May 15, 1951 S. D. ALONSO 2,552,703

DOUBLE-ACTION DUPLEX PUMP

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FIG. 1.

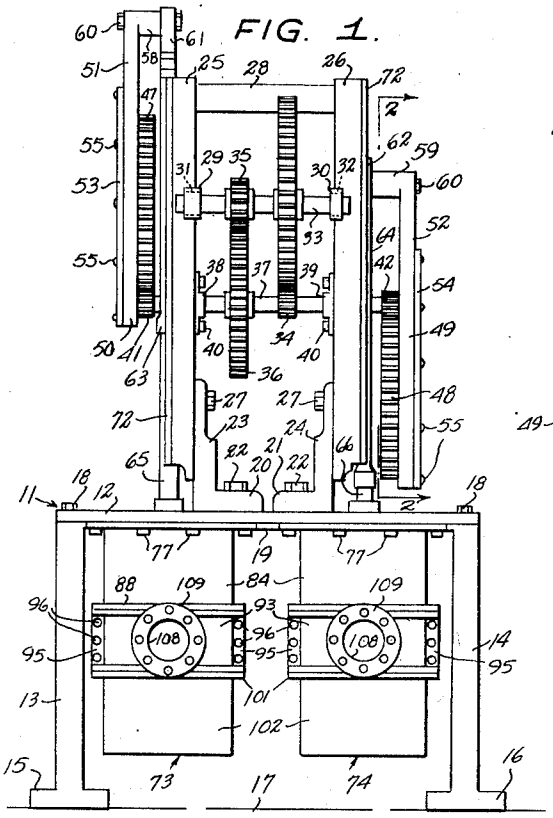


FIG. 2.

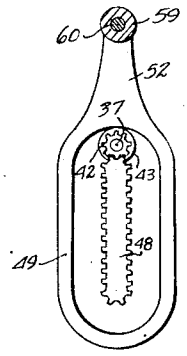


FIG. 3.

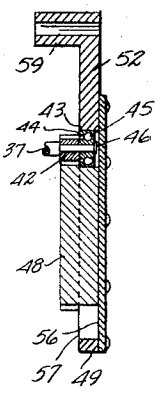


FIG. 4.

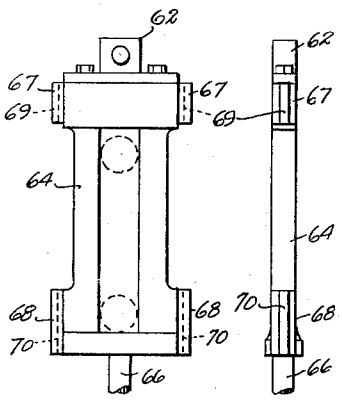
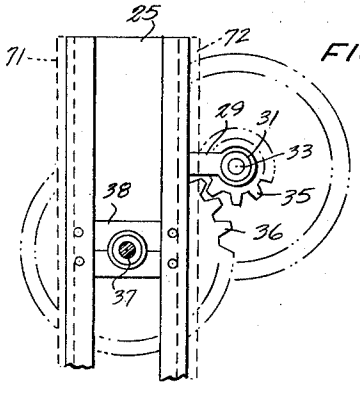


FIG. 5.

FIG. 6.



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FIG. 7.

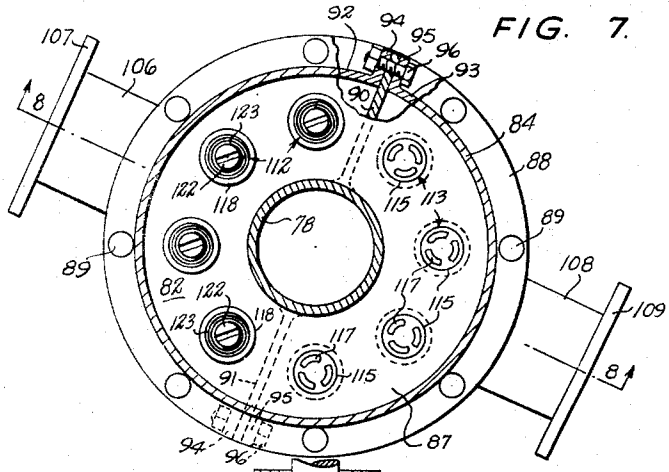


FIG. 9.

