No. 668,233. Patented Feb. 19, 1901.

E. W. STULL.

BRAKE FOR ELECTRIC RAILWAY CARS.

(Application filed Dec. 12, 1899.)

(No Model.) 3 Sheets—Sheet 1.

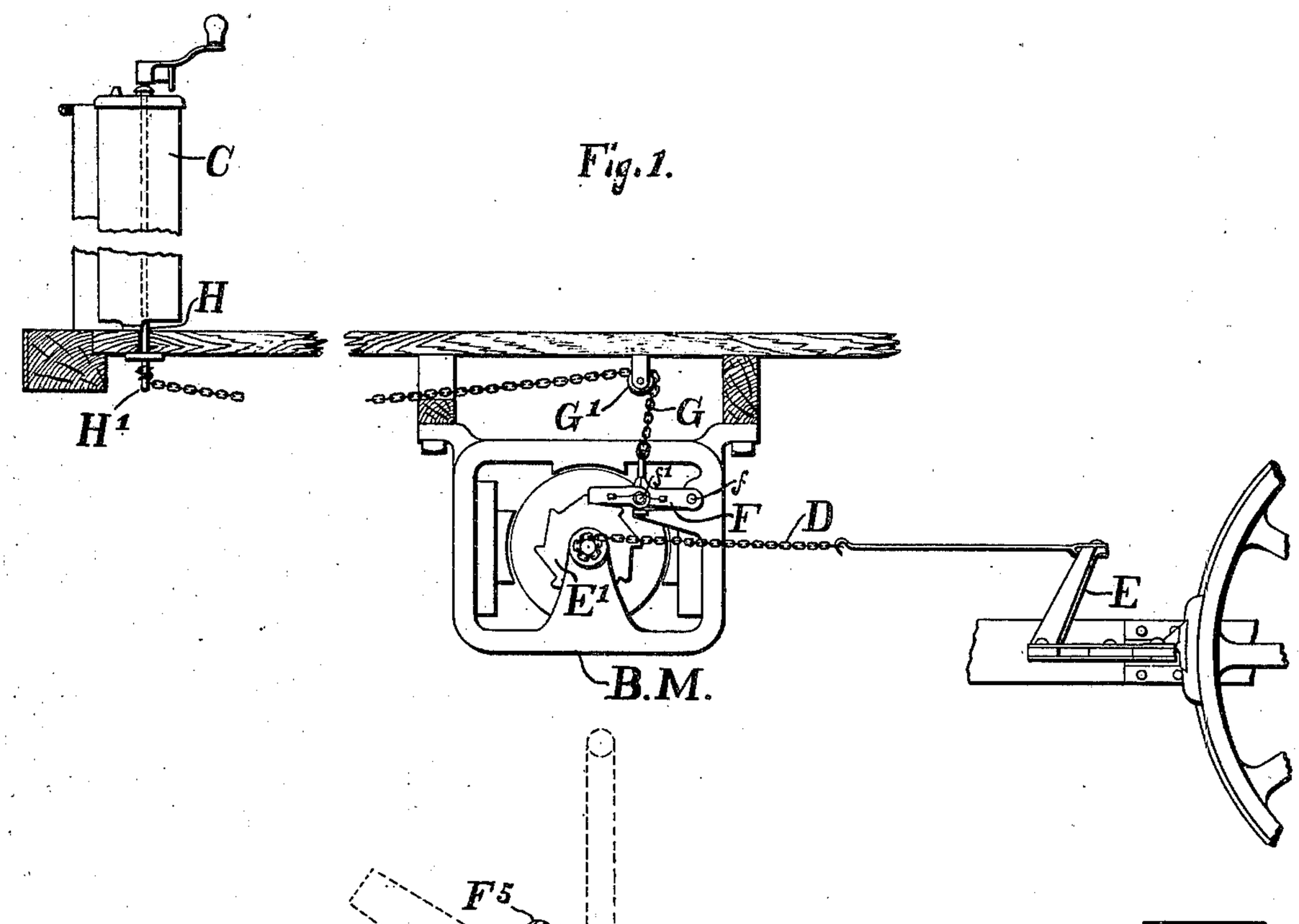

Fig. 1.

