No. 742,031. PATENTED OCT. 20, 1903.

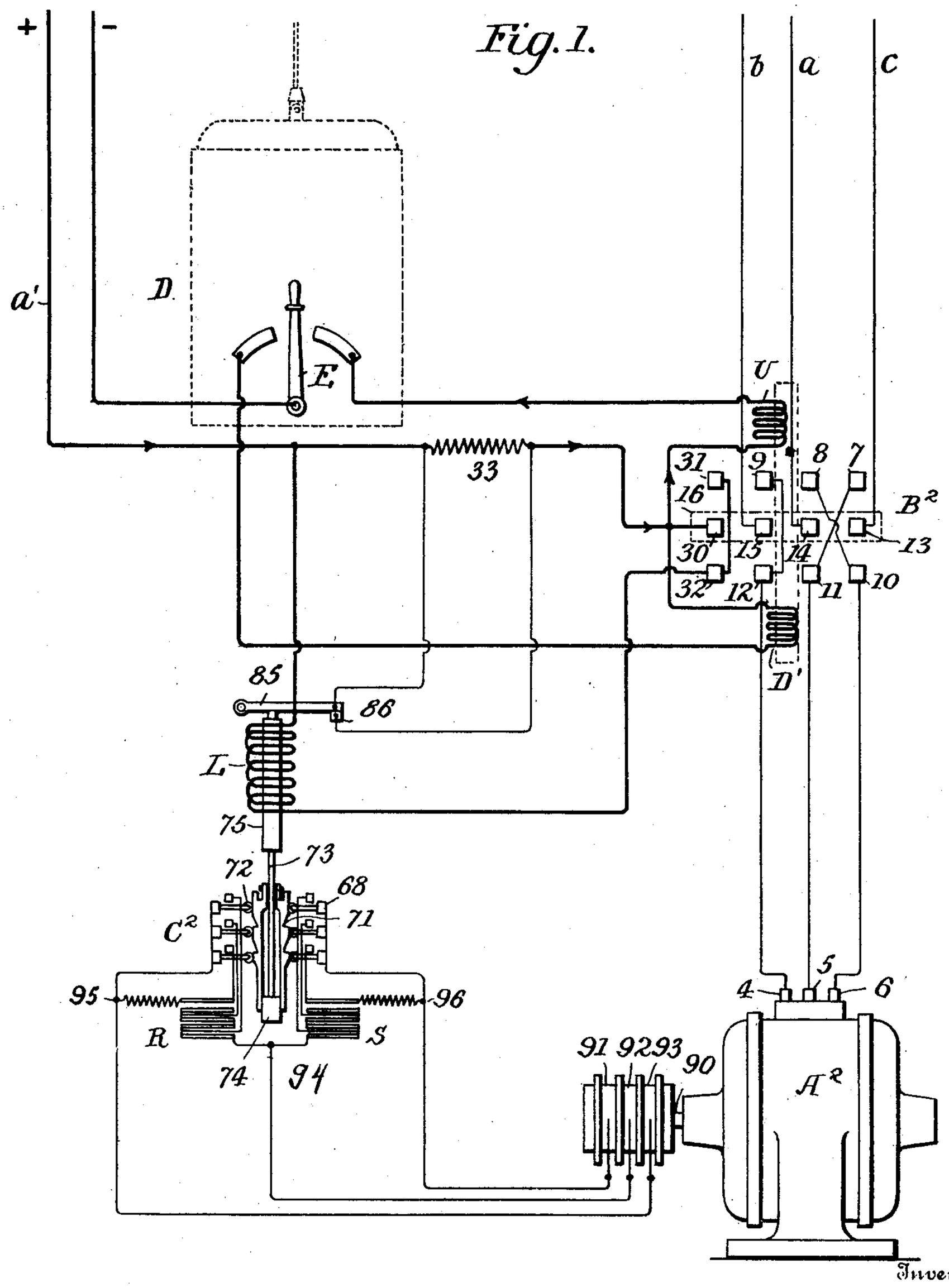
J. D. IHLDER.

ELECTRICAL CONTROLLING APPARATUS.