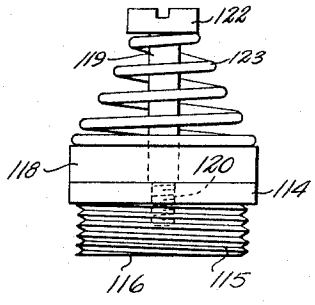


FIG. 8.

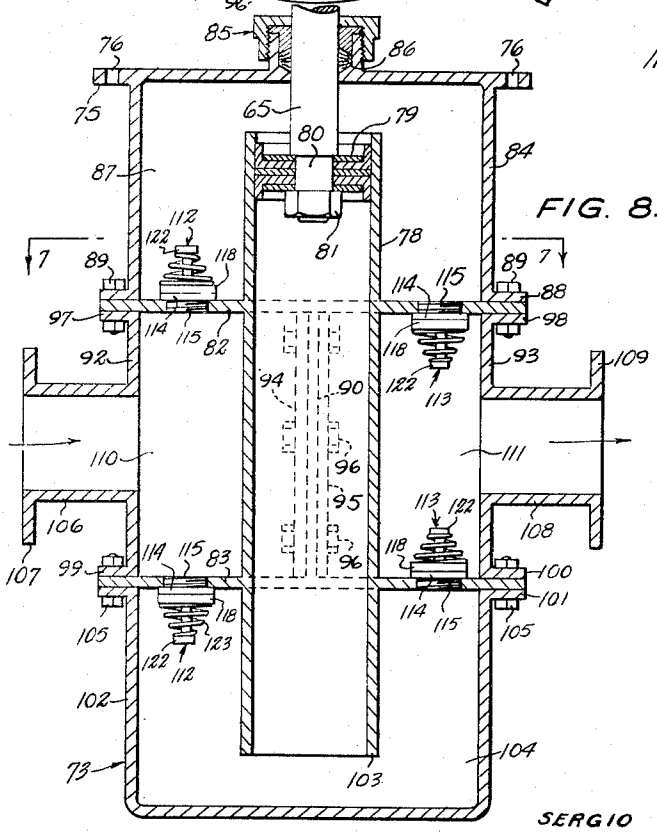
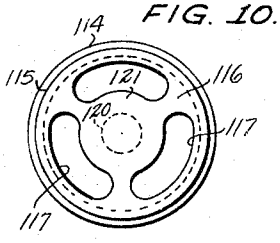


FIG. 10.



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DOUBLE-ACTION DUPLEX PUMP

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Application August 31, 1948, Serial No. 46,957
In Cuba September 13, 1947

4 Claims. (Cl. 103—177)

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This invention relates to reciprocating pumps, and particularly to double-action duplex pumps having two cylinders which are each connected with end chambers and intermediate intake and discharge chambers connecting with the latter through groups of valves.

The main object of my invention is to provide a double-action duplex pump which is smooth running and highly efficient in operation by virtue of the balanced and compact arrangement of the parts of the apparatus.

Another object is to provide pump apparatus with a pair of cylinder chambers mounted upon a common supporting frame with each cylinder chamber communicating at the ends thereof with separate end chambers alternately forming auxiliary intake and discharge chambers, while duplex operating mechanism serves to reciprocate the pistons in the cylinder chambers and surmounts the supporting frame.

Another object is to mount a main intake chamber and a main discharge chamber as an intermediate unit between the end chambers associated with each cylinder chamber and to provide one of the two main chambers with an intake pipe and with intake valves communicating with both end chambers and the other main chamber with a discharge pipe and with outlet valves communicating with both of the same end chambers.

It is a further object to provide such a double-action duplex pump in particularly compact form by disposing the operating parts in a vertical arrangement and thereby saving floor space and avoiding wear and tear on any side portions due to the effect of the force of gravity which would be the case if the parts operated in horizontal direction.

Other objects and advantages of my invention will appear in further detail as the specification proceeds.

