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WASHING MACHINES

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FIG. 1

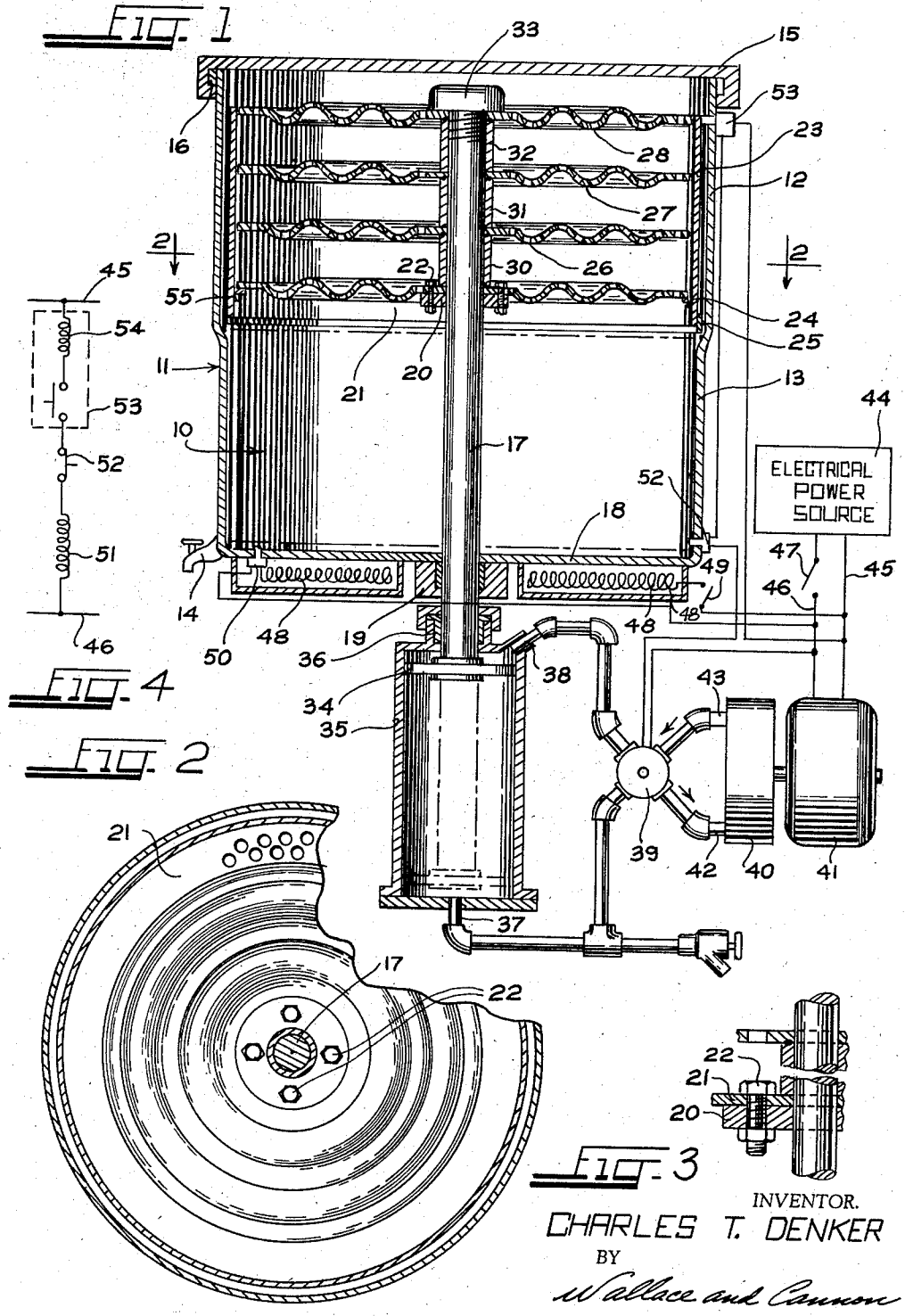


FIG. 4

FIG. 2

FIG. 3

INVENTOR.

CHARLES T. DENKER

BY

Wallace and Cannon

Atty's.

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WASHING MACHINES

Charles T. Denker, Chicago, Ill.

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This invention relates to a new and improved washing machine which may also be employed as a drying machine.

The machine is adapted to washing and drying fabrics such as clothing and also to washing and drying of other objects including dishes and the like.

