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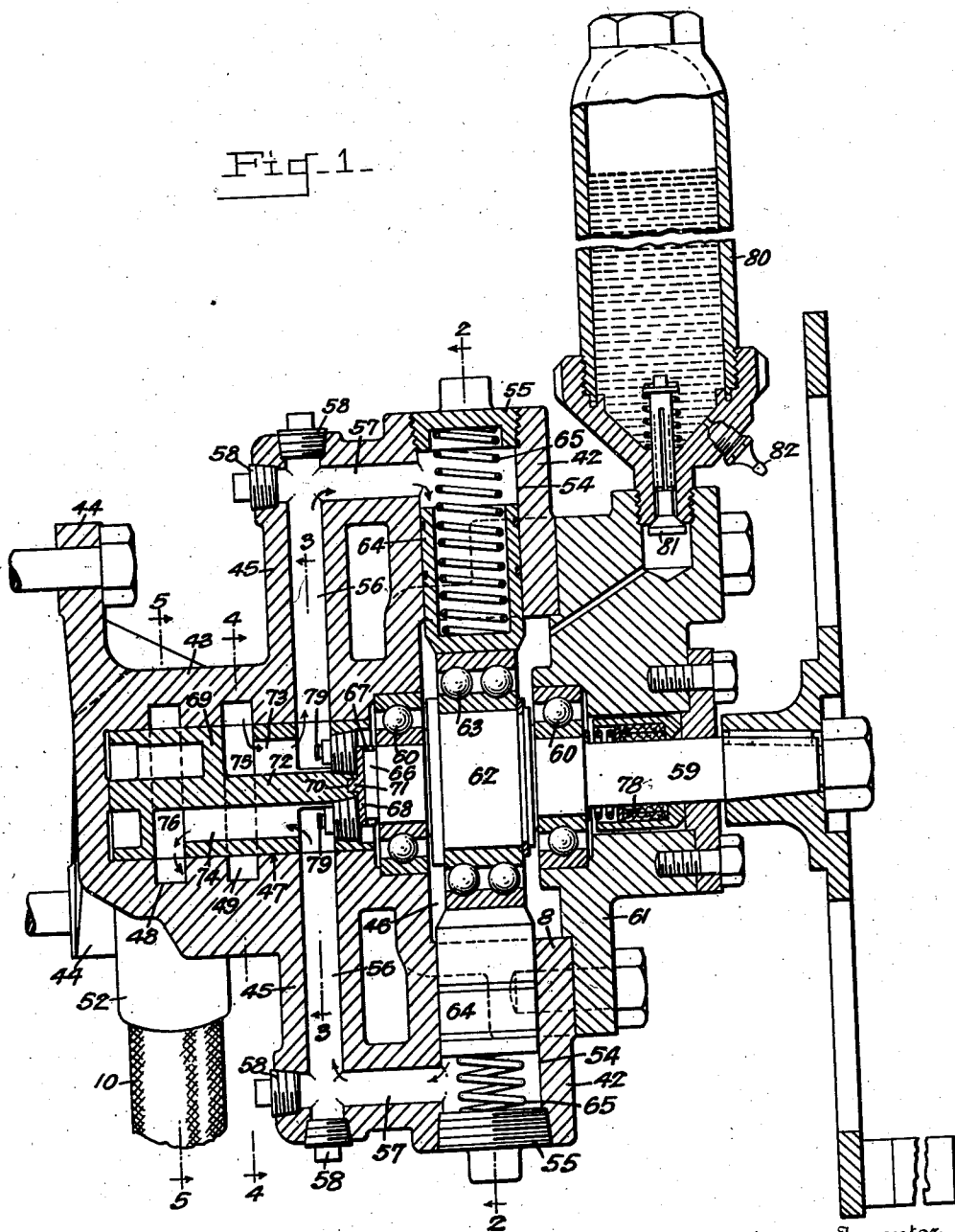
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2,381,910

PUMP

Filed March 18, 1942

3 Sheets-Sheet 1



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Fig. 2.

