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T. E. RAYMOND  
HYDRAULIC APPARATUS

2,455,271

Filed June 16, 1944

3 Sheets-Sheet 1

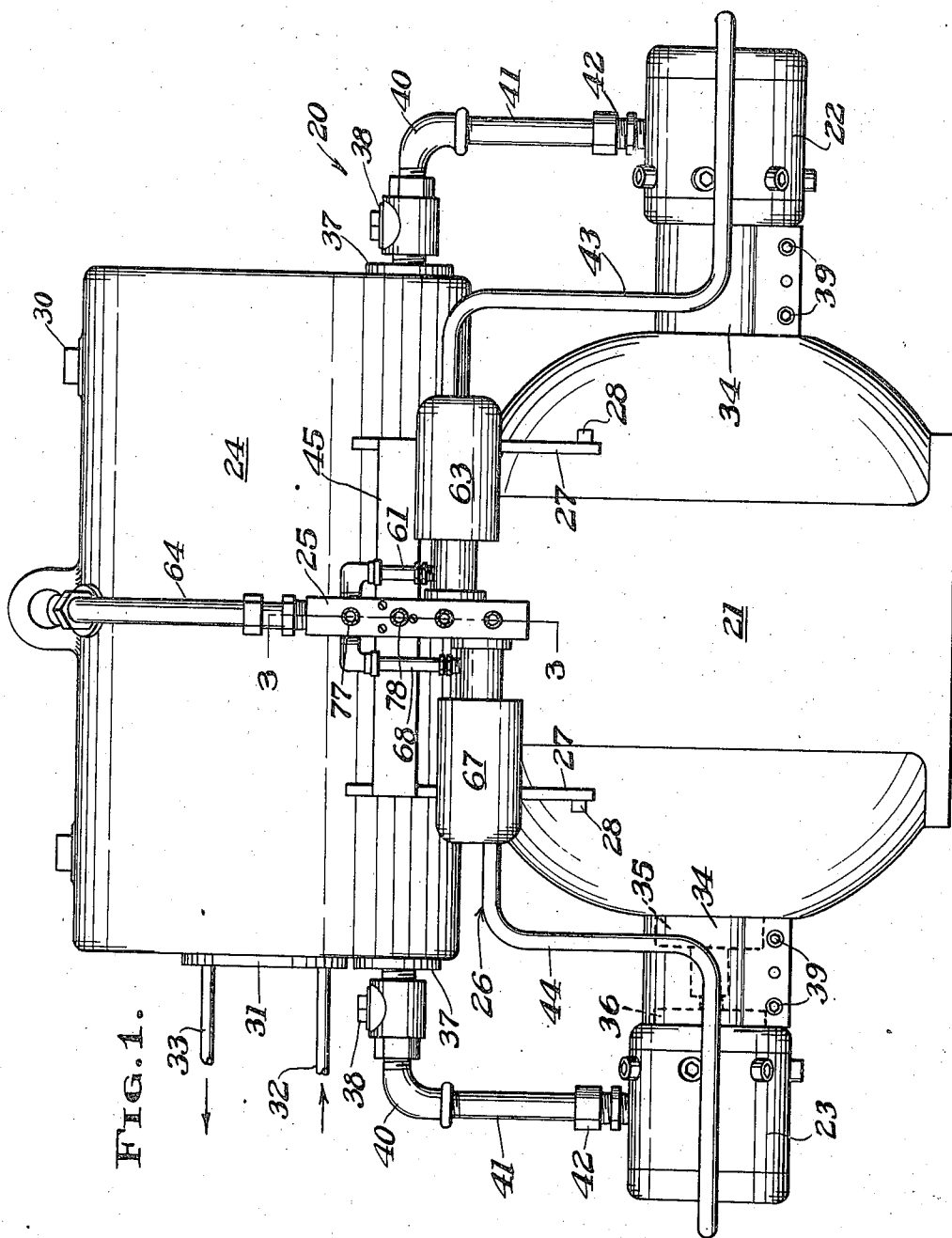


FIG. 1.

