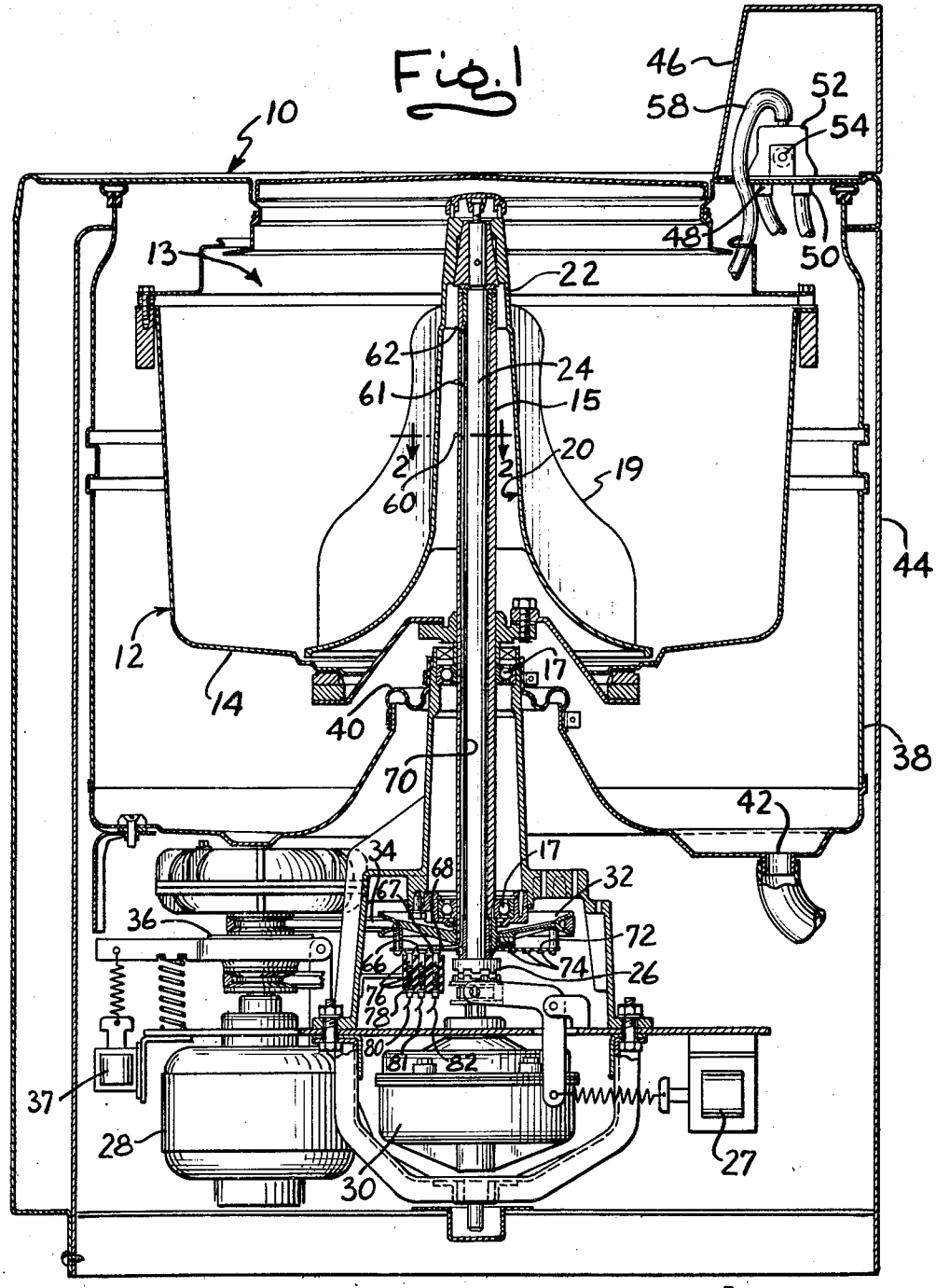
March 3, 1970 C. F. CZECH 3,498,085

WATER LEVEL CONTROL FOR LAUNDRY MACHINES

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Fig. 1



