

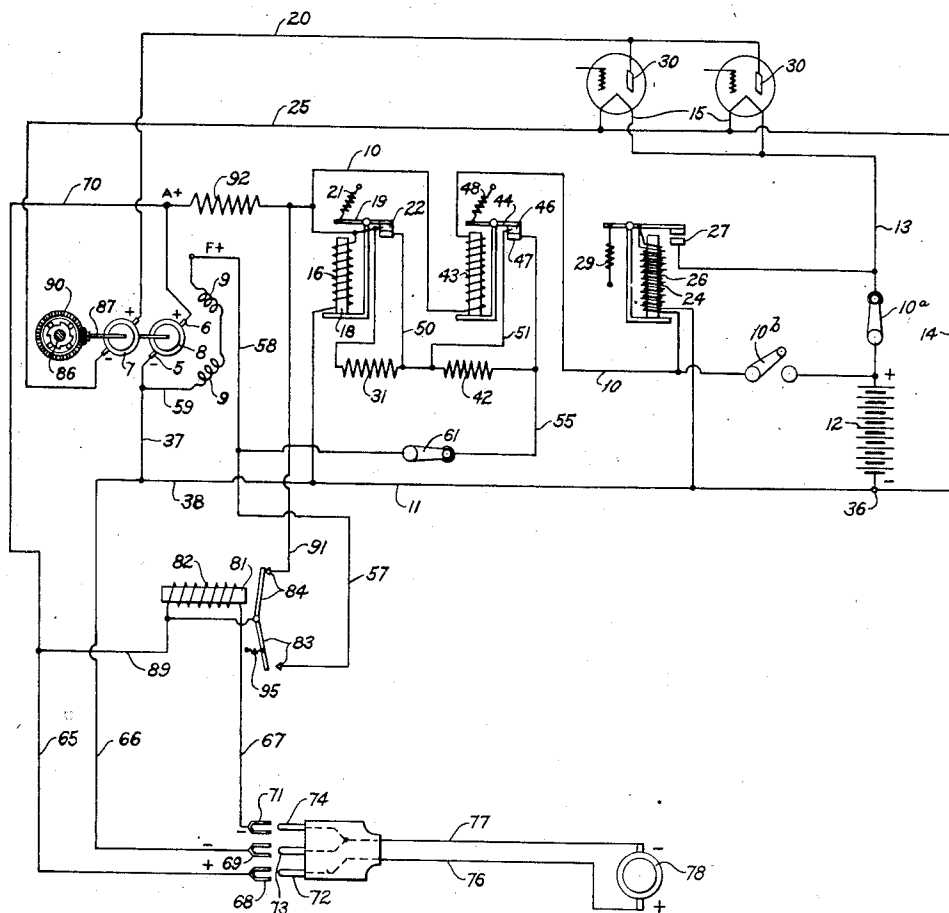
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ELECTRICAL APPARATUS

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ELECTRICAL APPARATUS

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This invention relates to electrical apparatus, and more particularly to an electrical power system for energizing the power consuming parts of a radio receiving or transmitting set, or other power consuming apparatus on an airplane or other vehicle.

One of the objects of the invention is to provide a novel power system involving a multiple output generator adapted to supply power at different voltages to different power consuming loads, such as the filament and plate circuits of the thermionic tubes in a radio receiving or transmitting set.

Another object is to provide in a power system involving a multiple output generator of the foregoing character, means for initially energizing the generator from a source of energy forming no part of the vehicle on which the generator is installed.

A further object of the invention is to provide in a system of the foregoing character, novel means for automatically transferring the source of energization of the generator from elements not carried by the vehicle (but temporarily connected therewith) to elements which are carried by the vehicle, such automatic transfer being responsive to the single manual act of severing the temporary connection.

A further object includes the provision of a multiple output generator which is normally mechanically driven, in combination with a battery for supplying current to the generator to operate it as a dynamotor, independently of the mechanical drive, together with dual means for simultaneously energizing the generator and battery, one of said dual means being constituted by said mechanical drive, and the other being of an electrical nature.

A still further object includes the provision of a generator in combination with means for actuating the generator from any one of three power sources, one of said sources being a battery which can be charged by energy derived from either of the other two sources, one of which is available only when the vehicle is in a certain location, as for example the hangar, garage or other home station of the craft.