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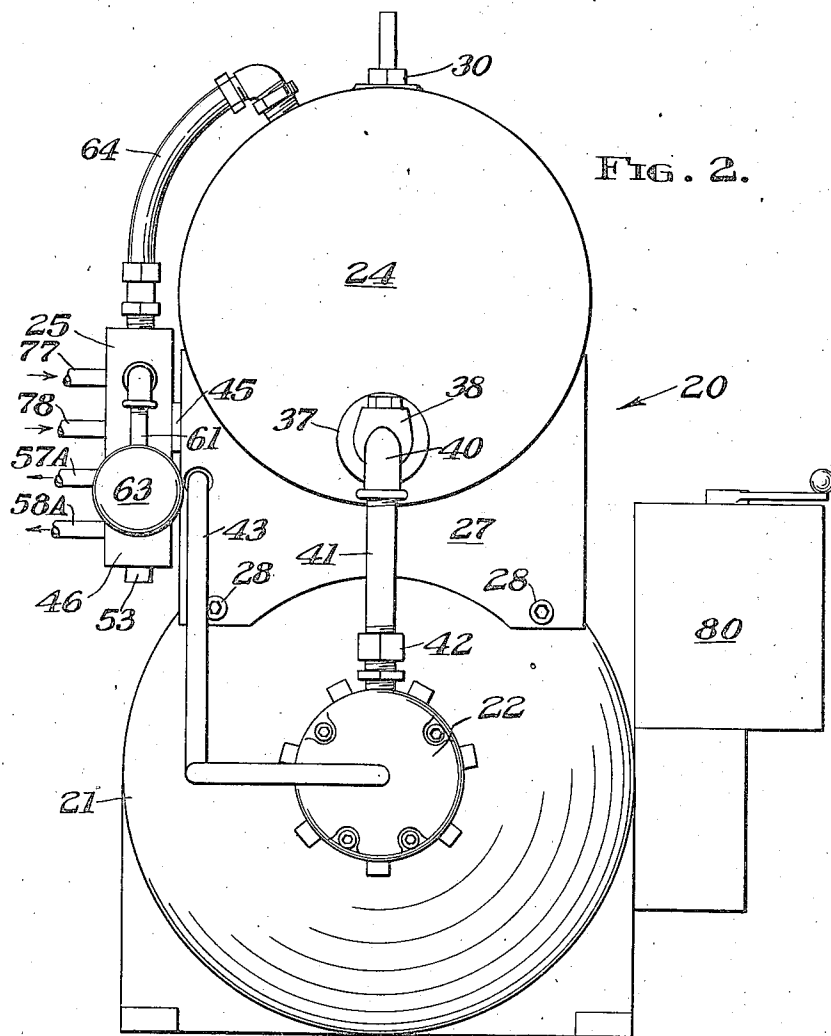
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3 Sheets-Sheet 2



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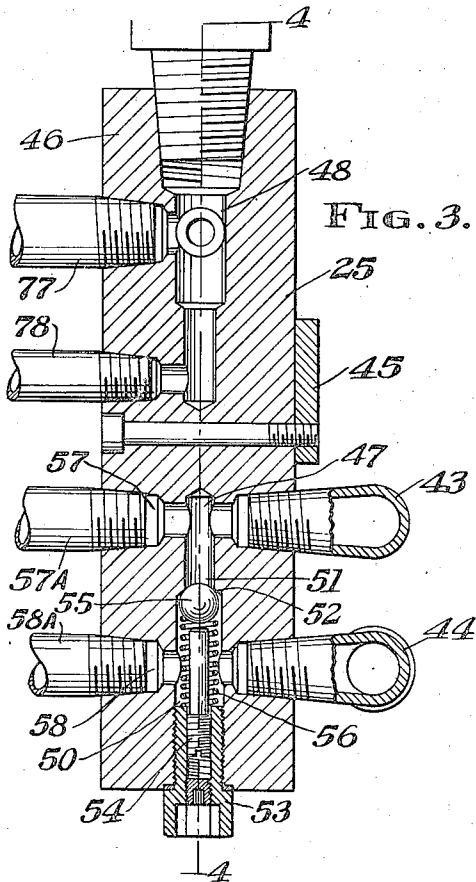
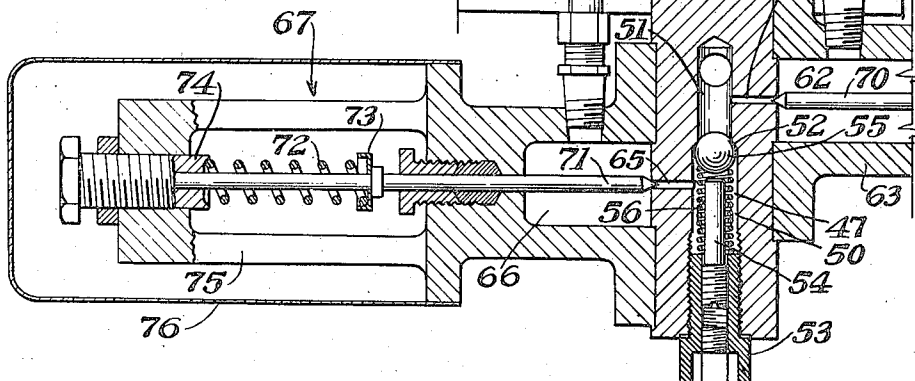
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## UNITED STATES PATENT OFFICE

