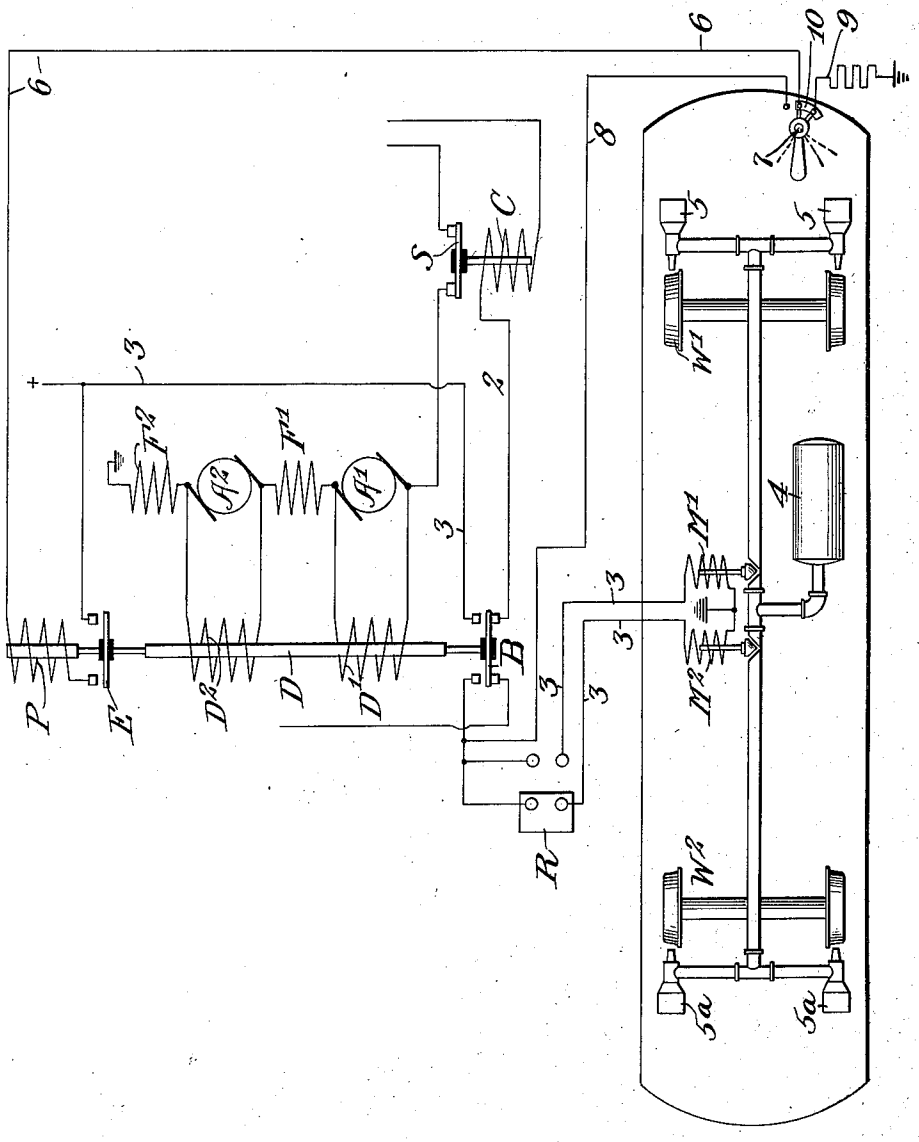
J. S. DOYLE & F. HEDLEY.

AUTOMATIC CONTROL AND SANDING DEVICE FOR CARS OPERATING ON SLIPPERY RAILS.

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WITNESSES

J. Howden Dett.

A. Scott Fowler.

INVENTORS

James S. Doyle

BY Frank Hedley

Edward Wright.

ATTORNEY

UNITED STATES PATENT OFFICE.

JAMES S. DOYLE, OF MOUNT VERNON, AND FRANK HEDLEY, OF YONKERS, NEW YORK.

AUTOMATIC CONTROL AND SANDING DEVICE FOR CARS OPERATING ON SLIPPERY RAILS.

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To all whom it may concern:

Be it known that we, JAMES S. DOYLE and FRANK HEDLEY, both citizens of the United States, residing, respectively, at Mount Vernon and Yonkers, in the county of Westchester and State of New York, have invented a certain new and useful Improvement in Automatic Control and Sanding Devices for Cars Operating on Slippery Rails, of which improvement the following is a specification.

