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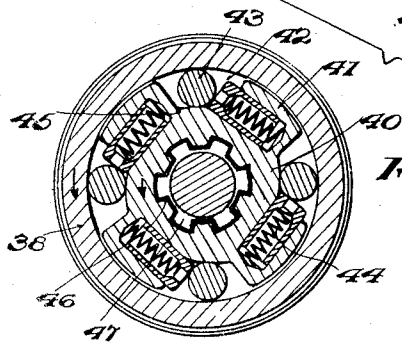
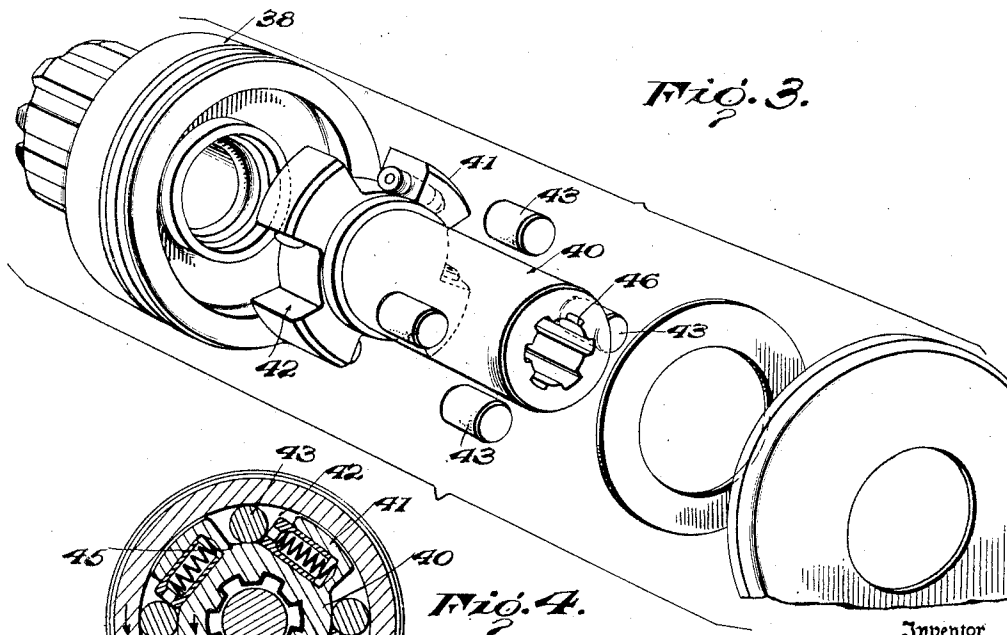
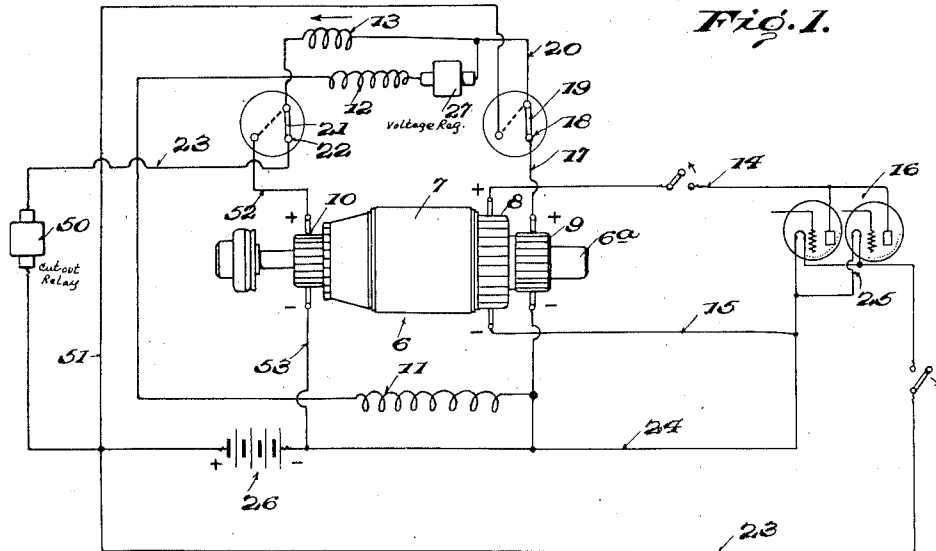
W. P. LOUDON

