

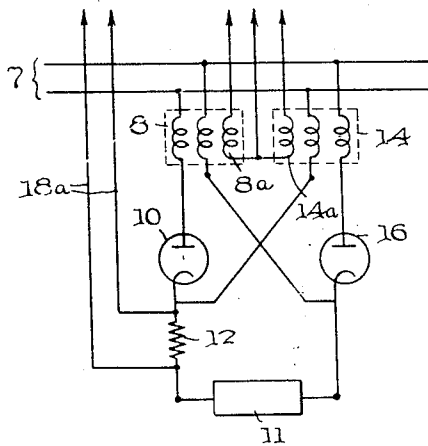
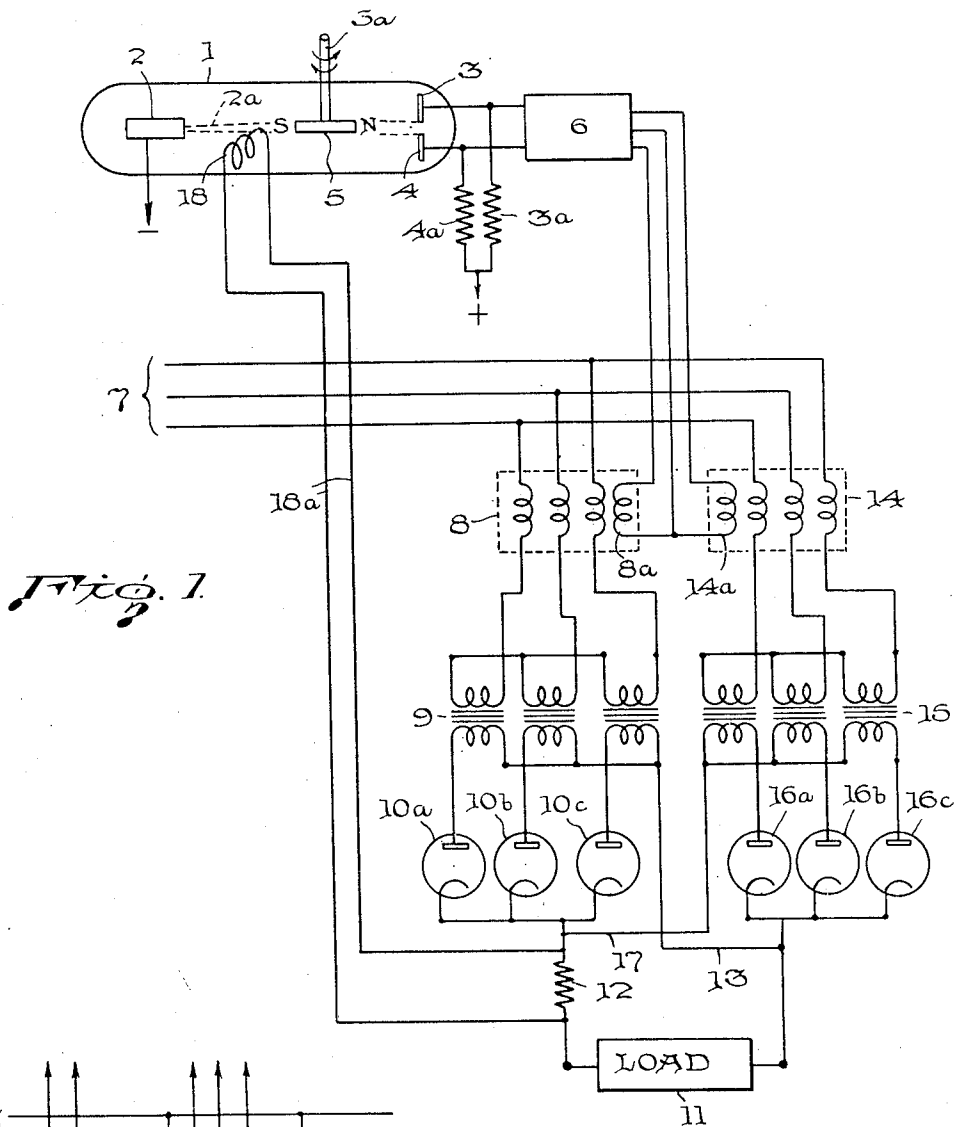
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DIRECT CURRENT POWER SUPPLY SYSTEM

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DIRECT CURRENT POWER SUPPLY SYSTEM

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This invention relates to power supply systems, and the broad object of the invention is the provision of a system to supply direct current power in either of two directions in a work circuit, and variable in magnitude from zero to a considerable value in either direction.

