United States Patent

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[54] **PUMP FOR LIQUIDS**
7 Claims, 2 Drawing Figs.

[52] **U.S. Cl.** **210/121,** 210/169, 210/416, 415/100
[51] **Int. Cl.** **B01d 35/26,** B01d 35/02
[50] **Field of Search** 417/424; 415/100, 131, 88; 210/121, 416, 167, 169, 172, 152, 251

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ABSTRACT: The pump includes a body having two inlets, arranged one above the other, and an outlet. A pair of spaced-apart impellers rotate within the body between the two inlets and draw liquid into the body through the two inlets, respectively, and discharge the liquid through the outlet. Surface liquid flows over an annular float into the upper inlet. The body is formed of two telescoping parts adjustable so that one of the inlets may be closed. Top and bottom walls within the body define an impeller chamber, and the upper impeller is located closer to the top wall than the spacing between the lower impeller and the bottom wall, so that the upper impeller develops a higher pressure than the lower impeller.

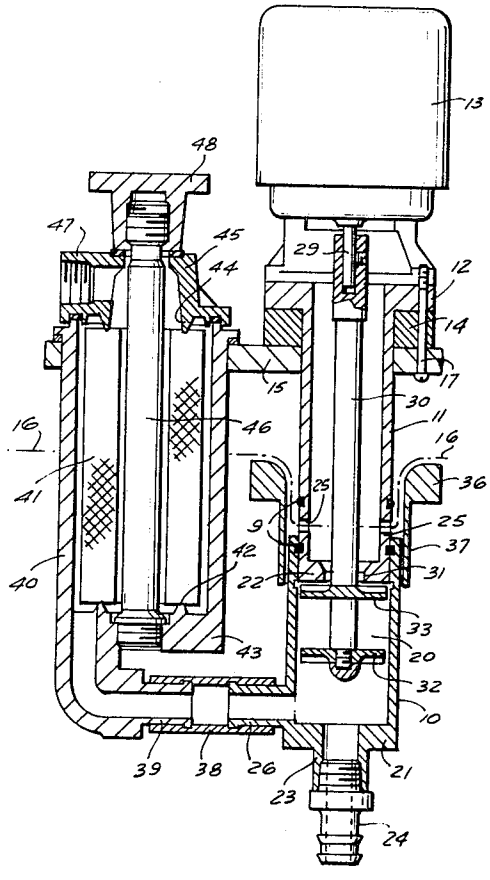


FIG. 1

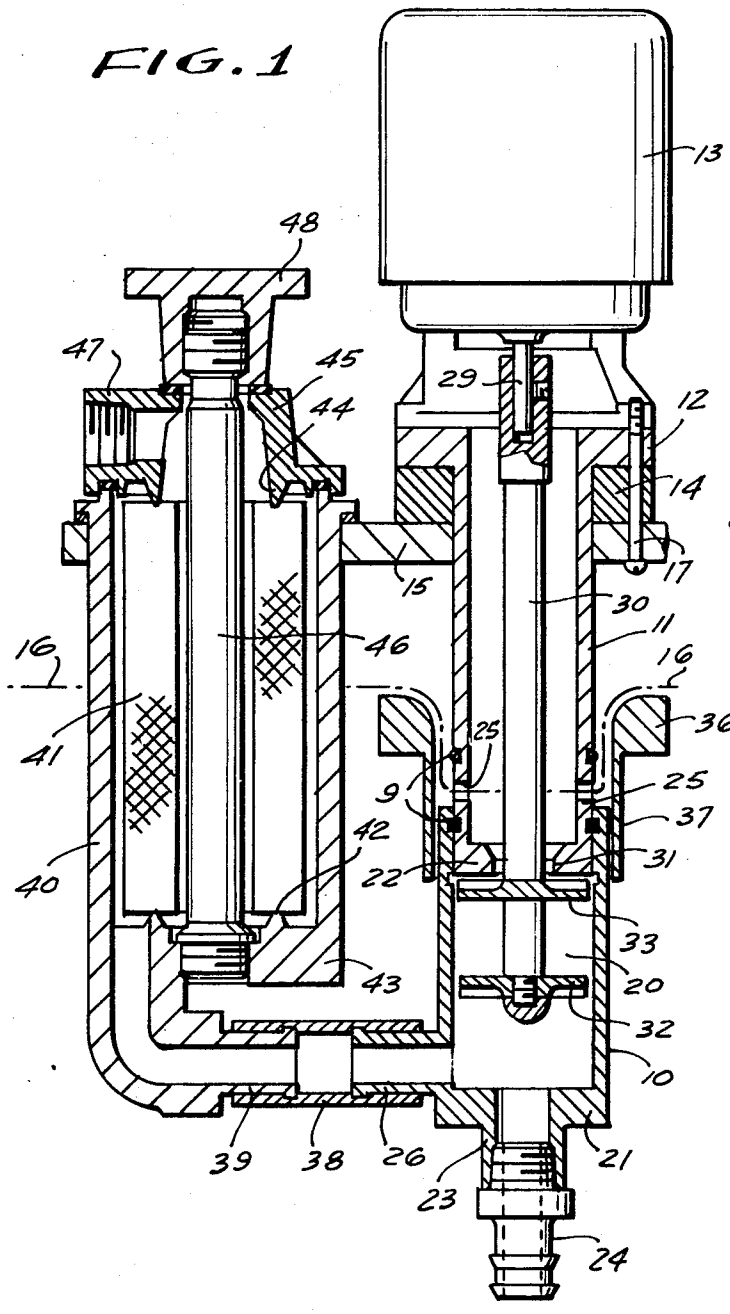
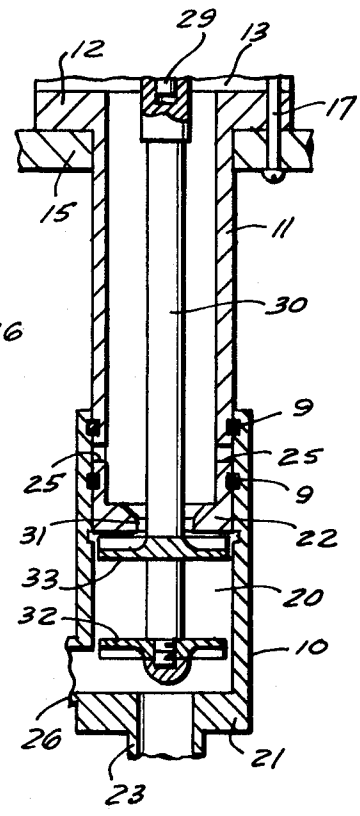


FIG. 2



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PUMP FOR LIQUIDS

The invention relates to centrifugal pumps, and more particularly to such a pump including two impellers on a single shaft for simultaneously moving liquid in two different directions through the pump body.

It is an object of this invention to provide a pump capable, when immersed in a body of liquid, of simultaneously (a) pumping liquid from below the liquid surface, and (b) skimming liquid from the surface of the body. Advantageously, the pump is associated with a filter so that matter suspended in the liquid body as well as floating particles can be filtered out.

It is another object of the invention to provide such a pump which can be adjusted to pump only liquid from below the surface.

