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A. E. DOMAN ET AL

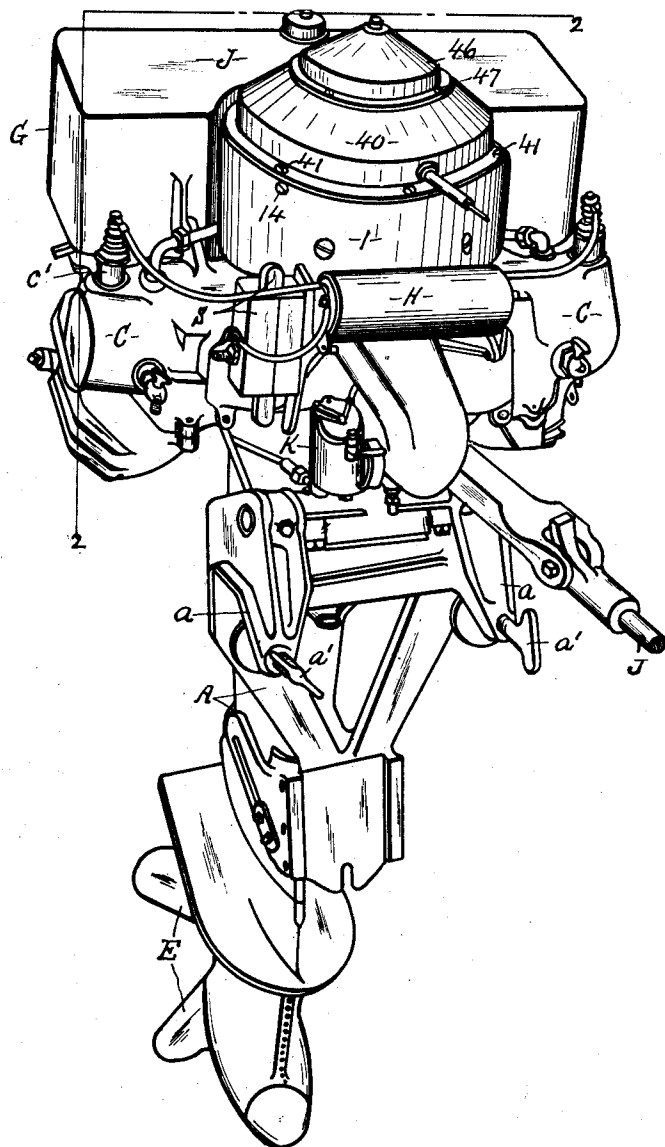
1,966,381

OUTBOARD MOTOR

Filed Oct. 27, 1930

3 Sheets-Sheet 1

FIG. 1.