In order to facilitate ready comprehension of this invention for a proper appreciation of the salient features thereof, the invention is illustrated on the accompanying drawings forming part hereof, and in which:

Figure 1 is a front elevation of a double-action duplex pump made according to the invention and embodying the same in a practical form;

Figure 2 is a section taken on line 2—2 in Figure 1, showing the main portions of an elongated rack-and-guide frame with a pinion engaging with the rack;

Figure 3 is a vertical central section of the oblong rack-and-guide frame of Figure 2;

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Figure 4 is a side elevation of one of the vertically-slidable crossheads surmounting the piston rods of the apparatus;

Figure 5 is another elevation of the same crosshead as seen from the right in Figure 4;

Figure 6 is a fragmentary elevation as seen from the left in Figure 1, with the upper left crosshead and the oblong rack-and-guide frame removed to illustrate the mounting of two of the operating shafts and their gearing;

Figure 7 is a transverse section on an enlarged scale of one of the cylinder assemblies of Figure 1, but as particularly indicated on line 7—7 in Figure 8;

Figure 8 is an enlarged vertical section of the same cylinder assembly taken on line 8—8 in Figure 7;

Figure 9 is an enlarged elevation of one of the intake or discharge valves shown in plan view in Figure 7 and on a reduced scale in Figure 8 in front elevation;

Figure 10 is a bottom plan view of the valve of Figure 9.

Throughout the views, the same reference numerals indicate the same or like parts.

Ordinary reciprocating pumps are, of course, well known with their drawbacks of more or less fitful delivery of the fluid pumped due to the use of but one cylinder in many cases, and also their ungainly structure with long operating parts which waste space and power. Upon considering this situation, and particularly the desirability of having an efficient pump which is reasonably compact in structure and which also has a smooth, efficient delivery of fluid, it has occurred to me that primarily each cylinder should be connected to end chambers which in turn are connected to intake and discharge chambers located intermediate said end chambers, all these chambers, together with the cylinders, forming a cylinder assembly, and then using two such cylinder assemblies operating alternatively and provided with appropriate operating means so that a new high in efficiency in pumps would be attained.

As a result, I have succeeded in evolving a vertically-arranged, double-action duplex pump which generally avoids the drawbacks of conventional pumps and fulfills the foregoing objects in a satisfactory manner, as will now be particularly explained in the following:

Hence, in the practice of my invention, and referring again to the drawings, the supporting frame, generally indicated at 11, primarily includes a horizontal supporting plate 12, upright

pedestal supports 13, 14 having the stabilizing feet 15, 16 which may be secured to the floor or foundation 17 by means of screws or bolts, if desired, while on the other hand, the supporting plate 12 may be secured in place upon the pedestal supports 13 and 14 by means of screws or bolts 18, 18, for example, while horizontal frame portions 19 beneath plate 12 serve to reinforce the latter. Upon the intermediate portion of support plate 18 of frame 11 are secured a pair of oppositely-directed angle members 20, 21 by means of bolts or screws 22, 22 with the upright portions 23, 24 secured to and supporting a pair of corresponding upright frames 25, 26 by means of screws or bolts 27, 27, the upper ends of these frames 25 and 26 being bridged and secured together by means of a cross-member 28 which may well be a tie rod if so desired, and serving to space the frame members 25 and 26 accurately apart and thereby also causing one frame member to reinforce the other. From the near edges of the frame members 25 and 26, as seen in Figure 1, rigidly extend a pair of bearings supports 29, 30 for bearings 31, 32 rotatably supporting a shaft 33 upon which is mounted a driven gear 34 and a pinion 35. The gear 34 may be meshed with a driving gear or pinion of a motor shaft or other prime mover, or may be substituted by a pulley and driven by a belt from a power shaft or a pulley on a motor or other prime mover, but in any event, shaft 33 is driven from an outside source of power. Pinion 35 meshes with a gear 36 fixed on a driven shaft 37 rotatably mounted in bearings 38 and 39 secured to frame members 25 and 26 by means of screws or bolts 40, 40, etc., the shaft 37 projecting out through both frame members and being provided upon the ends thereof with a pair of equal pinions 41, 42, and beyond each pinion with a guide roller 43 in each case, as best seen in Figures 2 and 3. The shaft 37 may have the roller 43 mounted directly thereon for rotation, but preferably a ball race 44 is fixed thereon for a series of ball bearings 45, while the roller itself forms the outer ball race riding on said ball bearings. Upon the end of the shaft 37 is a stop 46 at each end serving to retain the inner ball race 44 in position to prevent accidental displacement thereof, both the ball race and pinion 41 or 42, as the case may be, being held fast on the shaft to rotate positively therewith.

