(No Model.) 3 Sheets—Sheet 1.

E. W. RICE, Jr.

CURRENT AND SWITCH CONTROLLING MECHANISM.

No. 432,644. Patented July 22, 1890.

Fig. 1.

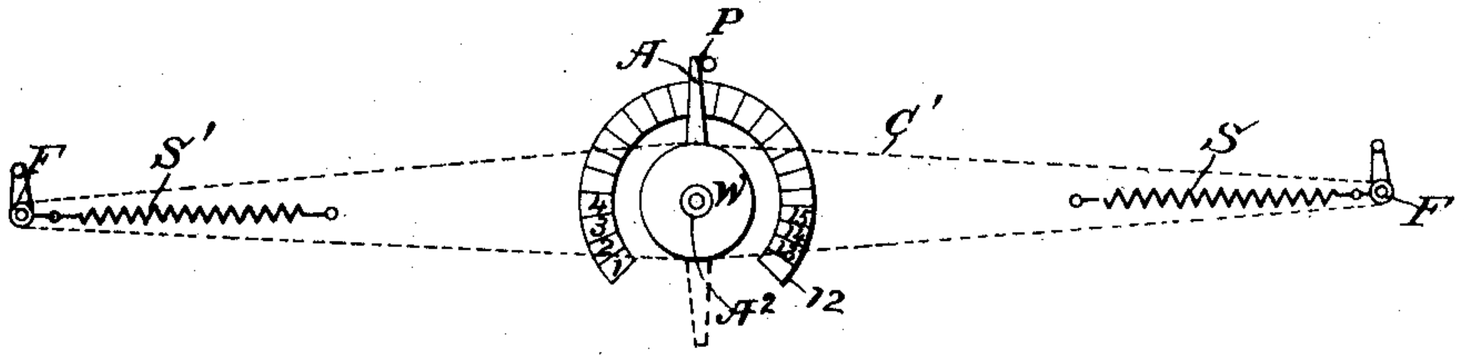
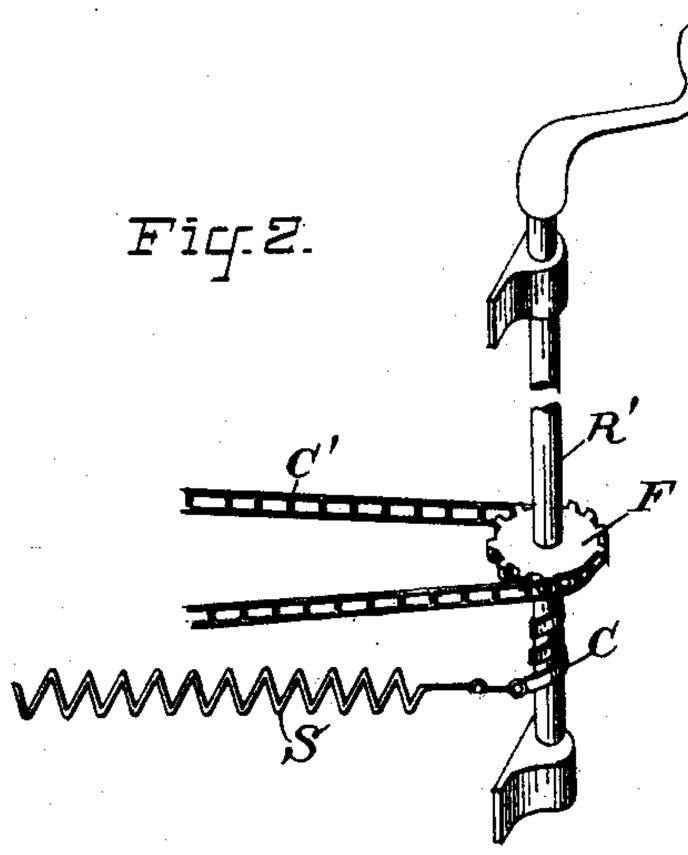


Fig. 2.



ATTEST:

J. Thurdle

T. F. Conroy.

INVENTOR:

Edwin Wilbur Rice Jr.

