SPRAYING DEVICE FOR DISHWASHING MACHINES

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This invention relates to an improved spraying device for spraying a cleaning fluid, under pressure, over articles to be cleaned, and more particularly to a spraying device of the type described for use in automatic dishwashing machines.

In certain types of dishwashers, one or more water distribution arms are provided which spray water onto the surfaces of the dishes or other articles being cleaned as the arm or arms rotate. It has been customary in such dishwashers to provide distribution arms which spray jets of water always having the same angle of impingement relative to any article being cleaned. While distribution arms of this type having fixed spray angles are at least partially satisfactory, it is considered more desirable to employ a water distribution arm which can continuously vary the angle at which the water strikes the objects being cleaned, the reason being that matter can be removed from the surfaces of an object more efficiently with this type of spray.

Accordingly, as an overall object, the present invention seeks to provide an improved efficient spraying device for dishwashers and the like wherein the angle at which jets of cleaning fluid strike dishes or other articles being cleaned is continually varied to improve their cleaning action.

Another object of the invention is to provide an improved automatic dishwasher spraying device which is self-propelled, the motive force being provided bysprays of the cleaning fluid.

A further object of the invention is to provide an improved spraying device for automatic dishwashers and the like wherein a more uniform distribution of the cleaning fluid over the articles being cleaned is achieved.

Another object of the invention is to provide an improved spraying device wherein the sprays of the cleaning fluid cover a greater area than heretofore possible.

In accordance with the invention, an improved spraying device is provided having at least one fluid distributing arm or sprayer pipe for spraying a cleaning fluid over the articles to be cleaned. The sprayer pipe extends in cantilever beam relation over or below the articles to be cleaned and is provided with sets of jet openings which provide sprays of the cleaning fluid. These sets of jet openings are positioned along the length of the sprayer pipe so as to distribute the cleaning fluid uniformly and are arranged so as to provide a force couple or moment which rotates the sprayer pipe about its longitudinal axis.

The sprayer pipe is supported for rotation about two axes which are preferably mutually perpendicular. One axis of rotation comprises the longitudinal axis of the sprayer pipe, the aforementioned force couple or moment providing the motive force for rotating the sprayer pipe about this axis. The other axis of rotation is disposed at one end of the sprayer pipe such that during rotation about this axis, the sprayer pipe sweeps along an arcuate path of travel in much the same manner as a spoke of a wheel.

Means is provided for rotating the sprayer pipe differentially about these two axes whereby the angular velocity of the sprayer pipe about one axis will be different from the angular velocity of the sprayer pipe about the other axis. That is, for each complete revolution about the second axis, the sprayer pipe is rotated through more than one complete revolution about the longitudinal axis. Hence, with respect to a fixed article at a given location along the path of travel of the sprayer arm, the angle at which the fluid sprays strike or impinge upon the article changes continuously. As is known, matter can be removed from the surface of an article being cleaned more efficiently by a jet of water which strikes the surface from various angles than by a jet of water which strikes the surface from only one angle.

In one embodiment of the invention, the differential rotation of the sprayer arm about the two axes is afforded by a pair of members, the first member being rotatable with the sprayer arm and disposed in rocking engagement with the second member which is stationary. The arrangement is such that the diameter of the circular path over the first member rolls is greater than the diameter of the first member. Hence, the angular velocity of the sprayer pipe about its longitudinal axis will be greater than the angular velocity of the sprayer pipe about the second axis.

In an alternative embodiment of the invention, a fluid supply chamber is provided from which extends at least one sprayer pipe. A cap member rigidly secured to the fluid supply chamber serves to close the exterior end of the sprayer pipe. The chamber is supported for free rotation about a central axis thereof which is disposed at right angles to the longitudinal axis of the sprayer pipe, while the sprayer pipe is supported for free rotation about its longitudinal axis. The aforementioned jet openings are again employed to rotate the sprayer pipe about its longitudinal axis. However, in this embodiment, at least one additional jet opening is provided in the cap member and positioned so as to rotate the cap member, the sprayer arm and the fluid supply chamber as a unit about the central axis of the fluid supply chamber. The one jet opening in the cap member will rotate the cap member, the sprayer arm and the fluid supply chamber about the central axis at a first angular velocity, while the plurality of jet openings in the sprayer arm will rotate the sprayer arm about its longitudinal axis at a different or higher angular velocity.

