No. 832,462 PATENTED OCT. 2, 1906.

A. L. DUWELIUS.

AUTOMATIC ELECTRIC BRAKE.

APPLICATION FILED MAY 7, 1904.

3 SHEETS—SHEET 1.

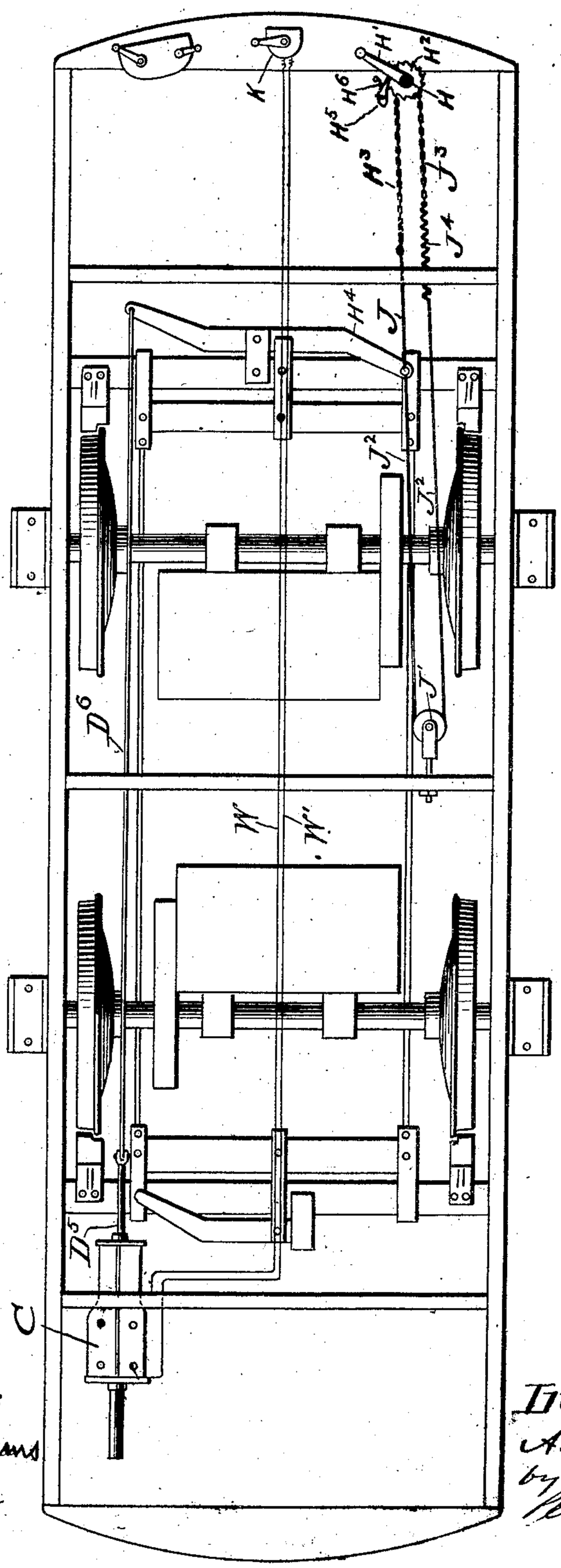

Fig. 1.

