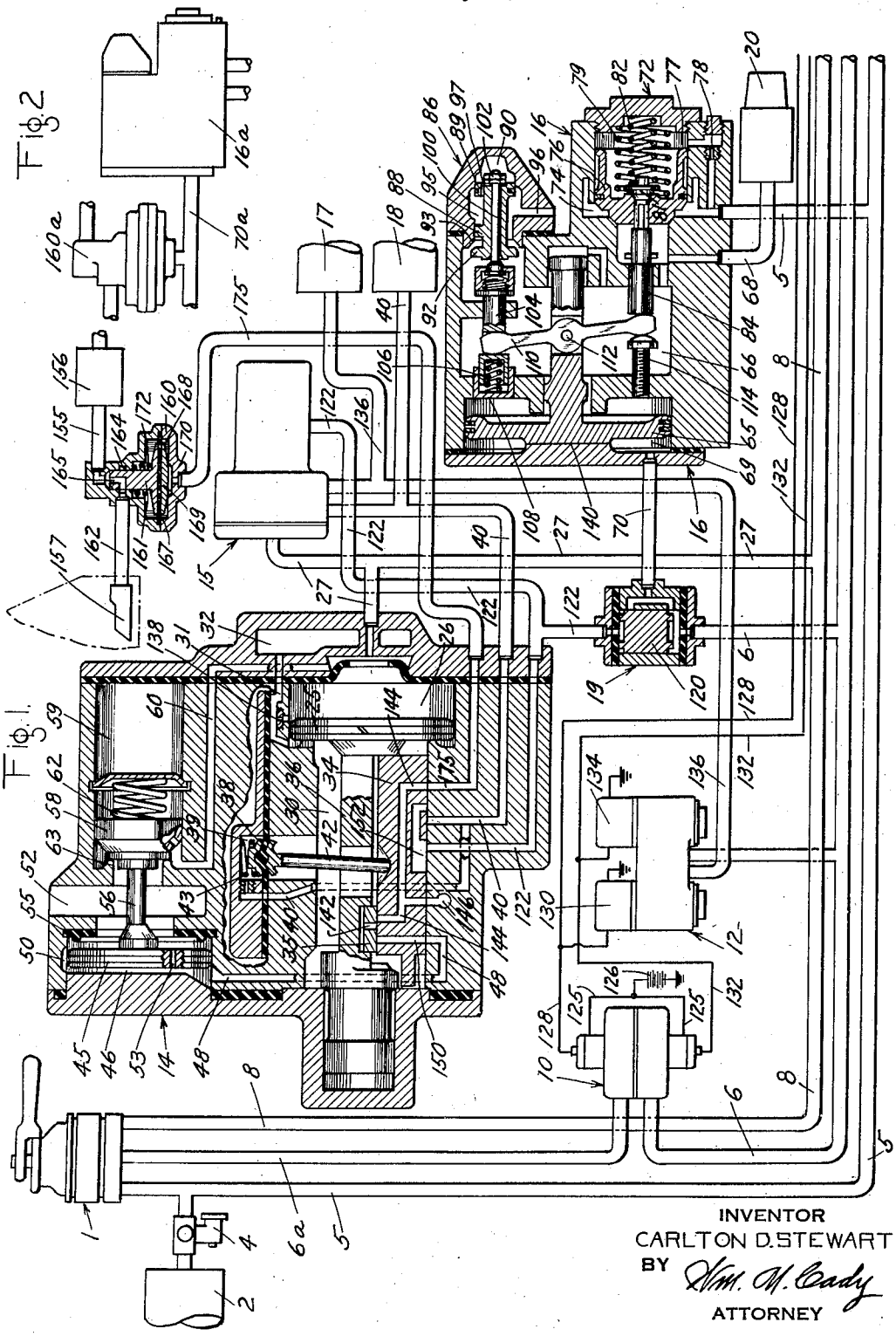
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AUTOMATIC FUEL-CONTROL DEVICE

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AUTOMATIC FUEL-CONTROL DEVICE

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This invention relates to a fuel control system and particularly to means for regulating the supply of fluid fuel to the furnace of a locomotive boiler.

As usually constructed, locomotive boilers are provided with fire boxes in which the combustion of the fuel takes place. The fire box is usually arranged at the rear of the boiler and its upper wall is known as the crown sheet. The lower face of the crown sheet is exposed to the fire in the fire box, while the water in the boiler is normally maintained at such a level that the crown sheet is covered to thereby prevent over-heating of the crown sheet and resultant injury thereto.

Because of the high operating speeds now employed, very effective braking is required and results in high rates of deceleration of the train and of the locomotive. On a reduction in the speed of a locomotive, the force of inertia acting on the water in the locomotive boiler causes the water to move relative to the boiler from the rear of the boiler to the front.

It has been found that the high rates of deceleration employed at the present time may cause so great a movement of the water in the boiler from the rear to the front as to leave crown sheet bare. If this condition occurs, and if the furnace is being fired heavily at this time, the crown sheet may be overheated and seriously damaged.

It is an object of this invention to provide means associated with the brake equipment of a locomotive and automatically operable in response to a brake application of a degree somewhat less than that sufficient to produce a rate of retardation of the locomotive which will cause the crown sheet to be uncovered to restrict the rate of supply of fuel to the furnace of the locomotive boiler to prevent overheating of the crown sheet and resultant injury thereto.

A further object of this invention is to provide means automatically operable on a predetermined relatively heavy application of the brakes or on an emergency application of the brakes on the locomotive to restrict the rate of supply of fuel to the furnace of the boiler of the locomotive to prevent overheating of the crown sheet.

Another object of the invention is to provide improved means of the type described which can be readily incorporated in the brake equipments provided for locomotives employed in high speed service.

A further object of the invention is to provide means of the type described which can be easily incorporated in the fuel supply systems employed on locomotives fired with fluid fuel.

Another object of the invention is to provide improved means of the type described.

Other objects of the invention and features of novelty will be apparent from the following description taken in connection with the accompanying drawing in which,

Fig. 1 is a diagrammatic view, partly in section, of the brake equipment for a locomotive provided with the fuel control system embodying my invention, and

Fig. 2 is a fragmentary view showing a modified form of construction embodying my invention.

The fuel control system provided by this invention is shown in connection with a brake equipment of the type employed on locomotives which are operated in high speed train service. The brake equipment shown in Fig. 1 of the drawing is similar to that shown and claimed in application Serial No. 741,063 of Ellis E. Hewitt, filed August 23, 1934, and assigned to the same assignee as this application. Only such portions of the brake equipment are shown and described in this application, and only the portions of the operation of the brake equipment are described in this application, as are essential to the understanding of this invention.

Referring to Fig. 1 of the drawing, the brake equipment includes an engineer's brake valve 1, a main reservoir 2, a feed valve device 4, a supply pipe 5, a control pipe 6, a brake pipe 8, a pneumatic switch device 10, a magnet valve device 12, an emergency valve device 14, a service valve device 15, a relay valve device 16, an auxiliary reservoir 17, an emergency reservoir 18, a double check valve 19, and a brake cylinder 20.

