Dec. 10, 1929. A. JORDAO, JR 1,739,000

PUMPING UNIT

Filed March 15, 1928 2 Sheets-Sheet 1

FIG.-1.

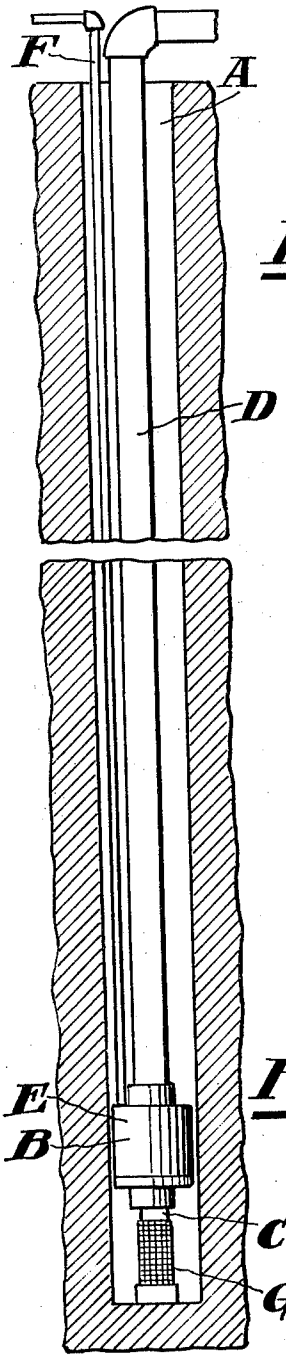


FIG.-2.

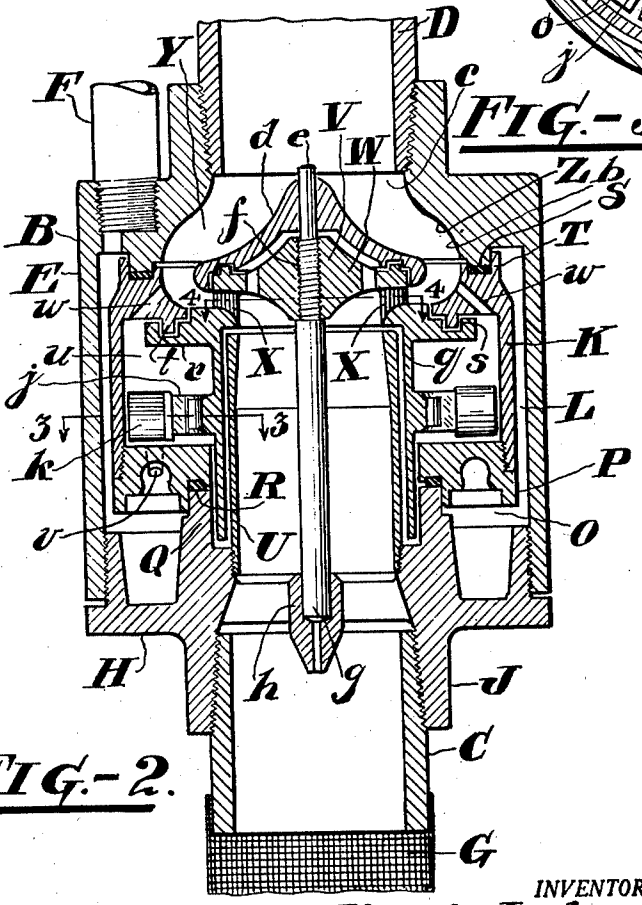


FIG.-3.

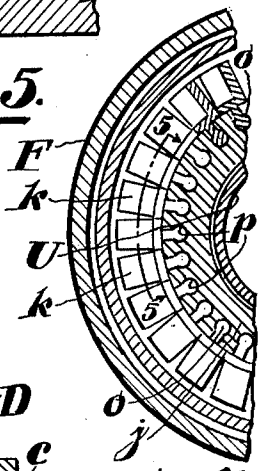


FIG.-4.

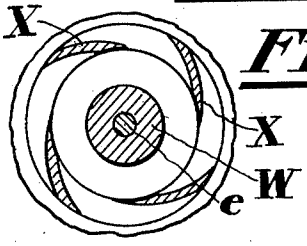
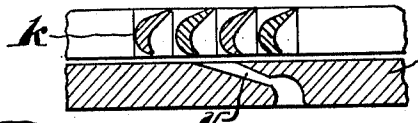


FIG.-5.



