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AUTOMATIC FLUSHING SYSTEM

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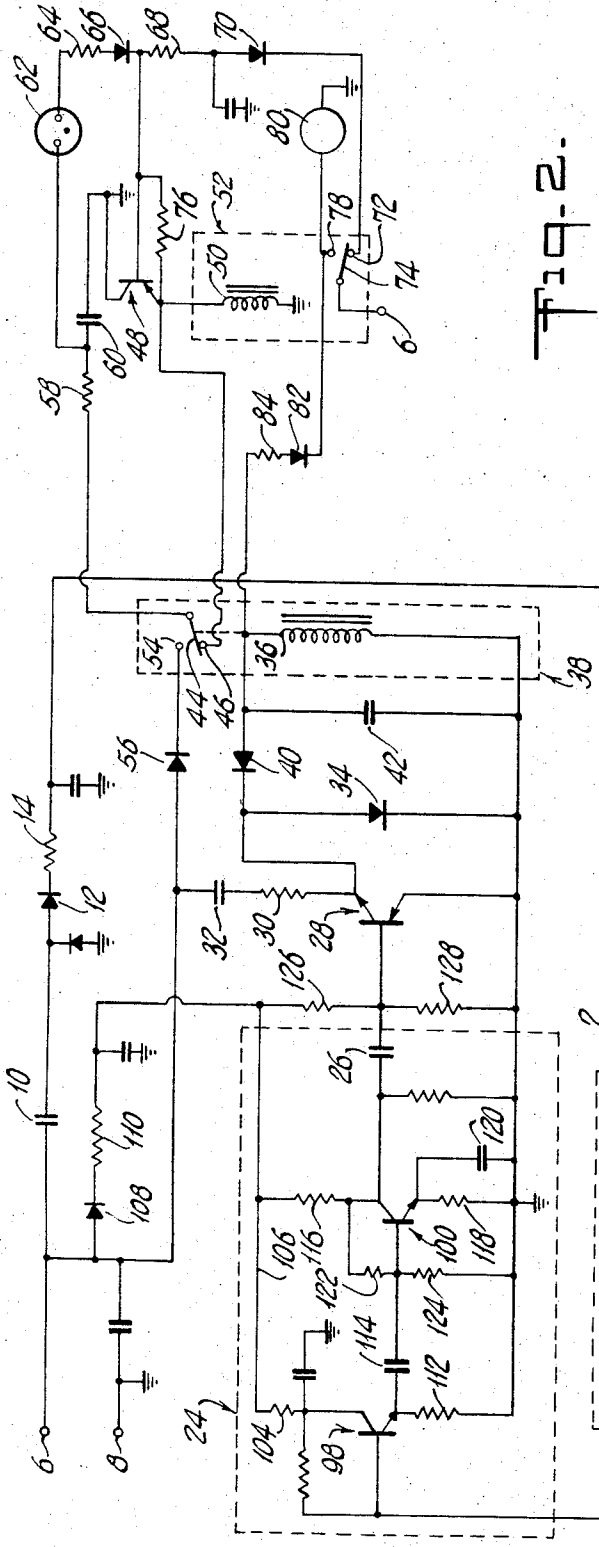


Fig. 1.

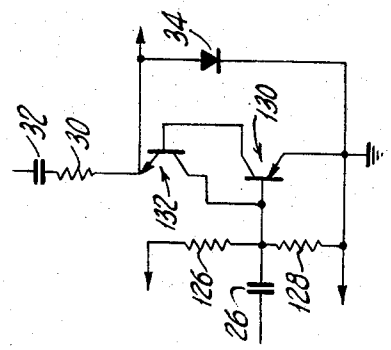


Fig. 2.

