No. 648,995. Patented May 8, 1900.

# W. B. POTTER.

## ELECTRIC TRAIN SYSTEM.

(Application filed Mar. 31, 1898.)

(No Model.)

FIG. 1.

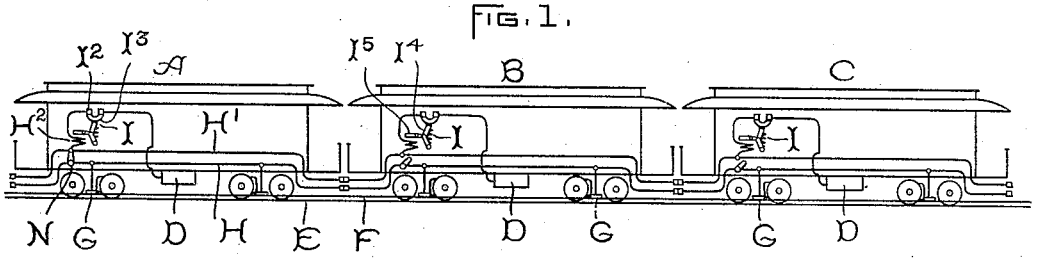



FIG. 2.

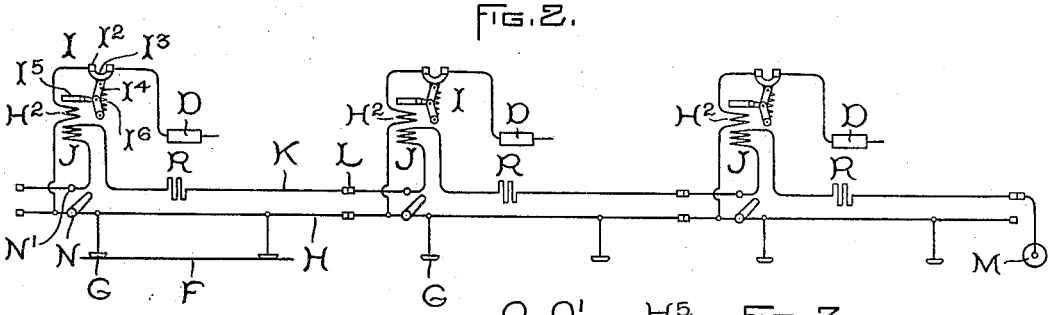
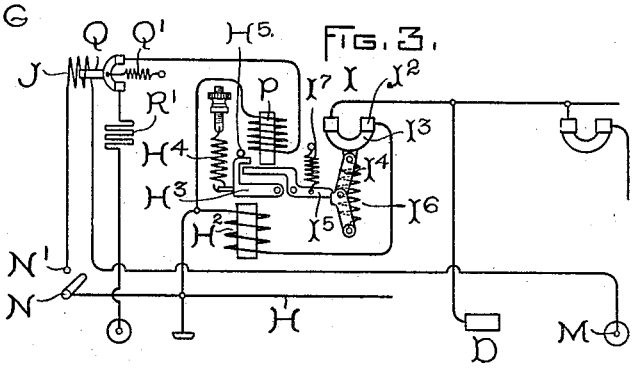



FIG. 3.

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# UNITED STATES PATENT OFFICE.

WILLIAM B. POTTER, OF SCHENECTADY, NEW YORK, ASSIGNOR TO THE GENERAL ELECTRIC COMPANY, OF NEW YORK.

## ELECTRIC-TRAIN SYSTEM.

SPECIFICATION forming part of Letters Patent No. 648,995, dated May 8, 1900.

Application filed March 31, 1898. Serial No. 675,846. (No model.)

*To all whom it may concern:*

Be it known that I, WILLIAM B. POTTER, a citizen of the United States, residing at Schenectady, in the county of Schenectady, State of New York, have invented certain new and useful Improvements in Electric-Train Systems, (Case No. 694,) of which the following is a specification.