APPLICATION FILED JUNE 10, 1902.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. 1.



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NO MODEL. 2 SHEETS—SHEET 2.

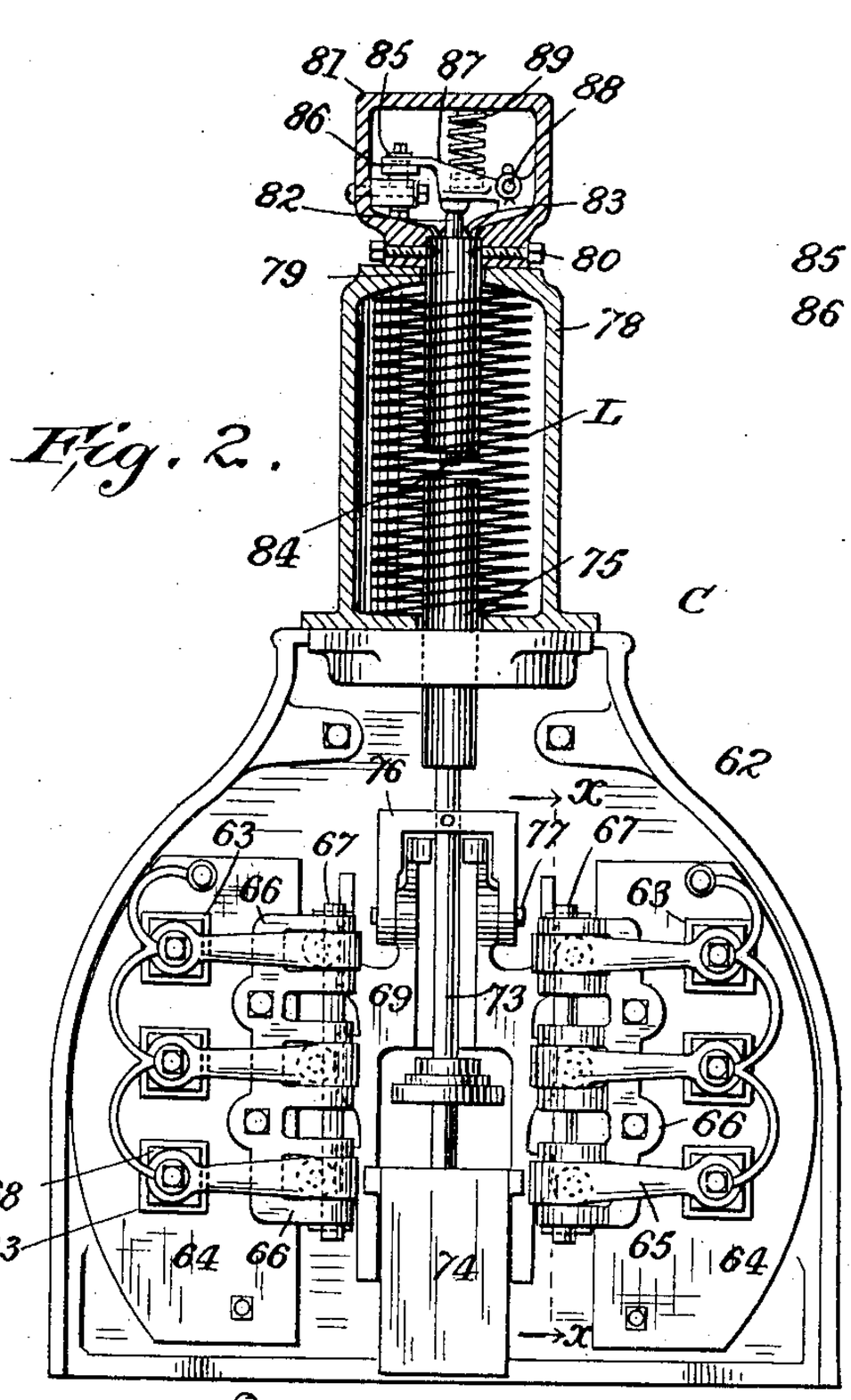

Fig. 2.

