June 27, 1933. A. E. DOMAN 1,915,982

MOTOR GENERATOR CIRCUIT FOR OUTBOARD MOTORS

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Fig. 1.

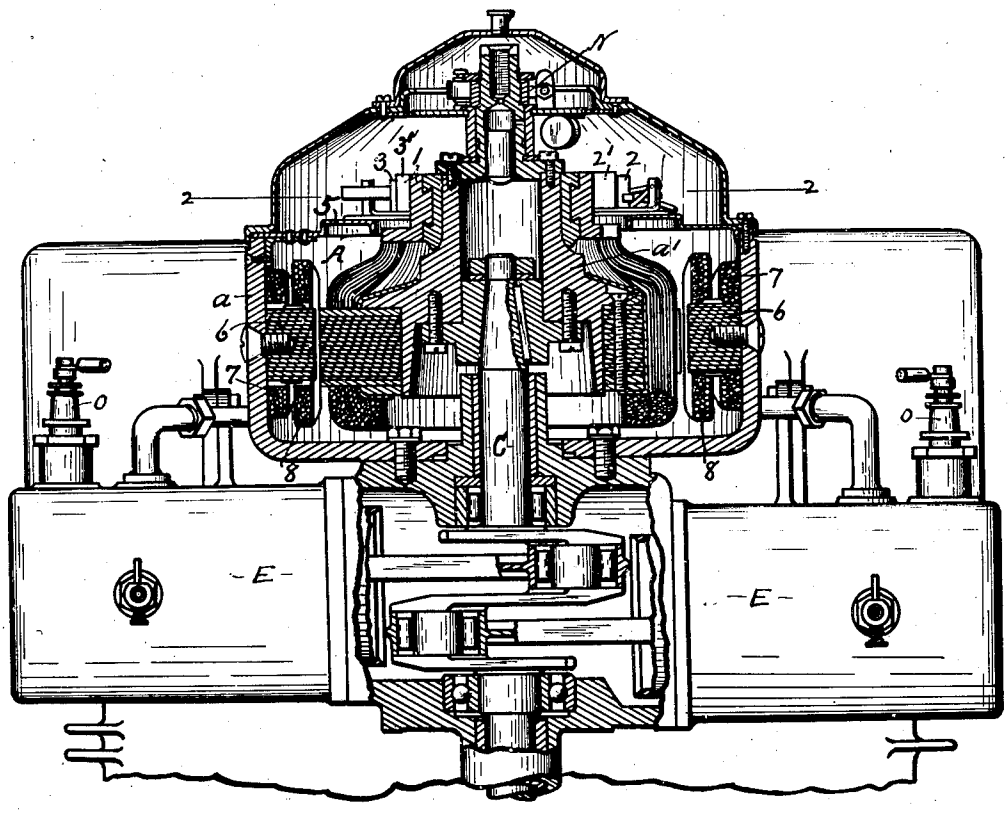

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FIG. 2.

