No. 645,765. Patented Mar. 20, 1900.

A. SUNDH.

CONTROLLING APPARATUS FOR ELECTRIC CARS.

(Application filed Aug. 26, 1899.)

(No Model.) 3 Sheets—Sheet 1.

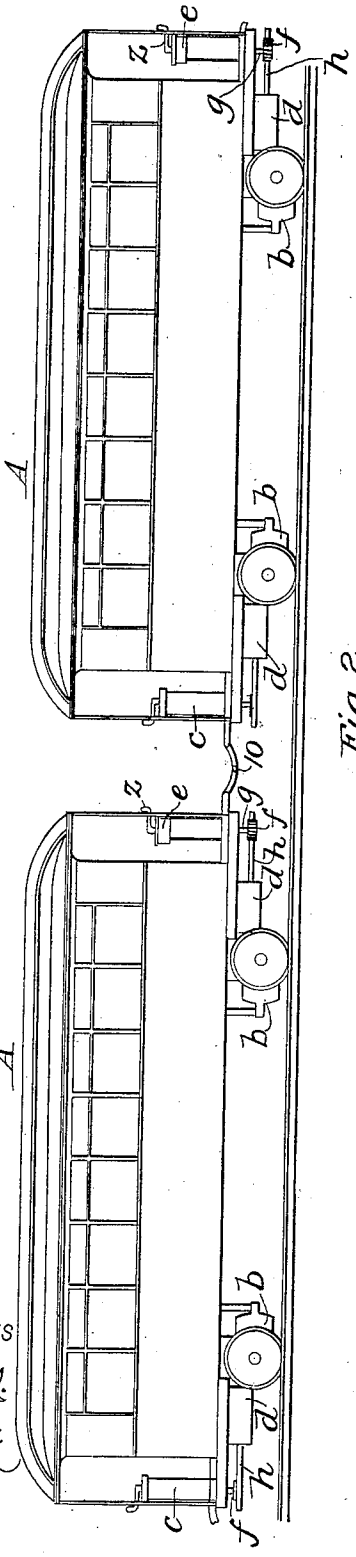

Fig. 1.

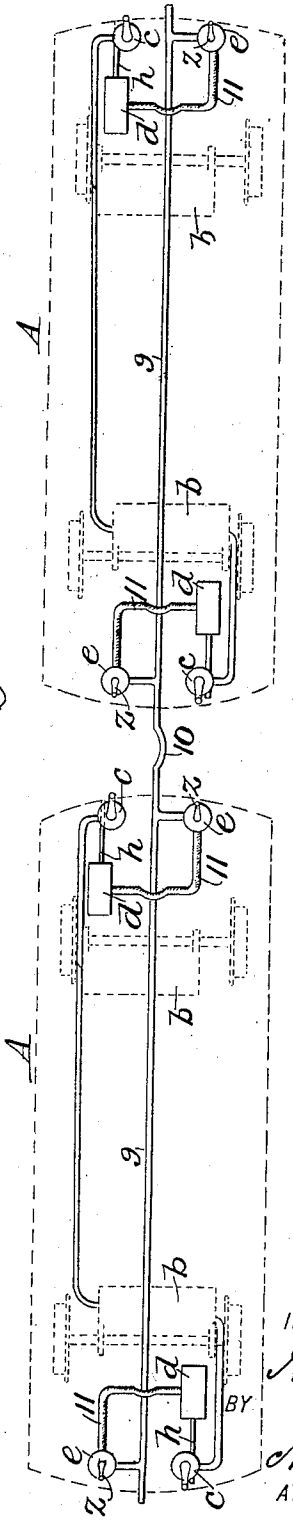

Fig. 2.