2,455,271

## HYDRAULIC APPARATUS

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Application June 16, 1944, Serial No. 540,605

10 Claims. (Cl. 103—11)

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This invention relates to hydraulics and is particularly directed to apparatus for producing fluid pressures which may be employed in the operation of machine tools, presses, rams, motors and other hydraulic equipment.

In some machine tools such as presses, shapers, planers and the like which are operated by hydraulic pressure, a piston, ram or other element is required to move a considerable distance without exerting appreciable force and then near the termination of its travel is required to exert a maximum force to perform useful work. During the major portion of travel, only slight power is required to move the piston but when the useful work is to be performed, increased force is necessary. It is an object of this invention to provide a power unit for a machine operating in this manner which power unit has a plurality of pumps for quickly delivering a large quantity of fluid to the piston cylinder at relatively low pressure during the first part of the piston stroke and a smaller quantity of fluid at high pressure during the final stage of the piston's stroke, the unit being so constructed that undue loads will not be applied to the pumps or other parts of the system during the time the high pressure is being utilized.

An object of this invention also is to provide an integral, compact, fluid power unit which may be connected in circuit with an article of hydraulic equipment and employed to furnish the motive power for such equipment, the unit being so fabricated that it may be disconnected, bodily removed, serviced and replaced without dismantling the other equipment or the system therefor.

Another object of this invention is to provide a fluid power unit having a prime mover and a plurality of pumps with different volumetric and pressure capacities secured for operation therewith, the pump outlets being in communication so that the flow from both pumps may be utilized in the operation of a piece of mechanism, means also being associated with the pumps to isolate one from the other when certain pressures prevail in the system.

Another object is to provide a fluid power unit having a pair of power operated pumps capable of producing different pressures and communicating with a chamber divided by suitable means into high and low pressure sections and providing the different sections of the chamber with relief means to permit fluid to escape after a predetermined pressure has been reached, the chamber dividing means being so constructed as to

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permit communication between the low and high pressure section as long as the pressure in the latter does not exceed the pressure in the former, and when a predetermined pressure in the chamber is reached, the relief valve for the low pressure section will operate to prevent the overloading of the low pressure pump; at this time the chamber dividing means will prevent fluid flow from the high to the low pressure section.

A further object of the invention is to provide a fluid power unit having a motor with a fluid pump at either end connected for operation with the motor and conducting the fluid from the pumps to a manifold from which it may be directed to the point of use, the manifold having means for relieving the load on each pump when the pressure capacity thereof is exceeded and means for preventing the relief of a higher capacity pump through the relief means for a lower capacity pump.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein a preferred form of embodiment of the invention is clearly shown.

In the drawings:

Figure 1 is a front elevational view of a hydraulic power unit formed in accordance with the present invention;

Figure 2 is an end elevational view of the unit shown in Figure 1;

Figure 3 is a detailed vertical sectional view taken through a manifold used on the unit shown in Figure 1, the plane of the section being indicated by the line 3—3 of Figure 1; and

Figure 4 is a similar view taken through the manifold and associated mechanism on the plane indicated by the line 4—4 of Figure 3.

Referring more particularly to the drawings, the power unit forming the present invention is designated generally by the numeral 20. This unit includes an electric motor 21, high and low pressure hydraulic pumps 23 and 22, a reservoir 24, a manifold 25 and a connecting pipe system designated generally by the numeral 26. In its preferred form, the unit has a pair of plates 27—27 which are secured to the housing of the motor 21 by screws or other fastening elements 28. The upper edges of the plates 27 are curved to receive the reservoir 24 which may be secured to the plates by welding or other suitable means. In this instance, the reservoir is in the form of a cylindrical tank having one or more plugs 30 in the top through which hydraulic fluid may be introduced to the reservoir. One end

of the tank 24 is provided with an opening which is normally closed by a cap 31 through which tubes 32 and 33 extend, these tubes having their inner ends connected with a cooling coil, not shown. The water or other cooling medium may be supplied to the cooling coil and conducted therefrom through the pipes 32 and 33.

