Nov. 25, 1947. A. F. ANDERSON 2,431,445

ANTISLIPPING DEVICE FOR RAILWAY CARS

Filed Nov. 6, 1944 2 Sheets-Sheet 1

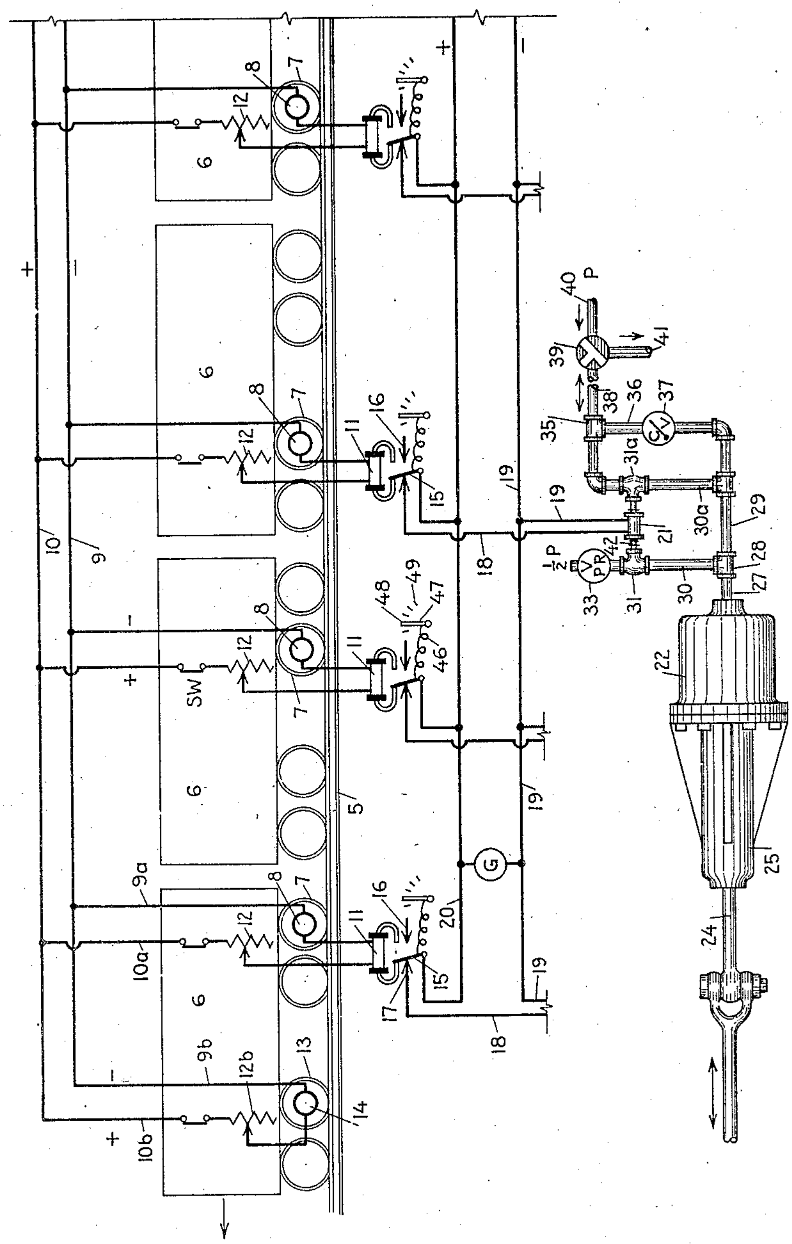

Figure 1

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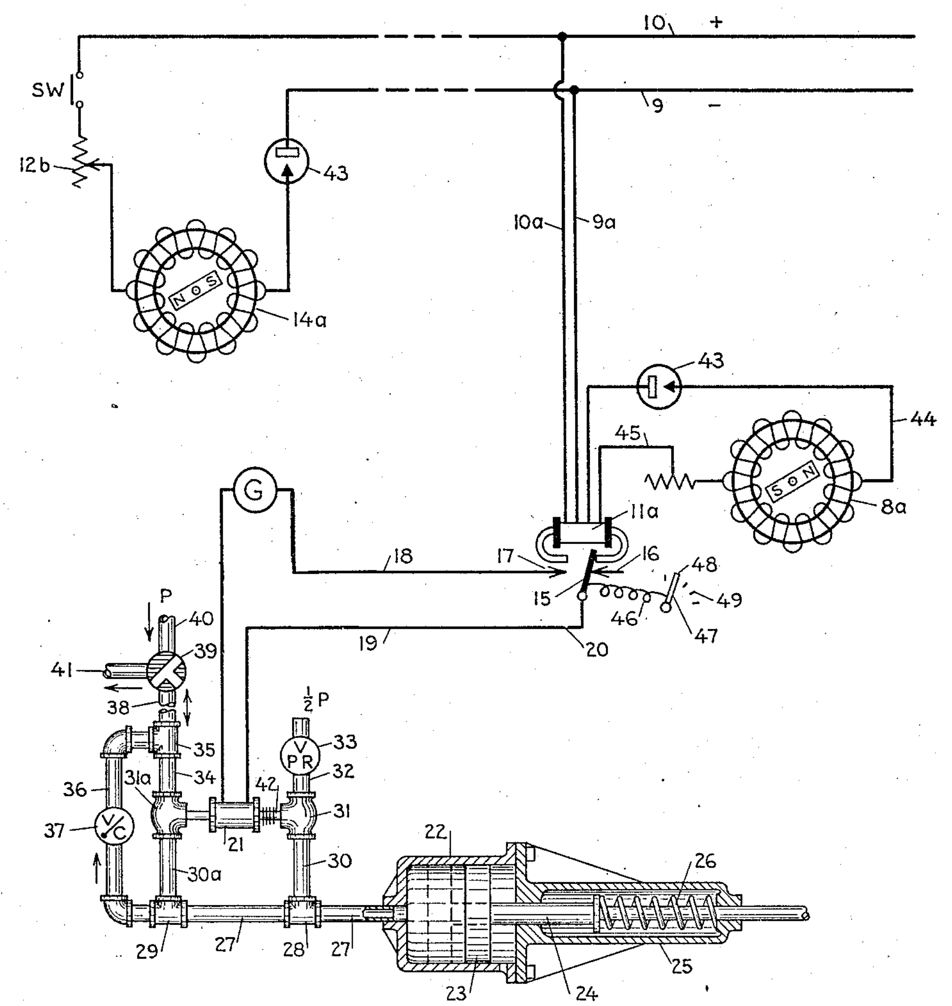

Figure 2

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ANTISLIPPING DEVICE FOR RAILWAY CARS

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4 Claims. (Cl. 303—21)

This invention relates to improvements in anti-slipping devices for locomotives and railway trains of the general type described and claimed in United States Letters Patent No. 2,321,059 granted June 8, 1943.

It is well known that the static coefficient of friction is greater than the sliding coefficient and therefore the maximum tractive effort is obtained with the maximum amount of power that can be applied to the drive wheels without causing them to slip on the rails; conversely, the maximum braking effort is attained just before the wheels start sliding. After the wheels slide on the rails, the braking action is reduced.

For the purpose of preventing the application of too much power, or of too much brake pressure, various devices have been invented. Such devices are especially useful on high speed trains in effecting rapid starts and stops and for any and all trains in case of emergencies. Where the stopping distance is limited, such devices are particularly necessary. Since practically all locomotives and trains are provided with air brakes, it is essential that the anti-slipping devices shall be so designed and constructed that they do not dangerously reduce the air pressure and deprive the engineer of control of the brakes.

One of the objects of this invention is to provide air operated brake control devices of the type referred to, with means for preventing the waste of air.

Another object is to produce an anti-slipping device in which the engineer or train pilot can apply corrective measures while the anti-slipping device is functioning.

Another object is to produce a device having two or more sources of electrical power connected in opposed relation; one of which generates a voltage proportional to the speed of the train relative to the rails, or in other words proportional to the peripherial speeds of wheels that will never be subjected to a sufficient breaking action or power to cause them to slide on the rails and the other (or others) of which generates a voltage proportional to the peripherial speed of brake and power responsive wheels that may slip on the rails. The voltages generated under normal operation being equal and connected to the line in opposition, a differential voltage develops only when the brake and power responsive wheels slip and this is utilized to reduce the brake action.

The above and any other objects that may become apparent as the description proceeds are attained by means of a construction and an arrangement of parts that will now be described in detail, and reference for this purpose will be had to the accompanying drawing in which the invention has been illustrated, and in which:

Figure 1 is a schematic representation of the

invention showing the relative positions of the various elements; and

Figure 2 is a diagram showing the elements in greater detail.

