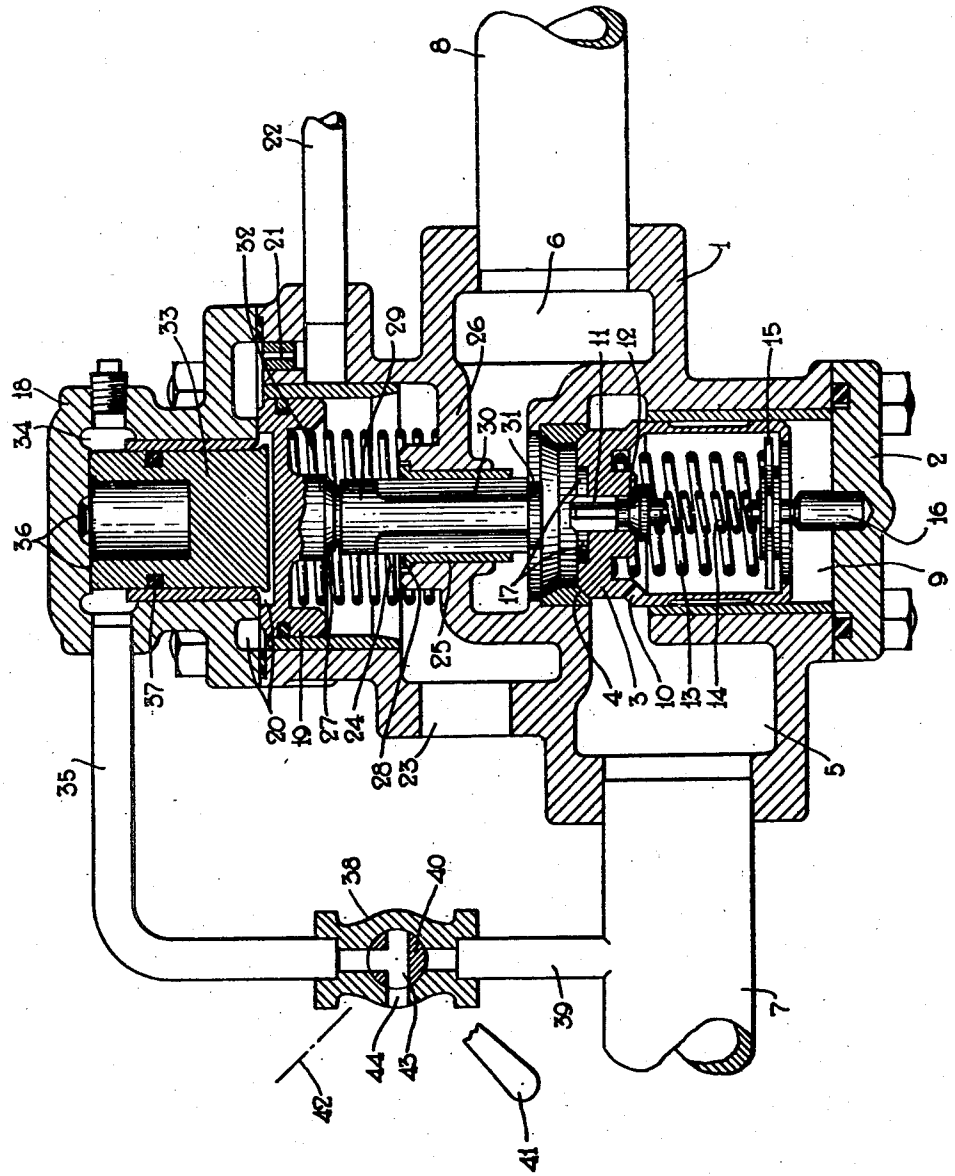
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CONTROL VALVE DEVICE

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CONTROL VALVE DEVICE

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This invention relates to control valve devices and more particularly to the relay type arranged to be operated by fluid under pressure for supplying fluid under pressure to effect a desired operation.

In certain Diesel engines air under relatively high pressure, such as 250 to 300 pounds, is employed for starting the engine, and the supply of this air to the engine is controlled by a fluid pressure actuated starting air valve or relay valve device. The actuating fluid pressure to the relay valve device is usually controlled by a manually operative controller and mechanism interlocked with the engine's reversing gear, so that in reversing the engine, starting air will not be supplied to the engine by the relay valve device until after the reversing gear has been actuated to condition the engine for operation in the selected direction. A structure of this general type is fully disclosed in the copending application of Roy R. Stevens and Erik G. Erson, Serial No. 520,256, filed January 29, 1944 which issued as Patent No. 2,395,202 on February 19, 1946.

One object of the invention is the provision of an improved fluid pressure actuated relay valve device particularly adapted, but not limited, for controlling the supply of starting air to a Diesel engine.