The emergency valve device 14 comprises a body having a bore therein in which is mounted a piston 25 having at one face thereof a chamber 26, which is constantly connected by way of a branch pipe and passage 27 with the brake pipe 8. The piston 25 has at the other face thereof a valve chamber 30 which is constantly connected by way of a passage 31 with a pressure chamber 32. A main slide valve 34 is mounted in the valve chamber 30 and is movable upon a seat formed on the body of the valve device, while an auxiliary slide valve 35 having movement relative to the main slide valve 34 is also mounted in the valve chamber. The main slide valve 34 and the auxiliary slide valve 35 are operated by means of the piston 25 through the medium of a stem 36 formed integral with the piston.

The emergency valve device 14 has associated therewith a movable abutment in the form of a diaphragm 38 which is subject on one face to the pressure of the fluid in the chamber 39 which is constantly connected by way of a passage and pipe 40 with the emergency reservoir 18. The other face of the diaphragm 38 is engaged by an end of a stem 42 which extends between the diaphragm 38 and the main slide valve 34

and serves to maintain the slide valve 34 in engagement with its seat. A spring 43 is mounted in the chamber 39, and operates through the diaphragm 38 and the stem 42 to press the slide valve 34 against its seat.

The emergency valve device 14 has associated therewith a vent valve device comprising a piston 45 mounted in a bore in the body of the emergency valve device, and having at one face thereof a chamber 46 which is constantly connected by way of a passage 48 with a port in the seat of the main slide valve 34. The bore in which the piston 45 is mounted has a groove 50 cut therein, which in one position of the piston 45 extends around the piston to permit fluid under pressure to flow from the chamber 46 to an atmospheric exhaust passage 52, while the piston 45 has a restricted passage 53 extending therethrough through which fluid under pressure may flow at a restricted rate from the chamber 46 to the atmospheric passage 52.

A gasket 55 is mounted at an end of the bore in which the piston 45 is mounted, while this gasket has an annular seat rib formed thereon which at certain times is engaged by a face of the piston 45 to prevent flow of fluid under pressure around the periphery of the piston and thence to the atmospheric passage 52.

The piston 45 has formed integral therewith a stem 56 on which is secured a vent valve 58, which is mounted in a chamber 59 which is constantly connected by way of a passage 60 with the chamber 26, and thereby through the branch pipe 27 with the brake pipe 8. The vent valve 58 is yieldingly pressed by means of a spring 62 into engagement with the seat rib 63 surrounding a passage open to the atmospheric passage 52.

The relay valve device 16 comprises a body having a bore therein in which is mounted a piston 65 having at one face a chamber 66, which is constantly connected by means of a passage and pipe 68 with the brake cylinder 20. The piston 65 has at the other face thereof a chamber 69, which is constantly connected by way of the pipe 70 with a passage in the double check valve device 19.

The relay valve device 16 has associated therewith the supply valve device indicated generally by the reference numeral 72, and mounted in a chamber 74 to which is connected a branch of the supply pipe 5 leading from the feed valve device 4.

The supply valve device 72 comprises a valve piston 76 slidable in a bore in the body of the relay valve device 16 and subject on one face to the pressure of the fluid in the chamber 74, and subject on the other face to the pressure of the fluid in a chamber 77 which is connected through a choke 78 with the chamber 74. The valve piston 76 is yieldingly urged by means of a spring 79 into engagement with a seat surrounding a passage open to the chamber 66.

The valve piston 76 has a bore extending therethrough in which is mounted a valve 81 having a seating face thereon adapted to engage a seat surrounding the bore through the piston 76. A coil spring 82 is mounted in the chamber 77 and yieldingly presses the valve 81 to the seated position, while the stem of the valve 81 projects from the face of the valve piston 76 and is adapted to be engaged by a plunger 84 mounted in a bore in the body of the relay valve device 16.

The relay valve device 16 has associated therewith release valve means indicated generally by the reference numeral 86 and comprising a valve member 88 mounted in a bore in the body of the relay valve device 16. The valve member 88 has at one end a head 89 which is subject on one face to the pressure of the fluid in a chamber 90, while the valve member 88 has at its other end a head 92 which is subject to the pressure of the fluid in the chamber 66. The head 92 has a seating face thereon adapted to engage a seat 93 surrounding the bore in which the valve member is mounted. The chamber 95 intermediate the heads 89 and 92 is constantly open to the atmosphere through a passage 96, while the head 89 has a restricted passage 97 extending therethrough through which fluid under pressure may flow at a restricted rate from the chamber 90 to the chamber 95, and thence to the atmosphere.

The valve member 88 has a bore extending therethrough, while the stem of a valve 100 is loosely mounted in this bore. The valve 100 has at one end of its stem a head having a seating face thereon adapted at certain times to engage a seat formed on the valve member 88 surrounding the bore in which the stem of the valve 100 is mounted, while the other end of the valve stem has nuts 102 secured thereon to limit movement of the valve 100 to the left, as viewed in the drawing, relative to valve member 88. The face of the valve member 88 has grooves therein through which fluid under pressure supplied to the bore in the valve member 88 may flow to the chamber 90 when the nuts 102 engage the face of the head 89.

The valve 100 has secured thereto a plunger 104, which is reciprocable in a bore in the body of the relay valve device 16, while a coil spring 106 extends between a spring seat 108 and the end of the plunger 104 and yieldingly urges the plunger to the right, as viewed in the drawing. The plunger 104 has an opening formed therein into which extends a rounded end of a floating lever 110 which is pivotally supported intermediate its ends by a pin 112 on the stem of the piston 65.

The other end of the lever 110 extends between the plunger 84 associated with the supply valve means 72, and an adjustable stop screw 114.

The double check valve device 19 comprises a body having a passage therein to which is connected an end of the pipe 70 leading from the chamber 69 of the relay valve device 16, while this body has a bore therein in which is mounted a valve element 120 having on one end an annular seat rib adapted to engage a sealing gasket surrounding a passage to which is connected a branch of the control pipe 6. The valve element 120 has on its other end a similar annular seat rib adapted to engage a sealing gasket surrounding a passage to which is connected the end of a branched pipe 122, one branch of which is connected to a port in the seat of the main slide valve 34 of the emergency valve device 14, while the other branch of the pipe 122 is connected by way of a passage in the body of the service valve device 15 to a port in the seat of the main slide valve of this valve device.

The engineer's brake valve 1 may be of any suitable well known construction, and controls the supply and release of fluid under pressure to and from the brake pipe 8, and also to and from a pipe 6a leading to the pneumatic switch device 10.

The construction of the pneumatic switch device 10 is shown and described in detail in the above identified application of Ellis E. Hewitt. The switch device 10 comprises a movable abutment in the form of a diaphragm, not shown, subject to the opposing pressures of the fluid in

the control pipe 6 and of the fluid in the pipe 6a. This abutment has associated therewith movable contacts, not shown, which are connected by way of wires 125 with one terminal of a suitable source of electric current, such as a battery 126, the other terminal of which is connected to ground. The diaphragm of the pneumatic switch device 10 is adapted to move one of the movable contacts into engagement with a stationary contact which is connected by way of a wire 128 with the winding, not shown, of the release portion 130 of the magnet valve device 12, while a branch of the wire 126 extends to the rear of the locomotive and is connected by suitable means, not shown, to the circuit on the cars of the train hauled by the locomotive to energize the windings of the release portions of the magnet valve devices carried by these cars.