INVENTOR.
Alfredo Jordao Jr.
BY Clarke & Allen.
HIS ATTORNEY.

Dec. 10, 1929. A. JORDAO, JR 1,739,000

PUMPING UNIT

Filed March 15, 1928 2 Sheets-Sheet 2

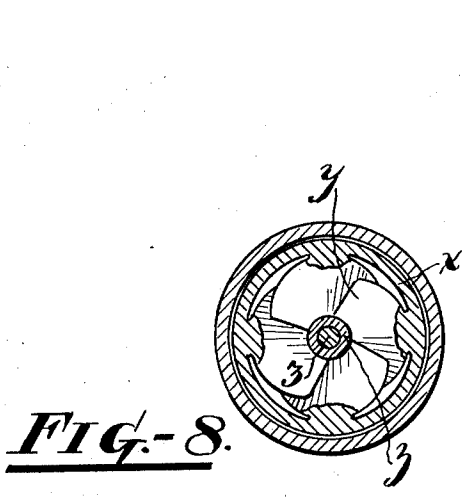


FIG.-8.

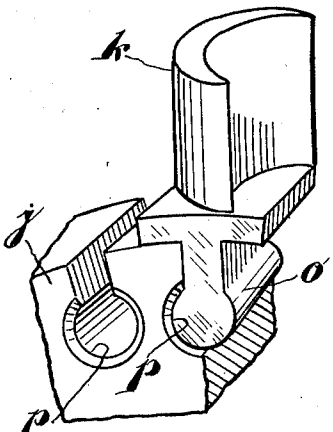


FIG.-6.

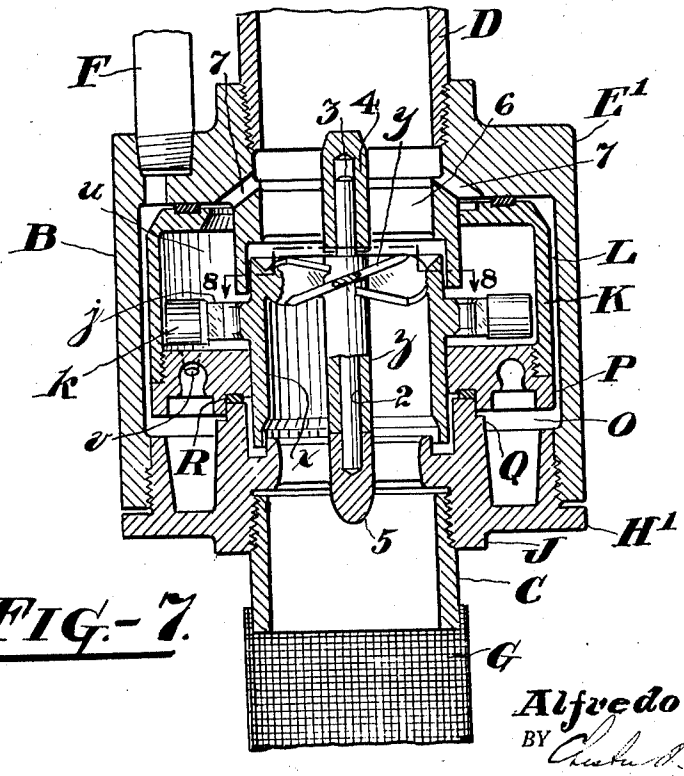


FIG.-7.

INVENTOR.
Alfredo Jordaoo
BY
HIS ATTORNEY.

Patented Dec. 10, 1929 1,739,000

UNITED STATES PATENT OFFICE

ALFREDO JORDAO, JR., OF SAO PAULO, BRAZIL

PUMPING UNIT

Application filed March 15, 1928, Serial No. 261,873, and in Brazil January 18, 1928.

This invention relates to pumps, but more particularly to a pumping unit adapted to be inserted in wells and the like for pumping the liquid therefrom.

The pumping unit, whose principal application is in deep wells, shallow wells, rivers and wherever it is possible to employ vertical air lift, is operated by pressure fluid for forcing the liquid from a low level to a high level, and has the advantage that the source of pressure fluid can be located from the scene of operation.

