March 23, 1954 E. M. SMITH 2,672,822

SELF-PRIMING CENTRIFUGAL PUMP

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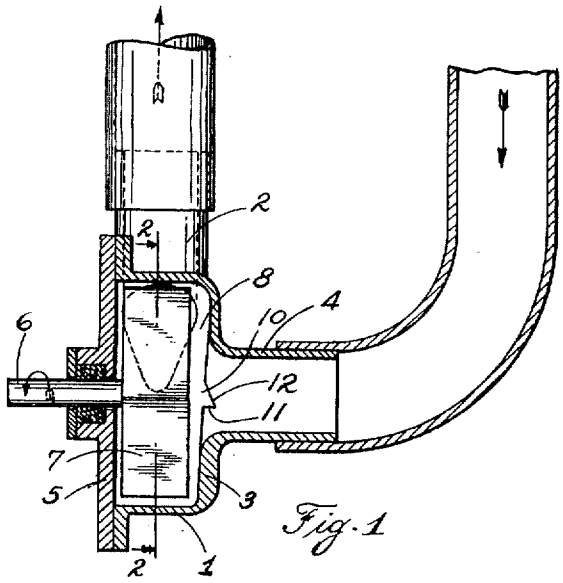


Fig. 1

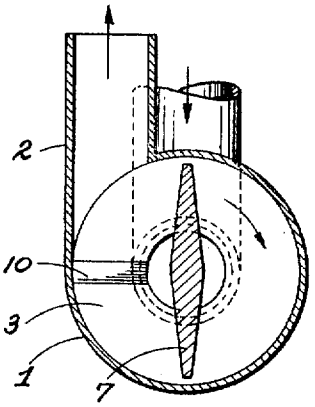


Fig. 2

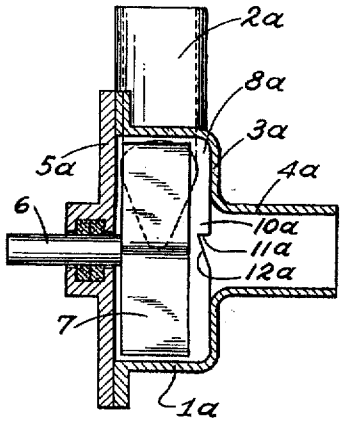


Fig. 3

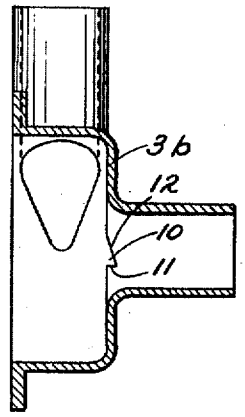


Fig. 4

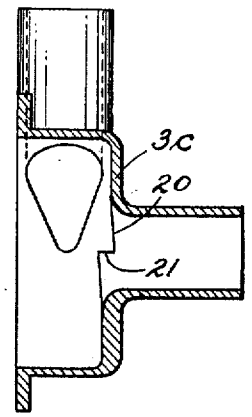


Fig. 5

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SELF-PRIMING CENTRIFUGAL PUMP

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3 Claims. (Cl. 103—113)

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This invention relates generally to centrifugal pumps and is particularly concerned with a self-priming pump, i. e., one from which air trapped in the pump body may be expelled at the initiation of pumping action.

Centrifugal pumps which handle liquids intermittently while the impeller runs continuously become inoperative because of air trapped in the impeller chamber even though the liquid may be supplied from a source above the level of the pump. This inoperative condition may be corrected either by venting the air through an additional vent tube which is not especially positive and is quite expensive, or by causing the pump to discharge air against the static head in the discharge pipe. This latter method is preferable and various means for practicing it have been provided in large pumps, but such means are not suitable for use in small pumps because of the lack of necessary space.

The present invention solves the problem of removing air from the impeller chamber of a centrifugal pump by providing a new means and a new method of mixing such air with liquid in the chamber and moving the mixture to the pump outlet where the air may escape from the pump.

The present invention will be better understood by those skilled in the art from the following description and the accompanying drawings, in which:

Fig. 1 is a longitudinal, central, sectional view taken through a pump embodying the present invention;

Fig. 2 is a cross-sectional view taken on line 2—2 of Fig. 1;

Fig. 3 is a view similar to Fig. 1, with parts omitted, showing a modified form of the present invention; and

Figs. 4 and 5 are central, longitudinal, sectional views taken through the main bodies of pump housings embodying modifications of the present invention.

The pump of Figs. 1 and 2 comprises an impeller housing including a main body which has a generally cylindrical side wall 1 provided with a peripheral outlet 2 and a front end wall 3 having a central inlet 4, and another body comprising a rear wall 5 through which extends an impeller shaft 6 which is connected to an impeller 7 within the impeller chamber defined by walls 1, 3 and 5.

It will be noted that front wall 3 is inclined at a small angle to rear wall 5. Due to this inclination the impeller chamber 8 has a greater axial length than at the opposite side of the chamber which is a portion of restricted axial length. As shown, the axial length of the chamber decreases from a maximum adjacent to the outlet 2 to a minimum at said restriction opposite that outlet. Also due to this inclination of front wall 3, the front or intake edge of the impeller is spaced farther from the inner surface of the front wall near outlet 2 than opposite the outlet and below outlet 2.

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The inner surface of front wall 3 is provided with a recess or depression 10 which extends from a point adjacent the outer wall 1 to, or approximately to, the inlet 4. This recess or depression 10 is defined by a surface 11 which is disposed longitudinally of the pump and extends into the wall 3 and a surface 12 which is inclined inwardly in the direction of rotation of the impeller from the outer end of surface 11 to the inner surface of wall 3. Preferably, this recess or depression extends radially but it may extend tangentially or spirally or otherwise.

