

May 4, 1954

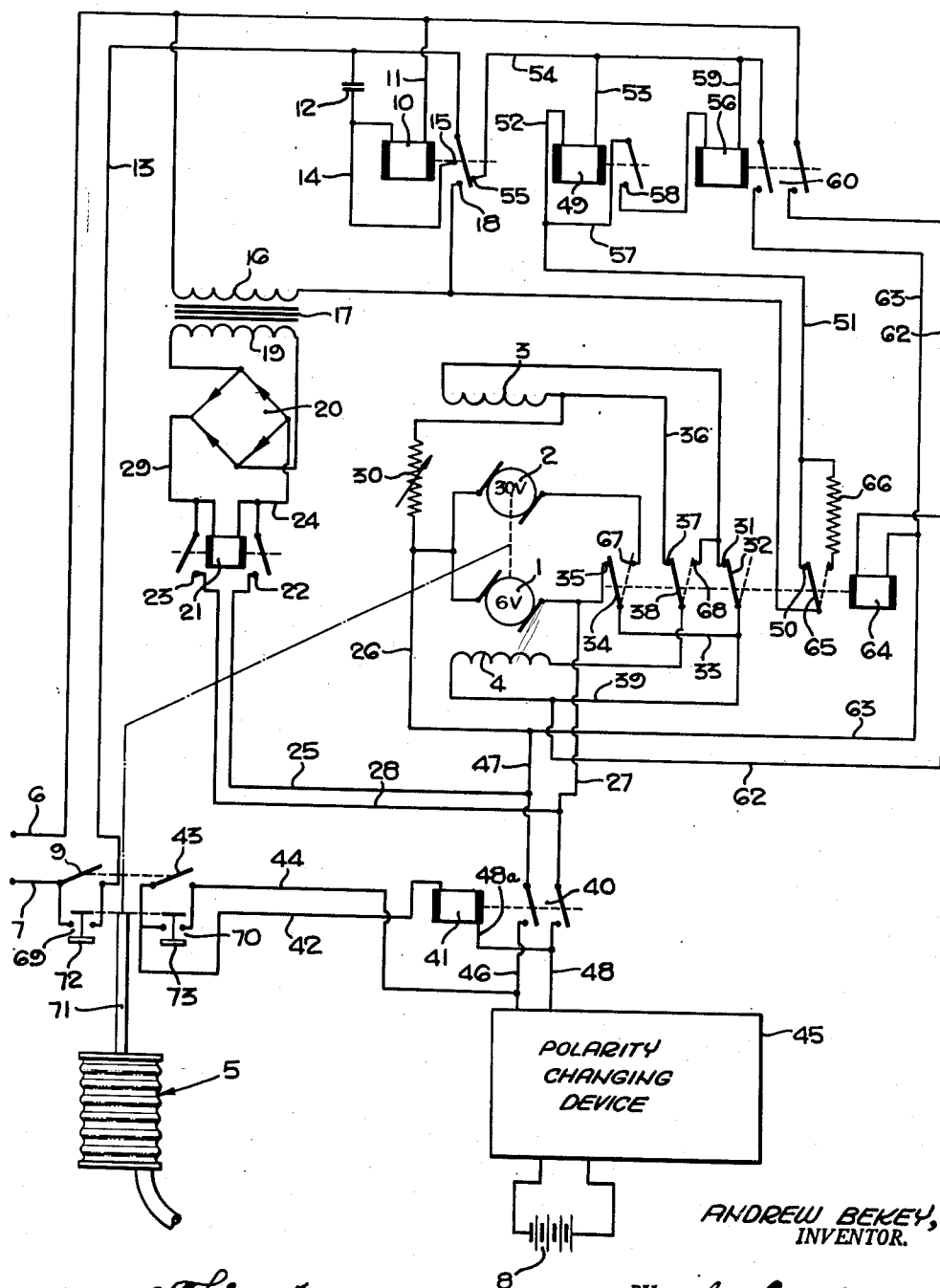
A. BEKEY

2,677,798

ELECTRICAL SUPPLY SYSTEM FOR OPERATING LOADS

Filed Oct. 9, 1950

3 Sheets-Sheet 1



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3 Sheets-Sheet 2

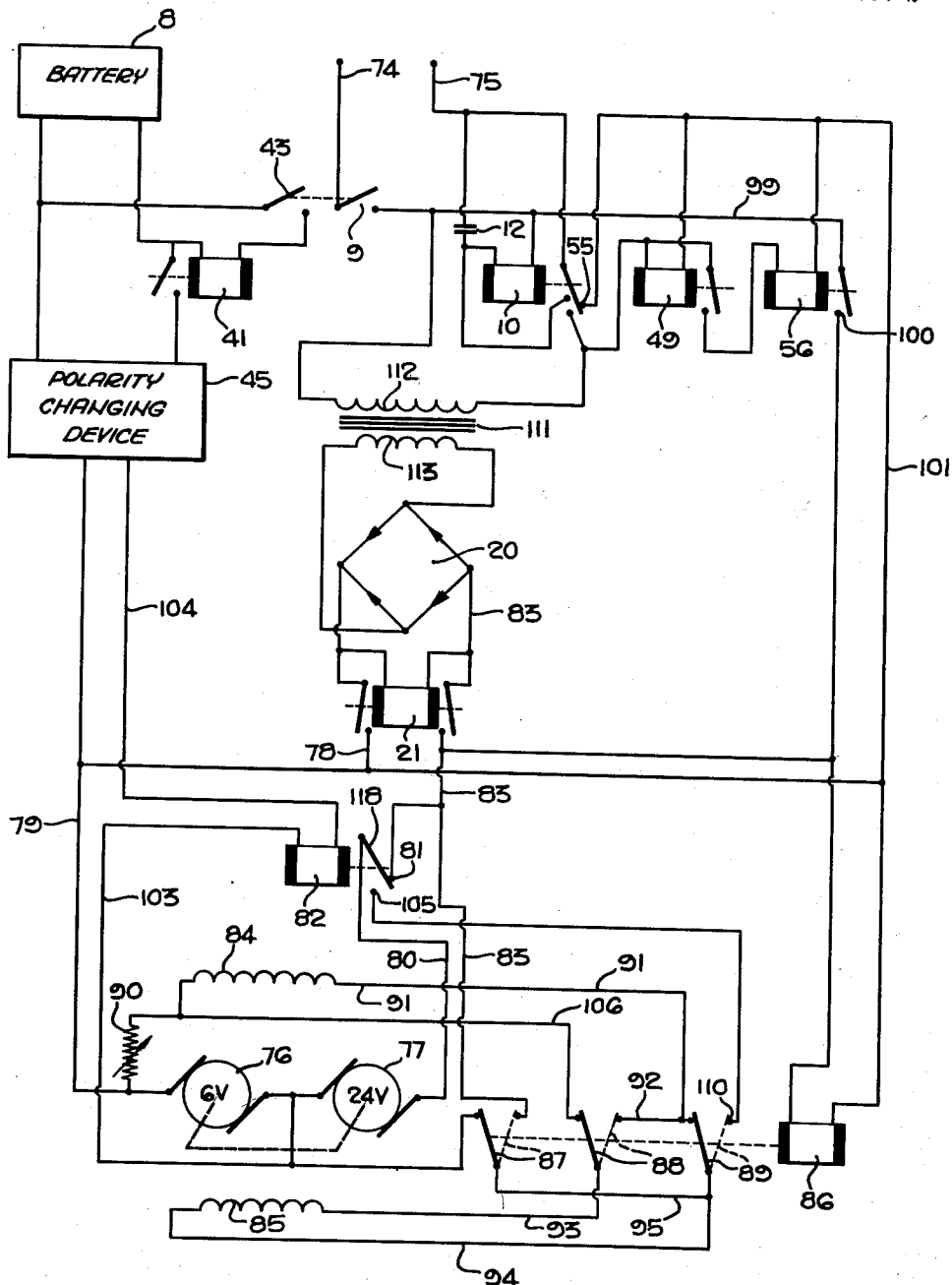


Fig. 2.

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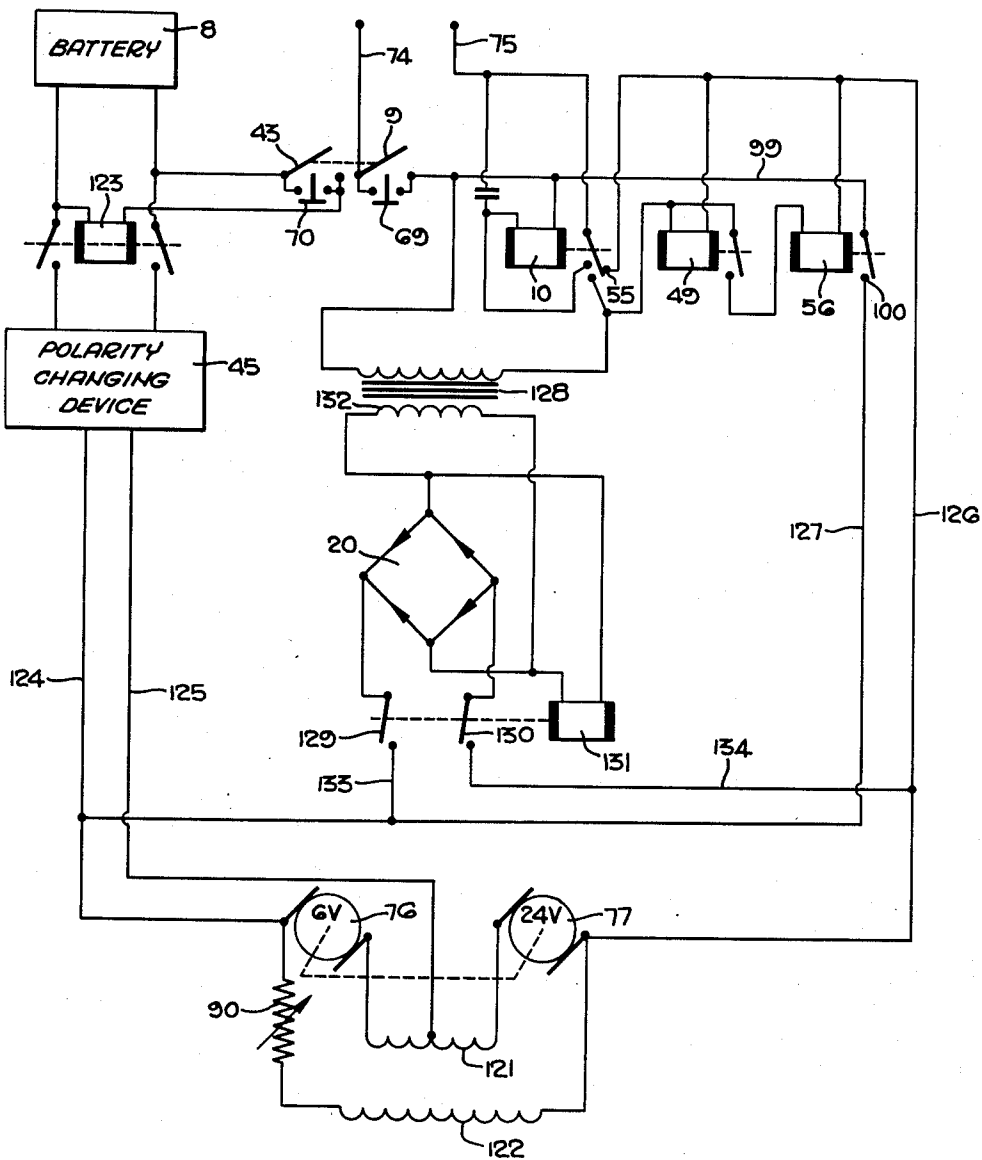
A. BEKEY

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ELECTRICAL SUPPLY SYSTEM FOR OPERATING LOADS

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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

2,677,798

ELECTRICAL SUPPLY SYSTEM FOR
OPERATING LOADS

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Application October 9, 1950, Serial No. 189,102

21 Claims. (Cl. 318-441)

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This invention relates to an electrical system for operating a load (such as a motor), and particularly to one that may operate effectively when connected to any one of a number of sources.

