A. SIMON.

MOTOR CONTROLLER.

APPLICATION FILED JAN. 11, 1909.

1,116,504.

Patented Nov. 10, 1914.

4 SHEETS—SHEET 1.

Fig. 1.

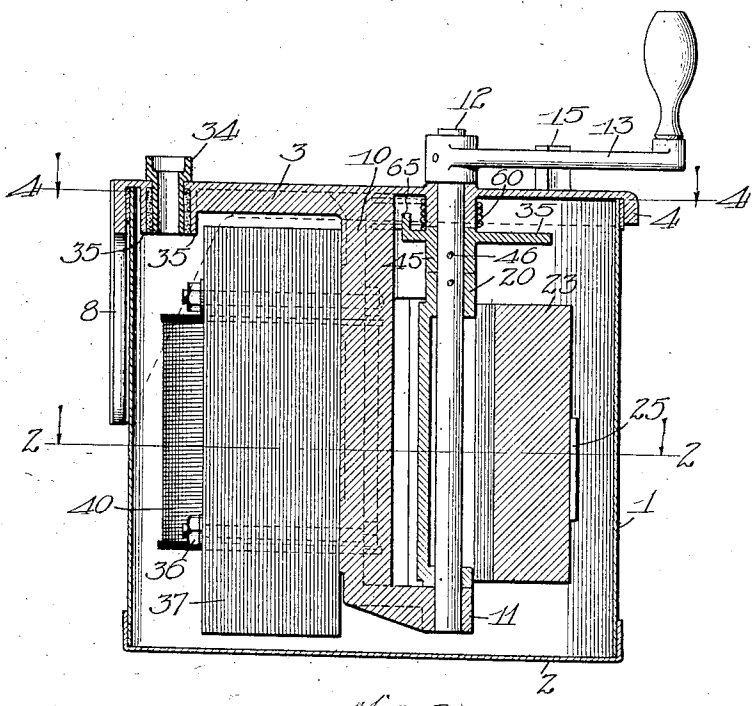
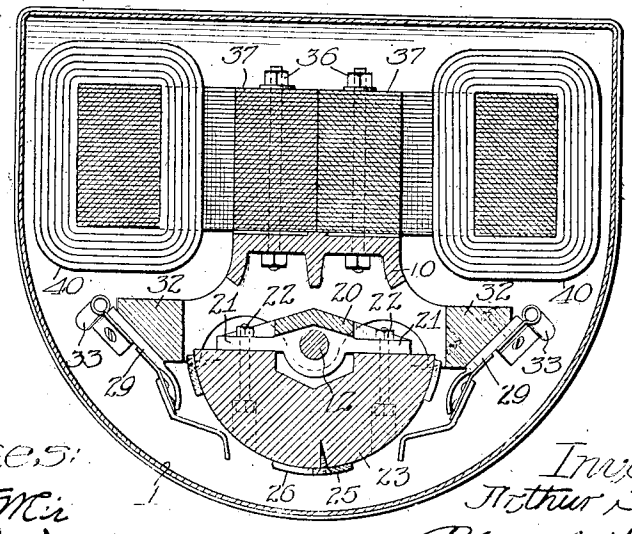


Fig. 2.



Witnesses:

Robert N. Mc Ir

Frank H. Hubbard

Inventor:

Arthur Simon

By: Edwin B. Hunter Jr

Atty.

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4 SHEETS—SHEET 2.

Fig. 3.