By H. L. Townsend

Attorney

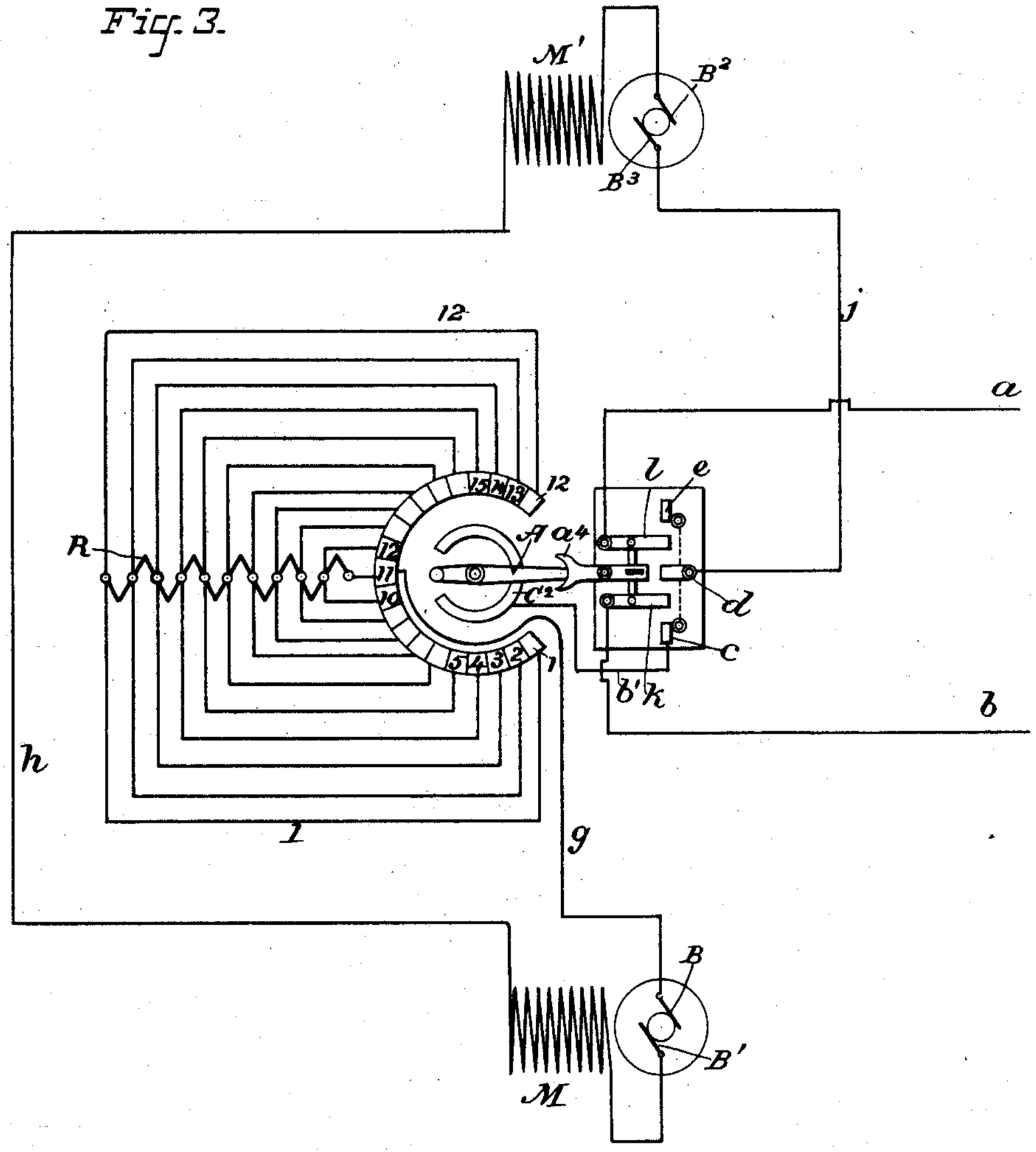
(No Model.) 3 Sheets—Sheet 2.

E. W. RICE, Jr.

CURRENT AND SWITCH CONTROLLING MECHANISM.

No. 432,644. Patented July 22, 1890.

Fig. 3.



ATTEST:
A. Murdy
F. F. Courcy.

INVENTOR:
Edwin Wilbur Rice Jr.

By H. C. Townsend
Attorney

(No Model.) 3 Sheets—Sheet 3.

E. W. RICE, Jr.

CURRENT AND SWITCH CONTROLLING MECHANISM.

No. 432,644. Patented July 22, 1890.

Fig. 4.

