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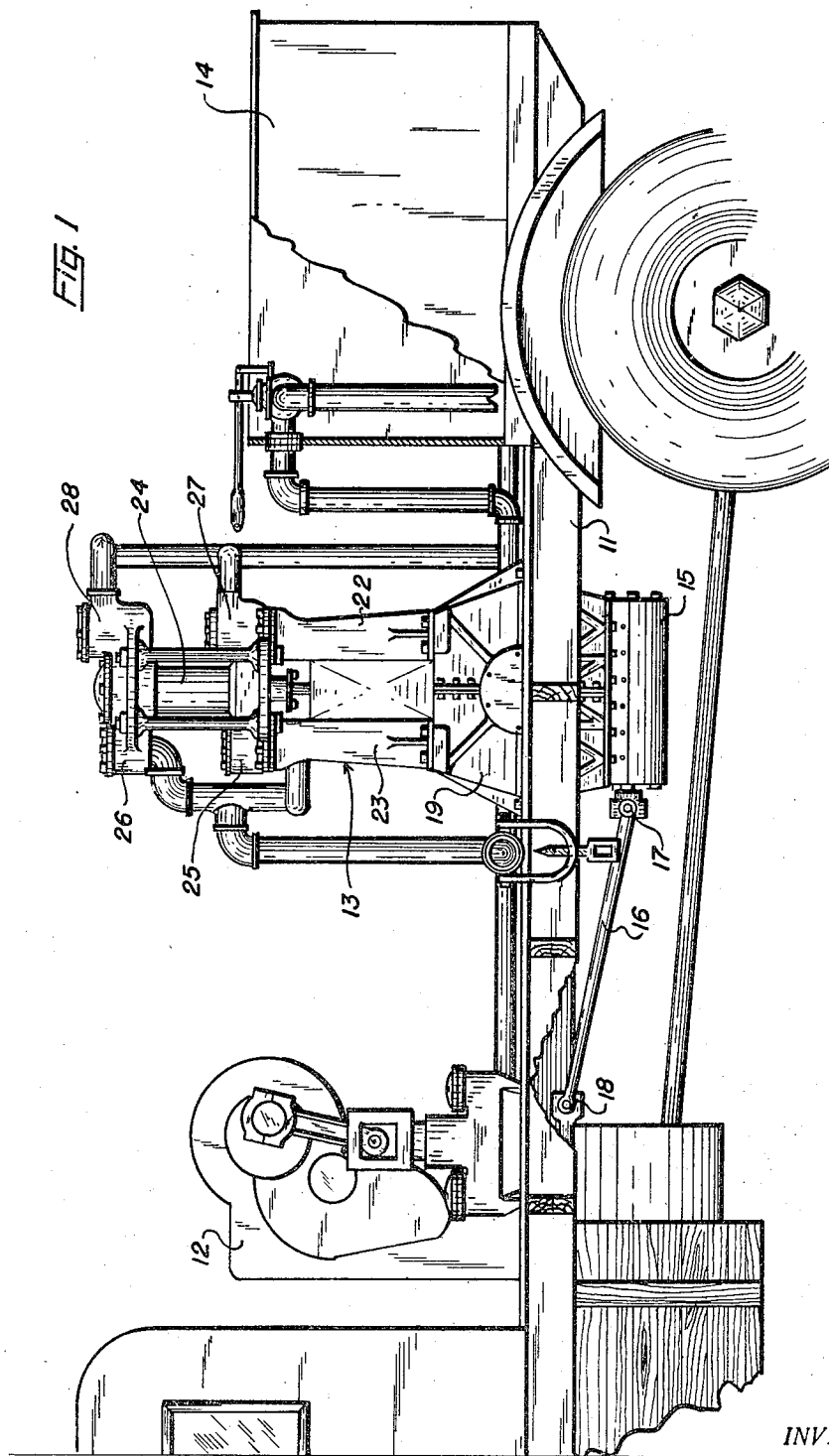
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2,216,573

