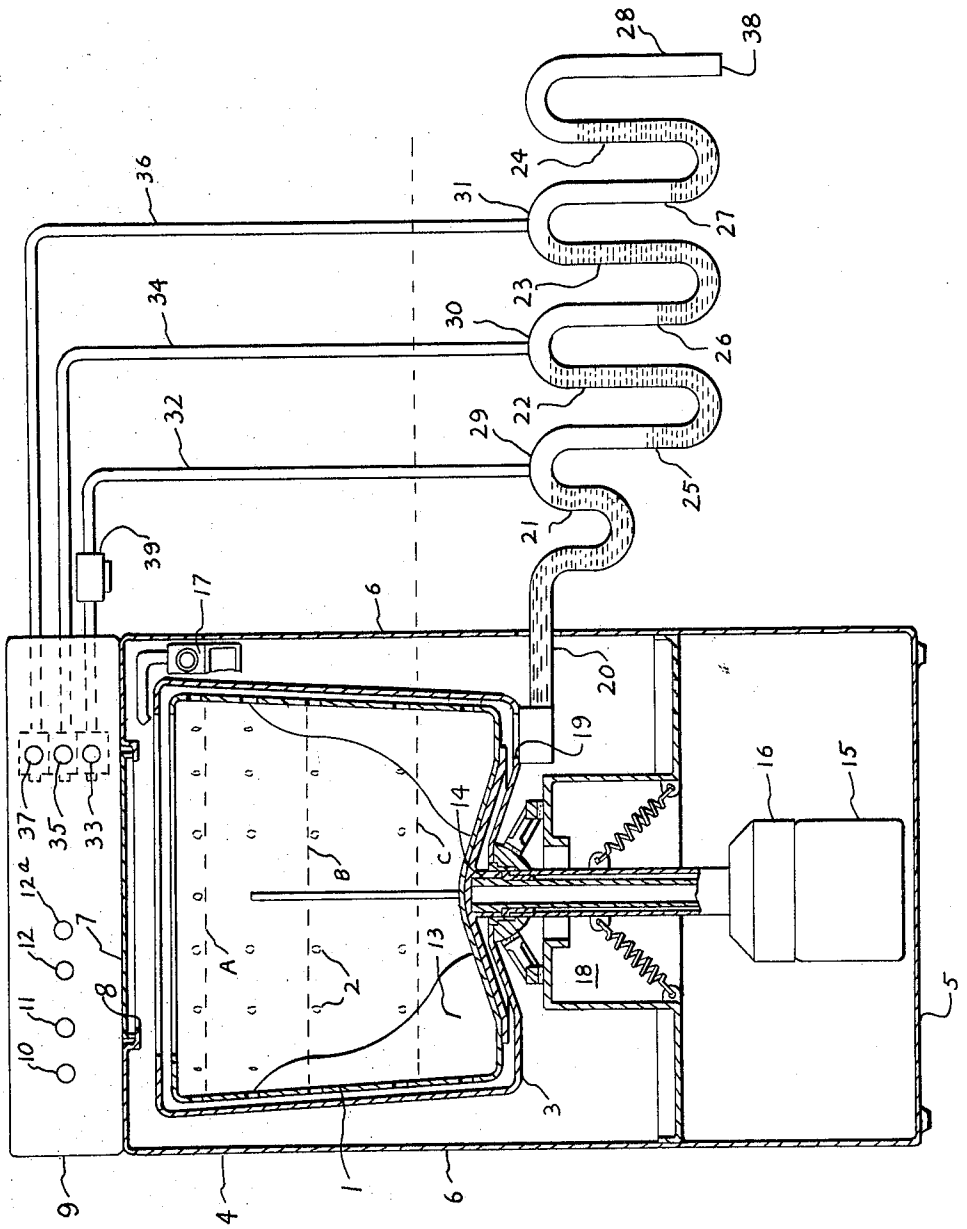
May 3, 1966 J. BOCHAN 3,249,118

DRAIN CONTROL MEANS FOR LIQUID-CONTAINING VESSEL

Filed Dec. 4, 1963



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United States Patent Office 3,249,118 Patented May 3, 1966

3,249,118

DRAIN CONTROL MEANS FOR LIQUID-CONTAINING VESSEL

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Filed Dec. 4, 1963, Ser. No. 327,981
5 Claims. (Cl. 137—577)

This invention relates to drain control means for liquid-containing vessels, and more particularly to gravity drain means which may selectively permit or prevent draining of liquid without any valve or pump means in direct contact with the liquid.

It is an object of this invention to provide an improved drain control means for selectively preventing or permitting draining of liquids through a conduit connected to a drain opening of the vessel.

More particularly, it is an object of my invention to achieve this goal without the use of a pump and without a valve in the drain line.

It is a further specific object of my invention to achieve liquid level control in the vessel by such means.

