Oct. 22, 1963 R. J. GILSON 3,107,859

LIQUID SPRAY APPARATUS FOR DISHWASHING MACHINES

Filed May 21, 1962 3 Sheets-Sheet 1

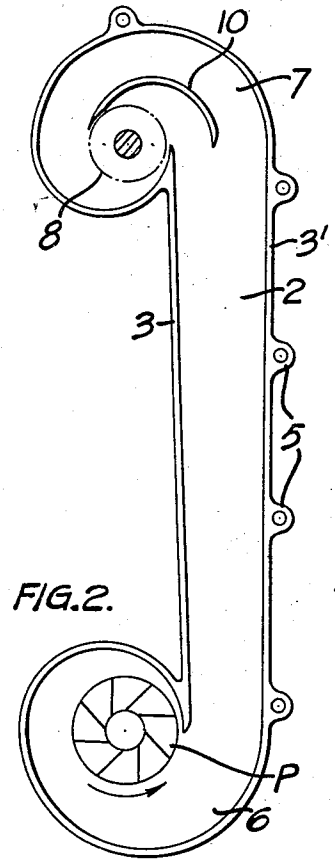


FIG. 2.

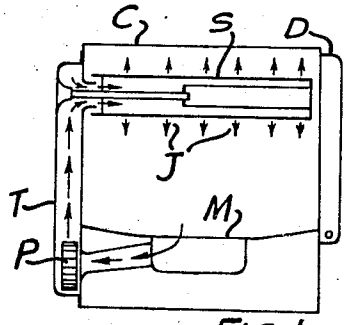


FIG. 1.

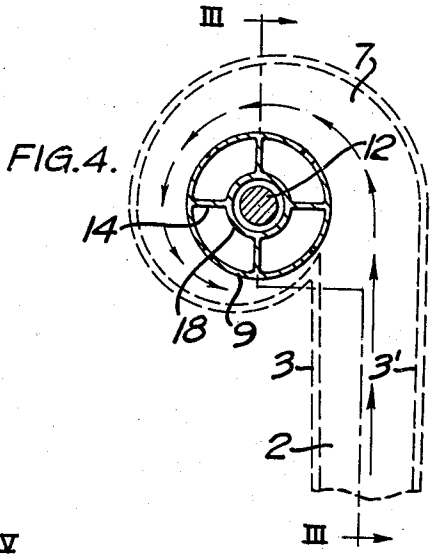


FIG. 4.

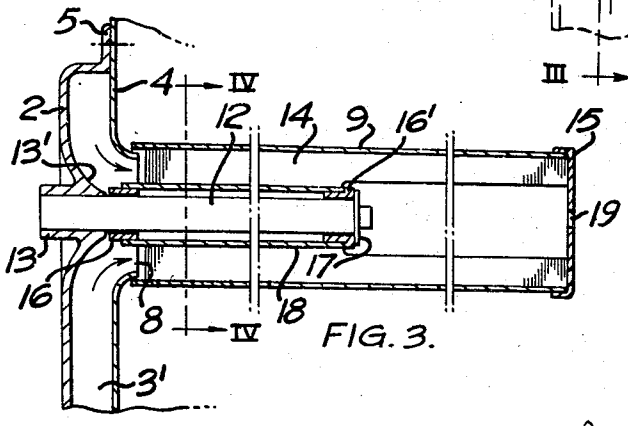


FIG. 3.

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LIQUID SPRAY APPARATUS FOR DISHWASHING MACHINES

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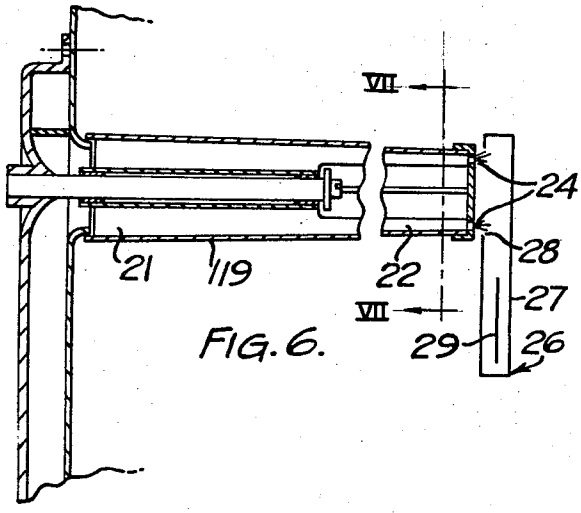


FIG. 6.

