May 24, 1949. R. K. SEDGWICK 2,471,289

PREFERENTIAL OPERATING VALVE

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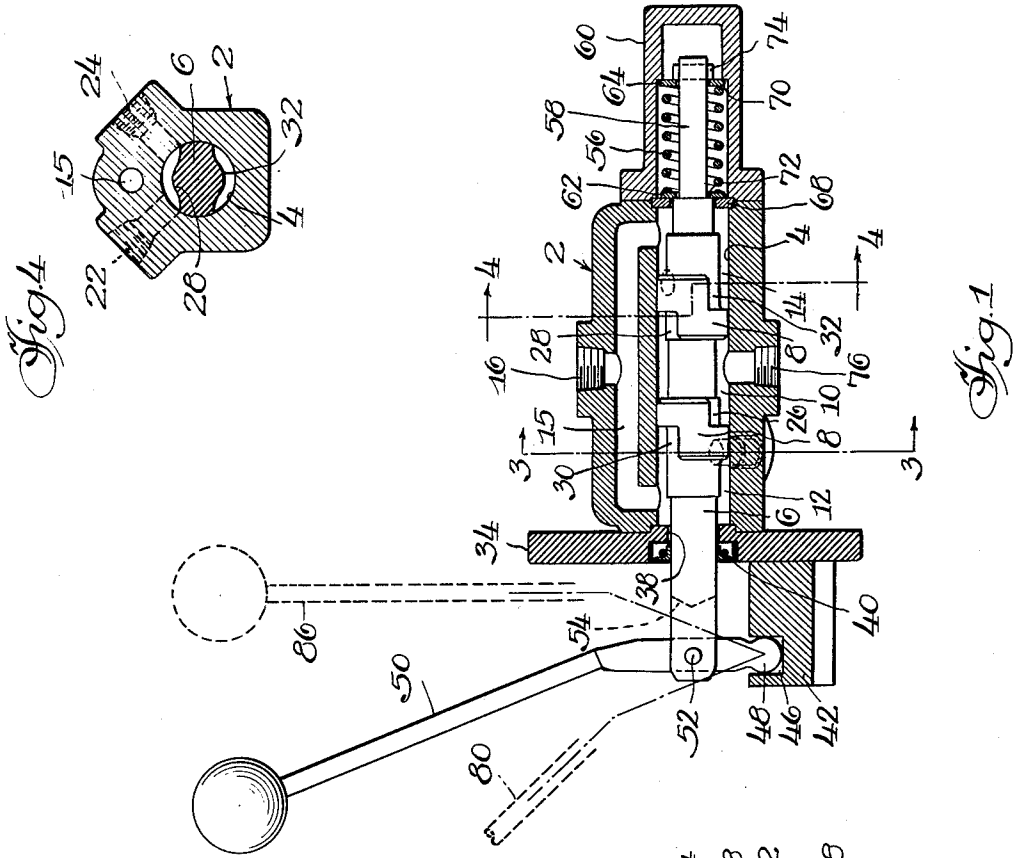


