This invention relates to dishwashers of the type in which the washing liquid is discharged from a spray member revolving about an axis extending through a clear path between the dishes, the spray member actually being caused to rotate by jet reaction or by reaction with the incoming liquid. The rotary spray member may take the form of an apertured spray tube, or an equivalent elongated rotary member capable of discharging spray or jets all along and around its path of rotation.

It has hitherto been the practice to operate such a spray member at a rotational speed of anything from 100 to 1,000 r.p.m. I have now found that a markedly improved washing action can be achieved if the speed of rotation is much reduced, e.g. to below 120 r.p.m. and preferably as low as, say, 10 or 20 r.p.m.

With a spray member operating at the customary speed of rotation, the dishes are, for all practical purposes, immersed in a heavy continuous rain of spray drops, with the result that newly-arriving drops impinge on and are dissipated by spent surface water resulting from previous drops which have not had time to drain off. In contrast to this, when the rotational speed is considerably reduced, the spray jets impinge on any one dish in a series of intermittent pulses timed sufficiently far apart to allow the spent surface water resulting from one pulse to drain away from the soiled surfaces before the next pulse arrives; thus the full energy of each newly-arriving pulse is available to act on any particles of food adhering to the dishes at given points. I have found that the best results can be obtained when the spray pulses are timed to arrive at intervals of anything from about half a second to about five seconds.

An obvious way to reduce the speed of rotation of a spray member, driven by reaction of or with the liquid, is to reduce the driving torque; for instance, if the spray member is caused to rotate by jet reaction, a reduction of speed can be obtained by directing some or all of the jets in a more nearly radial direction, or by counter- opposing some of the jets. I find, however, that if this simple method is adopted, the driving torque becomes too low to provide reliable operation, inasmuch as there is insufficient margin of torque to overcome the retarding effect that can be caused occasionally by small food particles lodging in the gap between the spray member and the associated liquid-supply fitting, or in the bearing surface clearances. What is needed is a means of reducing the speed without reducing the driving torque, and preferably, of course, without having to resort to any form of geared drive or other mechanical elaboration.

According to the invention a method of operating a dishwasher comprises supplying liquid under pressure to a spray system including an elongated rotary spray member revolving about an axis extending through a clear path between dishes to be washed, applying a rotational torque to the rotary spray member by reaction of the liquid supplied thereto on reaction surfaces or jet orifices comprised by the spray member, and applying speed responsive braking to said spray member to restrict and control the speed of rotation of the latter without reducing the torque applied thereto. Since the degree of braking will be related to the speed of rotation of the spray member, a governor action will be obtained which will enable the control of the speed of rotation of the spray member within reasonably close limits, without any reduction in the torque applied to the spray member, this torque being fully available to overcome any tendency to jamming by food particles or the like.

In practice, it is preferred to obtain the braking effect by introducing viscous drag between the revolving member and the fixed axle or support on which it is mounted to rotate. I find that in this way it is readily possible to reduce the speed to only a small fraction (e.g. 5%) of what it would be without the braking effect, whilst retaining the maximum possible driving torque to guard against the above mentioned possibility of occasional jamming by food particles or debris.

According to the invention also a dishwasher comprises a spray system including an elongated rotary spray member, revolving about an axis extending through a clear path between dishes to be washed and provided with jet orifices or reaction surfaces designed on discharge of jets of liquid therefrom to impart by reaction a substantial rotational torque to the spray member, and speed responsive braking means to restrict and control the speed of rotation of said member without reducing the torque applied thereto.

A further object of the invention is to provide an improved construction of spray member which will be less liable to clogging than conventional spray tubes and will provide an improved washing action by improving the efficiency with which the energy of the pressurized fluid supplied to the spray member is converted into the kinetic energy of the spray.

