No. 646,768. Patented Apr. 3, 1900.

A. SUNDH.

CONTROLLING APPARATUS FOR ELECTRIC RAILWAY CARS

(Application filed Sept. 25, 1899.)

(No Model.) 4 Sheets—Sheet 1.

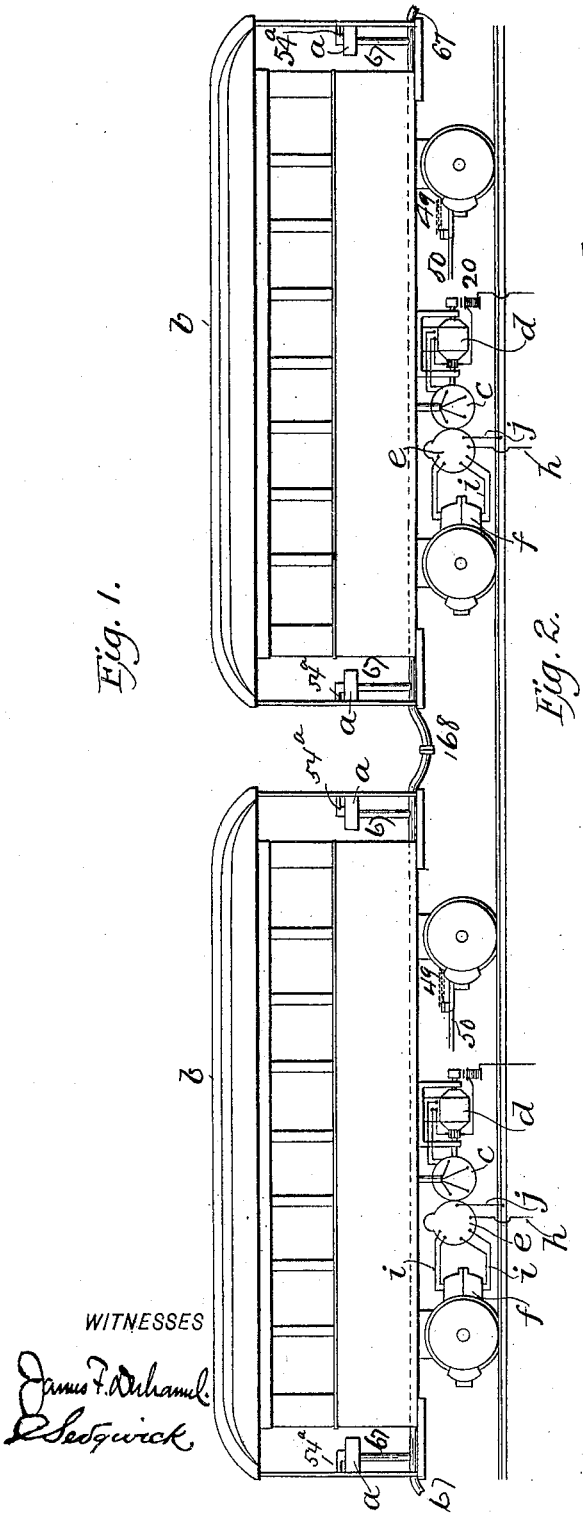

Fig. 1.

