

T. E. BARNUM.

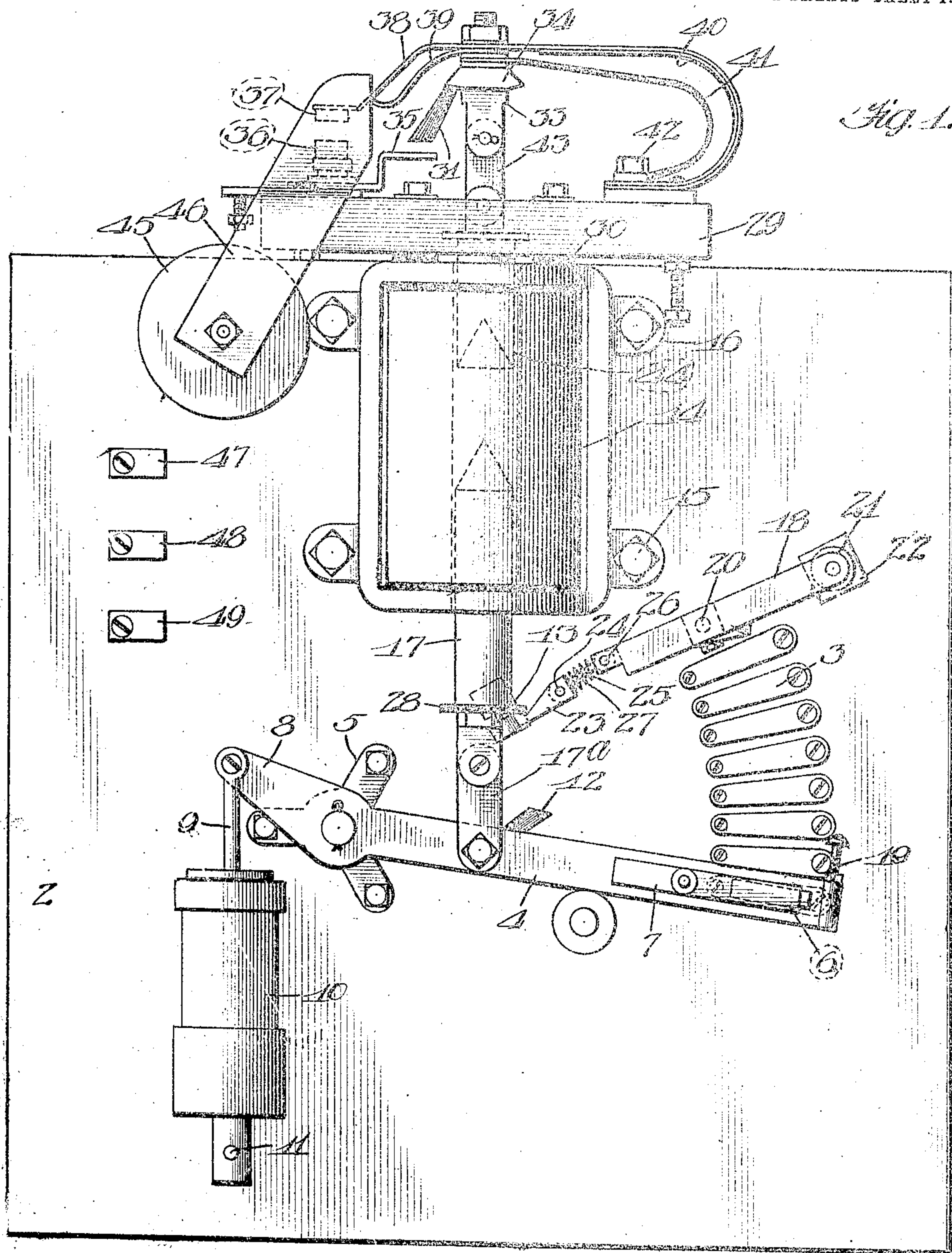
SELF STARTER.

APPLICATION FILED MAR. 14, 1907. RENEWED JULY 14, 1909.

989,687.

Patented Apr. 18, 1911.