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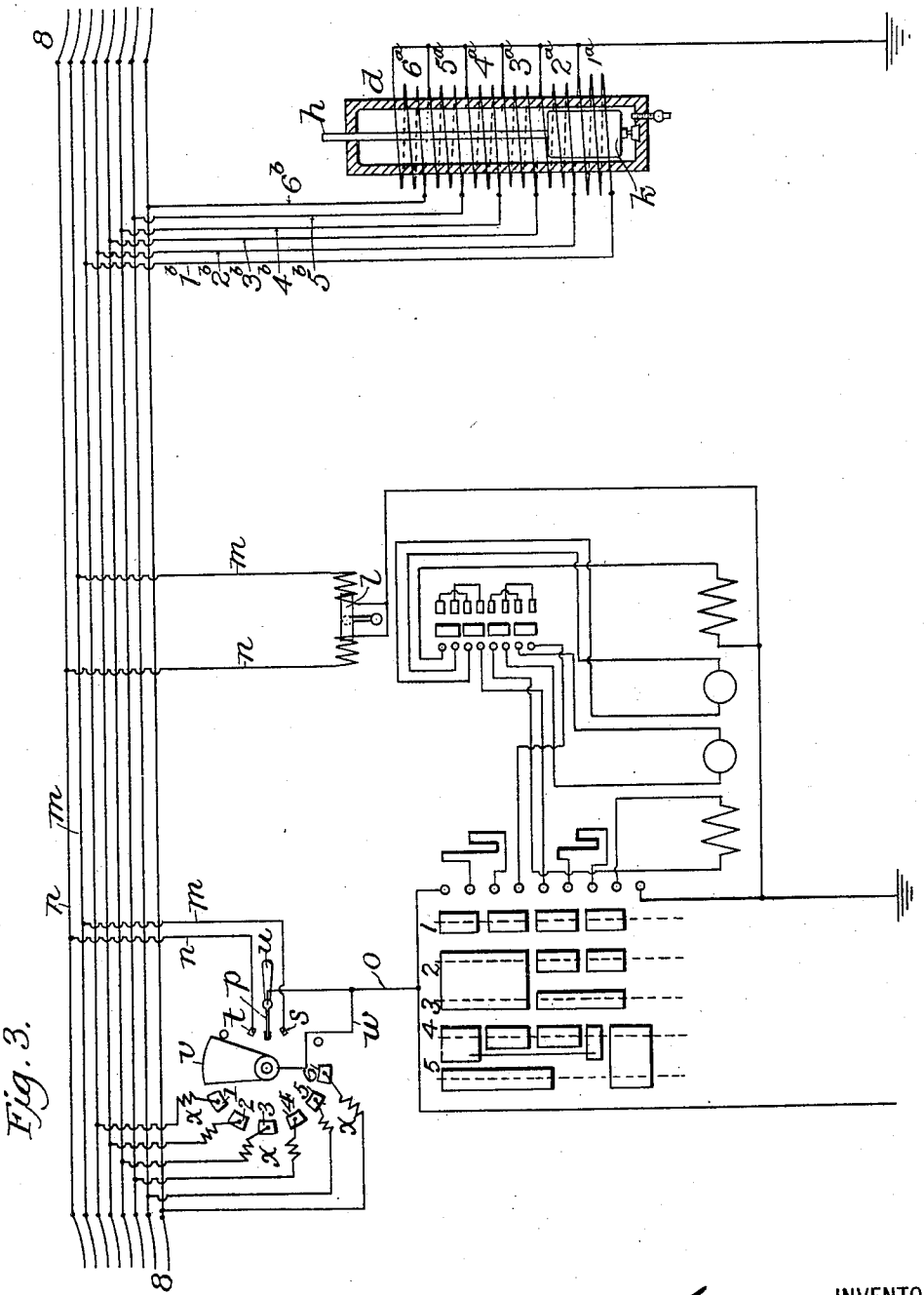

Fig. 3.

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(No Model.) 3 Sheets—Sheet 3.

Fig. 5.

