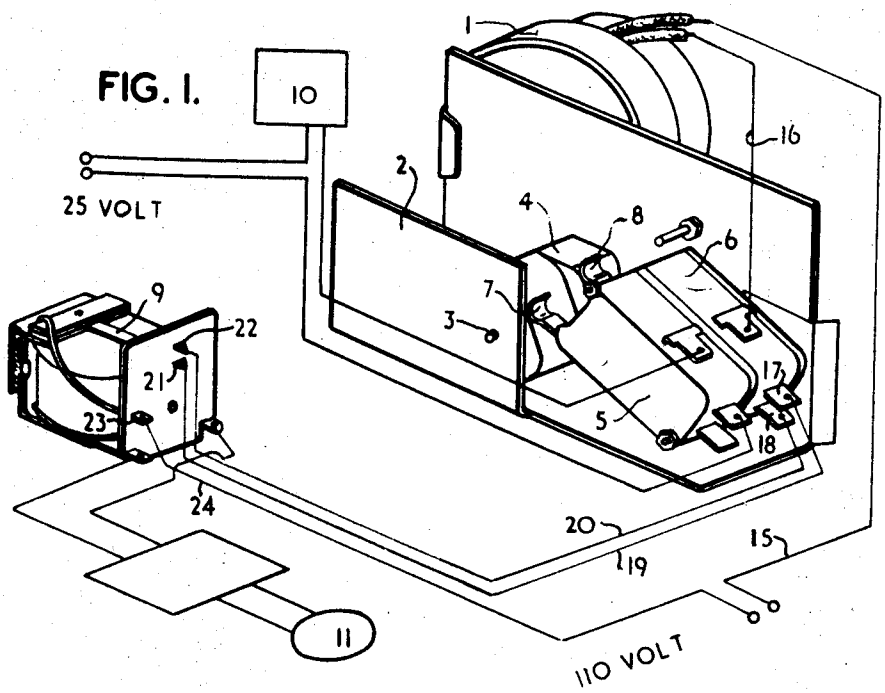
Aug. 11, 1970 E. K. ZORN 3,523,305

AUTOMATIC FLUSHING APPARATUS FOR TOILETS

Filed Jan. 2, 1968 2 Sheets-Sheet 1

FIG. 1.



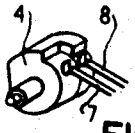


FIG. 3.

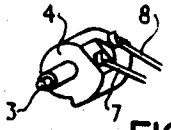


FIG. 4.

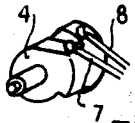


FIG. 5.



FIG. 6.



FIG. 7.

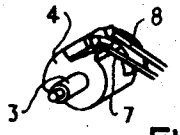


FIG. 8.

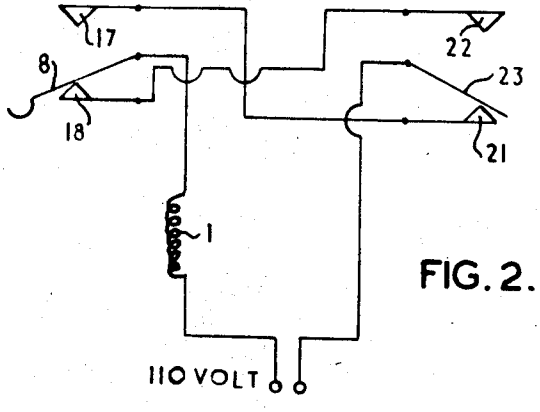


FIG. 2.



FIG. 9.

