H. W. CHENEY.

CONTROLLER.

APPLICATION FILED NOV. 1, 1907.

916,843.

Patented Mar. 30, 1909.

3 SHEETS—SHEET 1.

Fig. 2.

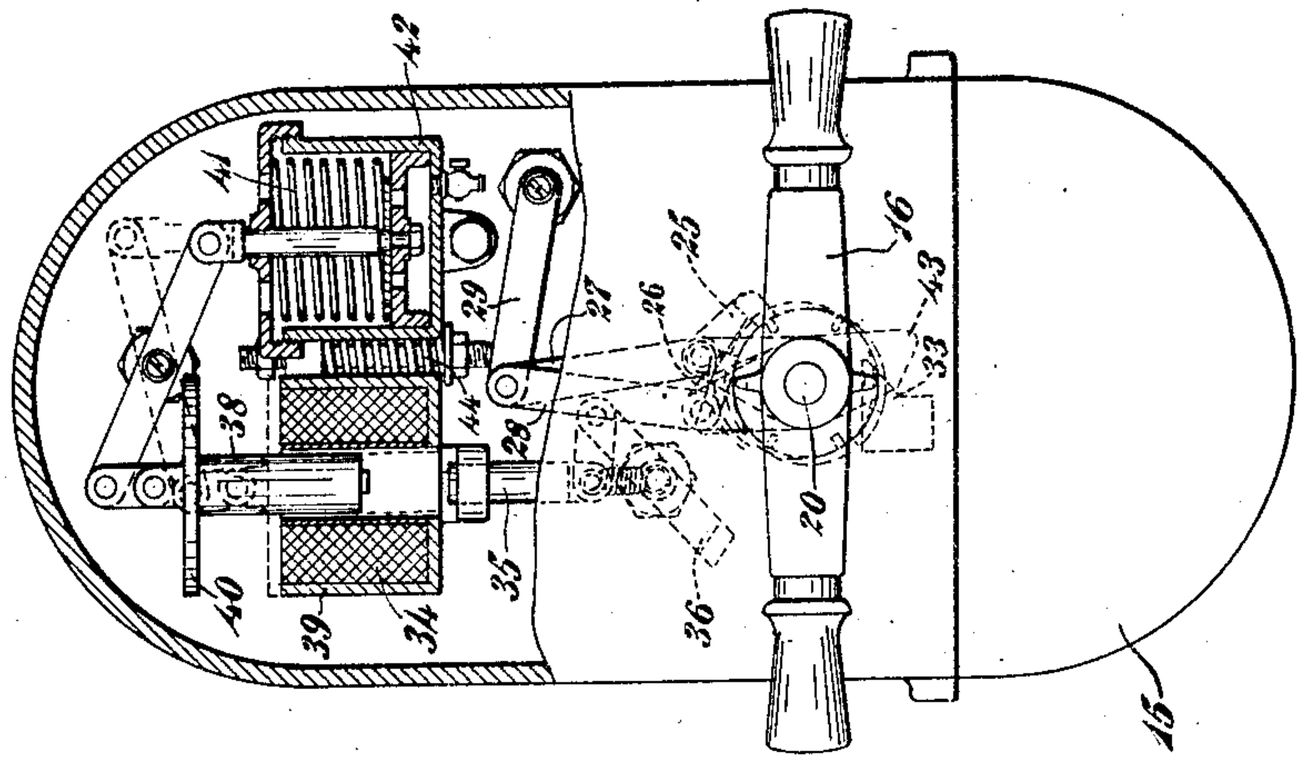
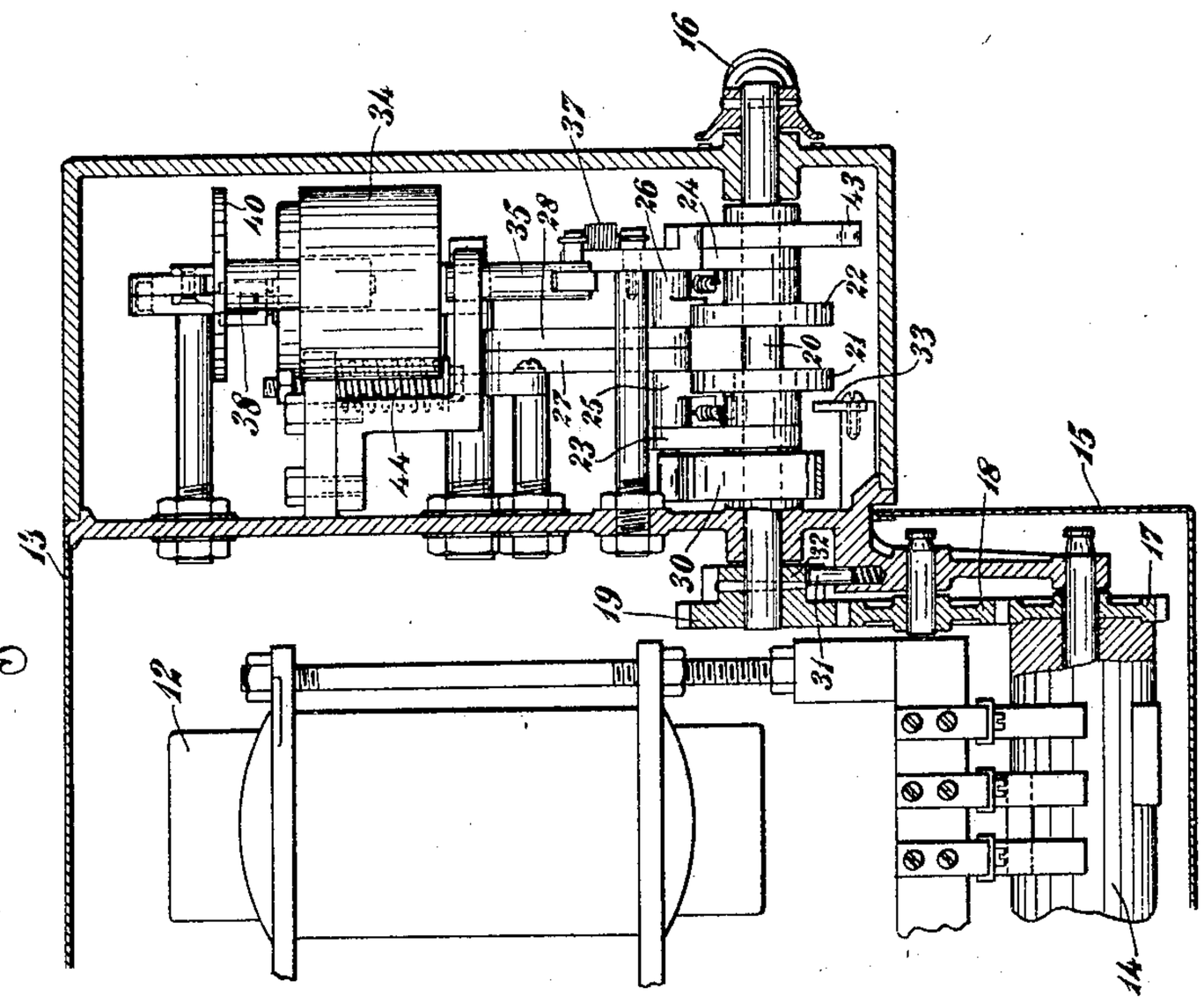


