No. 701,947. Patented June 10, 1902.

L. SAXON.

MEANS FOR TRANSMITTING SYNCHRONOUS MOTION TO DISTANT POINTS.

(Application filed Oct. 18, 1901.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

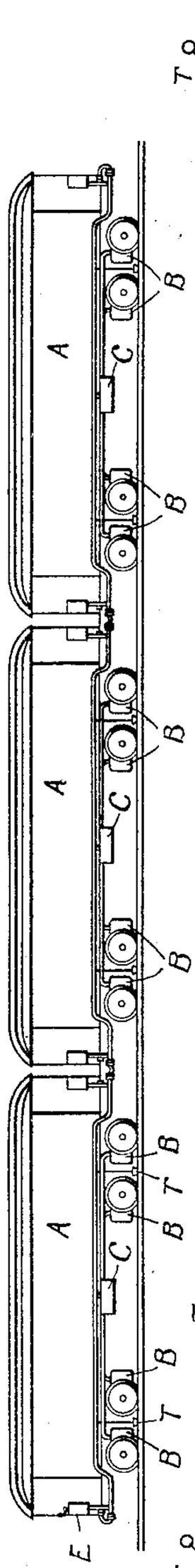

Fig. 2.

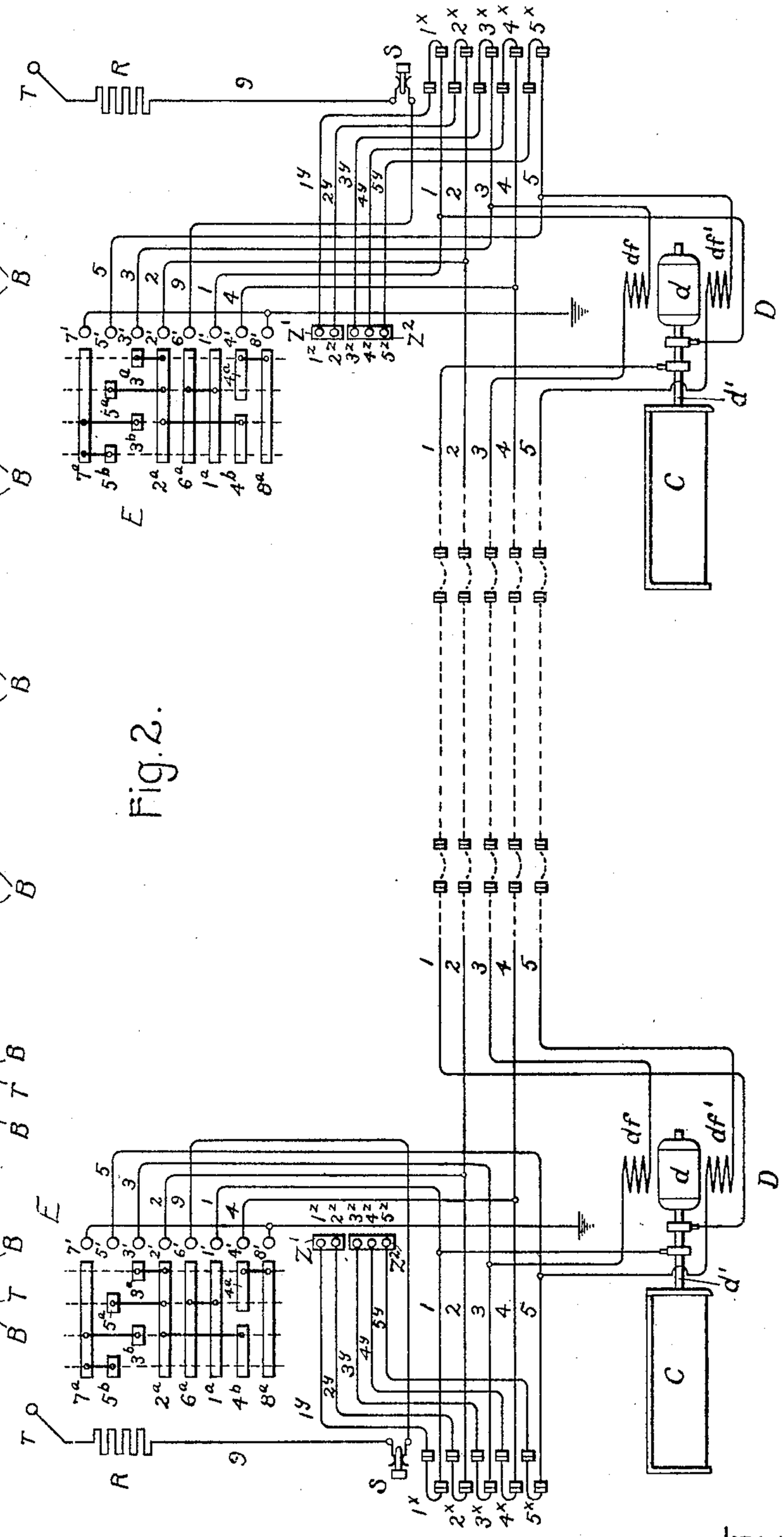

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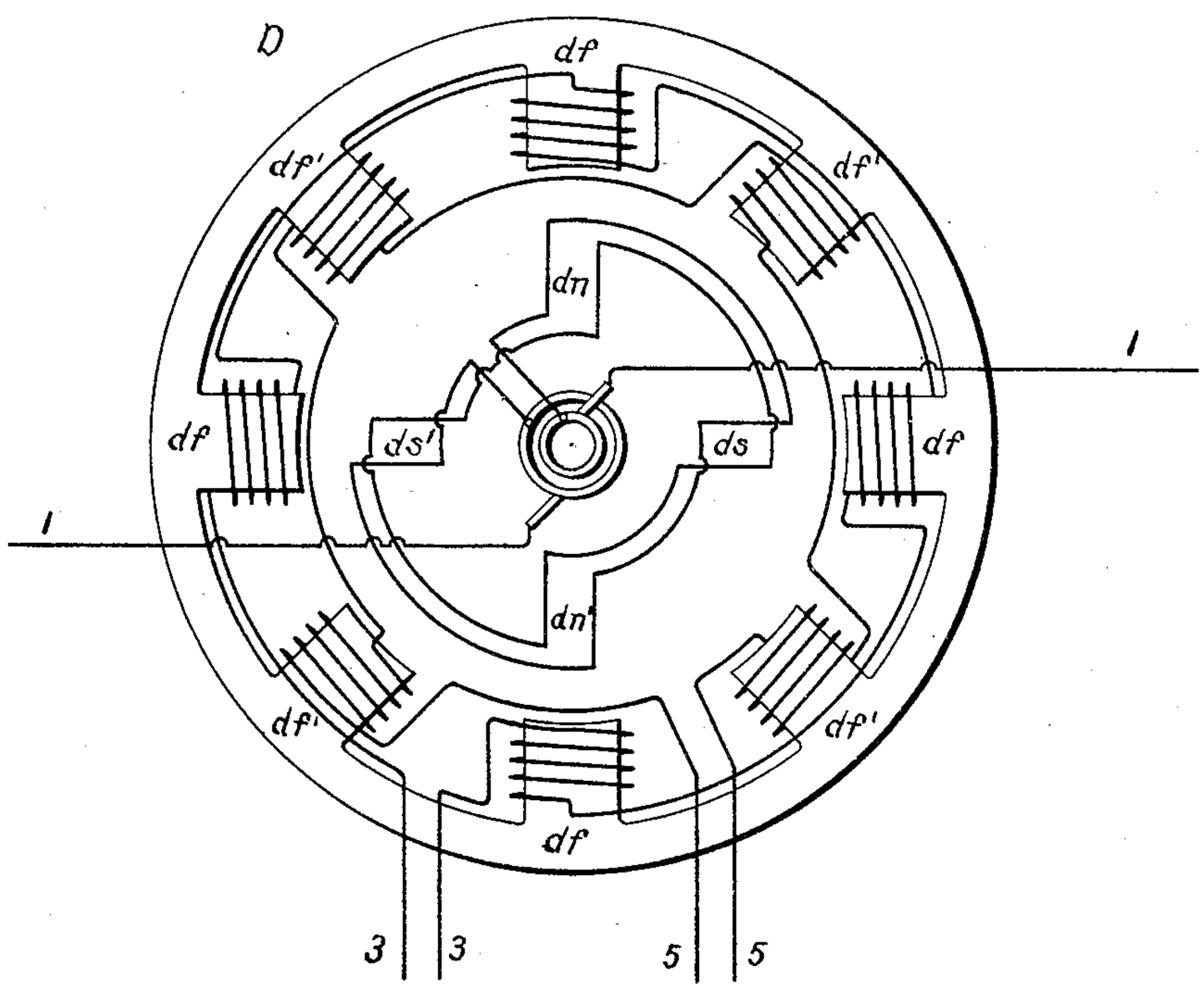
Fig. 3.



