Oct. 4, 1960 J. L. ANDREWS 2,954,791

DRAINAGE CONTROL MEANS FOR DISHWASHING APPARATUS

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Fig. 1.

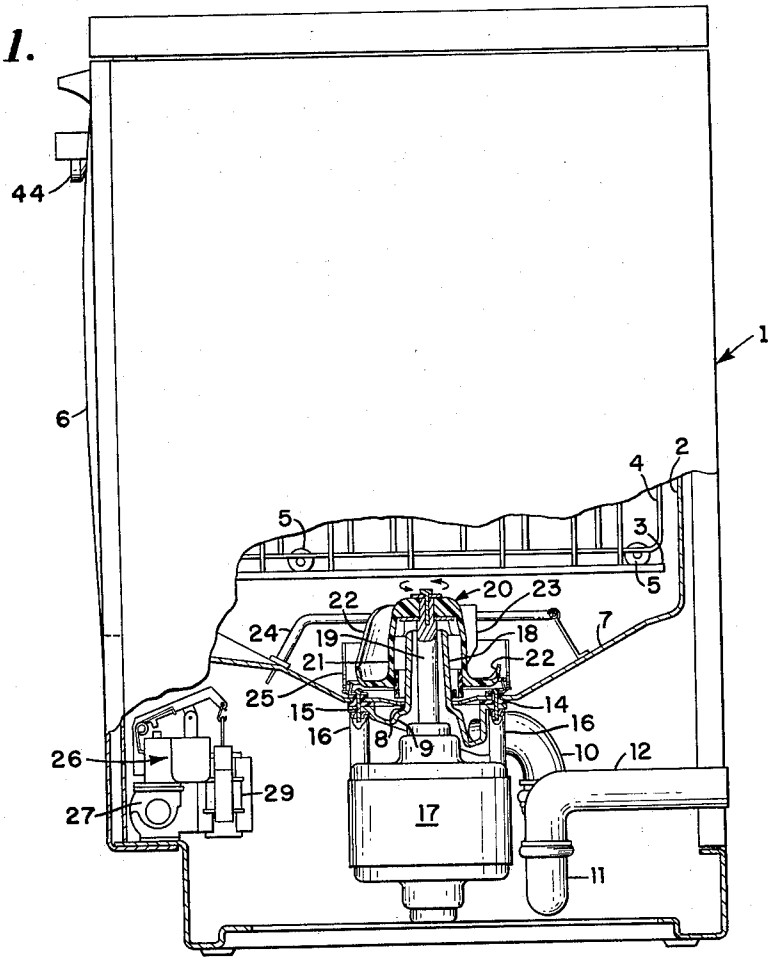


Fig. 2.

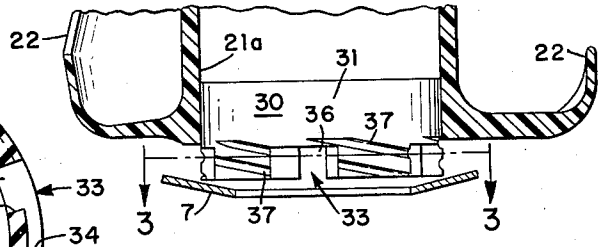
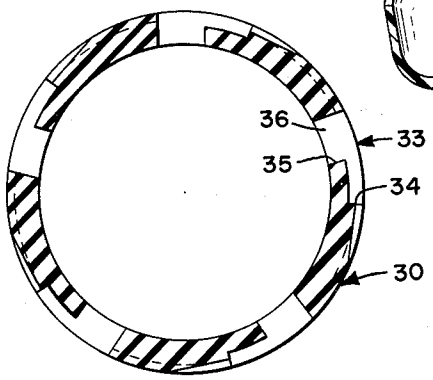


Fig. 3.



INVENTOR.
JOHN L. ANDREWS

BY
Andrew G. Hubbard

ATTORNEY

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Fig. 4.

