June 4, 1963 B. L. HUBBARD 3,091,953

LAUNDRY APPARATUS HAVING LEAKAGE DETECTING MEANS

Filed Nov. 28, 1962 3 Sheets-Sheet 1

FIG. 4.

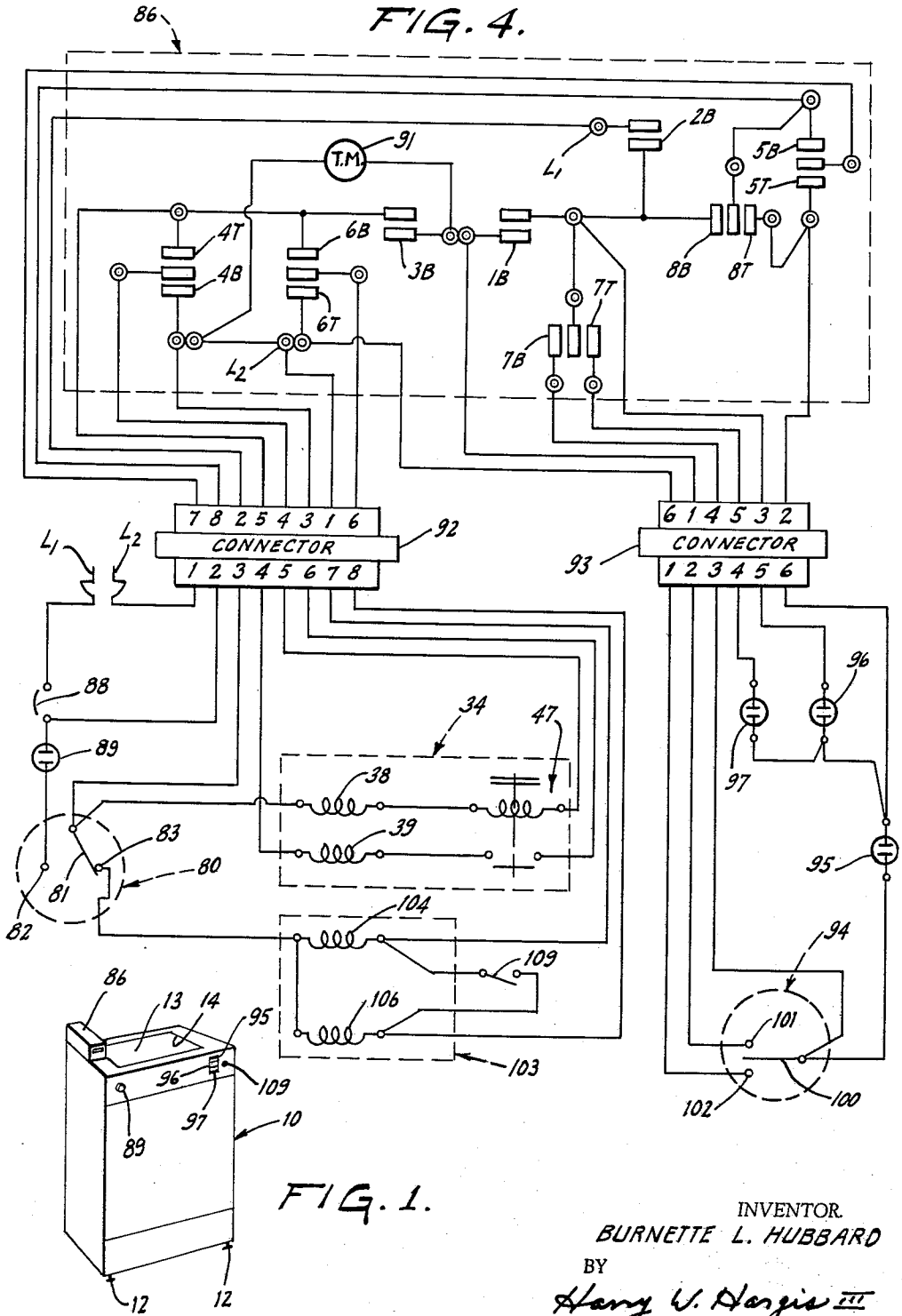


FIG. 1.

