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Ohlsson et al.

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[54] **WATER PUMP WITH AIR LOCK BREAKING MEANS**

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[73] Assignee: **Whirlpool Corporation**

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[51] **Int. Cl.** **F03b 13/00**, B01f 5/16, F04b 17/00

[58] **Field of Search**.....415/53, 212, 213, 214, 121; 62/320; 55/178, 87; 259/96; 417/424, 40

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[57] **ABSTRACT**

A water pump such as for use with a commercial ice maker wherein the pump is normally submerged but the operation of which is controlled in response to a condition of the system independent of the water level at the pump whereby air bubbles may form at the pump inlet due to a low level of water upon initiation of the pump operation. A breakup means is mounted on the impeller of the pump to project through the inlet to the pump for breaking up air bubbles that so form. The breakup means may comprise a pin member formed integrally with the impeller.

7 Claims, 3 Drawing Figures

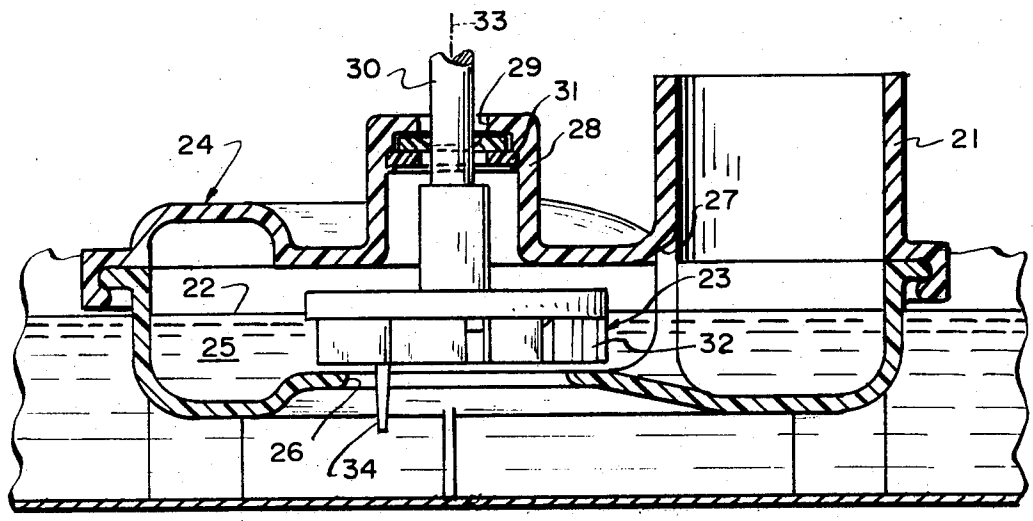


FIG. 1

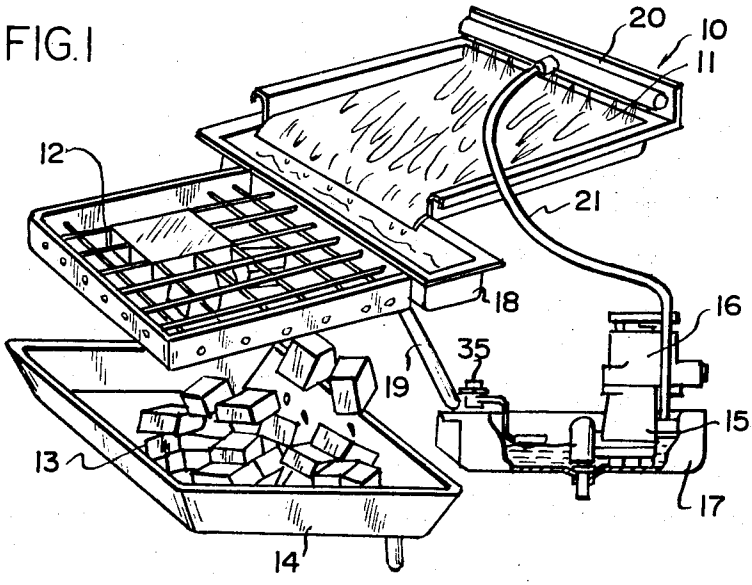


FIG. 2

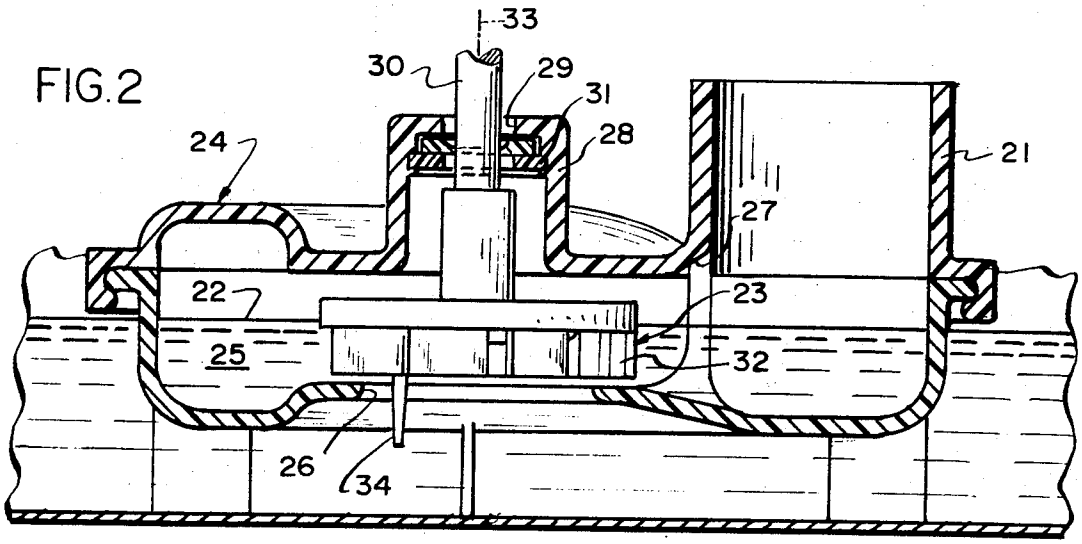
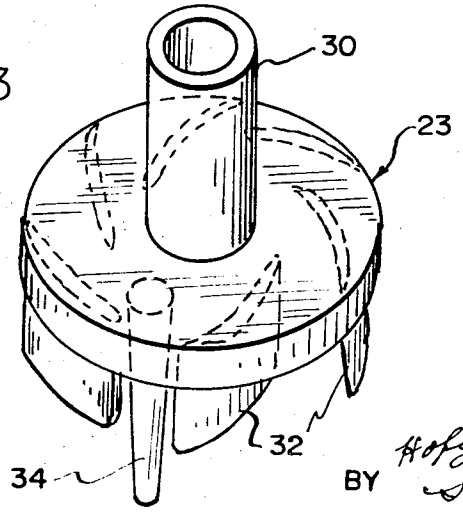


FIG. 3



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WATER PUMP WITH AIR LOCK BREAKING MEANS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to liquid pumps and in particular to submersible liquid pumps.

2. Description of the Prior Art

In one form of conventional submersible pump for use with commercial ice makers and the like, the pump is normally disposed in a sump below the level of water to be pumped in the system. However, in such systems, the operation of the pump may be automatically controlled in response to sensing of a condition of the system which is independent of the water level at the pump. Conventionally, in