Aug. 13, 1935. A. M. LOCKWOOD 2,011,451

PUMPING APPARATUS

Filed May 31, 1934

Fig. 1.

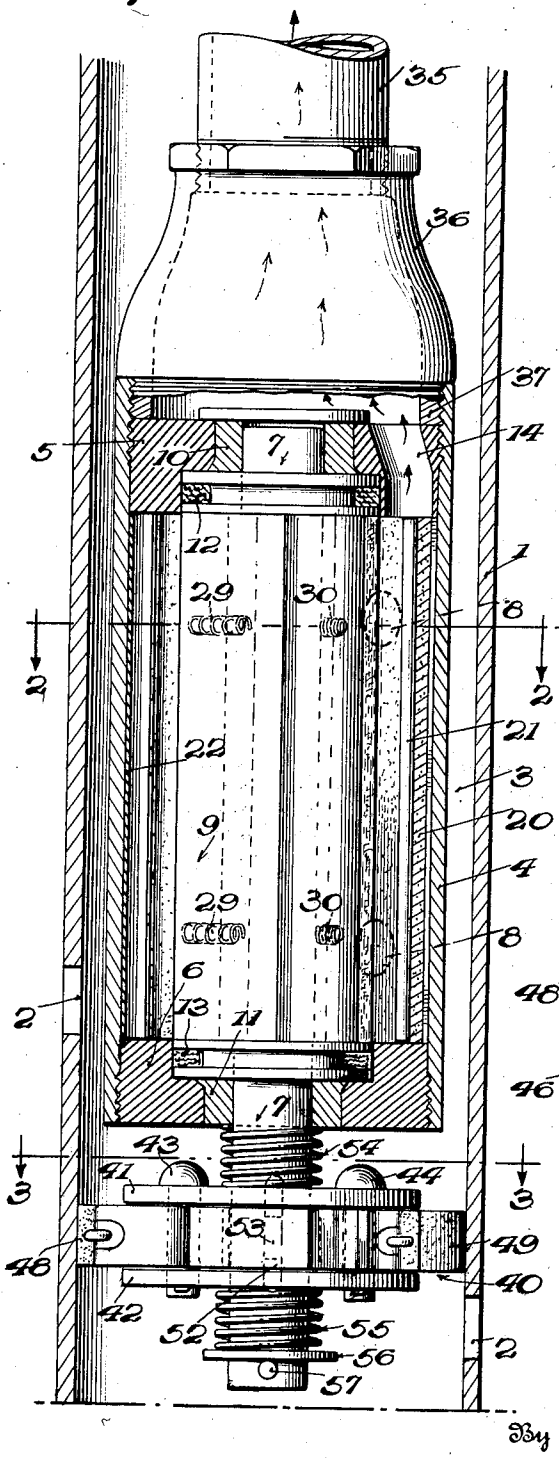


Fig. 2.

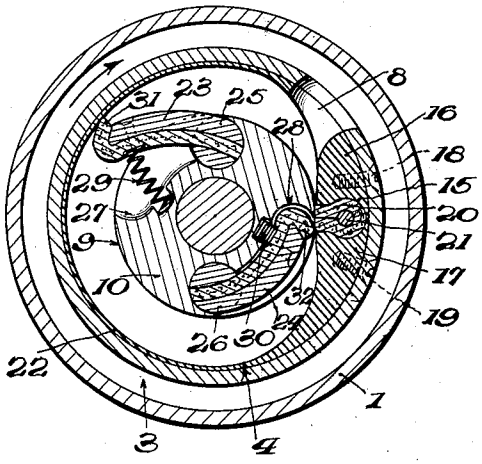
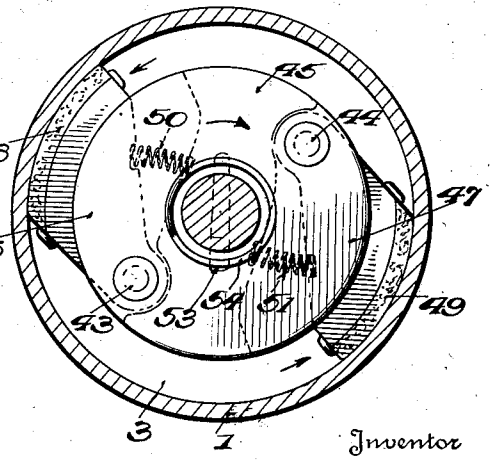


Fig. 3.



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PUMPING APPARATUS

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12 Claims. (Cl. 103—119)

The present invention relates to pumps and, more particularly, to a rotary pumping apparatus particularly designed for pumping from a well.