The operation of the apparatus of Figs. 1 and 2 is substantially as follows: When the impeller chamber is partly filled with liquid and the impeller is rotated it causes the liquid to flow along the surface of wall 1. As the impeller moves the liquid downwardly toward the part of the chamber of shortest axial length, i. e., the part opposite outlet 2, the radial depth of the liquid is increased due to the convergence of the surfaces of the front and rear end walls 3 and 5, and as the impeller moves the liquid from this place of restriction to the upper and larger part of the impeller chamber, the water increases in axial length and decreases in radial length, thereby creating a vacuum in the region of recess 10. Rotation of the impeller causes the liquid to flow across the recess repeatedly where it entraps air. This air is carried along with the liquid for, perhaps, several revolutions and is gradually moved to the outer part of the moving liquid from which it escapes readily when passing outlet 2. This entrapping or mixing of air creates additional vacuum in the impeller chamber which induces a flow of air through the inlet into the chamber and recess. Thus, air is exhausted from the chamber and inlet with resultant priming of the pump.

In Fig. 3 the means for mixing the air and the liquid for the purpose of priming the pump comprises a modified form of recess forming apparatus. In this case the inner surface of the front end wall 3a is substantially parallel to the inner surface of the rear end wall 5a and the recess 10a is quite like recess 10 but is not formed in the wall 3a. This recess 10a is formed by a longitu-

dinal surface 11a projecting inwardly from the inner surface of wall 3a and extending radially from closely adjacent to the inner surface of cylindrical wall 6a to a place adjacent to the inlet 4a. From the inner surface of wall 3a, a surface 12a slopes inwardly to the inner end of surface 11 in the direction of rotation of the impeller.

The operation of the pump of Fig. 3 is substantially the same as that of Figs. 1 and 2 except that it does not include the vacuum creating effect of the inclined front wall 3. When liquid partly filling the impeller chamber 8a of Fig. 3 is rotated and agitated therein by the impeller 7, a partial vacuum is created when the liquid moves across recess 10a and air drawn into that recess is thereupon mixed with the liquid. Later this air escapes into outlet 2a. Thus, the pump speedily primes itself.

In Fig. 4 is shown the main part of an impeller housing like that shown in Fig. 3 with a depression 10 therein formed by walls 11 and 12 like the correspondingly numbered parts of Fig. 1 but with front wall 3b being parallel to the rear wall (not shown). The operation of the pump having a main housing part as shown in Fig. 4 is substantially the same as has been described above in connection with Fig. 1 omitting, however, the action traceable to the convergence of the front end wall 3 toward the rear end wall 5.

In Fig. 5 is shown the main housing part of a centrifugal pump which is quite like the housing of Fig. 3 or 4 but the front end wall 3c is provided with an inner surface 20 which is in the form of a spiral. Starting from the outer end of surface 21, this inner surface 20 gradually moves inwardly in the direction of rotation of the impeller and intersects with the inner end of surface 21. Thus, the impeller chamber decreases in axial length from the inner end of surface 21 to the outer end thereof.

The action traceable to this inclination of the inner surface of front end wall 20 is quite like that described for the inclination of the front wall 3 of Fig. 1, i. e., liquid being agitated and mixed with air and propelled downwardly in the chamber from an axially longer part of the chamber through the restricted part and then upwardly into an enlarged part will induce a flow of air into the chamber from the inlet opening and will then permit some of the air to escape through the outlet. The action of the recess formed by the intersection of surfaces 20 and 21 is substantially the same as that described above in connection with Fig. 3.

It will be understood that any of the recess-forming means of Figs. 3, 4 and 5 may be used with either the spiral or inclined inner surfaces of the main housing part and that if desired the inclined surfaces of the main housing parts shown in Fig. 1 may be used without the recess-forming means of Figs. 1, 3 and 4.

Having thus described the present invention so that others skilled in the art may be able to understand and practice the same, I state that

what I desire to secure by Letters Patent is defined in what is claimed.

What is claimed is:

1. A centrifugal pump comprising a housing including a cylindrical side wall having a peripheral outlet, a front end wall having a central inlet, a rear wall through which an impeller shaft extends, the front wall being inclined to the rear wall, said walls defining an impeller chamber having a portion of restricted axial length, and an impeller in said chamber having a lesser clearance with the front wall in the region of said restricted length.

2. A centrifugal pump comprising a housing including a cylindrical side wall having a peripheral outlet, a front end wall having a central inlet, a rear wall through which an impeller shaft extends, the front wall being inclined to the rear wall and including recess-forming means, said walls defining an impeller chamber which decreases in axial length from the outlet side to the opposite side, an impeller in said chamber having a greater clearance with the front wall adjacent said outlet and lesser clearance opposite said outlet, said recess-forming means extending radially on the inner side of said front wall.

3. A self-priming centrifugal pump comprising a housing having a rear wall, a front wall provided with a central inlet, and a peripheral wall provided with an outlet and joining the outer peripheries of said rear wall and said front wall, said walls defining an impeller chamber, and means for mixing air and liquid in said chamber, said mixing means including an impeller rotatable in said chamber and coaxial with said inlet and substantially straight recess-forming means extending radially of the impeller axis along the inner side of said front wall adjacent to said impeller from said inlet substantially to said peripheral wall, said impeller serving, when rotated, to cooperate with said recess-forming means to mix air and liquid and to propel that mixture toward said outlet.

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