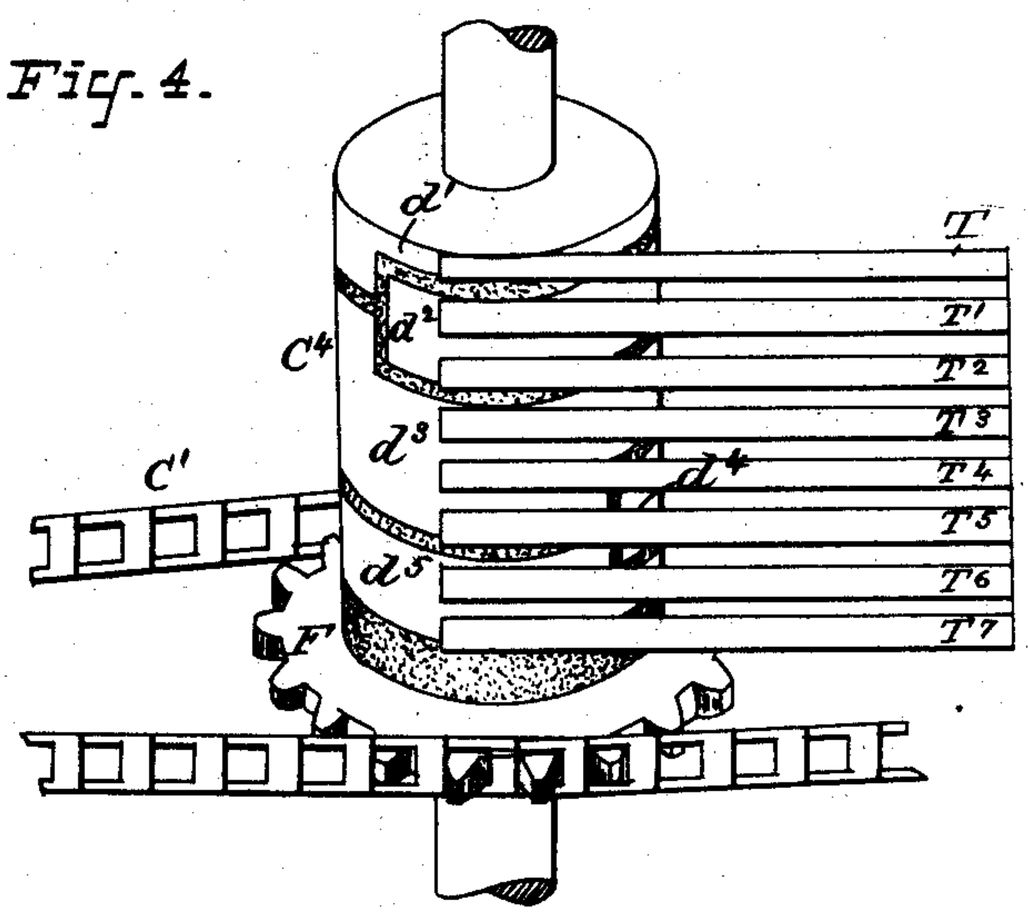


Fig. 5.

