No. 871,205. PATENTED NOV. 19, 1907.

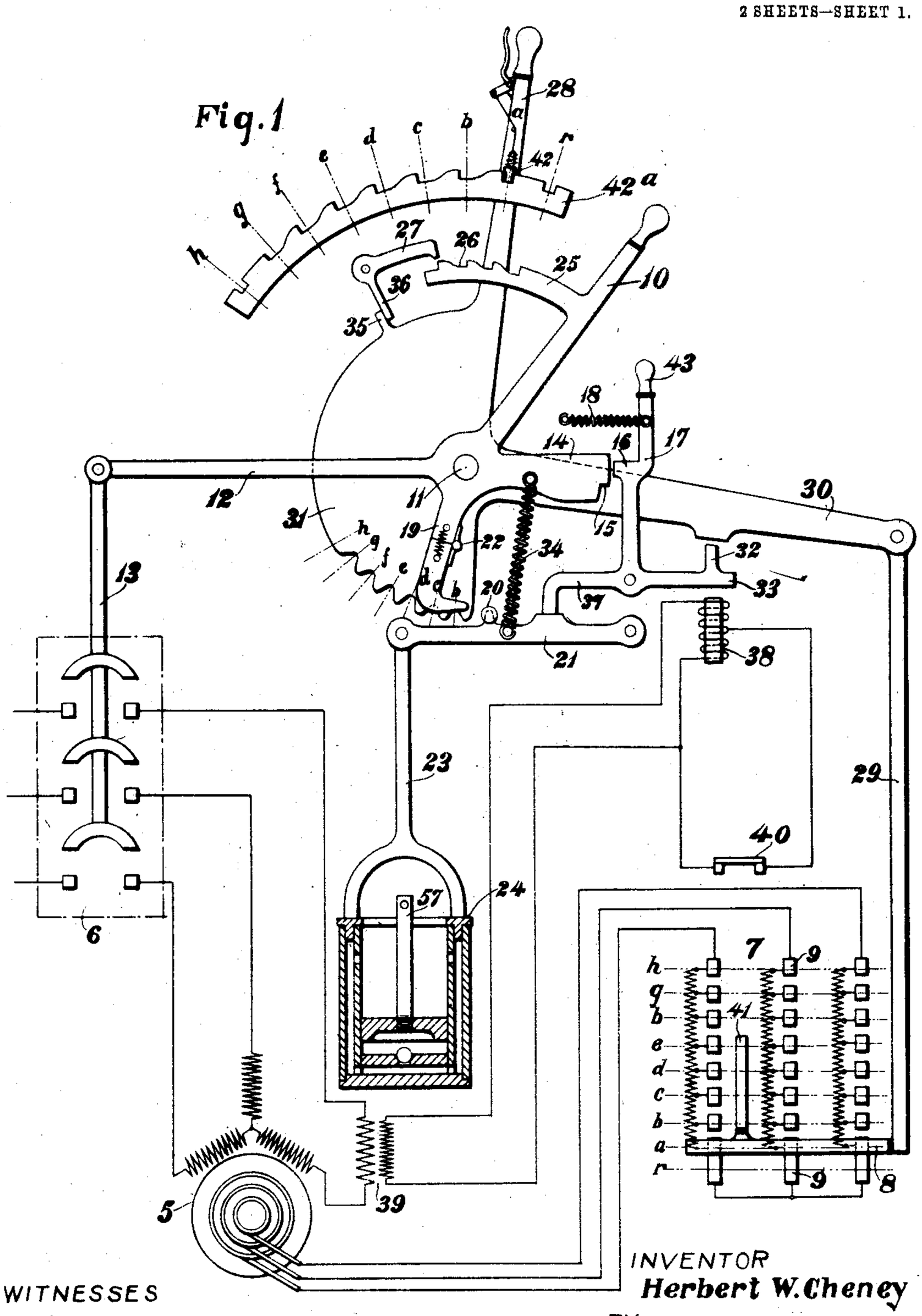
H. W. CHENEY.

CONTROLLING MECHANISM.

APPLICATION FILED JUNE 28, 1906.

2 SHEETS—SHEET 1.

Fig. 1



WITNESSES

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2 SHEETS—SHEET 2.