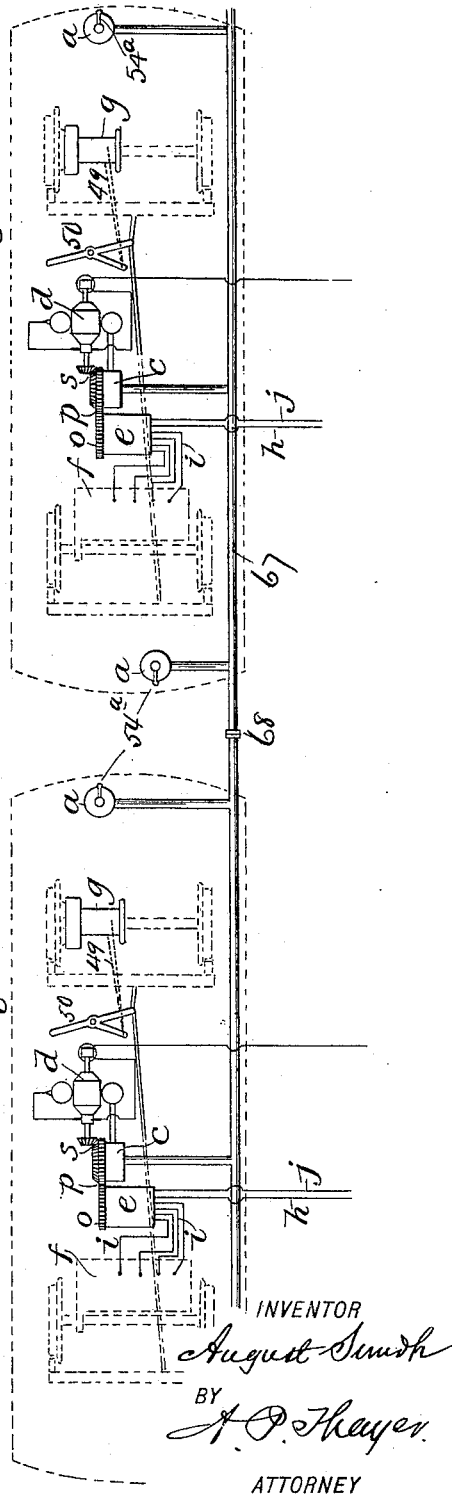

Fig. 2.

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(No Model.) 4 Sheets—Sheet 2.

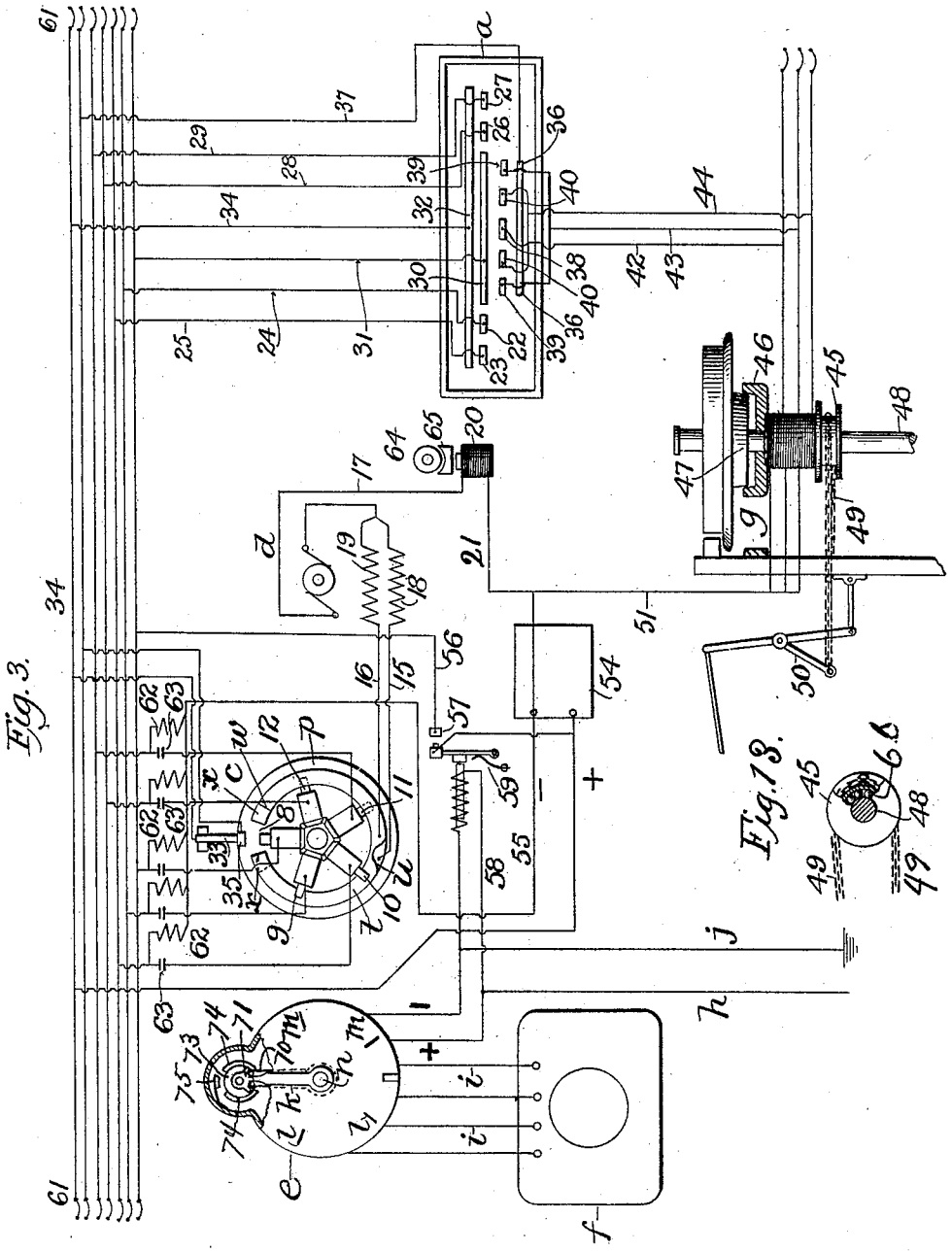

Fig. 3.

