

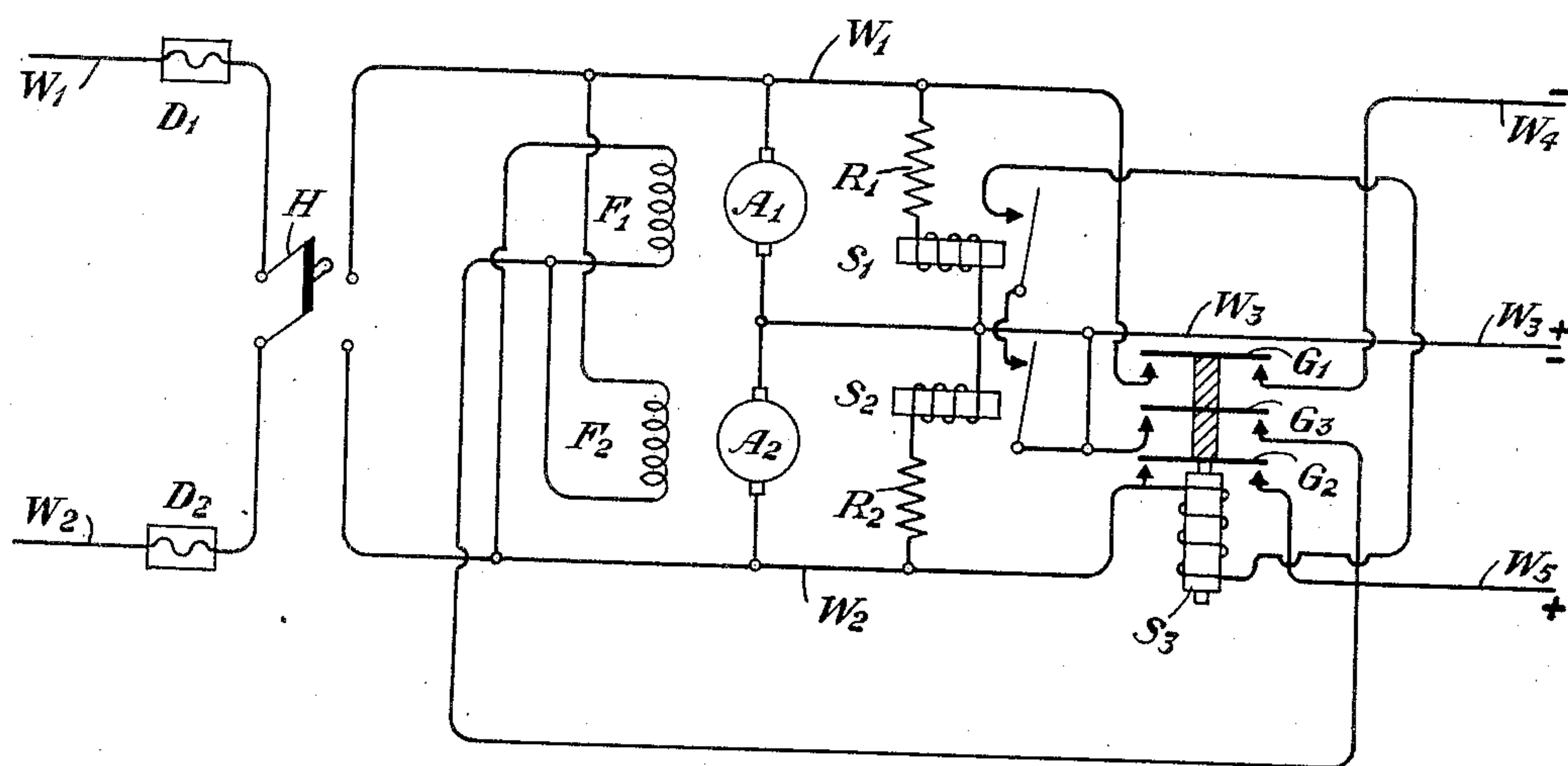
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DIRECT CURRENT POWER SYSTEM

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DIRECT CURRENT POWER SYSTEM

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This invention relates to direct current power systems and to systems for converting direct current power of one voltage to direct current power of a different voltage. This invention also relates to direct current power systems suitable for supplying power to telephone and like apparatus as, for example, teletypewriters.