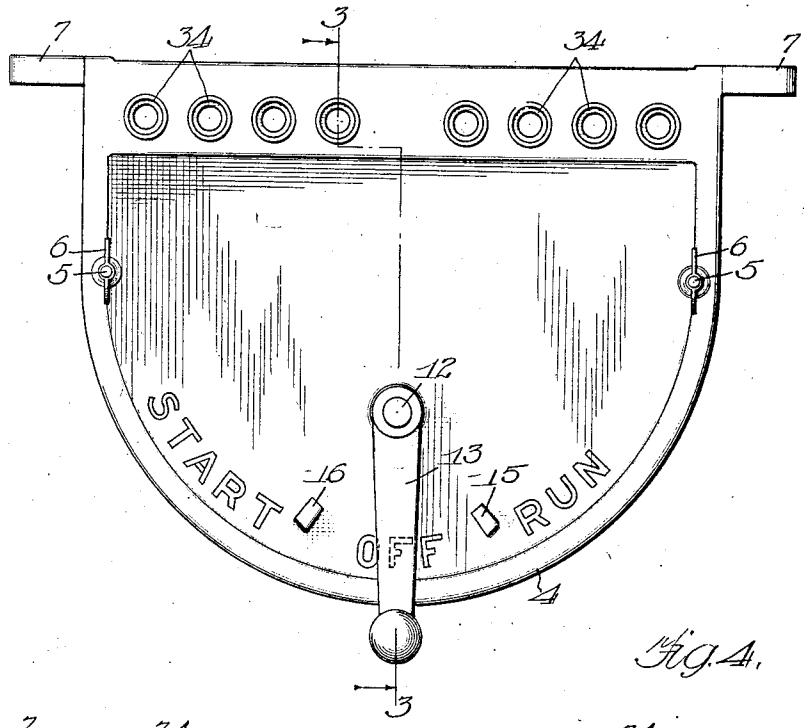
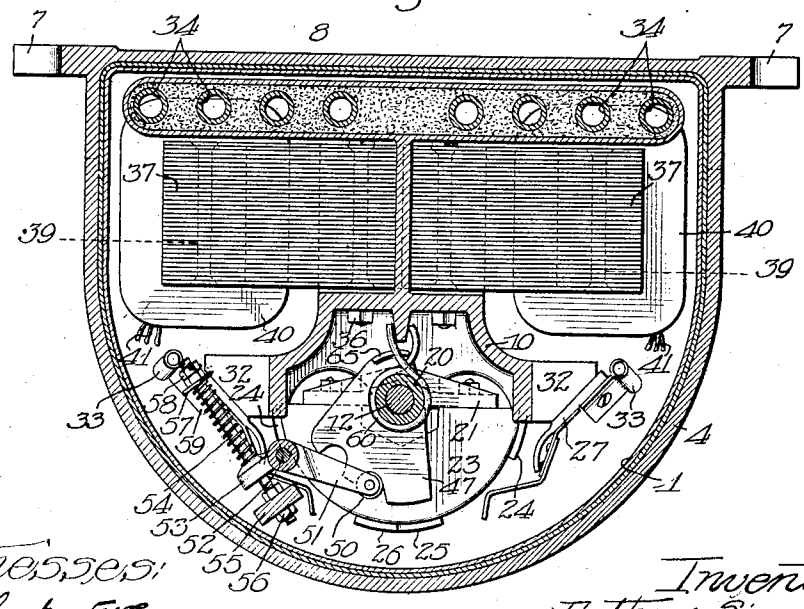


Fig. 4.



Witnesses:

Robert N. Weir

Frank H. Hubbard

Inventor:

Arthur Simon

By: Edwin B. H. Lowe Jr.

Atty.

A. SIMON.

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4 SHEETS—SHEET 3.

Fig. 5.

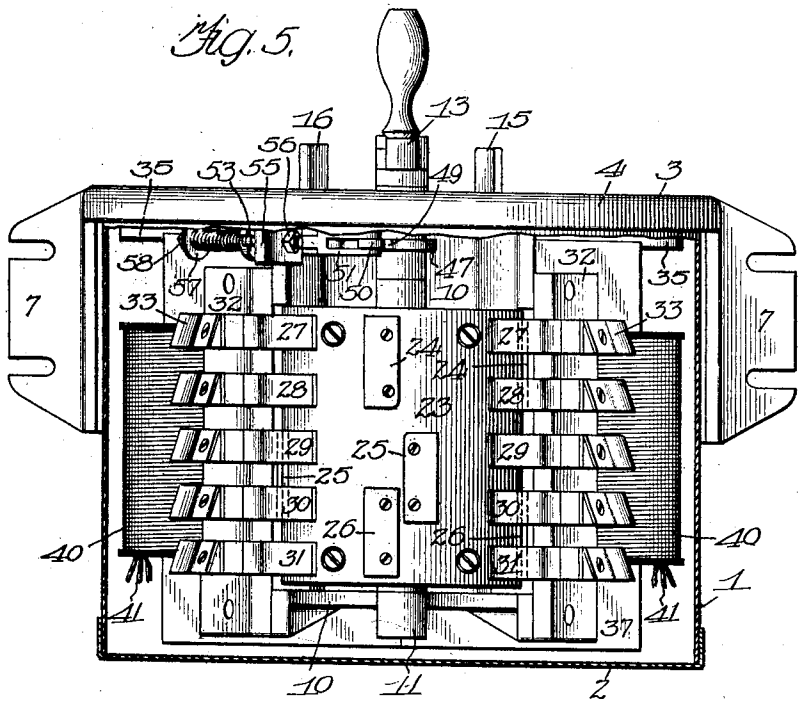
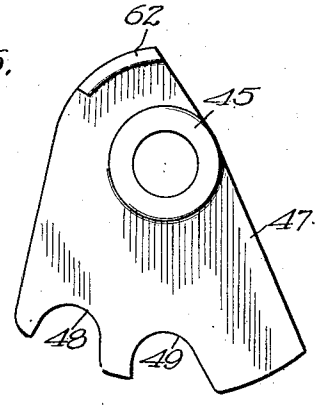