Another object of the invention is the provision of a relay valve device such as just defined embodying fluid pressure controlled means for effecting operation thereof in case the supply of actuating fluid pressure, above mentioned, should for any reason fail.

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

In the accompanying drawing, the single figure is a longitudinal sectional view of a relay valve device constructed in accordance with the invention.

As shown in the drawing, the relay valve device comprises a body 1 having a bore closed by a cover 2, and slidably mounted in said bore is an inverted cup shaped poppet type fluid pressure supply valve 3. A ring-shaped seat 4 is provided in the body for sealing engagement by the head of valve 3 to close communication between a chamber 5 at one side of the seat and a chamber 6 at the opposite side of the seat. The chamber

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5 is connected to a fluid pressure supply pipe 7 which may constitute a source of high pressure starting air for a Diesel engine, while chamber 6 is open to a pipe 8 which may lead to air starting mechanism of said engine. With valve 3 disengaged from seat 4 it will be apparent that fluid under pressure will be permitted to flow from pipe 7 to pipe 8, while with said valve closed against said seat, the supply of fluid under pressure to pipe 8 will be cut off.

Between cover 2 and valve 3 is a chamber 9 which is constantly open through a relatively small port 10 in said valve to chamber 5 and the fluid pressure supply pipe 7. The head of valve 3 is provided with an axial bore connecting chamber 9 to chamber 6 and containing a fluted stem 11 of a poppet valve 12 contained in chamber 9 and adapted to engage a seat provided on said head around the adjacent end of said bore. Opening of valve 12 will permit flow of fluid from chamber 9 to chamber 6, while closing of said valve will prevent such flow.

In chamber 9 are disposed two concentrically arranged coil bias springs 13 and 14 acting on valves 3 and 12, respectively, and supported on a follower 15 which in turn is supported on a pin 16 secured in cover 2. Both of these springs are under pressure so as to urge the respective valves in their seats.

With valve 12 closed, chamber 9 will become charged by way of port 10 with fluid at the same pressure as supplied to chamber 5 through pipe 7, and this pressure acting in conjunction with the pressure of springs 13 and 14 will close valve 3 against opposing pressure of fluid in chamber 6. The valve 12 when open is adapted to release fluid under pressure from chamber 9 to chamber 6 at a rate so exceeding the capacity of port 10 to supply fluid to chamber 9 as to reduce the pressure of fluid in the latter chamber substantially to that acting in chamber 6, so as to thereby reduce the seating force on the valve 3 to facilitate opening thereof, which will be later described.

The stem 11 of valve 12 extends beyond the valve 3 into chamber 6 a slight distance, and in the adjacent face of valve 3 and at either side of said stem are slots 17 which are provided for reasons which will be later described.

The body 1 is provided at the chamber 6 side of valve 3 with another bore over the outer end

of which is mounted a cover 18 and in which there is slidably mounted a piston 19 in coaxial relation to the valve 3. The piston 19 has at one side a pressure chamber 20 which is open through a choke 21 to a control pipe 22 which may constitute the usual starting control pipe for a Diesel engine. The piston 19 has at the opposite side a chamber 23 which may be open directly to the atmosphere as shown in the drawing.

The piston 19 is provided with a stem 24 projecting therefrom through chamber 23 and through a bushing 25 provided in a wall 26, separating said chamber from chamber 6, and into the latter chamber in operating alignment with valve 3 and stem 11 of valve 12. The piston stem 24 has adjacent the piston 19 a release valve 27 for sealing engagement with a seat 28 provided on the adjacent end of bushing 25. Adjacent valve 27, the stem 24 is provided with a cylindrical portion 29 adapted to slidably enter and substantially close the bore in bushing 25, while the remaining portion 30 of the stem is fluted. With piston 19 in the position shown in the drawing, the fluted portion 30 of the stem extends from chamber 6 into chamber 23 to allow release of fluid under pressure from chamber 6 to chamber 23 and to atmosphere.

In the end of piston stem 24 is a striker button 31 provided for contacting the stem 11 of valve 12 and for also engaging valve 3. The length of the cylindrical portion 29 of the piston stem 24 is such as to be disposed in bushing 25 to close communication between chambers 6 and 23 past the fluted portion 30 of said stem with the striker button 31 in substantial contact with valve stem 11, when the valves 12 and 3 are both seated, as shown in the drawing.

A coil spring 32 disposed in chamber 23 has one end supported on the body wall 26. The other end bears against piston 19. This spring is under pressure for urging the piston 19 to the position shown in the drawing and defined by contact with cover 18.