The above and other objects and advantages of the present invention will become apparent from the following detailed description by reference to the accompanying drawings, in which:

FIG. 1 is an isometric view of one embodiment of the present fluid distributing arm;
FIG. 2 is a plan view of the fluid distributing arm of FIG. 1;
FIG. 3 is a cross-sectional view taken along the line III—III of FIG. 2, illustrating the internal construction of the fluid distributing arm;
FIG. 4 is a cross-sectional view taken along the line IV—IV of FIG. 2, illustrating the relative position of jet openings provided in the fluid distributing arm;
FIG. 5 is a view schematically illustrating the several angular positions of the fluid sprays relative to articles disposed above and below the fluid distributing arm;
FIGS. 6 and 7 are fragmentary side views illustrating alternative means providing differential rotation of the fluid distributing arm about two mutually perpendicular axes;
FIG. 8 is an isometric view of an alternative embodiment of the present fluid spraying device;
FIG. 9 is a cross-sectional view taken along the line IX—IX of FIG. 8, illustrating the internal construction of the spraying device of FIG. 8; and FIG. 10 is a cross-sectional view taken along the line X—X of FIG. 8, illustrating jet openings provided in the fluid supply arm and in a cap member employed in the embodiment of FIG. 8.

Referring now to FIGS. 1-3, inclusive, there is illustrated a spraying device comprising a fluid distributing arm or sprayer pipe 22 having one end thereof connected to a collar 24 which surrounds a fluid supply chamber 26. The collar 24 is connected to the fluid supply chamber 26 is an inlet conduit 25 supplying cleaning fluid under pressure to the interior thereof. The sprayer pipe 22 is rotatable about its longitudinal axis indicated in FIGS. 1 and 3 by the dash-dot line 30. The collar 24 also is supported for rotation about a second or central axis of the fluid supply chamber 26 indicated in FIGS. 1 and 3 by the dash-dot line 34. The sprayer pipe 22 is provided with sets of aligned jet openings 38, 40 which, as will be described, provide oppositely directed sprays for rotating the sprayer pipe about the longitudinal axis 30 in the direction indicated by the arrow 32 of FIG. 1. Drive means 42 serve to rotate the sprayer arm 22 about the central axis 34 in response to the rotation of the sprayer pipe 22 about its longitudinal axis 30. The direction of rotation of the sprayer pipe 22 about the central axis 34 is indicated by the arrow 36 in FIG. 1.

Referring now to FIGS. 2-4, inclusive, the sprayer pipe 22 preferably comprises a square conduit 44 having opposed faces 46, 48 in which are provided the sets of aligned jet openings 38, 40, respectively. The square conduit 44 has a closed end 50 and an open end 52. The open end 52 is secured to a bevel gear 53 which, as will be described, forms part of the internal mechanism 42. A tubular extension 54 also is secured to the bevel gear 53. The tubular extension 54 is coaxially aligned with the square conduit 44 and communicates with the open end 52 thereof. The collar 24 is provided with a journal 56 which receives the tubular extension 54, the arrangement being such that the sprayer pipe 22 may be disconnected from the collar 24. A suitable seal, such as an O-ring 58, is employed to prevent outflow of the cleaning fluid through the opening in the collar 24 in which the tubular extension 54 is received. A spring member 60 is secured to the top of collar 24 and extends therefrom outwardly beyond the bevel gear 53. The spring member 60 is provided with a ball bearing 62 rotatably supported in the outer end 64 thereof. The spring member 60 maintains the sprayer pipe 22 connected to the collar 24. The ball bearing 62 permits free sliding movement of the bevel gear 53 past the spring member 60 during rotation of the sprayer arm about its longitudinal axis 30.

