Dec. 15, 1931. J. D. NIXON 1,836,184

BALANCED VALVE MECHANISM

Filed Oct. 26, 1926 3 Sheets-Sheet 1

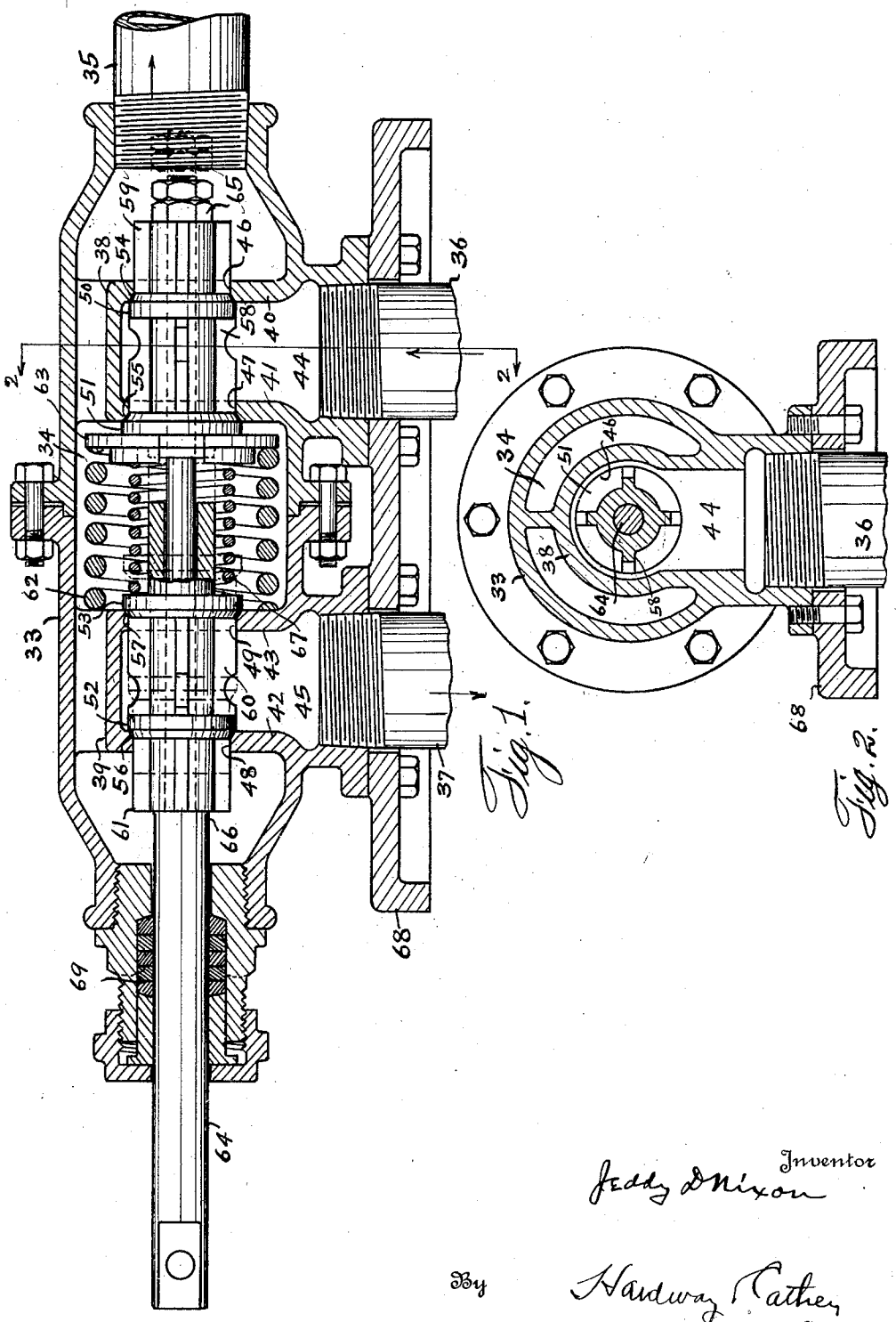


Fig. 1.

