No. 652,360. Patented June 26, 1900.

# J. L. HALL.

## MOTOR RHEOSTAT.

(Application filed May 10, 1900.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

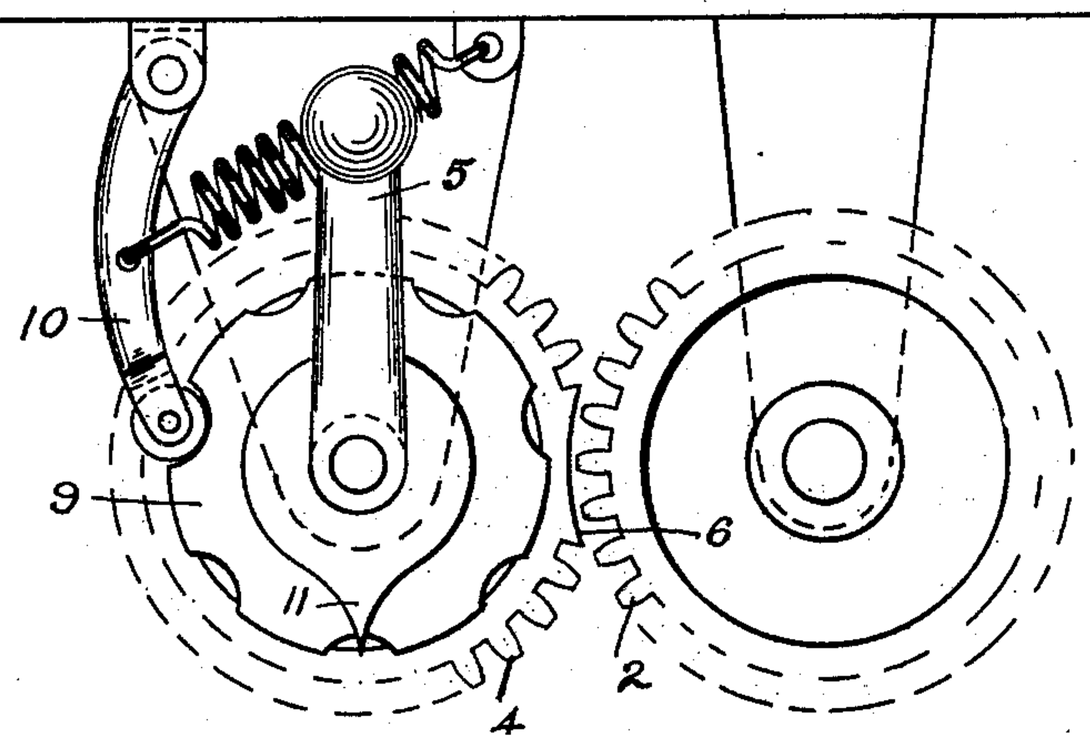
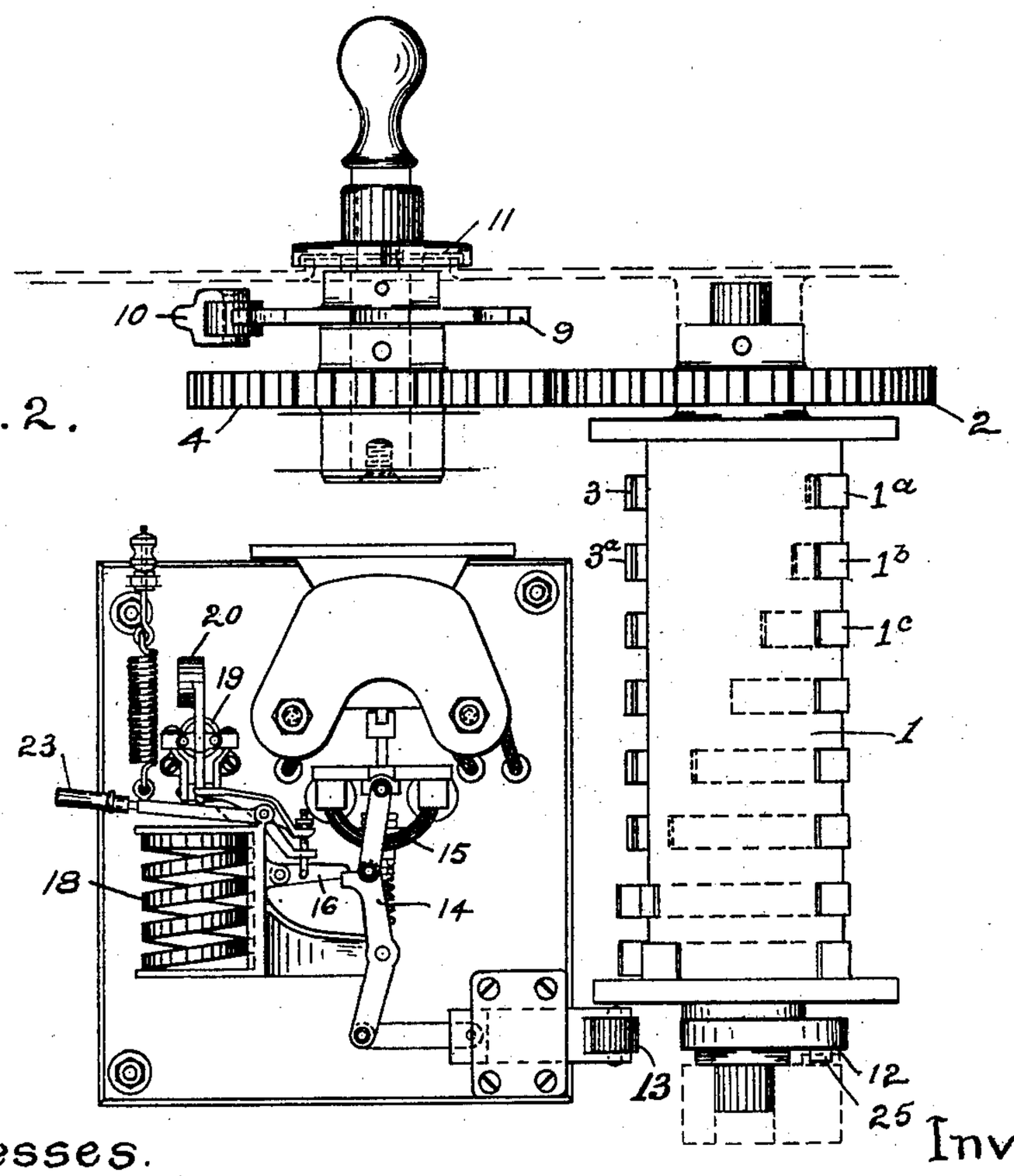



