Sept. 16, 1941. J. CANETTA 2,256,289

RAIL SANDING APPARATUS

Filed Dec. 30, 1939 8 Sheets-Sheet 1

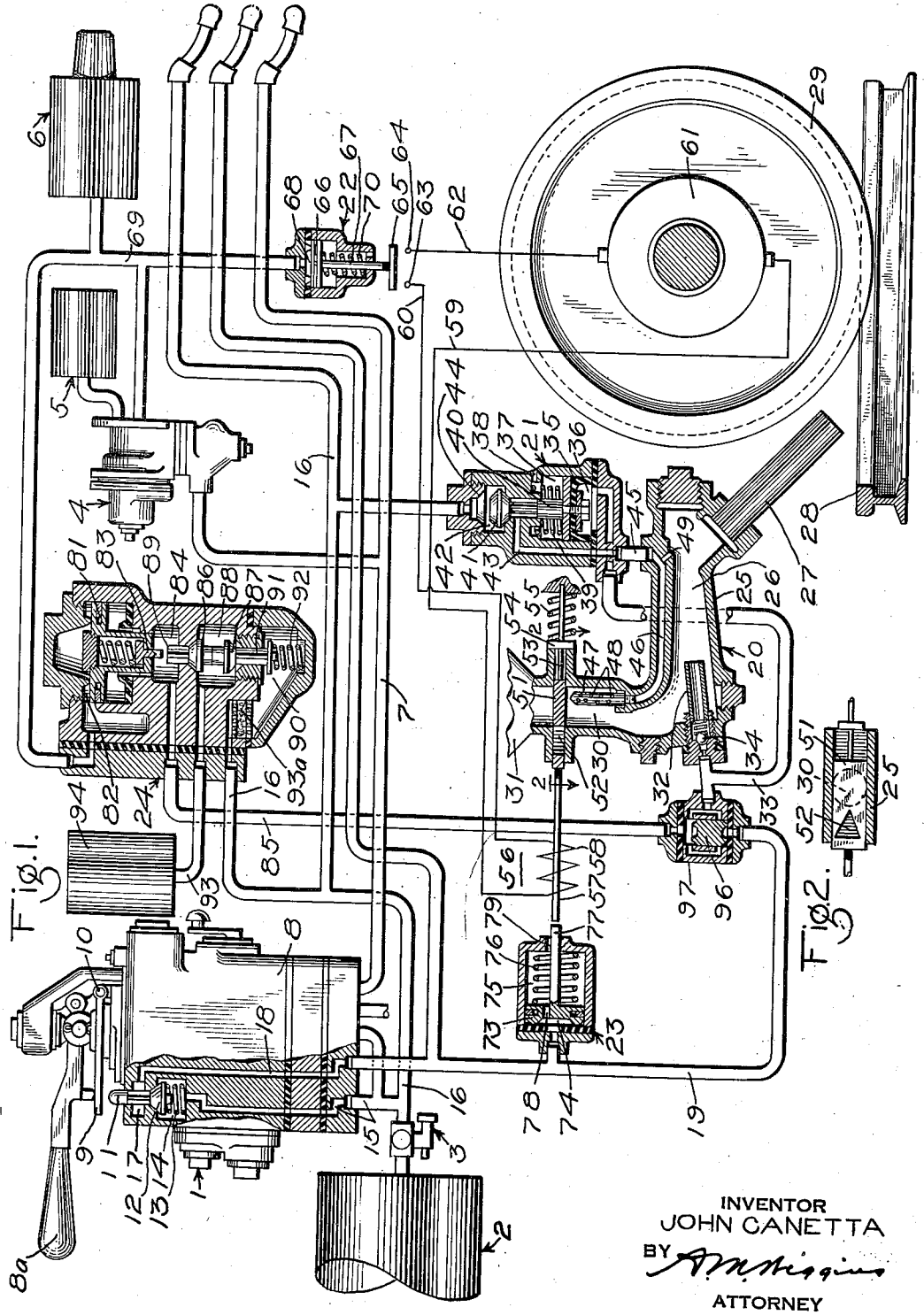


Fig. 1.

Fig. 2.

INVENTOR
JOHN CANETTA
BY A. M. Higgins
ATTORNEY

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RAIL SANDING APPARATUS

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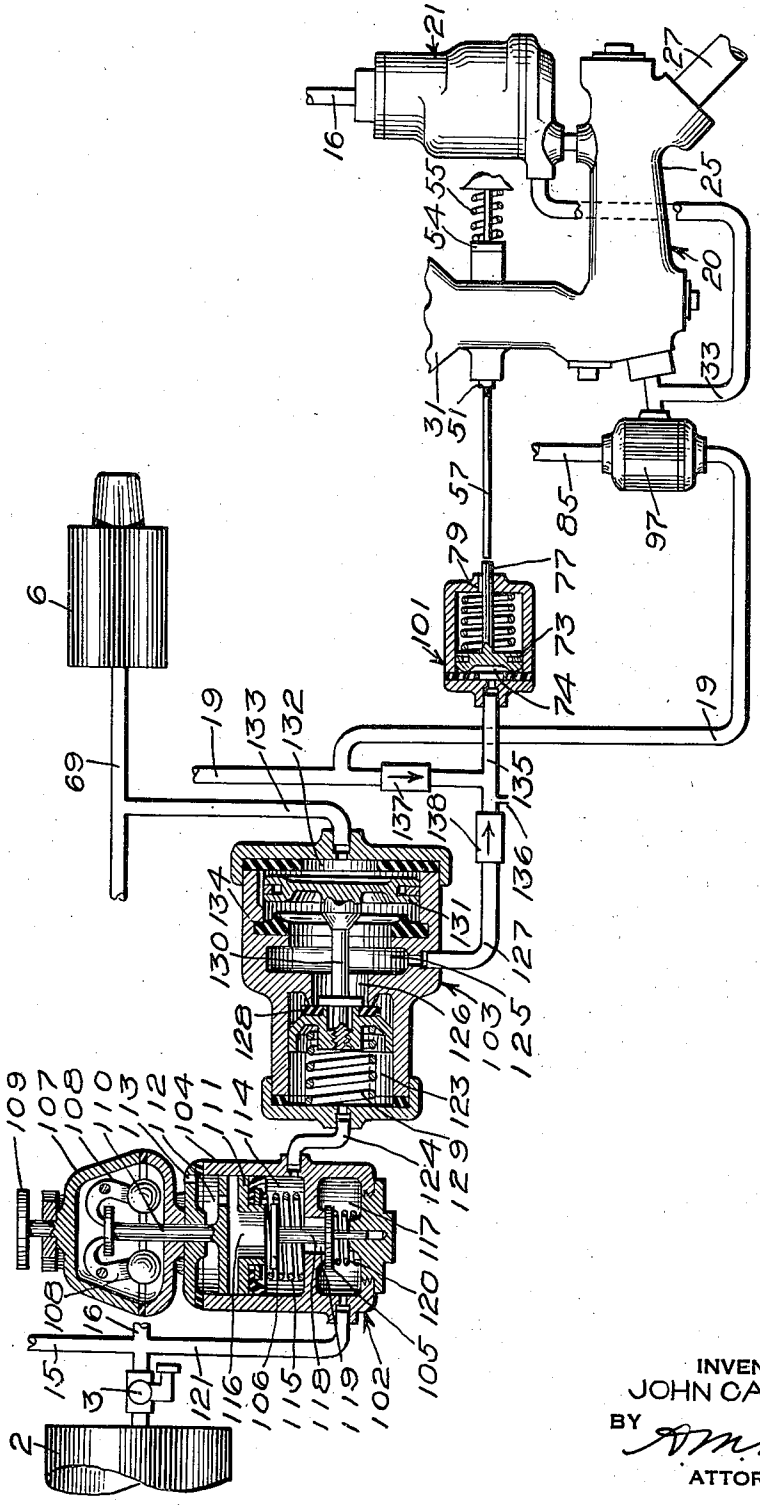


Fig. 3.

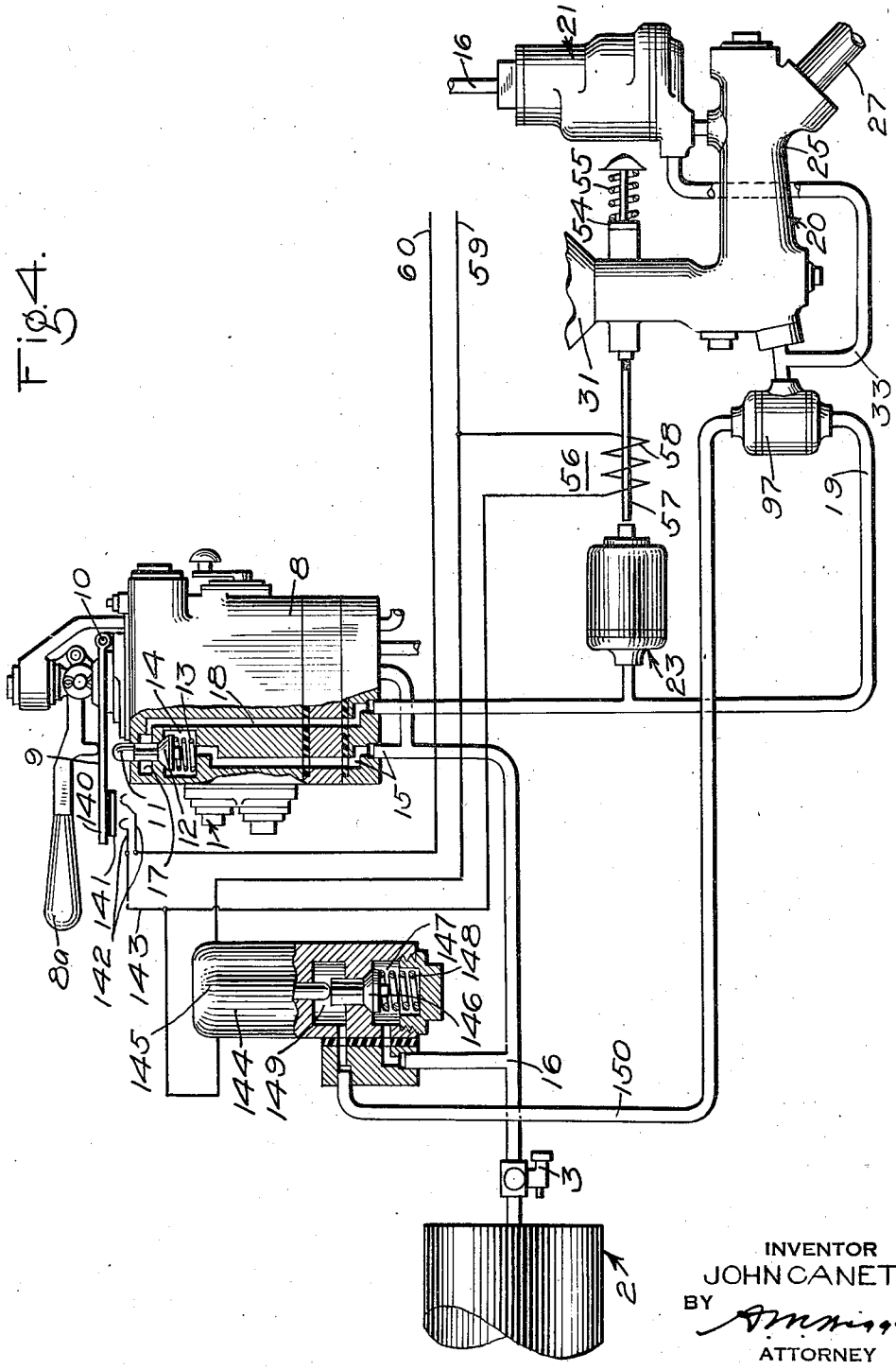
INVENTOR
JOHN CANETTA
BY
ATTORNEY

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RAIL SANDING APPARATUS

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Fig. 4.



INVENTOR
JOHN CANETTA
BY
ATTORNEY

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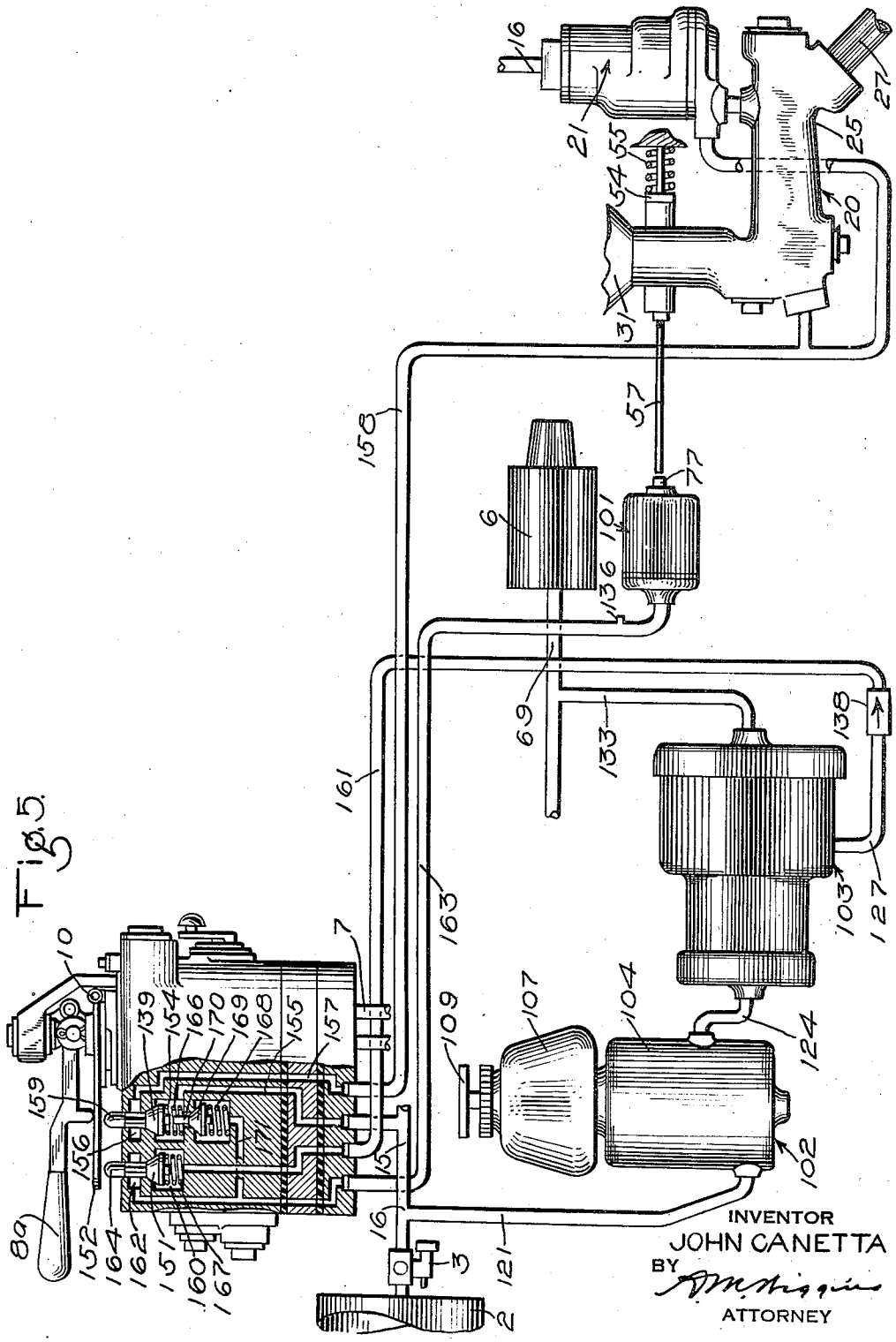


Fig. 5.