The cover 18 has a bore open to chamber 20 in coaxial relation with piston 19 and containing a piston 33. One side of piston 33 is thus subject to pressure of fluid in chamber 20 and is arranged for contact with piston 19 while at the opposite side of said piston is a pressure chamber 34 open to a control pipe 35. The cover 18 is provided with stops 36 extending into chamber 34 for contact with piston 33 to limit movement thereof in a direction away from piston 19. A ring seal 37 is carried in an annular groove provided in piston 33 and has a sealing contact with the wall of the bore in which the piston operates to prevent leakage of fluid under pressure between chambers 20 and 34.

The pipe 35 is connected to a manually operable valve device 38 to which is also connected a pipe 39 from the starting air supply pipe 7. The valve device 38 may, for the purpose of illustration, be of a type comprising a casing containing a rotary plug valve 40 to which is connected a manually operable handle 41 for turning said valve. The valve 40 and handle 41 have a normal position as shown in the drawing and are movable from this position to an engine starting position in which the handle will be located in a position such as indicated by a dot and dash line 42.

The plug valve 40 is provided with a T-shaped passage 43 which in the normal position of said valve opens pipe 35 to a vent port 44 leading to atmosphere, the connection with pipe 39 being lapped or closed in this position of said valve. In the engine starting position of valve 40 the vent port 44 is lapped and port 43 opens communication between pipes 39 and 35.

In the operation of the improved relay valve device when employed for controlling the supply of starting air from pipe 7 to the engine by way of pipe 8, and when fluid under pressure is available for supply to pipe 22, the manually operable valve device 38 will be conditioned as shown in the drawing for opening piston chamber 34 to atmosphere. With the parts thus conditioned if it is desired to supply starting air to the engine, fluid under pressure will be supplied to pipe 22 by the conventional means (not shown) and thence through choke 21 to chamber 20. When the pressure of fluid in chamber 20 is thus increased sufficiently to overcome the opposing force of spring 32, said piston will move away from cover 18 in the direction of valve 3 and stem 11 of valve 12. At substantially the time or just prior to the button 31 in the end of the piston stem 30 engaging the valve stem 11, the cylindrical portion 29 of the piston stem will enter bushing 25 to close the fluid release communication from chamber 6. After the button 31 engages the valve stem 11, further movement of piston 19 will then unseat valve 12 to release fluid under pressure from chamber 9 to chamber 6 for reducing the pressure of fluid in chamber 9 as above described. The valve 12 will thus be moved relative to valve 3 until the button 31 engages valve 3 at opposite sides of slots 17 provided in the head of said valve, whereupon further movement of piston 20 by fluid under pressure will move the supply valve 3 away from its seat until the release valve 27 engages its seat 28. With the supply valve 3 thus open, fluid under pressure will flow from pipe 7 to pipe 6 to effect the starting of the engine.

The slots 17 are provided to maintain open the venting communication from chamber 9 past valve 12 to chamber 6 with the button 31 in contact with the supply valve 3 so as to thereby maintain the differential in fluid pressures on the supply valve 3 at a relatively low degree. Engagement of the release valve 27 with seat 28 is provided to prevent any leakage of starting air from chamber 6 with the valve 3 open, while the cylindrical portion 29 of the piston stem minimizes such leakage during opening of the supply valve 3 as well as during closing which will now be described.

When it is desired to cut off the supply of starting air to pipe 8, fluid under pressure will be released from pipe 22 and piston chamber 20 whereupon the pressure of spring 32 will return piston 20 to its normal position shown in the drawing. As the piston 20 is thus moved toward its normal position the supply valve 3 is seated by spring 13 followed by seating of valve 12 by spring 14 so as to prevent further supply of fluid under pressure from pipe 7 to pipe 8. At substantially the same time as valve 12 is seated, the cylindrical portion 29 of the piston stem 24 will move out of the bushing 25, whereupon fluid under pressure will be released from pipe 8 past the fluted portion 30 of the piston stem and thence through chamber 23 to atmosphere.

It will be noted that when the cylindrical portion 29 of the piston stem moves out of bushing 25, the flow of fluid under pressure from pipe 8 to chamber 23 will increase the pressure of fluid in chamber 23, and particularly when the fluid released from pipe 8 is high pressure engine start-

ing air, this increase in pressure in chamber 23 may be of such a degree as to tend to slam the piston 19 against the cover 18. Such slamming is however prevented by choke 21 which so restricts the release of fluid under pressure from chamber 20 as to create an air cushion upon sudden movement of the piston to thus absorb the inertia of the piston and prevent its moving against the cover 18 with damaging force.