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AUTOMATIC FLUSHING SYSTEM

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Our present invention comprises an improvement of the capacity operated automatic flushing system disclosed and claimed in our co-pending application Ser. No. 369,543, filed May 22, 1964 now Patent No. 3,314,081. In the pending application, a system is disclosed wherein the presence of an individual using the facility varies the charge on a capacitor which results in the deenergization of a normally energized relay. Deenergization of the relay initiates the charging of a capacitor. When the individual leaves the vicinity, the relay becomes reenergized and in so doing connects the charged capacitor to the winding of a second, normally deenergized, relay through which the capacitor thereupon discharges. The second relay controls the operation of a solenoid operated flush valve. Thus, in the system of the application, the presence of an individual initiates the charging of the capacitor and the departure of the individual insures discharge of the capacitor and flushing of the premises. As it takes time to charge the capacitor controlling the normally deenergized relay to a value sufficient to energize that relay, the premises will not be flushed when an individual stops only momentarily in the vicinity of the facility. However, in the actual operation of installations equipped with the system of the pending application, it has been found that an erratic movement in the vicinity of the facility has at times caused premature flushing of the system with the result that the individual may not have moved away when the water is turned on. An individual who is feeble or unsteady on his feet for one reason or another may weave back and forth within the facility prior to taking up a firm position and thereby, with the system of the pending application, subject himself to possible wetting. Furthermore, as the period of flushing is coextensive with the period of discharge of the capacitor, incomplete flushing occasionally resulted when the capacity was not fully charged at the time the individual moved away from the facility.

The present application avoids any possibility of the flushing operation being initiated too soon or, when initiated, being incomplete. More specifically, in the circuit of the present application, a transistor is provided that is so connected in the circuit as to be normally conducting when the charge on the capacitor is less than a predetermined value. The transistor, when conducting, shunts the winding of the normally deenergized relay and thus prevents any current from reaching the winding of this relay until the charge on the capacitor has reached the predetermined value indicative of the presence of an individual for a predetermined time.

A further improvement in the circuit of the present application is the provision of circuit means, operative when the normally deenergized relay is energized, to maintain the first relay energized irrespective of the presence or absence of the individual. These means insure that the normally deenergized relay will be energized for the full period of discharge of the capacitor and that no intermittent opening and closing of the flush valve can occur.

The control circuit responsive to body capacity for the normally energized relay is substantially the same as that of the said co-pending application but with significant changes in certain components. Briefly, the circuit comprises a plate or "antenna" mounted in the vicinity of a urinal and serving as the capacity to ground which is increased by the presence of an individual, an oscillator

which, in the absence of an individual in the neighborhood of the antenna, provides a null or low signal to a transistor amplifier and which, when an individual approaches the antenna, provides pulses to the amplifier which when amplifier render conductive a semiconductor switching device connected in parallel with the winding of the normally energized relay. Thus, when the semiconductor switching device is rendered conductive, the relay is deenergized closing the charging circuit for the capacitor which, when discharged through the winding of the second relay, effects the operation of the flush valve. As in the circuit of the said co-pending application, the semiconductor switching device may be a four-zone PNPN semiconductor which is triggered conductive by negative pulses at its inner N zone. A diode is shunted across the semiconductor device to bypass current during the positive half cycle of the voltage wave at the collector of the semiconductor device and the winding of the normally energized relay is connected in series with a second diode across the first diode and across the semiconductor switching device. With this arrangement, during the positive half cycle of the voltage wave at the collector of the semiconductor device, the shunting diode prevents energization of the relay and during the negative half cycle of the voltage wave at the collector of the semiconductor device, the relay winding will be energized if the semiconductor device is not conducting current, that is, if there is no one in the vicinity of the antenna of the facility. A capacitor connected across the winding of the normally energized relay maintains the relay energized during the positive half cycle of the voltage wave.

For a better understanding of the invention and of a specific embodiment thereof, reference may be had to the accompanying drawing of which:

FIG. 1 is a schematic circuit of the presently preferred embodiment of the invention; and

FIG. 2 is a fragmentary circuit illustrating an alternative embodiment.

In the drawing, the antenna **2** represents a plate suitably positioned in a urinal to be influenced by the presence of an individual. A condenser **4**, shown in dotted lines, represents the residual capacity to ground of the antenna plate **2**. Excitation voltage, which may be, for example, a 117 volt alternating current supply, is connected to terminals **6** and **8**, terminal **8** being grounded. Terminal **6** is connected through a capacitor **10**, a diode **12** and resistors **14** and **16**, to an oscillator **18**, and through a capacitor **20** to the antenna **2**. The output of the oscillator **18** is connected through a lead **22** to the input of an amplifier **24** and the output of the amplifier **24** is connected through a capacitor **26** to the base or inner N zone of a semiconductor switching device **28** which may be a 2N1966. The collector of the semiconductor device **28** is connected through a load resistor **30** and phase shifting capacitor **32** to the ungrounded input terminal **6** of the source and the emitter of device **28** is grounded. A diode **34** is connected across the collector and emitter of the semiconductor device. The winding **36** of a relay **38** is connected in series with a diode **40** across diode **34** and a capacitor **42** is connected across the winding **36**.