When a spray tube is used, the holes in the tube are necessary of such a size that they can occasionally become clogged by debris such as egg shell or fruit pits. Furthermore, the jets from the holes in a spray tube lack solidity since the holes are little more than apertures in a thin wall, and for the same reason the change in direction and conditions of flow adjacent the holes is fairly drastic, leading to energy losses due to turbulence. Also, in a spray tube, any leakage of liquid other than through the holes leads to loss of efficiency.

According to the invention, a spray system for a dishwasher comprises the combination of a fixed nozzle member, arranged to direct a jet or jets along a path between articles to be washed, and a spray member comprising a columnar deflector member, rotatably mounted on a fixed axle extending in the direction of the jet or jets and substantially central thereto, the deflector member being provided with one or more series of jet deflector channels, successive channels in the or each series being spaced circumferentially of and along the length of the axis of rotation, so as suc-
cessively to intercept the jet or jets and redirect it or them onto the articles, when positioned in the washing chamber, the 1,000 or more of these elements disposed so that the reaction of the deflected jet or jets exerts a torque causing rotation of the deflector member.

In a preferred embodiment of this latter feature, the columnar deflector member is made up of a number of stepped elements, mounted on a common sleeve rotatable on the axe and so arranged that successive elements overlap and are thus staggered circumferentially and in the axial direction to form channels, which cut across and intercept the jets during rotation resulting in the discharge of radiating jets over the length of the deflector member. Each element may consist of a hub or collar, having a radially extending portion, which portion, when viewed axially, is curved so that the direction of jet discharge is non-radial, thus providing a driving torque which causes the stack of elements to rotate on the axe.

The main advantages of this construction over the widely-used aperture spray tube are:

1. The danger of clogging by food particles or debris is greatly lessened. The apertures in a spray tube are necessarily of such size that they can occasionally become clogged by debris such as egg-shell, fruit pits, etc., whereas the channels in the deflector column of the present invention are non-radial and are tapered in width so as to widen out in the direction of flow. Not only are they therefore much less prone to clogging, but, in the unlikely event of a piece of debris becoming wedged in, it is readily seen and removed, without any dismantling.

2. The nozzle apertures in the nozzle member being much larger than the apertures in a spray tube, are not prone to clogging.

3. Possibility of decreased washing action due to leakage of liquid entering the spray tube is eliminated as also is jamming or reduction in speed due to small food particles lodging in the gap between the spray tube and its associated liquid supply fitting.

4. The jets from the apertures in a spray tube lack solidity, since the apertures are little more than holes in a thin wall. In contrast, the nozzle outlets in the fixed nozzle member used in the system of this invention can have the correct form and shape to provide full control of jet formation, and can thus provide really solid high-velocity jets with a minimum of turbulence or other losses. Also the local deflector channels can provide a smooth shock-free change of direction with the minimum of losses; in contrast, the shape and conditions of flow at the apertures in a spray tube is far more drastic. The net result is that the jets impinging on the dishes, are markedly stronger and more effective in the case of the present system than can be obtained from the customary spray tube arrangements.

5. The deflector channels can be so shaped as to deflect the primary jets through an angle greater than 90° so as to point backwards relatively to the primary jets. This can be very advantageous in securing good washing action on closely stacked plates and on deeply filled items such as soup plates or cereal bowls.

6. The combination of the high-efficiency jets given by the deflector channels with the very slow rotational speed of the spray member provides a marked improvement in washing efficiency. Whereas it has been customary to use a rotational speed of anything from several 100 r.p.m. up to several 1,000 r.p.m. where a rotary spray tube is used, I have found that improved washing action can be obtained if the speed is kept below 100 r.p.m. and preferably as low as 10 or 20 r.p.m.

A preferred embodiment of the invention is described with reference to the accompanying drawings, in which:

FIG. 1 is a section through the axis of the outer end of a spray member.

FIG. 2 is a section through the axis of the outer end of a spray member and adjacent parts.

FIG. 3 is an elevation of the inner end of the spray member of FIG. 2, with the shroud described below omitted for clarity.