INVENTOR
JOHN CANETTA
BY
ATTORNEY

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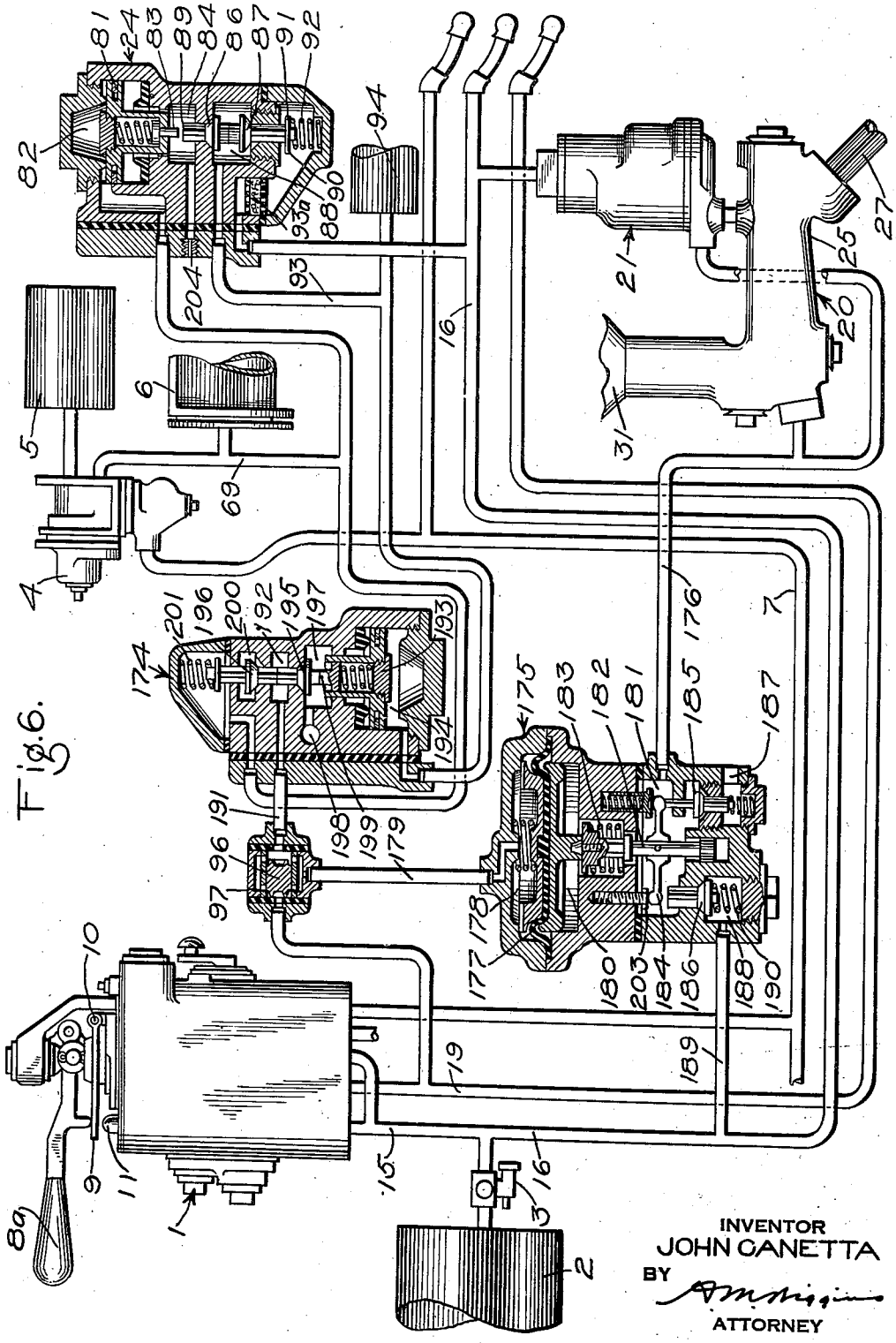


Fig. 6.

INVENTOR
JOHN CANETTA
BY
ATTORNEY

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Fig. 7.

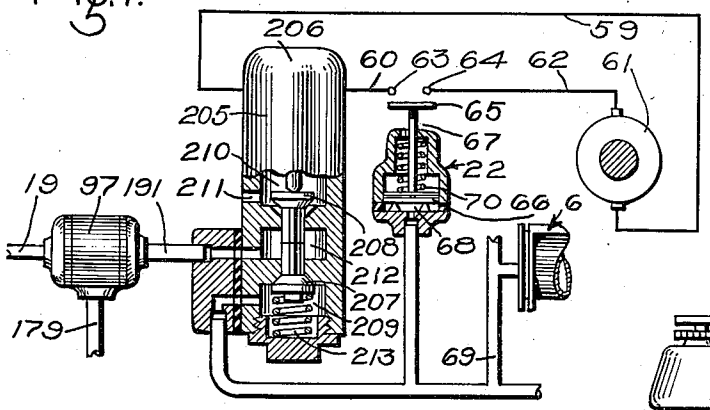


Fig. 8.

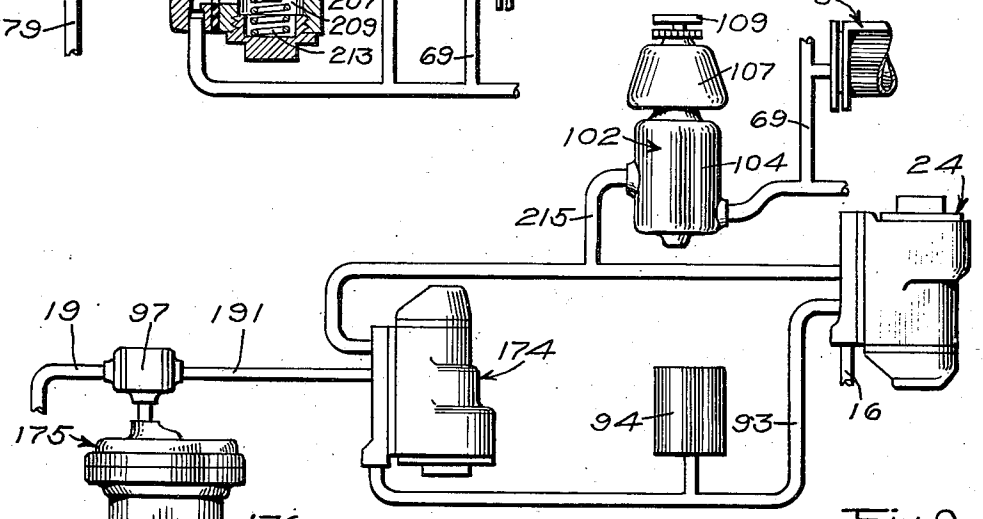
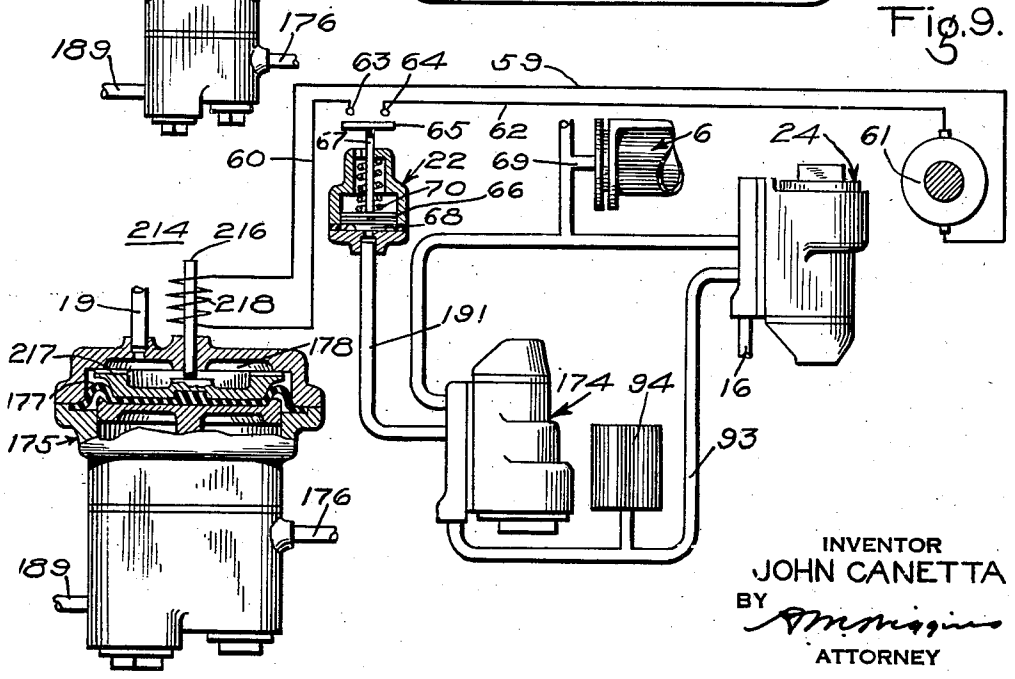


Fig. 9.

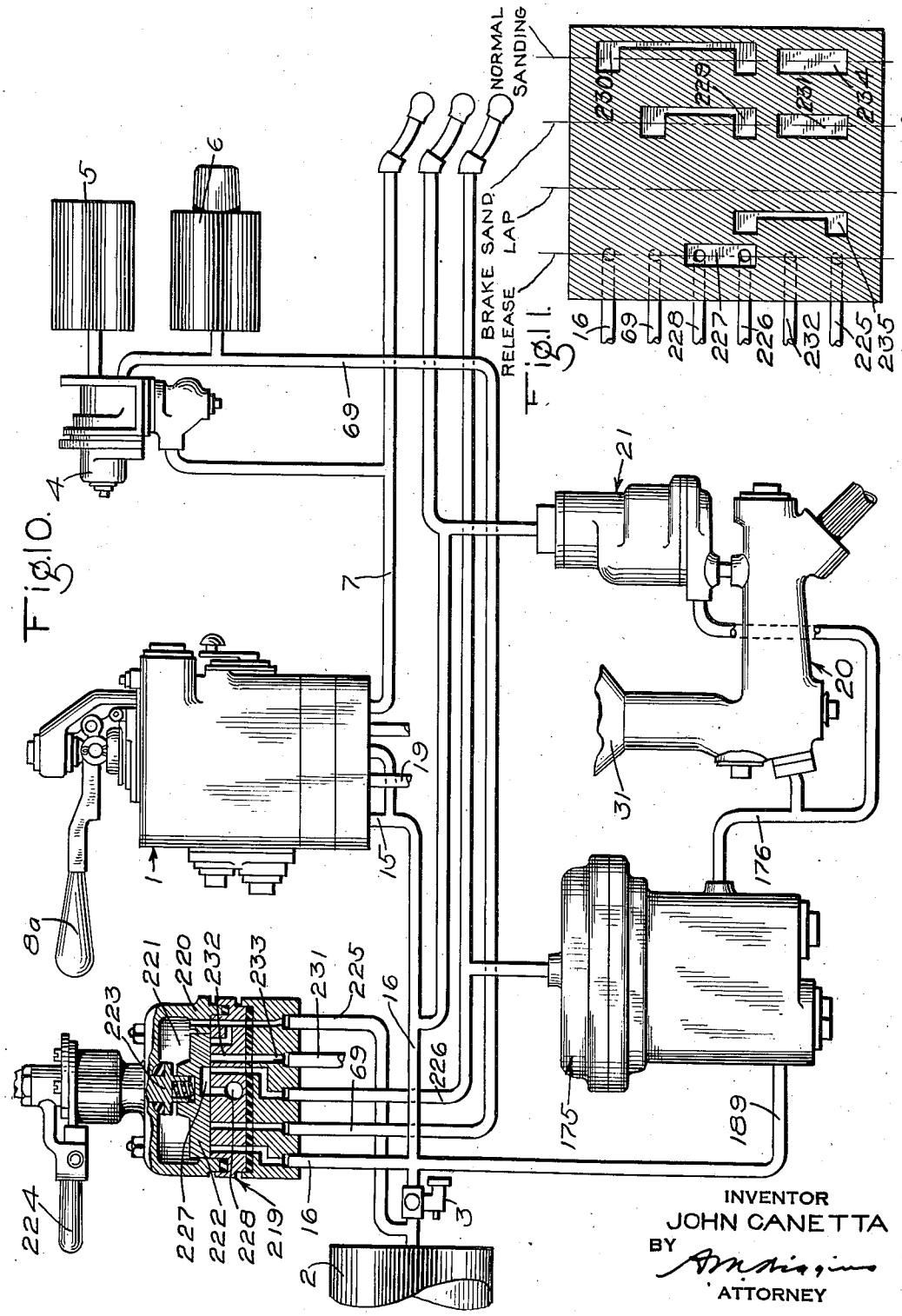


INVENTOR
JOHN CANETTA
BY
ATTORNEY

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RAIL SANDING APPARATUS

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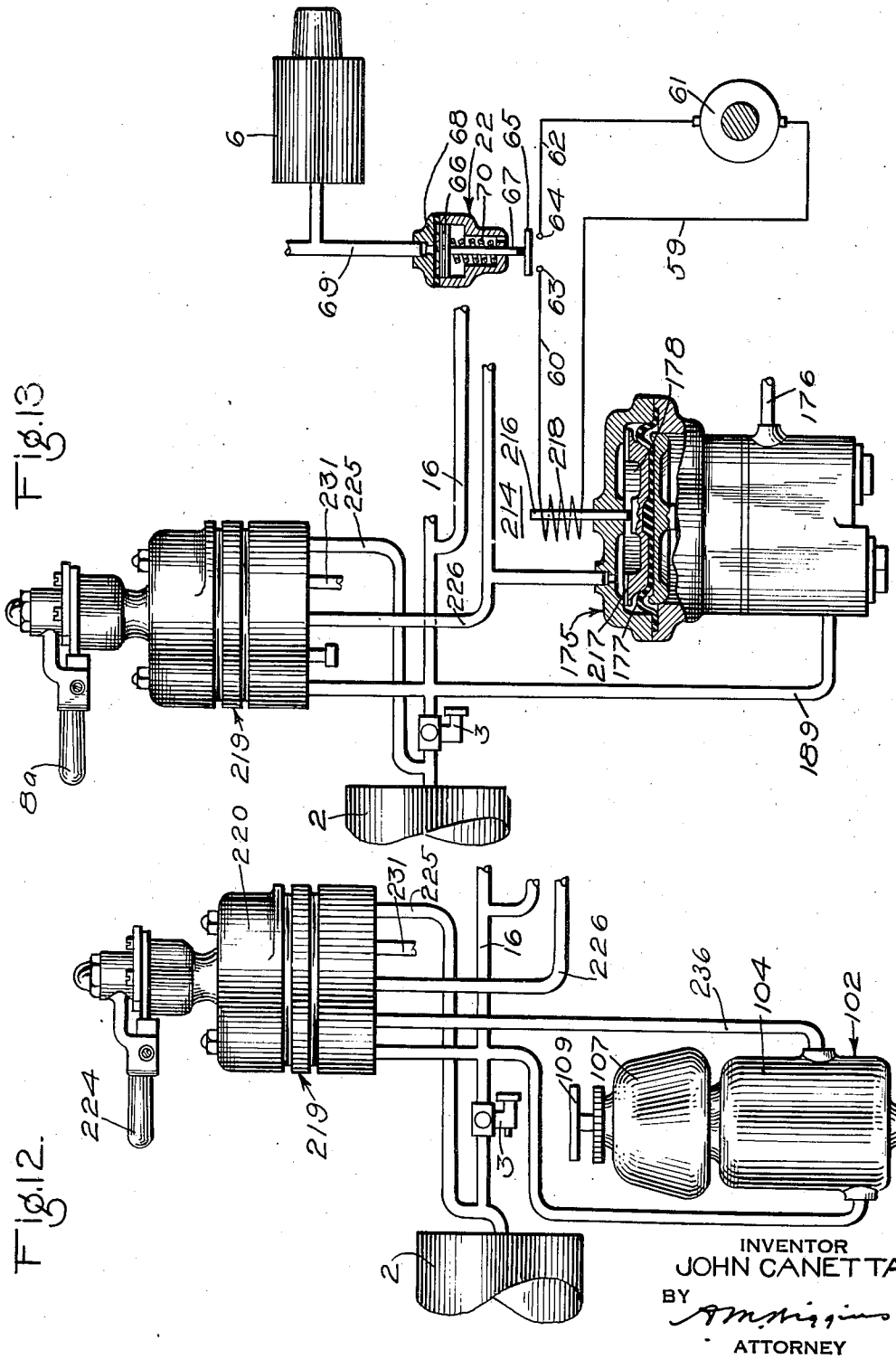


Fig. 13

Fig. 12.

INVENTOR
JOHN CANETTA
BY
ATTORNEY

Patented Sept. 16, 1941

2,256,289

UNITED STATES PATENT OFFICE

2,256,289

RAIL SANDING APPARATUS

John Canetta, Wilkinsburg, Pa., assignor to The Westinghouse Air Brake Company, Wilmerding, Pa., a corporation of Pennsylvania

Application December 30, 1939, Serial No. 311,721

52 Claims. (Cl. 291—3)

This invention relates to sanding apparatus and more particularly to the type for use on railway vehicles for sanding the track rails.

In order to decelerate or stop the modern ultra high-speed railway trains in the relatively short distances required to meet operating schedules and to insure the safety of the trains, it is necessary to employ braking forces which are greater than ever before used.

The maximum degree of braking force which however may be employed on any railway vehicle or train is limited by the coefficient of adhesion between the vehicle wheels and rails since a greater degree of braking force is liable to cause sliding of the wheels which results not only in producing flat spots on the wheels but also in an undesired lengthening of the distance required to bring the train to a stop. The coefficient of adhesion of course usually depends upon the condition of the track rails, that is, whether the track rails are dry or wet, and is much greater when the track rails are dry than when wet, and in fact is usually so low when the rails are wet as to prevent the use of braking forces such as required to provide a desired stop. To overcome this difficulty the use of sand on the track rails has been resorted to since it will provide a maximum and substantially uniform degree of adhesion regardless of the condition of the track rails.

Heretofore sanding of the rails has usually been effected automatically when an emergency application of the brakes on a train has been effected since the degree of braking provided on a train at this time is usually the maximum obtainable. Manually controlled sanding has also been provided on most of these trains and while it has been available for use at any time, as during service brake applications, the primary purpose thereof has been to provide sand on the rails for increasing the traction of the locomotive unit during acceleration, but it is believed that with the further development and use of ultra high speed trains, sanding of the track rails during service brake applications will become and be considered substantially as essential as during emergency brake applications, in order to provide under all conditions of operation the most uniform and efficient brake control of the train.

