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1,821,772

REVERSIBLE CENTRIFUGAL PUMP

Filed June 4, 1926

2 Sheets-Sheet 1

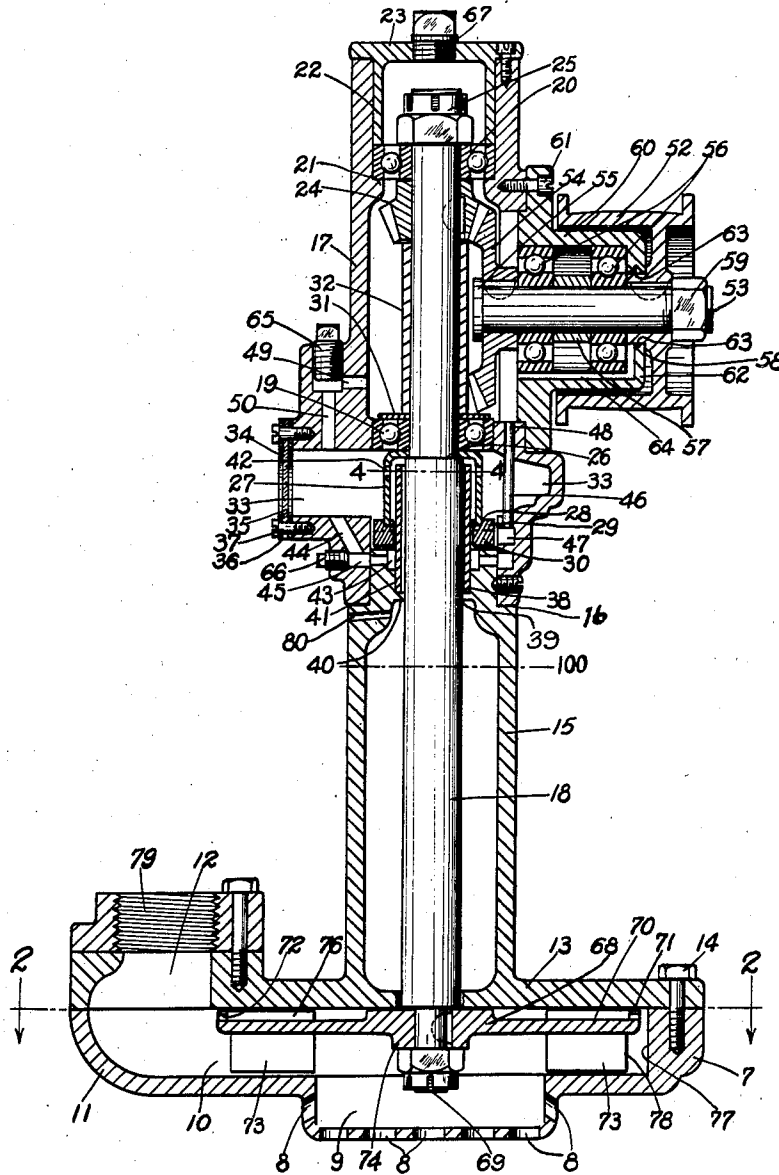


Fig. 1.

