(No Model.)

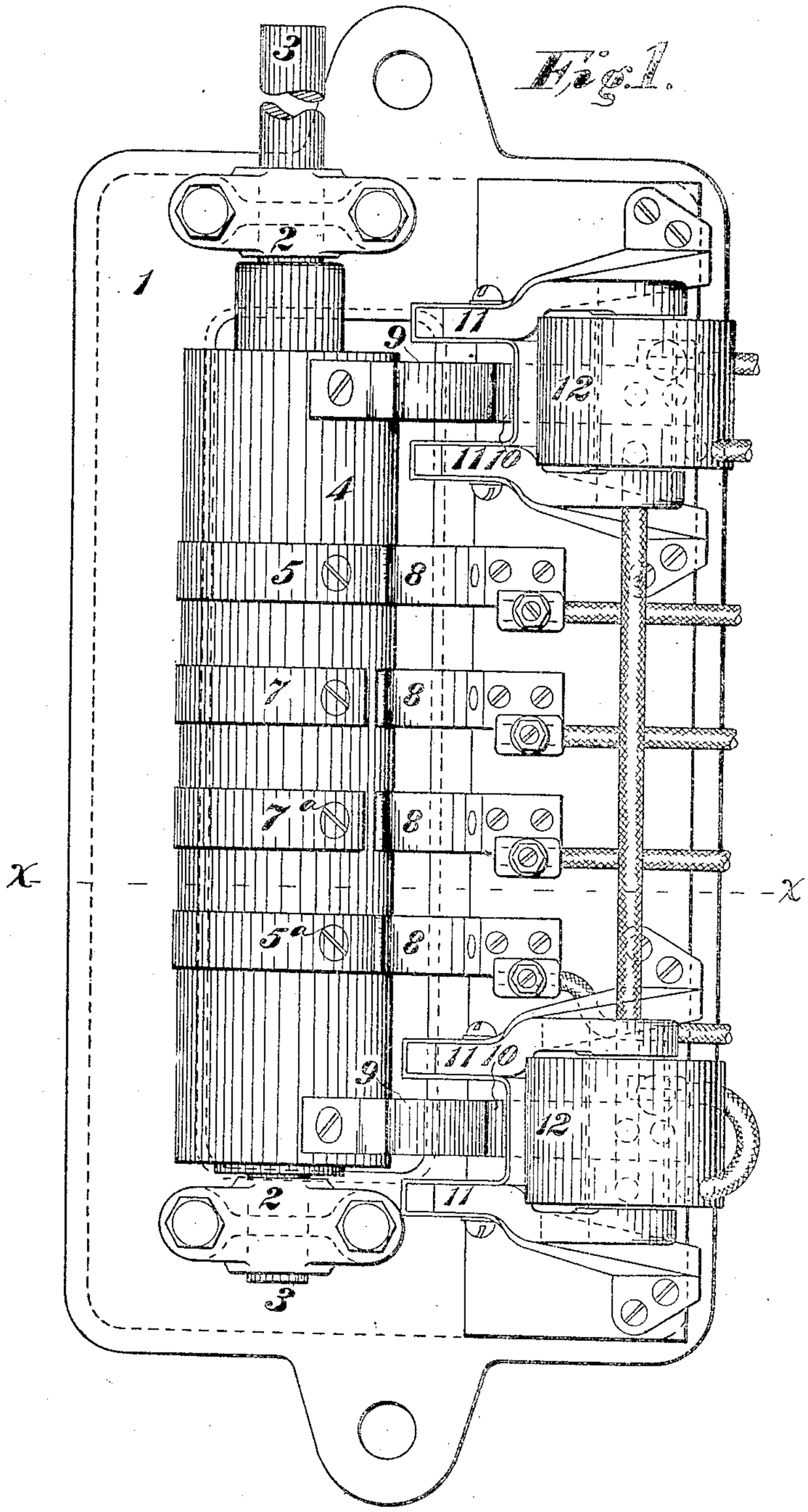
4 Sheets—Sheet 1.

H. P. DAVIS.

CONTROLLER FOR ELECTRIC MOTORS.

No. 584,856. Patented June 22, 1897.

Fig. 1.



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(No Model.) 4 Sheets—Sheet 2.

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CONTROLLER FOR ELECTRIC MOTORS.

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Fig. 2.