Sanding arrangements heretofore employed on railway vehicles have been designed to provide a substantially constant rate of flow of sand for sanding purposes. The same amount of sand has thus been provided for sanding the track rails when a train is operating at a high speed as when operating at a low speed, and obviously if the amount of sand is adequate for the high speed operation it is excessive for low speed operation. This naturally results in the wasting of sand at the lower speeds and necessitates carrying greater amounts of sand on the train or vehicle than would otherwise be required. Further, excessive use of sand on track rails at times interferes with the signal systems employed on railroads and is therefore undesirable.

One object of the invention is therefore to provide an improved sanding arrangement for railway vehicles which is operative to automatically proportion the amount of sand supplied for sanding a track rail during sanding operation substantially in accordance with the actual requirements.

Still another object of the invention is to provide an improved sanding arrangement such as above described which is operative in effecting both service and emergency brake applications and which may be entirely automatic in operation or which may be controlled manually by the operator.

A still further object of the invention is to provide an improved sanding arrangement for a vehicle adapted at one time to provide sand for sanding at a rate which varies substantially in proportion to the speed of the vehicle and which may be operated at the will of the operator to provide a certain maximum rate of sanding.

Another object of the invention is to provide an improved sanding arrangement for a railway vehicle adapted to supply sand for sanding a rail under said vehicle at a rate which varies substantially in proportion to the speed of the vehicle so as to avoid excessive use and waste thereof.

Another object of the invention is to provide an improved sanding arrangement for use on railway vehicles adapted to provide sand for sanding a track rail in an amount substantially proportional to the speed at which the vehicle is operating whereby substantially the same amount of sand will be provided on a unit length of track rail for all train speeds so as to minimize waste and excessive use of sand.

Other objects and advantages will be apparent from the following more detailed description of the invention.

In the accompanying drawings; Fig. 1 is a diagrammatic view, partly in section and partly in outline, of a fluid pressure brake equipment for a railway vehicle and one form of the improved

sanding arrangement associated therewith; Fig. 2 is a sectional view taken on the line 2—2 in Fig. 1; Figs. 3 to 5 are diagrammatic views mainly in outline of a portion of the apparatus shown in Fig. 1 and with which there is associated various modified forms of the invention; Fig. 6 is a diagrammatic view somewhat similar to Fig. 1 disclosing another embodiment of the invention; Figs. 7, 8 and 9 are diagrammatic views mainly in outline of arrangements disclosing different modifications of the structure shown in Fig. 6; Fig. 10 is a diagrammatic view mainly in outline of an apparatus embodying another modification of the invention; Fig. 11 is a diagrammatic development view of a part of a valve device shown in Fig. 10; and Figs. 12 and 13 are diagrammatic views of a portion of the apparatus shown in Fig. 10 and disclosing modified forms thereof.

Description of embodiment of invention shown in Fig. 1

The fluid pressure brake equipment shown in Fig. 1 for the purpose of illustrating one application of the invention comprises an engineer's automatic brake valve device 1, a main reservoir 2, a feed valve device 3, an automatic brake controlling valve device such as a triple valve device 4, an auxiliary reservoir 5 and a brake cylinder device 6.

The engineer's brake valve device 1 may be of the type disclosed in Patent No. 2,106,483 issued to Ellis E. Hewitt on January 25, 1938, and which is adapted to control the brakes on a vehicle or train through the medium of a brake pipe 7. The brake valve device comprises a casing 8 to which the brake pipe 7 is connected and an operating handle 8a adapted to be turned in a horizontal plane for at one time reducing the pressure in the brake pipe 7 for effecting an application of the brakes on the vehicles of a train and for at another time effecting an increase in pressure in the brake pipe for effecting a release of the brakes on the vehicles of the train.

The operating handle 8a is preferably of the safety control type which is also movable in a vertical plane, and is operative upon downward movement from the normal position shown, in all brake controlling positions of the handle, to actuate a sanding bail 9 which is mounted to pivot on a shaft 10 secured in the brake valve casing. The sanding bail 9 is arranged to engage the stem 11 of a sand valve 12 upon downward movement of the bail for unseating said valve against a spring 13; such spring being provided for seating the valve 12 upon return of the handle 8a to its normal position.

The sand valve 12 is contained in a chamber 14 which is connected by way of a passage and pipe 15 to a fluid pressure supply pipe 16 which is supplied with fluid at a desired reduced pressure through the feed valve device 3 from the main reservoir 2. The valve stem 11 is provided with a fluted portion extending from the valve through a chamber 17. The chamber 17 is connected by a passage 18 to a sand pipe 19. The valve 12 is operative when unseated to supply the fluid under pressure from chamber 14 to chamber 17 and thence to the sand pipe 19, and when seated to cut off such supply of fluid under pressure.

The triple valve device 4 may be of any suitable type adapted to respond to either a service or an emergency reduction in pressure in brake pipe 7, effected by operation of the brake valve device 1, to supply fluid under pressure from the auxiliary reservoir 5 through a pipe 69 to the brake cylinder device 6 to effect either a service or an emergency application of the brakes, respectively, on the vehicle. Upon an increase in pressure in brake pipe 7 the triple valve device 4 is adapted to operate to recharge the auxiliary reservoir 5 from brake pipe 7 and to connect the brake cylinder 6 to the atmosphere for effecting a release of the brakes on the vehicle. A further description of the construction and operation of the fluid pressure brake equipment on the vehicle is not deemed essential to a comprehensive understanding of the invention.

According to the embodiment of the invention shown in Fig. 1, an improved sanding apparatus is provided which is so associated with the fluid pressure brake equipment above described as to operate automatically when either a service or an emergency application of the brakes is effected on the vehicle to supply sand for sanding the track rails at a rate or to a degree which varies substantially according to the speed at which the vehicle is operating, so as to thereby ensure most efficient braking of the vehicle but at the same time avoid excessive use and waste of sand. For the purpose of simplicity only the apparatus necessary to provide sand for one rail is shown in the drawings, it of course being understood that both rails of a railway track are to be sanded and that such duplication of devices or parts thereof as required to accomplish this end fall within the scope of the present invention.

The improved sanding apparatus shown in Fig. 1 comprises a sanding device 20, a cleaning device 21 therefor, a pneumatic switch device 22, a pneumatic cylinder device 23, a timing valve device 24, and ceratin other parts which will be later brought out.

The sanding device 20 is of conventional structure comprising a casing 25 having therein a substantially horizontally extending sand carrying cavity 26. The cavity 26 is open at one end of the casing to an outlet pipe 27 for conveying sand supplied thereto from cavity 26 to a track rail 28 in front of a vehicle wheel 29. The opposite end of cavity 26 is open to an upwardly extending sand supply passage 30, the upper end of which connects to the bottom of a sand box 31 which is provided on the vehicle for carrying a supply of sand for sanding purposes and from which sand is adapted to flow by gravity through the passage 30 into the cavity 26.

An air jet 32 is disposed in cavity 26 below passage 30 and is so arranged as to direct a blast of air supplied thereto in the direction of the outlet pipe 27 for thereby blowing sand deposited by gravity in cavity 26 to said outlet pipe for sanding the track rail 28. The jet 32 is connected to a pipe 33 through which fluid under pressure is adapted to be supplied to the jet, and between said jet and pipe there is provided a check valve 34 for preventing sand from cavity 26 entering the pipe 33.

The cleaning valve device 21 is also of usual construction comprising a piston 35 having at one side a chamber 36 connected to pipe 33 and having at the opposite side a chamber 37 open to the atmosphere through a passage 38 and containing a spring 39 acting on said piston for urging same to the position shown. The piston 35 is provided with a stem 40 which extends through a suitable bore in the casing and which is provided on its end with a double beat valve

41 disposed to operate in a chamber 42. In the position which valve 41 is shown said valve is adapted to close communication between chamber 42 and a passage 43. The valve 41 is adapted to be moved by piston 35, when fluid under pressure is supplied to chamber 36, from the position shown to an opposite position into engagement with a seat 44 for closing communication between the fluid pressure supply pipe 16 and chamber 42. During movement of the valve 41 between its two seated positions a limited flow of fluid under pressure is adapted to occur from the fluid pressure supply pipe 16 through the chamber 42 to passage 43 as will be apparent.

The passage 43 is connected by a pipe 45 to a passage 46 in casing 25 of the sanding device 20. One end of passage 46 is connected to a cleaning pipe 47 the outer end of which is preferably closed and which is provided with a plurality of spirally arranged outlet jets 48 through which a blast of air is adapted to be directed into passage 30 for loosening and blowing sand out of said passage to the cavity 26. At the end of passage 46 connected to pipe 45 there is provided a port 49 connecting said passage to cavity 26 and arranged to direct a blast of air from said passage toward the outlet pipe 27 for blowing sand out of said pipe. By this arrangement, all of which is conventional, both the outlet pipe 27 and sand supply passage 30 are adapted to be cleaned upon initiating a sanding operation so as to insure prompt and intended flow of sand for sanding purposes, as will be later brought out.

According to the invention a slide valve 51 is provided for controlling the flow capacity of passage 30 to supply sand by gravity from the sand box 31 to cavity 26. This slide valve normally closes communication through the passage 30 so as thereby to cut off all supply of sand to cavity 26 and is provided with a port 52 adapted upon movement in the direction of the right hand, as viewed in Figs. 1 and 2 of the drawings, to open communication between the sand box 31 through passage 30 to cavity 26. The area of this communication and the capacity thereof to supply sand by gravity to cavity 26 obviously depends upon the position of port 52 in valve 51 with respect to passage 30 and increases upon movement of the valve toward the right hand. The port 52 may be of any desired shape, such as triangular as shown in Fig. 2, to provide the desired different rates of supply of sand in different positions which it may assume, as will be later brought out.

The slide valve 51 is provided at one end with a stem 53 having a collar 54 adapted to engage the casing for defining the closed position of the valve, as shown in the drawings. A spring 55 is provided to act on collar 54 for moving the valve 51 to its closed position. An electro-magnet 56 is provided for controlling the position of the valve 51 and comprises an armature 57 operatively connected to the opposite end of the valve and an operating coil 58 connected across a pair of electrical conductors 59 and 60.

An electric generator 61 is provided for controlling the operation of the electro-magnet device 56 in accordance with the speed at which the vehicle is operating and to this end is secured for operation from the vehicle wheel 29 so that the output of the generator will vary in accordance with variations in the speed of the vehicle. One terminal of the generator 61 is connected to the electric conductor or wire 59 while the other terminal is connected to a wire 62. The wires 60 and 62 are connected, respectively, to fixed contact fingers 63 and 64 which are arranged to be electrically connected by a movable contact 65 associated with the pneumatic switch device 22.

The pneumatic switch device 22 comprises a casing containing a piston 66 which is provided with a stem 67 carrying at its outer end the contact 65. At one side of piston 66 there is provided a chamber 68 which is connected by pipe 69 to the brake cylinder device 6. A spring 70 is provided to act on the opposite face of piston 6 for operating said piston to draw the contact 75 out of circuit closing relation with the contact fingers 63 and 64.

With the movable contact finger 65 in circuit closing relation with contact fingers 63 and 64 it will be noted that the output of generator 61 is impressed on the operating coil 58 of the electro-magnet 56 and will effect movement of armature 57 and thereby of the slide valve 51 in the direction of the right hand, as viewed in Figs. 1 and 2 against the opposing and measuring pressure of spring 55. The extent of this movement of valve 51 is adapted to vary in accordance with the output of the generator 61 as governed by the speed at which the vehicle is operating and, as will be apparent, the area of port 52 in valve 51, which controls the rate at which sand will be supplied from the sand box 31 to cavity 26 will therefore vary in accordance with the speed at which the vehicle is operating. These parts are so designed that when the vehicle is operating at a certain relatively high speed the slide valve 51 will be positioned with the full area of port 52 in said valve effective to supply sand to cavity 26. When the vehicle speed is substantially zero the slide valve will be positioned to substantially cut off all supply of sand to cavity 26, and for all intermediate speeds the slide valve will be positioned so that the opening through port 52 for supplying sand to cavity 26 will vary the rate of sand supply to cavity 26 in proportion to the different speeds.

The pneumatic cylinder device 23 comprises a casing containing a piston 73 having at one side chamber 74 connected to pipe 19 and having at the opposite side a chamber 75 containing a spring 76 which acts on the piston for urging the same to the position shown in the drawings. The piston 73 is provided with a stem 77 extending through chamber 75 and an opening in the end of the casing into coaxial alignment with the armature 57 of the electromagnet device 56. A release port 78 is provided through piston 73 connecting chamber 74 to chamber 75 and the latter chamber is open to the atmosphere by way of a leakage groove 79 provided through the casing along stem 77. With the piston stem 79 in its normal position shown and with the armature 57 of the electro-magnet device 56 also in its normal position there is provided a slight clearance space between the adjacent ends of said stem and armature, as clearly shown in the drawings.

The timing valve device 24 comprises a piston 81 having at one side a chamber 82 which is connected to the brake cylinder pipe 69 and having at the opposite side an operating stem 83 which projects into a chamber 84 connected to a pipe 85. A pair of oppositely seating valves 86 and 87 are provided in a chamber 88 in coaxial alignment with the piston stem 83. The valve 86 is provided for controlling communication between chambers 88 and 84 and has a fluted

stem 89 arranged to be engaged by the piston stem 83. The valve 87 is arranged to control communication between chamber 88 and a chamber 90 and is provided with a fluted stem 91 extending into the latter chamber wherein a spring 92 is arranged to act on said stem for moving the valves 86 and 87 to their normal positions, shown in the drawings.

The chamber 90 in the timing valve device is connected through an air strainer device 93a to the fluid pressure supply pipe 16. With the valves 86 and 87 positioned as shown in the drawings, fluid under pressure supplied from the supply pipe 16 to chamber 90 is adapted to flow past valve 87 to chamber 88 and then through a pipe 93 to a sanding reservoir 94 for charging said reservoir with fluid under pressure. The valves 86 and 87 are adapted to be shifted to their opposite positions by the piston 81 when fluid under pressure is supplied to chamber 82, and when thus positioned to close communication between chambers 90 and 88 and open communication between chambers 88 and 84 to supply fluid from the sanding reservoir 94 to the pipe 85.

The pipe 85 is connected to one end of a double check valve device 97 the other end of which is connected to pipe 19. The side outlet of the double check valve device 97 is connected to the pipe 33. The double check valve device comprises a double check valve 96 arranged to operate in the usual manner to control communication between the pipe 33 and the pipes 19 and 85.

Operation of embodiment of invention shown in Fig. 1

Whenever either a service or an emergency application of the brakes on the vehicle is effected by operation of the brake valve device 1, fluid at the pressure supplied to the brake cylinder device 6 flows to piston chamber 68 in the pneumatic switch device 22 and to piston chamber 82 in the timing valve device 24.

The fluid pressure thus supplied to the switch device 22 actuates the piston 66 to effect movement of the movable contact 65 into engagement with the contact fingers 63 and 64 thereby connecting the coil 58 of the electro-magnet device 56 in circuit with the generator 61 operated from the wheel 29. The output of the generator is thus impressed upon the operating coil 58 of the electro-magnet device 56 and effects movement of the armature 57 and valve 51 against the opposing force of spring 55 to a position dependent upon the speed at which the vehicle is operating at the time. This movement of the valve 51 opens communication between the sand box 31 and cavity 26 in the sanding device through port 52 in the valve to permit sand to flow by gravity from said sand box to said cavity at a rate which is proportional to the speed of the vehicle.

At the same time as the pneumatic switch device 22 is thus operated fluid pressure supplied to piston chamber 82 in the timing valve device 24 actuates the piston 81 to unseat the valve 86 and to seat the valve 87. With the valve 86 unseated fluid under pressure flows from the sanding reservoir 94 to pipe 85 leading to one end of the double check valve 96. The fluid pressure in pipe 85 then shifts the double check valve 96 to the position for closing communication between pipe 33 and pipe 19 and for connecting the pipe 85 to the pipe 33 whereupon fluid under pressure flows from pipe 85 to pipe 33 and then to jet 32 in the sanding device and also to piston chamber 36 in the cleaning valve 21.

The fluid pressure thus supplied to piston chamber 36 actuates piston 35 to effect movement of the double beat valve 41 from the position shown to its opposite position into engagement with the valve seat 44 and during such movement a limited flow of fluid under pressure occurs from the fluid pressure supply pipe 16 to the passage 43. The fluid pressure thus supplied to passage 43 flows to passage 46 in the sanding device 20 and then through jets 48 in the cleaning pipe 47 to passage 30 for cleaning sand out of said passage and also from passage 46 through the port 49 to the sand pipe 27 for cleaning sand therefrom. This supply of fluid to jets 48 and to the port 49 is in the form of a sudden blast of short duration to accomplish the cleaning action just described.

At the same time as the cleaning device 21 is operated, as just described, fluid under pressure flows from pipe 33 past the check valve 34 and through the jet 32 into cavity 26 of the sanding device 20 and through said cavity to the outlet pipe 27, and this stream of air is adapted to pick up and carry the sand supplied to said cavity through the sand valve 51 to the outlet pipe 27 through which said sand is adapted to be conveyed to the rail 28 ahead of the wheel 29 for increasing the traction thereof.