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Fig. 2

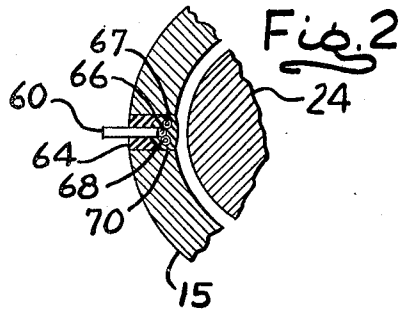
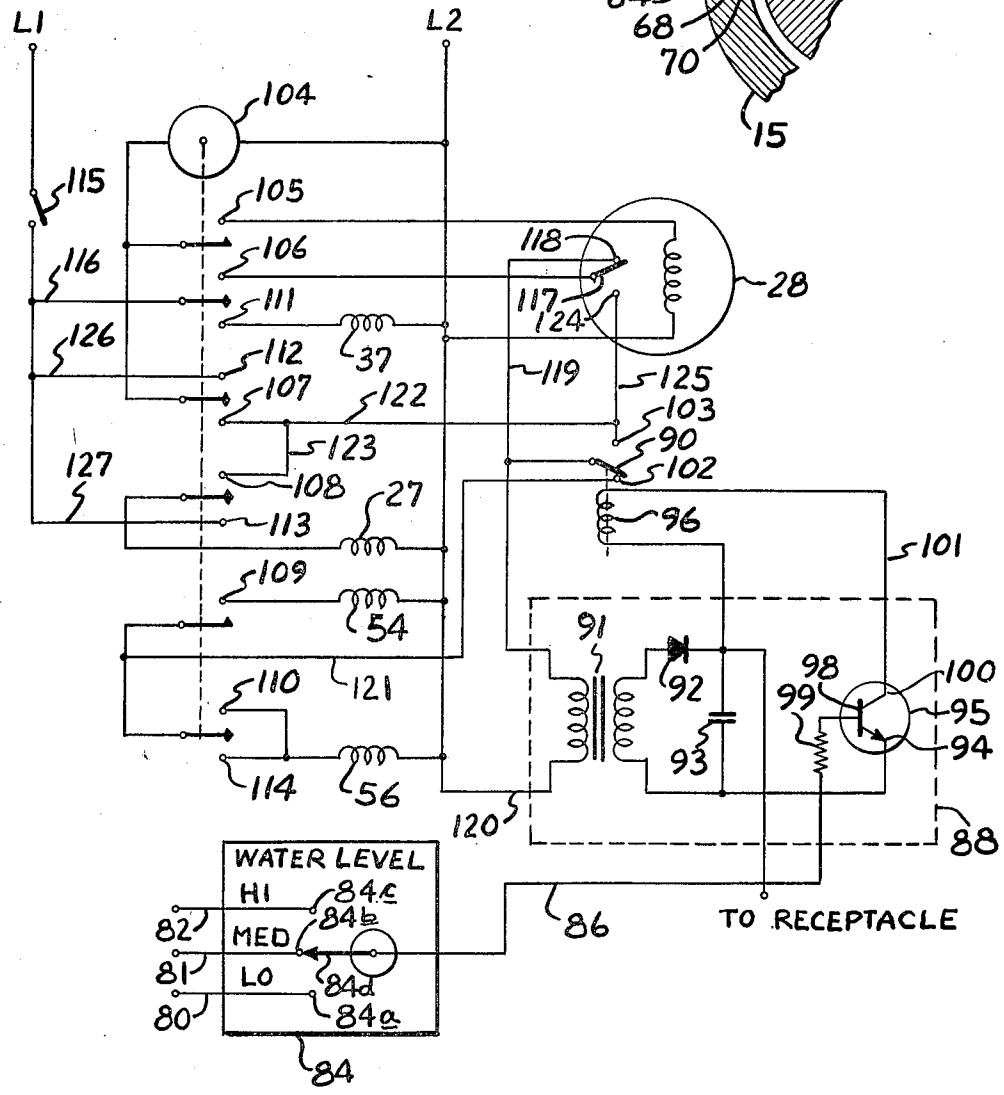