The diaphragm of the pneumatic switch device 10 is also adapted at certain times to move the other of the movable contacts into engagement with a stationary contact which is connected by way of a wire 132 with the winding, not shown, of the application portion 134 of the magnet valve device 12, while a branch of the wire 132 extends to the rear of the locomotive and is adapted to be connected to a corresponding circuit on the cars on the train hauled by the locomotive to energize the windings of the application portions of the magnet valve devices carried by these cars.

The service valve device 15 may be of any suitable well known construction and comprises a body having a bore therein in which is mounted a piston, not shown, which is subject on one face to the pressure of the fluid in a chamber which is connected by way of the branch pipe 27 with the brake pipe 8. The piston of the service valve device 15 is subject on the other face to the pressure of the fluid in a valve chamber which is constantly connected by way of a pipe 136 with the auxiliary reservoir 17, while a branch of the pipe 136 leads to a passage in the magnet valve device 12.

The valve chamber of the service valve device 15 has slide valves, not shown, mounted therein which are operated by means of the piston to control the supply of fluid under pressure to a branch of the pipe 40 leading to the emergency reservoir 18, and to also control the supply and release of fluid under pressure to and from a branch of the pipe 122 leading to the double check valve device 19.

In initially charging the system, the handle of the engineer's brake valve 1 is turned to the release position in which the pipe 6a is connected to the atmosphere, and in which fluid under pressure at the pressure supplied by the feed valve device 4 is supplied to the brake pipe 8 and charges it with fluid at the pressure supplied by the feed valve device. In addition, fluid under pressure supplied by the feed valve device 4 flows to the supply pipe 5, and thence to the chamber 74 of the relay valve device 16, but as the valve piston 76 is held in the seated position by the spring 79 at this time, fluid under pressure cannot flow from the chamber 74 to the chamber 66.

Fluid under pressure supplied to the brake pipe 8 flows through the brake pipe to the connected cars and charges the brake pipe and the associated equipment on these cars with fluid under pressure, while fluid under pressure flows from the brake pipe 8 by way of the branch pipe 27 to the chamber 26 at the face of the piston 25 of the emergency valve device 14, and on an increase in the pressure of the fluid in the chamber 26, the piston 25 is moved to the release position in which it is shown in Fig. 1 of the drawing, if it is not already in this position. In this position of the piston 25, communication is opened between the chamber 26 and the passage 31 through a restricted passage 138 so that fluid under pressure flows through the passage 138 to the passage 31, through which it flows in one direction to the pressure chamber 32 and in the other direction to the valve chamber 30 to charge these chambers with fluid at the pressure supplied to the brake pipe 8 by the feed valve device 4.

Fluid under pressure supplied to the branch pipe 27 also flows to chamber at the face of the piston of the service valve device 15, and moves the piston of this valve device to its release position, if it is not already in this position, in which communication is opened through feed grooves extending around the piston with the result that fluid under pressure may flow from the branch pipe 27 to the valve chamber of the service valve device 15, and thence by way of the pipe 136 to the auxiliary reservoir 17 to charge this reservoir with fluid at the pressure supplied to the brake pipe 8.

In addition, in the release position of the piston of the service valve device 15, the slide valves controlled thereby are moved to a position in which fluid under pressure is permitted to flow at a restricted rate from the valve chamber of the valve device to the pipe 40 leading to the emergency reservoir 18, and charges this reservoir with fluid at the pressure supplied from the brake pipe 8. Fluid under pressure supplied to the pipe 40 also flows to the passage 40 in the body of the emergency valve device 14, and thence to the chamber 39, and on an increase in the pressure of the fluid in this chamber force is exerted through the diaphragm 38 and the stem 42 to press the slide valve 34 against its seat.

At this time as the pipe 6a is connected to the atmosphere, the diaphragm of the pneumatic switch device 10 is biased by means associated therewith to a position in which one of the movable contacts associated with the diaphragm engages the stationary contact to which is connected the wire 128 leading to the winding of the release portion 130 of the magnet valve device 12, while at this time current is not supplied to the winding of the application portion 134 of the magnet valve device 12.

When the winding of the release portion 130 of the magnet valve device 12 is energized, the valve of this portion is held in the open position in which the control pipe 6 is connected to the atmosphere. When the winding of the application portion 134 of the magnet valve device 12 is deenergized, the valve of this portion is biased by means associated therewith to the closed position to prevent the supply of fluid under pressure from the pipe 136 and the auxiliary reservoir 17 to the control pipe 6. Accordingly, the magnet valve device 12 does not supply fluid under pressure to the control pipe 6, and connects this pipe to the atmosphere.

In order to effect a straight air service application of the brakes, the handle of the engineer's brake valve 1 is turned from the release position to a point in the straight air service application zone in which fluid under pressure is supplied to the pipe 6a at a pressure which varies in accordance with the position in the straight air service application zone to which the handle is moved. When the handle of the brake valve is in the straight air service application zone, the supply

of fluid under pressure to the brake pipe 8 is maintained.

On the supply of fluid under pressure to the pipe 6a there is an increase in the pressure of the fluid at one face of the diaphragm of the pneumatic switch device 10, and this diaphragm is moved to a position to interrupt the supply of current to the winding of the release portion 130 of the magnet valve device 12, and to cause one of the movable contacts associated therewith to establish a circuit from the battery 126 to the wire 132 leading to the winding of the application portion 134 of the magnet valve device 12.

Upon energization of the winding of the application portion 134, the valve of this portion is moved from the seated position to the open position to permit fluid under pressure supplied from the auxiliary reservoir 17 by way of the pipe 136 to flow to the control pipe 6 and increase the pressure of the fluid therein. On an increase in the pressure of the fluid in the control pipe 6, fluid under pressure flows therefrom to the double check valve 19 and moves the valve element 120 to its upper seated position, as shown in Fig. 1 of the drawing, so that fluid under pressure may flow from the pipe 6 to the passage and pipe 70 leading to the chamber 69 at the face of the piston 65 of the relay valve device 16.

On an increase in the pressure of the fluid in the chamber 69, the piston 65 is moved to the right, as viewed in Fig. 1 of the drawing, and on initial movement of the piston the floating lever 110 pivots about its lower end, which engages the plunger 84 associated with the supply valve means 72, which at this time is held in the seated position by the springs associated therewith. On this movement of the lever 110, force is exerted through the plunger 104 to move the valve 100 relative to the valve member 88 until the valve 100 seats on the valve member, and upon further movement of the piston 65 and the plunger 104 to the right, the valve member 88 is moved relative to the body of the relay valve device until the seat on the head 92 engages the seating face 93 surrounding the passage which is open to the chamber 95.

Upon further movement of the piston 65 to the right, the floating lever 110 pivots about its upper end, which engages a surface on the plunger 104, which plunger cannot move further at this time as the valves 100 and 92 are in their seated positions. On this movement of the lever 110, force is exerted through the plunger 84 to move the valve 81 against the spring 82 away from the seat on the valve piston 76 to thereby open a passage through which fluid under pressure may flow at a relatively rapid rate from the chamber 77 at the spring side of the valve piston 76 through the bore in the valve piston 76 to the chamber 66. When the valve 81 is unseated fluid under pressure can flow from the chamber 77 to the chamber 66 at a substantially more rapid rate than fluid can be supplied through the choke 78 to the chamber 77, and, accordingly, there is a rapid reduction in the pressure of the fluid in the chamber 77 as soon as the valve 81 is moved to the open position. On this reduction in the pressure of the fluid in the chamber 77, the higher pressure of the fluid in the chamber 74 operating upon the face of the valve piston 76 outwardly of the seat engaged by this valve piston moves the valve piston against the spring 79 to open a relatively large communication through which fluid under pressure supplied from the supply pipe 5 to the chamber 74 may flow to the chamber 66, and thence by way of the pipe 68 to the brake cylinder 20 to increase the pressure of the fluid in the brake cylinder and thereby effect an application of the brakes.

