Feb. 25, 1941. E. E. HEWITT 2,232,914

RAIL SANDING CONTROL MEANS

Filed Sept. 29, 1939 2 Sheets-Sheet 1

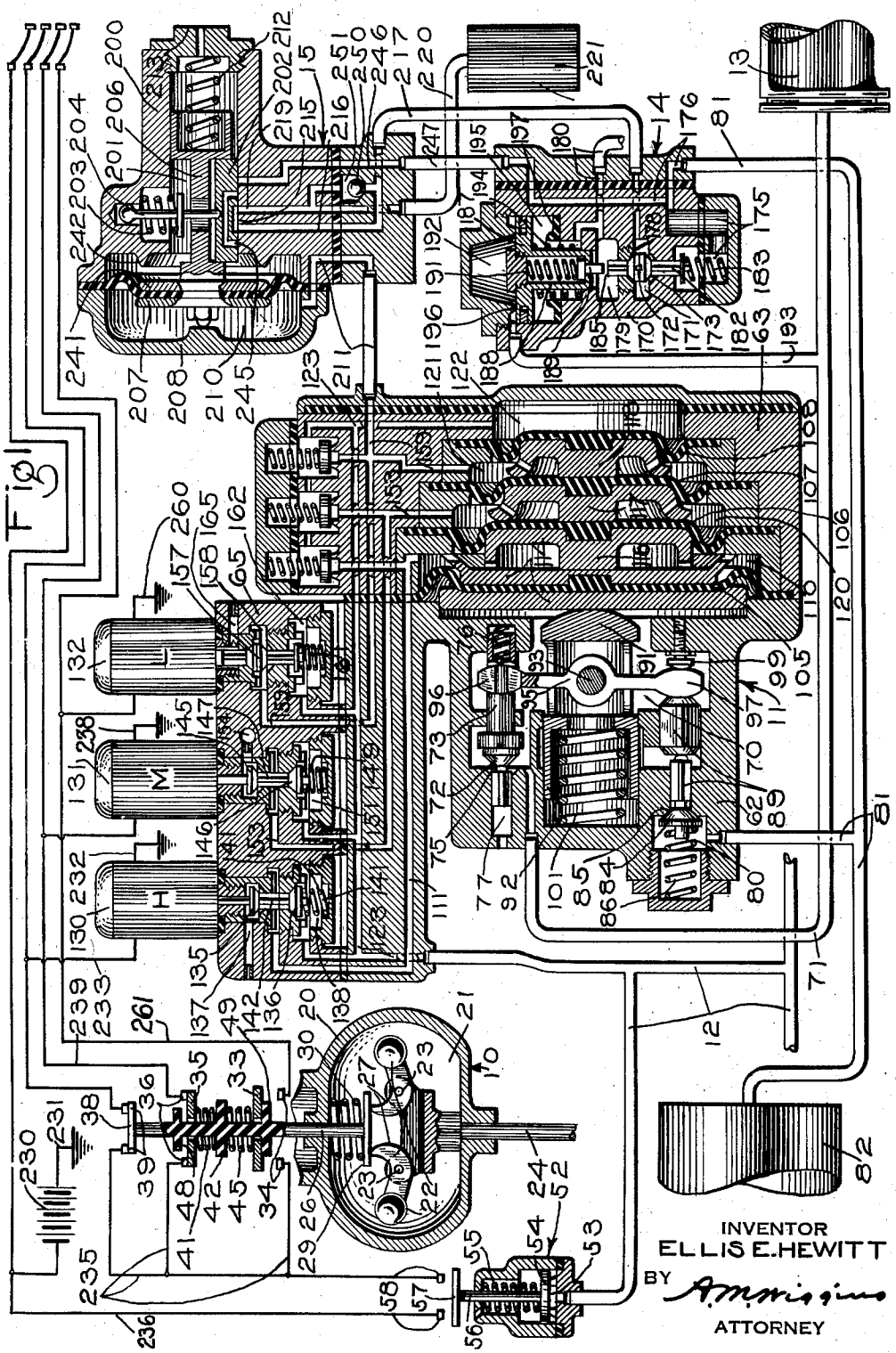


Fig 1

INVENTOR
ELLIS E. HEWITT
BY A. Morrison
ATTORNEY

Feb. 25, 1941. E. E. HEWITT 2,232,914

RAIL SANDING CONTROL MEANS

Filed Sept. 29, 1939 2 Sheets-Sheet 2

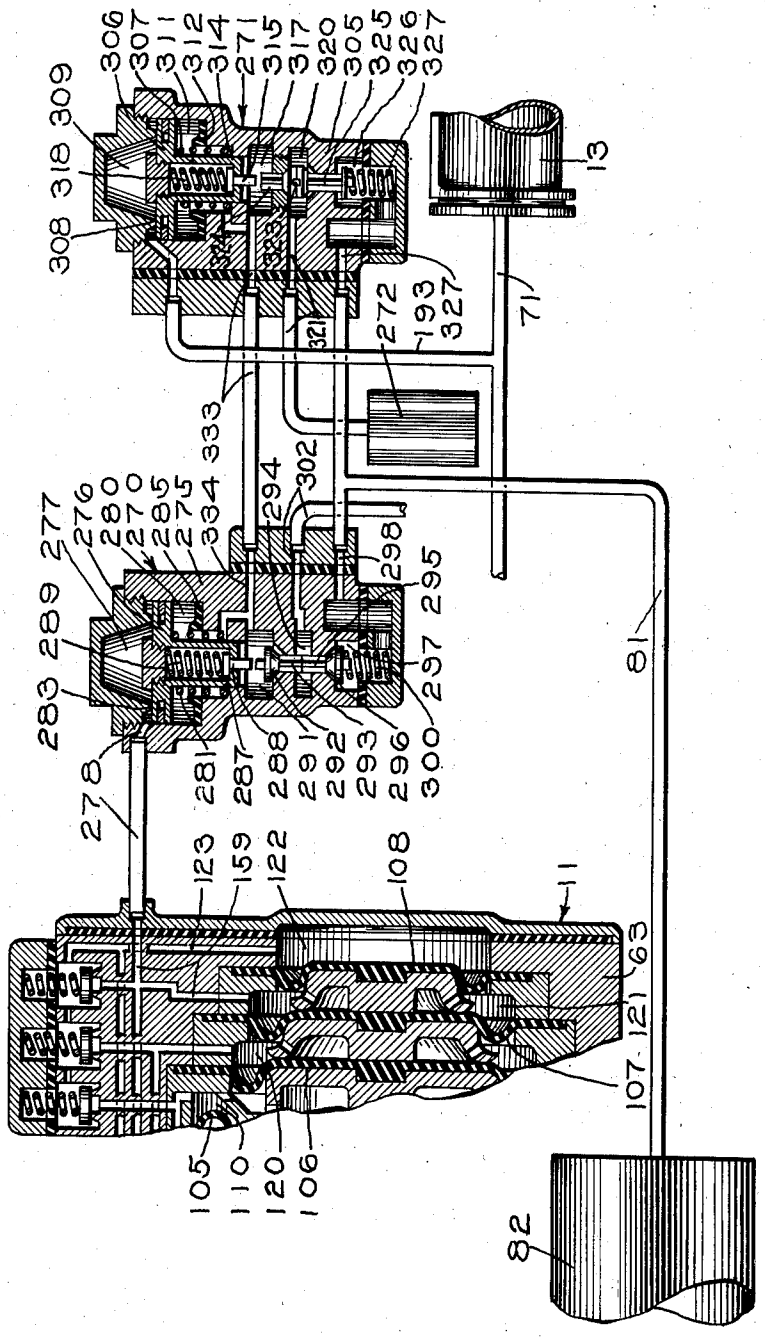


Fig. 2

INVENTOR
ELLIS E. HEWITT
BY A. M. Higgins
ATTORNEY

Patented Feb. 25, 1941

2,232,914

UNITED STATES PATENT OFFICE

2,232,914

RAIL SANDING CONTROL MEANS

Ellis E. Hewitt, Edgewood, Pa., assignor to The Westinghouse Air Brake Company, Wilmerding, Pa., a corporation of Pennsylvania

Application September 29, 1939, Serial No. 297,121

12 Claims. (Cl. 291—15)

This invention relates to vehicle carried sanding devices, and more particularly to a rail sanding control apparatus for a high speed railway train.

It has been proposed to equip railway trains of the high speed type with automatic sanding apparatus operative upon initiation of an application of the brakes to supply sand to the rail for a limited period of time, the length of which is usually predetermined so as to approximate the interval normally required in stopping the train after it has attained maximum speed. With such sanding apparatus, an application of the brakes on a train traveling at a low speed may be accompanied by automatic operation of the sanding apparatus to supply sand for too long a period, it having been found in practice that sand may continue to flow to the rails for one-half to three-quarters of a minute after the train has been brought to a stop from a relatively low speed. This is obviously an unnecessary waste of sand.

The principal object of my invention is to provide an improved sanding control equipment controlled in accordance with the speed of the vehicle, and which is automatically operative upon initiation of an application of the brakes to effect supply of sand to the rails in the usual manner while the vehicle is traveling at a speed above a predetermined minimum speed, and then operative upon reduction of the vehicle speed below said minimum speed to continue the supply of sand for only a predetermined and relatively short interval of time.

Another object of the invention is to provide a sanding control apparatus of the above type which is adapted to be associated with an air brake equipment of the class including speed control means, together with means operatively interlocking the sand control means with the speed controlled portion of the brake system.

Other objects and advantages of the invention will be apparent in the following description thereof, taken in connection with the accompanying drawings, in which

Fig. 1 is a diagrammatic sectional view of a rail sanding control apparatus constructed in accordance with the invention, and the associated parts of a fluid pressure brake equipment; and

Fig. 2 is a diagrammatic sectional view in fragmentary form of another form of sanding apparatus embodying features of the invention.

Apparatus shown in Fig. 1

