April 20, 1965 T. W. DUNCAN ETAL 3,179,307

PUMP ASSEMBLY FOR DISHWASHING MACHINES

Filed Oct. 24, 1963 6 Sheets-Sheet 1

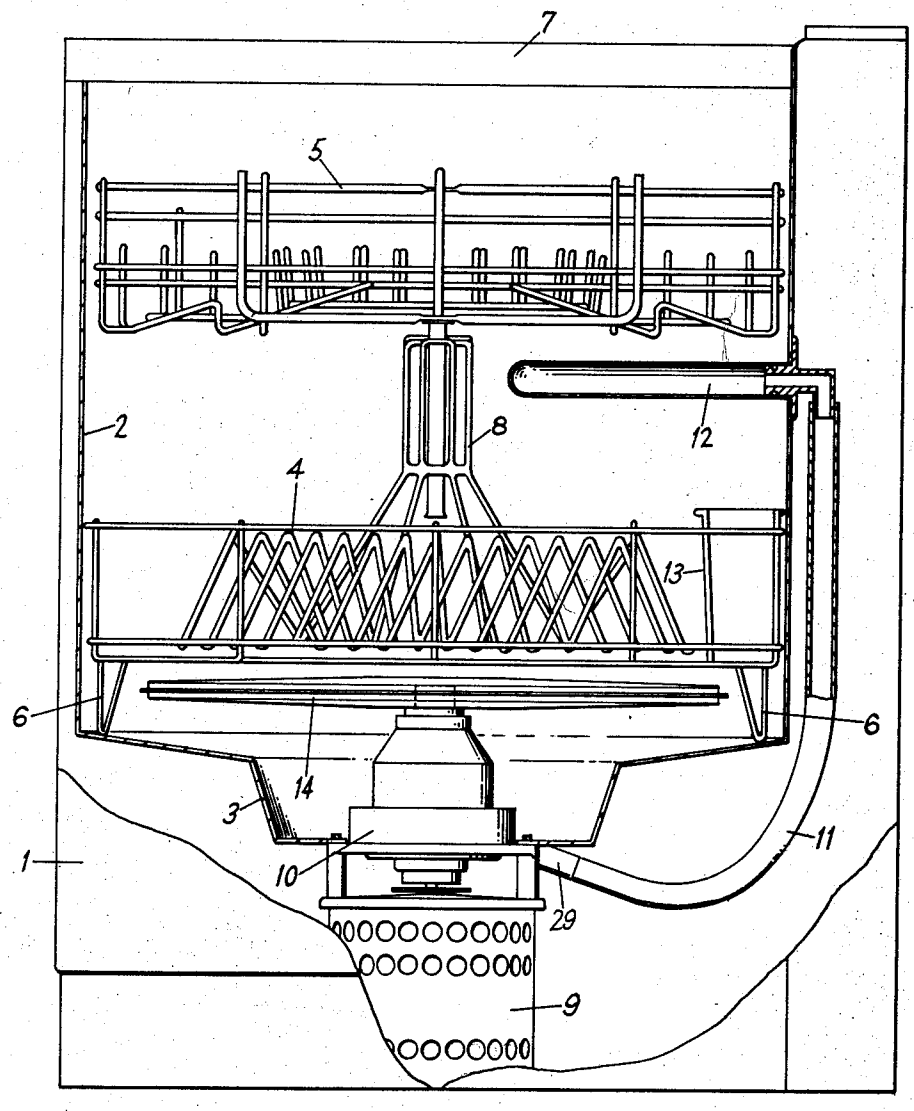


Fig. 1

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PUMP ASSEMBLY FOR DISHWASHING MACHINES

