(No Model.) 2 Sheets—Sheet 1.

F. B. RAE.

RHEOSTAT SWITCH FOR ELECTRIC MOTORS.

No. 539,778. Patented May 21, 1895.

Fig. 1.

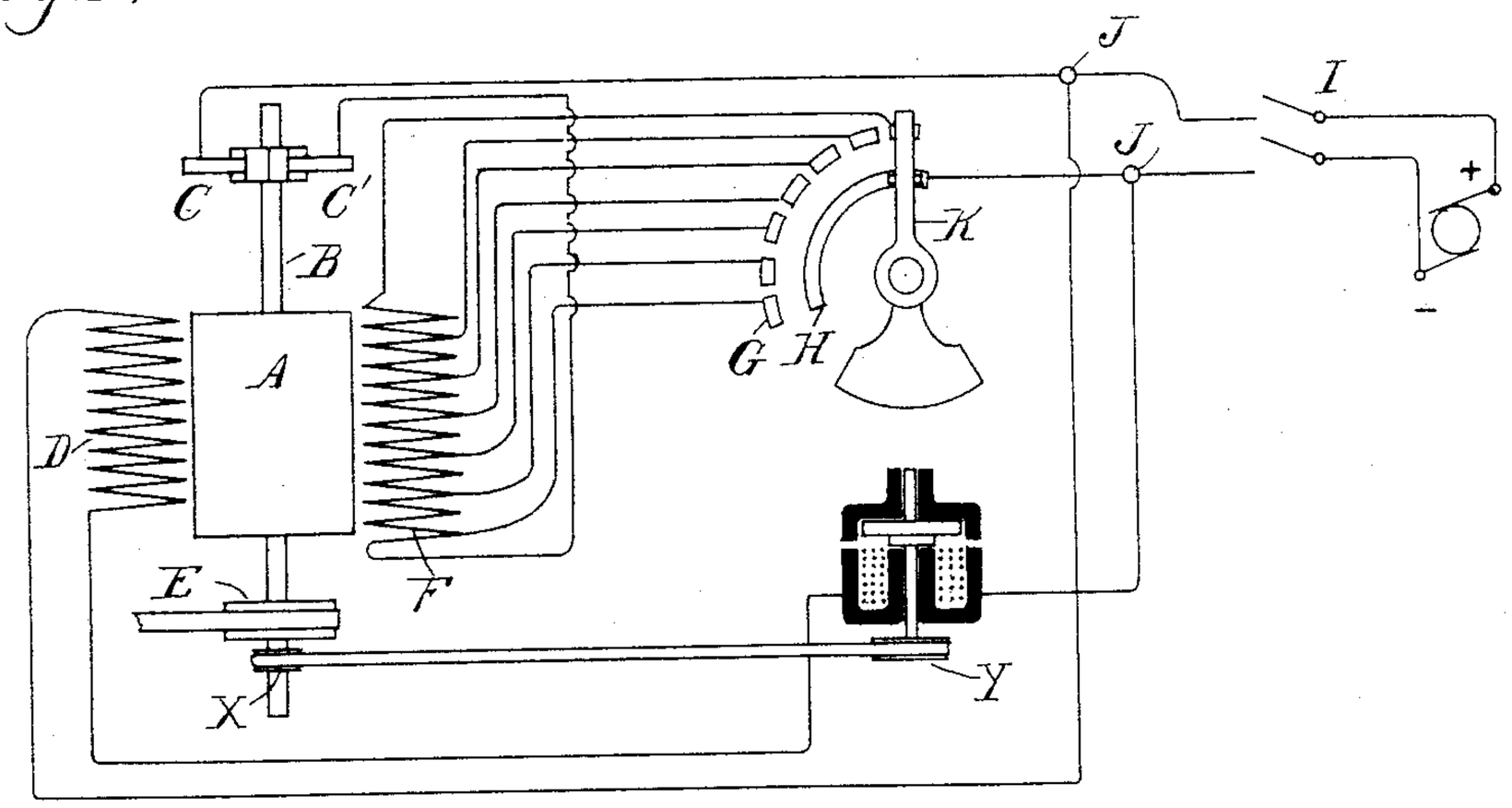
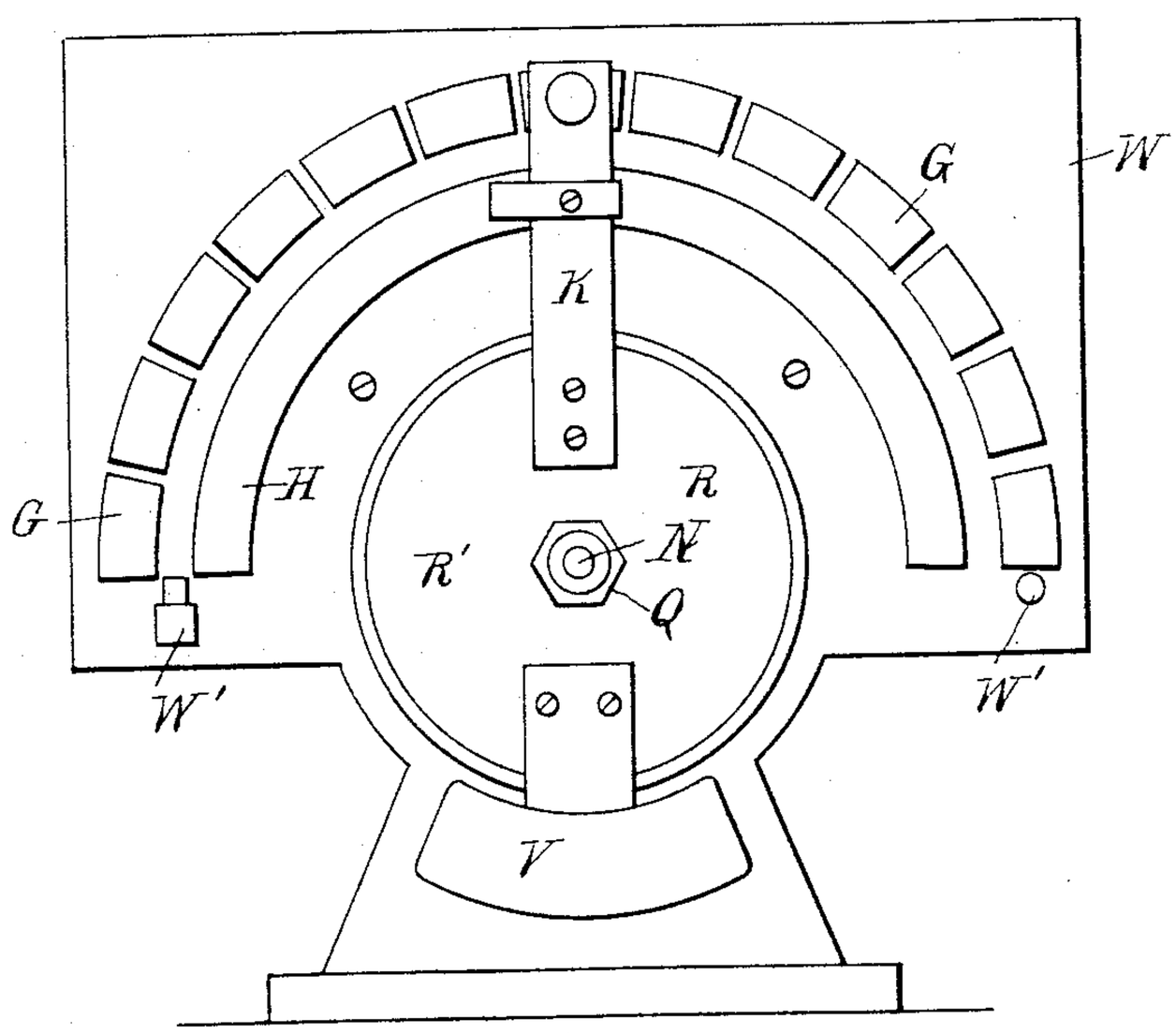