Fig. 2

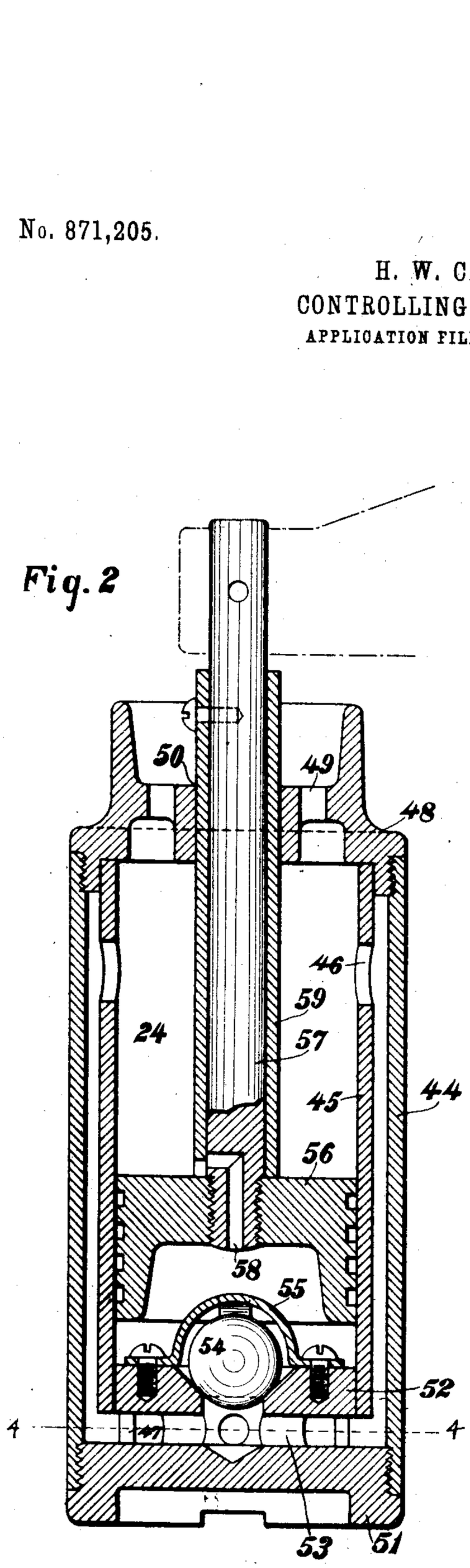


Fig. 3

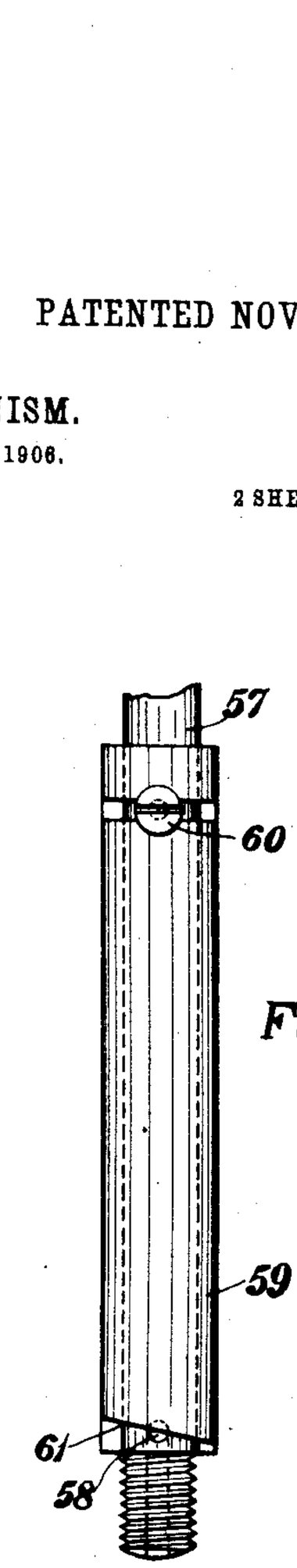
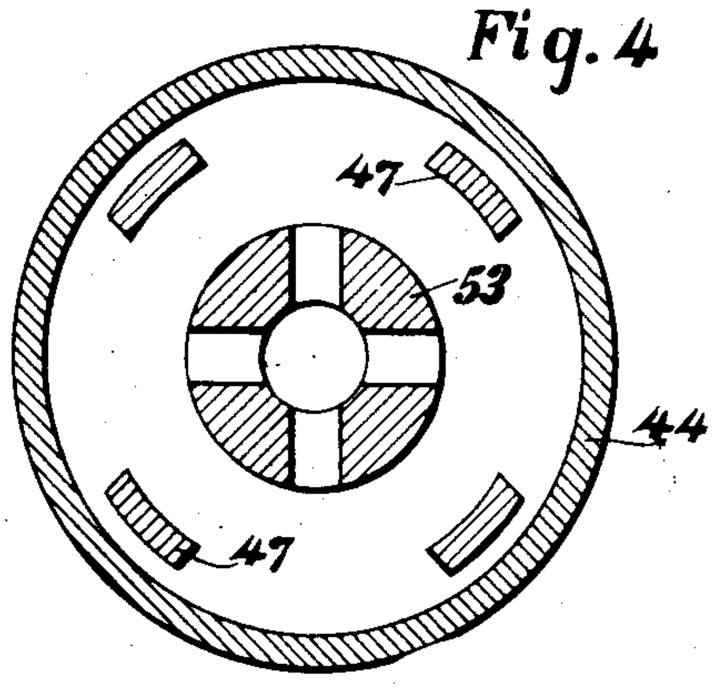