The apparatus is particularly applicable for deep wells in which air lifts are usually employed for carrying the liquid to the surface. As is well known however, air lift devices have certain limitations which tend to narrow their field of usefulness. A few of the most outstanding of these disadvantages are, small capacities, and the necessity of a certain column of water in the well which, dynamically, should not be below a certain percentage, as for instance 40%, of the total length. This condition when not attainable owing to insufficiency of liquid in the underground veins, necessitates increasing the depth of the well to obtain the necessary submergence column. Otherwise the efficiency of the evacuating device will be very low and the well not worth while working.

It is well known that the capacity of a well is proportional to the difference of the static and dynamic heads, and the lower the latter the greater will be the afflux of the subterranean veins. It would be ideal to have the dynamic level—zero, because with that condition the veins would flow with complete efficiency for the capacity of the well. This cannot be obtained with the submergence system for the reason already stated, i. e. that 40% submergence of total depth of elevating pipe is required. If this condition does not exist, the result is that the rising column of liquid is broken and the air escapes out through the top of the tube without doing any work.

These are the conditions that form the most serious draw-backs to the submergence system for deep wells, as also in low level wells, shallow reservoirs, rivers or other sources where only a low hydro-static lift is available. Owing to the great importance of obtaining liquid from subterranean sources, and bearing in mind the above shortcomings in the submergence system, various authorities have tried to substitute centrifugal or screw pumps, located in the bottom of the wells, driven from motors on the surface by a vertical shaft. These devices, however, have met with little success owing to their great weight and the resulting losses of power due to friction.

The objects of the invention are to increase the afflux of the subterranean veins leading to a well, to effect the pumping of liquid from wells with a minimum expenditure of power and to construct a pumping unit of simple and rugged construction capable of prolonged periods of interrupted operation and with a minimum of attention.

Other objects will be in part obvious and in part pointed out hereinafter.

The invention consists of the combination of elements, features of construction and arrangement of parts substantially as hereinafter described and claimed and illustrated in the accompanying drawings, in which

Figure 1 is a sectional elevation of a well showing the invention inserted thereinto,

Figure 2 is a sectional elevation of the pumping unit,

Figure 3 is a transverse view taken through Figure 2 on the line 3—3 looking in the direction of the arrows,

Figure 4 is a transverse view taken through Figure 2 on the line 4—4 looking in the direction indicated by the arrows,

Figure 5 is a sectional view of a detail taken on Figure 3 on the line 5—5 looking in the direction indicated by the arrows,

Figure 6 is a perspective view of a portion of the motor or turbine wheel showing the manner in which the blades are inserted into the wheel,

Figure 7 is a sectional elevation of a modified form of the invention, and

Figure 8 is a transverse view taken through Figure 7 on the line 8—8 looking in the direction indicated by the arrows.

Referring more particularly to the draw-

ings, and at first to Figure 1, A designates a well in which is disposed a pumping unit B having a suction pipe C which, as illustrated, may bear upon the bottom of the well A. The suction pipe C may be suitably apertured along its periphery to permit the passage of liquid from the well into the pipe C to be elevated by the pumping unit B to the surface through a discharge pipe D threaded to the upper end of a pump casing E.

The pumping unit B is adapted to be actuated by pressure fluid, such as compressed air or steam, and such pressure fluid is conveyed from a suitable source of supply (not shown) to the pumping unit B through a pipe F threaded to the casing E. Preferably a screen G of a suitable type is wrapped around the suction pipe C to overlap the perforations (not shown) for preventing the carrying of solid matter entrained in the liquid into the pump.

The casing B is preferably of cylindrical formation and may be of a diameter to fit loosely into the well. Into the lowermost part of the casing E is threaded a head H having an internally threaded flange J to which is threaded the suction pipe C.

Within the casing E is disposed a sleeve K of somewhat smaller diameter than the interior of the casing E to form an annular chamber L therebetween for the passage of pressure fluid from the pipe F to a distributing chamber O in the lowermost end of the casing. The sleeve K in this instance is supported by an orifice plate P which itself is supported by an inwardly extending annular flange Q on the head H. Preferably, a suitable packing R is inserted in the orifice plate P to bear on the end of the flange Q for preventing leakage of pressure fluid from the distributing chamber at this point. The uppermost end of the sleeve K is centralized by a depending flange S in the casing E which projects into the end of the sleeve K and a packing ring T is interposed between the depending flange S and the cooperating surface of the sleeve K to prevent leakage of pressure fluid from the annular chamber L into the interior of the casing E.

