

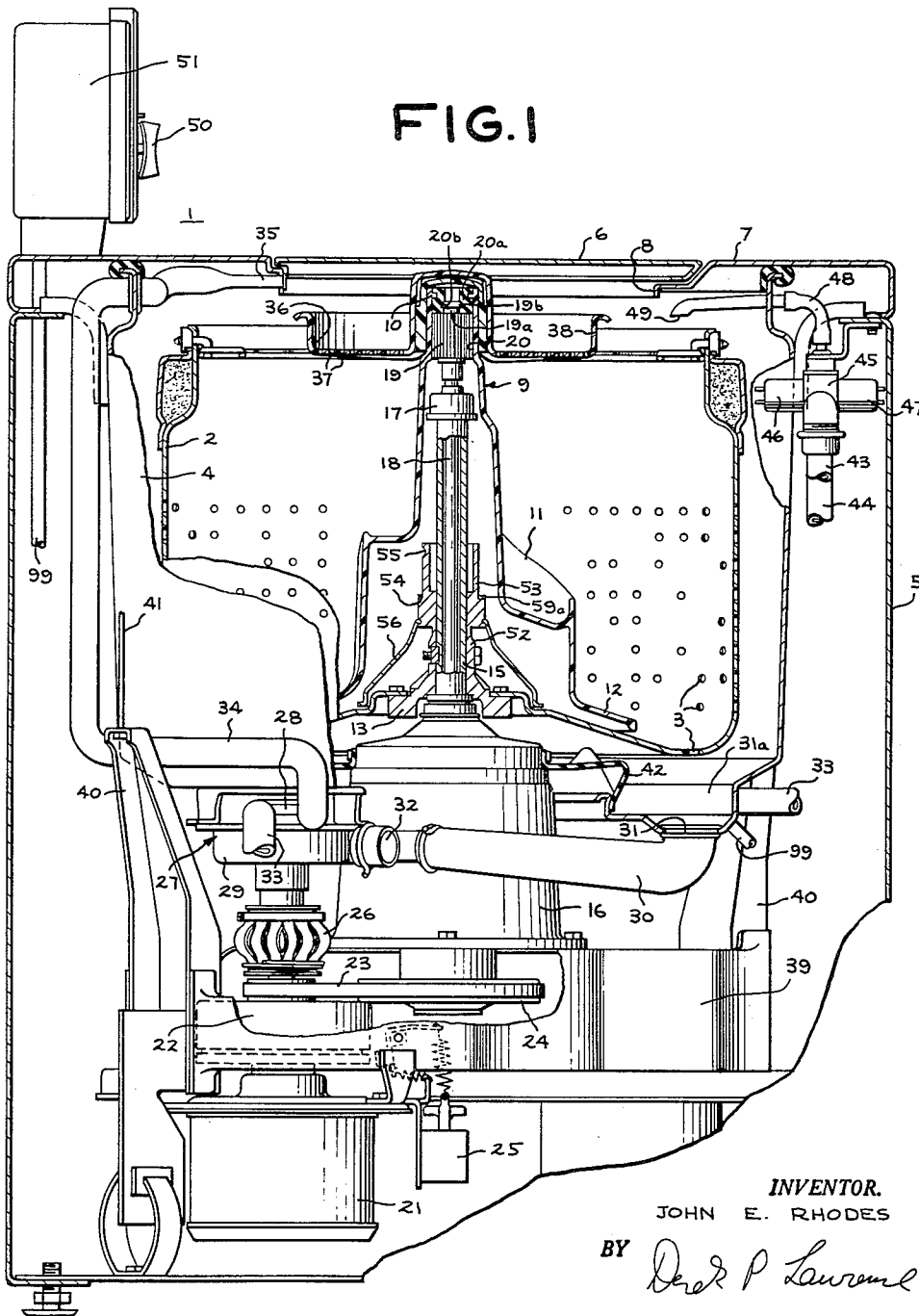
May 28, 1963

J. E. RHODES  
CLOTHES WASHING MACHINE

3,091,107

Filed March 26, 1962

4 Sheets-Sheet 1



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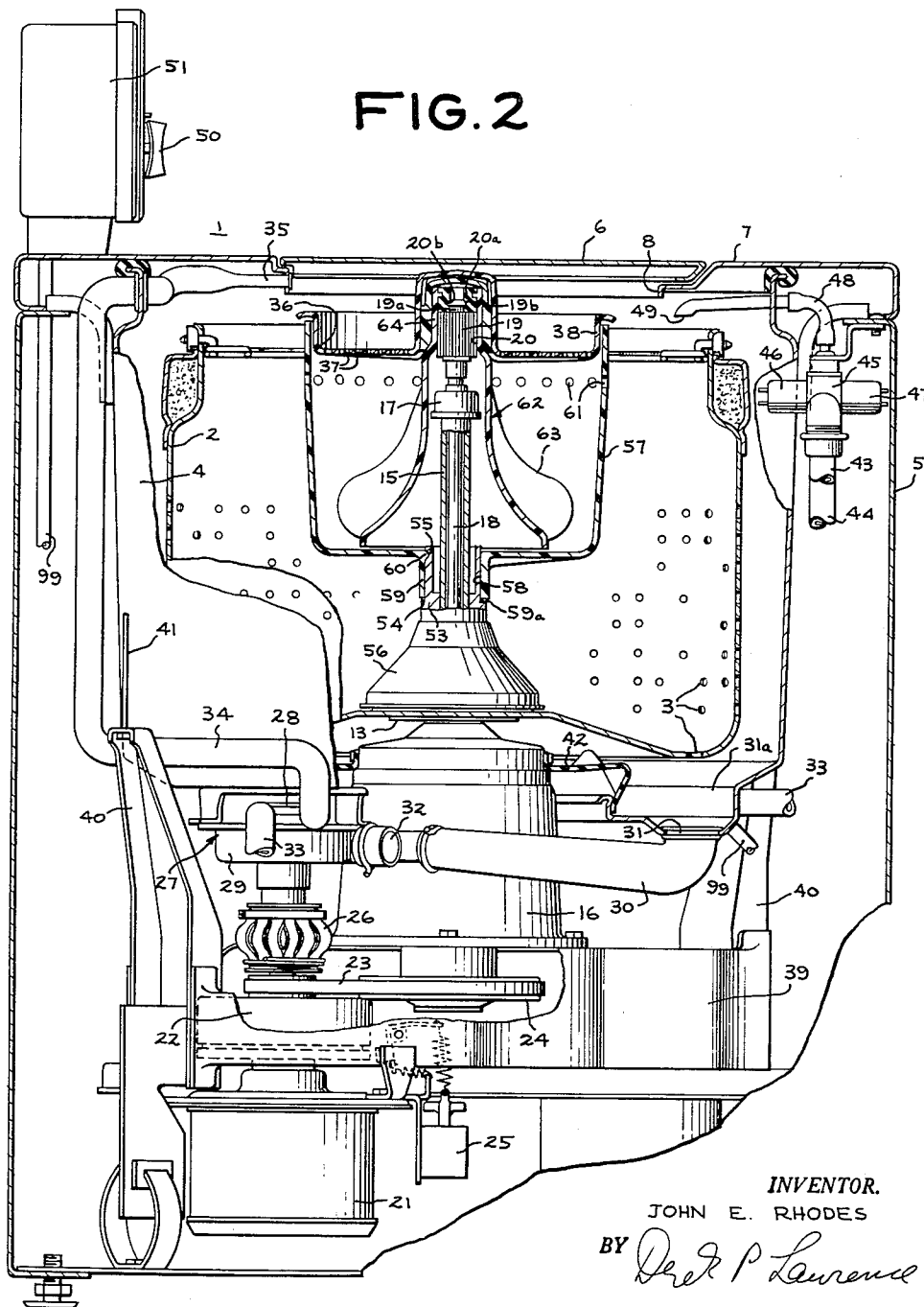
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4 Sheets-Sheet 2



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4 Sheets-Sheet 3

The schematic diagram illustrates a control system for a pump assembly. The main power supply is connected to a network of components including switches (70, 71, 72, 73, 74, 75, 76, 77, 78, 79), relays (80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91), solenoids (92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113), and various sensors or actuators (65, 66, 67, 68, 69). The system is designed to manage the flow of fluid through the pump assembly, which includes a motor (100) and various valves (101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113). The control logic involves multiple interlocking mechanisms to ensure safe and efficient operation.

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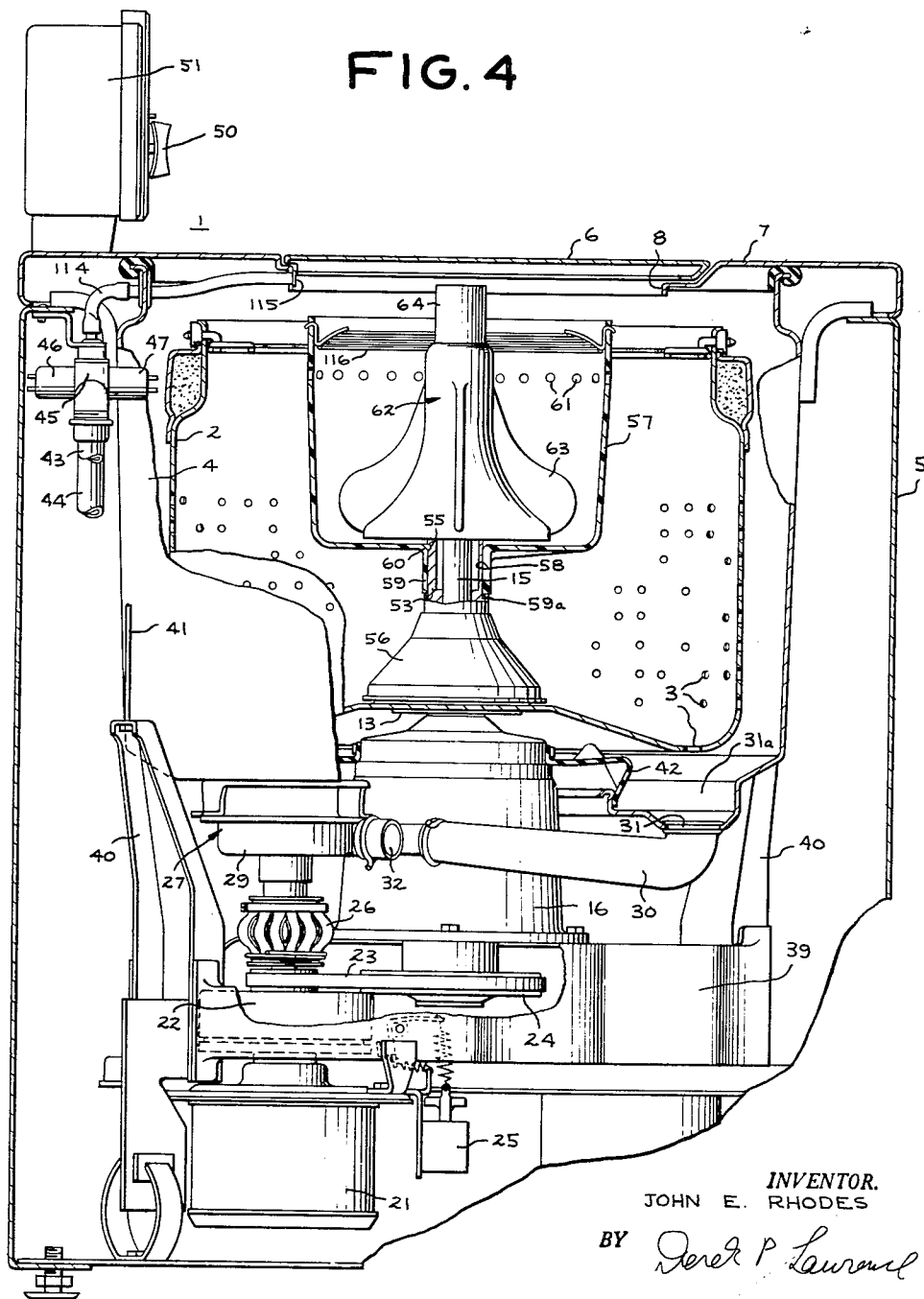
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3,091,107