Fig. 3



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WATER LEVEL CONTROL FOR LAUNDRY MACHINES

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ABSTRACT OF THE DISCLOSURE

A water level control for laundry machines in which a vertically positioned electrical sensor is mounted on the agitator post to complete a water fill control circuit through water in the tub when the water reaches the sensor level and in which the sensor is shielded from splashing and turbulence by the surrounding agitator.

The present invention relates to water level control means for laundry machines.

Various means have been employed heretofore for measuring and controlling the water level in laundry machines, such as floats and pressure operated devices and timed-flow mechanisms. In laundry machines having a solid clothes treating receptacle, as opposed to perforated backets, certain of the prior devices are impractical because they are not adapted to be placed directly into the clothes basket. Others permit only a single given amount of water to be used, and others are unreliable because of uncontrollable factors such as variations in water supply pressure.

It is therefore an object of the present invention to provide a water level control device for laundry machines which is simple in construction and permits selection of any of a number of water levels.

Another object is to provide a reliable water level control device particularly adapted for machines having a vertical axis, solid clothes receptacle. A related object of the invention is ot control the level of water in a laundry machine without interfering with access to the clothes receptacle or washing and spin drying operations.

Other objects and advantages of the invention will become apparent upon reading the following detailed description and upon reference to the drawings, in which:

FIGURE 1 is a vertical section of a laundry machine embodying the present invention;

FIG. 2 is a cross section of the receptacle and agitator shafts on the laundry machine;

FIG. 3 is a diagram of the electrical control circuit for the machine of FIG. 1, including the electrical circuit for the water level control of the present invention.

Illustrated in FIG. 1 is a domestic, automatic laundry machine **10** embodying the present invention. A clothes receptacle **12** in which a measured amount of washing and rinsing water is to be placed is mounted in the machine for rotation on a vertical axis. The clothes receptacle is an upstanding cylinder, having an open top **13** for loading and unloading clothes and a closed bottom **14**. Supporting the receptacle is a hollow shaft **15** extending upwardly through a central opening in the bottom of the receptacle **12** and downwardly through suitable bearings **17** which journal the shaft rotation. The bottom plate **14** of the receptacle is secured to the shaft **15** by a suitable watertight connection. The upper end of the supporting shaft **15** projects above the level of the upper edges of the receptacle **12** to prevent water from leaking through the center of the shaft.

Positioned over the receptacle supporting shaft **15** is a bell-shaped clothes agitator **19** having an outwardly flared skirt at its lower end adjacent the bottom of the clothes receptacle **12**, and radially projecting blades along its sides. The central portion of the agitator **19** is hollow such that its inner surfaces **20** are spaced from the receptacle supporting shaft **15**, permitting water in the receptacle to rise along the shaft to the water level in the major portion of the tube. For purposes to be explained later, the upper end portion of the agitator **19** is provided with one or more small air holes **22** to release air trapped under the agitator as water is introduced into the receptacle.

Driving the agitator **19** is a vertical shaft **24** placed within the hollow central portion of the receptacle supporting shaft **15**. The upper end of the agitator shaft **24** is splined or otherwise fastened to the top portion of the agitator to form a driving connection. The lower end of the agitator shaft **24** is connected by means of a clutch **26** controlled by a solenoid **27** to a drive motor **28** through a suitable transmission **30** for imparting an oscillatory motion to the agitator **19**. The receptacle supporting shaft **15** is drivingly connected to the drive motor **28** by a pulley **32** and belt **34** at its lower end and a clutch **36** controlled by a solenoid **37** for rapidly rotating the supporting shaft and receptacle to empty the receptacle and to dry the clothes after the washing and rinsing operations.

