July 7, 1964 A. P. SAUNDERS 3,139,832

CENTRIFUGAL ENCLOSED INERT PUMP

Filed July 24, 1963 2 Sheets-Sheet 1

Fig. 1

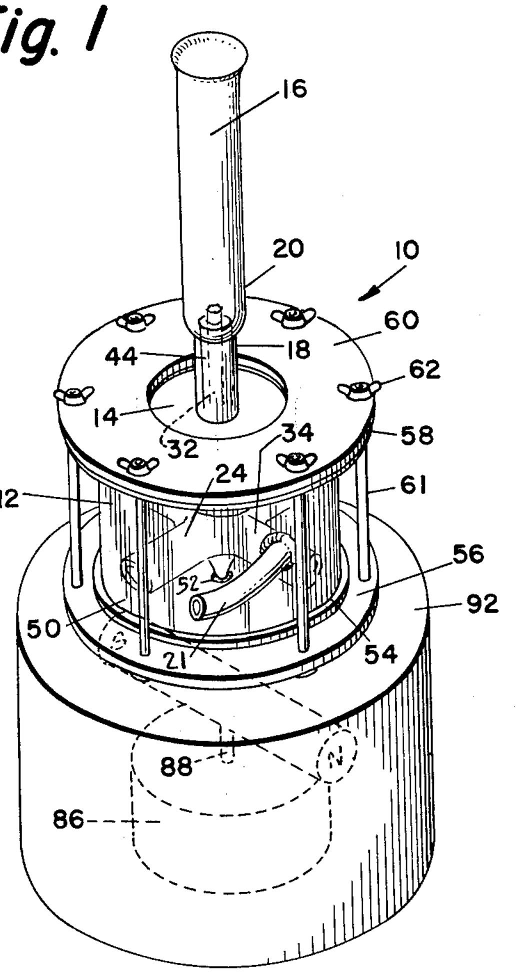


Fig. 2

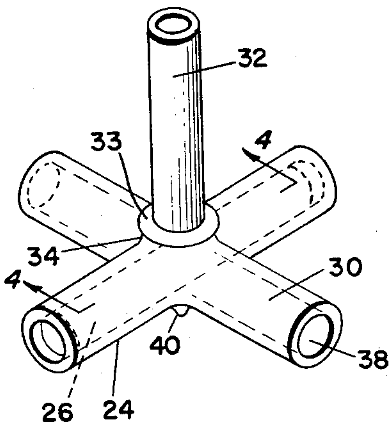


Fig. 3

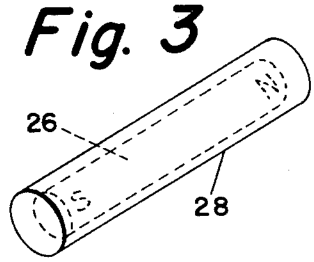
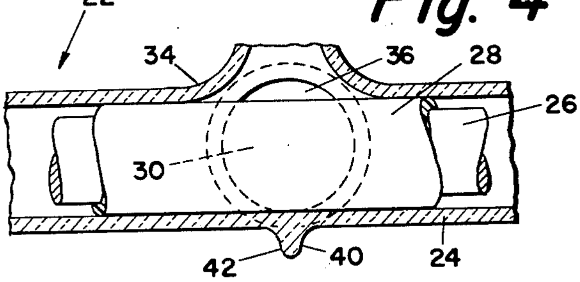


Fig. 4



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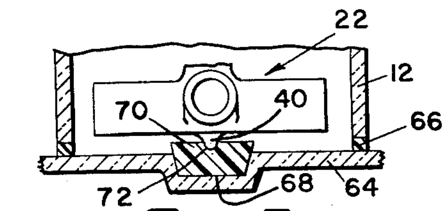