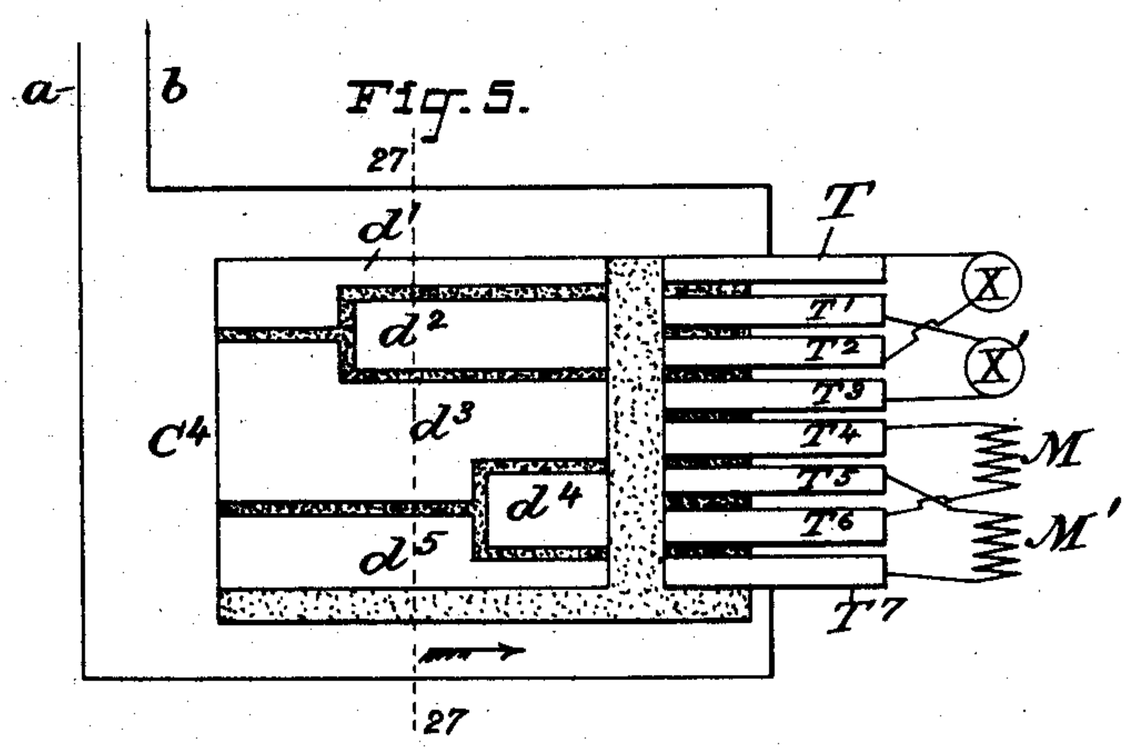
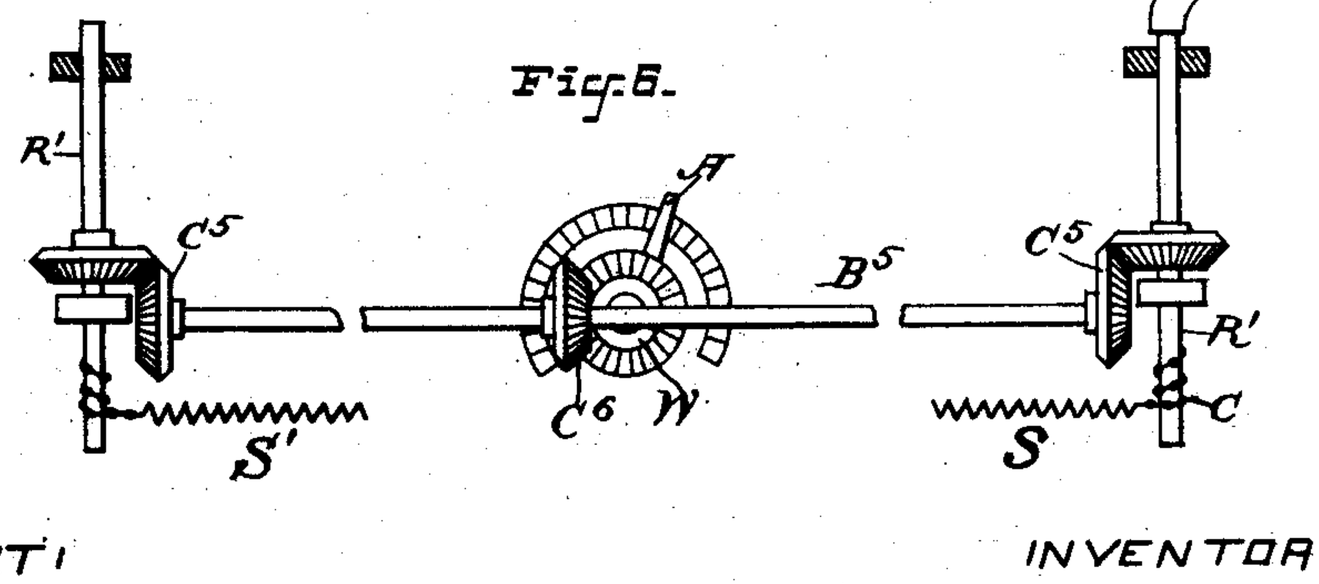


Fig. 6.



ATTEST:
J. Hurdle
T. F. Conroy.

INVENTOR:
Edwin Willow Rice Jr.
By H. G. Townsend
Attorney

UNITED STATES PATENT OFFICE.

EDWIN WILBUR RICE, JR., OF LYNN, MASSACHUSETTS.

CURRENT AND SWITCH CONTROLLING MECHANISM.

SPECIFICATION forming part of Letters Patent No. 432,644, dated July 22, 1890.