Fig. 4



WITNESSES

Oliver W. Thurman

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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.

CONTROLLING MECHANISM.

No. 871,205. Specification of Letters Patent. Patented Nov. 19, 1907.

Application filed June 28, 1906. Serial No. 323,789.

To all whom it may concern:

Be it known that I, HERBERT W. CHENEY, a 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 Controlling Mechanism, of which the following is a full, clear, and exact specification.

My invention relates to controllers for electric motors and particularly to resistance starters for induction motors.

Heretofore it has been common to provide means for preventing a starting controller from being moved too rapidly. Sometimes, however, for reasons hereinafter explained, it is desirable to prevent the controller from being moved too slowly, especially in starters for induction motors, and one of the objects of my invention is to provide means for doing this.

Another object of my invention is to provide means for breaking the main circuit of the motor in case any one of several undesirable things happen, such as a too rapid or too slow movement of the controller, or an overload on the motor.

Another object is to provide a novel interlocking means whereby the current-admitting switch cannot be moved unless the regulating switch is in proper position for such movement.

A further object of my invention is to provide, in connection with my starting device, an overload magnet which is more sensitive during normal running than during starting.

A still further object of my invention is to provide a novel form of dash-pot.

Other objects of my invention will appear hereinafter.

In one aspect my invention comprises a controller, means for breaking the circuit if the controller is moved too slowly.

In a more specific aspect my invention comprises the combination of a current-admitting switch, a regulating switch movable step by step, and means for tripping the current-admitting switch if the time interval between its closing and the first step of the regulating switch or between successive steps of the regulating switch is above a predetermined value.

Still more specifically my invention comprises the combination of a current-admitting switch, a resistance-varying switch movable step by step, a lever movable in one direction by the closing of the current-admitting switch and by each step of the resistance-varying switch, a spring for returning said lever to its normal position to trip the current-admitting switch, means for retarding the return movement of said lever, and an overload magnet for tripping said current-admitting switch when the load on the motor exceeds a predetermined limit.

In another aspect my invention comprises an induction motor, a starting resistance in the secondary thereof, means for cutting out said resistance, an overload magnet for breaking the primary circuit thereof if the current exceeds a predetermined value during starting, and means for increasing the sensitiveness of said magnet after the starting resistance has been cut out.

In still another aspect my invention comprises an induction motor, a switch for admitting current to the primary thereof, a starting resistance in the secondary thereof, a switch for gradually cutting out said resistance, and means whereby the current-admitting switch is tripped if the resistance-varying switch is moved at less than a predetermined speed in the direction to cut out resistance, or is moved in the other direction beyond highest resistance position, and means for preventing the closure of the current-admitting switch unless the whole starting resistance is in circuit.

From another point of view, my invention consists of a dash-pot forming part of my improved controlling device, which comprises an outer tube, an inner tube spaced from said outer tube to form an annular chamber between them, and a piston movable in said inner tube.

