

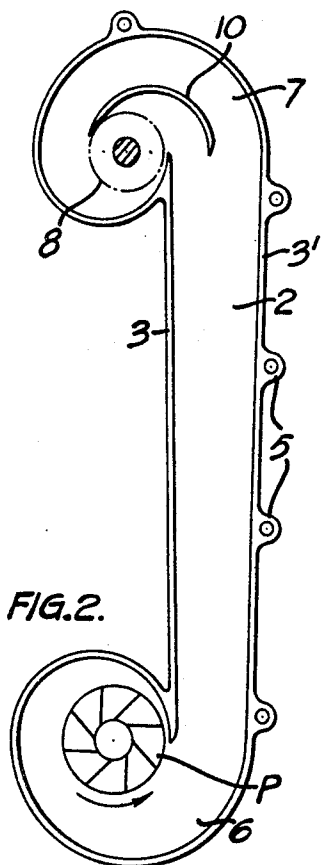
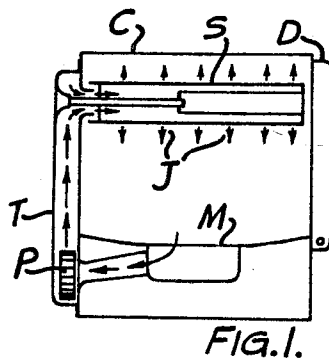
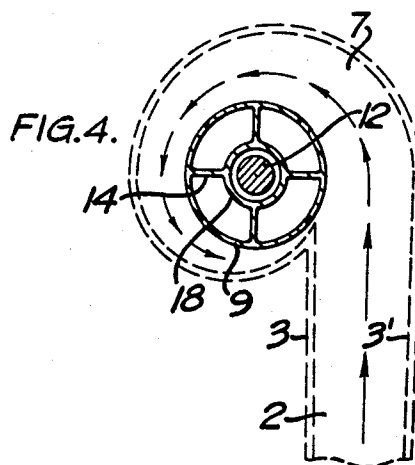
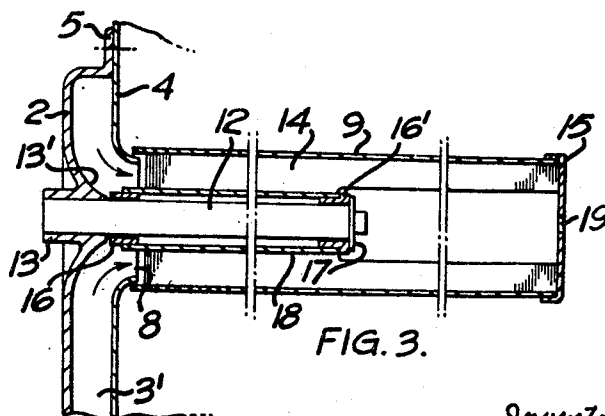
Jan. 15, 1963

R. J. GILSON
DISHWASHING MACHINES

3,073,527

Filed March 23, 1961

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

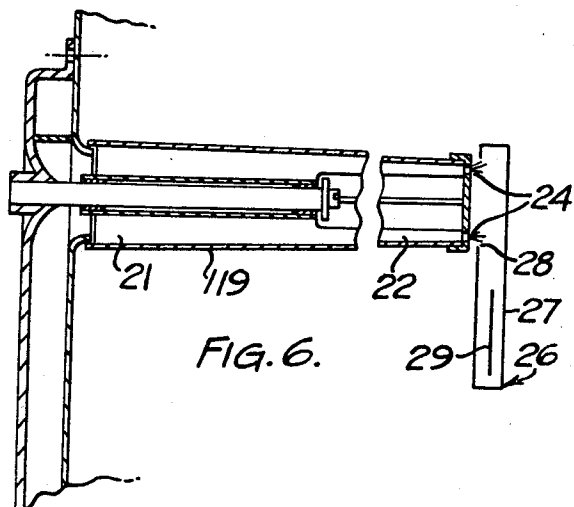


FIG. 6.