2 SHEETS—SHEET 1.



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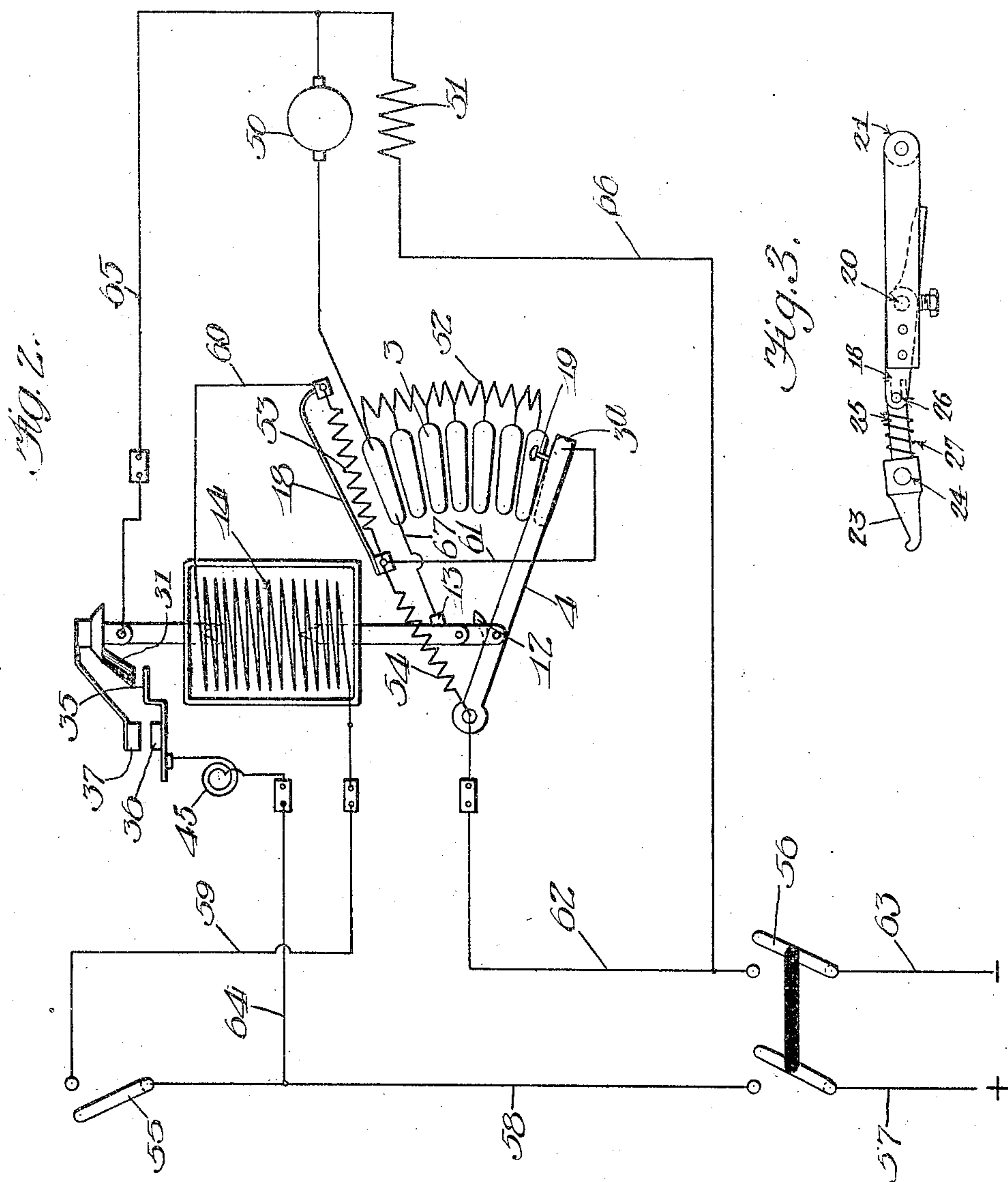
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# UNITED STATES PATENT OFFICE.

THOMAS E. BARNUM, OF MILWAUKEE, WISCONSIN, ASSIGNOR TO THE CUTLER-HAMMER MANUFACTURING COMPANY, OF MILWAUKEE, WISCONSIN, A CORPORATION OF WISCONSIN.

## SELF-STARTER.

989,687.

Specification of Letters Patent.

Patented Apr. 18, 1911.

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*To all whom it may concern:*

Be it known that I, THOMAS E. BARNUM, a citizen of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented new and useful Improvements in Self-Starters, 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 self starters for electric motors, having for one of its objects the provision of a single electro-responsive device for operating a main switch for controlling the motor circuit, and the resistance controlling member of the starting device.