Fig. 2.




Witnesses.
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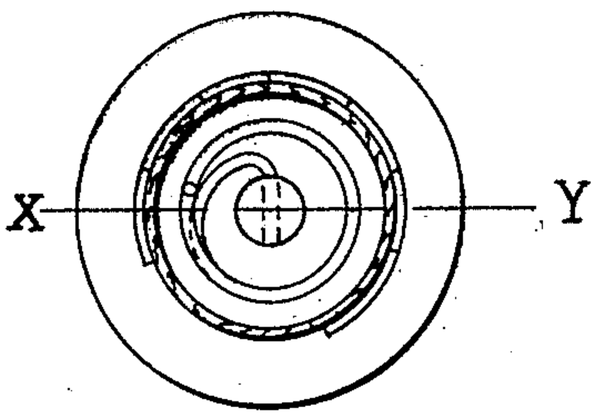


Fig. 3.

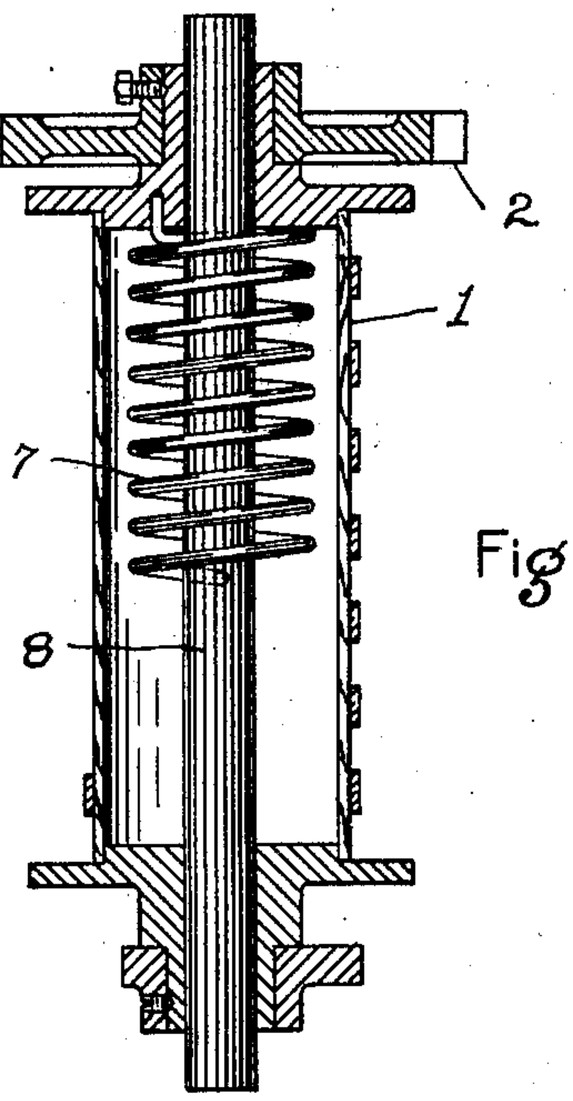


Fig. 4.