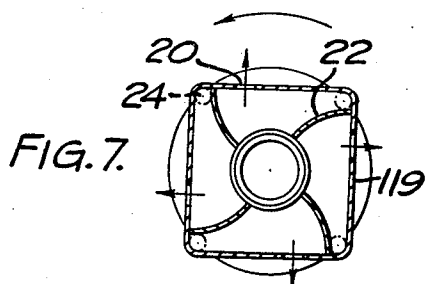


FIG. 7.

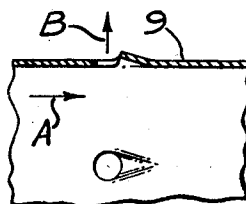


FIG. 5.

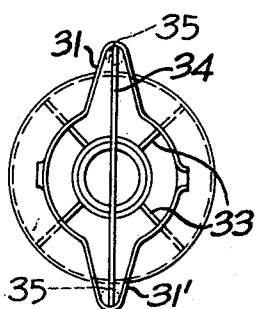


FIG. 9.

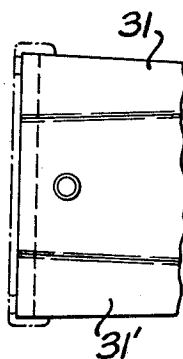
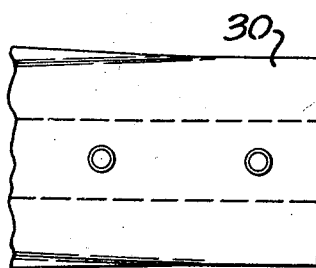


FIG. 8.

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3,073,527

DISHWASHING MACHINES

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Claims priority, application Great Britain Sept. 7, 1960
15 Claims. (Cl. 239—1)

This invention relates to dishwashing machines having an apertured spray tube rotatably mounted within the washing chamber and supplied with washing liquid by a pump arranged to draw liquid from a chamber and to deliver said liquid to the spray tube from which it issues as jets directed to impinge on the articles to be washed.

It is already known, for example, as described in British patent specification No. 773,080 and United States Patent No. 2,734,520, to cause rotation of such spray tube by imparting some degree of rotary movement to the stream of water entering the spray tube, but the efficiency of the methods and constructions used has not been high and it has also been found necessary to provide an outboard bearing to steady the far end of the spray tube remote from the liquid entry end. The object of the present invention is to provide a simplified and more efficient construction whereby the spray tube is rotated at a very much higher speed, and the need for an outboard bearing is eliminated. There are also other advantages obtained which will be enumerated in the following description.

According to the present invention, a method of imparting rotation to a spray tube for use in a dishwashing machine of the type described above and wherein the tube is provided with internal blades or fins, consists in supplying liquid to one end of the tube, the liquid immediately prior to its entry passing through a volute chamber, the inner surfaces of which are of spiral configuration so disposed that the whole flow of water is positively and progressively guided into a forced spiral vortex having a high rotational velocity with a minimum of energy losses.

The volute chamber may conveniently be integral with a liquid transfer duct connecting the discharge side of the pump to the inflow end of the spray tube. The volute chamber may be provided with one or more internal guide vanes of spiral form so disposed as to divide the total flow of liquid into two or more equal streams. Also an inwardly-projecting conical or volcano-shaped boss coaxial with the spray tube axis may be provided on the outer wall of the volute chamber so as to assist the smooth flow of liquid out of the volute chamber and into the open mouth of the spray tube.

In operation the effect of the positively enforced high efficiency vortex flow provides a greatly increased driving torque, and a correspondingly increased rotational speed of the spray tube, compared with that obtained from previously used constructions. Tests were made on two otherwise identical dishwashing machines each having an identical pump running at the same speed, but one fitted with a circular water inlet fitting of the type described in U.S. Patent No. 2,734,520, and the other having a volute chamber with spiral walls and guide vane as described in the present specification. The spray tubes used in the two tests were identical and were provided with blades as shown at 14 in FIGURES 3 and 4 of the drawings in the present application. Thus, the conditions under which the two tests were conducted were the same except that in one a circular water inlet fitting as shown in Patent 2,734,520 was used, and in the other a volute chamber with spiral walls and a guide vane as disclosed in the present application was used. The driving torque acting to cause rotation of the spray tube was measured by applying dead weights to a radially projecting lever affixed to the