Fig. 5

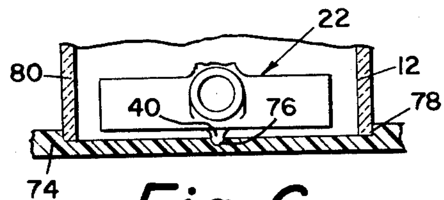

Fig. 6

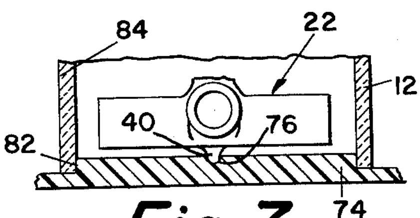

Fig. 7

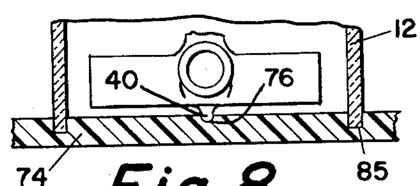

Fig. 8

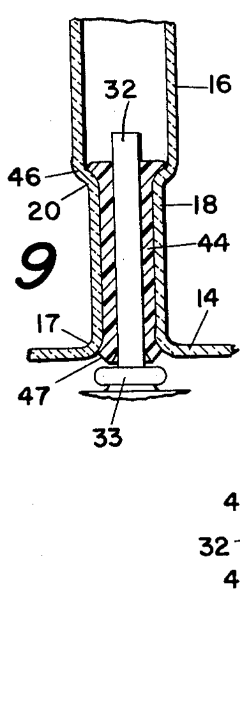

Fig. 9

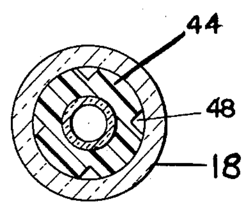

Fig. 10

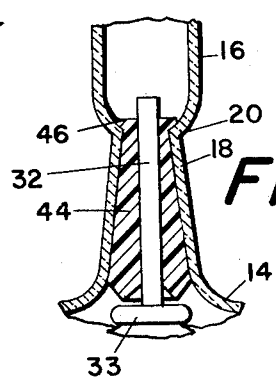

Fig. 11

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CENTRIFUGAL ENCLOSED INERT PUMP

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16 Claims. (Cl. 103—103)

This invention relates to a centrifugal pump whose primary object is to provide for the pumping of most acids, weak alkalies, blood, microbiological media, high purity electrolytes, hydrocarbons and similar fluids without fear of contaminating the fluids by virtue of their contact with the pump.

Another object of the invention is to provide a centrifugal pump of the character described which combines a glass-plastic enclosure with an external magnetic drive thereby eliminating the possibility of contamination from the outside while permitting the pumping of fluids which will not attack the glass and plastic enclosure.

Another object of the invention is to provide a centrifugal glass-plastic enclosed centrifugal pump with external magnetic drive which is so constructed as to insure fluid-tightness yet is readily dismantled to permit repair and replacement of parts therein.

Another object of the invention is to provide a centrifugal glass-plastic enclosed centrifugal pump with external magnetic drive which is exceptionally easy and economical to manufacture and assemble as well as to dismantle, when required, to effect removal and replacement of all of its parts.

These objects are attained by providing a centrifugal pump comprising a glass chamber having a substantially cylindrical annular wall, a fluid-outlet tube extending tangentially therefrom, an upper wall and a fluid-inlet tube extending vertically from the center thereof, a substantially cruciform tubular glass impeller in said chamber in a generally horizontal plane, one arm of said impeller removably receiving and retaining a magnet encased in a substantially acid and alkali resistant, elastic plastic, said impeller also including a tubular member extending vertically from the center thereof and a protuberance vertically opposite said tubular member, said tubular member extending into said fluid-inlet tube, bearings rotatably journaling said tubular member and said protuberance of said impeller for rotation about a vertical axis through said tubular member and said protuberance, said bearings being made of a substantially acid and alkali resistant, elastic plastic having a low coefficient of friction, a plate supporting a member made of glass or the aforementioned plastic containing the bearing for said protuberance and covering the bottom of said wall of said chamber, and means exterior of said chamber acting between said upper wall of said chamber and said plate to removably clamp said plate and thereby retain the impeller and bearings in proper operative and enclosed positions in the chamber.