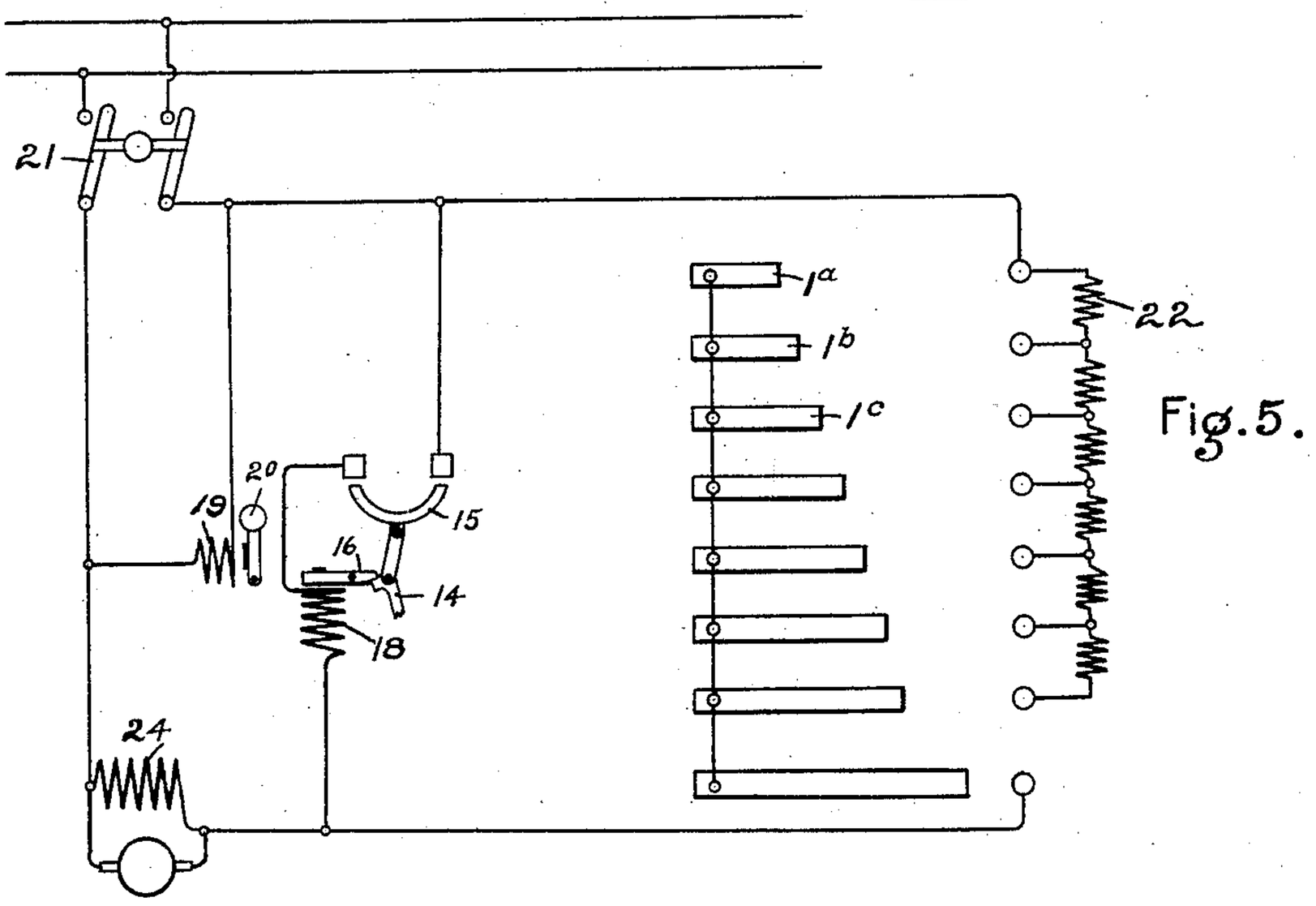


Fig. 5.

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# UNITED STATES PATENT OFFICE.

JOHN L. HALL, OF SCHENECTADY, NEW YORK, ASSIGNOR TO THE GENERAL ELECTRIC COMPANY, OF NEW YORK.