PUMP

Filed June 23, 1938

4 Sheets-Sheet 1



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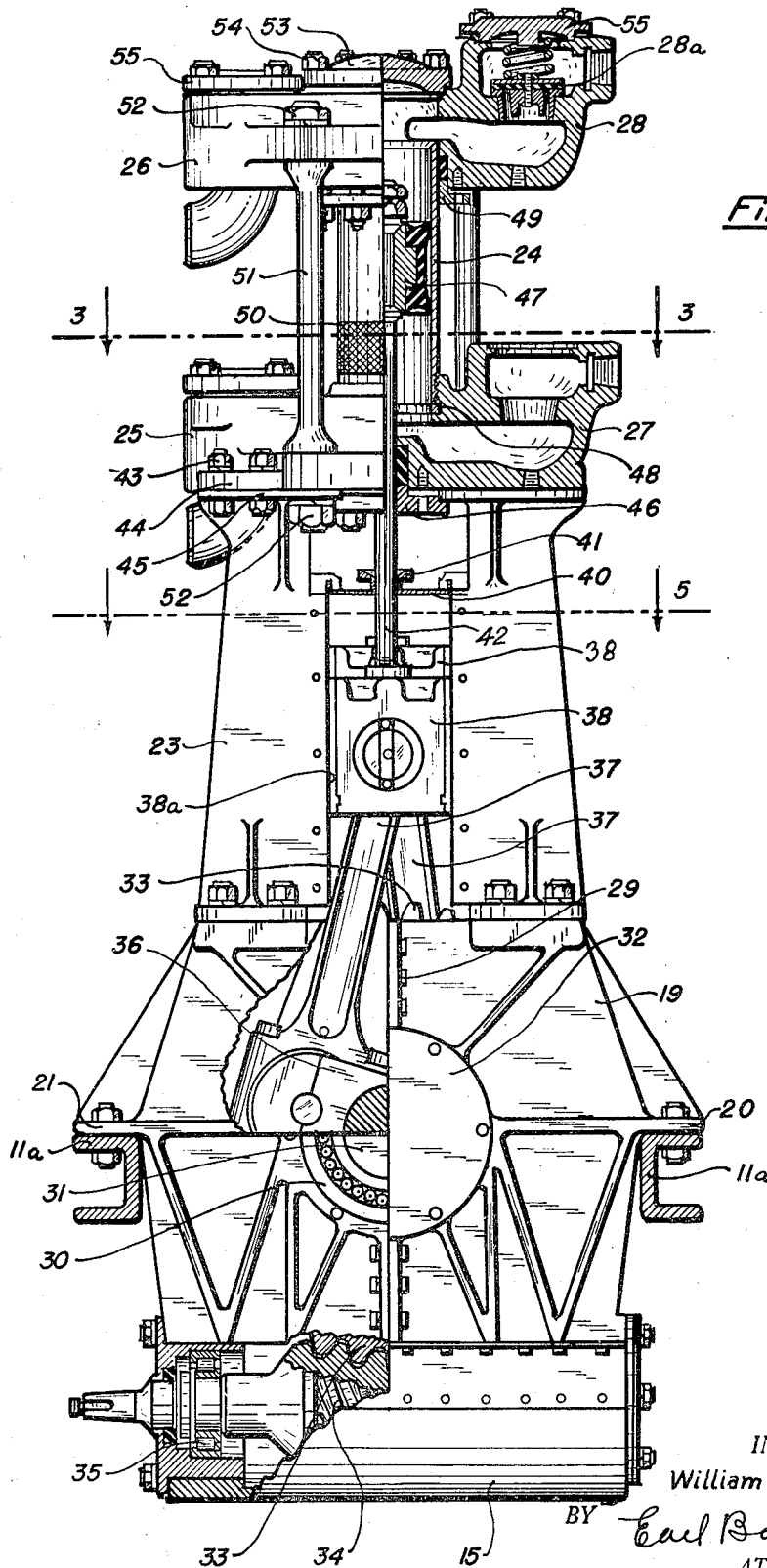