After movement of the valve piston 76 away from its seat, fluid under pressure will flow through the choke 78 to increase the pressure of the fluid in the chamber 77 to the pressure present in the chamber 74. However, at this time the end of the plunger 84 engages the face of the valve piston 76 and prevents the spring 79 from moving the valve piston to the seated position.

On an increase in the pressure of the fluid in the control pipe 6 there is a corresponding increase in the pressure of the fluid in the chamber of the pneumatic switch device 10 at the face of the diaphragm therein, and when the pressure of the fluid in the control pipe 6 has increased substantially to the pressure to which fluid is supplied by operation of the engineer's brake valve 1 to the pipe 6a, the diaphragm of the pneumatic switch device 10 will be moved to an intermediate or lap position in which neither of the movable contacts associated therewith is in engagement with a stationary contact with the result that electric current is not supplied to the windings of either the release or application portions of the magnet valve device 12.

When the supply of current to the winding of the application portion 134 is cut off, the valve of this portion is moved from the open position to the closed position to cut off the supply of fluid under pressure from the pipe 136 to the control pipe 6, while, as the winding of the release portion of the magnet valve device 12 remains de-energized, the valve of this portion remains in the seated position to prevent the release of fluid under pressure from the flow pipe 6.

On the supply of fluid under pressure to the control pipe 6, fluid flows therefrom through the double check valve 19 and the passage and pipe 70 to increase the pressure of the fluid in the chamber 69 of the relay valve device 16 substantially to the pressure present in the control pipe 6.

On the supply of fluid from the auxiliary reservoir 17 to the control pipe 6 by operation of the magnet valve device 12 there is a reduction in the pressure of the fluid in the auxiliary reesrvoir 17, and on this reduction in the pressure of the fluid in the auxiliary reservoir, fluid under pressure flows from the brake pipe 8 and the branch pipe 27 through the feed grooves in the service valve device 15 to the valve chamber of this valve device, and thence by way of the pipe 136 to the auxiliary reservoir 17 to restore the pressure of the fluid in this reservoir to the pressure present in the brake pipe 8.

On the supply of fluid under pressure by operation of the supply valve means 72 of the relay valve device 16 to the chamber 66 of this valve device, and to the brake cylinder 20, there is an increase in the pressure of the fluid in the chamber 66, and a similar increase in the force exerted by this fluid under pressure upon the piston 65 in opposition to the force exerted by the fluid in the chamber 69.

When the pressure of the fluid in the brake cylinder 20 and in the chamber 66 is increased substantially to or slightly above the pressure present in the chamber 69 and the control pipe 6, the fluid in the chamber 66 will move the piston 65 against the opposing force of the fluid in the chamber 69, and on this movement of the piston 65, the floating lever 110 will pivot about its upper end, movement of which is resisted by the spring

106, while the lower end of this lever is moved toward the stop screw 114 with the result that the spring 82 is able to move the valve 81 to its seat on the valve piston 76, while the spring 79 is able to move the valve piston 76 towards its seat. When the piston 65 has been returned a part of the distance to the release position in which it is shown in Fig. 1 of the drawing, the spring 79 will be able to move the valve piston 76 to the seated position to cut off the further supply of fluid under pressure from the supply pipe 5 to the valve chamber 66 and to the brake cylinder 20, while the spring 82 will hold the valve 81 in the seated position to thereby cut off communication between the chambers 77 and 66.

It will be seen that on a straight air service application of the brakes, the engineer's brake valve supplies fluid under pressure to the pneumatic switch device 10 which thereupon controls the magnet valve device 12 to cause it to supply fluid under pressure to the control pipe 6 to increase the pressure of the fluid in the control pipe 6 substantially to the pressure supplied by the engineer's brake valve 1 to the pneumatic switch device 10. Likewise, on an increase in the pressure of the fluid in the control pipe 6, the relay valve device 16 operates to supply fluid under pressure to the brake cylinder 20 to increase the pressure present therein substantially to the pressure present in the control pipe 6.

In order to effect a release of the brakes following a straight air application, the handle of the engineer's brake valve 1 is returned to the release position in which the supply of fluid under pressure to the pipe 6a is cut off, and in which fluid under pressure is released from the pipe 6a, while the supply of fluid under pressure to the brake pipe 8 is maintained.

Upon the release of fluid under pressure from the pipe 6a, the higher pressure of the fluid in the control pipe 6 moves the diaphragm of the pneumatic switch device 10 to a position in which the supply of current from the battery 126 to the wire 132 leading to the application portion of the magnet valve device 12 is cut off, and in which a circuit is established from the battery 126 to the wire 128 leading to the winding of the release portion 130 of the magnet valve device 12. Upon energization of the winding of the release portion, the valve associated with this portion is moved to the open position to release fluid under pressure from the control pipe 6, while at this time, as the winding of the application portion 134 is not energized, the valve of this portion is held in the seated position to prevent the supply of fluid under pressure from the auxiliary reservoir 17 and the pipe 136 to the control pipe 6.

Upon the release of fluid under pressure from the control pipe 6, fluid under pressure flows to this pipe from the chamber 69 at the face of the piston 65 of the relay valve device 16, thereby reducing the pressure of the fluid present in the chamber 69.

On this reduction in the pressure of the fluid in the chamber 69, the higher pressure of the fluid present in the chamber 66 at the opposite face of the piston 65 moves the piston to the left into engagement with a stop 140 formed on the cover of the chamber 69. On this movement of the piston 65, the lower end of the floating lever 110 is in engagement with the adjustable stop 114 so that the lever 110 is pivoted about the pin 112 with the result that the upper end of the lever is moved to the left, as viewed in Fig. 1 of the drawing. Upon initial movement of the floating lever 110, the plunger 104 is moved against the spring 106, while the valve 100 is moved relative to the valve element 88 with the result that the head of the valve 100 is moved away from the seat on the valve member 88, thereby permitting fluid under pressure to flow from the chamber 66 to the bore in which the stem of the valve 100 is mounted, and thence to the chamber 90 at the face of the head 89. On an increase in the pressure of the fluid in the chamber 90, force is exerted upon the head 89 of the valve member 88 to substantially offset the opposing force of the fluid under pressure in the chamber 66 operating upon the head 92. Upon further movement of the plunger 104 to the left, the nuts 102 on the end of the stem of the valve 100 engage the face of the head 89 so that the valve member 88 is moved to a position in which the head 92 no longer engages the seating face 93, and fluid under pressure may thereupon flow from the valve chamber 66 to the chamber 95, and thence to the atmosphere through the passage 96, while upon this reduction in the pressure of the fluid in the chamber 66 fluid under pressure flows to this chamber from the brake cylinder 20, thereby reducing the pressure of the fluid present in the brake cylinder.

