April 30, 1929. F. DAVIS 1,711,045

WELL CASING PUMP

Filed May 5, 1927 2 Sheets-Sheet 1

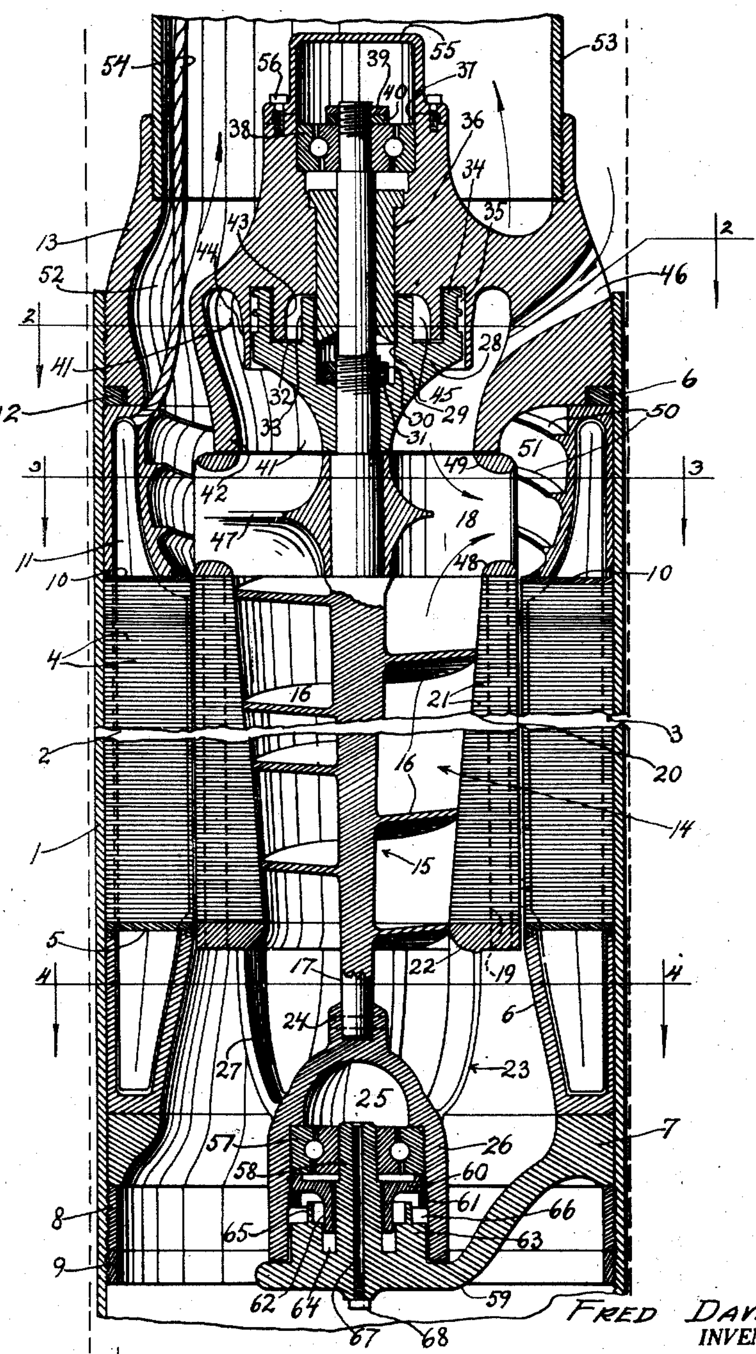

FIG. 1

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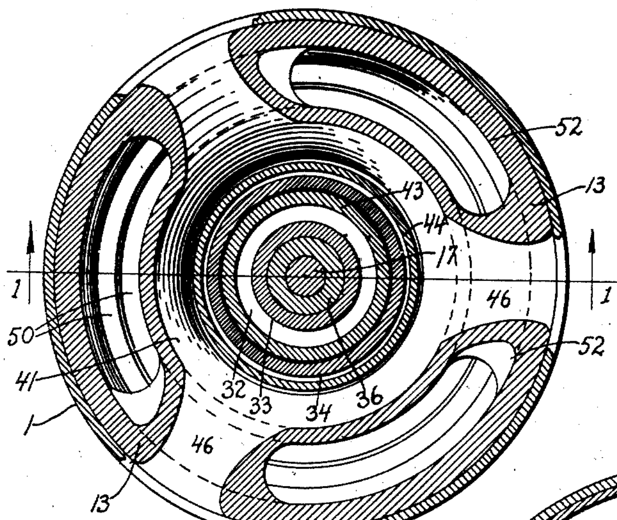
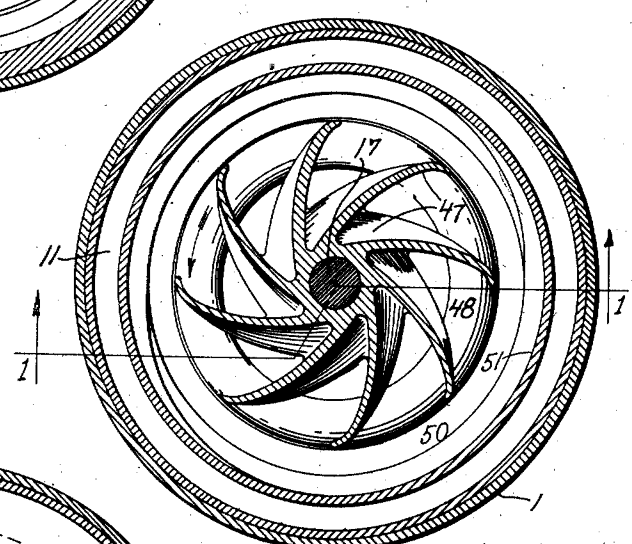


FIG. 2

FIG. 3



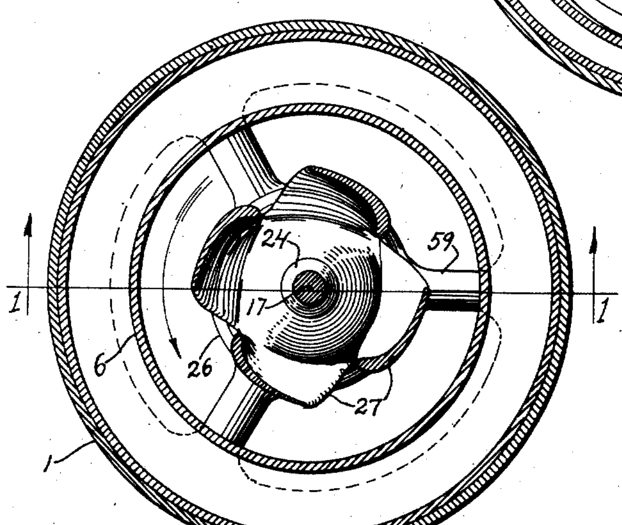


FIG. 4

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UNITED STATES PATENT OFFICE.

FRED DAVIS, OF BERKELEY, CALIFORNIA.

WELL-CASING PUMP.

Application filed May 5, 1927. Serial No. 189,093.

My invention relates to pumps adapted to pump liquid from wells or other cavities, and it consists in the combination, construction, and arrangement of parts hereinafter described and claimed.

One object of the invention is to provide a pump with a rotary element for producing the pumping action and to combine this rotary element with rotary and stationary elements of an electric motor so that both the pump and the motor are embodied in a unitary structure.

Another object of this invention is to construct a pump of this character having all rotary elements supported by and operated on bearings located in two bearing housings, which are built into and form parts of the unitary structure.

A further object of this invention is to construct an electric pump of this character with two bearing housings built into the main structure and so arranged that they may be filled with lubricant enough to lubricate the bearings for a considerable time, and to seal the bearing housings with packings so that the packings will be inside of the rotating element in the respective chambers containing the packings, thereby using the centrifugal action on the packings to force them out, and to pack them firmly against the only passages through which the lubricant could get out or grit or any other foreign matter could get into the respective housings.

A further object of this invention is to provide an upper and a lower bearing assembly having a rotary element between them and operating on both bearings, each being housed in a chamber having a closed top and being so constructed that all foreign matter must follow a course upward against gravity and toward the center against the centrifugal action in order to reach the bearings when the machine is in operation, and is thus prevented from getting into the bearings, there being no straight or single shaft along which any substance can work or be pressed from the outside directly into the chambers containing the respective bearings.

