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2,614,501

SCREW AND CENTRIFUGAL PUMP

Filed Dec. 19, 1949

2 SHEETS—SHEET 1

Fig. 1.

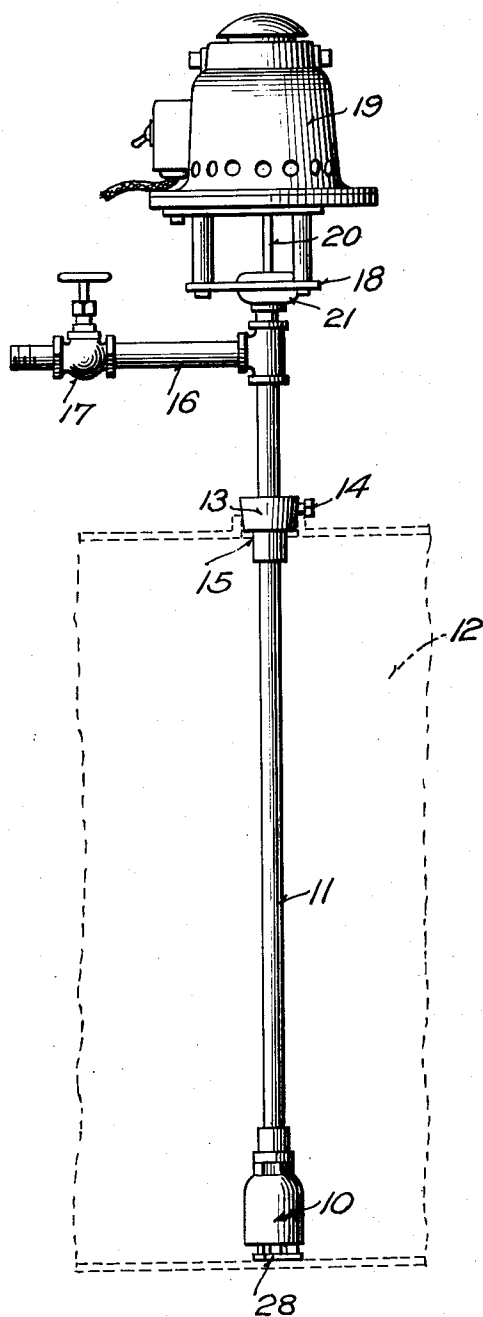


Fig. 2.

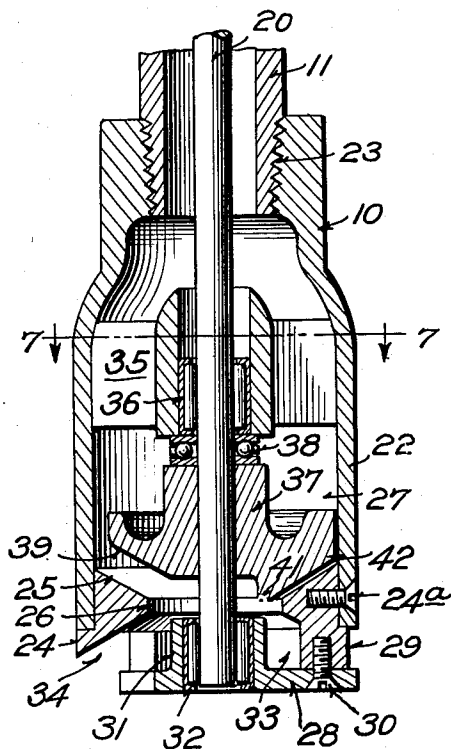
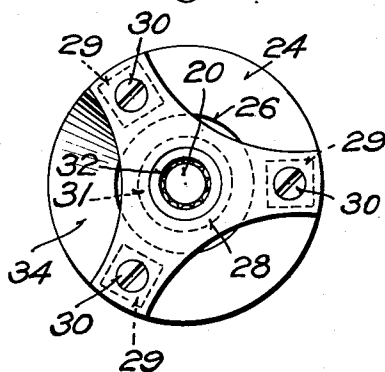


Fig. 3.



