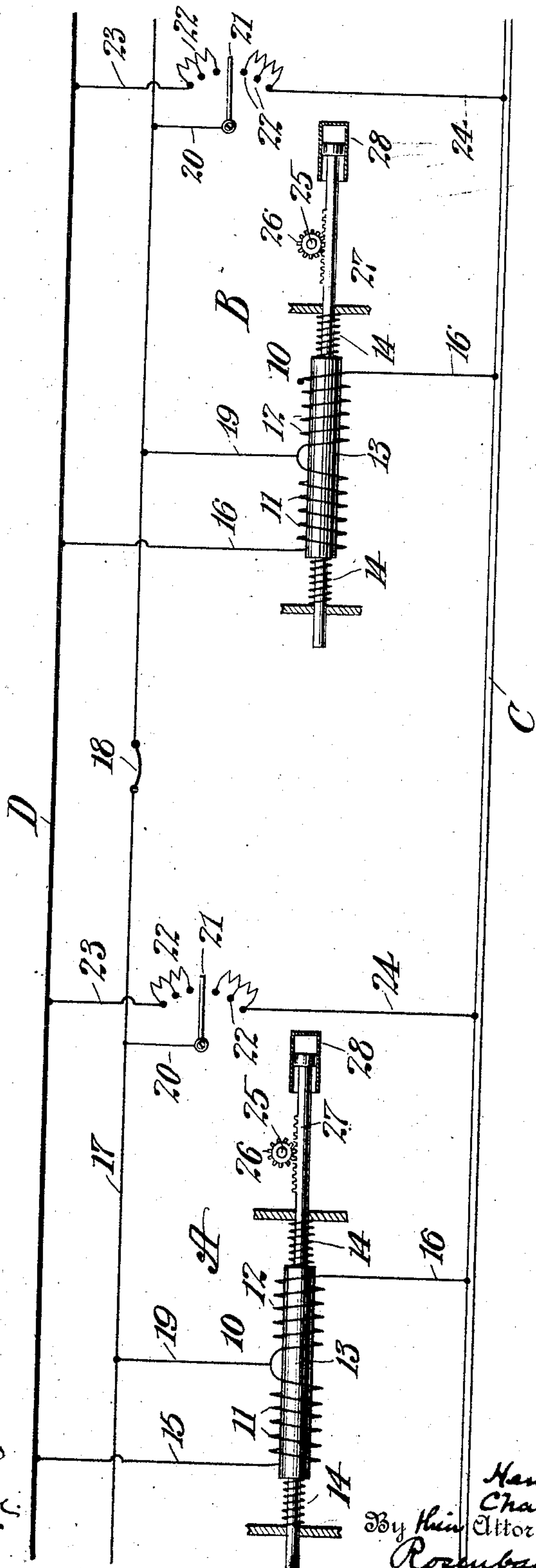


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H. M. HARDING & C. M. CLARK.
MULTIPLE UNIT CONTROL SYSTEM.

APPLICATION FILED JAN. 6, 1906.



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UNITED STATES PATENT OFFICE.

HENRY M. HARDING, OF NEW YORK, N. Y., AND CHARLES MARTIN CLARK,
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MULTIPLE-UNIT CONTROL SYSTEM.

No. 821,287.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that we, HENRY M. HARDING, residing at the city of New York, borough of Manhattan, and State of New York, and CHARLES MARTIN CLARK, residing at Summit, county of Union, and State of New Jersey, citizens of the United States, have invented certain new and useful Improvements in Multiple-Unit Control Systems, of which the following is a full, clear, and exact description.

Our invention relates to a control system particularly adapted to electric trains operated by separate or individual motor units upon the several cars. This is the common method of running electric trains, especially in municipal traction, and the control is commonly effected by an operating or pilot circuit having two or more wires joined to extend throughout the length of the train and included in the circuits of pilot-motors or other magnetic devices upon the several cars, by which their controllers are set to zero position, full speed forward, full speed reverse, or any intermediate relation. So far as we are aware at least two pilot-wires have always been joined throughout the train for securing the above control. By the present invention we secure a complete multiple-unit control system in which the motors of all the cars are controlled to zero, full speed forward, full speed reverse, or any intermediate relation by a single pilot-wire joined to extend throughout the train.