A further object of this invention is to construct a pump of this character so that it is adapted to be submerged or sunk into, and placed in a vertical position in, a well casing, and to provide the pump with a double-suction impeller, thereby enabling the pump to receive therein and to discharge therethrough any liquid entering the well casing either above or below the pump, without necessitating the liquid to pass between the casing and the outside wall of the pump structure.

A further object of this invention is to embody an electric motor in a pump of this character and to extend a centrifugal impeller combined with a screw-type impeller through the armature thereof and secure it thereto, so that the impeller forms a unit with the motor.

Further objects of this invention are to provide a pump of this character with a tubular shell; to provide an electric motor with a laminated stator-core, which is chambered so as to receive therein the coils for conducting the electric current of the motor; to press this stator-core into the shell; and to provide means, which prevent moisture or any foreign matter from reaching the coil chambers and also act as a cushion in order to allow the expansion and the contraction of the stator at different temperatures.

Still further objects and advantages will be understood from the following detailed description of the preferred embodiment of the invention, illustrated in the accompanying drawings, in which:

Figure 1 is a broken vertical section of the pump taken in planes indicated by the lines 1—1 in Figures 2, 3, and 4;

Figure 2 is a sectional plan taken in planes indicated by the lines 2—2 in Figure 1;

Figure 3 is a sectional plan taken in a plane indicated by the line 3—3 of Figure 1; and

Figure 4 is a sectional plan taken in a plane indicated by the line 4—4 of Figure 1.

In carrying out my invention, I provide a tubular shell 1, adapted to be sunk into, and placed in a vertical position in, a well casing, which is indicated by dotted lines in Figure 1, and into this shell is pressed the stator core 2 of an induction motor 3. The stator consists of closed-slot laminæ 4, which are firmly pressed together, so as to form an air-tight chamber within the stator, and the bottom of the stator thus constructed contacts with an annular gasket 5, fitting and closing the top of an annular bell 6, which is at its bottom supported on a main lower supporting-member 7, the latter being held in position by two locking rings 8 and 9. At its top the stator contacts with an annular gasket 10, fitting and closing the bottom of an annular bell 11, which at its top contacts with a locking ring 12, screwed into the shell and in its turn being locked in place by a main upper supporting-member 13. It is understood that the annular bells 6 and 11 hold the stator core 2 between the gaskets 5 and 10 with a sufficient pressure so that the completed stator is not only fixed within the shell, but also so that any possible leaks in the stator are thereby sealed, and that the gaskets are of compressible material for permitting the expansion and contraction of the stator at varying temperatures.

A rotary element 14 operating in conjunction with the stator to make a complete electric motor, consists of a screw 15, which comprises spiral blades 16 and has a stem 17 extending both above and below the blades. Immediately above the upper end of the screw the stem is machined, and a centrifugal impeller 18 is pressed on the stem and against the end of the screw. In proper places on the lower surface of the impeller are securely fastened, by brazing or any other approved method, suitable conducting bars 19, indicated by dotted lines in Figure 1. Upon the blades of the screw 15, which is conical in shape, as shown in Figure 1, and forms a spider adapted to receive the armature 20 of the motor thereon, and upon the conducting bars 19 are stacked the discs or laminæ 21, of which this armature or rotor is formed, the discs 21 being reamed so as to correspond with the dimension and the shape of the screw blades and being properly slotted for receiving the conducting bars 19 therein so that, after being stacked upon the conducting bars, the laminæ may be forced together with a pressure sufficient for forming a rigid mass. The lower ends of the conducting bars are pressed into slots formed in the annular top 22 of a member 23, and the lower end of the stem 17 at the same time is pressed into and suitably secured in a socket 24, formed concentrically in the member 23 on the closed top of a lubricant chamber 25 at the upper portion of an inverted bearing-housing 26, which is integrally joined to the annular top 22 by scoop-shaped propeller blades 27, and the conducting bars may be additionally secured by brazing or any other suitable means to the annular top 22, so that the element 14 in the stator, the centrifugal impeller 18 and the member 23 together constitute a unitary rotary element.