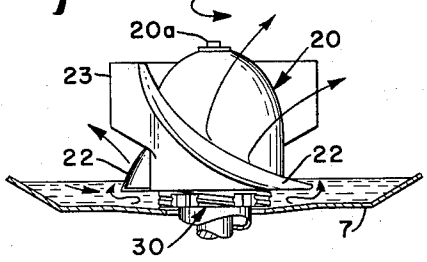


Fig. 5.

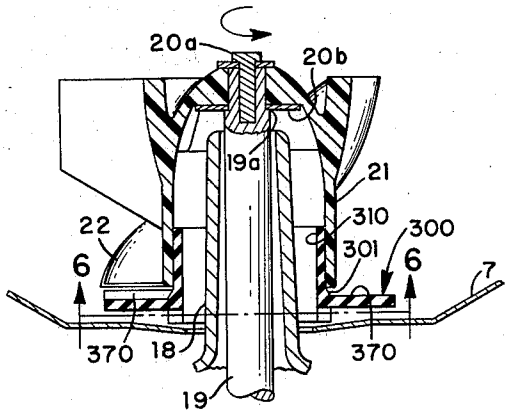


Fig. 6.

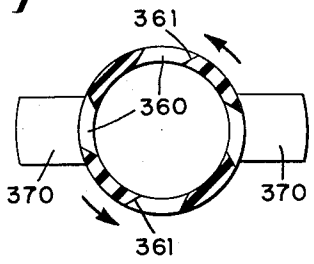


Fig. 7.

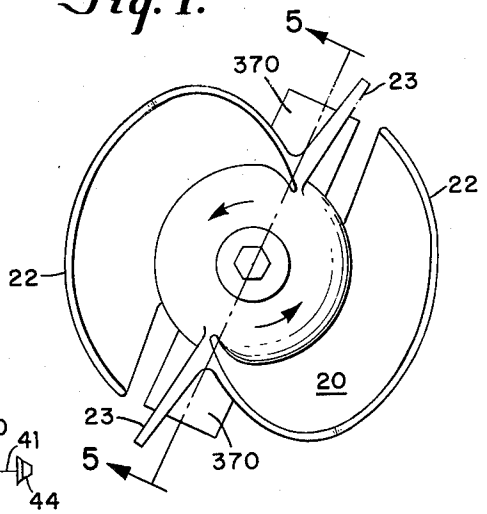
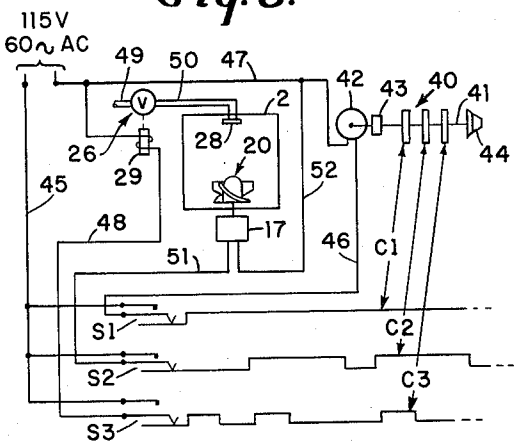


Fig. 8.



INVENTOR.
JOHN L. ANDREWS
BY
Andrew G. Hubbard
ATTORNEY

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DRAINAGE CONTROL MEANS FOR DISHWASHING APPARATUS

John L. Andrews, Chicago, Ill., assignor to General Electric Company, a corporation of New York

Filed Jan. 2, 1958, Ser. No. 706,678

10 Claims. (Cl. 134—186)

This invention relates to dishwashing apparatus and, in particular, to means for controlling the drainage of liquid from the washing tub of such apparatus. The application is a continuation-in-part of my pending application, Serial No. 254,288, filed November 1, 1951, for "Drainage Control Means for Dishwashing Apparatus and the Like," now Patent 2,825,350, granted March 4, 1958, and assigned to my assignee herein.