The pumps 22 and 23 are of the type shown in my copending application Serial No. 529,957, filed April 7, 1944, now abandoned, and are attached to the opposite ends of the armature shaft of the motor 21, mounting collars 34 being employed to support the pumps in alignment with the ends of the armature shaft. These collars are also disclosed in detail in the above mentioned application. They are split and are clamped to bosses 35 and 36 provided on the motor and pump housings through the use of screws 39. The pump shafts are suitably coupled to the ends of the armature shaft. Thus when the armature shaft revolves, both of the pumps will be revolved at the same rate of speed.

Each end of the reservoir 24 is provided with a cap 37 into which one end of a pipe valve 38 is threaded. The opposite ends of the valves 38 receive elbow members 40 which, in turn, are connected by tubing 41 and couplings 42 with the inlet ports of the pumps 22 and 23. The outlet ports of these pumps are connected with conduits 43 and 44 which extend toward one another and are connected at their proximate ends with the manifold 25. This manifold is secured to a cross brace 45 extending between the plates 27.

As shown in Figs. 3 and 4, the manifold 25 includes a block like body 46 bored at each end to provide chambers 47 and 48. The chamber 47 includes sections 50 and 51 which are separated by a valve seat 52. The conduit 43 leading from the low pressure pump 22 is connected, as shown in Fig. 3, with the section 51 of the chamber 47 while conduit 44 leading from the outlet of the high pressure pump 23 communicates with the section 50 of the chamber 47. The outer end of this chamber is closed by a plug 53 which is threaded into the block 46. This plug 53 has a threaded opening formed therein to receive a stop pin 54 which serves to limit the movement of a ball valve 55 away from the seat 52, this ball valve being normally urged toward the seat by a coil spring 56. Through the provision of the seat and the valve, chambers 50 and 51 are separated from one another and communication can only be established therebetween by moving the ball valve 55 away from the seat 52. This communication will occur only when pressure within chamber 51 is sufficient to overcome the combined force of the pressure in chamber 50 and spring 56. By substituting springs with different tensions for spring 56, the responsiveness of valve 55 may be varied. If desired, this communication may be prevented by threading the member 54 into the member 53 until the inner end of the former engages the ball valve 55. These parts are so positioned in one use of the apparatus to be set forth hereafter.

The conduits 43 and 44 are connected with the body 46 at the rear thereof while the front portion of this body is provided with outlet ports 57 and 58 for the reception of additional conduits 57A and 58A, the former communicating with the low pressure section 51 of the chamber 47 and the latter communicating with the high pressure section. These conduits 57A and 58A are utilized to conduct fluid under high and low pressure from the manifold 25 to any desired points of use,

such as fluid motors of the rotary or piston and cylinder type. In some instances, conduit 57A will be connected with one fluid motor while conduit 58A is connected with another. It is also possible to plug the port 57 and utilize the fluid from both high and low pressure pumps in one motor, this fluid being conducted from manifold 25 through pipe 58A.

From the mechanism thus far described, it will be apparent that when motor 21 is in operation, pumps 22 and 23 will deliver fluid to the manifold 25 from which it may be conducted to one or more fluid motors. When the operation is initiated, and the fluid is still at low pressure in the system, fluid from low pressure pump 22 may flow past valve 55 and thus be conducted through both conduits 57A and 58A to the points of use. When a certain pressure, determined by the tension of spring 56, has been built up in chamber 50, this communication between sections 50 and 51 will be terminated and all fluid from the low pressure pump must pass out of the manifold 25 through conduit 57A or through bypass port 60 and conduit 61. This conduit 61 connects a chamber 62 formed in a relief valve 63 with the chamber 48 formed in the upper end of the body 46. Chamber 48 is connected by pipe 64 with the reservoir 24. Thus when fluid flows from section 51 through the bypass port 60, it will be returned to the reservoir 24 for further use.

A second bypass 65 extends from the section 53 to a chamber 66 formed in a second relief valve 67. A conduit 68 connects chamber 66 with chamber 48 so that when fluid flows from the section 50 through bypass port 65 to chamber 66, this fluid will also be conducted to the reservoir. When valve 55 is held against seat 52 and more fluid than the system can utilize is supplied to chamber section 50 by the high pressure pump 23, the excess fluid will be returned to the reservoir through the bypass port 65, conduit 68 and pipe 64.