My present invention relates to electric trains containing a plurality of motor-cars, of which two or more are provided with one or more circuit-breakers each preferably of the automatic type and set to operate on a definite overload. It is advantageous in electric-train systems to control all of the motors of the train from a single point, and various arrangements have been devised by which this can be accomplished without the necessity of carrying all of the current flowing through the fields and armatures of the motors back and forth from the controlling-point. For example, it is possible to have a number of motor-controllers on the separate cars and one or more master-controllers, each master-controller being arranged to regulate simultaneously the action of all of the motor-controllers and each motor-controller being supplied with current from a separate contact-shoe carried by its own particular car. In such a system the circuit of the various motors is opened merely by the operation of the controllers under the control of the master-controller.

My invention also aims to provide in addition to this arrangement a device whereby when for any reason it becomes necessary the circuit may be instantaneously interrupted in all of the cars of the train by means controlled from a single point.

In the accompanying drawings, which show several embodiments of my invention, Figure 1 represents a three-car train equipped with means for carrying out my invention, while Figs. 2 and 3 represent, respectively, various modifications.

In order to illustrate my invention more clearly, I have omitted everything which is not essential to the operation of my invention; but it is to be understood that each motor-car on the train is equipped with its own apparatus in the usual manner and may and preferably will be equipped with a master-controller also, as above described.

The train shown consists exclusively of motor-cars, (lettered, respectively, A B C) each provided with its own motor, controller D. Extending parallel to the traffic-rails E is a third rail or other conductor F, which supplies current to the various cars through the contact-shoes G. Extending through the train is a train-wire H, to which all the contact-shoes are connected in multiple. An auxiliary train-wire H′ also extends through the train and is connected, preferably through the usual automatic circuit-breakers I, to the motor-controllers D, and thence to the motors and to ground. It will thus be seen that all of the electrical apparatus on the various cars is connected in multiple from this auxiliary train-wire. A number of switches or circuit-controllers N are provided at different parts of the train, so arranged that any one of them connects the train-wire H to the auxiliary train-wire H′. For example, suppose that it is desired to control the train from its left-hand end. The left-hand switch N, Fig. 1, will then be closed and current will be supplied to the train-wire H through all the contact-shoes G G upon the train, thence through the switch N to the auxiliary train-wire H′, and thence to the translating devices. It results from this arrangement that the man in charge of the train is able to instantaneously cut off current from all the translating devices of the car by the movement of a single switch N, while at the same time the accidental jumping of one contact-shoe, the presence of a short unconnected section of the third rail, a piece of paper upon the track, or other momentary interruption of contact, affecting only one or two contact-shoes, will not interrupt the supply of current to the train or to any part thereof. The circuit-breakers I are similar in construction to that shown in Fig. 2, and consist of a pair of contacts $I^2$ and a moving contact $I^3$, carried upon the upper end of the toggle $I^4$, normally retained in position by a lock $I^5$, controlled by the solenoid $H^2$. (Shown in Fig. 1.) This solenoid is in series with the contacts $I^2$ $I^3$ and with the translating device. When any overload occurs on a particular car, the coil $H^2$ will

pull the armature $I^5$ and release the toggle $I^4$, whereupon the contact $I^3$ will be drawn by the action of the spring $I^6$, and the translating devices of that particular car will be cut out. It thus appears that when a short circuit appears upon any particular car I am able to protect the apparatus of that car by the special circuit-breaker I, and at the same time I am able to cut off current from the whole train instantaneously by the action of the switch N.

I have shown in Fig. 2 a modification of my invention in which the auxiliary train-wire H' is omitted and the motor-controllers D are connected directly to the train-wire H through the circuit-breaker I, as before. I provide, however, a control-wire K, extending through the train, grounded at one end and containing a number of tripping-coils J J J. Switches N are provided by which the auxiliary wire K may be connected with the train-wire H when desired. The coils J are wound upon the same core with the overload-coils $H^2$ of the circuit-breakers I and are so arranged that when any considerable amount of current passes through the coils J the circuit-breakers will be opened irrespective of the amount of current passing in the coils $H^2$. The operation of this form will be obvious from what has been already stated. When the apparatus has been running in its normal position, the switch N is kept open and no current passes in the wire K or in the coils J. If the motors of any particular car become short-circuited or grounded in any way, so as to cause an excessive flow of current in any particular car, the coil $H^2$ of the corresponding circuit-breaker I attracts the armature $I^5$ and cuts off current from that particular car. If, on the other hand, it becomes necessary to open-circuit all of the cars of the train simultaneously—as, for example, where the master-controller refuses to work on a downgrade—it is simply necessary to close the switch N upon the contact N', when current will pass from the third rail F, through the shoes G to the wires A, thence by switch N to the point N', and through the various tripping-coils J to ground at M, thus actuating all of the circuit-breakers immediately and cutting off current from all of the apparatus. I prefer to introduce resistances R R R in series with the control-wire K to reduce the amount of current flowing therein.