CLOTHES WASHING MACHINE

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4 Sheets-Sheet 4



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3,091,107

## CLOTHES WASHING MACHINE

John E. Rhodes, Louisville, Ky., assignor to General Electric Company, a corporation of New York  
Filed Mar. 26, 1962, Ser. No. 182,265  
9 Claims. (Cl. 68—4)

This invention relates to automatic clothes washing machines, and more particularly to an improved structure in such machines for effecting the washing of very small loads of clothes.

Automatic clothes washing machines customarily provide, in a clothes basket adapted to hold several pounds of clothes, a sequence of operations in order to wash, rinse and dry the clothes in the basket. The sequence ordinarily includes a washing operation which, in vertical axis type machines, is provided by an agitator movably arranged within the basket; a first centrifugal liquid extraction operation in which the wash water is removed from the clothes by spinning the basket; a rinsing operation in which the clothes in the basket are rinsed in clean water; and a final centrifugal liquid extraction operation in which the basket is spun to remove the rinse water from the clothes. Machines having this type of cycle, or a variation thereof, generally produce highly satisfactory results in that the clothes in the machine come out properly clean and with a substantial part of the liquid removed.

As stated, in order to have an adequate capacity the clothes containing basket must be large enough to accept several pounds of clothing, generally in the range of 8–12 pounds, and to contain them loosely enough so that a satisfactory washing effect will be obtained. Because of this prime factor, that of adequate clothes capacity, the clothes containing basket presents some disadvantages when a very small load of clothes is to be washed. This type of load may occur for various reasons, but in particular it occurs with respect to delicate and dainty garments which should not be washed at the same time as other heavier garments, and with respect to clothes which are not colorfast, such as some socks, and therefore would harm other clothing if washed with it.

One disadvantage which presents itself when very small loads are washed in the basket of a washing machine is that the amount of water required for washing a few small garments may be comparable to the amount of water used for washing several pounds of clothing. This, of course, represents an inefficient use of water with a resulting high cost of water in consideration of the result being obtained. Also, there is the corollary that the greater the quantity of water used, the greater the quantity of detergent needed in order to effect a proper detergent concentration in the water, and this too represents an increased cost factor. Considerations such as these have quite often led the owners of domestic automatic clothes washing machines to do their washing of small quantities of garments by hand despite the availability of the machine.

It is an object of this invention to provide an improved automatic washing machine wherein the washing of small quantities of clothing is made possible without the requirement that a substantial amount of water be introduced into the conventional clothes receiving basket.

A further object of my invention is to achieve the desired result of facilitating the washing of small quantities of clothes by providing (a) a main agitator for the machine which is removable from the agitator drive shaft, and (b) a small basket which may be secured within the large basket and a small agitator to be secured on top of the agitator shaft, so that a miniature complete washing machine basket and agitator may be provided when the main agitator is removed.

In one aspect of my invention, I provide a vertical axis

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washing machine which has the conventional liquid and clothes containing means including the usual relatively large clothes basket rotatable at high speed for the removal of liquid from the clothes. Within this basket, there is a relatively large agitator removably mounted on appropriate agitator mounting means which extends upwardly into the basket. The agitator mounting means may be moved in such a way as to impart a washing action to the agitator when it is secured thereon.

Secured to the large clothes basket, there is appropriate means for mounting a relatively small second clothes basket within the large basket. This basket mounting means is positioned in the large basket about the agitator mounting means and is concealed beneath the large agitator when it is in position so that, in normal use of the machine, the mounting means for the small clothes basket is neither visible nor accessible. However, when the large agitator is removed, a relatively small substantially imperforate clothes basket may be removably secured on this mounting means. In addition, a relatively small second agitator may be removably secured on the agitator mounting means. Thus, in effect, a very small basket and a very small agitator are provided to effect the washing of very small loads, this entire additional structure being made possible by the ready removal of the main agitator.

In one embodiment of my invention I maintain the small basket filled by an appropriate recirculation system, the concept being that water will be circulated into the small basket, overflow therefrom, and then be recirculated around again. In a second embodiment, in view of the fact that the small basket is stationary during washing and there will be relatively little loss of liquid therefrom, I provide only a water inlet which discharges directly into the small basket; thus, in machines wherein no recirculation is provided, my invention may nonetheless be used.

The subject matter which I regard as my invention is particularly pointed out and distinctly claimed in the concluding portion of this specification. The invention itself, however, both as to its organization and method of operation, may best be understood by reference to the following description taken in conjunction with the accompanying drawings.

In the drawings, FIGURE 1 is a side elevational view of a clothes washing machine including my invention, the view being partially broken away and partially in section to illustrate details;

FIGURE 2 is a side elevational view of the clothes washing machine of FIGURE 1 showing the machine with the small basket and small agitator of my invention mounted thereon;

FIGURE 3 is a schematic diagram of an electrical control circuit suitable for use with the machine of FIGURE 1; and

FIGURE 4 is a side elevational view of a washing machine incorporating a second embodiment of my invention.

Referring now to FIGURE 1, I have shown therein a washing machine 1 having a conventional basket or clothes receptacle 2 provided over its side and bottom walls with perforations 3 and disposed within an outer imperforate tub or casing 4. Tub 4 is mounted within an appearance cabinet 5 which includes a cover 6 hingedly mounted in the top portion 7 of the cabinet for providing access to an opening 8 to the basket 2. At the center of the basket 2 there is positioned a vertical axis agitator 9 which includes a top mounting portion 10 and a plurality of curved water circulating vanes 11 joined at their lower ends by an outwardly flared skirt 12.