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Filed Nov. 28, 1962 3 Sheets-Sheet 2

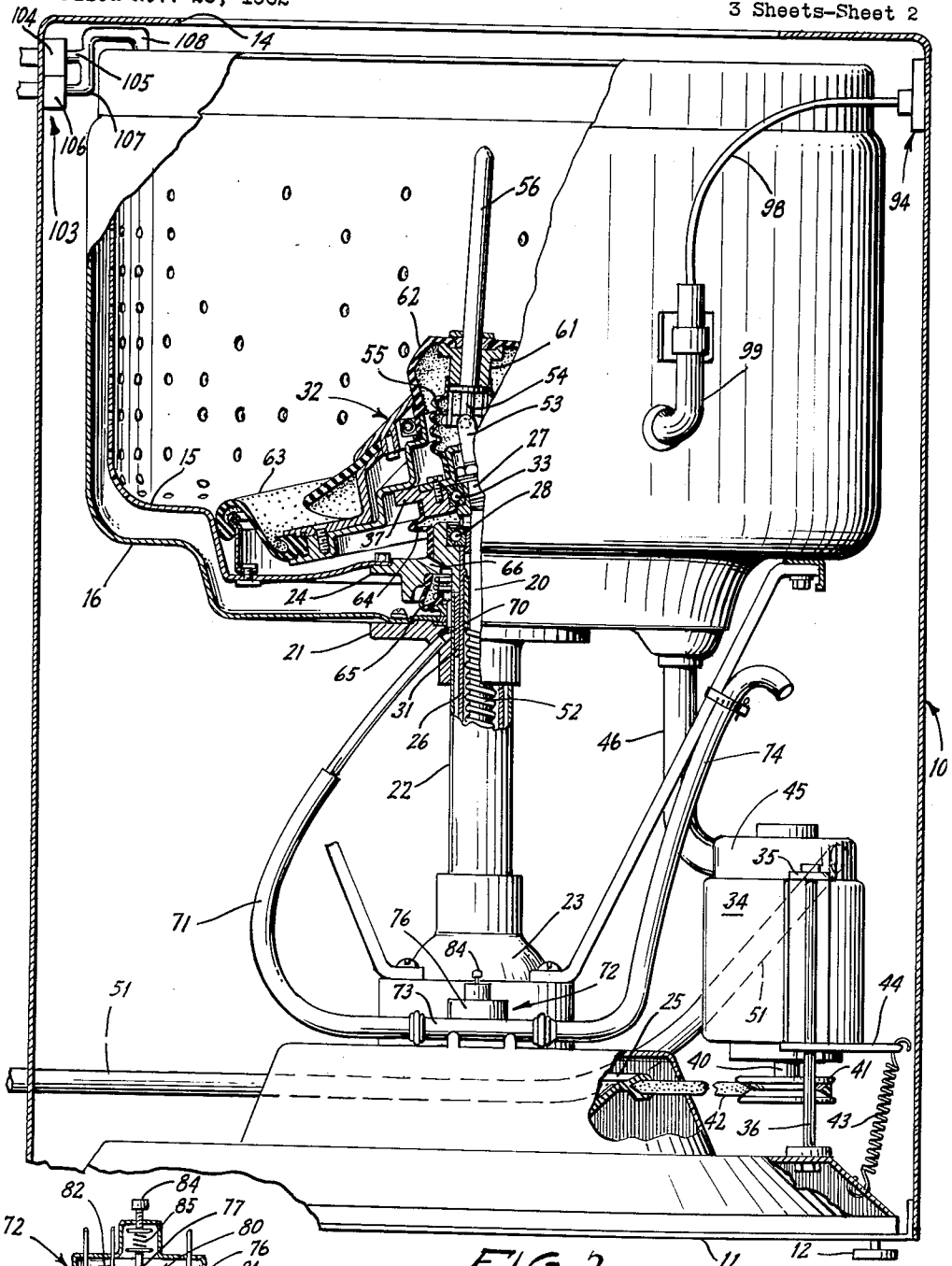


FIG. 2.

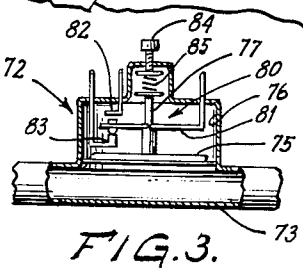


FIG. 3.