Upon the release of fluid under pressure from the control pipe 6 by operation of the magnet valve device 12, there is a reduction in the force exerted by the fluid under pressure in the control pipe upon the diaphragm of the pneumatic switch device 10. The diaphragm of this switch device, however, is arranged so that when the control pipe 6 is reduced to atmospheric pressure, the diaphragm will be biased by means associated therewith to a position to maintain the movable contact associated therewith in engagement with the stationary contact to which is connected the wire leading to the winding of the release portion 130 of the magnet valve device 112. Accordingly, the winding of this portion of the magnet valve device will remain energized, and the valve of this portion will remain in the open position to connect the control pipe 6 to the atmosphere.

As the control pipe 6 is reduced to atmospheric pressure, the chamber 69 at the face of this piston 65 of the relay valve device 16 is similarly reduced to atmospheric pressure.

When the pressure of the field in the brake cylinder 20, and in the chamber 66 of the relay valve device 16 is reduced substantially to atmospheric pressure, the force exerted thereby upon the piston 65 is negligible, and the spring 106 will expand and will move the plunger 104 and the upper end of the floating lever 110 to the right, as viewed in Fig. 1 of the drawing, thereby moving the valve 100 towards the seated position, while the piston 65 will be moved away from the stop 140. The spring 106 is of such length, however, that it cannot move the plunger 104 far enough to move the valve member 88 to a position in which the head 92 engages the seating face 93. Accordingly, the valve member 88 will remain in the open position and permit fluid under pressure to flow from the brake cylinder 20 and the chamber 66 to the atmosphere and reduce these to atmospheric pressure.

This brake equipment incorporates means to effect an automatic service application of the brakes if desired. This means of effecting an application of the brakes is intended to be em-

ployed only where the means for effecting a straight air service application of the brakes is inoperative.

In order to effect an automatic service application of the brakes, the handle of the engineer's brake valve 1 is turned through the straight air service application zone to the automatic service application position. In this position fluid under pressure is supplied to the pipe 6a at the maximum pressure which the engineer's brake valve is capable of supplying. If the equipment is in the proper working condition, the pneumatic switch device 10 will effect operation of the magnet valve device 12 to supply fluid under pressure from the auxiliary reservoir 17 to the control pipe 6 to increase the pressure of the fluid in the control pipe 6 to the pressure present in the pipe 6a, while on this increase in the pressure of the fluid in the control pipe 6, the relay valve device 16 will operate, as described in detail above, to supply fluid under pressure to the brake cylinder 20.

In addition, in this position of the handle of the engineer's brake valve 1, fluid under pressure is no longer supplied to the brake pipe 8, while fluid under pressure is released from the brake pipe 8 to reduce the pressure of the fluid present therein at a service rate. On a reduction in the pressure of the fluid in the brake pipe 8 at a service rate, there is a corresponding reduction in the pressure of the fluid present in the chamber 26 at the face of the piston 25 of the emergency valve device 14, and on this reduction in the pressure of the fluid in the chamber 26, the higher pressure of the fluid present in the valve chamber 30 moves the piston 25 to the right.

On this movement of the piston 25, the auxiliary slide valve 35 is moved relative to the main slide valve 34 so that a port 142 through the auxiliary slide valve 35 is in alignment with a port 144 through the main slide valve 34, which in this position of the main slide valve 34 is in registration with an atmospheric port 146. On movement of the auxiliary slide valve 35 to this position, fluid under pressure is released from the valve chamber 30 and the pressure chamber 32 through the ports 142 and 144 and the atmospheric port 146 to reduce the pressure of the fluid present in the valve chamber 30 and the pressure chamber 32 substantially as rapidly as brake pipe pressure and the pressure of the fluid in the chamber 26 is reduced during a reduction in brake pipe pressure at a service rate.

As the pressure of the fluid in the valve chamber 30 is reduced substantially as rapidly as brake pipe pressure is reduced, the piston 25 will not be moved farther towards the application position, and will not move the main slide valve 34 on its seat.

On this reduction in brake pipe pressure at a service rate, there is a corresponding reduction in the pressure of the fluid in the chamber at the face of the piston of the service valve device 15, and the piston of this valve device is moved from the release position to its application position in which fluid under pressure can no longer flow from the brake pipe to the valve chamber, and thence by way of the pipe 138 to the auxiliary reservoir 17, while the supply of fluid under pressure from the brake pipe to the emergency reservoir 18 is also cut off.

On movement of the piston of the service valve device 15 to its application position, fluid under pressure is supplied from the auxiliary reservoir 17 to the pipe 122 leading to the double check valve 19, and on a supply of fluid under pressure to the pipe 122, the valve element 120 may be moved away from the sealing gasket surrounding the end of the pipe 122 so that fluid under pressure may flow from the pipe 122 to the pipe 70 leading to the chamber 69 of the relay valve device 16. As will be understood the valve element 120 of the double check valve 19 is subject to the opposing pressures of the fluid in the control pipe 6, and of the fluid in the pipe 122, and the position occupied by this valve element is dependent upon the relative pressures in these pipes. If the pressure of the fluid in the pipe 122 exceeds the pressure in the control pipe 6, the valve element 120 will be moved to a position to permit fluid under pressure to flow from the pipe 122 to the chamber 69.

The service valve device 15 will continue to supply fluid under pressure from the auxiliary reservoir 17 to the pipe 122 leading to the relay valve device 16 until the pressure of the fluid in the chamber 17 has been reduced to the pressure present in the brake pipe 8, or slightly below that pressure, and when the pressure in the auxiliary reservoir 17 has been reduced to this valve, the piston of the service valve device 15 will move from the application position to the lap position in which the supply of fluid under pressure from the auxiliary reservoir to the pipe 122 is cut off.

Upon the supply of fluid under pressure to the chamber 69 by operation of the magnet valve device 12 or the service valve device 15 during an automatic service application of the brakes, the relay valve device 16 operates in the manner described in detail above to supply fluid under pressure to the brake cylinder 20 to increase the pressure of the fluid in the brake cylinder substantially to the pressure present in the chamber 69.

When the desired degree of brake pipe reduction has been secured, the handle of the engineer's brake valve is turned from the automatic service application position to a lap position in which fluid under pressure is no longer vented from the brake pipe 8, and in which fluid under pressure is not supplied to the brake pipe 8. The service valve device 15 will continue to supply fluid under pressure from the auxiliary reservoir 17 to the pipe 122 leading to the relay valve device 16 until the pressure of the fluid in the auxiliary reservoir 17 is reduced substantially to the pressure at which the brake pipe is reduced, and the service valve device 15 will thereupon operate to cut off the further supply of fluid under pressure to the pipe 122.

In order to release the brakes following an automatic service application of the brakes, the handle of the engineer's brake valve is turned to the release position in which fluid under pressure is again supplied to the brake pipe 8, and on this increase in the pressure of the fluid in the brake pipe, fluid under pressure flows therefrom by way of the branch pipe 27 to the chamber 26 at the face of the piston 25 of the emergency valve device 14, and moves this piston to the release position in which it is shown in Fig. 1 of the drawing, while fluid under pressure flows through the restricted port 138 to the passage 31, and thence to the valve chamber 30 and to the pressure chamber 32 to charge these chambers to the pressure present in the brake pipe.