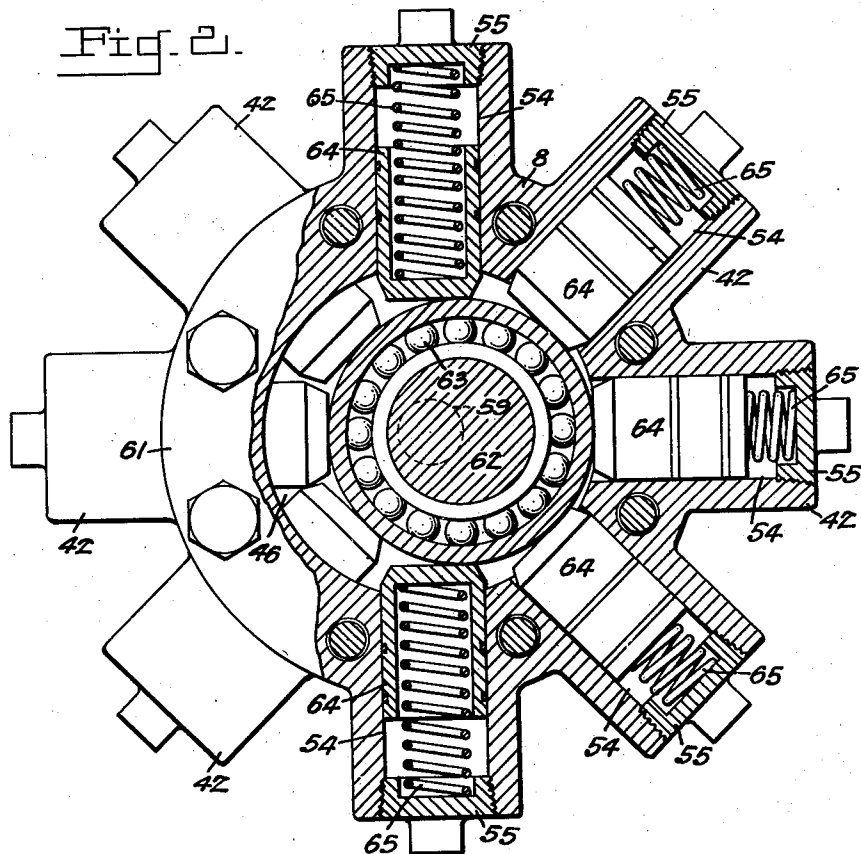
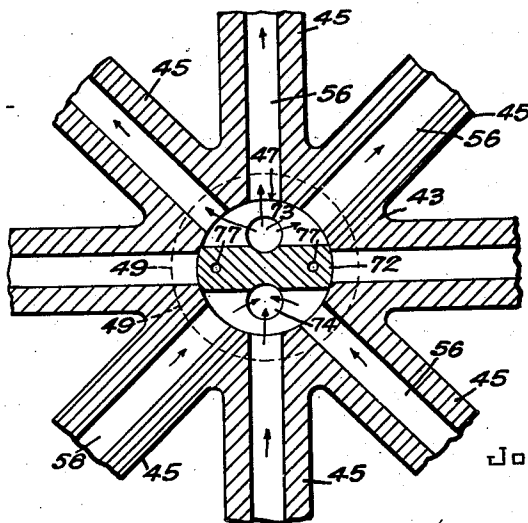


Fig. 3.



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Fig. 4.

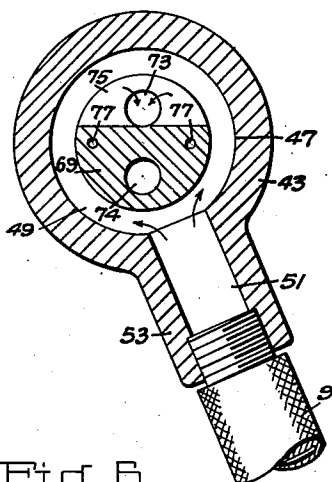


Fig. 5.

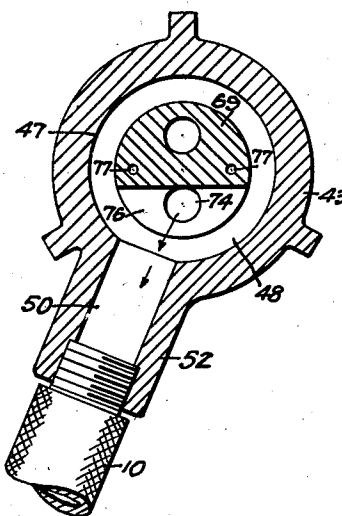


Fig. 6.