An object of the invention is to provide a deep well pumping apparatus including a rotary pump and employing the riser pipe of the well for operating the rotary member of the pump.

Another object is to provide a rotary pump including novel means for holding the stationary member of the pump against rotation.

A further object is to provide a deep well pumping apparatus including novel means cooperating with the well casing for holding the stationary member of the pump against rotation.

A still further object is to provide a well pumping apparatus which is so constructed that its operation will impart an initial velocity to the water to be pumped.

A still further object of the invention is to provide a pumping apparatus which will be strong and rugged in construction but which will be susceptible of easy and economical manufacture and ready installation and adjustment.

Other objects and features of novelty will be apparent from the following description and drawing, it being expressly understood, however, that the invention is in no way limited thereby, or otherwise than by the appended claims.

Referring to the drawing, in which similar reference characters refer to like parts:

Fig. 1 is a view, partly in section of a pumping apparatus according to the present invention;

Fig. 2 is a sectional view, taken on the line 2—2 of Fig. 1, and

Fig. 3 is a sectional view, taken on the line 3—3 of Fig. 1.

It has been, in the past, the almost universal practice to employ reciprocating, or jack-type, pumps in deep well pumping apparatus. Pumps of this type offer numerous and considerable disadvantages and in a few cases rotary type pumps have been employed for deep well pumping, although the practice is not general nor is the rotary apparatus known to the art suitable for well pumping in an efficient manner. The present invention, accordingly, contemplates the provision of novel means for effecting deep well pumping by rotary means.

According to the present invention there is provided a well casing 1, the same constituting a cylindrical casing sunk into the ground for any desired distance as is the usual practice in deep well pumping. Suitable means, such as openings 2 may be provided in the casing for the admission of water thereinto, although other means such as an open lower end for the casing may also be provided for this purpose. Disposed within the casing and below the water level therein is the rotary pumping device, denoted generally by the reference numeral 3.

The rotary pumping device 3 comprises a cylindrical casing or shell 4, the upper and lower ends of which are closed by the closure rings 5, 6, the same being centrally bored to receive the shaft 7 which is formed integrally with or rigidly attached to the vane-carrying member 9 of the pump, the same being mounted concentrically within the casing 4. Bearing sleeves 10, 11 and packing glands 12, 13 may be provided in the upper and lower rings 5, 6 for guiding and lubricating the shaft 7 and for preventing the escape of water from the interior of the pump casing to the suction side of the pump around the shaft. A bearing plate may be disposed across the upper, open end of bearing 10 in order to provide a reaction plate for water discharged from the pump, whereby it is insured that the vane bearing member is entirely relieved from water column loading, all such loading being carried by the rotating cylinder and its ring closure. A discharge port 14 is also provided in the upper closure ring 5 for the delivery of water from the pump.

Mounted on the internal wall of the casing 4, or integrally formed therewith, is an inwardly-extending wall or abutment 15, the same extending the full longitudinal length of the pump casing between the inner faces of closure rings 5, 6 and decreasing in radial thickness from its center in both circumferential directions toward the internal wall of the pump casing. Such wall or abutment is preferably formed in two identical parts 16, 17 which, in the embodiment disclosed, are attached to the pump casing by screws 18, 19 and are separated by a packing member 20, the same being formed by folding a flat piece of packing about a rod 21 which is disposed longitudinally of the pump casing, the entire packing assembly being disposed within a longitudinal recess between the abutment members 16, 17. A liner 22 may be provided on the internal wall of the pump casing and such liner is of such thickness that the internal wall thereof will be flush with the reduced end portions of the wall members 16, 17.

The vane carrying member 9 of the pump comprises a cylindrical member 10 which extends the full length of the pump casing between the inner faces of bearing rings 5, 6 and is of such radial dimensions as to just abut the packing 20 at the

central, or thickest, portion of the abutment member 15 described hereinbefore. It will, therefore, be apparent that a pumping chamber will be defined between the inner faces of the abutment member 15, the inner wall of the lining 22 and the outer periphery of the vane-carrying member 10, which chamber will be of uniform radial width throughout 195° to 200° of its annular extent, and throughout the other 165° to 160° of its annular extent will decrease in thickness in two directions toward the point where the packing 20 abuts the outer surface of the vane-carrying member. A plurality of intake ports 8 are formed in the wall of the pump casing and extend through the abutment member 16. The direction of rotation of the pump casing being clockwise, as indicated by the arrow in Fig. 2 of the drawing, it will be apparent that the intake ports trail the central or enlarged portion of the abutment 15. On the other hand, the exhaust port 14 is positioned in the closure ring 5 closely adjacent to the point where the abutment member 17 contacts the packing 15. In practice the upper portion of abutment 17 may be cored out adjacent the packing 15 and the opening extended in the direction of travel of the pump an amount sufficient to pass the volume of water the pump will throw. The exhaust port of the pump, therefore, leads the central or enlarged portion of abutment 15 in the rotation of the pump casing.