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spray tube, and the rotational speed was measured by a stroboscopic device. The results of these tests were as follows:

Circular Water Inlet Fitting as U.S. Patent 2,734,520			
Torque:		Speed	
3½ oz. ins.	-----r.p.m.	200-400	
Volute chamber as present specification 18			
oz. ins.	-----r.p.m.	2,300	

It will be seen that the volute chamber construction gave a five-fold increase in the driving torque, and increased the speed of rotation 6 to 10 times, compared with that obtained from the circular inlet fitting; the reason for the fluctuating speed with the circular inlet fitting was that the low driving torque was barely adequate to provide positive rotation, with the result that slight variations in bearing friction caused the speed to fluctuate between the two values given.

The invention is illustrated in the accompanying drawings, in which:

FIGURE 1 is a diagrammatic view of a washing machine in side elevation and showing the washing chamber, circulatory pump, liquid transfer duct, and the spray tube.

FIGURE 2 is a view of the open side of a liquid transfer duct.

FIGURE 3 is a sectional view in elevation showing the upper part of the transfer duct, together with the spray tube and the stub axle on which it is rotatably mounted.

FIGURE 4 is a cross-sectional view of the apertured spray tube mounted on the stub axle with the upper part of the transfer duct shown in broken lines.

FIGURE 5 is a view of part of the wall of the spray tube showing one of the jet apertures in section and another in elevation, as viewed from inside the tube.

FIGURE 6 is a view similar to that of FIGURE 3 incorporating an alternative form of spray tube and showing a filter device for use therewith.

FIGURE 7 is a transverse section of the spray tube of FIGURE 6 but on an enlarged scale.

FIGURES 8 and 9 are an elevation and transverse section of another form of spray tube.

Referring to FIGURE 1, there is shown a washing chamber C, a liquid transfer duct T communicating at its lower end with the discharge from a centrifugal liquid forcing pump P, and communicating at its upper end with the open end of the apertured spray tube S. The pump P draws liquid from a bowl or sump at the base of the washing chamber and circulates it in the direction of the small arrows to issue as jets J from the apertures in the spray tube. Access to the washing chamber is through a door D hinged to open down horizontally.

FIGURE 2 shows a liquid transfer duct having integral volute chambers at each end. The duct comprises an outer wall 2 with side walls 3 and 3', having fixing lugs 5 by means of which it is bolted to an end wall 4 of the washing chamber C. The volute chamber 6 at the lower end receives the discharge from a centrifugal pump rotor P, and the volute chamber 7 at the upper end discharges into the open end of the spray tube.

It will be appreciated that this construction of a liquid transfer duct with integral volute chambers at each end avoids any sudden change of direction or area in the liquid flow passage, and thus helps to maintain high flow efficiency with a minimum of turbulence or energy losses, while the elimination of joints or connections favours low cost and trouble-free operation.

The volute chambers are formed by shaping the side wall 3' into a spiral of approximately one complete turn as will be clear from FIGURE 2. A circular discharge orifice with a flanged or rounded edge indicated at 8 in FIGURE 3, is formed in the rear wall 4 of the wash-

ing chamber C to which the transfer duct is bolted. On the outer wall 2 of the transfer duct a conical or volcano-shaped boss 13 is provided, into which is fixedly secured a stationary stub axle 12. This boss is bounded on the inside of the outer wall 2 by a volcano-shaped, i.e. concavely curved wall surface 13', the purpose of which is to assist the general forward flow of liquid through orifice 8 and into the open end of the spray tube 9. The boss 13 and stub axle 12 are co-axial with the discharge orifice 8. A guiding blade or blades as indicated at 10 may project from the outer wall 2 of the transfer duct in order to divide the flow of water through the volute chamber into two or more equal streams. The upstream end of the vane 10 begins at a location radially between the radially outermost part of the volute casing and the discharge opening 8; and the downstream end of the vane merges with the axial projection of the perimeter of the discharge opening. The use of such guide blades helps to maintain a smooth controlled vortex flow free from turbulence or other energy losses.