Filed Oct. 24, 1963 6 Sheets-Sheet 2

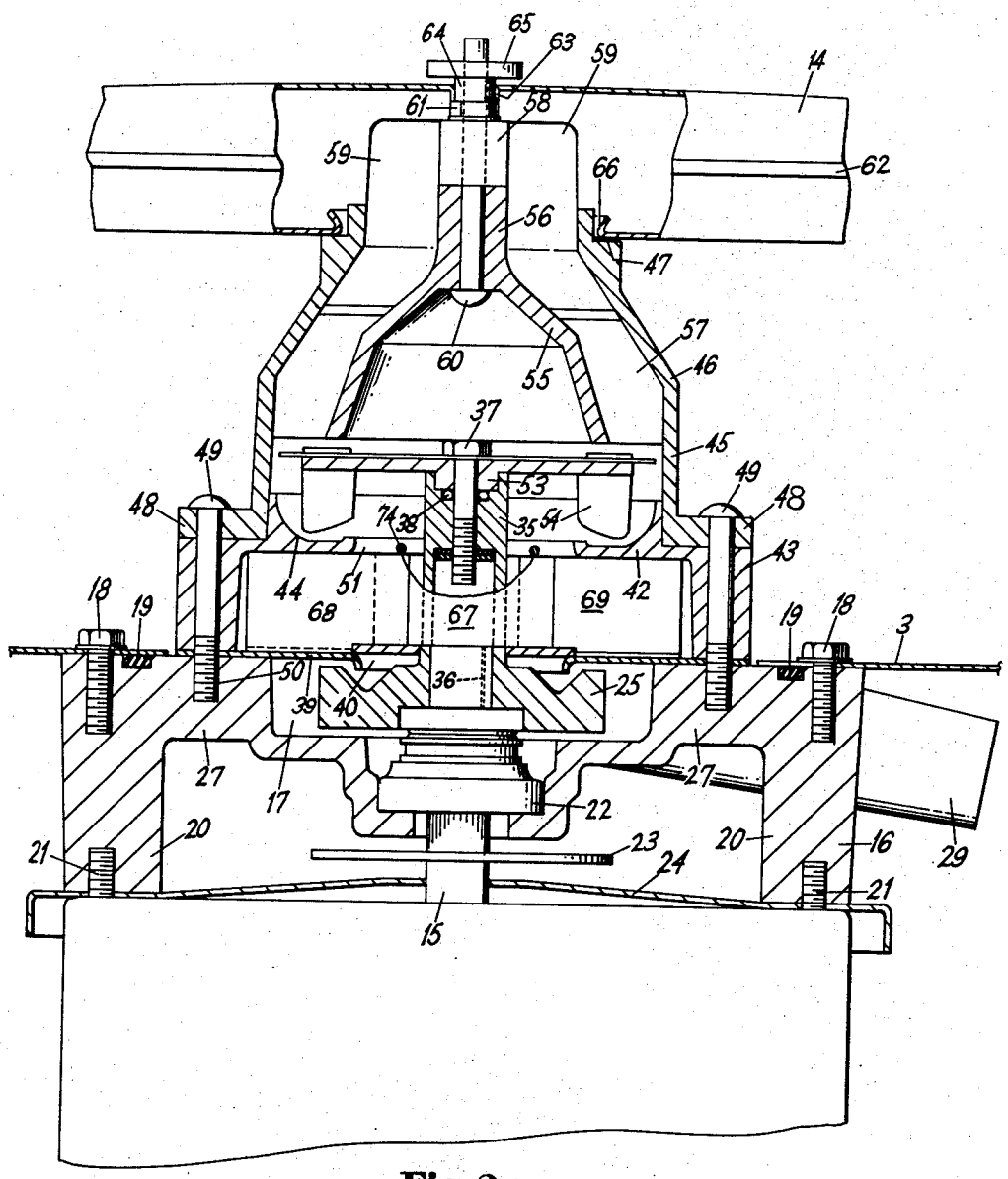


Fig. 2

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PUMP ASSEMBLY FOR DISHWASHING MACHINES

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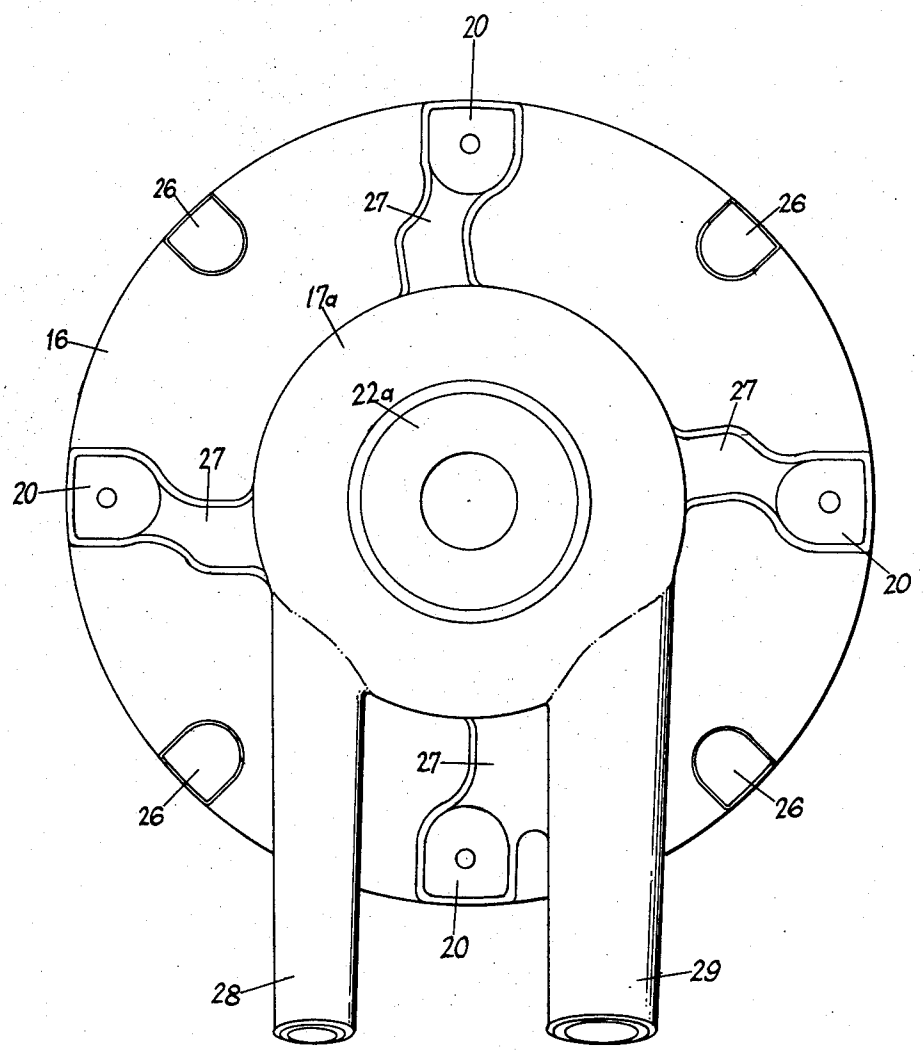


