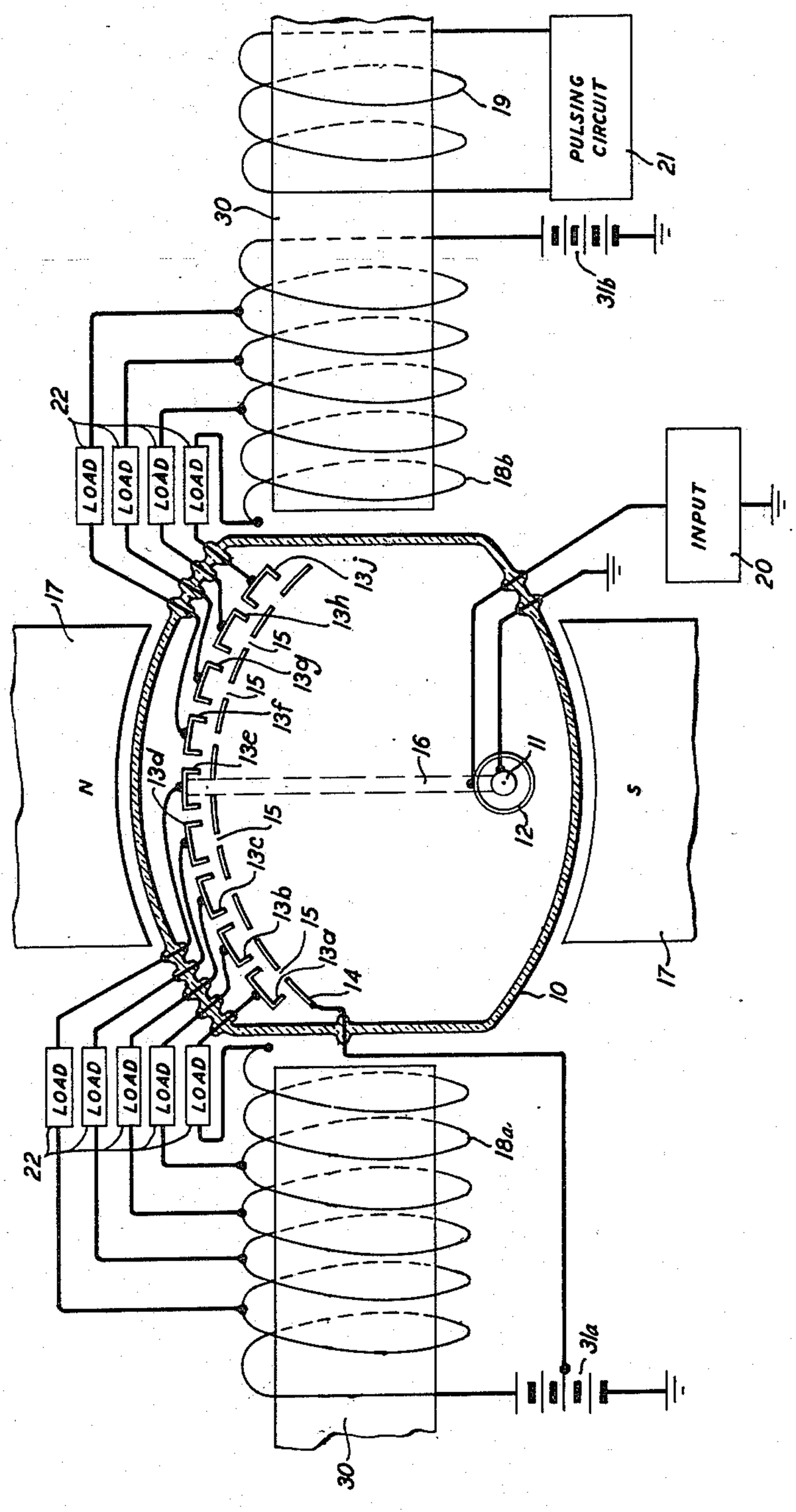
Feb. 19, 1946. A. M. SKELLETT 2,395,299

ELECTRON DISCHARGE APPARATUS

Filed June 29, 1944



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Patented Feb. 19, 1946 2,395,299

UNITED STATES PATENT OFFICE

2,395,299

ELECTRON DISCHARGE APPARATUS

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Application June 29, 1944, Serial No. 542,665

7 Claims. (Cl. 250—157)

This invention relates to electron discharge apparatus and more particularly to such apparatus including an electron discharge device of the multianode beam type.

