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2,376,882

SPACE DISCHARGE DEVICE

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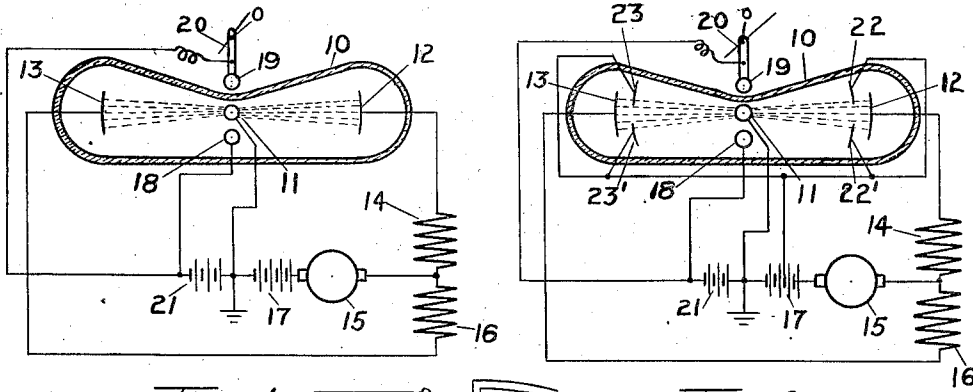


FIG. 1

FIG. 2

FIG. 5

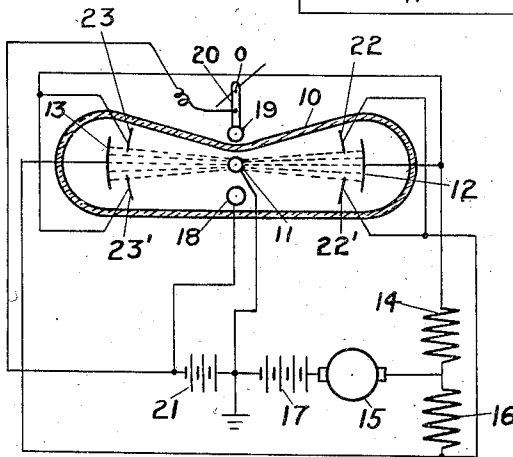
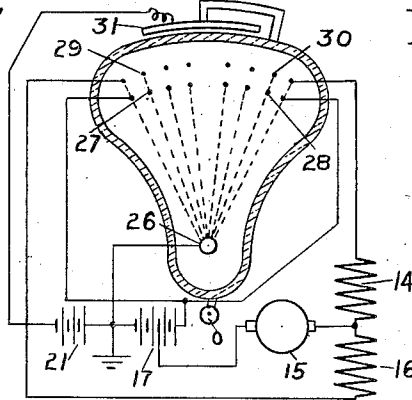


FIG. 3

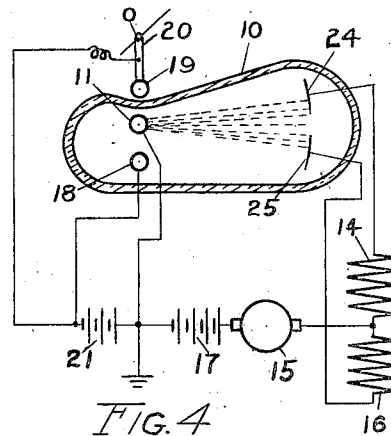


FIG. 4

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SPACE DISCHARGE DEVICE

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8 Claims. (Cl. 250—159)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

This invention, which is a continuation-in-part of my co-pending application, Serial No. 438,679, filed April 13, 1942, relates to electron discharge devices of the so-called beam type and its principal object is to provide a novel arrangement for deflecting the beam relative to an anode in the device, thereby changing the electron flow in the anode-cathode circuit.

A more specific object is to provide a device of the character described in which deflection of the beam is controlled in accordance with the position of an electrode located outside of the device.

Such a device can be used for various applications in which a change in electric current in response to a variation in a condition is desired, the particular application illustrated being for motor control in which it is desired to control the direction of rotation of the motor in accordance with a change in a condition such as the change in the position of a sensitive instrument pointer.

The foregoing and other objects of the invention will become more apparent from the detailed description to follow when considered with the accompanying drawing, in which:

Fig. 1 is a diagrammatic view of one form of discharge device embodying the invention;

Fig. 2 is also a diagrammatic view of another embodiment of the invention;

Fig. 3 is a modification of the device shown in Fig. 2; and

Figs. 4 and 5 are further embodiments illustrating the invention.