It will be understood that the washing liquid pumped by the centrifugal pump rotor P is discharged through the lower volute chamber 6 from whence it flows upwards through the straight part of the transfer duct and enters the upper volute chamber 7, whence it is constrained to discharge through the orifice 8 into the open end of the spray tube 9 with a combined rotational and axial movement.

Referring now to FIGURES 3 and 4, the spray tube 9 is provided with internal fins or blades 14, which extend axially over the whole length of the tube. It is found advantageous to have these blades or fins extending for the full length of the spray tube, since this ensures that the whole of the body of liquid contained therein, rotates at the same speed. If the blades start at the liquid-entry end, but extend only part way along the bore of the tube, rotation of the spray tube itself is not affected, but the liquid at the other end of the tube rotates less rapidly and thus causes some reduction in jet velocity and washing efficiency.

Integral with or secured within blades 14 is a shorter and smaller diameter tube 18, carrying at either end bearing bushes 16 and 16' which are a running fit on the fixed stub axle 12. The spray tube complete with its two bearing bushes 16 and 16' is retained on the stub axle 12 by a thrust washer 17 held in place by a suitable screw or nut. The outer end of the spray tube, i.e. the end remote from the transfer duct, is closed by a cap 15 having a central aperture 19, the purpose of which is to allow the release of foam as described below. The jet apertures in the spray tube 9 are distributed over its whole length, and may be arranged to discharge liquid jets radially or in a backwards or forwards direction as found convenient for effective impingement on the articles to be washed.

It is found in practice that the jet thrown out from the apertures nearest the entry end of the spray tube do not issue in a plane at right angles to the axis of rotation, but tend to have a forward throw, i.e. away from the transfer duct, due to the comparatively high axial velocity of liquid flow inside the spray tube at the entry end. To overcome this forward throw of the jets, some or all of the jet apertures may be locally formed or lipped as indicated in FIGURE 5, in which arrow A shows the generally forward flow of liquid inside the body of the spray tube, and arrow B shows the jet issuing in a plane at right angles to the rotational axis, due to the influence of the local lippping of the aperture.

In practice, the use of the volute chamber as described in the foregoing provides a rotational speed of the spray tube sufficiently great to prevent it becoming completely full of liquid when running. It will be appreciated that the reason for this is that the centrifugal head developed in the body of liquid contained within and rotating with the spray tube is great enough to cause it to issue from the

jet apertures at a rate exactly equal to the rate at which the liquid is delivered from the pump. Thus the rotating spray tube contains an annular body of liquid with a hollow core, and by virtue of this condition the spray tube becomes self-balancing and thus permits the use of the relatively short stub axle mounting without any form of outboard bearing at the overhanging end. Moreover, the amount of end thrust acting on the spray tube is obviously much reduced when it is only partially filled, and this again favours the use of the short stub axle and small-diameter bearings used in the construction illustrated and described in the foregoing. These small-diameter bearings have relatively little frictional resistance, thus favouring a high speed of rotation.

A further virtue of the high speed of rotation with the resulting hollow core in the body of rotating liquid is that any foam produced by the action of the detergent tends to become forced into said hollow core, from which it can be discharged through the central orifice 19 in the front end cap 15 of the spray tube. Thus the foam is kept out of the washing jets, thereby avoiding any reduction in kinetic energy and washing efficiency.

A still further advantage of the high rotational speed obtained is that soil particles entrained in and circulating with the washing liquid tend to concentrate near the maximum diameter of the body of liquid in the rotating spray tube; advantage can be taken of this by making the tube non-circular in cross-section, for example of square instead of round shape, and positioning the washing jet orifices in that part of the wall of the spray tube which is nearest the axis of rotation. Thus the liquid discharged from said orifices will contain a reduced proportion of soil, with the result that less soil is thrown over the articles being washed, and there is subsequently less tendency to redeposit small particles of soil on the more shielded surfaces not directly exposed to the jets. If desired, auxiliary jet orifices located in that part of the tube furthest from the axis of rotation may be arranged to discharge a proportion of the total flow of liquid into some convenient form of by-pass filter, such as that described in the co-pending application of Arthur James Alabaster Serial No. 78,159, filed December 23, 1960 and owned in common with the present application.