Our invention consists in the construction, combination, location, and arrangement of circuits and parts by which the foregoing purposes are carried out, as hereinafter set forth and shown, and finally particularly pointed out in the appended claims.

The drawing illustrates a diagrammatic arrangement of circuits for securing a multiple-unit system embodying the principles of our invention.

A common method of securing a multiple-unit control of trains is by having two or more wires leading to the armature-circuits of pilot-motors throughout the train, which may be caused to rotate in either direction by reversing the current through the pilot-wires. It is evident that it is impossible to operate any arrangement based upon this principle with less than two pilot-wires, because the potential of the respective pilot-

wires is necessarily alternated or interchanged in this case, the positive becoming negative and the negative positive, so that a constantly neutral ground-return cannot be made use of, it being understood that the pilot-current has to be obtained from the power-circuit. By the present invention we secure all the necessary results in a different way by a single pilot-wire and track-return and without necessitating a reversal of current or potential in said wire or track-return.

Referring to the drawing, in which like parts are designated by the same reference-sign, A and B are similar diagrams indicating the wiring upon two cars of the train.

C designates the usual track-rails, and D indicates a third rail or trolley, which we will consider to be charged with a potential of five hundred volts.

Upon each car we arrange magnetic means which may be of widely-different forms in practice, but in any case should be differentially wound, so that a continuous current passed therethrough will traverse the successive windings, producing a neutral magnetic effect. We have shown solenoids 10 upon the several cars having differential or opposed windings 11 12. 13 designates cores for the solenoids, which are spring-held in the central position shown by any suitable springs 14. It is obvious that this construction is merely an exemplary and largely diagrammatic one, the essential feature being merely some form of magnetic device having a movable part elastically held in mid-position, said magnetic device having opposed or differential windings in continuous series circuit with one another, so as to act on the movable part.

The magnetic devices above mentioned, and particularly the solenoids 10, as shown, are energized from the power or controller circuit. In the drawing the connections are shown at 15 and 16, by which the five-hundred-volt current from the trolley D is successively passed through the coils 11 and 12 until finally it enters the ground or track return C through the wires 16. In this way the coils 11 and 12 are normally energized; but as their magnetic effects oppose one another the core or armature 13 is not acted upon, but remains in its mid-position under the influence of the springs 14.

The pilot-wire is indicated at 17 in the

drawing and extends through the successive cars, being joined at the couplings by the flexible connections 18. The pilot-wire 17 has branch connections 19 with the magnetic devices on each train, being connected between the opposed or differential windings, as clearly shown in the drawing. It will be seen that the branches 19 are symmetrically connected between the opposed or differential windings 11 and 12 at a point corresponding to about half the entire potential drop through the complete magnetic device. The pilot-wire 17 is additionally connected to controllers upon the several cars by branch connections 20 with controller-arms 21.

22 indicates resistance-contacts in the path of the arms 21 and arranged in separate series respectively joined to the trolley D and the track-return C.

23 and 24 indicate these respective connections.

The above constitutes all the essential features of our control system—namely, the magnetic devices having the differential or opposed windings and the single pilot-wire circuit joined to said magnetic devices at a point intermediate the differential windings. In order to show the invention practically applied, however, we have indicated at 25 the controller-shafts on the several cars, having pinions 26 thereon meshing with rack-sections 27 upon the cores or armatures 13.

28 indicates dash-pot devices for rendering the movement of the parts more uniform and steady.

The operation is as follows: Supposing the pilot-controllers 21 of all the trains to be in the position shown, the motor-controller shafts 25 will be correspondingly located at their mid-position corresponding to zero or off position of the motors. This occurs by reason of the five-hundred-volt potential drop from the trolley D being equally distributed between the windings 11 and 12 of each solenoid 10, so that the springs 14 balance one another and serve, together with the magnetic action of the solenoid as a whole, to hold the core 13 in mid-position, correspondingly positioning the pinions 26 and the motor-controllers 25. It is obvious that in this action the potential falls regularly through the successive windings, so that at an intermediate point of each solenoid to which is connected the branches 19 of the pilot-circuit the potential will be half-way between five hundred and zero or neutral—namely, two hundred and fifty volts. In other words, the pilot-wire 17 will under these circumstances be at a potential of about two hundred and fifty volts. If now the pilot-controller arm 21 on any car is swung upward, a connection is made through the resistance-contacts 22 with the branches 23 from the trolley D, so that the potential of the pilot-wire 17 is correspondingly raised a greater or less extent, de-