Referring now to Fig. 1, the discharge device comprises an envelope 10, the upper surface of which is depressed arcuately at the central portion. Within the envelope 10 is disposed a cathode 11 and a pair of anodes 12 and 13, each of which is spaced at the same distance from the cathode 11 but on opposite sides thereof.

Connected in the cathode-anode circuit including anode 12 is one motor field winding 14 and the motor armature 15. In the other cathode-anode circuit including the anode 13 is a second motor field winding 16 and the armature 15. Suitable anode potential for these circuits is furnished by any adequate source such as the battery 17.

For focussing the electron stream from the cathode 11 into two beams, one between cathode 11 and anode 12 and the other between cathode 11 and anode 13, and for also controlling the deflection of these beams relative to their respective anodes, I provide a pair of electrodes 18 and 19. Electrode 18, which occupies a fixed position, is located inside of the envelope 10 and is

placed very close to the cathode 11. Electrode 19 is also disposed very close to cathode 11 but is located outside of the envelope 10 at the depressed central portion thereof and is mounted on an instrument pointer 20 and rotatable with the latter about an axis O.

Electrodes 18 and 19 are similarly and negatively charged relative to the cathode 11 by suitable biasing means such as battery 21.

The operation of the device should now be apparent. With the movable electrode 19 in the position shown in Fig. 1, the axes of the electron beams are substantially normal to a line passing through electrodes 18, 19 and cathode 11. Consequently electron flow between cathode 11 and anode 12 is the same as that between cathode 11 and anode 13 and the two motor field windings 14 and 16 are equally energized producing equal field strengths. However, it will be seen that current flow through the two fields are in opposite directions with respect to each other and thus the field fluxes neutralize one another with the result that no field is produced and the armature remains stationary.

In the event that the instrument pointer 20 should move in a counter-clockwise direction, the electrode 19 will move similarly and cause the electron beam between cathode 11 and anode 12 to be deflected downwardly. Part of this beam would thus move off anode 12 resulting in a decrease in current flow through the circuit including field winding 14. This unbalances the two opposed field windings 14 and 16 thereby causing the armature 15 to rotate in one direction.

Should the pointer 20 move clockwise, causing similar movement of electrode 19, the electron beam between cathode 11 and anode 13 will be deflected downwardly and lessens the current flow through field winding 16. This unbalances the field windings 14 and 16 in the other direction thereby effecting rotation of the armature 15 in an opposite direction.

In the arrangement shown in Fig. 2, the basic arrangement of parts is the same as those in Fig. 1 and the same reference characters have been utilized to indicate like parts. In addition, the Fig. 2 structure includes accelerating electrodes 22—22' between cathode 11 and anode 12 and similarly placed electrodes 23—23' between cathode 11 and anode 13. In this arrangement, a deflection in either of the beams, results in much sharper reduction in current flow through the field windings 14 and 16.

The arrangement shown in Fig. 3 is much the same as that shown in Fig. 2 with the exception

that beam current deflected to the accelerating electrodes 22—22' and 23—23' is utilized to increase the differential effect in the field windings 14 and 16. Thus, beam current intercepted by electrodes 22—22' is added to the current already flowing through winding 16 as the current flow through winding 14 is decreased. In a similar manner, beam current intercepted by electrodes 23—23' is added to the current already flowing in winding 14 as the current flow through winding 16 is decreased.

Thus a deflection of the electrode 19 would not only reduce current in one field winding but would add the difference to the current traversing the opposed field winding. This obviously increased the sensitivity of the control action.

In the modification shown in Fig. 4, a somewhat different arrangement of parts is utilized. Instead of having two beams, only one is employed and is split between two anodes 24 and 25 placed side by side. When electrode 19 is in a central position, the electron beam is split equally between the plates 24 and 25 and an equal amount of current flows in the windings 14 and 16. However should the beam be deflected either upward or downward as the case may be, the current flow through one of the field windings will be decreased while the other is increased thus bringing about the desired differential action.