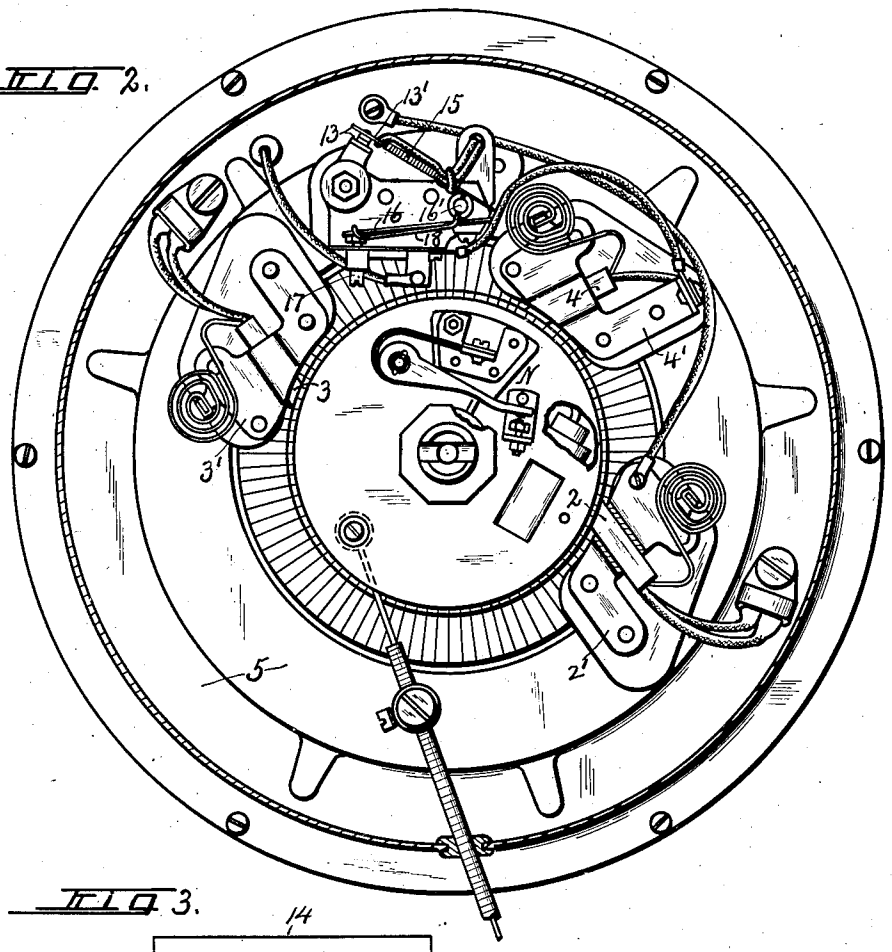
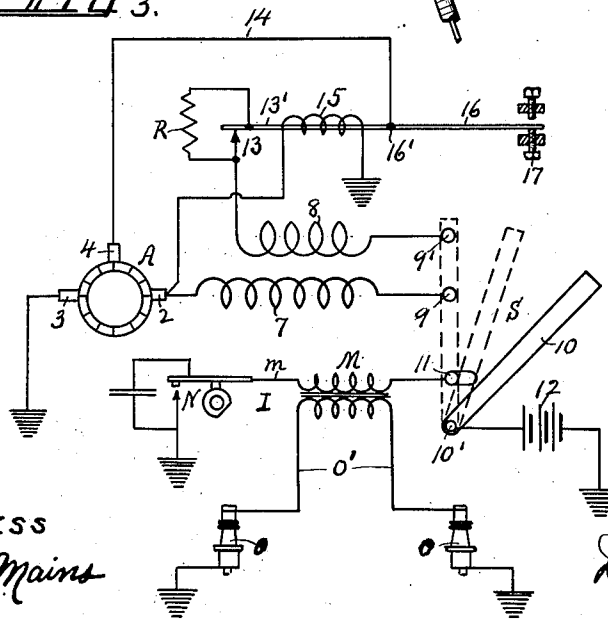


FIG. 3.



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UNITED STATES PATENT OFFICE

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MOTOR GENERATOR CIRCUIT FOR OUTBOARD MOTORS

Application filed June 10, 1930. Serial No. 460,213.

This invention relates to an electric starter system for outboard motors of the internal combustion engine type involving the use of a motor-generator of the third-brush type receiving current from a storage battery and operatively connected to the crank-shaft of the engine coaxial therewith for starting the engine, charging the battery and other purposes, as set forth in my pending joint application, Serial No. 491,492 filed October 27, 1930, but refers more particularly to the several circuits of the battery and generator and their relation to each other.

The main object is to combine these circuits in a simple and efficient system of electrical distribution for starting outboard motors in which the motor circuit, generator circuit and ignition circuit are all under control of a single manually operated switch.

Another object is to provide specific means for automatically regulating the voltage output of the variable speed engine-driven generator, so as to prevent overcharging of the battery or, inversely, to utilize any excess charge or excess discharge of the battery for the automatic operation of the voltage regulator.