FIG. 4 is an elevation of the spray member, as viewed from the left of FIG. 3, additionally showing the shroud.

FIG. 5 is a part view of the inner end of the spray member.

Referring first to FIG. 1, a fixed axle 2 carries a spray member 4, journaled on the outer end of the axe by an end plate 6. Although it is preferred that the spray member is of the construction described below, it should be understood that any reaction driven rotary spray member having an axis extending through a clear path between the dishes to be washed may be substitutable and that the performance of such a spray member will benefit from use of the arrangement shown in FIG. 1.

To the end of the axe 2, a disc 8 is made fast by means of a screw 10 engaging a threaded bore 12 in the axe. The disc is housed in a confined chamber 14 formed between the end plate 6 and a housing 16. The housing 16 is closed by a screw plug 18 screwed into a threaded orifice in the housing so as to take up play between itself and the head of the screw 10, thus in combination with the end plate 6 and the disc 8 retaining the spray member 4 on the axe.

The chamber 14 is filled through a screw plug 20 with a high viscosity dampening fluid, which may for example be a silicone dampening fluid having a viscosity in the region of 10,000 to 100,000 centistokes. Such a fluid has the advantage of showing a relatively small change in viscosity over the working temperature range. It will be clear that the desired speed of rotation may be obtained by suitable selection of the thickness of the film between the disc 8 and the inner surface of the chamber 14, as well as of the viscosity of the fluid. It is most important that the liquid in the chamber 14 be isolated from the washing liquid, as the ingress of even very small quantities of the latter into the chamber will greatly reduce the drag effect of the silicone fluid. A seal 22 retained by a collar 24 is therefore provided to prevent ingress of washing liquid between plate 6 and axe 2.

Referring now to FIGURES 2-5, liquid from a circulatory pump (not shown) flows through a transfer duct 30 and emerges as jets 32 from a nozzle or cluster of nozzles 34 formed in a nozzle member 36 attached to one of the walls 38 of the washing chamber. The fixed axe 2 projects from the nozzle member in the same direction as the jets, change in direction being possible by axial and radially extending portions 42 are mounted by means of root portions 43 on a tubular sleeve 44 journaled to rotate on the axe 2; the elements are shaped at their ends nearest the nozzles to form channels 46 which cut across and intercept the jets 32 during rotation, resulting in the discharge of radiating jets 48, spaced over the whole length of the spray member so as to spray the dishes which can be supported in suitable racks arranged within the washing chamber to surround the spray member.

A shroud 50 encloses the space around the sleeve 44 swept by the jets 32 except in the immediate vicinity of the channels 46. This prevents undue spread of the primary jets 32 and thus helps maintain satisfactory spray formation. The channels 46 widen out and are smoothly and continuously curved in the direction of liquid flow to obtain a smooth change of direction in the liquid. FIG. 4 is an elevation of portions 42 and hence the channels present a curved cross section in a plane at right angles to their rotational axis so that the secondary jets 48 are discharged non-radially, their reaction providing the driving torque for the spray member.

It should be understood that the embodiment illustrated, i.e. a composite column built up by stacking overlapping individual elements on one another, is only one of many possible methods of fabrication. The principle involved, is the use of a columnar group of jet-deflector channels spaced over the effective length of spray
discharge in the form of a staggered row or rows, covering substantially 360° in end view, and mounted for rotation about an axis located at the centre of the cluster of fixed jet-nozzles so that during rotation, each said channel cuts across each said jet and in so doing, re-directs or deflects the jet through approximately 90° so as to cause it to impinge on the surrounding dishes. Each primary jet will therefore give rise to as many secondary, dish impinging, jets as there are channels, each secondary jet being directed to a separate zone of the washing chamber.