Referring to Fig. 1 of the drawings, the brake control and sanding equipment illustrated comprises a speed governed switch device 10, a brake controlling valve device 11, which is adapted to respond to variations in the pressure of fluid in a control pipe 12, a brake cylinder device 13, a sanding control device 14, and a sanding selector device 15. The speed governed switch device 10 and brake controlling device 11 may be of any suitable construction and as illustrated are substantially similar to the corresponding devices of the speed controlled brake system disclosed in the United States Patent 2,140,624, which was issued December 20, 1938, to E. E. Hewitt and assigned to the assignee of the present application.

The speed governed switch device 10 comprises a casing 20 having a chamber 21 within which are mounted a plurality of weights 22, each of which is operatively mounted on a pin 23 carried by the head portion of a shaft 24, which is journaled in the casing and is adapted to be driven by a wheel of the vehicle in accordance with the speed thereof. The weights 22 are adapted to respond to centrifugal force for operating a substantially vertically disposed rod 26 which is slidably mounted in a suitable bore formed in the casing 20, each of the weights 22 having suitable extensions 27 formed thereon and adapted to engage a disk 29 carried by the rod 26. A coil spring 30 is interposed between the disk 29 and the upper wall of the chamber 21 for urging the rod 26 downwardly against the extensions 27 of the weights in opposition to the resultant force produced when the weights 22 are subjected to centrifugal action. It will thus be apparent that the rod 26 is adapted to be moved upwardly as the speed of the vehicle increases.

The upper end of the rod 26 has operatively associated therewith a plurality of suitably insulated switch contact members, including a contact member 33 which is adapted to engage a pair of stationary contact elements 34, a contact member 35 which is adapted to engage a pair of stationary contact elements 36, and a contact member 38 adapted to engage a pair of contact elements 39. The contact member 38 is secured to the end of rod 26, and the contact members 35 and 33 are slidably mounted thereon, a spring 41 being interposed between a collar portion 42 of the rod and the contact member 35 for urging that member upwardly toward a circuit-closing position, and a similar spring 45 being interposed between the collar portion 42 and contact member 33 for urging the latter member toward the contact elements 34. An insulated collar 48 is carried on the rod 26 in operative alignment with the contact member 35 for moving said member away from the contact elements 36 upon downward movement of the shaft as hereinafter explained. Similarly, an insulated collar 49 is carried on the rod 26 for moving the contact member 33 away from the contact elements 34 when the rod 26 is moved upwardly.

Associated with the speed governed switch device 10 is a fluid pressure switch 52, comprising a casing having a chamber 53 communicating with the control pipe 12, which chamber is formed at a pressure face of a piston 54 operatively mounted in the casing and subject to the force of a spring 55 acting on the piston in opposition to the pressure of fluid in the chamber 53. The piston 54 has a piston rod 56 which extends outwardly of the casing and carries a suitably insulated switch contact member 57 that is adapted for engagement with a pair of contact elements 58. The spring 55 is normally adapted to hold the contact member 57 in circuit-open position as shown in the drawing.