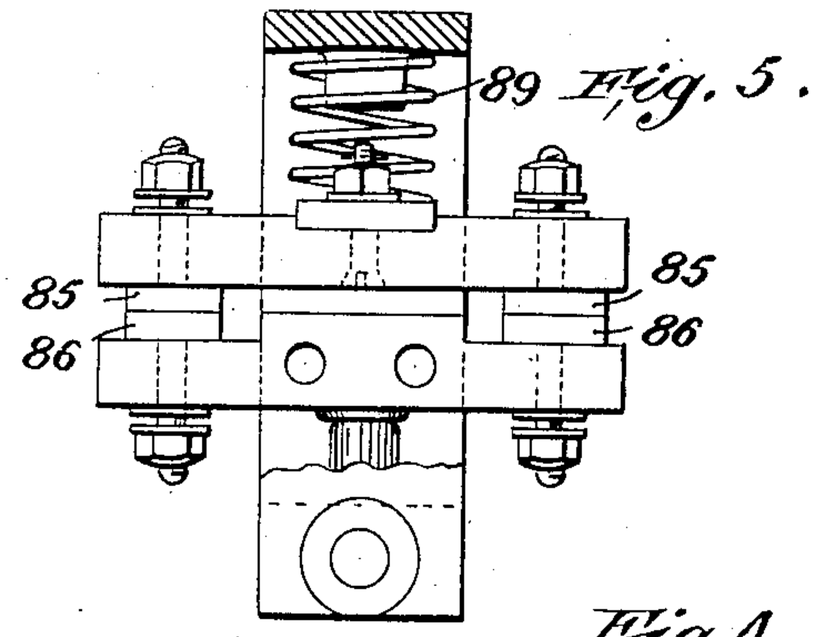

Fig. 5.

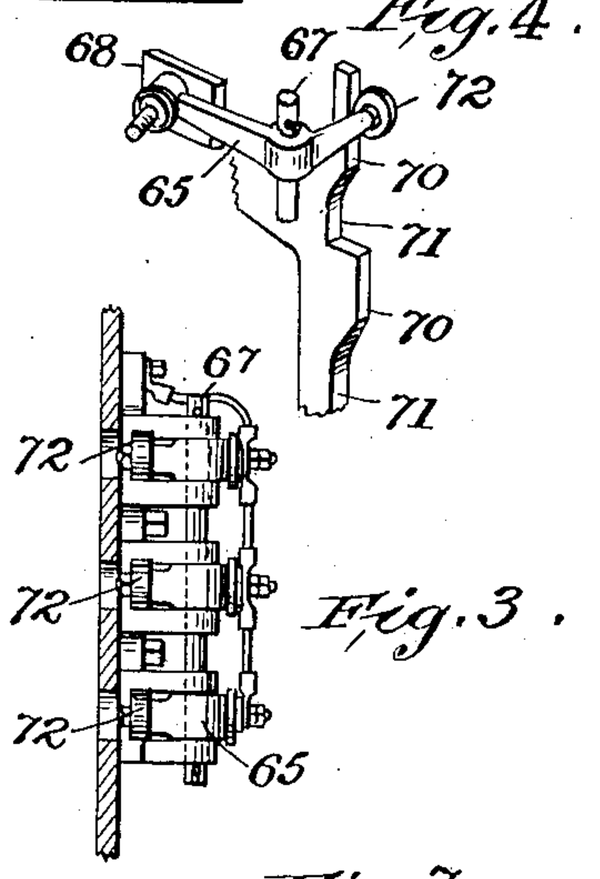

Fig. 4.

Fig. 3.