Fig. 2.

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BALANCED VALVE MECHANISM

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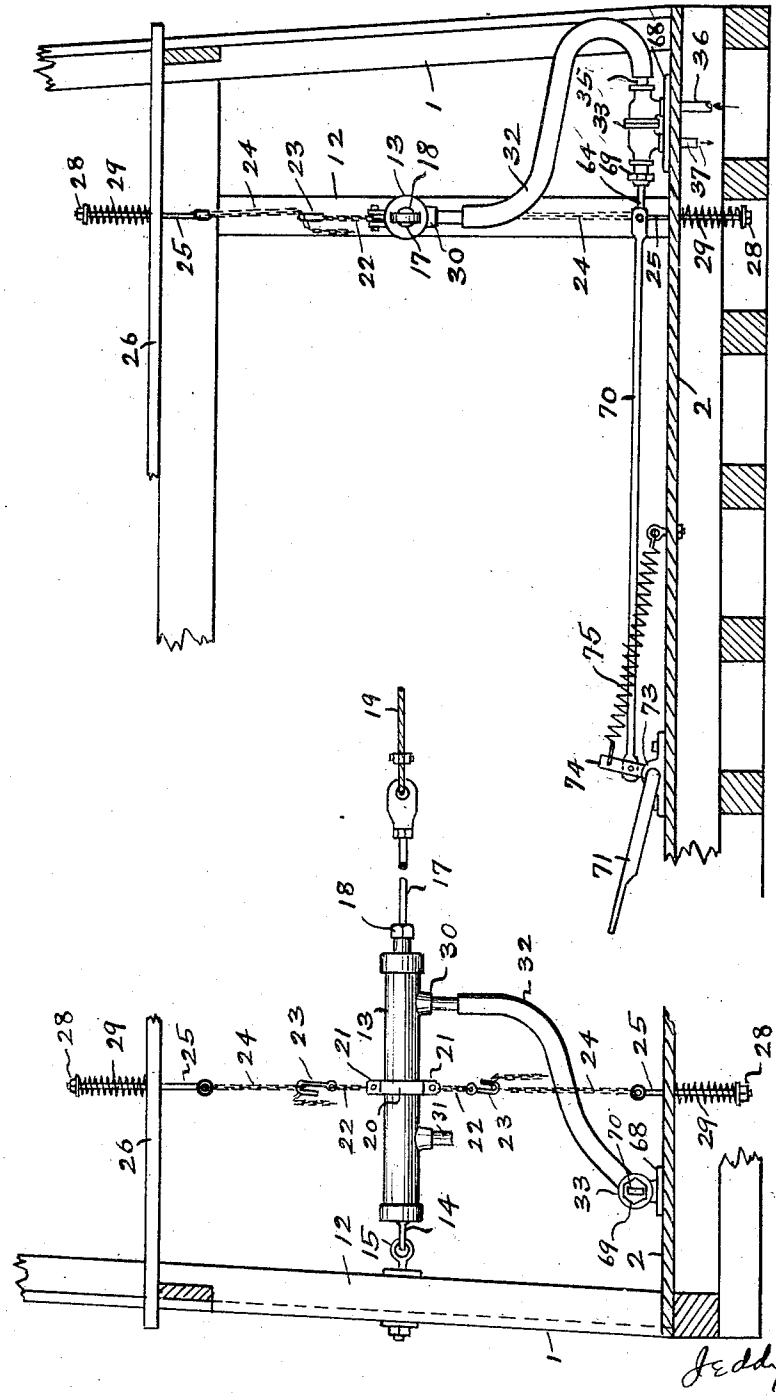


Fig. 3.

Fig. 4.