The brake controlling valve device 11 is of a class well known in the air brake art, and is herein described in detail only to the extent required to explain the cooperative relation of the device with the elements of the sanding control apparatus embodying the invention. The control valve device 11 comprises a relay valve portion 62, which includes a valve mechanism of the self-lapping type operative to control the supply and release of fluid under pressure to and from the brake cylinder device 13 as hereinafter explained, a diaphragm portion 63 which includes a plurality of diaphragms selectively operable to control the relay valve portion in accordance with the pressure of fluid in the control pipe 12, and a magnet valve portion 65 including electro-responsive means conditioned in accordance with operation of the speed governed device 10 for selectively cutting the diaphragms in the portion 63 into and out of operation.

The relay valve portion 62 of the control valve device 11 includes a casing having formed therein a pressure chamber 70 communicating by way of a pipe 71 with the brake cylinder device 13 and having mounted therein a discharge valve element 72, which has a stem 73 slidably mounted in suitable bores formed in the casing and is urged toward a seat 75 under the force of a coil spring 76 for closing communication from the chamber 70 to a discharge passage 77. Also formed in the casing of the relay valve portion 62 is a chamber 80, which communicates by way of a pipe 81 with a normally charged reservoir 82 or other suitable source of fluid under pressure, and which has mounted therein a supply valve element 84 that is movable into engagement with a seat 85 under the force exerted by a spring 86 for closing communication from the chamber 80 to the chamber 70. The supply valve 84 is operatively mounted in the casing of the relay valve portion for movement paralleling that of the discharge valve 72, and is provided with a fluted stem assembly 89 slidably mounted in suitable bores formed in the casing.

For operating both of the valves 72 and 84 there is provided a centrally disposed plunger 91, which has an end portion 92 slidably mounted in a suitable bore formed in the casing and carries a pin 93 having pivotally mounted thereon a yoke member 95, one arm 96 of which is operatively connected to the stem 73 of the discharge valve element 72, and the other arm 97 of which yoke member is operatively interposed between the end of the stem assembly 89 of the supply valve member 84 and a stationary stop member 99 carried by the casing and extending into the chamber 70. A coil spring 101 is interposed between a wall of the casing and the end portion 92 of the plunger for urging that member together with the yoke member 95 inwardly, or toward the right as viewed in Fig. 1. It should be understood that the spring 101 is adapted to exert a greater force than that of the spring 86 acting on the supply valve 84, which is in turn adapted to exert greater force than that of the spring 76 which urges the discharge valve member 72 toward seated position, so that while the plunger 91 is not subjected to a force opposing that of the spring 101, the latter spring is effective through the medium of the plunger and the yoke member 95, which is fulcrumed at the stop member 99, to overcome the force of the spring 76 and thereby to maintain the discharge valve 72 in its unseated position, while the supply valve 84 is held in seated position by the spring 86, as shown in Fig. 1 of the drawings.

The diaphragm portion 63 of the brake controlling valve device 11 comprises a casing having clamped therein four flexible diaphragms 105, 106, 107 and 108, which are of different sizes, the diaphragm 105 being the largest and the diaphragm 108 the smallest, and are disposed in pile relation in operative alignment with the plunger 91 of the relay valve portion 62. The diaphragm 105 is subject to the opposing pressures of fluid in the chamber 70 of the relay valve portion and of fluid in a chamber 110 communicating with a passage 111, and has mounted at opposite faces thereof a pair of follower plates 114, one of which engages the end of the plunger 91 within the chamber 70 of the relay valve portion. A follower plate 116 is attached to the diaphragm 106 within the chamber 110 and is adapted to engage the follower plate 114 of the diaphragm 105. Similarly, follower plates 117 and 118 are secured to the diaphragms 107 and 108, respectively, the plate 117 being adapted for engagement with the diaphragm 106 and the plate 118 being adapted for engagement with the diaphragm 107 when the elements are in the normal position as shown. Formed between the diaphragms 106 and 107 is a chamber 120. The smallest diaphragm 108 is interposed between a chamber 121, formed at the side of the diaphragm 107 opposite that exposed to chamber 120, and a chamber 122, which communicates at all times through a passage 123 with the control pipe 12.

The magnet valve portion 65 of the brake controlling valve device 11 comprises a casing having mounted thereon high speed, medium speed and low speed magnet portions 130, 131 and 132, respectively, which are selectively controllable in accordance with operation of the speed governed switch device 10 under different vehicle speed conditions. The magnet valve 130 is adapted to be energized as hereinafter explained when the vehicle is traveling at a speed greater than a predetermined high speed, which may be sixty miles per hour, and controls operation of a pair of connected valve elements 135 and 136, which are respectively disposed in an atmospheric exhaust passage 137 and a chamber 138 which communicates with the passage 123. The valve element 136 is adapted to control communication from the chamber 138 through passage 111 to the diaphragm chamber 110, and is normally urged toward its seated position by the force of a coil spring 141 disposed in the chamber 138. The valve element 135 has a fluted stem 142 which is cooperative with the valve element 136, and is adapted to control communication from the passage 111 to the atmospheric passage 137.

The magnet 131 is adapted to be energized at

vehicle speeds in excess of a medium speed, such as forty-five miles per hour, and controls the operation of a pair of valve elements 145 and 146 which are operatively connected by means of a fluted stem 147. The valve element 146 is adapted to be urged toward seated position by the force of a spring 149 and controls communication from the passage 123 by way of a chamber 151 to a passage 153 communicating with the diaphragm chamber 120. The valve element 145 is adapted to be held in unseated position when the valve element 146 is seated, and controls communication from the passage 153 to an atmospheric exhaust port 154.

The magnet 132 is adapted to be energized only when the speed of the vehicle falls below a low speed, such as twenty miles per hour, and controls operation of a double beat valve 157, which is disposed in a chamber 158 communicating by way of a passage 159 with the diaphragm chamber 121, the valve being normally held in an upper seated position by the force of a spring 161 for maintaining communication between the chamber 158 and a chamber 162 communicating with the passage 123. When magnet 132 is energized, the valve 157 is adapted to be moved to a lower seated position for establishing communication from the chamber 158 to an atmospheric exhaust passage 165.