These and other objects of the invention will become more apparent as the following description proceeds in conjunction with the accompanying drawings, wherein:

FIG. 1 is a perspective view of the centrifugal pump of the instant invention;

FIG. 2 is a perspective view of the impeller per se;

FIG. 3 is a perspective view of the magnet for the impeller;

FIG. 4 is a sectional view taken on the line 4—4 of FIG. 2;

FIG. 5 is a fragmentary vertical sectional view through the chamber closure plate and bearing for the lower end of the impeller of one form of the invention;

FIG. 6 is a view similar to FIG. 5 of another form of the invention;

FIG. 7 is a view similar to FIG. 5 of yet another form of the invention;

FIG. 8 is a view similar to FIG. 5 of yet another form of the invention;

FIG. 9 is a fragmentary vertical sectional view through the fluid-inlet tube and upper impeller bearing, the impeller tube being shown in elevation;

FIG. 10 is a horizontal sectional view of a modified form of upper impeller bearing; and

FIG. 11 is a view similar to FIG. 9 of a modified form of upper impeller bearing.

Specific reference is now made to the drawings in which similar reference characters are used for corresponding elements throughout.

The pump of the instant invention is generally indicated at 10 in its assembled form. The chamber thereof is blown or otherwise fabricated of glass, preferably Pyrex, and includes an annular substantially cylindrical wall 12 which is open at its bottom but joined by an upper wall 14 and to which is fused centrally thereof as at constriction 17 an upstanding fluid-inlet tube 16, the latter including a neck portion 18 and an annular constriction 20, see FIGS. 1, 9 and 10, for a purpose later to appear. The annular wall 12 also has fused thereto a tangentially extending fluid-outlet tube 21.

The impeller, as seen in FIG. 2, includes a substantially cruciform tubular glass member 22, which extends in a generally horizontal plane, one arm 24 of which receives and retains over the major portion of its length a unit containing a magnet 26 which is enclosed in a plastic casing 28. The casing is made of a plastic which is substantially acid and alkali resistant, is elastic and doesn't degrade over a wide range of temperatures. An example of such a material is a polymer of monochlorotrifluoroethylene commercially available from the Minnesota Mining and Manufacturing Company as Kel-F. The magnetic unit 26, 28 is removably retained in the arm 24 by a press fit, the casing 28 being slightly greater in outer diameter than the inner diameter of the arm 24 but somewhat compressible by virtue of the elasticity of the plastic from which the casing is made.

Upstanding centrally from the position of juncture of the arm 24 carrying the magnet and the cross arm 30 is a tube 32 which extends through the neck 18 and into the fluid-inlet tube 16. At its end adjacent the cross arms 24 and 30, the tube 32 has an annular shoulder 33 for a purpose soon to appear. As will be evident from FIG. 4, fluid from the inlet tube 16 can flow through tube 32 of the impeller, and into the cross arm 30, by virtue of the neck 34 joining the tube 32 to the cross arm 24 and 30 and the fact that, at its interior, the neck 34 extends above the magnet casing 28 and communicates with the cross arm 30 as at 36. The fluid then passes out of the open ends 38 of the impeller cross-arm 30. The length of the impeller cross arms are shorter than the diameter of the chamber annular wall 12.

Depending centrally from the impeller vertically opposite the tube 32 is a protuberance 40, preferably tapered and with a rounded or snub tip 42.

Interposed between the vertical tube 32 of the impeller and the neck 18 of the fluid-inlet tube is a tubular bearing 44 which is made of a substantially acid and alkali resistant plastic which is elastic and has a low coefficient of friction. Such a plastic is commercially available from the Du Pont Company as Teflon. Other plastics of equivalent properties may be used as well. The bearing terminates in upper and lower beads 46 and 47, see FIG. 9, which snap around the constrictions 20 and 17 respectively to thereby restrain the bearing against vertical movement. The outer diameter of the tube 32 is less than the inner diameter of the bearing 44 and is therefore rotatable therein. To allow passage of air upwardly through the fluid-inlet tube 16 when fluid is introduced therein to prime or start the pump, the bearing 44 may be provided with vertically extending, circumferentially spaced grooves 48 as seen in FIG. 10. The bearing 44 may be varied as shown in FIG. 11 to eliminate the lower bead 47 and instead to taper the exterior of the bearing upwardly. This plus the fact the neck 18 will be similarly tapered, will restrain upward movement of the bearing relative to the neck whereas the engagement of the bead 46 with the construction 20 will restrain lower movement thereof.

