Jan. 23, 1968 J. G. SCHMITT-MATZEN 3,364,860

COMBINED RECIRCULATING AND DRAIN PUMP CONSTRUCTION

Filed Sept. 1, 1966 6 Sheets-Sheet 1

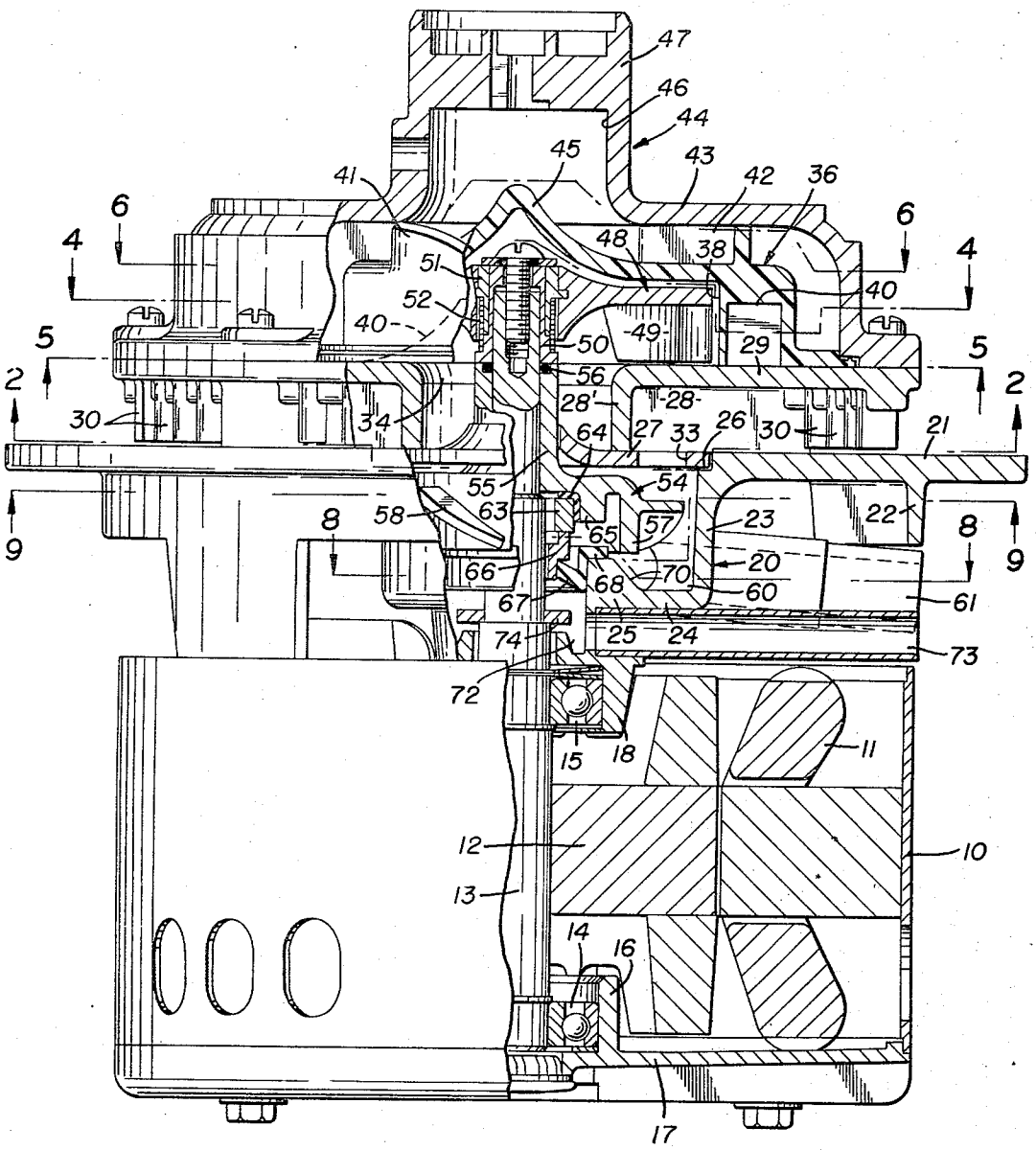


FIG. 1

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Filed Sept. 1, 1966 6 Sheets-Sheet 2