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UNITED STATES PATENT OFFICE.

LOUIS SAXON, OF NEW YORK, N. Y., ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

MEANS FOR TRANSMITTING SYNCHRONOUS MOTION TO DISTANT POINTS.

SPECIFICATION forming part of Letters Patent No. 701,947, dated June 10, 1902.

Application filed October 18, 1901. Serial No. 79,145. (No model.)

To all whom it may concern:

Be it known that I, LOUIS SAXON, a citizen of the United States, residing at New York, in the county of New York, State of New York, have invented certain new and useful Improvements in Means for Transmitting Synchronous Motion to Distant Points, (Case No. 1,993,) of which the following is a specification.

This invention relates to means for transmitting motion to one or more distant points; and its object is to provide a new and improved system whereby apparatus at one or more points removed from the point of control may be caused to move through a definite predetermined distance or step each time that a controlling device at the point of control is moved from one position to another.

My invention is generally applicable to all cases in which the above-mentioned result is desired; but it is peculiarly adapted for systems of control for electric motors in which it is desired that a movement of a master-controller over one step shall cause a corresponding movement of the motor-controller at a distant point.

Since my invention comprises features which render it especially advantageous when applied to systems of electric train control, I have elected to illustrate it in that connection, and especially in that system of train control in which the motor-controllers are of the type commonly used in street-railway systems, having a set of contact-segments mounted on a rotatable cylinder and arranged to be brought into engagement with a set of fixed finger-contacts to which the motor-circuits are connected. Such systems have been devised in which each controller is actuated by its own electric motor; but such systems require suitable devices for stopping the motor or motors at the desired points in the rotation of the controller-cylinder. By my invention I secure the positive movement of one or more motor-controllers upon each movement of a master-controller and the stopping of all of said controllers at the desired point. I attain this end by so constructing and connecting the devices constituting the controller-actuating devices that the torque which is created in each actuating-motor when the master-controller is advanced by one step disappears as soon as it has moved the controller-cylinder through the required angle.

The motors which actuate the controller-cylinders have two members relatively rotatable and provided with suitable windings. The winding of one is connected permanently with a source of direct current, so that said member will be permanently polarized along one or more lines. The winding of the other member is divided into two distinct circuits, each arranged to develop the same number of poles as those on the other member, the sets of poles in this second member being alternated. Circuit connections are led from the motor to a master-controller, whereby these sets of poles can be alternately established and the polarity of each set reversed at each energization. The result is that at each movement of the master-controller there are set up in the motor axes of polarity which do not coincide and which attract each other until they do coincide, in which position they remain at rest. By so arranging the windings in each member that the resulting poles will be spaced at equal distance apart the step-by-step movement thus produced will be by equal increments.

In a train-control system each car is provided with a main or motor controller having its shaft equipped with one of my actuating-motors. At one or both ends of the car is a master-controller governing the circuits of the actuating-motor. If two or more cars are coupled up into a train, the several controller-actuating motors are connected in series by flexible couplings between the cars.

In the accompanying drawings, Figure 1 is a side elevation of a train of three motor-cars equipped with my system of control. Fig. 2 is a diagram of the master-controllers at front and rear ends of a car or a train and the circuits with which they are connected. Fig. 3 is a diagrammatic representation of the motor for actuating the controllers.

