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[54] **AUTOMATICALLY FLUSHING SANITARY APPLIANCE**

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[51] **Int. Cl.** **E03d 5/10,** E03d 13/00

[58] **Field of Search** ..... 4/100, 101, DIG. 3, 4/249; 307/273

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[57] **ABSTRACT**

Electrodes are located in the appliance which has normally a water level, in a bowl. Water supply is controlled by an electromagnetically operating valve. Upon sensing of change of resistance between a pair of electrodes, for example upon bridging of the electrodes by urine, a time delay period is initiated and a relay pulls in, charging a capacitor. When the resistance between the electrodes reverts back to its normal value, discharge of the condenser is initiated through a multivibrator circuit which triggers opening of the electromagnetic valve for a predetermined period of time, to flush the bowl. In case the drain from the bowl should be obstructed, the electrodes will not revert back to their normal resistance, so that repeated flushing is inhibited.

14 Claims, 4 Drawing Figures

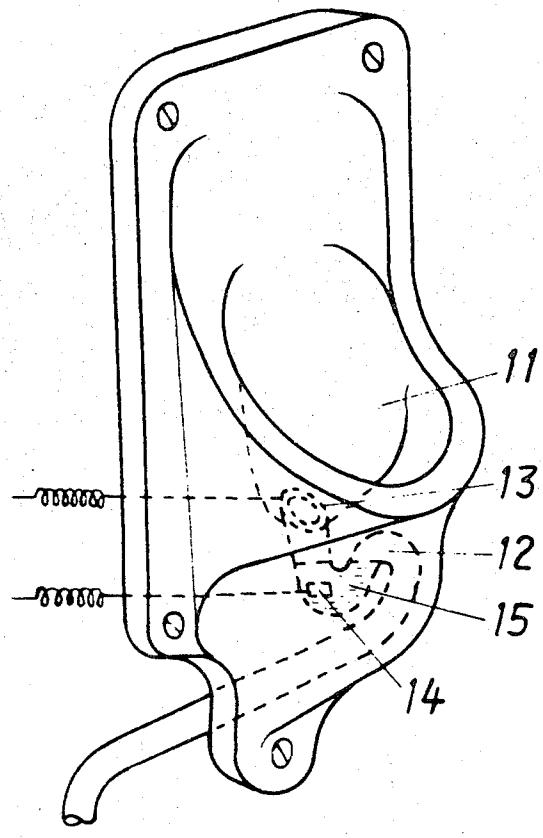


Fig. 1

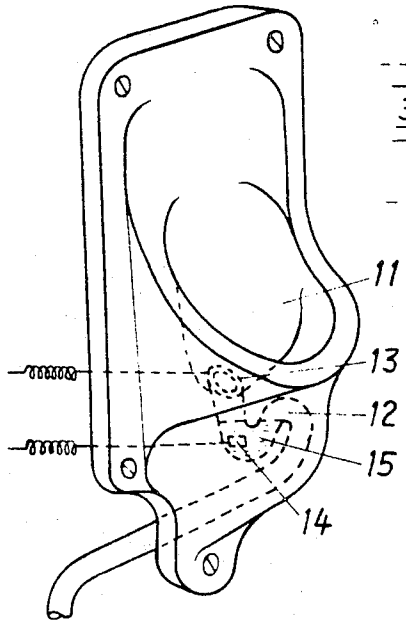


Fig. 2

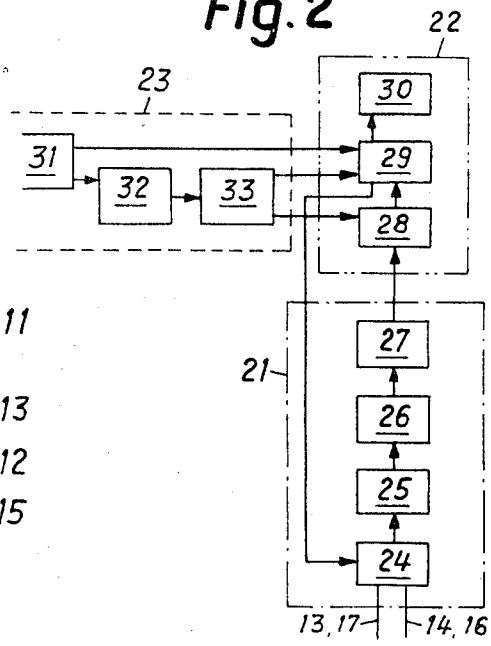


Fig. 3

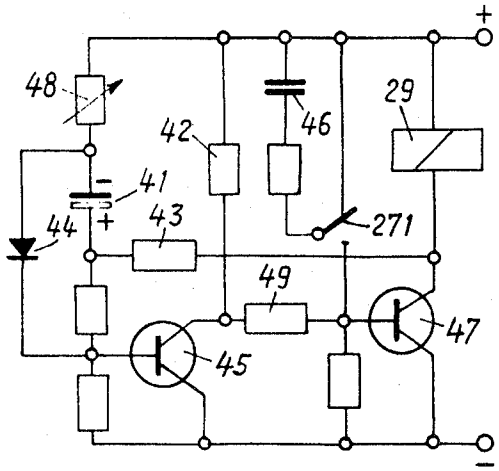
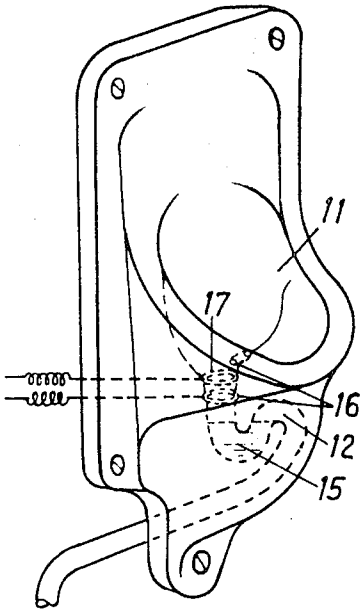


Fig. 4



AUTOMATICALLY FLUSHING SANITARY APPLIANCE

The present invention relates to an automatically flushing sanitary appliance, and more particularly to a toilet, and specifically to a urinal, in which the flushing action is automatically initiated when use of the appliance has been sensed, by controlling the opening of an electromagnetically controlled valve.

Electronic devices have been proposed to automatically flush bowls and the like. Most of these operate optically, and utilize a light beam, and a photosensitive element, such as a photo diode. The beam generating lamp and the photo diode are located, usually, in small additional boxes adjacent, or in front of the bowl. The flushing action is initiated when the light beam from the light source to the photosensitive device is interrupted, or interfered with. Such a construction requires installation of at least two boxes on the bowl, one for the light generator and one for the photosensitive device such as a photo diode. This installation increases the complexity of placement, and is time consuming and expensive. The lifetime of the light source, typically a small bulb, is limited and therefore maintenance of the automatic device is required. The flushing action is triggered, even if someone only passes the bowl, not requiring actual flushing of the bowl.