In addition fluid under pressure flows from the brake pipe 8 to the service valve device 15 and moves the piston of this valve device to the re-

lease position in which the pipe 122 is connected to atmosphere, while fluid under pressure flows through the feed grooves around the piston to the auxiliary reservoir 17 and to the emergency reservoir 18 to recharge these reservoirs.

On the release of fluid under pressure from the pipe 122 by the service valve device 15, fluid under pressure flows thereto from the chamber 69 of the relay valve device 16, and on the reduction in the pressure of the fluid in this chamber, the relay valve device 16 operates as described in detail above to release fluid under pressure from the brake cylinder 20.

In the release position of the engineer's brake valve 1, the pipe 6a is connected to atmosphere, while the pneumatic switch device 10 operates as described in detail above to control the relay valve device 12, if this part of the equipment is functioning at this time.

The brake equipment incorporates means to effect an automatic emergency application by operation of the engineer's brake valve 1, or in the event of a sudden reduction in brake pipe pressure produced by any other means.

In order to effect an automatic emergency application of the brakes, the handle of the engineer's brake valve 1 is turned to the emergency application position in which fluid under pressure is supplied to the pipe 6a at the maximum pressure which the engineer's brake valve is capable of supplying, while fluid under pressure is released from the brake pipe 8 at a rapid or emergency rate.

On the supply of fluid under pressure to the pipe 6a, the pneumatic switch device 10 operates as described in detail above to cause the magnet valve device 12 to supply fluid under pressure to the control pipe 6, thereby supplying fluid under pressure to the relay valve device 16 to condition it to supply fluid to the brake cylinder 20.

On a sudden reduction in brake pipe pressure there is a corresponding reduction in the pressure of the fluid in the chamber at the face of the piston of the service valve device 15, and this piston is moved to the application position in which the supply of fluid under pressure to the auxiliary and emergency reservoirs is cut off, while fluid under pressure is supplied from the auxiliary reservoir 17 to the pipe 122 leading to the double check valve 19 and the relay valve device 16.

In addition, upon this sudden emergency reduction in brake pipe pressure there is a corresponding rapid reduction in the chamber 26 of the emergency valve device 14, and the higher pressure of the fluid in the valve chamber 30 moves the piston 25 to the right, as viewed in Fig. 1 of the drawing, while the auxiliary slide valve 35 is moved relative to the main slide valve 34 to bring the port 142 through the auxiliary slide valve into registration with the port 144 through the main slide valve 34.

On a reduction in brake pipe pressure at an emergency rate, the pressure of the fluid in the chamber 26 is reduced more rapidly than the pressure of the fluid in the valve chamber 30 can reduce by flow through the ports 142 and 144, and as a result the piston 25 is moved farther to the right, and moves the auxiliary slide valve 35 relative to the main slide valve to a position in which the auxiliary slide valve 35 uncovers a port 150 through the main slide valve 34, which in this position of the main slide valve is in registration with the passage 48 leading to the chamber 46. As a result fluid under pressure from the valve chamber 30 flows through the port 150 to the passage 48, and thence to the chamber 46 at the face of the vent valve piston 45.

On the supply of fluid under pressure to the chamber 46, force is exerted upon the piston 45 to move it to the right, as viewed in Fig. 1 of the drawing, while the piston is moved into engagement with the seat rib on the gasket 55 to prevent flow of fluid around the periphery of the piston to the atmospheric passage 52. On this movement of the piston 45, force is exerted through the stem 56 to move the vent valve 58 against the spring 62 away from the seat rib 63 to thereby open a large communication through which fluid under pressure may be released from the brake pipe 8 by way of the branch pipe 27, the chamber 26, the passage 60 and the chamber 59 to the atmospheric passage 52.

Upon the rapid reduction in brake pipe pressure which occurs when the vent valve 58 is opened, the higher pressure of the fluid then present in the valve chamber 30 moves the piston 35 further to the right, thereby moving it to a position in which the restricted port 138 no longer establishes communication between the valve chamber 30 and the chamber 26, while the main slide valve 34 is moved upon its seat to a position in which the end of the passage 48 is uncovered with the result that fluid under pressure may thereafter flow directly from the valve chamber 30 to the passage 48, and thence to the chamber 46 at the face of the vent valve piston 45.

In addition upon this movement of the main slide valve 34, a cavity 152 in the main slide valve establishes communication between a branch of the passage 40 leading from the emergency reservoir 18, and a passage 122 to which is connected a branch of the pipe 122 leading to the double check valve 19 and the relay valve device 16. Accordingly, fluid under pressure flows from the emergency reservoir 18 through the cavity 152 to the pipe 122, and thence to the relay valve device 16.

Fluid under pressure supplied to the chamber 46 flows therefrom at a restricted rate through the passage 53 through the piston 45 and gradually reduces the pressure of the fluid in the valve chamber 30 and the pressure chamber 32. When the pressure of the fluid in the chamber 46 has been reduced to a predetermined relatively low value, the force exerted thereby upon the piston 45 is insufficient to maintain the vent valve 58 in the open position against the spring 62, and the spring 62 thereupon moves the vent valve 58 into engagement with the seat rib 63, while the piston 45 is moved to a position in which the groove 50 extends around the piston with the result that any fluid under pressure remaining in the pressure chamber 32 and the valve chamber 30, or the chamber 46, may escape to the atmosphere through the groove 50 and the atmospheric passage 52. However, before the piston 45 is moved to this position by the spring 62, the vent valve 58 will have been in the open position long enough to permit the pressure of the fluid in the brake pipe 8 to reduce to atmospheric pressure or to a relatively low value.

On the supply of fluid under pressure to the chamber 69 of the relay valve device 16 by the magnet valve device 12, the service valve device 15, and the emergency valve device 14, the re-

lay valve device 16 operates as described in detail above to supply fluid under pressure to the brake cylinder 20 and thus effect an application of the brakes.

In order to release the brakes following an automatic emergency application, the handle of the engineer's brake valve 1 is returned to the release position in which the pipe 6a is connected to the atmosphere, and in which fluid under pressure is supplied to the brake pipe 8 at the pressure supplied by the feed valve device 4.

On the release of fluid under pressure from the pipe 6a, the pneumatic switch device 10 operates, as described in detail above, to interrupt the circuit to the winding of the application portion 134 of the magnet valve device 12, if the circuit to this winding is not already interrupted, while the pneumatic switch device 10 also operates to establish a circuit from the battery 126 to the winding of the release portion 130 of the magnet valve device 12 to thereby effect operation of the release portion 130 to connect the control pipe 6 to the atmosphere.

On the release of fluid under pressure from the control pipe 6, the fluid at the higher pressure present in the pipe 122, to which fluid under pressure is supplied at this time from the auxiliary reservoir 17 by the service valve device 15, and from the emergency reservoir 18 by the emergency valve device 14, moves the valve element 120 to its lower seated position with the result that fluid under pressure cannot flow from the chamber 69 to the control pipe 6 on a reduction in the pressure of the fluid in the control pipe 6.