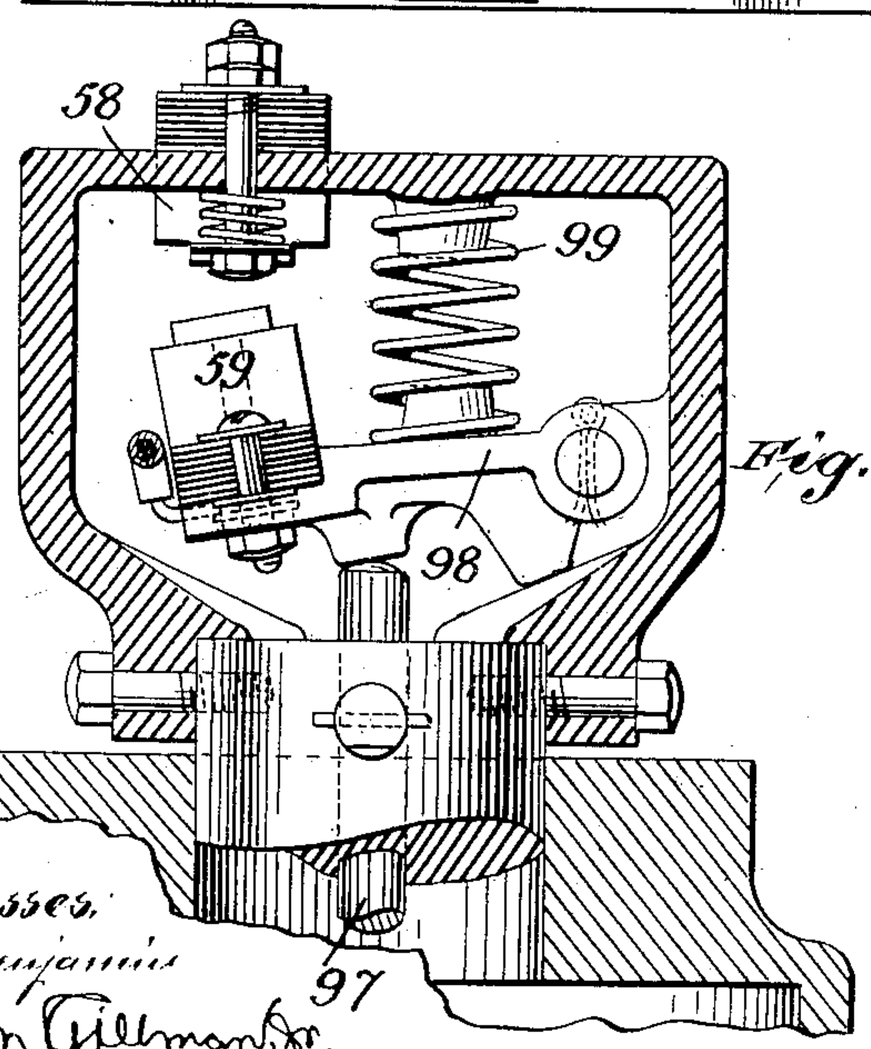

Fig. 6.