Fig. 1B.

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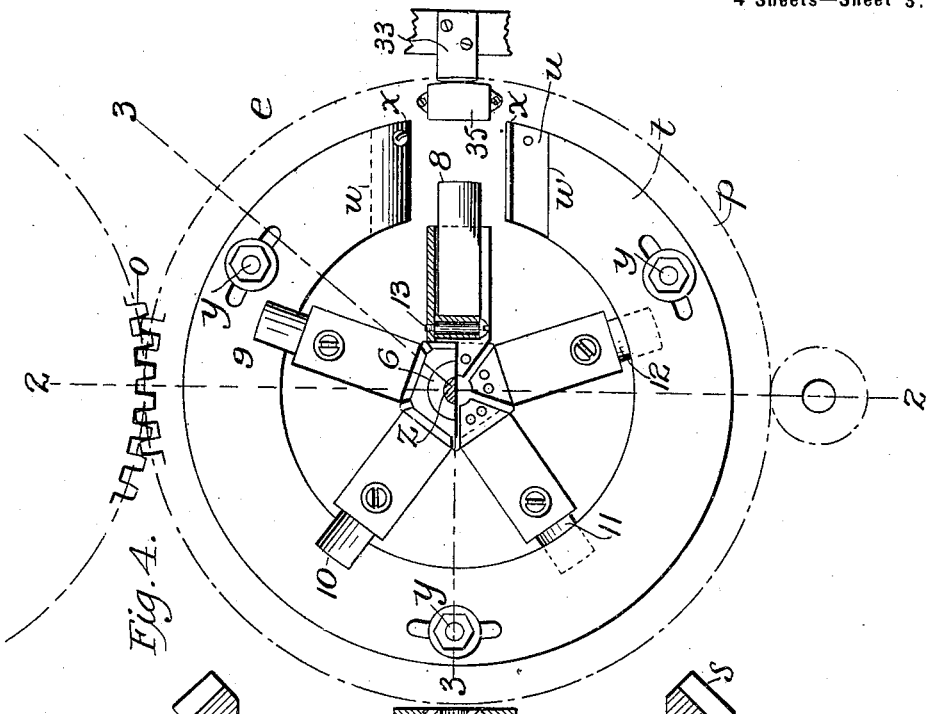

Fig. 4.

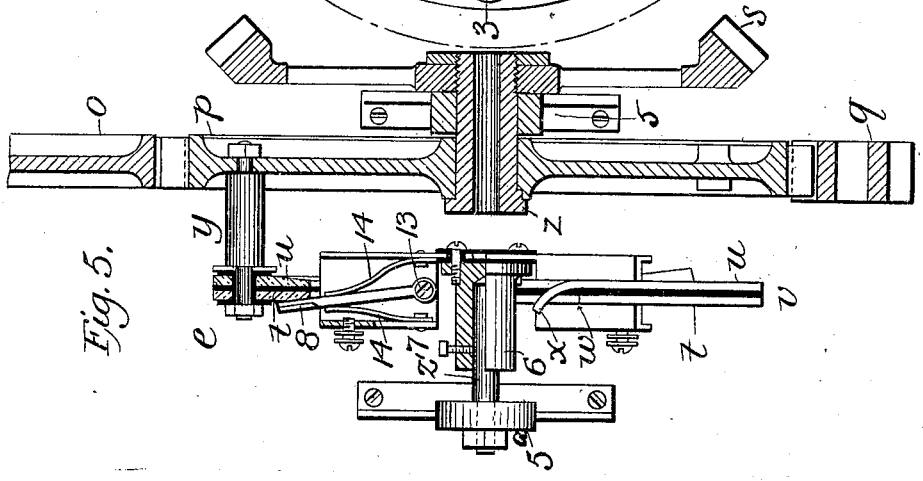

Fig. 5.