From still another point of view my invention consists of a dash-pot especially adapted for use in connection with a starting switch, which comprises a cylinder, a piston and piston rod slidable therein, said piston rod being provided with an opening, and a tube fitting around said rod and having a cut-away portion for adjusting the effective size of said opening.

Other features of my invention will appear from the following description in connection with the accompanying drawings, and will be specifically set forth in the claims.

Figure 1 shows the various features of my

invention, partly diagrammatically. Fig. 2 is a longitudinal section of my novel form of dash-pot. Fig. 3 is an elevation of the piston rod and surrounding tube of the dash-pot taken at right angles to the view shown in Fig. 1. Fig. 4 is a section on the line 4—4 of Fig. 2.

Referring more particularly to Fig. 1, the motor to be controlled, here shown as an induction motor is denoted by 5, the primary or stator winding of the motor being supplied through an oil switch 6. The secondary or rotor winding of motor 5 is connected to a starting resistance 7 arranged to be short-circuited or otherwise cut out by means of the bar 8 slidable over the contacts 9 of the resistance 7. This resistance is shown as being star connected in order to agree with the windings on the rotor, but it is obvious that if the rotor windings are delta-connected the resistance can be connected to correspond. The lowermost contacts 9 for each part of the resistance 7 are shown longer than the other contacts for a purpose to be hereinafter explained.

The switch is operated by means of a handle 10 pivoted on a shaft 11. This handle 10 is one arm of a complex lever, another arm 12 of which is connected to the operating rod 13 of the switch 6, a third arm 14 of which forms a latch plate, having a shoulder 15 with which a latch 16 on arm 17 of an inverted T-shaped lever engages, to hold the switch 6 in closed position, the arm 17 being drawn towards the left by means of a spring 18. There is a fourth arm 19 of this complex lever, the cam-like end of which when moved in one direction engages with a pawl 20 on lever 21 to force said lever 21 downwards, but when moved in the other direction, by reason of a hinge 22 slides over said roller 20 without moving it. The lever 21 is attached to a rod 23 which in turn is fastened to the cylinder of dash-pot 24, the piston 57 of said dash-pot being held firmly against movement. This dash-pot is constructed to allow free downward movement of the rod 23, but to retard the upward movement thereof, the structure of the dash-pot being explained hereinafter. The handle 10 is also provided with an arc-shaped extension 25 which has a number of notches 26 with which the pawl 27 is arranged to engage at certain times to prevent movement of said handle 10 to the left.

A second handle 28 is pivoted on shaft 11, and arranged to operate the resistance-varying bar 8 by means of a rod 29 and arm 30, the latter of which is integral with said handle 28. Also integral with the handle 28 is a notch plate 31. The sides of the notches of this plate form cams which engage the roller 20 of lever 21 to operate the dash-pot 24 in the same manner as arm 19 does. The last of the cams, which acts as handle 28 is moved into position *h*, is higher than the rest and has no notch beyond it, so that the lever 21 does not move upward when handle 28 is in position *h*, and also so that when handle 28 is moved backward from position *h*, the roller 20 will clear the tops of the other cams and avoid bumping. The handle 28 is shown in the position in which all the resistance is included in the rotor circuit, this position being marked *a*. It can be moved forward into positions *b*, *c*, *d*, etc. to its running position *h* at which time the whole starting resistance 7 is cut out. These positions are marked on the drawing for the resistance varying rod 8 as well as for the handle 28 and also for the parts of the notch plate which coöperate with roller 20. There is another position, marked *r*, for this handle 28 into which said handle is moved in order to cause the arm 30 to engage with a projection 32 on an arm 33 of the T-shaped lever of which latch-arm 17 forms the upright. This engagement causes latch 16 to be moved away from shoulder 15 thus allowing spring 34, which extends from arm 14 to lever 21, to open switch 6. The position *r* is therefore the releasing position.

Extending from notch plate 31 is a projection 35 arranged to engage an arm 36, integral with pawl 27. The parts 35 and 36 are in engagement, and pawl 27 is raised when the handle 28 is in position *a*, as shown, at which time the handle 10 is free to move to close the switch 6. If the handle 28 is in any of positions *b* to *h*, the parts 35 and 36 are out of engagement and pawl 27 rests against extension 25, and unless switch 6 is fully closed, engages in one of the notches 26 to prevent movement of handle 10 to the left. Parts 35 and 36 are also in engagement when the arm 28 is in position *r*, but at such time, although the arm 10 can be moved to close switch 6, it will not remain in such position after being released by the hand because of the non engagement between latch 16 and shoulder 15.

