Oct. 5, 1948. H. C. MAY 2,450,481

DUPLEX CONTROL VALVE DEVICE

Filed July 31, 1943

Fig. 1

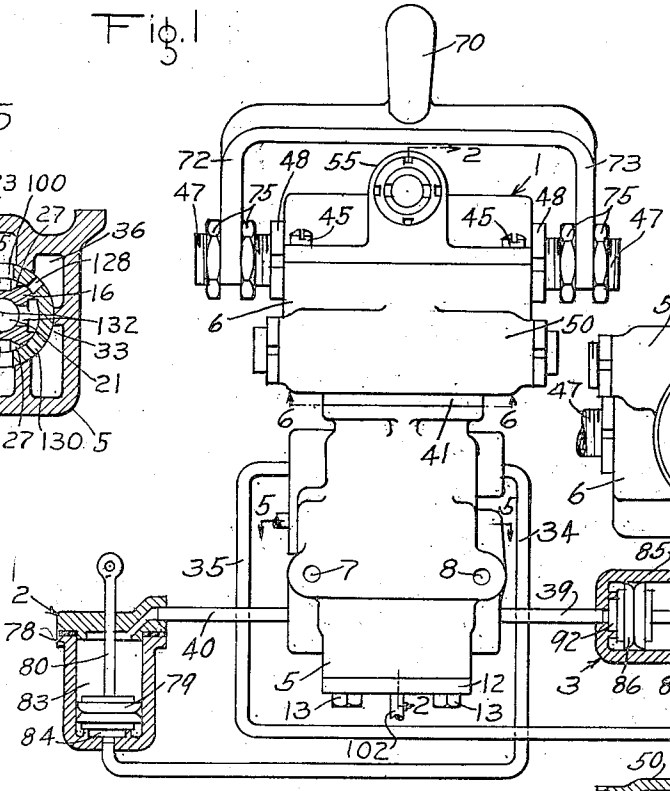


Fig. 5

Fig. 6

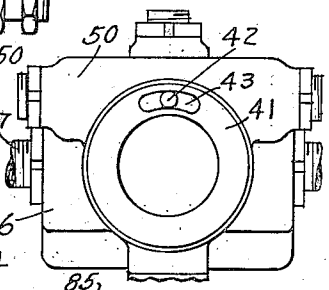


Fig. 4

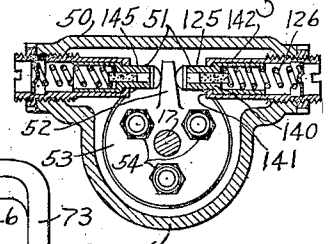


Fig. 2

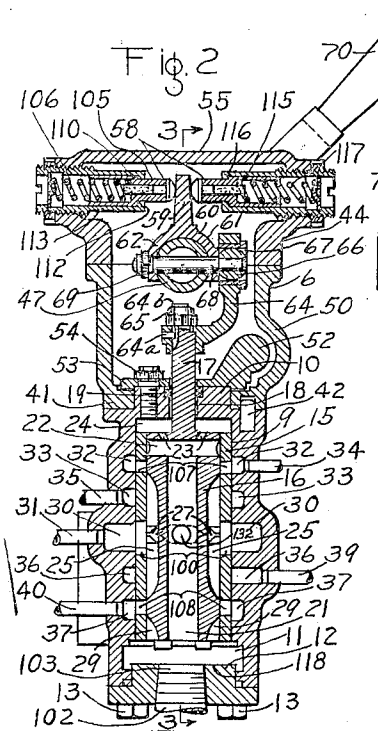
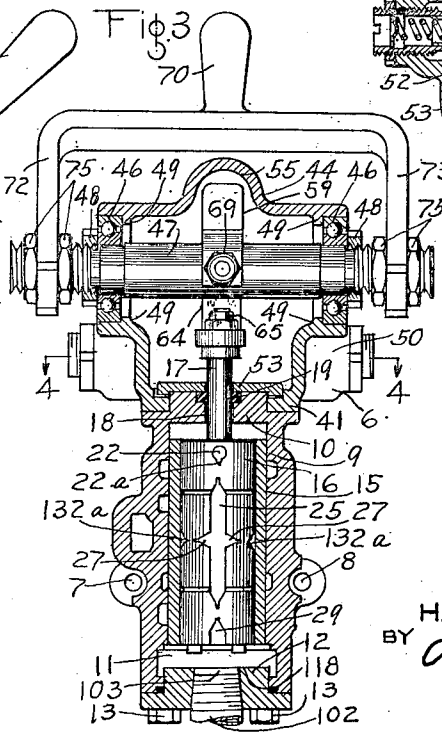


Fig. 3



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DUPLEX CONTROL VALVE DEVICE

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This invention relates to control valve devices and more particularly to a control valve device of the type employed to control fluid pressure operated mechanism such as is used to control search lights, gun turrets and various kinds of machinery where the mechanism is capable of movement in more than one plane.

The principal object of the invention is to provide an improved control valve device of the above mentioned type.

Another object of the invention is to provide a single control valve device which is operative to control fluid pressure operated mechanism which is capable of producing either vertical or horizontal movement or any combination of the two movements.