Mounted in the vane-carrying member 9 are two vane members 23, 24 which extend the entire longitudinal length of the cylindrical member 10 and whose external faces are formed on the same arc as the external face of the cylindrical member 10. The vane members are pivoted to the cylindrical member 10 by means of elongated cylindrical enlargements 25, 26 on the vane members, such enlargements being disposed within elongated cylindrical recesses formed within the member 10. It will be noted that these recesses are so formed that their walls extend for more than 180°, whereby the cylindrical enlargements 25, 26 of the vane members may not escape therefrom after having been inserted longitudinally into the recesses. The walls of the cylindrical member 10 are also provided with arcuate recesses 27, 28 for the reception of the vane members when the same are in their depressed position. Springs 29, 30 are seated at their inner ends in depressions in the walls of recesses 27, 28 and bear at their outer ends against the inner faces of the vane members in order to constantly urge the vane members against the inner wall of the pump casing. Suitable packing means 31, 32 may be provided on the vane member to bear between such members and the inner face of the pump casing.

In the operation of the above-described pump, the casing 4 is adapted to be rotated in a clockwise direction, by means to be described more fully hereinafter, thereby rotating also the abutment member 15 and lining 22, all of these members being rigidly attached together as a unit. The vane-carrying member 9 is held against rotation, by means to be described hereinafter, and it will be apparent that as the casing is rotated, the springs 29, 30 will hold the vanes against the casing in such a way that the vanes oppose the rotation of the casing, all as clearly disclosed in Fig. 2. It will now be apparent that as the casing 4 rotates, the intake ports 8 will take in water from the interior of the well casing 1, whereby the space between the casing 4 and the vane-carrying member 9 will be constantly supplied with water. Also, as the casing rotates, the curved wall of the abutment 17 will act to force the water within the pump casing in a clockwise direction, which movement of the water will be prevented by that one of the vanes which is in open position (vane 23 in Fig. 2). The trapped water will, therefore, be forced through the exhaust port 14 which, as described hereinbefore, is disposed above the reduced portion of the abutment 17. As the casing rotates in a clockwise direction from its position in Fig. 2, the vane 24 will open and the vane 23 will be closed, whereby when the exhaust port passes vane 23, the vane 24 will cause water to be forced through the exhaust port. In this way the continuous and steady flow of a stream of water through the exhaust port is caused, there being no possibility of an uneven or pulsating stream. For each complete rotation of the pump, one vane is fully open or in full pressure position for approximately 199°. Therefore, for the last 38° of travel this vane is in full pressure position and the following vane is also in full pressure position. Actually both vanes are in tandem pressure position each revolution for about 240°. The 120° of travel, when pressure is exerted by one vane only, is that interval between which the leading or closing vane uncovers the discharge port and the time it passes the suction ports.

Means are provided by the present invention for rotating the pump casing, and such means comprise the riser pipe 35, the upper end of which may be connected to a windmill or other prime mover whereby rotation of the riser pipe is effected. The lower end of the riser pipe is screw connected to one end of a reducer 36, the lower end of which is provided with a reduced screw-threaded connecting flange 37 which may be screw threaded to the interior of the pump casing 4. It should be noted that inasmuch as the pump is adapted to rotate in a clockwise direction, the screw-threaded connections should be by right hand threads in order to insure against their release.

Means are also provided by the present invention for holding the vane-carrying member of the pump against rotation, and such means comprise the one-way locking device 40 which is operable to lock the vane-carrying member to the well casing 1 during clockwise rotation of the pump casing. The locking device 40 is preferably disposed below the pump device and comprises a pair of spaced, circular plates 41, 42 which may be attached in spaced relationship by any suitable means, such as by the bolts 43, 44. Mounted between the plates 41, 42 is an abutment member 45, the same being provided with recesses for the reception of locking members 46, 47, which are pivoted adjacent their one ends on the bolts 43, 44. Each of the locking members is provided with an arcuate face which is formed with approximately the same radius as the interior of the well-casing 1, and each of such arcuate faces is preferably provided with a lining 48, 49 for providing a gripping surface when the said face and lining is brought into engagement with the inner wall of the well casing. Springs 50, 51 bear at their one ends in depressions formed in the abutment member 45 and at their outer ends against the inner faces of the locking members 46, 47, thereby urging said locking members in a counterclockwise direction about the pivots 43, 44 and into constant en-

gagement with the interior face of the well casing.