Dishwashing apparatus of the conventional automatic type comprises a tub within which are racked the articles to be washed, means for circulating detergent solutions and rinsing water throughout the tub and the contents thereof, and means for conducting the apparatus through a sequence of operations which includes washing the dishes, draining the washing liquid from the tub, rinsing the dishes and subsequently draining the rinse water from the tub, and, finally, drying the dishes by exposure thereof to warm air while they remain in the tub. There may be a prerinse, one or more separate washing operations, and one or more separate rinsing operations—all under control of a time-cycle switch which energizes electro-motor controlled water inlet and water drain valves, and a motor-driven impeller, according to a predetermined operational schedule.

It has been the practice to employ mechanical or electro-mechanical valves for controlling drainage from domestic dishwashers in order to prevent loss of the relatively small amount of washing and rinsing liquid. In such dishwashers, for example, only about twelve pints of water are used for each operation; and loss of any substantial portion thereof would impair the washing and rinsing efficiency.

As stated in my aforesaid copending application, studies of the water action in dishwashing machines established that a rotating impeller of the type disclosed in Koertge U.S. Patent 2,422,022, dated June 1, 1947—which impeller has been used in vast numbers in dishwashers manufactured by my assignee herein—may be used as a basic component of a dishwasher drainage control system. I discovered, for example, that if a continuously open drain port were located wholly within the area of the tub bottom circumscribed by the hub of the impeller, a cylindrical drain control device disposed wholly within the impeller hub and also circumscribing the drain opening could be formed to provide a pumping action which will effectively keep the liquid from reaching the drain opening but not create such pumping pressure or turbulence as to interfere with the normal operation of the dishwasher impeller. It was also found that the drainage control cylinder should be shaped as to have segments which are separated by passages which are only a fraction of the length of the segments, thereby providing

elongated imperforate wall areas separated by water passages which are of relatively restricted capacity. Further, it was discovered that the bottom of the cylinder should be as close as practicable to the bottom of the tub so as effectively to limit the flow of water to the drain opening to that which will pass through the water passages during quiescent periods of the impeller. Desirably, the cylinder should rotate in full engagement with the bottom of the tub; but as a practical matter, manufacturing tolerances, the slight tilting of the impeller relative to the tub bottom during rotation, and occasional high spots which may be present in the critical area as a result of the vitreous enamel coating applied to the interior of the tub, make impossible to establish a minimum uniform clearance between the bottom of the drainage control cylinder and the tub. In accordance with the invention, therefore, the inside wall of the lower portion of the impeller hub is made cylindrical and the cylindrical drain control device is sized so as to have an interference fit with the inside wall of said hub. Such fit is, of course, essentially frictional, and while it is such that the cylindrical member will be rotated by the impeller and thus perform its pumping function, the cylindrical member is nevertheless capable of axial displacement relative to the hub of the impeller and the bottom of the tub. The importance of this arrangement is that during the manufacture of the dishwasher the workman may, without gauges or the like, manually move the cylindrical member into contact with the bottom of the tub and leave it in that position. During the first revolution of the impeller and the associated cylindrical member, the latter will find its proper relationship with the tub bottom, for any irregularity or slight rise in that portion of the tub will move the cylindrical drain control device upwardly so that, although it may always be in point contact with the tub bottom, the major portion of the periphery of the member will be slightly spaced therefrom. Such spacing is, at most, a matter of a few thousandths of an inch; and because such a relationship is most prevalent in the dishwashers embodying the invention, the expression "in spaced relation to the bottom of the tub" is to be interpreted to include the condition that the member is slightly spaced from the tub bottom throughout to major portion of the periphery of the drainage control cylinder.

It is, therefore, an object of the present invention to provide a drainage control system for a dishwasher comprising a pumping element disposed within the tub about a drainage opening and mechanically associated with the dishwasher impeller to be rotated thereby while having free axial displacement relative to the impeller.

It is another object of the invention to provide a dishwasher drainage control system comprising a low-cost cylindrical member, removably associated with the dishwasher impeller so that in the event a replacement of the control device is necessary, an unskilled workman can make such replacement without having carefully to establish the relationship of the replacement element with the bottom of the tub.