Fig. 3

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PUMP ASSEMBLY FOR DISHWASHING MACHINES

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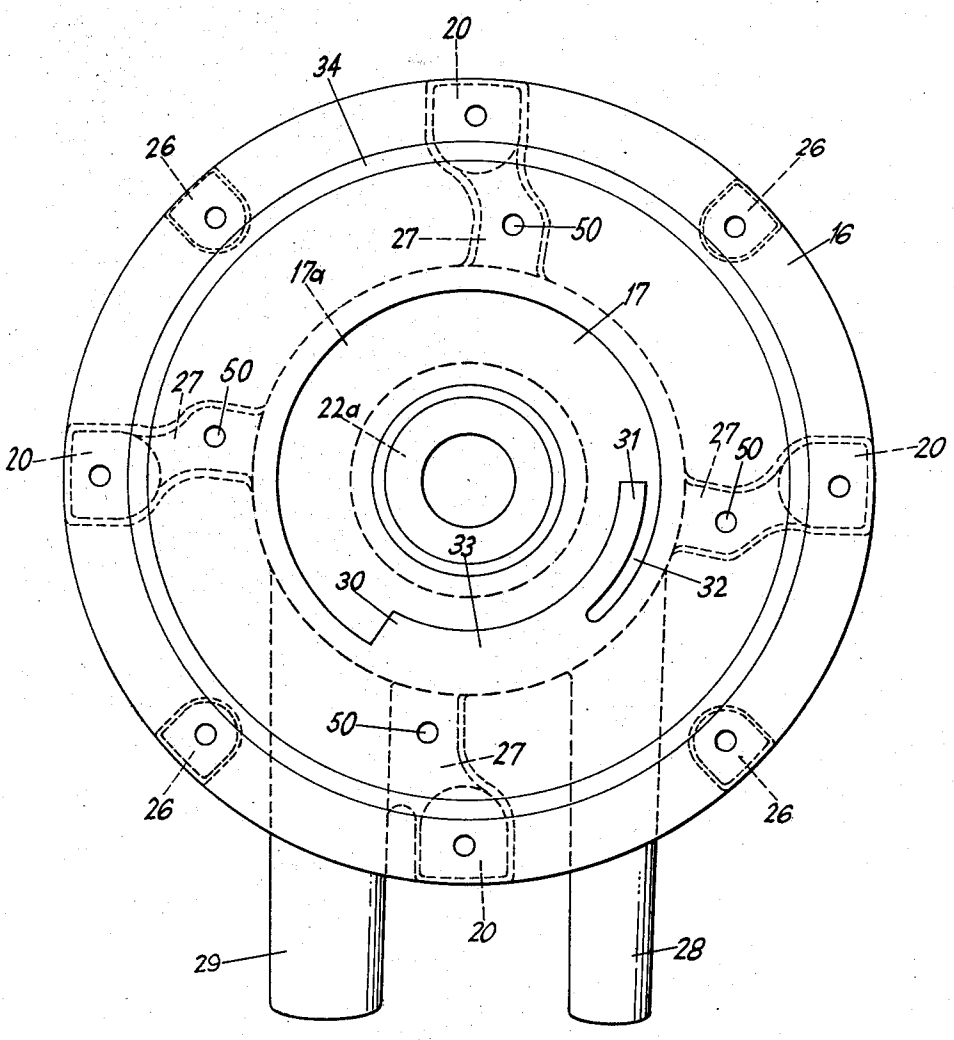


Fig.4

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PUMP ASSEMBLY FOR DISHWASHING MACHINES