Immediately above the impeller 18 the stem 17 is suitably formed for receiving thereon a rotary member 28, which is provided with a central, preferably flat-bottomed bore 29, so that, after the member has been pressed on the stem and against the upper face of the impeller, the member may be locked in place on the impeller by lock nuts 30 and 31 at the bottom of the bore, the stem being threaded at this portion for receiving the nuts thereon. The rotary member 28 is at its top provided with an annular packing chamber 32, formed between an inner, annular flange 33 and an outer, annular flange 34, the flange 33 forming a portion of the cylindrical wall for the bore 29, and the flange 34 being in its periphery provided with packing grooves 35. In the upper supporting-member 13 is a central bore, somewhat smaller in diameter than the bore 29 in the rotary member 28 in order to have pressed thereinto or otherwise secured therein a sleeve bearing 36, preferably of bronze, the flange 33 thus being allowed a free rotative movement around the bearing, while the stem 17 is allowed to rotate freely within it when the supporting member has been screwed into the shell 1 against the top face of the upper bell 11. Above the sleeve bearing 36 the central bore in the supporting member 13 is preferably enlarged, as shown at 37, and provided with an annular shoulder, and into this enlarged portion 37 and against the shoulder is pressed the outer race of a ball bearing 38, the inner race of which fits upon a reduced, shouldered, and at its extremity threaded portion at the upper end of the stem 17, and lock nuts 39 and 40 are screwed upon this threaded stem portion for holding the inner race against the shoulder and thereby firmly securing the race upon the stem.

In order to admit the member 28 into the upper supporting-member 13 as well as to provide a path for liquid therethrough, the supporting member has therein a large, central passage 41, bounded by an annular flange portion 42, which, when the supporting member is secured in place in the shell 1, has its bottom sufficiently close to the top of the impeller 18 and near to the periphery thereof for forming a virtually continuous path for liquid from the passage into the impeller, but sufficiently spaced from the impeller for allowing a free running of the latter. The supporting member 13 is in its body provided with downward extending annular flanges 43 and 44, forming between them an annular recess into which, when the members 13 and 28 are in place, the flange 34 extends with freedom of rotation, while the inner flange 43 in the supporting member 13 extends into the packing chamber 32 with freedom of rotation close to the flange 34 and thereby forms within the packing chamber an annular compression channel 45 for the packing in the packing chamber. On its inside and at its root the flange 43 is preferably curved so as to press the packing in the chamber 32 and the channel 45 toward the flange 33, while at the same time the outer flange 44 presses upon the packings in the grooves 34. Liquid, grit or any other foreign matter is thereby prevented from passing to the ball bearing 38 at the top of the member 13, the sleeve bearing 36 acting as a further seal for preventing foreign substances from reaching the ball bearing 38 and also having a steadying effect upon the stem 17 of the rotary element 14.

The upper supporting-member 13 is provided with inlet ports 46, which lead radially and obliquely downward into the passage 41, and the outer flange 44 extends downward into this passage in front of the lower ends of the inlet ports, thus causing the liquid, coming from the ports, to be diverted from the packed connections between the members 13 and 28, the latter being reduced in diameter toward its lower end in correspondence with the reduced hub portion at the upper end of the impeller 18, so that the liquid, entering through the inlet ports 46, has a tendency to be evenly distributed and to run initially toward the central portion at the top of the impeller. The impeller itself is provided with vanes 47, which extend virtually tangentially from the hub portion of the impeller and are curved, as shown in Figure 3, so that, when the impeller is rotated in the direction of the curved arrow, a centrifugal as well as an upward, twirling motion is imparted to the liquid. At its bottom the impeller is provided with an annular portion 48, which fits the top of the armature 20 and to which the conducting bars 19 are secured, as before described, and at its top the impeller has similarly an annular portion 49 which coincides with the annular flange 42 in order to form a path for the liquid, as has also already been described. While thus the flow of the liquid is restricted by the annular portions 48 and 49, the joining of the vanes to the annular portions allows the liquid, when the impeller is rotated, to be forced by the centrifugal action of the vanes sidewise of the impeller and upon blades 50, which are formed spirally upon the annular wall 51 of the bell 11 and lead upward in accordance with the rotational direction of the impeller to passages 52, also spirally formed in the same direction between the passage 41 and the outer wall of the upper supporting-member 13 and leading to the upper end of the latter. At this end the supporting-member is threaded so that a discharge casing 53 may be screwed thereinto. This casing leads upward to a point of discharge, not shown, and is suitably fastened at its top for supporting the entire pump structure, and through the casing extends a suitable cable or pipe 54, which is sealed in the bell 11 and has therein suitable conductors for leading the current to the windings of the motor 3 from a source of electric energy.