Fig. 1.



Witnesses

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3 SHEETS—SHEET 2.

Fig. 4.

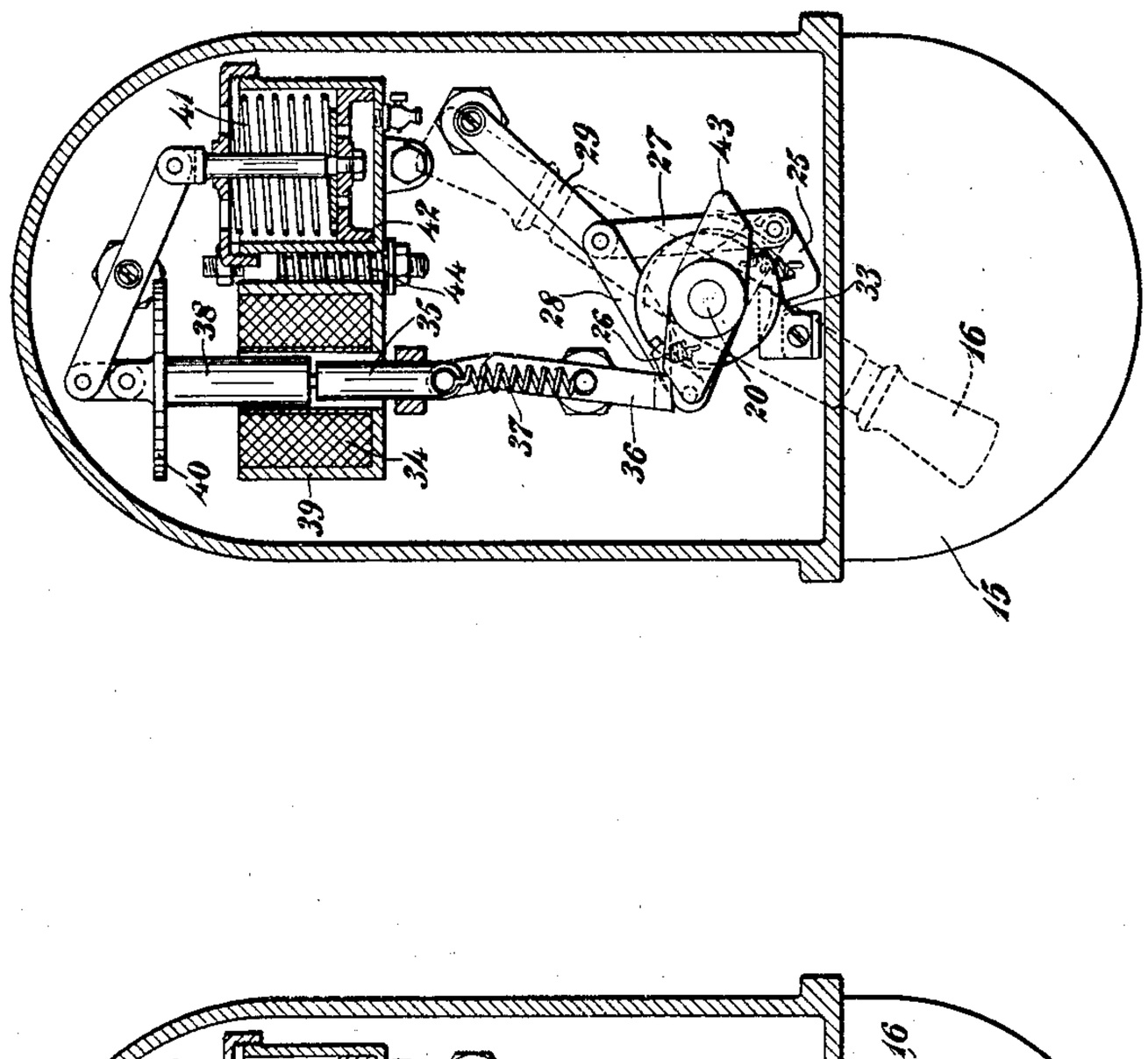
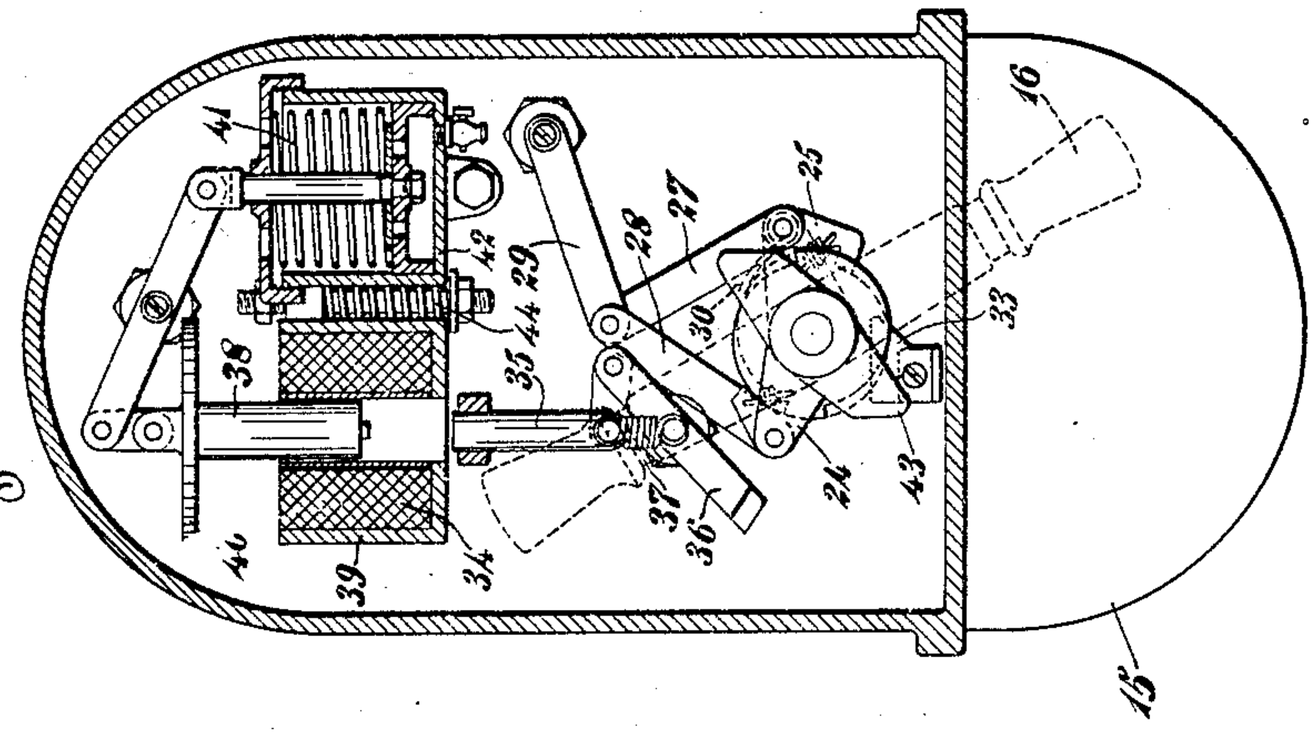


Fig. 3.