Such a system is especially useful for assuring substantially continuous operation of a load when the load is switched from a commercial lighting system to a storage battery or to a source of low voltage direct current, as on a train, or airplane.

For example, power-operated respirators for the use of poliomyelitis patients are now manufactured in such sizes that they are much more readily portable than the old forms of "iron lungs." Accordingly, it would be quite simple to transport such a patient via trains, steamships, airplanes, or automobiles, provided that the respirator be kept in operation. Since such respirators are primarily designed to operate on the usual house lighting mains of about 110 volts A. C., the use of stand-by batteries supplying a comparable voltage is not feasible.

It is one of the objects of this invention to make it possible to operate such a system on either A. C. or D. C. of different voltages, and particularly without requiring any manual change in connections. While such a system is especially useful for operating artificial respirators, it is not limited to such use.

Accordingly, this system contemplates that a mere plugging in to a D. C. supply on a railroad car, or on an airplane, automatically causes selector circuits to operate, adapting the system to the new source of supply. And in the period of transportation to or from a home or hospital to or from a train or airplane, a stand-by storage battery of low voltage is automatically effective to keep the respirator in operation.

Thus, for example, such a system is designed to operate effectively and automatically on an A. C. source of 110 volts, or on a D. C. source of between 28 and 32 volts (commonly found on trains and planes) or on a D. C. source of about 6 volts (corresponding to a storage battery). Accordingly, it is another object of this invention to provide a system of this character that automatically adapts itself to such operation.

It is still another object of this invention to ensure that the stand-by storage battery will be charged during periods of operation from other sources.

By the aid of this invention, therefore, the patient is assured of continuous operation of the apparatus in transit from one locality to another, and yet without the provision of extremely bulky equipment.

This invention possesses many other advantages, and has other objects which may be made more clearly apparent from a consideration of

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several embodiments of the invention. For this purpose there are shown a few forms in the drawings accompanying and forming part of the present specification. These forms will now be described in detail, illustrating the general principles of the invention; but it is to be understood that this detailed description is not to be taken in a limiting sense, since the scope of the invention is best defined by the appended claims.

Referring to the drawings:

Figure 1 is a wiring diagram illustrating a system incorporating the invention;

Fig. 2 is a diagram of a modified form of the invention; and

Fig. 3 is a diagram of another modified form of the invention.

In Fig. 1, the load to be energized is shown as a direct current motor. In the present instance, the direct current motor is shown as having a low voltage armature 1 and a high voltage armature 2. For example, the low voltage armature 1 may be operated by six volt direct current, and the armature 2 is adapted to be operated by a thirty volt direct current. These two armatures may be connected to a common shaft for alternately expanding and contracting a bellows mechanism 5 operating an artificial respirator.

Cooperating with these armatures is a pair of field windings 3 and 4.

The input lines 6 and 7 are so arranged that the system may be plugged in by the usual plug devices to either an alternating current source, or to a source of direct current such as may be found on airplanes, ambulances, and railroad trains.

In order to make it possible to provide uninterrupted operation of the direct current motor, the mere plugging in of the lines 6 and 7 either to a direct current line of six or thirty volts, or to an alternating current line will produce proper energization of the motor circuits. In this way, it is assured that the respirator will be in operation during transit of a patient, and especially since a standby storage battery 8 is provided.

This storage battery 8 serves to supply direct current at six volts to the six volt armature 1 and to the shunt field windings 3 and 4 in parallel, so as to make it possible to continue the operation of the respirator even when the lines 6 and 7 are disconnected.

Assuming that the lines 6 and 7 are connected to a source of alternating current, delivering, for example, 110 volts, and assuming that the circuit controller or switch 9 is closed, a relay 10 is energized. This relay circuit includes the line 6, connection 11, relay 10, a condenser 12, connection 13, circuit controller 9, and line 7. The condenser 12 is of the type that may carry a substantial current for a short time, in order to energize relay 10. As soon as the relay is ener-

gized, a holding circuit is established through a connection 14, front contact 15, to line 13.

Energization of the relay 10 completes an energizing circuit for the primary winding 16 of transformer 17. This energization is accomplished through the front contact 13 of relay 10.

The transformer 17 is a step-down transformer having a secondary winding 19 supplying energy to a rectifier 20. The transformer 17 is so designed with respect to the rectifier 20 that, for a 110 volt supply at lines 6 and 7, the rectifier 20 delivers about 6 volts. This rectifier, in turn, is connected to the six volt armature 1 and the windings 3 and 4. Thus, as soon as the rectifier 20 is energized, a relay 21 is operated to close the contacts 22 and 23, connecting the rectifier across the armature 1. Further controlling functions of relay 21 will be hereinafter described.

The armature 1 is supplied with energy from the rectifier 20 through the following circuit: connection 24, front contact 22 of relay 21, connections 25, 47, and 23, armature 1, connections 27 and 28, contact 23, and connection 29.

