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2,579,116

PLURAL PRESSURE HYDRAULIC FEED SYSTEM

Filed April 14, 1947

4 Sheets-Sheet 1

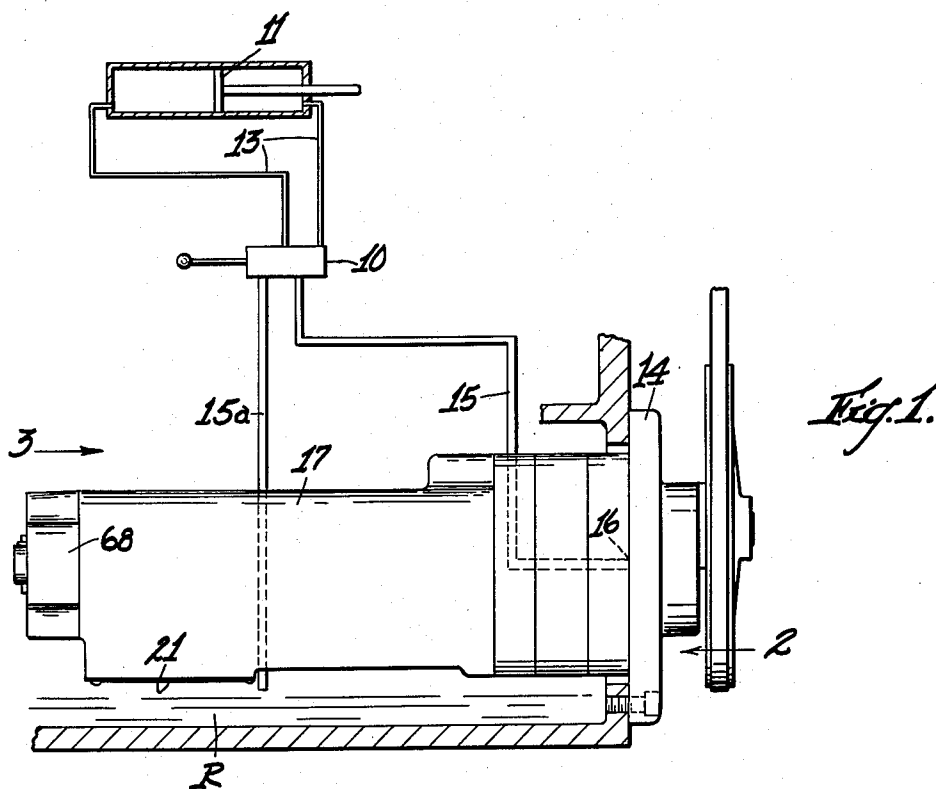


Fig. 1.

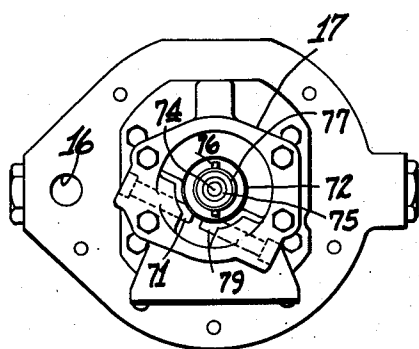


Fig. 3.

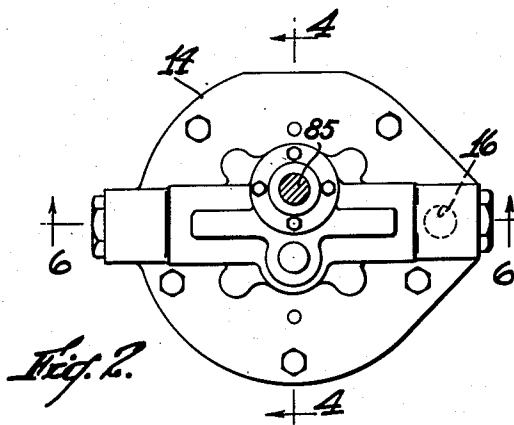


Fig. 2.