Both the clothes basket 2 and the agitator 9 are movably mounted. The basket is mounted to a flange 13, and flange 13 is secured to an upwardly extending sleeve 15 arranged to extend upwardly out of a transmission

assembly 16 so as to be rotatable thereby as will be explained herebelow.

At the top of sleeve 15 there is provided a combination seal and bearing, generally indicated at 17, which provides the top rotatable support for an agitator shaft 18 extending upwardly within the sleeve 15, and concentrically therewith, out of the transmission 16. The agitator shaft extends up through the bearing 17 so as to be supported in rotatable relation to the sleeve 15, and terminates at its upper end in a male splined portion 19 topped by an upwardly extending part 19a having an annular latching ridge 19b. The internal surface of the top agitator mounting part 10 is formed as a female splined surface 20 so that the agitator may be slipped over the agitator shaft 18 and the splined surfaces will go into mating engagement. This secures the agitator on the shaft for rotation therewith, providing an effective cooperative relationship whereby the agitator is caused to oscillate in a rotary path by the mounting means as will be further described herebelow. In addition, a part 20a of relatively soft rubber may be secured within part 10 above surface 20. Part 20a has an annular recess 20b into which ridge 19b fits when agitator 9 is properly in position. This engagement of ridge 19b in recess 20b secures the agitator against unwanted vertical motion during machine operation, but is yieldable enough to permit ready removal of the agitator by the operator.

With the structure shown, the agitator may be oscillated back and forth in a horizontal plane, i.e., on a vertical axis, by oscillating rotation of shaft 18, and the basket may be rotated at high speed by rotation of the sleeve 15 and hub 13. During a cycle of operation of the machine 1, liquid is introduced into tub 4 and the agitator is oscillated back and forth on its axis within the basket 2 to wash the clothes therein. Then, after a predetermined period of this washing action, the basket 2 is rotated at high speed to extract centrifugally the washing liquid from the clothes and discharge it to drain, as will be explained. Following this extraction operation, a supply of clean liquid is introduced into the basket for rinsing the clothes and the agitator is again oscillated. Finally, the basket is once more rotated at high speed to extract the rinse water.

Basket 2 and agitator 9 may be driven by any suitable means as the drive means forms no part of the present invention. However, by way of example, I have shown them as driven from a reversible motor 21. Motor 21 drives the basket and the agitator through a drive including a clutch 22 which is mounted on the motor shaft. This clutch allows the motor to start without a load and then to accept the load as it comes up to speed. A suitable belt 23 transmits power to the transmission assembly 16 through a pulley 24. Thus, depending upon the direction of motor rotation, pulley 24 of transmission 16 is driven in opposite directions. Preferably, as will be more fully explained herebelow, transmission clutch 22 is also a two-speed clutch, and a solenoid member 25 is provided in order to achieve the two-speed operation. Specifically, in the illustrated machine, when solenoid 25 is de-energized clutch 22 provides a direct drive between motor 21 and pulley 24, and when solenoid 25 is energized clutch 22 provides a reduced speed drive to pulley 24. A two-speed clutch of this type, particularly suited for use in the illustrated machine, is described in detail and claimed in Patent 2,869,699 issued to John Bochan on January 20, 1959 and assigned to the General Electric Company, assignee of the present invention.

The transmission 16 is so arranged that it supports and drives both the agitator drive shaft 18 and the basket mounting flange 13 and sleeve 15. When motor 21 is rotated in one direction the transmission causes the agitator 9 to oscillate in a substantially horizontal plane within the basket 2. Conversely, when the motor 21 is driven in the opposite direction, the transmission rotates the wash basket 2 and agitator 9 together at high speed

for centrifugal extraction of liquid from clothes in the basket. While the drive mechanism forms no part of the invention, reference is made to Patent 2,844,225 issued to James R. Hubbard et al. on July 22, 1958 and owned by the General Electric Company, assignee of the present invention. That patent discloses in detail the structural characteristics of a transmission assembly suitable for use in the illustrated machine.

In addition to operating the transmission 16 as described, motor 21 also provides a direct drive through a flexible coupling 26 to a pump structure generally indicated at 27. Pump structure 27 may include two separate pumping units 28 and 29 both operated simultaneously by motor 21. Pumping unit 29 has an inlet which is connected by a conduit 30 to an opening 31 formed in a sump 31a at the lowermost point of tub 4. Pump 29 also has an outlet connected by a conduit 32 to a suitable drain (not shown). The pump 28 has an inlet connected by a conduit 33 to the interior of tub 4 at sump 31a and an outlet connected by a conduit 34 to a nozzle 35. The pumps are formed so that in the spin direction of motor rotation pump 29 will draw in liquid from opening 31 through conduit 30 and then discharge it through conduit 32 to drain, and in the other direction of rotation pump 28 will draw in liquid through conduit 33 and discharge it through conduit 34 and nozzle 35, each of the pumps being substantially inoperative in the direction of rotation in which it is not used.

Nozzle 35 is positioned to discharge into a filter pan 36 secured to the outside surface of portion 10 of agitator 9 so as to be movable therewith. With this structure then, when the motor is rotating so as to provide agitation, pump 28 draws liquid through conduit 33 from tub 4 and discharges it through conduit 34 so that the liquid passes from the nozzle 35 through an air gap, into filter pan 36, then down through a number of small openings 37 provided in the bottom of the filter pan, and back into basket 2. In this manner, the filter pan 36, with its small openings 37 and its upstanding side wall 38, causes lint which is separated from the clothes during the washing operation to be filtered out of the water, and thus prevents it from being redeposited on the clothes. This type of structure is more fully described and claimed in Patent 2,481,979 issued to Russell H. Colley on September 13, 1949 and assigned to the General Electric Company, owner of the present invention.