On each motor-car A is a set of propelling-motors B and a controller C for governing the circuits of said motors. Each controller C is actuated by a small motor D, whose armature d may be mounted on an extension of the controller-shaft d'. For convenience I have

shown a motor D in which the armature has two permanently-polarized pairs of poles *dn dn'*, *ds ds'*, arranged at right angles, and eight field-poles arranged in two sets *df*, *df'*, spaced at equal angular distances, those in each set being connected in series in a circuit distinct from those in the other set and alternating therewith; but any desired number of the poles may be used, it being necessary merely to have the same number of poles in each set as in the armature. Moreover, if desired, the moving element may have the larger number of variable poles and the stationary element the smaller number of permanent ones, as will be readily understood.

The step-by-step movement of the motor D and controller C results from an alternate energizing of the two sets of field-poles and a reversal of polarity of each pole in the set at each energization. Thus for any given field-pole the cycle is north, dead, south, dead, depending upon the polarity and proximity of the armature-pole which is to be attracted or allowed to depart. Thus with the parts in the position shown in Fig. 3 if it is desired to turn the armature one step (an eighth revolution) to the right the poles *df'* will be energized. Designating then by the points of the compass the N E and S W poles will be of south polarity and the N W and S E poles of north polarity. The two north poles of the armature *dn* and *dn'* will be attracted toward the N E and S W poles, respectively, and the south poles *ds ds'* to the S E and N W poles, respectively. For the next step movement the field-poles *df* will be energized, those next in advance of the north poles of the armature being given a south polarity and the others a north polarity. For the third step the poles *df'* are energized again, but with a reversal of polarity—that is, the N E and S W poles will be of north polarity and the N W and S E of south polarity, and so on. In order to accomplish this cycle with the motor D illustrated, the master-controller E may be used in connection with the circuits shown in Fig. 2. There are five train wires or conductors 1 2 3 4 5 running through the car and provided at each end with a flexible coupling 1^x 2^x, &c., for connecting each with the corresponding conductor on an adjoining car or else with an auxiliary conductor 1^y 2^y, &c., leading to fingers 1^z 2^z, &c., in the master-controller. Conductor 1 has intercalated in it the armature *d* of the motor D. Conductor 2 is the return-circuit for said armature. Conductor 3 has intercalated in it one set of field-windings *df*, and conductor 5 has similarly intercalated the windings *df'*. Conductor 4 is the common return-circuit for the field-windings. Each conductor is connected by a branch wire with a corresponding finger 1′ 2′ 3′ 4′ 5′ in the controller. A finger 6′ is connected by a branch conductor 9 with the trolley T through a plug-switch S and a resistance R. Two fingers 7′ and 8′ are grounded.

The controller-cylinder carries five contact-segments 1^a 2^a 6^a 7^a 8^a, which extend across the four positions of the controller and are adapted to make contact with their respective fingers. Segments 1^a and 6^a are looped together. In line with finger 3′ is a segment 3^a in the first position and looped to segment 2^a. In the third position is a segment 3^b, looped to segment 7^a. In line with finger 4′ is a segment 4^a, covering the first and second positions and looped to segment 8^a, and in the third and fourth positions segment 4^b, looped to segment 2^a. In line with finger 5′ is segment 5^a in the second position and looped to segment 2^a, and in the fourth position segment 5^b, looped to segment 7^a. The controller E also carries a segment Z′, making contact with the fingers 1^z and 2^z when the controller is in the "off" position and segment Z^2, covering the fingers 3^z 4^z 5^z in the same position of the controller. In this off position the armatures *d* are connected in a closed circuit, and so also are the field-windings. When either controller E is moved to the first position, it first breaks the closed circuits of the armatures and field-coils at that end of the car or train, as the case may be, and connects them up as follows: trolley to finger 6′, segments 6^a 1^a to finger 1′, train-wire 1, armatures *d* in series, segment Z′ on the last controller of the car or train, back through the return train-wire 2 to finger 2′, segments 2^a 3^a, train-wire 3, field-windings *df* in series, segment Z^2 on rear controller, return train-wire 4, finger 4′, segments 4^a 8^a, and finger 8′ to ground. In the second position the field-windings *df'* are energized instead of the windings *df*. In the third position the circuit is the same as in the first, except that the direction of the current through the field-windings *df* is reversed. The fourth position reverses the current through the windings *df'*. In all four positions the current through the armatures remains in the same direction.

