(No Model.) G. H. WHITTINGHAM. 2 Sheets—Sheet 1.

AUTOMATIC DEVICE FOR REMOVING RESISTANCES IN STARTING ELECTRIC MOTORS.

No. 602,413. Patented Apr. 12, 1898.

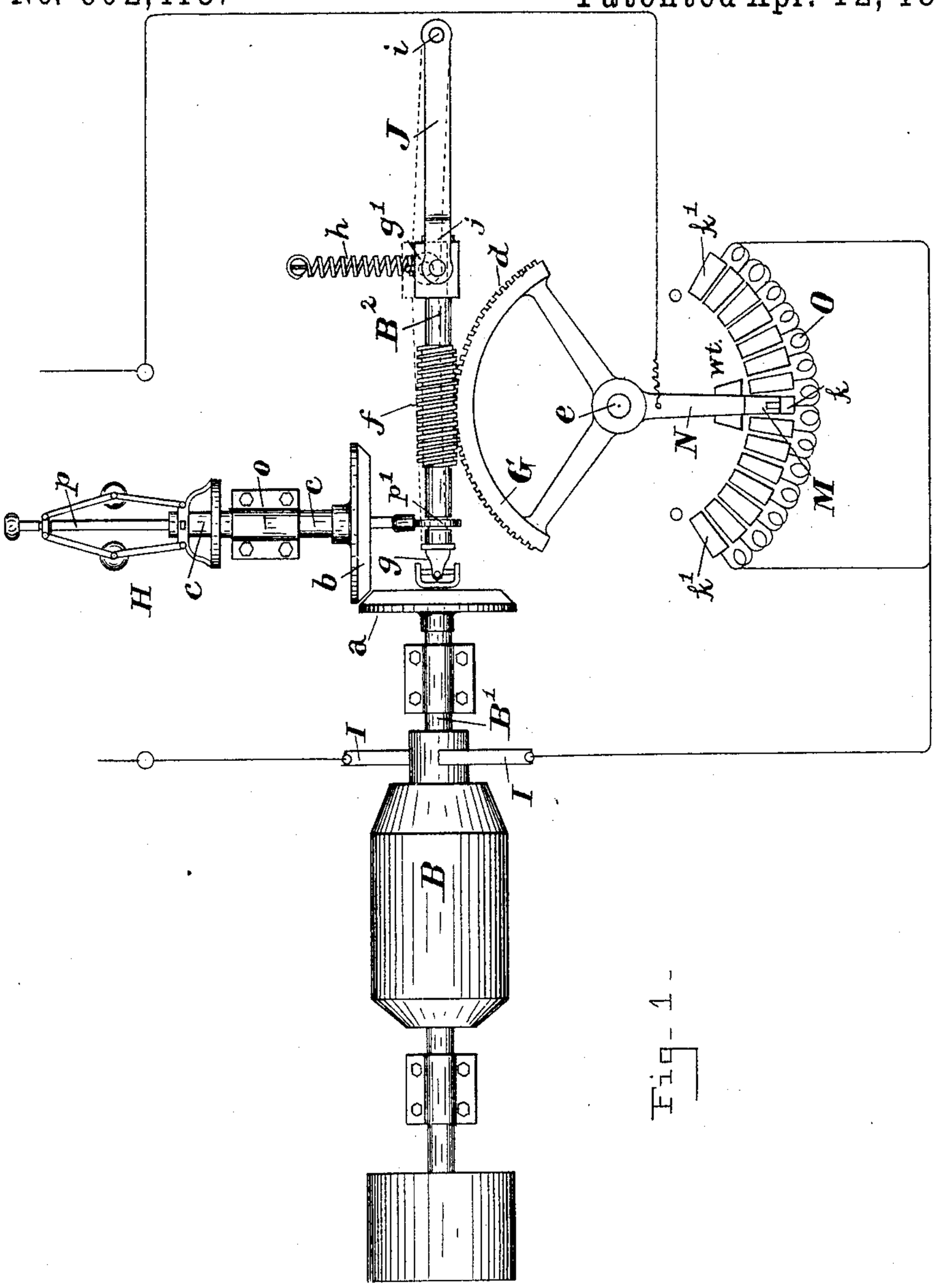

Fig. 1.

