

Aug. 10, 1943.

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2,326,378

SUBMERGED DOUBLE ACTING PUMP

Filed Jan. 8, 1940

2 Sheets-Sheet 1

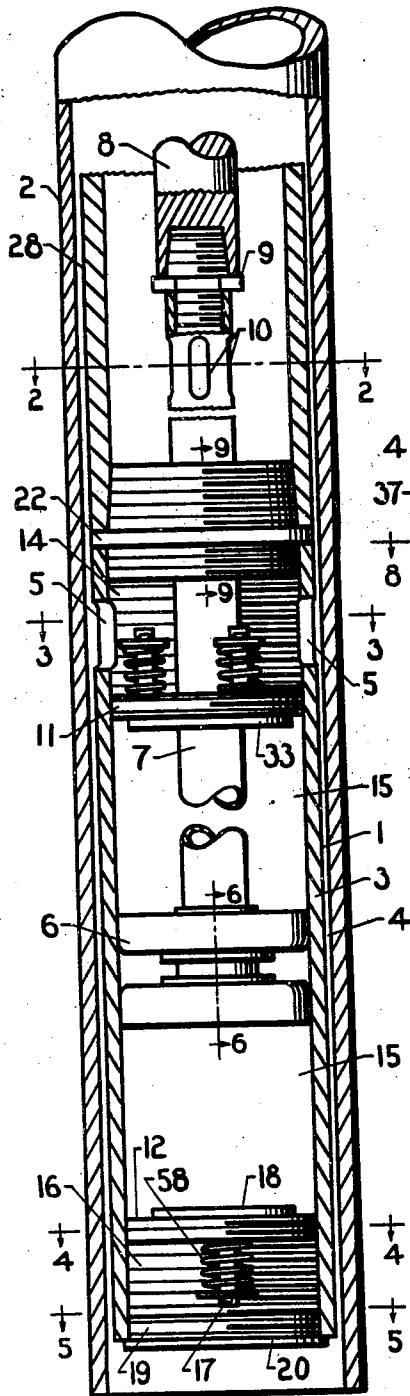


FIG-1

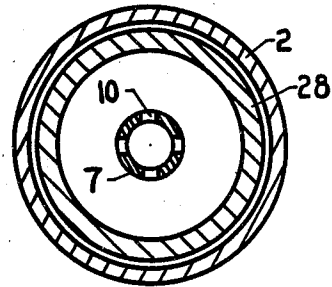


FIG-2

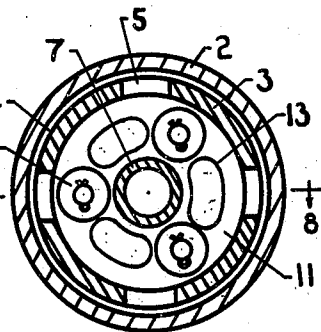


FIG-3

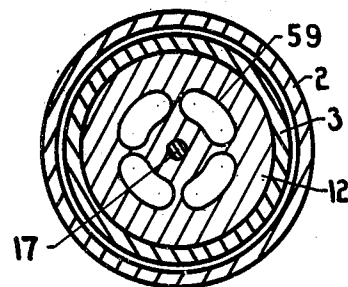


FIG-4

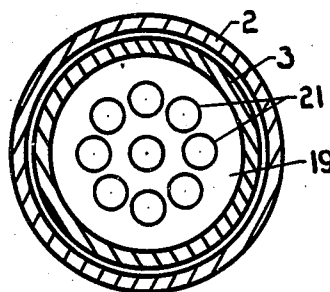


FIG-5

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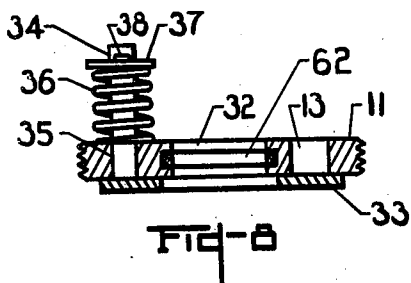
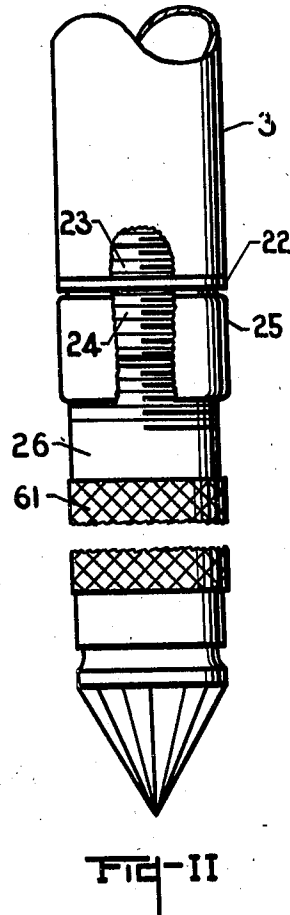
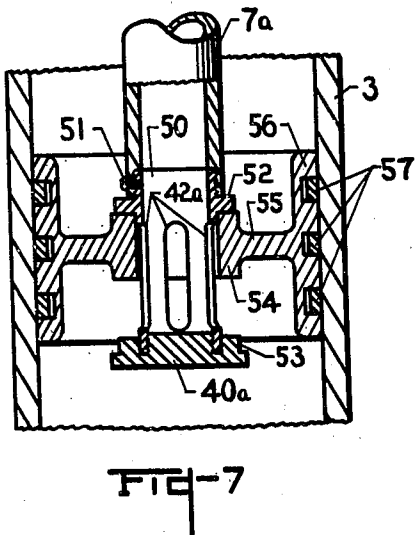
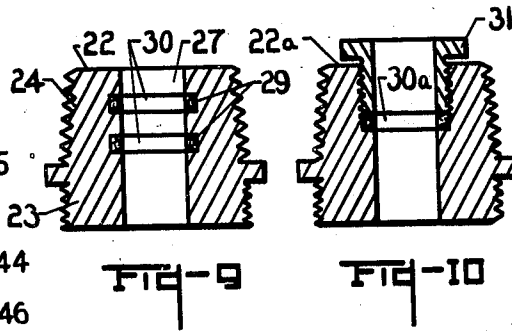
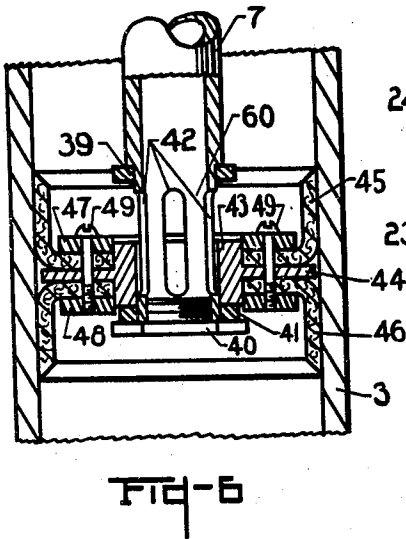
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SUBMERGED DOUBLE ACTING PUMP

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2 Sheets-Sheet 2



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SUBMERGED DOUBLE ACTING PUMP

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Application January 8, 1940, Serial No. 312,824

8 Claims. (Cl. 103—192)

The present invention relates broadly to pumps, and in its specific phases to double acting pumps of the type which, during operation, are submerged in the fluid to be pumped.

The pumps of the prior art adapted for submerged use have commonly been of single acting construction, and these, as well as the few double acting pumps of this type, have been of such cumbersome construction that a large diameter relatively expensive drive pipe was necessary where the pump was to be used in a driven well. This is typified by the complete absence from the market of a commercial double acting pump adapted for use in driven wells having a two inch drive pipe. These pumps also are commonly constructed with exposed lower inlet valves or inlet ports which facilitate clogging of the pump, injury of the pump's working parts from sand or gravel, and in many cases obstruction preventing the opening and closing of the lower inlet valve. Sliding sleeve inlet valves and hinged or other non-positive inlet valves have also been proposed and, as a consequence of this and other defects or shortcomings of the art, have resulted in the production of pumps which have exceptionally low efficiency based on bore and stroke computation. The present invention was devised in view of these difficulties, complexities, limited use adaptability, and shortcomings of the prior pump constructions.

Accordingly, among the objects of the present invention is the provision of a double acting pump of the submerged type adapted for a wide range of use and which is positive acting in operation and of simplified construction so as to not be readily susceptible to clogging or development of defects.