1,957,016

ELECTRICAL APPARATUS

Filed Nov. 25, 1929

2 Sheets-Sheet 1



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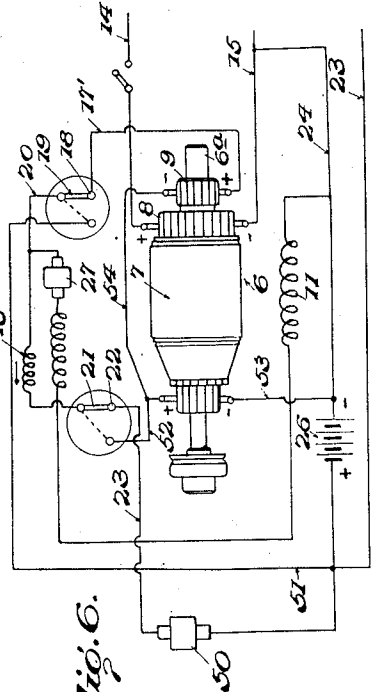
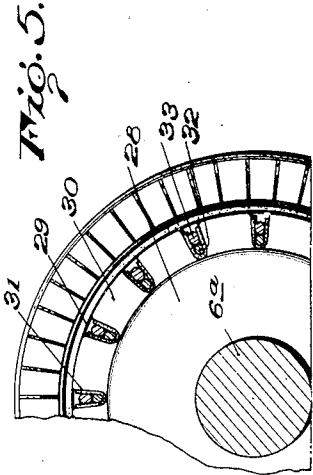
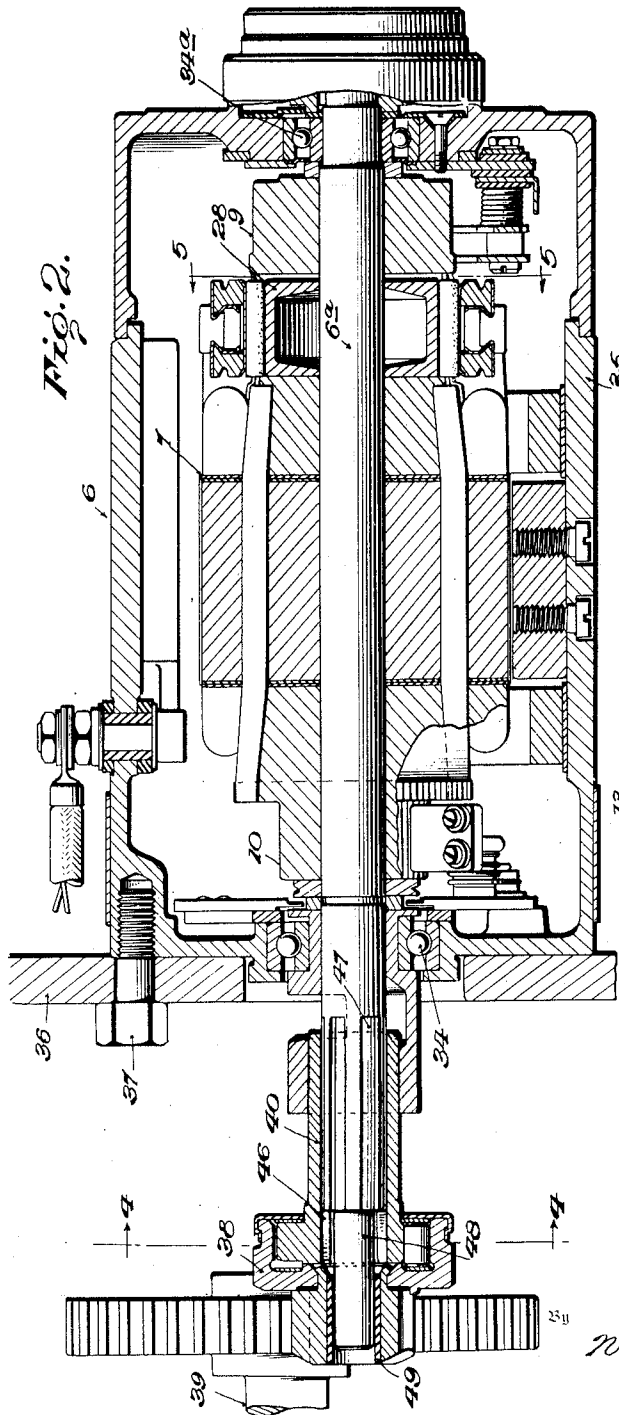
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ELECTRICAL APPARATUS