Latch 16 is movable away from shoulder 15 by the engagement of lever 21 with the arm 37 of the T-shaped lever 17, such an engagement between the parts 21 and 37 taking place whenever the arm 21 under the influence of the spring 34 reaches a predetermined point in its upward movement. There is also an overload magnet 38 which by acting on arm 33 as its armature under certain conditions moves latch 16 out of engagement with shoulder 15, this overload magnet being connected through a series transformer 39 to respond to excessive currents in the primary circuit of the motor 5. The lower half, or other desired part of the winding of overload magnet 38 is normally short-circuited by a switch 40, which switch is arranged to be opened when the starting resistance has been fully cut out by a projection 41 from resistance varying bar 8.

The handle 28 is freely movable from positions *g* to *a*, *i. e.*, in the backward direction from position *g*, but in moving in the forward direction from any position, or in the backward direction from positions *h* and *a*, it is necessary that a latch 42 be lifted out of the notches in plate 42ª with which it coöperates.

The operation of the system is as follows. If the handle 28 is in position *r* or *a* the handle 10 can be moved to close the switch 6, though said switch will not remain closed when the hand is removed from handle 10, if the handle 28 is in position *r*. If handle 28 is in position *a*, however, the switch 6 will remain closed because of the engagement which occurs between latch 16 and shoulder 15. If the handle 28 is in any of positions *b* to *h*, the handle 10 cannot be moved to close switch 6, the several notches 26 being provided to prevent closure of said switch should the handle 10 for any reason not be in full "off" position when an attempt is made to close it while the handle 28 is in one of positions *b* to *h*. Assuming that the handle 28 is in position *a* and the switch 6 is closed by moving handle 10 and locked closed by catch 16, the closing movement of handle 10 causes the end of arm 19 to engage roller 20 to move the arm 21 and dash-pot 24 downward. The lever 21 immediately begins to move upward under the influence of spring 34, but is retarded by the dash-pot 24. If the lever 21 reaches a predetermined point at or near the end of its upward movement, it moves latch 16 from shoulder 15, thus tripping the switch 6 which is opened by spring 34. However, if before the lever 21 reaches or approaches too closely its uppermost position the handle 28 is moved forward one notch, the lever 21 is again moved downward and must start its upward movement anew. If the successive steps of the resistance varying handle 28 are made without allowing time enough between any two successive steps for the arm 21 to reach or approach too near to its uppermost position, the switch 6 remains closed, but if between any two successive steps more than a predetermined time elapses, the switch 6 is tripped and it is necessary to move the arm 28 back to position *a* in order to again close said switch. The purpose of this construction is this. The starting resistance may not be sufficiently heavy to stand the heavy starting current, or indeed even the normal running current, for any considerable length of time. There is also danger, especially with a heavy load on the motor, that the motor will not start immediately upon closing the switch 6, and that the attendant would leave the switch 6 closed and the handle 28 in one of its starting positions while he investigated. If this is done the switch 6 is automatically opened before the heavy starting current can do any damage to the motor.

If the handle 28 is moved forward too rapidly, too great a current will flow in the primary winding of motor 5, and the upper or non-short-circuited coils of overload magnet 38 will attract the armature 33 to trip the switch 6, thus necessitating a movement of handle 28 to its position *a* before said switch can be again closed. However if the arm 28 is moved forward neither too rapidly nor too slowly, the motor is successfully started and when the resistance 7 has been fully cut out the switch 40 is automatically opened, thereby substantially doubling the effective windings of magnet 38. The switch 6 will now be tripped at any overload upon the motor 5, but the current required for this overload during normal running is less than the current required for an overload during starting, thus allowing the use of the large current which is always required at starting, especially if the motor is starting under load.

If it is desired to stop the motor 5, this can be done either by moving the handle 28 back to release position thereby causing an engagement between parts 30 and 32 to trip switch 36, or the handle 43 on arm 17 can be pulled to the right to cause said tripping. During the backward movement of the handle 28 the roller 20 clears the tops of the cams of the notch plate 31. The long lower contacts 9 of resistance 7 are for the purpose of allowing the handle 28 to move between positions *a* and *r* without varying the resistance 7.