The amount or quantity of sand thus supplied to the rail 28 is limited, as will be apparent, to the effective capacity of port 52 in valve 51 to supply sand from the sand box 31 to the cavity 26 and will be greatest when the speed of the vehicle and therefore the output of the generator 61 is sufficient to operate the electro-magnet device 56 to position the valve 51 so as to render the full area of port 52 effective.

As the speed of the vehicle is reduced during braking, the output of the generator 61 is adapted to reduce accordingly and the corresponding reduction in force of the electro-magnet device 56 permits the spring 55 to move the valve 51 toward the left hand to a position depending upon the reduction in vehicle speed, and as will be apparent, the effective opening through port 52 in valve 51 will be reduced in proportion so that the amount or quantity of sand supplied from the sand box 31 to cavity 26 will be correspondingly reduced. The supply of sand for sanding the track rail 28 will be thus varied in proportion to the speed of the vehicle wheel 29 and the parts are so designed and arranged that the amount or quantity of sand supplied for sanding rail 28 will provide a substantially uniform degree of sanding regardless of the speed at which the vehicle is operating. Efficient braking of the vehicle is thereby ensured, and at the same time excessive use or waste of sand avoided.

The volume of the timing reservoir 94 is such as to provide for the flow of fluid under pressure through the jet 32 for a sufficient length of time to supply sand through the supply pipe 27 to the rail 28 until the vehicle is brought to substantially a complete stop from the maximum speed at which the vehicle might be operating at the time an application of brakes is initiated. The valve 51 and its control by the generator 61 are so arranged that at the time the vehicle speed reduces to substantially zero the spring 55 will have fully closed the valve 54 against the opposing reduced force of the electro-magnet 56. By this arrangement sand will not be supplied to the rail

28 and thus wasted when the vehicle is stopped and there is no use for sand.

When the fluid pressure is substantially completely vented from the sanding reservoir 94 and piston chamber 36 of the cleaning valve device spring 39 acting on piston 35 returns the piston 35 to its normal position shown thereby moving the valve 41 out of engagement with seat 44 and back to its normal position shown. During this movement of the double beat valve 41 a sudden but limited blast of fluid under pressure will flow from the fluid pressure supply pipe 16 to passage 43 and then to the sanding device 20 for effecting cleaning thereof in the same manner as occurred at the time the sanding operation was initiated. The sanding device 20 is thereby conditioned to properly function upon a subsequent application of the brakes.

As is well known, it is customary to reduce the degree of brake application on a vehicle or train as the speed reduces in order to avoid too rapid deceleration thereof or the possibility of sliding of wheels. As a result, at the time the vehicle comes to a substantial stop the degree of pressure still acting in the brake cylinder device 6 will be relatively low. The spring 67 in the pneumatic switch device 22 is so designed as to move the piston 66 back to its initial position for thereby disengaging the contact 65 from the contact fingers 63 and 64 whenever the pressure in the brake cylinder 6 becomes reduced to the relatively low degree that might exist at the time the train is brought to a full stop. By this arrangement the coil 58 of the electro-magnet device 56 is disconnected from the generator 61 at a time when no further sanding of the rail 28 is required so as to thereby avoid overheating of said coil.

If when the brakes on the vehicle are applied the vehicle wheel 29 should cease to turn on the rail 28 the output of the generator 61 and the force of the electro-magnet device 56 will immediately reduce to substantially zero and as a consequence permit spring 55 to promptly close the valve 51 and thereby cut off the supply of sand to the rail 28 in front of the wheel 29. This is very desirable in that it will avoid excessive abrasion of the wheel and rail during the period of wheel sliding. If, subsequently, during the brake application the wheel 29 starts turning on the rail 28 then current is again delivered by the generator 61 and operates the electro-magnet device 56 to again sand the rail 28 for increasing the traction between said wheel and rail.

When the operator operates the brake valve device 1 to effect a release of the brakes on the vehicle subsequent to an application, fluid under pressure is vented from piston chamber 82 of the timing valve device 24 along with that from the brake cylinder device 6 and when reduced sufficiently the spring 92 acting on the valve stem 91 unseats the valve 87 and seats the valve 86. With the valve 87 thus open the sand reservoir 94 is again charged with fluid under pressure from the fluid pressure supply pipe 16 so as to be in condition for a subsequent sanding operation, such as just described.

If, at any time, the operator desires to supply sand to the rail 28, for increasing the degree of adhesion between the rail and wheel 29 either during braking or during acceleration of the vehicle, he may depress the brake valve handle 8a and thereby operate the bail 9 to move the valve stem 11 in a downwardly direction for unseating the sand valve 12. When the sand valve 12 is thus unseated, fluid from the supply pipe 16 flows to chamber 17 and then through passage 18 to pipe 19.

Fluid under pressure thus supplied to the pipe 19 flows to piston chamber 74 in the pneumatic cylinder device 23 and therein acts on piston 73 for effecting movement thereof in the direction of the right hand against the opposing pressure of spring 76. After slight movement, the piston stem 77 engages the armature 57 of the electro-magnet device 56 so that further movement of the piston 73 then acts through said armature to shift the slide valve 51 against the pressure of spring 55 to the position in which the full effective area of port 52 is available to provide for a maximum flow of sand from the sand box 31 to cavity 26 in the sanding device 20.

At the same time as the pneumatic cylinder device 23 is thus operated, fluid under pressure supplied to pipe 19 also flows to the double check valve device 97 and operates the check valve 96 to disconnect pipe 65 from pipe 33 and to connect pipe 33 to pipe 19 so that fluid pressure then flows from the pipe 19 to pipe 33 and then to the jet 32 in the sanding device and to the cleaning device 21. The cleaning device then operates in the same manner as hereinbefore described while the fluid pressure supplied to the jet 32 blows the sand supplied through the valve 51 to cavity 26 out of said cavity to sand pipe 27 and then to the rail 28.

The piston 73 may be operated to actuate the valve 51 as just described when the electro-magnet 56 is effective during braking or at any other time desired. This is however immaterial since whenever the piston 73 is operated it provides sufficient force to overcome the spring 55 and move the valve 51 to its full open position.

Whenever it is desired to terminate manual sanding of the track rail 28, as just described, the operator permits the handle 8a of the brake valve device 1 to return to its normal position shown thereby relieving the unseating pressure on valve 12 which permits spring 13 to seat said valve and cut off the supply of fluid under pressure to pipe 19. The fluid pressure acting in piston chamber 74 of the pneumatic cylinder device 23 is then dissipated through the release port 78 to chamber 75 and then to the atmosphere through the leakage groove 79 whereupon spring 76 returns the piston 73 to its normal position shown. Spring 55 acting on the slide valve 51 then returns said supply valve to its normal position so as to cut off further flow of sand to the sand device 20, or to a position depending upon the degree of energization of the electro-magnet device 56 in case the manual sanding was superimposed upon automatic sanding at which time the opening of valve piston 51 was controlled by the electro-magnet device 56. Upon the venting of fluid from pipe 19 the manually controlled supply of fluid to the jet 32 and cleaning device 21 is also terminated and said cleaning valve will then operate as heretofore described to effect cleaning of the sanding device 20.

Since automatic sanding of the track rail 28 is insured whenever an application of the brakes on the vehicle is effected, regardless of whether such application is a service or an emergency application, the operation of the brake valve handle 8a to manually effect sanding of the rail during braking will seldom if ever be resorted to as will be apparent. However, this manual sanding control provides for the usual sanding of the rails during acceleration and at any other time in case of emergency.

It is customary to make a standing test of the brakes on a train before the train leaves a terminal, that is, a test with the train not under motion, under which condition there is obviously no need for sand on the rails. As will be apparent, no sanding of the rails will be effected with the present embodiment of the invention under the condition just described, since the sanding is dependent upon movement of the vehicle.

Description of embodiment of invention shown in Fig. 3

In this embodiment of the invention means are provided for adjusting the position of the sanding valve **51** in the sanding device **20** by fluid at a pressure which is varied according to the speed at which the vehicle is operating, instead of by the generator **61** and electro-magnet device **56** shown in Fig. 1 and hereinbefore described.

As shown in Fig. 3, a pneumatic cylinder device **101** is employed to cooperate with spring **55** under all conditions of sanding to position the sanding valve **51**. The cylinder device **101** may be the same as the cylinder device **23** shown in Fig. 1 except in the device **101** there is no spring provided at the low pressure side of the piston **73** to oppose movement thereof upon the supply of fluid under pressure to chamber **74** at the opposite side of the piston. Extending from the slide valve **51** for engagement by the piston rod **77** is any suitable member such as armature **57** hereinbefore described.

The apparatus shown in Fig. 3 further differs 'from tha shown in Fig. 1 in that it embodies a speed controlled device **102** for supplying fluid at a pressure which varies in accordance with the speed at which the vehicle is operating, and a cut-off valve device **103** for controlling the supply of fluid from the device **102** to the pneumatic cylinder device **101**.

The device **102** comprises a casing having a stationary portion **104** embodying a self-lapping valve mechanism including a supply valve **105** and a release valve **106**, and a rotary portion **107** embodying a centrifuge device including weighted levers **108** pivoted intermediate their ends to said rotary portion **107** of the casing and rotatable therewith. The rotary casing section **107** is adapted to be rotated according to the speed of the vehicle as by an endless belt drive from an axle or other element driven according to the speed of the vehicle to a pulley **109** coaxially secured to the casing **107**. A rod or stem **110** extends into the stationary and rotary portions of the casing and is slidable with respect thereto and the end of said rod in said rotary portion is engaged by the inner ends of levers **108**. As the speed of the vehicle increases the outer weighted ends of the levers **108** are adapted to move outwardly for urging the rod **110** in the direction of the stationary portion **104** of the casing, while upon a decrease in vehicle speed the weighted ends of the levers are adapted to move inwardly to permit movement of rod **110** in the opposite direction.

A movable abutment in the form of a piston **111** is slidably mounted in the stationary casing section **104** and is secured to the lower end of the stem **110**. At the upper side of the piston **111** is a chamber **112** which is constantly open to the atmosphere through a port **113**. At the opposite side of piston **111** is a chamber **114** which contains the release valve **106** and a light bias spring **115** which acts on the piston for urging same in the direction away from the release valve. The piston **111** is provided centrally with an exhaust passage **116** which is at all times open to chamber **112**, and the valve **106** is arranged to control communication between the chamber **114** and said passage.

The supply valve **105** is contained in a chamber **117** and said valve and the release valve **106** are connected together by a stem **118** which extends loosely through a passage **119** connecting chambers **117** and **114**. A spring **120** in chamber **117** acts on the supply valve **105** for urging it to its closed position shown in the drawings. The chamber **117** is connected to a pipe **121** through which fluid at the pressure carried in the supply pipe **16** is adapted at all times to be supplied to said chamber.

Briefly, the operation of the speed controlled valve device **102** is as follows: Assuming that the vehicle is moving along the track the rotary housing **107** is caused to turn at a speed which is proportional to the rate of movement of the vehicle. The action of centrifugal force on the weighted levers **108** causes said levers to move outwardly and exert a force on stem **110** for moving the piston **111** in a downwardly direction into engagement with release valve **106** so as to close communication between the chamber **114** and release passage **116**. As the action of centrifugal force on the weighted levers **108** continues to force the piston **111** down, said piston acts through the release valve **106** and stem **118** to unseat the supply valve **105** whereupon fluid under pressure flows from chamber **117** through the passage **119** to chamber **114** and therein acts on the piston **111** in opposition to the action of centrifugal force on said piston.

When the pressure of fluid in chamber **114** is thus increased sufficiently, acting in conjunction with the relatively light biasing pressure of spring **115**, to overcome the action of centrifugal force on piston **111**, said piston is moved upwardly to permit the supply valve **105** to close to prevent further increase in pressure therein. Thus if the vehicle is operating at a relatively high speed a relatively high fluid pressure will be obtained in chamber **114**, while in case the vehicle is operating at a relatively low speed the pressure of fluid obtained in said chamber will be at a correspondingly low degree. If the speed of the vehicle increases an increase in centrifugal force will actuate the piston **111** to provide a proportionate increase in the pressure of fluid in chamber **114**, as will be evident. In case the speed of the vehicle reduces, the action of centrifugal force on piston **111** reduces a corresponding amount, which permits pressure of fluid in chamber **114** to move said piston in an upwardly direction and out of contact with the release valve **106**. As a result, fluid under pressure is released from chamber **114** through the exhaust passage **116**. This release of fluid from chamber **114** reduces the pressure of fluid on piston **111** and, as will be readily apparent, when this pressure is reduced sufficiently the action of centrifugal force transmitted through stem **110** to said piston will move the piston back into engagement with the release valve **106** for preventing the further release of fluid under pressure from chamber **114**. In this manner the pressure in chamber **114** will be maintained proportional to the speed at which the vehicle is operating at all times.

The cut-off valve device **103** comprises a casing having a chamber **123** which is at all times con-

nected to chamber 114 in the speed controlled device 102 by way of a pipe 124. Whenever the vehicle is operating it will therefore be apparent that chamber 123 will be charged with fluid at a pressure proportional to the speed of the vehicle.

The casing of the cut-off valve device also has a chamber 125 open to chamber 123 through a bore 126 and also open to an outlet pipe 127. A valve 128 is provided in chamber 123 for controlling communication between chamber 125 and the bore 126. A spring 129 in chamber 123 acts on valve 128 for normally urging it to its seat.

The valve 128 is connected to a stem 130 which projects from one face of a piston 131 through chamber 125. At the opposite side of piston 131 there is provided a chamber 132 which is connected to a pipe 133 leading to the brake cylinder pipe 69. A gasket 134 is provided on the side of piston 131 adjacent chamber 125 for engagement by said piston.

The outlet pipe 127 is connected through a check valve device 138 to a pipe 135 which leads to piston chamber 74 in the pneumatic cylinder device 101. The pipe 19 through which sanding on the vehicle is adapted to be manually controlled in the same manner as described in connection with the construction shown in Fig. 1 is also connected to the pipe 135 through a check valve device 137.

Operation of embodiment of invention shown in Fig. 3

Whenever fluid under pressure is supplied to the brake cylinder device 6 for applying the brakes on the vehicle, fluid also flows from the brake cylinder pipe 69 through pipe 133 to piston chamber 132 in the cut-off valve device 103 and therein acts on the piston 131 to effect movement thereof into sealing engagement with the gasket 134. This operation of the piston 131 acts to unseat the valve 128 and thereby permit fluid at the pressure supplied by the speed governor device 102 to chamber 123 to flow to chamber 125 and then through pipe 127, check valve device 138 and pipe 135 to piston chamber 74 in the pneumatic cylinder device 101.

The pressure of fluid thus obtained in chamber 74 acts on piston 73 to effect movement thereof in the direction of the right hand against the opposing pressure of spring 55. The extent which the piston 73 is thus moved depends upon the pressure of fluid supplied to chamber 74, said fluid pressure and that of spring 55 cooperating to define a position of the sanding valve 51, shown in Fig. 1, which corresponds to the pressure of fluid acting on the piston 73 and therefore to the speed at which the vehicle is operating. Sand is thus supplied from the sand box 31 to the sanding device 20 at a rate determined by the speed of the vehicle.

As the vehicle speed reduces the speed controlled device 102 acts to reduce the pressure of fluid in chamber 114 as above described and as a result the pressure of fluid in chamber 74 acting on piston 73 in the pneumatic cylinder device 101 correspondingly reduces through a small leak port 136 which may be provided in pipe 135, it being noted that with this construction the speed controlled device acts to maintain the pressure of fluid in chamber 74 substantially equal to that in chamber 114 against the continuous loss through this small leak port. As a result of the reduction to fluid pressure in chamber 74 spring 55 acts to urge the sand valve 51 in the direction of the left hand to a position where the spring force is counterbalanced by the reduced pressure of fluid in chamber 74. The valve 51 thus assumes a new position corresponding to the reduced speed at which the vehicle is operating and reduces the amount or quantity of sand supplied to the sanding device 20 in proportion to the reduction in speed. The spring 55 will thus continue to act as the pressure of fluid in chamber 74 continues to be reduced by the speed controlled device 102 as the vehicle speed reduces to cause further corresponding changes in the position of the sand valve 51 to thus reduce the rate at which sand is supplied from the sand box 31 to the sanding device 20 in proportion to the reduction in speed of the vehicle. In other words, by varying the pressure of fluid supplied to chamber 74 for acting on piston 73 according to the changes in speed at which the vehicle operates the position of valve 51 will be varied by spring 55 to vary the rate at which sand is supplied to the sanding device 20 for sanding the track rail in proportion to the vehicle speed, in the same manner as accomplished electrically with the apparatus shown in Fig. 1.

If, when the brakes on the vehicle are applied the wheel driving the speed controlled device 102 should cease rotation and start sliding on the rail, the action of centrifugal force on the weighted levers 108 will promptly reduce to zero, as a result of which, the piston 111 will be moved to the position shown by the pressure of fluid and that of spring 115 in chamber 114. The supply of fluid to the cylinder device 101 will be thus cut off and the fluid pressure in chamber 74 thereof will then promptly vent to the atmosphere through the leak port 136. As a result, spring 55 will operate the valve 51 to cut off the supply of sand for sanding the track rail. If subsequently the wheel for driving the speed controlled device 102 should again start rotating, then fluid under pressure will again be supplied to the cylinder device 101 to effect the supply of sand for sanding the rail at a rate proportional to the rate of such rotation, as will be apparent.