It is a further object of the invention to provide a dishwasher drainage control system comprising a pumping element associated with the dishwasher impeller, said pumping element being effective to preclude flow of liquid from the tub to a continuously open drain port therein without, however, establishing such powerful pumping actions as to interfere with the operation of the dishwasher impeller.

It is another object of the invention to provide a dishwasher drainage control system comprising a standard form of dishwasher impeller within which is disposed a drainage control cylinder having means which pump the liquid away from a continuously open drainage opening while the impeller is rotating but permits flow of liquid to the opening when the impeller is still; said control means further having structure wherein it tends to lift the liquid into the zone of influence of the dishwasher impeller blades, thus improving the operation of the latter.

Other features and advantages will best be understood from the following detailed description of a presently preferred embodiment, read in connection with the accompanying drawings in which:

Fig. 1 is a side elevation, partially in section, of a dishwasher embodying one form of the present invention;

Fig. 2 is a fragmentary elevational section of an impeller, showing, in elevation, a drainage control cylinder constructed according to a preferred form of the invention and showing the normal relationship of the drainage control cylinder to the bottom of the tub;

Fig. 3 is a plan section looking in the direction of the arrows 3—3 of Fig. 2;

Fig. 4 is a somewhat schematic representation showing the water action produced by the impeller and the drainage control member of Fig. 2 during operation of the impeller;

Fig. 5 is a vertical elevation showing the dishwasher impeller and a second form of drainage control device;

Fig. 6 is a bottom plan sectional view of the drainage control member of Fig. 5, looking in the direction of the arrows 6—6 of Fig. 5;

Fig. 7 is a top plan view of the impeller and drainage control device of Fig. 5; and

Fig. 8 is a schematic wiring diagram.

Referring now to Fig. 1, a dishwasher embodying a preferred form of the invention comprises an outer casing 1 within which is secured a dishwashing tub or vat 2 having tracks or guideways 3 for mounting a rack 4 which receive the dishes and other articles (not shown) which are to be washed. Pursuant to conventional practice, the rack 4 is provided with rollers 5 which are guided by the tracks 3, whereupon when the bottom-hinged door 6 is moved from its illustrated vertical closed position to a horizontal open position, the racks may be rolled out onto the door for loading and then returned to the tub for the dishwashing operation. The dishwasher tub has a sump portion 7 of which the central portion slopes relatively gradually to a continuously open drainage port 8. A drainage fitting 9 disposed immediately below the port 8 communicates directly with an elbow 10 which, in turn, receives the trap 11 of a conventional plumbing waste fitting. It will be understood that the branch 12 of the trap is arranged to communicate with the soil or waste line (not shown) of the building within which the dishwasher is located. It will be noted that the drainage fitting 9 is affixed to the tub bottom by means which include a resilient gasket 14 and that the bolts 15 which secure the drainage fitting to the tub bottom additionally enter the posts 16 extending upwardly from the external body structure of the electric motor 17. Because of the resiliency of the gasket 14, the motor 17 is flexibly mounted relative to the tub bottom. The drainage fitting 9 has an upstanding cylindrical neck 18 which projects through the drainage opening 8, whereby the said drainage opening is essentially of annular shape. The cylindrical portion 18 extends to above the maximum free level of liquid within the tub, whereby to prevent any escape of liquid along the shaft 19 which extends vertically from the motor 17 coaxial with the member 18. A dishwasher impeller 20, of the type disclosed in the aforesaid Koertge patent, is rigidly secured to the end of the shaft 19 to rotate therewith. The impeller 20 has a hollow hub portion 21, from which extend liquid circulation blades 22 and

air circulation blades 23. The liquid circulation blades are designed so as efficiently to pick up the free liquid in the bottom of the tub and circulate it forcefully throughout the tub so as to impinge upon the dishes and other articles disposed therein. As shown in the said Koertge patent and illustrated particularly in Fig. 4 herein, the impeller hub portion is imperforate below the free liquid level. The air circulation blades are used to facilitate drying of the dishes after the final rinsing operation and are effective to circulate the air within the tub among the dishes so as to dry them while they remain within the tub. To improve the drying operation, it is customary to employ a sheathed heating element 24 suitably supported about the impeller; said heating element is energized during the last portion of the dishwasher operation so that it heats up the air within the tub and thus accelerates the drying operation. Finally, it is the usual practice to provide a suitable screen 25 about the impeller so as to guard against damage to the impeller and also to separate out any large particles of food waste, such as leafy vegetable fragments which may have been dislodged from the dishes during the rinsing or washing operations.