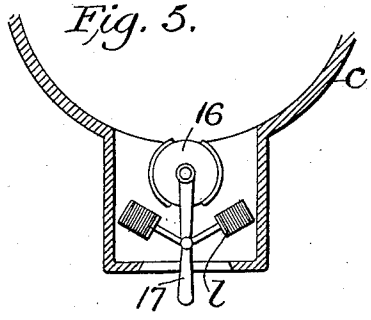
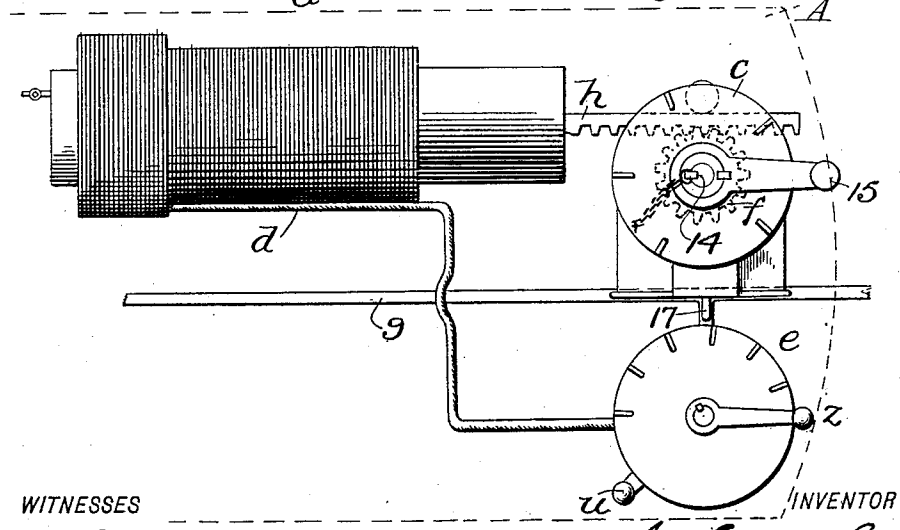


Fig. 4.

Fig. 6.



WITNESSES

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UNITED STATES PATENT OFFICE.

AUGUST SUNDH, OF YONKERS, NEW YORK.

CONTROLLING APPARATUS FOR ELECTRIC CARS.

SPECIFICATION forming part of Letters Patent No. 645,765, dated March 20, 1900.

Application filed August 26, 1899. Serial No. 728,546. (No model.)

To all whom it may concern:

Be it known that I, AUGUST SUNDH, a citizen of the United States of America, and a resident of Yonkers, county of Westchester, State of New York, have invented certain new and useful Improvements in Controlling Apparatus for Electric Cars, of which the following is a specification.

The object of my invention is to provide improved means whereby the controlling apparatus of all the electrically-propelled cars of a train may be operated synchronously from any one of the cars of a train, the controlling apparatus of each car being at the same time alike operative for controlling the car individually when used independently of other cars.

The purpose is to insure greater uniformity in the distribution of the work between the motors of the several cars of the train than is possible with a motorman in charge of the motor-controller of each car and to economize labor by enabling the control of the whole train to be accomplished by one man, as hereinafter described, reference being made to the accompanying drawings, in which—

Figure 1 is a side elevation of a train of two cars provided with my improved controlling apparatus. Fig. 2 is a plan view of the controlling apparatus with the cars and the motors indicated in dotted lines. Fig. 3 is a diagram of the wire system of a car, motor-controller, contacts, and switch, and diagram of the switch and connecting-wires for governing the solenoid employed for actuating the motor-controller. Fig. 4 represents a sectional elevation of the motor-controller and the solenoid for operating the controller. Fig. 5 is a horizontal section through part of the motor-controller, showing the magnet for operating the reversing-switch of the controller. Fig. 6 is a top view of the solenoid-motor controller and the solenoid-controlling switch.

a represents the cars; *b*, the motors for propelling the cars; *c*, the motor-controllers; *d*, solenoid-coils for operating the motor-controllers, and *e* the controlling-switch. The motor-controllers are located on the platforms in the usual position and have a pinion *f* on the projecting shaft *g* of the controller drum or cylinder 12, said shaft extending through the platform and gearing with a reciprocating toothed rack *h*, attached to the core *k* of the solenoid *d*, located under the car, so that the controller-drum will be turned forward and backward by the solenoid according as the core is reciprocated by the influence of the magnetism as applied by the different coils, a series of independent coils being used and adapted to shift the core step by step intermittingly both forward and backward, and thus shift the controller-contacts as required for varying the speed.