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AUTOMATIC FLUSHING APPARATUS FOR TOILETS

Filed Jan. 2, 1968 2 Sheets-Sheet 2

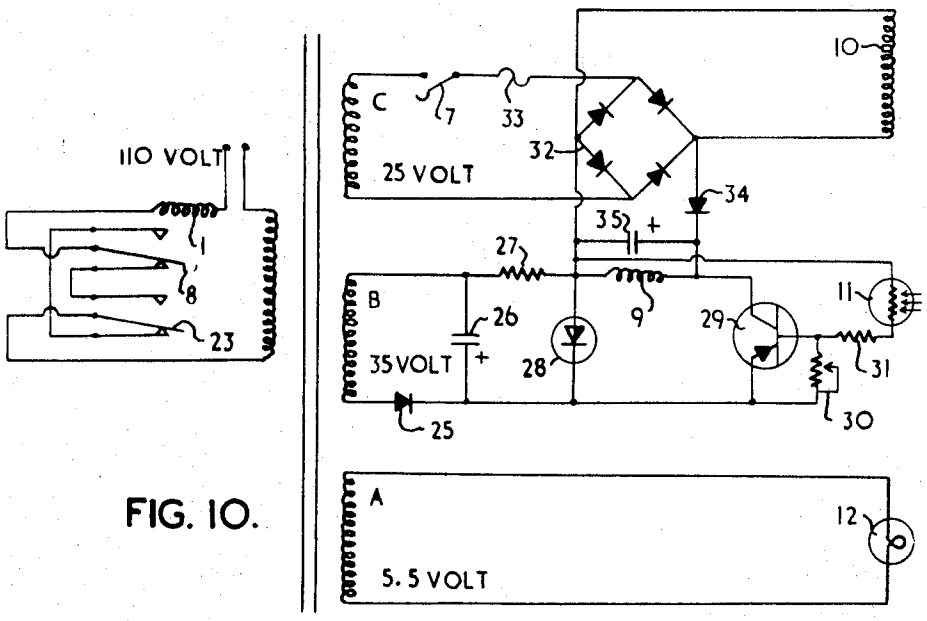


FIG. 10.

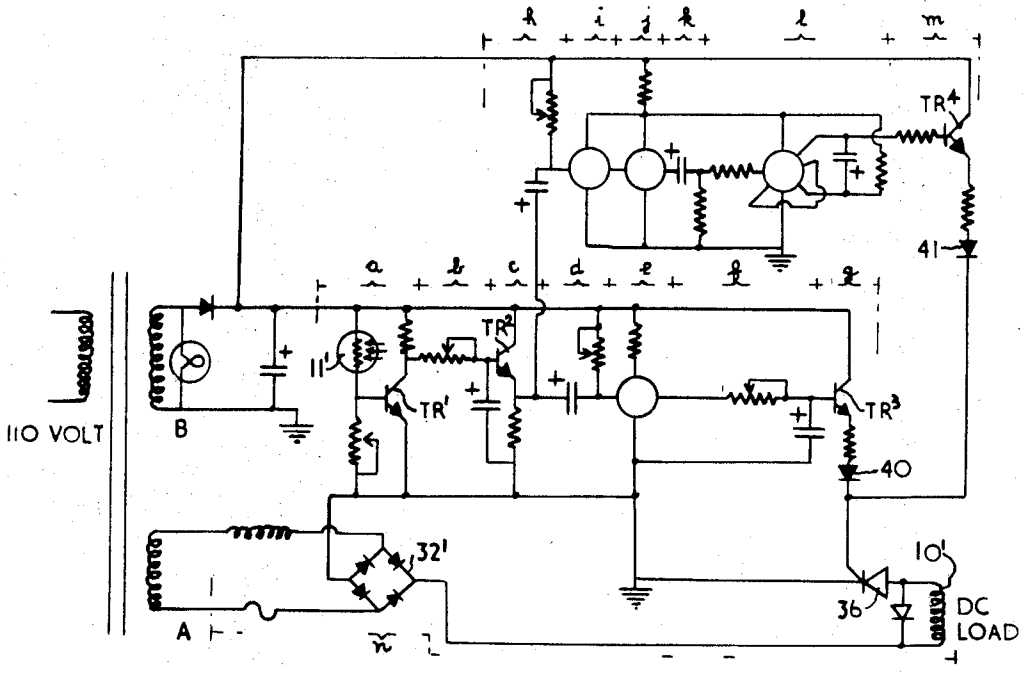


FIG. 11.

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AUTOMATIC FLUSHING APPARATUS FOR TOILETS

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Int. Cl. H63d 5/10; H01h 47/24
U.S. Cl. 4—100 6 Claims

ABSTRACT OF THE DISCLOSURE

An automatic flushing apparatus operated by a photoelectric cell type of person sensing device that employs a solenoid to actuate the water releasing valve in a gravity feed tank or in the water pressure line; special timing mechanism related to the person sensing photocell including a relay with alternate voltage assuring that the operating cycle once started will continue despite untimely interruption of the light source beamed on the cell. Additionally, switches controlled by a motor driven cam make and break circuits to the motor and the valve releasing solenoid.

This invention relates to improvements in automatic flushing apparatus for toilets and especially to one that is actuated by sensing the person.

Various methods of automatically flushing a toilet have been tried such as mechanical devices, door switches, seat-operated switches and the sensing of the stand water. Many disadvantages have been found, some were unreliable and did not always flush every time the toilet fixture was used, some operated on frequent occasions when flushing was not required as in the case of a door-actuated switch in the washroom of a private home, while others would flush at inappropriate times as when a person was using the toilet as with the water sensing device. These last two methods as well as the time interval flushers are wasteful of water particularly in heavily used toilet installations available to the general public.