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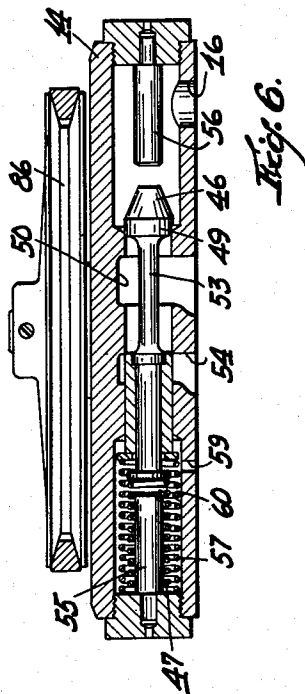
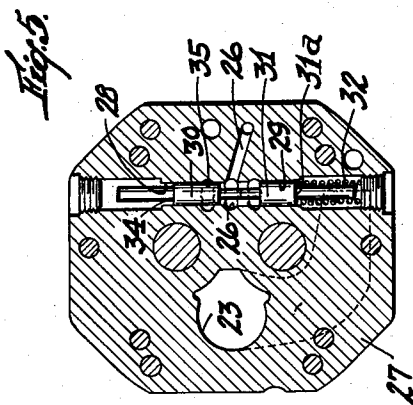
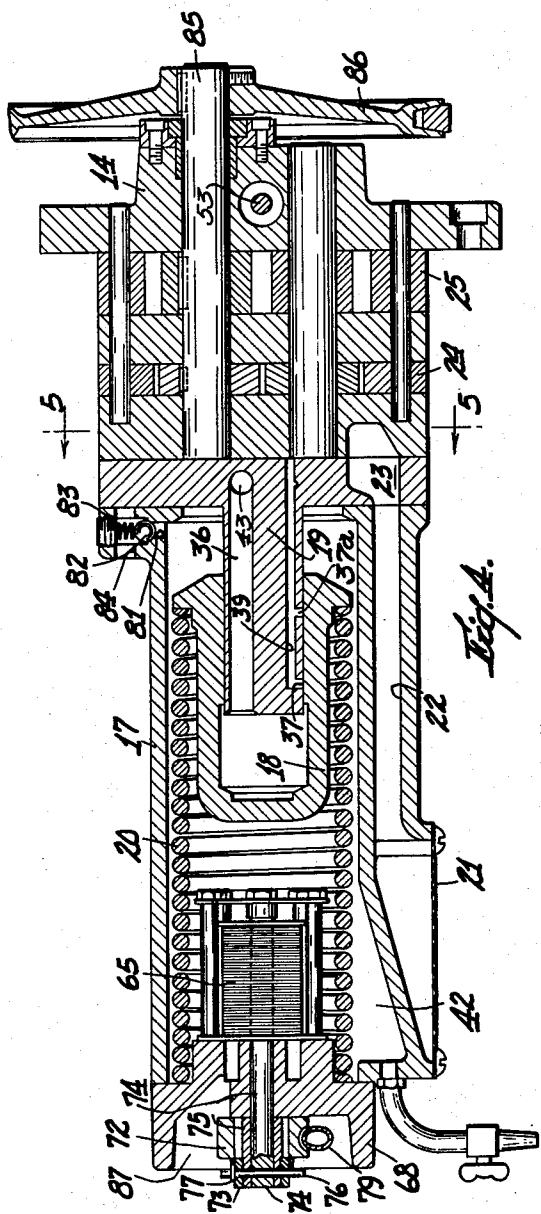
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4 Sheets-Sheet 2