A further object of the invention is to provide a single control valve device which controls the rate of movement of the mechanism operative to produce vertical or horizontal movement or any combination of the two movements.

A still further object of the invention is to provide a control valve device with a single operating handle for controlling operation of fluid pressure mechanism capable of producing vertical or horizontal movement or any combination of the two movements, which handle is automatically returnable to a neutral position when freed by the operator.

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

In the accompanying drawing:

Fig. 1 is a diagrammatic view of a fluid pressure system, partly in section, embodying the invention.

Fig. 2 is a sectional view of the control valve device taken along the line 2—2 of Fig. 1.

Fig. 3 is a sectional view of the control valve device taken along the line 3—3 of Fig. 2.

Fig. 4 is a sectional view of the control valve device taken along the line 4—4 of Fig. 3.

Fig. 5 is a sectional view of the control valve device taken along the line 5—5 of Fig. 1.

Fig. 6 is a plan view of the control valve device looking in the direction indicated by the line 6—6 of Fig. 1.

In Fig. 1 of the drawing a fluid pressure system is shown in which a control valve device embodying the invention is used. This system comprises a control valve device 1 and a pair of double acting fluid pressure motors 2 and 3, the motor 2 being operative to effect vertical movement of a device to be operated such for instance as a search light and the motor 3 being operative to effect

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horizontal movement the device to be operated.

For the purpose of illustration the control valve device 1 has been shown associated with the double fluid pressure motors 2 and 3 but it will be understood that this is merely illustrative and that the control valve device 1 may be used to control the supply of fluid under pressure to and the release of fluid under pressure from any desired type of fluid pressure operated mechanism where a plurality of controlled actuators are employed.

The control valve device 1 may comprise a lower body casing 5 and an upper body casing 6. The lower body casing 5 is provided with apertures 7 and 8 through which bolts or the like (not shown) may pass for rigidly securing the casing to a bracket or the like.

The body casing 5, as best shown in Figs. 2 and 3, is provided with a central bore 9 which is closed at its upper end by a wall 10, and which at its lower end is open to a counter-bore 11 of enlarged diameter, the enlarged bore 11 being closed by means of a bottom cap 12 which is secured to the casing in any suitable manner such as by nuts 13 having screw-threaded engagement with studs carried by the casing and passing through suitably aligned holes in the cap.

Contained in the central bore 9 is a bushing 15 which for a purpose hereinafter described is provided with a plurality of spaced oppositely disposed through ports. Operatively mounted for both rotary and vertical movement in the bushing 15 is a valve 16. This valve is provided with a stem 17 which extends through a central aperture 18 provided in wall 10 of the casing. Carried by the wall 10 and surrounding the stem 17 is gasket 19 for preventing leakage of fluid along the stem.

The valve 16, as best shown in Fig. 2, is provided with a central bore or discharge passage 21 which at its lower end is open to the enlarged bore 11 in the casing and at its upper end opens into a cross port 22 provided in the valve. This cross port 22 is connected through a plurality of passages 23 with a chamber 24 formed by the wall 10 of the casing 5, the top of the valve 16 and the walls of the bore 9 when the valve is in the position shown. At each end of the cross port 22 as clearly shown in Fig. 3 of the drawing and the outer face of the valve 16 is provided with a short downwardly extending V-shaped notch 22a which tapers in depth and which is in open communication at its upper or widest and deepest end with the port 22.

The valve 16 is also provided with a pair of

oppositely disposed supply cavities 25 which extend longitudinally of the valve. These supply cavities are each provided with lateral V-shaped extensions 27, the side walls of each extension converging toward each other. The upper and lower ends of the cavities 25 are also tapered in width. The bottom walls of the tapered portions of the cavities 25 and of the extensions 27 thereof slope upwardly and merge with the outer surface of the valve at the ends of the tapering portions. From this it will be understood that the ends of the cavities and the extensions 27 thereof taper in depth as well as in width, thus gradually reducing the flow areas of these ends and extensions toward thin ends. In addition valve 16 is provided with a pair of oppositely disposed cavities 29. The side walls of the upper end of the cavity 29 at each side of the valve converge toward each other and close the ends, the bottom of this portion of the groove sloping upwardly from the deepest portion of the cavity.

These tapering portions of the port 22 and cavities 25 and 29 are provided for the purpose of controlling the rate of flow of fluid through the port and cavities as will hereinafter more fully appear under operation of the device.

As best shown in Fig. 2 the lower body casing 5 is provided intermediate its end with a supply chamber 30 which is in constant open communication with a supply pipe 31 which leads to a source of fluid under pressure (not shown). Intermediate the chamber 30 and the wall 10 of the casing 5 there is a chamber 32 and a chamber 33. The chamber 32 is connected to one end of the fluid pressure motor 2 by means of a pipe 34, while the chamber 33 is connected to one end of the fluid pressure motor 3 by means of a pipe 35. The casing 5 is also provided with a chamber 36 and a chamber 37, which chambers are disposed intermediate the chamber 30 and the lower end of the casing. The chamber 36 is connected through a pipe 39 to the opposite end of the fluid pressure motor 3 while the chamber 37 is connected through a pipe 40 to the opposite end of the fluid pressure motor 2.