Another object of the present invention is to provide a double acting pump which has a high operating efficiency, and yet which is of simplified construction with resultant relatively low manufacturing cost and maintenance expense.

Another object is to provide each end of the cylinder of the double acting pump with internal threads adapted to receive peripherally threaded partition members, each of which carries an inlet valve and is adapted to be threadedly anchored completely within the cylinder.

Another object is to provide positive operating inlet valves within said cylinder adjacent both ends thereof.

A further object is to provide the cylinder with a single double acting valved piston which has a body member having cylinder wall contacting parts and a central portion adapted for endwise

sliding on a slotted portion at the end of the hollow plunger rod within the cylinder, the sliding of the body member assembly relative to the slotted end of the hollow plunger rod acting to open an outlet passageway from the interior of the cylinder to permit fluid from one end of the cylinder to flow therethrough while the piston also acts to draw fluid under suction into the other end of the cylinder preparatory to displacement of same in similar manner upon reversal of direction of movement of the plunger rod.

Still further objects and advantages of the invention will appear as the description proceeds.

To the accomplishment of the foregoing and related ends, the invention, then, consists of the means hereinafter fully described and particularly pointed out in the claims, the annexed drawings and the following description setting forth in detail certain means for carrying out the invention, such disclosed means illustrating, however, but several of various ways in which the principle of the invention may be used.

In said annexed drawings:

Figure 1 represents a partially sectional side elevational view of one form of the submerged type double acting pump of the present invention.

Figure 2 is a section taken along the line 2—2 of Figure 1 looking in the direction of the arrows.

Figure 3 is a section taken along the line 3—3 of Figure 1 looking in the direction of the arrows.

Figure 4 is a section taken along the line 4—4 of Figure 1.

Figure 5 is a section taken along the line 5—5 of Figure 1 looking in the direction of the arrows.

Figure 6 is a sectional assembly view of a preferred form of modified piston construction as taken at a position corresponding with line 6—6 of Figure 1.

Figure 7 is a sectional assembly view showing a modified form of piston construction.

Figure 8 is a partially sectioned view of the upper partition plate taken along the line 8—8 of Figure 3 looking in the direction of the arrows, with but one spring assembly shown for clarity of illustration.

Figure 9 is a center sectional view of a connector member for the end of the pump cylinder as taken along the line 9—9 of Figure 1.

Figure 10 is a central sectional view of a modified form of connector member for the end of the pump cylinder.

Figure 11 is a partially sectioned assembly view of the lower end of the pump cylinder with a well point mounted thereon.

Referring more particularly to the drawings, where the double acting pump 1 (Figure 1) is to be used in a conventional driven well, a suitable pipe or well casing 2 will be used. Under these conditions, the pump cylinder 3 will be of an outside diameter sufficiently smaller than the inside diameter of the well casing 2 to permit easy installation of same therein, as well as to provide a passageway 4 therebetween which will permit flow of fluid to the upper end of the cylinder 3 and into the interior of same through upper inlet ports 5. The double acting pump 1, however, is not limited to use inside of a well casing 2, since obviously it is adapted for submerged use in a conventional dug well, cistern, or body of fluid to be pumped.

The double acting pump 1 (Figure 1) includes a pump cylinder 3 with upper inlet ports 5. A piston 6 suitably mounted on a hollow plunger rod 7 is adapted for reciprocating endwise movement within cylinder 3 under the influence of endwise movement of piston rod 8 suitably connected to plunger rod 7, for instance, by means of a threaded connector member 9. Outlet means for fluid flowing through hollow plunger rod 7 is provided, and one conventional form of this consists of outlet slits or passageways 10 adjacent connector member 9. The inner surface of cylinder 3 at the ends thereof is preferably threaded a distance such that upper and lower partition plates 11 and 12, which are correspondingly threaded on their periphery, may be screwed thereinto a suitable distance, which in preferred construction will correspond with the end of the threads on the inner circumference of the cylinder 3. Threading the cylinder in this manner presents the advantage of allowing the upper and lower partition plates to be frictionally held in desired position due to binding action of the threads when the partition plates reach a position corresponding with the end of the threads in the cylinder. This provides a simplified positive construction which is highly advantageous from the manufacture, assembly, and maintenance standpoint.