Surrounding the receptacle **12** is a drain tub **38** open at the top and sealed at its bottom to the shaft supporting structure by a flexible boot **40** of rubber or other suitable material. The upper edge of the tub **38** extends above the top of the clothes receptacle for receiving water centrifuged from the receptacle **12**. An opening **42** is provided in the tub for draining water received from the receptacle. To dispose of the waste water, drain conduits and pumping means (not shown) may be provided in a manner well known in the art.

The entire machine is enclosed in a rectangular cabinet **44** having a hollow basksplash **46** in which are placed the controls and switches for operation of the machine. Adjacent the backsplash at the top rear of the machine are the water supply connections, including hot and cold water inlet pipes **48**, **50**, which lead to a mixing valve **52**. The valve includes individual valves for the hot and cold water, each of which can be opened independently by energizing one or the other or both of two electrical solenoids **54**, **56**, one for each valve. From the mixing valve the water is supplied to the clothes receptacle by a conduit **58** projecting over the upper edge of the receptacle **12**.

Referring more particularly to the water level control, means are provided for utilizing the electrical conductivity of the washing fluid, such as water, to stop the flow of fluid into the clothes receptacle at preselected levels of water in the receptacle. For this purpose electrical sensing means are spaced at one or more levels within the clothes receptacle corresponding to a desired level or levels of water such that the sensing means will be contacted by water rising in the receptacle as it is filled. When more than one sensing means is used, the means are spaced to be contacted sequentially as the water level rises.

In carrying out the invention, the sensing means are positioned in a protected position substantially free from splashing water as the tub is filled. As shown in the preferred form of the invention, the sensing means are spaced at intervals along the receptacle supporting shaft **15** where they are protected or shielded by the agitator **19** from splash during filling of the tub. To insure that the water level within the hollow agitator is the same as that in the major portion of the receptacle, one or more air holes **22** are formed at the top of the agitator, as previously described. The air holes prevent the trapping of air under

the agitator which otherwise would depress the level of water along the supporting shaft.

Each of the illustrated sensing means comprises a small, electrically conducting projection or button **60**, **61**, **62**, preferably of corrosion resistant material. The buttons are mounted on the outer surface of the hollow support shaft **15** and are surrounded by annular insulating collars or bushings **64** to insulate them from the shaft. For purposes of illustration, three sensing means are shown in the drawing representing, respectively, low, medium, and high water levels.

Means are also provided for detecting the flow of current through the water to a predetermined one of the sensors when it is contacted by water in the receptacle. This means includes an electrical connection to the water which may conveniently be through the metallic clothes receptacle and additional electrical connections to each of the sensors. The individual connections to the water and sensors are utilized to actuate switch means for stopping the flow of water into the tub at the level of the preselected sensor. The connection means for the sensors **60**, **61**, **62** comprises an individual conductor **66**, **67**, **68** of insulated wire which is electrically connected at its upper end to each sensor button and which extends downwardly along the shaft **15**. Preferably the wires are in a longitudinal groove in the outer or inner surface of the shaft **15** and are sealed therein by suitable insulating compound. In the drawings, a groove **70** is shown on the inner surface and the sensors extend through the shaft wall to contact the wires.

To permit rotation of the clothes receptatcle during spin drying without breaking the sensor conductor wires, means is provided to form a slidable electric contact to the sensing button wires. For this purpose a brush and slip ring arrangement is used comprising a disk **72** of electrical insulating material which is fixed coaxially to the lower side of the spin drive pulley **32** and a series of spaced, flat rings **74** of metallic material which are mounted to the outer or lower face of the disk. Each of the sensor wires is connected to one of the metallic rings. Slidingly engaging each ring is a spring biased brush **76** of copper, carbon, or other conducting material. The brushes are mounted in a supporting block **78** fixed to the machine frame and having suitable holes for receiving the brushes and biasing springs. To each brush is connected a lead wire **80**, **81**, **82** for completing the electrical connection from a sensor to a selector means.