Another object is to devise a control arrangement for the power supply system which requires practically no energy to move or operate the control element and in which there is no reaction of the load circuit on the control element.

A further object is to provide an arrangement for maintaining substantially a linear relation between the output current and the movement of the control element.

My invention has a wide field of application, especially in the art of remote control, such as the operation of a rudder from a remotely located steering wheel, or in various telemetric systems.

The preferred embodiment of my invention is diagrammatically illustrated in Figure 1, and a variation thereof is shown in Figure 2.

Referring to the drawing, the control device for the system comprises a cathode ray tube having an envelope 1 enclosing an electron gun 2 which produces a concentrated stream of electrons 2a normally directed between two anodes or target electrodes 3 and 4 which are connected through suitable coupling resistances 3a and 4a to the positive terminal of a source of current, the gun 2 being connected to a negative terminal. The direction of electron beam 2a is controlled by means of a magnet 5 which preferably is a permanent magnet although it may be formed as an electromagnet. The magnet 5 is located at one side of the tube and is mounted on a shaft 5a which may be rotated in either direction about a vertical axis, whereby the south pole or the north pole may be moved nearer to the tube than the other pole. When the south pole is turned towards the tube, the beam will be deflected towards one of the anodes and away from the other, and when the north pole is moved towards the tube the direction of deflection is reversed.

With the electron beam in its normal position, no potential difference will exist between anodes 3 and 4, but when the beam is deflected away from its neutral position, a potential difference will develop, and the magnitude of the potential will depend upon the amount of deflection, while the polarity will depend upon the direction of deflection. Thus, by turning shaft 5a in one direction, a potential difference will be developed between anodes 3 and 4 of a given polarity, and the magnitude will vary according to the amount of turn-

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ing of shaft 5a. If the shaft is turned in the opposite direction from its normal position where the magnet 5 is generally parallel with the electron beam, the polarity of the potential difference will be reversed, and the magnitude will vary according to the amount of turning of the shaft 5a.

The control tube 1 is employed to vary the amount of power transmitted from an alternating current source to a direct current work circuit through a suitable rectifying arrangement. In Figure 1 the source of power is represented by the 3-phase alternating current circuit 7 which may be the usual 60-cycle commercial circuit. Alternating current from lines 7 is supplied through a 3-phase saturable reactor 8 to a 3-phase transformer 9, the secondary windings of which supply three rectifiers 10a, 10b and 10c which are represented as diodes in Figure 1 although other types of rectifiers may be employed. The three cathodes of the rectifier tubes are connected together and connected to one terminal of a load circuit 11 through a series resistor 12. The neutral point of the secondary circuit of transformer 9 is connected through connection 13 to the other terminal of the load circuit, whereby rectified 3-phase alternating current will be supplied to the load circuit in one direction under proper conditions of operation of reactor 8.

Alternating current is also supplied from 3-phase lines 7 through a second 3-phase saturable reactor 14 to a 3-phase transformer 15, the secondary windings of which are connected to suitable rectifiers 16a, 16b and 16c. The cathodes of these rectifiers are connected together and to the opposite side of the load circuit from the side connected directly to the cathodes of rectifiers 10a, 10b and 10c, and the neutral point of the secondary circuit of transformer 15 is connected to the input side of resistor 12 through a connection 17. Thus, under proper conditions of operation of reactor 14, rectifiers 16a, 16b and 16c will supply rectified 3-phase alternating current to the load 11 in the opposite direction from that supplied by rectifiers 10a, 10b and 10c.

Saturable reactor 8 is provided with a saturating or magnetizing winding 8a, and reactor 14 is provided with a similar winding 14a. These two windings are energized from the output circuit of the control tube 1, either directly or through a suitable amplifier 6.

Operation of Figure 1 is as follows: With the magnet 5 in its normal position and the beam 2a directed midway between anodes 3 and 4, no potential difference is developed across these anodes, and windings 8a and 14a remain de-energized.