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BALANCED VALVE MECHANISM

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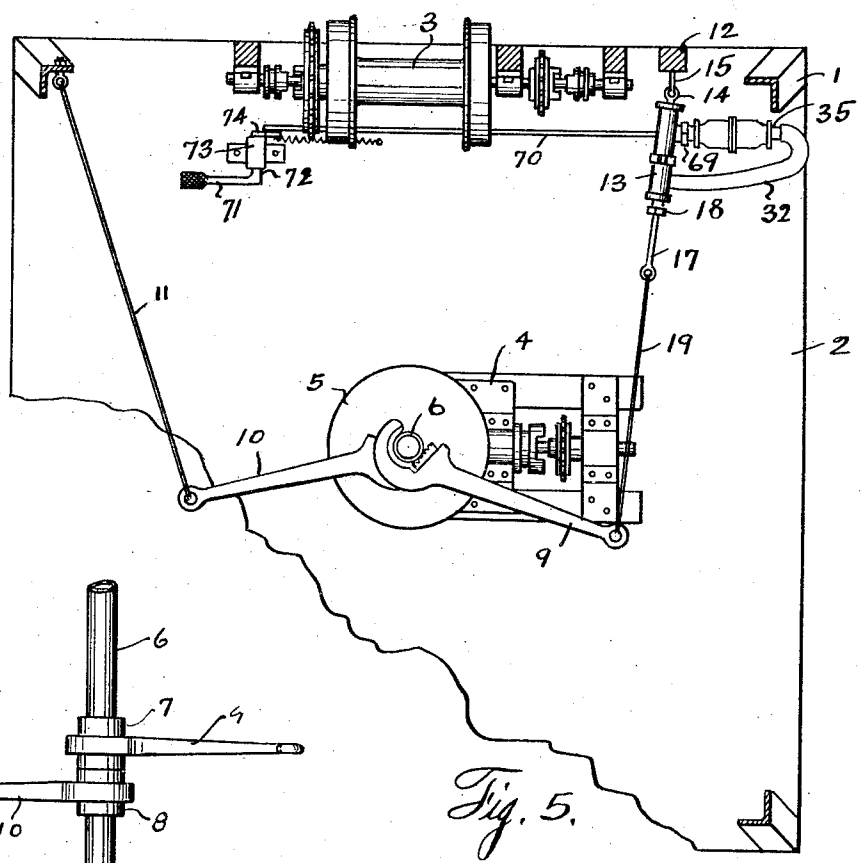


Fig. 5.

Fig. 6.

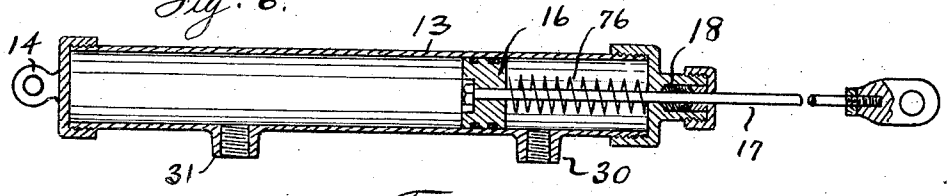


Fig. 7.

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UNITED STATES PATENT OFFICE

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BALANCED VALVE MECHANISM

Application filed October 26, 1926. Serial No. 144,215.

This invention relates to new and useful improvements in a balanced valve mechanism.

One object of the invention is to provide a mechanism of the character described specially designed for the purpose of controlling the application of steam, or other pressure fluid, to a joint breaking apparatus used for unscrewing drill pipe joints and for screwing said joints together in breaking out and making up a drill stem, or other pipe in the well bore.

Another object of the invention is to provide a valve mechanism of the character described capable of general use in controlling the application of fluid under pressure to the work to be accomplished and in relieving said fluid pressure.

With the above and other objects in view the invention has particular relation to certain novel features of construction, operation and arrangement of parts, an example of which is given in this specification and illustrated in the accompanying drawings, wherein:—

Figure 1 shows a longitudinal sectional view of the valve mechanism.

Figure 2 shows a cross sectional view taken on the line 2—2 of Figure 1.

Figure 3 shows a fragmentary vertical sectional view of the derrick showing the gun mounted therein and the valve mechanism in operative connection with said gun.

Figure 4 shows a fragmentary vertical sectional view of the derrick with the breaking gun and valve mechanism mounted therein, taken at right angles to the view shown in Figure 3.