In the illustrative embodiment the selector means comprises a single pole, three position switch **84**. Each of the stationary contacts **84***a*, **84***b*, **84***c* of the switch is connected to a respective one of the sensors **60**, **61**, **62** through a lead wire, slip ring and supporting shaft connecting wire. The movable arm **84***d* of the switch is electrically connected by a wire **86** to an electrical amplifier **88** to increase the small current conducted by the water to a value sufficient to operate a water level control relay **90**. Although various forms of amplifiers known in the art may be used, a transistor type amplifier is illustrated in the preferred form of the invention.

In the amplifier of the drawings, a common-emitter transistor circuit using an NPN type transistor is shown. To power the amplifier and provide a source of current to the sensors, a transformer **91** steps down the conventional alternating current supply voltage to 24 volts, which output is connected to a conventional rectifier circuit including a diode rectifier **92** and a smoothing condenser **93**. The negative side of the direct current output of the rectifier is connected to the emitter **94** of a transistor **95**, and the positive side is connected to one side of the coil **96** of a relay switch **90** and to the receptacle **12**. Ordinarily, the receptacle is electrically grounded to the frame of the machine through the supporting shafts and bearings such that the negative side of the power supply may be connected to any convenient portion of the frame. However, if desired, a wire may be connected to the receptacle supporting shaft through an additional slip ring and brush for a more direct connection. The 24 volt output of the amplifier power supply is sufficiently low so that there is substantially no danger of the operator's receiving an electrical shock from either the frame or water in the receptacle.

The electrical signal from the sensors to be amplified is obtained from the movable contact **84***d* of the selector switch which is connected by a wire **86** to the base **98** of the transistor through an electrical resistor **99**. When no water is in the receptacle or the water has not reached the level of a sensor connected in the circuit by the selector switch **84**, the transistor base **98** is open circuited and no current flows through it. When the water level reaches the selected sensor, the water provides an electrical resistance between the sensor and the receptacle in series with the input resistor **99** of the amplifier. This permits current to flow from the positive side of the power supply through the water to the selected sensor and then through the selector switch, input resistor and the internal junction between the transistor base **98** and emitter **94**. The current flowing in this circuit is quite small but is amplified by the transistor into a larger electrical current flowing through the collector **100** of the transistor and the relay switch coil **96** whose second terminal is connected by a wire **101** to the transistor collector **100**.

The relay switch **90** has two functions, one to stop the flow of water, the other to start the next operation of the washing cycle. To accomplish this, the relay is a single pole, double throw switch having a normally closed contact **102** for controlling the water level and a normally open contact **103** for initiating the next operation.

A control circuit for an automatic washing machine embodying the present invention is illustrated diagrammatically in FIG. 3 and is arranged to perform a sequence of filling, washing, draining, rinsing, and centrifugal drying of the clothes. The sequential control mechanism is operated by an electrical timing motor **104** which drives a series of cams for opening and closing cam operated switches. Timers of this type are well known and need not be described in detail here.

Power for operating the washing machine is obtained from a conventional alternating current power source through lines L_1 and L_2. Control for the operations is obtained by switches interposed between one side of the controlled machine elements and power line L_1. The other side of the controlled elements, such as the motors, amplifier, and control solenoids, are connected directly to power line L_2.