pending upon the particular notch to which that pilot-controller is moved. If the pilot-controller is moved to the last notch, it is clear that all resistance is cut out of the resistance-contacts 22 and the pilot-wire is directly connected to the trolley, so as to receive a potential of five hundred volts. The result of raising the potential of the pilot-wire 17 is to neutralize the windings 11 of all the magnetic devices 10 and increase the effect of the windings 12, which now being partly or wholly unopposed become effective to draw the movable element 13 in a direction to apply power at the motor-controllers 25. The amount of this movement, and thereby the amount of power applied by the motor-controllers, varies with the relative intensity of the effect of windings 11 and 12 and in turn with the degree of movement of the pilot-controller arms 21. If the pilot-controller arms 21 are swung in the opposite direction or downward in the figure, the pilot-wire 17 will be directly or indirectly connected with the track-return C and acquire a potential value less than two hundred and fifty volts and approaching zero as a limit. The effect of this condition is to neutralize the action of the windings 12 and strengthen the action of the windings 11, so that the movable elements 13 of the magnetic devices are moved in the opposite direction to that above described and serve to reverse the power through the usual motor-controllers 25. Thus it will be seen that we secure a complete multiple-unit system which attains all the practical required conditions and by the use of a single pilot-wire or circuit extending throughout the train and operable from any car thereof.

What we claim is—

1. In a multiple-unit control system, a single pilot-wire extending throughout the train, and means for controlling the motor-circuits of the several cars to forward, stop, or reverse conditions therefrom.
2. In a multiple-unit control system, a single pilot-wire extending throughout the train, and branch connections in the several cars for securing forward, stop, or reverse conditions of the car-motors by varying the potential of said pilot-wire.
3. In a multiple-unit control system, a single pilot-wire extending throughout the train, branch connections therefrom within the several cars, and magnetic devices within the several cars and operable from said pilot-wire for setting the motors to forward, zero, or reverse movement.
4. In a multiple-unit control system, a single pilot-wire extending throughout the train, magnetic devices within the several cars for controlling the motor-circuits thereof, and branch connections from said pilot-wire to said motor-circuits for arranging them in forward, zero or reverse relation of the motors.

5. In a multiple-unit control system, a single pilot-wire extending throughout the train, magnetic devices within the several cars for controlling the motor-circuits thereof, and branch connections from said pilot-wire for arranging said motor-circuits in any desired relation by varying the potential of said pilot-wire.

6. In a multiple-unit control system, magnetic devices within the several cars having differential or opposed windings, a single pilot-wire extending throughout the train, and connections from said pilot-wire to said magnetic devices at points between the opposed windings.

7. In a multiple-unit control system, magnetic devices upon the several cars having opposed or differential windings, means for normally impressing a continuous current in series through said opposed windings, a pilot-wire extending throughout the train, and branch connections from said pilot-wire to said magnetic devices at points between the opposed windings.

8. In a multiple-unit control system, magnetic devices on the several cars having opposed or differential windings, means for impressing a continuous current in series through said windings, a pilot-wire extending throughout the train and connected to said windings, and means for varying the potential of said pilot-wire whereby the relative effect of the

opposed windings of each magnetic device is changed.

9. In a multiple-unit control system, a pilot-wire extending throughout the train, pilot-controller arms connected thereto, resistance-contacts in the path of said arms and respectively connected to the trolley and to the track-return, and magnetic devices upon the several cars for setting the motors to forward, zero or reverse rotation by the varying potential of said wire.

10. In a multiple-unit control system, magnetic devices upon the several cars having opposed windings through which the potential drops from its maximum value to zero, a pilot-wire extending throughout the train, and branch connections for varying the distribution of the potential drop through said windings of the magnetic devices.

11. In a multiple-unit system, a magnetic device constantly energized by the power-circuit, a pilot-wire connected to the windings of said magnetic device, and means for varying the potential of said pilot-wire.

In witness whereof we subscribe our signatures in the presence of two witnesses.

HENRY M. HARDING.

CHARLES MARTIN CLARK.

Witnesses:

ALFRED W. PROCTOR,
WALDO M. CHAPIN.