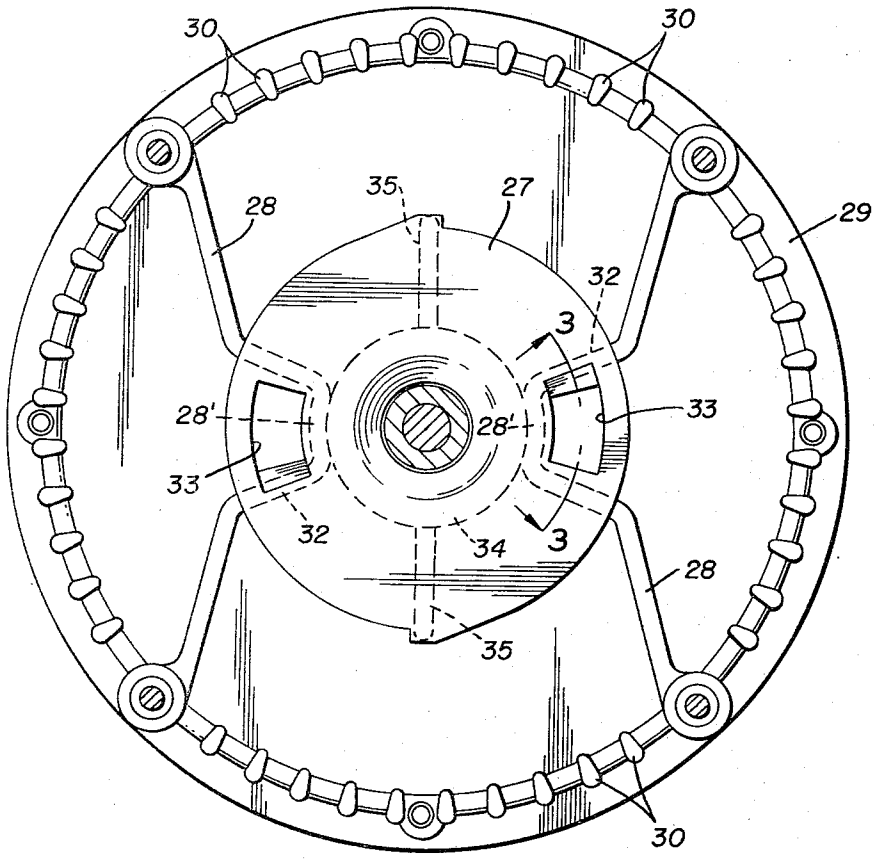


FIG. 2

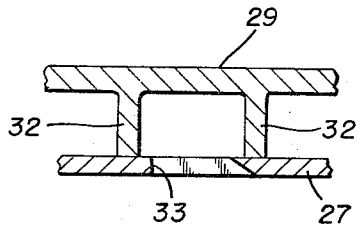


FIG. 3

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Jan. 23, 1968 J. G. SCHMITT-MATZEN 3,364,860