At the beginning of the washing cycle a drive motor cam switch **105**, a water fill cam switch **106**, a timer motor auxiliary cam switch **107**, an agitator solenoid auxiliary cam switch **108**, a wash hot water cam switch **109**, and a wash cold water cam switch **110** are closed. A spin solenoid cam switch **111**, a main timer cam switch **112**, a main agitator solenoid cam switch **113**, and a rinse cold water cam switch **114** are open. Upon closing a line switch **115**, the closed cam switches complete a circuit from power line L_1 through wire **116** and the water fill cam switch **106** to the movable contact **117** of a double throw centrifugal switch on the motor **28**. The centrifugal switch has a contact **118** which is closed when the motor **28** is at rest and is thus energized at the beginning of the cycle. A connection **119** from the normally closed centrifugal switch contact **118** to one side of the amplifier power transformer **91** completes the circuit from power line L_1. The other side of the transformer **91** is connected by a wire **120** to power line L_2 such that the amplifier is energized for measurement and control of the water in the clothes receptacle. The normally closed contact **118** of the centrifugal switch also is connected to the movable contact **90** of the amplifier controlled relay switch energizing the normally closed relay contact **102**. A wire **121** connects the nor-

mally closed relay contact **102** to the hot and cold water cam switches. Since the hot and cold water cam switches **109, 110** are closed, the hot and cold water solenoids **54, 56** are energized to admit water to the receptacle **12** through the mixing valve **52**.

Assuming that the water level selector switch **84** is set on the medium position **84***b*, the middle sensing element **61** is connected to the input resistor **99** in series with the transistor base **98**. As water flows into the receptacle **12**, no change occurs in the machine operation until the water reaches the middle sensing element **61**. When this happens the amplifier **88** causes the relay coil **96** to be energized as previously explained, and to open the normally closed relay contact **102** which deenergizes and closes the water valve **52**. The relay switch **90** is now closed to the normally open contact **103** causing the closed auxiliary timer and agitator solenoid cam switches **107, 108** to be energized through wires **122, 123**. The movable contacts of these switches **107, 108** are connected to the timer motor **104** and agitator solenoid **27**, respectively energizing the timer motor **104** to start the timed cycle and the agitator solenoid **27** to engage the agitator drive clutch. Also connected to the movable contact of the auxiliary timer switch **107** is the motor cam switch **105** which, being closed, simultaneously starts the drive motor **28** to commence agitation of the clothes.

When the drive motor **28** comes up to speed the normally closed centrifugal switch contact **118** is opened to deenergize the water level switch **90** and amplifier **88**. At this time the centrifugal switch **117** closes its normally open contact **124** which is connected by a wire **125** to by-pass the normally open contact **103** of the water level switch and to continue to energize the auxiliary timer and agitator cam switches **107, 108**. The latter cam switches would otherwise be deenergized by the return of the water level switch to its normal position upon deenergization of the amplifier. The drive motor centrifugal switch therefore operates to turn off the water level amplifier and relay switch and to by-pass the relay switch for continuing operation of the drive motor, timer motor, and agitator solenoid.

Subsequently during the agitation period of the cycle a third circuit is established for energizing the drive and timer motors **28, 104** and agitator clutch solenoid **27** independently of both the water level relay switch and the centrifugal switch, which are switched out of the circuit. For this purpose the timer motor moves the switch cams to keep the drive motor cam switch **105** closed and to close the timer motor and the agitator main cam switches **112, 113** as the auxliary timer and agitator cam switches **107, 108** and the water level cam switch **106** are opened. A direct circuit is thus formed from power line L_1 through a connection **126** to the timer main cam switch **112** and another connection **127** to the main agitator cam switch to energize the timer motor and the agitator solenoid, respectively.

Agitation continues for a timed period, after which the timer motor opens the main agitator cam switch **113** and closes the spin clutch solenoid cam switch **111** to energize the spin solenoid **37** from line L_1 through the wire **116** to the spin switch and from the spin switch through a connection to the solenoid. The timer motor and drive motor cam switches **112, 105** continue to be closed as the clothes receptacle begins to spin and drive the wash water out of the receptacle and clothes by high speed rotation or spin.