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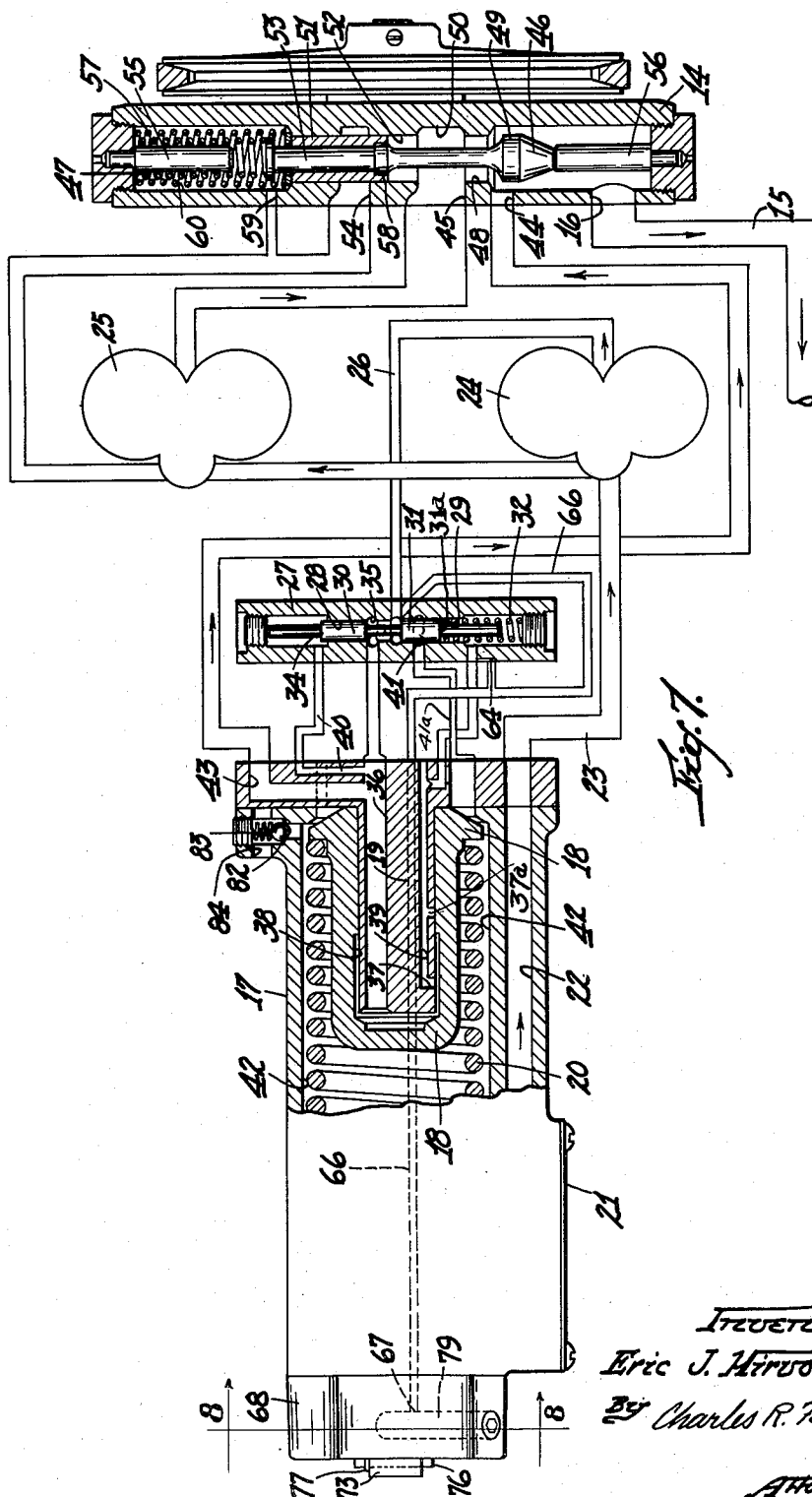
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PLURAL PRESSURE HYDRAULIC FEED SYSTEM