such systems, the water charge may be drained upon completion of an ice making operation to permit a fresh charge of water to be introduced during a subsequent ice making operation. Thus, the pump may be drained at times in the normal cycling of the system. Low water level conditions may arise due to low water pressures in the refilling means. Slush formation during operation of the system may inhibit free circulation whereby low level conditions may obtain.

It has been found with the conventional pumps provided in such commercial ice makers that air locks may occur where the pump operation is initiated at a time when the water level is low so as to not fully cover the impeller of the pump. Such air locks present serious problems as they interfere with the proper operation of the ice maker apparatus and may cause injury to the pump and drive motor by virtue of the operation thereof without normal water load.

SUMMARY OF THE INVENTION

The present invention comprehends an improved pump construction eliminating the disadvantages of such known pump constructions by eliminating such air locks in a novel and simple manner. The pump construction of the present invention is extremely economical of construction while yet providing an improved operation of the system as discussed below.

More specifically, the invention comprehends providing a breakup means carried for rotation with the impeller and projecting into the inlet of the pump housing thereby to break up large air bubbles that may form in the water at the pump inlet such as in the event the pump operation is initiated when the water level is low. The breakup means may comprise a pin member carried integrally with the impeller and may be tapered downwardly to provide an improved breakup of air bubbles at the inlet. The pin is carried eccentrically of the impeller axis and may be juxtaposed to the annular configuration of the impeller vanes for improved bubble breakup action.