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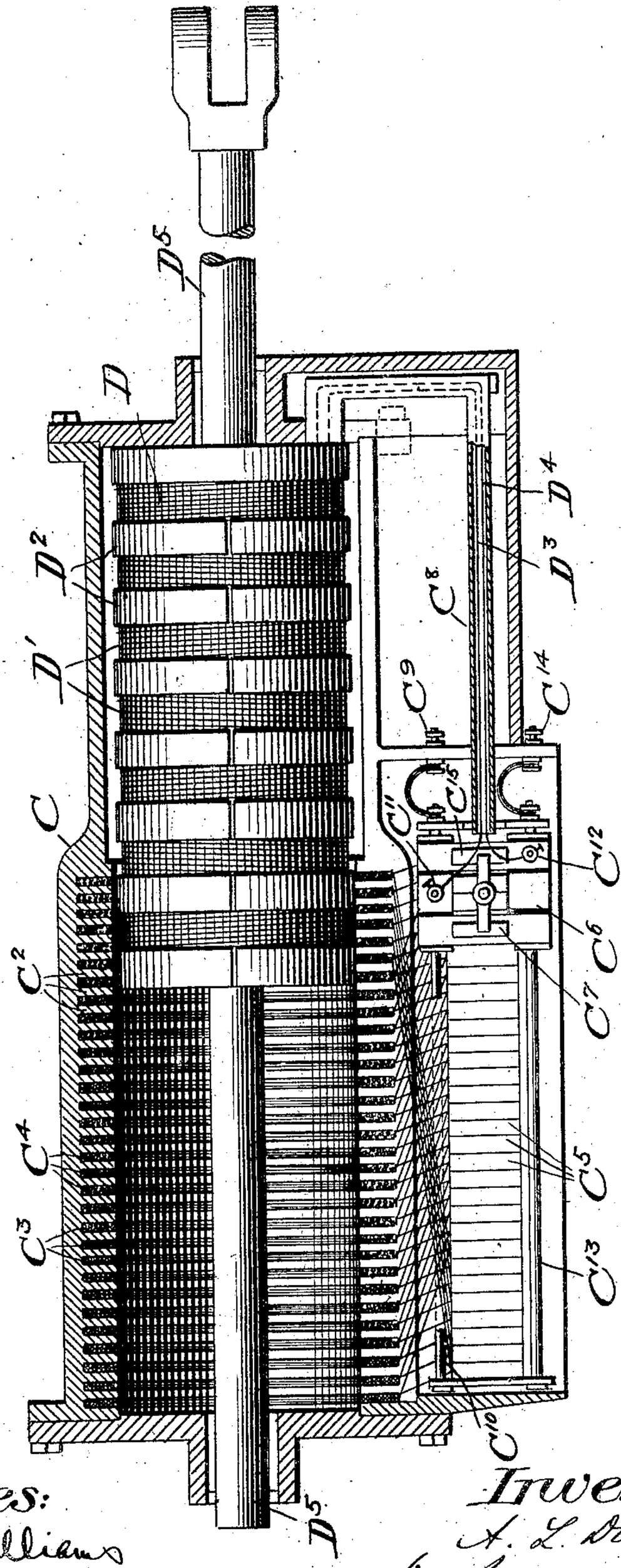
3 SHEETS—SHEET 2.

Fig. 2



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3 SHEETS—SHEET 3.

Fig. 5

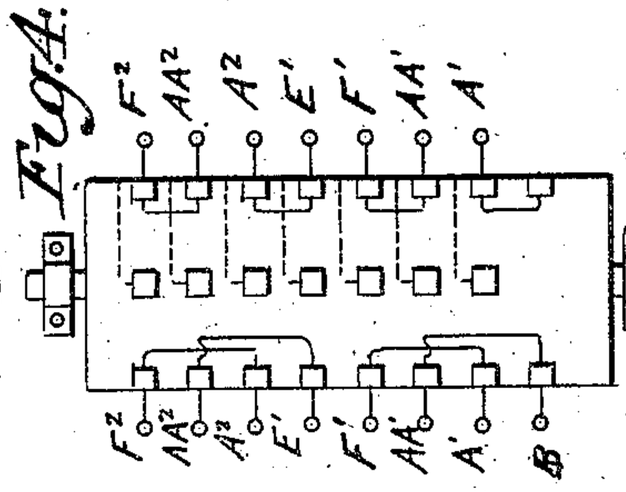
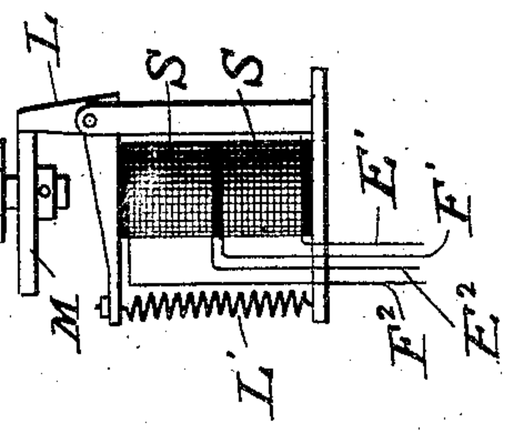


Fig. 4.