Fig. 6.



Witnesses:
Robert N. Weir
Frank H. Hubbard

Inventor:
Arthur Simon
By Edwin B. H. Lower
Atty.

A. SIMON.

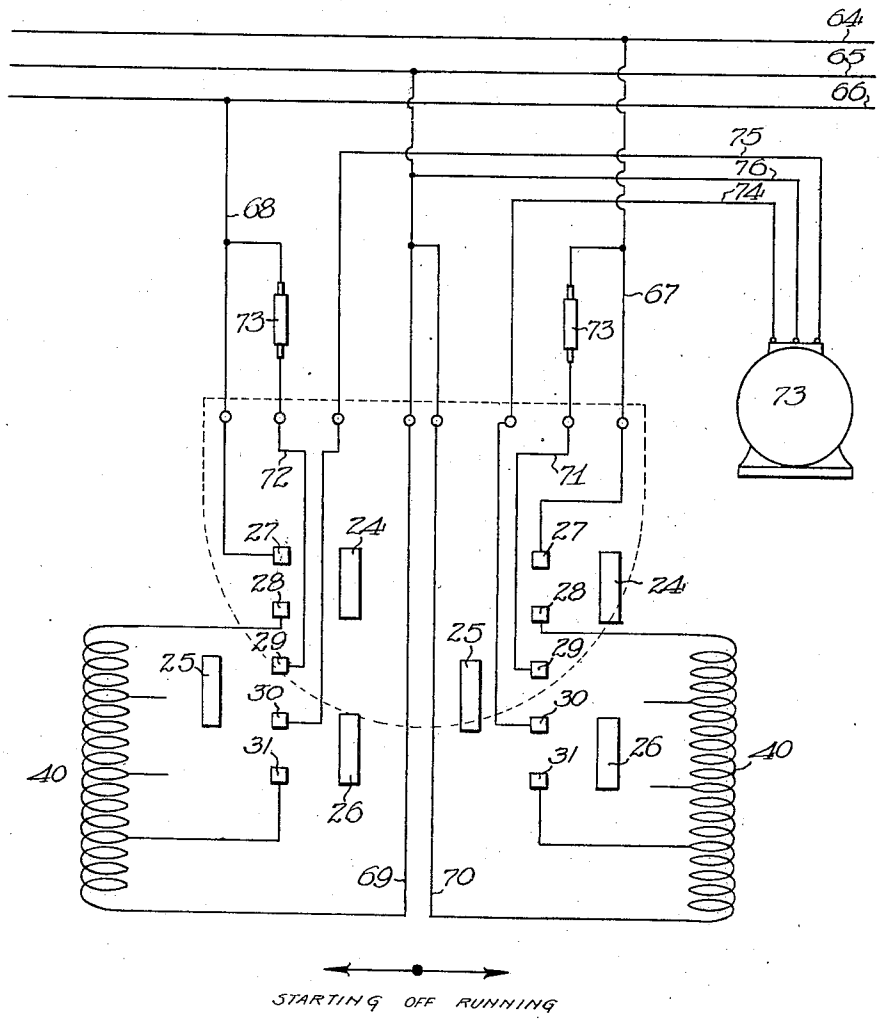
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4 SHEETS—SHEET 4.

Fig. 7.



Witnesses:
Robert N. Weir
Frank H. Hubbard

Inventor:
Arthur Simon
By: Edwin B. H. Towers Jr.
Atty.

UNITED STATES PATENT OFFICE.

ARTHUR SIMON, OF MILWAUKEE, WISCONSIN, ASSIGNOR TO THE CUTLER-HAMMER MFG. CO., OF MILWAUKEE, WISCONSIN, A CORPORATION OF WISCONSIN.