Another object of my invention is to provide in a motor starting device, means which prevents the closing of the switch for controlling the motor circuit, until all the resistance is in circuit with the motor.

For the purpose of disclosing my invention, I have illustrated in the accompanying drawings, one device embodying the principle thereof.

In said drawings: Figure 1 is a front elevation of a motor starter embodying my invention, Fig. 2 is a diagrammatic view showing the circuit arrangement thereof, and Fig. 3 is an enlarged detail view of a switch shown in Fig. 1.

In the device illustrated in Fig. 1 upon a suitable base or panel 2 resistance contacts 3 are circularly mounted. An arm 4 pivotally mounted upon a stud 5 secured through the base, is provided at one end with a brush 6 arranged to sweep over and make contact with the contact plates 3. The brush 6 is preferably held in close engagement with the contacts 3 by means of a spring pressed arm 7, secured to the arm 4. The opposite end of the arm is provided with a projection 8 pivotally connected to a piston rod 9, the piston of which operates in a dash-pot 10, pivotally mounted at 11 upon the base 2. The arm 4 is also provided with a contact brush 12 arranged to engage a contact 13 also mounted upon the base 2, for a purpose more fully hereinafter set forth. A solenoid 14 is mounted upon the base 2 by bolts 15 passing through lugs 16 formed on the frame thereof. The core 17 of the solenoid is connected with the arm 4 by means of a link 17<sup>a</sup> formed of fiber or other suitable

insulating material. A switch 18 for controlling one section of resistance in circuit with the winding of the solenoid 14, is mounted on the base 2, above the resistance controlling arm 4 and in a position to be opened by a projecting screw 19 mounted upon the outer end of the arm 4. This switch is preferably of the structure illustrated in detail in Fig. 3, and comprises an arm pivoted at 20 and having at its outer end a contact 21 arranged to engage a contact plate 22 mounted upon the base 2. The inner end of the arm 18 has a toggle connection with a small arm 23 pivoted at 24 upon the base 2. The arm 23 is provided with a cylindrical portion 25 having its end bifurcated or slotted to receive a pin 26 carried by the arm 18. A coiled spring 27 mounted on the cylindrical portion 25 of the arm 23, tends to maintain the arms 23 and 18 out of alinement. By this construction when the end of the arm 23 is thrown downwardly, the contact 21 is moved into engagement with the contact plate 22 and the toggle connection is thrown to the position illustrated in the drawing. The switch will remain in this position until the projection or screw 19 on the outer end of the arm 4 engages the arm 18 and opens the same, reversing the position of the toggle, which will retain the switch 18 open until a small insulating disk 28 carried upon the lower end of the core 17 engages the inner end of the arm 23 and closes the switch 18. The disk 28 arranged upon the lower end of the core 17 will not engage the arm 23 until the arm 4 is almost to its lowermost position, whereby the switch 18 will not be closed until the arm 4 is in a full "off" position.

The main switch for controlling the motor circuit is mounted upon a suitable insulating base or block 29 secured upon the top of the frame of the solenoid 14. This block may be of any suitable material, as soapstone or the like, and is additionally insulated from the frame of the solenoid 14 by small fiber disks 30 interposed between the bottom of the block and the top of the frame of the solenoid. The main switch is mounted upon the upper side of the block, and comprises a main contact 31 and an arcing contact 37. The contact 31 is preferably formed of leaves or strips of copper suitably held upon a supporting rod 33 by a cup 34.



This contact is arranged to make engagement with a contact plate 35 also secured upon the upper side of the base 29. The contact plate 35 has mounted thereon a carbon contact 36 arranged to be engaged by the arcing contact 37. The arcing contact 37 is preferably mounted upon the end of the spring arm 38, carried by the rod or supporting member 33. A stiff arm 39 is interposed between the main contact 31 and the arm 38 of the arcing contact to prevent the arm 38 from coming into engagement with the main contact. The arm 38 of the arcing contact is extended to form a curved supporting arm and connected to the base 29 by screws or other suitable means. A spring 40 assists the arm in maintaining the contacts in an open position and in order to relieve the arm of the arcing contact of carrying the main current, which would tend to deteriorate the spring of the same, a braided conductor 41 is connected between the main contact 31 and the binding post 42 mounted upon the base 29.