Each of the pinions 41 and 42 meshes with the oblong racks 47 or 48, while the outer race or roller 43 rolls against the correspondingly-oblong guide wall 49 or 50 of the two pendent rack guide members or frames 51, 52 having the outside plates 53, 54 secured thereto by means of screws 55, 55, etc., in order to support the racks 47 and 48 and connect them rigidly with the frame portions 49 and 50, each rack being undercut, as indicated at 56 in Figure 3, to provide the groove 57 between the lower undercut portion of the rack and the guide wall 49 or 50, as the case may be. Upon the upper ends of rack guide frames 51 and 52 are inwardly-directed, integral hubs 58, 59 pivotally mounted by means of pivot bolts 60, 60 to the upper ends 61, 62 of a pair of vertically-slidable piston crossheads 63, 64 rigidly connected at their lower ends with piston rods 65, 66. The upper and lower ends of the slidable crossheads 64 at the sides thereof are provided with vertically-slotted guides 67, 67, 68, 68 provided with the outwardly-open grooves or slots 69, 69, 70, 70 adapted to engage slidably with the inner opposite edges of guide plates 71, 72 screwed or

bolted or otherwise secured to the upright frame members 25, 26. Obviously, the crosshead 63 is similarly constructed as just described in connection with crosshead 64, and the vertical movement of the crossheads corresponding exactly with the vertical sliding movement of the piston rods 65 and 66.

The structure thus far described, except for the piston rods, is wholly mounted above the frame 11 on supporting plate 12, while the piston rods extend through this plate down into cylinders which are now about to be described. Upon the under side of plate 12 are fixed a pair of cylinder assemblies, generally indicated at 73, 74, each of which is provided with a flange 75 at the upper end thereof with apertures 76, 76 through which bolts or screws 77, 77 extend into plate 12, thereby suspending the cylinder assemblies 73 and 74 rigidly to said plate. If we now turn our attention specifically to the cylinder assembly 73 shown in enlarged form in Figures 7 and 8, it must be understood beforehand that the cylinder assembly 74 is identical in all respects with the same, so that description of one will also describe the other. The cylinder assembly primary includes the internal cylinder 78 in which a piston 79 secured upon the lower end of piston rod 65 is reciprocable, the lower end 80 of the piston rod being reduced and provided with a nut 81 screwed upon the threaded portion of the lower end 80 of said rod, this feature of construction being rather conventional and therefore need not be dwelt upon in further detail. Upon the cylinder 78 are spaced-apart a pair of integral flanges 82, 83 forming partitions defining chambers, as will now appear. Over the upper end of the cylinder 78 is mounted a downwardly-open end chamber container 84 with the upper end thereof provided with a gland, generally indicated at 85 and containing a packing 86 for piston rod 65 which passes slidably through the gland and the packing into the upper resulting end chamber 87. The upper flange 75 by which the unit as a whole to secure it to the supporting plate 12 of frame 11. At the lower end of container 84 is an integral flange 88 resting directly upon the partition flange 82 of the cylinder and being bolted thereto by means of bolts 89, 89 which incidentally serve a further purpose. Intermediate the two partition flanges 82 and 83 are located a pair of vertical opposite flanges or partitions 90, 91 also integral with the cylinder 78 and at their upper and lower end with the flanges 82 and 83. Furthermore, a pair of semi-circular shells 92, 93 provided along their vertical edges with outwardly-extending flanges 94, 94, 95, 95 are disposed between the upper and lower flanges 82 and 83 of the cylinder 78 in such position as to locate the mentioned flanges 94, 95 on the opposite sides of the ends of partition walls 91, 91 to which they are bolted by means of bolts 96, 96. In addition, the mentioned shells 92 and 93 are provided on their upper and lower edges with flanges 97, 98, 99 and 100, the upper flanges 97 and 98 being secured to the upper horizontal flange 82 of cylinder 78 by means of the previously-mentioned bolts 89, 89 which also secure the upper end chamber or container 84 to this flange 82. The lower flanges 99 and 100 engage against the upper surfaces of the lower flange or partition 83 integral with cylinder 78, while below the same flange is fixed the flange 101 of a lower end container 102 surrounding the lower end 103 of the cylinder and providing the end chamber 104