MOTOR-CONTROLLER.

1,116,504. Specification of Letters Patent. Patented Nov. 10, 1914.

Application filed January 11, 1909. Serial No. 471,698.

To all whom it may concern:

Be it known that I, ARTHUR SIMON, a subject of the German Emperor, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented new and useful Improvements in Motor-Controllers, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawing, forming a part of this specification.

My invention relates to improvements in motor controllers, and more particularly to starting devices for alternating current motors.

One object of my invention is to provide a device in which the controlling switch and the transformer or compensator are both arranged within the same casing and preferably immersed in oil.

A further object of my invention is to provide means for insuring the proper operation of the controlling switch.

Other objects and advantages of my invention will be hereinafter fully and clearly set forth.

For the purpose of more fully setting forth the characteristic features of my invention, I shall describe the device illustrated in the accompanying drawings, which embodies my invention in one form. Of course, my invention is susceptible of various modifications.

In the drawings: Figure 1 is a vertical sectional view taken through the device; Fig. 2 is a sectional view taken on line 2—2, Fig. 1; Fig. 3 is a top plan view of Fig. 1; Fig. 4 is a sectional view taken on line 4—4, Fig. 1; Fig. 5 is a front elevation of the device, with the front of the inclosing casing removed or broken away; Fig. 6 is an enlarged detail view of a part of the device, and Fig. 7 is a diagrammatic view showing one form of circuit connections for the device.

The several parts of the device illustrated are inclosed within a casing comprising vertical walls 1, bottom 2, and top 3. The casing may be of any suitable size and shape, and may be constructed in any preferred manner. The casing should be capable of containing oil or other suitable fluid. The top 3 of the casing is preferably formed of cast iron and is provided with downwardly extending flanges 4, which closely fit around the top of the casing. The lower portion of the casing is detachably secured to the top 3. A convenient manner of securing the casing to the top 3 is to provide the casing with bolts 5, which pass through suitable apertures in the top 3. The bolts 5 are provided with wing nuts 6, adapted to firmly secure the parts of the casing together. With this arrangement it will be seen that by removing the wing nuts 6 from the bolts 5 the lower portion of the casing may be readily detached from the top. At its rear end the top 3 is provided with outwardly extending lugs or ears 7, by means of which the casing may be secured to a wall, or other suitable support. The top is also provided with downwardly extending portions 8, adapted to bear against the wall or other support to take the strain off of the lower portion of the casing, which is preferably formed of sheet metal, and, consequently, not very rigid. Depending from the top 3, and preferably formed integrally therewith, is a frame or bracket 10, which projects nearly to the bottom of the casing. At its lower end the bracket 10 is provided with a forwardly extending member 11. Revolubly mounted in bearings formed in the top 3 of the casing and the portion 11 of the bracket 10 is a vertically disposed shaft 12. The shaft 12 projects above the top 3 of the casing and has, rigidly secured to its upper end, an operating handle or lever 13. The handle 13 is movable between lugs or stops 15 and 16, provided on the top 3. Rigidly secured to the shaft 12 within the casing is a frame 20, which extends upwardly from the portion 11 of the bracket 10, nearly to the top of the casing. At its ends the frame 20 is provided with outwardly extending arms or lugs 21. Secured to the lugs 21 of the frame 20, by bolts 22, is a semi-cylindrical contact drum 23, which may be of any suitable construction. Inasmuch as the frame 20 is rigidly secured to the spindle 12, it will be apparent that as the operating lever or handle 13 is moved said frame 20 and the semi-cylindrical drum 23 will be rotated therewith. The drum 23 carries two sets of contact segments 24, 25 and 26. Arranged on opposite sides of the shaft 12 are two sets of contact fingers 27 to 31 inclusive, each set being arranged to be engaged by one set of the contact segments on the drum as the same is rotated in

one direction or the other. The contact segments are so arranged on the drum that when the operating handle 13 is midway between the stops 15 and 16, provided on the top of 3 of the casing, said contact segments will all be out of engagement with their corresponding contact fingers. It will thus be seen that such a position of the operating handle corresponds to the off position of the controller. When the operating handle 13 is moved in one direction the contact segments 24 will each engage one pair of contact fingers 27 and 28, while the segments 26 will each engage one pair of contact fingers 30 and 31. When the operating lever is thrown in the opposite direction, the contact segments 24 and 26 will be disengaged from their respective contact fingers, while each of the contact segments 25 will be thrown into engagement with one pair of the contact fingers 29 and 30.