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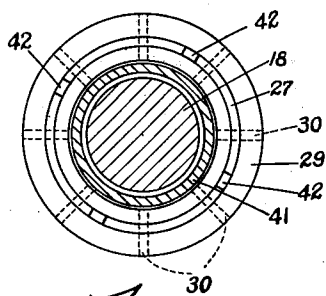
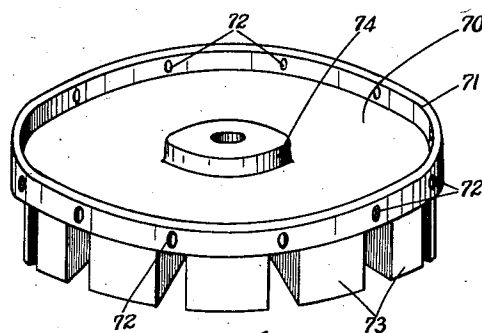
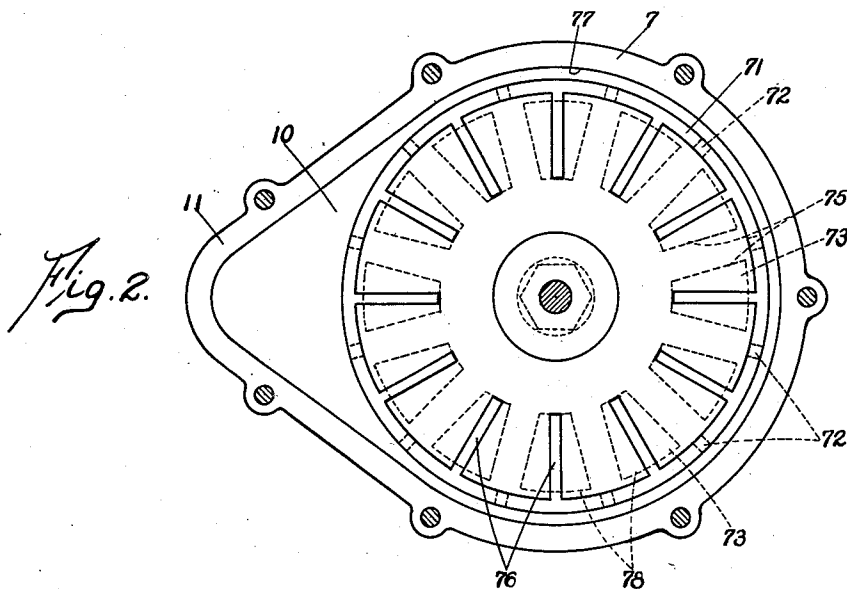


Fig. 4.

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REVERSIBLE CENTRIFUGAL PUMP

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This invention relates to centrifugal pumps and has for an object the provision of a device of this kind which requires no priming and one which will attain its maximum volume and pressure of output almost immediately after being started from rest.

Another object is to provide a device of this kind wherein the necessity for packing elements is eliminated.

Another object is to provide a device of this kind wherein the usual relief valves or the like are eliminated.

Another object is to provide a device of this kind which is so constructed as to permit passage of grit, small chips and other foreign matter through the pump without injury to the mechanism and without impairing its efficiency.

Another object is to provide a pump of this kind wherein perfect hydrostatic balance is attained, to the end that the bearings are kept free of the cutting lubricant to be pumped without requiring the interposition of packing elements.

Another object is to provide a device of the class referred to having an impeller so constructed as to attain the highest efficiency with a minimum of power.

Another object is to provide a pump of this kind having a self-contained and visible feed lubricating mechanism for supplying lubricant to the bearing parts thereof.

These and other objects are attained by means described herein and disclosed in the accompanying drawings, in which:

Fig. 1 is a cross sectional elevation of a device of my invention.

Fig. 2 is a view taken on line 2—2 of Fig. 1.

Fig. 3 is a perspective view of a modified form of impeller used with the device of my invention.

Fig. 4 is a cross sectional view on line 4—4 of Fig. 1.

The device of my invention comprises a lower casing 7 having inlet perforations 8 which in the embodiment disclosed herein are located in the wall of the central depression or well 9, which is in open communication with the hollow interior 10.

The casing 7 has an extended portion 11 over which the discharge opening 12 in cover 13 is positioned. The cover 13 is secured upon casing 7 by means of suitable cap screws 14. A tubular upright member 15 which is preferably formed integral with the cover member 13 is shouldered at its upper end as at 16 to receive the lower end of a housing 17 within which the vertical impeller shaft 18 is journaled in ball bearings 19 and 20.

The bearing 20 has its outer race seated upon shoulder within the housing 17 and is retained by a depending inner flange 22 of a cover cap 23. The vertical impeller shaft 18 has a bevel gear 24 keyed to it and abutting the lower face of the inner race of bearing 20. The upper free end of the shaft 18 extends through and above the top face of bearing 20 and receives suitable lock nuts 25 which abut the upper face of the inner race of bearing 20. A shoulder 26 on shaft 18 is adapted to receive a cup-shaped member 27, the lower edge of which is placed into an annular groove 28 in a small impeller 29 having radial impeller blades 30 on the lower face thereof and forming part of a sight feed lubricating system for the gears and bearings. The inner race of bearing 19 seats upon the member 27 and receives over its upper face a washer 31 which precludes too free passage of oil through the bearing 19. A sleeve 32 surrounds shaft 18 and extends between bevel gear 24 and washer 31. From the foregoing it will be apparent that when the parts mentioned are positioned on the shaft 18 and lock nuts 25 are tightened, the parts will all be clamped between the shoulder 26 and nuts and will rotate with the shaft.

