Oct. 18, 1938. L. G. BROTZMAN ET AL 2,133,655

BALANCED PUMP

Filed Aug. 3, 1937 2 Sheets-Sheet 1

FIG. 1.

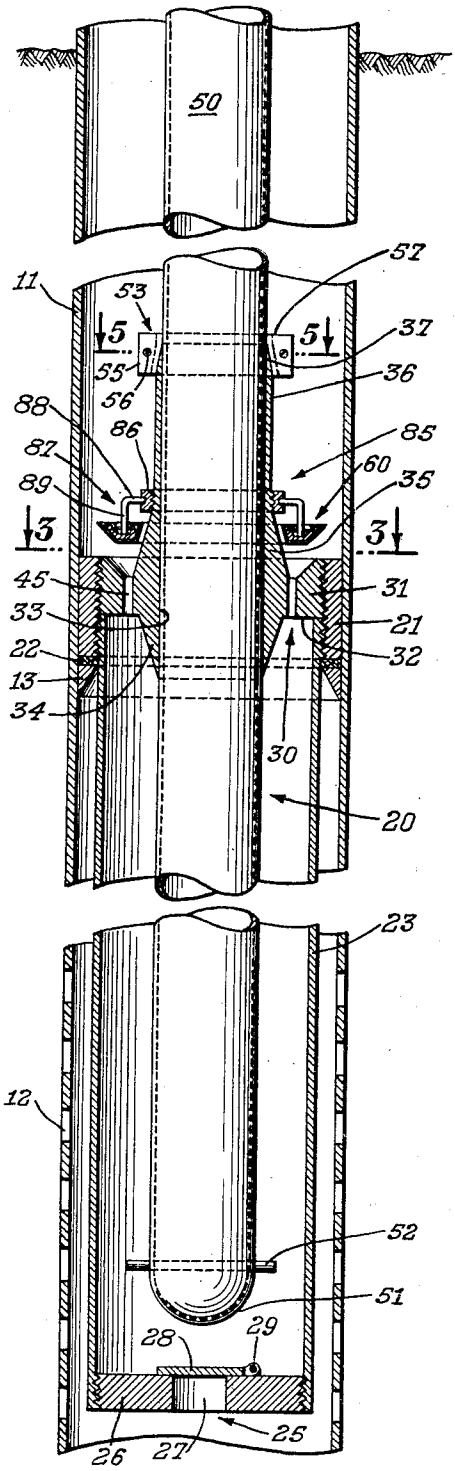


FIG. 2.

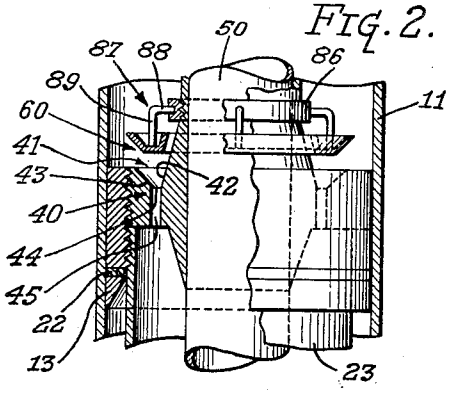


FIG. 3.

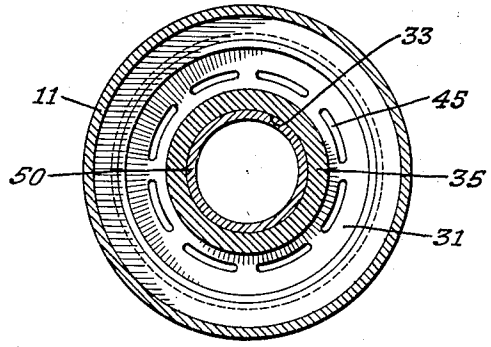


FIG. 4.

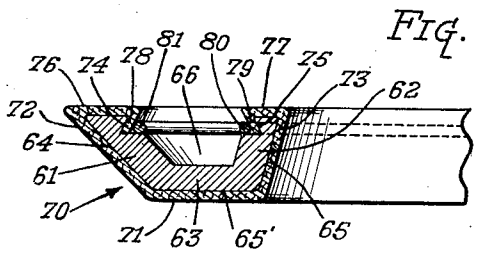
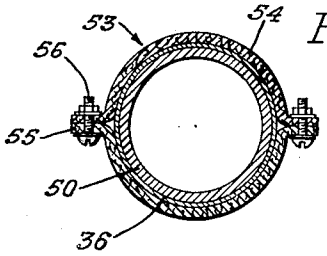


FIG. 5.



