June 14, 1932. J. A. WINTROATH 1,863,213

ADJUSTABLE SPIDER FOR DEEP WELL TURBINE PUMPS

Filed Dec. 10, 1927

Fig. 1.

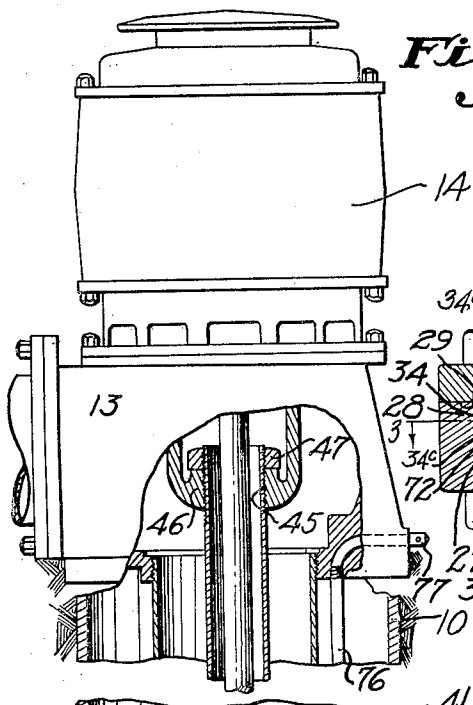
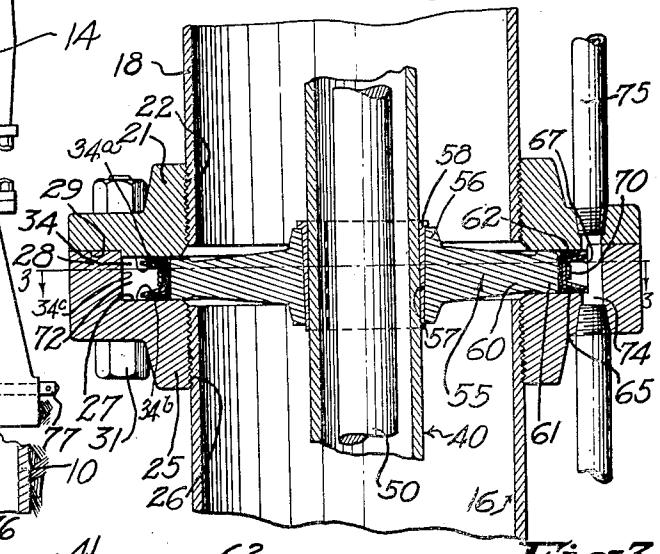


Fig. 2.



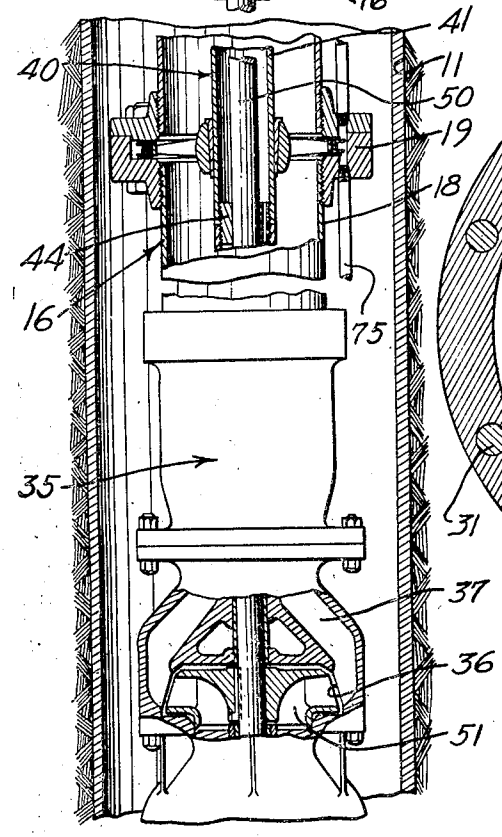
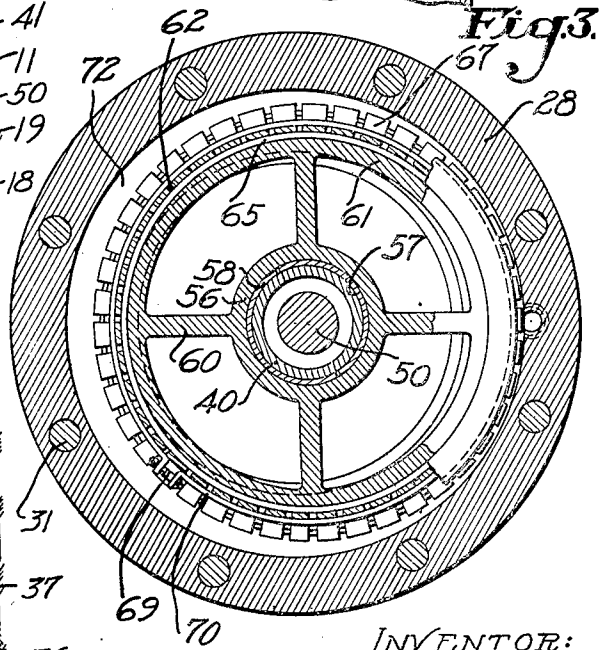