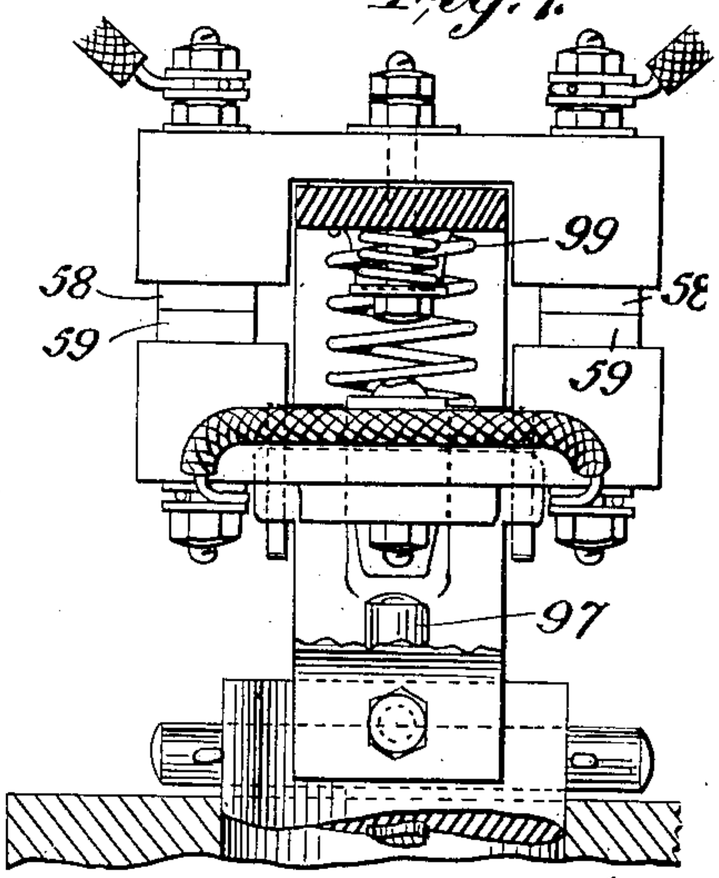

Fig. 7.

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No. 742,031. Patented October 20, 1903.

UNITED STATES PATENT OFFICE.

JOHN D. IHLDER, OF YONKERS, NEW YORK, ASSIGNOR TO OTIS ELEVATOR COMPANY, OF EAST ORANGE, NEW JERSEY, A CORPORATION OF NEW JERSEY.

ELECTRICAL CONTROLLING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 742,031, dated October 20, 1903.

Application filed June 10, 1902. Serial No. 111,055. (No model.)

To all whom it may concern:

Be it known that I, JOHN D. IHLDER, a citizen of the United States, residing at Yonkers, Westchester county, New York, have invented certain new and useful Improvements in Electrical Controlling Apparatus, of which the following is a specification accompanied by drawings.

My invention relates to motor control, and more particularly to the control of electric motors for the operation of elevators or hoists; but it is applicable to the control of motors in general.

While my invention may be applied to both direct and alternating current motors, it is more especially designed for use with induction-motors for the starting and stopping of the same.

The objects of my invention are to enable alternating electric motors, more especially induction-motors, to be readily and automatically controlled by improved means which are strong and compact and do not readily get out of order.

Further objects of my invention are to enable motors of the class referred to to be readily controlled from a distance with certainty of operation and minimum liability of accident or derangement of parts.

Further objects of my invention will hereinafter appear.

To these ends my invention consists in apparatus for carrying out the above objects arranged and constructed and having the general mode of operation substantially as hereinafter fully described and claimed in this specification and shown in the accompanying drawings, in which—

Figure 1 is a diagrammatic representation of circuits in apparatus embodying my invention shown as applied to an electric-elevator system. Fig. 2 is a front elevation, partly in section, of my improved switch. Fig. 3 is a sectional view of a portion of the same on the line $x\ x$ of Fig. 2 looking in the direction of the arrows. Fig. 4 is a perspective view of a detail of the apparatus, showing the construction and arrangement of the contact-arms. Fig. 5 is an enlarged detail side view of the switch-contacts shown in the upper portion of Fig. 2. Fig. 6 is an enlarged sectional side view of the contacts controlled by the brake-magnet, and Fig. 7 is a side view of the contacts controlled by the brake-magnet.

While my invention may be embodied in different forms and is applicable to different uses, I have illustrated it in connection with the control of a motor for the operation of an elevator or hoist, in this instance the motor A^2 being shown as a three-phase induction-motor the direction of rotation of which is controlled by a reversing-switch B^2 and the starting and stopping of which is controlled by an electromagnetic switch C^2. The motor may be connected in any suitable manner to operate the car D, the mechanical connections for so operating the car being omitted for the sake of simplicity, it being understood that according to the direction of rotation of the motor the car is moved up or down along suitable stations, which may be floors or landings. (Not shown.)

Motor-controlling circuits and apparatus are provided whereby the operation of the motor and the travel of the car may be controlled from the car. It is impractical and unwise to supply the controlling-circuits which extend to the floor or stations and to the car and remain constantly energized during the travel of the car with an alternating current of high potential, such as used in operating the motor.