At the end of the timed spin period all cam switches except the timer motor main cam switch **112** are opened permitting the rotating receptacle to coast to a stop. At the end of the coasting period the timer motor main cam switch **112** also opens and concurrently closes the drive motor and water level cam switches **105, 106** and the timer motor and agitator auxiliary cam switches **107, 108**. The circuit is now in the same condition as at the beginning of the cycle for again filling the clothes receptacle **12** with water for rinsing the clothes. The only difference at this point is that the hot and cold water wash cam switches **109, 110** are open and the cold water rinse cam switch **114** is closed. In the illustrative circuit only the cold water solenoid **56** is energized for rinsing, but it will be understood that provision can be made for varying the rinse water temperature, if desired. Suitable thermostatic valves or switching circuits can be used to give combinations of hot, warm, or cold water for either wash or rinse purposes by means well known in the art.

Other than the described closing of the rinse water cam switch rather than the wash water cam switches, the operation of the rinse fill, agitation, and spin drying repeats the same sequence of events as described for the previous portion of the cycle. At the end of the cycle it is common in domestic automatic laundry machines for the timer motor to open the main line switch **115** by a separate cam control (not shown) and to set the appropriate cam switches for a new cycle. Operation is thereafter initiated by manually closing the line switch.

I claim as my invention:

1. In a washing machine for use with an electrically conductive washing fluid and having a receptacle for receiving washing fluid, the combination comprising a pair of electrical connections adapted to be contacted by fluid in said receptacle, one of said connections including a sensor element vertically positioned at a level corresponding to a desired level of washing fluid in said receptacle, means for shielding said sensor element from splashing of fluid in a major portion of said receptacle, conduit means including electrically operated valve means for directing fluid to the major portion of said receptacle to fill the same, and electrical amplifying means having a pair of input connection means connected respectively to said first named electrical connections, said amplifying means having output connection means for operating said valve means to stop the the flow of fluid to said receptacle when fluid contacts both of said first named electrical connections.

2. The combination of claim **1** in which said receptacle is of electrically conductive material and the other of said first named electrical connections is the inner surface of said receptacle.

3. The combination of claim **1** in which said shielding means comprises an agitator having a hollow interior in communication with the major portion of said receptacle for receiving washing fluid from said receptacle in said hollow interior, said sensor element being positioned within said hollow interior of said agitator.

4. The combination of claim **3** in which said agitator is bell-shaped having an open bottom portion in communication with fluid in said receptacle and having an air escape opening communicating with the hollow interior thereof at its upper end portion.

5. The combination of claim **3** including an upright shaft for supporting said receptacle, said shaft having a portion extending upwardly into the hollow interior of said agitator, bearing support means for said shaft for rotation of said shaft and receptacle, said sensor element being mounted on said upwardly extending portion of said shaft, and amplifier input connection means including an insulated electrical conductor extending lengthwise of said shaft and connected at its upper end to said sensor.

6. The combination of claim **5** in which said amplifier input connection means includes slip ring and rush means interposed between said electrical conductor on said receptacle support shaft and said amplifier.

7. The combination of claim **1** in which said amplifying means includes an electrical transistor amplifier and a valve operating relay switch means energized by said transistor amplifier, the input of said transistor amplifier being normally open-circuited and adapted to be closed when fluid in said receptacle contacts said sensor element.

8. The combination of claim **7** having power drive means and means including timer operated switches for

controlling said machine through a timed sequence of filling, washing, rinsing and draining operations, said relay switch means having a normally closed switch and a normally open switch, said control means being adapted for energizing said transistor amplifier and said flow control valve means through said normally closed relay switch to initiate flow of fluid to said receptacle at preselected times, said relay switch means upon closing of the transistor amplifier input circuit being adapted to open said normally closed relay switch to deenergize said transistor amplifier and stop flow of fluid and to close said normally open relay switch to initiate the following sequential operation.

9. The combination of claim 1 having a plurality of sensor elements positioned at a plurality of respective levels and said amplifier input connection means including a selector switch for connecting a selected one of said sensor elements to said amplifier.

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