Fig. 3.



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UNITED STATES PATENT OFFICE

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ADJUSTABLE SPIDER FOR DEEP WELL TURBINE PUMPS

Application filed December 10, 1927. Serial No. 239,253.

My invention relates to pumps and more particularly to an adjustable spider for a deep well pump.

Before installing a turbine pump in a well, it is common practice to set a well casing therein. A pump head is situated at the top of the well casing. Extending from the pump head downward into the well is a discharge casing which carries a pump section at the lower end thereof, this pump section being below the surface of the fluid in the well. Also extending from the pump head to the pump section is a tubing. The tubing is supported inside of the discharge casing by means of spiders. Inside the tubing at frequent intervals are bearings which journal a shaft which extends from the pump head to the pump bowl in the well. The shaft carries impellers located in impeller chambers of the pump bowl. The impellers are rotated by suitably rotating the shaft and fluid is pumped to the surface of the ground through the discharge pipe.

The spiders commonly in use hold the tubing rigidly, and in such a position that the axis of the tubing falls along the axis of the discharge casing. Frequently, wells are not straight and any bend therein will cause the discharge casing to be bent also. This, in turn, will cause the shaft and the tubing to be similarly bent.

It is an object of my invention to provide a spider which is adjustable.

It is a further object of my invention to provide a spider which will not necessarily hold the tubing and the discharge casing in axial alignment.

A further object of my invention is to provide a spider which will allow the shaft to be straight irrespective of any slight crookedness in the well.

A further object of my invention is to provide a spider which will allow a relative sidewise movement between the discharge casing and the shaft or tubing.

It is extremely desirable that the shaft be exactly straight, for if the shaft is to have an axis which is slightly bent, undue forces will be exerted on the bearings journalling the shaft causing them to quickly wear out. Furthermore, each revolution of the shaft will cause a reversal of stress in the bent-axis shaft which will eventually cause the shaft to fail in a typical fatigue failure. When such a shaft is bent and rotated, an oscillation is set up in the bearings thereof, the period of this oscillation being the length of time of one revolution. This oscillating movement tends to throw the bearing from one side of the discharge casing to the other and is detrimental to both the shaft and the bearings.

It is an object of my invention to provide a spider which will tend to damp out a sidewise oscillation.

A further object of my invention is to provide a spider operating on the principle of a dashpot to prevent any sidewise movement between the shaft and the discharge casing.

A further object of my invention is to provide a spider having a resistance to sidewise movement, this resistance being controllable at the surface of the ground.

Further objects and advantages of my invention will be made evident hereinafter.

In the drawing,—

Fig. 1 is a view showing the utility of the invention.