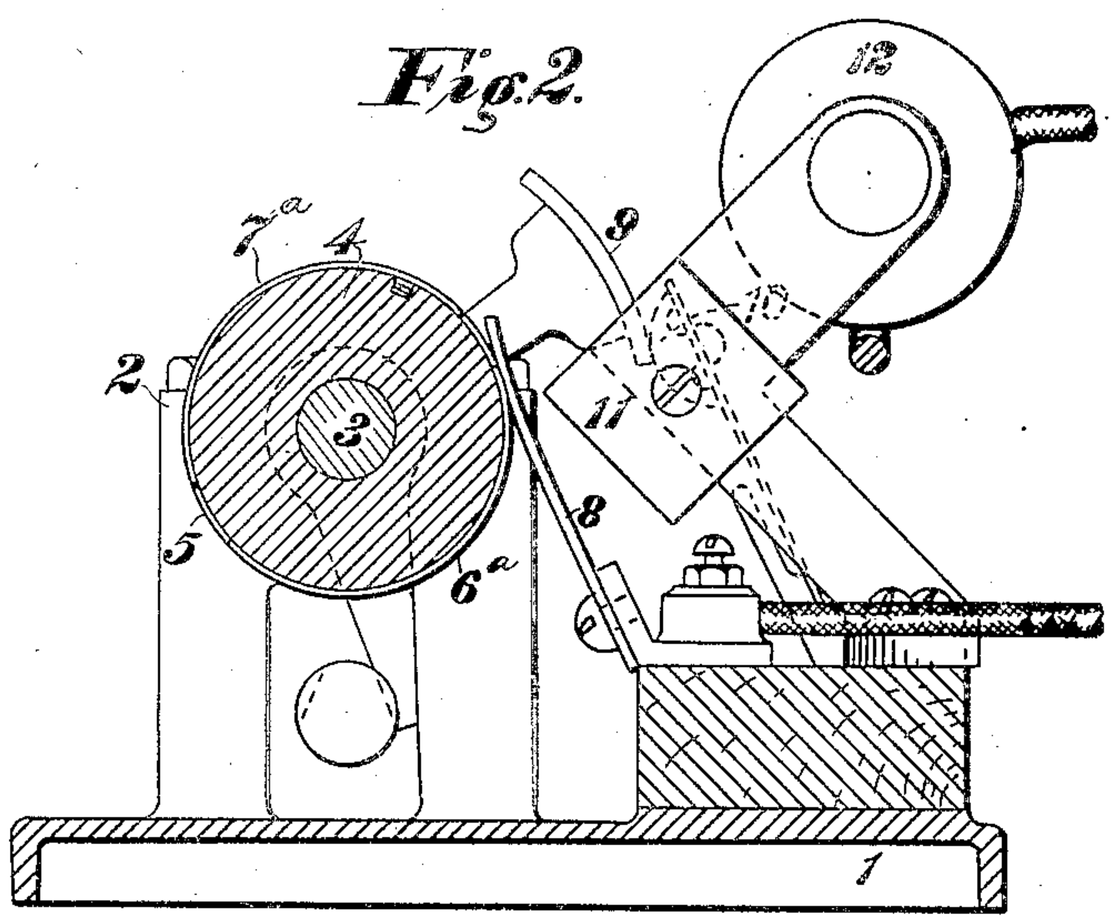


Fig. 3.