A cap 55 is provided for protecting the bearings 38 and 36 in the supporting member 13. This cap is adapted to be filled with a suitable lubricant for the bearings and may be secured by bolts 56 to the member after a suitable gasket has been placed between the member and the cap so as to seal the joint.

At the bottom of the lubricant chamber 25 the bearing housing 26 is provided with an annular shoulder, and into the housing and against the shoulder is pressed the outer race of a ball bearing 57 while the inner race of the bearing is slidably fit upon a pivot member 58, which extends centrally upward from a spider 59, formed in the lower supporting-member 7, so that, when the supporting member is in place within the shell 1, the pivot 58 is aligned with the stem 17 and thus the rotary elements of the pump may be adapted to rotate freely within the shell 1, the upper ball-bearing 38 acting as a thrust bearing while being assisted by the lower bearing 57 in carrying the radial load of the rotary elements in the shell. In order to firmly lock the lower ball-bearing 57 in place within the housing 26, a member 60 is screwed into the housing against the outer race of the bearing, and this member in its turn is locked in place by an annular lock nut 61. The member 60 is formed with an annular flange 62, and the spider 59 has formed thereon an upward, annular boss 63, which is sufficiently spaced from the housing 26 to allow the housing to rotate freely and is spaced from the pivot 58 so as to form an annular groove 64, adapted to receive rotatably therein the flange 62. On the top of the boss 63 is formed an upward, annular flange 65, which is adapted to be spaced from the flange 62 so as to form an annular recess 66, adapted to receive therein a suitable packing, and the flange 62 is preferably curved at its root and toward the flange 65, so that it is adapted to press upon the packing in the recess, when the supporting member 7 is in its place against the bottom of the lower bell 6, in order to prevent liquid, grit or any other foreign matter from working its way to the bearing 57. The pivot 58 is provided with a longitudinal holes 67 thru its center, threaded at the lower end to receive a plug 68, so that lubricant for the bearing 57 may be forced at any time into the chamber 25.

When a pump, constructed and assembled as described, is sunk into a well casing or into any liquid body so that the inlet ports 46 also are submerged, and when an electric current flows to the motor 3, thereby rotating the rotary elements in the direction indicated by the curved arrows in Figures 3 and 4, the liquid is forced through the pump both at the bottom through the openings in the spider 59 and at the top through the inlet ports. The liquid that enters the pump at the bottom is first scooped by the blades 27 on the rotary member 23 toward the auger 15, and the blades 16 thereafter force the liquid upward and into the impeller 18, while at the same time the liquid that enters through the inlet ports 46 flows downward through the passage 41, both streams of liquid then being thrown centrifugally toward the spiral blades 50 as indicated by the curved arrows in Figure 1, and following an upward, spiral path through the passages 52 and up into and out through the casing 53, as is also indicated by arrows in the same figure.

Since the pump of my invention thus draws the liquid from two levels and thereby materially reduces the length of travel for a considerable quantity of the liquid, it is obvious that the pump is exceedingly efficient in its operation. Its efficiency is also of a lasting nature, since, by the means described, liquid, grit or any other foreign substances are prevented from reaching the bearings of the pump or the coil chambers of the motor for the pump.

I claim as my invention:

1. A pump adapted to be immersed into a liquid body and having inlet openings for the liquid at different levels; an element mounted in the pump for forcing the liquid at the different levels through and from the pump, and an electric motor for rotating said element, said element being disposed in said motor and between said inlet openings.

2. A pump adapted to be immersed into a liquid body and having inlet openings for the liquid at different levels; an element mounted in the pump for forcing the liquid at the different levels through and from the pump, means for operating the element, said means being disposed between said inlet openings.