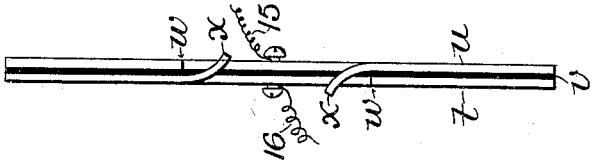

Fig. 6.

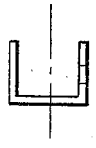

Fig. 7.

Fig. 8.

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(Application filed Sept. 25, 1899.)

(No Model.) 4 Sheets—Sheet 4.

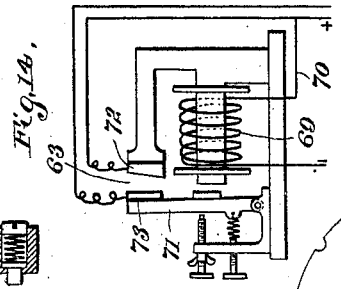

Fig. 14.

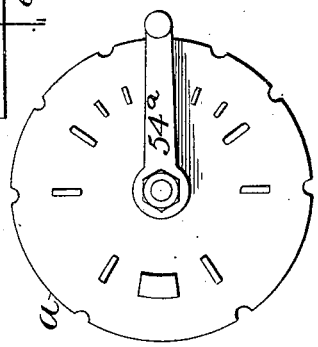

Fig. 10.

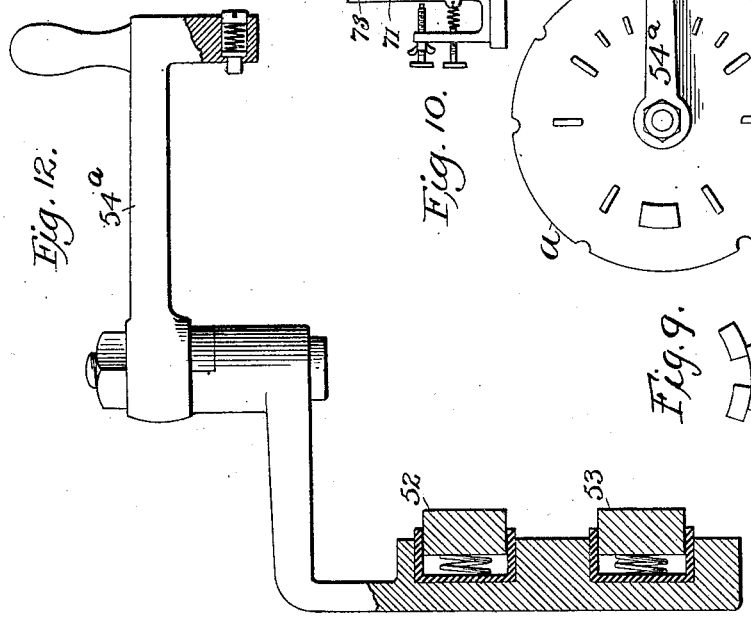

Fig. 12.

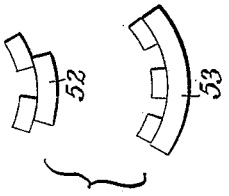

Fig. 9.

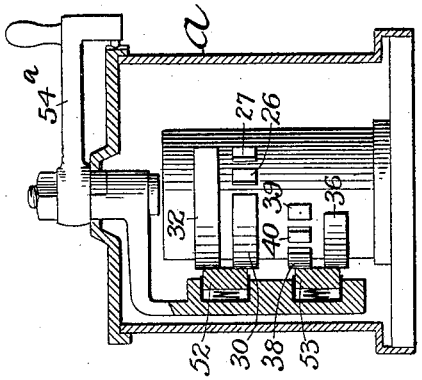

Fig. 11.

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UNITED STATES PATENT OFFICE.

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CONTROLLING APPARATUS FOR ELECTRIC-RAILWAY CARS.

SPECIFICATION forming part of Letters Patent No. 646,768, dated April 3, 1900.

Application filed September 25, 1899. Serial No. 731,505. (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, and State of New York, have invented certain new and useful Improvements in Controlling Apparatus for Electric-Railway Cars, of which the following is a specification.

This invention embraces appliances for controlling the impelling mechanism of an electrically-driven car by means of a manually-operating governor on each platform and in combination with such appliances a system of train-wires, by means of which the impelling mechanism of a multiplicity of such cars coupled together in a continuous train can be simultaneously started or stopped or otherwise synchronously operated from either platform on any one of the cars.