## MOTOR-RHEOSTAT.

SPECIFICATION forming part of Letters Patent No. 652,360, dated June 26, 1900.

Application filed May 10, 1900. Serial No. 16,113. (No model.)

*To all whom it may concern:*

Be it known that I, JOHN L. HALL, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Motor-Rheostats, (Case No. 1,474,) of which the following is a specification.

This invention relates to an automatic switch or rheostat for an electric motor, the object being to permit such a device to be employed with motors of large horse-power, to be easy of control or manipulation, and to guard against damage to the rheostat-contacts from arcing. A difficulty has been encountered in providing a rheostat for motors of large horse-power and considerable voltage in the burning of the contacts of the sectional resistance and also in permitting the automatic switch to move with sufficient freedom. Devices of this kind are commonly constructed so that the releasing-coil may operate at over or under load and permit the control-switch to fly back under the action of a spring to its initial open-circuit position, during which arcing occurs at the contacts as the sections are progressively cut out. It is one of the objects of my invention to avoid this arcing. I provide an automatic circuit-breaker by which a branch circuit around the rheostat is closed after the motor is started up, the circuit-breaker being provided with operating-coils which release it upon overload or other abnormal circuit conditions. I provide my starting device with means for restoring the rheostatic switch to its normal position after the motor has been put on short circuit. Thus the circuit-breaker having been set and a parallel branch closed for current with respect to the rheostat, the latter in returning to its initial position carries but little current, and damage to the contacts is avoided.

My invention involves, in addition to the features above indicated, other features of novelty relating to the structure of the apparatus and the system of control, which will be hereinafter more fully described, and definitely indicated in the claims.

In the accompanying drawings, which illustrate the invention, Figure 1 is a top plan view of a hand-operated device governing the motor-rheostat. Fig. 2 is a side elevation of the component parts. Fig. 3 is a cross-section of the switch or controller-drum. Fig. 4 is a vertical section, the controlling-spring being shown in elevation, the plane of section being indicated on the line X Y of Fig. 3; and Fig. 5 is a diagram of circuit connections employed in my organization.

I prefer to employ as the resistance-switch a drum similar to that employed in controllers for electric tram-cars, gearing this to an operating-handle, by which it may be turned through a determinate angle and then released. The means by which I effect this release are indicated in Figs. 1 and 2, where 1 represents the drum, provided with a plurality of fixed conducting-segments $1^a$ $1^b$ $1^c$, &c., normally standing in open relation to a corresponding set of pivoted contact-blocks 3 $3^a$, &c., the latter being fixed to a support in such relation as to ride over and engage the arc-shaped segments $1^a$ $1^b$ when the drum is turned. The gear-wheel 2 engages a corresponding gear 4, having an operating-handle 5, by which it may be turned, and over one part of this wheel the teeth are omitted, as indicated at 6, so that when the handle has been turned to its full limit the parts will be in the position indicated by Fig. 1, thereby permitting relative motion between the wheels 2 and 4. The wheel 2, which is fixed to the resistance-controlling drum, is governed by a helical spring 7, one end of which is fastened to the drum and the other end to the fixed post 8, upon which it turns. Thus after the handle 5 has been shifted to bring the parts to the position indicated in Fig. 1 the spring is permitted to rebound and restores the resistance-varying drum to its initial position. Fixed to the arbor on which the handle 5 and the gear-wheel 4 are mounted is a notched disk 9, the notches being spaced at different circumferential positions corresponding to definite steps of the resistance graduation, and a spring-actuated arm 10, carrying a roller, as indicated in Fig. 1, is held against the disk, causing the roller to fall into the notches as they pass it, thus tending to obstruct a too-