Fig. 1

Fig. 4

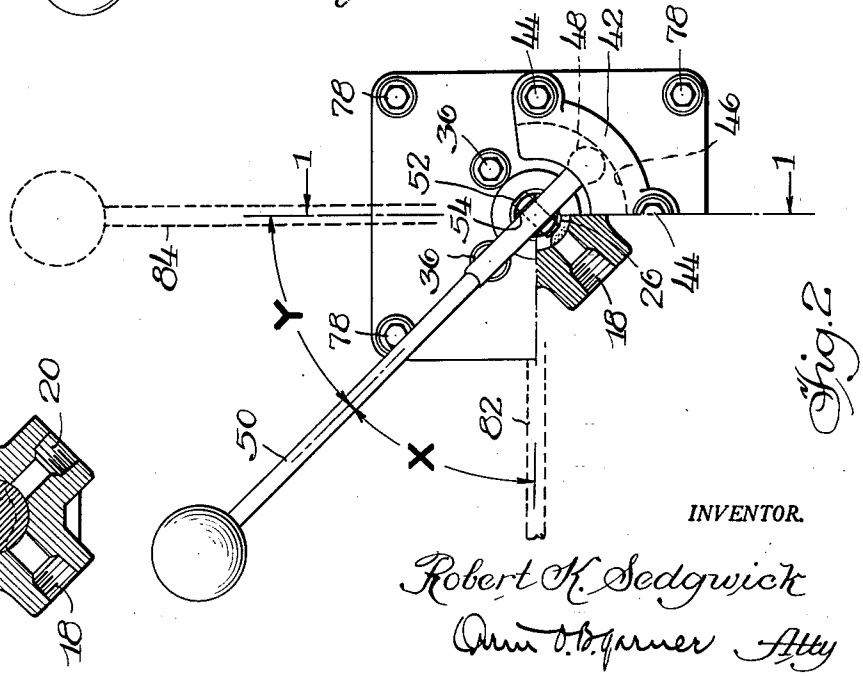


Fig. 2

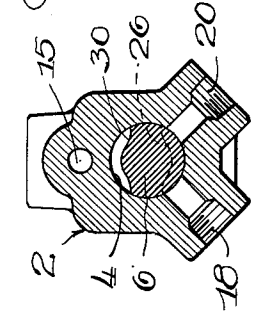


Fig. 3

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PREFERENTIAL OPERATING VALVE

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Application June 5, 1944, Serial No. 538,720

21 Claims. (Cl. 251—76)

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My invention relates to valves and more particularly to a preferential operating or distribution valve by means of which hydraulic actuating fluid is transmitted to a plurality of hydraulic devices for actuation thereof.

The general object of my invention is to design an operating valve by means of which the operator of a hydraulic machine may control two different cylinders or hydraulic motors at the same time in such manner as to operate one of the cylinders or motors faster than the other or to the exclusion of the other, or at the same speed as the other, at the option of the operator.

It is a prime characteristic of hydraulic machinery that when two cylinders are fed from the same line or "manifold," they tend to draw the same amounts of fluid from the line only when they encounter equal resistance, which is very seldom. As a consequence, the ram operable within one of the cylinders tends to creep ahead of the ram operable within the other, and this condition grows steadily worse during the stroke until at the end of the stroke, the first ram must wait for the slow one before the next part of the cycle can proceed.

Many automatic devices have been proposed to correct the conditions above described such as, for example, that shown and described in a copending application, Serial No. 412,819, filed September 29, 1941, in the United States Patent Office in the name of Relza J. Hess for "Equalizing hydraulic ram travel," issued on May 29, 1945 as Patent No. 2,377,007; however such devices are objectionable in that the corrective means are stimulated by the phenomenon corrected, for example, the unequal travel of the rams, thus leaving the final result a little short of the desired end. The object of the present invention is to design a valve in which these correcting means are in the hands of the operator.

In the drawings,

Figure 1 is a sectional view through my novel valve, taken in the longitudinal vertical plane bisecting the device substantially as indicated by the line 1—1 of Figure 2, the valve stem and operating handle being shown in elevation.

Figure 2 is a front elevation taken from the left as seen in Figure 1 with the valve being shown in section through the left front distribution port thereof and with the valve stem moved to its "out" position.

Figures 3 and 4 are sectional views taken respectively in the planes indicated by the lines 3—3 and 4—4 of Figure 1.

Describing my invention in detail, the valve

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body generally designated 2 comprises a cylindrical bore 4 within which is positioned a valve stem or spindle 6 having cylindrical portions or spools 8, 8 (Figure 1) slidably fitted within said bore and defining therewithin a central inlet chamber 10 and longitudinally spaced outlet chambers 12 and 14. The body 2 is formed with an exhaust or discharge passage 15 extending longitudinally thereof and communicating adjacent opposite extremities thereof with the discharge chambers 12 and 14. The passage 15 is provided with an exhaust or discharge port 16 which may be connected in any convenient manner to a discharge pipe or conduit.