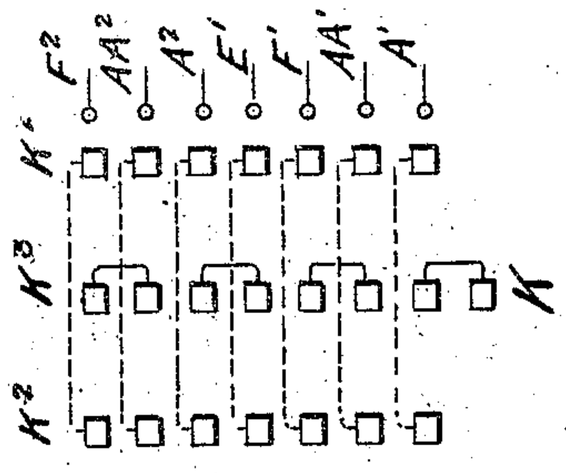
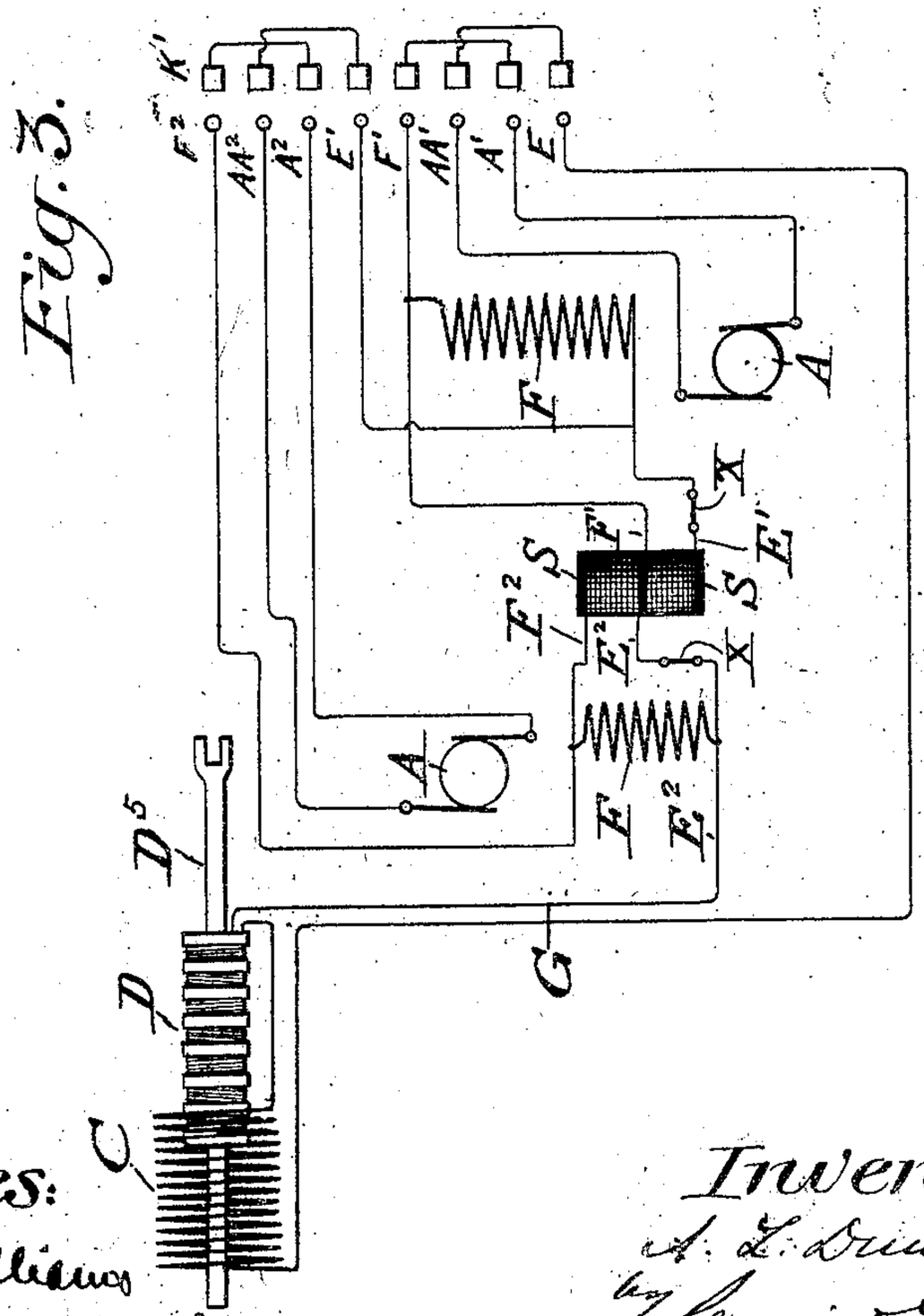