By providing valves 70 and 71 for engagement with bypass ports 60 and 65, fluid will be prevented from flowing through these bypass ports until certain predetermined pressures have been reached. As shown in Fig. 4, valves 70 and 71 are yieldably urged toward their port closing positions by coil springs 72 which engage collars 73 on the valve stems and adjustable screws 74 threadably received by the relief valve frames 75. Through the adjustment of screws 74 of the relief valves, the tension on springs 72 may be varied to change the pressures at which fluid will be permitted to flow through bypass ports 60 and 65. Suitable housing means 76 are provided to protect the relief valves 63 and 67 from unauthorized adjustment.

In the operation of the pressure generating unit, both pumps supply fluid to be used in the system until a certain pressure has been reached in chamber 47, at which time, valve 55 will seat to prevent fluid under higher pressure from flowing into section 51 and being bypassed through port 60 to the reservoir. In the event the system supplied by the unit is fed through conduit 58 only, the entire output of pump 22 will be bypassed through the relief valve 63 when the pressure in chamber section 50 exceeds that for which valve 63 has previously been set. Fluid exhausted from the fluid motor or motors in the system is returned to the manifold through pipes 77 and 78. These pipes communicate with chamber 48 and fluid is conducted therefrom to the reservoir through the pipe 64.

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This power unit is particularly useful in supplying the motivating force for a machine tool in which a piston or other element is required to travel a considerable distance then develop or exert a strong force during the final stage of its travel. When connected with such a machine, the high and low pressure pumps 22 and 23 will together deliver a sufficient volume of fluid to cause the moveable element to travel at the desired rate and when the end of this travel is approached, and high fluid pressures are necessary to perform the useful work, these high pressures will be developed by the pump 23 which delivers a small volume of fluid at high pressure. Through the provision of the self closing valve 55, the load of this high pressure will not be imposed on the low pressure pump. Valve 55 in such instance, will prevent the escape of fluid from chamber section 50 through the low pressure bypass and will thus make the power unit more efficient.

The mechanism may be employed as above described wherein valve 55 is permitted to open when pressures in chamber sections 50 and 51 are substantially equal or the pressure in the latter section exceeds that in section 50. When this valve is so set, communication may take place in a direction from section 51 to section 50 so that the low pressure high volume pump will be permitted to supply fluid to the portion of the system connected with pipe 58.

The mechanism may also be employed in a different combination in which stop 54 is adjusted to hold the valve 55 in engagement with seat 52 and prevent communication between chamber sections 50 and 51. When the stop is so adjusted, the effect of separate pressure generating units will be secured, all the fluid supplied by the low pressure pump being conducted from the manifold 25 to the portion of the system connected therewith through pipe 57 and the high pressure fluid flowing from the manifold through pipe 58.

A third combination is also possible wherein check valve 55 is removed and the flow from pumps 22 and 23 combined. In this particular combination, the fluid from both pumps will be bypassed to the reservoir through the low pressure relief valve 63 unless an adjustment is made in the setting of the high pressure relief valve 67. Both valves 63 and 67 should be set to operate at the same pressure.

From the foregoing, it will be seen that a novel pressure generating unit has been provided which is compact and efficient. It may be bodily removed from a hydraulic system, serviced and replaced without dismantling the system since the unit 20 is self contained and has been designed to be connected with a hydraulic system quickly and with a minimum expenditure of time and effort.

A control panel 80 is provided at the rear of the unit to govern the operation of the motor 21. This panel may be equipped with any suitable means to effect the desired operation of the unit.

While the form of embodiment of the present invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

I claim:

1. A fluid pressure unit comprising, in combination, a high volume low pressure pump; a low volume high pressure pump; means forming a manifold chamber communicating with the outlets of said pumps; valve means in said manifold chamber dividing the same into high and low pres-

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sure sections, said low and high pressure pumps communicating with said low and high pressure sections respectively, said valve means preventing fluid flow from said high to said low pressure section; said manifold having an outlet from each of said sections; and relief valves for controlling fluid flow through said last-mentioned outlets, said relief valves being responsive to different pressures.