The primary or stator of the induction-motor A^2 is suitably connected from binding-posts 4 5 6 on the stator to suitable contacts 7, 8, 9, 10, 11, and 12 on the reversing-switch B^2, the contacts 13, 14, and 15 being carried by a movable armature 16, actuated by suitable electromagnets or up and down relays D′ and U in such manner that according to the direction of the current in the controlling-circuits either D′ or U will be energized to move the armature 16 to one side or the other of the center and complete the circuits of the motor in a direction to cause it to rotate as desired. The connection between the contacts 9 12 and binding-post 4 is never reversed; but the remaining connections from the reversing-switch to binding-posts 6 and 5 are reversed according to the movements of the switch B^2. The alternating-current-mo-

tor mains *a b c* are connected to contacts 15, 14, and 13 on the reversing-switch in order to energize the stator of the motor.

The switch E on the car is connected to complete circuit to either the up relay U or the down relay D′ and is preferably included in a direct-current circuit of low potential. In this instance *a′* is the positive lead, in branches of which the relays U and D′ are arranged, the return-wires being connected to the contacts of switch E. Connection is made from the positive lead *a′* to contact 30 of reversing-switch B^2, while a magnet L, controlling the rotor-circuit controller C^2, is connected to contacts 31 and 32 on switch B^2, so that as said switch is operated the circuit of magnet L will be closed to operate the controller C^2.

The up relay U actuates reversing-switch B to close the circuits of the stator to start the motor in the desired direction to move the car upward. The starting of the motor is, however, controlled by further apparatus embodied in the starting-switch C^2. Without regard at this time to the operation of the starting-switch it will be pointed out that assuming the motor to have started the car may be stopped at any time by operation of the switch E. When the reversing-switch B^2 is operated to close the circuits of the stator, contact 30 is moved into contact with either 31 or 32, thereby completing the circuit of the magnet L. When the circuit of the stator is closed at the reversing-switch B^2, only enough current is admitted to the stator to prevent backward rotation of the motor, because, as will hereinafter be described, the maximum stating resistance is connected in the rotor-circuit. After the circuit of the magnet L is closed the resistance is gradually cut out of the rotor-circuit.

The starting-switch C^2 is illustrated in its details of construction in Figs. 2, 3, and 4, in Fig. 1 this switch being shown diagrammatically only for the sake of clearness. Referring then more particularly to Figs. 2, 3, and 4, upon a suitable frame or support 62 are supported contacts 63, arranged in this instance upon plates 64, secured by suitable means to the frame 62. Contact-arms 65 are pivoted adjacent the contact 63, as shown, the contact-arms being supported in brackets 66, suitably secured to the frame or, as shown, to the plates 64, and in this instance each set of arms 65 is provided with but one common pivot-pin 67, although this pivoting could be carried out in any suitable manner.

Means are provided for successively actuating the contact-arms, and, as will hereinafter appear, the lowermost contact-arms are actuated first to close circuit between their contacts 68 and the contacts 63, supported by the frame 62, and then the next contact-arms above are actuated, and so on. There may of course be any number of contact-arms in each set, I having shown only three in each set by way of illustration.

The means I prefer for actuating the contact-arms are embodied in a movable member 69, shown in the form of a plate with cam-shaped edges, which may be formed in any suitable manner; but in this instance the shoulders 70 are separated from each other by notches 71, and the shoulders are of different lengths, the lowermost shoulders being shorter than those next above, and so on, the length of the shoulders increasing from bottom upward.

While any suitable form of contact-arm may be provided, in this instance and according to my invention the contact-arms are angular in form, as illustrated, each arm being provided with portions extending from the pivot at substantially right angles to each other, one of said extending portions being provided with the contact 68, as described, and the other being provided with a follower shown in the form of a roller 72, which is adapted to bear against the shoulders 70 and enter the notched portion 71 of the plate 69, according to the movement of the plate. Means are provided for moving the plate 69 in this instance vertically, and according to the arrangement of contact-arms, as shown, with vertical pivots it will be seen that the plane of motion of the contact-arms as actuated by the plate 69 is transverse to the direction of motion of the plate itself. As illustrated, the plate 69 is designed to move in a plane extending substantially at right angles to the plane of movement of the contact-arms 65. As the plate 69 is moved upward from the position shown in Fig. 2, in which position all of the rollers 72 on the contact-arms are bearing upon the shoulders 70, the lowermost rollers 72 first pass from the shoulders into the reduced portion of the plate, thereby allowing the contact-arms 65 to swing about their pivots and bring the contacts 68 thereon into contact with 63 to close the circuit. As the plate 69 is moved farther upward the next contact-arms above are actuated by reason of the roller 72 passing into the notches 70, and so on upward. If electric circuits are connected to the contact on the arms, and thus supported on the frame 62, it will readily be seen that the switch described affords a means for controlling said circuits and successively cutting out starting resistance from any kind of motor, the switch having been illustrated in the drawings as applied to an alternating-current motor.