Fig. 2 is a vertical cross-sectional view of the spider of my invention.

Fig. 3 is a horizontal cross-sectional view of my invention taken along the line 3—3 of Fig. 2.

Referring particularly to Fig. 1, a well casing 10 is set in a well 11. A pump head 13 is situated at the top of the well casing 10 and has a motor 14 situated on the top thereof. Extending downward in the well inside of the well casing 10 is a discharge casing 16 formed of lengths 18 secured together by suitable couplings 19. Each coupling 19, as best shown in Fig. 2, has an upper collar 21 threaded to the lower end of a length 18 as indicated at 22. A lower collar 25 is threaded on the upper end of each length 18, as indicated at 26. The lower collar 25 is counterbored, as indicated at 27, leaving a side flange 28 surrounding it. The upper collar 21 is slightly undercut, as indicated at 29, to receive the side wall 28. The upper and lower collars 21 and 25 are suitably secured

together by bolts 31. That portion of the counterbore 27 which is bounded at the top by the lower edge of the upper collar 21 forms an annular channel 34 for a purpose to be described, this annular channel providing a pair of opposed side walls 34*a* and 34*b* and a bottom wall 34*c*.

Secured to the lowest length 18 of the discharge casing 16 is a pump section 35 having one or more impeller chambers 36 formed therein. Passages 37 communicate between the impeller chambers 36 and the interior of the discharge casing 16.

Extending from the pump head 13 to the pump section 35 inside of the discharge casing 16 is a tubing 40 formed of sections 41. The sections 41 are secured together by means of bearings 44 which are threaded into adjacent lengths 41 to securely hold them together, as best shown in Fig. 1. The uppermost section of tubing passes through an opening 45 in a saddle 46 of the pump head. The upper end of this section of tubing is threaded to receive a nut 47 which is adapted to bear against the saddle 46 and place a tension on the tubing. A shaft 50 extends from the motor 14 through each of the bearings 44 and enters the pump section 35. An impeller 51 is secured to the shaft 50 in each of the impeller chambers 36, these impellers being adapted to draw well-fluid from the bottom of the pump section and raise it through the annular space between the discharge casing 16 and the tubing 40. This fluid is discharged from the pump head 13.

Located at each of the cuplings 19 of the discharge casing 16 is a spider 55 of my invention. The spider 55 has a hub 56 having a tapering hole 57 formed thereon. The tapering hole 57 is larger than the outside diameter of the tubing 40. Split taper bushings 58 are forced in the hole 57 of the hub 56 between the hub and the tubing, as best illustrated in Figs. 2 and 3. These bushings 58 are adapted to fit the tapering hole 57 and to centralize the tubing 40 in the hub 56 of each spider 55. By tightly driving the split taper bushings 58 between the hub 56 and the tubing 40, it is possible to securely clamp this tubing to the hub. I prefer, however, not to form a tight fit between the tubing 40 and the hub 56. By making the split taper bushings slightly wedge-shaped to exactly fit the tapering opening 57 in the hub, it is possible to allow the tubing 40 to be raised relative to the hub 56, the split taper bushings rising a distance in the bore 57 and separating a small distance to allow this movement. Any downward movement of the tubing 40 will be arrested by the split taper bushings 58 firmly seating in the hub 56.

Extending outward from the hub 56 are arms 60. The outer ends of the arms 60 are joined by a rim 61 which is adapted to extend into the annular chamber 34 of the coupling 19. The rim 61 has an outer periphery 62 which is larger in diameter than the discharge casing 16, but smaller in diameter than the annular chamber 34. Thus, the spider 55 may be moved sideways in a plane perpendicular to the axis of the shaft.