It will be noted that during sanding operation, the leak port 136 in pipe 135 provides a constant leak of fluid under pressure from chamber 114 in the speed controlled device 102 and another purpose for this is that it causes the piston 111 to be constantly in operation during the sanding period so as to thereby remain in a very sensitive condition to accurately vary the pressure of fluid in chamber 74 of the cylinder device 101 according to changes in vehicle speed. The check valve 137 is provided to prevent the flow of fluid under pressure from pipe 135 as to pipe 19 leading to the brake valve device 1 during automatic sanding operation just described.

Sand will continue to be supplied for sanding the track rail as above described as long as fluid is supplied to piston chamber 74 in the pneumatic cylinder device at a pressure sufficient to open the valve 51 to any degree. The supply of sand may be terminated either by a reduction in brake cylinder pressure in piston chamber 132 to a relatively low degree, such as five pounds, which may occur at substantially the time the vehicle comes to a stop and at which pressure the valve 128 may be closed by spring 129, or said supply of sand may be terminated by the speed controlled device 102 at substantially the time the vehicle comes to a stop when the force of the light bias spring 115 becomes sufficient to overbalance the action of centrifugal force on the

weighted lever arms 108 and move piston 111 away from the release valve 106. In either case the supply of sand to the rails will be terminated by the time the vehicle stops and waste of sand will be avoided. The primary purpose of the cut-off valve device 103 however is to prevent the supply of fluid under pressure to the pneumatic cylinder device 101 when the brakes on the vehicle are released.

Since the speed controlled device 102 acts to supply fluid under pressure for effecting sanding only when the vehicle is under motion it will be noted that sand will not be supplied for sanding a track rail when making a standing test of the brake system.

In case it is desired to manually effect sanding of the track rail the brake valve device is operated to supply fluid under pressure to pipe 19 through which it flows to the double check valve device 97 and thence to the sanding device 20 for effecting operation thereof in the manner before described. Fluid pressure supplied to pipe 19 also flows through the check valve device 137 to pipe 135 and thence to piston chamber 74 in the pneumatic cylinder device 101. The pressure of fluid thus provided in chamber 74 acts on the piston 73 to effect movement of the sand valve 51 to its wide open position against the opposing pressure of spring 55. The maximum amount of sand for sanding of the track rails is thus obtainable upon operation of the brake valve device, as will be apparent. The check valve 138 acts during manual sanding, just described, to prevent the flow of fluid under pressure from pipe 135 to pipe 127.

Description of embodiment of invention shown in Fig. 4

In the arrangements shown in Figs. 1 and 3 of the drawings sanding of the track rail during braking is effected automatically whenever either a service or an emergency application of the brakes is effected on the vehicle. In Fig. 4 of the drawings is shown an arrangement whereby all sanding, including sanding according to speed, is directly under the control of the operator of the vehicle.

In the apparatus shown in Fig. 4, the sanding bail 9 is provided with an extension 140 on the lower face of which is fixed an electrical contact 141 adapted upon downward movement of the bail to engage two flexible contact fingers 142 prior to engagement of the bail with the sand valve stem 11.

The wire 60, shown in Fig. 1 connected to the pneumatic switch device 22, is in this embodiment connected to one contact finger 142. In this embodiment the electromagnet device 56 is employed to position the sand valve 51 and one terminal of the coil 58 of said device is connected to wire 59 as in Fig. 1 while the other terminal of said coil is connected to a wire 143 leading to the other contact finger 142. It will thus be evident that the contact 140 associated with the sand bail 9 and the contact fingers 142 constitutes a manually operative switch for controlling the energization and deenergization of the electro-magnet device 56.

A supply magnet valve device 144 is provided for controlling the supply of fluid under pressure to the sanding device 20 and to the cleaning device 21 in place of the timing valve device 24 shown in Fig. 1. This magnet valve device 144 comprises a magnet 145 connected across the wires 143 and 59 in parallel with the electro-magnet device 56 and a valve 146 arranged to be opened upon energization of the magnet 145. The valve 146 is contained in a chamber 147 which is connected to the fluid pressure supply pipe 16 and in said chamber there is provided a spring 148 acting on the valve for seating same upon deenergization of the magnet 145. The valve 146 is provided for controlling communication between chamber 147 and a chamber 149 which is connected to a pipe 150 leading to the double check valve device 97 in place of the pipe 85 shown in Fig. 1.

Operation of embodiment of invention shown in Fig. 4

Whenever it is desired to effect sanding of the track rail 28 at a rate proportional to speed during braking, the operator depresses the brake valve handle 8a to a degree sufficient for operating the sanding bail 9 to move the contact 140 into circuit closing relation with the contact fingers 142 for thereby connecting the electromagnet device 56 and also the magnet valve device 144 in circuit with the generator 61 which is secured to rotate with the wheel of a vehicle as shown in Fig. 1 and as hereinbefore described. As a result the electro-magnet device 56 is energized and operates in the same manner as hereinbefore described to position the sanding valve 51 against the pressure of spring 55 so as to thereby supply sand from the sand box 31 to chamber 26 in the sanding device 20 at a rate depending upon the speed at which the vehicle is operating.

At the same time as sand is thus supplied to the sanding device 20 the eenrgization of the magnet 144 unseats valve 146 and supplied fluid under pressure from pipe 16 to pipe 150 and then through the double check valve device 97 to the sanding device 20 for blowing the sand to pipe 27 for flow to the track rail.

The amount or quantity of sand supplied for sanding the rail will with this embodiment of the invention vary in proportion to the speed of the vehicle as will be apparent and will continue so long as the operator maintains the brake valve handle 8a in a position in which the contact 140 bridges the contact fingers 142 or until the vehicle is brought to a substantial stop at which time the pneumatic switch device 22, shown in Fig. 1, will operate to open the circuit through the electro-magnet device 56 and the magnet valve device 144 to cut off the supply of sand.

In this embodiment of the invention the maximum amount of sand for sanding of the track rails may be obtained at any time by further depression of the brake valve handle 8a and consequent operation of the bail 9 to unseat the sand valve 12 for supplying fluid under pressure to pipe 19, as will be apparent.

Description of embodiment of invention shown in Fig. 5

In this embodiment of the invention all sanding of the track rails is adapted to be controlled manually as in the embodiment just described but differs therefrom in that arrangements are provided for positioning the sand supply valve 51 pneumatically in a manner similar to that disclosed in Fig. 3 and above described.

As in Fig. 3, the speed controlled device 102 and cut-off valve device 103 are provided to control the supply of fluid at a pressure dependent upon the speed at which the vehicle is operating for controlling the operation of the pneumatic cylin-

der device 101 and thereby the position of the sand valve 51 whenever the brakes on the vehicle are applied. The supply of fluid under pressure to the pneumatic cylinder device 101 from the speed controlled device 102 is however under the manual control of the operator's brake valve handle 8a as will now be described.

In the brake valve device there are provided two poppet valves 139 and 151 which are arranged side by side and adapted to be simultaneously operated by a sanding bail 152 upon depression of the brake valve handle 8a. The valve 139 is contained in a chamber 154 which is connected through a passage 155 to the fluid pressure supply pipe 16 and is adapted to control communication between said chamber and a chamber 156 which is connected through a passage 157 and a pipe 158 leading to the jet 32 in the sanding device 20 and to the cleaning device 21. The valve 139 is provided with a stem 159 extending through chamber 156 and through the casing of the brake valve device into operating alignment with the sanding bail 152.

The valve 151 is contained in a chamber 160 which is connected by way of passage and pipe 161 to check valve device 138 and thence through pipe 127 to the cut-off valve device 103 and is provided for controlling communication between said chamber and a chamber 162 which is connected through a passage and a pipe 163 to the pneumatic cylinder device 101. The valve 151 is provided with a stem 164 which extends through chamber 162 and the casing of the brake valve device into operating alignment with the sanding bail 152, said stem and the stem 159 being arranged to be engaged by the sanding bail 152 at substantially the same time upon downward movement thereof.

A spring 166 in chamber 154 acts on valve 139 for urging it to its seated position shown, while a spring 167 in chamber 160 acts on the valve 151 for urging it to its closed position also shown.

Disposed in a chamber 168 is a sand valve 169 adapted to perform the function of the sand valve 12 shown in Fig. 1. The valve 169 is arranged below and in coaxial relation with the valve 139 and is provided with a stem 170 which extends through a port connecting chambers 154 and 168. This stem is of such length that with both of the valves 139 and 169 seated there is slight clearance space between said stem and the valve 139 to provide for unseating of the valve 139 before engagement of valve 139 and said stem. Chamber 168 is connected through a passage 171 to the passage and pipe 163.

Operation of embodiment of invention shown in Fig. 5

Whenever the brakes on the vehicle are applied and it is desired to effect sanding of the track rail at a rate depending upon the speed at which the vehicle is operating the operator depresses the handle 8a sufficiently to actuate the sanding bail 52 to unseat the valves 139 and 151 without however unseating the valve 169. The unseating of valve 151 permits fluid at a pressure supplied by the speed controlled device 102 through the cut-off device 103 to chamber 160 to flow to chamber 162 and then through passage and pipe 163 to the pneumatic cylinder device 101 which is thereby operated to position the valve 51 to supply sand from the sand box 31 to the sanding device 20 at a rate or in a quantity which is proportional to the speed at which the vehicle is operating.

At the same time as sand is thus supplied to the sanding device 20 fluid under pressure from the supply pipe 16 flows past the valve 139 to chamber 156 and then through passage 157 and pipe 158 to the sanding device 20 and cleaning device 21 for operating same in the same manner as hereinbefore described to blow the sand supplied to said sanding device through pipe 27 to the track rail for sanding same.

The speed controlled valve device 102 operates as hereinbefore described to reduce the pressure supplied for actuating the pneumatic cylinder device 101 as the speed of the vehicle reduces, and accordingly, the sand valve 51 is operated by the spring 55 to reduce the rate at which sand is supplied to the sand device 20 in proportion to the reduction in vehicle speed. The amount of sand supplied to the track rail 28 for sanding same will thus be varied such as to provide for a uniform degree of sanding regardless of the vehicle speed.

The operator may terminate sanding at will by removing pressure from handle 8a to permit closing of valves 139 and 151 in which case the leak port 136 provided, in this embodiment, in pipe 163 will promptly dissipate the fluid pressure from the pneumatic cylinder device 101 and permit closure of valve 51.

In case the operator maintains the valves 139 and 151 open throughout the stop, the supply of sand will be terminated automatically either by closure of the cut-off valve device 103 when the brake cylinder pressure is reduced to a relatively low degree or upon failure of the speed controlled device 102 to further supply fluid under pressure which will occur at the time the vehicle comes to a substantial stop.

Whenever the operator desires to supply the maximum amount of sand to the track rail either during braking or acceleration he depresses the handle 8a to a maximum degree and in so doing moves the valve 139 into engagement with the valve stem 170 and unseats the valve 169. Fluid from the supply pipe 16 supplied to chamber 154 then flows past the valve 169 to chamber 168 and then through passage 171, and pipe 163 to the pneumatic cylinder device 101 wherein this pressure acts to fully open the sand valve 51 against the opposing pressure of spring 55. The maximum amount of sand is thus supplied to the sanding device 20 for sanding purposes, and fluid under pressure continues to be supplied in this position of the brake valve handle past the valve 139 and through pipe 158 to the sanding device 20 for blowing the sand supplied thereto to the track rail. In order to terminate this sanding of the track rail the operator relieves manual pressure on the brake valve handle 8a which permits the various springs to seat the valves 139, 151, and 169 as will be apparent.

Description of embodiment of invention shown in Fig. 6

In the various embodiments of the invention above described, the amount of sand supplied for sanding the track rail was varied in accordance with the speed at which the vehicle was operating by varying the position of the sand valve 51. Substantially the same result may be accomplished by varying the amount of pressure of fluid supplied to jet 32 in the sanding device 20. By this arrangement the communication 30 connecting the sand box 31 to cavity 26 in the sanding device 20 may always be fully open to permit a maximum rate of flow of sand to said

cavity but the amount of sand which will be blown from said cavity to the outlet pipe 27 for sanding the track rail will vary according to the amount or pressure of fluid supplied through the jet 32.

When the brakes on a vehicle are applied the degree of application depends upon the pressure supplied to the brake cylinder device. It is customary to provide a maximum degree of pressure in the brake cylinder at the time an application of the brakes is initiated and to gradually reduce this pressure as the speed of the vehicle reduces, either by automatic means which may be controlled by the speed of the vehicle, or manually by the operation of a brake valve device. In either case the brake cylinder pressure is generally reduced according to the reduction in vehicle speed and therefore is usually at all times during braking substantially a function of speed.

In the embodiment of the invention shown in Fig. 6 advantage is taken of this relation between brake cylinder pressure and vehicle speed to vary the amount or pressure of fluid supplied to the jet 32 in the sanding device 20 for blowing sand to the track rail whereby the amount of sand supplied for sanding purposes will vary substantially as the vehicle speed varies.

The brake equipment shown in Fig. 6 is, for the purpose of simplicity, adapted to be manually controlled, and let it be assumed that the triple valve device 4 is of the type adapted to effect a graduated release of fluid from brake cylinder 6 upon the usual graduated release operation of the brake valve device 1 by the operator whereby the pressure of fluid in the brake cylinder device during deceleration of the vehicle may be maintained substantially proportional to the speed at which the vehicle is running.

According to this embodiment of the invention the pressure existing in the brake cylinder device 6, when the brakes on the vehicle are applied, is employed as a pilot pressure for controlling a differential relay valve device 175 which is adapted to operate to provide a corresponding pressure in a pipe 176 leading to the jet 32 in the sanding device 20 and to the cleaning device 21. A timing valve device 174 is provided for control by the pressure of fluid in the sanding reservoir 94 to limit the length of time which the relay valve device 175 will operate to supply fluid under pressure for sanding purposes. The valve device 24 is provided for controlling the operation of the timing valve device 174 according to the pressure existing in the brake cylinder 6.

The relay valve device 175 comprises a movable abutment in the form of a flexible diaphragm 177 having at one side a chamber 178 connected to a pipe 179 and having at the opposite side a chamber 180 connected through a chamber 181 to the pipe 176 leading to the sanding device 20 and cleaning device 21. A sliding stem 182 is provided for movement by the diaphragm 177 upon deflection thereof in a downwardly direction while a spring 183 acts on the stem for moving it in the opposite direction. A rocking beam 184 in chamber 181 is pivotally connected intermediate its ends to the stem 182. One end of the beam 184 is arranged to control the operation of a release valve 185 while the opposite end of the beam is arranged to control the operation of a fluid pressure supply valve 186. The release valve 185 is connected to the beam 184 for movement therewith and is provided for controlling communication between chamber 181 and a release port 187 which leads to the atmosphere. The supply valve 186 is contained in a chamber 188 which is connected by a pipe 189 to the fluid pressure supply pipe 16. A spring 190 in chamber 188 is provided for urging the supply 186 to its closed position.

The pipe 179 connects chamber 178 to the side outlet of double check valve device 97. One end of the double check valve 97 is connected to pipe 19 as in Fig. 1 through which fluid under pressure is adapted to be supplied for sanding of the track rail at any time. The other end of the double check valve device is connected to the pipe 191 which leads to a chamber 192 in the timing valve device 174.

The timing valve device 174 comprises a casing containing a piston 193 having at one side a chamber 194 which is connected to the timing reservoir pipe 93. In the casing there are provided two oppositely seating valves 195 and 196 having fluted stems which engage in chamber 192. The valve 195 is contained in a chamber 197 which is open to the atmosphere through a vent port 198. The piston 193 has a stem 199 extending into chamber 197 for controlling the valve 195 and the oppositely seating valve 196. The valve 196 is contained in a chamber 200 which is connected to the brake cylinder pipe 69. A spring 201 acts on the valve 196 for urging it to its seated position and for urging the valve 195 out of engagement with its seat.

Operation of embodiment of invention shown in Fig. 6

When the brakes on the vehicle are released and the brake cylinder 6 is thereby void of fluid under pressure, piston chamber 82 in the valve device 24 is likewise vented which permits spring 92 to unseat the valve 87 and to seat the valve 86. This permits fluid under pressure to flow from the fluid pressure supply pipe 16 through chamber 90, past the valve 87 to chamber 88 and then through pipe 93 leading to the timing reservoir 94 and to piston chamber 194 in the timing valve device 174. As a result, the timing reservoir 94 is charged with fluid at the pressure supplied to the supply pipe 16 and this pressure acting in chamber 194 of the timing valve device on piston 193 shifts said piston to and holds same in the position shown in which the valve 195 is seated and the valve 196 is unseated. With the valve 196 unseated the brake cylinder 6 is placed in communication with chamber 178 in the relay valve device 175 through the brake cylinder pipe 69, past the valve 196, through chamber 192, pipe 191 and double check valve device 97 and pipe 179.