One of the specific objects is to provide electro-thermostatic means controlled by the voltage in the charging circuit for cutting an electric resistance into and out of the third-brush circuit of the motor-generator, as a part of the voltage regulating means.

Another specific object is to provide thermostatic means for preventing the opening of the thermostatic switch under temperatures of the ambient atmosphere.

Other objects and uses will be brought out in the following description.

In the drawings:—

Figure 1 is a vertical sectional view of the upper portion of an outboard motor equipped with my improved electric starting system.

Figure 2 is an enlarged horizontal sectional view taken on line 2—2, Figure 1, showing the major parts of the electric starting system in top plan.

Figure 3 is a diagrammatic view of the electric starting system and the several circuits therefor.

This electric starter system is adapted to be used in connection with an outboard motor of the internal combustion engine type similar to that set forth in my pending application referred to, in that it involves the use of a motor generator —A— of the third-brush type having its field section —*a*— releasably secured to the top wall of the crank-case coaxial with the crank-shaft —C— of the engine, and a flywheel armature section —*a'*— releasably connected to said crank-shaft to rotate therewith within the field section —*a'*— through the medium of an adaptor coupling.

The armature section —*a'*— is provided with a commutator —1— engaged by main brushes —2— and —3— and a third brush —4— mounted respectively in separate holders —2'—, —3'— and —4'— which, in turn, are secured to a horizontal supporting plate —5—, the latter being releasably secured to the upper marginal edge of the cup-shaped field section —*a*— as shown in Figures 1 and 2.

The iron field section —*a*— is provided with laminated pole pieces —6—, each surrounded by a series winding —7—, and a shunt winding —8— connected respectively in the main armature circuit through the medium of the brushes —2— and —3— and in the shunt circuit through the third brush —4— and main brush —3—, as shown more clearly in Figure 3, the main circuit and shunt circuit being provided respectively with terminal contacts —9— and —9'— of an electric switch —S— having a normally open switch member —10— movable into contact with the terminals —9— and —9'— for simultaneously closing both circuits.

The switch —S— is also utilized to control a suitable ignition system —I— for igniting the explosive mixture of the internal combustion engine —E—. The ignition system includes a spark-coil —M—, a circuit breaker or distributor —N— and a switch terminal —11— both in the primary circuit —*m*—, and spark-plugs —*o*— in the secondary circuit —*o'*—.

The switch terminal —11— is arranged in the path of the switch member —10— to be engaged thereby when the latter is moved into engagement with the terminals —9— and —9′— for closing the primary ignition circuit —*m*— and thereby energizing the spark-plugs slightly in advance of the closing of the motor circuits.

A storage battery —12— is connected across the main circuit of the motor-generator for supplying current thereto when the latter is used as a starter for the engine, and also to receive current therefrom, when the starter is acting as a generator, for charging the battery and also for supplying current to the ignition system and other translating devices when the engine is at rest or driven under relatively low speed.

As illustrated, the positive pole of the battery —12— is connected to the switch member —10— through its pivot —10′— so that when the member —10— is closed, the current from the battery may flow through the main and shunt circuits of the motor generator and also through the primary circuit —*m*— of the ignition system for starting the engine and causing the latter to operate under its own power, and thereby to cause the motor-generator to supply current for charging the battery in addition to supplying current to the shunt circuit and to the ignition system, particularly in case the battery should fail to properly function, under which conditions the engine could be started by means of a cranking wheel not shown.

The means for automatically regulating the voltage output of the motor-generator and thereby preventing an excesive charging rate to the battery —12—, comprises an electrical resistance —R— and an electro-thermostatic switch —13— both connected in the shunt or third brush circuit —14—, and a voltage coil —15— which is connected across the main circuits of the generator —A— and battery —12— in such manner that an excess voltage in said circuits will heat the coil —15— and thereby open the thermostatic switch —15— to cut in the resistance —R— in the shunt circuit —14—, the effect of which is to reduce the voltage output of the generator and thus prevent overcharging of the battery.