In one aspect of my invention, I provide drain control means comprising a conduit having one end connected to the drain opening of a liquid-containing vessel, and the other end positioned below the drain opening so as to permit gravity-caused liquid flow through the conduit. The conduit has a plurality of alternating downwardly and upwardly extending sections; adjacent downwardly and upwardly extending sections, where they are joined at their respective tops, are selectively vented to atmosphere. When the vent is closed, the back pressure of air trapped in the conduit causes liquid to be retained in the vessel; however, when the venting means is opened, there is no longer a back pressure of air and liquid thus drains out of the vessel as desired.

In the drawing, the single figure is a side elevational view, partly broken away and partly in cross section to show details, of a clothes washing machine in which a liquid-containing vessel incorporates the improved drain control means of my invention.

Referring now to the figure of the drawing, there is shown therein, for purposes of illustration, a vertical axis washing machine having a perforated clothes basket **1**, with perforations **2** provided therein, disposed within an outer imperforate liquid-containing tub or vessel **3**. Enclosing basket **1** and tub **3** is a frame in the form of an appearance cabinet **4** which includes a base **5** adapted to be seated on an appropriate floor, vertically extending walls **6**, and a lid **7** pivotable to an open position to uncover opening **8** into the basket and tub. Secured on the top of cabinet **4** there may be provided a conventional control panel **9**. Control panel **9** may include a control member **10** to control the filling of the vessel **3** with water, a member **11** to provide an agitating action of basket **1**, a member **12** to provide a centrifuging action of the basket, and an "off" switch **12***a*.

Within basket **1**, suitable means such as vanes **13** may be provided for effecting a circulatory motion of water contained therein in order to achieve washing of the clothes placed in the basket. The basket may be rigidly secured on a shaft **14** extending upwardly from a motor **15** and transmission **16** which cooperate, for one direction of motor rotation, to provide an oscillating motion to shaft **14** and therefore to basket **1**. This, in turn, through vanes **13**, effects a washing action on the clothes. Motor **15** may be of the reversible type; when it is reversed from the direction of rotation in which oscillation of basket **1** occurs, it causes, through transmission **16**, a continuous high speed rotation of the basket to centrifuge liquid out of the clothes contained therein.

A conventional solenoid-controlled valve **17** may be

provided for controlling entry of water into the basket. It will be recognized that solenoid **17** is energized by depression of member **10** so as to cause filling of the basket. Member **11** causes rotation of motor **15** in the first direction so as to effect the washing movement of basket **1**, and member **12** causes the opposite rotation of the motor so as to effect centrifuging action previously described.

A suitable suspension system for supporting the basket **1** and tub **3** is generally indicated by the numeral **18**. Such a suspension system is fully described and illustrated in Patent 3,026,700 issued on March 27, 1962, to John Bochan et al.; since the particular means of mounting the liquid-containing vessel has no significance insofar as my invention is concerned, a detail description thereof will not be given herein.

At the bottom of vessel **3** there is provided an opening **19** through which the drain liquid may discharge into a conduit **20**. It will be observed that the end of conduit **20** connects substantially horizontally with opening **19** so that the liquid will flow relatively smoothly along the conduit **20**, rather than very suddenly filling it. Conduit **20** has a serpentine configuration made up of upwardly extending sections **21**, **22**, **23** and **24** and downwardly extending sections **25**, **26**, **27** and **28**, the downwardly and upwardly extending sections alternating with each other. The adjoining upwardly extending section **21** and downwardly extending section **25** are joined at their tops by a section **29**; similarly, sections **22** and **26** are joined by section **30**, and sections **23** and **27** are joined by section **31**. Top sections **29**, **30** and **31**, in my preferred embodiment shown, are no higher than the level of opening **19** as shown. In any event, they should be below the minimum liquid level desired to be retained within the vessel **3**.

Top section **29** is joined by a conduit **32** to a small button-operated air valve **33**. Valve **33** either seals off the end of conduit **32** or vents it to atmosphere. Similarly, a conduit **34** controlled by a button-operated valve **35** is connected to top section **30**, and a conduit **36** controlled by a button-operated valve **37** is connected to top section **31**.

Let it be assumed that liquid is to be retained in vessel **3** up to level A. As liquid pours into basket **1** and vessel **3**, it will also flow through opening **19** into the inlet end of conduit **20**. The liquid will then flow along through conduit **20** and up into section **21**. When it reaches the top of section **21**, liquid will flow over the bottom of this top section and start to fill the U-shaped conduit portion which is made up of sections **25** an **22**; this flow is sufficiently slow so that it never requires the full area of the conduit to pass it. As it does so, it will trap some air in conduit section **25** and tend to compress this air. As a result of the resistance of the air to such compression, the liquid rises more rapidly in section **22** than in section **25**.

When the liquid reaches top section **30**, it will again flow down to start filling the conduit portion made up of sections **26** and **23**; similarly to what happened before, air will be trapped in section **26** and will be compressed; this will result in an even further compression of the air within section **25**. It will be recognized that these air pockets thus created provide a resistance head to flow through the conduit, that is, they require that there be a substantial head of liquid before the liquid can overcome the resistance of the air pockets and flow through conduit **20** to the outlet **38** thereof. Once the liquid gets up to the top of section **23**, the same thing happens again, that is, the portion made up of sections **27** and **24** starts to fill with liquid and create an even higher back pressure.