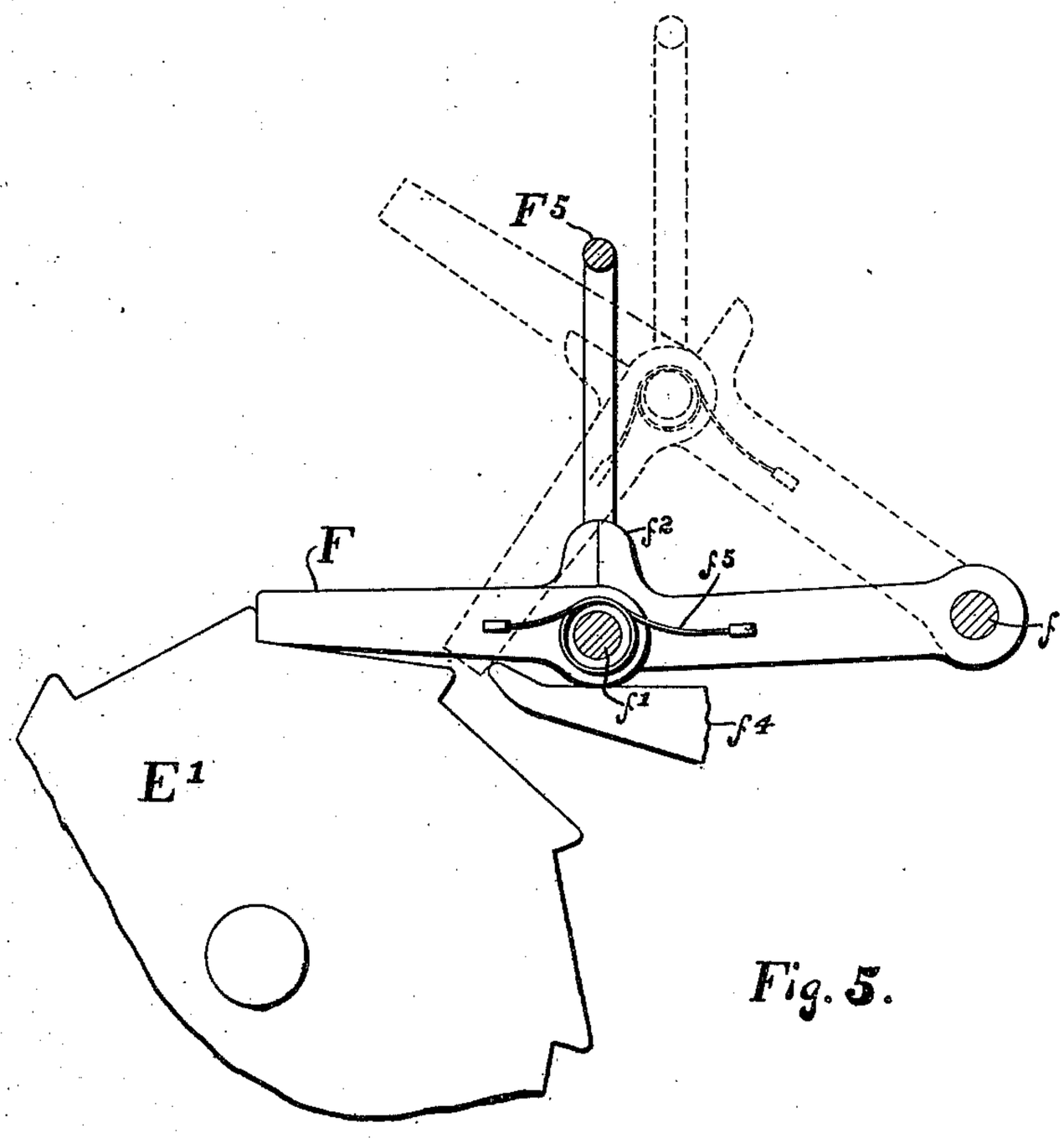

Fig. 5.

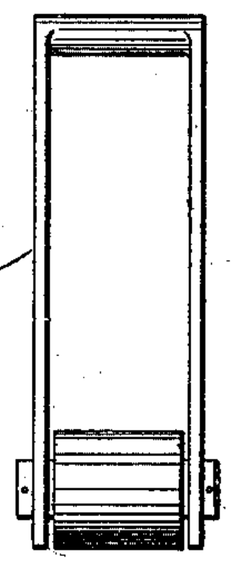

Fig. 6.

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3 Sheets—Sheet 2.