The magnet *l*, Fig. 3, and shown in application to the motor-controller in Fig. 5, controls the reversing-switch 16 in the motor-controller according as the wires *m* or *n* are put in connection with the supply-wire *o* by the switch *p*, located in the controlling-switch case *e*, when it is set over to one or the other of the contacts *s* or *t* by hand through the instrumentality of the hand-lever *u*.

v represents the shifting contact of the governing-switch. It is in electrical connection with the supply-wire *o* by the branch *w* and has the handle *z* above the top of the inclosing box for manipulating it.

1, 2, 3, 4, 5, and 6 are the stationary contacts of the controlling-switch, respectively connected with the independent coils 1^a, 2^a, 3^a, 4^a, 5^a, and 6^a of the motor-actuating solenoid *d* by the wires 1^b, 2^b, 3^b, 4^b, 5^b, and 6^b. A blow-out magnet *x* is provided for each stationary contact in the circuits to disrupt the arcs formed when the circuits are broken, and they are gaged in effective capacity to the maximum strengths of the currents required for the maximum number of cars in a train.

The contacts of the motor-controller comprise five steps. (Shown in the diagram Fig. 3, and arranged, as indicated by the radial lines *y*, on the top of the controller in Fig. 6.) The combinations of said steps for distributing current are as follows: first, motors in series, all resistance in; second, motors in series, one-half resistance in; third, motors in series, no resistance in; fourth, motors in parallel, resistance in; fifth, motors in parallel, no resistance in.

When the solenoid-core *k* is in the position represented in Figs. 4 and 6, the motor-controller is in the neutral position. Shifting contact *v* onto the several stationary contacts 2 to 6, inclusive, of the controller *d* either

way will shift the solenoid-core *k* accordingly, and it will similarly actuate the motor-controller for distributing the main driving-current as required.

The solenoid may be arranged vertically, and in such case the weight of the solenoid-core and the rack might generally be depended on to effect the reverse movements; but I consider it would be important to use the coils for pulling it down for safety against any accidental or other unusual resistance of the parts that the weight might not overcome.

It will be seen that with the above-described apparatus, including a controlling-switch on each end of the car, same as is the case with the common arrangement of motor-controllers, the individual car may be controlled the same as with the said common arrangement of motor-controllers, and with the wire systems of a plurality of cars in a train coupled together, as indicated at 8, the motor-controllers of all the cars are at once put under the control of any one of the controlling-switches anywhere along the train for uniform action of the motors and equal distribution of the work, whereby damage liable to occur when a motor is overloaded, as would be frequently the case without uniformity of action, is avoided, and the train responds more evenly and quickly when the current is turned on, and it works more smoothly and economically.

The wires are inclosed in protective tubes 9, with suitable flexible connections 10 between the cars and branch tubes 11 between the governors *e* and solenoids *d* and main tubes 9. In a train of cars only one controlling-switch, or preferably one at each end of the train, so that the motorman may occupy the forward end whichever way the train may be run, will serve for the control of the entire train; but there is advantage in all the cars in a train being provided with the switches necessary to the individual car, so that in case the motorman at the head of the train should fail to act another anywhere along the train could take control.

The shaft *g* of the controller-drum 12 is fitted to the drum within a sleeve 13, which is secured to the shaft by a key 14 when the drum is to be actuated by the solenoid, the drum being fitted to the sleeve so as to be rotated by it; but the key 14 is fitted detachably, so that when the car is to be used independently of other cars and it is not required to operate the drum by the solenoid the solenoid may be disconnected by removing the key, and the drum may be operated by the handle 15, same as in the usual way, said handle being positively fitted to the sleeve, and the reversing-switches 16 are provided with a handle 17 for shifting them also in such case.