The motor 21, transmission 16, basket 2 and agitator 9 form a suspended washing and centrifuging system which is supported by the stationary structure of the machine so as to permit isolation of vibrations from the stationary structure. It will be understood that such vibrations occur primarily as a result of high speed spinning of basket 2 with a load of clothes therein, as mentioned above. While any suitable suspension structure may be used, one such structure includes a bracket member 39 with transmission 16 mounted on top thereof and motor 21 mounted to the underside thereof. The bracket member in turn is secured to upwardly extending rigid members 40, and each of the two upwardly extending members 40 is connected to a cable 41 supported from the top of the machine. Only a portion of the suspension system is shown in FIGURE 1; such a vibration isolating system is fully described and claimed in Patent 2,987,190 issued on June 6, 1961 to John Bochan and assigned to the General Electric Company, assignee of the present invention.

In order to accommodate the movement which occurs between basket 2 and tub 4 without any danger of leakage between them, the stationary tub 4 is joined to the upper part of transmission 16 by a flexible boot member 42. Boot 42 may be of any suitable configuration, many of which are known in the art, to permit relative motion of the parts to which it is joined without leakage therebetween.

Hot and cold water may be supplied to the machine

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1 through conduits 43 and 44 which are adapted to be connected respectively to sources of hot and cold water (not shown). Conduits 43 and 44 extend into a conventional mixing valve structure 45 having solenoids 46 and 47. Energization of solenoid 46 permits passage of hot water through the valve to a hose 48, energization of solenoid 47 permits passage of cold water through the valve, and energization of both solenoids permits mixing of hot and cold water in the valve and passage of warm water into hose 48. Hose 48 has an outlet 49 positioned to discharge into basket 2 so that when one or both of the solenoids 46 and 47 are energized, water passes into the basket 2 and tub 4.

The level to which water rises in the basket and tub may be controlled by any suitable means either of the liquid level sensing type or of the time operated type. In this connection one particular suitable arrangement is schematically shown in FIGURE 3 for purposes of illustration and will be described in connection with that figure. Continuing with respect to FIGURE 1, the selection of level is generally achieved by suitable manual controls, such as those shown by the numeral 50, extending from a backsplash control structure 51. In addition to the liquid level, the controls 50 will normally be suitable for permitting selection of various factors, such as washing and spin speeds, water temperatures, and the like so as to permit the effective washing of different types of fabrics.

Returning now to the structure for driving basket 2 from transmission 16, it will be observed that the flange 13 includes an upwardly extending portion 52 which terminates in a mounting structure 53. Structure 53 has a shoulder 54 for a purpose to be hereinafter described, as well as a locking keyway or indentation 55 whose purpose will also become apparent hereafter. Secured to the bottom of member 53, there may be provided a skirt 56 which has a base fitting against the bottom of the main basket 2. It will be observed that this entire structure is within the hollow agitator 9 when agitator 9 is positioned as shown in FIGURE 1, so that this structure does not interfere with the washing action and does not come in contact with clothes when they are being washed within the basket 2.

It will be recalled that agitator 9 is removably mounted on the agitator mounting means by virtue of the mating engagement of the male and female splines 19 and 20. Accordingly, it will be seen that not only may the filter pan 36 be removed from the top of agitator 9, but the agitator itself may readily be removed to expose the male spline member 19 and the mounting means 53.

Referring now to FIGURE 2, there is shown a small substantially imperforate basket 57 with an opening 58 at its bottom end formed by a downwardly extending sleeve 59. Sleeve 59 is so formed that it fits snugly over the upper portion of mounting member 53, and may be pushed downwardly until the bottom of the sleeve comes into engagement with the shoulder 54 of member 53, or, preferably, with a sealing washer member 59a of any suitable material such as relatively soft rubber. In addition, the sleeve has an indentation or projection 60 which fits into the recess 55 of member 53 so as to lock the sleeve 59 to member 53 for movement therewith. It will be observed that the basket 57 is sealed closed at its bottom end by this engagement. Near the top of the basket 57 there is provided a row of openings 61 so that when the liquid level within the basket 57 reaches the openings, the water overflows to keep the liquid level at the openings.

Once the small basket 57 has been positioned as shown, a special small agitator 62 may be positioned within basket 57. Agitator 62 will generally be provided with suitable washing vanes 63, and with a top portion 64 which has the same inner female spline structure as agitator 9, permitting it to be secured over

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the member 19. Also, the same latching structure to preclude unwanted vertical motion will preferably be provided as shown.

The outside of small agitator 62 may be formed so that it supports the filter pan 36 in the same manner as does agitator 9. This, then, provides a complete washing structure which includes the imperforate basket 57 secured to mounting member 53, together with agitator 62 movable within the basket 57. Further, the filter pan 36 serves as a means for retaining clothes within the basket 57.

It will readily be seen that because mount 53 is secured to move with basket 2, the basket 57 also so moves, and because the agitator 62 is mounted on the same mounting member 19 as the agitator 9, it also has a similar movement when operated. The same sequence of washing by the oscillation of the agitator and of liquid extraction by high speed rotation of the basket may be followed as was true with the large agitator 9 and large basket 2, shown in FIGURE 1. It will further be seen that this is effected in a most satisfactory manner by a structure which is entirely concealed by virtue of the large agitator 9 when it is in its use position.

The provision of this small basket and agitator combination makes possible the washing of very small loads of clothes without use of an excessive amount of water. As will be explained herebelow in connection with the control circuit of FIGURE 3, a very small amount of water may be provided when the small basket 57 is to be used. Preferably, this amount of water is equal to the capacity of the small basket 57 up to opening 61, plus half a gallon or a gallon. With this amount of excess water, when the recirculation system starts to operate water will be pumped up through conduit 34 and out through nozzle 35 into the basket 57, where it will overflow through openings 61 and thus undergo a continual recirculation (just as when the large basket is used).