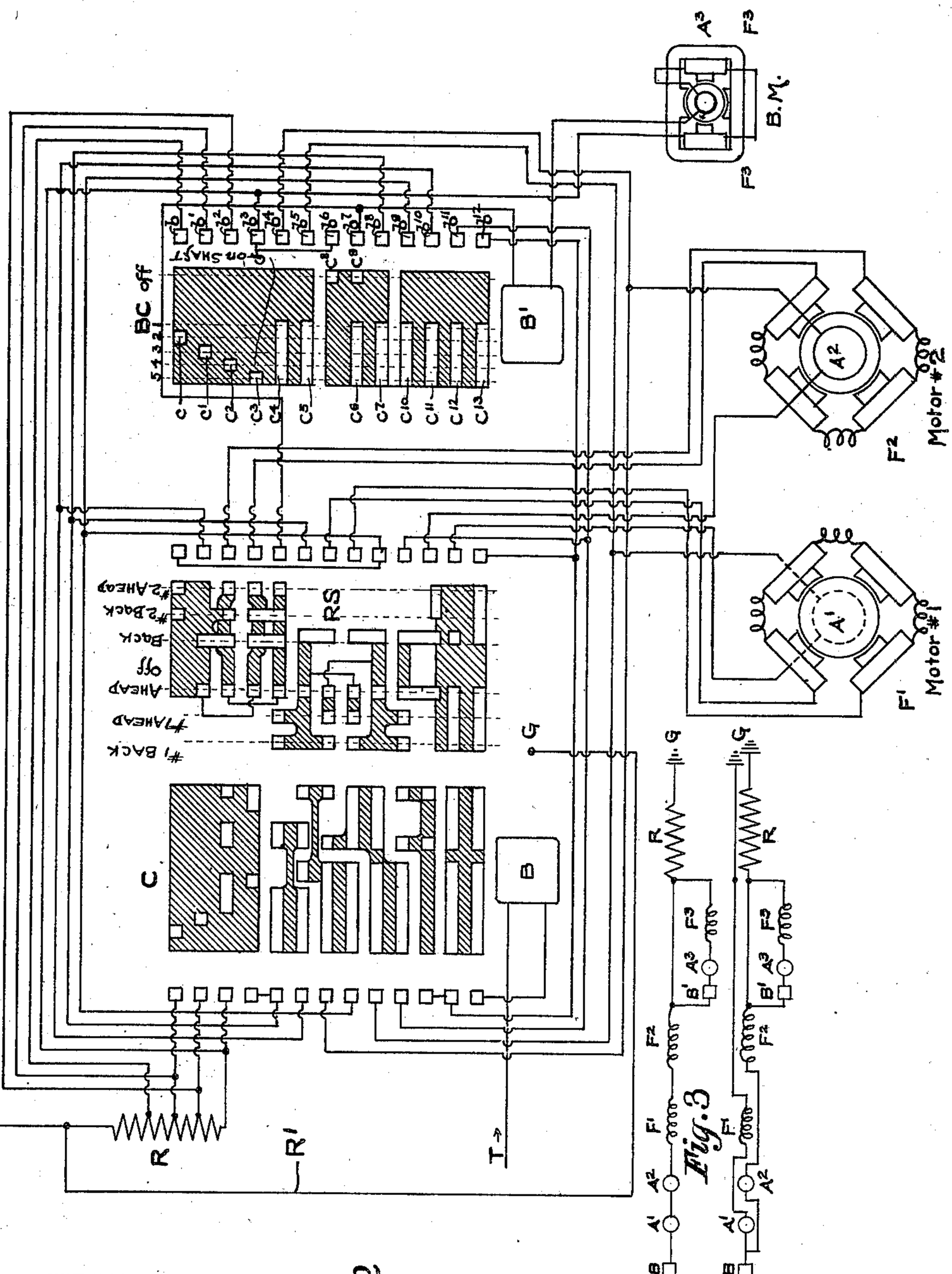

Fig. 2

Fig. 3

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