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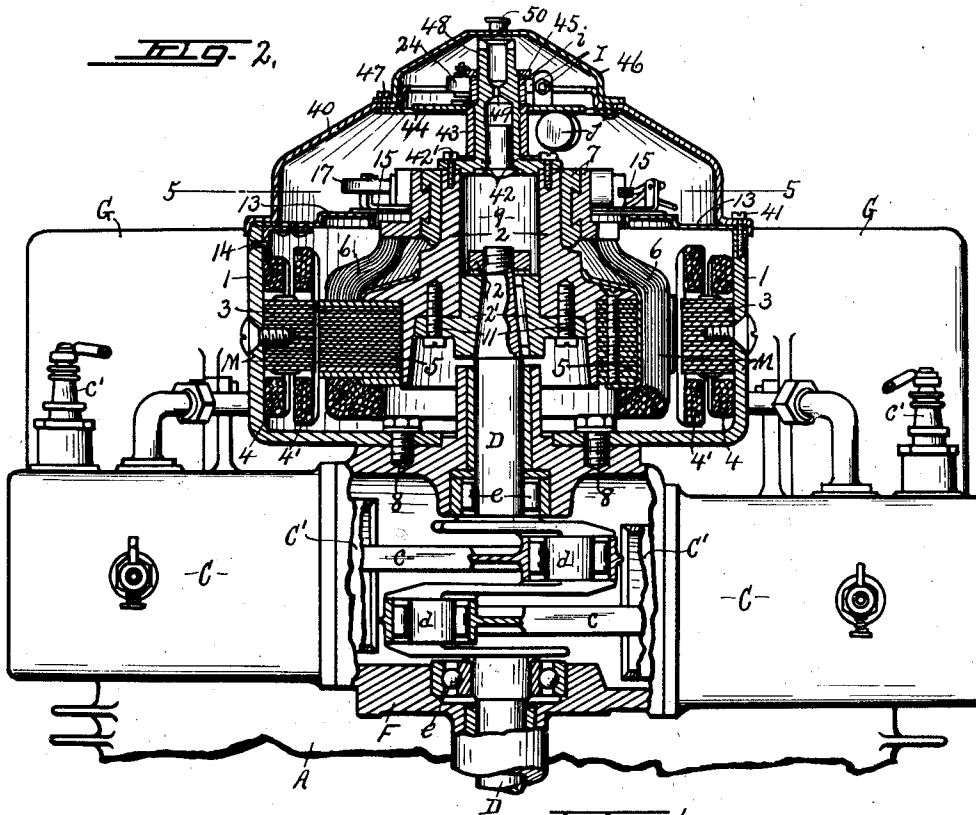
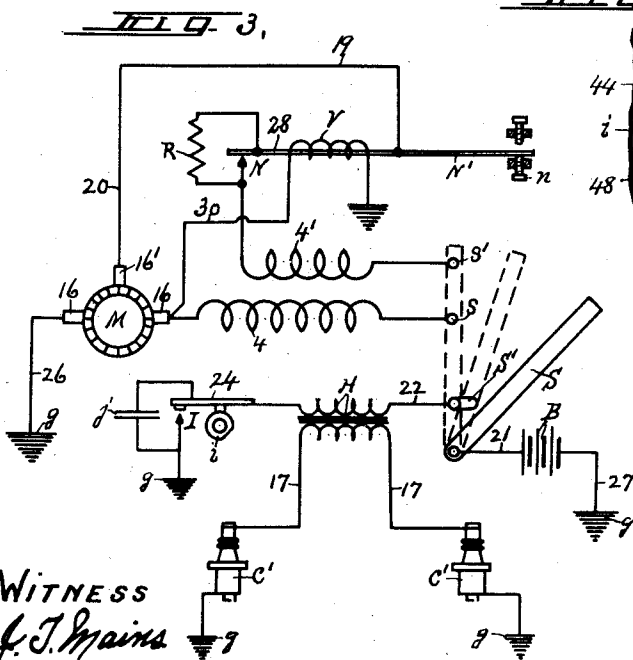
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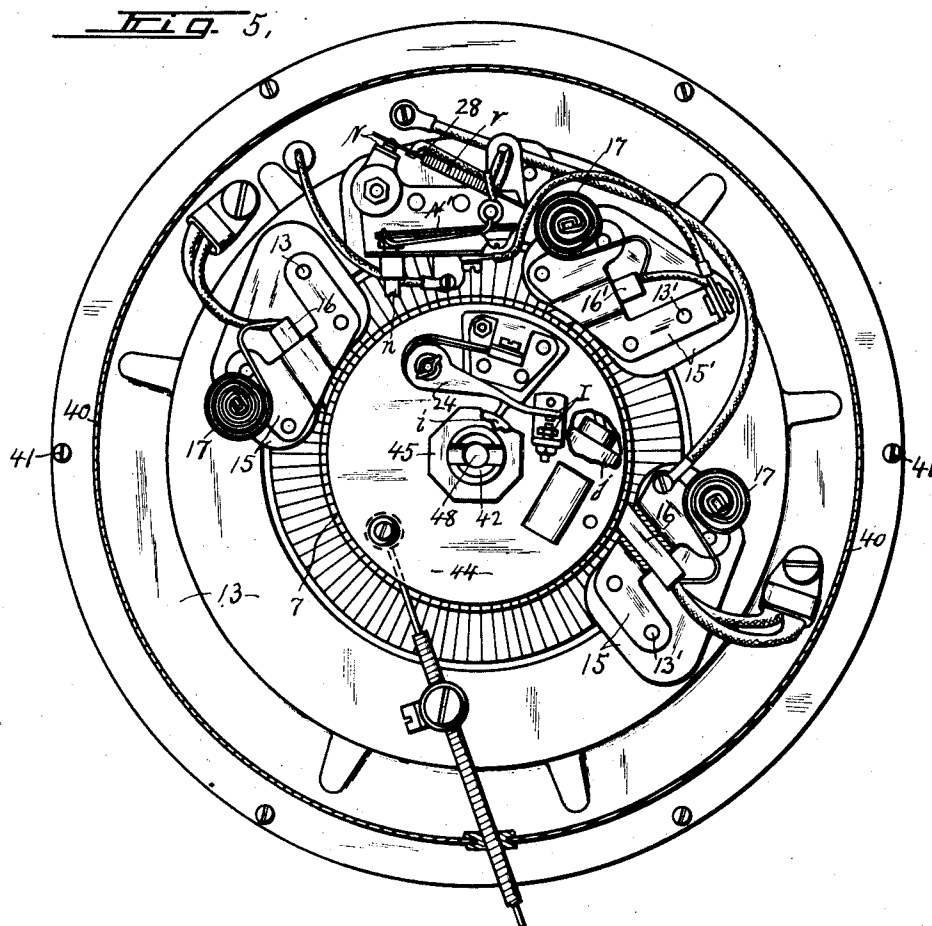
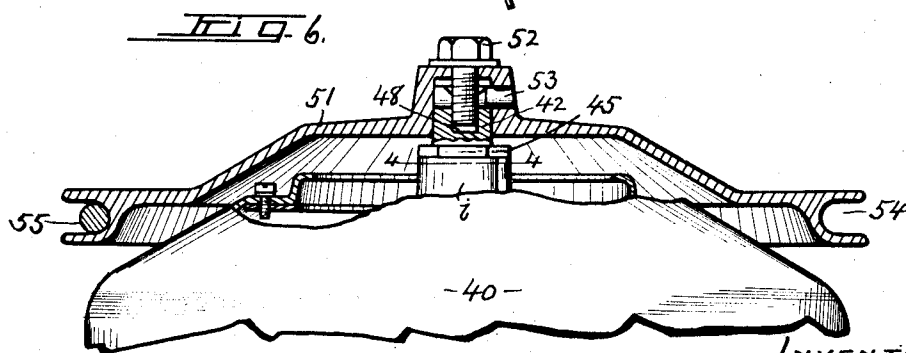
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3 Sheets-Sheet 3