The body 2 is formed with a pair of front distribution or cylinder ports 18 and 20 which may be connected by suitable piping to the main ram chambers of a pair of associated hydraulic devices, as will be clearly understood by those skilled in the art, and the body is also formed with a pair of rear distribution or cylinder ports 22 and 24 which may be connected by suitable piping to the pull-back chambers of said devices. The adjacent edges of the spools 8, 8 are formed on the bore engaging faces thereof with the reversely arranged or diametrically opposite inlet notches 26 and 28 and, likewise, the remote edges of the spools 8, 8 are provided with the reversely arranged or diametrically opposite outlet notches 30 and 32. By means of this arrangement the inlet and outlet notches in each spool 8 are disposed at diametrically opposite points thereon for a purpose hereinafter more fully described.

A cover plate 34 is mounted at 36, 36 (Figure 2) on the front extremity of the body 2, said plate comprising a central opening 38 (Figure 1) to accommodate the forward end of the spindle 6, said opening being provided with conventional packing means indicated at 40. A fulcrum block 42 is mounted at 44, 44 (Figure 2) on the plate 34, said block comprising an arcuate groove or slot 46 receiving the ball end 48 of the operating handle 50 which is pivotally connected at 52 to the forward end of the spindle 6 within a slot 54 therein. A spring 56 (Figure 1) is sleeved over the rear extremity 58 of the spindle 6, said spring being housed within a spring cap 60 which is integral with or secured in any convenient manner to the rear extremity of the body 2. The spring 56 is seated at opposite ends thereof against annular abutment plates or rings 62 and 64 which are seated respectively against a ring 68 recessed within the cap 60 at the forward extremity thereof and against a shoulder 70 formed within said cap. The spindle 6 comprises a shoulder 72 en-

gaging the ring 62, and a pin 74 is mounted on the rear end of the spindle in engagement with the ring 64. It will be understood that by means of the arrangement above described, the spring 56 is operable to maintain the spindle 6 in its neutral position wherein all of the distribution ports 18, 20, 22 and 24 are blocked by the spools 8, 8 from communication with the central or inlet chamber 10 which is connected by means of an inlet port 76 and suitable piping (not shown) connected thereto, with any source of pressure fluid such as, for example, a pump or an accumulator.

The plate 34 is adapted to be mounted by any suitable means, such as bolts 78, 78 (Figure 2) to any suitable support structure such as, for example, an operating panel.

With the spindle 6 in the neutral position illustrated in Figure 1, the fluid pressure is blocked within the inlet chamber 10 by means of the spools 8, 8 which are afforded a close sliding fit in the bore. The remote edges of the spools do not cover the extremities of the discharge passage 15 so that any leakage past the spools will drain off to the exhaust and will not cause creeping of the associated rams. Under these conditions, the handle 50 is disposed in the neutral position illustrated in solid lines in Figure 1; and in the front view of Figure 2, the handle is disposed at an angle of 45°, which is the angular neutral.

When the operator desires to advance both rams at once, the handle is moved to the "out" position illustrated at 80 (Figure 1) which displaces the spindle from its neutral position toward the left, as seen in this figure, and thereby establishes communication between the inlet chamber 10 and the front ports 18 and 20 through the notch 26. The lower right edge of the left spool in the "out" position of the spindle, as seen in Figure 1, assumes a position slightly to the left of the front port center line which coincides with the line 3—3 of this figure.

Under these conditions, the pressure fluid flows into both front ports 18 and 20 to the main ram chambers of the respective cylinders thereby advancing the rams. Almost immediately some discrepancy will occur between the motion of the two rams, which the operator may or may not wish to correct before the end of the stroke. The correction is made by altering the angular position of the handle 50, as indicated in the front view of Figure 2, while holding the handle "out." If, for example, the right ram were to lag behind, the operator would swing the handle in a counterclockwise direction from the position illustrated in solid lines in Figure 2 within the right preferential range X, which would reduce the flow to the left distribution port 18 without diminishing the flow through the right front distribution port 20. After the equalization of ram travel has thus been accomplished, the operator may return the handle 50 to angular neutral as illustrated in solid lines in Figure 2, or, if the disturbing force is still present, he may position the lever at some intermediate position in the right preferential range indicated at X (Figure 2), thus maintaining the desired equalization of ram travel.