Heretofore, equipment such as teletypewriters and the like, were supplied with 220 volt D. C. power by connecting the equipment to the power line by means of a potentiometer of large capacity. Although the potentiometer arrangement operated satisfactorily it was found to be objectionable, however, because of the considerable amount of heat generated by the current traversing the potentiometer resistance. Some other form of arrangement free from this objection was required to properly connect the power line to the equipment to be operated.

In accordance with this invention a special form of arrangement has been set up for converting 220 volt D. C. power supplied over a two-wire circuit to 110 volt D. C. power to be fed over a three-wire circuit. The arrangement consists of two mechanically coupled D. C. motors of identical characteristics (which may comprise a motor-generator set) so connected to the three-wire line that the load or equipment to be operated will be connected to the armatures of the mechanically coupled motors only after the armatures of these motors have reached something approaching their rated speed.

This invention will be better understood from the detailed description hereinafter following when read in connection with the accompanying drawing showing one embodiment of the invention merely for the purpose of illustration.

Referring to the drawing, the reference characters W_1 and W_2 comprise a two-wire D. C. power line which may be, for example, of 220 volts. The line W_1 — W_2 is connected through two fuses D_1 and D_2 and a double-pole single-throw switch H to the armatures A_1 and A_2 of two mechanically coupled motors. Although these armatures are mechanically coupled, they are also connected in series relationship across the line W_1 — W_2 as are also the field windings F_1 and F_2 of these two motors. It will be observed that the upper terminal of the armature A_1 is connected to the conductor W_1 while the latter conductor is connected to the field winding F_2 which controls the armature A_2 , and that the lower terminal of the armature A_2 is connected to the conductor W_2 while the latter con-

ductor is connected to the field winding F_1 which controls the armature A_1 .

The terminal common to the armatures A_1 and A_2 is connected to the neutral conductor W_3 of a three-wire circuit W_3 — W_4 — W_5 . A resistor R_1 and the winding of a relay S_1 are connected in series with each other across the conductors W_1 and W_3 . A similar resistor R_2 and the winding of a similar relay S_2 are also connected in series with each other across the conductors W_2 and W_3 . The conductor W_1 will be connected to one of the outer conductors W_4 of the three-wire circuit by the armature G_1 of a power relay S_3 when the latter relay is operated. Similarly, the conductor W_2 will be connected to the other outer conductor W_5 of the three-wire circuit by the armature G_2 of the relay S_3 when the latter relay is operated. In response to the operation of the relay S_3 the inner armature G_3 will connect the neutral conductor W_3 to the terminal common to the field windings F_1 and F_2 . When this happens the field winding F_1 will be connected across the conductors W_2 and W_3 as well as across conductors W_3 and W_5 of the three-wire circuit, while the field winding F_2 will be connected across the conductors W_1 and W_3 as well as across conductors W_3 and W_4 of the three-wire circuit. A plurality of load devices, such as teletypewriters or the like, (not shown) may be connected across the three-wire circuit W_3 — W_4 — W_5 , preferably in such a way as to distribute the load fairly evenly between the two pairs of conductors W_3 — W_4 and W_3 — W_5 .

When the switch H is open the armatures A_1 and A_2 will, of course, be stationary and the relay S_3 (as well as relays S_1 and S_2) will be released. The load devices will be disconnected from the armatures A_1 and A_2 .

One of the objects of this invention is to connect the load devices, above referred to, to the armatures A_1 and A_2 only after the armatures have reached a predetermined speed of rotation. The armatures A_1 and A_2 each have low impedances of, for example, 10 or less ohms when these armatures are not in rotation, and the resistors R_1 and R_2 may each have impedances of about 3800 ohms, while the windings of the relays S_1 and S_2 may each have impedances of approximately 35 ohms.