Other automatic flushing devices have been proposed, in which the bowls are flushed automatically from time to time, regardless of use. Such devices use water at an excessive rate. Additionally, should the bowl be stopped up, repeated flushing will cause overflow and flooding.

It is an object of the present invention to provide a sanitary appliance having an automatic flushing system which is simple in installation, requires no specific maintenance, and in which flooding is automatically prevented.

SUBJECT MATTER OF THE PRESENT INVENTION

Briefly, a pair of electrodes are provided, and the resistance between the electrodes is sensed. The electrodes are located in the bowl. If the electrodes are contacted by contaminating liquid, so that the resistance between the electrode changes, a sensing circuit is activated providing a control signal which triggers a valve control circuit, when a second signal is obtained from the electrodes. The second signal, typically, is derived when the resistance value of the electrodes reverts back to normal, quiescent value, that is, upon cessation of flow of contaminating liquid across the electrodes. Preferably, the change in resistance between the electrodes must continue for a first predetermined period of time (to avoid spurious responses) before the first output signal is obtained from the sensing circuit. This first output signal is used to activate, or set the multivibrator, for example to initiate charging of a condenser. Upon termination of the change in resistance, charging action is terminated and discharge of the condenser is permitted, the discharge of the condenser initiating flushing action. Preferably, discharge of the condenser triggers a monostable multivibrator, the unstable period of time of the multivibrator determinating the open period of the electromagnetic valve.

If there should be an obstruction in the bowl, the resistances will not revert back to their normal value so that flushing action is inhibited, and overflow of the bowl is prevented.