Similarly, if the left ram should lag behind, this may be corrected by moving the handle 50 clockwise into the left preferential range indicated at Y in Figure 2, while holding the handle in the "out" position indicated at 80 in Figure 1.

When the rams have reached the end of their stroke, one may have overtravelled slightly in spite of the above-mentioned corrective efforts, inasmuch as sudden and unexpected extra resistances may have been encountered during the stroke which the operator was unable to correct because of their short duration and lack of predictability. Under the circumstances where the two rams connected to the valve are mounted in opposition to each other so that the result of the inequality in ram travel is to shift the work from the center of the machine, this can be corrected after completion of the ram strokes in the following manner. First, the operator decides in which direction the work should be shifted to bring it to center. He then swings the handle in that direction, thus rotating the spindle 6 without displacing it from its neutral position, (shown in Figure 1) until the handle is all the way to the horizontal or to the vertical positions indicated respectively in dotted lines at 82 and 84 (Figure 2). Then the operator moves the handle to the "out" position. It will be noted that when handle 50 is pulled from the neutral position to actuate spindle 6 horizontally to the "out" position, as indicated at 80 (Figure 1), the lower right edge of the left spool in the extremely outward position of spindle 6, as seen in Figure 1, assumes a position slightly to the left of the front port center line which coincides with line 3—3 of this figure. It is apparent that ports 18 and 20 are therefore not fully open. If the operator, after having ports 18 and 20 both open and in communication with the inlet port 76 desires, for example, to close port 18 and keep open port 20, he would then swing handle 50 to the left toward port 18, in a position between 50 and 82 (Figure 2). If the operator should want to relieve some pressure on port 18 and at the same time maintain communication of port 20 with inlet port 76, he would swing handle 50 to the extreme left position as at 82 (Figure 2) and keep handle 50 in the "out" position. At that time the spindle 6 is in a position where port 20 is in communication with port 76 through notch 26 and port 18 is in communication with discharge passage 15 through notch 30, the said port 18 being only partially open and in communication with discharge passage 15 through notch 30. If handle 50 is pulled to the "out" position and then moved to the extreme right, the spindle 6 is in a position where port 20 is in communication with discharge passage 15 through notch 30 and leaves port 18 open to port 76 through notch 26. Thus fluid is fed only to the slow ram inasmuch as the notch 26 is rotated to a point where it communicates with one only of the front distribution ports 18 and 20. At the same time, the other port is opened to communication with the discharge passage 15 by means of the discharge notch 30, thus allowing the fast ram to retract under the thrust of the slow ram until the work has been shifted to the desired position centrally of the machine. The operator then moves the handle 50 to its neutral position.

It will be understood that by moving the handle to the "in" position illustrated in dotted lines at 86 (Figure 1) the rear distribution ports 22 and 24 are opened to communication with the inlet chamber 10 by means of the inlet notch 28, thus permitting the pressure fluid to flow to the pull-back chambers associated with the rams in order to cause retraction thereof from the work, as will be clearly understood by those skilled in the art, and it will be further understood that with the handle in its "in" position, the spindle may be rotated by moving the handle to the right

preferential range X or the left preferential range Y, thus causing the rams to retract at varying speeds or causing one ram to retract to the exclusion of the other, as may be desired by the operator.

Inasmuch as the handle moves in two planes, it will be understood that it can assume an infinite number of positions in space, each of which corresponds to a combination of speed and stroke of the two rams, including zero for either ram. This is all accomplished by means of a single control handle, leaving the operator's other hand available for steadying the work or operating another control for some other function. Thus the operator may correct any inequality in ram travel either before or after the strokes are completed, as may be desired, and he can also stop one ram completely and cause one to travel alone. It will also be understood that by assembling the valve with the body backwards or upside down, or with the spindle upside down, and also by partially or totally reversing the external piping associated with the valve, any desired response may be obtained and the operation may be altered by reassembly in the field, as desired.

It is to be understood that I do not wish to be limited by the exact embodiment of the device shown which is merely by way of illustration and not limitation as various and other forms of the device will, of course, be apparent to those skilled in the art without departing from the spirit of the invention or the scope of the claims.