The invention further includes the combination of said manually-operating governor with the brake mechanism of a car and by means of said train-wires with the brake mechanisms of all the cars.

The accompanying drawings and diagrams, illustrating the invention, are as follows:

Figure 1 is a side elevation of two motor-cars in a train equipped with controlling apparatus and also with brakes in accordance with my invention. Fig. 2 is a plan view of the controlling apparatus and brakes with the car-bodies indicated in dotted lines. Fig. 3 is a diagram of the wire system of each car and plan view of an electric brake with a part in section. Fig. 4 is a side elevation of a governor for controlling the pilot-motor with a part in section. Fig. 5 is a section on lines 2 2 and 3 3, Fig. 4. Fig. 6 is a front elevation of the rings of the governor. Fig. 7 is an end elevation, and Fig. 8 a longitudinal section, of contact-finger-carrying arms of the governor. Fig. 9 is a top view of the brushes of the circuit-closer for controlling the governor and the brake. Fig. 10 is a top view of the circuit-closer. Fig. 11 is an enlarged view of details of the circuit-closer by which the motorman controls the governor of the pilot-motor, partly in sectional elevation and partly in side view. Fig. 12 is a sectional elevation of the movable contact device of the circuit-closer. Fig. 13 is a section of a car-axle and end elevation of the brake-drum with a part broken out. Fig. 14 is a diagrammatic representation of a relay to be used in the governing-circuits to prevent return-currents in case a governing-circuit fails of being broken at the proper time.

The motorman's circuit-closer is designated generally by reference-letter *a*, one being located, preferably, on each end of a car *b*.

c represents the governor for controlling the pilot-motor *d*.

e indicates the barrel-switch for the main driving-motor *f*, and *g* represents the brake.

The motor *f* is represented in Figs. 1 and 2 about as usually arranged in a motor-car, and the brake may be located about as shown; but the pilot-motor, its controlling-switch, and the barrel-switch are only located in the drawings, for being clearly represented they may and preferably will be otherwise placed in practice.

The main current is supplied to the barrel-switch *e* by the wire *h*. *i* represents the motor-circuit wires, and *j* the ground-wire. The indicator *k* of the barrel-switch is represented in the neutral position. Two contacts *l l* and *m m* are indicated on opposite sides of the indicator, respectively. Connection in the barrel-switch with the contacts of one side causes rotation of the motor in one direction and reverse connection causes reverse rotation of the motor.

The barrel-switch shaft *n* is geared by a pair of wheels *o p* with the governor *c*, and the governor is geared with the armature of the pilot-motor *d* by bevel-wheels *s* or other approved means to shift the controller *e* one way or the other, according as the current is sent through the governor by the circuit-closer. The said shaft *n* carries an arm 70, the end of which engages the segment 71 on the shaft of the reversing-switch 73 for automatically reversing the said switch when the barrel-switch reverses. Said arm holds switch 73 in the off position when the barrel-switch is in the off position, as indicated in Fig. 3.

74 represents the contacts of the reversing-switch, and 75 the brush.

The construction of the governor is as fol-

lows: Two concentrically-curved metallic strips $t\,u$, hereinafter called "contact-rings," are placed side by side with suitable insulating material v between them, said rings being formed with a radial gap, their terminals w and x being on opposite sides of said gap, respectively. The terminal x of each ring is bent laterally across the plane of the other ring, as shown in Figs. 5 and 6. These rings are mounted on one side of wheel p parallel with its plane by studs y and insulated from said wheel. Wheel p is mounted on a pivot-stud z, supported in a bracket 5. A stud z' is supported by any suitable bracket 5^a in the line of the axis of wheel p and so that its free end reaches the plane of the contact-ring u, or thereabout. A hub 6 is carried on this stud z, being fixed in its position by a set-screw 7 or other approved means. This stud has five radiating arms at equal distances apart circumferentially, all insulated from each other and carrying at their outer extremities contact-fingers 8, 9, 10, 11, and 12, respectively. The contact-fingers are pivoted to their supporting-arms, as indicated at 13, so that they can be shifted onto either of the contact-rings t or u by engagement with either of the bent terminals x, according as the rings are turned one way or the other relatively to said contact-fingers. The number of contact-fingers is governed by the number of the contacts in the barrel-switch. Contact-finger 8 is shown in the gap between the ends of the rings. Contact-fingers 9 and 10 are shown bearing on the ring t and contact-fingers 11 and 12 on ring u. When either contact-finger is in the said gap, the springs 14 maintain it in a plane midway between rings $t\,u$, but permit it to yield and engage one side or the other of the rings, according as they may be turned. These contact-rings are respectively connected with the fields of the series-wound pilot-motor d by wires 15 and 16, reversely wound thereon, as indicated at 18 and 19, for causing reverse action of said motor, according as the current is sent through one or the other of said rings. From this motor the armature-wire 17 leads to a brake-coil 20, which is connected by the wire 21 to the return-wire of the storage battery 54.