There are two general types of washing apparatus which have been widely used as domestic washing machines. In one device of this nature, the clothing or other fabrics are placed into a tub in which a blade agitator is located. The tub is filled with a water and detergent solution and the clothing is agitated for a substantial period of time, after which it is rinsed and subsequently dried. In some of these machines, the washing, rinsing, and drying functions are all carried out automatically. The other type of fabric-washing machine in general use for domestic applications comprises a cylindrical member having a series of projections extending inwardly therefrom and generally referred to as a tumbler. In machines of this type, the clothing is placed in the tumbler along with a detergent solution and the tumbler is rotated for a substantial period of time, after which the clothing is rinsed and dried. In this instance, also, the washing, rinsing, and drying functions of the machine may be automatically regulated. Quite frequently, rapid rotation of the tub or tumbler, depending upon construction of the machine, is utilized to remove most of the washing solution from the fabrics by centrifugal action.

In commercial applications, other types of washing machines have been employed, including some in which a tub is reciprocated in a vertical direction to agitate the fabrics within a detergent solution. Generally speaking, the vertical stroke of these machines has been relatively short in relation to the depth of the tubs employed and mechanical vibration of the fabrics within the detergent solution has been relied upon to effect the desired cleaning action. Some of these devices have also been utilized further to rinse and to dry the fabrics.

In these prior art washing machines, efficient cleaning is predicated upon relatively violent agitation of the clothing or other fabrics within the detergent solution, particularly where a relatively short washing cycle is desired. Consequently, the fabrics may be worn or otherwise damaged in the course of the washing operation. Moreover, the prior art washing machines frequently leave much to be desired with respect to efficiency in the washing operation in that they may fail to bring the detergent solution adequately into contact with all of the fabric being washed.

A principal object of the invention, therefore, is to provide a new and improved washing machine which substantially minimizes the aforementioned disadvantages of prior art devices.

A more specific object of the invention is the provision of a new and improved washing machine in which a detergent solution is forced into contact with the material being washed, and, in the case of fabrics, is impelled to some extent through the fabric structure.

An additional object of the invention is the provision of a washing machine adapted to wash and to dry both fabrics and/or other objects such as dishes, utensils, and the like.

Another object of the invention is the provision of a washing machine in which damage to the materials being washed is effectively minimized without substantial sacrifice in washing efficiency.

A corollary object of the invention is the provision of a new and improved washing machine which is relatively economical in construction and therefore suitable for domestic use and which is also relatively convenient in operation.

A washing machine constructed in accordance with the invention comprises a cylindrical tub including upper and lower sections, the upper section having a cross-sectional area substantially larger than the area of the lower section. Preferably, both sections of the tub are circular in cross-sectional configuration. An axially movable piston rod extends vertically into the tub, preferably at the center thereof, and a substantially imperforate open-ended wash cylinder is mounted on the piston rod for movement therewith. This wash cylinder is constructed to have a cross-sectional configuration and area effectively corresponding to the configuration and area of the lower tub section and is smaller in height than the upper tub section. At least one perforate support member, which has a cross-sectional configuration and area corresponding to the wash cylinder, is supported within that cylinder for movement therewith, the support member being positioned substantially above the bottom of the cylinder. In addition, the washing machine includes driving means for effecting reciprocal axial movement of the piston rod to reciprocate the basket between the upper and lower sections of the tub.

Other and further objects of the present invention will be apparent from the following description and claims and are illustrated in the accompanying drawing which, by way of illustration, shows a preferred embodiment of the present invention and the principles thereof and what I now consider to be the best mode in which I have contemplated applying these principles. Other embodiments of the invention embodying the same or equivalent principles may be used and structural changes may be made as desired by those skilled in the art without departing from the present invention and the purview of the appended claims.

In the drawings:

Fig. 1 is a sectional elevation view, partly in diagrammatic form, of a washing machine embodying the inventive concept;

Fig. 2 is a sectional view of the washing machine of Fig. 1 taken along line 2—2 therein;

Fig. 3 is an enlarged detail view showing a mounting arrangement employed for a part of the washing machine of Fig. 1; and

Fig. 4 is a wiring diagram illustrating one control scheme which may be employed in operating the washer of Fig. 1.

The washing machine 10 illustrated in Fig. 1 comprises a cylindrical tub 11 having an upper section 12 and a lower section 13. As indicated in the drawings, tub sections 12 and 13 are both preferably circular in cross-sectional configuration, although this is not essential since no rotational movement is entailed in operation of the washing machine, as will be made apparent hereinafter. The lower tub section 13 is made substantially smaller than the upper section 12 and is provided with a drain outlet as indicated by valve 14. Tub 11 is also provided with a cover 15 and is equipped with suitable means for

retaining the cover securely on top of the tub, as by an interrupted thread or locking ring 16.