COMBINED RECIRCULATING AND DRAIN PUMP CONSTRUCTION

Filed Sept. 1, 1966 6 Sheets-Sheet 3

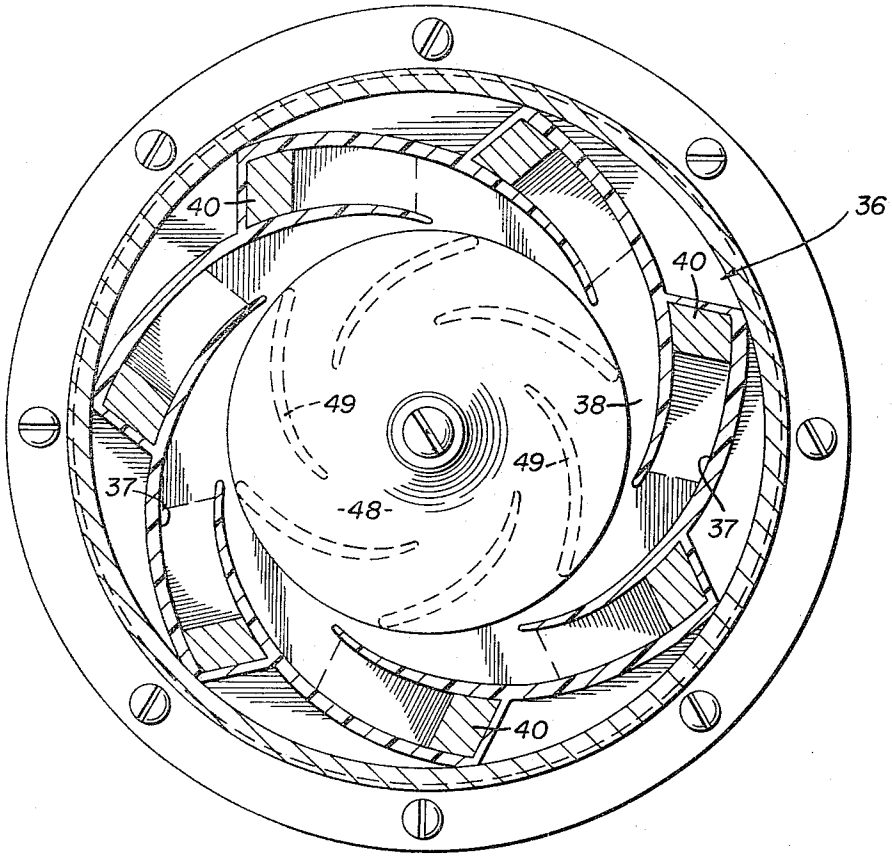


FIG. 4

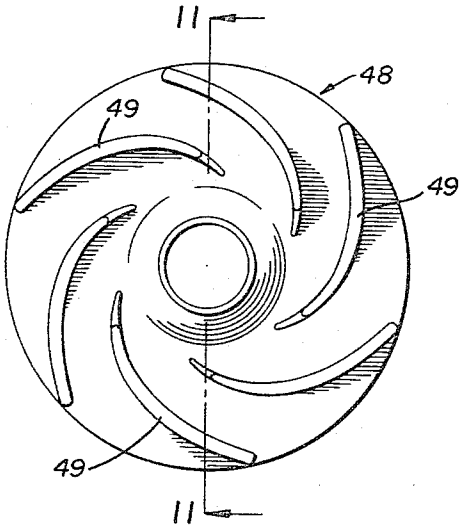


FIG. 10

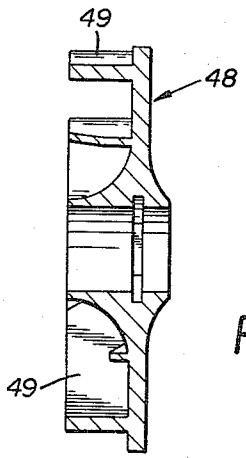


FIG. 11

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Jan. 23, 1968 J. G. SCHMITT-MATZEN 3,364,860

COMBINED RECIRCULATING AND DRAIN PUMP CONSTRUCTION

Filed Sept. 1, 1966 6 Sheets-Sheet 4

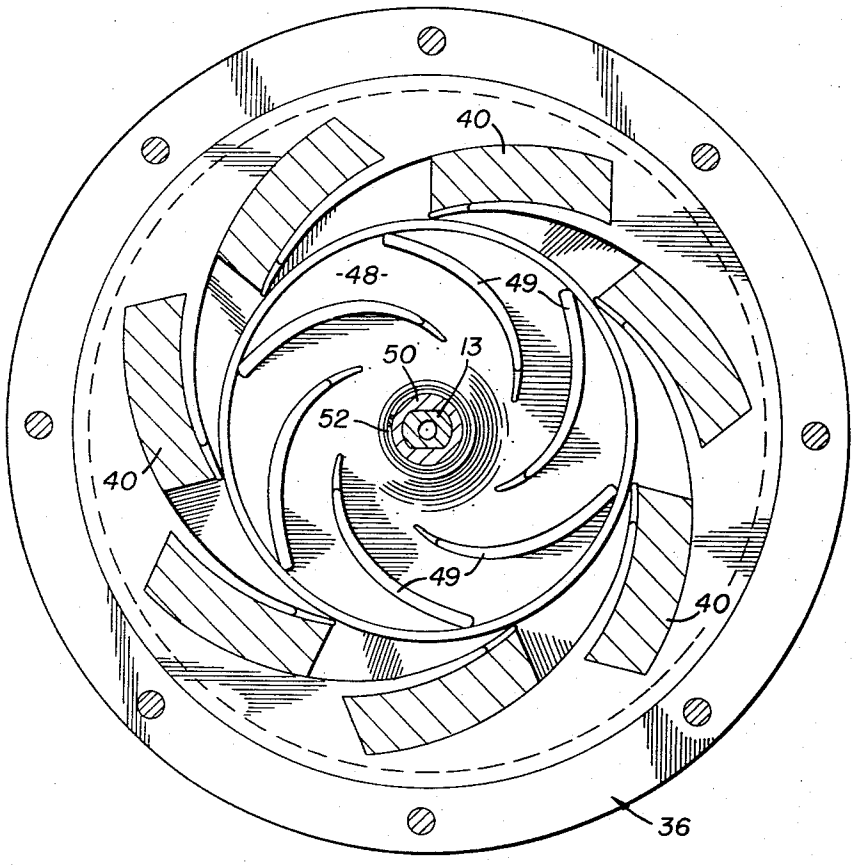


FIG. 5

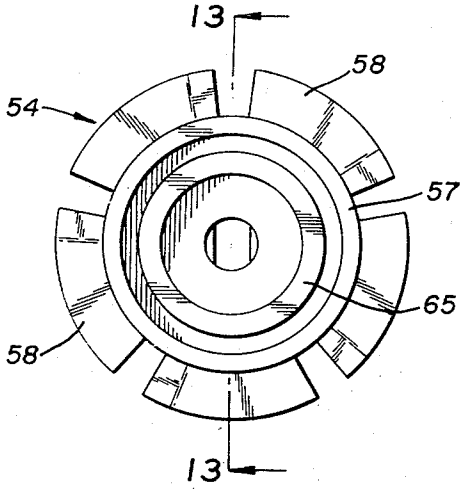


FIG. 12

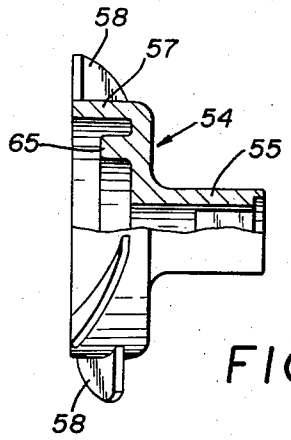


FIG. 13

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Jan. 23, 1968 J. G. SCHMITT-MATZEN 3,364,860