The circuit-closer a has two contacts 22 and 23, respectively connected with contact-fingers 9 and 10 of the governor by the wires 24 and 25; also two contacts 26 and 27, respectively connected with contact-fingers 12 and 11 of the governor by the wires 28 and 29; also a contact 30, connected with contact-finger 8 of the governor by the wire 31, and also a contact 32, connected with a brush 33 by wire 34, said brush being in a fixed position to make connection with a contact 35 on wheel p when said wheel comes to the middle neutral position. The circuit-closer also has a contact 36 connected with contact 35 by wire 37. There is also in the circuit-closer a contact 38, two contacts 39, and two contacts 40, respectively connected with three magnetizing-coils on the loose drum 45 of a friction-clutch on one of the car-axles 48 by wires 42, 43, and 44, said drum having a cupped disk 46 to grip a cone 47, fixedly secured on the axle 48 when magnetism is excited in the disk by current passing through one or more of the coils.

Several separate coils are employed to graduate the action of the brake by first slightly exciting the clutch and later increasing the effect by one or more additional currents. The drum 45 has two chains 49 wound on it reversely to each other and both connected to a brake-actuating lever 50, so as to force on the brakes alike whichever way the car runs. From the magnetizing-coils the respective wires join the return-circuit wire 51. The drum 45 has ball-bearings 66 on the axle to facilitate release when the clutch is demagnetized.

The circuit-closer and the automatic governor have each four contacts and circuits therefor corresponding with the four contacts of the barrel-switch, and besides these they also have other contacts and a circuit for controlling the contact-rings of the governor and the brake. 52 and 53 represent the brushes of the circuit-closer, and 54^a the motorman's lever.

The operation is as follows: Suppose the brush 52 to be set on contact 26. The circuit will then be closed through wire 28, contact-finger 12, and ring u of the governor, and also through the pilot-motor d by wire 15. The pilot-motor will then be set in motion in the direction for bringing the gap of the contact-rings to contact-finger 12, which will shift the barrel-switch so as to close the main circuit through the upper contact m and set the main motor in operation, and the gap will at the same time break the circuit through contact-finger 12 to the pilot-motor, which will then stop. The main motor will then continue to run as long as brush 52 remains on said contact 26. If the brush 52 be shifted onto contact 27, the circuit will then be closed through wire 29, contact-finger 11, and ring u of the governor, and also through the pilot-motor by wire 15, which will again be set in motion to bring the gap to contact-finger 11 and again break the pilot-motor circuit and at the same time to set the barrel-switch farther over to the lower contact m, where it will remain, as before, as long as brush 52 is on contact 27. When the contact-rings have been shifted to break the circuit at, say, contact-finger 12, contact-finger 8 will be in connection with ring t, and if it be desired to stop the car brush 52 will be returned to contact 30 to close the circuit through contact-finger 8, ring t, wire 16, and the pilot-motor, causing reverse motion of the latter, and thus bringing the gap of the rings to contact-finger 8 and returning the barrel-switch to the middle position. If the motor-circuit be closed through

lower contact *m* and it be desired to reduce the speed by making the circuit through upper contact *m*, the brush 52, which will then be on contact 27, will be shifted back to contact 26, closing the circuit through contact-finger 12, which will then be on ring *t*, and direct the pilot-motor current through wire 16, causing the gap to return to contact-finger 12 and the motor-controlling switch to shift the connection back to upper contact *m*. It will be understood that by shifting brush 52 in like manner relatively to contacts 22, 23, and 30 it will similarly close the main-motor circuit through contacts *l l* of the barrel-switch for running the car reversely. When the governor returns to the middle position for shutting off the motor-current and stopping the car, contact 35 then makes connection with brush 33 and closes the circuit to contact 36 in the circuit-closer through wire 37. Brush 53 of the circuit-closer then, after brush 52 has broken the governor-circuit, closes the brake-circuit through one or the other of contacts 39 and contact 36, according to which way the brush is shifted. Brush 53 is of sufficient length to reach onto contacts 40 and 38 without breaking with contact 39, and thus successively apply current to all three of the brake-coils.