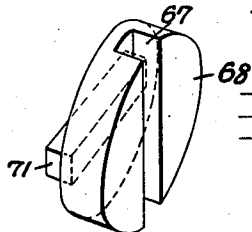
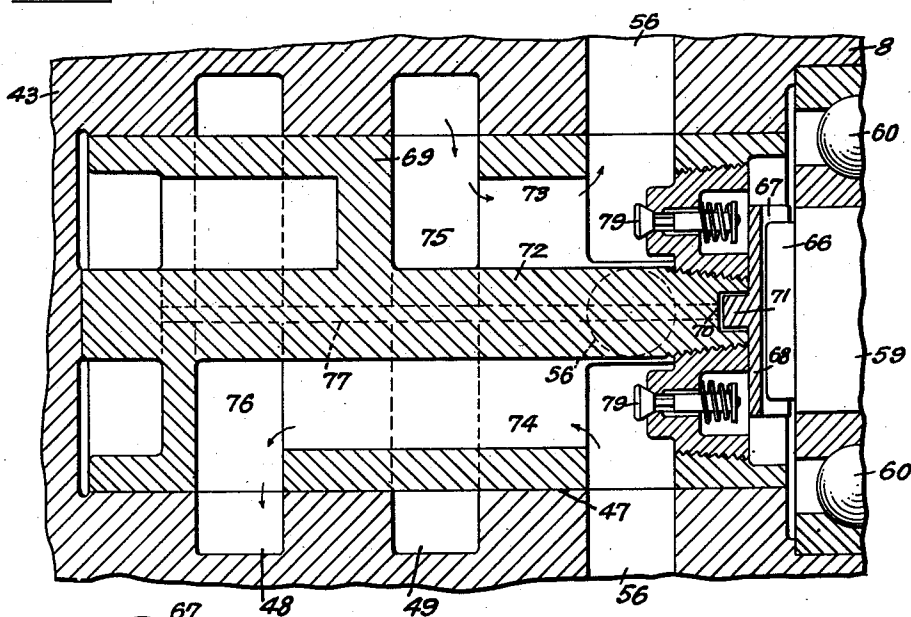


Fig. 7.

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UNITED STATES PATENT OFFICE

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Application March 18, 1942, Serial No. 435,188

7 Claims. (Cl. 103-174)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to me of any royalty thereon.

This invention relates to a reversible fluid pump and more particularly to a pump adapted to function in a hydraulic elevating mechanism such as that shown in my copending application, Serial No. 435,186, filed March 18, 1942.

As a result of the weight and bulkiness of the equipment previously used, hydraulic elevating mechanisms have been limited in their application to fixed guns of the type employed on warships and in coast defense emplacements. It is therefore an object of this invention to produce a small compact hydraulic pump capable of manual operation and which has sufficient capacity to function as an element of a hydraulic elevating mechanism on mobile artillery weapons.

It is a further object of this invention to provide a reversible flow, multi-cylindrical, hydraulic pump capable of delivering a smooth continuous flow at relatively high pressures.

It is a further object to provide a reciprocating pump in which any piston or valve leakage will be trapped and returned to the intake side of the system regardless of the direction of operation of the pump.

The exact nature of the invention as well as other objects and advantages thereof will clearly appear from a description of a preferred embodiment as shown in the accompanying drawings, in which:

Fig. 1 is a vertical longitudinal sectional view of the pump.

Figure 2 is an end elevational view of the pump body partially in section on the line 2-2 of Fig. 1.

Figure 3 is a vertical cross sectional view on the line 3-3 of Fig. 1.

Figure 4 is a similar view on the line 4-4 of Fig. 1.

Figure 5 is a similar view on the line 5-5 of Fig. 1.

Figure 6 is an enlarged longitudinal sectional view of a portion of Fig. 1 showing the pump valve and associated parts in more detail, and

Figure 7 is a perspective view of the coupling member for the pump valve.

Referring to the drawings by characters of reference the pump body 8 comprises a cylindrical portion having a plurality of radial protuberances 42 and a coaxial cylindrical portion 43 provided on its end remote from the radial protuberances with mounting feet 44. Radial members 45 on the cylindrical portion 43 and parallel with the

protuberances 42 are joined at their outer extremity with the protuberances 42. An axial cam chamber 46 is provided in the interior of the main body portion and a coaxial valve chamber 47 is provided in the cylindrical portion 43. Two circumferential grooves 48 and 49 are provided in the inner wall of the valve chamber 47 and in communication with these grooves are, respectively, fluid conduits 50 and 51 extending through bushings 52 and 53 to which flexible fluid lines 10 and 9 may be attached. Cylindrical bores 54 are formed in each of the radial protuberances 42 communicating with the cam chamber 46 and closed at their outer end with plugs 55. Radial bores 56 parallel with the cylinders 54 are provided in each of the radial members 45 and placed in communication with the cylinders by bores 57 parallel to the axis of the body. Suitable plugs 58 are provided to close the exposed ends of the holes which were left by the drilling operation.