Fig. 3.



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UNITED STATES PATENT OFFICE.

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AUTOMATIC ELECTRIC BRAKE.

No. 832,462. Specification of Letters Patent. Patented Oct. 2, 1906

Application filed May 7, 1904. Serial No. 206,861.

To all whom it may concern:

Be it known that I, AUGUSTUS L. DUWELIUS, a citizen of the United States, residing at Cincinnati, county of Hamilton, State of Ohio, have invented certain new and useful Improvements in Automatic Electric Brakes; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to electric brakes for vehicles, and has for its object to provide means for electrically retarding and arresting the movement of the vehicle quickly and without injury to it or its contents.

To this end the invention comprises an electromagnetic actuator for operating the vehicle-brakes, which actuator is energized by current from an electrical generator on the vehicle, said generator under normal conditions of operation constituting the vehicle-motor, but in the breaking operation being transformed into a generator by breaking the circuit leading to the power source and concurrently establishing another circuit from the generator through the brake-actuator.

Good engineering practice has fully demonstrated that the usual hand-brake rigging of a vehicle cannot be safely discarded, and in view of this I have devised means of such a character as to constitute an addition to such rigging instead of a substitute therefor, the apparatus being so designed as to secure such coaction between the hand braking apparatus and the electrical-power-actuated mechanism as to insure safety, reliability, durability, and a minimum cost of operation and maintenance.

My invention is illustrated in the accompanying drawings, in which—

Figure 1 is a plan view of a car equipped with my invention. Fig. 2 is a longitudinal section of my brake-cylinder. Fig. 3 is a diagrammatic view of the electrical connections. Fig. 4 is an end elevation of my brake-controller. Fig. 5 is a plan view thereof.

Referring to Fig. 1 of the drawings, the brake-cylinder C, with its forked plunger-rod D^5, is bolted to the car-body and mechanically connected with the usual brake-rigging by brake-rod D^6. The wires W W′ serve to connect the cylinder with a brake-controller K, which latter is illustrated in detail in Figs. 3, 4, and 5 and will be more particularly described hereinafter. The usual hand-brake staff H and crank H′, together with the ratchet-wheel H^2 and its locking-pawl H^5, are mounted on the forward end of the car, and said staff is connected by means of the hand-brake chain H^3 and rod J with the brake-lever H^4. Fastened to the same lever and extending toward the rear of the car is the rope J^2, passing over a pulley J′, secured to the car-frame, which rope is secured to the brake-staff by a chain J^3, with a stout spring J^4 interposed between the chain and the rope end. A spring H^6 normally forces pawl H^5 into engagement with the ratchet-wheel H^2 and serves to hold the brake set until the ratchet-wheel is released by the motorman.