The invention will be described by way of example with reference to the accompanying drawings, wherein:

FIG. 1 is a schematic diagram of a urinal, with electrodes applied thereto;

FIG. 2 is a block circuit diagram illustrating the circuit portion of the flushing system;

FIG. 3 is a partly schematic block circuit diagram of the circuit of the monostable multivibrator initiating flushing action; and

FIG. 4 is a schematic, perspective view of a urinal with modified electrode locations.

A urinal **11** has a siphon **12**, in which water is normally located in a trap, having a water level **15**. An electrode **13** is inserted in a small recess formed, above water level, in the inner surface of the bowl. A second electrode **14** is located below the normal level of the siphon water **15**, within the siphon **12**.

Electrodes **13, 14** are part of an electrode sensing circuit **24**. FIG. **2** illustrates the circuit, schematically in block form. A resistance measuring portion **21** is connected to a control portion **22**, both being supplied by a power supply **23**. The resistance measuring portion **21**, in detail, includes a resistance measuring sensing circuit **24**, for example a bridge circuit or the like. The output thereof is connected to an amplifier **25**. The output from amplifier **25** is connected to a relay response delay circuit, which provides an output if, and only if the signal from sensing circuit **24** persists for a predetermined period of time t_v. If this output persists, it is then applied to relay **27** (which may be a solid state circuit).

If more than two electrodes are connected to the sensing circuit **24**, double-bridge circuits may be used, or different electrodes can be connected in different arms of the bridge, as well known in the art.

The electrodes themselves can be located, as seen in FIGS. **1** and **4**, within the bowl, as will be discussed below.

The circuit portion **22** includes a monostable multivibrator **28**, the output of which controls the coil of a control relay **29** which actuates a magnetic valve **30** which, in turn, admist water to flush the urinal.

Power supply **23** is connected to a power network **31**. It includes a transformer **32**, and a rectifier circuit **33**, preferably a bridge rectifier.

The monostable multivibrator **28** is shown in detail in FIG. **3**. If relay **27** (FIG. **2**) is activated, the changeover contact **271** (FIG. **3**) changes position to that shown in FIG. **3**. This causes operating potential to be applied to the capacitor **41**. Capacitor **41** is charged over resistances **42, 43**, diode **44**, and the base-emitter path of transistor **45**.

When there is no liquid interconnecting electrodes **13, 14** so as to change their resistance values, that is, as soon as the sensing electrode circuit **24** no longer senses a change resistance value between the electrodes, relay **27** will drop out, changing the contact **271** to the position now shown in FIG. **3**. This initiates flushing action, by triggering the monostable multivibrator **28** into its unstable state. Condenser **41** discharges over condenser **46**, which triggers transistor **47** to become conductive. Feedback resistance **49** brings transistor **45** into blocking condition. Discharge of condenser **41** will continue over the low resistance collector-emitter path of transistor **47**, as soon as transistor

47 becomes conductive, and over resistances 43 and 48. The coil of relay 29 will be, likewise, subject to operating potential and current will flow from the power source through the relay 29, causing it to pull in, and flushing valve 30 to be activated. Condenser 41 cannot, however, charge to an opposite polarity because, as soon as condenser 41 has completely discharged, diode 44 would again become conductive, and switch-over the transistor 45. The discharge time of condenser 41 is governed by the R-C circuit formed by condenser 41 and resistance 48, resistance 48 preferably being variable, so that it can be matched to water requirements and various electromagnetic valves. Transistor 47 will again block, after discharge, due to absence of current through resistance 49, and stable operating conditions will again obtain.

FIG. 4 illustrates a further embodiment of the urinal, and particularly the siphon 12. Electrodes 16, 17, for example as semi-circular rings, are located above the water level 15 at the inner surface of the bowl 11.