In the arrangement shown in Fig. 5, the electron stream from a cathode 26 is divided into two equal streams by identical accelerating screen electrodes 27 and 28 at the same voltages. Two other screens, 29 and 30 are positioned behind screens 27 and 28 respectively, with the wires of screen 29 registering with those of screen 27 and the wires of screen 30 registering with those of screen 28. By adjusting to suitable relation the voltages on these screens, the streams of electrons coming through the openings in screens 27 and 28 will be focussed to be in a straight or even divergent beam as they come through the openings in screens 29 and 30. The relative spacing and voltages of screens 27, 28 and 29, 30 are furthermore so chosen that the accelerated electrons go through the openings in screens 29 and 30 but only slightly beyond and then turn back. The streaming electrons being slowed up near screens 29 and 30, a good part of them will be absorbed by screens 27 and 28. A plate 31 outside the tube and revolved with the instrument pointer pivoted at 0 is charged to a high negative voltage. Consequently the electron streams to the parts of screens 29 and 30 underneath the plate 31 are retarded and reverse before reaching them. Hence if plate 31 is deflected from center, say to the right, so that it projects more over screen 30 than screen 29, the current to screen 30 will be reduced below normal while the current to screen 29 will be raised above normal. This brings about the desired differential effect in the motor field windings 14 and 16.

In conclusion, I wish it to be understood that other changes and modifications in the structures shown and rearrangement of parts may become apparent to those skilled in the art and may be made without departing from the spirit and scope of the invention as defined in the appended claims.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

Having thus fully described my invention, I claim:

1. An electron discharge device comprising an envelope, a cathode for emitting electrons, a pair of charged electrodes disposed on opposite sides of and closely adjacent to said cathode for forming said electron emission into a beam, an anode for receiving said beam, and means for moving one of said electrodes relative to the other whereby said electron beam may be deflected relative to said anode to vary the amount of current flowing in the anode-cathode circuit of said device.
2. The combination in claim 1 wherein one of said electrodes is fixed and disposed interiorly of the envelope and the other electrode is movable and disposed exteriorly of the envelope.
3. An electron discharge device comprising an envelope, a cathode for emitting electrons, a pair of anodes disposed on opposite sides of said cathode, a pair of charged beam forming electrodes also disposed on opposite sides of said cathode and closely adjacent thereto but on an axis substantially normal to the axis through said cathode and anodes, and means for moving one of said electrodes relative to the other whereby one or the other of said beams may be deflected relative to its respective anode to vary the amount of current flowing in the respective anode-cathode circuit.
4. The combination in claim 3 wherein one of said electrodes is fixed and disposed interiorly of the envelope and the other electrode is movable and disposed exteriorly of the envelope.
5. An electron discharge device comprising an envelope, a cathode for emitting electrons, a pair of anodes disposed on opposite sides of said cathode, a pair of charged beam forming electrodes also disposed on opposite sides of said cathode but on an axis substantially normal to the axis through said cathode and anodes, accelerating electrodes disposed between said cathode and each of said anodes, and means for moving one of said electrodes relative to the other whereby one or the other of said beams may be deflected relative to its respective anode to vary the amount of current flowing in the respective anode-cathode circuit.
6. An electron discharge device comprising an envelope, a cathode for emitting electrons, a pair of anodes disposed on opposite sides of said cathode, a pair of charged beam forming electrodes also disposed on opposite sides of said cathode and closely adjacent thereto but on an axis substantially normal to the axis through said cathode and anodes, accelerating electrodes disposed between said cathode and each of said anodes, means for moving one of said electrodes relative to the other whereby one or the other of said beams may be deflected relative to its respective anode to vary the amount of current flowing in the respective anode-cathode circuit, and means for adding the current intercepted by the accelerating electrodes disposed between said cathode and one anode to the current flowing in the cathode-anode circuit which includes the other of said anodes.
7. An electron discharge device comprising an envelope, a cathode disposed at one end of said envelope for emitting electrons, a pair of anodes disposed at the other end of said envelope, an anode-cathode circuit for each of said anodes, a pair of charged beam forming electrodes disposed on opposite sides of said cathode and means for moving one of said electrodes relative to the other whereby said electron beam may be deflected rela-

tive to said anodes to vary the amount of current flowing in the respective anode-cathode circuits of said device.

8. In an electron discharge device of the type in which an electron beam is formed between a cathode and an anode interiorly of an envelope, means for controlling the deflection of said beam

relative to said anode comprising a pair of charged electrodes disposed on opposite sides of said cathode, one of said electrodes being movable and disposed interiorly of said envelope and the other electrode being disposed exteriorly of said envelope.

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