In providing radio transmitting apparatus for use in airplanes, it is not only desirable that the weight of the apparatus be maintained at a minimum, but it is further desirable that means, independent of the airplane engine, be provided for actuating the transmitting apparatus in order that signals may be sent when said engine is not in operation, and when a forced landing has

been made, for example. To supply this need there have been employed heretofore multiple output generators adapted to be driven mechanically from the engine of the plane when the latter is in operation and also adapted for electrical energization independent of the engine when the latter is not running. The present invention contemplates the provision, in conjunction with such alternative sources of energy for a multiple output generator, a third source of energy which may be located outside the craft itself and which may be utilized to energize the generator through passage of current to the same parts thereof as have been used to energize the unit electrically heretofore, the arrangement being such that this external energization, when employed, automatically eliminates the normal output regulating parts associated with the generator and substitutes therefor an alternative regulating device which insures the maintenance, across the load terminals, of a voltage corresponding to that produced by either of the two sources of energy carried by the craft itself.

In this connection, a feature of the invention is the provision of a resistance unit in the armature circuit of the generator which is of a value to correspond to the predetermined fixed load to be supplied, and serves to insure the maintenance of a constant voltage across the terminals of said load, said resistance unit being automatically eliminated as soon as the absorption of current from this external source is discontinued and the energization is picked up by one or the other sources of energy carried by the craft—that is, the propelling engine of the craft or the current accumulating battery.

These and other objects of the invention will become apparent from inspection of the following specification when read with reference to the accompanying drawing wherein is illustrated the preferred embodiment of the invention. It is to be expressly understood, however, that the drawing is for the purpose of illustration only, and is not designed as a definition of the limits of the invention, reference being had to the appended claims for this purpose.

In the drawing, which is a diagrammatic view of the elements involved in the preferred embodiment, the reference characters 5 and 6 indicate the brushes for one of the commutators of a generator, the latter being preferably of the direct current, multiple output type having an armature drum carrying two or more separate windings and a corresponding number of commutators, the windings being of such a character that when the

generator is employed to energize radio apparatus, a relatively high voltage is delivered by one of the commutators such as that shown at 7, and a relatively low voltage by another of the commutators, such as the commutator indicated by the reference character 8. The shunt field winding shown at 9 is preferably common to all the armature windings. The high voltage armature winding is adapted to supply current through suitable leads 20 and 25 to a substantially constant load 30 such as the plate circuits of the radio tubes of a receiving or transmitting set. The low voltage end of the generator is adapted to supply current through leads 10 and 11 and a normally closed cut-out switch 10a to a variable load constituted by a battery 12, and through leads 13 and 14 to a substantially constant load 15, such for example as the filament circuits of the radio tubes. Means are provided in the output circuit of the low voltage end of the generator for controlling the electrical output of both commutators of the generator. For this purpose a voltage regulator 16 of any suitable type, such as the vibrating contact type operates to control the current through the field winding 9, by alternately inserting and removing a resistance 31 in the field circuit. As shown, the voltage regulator includes an electromagnet having a core 18 and a rocking armature 19 controlling, in conjunction with a spring 21, the opening and closing of a switch 22. Interposed in the positive side 10 of the line is a reverse current cutout relay having a series coil 24 which coacts in the usual manner with a shunt winding 26 to hold switch 27 closed more firmly than it could be held by the shunt coil 26 acting alone. The winding 24 also serves, in the event of a tendency to a reversal in the direction of current flow, to set up a reverse magnetic effect, assisting the spring 29 to open the switch 27, thus effectively preventing a current flow from the battery toward the generator, except when the normally open switch 10b is closed, to provide a current path in shunt with the switch 27 for energization of the machine as a battery excited dynamotor during emergency occasions, as for example, to send distress signals after a forced landing, with a dead engine. The brush 5 of the commutator 8 is connected with the negative terminal 36 of the storage battery through suitable leads 37 and 38, the latter connecting with the external negative lead 11 previously referred to.

In addition to the voltage regulating device already described, there may be employed current regulating means adapted to insert additional resistance in the field 9 of the machine to control the current output of the latter, such a resistance unit being indicated at 42. In the form shown, the current regulator comprises a coil 43 and a pivoted armature 44 carrying a contact 46 which is normally maintained in engagement with a fixed contact 47 by means of spring 48 attached at one end to armature 44 and at its other end to a suitable fixed support. The contacts 46 and 47 are in series, through leads 50 and 51, with the switch 22 of the voltage regulator, and are also in series with the field winding 9, the circuit passing through a lead 55, normally closed emergency switch 61 and conductor 58 to the field winding 9, the return connection to the negative lead being shown at 59.