OPERATION

Let it be assumed that a contaminating liquid, for example urine, flows along the surface of the bowl 11 into the siphon 12. This will cause a drop in the resistance between electrodes 13 and 14 and thus cause response of the sensing circuit 24. The liquid flowing over electrode 13 bridges the electrical resistance, normally present between electrodes 13 and 14, electrode 14 being located within the siphon water 15. Change of resistance, as sensed by sensing circuit 24 is amplified by amplifier 25. If this change persists for a predetermined period of time (to prevent spurious response) the delay circuit 26 will respond after a delay t_v, and energize relay 27. Upon energization, the switch-over contact will switch over into the position shown in FIG. 3. The relay is only energized when at least during the delay period t_v, the liquid bridges the electrodes 13, 14. Upon termination of flow of liquid between the resistances, that is, as soon as the resistances revert to normal resistance value, relay 27 will drop out, causing changeover of its contact to the open position (FIG. 3), triggering monostable multivibrator 28 in its unstable state. During the unstable state of the multivibrator, determined by the time constant of condenser 41 and the variable resistance 48, control relay 29 is pulled in and operates the magnetic valve 30 to flush the bowl 11. Additional time delays may be incorporated in the circuit, for example between multivibrator 28 and the control relay 29, or between control relay 29 and the electromagnetic valve, to provide a brief time delay between termination of contaminating liquid and flushing action.

Control relay 29 has a dual function; and the one hand, it connects power from the power supply 23 to the magnetic valve 30, so that, while the control relay 29 is energized, flushing water can be admitted to bowl 11 (as well known in the art). Additionally, relay 29 interrupts current supply from power supply 23 to the sensing electrode circuit 24. This may be desirable under certain conditions, particularly when the flushing water has sufficient mineral content to lower the resistance value between the electrodes, so that the flushing water will not affect operation of the sensing circuit, and erroneously cause further flushing action to be initiated.

The interconnection between the sensing electrode circuit 24 and the power supply 23, controlled by the control relay 29 is not strictly necessary, since the multivibrator 28 is so constructed that separate interruption of power supply to the sensing electrode circuit, by the relay 29, is not necessary. After a predetermined flushing time, the monostable multivibrator 28 will revert into its stable state, and control relay 29 will open. This disconnects the valve 30 and no more flushing water will flow into bowl 11. The resistance measuring circuit 21 is again activated, the apparatus being ready for sensing further flushing action.

The delay time t_v of relay 27 is so set that the flushing water, which is in bowl 11 after the magnetic valve has closed, will flow out in a shorter time than the delay time t_v. This water, while it may be sensed by the sensing electrodes will not, however, cause further flushing action since the time of flow is insufficient to cause relay 27 to pull in.

Relay 27 can be a mechanical relay, a reed relay, or a solid-state relay, and include the time delay circuit 26.

It may occur that the siphon 12 of the bowl is plugged, so that water cannot flow out freely. Since the flushing action is only initiated upon termination of sensing of change in resistance value, and continued presence of water in the bowl will cause the resistance to be lowered, no flushing action will be initiated until the water has drained out. Relay 27 will remain energized until water has drained out from the bowl. The monostable multivibrator 28 thus cannot respond to cause further flushing action by controlling relay 29 and magnetic valve 30. Thus, the entire system is safe against continued water supply, upon presence of a stopped condition, and thus overflow and flooding are prevented.

The electrodes may be located at various places in the bowl. As seen in FIG. 4, electrodes 16, 17 are located, one above the other, and above the water level 15 of hte siphon water at the inner wall of bowl 11. The liquid which flows simultaneously over electrodes 16, 17, changes their electrical resistance. If this liquid flow continues for the time duration t_v, relay 27 is pulled in. As soon as no liquid simultaneously flows over electrodes 16 and 17, relay 27 drops out, thus initiating flushing action.

The resistance measuring elements may be electrodes exposed to the liquid, or they may be temperature sensitive devices, responsive to change in temperature upon sensing presence of a liquid. In this example, the electrodes are heated to a temperature of roughly 50° C, and are located above the water level 15 of the siphon water. When liquid flows over the electrode, its temperature will change, and thus the electrical resistance thereof. The change in resistance, as before, is utilized in the sensing electrode circuit to initiate flushing action. Depending on the form of the bowl 11, at least one such electrode must be used so that reliable cooling by contaminating liquid is obtained.

In one example of an actual construction of the present invention, the circuit portion 21, as well as the power supply 23, and the switching unit 22 are all contained on a single printed circuit. Without the magnetic valve — which is part of the plumbing assembly — the circuit, including power supply, can be contained in a space of about 6 × 9 × 2 cm, that is, approximately the size of a pack of cigarettes, which can be plugged in di-

rectly into a connector, located beneath the bowl 11. The automatically flushing bowl 11 can thus be mounted directly on the wall, without requiring any additional installation, or location work.