An axially movable piston rod 17 is included in washing machine 10 and extends vertically through the bottom 18 of tub 11, preferably at the center thereof as indicated in Fig. 2. Piston rod 17 is adapted for axial movement within the tub, as will be explained more completely hereinafter, and is provided with a suitable sealing device 19 to prevent loss of fluid from tub 11. As best shown in Fig. 3, a support ring 20 is affixed to piston rod 17 at a point spaced from the upper end thereof; ring 20 may be mounted upon the piston rod by any suitable means which effectively prevents axial movement of the support ring along the rod. A first perforate disc-shaped support member 21 is affixed to support ring 20 as by a plurality of bolts 22 or other suitable means. Support member 21 may be fabricated from relatively heavy metal mesh material, relatively heavy expanded metal or from a metal sheet which has been perforated by punching or other suitable technique to afford a multiplicity of openings therethrough. Preferably, support member 21 is not planar in configuration; rather, it is formed in a series of convolutions or corrugations, preferably concentric, as indicated in Figs. 1 and 2.

Washing machine 10 further includes an imperforate open-ended wash cylinder 23 having an internal axial opening corresponding in dimensions and configuration to the peripheral edge of support member 21. Wash cylinder 23 is affixed to support member 21 by some suitable means, such as a plurality of mounting brackets 24, so that the wash cylinder is effectively mounted upon piston rod 17 for movement therewith. In accordance with the inventive concept, wash cylinder 23 should be constructed with a height smaller than the height of either of tub sections 12 and 13, and particularly should be made smaller in height than the upper tub section 12. Moreover, the external diameter of wash cylinder 23 is made approximately equal to the internal diameter of lower tub section 13 in order that the wash cylinder may operate effectively as a piston within the lower section of the tub, as will be explained more completely hereinafter. Wash cylinder 23 may also be provided with a sealing ring 25 on the lower peripheral edge thereof to afford a hydraulic seal between the wash cylinder and the lower tub section when the washing machine is placed in operation.

A plurality of secondary perforate support members are also mounted within wash cylinder 23 as indicated by the support members 26, 27, and 28 in the illustrated embodiment of the invention. Each of support members 26—28 is preferably fabricated from metal mesh material substantially similar to that utilized for primary support member 21 and is given a convoluted or corrugated configuration as shown in the drawings. Support member 26 is supported above member 21 by a sleeve 30 which is loosely slidable upon piston rod 17; sleeve 30 may comprise a completely separate member or may be suitably attached to the secondary support member 26. Similarly, support member 27 is supported above member 26 by means of a sleeve 31 and support members 27 and 28 are separated by yet another sleeve 32. Each of the disc-like perforate support members 26—28 has a configuration and dimensions approximately corresponding to the internal cross-sectional area of cylinder 23, but the overall diameter of the support members may be made slightly smaller than the internal diameter of the wash cylinder to facilitate insertion and removal of the support members into and from the cylinder. The relative positions of the support members are maintained constant by a locking cap 33 which is threaded onto or otherwise removably secured to the upper end of piston rod 17.

The end of piston rod 17 extending outside of tub 11 is affixed to a piston 34 mounted within a hydraulic cylinder 35. The upper end of cylinder 35 through which the piston rod extends is of course provided with a suitable seal as indicated at 36. Hydraulic cylinder 35 is also provided with two operating ports 37 and 38 which are connected by suitable fluid conduits to a solenoid-operated four-way valve 39. Valve 39 is also connected by suitable fluid conduits to a conventional hydraulic pump 40 which is energized from a suitable electric motor or other prime mover 41. Valve 39 may comprise any conventional valve adapted to reverse the inlet and outlet relationship of two of its ports in relation to the other two ports under control of an electrically operated solenoid mechanism. Pump 40, on the other hand, may comprise any conventional hydraulic pump, the inlet port of the pump being indicated at 42 and the outlet port at 43.