Preferably electromagnetic means are provided for actuating the cam-shaped plate 69. The central actuating-rod 73 extends downwardly into a suitable dash-pot 74 and upwardly through the top of the frame 62 and is provided at its upper portion with a core 75. A yoke 76 is connected in any suitable manner to the rod 73 and also connected, as by a pin 77, to the plate 69, so that upward movement of the rod 73 causes movement of the plate 69, gravity serving to return the plate to its normal position. The core 75

extends, as shown, upwardly into a chamber 78, and extending downwardly into said chamber is another core, 79, secured in any suitable manner, as by bolts 80, either to the walls of the chamber 78 or, as shown, to a cap-piece 81. In this instance the core 79 is hollowed and is provided with a movable plunger 82, having lugs 83 or other suitable means for preventing the down movement of the plunger beyond the extent to which it is shown in Fig. 2, so that the lower end 84 of the plunger projects beyond the lower end of the core 79. The upward movement of core 75 as it is attracted by the energizing of magnet L causes the upward movement of the rod 82 by reason of the core 75 striking against the lower end 84 of said rod, and a movable contact 85 is arranged to be actuated by the rod 82 to break circuit with contact 86, the contact-arm 87, carrying the contact 85, being pivoted as shown at 88, while a spring 89 serves to bring the contacts together again when the magnet is deënergized. These contacts 85 and 86 are shown diagrammatically in Fig. 1, and connected thereto are circuit-wires extending to each side of resistance 33 in the circuit of the relays U and D′, so that after the motor has started the contacts 85 and 86 are broken by the starting-switch and the resistance 33 is thrown into the circuit of the magnets D′ and U, thereby reducing the current therein during the operation of the motor.

While the relative arrangement of contact-arms and a movable member on the switch C^2 may be varied, as shown, a preferable arrangement is to place the movable plate 69 between the series of contacts and the sets of contact-arms, the whole forming a compact and durable structure suitable for the ends in view.

The electrical connections from the motor to the switch C^2 are illustrated diagrammatically in Fig. 1. The motor-shaft 90 is shown provided with the slip-rings 91, 92, and 93 for the three-phase motor, it being understood that the connections of the secondary or rotor are led to the slip-rings in any suitable manner, as is well known in the art, and from thence starting resistances R and S are included in the circuit of the secondary. While any desired number of such resistances may be included in the secondary, which may be star or mesh wound, as shown by way of illustration, only two resistances are so connected and adapted to be short-circuited as the motor speeds up. According to this arrangement electrical connection is made between the slip-ring 92 and a point between the resistances R and S. Connection is also made between all of the stationary contacts 63 on one side and slip-ring 91, while electrical connection is also made between all of the stationary contacts 63 on the other side of the switch and slip-ring 93. The resistances R and S are then connected, respectively, at the points 95 and 96 to the rollers leading to the slip-rings 91 and 93. The contacts 68 at each side of the switch are connected, respectively, to points on the resistances R and S, so that as the contacts 63 and 68 are successively actuated at each side of the switch the resistances R and S will gradually be short-circuited.

The mechanical construction of the contacts 58 and 59, which may be controlled by any suitable brake-magnet, is illustrated in Figs. 6 and 7, the same operation being applied in this connection as that applied in the construction of the starting-switch C^2. In other words, a movable rod or plunger 97 is adapted to be actuated by the core of the brake-magnet in such manner that a contact-arm 98 bearing thereon will be moved to close the circuit between its contact 59 and the contact 58, a suitable spring 99 serving to break the circuit when the brake-magnet is deënergized.