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3 SHEETS—SHEET 3.

Fig. 7

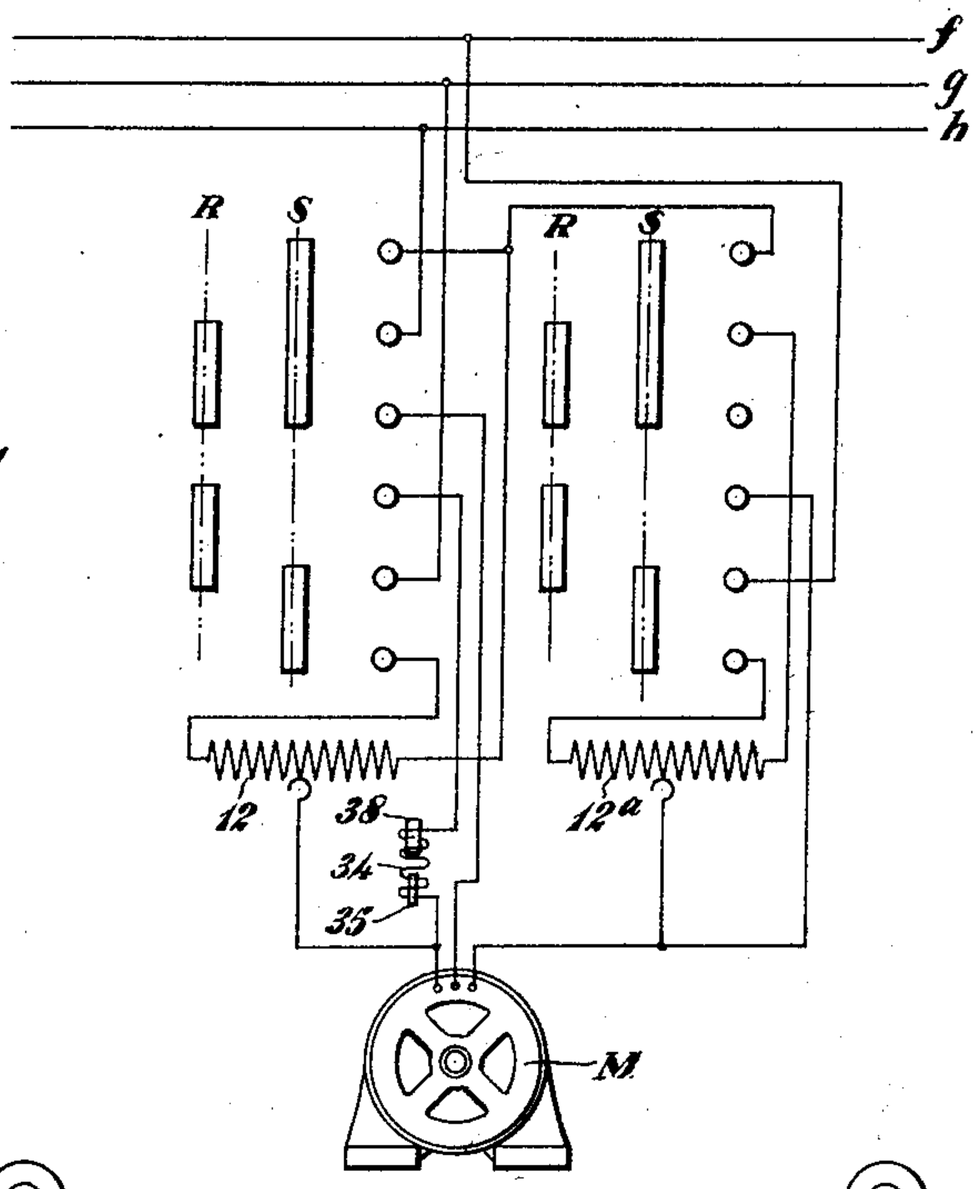


Fig. 5

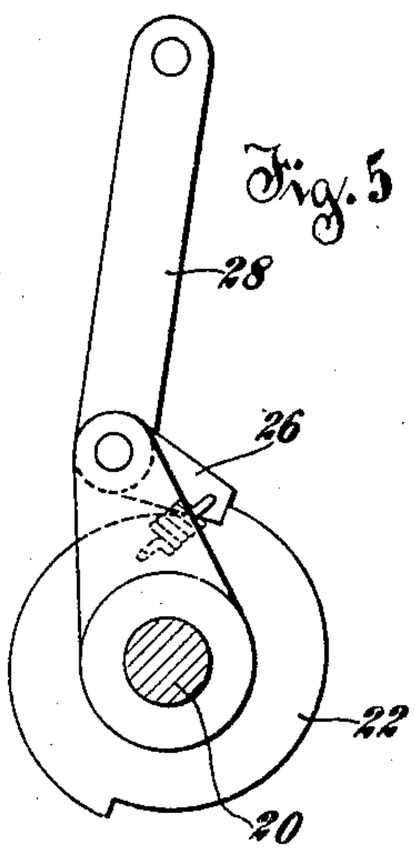
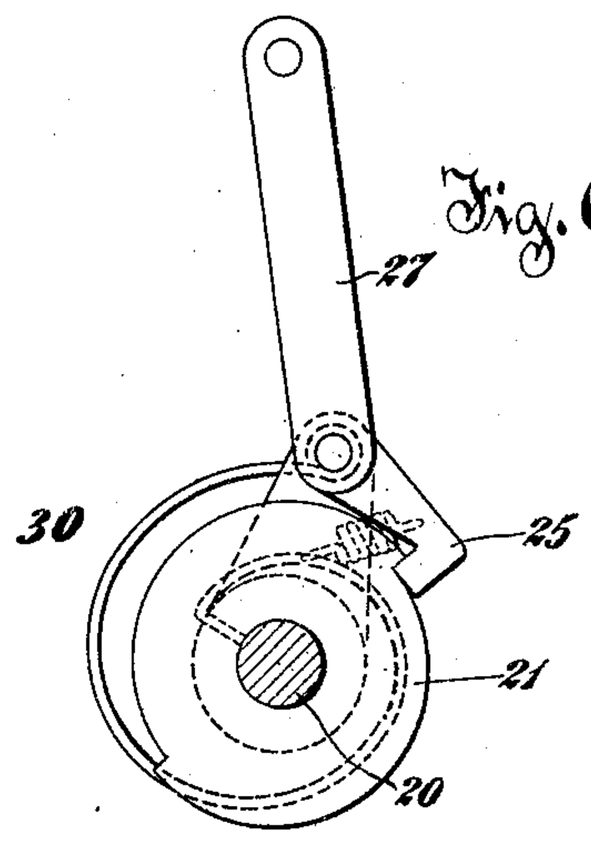


Fig. 6



Witnesses

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UNITED STATES PATENT OFFICE.

HERBERT W. CHENEY, OF NORWOOD, OHIO, ASSIGNOR TO ALLIS-CHALMERS COMPANY, A CORPORATION OF NEW JERSEY, AND THE BULLOCK ELECTRIC MANUFACTURING COMPANY, A CORPORATION OF OHIO.

CONTROLLER.

No. 916,843. Specification of Letters Patent. Patented March 30, 1909.

Application filed November 1, 1907. Serial No. 400,209.

To all whom it may concern:

Be it known that I, HERBERT W. CHENEY, citizen of the United States, residing at Norwood, in the county of Hamilton and State of Ohio, have invented certain new and useful Improvements in Controllers, of which the following is a full, clear, and exact specification.

My invention relates to starting controllers for electric motors, and more particularly to fool-proof potential starters for polyphase induction motors.

In operating starting devices for some types of motors, especially potential starters for induction motors, it is often undesirable that the controller be moved backward from a running to a starting position. To this end controllers have been designed which move directly from the running to the off position without passing through the starting positions.

In my co-pending application Serial No. 264,162, filed June 7, 1905, there is described a potential starter in which means are provided for preventing the controller from being moved backward from a running to a starting position or from an off position directly to a running position, while allowing a backward movement of the controller from any starting position. It is possible however for controllers such as are there shown to be left in a starting position indefinitely instead of being moved to running position as soon as the motor has gained sufficient speed. As the various windings which are connected in circuit when the controller is in a starting position are not proportioned to carry current continuously but only for a brief period during starting, the result of leaving the controller indefinitely in a starting position may be to cause such windings to be burned out.

In my prior patent No. 864,446, dated Aug. 27, 1907, there is described an arrangement in which it is impossible for an operator to leave the controller in a starting position, arrangements being provided for automatically moving the controller backward to off position if it is released by the operator while it is in a starting position. It may also sometimes be desirable to have means whereby with such a controller as shown in said prior application and patent means are provided for automatically moving the controller forward from running position to off position in case abnormal conditions, such as "no voltage" or an overload, arise.