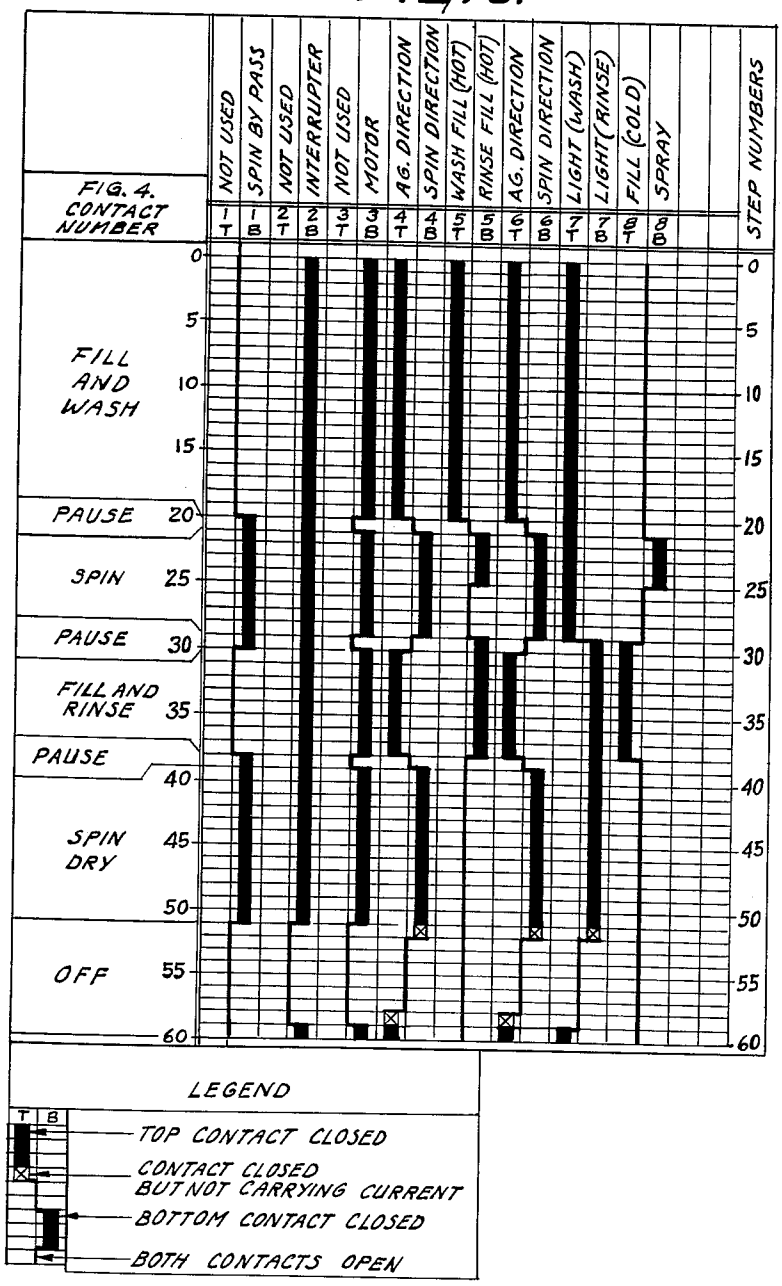
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LAUNDRY APPARATUS HAVING LEAKAGE DETECTING MEANS

Filed Nov. 28, 1962 3 Sheets-Sheet 3

FIG. 5.



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LAUNDRY APPARATUS HAVING LEAKAGE DETECTING MEANS

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9 Claims. (Cl. 68—12)

This invention relates to laundry apparatus and more particularly to means for modifying the normal operating cycle of a washing machine in the event a fluid-retaining seal should rupture. While of broader applicability, the invention has particular utility in washing machines of the vertical-axis type.

In coin-operated laundry machine establishments, washing machines are usually disposed side-by-side within a concrete basin, or the like, and rigidly anchored to the same. The basin serves to confine wash-fluid as it is drained from the machines so that it will not flow onto the floor of the building within which the machines are located. Under such conditions of installation, frequently characterized by relative inaccessibility of the floor region upon which the machines rest, it is difficult to determine when wash-fluid seals in a machine have started to leak. In view of the extensive repeated usage a coin-operated machine undergoes, leakage caused by rupture of a seal is likely to result in severe mechanical damage to transmission and bearing means normally protected by the seal.