One object of this invention is to enable selective magnetic deflection of an electron beam in a multianode electron discharge device, in accordance with signal pulses such that the beam will be held focussed upon any desired anode after the cessation of the signal pulse resulting in direction of the beam to such anode.

In one illustrative embodiment of this invention, electron discharge apparatus especially suitable for step-by-step switching operation comprises a cathode, a plurality of anodes mounted side by side opposite the cathode, means for producing a constant magnetic field in the anode-cathode region for normally directing the electron beam in a prescribed direction, for example, for normally focussing it upon one of the anodes, and means for producing magnetic field pulses at an angle, for example substantially a right angle, to the constant field, to deflect the beam in one direction or the other, dependent upon the polarity of the pulses, so that it impinges upon any desired one of the anodes.

In accordance with one feature of this invention, means are provided for producing an auxiliary magnetic field in the anode-cathode region, at an angle, for example substantially a right angle, to the constant field and of an intensity dependent upon the amplitude of the beam deflection due to the field pulses such that the beam is held focussed upon the anode to which it is deflected. In one illustrative embodiment, the auxiliary field-producing means comprises a coil having its longitudinal axis normal to the direction of the constant field and connected in circuit with the cathode and the several anodes in such manner that the amplitude of the magnetic field due thereto when the beam is impinging upon any anode is such as to maintain the beam directed upon that anode.

The invention and the above-noted and other features thereof will be understood more clearly and fully from the following detailed description with reference to the accompanying drawing in which the single figure is in part a circuit diagram and in part a sectional view of an electron discharge device, showing an electronic switching system illustrative of one embodiment of this invention.

Referring now to the drawing, the electron discharge device therein illustrated comprises an evacuated enclosing vessel 10 in which there are mounted a cathode 11, a control or accelerating electrode or grid 12 encompassing the cathode, a plurality of trough-shaped anodes, 13*a* to 13*j*, mounted side by side along an arc concentric with the cathode, and an arcuate screen electrode 14 having therein a plurality of apertures 15 each opposite a respective anode. The several electrodes advantageously are parallel and elongated in the direction normal to the plane of the drawing, so that when the electrodes are energized as described hereinafter an electron beam, indicated in one position at 16, of rectangular section and high current is produced.

A magnet having pole-pieces 17 is mounted outside the vessel 10 to produce a field of prescribed intensity substantially parallel to a line from the cathode 11 to the anode 13*e*. A pair of field coils 18*a* and 18*b* are mounted in alignment on opposite sides of the vessel 10, for example on a magnetic yoke 30, and as pointed out hereinafter, produce in the region between the cathode and the anodes a magnetic field substantially normal to the field due to the magnet and of an intensity dependent upon the position of the beam. An auxiliary or pulsing coil 19 coaxial with the coils 18 is provided on the yoke 30 to produce field pulses also normal to the field due to the magnet.

Each of the anodes 13 is connected to a respective tap on one of the coils 18 and thence to the positive terminal of one of the sources 31, such as batteries, the negative terminal of each source being connected to the cathode by way of ground as shown. Loads 22, such as relays, may be connected in circuit with the anodes. The screen electrode 14 is connected to an intermediate positive terminal of one of the sources. The electrode or grid 12 may be held at a fixed potential, positive or negative, with respect to the cathode 11 or may have a variable potential applied thereto by way of a suitable input element 20. The auxiliary coil 19 is adapted to be energized from a suitable pulsing circuit 21.

The constant field due to the magnet is made such that in the absence of fields due to the coils 18 and 19, the electrons emanating from the cathode 11 are concentrated into a beam focussed upon the anode 13*e*. If the coil 19 is energized, the electrons emanating from the cathode are subjected to two magnetic fields at right angles to each other and, consequently, the beam will be deflected so that it is substantially parallel to the resultant of the two magnetic fields. The direction and amplitude of the beam deflection will be dependent, of course, upon the polarity and magnitude of the field due to the coil 19. Assume that the coil 19 is ener-

gized by a pulse such that the electron beam is shifted from the anode 13*e* to the anode 13*f*. Then, as is apparent, a circuit will be completed from the anode 13*f* to the cathode 11 through the source 31*b* and a part of the coil 18*b* so that a magnetic field, due to the coil 18*b*, normal to the constant field, is introduced into the anode-cathode region. If the field due to the coil 18*b* is of the proper intensity, it will be seen that the beam will be held upon the anode 13*f*. If, now, a second energizing pulse of proper amplitude and polarity is supplied to the coil 19, the beam will be deflected to terminate upon the anode 13*g* so that a circuit, including a greater number of turns of the coil 18*b*, is completed between the anode 13*g* and the cathode and a field of intensity proportional to the number of turns included in the circuit is produced in the anode-cathode region, the field being normal to the constant field. As is apparent, if the field due to the coil 18*b* is of the proper intensity the beam will be held upon the anode 13*g*.