Filed Oct. 24, 1963 6 Sheets-Sheet 5

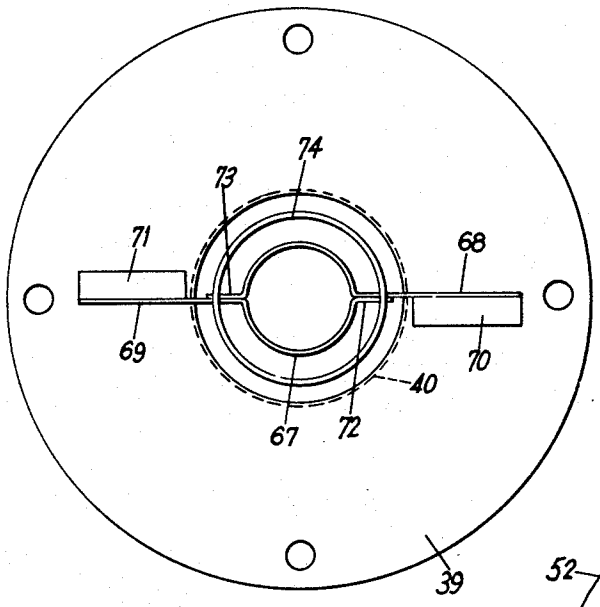


Fig.5

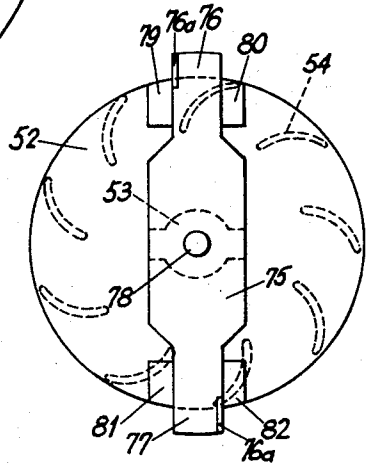


Fig.6

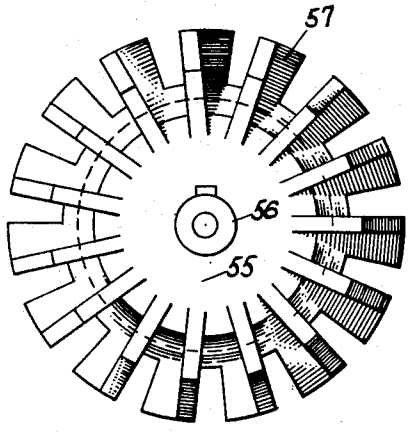


Fig.8

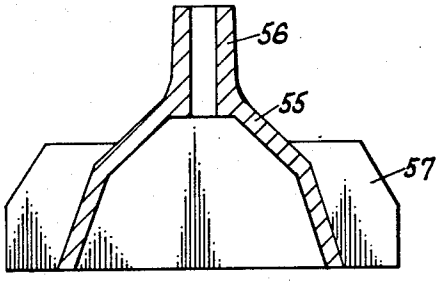


Fig.7

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PUMP ASSEMBLY FOR DISHWASHING MACHINES

Filed Oct. 24, 1963 6 Sheets-Sheet 6

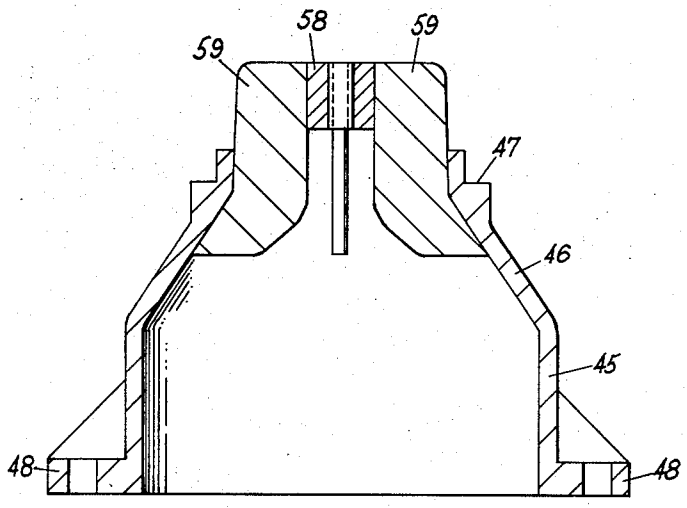


Fig. 9

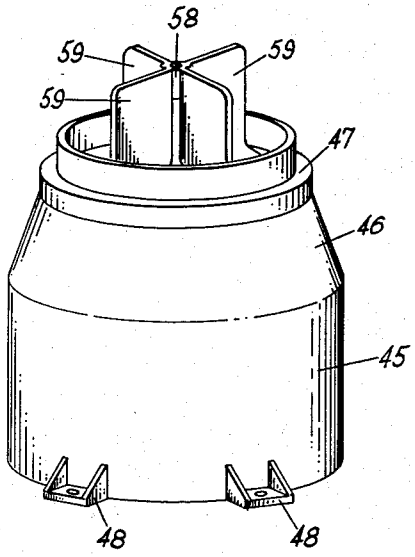


Fig. 10

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United States Patent Office

3,179,307

Patented Apr. 20, 1965

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PUMP ASSEMBLY FOR DISHWASHING MACHINES

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Filed Oct. 24, 1963, Ser. No. 318,732
11 Claims. (Cl. 222—333)

The invention has to do with dishwashing machines of a type having a vat or tub containing upper and lower racks for tableware. The invention as hereinafter described is applicable both to top opening and to side opening dishwashing machines. The upper rack will preferably be mounted so as to revolve within the vat as hereinafter explained.

The vat will have a sump on its bottom and there will be a motor mounted below the sump. The motor will drive several instrumentalities, one of which is a first pump connected to the vat through the bottom of the sump. The first pump serves two functions. When the motor is driven in one direction, the first pump operates to withdraw water from the vat and exhaust it to a drain through suitable conduit means as known in the art. When the motor is driven in the opposite direction, it also withdraws water from the vat, but through other conduit means, it delivers this water to a spraying means located within the vat and beneath the upper rack.

In the type of dishwashing machine to which this invention is addressed, the motor does not drive an impeller within the vat, but instead it drives a second pump located above the first pump and serving to feed a spray arm pivotally mounted beneath the lower rack, as will hereinafter be more fully explained.

In dishwashing machines of the type to which reference has been made, certain problems are encountered, one of these being the problem of controlling the flow of water simultaneously to the two pumps. The term water as used herein is intended to include washing solutions as well as rinse water employed in the various cycles of operation of the machine. Means for introducing water into the vat as well as detergent substances employed during washing cycles are well known in the art and do not constitute a limitation on the invention. They will not be illustrated or described herein.