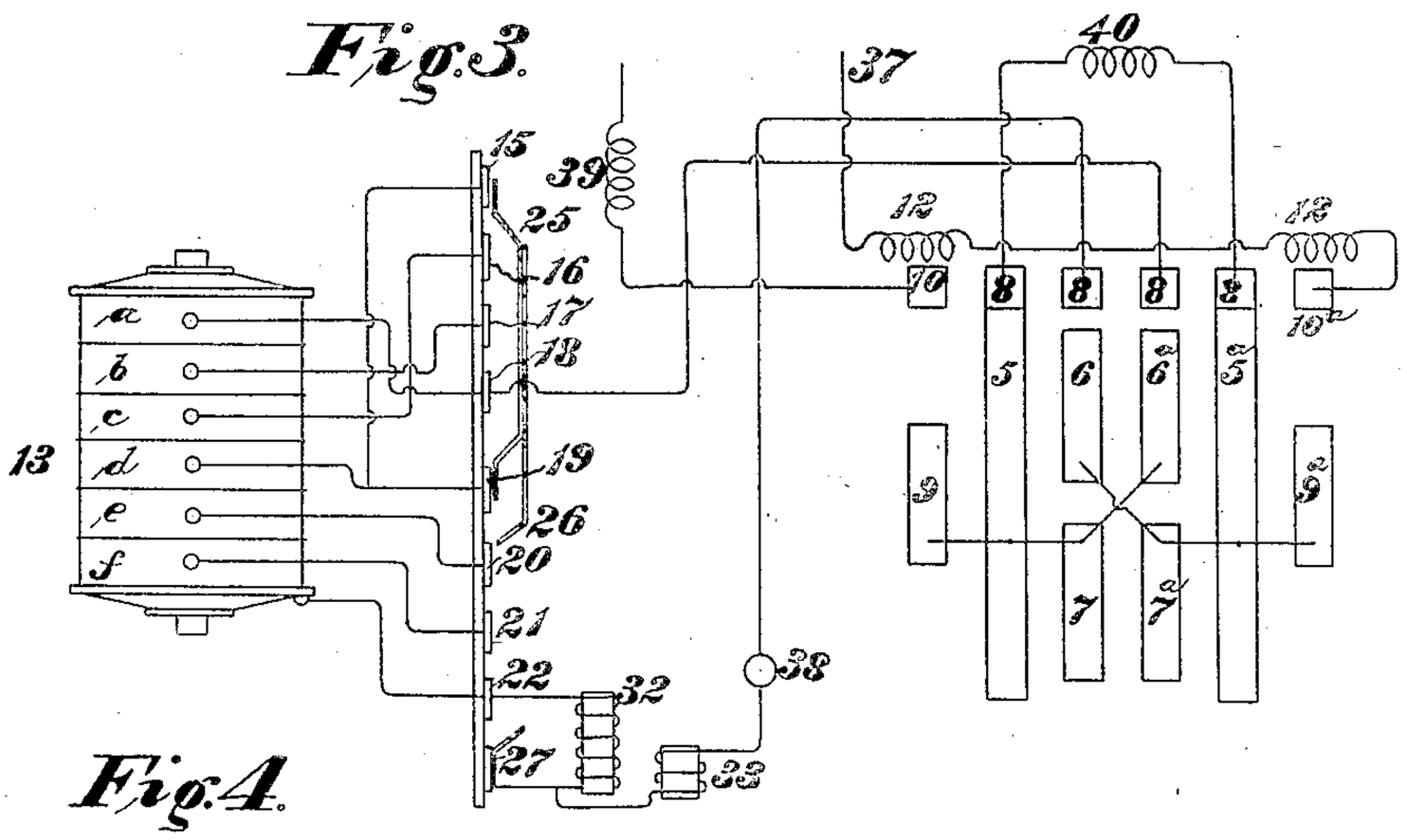
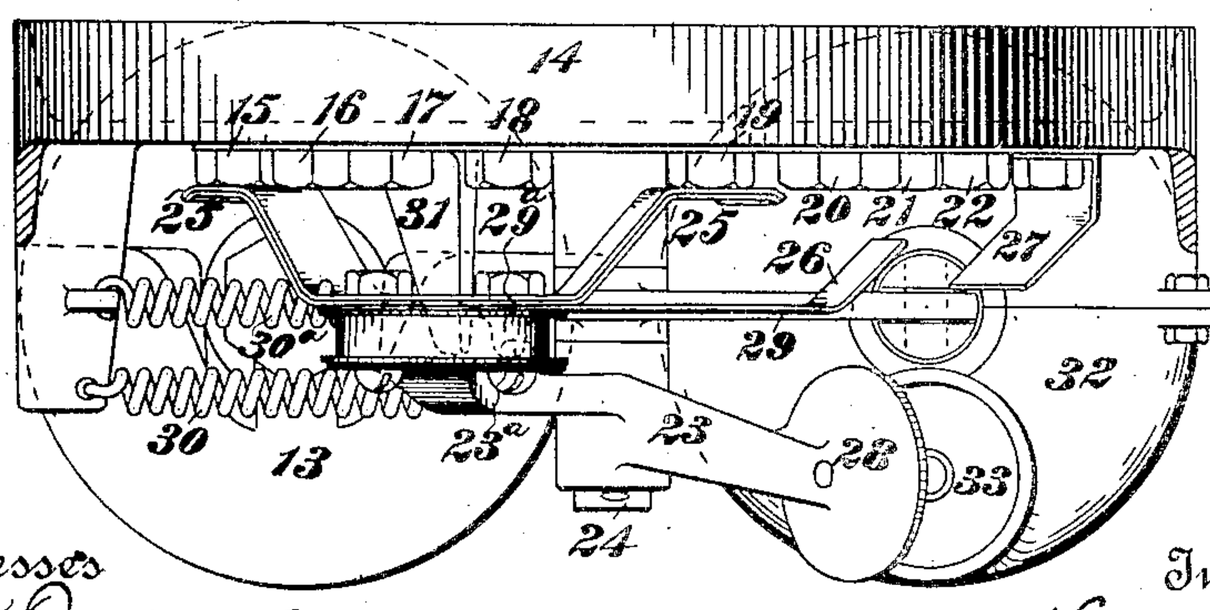