A solenoid-operated valve 26, of any suitable pattern, is used as a means for controlling the admission of liquid into the dishwasher tub. The valve body 27 is arranged to be attached to piping leading from the hot water supply system of the building, and it controls water flow to an inlet fitting 28 (shown schematically in Fig. 8) disposed at the top of the tub. The valve is of the normally closed type and is arranged to be operated to open position by means of a suitable solenoid 29.

The above noted dishwasher construction and components are now old and very well-known in the art and as such form no part of the present invention.

The drainage control mechanism which comprises a preferred embodiment of my invention is best illustrated in Figs. 2, 3, and 4. As shown in Fig. 2, a cylinder 30 is molded from material which is of inherently smooth, yieldable nature—for example, rubber having a durometer hardness of not much less than 50, nor more than 75, on the Shore "A" scale. In the commercial embodiment, a hardness of 60 to 70 has been successfully used. The upper portion 31 thereof is sized to make a snug friction fit with the cylindrical inner wall 21*a* of the impeller, whereby the cylinder 30 rotates with the impeller but is nevertheless capable of axial movement therein. The lower part 32 of the drain control cylinder is shaped to provide pumping and drainage portions 33 which are wholly below the bottom surface of the impeller hub 21. These portions, best shown in Fig. 3, desirably have a stepped shape when viewed in plan section; the walls 34 and 35 produce enough centrifugal pumping action when the cylinder 30 is rotated at the usual motor speed of 1750 r.p.m. to prevent the passage of liquid through the openings 36, but insufficient to move the liquid forcefully outward of the water circulation blades. Fig. 4 illustrates what observation indicates to be the free water level in the sump, and the probable water action of the pumping elements during the rotation of the impeller and the cylinder 30 associated therewith. The water movement is not out substantially beyond the reach of the liquid impeller blades, whereupon the normal pumping action of said blades is not disturbed. It will be noted from Fig. 3 that the openings 36 cumulatively total only a fraction of the exposed area of the cylinder; in the preferred embodiment, the openings 36 constitute only about one-quarter of the area of the inner wall of the cylinder below the impeller hub. The cylinder is relatively thick. In the illustrated embodiment, it is one-quarter of an inch thick and has an overall diameter of approximately 2.8 inches. It is obvious from Fig. 2, however, that the radially outermost bottom edge of the cylinder 30 is closest to the surface of the tub bottom. It has been found that in such construction, there

is no problem of lubricating the cylinder relative to the tub bottom, for it is well known that water is an efficient lubrication medium for rubber surfaces, and, of course, during the operation of the impeller the cylinder is actually immersed in water. Thus, even in an ideal situation in which the cylinder seats against the tub throughout its full periphery, the relatively small area of contact between the cylinder and the tub maintains friction at a minimum.

It is advantageous to construct the drainage control cylinder to have an upwardly pumping effect as well as an outwardly pumping action. This improves the water movement as respects the impeller blades, for it insures a continuous immersion of the leading edges of the blades. In the Fig. 2 embodiment, this vertical pumping effort is provided by the helical grooves **37** formed in the outside wall of the cylinder **30**. The downward reaction exerted on the cylinder by the slope of the grooves tends to maintain it seated against the tub.