The contacts of the main switch are arranged to leave the contact plate in the manner in which they have been named, that is, the main contact 31 first leaves the plate and then the arcing contact 37 leaves the carbon contact 36. The support 33 upon which the main switch is mounted is connected by a fiber link 43 with a core 44 of the solenoid 14 whereby the main switch is operated by the same means which operates the arm 4.

In order to disrupt the arc formed between the arcing contact 37 and its corresponding carbon contact 36 a blowout magnet 45 is mounted upon the base 2 and is provided with pole pieces 46 which extend upwardly and upon either side of the arcing contact. One terminal of the blowout magnet is connected with the contact plate 35 and the other terminal thereof is connected with the binding post 47 of the series of binding posts 47, 48, and 49 which are also mounted upon the base 2 and to which the various conductors of the motor and main line circuits are connected.

In the circuit arrangement illustrated in Fig. 2, the motor armature 50, having a shunt field 51, is connected in series with the resistance 52 which is divided into sections, and connected with the resistance contacts 3. The winding of the solenoid 14 is connected in a shunt circuit and has arranged in series therewith, a resistance 53 and a resistance 54. The resistance 53 is controlled by the switch 18, and a short circuit around the resistance 54 through the insulated contact 3<sup>a</sup> and the arm 4, provides means for controlling this resistance 54.

In operation assuming that the parts are in the position illustrated in the drawing, which is the "off" position, and assuming that the hand switch 55 and the knife 56 are

closed, current will then flow from one side 57 of the main line through the conductor 58 through the switch 55, by conductor 59 through the winding of the solenoid 14, by conductor 60, across the switch 18, conductor 61 to the insulated contact 3<sup>a</sup>. The resistance controlling arm 4 rests upon the contact 3<sup>a</sup>, and current will, therefore, pass from this contact across the resistance controlling arm, by conductor 62 to the opposite side 63 of the main line. The solenoid 14 is thus energized and attracts its cores 17 and 44, which starts the resistance controlling arm moving upwardly, and at the same time closes the main switch contacts 31 and 37. As soon as the arm 4 leaves the insulated contact 3<sup>a</sup>, the short circuit through the conductor 61 is opened and the resistance 54 is inserted in circuit with the winding of the magnet 14. This cuts down the current passing through the magnet as it is unnecessary for the solenoid to have as great strength to draw up the starter arm as it needs to close the main switch. As soon as the main line switch is closed, then current will flow from one side 57 of the main line, through the conductor 58, conductor 64, through the winding of the blowout magnet 45 across the main switch, by conductor 65, through the armature 50 of the motor, through the resistance 52 across the resistance controlling arm 4, by conductor 62 to the opposite side 63 of the main line. Circuit will also be closed from conductor 65 through shunt field 51 and by conductor 66 to the opposite side 63 of the main line. The motor will thus start and as the arm 4 continues to be moved upwardly, the resistance 52 will be cut out, section by section until all of the resistance is cut out. When the arm reaches its full "on" position the projection 19 on the end of the arm engages the switch 18, opening the same and inserting the resistance 53 in circuit with the solenoid 14. Under these conditions the current passing through the solenoid 14 is reduced to such an extent that while it will retain the arm 4 in its "on" position, and the main switch closed, it will not be of sufficient strength to raise the arm in event it falls, or close the main switch in event it opens. When the arm has reached its full "on" position, the contact 12 will engage contact 13 and current will pass by way of the conductor 67 instead of by the contact brush carried on the end of the arm 4. With the motor running with all resistance cut out, in event the voltage of the line falls below a predetermined point or fails entirely, the solenoid will immediately be de-energized, or the strength thereof will be cut down to such an extent that the main switch will open, thereby opening the motor circuit and the arm will drop to the "off" position, when, if the voltage again raises, the cycle of operation previously described



will be repeated and the motor will again be started. In event, however, the voltage on the line is restored to normal, before the arm 4 drops to its full "off" position, then the solenoid 14 might be of sufficient strength to retain the arm 4 in an intermediate position or move the arm back to the full "on" position, but it will be noted that the resistance 54 is still in circuit with the winding of the solenoid 14, and it is not of sufficient strength to close the main line switch, therefore, the motor will not start. Under these circumstances, if it is desired to again start the motor, it will be necessary for the attendant to first open the switch 55 to deenergize the solenoid and permit the resistance controlling arm 4 to return to its "off" position, when the switch 55 may again be closed and the starting device will operate to start the motor.