As can best be seen in FIG. 4, the jet openings 38 provided in the face 46 of the square conduit 44, are aligned along a first plane indicated by the dash-dot line 66. The jet openings 40 provided in the opposite face 48 of the square conduit 44, are aligned along a second plane indicated by the dash-dot line 68. The planes 66, 68 are equidistantly spaced from and parallel to the longitudinal axis 30. Hence, when the cleaning fluid is ejected through the jet openings 38, 40, a moment is created which rotates the sprayer pipe 22 about the longitudinal axis 30 in the direction of the arrow 32.

As can best be seen in FIG. 3, the collar 24 is a cylindrical member surrounding the fluid supply chamber 26. Journals 70, 72 disposed at the top and bottom respectively of the collar 24, support the collar 24 for rotation about the central axis 34. O-rings 74 are provided in the annular space between the collar 24 and the fluid supply chamber 26 for sealing the same. The O-rings 74 are positioned above and below a plurality of discharge openings 76 provided in the fluid supply chamber 26. The discharge openings 76 are positioned at the level of the entrance to the tubular extension 54 so that when cleaning fluid is introduced into the fluid supply chamber 26, the cleaning fluid will flow out through the discharge opening 76 through the tubular extension 54 into the interior of the sprayer pipe 22 and thereafter out through the jet openings 38, 40.

In this embodiment, the aforementioned drive means 42 is comprised of the bevel gear 53 and a second or stationary bevel gear 78 which is secured to the fluid supply chamber 26, as for example, by means of a threaded connection 79. The bevel gear 78 and the fluid supply chamber 26 are non-rotatably secured to a suitable support 80 schematically illustrated at 80. As can be seen in FIG. 3, the bevel gear 53 meshes with the stationary bevel gear 78 and rolls thereover when the sprayer pipe 22 rotates about the longitudinal axis 30. Hence, the bevel gears 53, 78 comprise means operative by the rotation of the sprayer pipe 22 about its longitudinal axis 30 for rotating the sprayer pipe 22 about the central axis 34.

To accomplish the desired differential speed of rotation of the sprayer pipe 22 about the axes 30, 34, the pitch diameter of the stationary bevel gear 78 preferably is larger than the pitch diameter of the bevel gear 53. Hence, the angular velocity of the sprayer pipe 22 about the longitudinal axis 30 will be greater than the angular velocity of the sprayer pipe 22 about the central axis 34. For each complete revolution of the sprayer pipe 22 about the central axis 34, the sprayer pipe 22 will undergo more than one complete revolution about its longitudinal axis so that for a given position of the sprayer pipe 22 along its path of travel around the central axis 34, the angle at which the fluid sprays strike the articles supported above this position, will continuously change. To further explain how the angle of the sprays is changed continuously, reference is directed to FIG. 5 wherein there is schematically illustrated the sprayer pipe 22 being rotated about its longitudinal axis 30 in the direction of the arrow 32 and which rotates about the central axis 34 as described above. A plurality of articles, such as dishes 82, are shown supported on suitable racks 84 above and below the sprayer pipe 22.

It will be assumed, in this instance, that the bevel gear 53 has ten teeth while the bevel gear 78 has eleven teeth. Hence, for each complete revolution of the sprayer pipe 22 about the central axis 34, the sprayer pipe 22 also will be rotated about its horizontal axis 30 through 396 angular degrees, i.e., one-tenth more than one complete revolution. For the sake of simplicity, the sprayer pipe 22 will be assumed to have one jet opening providing one spray indicated by the arrow 86.

Initially, the spray 86 will be oriented vertically. After one complete revolution about the central axis 34, the sprayer pipe 22 will be oriented so that the spray is angularly offset from the initial vertical orientation by one-tenth of a revolution or 36° and will be directed along the arrow 86c. After the second revolution about the central axis 34, the sprayer pipe 22 will be oriented so that the spray is angularly offset from the initial vertical orientation by two-tenths of a revolution or 72° and will be directed along the arrow 86d. After the revolution about the central axis 34, the spray will be directed along the arrow 86c which is vertically oriented relative to the initial vertical position. This action continues and after the tenth complete revolution about the central axis 34, the sprayer pipe 22 again will be oriented with the spray 86 in a vertical plane.

