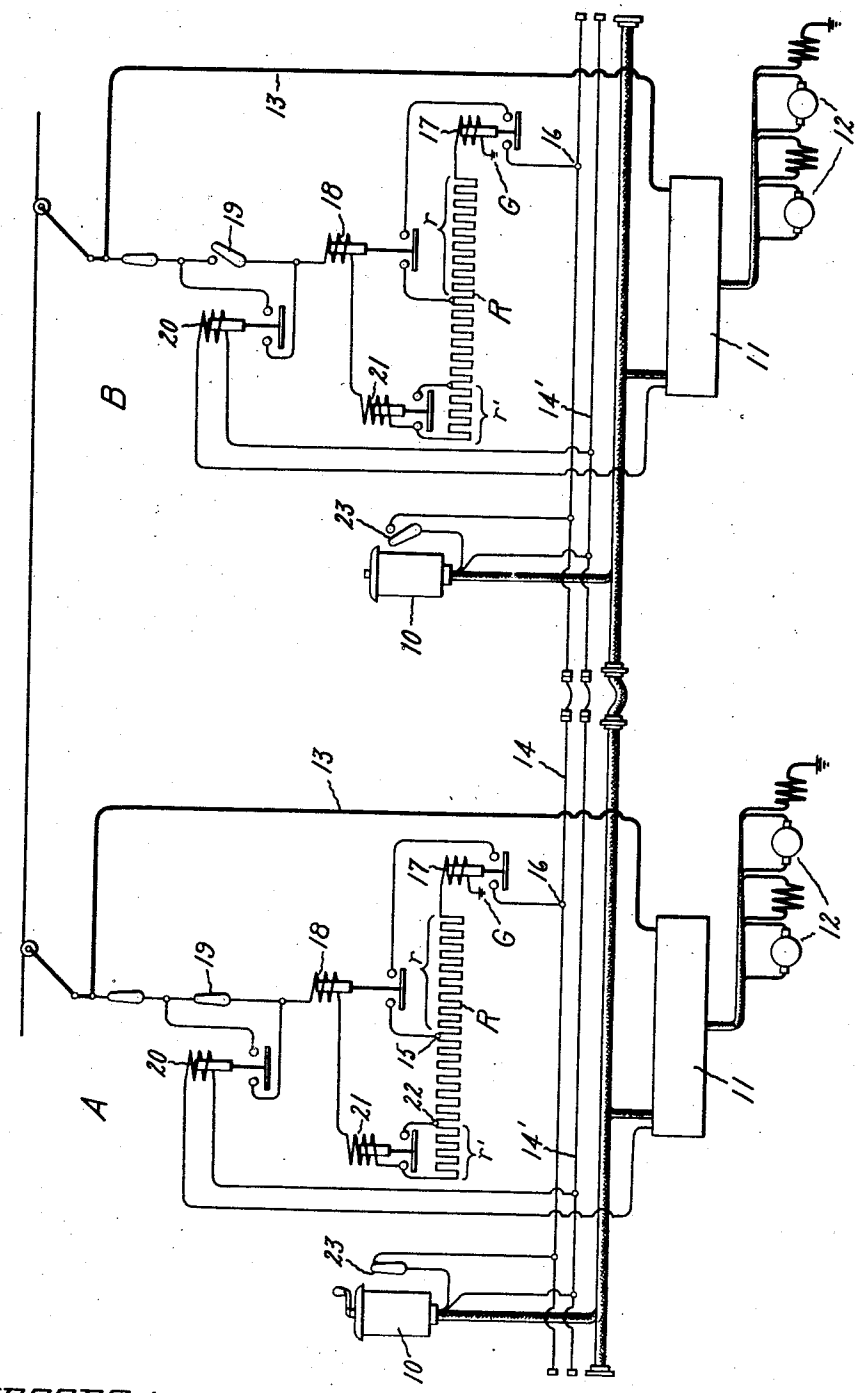
F. E. CASE.

MOTOR CONTROL SYSTEM.

APPLICATION FILED JULY 16, 1912.

1,077,802. Patented Nov. 4, 1913.



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MOTOR-CONTROL SYSTEM.

1,077,802. Specification of Letters Patent. Patented Nov. 4, 1913.

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To all whom it may concern:

Be it known that I, FRANK E. CASE, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Motor-Control Systems, of which the following is a specification.

This invention relates to control systems in which the motor or motors are controlled by separately actuated switches or contactors which in turn are controlled by a master controller on a separate control circuit. In motor control systems of this character it is often desirable to have a source of relatively low potential for the control circuit, that is, the circuit of the energizing windings of the contactors. This is more particularly true in train control systems operating on high voltage. Various methods have been employed for producing the lower voltage for the control system, one of the commonest methods in the case of train control systems being the employment of a motor generator or "dynamotor" driven from the main supply circuit.

One of the objects of my invention is to provide means whereby such a low voltage may be produced without the use of a generator or similar apparatus.