Thus, it will be appreciated that the beam may be shifted successively from one anode to the next by pulses supplied to the coil 19 and held upon any anode to which it is deflected by virtue of the field due to the coil 18, this field being of an intensity at any time determined by the position of the beam at that time, i. e., by which of the anodes the beam is impinging upon. Stated in another way, when the beam is impinging upon any anode, it automatically adjusts the field normal to the constant field to the value requisite to hold the beam upon that anode.

In the illustrative cases considered above, the polarity of the field due to the coil 19 has been assumed such as to produce clockwise deflection of the electron beam. Of course, if the polarity is reversed, the beam will be deflected in the opposite, i. e., counter-clockwise, direction. Hence, the beam may be shifted from one anode to another anode upon either side of it by applying an energizing pulse of appropriate polarity and amplitude to the coil 19.

In the specific embodiment of the invention illustrated and above described, the several magnetic field-producing elements are oriented so that the electron beam initially is directed upon the center anode and is deflected to one side or the other of this anode. It will be apparent that the field-producing elements may be oriented so that initially the beam is impinging upon any other anode, for example, either end anode 13*a* or 13*j*. It will be understood also that various modifications may be made in the embodiment illustrated and described without departing from the scope and spirit of the invention as defined in the appended claims.

What is claimed is:

1. Electron discharge apparatus comprising a source of electrons, a plurality of electron receiving electrodes mounted side by side opposite said source, means for producing a magnetic field to concentrate electrons emanating from said source into a beam, means for deflecting said beam selectively to direct it against any one of said electron receiving electrodes, and means for holding said beam upon the electrode against which it is directed by said deflecting means, said holding means comprising means for producing a second magnetic field at an angle to said first magnetic field and of an intensity proportional to the amplitude of deflection of said beam.

2. Electron discharge apparatus in accordance with claim 1 wherein said deflecting means comprises magnetic means for producing magnetic field pulses at an angle to said first magnetic field.

3. Electron discharge apparatus in accordance with claim 1 wherein said means for producing said second magnetic field comprises a magnetic field coil connected in circuit with said source and all of said electron receiving electrodes.

4. Electron discharge apparatus comprising means including a cathode for producing an electron beam, a plurality of anodes mounted side by side opposite said cathode, means for establishing a constant magnetic field having its lines passing from said cathode to one of said anodes and of such intensity as to focus said beam upon said one anode, means for deflecting said beam to shift its terminus from said one anode to another of said anodes, and means for holding said beam upon the anode to which it is shifted, said holding means comprising means for producing a magnetic field substantially normal to said constant field and of intensity proportional to the amplitude of deflection of said beam when its terminus is shifted from said one anode to another anode.

5. Electron discharge apparatus comprising means including a cathode for producing an electron beam, a plurality of anodes mounted opposite said cathode, means for deflecting said beam to deflect it selectively against any one of said anodes, and means separate from said deflecting means for holding said beam upon the anode against which it is directed, said holding means comprising means for producing a magnetic field in the direction of deflection of said beam and of an intensity dependent upon which anode said beam is directed against.

6. Electron discharge apparatus comprising a cathode, a plurality of anodes mounted side by side opposite said cathode, means for producing a magnetic field having its lines extending from said cathode to one of said anodes to concentrate electrons emanating from said cathode into a beam focussed upon said one anode, means for deflecting said beam to shift its terminus from said one anode to another anode, said deflecting means comprising means for producing magnetic field pulses normal to said first field and of an intensity to deflect said beam from one anode to the next adjacent anode, and means for producing a second magnetic field parallel to said pulses and of an intensity at any time substantially proportional to the amplitude of deflection of said beam from said one anode, said last-mentioned means comprising a magnetic field coil connected to said cathode and all of said anodes.

7. Electron discharge apparatus comprising a cathode, a pair of anodes, means for producing a magnetic field having its lines extending from said cathode to one of said anodes to concentrate electrons emanating from said cathode into a beam focussed on said one anode, means for deflecting said beam to cause it to impinge upon the other of said anodes, and magnetic field coil means connected between said cathode and said other anode and energized in accordance with current flow therebetween for producing a second magnetic field substantially normal to said first field and of intensity to hold said beam upon said other anode upon cessation of operation of said deflecting means.

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