One of the objects of the invention is to provide means for controlling the flow of water to the first and second pumps during washing and rinsing cycles, i.e. during such operations as occur when the first pump is delivering water to the upper spray nozzle, and the second pump is delivering water to the rotating spray arm. Under these circumstances it is desirable that each pump be supplied with all of the water which it can handle, and that both pumps deliver satisfactory flow volumes.

Another object of the invention is to control the supply of water to the first and second pumps at times when the first pump is exhausting water from the vat and delivering it to the drain. Under these circumstances it is desirable that the first pump deliver a large volume of flow, while the second pump delivers a substantially lessened volume of flow.

It is an object of the invention to provide a mechanism for the purposes described which is simple, efficient, relatively inexepnsive, not likely to get out of order, and easily disassembled and repaired.

These basic objects of the invention and ancillary objects which will be pointed out hereinafter or will be apparent to one skilled in the art upon reading these specifications, are accomplished by that certain structure and arrangement of parts of which an exemplary embodiment will now be described. Reference is made to the accompanying drawings wherein:

FIG. 1 is a vertical sectional view of an exemplary dishwashing machine of this invention.

FIG. 2 is an enlarged partial sectional view showing a portion of the vat of the machine, a portion of the motor thereof, the motor mounting, the first and second pumps, and the pivoted spray arm.

FIG. 3 is a bottom view of the housing of the first pump.

FIG. 4 is a top plan view of the first pump housing.

FIG. 5 is a plan view of a plate member serving as a cover for the first pump housing, and including anti-swirl means.

FIG. 6 is a top plan view of the impeller for the second pump.

FIGS. 7 and 8 are respectively vertical cross section and top plan view of a device located above the second pump and conveniently termed a diffuser.

FIGS. 9 and 10 are respectively a vertical cross sectional view and a perspective view of a housing surrounding the diffuser and serving to mount the rotating spray arm.

Referring first to FIG. 1 there is shown an exemplary form of the dishwasher of this invention, comprising a housing **1** containing a vat **2**. The vat has a sump generally indicated at **3**. Within the vat there is a lower rack for tableware shown at **4**, and an upper rack shown at **5**. The lower rack may be supported within the vat by means of legs **6** so that the bottom of the rack lies substantially above the sump. This is a construction appropriate to top opening dishwashers such as the one illustrated in FIG. 1, which has a lid **7**. In side opening dishwashers, as equally well known in the art, the lower rack **4** may be provided with rollers or casters so that it may be drawn out of the vat and over the door of the dishwasher for loading and unloading.

As previously indicated, the upper rack **5** is preferably mounted for rotation. This may be done on separate supporting means as in Patent No. 2,799,285, or, as illustrated in FIG. 1, it may be mounted on an upwardly projecting central portion **8** of the lower rack. In a top opening dishwasher the upper rack will either be removable by lifting, or it may have hinged portions as illustrated in Patent No. 3,035,706.

There is also shown in FIG. 1 a motor **9** the armature shaft of which drives a double pump assembly indicated generally at **10**. One of the outlets of the lower pump of this assembly is connected by a conduit **11** to a spray tube **12** located within the vat and beneath the upper tableware rack. It will be understood that the spray tube **12** has openings in its upper surface to direct water delivered to it against the tableware in the upper rack, and that some at least of these openings have a directional affect such that the jets delivered by them, impinging on the tableware in the upper rack, will cause the upper rack to rotate. The spray tube **12** may also have certain openings in its lower surface to direct one or more jets of water against silverware contained in a basket or like structure **13** forming essentially a part of the lower rack.

There is also shown in FIG. 1 a rotating spray arm **14** to which water will be delivered by the pump assembly in a way hereinafter more fully explained. The spray arm has openings in its upper surface to direct jets of water against tableware held in the lower rack. Certain of these jets are directed at an angle other than the vertical so that, by reaction, the spray arm **14** is caused to rotate beneath the lower tableware rack **4**.

Referring now to FIG. 2, the motor **9** has a driven shaft **15** extending upwardly through the bottom of the sump **3**. A fixture generally indicated at **16** has a central hollow portion **17** which serves as a housing for the lower pump. The fixture (hereinafter referred to for convenience as the lower pump housing) is fastened to the sump

bottom wall by a series of bolts 18. A seal is effected between the sump bottom wall and the pump housing by means of an O-ring 19.

The specific nature of the pump housing will hereinafter be more fully outlined; but it will be apparent from FIG. 2 that the pump housing 16 has a plurality of depending legs 20 to which the housing of the motor 9 may be fastened by means of bolts or screws 21. The motor may thus be mounted to the sump, and needs no other support.

The hollow interior 17 of the pump housing has a central downward extension adapted to hold a seal 22 surrounding the motor shaft 15. This seal may be of any conventional form, and its object is to prevent leakage of water from the pump housing downwardly around the motor shaft. The motor shaft may have affixed to it a water slinger disc 23 which, rotating with the shaft, will serve to flow laterally any water which may get past the seal. A water deflecting cap 24 for the motor housing, may be engaged between the housing and the legs 20 as shown.