This invention relates to railway cars and more particularly to electrically propelled railway cars or other motor propelled rolling stock in which the traction of the wheels is employed in propelling and in stopping. It is well known that the effective tractive force available varies with the condition of the surface of the rails on which the wheels roll, being maximum on a clean dry rail surface, but diminishing rapidly when the surface of the rail becomes moist and greasy, or is otherwise in what is known as a slippery or bad condition. When the surface of the rail is in this bad or greasy condition, the wheels are liable to slip and spin around rapidly upon the rails when the power is applied to the motor, without having any material effect in propelling the car, and one of the objects of our present invention is to provide means operating automatically at such times to cut off the power and to apply sand to the rails. It is also well known that when running on a bad or greasy rail surface, the wheels are liable to become locked and skid, or slide along the rails without turning, when the brakes are applied, and another object of this invention is to provide improved means operating automatically to apply sand to the rails in case the wheels slide.

In the operation of electrically propelled cars two motors, at least, are usually employed, one being applied to an axle at each end of the car, or in the case of double truck cars, with four motor equipments, one motor being applied to each of the four axles, and with such equipments, it almost invariably happens that one pair of wheels will slip before the other, or another pair when the power is applied to start or accelerate the car upon a bad or greasy rail surface. Consequently there will be a difference between the counter electromotive force of the motor or armature of the axle or pair of wheels which is slipping and turning rapidly and that of the armature of the axle that is nearly stationary or turning but very slowly, and it is this differential in the counter electromotive force which is, according to our invention, utilized for effecting the automatic control and sanding of the rails. In a similar manner, when one pair of wheels becomes locked or skids due to an application of the brakes, when running on a bad or greasy rail, and another pair of wheels continues to revolve, there is also a differential produced in the counter electromotive force of the armatures of said axles, which according to our invention, is also utilized to effect automatic sanding of the rails to prevent the sliding of the wheels.

Various forms of devices may be designed for practising our invention, and we have shown one preferred form of construction in the accompanying drawing, which is a diagrammatic illustration.

As shown herein, our improvement is applied in connection with an electric car having a standard two motor equipment, including motors having armatures A′ and A², with fields, F′ and F², the armatures being applied to the axles of the respective pairs of wheels, W′ and W². The current in the motor circuit may be controlled by the usual line switch, S, having coil, C, located in the control circuit, 2, as usual, only a portion of said circuits sufficient to illustrate our invention being shown.

According to our improvement, a differential relay, D, having coils, D′, and D², with terminals connected to the poles of the respective armatures, A′ and A², is employed for actuating the switch, B, which opens and closes the control circuit, 2, and the sanding circuit, 3. The coils, D′ and D², being connected in shunt with the respective armatures, receive current from the line when the power is on, and current produced by the counter electro-motive force of the armatures when running with the power off, and as the coils are of equal strength, and wound in opposite directions, the force exerted upon the differential relay will be balanced and have no effect upon

the switch, B, so long as the armatures and their corresponding pairs of wheels are rotating at the same speed. In the normal position of the switch, B, the control circuit, 2, is closed and the circuit, 3, is open, and the various switches and circuits of the standard equipment may then be operated in the usual way to control the running of the car. The circuit, 3, leads to the magnet valves, M′ and M², controlling the supply of air from a reservoir, 4, to either set of pneumatic sanding devices, 5 or 5ª, located upon the opposite sides of the wheels for sanding in either direction. An interlock switch bar, R, actuated by the usual reverser is employed to close the circuit to the proper magnet valve, M′ or M², according to the direction the car is running.

With this construction, when the power is on, current from the line flows through the armatures, and also through the shunts containing the respective coils, D′ and D², and as long as the respective pairs of wheels and corresponding armatures continue to rotate at the same speed, the counter electro-motive force and corresponding resistance of the respective armatures remains equal, consequently the same amount of current flows through the respective coils of the differential relay so that the effect is balanced and there is no movement of the switch, B. There will then be no current in the circuit, 3, and no action of either of the magnet valves to admit air to the sanding devices. If however, one pair of wheels should slip and spin around due to the rails being greasy or in bad condition, it will be evident that the greater counter electro-motive force of the corresponding rapidly revolving armature will increase the resistance to the flow of current through the same and consequently cause an increase in the amount of current from the line passing through the corresponding coil of the differential relay. This has the effect of unbalancing the relay whereby it is actuated to raise the switch, B, thereby opening the control circuit, 2, leading to the coil of the line switch, and closing the sanding circuit, 3. One of the magnet valves, M′ or M², is thereby operated to supply air to one of the sanding devices, 5 or 5ª, according to the direction of travel of the car, thus applying sand to the slippery rail surface to prevent the slipping of the wheels. At the same time, the line switch opens to cut off power from the motors. As soon as the respective pairs of wheels are again revolving at the same speed, the differential relay becomes balanced, and the switch, B, returns to its normal position, opening the sanding circuit and closing the control circuit. The line switch then closes and current is again supplied to the motors to propel the car, this operation being repeated each time that a pair of wheels slips upon the rails. The motorman may throw his controller to the off position when the wheels slip, and in that case, of course, the current will not be supplied to the motors again until the controller is turned on. In a similar manner, when the power is shut off and the brakes are being applied, if the rails are greasy or in bad condition, and one pair of wheels "pick up" and slides or skids along the rails, there will be a sufficient difference in the counter electro-motive force of the two armatures to cause the operation of the differential relay and switch, B, thereby closing the sanding circuit, 3, and actuating one of the magnet valves to apply sand to the rails. As soon as the pair of sliding wheels begins to revolve again the switch, B, falls and opens the circuit, 3. In connection with this feature of our improvement, it is not essential that the electric machines operate as motors for propelling the car, but merely as generators operatively connected to the respective pairs of wheels and driven thereby, and other propelling means may be employed if desired.