It is a further object of the invention to provide such a pump in which no seal is required around the shaft which carries the two impellers.

It is an additional object of the invention to provide a compact pump,, skimmer and filter unit which can be accommodated within the small space allocated in industrial electroplating vessels.

Additional objects and features of the invention will be apparent from the following description in which reference is made to the accompanying drawings.

In the drawings:

FIG. 1 is a vertical cross-sectional view through a pump and filter arrangement according to the present invention, the pump being adjusted for pumping liquid both on and below the surface; and

FIG. 2 is a vertical cross-sectional view of a portion of the pump adjusted to pump only liquid below the surface.

The pump chosen to illustrate the present invention includes a lower pump body section **10** and an upper pump body section **11** telescopically arranged within the lower section **10**. Two O-ring seals **9** surround section **11**, only one of these seals being in use in the FIG. **1** position. The upper body section **11** is formed at its upper end with a flange **12** upon which an electric motor **13**, for driving the pump, is seated. In the adjusted position shown in FIG. **1**, the flange **12** rests on a positioning ring **14** which in turn rests on a support plate **15**, the section **11** passing through an opening in the plate. The plate **15** is adapted to be mounted on the vessel (not shown) containing the liquid to be pumped and filtered, in such a way that the pump body **10**, **11** is partially immersed below the liquid surface **16**. The pump body and motor are fixed to the plate **15** by screws **17** (one shown in FIG. **1**) passing through holes in plate **15**, ring **14**, and flange **12**, and threaded into the base of motor **13**.