Extending around the periphery 62 of the rim 61 is a channel-shaped washer 65. Spaced closely together inside of the channel-shaped washer 65 are spring clips 67 which are adapted to engage the legs of the channel-shaped washer and force them outward against the upper and lower walls of the annular chamber 34. A ring 70 is passed around each of the spring clips 67 and compresses these clips and the washer 65 against the outer periphery 62 of the spider 55. The tension in the ring 70 is adjusted by means of a bolt 69 which passes through the ends of the member which form the ring 70. By tightening the bolt 69, it is possible to tightly compress the ring against the spring clips which in turn compress the washer 65 against the outer periphery 62.

That portion of the annular channel 34 which is outside of the washer 65 comprises an annular chamber 72. Communicating between each chamber 72 and the exterior of the couplings 19 is an opening 74. The openings 74 of each of the couplings 19 are connected together by means of pipes 75, as best shown in Figs. 1 and 2. These pipes 75 communicate with a pipe 76 which enters the pump head 13. A suitable high-pressure lubricating nipple 77 is secured to the upper end of this pipe. Such a nipple is well known in the art, and is adapted to receive the fitting of a high-pressure gun containing a suitable medium. The nipple 77 has a ball check valve to prevent any return flow of medium forced therethrough.

The operation of my invention is as follows:

The pump section is assembled and lowered into the well a short distance. Lengths of discharge tubing 18 are assembled thereon and are secured together by couplings 19 in the manner previously described. At the same time, the tubing 40 is inserted in place length by length, and the shaft 50 is journalled in the bearings 44 therein. As each coupling 19 is assembled, it is desirable to pack the annular chamber 72 thereof with a heavy oil. I prefer to use an oil having a high viscosity for a purpose to be described. When the pump and pump head are completely assembled, the oil is forced through the nipple 77 into the pipes 75 and 76. These pipes are completely filled with the heavy oil. The pressure of this oil can be regulated by the amount of oil forced through the nipple 77. At this time a considerable tension is placed on the tubing 40 by tightening the nut 47. When this is done, the axes of the tubing will tend to assume a straight line. This

is made possible even though the discharge casing 16 is slightly curved, due to the use of the spiders 55 of my invention. These spiders may move sidewise relative to the discharge casing 16, and, in so doing, the rim 61 becomes decentralized relative to the discharge casing 16. Such a condition is shown in the drawings. Here the spider 55 has moved to the right and it will be noticed that the rim 61 is pushed further into the annular channel 34 on the right-hand side than on the left-hand side thereof, as shown in Figs. 2 and 3. As the spider 55 moves to one side, the fluid in the annular chamber 72 will be displaced away from the side toward which the spider moves and will move around into that space diametrically opposite. This is because of the fact that, as the spider 55 is moved, the volume of the annular chamber 72 on the side toward which movement takes place is decreased, and the volume of the annular chamber 72 on the side opposite the direction of movement will be increased. Thus, the oil in the chamber will have to flow from one side of the chamber to the other to compensate for this difference in volume. By using the oil of sufficient viscosity, it should be apparent that this movement of the oil through the annular chamber 72 would be impeded, especially inasmuch as the spring clips 67 offer an added surface of contact between the oil and the spider 55. The annular chambers 34 thus act as a dashpot to prevent the sudden movement of the spiders 55 to one side. Such a sidewise oscillating motion is set up with every revolution of the shaft 50 if this shaft is not exactly straight. Such an oscillating movement will be transmitted to the tubing 40 through the bearings 44 and will thus tend to vibrate the spider 55 from one side to the other. The oil in the chamber 72 effectively prevents any quick movement of the spider 55 from taking place. Any continued pressure in a certain direction would, however, move the spider in that direction as the oil could flow in the chamber 72 to compensate for this displacement, if given sufficient time. It should thus be apparent that my invention not only tends to let the shaft 50 rotate on a straight axis, but that it also tends to prevent the whipping of the shaft should there be any slight bends therein.

It is also within the scope of my invention to assemble the pump and pump head without supplying each coupling 19 with a lubricating medium as it is assembled. In such a case the oil could be forced through the nipple 77 and would be transferred to each coupling 19 through the pipes 76 and 75.