WITNESS

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1,966,381

OUTBOARD MOTOR

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Application October 27, 1930, Serial No. 491,492

3 Claims. (Cl. 115--17)

This invention relates to an outboard motor for water craft in which an internal combustion engine is used as the motive power for driving the impeller shaft having a suitable impeller for propelling the craft in the water.

The engine together with a suitable steering mechanism are usually mounted in or upon a supporting frame or housing to form a unitary portable structure which is adapted to be easily and quickly applied to or removed from the stern gunwale of the craft in a manner well known to those skilled in this art.

In the majority of outboard motors now in common use it is necessary to start the engine by means of a hand-crank or balance wheel operatively connected to the crank-shaft of the engine to cause the engine to operate under its own power which of course is inconvenient, laborious and more or less dangerous depending somewhat upon the power of the engine.

The main object of the present invention is to provide a simple, compact and efficient electric starting unit deriving current from a storage battery and capable of being easily and quickly installed in or upon the housing of various types of new or old outboard motors either as a replacement of a manually operated starter or as a new equipment without material alteration of the housing or other parts of the motor.

Another object is to utilize the starting motor as a current generator when the engine is running under its own power for charging the battery and other purposes, and at the same time to render the output of the generator self-regulating to avoid overcharging of the battery.

A further object is to enable the field section and armature section of the starting motor to be releasably installed in sequence upon the crankcase and crank-shaft of the engine respectively.

Other objects and uses relating to specific parts of the invention will be brought out in the following description.

In the drawings:—

Figure 1 is a perspective view of an outboard motor with our invention incorporated therein.

