No. 798,374. PATENTED AUG. 29, 1905.

H. E. WHITE.

ELECTRIC SWITCH.

APPLICATION FILED MAR. 22, 1904.

2 SHEETS—SHEET 1.

Fig. 1.

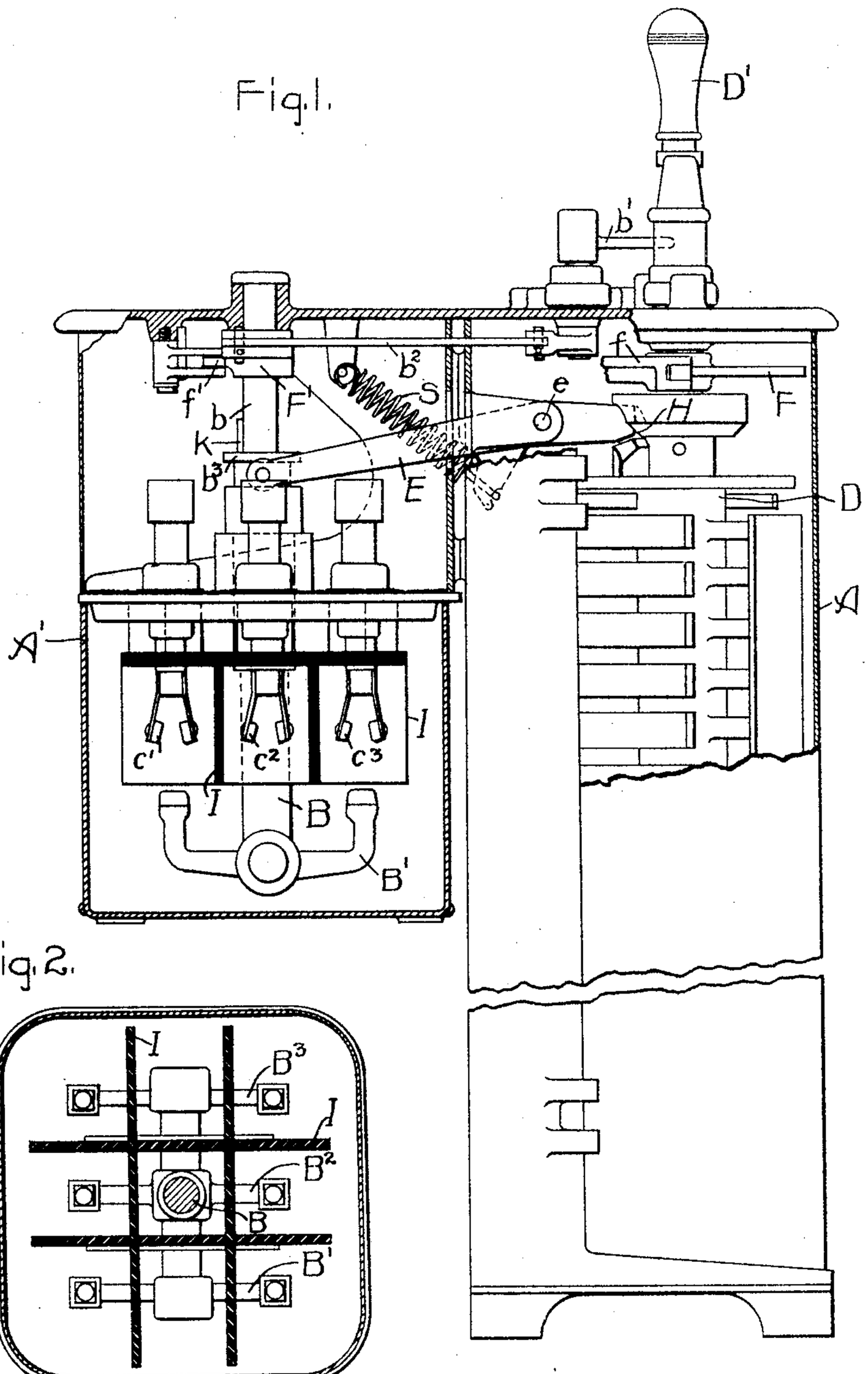

Fig. 2.

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2 SHEETS—SHEET 2.

Fig. 3.