Referring now to FIGURE 3, there is shown an electrical control system for the machine 1. It will be understood that present day washers often include various improvements such as control panel lights, bleach dispenser controls, etc., which do not relate in any way to the present invention, and that to some extent these have been omitted for the sake of simplicity and ease of understanding. In order to control the sequence of operation of washing machine 1, the circuit includes a timer motor 65 which drives a plurality of cams 66, 67, 68 and 69. These cams, during their rotation by the timer motor, actuate various switches (as will be described) so as to cause the machine to pass through an appropriate cycle of operations, first washing the clothes, next extracting the water from them, then rinsing the clothes in clean water, and finally extracting the rinse water from the clothes.

The electric circuit as a whole is energized from a power supply (not shown) through a pair of conductors 70 and 71. Cam 66 controls a switch 72 which includes contacts 73, 74 and 75. When this cam has assumed a position where all three contacts are separated, machine 1 has been disconnected from the power source and is inoperative. When operation of machine 1 is initiated, as will be explained below, switch 72 is controlled by cam 66 so that contacts 73 and 74 are engaged. When the main switch 76 is closed, power is then provided to the control circuit of the machine from conductor 70 through contacts 73 and 74. From contact 74 the circuit extends through a conductor 77 and a manually operable switch 78 to the control solenoid 46 of the hot water valve. Also, from conductor 77, a circuit extends through a manually operable switch 79 to the control solenoid 47 of the cold water valve. In addition, a circuit is completed from conductor 77 through a conductor 80 to the switch arm 81 of a switch 82 controlled by the cam 67. When switch arm 81 is in its "up" position, engaging a contact 83, it completes a connection from conductor 80 to the cold water solenoid 47. When the switch arm 81

is in a "down" position engaging contact 84, it completes a connection from conductor 80 to the hot water solenoid 46. It will thus be seen that when switches 78 and 79 are open, energization of solenoids 46 and 47 is under the control of switch 82. When switch 78 is closed, the hot water solenoid is energized independently of the position of switch 82, and when switch 79 is closed the cold water solenoid is energized independently of the position of switch 82.

From the hot and cold water solenoids, the energizing circuit extends through a conductor 85 and the coil 86 of a relay 87, and then through the main winding 88 of motor 21 and a conventional motor protector 89 to conductor 90. The circuit is then completed through switch 91 controlled by cam 69, switch 76 and the conductor 71.

Motor 21 is of the conventional type, provided with a start winding 92 which assists the main winding 88 during the starting of the motor and is energized in parallel therewith. When a relatively high current passes through the relay coil 86, it causes the relay contact 93 to be closed and this then permits an energizing circuit for the start winding to be completed in parallel with the main winding through the contact 94 of a switch generally indicated at 95, contact arm 96, the relay contact 93, the start winding 92, contact arm 97 of switch 95, and contact 98 of the switch. A circuit is also completed in parallel with motor 21 from conductor 85 through the timer motor 65.

The relay coil 86 is designed to close contact 93 when a relatively high current, of the level demanded by the motor when the rotor is rotating below a predetermined speed, is passing through it. At other times, when there is no current passing through the relay coil 86, or when the current is below the required energizing level as is true at running speed of the motor, the contact 93 is open.

When the main winding 88 of motor 21 is in series with the valve solenoids 46 and 47 as described, a much lower impedance is presented in the circuit by the motor 21 than is presented by the valve solenoids. As a result, the greater portion of the supply voltage is taken up across the solenoids and relatively little across the motor. This causes whichever of the solenoids is connected in the circuit to be energized sufficiently to open its associated water valve. As a result, water at the selected temperature is admitted to the machine through inlet 49, motors 21 and 65 remaining inactive.

This action continues, with the circuitry thus arranged, so that the water pours into the basket 2 and tub 4. Because of the perforations 3 in the side of basket 2, the water rises in both basket and tub at the same rate. As the water rises, it exercises an increasing head of pressure on air which is trapped in a conduit 99 (FIGURE 1) connected to the sump 31 of tub 4. This pressure is transmitted through the column of air up to a pressure sensitive mechanism which is not shown in FIGURE 1, but which may be positioned within the control panel 51. This level control mechanism is schematically shown by the numeral 100 in FIGURE 3.

The structure of mechanism 100 is such that, upon a predetermined air pressure being transmitted through conduit 99, switch 101 is actuated. Mechanism 100 is adjustable so that the de-energization of the solenoids 46 and 47, and the starting of motors 21 and 65, may be achieved at any one of four levels within tub 4. Three of these may be such as to provide various washing levels within the basket 2; the other level is substantially less than that required for any washing to be achieved within the basket 2. This selection of levels may be effected by any suitable means; for instance, a suitable manual control may be used to rotate a cam 102 to four different positions so as to move the fixed contact 103 of switch 101 closer to or farther from a movable contact 104 controlled by a diaphragm 105 responsive to the pressure in tube 99.

Once the two motors 21 and 65 have been put into operation by the closing of switch 101, then they continue to operate until opening of switch 91 by cam 69 causes the drive motor 21 to cease operation, the timer continuing to operate. When this occurs, motor 65 continues to be operated through switch 101.

It will be observed that when switch arms 96 and 97 are moved by cam 68 to engage contact 98 and a contact 106 respectively, the polarity of the start winding is reversed since the circuit from conductor 85 then proceeds through contact 106, contact arm 97, start winding 92, contact arm 93, contact arm 96 and contact 98 to the protective device 89 and conductor 90. With motor 21 stopped, the reversal of switch 95 is effective, then, to cause the motor to operate in the opposite direction from that previously provided once the motor is started up again. In order to energize motor 21 independently of the water level switch and the valve solenoids during the next rotation of the motor (which, as explained, provided spin) cam 66 causes all three contacts 73, 74 and 75 of switch 72 to be closed for the extraction, or spin, step so that power is supplied through contact 75 and conductor 85 to the motors directly rather than through the water level switch and the valve solenoids. At the end of a spin step, switch 91 is opened again. The impedance of motor 65 is made much greater than that of the valve solenoids. Thus, at the end of a spin step, when switch 91 opens, motor 65 takes up most of the supply voltage and continues in operation even after contact 75 of switch 72 is once more disengaged, leaving so little voltage across the solenoids that they do not operate their respective valves.