I claim:

1. A slide valve for distribution of liquid to a plurality of hydraulic devices, which comprises a valve casing, a cylindrical bore therein, spaced discharge ports in said casing adjacent opposite ends thereof, each communicating with said bore, an inlet port in said casing intermediate said discharge ports and communicating with said bore, a movable valve element inside said casing having two piston-like portions slidably engaging the wall of said bore, said element comprising three portions of reduced cross-sectional area forming two end and one central annular chambers inside said bore, said pistonlike portions having notches in the bore engaging surfaces thereof communicating with said central chamber, a pair of spaced distribution ports in said casing adjacent each extremity thereof and communicating with one of said end chambers, all of said distribution ports being closed against communication with said central chamber by said pistonlike portions in the neutral position of said element, actuating means for moving said element longitudinally of said bore and for rotating said element therein, said element being adapted, when displaced in either direction longitudinally of the bore from its neutral position, to open one pair of said distribution ports to communication with said central chamber through the associated notch, and said element being adapted, when rotated in either direction while in said displaced position, to decrease the opening of one of said last-mentioned ports into the associated notch, and resilient means for resisting movement of said element from its neutral position.

2. A slide valve for the distribution of liquid to a plurality of hydraulic devices, which comprises a valve casing, a cylindrical bore therein, spaced exhaust ports in said casing, each communicating with said bore, a movable valve element inside said casing having at least two pistonlike portions slidably engaging the wall of said bore, said element comprising at least three portions of reduced diameter forming within said bore one central annular chamber and at least one pair of chambers spaced longitudinally of said bore and disposed at opposite sides of said central chamber, inlet means through said casing communicating with said central chamber, said pistonlike portions having passage means in the bore engaging surfaces thereof communicating with said central chamber, a plurality of distribution ports in said casing communicating with said bore, said element being adapted in its neutral position to obstruct all of said distribution ports from communication with said central chamber, actuating means for moving said element longitudinally of said bore and for rotating said element therein, said element being adapted, when displaced from its neutral position in either direction longitudinally of the bore, to open a plurality of said distribution ports to communication with said central chamber through the associated passage means, and said element being adapted, when rotated in either direction while in said displaced position, to regulate the opening of certain of said last-mentioned ports to the associated passage means, and means for yieldingly resisting displacement of said element from its neutral position longitudinally of the bore.

3. In a preferential valve, a valve body comprising a cylindrical bore, a valve spindle with spaced spools slidably fitted within said bore and defining therewith spaced discharge chambers adjacent opposite ends of the body and an inlet chamber intermediate the ends thereof, discharge outlet means communicating with said discharge chambers, and inlet means communicating with said inlet chamber, diametrically opposite inlet notches in the adjacent edges of the bore engaging surfaces of respective spools communicating with said inlet chamber, diametrically opposite discharge notches in the remote edges of the bore engaging faces of respective spools communicating with respective discharge chambers, two pairs of distribution ports through said body adjacent respective ends thereof, all of said distribution ports being blocked from communication with said inlet chamber by said spools in the neutral position of said spindle, actuating means for dsplacing said spindle longitudinally within said passage and thereby moving the inlet notch in one of said spools into communication with one pair of said ports, said actuating means also being operable to rotate said spindle within said bore, said spindle being adapted when rotated to its extreme rotatable position in either direction, while maintained in said displaced position, to open one port of said pair to communication with the associated outlet notch while the other port of said pair remains in communication with the associated inlet notch.

4. A slide valve for distribution of liquid to a plurality of hydraulic devices which comprises a valve casing, a cylindrical bore therein, spaced discharge ports in said casing adjacent opposite ends thereof, each communicating with said bore, an inlet port in said casing intermediate said discharge ports and communicating with said bore, a movable valve element inside said casing having two pistonlike portions slidably engaging the wall of said bore, said element comprising three portions of reduced cross-sectional area forming two end and one central annular chambers inside said bore, said pistonlike portions having notches in the bore engaging surfaces thereof communicating with said central cham-

ber, a pair of spaced distribution ports in said casing adjacent each extremity thereof and communicating with said bore, all of said distribution ports being closed against communication with said central chamber by said pistonlike portions in the neutral position of said element, and actuating means for moving said element longitudinally of said bore and for rotating said element therein, said element being adapted, when displaced in either direction longitudinally of the bore from its neutral position, to open one pair of said distribution ports to communication with said central chamber through the associated notch, and said element being adapted, when rotated in either direction while in said displaced position, to decrease the opening of one of said last-mentioned ports into the associated notch.