Disposed coaxially with the pipes C and D and, in the construction shown, thus also coaxially with the casing E is a tube U which is threaded with its lowermost end into the head H for conveying liquid through the casing E to the discharge pipe D. The liquid is drawn through the pipe C and the tube U by a pump generally designated by V and in this instance comprising a head W which lies across the uppermost end of the tube U. The pump is provided with a plurality of radial impellers X, whereby the liquid is drawn through the tube U and is discharged into an annular discharge chamber Y encircling the pump V.

The impellers X are preferably of the open type and the liquid is discharged therefrom in a radial direction into the discharge chamber Y. In order to deflect such liquid from the radial course to a perpendicular course and thus direct it into the discharge pipe D, the outer wall Z of the discharge chamber Y is curved outwardly at the discharge opening of the impellers X as at *b*. From this outwardly curved portion the wall develops into an inwardly curved portion thus contracting the outlet opening *c* of the discharge chamber Y to a cross sectional area substantially the same as that of the interior of the discharge pipe D.

In cross section the discharge chamber Y gradually widens from a point adjacent the impellers X to the outlet opening *c*. This form is obtained by the use of a hood or guide *d* disposed over the pump V and thus concentrically within the discharge chamber Y. The guide *d* may, if desired, be an integral portion of the casing E.

In the construction shown, the guide *d* acts as a thrust plate for the pump V and also as a bearing for a shaft *e* on which the pump V is mounted. The shaft *e* may be secured to the pump V in any suitable manner, as for instance by screw threads *f*, and extends axially through the tube U and at its lowermost end *g* into a bearing *h* in the head H.

Preferably formed integrally with the pump V is a turbine wheel *j* which encircles the tube U and carries in its periphery the usual blades *k* having integral trunnions *o* which may be inserted in suitable apertures *p* in the wheel *j*. The trunnions *o* may be of a length to enable their ends to be slightly peened or riveted across the ends of the apertures *p* for the purpose of maintaining said blades in the operative position.

The wheel *j* and the pump V are in this instance connected by a hollow hub *q* through which the tube U extends. At the juncture of the hub *q* and the pump V is a lateral flange *r* having an annular groove *s* in its uppermost end to receive an annular depending flange *t* on the sleeve K for preventing the flow of liquid from the discharge chamber Y into a motor chamber *u* in the sleeve K wherein the wheel *j* is adapted to rotate.

As is customary, the wheel *j* is located in close proximity to the orifice plate P and pressure fluid for rotating the wheel *j* and thus also the pump V is conveyed through orifices *v* in the orifice plate P. The orifices *v* may be of any suitable conformation but are preferably of the conical type diverging toward their outlet opening and are inclined in the direction in which it is desired to rotate the turbine wheel.

In order to convey the pressure fluid utilized for rotating the wheel *j* from the motor chamber *u* a plurality of passages *w* are

formed in the upper portion of the sleeve K to open into the discharge chamber Y.

The operation of the device is as follows: After the pumping unit, together with the discharge and pressure supply pipes have been installed in the well, pressure fluid may be supplied to the unit through the pipe F. Such pressure fluid will flow through the annular chamber L into the distributing chamber from whence it will flow through the orifices *v* against the blades *k* and rotate the wheel *j* and the pump V for the purpose of drawing liquid from the well A and elevating same through the discharge pipe D. After passing through the blades *k* into the chamber U where it expands, the pressure fluid passes through the passages *w* into the discharge chamber Y and thus excludes the liquid from the chamber U. At this point such pressure fluid will intermingle with the fluid discharged from the pump V and, expanding further in the discharge pipe D, will augment the force of the pump in elevating the liquid through the discharge pipe to the surface. In this way is obtained a rising column of reduced weight depending upon the proportion of the mixture of the volume of water and pressure fluid. Thus with the reduced column of liquid in the well, it is possible to obtain maximum production or capacity by taking full advantage of the hydro-static load of the subterranean veins which feed the well.