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2 Sheets-Sheet 2



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# UNITED STATES PATENT OFFICE

1,957,016

## ELECTRICAL APPARATUS

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Application November 25, 1929, Serial No. 409,696

13 Claims. (Cl. 290—1)

This invention relates to electrical apparatus and more particularly to an electrical generating apparatus and its associated distributing system.

Heretofore there have been proposed electrical generators of the type employing high and low voltage armature windings wound upon the same armature drum and having a common field, for use on vehicles such as for example, aircraft, in order to supply anode and cathode energy to the thermionic tubes of a radio transmitter. These generators, for the most part, have been provided with a positive driving connection to the engine of the aircraft, or have a separate rotating element such as a small air-driven propeller.

In certain instances, as for example when the aircraft engine is disabled or not in operation, it may be highly desirable to operate the radio transmitter in order to transmit signals.

Accordingly, one of the objects of the present invention is to provide a novel electrical installation of the above character adapted for use independently of the operation of the power means normally employed for actuating the same.

Another object of the invention is to provide in an electrical generator adapted to deliver energy at a plurality of voltages, novel means whereby the generator may be driven by mechanical means or operated as a motor-generator.

Another object is to provide means of the above type, which includes a three winding generator whereby the latter may be operated as a motor-generator.

A further object is to provide a double voltage electrical generator which is compact, light in weight, and one which is particularly adapted for use on aircraft to supply electrical energy at all times to a radio transmitter.

Other objects and features of novelty will appear more fully hereinafter from the following description taken in connection with the accompanying drawings which illustrate one embodiment of the invention. It is to be expressly understood, however, that the drawings are for purposes of illustration only, and are not designed as a definition of the limits of the invention, reference being had for this purpose to the appended claims.

Referring to the drawings, wherein like reference characters refer to like parts throughout the several views:

Fig. 1 is a diagrammatic view of the circuit connections of the apparatus of the present invention;

Fig. 2 is an axial section of the generator and driving means therefor;

Fig. 3 is a view in perspective of the disassembled portions of the one-way clutch;

Fig. 4 is a section taken on line 4—4 of Fig. 2;

Fig. 5 is a section taken on line 5—5 of Fig. 2 and illustrating the disposition of the low voltage winding with respect to the high voltage commutator; and

Fig. 6 is a diagrammatic view of another embodiment of the invention.

Referring more particularly to Figs. 1 and 2 there is shown a generator 6 of the direct current, compound type, having an armature shaft 6<sup>a</sup> and an armature drum 7, which latter is adapted to carry three separate windings. These windings are so arranged and designed that two of them constitute high and low voltage generating windings while the third winding constitutes a motor winding, for a purpose which will appear more fully hereinafter.