It is therefore an object of this invention to provide means which will automatically terminate operation of a machine when leakage occurs, and until the defect causing such leakage has been corrected.

It is a further object of the invention to provide means for both detecting and indicating a leak quickly, whereby minimum damage to components will be done due to operation of a machine which has started to leak.

It is still a further objective of the invention to provide leak detecting means for a washing machine that will ensure removal of fluid from the tub prior to terminating operation thereof.

First briefly described, the invention contemplates, in a laundry machine, tub means for containing fabric treating fluid, said tub means being susceptible of leakage of fluid therefrom, means for controlling the sequence of fabric treatment including means operative sequentially to introduce fluid into and to drain fluid from said tub means, and means for detecting leakage of fluid from said tub means, operable upon detection of leakage to render inoperative said means for introducing and draining fluid, after said last recited means has operated to drain fluid from said tub means.

A preferred embodiment of the invention comprises, in combination with a washing machine having a centrally located agitator and shaft means for driving the same journalled within and extending through a lower region of the tub, conduit means connected to a region adjacent a shaft journal normally devoid of wash-fluid, the lower portion of the conduit means being connected with a fluid pressure switch having attached to its outlet another upwardly extending conduit means, the construction and arrangement being such that upon leakage of fluid into the region of the journal a liquid head is created by fluid accumulated in the switch and the conduit means, whereby to activate the pressure switch. Activation of the pressure sensing switch interrupts the energizing circuit for the fluid-fill solenoids, and completes a circuit to a warning light. Interrupting the energizing circuit for the fluid-fill solenoids will prevent the machine from again going into operation following completion of the particular cycle in which the pressure switch is actuated, since a second pressure switch is required to be actuated by fluid in the tub before the drive motor can be energized.

It is an important feature of the invention that, in the event leakage does occur, the pressure sensing switch so conditions the electrical circuit and the fluid-fill solenoids as to permit the machine to continue to operate and pump out any fluid left in the tub, but not to permit refilling of the tub.

By virtue of the foregoing arrangement, the tub will always be emptied of wash-fluid at the end of a cycle, thereby obviating the need for draining the tub in order to correct a leak.

The manner in which the foregoing objects and features of the invention can best be achieved will be better understood upon consideration of the following description, taken in conjunction with the accompanying drawing in which:

FIGURE 1 is a perspective showing of laundry apparatus embodying the invention;

FIGURE 2 is an enlarged elevational showing, partly in section and with parts broken away, of the apparatus shown in FIGURE 1 as viewed from the side;

FIGURE 3 is a further enlarged elevational showing, with parts broken away, of a portion of the apparatus seen in FIGURE 2;

FIGURE 4 is a somewhat diagrammatic showing of electrical circuitry embodying the invention; and

FIGURE 5 comprises a timing chart showing the sequence of operation of the machine when carrying out a laundering cycle.

Now making more particular reference to the drawings, and first to FIGURES 1, 2 and 3, a washing machine embodying the present invention includes an outer cabinet 10 supported upon a base member 11 provided with conventional levelling feet 12. A door 13 (FIGURE 1) disposed in an opening 14 in the upper horizontal wall of cabinet 10 provides access to an upwardly presented generally cylindrical rotatable basket 15 which is disposed coaxially with an outer tub 16 mounted within cabinet 10. Tub 16 comprises a hub portion 21 from which there extends downwardly a tubular member 22. Mounting of tub 16 is provided by resilient engagement of a suitably formed lower portion 23 of member 22 with a central region of base 11. A drive shaft 20 extends coaxially with respect to tubular member 22 and through hub portion 21 of tub 16 and through a hub portion 24 of rotatable basket 15. The lower end portion of shaft 20 is disposed below base member 11 and has a pulley 25 affixed thereto. Hub portion 24 of basket 15 comprises a downwardly extending tubular member 26 coaxial with and journalled by bearing means 31 disposed within hub portion 21 to provide for rotation of basket 15 within tub 16.

In the particular machine illustrated, the upper portion of shaft 20 includes an inclined portion 27 adapted to drive a wobble-plate agitator 32 through its base 37, when the shaft is driven in one direction. Basket 15 is rotated with agitator 32 when shaft 20 is driven in the opposite direction. While a detailed description of clutch apparatus providing for this mode of operation is not necessary to an understanding of the present invention, a complete description of one example of such apparatus is found in U.S. Patent No. 2,924,086 assigned to the assignee of the present invention. Means for driving pulley 25 may conveniently comprise a motor 34 mounted by a bracket 35 for pivotal movements upon a pin 36 extending vertically from base 11.