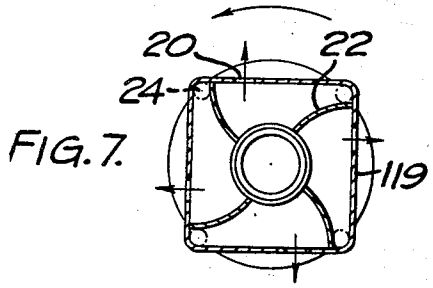


FIG. 7.

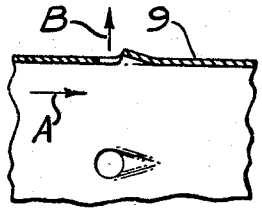


FIG. 5.

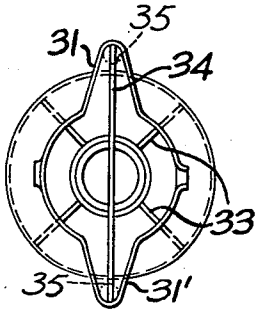


FIG. 9.

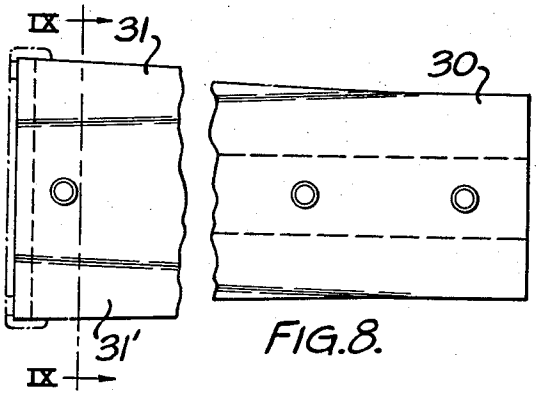


FIG. 8.

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LIQUID SPRAY APPARATUS FOR DISHWASHING MACHINES

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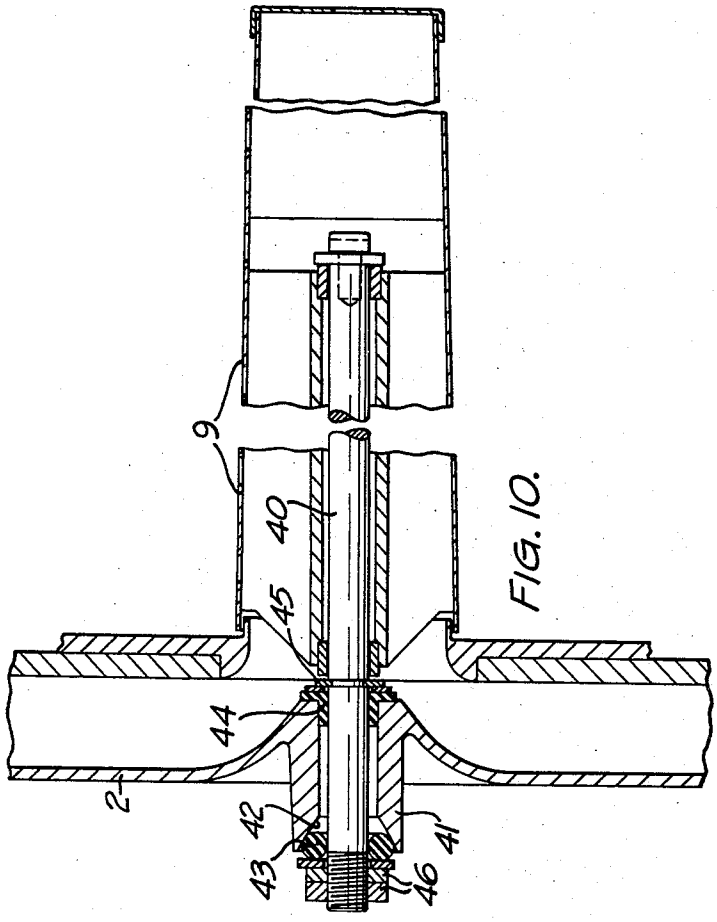


FIG. 10.