Fig. 2

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Fig. 3

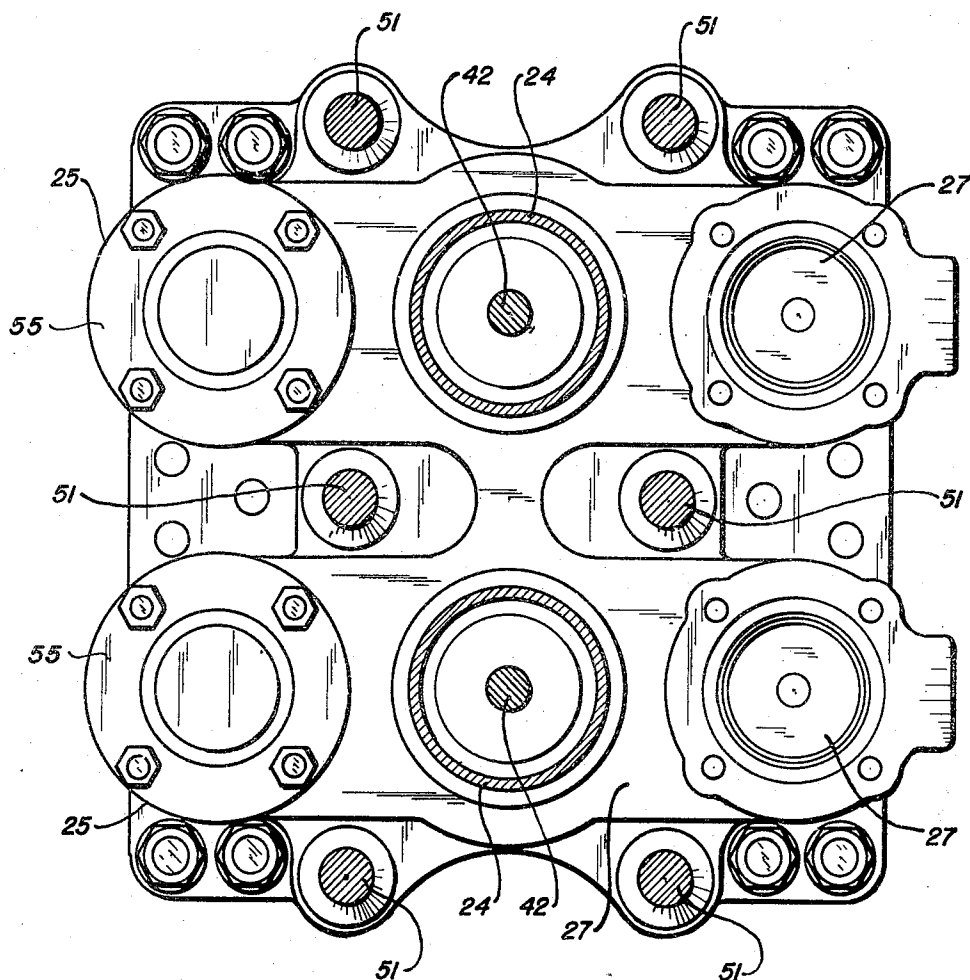
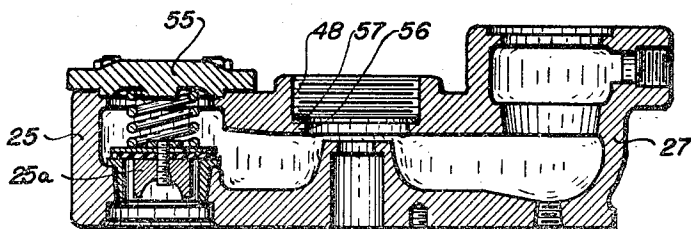


