No. 625,454. Patented May 23, 1899.

H. S. MAXIM.

REGULATOR FOR ELECTRIC CAR MOTORS

(Application filed Nov. 5, 1898.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1

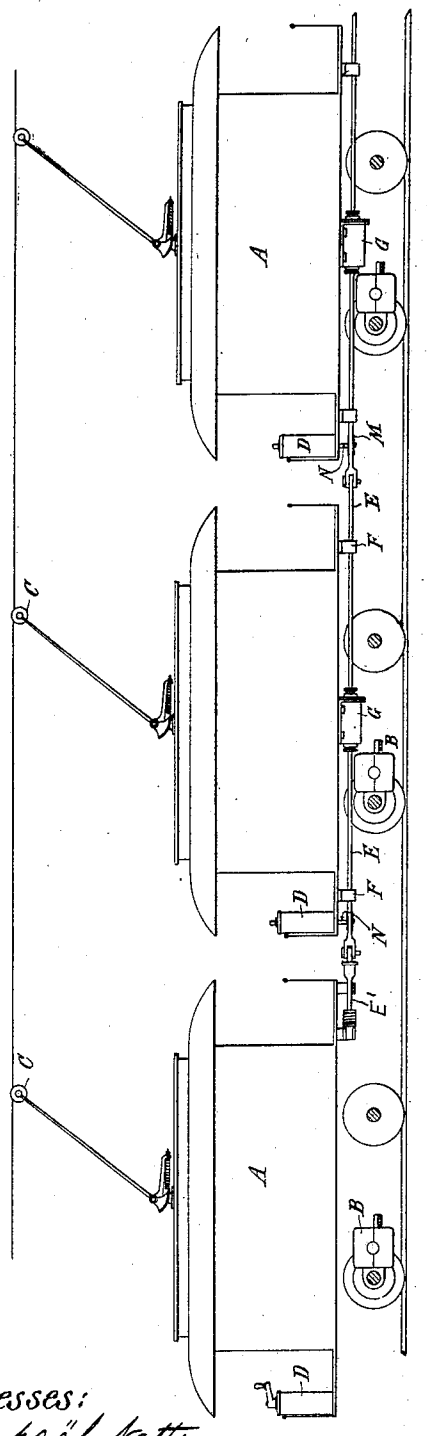
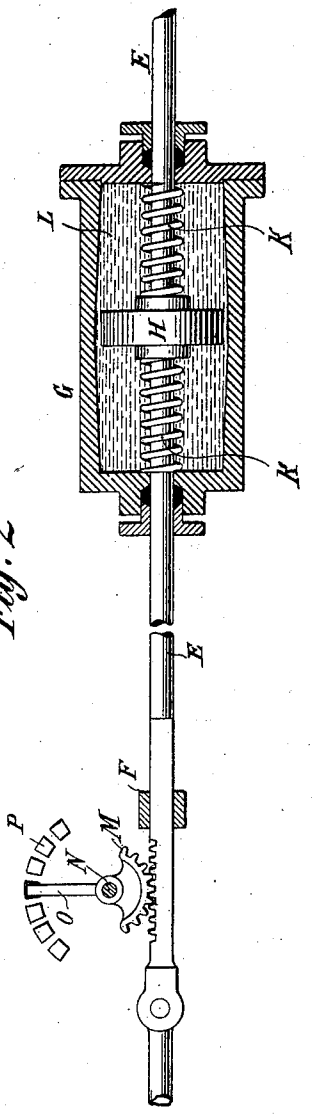


Fig. 2



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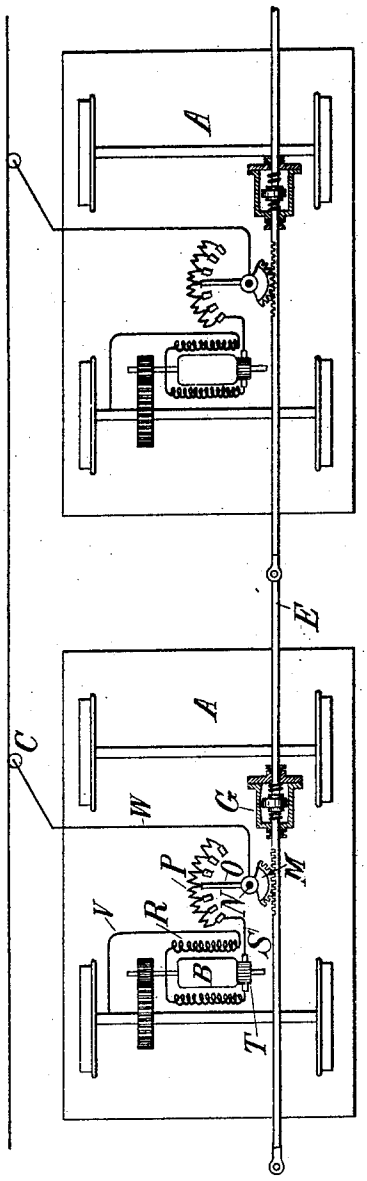