In the drawing reference numeral **5** designates a railway rail or track on which a train, comprising several coaches **6**, is supported. Each coach has been shown as supported on two trucks, each having two pairs of wheels interconnected in the usual way. The wheels designated by reference numeral **7** are acted upon by air brakes in the usual manner. Driven from the axles of wheels **7** are electrical generators **8**, which, in Figure 1, have been shown as direct current generators. Extending the length of the train is an electric circuit comprising two wires **9** and **10**, the former of which has been designated as the negative and the latter as the positive. The generators are connected with the main circuit by means of conductors **9***a* and **10***a*. Connected in series with the conductors **10***a* are polarized relays **11** and resistances **12**. In Figure 1 the pair of wheels designated by reference numeral **13** represent wheels that have no brakes and which therefore rotate at a peripherial speed equal to the speed of the train along the rails. Generator **14** is the pilot generator and corresponds to generators **8**; all of the generators should have the same voltage characteristics. Generator **14** is connected to the train circuit by means of conductors **9***b* and **10***b*. A resistance **12***b* is connected in series in conductor **10***b*. Generator **14** is connected in opposition to the generators **8** and therefore there will be no current flowing through any of the conductors of the circuit containing the relays so long as the voltages developed by the several generators are equal. If, during the braking of the train for the purpose of retarding its speed or stopping it, any one of the wheels **7** begins to slip, the voltage of the corresponding generator will consequently diminish, because it is proportional to the speed at which the armature rotates. When this occurs, the voltage between conductors **9** and **10** then being greater, will force a current through the corresponding relay **11** and the corresponding resistance **12**. Armature **15** will, thereupon, be moved towards the right into contact with the stop **16** and away from the contact **17**, thereby opening the circuit comprising the wires **18**, **19**, the generator G and the conductor **20**.

Referring now to the second relay from the right in Figure 1, it will be observed that as soon as the armature moves towards the stop **16** and breaks the circuit through wires **18** and **19**, electromagnet **21** will become deenergized.

In Figures 1 and 2, to both of which reference will now be had, reference numeral **22** designates the air cylinder of the brake mechanism in which is positioned the piston **23**. Piston rod **24** extends from the piston through the tubular housing 25 and to the brake mechanism which has not been shown because the usual air brake mechanism is used. A spring 26 tends to move the piston towards the left, when viewed as in Figure 2. An air pipe 27 extends from and is in communication with the interior of the cylinder. A T 28 is positioned in pipe 27 adjacent the cylinder and another T 29 is also positioned in this pipe, but spaced therefrom as shown in both of the figures. Extending upwardly from the T 28 is a pipe 30 whose upper end is connected to a solenoid operated valve 31 that is normally closed. Pipe 32 connects valve 31 with the pressure relief valve 33, which is adjustable to any desired pressure. Extending upwardly from T 29 is a pipe 30*a* that connects with a normally open solenoid operated valve 31*a* from the other side of which a pipe 34 extends and connects it with one end of T 35. The two T's 29 and 35 are connected by a branch pipe 36 in which is positioned a check valve 37 that permits fluid to flow upwardly in the direction of the arrow, but prevents it from flowing in the opposite direction. Pipe 38 connects T 35 with the usual triple or control valve 39. This valve can connect the pipe 38 with either the air pressure supply pipe 40, or with an exhaust pipe 41. Valve 39 represents the train control valve positioned adjacent the pilot or engineer of the train in what is known as "straight air brake systems" and represents the "automatic triple valve" in the usual air brake systems or that of other names in improved systems, and is situated at each air brake cylinder or at least at each "compressed air reservoir" on each car of the train, in usual installations or systems. It is evident that by rotating the control valve in the proper direction, air may be supplied to the brake cylinder 22, or exhausted therefrom, as may be necessary during the operation of the train. This operation is the function of the usual "triple valve" at each brake cylinder under each car in automatic air brake systems.

In the arrangement shown in Figure 1, all of the generators are presumed to be direct current and are provided with proper means for adjusting the voltage which comprises the resistance 12; in addition to this, if found to be necessary or desirable, the generators may also have a field rheostat in the usual manner. In Figure 1, the circuit containing wires 19 and 20, the solenoid 21 and the generator G have been shown as a closed circuit during normal operation. In this arrangement, solenoid 21 retains valve 31 in closed position, against the action of spring 42. It is, of course, evident that this circuit can be open during normal operation in which case spring 42 is arranged so as to normally retain valve 31*a* open and 31 closed. The last mentioned arrangement has been shown in Figure 2, and is the preferred arrangement.