Fig. 4



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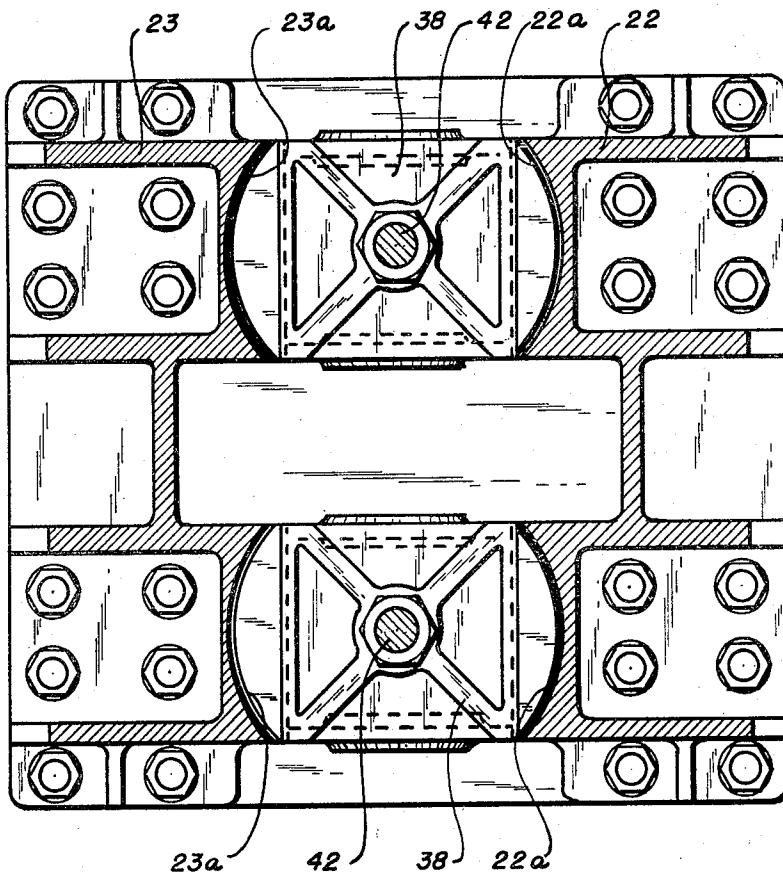
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4 Sheets-Sheet 4

Fig. 5



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Application June 23, 1938, Serial No. 215,355

5 Claims. (Cl. 103—175)

This invention relates to pumps, and more particularly to a pump adapted to be mounted upon a truck for use in pumping cement slurry or other heavy, viscous or abrasive liquid.

It is common practice, in the cementing of oil wells, and like applications, to mix cement by a jet of water and then deliver, under fluid pressure, the grout or slurry to the point where it is to solidify. The pumps used for this purpose are mounted upon a truck, together with tanks for measuring the water which is mixed with the cement, one pump being used to supply the water to the mixer and the other being used to pump the cement slurry into the well. Apparatus of this general nature is disclosed in the patents to Halliburton, Nos. 1,486,883 granted March 18, 1924, for "Method of hydrating cement and the like," and 1,500,385 granted July 8, 1924, for "Method of and apparatus for mixing materials."

The present invention is concerned primarily with a pump which can be used to pump cement slurry after it is mixed. The conditions met with in pumping cement slurry are exacting in that high pressures are sometimes encountered, the slurry is of an abrasive nature, is heavy and viscous and if not kept in motion is apt to lodge and solidify in various parts of the pump. Also, since the pump is mounted upon a truck which also carries a tank or tanks of water, excessive vibration due to the action of the pump causes the tanks to slop over and makes it difficult to measure accurately the amount of water used in the process of mixing.

Accordingly, it is an object of the present invention to provide a truck with a pump for cement slurry in which the construction is such that the vibration set up on the chassis of a truck is materially reduced as compared to pump arrangements heretofore employed for that purpose.

It is a further object of the invention to provide a pump suitable of withstanding high pressures and for pumping cement slurry or the like.

It is still a further object of the invention to devise a high pressure duplex double acting piston pump in which the fluid ends are divided and held together with tie rods.

It is still another object of the invention to devise a duplex double acting piston pump in which the valve pots are not integral with the cylinder so that the cylinder may be easily removed and any leaks past the outer wall of the cylinder may be easily detected.

It is still another object of the invention to

devise a duplex double acting piston pump in which the fluid passages are large and relatively straight so that the fluid, as it passes through is not apt to become stationary in any portion thereof.

It is still another object of the invention to devise duplex double acting piston pump in which no liner is employed, the cylinder itself being replaceable and taking the place of the liner commonly employed in pumps of this nature. The advantage of this construction results primarily from the fact that in previous pump designs for similar purposes the liner soon becomes cemented in place in the cylinder and is very difficult to remove.

Other objects and advantages reside in certain novel features of the arrangement and construction of parts as will be apparent from the following description taken in connection with the accompanying drawings, in which:

Figure 1 is a view in side elevation of a portion of a cementing truck showing a pump constructed in accordance with the principles of the present invention mounted thereon;

Figure 2 is a view in side elevation of the pump of Figure 1, the upper portion of the pump being shown in quarter section and the lower portion being partially cut away to illustrate the construction.