The regulator switch —13— includes a thermostatic bar —13′— around which the voltage coil —15— is wound to transfer its heat thereto but in climates of widely varying atmospheric temperatures, it has been found that when such temperature exceeds a predetermined degree, it is more or less liable to prematurely open the switch —13— and thus prevent a proper voltage output of the generator for battery charging and other purposes unless some means is provided to counteract such liability.

In order to avoid this premature opening of the switch, an additional thermostatic bar —16— is operatively connected to the bar —13′— as shown in Figure 3, which is similar to that set forth in my Patent No. 1,498,077, issued June 17, 1924, or as shown in Figure 2, which is similar to that set forth in my pending application, Serial No. 341,425 filed February 20, 1929, both bars being mounted on the same pivot as —16′—.

That is, under rising temperatures of the voltage coil —15— or ambient atmosphere, the bar —13′— tends to deflect in one direction to open the switch —13—, while in Figure 3 the bar —16—, under the same atmospheric temperatures, tends to deflect in the opposite direction against an adjustable stop —17— thus placing the bar under more or less spring tension which serves to yieldingly hold the switch bar —13′— in its closed position until opened by the heat of the voltage coil —15—.

The compensating bar —16— shown in Figure 2, is arranged in V-shaped relation to the bar —13′— and is adapted to deflect in the same direction as the bar —13′—, under like atmospheric temperatures, against the action of a spring —18— which yieldingly holds the bar —13′— against the stop —17— and also yieldingly holds the switch bar —13— in its closed position until opened by the heating of the voltage coil —15—. This voltage regulator is mounted upon the supporting plate —5— for the brush holders —2′— and between one of the holders as —3′— and the third brush holder —4′— so that all of the brush holders and the voltage regulator may be arranged in compact relation around the axis of the crankshaft of the engine and flywheel armature section —*a*′—, as shown more clearly in Figure 2.

When the switch member —S— is closed on the terminals —11—, —9— and —9′—, the current from the battery —B— will flow through the ignition system and return for igniting the combustible mixture, while at the same time, a part of the battery is free to flow through the series winding —7— of the motor-generator circuit for operating the latter to start the engine.

When the engine is running under its own power and thereby operating the motor-generator, the current from the generator may pass through the series winding —7—, closed switch —S— and thence through the ignition system and return to supply current to the engine independently of the battery in case the latter should fail to properly function, while a part of the generator current may pass to the battery and return for charging said battery.

At the same time, a part of the generator current may pass through the series winding —7—, closed switch —S—, shunt winding —8—, and thermostatic switch —13— of the third-brush circuit —14— to effect a

partial automatic regulation of the voltage output, as previously described.

It will also be noted that a part of the generator current may pass from the brush —2— through the voltage coil —15— and return so that in case the voltage exceeds that required for properly charging the battery and other purposes, the voltage coil will become heated and the heat thus developed will be transferred to the thermostatic bar —13'— for opening the switch —13— and thereby cutting in the resistance —R— as a further means for automatically regulating the voltage output of the generator.

It is evident, however, that any suitable electric ignition system may be used in connection with the electric starting system and that various changes may be made in the arrangement of the starting system, without departing from the spirit of this invention.

I claim:

In an electric starting and ignition system for internal combustion engines, a starting-motor-generator of the third brush type having a self closing thermostatic switch and an electric resistance connected in parallel in the third brush circuit, a storage battery and a voltage coil connected in parallel across the main brush circuit, said voltage coil being in heat transfer relation to the thermostatic switch for controlling the battery-charge, an ignition device connected in the battery circuit and also in the main brush circuit, and a single electric switch operable at will for controlling the battery-charging circuit, the ignition circuit, and the third brush circuit and adapted to close the ignition circuit from the battery in advance of its other circuits.

In witness whereof I have hereunto set my hand this 27th day of May, 1930.

ALBERT E. DOMAN.