In Fig. 3 I have shown one of the circuit-breakers I of Fig. 2, but arranged to work automatically upon an underload as well as upon an overload. It will be seen that the lock $I^5$ of the toggle $I^6$ is under normal conditions retained in place against the action of the spring $I^7$ by the shunt underload-magnet P, whose circuit is closed from trolley to ground through the switch Q, held in place by the spring Q', and through a suitable resistance R', if required. The overload-magnet $H^2$ is placed in series with the contacts $I^3$ $I^3$ and with the motor-controller D, as before, but acts upon the pivoted armature $H^3$, which is normally held against the stop $H^5$ by the adjustable tension-spring $H^4$. For convenience only one circuit-breaker is shown, but it is to be understood that each car of a train may be provided with such circuit-breakers and connected in the manner shown in Figs. 1 or 2.

Assuming that an overload occurs on the car, the magnet $H^2$ will become highly energized and attract its armature $H^3$, which will engage with the lock $I^5$ and release the toggle, and the circuit will be opened by the action of the spring $I^6$. If for any reason the potential of the supply system falls below a certain amount, the magnet P will become weakened and release the locking device, and the main circuit will be interrupted at the circuit-breaker I by means of the spring $I^6$. If it is desired to open all the breakers on the train simultaneously, the switch N is moved into engagement with the terminal N', and current will flow from the train-wire H, through all the tripping-coils J on the train, and to ground at M. This will cause the coils J to open the switches Q against the action of the spring Q', which will interrupt the circuit of the shunt-magnets P. This in turn will allow the springs $I^7$ to trip the circuit-breakers.

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

1. The combination with a plurality of motor-cars united to form a train, or a portion of a train, of a train-wire, means for supplying current thereto, circuits from said train-wire to a plurality of translating devices, and means controlled from a single point for instantaneously interrupting the supply of current to all of said circuits.

2. The combination with a plurality of motor-cars united to form a train, or portion of a train, of contact devices, and a train-wire to which said contact devices are connected in multiple, circuits from said train-wire to a plurality of translating devices, and means controlled from a single point for instantaneously interrupting the supply of current to all of the said circuits.

3. The combination with a plurality of motor-cars united to form a train, or portion of a train, of contact devices, and a train-wire to which said contact devices are connected in multiple, circuits from said train-wire to a plurality of translating devices, automatic circuit-breakers in such circuits, and means controlled from a single point for instantaneously interrupting the supply of current to all of the said circuits.

4. The combination of a plurality of motor-cars united in a manner to form a train or portion of a train, a circuit-breaker on each car for protecting the electrical apparatus thereon, an electrically-controlled device for actuating the breaker, and means located at a selected point for controlling the action of all the circuit-breakers.

5. The combination of a plurality of motor-cars united in a manner to form a train or portion of a train, a circuit-breaker on each

car for protecting the electrical apparatus thereon, a tripping-coil on each breaker, and a switch located on one of the cars, for energizing all of the tripping-coils.

6. The combination of a plurality of motor-cars united to form a train or portion of a train, a circuit-breaker on each car for protecting the electrical apparatus thereon, a control-wire extending through the train, tripping-coils mounted on the breakers and connected to said wire, and a switch located at any convenient point for closing the circuit of the tripping-coils.

7. The combination of a plurality of motor-cars united to form a train or portion of a train, a circuit-breaker on each car for protecting the electrical apparatus thereon, a train-wire which is connected to the source of supply, a wire extending from the train-wire to each of the motor-controllers, a tripping-coil mounted on each breaker, a control-wire to which all of the tripping-coils are connected, and a switch for closing the circuit of the control-wire.