Now if it is desired to brake the vehicle, the brake valve device is operated to effect operation of the triple valve device 4 to supply fluid under pressure to the brake cylinder 6 in the usual well known manner. Fluid at the pressure supplied to the brake cylinder device then flows through pipe 69 to chamber 82 in the valve device 24 and also to chamber 200 in the timing valve device 176. Fluid at brake cylinder pressure thus supplied to chamber 200 flows past the unseated valve 196 to chamber 192 and then through the double check valve device 97 to diaphragm chamber 178 in the relay valve device 175. The pressure of fluid thus supplied to chamber 178 in the relay valve device 175 acts on the diaphragm 177 and deflects same in a downwardly direction which moves the stem 182 and

thereby the fulcrum for beam 184 in the same direction.

During the initial downward movement of stem 182, as just described, one end of the beam 184 fulcrums about a stop screw 203 provided in the casing, due to which the opposite end of the beam acts to seat the release valve 185. After the release valve is thus seated, further downward movement of the stem 182 rocks the beam 184 about its connection with the release valve so that the opposite end of the beam engages the supply valve 186 and unseats same against spring 190. Fluid under pressure supplied to chamber 188 then flows past the supply valve 186 to chambers 181 and 180 and from chamber 181 through pipe 176 to jet 32 in the sanding device 20 and to the cleaning device 21 for effecting operation thereof in the manner hereinbefore described.

It will be noted that there will be a continual venting of fluid under pressure from chamber 181 through the jet 32 in the sanding device 20, but the capacity of supply valve 186 to supply fluid under pressure to chamber 181 exceeds the venting capacity of the jet 32, as a result of which the pressure of fluid increases in chamber 181 and in chamber 180 at the lower side of the diaphragm 177 and when increased to a degree substantially equal to brake cylinder pressure acting in chamber 178, the spring 183 starts moving the stem 182 in an upwardly direction. As the stem 182 is thus operated the beam 184 is also operated to permit spring 190 to move the valve 186 toward its seat so as to reduce the rate of supply of fluid under pressure to chamber 181 to a degree which will maintain the pressure of fluid in said chamber substantially equal to brake cylinder pressure acting in chamber 178. The pressure of fluid thus supplied to the jet 32 in the sanding device 20 will equal that acting in the brake cylinder device 6 and will blow sand through the sanding device to the sand pipe 27 in an amount proportional to said pressure and therefore proportional to brake cylinder pressure and the degree of brake application.

When a reduction in pressure in brake cylinder 6 is effected to compensate for a reduction in the speed of the vehicle said reduction becomes effective in chamber 178 of the relay valve device 175. As a result, the higher pressure in chamber 180 deflects the diaphragm 177 in an upwardly direction which permits spring 183 to elevate the stem 182 permitting closure of the supply valve 186 and then opening of the release valve 185. Unseating of the release valve permits the pressure of fluid acting in chambers 181 and 180 to reduce and when so reduced to a degree slightly less than the reduced brake cylinder pressure acting in the diaphragm chamber 178 the diaphragm 177 is again moved downwardly by brake cylinder pressure and acts through the stem 182 to first seat the release valve 185 and then unseat the supply valve 186 to an amount sufficient to maintain the pressure of fluid in the chamber 181 and in chamber 180 substantially equal to brake cylinder pressure in chamber 178.

In actual practice the release valve 185 may never open under the condition just described since the required reduction in pressure in chamber 180 to effect readjustment of the supply valve 186 to the reduced brake cylinder pressure acting in chamber 178 may occur through the jet 32.

In either case the pressure of fluid supplied through pipe 176 to the jet 32 in the sanding device 20 is reduced according to the reduction in brake cylinder pressure so that a lower pressure head is available to blow sand through the sanding device 20 to the outlet pipe 27 for sanding the rail. This results in less sand being supplied to the sand pipe 27 for sanding purposes, and assuming that the reduction in pressure in the brake cylinder device 6 corresponds to the reduction in vehicle speed the amount of sand supplied for sanding is reduced in proportion.

When a further reduction of pressure in the brake cylinder 6 is effected to compensate for a further reduction in vehicle speed, the relay valve device 175 will again operate to correspondingly reduce the pressure of fluid supplied to the sanding device 20 and the amount of sand supplied for sanding the rail will be proportionately reduced, as will be apparent.

It will now be evident that if brake cylinder pressure is reduced in proportion to the reduction in vehicle speed in order to provide for instance, a constant rate of deceleration of a vehicle, the sanding of the rails under a vehicle may be controlled by fluid at a pressure which varies in proportion to brake cylinder pressure and provide a substantially uniform degree of rail sanding for all vehicle speeds. In other words, the rate at which sand will be supplied or the quantity of sand supplied will vary in proportion to the vehicle speed.

At the time the application of brakes is initiated the fluid at brake cylinder pressure supplied to piston chamber 82 in the valve device 24 moves the piston 81 in a downwardly direction to unseat the valve 86 and to seat the valve 87. This cuts off the supply of fluid to the timing reservoir 94 and connects said reservoir past the valve 86 to chamber 84 which is open to the atmosphere through a choked passage 204. As a result, the pressure of fluid in the timing reservoir 94 acting on piston 93 in the timing valve device for holding the valve 196 open starts to reduce to the atmosphere immediately when a certain low degree of pressure, such as five pounds, is obtained in the brake cylinder device 6. When the timing reservoir pressure becomes reduced to a relatively low degree the spring 201 in the timing valve device 174 acts to seat the valve 196 and unseat the valve 195 and during such movement moves the piston 193 from the position shown in a downwardly direction.

The closing of valve 196 terminates the supply of fluid at brake cylinder pressure to the relay valve diaphragm chamber 178 while the opening of valve 195 vents said chamber to the atmosphere by way of valve 195 to chamber 197 and then through the vent port 198. When this occurs the pressure of fluid acting in chamber 180 of the relay valve device returns the diaphragm 177 to its normal position shown which permits spring 183 to elevate the stem 182 and thereby operate the beam 184 to permit closing of the supply valve 186 and opening of the release valve 185. This vents fluid under pressure from chambers 180 and 181 and from pipe 176 to the atmosphere by way of the vent port 187 thus terminating the supply of fluid under pressure to the jet 32 for sanding the track rails.

The size of the timing reservoir 94 is however so related to the venting capacity of the choke 204 that the timing valve device 174 will not operate to terminate sanding, as just described, until a vehicle has been brought to a substantial

stop from a maximum speed with the brakes on the vehicle applied to a maximum degree, thereby insuring adequate sand for braking during the most severe period of operation, but preventing undue loss of sand which might occur if the timing valve device 174 were not provided to limit the duration of sanding.

The only function of the valve device 24 in this embodiment is to charge the timing reservoir 94 when the brakes on the vehicle are released and to disconnect said reservoir from the fluid pressure supply pipe 16 and to connect same to the exhaust port 204 during an application of the brake for controlling the period of operation of the timing valve device 174 as just described.

If at any time the engineer desires a maximum amount of sand applied to the track rail either during braking or acceleration he depresses the brake valve handle 8a to unseat the sand valve 12 in the brake valve device to supply fluid from the fluid pressure supply pipe 16 to pipe 19 in the same manner as above described in connection with Fig. 1. The fluid thus supplied to the pipe 19 flows through the double check valve 97 to diaphragm chamber 178 in the relay valve device 175 and operates said device to seat the release valve 185 and to unseat the supply valve 186 past which fluid at the pressure in the supply pipe 16 will be supplied to pipe 176 leading to the jet 32 in the sanding device 20 and to the cleaning device 21 which then operate to provide a maximum flow of sand to the sand pipe 27 for sanding the rail. Since the pressure of fluid supplied by the brake valve device to diaphragm chamber 178 equals that which is obtainable past the supply valve 186 in diaphragm chamber 180, the diaphragm 177 will maintain the supply valve 186 in a substantially wide open position to insure that the pressure obtained at the jet 32 in the sanding device 20 for sand purposes will be substantially the same as in the supply pipe 16 as will be evident.

Description of embodiment of invention shown in Fig. 7

If desired, the duration of the sanding period by the apparatus shown in Fig. 6 may be controlled by movement of the vehicle instead of by the timing valve device 174 and timing reservoir 94, just described. An apparatus embodying this modification is shown in Fig. 7 of the drawings wherein the reference character 205 indicates an electromagnet device which is adapted to be connected in circuit with the generator 61 associated with the vehicle wheel 29 upon operation of the pneumatic switch device 22 when a certain low pressure is obtained in the brake cylinder device 6, such as five pounds as hereinbefore described in connection with the disclosure in Fig. 1.

The electro-magnet device 205 comprises a magnet 206 having one terminal connected to the wire 60 and the other to the wire 59, shown in Fig. 1 of the drawings, and further comprises a pair of oppositely seating valves 207 and 208. The valve 207 is contained in a chamber 209 connected to the brake cylinder pipe 69 while the valve 208 is contained in a chamber 210 which is open to the atmosphere through a vent port 211. The two valves have fluted stems which engage in a chamber 212 which is open through pipe 191 and the double check valve device 97 to pipe 179 leading to the relay valve device 175. A spring 213 is provided in chamber 209 for seating valve 207 and for unseating valve 208.

Operation of embodiment of invention shown in Fig. 7

In operation, whenever fluid under pressure is supplied to the brake cylinder device 6 to apply the brakes on the vehicle the pneumatic cylinder device 22 is operated to move the contact 65 into circuit closing relation with the contact fingers 63 and 64 so as to connect the magnet 206 into circuit with the generator 61.

The magnet 206 is thereby energized and operates to seat valve 208 and unseat valve 207 whereupon fluid at brake cylinder pressure flows from pipe 69 through chamber 209 past valve 207 to chamber 212 and then through pipe 191, double check valve device 97 and pipe 179 to the relay valve device 175. The relay valve device 175 then operates as hereinbefore described to supply fluid at a corresponding pressure to the sanding device 20 for effecting operation thereof to provide a proportionate flow of sand to the track rail for sanding same. As the brake cylinder pressure is reduced the relay valve device 175 will operate to reduce the pressure of fluid supplied to the sander device 20 and thus correspondingly reduce the amount of sand applied to the track rail for sanding in the same manner as in the embodiment of the invention shown in Fig. 6.

The supply of sand for sanding the track rail may be terminated in this embodiment of the invention either by the reduced output of generator 61 at the time the vehicle is substantially stopped or by brake cylinder pressure reduced to a low degree at this time, as will now be described.

When the vehicle becomes substantially stopped, the output of the generator 61 will be insufficient to maintain the magnet 206 energized, as a result of which spring 213 will seat valve 207 and unseat valve 208. The supply of fluid from the brake cylinder device to the relay valve device 175 will be thus cut off and diaphragm chamber 178 in said relay valve device vented to the atmosphere past the valve 208 and through the vent passage 211. The relay valve device will then operate as hereinbefore described to cut off the supply of fluid under pressure to the sanding device 20 to thus terminate sanding of the rail. In case the pressure of fluid in the brake cylinder device 6 should become reduced sufficiently low before the output of generator 61 becomes reduced sufficiently to terminate sanding, then the pneumatic switch device 22 will operate to open the circuit through the magnet 206 and terminate sanding. The primary purpose of the pneumatic switch device 22 is however to open the circuit through magnet 205 at all times except during braking.

If, in this embodiment, the vehicle wheel to which the generator 61 is connected should cease to rotate at any time during braking the magnet valve device 205 will operate to cut off the supply of fluid under pressure to the relay valve device 175 which in turn will cut off the supply of fluid under pressure for blowing sand to the track rails, so as to thus prevent excessive abrading of the vehicle wheel during such sliding. In case the vehicle wheel should subsequently start rotating again, sanding of the rail will again occur, as will be apparent.

Description of embodiment of invention shown in Fig. 8

In the embodiment of the invention shown in Fig. 6 the amount of sand supplied for sanding

the track rail is varied in accordance with manual adjustments or reductions in pressure in the brake cylinder device 6 corresponding to reductions in the speed of the vehicle. Such manual adjustments may be fine or coarse, depending upon the operator, and if fine may provide a direct proportionality of sand to vehicle speed as desired. However, direct proportionality of sand to vehicle speed may be ensured by the provision of a speed controlled valve device 102 in the connection between the brake cylinder device and differential relay valve device 175, as shown in Fig. 8 of the drawings.

In this embodiment the speed controlled valve device 102 is the same as that enclosed in Fig. 3 of the drawings and the brake cylinder pipe 69 constitutes the fluid pressure supply pipe thereto. The outlet from the speed controlled valve device, to which said valve device is adapted to supply fluid at a pressure proportional to the speed at which the vehicle is operating, is connected to a pipe 215 which leads to chamber 200 in the timing valve device 174 and to chamber 82 in the valve device 24.

Operation of embodiment of invention shown in Fig. 8

In the operation of this embodiment whenever fluid under pressure is supplied to the brake cylinder device 6 for applying the brakes on the vehicle the speed governor device 102 operates to supply fluid from the brake cylinder pipe 69 to the pipe 215 at a pressure dependent upon the speed. The fluid pressure thus supplied to the pipe 215 then flows through the timing valve device 174 to the relay valve device 175 which is operated thereby in the same manner as hereinbefore described to supply fluid at the same pressure to pipe 176 for blowing sand from the sanding device 20 to the outlet pipe 27 for sanding the track rail. As the speed of the vehicle is reduced the speed control valve device 102 acts to reduce the pressure in pipe 215 proportionately and the relay valve device 175 acts to effect a corresponding reduction in the pressure of fluid supplied to pipe 176. The amount of sand thus supplied to the rail 27 is reduced correspondingly. In this manner the amount of sand for sanding purposes will continue to be reduced directly in proportion in the reduction in vehicle speed due to operation of the speed controlled valve device 102 to reduce the pressure in pipe 215 until eventually sanding is terminated by operation of the timing valve device 174 when the pressure of fluid in the timing reservoir 94 is reduced to a sufficiently low degree.

In the embodiment shown in Fig. 3, the cut-off valve device 103 was associated with the speed controlled device 100 to cut off the supply of sand for sanding when the brakes on the vehicle were released and this was required due to the fact that the supply of fluid under pressure to the speed controlled device was constant, being taken directly from the supply pipe 16. No such cut-off valve is however required in the present embodiment of the invention since the supply of fluid to the speed controlled device is taken from the brake cylinder pipe 69 which is normally vented.

Description of embodiment of invention shown in Fig. 9

Direct proportioning of the amount of sand supplied to the rail 27 for sanding same in accordance with the speed at which the vehicle operates and the timing of the duration of the sanding period may also be obtained by the arrangement in Fig. 9. In this embodiment an electromagnet device 214 is provided for controlling the sanding operation of the relay valve device 175 whenever the brakes on the vehicle are applied.

The electro-magnet device 214 comprises an armature 216 extending through the casing of the relay valve device 175 into chamber 178 and therein engaging a follower 217 secured to the upper face of the flexible diaphragm 177. The electromagnet device 215 further comprises an operating coil 218 one terminal of which is connected to wire 59 leading to one terminal of the generator 61 associated with the vehicle wheel 29. The other terminal of the coil 218 is connected to wire 60 and a pneumatic switch device 22 is provided for electrically connecting said wire to wire 62 leading to the other terminal of the generator 61. The pneumatic switch device 22 is connected for control to pipe 191 leading to the timing valve device 174.

Operation of embodiment of invention shown in Fig. 9

Whenever fluid under pressure is supplied to the brake cylinder device 6 to apply the brakes on the vehicle fluid from the brake cylinder pipe 69 flows through the timing valve device 174 to pipe 191 and then to the pneumatic switch device 22 for operating same to move the contact 65 into circuit closing relation with contact fingers 63 and 64. The coil 218 of the electromagnet device 214 is thus placed in circuit with the generator 61 and exerts a downward force on the armature 216 which varies according to the output of said generator.

The armature 216 is thereby operated to deflect the diaphragm 177 in a downwardly direction so that fluid at a pressure dependent upon the downward force of armature 216 is supplied to pipe 176 for supply to the sanding device 20 for blowing sand to the track rail. It will be noted that the pressure of fluid thus supplied for sanding purposes is dependent upon the electromotive force of the electro-magnet device 214 which force in turn depends upon the speed of operation of generator 61. As a result, as the speed of the vehicle and thereby of the generator 61 reduces, the electromotive force of magnet device 216 correspondingly reduces and the relay valve device 175 operates to reduce the pressure of fluid supplied to pipe 176 for sanding purposes in proportion. In other words, by controlling the relay valve device 175 from the generator 61 the relay valve device will operate at all times to provide fluid to pipe 176 at a pressure which varies according to the train speed and as a consequence the amount of sand blown from the sanding device 20 for sanding the track rail will vary accordingly.

In this apparatus the sanding period is controlled by the timing reservoir 94 and subsequent operation of the timing valve device 174 to vent pipe 191 for effecting operation of the pneumatic switch device 22 to open the circuit through the magnet coil 218 as will be apparent.

In this embodiment of the invention pipe 19 through which fluid under pressure is adapted to be supplied for effecting sanding at the will of the operator is connected directly to the diaphragm chamber 178.

Description of embodiment of invention shown in Fig. 10

In this embodiment of the invention the amount of sand supplied for sanding the track rail is adapted to be varied in accordance with variations in brake cylinder pressure as in the embodiment shown in Fig. 6, but the sanding operation is adapted to be fully under the control of the operator and for this purpose there is provided a manually operative sand valve device 219 for controlling all rail sanding. This device is separate from the brake valve device 1 in contrast to all previously described embodiments, particularly those shown in Figs. 4 and 5. In the present embodiment there is no control of sanding provided in the brake valve device 1.