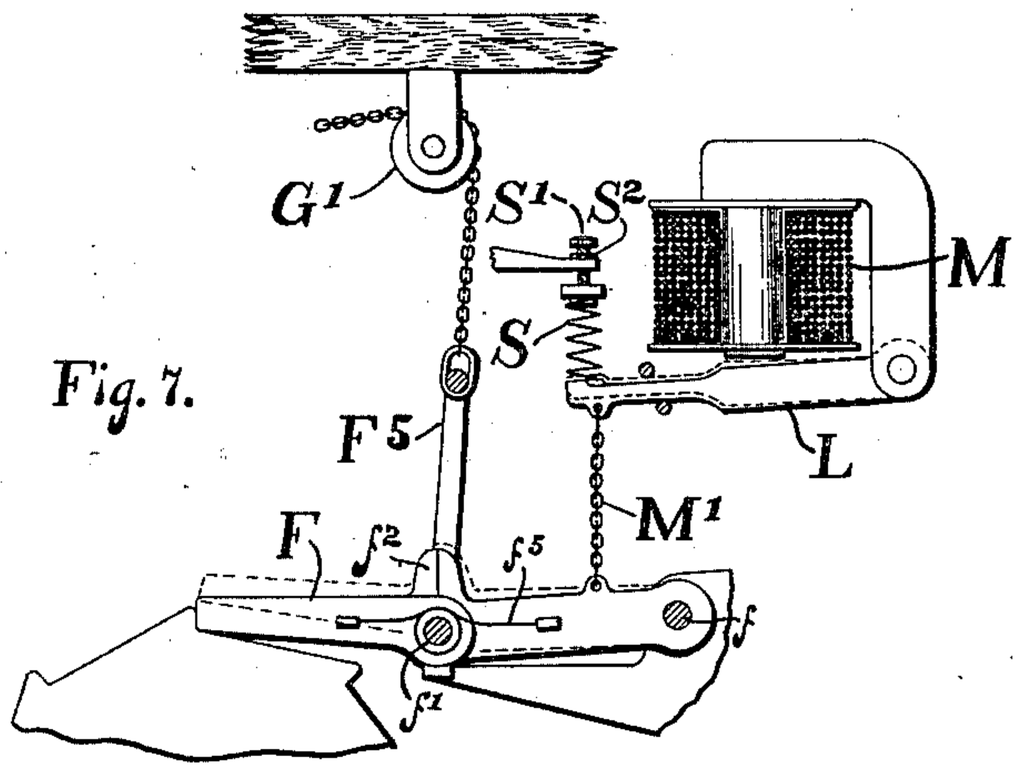
(No Model.) 3 Sheets—Sheet 3.

Fig. 7.



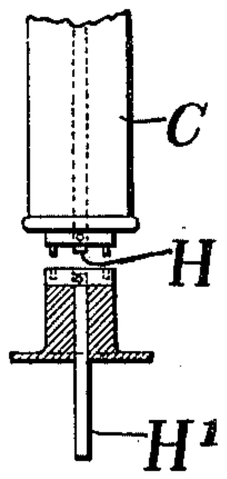


Fig. 8.