Each of these windings is connected to a commutator, the high and low voltage generating windings being connected to commutators 8 and 9 respectively, while the motor winding is connected to a commutator 10. A shunt field winding 11, 12 and series field winding 13 are common to the armature windings and are adapted to furnish the proper field excitation. The high voltage commutator 8 is adapted to be connected through leads 14 and 15 to a substantially constant load 16 such as for example, the anode circuit of a plurality of thermionic tubes of a radio transmitting set. The low voltage commutator 9 is adapted to furnish energy through lead 17, contact 18, switch arm 19, connections 20, 21, 22, 23 and lead 24 to a substantially constant load such as the cathodes 25 of the thermionic tubes of the transmitting set. A battery 26, constituting a variable load is connected in parallel with the load 25 and is adapted to be charged by the low voltage winding during normal operation of the generator.

In order that the electrical output from both the high and low voltage commutators may be controlled within narrow limits, a voltage regulator 27 of the vibrating contact type, may be connected in series with the shunt field windings 11 and 12 across the terminals of the low voltage commutator. Since the operation of such regulators is well understood in the art, and since the details thereof form no part of this invention, further description is unnecessary.

In placing the commutators 8 and 9 at one end of the armature drum, means are provided where-

by the low voltage winding may be led through the high voltage commutator in order to permit the proper electrical connections to be made. In the form shown such means is constituted (Fig. 5) by a bridge 28 fixed in any suitable manner to armature shaft 6<sup>a</sup>, the outer periphery of said bridge having longitudinal channels 29 formed therein leaving projections 30. Disposed in these channels and insulated therefrom as by quills 31, are the ends 32, 33 of the coils constituting the low voltage winding, which coil ends are connected to the commutator segments of commutator 9 in a manner well understood by those skilled in the art. The connection of the two generating windings to their respective commutators at one end of the armature enables the heavier motor winding to be easily connected to the commutator 10 at the opposite end of the armature.

The armature shaft 6<sup>a</sup> may be rotatably mounted as by means of ball bearings 34 and 34<sup>a</sup> in a suitable housing 35 which may be attached to a mounting bracket 36 by means of a plurality of screws one of which is shown at 37.

In aircraft installations, the radio generators heretofore employed have been positively connected through suitable driving connections with a rotating portion of the internal combustion engine. In such cases, with the engine not in operation, the generator was not available as a source of power in order to energize the radio transmitter. In accordance with this invention, a one-way clutch is interposed in the driving connection between the armature of the generator and the internal combustion engine, and when the latter is not in use, the battery 26 is connected to the motor commutator 10 in order to operate the generator as a motor-generator. During such operation, the battery also furnishes energy to the load 25, the low voltage winding being disconnected therefrom.

Referring to Figs. 2, 3 and 4 the roller or one-way clutch is constituted by a driving member 38 adapted to be driven through any suitable gearing by the crankshaft or extension thereof 39 of an internal combustion engine, and a driven member 40 adapted to be drivably connected to the armature shaft 6<sup>a</sup>. The driven member is provided with a plurality of projecting portions 41 and a corresponding number of channels 42 which latter are adapted to contain the rollers 43 of the clutch. As shown in Fig. 4 these rollers are normally maintained in engagement with the inner surface of the cup-shaped driving member by resilient means such as springs 44 housed within counterbores arranged tangentially in portions 41. It is pointed out that the bottom 45 of channels 42 is a cam surface so formed that as member 38 rotates in a counterclockwise direction, rollers 43 will become wedged between the flange of member 38 and the cam surface 45 to rotate the driven member 40. However, if it is attempted to transmit torque from member 40 to member 38 in the same direction of rotation, the rollers 43 will become disengaged with respect to the member 38 which will consequently not rotate.

In order to drivably connect the member 40 to the armature shaft of the generator, the said member is formed with internal splines 46 which are adapted to cooperate with splines 47 formed on an extension of armature shaft 6<sup>a</sup>. This extension is continued to the left of splines 47, as indicated at 48 and is reduced in diameter to permit of easy assembly. The end of the extension 48 has a bearing fit in a bushing 49.

A cut-out relay 50 of suitable construction is preferably placed in series with the battery 26 in order to prevent discharge of the battery through the low voltage winding when the induced voltage therein is less than the voltage of the battery.