The high voltage output winding of the generator may deliver 400 volts, for example, to the plate circuit 30. The low voltage output winding of the generator delivers, for example, 2 amperes at 15 volts for charging battery 12 and possibly 4

amperes at 10 volts to the filament circuit 15, suitable resistances (not shown) being provided if desired to secure this lower output. The generator may be driven by an internal combustion engine through a shaft 86 preferably connecting with the armature shaft 87 of the dynamo through a suitable one-way clutch 90 which permits rotation of the armature shaft 87 relatively to the engine shaft 86 when the engine is dead.

When the engine is stopped, the normally open switch 10b may be closed as above indicated so that the battery may be employed to drive the low voltage end of the generator, which latter is now operated as a dynamotor, whereby the high voltage end of the generator is effective to supply current to the plate circuit of the radio set.

As the speed of the engine varies, the speed of the armature of the generator will vary accordingly. The change in voltage produced by this change in speed of the armature is effectively controlled by the coaction of the current regulator and the voltage regulator, and therefore radio signals can be effectively transmitted under these conditions.

Having thus described the parts involved in the energization of the generator and in the regulation of the output thereof during operation away from the home station, there remains to be described the additional means provided by the present invention for energizing the generator and regulating its output before the craft leaves the home station.

Referring to the drawing, such means includes a plurality of leads 65, 66 and 67 connecting to sockets 68, 69 and 71 respectively, located preferably on the fuselage of the plane, in position to receive current conducting plugs 72, 73 and 74 on the ends of leads 76 and 77 connected to a generator 78 or other suitable source of current located at the home station, as for example, a part of the power plant of a vessel ("aircraft carrier") from which the craft is adapted to take-off. Interposed in the lead 67 is a relay 81 having a winding 82 adapted when energized to close a normally open switch 83 and open a normally closed switch 84, the said switches being associated with parts of the generator as indicated.

In order to test the radio equipment when the engine is not running (and to initially charge the battery 12, if discharged) the disconnect plugs 72-74 are inserted in sockets 68-71 so that current is drawn from the external source 78 to energize the windings associated with the commutator 8 to operate the machine as a motor. the current passing through the positive leads 65 and 70 to the positive terminal A+, then through the armature winding and returning by way of the negative leads 37 and 66. At the same time, a second circuit is established, branching from the positive lead 65 by way of lead 89 and passing through the winding 82 and returning to the negative side of the source 78 by way of conductors 67 and 77.

The current passing through the relay 81 acts to immediately open the switch 84 and close the switch 83, whereupon a circuit is established to energize the shunt field winding of the machine, the circuit passing by way of wire 89, switch 83 and wire 58 to the winding 9, and then by way of wire 59 to join the armature current in the return leads 37 and 66. At the same time, the opening of switch 84 prevents a flow of current through the conductor 91 which would otherwise constitute a path of low resistance from the posi-

tive lead 65 to the lead 10, battery and load 15. Such a flow through this comparatively low resistance circuit would be objectionable while source 78 is in use, as it would be in effect, a short circuit around the commutator 8, and would therefore interfere with the generation of current at suitable voltage for the loads 15 and 30. Accordingly, I propose not only to hold the switch 84 open while the source 78 is in use, but also to insert a resistance unit 92 between the terminal A+ and the line 10, and constituting a path of higher resistance leading to the loads 12 and 15, said higher resistance path being in shunt with the now open switch 84. This resistance unit 92 will be of a predetermined value, to correspond to the predetermined fixed load 15, and will maintain a constant voltage across the load terminals equal to that obtained in normal running by the action of the voltage regulating means 16 upon the field 9. It will be further observed that this voltage regulating means as well as the current regulating means shown at 43 is of no effect in controlling the strength of the shunt field 9 so long as the generator 78 is in use.

As soon as the plugs 72-74 are removed, the switch 83 is immediately opened by the action of spring 95 and the simultaneous closure of the switch 84 establishes a direct circuit between the positive brush 6 of the generator and the lead 10, such circuit being in shunt with the resistance 92 and passing by way of leads 70 and 89 to the switch 84 and then by way of the lead 91 to the positive lead 10. Thus the resistance unit 92 is eliminated and the regulation of the supply of current through the battery 12 and load 15 is automatically taken up by the units 16 and 43.

While the invention has been particularly described in connection with radio-transmitting apparatus for airplanes it will be understood by those skilled in the art that the novel apparatus herein set forth is capable of a wide variety of uses, and that various changes may be made in the arrangement of the elements thereof. The terms "high" and "low" voltage have been used merely to facilitate description and where desired the generator may be so constructed that the output windings will deliver current at substantially equal voltages. In certain installations the voltage control means may be unnecessary, and the current regulator may also be eliminated. Moreover, either end of the generator may be employed as a motor to drive the other end by providing suitable leads and switches from the battery to said ends, and the mechanical drive eliminated, so that the machine operates as a dynamotor only. Reference therefore will be had to all the appended claims for a definition of all phases of the invention.