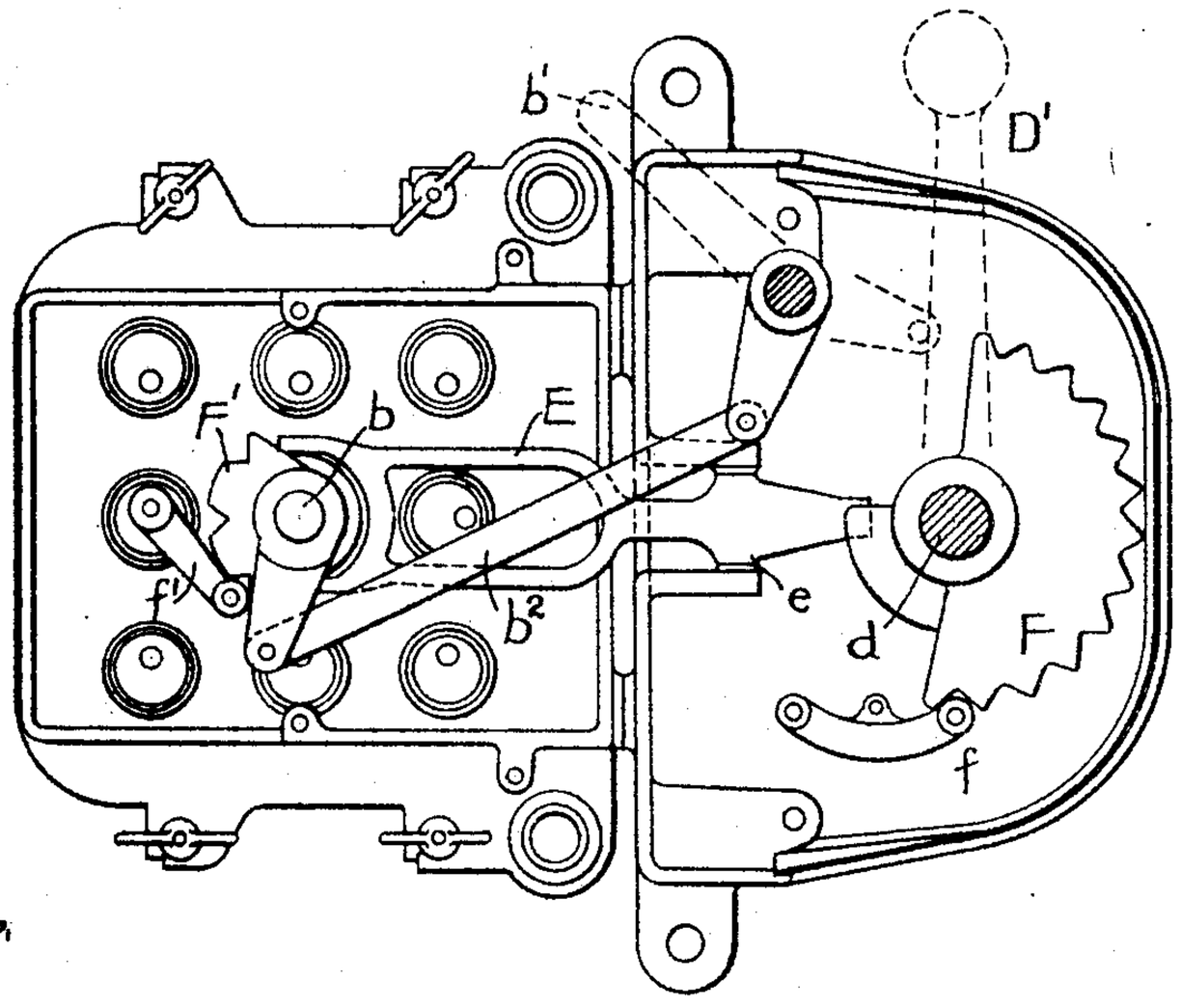
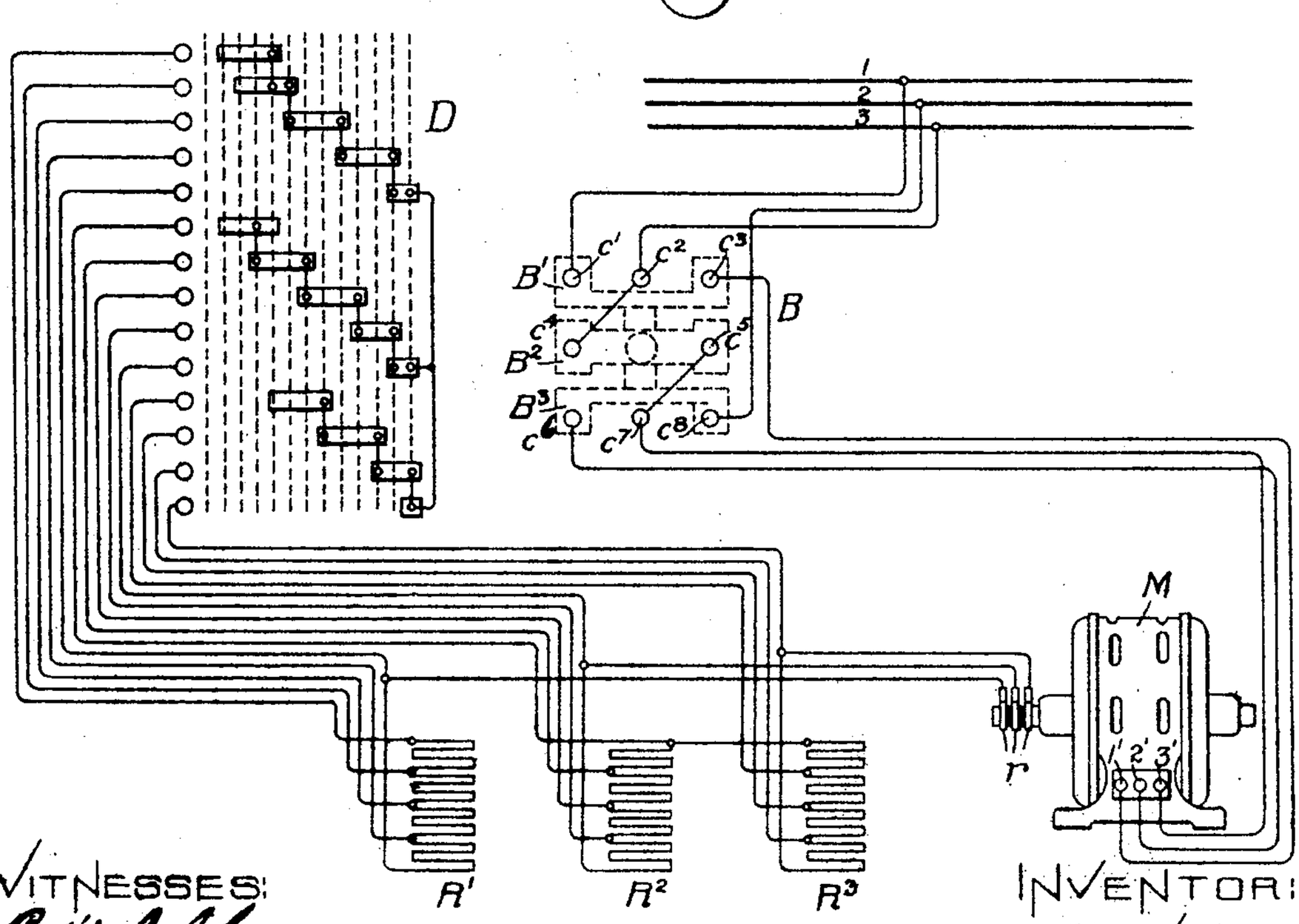