5. In a valve, a body with a cylindrical bore, a valve spindle comprising at least two spaced cylindrical portions slidably fitted in said bore and at least three portions of reduced cross-sectional area alternately arranged with said cylindrical portions and defining at least two chambers spaced longitudinally of said bore, and a central chamber intermediate said first-mentioned chambers and spaced therefrom, discharge outlet means in said body communicating with said first-mentioned chambers, a plurality of distribution ports through said body communicating with each of said first-mentioned chambers, fluid passage means in the bore engaging surfaces of said cylindrical portions communicating with said central chamber, fluid inlet means through said body communicating with said central chamber, said spindle being so formed and arranged that in its neutral position longitudinally of the bore, all of said distribution ports are closed by said cylindrical portions, actuating means for rotating said spindle in its neutral position to align said passage means longitudinally of the bore with certain only of the distribution ports in each of said first-mentioned chambers, said actuating means also comprising means for displacing said spindle longitudinally of the bore while in said rotated position, thereby moving the passage means in certain of said cylindrical portions into communication with the aligned ports within the adjacent of said first-mentioned chambers.

6. A slide valve for the distribution of liquid to a plurality of hydraulic devices, which comprises a valve casing, a cylindrical bore therein, a movable valve element inside said casing having at least two pistonlike portions slidably engaging the wall of said bore, said element comprising at least three portions of reduced diameter forming within said bore one central chamber and at least two other chambers disposed at opposite ends of said central chamber and spaced therefrom, inlet means through said casing communicating with said central chamber, exhaust means communicating with said other chambers, said pistonlike portions having passage means in the bore engaging surfaces thereof communicating with said central chamber, a plurality of distributtion ports in said casing communicating with said bore, said element being adapted in its neutral position to obstruct all of said distribution ports from communication with said central chamber, and actuating means for moving said element longitudinally of said bore and for rotating said element therein, said element being adapted, when displaced from its neutral position in either direction longitudinally of the bore, to open a plurality of said distribution ports

to communication with said central chamber through the associated passage means, and said element being adapted when rotated in either direction while in said displaced position, to regulate the opening of certain of said last-mentioned ports to the associated passage means.

7. In a preferential valve, a valve body comprising a cylindrical chamber with spaced outlets adjacent opposite ends thereof and a central inlet, a valve spindle with spaced cylindrical portions intermediate its ends slidably fitted in said chamber at opposite sides of said inlet, said portions being respectively formed on their adjacent edges with reversely arranged inlet notches and on their remote edges with reversely arranged discharge notches, the notches in each portion being reversely arranged with respect to each other, a pair of spaced distribution ports in said body adjacent each end thereof, each pair of said ports being adapted to be opened to communication with said inlet by the inlet notch in the adjacent portion and to be selectively opened to communication with the adjacent outlet by the discharge notch in the adjacent portion, and actuating means for said spindle for displacing the same longitudinally within said chamber, whereby one pair of said ports is opened to communication with said inlet through the associated inlet notch, said actuating means including means for rotating said spindle in its displaced position and thereby selectively opening one port only of the last-mentioned pair to communication with the adjacent outlet through the associated outlet notch, while the other port of said last-mentioned pair remains in communication with said inlet through the associated inlet notch.

8. A slide valve for distribution of liquid to a plurality of hydraulic devices which comprises a valve casing, a cylindrical bore therein, a movable valve element inside said casing having two spools slidably engaging the wall of said bore, said element comprising three portions of reduced cross-sectional area forming one central annular inlet chamber within said bore and two spaced annular outlet chambers, inlet means communicating with said inlet chamber, outlet means communicating with said outlet chambers, said spools having notches in the bore engaging surfaces thereof communicating with said inlet chamber, a pair of spaced distribution ports in said casing communicating with each outlet chamber, all of said distribution ports being closed against communication with said inlet chamber by said spools in the neutral position of said element, actuating means for moving said element longitudinally of said bore and for rotating said element therein, said element being adapted, when displaced from its neutral position in either direction longitudinally of the bore, to open one pair of said distribution ports to communication with said inlet chamber through the associated notch, and said element being adapted when rotated to its extreme position in either direction, while in said displaced position, to move said associated notch out of communication with one of said last-mentioned ports.