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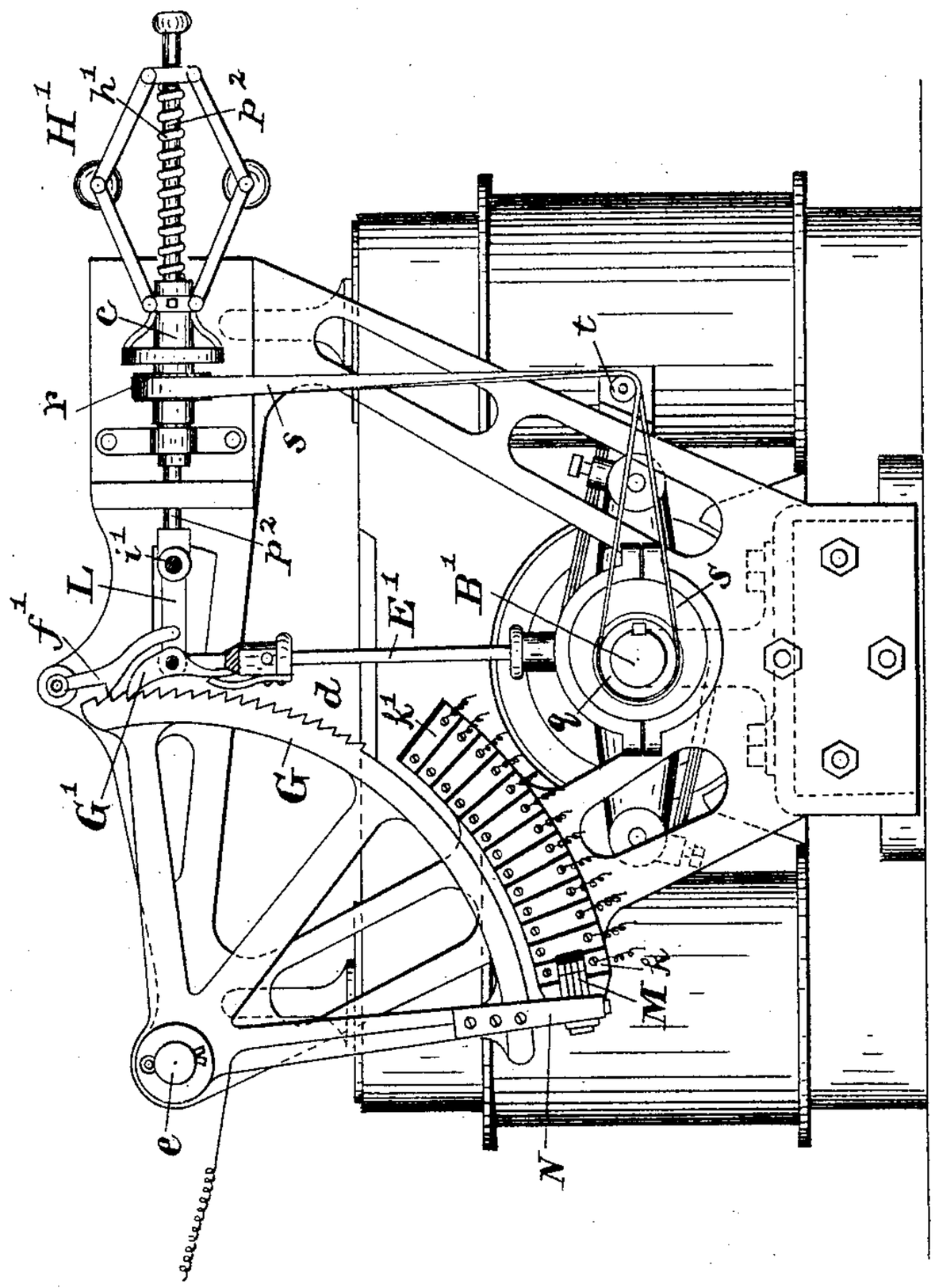
Fig. 2.



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UNITED STATES PATENT OFFICE.

GEORGE H. WHITTINGHAM, OF BALTIMORE, MARYLAND, ASSIGNOR TO THE AUTOMATIC SWITCH COMPANY OF BALTIMORE CITY, OF MARYLAND.

AUTOMATIC DEVICE FOR REMOVING RESISTANCE IN STARTING ELECTRIC MOTORS.

SPECIFICATION forming part of Letters Patent No. 602,413, dated April 12, 1898.

Application filed September 9, 1897. Serial No. 651,028. (No model.)