What is claimed is:

1. The combination with a direct current generator having high and low voltage outputs, of a load circuit connected to the high voltage terminals of the generator, a second circuit including a battery and a second load connected to the low voltage terminals of the generator, means in said second circuit for controlling the voltage output of said low voltage terminals, means distinct from said battery for supplying electrical energy to operate said generator as a dynamotor, and means responsive to said last named means for rendering said voltage controlling means ineffective to control the voltage output of said low voltage terminals.

2. The combination with a direct current generator having high and low voltage outputs, of

mechanical means for driving said generator, a load circuit connected to the high voltage terminals of the generator, a second circuit including a battery and a second load connected to the low voltage terminals of the generator, means in said second circuit for controlling the voltage output of said low voltage terminals, means distinct from said battery for supplying electrical energy to operate said generator as a dynamotor, and means responsive thereto for rendering said voltage controlling means ineffective to control the voltage output of said low voltage terminals, said last named means being further operative to insert a predetermined resistance in said second circuit to maintain a substantially constant voltage across said second load even when said first named voltage controlling means is ineffective.

3. The combination with a direct current generator having high and low voltage outputs of mechanical means for driving said generator, a load circuit connected to the high voltage terminals of the generator, a second circuit including a battery and a second load connected to the low voltage terminals of the generator, means in said second circuit for controlling the voltage output of said low voltage terminals, means distinct from said battery for supplying electrical energy to operate said generator as a dynamotor, and means responsive thereto for rendering said voltage controlling means ineffective to control the voltage output of said low voltage terminals, said last named means including an electro-magnetic device which is also operative to insert a predetermined resistance in said second circuit to maintain a substantially constant voltage across said second load even when said first named voltage controlling means is ineffective.

4. The combination with a direct current generator having high and low voltage outputs, of a load circuit connected to the high voltage terminals of the generator, a second circuit including a battery and a second load connected to the low voltage terminals of the generator, means in said second circuit for controlling the field strength of the generator, means distinct from said battery for supplying electrical energy to operate said generator as a dynamotor, and means responsive to said last named means for rendering said controlling means ineffective.

5. The combination with a direct current generator having high and low voltage outputs, of mechanical means for driving said generator, a load circuit connected to the high voltage terminals of the generator, a second circuit including a battery and a second load connected to the low voltage terminals of the generator, means in said second circuit for controlling the field strength of the generator, means distinct from said battery for supplying electrical energy to operate said generator as a dynamotor, and means responsive thereto for rendering said controlling means ineffective, said last named means being further operative to insert a predetermined resistance in said second circuit to maintain a substantially constant voltage across said second load even when said controlling means is ineffective.

6. The combination with a direct current generator having high and low voltage outputs of mechanical means for driving said generator, a load circuit connected to the high voltage terminals of the generator, a second circuit including a battery and a second load connected to the low voltage terminals of the generator, means in said second circuit for controlling the field

strength of the generator, means distinct from said battery for supplying electrical energy to operate said generator as a dynamotor, and means responsive thereto for rendering said controlling means ineffective, said last named means including an electro-magnetic device which is also operative to insert a predetermined resistance in said second circuit to maintain a substantially constant voltage across said second load even when said controlling means is ineffective.

7. The combination with a dynamo electric machine of a circuit including a battery and a substantially constant load, means in said circuit for controlling the field strength of the machine, means distinct from said battery for energizing said machine, and means responsive thereto for rendering said field strength controlling means ineffective.

8. The combination with a dynamo electric machine of a circuit including a battery and a substantially constant load, means in said circuit for controlling the field strength of the machine, means distinct from said battery for energizing said machine, and means responsive thereto for rendering said field strength controlling means ineffective, said last named means including an electro-magnetic device which is operative to

insert a predetermined resistance in said load circuit to maintain a substantially constant voltage across said load.

9. The combination with a dynamo electric machine of a circuit including a battery and a substantially constant load, means in said circuit for controlling the voltage across said load, means distinct from said battery for energizing said machine, and means responsive thereto for rendering said voltage controlling means ineffective, said last named means including an electro-magnetic device which is also operative to control the energization of the field winding of the machine.

10. The combination with a dynamo electric machine of a circuit including a battery and a substantially constant load, means in said circuit for controlling the voltage across said load, means distinct from said battery for energizing said machine, and means responsive thereto for rendering said voltage controlling means ineffective, said last named means including an electro-magnetic device which is operative to insert a predetermined resistance in said load circuit to maintain a substantially constant voltage across said load.

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