In some cases it may be desirable to continue the application of sand to the rails throughout the braking application, even after the sliding wheels begin to revolve, and for this purpose an additional potential relay, P, may be employed, having a switch, E, adapted to be moved to closed position by the differential relay, D, to close a circuit through the relay coil, P, and wire, 6, to the motorman's brake valve, 7, upon the car, the brake valve being provided with switch means, 10, for closing connection between circuit, 6, and wire, 8, leading to the sanding circuit, 3, in all braking positions of the valve, and adapted to open said circuit, and to close connection between wire, 6, and a grounded resistance, 9, in the normal running position of the brake valve, as shown in full lines in the drawing.

With this construction, when the differential relay operates to close the sanding circuit, 3, it also closes switch, E, energizing coil, P, which then operates to hold the switch, E, closed, independently of the relay, D. Current then flows through wire, 6, switch, 10, and wire, 8, to the sanding circuit and magnet valve as long as the brake valve remains in the braking positions, even after the differential relay is balanced. By this means the sanding device continues to supply sand to the rails after the pair of sliding wheels resumes its rotation, and until the brake valve is moved to release the brakes.

When the rails are in such a greasy condition that the wheels slip at the time power is applied to propel the car, it will probably be desirable to automatically apply sand to the rails at the time of the first brake appli-

cation, in order to prevent skidding, and for this purpose, a grounded resistance, 9, may be provided, having a contact point adapted to be connected with circuit, 6, by the switch means, 10, of the brake valve, 7, when in normal running position, as indicated in the drawing. Then when the differential relay is operated by the slipping of a pair of wheels, as before described, the switch, E, of the potential relay, P, is closed and current flows through coil, P, circuit, 6, switch, 10, and resistance, 9, to ground, thereby holding switch, E, closed and circuit, 6, energized during the time that power is applied to propel the car. The switch means, 10, of the brake valve is arranged to make an electrical connection between wires, 6 and 8, just before the connection between wires, 6 and 9, is broken, as the brake valve is turned from normal running position toward braking positions, indicated by the lower dotted lines, therefore circuit, 6, remains energized and the magnet valve of the sanding circuit is actuated by current through connecting wire, 8, when the brake valve is moved to apply the brakes.

When the brake valve is thrown to full release position, which is beyond the position for running, as indicated by the upper dotted line, the switch means, 10, first disconnects the wire, 8, and then passes off from the wire, 6, thereby opening the circuit and deënergizing the coil, P, whereupon the switch, E, falls, leaving the circuit, 6, open when the brake valve is returned to its normal running position.

It will now be apparent that by means of our improvement, we provide for automatically applying sand to the rails when a pair of wheels slips, due to a bad or greasy condition of the rail surface, and also when a pair of wheels slides or skids due to the same cause, when the brakes are applied. Also, the automatic application of sand may then be further continued throughout the braking operation; or where the wheels slip at starting, the sand will be automatically applied at and throughout the next braking application, thereby preventing skidding of the wheels.

Having now described our invention, what we claim as new and desire to secure by Letters Patent is:—

1. In a controlling apparatus for cars, the combination with a plurality of pairs of wheels, and separate electric motors for driving different pairs of wheels, of electric mechanism operating automatically by the slipping of one pair of wheels relative to another pair to apply sand to the rails.

2. In a controlling apparatus for cars, the combination with a plurality of pairs of wheels, and separate electric motors for driving different pairs of wheels, of electric mechanism operating automatically by the slipping of one pair of wheels relative to another pair to cut off the supply of current to the motors and apply sand to the rails.

3. In a controlling apparatus for cars, the combination with a plurality of pairs of wheels, and separate electric motors for driving different pairs of wheels, a fluid pressure sanding device, and electric mechanism operating automatically by the slipping of one pair of wheels relative to another pair to supply fluid to said sanding device.