In the embodiment of the drainage control member shown in Figs. 5 through 8, the cylindrical structure **300** is shown in its maximum raised position, as determined by the engagement of the angular wall **301** with the bottom edge of the hub **21**. The hub portion **310** of the drainage control member is in frictional engagement with the cylindrical inner wall of the hub **21**, as in the previous embodiment. The bottom pumping structure, however, is modified to enlarge the drain passages to accelerate drainage of liquid from the tub. As indicated in Fig. 6, each of the passages **360** is defined by a sloping rear wall **361**, considered with respect to the direction of rotation; said walls **361** are considerably more efficient in pumping action than the stepped formation previously described. Nevertheless, it remains of importance not to have the pumping action interfere with the normal operation of the liquid circulation blades **22**, for the primary objective of the impeller **20** is to circulate the washing or rinsing liquid forcefully throughout the tub and the articles stacked therein. Accordingly, in the present embodiment I provide pumping blades **370** which extend substantially to the radially outermost edge of the liquid circulation blades. The blades **370** are of substantial area and pumping effect and are arranged to intercept the liquid which is being discharged in the radially outward direction by the pumping surfaces **361** and lift the liquid into the immediate path of the leading edge of the respective liquid impeller blades. As appears in Fig. 5, the trailing edge of each blade **370** is only slightly below the leading edge of the adjacent liquid impeller blade. Therefore, although the shape of the walls **361** produces a relatively more powerful outwardly directed pumping action than do the surfaces **34** and **35** of the earlier embodiment, there is no interference with the important pumping action of the blades **22**.

During the manufacture of the dishwasher, the workman assembles the drain control device (of either type) within the impeller hub with said device extending below the impeller an amount which is greater than the eventual mounting of the impeller on the shaft **19** will permit. It makes no difference how much of an excess extension is present, and therefore, the workman will insert the device **300** or **30** sufficiently within the hub **21** to prevent the accidental separation of the respective parts during handling. He will then place the impeller on the shaft **19** and make it secure by inserting and making up on the machine screw **20***a* until the drive plate **20***b* of the impeller seats securely on the shoulder **19***a* of the shaft **19**. Of course during the operation of securing the impeller, the drain control device is being pressed against the tub bottom, or at least any localized bump or irregularity that may be raised above the rest of the tub bottom. When the tightening of the impeller is completed therefore, it is quite possible that the bottom edge of the drain control device may be distorted, for it is of elastic material. However, the workman need not concern himself with the fit of the impeller within the tub or its relationship to the tub bottom, for during the first revolution of the impeller, the axial adjustment permitted the drain control member will correct such initial irregularities. The softness of the rubber and its inherent lubricity in the presence of water prevent damage to the tub—which usually has a vitreous enamel coating—even though the control member may continuously engage portions of the tub bottom during operation. It is, therefore, apparent that the mounting of the impeller and the positioning of the drain control member therein is satisfactorily accomplished without the necessity of gauges, jigs, or the like. This ease of installation is particularly advantageous in servicing the dishwasher, for the impeller and drain ring may be replaced without difficulty.

Another advantage of the axial adjustability of the drainage control member derives from the situation that the motor **17** is resiliently mounted and hence capable of a slight amount of gyration during operation under load. The resulting gyratory movement described by the bottom of the drain control cylinder within the tub will bring the drain control cylinder into contact with the tub, whereupon there will be a slight yielding of the drainage control member by reason of its elasticity and its axial adjustability.

Fig. 8 very schematically shows a portion of the dishwasher operational cycle. A time-cycle controller **40** of any conventional type has control cams **C1**, **C2**, and **C3**, mounted on a cam shaft **41** which is driven at a controlled rate of speed by a synchronous motor **42** operating through a slip clutch and reduction gear mechanism **43**. A setting knob **44** at one end of shaft **41** is mounted for convenient access on the exterior of cabinet **1**, as shown in Fig. 1. The motor **42** drives the cam shaft through an operational cycle of 350° and then terminates its own operation. In order to begin a dishwashing cycle, therefore, the user manually rotates the knob **44** through an angle of about ten degrees from an "off" to a "start" position. In Fig. 8, the several switch controlled cams are in the "off" position.