Figure 2 is an enlarged vertical sectional view through the upper portion of the apparatus taken in the plane of line 2—2, Figure 1.

Figure 3 is a diagrammatic view of the electric battery starting and charging circuits including the ignition circuit.

Figure 4 is an enlarged sectional view taken in the plane of line 4—4, Figure 6.

Figure 5 is a horizontal sectional view taken along the line of 5—5, Figure 2.

Figure 6 is an elevation, partly in section, of the upper portion of the field and armature housing shown in Figures 1 and 2 in which the crank shaft is provided with a hand wheel or pulley adapted to be used with the usual ignition system for starting the engine in case the starting motor should fail to function.

As illustrated, this outboard motor comprises an upright frame A having offset brackets *a* and clamping screws *a'* by which the frame may be firmly clamped to the stern portion of the gunwale of a water craft.

The frame A also serves to receive and support an internal combustion engine consisting, in this instance, of a pair of spaced horizontally opposed piston motors C arranged in axial alignment at opposite sides of the vertical center of the frame and provided with opposed pistons C' which are connected by pitmen *c* to reversely arranged crank arms *d* on an upright crank shaft D. This crank shaft extends through a vertical opening in the frame A above and below the upper and lower ends thereof and is provided at its lower end with an impeller E while the upper end is journaled in suitable bearings *e* in the lower and upper walls of the crank case F, Figure 2, forming a part of the main supporting frame.

The cylinders C of the engine are provided with spark plugs *c'* which, together with the spark coil H are connected in the ignition circuits of a storage battery B and motor generator M, said circuits being further controlled by a manually operated switch S and a circuit breaker I having a condenser *j* in parallel therewith as shown more clearly in the diagrammatic view, Figure 3.

Liquid fuel may be supplied to the combustion chambers of the cylinders C through the medium of a fuel tank G and a carburetor K, both of which are mounted upon the frame A and connected in any well known manner to the cylinders of the engine.

The outboard motor may be provided with any well known type of steering mechanism commonly used with apparatuses of this character and controlled by a steering rod J, shown in Figure 1.

The main supporting frame, internal combustion engine, fuel supply means for the engine, propeller shaft and steering mechanism and means for attaching the frame to the water craft may be of any suitable construction adapted for outboard motors and forms no part of the present invention except as it is related to the housing for the starting motor generator, including

the commutator and brushes therefor and certain parts of the ignition system hereinafter more fully described.

The starting means for the internal combustion engine involves the use of an electric motor-generator comprising a cylindrical cup shaped field-supporting section 1 and an armature-supporting section 2, the sections 1 and 2 being preferably made of iron, steel or other suitable material.

The field-supporting section 1 is provided with suitable pole pieces 3 for the field windings 4 and shunt windings 4' secured to the inner upright walls thereof while the armature section 2 is provided with a laminated core 5 and a winding 6 connected in any well known manner to a commutator 7 which is secured to the armature supporting section 2, as shown in Figure 2, to rotate therewith.

The upper shaft bearing *e* and adjacent portion of the shaft D extend upwardly through a central opening in the bottom of the field-supporting section 1 which is secured to the horizontal portion of said bearing by bolts 8 which are removable to permit removal and replacement of the section 1 when the armature supporting section and parts carried thereby are removed.

The armature section 2 is provided with a central vertical opening 9 for receiving the upper end of an adapter-coupling 2' which is splined on the tapered upper end of the shaft D and removably secured to the section 2 by bolts 11 or equivalent fastening means, the upper end of the shaft D being threaded and engaged by a nut 12 for holding the shaft D and section 2 against relative axial movement when adjusted for use, as set forth in the Sayre application Ser. No. 491,484 filed October 27, 1930.

The lower end of the central opening 9 in the armature supporting section 2 is enlarged to receive the sleeve or bushing 2' and thus permit the armature supporting section and field supporting section to be brought into close compact relation vertically.

The armature supporting section 2 extends upwardly through a central opening in a brush supporting plate 13 which is removably secured by bolts 12 or equivalent fastening means to the upper end of the field supporting section 1 to extend across the intervening space between the commutator 7 and outer walls of the section 1.