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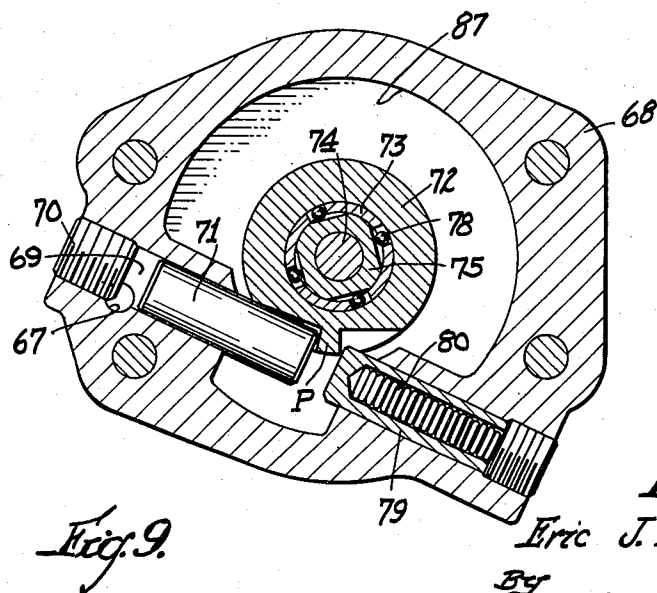
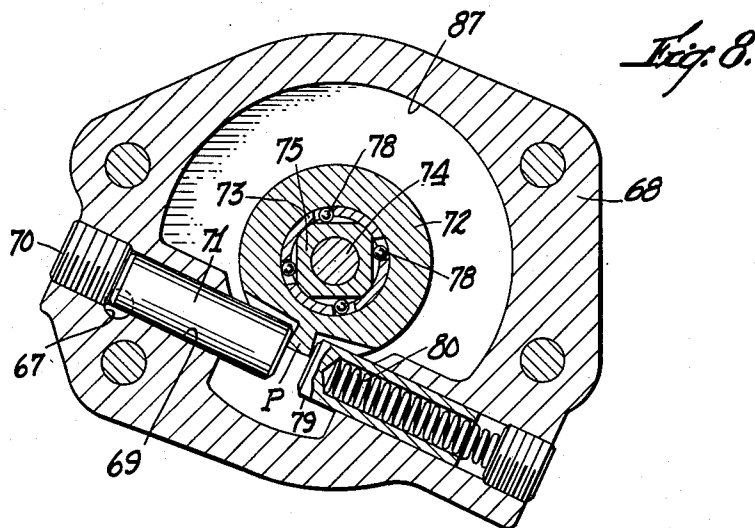
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PLURAL PRESSURE HYDRAULIC FEED SYSTEM

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4 Sheets-Sheet 4



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## UNITED STATES PATENT OFFICE

2,579,116

## PLURAL PRESSURE HYDRAULIC FEED SYSTEM

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12 Claims. (Cl. 60—51)

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This invention relates to improvements in a hydraulic pump and feed device.

The principal object of the invention is to provide an improved constant feed hydraulic pump particularly adapted for operation in conjunction with a hydraulic feed control mechanism providing for a rapid traverse of a hydraulic piston which may be used, for example, to operate a drill head or other device, and including a slow feed for the same piston. Another object of the invention is to provide a high pressure to the hydraulic feed control mechanism at all times that it is needed regardless of leaks in the fluid system or demands upon the feed control mechanism, and including a new and improved accumulator therefor.

Another object of the invention is to provide a method and apparatus for automatically cleaning the fluid which is used in the system. A further object of the invention is to provide a novel valve system in conjunction with the accumulator so that the fluid is not allowed to assume a high temperature rise when the mechanism is not using the fluid, the accumulator still maintaining the high pressure for instant use while the constantly driven pump is not supplying pressure, the valve system by-passing the fluid, or directing it to a reservoir.

Still further objects of the invention include the provision of a double pump unit having a high pressure line and a low pressure high volume line, the former feeding the accumulator but being normally open from the accumulator to the feed control mechanism above described to supply the same; and the low pressure line leading more directly to the feed control mechanism, both high and low pressure lines merging in a novel automatic valve operative by back pressure from the feed control mechanism to close the low pressure line so that the accumulator is then loaded by the high pressure line, and including a line to direct the low pressure fluid directly back to the low pressure pump, in effect by-passing the low pressure fluid; and the provision of another but different automatic valve between the high pressure part of the pump and the accumulator so that the latter being fully loaded, and the feed control mechanism still not using fluid, the high pressure line is diverted to the fluid reservoir, passing through the novel hydraulically operated fluid cleaner above mentioned.

Other objects and advantages of the invention will appear hereinafter as related to the provision of a constant fluid pressure supply apparatus, a novel accumulator, novel valves, a fluid piping system, a fluid cleaner, and appurtenant devices,

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and in combinations and modifications thereof, as pointed out in the appended claims.