Figure 3 is an enlarged cross-sectional view of the pump of Figure 2, the view being taken on the lines 3—3 thereof;

Figure 4 is a vertical cross-sectional view of one of the valve castings; and

Figure 5 is an enlarged cross-sectional view of the pump of Figure 2, the view being taken on the line 5—5 thereof.

Referring to the drawings in detail, it will be seen that a portion of a chassis of a truck is shown at 11 in Figure 1, there being a mixing pump shown at 12 and a slurry pump designated generally at 13 mounted thereon, together with a water tank 14 and the pipes and valves necessary to make the desired connections to the pumps.

The present arrangement is primarily concerned with the pump designated 13. The practice, heretofore, has been to mount the slurry pump horizontally upon the truck, this being thought necessary in order to distribute the weight of the pump evenly upon the truck frame. In accordance with the present invention and as shown in Figure 1, the slurry pump is mounted vertically upon the truck frame with the fluid end or cylinders above the power end, the entire pump

being hung in a special cradle in the frame of the truck so that its center of gravity is no higher than in the case of a horizontal pump and so that the center of gravity of the pump is approximately over the center line of the chassis.

As shown in Figure 2 the pump 13 is designed as to be driven by a worm gear 34 carried by a housing 15 mounted on the bottom of the main housing. The worm gear is mounted in an angular contact thrust ball bearing (not shown) and a straight roller bearing 35 (shown in Figure 2). The bearings may be of any known type. The worm gear is driven by means of a torque tube 16 provided with universal joints 17 and 18, the joint 18 being connected directly to a power take-off on the truck and the joint 17 being splined or otherwise connected to the worm gear shaft. As shown in Figure 2, the main housing 19 for the gears on the power end of the pump is provided with flanges 20 and 21 which are adapted to rest upon and be bolted to transversely extending structural members 11a which form a part of the chassis or frame 11 of the truck. The entire weight of the pump is therefore supported upon these flanges 20 and 21.

Bolted to the upper portion of the housing 19 are two vertically extending cross-head guide members 22 and 23 which also serve as means for supporting the cylinders 24 of the pump and the valve pots 25, 26, 27 and 28. Since the pump is of the duplex type and is double acting, it will be understood by those skilled in the art that there are, in all, two cylinders, two pistons, four suction valves, four discharge valves, two cross heads, two connecting rods and two cranks, the cranks being angularly spaced 90 degrees in accordance with the usual practice. Since many of these devices are duplicates, they have been given the same reference characters on the drawings.

The housing member 19 referred to above is made in two complementary flanged parts bolted together as shown at 29 in Figure 2. After these parts are bolted together the bore for the main bearing is drilled and the main bearing 30 placed therein. The main bearing 30 is of the roller type and supports the crank shaft 31, the housing being sealed by means of end plates on the opposite sides, one of which is shown in the drawings at 32. The shaft 30 carries a large gear wheel 33 which is in mesh with a worm gear 34. The shaft 31 also carries the two cranks 36 to the ends of which the connecting rods 37 are attached. The cross-heads 38 connected to the upper ends of the connecting rods 37 have portions fore and aft which are the segments of a cylinder, these cooperating with the inner surfaces of the cross-head guides 22 and 23 which are of double segmental cylindrical shape as shown in Figure 5. The shoes 38a of the cross heads are secured thereto by bolts and keys and are adjusted for wear by shims.

An unusual feature of the pump is the construction of the cross-head guides. These are best shown in Figure 5 and consist of two identical castings 22 and 23. Each casting is provided with vertically extending reinforcing flanges and upper and lower horizontally extending flanges which serve as means for bolting the guide members to the lower half of the fluid end and to the top of the housing 19, as shown in Figure 2.

The cylindrical surfaces 22a and 23a between which the cross-heads are confined are accurately bored before assembly, by mounting the mem-

bers 22 and 23 in a jig which holds them in exactly the same relative position which they occupy when mounted upon the housing 19.

The housings 15 and 19 are filled with sufficient oil to cover the worm gear. To prevent oil from splashing out of the housing covers 39 are secured to the cross-head guides 22 and 23, as shown in Figure 1 and it is preferable also to provide oil sealing plates between the cross-head guides above the cross-heads as shown at 40 in Figure 2, these plates having glands 41 through which the piston rods 42 extend.