9. In a valve, a valve body having a cylindrical bore therewithin, a spindle having a pistonlike portion slidably fitted within said bore and defining an inlet and an outlet chamber therewithin at opposite sides of said portion, inlet means communicating with said inlet chamber, outlet means communicating with said outlet chamber, a pair of spaced distribution ports in said body communicating with said outlet chamber, said ports

being blocked from said inlet chamber by said portion in the neutral position of said spindle, a notch in the bore engaging face of said portion communicating with said inlet chamber, and actuating means for said spindle comprising means for displacing the latter from its neutral position longitudinally of said bore and thereby registering said notch with said ports, said actuating means comprising means for rotating said spindle clockwise or counterclockwise within said bore and thereby selectively decreasing the cross-sectional area of either port registering with said notch in the displaced position of said spindle, and another notch in the bore engaging face of said portion adapted to open one of said ports to communication with said outlet means when said spindle is in the extreme rotated position while the other of said ports remains in communication with said first-mentioned notch.

10. In a preferential valve, a valve body comprising a cylindrical bore, a valve spindle with spaced cylindrical portions slidably fitted within said bore and defining therewith spaced discharge chambers at opposite ends of the body and an inlet chamber intermediate its ends, discharge outlets communicating with respective discharge chambers, and an inlet communicating with said inlet chamber, diametrically opposite inlet notches in the adjacent edges of respective cylindrical portions and communicating with said inlet chamber, diametrically opposite discharge notches in the remote edges of respective portions communicating with respective discharge chambers, two pairs of distribution ports through said body adjacent respective ends thereof communicating with respective discharge chambers in the neutral position of said spindle, and actuating means for moving said spindle longitudinally in said passage and thereby moving the inlet notch in one of said portions into communication with one pair of said ports, said actuating means also being operable to rotate said spindle, thereby selectively decreasing the opening of one port of said pair into the associated inlet notch.

11. In a valve, a valve body having a cylindrical bore therewithin, a spindle having a cylindrical portion slidably fitted within said bore and defining an inlet and an outlet chamber therewithin at opposite sides of said portion, inlet means communicating with said inlet chamber, outlet means communicating with said outlet chamber, a pair of distribution ports communicating with said outlet chamber, said ports being blocked from said inlet chamber by said portion in the neutral position of said spindle, a notch in the bore engaging face of said portion communicating with said inlet chamber, and actuating means for said spindle comprising means for displacing the latter from its neutral position longitudinally of said bore and thereby registering said notch with said ports, said actuating means comprising means for rotating said spindle, while in its displaced position, clockwise or counterclockwise within said bore and thereby moving an edge of said notch across one of said ports to decrease the cross-sectional area thereof registering with said notch.

12. In a valve, a body with a cylindrical bore, a valve stem with a spool slidably fitted in said bore, inlet and discharge chambers in said bore at opposite sides of said spool, a plurality of distribution ports through said body communicating with said discharge chamber, an opening in the bore engaging face of said spool communicating with said inlet chamber, said opening extending for a limited portion only around the circumference of said face, and actuating means for said stem comprising means for displacing said spool longitudinally of said bore and thereby moving said opening into communication with said ports, said actuating means including means for rotating said portion while in said displaced position to regulate the flow through respective of said ports.

13. In a valve, a body with a cylindrical bore, a valve stem with a cylindrical portion slidably fitted within said bore, inlet and discharge chambers in said bore at opposite sides of said portion, a plurality of distribution ports through said bore communicating with said discharge chamber, passage means in the bore engaging surface of said portion communicating with said inlet chamber, and actuating means for said stem comprising means for rotating said portion and thereby aligning said passage means longitudinally of the bore with certain only of said ports, said actuating means including means for moving said portion longitudinally of the bore and thereby moving said passage means into communication with the last-mentioned of said ports.