4. In a controlling apparatus for cars, the combination with a plurality of pairs of wheels, and separate electric generators operatively connected to different pairs of wheels, of electric mechanism operating automatically upon the skidding of one pair of wheels relative to another pair to apply sand to the rails.

5. In a controlling apparatus for cars, the combination with a plurality of pairs of wheels, and separate electric motors for driving different pairs of wheels, of means governed by the differential in the counter electromotive force of the motors for controlling a supply of sand to the rails.

6. In a controlling apparatus for cars, the combination with a plurality of pairs of wheels, and separate electric motors for driving different pairs of wheels, of means governed by the differential in the counter electromotive force of the motors for controlling the current supply to said motors and applying sand to the rails.

7. In a controlling apparatus for cars, the combination with a plurality of wheels and axles, and electric motors applied to said axles for propelling the car, of differential coils, one connected to each motor, and means governed by said differential coils for supplying sand to the rails.

8. In a controlling apparatus for cars, the combination with a plurality of wheels and axles, and electric motors applied to said axles for propelling the car, of a differential relay having a coil connected across the armature of each motor, and electric contact means operated by the differential of the current produced in said coils for controlling a supply of sand to the rails.

9. In a controlling apparatus for cars, the combination with a plurality of wheels and axles, and electric motors applied to said axles for propelling the car, of differential coils, one connected to each motor, and means governed by said differential coils for cutting off the current supply to said motors and supplying sand to the rails.

10. In a controlling apparatus for cars, the combination with a plurality of pairs of wheels and generators operatively connected to the same, of means operating automatically by the rotation of the wheels at different speeds for controlling a supply of sand

to the rails, a brake applying apparatus, and means governed thereby for also controlling the supply of sand to the rails.

11. In a controlling apparatus for cars, the combination with a plurality of pairs of wheels and generators operatively connected to the same, of means operating automatically by the rotation of the wheels at different speeds for controlling a supply of sand to the rails, a brake valve for controlling the application of the brakes, and means operated thereby for also controlling the sanding apparatus.

12. In a controlling apparatus for cars, the combination with a plurality of pairs of wheels and generators operatively connected to the same, of an electric circuit for controlling a supply of sand to the rails, a relay device operated by the rotation of the wheels at different speeds for opening and closing the sanding circuit, and a brake valve having means for also controlling the sanding circuit.

13. In a controlling apparatus for cars, the combination with a plurality of pairs of wheels and generators operatively connected to the same, of an electric circuit for controlling a supply of sand to the rails, a relay device operated by the rotation of the wheels at different speeds for opening and closing the sanding circuit, and a brake valve having switch means adapted to supply current to the sanding circuit in the braking positions of said valve and to open said circuit in the normal running position of said valve.

14. In a controlling apparatus for cars, the combination with the wheels, and motors for propelling the car, of a brake valve having contact means for closing an electric circuit when in braking position, a sanding device operated by current in said circuit, and means operated automatically by the slipping of the wheels under power to close said circuit to the brake valve contacts.

15. In a controlling apparatus for cars, the combination with the motors and a plurality of pairs of wheels, of a sanding device, an electric circuit for controlling the same, a brake device having contacts for controlling the current in the sanding circuit, a supply circuit leading to brake device contacts, and having a potential relay and switch, and means operated automatically by the slipping of a pair of wheels under power to close said switch.

16. In a controlling apparatus for cars, the combination with the motors and a plurality of pairs of wheels, of a sanding device, an electric circuit for controlling the same, a brake device having contacts for controlling the current in the sanding circuit, a supply circuit leading to the brake device contacts, a switch and a relay coil in said supply circuit, the coil operating to hold said switch closed when energized, and means operated automatically by the wheels rotating at different speeds to close said switch.

17. In a controlling apparatus for cars, the combination with a plurality of pairs of wheels, and motors for propelling the car in either direction, of electrically operated sanding devices for applying sand to the rails upon either side of the wheels, and switch mechanism interlocked with the motor reverser for cutting in either sanding device according to the direction the car is running.

18. In a controlling apparatus for cars, the combination of a plurality of pairs of wheels, separate electric generators operatively connected to different pairs of wheels, and means governed by the differential in the current produced by said generators for preventing skidding of the wheels.

19. In a controlling apparatus for cars, the combination of a plurality of pairs of wheels, separate electric generators operatively connected to different pairs of wheels, and means governed by the current from said generators for controlling a supply of sand to the rails.

20. In a controlling apparatus for cars, the combination of a plurality of pairs of wheels, separate electric generators operatively connected to different pairs of wheels, differential coils, one connected to each generator, and means governed by said coils for controlling a supply of sand to the rails.

JAMES S. DOYLE.
FRANK HEDLEY.

Witnesses:
C. V. SMITH,
WARREN MARCUS.