Fig 3.

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UNITED STATES PATENT OFFICE.

HIRAM STEVENS MAXIM, OF LONDON, ENGLAND.

REGULATOR FOR ELECTRIC-CAR MOTORS.

SPECIFICATION forming part of Letters Patent No. 625,454, dated May 23, 1899.

Application filed November 5, 1898. Serial No. 695,559. (No model.)

To all whom it may concern:

Be it known that I, HIRAM STEVENS MAXIM, residing at Queen Gate Place, South Kensington, London, England, have invented certain new and useful Improvements in Regulators for Electric-Car Motors, of which the following is a specification, reference being had to the drawings accompanying and forming a part of the same.

It is frequently necessary in electric-railroad systems to couple together two or more cars, and in such cases it is usual to depend upon the motors of the forward car only as the drawing force, the remaining cars of the train being simply trailers. This imposes an abnormally-great load upon the hauling-motors, unless the latter are of a capacity greater than is usually required for propelling a single car, and even in such cases the number of cars in a train that can be practically managed in this way is very limited. It has hence been recognized as desirable to propel each car independently by its own motor or motors; but this involves the careful regulation of the current supplied to each individual motor of the train in order that each may perform its proper share of the work. Various means have been proposed for controlling all the motors of the train from one point, usually on the first car of the train; but this plan does not insure such action of the several motors that no one performs more or less than its proper amount of work.

The object of my present invention is to provide an automatic means of regulating the motors on the several electrically-propelled cars of a train so that each shall do only so much work as may be necessary to prevent its car from forging ahead or lagging behind and so pushing or pulling the cars immediately in advance or in the rear. For this purpose I employ an inextensible rod, bar, or other suitable form of connection extending from car to car throughout the train and with reference to which each car has a normally-determined position. I also provide means whereby any departure of a car from this normal position or relation will set in operation devices which will supply more current to the car-motor if its motion is retarded or less current if its motion is accelerated.

In the drawings I have illustrated a means by which the objects of my invention may be secured in the best and most practicable manner at present known to me.

Figure 1 represents a train of cars equipped with means for carrying out the invention. Fig. 2 is an enlarged sectional view of the essential portions of the apparatus. Fig. 3 is a diagram illustrating the circuit connections employed in my system.

A A represent two or more cars each provided with one or more propelling-motors B, to which current is led, as by a trolley C. It is assumed for the purposes of the present case that the cars are in all material respects similar to those now in common use and that each is provided with the usual controller D. Under each car extends a rod E, which is supported in suitable guides F and provided at its ends with means whereby it may be coupled to similar rods on other cars, as shown, so that when a number of cars are made up into a train the several sections of rod will form an inextensible bar from end to end of the train. Under each car is secured a cylinder G, through which the rod-section E extends, and on said rod, within the cylinder, is a piston H. The piston has a normal tendency to occupy a given, usually central, position in the cylinder owing to the action of two stout springs K, interposed between the heads of the cylinder and the opposite sides of the piston, and the cylinder is preferably filled with a fluid L, which acts to prevent sudden movements of the piston. To permit the flow of fluid from one compartment to the other within the cylinder, I preferably make the bore of the cylinder at the center slightly greater than the piston, but gradually reduce the diameter toward the ends, so that as the piston approaches the limits of its travel the resistance to its movement will be increased by the diminution of the clearance-space. At a convenient point of each of the rod-sections E, and preferably under the controller-box D on the platform, teeth are cut which engage with a segmental rack M, so that by the forward or

rearward movement of the rod the segmental rack M will be correspondingly turned about its pivotal center. This movement of the rack is utilized to turn a stem N, that extends up through the controller-box and carries a contact-arm O, that sweeps over the controller-points P. These parts are so arranged that when the piston H moves from its normal position forward in the cylinder or in the direction of motion of the car current will be directed into the motor of the car and so that the propelling effect of the motor will be increased in proportion to such forward movement, and, conversely, as the piston moves backward toward its normal position the current will be reduced until in the normal position of the piston it will again be shut off from the driving-motor.