As shown, the lower end of motor shaft 40 includes a pulley 41 drivingly connected with pulley 25 by a belt

42. Belt tension is maintained by a spring 43 interconnecting a lever 44 of bracket 35 with base 11, the construction and arrangement being such that the spring pivotally urges motor 34 against the opposing force exerted by belt 42 encircling pulleys 25 and 41.

A wash fluid drain pump 45 is mounted upon the upper end of motor 34 for drive by shaft 40, and is disposed in fluid flow communication with a flexible hose 46 attached to a sump portion of tub 16. Pump 45 is of a known impeller type adapted to be driven by motor 34 and to discharge fluid drained from tub 16 through a drain hose 51 and is so constructed and arranged that it will discharge the fluid when rotated in one direction and will prevent discharge of the fluid when rotated in the other direction.

Motor 34 is of the reversible type, and when driven in one direction (agitate), conditions conventional brake means (not shown), including an activating compression spring 52, so as to prevent basket 15 from rotating and cause agitator shaft 20 to operate agitator 32. When motor 34 is driven in the other direction (spin) the braking means is actuated to release the basket and permit agitator and basket rotation as a unit.

Considering additional structural features of agitator 32, and in order more fully to understand the invention, the agitator shaft inclined portion 27 is articulately joined by universal joint means 53 with a shaft portion 54 that extends into a hollow column 56, which joint means is disclosed and claimed in U.S. Patent No. 2,931,201 assigned to the assignee of the present invention, and will not be further described herein. Joint means 53 is sealed within a sleeve 55 extending between base portion 37 of agitator 32 and a cylindrical member 61 fitted onto column 56. An inverted cup-like flexible and resilient sealing member 62 is fitted onto column 53 and engages an upper portion of agitator 32. A flat annular seal 63 extends between an annular edge of depressed portion of basket 15 and a lower rim portion of agitator 32.

Additional seals comprise sleeve 64 connecting agitator base 37 with basket hub 24, and a sleeve 65 extending between hub 24 and tub hub 21. Thus, seals 62, 63, and 65 might be considered as primary seals, whereas sleeves 55 and 64 are secondary seals, said latter seals being disposed and adapted to protect joint 53, bearings 33, 28, and 31, as well as linkage means disposed within flared portion 23 of tubular member 22.

Considering now the various conditions of leakage that might occur and cause damage, it is seen that combined rupture of seals 62 and 55 would expose joint 53, bearing 33, bearing 28 and the interior of housing 23, via tubular member 22, to leaking fluid. Also, a combination of leakage through seals 63 and 64 would expose at least the bearing 28 and the interior of housing 23 to fluid, whereas breakage of seal 65 would expose at least the housing 23 to fluid.

Due to the nature of the mechanism, and by way of example alone, annular seal 63 undergoes substantial repeated stresses from wobbling movement of agitator 32, and any leakage therethrough will be conducted through a conduit 66 specially provided in basket hub 24, thence into the region sealed off by sleeve 65 and through another conduit 70 extending through tub hub 21. Similarly, a rupture of seals 62 and 55 permits fluid to flow downwardly through bearings 33, 28 and into conduit 70. It will therefore be appreciated that prolonged, undetected leakage of fluid through these sealed-off regions probably would result in substantial damage to machined surfaces, bearings, bushings, and the like.

In particular accordance with the invention, a fluid conduit 71 is connected to hub conduit 70 and extends downwardly into fluid flow communication with an open ended tubular body portion 73 of pressure switch means 72. The other end of tubular portion 73 is connected to an upwardly extending conduit 74 that is open at its upper end to the atmoshpere.