The contact fingers may be of any preferred type. Each set of contact fingers is secured to an insulating base 32, said insulating bases being secured at their ends to portions of the supporting bracket 10. Each contact finger is provided at its rear end with a binding clip 33 for receiving the end of a suitable lead or conductor, and said clips are preferably disposed at an angle to facilitate the insertion of the conductors or leads therein. Certain of the contact fingers are adapted to be connected to conductors arranged to pass through the casing. I prefer to have such conductors pass through the top of the casing adjacent to the rear edge thereof. I, therefore, provide, adjacent to the rear edge of the top, a series of apertures in each of which I prefer to place an insulating bushing or sleeve 34. On the under side of the top, and preferably formed integrally therewith, I provide a pair of parallel walls 35 on opposite sides of the series of apertures. In order to firmly hold the insulating bushings or sleeves 34 in place, I preferably fill the space between said sleeves and the walls 35 with a suitable cement. Any desired number of apertures may be provided in the top 3. The leads passing through these apertures may be connected to the supply lines and to the terminals of the motor.

Secured to the back of the bracket 10, by bolts 36, are a pair of transformer or compensator frames 37. Each of these frames is preferably rectangular in form and made up of a plurality of laminations. The laminations of the top and bottom of each frame are disposed at right angles to the laminations of the side portions of said frame. Each of the end pieces and side pieces of the frame is formed of laminæ of two different lengths arranged alternately, thereby enabling the longest laminæ of the side pieces and end pieces to be interfitted to produce a substantially solid frame. The laminations of each member of the frame may be secured together by any suitable means, such as rivets 39, and the several members of the frame may be secured together by similar means. Surrounding the outside vertical member of each frame is a transformer or compensator winding 40. Each of the windings 40 is adapted to be connected to certain of the switch contacts previously described. In practice I prefer to provide each of the windings 40 with a plurality of taps having leads 41 extending therefrom, adapted to be interchangeably connected to certain of the contact fingers of the controlling switch. With this arrangement, the potential impressed upon the motor in starting may be adjusted to meet different requirements.

As will be hereinafter explained, when the device described is used for controlling a motor, the operating handle 13 should first be thrown to the left to establish starting connections for the motor, and then thrown to the extreme right to establish running connections therefor, it being remembered that the operating handle is in the off position when midway between the stops 15 and 16. In order to insure the proper operation of the handle in starting the motor, I have provided means for rendering it impossible, or at least very difficult, to throw the operating lever into running position from its off position. The means which I have shown for accomplishing this result comprises a member 45 mounted on the operating shaft 12 above the frame 20 and secured thereto by a pin 46. The member 45 is provided with a cam 47 having notches 48 and 49 in the periphery thereof. The notches 48 and 49 are arranged to receive a roller 50, carried at the end of a lever 51 fulcrumed on a pin 52 carried by the top 3 of the casing. The lever 51 has a bifurcated tail piece 53 between the bifurcations of which extends a bolt 54 which is secured to a lug 55 projecting downwardly from the top 3. The rod passes through the lug and is held in place by means of nuts 56. At its outer end the rod carries a disk or collar 57, held thereon by nuts 58. Surrounding the rod, and interposed between the collar 57 and the tail piece of the lever 51, is a coiled spring 59. The tendency of the spring 59 is to turn the lever 51 so as to hold the roller 50 against the periphery of the cam 47. The right hand edge or side of each of the notches 48 and 49 curves or slants away from the center thereof. It will thus be seen that as the cam 47 is moved to the left the curved or inclined edge of either notch, in which a roller is disposed, will gradually force said roller outwardly onto the outer periphery of the cam 47. It will thus be seen that, inasmuch as the handle moves in the same direction as the cam, said handle may be moved to the

left with little or no opposition from the roller 50. On the other hand, it will be noted that the left hand edge of the notch 49, in which the roller 50 rests when the operating arm 13 is in the off position, is so curved as to render it very difficult, if not impossible, to move said roller outwardly by attempting to turn the cam to the right. Hence, while it is possible to move the operating handle and cam to the left from the off position, it is very difficult, if not impossible, to move said handle and said cam to the right from off position, thus insuring the proper initial movement of the operating handle to start the motor. To permit the operating handle to be thrown from the starting position to running position, I provide the cam 47 with an elongated portion onto which the roller 50 is thrown as it leaves the notch 49. When the roller 50 reaches this position the operating handle is in starting position. When the roller 51 is in this position the operating handle may be thrown into running position before said roller has time to reënter the notch 49. However, to accomplish this, the operating handle must be moved very quickly. When the operating handle reaches running position the roller 50 will enter the notch 48 and tend to hold the controller in this position. The operating handle may be returned to the off position any time by forcing the same to the left, whereupon the roller 50 will be gradually forced out of the notch 48, and when the operating handle reaches the off position, will reënter the notch 49.