The dash-pot 24 is constructed of an outer tube 44 in which is a tube 45. The tube 45 has holes 46 near its upper end and cut-away portions at its lower end to form supports 47. Secured into the upper end of tube 44 is a head 48 provided with holes 49 for pouring in the fluid of the dash-pot, and a center hole or bearing 50 in which the piston rod slides. Secured into the lower end of tube 44 is a head 51 integral with which is a smaller head or disk 52 which fits closely in the end of the inner tube 45. The heads 51 and 52 are joined by a neck 53, the head 52 and neck 53 being drilled as shown in Fig. 4. The upper surface of disk 52 forms a seat for a ball 54 which is retained in place by guards 55.

The piston 56 is attached, as by screw threads, to the piston rod 57. Drilled in the piston rod 57 is a passage 58 connecting together the spaces at the two sides of the piston. The upper opening of this passage is adjustable by means of tube 59 which may be turned through 180° around the piston rod and fastened in any desired position by a screw 60, the movement of the tube around the rod causing a greater or less closure of the passage 58 because of the oblique cut-away part 61 at the lower end of tube 59. This dash-pot allows a free upward movement of the piston or a free downward movement of the cylinder, the oil or

other fluid in the dash-pot flowing freely during such movement through the openings 46, the annular chamber between the two tubes 44 and 45, the openings between supports 47, the holes in neck 53 and head 52 to the chamber at the lower side of the piston 56. The downward movement of the piston 56 or the upward movement of the cylinder is retarded because of the seating of the ball 54 on its seat, the fluid below the piston being able to reach the other side only by passing through the small opening 58 in the piston rod.

As herein described and shown, the regulating or resistance-varying switch never breaks the circuit, but for some kinds of motors to which certain features of my invention are applicable, it might be desirable to have this switch break the circuit. The term "highest resistance position" as herein used is intended to cover both the position of highest resistance in those cases where the circuit is not broken, and the "off" position or position of infinite resistance when the circuit is broken.

It is obvious that many equivalents of the various parts shown and described may be used without departing from the broad spirit of the invention, and all of these equivalents are intended to be covered by the following claims.

What I claim as new and desire to secure by Letters Patent is:—

1. In combination, an alternating current motor, a current-admitting switch in the primary circuit thereof, a resistance in the secondary circuit thereof, means for varying said resistance, and means for tripping the current-admitting switch if the resistance-varying means is moved too rapidly.

2. In combination, an alternating current motor, a current-admitting switch in the primary circuit thereof, a resistance in the secondary circuit thereof, means for varying said resistance, and means for tripping the current-admitting switch if the resistance-varying means is moved too slowly.

3. In combination, an alternating current motor, a current-admitting switch in the primary circuit thereof, a resistance in the secondary circuit thereof, means for varying said resistance, and means for tripping the current-admitting switch if the resistance-varying means is allowed to remain for more than a predetermined time in other than its position of lowest resistance.

4. In combination, an induction motor, a current-admitting switch therefor, a resistance in the secondary circuit of the motor, means for varying said resistance, and means for tripping the current-admitting switch if the resistance-varying means is moved either too rapidly or too slowly.

5. In combination, an induction motor, a switch for admitting current to the primary member thereof, a starting resistance in the circuit of the secondary member thereof, means for gradually cutting out said resistance, and means for tripping the current-admitting switch if the resistance-varying means is moved at less than a predetermined speed.

6. A controller for electric motors comprising a current-admitting switch, a regulating switch, means for tripping the current-admitting switch if the regulating switch is moved too slowly, and means for preventing the closing of the current-admitting switch if the regulating switch is not in highest resistance position.

7. A controller for electric motors comprising a current-admitting switch, a regulating switch, means for tripping the current-admitting switch if the regulating switch is moved either too rapidly or too slowly, and means for preventing the closing of the current-admitting switch if the regulating switch is not in highest resistance position.

8. In combination, an induction motor, a current-admitting switch therefor, a resistance in the secondary circuit of the motor, means for varying said resistance, and means for tripping the current-admitting switch if the resistance-varying means is moved too slowly or if an overload occurs on the motor.