The above-described locking device is mounted on the lower end of shaft 7, which extends below the pump device. Formed in the lower end of shaft 7 is an elongated longitudinal slot 52, through which extends a key 53, the ends of which are rigidly attached to the plates 41, 42 and abutment member 45 of the locking device 40. It will be seen from Fig. 1 that the depth of the key is much smaller than the length of slot 52 and it will, therefore, be apparent that the locking device 40 and key 53 may be moved through a considerable travel longitudinally of the shaft 7, such travel being limited by the length of the slot.

Means are provided for resiliently positioning the locking device 40 on the shaft 7 and for absorbing shocks due to movements of the pump, and preventing such shocks from being transmitted to the locking mechanism. Such means comprise the springs 54, 55, one of which, spring 54, is coiled about shaft 7 above the locking device and the upper end of which bears against the ring 6 forming the bottom of the pump casing, while the lower end of which bears against the upper face of the upper plate 41 of the locking device. The other spring 55 is disposed below the locking device and the upper end of this spring bears against the lower face of lower plate 42 of the locking device, while its lower end bears against a bearing washer 56, sleeved about shaft 7 and held in position thereon by a pin 57. Due to this construction it will be seen that the locking device 40 will be attached to shaft 7 by the key and slot connection, and may move longitudinally of such shaft due also to such connection, but is resiliently maintained in a predetermined position longitudinally of the shaft by means of the springs 54, 55.

In the operation of the pumping apparatus according to the present invention, the pump and locking device are formed as a unitary structure and are placed within the well casing by forcing the one-way locking members 46, 47 interiorly of the plates 41, 42 until the locking device may be inserted into the well casing, after which the entire pump and lock unit may be lowered to any desired point in the casing by means of the riser pipe which is attached thereto, it being preferably to rotate the pump and locking device slowly in a counter-clockwise direction during insertion into the well casing in order to avoid excessive wear on the facings 48, 49. It will be apparent that the locking members are now held in engagement with the inner walls of the well casing by springs 50, 51. Any suitable means, such as a windmill or other prime mover, may now be employed for rotating the riser pipe, as long as such rotation is in a clockwise direction for a structure such as is disclosed in the drawing. Such rotation of the riser pipe will cause the pump casing 4 to rotate in the same direction, due to its connection with the riser through reducing sleeve 36. It will now be apparent that when the pump casing rotates in a clockwise direction, such rotation will be opposed by the vanes, 23, 24 carried by the member 10, and the member 10, shaft 7, key 53 and locking device 40 will therefore, be also urged in a clockwise direction, whereby the locking dogs or members 46, 47 will be forced into binding or locking engagement with the well casing 1, thereby securely locking and maintaining the vane-carrying member 10 and vanes 23, 24 against rotation. Relative rotation between the pump casing and the vane-carrying member now takes place and the pump operates in the manner described hereinbefore.

Water in the well casing will be drawn into the pump casing through port 3 and it will be seen that due to the rotation of the pump casing and ports, the water will enter the pump casing with an initial velocity, which gives to the water in the pump kinetic energy which assists its travel through the pump and into the riser pipe, thereby increasing the efficiency of the pump.

Water delivered by the pump passes therefrom, through the outlet or exhaust port 14 and into the riser pipe which also acts as a means for rotating the pump casing. Due to this construction the need for a separate operating shaft for the pump is removed, thereby effecting considerable saving in the cost of the pumping apparatus.

In the event that any shocks are transmitted through the riser pipe to the pump, or in the possible event of any pounding by the pump in an axial direction, such shocks or pounding will not affect the locking mechanism in any way, nor have deleterious effects on the pump, due to the provisions of the springs 54, 55 by means of which the pump casing is resiliently attached to and supported on the locking device. Such springs will, therefore, act to absorb any shocks transmitted to the pump, or to cushion any pounding of the pump. The resilient mounting will also absorb any changes in the length of the riser pipe, such as those due to changes in temperature.

If it should be desired to remove the pump and locking assembly from the well casing, it is only necessary to rotate the riser pipe and pump casing in a counter-clockwise direction, such operation causing release of the force urging the locking dogs into engagement with the well casing, whereby the pump and locking assembly may be withdrawn.

While I have illustrated and described one embodiment of my invention, it will be apparent to those skilled in the art that the invention is in no way limited thereby and that the same includes other embodiments, modifications and improvements, which may be practiced without in any way departing from the spirit or scope of the invention, for the limits of which reference must be had to the appended claims.