Upon the closure of the switch H the voltage supplied over the conductors W_1 and W_2 will cause current to flow through the field windings F_1 and F_2 which are in series relationship. The armatures A_1 and A_2 being of lesser impedance than the respective impedances of the resistor

and relay winding combination in shunt therewith, will receive a substantial current from the source W_1 — W_2 and hence, will start to rotate. The relays S_1 and S_2 , however, will remain unoperated for a substantial interval of time. As the speed of rotation of the armatures A_1 and A_2 increases, more and more current will flow through the resistors R_1 and R_2 and through the corresponding windings of relays S_1 and S_2 , and as these armatures approach their rated speeds the flow of current through the windings of relays S_1 and S_2 will be sufficiently great to cause these relays to operate. In response to the operation of both relays S_1 and S_2 , and only after relays S_1 and S_2 have both operated, the relay S_3 will be operated, the current for which is supplied by the voltage built up across the armature A_2 . This current flows over the circuit including the conductor W_2 , the winding of relay S_3 , the contact and armature of relay S_1 , the contact and armature of relay S_2 , and conductor W_3 . Upon the operation of relay S_3 the armature G_1 will complete the circuit between the outer conductors W_1 and W_4 of one of the pairs of circuits of the three-wire circuit extending to the armature A_1 , while the armature G_2 will complete the circuit between the other pair of conductors W_2 and W_5 of the other circuit of the three-wire system connected to the armature A_2 .

It will be observed that the two circuits of the three-wire system to which the load elements (not shown) are connected will be supplied with power only after the armatures A_1 and A_2 have reached some predetermined speed of rotation. If the power supplied to conductors W_1 and W_2 is of 220 volts then the circuits W_3 — W_4 and W_3 — W_5 will each be supplied with D. C. power of about 110 volts. At the same time if the load is fairly evenly distributed between the two circuits of the three-wire system just referred to, there will be virtually no current in the neutral conductor W_3 . Moreover, the operation of relay S_3 will connect the common terminal of these field windings to the neutral conductor W_3 thereby bridging the field winding F_1 across the conductors W_3 and W_5 and the field winding F_2 across the conductors W_3 and W_4 , as already pointed out.

The currents traversing the field windings F_1 and F_2 will be substantially identical when the loads connected to the two circuits of the three-wire system are substantially the same. Because of the balanced relationship usually prevailing in this system, the motors which include the armatures A_1 and A_2 need not be of large capacity as will be readily understood by those skilled in the art. The relays S_1 , S_2 and S_3 are all operated under normal conditions, that is, when the switch H is closed and armatures A_1 and A_2 are rotating at about their rated speed. The relay S_3 will be a power relay having a winding able to carry a large current, while the relays S_1 and S_2 are much smaller relays carrying only a very small current.

In the event that the load connected to one of the circuits, such as W_3 — W_5 of the three-wire system, is increased to substantially exceed the load applied to the other circuit W_3 — W_4 of the system, the increased load on the circuit W_3 — W_5 will act to reduce the voltage across that circuit as compared to the voltage across the circuit W_3 — W_4 . The field winding F_1 , which is connected across the W_3 — W_5 circuit, will therefore receive a smaller current than is supplied to the field winding F_2 which is bridged across the cir-

cuit W_3 — W_4 on which the load is unchanged. Consequently, the armature A_1 will tend to increase in speed. In that case the armature A_1 will act as a motor and the other armature A_2 , coupled thereto, will act as a generator. With normal current flowing through the field winding F_2 , the windings of armature A_2 will thus generate power to be supplied to sustain the increased load on the circuit W_3 — W_5 and thus tend to compensate the increased load on this circuit.

Throughout the unbalanced condition there will be a flow of current through the neutral conductor W_3 equal to the load unbalance. This current will drop to zero when the loads are again equalized.