The field windings 3 and 4 are connected in parallel across the armature 1. This parallel circuit includes a variable resistor 30 for adjusting the speed of the motor. The winding 3 is connected to one terminal of the resistor 30; its other terminal extends to a contact 31, movable contact arm 32, connection 33, movable contact arm 34, and contact 35, to the other side of the armature 1. The field winding 4 is similarly connected from the upper terminal of the resistance 30 through a connection 36, contact 37, contact arm 38, winding 4, connections 39 and 33, arm 34, and contact 35 to the armature 1.

At the same time, the storage battery 8 is connected across the armature 1 in stand-by relation thereto, so that, should the source of power at terminals 6 and 7 fail, for any reason, the battery 8 will uninterruptedly continue to operate the motor. While the battery 8 is in such stand-by relation, it may be charged, if need be.

The battery is connected through a polarity changing device 45 to connections 25 and 23, by connections 46 and 43 respectively, thereby paralleling the rectifier connections to the armature 1. This polarity changing device 45 assures that the battery 8 will always be connected in a proper manner to the armature 1, operating as generator, irrespective of the mode of connection of terminals 6 and 7 to an external supply. Since such a pole changing system is old, no further description thereof is necessary.

A double pole switch 40 is interposed in the connections 46 and 43, and is operated by a remote control relay 41. The relay 41 is energized directly from the battery 8 through the polarity device 45, and is controlled by a remote control switch 43. Such circuit may be traced as follows: connection 48 at one side of the polarity device 45, connection 48a, relay 41, connection 42, remote control switch 43, connection 44 to connection 46 at the other side of the polarity device 45. Should there be no external supply, the relay 41 will be operated by current through the battery circuit, or, if the battery 8 is in stand-by relation only, it will be operated by generated voltage across the armature 1 in that connections 43 and 43 parallel the armature 1. The switch 43 is connected to the switch 9, so that both of the switches are simultaneously operated.

In the event that the system is entirely dis-

connected from any source at terminals 6 and 7 after it has been in operation, the relay 41 continues to be energized from the battery 8, and maintains this battery 8 in operating condition to supply energy to the armature 1 and the shunt field windings 3 and 4 in parallel.

When the apparatus is disconnected from all sources, including the battery 8, relay 21 is de-energized, remote control switch 43 is open, and switch 40 is open in that switch 43 interrupts supply to the relay 41. If it is desired to start operating the motor from the battery 8, there being no external supply available, for instance, switch 43 is closed. Relay 41 then operates, and the battery 8 is connected across the armature 1. The relay 21 can be caused to close only by the energization of the rectifier 20, and accordingly, the battery voltage cannot be applied across the rectifier 20. The relay 21 thereby insures against short circuiting of the battery, for in the absence of a voltage across secondary 19 for operating the rectifier, there is a large possibility that the battery voltage would be of unfavorable polarity with respect to the rectifier 20.

In the event direct current of six volts is impressed upon the lines 6 and 7, the relay 10 cannot be energized because of the stopping condenser 12. Under such circumstances, a relay 49 is energized. This relay has an energizing circuit that includes the primary winding 16. This energizing circuit includes line 6, winding 16, movable arm 65, a circuit controller contact 50, connections 51 and 52, relay 49, connections 53 and 54, back contact 55 of relay 10, connection 13, and switch 9 to line 7.

The winding 16 is of relatively low resistance, so that it does not interfere with the energization of relay 49 by direct current. However, it has a relatively high impedance to alternating current. Accordingly, it is assured that, when alternating current is used, relay 49 cannot be effectively energized for an appreciable time. This time delay ensures that relay 10 will operate first (when A. C. is used), thereby opening the back contact 55 and preventing energization of relay 49. Thus there is no danger that an excessive alternating current can be passed, due to closing of relay 49, to the armatures 1 and 2.

In order further to add to the time delay, another relay 56 is interposed between the motor circuit and the lines. This relay 56 is energized only after relay 49 is energized. Thus, the circuit for relay 56 includes line 6, winding 16, arm 65, contact 50, connections 51 and 57, front contact 53 of relay 49, relay 56, connection 59, connection 54, back contact 55, connection 13, switch 9, to line 7.

Relay 56, when energized, serves to close the double pole switch 60. When this switch closes, the armature 1 is supplied with direct current through the following circuit: line 6, right-hand side of switch 60, connections 62, 39, and 33, arm 34, contact 35, armature 1, connections 26 and 63, left-hand side of switch 60, connection 54, back contact 55, connection 13, switch 9, to line 7. The circuit for field windings 3 and 4, heretofore traced, places them directly in shunt with the armature 1, and these windings are in parallel.

Should the lines 6 and 7 be connected to a higher direct current voltage, such as from 28 to 32 volts, a circuit controller arrangement is provided to disconnect the armature 1 and to substitute the higher voltage armature 2. Also, the

windings 3 and 4 are placed in series across the armature 2.

For this purpose, use is made of a relay or electromagnet 64 energized through the switch 60. This relay is not sufficiently energized to operate a circuit controller on six volts, but it is energized sufficiently to operate the circuit controller when a higher direct current voltage is supplied.

This circuit controller includes the arms 32, 33, and 34, as well as the arm 65. When the relay 64 is de-energized, these arms assume the positions shown in full line. However, when a higher direct current voltage is impressed on relay 64, this relay moves the arms to the dotted line positions indicated. The arm 65 serves to interpose a resistance 66 in the circuits of relays 49 and 56; and thus the current through these relays is held at a value comparable to that when using a 6 volt source.