In normal operation, the switches 19 and 21 are closed in their full lined positions on contacts 18 and 22, respectively, whereby the high and low voltage windings are connected to their respective loads. The internal combustion engine now drives the generator through the one-way clutch heretofore described, and sufficient energy is generated in the high and low voltage windings to enable efficient operation of the transmitting set.

During the time that the engine is not in operation as for example in the case of aircraft installations when a forced landing is necessary, switches 19 and 21 are moved to the dotted line positions (Fig. 1) thereby disconnecting the low voltage commutator at contact 18 and connecting battery 26 through lead 51, switch 19, lead 20, switch 21 and connection 52 to the motor commutator and from the latter, through lead 53 to the battery in order to operate the generator as a motor-generator. Due to the one-way clutch between the generator and the internal combustion engine, the armature shaft will rotate free from any driving connection with the engine crankshaft, and energy at high voltage will be supplied the load 16 of the transmitting set. The load 25 will be supplied with energy from the battery 26 through leads 23 and 24.

Fig. 6 illustrates a modified arrangement of the circuit shown in Fig. 1, the connections being such that during the time the generator is drivably connected to the engine, the motor winding may be connected in series with the low tension generating winding. The wiring connections of this embodiment of the invention are similar to those indicated on Fig. 1 except that contact 18 is connected to the opposite brush of commutator 9 by leads 17', and lead 52 is continued from motor commutator 10 to the low tension commutator 9 as indicated at 54. In order to properly connect the two windings in series, the direct connection between the end of shunt field coil 11 and the commutator 9 shown in Fig. 1, has been eliminated.

In operation when the unit illustrated in Fig. 6 is engine-driven, closure of switches 19 and 21 upon contacts 18 and 22 will connect the low tension generating winding in series with the motor winding, the latter then functioning as a portion of the low tension generating winding. The low tension output circuit comprises lead 17', contact 18, switch 19, series field 13 and connections 21-23 to the load, through connections 24 and 53 to the motor winding and thence by 54 to the commutator 9. It is pointed out that by connecting the motor and low tension generating windings in series, for generating purposes there is obtained a highly efficient arrangement, and one which is adapted to deliver an increased output at low voltage.

When it is desired to operate the machine as a motor-generator it is only necessary to move switches 19 and 21 to the dotted line positions whereupon the operation of the apparatus will be similar to that of the apparatus of Fig. 1 when operated as a motor-generator.

There is thus provided a novel multi-wound

generator capable of delivering energy at a plurality of voltages and one which is particularly adapted to be used on aircraft to supply energy to a radio transmitting set. By providing the one-way driving connection between the prime mover and the armature shaft of the generator, and the motor winding on the generator, a source of operating power for transmission of radio signals is always insured. This is particularly advantageous in the case of aircraft installations where it is desired to transmit signals after a forced landing has been made. By employing a three winding generator each winding may be designed for its particular function whereby unusually efficient operation is secured.

While there has been shown and described, only two embodiments of the invention, it is to be understood that the same is not limited thereto, but may be embodied in several electro-mechanical forms. For example, the motor winding may be disposed at the other end of the armature rather than at the one shown, or the motor winding may be placed together with either of the generating windings at either end of the armature. It is also to be understood that one-way driving connections other than the one illustrated and described may be employed without departing from the spirit of the invention. Reference will therefore be had to the appended claims for a definition of the limits of the invention.

What is claimed is:

1. In combination with a driving member, a generator having a plurality of output windings and a motor winding, means including a one-way clutch for drivably connecting said driving member and generator, output circuits operatively connected to said output windings, a battery in one of said circuits, and means for connecting said battery to said motor winding whereby to operate the generator as a motor-generator.

2. In combination with a driving shaft, a generator having high and low voltage output windings and a motor winding, means for drivably connecting said shaft and said generator including a one-way driving connection, load circuits operatively connected to said output windings, a battery in the low voltage circuit and adapted to be normally charged thereby, and means for connecting said battery to said motor winding to operate the generator as a motor-generator when the driving shaft is not in operation.