Fig. 4.



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CONTROLLER FOR ELECTRIC MOTORS.

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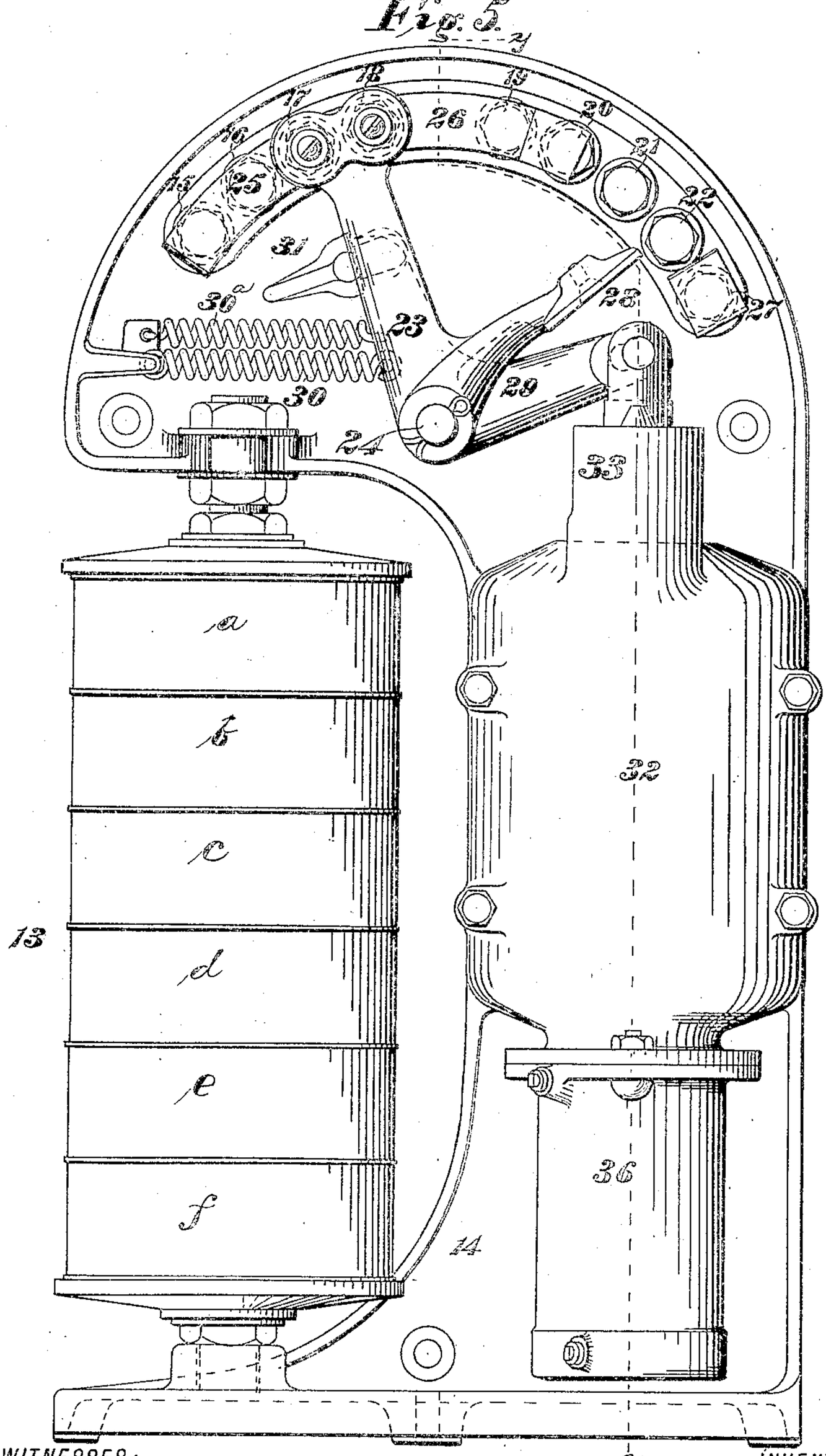
Fig. 5.