For returning the controller to the off position, should it be inadvertently left in starting position, I provide a coiled spring 60 surrounding the shaft 12, one end of which bears against a lug 61 provided on the underside of the top 3, and the other end of which bears against a lug 62 on the cam 7. It will be seen that when the cam is moved to the left the spring 60 will be put under tension and will return the controller to off position should the operating handle be released.

With the structure which I have described, it will be seen that the top of the casing carries all parts of the switch mechanism and the transformer, and that by removing the lower portion of the casing all the parts will be rendered accessible. The switch may then be readily connected to different taps of the transformer winding, as desired.

Fig. 7 illustrates diagrammatically one circuit arrangement for the device described. In this circuit arrangement the contact fingers 27 of the controller are connected by conductors 67 and 68 to the line conductors 64 and 66, respectively, of a three-phase circuit. Each of the contact fingers 28 is connected to a terminal of one of the transformer windings, while the opposite terminals of said windings are connected by conductors 69 and 70 to the line conductors 65. The contact fingers 29 are connected by conductors 71 and 72 to conductors 67 and 68, respectively, through suitable fuses 73. Two terminals of the motor are connected, by conductors 74 and 75, directly to the contact fingers 30, while the third terminal thereof is connected to conductor 69 by conductor 76. The contact fingers 31 are each connected to one of the taps of the transformer windings.

As already stated, to start the motor the controller handle should first be moved to the left to cause the contact segments 24 to electrically connect the contact fingers 27 and 28, and the contact segments 26 electrically connect the contact fingers 30 and 31. Bridging of the contact fingers 27 and 28 causes each of the transformer and compensator windings 40 to be connected across one phase of the supply circuit. For instance, one terminal of the left hand transformer winding is connected through the contact segment 24 and conductor 68 to line conductor 66, while its opposite terminal is connected by conductor 69 to the line conductor 65. In a similar manner one terminal of the other winding is connected through contact segment 24 and conductor 67 to line conductor 64, while the opposite terminal is connected by conductors 70 and 69 to line conductor 65. It will thus be seen that the transformer windings are connected across different phases of the supply circuit. Bridging of the contact fingers 30 and 31 results in connecting the motor to the transformer windings to start the motor. The starting potential may be adjusted, as desired, by connecting the contact fingers 31 to different taps of the transformer windings. During the starting period, the fuses 73 are not connected in circuit. With the controller in the position described one phase of the motor circuit extends from line conductor 66 by conductor 68 through one transformer winding, or part thereof, across one contact segment 26 by conductor 75 to one terminal of the motor to another line conductor, as by way of conductor 76 to line 65. Another phase extends from line conductor 64 by conductor 67 through the other transformer winding across the other contact segment 26 by conductor 74 to one terminal of the motor, and thence from another terminal of the motor to another line conductor. To establish running connections the controller should be moved to the left to cause each of the segments 25 to bridge one pair of the contact fingers 29 and 30. This results in disconnecting the transformer windings from circuit and connecting the motor directly to the supply lines through the fuses 73. With the controller in this position, one terminal

of the motor is connected by conductor 74 across one of the segments 25 by conductor 71 through a fuse 73 and conductor 67 to line conductor 64. A second terminal is similarly connected by conductors 76 and 69 to line conductor 65.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. In combination, a fluid containing casing, a stationary bracket therein, a transformer fixed to said bracket, and a controlling switch mounted on said bracket independently of said transformer.

2. In combination, a fluid containing casing, and a transformer and controlling switch suspended from the top of said casing, said transformer being fixed and said switch being arranged to one side of said transformer.

3. In combination, a fluid containing casing, a bracket depending from the top of said casing, a switch mounted upon said bracket including two series of contacts and a rotatable drum between the same, and a transformer fixed to said bracket at one side of said switch.