To all whom it may concern:

Be it known that I, GEORGE H. WHITTINGHAM, a citizen of the United States, residing at Baltimore, in the State of Maryland, have invented certain new and useful Improvements in Automatic Devices for Removing Resistances in Starting Electric Motors, of which the following is a specification.

This invention relates to an automatic starting device for electric motors, and has for its object to gradually reduce the resistance in the armature-circuit of the motor automatically when the current is turned on and the motor starting by cutting out the coils of resistance one after the other from that of the greatest resistance to that of the least resistance and maintaining it in this position during the running of the motor, so that when the circuit through the motor is first completed to start the motor the current will meet with the greatest resistance and when the motor is fully running there will be the least resistance to the passage of the current. This is done to prevent the burning out of the armature of the motor when starting. When the current is shut off, this device operates to automatically replace the resistance in the circuit in readiness to be started again.

My present invention consists in combining an arm to cut out the resistance, mechanism for operating said arm in the direction for cutting out the resistance and which when at rest is free of connection with said arm, and a centrifugal governor which effects the connection between said resistance-arm and the mechanism that operates it. This combination with a centrifugal governor differs from any hitherto made.

It has been heretofore proposed in United States patent to Edison, No. 248,429, dated October 18, 1881, to operate the resistance-arm through its entire movement by the varying centrifugal force of a ball-governor; but the possibility of such a device cutting out all the resistance is dependent on the governor first attaining a certain speed of rotation. My present combination is different in that a high speed of the governor is unnecessary. When the governor begins to rotate, the only work devolved on it is to make a single slight movement of mechanism that will connect with the resistance-arm. Once this connection is made the resistance-arm will have imparted to it by said mechanism a positive and full movement until all resistance is cut out.

The invention is illustrated in the accompanying drawings; but it is to be understood that the invention is not limited to the details of construction here shown, as the same may be embodied in other forms.

Figure 1 is a view showing the several parts. Fig. 2 is an elevation showing another construction, but embodying my invention.

Referring to Fig. 1, the letter B designates the armature, B^2 the armature-shaft or driving-shaft, and I the commutator-brushes, of an electric motor, which may be of any desired construction. A segment-shaped bar G is pivoted at *e*, so as to swing in a vertical plane. This bar has teeth *d* and is so constructed that normally when not in use its gravity will cause it to hang pendent and take the position shown in the drawings. To facilitate this, the segment-bar in the present instance carries a weight *w t* on its downward-projecting arm N, which latter is insulated from the segment part. This arm carries a contact-shoe M, of any desired construction. Contact-plates *k k'* are arranged in an arc of a circle described from the pivot-stud *e*, and each plate is insulated from the others and is connected with the resistance-coil O. The center plate *k* is the one of greatest resistance, and the two plates *k'* at the opposite ends, respectively, of the arc are the ones of least resistance. When the motor is not running, the contact-shoe M on the arm of the segment rests on the center plate, and when the current is turned on to start the motor the arm or shoe will move toward one or the other of the end plates *k'*, according to the turning of the armature-shaft one way or the opposite way. A worm *f* is fixed on a supplemental section B^2 of the armature-shaft and intermediate of its ends. This worm-section is connected with the armature-shaft proper by a universal joint *g* and turns with it. Under certain conditions the worm meshes with the teeth *d* of the segment-shaped bar G. It will be seen that with the universal joint *g* as a center the other end of the sup-

plemental section B^2, being free, may be raised and lowered, whereby the worm *f* can be made to engage with or disengage from the teeth *d* on the segment-shaped bar. The end of the supplemental section B^2 opposite the one connected with the universal joint *g* is loose, so as to both turn and slide in a collar *g'*, pivoted between the forked arms *j* of an arm J, pivoted on a stud *i*. A spiral spring *h* tends to draw the worm away from the segment-bar, and when the mechanism is at rest the said bar of the resistance-arm is out of engagement or free of connection with said worm, as indicated by broken lines.

The driving-shaft B' on the part turning in fixed bearings carries a bevel-gear *a*, which meshes with another bevel-gear *b* on a hollow shaft *c*, turning in a bearing *o*. The centrifugal governor H is carried by this hollow shaft *c* and operates a rod *p*, passing loosely through the hollow shaft. The hollow shaft revolves with the governor, but the rod *p* merely has endwise movement through said shaft. The end of the rod *p* has a collar *p'*, which takes around the worm-section B^2 of the driving-shaft. It will now be seen that when the mechanism is in motion the balls of the governor revolve and the effect will be to push the rod *p* in the direction to cause the worm *f* to engage or connect with the bar G of the resistance-arm, and the latter will then by the power obtained from the driving-shaft have a positive and continuous movement until all the resistance is cut out. When the current is cut off and the motion of the governor ceases, the rod *p* will no longer maintain the connection and the spring *h* will disengage the worm from the bar and the weighted resistance-arm will swing back to the highest resistance in readiness to start again.