Referring now more particularly to Figure 2, the pilot generator 14*a* corresponds to generator 14 in Figure 1, but is an alternating current generator instead of a direct current and generator 8*a* corresponds to generator 8 in Figure 1, but is alternating instead of direct. Since it is necessary to provide the train circuit, comprising conductors 9 and 10, with direct current, half wave rectifiers such as those designated by reference numeral 43, have been connected in each circuit. The terminals of the pilot generator are connected with the train circuit as shown and from this circuit branches comprising wires 9*a* and 10*a* extend to the polarized relay 11*a* and are connected with one energizing coil. The terminals of the generators 8*a* are connected by means of conductors 44 and 45 with the other coil on their associated relay 11*a*. The two coils are wound in opposition and have the same number of turns so that when the current in one is greater than in the other the unbalanced force resulting will effect a corresponding movement of the armature 15, which is polarized in the usual manner. Springs 46 connect the armatures to a tensioning element 47 having an adjustment lever 48 that moves over a scale 49. The means for varying the tensions of springs 46 constitute one of the several separate means employed for properly adjusting the operation of the several generators and relay armatures.

Operation

Let us now assume that a device constructed and interconnected in the manner specified is applied to a railway train comprising one or any number of cars, the operation will then be as follows:

When the train is traveling without the application of brakes, the pilot generator 14 and all of the other generators will develop the same voltage with the result that no current flows through the coils of the balanced relays. If, during the application of the brakes any one of the wheels 7 begins to slip, the voltage developed by the generator connected therewith will decrease; consequently current will flow from wires 9 and 10 through the relay 11, thereupon opening the circuit comprising conductors 18 and 19, and de-energizing solenoid 21, allowing the normally open valve 31*a* to close and the normally closed valve 31 to open. This operation immediately cuts off the communication between the brake cylinder and the valve 39 and connects the interior of the cylinder with the pressure reducing valve 33. For the purpose of this description we will assume that the pressure in the air brake supply is 100 pounds per square inch and that the pressure relief valve is set for one-half of this, or 50 pounds per square inch. It now becomes evident that as soon as valve 31 is open and valve 31*a* closed, the pressure in the brake cylinder will reduce to 50 pounds or the pressure set by the relief valve, thereby reducing the braking action without wasting all of the compressed air in the brake cylinder and without removing or eliminating the entire braking effect of the wheels, but only the amount necessary to prevent skidding.

While valve 31*a* is closed, it is also by-passed through the branch line comprising pipe 36 and check valve 27 and air is thus prevented from entering the brake cylinder in response to the operation of valve 39, but the pressure in the brake cylinder can be further reduced by connecting the interior of pipe 36 with the atmosphere. The engineer is therefore in position to further reduce the braking action, if he should find this to be necessary or desirable. As soon as the brakes have been released to the desired extent, the corresponding wheels start rotating, the voltage will again increase and the flow of current through the relay 11 cease, causing solenoid 21 to close valve 31 and open valve 31*a* thus returning normal control of the brakes to the engineer.

It is evident from the above description that the present invention is so constructed that the brakes will not be entirely removed from the wheels, but only reduced in pressure so as to permit the wheels to resume rotation in response to the friction between them and the rails.

The use of alternating or direct current generators is optional. The alternating current must, however, be rectified in the manner shown in Figure 2. It is also optional whether the circuit, including the relays **21** shall be a normally closed or a normally open circuit and whichever of these two arrangements is believed to be the most desirable from the point of view of safety can therefore be adopted. Suitable switches are, of course, provided wherever necessary and some of these have been indicated by the symbol *Sw*.

Conventional instruments such as voltmeters, ammeters or wattmeters may, of course, be connected to the circuit in any manner, if desired.

Normally the pipes forming the passageways for the compressed air will be eliminated and the air passageways will be formed compactly in the body of air brake cylinder and triple valve.