According to the invention the sanding control device 14 comprises a casing 170 having formed therein a valve chamber 171, within which is disposed a double beat valve member 172 which is engageable with a lower seat 173 for controlling communication between the valve chamber and a chamber 175 communicating through a passage 176 with the supply pipe 81, and which valve is also cooperative with an upper seat 178 for controlling communication between the chamber 171 and a chamber 179, which is connected by way of a passage and pipe 180 with suitable fluid pressure operated rail sanding means, not shown. The double beat valve 172 has a fluted stem 182 which extends downwardly into the chamber 175, where a spring 183 is interposed between the end of the stem and the lower wall of the chamber for urging the valve toward the upper seat 178 as shown in Fig. 1. A fluted stem 185 extends upwardly from the valve 172 through a suitable bore and into the chamber 179.

An operating piston 187 is slidably mounted in a suitable bore formed in the casing 170 above the chamber 179, as viewed in the drawings, which piston has a hollow stem 188 having operatively disposed in a suitably apertured end thereof a plunger 189 that is urged downwardly towards the fluted stem 185 under the force of a coil spring 191 contained within the hollow stem. The piston 187 has formed at the upper side thereof a chamber 192 communicating by way of a branch pipe 193 with the brake cylinder pipe 71, and is subject at the opposite side thereof to the force of a coil spring 194 that is interposed between the piston and the lower wall of a chamber 195 formed in the casing and communicating with the sanding passage 180. The spring 194 normally maintains piston 187 in engagement with an annular rib 196 formed within chamber 192. A gasket 197 is disposed in the chamber 195 for providing a seal against which the piston 187 is adapted to be pressed under the pressure of fluid supplied to the chamber 192, as hereinafter explained.

The sanding selector device 15 comprises a casing 200 having a valve chamber 201 formed therein, in which chamber is mounted a slide valve 202, which is adapted to be held firmly against its seat by the pressure of a spring 203 interposed between the upper wall of the chamber and a collar carried by a movable thrust rod 204 engaging the upper surface of the slide valve. The slide valve 202 is operatively connected to a stem 206, which is disposed within the valve chamber 201 and is secured to a flexible diaphragm 207 which is clamped between the casing 200 and a cover member 208 bolted or otherwise secured thereto. The diaphragm 207 is subject on one side to atmospheric pressure in chamber 201 and on the other side to the pressure of fluid in a pressure chamber 210, which communicates by way of a passage and pipe 211 with the passage 159 in the brake controlling valve device 11. A coil spring 212 is interposed between the free end of the stem 206 and a cap member 213 carried by the casing for opposing movement of the valve 202, stem 206 and diaphragm 207 under the pressure of fluid in chamber 210.

With the slide valve 202 held in its normal position by the force of the spring 212 as shown in Fig. 1, a cavity 215 formed therein establishes communication between a passage 216, which communicates by way of a pipe and passage 217 with the valve chamber 171 of the sanding control device 14, and a passage 219, which communicates by way of a pipe 220 with an auxiliary sanding reservoir 221. This reservoir is adapted to be charged with sufficient fluid under pressure to provide limited sanding operation after the vehicle speed has been reduced below a minimum speed, such as twenty miles per hour, as hereinafter more fully explained.

Operation

When the equipment shown in Fig. 1 of the drawings is conditioned for operation, fluid under pressure supplied in the usual manner to the main reservoir 82 flows therefrom through the supply pipe 81 to the valve chamber 80 of the brake controlling valve device 11, and also flows through the chamber 175 of the sanding control device 14, past the double beat valve 172, and through chamber 171 and pipe 217 to passage 216 in the sanding selector device 215, and thence by way of the slide valve cavity 215, passage 219, and pipe 220 to the reservoir 221, which is thereby initially charged with fluid under pressure. With the brakes released, the control pipe 12 is connected to the atmosphere through suitable communications in a brake valve device or other control mechanism, not shown, so that the fluid pressure switch 52 is at this time maintained in circuit-open position, the spring 55 being effective through the medium of the piston 54 and stem 56 to hold the contact member 57 out of engagement with the contact element 58. With the fluid pressure switch 52 in circuit-open position, the magnets 130, 131 and 132 of the control valve device 11 are deenergized, and the several valve elements controlled thereby are consequently positioned as shown in Fig. 1, from which it will be readily apparent that each of the diaphragm chambers 110, 120 and 121, together with the chamber 210 of the sanding selector device 15, are connected to the respective atmospheric exhaust ports controlled by the valve elements. At the same time, the chamber 122 in the brake controlling valve device is connected to the atmosphere by way of the passage 123 and control pipe 12, while the chamber 70

in the relay valve portion communicates past the normally unseated valve 72 with the vent passage 77.

When the vehicle is operated at a high rate of speed, in excess of sixty miles per hour, for example, the elements of the speed governed switch device 10 assume the position shown in Fig. 1, the shaft 24 being revolved rapidly enough to cause the weights 22 to be thrown outwardly under the effect of centrifugal force, so that the vertically disposed rod 26 is maintained in its uppermost position against the force of the spring 30. With the rod 26 in this position, the contact member 38 is adapted to bridge the contact elements 39, while the contact member 35 similarly bridges the contact elements 36 under the pressure of the spring 41. At the same time, the collar portion 49 of the rod 26 is so disposed with respect to the contact elements 34 as to hold the contact member 33 out of engagement therewith.

If it is now desired to effect an application of the brakes, the brake valve device controlling the pressure of fluid in the control pipe 12 is operated in the usual manner to effect an increase in the pressure of fluid therein corresponding with the desired degree of application of the brakes. Fluid under pressure thus supplied to the control pipe flows therefrom through passage 123 in the brake controlling valve device 11 to the connected chambers 138, 151, 162 and 122, while the pressure of fluid in the chamber 53 of the fluid pressure switch 52 is correspondingly increased for moving the piston 54, stem 56 and contact member 57 upwardly until the contact member bridges the contact elements 58. When the fluid pressure switch 52 is actuated to circuit closing position and while the speed governed switch device 10 is maintained in the high speed position as shown in Fig. 1, circuits for energization of the magnets 130 and 131 of the brake controlling valve device 11 are established. The circuit for the high speed magnet 130 includes the positive terminal of a battery or other suitable source of electric power 230, a grounded conductor 231, a similarly grounded conductor 232 connected to the magnet 130, a conductor 233, the connected switch contact elements 38 and 39, a conductor 235, the contact element 57 and 58, and a return conductor 236 connected to the negative terminal of a battery. The circuit for the medium speed magnet 131 includes the battery 230, the grounded conductor 231, a grounded conductor 238 connected to the magnet, a conductor 239, the connected contact elements 35 and 36, the conductor 235, connected switch elements 57 and 58 and the return conductor 236.