The preferred form of my brake-actuating device is illustrated in detail in Fig. 2, and consists of an iron or steel cylinder C, in which reciprocates a plunger D, provided with a rod D^5, extending through opposite ends of the cylinder and constituting a support for the plunger, as well as means for connecting the latter to the brake-lever through the connecting-rod D^6. The plunger D consists of an iron or steel spool provided with a series of circumferential flanges D^2 throughout its length, between which flanges are wound coils D′ of insulated wire in such manner that the direction of winding in any one space is reversed to that of the space adjoining it, for the purpose, when electrically energized, of producing magnetic poles of alternately opposite polarity in the plunger. The terminals D^3 D^4 of the plunger-winding are brought out through the hollow connecting-rod C^8, which is an L-shaped pipe or casing secured at one end to the plunger and to a sliding carriage C^6 at its other end for the purpose of imparting a movement to said carriage corresponding exactly to that of the plunger. Said carriage is slidably mounted upon two parallel conductor-rods C^{10} and C^{13}, mounted in a lateral extension of the cylinder C and connected, respectively, to the circuit-terminals C^9 and C^{14}. Terminal wire D^3 is connected through carriage C^6 with rod C^{10}, and terminal wire D^4 is electrically connected with a brush or contact device C^{15}, mounted in said carriage, while a second brush or contact device C^7, mounted upon the opposite side of said carriage, is electrically connected with conductor-rod C^{13}. Said brushes or contact devices move over a commutating device consisting of a series of insulated bars C^5, mounted in the cylinder-casing, so that as

the carriage is reciprocated, the sliding contact devices C^7 C^{15} engage the upper surfaces of said bars and form electrical contact therewith. The inner surface of the cylinder is provided with a series of ribs C^2, forming a corresponding series of grooves C^3 between contiguous ribs, in which latter are secured rings or coils of insulated wire C^4. The number of these grooves and coils is preferably always one more or one less than some multiple of the number of flanges on the plunger. In the particular instance illustrated there are eight flanges D^2 on the plunger and thirty-one grooves and thirty-one coils C^4 in the cylinder. The terminals of each cylinder-coil are connected with those of two other coils in the cylinder, each eight numbers from it in opposite directions. For instance, one terminal of coil No. 9 connects with its opposite of coil No. 1, the other with its opposite of coil No. 17, &c., in regular order until one terminal of coil No. 31 connects with its opposite of coil No. 23 and the other with its opposite of coil No. 8, thus completing a closed circuit including all of the coils. Each junction of the coil-terminals is electrically connected with one of said insulated bars C^5 of the commutator device. The practical effect of this arrangement of parts is such, that when supplied with electrical current, the cylinder being stationary, the plunger is drawn into the cylinder and actuates the brake-rigging. It will be understood, of course, that the same result may be produced by making the plunger stationary and the cylinder movable and also by constructing the plunger with the multiplicity of grooves and coils shown in the cylinder and employing the plunger construction of flanges and coils in the cylinder. The form illustrated, however, presents the fewest mechanical difficulties and is therefore to be preferred. When the power is applied to the brake-actuating cylinder, the course traversed by the current is as follows: passing from the external circuit to binding-post C^9, through guide-rod C^{10}, binding-post C^{11} on carriage C^6, through conductor D^3 in the hollow connecting-rod C^8, to and through the plunger-windings thence, through conductor D^4 in the connecting-rod C^5, back to binding-post C^{12} and sliding contact C^{15}, to the particular insulated bar-section C^6, with which said sliding conductor C^{15} is in contact, to the cylinder-coil connected to said insulated bar, thence through the various cylinder-coils in the manner above specified, the last of which is connected with the particular insulated bar-section with which the sliding contact C^7 is engaged by way of said contact to carriage C^6, thence to guide-rod C^{13} and binding-post C^{14} to the return-lead of the external circuit. As the plunger is drawn into the cylinder the carriage C^6 is correspondingly advanced along the commutator-sections C^5, with the result that the current is directed through the cylinder-coil in such manner as to afford the maximum attractive effect upon the alternating poles of the plunger.

In Fig. 3 are shown diagrammatically the electric windings of the cylinder C and plunger D, together with the electrical connections with the brake-controller K, the armatures A A, and the field-coils F F of the electric generators. It is to be understood that the motors are connected to the motor-controller through the brake-controller. The armature-terminals are indicated by A' A A' A^2 AA^2, and the field-coil terminals by F' E' F^2 E^2, the latter connecting with the ground-wire G. Connected with the field-coil terminals are the shunts S S, preferably composed of carbon plates. Opposite the generator-terminals is shown a diagrammatic plan of the contacts K' K^2 K^3 of the brake-controller K and beyond these the continuation of the generator or motor-terminals leading to the usual car-controller, which, however, is not here shown, as it forms no part of my invention.