It is the object of my present invention to provide such means.

The novel features of my invention will appear from the description and drawings and will be particularly pointed out in the claims.

Figure 1 is a side elevation of a controller embodying my invention, the casing and some of the operative parts being shown in section; Fig. 2 is an end elevation of the controller of Fig. 1, the casing and dash-pot in the upper part of the figure being in section and the controller being in off position; Figs. 3 and 4 are views somewhat similar to Fig. 2, but with the controller in starting and running positions respectively and with more parts in section; Figs. 5 and 6 are details of the notched disks on the handle shaft, together with their coöperating dogs and levers; and Fig. 7 shows a diagram of the electrical connections.

The details of the starting controller proper will not be fully described herein because they form no part of the present invention and are unnecessary to an understanding thereof. What does not appear in the following description is fully set forth in my aforesaid co-pending application.

The three-phase induction motor M is supplied with current from three-phase mains *f*, *g* and *h*. When the controller is in starting position the auto-transformer windings 12 and 12^a, which are within the casing 13, are each connected between two of the mains, the main *h* being connected to one terminal of each winding. One of the terminals of motor M is connected to those two terminals of the windings 12 and 12^a which are connected in common to the main *h* and the other two motor terminals are connected to intermediate points on the auto-transformer windings 12 and 12^a respectively. The windings 12 and 12^a thus constitute in effect a single V-connected auto-transformer, the main *h* and the middle terminal of the motor being connected to the middle of the V. When the controller is in running position the auto-transformer windings 12 and 12^a are entirely disconnected and the motor terminals are connected to the three mains respectively. In the controller shown there is but one

starting position between off and running positions, but it is obvious that any desired number of such starting positions may be employed.

The normal operation of the controller is continuously in the same direction, a movement through 180° constituting a complete operation. The controller drum 14, which is immersed in oil in the tank 15, is moved by the operating handle 16 through the gear wheels 17, 18 and 19. The two opposite halves of the controller drum are identical in structure and each half coöperates in turn with each of two sets of contact fingers during successive operations of the controller, the sets of contact fingers being on opposite sides of the drum and arranged to simultaneously co-act with the two halves of the drum respectively.

Fixed on the shaft 20, which carries the gear 19 and handle 16, are two notched disks 21 and 22. Loosely mounted on the same shaft in juxtaposition to the disks 21 and 22 respectively are arms 23 and 24. Carried at the ends of the arms 23 and 24 are pawls 25 and 26 respectively, said pawls being spring-pressed inwardly against the edges of the disks 21 and 22 respectively. Two links 27 and 28 connect the ends of the arms 23 and 24 to the free end of an arm 29. The arm 23 is biased in a counter-clockwise direction, as by means of the spiral spring 30.

When the controller is in off position O the parts are as shown in Figs. 1, 2, 5 and 6. By moving the handle 16 substantially 60° in a clockwise direction, the starting position S illustrated in Fig. 3, is reached, and the motor is connected to the supply circuit through the anto-transformer windings 12 and 12ª. The starting position may be accentuated if desired by means of a plunger 31 which coöperates with the notch disk 32, the latter being preferably integral with the gear 19. As the controller is thus moved from the off to the starting position, the disk 21 by its engagement with the pawl 25 carries the arm 23 in a clockwise direction with it, winding up the spring 30, and through the links 27 and 28 and the arm 29 also moves the arm 24 in a counter-clockwise direction. If the operator releases his grasp on the handle 16 with the controller in this position, the spring 30, unwinding, carries the controller back to the off position, shown in Fig. 2. Thus it is impossible for the controller to be left in the starting position without attention.

If the operator does not release his grasp on the handle 16 while the controller is in starting position, but when the motor has gained sufficient speed moves said handle substantially 60° farther in a clockwise direction, the controller is brought to running position R, as shown in Fig. 4. As the shaft 20 is thus moved, the disk 21 through its engagement with the dog 25 carries the arm 23 farther in a clockwise direction, further winding the spring 30, and also through the links 27 and 28 and the arm 29 forces the arm 24 farther in a counter-clockwise direction. As the parts approach the running position, the dog 26 drops into one of the notches of the disk 22 and slightly later the cam 33 forces the dog 25 out of the notch in the disk 21 with which it has been in engagement. Backward movement from this running position is prevented by the dog 26 and the tooth of the disk 22. For further insuring the prevention of such backward movement from this position, the notches of the disk 32 may be so shaped that because of the engagement of the plunger 31 with said disk such backward movement is impossible.