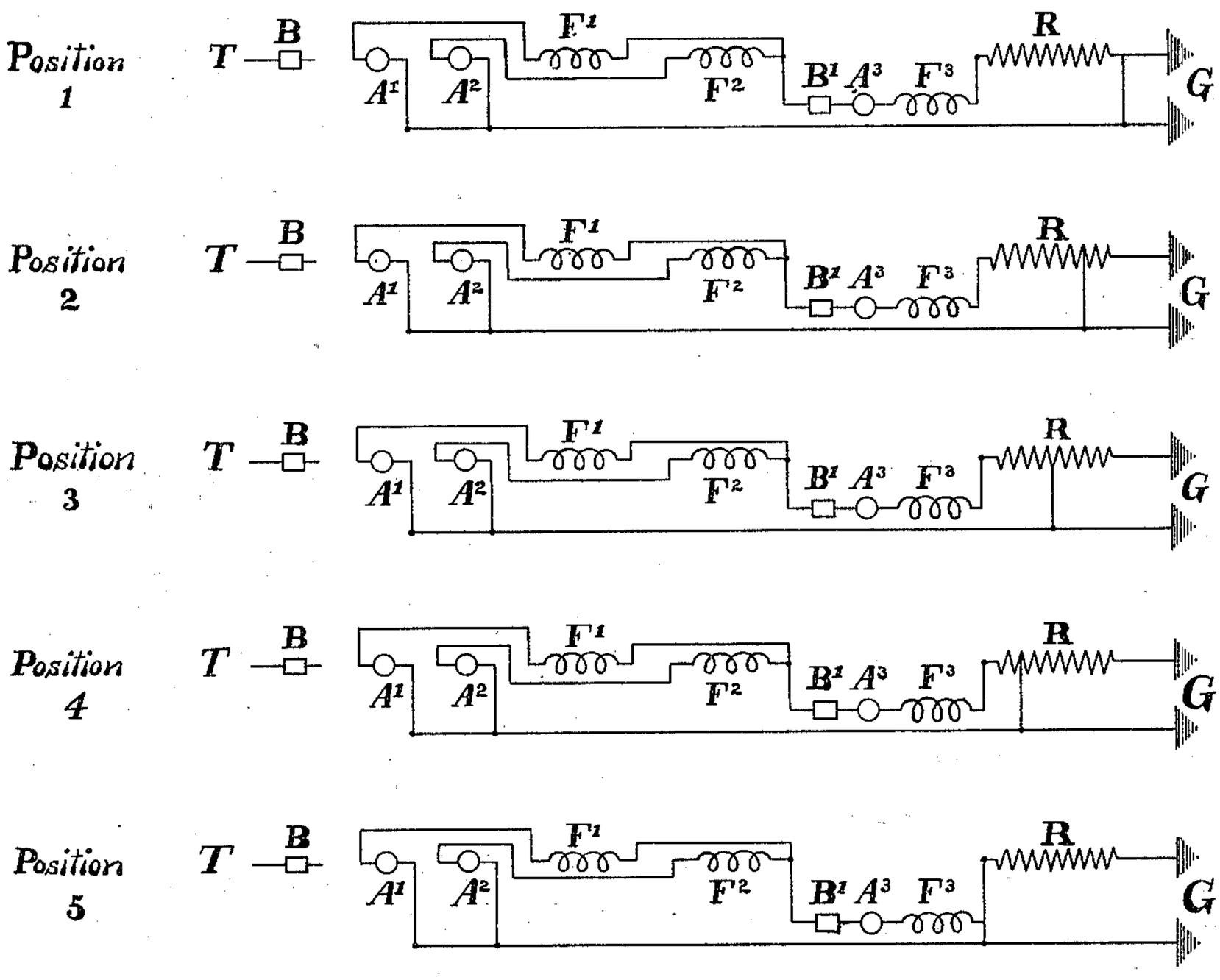


Fig. 4.

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BRAKE FOR ELECTRIC-RAILWAY CARS.

SPECIFICATION forming part of Letters Patent No. 668,233, dated February 19, 1901.

Application filed December 12, 1899. Serial No. 740,085. (No model.)

To all whom it may concern:

Be it known that I, EMMETT W. STULL, of Johnstown, in the county of Cambria and State of Pennsylvania, have invented a new and useful Improvement in Brakes for Electric-Railway Cars, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, which form a part of this specification.

My invention has relation to certain new and useful improvements in brakes for electric-railway cars, and more particularly to brakes of that class wherein the motors are connected in a local circuit to run as generators driven by the momentum of the car. It is well known that with brakes of this class a car cannot be brought to a full stop on grades for the reason that as the speed of the car decreases the braking action of the motor-generators becomes less and less until it reaches a point where it is balanced by the gravity of the car, and the latter will run slowly forward or backward, according to the grade. In such cases it is necessary to have recourse to the mechanical brake mechanism of the cars. In the usual equipment on cars having brake mechanism of this character there are employed a main or power controller, an independent brake-controller, and also a mechanical brake staff and lever. The motorman in bringing a car to a stop under the conditions above stated must therefore operate three independent handles—that is to say, he must first move the handle of the main or power controller to "off" position, then actuate his brake-controller, and, finally, the mechanical brake-rigging.

The object of my invention is mainly to obviate the necessity for the separate manipulation of the mechanical brakes and to provide means whereby the latter may be effectively applied by the operation of the brake-controller, also to provide means for preventing "sliding" of the car-wheels by reason of a sudden application of the brakes.

My invention consists in the combination, with a brake-controlling switch arranged to connect the motors in a local circuit to run as generators, of a small auxiliary motor driven by the current produced by the motor-generator whose operative connection in circuit is controlled by the said switch and which is employed to wind up the brake-chain and apply the brake-shoes to the wheels.

The invention also comprises means whereby the movement of the said switch to off position not only removes said motor from circuit, but also releases the brake-chain and permits the usual brake-release springs to act to release the brake-shoes.

The invention also comprises the use, in combination with the other features, of artificial resistance in the motor-generator circuit for regulating the amount of current generated.