On the supply of fluid under pressure to the brake pipe 8 as a result of movement of the handle of the engineer's brake valve 1 to the release position, there is an increase in the pressure of the fluid in the brake pipe, and fluid under pressure flows therefrom by way of the branch pipe 27 to the chamber 26 at the face of the piston 25 of the emergency valve device 14, and moves this piston to its release position, while the auxiliary slide valve 35 is moved relative to the main slide valve 34 to lap the ports 144 and 150. In addition, the main slide valve 34 is moved upon its seat to a position in which the cavity 152 therein no longer establishes communication between the passage 40 leading from the emergency reservoir 18, and the passage 122 to which is connected a branch of the pipe 122 leading to the double check valve device 19.

On an increase in the pressure of the fluid in the brake pipe 8 to a pressure slightly higher than that present in the auxiliary reservoir 17, the piston of the service valve device 15 is moved to the release position in which the slide valves controlled thereby operate to release fluid under pressure from the pipe 122 to the atmosphere, while communications are opened through which fluid under pressure supplied to the branch pipe 27 may flow around the piston and thence to the auxiliary reservoir 17 and to the emergency reservoir 18 to recharge these reservoirs.

On the release of fluid under pressure from the pipe 122 by operation of the service valve device 15, fluid under pressure flows to the pipe 122 and thence to the atmosphere from the chamber 69 of the relay valve device 16, and on the reduction in the pressure of the fluid in the chamber 69, the relay valve device 16 operates, as described in detail above, to release fluid under pressure from the brake cylinder 20, and thereby effect the release of the brakes on the locomotive.

The apparatus and the operation thereof as so far described is substantially the same as that of the hereinbefore mentioned application Serial No. 741,063 of Ellis E. Hewitt, and now the construction and operation of my invention will be described.

Upon an emergency application of the brakes a high degree of braking effect is developed, and the locomotive is retarded at a rapid rate. Because of the rapid reduction in the speed of the locomotive, the force of inertia acting upon the water in the boiler of the locomotive may cause the water to move forward in the boiler and leave the crown sheet uncovered. If this condition arises, and if the furnace for the locomotive boiler continues to be supplied with fuel at a rapid rate, the crown sheet may be overheated and seriously damaged. Accordingly, the fuel control system provided by this invention is arranged so that upon an emergency application of the brakes it will operate automatically to reduce to a predetermined relatively slow rate the supply of fuel to the furnace of the locomotive boiler to thereby prevent overheating and possible injury to the crown sheet of the boiler.

The fuel control system provided by this invention includes a pipe 155 through which fluid fuel under pressure may be supplied by fuel feeding means indicated diagrammatically at 156 to the burner 157 in the fire box of a locomotive boiler, a portion of which is shown diagrammatically in broken lines in the drawing. Any suitable fuel feeding means 156 for supplying fluid fuel to the pipe 155 may be employed, and one form of means which may be employed is shown in U. S. Patent No. 1,295,077, issued February 18, 1919 to S. G. Down and myself, and in our Reissue Patent No. 15,942, issued November 11, 1924.

The control system provided by this invention includes a control valve device 160 which controls the supply of fuel from the pipe 155 to the burner 157. The control valve device 160 comprises a body having a bore therein in which is mounted a plunger 161. The pipe 155 is connected to a passage in the body of the valve device 160 which is open to the end of the bore in which the plunger 161 is mounted, while a pipe 162 leading to the burner 157 is connected to an annular groove or channel 164 surrounding the bore in which the plunger 161 is mounted. The plunger 161 has a port 165 therein, one end of which is open to the passage to which the pipe 155 is connected, while the other end of the port 165 is adapted to register with the groove or channel 164.

The control valve device 160 includes a movable abutment in the form of a diaphragm 167, one face of which is engaged by the head of the plunger 161, while the other face of the diaphragm is subject to the pressure of the fluid in a chamber 168. A member 169 is mounted in the chamber 168 and engages stops formed on the cover section 170 to limit downward movement of the diaphragm 167.

A coil spring 172 is mounted on the plunger 161 and extends between the head of the plunger 161 and a shoulder on the body of the control device, and yieldingly presses the plunger 161 and the diaphragm 167 downwardly until the member 169 engages the stops on the cover 170. When the plunger 161 is in this position, the port 165 therein is in full registration with the annular groove or channel 164 so that fuel may flow from the pipe 155 through the port 165, and thence to the pipe 162 leading to the burner 157 at a

rate equal to the full flow capacity of the port 165.

The chamber 168 at the face of the diaphragm 167 is constantly connected by way of a pipe and passage 175 with a port in the seat of the main slide valve 34 of the emergency valve device 14.

When the main slide valve 34 of the emergency valve device 14 is in its release position, as shown in Fig. 1 of the drawing, a branch of the port 144 in the main slide valve 34 is in registration with the port to which the pipe 175 is connected with the result that the pipe 175 and the chamber 168 are connected to the atmospheric port 146.

When the main slide valve 34 of the valve device 14 is moved to its application position on an emergency application of the brakes, the cavity 152 therein establishes communication between the passage 40, which is connected to the emergency reservoir 18, and the passage 175 with the result that fluid under pressure flows from the emergency reservoir 18 to the passage and pipe 175, and thence to the chamber 168 at the face of the diaphragm 167 of the control valve device 160.

On an increase in the pressure of the fluid in the chamber 168, force is exerted upon the diaphragm 167 and moves the diaphragm and the stem 161 upwardly against the opposing force of the spring 172 until the end of the plunger 161 engages a shoulder at the upper end of the bore in which the plunger is mounted. When the plunger 161 is moved to this position, the lower end to the port 165 in the plunger 161 is moved partially out of registration with the annular groove or channel 164, thereby restricting the rate of flow of fluid from the port 165 to the annular groove or channel 164 and thence by way of the pipe 162 to the burner 157.

The various parts of the control valve device 160 are arranged and proportioned so that when the upper end of the plunger is in engagement with the shoulder on the body of the control valve device, fuel may flow from the port 165 to the annular groove or channel 164, and thence to the burner 157 at a restricted rate only sufficient to maintain the fire in the burner 157. This rate is such that there is no danger that the crown sheet of the boiler will be overheated or injured, even if the crown sheet is not covered with water at this time.

On the release of the brakes following an emergency application, the main slide valve 34 of the emergency valve device 14 is returned to the release position in which a branch of the port 144 therein establishes communication between the passage 175 and the atmospheric passage 146 with the result that the fluid in the chamber 168 of the control valve device 160 is reduced to atmospheric pressure, while the spring 172 moves the plunger 161 and the diaphragm downwardly until the member 169 engages the stops on the cover 170. On this movement of the plunger 161, the lower end of the port 165 is brought into complete or full registration with the annular groove or channel 164 to thereby permit fluid fuel to be supplied to the burner 157 at the rate at which fuel is supplied by the fuel feeding means 156 to the pipe 155.

It will be seen that the fuel control system shown in Fig. 1 of the drawing is arranged so that on an emergency application of the brakes, the rate of supply of fluid fuel to the burner of furnace of the locomotive boiler is automatically reduced to a predetermined low rate which is sufficient to maintain a fire in the burner, but which is such that no injury or overheating of the crown sheet of the boiler will result even though the crown sheet is not covered with water at this time, which may be the case because of the relatively high rate of retardation of the locomotive which is effected during an emergency application of the brakes.

A modified form of fuel control system provided by this invention is shown in Fig. 2 of the drawing. This control system is also responsive to operation of the locomotive brake equipment and operates on a predetermined relatively heavy application of the brakes, either a service or an emergency application, to reduce the rate of supply of fuel to the burner of the furnace of the locomotive boiler.