The housing 17 is enlarged adjacent its lower end to form an oil well 33 having a sight opening 34 covered by a plate of glass or celluloid 35 suitably secured thereover by means of a frame 36 and screws 37. The upright member 15 has an enlarged bore 38 and a restricted bore 39 in its upper end whereby to form a shoulder 40. A sleeve 41 is pressed into bore 38 and seating upon shoulder 40 extends upwardly through the

small impeller 29 and cup-shaped member 27 and thus forms an inner cylindrical wall for the oil well 33. The cup-shaped member 27 is perforated as at 42 adjacent the top edge of tube 41 and these perforations determine the oil level for the lubricant well 33 and also preclude capillary action between the inner wall of member 27 and the outer wall of tube 41 from siphoning the oil out of the well 33 and between shaft 18 and the inner wall of tube 41. A groove 43 surrounding tube 41 is placed in communication with the oil well 33 by means of perforations 44 and 45 in order to permit passage of the oil from the oil well to the impeller blades on the small impeller 29. A small pipe 46 extends through the oil well 33 and has its lower end in communication with the outlet 47 of the lubricant pump and has its upper end 48 communicating with the hollow interior of the housing 17 above the top of bearing 19. The washer 31 precludes the oil pumped into the bottom of housing 17 to flow directly through the bearing into the well 33, so that the oil will rise for a distance in the bottom of the housing 17 and maintain a level determined by the overflow 49 which communicates with the well 33 by means of a passage 50.

In the embodiment disclosed herein the pump is actuated from a pulley 52 which rotates a horizontal shaft 53 for carrying a bevel gear 54 which meshes with the bevel gear 24 on the impeller shaft 18. The horizontal shaft 53 has a shouldered inner end 55 and bevel gear 54 abuts said shoulder and is keyed to the shaft 53.

The pulley 52 is also keyed to horizontal shaft 53 and is hollowed out to overhang a substantial part of said shaft. A pair of ball bearings 56 spaced by a collar 57 are carried by the shaft intermediate the flange 58 on the pulley and the bevel gear 54 and the inner races of said bearings and also the sleeve are clamped in position by a nut 59 on the shaft 53, the outer races of the bearings 56 are free to float and the entire structure comprising the wall and shaft and parts carried thereby are retained in position by a flanged retaining member 60 which is secured to housing 17 by suitable screws such as 61. The retaining member 60 has at its outer end an inwardly turned flange 62. The inner peripheral edge of the flange 62 is provided with a groove 63 and the inner wall of the retaining member 60 has at its lower level a channel 64 communicating with the groove 63 in the edge of the flange thereof. The groove 63 collects the superfluous oil and permits it to return by way of channel 64 to the oil chamber above the washer 31 in the housing 17. It should be noted that the outer races of the bearings 56 and also of the bearing 19 are free floating while the outer race of the bearing 20 is

retained against movement. The operation of the above described portion of the device is as follows: The oil well 33 is filled with oil through the enlarged threaded upper end of the passage 50 and a threaded plug 65 is inserted therein. Power is supplied by a belt passing over the pulley 52 and the bevel gear 54 thereon which in turn rotates the bevel gear 24 and drives the vertical shaft 18. The small auxiliary impeller 29 pumps oil from the oil well 33 up through pipe 46 and fills that portion of housing 17 immediately above the washer 31 up to the level of the overflow 49. The rapidly revolving bevel gear 54 revolves in the pocket of oil above the washer 31 and effectively throws the oil to all of the bearings and also lubricates the gears. The returning oil is precluded from seepage by the collecting groove 63 and is returned by way of channel 64 into said oil pocket and flows through overflow 49, and passage 50 and returns to the well 33. The height of the oil in the oil well as well as the return flow of oil are visible through the glass or celluloid 35 so that it is possible to tell at a glance whether or not the bearings of the pump are being properly lubricated. A drain plug 66 is provided in the bore 45 below the impeller for cleaning the pump. A removable plug 67 in the top of cap 23 permits entry of a cleaning fluid such as kerosene or the like in order to cleanse the working mechanism of the pump without dismantling it.