It also consists in the novel construction, arrangement, and combination of parts, all as hereinafter described, and pointed out in the appended claims, reference being had to the accompanying drawings, in which—

Figure 1 is a sectional elevation of a portion of a car-body, showing the application of the invention. Fig. 2 is a diagram showing the motors, the power-controller, the reversing and cut-out switch, the brake-controller, and the electrical connections. Fig. 3 is a diagram showing conventionally the circuit connections in the first and last positions of the power-controller. Fig. 4 is a similar view showing the connections in the five positions of the brake-controller. Fig. 5 is a detail view of the pawl-and-ratchet locking device used in connection with the auxiliary motor. Fig. 6 is a detail view of a part of said device detached. Fig. 7 is a detail view of a device for preventing sliding of the car-wheels, and Fig. 8 is a detail view showing a preferred construction of the brake-controlling switch-drum.

Referring to the diagram Fig. 2, the two motors which propel the car are designated, respectively, as "Motor No. 1" and "Motor No. 2," their respective armatures being marked A' and A^2 and their field-coils F' and F^2.

B M indicate the auxiliary or brake motor, A^3 the armature, and F^3 the field-coils of the same.

C is the power-controller, R S the reversing and cut-out switch, and B C the brake-controller, which is preferably mounted in the same frame or casing as the controller C.

R is artificial resistance designed to be connected in circuit with the motors in certain positions of the controller C when the motors are running as motors, as in starting from a position of rest, and also for connection in the local circuit when the motors are run as generators.

B indicates a "blow-out" coil for the controller C, and B′ a similar coil for the brake-controller B C.

G indicates ground connections, and T the connection to the trolley or supply side of the circuit.

The controller C and the resistance and cut-out switch form no part of the present invention, but are shown in order that the complete circuits may be readily traced. The controller C may be of any well-known type, preferably of the class known as "series-parallel" controllers, with contacts and connections for changing the motors from series to parallel relation through a number of intermediate steps in which the speed of the motors is gradually accelerated. The resistance and cut-out switch is also of a type well known in the art and need not be described.

The brake-controller B C consists of a rotary drum or cylinder having upon its periphery a series of contact-pieces, (designated by the letters c c' c^2, &c., to c^{13}.) These contacts are arranged in three groups, the individual contacts of each group being electrically connected among themselves, but the groups themselves being electrically disconnected from each other. The first group comprises the four short contacts c c' c^2 c^3 and the two long contacts c^4 and c^5. The second group comprises the two long contacts c^6 and c^7 and the two short contacts c^8 and c^9. The third group comprises the four long contacts c^{10} c^{11} c^{12} c^{13}. b b' b^2, &c., to b^{12} designate a series of contact-fingers designed to engage the said contact-pieces, or some of them, as the drum is rotated. Said drum has five different positions, (indicated on the diagram by the vertical lines 1, 2, 3, 4, and 5,) besides an "off" position, in which the contacts c^8 and c^9 only are engaged. There is nothing new in the mechanical construction of this drum or of the contact-fingers, and it is therefore unnecessary to show and describe such construction.

Contact-fingers b b' b^2 b^3 are electrically connected to different portions of the resistance R. Finger b^3 is also connected to one terminal of the motor B M and also to finger b^6. Finger b^4 is connected to the negative terminal of the armature A^2 and finger b^5 to the negative terminal of armature A′. Finger b^7 is connected to the reversing and cut-out switch and also to the other terminal or motor B M through blow-out coil B′. Fingers b^8, b^9, and b^{10} are connected to the respective terminals of field-coils F′ F^2 through the reversing and cut-out switch. Finger b^{11} is connected to the positive side of armature A^2 and finger b^{12} to the positive side of armature A′.