Now if for any reason there is no fluid pressure available for supply to pipe 22 to control the operation of the relay valve device as above described, and under which condition the pressure of fluid in chamber 20 will be substantially that of the atmosphere, the relay valve device may be operated to supply fluid under pressure to pipe 8 by turning plug valve 40 and handle 41 from the position shown in the drawing to the engine starting position indicated by line 42. In this engine starting position fluid under pressure will be supplied from the air supply pipe 7 to pipe 35 and thence to chamber 34 above the piston 33. The piston 33 will then move downwardly and actuate the piston 19 to cause fluid under pressure to be supplied to the starting pipe 8 in the same manner as when piston 19 is operated by fluid under pressure supplied to chamber 20 as above described. When the operator desires to cut off the supply of engine starting air to pipe 8 and to release the fluid under pressure from said pipe, he will operate handle 41 to return valve 40 to the position shown in the drawing for releasing fluid under pressure from piston chamber 34. Pistons 19 and 33 will then be returned to their normal positions shown in the drawing by spring 32, and the relay valve device will release fluid under pressure from pipe 8 in the same manner as above described.

In the control of Diesel engines the pressure of the engine starting air such as provided in pipe 7, may be several times, for instance three, the pressure of controlling fluid available for supply to the engine starting control pipe 22. Since the piston 33 is operated by the starting air, its area need therefore be only a fraction such as one-third, of the area of piston 19 to obtain the same force for opening the supply valve 3.

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

1. A relay valve device comprising a casing, a supply valve in said casing operable to supply fluid under pressure to a first chamber, a piston in said casing subject to opposing pressures of fluid in second and third chambers, said third chamber being open to atmosphere, a stem carried by said piston and operable by said piston upon supply of fluid under pressure to said second chamber to actuate said supply valve to supply fluid under pressure to said first chamber, a release valve on said stem, a seat in said casing arranged to be engaged by said release valve to close a fluid pressure release communication from said first chamber to said third chamber upon operation of said supply valve to supply fluid under pressure to said first chamber, said stem also comprising release control means arranged to close said communication ahead of said release valve and prior to operation of said supply valve to supply fluid under pressure to said first chamber, means operable upon release of fluid under pressure from said second chamber to effect operation of said piston and stem to unseat said release valve and to effect operation of

said supply valve to cut off the supply of fluid under pressure to said first chamber, said release control means opening said communication upon release of fluid under pressure from said piston subsequent to operation of said supply valve to cut off the supply of fluid under pressure to said first chamber, and flow restricting means arranged to restrict release of fluid under pressure from said piston.

2. A relay valve device comprising a casing, a supply valve in said casing operable to supply fluid under pressure to a chamber, a stem slidably mounted in a bore in said casing operable upon movement in one direction to open said supply valve and operable upon movement in the opposite direction to permit closing of said supply valve, said casing having a valve seat around said bore, a release valve on said stem arranged to contact said seat with said supply valve open and to disengage said seat with said supply valve closed, said stem also having a cylindrical portion adjacent said release valve adapted to slidably enter said bore to close communication through said bore ahead of opening said supply valve and movable out of said bore after closing of said supply valve, and said stem comprising another portion projecting from said cylindrical portion through said bore for engagement with said supply valve and so constructed as to allow release of fluid under pressure from said chamber through said bore, a piston connected to said stem and operable by fluid under pressure to actuate said stem to open said supply valve, and means operable upon release of fluid under pressure on said piston to actuate same to move the cylindrical portion of said stem out of said bore.

3. A relay valve device comprising a casing having a first chamber supplied with fluid under pressure and having a second chamber, a poppet type supply valve in said casing having an open position for supplying fluid under pressure from said first chamber to said second chamber and a closed position for cutting off the supply of fluid under pressure to said second chamber, said poppet valve being subject to pressure of fluid in a third chamber which urges it to its closed position, a port arranged to supply fluid under pressure from said first chamber to said third chamber, a pilot valve having a fluid flow capacity exceeding that of said port and operable to release fluid under pressure from said third chamber to said second chamber, said pilot valve being disposed axially in said supply valve, a stem slidably mounted in a bore in said casing in coaxial relation to said valves and operable upon movement in the direction of said valves to first open said pilot valve and then said supply valve and operable upon movement in the opposite direction to permit closing first of said supply valve and then of said pilot valve, means operable to close said valves upon movement of said stem in said opposite direction, said casing having a valve seat around said stem, a release valve formed on said stem to engage said seat upon opening of said supply valve, said stem comprising a cylindrical portion arranged to enter and to have sliding contact with the wall of said bore ahead of opening of said pilot valve and movable out of said bore upon closing of said pilot valve, said stem further comprising a portion projecting from said cylindrical portion through said bore for operating said pilot and supply valves and so constructed as to permit release of fluid under pressure from said second

chamber, a piston connected to said stem and operable by fluid under pressure supplied to a fourth chamber to move said stem in the direction of said supply valve, means operable upon release of fluid under pressure from said fourth chamber to effect movement of said piston and stem in the said opposite direction, and means arranged to restrict release of fluid under pressure from said fourth chamber.

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