

Description

The present invention relates to a water supply control for an automatic faucet having light-emitting means for periodically emitting light with a first repetition period in a standby condition, light-detecting means for detecting light emitted from the light-emitting means and reflected from a portion of the body of a user, and for producing a detected signal indicative of whether the light is detected or not, and control means for controlling a faucet to supply water based on the detected signal from the light-detecting means, wherein said control means comprises auxiliary light-emitting actuating means for enabling said light-emitting means on the basis of the detected signal from said light-detecting means to effect a plurality of light emissions having a second repetition period which is smaller than the first repetition period, and decision means for counting the number of times in which the light is detected by said light-detecting means, among the light emissions caused by said auxiliary light-emitting actuating means and for controlling said faucet on the basis of the counted number.

There are known water supply control systems for use in toilets or the like, wherein an optical means detects whether or not a user is present and, wherein water is supplied appropriately through a faucet. A water supply control including the above-mentioned features is known from US-A-4,742,583. This known water supply control comprises an infrared radiation sensor having a light-emitting element and a light-detector element. The light-emitting element emits infrared light, and when a user is present in front of the light-emitting element, at least a part of the emitted light is reflected from the body of the user towards the light detector element which provides a detected signal indicative of whether light has been detected in order to determine whether a user is present.

The light-emitting means of the water supply control according to US-A-4,742,583 are adapted to emit light pulses of a first repetition period when the water supply control is in a standby condition. Thus it can be avoided that for sensing the presence of a user light has to be emitted and detected continuously, such that the electric energy consumption of the water supply control may be reduced and a battery used as power supply may be of relatively low power requirement.

When the light-detecting element detects a light pulse time-correlated with an emitted light pulse, a control circuit reduces the first repetition period such that the light emitting element emits light pulses of a second repetition period shorter than the first repetition period in order to increase the accuracy of response.

Only if the light-detecting element has received a predetermined number of consecutive pulses at the (shorter) second repetition period, the control circuit determines that a user is present in order to provide a control signal for actuating a faucet. The water supply control according to the US-A-4,742,583 may be employed to control a flushing device in the form of a urinal. In this case the control circuit actuates the faucet after the detected signal has changed from the condition indicative of the presence of a user to the condition indicative of the absence of a user.

The water supply control according to the US-A-4,742,583 may also be employed to control a flushing device in the form of a washing basin. In this case the faucet is actuated for a time interval during which the detected signal indicates the presence of a user.

In any case, the mode of emitting light pulses with a second (shorter) repetition period is maintained at least throughout the whole period during which a user is present. In case of frequent use of the known water supply control, a comparatively large amount of electric energy is consumed by the light-emitting means, since the light emitting means is always driven at a higher frequency (lower repetition period) whenever a user is present, and this higher frequency must be high enough to provide the desired accuracy of response.

It is the object of the present invention to improve the water supply control of the type mentioned above such that the consumption of electric energy may be further reduced without substantially reducing the sensitivity and accuracy of response.

To solve this technical problem the water supply control for an automatic faucet according to the present invention is characterized in that said auxiliary light-emitting actuating means is adapted to cause a predetermined number of light-emissions at the beginning of the first repetition period in response to the detected signal from the light-detecting means and to suppress further light emissions during that period.

According to the present invention it is not required to maintain the mode of emitting light pulses with the shorter repetition period throughout the whole period in which a user is present. To provide the desired accuracy of response, i.e. to make sure that a user is detected, it is sufficient to emit only a limited number of light emissions at the beginning of a first repetition period upon detection of a respective first light pulse which is time-correlated to an emitted light pulse. If a predetermined number of consecutive light pulses with the second repetition period is detected, it can be assumed that the detected light pulses result from a reflection by a user. In order to check whether a

user is continuously present, it is proposed to emit pulse trains with the limited number of light emissions with the second repetition period at periodical time intervals according to the first repetition period until the detected signal indicates absence of the user.

The time interval of each pulse train of pulses of the second repetition period in each case is shorter than the first repetition period. Therefore, pulse trains with light pulses with the second (shorter) repetition period are not emitted without interruption throughout the whole period in which the user is present. Accordingly, the light-emitting means of the water supply control according to the present invention, when compared with the prior art discussed above, are less often energized during a given time interval in which a user is present. Thus, the effective time in which the light-emitting means consumes electric energy in such a given time interval may be considerably shorter. Therefore, the water supply control according to the present invention does not require a large amount of electric power even in the case of frequent use.

In a preferred embodiment of the present invention said auxiliary light-emitting actuating means causes said predetermined number of light emissions after the presence of the user has been indicated by the detected signal from the light-detecting means, wherein said decision means actuates said faucet to supply water if the counted number of light emissions caused by said light-emitting actuating means and detected during the respective first repetition period by the light detecting means is equal to or smaller than a predetermined number. This preferred embodiment is preferably adapted for use in an automatic flushing device for a toilet or the like. If the counted number of light emissions having the second repetition period is equal to or smaller than the predetermined number it can be assumed that the user has left the toilet, such that the actuation of the faucet to supply water takes place after the user has left the toilet.