Under this condition, reactors 8 and 14 are effective in preventing the flow of power through both rectifying paths. By turning the magnet 5 in one direction or the other, a potential difference is developed in the output of the tube 1 which causes one of the windings 8a or 8b to be energized in accordance with the amount of turning of the magnet, and this correspondingly lowers the impedance of the reactor to permit the passage of power through the corresponding rectifying circuit, thus establishing direct current in the load circuit in a given direction and in an amount dependent upon the amount of turning of the magnet 5 from its normal position. Turning of the magnet in the opposite direction results in energization of the magnetizing winding associated with the reactor in the other rectifying path and establishes the flow of direct current in the load circuit in the opposite direction.

For the purpose of establishing a substantially linear relation between the current in the load circuit and the amount of turning of the magnet 5, I provide a deflecting winding 18 for the tube 1, and this winding is energized by the drop potential across resistance 12 through the connections 18a. Winding 18 is so positioned and connected that the current in this winding tends to deflect electron beam 2a in a direction opposite to the direction of deflection by the magnet 5. The action of winding 18 tends to stabilize the operation and to establish a substantially linear relation between the current in the load circuit and the magnitude of turning of the magnet 5. Instead of using a rotary magnet 5 for deflecting the electron beam in one direction or the other, other known types of deflecting arrangements may be employed.

While the preferred arrangement of my invention is illustrated in Figure 1, in which the load circuit is supplied with 3-phase rectified current, it is possible to operate the system on a single phase source of alternating current as shown in Figure 2. In this arrangement the supply circuit 7 is a single phase A. C. circuit. One rectifying path from circuit 7 extends through a pair of windings in reactor 8 and through rectifier 10 to the load 11 through resistor 12. Another rectifying path extends from the circuit 7 through two windings on saturable reactor 14 and through rectifier 16 to the load 11 through resistor 12, the two paths being connected to supply direct current in opposite directions to the load 11. The control arrangement for Figure 2 is the same as illustrated in Figure 1.

As explained above, my invention may be applied to different uses where the load 11 would assume different forms. For example, load 11 may constitute a motor for operating a rudder in opposite directions according to the movement of a steering wheel which would be attached to the shaft 5a. For certain purposes, the rudder might normally be biased for return to neutral position. Another obvious application of my in-

vention is in regulating arrangements where the load 11 would constitute a motor for driving a condition controlling element in one direction or the other according to variations in such condition which are imparted to the shaft 5a by a condition responsive device. Various other applications will be apparent to those skilled in the art.

I claim:

1. In combination, a source of alternating current, a load circuit, a pair of rectifiers having output circuits connected to said load circuit in opposite directions, a pair of separate supply lines connecting said rectifiers to said source of alternating current to energize said rectifiers over separate and independent paths, a saturable reactor connected in each of said supply lines and being effective in unsaturated state to prevent the flow of power in said supply lines, a control element movable in opposite directions from a normal position, and means to variably magnetize said reactors including means controlled by said control element for increasing the magnetization of one of said reactors for one direction of movement of said element from its normal position and for increasing the magnetization of the other reactor for the other direction of movement of said element, whereby movement of said control element from its normal position controls both the direction and the amplitude of the rectified current supplied to said load circuit.

2. A combination according to claim 1 wherein the means for variably magnetizing said reactors comprises a cathode ray tube having electron beam deflectable in opposite directions from a neutral position, and including means controlled by the deflection of said beam for variably energizing one or the other of said magnetizing means according to the direction of movement of said beam.

3. A combination according to claim 2 wherein said beam is deflected in opposite directions from its neutral position by a movable magnet mounted adjacent said cathode ray tube.

4. A combination according to claim 2 and including a deflecting winding for said cathode ray tube, and means for energizing said winding in accordance with the current in the load circuit and in a direction to deflect said beam counter to the deflection by said control element.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,844,704	Thompson	Feb. 9, 1932
1,874,777	Maser	Aug. 30, 1932
2,000,189	Power	May 7, 1935
2,208,400	Steinmetz	July 16, 1940
2,212,229	Giroz	Aug. 20, 1940
2,261,699	Rampacher	Nov. 4, 1941