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United States Patent Office 3,107,859 Patented Oct. 22, 1963

3,107,859

LIQUID SPRAY APPARATUS FOR DISHWASHING MACHINES

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Filed May 21, 1962, Ser. No. 197,190
Claims priority, application Great Britain May 24, 1961
7 Claims. (Cl. 239—468)

This invention relates to liquid spray apparatus for 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.

This application is a continuation-in-part of my copending application Serial No. 97,912, filed March 23, 1961, now Patent No. 3,073,527, dated January 15, 1963. It is already known, for example, as described in British Patent 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 comprises 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 spray tube being mounted on a resiliently supported axle enabling the spray tube to be self balancing in operation.

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 volcano-shaped boss co-axial 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 United States 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 driving torque acting to cause rotation of the spray tube was measured by applying dead weights to a radially projecting lever affixed to the spray tube, and the rotational speed was measured by a stroboscopic device. The results of these tests were as follows:

	Torque, oz. ins.	Speed, r.p.m.
Circular Water Inlet Fitting as U.S. Patent 2,734,520	3½	200–400
Volute Chamber as Present Specification	18	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.

According to another feature of the present invention, the stub axle on which the spray tube is journalled for rotation, is secured in a resilient mounting in the wall of the volute chamber so as to have a sufficient degree of flexibility to allow the spray tube, when in operation, to rotate about an axis passing through its centre of gravity, and thus to become self-balancing.

In one construction in accordance with the invention, the stub axle is resiliently held in an opening in the side wall of the volute chamber by means of rubber or like resilient bushes.

For this purpose the wall of the volute chamber may be formed with a hub boss having a bore larger than the axle spindle so that the latter is a clearance fit, the boss being formed with a conical seating at its outer end for an annular resilient bush, which is fitted over the stub axle.

On the inner side of the boss, the stub axle is supported in a flanged resilient bush, the flange of which also serves as a liquid-tight seal against egress of liquid.

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 fragmentary vertical section on the line III—III of FIGURE 4, 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 on the line IV—IV of FIGURE 3, showing 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 on the line VII—VII of FIGURE 6, but on an enlarged scale.

FIGURE 8 is an elevation of another form of spray tube.

FIGURE 9 is a transverse section on the line IX—IX of FIGURE 8.

FIGURE 10 is a view similar to FIGURE 3, but showing a spray tube having an improved mounting.

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 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 favors 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 opening with a flanged or rounded edge indicated at 8 in FIGURE 3, is formed in the rear wall 4 of the washing chamber C to which the transfer duct is bolted. On the outer wall 2 of the transfer duct, a boss 13 is provided, into which is fixedly secured a stub axle 12. This boss is bounded on the inside of the outer wall 2 by a volcano-shaped wall 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 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 jets 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, dut to the influence of the local lipping 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 favors 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 favoring 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 Arthus 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 detachable secured in position to permit of removal should it be necessary to have access to the fixing screw for the purpose of detaching the spray tube.

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 blade **34** is provided. Soil concentrate discharge orifices **35** located at the maximum diameter are arranged to discharge into a filter bag similar to **26** above.

Referring now to FIGURE 10, the mounting of the spray tube **9** is by means of a stub axle **40** which is a clearance fit in a hub boss **41** in the outer wall of the volute casing **2** providing a support for the stub axle, the boss having a conical seating **42** for a rubber ring **43**, axle **40** being supported at its inner end in a flanged resilient rubber bush **44**.

A circlip **45** is arranged in a groove in the spindle and locates it axially in relation to the hub boss and enables the rubber ring to be placed in compression by lock nuts **46**. The bore in the boss **41** in which the stub axle **40** is mounted is enlarged to provide clearance between the bore wall and the stub axle, the conical seating **42** being an extension of the bore. Since the axle **40** is a stub axle, i.e. has only its left end part, as viewed in FIGURE 10, connected to the supports **2**, **41**, its opposite or right end being unsupported, the axle has a cantilever connection to the support. Due to the flexibility introduced by the ring **43** and the limited movability of the stub axle, the spray tube becomes self-balancing, which produces smoother running at the high speeds set up by the vortex flow drive.