The upper body casing 6 is provided at its lower end with an inwardly extending flange 41 which is rotatably mounted on the wall 10 of the lower body casing 5. As best shown in Figs. 2 and 6 of the drawing, rotary movement of this casing 6 is limited by a pin 42, carried by the lower body casing 5, engaging with one or the other of the ends of a slot 43 formed in the flange 41.

The casing 6 is hollow and the open upper end is closed by a cover portion 44 which is secured to the casing 6 in any suitable manner such as by screws 45, as shown in Fig. 1. The casing 6 and cover portion 44 define two horizontally aligned recesses for the reception of a pair of ball bearing members 46. Rotatably mounted in said bearing members is a shaft 47. The opposite ends of the shaft 47 extend to the exterior of the casing and are preferably screw-threaded. A pair of nuts 48, one having screw-threaded engagement with one end of the shaft and the other having screw-threaded engagement with the opposite end of the shaft, are employed to engage the bearings and hold them in position against shoulders 49 formed on the casing 6 and the cover 44.

The casing 6 is provided with an outwardly projecting cylindrical portion 50. Contained in this portion, as best shown in Fig. 4, is a pair of oppositely disposed spring actuated plungers 51 which engage opposite sides of an upwardly projecting arm 52 carried by a disc member 53 for a purpose hereinafter described. This disc member 53, as best shown in Figs. 2 and 4, is rigidly secured to the wall 10 of the lower casing 5 by means of a plurality of bolts 54. This disc member together with the casing 5 defines a groove which accommodates the flange 41 and serves to maintain the casing 6 in its proper rotatable relationship with the casing 5. The member also serves to retain the gasket 19 in place.

The cover portion 44 is also provided with an outwardly projecting cylindrical portion 55 which extends at right angles to the cylindrical portion 50. Contained in this portion 55 is a pair of oppositely disposed spring actuated plungers 58 which engage opposite sides of an upwardly extending arm 59 carried by a member 60 for a reason hereinafter described. The member 60 is provided with a pair of spaced arms 61 and 62 which straddle the shaft 47.

The stem 17 of the valve 16 extends through a suitable aperture in the disc 53 and at its end has rigidly connected thereto one end of an extension 64, which is offset in the direction toward the right-hand as viewed in Fig. 2. The stem 17 passes through the lower end of the extension and has screw-threaded engagement with a nut 65 which engages the extension and holds it in place on the stem. The rigid connection between the stem 17 and the extension 64 is made by means of a pin 64*a* which is secured to the extension and which has a close fit in a vertical groove 64*b* provided in the stem. This connection serves to prevent relative rotary movement between the stem and extension and also serves to facilitate the proper positioning of the valve with relation to the stem in assembling the several parts of the valve device. The opposite end of the extension 64 is operatively connected to the shaft 47 by means of a pin 68 and a ball like member 66 carried by the pin. The pin passes through arm 62 of member 60, the shaft 47 and arm 61 of member 60 at the opposite side of the shaft and through the member 66 which is disposed in an opening 67 provided in the upper end of the extension 64. One end of the pin 68 projects outwardly beyond the arm 62 and has screw-threaded connection with a nut 69 which engages the arm 62. When the nut is tightened it pulls the bolt 68 toward the left causing the member 66 to be drawn into clamping engagement with the member 60, thus making a rigid connection between the shaft 47 and the member 66. This member 66 has a snug fit in the opening 67 so that any movement of the shaft will be immediately transmitted to the extension 64. It will however be understood that the member 66 is free to rock slightly relative to the extension when the shaft 47 is rotated to shift the valve vertically as will hereinafter be described.

For the purpose of rotating the shaft 47 to effect vertical movement of the connected valve 16 and for the purpose of rotating the upper body casing 5 to effect rotary movement of the valve 16 a handle 70 is provided. This handle comprises a pair of spaced arms 72 and 73 which are connected to opposite ends of the shaft 47 by means of nuts 75 having screw-threaded engagement with the shaft 47 and engaging opposite sides of the arms 72 and 73 as clearly shown in both Figs. 1 and 3.

The fluid pressure motors 2 and 3 as shown in the present embodiment of the invention are identical in construction but for convenience in describing the operation different reference nu-

merals have been used to indicate similar parts.

The motor 2 may comprise a casing 78 in which there is disposed a double acting piston 79 having an operating stem 80. At one side of the piston 79 there is a chamber 83 which is in constant open communication with chamber 37 in the control valve device 1 through pipe 40. At the opposite side of the piston is a chamber 84 which is in constant open communication with the chamber 32 through pipe 34.

The motor 3 may comprise a casing 85 in which there is disposed a double acting piston 86 having an operating stem 87. At one side of the piston 86 there is a chamber 93 which is in constant open communication with chamber 33 through the pipe 35. At the opposite side of this piston is a chamber 92 which is in constant open communication with the chamber 36 through the pipe 39.