about the same. The mentioned flanges 99 and 100 and flange 101 are secured to the integral flange or partition 83 of the cylinder by means of bolts 105, 105 similar to bolts 89 already mentioned. In addition to the foregoing features of the intermediate unit formed by the shells 92 and 93, it should be pointed out that the shell 92 is provided with an inlet pipe 106 terminating externally in a flange 107 by which it may be bolted to a longer pipe or some other source of fluid to be pumped, while the other shell 93 is similarly provided with an outlet or delivery pipe 108 also provided with a flange 109 similar to flange 107 by which to bolt it or connect it to further piping or a system to be supplied with fluid pumped by the apparatus. Due to the presence of the vertical partition walls 90, 91, the space about cylinder 78 within shells 92 and 93 is subdivided into an intake chamber 110 and a delivery or discharge chamber 111, periodically communicating with the end chambers 87 and 104 by means of a group of valves in partitions 83 and 82.

The mentioned valves are pressure-responsive valves generally indicated at 112, 112, extending into the end chambers 87 and 104 forming intake valves, while exactly similar outlet or discharge valves, generally indicated at 113, 113, also disposed in the same partitions 82 and 83, are so located as to project into the discharge or delivery chamber 111, all the valves being identical in construction, as now to be noted. Primarily, each valve includes a ring 114 having a threaded reduced portion 115 adapted to be screwed into the partitions 82 and 83 which have appropriately-tapped apertures therefor, the threaded portion 115 being hollow and having the end 116 thereof provided with a plurality of slots 117, 117 providing free passage for fluid through threaded portion 115 and ring 114. Surmounting the ring 114 is a disc 118 through which the shank 119 of a screw 120 extends slidably, the screw being screwed down into the central portion or body 121. The upper end of the screw is provided with a head 122 serving to retain a conical spring 123 in position between said head and disc 118 in order to bias the latter downwardly upon ring 114 so that the disc 118 will form a closure for the latter ring. It is evident that if fluid under pressure should enter the passages 117 and exert pressure against the under side of disc 118 against the bias of spring 123, the fluid would cause disc 118 to rise and pass fluid between said disc and ring 114 provided the pressure is sufficient to overcome the pressure of spring 123.

Returning now to the cylinder assembly 73 of Figure 8, it may be noted that the valves 112 extending into the end chambers 87 and 104 are all located at one side of the partition walls 90, 91 in the intermediate intake chamber 110 in such position that when fluid under pressure enters intake pipe 106, or rather when the pressure is removed from end chamber 104, for example, by the piston 79 reciprocating upwardly through cylinder 78, suction is produced within the mentioned chamber 104 causing the fluid entering through intake pipe 106 and intake chamber 110 to open the discs 118 of valves 112 and cause fluid to enter said end chamber 104 as long as the piston rises through cylinder 104. Simultaneously the piston will exert pressure upon the fluid in the cylinder above the piston, forcing said fluid into the upper end chamber 87, and thereby opening the discs 118 in valves 113 located in the upper partition or flange 82 and opening into delivery or discharge chamber 111 within shell 93, delivering the fluid into said chamber 111 and out through delivery pipe 108. When the piston 79 begins to descend through the cylinder, the previously-mentioned valves 112 in the lower partition 83 communicating with the intake chamber 110 will immediately be closed by the pressure of the fluid in the cylinder and lower end chamber 104, while the lower valves 113 will be opened by the fluid raising the discs 118 in those valves disposed within the delivery chamber 111 in lower flange 83, thus forcing fluid into the delivery chamber 111 and out through the delivery pipe 108.

Simultaneously suction will be produced in the upper end chamber 87 by the descent of piston 79, thereby allowing the fluid entering into pipe 106 and intake chamber 110 to raise the disc 118 of valves 112 in upper flange 82 communicating with said intake chamber so as to draw fluid into the end chamber 87 above said flange 82, while the suction simultaneously closes the other valves 113 in said flange or partition, these valves being also closed by the pressure exerted in delivery chamber 111 by the fluid entering from the lower end chamber 104. It is thus seen that two sets of valves are in operation at each stroke of the piston and for each stroke fluid is drawn into the intake pipe 116 and intake chamber 110 and propelled through one of the end chambers 87 or 104 to the delivery chamber 111 and out through delivery or discharge pipe 108, and as two cylinder assemblies 73 and 74 are used, the flow of fluid from the delivery pipes 108 and the corresponding pipe of the other assembly 74 is substantially constant during operation of the apparatus.