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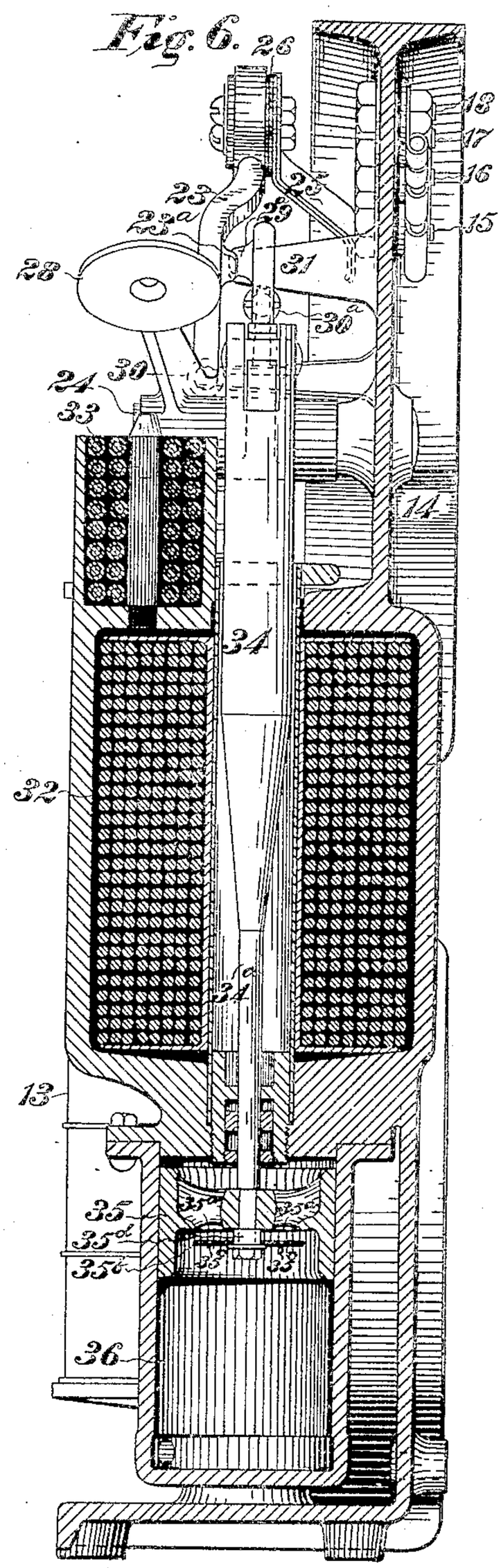
CONTROLLER FOR ELECTRIC MOTORS.

No. 584,856. Patented June 22, 1897.

Fig. 6.



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UNITED STATES PATENT OFFICE.

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CONTROLLER FOR ELECTRIC MOTORS.

SPECIFICATION forming part of Letters Patent No. 584,856, dated June 22, 1897.

Application filed October 28, 1896. Serial No. 610,332. (No model.)

To all whom it may concern:

Be it known that I, HARRY P. DAVIS, a citizen of the United States, residing at Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Controllers for Electric Motors, (Case No. 712,) of which the following is a specification.

My invention relates to controllers for electric motors, and more particularly to devices of this class which are employed in connection with motors utilized for operating elevators.

The object of my invention is to provide a controller which is simple in construction, effective in operation, and readily manipulated, and one which will serve to automatically and gradually short-circuit the starting resistance, which will short-circuit the actuating means for the resistance-switch when it has done its work, and which will insure the quick return of the resistance-switch to its initial position when the main circuit is open.