Referring now to FIGURES 6 and 7, there is shown a modified design of spray tube 119 which, at its open end, is circular but for the major portion of its length is of rectangular section, each of the four sides being provided with a number of jet orifices 20 which, it will be noted, are offset slightly from the centre.

In this design of spray tube the vanes at the inlet end and extending the length of the stub axle are of normal design and consist of flat blades 21. At the front end the vanes are curved, as indicated at 22, and are detachably secured in position to permit of removal should it be necessary to have access to the fixing screw for the purpose of detaching the impeller.

The provision of auxiliary jet orifices 24 located in that part of the tube 119 furthest from the axis i.e. at the corners, ensures that liquid containing a higher concentrate of soil, will issue as a separate discharge. It then becomes a simple matter to collect this liquid in a filter device indicated generally at 26 and which is additional to the main filter indicated at M, in FIGURE 1.

The auxiliary filter 26 consists of a bag formed of fine mesh material 27, the bag, which is of narrow cross-section so as to reduce the amount of space it occupies, having an opening 28 at the top. The soil will collect in the pocket formed at the bottom which may be provided with a central baffle 29.

Referring now to FIGURES 8 and 9, there is shown another design of spray tube 30, which at the rear end is circular but is provided at its forward end with lobes 31, 31', giving a fishtail effect. In this arrangement, the vanes at the inlet end are of normal design, being radial, as indicated at 33 but at the front end, a single

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blade 34 extends across the entire width of the two lobes 31, 31'. Soil concentrate discharge orifices 35 located at the maximum diameter are arranged to discharge into a filter bag similar to 26 above.

What is claimed is:

1. A liquid impelling apparatus for a dishwashing machine, comprising a hollow spray impeller head having a wall defining an interior chamber open at one end and being provided with a plurality of jet orifices for delivering liquid outwardly from said chamber as a spray; stationary means mounting said impeller head for free rotation about an axis extending through and being normal to said impeller head open end; a volute casing fixed with respect to said stationary means and comprising a first end wall, a second end wall having a discharge opening directly registering and communicating with said impeller head open end, and a spiral wall between and connecting said volute end walls, said spiral wall spirally converging with constantly decreasing radius from a point spaced radially relatively far from said discharge opening progressively radially inwardly toward said discharge opening, said volute casing having an entrance opening between part of the spiral wall radially nearest said discharge opening and the part of said spiral wall radially farthest therefrom means for delivering fluid under pressure to said entrance opening, whereby to enforce a high velocity rotational flow of liquid through said volute casing discharge opening and said volute for delivery while still swirling through said impeller head open end into said impeller head chamber; and means on the inside of said impeller head chamber wall and in addition thereto contactable by the swirling liquid for rotating said impeller head.

2. A liquid impelling apparatus for a dishwashing machine according to claim 1 in which said volute casing has at least one curved guide vane whose upstream end begins at the start end of the spiral of the volute casing at a location radially between the radially outermost part of the volute casing and said discharge opening and whose downstream end merges with the axial projection of the perimeter of the discharge opening.

3. A liquid impelling apparatus for a dishwashing machine according to claim 1 in which the means mounting the impeller comprises a stub axle fast with said first end wall of the volute casing and bushing means rotatably mounted on said stub axle, and in which the spray impeller head comprises a tubular member having internal axially extending vanes connected to said bushing means.

4. A liquid impelling apparatus for a dishwashing machine comprising a washing chamber, a tubular spray member open at one end and closed at the other end provided with a plurality of jet orifices for delivering liquid therefrom as a spray, an axle fixed with respect to and extending from one side of the washing chamber on which the spray member is mounted to revolve, means for delivering liquid under pressure, a volute casing fixed to said one side of said washing chamber and having an entrance opening for receiving the liquid under pressure and a discharge opening which is circular and is arranged concentrically with the axis of the spray tube and in direct communication with the spray tube through the open end of the latter for delivering liquid from the volute into the interior of the tube in a forced vortex, said volute casing also having a spiral wall converging with constantly decreasing radius from a point spaced radially relatively far from said discharge opening progressively radially inwardly toward said discharge opening, and radial blades on the inside of the spray tube which extend axially for substantially the entire length of the tube and against which the rotating liquid impinges to impart drive to the spray tube.