Prime mover 41, which may, for example, comprise a conventional single-phase A.C. motor, is connected to a suitable electrical power source 44 through a circuit comprising a pair of conductors 45 and 46, a master switch 47 being interposed in series with conductor 46. Power source 44 may, of course, comprise the usual source of 120 volt 60 cycle power available in most homes or any other suitable source of electrical energy from which motor 41 may be energized. A series of heating coils 48 are supported beneath the base of tub section 13 and may be connected across the electrical energizing circuit comprising conductors 45 and 46. Preferably, a heater control switch 49 is interposed in the heater circuit and a thermostatic control switch 50 is also incorporated in the heater circuit; if desired, these two switches may be combined in a single unit.

The operating coil 51 for solenoid valve 39 has one terminal connected to power line 46, as indicated in Fig. 4, the other terminal of the solenoid being connected to power line 45 through a normally-closed limit switch 52 and a normally-open solenoid-operated limit switch 53, the operating coil for switch 53 being indicated at 54 in Fig. 4. As indicated in Fig. 1, switch 52 is located within the base portion of lower tub section 13, whereas limit switch 53 is positioned near the upper edge of the upper tub section 12.

In operation, tub 11 is filled with a detergent solution, preferably approximately to the level indicated at 55. The material to be washed, such as clothing or other fabrics, is disposed in the several spaces separating support members 21, 26, 27, and 28, the entire support member assembly being locked together by cap 33 after the material to be washed is placed in position. Cover 15 is then mounted upon the washing machine and the machine is ready for operation.

For the control arrangement shown in Fig. 4, solenoid valve 39 must be energized to operate the piston rod 17 in a downward direction and must be de-energized in order to impell the piston rod upwardly. Assuming that operation is started in the position as shown, wash cylinder 23 is in engagement with limit switch 53, closing the limit switch and therefore maintaining solenoid valve 39 in energized condition. As soon as master switch 47 is closed, therefore, and pump 40 is energized, fluid under pressure from pump 40 is impelled from the pump outlet port 43 into valve 39 and into hydraulic cylinder 35 through inlet port 38. The incoming oil or other hydraulic fluid impells piston 34 downwardly, any fluid in the cylinder being forced out through port 37 and back through valve 39 into the pump inlet port 42. Consequently, piston rod 17 is moved downwardly along with piston 34.

As piston rod 17 moves downwardly, bringing the support assembly comprising the several perforate support members and wash cylinder 23 with it, the wash cylinder is effectively sealed to lower tub section 13. Because the wash cylinder contacts the surface of the washing solution before the support member 21, the air entrapped within the cylinder, as well as the washing liquid, is forced through the material supported within cylinder 23. Consequently, a very positive washing action is afforded for the material supported within wash cylinder 23.

As soon as cylinder 23 begins its downward movement, it is released from engagement with limit switch 53 but this switch is maintained closed by energization of its operating coil 54. Consequently, the downward movement of the cylinder continues until the wash cylinder engages limit switch 52, opening this switch and de-energizing operating coil 54 and solenoid coil 51. When this occurs, solenoid valve 39 reverses its internal fluid connections and, as a consequence, the fluid under pressure from pump 40 is impelled into hydraulic cylinder 35 through port 37 and is drained therefrom through port 38 and back through valve 39 to the pump. Accordingly, piston 34 is impelled upwardly until such time as wash cylinder 23 encounters limit switch 53 and again completes the control circuit, at which time the action is again reversed. Thus, the simple control scheme illustrated in Fig. 4 effectively controls the washing cycle to maintain reciprocal vertical movement of piston rod 17 with its associated wash-supporting structure within tub 11. Reciprocal movement of the piston rod and the members supported thereon is continued until the contents of the washer are thoroughly cleansed. Of course, the speed of reciprocation of the piston within tub 11 is dependent upon the capacity of pump 40, which should be selected to afford operation at a rate at least of the order of three complete cycles or oscillations per minute. If the reciprocal action of the piston is increased unduly in speed, the fluid forced through the wash cylinder may damage the material being washed to some extent, although this is not likely to occur unless speeds very greatly in excess of that indicated above are achieved; on the other hand, excessive speed may lead to distortion of the support members 21, 26, 27 and 28. Too slow a speed, on the other hand, may substantially reduce the efficiency of the washing action and may therefore require excessive time in operation.

After the contents of the washer have been thoroughly cleansed, the washing machine may be shut down by opening master switch 47 and valve 14 may be opened to drain the detergent solution, after which tub 11 may be refilled with clear liquid. The washed material may then be rinsed in the same manner as employed for washing. Of course, the speed of operation of the washer may be controlled by incorporating a suitable speed control in the energizing circuit for motor 41, although such a control is not essential. The motor speed may also be adjusted to change speed of operation of the washing machine in accordance with the density of material to be cleansed.