BRIEF DESCRIPTION OF THE DRAWING

Other features and advantages of the invention will be apparent from the following description taken in connection with the accompanying drawing wherein:

FIG. 1 is a perspective view of an ice maker having a water pump construction embodying the invention;

FIG. 2 is an enlarged diametric section of the water pump; and

FIG. 3 is a perspective view of the impeller provided with a pin member breakup means embodying the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the exemplary embodiment of the invention as disclosed in FIGS. 1–3 of the drawing, and ice maker generally designated **10** is shown to comprise a commercial ice maker similar to that disclosed in D. F. Swanson U.S. Pat. No. 3,164,972 issued Jan. 12, 1965 and owned by the Assignee hereof. Briefly, the ice maker includes a refrigerated inclined plate structure **11** over which water is flowed to gradually form a slab of ice thereon. Upon suitable release thereof, the ice slab moves downwardly onto an electrically heated grid structure generally designated **12** which cuts the slab into a plurality of cubes **13** allowing the cut cubes to fall into a collecting pan **14** subjacent the grid structure.

The water flow over the inclined plate structure is effected by means of a pump **15** driven by a suitable electric motor **16**. The pump comprises a submersible pump disposed within a sump **17**. The water flowing over the plate structure **11** is collected in a pan **18** and conducted therefrom to sump **17** by means of a transfer duct **19**. Pump **15** functions to circulate the water from sump **17** back to a header **20** at the upper end of the inclined plate structure **11** through a return duct **21**. Thus, the water is continuously circulated to flow over the refrigerated plate whereby the slab is slowly built up to the desired thickness as discussed above.

Conventionally, such slab ice makers are operated to terminate the water circulation when the ice slab achieves the desired thickness as may be determined by mechanical sensing means (not shown), or by a thermostat having a sensing means (not shown) which senses when the temperature of the refrigerated plate reaches a preselected low temperature. Suitable plate heating means (not shown) are further provided to release the slab from the inclined plate for severance into the discrete cubes by the electrical grid **12** as discussed above. Further conventionally, the circulated water is discharged from the sump at this time to permit the next ice slab formation to be effected with fresh water introduced into the system by suitable means (not shown).

Normally, the level of the water in sump **17** is at level **22**, as shown in FIG. **2**. The pump **15** includes an impeller generally designated **23** which is normally submerged below the water level **22** and received within a housing generally designated **24** defining an impeller chamber **25** having an inlet **26** and an outlet **27**. Housing **24** includes an upstanding cup-shaped portion **28** defining a seal chamber provided with an opening **29**. A shaft **30** extends between motor **16** and pump **15** through opening **29**, as shown in FIG. **2**, for rotating the impeller by the electric motor to effect the desired pumping operation. Sealing means generally designated **31** are provided within seal chamber **28** for rotatably sealing the shaft to the housing.

Impeller **23** includes a series of vanes **32** spaced annularly concentrically about the axis **33** of shaft **30** and impeller **23**. In normal operation, rotation of impeller **23** causes water in chamber **25** to be pumped out-

wardly through outlet 27 and upwardly through duct 21 to header 20 for recirculation over the inclined plate structure into pan 14 and through duct 19 back to sump 17.

As long as the level 22 is maintained so as to cause impeller 23 to be submerged during pumping operation, the circulation of the water may be effected readily as discussed above. However, at times, should the level of water drop below the level of impeller 23, air may be introduced into the portion of chamber 25 occupied by impeller 23. Where the pump operation is initiated when the water level is below the impeller, air lock of the pump may occur wherein a large air bubble, or bubbles, may form at the inlet 26 preventing proper pumping operation. To eliminate this undesirable condition, a breakup means generally designated 34 is provided in the form of a pin member depending from the impeller through inlet 26. Pin member 34 is spaced from impeller axis 33 to be adjacent the annular arrangement of vanes 32. In the illustrated embodiment, the pin member is spaced closer to the annular configuration of the vanes than from the axis 33, as best seen in FIG. 2. Pin member 34 comprises an elongated relatively small diameter element having a downward taper. As the shaft 30 and impeller 23 are rotated about axis 33, pin member 34 moves in an annular path concentrically about the axis to traverse the inlet opening 26 and thereby break up an air bubble, or bubbles, which may have formed in the inlet opening such as by virtue of a low water level in the sump 17.