Application filed July 29, 1889. Serial No. 319,131. (No model.)

To all whom it may concern:

Be it known that I, EDWIN WILBUR RICE, Jr., a citizen of the United States, and a resident of Lynn, in the county of Essex and State of Massachusetts, have invented a certain new and useful Current and Switch Controlling Mechanism for Electric Cars, of which the following is a specification.

My invention relates to the controlling apparatus for the driving-power of an electrically-propelled car, the object being to so arrange the apparatus that no neglect on the part of the attendant to perform his work in the proper manner will result in permitting the car mechanism to get beyond control and thus cause possible accident or injury.

A further object of my invention is to reduce the number of pieces of apparatus required for controlling the operation of the motor, thus securing ease of manipulation and simplicity.

My invention consists, essentially, in providing the electric controlling device for the electric motor on the car with a manual actuator of any proper description, which is at all times left free or unobstructed against a return-movement, and in applying to the electric controlling mechanism or actuating devices therefor a suitable retractor which shall return the controlling devices and actuating mechanism to position for stopping or throwing the motor out of action whenever the manual actuator is freed by the hand of the operator.

My invention consists, further, in the combination, with the electric motor on the car, of an electric power-controlling device adapted when in an intermediate position to bring the motor to rest, and when moved in either direction from such position to increase the speed thereof, manual actuating devices of any proper description located at opposite ends of the car and connected with such speed-controller, and a retracting device, as hereinafter described, adapted to return the speed-controller to the position of stoppage for the car when the controller is moved away from such position in either direction.

My invention consists, further, in applying to the manual actuating devices which operate the electric controlling mechanism for an electric-railway car a suitable retractor or power-storage resistance, such as a spring which applies an increasing retractive influence as the manual actuating mechanism is moved farther and farther to increase the speed of the motor, said manual actuating devices being free to move at all times or unprovided with any catch or lock, so that the motor-man will be obliged at all times to exercise a constant effort in order to hold the mechanism adjusted to each new or changed position for increasing the speed.

My invention consists, further, in the combination, with the motor, of a speed or power controlling mechanism, as hereinafter described, adapted to increase the speed of the motor when moved in either direction from an intermediate position, suitable actuating appliances for operating said speed-controller, and a pole-changing switch actuated on movement of the speed-controller from its intermediate position, but free to retain its position of reversal and permit the speed-controller to be moved to increase the speed to any desired amount without imparting movement to the pole-changing switch.

My invention consists, further, in certain novel combinations of apparatus tending to simplicity, which will be described in connection with the accompanying drawings, and then more specifically stated in the claims.

I have herein described my invention as carried out by means of an electric regulator which is adapted to change the power and speed of the motor by inserting resistance into the circuit thereof; but any other desired means of regulating the power and speed may be employed, as will be obvious to electricians. I have also shown and described one form of mechanism for actuating the pole-changing switch on movement of such speed-controlling mechanism in either direction, but adapted to permit the switch to retain its position of reversal, while the speed-regulator may continue its movement for further increasing the speed. It will be obvious, however, to mechanics that other mechanisms for such purpose might be used besides the particular mechanism hereinafter set forth.

In the accompanying drawings, Figure 1 is a general plan showing the manner of arranging the electric controlling mechanism and manual actuating devices thereof on the electric motor of a railway-car. Fig. 2 is a perspective view of a part of the actuating mechanism. Fig. 3 is a plan and diagram illustrating the electric controlling devices for stopping, starting, and reversing the motors of the car. These devices are omitted from Fig. 1 for the sake of simplicity. Fig. 4 illustrates in perspective, and Fig. 5 in plan and diagram, another form of electric controlling device that may be used in carrying out my invention. Fig. 6 is a side elevation of another form of manually-actuated mechanism that may be used for operating the electric controlling devices of a railway-car.