Within lower pump body section **10** is an impeller cavity **20** defined at its lower end by the bottom wall **21** of section **10**, and at its upper end by the bottom wall **22** of section **11**. The pump body is furnished with two inlets, the lower inlet **23** being in the center of wall **21**. Inlet **23** is shown carrying an adapter **24** for connection to a hose (not shown). The hose is used when it is desired to mount the pump outside the liquid-containing vessel, in which case the free end of the hose is placed in the liquid. The upper inlet comprises apertures **25** in the sidewall of upper body section **11**, the apertures being spaced above the bottom wall **22**. In the position of FIG. **1**, the inlet apertures **25** are outside the lower body section **10**. Adjacent to bottom wall **21**, the sidewall of body section **10** is formed with an outlet **26**.

Fixed to the motor shaft **29** is the upper end of an impeller shaft **30**, the lower end of which passes through an opening **31** in the wall **22** and into the impeller cavity **20**. Within the cavity **20** are two impellers **32** and **33**, which may be identical, both fixed to the impeller shaft **30**. Impeller **32**, at the lower end of shaft **30**, is arranged when rotated to draw liquid in through inlet **23** and deliver it to outlet **26**. Impeller **33**, spaced above impeller **32**, has a reverse orientation with respect to the latter impeller, and hence draws liquid in through inlet **25**, via opening **31**. Upper impeller **33** is spaced closer to top wall **22** of the impeller cavity **20** than the spacing between lower impeller **32** and the bottom wall **21**. Consequently, impeller **33** develops a higher pressure than impeller **32**, and the liquid drawn through inlet **25** by impeller **33** is forced through outlet **26** together with the flow from inlet **23**.

An annular float **36** having a depending skirt **37** surrounds the region of the pump body having the inlet apertures **25**. The internal diameter of the float is only slightly larger than the external diameter of body section **10**, so that the float is free to move longitudinally with respect to the pump body. In practice, the inlet apertures **25** are located below the liquid surface **16**, but the float **36** insures that the bulk of the liquid entering apertures **25** flows over the top of the float, i.e., the float **36** serves as a skimmer. Furthermore, since the float is free to move vertically with respect to the pump body, it continues to serve its skimming function regardless of minor variations in the liquid level.

In the present illustration, outlet **26** is connected by a short length of tubing **38** to the inlet **39** of a filter chamber **40**. The filter chamber is supported by plate **15**. Within the chamber **40**, a filter tube **41** rests on an annular ridge **42** projecting from the chamber bottom wall **43**. A similar ridge **44** presented by the chamber cover **45** presses against the upper end of the filter tube **41**. The cover **45** and chamber **40** are locked together by a stem **46**, the lower end of which is threaded into the bottom wall **43**, and the threaded upper end of which carries an internally threaded knob **48**. Cover **45** is formed with an outlet **47** which may communicate, by means of suitable tubing (not shown), with the liquid-carrying vessel, so that filtered liquid is returned to the vessel. It will be noted that inlet **39** communicates with the annular space surrounding filter tube **41**, and outlet **47** communicates with the annular space within the filter tube. Thus, liquid is forced to flow through the filter tube before leaving chamber **40**.

In operation, rotation of impeller shaft **30** by motor **13** causes rotation of impellers **32** and **33** within cavity **20**. Impeller **32** draws liquid, including undesirable particles suspended in the liquid, through inlet **23** and discharges it through outlet **26**. At the same time, due to the action of impeller **33**, liquid and floating particles are skimmed off the surface of the liquid. The surface liquid flows over the top of float **36**, through inlet apertures **25**, opening **31**, and chamber **20** to outlet **26**. The mixture of surface liquid, floating particles, below surface liquid, and suspended particles leaving outlet **26** flows through filter chamber **40**, during which flow the particles are caught by filter tube **41**. As a result, only filtered liquid leaves chamber **40** through outlet **47**. It should be mentioned that since impeller **33** operates to drive liquid downwardly, no seal is needed between the impeller shaft **30** and the pump body, since the action of impeller **33** prevents flow of liquid up the shaft.

The pump of the present invention is so conceived that it may be adjusted, when desired, to pump below-surface liquid without skimming the surface of the liquid. The pump body is shown in FIG. **2** after such an adjustment. The adjustment is made by removing screws **17** and withdrawing positioning ring **14** from beneath flange **12**. If the ring is made in two halves, they are simply withdrawn laterally. If the ring is whole, the assembly of motor **13** and body section **11** is lifted upwardly, bring impellers **32** and **33** with it, and ring **14** is simply slipped downwardly past the impellers for removal. The body section **11** is then replaced, as shown in FIG. **2**. Since body section **10** remains in the same location it occupies in FIG. **1**, removal of ring **14** causes the body section **11** to move further into section **10** before flange **12** comes to rest on support plate **15**, whereupon screws **17** once again secure section **11** and motor **13** to the plate. Inlet apertures **25** are now located within section **10**, with seals **9** on both sides of it, so that these apertures will not longer function as inlets to the pump body. Of course, the annular float **36** is also not used, since no skimming is to be performed.