After the washing and rinsing operation has been completed, the machine may again be shut down and drained, after which it is again set in operation with heat control switch 49 closed to energize heating coils 48. When washing fabrics, it is preferable that the cleansed material be wrung out before the drying operation entailed in use of heater coils 48 is initiated. Heat from coils 48 substantially raises the temperature of the air within the closed chamber defined by tub 11 and cover 15 and the reciprocal movement of the wash cylinder within tub 11 forces the heated air through the material. Consequently, the machine may be employed to effect relatively rapid drying of the clothing or other fabric after washing has been completed. This action, like the washing action, is of course materially assisted by the provision of the flexible packing ring 25 on cylinder 23, which permits operation of the wash cylinder as an air piston during the drying operation and as a hydraulic piston during the washing operation. The drying temperature within the washer may of course be controlled in the usual manner by thermostat 50.

In many instances it may be desirable to afford a constant temperature for the washing solution during the washing operation. A variable thermostat may be utilized for element 50 and may be set to maintain the desired washing temperature within the machine throughout the

washing cycle. The thermostat may then be set at a higher temperature for the drying cycle of the machine. Morever, the same machine may be utilized for washing dishes or other non-fabric articles in essentially the same manner as described hereinabove in connection with the cleansing of fabrics. When it is desired to utilize the machine as a dish washer, it may be desirable to substitute wire or other suitable racks for the support members 26, 27, and 28 in order to hold the dishes in fixed position within the wash cylinder or to add such racks to the support members.

It will be understood that the control arrangement illustrated in Figs. 1 and 4 is typical of a wide variety of electrical control schemes which may be employed for this purpose and may be varied as desired. Moreover, mechanical-control arrangements, coupled with a mechanically-controlled four-way valve, may also be used for this purpose, such arrangements being well known in the art. Indeed, the use of a hydraulic driving system for piston 17 is in no way essential to operation of the invention, and other driving arrangements such as cam-operated systems for obtaining the requisite reciprocal movement of the operating piston rod may be utilized as desired.

From the foregoing structural and operational description of the invention, it will be apparent that the inventive concept provides a washing machine which is relatively simple in construction yet which affords a positive washing and/or drying action without entailing undue wear or other damage to the material being washed, whether it be fabrics, dishes, or other articles. The washing machine of the invention is simple to operate and may be made completely automatic by relatively simple controls, as will be apparent to those skilled in the art.

Hence, while I have illustrated and described the preferred embodiment of my invention, it is to be understood that this is capable of variation and modification, and I therefore do not wish to be limited to the precise details set forth, but desire to avail myself of such changes and alternations as fall within the purview of the following claims.

I claim:

1. A washing machine comprising: a cylindrical tub comprising an upper section and a lower section, said upper section having an inside diameter substantially larger than the inside diameter of said lower section; an axially movable piston rod extending vertically into said tub approximately at the center thereof; a substantially imperforate open-ended wash cylinder mounted on said piston rod and having an outside diameter smaller than that of said upper tub section so as to provide a circumferential space between the wash cylinder and the upper tub section when the wash cylinder is moved into the upper tub section, the outside diameter of said wash cylinder being substantially equal to that of said lower tub section so as to have a substantial seal fit therewith when moved into the lower tub section, said wash cylinder having a height smaller than the height of said upper tub section; at least one perforate support member, having a cross-sectional configuration and area corresponding to said wash cylinder, supported within said cylinder for movement therewith at a position substantially above the bottom of said cylinder; and driving means operative to effect reciprocal axial movement of said piston rod to reciprocate said wash cylinder upward into said upper section to dispose the bottom of the wash cylinder above the upper end of said lower section permitting free flow of liquid from said upper section to said lower section downward through said circumferential space when said wash cylinder is so disposed in said upper section, and said driving means being operative to effect lowering of said wash cylinder into said lower section whereby the wash cylinder then serves as a piston causing a violent surge of fluid upward into said upper section.

2. A washing machine according to claim 1 wherein said piston rod extends vertically through said wash cylinder and there are a plurality of perforate support members having openings in the medial portions freely surrounding said piston rod so as to be removable from the piston rod, and wherein said perforate support members are located within said wash cylinder and are spaced one from another by separators concentric to the piston rod and interposed between each pair of perforate supports to space the same.

3. A washing machine according to claim 1 wherein the upper and lower sections of the tub are of substantially equal height.

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