5. A liquid impelling apparatus as claimed in claim 4 in which the fixed axle is of substantially less length than the spray tube so that the latter overhangs its bearing without support at the closed end.

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6. A liquid impelling apparatus as claimed in claim 4 in which the tubular spray member is of non-circular cross-section and has the jet discharge orifices located in that part of the tube wall nearest the axis of rotation and distributed along said spray member for delivering jets of relatively unsoiled liquid dispersed in the washing chamber, said spray member also having auxiliary apertures in that part of the wall of the spray member farthest from the axis of rotation and positioned to discharge relatively highly soiled liquid at a location avoiding impinging of the relatively highly soiled liquid on articles within said chamber.

7. A liquid impelling apparatus as claimed in claim 4 in which the spray tube has a central venthole in its closed end to allow the discharge of foam.

8. A liquid impelling apparatus as claimed in claim 6 in which auxiliary jet apertures are provided in that part of the wall of the spray tube farthest from the axis of rotation, and adapted to discharge into a filter bag or other soil-collecting means.

9. A liquid impelling apparatus for a dishwashing machine having a washing chamber; a tubular spray member, which is open at one end and closed at the other, stationary means mounting said spray member to revolve within the washing chamber and provided with a plurality of jet orifices for delivering liquid therefrom as a spray over articles, when placed in the washing chamber; means for circulation of liquid and delivering it to the spray tube, said means including a transfer duct arranged externally of the wall of the washing chamber and being fixed with respect to said stationary means; a pump by which liquid is extracted from the washing chamber and discharged under pressure into the transfer duct, said duct terminating in a volute casing, the volute casing including a first and outer end wall, which forms part of the transfer duct and an inner end wall having a discharge opening registering and communicating with the spray member through its open end, and a spiral side wall between and connecting said volute end walls; a stub axle fixed at one end in the outer end wall of the volute casing and extending therethrough and into the washing chamber by which the spray member is supported for rotation; the spiral wall spirally converging with constantly decreasing radius from a point spaced radially relatively far from said discharge opening and progressing radially inwards towards said discharge opening to provide a radially converging spiral volute chamber passage, whereby the pressure developed by the pump is utilized to force the liquid through the radially converging spiral passage of the volute chamber and thus cause the liquid to enter the spray member in the form of a forced spiral vortex of high rotational velocity; and a series of blades extending longitudinally of the spray member for engagement by the rotating liquid for causing rotation of said spray member.

10. Liquid impelling apparatus as claimed in claim 9 in which the volute casing is formed integrally with the discharge end of the transfer duct.

11. Liquid impelling apparatus according to claim 9 in which the outer wall of the volute casing is provided with a conical boss, in which the stub axle is fixed, the narrow end of the boss being directed inwardly so as to act with the spiral of the volute in ensuring a smooth flow of liquid into the spray tube.

12. A liquid impelling apparatus according to claim 11 in which the surface of the boss is formed with a concave curvature.

13. A liquid impelling apparatus according to claim 11 in which there is provided in the vortex chamber of the volute casing a curved guide blade, the upstream end of which commences at a point opposite the start end of the spiral wall.

14. A liquid impelling apparatus according to claim 9 in which a central hole is provided in the closed end of the spray tube to permit of egress of foam.

15. A method of imparting drive to a spray tube of

the type described in a dishwashing machine wherein the tube is open at one end and closed at the other, which comprises delivering liquid into the open end of the spray tube, and while so delivering the liquid and prior to its entering the spray tube, constraining the liquid to follow a spiral path which converges with constantly decreasing radius and thereby producing a vortex from the central part of which the liquid is discharged into the open end of the spray tube so that the liquid on entering the tube possesses high rotational velocity, and so balancing the input flow rate with the rate of discharge from the spray tube that the latter, when in operation, is not completely full of liquid.

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