With regard to the upper operating mechanism, it might be well at this juncture to note the operation which provides vertical reciprocation of the pistons by means of the piston rods 65 and 66 in alternation. The arrangement is such that when the first gear 34 is rotated, as already outlined, from a motor or other prime mover, the pinion 35 will drive gear 36, rotating shaft 37 and pinions 41 and 42. These pinions are maintained in mesh with the oblong racks 47 and 48 by virtue of the rollers 43 rolling against the guide walls 49 and 50 with the result that when pinions 41 and 42 are continuously rotated, the pinions will first travel down along one side of the oblong racks 47 and 48 around the lower end thereof, and then up on the other side of the rack, then over across the top and down on the first side again, and this movement will be constantly repeated so long as the pinions rotate. It is obvious that when the pinion rotates alongside one row of teeth on the oblong racks, the pinion remains in the same axial position throughout, while the rack is thus forced to travel first upwardly and then downwardly, which naturally first lifts each of the frame members 51 and 52 and then draws them down again, and as these guide frame members 51 and 52 are pivotally connected by pivot bolts 60 to the upper ends 61 and 62 of piston rod crossheads 63 and 64, the latter crossheads will be first raised and then lowered, which will obviously raise and lower piston rods 65 and 66 and the piston 79 at the lower end of each cylinder within each cylinder assembly 73 or 74. The two guide rack frame members 51 and 52 are so relatively arranged with respect to each other that one is ascending while the other is descending, so

that one piston will be rising while the other falls, and vice versa, which provides a balanced movement of the parts which contributes to the smoothness of the delivery of fluid from the pump apparatus as a whole.

As may be seen in Figure 1, the two outlet pipes 108, 108 of both cylinder assemblies 73 and 74 are located upon the same side of the apparatus to facilitate connection to the same delivery pipe or system from the delivery chambers in both cylinder assemblies. While the semi-circular shells 93 and 92 have been shown clamped to vertical partitions 90 and 91 for convenience in assembling, it is manifest that other arrangements may be resorted to for assembling the intermediate unit.

Manifestly, other variations may be resorted to and parts and features may be modified or used without others within the scope of the appended claims.

Having now fully described my invention, I claim:

1. A double-action duplex pump including a supporting frame having a supporting plate thereon, two upright cylinder assemblages spaced apart beneath the supporting plate, a pair of pistons having piston rods extending vertically therefrom through said supporting plate, and driven means for reciprocating the piston rods and their pistons in alternation, said driven means comprising a pair of upright frame members fixed upon the supporting plate and spaced apart, a cross-bar securing the upper ends of the frame members together, a pair of vertical guide strips or plates spaced apart upon each upright frame member, a piston rod crosshead slidably mounted between each pair of vertical guide plates and rigidly secured to the upper end of one of the piston rods, a pair of bearings mounted on said upright frame members, a horizontal shaft rotatably mounted in said bearings and extending through the latter frame members, a pinion fixed upon each end of the shaft, a round guide member mounted on each end of said shaft exteriorly of the pinion thereon, an oblong rack having rack teeth on both sides and ends thereof meshing with each pinion, a correspondingly oblong guide frame surrounding each rack and engaged by the round guide member associated with a pinion respectively meshing with the rack involved, a plate securing each rack in position in its associated oblong guide frame, a hub extending rigidly from the upper portion of each oblong guide frame, and a pivot member pivotally connecting the upper end of each of the latter with the upper end of one of the piston rod crossheads to move the latter crossheads and piston rods with the guide frames when the latter are raised and lowered by rotation of said pinions, and said cylinder assemblages each including a vertical cylinder disposed beneath one of said upright fixed frame members and in which the piston associated with one of the piston rods and crossheads is reciprocable, the upper and lower ends of the cylinder being open, a pair of flanges or partitions fixed upon the cylinder in vertically spaced-apart relation, an end chamber enveloping the upper open end of the cylinder out of contact therewith, a peripheral flange upon the upper end of the end chamber secured to said supporting plate by which to suspend the entire cylinder assemblage therefrom, a second peripheral flange upon the lower end of said end chamber secured upon the upper flange or partition of the cylinder, a second end chamber enveloping the lower open end of the cylinder out of contact therewith and having a peripheral flange upon the upper end thereof secured to the lower flange or portion of said cylinder, an intermediate chamber unit disposed between the upper and lower flanges or partitions, a pair of upright partitions extending from one flange or partition to the other and dividing the interior of the intermediate chamber unit into an intake chamber and a delivery or discharge chamber, the intake chamber having an intake pipe connected thereto and the delivery chamber having a discharge pipe connected thereto, a plurality of spring-biased and pressure-responsive intake valves in each of the upper and lower flanges or partitions upon the cylinder providing communication with the intake chamber and both end chambers and projecting and opening into the latter, and a plurality of similar spring-biased and pressure-responsive outlet or discharge valves in both flanges or partitions of said cylinder providing communication between the discharge chamber and both end chambers and projecting and opening into said discharge chamber.