Having described the invention what is claimed as new is:

1. An air brake mechanism for use with a railway car having a pair of brake responsive wheels and at least one freely rotatable wheel in engagement with the track, a brake operatively associated with the brake responsive wheels and control means for the brake comprising, a brake cylinder, a supply of air under pressure, a pipe interconnecting the two and a control valve in the pipe, means separate from the control valve for reducing the braking action when the peripheral speed of the brake wheel varies a predetermined amount from that of the freely rotatable wheel, comprising a normally open valve between the brake cylinder and the control valve, a pipe connecting opposite sides of the normally open valve forming a by-pass, a check valve in said by-pass, opening away from the cylinder, a pressure relief pipe in communication with the cylinder at all times, a normally closed valve in said pipe, a relief valve in the pipe beyond the valve, and means comprising two electrical generators of identical characteristics, one driven from the brake responsive wheels and the other from the freely rotatable wheel, connected in opposition, for simultaneously closing the normally open valve and opening the normally closed valve, whereby the cylinder will be disconnected from the air supply line and whereby the air pressure in the cylinder will be reduced to an amount depending on the setting of the relief valve and whereby the pressure in the cylinder can be further reduced by operation of the control valve.

2. In an air brake mechanism for use with railway cars having a brake responsive wheel, a freely rotatable wheel that rotates at a peripheral speed equal to the speed of the car along the track, and a brake cylinder, a supply of air under pressure, a pipe connecting the brake cylinder with the air supply, and means comprising a control valve in the pipe for connecting the cylinder at will to the air supply or to atmosphere and for confining the air in the cylinder, means separate from the control valve means, for effecting a reduction of air pressure in the cylinder to a predetermined value whenever the peripheral speeds of the freely rotatable wheel and the brake responsive wheel differ by a predetermined amount, comprising a normally open valve in the pipe between the cylinder and the control valve, another pipe in communication at all times with the cylinder, a relief valve connected with said last named pipe, and a normally closed valve therein between the cylinder and the relief valve, means rendered operable when the peripheral speeds of the brake responsive wheel varies a predetermined amount from that of the freely rotatable wheel, for simultaneously closing the normally open valve and opening the normally closed valve, whereby the pressure in the cylinder will be reduced to a value determined by the setting of the relief valve, a pipe connecting opposite sides of the normally open valve, forming a by-pass, and a check valve therein, opening away from the cylinder, whereby the air pressure in the cylinder may be further reduced by the said control valve means.

3. An automatic air brake control mechanism for use with a railway car having wheels that are free to rotate at a peripherial speed equal to the speed of the car along the track, brake responsive wheels in frictional engagement with the track rail, and an air brake mechanism operatively associated with the last named wheels, said brake mechanism comprising a brake cyinder, a source of air under pressure, a pipe connecting the air source to the cylinder, a control valve means in the pipe, for connecting the interior of the cylinder at will to the air supply, or to atmosphere, and for confining the air in the cylinder, a normally open valve in the pipe between the control valve mechanism and the cylinder, a by-pass about the normally open valve, comprising a check valve opening away from the cylinder, a branch pipe connected at all times with the interior of the cylinder, a normally closed valve in the branch pipe, a relief valve positioned beyond the normally closed valve and means comprising two electrical generators connecting in opposition, one driven from the freely rotatable wheels and the other from the brake responsive wheels, operable in responsive to a predetermined difference in the peripherial speeds of the freely rotatable wheels and brake responsive wheels, for simultaneously closing the normally open valve and opening the normally closed valve, whereby the air pressure in the brake cylinder will be reduced to an amount determined by the setting of the relief valve, the by-pass providing means for further reducing the air pressure by operation of the control valve.

4. In an air brake mechanism for use with railway cars having a brake responsive wheel, a freely rotatable wheel and a brake cylinder, a supply of air under pressure, a pipe connecting the brake cylinder with the air supply, and means comprising a control valve in the pipe for connecting the cylinder at will to the air supply or to atmosphere and for confining the air in the cylinder, means separate from the control valve means, for effecting a reduction of air pressure in the cylinder to a predetermined value whenever the peripheral speeds of the freely rotatable wheel and the brake responsive wheel differ by a predetermined amount, comprising a normally open valve in the pipe between the cylinder and the control valve, another pipe in communication at all times with the cylinder, a relief valve connected with said last named pipe, and a normally closed valve therein between the cylinder and the relief valve, and means rendered operable when the peripheral speeds of the brake responsive wheel varies a predetermined amount from that of the freely rotatable wheel for simultaneously closing the normally open valve and opening the normally closed valve, whereby the pressure in

the cylinder will be reduced to a value determined by the setting of the relief valve.

ALBERT F. ANDERSON.

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