It has been found that the most reliable automatic flushing actuation is obtainable by accurately sensing the person because with this method it is possible to assure that the toilet will be flushed on every occasion that it is used and yet avoid any accidental or unwanted flushing at any other time. See U.S. patents—Tekenos et al. No. 2,858,546; Gelhar No. 3,121,880; and Lefebvre No. 3,193,846.

Accordingly, it is an object of this invention to provide an improved automatic flushing apparatus for toilets, urinals or the like that employs a person sensing system for reliable foolproof flushing of the fixture on every occasion that it is used.

A further object of the invention is to provide an automatic toilet flushing appartus of the person sensing type in which timing is reliably performed by a motor operated switch.

A further object of the invention is to provide an automatic toilet flushing apparatus of the person sensing type of control that is readily adaptable to any normal situation by using a photocell which operates mainly in the infra-red portion of the spectrum and in which the effect of ambient light interference is reduced by the filtering of all visible light.

A further object of the invention is to provide a person sensing automatic toilet flushing apparatus suitable for use with a fixture serviced by a gravity feed tank or directly connected to and serviced by a water supply under pressure through which the flow to the fixture is controlled by a solenoid actuated valve.

A further object of the invention is to provide an automatic flushing apparatus for a toilet connected directly to a water pressure line having a novel, double flush action wherein two successive and distinct charges of water separated by a time interval are supplied to the fixture to (a) flush the unit, (b) break the siphoning and (c) refill the bowl.

A still further object of the invention is to provide a person sensing flushing apparatus employing a solenoid actuated flush valve in which a solenoid controlling relay normally in the photocell circuit may be supplied with voltage during any interruption of the photocell circuit whilst the flush valve solenoid is energized.

To the accomplishment of these and related objects as shall become apparent as the description proceeds, the invention resides in the construction, combination and arrangement of parts as shall be hereinafter more fully described, illustrated in the accompanying drawings and pointed out in the claims hereunto appended.

The invention will be best understood and can be more clearly described when reference is had to the drawings forming a part of this disclosure wherein like characters indicate like parts throughout the several views.

In the drawings:

FIG. 1 is a perspective view of the motor switch and relay for my improved toilet flushing apparatus together with the associated circuit;

FIG. 2 is a diagram of the **110** volt motor switch and relay circuit;

FIGS. 3–6 inclusive are perspective views of the motor driven cam in four successive rotative positions;

FIGS. 7–9 inclusive are perspective views of a modified, double flush cam in successive rotative positions;

FIG. 10 is a diagram of the person sensing photocell and motor switch circuits for the novel actuation of a solenoid flush valve; and

FIG. 11 is a modified circuit diagram substituting a transistorized circuit for the motor switch.

Because it is so important that automatic toilet flushing be reliable, the present invention incorporates a special motor operated switch to assure the timing of the flushing cycle and additionally provides for continuity of the actual flushing action once it has been started by affording alternative voltage to the critical circuiting in the event of casual interruption of the photocell circuit.

Referring now particularly to this preferred form of solenoid valve actuator relying on a motor-operated cam, FIG. 1 shows an electric motor **1** secured on the outer side of one wall of a U-shaped mounting bracket **2**. A motor driven shaft **3** extends through the bracket, carrying a compound cam **4** on its reach portion intermediate of the sides of the U-shaped bracket. A pair of companion switches **5** and **6** in side-by-side position are carried in the bracket **2** in juxtaposed relation to said cam having cam-wiping switch arms **7** and **8** respectively. The operation of the compound cam **4** will be described hereafter when reference is made to its various rotative positions shown in FIGS. 3 to 6 inclusive. Suffice it to say at this point that wiper arm **8** of switch **6** controls the 110 volt line circuit to the motor **1** through relay **9**, whilst wiper arm **7** of switch **5** controls the 25 volt circuit to the flush valve solenoid **10**. Also shown in FIG. 1 is the connection of the relay energizing circuit of photocell **11**. As the toilet flushing apparatus may be of the usual tank type, where the automatic actuator may lift a tank ball valve to release the tank contents to flush a toilet bowl by gravity or displace a solenoid actuated valve controlling a water pressure service direct to the toilet bowl, solenoid valve actuator or similar expressions may be considered as applying to any comparable water supply releasing device under control of