Thus, conduits 71, 74 and tubular body portion 73 form a U-shaped sump means within which fluid may collect and create a predetermined liquid head sufficient to actuate a diaphragm 75 movable within a cylinder 76, the axis of which extends vertically as respects the axis of horizontally extending body portion 73. Diaphragm 75 is linked by an insulative rod 77 to the flexible and resilient arm 81 of a single-pole double-throw switch comprising an upper contact 82 and a lower contact 83. The force required to move diaphragm 75 may be varied by manually adjustable means including a screw 84 mounted upon cylinder 76 and rotatable to vary the force exerted by a compressed coil spring 85 reacting between rod 77 and the screw. The switch arm 81 and diaphragm 75 are shown in their rest positions, that is under conditions of no-leakage when conduits 71, 74 and tubular portion 73 are devoid of fluid. When the conduits and the tubular body portion are filled to a predetermined level with liquid, the diaphragm will be forced upwardly, disengaging switch arm 81 from lower contact 83 and causing the arm to engage upper contact 82.

Considering now FIGURES 4 and 5, and in order more fully to appreciate salient features of the invention, and particularly the manner in which the tub is emptied of fluid prior to disabling the motor, switch arm 81 and contacts 82, 83 are connected in the control circuit of washing machine 10. Basically, the control circuit comprises cam-actuated multiple switch means 86 including a motor 91 for driving the cams (not shown), which combination commonly is known as a timer, and a pair of connector bodies 92 and 93 for placing the timer in electrical circuitry with remaining circuit groups briefly to be described. One such group is attached to connector body 93 and comprises pressure sensitive fill switch 94, "on" indicator light 95, "wash" indicator light 96, and "rinse" indicator light 97.

As seen in FIGURE 2, sensing element 98 of switch 94 is connected to a tubular extension 99 of tub 16. The construction and arrangement of these elements is such that prior to a sufficient level of fluid in the tub 16, switch arm 100 of switch 94 is in a position contacting upper terminal 101, and when a sufficient level is attained, switch arm 100 moves to a position contacting the lower terminal 102. Thus terminal 101 is engaged prior to completely filling the tub, or while spinning the basket and pumping the tub out, whereas terminal 102 is engaged while the agitator is operating during the wash period when the tub is filled to its normal level with fluid.

Turning to the other portion of the electrical circuit, which leads through connector body 92, there is included the hereinbefore described pressure switch 80. Contacts 82, 83 and arm 81 of switch 80 are disposed in electrical circuitry with line L_1, L_2 a circuit breaker 88, a leak indicator light 89, motor 34, and fluid or water fill valving means 103 comprising a solenoid 104 for actuating the hot water supply valve 105 and a solenoid 106 for the cold water supply valve 107. As shown in FIGURE 2, valves 105 and 107 empty into a common nozzle 108 for directing fluid into basket 15 and tub 16.

A manually operable switch 109 is connected to solenoids 104 and 106 in the manner shown to afford selectivity of wash fluid temperature, the switch being set, for example, at the warmer of the fluid selections. Motor 34 is of the reversible type and comprises respective start and run windings 38, 39, and start winding relay switch means 47.

In FIGURE 4 excessive cross-overs of the various lines leading through the connectors 92 and 93 are avoided by assigning one set of leads consecutive numbers at each connector, with the mating sets of leads from timer 86 assigned corresponding numbers but not in the same order.

Referring now in more detail to timer **86** as illustrated in FIGURE 4, and to the sequence chart illustrated in FIGURE 5, movable contacts of the various switches operated by the timer cams each are shown as open rectangles disposed either adjacent or between numbered open rectangles, the latter representing top (T) or bottom (B) fixed timer switch contacts and numbered 1 to 8. These switches are conditioned to provide the sequence of operations shown in the left hand column of FIGURE 5 by movements of the cam-actuated movable contacts into engagement with the fixed contacts, in accordance with locations of the vertically extending bars. A key is provided at the bottom of FIGURE 5 to define meanings of the bar locations appearing in the main diagram. With reference to the key it is seen that a switch may have its top contact (T) closed, its bottom contact (B) closed, or neither closed, and a contact may be closed without carrying current. The functions assigned to each contact, T or B and numbered 1 to 8, appears at the top of the sequence chart, with the sequential time units, or step numbers, through which the timer cams move noted at the extreme right, as well as at the left, for convenience.