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FIG. 6.

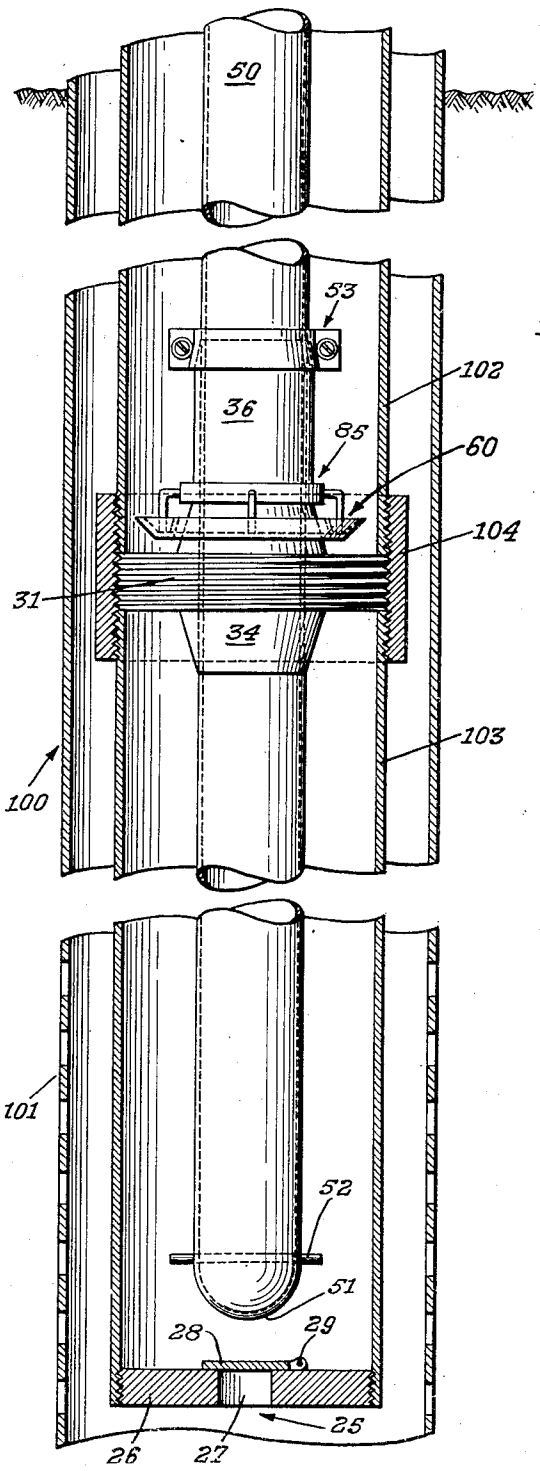


FIG. 7.

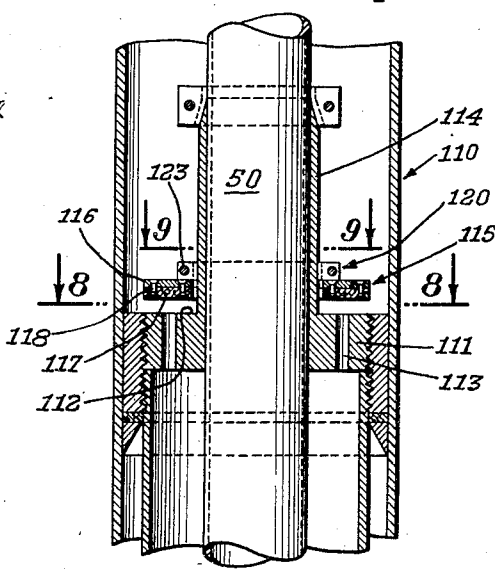


FIG. 8.