An armature **44**, when the relay **38** is energized, engages a terminal **46** that is connected to the emitter of a transistor **48** and to the ungrounded end of the winding **50** of a relay **52**. When relay **38** is deenergized, the armature **44** engages a terminal **54** which is connected through a diode **56** to the ungrounded terminal **6** of the source. The armature **44** is connected through a resistor **58** to one side of a capacitor **60**, the other side of which is grounded.

Connected to the junction of resistor **58** and capacitor **60** is a series circuit comprising a neon tube **62**, a resistor **64**, a diode **66**, a resistor **68**, a second diode **70**, a terminal **72** engaged by the armature **74** of relay **52**

when the relay is deenergized and the terminal 6 of the source. The collector of transistor 48 is grounded and the base of transistor 48 is connected to its emitter through a biasing resistor 76 and to the junction of diode 66 with resistor 68. When the charge on capacitor 60 is less than the breakdown voltage of the neon tube 62, the potential at the base of transistor 48 will be sufficiently negative to cause that transistor to conduct. Only when the neon tube breaks down to pass some current through resistor 64 and diode 66 will the potential at the base of transistor 48 be positive and the transistor thereby blocked.

Armature 74 of relay 52, when the relay becomes energized, engages a terminal 78 which is connected to the solenoid valve 80 for actuation of the flush valve from the alternating current source connected to the armature, the other terminal of the valve 80 being grounded. Terminal 78 is also connected through a diode 82 and resistor 84 to the ungrounded end of the winding 36 of relay 38. Thus, when relay 52 is energized, the flush valve is operated and relay 38 is maintained energized.

Before describing the overall operation of the system, the oscillator 18 will now be briefly described. The oscillator 18 is of the type disclosed and claimed in our co-pending application Ser. No. 388,644 and its principle of operation is identical therewith. The present circuitry however is more sensitive in detecting the presence of an individual than the specific circuits disclosed in said co-pending application. In the preferred oscillator circuit of said co-pending application, two capacitors are shown with one plate of each connected through a charging resistor to the source of energy, one of the capacitors diagrammed as variable, having its other plate connected to ground and the other plate of the other capacitor connected to the output lead of the oscillator. In said circuit, the antenna is connected to the lead joining the plates of the two capacitors to the charging circuit. In the present oscillator circuit, the separate variable capacitor connected between the charging circuit and ground is not shown as its function is performed by the antenna 2. That such separate variable capacitor may be eliminated from the circuit will be clear when it is appreciated that the ungrounded plate of the omitted variable capacitor is physically connected to one plate of the second capacitor and hence may be considered as that plate and the other plate of the variable capacitor is grounded and hence may be considered as the ground between which and antenna 2 there is the residual capacity 4 of the present circuit.

In the present oscillator circuit, the fixed capacitor is shown at 86 with one plate connected to resistor 16 in the charging circuit and to antenna 2 through capacitor 20. The other plate of capacitor 86 is connected to output lead 22. Two neon tubes 88 and 90 are connected in series with a resistor 92 and an adjustable resistor 94 between the grounded terminal 8 of the source and the junction of capacitor 86 with resistor 16. The oscillator includes also a resistor 96 connected between line 22 and the junction of resistor 92 and tube 90.