The motor shaft 15 drives an impeller 25 for the first pump, as more fully described later.

FIGS. 3 and 4 are respectively bottom and top views of the first pump housing. It will be seen in FIG. 3 that the housing fixture is a circular member having a top of plate-like configuration at its periphery, excepting for the legs 20, certain lug-like members 26 intermediate the legs, and perforated and threaded for the reception of more of the bolts 18, and excepting for some thickening webs 27, which may be drilled and tapped for the receipt of bolts hereinafter described. FIG. 3 also shows the outer surface of the seal-receiving depression 22*a*, and the larger pump housing depression 17*a*. It will also be noted that two hollow outlet members, to which conduits may be attached, are connected with the portion 17*a*. The somewhat larger member 29 will be connected by the conduit 11 shown in FIG. 1 with the spray tube 12 in that figure. The other outlet member 28 will be connected by a conduit (not shown) with the drain.

The rotor or impeller 25, later described in more detail, has a plurality of radially extending vanes and acts as a centrifugal impeller when the pump is in operation. Reference to FIG. 4, in which like parts are given like index numerals, will indicate the configuration of the hollow interior 17 of the pump housing. For the most part, the portion 17 has a circular periphery; but adjacent the outlet member 29 there is an interior shoulder 30, and adjacent the outlet member 28 there is an arcuate wall 31 spaced from the interior periphery of the member 17 and providing a passageway 32. The diameter of the impeller, 25, is such that there is a minimum clearance effected between it and the wall 33 formed between 30 and 31. While the impeller itself is not shown in FIG. 4, it will be understood that when the impeller is rotating in the counterclockwise direction, the water trapped between the straight vanes of the impeller and the wall 33 will be rotated at the same rate as the impeller; thus, this portion of the water will pass the end of the arcuate wall 31 at such a velocity as to cause a negative air pressure in the passageway 32. This is sometimes referred to as "aspiration." As this water is thrown outwardly by centrifugal force upon leaving the confines of the wall 31, its velocity head is converted to a pressure head, as is common to the principle of centrifugal pumps. This pressure head then forces the water out outlet 29. Since there is relatively little pressure head generated in the area of the entrance to passageway 32, and since the air pressure in the passageway 32 is less than atmospheric, due to the aforementioned aspiration effect, negligible water is lost through outlet 28 when the impeller is rotated in the counterclockwise direction. The straight vanes, although less efficient than the curved ones used on the second impeller as at 54, are necessary for the aspiration effect in that the trapped water referred to above,

is carried past the opening to the passageway 32, and not forced into it as would be the result of tangential flow off the ends of the curved vanes. It should be understood that there is a definite and precise balance necessary between the size and shape of the openings into and from the pump housing in order for the system to function as desired. The motor which drives the lower pump is reversible. Upon reversal of the motor 9, the impeller rotates in a clockwise direction and the water will again be thrown outwardly with creation of a pressure head. The rotation of the water plus the pressure head created will force the water out the passageway 32 and thus into the oulet 28.

FIG. 4 shows at 34 a circular groove for the reception of the O-ring 19.

The impeller 25 (as indicated in FIG. 2) has an upwardly extending hub 35. Throughout the greater portion of its length this hub has a central hollow of sufficient diameter to accept the shaft 15; and the impeller is fixed to the shaft so as to be rotated thereby in any suitable way but preferably by a spline 36. The upper end of the hub 35 has a smaller bore to accept a bolt 37 threaded into a capped opening on the end of the motor shaft 15. This bolt is used to hold in place the impeller of the upper or second pump, later to be described. It may be noted, however, that the extreme upper end of the hub 35 has a configuration such as to effect a non-rotative connection with a hub on the upper impeller, and that an O-ring 38 may be used as a seal. The vanes of the impeller of the first pump are straight and radially disposed, there being a sufficient number of the vanes for efficient operation.

The housing for the first pump is closed on its upper side by a plate indicated at 39. There is certain structure attached to and supported by the plate outside the first pump. This structure will later be described. It is sufficient at this point to call attention to the fact that the plate 39 has a central opening substanially larger than the hub 35 of the first pump impeller, and that the edges of the plate are turned downwardly as at 40 forming a flange. This flange not only helps to guide water into the first pump from the space above it, but also tends to retain water in the pump cavity during the operation of the pump.

Various structural members lie above the first pump and are entirely supported by the first pump housing member 16. These elements include the heretofore mentioned plate and its appurtenances, a spacing member having deflecting surfaces, a housing for the second or upper pump which also serves as a support for a diffuser and a support for the rotating spray arm 14. These elements will now be described in order.

Still referring to FIG. 2, the spacing member comprises a horizontal platform portion with spaced depending legs 43. On its upper surface the platform portion of the spacer has an annular arcuate surface 44 the purpose of which will later be described.

There is a hollow member, hereinafter called for convenience the housing of the upper pump, which is best shown in FIGS. 9 and 10. This housing member has a cylindrical body portion 45, surmounted by a tapered or conical portion 46. The upper end of the portion 46 is stepped as shown at 47. The cylindrical portion of the housing, 45, is provided at its lower end with certain radially disposed foot portions 48 which correspond in spacing to the legs 43 on the platform member 42 of the spacer. It can be seen in FIG. 2 how these various members including the plate 39 are held to the housing 16 of the first pump by elongated bolts 49. The bolts 49 are engaged in threaded recesses 50 (FIG. 4), passing partially through the webs 27.