Figure 5 shows a fragmentary horizontal sectional view of the derrick showing the rotary drilling machine mounted therein with the breaking gun and valve mechanism assembled and in operative connection with the drill pipe.

Figure 6 shows a fragmentary side elevation of the drill pipe with the tongs applied thereto, and

Figure 7 shows a longitudinal, sectional view of the breaking gun employed.

Referring now more particularly to the drawings, wherein like numerals of reference designate similar parts in each of the figures the numeral 1 designates the derrick having the floor 2. This floor supports the conventional draw works, designated generally by the numeral 3 and by means of which the pipe, to be made up and broken up, is handled and the numeral 4 designates the conventional rotary drilling machine which is mounted on the floor 2 and which embodies a rotary table 5 having a central opening to receive the pipe 6. This pipe is made up of sections connected in the usual way by tool joints, or similar couplings, each tool joint embodying an upper or male member 7, and a lower, or female member 8. In screwing together and unscrewing these joints a gripping means, usually consisting of tongs 9 and 10 are applied to the male and female members 7 and 8, respectively and the tong 10 held stationary by any suitable means, as by a wire cable, or line 11, which is attached, at one end to the handle of the tong 10 and at its other end to a leg of the derrick, or to some other stationary anchor. A jack post 12 is erected in the derrick and the breaking gun, including the cylinder 13, is attached thereto by means of the eye 14, attached to one end of the cylinder 13 and which is connected through an eye bolt 15, which in turn is connected to said jack post. The gun embodies also a piston 16, which works in the cylinder 13, and which is connected to the inner end of the piston rod 17, which works through a stuffing box 18, at the other end of the cylinder. A cable, or wire line, 19 has one end connected to the outer end of the rod 17 and its other end connected to the free end of the tong 9. This breaking gun is swingingly mounted in the derrick. This mounting is accomplished by means of the clamp collar 20, which is clamped around the cylinder 13 and which has the upper and lower ears 21, 21, to which the upper and lower chains 22, 22, are connected, said chains having the end hooks 23, 23, adapted, to be engaged in the links of the upper and lower supporting chains 24, 24. These chains 24, are connected to the upper and lower guide-rods 25, 25, which work through aligned

bearings in the derrick timber 26 and the derrick floor 2 respectively and which carry the upper and lower end nuts 28, 28. Surrounding the rods 25 are the upper and lower coil springs 29, 29, the upper spring being mounted on the derrick timber 26 and interposed between it and the corresponding nut 28, and the lower spring 29 being interposed between the lower nut 28 and the bottom of the derrick floor. The gun is thus sustained in approximately horizontal position but is permitted to vary in its position. This variation is necessary, for the reason that the joint to be broken varies in its elevation above the derrick floor and it is desirable that the gun assumes a straight line position relative to the cable 19, when a pull is exerted on the tong 9, as hereinafter explained.

The cylinder 13 has a pressure fluid inlet line 30 and a relief port 31. Connected into the inlet port there is an inlet line 32, which is flexible to permit the freedom of movement of the gun hereinabove referred to.

There is a balanced valve mechanism specially designed for the purpose of controlling the application of pressure fluid to, and relieving the same from, said gun which will now be described:

This mechanism embodies a valve casing 33, preferably formed of two sections, as shown, which are bolted together along a central transverse plane for convenience in construction and assembly. This valve casing has an inside pressure fluid chamber 34 and the line 32 is connected into the outlet from this chamber by means of the outlet nipple 35. A pressure fluid supply line 36 is connected into the chamber 34 and leading from said chamber there is an exhaust line 37. In the valve casing there are the web-like partitions 38 and 39 whose side walls are preferably of a general arcuate contour and whose end walls 40, 41 and 42, 43, respectively are disposed transversely with respect to the axial line of the casing 33 and are substantially parallel and spaced apart thus forming inlet and exhaust chambers 44 and 45 within, but separated from the chamber 34. The end walls 40, 41, have the inlet openings 46 and 47 respectively and the end walls 42, 43, have the discharge openings 48 and 49 respectively, said inlet and discharge openings being arranged in alignment and these openings are controlled by the inlet valves 50, 51, and the discharge valves 52, 53, respectively, which cooperate with the valve seats 54, 55, and 56, 57, into which said respective inlet and discharge openings are formed. The valves 50, 51, are connected and maintained in fixed relation by means of a spider 58 which forms a guide through the opening 47 and the valve 50 has also a guide 59 which works through the opening 46. The valves 52, 53, are also connected by the spider 60 forming also a guide which works through the opening 49 and formed integrally with the valve 52 there is a guide 61 which works through the opening 48. The pressure fluid delivered through the line 36 into the chamber 44 exerts a constant pressure against the valves 50, 51, but in opposite directions and inasmuch as the area of the valve 51 is somewhat greater than the area of the valve 50 the pressure normally tends to open said valves, but the valves are held closed by the strong coil spring 62, located within the chamber 34 and interposed between the end wall 43 and an annular flange 63 carried by the valve 51. This spring 62 is strong enough to overcome the pressure against the valve 51 and to normally hold said valve 50 and 51 in closed position. A valve rod 64 is fitted axially through said valves but the valves are loosely mounted thereon. The inner end of this rod has a nut 65 threaded thereon, which abuts the outer end of the guide 59 and that portion of the rod 64 which works through said valves is reduced forming an annular shoulder 66 which normally abuts the free end of the guide 61. Within the coil spring 62 there is another light coil spring 67 which surrounds the rod 64 and is interposed between the valves 51 and 53. The valve mechanism is mounted on and anchored to a suitable base plate 68 which in turn is anchored to the derrick floor 2. The outer end of the valve rod 64 works through a suitable stuffing box 69, carried by the corresponding end of the valve casing 33 and is pivotally connected to the adjacent end of the reach rod 70. There is a foot pedal 71 fixed to one end of the short shaft 72 which works in a bearing 73 anchored to the derrick floor and the other end of this shaft has an upstanding arm 74, to which the other end of the reach rod 70 is pivoted and a coil pull spring 75 is connected at one end to the upper end of the arm 74 and is connected at its other end to the derrick floor and is disposed to operate through the reach rod 70 and the valve rod 64 in opposition to the spring 67 and being somewhat stronger than said spring 67 normally holds the discharge valves 52, 53, in open position. When it is desired to operate the gun the foot pedal 71 is depressed thereby exerting a pull through the reach rod 70 and the valve rod 64 and thus opening the inlet valves 50, 51, and permitting the pressure fluid to enter the chamber 34. The spring 67 being now relieved will close the discharge valves 52, 53, and they will be now held securely closed by said spring 67 and the steam pressure in the chamber 34. The pressure fluid will now pass through the inlet line 32 into the cylinder 13 and actuate the plunger 16, thereby exerting a pull through the plunger rod 17 and the cable 19, on the tong 9, thus operating to suitably turn the tool joint member 7 and the string of pipe beneath will be held against turning by the tong 10.

When the plunger clears the relief port 31 the pressure will be relieved in the cylinder and an air cushion will be formed between said plunger and the cylinder head thus protecting said head as well as, partly at least, returning the plunger to original position. In order to prevent the plunger from being returned suddenly against the other end of the head of the cylinder a coil spring 76 is disposed around the plunger rod 17 and interposed between the plunger and said end of the cylinder.

When the pedal 71 has been depressed it should then be immediately released and the spring 62 will thereupon close the inlet valves and spring 75 will open the discharge valves so that upon the return of the plunger 16 the pressure fluid in the cylinder will be returned back through line 32 into the chamber 34 and then out through the openings 48, 49, and the discharge line 37. By the use of the valve herein described the line 32 may be employed, both as an inlet line and as a discharge line, and in the event the plunger 16 should not travel far enough to clear the relief port 31, the foot pedal 71 being immediately released after its operation the pressure fluid will nevertheless be relieved through the line 32, as above explained.

When the pull is exerted on the tong 9 it is then swung back to its original position, thus pulling the plunger to starting position and the tong is again engaged with the tool joint member 7 and the operation repeated until the joint is screwed up or unscrewed.