COMBINED RECIRCULATING AND DRAIN PUMP CONSTRUCTION

Filed Sept. 1, 1966 6 Sheets-Sheet 5

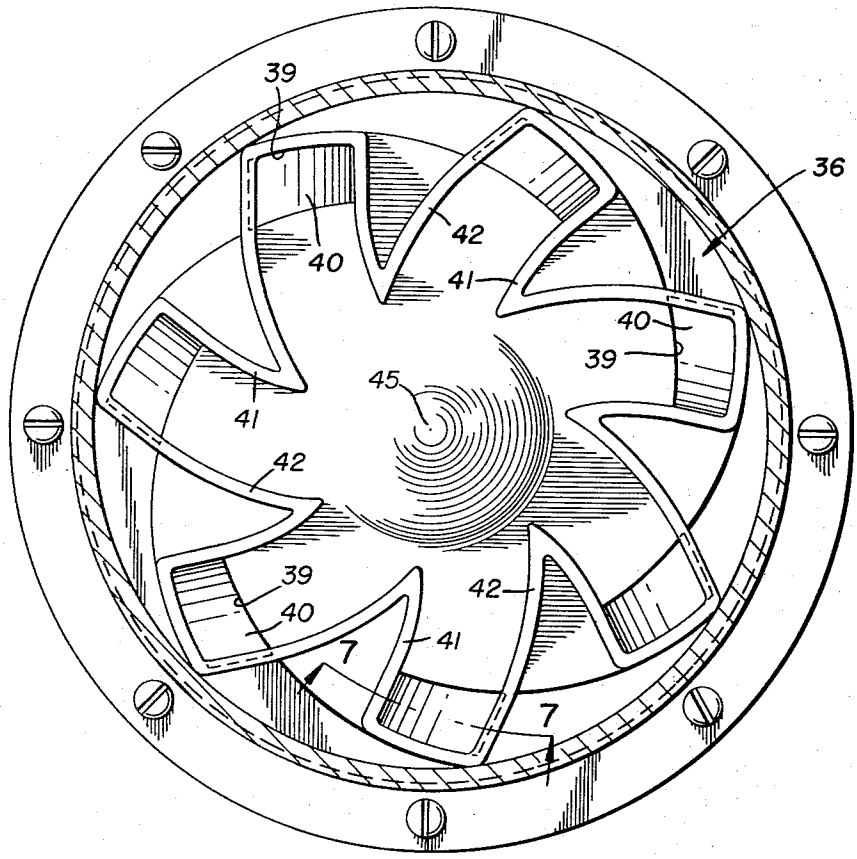


FIG. 6

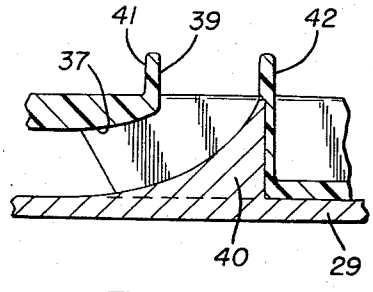


FIG. 7

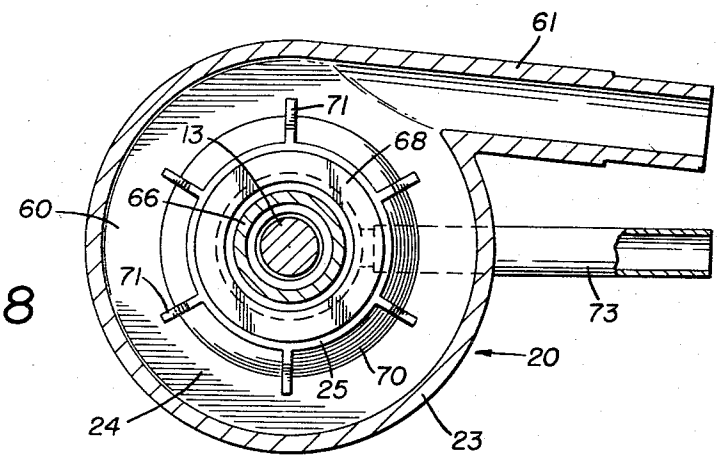
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COMBINED RECIRCULATING AND DRAIN PUMP CONSTRUCTION