In the accompanying drawings, Figure 1 is a plan view of a stopping, starting, and reversing switch forming part of my controller mechanism. Fig. 2 is a transverse section on line *x x* of Fig. 1. Fig. 3 is a diagram of the controller switches and circuits. Fig. 4 is a plan view of the variable resistance and the controlling mechanism therefor, the flange at the front side at the top of the frame being broken away in order to more clearly disclose the operative parts of the device. Fig. 5 is a front elevation of the resistance and the controlling-switch therefor. Fig. 6 is a vertical section taken on line *y y* of Fig. 5.

Referring now particularly to Figs. 1, 2, and 3 of the drawings, 1 is a base provided with bearings 2, in which is mounted a shaft 3. This shaft has rigidly mounted upon it a drum 4, provided with contact-strips 5, 5^a, 6, 6^a, 7, and 7^a. The contact-strips 6 and 7^a are electrically connected, as are also the strips 6^a and 7, and the strips 5 and 5^a extend completely around the drum. Suitable stationary contacts 8 engage the contact-strips above referred to. The spaces between the strips 6 and 7 and between the strips 6^a and 7^a are of such width that they are bridged by the corresponding stationary contacts 8 as the drum is rotated. Upon the drum, near the respective ends thereof, are mounted contact pieces or arms 9 and 9^a, which project some little distance therefrom. These engage, respectively, with stationary contacts 10 and 10^a. Each of the contacts 10 and 10^a is partially surrounded by the pole-pieces 11 of an electromagnet, the coil 12 of which is included in the main circuit. The object of these magnets is to rupture any arcs which may be formed when the circuit is interrupted by the separation of the contacts 9 and 10 and 9^a and 10^a.

The shaft 3 will preferably be operated from the elevator-car by means of a cord and pulleys, (not shown,) as is usual in such apparatus.

The operation of this switch will be hereinafter more fully described in connection with that of the other controlling devices.

Referring now to Figs. 4, 5, and 6 in connection with Fig. 3, 13 is a resistance-column comprising six elements or parts *a*, *b*, *c*, *d*, *e*, and *f*, preferably of the construction set forth in my Patent No. 513,457, granted January 23, 1894. The resistance-column 13 is mounted in a frame 14, and the parts *a f* are connected to two sets of stationary contacts 15, 16, 17, and 18 and 19, 20, 21, and 22, arranged in the arc of a circle on the frame 14.

23 is a bell-crank lever pivotally mounted upon a bearing stud or post 24, projecting from the frame 14. The free end of the short arm of lever 23 is provided with an armature 28, and the free end of its long arm is provided with a long contact-brush 25, which is of sufficient length to constitute a conducting-bridge between two stationary contacts which are not in the same set and which are separated by two or more intervening contacts. An auxiliary contact-brush 26 is mounted upon lever 23 and is electrically and mechanically joined to the brush 25. The brush 26 is so located with reference to the brush 25

that it will make contact with a stationary contact-piece 27 when the resistances are all short-circuited. A second bell-crank lever 29 is pivotally mounted upon the stud 24 independently of the lever 23.

The inside of the long arm of the lever 23 is provided with a lug 23^a, and the adjacent side of the corresponding arm of the lever 29 is provided with a corresponding lug 29^a, located behind the former. The long arm of the lever 23 is connected to the frame 14 by a coiled spring 30, and the corresponding arm of lever 29 is connected to the frame by a similar spring 30^a. A stop lug or post 31 projects from the frame 14 in position to be engaged by the lever 29 when it is retracted by its spring.

A solenoid 32 is mounted upon the frame 14, and, as shown in the present instance, a portion of its casing forms an integral part of such frame. A small magnet 33 is mounted above the solenoid 32 in position to attract and hold the armature 28 when the latter is brought within its magnetic field. The core 34 of the solenoid 32 is loosely attached at its upper end to the free end of the adjacent arm of lever 29 by a slot-and-pin connection. The rod 34^a, constituting a continuation of core 34, extends through and is fastened to a dash-pot plunger 35, which is provided with passages 35^a. A thin metal disk 35^b, having one or more small holes 35^c, is loosely mounted upon a bushing 35^d, which surrounds the lower end of rod 34^a. The dash-pot cylinder 36 contains a suitable liquid for retarding the movement of the core by the solenoid 32.