Relay 27, and the mechanical contact 271 (FIGS. 2,3) need not be mechanical, but may be replaced by solid-state circuitry, such as a controlled semiconductor switch, with a turn-off circuit. The delay time t_v, determined by the circuit 26, in the illustrative example forms part of the sensing circuit 21; it can be incorporated in the relay circuitry, in the amplifier, to effect setting, or priming of the circuit initiating flushing action only after the electrodes have sensed contaminating liquid for a predetermined period of time.

Various changes and modifications may be made within the inventive concept.

I claim:

1. Automatically flushing sanitary appliance in which a bowl (11) is flushed upon detection of contamination of the the water level (15) thereof, comprising

an electromagnetic valve (30) controlling admission of water to the appliance;

sensing means including at least one electrode (13,14, 16, 17) located in the bowl (11), said electrode changing its resistance upon contact with contaminating liquid;

sensing circuit means (21; 24, 25, 26, 27) deriving a first control signal upon such change in resistance from a predetermined value in a first direction, and a second control signal upon changes of resistance in the opposite direction and towards said predetermined value upon subsequent absence of the contaminating liquid;

and a valve control circuit (28) connected to and controlled by the first and second control signals, said valve control circuit being enabled upon having said first control signal applied thereto and providing an output control pulse upon sensing said second control signal, said output control pulse being connected to said electromagnetic valve to provide flushing action to the bowl upon occurrence of said second control pulse.

2. Appliance according to claim 1, wherein two electrodes are provided, one (13) being located above the water level (15) of the bowl (11) and another (14) below the water level.

3. Appliance according to claim 2, wherein the one of the electrodes (13) located above the water level (15) is placed along the surface of the inner wall of the bowl (11), the other electrode being located within the siphon section (12) of the appliance.

4. Appliance according to claim 1, wherein two electrodes (16, 17) are provided, located above the water level (15) of the bowl (11).

5. Appliance according to claim 1, wherein two electrodes are provided, and one of the electrodes (13, 16) is located above the water level (15) in the bowl (11) and comprises a temperature sensitive resistance.

6. Appliance according to claim 1, wherein the valve control circuit (28) includes a monostable multivibrator (45,47) and a charge condenser (41), the charge condenser being charged upon application of the first control signal to enable the monostable multivibrator, the monostable multivibrator being triggered into unstable state upon sensing of the second control signal.

7. Appliance according to claim 6, wherein change of resistance in the opposite direction comprises reversion of the electrodes to essentially said predetermined resistance value to cause generation of said second control signal, said monostable multivibrator being triggered into unstable state upon essential reversion of resistance to said predetermined value after having changed to a resistance value different from said predetermined value.

8. Appliance according to claim 6, wherein the sensing circuit means includes a controlled switch (27) providing charging potential to the condenser (41) after sensing of change of resistance for at least a predetermined period of time.

9. Appliance according to claim 6, wherein the sensing circuit means comprises

a time delay circuit (26) to supply the first control signal only upon change of resistance of said sensing means for a predetermined period of time (t_v).

10. Appliance according to claim 6, wherein the valve control circuit comprises

a monostable multivibrator (28), said monostable multivibrator having an R-C circuit (48,41) determining the unstable time of the monostable multivibrator, the unstable time being matched to the capacity of the bowl and the water passage of said electromagnetic valve, to effect opening of the electromagnetic valve for a predetermined flushing period, and hence flush the bowl during said flushing period.

11. Appliance according to claim 1, including power supply means (23) for said electromagnetic valve and for said sensing circuit means;

and an interruptible connection between the power supply means and the sensing circuit means, the interruptible connection being controlled by said valve control circuit to disable the sensing means at least during opening of said electromagnetic valve.

12. Appliance according to claim 1, wherein said sensing circuit means comprises

a first timing circuit (26) and providing the first output signal after a predetermined period of time after change of resistance of said electrodes is first detected;

said sensing circuit means providing said second output signal upon sensing said change of resistance of said electrodes in the opposite direction, the second output signal controlling said valve control circuit; and a second timing circuit (28) to provide said output control pulse for a flushing time period to cause the electromagnetic valve to provide flushing action.

13. Appliance according to claim 12, wherein the second change of resistance comprises reversion of the resistance to essentially its predetermined value to provide the second output signal after termination of sensing of contaminating liquid contacting the electrodes, to change their resistances.

14. Appliance according to claim 1, wherein the sanitary appliance is a urinal.

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