The drive means 42 preferably comprises the gears 53, 78 since, the gears 53, 78 will provide precise indexing of the sprayer pipe 22 during its rotation along the axis 30, 34. That is to say, after every ten revolutions about the axis 30 as in the example above, the orientation of the sprayer pipe 22 will be identical with the initial orientation at the start of the first revolution.

Where exact indexing of the sprayer arm 22 is not absolutely necessary, alternative drive means may be employed, which are illustrated in FIGS. 6 and 7.
spending numerals will be employed to identify cor-responding parts already described. In FIG. 6, a friction-type drive means 88 is shown comprising a small diameter frusto-conical member 90 secured to and rotatable with the sprayer pipe 22 and a second or large diameter frusto-conical member 92 se-cured to the fluid supply chamber 26 and engaged with the small diameter member 90. In FIG. 7, an alternative friction-type drive means 94 is shown comprising a cylindrical member 96 secured to and rotatable with the sprayer arm 22. The cylindrical member 96 has a peripheral edge 98 engaged with the top portion 100 of a stationary member 102 secured to the fluid supply chamber 26. It is to be noted that the alternative drive means 88, 94 of FIGS. 6 and 7 operate substantially identically to the drive means 42 with the exception that occasional slippage between the members would be detrimental to the indexing herefore described. Reference is now directed to FIGS. 8–10, inclusive, wherein an alternative embodiment of the present spraying device is illustrated and generally indicated by the numeral 110. The spraying device 110 comprises an elongated fluid supply chamber 112 supported for rotation about its central axis indicated by the dash-dot line 114, by suitable bearing elements 116 at each end thereof. An inlet conduit 118 introduces cleaning fluid, under pressure, into the interior of the chamber 112. Adjacent to the upper end of the fluid supply chamber 112 there is provided a first pair of coaxially aligned, oppositely extending sprayer pipes 120a. Adjacent to the lower end of the fluid supply chamber 112, there is provided a second pair of coaxially aligned, oppositely extending sprayer pipes 120b which preferably are disposed at right angles to the sprayer pipes 120a. Each of the sprayer pipes 120a, 120b, has a cap 122 clamping the outer end thereof. In FIG. 9 there is illustrated a suitable construction of one of the sprayer pipes 120a and the associated cap member 122. The remaining sprayer pipe 120a and the second of sprayer pipes 120b are similarly constructed. It should be understood that the construction shown in FIG. 9 is intended merely to illustrate one suitable con-struction and that other constructions accomplishing the desired results are equally as satisfactory.

As can be seen in FIG. 9, the cap member 122 is pro-vided with a central hub 124 internally thereof, into which is received a threaded end of a stabilizing bar 126. The stabilizing bar 126 extends through the sprayer pipe 120a and the fluid supply chamber 112 and has its other end similarly connected to the opposite cap member 122 (not shown). A suitable fastener, such, as set screw 128, rigidly secures the bar 126 within the hub 124. The stabilizing bar 126 is rigidly secured to the fluid supply chamber 112 by means of a suitable fastening element 130. The overall arrangement is such that the cap member 122, the sprayer pipes 120a, 120b and the fluid supply chamber 112 rotate as a unit about the central axis 114, for example, in the direction of the arrow 132 (FIG. 8).

The sprayer pipe 120a is supported for rotation about its longitudinal axis indicated by the dash-dot line 134, by means of journals, such as thrust bearings 136, 138. The bearing 136 is interposed between an outwardly ex- tended flange 140 provided at one end of the sprayer pipe 120a and an inwardly extended flange 142 pro-vided on the cap member 122. An O-ring 144 prevents the outflow of the cleaning fluid between the flanges 140, 142. The bearing 138 is interposed between a second outwardly extended flange 146 provided at the opposite end of the sprayer pipe 120a and a side wall 148 of the fluid supply chamber 112. An O-ring 150 prevents the outflow of the cleaning fluid between the flange 146 and the side wall 148. The opposite sprayer pipe 120b is similarly supported. The overall arrangement is such that each of the sprayer pipes 120a, 120b is rotatable about its longitudinal axis 134 independently of the remaining sprayer pipes.