Assuming that the tub **2** has been loaded with the articles to be washed and a detergent compound is placed within the tub, the user operates the knob **44** to the "start" position. In such position, cam **C1** closes **S1**, whereupon a circuit is completed to the timer motor **42** by way of line conductor **45**, switch **S1** and conductors **46** and **47**. Immediately thereafter, inlet valve solenoid **29** is energized through the then closed switch **S3** and conductors **45**, **48** and **47**, whereupon valve **26** opens and water received from the hot water supply through a pipe **49** passes through pipe **50** to the inlet fitting **28** within the upper portion of the tub. Switch **S3** remains closed for about forty-five seconds to permit cold water to be purged from the piping; and during this prerinse interval, gross soil is flushed from the dishes. Cam **C2** has not yet closed its switch **S2** to energize the main motor **17** and the impeller is, therefore, still. The water entering the tub during this forty-five second interval passes directly through the drain control device ports and goes to the plumbing waste line. After a short interval during which valve **26** is closed to permit the complete drainage of the prerinse water, cam **C2** closes its switch **S2** to energize the motor **17** through the circuit comprising line conductor **45**, switch **S2** and conductors **51**, **52**, and **47**.

After a short interval which permits the drive motor to operate the impeller at normal speed, cam **C3** again closes switch **S3** for an interval long enough to introduce a desired quantity of water into the tub. Usually domestic dishwashers operate on about twelve pints of water for each of the washing and subsequent rinsing operations. In view of the fact that the impeller is rotating and the drainage control mechanism is, therefore, effective to prevent the loss of water to the drain, the first washing operation is then under way and continues for a suitable interval—usually about five minutes. Cam **C2** then

opens its switch S2 for a period long enough to stop the impeller for complete drainage of the first wash water from the tub, whereupon the cam C2 again energizes the main motor circuit and shortly thereafter cam C3 again energizes the inlet valve solenoid so that a second charge of water—which may be either a washing or a rinsing operation—is introduced and another operational cycle is under way.

In view of the fact that it is unnecessary for a thorough understanding of the present invention to continue the operational cycle of the dishwasher through any more of its functions, such as final rinsing and air drying, these elements have been eliminated from the disclosure.

It will be obvious that drainage control means constructed and arranged pursuant to the invention is even more advantageous in dishwashers of the manually controlled type, for such appliances are manufactured for sale in highly competitive markets. The low manufacturing cost of the cylindrical drain control device, and its ease of assembly and service, offers great advantages over the conventional drain valves or centrifugal pumping devices of the prior art.

While there have been described what is at present considered to be the preferred embodiments of the invention, it will be understood that various modifications may be made therein, and it is intended to cover in the appended claims all such modifications as fall within the scope of the invention.

I claim:

1. A liquid circulation and drainage control device for a dishwasher having a tub for the reception of articles to be washed, said tub having a bottom wall sloping toward a drainage opening at a low point thereof, and means for introducing liquid into said tub; comprising an impeller for circulating liquid throughout said tub, said impeller having an imperforate cylindrical hub portion, liquid-engaging blade members extending from said hub portion, shaft means for supporting said impeller for rotation about a vertical axis concentric with said drain opening, said shaft means maintaining said impeller with the bottom of said hub portion above the bottom wall of said tub, a cylindrical member mounted for rotation with said impeller, said cylindrical member extending downwardly from said hub portion into close proximity with said tub, said downwardly extending portion being formed with a plurality of mutually spaced pumping elements circumscribing the drainage opening and providing continuously open drain ports, said pumping elements having wall means effective during rotation of said impeller to urge liquid away from said drain ports to deter the flow of liquid to said drainage opening, means for mounting said cylindrical member for bodily displacement in an axial direction during the rotation of said impeller, and means for rotating said impeller.

2. Apparatus according to claim 1, in which said cylindrical member is of elastomeric material.

3. Apparatus according to claim 1, in which said cylindrical member is of rubber having a durometer rating greater than 50.