The upper partition plate 11 in its final assembly position will preferably be slightly below upper inlet ports 5 to facilitate flow of fluid into the chamber 14 above upper partition plate 11 for relatively free flow under operating conditions through ports 13 (Figure 3) into the upper portion of the pumping chamber 15 of the cylinder 3, as will be hereinafter described. Construction in this manner also presents the advantage of protecting the inlet valve assembly from external interference.

The lower partition plate 12 in its preferred operating position will be sufficiently spaced from the lower end of cylinder 3 to provide a chamber 16 in which stem 17 of spring-held lower inlet valve 18 may freely operate without external interference.

To prevent the lower end of cylinder 3 from settling into the debris or relatively solid material at the bottom of the well in case the pump is dropped too far down the well, a protecting means is preferably provided so as to avoid interference with the operation of lower inlet valve 18. One preferred construction of this protecting means involves the use of a threaded disc 19 (Figure 1) having a shoulder 20 adapted to abut the end of cylinder 3 upon rotation into final position. To permit flow of fluid through disc 19, it is provided with perforations 21 (Figure 5) sufficiently small in size to prevent passage of

large pieces of gravel or rock therethrough, a thing which would interfere with the free operation of inlet valve 18.

Instead of using a threaded disc 19, the lower end of cylinder 3 may be provided with a connector member 22 (Figure 11) having externally threaded end projections 23 and 24, the first of these projections being adapted to threadedly engage the lower inner end of cylinder 3, while threaded projection 24 is adapted to receive the end of a coupling sleeve 25, which in turn is adapted to engage the upper end of a conventional well point 26 which is constructed with screen section 61 to separate gravel and sand from water or other fluid being drawn there-through. A central passageway 27 (Figure 9) through connector member 22 acts to connect chamber 16 in the end of pump cylinder 3 with the interior of well point 26.

A similar connector member 22 is preferably used at the upper end of cylinder 3 (Figure 1) for joining same to the lower end of production tube 28 which is adapted to carry the fluid being pumped to the surface or delivery spout (not shown). Where the connector member 22 is used at the upper end of the cylinder 3, its passageway 27 will be centrally located and of a size closely fitting, but permitting free endwise movement of hollow plunger rod 7 therethrough. To prevent leakage through passageway 27, packing grooves 29 may be provided and suitable packing 30, such as a leather ring, used therein. A modified construction for the connector member 22 is shown in Figure 10. This connector member 22a is counterbored at its upper end and threaded to receive a packing gland 31 adapted to compress packing 39a in accordance with standard packing gland practice.

The upper partition plate 11 (Figures 1, 3, and 8) is provided with a central passageway 32 which is preferably centrally located and of a size closely fitting, but permitting free endwise movement of hollow plunger 7 therethrough. The passageway 32 in preferred construction is grooved and provided with suitable packing 62 of leather or the like as a further aid in producing a fluid-tight joint with hollow plunger rod 7. Inlet ports 13 through partition plate 11 are provided, and these ports are normally closed by an annular valve plate 33 carrying upwardly projecting stems 34 which pass through and slidably fit suitable openings 35 in partition plate 11 between ports 13. Compression springs 36 are conventionally mounted on stems 34 and held in operable position as by means of washers 37 and cotter pins 38. The springs 36 used in this connection are preferably of mild tension which will normally hold annular valve plate 33 in closed position, but will allow same to readily lower to permit inflow of fluid through ports 13 under suction conditions produced by downward movement of piston 6. The spring 58 used in connection with lower inlet valve 18 is likewise preferably of mild tension sufficient to cause positive operation of the valve with very moderate resistance to the opening of the valve under conditions of flow of fluid into the pumping chamber 15. The use of mild tension springs at these points presents the advantage of reducing the force to be exerted in operating the pump with corresponding increase in efficiency of power input per unit of fluid pumped.