When the brake-controller is in off position, the blow-out coil B′ and the brake-motor B M are short-circuited by the engagement of fingers b^6 and b^7 with the contacts c^8 and c^9 and the connection between the contact-fingers b^3 and b^6. This is clearly shown by Fig. 3, which represents the circuit relations in the first and last positions of the controller C or the series and the parallel relation of the motors Nos. 1 and 2. The circuits in both positions may be readily traced on the drawings. When, however, the power-controller C is turned to off position and the brake-controller is moved to its first position, (indicated by the dotted vertical line 1,) the motors Nos. 1 and 2 are disconnected from the line-circuit and are connected in multiple in a closed local circuit with the connections to their armatures reversed. The short circuit around the brake-motor B M is removed by the fingers b^6 and b^7 leaving the contacts c^8 and c^9, and said motor, together with the resistance R, is connected in series with the motors Nos. 1 and 2. This is shown in Fig. 4, and the circuit may be traced as follows: The motors are now running as generators driven by the momentum of the car, and the current generated thereby passes from the positive brushes thereof into the fourth group of contacts on the brake-controller drum by way of the contact-fingers b^{11} and b^{12}. One portion of the current leaves these contacts by way of the contact-fingers b^{10}, goes to the reversing-switch, (to follow the connections through this switch the row of contact-fingers at the right may be supposed to be resting on the contacts on the vertical line marked "Ahead,") thence to and through the field-coils F^2, thence back to the reversing-switch, thence to and through the blow-out coil B′, armature A^3, fields F^3 in series, thence to and through a portion of the resistance R. From the resistance R the current returns to the contacts of the first group on the brake-controller drum by a connection R′ to the frame of the controller, which is electrically connected to the casting on which said contacts are mounted. Return connection from these contacts to the negative brushes of the armatures is made through the fingers b^4 and b^5, which respectively engage the contacts c^4 and c^5. The other portion of the current leaves the contacts of the fourth group by the finger b^9, goes through field-coils F′ by way of the reversing-switch, returns to the brake-controller at the finger b^8, to contacts c^7 c^6, and by brush b^7 and connection unites with the other portion of the current and goes through the brake-motor resistance and returns to armatures by the path above described. It will be seen, therefore, that the current generated by the motors 1 and 2, running as generators, is utilized to drive the motor B′, the resistance R acting to prevent current becoming excessive. When the brake-controller is moved to position 2, the only effect is to engage the finger b with the

contact c, thereby short-circuiting a portion of the resistance by providing a shorter return-path to the contacts of the first group. In positions 3 and 4 contacts c' and c^2 are successively and respectively engaged by the fingers b b^2 and still more of the resistance is short-circuited. In position 5 all the resistance is short-circuited by the engagement of finger b^3 with the contact c^3. In this manner the resistance in circuit is gradually decreased as the speed of the car becomes less and is finally entirely removed.

While I have thus described the brake-controller in detail and have traced out the circuits, I desire it to be understood that my invention in its broadest sense is entirely independent of this particular controller and any controller may be used which has proper contacts and connections for connecting the driving-motors to run as generators and for connecting in series therewith an auxiliary motor.

I will now proceed to describe the mechanical devices by which the auxiliary motor is made effective in applying the brake-shoes to the wheels. The said auxiliary motor is suitably supported underneath the car, as shown in Fig. 1, and to its armature-shaft is connected a chain D, whose opposite end is connected to a brake-rod E or to any other portion of an ordinary brake-rigging, the actuation of which will apply the brake-shoes to the wheels. On said shaft is also secured a ratchet wheel or disk E′, whose teeth are engaged by a pawl F. Said pawl is pivoted at f and has therein a joint at f', adjacent to which the jointed sections are formed with abutted lugs f^2, which normally prevent the pawl from buckling.

f^5 is a spring bearing on the pawl-sections across the joint.

f^4 is a stop on which the pawl rests when in operative position.

F^5 is a yoke which is connected to the joint-pin f' and to which is connected one end of a chain G or its equivalent, which passes over a pulley G′, hung in a bracket secured to and depending from the under side of the car-body, and is wound at its opposite end portion around a downward extension H′ of the shaft H of the brake-controller drum. For convenience in handling and shipping the controller I prefer to make the lower portion of said drum with the shaft extension H′ in a separate detachable piece, as shown in Fig. 3, with a pin-and-socket or other suitable connection.

The operation is as follows: Under normal running conditions when the brake-controller is in off position the chain G is wound upon the shaft extension H′ to such an extent that the pin f' is raised to a position such as is shown in Fig. 5, thereby holding the jointed pawl F out of engagement with the ratchet wheel or disk E′. The brake-shoes at this time are held away from the car-wheels by the action of the usual release-springs. (Not shown.) When the brake-controller drum is turned to operative position, the chain G is unwound from the shaft extension H′, which permits the pawl F to drop into engagement with the teeth of the ratchet-wheel E′, thereby locking the shaft of the brake-motor against backward movement and making said motor effective in winding up the brake-chain and setting and holding the brake-shoes in contact with the car-wheels. This action, combined with the braking action of the motors Nos. 1 and 2 running as generators, brings the car quickly to a full stop. When the brake-controller drum is again turned to off position, the chain G is rewound on the shaft extension H′, which withdraws the pawl F from engagement with the ratchet-wheel E′ and permits the release-springs to act to retract the brake-shoes from braking engagement with the car-wheels.