Reference is to be had to the accompanying drawings in which

5 Fig. 1 is a diagrammatic view of the piping and the accumulator connected with a hydraulic feed device and piston in accordance with this invention;

10 Fig. 2 is a view taken in the direction of arrow 2 of one end of the accumulator shown in Fig. 1, with the driving pulley removed;

Fig. 3 is a view taken in the direction of arrow 3 in Fig. 1;

15 Fig. 4 is a transverse sectional view on the line 4—4 of Fig. 2;

Fig. 5 is a sectional view on line 5—5 of Fig. 4, showing the valve between the high pressure line and the accumulator closed;

20 Fig. 6 is a sectional view on line 6—6 of Fig. 2 showing the other valve in closed position;

Fig. 7 is an exploded diagrammatic view showing the flow lines of the fluid system with the valves in the normal operating position;

25 Fig. 8 is a sectional view on line 8—8 of Fig. 7 showing the filter ratchet mechanism in normal position; and

Fig. 9 is a similar view showing the filter ratchet in operating position.

This invention is designed to operate a hydraulic feed control mechanism 10 in conjunction with a piston 11 such as might be used to operate a drill head as described in U. S. Patent No. 1,905,133, April 25, 1933. There has always been a high fluid temperature rise in this system because the pump being a constant volume type generates heat when passing fluid through relief valves in prior art constructions. Also, the present invention may use the same fluid for long periods of time, whereas in the prior art, the fluid quickly becomes dirty due to the relief of fluid directly to the reservoir. It will be understood that a high pressure is not necessary when the working piston is under a rapid traverse condition, but this pressure is necessary under a slow traverse condition such as in the case of a drill engaging the work and feeding in slowly, and also under the idle condition to operate the controls.

The piston 11 which is shown diagrammatically in Fig. 1 is connected with the hydraulic feed control mechanism 10 by pipes 13, and the feed control mechanism is connected to a valve housing generally indicated at 14 by means of a pipe 15 leading from a port 16 in a valve to be described, and having a return 15a. An accumulator housing is indicated at 17 and this accumulator in-

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cludes a cylinder 18, see Figs. 4 and 7, sliding upon a fixed piston 19, the cylinder being constantly urged to the right in these figures by a spring 20. The fluid is introduced through the screened opening 21 from a reservoir R and passes through the cavity 22 to the line 23 thence to the high pressure pump part 24 and also the low pressure pump part 25, see Fig. 7. The fluid is fed through opening or line 26 to a valve 27 which for convenience will be referred to as the high pressure valve. This high pressure valve is composed of a housing in which are bored holes 28 and 29, 29 being of slightly larger diameter. Into these holes are placed separate plungers 30 and 31 respectively, the diameter of plunger 31 being slightly greater than the diameter of plunger 30. The latter is kept in the position shown in Fig. 7 by engagement of plunger 31, which is in turn kept in the position shown in Fig. 7 by a small spring 32 with just sufficient pressure to maintain such a position when there is no operation or pressure on the part of the plungers 30 and 31. The diameter of the plunger 31 is larger than that of the plunger 30 in order to maintain this position even though the pressure on end surface 31a of plunger 31 should be less than the pressure on the end surface 34 of the plunger 30.

Assuming that the plungers 30 and 31 are as shown in Fig. 7, the fluid passes through line 26 and port 35 to an open ended passage 36 in piston 19. At times when this pressure becomes greater than the pressure exerted on the cylinder 18 by the spring 20, the cylinder is forced back against the action of the spring, loading the accumulator and closing a port 37 and opening port 37a, so that pressure coming from the pump no longer is connected, by enlarged opening 38 in cylinder 18, to a small passage 39 leading into the space 29. There being no pressure on the fluid in the passage 39, the pressure in a passage 40 to space 28 being, of course, high, the plungers 30 and 31 are forced by the pressure of fluid coming through passage 40 until port 35 is covered by plunger 30. The fluid then is passed from line 26 through port 41 and passage 41a to the sump 42 of the accumulator 17. The pressure in the cylinder 18 is at all times passed through port 43 to the valve housing 14 at port 44 thereof.