The armature and field circuits through the switch 60 may now be traced as follows: from the left-hand side of switch 60, connection 63, connection 26, armature 2, contact 67, arm 34, connections 33, 39 and 62, to the right-hand side of switch 60. The field windings 3 and 4 are also connected in series across the armature 2 as follows: through resistance 30, winding 3, contact 68, arm 38, winding 4, connections 39 and 33, arm 34 and connection 67. Armature 1 remains connected to battery 8; accordingly the voltage generated by this armature is effective to charge the battery, as well as to close switch 40.

When the system is shut down completely, the cycle of bellows operation is terminated so that the bellows 5 must assume a collapsed position. In order to ensure that the motor will be energized until the bellows 5 is contracted, circuit controllers 69 and 70 are respectively arranged in parallel with the switches 9 and 43. Accordingly, even when these switches 9 and 43 are opened, the circuit controllers 69 and 70 continue to be closed for operating the motor until the bellows 5 is contracted. For this purpose, the rod 71, connected to the moving end of the bellows 5, is connected to the contact members 72 and 73 for moving the circuit controllers 69 and 70 to opened position as the bellows 5 is contracted.

In the form just described, the lines 6 and 7 may be connected either to alternating current or to direct current, and the system remains operative for either type of supply without the attention of an operator. Furthermore, the motor, including the armatures 1 and 2, is selectively energized to operate with the direct current voltage impressed. The battery 8, so long as the system is operating, is charged by the energy generated in armature 1.

In the form shown in Fig. 2, a simplified system is provided. In this system, either thirty volt direct current or 110 volt alternating current may be supplied to the lines 74 and 75. The electric motor in this case has two armature windings 76 and 77 respectively adapted to operate on 6 volts and 24 volts.

The armature 76 is alone energized when 6 volts are impressed from the battery 8. Of course, any six volt direct current source may be substituted for the battery. For operation of the mechanism, the switch 9 is closed. This switch is connected to remote control switch arm 43, which serves to connect the relay 41 for operation from the battery 8. Energization of the relay 41 causes the battery 8 to be operatively associated with the polarity changing device 45 and

the armature and field circuits to be hereinafter described.

For battery operation, a circuit for the armature 76 is established from the polarity changer 45; connection 79, armature 76, connection 103, relay 82, and connection 104.

Upon initiation of battery operation, the relay 82 moves switch arm 118 from back contact 81 to front contact 105. In a manner to be described more fully hereinafter, relay 82 insures de-energization of a control relay 86. Relay 86 being de-energized, relay arms 87, 88, and 89 are in back contacting position.

Back contacting position of the arms 87, 88, and 89 inserts the field windings 84 and 85 in paralleling relationship with respect to each other, and in shunting relationship to the armature 76, similar to the form illustrated in Fig. 1. Such circuits for the fields 84 and 85 each include the adjustable resistance 90 connected to one side of the armature 76 and the circuits include, at the other side, the common connection 95 connected with the other side of the armature through arm 87. The circuit for the winding 84 is as follows: resistance 90, winding 84, connection 91, arm 89 in back contacting relation, and common connection 95. The circuit for the winding 85 may be traced as follows: resistance 90, connection 106, arm 88 in back contacting position, connection 93, winding 85, connection 94, and common connection 95.

The relays 10, 49, and 56 in this form operate as before. The rectifier system 20 is supplied from a transformer 111, having a primary winding 112 and a secondary winding 113. Rectifier 20, as before, operates control relay 21. These relays and the rectifier 20 are inoperative for operation by the battery 8.

When either 30 volt direct current or alternating current is supplied to the lines 74 and 75, the system operates in such a manner as to place the field windings in series relation to each other for operating together as a shunt winding. For either 30 volt direct current or substantially 110 volt alternating current, 30 volts is placed across the series connected armatures, supplying full voltage therefor.

Thus, in alternating current operation, the relay 10 operates as before to energize the primary winding 112 of transformer 111. The secondary 113 is connected to the rectifier, and is so designed that the output from the rectifier 20 is now about 30 volts.

Operation of relay 21 from the rectifier serves to energize the relay 86, moving the circuit controlling arms 87, 88, and 89 to front contacting position, illustrated in dotted lines.

Immediately before the insertion of alternating current in the system, the battery 8 has been supplying current to the motor. Current through the battery circuit operated relay 82, and arm 118 is in front contacting position as alternating current is first connected.

The relay 86 now being operated, and the relay 82 being in front contacting position, the following series circuit is effected for the armatures 76 and 77: connections 78, 79, armatures 76, 77, connection 80, arm 118, front contact 105 of relay 82, contact 110, arm 89, connection 95, arm 87, and lead 83. This circuit has been traced between the output terminals of the rectifier 20, formed by arms of relay 21.

Operation of the relay 86 also serves to insert the field windings in series relation with each other, but in shunt relation to the armatures.

Such circuits may be traced as follows: adjustable field resistance 90 connected to the outside terminal of the 6 volt armature 76, field winding 84, connections 91 and 92, arm 86, connection 93, field winding 85, connections 94 and 95, arm 87, and connection 33 which is connected to the outside terminal of armature 77 also through lead 95, as above described.

After a short period of such operation, substantial flow of current through the battery circuit ceases, and relay 82 is deenergized. This is due to the charging relationship now existing between the battery and the armature 76 now supplied from the rectifier 20. Accordingly, arm 118 contacts back contact 81. However, this does not alter the operation of the system for continued supply of alternating current. This is apparent in that the outside terminal of armature 77 is now directly connected to the line 83, without dependence upon the relay arm 89.

Should the supply of alternating current fail, momentarily or otherwise, the circuit arrangement is such that the motor will operate again from the battery 8. The relay 86 will not be operated from the rectifier 20, as this rectifier is now de-energized. As the battery circuit starts to operate, the relay 82 is energized by flow of battery current, and momentarily interrupts the circuit of the armature 77 by moving the arm 118 from contact 81. Accordingly, the brush lead 89 is momentarily incapable of supplying voltage by generator action to the relay 86, and accordingly, the relay 86 will be de-energized from all sources. The circuit controlling arms 87, 88, and 89 will therefore drop to back contacting position, and the field coils 84 and 85 will be connected, as heretofore described, for operation from the battery 8.