9. A controller for electric motors comprising a current-admitting switch, a regulating switch, means for tripping the current-admitting switch if the regulating switch is moved too slowly or if an overload on the motor occurs, and means for preventing the closing of the current-admitting switch if the regulating switch is not in highest resistance position.

10. In combination, an induction motor, a current-admitting switch therefor, a resistance in the secondary circuit of said motor, means for varying said resistance step by step, and means for tripping the current-admitting switch if the time interval between its closing and the first step of the resistance-varying means is too great and if an overload occurs on the motor.

11. In combination, an induction motor, a current-admitting switch therefor, a resistance in the secondary circuit of said motor, means for varying said resistance step by step, and means for tripping the current-admitting switch if the time interval between its closing and the first step of the resistance-varying means or between successive steps of the resistance-varying means is above a predetermined value or if an overload occurs on the motor.

12. In a controller for electric motors, a current-admitting switch, a resistance-varying switch movable step by step, a lever movable in one direction by the closing of the current-admitting switch and by each step of the resistance-varying switch, a spring for

returning said lever to its normal position to trip the current-admitting switch, and means for retarding the return movement of said lever.

13. In a controller for electric motors, a resistance-varying switch movable step by step, a lever biased in one direction, but movable in the other direction by each step of the resistance-varying switch, means for retarding the movement of said lever in the first direction, and means for breaking the motor circuit when said lever reaches a predetermined point in its movement in said first direction.

14. In a controller for electric motors, a current-admitting switch therefor, a resistance-varying switch movable step by step, a lever movable in one direction by the closing of the current-admitting switch and by each step of the resistance-varying switch, a spring for returning said lever to its normal position to trip the current-admitting switch, means for retarding the return movement of said lever, and an overload magnet for tripping said current-admitting switch if the load on the motor exceeds a predetermined limit.

15. In a controller for electric motors, a resistance-varying switch movable step by step, a lever biased in one direction, but movable in the other direction by each step of the resistance-varying switch, means for retarding the movement of said lever in the first direction, means for breaking the motor circuit when said lever reaches a predetermined point in its movement in said first direction, and an overload magnet for tripping said current-admitting switch if the load on the motor exceeds a predetermined limit.

16. In a controller for electric motors, a current-admitting switch therefor, a resistance-varying switch movable step by step, a lever movable in one direction by the closing of the current-admitting switch and by each step of the resistance-varying switch, a spring for returning said lever to its normal position to trip the current-admitting switch, means for retarding the return movement of said lever, and an overload magnet which trips the current-admitting switch if the current supplied to the motor exceeds a predetermined amount during the starting of the motor or exceeds a smaller predetermined amount during the normal running of the motor.

17. In a controller for electric motors, a resistance-varying switch movable step by step, a lever biased in one direction, but movable in the other direction by each step of the resistance-varying switch, means for retarding the movement of said lever in the first direction, means for breaking the motor circuit when said lever reaches a predetermined point in its movement in said first direction, and an overload magnet which trips the current-admitting switch if the current supplied to the motor exceeds a predetermined amount during the starting of the motor, or exceeds a smaller predetermined amount during the normal running of the motor.

18. In a controller for electric motors, a resistance-varying switch, a series of cams movable with said switch, a lever actuated in one direction by said cams, a spring for returning said lever, a dash-pot attached to said lever and so constructed that the return movement only of said lever is retarded, and means for breaking the circuit when said lever reaches a predetermined point of its return movement.

19. In a controller for electric motors, a current-admitting switch, a resistance-varying switch, a series of cams movable with said latter switch, a lever actuated in one direction by said cams, a spring for returning said lever, a dash-pot attached to said lever and so constructed that the return movement only of said lever is retarded, and means for tripping the current-admitting switch if said lever reaches a predetermined point in its return movement.

20. In combination, an induction motor, a switch for admitting current to the primary thereof, a starting resistance in the secondary thereof, means for cutting out said resistance, an overload magnet for tripping said current-admitting switch if the current rises too high, and means for increasing the sensitiveness of said overload magnet when the starting resistance has been fully cut out.

21. In combination, an induction motor, a starting resistance in the secondary circuit thereof, means for cutting out said resistance, an overload magnet for breaking the primary circuit thereof if the current exceeds a predetermined value during starting, and means for increasing the number of turns on said magnet after the starting resistance has been cut out.