What is claimed is:

1. A pumping device comprising a well casing, a pump within said well casing, said pump comprising a casing member and a vane member within and contacting said pump casing, said pump casing and vane member being relatively rotatable, and means carried by said vane member and cooperating with the sides of said well casing for holding said vane member from rotation.

2. A pumping device comprising a hollow shaft, a pump disposed within said hollow shaft, said pump comprising a rotatable casing and a vane member within said casing, a shaft attached to said vane member, and means carried by said second-named shaft and engaging the lateral walls of said hollow shaft for holding said vane member from rotation.

3. A pumping apparatus comprising a well casing, a rotatable pump casing within said well casing, a vane member within and engaging said pump casing, a shaft attached to said vane member, a one-way locking device carried by said shaft and engaging with the lateral walls of said well casing for locking said vane member to said well casing to thereby hold said vane member from rotation with said pump casing.

4. A pumping device comprising a well casing, a pump disposed within said well casing and comprising a rotatably disposed pump casing and a vane member within said pump casing, inlet and discharge ports in said pump casing, a rotatable hollow shaft connected to said pump casing, said discharge port opening into said hollow shaft, and a one-way locking device carried by said pump and engaging the lateral walls of said well casing and adapted to prevent rotation of said vane member when said pump casing is rotated in one direction.

5. A pumping device comprising a well casing, a pump in said well casing and having a pump casing having inlet and discharge ports therein, a hollow shaft connected to said pump casing, means for rotating said hollow shaft and said pump casing, said discharge ports opening into said hollow shaft, a vane member in said pump casing, and means carried by said vane member and cooperating with the sides of said well casing to lock said vane member to said well casing for preventing rotation of said vane member with said pump casing, said locking means being operable only when said pump casing is rotated in one direction.

6. A pumping device comprising a well casing, a pump within said well casing and comprising a rotatable pump casing and a vane member within and engaging said pump casing, means for locking said vane member against rotation with said casing, said means comprising a locking device carried by said vane member and engaging the lateral walls of said well casing for holding said vane member from rotation with said casing, and means for resiliently mounting said locking device on said pump.

7. A pumping device comprising a well casing, a pump within said well casing comprising a rotatable pump casing and a vane device within and contacting said pump casing, a locking device carried by said vane device and normally engaging with the lateral walls of said well casing for holding said vane member from rotation with said pump casing, and resilient means separating said pump and said locking device.

8. A pumping device comprising a well casing, a pump within said well casing and comprising a rotatable casing and a vane device within and contacting said casing, a shaft attached to said vane device and having a portion extending exteriorly of said casing, a locking device slidably carried by said shaft and disposed exteriorly of said pump casing and engaging the lateral walls of said well casing for holding said shaft and said vane device from rotation with said pump casing, means resiliently separating said pump and said locking device, and other means resiliently urging said locking device toward said pump.

9. A pumping device comprising a rotatable pump casing, a vane device mounted within said casing, a shaft attached to said vane device and having a portion extending exteriorly of said casing, a locking device keyed to and slidably mounted on the exterior portion of said shaft and adapted to engage a fixed member to prevent rotation of said vane device with said casing, and resilient means disposed between and engaging said casing and said locking device for resiliently mounting said locking device on said shaft with respect to said casing.

10. A pumping device comprising a rotatable casing and a vane device within and engaging said casing, a shaft attached to said vane device and having a portion extending exteriorly of said casing, a support comprising a plurality of spaced plates slidably mounted on the exteriorly-extending portion of said shaft and being resiliently spaced from said casing, and a plurality of shoes pivotally mounted on said support and adapted to engage a fixed member to hold said vane device from rotation with said casing.

11. A pumping device comprising a pump casing adapted for rotation, a vane device mounted within and engaging said casing and adapted to be held from rotary movement with said casing, a shaft attached to said vane device and having a portion extending exteriorly of said casing, an abutment on the exterior portion of said shaft, a one-way locking device slidably carried by the exterior portion of said shaft and adapted to engage a fixed member to thereby prevent rotation of said vane device, a spring separating said casing and said locking device, and a second spring separating said casing and said abutment, said springs resiliently mounting said locking device with respect to said casing.

12. A pumping device comprising a rotatable casing and a vane device within and engaging said casing, a shaft attached to said vane device and having a portion extending exteriorly of said casing, an abutment on the end of said shaft, a plurality of spaced plates slidably mounted on said shaft intermediate said casing and said abutment, a plurality of shoes pivotally mounted on said plates, resilient means separating said plates and said casing, and resilient means separating said plates and said abutment, said shoes being adapted to engage a fixed member to thereby hold said vane device from rotation with said casing.

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