Filed Sept. 1, 1966 6 Sheets-Sheet 6

FIG. 8



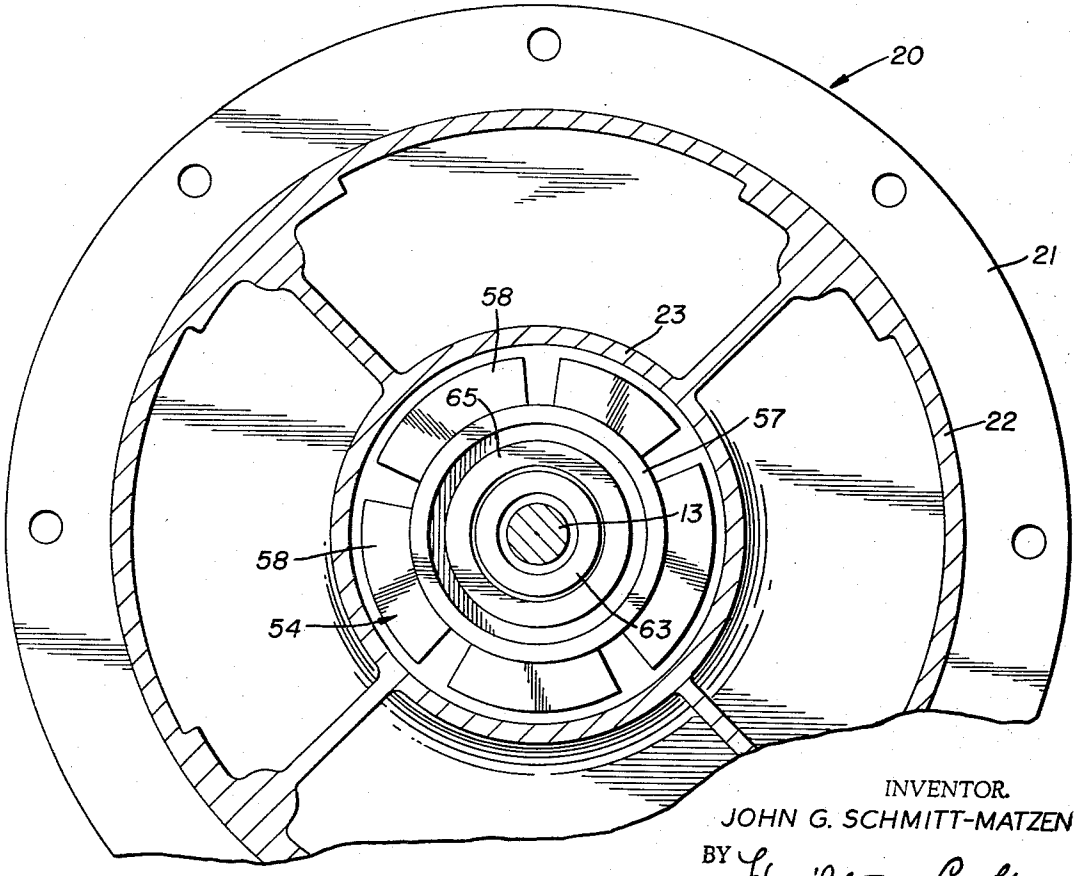


FIG. 9

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United States Patent Office

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Patented Jan. 23, 1968

3,364,860

COMBINED RECIRCULATING AND DRAIN PUMP CONSTRUCTION

John G. Schmitt-Matzen, Bellville, Ohio, assignor to Gorman-Rupp Industries, Inc., Bellville, Ohio, a corporation of Ohio

Filed Sept. 1, 1966, Ser. No. 576,568
12 Claims. (Cl. 103—3)

The invention relates generally to recirculating and drain pumps for dishwashers and the like having a washing cycle during which water is recirculated for spraying or washing articles confined in a receptacle, and a drain cycle during which the water containing the removed particles is discharged to waste. More particularly, the invention relates to a combined recirculating and drain pump unit which recirculates when rotated in one direction and drains when rotated in the opposite direction.

Certain conventional dishwashers have independently driven recirculating and drain pumps requiring separate power drive and control valves for directing the flow during the recirculating and drain cycles. It has been proposed to mount the recirculating and drain impellers on the same shaft and thus eliminate one power drive, but in such constructions difficulties were encountered in separating flow during the cycles, and the drain impeller accomplished a certain amount of pumping during the recirculating cycle, tending to suck air and siphon food particles from the drain line back into the recirculating water. In one such prior construction, the discharge passage from the drain pump is connected to an air vent tube projecting above the water level in the washing receptacle to break the suction, but the tube tends to become covered or clogged.

It is an object of the present invention to provide a novel and improved recirculating and drain pump construction which has recirculating and drain impellers mounted on the same drive shaft for recirculating in one direction of rotation and draining in the opposite direction.

Another object is to provide an improved combined recirculating and drain pump construction which overcomes the difficulties of prior constructions.

A further object is to provide an improved combined recirculating and drain pump construction having an improved channeling arrangement for separating the suction to the recirculating impeller from the suction to drain impeller.

Another object is to provide an improved combined recirculating and drain pump construction having an axial flow drain impeller cooperating with a suction port arrangement to regulate flow to drain when rotated in one direction.

A further object is to provide a novel combined drain pump construction having an axial flow impeller cooperating with a centrifugal discharge cavity to augment the flow to drain when rotated in one direction and a substantially nullify flow when rotated in the opposite direction.

A still further object is to provide a novel combined drain pump construction which enables control during the recirculating cycle of the static discharge pressure in the drain line to prevent sucking air and siphoning impurities into the recirculating water, as well as to prevent interfering with suction to the recirculating impeller.

Still another object is to provide a novel combined drain pump construction which regulates flow through the discharge to prevent splashing at the outlet and also to prevent completely draining before the end of the drain cycle causing the shaft seal to run dry and deteriorate.