With the controller in the running position the solenoid 34 is energized, being connected in one or partly in each of more than one of the motor leads. With normal current this solenoid lifts the smaller core 35 to bring the latch 36 into position to prevent clockwise movement of the arm 24, which would occur if the handle 16 were released by the operator at this point if such a latch were not provided. However, with the arrangement shown the operator may release his grasp on the handle 16 at this time and leave the motor for its normal operation.

In case the supply of current fails the solenoid 34 acts as a "no voltage" release magnet to allow the core 35 to drop under the combined influence of gravity and the spring 37 to move the latch 36 out of the path of the arm 24. This permits the spring 30, through the arm 23, links 27 and 28 and arm 29 to move said arm 24 back to the position in which it is shown in Fig. 1, in this movement carrying the disk 22, and through it the controller proper, in a clockwise direction to the off position, this off position being 180° from the off position from which the start was made.

If with the controller in the running position an overload on the motor occurs, the strength of the solenoid 34 is increased and said solenoid pulls down the core 38. The core 38, descending, forces the smaller core 35 out of the solenoid 34, and in the same manner as above described for the "no voltage" condition releases the latch 36 to allow the spring 30 to move the controller forward to off position. The solenoid 34 and its iron casing 39 are so designed that the reluctance of its magnetic circuit is decreased by the descent of its core 38 and the iron plate 40 carried by said core, although the core 35 is forced outward. The extent of the overload necessary to trip the controller may be determined by adjusting the spring 41, while the action of the overload release is controlled by an adjustable time limit device 42,

such as a dash-pot provided with a pet-cock, so that momentary overloads will not trip the controller.

When with the controller in running position it is desired to stop the controlled motor, the operator moves the handle 16 approximately 60° still farther in a clockwise direction, thus bringing the controller drum again to off position and breaking all circuits. However, in order to prevent the dog 26 from striking a heavy hammer-blow upon a tooth of the disk 22 after the circuit is broken, a cam 43 is provided for forcing the latch 36 out of engagement with the arm 24 as soon as clockwise movement of the arm 16 from the running position has been started. Instead of or besides using this device, a buffer spring 44 may be provided for receiving the shock of any hammer-blow, such spring being located at any desired point, as above the arm 29.

When the controller is thus brought to running position, whether manually or automatically, the dog 25 drops into the other notch of the disk 21 so that the controller may again be moved forward from off position, and the action above described be repeated.

Many modifications may be made in the particular arrangement here shown and described and the spirit of the invention still be retained. All such modifications I aim to cover in the following claims.

What I claim as new is:—

1. A controller biased backward to off position when in any starting position and biased forward to off position when in running position.

2. A controller the movable member of which is biased backward to off position when in any starting position and biased forward to off position when in running position, and means for normally locking said movable member against forward movement when in running position.

3. A controller biased backward to off position when in any starting position and biased forward to off position when in running position, means for normally locking said controller against forward movement when in running position, and means for releasing said controller from said locking means.

4. A controller biased backward to off position when in starting position and biased forward to off position when in running position, means for normally locking said controller against forward movement when in running position, and means for manually releasing said controller from said locking means.

5. A controller the movable member of which is biased backward to off position when in any starting position and biased forward to off position when in running position, means for normally locking said movable member against forward movement when it is in running position, and means responsive to "no voltage" for releasing said movable member from said locking means.

6. A controller the movable member of which is biased backward to off position when in any starting position and biased forward to off position when in running position, means for normally locking said movable member against forward movement when it is in running position, and means responsive to an overload for releasing said movable member from said locking means.

7. A controller biased backward to off position when in any starting position and biased forward to off position when in running position, means for normally locking said controller against forward movement when in running position, and means responsive to "no voltage" or overload for releasing said locking means.

8. A controller biased backward to off position when in starting position and biased forward to off position when in running position, means for normally locking said controller against forward movement when in running position, means responsive to an overload for releasing said locking means, and a time limit device for controlling said releasing means.

9. A controller biased backward to off position when in starting position and biased forward to off position when in running position, means for normally locking said controller against forward movement when in running position, means responsive either to "no voltage" or overload for releasing said locking means, and a time limit device for controlling the release on overload.

10. A controller biased backward to off position when in any starting position and when in running position biased forward to off position upon abnormal conditions in the circuit.

11. A controller biased in one direction when on one side of running position and in another direction when on the other side of running position.

12. A controller for electric motors comprising fixed and movable contacts, the latter being biased backward to off position when in any starting position, and biased forward to off position when abnormal conditions arise while it is in running position.

13. In a controller, contact fingers, a rotatable drum coöperating therewith, said drum having off, starting and running positions, and a spring which tends to move said drum backward to off position when the latter is in any starting position and tends to move said drum forward to off position when the latter is beyond running position.

14. In a controller, contact fingers, a rotatable drum coöperating therewith, said drum having off, starting and running positions,

and a spring which tends to move said drum backward to off position when the latter is in any starting position and tends to move said drum forward to off position when the latter is in running position.