In one preferred construction, the lower end of the hollow plunger rod 7 is machined to a reduced uniform diameter for a short distance to

form a joiner member 60 on which a collar 39 (Figure 6) is pressed. The inner surface of joiner member 60 at its lower end is provided with threads adapted to cooperate with corresponding threads on short cap screw 40 which is adapted to press a collar 41 onto the lower end of joiner member 60 on plunger rod 7 and support same in that position. Joiner member 60 between collars 39 and 41 is provided with a plurality of longitudinal passageways or slits 42 which act as outlets for fluid from the interior of pump cylinder 3 into hollow plunger rod 7 for delivery to a point of use. These slits in preferred construction are a little shorter than the space between collars 39 and 41 and centrally located so as to form a land or solid portion adjacent each collar, a thing which facilitates a better seal against leakage under pumping operation. A piston body member 43 or hub with outwardly extending central flange 44 is mounted on joiner member 60 for a relatively tight, but free sliding fit throughout on the portion thereof between collars 39 and 41, the lower edge of body member 43 being adapted to form a tight seal on collar 41 when the body member is in its lowermost position. The upper end of body member 43 is likewise adapted to form a tight seal with collar member 39 when the body member is in its uppermost position. The use of the uniform outer diameter of joiner member 60 between collars 39 and 41, and a corresponding uniform bore through the body member of the piston as described facilitates smooth operation of the piston and aids in preventing leakage at the body portion thereof. Mounted in contact with the upper face of flange 44 of body member 43 is the turned flange of an upwardly directed cup leather 45 or the like, while the lower face of flange 44 is in contact with the turned flange of a downwardly directed cup leather 46 or the like. Suitable means are used for fastening the cup leathers 45 and 46 to flange 44, and a preferred construction for accomplishing this involves the use of upper and lower annular rings 47 and 48 with suitable openings through the assembly for receiving threaded screws 49 which are adapted to engage corresponding threads in annular ring 48. The use of rings 47 and 48 presents the advantage of continuous support for the turned flange of the corresponding cup leather with increased stability of the assembly. The lower ends of screws 49 may be hammered after assembly if desired to obviate any possibility of same working loose under operating conditions, and yet permit the removal of same for replacement of the cup leathers after they have become worn from long use. While only two cup leathers have been shown, the invention is not limited to that number, since obviously more than two could be used without departing from the spirit of the present invention.

A modified piston construction is shown in Figure 7. In this construction hollow plunger rod 7a instead of being machined to a smaller outside diameter at its end is internally threaded for a short distance to receive the end of a correspondingly threaded joiner member 50 which may be locked in place after assembly by means of a screw 51 if desired, a thing which will prevent joiner member 50 from working loose and dropping off of the end of hollow plunger rod 7a under conditions of use. Joiner member 50 adjacent its upper threaded end is provided with an integral collar 52. The lower end of joiner member 50 is internally threaded for engagement with a

correspondingly threaded short cap screw 40a which may carry a collar 53 as an integral part thereof. Longitudinal slits or passageways 42a are provided in body member 50 between collars 52 and 53. For purposes of attaining a better sealing action against leakage, the longitudinal slits 42a preferably terminate at their ends just short of the collars above and below same. A body member 54 with outwardly extending flange 55 carrying cylinder wall contacting skirt 56 is mounted on joiner member 50 for relatively tight, but free sliding fit thereon between collars 52 and 53, the lower edge of body member 54 being adapted to form a tight seal on collar 53 when the body member is in its lowermost position. The upper end of body member 54 is likewise adapted to form a tight seal with collar member 52 when the body member is in its uppermost position. The cylinder wall contacting skirt 56 is normally provided with packing members, and in preferred construction these consist of piston rings 57. The body members 43 and 54 with associated cylinder wall contacting parts are of interchangeable construction, and cap screw 40 with separate collar 41 may be interchanged for cap screw 40a with integral collar 53. While any conventional structural metal may be used in constructing the pump, the use of brass due to its non-rusting qualities is preferred when the pump is to be employed for pumping water.