A main drive or cam shaft 59 is supported by bearings 60 in the cam chamber 46, the outer bearing being engaged by a closure plate 61 secured to the main body. Between the bearings an eccentric portion 62 of the shaft 59 engages the inner raceway of a ball bearing 63 of conventional form. Pistons 64 are provided in each of the cylinders and constrained into engagement with the outer raceway of the bearing 63 by springs 65 engaged between the pistons 64 and the plugs 55. It will be obvious that as the shaft is rotated the pistons will be in turn reciprocated in the cylinders through a distance equal to twice the distance which the center of the eccentric portion 62 is removed from the axis of rotation of the shaft 59.

The inner end of the main shaft is provided with a tongue 66 to engage a slot 67 in a coupling member 68 shown in perspective in Figure 7. A valve 69 is received in the valve chamber 47 as best shown in Figure 6 and provided with a diametral slot 70 which receives the tongue 71 on the coupling member constraining the valve to rotation with the main drive shaft. It will be noted from Figure 3 that, in the portion of the valve cut by that section, symmetrical segmental portions have been removed to form a diametral planar dividing wall 72 between the radial passages 56, hence all of those cylinders on one side of the plane of the valve will be placed in communication with one of the longitudinal passages 73 and 74 formed in the valve while those cylinders on the other side of the plane of the valve will be in communication with the other of the passages 73 and 74. The thickness of the dividing wall 72

is such that the cylinders directly in line with the plane of the valve will be cut off from communication with either side. It should be further noted that the plane passing through the center of the dividing wall 72 is the same plane in which the axis of rotation of the drive shaft 59 and the eccentric axis of the cam portion 62 of such shaft are located. Segmental portions 75 and 76 of the valve have been removed in opposition to each of the circumferential grooves 48 and 49 in such a manner that the longitudinal passage 74 in the valve will be, through segmental port 76, continuously in communication with the circumferential groove 48, fluid conduit 50 and flexible fluid line 10 while the longitudinal passage 73 will be, through segmental port 75, in communication with the circumferential groove 49, fluid conduit 51 and flexible fluid line 9.

For the purpose of illustration it may be assumed that the main drive shaft 59 is rotated in clockwise direction as viewed in Figure 2. The valve 69 being coupled to the drive shaft will also rotate in clockwise direction as viewed in Figures 2 to 5. Considering a line drawn from the axis of rotation of the shaft through the center of the eccentric portion as being a line drawn from the center of a clock face to 3 o'clock it will be seen that those cylinders in alignment with this line will be blocked off by the ends of the dividing wall 72 of the valve while those cylinders in the 9 to 3 o'clock zone will communicate with fluid line 9; as the shaft is rotated clockwise, the pistons of those cylinders will be impelled nearer to the center of the shaft by the springs with a result that there will be an inflow of oil through line 9, valve port 75, and valve passage 73 to these cylinders. Arrows have been provided to indicate the direction of flow through the pump on clockwise rotation of the drive shaft. On the other hand those cylinders in the 3 to 9 o'clock zone will have been previously filled with oil and on clockwise rotation will be displaced outwardly by the cam in opposition to spring pressure displacing the fluid therein which will pass through the valve passage 74 and valve port 76 to the fluid line 10. Thus, each piston in turn will be filled as it is forced inwardly by the spring, momentarily shut off, connected to the outlet, and forced out by the cam to discharge the fluid, again momentarily shut off, and, the cycle repeated. Obviously a reversal of the direction of rotation of the drive shaft will cause a reversal in the flow of fluid in the fluid lines 9 and 10 and hence in the direction of motion of a hydraulic motor device such as a gun elevating cylinder connected thereto.

It is possible that there may be some leakage longitudinally of the valve, from the circumferential grooves 48 and 49 in the valve chamber. To prevent any excess pressure from building up in the back end of the valve chamber and to equalize pressures on the two ends of the valve, pressure equalizing passages 77 are drilled longitudinally of the valve and communicate with both ends thereof. Any tendency to end thrust of the valve will thereby be avoided. Packing 78 is provided on the shaft 59 to prevent the escape of oil between the closure plate 61 and shaft while allowing the shaft to be freely rotated. To relieve any pressure which might tend to build up in the cam chamber bleeder valves 79 may be provided in the cam end of the valve, one of the bleeder valves being in alignment with each of the longitudinal passages 73 and 74. Since, depending on the direction of rotation, one or the other of these passages becomes an intake or low pressure pas-

sage two valves are provided in order that there will always be one conditioned to open to the low pressure side. If this provision were not made, the slight piston leakage which may reasonably be expected, might in time build up sufficient pressure in the cam chamber to partially overcome the force of the piston return springs resulting in a reduced piston stroke or possibly in an inoperative condition of the pump.