As hereinbefore stated the valves 50, 51, when closed, are subjected to the pressure of the pressure fluid in opposite directions, but are normally held closed by the spring 62, which is strong enough to just overcome the excess of the pressure against the valve 51 over the pressure exerted in the opposite direction against the valve 50 so that only slight pressure on the pedal 71 is required to open said valves. When the valves 52, 53, are closed the pressure in the chamber 34 is exerted against them in opposite directions the pressure against the valve 53 tending to hold said valves closed and the pressure against the valve 52 tending to open said valves and the area of the valve 53 being somewhat greater than the area of the valve 52 said valves will normally be held closed, when there is pressure in the chamber 34, by said pressure. When the foot pedal 71 is released the shoulder 66 will strike against the outer end of the guide 61 with sufficient force to overcome said pressure and open said valves thus immediately relieving the pressure in the chamber 34 and reducing the pressure against the valve 53 so that the spring 75 will then fully open said discharge valves, placing the spring 67 under pressure, and will thereafter hold the discharge valves open in the position indicated in dotted lines in Figure 1, until the inlet valves are again opened.

What I claim is:

1. A valve mechanism including a valve casing having a pressure fluid chamber therein, with an outlet leading from said chamber, partitions within said casing forming independent inlet and discharge chambers within the casing, the walls of said inlet and discharge chambers having oppositely disposed inlet and discharge openings formed with valve seats, a pair of inlet valves and a pair of discharge valves controlling the inlet and discharge openings respectively, one valve of each pair being of larger area than the other valve of said pair, the valves of each pair being anchored in fixed relation, the larger valves of said pairs being located in the pressure fluid chamber, and the other valves of said pairs being located in the inlet and discharge chambers respectively.

2. A valve mechanism including a valve casing having a pressure fluid chamber therein with an outlet leading from said chamber, partitions within said casing forming independent inlet and discharge chambers within the casing, the walls of said inlet and discharge chambers having oppositely disposed inlet and discharge openings formed with valve seats, a pair of inlet valves and a pair of discharge valves controlling the inlet and discharge openings respectively, one valve of each pair being of larger area than the other valve of said pair, the valves of each pair being anchored in fixed relation, the larger valves of said pairs being located in the pressure fluid chamber, and the other valves of said pairs being located in the inlet and discharge chambers, respectively, and a yieldable member normally holding the inlet valves closed.

3. A valve mechanism including a valve casing having a pressure fluid chamber therein, with an outlet leading from said chamber, partitions within said casing forming independent inlet and discharge chambers within the casing, the walls of said inlet and discharge chambers having oppositely disposed inlet and discharge openings formed with valve seats, a pair of inlet valves and a pair of discharge valves controlling the inlet and discharge openings respectively, one valve of each pair being of larger area than the other valve of said pair, the valves of each pair being anchored in fixed relation, the larger valves of said pairs being located in the pressure fluid chamber and the other valves of said pairs being located in the inlet and discharge chambers, respectively, and yieldable members normally tending to hold said valves closed.

4. A valve mechanism including a valve casing having a pressure fluid chamber therein, with an outlet leading from said chamber,

partitions within said casing forming independent inlet and discharge chambers within the casing, the walls of said inlet and discharge chambers having oppositely disposed inlet and discharge openings formed with valve seats, a pair of inlet valves and a pair of discharge valves controlling the inlet and discharge openings respectively, one valve of each pair being of larger area than the other valve of said pair, the valves of each pair being anchored in fixed relation, the larger valves of said pairs being located in the pressure fluid chamber and the other valves of said pairs being located in the inlet and discharge chambers, respectively, a yieldable member normally holding the inlet valves closed, manually operable means through which the inlet valves may be actuated into open position and a yieldable member acting through said manually operable means and effective to normally maintain said discharge valves in open position.