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2 SHEETS—SHEET 2

Fig. 4.

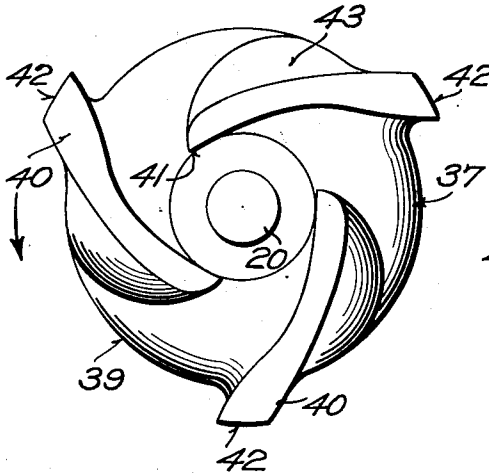


Fig. 5.

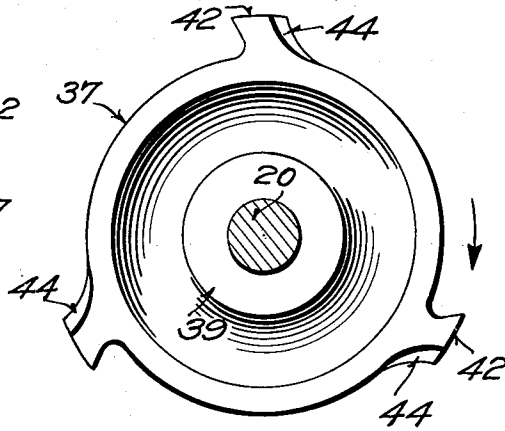


Fig. 6.

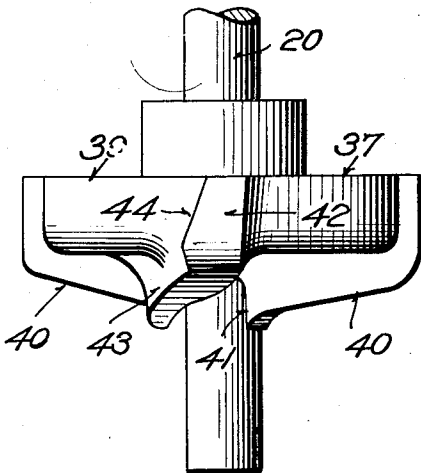
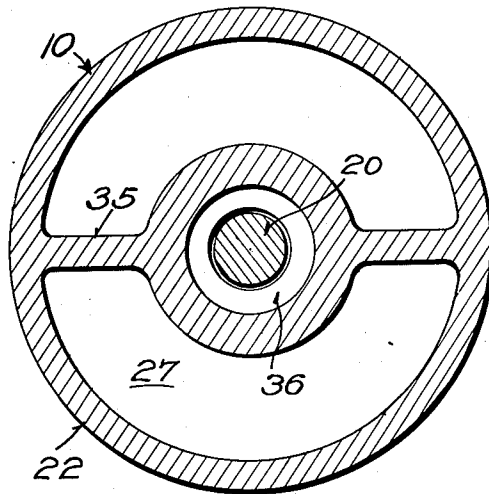


Fig. 7.



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SCREW AND CENTRIFUGAL PUMP

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8 Claims. (Cl. 103—88)

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This invention relates to pumps and more particularly to centrifugal liquid pumps.

An object of the invention is to provide a centrifugal pump of very compact design that may be inserted into an oil drum or the like for the purpose of pumping out the contents thereof.

Another object is to provide in a pump of this character a rotor or impeller having vanes constructed and arranged to impart high pressures to the liquid being pumped and to operate with good efficiency.

Another object is to provide a centrifugal liquid pump having a simple bearing arrangement whereby thrust forces are effectively compensated.