Operation

Assuming the handle 70 of the control valve device 1 to be in the position shown and the system charged with fluid under pressure, the valve 16 will be in the position shown and the supply pipe 31 and consequently the supply chamber 30 of the control valve device will be charged with fluid under pressure. Fluid under pressure thus supplied to the supply chamber 30 flows therefrom through ports 100 and 101 in the bushing 15 to the supply cavities 25 in the valve 16. The chamber 24 above the valve 16 is connected to a discharge pipe 102 by way of passage 23 in the upper wall of the valve 16, cross port 22, discharge port 21, enlarged chamber 11 below the valve and a passage 103 in the bottom cap 12. With the valve in this position all other ports and cavities in the bushing are lapped. It should here be mentioned that the plunger mechanisms 51 and 53 yieldably maintain the several parts of the valve device in the positions just described against accidental movement.

It should here be noted that the chamber 24 above the valve 16 and the chamber 11 below the valve are connected together and to the discharge pipe 102 so that the pressure acting on opposite ends of the valve are equal, thus the valve is balanced in a vertical direction. It will also be noted that the pressure in the supply chamber 30 acts on opposite sides of the valve so that the valve is balanced in a horizontal direction.

When it is desired to effect movement of the piston 79 upwardly from the position in which it is shown in Fig. 1 of the drawing, the handle 70 of the control valve device 1 is rotated in a counterclockwise direction about the axis of shaft 47 from the neutral or normal position in which it is shown in Fig. 2. Counterclockwise rotation of the handle 70 causes the shaft 47 and connected member 60 to rotate in the same direction. As the member 60 is thus rotated the arm 59 carried by the member causes a plunger 105 disposed in the spring actuated plunger mechanism 58 at the left-hand side of the arm 59, as viewed in Fig. 2 of the drawing, to move inwardly against the opposing pressure of a spring 106 and the valve 16 is moved vertically upwardly through the medium of pin 68, member 66, extension 64 and stem 17, the member 66 rocking freely in the opening 67. It will be noted that counterclockwise rotation of the handle 70 will be brought to a stop when the top of the valve 16 engages the wall 10 of the casing 5.

As the valve 16 is moved upwardly the supply chamber 30 in the control valve device 1 is connected to the chamber 84 in the fluid pressure motor 2 by way of ports 100 and 101 in the bushing 15, supply cavities 25 in the valve 16, a pair of oppositely disposed ports 107 in the bushing 15, chamber 32 in the casing and pipe 34. At the same time the chamber 83 at the opposite side of the piston 79 in the fluid pressure motor 2 is connected to the discharge pipe 102, by way of pipe 40, chamber 37 in the control valve device 1, a pair of oppositely disposed ports 108 in the bushing 15, cavities 29 in the valve 16, chamber 11 and passage 103. With these communications established fluid under pressure is supplied to chamber 84 at the lower side of piston 79 in the motor 2 and fluid under pressure in chamber 83 at the upper side of piston 79 is discharged so that the piston 79 and attached stem 80 are caused to move upwardly from the position in which they are shown in the drawing. This upward movement of the piston 79 and attached stem 80 may be employed, as hereinbefore mentioned, to actuate search lights, gun turrets and various kinds of machinery in one direction.

It should here be mentioned that the speed at which the piston 79 is caused to move is controlled by the rate of flow of fluid under pressure to and the release of fluid under pressure from opposite sides of the piston and that the rate of flow of fluid under pressure may be controlled by the valve 16 in the controlling valve device 1.

If the movement of the handle 70 has been sufficient to bring the upper end of the valve into engagement with the wall 10 of the casing 5, the cavities 25 and 29 in the valve 16 will at this time be fully open, so that the supply of fluid under pressure to chamber 84 and the release of fluid under pressure from the chamber 83 in the motor 2 will be at a fast rate and as a result the piston 79 therein will move quickly upwardly.

If the handle 70 of the control valve device 1 is rotated counterclockwise to any position intermediate the neutral position in which it is shown and its uppermost position in which cavities 25 and 29 are fully open as above described, the tapering portion at the top of the supply cavities 25 will restrict the rate of flow of fluid from the supply chamber 30 to the chamber 84 in the motor, and that the tapering portion at the top of the cavities 29 will restrict the rate of flow of fluid discharged from the chamber 83 in the motor.

From the foregoing it will be understood that the piston 79 and attached rod 80 may be moved upwardly at the rate of speed desired by proper manipulation of the handle 70.

When the operator releases his grip on the handle 70 of the control valve device 1, the spring 106 acting through the medium of the plunger 105 and the arm 59 of the member 60 causes the shaft 47 to rotate in a clockwise direction to thereby return the handle 70 to its neutral position, in which position it is brought to a stop by a shoulder 110 carried by the plunger 105 coming into engagement with stop 112 provided on a guide member 113. As the shaft 47 and thereby the handle 70 are rotated clockwise as just described, the valve 16 is moved downwardly to its neutral position as shown. In this position the cavities 25 and 29 are lapped. With the cavities 25 and 29 lapped further flow of fluid under pressure to chamber 84 in the motor 2 and the discharge of fluid from chamber 83 in the motor is cut off so that the piston 79 will be maintained in its uppermost position.

Now when it is desired to effect movement of

the piston 79 from its uppermost position to the position in which it is shown in the drawing, the handle 70 of the control valve device 1 is rotated in a clockwise direction about the axis of the shaft 47 from its neutral position. This clockwise rotation of the handle 70 causes the shaft 47 and connected member 60 to rotate in the same direction thereby causing the arm 59 carried by the member to move a plunger 115 disposed in a guide member 116 of the spring actuated plunger mechanism 58 at the right-hand side of the arm, as viewed in Fig. 2, inwardly against the opposing pressure of a spring 117. As the shaft 47 is thus rotated the valve 16 is moved downwardly through the medium of pin 68, member 66, extension 64 and stem 17 and movement in this direction may be continued until the valve 16 is brought to a stop by the bottom of the valve engaging the inner wall 118 of the bottom cap member 12.