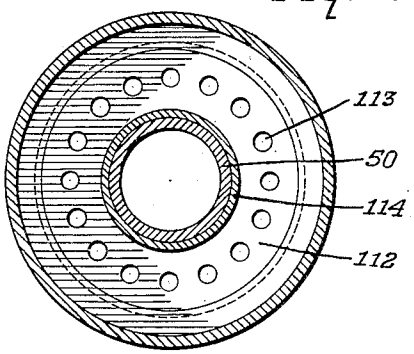
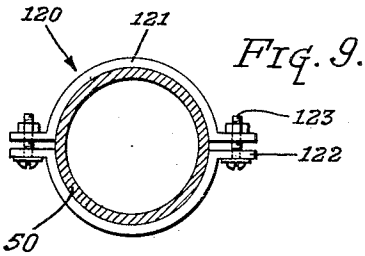


FIG. 9.



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UNITED STATES PATENT OFFICE

2,133,655

BALANCED PUMP

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Arroyo Grande, Calif.

Application August 3, 1937, Serial No. 157,134

13 Claims. (Cl. 103—155)

Our invention is designated a balanced pump, this being of the type of a displacement plunger pump in which a plunger of relatively large diameter has a reciprocating motion in the liquid in the well such as for instance, water or oil, and by the displacement of the plunger forces liquid upwardly on each stroke. On account of having the plunger immersed in the liquid the plunger may be substantially balanced and the plunger may be so balanced that for practical purposes it sinks by its own weight or but little force is required to force the plunger downwardy.

Our invention relates to various improved features and details of such type of pump including an arrangement by which the whole of the pump barrel which has a check valve at the bottom and in which the plunger operates may be lifted or elevated to the top of the well without removing the casing in which the well is mounted and from which the liquid is pumped. Such an arrangement is made by providing a valve seat for the upper valve connected to a ring or collar and this resting on shoulders secured to the casing of the well or similar structure. Therefore, by providing the bottom of the plunger which is closed with a lifting pin or the like, the pin engages underneath the seat and lifts the seat including the ring or collar and the pump barrel secured to the top of the well when desired. This constitutes one of the main features of our invention and is mainly suitable for a new installation.

Our invention also comprehends another type of setup of the pump suitable for a completed well in which a pump casing and a pump barrel are connected by a collar and this collar also forms a mounting for the upper valve seat. The plunger operates through the seat with the vertical reciprocating motion, the bottom of the plunger being provided with a lifting pin or the like, by which, on an up-pull of the plunger, the pin engages the seat and hence lifts the pump barrel and the pump casing to the top of the well.

Another feature of our invention relates to the construction of the upper valve and its combination with the pump barrel and the bottom or standing valve. Such pump barrel is preferably cylindrical and connected to the collar to which the upper valve is attached.

Another characteristic of our invention resides in a sleeve which extends upwardly from the seat and forms a guide for the vertically reciprocating plunger. The upper end of the sleeve has a sealing ring formed of pump leathers or the equivalent clamped on the upper end of the sleeve and engaging the plunger, thus preventing a downward leak or drain along the walls of the plunger through the sleeve and thus through the seat of the upper valve.

Another characteristic of our invention relates to the details of the valve construction and in one form we provide the valve seat with an annular, somewhat V-shaped groove with slots concentric with the plunger extending from the base of the groove through the structure forming the seat, this being for the upflow of the liquid. The valve plug is of a floating type and with the V-shaped seat is made of a similar cross section and thus forming an annulus. However, it is desirable to have the lower corners cut off or flattened in order that the floating plug will not seat exactly on the base of the groove but form a contact on its inner and outer peripheral walls.

Another detailed feature in this type of floating plug resides in the manner of attaching a valve leather or the like on the working face of the floating valve, this being stretched over the outer and inner sides and across the bottom and attached at the top of the valve. For the sake of lightness, the floating valve is preferably made hollow, that is with an annular depression, the edges of the valve leather fitting therein and being secured by rings.

In another form of our invention as relates to the valve assembly, this is made with a flat or plane top surface and has a plurality of circular perforations or slots extending through the seat concentric of the axis of the plunger. The floating valve is in the form of a flat ring or annulus having a leather or equivalent packing attached to the underside, this seating on the flat or plane surface of the valve seat. With both types it is desirable to have a stop device such as a clamping collar or the like, attached to the sleeve to limit the upward movement of the floating valve plug. It will thus be seen that in the manner of operation the pump barrel becomes filled with liquid on the upstroke of the plunger, this entering through the standing valve and being filled complete except for the space occupied by the part of the plunger projecting downwardly into the pump barrel. On the downstroke, the plunger displaces this liquid which is forced upwardly through the upper valve. In one form of our invention, preferably for new equipment, this liquid flows upwardly inside of the well casing and for old equipment preferably flows upwardly through a pump casing.