In the form of the invention shown in FIGS. 1–4, a plate 50 is provided which is made of Teflon or equivalent plastic having a central depression 52 serving as a bearing to rotatably receive the protuberance 40 of the impeller. Thus the impeller is freely rotatable about a vertical axis through the bearings 44 and 52.

The lower edge 54 of the annular chamber wall 12 rests on the Teflon plate 50 which in turn is seated upon a larger lower metallic plate 56. Bearing on the upper chamber wall 14 is a gasket 58 and upon this an upper plate 60, the gasket 58 and plate 60 being apertured centrally to clear the fluid-inlet tube for mounting on the wall 14. Circumferentially spaced screws 61 extend through the upper and lower plates 56 and 60 exteriorly of the chamber wall 12 and receive wing nuts 62 serving to clamp the plates together to thereby seal the lower end of the chamber wall 12 and retain the parts of the pump in proper operative positions.

Variants of the bottom closure plate and lower bearing of the impeller are shown in FIGS. 5–8. Thus, in FIG. 5, the Teflon plate 50 can be replaced by a glass plate 64 and a gasket 66 is interposed between the lower edge of the annular chamber wall 12 and the plate to provide a fluid tight seal. Such a seal is not required when glass to Teflon contact is provided as in the unit shown in FIGS. 1–4. The glass plate 64 has a central well 68 in which is press-fit a Teflon or equivalent plastic bearing 70 with a central depression 72 to rotatably receive the protuberance 40 depending from the impeller. In FIG. 6, the bottom plate 74 is made of Teflon, or equivalent plastic and a depression 76 centrally thereof to rotatably receive the protuberance 40. But, an annular shoulder 78 is provided in the plate 74 against which the outer face 80 of the annular wall 12 bears so that the chamber is properly centered on the plate. The same function is provided by the constriction shown in FIG. 7 where the annular shoulder 82 provided in the plate 74 bears against the inner face 84 of the annular wall 12. If desired an annular groove 85 may be provided in the Teflon plate 74 to locate and receive the lower edge of the annular chamber wall 12, as shown in FIG. 8.

In use, the pump is primed by filling the inlet tube 16 with fluid to a point above the free end of the vertical impeller tube 32. A motor 86 driving a shaft 88 upon which is mounted a bar or horseshoe magnet 90 is positioned centrally beneath the lower plate 56. For convenience, the motor and magnet may be enclosed in a casing 92 upon which the pump is seated as shown in FIG. 1. As the motor magnet rotates, the impeller is induced to rotate whereby fluid is drawn from tube 16 through tube 32, into cross arm 30, out of the open ends 38 thereof and then through the tangential outlet tube 21. The ledge 33 is provided on the impeller-inlet tube 32 so that, when the impeller spins rapidly and thus rises, the ledge 33 will contact the lower end of the upper impeller bearing 44 and thereby prevent the protuberance 40 from leaving its bearing 76. The fluid pump comes into contact only with glass and Teflon or equivalent plastic and hence can safely pump any fluid which does not attack these materials. Moreover, as the impeller is rotated by an external magnetic drive contamination from sources external to the pump chamber are effectively eliminated. By virtue of the ease with which the plates 56 and 60 can be assembled or unclamped, the bearing 44 and plate 50 can be assembled or removed, the impeller 22 can be assembled or removed and even the magnet 26, 28 can be inserted and removed from the impeller cross-arm, the overall pump is economical to manufacture and repair and at the same time is useful for pumping a wide variety of acids, weak alkalies, biological fluids, electrolytes and other liquids of high purity.

While preferred embodiments of the invention have here been shown and described, it is understood that skilled artisans may make minor variations without departing from the spirit of the invention and the scope of the appended claims. Thus, for example, the impeller can be made of Teflon or equivalent plastic instead of glass and the casing 28 can also be made of Teflon instead of Kel-F.