Referring again to FIG. 8, each of the sprayer pipes 120a, 120b is square in cross section and is provided with a first set of aligned jet openings 154 and a second set of aligned jet openings 156 (not visible). The sets of aligned jet openings 154, 156 provide sprays of the cleaning fluid which are ejected in opposite directions to provide a moment, described above in connection with FIG. 4, for rotating the sprayer pipes 120a, 120b in the direction indicated by the arrows 152.

Referring now to FIGS. 8 and 10, each of the cap members 122 has at least one jet opening 158 providing a spray 160 of the cleaning fluid, whose line of action is disposed in the plane of rotation of the sprayer pipes 120a, 120b about the axis 114. As positioned in FIG. 8, the sprays 160 will rotate the spraying device 110 about the central axis 114 in the direction of the arrow 132.

Since the sprayer pipes 120a, 120b are rotated about their longitudinal axes 134 by means of the sprays provided by the sets of aligned jet openings 154, 156 and the spraying device 110 is rotated about the central axis 114 by means of the sprays 160, the spraying device 110 is entirely self-propelled. It should be evident that the four sprays 160 will rotate the spraying device 110 about the central axis 114 at a first angular velocity. The sets of aligned jet openings 154, 156 will rotate each of the sprayer pipes 120a, 120b about their longitudinal axes 134 at a second angular velocity which is greater than the first angular velocity. Hence, the differential speed of rotation of the sprayer pipes 120a, 120b about axes 114, 134 causes the angle at which the sprays from the jet openings 154, 156 strike the stationary articles disposed along the paths of travel of the sprayer pipes 120a, 120b, to change continuously and therefore provide the action required.

Although the invention has been shown in connection with certain specific embodiments, it will be readily appre-ciated that various changes in form and arrangement of parts may be made to suit requirements without de-parting from the spirit and scope of the invention.

I claim as my invention:

1. A spraying device, the combination comprising: a sprayer pipe assembly having a closed end and an open end, said open end communicating with a fluid supply conduit; means supporting said sprayer pipe assembly for rotation about its longitudinal axis; means supporting said sprayer pipe assembly for rotation about a second axis extending transversely of said longitudinal axis; and means for rotating said sprayer pipe assembly simultaneously about said longitudinal axis and said second axis, said last-mentioned means including jet means carried by said sprayer pipe assembly and so disposed relative to said axes that the rotation is effected by jets of spray.

2. In a spraying device, the combination comprising: a chamber supported for rotation about a central axis thereof; means for introducing fluid under pressure into said chamber; a sprayer pipe extending from said chamber transversely of said central axis, one end of said sprayer pipe communicating with the interior of said chamber; a cap member closing the opposite end of said sprayer pipe and being non-rotatably secured to said chamber; journal means at each end of said sprayer pipe for supporting the same for rotation about its longitudinal axis; said journal means including said cap member and said chamber, and means for rotating said cap member and said chamber as a unit about said central axis.

3. A spraying device comprising a chamber supported for rotation about a central axis thereof; means for introducing fluid under pressure into said chamber; at least...
one pair of axially aligned sprayer pipes extending transversely of said central axis, each of said sprayer pipes having one end connected to said chamber and communicating with the interior thereof; cap members for closing the opposite ends of said sprayer pipes; a rod extending through said sprayer pipes and said chamber and having its ends rigidly connected to one of said cap members; means rigidly connecting said rod to said chamber; journal means at each end of each of said sprayer pipes for supporting the same for rotation about their longitudinal axes; jet means in each of said cap members for rotating said chamber, said sprayer pipes and said cap members as a unit about said central axis; a first set of spaced, oppositely facing jets formed in one of said sprayer pipes for spraying fluid in opposite directions whereby said one of said sprayer pipes is rotated about its longitudinal axis; and a second set of spaced, oppositely facing jet means formed in the other of said sprayer pipes for spraying fluid in opposite directions whereby said other of said sprayer pipes is rotated about said longitudinal axis independently of the rotation of said one of said sprayer pipes.

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