Downward movement of the valve 16 connects the supply chamber 30 in the casing 5 of the control valve device 1 with the chamber 83 in the motor 2 and at the same time connects the chamber 84 at the opposite side of the piston 79 in the motor 2 to the discharge pipe 102. The communication between the supply chamber 30 and the chamber 83 in the motor 2 is established by way of ports 100 and 101 in the bushing 15 supply cavities 25 in the valve 16 ports 126 in the bushing 15, chamber 37 in the control valve device and pipe 40. The communication between the chamber 84 in the motor 2 and the discharge pipe 102 is made by way of pipe 34, chamber 32 in the control valve device, ports 107 in the bushing 15, cross port 22 in the valve, discharge port 21, enlarged chambers 11 and passage 103. With these communications established the pressure of fluid in chamber 83 is increased and the pressure of fluid in chamber 84 is decreased thus causing the piston 79 to move downwardly from its upper position to the position in which it is shown in the drawing.

From the previous description in connection with effecting upward movement of the piston 79 it will be understood that the rate of flow of fluid under pressure to and the release of fluid from opposite sides of the piston 79 in the motor 2 will determine the speed at which the piston is caused to move downwardly. It will also be understood that the rate of flow of fluid under pressure to the chamber 83 and the discharge of fluid from the chamber 84 is controlled by the cavities 25 and cross port 22 respectively, the control being such that when the valve 16 is moved to its lowermost position in which the valve engages the bottom cover 12 the cavities 25 and port 22 will be fully open to effect a fast rate of flow of fluid for quickly moving the piston 79 downwardly, and that the lower tapered portion of the cavities 25 and the lower tapered portion of the port 22 will restrict the rate of flow of the fluid to and from the motor and thereby the rate at which the piston 79 is moved when the valve 16 is moved to any position intermediate the position in which the cavities and port 22 are fully open and neutral position.

When further movement of the piston 79 is undesired, the operator releases his grip on the handle 70 and the spring actuated plunger mechanism 58 at the right-hand side of the arm 59 operates, in identically the same manner, as the similar mechanism, hereinbefore described, at the left-hand side of the arm 59, to rock the shaft 47 in a counterclockwise direction and thereby the handle 70 and valve 16 to their neutral position in which the cavities 25 and port 22 are lapped.

When it is desired to effect movement of the piston 86 in the fluid pressure motor 3 in a direction toward the right-hand from the position in which it is viewed in the drawing, the handle 70 of the control valve device 1 is moved in a horizontal plane in the direction toward the left-hand from the neutral position in which it is shown in Figs. 1 and 3 of the drawing. This movement of the handle 70 causes the shaft 47 and thereby the upper body casing 6 with attached cover portion 44 to rotate in the same direction.

It will be noted that as the upper body casing 6 is thus rotated it moves relative to the arm 52 carried by the disc 53 since the disc is, as hereinbefore mentioned, rigidly secured to the lower body casing 5. As the casing 6 is thus rotated the arm 52 causes a plunger 125 disposed in the spring actuated plunger mechanism 51 at the right-hand side of the arm 52 to move inwardly against the opposing pressure of a spring 126 comprising a part of said mechanism. Movement of the shaft 47 in this direction, acts through the medium of pin 68, extension 64, member 66 and stem 17 to rotate the valve 16 in the same direction. It will be seen from an inspection of Fig. 5 of the drawing that such movement causes the valve 16 to rotate in a clockwise direction, and from an inspection of Fig. 6 it will be seen that such movement may be continued until brought to a stop by the pin 42 carried by the lower body casing 5 engaging the left-hand end of the slot 43 in the casing 6.

The valve 16 as it is rotated in a clockwise direction as just described, and as best shown in Fig. 5 establishes communication between supply chamber 30 and chamber 36 by way of ports 100 and 101 in the bushing 15, cavities 25 in the valve and oppositely disposed ports 128 in the bushing 15. At the same time said valve establishes communication between chamber 33 in the casing 5 and the discharge port 21 in the valve 16 by way of a pair of oppositely disposed ports 130 in the bushing 15 and cavities 132 in the valve 16. With these communications established, fluid under pressure is supplied to the chamber 92 at the left-hand side of piston 86 in the fluid pressure motor 3 by way of supply chamber 30, ports 100 and 101 in bushing 15, cavities 25 in the valve 16 ports 128 in the bushing, chamber 36 in the casing 5 and pipe 39. At the time the fluid in chamber 90 at the right-hand side of the piston 86 in the motor 3 is released to the discharge pipe 102 by way of pipe 35, chamber 33 in the casing 5 of the control valve device 1, ports 130 in the bushing 15, cavities 132 in the valve 16, discharge port 21, chamber 11 and passage 103 in the bottom cap 12, so that the piston 86 and attached stem 87 are caused to move in a direction toward the right-hand from the position in which they are shown in Fig. 1 of the drawing. Each of the cavities 132 is provided at each end with a shallow or restricted narrow extension 132a.