In carrying out my invention I provide a resistance which is connected across the supply circuit, and connect the control circuit at some intermediate point on the resistance. In the case of a train control system, the resistance is connected across the line from trolley to ground on each car and a bus line which runs through the train is connected with an intermediate point on the resistance so as to utilize the drop across a portion of the resistance for the control circuit. Inasmuch as the current drawn by the motor controller may vary as the contactors operate, I provide means for maintaining the potential on the bus line substantially constant while the current in the master control circuit varies. I also provide means for disconnecting the resistance tap from the bus line in case the resistance becomes open circuited either at its ground or positive side. In order to reduce the amount of energy lost I provide means whereby the resistances on all cars but the front car are disconnected when the master controller is thrown off. I also provide means for automatically disconnecting the control circuit of any particular car on which the resistance is not in circuit.

Other objects and purposes of my invention will appear in the course of the following specification in which I have shown my invention embodied in concrete form for purposes of illustration.

In the accompanying drawing I have illustrated my invention in connection with a train control system, although it is not necessarily limited in its application to a system of this character. In the drawing I have shown the invention diagrammatically in connection with two cars of a train, although it is obvious that my invention is in no sense limited with respect to the number of cars nor the particular application illustrated.

Referring to the drawing, A represents the equipment of one car and B the equipment of the other car. The equipment in both cars being the same it will only be necessary to describe one of them in detail. 10 represents the master controller on the forward car and 11 the main controller for controlling the motors 12 in series and parallel in a well known manner, the current from the trolley to the master controller being conducted through the conductor 13. The cars are connected by a bus line 14 which extends throughout the train. In order that the bus line 14 may have a potential which is less than the potential of the trolley I provide a resistance R which is connected from trolley to ground G. The bus line is connected at an intermediate point 15 of the resistance, the connection to the bus line being made at 16. The voltage applied to the bus line will therefore be equal to the drop across the section r' of the resistance which is on the ground side of the point 15 and the point 15 is so located as to produce the drop of potential required for the control circuit. The connection between the resistance and

the bus line is controlled by an electromagnetic switch 17 having its energizing winding in series with the resistance R. If the circuit of the resistance is broken at any point, the connection to the bus line will be broken by the opening of the switch 17. A second switch 18 is located in the circuit between the resistance and the bus line and is adapted to be controlled by a switch 19. The switch 18 is likewise controlled by an electromagnetic switch 20 having its contacts in parallel with the contacts of switch 19. The winding of the switch 18 will therefore be energized by the closing of either switch 19 or switch 20. The switch 20 is controlled by the master controller, the arrangement being such that when the master controller is thrown to off position the switch 20 will open. A switch 19 is provided on each car, but is to be closed only on the car on which the operator is stationed, viz., the first car. The closure of switch 19 on this car is necessary in order to complete the control circuit on this car for closing the switch 20. The switch 19 on the other cars being open, the switches 18 on these cars will be under the control of the master controller so that when the latter is thrown to off position the switches 20 will open and thereby open switches 18 to cut out the resistance on all but the first car.

It is obvious that the current in the control circuit will vary as the various contactors of the main controller operate. Such a variation in current would ordinarily cause a variation of the voltage drop across the resistance which furnishes the drop, thereby causing a variation in the voltage of the control circuit. In order to maintain this voltage of the control circuit substantially constant upon variations of current drawn by the contactors in the control circuit, I have provided the electromagnetic switch 21 having its energizing winding in series with the winding of switch 18. The contacts of this switch are adapted to short circuit a portion r' of the resistance R by having one contact connected to the end of the resistance while the other contact is connected with a point 22 on the resistance. The winding of switch 21 is connected with one of its switch contacts so that it will always be in series with resistance R. If the current in the control circuit rises to a predetermined value so as to decrease the drop across the section r of resistance R, the switch 21 will close and short circuit the section r' of the resistance so that the supply circuit will get a large proportion of the drop of potential across the resistance. A switch 23 is provided for opening the control circuit and at the same time opening switch 20 to cut out the resistance R. Of course the resistance is not cut out on the car on which switch 19 is closed by the opening of switch 23.