3. A pump adapted to be immersed into a liquid body and having inlet openings for the liquid at different levels; an element mounted in the pump so as to be rotatable between the different levels for forcing the liquid through and from the pump; and means disposed between said levels for rotating the element.

4. A pump adapted to be immersed into a liquid body and having inlet openings for the liquid at different levels; an element mounted in the pump and adapted to be operated for forcing the liquid at the different levels through and from the pump; and means embodied in a unitary structure with the element and disposed between said levels for causing the operation thereof.

5. In a pump of the character described, a shell adapted to be immersed into a liquid body; supporting members mounted in the shell and having inlet openings at different levels and adapted to allow liquid to flow therethrough; bearings supported by the members; a rotary element between said supporting members and inlet openings adapted to produce a pumping action and having a stem mounted in the bearings; and means for preventing liquid, grit or any other foreign matter from reaching the bearings.

6. In a pump of the charac' r described, a shell adapted to be immersed into a liquid body; supporting members mounted in the shell having inlet openings thereon at different levels and adapted to allow liquid to flow therethrough; bearings supported by the respective members; a rotary element adapted to produce a pumping action and having a stem mounted in the bearings; means for preventing liquid, grit or any other foreign matter from reaching the bearings; and means between said supporting members for rotating the element.

7. In a pump of the character described, a shell adapted to be placed in a virtually vertical position and to be immersed into a liquid body; an upper and a lower supporting member mounted in the shell each having an inlet opening thereon and adapted to allow liquid to flow therethrough; bearings supported by the respective members; a rotary element adapted to produce a pumping action and having a stem mounted in the bearings; means for preventing liquid, grit or any other foreign matter from reaching the bearings; and means embodied in a unitary structure with the element for causing the rotation thereof.

8. In a pump of the character described a shell; an electric motor comprising a stator secured in the shell and sealed against moisture, and a tubular armature rotatable within said stator; propeller blades inside of said armature being secured to said armature, a stem centrally embodied in a unitary structure with said blades; and supporting members mounted in the shell for rotatably supporting said stem; and adapted to allow liquid to flow therethrough; said supporting members having inlet openings thereon disposed at different levels.

9. In a pump of the character described a shell; an electric motor comprising a stator secured in the shell and sealed against moisture, and a tubular armature rotatable within said stator; propeller blades inside of said armature being secured to said armature, a stem centrally embodied in a unitary structure with said blades; supporting members mounted in the shell for rotatably supporting said stem; and adapted to allow liquid to flow therethrough; said supporting members having inlet openings thereon disposed at different levels, and bearings with packing glands thereon at the opposite ends of said stem for cooperating with said supporting members in such a manner as to prevent liquid, grit, or other foreign matter to reach the bearings.

10. In a pump of the character described a shell; an electric motor comprising a stator secured in the shell and sealed against moisture, and a tubular armature rotatable within said stator; propeller blades inside of said armature being secured to said armature, a stem centrally embodied in a unitary structure with said blades, supporting members mounted in the shell for rotatably supporting said stem; and adapted to allow liquid to flow therethrough; said supporting members having inlet openings thereon disposed at different levels, bearings supported on said supporting members and adapted to hold a reserve supply of lubricant therein, and means for preventing liquid, grit, or any other foreign matter from reaching the bearings.

11. In a pump of the character described a shell; an electric motor comprising a stator secured in the shell and sealed against moisture, and a tubular armature rotatable within said stator; propeller blades inside of said armature being secured to said armature, a stem centrally embodied in a unitary structure with said blades; supporting members mounted in the shell for rotatably supporting said stem; and adapted to allow liquid to flow therethrough; said supporting members having inlet openings thereon disposed at different levels, and an impeller secured to said stem between said electric motor and an uppermost supporting member for forcing the liquid through said member.

12. In a pump of the character described, a shell; an electric motor comprising a stator, secured in the shell and chambered so as to receive the coils for conducting an electric current to the motor, and a tubular member rotatable within the stator; blades in said member, a rotary element extending through the blades, said tubular member being adapted to carry an armature; means for sealing the ends of the stator and for permitting the expansion and contraction of the stator at varying temperatures.

In testimony whereof I affix my signature.

FRED DAVIS.