Upon energization of the high speed magnet 130, the valve elements 135 and 136 are operated thereby against the force of the spring 141 to their seated and unseated positions, respectively, whereupon fluid under pressure from the control pipe 12 is supplied by way of passage 123, and chamber 138, past the unseated valve 136 and through the passage 111 to the diaphragm chamber 110 in the brake controlling device 11. Similarly, upon energization of the medium speed magnet 131 the valve elements 145 and 146 are moved against the force of the spring 149 to their respective seated and unseated positions, so that fluid under pressure is supplied from the control pipe by way of the passage 123, chamber 151, past the unseated valve 146 and through passage 153 to diaphragm chamber 120. Since the low speed magnet 132 is not energized at this time, the double-beat valve 157 remains in its upper seated position as shown, and fluid under pressure is thus supplied by way of the passage 123, chamber 162, chamber 158 and passage 159 to the diaphragm chamber 121, and also by way of the pipe and passage 211 to the pressure chamber 210 in the sanding selector device 15.

The pressure of fluid supplied to the chamber 210 of the sanding selector device 15 acts against the diaphragm 207 to force the diaphragm, the stem 206 connected thereto, and slide valve 202 to the right, as viewed in the drawings, until a follower element 241 carried by the diaphragm engages a stop rib 242 formed on the casing 200. When the slide valve 202 is so operated, a passage 245 formed therein is brought into registration with the passage 216 and a passage 246 which leads through a pipe 247 to the passage 176 in the sanding control device 14. At the same time, the cavity 215 in the slide valve is moved out of registration with the passage 216, but fluid under pressure is still free to flow to reservoir 221 from the supply pipe 81 by way of the passage 176 in the sanding control device, pipe 247, passage 246, slide valve passage 245, passage 216, past a ball check valve 250 and through a chamber 251 containing the same, the passage 219 and pipe 220.

Meanwhile, the pressure of fluid supplied from the control pipe to the diaphragm chamber 110 of the brake controlling valve device 11 acts through the medium of the diaphragm 105 to move the plunger 91 outwardly against the force of the spring 101, it being understood that the diaphragm 105 is at this time adapted to move independently of the other diaphragms 106, 107 and 108, the opposing fluid pressures on which are equalized, as hereinbefore explained. As the plunger 91 is thus moved outwardly, the yoke member 95 carried thereby is initially fulcrumed at the point of engagement of the arm 97 with the stem assembly 89, and the yoke member is thus turned about the pin 93 for causing the arm 96 thereof to move the valve element 72 into engagement with the seat 75 for closing the communication from the chamber 70 to the atmosphere. Upon seating of the valve element 72, continued movement of the plunger 91 by operation of the diaphragm 105 is effective to tilt the yoke member 95 in a clockwise direction about the pin 93, the arm 96 of the member being then fulcrumed at the point of engagement with the stem 73, so that the arm 97 of the yoke member is operated to shift the stem assembly 89 and the valve element 84 outwardly against the force of the spring 86, the valve element thus disengaging the seat 85 for permitting flow of fluid under pressure from the supply pipe 81 through chamber 80 and past the fluted stem 89 to the chamber 70. Fluid under pressure thus supplied to the chamber 70 flows therefrom through the brake cylinder pipe 71 to the brake cylinder device 13, which is thereby operated to effect an application of the brakes.

Fluid under pressure is also supplied from the brake cylinder pipe 71 through the branch pipe 193 to the portion of the chamber 192 of the sanding control device 14 outwardly of the rib 196, and, assuming that brake cylinder pressure is increased sufficiently, the piston 187 is then forced away from the rib 196 so as to expose its entire area to the chamber 192, whereupon the piston is shifted downwardly with a snap-like action into sealing engagement with the rubber gasket 197.

The plunger 189 is thereby brought into engagement with the fluted stem 185 and through the medium thereof moves the double-beat valve 172 away from the seat 178 and into engagement with the seat 173, thus establishing communication between the chambers 171 and 179. Fluid under pressure is then quickly supplied from the supply pipe 81 through passage 176, pipe 247, passage 246 in the sanding selector device 15, slide valve passage 245, passage 216 and pipe 217 to chamber 171, and thence past the double-beat valve 172 and through chamber 179 and passage and pipe 180 to the usual fluid pressure responsive sanding mechanism, not shown. It will be understood that, while the sanding selector device 15 and the sanding control device 14 are maintained in the operating position to which they have been moved during an application of the brakes while the vehicle is traveling at a high speed, as just explained, the sanding of the rail is continued at a substantially constant rate, since the reservoir 82 from which fluid under pressure is supplied for the sanding operation constitutes a practically unlimited source.

The brake controlling device 11 is automatically operated to cut off further supply of fluid under pressure to the brake cylinder device 13 when the pressure of fluid in the chamber 70 is increased slightly above the opposing pressure of fluid in the chamber 110. The diaphragm 105 and the associated plunger 91 are thus adapted to be shifted to the right as viewed in the drawings, when the combined pressures of fluid in the chamber 70 and of the spring 101 overbalance the fluid pressure in chamber 110, and with the end 96 of the yoke member 95 held stationary by the force of the spring 76, the yoke member is thereby turned in a counterclockwise direction about the pin 93 for permitting the spring 86 to move the supply valve 84 into engagement with the seat 85. The relay valve mechanism is thus moved to lap position, wherein both the supply valve 84 and the discharge valve 72 are held in seated position.

As the speed of the vehicle reduces, the speed governed switch device 10 is operative to control the circuits for the magnet valve devices so as to effect reduction in the force exerted by the several diaphragms in the brake controlling valve device 11 in controlling operation of the relay valve portion thereof, the degree of application of the brakes thereby regulated in a series of steps or in successively decreasing ratios with respect to the control pipe pressure, the ratio of brake cylinder pressure to control pipe pressure at any time being determined by the vehicle speed. This operation of the brake equipment is well understood by those skilled in the art and is clearly explained in the aforementioned Patent 2,140,624. The rail sanding control apparatus associated with the braking equipment shown in Fig. 1 is operative to effect a constant supply of sand to the rails, as hereinbefore explained, throughout the range of speed of the vehicle so long as the speed exceeds a predetermined minimum value, which may be twenty miles per hour.