These and other objects which will become apparent from the specification are accomplished by the parts, improvements, constructions and combinations comprising the present invention, a preferred embodiment of which is disclosed by way of example in the accompanying drawings and specification and defined in the appended claims. Various modifications and variations in details of construction are comprehended within the scope of the claims.

In the drawings:

FIG. 1 is a vertical sectional view, partly in elevation, of a preferred embodiment of the improved combined recirculating and drain pump construction.

FIG. 2 is a cross section on line 2—2 of FIG. 1 looking upward in the direction of the arrows.

FIG. 3 is a fragmentary cross section on line 3—3 of FIG. 2.

FIGS. 4, 5 and 6 are horizontal cross-sectional views taken on the lines 4—4, 5—5 and 6—6 of FIG. 1.

FIG. 7 is a fragmentary sectioinal view taken on line 7—7 of FIG. 6.

FIG. 8 is a horizontal sectional view taken on line 8—8 of FIG. 1.

FIG. 9 is a horizontal sectional view taken on line 9—9 of FIG. 1.

FIG. 10 is a detached bottom plan view of the recirculating impeller shown in cross section in FIG. 4.

FIG. 11 is a sectional view on line 11—11 of FIG. 10.

FIG. 12 is a detached bottom plan view of the drain impeller.

FIG. 13 is a cross-sectional view on line 13—13 of FIG. 12.

The combined recirculating and drain pump construction is preferably embodied in a unit adapted for fitting within the usual sump in the bottom of a dishwasher tube and has separated suction inlet channels, one leading from the sump to the suction of an upper recirculating impeller for forcing water upwardly to a suitable spray device within the tub, and the other to a lower drain impeller for pumping water from the sump to discharge during the drain cycle. The two impellers are mounted on the same vertical shaft which is driven by an electric motor in the bottom of the unit. A perforated inlet plate regulates the suction to the drain impeller and cooperates therewith to prevent draining during the recirculating cycle, and a centrifugal discharge cavity below the drain impeller augments the pumping action during the drain cycle and nullifies it during the recirculating cycle.

Referring to the drawings, the unit shown in FIG. 1 has a bottom housing 10 enclosing a conventional electric drive motor having a stator coil 11 and a rotor 12. The rotor 12 is secured on a vertical drive shaft 13 journaled in lower and upper anti-friction bearings 14 and 15, respectively. The bearing 14 is mounted between the shaft 13 and an annular flange 16 projecting upwardly from the bottom wall 17 of the housing. The bearing 15 is mounted between the shaft 13 and an annular flange 18 projecting downwardly into the housing 10 from the hub of a drain pump housing member surrounding the shaft and indicated as a whole at 20 (FIGS. 8 and 9).

The pump housing 20 has a top plate 21 having a depending tapered skirt flange 22 for fitting within the usual bottom opening of the dishwasher tub (not shown). The perforated outer rim portion of the plate 21 is adapted to overlap and be secured to the tub bottom wall with suitable gasket means between the rim and tub, in a usual manner.

The drain pump housing member has an annular wall 23 depending from plate 21 and connecting with a radially inwardly directed wall 24 which joins the hub 25 from

which annular flange 18 depends. At the top of annular wall 23 is an annular shoulder 26 on which is seated the outer rim of a drain inlet plate 27 forming the top wall of the pump housing chamber defined by annular wall 23 and bottom wall 24.

Resting on the inlet plate 27 are the bottom ribs 28 of a suction guide plate 29 having a circumferential series of spaced fingers 30 depending from its outer rim and providing a coarse strainer for large pieces of foreign matter in the tub. The shape and arrangement of the guide ribs 28 is shown in FIG. 2, the drain inlet plate 27 being shown in proper superimposed relation thereon.

The ribs 28 comprise a pair of diametrically opposed wing-shaped ribs each having an inner pocket formed by the bridge portion 28' connecting the angular portions 32. The pockets register with two diametrically opposite substantially rectangular ports 33 in the inlet plate 27. Thus, water from the outer rim of plate 29 is guided by ribs 28 in two channels inwardly to the ports 33 leading downward to the drain pump chamber, and between the two ribs 28 it is guided inwardly to the central opening 34 which is the suction inlet to the upper circulating pump chamber above plate 29. Diametrically opposite radial ribs 35 divide the flow into the opening 34.

The separation by ribs 28 of the flow to the drain suction ports 33 and to the recirculating suction 34 facilitates the use of different mesh screens for the two suction inlets, if desired. Thus, coarse screens can be positioned between the ribs to screen the channels leading to ports 33 and relatively fine screens to screen the channels leading to port 34.

The bottom wall of the circulating pump chamber is formed by plate 29, and a diffuser plate indicated as a whole at 36 rests on the top of plate 29 and completes the formation of the circulating chamber. As shown in FIG. 4, the diffuser plate 36 has a circumferential series of tangential discharge channels 37 leading outwardly from the central impeller housing 38, and the channels connect at their outer ends with upwardly directed, substantially rectangular outlet ports 39 (FIGS. 6 and 7.)