In practice the train-wires are grouped into a cable, and the flexible couplings at each end are short lengths of cable with plug-connectors at the end adapted to enter suitable sockets on the car containing the terminals of the train-wires. Another similar socket contains the terminals of the auxiliary conductors 1^y, &c. These devices are so well known that I have not illustrated them in detail, as they form no part of my invention. The plug-switch S, which controls the branch trolley connection 9, is included in the plug and socket connector, so that when the connection with the auxiliary conductors 1^y, &c., is broken by pulling out the connector from the socket the branch trolley connection at that master-controller is broken also. In this condition of things, even if one of the intermediate controllers is accidentally turned on no harm will result, because no current can flow into the control-circuits. The train can thus be handled only by the master-controllers at

each end of the train and not by intermediate ones; but inasmuch as the train is almost always worked from the front or rear end it is not believed that lack of control at intermediate points will be objectionable.

It will be understood that all necessary switches for turning on and off or reversing the flow of the current and resistances for cutting down the control-current to the proper point and regulating its flow, as well as other necessary adjuncts to a complete system of train control, will be used in practice by those skilled in the art, so that I have not thought it best to confuse the drawings and description by any detailed setting forth of such appliances.

What I claim as new, and desire to secure by Letters Patent of the United States, is —

1. In a system for transmitting synchronous motion, the combination with a motor, having two relatively rotatable members, one provided with a given number of permanent poles and the other with twice as many pole-pieces, of means located at a distance from the motor and under the control of the operator, whereby said pole-pieces can be energized alternately and with alternate polarity.

2. In a system for transmitting synchronous motion, the combination with a motor having two relatively rotatable members, one provided with a given number of permanent poles and the other with twice as many pole-pieces and coils, of two separate circuits each including every alternate coil, and means located at a distance and under the control of the operator whereby each circuit can be supplied with current alternately, and in alternate directions.

3. In a system for transmitting synchronous motion, the combination with a motor having two relatively rotatable members, one provided with a given number of permanent poles and the other with twice as many pole-pieces and coils, of two separate circuits each including every alternate coil, and a master-controller connected with said circuits whereby an operator can energize a different circuit at each movement of the controller.

4. In a system for transmitting synchronous motion, the combination with a motor having two relatively rotatable members, one provided with a given number of permanent poles, and the other with twice as many pole-pieces and coils, of two separate circuits each including every alternate coil, and a master-controller provided with segments arranged to connect said circuits alternately with a source of power and to reverse the direction of the current in each circuit each time it is cut in.

5. In a system of train control, the combination with one or more motor-cars, of a main controller for the car-motors, a motor for actuating the controller having two relatively rotatable members, one provided with a given number of permanent poles and the other with twice as many pole-pieces and coils, and a master-controller connected with the motor whereby one member will be kept permanently polarized when the current is turned on, and the coils on the other member will receive current alternately and in alternate directions, as the master-controller is rotated.

6. In a system of train control, the combination with a train of two or more motor-cars, of a main controller on each car for controlling the car-motors, an actuating-motor for each main controller, having two separate sets of coils in one of its members, one or more master-controllers on each car, and circuit connections whereby the coils in one member of said motors are connected in series with each other and with one or the other of said sets of coils in the other member, and whereby current can be sent through said sets of coils alternately and in alternate directions as the master-controller is rotated.

7. In a system of train control, the combination with the main controller, of an actuating device therefor comprising a multipolar direct-current motor having a permanently-polarized armature and a field-magnet containing twice as many poles as the armature, and a master-controller for alternately energizing alternate poles in order to produce a step-by-step movement of the armature, in synchronism with the motion of the motor-controller.

In witness whereof I have hereunto set my hand this 15th day of October, 1901.

LOUIS SAXON. [L. S.]

Witnesses:
W. W. MANSFIELD,
CHESTER D. REID.