be made substantially parallel to the arrow 5.

It will be evident also, that if before the magnet was cut, the lines of force were not quite symmetrically placed in the gap, a slight mutual adjustment of the two halves 3 and 4 will align the field with the arrow 5 in the case when the latter happens to be perpendicular to the pole pieces, so that the adjustment according to the invention takes care of manufacturing variations both in the magnet and in the electron discharge device.

Figs. 2 and 3 show the invention applied to a magnet of somewhat different form. The magnet comprises in this case two similar halves 7 and 8 forming a closed ring embracing the envelope 1 of the electron discharge device. These halves will be magnetised so that the north and south poles are located in the narrow parts as indicated, so that a field transverse to the envelope 1 is produced. The two halves 7 and 8 are held together by two screws 9 and 10 fixed in holes of oval or elongated section to allow a certain amount of lateral adjustment of the two halves, as indicated by the arrows. It will be evident that the magnetic field may be tilted either way by this means.

It should be noted that while it is generally preferable to employ permanent magnets for focussing the electron beam, the same principles

could be applied to electro-magnets. Thus, for example in Fig. 1, the portions 3 and 4 could each be of soft iron, and each could be provided with a suitable magnetising winding (not shown).

What is claimed is:

1. An electron discharge device having a section non-circular in cross-section and a focussing magnet having pole pieces closely embracing said section, said magnet comprising two similar magnet portions in end to end abutment and slidable one over the other on at least one surface of contact.

2. In an electron discharge device arrangment, a focussing magnet comprising two similar magnet portions abutting each other on and slidable one over the other on a pair of oppositely polarized pole surfaces, a second pair of pole surfaces of opposite sign closely adjoining either side of said device.

JOHN HEAVER FREMLIN.

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