The simplicity and unusual efficiency of the pump of my invention resides in the structure of the impeller indicated generally as 68 which is keyed to the reduced end 69 of the vertical shaft 18 and disposed within the hollow interior 10 of the casing 7. The impeller 68 is an integral structure comprising a disk portion 70 having an upstanding lip 71 provided with a plurality of perforations 72. Depending from the lower face of the disk 70 are impeller blades 73 which are positioned radially and spaced at a distance from the hub 74. The adjacent faces 75 of adjacent blades 73 are parallel and the outer ends of the blades coincide with a circumference somewhat smaller than the circumference of the lip 71 above, see Figs. 1, 2, and 3. In the preferred form as shown in Figs. 1 and 2, the upper face of the disk 70 carries a plurality of radial blades 76 one of which is disposed midway between each pair of perforations 72 in the lip 71. In the modified form of impeller shown in Fig. 3, the blades 75 are omitted. Otherwise the impellers are alike. By reference to Fig. 2 it will be apparent that the inner vertical wall 77 of the casing 7 is generally concentric with the impeller and that there is a considerable clearance between the periphery of the disk 70 and the wall 77. It will also be

noted that there is a relatively greater clearance between the outer ends 78 of the impeller blades 73 and the wall 77. This structure permits free passage of grit, small chips and the like through the pump without derogatory effect on the mechanism. By providing the shallow cup produced within the lip 71 above the disk 70 but providing the perforations 72 through the lip 71 it is possible to throttle the output of the pump without stopping the impeller and without causing the fluid to rise above its normal level in the tubular member 15. This efficiency is attained by having the combined area of the perforations 72 in the lip 71 equal to or less than the relative space of clearance between the top of the lip and the lower face of the cover 13 adjacent the impeller so that the upper structure of the impeller will act as a separate centrifugal pump to prevent the fluid from rising above the normal level of the supply. In operation the pump in the embodiment disclosed would be submerged in a pan of cutting lubricant or the like up to the level indicated by the line 100 on the tubular portion 15 and a suitable conduit would be coupled at 79 to carry the lubricant to the desired place. Such discharge conduits (not shown) are usually provided with shut-off valves in order to regulate the flow and also to stop the flow if desired. When power is applied to the pulley 52 the bevel gears 54 and 24 will impart high speed rotation to the shaft 18 and the impeller 68. The cutting lubricant or cooling medium in the pan (not shown) which entered into the hollow interior 10 of the casing 7 through the perforations 8 will be thrown outwardly by the parallel faces 75 of the impeller blades 73 and will thus force a substantial volume of lubricant at a suitable pressure through the discharge port 12 and into the conduit (not shown).

Among the particular advantages of pumps constructed in accordance with the present invention are the following: The pump requires no priming and the flow therefrom may be throttled or shut off without stopping the pump. This makes the device particularly adaptable for supplying a cooling medium to cutting tools of machine tools.

The stream is steady and free from pulsations and from air bubbles. Another advantage lies in the fact that by reason of the parallel faces between impeller blades, the pump is reversible and equally efficient when rotated in either direction.

A special advantage not found in other pumps lies in the fact that the casing 7 may be replaced by a container casing having an intake conduit connected with a supply of fluid in which case the pump may be disposed outside of the pan and in any convenient location. In such cases the highest

level of the remote supply of lubricant or cooling medium should be on a level with the line 100 on the tubular member 15. Air passage 80 in the tubular member 15 permits the fluid to be pumped to find its normal level within said member so that the pump is always primed. Upper shallow dished portion of the impeller precludes the fluid from being forced above its normal level, when the discharge is throttled down or shut off while the impeller is in operation. A pump constructed as disclosed herein and having an impeller of about six inches in diameter has a capacity of 53 gallons per minute at a 4 foot head when the pump is rotating at the rate of 400 R. P. M.