The operation of the pump when pumping a fluid such as water is as follows: With the pump cylinder immersed in the water and the piston in lowered position, movement of the piston rod 8 in an upward direction will cause the hollow plunger rod 7 to move upward until the piston body member comes in contact with the lower collar 41, as is shown in Figure 6. Further upward movement of piston rod 8 will then carry piston 6 with it, and under these conditions, suction will be produced below the piston which will cause lower inlet valve 18 to open to permit water to flow into the lower end of the cylinder through ports 59 (Figure 4) in response to the suction therein. At the same time, upper inlet valve 33 (Figure 1) will be closed and upward movement of the piston will cause the water between same and upper partition plate 14 to flow through longitudinal slits 42 into and through hollow plunger rod 7 and out of outlet passageways 10 at the upper end thereof into production tube 28 through which it flows upward to the point of delivery upon continued pumping action. When the upper end of the pumping stroke has been reached, piston rod 8 moves downward and, due to friction of the piston on the cylinder wall, causes the joiner member on the lower end of the plunger rod to move downward through the body member of the piston until the latter comes in contact with the upper collar, as is shown in Figure 7, whereupon the piston 6 moves downward in unison with the downward movement of piston rod 8. Under these conditions, suction is produced above piston 6 and this causes the upper inlet valve 33 of upper partition plate 14 to open, thus permitting water to flow through ports 13 thereof in response to the suction above piston 6. At the same time, lower inlet valve 18 in lower partition plate 12 will be closed. Under these conditions, the water between piston 6 and lower partition plate 12, due to downward movement of the piston, will flow through the longitudinal slits in the joiner member into and through the hollow plunger rod and out of outlet passageways 10 at the upper end thereof into production tube

28 through which it flows upward to the point of delivery upon continued pumping action. At the end of this pumping stroke, reversal of movement of piston rod 8 will cause the same cycle of pumping operation to begin again.

Other modes of applying the principle of my invention may be employed instead of those explained, change being made as regards the mechanism herein disclosed, provided the means stated by any of the following claims or the equivalent of such stated means be employed.

I therefore particularly point out and distinctly claim as my invention:

1. In a pump, the combination which includes a cylinder internally threaded a short distance at both ends, externally threaded upper and lower partition plates, one at each end of said cylinder and threadedly engaging same substantially at the inner end of the threads thereof, inlet valve means for said cylinder, said valve means being separately mounted on both of said partition plates, a connector member for the upper end of said cylinder, said upper partition plate being substantially spaced from the connector member to provide a compartment therebetween, said cylinder having at least one passageway through the side thereof into said compartment between the connector member and upper partition plate, a plunger rod passing through said connector member and upper partition plate and forming a relatively fluid tight sliding fit therewith, a piston mounted on said plunger rod for reciprocation within said cylinder in the space between said inlet valve carrying partition plate assemblies, and an outlet means from said cylinder, said outlet means including a longitudinal passageway in said plunger rod with discharge outlet therefrom outside of said cylinder, and a valve means at said piston connecting said passageway first at one side of said piston and then the other to said cylinder for flow of pumped fluid from the latter.

2. In a double acting pump, the combination which includes a cylinder which is internally threaded a short distance at both ends, externally threaded upper and lower partition plates, one at each end of said cylinder and threadedly engaging same substantially at the inner end of the threads thereof, inlet valve means for said cylinder, said valve means being separately mounted on the inner face of both of said partition plates, a connector member for the upper end of said cylinder, said upper partition plate being substantially spaced from the connector member to provide an inlet compartment therebetween, said cylinder having at least one passageway through the side thereof into said inlet compartment between said connector member and said upper partition plate, a plunger rod passing through said connector member and said upper partition plate and having a relatively fluid tight sliding fit with both, a piston mounted on said plunger rod for reciprocation within said cylinder in the space between said inlet valve carrying partition plate assemblies, and an outlet means for said cylinder, said outlet means including a longitudinal passageway in said plunger rod with discharge outlet therefrom outside of said cylinder, said piston being mounted on the end of said plunger rod in manner permitting limited endwise movement thereon, and the end of said plunger rod having suitable openings therein to cooperate with said piston to provide outlet valve action in manner connecting said cylinder interior to said outlet passageway first on one side

of said piston and then the other in accordance with outlet requirements.

3. In a double acting pump, the combination which includes a cylinder which is internally threaded a short distance at both ends, externally threaded means, one at each end of said cylinder and adapted to engage said internal threads of said cylinder, a piston, a plunger rod, said externally threaded means at the upper end of said cylinder having a suitable central passageway through which said plunger rod is adapted to slidably pass and closely fit, said externally threaded means at the upper end of said cylinder also having inlet openings therethrough, an annular valve means within said cylinder and adapted to cooperate with said inlet openings to control the fluid flow therethrough in accordance with pumping requirements, said externally threaded means at the lower end of said cylinder having at least one inlet passageway therethrough, a valve means within said cylinder and adapted to cooperate with the inlet portion of said last named externally threaded means to control the fluid flow therethrough in accordance with pumping requirements, said externally threaded means at both ends of said cylinder extending therinto a sufficient distance to form an inlet compartment at each end of said cylinder and from which fluid can flow through said inlet passageways as required for pumping purposes, each of said compartments having at least one suitable inlet for flow of fluid therinto and thence through said respective valve controlled inlets through said externally threaded means, external means for protecting said lower inlet valve, means on the end of said plunger rod within said cylinder for mounting said piston for limited endwise movement thereon, said piston cooperating with the means on the end of said plunger rod so as to act both as a piston and an outlet valve, and an outlet means for said cylinder, said outlet means including a longitudinal passageway through said plunger rod with discharge outlet therefrom outside of said cylinder, said piston connecting the interior of said cylinder with the passageway through said plunger rod first on one side of said piston and then the other in accordance with the reciprocation of the plunger rod.