When the source of energy is connected to the system, capacitors 4, 20 and 86 will charge positively through the diode 12 and elements connected in series therewith until the breakdown voltage of the neon tubes 88 and 90 is reached. At this voltage, capacitors 4 and 20 will discharge through the neon tubes and the resistors 92 and 94 to ground. Capacitor 86 will discharge through the tubes 88 and 90 and resistor 96 to the other side of the capacitor 86. Thus, the current will flow in one direction through resistors 92 and 94 and in the opposite direction through resistor 96. When the capacitors are discharged, the conduction through tubes 88 and 90 will cease until the breakdown voltage is again reached. Thus, there will be a series of positive pulses in the circuit including resistors 92 and 94 and a series of negative pulses in the resistor 96. The sum of these pulses is substantially a null voltage if, as is preferred, resistor 96 has a magnitude equal to the sum of resistors 90 and 92 and if the capacitor 86 is equal in magnitude to capacitor 20 as augmented by the residual capacity 4. When an individual is positioned adjacent antenna 2, the capacity to ground is increased with the result that a greater amount of current is stored by the series capacitors 20 and 4. Accordingly, when the neon tubes 88 and 90 break down, the positive pulses across resistors 92 and 94 will exceed the negative pulses across resistor 96. Consequently, positive pulses will be impressed upon the amplifier through lead 22. The null signal appearing at line 22 when there is no one in the vicinity of antenna 2 is reduced by the provision of a series circuit comprising blocking capacitor 95 and high resistor 97 connected across the capacitor 86. As described in our co-pending application Ser. No. 369,543, this series circuit has been found in practice to materially reduce the null signal and thereby to make the system more sensitive to change in capacity resulting from the presence of an individual.

The amplifier 24 comprises a first NPN transistor 98, a second NPN transistor 100, and the output capacitor 26. Transistor 98 has its collector connected through a resistor 104 to a lead 106 which is maintained positive with respect to ground by means of a diode 108, the anode of which is connected to terminal 6 and the cathode of which is connected through a resistor 110 to the lead 106. The emitter of transistor 98 is connected through a resistor 112 to the grounded terminal 8 and through a capacitor 114 to the base of transistor 100. The collector of transistor 100 is connected through a resistor 116 to the lead 106 and through the capacitor 26 to the base of the semiconductor device 28. The emitter of transistor 100 is connected to the grounded terminal through a resistor 118 by-passed by capacitor 120. The base of transistor 100 is also connected to a potential divider comprising resistors 122 and 124 connected between the collector of transistor 100 and grounded terminal 8. Resistors 126 and 128 are connected in series between the lead 106 and the grounded terminal and the junction thereof is connected to the base of the semiconductor device 28 to provide a positive bias tending to prevent conduction of the semiconductor device.

In the absence of an individual adjacent the plate or antenna 2, the output from amplifier 24 will be insufficient to overcome the positive bias on the gate of the semiconductor device 28 and accordingly that device does not conduct. During the negative half cycle of the voltage wave applied to the collector of the semiconductor device, relay 38 will be energized as heretofore described. During the positive half cycle of the voltage wave, the semiconductor device will be shunted by diode 34. When the positive pulses across resistors 92 and 94 of the oscillator increase in magnitude due to the presence of an individual, the resulting positive pulses impressed upon the base of transistor 98 cause that transistor to conduct copiously and create positive pulses at its emitter which are transmitted through capacitor 114 to the base of transistor 100. Transistor 100 therefore conducts copiously and through capacitor 102 impresses negative pulses on the gate of the semiconductor device which pulses are sufficient to overcome the positive bias on the gate. Accordingly, during the negative half cycle of the voltage wave, device 28 conducts, shunting the winding of relay 38 and causing the armature 44 to engage the contact 54. Capacitor 60 will now be charged positively through the circuit including diode 56, armature 44 and resistor 58, and will continue to charge so long as the individual stays in position by the antenna 2. When the charge on capacitor 60 exceeds the breakdown voltage of the neon tube 62, some current will flow through that tube and through resistor 64 and diode 66 to place a positive potential on the base of transistor 48 sufficient to render that transistor non-conductive. When the individual moves away from the vicinity of the antenna 2, the amplified pulses from the oscillator are insufficient to overcome the positive bias on the gate of the semiconductor device and accord-

ingly that device becomes non-conductive and the relay 38 is again energized to return this armature 44 into engagement with contact 46. Capacitor 60 thereupon discharges through the relay winding 50 of relay 52 because, at this time, transistor 48 has been blocked by the positive potential resulting from flow of current through the neon tube 62. When relay 52 is energized, armature 74 engages terminal 78 and the solenoid 80 is energized to cause flushing of the system. At the same time, the ungrounded terminal of the source is applied through armature 74, terminal 78, diode 82 and resistor 84 to the winding of relay 38 to maintain that relay energized during the period of discharge of the capacitor 60 through the winding of relay 52.