Upon resumption of alternating current, the cycle of operation is initiated, as described hereinabove.

When the lines 74 and 75 are connected to a 30 volt direct current source, the relay 56 closes as in direct current operation set fourth in connection with the form illustrated in Fig. 1. The electromagnet 86 is then directly energized through line 74, switch 9, connection 99, contacts 100, electromagnet 86, and connection 101, to line 75.

As the relay 86 is operative, the armatures are connected in series. As the lines 99 and 101 are joined to connections 83 and 78 respectively, the energization circuit for the armatures is substantially identical with that for alternating current operation through the rectifier 20, except that the lines 99 and 101 are connected to the circuit by relay 56 in place of the rectifier 20. The field circuits are also connected in series as in alternating current operation.

In direct current operation, the relay 82 shifts to back contacting position after a short period of operation, and functions in a manner similar to that in connection with alternating current operation. Should there be a failure in the direct current supply at connections 74 and 75, de-energization of relay 86 reconditions the entire system for operation from the battery 8, as described in connection with alternating current operation.

As direct current is resumed at the connections 74 and 75, the cycle of operation is again initiated, as above described.

It is thereby provided that the system insures operation of the motor for any source of supply. No special skill or knowledge is required by the

operator, as the various circuits themselves perform the required functions for operation according to the various supplies. It is furthermore insured that should there be any failure in the source of supply immediately relied upon, the battery is in stand-by condition for operation of the motor without interruption, provided, of course, the switch 43 is maintained closed. When the leads 74 and 75 are intentionally disconnected, such as to change the source of supply, or otherwise, the battery 8 thereupon operates the motor. The system automatically provides for charging of the battery as the motor is operated from other sources.

The form of the invention illustrated in Fig. 3 shows a further simplified, but differently characterized system. In this instance, the motor armatures are permanently connected to a series field winding 121 and across a shunt field winding 122.

For operation from the battery 8, the remote control relay 123 is operated by remote control switch 43 to connect the battery to the polarity changing device 45. Leads 124 and 125 connect respectively from the polarity changer 45 to the armature 76 and the series field winding 121 to establish a series field motor circuit as follows: connection 124, armature 76, series field winding 121, and connection 125.

The armature 77 serves to control the operation of the motor for 6 volt operation by generating and supplying exciting current for the shunt field winding 122 after the armature 76 has started as a series motor.

The relays 10, 49, and 56 operate as before according to the type of voltage impressed upon leads 74 and 75. If direct current of about 30 volts is impressed, the relay 56 operates to directly insert the line voltage from connections 74 and 75 to the armature windings 76 and 77 in series. Connection 126 connects line 75 to the outside terminal of the armature 77, and connection 127 established by relay 56 connects with connection 124 to armature 76. Compound operation of the motor is thereby effected, and both armatures as motors supply mechanical output. Should the source of supply fail at connections 74 and 75, the battery 8 is in condition for maintaining operation of the motor by the armature 76, as the battery 8 is constantly in stand by and charging relation pending discontinuance of the supply at the connections 74 and 75.

Upon establishment of the source at connections 74 and 75, the cycle of operations is again initiated.

For alternating current operation, the relay 10 serves to connect a transformer 128 for operating the rectifier 20. Circuit controlling arms 129 and 130 are effective to connect the output of the rectifier 20 across the armatures 76 and 77. These circuit controlling arms are effective only upon the existence of operating conditions of the transformer 128, as a relay 131 associated with arms 129 and 130 is operated only by operation of the secondary 132 of transformer 128. Connections 133 and 134 are then effective to supply rectified current to the armatures as follows: one side of rectifier 20, arm 129, connection 133, connections 127 and 124, armature 76, field winding 121, armature 77, connection 126, connection 134, arm 130 to the other side of the rectifier 20.

Of course the field windings 121 and 122 are in permanent connection with the armatures, and

no special switching means are in this instance necessary.

Should the source of supply at connections 74 and 75 be momentarily interrupted, or otherwise, the battery is in stand-by condition for maintaining operation of the motor, similar to that described in connection with operation from direct current at connections 74 and 75.

The inventor claims:

1. In an electrical supply system: a direct current motor having a low voltage armature winding and a high voltage armature winding; means connecting said armature windings in series; a series field coil for said low voltage armature winding; shunt field windings connected across said series connected armature windings; a storage battery connected across said low voltage armature winding and said series field coil; means forming a pair of terminals connectible to a source of alternating or direct current; circuit forming means including a circuit controller responsive to the existence of direct current at said terminals for connecting said terminals across said armatures in series; a rectifier system having an output paralleling said circuit forming means, and adapted to supply rectified current across said armatures in series; and circuit means responsive to the existence of alternating current at said terminals for connecting said rectifier system across said terminals.

2. In an electrical supply system: a direct current motor having a low voltage armature winding and a high voltage armature winding, and adapted for operation upon energization of said low voltage armature winding alone; field coil means for said low voltage armature winding; a storage battery connected across said low voltage armature winding; means forming a pair of terminals connectible to a source of alternating or direct current; circuit forming means including a circuit controller responsive to the existence of direct current at said terminals for connecting said terminals to said motor for operating said high voltage armature winding; a rectifier system having an output connected to said high voltage armature winding; and circuit means responsive to the existence of alternating current at said terminals for connecting said rectifier system across said terminals.