Operation of cams 66, 67, 68 and 69 by the timer motor 65 to actuate switches 72, 82, 95 and 91 in a predetermined sequence thus effects the basic washing operation by causing provision of a washing step (filling followed by oscillation of the agitator), a rinsing step (similar to the washing step), and suitable extraction steps (high speed rotation of the basket) after the washing and rinsing steps.

To facilitate understanding of the operation and advantages of my invention, a full operation of machine 1 will be described in connection with the control circuit of FIGURE 3. At the beginning of a cycle, switch 76 is closed and cam 66 closes contacts 73 and 74 of switch 72. Also, contacts 81 and 84 of switch 82 are engaged, contact arms 96 and 97 of switch 95 are in the position shown, and switch 91 is closed. With this arrangement, assuming both switches 78 and 79 to have been manually opened, the hot water solenoid is energized to fill the machine with hot water until control 100 causes the closing of water level switch 101. This in turn starts the operation of the drive motor and the control motor to provide a timed washing operation.

The washing operation is terminated by the opening of switch 91 to de-energize the main motor (but not the timer motor), and during the de-energization of the main motor all three contacts 73, 74 and 75 of switch 72 are closed, switch 95 has its position reversed, and switch 91 is then closed to re-energize the drive motor which, because of the opposite connection of the start winding, starts up in the opposite direction, to provide a spin operation. At the end of the spin operation the switch 91 is again opened, the switch 95 is returned to its first position, switch 72 is returned to its first position, and contacts 81 and 83 of switch 82 are caused to engage. As a result, when switch 91 closes once more, the timer motor is de-energized, and the cold water solenoid is energized to provide cold water into the machine until the water level control switch 101 is tripped. At this time the control motor and the main motor start operation to provide the same type of agitator motion as the washing operation. This then is followed in the same manner as the washing operation by de-energization of the main motor and the change in switching appropriate to cause

the final spin operation, after which all the timer control switches are opened to de-energize the machine.

In order to attain maximum washing effectiveness with different types of loads, the speed of oscillation of the agitator mechanism during the washing and rinsing steps may be provided at either high speed or low speed, and the spin speed of the basket during spinning may also be provided at high or low speed. As stated above, solenoid 25 is provided in connection with clutch 22 in order to achieve the two output speeds of the clutch to provide for high and low speed operations.

A manually operable switch 107 controls the agitation speed, and a manually operable switch 108 controls the spin speed. When switch 107 is connected to contact 109 and conductor 110, solenoid 25 is not energized during agitation, and consequently a high speed agitation is provided; if switch 107 engages contact 111 and conductor 90, the solenoid is energized during agitation and a low speed agitation is provided. In the same manner, connection of switch 108 with contact 112 and conductor 110 precludes energization of solenoid 25 during spin and a high speed spin is provided, while connection of switch 108 to contact 113 causes energization of solenoid 25 during spin and a low spin speed is provided. The precise manner in which the setting of the switches 107 and 108 controls the energization of solenoid 25 is described in detail and claimed in Patent 2,950,612 issued August 30, 1960 to Wallace H. Henshaw and assigned to the General Electric Company, owner of the present invention. Accordingly, since it forms no part of the present invention, the precise manner in which the control of solenoid 25 is achieved will not be further described herein.

Returning now primarily to consideration of FIGURES 1 and 2, it will be recalled that control assembly 100 may be used to provide four different water levels in tub 4, three of them being operative to provide water within basket 2 and one of them being at such a low level within tub 4 that there is insufficient water in basket 2 to provide any washing action. This last low water level is provided when it is desired to use the small basket 57 to wash a very small load. When such a load is to be washed, the agitator 9 of FIGURE 1 is lifted off, and in its place the small basket 57 shown in FIGURE 2 is positioned on the mounting member 53, and the small agitator 62 is positioned on agitator mounting member 19. The filter pan 36 is then placed over the agitator so as to provide a clothes retainer at the top of the small basket without preventing the provision of water thereto through the perforations 37 in the filter pan.

When the low level selected is reached, switch 101 closes and, as described, motor 21 starts operation in a direction suitable for oscillating the agitator mechanism. As described, this also causes pump 28 to operate in the direction to pump water up through conduit 34 and out from nozzle 35 into the filter pan 36. This water then passes through the openings 37 in the filter pan and down into the basket 57 containing a small load of delicate garments. Because basket 57 is substantially imperforate the water quickly rises in basket 57 regardless of the fact that the basket 2 does not have any water or has virtually no water in it. The water continues to rise in the basket 57 until it reaches substantially to the level of overflow outlets 61. Then, because the water level is at the outlets 61, and because of the motion of the water as it is stirred up by agitator 62, water flows out of openings 61. This water then passes down into the large basket 2, and because of the perforated nature of the large basket 2, flows back to the bottom of tub 4 where the pump 28 again recirculates the water into the small basket 57.

It will be understood at this point that reference to the basket 57 as "imperforate" means, in effect, that the basket 57 is sufficiently free from openings below the level of top openings 61 that it will hold liquid substantially up to the

level of openings 61 when liquid is being recirculated from nozzle 35 as previously mentioned. In other words, the presence of a number of openings such as the small soil openings which are often conventionally provided in imperforate wash baskets, does not detract from the imperforate nature of basket 61 as meant in this context, although they do permit some leakage from the basket. On this point, it might be added, as an example, that one practical structure for basket 33 could include six openings (not shown) spaced about the bottom of basket 57, each such opening being about an eighth of an inch in diameter.

With the structure described, a proper washing action is obtained with a very small amount of water, the machine proceeding through the sequence of washing, rinsing, and extraction steps, described above. In addition, with the recirculation system shown, the same advantages of recirculation are obtained when the small basket and agitator are used as when the large basket and agitator are used. In this manner, a highly satisfactory washing action is obtained using the desired small quantity of water and detergent for the washing operation, while at the same time attaining the desired concentration of detergent needed for proper cleansing of clothes.