4. In combination, a fluid containing casing, a bracket depending from the top of said casing and formed integrally therewith, a transformer mounted on one side of said bracket, and a controlling switch revolubly mounted on the opposite side of said bracket.

5. In combination, a fluid containing casing, a bracket depending from the top thereof and provided at one side with a pair of spaced upright members, contacts mounted on said members, a coöperating contact drum rotatably mounted between said members, and a transformer fixed to said bracket in a spaced relation with said drum.

6. In an alternating current motor controller, in combination, a fluid containing casing, a bracket depending from the top of said casing, a transformer and controlling switch carried by said bracket, the winding of said transformer having a plurality of taps arranged to be directly and interchangeably connected to the stationary contact or contacts of said switch.

7. In an alternating current motor controller, in combination, a fluid containing casing, a bracket depending from the top of said casing, a transformer and controlling switch carried by said bracket, the winding of said transformer having a plurality of taps arranged to be directly and interchangeably connected to the stationary contact or contacts of said switch, the top of said casing having a series of apertures therein for receiving the conductors inserted in said casing.

8. In a controller for alternating current motors, in combination, a fluid containing casing, a bracket depending from the top of said casing, a laminated transformer frame secured to one side of said bracket, a winding carried by said transformer frame, a controlling switch mounted on the opposite side of said bracket, said transformer winding having a plurality of taps adapted to be interchangeably connected to said switch.

9. In a controller for alternating current motors, in combination, a fluid containing casing, a bracket depending from the top of said casing, a pair of laminated transformer frames secured to one side of said bracket, a winding carried by each of said transformer frames, a controlling switch revolubly mounted on the opposite side of said bracket, said windings having a plurality of taps adapted to be interchangeably connected to said switch.

10. In combination, a transformer, a control switch having movable contacts and stationary contacts, a casing inclosing said transformer and said switch and connection leads to and from said switch including leads for said transformer, all of said leads being connected to the stationary contacts of said switch.

11. In combination, a fluid containing casing, a substantially centrally disposed bracket depending from the top of said casing, a transformer mounted on one side of said bracket, and a controlling switch mounted on the opposite side of said bracket.

12. In combination, a fluid containing casing, a transformer and a controlling switch suspended from the top of said casing, said controlling switch including a revoluble contact carrying drum free of all connection leads.

13. In combination, a fluid containing casing, bracket depending from the top thereof, a transformer and controlling switch for said transformer mounted on said bracket, said switch comprising stationary contacts and a revoluble contact carrying drum, and circuit connections to and from said switch including connections between said transformer and said switch, all of said connections being made directly with the stationary contacts of said switch.

14. In a controller for alternating current motors, in combination, a casing, a transformer and controlling switch arranged therein, said switch having two operative positions and an intermediate position, means necessitating movement of said switch to said operative positions in a definite sequence, and means biasing said switch from its first operative position to its intermediate position.

15. In combination, a rotatable switch member movable into two operative positions from an intermediate position said switch member being biased to said intermediate position, a cam movable with said

member, a spring pressed pawl having a roller engaging the periphery of said cam and arranged to enter a notch in said cam to oppose the movement of said member to one of said operative positions from said intermediate position, said member being free to move from the first operative position to the other.

16. In combination, a rotatable switch member movable into two operative positions from and intermediate position, said switch member being biased to said intermediate position, a cam movable with said member, a spring pressed pawl having a roller engaging the periphery of said cam and arranged to enter a notch in said cam to oppose the movement of said member to one of said operative positions from said intermediate position, said member being free to move from the first operative position to the other, said roller being adapted to enter a second notch in said cam when said member is moved into the second operative position.

17. In a controller for alternating current motors, in combination, a fluid containing casing, a bracket depending from the top of said casing, a pair of transformer frames secured to one side of said bracket, a winding carried by each of said transformer frames, a shaft rotatably mounted on the opposite side of said bracket, a contact drum carried by said shaft, two sets of contact fingers carried by said bracket and arranged to be engaged by the contacts on said drum, one of each set of contact fingers being adapted to be connected to different points on one of the transformer windings, said drum being movable in opposite directions from an intermediate position to establish starting and running connections for the motor.

In witness whereof, I have hereunto subscribed my name in the presence of two witnesses.

ARTHUR SIMON.

Witnesses:
FRANK H. HUBBARD,
SHEPLER W. FITZGERALD.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."