Fig. 2.



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RHEOSTAT SWITCH FOR ELECTRIC MOTORS.

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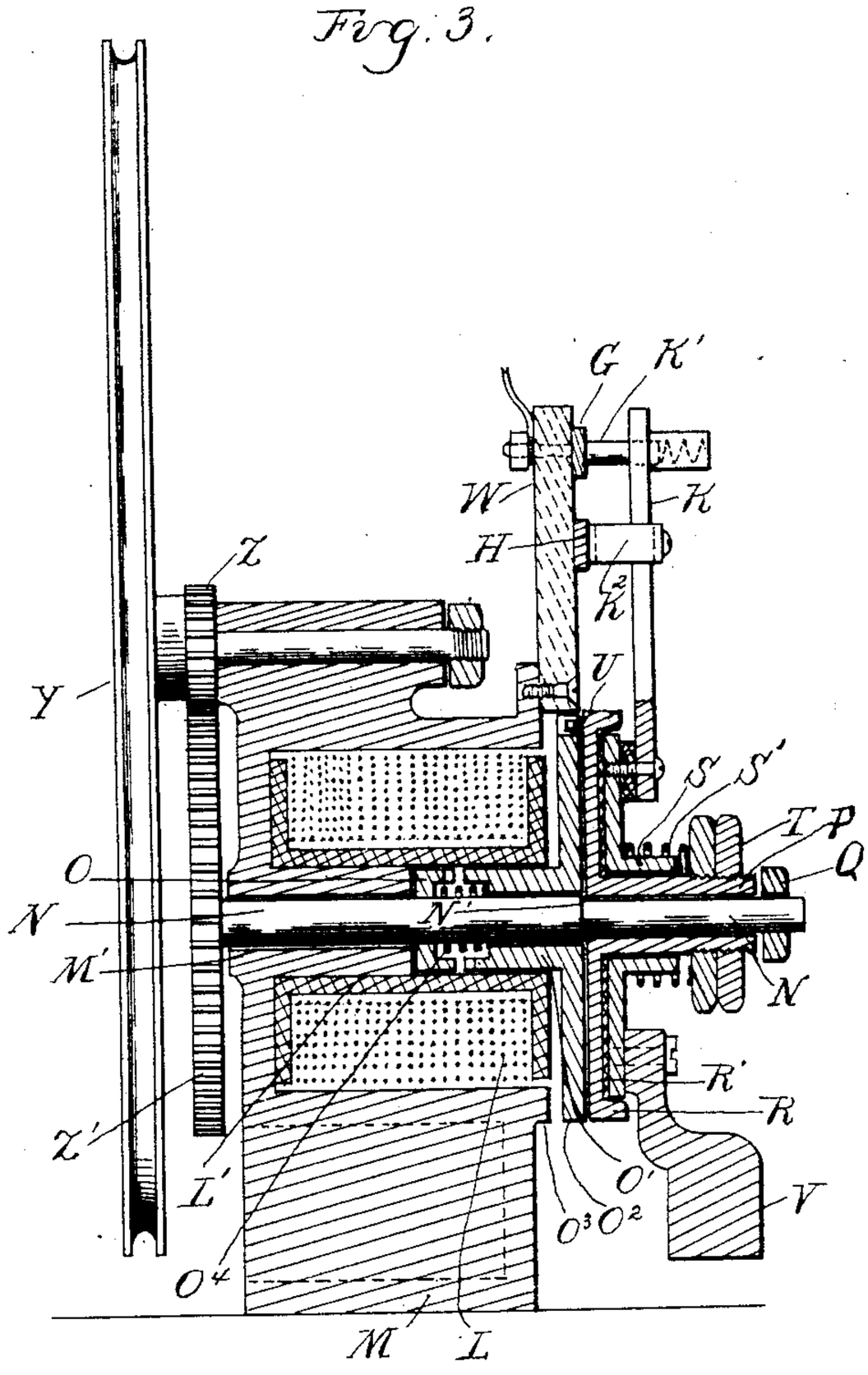
Fig. 3.



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UNITED STATES PATENT OFFICE.

FRANK B. RAE, OF DETROIT, MICHIGAN.

RHEOSTAT-SWITCH FOR ELECTRIC MOTORS.

SPECIFICATION forming part of Letters Patent No. 539,778, dated May 21, 1895.

Application filed July 6, 1894. Serial No. 516,737. (No model.)

To all whom it may concern:

Be it known that I, FRANK B. RAE, a citizen of the United States, residing at Detroit, in the county of Wayne and State of Michigan, have invented certain new and useful Improvements in Rheostatic Switches for Electric Motors, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention is principally designed for use in electric motors which are frequently stopped and started as in operating elevators, organs, &c., and relates to a device which will automatically introduce or remove artificial resistance in the armature circuit of the motor just in proportion as it is required by the reduction or increase of the counter electromotive force of the armature when the current is turned on or off.