If the handle 70 and thereby the upper body casing 6 are rotated in a direction toward the left-hand until brought to a stop by the pin 42 carried by the stationary casing 5 engaging the left-hand end of the slot 43, the cavities 25 and 132 in the valve 16 will be fully open, so that the supply of fluid under pressure to chamber 92 and the release of fluid from chamber 90 in the motor

3 will be at a fast rate and as a result the piston 86 will move quickly

From the previous description of the operation of the control valve device 1 in connection with the fluid pressure motor 2 it will be understood that the left-hand lateral extension 27 of the supply cavity 25 is tapered as viewed in Fig. 3 to restrict the rate of flow of fluid under pressure from chamber 30 to chamber 36 and that the cavity extensions 132a are tapered to restrict the rate of release of fluid from the chamber 33 to the discharge passage 21 in the valve 16. Since, as above mentioned, the cavities 25 and 132 are fully open when the handle 70 has been moved in a direction toward the left-hand until brought to a stop by the pin 42 engaging the left-hand end of the slot 43, it will be apparent that the flow restricting portions of the cavities 25 and 132 will control the rate of flow to and from the motor 3 and thus the speed at which the piston 86 in said motor operates.

Just as soon as the operator releases his grip on the handle 70, the spring 126, acting through the medium of plunger 125 and the arm 52 of disc 53, causes the upper body casing 6 and thereby the shaft 47 and attached handle 70 to rotate in a direction toward the right-hand until it reaches its neutral position in which it is brought to a stop by a shoulder 140 carried by the plunger 125 coming into engagement with a stop 141 provided on a guide member 142. As the shaft 47 is moved in a direction toward the right-hand as just described, the valve 16 is rotated, through the medium of pin 68, member 66 and extension 64, in a counter-clockwise direction to its neutral position, in which position the cavities 25 and 132 are lapped. With these cavities lapped, the supply of fluid under pressure to and the release of fluid from the motor 3 is cut off and as a result the piston 86 therein is maintained in its outermost position, that is, in a position to the right of which it is shown in the drawing.

When it is desired to effect movement of the piston 86 in the motor 3 from its outermost position to the position in which it is shown in the drawing, the handle 70 of the control valve device 1 is moved in a direction toward the right-hand from its neutral position. When the handle 70 is thus moved, the shaft 47 and upper body casing 6 are rotated in the same direction. The casing 6 as it thus moves, causes a plunger 145 disposed in the spring actuated mechanism 51 provided at the left-hand side of the arm 52 to move inwardly against the opposing pressure of a spring 146 comprising a part of this mechanism. The shaft 47 as it moves in this direction acts through the medium of pin 68, extension 64, and member 66 to cause the valve 16 to rotate in a counterclockwise direction, it being understood that such movement may be continued until the pin 42 engages the right-hand end of the slot 43.

As best shown in Fig. 5, counterclockwise rotation of the valve 16 connects chambers 30 and 33 in the casing and, as a result, fluid under pressure flows from chamber 30 to the chamber 90 at the right-hand side of the piston 86 in the fluid pressure motor 3 by way of ports 100 and 101 in bushing 15, cavities 25 in the valve 16, ports 130 in the bushing 15, chamber 33 and pipe 34. At the same time the valve connects chamber 36 in the casing 5 with the discharge passage 21 in the valve so that fluid in chamber 92 at the left-hand side of piston 86 in the motor 3 is released to the discharge pipe 102 by way of pipe 39, chamber 36, ports 128 in the bushing 15, cavities 132 in the valve 16, discharge passage 21, chamber 11 and passage 103. Due to the increase in pressure in chamber 90 and the decrease in pressure in chamber 92 of the motor 3 the piston 86 is caused to move in a direction toward the left-hand from its outermost position to the position in which it is shown in the drawing.

When the casing 5 and thereby the handle 70 is brought to a stop by the pin 42 engaging the right-hand end of the slot 43, the cavities 25 and 132 in the valve are fully open and as already mentioned in connection with the operation of the piston 86 of the motor 3 in a direction toward the right-hand these cavities are tapered. The tapering portion of the cavities being so arranged that as the valve 16 is moved from neutral position toward the position in which it is stopped, the flow area through said cavities in the valve is increased thus the degree the handle is moved out of neutral position in a direction toward its stopped position controls the rate of flow of fluid to the piston chamber and thereby the rate of speed at which the piston 86 is moved.

It will be understood that when the operator releases his grip on the operating handle 70 the spring actuated mechanism 51 at the left-hand side of the arm 52 will operate in the same manner as the spring actuated mechanism 51 at the opposite side of the arm 52 to return the handle 70 and valve 16 to their neutral position in which the cavities 25 and 132 are lapped.

It should here be understood that if desired, the handle 70 of the control valve device 1 may be manipulated to effect both vertical and rotary movement of the valve 16 and thereby cause both fluid pressure motors 2 and 3 to operate at the same time and at the same speed or at the same time and at different speeds.