Current for the controlling-circuits is to be supplied by a storage battery 54, which may be charged from the main line or in the station, not much current being required for the said circuits, as it is only used during the intermittent operation of the controlling apparatus. The current from this battery is supplied to the governor contact-fingers of the circuit-closer by the wire 34 and to the brake-contacts by brush 33 and wire 37.

51 is the return-wire of the brake-coils.

A branch circuit 56 connects the battery directly with the contact-finger 8 of the governor with a relay 57 in said circuit, which is normally kept open by a branch circuit 58 of the main-motor circuit, but will be instantly closed by the spring 59 if the trolley runs off the wire, and the pilot-motor will be set in motion to return the governor to the center position and stop the car.

Each car is fully equipped for operating independently of the others when not coupled in a train, and when so coupled the circuit-wires are also coupled, as indicated at 61, so that the controlling apparatus of all the cars may be operated from any one of the circuit-closers anywhere along the train, the operation of the several circuit-closers being practically in unison and insuring equal duty in all the main driving-motors; but in case it should happen that there should be difference in the speeds of the pilot-motors and they should not act in unison, so that current might flow from contact-fingers on one of the governors to contact-fingers on another governor, and thus cause conflicting effects on the different cars, I have provided a relay 62 in each of the governor-circuits to break the circuits, as indicated by the gaps 63, Fig. 3, and thus prevent any such return-currents. For instance, if in the governor of one car the contact-rings should overrun the proper limit and the extremity *x* on the other side of the gap should come in touch with the contact-finger before the gap in the governor of another car has reached the breaking-point current will be sent through the fields of the pilot-motor in the car in which the governor-circuit is not yet broken and it will stop before breaking the circuit, which, thus remaining closed, would send return-currents through other circuit-wires and field-coils of the pilot-motors with conflicting effects were it not for the current-breaking contacts of the relays.

The relay 62 is more clearly shown in Fig. 14, in which 69 represents the electromagnet, which is connected in a branch circuit 70 of the governing-circuit wires in which the two contacts 72 and 73 are provided, the latter being on the armature 71, whereby the circuit is closed whenever current is sent through the governing-circuit and is broken at the gap 63 whenever current is turned off from the circuit-wire in the circuit-closer, thus preventing any such return-currents.

The circuit-wires are inclosed in tubular protective casings 67, and they have coupling-joints 68 and are suitably flexible in the locality of the joints to vibrate as the motions of the cars require.

In the electric brake 20 connected in each pilot-motor circuit the drum 64 is to be understood as being on the shaft of the pilot-motor armature, the armature 65 is to be forced on the drum by the retracting-spring of the armature, and the magnet attracts the armature and releases the brake while the current is turned on.

What I claim as my invention is—

1. The combination with an electric motor and its controller, of a pilot-motor for shifting the controller, a governor having a plurality of contact-fingers and shifting contact-rings for controlling the pilot-motor, a circuit-closer having a corresponding plurality of contacts for controlling the governor and a reversing-switch operated by the controller.

2. The combination with an electric motor and its controller, of a pilot-motor for shifting the controller, a governor having a plurality of contact-fingers and shifting contact-rings for controlling the pilot-motor, and a circuit-closer having a corresponding plurality of contacts, for controlling the governor, said pilot-motor, shifting contact-rings of the governor, and the motor-controller geared together for unity of action.

3. The combination with the motor-controller, and the pilot-motor, of the governor having the shifting rings respectively connected with the pilot-motor fields by wires reversely wound thereon, a plurality of stationary contacts for the rings, said contacts au-

tomatically changeable from one ring to the other, and a circuit-closer having contacts and circuit connections with the rings and contact-finger of the governor, said rings of the governor geared with the pilot-motor and motor-controller.

4. The combination with an electric motor, of a motor-controller having duplicate sets of contacts on opposite sides of an intermediate reversing-switch, a pilot-motor geared with said controller for shifting the contacts, and a governor for the pilot-motor having contacts in circuit with the pilot-motor for turning it in either direction, and also contacts in circuit therewith, corresponding with the contacts of the motor-controller, said pilot-motor and contact-controlling rings of the governor geared with the motor-controller for unity of action.