While I have described in detail one form of my invention it will be understood that I do not wish to be limited to the structural details illustrated and set forth herein, but that various changes and modifications may be made without departing from the spirit of my invention as set forth in the appended claims.

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

1. In a controller for electric motors, in combination, a main switch, a resistance controlling switch and a single electromagnetic winding for operating said switches, said winding having two movable cores, each core being connected to one of said switches.

2. In a controlling device for electric motors, in combination, a main switch, a resistance controlling switch and a single electromagnetic winding for operating said switches, said winding having two plungers movable in opposite directions, one of said plungers having a tapered end adapted to enter a correspondingly shaped recess in the end of the other of said plungers, each of said plungers being connected to one of said switches.

3. In a starting device for electric motors, in combination, a main switch, a pivoted resistance controlling element, a series of contacts adapted to be successively engaged by said element, a resistance connected to said contacts and a single electromagnetic winding for operating said switch and said resistance controlling element, said winding having two plungers movable in opposite directions, one of said plungers being connected to said switch and the other to said resistance controlling element.

4. In a starting device for electric motors, the combination with a resistance, of a controlling member therefor, a main line switch, a single electromagnetic winding having two movable cores, one of said cores being con-

nected to said resistance controlling member and the other of said cores to said main line switch, and means necessitating the insertion of a predetermined amount of said resistance in the motor circuit prior to the closure of said main switch.

5. In a starting device for electric motors, the combination with a resistance, of a controlling member therefor, a main line switch, an electromagnetic winding having two plungers movable in opposite directions and adapted to seal with one another at the limit of their travel, one of said plungers being operatively connected to said resistance controlling member and the other to said main switch, and means rendering said winding inoperative to close said main switch under predetermined conditions.

6. In a starting device for electric motors, the combination with a resistance, of a controlling member therefor, a main line switch, an electromagnetic winding having two plungers movable in opposite directions, one of said plungers being operatively connected to said resistance controlling member and the other to said main line switch, a resistance connected in circuit with said winding for rendering the same inoperative to close said main switch, and means for automatically removing said resistance from circuit when said resistance controlling member is in a predetermined position.

7. In a starting device for electric motors, the combination with a resistance, of a controlling member therefor, a main line switch and an electromagnetic winding having two movable cores, one of said cores being connected with said resistance controlling member and the other to said main line switch, means necessitating the insertion of a predetermined amount of said resistance in the motor circuit prior to the closure of said main switch and means for automatically reducing the flow of current through said winding after said resistance has been removed from the motor circuit.

8. In a starting device for electric motors, the combination with a resistance, of a controlling member therefor, a main line switch, an electromagnetic winding having two movable cores, one of said cores being connected to said resistance controlling member and the other to said main line switch, means necessitating the insertion of a predetermined amount of said resistance in the motor circuit prior to the closure of said main switch, a resistance connected in circuit with said winding, a switch for short circuiting said resistance, said switch being automatically opened by said resistance controlling member when in a predetermined position and automatically closed upon the insertion of a predetermined amount of said starting resistance in the motor circuit.

9. In a starting device for electric motors,



the combination with a starting resistance, of a controlling member therefor, an electromagnetic winding for actuating said member, a resistance connected in circuit with said winding, a pivoted switch adapted to short circuit said resistance, said switch being automatically opened upon the removal of all of said starting resistance from the motor circuit, and a pivoted arm having a toggle connection with said switch for maintaining the same in open position, said pivoted arm being arranged to be automatically operated to close said switch upon the insertion of a predetermined amount of said starting resistance in the motor circuit.

10. In a starting device for electric motors, the combination with a starting resistance, of a controlling member therefor, a main line switch, an electromagnetic winding having two plungers movable in opposite directions and adapted to seal with one another at the limit of their travel, one of said plungers being operatively connected to

said controlling member and the other of said plungers being operatively connected to said main switch, a resistance connected in circuit with said winding for rendering the same inoperative to close said main switch, a shunt circuit around said resistance adapted to be closed while said controlling member is in a predetermined position, a second resistance connected in circuit with said winding, a switch for short circuiting said second resistance, said switch being automatically opened by said controlling member when in a predetermined position and closed by said controlling member when all of said starting resistance is in circuit with the motor.

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

THOMAS E. BARNUM.

Witnesses:

OSCAR A. KELLER,  
A. H. BARNIKEL.