For example, if it is desired to effect movement of the piston 79 and 86 of the motors 2 and 3, respectively, from the position in which they are shown to their outermost positions at the same time and at a fast rate, the handle 70 of the control valve device is rotated in a vertical counterclockwise direction from its neutral position until brought to a stop by the top of the valve engaging the wall 19 of the casing 5 and at the same time rotated in a horizontal plane in a direction toward the left-hand until the pin 42 engages the end of the slot 43. With the handle of the control valve device thus positioned it will be understood that the cavities 25 and 29 in the valve 16, which control the supply of fluid under pressure to and the release of fluid from the piston chambers 84 and 83, respectively, of the motor 2, are fully open, and that the cavities 25 and 132 in the valve 16, which control the supply of fluid under pressure to and the release of fluid from the piston chambers 92 and 90, respectively, of motor 3 are also fully open, thus fluid under pressure is supplied to and released from both motors at the same time at a fast rate through the circuits hereinbefore traced in connection with individual operation of said motors.

If it is desired to actuate the piston 79 of the motor 2 from the position in which it is shown to its outermost position at a fast rate and the piston 86 of the motor 3 from the position in which it is shown to its outermost position at a slower rate, the handle 70 of the control valve device 1 is rotated vertically counterclockwise until stopped in the manner just described and at the same time rotated in a direction toward the left-hand to a position between neutral position and the position in which it is brought to a stop by the pin 42

engaging the end of the slot 43. The positioning of the valve between these latter positions being dependent upon the speed at which it is desired to effect movement of the piston 86.

It will be noted that in either of the above cases, when the operator releases his grip on the handle 70 the spring actuated plunger mechanisms 51 associated with arm 52 and the similar actuated plunger mechanisms 58 associated with the arm 59 will cooperate to effect movement of the handle 70 and thereby the valve 16 to its neutral position in which the supply and release cavities for each motor are lapped by the valve.

From the foregoing description it will be understood that when the handle 70 of the control valve device 1 is rotated in a vertical clockwise direction from its neutral position the piston 79 of the fluid pressure motor 2 is caused to move upwardly, and when it is rotated in a vertical counterclockwise direction from its neutral position said piston is caused to move downwardly. When the handle 70 is moved in a horizontal clockwise direction from its neutral position the piston 86 of the fluid pressure motor 3 is caused to move in a direction toward the left-hand and when the handle is moved in a horizontal counterclockwise direction from its neutral position said piston is caused to move in a direction toward the right-hand. It will be understood that the speed at which either of said pistons is moved in either direction is controlled by the rate of flow of fluid under pressure to and the release of fluid from opposite sides of the piston to be operated. It will also be understood that the rate of flow of fluid under pressure to and the release of fluid from opposite sides of the piston to be operated is controlled by the degree the handle 70 is moved from its neutral position in any given direction.

It will also be apparent that the valve 16 may be manipulated so as to cause the piston 79 in the motor 2 to be moved either upwardly or downwardly at any desired speed without effecting movement of the piston 86 in motor 3 or that the pistons 79 and 86 may be actuated at the same time and at the same speed or at the same time at different speeds to produce either longitudinal or horizontal or any combination of the two movements. It will be understood that the motors 2 and 3 may be arranged to operate a drive shaft through a worm gear or some similar arrangement if desired and that either hydraulic fluid under pressure or air under pressure may be employed to operate said motors.

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

1. In a control valve device, in combination, a casing having fluid pressure conducting passages therein, a valve mounted in said casing for rotary and/or longitudinal movement from a neutral or normal position for effecting the flow of fluid through said passages, means including a shaft carried by said casing and operatively connected to said valve, said shaft being manually operative in either a vertical clockwise or counterclockwise direction to move said valve longitudinally from its neutral position and operative in either a horizontal clockwise or counterclockwise direction to rotate said valve from its neutral position, and spring means automatically operative upon the manual release of said means to return said valve to its neutral position.

2. In a control valve device, in combination, a casing having fluid conducting control passages provided therein, a valve mounted in said casing for rotary and longitudinal movement and having a fluid conducting cavity provided therein connected to one of said passages upon rotary movement and connected to another of said passages upon longitudinal movement of the valve, said cavity being provided with portions tapering in flow area to graduate the rate of flow of fluid through said cavity as the valve is moved and means carried by said casing and positively connected to said valve and being manually operative relative to the casing in one direction to positively rotate said valve and manually operative relative to the casing in a direction at an angle to said one direction to positively move said valve longitudinally.

3. In a control valve device, in combination, a casing having an inlet passage and two control passages, a valve mounted in said casing for rotary and/or longitudinal movement from a neutral position, a flow control cavity in said valve, said cavity being effective only upon rotary movement of the valve to connect said inlet passage to one of said control passages and only upon longitudinal movement of the valve to connect said inlet passage to the other of said control passages and provided with portions tapering in flow area to graduate the rate of flow of fluid from said inlet passage to said control passages upon rotary and/or longitudinal movement of the valve, and lever means carried by said casing and positively connected to said valve, said valve means being manually operative relative to the casing in one direction to positively rotate said valve from its neutral position and manually operative in a direction at an angle to said one direction to positively move said valve longitudinally from its neutral position.