The platform member 42 of the spacer has a central opening 51, and it will now be appreciated, by reference to FIG. 2, that water from the sump 3 enters the space between the first and second pumps by passing between

the legs 43 of the spacer member. Some of the water may pass downwardly into the first pump through the opening surrounded by the flange 40 in the plate 39. Another portion of the water may pass upwardly through the opening 51 in the spacer member so as to enter the second pump.

The impeller for the second pump is shown in vertical section in FIG. 2 and in plan in FIG. 6. It has a disc-like body 52, a depending central hub 53, already mentioned, and shaped to have a non-rotative connection with the hub portion 35 of the first pump impeller. It also is characterized by peripheral depending vanes 54 lying generally opposite the arcuate surface 44 of the spacer member. The impeller of the second pump also has a centrifugal action; but its vanes 54 are curved in configuration, as shown. This makes the impeller of FIG. 6 much more efficient in its centrifugal action when turning in a counterclockwise direction as viewed from above. It is substantially less efficient as a centrifugal pump when turning in the clockwise direction; and since this direction corresponds with the direction of rotation of the impeller 25 of the first pump during the operation of emptying the vat, it will be seen that the second pump of the device of this invention will tend to accept less water during a draining operation. During a washing or rinsing operation when the second pump will be delivering water to the rotating spray arm and the first pump will be delivering water through the conduit 11 to the spray nozzle 12 in the vat, the capacity of the second pump will be much greater.

Water moved in the centrifugal direction by the impeller of the second pump will be deflected or diverted by the arcuate surface 44 of the spacer member so as to tend to move upwardly or in an axial direction within the housing portion 45. The water as so moved will tend to have a circular or swirling motion which is undesirable. To correct the flow of the water delivered by the second pump, use is made of a diffuser next to be described. Reference is made to FIGS. 7 and 8 wherein it will be seen that the diffuser has a generally tapering hollow body portion terminating upwardly in a hollow neck portion 56. Vanes 57 are formed on the outer surface of the diffuser, and as can be seen in FIG. 8, these vanes are preferably curved at least at their bottom portions. The water from the second pump passes upwardly between the housing member and the outer portion of the body of the diffuser. The vanes of the diffuser minimize or eliminate the swirl of the water prior to the entry of the water into the tapering hollow body portion of the housing to prevent the substantial pressure loss which occurs when rapidly rotating fluid is forced into a converging cone.

FIGS. 9 and 10 show that above the top of the second pump housing member there is a short hollow hub 58 supported from the housing member by four straight vanes 59, forming a spider. The diffuser is mounted to this hub by means of a bolt 60 passing through the hollow neck 56 of the diffuser and through the hub 58, and held in place by a nut 61. The rotating spray arm 14 is conveniently formed from two stamped hollow sheet metal members with lateral flange portions on either side, one set of such portions being shown at 62 in FIG. 2. The flange portions may be crimped or otherwise fastened together to form the hollow spray arm closed at its ends; and it will be understood that the spray arm on its upper surface will have openings to form jets for washing the tableware in the lower rack and for rotating the spray arm as previously described. The upper member of the spray arm is formed with a small flanged opening 63 at its center which has a bearing on a bushing or sleeve 64 placed over the extending upper end of the bolt 60, and held in place by a knurled or otherwise easily removable nut 65. The lower member of the rotating spray arm 14 may be provided with a larger flanged opening 66 capable of riding in but not on the step 47 formed at the outer top surface of the second pump housing member.

Various parts of the apparatus thus far described may be made in various ways from various materials. Where substantial strength is a necessity, as in the first pump housing, a casting of steel or light metal is preferably employed. Other parts such as the first pump impeller 25, the spacer member, the second pump impeller and the diffuser may be made of metal die castings or even from suitably strong molded plastics. The second pump housing, which again may be made either of die cast metal or of plastic, preferably has the vanes 59 and the hub 58 formed integrally therewith. The external dimensions of the diffuser vanes are preferably such that the diffuser has a tight fit within the second pump housing, since rotation is not desired.

Where a centrifugal pump such as the first pump of this invention receives water from an opening in the sump of a dishwasher vat, it has hitherto been suggested that the swirling action which might interfere with the proper feeding of the pump be overcome by the use of a substantial number of radially disposed anti-swirl vanes. It has already been explained hereinabove how the water for both the first and second pumps enters the spaces between them; but it has been ascertained in connection with this invention that the swirling is primarily caused by contact of the water in the sump with the rotating hub of the first pump impeller. It has further been found that swirling can be effectively minimized by keeping the water away from the hub or any similar rotating part. Anti-swirl means are provided in connection with the plate 39 of this invention; but as shown in FIG. 5, the anti-swirl means consist primarily in a non-rotating and stationary collar or sleeve 67 which surrounds but does not touch the hub 35 of the first pump impeller. The collar 67 is held in place most conveniently by a pair of vanes 68 and 69 which have foot portions 70 and 71 respectively, spot welded or otherwise attached to the plate 39. The collar 67 may be a separate member but is most conveniently and cheaply formed from end portions of the vanes themselves as shown in FIG. 5. The curved portions of the vanes have end flanges 72 and 73 which are spot welded to the opposite vanes.