Another object is to provide a pump structure having a minimum number of parts and capable of ready manufacture, assembly and maintenance. The simplicity of construction and operation of the pump insures long and trouble-free service life.

The foregoing and other aims, objects and advantages of the invention are realized in a centrifugal liquid pump having an impeller housing providing a cavity therein defined by cylindrical side walls, an inverted conical bottom providing an axial liquid intake port, and a top providing an axial liquid outlet port, axial shaft bearing means in the housing, a driven axial impeller shaft carried in the bearing means and extending out of the housing through the liquid outlet port, a rotary impeller mounted on the shaft adjacent to the bottom of the housing, the impeller comprising a hub having bottom and sides spaced from and conforming substantially to the shape of the bottom and adjacent side wall portions of the cavity, and a plurality of arcuately disposed vanes on the hub, each of the vanes extending substantially entirely across the space between the hub and the opposed internal faces of said cavity and being shaped to spiral outwardly across the bottom of the hub in a direction away from the direction of rotation of the impeller from a central point to a peripheral point and to extend up the sides of said hub, the leading face of the bottom portion of each vane being inclined downwardly away from the direction of rotation of the impeller and the leading face of the side portion of each vane being inclined upwardly away from the direction of rotation of the impeller.

In the drawings:

Fig. 1 is a vertical elevational view of a pumping assembly for evacuating an oil drum showing

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the pump in position in the bottom of a drum;

Fig. 2 is an enlarged axial sectional view of the pump of the invention;

Fig. 3 is a bottom view of the pump shown in Fig. 2;

Fig. 4 is a bottom view of the impeller on a somewhat enlarged scale;

Fig. 5 is a top view of the impeller;

Fig. 6 is a side view thereof; and

Fig. 7 is an enlarged sectional view taken along the plane of the line 7—7 of Fig. 2.

Referring to the drawings, particularly to Fig. 1, the pumping assembly shown includes the pump proper 10 fitted to the bottom of a rising conduit or pipe 11 that extends through the top opening 15 of a drum 12. The riser 11 has a collar 13 thereon provided with a set screw 14 for adjustably positioning the collar on the riser at such point that, when the collar is fitted in the drum opening 15, the pump 10 is properly positioned in the bottom of the drum.

Above the collar, the riser 11 is provided with a lateral take-off pipe 16 having a manually operated valve 17. A motor mounting bracket 18 is fitted to the top of the riser 11 and carries an electric motor 19, or other conventional power source, that drives the shaft 20 that operates the pump 10. The shaft 20 passes through a packing gland 21 and extends down through the riser 11 to the pump 10.

Referring to Figs. 2 and 3, the pump 10 is shown as being threadedly attached to the bottom of riser 11. The pump has a housing including an upper bell-shaped portion 22 providing a top outlet opening 23 into which the riser 11 is fitted. The bottom of the housing is formed by a portion 24 having an inverted conical top surface 25 and a central axial liquid intake opening 26. These two housing portions, which are secured together by screws 24a, define the impeller cavity 27. The top surface 25 of the bottom housing portion typically makes an angle of about 30° with the horizontal.

A foot-plate 28 is fastened to the three depending legs 29 of the bottom portion 24 by means of machine screws 30. The foot-plate carries a bearing boss 31 into which is fitted a bearing 32, preferably a needle bearing. From an inspection of Figs. 2 and 3, it will be seen that the foot-plate 28 and the bottom housing portion 24 cooperate to define an intake cavity 33 communicating with the outside through ports 34 and communicating with the impeller chamber through the central opening 26.

Inside the impeller cavity 27 is a transverse

bearing support 35 carried by the walls of the upper portion of the housing and in which is mounted an upper needle bearing 36 for the shaft. As shown, the impeller shaft 20 is journaled in the needle bearings 32 and 36.