It is desirable to provide some means for preventing slipping or sliding of the car-wheels in case the brake-controller handle be thrown around rather quickly, so that the motors will generate a strong current and produce a strong torque on the brake-motor. This may bring the brake-shoes against the wheels with force sufficient to slide the wheels, if the pawl F is in engagement with the ratchet E when this point is reached. This may be prevented by so arranging the chain G that it is normally wound so taut on the shaft extension H′ that the brake-controller must be turned to a considerable extent, or even to a point beyond its last contact position, before sufficient slack is given said chain to drop the pawl into engagement with the ratchet-wheel. By the time such position is reached and all the resistance has been removed from the brake-circuit the momentum of the car will ordinarily have been sufficiently checked to prevent skidding of the wheels, or I may provide in addition to said claim the more positive means shown in Fig. 7. Such means consists of a magnet M, connected in the brake-circuit and having an armature-lever L, which is connected by a chain M′ or its equivalent with the pawl F. Said lever is normally held away from the magnet-pole by the action of a spring S, whose tension may be regulated by a screw S′ and thumb-nut S^2. When this device is used, increase of current in the brake-circuit beyond a predetermined point, regulated by the spring S, will cause the armature-lever to be attracted to the magnet, and thereby raise the pawl F from engagement with the wheel E′.

I do not desire to limit myself to the non-essential details which I have herein shown and described for the purpose of representing a complete operative device, as these may be changed in many respects without affecting the essentials of my invention as pointed out in the appended claims.

Having thus described my invention, what I claim, and desire to secure by Letters Patent, is—

1. In combination with the motor or motors

of an electrically-propelled car, a brake-controlling switch arranged to connect said motor or motors to run as generators in a local circuit, an auxiliary motor having its armature connected to the mechanical brake-rigging of the car, locking means for preventing a backward or brake releasing movement of said armature, and a mechanical connection between the said locking means and a movable member of the said switch, whereby the operation and release of the said switch effects the operation of the said locking means.

2. In combination with the motor or motors of an electrically-propelled vehicle, a brake-controlling switch arranged to connect said motor or motors to run as generators in a local circuit, an auxiliary motor having its armature connected to the mechanical brake-rigging of the car, a pawl-and-ratchet device for preventing backward or release movement of the said armature, a connection between the pawl and a movable member of the said switch, and an electromagnetically-actuated device also connected to said pawl for disengaging the same under certain circuit conditions.

3. In braking apparatus of the class described, the combination with the driving motor or motors and a switch for connecting the same to run as generators in a local circuit, of an auxiliary motor for connection in said circuit, a connection between the said motor and the mechanical brake-rigging of the car, a device for locking the brake-rigging in its operative position controlled by the operation of said switch, and means for automatically releasing said locking device independently of the switch, substantially as described.

4. In braking apparatus of the class described, the combination with the driving motor or motors, the brake-controller therefor, the auxiliary motor, and the connection between the said motor and the mechanical brake-rigging of the car, of the pawl-and-ratchet device for locking the brake-rigging in operative position, and a connection between the pawl and the shaft of said controller, whereby the pawl is engaged with and disengaged from the ratchet by the operation of said controller, substantially as described.

5. In braking apparatus of the class described, the combination with the brake-controlling switch and the auxiliary motor, having a ratchet on its armature-shaft, of the jointed pawl for engagement with the said ratchet, and a connection between the said pawl and the shaft of the controller, substantially as described.

6. In braking apparatus of the class described, the combination with the brake-controlling switch having the downwardly-extending shaft, and the auxiliary motor having a ratchet on its armature-shaft, of the pawl for engagement with said ratchet, and the chain connection between said pawl and the extension of the brake-controlling-switch shaft, substantially as described.

7. In braking apparatus of the character described, the combination with the motor having its armature-shaft operatively connected to the brake-shoes of the car, of the ratchet-wheel on said shaft, the pawl arranged to engage said wheel, a magnet included in the circuit of said motor, and a connection between the armature of said magnet and the said pawl, substantially as described.

8. The combination with the driving-motors of an electrically-propelled vehicle, of an auxiliary motor whose rotary armature-shaft is connected to the brake-rigging of the vehicle, and a brake-controlling switch having contacts and connections for connecting the driving-motors in parallel a local circuit to run as generators, and for connecting the auxiliary motor in series with the parallel connected motor-generators in said circuit, and other contacts for short-circuiting said auxiliary motor when said switch is turned to off position, substantially as described.

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

EMMETT W. STULL.

Witnesses:
H. W. SMITH,
M. E. SHARPE.