The sand valve device 219 comprises a casing 220 having a chamber 221 containing a rotary valve 222 which is adapted to be turned to different operating positions by a key 223. The key 223 extends to the outside of the casing where a handle 224 is secured thereto for manual turning of the rotary valve 222 to its different control positions.

The rotary valve chamber 221 is connected directly to a pipe 225 which leads to main reservoir 2 so that fluid at main reservoir pressure is always present in said chamber. The fluid pressure supply pipe 16 is connected to the seat of the rotary valve 22 as are also the brake cylinder pipe 69 and a pipe 226 which is connected to diaphragm chamber 178 in the relay valve device 175.

Operation of embodiment of invention shown in Fig. 10

The rotary valve 222 is shown in the position in which it will be normally carried. This position may be called a release position as indicated in the diagrammatic development view of the rotary valve and seat shown in Fig. 11. In this position the pipe 226 from the relay valve device 175 is connected through a cavity 227 in the rotary valve 222 to atmospheric release port 228 so that diaphragm chamber 178 in the relay valve device 175 will be at atmospheric pressure. The relay valve device will thus occupy its normal position in which there will be no supply of fluid under pressure to pipe 176 for operating the sand device 20, as will be apparent.

If, when the brakes are applied, it is desired to supply sand for sanding the track rail in an amount depending upon the degree of application, which may be a function of the vehicle speed, the operating handle 224 is manually turned from the release position to the brake sand position indicated in Fig. 11. In this position the pipe 226 is connected through a cavity 229 (Fig. 11) in the rotary valve 222 to the brake cylinder pipe 69 so that fluid at the pressure acting in the brake cylinder device is supplied to diaphragm chamber 178 in the relay valve device 175 wherein such pressure acts to effect operation of said relay valve device to supply fluid at a corresponding pressure to pipe 176 for operating the sand device 20 to supply sand to the track rail. With the rotary valve 222 left in this brake sand position the relay valve device 175 will then operate as the pressure in the brake cylinder 6 is reduced to correspondingly reduce the pressure of fluid supplied to the pipe 176 and the amount of sand supplied by the sanding device 20 for sanding of the track rail will thus also be reduced in proportion, in the same manner as hereinbefore described in connection with the disclosure shown in Fig. 6. Whenever the operator desires a maximum amount of sand for sanding the track rail, either during braking or acceleration, he operates the handle 224 to turn the rotary valve 222 to the normal sanding position indicated in Fig. 11 and in this position establishes a direct connection from the fluid pressure supply pipe 16 through a cavity 230 to pipe 226 whereby fluid at the pressure in pipe 16 is supplied to diaphragm chamber 178 in the relay valve device 175 for operating same to provide substantially the same fluid pressure to the sanding device 20.

In the brake sand position a cavity 231 in the rotary valve connects the main reservoir pipe 225 to a vent port 232 having a restricted portion 233 through which a blow of air is adapted to occur to the atmosphere to warn the operator that he is in this brake sand position. A port 234 is provided in the rotary valve 222 for connecting the main reservoir passage 225 to the warning port 232 for warning the operator that he is in the normal sanding position. These warning arrangements are provided so that the operator will not unintentionally leave the sand valve device 219 in these positions supplying sand to the track rail when sand is not required.

In the rotary valve 222 there is also provided a port 235 which is adapted to establish communication between the main reservoir pipe 225 and 226 leading to the relay valve device 175 as the rotary valve is moved from its release position to either of its sanding positions. By this arrangement there will always be a sudden but very limited flow of fluid at high pressure from the main reservoir pipe 225 to the relay valve device 175 for effecting operation thereof to provide a very limited blast of high pressure to pipe 176 before the sanding position is obtained. The purpose of this sudden but limited flow of fluid at high pressure to pipe 176 is to effect operation of the cleaning pipe 21 to effect cleaning of the sander device 20 before the sanding positions of the rotary valve are obtained so as to insure prompt supply of sand for sanding purposes in said positions.

Intermediate the release and brake sand positions there is provided a lap position in which no communications are established through the rotary valve 222. This lap position is useful if it is desired during acceleration to supply less than the maximum amount of sand to the track rail. To accomplish this the rotary valve 222 will be moved to the normal sanding position and held there until sufficient pressure is built up in diaphragm chamber 178 of the relay valve device 175 to obtain the desired limited amount of sanding. The operator will then turn the rotary valve 222 from the normal sanding position back to the lap position and the limited fluid pressure acting in the relay valve device will then be bottled in chamber 178 so that said device will continue to maintain the desired limited flow of sand to the track rail. If it is desired to increase the amount of sand supplied to the track rail above this limited amount, but to a degree less than the maximum, the rotary valve 222 may again be moved to the normal sanding position and then back to the lap position and as a result the fluid pressure supply to pipe 176 will be increased to provide for an increased degree of sanding. When it is desired

to terminate such sanding or to terminate the sanding at any other time the rotary valve 222 is returned to the release position.

Embodiment of invention shown in Fig. 12

In this embodiment of the invention a speed controlled device 102 is provided for controlling the pressure of fluid supplied to the sand valve device 219 for supply to pipe 226 for sanding purposes when the brakes on the vehicle are applied, it being noted that the speed controlled device has its fluid pressure inlet connected to the fluid pressure supply pipe 16 and its outlet connected to a pipe 236 which replaces the brake cylinder pipe 69 shown in Fig. 10. By this arrangement the relay valve device 175 will be controlled during brake sanding by fluid at a pressure which varies according to the speed of the vehicle whereby the supply of sand to the track rail will likewise vary. Otherwise this arrangement is substantially the same as shown in Fig. 10.

Embodiment of invention shown in Fig. 13

In this embodiment the operation of the relay valve device 175 is adapted to be controlled by the electromagnet device 214 which is responsive to the output of the generator 61 in the same manner as in the embodiment disclosed in Fig. 9, except in this arrangement the pneumatic switch device 22 controlled directly by brake cylinder pressure, controls the cutting in and the cutting out of the electro-magnet device 215 and thereby of automatic sanding. By this arrangement sanding will be automatically effected in both service and emergency applications of the brakes and to a degree which will vary in direct proportion to the speed at which the vehicle is operating. The sand valve device 219 in this embodiment is adapted to control the sanding operation of the relay valve 175 only in the normal sanding position thereof, as will be apparent.

Summary

It will now be evident that by the use of the present invention a rail under a train or vehicle may be sanded during braking to a degree which varies in proportion to the speed at which the train or vehicle is operating, or in proportion to the braking effort provided on the vehicle or train and which usually is a function of the speed, so as to thereby provide substantially the same amount of sand on a rail, per unit of length, for all speeds. By this arrangement excessive and wasteful use of sand is avoided and most efficient operation of the train or vehicle is insured.

The proportioning of the sand supplied for sanding purposes may be controlled either by the positioning of a sand supply valve to vary the flow of sand according to speed or by varying the pressure or amount of fluid supplied for blowing sand from the sanding device. The sanding operation during braking may be controlled either automatically or manually by the engineer and the duration of the sanding period may be limited to a certain fixed time as by reducing the pressure of fluid in a normally charged reservoir or may be controlled by the movement of the train or vehicle and be terminated at substantially the time the vehicle is brought to a stop. In the latter case the supply of sand to the rail will automatically be cut off in case a wheel, which controls the sanding supply, stops rotating during braking and slides on the rail, which is desirable.

While several embodiments of the invention have been described in detail, it is not the intention to limit the scope to these embodiments or otherwise than by the terms of the appended claims.

Having now described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. A sanding apparatus for sanding a rail under a railway vehicle, comprising sander means for supplying sand in various quantities for sanding said rail, regulating means for controlling the quantity of sand supplied by said sander means and adjustable to different positions to provide various quantities of sand supply, and means adapted to operate substantially in accordance with variations in the speed of said vehicle to adjust said regulating means to said different positions for limiting the quantity of sand supplied by said sander means for sanding said rail to a degree substantially in proportion to the speed of the vehicle.

2. A sanding apparatus for sanding a rail under a railway vehicle, comprising sander means for supplying sand in various quantities for sanding said rail, regulating means for controlling the quantity of sand supplied by said sander means and adjustable to different positions to provide various quantities of sand supply, and means responsive to the speed of the vehicle operative to adjust said regulating means to said different positions for limiting the quantity of sand supplied by said sander means for sanding said rail to a degree proportional to the speed of the vehicle.

3. A sanding apparatus for sanding a rail under a railway vehicle, comprising sander means for supplying sand in various quantities for sanding said rail, a valve means for controlling the quantity of sand supplied by said sander means and adjustable to different positions to provide various rates of sand supply, and means conditionable substantially in accordance with the speed of the vehicle for adjusting said valve means to said different positions to limit the quantity of sand supplied by said sander means for sanding said rail to a degree substantially in proportion to the speed of the vehicle.

4. A sanding apparatus for sanding a rail under a railway vehicle, comprising sander means for supplying sand in various quantities for sanding said rail, regulating means for controlling the quantity of sand supplied by said sander means and adjustable to different positions to provide various rates of sand supply, means adapted to be operated by a variable force for adjusting said regulating means to said different positions to vary the quantity of sand supplied by said sander means for sanding said rail in proportion to the degree of said force, and means conditionable in accordance with the speed of the vehicle for varying the degree of said force substantially in proportion to the speed of the vehicle.

5. A sanding apparatus for sanding a rail under a railway vehicle, comprising sander means for supplying sand in various quantities for sanding said rail, regulating means for controlling the quantity of sand supplied by said sander means and adjustable to different positions to provide various quantities of sand supply, power generating means operable at a speed proportional to the vehicle speed for providing a proportional

output of power, and means conditionable by the power delivered by said power generating means for adjusting said regulating means to said different positions to vary the quantity of sand supplied by said sander means for sanding said rail in proportion to the vehicle speed.

6. A sanding apparatus for sanding a rail under a railway vehicle, comprising sander means for supplying sand in various quantities for sanding said rail, regulating means for controlling the quantity of sand supplied by said sander means, an electric generator operable at a speed proportional to the speed of the vehicle for providing a proportionate electro-motive force, and means conditionable by said electro-motive force for effecting adjustment of said regulating means to vary the quantity of sand supplied by said sander means for sanding said rail in proportion to the speed of said vehicle.

7. In combination, means for applying the brakes on a vehicle and for varying the degree of brake application in accordance with variations in the speed of the vehicle, sander means operable to supply sand in various quantities for sanding a rail under the vehicle, regulating means adjustable to vary the amount of sand supplied by said sander means, and means operable in accordance with the degree of brake application to adjust said regulating means for proportioning the quantity of sand supplied by said sander means for sanding the track rail in accordance with the degree of brake application.

8. In combination, means for applying the brakes on a vehicle and for varying the degree of brake application in accordance with variations in the speed of the vehicle, sander means operable to supply sand in various quantities for sanding a rail under the vehicle, regulating means adjustable to vary the amount of sand supplied by said sander means, and means operable automatically upon effecting an application of the brakes on said vehicle for effecting operation of said regulating means to vary the quantity of sand supplied by said sander means in substantial proportion to the speed of the vehicle.

9. In combination, a brake cylinder device operable by fluid under pressure to apply the brakes on a vehicle, means for varying the pressure of fluid in said brake cylinder device to vary the degree of the brake application on the vehicle, sander means for supplying sand in various quantities for sanding a rail under a vehicle, and means controlled by the pressure of fluid in said brake cylinder device for proportioning the amount of sand supplied by said sander means in accordance with the degree of pressure in said brake cylinder.

10. In combination, a brake cylinder device operable by fluid under pressure to apply the brakes on a vehicle, sander means for supplying sand in various quantities for sanding a rail under a vehicle, regulating means controllable by fluid under pressure supplied from said brake cylinder device for proportioning the quantity of sand supplied by said sander means in proportion to the pressure of fluid supplied from said brake cylinder device, and means controlled by the speed of the vehicle controlling said supply of fluid under pressure to said regulating means and operable to limit the pressure of said fluid to a degree proportional to the speed of the vehicle.

11. Sanding means for a railway vehicle operable by fluid under pressure to supply sand for sanding a rail under said vehicle in quantities which varies in accordance with the degree of fluid under pressure supplied thereto, a source of fluid under pressure, and means conditionable in accordance with the speed of the vehicle for supplying fluid from said source to said sanding means at a pressure which varies according to the speed of the vehicle.

12. In combination, means operative to effect an application of the brakes on a vehicle and to vary the degree of said application, sander means operable to supply various quantities of sand to a rail under said vehicle for sanding same, regulating means operable to adjust the quantity of sand supplied by said sander means to said rail to a degree substantially in proportion to the speed of the vehicle, control means conditionable substantially in accordance with the speed of the vehicle for controlling said regulating means, and means operable when an application of the brakes is effected on the vehicle to render said regulating means controllable by said control means.

13. In combination, sander means operable to supply sand to a rail under a vehicle for sanding said rail, regulating means adjustable to vary the quantity of sand supplied by said sander means to a degree substantially in proportion to the speed of the vehicle, control means conditionable in accordance with the speed of the vehicle for effecting adjustment of said regulating means, and means operable when either a service or an emergency application of the brakes is effected on said vehicle to effect operation of said control means.

14. In combination, sander means operable to supply sand to a rail under a vehicle for sanding said rail, regulating means adjustable to vary the quantity of sand supplied by said sander means to a degree substantially in proportion to the speed of the vehicle, control means for effecting adjustment of said regulating means, means operative to effect an application of the brakes on the vehicle, and means responsive to the degree of brake application on the vehicle for controlling the operation of said control means.

15. In combination, brake applying means operable to apply the brakes on a vehicle and to vary the degree of the brake application, sander means operable to supply sand for sanding a rail under the vehicle in quantities which vary according to the degree of brake application, regulating means adjustable to vary the quantity of sand supplied by said sander means, and means controlled cooperatively by movement of the vehicle and said brake applying means for adjusting said regulating means to vary the amount of sand supplied by said sander means substantially in proportion to the degree of brake application.

16. In combination, brake applying means operable to apply the brakes on a vehicle and to vary the degree of the brake application, sander means operable to supply sand for sanding a rail under the vehicle in quantities which vary according to the speed of the vehicle, regulating means adjustable to vary the quantity of sand supplied by said sander means, and means controlled cooperatively by movement of the vehicle and said brake applying means for adjusting said regulating means to vary the amount of sand supplied by said sander means substantially in proportion to the speed of the vehicle.

17. In combination, brake control means for effecting an application and a release of the

brakes on a vehicle, a sanding arrangement for the vehicle comprising sander means for supplying sand in various quantities for sanding a rail under said vehicle, regulating means for varying the quantity of sand supplied by said sander means, control means adjustable substantially in accordance with variations in speed of said vehicle for adjusting said regulating means to limit the quantity of sand supplied by said sander means to a degree substantially in proportion to the speed of the vehicle, and means operable when an application of the brakes is effected to render said sanding arrangement operative and when a release of the brakes is effected to render said sanding arrangement non-operative to supply sand.

18. In combination, a brake cylinder device operative to apply the brakes on a vehicle to a degree dependent upon the pressure of fluid acting therein, a sanding arrangement for the vehicle comprising sander means operable to supply various quantities of sand to a rail under said vehicle for sanding same, regulating means operable substantially in accordance with the speed of the vehicle for varying the quantity of sand supplied by said sander means substantially in proportion to the speed of the vehicle, and means operative upon an increase in pressure in said brake cylinder device to a chosen degree to render said regulating means operable and upon a reduction in brake cylinder pressure below said chosen degree non-operable.

19. Apparatus for sanding a rail under a vehicle comprising sander means operable to supply various quantities of sand for sanding said rail, regulating means adjustable to different positions to vary the quantity of sand supplied by said sander means in substantial proportion to the vehicle speed, means adapted to operate substantially in accordance with the speed of the vehicle to effect adjustment of said regulating means to said different positions, and manually controlled means operative to cut the last named means and thereby said regulating means into and out of operation.

20. In combination, brake applying means for applying the brakes on a vehicle to different degrees, sander means operable to supply various quantities of sand for sanding a rail under said vehicle, regulating means adjustable in accordance with the degree of brake application on the vehicle for adjusting the quantity of sand supplied by said sander means in proportion to the degree of brake application, and manually controlled means for rendering said regulating means adjustable or non-adjustable according to the degree of brake application.

21. A sanding arrangement for a rail under a vehicle comprising sander means for providing a maximum and various lesser rates of supply of sand for sanding said rail, regulating means for controlling the rate of supply of sand by said sander means, control means adapted to operate to adjust said regulating means to vary the rate of sand supply by said sander means substantially in proportion to the speed of the vehicle, means conditionable substantially in accordance with variations in speed of the said vehicle for controlling said control means, and means operative manually at the will of the operator to provide said maximum rate of supply of sand by said sander means.

22. A sanding arrangement for a rail under a vehicle comprising sander means for providing a maximum and various lesser rates of supply of sand for sanding said rail, regulating means for controlling the rate of supply of sand by said sander means, brake controlling means for applying the brakes on the vehicle, control means conditionable substantially in accordance with the speed of the vehicle upon operation of said brake controlling means to adjust said regulating means to vary the rate at which sand is supplied by said sander means substantially in proportion to the speed of the vehicle, and means operative manually at the will of the operator to effect adjustment of said regulating means to provide for said maximum rate of sand supply by said sander means.