There is also a flow of fluid from the low pressure pump 25 to the valve housing 14 through port 45, and this combined volume flows out through port 16 to the feed control mechanism 10. However, if there is built up a back pressure in the line 15, a valve plug 46 in valve housing 14 is forced back against a spring 47 closing opening 48 in the housing 14 with the enlarged portion 49 of the valve plug 46. In order to prevent a kickback of the trapped oil in the cavity 50 a sleeve 51 is slidably mounted in cavity 52 and is freely movable on the valve stem 53 so that the pressure on this sleeve will force it back uncovering port 54 so that the fluid circulates freely through port 45, cavities 50 and 52, out port 54 and back through pump 25. The valve is prevented from moving too far in this position by a pin 55. When the back pressure in line 15 is lessened sufficiently, the spring 47 forces the valve back to its normal position against pin 56. This relieves the pressure in the cavities 50 and 52 allowing the spring 57 to force the sleeve 51 back to its normal operating position against a shoulder 58 on valve stem 53.

It will be noted that when sleeve 51 is seated against shoulder 58 the distance for the sleeve to move before it uncovers port 54 is greater than

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the distance for the valve to move to have the enlarged portion 49 block the opening 48. This is to eliminate any hunting of the valve. Its movement must be positive. It will be noted that there is a port 59 into the cavity 60 for spring 47 which is merely an escape port for the fluid in this cavity.

Should the high pressure or low pressure pump be stopped and the machine started there will be no lag to build up pressure as the accumulator cylinder 18 is forced back by the spring 20 until the pressure is able to pass through the port 37 and channel 39 to cavity 29, forcing the plunger 31 up, even though the pressure in the line 40 is the same, because of the larger diameter of plunger 31. Port 64 is intended to help maintain a small amount of pressure so that should the spring 32 break the plungers will still return to the up position during normal operation. Port 37a acts as an escape port when the plunger 31 is forced down due to the accumulator having reached its maximum capacity and closing port 37, as above described. With the plungers down, port 64 provides against pressure rise in space 29.

Another feature of this invention is that the fluid by-passing the accumulator has to pass through a rotary blade type filter 65 which is operated intermittently and by an arrangement as shown in Figs. 3 and 4 and Fig. 8. Since line 66 is connected to line 26, line 66 will be subject to intermittent changes from high to low pressures depending on the status of ports 35 and 41 as controlled by the plungers 30 and 31. Thus fluid impulses will be present in line 66 and convey the impulses to a port 67 in end cap 68 for the accumulator.

This port 67 is connected to a cavity 69 which is closed by a plug 70 on one end and has a slidable plunger 71 mounted therein. The port 67 is so located as to force plunger 71 away from the plug 70 and against a projection P of a filter advance pawl 72. This pawl 72 is in turn mounted on an apertured lock roll sleeve 73. The shaft 74 of the rotary type filter 65 has mounted thereon a hub 75 shaped as shown in Fig. 8 and pinned to shaft 74 by pin 76 as shown in Fig. 4. Spring 77 is connected to pin 76 and to the sleeve 73 so that the sleeve 73 is continually exerting pressure against the rolls 78 in the sleeve apertures, in a counter-clockwise direction. When plunger 71 forces pawl 72 in a counter-clockwise direction the rolls 78 become wedged between pawl 72 and hub 75 and the shaft 74 is therefore forced around in a counter-clockwise direction an amount equal to the rotation of the pawl 72 by the plunger 71. When the pressure in the line 66 lowers sufficiently, a plunger 79 is forced by a spring 80 to rotate the pawl 72 in a clockwise direction until the plunger 71 comes into contact with plug 70 and remains in that position until the oil pressure in line 66 rises again. The clockwise rotation of the pawl does not turn the filter shaft 74 clockwise as the rolls 78 are not wedged in that direction. Since the filter can be any one of the standard rotary types with alternate disc cleaning blades which allow the passage of oil, a complete rotation of the shaft 74 cleans every disc completely. This invention, therefore, maintains a clean oil filter automatically.