In the modification illustrated in Figures 7 and 8, the liquid drawn through the pipe C passes through a hollow hub *x* on the exterior of which is formed the turbine wheel *j*. The hollow hub *x* thus forms a passage for the liquid from the suction pipe C into the discharge pipe D.

In the outlet opening of the hollow hub *x* is a propeller *y* which is preferably integral with the hub *x* for pumping the liquid from the well. The propeller *y* itself is provided with a hub *z* having a bore 2 through which passes a shaft 3 seated at its uppermost end in a bearing 4 carried by the casing E′ and its lowermost end in a bearing 5 of the head H′.

The liquid drawn through the suction pipe C and the hub *x* is discharged into a discharge chamber 6 preferably of cylindrical form. In the discharge chamber 6 the liquid intermingles with pressure fluid issuing from the chamber *u* in the sleeve K through passage 7 formed in the casing E′ and opening into the discharge chamber 6.

In practice, the invention has been found to be peculiarly adapted for the purpose described. The pumping unit is of compact and rugged construction and is capable of operating at high efficiency since the loss of pressure during its passage through the turbine wheel *j* is small, and the pressure fluid discharged therefrom is therefore capable of exerting a considerable force on the liquid column in the discharge pipe D for the purpose of elevating such liquid to the surface. Moreover, the device is of simple construction and is therefore capable of prolonged periods of service with a minimum of attention.

I claim:

1. A pumping unit for wells and the like, comprising a casing adapted to be connected to a discharge pipe, a motor chamber in the casing, a fluid actuated rotary motor in the motor chamber, an impeller on the motor for drawing liquid axially through the motor and the casing, and an annular discharge chamber for the motor and the impeller in which discharge fluid from the motor chamber and liquid issuing from the impeller intermingle to reduce the weight of the liquid during its passage through the discharge pipe.

2. A pumping unit for wells and the like, comprising a casing adapted to be connected to a discharge pipe, a motor chamber in the casing, a fluid actuated motor in the motor chamber, an impeller actuated by the motor for pumping liquid through the discharge pipe, said casing having a discharge chamber encircling the impeller and curved to deflect discharge liquid from a radial course to a course perpendicular to the pump, and passages in the casing for conveying discharge fluid from the motor chamber to the discharge chamber wherein such discharge fluid intermingles with the liquid for elevating the liquid through the discharge pipe.

3. A pumping unit for wells and the like, comprising a casing adapted to be connected to a discharge pipe, a fluid actuated motor in the casing, an impeller above the motor and actuated by the motor for pumping liquid through the discharge pipe, said casing having an annular discharge chamber encircling the impeller and communicating with the discharge pipe, said discharge chamber gradually increasing in area towards its outlet end and being curved to deflect discharge liquid from a radial course to a course perpendicular to the impeller, and passages in the casing for conveying discharge fluid from the motor to the discharge chamber to aerate the liquid issuing from the impeller and assist the impeller in elevating the liquid through the discharge pipe.

4. A pumping unit for wells and the like, comprising a casing adapted to be connected to a discharge pipe, said casing having a passage, a fluid actuated rotary motor in the casing, an impeller on the motor for pumping liquid through the passage to the discharge line, a shaft extending through the passage to support the motor and the impeller, an annular discharge chamber encircling the impeller and curved to deflect the liquid issuing from the impeller from a radial course

to a vertical course, said discharge chamber gradually increasing in cross-sectional area toward the discharge pipe, and passages in the casing conveying discharge fluid from the motor to the discharge chamber to intermingle with the liquid therein to reduce the weight of the liquid in the discharge pipe.

5. A pumping unit for wells and the like, comprising a casing adapted to be connected to a discharge pipe, said casing having a passage, a fluid actuated rotary motor in the casing, an impeller above the motor for pumping liquid through the passage to the discharge line, a shaft extending through the passage to support the motor and the impeller, a sleeve in the casing and spaced with respect thereto to form a passage for conveying pressure fluid from a source to the motor, an annular discharge chamber in the casing encircling the impeller, said discharge chamber being curved to deflect the liquid issuing from the impeller from a radial course to a vertical course, and passages in the sleeve conveying discharge fluid from the motor to the discharge chamber to intermingle with the liquid therein for reducing the weight of the liquid in the discharge pipe.

In testimony whereof I have signed this specification.

ALFREDO JORDAO, JR.