ABSTRACT OF THE DISCLOSURE

A flushing control system having a proximity sensor for sensing for the presence of a user at the urinal including a water valve responsive to the proximity sensor for starting the water flow at a slow rate through the urinal when a user approaches. Moreover, the system includes a second water valve responsive to the proximity sensor for starting a fast water flow through the urinal for a predetermined time after the user departs therefrom.

This invention relates to an automatically controlled plumbing device and more particularly to a proximity-flushed urinal.

Most conventional urinals are generally flushed by the user manually operating a flushing device. However, since many users are careless and do not operate the valve device unpleasant odors and unsanitary conditions are prevalent in public comfort stations and washrooms. In order to alleviate such conditions, some public urinals are periodically flushed at given time intervals. While this minimizes the odor and sanitary problems, there is a considerable waste of water. In these times of critical water shortages the wasting of water is a problem.

It is therefore a prime object of the invention to provide an improved urinal which, while improving the sanitary conditions of a toilet, only uses the minimum amount of water.

It is a further object of the invention to provide an improved automatically flushed urinal which reliably operates only in response to the use of the urinal.

It is still a further object according to the invention to provide an improved automatically flushed urinal that is inexpensive to manufacture, easy to assemble, and reliable in operation.

Briefly, the invention contemplates a flushing control system for a urinal that is connected to a water supply. The system comprises proximity-sensing circuitry for sensing for the presence of a user at the urinal. A slow water control is provided responsive to the proximity-sensing circuitry for starting a water flow at a low rate of flow from a water supply through the urinal when a user approaches. Moreover, a fast water control is provided responsive to the proximity-sensing circuitry for starting a water flow through the urinal at a higher rate of flow for a predetermined time after the user departs therefrom.

Another novel feature of the invention includes the use of a capacitance bridge having a capacitance proximity switch for driving circuitry which is insensitive to transient electrical noise. The circuitry is used to control the valves required for turning the flow of water on and off. Other objects, features, and advantages of the invention will be apparent from the following detailed description when read with the accompanying drawings which show by way of example several embodiments of the invention.

In the drawings wherein corresponding elements have identical references throughout the several views:

FIGURE 1 shows a schematic diagram of one embodiment of a urinal-flushing control system according to the invention employing a timing circuit for timing the flow of water in response to signals from a proximity-sensing capacitance bridge.
these two voltage drops are not equal, and the voltage from junction 116 to ground is essentially the difference between them. The bridge is initially balanced or unbalanced by adjusting the resistance ratio 109:110. In use, the bridge is balanced or unbalanced by the approach of the user, that is, by the addition of capacitor 111 to the circuit.

Physically, the capacitors of bridge 10 are shown in Figure 3. The construction consists of a pair of vertical antennas 51 and 52, with their apertures secured to the opposite walls of urinal 32. A shield plate 50 is included at the back of the urinal adjacent to the wall supporting the urinal. A shielded coaxial cable 53 connects the antennas and the shield plate to junctions 116 and 117 in the circuit of bridge 10. The center conductor of coaxial cable 53 couples junction 117 to both antennas 51 and 52. The shield of cable 53, connected to junction 116, is electrically coupled to shield 50 at the back of urinal 32. Capacitor 112 is the stray capacitance between sensor plate 50 and ground. Capacitor 111 represents the capacitance of the user. The capacitor 113 is the capacitance of the coaxial cable 99 in Figure 3.

When the user is close to antennas 51 and 52, capacitor 111 is present in bridge 10. The bridge thus becomes unbalanced and the pulses generated by the free-running relaxation oscillator are transmitted to high-gain tuned amplifier 16. However, these pulses are greatly attenuated. Because of their low level, amplifier 16 includes a tuned stage. The output 52 of the terminal of amplifier 16 is connected to the input terminal of transistor 120 of coincidence detector 14.