I claim:

1. In a vertical, packless centrifugal pump structure the combination of a hollow casing having a continuous inner wall, an impeller disc having a radially perforated upstanding annular lip, depending blades on the lower face of the disc, said blades terminating in a circumference concentric with and of lesser diameter than the annular lip, a cover for the casing, a shaft secured to the impeller and extending through the casing and means for rotating the shaft.

2. In a vertical, packless centrifugal pump the combination of a hollow casing, an impeller disc rotatably mounted in the casing, an annular lip extending upwardly from the disc and having spaced radial perforations therethrough and spaced blades having parallel adjacent faces depending from the disc and terminating in a circumference of lesser diameter than the annular lip and means for rotating the impeller disc.

3. In a device of the class described the combination of a hollow casing, a cover for the casing, a tubular member on the cover having communication with the hollow interior of the casing, said casing and tubular member being adapted to contain a liquid to be pumped, a shaft extending through the tubular member and into the casing, an impeller on the shaft and a perforate annular lip on the impeller adjacent the cover for effecting a hydrostatic balance between the liquid in the tubular member and the liquid in the casing when the impeller is rotated.

4. A packless vertical centrifugal pump comprising a casing, a cover for the casing, a tubular member extending upwardly of the cover and having communication with the interior of the casing, a shaft journaled in the tubular member and extending through the cover into the casing, an impeller disc in the casing and secured to the shaft, impeller blades depending from said disc and terminating in a circumference of lesser diameter than the disc, a peripheral radially perforated lip extending from the disc and terminating adjacent the

lower face of the cover and means for rotating the shaft, the depending blades serving to pump a liquid contained within the casing and lower portion of the tubular member while the disc and perforate annular lip rotating therewith, effects a hydrostatic balance between the liquid in the casing and that in the tubular member.

5. As a new article of manufacture an impeller for a vertical packless centrifugal pump, comprising a flat disc portion, a peripheral annular lip having radially disposed perforations therethrough and extending at right angles to the disc, on one side thereof, and depending impeller blades on the opposite side of the disc, adjacent faces of adjacent blades being parallel and the ends of said blades terminating in a circumferential plane disposed within the body line of the disc.

6. As a new article of manufacture an impeller for a vertical, packless centrifugal pump comprising a disc, a peripheral lip extending upwardly from one side of the disc, said lip having radially spaced perforations therethrough, blades extending radially inwardly from said lip and being positioned intermediate the perforations therein, radially disposed depending impeller blades extending from the disc and terminating in a circumference of lesser diameter than the disc.

7. In a packless vertical pump a combination of an enclosed hollow casing having a vertical communicating tubular member extending therefrom, the casing and tubular member being adapted to contain a fluid extending to a predetermined level in the tubular member, a shaft journaled in the tubular member above the liquid level and extending into the casing, an impeller disc in the casing and rotatable with the shaft, radially disposed impeller blades depending from the disc, an annular lip extending between the disc and the housing and having radially spaced perforations therethrough for effecting a hydrostatic balance between the liquid in the tubular member and the liquid in the casing whereby said liquid is precluded from rising above its normal level in the tubular member.

8. In a reversible packless pump structure the combination of a casing for containing a liquid to be pumped, an upright tubular member on the casing and into which said liquid extends to a predetermined level, a shaft having bearings in the tubular member above the normal liquid level and extending downwardly into the casing, an impeller on the shaft disposed in the casing, means on the impeller for effecting a hydrostatic balance between the liquid in the tubular member and the liquid pumped by the impeller, an extension on the tubular member providing an oil well therein above the

normal liquid level and means actuated by the shaft for moving oil from the well to the bearings.

9. In a vertical centrifugal packless pump the combination of a substantially flat, hollow impeller casing having an inlet port and an outlet port therein, a vertical tubular member extending from the casing and communicating therewith at the top and with the atmosphere, a vertical shaft journaled in the upper portion of the tubular member and depending into the casing and an impeller on the shaft in the casing comprising a disk, depending radial blades on the bottom of the disk and a perforate annular lip on the top of the disk disposed closely adjacent the top wall of the casing and encircling the communicating area between the casing and the tubular member.

In testimony whereof, I have hereunto subscribed my name this 27th day of May, 1926.

EDWARD J. RUTHMAN.