5. A valve mechanism including a valve casing having a pressure fluid chamber therein with a pressure line leading therefrom, partitions within said casing forming independent inlet and discharge chambers therein, the walls of said inlet and discharge chambers having inlet and discharge openings respectively formed with valve seats, a pair of inlet valves controlling said inlet openings, a pair of discharge valves controlling said discharge openings, said valves of each pair being fixed relative to each other, a supply line entering said inlet chamber, said discharge chamber being provided with an outlet, a valve actuating rod slidably mounted in the casing and on which the valves are slidably mounted, said rod being effective to open the inlet valves when actuated in one direction and to open the discharge valves when actuated in the other direction.

6. A valve mechanism including a valve casing having a pressure fluid chamber therein with a pressure line leading therefrom, partitions within said casing forming independent inlet and discharge chambers therein, the walls of said inlet and discharge chambers having inlet and discharge openings, respectively, formed with valve seats, a pair of inlet valves controlling said inlet openings, a pair of discharge valves controlling said discharge openings, said valves of each pair being fixed relative to each other, a supply line entering said inlet chamber, said discharge chamber being provided with an outlet, a valve actuating rod slidably mounted in the casing and on which the valves are slidably mounted, said rod being effective to open the inlet valves when actuated in one direction and to open the discharge valves when actuated in the other direction and means effective to close one pair of valves when the other pair is opened.

7. A valve mechanism including a casing having a pressure fluid chamber therein and having a pressure fluid supply line, a pressure fluid delivery line and an exhaust port, all connected into said chamber, a pair of valve seats for the admission of pressure fluid from the supply line into said chamber, inlet valves controlling the admission of pressure fluid from the supply line through said seats, into said chamber, a discharge valve controlling the flow of said fluid from said chamber, said inlet and discharge valves being simultaneously exposed to the pressure fluid in said chamber and being so disposed that the pressure of said fluid will at all times tend to hold them closed.

8. A valve mechanism including a valve casing having a pressure fluid chamber therein with a pressure line leading therefrom, partitions within said casing forming independent inlet and discharge chambers therein, the walls of said inlet and discharge chambers having inlet and discharge openings respectively formed with valve seats, a pair of inlet valves controlling said inlet openings, a pair of discharge valves controlling said discharge openings, one valve of one pair having a greater area exposed to pressure of the fluid in said pressure fluid chamber than that of the other valve of said pair whereby said pressure at all times will tend to hold said pairs of valves in closed position, said valves of each pair being fixed relative to each other, a supply line entering said inlet chamber, said discharge chamber being provided with an outlet.

9. A valve mechanism including a valve casing having a pressure fluid chamber therein with an outlet leading from said chamber, said casing being formed to provide an independent inlet chamber and an independent discharge chamber within the casing, said inlet and discharge chambers having inlet and discharge openings, respectively formed with valve seats, a pair of inlet valves and a pair of discharge valves controlling the inlet and discharge openings, respectively, one valve of each pair having a larger area exposed to fluid pressure than the other valve of said pair, whereby said pressure will at all times tend to hold said valves closed, the valves of each pair being simultaneously movable, the said valve of larger area of each pair of valves being exposed to the pressure of the fluid in said pressure fluid chamber and said valve of smaller area of each pair of valves being exposed to the pressure of fluid in said corresponding inlet and discharge chambers respectively.

10. A valve mechanism including a valve casing having a pressure fluid chamber therein with an outlet leading from said chamber, said casing being formed to provide an independent inlet chamber and an independent discharge chamber within the casing, said inlet and discharge chambers having inlet

and discharge openings, respectively formed with valve seats, a pair of inlet valves and a pair of discharge valves controlling the inlet and discharge openings, respectively, one valve of each pair having a larger area exposed to fluid pressure than the other valve of said pair, the valves of each pair being simultaneously movable, the said valve of larger area of each pair of valves being exposed to the pressure of the fluid in said pressure fluid chamber and said valve of smaller area of each pair of valves being exposed to the pressure of fluid in said corresponding inlet and discharge chambers respectively, a yieldable member acting against one of said valves of larger area and normally tending to hold the valves of the corresponding pair closed, and a yieldable member interposed between said pairs of valves and normally tending to hold the valves of each pair closed.

In testimony whereof I have signed my name to this specification.

JEDDY D. NIXON.