The total back pressure is sufficient so that, if liquid is provided within vessel **3** up to level A, and all three vent

valves 33, 35 and 37 are closed, then the head of liquid existing as a result of the filling of vessel 3 to level A will not be sufficient to overcome the resistance provided by the air pockets. Consequently, no liquid will flow out from end 38 of conduit 20. Thus, liquid may be retained within the machine for washing purposes by the use of simple small air vents rather than by a valve in the liquid line itself.

If, after the liquid has reached level A, the operator wishes to decrease the liquid level to line B in vessel 3, it is merely necessary to open one of the vents which may, for instance, be vent 37. As soon as vent 37 is opened, the air trapped in section 27 will no longer be compressed and provide a back pressure. As a result of the elimination of this back pressure, some of the liquid in the portion formed by sections 26 and 23 will flow over top 31 into sections 27 and 24. When the liquid in sections 26 and 23 is thus moved, there is a decrease in the pressure of the air pocket in section 26 and this decreased back pressure is eventually transmitted to the opening 19.

In other words, with less air trapped in the conduit 20, a smaller head of liquid is vessel 3 can be provided without liquid passing out through opening 38. Consequently, liquid will drain out until the level has decreased from level A to level B and will then stop, with air pockets still present in sections 25 and 26. In the same way, level C can be obtained by opening vent 35 in addition to vent 37.

If no liquid at all is to be retained in the vessel 3, then all three of the vents 33, 35 and 37 are opened, and liquid will drain out of the conduit 20 so as to completely empty vessel 3. It will be seen that with all three vents open, basket 1 may be spun at high speed and that liquid thus centrifuged out of the clothes will flow down the walls of vessel 3 and pass down through opening 19 into the conduit 20 so as to be drained.

It can thus be seen that, without any direct contact with the liquid being drained, either by a pump or a valve, the liquid may either be caused to drain or be prevented from draining, and that this is done by either causing air pockets providing back pressure, or eliminating these air pockets by venting them to atmosphere.

It will readily be seen that many variations on this concept, and many uses of it other than in a washing machine, are possible. For instance, if it were simply desired that the vessel be full or empty, all the vent conduits might be joined at the end at which they are vented, with a single vent valve then controlling them. In addition, while the serpentine configuration shown is preferred, it will be obvious that other arrangements may be provided. In fact, an ordinary coiled hose, with the axis of the coil generally horizontal, would be effective to provide the desired results if the proper selective connections to atmosphere were made at the tops of the coils.

Also, it will be apparent that inlet valve 17 may be controlled by a conventional pressure-responsive switch, schematically shown at 39, positioned to be responsive to the pressure in conduit 32. If this be done, then valve 17 is shut off in the conventional way by switch 39 when a predetermined liquid level in tub 3 has created a predetermined pressure in conduit 32. By making switch 39 adjustable, the level in vessel 3 at which valve 17 shuts off is also made adjustable.

Thus, while in accordance with the patent statutes I have described what at present is considered to be the preferred embodiment of my invention, it will be obvious to those skilled in the art that various changes and modifications 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 my invention.

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

1. For use with a liquid-containing vessel having a drain opening formed therein, drain control means comprising:

(a) a conduit having one end connected to said drain opening and its other end positioned below said drain opening to permit gravity-caused liquid flow through said conduit, said conduit being formed with a plurality of alternating downwardly and upwardly extending sections, adjacent sections being joined at their respective tops below the minimum liquid level used in said vessel;

(b) and means for selectively venting said conduit to atmosphere connected to at least one of said tops of adjacent sections, whereby liquid is retained in said vessel when said venting means is closed and drains out of said vessel when said venting means is opened.

2. The drain control means defined in claim 1 wherein said tops of said adjacent sections are approximately at the height of said drain opening.

3. The drain control means defined in claim 1 wherein a plurality of venting means are provided respectively connected to the tops of adjacent sections, said venting means being individually operable to provide for different levels of liquid within said vessel.

4. The drain control means defined in claim 1 wherein said conduit has a serpentine configuration.

5. For use with a liquid containing vessel having a drain opening formed therein, drain and level control means comprising:

(a) a conduit having one end connected to said drain opening and its other end positioned below said drain opening to permit gravity-caused liquid flow through said conduit, said conduit being formed with a plurality of alternating downwardly and upwardly extending sections, adjacent sections being joined at their respective tops below the minimum liquid level used in said vessel;

(b) liquid inlet means arranged to provide water to said vessel;

(c) means for selectively venting said conduit to atmosphere connected to at least one of said tops of adjacent sections, whereby liquid is retained in said vessel when said venting means is closed and drains out of said vessel when said venting means is open;

(d) and a pressure responsive switch connected to be responsive to the pressure at said one top of adjacent sections and controlling said liquid inlet means so as to shut said liquid inlet means off when a predetermined pressure exists at said one top.

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