In order to eliminate air bubbles in the fluid and to insure cylinder filling at all times it is contemplated that the pump be operated in connection with a closed system, charged to a pressure preferably about 50 lbs. per square inch above atmospheric. To insure that the system be maintained full of fluid a reserve chamber 80 is provided in communication with the cam chamber. The reserve chamber 80 is provided with a one-way valve 81 at its bottom end through which fluid may pass freely into the system by way of the cam chamber and bleeder valves while its return therefrom will be prevented by the automatic closing of the valve when the system pressure is at least as great as that of the air trapped over the oil in the reserve chamber. Provision is made for replenishing the supply of oil and thus maintaining the pressure by means of a pressure gage equipped oil gun discharging into the system through the ball valve type oil fitting 82 located on the base of the reserve chamber.

Although the pump of this application is ideally suited to hand operation it is obviously not limited thereto. Such a pump has a minimum number of moving parts and is capable of delivering a smooth pulsationless flow if operated at high speeds by a motor or other source of power. The simple construction of this pump greatly reduces the cost of manufacture and makes it economical to use and to maintain.

I claim:

1. A pump comprising a body having a chamber, a pressure outlet, and a suction inlet at least one cylinder in said body radiating from the center of said chamber, a piston reciprocable in said cylinder, rotary means in said chamber to cause said piston to reciprocate, a valve chamber in said body coaxial with said chamber, a valve having two ports in said valve chamber and rotatable with said rotary means one of said ports being in communication with the pressure outlet of the pump and the other port being in communication with the suction inlet, and a pair of bleeder valves on said valve, one of said bleeder valves communicating between said chamber and one of said ports and the other of said bleeder valves communicating between said chamber and the other of said ports, whereby the particular one of the said pair of bleeder valves in communication with the said suction port serves to relieve the pressure in the said chamber.

2. A pump as described in claim 1, said valve being penetrated longitudinally by pressure equalizing passages whereby unbalanced pressures which might tend to cause axial movement of said valve may be relieved.

3. In a hydraulic pump, a cylindrical chamber, at least one pump cylinder radiating outward from the chamber, a piston in the chamber, driving means for the piston, a shaft centered in the chamber and rotatable to operate the driving means, a rotatable valve in one end of the chamber, and a coupling between the shaft and the valve, the coupling being movable transversely of the shaft on a diameter thereof and being

movable transversely of the valve on a diameter thereof, said diameters being substantially 90° apart.

4. The invention as in claim 3, in which the coupling is a member having a slot in one face and a protruding tongue on its opposite face, the slot and tongue being substantially 90° apart and being adapted to cooperate with a corresponding tongue and a corresponding slot in the valve and shaft.

5. In a hydraulic pump, a cylindrical chamber, a pump cylinder radiating outward from the chamber, a piston reciprocable in the chamber, a shaft rotatable in the chamber, eccentric means on the shaft to drive the piston, means to bias the piston into contact with the eccentric means, a rotary valve at one end of the chamber, and a coupling between the shaft and the valve, the coupling being movable transversely of the shaft on a diameter thereof and being movable transversely of the valve on a diameter thereof, said diameters being substantially 90° apart.

6. The invention as in claim 5, in which the coupling is a member having a slot in one face and a protruding tongue on its opposite face, the slot and tongue being substantially 90° apart and being adapted to cooperate with a corresponding tongue and a corresponding slot in the valve and shaft.

7. A pump adapted for operation in a closed fluid system, comprising a body having a chamber, a pressure outlet, and a suction inlet, at least one cylinder in said body radiating from the center of said chamber, a piston reciprocable in said cylinder, rotary means in said chamber to cause said piston to reciprocate, a valve chamber in said body coaxial with said chamber, a valve having two ports in said valve chamber and rotatable with said rotary means, one of said ports being in communication with the pressure outlet of the pump and the other port being in communication with the suction inlet, a pair of bleeder valves on said valve, one of said bleeder valves communicating between said chamber and one of said ports and the other of said bleeder valves communicating between said chamber and the other of said ports, whereby the particular one of the said pair of bleeder valves in communication with the said suction port serves to relieve the pressure in the said chamber, means containing a reserve fluid supply adapted to be placed in communication with said chamber, and means to apply pressure to said reserve fluid-supply-containing means whereby fluid losses in the closed fluid system in which said pump is adapted to operate may be replenished as they occur.

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