Our invention is illustrated in connection with the accompanying drawings, in which:

Figure 1 is a vertical section through one form of the pump;

Fig. 2 is a section through the upper valve on a slightly larger scale, illustrating a floating valve plug having a metal-to-metal contact with the seat;

Fig. 3 is a horizontal section on the section line 3—3 of Figure 1 in the direction of the arrows;

Fig. 4 is an enlarged vertical section taken on any radius line through the floating valve plug of Fig. 1;

Fig. 5 is a horizontal section on the line 5—5 of Fig. 1 in the direction of the arrows;

Fig. 6 is a vertical section through another form of our invention in which the pump casing and pump barrel are connected together, this type of pump being lowered as a unit in the well casing; this shows the same type of upper valve as Fig. 1;

Fig. 7 is an enlarged vertical section similar to Figure 2 but of a modification showing a flat type of upper valve and floating valve plug;

Fig. 8 is a horizontal section on the line 8—8 of Fig. 7 in the direction of the arrows; and

Fig. 9 is a horizontal section on the line 9—9 of Fig. 7 in the direction of the arrows.

Referring first to the construction of Figures 1 through 5, a pump casing is indicated by the numeral 11 which extends from the ground level to a position which has its lower end immersed in the liquid and provided with liquid inflow openings 12. An abutment ring 13 is secured as by welding above the liquid inflow openings. The pump assembly designated by the numeral 20, employs a collar 21 which seats on the ring 13, there being preferably a resilient washer 22 supported on the upper face of the abutment ring. The pump barrel 23 has a screw-threaded connection with the collar 21 and at the bottom is provided with a standing valve 25 which has a head forming a valve seat 26 screw-threaded to the lower end of the barrel and provided with a central intake opening 27, this being closable by a pivoted flap valve 28 pivoted at 29 to the structure forming the seat.

A combination guide and upper valve seat designated by the assembly numeral 30 has a disc 31 threaded in the collar 21 and preferably engaging the upper end of the pump barrel 23. This has preferably a horizontal lower surface 32. There is a cylindrical opening 33 through the center and a somewhat cone-shaped guide flange 34 extending downwardly and a second or upwardly extending guide flange 35. Flange 35 merges with the sleeve 36 cylindrical on its inside face and having a tapered upper end indicated at 37.

The valve seat structure 40 has an annular triangular-shaped groove 41 in which the inner slope 42 is preferably formed on the same slope as the upper flange 35. The outer side 43 need not be so steep and the bottom of the groove is preferably transverse as indicated at 44 instead of having a sharp bottom to the V-shaped groove. A series of slots 45 extend downwardly from the base of the groove through the disc structure 31 and are concentric with the axis of the disc and hence with the pump barrel.

The pump plunger designated by the numeral 50 has a lower tubular section and may be hollow for the sake of lightness having a closed lower end 51 with a transverse lifting pin 52 positioned slightly above this end. The plunger operates through the guide structure formed by the disc 31, the downwardly and upwardly extending flanges 34 and 35, and the sleeve 36. Attached to the bevel 37 of the sleeve there is a circular leather or similar packing 53 with a clamp 54 provided with flanges 55 through which extend bolts 56. This ring is thus clamped to the bevel and is somewhat cone-shaped except for the upper or flexible edge portion 57 which bears against the plunger and hence is cylindrical.