This plate 13 is disposed in a substantially horizontal plane for receiving and supporting a pair of main brush holders 15 and a third brush holder 15', said brush holders being provided with more or less tangential guides for receiving a corresponding number of brushes 16 and 16' as shown more clearly in Figure 5.

These several brushes are automatically urged toward the commutator by similar coil springs 17 which are also mounted upon the plate 13 and are shown more clearly in Figure 5.

The field structure and armature structure together with the commutator 7 and brushes 16 and 16' are placed in electric connection with the storage battery B and form a motor-generator of the third brush type adapted to be operated by the battery current for starting the engine and for charging the battery in which case the third brush circuit including therein the shunt winding serves to establish a partial automatic regulation of the voltage output of the generator.

An electrical resistance R and thermostatic switch N are connected in parallel and in series with the shunt winding 4' of the third brush cir-

cuit, said switch being automatically closed to short-circuit the resistance R but is adapted to be opened to cut in the resistance by the energizing of a voltage coil V in heat transfer relation to the movable member of the switch N as shown more clearly in Figure 3.

The movable member of the thermostatic switch N is provided with a thermostatic compensating bar N' having its free end normally engaged with an adjustable stop *n* and thermally deflectable toward said stop, the object of which is to oppose the opening of the switch N under widely varying ambient atmospheric temperatures.

For example, if the surrounding atmospheric temperature should be sufficiently high tending to open the thermostatic switch N it would also tend to deflect the thermostatic bar N' against the stop *n*, thereby holding the switch *n* closed until opened by the heat developed in the voltage coil V in a manner hereinafter described.

The movable switch member S is electrically connected to one pole of the battery B and is movable into and out of contact with a terminal S' which is connected by a wire 22 to the primary winding of the spark coil H having its other end connected to the movable terminal 24 of the circuit breaker I, the movable terminal 24 being connected across the circuit breaker to a ground *g* through the medium of a condenser *j* as shown in Figure 3. The switch member S is also movable into contact with one of the terminals *s* of the series winding 4 having its other terminal connected to one of the brushes as 16 of the motor generator M, the opposite brush 16 being grounded at *g* through the wire 26.

The switch member S is also movable into contact with one of the terminals *s'* of the shunt winding 4' having its other terminal connected to the thermostatic switch N.

The movable member of the switch N consists of a thermostatic bar 28 electrically connected by wires 19 and 20 to the third brush 16' of the motor generator thereby normally short-circuiting the resistance R.

The voltage coil V is placed in heat transfer relation and preferably surrounds the thermostatic bar 28 and has one end connected by wire 30 to one commutator brush 16 of the motor generator M and its other end grounded at *g*, Figure 3.

The secondary winding of the spark coil H is connected by wires 17 to the spark plugs *c'* of the internal combustion engine cylinders C for simultaneously energizing both spark plugs and at the same time igniting the combustible fuel in the opposed cylinders of the engine.

The circuit breaker I is of the self-closing type adapted to be opened at regular intervals by a rotary cam member *i* which forms a part of the specific ignition device set forth in the pending application of G. B. Sayre, Ser. No. 491,433, filed October 27, 1930.

As previously stated the supports 15 and 15' for the brushes 16 and 16' are mounted upon the horizontal partition 13 on the upper end of the field-supporting case 1 with the brushes 16 and 16' in contact with the commutator 7.

An inverted cup-shaped cap section 40 has its lower marginal edge removably secured by bolts 41 to the upper marginal edge of the field supporting section 1 and is provided with a frusto-conical top having a central opening therein for receiving an upwardly projecting extension 42 of the armature supporting section 2, said section 42

being bolted or otherwise removably secured to the upper end of the section 2 by bolts 42' or equivalent fastening means, Figure 2.

The extension 42 which is rotatable with the armature supporting section 2 is journaled within and extends above a tubular hub 43 carrying at its upper end a horizontal plate 44 upon which is mounted the contact members of the circuit breaker I, one of which is secured to the plate and the other pivoted thereto to be actuated by the cam member *i*, shown in Figures 2, 3 and 5.

This cam member is secured to the upper end of the extension 42 by means of a nut 45, Figures 2 and 5, to rotate therewith for operating the movable member 24 of the circuit breaker.