An impeller, generally designated by the reference numeral 37 is mounted on the shaft 20 below the bearing mount 35 and above the bottom portion 24 of the housing. A thrust bearing 38 is positioned between the top of the impeller and the bottom of the upper bearing mount.

The impeller 37 is shown in detail in Figs. 4, 5 and 6. It may be formed as a casting and it has a hub portion 39 that conforms generally in shape to the lower cylindrical side walls of the impeller cavity and the inverted conical bottom thereof. The hub is somewhat smaller in diameter than the cavity and is spaced from the walls thereof. The space between the cavity walls and the impeller hub accommodates the impeller vanes 40, preferably three in number and formed integrally with the hub and disposed arcuately thereabout at 120° intervals. As seen in Fig. 4, the vanes 40 spiral generally outwardly from centrally disposed points 41 across the bottom of the impeller hub to peripheral points 42 adjacent the circle of intersection of the conical bottom surface 25 and the cylindrical side walls of the impeller housing. The vanes then extend up the sides of the impeller hub 39.

The outer faces of the vanes that are adjacent to the impeller cavity walls are machined as are the cavity walls to provide a relatively close fit therebetween.

As best seen in Figs. 4 and 6, the leading face 43 of the bottom section of each vane is inclined downwardly and away from the direction of rotation of the impeller. Preferably the angle of inclination is about 30° to the vertical.

Referring to Figs. 5 and 6, the leading face 44 of the side portions of the vanes are inclined upwardly and away from the direction of rotation of the impeller. The angle of inclination of the side portions of the vanes may also be about 30° to the vertical.

The trailing or following faces of the impeller vanes may be disposed substantially vertically, or they may be somewhat inclined to the vertical.

Although the angle of inclination of the vane faces is preferably about 30°, this angle is not critical and the faces may be inclined in the directions indicated from about 20° to about 40° from the vertical.

In operation, the impeller 37 is rotated in the direction of the arrows of Figs. 4 and 5. As shown in Fig. 2, liquid is drawn into the intake cavity 33 through the ports 34 and is drawn from the cavity 33 through the central opening 26 into the impeller chamber. The liquid is forced outwardly between the impeller and the bottom of the impeller cavity by the lower sections of the vanes and upwardly past the side sections of the vanes. The slope of the side sections is such that they impart added lift to the liquid which is forced up through the impeller chamber, into the riser 11 and through the lateral conduit 16 to a point of disposition.

The inclination of the vane faces is such that the lower vane faces impart an upward thrust to the rotor while the side vane faces tend, in part, to counteract this thrust. However, the resultant thrust is upward and this thrust is taken by the bearing 38 placed between the impeller 37 and the upper bearing support 35. It is not necessary to provide a lower thrust bearing in

the device of the invention and, although the lower needle bearing 32 is desirable and preferred, it may be eliminated without adversely effecting operation of the pump if the shaft 20 is sufficiently rigid and is adequately journaled in the upper bearing 36.

I claim:

1. In a centrifugal liquid pump, an impeller housing providing a cavity therein defined by vertical cylindrical side walls, an inverted conical bottom providing an axial liquid intake port, and a top providing an axial liquid outlet port, axial shaft bearing means in said housing, a driven axial impeller shaft carried in said bearing means and extending out of said housing through said liquid outlet port, a rotary impeller mounted on said shaft adjacent to the bottom of said housing, said impeller comprising a hub having bottom and sides spaced from and conforming substantially to the shape of the bottom and adjacent side wall portions of said cavity, and a plurality of arcuately disposed vanes on said hub, each of said vanes extending substantially entirely across the space between said hub and the opposed internal faces of said cavity, and being shaped to spiral outwardly across the bottom of said hub in a direction away from the direction of rotation of said impeller from a central point to a peripheral point and to extend up the sides of said hub, the leading face of the bottom portion of each vane being inclined downwardly away from the direction of rotation of the impeller and the leading face of the side portion of each vane being inclined upwardly away from the direction of rotation of the impeller.