The floating valve plug designated by the assembly numeral 60 is in the form of a ring (note particularly Figs. 2 and 4) which has an outside wall structure 61, an inner wall 62, and a base 63. Of these, the curvature and slope of the outer periphery 64 is the same as the surface 43 of the seat and the inner circular surface 65 is of the same slope as the inner side 42 of the seat. The bottom surface 65' is horizontal and when the plug is seated it is positioned above the flat annular bottom portion 44 of the groove. If it is desired to have a metal-to-metal contact between the seat and the plug the plug is of the simple form as shown in Fig. 2, and in both forms there is an annular depression 66. Where it is desired to have a soft facing to engage the valve seat, this is illustrated in Fig. 4, the facing being designated by the numeral 70. This may be formed of leather or the like stretched over the outside surfaces of the ring forming the valve plug and thus there is a horizontal bottom section 71, an outer surface section 72, and an inner surface section 73 of this soft facing. It is preferable to have dovetailed cuts 74 and 75 formed in the walls 61 and 62 adjacent their top so that the upper part of the soft facing may have a horizontal stretched section 76 over the upper edge of the wall 61 and a stretched upper surface 77 over the upper edge of the inner wall 62. The free edges are turned down as indicated at 78 and 79 fitting against the dovetail cuts 74 and 75. An inner spring ring 80 and an outer spring ring 81 fit in the recess 66 and thus hold the soft facing in place on the metal valve plug.

In order to limit the lift of the valve plug a stop-limit device 85 is utilized. This has a ring 86 threaded on the outside of the sleeve 36 preferably close to the upper flange 35 and from this there are bent fingers 87, each having a horizontal arm portion 88 and downwardly extending finger tips 89. These tips engage in the annular recess 66 when the valve plug is lifted or floats upwardly by the upward flow of liquid.

The action of the pump so far described is as follows: On the downstroke of the plunger this passes downwardly in the liquid already pumped up and filling the annular space between the pump casing 11 and the plunger 50 and also the pump barrel 23 and the plunger. The downstroke causes a pressure on the liquid in the pump barrel tending to cause a down-flow through the opening set up in the standing valve and causes a seating or closing of the flap valve 28. On account of the liquid being displaced it necessarily flows upwardly through the arcuate ports 45 and thus causes a lifting of the plug valve 60. Such valve may rise until the fingers 87 engage in the bottom of the recess 66. The valve therefore allows a free upward flow of the liquid.

On the upstroke of the plunger, the valve plug 60 seats by gravity and on account of the inner and outer wall surfaces conforming to the slope

of the V-shaped annular groove 41, the plug is properly seated in the valve groove and thus prevents a down-flow of liquid, the hydraulic pressure due to the liquid above the valve seat disc 31 being greater than the internal pressure in the pump barrel 23. As above mentioned, the valve plug may have a metal-to-metal or soft facing to metal engaging with the seat. The upstroke also functions to develop a flow of the liquid through the flap valve 28 to fill the space in the pump barrel taken up by the lower end of the plunger when in its lowermost position. As there is usually a greater hydraulic pressure on the intake stroke above the valve disc 31 than below, there would be a likelihood of a downward leakage of liquid between the plunger 50, the sleeve 36, the flanges 34 and 35, and disc 31. However, this is prevented by the ring 53 having a close fit and bearing on the tube 50.

In the construction of Fig. 6, which is intended mainly for use in old constructions or wells now in the ground, the well casing is indicated by the numeral 100 which has a perforated intake end 101. In this case the pump casing 102 and the pump barrel 103 are preferably of the same diameter and connected by a threaded collar 104. The ends of the pump casing and pump barrel engage the valve disc 31, thus holding this disc in place. The same type of sleeve, flanges, and V-shaped seating groove may be utilized.

The operation of this type of pump is the same as Figure 1, except that the liquid after passing the ports formed by the slots 45 flows upwardly inside of the pump casing 102. As above noted, this casing is spaced inwardly from the well casing or the wall of the well. The purpose of the cross pin 52 is for lifting the upper valve assembly when it is desired to remove the pump from the bottom of the well. In the construction of Fig. 1, this pin 52 moves upwardly as the plunger is pulled up engaging the lower edge of the lower flange 34 and thus lifting the valve seat disc with the collar 21 from the abutment ring 13. On account of the connection of the pump barrel with this seating disc, the pump barrel as a unit is pulled upwardly.

In the construction of Fig. 6, the pump plunger and the pin 52 may be used as a lifting element, this engaging the lower flange 34 and being operated to lift or elevate the whole of the assembly or pump casing 102 and the pump barrel upwardly to the top of the well and being for the purpose of removal such as to clean the pump or to replace worn parts.