In the event that the individual stays in the neighborhood of the antenna 2 for too short a period to insure full charge of capacitor 60, the neon tube 62 will not break down and, accordingly, the transistor 48 will continue to be conductive. Therefore, when relay 38 is energized after such a short period of time, the charge on capacitor 60 will not flow through the winding of relay 52 but will pass through the conducting transistor 48 to ground. Irrespective of the number of times that the individual may waver back and forth in and out of the position in which he affects the charge on the plate 2, the relay 52 cannot be energized until and unless he has remained in the proper position for a sufficient time to insure full charge of capacitor 60. Thus, by the provision of the transistor 48 serving to shunt current from the winding of relay 52 whenever an individual has not stayed in position for a predetermined length of time, danger of intermittent and undesired energization of the relay 52 with consequent chattering of the flush valve is avoided. Also, by the provision of the connection including diode 82 and resistor 84 to the normally open contact of relay 52, complete flushing, once the transistor 48 has been blocked, is assured.

The specific four-zone semiconductor device 28 diagrammed in FIG. 1 could be replaced as shown in FIG. 2 by a PNP transistor 130 and a NPN transistor 132 connected as a regenerative loop. Transistor 130, which may be a 2N3638, has its emitter connected to ground, its collector connected to the base of transistor 132, which may be a 2N2926 and its base connected to capacitor 26 and the junction of resistors 126 and 128. The collector of transistor 132 is connected to the base of transistor 130 and its emitter connected to resistor 30. The operation of the system with the two interconnected transistors 130 and 132 replacing the four-zone device 28 is the same as above described in connection with FIG. 1. The transistor circuit is normally non-conducting because of the positive bias on the base of transistor 130. When negative pulses are applied to the base of transistor 130 because of the presence of an individual near the antenna 2, transistor 130 conducts causing base current to flow in transistor 132 with consequent conduction of transistor 132. Conduction of transistor 132 increases the negative potential on the base of transistor 130, enhancing conduction of that transistor. During the positive half cycle of the voltage wave at the emitter of transistor 132, the circuit returns to its non-conductive state.

The invention has now been described in connection with the preferred embodiment thereof. Obviously, various changes in the particular elements shown in the drawing could be made without departing from the spirit of the invention or the scope of the accompanying claims. For example, although electromagnetic relays for control of switches have been illustrated and described, solid state switching devices could be substituted therefor as will be apparent to those skilled in the art. Also, although the specific oscillator illustrated and described in the present application is preferred over those shown in applicants' said pending application Ser. No. 388,644, the oscillator circuits of the said application could be substituted for the oscillator shown herein. Also, although two neon tubes connected in series are shown in the present oscillator, a single neon tube could be substituted. Use of the two tubes in series permits the use of higher breakdown voltage and consequently greater magnitude of the resulting pulses. Capacitor 20 shown in the drawing as being connected between the antenna and the charging circuit serves only as a protective feature to avoid accidental contact of an individual with a live conductor. The capacitor could be omitted if desired. Other variations within the spirit of the invention and the scope of the accompanying claims will be apparent to those skilled in the art.

We claim:

1. In an automatic flusher for urinals having a first control means that is responsive to the present and absence of an individual positioned for use of the urinal, a capacitor, a charging circuit for the capacitor which is closed by said first control means when an individual is so positioned, a second control means responsive to discharge of said capacitor when the individual moves away from said position, said second control means operative to cause flushing of the urinal, the improvement comprising means for preventing intermittent and incomplete flushing of the urinal when an individual moves into and out of position of use without remaining in such position for a predetermined time, said improvement including a discharge path for said capacitor by-passing said second control means and means responsive to a predetermined value of charge on said capacitor for blocking said discharge path whereby said second control means causes flushing of the urinal only when an individual has remained in said position long enough for the capacitor to be charged to said predetermined value and has then moved away from said position.

2. The improvement according to claim 1 wherein said means for blocking said discharge path include a transistor having emitter and collector terminals connected across said second control means and a base terminal connected to said capacitor through a non-linear breakdown device which conducts when the charge on said capacitor reaches said predetermined value and a circuit connected to said base terminal for maintaining said transistor conducting in the absence of breakdown of said device.