8. The combination of a plurality of motor-cars united to form a train or portion of a train, a circuit-breaker on each car for protecting the electrical apparatus thereon, a train-wire which is connected to the source of supply, a wire extending from the train-wire to each of the motor-controllers, an overload-coil on each breaker in circuit with said wire, a tripping-coil mounted on each breaker, a control-wire to which all the tripping-coils are connected, and a switch for closing the circuit of the control-wire.

9. The combination of a plurality of motor-cars united to form a train or portion of a train, a circuit-breaker on each car for protecting the electrical apparatus thereon, a train-wire which is connected to the source of supply, a wire extending from the train-wire to each of the motor-controllers, and an overload-coil on each breaker which is in circuit with said wire.

10. The combination of a plurality of motor-cars united to form a train or portion of a train, a train-wire extending through all the motor-cars, with which the contact devices of all the motor-cars are connected in multiple, a wire on each motor-car leading from the train-wire to the controller and motors, and an automatic circuit-breaker in each of said wires between the train-wire and the controller.

11. The combination of a plurality of motor-cars united to form a train or portion of a train, a train-wire extending through all the motor-cars to which the contact devices of all the cars are connected, a wire on each motor-car leading from the train-wire to the controller and motors, and an automatic circuit-interrupter in each of said wires.

12. The combination of a plurality of motor-cars united to form a train or portion of a train, a circuit-breaker on each car for protecting the electrical apparatus thereon, a coil arranged to trip the breaker at overload, a second coil arranged to trip the breaker when the line-voltage falls below a predetermined amount, and means situated on one of the cars, for controlling the operation of all the breakers on the train.

13. The combination of a plurality of motor-cars united to form a train or portion of a train, a circuit-breaker on each car for protecting the electrical apparatus thereon, a coil arranged to trip the breaker at overload, a second coil arranged to trip the breaker when the line-voltage falls below a predetermined amount, and a switch located at or near the circuit-breaker for interrupting the circuit of the underload-coil when it is desired to trip the breaker.

14. The combination in a circuit-breaker, of a coil arranged to trip the breaker on overload, a coil arranged to trip the breaker when the potential of the line decreases to a certain point, an armature in operative relation to one of said tripping-coils, a locking device for said circuit-breaker, adapted to be actuated by said armature, a second armature in operative relation to the other tripping-coil, and arranged to positively engage said locking device, and a switch for interrupting the circuit of the underload-coil when it is desired to control the operation independent of current changes.

15. The combination in a circuit-breaker of a coil arranged to trip the breaker on overload, a coil arranged to trip the breaker when the potential of the line decreases to a certain point, a switch for interrupting the circuit of the underload-coil, and means located at a distance for electrically controlling said switch.

16. In a system of distribution, the combination of a plurality of supply-circuits, each circuit receiving energy from a separate point, a plurality of automatic magnetically-actuated circuit-breakers arranged to make and break the circuits of the various supply-circuits, a tripping-coil mounted on each breaker and a switch located at a selected point for simultaneously energizing the tripping-coils of all the circuit-breakers.

17. In a system of distribution, the combination of a plurality of supply-circuits, each circuit receiving energy from a separate point, a plurality of translating devices, a plurality of automatic magnetically-actuated circuit-breakers arranged to make and break the circuit of the supply-circuits, a conductor connecting all of the supply-circuits so as to prevent temporary interruption of current-flow to any one of the translating devices, and a switch located at a selected point for causing the opening of all of the circuit-breakers.

18. In a system of distribution, the combination of a plurality of translating devices distributed in any suitable manner, a plurality of contact devices for supplying current thereto, a conductor to which all of said contact devices are connected in multiple, circuits from the conductor to the translat-

ing devices, automatic circuit-breakers included in each of the said circuits, and means controlled from a single point for simultaneously interrupting the supply of current to all of the circuits.

19. In an automatic circuit-breaker, the combination of moving and stationary contacts, a pivoted lock for controlling the operation of the moving contacts, a series coil, a shunt-coil, both of which coils act upon the pivoted lock, and a pivoted armature situated within the influence of the series coil, for actuating the said lock, a certain amount of lost motion being permitted between the armature and the lock.

In witness whereof I have hereunto set my hand this 26th day of March, 1898.

WILLIAM B. POTTER.

Witnesses:
EDWIN W. RICE, Jr.,
T. A. BRANION.