Fig. 4.



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UNITED STATES PATENT OFFICE.

HAROLD E. WHITE, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

ELECTRIC SWITCH.

No. 798,374. Specification of Letters Patent. Patented Aug. 29, 1905.

Application filed March 22, 1904. Serial No. 199,337.

To all whom it may concern:

Be it known that I, HAROLD E. WHITE, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Electric Switches, of which the following is a specification.

My invention relates to the control of alternating-current motors, and is particularly applicable to the control of induction-motors designed for operation on high-voltage circuits.

The object of my invention is to provide a novel construction and arrangement of controlling-switches for such motors. For the proper control of such motors it is necessary to provide means for opening and closing the primary circuit, for controlling the secondary circuit, and for reversing the motor. In order to secure a simple control, I provide a main switch for opening and closing the primary circuit and a switch for controlling the secondary circuit, both switches being controlled by a single handle. In order to avoid a third switch for reversing the motor, it is essential that the main switch be designed both for opening and closing the primary circuit and for making the necessary changes therein for reversing the motor, and in order to avoid a duplication of contacts in the controlling-switch for the secondary circuit it is essential that the main switch be operated to reverse the motor without moving the controlling-switch, so that one set of contacts in the controlling-switch may be used both for forward and for reverse rotation. Accordingly I provide a main switch suitable not only for opening and closing the primary circuit, but also for reversing the motor, and in addition to its control by the same handle that controls the switch for the secondary circuit I provide means for moving it to reverse the motor independently of said handle and without disturbing its control by said handle. Furthermore, I arrange the primary switch so that it is adapted for immersion in oil and is consequently specially well suited for use with high voltages and large currents.