In Fig. 2 a different construction is illustrated. The form of machine here shown is like that for which Letters Patent were granted me April 24, 1894, No. 518,906, reissued May 26, 1896. A full description of same, therefore, is unnecessary here.

The letter B' designates the armature-shaft; G, the segment-bar; N, the resistance-arm on said bar, but insulated therefrom; M, the contact-shoe; *k k'*, contact-plates of the resistance.

E' is an eccentric-rod having an up-and-down movement and carrying a ratchet-pawl G', which when in operation engages the teeth *d* of the segment-bar; but when the mechanism is at rest the said pawl is out of engagement or disconnected from the segment-bar. A holding-pawl *f'* is also arranged to engage the teeth of the segment-bar when the machine is in operation, but to disengage when the mechanism is at rest.

A pair of link-plates L have one end pivoted to a pin *i'* and the other end to the pivot of the pawl G'. The said pin *i'* is on the end of a rod p^2, which passes loosely through the hollow shaft *c* of the centrifugal governor device H'. The rod p^2 has endwise movement. It will now be seen that when the mechanism is in motion and the governor-balls revolve the effect will be to push the said rod p^2 toward the segment-bar G, and thereby cause the pawl G' to engage or connect with the bar G of the resistance-arm. The up-and-down movement of the eccentric-rod E', which carries said pawl, will lift the ratchet-bar G one tooth at a time, and thus the resistance-arm N will be moved until all the resistance is cut out and the circuit will be maintained at this point of lowest resistance during the run of the motor. When the current is cut off and the revoluble motion of the governor H' ceases, the rod p^2 will no longer maintain the pawls G' and *f'* in connection with the segment-bar G, and the spring *h'* will disengage said parts and thereupon the segment-bar G will fall and the resistance-arm N will be put in the position of highest resistance and the apparatus will be in readiness for again starting the motor.

The centrifugal governor H' in Fig. 2 may be turned by any preferred mechanism. In the present instance a pulley *q* is on the armature-shaft or driving-shaft B' and a pulley *r* is in the hollow shaft *c* of the governor. A suitable driving-belt *s* connects these two pulleys and passes under guide-rollers *t*.

Having thus described my invention, what I claim is—

1. In an automatic starting device for electric motors, the combination of a driving-shaft; a resistance included in the motor-circuit normally or when at rest; a toothed resistance-arm in engagement with said resistance; means adapted to engage said toothed arm when starting the motor but disengaged therefrom when the motor is not running; a centrifugal governor serving to effect the said engagement at the time of starting the motor, whereby the said resistance is cut out; and means for returning the resistance-arm to the point of greatest resistance when stopping the motor.

2. In an automatic starting device for electric motors, the combination of a driving-shaft; a resistance included in the motor-circuit normally or when at rest; a toothed resistance-arm in engagement with said resistance; a movable device to engage the teeth of said arm; and a centrifugal governor to cause the device to engage said toothed arm when starting the motor and to disengage therefrom when the motor is not running.

3. In an automatic device for removing resistance when starting electric motors, the combination of a driving-shaft; a resistance included in the motor-circuit normally or when at rest; a movable arm engaging the said resistance and when at rest free of connection with the driving-shaft; and a centrifugal governor which effects a connection between the driving-shaft and the movable arm, whereby, after such connection, each revolution of the driving-shaft shall impart to the said arm a movement in the direction of cutting out the resistance from the motor-circuit

until it is entirely cut out, and then maintain said circuit at the lowest resistance during the run of the motor.

4. In an automatic device for removing resistance when starting electric motors, the combination of a driving-shaft; a resistance in the motor-circuit; a resistance-arm; mechanism for operating the resistance-arm and which when at rest is out of engagement with said arm; and a centrifugal governor which effects the engagement of said mechanism with the resistance-arm.

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

GEORGE H. WHITTINGHAM.

Witnesses:

CHAPIN A. FERGUSON,

CHARLES B. MANN, Jr.