4. In a double acting pump, a cylinder, an inlet means at each end of said cylinder, each of said inlet means including a perforated partition member with a valve seat, a valve for each of said valve seats, a piston slidably mounted within said cylinder, said piston comprising a body member having a hub portion with a uniform cross-section longitudinal central passageway therethrough, means mounted on said body member for frictionally contacting the inner circumference of the cylinder wall and forming a sealed joint therewith under pumping action, said means comprising a pair of suitable size cup leathers, a radial flange extending from said body member, and means for gripping said cup leathers against said flange, a hollow plunger rod, the end of said plunger rod within said cylinder, for a short distance, being of a size adapted to closely, but slidably fit the passageway through the hub portion of the piston body member, and a pair of spaced-apart stop members on the inner end of said plunger rod, each extending completely around same, said hollow plunger rod being provided with a plurality of longitudinal slits between said stop members, said longitudinal slits terminating at each end just short of reaching said stop members to facilitate leakage resist-

ance, said piston body member being slidably mounted for limited travel on said hollow plunger rod between said stop members in manner such that when the body member is in contact with either stop member, a substantial portion of said slits will be exposed at the non-contacting end of the body member, the ends of said body member and the corresponding stop members having cooperating faces for forming a sealed joint when in contact with each other, whereby under pumping action said piston acts not only as a piston but a valve as well and hence facilitates highly efficient pumping action.

5. A pumping apparatus comprising a production tube, a pump cylinder, a connector member for joining the lower end of said production tube to the upper end of said cylinder, an upper partition plate within said cylinder and spaced from said connector member to form a compartment, means for fastening said partition plate in fixed position, said cylinder having openings through the sides thereof into said compartment, inlet valve means, said inlet valve means including an inlet valve mounted on said upper partition plate for permitting fluid flow from said compartment to the portion of the cylinder below said partition plate, means for closing said inlet valve at the end of flow of fluid from said compartment into said cylinder, a valve seat for said valve, a perforated inlet means at the lower end of said cylinder, a lower partition plate within said cylinder and spaced from said perforated means so as to form a compartment therebetween, means for fastening said partition plate in fixed position, an inlet valve means, said inlet valve means including an inlet valve mounted on said lower partition plate for permitting flow of fluid from said compartment into the space within said cylinder above said partition plate, means for closing said inlet valve at the end of flow of fluid from said compartment into said cylinder, a valve seat for said valve, a hollow plunger rod passing through said connector member and upper partition plate, said plunger rod having a relatively tight, but free sliding fit therewith, said plunger rod also having an inlet at its end within the cylinder and an outlet within the production tube, and a valved piston on the end of said hollow plunger rod within said cylinder and adapted to cooperate with the inlet on the end of said hollow plunger rod for flow of fluid therethrough for pumping action under reciprocating movement of said valved piston endwise of said cylinder and on said hollow plunger rod.

6. In a double acting pump adapted for submerged use while connected to a production tube, the combination of a pump cylinder internally threaded at each end, an externally threaded connector member for joining the lower end of said production tube to the upper end of said cylinder, a peripherally threaded upper partition plate within the upper end of said cylinder and held in place substantially at the lower end of said threads in the upper end of said cylinder, said upper partition plate being spaced from said connector member a sufficient distance to form a small compartment therebetween, said cylinder having passageways therethrough into said compartment, separate inlet ports through said upper partition plate, an annular inlet valve for said ports, spring means for normally holding said annular inlet valve in closed position, a perforated means connected to the lower end of said cylinder, an externally threaded lower partition plate within said cylinder and spaced from