a solenoid. In a normal installation of this invention, a light source such as lamp **12** and a photo-electric cell **11** are mounted in suitable locations with respect to a flush toilet, urinal or the like that is subject to flushing on the actuation of solenoid **10** that a user of the plumbing fixture must intrude in a manner to break the light beam of the lamp that is focused on the photocell. When this happens, the increase in the resistance of the photocell causes the relay **9** to close the circuit to the motor switch **6** which is also closed thereby starting the motor **1**. The motor now runs until the cam **4** raises wiper arm **8** to break the motor circuit (see FIG. 4). As the user of the toilet departs the light beam from lamp **12** again impinges on the photocell re-energizing the relay **9** which again completes the motor circuit and the motor again runs for a predetermined period (approximately four seconds) until cam **4** lifts wiper arm **7** of the flush control switch **5** closing the circuit to the flush valve solenoid **10** (see FIG. 5). It may be here stated that in tank model flushers, wiper arm **7** will drop off after a further rotation period of four seconds (see FIG. 6) and the motor switch wiper arm **8** will follow in a further two seconds to break the motor circuit and stop the motor (FIG. 3).

In pressure line flush valves now used with most automatic toilet flushing apparatus it is customary to incorporate a bleed valve to permit a limited flow of water to refill the bowl after a normal flushing action is completed. Producing this slow-down of the water flow not infrequently causes disadjustment of the valve especially if there be any sediment or foreign particles in the water. Moreover, the bleed valve feature complicates the flush valve structure and increases the cost thereof. To avoid using such a modified valve, I have found a direct, trouble-free way of employing a simple solenoid actuated valve to first flush the toilet bowl, next break the siphoning action and then refill the bowl by means of the modified form of motor-operated cam shown particularly in FIGS. 7, 8 and 9. Here, it will be noted that the flush switch actuating part of the cam **4** has an additional radial extension to cause wiper arm **7** to drop off after a rotation period of eight seconds to arrest the siphon action of the toilet (FIG. 7), after a period of two seconds lift it again for a further rotational period of two seconds (FIG. 8) to allow feed to fill the bowl and then again drop off to break the flush valve solenoid circuit. The motor will continue for another six seconds when wiper arm **8** will finally drop off to break the motor circuit (FIG. 9).

The 110 volt line circuit has a lead **15** to the motor **1** and a return lead **16** to the motor switch **6** from which alternative contacts **17** and **18** selectably engageable by wiper arm **8** are connected by leads **19** and **20** respectively to contacts **21** and **22** on the relay **9** that are alternatively connectible with the contact **23** on the return lead **24** of the line circuit.

For a more comprehensive understanding of the invention attention is now directed to FIG. 10. Through a transformer primary the 110 volt AC power supply serves three secondary windings, namely

(A) 5.5 volt to lamp;
(B) 35 volt to control circuit; and
(C) 25 volt to solenoid.

Winding A connects to light source lamp **12**. Winding B serves diode **25**, capacitor **26**, resistor **27**, Zener diode **28**, the relay **9**, transistor **29**, variable resistor control **30**, resistor **31** and photocell **11**. From winding C one lead runs to the diode bridge **32** that converts to DC whence the positive line runs to the solenoid **10** with the return to the negative side of the diode bridge **32** thence to fuse **33**, and the flush switch wiper arm **7** to which the other lead from the winding extends.

To avoid possible breaking of the motor circuit during a flushing operation that would cause the flushing to continue indefinitely, voltage for the relay is assured by extending the solenoid circuit into the control circuit by connecting the voltage appearing across the diode bridge, through a diode **34**, that acts as a one-way check to the positive side of the relay and returning the negative side of the relay to the negative side of the diode bridge. In cases where the diode bridge is not used (as with AC solenoids) diode **34** will do the rectifying from DC to AC and capacitor **35** will filter the rectified voltage.

With a gravity flush tank type toilet or a urinal, a single flush cam **4** as shown in FIGS. 3–6 inclusive is used. The double flush cam illustrated in FIGS. 7, 8 and 9, for use with the solenoid pressure line valve may be rotated at a slower rate if desired.

Diode bridge **32** is employed with a tank operator on DC while with a pressure line valve solenoid on AC the bridge is unnecessary and so if the bridge is incorporated in a printed circuit, it can be jumped.