Referring first to Fig. 3, M M′ indicate the field-magnets of two electric motors for a railway-car, B B′ commutator-brushes of one motor, and B^2 B^3 the commutator-brushes of the other. The motors are supplied from a circuit, the poles of which are indicated at *a* *b*, in the ordinary manner. D indicates a reversing-switch in the connection to the motor. This switch may be of any suitable construction, but is herein shown as consisting simply of the three contacts *e c d*, over which play the connected contact-levers *k* *l*, connected, respectively, to the wires *b* *a*. Contacts *e* *c* are electrically connected, and contact *d* connects by wire *j* with one terminal of the motor-circuit, while the contacts *e* *c* are connected with the other terminal of the motor-circuit through a variable-resistance or other electric speed and power regulating devices for the electric motor or motors. The contact-arm of such resistance, indicated at A, works in the fork a^4 of the operating-lever for the reversing-switch, and such contact-arm moving over a plate C^2 is electrically connected by the wire *b*′ with the reversing-switch and operates on the electric resistance, the plates of which are numbered consecutively and arranged in a circuit, as shown. It will be seen that the fork a^4, and the arm engaging between the arms of the fork, provides a simple and effective device, whereby the pole-changing switch D will be actuated or moved by the electric regulator or part moving therewith only when the latter moves from the position where the motor will be stopped, and that the movement of such electric regulator after the pole-changing switch has been set may freely continue without operating the pole-changing switch. By thus organizing the pole-changing switch and the electric regulator I am enabled to employ but a single manual actuator for operating both the pole-changer and the electric regulator. The pole-changing switch will obviously be at rest during the movement of the motor in one direction, although the electric regulator may be actuated for changing the speed of the motor. The variable resistance R has its divisions connected by wires, as indicated, to two sets of contact-plates, one numbered from 1 to 11, inclusive, and the other from 12 to 21 and 11, inclusive. The plate 11 is one terminal of the resistance and connects by wire *g* to the motor M, as indicated. The motors themselves are connected by the wire *h*.

In the position of the parts shown in Fig. 3, which illustrates the electric regulator at the intermediate position or the position where the motor will be at rest, the pole-changing switch will be in position ready to be operated by such regulator and to close the circuit through the motor in one direction or the other according to the direction of the movement of the regulator and the manual actuating devices. Assuming the arm A to be turned in the direction of the hands of a watch by the manual actuator to be presently described, the arm will throw the revolving switch so that connection will be made with contacts *d* *e*. A further rotation of the switch will directly establish contact between the arm and the switch-plate *l* of the rheostat R; but the continued movement of the switch-arm or other adjustable portion of the electric regulator or controller, after adjustment or tripping of the pole-changer, takes place without movement of the pole-changing switch, which will remain stationary and without interference from such stationary part of the mechanism. Therefore, after the pole-changing switch has been set, the electric power-regulator may be moved backward and forward for changing the speed freely without producing any mechanical operation upon the pole-changing devices, so as to move the latter. A circuit is now established through the motors M M′, as follows: through wire *a*, switch-arm *l*, contact-plate *e* *c*, wire *b*′, plate C^2, arm A, contact-plate 1, wire *l*, total resistance R, plate 11, wire *g*, brushes B B′, field of motor M, circuit *h*, field of motor M′, brushes B^2 B^3, circuit *j*, contact-plate *d*, switch-arm *k*, and to the other terminal of the circuit *b*. The motors M M′ in series are thus thrown into the circuit with all of the resistance R interposed, and the car starts slowly. The continued rotation of the arm A, by the mechanism to be described, over the contact-plates 2 3 4, &c., the rheostat R successively shunts portions of the resistance, allowing more current to flow to the motors M M′, arranged in series, and increasing their speed until the plate 11 of the rheostat is reached, when all of the resistance is cut out and the motors have attained their maximum speed. Assuming the arm A to have been rotated in the opposite direction, the first action will be the throwing of the switch D to the left, and when the arm A reaches contact-plate 12 of the rheostat R circuit is established through the motors, as follows: through wire *a*, switch-arm *l*, plate *d*, wire *j*, brushes B^3 B^2, field of the motor M′, wire *h*, field of motor M, brushes B′ B, wire *g*, plate 11, of

the rheostat R, wire 2, resistance R, plate 12, arm A, ring C^2, wire *b*, plate *c*, switch-arm K, and out to the other terminal of the circuit at *b*. The current in this case traverses the motors M M′ in series in the opposite direction to that just previously mentioned, so that they may revolve in the opposite direction, and, in the same manner as before, the entire resistance R is first interposed in circuit and successive portions shunted upon a continued rotation of the arm in a direction to move over the contact-plates 12 13 14 15, &c. By this electric controlling mechanism the electric motors may be started, stopped, and reversed at pleasure by the operation of the actuating mechanism and retractor connected to the controlling devices, as will be presently described.