4. In a dishwasher, a tub for the reception of articles to be washed, said tub sloping toward a drainage opening at a low point thereof, means for introducing liquid into said tub, an impeller for circulating liquid throughout said tub, said impeller having an imperforate cylindrical hub portion providing a smooth inner wall substantially greater in diameter than the diameter of said drainage opening, liquid engaging blade means extending from said hub portion, shaft means for supporting said impeller for rotation about a vertical axis concentric with said drain opening, said shaft means fixing said impeller with the bottom of said hub above the bottom of said tub, a drainage control member mounted wholly within said hub portion in frictional engagement therewith, whereby said member will rotate with said impeller but is capable of bodily displacement in an axial direction relative thereto, said member extending downwardly from said hub portion into close proximity with said tub, said downwardly extending portion being formed with a plurality of mutually spaced, elastic, arcuate segments providing continuously open drain ports having wall means providing pumping surfaces disposed wholly radially outward of said drainage opening, whereby during rotation of said drainage control member liquid will be urged outwardly of said drainage opening and during quiescent periods liquid may flow between said segments into said drainage opening, and means for rotating said impeller for predetermined time periods.

5. Apparatus according to claim 4, in which said arcuate segments have a circumferential length substantially greater than the minimum effective length of the spacing between adjacent segments.

6. In a dishwasher, a tub for the reception of articles to be washed, said tub having a bottom wall sloping toward a drainage opening at a low point thereof, means for introducing liquid into said tub, an impeller having an imperforate cylindrical hub portion and liquid circulation means extending therefrom above the bottom wall thereof for circulating liquid throughout said tub, means for mounting said impeller for rotation about a vertical axis concentric with said drainage opening, a drainage control member disposed between said liquid circulation means and said tub bottom, said control member comprising an open-ended cylindrical element having an upper wall portion in surface contact over a substantial area of the inner wall of said impeller hub whereby to associate said cylindrical element and said hub for conjoint rotation, and a lower wall portion extending below said hub into close proximity to said tub bottom, said lower wall portion wholly circumscribing said drainage opening and comprising a series of peripherally elongated arcuate segments separated by passages extending radially through said lower portion in openly facing relation to the bottom of said tub and open to the passage of liquid during all conditions of operation of said impeller, said passages having a peripheral length substantially shorter than the length of said segments and being characterized by end wall means disposed with respect to a predetermined direction of rotation of said impeller to repel liquid from said passages to minimize flow of liquid through said passages to said drain opening, and means for rotating said impeller in said direction of rotation.

7. Apparatus according to claim 6, in which said drainage control member additionally has wall means disposed between said passages and said impeller, for exerting an upwardly pumping effect on the liquid in contact therewith during rotation of said member.

8. A liquid circulation and drainage control device for a dishwasher having a washing tub provided with a continuously open drain port and means for introducing liquid into said tub; comprising an impeller having an imperforate cylindrical hub portion substantially greater in diameter than that of the drain port, liquid-engaging blade means extending radially from said hub portion, shaft means for supporting said impeller for rotation about a vertical axis concentric with said drain port, said shaft means fixing said impeller with the bottom of said hub portion above the bottom of said tub, a cylindrical member mounted in said hub portion for rotation therewith and free axial movement relative to the bottom of said tub, said cylindrical member having a portion extending downwardly from said hub portion into close relationship with said tub bottom, said downwardly extending portion being of elastic material and having a plurality of mutually spaced pumping elements circumscribing said drain port, said pumping elements urging liquid outwardly of said impeller during the rotation thereof whereby to permit flow of liquid to said drain port only during nonrotational periods of said impeller, means on said downwardly extending portion to urge said cylindrical member continuously toward said tub bottom

during said rotation, and motor means for rotating said impeller.

9. A liquid circulation and control device according to claim 8, in which the means for urging said cylindrical member toward said tub bottom comprises pumping elements extending radially from said cylindrical member immediately below the said blade means of said impeller.

10. A liquid circulation and control device according to claim 9, in which the said radially extending pumping elements have inclined surfaces for lifting the liquid to

the level of the leading edges of said impeller blade means.

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