In either form of pump, such as that of Fig. 1 or 6, I may use a different type of valve seat and valve assembly such being illustrated in Fig. 7 and designated as the flat valve assembly 110. This employs a valve disc 111 which is flat or plane on its upper surface 112 and may also be flat or transverse on its lower surface. Through this extends a series of vertical ports 113 which are spaced around the disc. A sleeve 114 extends upwardly from the disc and forms a guide for the pump plunger 50. In this construction it is not necessary to have substantially heavy flanges such as 34 and 35 of Fig. 1. The floating valve plug 115 is preferably made of a flat metal ring 116 with a soft ring 117 such as leather, rubber, or the like, attached thereto as by rivets 118. The same type of soft facing such as the ring 53 is secured to the upper end of sleeve 114 and engages the plunger. A limit stop device 120 to limit the upward floating or drift of the valve seat employs two semi-circular clamp half rings 121, each having opposite flanges 122 connected by a bolt 123. This construction is operated in the same manner as that of Figs. 1 and 6. On the downstroke, the liquid is displaced by the lower end of the plunger flowing upwardly through ports 113 causing a lifting of the floating valve plug and the upward flow of liquid outside of the plunger 50. On the upstroke the action is reversed, the flat ring-like valve seating by gravity on the plane upper surface 112 of the seat.

It will be understood that the plunger 50 may be made of light material and as this plunger must extend from below the valve seat to a high position in the well usually above the outlet for the water, the plunger may be considered as completely immersed when the pump is fully operating. If the plunger is too light so that due to its displacement it is buoyant and therefore thrust upwardly and develops an upward thrust on the operating mechanism, the plunger may be weighted in any suitable manner known in the art. It is in fact preferable to have the plunger slightly heavier than the water displaced so that it has a tendency to sink. This is on account of a positive pressure being necessary on the down or displacement stroke, however the plunger may be thus so weighted or substantially balanced that comparatively little force is required to reciprocate the plunger and this but slightly greater than that required to elevate or lift the amount of liquid actually displaced at each displacement stroke.

The above outlined structure and procedure is common engineering practice and design of which we do not claim to be the inventors.

Various changes may be made in the details of the construction without departing from the spirit or scope of the invention as defined by the appended claims.

We claim:

1. A pump comprising in combination a pump barrel having means to suspend the same from the top of a well, the barrel having an intake valve at the bottom, an upper discharge valve formed of a disk with a seat means securing the disk to the pump barrel, said disk having a central cylindrical opening with a sleeve extending thereabove, the upper end of the sleeve being beveled and having a packing ring secured thereto, a displacing plunger mounted in the cylindrical opening of the disk and the sleeve, the said packing engaging the plunger, the lower end of the plunger being closed, the disk having a series of ports concentric with the axis of the plunger, the upper valve including a floating type of annular plug having a surface to engage the seat on the disk and form a closure for the ports on the upstroke of the plunger and to lift on the downward or displacement stroke for the upflow of liquid.

2. A pump as described and claimed in claim 1, the means for suspending the pump barrel including a threaded collar threaded to the periphery of the upper valve disk and a casing structure extending to the upper part of the well and having an engagement with the said collar.

3. A pump comprising in combination a pump barrel having an intake valve at the bottom, a collar threaded thereto at the top, a combination upper valve disk and guide having its periphery threaded and engaging the said collar, means to support the collar suspended from the top of the well, the valve disk having a central cylindrical guide opening with a displacing type of pump plunger mounted therein for vertical reciproca-

tion, the disk having a series of ports concentric with the plunger and the upper valve having an annular valve plug positioned to close the said ports on the intake stroke of the pump and to float upwardly on the discharge stroke.

4. A pump as described and claimed in claim 3, the means to support the said collar including a well casing having an abutment ring secured thereto, the said collar resting on said ring, the pump plunger having a lifting means adjacent its lower end adapted on an upward pull of the plunger to engage the valve disk and elevate the disk, the collar and the pump plunger through the well casing.

5. A pump comprising in combination a pump barrel having an intake valve at the bottom, a collar threaded thereto at the top, an upper valve including a seating disk threaded to the collar and having a central guide opening with an upwardly extending sleeve, there being a series of ports positioned in the disk concentric to the axis of the said opening, a cylindrical valve plunger mounted for reciprocation in the opening and sleeve, an annular valve plug positioned to rest on the seat of the disk by gravity and form a closure for the ports on the intake stroke of the pump and adapted to lift on the discharge stroke for the upward flow of liquid displaced from the pump barrel by the descending plunger and a tubular structure secured to the said collar and extending to the top of the well for the flow of the pumped liquid.