A further increase in speed of the spray tube can be obtained without appreciable loss of jet impact on the articles to be cleaned by suitable choice of the discharge angle of the nozzles so that instead of discharging radially outwards, they point slightly backwards that is in a direction opposite to the direction of rotation of the spray tube.

The preferred backward discharge angle is about 20° to the radial but satisfactory results can be obtained up to 30°. It has been found that whereas a spray tube with radial apertures provides a rotational speed of about 2300 r.p.m. the 20° backward angle increases this figure to about 3000 r.p.m. without loss of jet impact.

It may be desirable in certain forms of dishwashing machine, especially those of larger cavity, to make use of more than one spray tube in the washing chamber.

What is claimed is:

1. Liquid spray apparatus for a dishwashing machine having a washing chamber, said spray apparatus comprising a support; an axle; resilient means interposed between and connecting one end part only of said axle and said support, the other end of said axle being unsupported, whereby said axle has a cantilever connection to said support and may move limitedly relatively to said support and transversely with respect to the axis of said axle; a spray tube mounted for rotation on said axle and having jet orifices along its length, and an open end; and means for delivering liquid into said tube open end and for imparting a rotary movement to the liquid entering said tube open end, the limited movability of said axle permitted by said resilient means enabling said spray tube to rotate about an axis passing through its center of gravity and thus become self-balancing.

2. Liquid spray apparatus for a dishwashing machine having a washing chamber, said spray apparatus comprising a support having a socket; an axle extending with clearance into said socket; resilient bush means within said socket and being interposed between and connecting one end part only of said axle and said support, the other end of said axle being unsupported, whereby said axle has a cantilever connection to said support and may move limitedly relatively to said support and transversely with respect to the axis of said axle; a spray tube mounted for rotation on said axle and having jet orifices along its length, and an open end; and means for delivering liquid into said tube open end and for imparting a rotary movement to the liquid entering said tube open end, the limited movability of said axle permitted by said resilient means enabling said spray tube to rotate about an axis passing through its center of gravity and thus become self-balancing.

3. Liquid spray apparatus for a dishwashing machine having a washing chamber, said apparatus comprising a support formed to provide a vortex chamber having an inlet and a central discharge opening from which liquid supplied to said inlet will be discharged with a vortex effect; a stub axle extending from a part of said support through said vortex chamber and said discharge opening; resilient means interposed between and connecting one end part only of said stub axle and said support, the other end of said axle being unsupported, whereby said stub axle has a cantilever connection to said support and may move limitedly relatively to said support and transversely with respect to the axis of said axle; and a spray tube rotatably mounted on said stub axle and having jet orifices along its length and an open end positioned adjacent said discharge opening to receive liquid discharged therethrough, the limited movability of said stub axle permitted by said resilient means enabling said spray tube to rotate about an axis passing through its center of gravity and thus becomes self-balancing.

4. Liquid spray apparatus according to claim 3 in which said support is formed with an enlarged bore receiving said stub axle with clearance, said resilient means comprising a bush within said bore and surroundingly engaging said stub axle, means being provided for securing said bush in said bore and applying axial pressure to said bush to seal said bore against egress of liquid therefrom.

5. Liquid spray apparatus according to claim 3 in which said vortex chamber has a wall and a boss projecting from said wall and being formed with an enlarged bore receiving said stub axle with clearance and having a tapered seating at one end of said bore, the other end of said bore facinng into said spray tube open end, said resilient means comprising bushes mounted on said

stub axle and respectively engaging said tapered seating and said bore at said other end thereof, means being provided for subjecting said bushes to axial compression to seal said bore against egress of liquid therefrom.

6. Liquid spray apparatus according to claim 3 in which said stub axle is of substantially less length than said spray tube.

7. Liquid spray apparatus according to claim 6 in which said spray tube comprises internal axially extending blade means projecting beyond said stub axle and extending substantially the length of said spray tube.

References Cited in the file of this patent

UNITED STATES PATENTS

2,529,262	Ratliff	Nov. 7, 1950
2,734,520	Abresch et al.	Feb. 14, 1956
2,956,572	Levit et al.	Oct. 18, 1960
2,980,120	Jacobs	Apr. 18, 1961
2,992,779	James et al.	July 18, 1961

FOREIGN PATENTS

42,812	Sweden	July 18, 1917
562,242	Germany	Oct. 6, 1932
832,756	Great Britain	Apr. 13, 1960