2. In a double action duplex pump, a frame, a pair of upright spaced cylinders positioned within said frame and supported therein adjacent the lower end thereof, a piston positioned within each of said cylinders and mounted for reciprocating movement, a piston rod having one end connected to each of said pistons and having the other end projecting from said cylinders, a horizontally disposed driven shaft positioned between the projecting ends of said piston rods and rotatably supported in the sides of said frame with the ends thereof projecting beyond said sides, a first cross head positioned in one side of said frame and mounted in the latter for vertical sliding movement, a first guide rack frame arranged exteriorly of said frame adjacent said first cross head and having one end pivotally connected to one end of said first cross head, a second cross head positioned on the other side of said frame and mounted in the latter for vertical sliding movement, a second guide rack frame arranged exteriorly of said frame adjacent said second cross head and having one end pivotally connected to the other end of said second cross head, each of said guide rack frames being provided with an endless gear track, and a pinion on each of the projecting ends of said shaft in meshing engagement with the gear track of the adjacent rack guide frame, said cross heads being disposed at different levels with respect to each other and each having its other end operatively connected to the adjacent projecting end of the piston rod.

3. In a double action duplex pump, a frame, a pair of upright spaced cylinders positioned within said frame and supported therein adjacent the lower end thereof, a piston positioned within each of said cylinders and mounted for reciprocating movement, a piston rod having one end connected to each of said pistons and having the other end projecting from said cylinders, a horizontally disposed driven shaft positioned between the projecting ends of said piston rods and rotatably supported in the sides of said frame with the ends thereof projecting beyond said sides, a first cross head positioned in one side of said frame and mounted in the latter for vertical sliding movement, a first guide rack

frame arranged exteriorly of said frame adjacent said first cross head and having one end pivotally connected to one end of said first cross head, a second cross head positioned on the other side of said frame and mounted in the latter for vertical sliding movement, a second guide rack frame arranged exteriorly of said frame adjacent said second cross head and having one end pivotally connected to the other end of said second cross head, each of said guide rack frames being provided with an endless gear track, a pinion on each of the projecting ends of said shaft in meshing engagement with the gear track of the adjacent rack guide frame, said cross heads being disposed at different levels with respect to each other and each having its other end operatively connected to the adjacent projecting end of the piston rod, and drive means rotatably supported within said frame and operatively connected to said driven shaft.

4. In a double action duplex pump, a frame, a pair of upright spaced cylinders positioned within said frame and supported therein adjacent the lower end thereof, a piston positioned within each of said cylinders and mounted for reciprocating movement, a piston rod having one end connected to each of said pistons and having the other end projecting from said cylinders, a horizontally disposed driven shaft positioned between the projecting ends of said piston rods and rotatably supported in the sides of said frame with the ends thereof projecting beyond said sides, a first cross head positioned in one side of said frame and mounted in the latter for vertical sliding movement, a first guide rack frame arranged exteriorly of said frame adjacent said first cross head and having one end pivotally

connected to one end of said first cross head, a second cross head positioned on the other side of said frame and mounted in the latter for vertical sliding movement, a second guide rack frame arranged exteriorly of said frame adjacent said second cross head and having one end pivotally connected to the other end of said second cross head, each of said guide rack frames being provided with an endless gear track, a pinion on each of the projecting ends of said shaft in meshing engagement with the gear track of the adjacent rack guide frame, said cross heads being disposed at different levels with respect to each other and each having its other end operatively connected to the adjacent projecting end of the piston rod, drive means rotatably supported within said frame and operatively connected to said driven shaft, said drive means comprising a rotatable drive shaft disposed in spaced parallel relation with respect to said driven shaft and adapted to be connected to a source of motive power, a drive gear carried by said drive shaft, and a driven gear carried by said driven shaft in meshing engagement with said drive gear.

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