My invention will best be understood by the accompanying drawings, in which—

Figure 1 shows a side elevation of controlling-switches arranged in accordance with my invention. Fig. 2 shows a cross-section of the main switch, showing the movable switch member and the insulating-barriers. Fig. 3 shows a plan view of the switches, the top of the casing being removed; and Fig. 4 is a diagram showing the circuit connections.

In the drawings, A and A′ represent two casings, the second of which is adapted to contain oil and in which are mounted the secondary controlling-switch D and the primary switch B, respectively. The controlling-switch D for the secondary circuit is of the ordinary well-known type of controller-drum. It is mounted upon the shaft *d* and rotated by the handle D′. It is provided with the segmental star-wheel F and the pawl *f* in the usual manner. The main switch B carries at its lower end the three bridging members B′, B², and B³ and is arranged to slide axially on the shaft *b*, but is prevented from rotation relative thereto by the key *k*. When switch member B is raised, the bridging members carried thereby are brought into engagement with the stationary contacts *c′ c²*, &c., which are separated from each other by the insulating-barriers I I. Switch member B carries at its upper end a flange b^3, which is engaged by a yoke formed by the end of the lever E. Lever E is pivoted at *e* and its other end travels in a cam-slot H, carried by the shaft of the secondary control-switch D.

As control-switch D is rotated by handle D′ lever E is rocked on its pivot by its engagement with cam-slot H, and the switch member B is consequently raised and lowered. As shown in Fig. 1, switch member B is in its lowest position, which is the open-circuit position for the switch. To start the motor, handle D′ is rotated, depressing the right-hand end of lever E in Fig. 1, raising the left-hand end, and consequently lifting switch member B, bringing its bridging members into engagement with the stationary contacts *c′ c²*, &c. Tension-spring S, engaging an arm or lug on lever E, assists lever E to raise switch B, the tension of the spring partially balancing the weight of the switch member.

By the arrangement as thus far described provision is made for operating the main switch B for opening and closing the circuit and the control-switch D for controlling the secondary circuit by a single handle D′. In order to provide means for operating main switch B to reverse the motor independently of handle D′ and without disturbing its control, I provide, in addition to the vertical re-

ciprocating movement of switch member B, means for rotating it in a horizontal plane by the rotation of the shaft or rod *b*. Shaft *b* is connected by the link b^2 to the handle *b'*, by means of which the switch member B may be rotated ninety degrees, thus altering the position of the bridging members B', B^2, and B^3 relative to the stationary contacts *c' c²*, &c., thereby securing a reversal of the motor, as will be hereinafter explained. The shaft *b* is provided with the segmental star-wheel F' and the pawl *f'* in the usual manner. In either position of switch member B for either forward or reverse rotation it is free to move vertically under the influence of lever B and handle D', so that whether the main switch is set for upward or reverse rotation both the main switch and the secondary circuit-control switch may be operated by a single handle, and a single set of contacts in the secondary control-switch may be used for both forward and backward rotation.

Turning now to Fig. 4, the circuit connections and the arrangement of the switch-contacts will be described. 1 2 3 represent a source of three-phase current for the three-phase induction-motor M, which is provided with the three terminals 1', 2', and 3'. The main and reversing switch B has eight stationary contacts *c'* to c^8, arranged in a square and connected as shown in the drawing. The bridging members B', B^2, and B^3 are indicated in dotted lines. With main switch B closed in the position shown the connections of the primary motor-circuit are as follows: From line-wire 1 the current passes to contact *c'*, through bridging member B', contact c^3, motor-terminal 1'. From line-wire 2 the current passes to contact c^8, through bridging member B^3, to contact c^6, to motor-terminal 2'. From line-wire 3 the current passes to contact c^2, to contact c^4, bridging member B^2, contact c^5, contact c^7, motor-terminal 3'. If switch B is rotated ninety degrees, it will be seen that the primary motor-circuits are changed as follows: Current will pass from line-wire 1 to contact *c'*, to contact c^6, to motor-terminal 2'. From line-wire 2 the current will pass to contact c^8, to contact c^3, to motor-terminal 1'. From line-wire 3 the current will pass to contact c^2, to contact c^7, to motor-terminal 3'. The motor is then connected for rotation in the reverse direction. D represents the controlling-switch for the secondary circuit, which is connected to the motor slip-rings *r r r*, which are connected to the secondary circuit of the motor and to the resistances R' R^2 R^3. As will be seen by tracing out the circuits, resistance is in circuit between two slip-rings only on the first point of the controller. Switch D acts simply to complete the resistance-circuit for the remaining slip-ring on the second point and then gradually to reduce the resistances until in its final position the secondary circuit is short-circuited. These steps will be evident from an inspection of the drawing and need not be described in detail.