My invention consists first in the construction, arrangement and operation of the device employed for the purpose and comprising a rheostatic switch for controlling the resistance coils and automatic actuating devices therefor operated by the motor.

My invention further consists in arranging the resistance coils controlled by the rheostat as a contingent part of the field coils in a manner to increase the efficiency of the field in starting the inertia of the load.

In the drawings, Figure 1 is a diagram of my invention. Fig. 2 is a front elevation of the regulator, and Fig. 3 is a vertical central cross-section thereof.

In Fig. 1, A represents the revolving armature; B, the shaft of the armature; C C′, the brushes to which the armature circuit is connected, and D the field coils of an electric motor of known construction and connected with a suitable source of electricity by way of the hand switch I and the binding posts J J for the purpose of generating power and transmitting it through the pulley E.

The devices for regulating and controlling this motor are constructed and arranged as follows: F is the resistance coil of a rheostat. G are the fixed contacts of the switch connected to portions of the resistance coil. H is a contact strip connected to the binding post J, and K is the contact hand provided with the spring pressed contacts K′ K² adapted to electrically connect the fixed contact strip H with the fixed contacts G. The resistance coil is connected into the armature branch of the motor in the usual manner whereby the movement of the contact hand varies the amount of resistance but in addition thereto it is incorporated with the field magnet coils in any suitable manner whereby it produces an increase in the magnetic strength of the field at the time for starting the motor as will be more fully hereinafter described.

The actuating device of the rheostat is constructed and arranged as follows: A solenoid L wound upon a spool L′ is stationarily housed in a corresponding recess of an iron supporting frame M. A shaft N passes through the hollow center of the spool and is journaled in a bearing M′ which also forms a central support and fixed core for the solenoid. Upon this shaft is secured the fixed member O of a clutch the sliding member O′ of which constitutes a movable core for the solenoid and is also provided with a pole piece O^2 which is in suitable proximity to the annular pole O^3, formed on the frame M, to draw the sliding member of the clutch into engagement with the fixed member when the solenoid is energized, a spring O^4 being interposed to hold two members normally apart. Upon the projecting end of the shaft N is placed a sleeve P (which may be seated against a shoulder N′) and a collar Q retains the sleeve in position free to revolve upon the shaft. The sleeve P is provided with the friction disk R which is adapted to frictionally engage with and carry a corresponding friction disk R′ which has a sleeve S sliding on the sleeve P and a coil spring S′ surrounding it and confined thereon by the adjusting nuts T screwed upon the sleeve P. The friction disk R has a dog U engaging into a recess in the pole piece O^2 and the friction disk R′ carries the metallic contact hand K suitably insulated from the disk and is also provided with a counter weight V adapted to draw the contact hand to point vertically upward and hold it normally in said position.

The fixed contacts G and H are mounted upon an insulating base W which is secured to a suitable flange formed on the frame M and the contacts are duplicated on opposite sides of the center so that the contact hand operates in like manner whether moving to

the right or left from its normal vertical position. Rubber stops W′ are placed on each side to check the movement of the contact hand when the end of either series is reached.

The shaft N is driven by the motor, a slow gear connection being preferably provided, such as by means of a small pulley X in the armature shaft belted on to a larger pulley Y which is mounted on a shaft journaled in the frame M and transmits the motion to the shaft N through the intermediate gear wheels Z Z′.