5. The combination with an electric motor, of a motor-controller having duplicate sets of contacts on opposite sides of an automatic reversing-switch, a pilot-motor geared with said controller for shifting the contacts, a governor for the pilot-motor having contacts in circuit with the pilot-motor for turning it in either direction, and also contacts in circuit therewith corresponding with the contacts of the motor-controller, and a circuit-closer for the governor, said pilot-motor and contact-controlling rings of the circuit-breaker geared with the motor-controller for synchronous action.

6. The combination with the circuit-closer, and motor-controlling apparatus subject thereto, of the electromagnetic car-brake actuator, said actuator being in electrical connection with said circuit-closer whereby it may be set in action by the circuit-closer when the motor-circuit is broken.

7. The combination with the circuit-closer and motor-controlling apparatus subject thereto, of the electromagnetic car-brake actuator, contacts of the circuit-closer in electrical connection with the brake by one or more brake-energizing coils, adapted to be closed by said circuit-closer subsequently to the breaking of the motor-controlling circuits.

8. The combination with the circuit-closer, and motor-controlling apparatus subject thereto, of the electromagnetic car-brake actuator, contacts of the circuit in electrical connection with the brake-actuator by a series of separate energizing-coils adapted to be closed by said circuit-closer subsequently to the breaking of the motor-controlling circuits, and also to be closed successively for graduating the action of the brake.

9. The combination with the circuit-closer and motor-controlling apparatus subject thereto, of the electromagnetic brake-actuator consisting of the friction-clutch in connection with a car-axle and geared with the brake mechanism, and one or more energizing-coils adapted to effect the grip of the clutch, said coils being in connection with the contacts of the circuit-closer to be closed thereby subsequently to the breaking of the motor-circuits.

10. In electric-car-operating mechanism the combination of a plurality of cars in a train, electric motors and controllers for said cars, reversing-switches actuated by the controllers, pilot-motors for actuating the controllers, governors having a plurality of contact-fingers and shifting contact-rings for controlling the pilot-motors, said pilot-motors, governors, and controllers of the respective cars geared together for unity of action, and one or more circuit-controllers of the circuit-breaking governors, the corresponding contacts of said governors and circuit-closer or circuit-closers being respectively connected in train-circuits.

11. In electric-car-operating mechanism the combination of a plurality of cars in a train, electric motors and controllers for said cars, pilot-motors for actuating the controllers, reversing-switches actuated by the controllers, circuit-breaking governors for controlling the pilot-motors, said pilot-motors, governors, and controllers of the respective cars geared together for unity of action, and one or more circuit-closers of the governor-circuits, the corresponding contacts of said governors and circuit-closer or circuit-closers being respectively connected in train-circuits with a relay-magnet intermediate of each governor-contact and the train-wire.

12. In electric-car-operating mechanism the combination of a plurality of cars in a train, electric motors and controllers for said cars, pilot-motors for actuating the controllers, governors having a plurality of contact-fingers and shifting contact-rings for controlling the pilot-motors, said pilot-motors, governors, and controllers of the respective cars geared together for unity of action, and one or more circuit-controllers of the circuit-breaking governors, the corresponding contacts of said governors and circuit-closer or circuit-closers being respectively connected in train-circuits.

13. The combination with an electric motor and its controller, of a pilot-motor for shifting the controller, a governor having a plurality of contacts for controlling the pilot-motor, a circuit-closer having a corresponding plurality of contacts for controlling the governor, a storage battery supplying current to the circuit-closer and pilot-motor and the relay in the storage-battery circuit.

14. The combination with an electric motor and its controller, of a pilot-motor for shifting the controller, a governor having a plurality of contacts for controlling the pilot-motor, a circuit-closer having a corresponding plurality of contacts for controlling the governor, and a storage battery for supplying current to the circuit-closer and pilot-motor,

the main circuit having a relay to normally hold the battery-circuit open and to close it when the main circuit is interrupted.

15. The combination with the pilot-motor, of an electrically-controlled governor having a plurality of contact-fingers and shifting contact-rings for controlling said pilot-motor, said pilot-motor and governor mechanically connected for operating the governor by the pilot-motor for interrupting the governor-circuits.

Signed by me at New York, N. Y., this 10th day of September, 1899.

AUGUST SUNDH.

Witnesses:
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