In applying this apparatus to the control of a train of cars the forward car does not require a controller-rod E, but is operated by the hand-switch or controller. A short rod E' is, however, fixed to the rear of the car, and to this the rod of the next car is coupled, as shown. When the forward car is started, it pulls on the rods under the cars to the rear, and as the latter are stationary the pistons are slowly drawn forward and current sent through the several car-motors. As the rear cars under the propelling effect of these motors are driven forward the pistons return, more or less, to their normal positions, and the propelling effect is thereby regulated in exact accordance with the speed of the forward car. It is desirable to use a sufficient number of contact-points in each controller, so that a movement of the pistons backward from their normal positions will gradually reverse the motors, so that should the forward car come suddenly to a stop or the speed of the rear cars be too great the forward movement of the latter will be positively arrested. With such an arrangement it follows that if the forward car be reversed the motors on all the cars of the train will also be reversed, and in general that the work which each motor performs will be in proportion to the load on or resistance of its car.

In Fig. 3 the circuit connections for the cars of a train are shown. These connections, it will be understood, are or may be the same as are usually employed, the electric current supplied to the motor of the first car of the train being controlled by hand in the usual manner, while that supplied to each of the other cars of the train through the controller is regulated automatically by the means described. For example, the current is taken by a trolley C and conveyed by conductor W to the arm O of the controller. From this arm the current passes through the coils P of the controller and wire S to the armature of motor B by means of the commutator T. Thence the current flows through the field R and conductor V to earth or the rails in the usual way. The controller-arm O is operated by the segmental rack M, which is in engagement with the bar E, as above described.

By the use of this apparatus each car in a train is caused to run at a speed regulated in accordance with that of the forward car and each motor made to do such amount of work that the relative positions of the cars are maintained without the use of the usual draw-bars. The rod-sections E, it will be observed, are not intended to serve the purpose of couplings or draw-bars from one car to another, although they may do so, but merely as a rigid or inextensible connection extending back from the forward car, and with reference to which each car of the train tends to preserve a certain position, for any tendency of a car to recede from such position is corrected by the additional current which its displacement throws into the motor, and, conversely, an advance movement of a car with respect to the rod tends to cut off or reduce such current.

Having now described my invention, what I claim is—

1. The combination with each car of a train of two or more electrically-propelled cars, of a rod or bar movable longitudinally with respect to the car, means for maintaining the bars in a given normal position with respect to their respective cars, connections between said bars and the circuit-controllers on the cars whereby the current supplied to each car-motor will be varied in accordance with the changes of relative position of the rod and the car, the said rods or bars being coupled together in an inextensible series throughout the train, as set forth.

2. The combination with a train of two or more electrically-propelled cars, an inextensible rod or bar secured to the forward car and extending along the other cars of the train with flexible couplings between the several cars, and connections between the circuit-controllers of each car and the said rod whereby a change of the relative position of any car to the rod in the direction of travel of the car will result in a corresponding variation of the current supplied to its motor through the said controller, as set forth.

3. The combination with an electrically-propelled car, of a cylinder secured thereto, a rod extending lengthwise of the car and carrying a piston which works within the cylinder, said rod being provided with means for coupling it to similar rods of other cars, and connections or gearing between the rod and the circuit-controlling devices on the car, whereby the longitudinal movements of the rod will vary the current supplied to the car-motor, as set forth.

4. The combination with an electrically-propelled car, of a cylinder secured thereto and containing a fluid, a rod extending lengthwise of the car and carrying a piston which

works within the cylinder through the fluid, springs acting on the rod or piston and tending to maintain it in a given normal position with respect to the car, means for coupling the rod to similar rods on other cars, and connections or gearing between the rod and the circuit-controlling devices on the car whereby the longitudinal movements of the rod will vary the current supplied to the car-motor, as set forth.

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