It will be observed that by the employment of the two sets of contact-plates for the rheostat R, arranged to be engaged by arm A on movements thereof in opposite directions, respectively, in connection with the reversing-switch operated by such arm, I am enabled to use the same resistance R in starting the motors M M′ in either direction of rotation.

Referring now to Figs. 1 and 2, W indicates a wheel which carries the contact-arm A of the variable resistance, and which may be rotated in either direction by an endless chain or belt C′, or by its equivalent, as will be presently described, operated from either end of the car in any suitable manner. A convenient means for operating such belt or other device is a spur-wheel F, secured to a spindle on shaft R′, that is provided with a handle extending upward to the car-platform and within easy reach of the driver. These devices constitute one form of manual actuator that may be used for operating the electric controlling mechanism of the motor. The arm A and wheel W are arranged to make a partial revolution only, being brought to rest by a suitable pin P at the point where the electric controlling mechanism is in position to give the motor its greatest power. The position where the motor will stop or be thrown out of action is indicated by the dotted lines A^2. The actuating devices described work against a suitable retractor when they are moved for the purpose of increasing the power of the motor by cutting out the resistance, and such retractor is preferably one whose retracting influence will increase as the controlling-arm A is turned from the point where the circuit is open toward the point where the resistance will be cut out and the motor allowed to operate with its maximum power.

I prefer to employ for the purpose of retracting the actuating mechanism and electrical controlling devices a spring or springs S S′, attached at one end permanently to some point underneath the car, and at the other connected to a chain or belt C, which will be wound up on the rod R′ upon the rotation of the spur-wheel F by the handle H, thus extending the spring and storing up power therein. When the springs S S′ are extended, as shown in Fig. 2, by the rotation of the handle H, there are no means provided—such as detents, dogs, or latches—for locking or holding the rod R′ or maintaining the spring S in an extended position.

It is the distinct purpose of my invention to avoid such locking devices, the desire being to arrange the apparatus in such manner that should the attendant for any reason whatsoever leave his post the springs S S′ will immediately act to rotate the wheel W in a direction to bring the arm A out of position or out of contact with the contact-plates of the rheostat R and to rupture the circuit between the mains *a b* and through the motors M M′, so as to stop the motor or motors.

It will be seen that by my invention the driver must constantly exert a certain pressure against the springs S S′ to bring the car up to speed, and the greater the speed the greater the pressure necessary. Thus the maximum speed of the car can only be maintained by a constant effort on the part of the driver, who is thus checked from running the car or vehicle at a dangerous speed, which might easily be done should means be provided for locking the switch-arm A in a position where the maximum current was being fed to the motors M M′. It will further be observed that by the organization of appliances hereinbefore described the electric motor may be reversed and its speed controlled as desired from either end of the car by the same manual actuating mechanism, and that if such actuating mechanism be freed from the hand of the operator at any time it will automatically, through the influence of the retracting devices described, return to position where the motor will come to rest, and that this automatic action will take place no matter whether the car is backing or is going forward.

It will be obvious that from the preceding description the same action of an automatic return of electric controlling mechanism to position to stop the motor will take place no matter which part of the actuating mechanism is operated and irrespective of the direction in which the electric motors are moving.

The electric controlling devices might be actuated by a manual actuator, such as that shown in Fig. 6, which differs from that of Fig. 1 only in the substitution of a rod and gear-wheels for the chain and wheels. In this instance B^5 is a shaft carrying the gear-wheels C^5 C^5 at opposite ends and at another point the gear-wheels C^6, which engage with the gear on the wheel W, as indicated. The wheels C^5 in turn gear with wheels on the spindles R′. The operation is obviously the same as in the case of Fig. 1, and the electric controlling devices may be turned or reversed

from either end of the car and will be automatically moved into position to stop the motor on the release of the handle of the actuating mechanism by the operator.