23. A sanding arrangement for a rail under a vehicle comprising sander means for providing a maximum and various lesser rates of supply of sand for sanding said rail, regulating means adjustable to vary the rate of supply of sand by said sander means in substantial proportion to the speed of the vehicle, brake control means operable by fluid under pressure to apply the brakes on a vehicle, means for controlling the operation of said brake control means, means conditionable by said fluid under pressure to automatically effect adjustment of said regulating means, and manually controlled means operable at the will of the operator to effect adjustment of said regulating means to provide said maximum rate of sand supply by said sander means.

24. A sanding arrangement for a rail under a vehicle comprising sander means for providing a maximum and various lesser rates of supply of sand for sanding said rail, regulating means for controlling the rate of supply of sand by said sander means, manually operative means movable to one position for effecting adjustment of said regulating means to provide said maximum rate of supply of sand by said sander means and adapted to be moved to another position for also affecting the supply of sand by said sander means, and means conditioned substantially in accordance with the speed of the vehicle and operative upon movement of said manually operative means to the last named position for controlling the adjustment of said regulating means to vary the rate at which sand is supplied by said sander means substantially in proportion to the speed of the vehicle.

25. A sanding arrangement for a railway vehicle comprising sander means operable to provide a maximum and lesser rates of supply of sand for sanding a rail, regulating means operative in accordance with variations in the degree of a control force for varying the rate of supply of sand by said sander means, manually operable means movable to one position for providing a certain maximum control force for said regulating means and movable also to another position, and means operable automatically in the last named position of said manually operative means to provide a control force on said regulating means which varies substantially in proportion to the speed of the vehicle.

26. A sanding arrangement for a railway vehicle comprising sander means operable to provide a maximum and lesser rates of supply of sand for sanding a rail, regulating means operative in accordance with variations in the degree of a control force for varying the rate of supply of sand by said sander means, manually operable means movable to one position for providing a certain maximum control force for said regulating means and movable also to another

position, an electric generator operative at a speed proportional to the vehicle speed, an electro-magnet adapted to be controlled by the output of said generator to provide a variable control force for said regulating means, and switch means operable in the last named position of said manually operative means to connect said electro-magnet device in circuit with said generator.

27. A sanding arrangement for a railway vehicle comprising sander means operable to provide a maximum and lesser rates of supply of sand for sanding a rail, regulating means operative in accordance with variations in the degree of a control force for varying the rate of supply of sand by said sander means, manually operable means movable to one position for providing a certain maximum control force for said regulating means and movable also to another position, means controlled by the speed of the vehicle adapted to provide fluid at a pressure which varies according to said speed, and means operable in the last named position of said manually operative means to subject said regulating means to the pressure of said fluid for controlling the operation thereof, said fluid pressure constituting the control force for said regulating means.

28. In combination, sander means for supplying various quantities of sand for sanding a rail under a vehicle, regulating means for controlling the quantity of sand supplied by said sander means, control means adapted to operate substantially in accordance with variations in the speed of said vehicle to adjust said regulating means to vary the quantity of sand supplied by said sander means in like proportion, means for effecting an application of the brakes on a vehicle, and timing means for controlling the operation of said control means and adapted to be conditioned when the brake application on the vehicle exceeds a chosen degree to render said control means operative and a predetermined time thereafter non-operating.

29. In combination, sanding apparatus for a rail under a vehicle comprising sander means for supplying various quantities of sand for sanding said rail, regulating means for controlling the quantity of sand supplied by said sanding means, control means adapted to operate substantially in accordance with variations in the speed of said vehicle to adjust said regulating means to vary the quantity of sand supplied by said sander means substantially in proportion to the vehicle speed, speed controlled means for controlling the operation of said control means, means for applying the brakes on the vehicle, and means operative when the brake application exceeds a chosen degree to connect said control means to said speed control means for control thereby and when less than said chosen degree to disconnect said control means from said speed control means.

30. In combination, sander means for supplying various quantities of sand for sanding the rail under a vehicle, regulating means for controlling the quantity of sand applied by said sander means, control means operable by fluid under pressure to adjust said regulating means to vary the quantity of sand supplied by said sander means in accordance with the pressure of said fluid, speed controlled means operative to supply fluid at a pressure which varies according to the speed of the vehicle, means for applying the brakes on the vehicle, and means conditioned when the application of brakes exceeds a chosen degree for supplying fluid from said speed control means to said control means for controlling same and when less than said chosen degree to cut off the supply of fluid from said speed control means to said control means.

31. In combination, sander means for supplying various quantities of sand for sanding the rail under a railway vehicle, regulating means for controlling the quantity of sand supplied by said sander means, control means for said regulating means including an electric generator operable at a speed proportional to the speed of the vehicle for conditioning said regulating means to vary the amount of sand supplied by said sander means in proportion to the speed of the vehicle, means for applying the brakes on the vehicle, and means conditionable when the application of brakes on the vehicle exceeds a chosen degree to render said control means operable and when less than said chosen degree non-operable.

32. In combination, means for supplying various quantities of sand for sanding the rail under a railway vehicle, regulating means for controlling the quantity of sand supplied by said sander means, control means including an electric generator operable at a speed proportional to the speed of the vehicle adapted to condition said regulating means to vary the amount of sand supplied by said sander means in proportion to the speed of the vehicle and to terminate said sanding upon operation of said generator at a predetermined low speed of the vehicle, and means for cutting said control means into and out of operation.

33. In combination, sanding means for supplying various quantities of sand for sanding the rail under a vehicle, regulating means for controlling the quantity of sand supplied by said sander means, control means operable by fluid under pressure to adjust said regulating means to vary the quantity of sand supplied by said sander means in accordance with the degree of said fluid pressure, a speed responsive device operable at a speed proportional to the speed of the vehicle for supplying fluid at a pressure in like proportion for controlling the operation of said control means, and means for opening and closing the communication through which fluid under pressure is adapted to be supplied from said speed controlled device to said control means.

34. In combination, a brake cylinder device operable by fluid under pressure to effect an application of the brakes on a vehicle, sander means operable to supply various quantities of sand for sanding a rail under a vehicle, fluid pressure controlled regulating means operative to regulate the amount of sand supplied by said sander means in accordance with the pressure of the control fluid, means controlled by the speed of the vehicle for supplying fluid at a pressure proportional to said speed for controlling the operation of said regulating means, and means operative upon a chosen increase in pressure in said brake cylinder device to open communication for supplying fluid under pressure from said speed controlled means to said regulating means and operative when the pressure in said brake cylinder device is at a lower degree to close this communication.

35. In combination, a brake cylinder device operable by fluid under pressure to effect an application of the brakes on a vehicle, manual operative means for controlling the pressure of fluid in said brake cylinder device, sander means op-

erable to supply various quantities of sand for sanding a rail under a vehicle, fluid pressure controlled regulating means operative to regulate the amount of sand supplied by said sander means in accordance with the pressure of the control fluid, means controlled by the speed of the vehicle for supplying fluid at a pressure proportional to said speed for controlling the operation of said regulating means, and means operative upon a chosen increase in pressure in said brake cylinder device to open a communication through which fluid under pressure is adapted to be supplied from said speed controlled means to said regulating means and operative when the pressure in said brake cylinder device is at a lower degree to close said communication, said manually operative means being operative to control the supply of fluid through said communication to said regulating means.

36. In combination, a brake cylinder device operable by fluid under pressure to effect an application of brakes on a vehicle, manually operative means for varying the pressure of fluid in said brake cylinder device, sander means operable to supply various quantities of sand for sanding a rail under a vehicle, fluid pressure controlled regulating means adapted to be controlled by the pressure of fluid in said brake cylinder device to regulate the amount of sand supplied by said sander means in accordance with the degree of brake cylinder pressure, control means controlled by the speed of the vehicle for controlling the supply of fluid under pressure from said brake cylinder device to said regulating means, and means controlled for the pressure of fluid in said cylinder device and operative when the pressure exceeds a predetermined degree for effecting operation of said control means to open communication between said brake cylinder device and regulating means and when less than said predetermined degree to effect operation of said control means to close said communication.

37. In combination, sander means operable to supply various quantities of sand for sanding a rail under a vehicle, regulating means adapted to be adjusted in accordance with the speed of the vehicle to vary the amount of sand supplied by said sander means in proportion to the vehicle speed, an electric generator oeprative by said vehicle and having an output which varies in proportion to the speed of the vehicle, electroresponsive means adapted to be controlled by the output of said generator for adjusting said regulating means, and a member operable manually to connect said electroresponsive means in circuit with said generator for control therefrom.

38. In combination, sander means operable to supply various quantities of sand for sanding a rail under a vehicle, valve means controlled by the speed of the vehicle for supplying fluid at a pressure proportional to said speed, regulating means adapted to be controlled by the pressure of fluid supplied by said valve means for adjusting the quantity of sand supplied by said sander means in proportion to the speed of the vehicle, and means operable manually for connecting said regulating means to said valve means for control therefrom.

39. A sanding apparatus for a rail under a railway vehicle comprising a sand carrying receptacle having a sand outlet through which sand is adapted to flow for sanding said rail, a valve which is adjustable to different positions to vary the rate of flow of sand through said outlet, regulating means adapted to be controlled by the speed of said vehicle to adjust the position of said valve to provide a flow of sand through said outlet substantially in proportion to the speed of the vehicle, and means for controlling the operation of said regulating means.

40. A sanding apparatus for a rail under a railway vehicle comprising a sand carrying receptacle having a sand outlet through which sand is adapted to flow for sanding said rail, a valve which is adjustable to vary the rate of flow of sand through said outlet, an electro-magnet operative to adjust said valve to vary the flow of sand through said outlet substantially in proportion to the degree of energization thereof, an electric generator operative at a speed in proportion to the speed of the vehicle for varying the energization of said electro-magnet, and means for connecting said electro-magnet into circuit with said generator.

41. A sanding apparatus for a rail under a railway vehicle comprising a sand carrying receptacle having a sand outlet through which sand is adapted to flow for sanding said rail, a valve which is adjustable to vary the rate of flow of sand through said outlet, fluid pressure controlled means operative to adjust said valve to vary the flow of sand through said outlet substantially in proportion to the pressure of fluid acting thereon, speed controlled means operative by movement of the vehicle to supply fluid at a pressure proportional to the vehicle speed, and means for supplying fluid at the pressure delivered by said speed controlled means to said fluid pressure controlled means for controlling the operation thereof.

42. A sanding apparatus for a rail under a railway vehicle comprising sander means from which sand is adapted to be blown by fluid under pressure for sanding a rail under a vehicle, a sand carrying receptacle having a sand outlet through which sand is adapted to flow to said sander means, a valve adjustable to vary the rate of flow of sand through said outlet to said sander means, speed controlled means controlled by movement of said vehicle and adapted to effect adjustment of said valve to vary the rate of flow of sand through said outlet in proportion to the speed of the vehicle, and means for connecting said valve to said speed controlled means for adjustment thereby and for at substantially the same time supplying fluid under pressure to said sander means for blowing sand therefrom.

43. A sanding apparatus for a rail under a railway vehicle comprising sander means from which sand is adapted to be blown by fluid under pressure for sanding a rail under a vehicle, a sand carrying receptacle having a sand outlet through which sand is adapted to flow to said sander means, a valve adjustable to vary the rate of flow of sand through said outlet to said sander means, speed controlled means controlled by movement of said vehicle and adapted to effect adjustment of said valve to vary the rate of flow of sand through said outlet in proportion to the speed of the vehicle, and means operative automatically in effecting an application of the brakes on the vehicle for connecting said valve to said speed controlled means for adjustment thereby and for at substantially the same time supplying fluid under pressure to said sander means for blowing sand therefrom.

44. A sanding apparatus for a rail under a vehicle comprising sander means from which sand for sanding said rail is adapted to be blown by fluid under pressure at a rate dependent upon the pressure of fluid supplied to said sander

means, regulating means operative in accordance with the degree of a control pressure for supplying fluid at a proportional pressure to said sander means for blowing sand therefrom, and means for varying the degree of said control pressure substantially in proportion to the speed of the vehicle.

45. In combination, means for applying the brakes on a vehicle and for varying the degree of brake application substantially in proportion to the speed of the vehicle, sander means from which sand for sanding a rail under the vehicle is adapted to be blown by fluid under pressure at a rate dependent upon a pressure of fluid supplied to said sander means, regulating means operative in accordance with the degree of a control force for supplying fluid at a proportional pressure to said sander means for blowing sand therefrom, and means controlled by the degree of brake application for varying the degree of said control force substantially in proportion to variations in the degree of the brake application.

46. A sanding apparatus for a rail under a vehicle comprising sander means from which sand for sanding said rail is adapted to be blown by fluid under pressure at a rate dependent upon the pressure of fluid supplied to said sander means, regulating means operative in accordance with the degree of a control force for supplying fluid at a pressure proportional to said force to said sander means for blowing sand therefrom, and means controlled by the speed of the vehicle adapted to vary the degree of said control force in proportion to the vehicle speed.

47. A sanding apparatus for a rail under a vehicle comprising sander means from which sand for sanding said rail is adapted to be blown by fluid under pressure at a rate dependent upon the pressure of fluid supplied to said sander means, regulating means including an electro-magnet operative upon energization for supplying fluid at a pressure proportional to the degree of said energization to said sander means for blowing sand therefrom, an electric generator arranged to operate at a speed proportional to that of the vehicle for effecting energization of said electro-magnet to a degree proportional to the vehicle speed, and means for connecting said electro-magnet in circuit with said generator whereby the rate of sand supply to said rail will be varied in accordance with the vehicle speed.

48. A sanding apparatus for a rail under a vehicle comprising sander means from which sand for sanding said rail is adapted to be blown by fluid under pressure at a rate dependent upon the pressure of fluid supplied to said sander means, fluid pressure controlled regulating means operative in accordance with the pressure of the control fluid for supplying fluid at a proportional pressure to said sander means for blowing sand therefrom, means controlled by movement of the vehicle and operative to supply fluid at a pressure which varies in accordance with the vehicle speed, and means for controlling the supply of fluid from the last named means to said regulating means whereby the supply of sand to said rail will vary in proportion to the speed of the vehicle.

49. A sanding apparatus for a rail under a vehicle comprising sander means from which sand for sanding said rail is adapted to be blown by fluid under pressure at a rate dependent upon the pressure of fluid supplied to said sander means, fluid pressure controlled regulating means operative in accordance with the degree of control pressure for supplying fluid at a proportional pressure to said sander means for blowing sand therefrom, a source of fluid under pressure, means for varying the pressure of fluid in said source substantially in proportion to the speed of the vehicle, another source of fluid at a higher pressure than in the first named source, and means for selectively connecting said regulating means for control by the pressure of fluid in either one of said sources or the other.

50. A sanding apparatus for a rail under a vehicle comprising sander means for supplying various quantitites of sand to said rail for sanding same, regulating means for varying the quantity of sand supplied by said sander means for sanding said rail, means including an electric generator operated at a speed proportional to the speed of the vehicle and an electro-magnet device adapted to be connected in circuit with said generator for adjusting said regulating means to vary the quantity of sand supplied by said sander means in proportion to the speed of the vehicle, a source of fluid under pressure, and means operative at the will of the operator to supply fluid under pressure from said source to said regulating means for effecting operation thereof to also control the supply of sand to said rail by said sander means.

51. In combination, a brake valve device comprising a handle movable in a horizontal plane to a plurality of brake controlling positions for controlling the brakes on the vehicle, said handle being movable in a vertical plane to either one or another of two sanding positions, means operative upon movement of said handle to one of said sanding positions for supplying sand for sanding said rail in an amount which varies substantially in proportion to the speed of the vehicle, and means operative upon movement of said handle to the other sanding position for supplying sand for sanding said rail independently of the speed of the vehicle.

52. In combination, sander means from which sand is adapted to be supplied for sanding a rail under a vehicle, a cleaning device adapted to be operated by fluid under pressure for cleaning sand from said sander means, regulating means adjustable in accordance with the degree of a control force for varying in proportion to the degree of said control force the amount of sand supplied by said sander means for sanding, means adjustable substantially in accordance with the speed of the vehicle providing a control force for said regulating means which varies in degree in substantial proportion to the vehicle speed, a source of fluid under pressure constituting a substantially constant control force for said regulating means, and a manually operative valve device having a normal position and movable therefrom to a sanding position to connect said regulating means for control by the control force provided by the means adjustable substantially in accordance with vehicle speed, said manually operative valve device being movable to another sanding position to connect said regulating means to said source of fluid under pressure for control therefrom, and said manually operative valve device being operative during movement from said normal position to each of said sanding positions to momentarily supply fluid under pressure to said cleaning device for effecting operation thereof.

JOHN CANETTA.

CERTIFICATE OF CORRECTION.

Patent No. 2,256,289. September 16, 1941.

JOHN CANETTA.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 16, second column, line 40, claim 14, after "means" insert --conditionable in accordance with the speed of the vehicle--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 17th day of February, A. D. 1942.

Henry Van Arsdale,

(Seal) Acting Commissioner of Patents.