Pulse amplifier 12 can be a common-emitter transistor amplifier whose base terminal is connected to line 46 and whose collector terminal is capacitor coupled via line 54 to the input terminal of transistor 121 of coincidence detector 14.

Coincidence detector 14 functions to prevent signals present on line 52 from being amplified except when a pulse is simultaneously present on line 54. Hence, most of the noise and interference on line 52 is rejected. Coincidence detector 14 comprises the two common-emitter amplifiers 120 and 121 having a common load resistor 123 and acting as an "AND" circuit. A positive-going pulse is transmitted on line 56, connected to the collector terminals of the transistors 120 and 121, only when negative-going pulses are simultaneously received at their base terminals. These pulses so generated are transmitted to integrator 18. Integrator 18 comprises diode 124, resistor 123 and capacitor 125. Integrator 18 accumulates a charge on capacitor 125 for each positive-going pulse received on line 56 via diode 124. Resistor 123, connected to line 56, continuously discharges capacitor 125. When a continuous burst of pulses is received, the voltage across capacitor 125 becomes sufficiently high to operate driver 22. However, random intermittent pulses are insufficient to raise the voltage across capacitor 125 to the required value. Therefore any random or intermittent pulses passing to capacitor 125 because of noise and interference have virtually no effect.

DC amplifier relay driver 22 is used to provide sufficient gain so that the high impedance signal on line 20 can operate a relay. The driver comprises a Darlington amplifier having transistors 126 and 127, and a silicon-controlled rectifier 128. The signal on line 20 is transmitted to the base terminal of transistor 126. The output signal of the Darlington circuit is transmitted from the emitter terminal of transistor 127 to the gate terminal of the silicon-controlled rectifier 128. The coil of relay 103 connects the anode of the rectifier to the AC power source 36 via line 38. The combination of resistors 129 and 130 and capacitor 131 is an "antichatter" circuit. A controlled ripple voltage is superimposed on the normal gate-cathode voltage of the rectifier with a phase such that the peak gate-cathode voltage always occurs near the first start of the conduction cycle. The superimposed ripple voltage prevents any ripple voltage resulting from underfiltering of the DC power source from causing relay chatter.

Relay 103, via its contact set 132 and 104, controls operating of timing circuit means 24. Timing circuit means 24 comprises the half-wave circuit which includes AC power source 60, diode 133 and capacitor 136. Timing resistor 134 connects one end of the coil of relay 135 to the output of the half-wave power supply (the junction of capacitor 136 and diode 133). The other end of the coil of relay 107 whose other end is connected to one terminal of timing capacitor 138. Discharge resistor 139 also connects the one terminal of capacitor 138 to junction 137. The other terminal of capacitor 138 is connected to line 64. Normally-open contact set 106 of relay 135 connects line 62 via junction 140 to one terminal of solenoid-operated valve 26 whose other terminal is connected via junction 141 to line 64. Similarly, normally-open contact set 105 of relay 107 connects line 62 via junction 142 to one terminal of solenoid-operated valve 34 whose other terminal is connected to line 64. The solenoid operated valves are energized by alternating current. Lines 62 and 64 are connected to the output terminals of AC power source 60.

Relay 103 operates in response to a user approaching the urinal. Contact set 132 closes and contact set 104 opens. Current flows from DC power supply 59 via timing resistor 134, the coil of relay 135 and contact set 104 to line 64. At the same time, the charge on capacitor 138 leaks off via resistor 139 and contact set 104. The current through the coil of relay 135 causes its normally-open contact set 106 to close. The alternating current from source 60 is applied across the terminals of solenoid-operated valve 26 causing it to open. The valve is dimensioned by means of a conventional flow washer to allow a slow rate of flow (e.g., 0.5 g.p.m.) from water source 30 to urinal 32.