rapid movement of the controller and effect a quick completion of contact at each resistance step. An indication of the position of the controller is afforded by a pointer 11, fixed to the casing, as to the amount of resistance cut out. On the bottom of the controller-drum is a cam 12, which after all the resistance has been cut out comes into engagement with a roller 13, mounted on a plunger connected to the circuit-breaker. This circuit-breaker may be of a standard type found on the market and adapted to respond to overload and underload conditions of the circuit. As it is a well-known piece of apparatus, it will require only a brief description. It is provided with a toggle 14, which when cramped to the position indicated in the figures causes a bridging contact 15, formed of a bundle of thin laminæ of copper or phosphor-bronze, to bridge the circuit-terminals. A spring having one end fastened to a fixed abutment and the other to a part of the moving element tends to open the circuit-breaker, but cannot do so until a latch 16, which holds the toggle cramped off center, is released. This release may be effected by a series coil 18 or by a shunt or potential coil 19. The armature of the former acts through a link, as indicated in the drawings, to lift the latch, and the armature of the latter may release a weight 20, which in falling strikes a pivoted arm capable of acting on the latch. The relation of these parts will be more clearly seen after an examination of Fig. 5, in which 21 represents the main controlling-switch of the motor, and 22 the resistance, the several sections of which may be progressively cut out of the circuit by the contacts $1^a$ $1^b$ $1^c$, a development of which is shown in this figure. Thus it will be seen that as the handle 5 is turned and the controller-drum moved the motor is first cut into circuit through all of the resistance and the latter then gradually reduced until the motor is placed on short circuit, when the cam 12 engages the roller 13 and sets the circuit-breaker, thereby closing a parallel branch of the circuit with respect to the resistance. Immediately afterward the gear-wheels come into a relation to permit a slip connection, and the rebound of the spring restores the controller-drum to its initial position, where it is arrested by a pin or stop 25, Fig. 2; but the resistance being short-circuited by the circuit-breaker no damaging arcing at the contacts can occur. The series coil 18 of the circuit-breaker has so little resistance that there is but a slight potential drop across its terminals, and this is insufficient to damage the contacts. The potential coil 19 releases the circuit-breaker upon underload or no-load condition of the circuit. The circuit may be opened most advantageously to cut out the motor by tripping the circuit-breaker, which may be done in any convenient manner—as, for example, for operating a handle 23, connected to the armature of the series coil. 24 represents the motor-controller, which may of course be of any suitable type. That shown is a shunt-wound motor.

A further advantage of the organization which I have described is that the device may be made easy to operate, as but little pressure need be put on the resistance-contacts. The circuit-breaker which carries the current in the full operating position of the motor being adapted to afford a superior contact and the contacts of the rheostat carrying small current and only for a short period in opening do not heat greatly and are not burned by arcing. As compared with a rheostat having a dial-switch the contacts are grouped on a smaller radius, thus further reducing the amount of power required to operate the switch.

A further advantage results from the circuit-breaker and rheostats being interlocked and requiring but one handle to manipulate them, which makes it impossible for an operator to wrongly perform the proper function, as he has but to turn the handle around once to not only cut out the resistance, but to short-circuit the rheostat-box by the circuit-breaker. Without this interlocking device it would be necessary first to operate the rheostat, after which to close the circuit-breaker by hand, in which case if the operator should by chance neglect to close the circuit-breaker on account of the contacts of the rheostat being made to carry the current but for a moment they would rapidly heat and probably fuse, which would necessitate making the rheostat with massive contacts to avoid this trouble.

What I claim as new, and desire to secure by Letters Patent of the United States, is—

1. A motor-rheostat comprising means for progressively cutting out resistance, a circuit-breaker operated thereby to close a branch circuit around the resistance when the motor is cut in, and a releasing device permitting the rheostat to be returned to its open position after the circuit-breaker has been closed.

2. A motor-rheostat comprising a hand-operated device for progressively cutting out the resistance, a circuit-breaker in a branch around a resistance set closed thereby when the resistance has been cut out, means for restoring the rheostat after the circuit-breaker has been closed, and independent releasing devices for opening the circuit at the circuit-breaker.

3. A motor-rheostat comprising a movable contact device for progressively cutting out the resistance, a circuit-breaker automatically cut into a branch circuit around the resistance when the motor is under speed, a spring for restoring the rheostat to its normal condition after the circuit-breaker has been set, and a releasing device for the circuit-breaker responsive to abnormal current conditions.

4. A motor-rheostat comprising a retractile contact-controller, a resistance-section progressively engaged thereby, a slip connection permitting return of the controller, and con-

nections for completing an independent connection between the supply-mains and the motor before release of the controller.

5. A motor-rheostat comprising a retractile contact-controller, an operating-handle geared thereto, means for disconnecting the gearing after a determinate range of movement and a branch circuit between the mains and the motor completed prior to said disconnection.

6. A motor-rheostat comprising a spring-retracted contact-controller, resistance-contacts progressively engaged thereby, an operating-handle connected therewith, means for disengaging the handle after a determinate range of movement, and a branch circuit around the resistance completed before the handle is disengaged.

7. A motor-rheostat comprising a spring-retracted contact-controller, resistance-contacts progressively engaged thereby, an operating-handle, means for disengaging the handle after a determinate range of movement, a branch circuit around the resistance completed before the handle is disengaged, and means for opening the branch circuit.

In witness whereof I have hereunto set my hand this 8th day of May, 1900.

JOHN L. HALL.

Witnesses:

BENJAMIN B. HULL,

EDWARD WILLIAMS, Jr.