Preferably, upwardly curved spaced deflector projections 40 (FIGS. 4, 5 and 7) are formed on the upper surface of guide plate 29 for fitting into the discharge channels 37, so that water impelled into the channels is gradually deflected and directed upwardly and discharges in an axial direction through the ports 39. As shown in FIGS. 1 and 6, the discharge from the ports 39 is guided inwardly toward the central portion of the diffuser plate by spirally curved ribs 41 and 42, each pair of ribs fitting against the top wall 43 of an upper discharge housing indicated generally at 44 and forming a channel from a port 39 leading to and merging into a central cone 45 which projects upwardly into the axial discharge port 46 of the discharge housing 43. The upper end of the hub 47 surrounding discharge port 46 is adapted for connection with a suitable spraying or washing device (not shown).

The recirculating impeller 48 (FIGS. 4, 10 and 11) is a centrifugal impeller having a plurality of spiral ribs 49 for impelling flow outwardly into the discharge channels 37 formed in the diffuser plate 36. The hub of impeller 48 is mounted on the upper end of shaft 13. Preferably, a spring clutch is interposed between the shaft 13 and the impeller 48 so that when the shaft rotates in the normal pumping direction (counterclockwise looking down on the shaft) it will drive the impeller in that direction, and when the shaft is rotated in the opposite direction it allows the impeller to slip on the shaft and not rotate. This is desirable so that during the drain cycle the impeller 48 will not create noise when running in a reverse direction and cause some inefficient recirculating action, although this action is not harmful if the clutch is omitted.

The clutch parts are shown in cross section in FIG. 1, part 50 being keyed on shaft 13 and part 51 being journaled on part 50 and secured to impeller 48. Surrounding part 51 is a coil spring 52 having its lower end secured to part 50, so that when part 50 is rotated counterclockwise the spring tightens and drives part 51, and when part 50 rotates clockwise the spring loosens and rotates on part 51, allowing it to remain stationary.

The drain pump impeller 54, located within the drain pump chamber wall 23 and below the inlet plate 27, has an elongated hub 55 splined to shaft 13 and having its upper end abutting the lower end of clutch part 50. An O-ring 56 may be interposed between hub 55 and clutch member 50 to prevent water from getting in to the shaft. The lower cup-shaped flange 57 on impeller 54 has a circumferential series spaced angular vanes 58 extending outwardly therefrom similarly to the vanes on a well-known type of axial flow impeller (FIGS. 12 and 13).

The vanes 58 are angled to cause axial flow from inlet ports 33 downwardly when impeller 54 is rotated clockwise as viewed looking down on shaft 13. The axial flow is directed downwardly into an annular cavity 60 formed at the bottom of the drain pump chamber by annular wall 23 and bottom wall 24. As best shown in FIG. 8, a tangential discharge outlet 61 projects outwardly from annular cavity 60 and is adapted at its outer end for connection with a hose or conduit.

As the impeller 54 rotates clockwise, the blades passing under the inlet ports 33 successively pull liquid through the ports and direct it axially downward in a rotating cylindrical mass. The trailing edges of the inlet ports 33 are preferably beveled as shown in FIGS. 2 and 3, to aid in inducing downward flow through the ports.

Now, as the rotating cylindrical mass of liquid is received in the annular cavity 60 and whirls therein to be discharged out of the tangential outlet 61, the circular discharging motion in the cavity augments the axial rotating flow induced by the vanes 58 of the impeller. In other words, the vanes induce flow in an axial direction into the annular cavity 60 where a centrifugal flow is created by the centrifugal effect of the rotating vanes.

The restricted inlets 33 serve to regulate flow through the impeller and out through outlet 61 to prevent splashing at the outer end of the drain conduit, and also to prevent draining all the liquid from the tub before the timed drain cycle has finished thereby causing the shaft seals to run dry and deteriorate.

The shaft seals comprise a ceramic ring 63 (FIG. 1) mounted in a rubber cup ring 64 within the ring flange 65 on the underside of the impeller, and a carbon ring 66 abutting ring 63 and mounted in the hub 25 of the pump housing and surrounding shaft 13. The seal ring 66 is mounted in a resilient annular leg 67 of a rubber gasket 68 seated in hub 25, so that the seal ring 66 is resiliently held in sliding contact with ceramic ring 63. The liquid in the drain impeller chamber has access to the seal assembly around the impeller flange 57 so as to keep the seals cool and wet, and prolong their life.

The inner annular surface of the cavity 60 is beveled or inclined as shown at 70, and is preferably provided with spaced radially disposed ribs 71 (FIG. 8). The ribs 71 aid in cooling the shaft seals by directing water into the seal area. In addition, the ribs provide a limited resistance to circular flow in the cavity 60 which helps to control the static discharge head which is desirably maintained in the impeller chamber during the washing cycle, as will hereinafter be described.

Below the seal assembly an annular drip chamber 72 (FIG. 1) is provided for collecting any seepage from the seal assembly, and a discharge tube 73 extends outwardly therefrom. A slinger ring 74 is preferably carried on the shaft within the drip chamber to throw seepage outwardly from the shaft into the chamber.