6. A pump as described and claimed in claim 5, the upper end of the sleeve being beveled and having a flexible packing ring secured thereto, a portion of the ring engaging the plunger to restrain downward flow of liquid between the plunger, the sleeve and through the opening of the disk and a stop limit means secured to the sleeve to restrain the upward lift of the annular plug.

7. A pump comprising in combination a pump casing having a lower perforated section for inflow of liquid from a well hole, an abutment ring secured to the said casing above the perforations, a collar fitted in the casing and bearing on the abutment ring, a pump barrel secured to the said collar and extending downwardly in the well having a lower intake valve, an upper valve including a disk secured to the collar having a central cylindrical opening and a plurality of ports concentric with said opening and also having a seating surface, a floating type of annular valve plug having an undersurface to seat on the disk and form a closure for the said ports or to lift above the disk on the upflow of liquid displaced by the plunger.

8. A pump as described and claimed in claim 7, the plunger having a lifting means positioned adjacent its lower end and adapted to engage the underside of the said disk on lifting the plunger and thereby elevate the disk, the collar, the pump barrel and the valve plug to the top of the well of liquid, the cylindrical plunger closed at the bottom mounted for vertical reciprocation through the said opening of the disk.

9. A pump comprising in combination a pump barrel having an intake lower valve, a collar secured to the upper end of the barrel, a pump casing secured to the collar, an upper valve including a valve disk secured to the collar between the barrel and the casing, said disk having a central cylindrical opening and a plurality of ports concentric with said opening and having an upper seating surface, a floating type of annular valve plug adapted to seat on the disk by gravity and form a closure for the ports or to lift on the upflow of liquid, a cylindrical plunger closed at its lower end mounted for vertical reciprocation in the opening of the disk to develop an inflow of liquid through the lower valve to the pump barrel and from the pump barrel upwardly through the ports of the upper valve.

10. In a displacement pump, an upper valve assembly including a threaded collar, a tubular pump barrel secured thereto, a valve disk threaded to the collar having an upper seating surface with a plurality of ports extending downwardly therethrough concentric to the center of the disk, the disk having a large cylindrical opening and a sleeve extending thereabove, the upper end of the sleeve being beveled and having a flexible packing ring secured thereto, the opening and the sleeve being adapted to accommodate a reciprocating displacement plunger with the ring engaging the plunger to restrict downward flow of liquid through the sleeve and the opening of the disk and an annular valve plug surrounding the sleeve and adapted to seat by gravity on the seating surface of the disk to form a closure for the ports or to lift on the upflow of liquid through the ports.

11. In a displacement pump as claimed in claim 10, a stop means secured to the sleeve and positioned to engage the plug when lifting and to restrict the upward movement of the plug.

12. In a pump, a disk-like valve seat structure with an annular groove substantially V shaped at any radial section and having a series of arcuate ports extending from the base of the groove through the disk concentric with the center of the disk, an annular ring-like valve plug having downwardly facing sloping surfaces and somewhat V shaped at any radial cross section to conform to the shape of the groove, the plug having a flat undersurface, said plug having an annular depression, a soft material cover on the bottom and the inside and outside slope with the edges extending into said depression with means attaching said edges to the plug.

13. A pump including in combination a pump barrel, means to suspend said barrel in a well, an intake valve at the bottom of said barrel, an upflow valve positioned at the top of the barrel and including a disk having a central opening, a displacing pump plunger mounted for reciprocation in said opening, the disk having a plurality of ports positioned concentric to the axis of the plunger, the upper valve including a floating type of annular valve plug surrounding the plunger and forming a closure with the ports, the said valve plug being adapted to lift on the upflow of liquid displaced from the pump barrel by the downward movement of the plunger, the said opening of the valve disk having an elongated bearing for the plunger and an upwardly extending sleeve, a sealing ring secured to the upper end of the sleeve and engaging the plunger to restrict the downward flow of liquid between the sleeve and the plunger.

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