It is within the scope of my invention to use any material in the annular chamber 72 of each coupling 19. For instance, it is entirely possible to force a substance through the pipes and into the chamber 72 which will eventually harden after the tubing 40 has been placed under tension to straighten it relative to the discharge casing 16. Such a substance might be any type of cement which will harden to form an extremely hard body when allowed to set. When such a material is used, the chambers 72 are filled with a solid instead of a fluid, and the spider 55 will be rigidly held in the position it assumes when the tension is placed on the tubing 40.

I claim as my invention:

1. In combination: an outer element; an inner element extending into said outer element; a spider between said outer and said inner elements, said spider being adjustable to allow a sidewise movement of one of said elements relative to the other of said elements; and fluid means around said spider, said means acting as a dashpot to retard said sidewise movement.

2. In combination: an outer element, said outer element having an annular channel; an inner element extending into said outer element; a spider on said inner element, said spider being smaller in diameter than said annular channel and set therein and engaging opposed walls of said annular channel to be guided in its sidewise movement therein; and a fluid in said channel adapted to retard the sidewise motion of said inner element relative to said outer element.

3. In a turbine pump, the combination of: a casing, said casing having an annular channel therein; a shaft in said casing; a spider supported concentric with said shaft, said spider resting in said annular channel and being smaller in diameter than said channel; a washer around said spider, said washer engaging the walls of said channel to form an annular chamber; and means in said annular chamber for retarding any movement of said spider in said annular channel.

4. In a turbine pump, the combination of: a casing, said casing having an annular channel therein; a shaft in said casing; a spider supported concentric with said shaft, said spider resting in said annular channel and being smaller in diameter than said channel; a washer around said spider, said washer engaging the walls of said channel to form an annular chamber; spring clips spaced around said washer; and means in said annular chamber for retarding any movement of said spider in said annular channel.

5. In a turbine pump, the combination of: a casing, said casing having an annular channel therein; a shaft in said casing; a spider supported concentric with said shaft, said spider resting in said annular channel and being smaller in diameter than said channel; a washer around said spider, said washer engaging the walls of said channel to form an annular chamber; spring clips spaced around said washer; a ring adapted to hold said clips in engagement with said washer; and means

in said annular chamber for retarding any movement of said spider in said annular channel.

6. In a turbine pump, the combination of: lengths of discharge casing; couplings joining said lengths, said couplings providing annular channels, each channel providing opposed side walls and a bottom wall; spiders in said annular channels and slidable relative to said side walls, said spiders being of smaller diameter than said bottom walls to permit sidewise movement of said spiders relative to said couplings; a tubing extending through said spiders; and means for placing a tension on said tubing.

7. In a turbine pump, the combination of: a discharge casing, the axis of which may be curved, said discharge casing having a plurality of annular channels formed along the length thereof, each channel providing opposed side walls and a bottom wall; a tubing extending through said casing; spiders surrounding said tubing and extending into said annular channels, said spiders being of smaller diameter than said bottom walls of said channels to permit sidewise movement of said tubing relative to said casing, said spiders cooperating with the walls of said channels to provide annular chambers; means for supplying a fluid to each of said chambers from a remote point; and means for supporting said tubing from its upper end so that its axis tends to assume a straight line.

8. In a turbine pump, the combination of: a discharge casing, the axis of which may be curved, said discharge casing having a plurality of annular channels formed along the length thereof; a shaft extending through said casing; spiders supported concentric with said shaft and extending into said annular channels in fluid-tight relationship with the upper and lower walls thereof, said channels containing a fluid which is displaceable to allow a slow sidewise movement of said shaft relative to said casing but which damps out quick sidewise movements; and means for supporting said shaft.

9. In combination: walls forming an annular channel; and an annular ring extending into said channel and being slidable sidewise therein in fluid-tight relationship with said walls thereof to form an annular chamber, said chamber being filled with a liquid.

In testimony whereof, I have hereunto set my hand at Los Angeles, California, this 5th day of December, 1927.

JOHN A. WINTROATH.