3. A capacity sensitive system for automatically flushing a urinal comprising:

(a) capacity sensitive means responsive to body capacity of an individual positioned for use of the urinal;

(b) a low frequency oscillator including said capacity sensitive means for providing a first range of signals in the absence of an individual from such position and a second range of signals when an individual is in such position;

(c) a capacitor having a normally open charging circuit;

(d) means responsive to said signals for closing said charging circuit when the signals are in said second range and for opening said charging circuit when said signals are in said first range;

(e) means for flushing the urinal;

(f) a first path for discharge of said capacitor when the charging circuit is open;

(g) means responsive to a charge on said capacitor of a predetermined value for blocking said first discharge path;

(h) a second path operative when said first path is blocked for discharge of said capacitor; and

(i) means in said second path for causing operation of said flushing means upon discharge of said capacitor through said second path,

whereby the urinal will be flushed only after an individual has remained in such position for a predetermined time and then moved away.

4. The capacitor sensitive system according to claim 3 wherein said first discharge path includes a normally conducting semiconductor device having a control electrode

connected to said capacitor through a non-linear breakdown device for reception of blocking voltage when the charge on said capacitor reaches a predetermined value sufficient to render said non-linear device conducting.

5. The capacitor sensitive system according to claim 3 including means operative when the capacitor discharges through said second path to maintain open the charging circuit of said capacitor.

6. In an automatic flusher for urinals having a first relay that is normally energized in the absence of an individual positioned for use of the urinal, a capacitor, a charging circuit for the capacitor which is closed when said relay is deenergized and a second relay which is energized by discharge of said capacitor therethrough when the individual moves away from said position, said second relay, when energized, causing flushing of the urinal, the improvement comprising means for preventing intermittent and incomplete flushing of the urinal when an individual moves into and out of position of use without remaining in such position for a predetermined time, said improvement including circuit means connected across the winding of said second relay and when conductive shunting said winding and means responsive to a predetermined value of charge on said capacitor for rendering said circuit means non-conductive whereby said second relay is energized to cause flushing of the urinal only when an individual has remained in said position long enough for the capacitor to be charged to said predetermined value and has then moved away from said position.

7. The improvement according to claim 6 wherein said circuit means connected across said winding includes a transistor having emitter and collector terminals connected across the winding of said second relay, and a base terminal connected to said capacitor through a non-linear breakdown device which conducts when the charge on said capacitor reaches said predetermined value and a circuit connected to said base terminal for maintaining said transistor conducting in the absence of breakdown of said device.

8. The improvement according to claim 6 including means controlled by said second relay for maintaining energized said first relay for the period of energization of said second relay to insure complete discharge of said capacitor and complete flushing of the urinal.

9. A capacity sensitive system for automatically flushing a urinal comprising:

(a) capacity sensitive means responsive to body capacity of an individual positioned for use of the urinal;

(b) a low frequency oscillator including said capacity sensitive means for providing a first range of signals in the absence of an individual from such position and a second range of signals when an individual is in such position;

(c) a capacitor having a normally open charging circuit;

(d) means responsive to said signals for closing said charging circuit when the signals are in said second range and for opening said charging circuit when said signals are in said first range;

(e) means for flushing the urinal;

(f) a relay which when energized causes operation of said flushing means and having a winding connected to said capacitor for energization by discharge of said capacitor therethrough; and

(g) circuit means for shunting said winding when the charge on said capacitor is below a predetermined value,

whereby the urinal will be flushed only after an individual has remained continuously in such position for a predetermined time and then moved away.

10. The capacity sensitive system according to claim 9 wherein said means for shunting said winding comprise a normally conducting semiconductor device having a control electrode connected to said capacitor through a non-linear breakdown device for reception of blocking voltage when the charge on said condenser reaches a predetermined value sufficient to render said non-linear device conducting.

11. The capacity sensitive system according to claim 9 including means operative when said relay is energized for maintaining open the charging circuit of said capacitor.

12. In an automatic flusher for urinals having a first control means that is responsive to the presence and absence of an individual positioned for use of the urinal and a second control means for causing flushing of the urinal when said individual moves out of said position, the improvement comprising means for preventing intermittent and incomplete flushing of the urinal when the individual moves into and out of position of use without remaining in such position for a predetermined time, said improvement including means for disabling said first control means as soon as said second control means begins to operate and for a predetermined time thereafter.

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