Let it now be assumed that the vehicle is traveling at less than the predetermined speed of twenty miles per hour, and that, with the fluid pressure switch 52 still in circuit-closing position, the elements of the speed governed switch device 10 have assumed their minimum speed position, wherein the contact member 33 is withdrawn from engagement with the contact elements 39, and contact member 35 is similarly positioned out of engagement with the contact elements 36, while the contact member 33 is held in engagement with the contact elements 34 under the force of the spring 45. With the switch contact members 38 and 35 thus disconnected from the respective pairs of contact elements 39 and 36, the circuits for the high and medium speed magnets 130 and 131 are broken, so that the valve spring 141 is rendered effective to shift the associated valve elements 136 and 135 to their seated and unseated positions respectively, while the valve spring 149 is similarly enabled to move to the valve elements 146 and 145 to seated and unseated positions, as shown in Fig. 1.

When the valve element 135 is thus moved to unseated position, the diaphragm chamber 110 is connected to the atmosphere by way of the passage 111, past the unseated valve element, and through the exhaust passage 137. With the valve 145 unseated, the diaphragm chamber 120 is connected with the atmosphere through the passage 153, past the unseated valve through the exhaust port 154.

At the same time, since the switch contact member 33 of the switch device 10 now engages the contact elements 34, the low speed magnet 132 is energized through a circuit comprising the positive terminal of the battery 230, grounded conductor 231, a grounded conductor 260 connected to the magnet 132, a conductor 261, the aforementioned switch contact elements, the conductor 235, the switch contact elements 57 and 58, and the return conductor 236 leading to the negative terminal of the battery. When the magnet 132 is thus energized, the double-beat valve 157 controlled thereby is shifted to its lower seated position against the force of the spring 161, with the result that the passage 159 is connected to the atmosphere by way of the exhaust passage 165 for venting the diaphragm chamber 121 of the brake controlling device 11, and for also venting the pressure chamber 210 of the sanding selector device 15, by way of the passage and pipe 211. It will be apparent, that with the three diaphragm chambers 110, 120 and 121 thus connected to the atmosphere, the relay valve mechanism of the brake controlling device 11 will thereafter be controlled in accordance with variations in control pipe pressure acting in the chamber 122 against the small diaphragm 108 in opposition to the pressure of fluid in chamber 70 acting against the large diaphragm 105.

When the pressure of fluid in the chamber 210 of the sanding selector device 15 is vented to the atmosphere, by reason of the above described operation of the brake controlling device 11 to correspond with the minimum range of speed of the vehicle, the spring 212 becomes effective to shift the stem 206, diaphragm 207 and the slide valve 202 to the left and into the position shown in Fig. 1 of the drawings, so that the valve passage 245 is moved out of registration with the passages 216 and 246 while the cavity 215 once more is brought into registration with passages 219 and 216. Meanwhile, the pressure of fluid in the chamber 192 of the sanding control device 14 is still effective to maintain the piston 187 in engagement with the sealing gasket 197, so that the double-beat valve 172 is held in engagement with the lower seat 173 for maintaining communication between the chambers 171 and 179, as already explained. Fluid under pressure for operating the sanding apparatus with which the vehicle is equipped is then supplied from the relatively small reservoir 221 by way of pipe 220,

passage 219 in sanding selector device 15, valve cavity 215, passage 216, pipe 217, valve chamber 171 in the sanding control device 14, past the double-beat valve 172 and thence through chamber 179 and passage and pipe 180. Since the volume of fluid under pressure initially stored in the reservoir 221 is sufficient to continue sanding of the rails for an interval of time approximating that required to bring the vehicle to a stop from a speed of about 20 miles per hour, it will be apparent that adequate sanding of the rails is thus obtained without undue waste of sand and fluid under pressure.

When the release of the brakes is effected by reduction of the pressure of fluid in the control pipe 12 in the usual manner, the consequent reduction in the pressure of fluid in the chamber 122 acting on the diaphragms in the control valve device 11 results in complete withdrawal of force opposing that of the fluid pressure in chamber 70 as aided by the force of spring 101, so that the relay valve mechanism is actuated to effect seating of the valve 84 and unseating of the exhaust valve 72. Fluid under pressure is thus vented from the brake cylinder device 13 and from the chamber 192 of sanding control device connected thereto. The spring 194 is then rendered effective to shift the piston 187 upwardly into engagement with the rib 196, while the plunger element 189 is withdrawn from the fluted stem 185 to permit the spring 183 to shift the double-beat valve 172 into its upper-seated position as shown in Fig. 1. The elements of the several brake control and sanding control devices shown in Fig. 1 are then disposed in the normal positions as illustrated.

Apparatus shown in Fig. 2 of the drawings

Referring to Fig. 2 of the drawings, the brake controlling equipment including the brake controlling device 11 is illustrated in fragmentary form in association with a sanding control apparatus constructed in accordance with a different embodiment of the invention. Included in the sanding control apparatus equipment are a sanding selector device 270, a low speed sanding control device 271, and an auxiliary sanding reservoir 272. The brake controlling device 11 is of the same construction as that shown in Fig. 1 and already described, and has formed therein the passage 159 which is adapted to be supplied with fluid under pressure from the control pipe, not shown in Fig. 2, when an application of the brakes is initiated, and to be vented to the atmosphere upon reduction of the speed of the vehicle below the predetermined minimum speed, such as 20 miles per hour.

The sanding selector device 270 comprises a casing 275 having a bore in which is operatively mounted a piston 276, which is subject on one side to the pressure of fluid in a chamber 277 communicating by way of a passage and pipe 278 with the passage 159 in the brake controlling valve device 11. On the side of the piston 276 opposite the chamber 277 is formed a chamber 280 containing a coil spring 281 which is interposed between the lower wall of the chamber and the piston 276 for urging it upwardly into engagement with an annular seat rib 283. The seat rib 283, like the similar rib 196 of the sanding control device 14 shown in Fig. 1 of the drawings, is adapted when engaged by the piston to provide an outer-seated area thereof initially exposed to the pressure of fluid supplied through the pipe 278 as hereinafter explained, and an inner-seated area which becomes exposed to the ffuid pressure upon downward movement of the piston. Mounted within the chamber 280 is a flexible sealing diaphragm 285 which is adapted to be engaged by the piston 276 upon downward movement thereof.