My invention, as above described, operates as follows: The car being driven forward, the driving-current through and from the car-controller reache the motors by way of the brake-controller through the right-hand or car-controller terminals F^2 AA^2 A^2 E' F' AA' A' and their brushes bearing on contacts K^2, connected, as shown, by dotted lines, thence to brushes and left-hand conductors F^2, AA^2, A^2, E', F', AA', and A', forming the terminals of the armatures A A and field-coils F F of the motors. When it is desired to stop the car, the driving-current is shut off by the car-controller. The brake-controller shaft is then given a partial turn, which breaks the connection between the car-controller and the motors and closes a local circuit, including contacts K' and brushes coöperating therewith, armature-terminals AA^2 A^2 AA' A' reversed, field-coil terminals F^2 E' F', brake-terminal B, and brake-cylinder and plunger-windings, ground-wire G, and field-coil terminal E^2. The effect of this manipulation is to convert the motors into generators of electrical current and to electrically and magnetically energize the cylinder C and cause plunger D to be drawn within the cylinder, and thereby actuate the brake-rigging to apply the brake-shoes to the car-wheels with a force or pressure commensurate with the speed of the car. To graduate the braking power applied, shunts S S are connected to the terminals of the field-coil to more or less short-circuit them and vary their magnetic strength, and therefore the generating power of the generators. In this instance carbon plates are employed, and their resistance to the passage of the current is varied by the pressure applied by a cam M, mounted on the brake-controller shaft, acting upon

the bell-crank lever L and transmitted to the carbon plates. A spring L′ normally draws the lever L into forcible contact with the plates, thereby increasing the pressure and reducing the resistance. When the brake-controller is rotated to connect with the motor-controller, cam M engages lever L and rocks the same out of contact with the plates, which plates, therefore, interpose a sufficient resistance to practically break the shunt to the field-coil. In order, however, to electrically disconnect the shunts S S from the field-terminals when the generators act as motors, switches X X are provided. It is frequently desirable and often necessary to maintain the application of the brakes after the movemen of the car has ceased, and as the generation of current likewise ceases with the movement of the car some means should be provided for locking the brakes after they are set. This object I attain by means of the rope J^2, which in its peculiar relation to the brake-beam and the hand-brake staff operates as a take-up for the slack and a means for actuating the brake-staff and automatically locking the brakes after they have been set by the electrical actuator. It will be seen that the action of the electrical actuator moves all parts of the brake-rigging in the same direction as that employed in setting the hand-brake. Ordinarily this would cause the hand-brake chain to drop slack. In order to take up the slack and lock the brakes, as above mentioned, the wire rope J^2, having one of its ends fastened to the brake-lever and passing over the pulley J', its other end connected with the spring J^4, which engages the end of the chain J^3, wound on the hand-brake staff in a direction opposite to that of the hand-brake chain, the movement of the plunger in the application of the brake being communicated by the brake-rod to one end of the brake-lever, causes the other end of said lever to move in the direction of the hand-brake staff, carrying with it one end of the slack-take-up rope J^2. The pulley J' reverses relatively the motion of the other end of the rope J^2, spring J^4, and chain J^3, causing the latter in unwinding to turn the hand-brake staff in the direction employed in winding the hand-brake chain to set the hand-brake. The slack of the hand-brake chain being taken up, it is held by the ratchet and pawl actuated by the foot of the operator or by the pawl-spring H^6. The degree of slack so held is limited by the tension of the spring J^4, and as said spring may, if desired, be made sufficiently powerful to take up any degree of slack it is obvious that the brake will be held by the hand-brake staff with whatever degree of pressure said brake may have been set by the electrical actuator. In order to make the electrical braking apparatus applicable when the movement of the car is reversed, I provide on the brake-controller a series of contacts K^3, which properly connect the generator-terminals in order to insure the generation of current in the changed direction. It is to be noted that the translating device constitutes a reciprocating electric motor of high efficiency and as such is adapted to be applied as a prime mover to any other form of mechanism in which a reciprocating motion is required.