Referring now to FIGURE 4 of the drawings, there is shown a second embodiment of my invention which may be found appropriate for use in those machines which do not include a recirculation system of the type described in connection with FIGURES 1 and 2. In the machine of FIGURE 4, it is important that the small basket 57 be substantially without leakage below the level of openings 61, so as to preclude the dropping of the water level during washing and rinsing operation, inasmuch as there is no replenishing of the water supply within basket 57. In the machine of FIGURE 4, the same inlet valve structure is provided as in the machine of FIGURE 1, but the outlet from the valve is connected through a hose 114 to an outlet 115 which is in substantially the same position as the recirculation outlet in the structure of FIGURES 1 and 2.

With this arrangement then, the water entering the machine will, when the small basket 57 is secured in place as shown, enter the small basket 57 first. The same system of stopping the inlet flow of water may be used as in the case of FIGURE 1, the inlet flow of water stopping when the selected level within sump 31a of tub 4 has been reached.

The only other difference in the structure of FIGURE 4 from that of FIGURE 1 is that, in the structure of FIGURE 4, there is no separate member to act as a lid for the basket 57. Consequently, some suitable clothes retaining structure such as that shown by the numeral 116 is desirable so that clothes will not tend to float or be spun over the side of the basket.

Because there is no movement of the basket 57 itself during a washing operation, but only movement of an agitator within that basket, the amount of water lost through the openings 61 during washing and rinsing operations is not such as to cause any major inconvenience and therefore the structure may be used without the recirculation of FIGURES 1 and 2, although, where such recirculation is provided, it is obviously desirable to provide for recirculation at all levels, including the lowest level of water when the small basket 57 is in use.

It will be seen from the foregoing that my invention provides a desirable washing system which uses an appropriate amount of water and detergent both for large loads and for very small loads. It will be understood that while a particular type of agitator has been shown, in which an oscillating movement in a generally horizontal plane is provided, different machines have agitators with different types of motions. One motion which occurs readily to mind is of the planetary type in which the entire agitator may be moved in an orbit. Another is one in which the agitator oscillates at a rapid rate in a vertical direction

rather than in a horizontal direction. It will be obvious that agitators of both these types may be used, it being understood that some minor and obvious modifications of the manner of securing the agitator on the agitator mounting means will be necessitated.

Another point which will be clear is that, although a four level pressure switch has been described for purposes of illustration, any desired means of limiting the water input to a very low level may be used. For instance, in machines using a timed fill, a very limited amount of time will be the equivalent of the low level setting described.

While in accordance with the patent statutes I have described what at present are considered to be the preferred embodiments of my invention, it will be obvious to those skilled in the art that various changes and modifications, such as, for instance (but not exclusively), those suggested above, may be made therein without departing from the invention, and I therefore aim in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A vertical axis clothes washing machine comprising:
  - (a) liquid and clothes containing means including a relatively large rotatably mounted first clothes receptacle;
  - (b) means for rotating said first receptacle at high speed for the removal of liquid from clothes;
  - (c) agitator mounting means extending upwardly into said first receptacle and adapted to receive a relatively large first agitator which may be removably secured on said agitator mounting means for movement therewith;
  - (d) means for providing a motion to said agitator mounting means which effects a washing action by an agitator secured thereon;
  - (e) receptacle mounting means for a relatively small second clothes receptacle, said receptacle mounting means being secured to said first receptacle and positioned in said first receptacle about said agitator mounting means and concealed by said first agitator when said first agitator is secured to said agitator mounting means;
  - (f) a relatively small substantially imperforate second clothes receptacle formed to be removably secured on said receptacle mounting means when said first agitator is removed; and
  - (g) a relatively small second agitator formed to be removably secured on said agitator mounting means when said first agitator is removed.
2. The apparatus defined in claim 1 wherein said agitator mounting means includes a vertically extending shaft oscillated on its axis, and said receptacle mounting means comprises a sleeve extending up into said first receptacle about said shaft.
3. The apparatus defined in claim 1 wherein said liquid and clothes containing means includes a relatively large

imperforate outer tub for containing liquid, and said first clothes receptacle is perforate and disposed within said outer tub.

4. The apparatus defined in claim 1 including means for recirculating liquid from said first clothes receptacle back into said second clothes receptacle when it is positioned on said receptacle mounting means.

5. The apparatus defined in claim 1 wherein inlet flow means are positioned to discharge into said second clothes receptacle when it is positioned on said receptacle mounting means.

6. The apparatus defined in claim 2 wherein the top of said shaft is formed as a male splined member adapted to be engaged within a female vertically splined member formed on the inner surface of each of said agitators for securement of either of said agitators on said agitator mounting means.

7. The apparatus defined in claim 1 wherein securement means is provided adjacent the top of said agitator mounting means for securing each of the agitators thereon.

8. The apparatus defined in claim 6 including yieldable latching means arranged to releasably secure each of said agitators against vertical motion on said agitator mounting means.

9. A vertical axis clothes washing machine comprising:

- (a) liquid and clothes containing means including a relatively large first clothes receptacle;
- (b) agitator mounting means extending upwardly into said first receptacle and adapted to receive a relatively large first agitator which may be removably secured on said agitator mounting means for movement therewith;
- (c) means for providing a motion to said agitator mounting means which effects a washing action by an agitator secured thereon;
- (d) receptacle mounting means for a relatively small second clothes receptacle, said receptacle mounting means being secured to said first receptacle and positioned in said first receptacle about said agitator mounting means and concealed by said first agitator when said first agitator is secured to said agitator mounting means;
- (e) a relatively small substantially imperforate second clothes receptacle formed to be removably secured on said receptacle mounting means when said first agitator is removed; and
- (f) a relatively small second agitator formed to be removably secured on said agitator mounting means when said first agitator is removed.

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