In the arrangement of FIG. **2**, impeller **32** serves the same purpose as it does in the FIG. **1** arrangement. In addition,

although impeller **33** no longer serves to skim the liquid surface, it is not without function. Some liquid flows around the peripheral edge of impeller **32** and into the space between the impellers. Ordinarily this liquid would tend to travel up rotating shaft **30**, and hence a seal would be provided around the shaft, perhaps between the shaft and the sidewall of opening **31**. However, due to the presence of impeller **33**, which as mentioned above develops a higher pressure than impeller **32**, no such seal is needed, since impeller **33** constantly urges the liquid which fills the cavity **20** downwardly, so that no liquid ever reaches the opening **31**.

The spacing between impellers **32** and **33** is also important, since it allows a column of liquid to exist between the impellers. Impeller **33**, during its rotation, tends to suck air into the pump body, and if the blades of impeller **33** were simply mounted on the upper face of impeller **32**, or if impellers **32** and **33** were arranged back to back, this air might be forced past the edge of impeller **32** and into outlet **26**, especially since impeller **33** develops a higher pressure than impeller **32**. However, the column of liquid between the impellers, within cavity **20**, serves as a trap to prevent air from reaching impeller **32**.

The invention has been shown and described in preferred form only, and by way of example, and it is understood, therefore, that many variations may be made in the invention which will still be comprised within its spirit.

What is claimed is:

1. A pump for liquids comprising:

a. a pump body having upper and lower inlets arranged one above the other, and an outlet,

b. top and bottom walls within said body defining an impeller chamber communicating with said inlets and outlet, said lower inlet being in said bottom wall and said top wall having an opening communicating with said upper inlet,

c. an impeller shaft extending into said body through said opening,

d. means for rotating said shaft, and

e. an upper and a lower impeller fixed to and rotatable with said shaft, said impellers being located within said chamber between said two inlets, said outlet being between said lower impeller and said bottom wall, said lower and upper impellers when rotated drawing liquid in through said lower and upper inlets, respectively, moving the liquid in opposite directions through said chamber, and discharging the liquid through said outlet,

whereby said upper impeller serves to both move liquid from said upper inlet to said outlet and prevent flow of liquid from said chamber upwardly along said shaft.

2. A pump as defined in claim **1**, including a filter communicating with said outlet.

3. A pump as defined in claim **1**, including an annular float surrounding the portion of said pump body having the upper of said inlets, surface liquid flowing over said float to said upper inlet.

4. A pump as defined in claim **1**, wherein said pump body is formed of two telescoping parts, one of said inlets being formed in each of said parts, the inner of said parts being movable into the outer of said parts to close one of said inlets.

5. A pump as defined in claim **1**, wherein the upper of said impellers is spaced closer to said top wall than the spacing between the lower impeller and said bottom wall.

6. A pump as defined in claim **5**, wherein the upper of said inlets is located above said top wall, said upper inlet communicating with said chamber via said opening.

7. A pump for liquids comprising:

a. a pump body having an inlet and an outlet;

b. first and second walls within said body defining an impeller chamber communicating with said inlet and outlet, said inlet being in said first wall,

c. an impeller shaft extending into said chamber through an opening in said second wall,

d. means for rotating said shaft, and

e. first and second independent impellers within said chamber and fixed to and rotatable with said shaft, said impellers being spaced apart along the length of said shaft, said first impeller being spaced relatively far from said first wall but said first impeller being closer to both said inlet and outlet than said second impeller and serving to draw liquid through said inlet and discharge liquid through said outlet, said impellers being arranged so that most of the liquid moves through only said first impeller as it flows from said inlet to said outlet and said second impeller being spaced relatively close to said second wall and urging liquid toward said outlet in a direction opposite to the direction in which said first impeller moves liquid, thereby preventing any liquid from moving through said opening from said chamber,

the space between said impellers being filled with liquid which serves to prevent air, entering said chamber through said opening, from reaching said outlet.