Obviously some features of my invention may be used without others and my invention may be embodied in widely-varying forms.

Therefore, without enumerating equivalents nor limiting myself to the construction shown and described, I claim and desire to obtain by Letters Patent the following:

1. In a switch, the combination of a plurality of contacts and contact-arms having contacts, a movable member for actuating said contact-arms successively, and electromagnetic means for moving said member in a plane transverse to the plane of movement of the contact-arms, for substantially the purposes set forth.

2. In a switch, the combination of a plurality of contacts, a plurality of pivoted angular contact-arms having contacts, a movable member coöperating with the contact-arms to successively actuate the same, and electromagnetic means for moving said member in a plane extending substantially at right angles to the plane of movement of the contact-arms, for substantially the purposes set forth.

3. In a switch, the combination of a plurality of contacts, a plurality of contact-arms provided with contacts coöperating therewith, and means for successively actuating said contact-arms, said means consisting of a movable member provided with bearing-surfaces of varying lengths upon which the contact-arms are adapted to bear, and electromagnetic means for actuating said member, for substantially the purposes set forth.

4. In a switch, the combination of a plurality of contacts, a plurality of contact-arms having contacts coöperating therewith, and an electromagnetically-operated member provided with bearing-surfaces of varying lengths coöperating with the contact-arms, whereby they may be actuated successively, for substantially the purposes set forth.

5. In an electric switch, the combination

with a frame, of a vertically-movable plate supported thereon and provided with notches in its sides forming shoulders of varying lengths, pivoted contact-arms arranged at each side of said plate and provided with rollers adapted to bear upon said shoulders and enter said notches upon movement of the plate, and electromagnetic means for actuating said plate, for substantially the purposes set forth.

6. In a switch, the combination of a movable member and electromagnetic means for actuating the same, contacts arranged adjacent thereto, and contact-carrying arms pivoted adjacent thereto, said movable member being provided with a plurality of cam-shaped surfaces coöperating with the contact-arms, and said arms being of angular shape and pivoted for movement in planes transverse to the direction of movement of said movable member, for substantially the purposes set forth.

7. In a switch, the combination of a frame, contacts thereon, a movable cam-plate supported upon the frame between said contacts, angular contact-arms pivoted at each side of said plate and provided with contacts coöperating with those on the frame and also provided with rollers adapted to bear upon said plate whereby when the plate is actuated the contact-arms are moved to make and break circuit, and electromagnetic means for actuating said plate, for substantially the purposes set forth.

8. In a switch, the combination of a frame provided with a plurality of contacts, a movable member provided with notches in its edge forming shoulders of different lengths, contact-arms arranged adjacent said movable member and provided with rollers adapted to bear upon the shoulders on said member and enter the notches, and electromagnetic means for actuating said member whereby the contact-arms are successively actuated to change the circuits, for substantially the purposes set forth.

9. The combination of an alternating-current motor, and a switch therefor, consisting of a frame, contacts thereon, an electromagnetically-actuated member arranged between said contacts, angular contact-arms pivoted at each side of said member and arranged to be actuated successively thereby in planes transverse to the direction of movement of said member, circuit connections including the contacts on the frame and on the contact-arms, and resistance in said circuit connections, for substantially the purposes set forth.

10. The combination of an alternating-current motor, and a switch therefor, comprising a frame, contacts thereon, an electromagnetically-actuated member arranged between said contacts, angular contact-arms pivoted at each side of said member and arranged to be actuated successively thereby in planes transverse to the direction of movement of said member, circuit connections including the secondary of the motor and the contacts on the switch, and resistance in said circuit connections, for substantially the purposes set forth.

11. The combination of an alternating-current motor, and a switch therefor, comprising contacts, an electromagnetically-operated member, contact-arms successively actuated thereby, said contact-arms bearing contacts, electrical connections from the secondary of the motor to the contacts of the switch, and resistance included in the secondary circuit, for substantially the purposes set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

JOHN D. HILDER.

Witnesses:
CHARLES B. MANVILLE,
F. W. NEWELL.