It will be seen from the foregoing description that I have provided a main switch suitable both for opening and closing the primary circuit and for reversing the motor and arranged to be controlled as regards its first function by the same handle that controls the controlling-switch for the secondary circuit and to be controlled as to its second function independently of and without disturbing its control by the said handle and that the construction is such that the reversing function cannot be exercised except when the controller is at the "off" position.

I do not desire to limit myself to the particular construction and arrangement of parts here shown, since changes which do not depart from the spirit of my invention and which are within the scope of the appended claims will be obvious to those skilled in the art.

What I claim as new, and desire to secure by Letters Patent of the United States, is—

1. In a controlling-switch for polyphase motors, a main switch in the primary circuit of said motor, a controlling-switch in the secondary circuit, a handle arranged to operate said main switch to open and close the primary circuit and to operate said controlling-switch to control the secondary circuit, and means independent of said handle for operating said main switch to reverse the motor.

2. In a controlling-switch for polyphase motors, a main switch in the primary circuit of said motor, a controlling-switch in the secondary circuit, a handle arranged to operate said main switch to open and close the primary circuit and to operate said controlling-switch to control the secondary circuit, and means for operating said main switch to reverse the motor without disturbing the control of said switch by said handle.

3. In combination, a switch capable of independent rotary and reciprocating movements, a second switch, a handle arranged to control the operation of said second switch and one of the movements of the first switch, and independent means for controlling the other movement of the first switch.

4. In combination, a switch capable of independent rotary and reciprocating movements, a second switch capable of rotary movement, a handle arranged to reciprocate the first switch and to rotate the second switch, and independent means for rotating the first switch.

5. In a controlling-switch for polyphase motors, a main switch arranged to open and close the primary circuit of the motor when reciprocated and to reverse the motor when rotated, a second switch arranged to control the secondary circuit of the motor, a handle

arranged to reciprocate the main switch and to operate the second switch, and independent means for rotating the main switch.

6. In a controlling-switch for polyphase motors, a main switch arranged to open and close the primary circuit of the motor when reciprocated and to reverse the motor when rotated, a second switch arranged to control the secondary circuit of the motor, a handle arranged to reciprocate the main switch and to operate the second switch, and means for rotating the main switch without disturbing its control by said handle.

7. In combination, a rotary switch, a cam carried thereby, a lever operated by said cam a second switch arranged to be reciprocated by said lever, and independent means for rotating said second switch.

8. In combination, a shaft, a switch mounted thereon and capable of axial movement only relative thereto, a second switch, a handle arranged to operate the second switch and to move the first switch axially on said shaft, and independent means for rotating said shaft.

9. In combination, a shaft, a switch mounted thereon and capable of axial movement only relative thereto, a rotary switch, a cam carried thereby, a lever operated by said cam and arranged to move the first switch axially on said shaft, and independent means for rotating said shaft.

10. In a switch, a plurality of stationary contacts, a switch member comprising a plurality of parallel bridging members adapted to engage said contacts, means for reciprocating said switch member to bring it into engagement with said contacts, and means for rotating said switch member to vary the relations of said bridging members to said contacts.

11. In combination, a three-phase motor, a plurality of stationary contacts connected in circuit with said motor, a switch member comprising three parallel bridging members adapted to engage said contacts, means for reciprocating said switch member to open and close the motor-circuit, and independent means for rotating said switch member to reverse said motor.

12. In a switch for three-phase circuits, eight stationary contacts arranged in a square, a switch member comprising three parallel bridging members adapted to engage said contacts, means for reciprocating said switch member to bring it into engagement with said contacts, and independent means for rotating said switch member to vary the relations of said bridging members to said contacts.

13. In a switch for three-phase circuits, a plurality of stationary contacts, a switch member comprising three parallel bridging members adapted to engage said contacts, means for reciprocating said switch member to bring it into engagement with said contacts, and a casing surrounding said switch and adapted to contain oil.

14. In a controlling-switch for induction-motors, a main switch in the primary circuit of said motor, a casing surrounding said switch and adapted to contain oil, a controlling-switch in the secondary circuit, a handle arranged to operate said main switch to open and close the primary circuit and said controlling-switch to control the secondary circuit, and independent means for operating said main switch to reverse the motor.

In witness whereof I have hereunto set my hand this 21st day of March, 1904.

HAROLD E. WHITE.

Witnesses:

BENJAMIN B. HULL,

HELEN ORFORD.