2. A fluid pressure generator comprising in combination, a prime mover; a pair of fluid pumps connected for operation with said prime mover; a fluid supply source communicating with the inlets of said pumps; manifold means communicating with the outlets of said pumps, said manifold means having a pair of outlets communicating with said fluid supply source; relief valves for controlling fluid flow through said pair of outlets; and means in said manifold between the outlets to limit fluid flow therebetween to but one direction.

3. A fluid pressure generator comprising in combination, a prime mover; a pair of fluid pumps connected for operation with said prime mover; a fluid supply source communicating with the inlets of said pumps; manifold means communicating at spaced points with the outlets of said pumps; seat means in said manifold between the points of connection thereof with said pumps, said manifold having an outlet on either side of said seat communicating with said fluid supply source; relief valve means controlling fluid flow through said outlets; and valve means engaging said seat to restrict fluid flow thereby to but one direction.

4. A fluid pressure generator comprising in combination, a prime mover; a pair of fluid pumps connected for operation with said prime mover; a fluid supply source communicating with the inlets of said pumps; manifold means having a body provided with an internal chamber communicating at spaced points with the outlets of said pumps; a seat formed in said chamber between the points of connection thereof with said pumps; a valve; and means for resiliently urging said valve into engagement with said seat to prevent fluid flow therethrough to but a single direction.

5. A fluid pressure generator comprising, in combination, a motor; a reservoir for hydraulic fluid disposed above said motor; a pump positioned at each end of said motor and connected for operation therewith; means connecting the inlets of said pumps with said reservoir; a manifold having a chamber communicating at spaced points with the outlets of said pumps; a valve seat in said chamber between the points of communication with said pumps, said manifold having an outlet communicating with said reservoir, said outlets being disposed on either side of said seat; pressure responsive valve means for controlling fluid flow through said outlets; and a spring pressed valve engaging said valve seat, said valve limiting fluid flow through said chamber to but one direction.

6. A fluid pressure generator comprising, in combination, a motor; a reservoir for hydraulic fluid disposed above said motor; a pump positioned at each end of said motor and connected for operation therewith; said pumps having different pressure capacities; means connecting the inlets of said pumps with said reservoir; a manifold having a chamber communicating at spaced points with the outlets of said pumps; a valve seat in said chamber between the points of communication with said pumps, said manifold having an outlet communicating with said reservoir on each

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side of said seat; valve means responsive to fluid pressures for controlling fluid flow through said outlets, the valve on the same side of said seat as the lower pressure pump being responsive to lower pressure than the other; and a valve member resiliently urged toward said valve seat to prevent fluid flow from said high pressure pump to the lower pressure outlet.

7. A fluid pressure unit comprising, in combination, a high volume low pressure pump; a low volume high pressure pump; means forming a manifold chamber communicating with the outlets of said pumps; valve means in said manifold chamber dividing the same into high and low pressure sections; said low and high pressure pumps communicating with said low and high pressure section respectively, said valve means preventing fluid flow from said high to said low pressure section; and a pressure responsive relief valve for the high volume low pressure pump operable to relieve the pressure when the valve is closed and after the pressure created by the low pressure pump attains a predetermined high value.

8. A fluid pressure unit comprising, in combination, a high volume low pressure pump; a low volume high pressure pump; means forming a manifold chamber communicating with the outlets of said pumps; valve means in said manifold chamber dividing the same into high and low pressure sections, said low and high pressure pumps communicating with said low and high pressure sections respectively, said valve means preventing fluid flow from said high to said low pressure section, each of said low and high pressure sections having an outlet for supplying fluid.

9. A fluid pressure unit comprising, in combination,

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tion, a high volume low pressure pump; a low volume high pressure pump; means forming a manifold chamber communicating with the outlets of said pumps; valve means in said manifold chamber dividing the same into high and low pressure sections, said low and high pressure pumps communicating with said low and high pressure sections respectively, said valve means preventing fluid flow from said high to said low pressure section; and a pressure responsive relief valve for the low volume high pressure pump operable to relieve the pressure after the pressure created by the high pressure pump attains a predetermined high value.

10. A fluid pressure unit comprising, in combination, a high volume low pressure pump; a low volume high pressure pump; means forming a manifold chamber communicating with the outlets of said pumps; valve means in said manifold chamber dividing the same into high and low pressure sections, said low and high pressure pumps communicating with said low and high pressure sections respectively, said valve means preventing fluid flow from said high to said low pressure section; and pressure responsive relief valve means for one of said pumps operable to relieve the pressure after the pressure created by said pump attains a predetermined high value.

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