I claim:

1. A centrifugal pump comprising a glass chamber having an annular wall, a fluid-outlet tube extending tangentially therefrom, an upper wall and a fluid-inlet tube extending vertically therefrom, a rotary glass impeller comprised of crossed tubes in a generally horizontal plane, an impeller-inlet tube at the position of juncture of said crossed tubes extending vertically therefrom and into said fluid-inlet tube and a protuberance depending from said crossed tubes opposite said impeller-inlet tube, a magnet, means removably retaining said magnet in one of said crossed tubes, a first tubular bearing made of a material which is substantially alkali and acid resistant, is elastic and has a low coefficient of friction interposed between said fluid-inlet and impeller-inlet tubes and a second bearing receiving said protuberance and made of a material which is substantially alkali and acid resistant, is elastic and has a low coefficient of friction, means to removably clamp said second bearing in place and to seal said chamber so that fluid passing therethrough will contact only glass and said bearing material, and a motor driven magnet adjacent to and beneath said chamber to effect rotation of said impeller.

2. The centrifugal pump of claim 1 wherein the material of which said bearings are made is polytetrafluoroethylene.

3. The centrifugal pump of claim 1 wherein said means removably retaining said magnet in said one crossed tube includes a casing made of a substantially acid and alkali resistant elastic plastic of diameter slightly in excess of the internal diameter of said one crossed tube so that said magnet and casing as a unit is press fit into said one crossed tube.

4. The centrifugal pump of claim 1 wherein said fluid-inlet tube includes a pair of vertically spaced constrictions and said first tubular bearing contains terminal beads adapted to snap over and be retained against relative vertical movement by said constrictions.

5. The centrifugal pump of claim 4 and longitudinal grooves along the length of said first tubular bearing to allow upward passage of air while admitting fluid into said fluid-inlet tube upon priming the pump.

6. The centrifugal pump of claim 1 wherein said fluid-inlet tube includes an upwardly tapered neck and a constriction at the upper end thereof, and said first tubular bearing is similarly tapered and includes an upper bead adapted to snap over said constriction whereby said first tubular bearing is retained against relative vertical movement.

7. The centrifugal pump of claim 1 wherein said second bearing is provided in a plate of polytetrafluoroethylene which bears against the lower end of said annular chamber wall, and covers the chamber.

8. The centrifugal pump of claim 7 wherein said plate includes an annular shoulder bearing against said annular chamber wall to center the same.

9. The centrifugal pump of claim 7 wherein said plate includes an annular groove receiving the lower end of anular chamber wall to center the same.

10. The centrifugal pump of claim 7 wherein said

clamping means includes further plates, one bearing on said upper chamber wall and the other beneath and supporting said first-named plate and means external of said annular chamber wall removably securing said further plates together so that said first-named plate bears firmly against and seals the lower end of said annular chamber wall.

11. The centrifugal pump of claim 10 wherein said means removably securing said further plates together includes circumferentialy spaced screws extending through said plates exteriorly of said annular chamber wall and closure nuts on said screws.

12. The centrifugal pump of claim 1 wherein said second bearing includes a polytetrafluoroethylene insert having an indentation receiving said protuberance, a glass plate mounting said insert and bearing against the lower end of said annular chamber wall.

13. In a centrifugal pump having a glass chamber including an annular wall open at its lower end and joined by an upper wall, a fluid-inlet tube upstanding therefrom and a fluid-outlet tube extending tangentially from the annular wall, an impeller comprised of crossed tubes in a generally horizontal plane, an upstanding impeller-inlet tube at the juncture of said crossed tubes extending into said fluid-inlet tube, a magnet encased in a substantially acid and alkali resistant elastic plastic and removably retained in one of said cross tubes and means including a polytetrafluoroethylene plate to removably close off said lower end of said annular wall.

14. The centrifugal pump of claim 13, a protuberance depending from said crossed tubes opposite said impeller-inlet tube, and means to rotatably support said impeller about a vertical axis through said impeller-inlet tube and said protuberance.

15. The centrifugal pump of claim 14 wherein said means to rotatably support said impeller includes a polytetrafluoroethylene tubular bearing interposed between said impeller-inlet tube and said fluid-inlet tube and a depression in said polytetrafluoroethylene closure plate receiving said protuberance.

16. The centrifugal pump of claim 15 wherein said means to removably close off said lower end of said annular wall includes further plates, one supporting said polytetrafluoroethylene plate and the other bearing on said upper wall, and means external of said annular wall acting to removably clamp said further plates together.

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