The impeller may comprise a molded plastic member with the pin member 34 being molded integrally therewith. Illustratively, an excellent plastic for such use is that sold under the trademark "Hercules Profax 7523" by Hercules Incorporated, Wilmington, Del. The impeller may have a diameter of approximately 1½ inch with the vanes being disposed adjacent the outer periphery thereof and extending inwardly to a minimum radial spacing from the axis 33 of approximately 0.55 inch. In the illustrated embodiment, seven vanes are provided but spaced apart 51° 26′. The lower distal end of the pin may have a diameter of approximately 0.100 inch where the pin has a length of approximately over five-eighths inch. At its upper end, pin member 34 may have a diameter of approximately 0.150 inch with the spacing of the center of the pin member from axis 33 being approximately 0.35 inch. The normal depth of water in sump 17 to provide the upper level thereof at 22 may be approximately 1¼ inch.

In operation, pump motor 16 is suitably energized to initiate a pumping operation as an incident of the occurrence of a condition of the system which may be independent of the water level at the pump such as when the inclined plate temperature reaches a preselected high temperature to initiate a further slab forming cycle. As discussed above, it has been found that at times the level 22 of water in the sump 17 and pump housing 24 is low such as because of low water pressure. Another abnormal low level condition may occur during operation of the system due to the formation of slush in the ice maker effectively precluding proper circulation of the water to the sump. Other abnormalities in the recirculation operation which may occur illustratively include an excessively long siphoning cycle preventing breaking of the siphon at the normal time, or an excessively short defrost period. Further, the adjustable float means 35 may stick and thereby preclude raising of the water level to the normal water level 22.

Thus, for any of a number of different reasons, the impeller may be exposed to air at the housing inlet 26 thereby causing a relatively large bubble, or bubbles, to form. Breakup means 34 breaks up the air bubbles as they form at the inlet by cyclically sweeping the inlet opening and causing the bubbles to be broken into smaller bubbles which may be pumped with the water by impeller 23 to avoid an air lock condition. A common abnormal condition is the formation of a single large air bubble at inlet 26 which is broken up into a large number of small air bubbles readily discharged with the water delivered to duct 21 by the impeller.

Thus, ice maker 10 provides an improved continuous circulation of the water to be frozen notwithstanding abnormal level conditions relative to the circulating pump. The air lock problem found in conventional recirculating pumps of such apparatus is eliminated in a simple and inexpensive manner to assure the desirable maintained circulation notwithstanding such abnormal water level variations.

The foregoing disclosure of specific embodiments is illustrative of the broad inventive concepts comprehended by the invention.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In a water pumping system having a sump, and a pump in the sump automatically controlled in response to the sensing of a condition of the system which is independent of the water level at the pump in the sump and in which successive charges of water are circulated for a period of time and then caused to be drained, an improved pump construction comprising: a pump housing defining a lower, horizontal water inlet opening, a water outlet and an impeller chamber above said inlet opening; means for causing a water supply level in the pump housing to rise above the level of said inlet opening on sensing of a low water level condition such as upon draining of the pump; a rotatable impeller; and means supporting said impeller in said chamber superjacent said inlet opening for rotation about a vertical axis, said impeller having a series of vanes spaced annularly concentrically about said axis, and a pin having a circular cross section depending vertically from said impeller through said inlet opening, said vertically extending pin preventing air lock of the pump by breaking up large air bubbles that form across the inlet opening upon a rising of the water level in the sump to said inlet opening upon delivering of a successive charge of water to the system and the rotation of the impeller.

2. The pump construction of claim 1 wherein said pin extends through said inlet opening intermediate said axis and a vertical cylinder surface defined by the path of the radially outermost portion.

3. The pump construction of claim 1 wherein said impeller comprises a molded element and said pin is molded integrally therewith.

4. The pump construction of claim 1 wherein said pin comprises a tapered pin narrowing downwardly from said impeller member.

5. The pump construction of claim 4 wherein said pin has a diameter at the distal end of approximately 0.100 inch.

6. The pump construction of claim 4 wherein said pin has a length of over approximately five-eighths inch.

7. The pump construction of claim 2 wherein said pin is spaced closer to said cylinder surface than to said axis.

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