One of the features of this invention is that with a circuit of the type illustrated and described, the loads connected to the two circuits of the three-wire system may be very large compared to the rating of the balancer machines which need to be only large enough to supply the unbalance in power between the two circuits. If a motor generator set were used in place of the circuit shown and described, it would have to be large enough to carry the full load. The two motors used in the form of circuit of this invention here illustrated were $\frac{1}{4}$ H. P. each.

The circuit of this invention permits teletypewriter or like apparatus to be supplied with low voltage D. C. power from a higher voltage source without endangering the apparatus supplying the load and without creating any substantial hazard for the operators manipulating the apparatus. The center armature G_3 of the relay S_3 also provides the added feature of protection against excessive voltage reaching any of the conductors of the three-wire system in the event that some trouble should develop in the armature A_1 — A_2 circuits as, for example, arises when one of the brushes of one of the armatures is removed or is open-circuited.

The resistors R_1 and R_2 may be considered as current limiting devices to restrict the current flowing through the respective windings of relays S_1 and S_2 . They may be omitted, if desired, in which case the impedances of the relay windings would have to be correspondingly increased.

The voltages and other constants specified hereinabove are given merely for the sake of illustration and are not to be construed as limitations on the invention.

While this invention has been shown and described in certain particular arrangements merely for the purpose of illustration, it will be understood that the general principles of this invention may be applied to other and widely varied organizations without departing from the spirit of the invention and the scope of the appended claims.

What is claimed is:

1. The combination of a source of direct current power, two rotatable armatures mechanically coupled to each other and connected in series with each other across said source of power, the field windings of said armatures being connected in series relationship with each other across said source of power, two circuits connected as a three-wire line to said armatures the neutral of which is connected to the terminal common to said armatures, a plurality of loads which may be connected to said two circuits, voltage responsive means for connecting said loads to said two circuits, and means responsive

to the rotation of said armatures at a predetermined speed to provide a sufficient voltage to operate said voltage responsive means to connect said loads to said two circuits.

2. The combination of a source of direct current power, a three-wire circuit for supplying power from said source to a load connected to said three-wire circuit, two similar rotatable armatures mechanically coupled with each other connected and in series relationship across said source of power, voltage responsive means for connecting said source of power to said three-wire circuit, and means responsive to a predetermined speed in said rotatable armatures for operating said voltage responsive means for supplying power from said source to said three-wire circuit, the neutral of said three-wire circuit being connected to the terminal common to said armatures.

3. The combination of a source of direct current power, two rotatable armatures mechanically coupled to each other and in series relationship across said source of power, the field windings of said armatures being connected in series relationship with each other across said source of power, two relays the windings of which are connected in circuits respectively across the two armatures, means responsive to a predetermined speed of rotation of said armatures to provide a sufficient voltage, for operating said relays, a three-wire circuit the neutral of which is connected to the terminal common to the two armatures, a third relay operated in response to

the operation of the other two relays for connecting the other two wires of the three-wire circuit to the other terminals of said rotatable armatures, and means responsive to the operation of said third relay for connecting the field windings across the two circuits of the three-wire circuit, each field winding being connected across the circuit of the three-wire system which is connected to the other rotatable armature.

4. The combination of a source of power, first and second loaded circuits arranged as a three-wire circuit, first and second similar rotatable armatures mechanically coupled to each other and arranged in series relationship across the source of power, first and second field windings associated respectively with said first and second armatures and connected in series relationship across said source of power, first and second relays the windings of which respectively shunt first and second said rotatable armatures and means responsive to a predetermined rate of speed of said rotatable armatures to provide a sufficient voltage to operate said first and second relays, means responsive to the operation of both of said relays to connect the first and second loaded circuits to said rotatable armatures, the neutral of which will terminate at the point where the two rotatable armatures are connected together, said latter means including means to connect the first field winding across the second loaded circuit and the second field winding across the first loaded circuit.

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