Should excessive pressure be built up in the accumulator body there is provided an outlet 81 which is kept closed by ball 82 and spring 83 until such pressures force ball 82 up allowing fluid to escape through port 84.

The pump is here shown as a double gear type

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operated by a shaft 55 and pulley 56 driven by a motor which is of the constant speed type.

Assuming the parts to be as shown in Fig. 7, the high and low pressure lines are feeding directly to line 15 supplying the control mechanism 10 with full power as for a rapid traverse of piston 11. If, however, the piston is then slowed by the control mechanism, a back pressure builds up in line 15, moving stem 53 to close port 48 and the accumulator becomes loaded. If high pressures are not required at the time when the accumulator is fully loaded, plungers 30 and 31 are moved to direct the high pressure line 26 to the sump 42, and the fluid passes through the filter and out at 87, whence it is directed to the reservoir R. As soon as pressure is again required, the accumulator supplies it, in the interval until the valves reverse.

Having thus described my invention and the advantages thereof, I do not wish to be limited to the details herein disclosed otherwise than as set forth in the claims, but what I claim is:

1. A hydraulic pump comprising a high pressure line and a separate low pressure line, a pressure responsive valve merging the two lines, an outlet, said valve being actuatable to cut off the low pressure line under conditions of back pressure in the outlet, a yieldable cylinder taking the high pressure during conditions of back pressure, and a second valve in the high pressure line between the pump and the cylinder, said second valve being actuatable to drain the high pressure fluid to a reservoir upon the yielding of the cylinder to a predetermined degree, and means to actuate the said second valve comprising a plunger operatively connected to the second valve and having a pressure area at each end thereof, a passage from the high pressure line to each pressure area of the plunger, pressure in which passage normally maintains the plunger in position so that said second valve directs the high pressure fluid to the said yieldable cylinder, and means cutting off the passage to one pressure area of the plunger at a predetermined degree of loading of the cylinder so that the plunger moves, closing off the high pressure line from the cylinder and opening the high pressure line to drain.

2. A hydraulic pump for supplying a device capable of developing back pressure and comprising separate high and low pressure lines, a valve receiving said lines separately and merging the same, an outlet from the valve to said device, said valve being effective to cut off the low pressure line therefrom in the presence of back pressure in the outlet, a second valve in the high pressure line, a fluid pressure accumulator in the high pressure line between the second valve and the first valve, said second valve leading selectively to a reservoir or to the fluid pressure accumulator, lines to the second valve tending to maintain the same in open condition to the accumulator, one of said last named lines being cut off by the accumulator to allow the second valve to be operated to direct the fluid in the high pressure line to the reservoir.

3. A hydraulic pump comprising high and low fluid pressure lines, a low pressure valve operable to selectively direct the low pressure fluid to a hydraulically operated device or to return the fluid to the pump, a high pressure valve operable to selectively direct fluid to an accumulator or to a reservoir, an accumulator receiving the high pressure fluid and yieldingly movable under tension to store fluid at high pressure, hydraulic

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means to operate the high pressure valve, said hydraulic means comprising a plunger operatively connected to the high pressure valve, a passage to each end of the plunger and leading high pressure fluid to each end thereof so as to normally maintain the plunger in predetermined position opening the high pressure fluid to the accumulator, the latter closing one of the said passages at a predetermined point in the movement thereof to cause shifting of the plunger, and means to aid the plunger to return to original position upon reopening of the closed passage.

4. The hydraulic pump of claim 3 including a line from the accumulator to the low pressure valve whereby the low and high pressure fluids merge to operate the hydraulic device, the low pressure valve operating to close the low pressure line thereto upon back pressure produced by the hydraulic device.

5. A hydraulic pump comprising means to apply pressure to fluids, a line from said means to a device to be operated thereby, a valve housing in the line, a pair of outlets for the valve to direct the fluid selectively to a reservoir or to an accumulator comprising a movable cylinder and means resisting such movement, a line from the accumulator to said device, a pair of plungers in the valve for separately and alternately closing said outlets, lines to the valve housing from the accumulator to admit fluid under pressure behind the plungers so that the latter are substantially balanced, said accumulator cylinder closing one of said last named lines at a predetermined point in the movement of the cylinder to allow the pressure of fluid in the other of said lines to shift the plungers.