When the user departs, relay 103 is deenergized; contact set 104 opens and contact set 132 closes. Capacitor 138 starts charging by drawing current from supply 59 via resistor 134, the coil of relay 135, and the now parallel combination of resistor 139 and the coil of relay 107. This charging current keeps relay 135 energized and also energizes relay 107. The normally-open contact set 105 of relay 107 closes and alternates current from source 60 flows through solenoid-operated valve 34. Valve 34 opens and a fast flow (e.g., 2.5 g.p.m.) of water passes from water source 30 to urinal 32. Now both valves are open.

As charging current of capacitor 138 falls off, relay 107 first deenergizes since the total discharge current flows through the coil of relay 135 but only a portion flows through the coil of relay 107 and the remaining portion through resistor 139. Valve 34 closes and the high-flow rate stops. Finally, the charging current drops to a value insufficient to keep relay 135 energized. At that time, valve 26 closes and all water flow stops.

In Figure 2 there is shown an alternate embodiment of the timing circuit means controlling the water system according to the invention. Since many of the elements are the same as those shown in Figure 1, prefix 200 characters are employed for reference to like elements. The basic difference is that a timing motor driving cam-operated switches is substituted in place of a resistance-capacitance network driving relays to control the solenoid-operated valves.

In particular AC power source 260 is connected to lines or buses 262 and 264. A timing motor 143, normally-open contact set 232 or relay 103 (FIG. 1) and normally-closed cam-operated switch 145 are connected in series across lines 262 and 264. Cam-operated switch 146, normally-closed contact set 240 of relay 103,
cam-operated switch 148 connect line 62 to junction 149 (connected to one terminal of a valve (similar to valve 34) within water supply 228). Junction 140 is connected to junction 240 (connected to one terminal of valve 26 within water supply 228). Line 264 is connected to junction 240 (connected to other terminals of valves 26 and 34 within supply 228).

Motor 143 drives cams 150 and 151. Cam 150 operates switch 145 (normally closed) and switch 146 (normally open). Cam 151 operates normally-open switch 148.

When a user approaches the urinal, relay 103 (FIG. 4A) is energized, contact set 132 thereof closes and contact set 204 thereof opens. Alternating current flows via switch 145, contact set 232 and motor 143. Motor 143 rotates until cam 150 opens switch 145 and closes switch 146. When switch 145 opens, motor 143 stops running. When switch 146 closes, alternating current is applied to a slow solenoid-operated valve (not shown) similar to valve 26. The slow-rate water flow begins. When the user leaves the urinal, relay 103 is deenergized, contact set 232 opens and contact set 204 closes. Motor 143 starts running by virtue of the alternating current flowing through switch 146, slow-closed contact set 204, line 66, motor 143 to line 264. As the motor rotates, cam 151 closes switch 148 and current is transferred from junction 153 to a high-flow solenoid-operated valve (not shown) similar to valve 34 in water system 228. High-rate water flow starts. After motor 143 has rotated a given amount, cam 151 allows switch 148 to open and high-rate water flow ends. After motor 143 rotates another given amount, cam 154 closes switch 145 and opens switch 146. Motor 143 stops and low-rate water flow also stops. The cycle is complete.

There has thus been shown an improved automatically operating urinal which is controlled by the proximity of the user. The urinal has a low-high-low rate of water flow sequence. Such a sequence has several advantages. Psychologically, the initial low flow indicates to the user that some sort of flushing is taking place and reassures him if he is concerned about the lack of any flushing handle. The curtain of water on the urinal wall during use tends to inhibit splashing. The turning on and off the water in stages rather than abruptly tends to reduce water hammer forces and hence noises.

In the present embodiment of the present invention, a single valve flushing control system comprising solenoid-operated valve 32 of FIGURE 1 is removed from water-system 28 and timing means 24 is replaced by the circuits of FIGURE 4A or FIGURE 4B. In FIGURE 4A, a timing circuit is disclosed according to the invention employing R-C network. When the user approaches the urinal, contact 132 opens and contact 104 closes. Capacitor 163 now discharges through diode 160, contact 104, and resistor 161. Diode 162 serves to bypass relay coil 135, preventing it from pulling in during the discharge of capacitor 163. Resistors 163 limits the discharge current to a safe value for contact 104, and also provides a "priming time" so that brief closure of contact 104 from interference or a passegry will not initiate flushing.