The parts being constructed and arranged as described and shown, they are intended to operate as follows: When the motor is at rest, the contact hand K is held by the counterweight in the position shown in the drawings in which position the whole of the resistance is included into the armature circuit. Therefore if the current is suddenly turned on to start the motor, the armature circuit is fully protected. At the same time the current which flows through this branch is expended in useful work as the resistance coils form now in their entirety a part of the field coils increasing the strength of the field magnets and thereby producing the maximum torque for starting the armature against the inertia of the load, which is an important advantage in my improvement. The solenoid which is shown connected in series with the field coils D will be energized by the current which flows over the branch of the circuit and the iron frame being rendered a magnet will immediately attract the sliding member O′ of the clutch into engagement with the fixed member O and therefore as soon as the armature begins to revolve, motion will be transmitted from the motor through the shaft N and clutch O O′ to the pole piece O^2 which carries the friction disk R with it through the dog U. The friction disk R′ being held in frictional contact with the disk R by the spring S′ will also revolve and turn the contact hand (either to the right or left according to the direction of the motion of the motor) from its initial vertical position until its motion is arrested by coming in contact with the stop at the end of the series of contacts. As the motion of the shaft N is relatively slow, time is given to the armature to develop counter electromotive force and as the motion of the contact hand depends on the movement of the armature, the resistance will be cut out in proportion as the counter electro-motive force of the armature is increasing. When the contact hand reaches the limit of its movement it is held against the stop as long as the solenoid keeps the clutch in engagement but the moment the current on the line is shut down the clutch will be disengaged and the counterweight V will carry the contact hand back to its normal position and introduce the artificial resistance into the armature circuit.

Should the current on the line for any reason be shut down without the knowledge of the person attending the motor, the device will instantly operate to throw the resistance into the armature circuit and thereby protect the armature from injury when the current is suddenly turned on again.

As the resistance coils may be simply wound upon one or both legs of the field magnet in addition to the ordinary field coils, my invention may be applied as an attachment for the two-fold purpose of preventing injury to the armature from excessive flow of current and of increasing the starting torque of such motors which is a great advantage in overcoming the statical resistance to motion, experienced in starting with a load and which with my device is accomplished with a current below the current strength required for the normal operation of the motor, while with the ordinary shunt motor it is just the opposite and is the cause of objectionable disturbances in the lamp circuits connected to the same supply mains with the motor.

What I claim as my invention is—

1. In an electric motor, the combination with the stopping and starting switch, of a rheostatic switch whose resistance coils are upon the field magnet and connected in series with the armature coils, said rheostatic switch having a self closing contact device to cut the resistance in, actuating connection to cut the resistance out by the movement of the motor shaft, and an electric clutch to make and break said connection, substantially as described.

2. In an electric motor, the combination with the stopping and starting switch, of a rheostatic switch the resistance coils of which are upon the field magnet and connected in series with the armature coils, said rheostatic switch having a self closing contact device to cut the resistance in, a slow speed actuating connection with the motor shaft to cut the resistance out, and a clutch in said connection operated by a solenoid in the circuit of the motor, substantially as described.

3. In an electric motor, the combination with the starting switch of a rheostat switch for introducing and removing resistance in the armature branch of the motor, actuating devices cooperating therewith to wholly remove said resistance by a predetermined motion of the motor shaft on starting the motor, and to introduce said resistance wholly into the circuit of the armature when the current is cut off and a solenoid controlled by the starting switch and controlling said actuating devices, substantially as described.

4. In a rheostatic switch for introducing and removing resistance into the armature circuit of a motor, the combination of resistance coils in series with the armature a contact device therefor controlled by a weight to normally move its contact hand to cut the resistance in, and having duplicate fixed contacts on opposite sides of its normal position, and cooperating therewith to cut the resistance out, and actuating connection for the contact device comprising a shaft having a slow drive gear connection with the motor shaft, a

clutch on the shaft, an electro-magnet in the motor circuit controlling the sliding member of said clutch, to throw it in or out of gear with the shaft a frictional connection between the sliding member of said clutch, and the contact hand and stops to limit the movement of the contact hand, substantially as described.

5. The combination in a rheostatic switch, of the resistance coils, the contact device co-operating therewith, the shaft for transmitting motion to the contact device, the fixed and sliding members of the clutch on said shaft, the electro-magnet controlling the sliding member, the friction disks carried by the sliding member of the clutch, the contact hand carried by the friction disks and the weight controlling the contact hand of the switch, substantially as described.

6. The combination in a rheostatic switch, of the resistance coils, the contact device co-operating therewith the magnetic frame M provided with poles M′ and O^3, the solenoid housed in said frame, the shaft N journaled in the axis of the solenoid, the fixed member O of the clutch on said shaft, the armature O^2 carrying the sliding member O′ of the clutch, the friction disks R R′ revolved by the armature O^2, the contact hand K, the weight V and the stops W′, all arranged to operate, substantially as described.

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

FRANK B. RAE.

Witnesses:
M. B. O'DOGHERTY,
L. J. WHITTEMORE.