The piston 276 has a hollow stem portion 287 slidably mounted in a suitable bore and carries a movable plunger 288 that is urged downwardly and outwardly of the stem under a force of a coil spring 289. The plunger 288 extends into a valve chamber 291 containing a valve element 292, which is operatively aligned with the plunger 288 and has a fluted stem 293 mounted in a suitable bore and projecting into a chamber 294 formed in the casing. The stem 293 operatively engages a similar fluted stem 295 of a valve 296 that is mounted in a valve chamber 297 communicating through a passage 298 with the supply pipe 81. A coil spring 300 is interposed between the valve 296 and the lower wall of chamber 297 for urging that valve and the companion valve 292 into their seated and unseated positions, respectively, as shown in Fig. 2. The valve 296 and valve 292 are adapted to control communication from the respective chambers 297 and 291 to the intermediate chamber 294, which is connected by way of a passage and pipe 302 with the usual fluid pressure responsive sanding means, not shown.

The low speed sanding device 271 is somewhat similar in construction to the sanding selector device 270, and comprises a casing 305 having a bore in which is slidably mounted a piston 306 which is normally urged upwardly by the force of a spring 307 into engagement with an annular rib 308 that is formed on the casing within a chamber 309 communicatng through the branch pipe 193 with the brake cylinder pipe 71. The spring 307 is disposed in a chamber 311, within which is mounted a sealing gasket 312 adapted to be engaged by the piston 306 on downward movement thereof under the pressure of fluid admitted to chamber 309, as hereinafter explained. The piston 306 has a hollow stem 314 having operatively mounted in a suitable bore formed in the lower end thereof a plunger 315, the end of which is urged into a chamber 317 of the casing under the force of a coil spring 318 contained within the hollow piston stem 314.

The casing 305 also has formed therein a valve chamber 320, which communicates through a suitable bore with the chamber 317 and through a passage and pipe 321 with the sanding reservoir 272. The chamber 320 contains a double-beat valve 323, which has one fluted stem 324 slidably mounted in the bore between chambers 320 and 317 and extending into operative alignment with the plunger 315, and another fluted stem 325 slidably mounted in a bore that communicates with the chamber 320 and with a chamber 326 formed in the casing. The chamber 326 communicates by way of a passage 327 with the supply pipe 81. A coil spring 327 is interposed between the wall of chamber 326 at the end of the fluted stem 325 and acts through the medium of the stem to urge the double-beat valve 323 toward its upper-seated position, as shown in Fig. 2, in which position the valve closes communication between the chamber 320 and chamber 317 while maintaining communication from the chamber 320 to chamber 326.

Operation

If the brake controlling valve device 11 is op-

erated in the usual manner to effect an application of the brakes while the vehicle is traveling at a speed in excess of 20 miles per hour, fluid under pressure is supplied in the manner already explained through the passage 159 in the control valve device, and thence through pipe and passage 278 to the chamber 277 of the sanding selector device 270. The piston 276 is thereby moved downwardly against the force of the spring 281 to cause plunger 288 to engage the valve element 292. Continued downward movement of the piston 276 then effects seating of the valve element 292 for closing communication between chambers 291 and 294, and at the same time moves the valve element 296 from its seat against the force of spring 300. With the valve 296 unseated, fluid under pressure is supplied from the main reservoir 82 by way of the supply pipe 81, passage 298, chamber 297, past the unseated valve, and through chamber 294 and passage and pipe 302 to the fluid pressure sanding means carried by the vehicle.

Meanwhile, the brake controlling device 11 is operated in the usual manner to effect supply under pressure through the pipe 71 to the brake cylinder device 13 for effecting the application of the brakes to a degree corresponding with the speed of the vehicle. Fluid under pressure at the same time flows from the brake cylinder pipe 71 through the branch pipe 193 to the chamber 309 in the valve device 271, and effects quick operation of the piston 306 and plunger 315 carried thereby to cause movement of the double-beat valve element 323 to its lower-seated position, in which position communication from the supply pipe by way of chamber 326 through the valve chamber 320 to the sanding reservoir 272 connected thereto is shut off, while communication is established from the chamber 320 to chamber 317. It will of course be apparent, however, that the fluid under pressure with which the sanding reservoir 272 has previously been charged remains bottled up therein and in the connected chambers 320, 317 and chamber 291 of the sanding selector device 270, so long as the valve element 292 remains seated.

When the speed of the vehicle has been reduced to below the minimum speed of 20 miles per hour, the brake controlling valve device 11 is automatically operated in the manner already explained to vent the passage 159, and with it the pipe and passage 278 and the piston chamber 277 of the sanding selector device 270, and the spring 281 thus becomes effective to move the piston 276 and plunger 288 upwardly to the position shown in Fig. 2, so that the spring 300 is permitted to move the associated valve elements 296 and 292 to their respective seated and unseated positions. Upon movement of the valve element 296 to its seated position, communication from the supply pipe 81 to the sanding means by way of the passage and pipe 302 is cut off, while fluid under pressure is supplied from the sanding reservoir 272 by way of pipe and passage 321, the connected chambers 320 and 317 of the low speed sand valve device 271, through a passage and pipe 333 and a passage 334 to the valve chamber 291 in the sanding selector device 270, and then past the unseated valve 292 and through passage and pipe 302 to the sanding means, not shown. As in the case of the reservoir 221 shown in Fig. 1 of the drawings, the sanding reservoir 272 has sufficient capacity to insure adequate supply of fluid under pressure to the sanding means during the interval of time required to bring the vehicle to a stop from the relatively low speed of twenty miles per hour.

From the foregoing description, it will be evident that an improved sanding control apparatus constructed in accordance with the invention may readily be designed for cooperation with any desired type of speed controlled fluid pressure mechanism, such as that included in a brake equipment for high speed trains, and that by reason of the automatic operation of the apparatus to effect unlimited sanding of the rails while the vehicle is traveling at a speed in excess of a predetermined speed so long as the application of the brakes is continued, and to effect sanding of the rails for a limited interval of time when the brakes are applied while the vehicle is moving at a lesser speed, substantial economies in the use of sand and fluid under pressure are insured.