A wire ring 74 is welded or otherwise attached to the tops of the vanes 68 and 69 near the collar 67. This ring, as will be apparent from FIG. 2, is so positioned as to lie substantially within the opening 51 of the spacer member; but it is smaller in dimensions than the opening. It serves the function of limitating the particle size of the foreign material that can enter into the second pump.

Since the second pump feeds the rotating spray arm and since some pieces of relatively soft food materials are likely to find their way into a dishwashing machine, it is generally advisable to provide in connection with the second pump some means for macerating such pieces of soft material as might otherwise tend to clog the openings in the spray arm. Although rotating parts are available in the structure of this invention, it is not desirable to cause them to operate against or adjacent each other with a shearing action. It has been found sufficient to provide in connection with the impeller of the second pump a knife-like device which, rotating with the impeller at high speed, but freely within the stream of moving water, will serve a macerating function. Such an element is illustrated in FIG. 6 as having an elongated body 75 with diminished end portions 76 and 77. The body is perforated for the passage of the bolt 37. The knife-like member has a total length greater than the diameter of the disc-like portion 52 of the impeller, so that its ends projects therebeyond, but such that the total length of the member 75 is just less than the inside diameter of the housing 45. The diminished ends 76 and 77 lie beyond raised abutments 79, 80, 81 and 82 formed in the top of the impeller so that rotation of the member 75 with the impeller is assured. The projecting end portions of the member are preferably sharpened as at 76*a*.

Modifications may be made in the invention without departing from the spirit of it. The invention having been described in an exemplary embodiment, what is claimed as new and desired to be secured by Letters Patent is:

1. A pump combination for use in a dishwashing machine of the type having a vat with a sump, the sump having a floor with an opening therein, the said combination comprising a first pump located beneath the floor of the sump, said first pump having a housing attached to said floor about the opening therein, a second pump located above the floor of said sump, the said second pump having a housing comprising a platform member with a central opening, and depending legs attached to the housing of the first pump, said depending legs providing a single space between the said two pumps above the floor of the sump through which water is delivered to both pumps, both of said pumps having centrifugally acting impellers, a motor depending from the housing of the first pump and having a shaft connected to the impellers of both pumps, the said second pump having an upwardly elongated housing connected with the said platform member, means within the said housing of the second pump for converting the centrifugal flow of water produced by the impeller thereof to an upwardly directed axial flow through said housing, plate-like means with an opening for admitting water to the first pump and forming part of the housing thereof, and means within the space between the two pumps for preventing a swirling action of the water entering said space and feeding both pumps, the said last mentioned means comprising a stationary sleeve surrounding the said motor shaft as it passes through said space from the first pump to the second pump.

2. The structure claimed in claim 1 wherein the said housing for said second pump contains a diffuser having a body portion with external vanes lying between the said body portion and the interior surface of said housing and serving to minimize a rotating flow of said water in said housing.

3. The structure claimed in claim 2 wherein said platform member has a means extending upwardly into the said elongated housing for the second pump and providing a deflecting means for converting the centrifugal flow of water from the impeller of said second pump to the axial flow within said housing.

4. The structure claimed in claim 3 wherein said stationary sleeve is supported on said plate by at least one vane attached to said plate and extending in a radial direction within said space.

5. The structure claimed in claim 4 including a ring element supported with respect to said plate and lying substantially within the opening to the said second pump.

6. The structure claimed in claim 1 wherein the motor is reversible, and wherein the impeller of the said second pump comprises a disc-like element with depending vanes on its underside.

7. The structure claimed in claim 6 wherein the said centrifugal impeller of the said second pump has vanes which curve out of a radial direction, whereby the said impeller is more efficient as a centrifugal impeller when rotating in one direction than in another.

8. The structure claimed in claim 7 wherein said first pump is a reversible pump acting when its impeller rotates in one direction to deliver water from said sump to an elevated point in said vat, and acting when its impeller rotates in the opposite direction to deliver water from said sump to a drain, and wherein the most efficient direction of operation of the impeller of said second pump coincides with that direction of operation of the impeller of the first pump which delivers water to said spray tube, and vice versa.

9. The structure claimed in claim 6 wherein the said first pump housing has a circular hollow to accommodate the centrifugal impeller, said hollow portion being of a larger diameter than the impeller except for a portion thereof which is stepped inwardly to form a projection in proximity to the ends of the vanes of said impeller, such proximity serving to define the water between the vanes of the impeller and the projection for a part of each rotation, said projection having an arcuate extension at one end, said extension being spaced from the periphery of the normal diameter of the hollow in said housing to form a wall, so that rotation of the impeller in the direction approaching this wall, forces water behind the wall and into an outlet, and so that when the impeller is rotated in the opposite direction, the water being carried past the said wall produces aspiration for a reduction in pressure in the said space.

10. The structure claimed in claim 9 wherein the said first pump impeller has straight vanes extending radially from the center of said impeller.

11. The structure claimed in claim 1 including knife-like means attached to the impeller of said second pump, said means to be rotated by the impeller in the axial flow of water produced by said pump.

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