14. In a valve spindle, an elongated member comprising a pair of spaced cylindrical spools, diametrically opposite notches in the adjacent sides of said spools interrupting the cylindrical perimeters thereof, and diametrically opposite notches in the remote sides of said spools interrupting the cylindrical perimeters thereof, each of said notches extending for a limited portion only around the perimeter of the associated spool, the notches in each spool being diametrically opposite each other.

15. In a valve spindle, an elongated member comprising a pair of spaced cylindrical spools, diametrically opposite notches in the adjacent sides of said spools interrupting the cylindrical perimeters thereof, and diametrically opposite notches in the remote sides of said spools interrupting the cylindrical perimeters thereof, each of said notches extending for a limited portion only around the perimeter of the associated spool.

16. In a valve, a body with an internal cylindrical passage, a spool in said passage defining inlet and outlet chambers therein at opposite ends of said spool, a plurality of distribution ports communicating with said outlet chamber, said ports being blocked from communication with said inlet chamber by said spool in the neutral position thereof, fluid passage means in said spool, said passage means being so formed and arranged that opposite ends thereof terminate respectively in said inlet chamber and at the cylindrical perimeter of said spool intermediate the ends thereof, said spool being of substantially uniform diameter from end to end thereof except for said passage means, and actuating means for rotating said spool thereby aligning said passage means with certain only of said ports, said actuating means being operable to shift said spool longitudinally of the bore while said spool is in its rotated position.

17. In a valve, a body with a cylindrical bore, a spool slidably fitted in said bore and defining inlet and outlet chambers at opposite ends of said spool, the engagement between said spool and said bore being substantially fluid-tight whereby said spool in its neutral position blocks said chambers from communication with each other, a notch in the bore engaging surface of said spool communicating with said inlet chamber, a plurality of distribution ports in said body

communicating with said outlet chamber, and actuating means for reciprocating said spool in said bore and for rotating said spool therein whereby said notch may be selectively registered with respective ports, said spool being of substantially uniform diameter from end to end thereof except for said notch.

18. In a valve spindle, an elongated member comprising at least two spaced cylindrical spools, and a pair of diametrically opposite notches in respective ends of each spool interrupting the cylindrical perimeter thereof, each of said notches extending for a limited portion only around the perimeter of the associated spool.

19. In a valve, a valve body with a cylindrical bore, a stem with a cylindrical portion having a slidable substantially fluid-tight fit in said bore and defining therewithin equidiameter inlet and outlet chambers spaced by said portion, a plurality of circumferentially aligned distribution ports in said outlet chamber, passage means in the bore-engaging face of said portion communicating with said inlet chamber, the engagement between said portion and said bore being adapted to prevent flow of fluid between said inlet chamber and said ports when said stem is in its neutral position, and resilient means disposed at one end of said stem for automatically self-aligning said stem in the neutral position, and actuating means for displacing said stem from its neutral position longitudinally of the bore and for rotating said stem therewithin.

20. In a valve spindle, an elongate member comprising a pair of spaced cylindrical spools, semiannular notches in the adjacent sides of respective spools interrupting the cylindrical perimeters thereof, and notches in the remote sides of respective spools interrupting said perimeters.

21. In a valve, a body with a cylindrical bore,

a cylindrical spool slidably fitted within said bore and defining inlet and outlet chambers therein, inlet and outlet notches in the cylindrical perimeter of said spool communicating with respective chambers, inlet and outlet passage means through said body communicating with respective chambers, a plurality of distribution ports through said body communicating with said outlet chamber, said ports being blocked from communication with said inlet chamber by said spool in the neutral position thereof, and actuating means operatively associated with said spool for shifting the latter longitudinally of the bore to a position across said ports and for rotating said spool within said bore to any of certain predetermined positions in said bore, said outlet notch being formed and arranged to register with certain of ports and said inlet notch being arranged to simultaneously register with the other of said ports when said spool is in any one of said certain predetermined positions and in position across said ports.

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