15. In a controller, contact fingers, a rotatable drum coöperating therewith, said drum having off, starting and running positions, a spring which tends to move said drum backward to off position when the latter is in any starting position and tends to move said drum forward to off position when the latter is in running position and there is an overload on the circuit.

16. In a controller, contact fingers, a rotatable drum coöperating therewith, said drum having off, starting and running positions, and a spring which tends to move said drum backward to off position when the latter is in any starting position, and tends to move said drum forward to off position when the latter is in running position and "no voltage" conditions arise in the circuit.

17. A controller biased backward to off position when in starting position, locked against backward movement when in running position, and biased forward to off position when while in running position abnormal conditions arise.

18. A controller for electric motors comprising fixed and movable members, and a spring which tends to move the movable member backward to off position when it is in any starting position and forward to off position when it is beyond running position.

19. In a controller, contact fingers, a rotatable contact-carrying member coöperating therewith, said member having off, starting and running positions, and means whereby said member is biased to off position in opposite directions when on opposite sides of the running position.

20. A controller for electric motors comprising a rotatable drum, contact fingers cooperating therewith, means for preventing backward movement of the drum from the off or the running position, and means which tend to move the drum backward to off position when the latter is in any position from which it may be moved backward and forward from the running position to the off position upon the occurrence of abnormal conditions.

21. A controller for electric motors comprising a rotatable drum, contact fingers cooperating therewith, means for preventing backward movement of the drum from the off or the running position, and means which tend to move the drum backward to off position when the latter is in any position from which it may be moved backward and forward from the running position to the off position when there is an overload on the controlled motor.

22. A controller for electric motors comprising a rotatable drum, contact fingers cooperating therewith, means for preventing backward movement of the drum from the off or the running position, and means which tend to move the drum backward to off position when the latter is in any position from which it may be moved backward and forward from the running position to the off position upon a "no voltage" condition.

23. A controller for electric motors so constructed and arranged that it will automatically be moved backward if released by the operator in any starting position, and will be automatically moved forward if abnormal conditions arise while it is in running position.

24. In a controller, contact fingers, a rotatable contact-carrying member coöperating therewith, said member having off, starting and running positions, and means which tends to move said member backward to off position when the latter is in any starting position and tends to move said member forward to off position when the latter is in running position.

25. In a controller, contact fingers, a rotatable contact-carrying member coöperating therewith, said member having off, starting and running positions, a spring which tends to move said member backward to off position when the latter is in any starting position, but moves said member forward to off position when the latter is in a running position and there is an overload on the circuit.

26. A controller which when in any starting position tends to move to off position without passing through running position and when in a running position tends to move to off position without passing through starting position.

27. A controller biased in one direction when on one side of running position and in another direction when in running position or on the other side thereof.

28. A controller which when in a starting position is biased to one open-circuiting position and when in a running position is biased to another open-circuiting position.

29. A controller having a plurality of off positions, the movable member of said controller being biased toward one of said off positions when in one operative position, and biased toward another of said off positions when in another operative position in the same operation of the controller.

30. A controller having a plurality of off positions, and means whereby the movable member of said controller will be moved automatically to one of said off positions when released by the operator on one side of a running position and automatically moved to another of said off positions when released by the operator on the other side of such running position.

31. A controller having a plurality of off

positions, and means whereby the movable member of said controller will be moved automatically to one of said off positions when released by the operator on one side of a running position and automatically moved to another of said off positions when released by the operator on the other side of such running position and automatically moved to the latter of said off positions when abnormal conditions arise while it is released in such running position.

32. A controller for electric motors arranged to be always normally moved in the same direction, and means whereby said controller will be automatically moved to off position if released by the operator at any point on either side of running position, and will also be moved to off position if while released by the operator in running position abnormal conditions in the circuit occur.

33. A controller for electric motors arranged to be always normally moved in the same direction, and means whereby said controller will be automatically moved to off position if released by the operator at any point on either side of running position.

34. In a controller, the combination of fixed and movable members, a spring which tends to move said movable member backward to off position when it is in a starting position and forward to off position when it is in a running position, and means for normally preventing said spring from acting on said movable member when the latter is in running position.

35. In a controller, the combination of fixed and movable members, a spring which tends to move said movable member backward to off position when it is in a starting position and forward to off position when it is in a running position, and means for preventing said spring from acting on said movable member when the latter is in running position unless abnormal conditions arise in the circuit controlled by such controller.

In testimony whereof I affix my signature, in the presence of two witnesses.

HERBERT W. CHENEY.

Witnesses:
GEO. B. SCHLEY,
FRED J. KINSEY