Assuming for purposes of illustration that a laundering cycle is to be instituted calling for hot water, for which switch **109** is opened, the operator institutes the first period of a sequence of operations by actuating timer means **86** through a coin mechanism (not shown). Actuating the timer simultaneously closes contacts 2B, 3B, 4T, 5T, 6T, and 7T, thus providing for energizing, from the source of energy L_1, L_2, the hot water solenoid **104**, and "on" indicator light **95**. The first period comprises the "Fill and Wash" portion of the sequence, in the course of which switch arm **100** first is contacting terminal **101** which is seen to result in timer motor **91** being deenergized. Upon completion of the fill, switch arm **100** moves to contact **102** thereby energizing timer motor **91**, deenergizing hot water fill solenoid **104**, and energizing motor **34** in the agitator direction with the "wash" indicator light **96**. At this point it is believed helpful to point out that the function of contacts 4T, 4B, 6B and 6T is to control the direction of rotation of drive motor **34**, and of 3B to control the energization of the motor.

During the sequence to be described no fluid or water leak has occurred. Therefore, pressure switch means **72** is devoid of fluid, its switch arm **81** is engaging contact **83** to maintain signal light **89** deenergized, and water fill solenoid **104** is energized.

Next in the sequence is a pause, in which only switch contacts 2B and 7T remain closed the other previously actuated contacts being opened under a "both contacts open" condition.

Moving into the next period of the sequence denoted the "spin" period it is seen that the following contacts are closed: 1B, 2B, 3B, 4B, 5B, 6B, 7T, and 8B. The closing of contact 1B shunts out fill switch **100** so that the solenoids **104** and **106** may remain energized for the spray rinse through closed contacts 8B and 5B. Closed contacts 3B, 4B, and 6B provide for rotation of the motor **34** in a direction effective to actuate the clutch and brake to spin basket **15**, and to actuate the pump **45** to discharge wash fluid through hose **51**. Throughout this period, the "wash" indicator light **96** remains energized by the closure of contact 7T, but the spray rinse only takes place for about half the period since switch contact 5B opens after such time.

The "spin" period is closely followed by a pause in the motor operation, due to opening previously closed contacts 3B, 4B, and 6B with contacts 1B, 2B, 5B, 7B and 8T being closed to energize the "rinse" indicator light **97** and to provide for energization of the hot water fill solenoid at this time, which temperature was selected in the beginning by opening switch **109**.

This pause is followed by the "fill and rinse" period which is effected by closure of switch contacts 2B, 3B, 4T, 5B, 6T, 7B, and 8T, and opening of contact 1B. This

period is therefore characterized by operation of the agitator **32** by driving motor **34** in the "agitate" direction while both solenoids **104** and **106** are energized to fill the tub with a mixture of hot and cold water. Also, the period is indicated by energization of "rinse" light **97** and accompanied by deenergization of the timer motor **91** until switch arm **100** moves to contact **102**.

The "fill and rinse" period is followed by another pause in which contacts 3B, 4T, and 6T are opened to deenergize motor **34** prior to reversing same for the "spin dry" period. Also, contacts 1B and 7B are closed again to energize timer motor **91** directly and to energize "rinse" light **97**.

The final period is the "spin dry" period, for which contacts 1B, 2B, 3B, 4B, 6B and 7B are closed to energize timer motor **91**, drive motor **34** in the "spin" direction, and the "rinse" indicator light **97**. Also in this period, the hot water fill solenoid **104** is deenergized.

Following the "spin dry" period all circuits are deenergized by the opening of contact 2B, and the sequence of operations is completed.

Throughout the above described sequence of operations under conditions of no leakage, and in particular accordance with the invention, switch arm **81** has engaged contact **83** to provide for maintaining direct connection of one side of the motor windings **38**, **39** and one side of fill solenoids **104**, **106** with L_2.

Assuming now, by way of example, that a leak has occurred in one of the seals hereinbefore described, and in the course of the "fill and wash" period, water will flow undesirably into the region enclosed by sleeve **65**. From this region the fluid will drain through conduit **70** into the U-tube system comprising conduits **71**, **74**, and tubular body member **73**. When the fluid rises to the predetermined required level in the U-tube system, the pressure of liquid against diaphragm **75** will force it upwardly to move switch arm **81** away from contact **83** and into engagement with contact **82**. This movement will immediately deenergize the water fill solenoids **104**, **106**, by breaking their connection to L_2, and will energize alarm light **89**, to signal that a leak has occurred. However, the "fill and wash" period will continue, followed by the "spin" period during the course of which the fluid will be pumped out of the tub. At this time, due to the absence of fluid from the tub, fill switch arm **100** will have moved into contact with its terminal **101** which opens the circuit between motor **34** and L_1. Since the fill solenoids **104**, **106** have been disabled, fluid cannot be introduced into the tub and cause fluid fill switch arm **100** to be moved into contact with terminal **102** again to start the motor. Thus, not only are the means for filling the tub disabled, but also disabled are the drive elements.