A supplemental inverted cup-shaped cap section 46 has its lower marginal edge removably secured by bolts 47 or equivalent movable fastening means to extend over the upper end of the extension 42 and thereby to co-operate with the cap section 40 to completely enclose the commutator brushes and circuit breaker and thereby to protect the same against moisture and other external foreign matter, it being understood that when the cap sections 40 and 46 are secured in place they, together with the field supporting section 1, constitute a complete housing for the motor generator and circuit breaker.

The plate 44 and its supporting hub 43 are adjustable angularly relatively to the extension 42 by any suitable means for advancing or retarding the ignition spark.

It is now clear that the complete engine starter including the motor generator and circuit breaker may be easily and quickly installed upon the upper end of the frame and crank shaft of various types of outboard motors without material alteration of the parts of said motor.

For example, when installing the starter the field supporting section 1 with the series and shunt windings thereon are placed from the top downwardly upon the top of the crank-case F and secured thereto by the bolts 8 after which the armature section 2 carrying the adapter 2' is placed in operative position within the field supporting section and upon the upper tapered end of the crank shaft D to which it is secured by the nut 12, the latter being accessible through the opening 9.

The brush supporting plate 13 is then secured in operative position to the upper end of the field supporting section 1 with the brush holders and brushes thereon in engagement with the commutator 7, it being understood that the brush supports are bolted or otherwise secured to the plate 13 by bolts or rivets 14 or equivalent fastening means.

The extension 42 is then secured by the bolts 42' to the upper end of the armature section 2 after which the cap section 40 is secured by the bolts 41 to the upper end of the field supporting section 1.

The hub 43 carrying the plate 44 with the timing distributor I mounted thereon are then placed over and upon the extension 42 after which the cam *i* is secured to the extension 42 by means of the nut 45 which, of course, is then accessible above the upper end of the cap 40.

The upper cap 46 is then secured to the upper end of the section 40 by means of the bolts 47 thus completing the assembly of the entire engine-starting unit upon the outboard motor, except the cranking device presently described.

It will be noted upon reference to Figure 2 that the upper end of the extension 42 is pro-

vided with an oil receiving socket 48 having suitable passages 49 leading therefrom to the periphery of the extension for lubricating the joint between the extension and hub 42, the upper cap section 46 being provided with a central normally closed oil cap 50 for permitting oil or other lubricant to be inserted into the socket 48.

Provision is made for the use of a hand operated starter in connection with the crank shaft adapted to be secured to the upper end of the extension 42 in case the self-starter should for any reason fail to operate and for this purpose we have shown in Figure 6 a hand operated starting wheel 51 which is adapted to be mounted upon the upper end of the extension 42 when the upper cap section 46 is removed, the socket in the upper end of said extension 48 being threaded to receive a clamping bolt 52 by which the hub of the hand wheel 51 is rigidly secured to said extension whereby the rotation of the hand wheel will effect a corresponding rotation of the crankshaft, and parts driven thereby, as set forth in the Sayre application Ser. No. 491,485 filed October 27th, 1930.

The upper end of the extension 48 is provided with radial openings for receiving a key or pin 53 which serves to further lock the hand wheel 51 to said extension against relative rotation.

The hand wheel is shown as provided with a peripheral groove 54 adapted to receive a cable 55 or similar device by which the wheel may be rotated.

Operation

When starting the motor the switch member S will be moved into contact first with the contact member S' and will sequentially be brought into contact with the members *s* and *s'* thereby first closing the battery circuit through the primary winding of the spark coil H and circuit breaker I thereby energizing the secondary winding and spark plugs C' connected thereto ready for operation of the engine from the storage battery B.

When the switch S is in contact with all of the terminals S', *s* and *s'* the current from the battery B will pass from one pole thereof through wire 21 to the switch member S and thence from the terminal *s* through the series winding 4 to one pole 16 of the motor generator M and thence through wire 26 to the ground *g* and through wire 27 to the other pole of the battery.