Other ways of gearing the solenoid for disconnection may obviously be employed, and I do not limit myself to the particular way shown.

The solenoid-core is provided with a coiled spring 18, the purpose of which is to return the controllers to the off position at any time when the circuit may be accidentally broken, and thus prevent damage that might occur if when the circuit should be closed again the controller should happen to stand so that full force would be applied. By arranging the solenoid in an upright position the weight of the solenoid-core may be utilized for this purpose.

A solenoid-actuator for the barrel-switch is more advantageous than a motor, because it stops and holds the switch-barrel positively without variation, while the motor is liable to overrun or stop short unless provided with special means for controlling it, as the stop devices of the patent to Potter, No. 617,601.

I am aware that a solenoid-controller for the switch of a rheostat used to vary the current in a motor for working an elevator has been used; but the rheostat-controller is not a practical substitute for the barrel-switch in an electric-car-train system.

What I claim as my invention is—

1. In an electric car, the combination with an electric motor and its barrel-switch controller, of a solenoid-motor mechanically geared with the barrel-switch for actuating it step by step in both forward and backward movements, and a governing-switch for the solenoid.

2. In an electric car, the combination with an electric motor and its barrel-switch controller, of a solenoid-motor mechanically geared with the barrel-switch for actuating it step by step in both forward and backward movements, a governing-switch for the solenoid, a magnet for actuating the controller-reversing switch, and a switch for controlling said magnet, said switch located in proximity to the governing-switch for the solenoid.

3. In an electric car, the combination with an electric motor and its barrel-switch controller, of a solenoid for actuating the barrel-switch, the core of said solenoid geared with the motor-controller shaft by a rack and pinion and adapted for operating the barrel-switch both forward and backward, a governing-switch for the solenoid, a magnet for actuating the reversing-switch of the motor-controller, and a switch in proximity to the solenoid-governing switch for controlling the reversing-switch magnet.

4. In an electric-motor-controlling system for electric cars, the combination with the motor and its barrel-switch controller, of a solenoid-motor for actuating the controller, said motor having a plurality of coils and being mechanically geared with the controller, and a governing-switch for the solenoid-motor having a plurality of contacts adapted for intermittently operating the solenoid-motor step by step in either direction.

5. The combination of a plurality of cars in a train, a plurality of electric motors and barrel-switch controllers for said motors, a

plurality of solenoid-motors having a plurality of coils and mechanically geared with the barrel-switches for operating them, and a plurality of governing-switches having a plurality of contacts adapted for intermittently operating the solenoid-motors step by step in either direction, the wire systems of the several cars being coupled from car to car.

6. In an electric car, the combination with the motor and its controller, of a governing-switch, and mechanism controlled by the governing-switch and geared with the controller for actuating it, said mechanism detachably geared with the barrel-switch of the controller, to release the barrel for operating it by hand.

7. In an electric car, the combination with the motor and its controller, of the solenoid-motor and the governing-switch for operating the controller, said solenoid-motor geared with the controller-shaft, and said shaft detachably geared with the barrel, to release the barrel for operating it by hand.

8. In an electric car, the combination with the motor and its barrel-switch controller, of the solenoid-motor and governing-switch for operating the controller, said motor mechanically geared with the controller-shaft, and means for effecting retraction of the solenoid-core to the off position wherein the current is interrupted.

9. In an electric car, the combination with the motor and its barrel-switch controller, of the solenoid-motor and governing-switch for operating the controller, said motor mechanically geared with the controller-shaft, and a spring for effecting retraction of the solenoid-core to the off position when the current is interrupted.

Signed by me at New York, N. Y., this 23d day of August, 1899.

AUGUST SUNDH.

Witnesses:
A. P. THAYER,
C. SEDGWICK.