4. A fluid pressure control valve device comprising a casing having a fluid pressure inlet and a plurality of control passages formed therein, a valve rotatable only to establish communication through which fluid flows from said inlet passage to one of said control passages, and movable only longitudinally of the casing to establish a communication from said inlet passage to another of said control passages, and means positively connected to said valve and operative in one direction for rotating the valve and operative in a direction at an angle to said one direction for moving the valve longitudinally of the casing and operative in both directions for both rotating and moving the valve longitudinally.

5. A control valve device comprising a casing having a plurality of fluid conducting control passages therein, a valve mounted in said casing for operation to control the flow of fluid through said passages, said valve having a neutral rotary position and being rotatable about its axis in either direction from said neutral rotary position for controlling the flow of fluid through certain of said passages, and said valve having a neutral axial position and being shiftable axially in either direction from said neutral axial position for controlling the flow of fluid to other of said passages, and means for actuating said valve.

6. A control valve device comprising a casing having a plurality of fluid conducting control passages therein, a valve mounted in said casing for operation to control the flow of fluid through said passages, said valve having a neutral rotary position and being rotatable about its axis in either direction from said neutral rotary position for controlling the flow of fluid through certain of said passages and said valve having a

neutral axial position and being shiftable axially in either direction from said neutral axial position for controlling the flow of fluid through other of said passages, means for actuating said valve, and means automatically operative incident to the release of the actuating power applied to the first mentioned means for returning said valve to the neutral position or positions from which it may have been previously moved.

7. A control valve device comprising a casing having at least two pairs of fluid conducting control passages therein, a valve mounted in said casing for rotary and/or axial movement for controlling the flow of fluid to said pairs of passages and having a normal position, said valve being rotatable in one direction from said normal position for controlling in a certain manner the flow of fluid through one of said pairs of passages and rotatable in the opposite direction from said normal position for controlling in a different manner the flow of fluid through this pair of passages, and said valve being shiftable axially in the one direction from said normal position for controlling in a certain manner flow of fluid to the other of said pairs of passages and being shiftable axially in the opposite direction from said normal position for controlling in a different manner the flow of fluid through this pair of passages, and said valve being rotatable in either direction in either position to which it may have been shifted axially, for controlling the flow of fluid through the first mentioned pair of passages, and means operative to selectively rotate and axially shift said valve.

8. A control valve device comprising a casing having fluid pressure conducting control passages therein, a valve mounted in said casing for operation to control the flow of fluid through said control passages, said valve being rotatable for controlling the flow of fluid through certain of said control passages and being shiftable axially for controlling the flow of fluid through other of said control passages, a member rotatably mounted on said casing, a shaft carried by said member for end for end rotary movement relative to said casing and for rotary movement about its axis relative to the member, means operative in response to the end for end rotation of said shaft for rotating said valve and operative in response to the rotation of the shaft about its axis for shifting said valve axially, and means for actuating said shaft.

9. A control valve device comprising a casing having fluid pressure conducting control passages therein, a valve mounted in said casing for operation to control the flow of fluid through said control passages, said valve having a normal position and being rotatable from said normal position for controlling the flow of fluid through certain of said control passages and being shiftable from said normal position axially for controlling the flow of fluid through other of said control passages, a member rotatably mounted on said casing, a shaft carried by said member for end for end rotary movement relative to said casing and for rotary movement about its axis relative to the member, means operative in response to the end for end rotation of said shaft for rotating said valve and operative in response to the rotation of the shaft about its axis for shifting said valve axially, means having a normal position and being operative from said normal position for actuating said shaft, and means energized incident to the operation of the shaft actuating means for operation upon the relief of the actuating power applied to the shaft actuating means to return the shaft actuating means and valve from any position to which they may have been moved to said normal position.

10. A control valve device comprising a casing having fluid pressure conducting passages therein, a valve mounted in said casing for rotary and/or axial movement for controlling the flow of fluid through said passages, said valve when rotated without axial movement controlling the flow of fluid through certain of said passages and said valve when moved axially without rotary movement controlling the flow of fluid through other of said passages, and said valve when rotated and moved axially controlling the flow of fluid through said certain and other passages, and means connected to said valve operative in a certain direction to rotate said valve and operative in another direction at an angle to said certain direction to impart axial movement to the valve and operative in both of said directions to impart both rotary and axial movements to the valve.

11. A control valve device comprising a casing having at least two pairs of fluid pressure conducting passages therein, a valve mounted in said casing for rotary and/or axial movement for selectively controlling the flow of fluid through said pairs of passages, said valve when rotated without axial movement controlling the flow of fluid through one of said pairs of passages and said valve when moved axially without rotary movement controlling the flow of fluid through the other of said pairs of passages and said valve when rotated and moved axially controlling the flow of fluid through both of said pairs of passages, and actuating means for said valve, said actuating means being operative in one direction for positively rotating the valve and operative in a direction at an angle to said one direction for positively moving said valve axially.

12. A control valve device comprising a casing having at least two pairs of fluid conducting passages therein, a valve mounted in said casing for selectively controlling either one or both of said pairs, said valve having a neutral position from which it may be rotated to control the flow of fluid through one of said pairs of fluid conducting passages and having a neutral position from which it may be shifted axially to control the flow of fluid through another of said pairs of fluid conducting passages, and means connected to said valve operative for selectively and positively moving said valve to either one or both of its control positions.

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