3. In an electrical supply system connectible to a source of electrical energy: a direct current motor having a pair of armature windings and a pair of field windings; a rectifier system for supplying energy to one of said armature windings and to said field windings; means operable only upon the existence of an alternating current at said source to cause said rectifier system to be energizable from said source; and means operable only in response to the existence of a direct current at said source to cause said other armature winding and the field windings to be directly energizable from said source.

4. In an electrical supply system connectible to a source of electrical energy: a direct current motor having a pair of armature windings and a pair of field windings; a rectifier system for supplying energy to one of said armature windings and to said field windings; means operable only upon the existence of an alternating current at said source to cause said rectifier system to be energizable from said source; means operable only in response to the existence of a direct current at said source to cause said other armature winding and the field windings to be directly ener-

gizable from said source; and a storage battery connected in stand by relation to said one armature and field windings, said battery being in parallel with said rectifier system.

5. In an electrical supply system connectible to a source of electrical energy: a direct current motor having a pair of armature windings and a pair of field windings; a rectifier system for supplying energy to one of said armature windings and to said field windings; means operable only upon the existence of an alternating current at said source to cause said rectifier system to be energizable from said source; and means operable only in response to the existence of a direct current at said source to cause said armature windings in series and said field windings to be directly energizable from said source.

6. In an electrical supply system cooperable with a source of electrical energy: a direct current motor having a pair of armature windings that are adapted to operate on different voltages, and field windings for cooperation therewith; a storage battery; means connecting said battery across one of said armature windings; means forming a pair of terminals connectible with said source; a rectifier system for supplying energy for operating said motor; circuit controlling means responsive to the existence of alternating current across said terminals to cause said rectifier system to be connected across said terminals; and circuit controlling means responsive to the existence of direct current across said terminals to cause said motor to be directly connected across said terminals.

7. In an electrical supply system connectible to a source of electrical energy: a direct current motor having a pair of armature windings and a pair of field windings; a rectifier system for supplying energy to said armature windings in series and to said field windings; means operable only upon the existence of an alternating current at said source to cause said rectifier system to be energizable from said source; means operable only in response to the existence of a direct current at said source to cause said armature windings in series and said field windings to be directly energizable from said source; and a storage battery connected in stand by relation to one of said armature windings.

8. In an electrical supply system connectible to a source of electrical energy: a direct current motor having a pair of armature windings that are adapted to operate on different voltages, and a pair of field windings adapted to be connected either in parallel or in series relation with respect to each other for cooperating either with the lower voltage armature or the higher voltage armature; a rectifier system for supplying energy to the lower voltage armature winding and to the field windings in parallel; means operable only upon the existence of an alternating current at said source to cause said rectifier system to be energizable from said source; means operable only in response to the existence of a direct current at said source to transmit said direct current; and a circuit controller operable in response to the application of a voltage corresponding to one of the different voltages of said source for selectively connecting said transmitting means to the armature windings and field windings to correspond to the voltage of said source.

9. In an electrical supply system connectible to a source of electrical energy: a direct current motor having a pair of armature windings

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that are adapted to operate on different voltages, and a pair of field windings adapted to be connected either in parallel or in series relation with respect to each other for cooperating either with the lower voltage armature or the higher voltage armature; a rectifier system for supplying energy to the lower voltage armature winding and to the field windings in parallel; means operable only upon the existence of an alternating current at said source to cause said rectifier system to be energizable from said source; means operable only in response to the existence of a direct current at said source to transmit said direct current; a circuit controller operable in response to the application of a voltage corresponding to one of the different voltages of said source for selectively connecting said transmitting means to the armature windings and field windings to correspond to the voltage of said source; said circuit controller being biased for low voltage operation; and a storage battery connected in stand by relation to said lower voltage armature, said battery being in parallel with said rectifier system.

10. In an electrical supply system connectible to a source of electrical energy: a direct current load; a rectifier system for supplying energy to said load; circuit means connectible with said source for directly connecting said load to said source; first circuit controlling means operated only upon the existence of an alternating current at said source to cause said rectifier system to be energizable from said source; a second circuit controlling means operable to render said circuit means effective; an energization circuit for said second circuit controlling means connectible to said source, said circuit being operable only when said first circuit controlling means is not operated; and time delay means associated with said second circuit controlling means for ensuring said first circuit controlling means is operated before effective energization of said second circuit controlling means upon the existence of alternating current at said source.

11. In an electrical supply system connectible to a source of electrical energy: a direct current load; a rectifier system for supplying energy to said load and including a transformer winding for transmitting energy to the rectifier system; a first circuit controller operable only upon the existence of an alternating current at said source to cause said transformer winding to be energizable from said source; a second circuit controller operable to cause said load to be directly energizable from said source; and an energization circuit for said second circuit controller and operable only when the first circuit controller is unenergized, said energization circuit being connectible to said source and including said transformer winding in series, said winding serving to ensure a time delay preventing energization of the second circuit controller when an alternating current exists at said source.

12. In an electrical supply system connectible to a source of electrical energy: a direct current load; a rectifier system for supplying energy to said load and including a transformer winding for transmitting energy to the rectifier system; a first circuit controller operated only upon the existence of an alternating current at said source to cause said transformer winding to be energizable from said source; and a control circuit operable only when the first circuit controller is not operated, said control circuit being energizable from said source in series with said wind-

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ing, said control circuit comprising two parallel branches, each in series with said winding, one of said branches when energized having means operable to cause said load to be directly energizable from said source, said one branch also including a controlling element rendering said one branch effective only after the existence of current through the other branch.

13. In an electrical supply system connectible to a source of electrical energy: a direct current load; a rectifier system for supplying energy to said load and including a transformer winding for transmitting energy to the rectifier system; a first circuit controller operated only upon the existence of an alternating current at said source to cause said transformer winding to be energizable from said source; a control circuit operable only when the first circuit is not operated, said control circuit being energizable from said source in series with said winding, said control circuit comprising two parallel branches, each in series with said winding, one of said branches when energized having means operable to cause said load to be directly energizable from said source, said one branch also including a controlling element rendering said one branch effective only after the existence of current through the other branch; and means responsive to the application of a voltage of said source corresponding to a predetermined value for inserting a resistance in series with said each branch of said control circuit.