Having thus described my invention, what I claim is—

1. An electric brake-actuating apparatus for vehicles, comprising an electric translating device for operating the brake-rigging with a force commensurate with the speed of the car, an electric generator driven from the vehicle-axle, a controller for connecting the generator and the translating device, a self-locking hand-operating device for setting the brake, and mechanism for actuating the hand-operating device concurrently with the electric apparatus, whereby the brake is locked in set relation.

2. An electric brake-actuating apparatus for vehicles, comprising an electric translating device for operating the brake-rigging with a force commensurate with the speed of the car, an electric generator driven from the vehicle-axle, a controller for connecting the generator and the translating device, a hand-operated brake-staff for operating the brake-rigging, means for locking said staff, and connection between said staff and said brake-rigging whereby the staff is operated and the brake is locked when the latter is set by the translating device.

3. An electric brake-actuating apparatus for vehicles, comprising an electric translating device for operating the brake-rigging with a force commensurate with the speed of the car, an electric generator driven from the vehicle-axle, a controller for connecting the generator and the translating device, a hand-operated brake-staff for operating the brake-rigging, a ratchet and pawl for locking the brake-staff, and connections between said staff and said brake-rigging whereby the staff is operated and the brake is locked when the latter is set by the translating device.

4. An electric brake-actuating apparatus for vehicles, comprising an electric translating device for operating the brake-rigging, an electric generator driven from the vehicle-axle, a controller for connecting the generator and the translating device, a hand-operated brake-staff for operating the brake-rigging, a ratchet and pawl for locking the brake-staff, and a chain and rope connecting the brake-staff and the brake-rigging to operate the staff and lock the brake when the latter is set by the translating device.

5. Braking mechanism for a vehicle, comprising an electric brake-actuator, a hand-brake actuator, an automatic lock for the latter, and means connecting the brake-rig-

ging and the hand-brake actuator to operate the latter and take up the slack of the brake-chain and lock the brake when the brake is set by the electric actuator.

6. Braking mechanism for a vehicle, comprising an electric brake-actuator, a hand-brake actuator, an automatic lock for the latter, a flexible connection between the brake-rigging and the hand-brake actuator to operate the latter and lock the brake when the brake is set by the electric actuator.

7. An electric actuating apparatus for electrically propelling vehicles, comprising an electric translating device for operating the brake-rigging, a controller for breaking the circuit between the motor and the source of power and connecting the motor as a generator to the translating device, a shunt comprising carbon plates in the generator-circuit, and clamping mechanism operated by said controller to adjust the pressure on said plates and regulate the power of the generator applied to the translating device.

8. An electric translating device for operating brakes and the like, comprising a cylinder, and a piston or plunger, both of magnetic material, provided with circular grooves containing coils of insulated wire so arranged and connected that when supplied with electric current, the piston or plunger will be drawn into the cylinder.

9. An electric translating device for operating brakes and the like, comprising a cylinder, and a piston or plunger, both of magnetic material, each provided with a series of circular grooves, coils of insulated wire arranged in said grooves, terminal bars connected with one series of coils, sliding contacts coöperating with said bars and connected with the other series of coils, and connectors between said sliding contacts and the moving part of the translating device to move said contacts over the terminal bars.

10. An electric translating device for operating brakes and the like, comprising a cylinder, and a piston or plunger, both of magnetic material, each provided with a series of circular grooves, coils of insulated wire arranged in said grooves, so proportioned that the number of coils in one part will be one greater or one less than a multiple of the number of flanges or ribs on the other, terminal bars connected with one series of coils, sliding contacts coöperating with said bars and connected with the other series of coils, and connectors between said sliding contacts and the moving part of the translating device to move said contacts over the terminal bars.

11. In an electric brake-actuating mechanism for vehicles, a translating device, comprising a cylinder, a piston or plunger, both of magnetic material, provided with circular grooves containing coils of insulated wires so arranged and connected that when supplied with electric current the piston or plunger will be drawn into the cylinder, connections between the translating device and the brake-rigging, an electric generator driven from the vehicle-axle, and a controller for connecting the generator and the translating device.

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

AUGUSTUS L. DUWELIUS.

Witnesses:
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HORACE H. ALLEN.