As thus constructed and arranged the operation of my device is as follows:—Assuming that the trolley voltage is 1200 volts and the switch 19 is closed on the first car— car A—the resistance R will be connected from the 1200 volt trolley through the windings of the switches 18 and 21 to ground. The winding of switches 18 and 17 being energized, these switches will close, thereby connecting the point 15 on the resistance with the bus line 14 at 16. If the point 15 on the resistance is at or near the central point of the resistance, the voltage impressed upon the bus line will be substantially equal to the drop across the section r, which in this case will be substantially 600 v. When the master controller is moved to starting position the control circuit will be from switch 19, winding of switches 18 and 21, through portion of resistance R to point 15, thence through the contacts of the switches 18 and 17 to the bus line at 16, thence through the switch 23 and the master controller to the train wire 14′, then to the winding of switch 20 and then to the main controller. This will cause the switch 20 to be closed on all the cars. The closing of this switch 20 on the first car has no effect, since the switch 19 in parallel with it is already closed, but the closing of the switch 20 on the car B connects the resistance R in circuit and impresses substantially the same voltage on the bus line as is impressed on the bus line of the car A. This will also be true on any other cars on the train. The bus line 14 is therefore connected on each car with a 600 v. supply circuit. As the contactors of the main controller operate the drop across the section r will be decreased due to the closing of the circuits through the energizing windings of the contactors in parallel with the resistance. Assume, for example, that the energizing of these contactors causes a drop across the section r to decrease from 600 v. to 400 v. This increase in current in the control circuit causes the switch 21 to operate to short circuit section r' of the resistance. The result is that if the voltage drop across the section r decreases to 400 v. then the drop across the remaining resistance will be increased to 800 v. and by short circuiting the section r' the section r becomes a larger proportion of the total resistance in circuit and the drop across the resistance r will be increased. By properly proportioning the resistance r' the drop across the resistance section r may be maintained substantially constant upon variations of current in the control circuit. If the circuit of the resistance should be broken at any time, the switch 17 will be automatically opened and cut off the connec-

tion to the bus line. By opening the switch 23 on any car the resistance is cut off and at the same time the control circuit is opened. When the master controller on car A is moved to off position, the switches 20 on the other cars will be opened so as to cut off the resistance and save energy. It will be seen that by this arrangement a control circuit is provided with potential lower than the trolley circuit in a very simple manner without the use of an auxiliary generating apparatus, and while I have described my invention as embodied in concrete form and as operating in a specific manner in accordance with the provisions of the patent statutes, it should be understood that I do not limit my invention thereto, since various modifications thereof will suggest themselves to those skilled in the art without departing from the spirit of my invention, the scope of which is set forth in the annexed claims.

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

1. In a train control system, a main motor controller on each motor car, a trolley connection to said main controller, a resistance connected from trolley to ground independently of the main controller, a master controller supplied from an intermediate point on said resistance, and an electromagnetic switch having its energizing winding in series with said resistance for controlling said supply.

2. In a train control system, a master controller and a main controller on each motor car, a trolley connection to said main controller, a resistance connected from trolley to ground independently of the main controller, a bus line between the cars for the master controller supplied from an intermediate point on said resistance, and an electromagnetic switch having its energizing winding in series with said resistance for controlling said supply.

3. In a train control system, a master controller and a main controller on each motor car, a trolley connection to each main controller, a resistance on each car connected from trolley to ground independently of the main controller, an electromagnetic switch controlled by each master controller for controlling the connection between the trolley and resistance, a manually operated switch in parallel with each electromagnetic switch, and a bus line between the cars connected to an intermediate point on said resistances.

4. In a train control system, a master controller and a main controller on each motor car, a trolley connection to each main controller, a resistance on each car connected from trolley to ground independently of the main controller, a bus line between the cars connected to an intermediate point on said resistances for supplying the master controller, means controlled by the master controller on each car for controlling the connection between the trolley and resistance on said car, and a manually operated switch on each car for rendering the controlling means ineffective on said car.

5. In a train control system, a master controller and a main motor controller on each motor car, a trolley connection to each main controller, a resistance on each car connected from trolley to ground independently of the main controller, a bus line between the cars connected to an intermediate point on said resistance for supplying the master controller, an electromagnetic switch controlled by each master controller for controlling the connection between the trolley and resistance, and a switch on each car controlling the connection from the bus line to the master controller and said electromagnetic switch.

6. In a train control system, a main motor controller on each motor car, a trolley connection to said main controller, a resistance connected from trolley to ground independently of the main controller, a master controller supplied from an intermediate point on said resistance, and means for maintaining a substantially constant potential on said master controller while variable current is being drawn by the master controller.

7. In a train control system, a master controller and a main controller on each motor car, a trolley connection to said main controller, a resistance connected from trolley to ground independently of the main controller, a bus line between cars connected to an intermediate point on said resistance for supplying the master controller, and means for maintaining a substantially constant potential on said bus line while variable current is being drawn by the master controller.

8. In a train control system, a master controller and a main controller on each motor car, a trolley connection to said main controller, a resistance connected from trolley to ground independently of the main controller, a bus line between cars connected to an intermediate point on said resistance for supplying the master controller, and an electromagnetic switch controlled by the current in said master control circuit for varying said resistance so as to maintain the potential on the bus line substantially constant.

9. In a motor control system, a main motor controller, a line connection to said main controller, a resistance connected from line to ground independently of the main controller, a master controller supplied from an intermediate point on said resistance, and an electromagnetic switch having its

energizing winding in series with said resistance for controlling said supply.

10. In a motor control system, a main controller, a line connection to said main controller, a resistance connected from line to ground independently of the main controller, a master controller supplied from an intermediate point on said resistance, and means for maintaining substantially constant potential on said master controller while variable current is being drawn from said master controller.

In witness whereof, I have hereunto set my hand this 15th day of July, 1912.

FRANK E. CASE.

Witnesses:

BENJAMIN B. HULL,

HELEN ORFORD.