Now, when the drain impeller is rotated counterclockwise during the washing cycle, the blades 58 passing under the inlet ports 33 tend to induce some flow upwardly through the ports rather than to suck liquid downwardly as when rotated in the opposite direction. This reverse flow is restrained to some extent by the restricted ports 33 but would of itself cause a negative pressure in the

drain line and tend to suck in air or siphon impurities, and might also create some slight turbulence at the inlet to the washing impeller which could interfere with the suction intake thereto.

However, this tendency of reverse flow is counterbalanced or nullified by the centrifugal effect of the rotating impeller blades on the liquid in the annular cavity **60** tending to cause an inefficient or partial flow out through the discharge **61**. The result is that the two effects balance each other and maintain a static discharge pressure in the drain impeller chamber during the washing cycle, without flow in either direction through the drain impeller chamber.

If it is desired to control the amount of static discharge head in the drain chamber through a range of positive to negative during the washing cycle, this can be accomplished by varying the ratio of the aggregate area of the inlet ports to the radial vane clearance of the drain impeller vanes, although the amount of radial vane clearance is not critical to the overall function of the drain pump. Only the aggregate area of the inlet ports is critical and not their location, number or shape. Moreover, the axial clearances between the impeller vanes and the inlet plate are not critical and can be made large enough to permit the passage of hard solids without vane breakage while not affecting the pumping function.

The novel recirculating and drain pump unit operates from a single drive and provides a construction in which the drain impeller while rotating does not pump in either direction during the recirculating cycle and the recirculating impeller is disconnected during the drain cycle, and in which separate channels lead to the suction ports for the two impellers. The pumping action of the drain impeller is nicely regulated to require the full duration of the drain cycle to empty the tub, and to avoid splashing at the drain outlet.

What is claimed is:

1. Combined recirculating and drain pump construction comprising, a drive shaft, a centrifugal flow recirculating impeller on said drive shaft having an axial inlet, means defining an inlet passageway to said axial inlet, means defining a tangential discharge outlet from said impeller when rotated in one direction, an axial flow drain impeller on said drive shaft, an inlet plate having ports directed toward said drain impeller in an axial direction, means defining a separate inlet passageway to said plate, and means defining an annular cavity on the opposite side of said drain impeller from said inlet plate and having a tangential outlet, said cavity adapted to receive fluid discharge axially from said drain impeller when rotated in a direction opposite to said one direction and to impart a centrifugal flow thereto for discharge out of the tangential outlet connected to said annular cavity.

2. Combined recirculating and drain pump construction as defined in claim **1** in which the inlet passageway to the recirculating impeller and the inlet passageway to the drain impeller have a common source.

3. Combined recirculating and drain pump construction as defined in claim **1** in which the reverse axial flow caused by reverse rotation of the drain impeller is balanced by the centrifugal effect in said annular cavity caused by rotation of the impeller.

4. Combined recirculating and drain pump construction as defined in claim **3** in which the recirculating impeller is provided with clutch means to disengage it from said drive shaft when the shaft is rotated in a direction opposite to said one direction.

5. Combined recirculating and drain pump construction as defined in claim **1** having diffuser means forming a plurality of tangential discharge outlets from the recirculating impeller when rotated in said one direction, and deflector means for discharging fluid in an axial direction from said outlets.

6. Combined recirculating and drain pump construction as defined in claim **5** in which the recirculating impeller is provided with clutch means to disengage it from said drive shaft when the shaft is rotated in a direction opposite to said one direction.

7. In a combined recirculating and drain pump having a drive shaft rotating in one direction for recirculating fluid in a receptacle and rotating in the opposite direction for draining fluid from the receptacle, an axial flow impeller on said drive shaft having circumferentially arranged vanes in a cylindrical housing, an inlet plate on one side of said impeller having ports directed toward said vanes in an axial direction, hub means defining an annular cavity on the opposite side of said impeller and having a tangential outlet, said cavity adapted to receive fluid discharged axially from said vanes when rotating in said opposite direction and to impart a centrifugal flow thereto for discharge out of said tangential outlet.

8. The combined recirculating and drain pump of claim **7** in which the reverse axial flow from the drain impeller when rotated in said one direction is balanced by the centrifugal effect in said annular cavity caused by the rotation of the impeller.

9. The combined recirculating and drain pump of claim **7** in which the relationship of the area of the inlet ports to the radial clearance between the impeller vanes and the housing is regulated to balance axial flow when the impeller is rotating in said one direction.

10. The combined recirculating and drain pump of claim **7** in which sealing means is provided between said impeller and said hub means, said sealing means having access to said annular cavity to supply fluid to said sealing means.

11. The combined recirculating and drain pump of claim **10** in which said hub means is provided with a drip chamber for catching seepage from said sealing means.

12. The combined recirculating and drain pump of claim **10** in which inclined radial ribs are provided on said hub means between said sealing means and said annular cavity to direct fluid from said cavity to said sealing means.

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