Instead of the electric controlling mechanism described, I might employ one such as is shown in Figs. 4 and 5, and which determines the speed of the motors by the establishment of different connections between the field-coils and armatures. In these figures, X X′ indicate the two armatures of the two motors, and M M′ the field-magnets thereof. T T′ T^2 T^3 T^4 T^5 T^6 T^7 indicate a series of brushes connected to such armatures and field-magnets in the manner indicated and adapted to bear on the surface of a commutator C^4, provided with conducting-plates d' d^2 d^3 d^4 d^5, insulated from one another, as shown. The surface of the commutator-cylinder C^4 is shown spread out in Fig. 5 on the plane of the paper. The terminal brushes T′ T^7 connect to the wires *a* *b*. The operation may be readily understood from inspection of Fig. 5. At first the brushes T T′ T^2, &c., rest upon insulation, and no current can flow between the mains *a* *b*. Should the commutator C^4 be now rotated until the plates d' d^2 d^3 d^4 d^5 are brought into connection with the brushes, a circuit is made between the mains *a* *b* and through the motors, as follows: wire *a*, brush T^7, field M′, brush T^5, plate d^4, brush T^6, field M, brush T^4, plate d^3, brush T^3, armature X′, brush T′, plate d^2, brush T^2, armature X, brush T, and out to the main *b*. The motors are thus first connected into circuit with their fields and armatures arranged in series, the connection most effective for great torque necessary in starting the car or vehicle. If the commutator be now advanced or rotated in the direction of the arrow until plate d^4 is cut out of circuit or to position corresponding to dotted line 27, Fig. 5, the arrangement of the connections to the motors will be changed, and as follows: plate d^5, brushes T′ T^7 in multiple, fields M M′ in multiple, brushes T^4 T^5 in multiple, plate d^3, brush T^3, armature X′, brush T′, plate d^2, brush T^2, armature X, brush T, and out at *b*—that is, the fields are in circuit in multiple and the armatures in series therewith, resulting in an increase of speed of the motors. A further rotation of the commutator C^4 until plate d^2 is out of contact with the brushes results in the establishment of a new set of connections to the motors, thus: d^5 T^6 T^7 in multiple, fields M M′ in multiple, brushes T^4 T^5 in multiple, plate d^3, brushes T^3 T^2 in multiple, armatures X′ X in multiple, brushes T T′ in multiple, plate d', and out at *b*—that is, the fields and armatures are in multiple each to each and in series with each other, resulting in a continued increase of speed. It is evident that any desired connection of circuits might be obtained in a similar manner.

What I claim as my invention is—

1. The combination, with the electric controlling devices for an electric-railway motor, of a retractor tending to move such controlling devices into position to decrease the power of the motor or throw the same out of action, and a manually-operated actuator for such controlling mechanism constantly free to return to position of stoppage under the operation of such retractor.

2. The combination, with an electric motor, of a pole-changing switch, a single resistance, a double set of contacts for the contact-arm of such resistance arranged, respectively, to be engaged on movement of the arm in opposite directions from the position where the resistance is the greatest, and an intermediate actuating device between the pole-changing switch and the movable part of the variable-resistance device, consisting of a fork and an arm adapted to engage with one another as the contact-arm of the resistance is turned in either direction from the position of stoppage of the motor.

3. The combination, with the electric motor, of the electric speed-controlling mechanism adapted to increase the speed of movement of the motor on being moved in either direction from a central or intermediate position, a manual actuator for operating said speed-controlling mechanism in either direction, as described, connected to operating-handles at opposite ends of the car, and a suitable retracting spring or springs connected with a winding chain or belt, so as to be wound on the operation of the manual actuator in either direction for increasing the speed of the motor.

4. The combination, with the electric controlling mechanism on an electrically-propelled car, of a manual actuating device for moving such electric controlling mechanism in either direction from the central or intermediate position where the motor will be at rest or its power the least, means at both ends of the car positively engaged with such controlling device for the purpose of reversing its movements, and retracting devices for returning the electric controlling devices to position for the stoppage on release of the operating-handle, said controller and manual actuating devices being at all parts free or unprovided with any catch or latch, so that on release of the operating-handle all the parts may return freely to position for stoppage under the operation of the retracting devices.

5. The combination, with an electric motor, of a speed-controlling mechanism adapted to increase the speed of the motor on movement in either direction from a normal or intermediate position, manual actuating devices for operating said speed-controlling mechanism in either direction from each of two or more points, a pole-changing switch mounted independently of the speed-controlling mechanism, an intermediate actuating mechanism for the latter between the same and some por-

tion of the speed-controlling mechanism, and its actuating devices adapted to throw the switch at the start in either direction and to leave the same at rest in circuit-closing position during adjustment of the speed-controlling mechanism for changing or varying the speed of rotation of the motor in the same direction.

Signed at Lynn, in the county of Essex and State of Massachusetts, this 22d day of July, A. D. 1889.

EDWIN WILBUR RICE, JR.

Witnesses:
JOHN W. GIBBONEY,
DUGALD MCKILLOP.