By virtue of the foregoing novel arrangement it will be appreciated that the machine is disabled upon detection of a leak only after all the fluid has been pumped out of the tub. The machine can be started again by a qualified person who need only, upon repairing the leak, partially dismantle the U-tube system to drain fluid therefrom so that pressure switch **80** may be reset by restoring engagement of switch arm **81** with contact **83**.

It will further be appreciated that the invention achieves the important objective of providing means for both detecting and indicating leakage quickly, whereby minimum damage to power transmitting components of a washing machine will be suffered in a machine that has started to leak. Also the invention affords simple and effective means for disabling a leaking machine with a minimum of inconvenience to the user, since the tub is always emptied of fluid before the machine is disabled.

I claim:

1. In a laundry machine, container means for fabric treating fluid, means operative sequentially to introduce fluid into and to drain fluid from said container means, and means operative, upon accidental leakage of fluid from said container means, to detect such leakage and

to condition said last recited means to drain fluid from said container means and to prevent subsequent introduction of fluid into the latter.

2. In laundry apparatus, a clothes tub for containing a clothes treating fluid and from which leakage of fluid may occur, valve means operative to introduce fluid into said tub, pump means operative to remove fluid from said tub, and leakage detecting means operative to disable said valve means and thereupon to provide for operation of said pump means upon leakage of fluid from said tub.

3. In a laundry machine, tub means for containing fabric treating fluid, said tub means being susceptible of leakage of fluid therefrom, means for controlling the sequence of fabric treatment including means operative sequentially to introduce fluid into said tub means and to drain fluid therefrom, and means for detecting leakage of fluid from said tub means being operable, upon detection of such leakage, to render inoperative both said means for introducing fluid and said means for draining fluid, when said last recited means has operated to drain fluid from said tub means.

4. In a washing machine, container means for fabric treating fluid, said container means including elements susceptible of permitting leakage of fluid therefrom, means for controlling the sequence of fabric treatment and operative sequentially to introduce fluid into and to drain fluid from said container means, and means operable in response to such leakage to render inoperative said means for introducing and draining fluid after said last recited means has operated to drain fluid from said container means.

5. A machine according to claim 4 and further including leakage indicator means operative by said means for rendering inoperative the means for introducing and draining fluid.

6. Laundry apparatus comprising: container means for fluid within which fabrics are treated; agitator means for said fabrics including shaft means extending through said container means; fluid seal means for the region of said container means through which said shaft means extends; means for entrapping any fluid flowing through said seal means; and means operative, in response to the presence of fluid in said means for entrapping, to provide for drainage of fluid from said container means and thereafter to prevent further treatment of said fabrics.

7. In laundry apparatus, the combination comprising: container means for fluid within which fabrics are placed for treatment; agitator means disposed for immersion in said fluid; drive elements for said agitator means disposed below the level of such fluid; seal means normally preventing contact of fluid with said drive elements, but being susceptible of accidental leakage permitting such contact; control means operative sequentially to introduce fluid into said container means and to drain fluid therefrom in the course of fabric treatment; and means for detecting such accidental leakage and operative in such event to condition said control means sequentially to prevent introduction of fluid into said container means and to drain any remaining fluid therefrom.

8. In laundry apparatus: a clothes tub; solenoid actuated valve means energizable to introduce wash fluid into said tub; pump means energizable to remove fluid from said tub; control means providing for sequential alternate energization and deenergization of said valve means and said pump means; and means for detecting leakage from said tub operable in the event of such leakage permanently to deenergize said valve means and to provide for energization of said pump means permanently to remove wash fluid from said tub until such time the leakage is corrected.

9. Apparatus according to claim 8 and characterized in that said means for detecting leakage comprises: sump means for collecting fluid as it leaks from said tub; and switch means disposed in normally energizing circuitry with the solenoid of said valve means, and operative in response to a predetermined level of fluid in said sump means to open the recited normally energizing circuitry, whereby introduction of fluid into said tub is prevented.

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