It will be understood from this construction that when the circuit through the controller is closed the solenoid-core will be attracted and therefore moved downward. The rapid movement of the solenoid-core which would otherwise result is prevented by the dash-pot, the disk 35^b being moved upward by the liquid in cylinder 36 to close the passages 35^a when the solenoid-core is moved downward, and thus preventing the passage of the retarding liquid except through the small openings 35^c. As the lug 29^a on the lever 29 is behind the corresponding lug 23^a on the lever 23, the former will engage the latter and gradually move the brush 25 over the stationary contacts 15 to 22. When the limit of the stroke is nearly reached, the armature 28 will be within the field of the magnet 33. The further movement of the lever 23, which serves to bring the auxiliary brush 26 into engagement with the stationary contact 27, will therefore be effected by the magnet 33. The solenoid 32 being short-circuited by means of the brush 26 and the contact 27 the core 34 will be released and the retracting-spring 30^a will draw the lever 29 and the core 34 back to their original positions, the movement being comparatively rapid on account of the opening of the passages 35^a by the depression of the disk 35^b. As the magnet 33 remains in circuit it will hold the brushes in the position to which they were moved by the solenoid 32 until the main circuit is interrupted.

The operation of the entire apparatus is as follows: Assuming that the parts of both switches are in the positions indicated diagrammatically in Fig. 3 of the drawings and the motor to be controlled and its load therefore at rest, if the shaft 3 be turned by any convenient means—such, for example, as a pulley and a cord or chain extending within reach of the operator, so that the contact-strips 6 and 6^a are brought into engagement with the corresponding stationary contacts 8 and the contact-arms 9 and 9^a into engagement with the respective stationary contacts 10 and 10^a, as indicated in Figs. 1 and 2—the circuit through the motor will be closed and the course of the current will be as follows: through the conductor 37, the coils 12 of the arc-rupturing magnets, the stationary contact 10^a, the contact-arm 9^a, the contact-strips 7^a and 6, the stationary contact 8 in engagement with the latter, the motor-armature 38, the magnet 33, the solenoid 32, the stationary contact 22 of the resistance-switch, all of the resistance 13, the stationary contact 18, back to the contact-strip 6^a, through the corresponding stationary contact 8, across to the contact-strip 7, and thence through the contact-arm 9, the stationary contact 10, and out through the series winding 39 of the motor field-magnet.

Where a motor having a compound-wound field-magnet is employed, as indicated in the drawings, the shunted current passes from the contact-strip 9^a to the strip 5^a, thence to the corresponding stationary contact 8, through the shunt-winding 40 of the motor to the strip 5, and thence out through the contacts 9 and 10 and the series winding 39.

By reason of the construction of the reversing-switch hereinbefore described, whereby the middle contact-fingers 8 are always in contact with either the strips 6 and 6^a or the strips 7 and 7^a, the circuit which includes the shunt-winding 40, the armature 38, and the resistance-switch is maintained permanently closed, all danger of breaking down the insulation of the shunt-winding being thus substantially avoided.

As soon as the current has started through the course above indicated the solenoid 32 will obviously draw down its core against the action of the retracting-spring and the dash-pot, and by reason of the impinging of the lug 29^a on the lever 29 against the corresponding lug 23^a on the lever 23 the contact-brush will be moved over the stationary contacts in such order that in its second position it will bridge the contacts 16 and 19. When in this position, the current will pass through the resistances *f*, *e*, and *d*, the stationary contact 19, the brush, the resistances *b* and *a*, and thence to the stationary contact 8 in engage-

ment with the strip 6ª, and so on, as above indicated, the resistance *c* being short-circuited.

In the third position the brush will bridge the contacts 16 and 20 and the resistances *c* and *d* be will short-circuited. In the fourth position the brush will bridge the contacts 17 and 20 and resistances *b*, *c*, and *d* will be short-circuited. In the fifth position the contacts 17 and 21 will be bridged and the resistances *b*, *c*, *d*, and *e* will be short-circuited. In the sixth position the contacts 18 and 21 will be bridged and the resistances *a*, *b*, *c*, *d*, and *e* will be short-circuited, and in the seventh and final position the contacts 18 and 22 will be bridged and all of the resistances will be short-circuited, the current passing directly through the brush. When the brush has reached this position, the auxiliary contact-brush 26 will engage with the stationary contact 27, and the current, which has previously passed through the large solenoid, will short-circuit this coil and pass from the auxiliary stationary contact through the two brushes and out. When the brushes have been moved to their final positions, the armature 28 will rest upon the top of the smaller coil 33 and will be held in that position by said coil, but the larger coil being short-circuited the core 34 will be released and its lever 29 will be retracted to its original position by means of the retracting-spring 30ª, the brushes being retained in position for short-circuiting the resistances by means of the small coil 33.