As an alternative to the motor driven cam operated switch, a transistorized circuit as shown in FIG. 11 may be used. With this circuit, the timing is accomplished by means of time delay components, transistors, and integrated circuits. It is designed to provide the same timing and the same dual flush as the motor-operated timing unit. An advantage of this circuit over the motor-operated unit is that there are no moving parts and there is nothing to wear out. All switching, even the energizing of the load is done with solid state components. The transformer secondary has two windings. Winding A supplies power to the flushing actuator, and winding B to the timing circuit as well as the lamp. Following is an explanation of the various portions of the circuit illustrated, section by section:

Section (a) provides the sensing with photocell **11'**. The change in voltage caused by the change in light, is amplified by transistor TR–**1**; in section (b) the RC timing circuit provides the initial 8 seconds delay, if this 8 seconds is not overcome, remainder of circuit will not go into operation; (c) emitter follower circuit to provide low impedance for integrated circuits; (d) RC timing circuit to provide time delay when person leaves before flushing starts; (e) integrated circuit which acts as a level indicator, voltage on input has to reach a certain level before output switches from 6 volt to ground; (f) RC timing circuit to determine length of flush; (g) transistor switch TR3 which turns thryristor **36** on for a time determined by timing circuit in section (f). At this point the flushing of a regular tank type toilet would be completed. For the dual flush however further circuitry will be required.

The combination of delay-**1**, delay-**2** and delay-**3** in sections (d), (e), (f) and (g) will require a total time of twelve seconds. At the conclusion of twelve seconds, the flushing will be completed.

Consider now the output of section (c) which is input to section (h) where RC timing circuit provides a time delay of 14 seconds, which it will be noted covers an extra 2 seconds over and above the 12 seconds required as hereinbefore described; in (i) the integrated circuit acts as a level indicator, same as (e); (j) is the inverter circuit which inverts the incoming signal; (k) the pulsing circuit, provides a pulse of sufficient length and amplitude to trigger multivibrator; (l) is a one shot multivibrator that turns on TR–**4** for a period of 2 seconds; and (m) the transistor switch to turn on thyristor **36** for a time determined by multivibrator.

Diode **40** prevents current from TR–**4** to feed back to TR–**3** and diode **41** vice versa. Section (n) covers the flushing actuator. Diode bridge **32'** rectifies the 25 volt from winding A. The thyristor acts as a switch to turn on the solenoid **10'**, the "contacts," which do not really exist, being closed by either TR–**3** or TR–**4**. Capacitor filtering is not used, so that the pulsating DC will go through zero, and turn the thyristor off. The DC load at **10'** is in the DC portion of the diode bridge. The bridge is still required, even with AC solenoids, since

the thyristor would cut off the negative portion of the supply voltage, and reduce the effective power. The AC load is connected in the AC portion of the bridge.

While I have illustrated and described the preferred embodiments of my invention, it is to be understood that I do not limit myself to the precise construction herein disclosed and that various changes and modifications may be made within the scope of the invention as defined in the appended claims.

What is claimed as new is:

1. For a toilet having a water supply and a valve controlling the flow thereof, an automatic flushing apparatus comprising an electric circuit; person sensing means including a photocell and a lamp beamed thereon, said cell and lamp being so mounted with respect to said toilet that a user must interrupt the lamp beam, said circuit including a transformer having a primary winding and secondary windings supplying (a) an actuator circuit for the valve, (b) a control circuit including the photoelectric cell, and (c) a circuit for the lamp respectively; a solenoid in said actuator circuit for actuating said valve; timing mechanisms controlling said solenoid actuator circuit including a relay in said control circuit; and alternate means for supplying voltage to said relay in the event the lamp beam is interrupted while said solenoid is energized.

2. The apparatus according to claim 1, wherein the alternate supply of voltage to the relay is by a connection between the solenoid actuator circuit and the control circuit including a diode that serves as a one-way check.

3. The apparatus according to claim 1, wherein the timing mechanism includes cam actuated switching mechanism and an electric motor for rotating the same.

4. The apparatus according to claim 1, wherein the timing mechanism includes associated with the primary winding an electric motor in said electric circuit, a cam rotated thereby and a cam actuated switch for said motor in series with a contact controlled by said relay.

5. The apparatus according to claim 1, wherein the timing mechanism includes associated with the primary winding an electric motor in said electric circuit, a cam rotated thereby, a cam actuated switch controlling the actuator circuit and a second cam actuated switch for said motor, the latter being in series with a contact controlled by said relay.

6. The apparatus according to claim 1, wherein the timing mechanism includes associated with the primary winding an electric motor in said electric circuit, a cam rotated thereby, and a cam actuated switch for said solenoid, said cam having two radial extensions to cause two spaced operations of said solenoid at predetermined intervals to provide for successively flushing the toilet, breaking the siphoning and refilling the bowl.

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J D MILLER, Primary Examiner

C. L. YATES, Assistant Examiner

U.S. Cl. X.R.

251—129; 317—130