After the user leaves the urinal, contact 132 closes and contact 104 opens. Capacitor 163 now charges via resistor 165, contact 132, and relay coil 135. The charging current pulls in relay 135, closing its contact 106 and energizing solenoid valve 26. Flush water is delivered to the urinal and flows for a time that depends on the charging time constant of R167 x C165. Where R167 is the resistance of the coil of relay 135. When the current charging capacitor of 163 falls below the drop-out current of relay 135, contact 106 opens, solenoid valve 26 is de-energized, and the flow of flush water ceases.

According to the invention the circuit of FIGURE 4B accomplishes the same flushing action as FIGURE 4A, but uses thermal relay 170 to provide the timing. When the user approaches the urinal, contact 132 opens and contact 104 closes. The heater of thermal relay 170 is energized via contact 104 and after a time (the pull-in time) determined by the design of thermal relay 104, contact 171 closes. When the user leaves the urinal, contact 131 closes and contact 104 opens, de-energizing thermal relay 170. However, the heater of thermal relay 170 cannot cool instantaneously, and therefore contact 171 remains closed for a time (the drop-out time) that is determined by the design of thermal relay 170. During this drop-out time, both contact 132 and contact 171 are closed, so that solenoid water valve 25 is energized via contacts 132 and 171, and flush water is delivered to the urinal. After the end of the drop-out time, contact 171 opens, current flow to the coil of solenoid water valve 26 is interrupted, and the flow of flush water to the urinal ceases.

There will now be obvious to those skilled in the art many modifications and variations which satisfy many of all of the objects of the invention but which do not depart from the spirit thereof as defined by the appended claims.

What is claimed is:

1. An automatic flushing control system comprising voltage actuated proximity sensing means for sensing the presence of a user at the urinal, first water control means responsive to said proximity-sensing means for starting a water flow at a first rate from a water supply through the urinal when a user approaches, and second water control means responsive to said proximity-sensing means for starting a water flow at a second rate from the water supply through the urinal for a predetermined time after the user departs therefrom.

2. The control system of claim 1 wherein said first water control means includes further means for terminating the water flow at said first rate a predetermined time after the second rate of flow terminates.

3. The control system of claim 2 wherein said proximity-sensing means includes capacitance-bridge means comprising a capacitance proximity-switch means.

4. The control system of claim 3 wherein said capacitance-bridge means includes first pulse generating means for generating a continuous train of electrical pulses and second pulse generating means for generating pulses when said capacitance proximity-switch means senses the presence of a user at the urinal, and pluse coincidence means connected to said first and second pulse generating means for transmitting control signals for controlling said first and second water control means.

5. The control system of claim 4 wherein said pulse coincidence means includes means for generating pulses responsive to the coincidence of pulses received from said first and said second pulse generating means, and integrating means for generating a control signal after a predetermined number of pulses have been sequentially generated.

6. The control system of claim 4 wherein said first water control means includes a first solenoid-operated valve means connected to the supply of water, means operated by the presence of a control signal from said first control means for energizing said first solenoid-operated valve means, a timing circuit responsive to said first valve means for generating a signal for continuing the energization of said first solenoid-operated valve means for a predetermined time after the termination of said control signal.

7. The water control system of claim 6 wherein said second water control means includes a second solenoid-operated valve means connected to said supply of water, said second valve means being responsive to said timing circuit and energized thereby for a period of time less than said predetermined period of time.

8. The control system of claim 7 wherein said timing circuit includes resistance-capacitance devices.

9. The control system of claim 7 wherein said timing circuit includes an electric motor, and a plurality of cam-operated switches coupled to said electric motor for actuating said first and second valve means.