If it be now desired to either stop the load carried by the motor or to reverse its movement, the drum 4 will be rotated in the reverse direction to that above specified. The main circuit will thus be interrupted by the separation of the contacts 9 9ª and 10 10ª. The lever 23 and its brushes being released they will be quickly returned to their initial position by the action of the retracting-spring.

If it is desired to move the load in the opposite direction to that above described, the drum will be rotated still farther in the direction last indicated until the contact-strips 7 and 7ª and the arms 9 9ª are brought into contact with the corresponding stationary contacts 8 and 10 and 10ª, when the current will pass through the arc-rupturing magnets, the contacts 10ª and 9ª, the strip 7ª, the corresponding stationary contact 8, the contact 18 of the resistance-switch, all of the resistances, beginning with the resistance *a* and ending with the resistance *f*, to the stationary contact 22, through the solenoid 32, the coil 33, and through the armature in the reverse direction to that before described, thence to the strip 7, the arm 9, stationary contact 10, and out through the series winding 39 of the field-magnet. The course of the current and the operation of the resistance-switch will thereafter be the same as before described, except that the current will be at all times in the reverse direction through the solenoids and the armature of the motor.

It will be seen from the construction and operation of the apparatus described that the maximum amount of resistance is in circuit with the motor at the start, as is necessary in the starting of electric motors under load, that such resistance is slowly and automatically reduced until the maximum speed is attained, and that the slowly-moving means for securing this automatic reduction of the amount of resistance in circuit is then retracted out of the way of the arm of the switch, so that the latter may quickly return to its initial position when the circuit is interrupted.

Another advantage incident to the construction described is that the large switch-actuating solenoid, which is included in series in the circuit during the reduction of the resistance, is short-circuited when the resistance has been all removed, and consequently the resistance of its many turns of fine wire is removed from the circuit, and the amount of effective current for use in operating the motor is thus materially increased beyond what it would be if this coil remained in circuit.

While I have shown and described a specific construction of apparatus, I desire it to be understood that variations in the form of the same and in the details of construction of the various parts may be made without departing from the spirit and scope of the invention.

It will also be understood that the invention is not limited to the control of motors having compound-wound field-magnets.

I claim—

1. The combination with an electric circuit and a resistance normally included therein, of a switch and an actuating-magnet for gradually reducing the amount of said resistance in circuit, means for short-circuiting said magnet when the minimum resistance is secured, and a second magnet for maintaining said last-named condition until the circuit is interrupted.

2. The combination with an electric motor, a starting, stopping and reversing switch therefor, and a starting resistance, of a switch and an actuating-magnet for gradually and automatically reducing the amount of said resistance in circuit, means for short-circuiting said magnet, and means for maintaining the condition of least resistance while the circuit remains closed.

3. The combination with an electric motor and its circuit, of a variable resistance normally in said circuit, a switch therefor spring actuated in one direction, a solenoid and core for actuating the switch in the opposite direction, means for short-circuiting said solenoid when the switch reaches the limit of its positive-movement and means for maintaining the switch in the last-named position until the circuit is interrupted.

4. A controller for electric motors compris-

ing a reversing and cut-out switch in combination with a variable resistance and a series of stationary contacts therefor, a movable arm provided with a contact for making engagement with said stationary contacts and with an armature, a holding-magnet for said armature, a main solenoid, a movable arm provided with a core for said solenoid and with means for engaging and moving said contact-carrying arm, means for retracting said arms independently, means for retarding the forward movement of said arms and means for short-circuiting the main solenoid when the final resistance-contact is reached.

5. In a controlling mechanism for electric motors, the combination of a starting, stopping and reversing switch and a variable starting resistance, with a controlling-switch therefor comprising a series of stationary contacts; a coöperating movable contact arm or lever provided with an armature, a spring for retracting said arm or lever, a second arm or lever provided with an armature and with means for engaging and moving said first-named arm or lever when positively actuated, a spring for retracting the second arm or lever, means for retarding its positive movement, an electromagnetic coil for each armature and means for short-circuiting one of them when the resistance is all short-circuited.

In testimony whereof I have hereunto subscribed my name this 14th day of September, A. D. 1896.

HARRY P. DAVIS.

Witnesses:
WESLEY G. CARR,
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