While two embodiments of the invention have been described in detail, it is not intended to limit the invention to those 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. In a vehicle carried sanding equipment, in combination, a primary sanding control means operable to effect sanding, a secondary sanding control means operable to effect sanding, and speed responsive means operative to condition said primary sanding control means for sanding operation while the vehicle is moving at a speed in excess of a predetermined speed, and to condition said secondary sanding control means for sanding operation while the vehicle is moving at a slower speed.

2. In a vehicle carried sanding equipment, in combination, a primary sanding control means adapted for continuous operation, a limited sanding control means adapted for operation for a predetermined interval of time, and speed responsive means operative to condition said primary sanding control means for operation while the vehicle is moving at a speed in excess of a predetermined speed, and to condition said limited sanding control means for operation while the vehicle is moving at a lower speed.

3. A sanding control apparatus for a vehicle equipped with fluid pressure brake means, comprising primary sanding control means operative to effect continuous sanding, secondary sanding control means operative to effect sanding for a limited period of time, and means controlled by said fluid pressure brake means and selectively cooperative with both the primary and the secondary sanding control means for effecting sanding operation during application of the brakes.

4. A sanding control apparatus for a vehicle equipped with fluid pressure brake means, comprising primary sanding control means operative to effect continuous sanding, secondary sanding control means operative to effect sanding for a limited period of time, and means responsive to an application of the brakes first to initiate operation of said primary sanding control means and then to stop operation thereof while causing operation of said secondary sanding control means.

5. A sanding control apparatus for a vehicle equipped with fluid pressure brake means and fluid pressure sanding means including a sand pipe adapted to be supplied with fluid under pres-

sure during sanding operation, said control apparatus comprising sanding valve means operative in response to an application of the brakes to effect continuous supply of fluid under pressure to said sand pipe, and sanding selector means responsive to a certain operating condition of the vehicle for closing the communication through which said sanding valve means supplies fluid to said sand pipe while initiating a limited supply of fluid under pressure to said pipe.

6. A sanding control apparatus for a railway vehicle equipped with fluid pressure brakes comprising, in combination, fluid pressure responsive sanding control means, means providing a constant supply of fluid under pressure, means providing a limited supply of fluid under pressure, and sanding selector means controlled in accordance with the operation of the fluid pressure brakes for effecting the supply of fluid under pressure to the fluid responsive sanding means from said constant supply source at one time, and from said limited supply source at another time.

7. A sanding control apparatus for a railway vehicle having fluid pressure operated sanding means and fluid pressure brake means controlled according to speed, comprising a primary source providing a constant supply of fluid under pressure, a secondary source providing a predetermined limited supply of fluid under pressure, and means conditioned during an application of the brakes when the vehicle is moving at or in excess of a certain speed to effect supply of fluid under pressure from said primary source to said sanding means, and otherwise conditioned to effect supply of fluid under pressure thereto from said secondary source during an application of the brakes when the vehicle speed is less than said certain speed.

8. A sanding control apparatus for a railway vehicle having fluid pressure operated sanding means and speed controlled fluid pressure brake means, including a control communication that is charged with fluid under pressure when an application of the brakes is effected while the vehicle speed exceeds a predetermined value and vented when the vehicle speed is less than such value, said sanding control apparatus comprising a primary source providing a constant supply of fluid under pressure, a secondary source providing a predetermined limited supply of fluid under pressure, a movable abutment subject to the pressure of fluid in said control communication, and valve means controlled by said abutment and operative upon an increase in said fluid pressure to establish communication from said primary source to said fluid pressure operated sanding means, and operative upon a reduction in fluid pressure in said control communication to establish another communication from said secondary source to said sanding means.

9. A sanding control apparatus for a railway vehicle having fluid pressure operated sanding means and speed controlled fluid pressure brake means, including a control communication that is charged with fluid under pressure when an application of the brakes is effected while the vehicle speed exceeds a predetermined value and vented when the vehicle speed is less than such value, said sanding control apparatus comprising a primary source providing a constant supply of fluid under pressure, a secondary source providing a predetermined limited supply of fluid under pressure, sanding selector valve means subject to the pressure of fluid in said control communication and operative upon an increase therein for establishing communication from said primary source to said fluid pressure operated sanding means, and upon reduction of the fluid pressure in the control communication to establish another communication from said secondary source to said sanding means, and auxiliary valve means also controlling said communications to the fluid pressure operated sanding means and operative to maintain said communications closed while the fluid pressure brakes are released.

10. A sanding control apparatus for a railway vehicle having fluid pressure operated sanding means and speed controlled fluid pressure brake means, including a control communication that is charged with fluid under pressure when an application of the brakes is effected while the vehicle speed exceeds a predetermined value and vented when the vehicle speed is less than such value, said sanding control apparatus comprising a primary source providing a constant supply of fluid under pressure, a secondary source providing a predetermined limited supply of fluid under pressure, control valve means normally positioned to supply fluid under pressure from said primary source to said secondary source and operative during an application of the brakes to supply fluid under pressure from said secondary source to a chamber, and selector valve means subject to the pressure of fluid in said control communication of the brake means and operative upon an increase in said fluid pressure to establish communication from said primary source to said fluid pressure operated sanding means, and upon a reduction in the fluid pressure in said control communication to establish communication from said chamber to said fluid pressure operated sanding means.

11. A sanding control apparatus for a railway vehicle having fluid pressure operated sanding means and speed controlled fluid pressure brake means, including a control communication that is charged with fluid under pressure when an application of the brakes is effected while the vehicle speed exceeds a predetermined value and vented when the vehicle speed is less than such value, said sanding control apparatus comprising a primary source providing a constant supply of fluid under pressure, a secondary source providing a predetermined limited supply of fluid under pressure, sanding control valve means operative when the brakes are released to effect supply of fluid under pressure from said primary source to a chamber and operative during an application of the brakes to establish communication from said chamber to said fluid pressure operated sanding means, and sanding selector valve means subject to the pressure of fluid in said control communication of the speed controlled brake means and operative upon an increase of said fluid pressure to establish communication from said primary source to said chamber in the sanding control valve means, and upon a reduction in the fluid pressure in said control communication to establish communication from said secondary source to said chamber.

12. In a vehicle carried sanding equipment, in combination, a primary sanding control means operable to effect sanding, a secondary sanding control means operable to effect sanding, and speed responsive means for sequentially effecting sanding operation of said two sanding control means.

ELLIS E. HEWITT.