Another important feature of the invention resides in the construction of the cylinders of the pump and the valve arrangement. The fluid end of the pump may be said to be divided into an upper and a lower half, these halves being similar but not identical. The construction of the lower half is shown in detail in Figures 3 and 4 and it will be understood that the upper half is the same except for differences noted hereinafter. The upper half constitutes the head end of the cylinder and the lower half the crank end.

As shown in Figures 3 and 4, the lower half of the fluid end consists essentially of a one-piece casting 25-27 having four valve pots, two of which are designated 25 and contain suction valves and two of which are designated 27 and contain discharge valves. This casting is preferably made of a chrome-nickel-molybdenum alloy steel and is heat treated to give it high strength and wear resisting properties.

In the bottom of this casting, as shown at 48 in Figure 2, provision is made for stuffing boxes for the piston rods 42 and the top is threaded, as shown at 48 in Figures 2 and 4, to provide means for connecting cylinders 24 thereto. In each cylinder receptacle, at the base of threads 48, a shoulder 56 is provided and a lead ring 57 is placed thereon and compressed by the beveled end of cylinder 24, as shown in Figure 2, to effect a seal.

The upper half of the fluid end is a single casting having two suction valve pots 26 and two discharge valve pots 28 and these are shaped similarly to those of the lower half. The cylinders 24 are not threaded to the upper casting, but merely extend through a gland in the bottom thereof as shown at 49 in Figure 2.

The lower valve pot casting 25-27 is bolted to the cross-head guides 22 and 23 as indicated at 43, this casting being provided with flanges 44 adapted to fit against the flanges 45 on the cross-head guides. Both the suction valve pots and the discharge valve pots employ identical valves. One of the suction valves is shown at 25a in Figure 4 and one of the discharge valves is shown at 28a in Figure 2. In both the suction and discharge valves, the fluid enters at the bottom of the pot and flows upwardly through the valve and then laterally out of the valve pot in the same general direction that it flowed in entering. The passages for the flow of fluid through the valve pots are thus comparatively straight and free from bends and without a reversal of direction, this valve arrangement thereby providing for internal efficiency, and there being little tendency for cement slurry to remain stationary in any part thereof and become solidified. Each valve pot is provided with its own lid so that the valve in any pot may be replaced without disturbing the others. The lids are designated 55.

The piston rods 42 extend upwardly through

the lower half of the fluid end and into the cylinders 24 to make connection with the pistons 47.

The pistons are of a known type and are provided with rubber packing members as illustrated.

Due to the fact that no liners are used, the cylinders 24 cooperate with the pistons directly and are made of steel and treated to be resistant to abrasion.

As mentioned above the upper end of the cylinders 24 are not screw threaded into the upper half 26—28 of the fluid end but merely extend into openings therein, the opening being packed off by a gland 48. Because of the construction at this point, any leakage between the cylinders 24 and the upper half of the fluid end is easily detected. At the same time the cylinders may be easily replaced since they may be removed from the lower half of the fluid end by merely unscrewing the same therefrom. To assist in this operation, it is preferable to provide a portion of the outside of each cylinder 24 with knurls such as are shown at 50 in Figure 2. The upper half of the fluid end is secured to the lower half and to the cross-head guides 22 and 23 by means of six tie rods 51 secured as by means of nuts 52 to flanges on the respective parts as illustrated. These tie rods also serve to secure the upper half of the fluid end to the cylinders and take the strain resulting from the pump pressure existing above the pistons within the cylinders.

The top of the upper half of the fluid end is provided with cylinder heads 53, these being secured as by means of the bolts 54. The openings in the upper half of the fluid end, when the cylinder heads 53 are removed, is sufficient to enable the cylinders 24 to pass upwardly therethrough. Therefore, the cylinders may be removed without disconnecting the tie rods 51.