14. In an electric system cooperable with a source of electrical energy for operating a respirator having an expansible and contractible bellows: a first circuit controller selectively positionable for energizing the system from said source; a second circuit controller paralleling the first circuit controller; and means for opening the second circuit controller only in response to the contraction of the bellows.

15. In an electrical supply system: a direct current motor having a low voltage armature winding and a high voltage armature winding, said windings being connected in series; a series field winding for said low voltage armature winding; a shunt field winding connected across said series connected armature windings; a storage battery connected across said low voltage armature winding and said series field winding; means forming a pair of terminals connectible to a source of alternating or direct current; circuit forming means including a circuit controller responsive to the existence of direct current at said terminals for connecting said terminals across said armatures in series; a rectifier system having an output connected to energize at least said low voltage armature winding and said series field winding; and circuit means responsive to the existence of alternating current at said terminals for connecting said rectifier system across said terminals.

16. In an electrical supply system connectible to a source of electrical energy: a direct current motor having a pair of armature windings that are adapted to operate on different voltages, and a pair of field windings adapted to be connected either in parallel or in series relation with respect to each other for cooperating either with the lower voltage armature or the higher voltage armature; a rectifier system for supplying energy to the lower voltage armature winding and to the field windings in parallel; means operable only upon the existence of an alternating current at said source to cause said rectifier system to be

energizable from said source; means operable only in response to the existence of a direct current at said source to transmit said direct current; and a circuit controller having two operating conditions, and selective to two different values of voltages of said source, said circuit controller in one condition having means cooperating with said transmitting means to energize one of said armature windings and connecting the field windings in parallel, said circuit controller in the other condition having means cooperating with said transmitting means to energize the other of said armature windings and connecting the field windings in series.

17. In an electrical supply system connectible to a source of electrical energy: a direct current motor having a pair of armature windings that are adapted to operate on different voltages, and a pair of field windings adapted to be connected either in parallel or in series relation with respect to each other for cooperating either with the lower voltage armature or the higher voltage armature; a rectifier system for supplying energy to the lower voltage armature winding and to the field windings in parallel; means operable only upon the existence of an alternating current at said source to cause said rectifier system to be energizable from said source; means operable only in response to the existence of a direct current at said source to transmit said direct current; a circuit controller having two operating conditions, and selective to two different values of voltages of said source, said circuit controller in one condition having means cooperating with said transmitting means to energize one of said armature windings and connecting the field windings in parallel, said circuit controller in the other condition having means cooperating with said transmitting means to energize the other of said armature windings and connecting the field windings in series; and a storage battery connected in stand-by relation to said lower voltage armature.

18. In an electrical supply system connectible to a source of electrical energy: a direct current motor having a pair of armature windings that are adapted to operate on different voltages, and a pair of field windings adapted to be connected either in parallel or in series relation with respect to each other for cooperating either with the lower voltage armature or the higher voltage armature; a rectifier system for supplying energy to the lower voltage armature winding and to the field windings in parallel; means operable only upon the existence of an alternating current at said source to cause said rectifier system to be energizable from said source; means operable only in response to the existence of a direct current at said source to transmit said direct current; and a circuit controller having two positions selected in response, respectively, to a higher and a lower voltage of said source, said circuit controller in the high voltage position connecting said transmitting means with said higher voltage armature, and connecting said field windings in series relationship with respect to each other, said circuit controller in the low voltage position connecting said transmitting means with said low voltage armature, and connecting said field windings in parallel with respect to each other.

19. In an electrical supply system connectible to a source of electrical energy: a direct current motor having a pair of armature windings that are adapted to operate on different volt-

ages, and a pair of field windings adapted to be connected either in parallel or in series relation with respect to each other for cooperating either with the lower voltage armature or the higher voltage armature; a rectifier system for supplying energy to the lower voltage armature winding and to the field windings in parallel; means operable only upon the existence of an alternating current at said source to cause said rectifier system to be energizable from said source; means operable only in response to the existence of a direct current at said source to transmit said direct current; a circuit controller having two positions selected in response, respectively, to a higher and a lower voltage of said source, said circuit controller in the high voltage position connecting said transmitting means with said higher voltage armature, and connecting said field windings in series relationship with respect to each other, said circuit controller in the low voltage position connecting said transmitting means with said low voltage armature, and connecting said field windings in parallel with respect to each other; and a battery connected in stand-by relation across said lower voltage armature.

20. In an electrical supply system connectible to a source of electrical energy: a direct current motor having a pair of armature windings that are adapted to operate on different voltages, and a pair of field windings adapted to be connected either in parallel or in series relation with respect to each other for cooperating either with the lower voltage armature or for both said armatures; a rectifier system for supplying energy to the armatures in series; means operable only upon the existence of an alternating current at said source to cause said rectifier system to be energizable from said source; means operable only in response to the existence of a direct current at said source to transmit said direct current to said armature windings in series, and independent of said rectifier system; circuit controlling means normally connecting said field windings in parallel, and operated by said rectifier system or said transmitting means to connect said field windings in series; and a battery in stand-by relation connected across the lower voltage armature.

21. In an electrical supply system: a direct current motor having a low voltage armature winding and a high voltage armature winding; a series field winding between the armature windings and connecting said armature windings in series; a shunt field winding across said series connected armature windings; a battery connected across the lower voltage armature winding and at least a portion of said series field winding; and means for connecting another direct current source of electrical energy across said series connected armature windings.

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