6. The hydraulic pump of claim 5 wherein the plungers are spaced by a pin and the first named line enters the valve housing between the plungers.

7. A hydraulic apparatus comprising a pump, a line therefrom to a hydraulic device to be operated thereby, a valve in the line, plungers in the valve directing the fluid selectively to the hydraulic device or to a reservoir, a resiliently loaded movable accumulator between the valve and the hydraulic device, said plungers being substantially hydraulically balanced by means of fluid pressure, a port controlling the balancing fluid to one plunger, said port being open in partially fluid loaded condition of the accumulator and covered by the accumulator as the latter approaches full loading, so that the balancing pressure to said one plunger is reduced, shifting the plungers to direct the fluid to the reservoir.

8. A hydraulic apparatus comprising a pump, a fluid line therefrom to supply an operating device, a valve housing in the line, a pair of spaced plungers in the valve housing, the line entering the housing between the plungers, an outlet from the housing, a movable cylinder connected thereto, means resisting movement of the cylinder under influence of the fluid in the line, the line continuing from the cylinder to the operating device, a passage into the valve housing behind each plunger, said passages being connected to the line to provide pressure behind each plunger, said cylinder closing one of said passages at a predetermined point in the movement of the cylinder, so that said plungers may be operated to shift the valve.

9. The apparatus of claim 8 wherein the plunger, the fluid passage to which is closed by the cylinder, is of greater pressure area than the other plunger, so that reopening of said passage will

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cause the plungers to be re-shifted to original position.

10. A hydraulic apparatus comprising a high and low pressure pump, a low pressure valve, separate inlets thereto for fluids under high and low pressure, means in the valve to merge the fluids, an outlet for the merged fluids, a valve stem in the valve shiftable under back pressure in said outlet to close off the low pressure fluid, and means to direct the latter back to the pump, in combination with a high pressure fluid operated valve between the pump and the low pressure valve, a plunger in the high pressure valve, a movable fluid accumulator to receive and store fluid under pressure in the presence of back pressure in the outlet, said high pressure valve normally admitting fluid to the accumulator, a hydraulic line to the high pressure valve to provide pressurized fluid at one end of the plunger to tend to maintain the high pressure valve in position to supply high pressure fluid to the accumulator, another line providing pressurized fluid to move the plunger to direct the fluid from the accumulator to a reservoir and means to close the first named hydraulic line upon movement of the accumulator to a predetermined loaded degree.

11. Hydraulic apparatus comprising a pump, a valve, an inlet from the pump to the valve, an outlet for the valve, a passage connecting the inlet and outlet, a valve stem in the passage, an enlarged head on the stem, said head being lo-

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cated between the outlet and the passage and effective to close the latter upon movement of the stem due to outlet back pressure on the head, an outlet from the valve to the intake side of the pump, movable means normally closing the last named outlet, the pressure from the pump moving said movable means upon closing of the passage.

12. The hydraulic apparatus of claim 11 wherein said movable means comprises a sleeve on the valve stem, and including resilient means to return the sleeve to original position upon opening of the passage.

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#### REFERENCES CITED

The following references are of record in the file of this patent:

#### UNITED STATES PATENTS

| Number    | Name          | Date          |
|-----------|---------------|---------------|
| 1,002,306 | Perkins       | Sept. 5, 1911 |
| 1,480,257 | Gerlinger     | Jan. 8, 1924  |
| 1,905,133 | Bishop et al. | Apr. 25, 1933 |
| 1,932,761 | West          | Oct. 31, 1933 |
| 1,982,711 | Vickers       | Dec. 4, 1934  |
| 2,074,618 | Roeder        | Mar. 23, 1937 |
| 2,077,744 | Cuno          | Apr. 20, 1937 |
| 2,264,375 | Hill et al.   | Dec. 2, 1941  |
| 2,277,640 | Harrington    | Mar. 24, 1942 |
| 2,283,516 | Tyler         | May 19, 1942  |