22. In combination, an induction motor, a starting resistance in the rotor circuit thereof, means for cutting out said starting resistance, an overload magnet for breaking the primary circuit thereof if the current therein exceeds a predetermined value during starting, a short-circuit around part of the winding of the overload magnet, and means for opening said short-circuit when the starting resistance has been fully cut out.

23. In combination, an induction motor, a switch for admitting current to the primary thereof, a starting resistance in the secondary thereof, means for cutting out said resistance, an overload magnet connected and arranged to trip said current-admitting switch when the current in the primary circuit of said motor rises above a certain predetermined value, a short-circuit around substantially half of the windings of said overload magnet, and means whereby said short-circuit is broken when the starting resistance has been fully cut out.

24. In combination, an induction motor, a switch for admitting current to the primary thereof, a switch for varying the resistance in the secondary thereof, and means whereby the movement of said resistance-varying switch back of the position where the full resistance is cut in trips the current-admitting switch.

25. In combination, an induction motor, a starting resistance in the secondary thereof, a switch for gradually cutting out said resistance, and means whereby the primary circuit of the motor is broken if the resistance-varying switch is moved too slowly in the direction to cut out resistance or is moved in the other direction beyond highest resistance position.

26. In combination, an induction motor, a starting resistance in the secondary thereof, a switch for gradually cutting out said resistance, and means whereby the primary circuit of the motor is broken if the resistance-varying switch is moved too slowly in the direction to cut out resistance or is moved in the other direction beyond highest resistance position, or if an overload on the motor occurs.

27. In combination, an induction motor, a switch for admitting current to the primary thereof, a starting resistance in the secondary thereof, a switch for gradually cutting out said resistance, and means whereby the current-admitting switch is tripped if the resistance-varying switch is moved at less than a predetermined speed in the direction to cut out resistance, or is moved in the other direction beyond highest resistance position.

28. In combination, an induction motor, a switch for admitting current to the primary thereof, a starting resistance in the secondary thereof, a switch for gradually cutting out said resistance, and means whereby the current-admitting switch is tripped if the resistance-varying switch is moved at less than a predetermined speed in the direction to cut out resistance, or is moved in the other direction beyond highest resistance position, or if the current in the primary circuit of the motor rises too high.

29. In combination, an induction motor, a starting resistance in the secondary thereof, a switch for gradually cutting out said resistance, means whereby the primary circuit of the motor is broken if the resistance-varying switch is moved too slowly in the direction to cut out resistance or is moved in the other direction beyond highest resistance position, and means whereby the primary circuit of the motor cannot be closed unless the whole starting resistance is in circuit.

30. In combination, an induction motor, a starting resistance in the secondary thereof, a switch for gradually cutting out said resistance, means whereby the primary circuit of the motor is broken if the resistance-varying switch is moved too slowly in the direction to cut out resistance or is moved in the other direction beyond highest resistance position, or if an overload on the motor occurs, and means whereby the primary circuit of the motor cannot be closed unless the whole starting resistance is in circuit.

31. In combination, an induction motor, a switch for admitting current to the primary thereof, a starting resistance in the secondary thereof, a switch for gradually cutting out said resistance, and means whereby the current-admitting switch is tripped if the resistance-varying switch is moved at less than a predetermined speed in the direction to cut out resistance, or is moved in the other direction beyond highest resistance position, and means for preventing the closure of the current-admitting switch unless the whole starting resistance is in circuit.

32. In combination, an induction motor, a switch for admitting current to the primary thereof, a starting resistance in the secondary thereof, a switch for gradually cutting out said resistance, means whereby the current-admitting switch is tripped if the resistance-varying switch is moved at less than a predetermined speed in the direction to cut out resistance, or is moved in the other direction beyond highest resistance position, or if the current in the primary circuit of the motor rises too high, and means for preventing the closure of the current-admitting switch unless the whole starting resistance is in circuit.

33. A dash-pot comprising an outer tube, an inner tube spaced from said outer tube to form an annular chamber between them, a piston and piston rod movable within said inner tube, said piston rod being provided with a passage connecting the spaces at the opposite sides of the piston, and a tube fitting closely around said rod for adjusting the effective size of said passage, thereby permitting the dash-pot to have a uniform retarding action throughout its range.

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

HERBERT W. CHENEY.

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