3. In apparatus of the class described a generator having high and low voltage windings and a motor winding, circuits normally connected to said high and low voltage windings, a battery adapted to be connected with said low voltage winding to be charged thereby, means for mechanically driving said generator including a one-way clutch, and means for connecting said battery to said motor winding to operate the generator as a motor-generator when the mechanical means is not in operation.

4. In combination, a generator having an armature and a plurality of generating windings disposed thereon, a motor winding, a plurality of commutators one for each winding, the commutators for the generating windings being disposed at one end of the armature and the commutator for the motor winding being disposed at the other end of the armature, a field winding, means for driving said armature including a one-way driving connection, means for connecting said motor winding in series with one of said

generating windings during operation of said driving means, and means for energizing said motor winding for operating the generator as a motor-generator when the driving means is not in operation.

5. In combination with a driving member, a generator having high and low voltage generating windings and a motor winding, load circuits normally connected to said generating windings, a battery connected to said low voltage load circuit, means for drivably connecting said member and generator including a one-way clutch, and means for simultaneously disconnecting said low voltage load circuit from said low voltage winding and for connecting said battery to said low voltage load circuit and to said motor winding to operate the generator as a motor-generator when the driving member is not in operation.

6. In combination with a driving shaft, a generator having a plurality of generating windings and a motor winding, means for drivably connecting said generator and shaft including a one-way clutch, means for connecting said motor winding in series with one of said generating windings during normal operation of the generator, and means for connecting a source of energy to said motor winding to operate the generator as a motor-generator.

7. In combination with a driving shaft, a generator having a plurality of generating windings and a motor winding, means for drivably connecting said generator and shaft including a one-way clutch, a battery adapted to be connected with one of said generating windings to be charged thereby, means for connecting said motor winding in series with one of said generating windings during normal operation of the generator, and means to connect said battery to said motor winding to operate the generator as a motor-generator when the driving shaft is not in operation.

8. In combination with an internal combustion engine, a generator having a plurality of generating windings and a normally inoperative motor winding, means for drivably connecting said engine and generator including a one-way driving connection, load circuits normally connected to said generating windings, a battery connected to one of said load circuits, means for disconnecting one of said load circuits from its associated winding, and means simultaneously operable with said disconnecting means for connecting said battery to said motor winding to operate the generator as a motor-generator.

9. In combination with a generator having a plurality of output windings and a motor winding, means for normally driving said generator including a one-way driving connection, means for connecting one of the output windings in series with the motor winding whereby the latter forms a part of the output winding during operation of said first mentioned means, and a source of electrical energy adapted to be connected to said motor winding for operating said generator as a motor-generator when said first mentioned means is not in operation.

10. In combination with a driving member, a generator having high and low voltage generating windings and a motor winding, means including a one-way driving connection for drivably connecting said member and generator, means for employing said motor winding as a part of said low voltage generating winding during operation of said first-mentioned means, a source of electrical energy, and means for con-

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necting said motor winding to said source whereby to operate the generator as a motor-generator when said first-mentioned means is not in operation.

5 11. In combination, a generator having an armature and a plurality of generating windings disposed thereon, a motor winding on said armature, means for mechanically driving said armature said means including a one-way driving  
10 connection, means for utilizing said motor winding as a portion of one of said generating windings during operation of said driving means, said motor winding being adapted to be connected to a source of electrical energy when said driving  
15 means is not in operation.

12. In combination with an internal combustion engine, a generator having two output windings and a motor winding, means for drivably connecting the generator and engine including

a one-way clutch, means for connecting said motor winding in series with one of said output windings and means for operating said generator as a motor-generator when said first mentioned means is not in operation.

13. In combination with a driving member, a generator having a plurality of output windings and a motor winding, means including a one-way clutch for drivably connecting said driving member and generator, circuits operatively connected to said windings, a battery in one of said circuits, and means including a switch in said battery circuit for controlling the transfer of electrical energy from said battery to said motor winding, whereby to operate the generator as a motor generator when said driving member is not in operation.

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