2. A pump as defined in claim 1 wherein said vane faces are inclined to the vertical at an angle of from 20° to 40°.

3. A pump as defined in claim 1 wherein said vane faces are inclined to the vertical at an angle of about 30°.

4. In a centrifugal liquid pump, an impeller housing providing a cavity therein defined by vertical cylindrical side walls, an inverted conical bottom providing an axial liquid intake port, and a top providing an axial liquid outlet port, axial shaft bearing means in said housing, second axial shaft bearing means carried by said housing and positioned below the liquid intake port, a driven axial impeller shaft carried in said bearing means and extending out of said housing through said liquid outlet port, a rotary impeller mounted on said shaft adjacent to the bottom of said housing, said impeller comprising a hub having bottom and sides spaced from and conforming substantially to the shape of the bottom and adjacent side wall portions of said cavity, and a plurality of arcuately disposed vanes on said hub, each of said vanes extending substantially entirely across the space between said hub and the opposed internal faces of said cavity, and being shaped to spiral outwardly across the bottom of said hub in a direction away from the direction of rotation of said impeller from a central point to a peripheral point and to extend up the sides of said hub, the leading face of the bottom portion of each vane being inclined downwardly away from the direction of rotation of the impeller and the leading face of the side portion of each vane being inclined upwardly away from the direction of rotation of the impeller.

5. In a centrifugal liquid pump, an impeller housing providing a cavity therein defined by vertical cylindrical side walls, an inverted conical

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cal bottom providing an axial liquid intake port, and a top providing an axial liquid outlet port, axial shaft bearing means in said housing, a foot-plate mounted in spaced relation to the exterior of the bottom of said housing, a driven axial impeller shaft carried in said bearing means and extending out of said housing through said liquid outlet port, a rotary impeller mounted on said shaft adjacent to the bottom of said housing, said impeller comprising a hub having bottom and sides spaced from and conforming substantially to the shape of the bottom and adjacent side wall portions of said cavity, and a plurality of arcuately disposed vanes on said hub, each of said vanes extending substantially entirely across the space between said hub and the opposed internal faces of said cavity, and being shaped to spiral outwardly across the bottom of said hub in a direction away from the direction of rotation of said impeller from a central point to a peripheral point and to extend up the sides of said hub, the leading face of the bottom portion of each vane being inclined downwardly away from the direction of rotation of the impeller and the leading face of the side portion of each vane being inclined upwardly away from the direction of rotation of the impeller.

6. In a centrifugal liquid pump, an impeller housing providing a cavity therein defined by vertical cylindrical side walls, an inverted conical bottom providing an axial liquid intake port, and a top providing an axial liquid outlet port, axial shaft bearing means in said housing, a foot-plate mounted in spaced relation to the exterior of the bottom of said housing, second axial shaft bearing means carried by said foot-plate and positioned below the liquid intake port, a driven axial impeller shaft carried in said bearing means and extending out of said housing through said liquid outlet port, a rotary impeller mounted on said shaft adjacent to the bottom of said housing, said impeller comprising a hub having

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bottom and sides spaced from and conforming substantially to the shape of the bottom and adjacent side wall portions of said cavity, and a plurality of arcuately disposed vanes on said hub, each of said vanes extending substantially entirely across the space between said hub and the opposed internal faces of said cavity, and being shaped to spiral outwardly across the bottom of said hub in a direction away from the direction of rotation of said impeller from a central point to a peripheral point and to extend up the sides of said hub, the leading face of the bottom portion of each vane being inclined downwardly away from the direction of rotation of the impeller and the leading face of the side portion of each vane being inclined upwardly away from the direction of rotation of the impeller.

7. A pump as defined in claim 6 wherein said vane faces are inclined to the vertical at an angle of about 30°.

8. A pump as defined in claim 7 wherein the elements of said conical bottom make an angle of about 30° to the horizontal.

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