The use of staggered rows of channels subtending approximately 360° in end view is desirable, since if less than 360° in end view is covered, then some of the jets 48 will pass straight through the cluster of channels and be wasted, whilst conversely, if more than 360° is covered then the individual channels most remote from the nozzle end will be starved of liquid. In the arrangement of FIGURE 4, there are three rows of channels 46, each spread over approximately 120° of arc in end view. Alternative construction comprises two rows each of 180°, four rows each of 90°, or one row of 360°.

The channels are shaped to deflect the jets 48 through rather more than 90° in side elevation, as shown by the jet 48 directional arrows, but it will be understood that the precise angle of deflection can be either more or less than 90°, depending on the precise position in which the plates and dishes are located.

When the spray device is mounted horizontally within the washing chamber, the nozzles 34 formed in the fixed nozzle member 36, may be directed slightly upwards, i.e. at an angle of say one or two degrees to the axis of the fixed axle, in order to compensate for the slight fall in the trajectory of the jets over the length of the column of elements.

It is found that the slow speed of rotation (preferably 5–50 r.p.m.) of the deflector column due to the arrangement of FIGURE 1 results in markedly superior washing action, and also it eliminates problems of vibration due to out-of-balance of the rotating column.

What I claim is:

1. A dishwasher comprising a spray system including an elongated spray member having spray jet reaction means spaced axially along its longitudinal extent; means mounting said member to extend through a clear path between positions of dishes to be washed and for rotation about its own longitudinal axis; means for delivering liquid to said member for discharge from said spray jet reaction means thereby to impart a torque to said spray member for rotating the latter; and speed responsive braking means for restricting the speed of rotation of said member without reducing said torque, said braking means comprising said restriction said speed of rotation of said member that spray pulses delivered by said jet reaction means are timed to arrive at given points on dishes being washed at intervals of not less than about half a second.

2. A dishwasher according to claim 1, in which the speed responsive braking means comprises a film of viscous liquid, isolated from the washing liquid between a surface associated with the spray member and a surface associated with a part on which the spray member is journalled.

3. A dishwasher according to claim 2, in which the surface associated with the part on which the spray member is journalled is the surface of a disc fast to said part, and the surface associated with the spray member is the inner surface of a confined chamber enclosing the disc and fast to the spray member said chamber being completely closed against ingress of washing liquid by means including a seal between said spray member and said means mounting said spray members.

4. A dishwasher according to claim 2, in which the spray system comprises a fixed nozzle member positioned to direct, on the supply of liquid under pressure thereto, fluid along a path between articles when positioned in a washing chamber, the spray member comprising a columnar deflector member, rotatably journalled on a fixed axle extending in the direction of the jet fluid and substantially central thereto, the deflector member being provided with serial outwardly extending deflector channels, serially successive channels being spaced circumferentially of and along the length of the axis of rotation, whereby successively to intercept the jet fluid on rotation of the member and re-direct it onto the articles, the outer ends of the channels being non-radially disposed whereby the reaction of the deflected jet fluid exerts a torque causing rotation of the deflector member.

5. A dishwasher according to claim 1, in which the spray system comprises a fixed nozzle member positioned to direct, on the supply of liquid under pressure thereto, jet fluid along a path between articles when positioned in a washing chamber, the spray member comprising a columnar deflector member, rotatably journalled on a fixed axle extending in the direction of the jet fluid and substantially central thereto, the deflector member being provided with serial outwardly extending deflector channels, serially successive channels being spaced circumferentially of and along the length of the axis of rotation, whereby successively to intercept the jet fluid on rotation of the member and re-direct it onto the articles, the outer ends of the channels being non-radially disposed whereby the reaction of the deflected jet fluid exerts a torque causing rotation of the deflector member.

6. A dishwasher according to claim 5, in which the channels widen out and are smoothly and continuously curved in the direction of flow.

7. A dishwasher according to claim 6, in which the path swept by the jets before deflection is enclosed by a shroud except in the immediate vicinity of the channels.

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