said perforated means so as to form a small compartment therebetween, said lower partition plate being held in place substantially at the upper end of the threads in the lower end of said cylinder, inlet ports through said lower partition plate, an inlet valve for said ports, spring means for normally holding said inlet valve in closed position, a hollow plunger rod passing through said upper partition plate and joiner member, said plunger rod having a relatively tight, but free sliding fit therewith, said plunger rod also having an outlet at its end within the production tube, a piston slidably mounted within said cylinder, said piston comprising a cylinder wall engaging portion with a body member having a hub portion with a uniform cross-section longitudinal central passageway therethrough, the end of said plunger rod within said cylinder being of a size adapted to closely, but slidably fit the passageway through the hub portion of the piston body member, and a pair of spaced apart stop members on said plunger rod, each extending completely around same, said hollow plunger rod being provided with a plurality of longitudinal slits between said stop members, said longitudinal slits terminating at each end just short of reaching said stop members, said piston body member being slidably mounted on said hollow plunger rod between said stop members in manner such that when the body member is in contact with either stop member a substantial portion of said slits will be exposed at the non-contacting end of the body member, the ends of said body member and the corresponding stop members having cooperating faces for forming a sealed joint when in contact with each other.

7. A device of the class described comprising a pump cylinder, partition members within said cylinder and spaced a short distance from the ends of same, means for anchoring said partition members in place, inlet valve means for said cylinder, said inlet valve means being mounted on said partition members, a tubular plunger rod passing through one of said partition members, means on said partition member for producing a substantially fluid tight sliding fit with said plunger rod, a connector means for joining one end of said cylinder to a production tube, said connector means closely fitting said plunger rod while permitting same to freely slide therethrough, a piston mounted on said plunger rod for reciprocation within said cylinder, said piston having a single sliding body member with means on its periphery forming a sliding seal with the cylinder wall, said body member being longitudinally bored and faced at its ends, a joiner member on the end of said tubular plunger rod, said joiner member forming a slip-fit joint with said body member so that the latter can slide endwise a limited distance thereon, and means for sealing the ends of said body member on said joiner member, alternately at one end of same and then the other to form a substantially fluid tight joint in either position, said joiner member having openings in its periphery in the area over which said body member slides, and at least adjacent the ends of such area, whereby under pumping action, the movement of said body member on said joiner member acts as an outlet valve with outlet of fluid from said cylinder on alternate sides of said piston through said tubular plunger rod.

8. A pumping apparatus comprising a production tube, a pump cylinder, a connector member for joining the lower end of said production tube

to the upper end of said cylinder, said connector member having an outside size not exceeding the outside diameter of said cylinder, an inlet valve means for said cylinder at the upper end thereof, means for connecting said inlet valve to the exterior of said cylinder for flow of fluid into said cylinder through said inlet valve under suction pressure, an inlet valve at the other end of said cylinder, means for protecting said inlet valve from external interference, means for connecting said inlet valve to the exterior of said cylinder for flow of fluid to said cylinder through said inlet valve under suction pressure, a hollow plunger rod passing from said production tube into said cylinder through said joiner member, means for forming a sealed joint between said joiner member and said plunger rod while permitting the latter to have a free sliding fit therewith, said plunger rod having an inlet at its end within the cylinder and an outlet at its end within the production tube, a piston within said cylinder, said piston having a body member longitudinally bored and faced at its ends and having means on its periphery forming a sliding seal with the cylinder wall, said sliding seal means

comprising a pair of cup leathers, a supporting member for said cup leathers, said supporting means comprising a radial flange extending from said piston body member, and continuous means for gripping said cup leathers with their backs against said flange, a joiner member on the end of said hollow plunger rod, said joiner member being adapted to slidably fit the bore of said piston body member in manner permitting limited endwise sliding of said body member on said joiner member, said joiner member having openings in its periphery in the area over which said body member slides, and at least adjacent but spaced from the ends of such area to check leakage, and shouldered means cooperating with said joiner member for sealing with the ends of said body member at the ends of its travel on said joiner member to form a substantially fluid tight joint, whereby under pumping action, the movement of said piston body member on said joiner member acts as an outlet valve for flow of fluid from said cylinder at alternate sides of said piston through said hollow plunger rod.

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