As shown in Fig. 2 of the drawing, there is a control valve device 160*a* which is similar in construction to the control valve device shown in Fig. 1 of the drawing, and which operates to regulate the rate of flow of fuel through the pipe through which fuel is supplied to the burner in the furnace of the locomotive boiler. The chamber at the face of the diaphragm of the control valve device is 160*a* is connected to the pipe 70*a* leading to the chamber at the face of the piston of the relay valve device 16*a*, which corresponds to the relay valve device 16 of the system shown in Fig. 1 of the drawing. The chamber at the face of the diaphragm of the control valve device 160*a*, therefore, will be supplied with fluid under pressure at the pressure at which fluid is supplied to the relay valve device 16*a*, while the relay valve device 16*a* operates to effect applications of the brakes which vary in degree in accordance with the pressure of the fluid supplied thereto. The spring and the other portions of the control valve device 160*a* are arranged and proportioned so that on a predetermined increase in the pressure of the fluid supplied to the pipe 70*a*, the control valve device 160*a* will operate to reduce the supply of fuel to the burner of the locomotive boiler to a predetermined relatively slow rate which is just sufficient to maintain the fire in the burner. The predetermined pressure in the pipe 70*a* which is sufficient to cause this operation of the control valve device 160*a* is preferably somewhat less than that which will produce an application of the brakes in a degree which will cause retardation of the locomotive to produce movement of the water of the boiler of the locomotive sufficient to cause the crown sheet of the boiler to be uncovered. Accordingly, the fuel control system provided by this embodiment of the invention will operate to restrict the rate of supply of fuel to the furnace before the crown sheet of the boiler is uncovered. This will insure that the crown sheet will be protected, and will not be overheated or damaged.

On the release of the brakes, fluid under pressure is released from the pipe 70*a* in the manner described in detail above, and on the reduction in the pressure of the fluid in this pipe, the control valve device 160*a* is operated to again permit a rapid flow of fluid fuel to the pipe leading to the burner of the furnace of the locomotive boiler.

While the two embodiments of the improved fuel control system provided by this invention have been illustrated and described in detail, and while the fuel control system has been described in connection with one form of brake equipment adapted for use on high speed locomotives, it is to be understood the invention is not limited to these details of construction, nor is it limited to employment in the particular form of brake

equipment shown and described, but that numerous changes and modifications may be made without departing from the scope of the following claims.

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

1. In a fuel supply system for the furnace of the boiler of a locomotive, fuel feeding means for supplying fuel to said furnace, braking means for the locomotive, and means responsive to operation of the brake equipment to produce a heavy application of the brakes on the locomotive to reduce the supply of fuel to the furnace by said fuel feeding means to a predetermined relatively slow rate.

2. In a fuel supply system for the furnace of the boiler of a locomotive, fuel feeding means for supplying fuel to said furnace, braking means for the locomotive, and means operable on an emergency application of the brakes by said braking means to reduce the supply of fuel to the furnace by said fuel feeding means to a predetermined relatively slow rate.

3. In a fuel supply system for the furnace of the boiler of a locomotive, fuel feeding means for supplying fuel to said furnace, braking means for the locomotive comprising a brake pipe and valve means subject to and operated on a reduction in brake pipe pressure to effect an application of the brakes, and means controlled by said valve means for controlling the rate of supply of fuel to the furnace by said fuel feeding means.

4. In a fuel supply system for the furnace of the boiler of a locomotive, fuel feeding means for supplying fuel to said furnace, braking means for the locomotive comprising a brake pipe and valve means subject to and operated on a reduction in brake pipe pressure to effect an application of the brakes, and means controlled by said valve means for controlling the rate of supply of fuel to the furnace by said fuel feeding means, said means being operable to limit the supply of fuel to said furnace to a predetermined relatively slow rate on operation of said valve device to effect an emergency application of the brakes.

5. In a fuel supply system for the furnace of the boiler of a locomotive, fuel feeding means for supplying fuel to said furnace, braking means for the locomotive comprising a brake pipe and valve means subject to and operated on a reduction in brake pipe pressure to effect an application of the brakes, and means responsive to the pressure of the fluid in a chamber for controlling the rate of supply of fuel to the furnace by said fuel feeding means, said valve means controlling the supply and release of fluid under pressure to and from said chamber.

6. In a fuel supply system for the furnace of the boiler of a locomotive, fuel feeding means for supplying fuel to said furnace, braking means for the locomotive comprising a brake pipe and valve means subject to and operated on a reduction in brake pipe pressure to effect an application of the brakes, means subject to and operated on an increase in the pressure of the fluid in a chamber to limit the supply of fuel to said furnace by said fuel feeding means to a predetermined relatively slow rate, said valve means being operable to supply fluid under pressure to said chamber on operation of said valve means to effect an emergency application of the brakes.

7. In a fuel supply system for the furnace of the boiler of a locomotive, fuel feeding means for supplying fuel to said furnace, braking means for the locomotive comprising a brake pipe and valve means operable upon a reduction in brake pipe pressure at an emergency rate to effect an emergency application of the brakes, and means controlled by said valve means for controlling the rate of supply of fuel to the furnace by said fuel feeding means.

8. In a fuel supply system for the furnace of the boiler of a locomotive, fuel feeding means for supplying fuel to said furnace, braking means for the locomotive comprising brake application means operative on the supply of fluid under pressure to effect an application of the brakes on the locomotive, and means responsive to the pressure of the fluid supplied to said application means for limiting the supply of fuel to said furnace by said fuel feeding means.

9. In a fuel supply system for the furnace of the boiler of a locomotive, fuel feeding means for supplying fuel to said furnace, braking means for the locomotive comprising brake application means operative on the supply of fluid under pressure to effect an application of the brakes on the locomotive, and means subject to and operated on a predetermined increase in the pressure of the fluid supplied to said brake application means to limit the supply of fuel to said furnace by said fuel feeding means to a predetermined relatively slow rate.

10. In a fuel supply system for the furnace of the boiler of a locomotive, fuel feeding means for supplying fuel to a communication through which fuel may be supplied to said furnace, braking means for the locomotive comprising brake application means subject to and operated on an increase in the pressure of the fluid in a chamber to effect an application of the brakes, and means subject to and operated on an increase in the pressure of the fluid in said chamber for limiting the rate of flow of fuel through said communication.

11. In a fuel supply system for the furnace of a locomotive boiler, fuel feeding means for supplying fuel to said furnace, control means subject to the pressure of the fluid in a chamber for controlling the rate of supply of fuel to said furnace, and braking means for the locomotive, said braking means controlling the supply of fluid under pressure to and the release of fluid under pressure from said chamber.

12. In a fuel supply system for a burner for heating a locomotive boiler of the type having a fire box at the rear thereof, said fire box having a crown sheet the upper face of which is normally covered by the water in the boiler and the lower face of which is exposed to the fire in the fire box, the water in said boiler being moved by inertia relative to said boiler on a reduction in the speed of the locomotive due to application of the brakes to a predetermined degree and thereby uncovering the crown sheet, the fuel supply system comprising means for supplying fuel to a communication leading to said burner, braking means for the locomotive, and means operative when said braking means has operated to effect an application of the brakes to a degree less than said predetermined degree to limit the rate of flow of fuel through said communication.

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