In previously constructed heavy duty pumps it is customary to have all the valves in one casting. As described above, it will be seen that in the present arrangement the upper and lower fluid ends are divided and held together with tie rods. This presents the following advantages: The cylinders are easily removed, not being integral with the valve pots and doing away with the necessity of a liner; a lighter construction is provided in proportion to the strength; leaks past the outer wall of the cylinders are easier to detect since such a leak readily shows up at the gland 46; a smaller cylinder head can be employed, thus enabling the pump to handle higher pressures without danger of rupturing the cylinder head bolts; and numerous other advantages such as the reduction in overall weight and the elimination of the various difficulties resulting where a liner is used in a pump for conveying cement slurry, some of which are mentioned above.

It will also be seen that by the provision of a vertical pump, advantages result in connection with the truck, in that the weight is centrally located with respect to the chassis, which is not the case where a horizontal pump is employed; that the dynamic or inertia loads are principally vertical with respect to the spring suspension of the truck and that other components of the pump load are parallel to the chassis, which makes the whole inertia load correspond to the spring weight of the truck so that there is no component tending to rock the truck sidewise, thus making it much easier to make fluid measurements in the tanks on the truck. It will also be seen that part of the weight of the pump is swung through the chassis so that the center of gravity of the pump is lowered and that the

fluid end is above the power end of the pump and readily accessible for inspection or removal and replacement of parts.

While only one embodiment of the invention has been shown and described herein, it is obvious that various changes may be made without departing from the spirit of the invention or the scope of the annexed claims.

I claim:

1. A high pressure duplex double acting piston pump having its valve and cylinder assembly divided into a head end and a crank end, each end consisting of a single casting having two suction valve pots and two discharge valve pots integral therewith, cylinders connected to said crank end and extending into said head end, pecking for sealing the cylinders at the point of entrance into said head end, tie rods connecting the ends together and holding said cylinders in said head end, and cylinder heads secured to said head end, said cylinder heads being of greater diameter than said cylinders whereby the cylinders may be removed from the assembly by removing said cylinder heads, disconnecting the cylinders from said crank end and passing the same through said head end.

2. A high pressure double acting piston pump having its valve and cylinder assembly divided into a head end and a crank end, each end having a suction and a discharge valve pot integral therewith, a cylinder disposed between said ends and tie rods connecting said ends together and holding said cylinder in place in at least one of said ends.

3. The combination in a pump structure, of two cylinder head castings, each having intake and discharge valve pots formed as integral parts thereof, said castings being spaced apart and held in fixed relation to each other by a plurality of tie rods, a cylinder disposed between said tie rods and removably anchored at one end to the first of said castings, the second of said castings having an opening for the reception of the other end of said cylinder, said opening extending through said last mentioned casting so as to permit said cylinder to be withdrawn therethrough, and releasable sealing means between the unanchored end portion of said cylinder and said second casting, the arrangement being such that the exterior of said cylinder is manually accessible through the space defined by said castings and tie rods jointly, whereby to facilitate detachment of said cylinder from said first casting and its removal through said opening without dismounting said second casting.

4. The combination in a pump structure, of two cylinder head castings, each having intake and discharge valve pots formed as integral parts thereof, said castings being spaced apart and held in fixed relation to each other by a plurality of tie rods, a cylinder disposed between said tie rods, one end only of said cylinder being threaded into the first of said castings and thus removably anchored thereto, the second of said castings having an opening in registration with the other end of said cylinder and into which said other end projects, said opening extending through said second casting and large enough to permit said cylinder to be passed therethrough, and a stuffing box formed in said second casting to receive the unanchored end of said cylinder to form a releasable seal between said cylinder and said second casting, the arrangement being such that the exterior of said cylinder is manually accessible through the space defined by said cast-

ings and tie rods, jointly, whereby to facilitate detachment of said cylinder from said first casting and its removal through said opening without dismounting said second casting.

- 5 5. The combination in a pump structure, of two cylinder head castings, each having intake and discharge valve pots formed as integral parts thereof, said castings being spaced apart and held in fixed relation to each other by a plurality of tie rods, a cylinder disposed between said tie rods and removably anchored at one end to the

first of said castings, the second of said castings having an opening for the reception of the other end of said cylinder, and releasable sealing means between the unanchored end portion of said cylinder and said second casting, the arrangement being such that the exterior of said cylinder is manually accessible through the space defined by said castings and tie rods jointly whereby to facilitate detachment of said cylinder from said first casting.

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