At the same time the battery current will pass from the terminal *s'* through the shunt winding 4' to the thermostatic switch N and thence through the thermostatic bar 28, wires 19 and 20 to the third brush 16' of the motor generator for strengthening the field, the current then passing through the brush 16 and wire 26 to the ground and then through wire 27 to the battery B.

This closing of the circuits through the motor generator causes the latter to operate as a motor for starting the engine which, when driven under its own power, operates the motor M as a generator capable of generating sufficient voltage for recharging the battery from brush 16 through the series winding 4, switch member S to one pole of the battery and thence from the other pole of the battery and return to the opposite brush of the generator through wire 26 and brush 16.

When the battery B is fully charged and its voltage is relatively high the current will pass from one pole of the battery through wire 21 to the switch S and thence through the series winding 4 and wire 30 through the voltage coil V to the

ground and return to the other brush 16 of the generator.

Under these conditions the heat developed in the voltage coil V will be transferred to the thermostatic member 28 thereby causing the switch N to open and to cut the resistance R into the third brush circuit for reducing the output of the generator and thus preventing overcharging of the battery.

In case the temperature of the surrounding atmosphere should tend to open the thermostatic switch N such opening movement would be counteracted by the compensating bar N' in the manner previously explained, thereby correspondingly increasing the efficiency of the voltage regulator under widely varying temperature of the ambient atmosphere.

Although we have shown and briefly described a specific type of dynamotor or motor generator and automatic means for regulating the voltage output of the generator within safe charging limits for the battery, it will be noted that the main object of the invention is to provide a battery operated engine-starting unit of any suitable construction capable of being easily and quickly attached to and removed from the frame and crankshaft of the engine of outboard motors of different construction in place of the usual hand-operated starting crank or wheel without material alteration of the outboard motor parts and therefore it is unnecessary to limit the invention to the specific construction and mode of operation shown and described.

What we claim is:—

1. An outboard motor comprising a combustion engine, an electromotive starter generator, an ignition device, a rope starter plate, and a common shaft upon which all said parts are mounted co-axially.
2. The combination with an outboard motor of the internal combustion engine type having an upright crank shaft, and an electric starter motor having its rotating element co-axial with and actuated by the crank shaft, of an electric ignition system including a distributor having its rotary element co-axial with and actuated by the rotary motor element.
3. The combination with an outboard motor of the internal combustion engine type having an upright crank shaft, and an electric motor-generator having a rotary armature co-axial with and actuated by the crank shaft, of an electric ignition system including a distributor having its cam-element co-axial with and actuated by the armature.

4. The combination with an outboard motor of the internal combustion engine type having an upright crank-shaft, and horizontally opposed piston motors connected thereto for simultaneous movement in reverse directions, and a motor generator having a rotary armature co-axial with and actuated by the crankshaft, of an ignition system including a spark-coil having its primary winding common to both circuits of the motor-generator and its secondary circuit connected to the spark plugs of both piston motors, said ignition system including therein a distributor having its rotary element co-axial with and actuated by said armature.

5. An outboard motor of the internal combustion engine type having a crank-shaft, and an electric starter having a revoluble element co-axial with the shaft, in combination with a mounting for said element, releasable means for securing the mounting to the crank-shaft, releasable means for securing the mounting to said element, and an ignition device having a rotary member co-axial with and actuated by said element.

6. An outboard motor as in claim 5 in which said element is provided with an opening to permit access to the first named releasable means for operating the same.

7. An outboard motor of the internal combustion engine type having an upright crank-shaft, and an electric starter having a revoluble flywheel armature section co-axial with the shaft, in combination with a mounting for said section, releasable means for securing the armature section to the crank-shaft, releasable means for securing the mounting to the armature section, and an ignition device having a rotary member co-axial with and actuated by said armature.

8. An outboard motor of the internal combustion engine type having an upright crank-shaft, and an electric starter having a revoluble flywheel armature section co-axial with the shaft, in combination with a mounting for said section splined on the upper end of the shaft for upward displacement therefrom, releasable means engaging the upper ends of the shaft and mounting for holding the mounting against upward displacement from the shaft, releasable means for securing the armature section to the mounting, and an ignition device having a revoluble member co-axial with and actuated by said armature.

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