Preferably a controllable faucet-actuating means is provided for actuating the faucet, wherein said decision means is adapted to apply a faucet-opening control signal to said faucet-actuating means to open the faucet for a predetermined period of time. The control means may include a disabling means operably responsive to detection of the user based on the detected signal from said light-detecting means for disabling said decision means unless a predetermined period of time elapses from the detection of the user.

The water supply control system according to the present invention may also be used for an automatic faucet device for a sink or the like which supplies water for a user to wash hands with. For

such an application it is proposed that said auxiliary light-emitting actuating means causes said predetermined number of light emissions after the presence of a user has been indicated by the detected signal from the light detecting means, wherein said decision means actuates said faucet to supply water if the counted number of light emissions caused by said light-emitting actuating means and detected during the respective first repetition period by the light-detecting means is equal to or greater than a predetermined number. In this case, actuating of said faucet takes place immediately upon the actual detection of a user.

Preferably, a controllable faucet-actuating means is provided for actuating the faucet, wherein said decision means applies a faucet-opening control signal to said faucet actuating means to open the faucet.

The decision means is preferably adapted to apply a faucet-closing control signal to said faucet-actuating means to close the faucet when the detected signal from the light-detecting means changes from a condition indicative of the presence of the user to a condition indicative of the absence of the user.

According to a further embodiment of the present invention for use with an automatic faucet device for a sink or the like, said auxiliary light-emitting actuating means is also adapted to cause a predetermined number of light emissions at the beginning of the first repetition period to suppress further light emissions during said period after the detected signal from said light-detecting means has changed from a condition indicative of the presence of the user to a condition indicative of the absence of the user, wherein said decision means applies a faucet-closing control signal to said faucet-actuating means to close the faucet, if the counted number of light emissions caused by said light-emitting actuating means upon said change of the condition of the detected signal and detected by said light-detecting means during the respective first repetition period is equal to or smaller than a predetermined number. If the counted number is equal to or smaller than said predetermined number, this is a reliable indication that the user is no longer present.

According to a further embodiment of the present invention a controllable faucet actuating means is provided for actuating the faucet wherein said auxiliary light-emitting actuating means causes said predetermined number of light emissions at the beginning of a first repetition period and suppresses further light emissions during said period after the detected signal from the light-detecting means has changed from a condition indicative of the presence of the user to a condition indicative of the absence of the user and wherein said decision

means applies a faucet-opening control signal to said faucet-actuating means to open the faucet for a predetermined period of time if the counted number of light emissions caused by said light-emitting actuating means and detected by said light-detecting means during said first repetition period is equal to or smaller than the predetermined number. The last-mentioned embodiment is adapted for use in a toilet flushing device. If the counted number is equal to or smaller than the predetermined number, this is a reliable indication that the user has left the toilet. The faucet is actuated to supply water after the user has left the toilet.

The above and further details and advantages of the present invention will become apparent from the following detailed description of preferred embodiments thereof when read in conjunction with the accompanying drawings.

- Fig. 1 is a block diagram of a circuit arrangement of a water supply control according to a first embodiment of the present invention;
- Fig. 2 is a timing chart of operation of the circuit arrangement shown in Fig. 1;
- Fig. 3 is a block diagram of the circuit arrangement shown in Fig. 1 as implemented by a microcomputer;
- Fig. 4 is a flow chart of an operation sequence of a microcomputer which implements the circuit arrangement according to the first embodiment, however, partly modified;
- Fig. 5 is a block diagram of a circuit arrangement of a water supply control system according to a second embodiment of the present invention.
- FIG. 6 is a timing chart of operation of the circuit arrangement shown in FIG. 5;
- FIG. 7 is a flowchart of an operation sequence of a microcomputer which implements the circuit arrangement shown in FIG. 5;
- FIG. 8 is a flowchart of a different operation sequence of the microcomputer which implements the circuit arrangement shown in FIG. 5;
- FIG. 9 is a block diagram of a circuit arrangement of a water supply control according to a third embodiment of the present invention;
- FIG. 10 is a timing chart of operation of the circuit arrangement shown in FIG. 9;
- FIG. 11 is a flowchart of an operation sequence of a microcomputer which implements the circuit arrangement shown in FIG. 9;
- FIG. 12 is a block diagram of a circuit arrangement of a water supply control

according to a fourth embodiment of the present invention;

FIG. 13 is a timing chart of operation of the circuit arrangement shown in FIG. 12; and

FIG. 14 is a flowchart of an operation sequence of a microcomputer which implements the circuit arrangement shown in FIG. 12.

A water supply control system including a water supply control according to a first embodiment of the present invention will hereinafter be described in detail with reference to the accompanying drawings.

The water supply control according to the first embodiment can primarily be incorporated in an automatic flushing device for a toilet or the like in a bathroom. When a user leaves the toilet after the user has been detected, the water supply control system automatically feeds or supplies water to the toilet through a faucet.

FIG. 1 shows in block form a circuit arrangement of the water supply control according to the first embodiment. In FIG. 1, the water supply control comprises a light-emitting means 1 such as a photodiode or the like, a light-detecting means 2 such as a phototransistor or the like for detecting light emitted from the light-emitting means 1 and reflected by a portion of the body of a user, a faucet actuator circuit 17 for actuating a faucet (not shown) to supply water to a toilet or the like after it has been used by the user, and a control means 3.

Normally, the light-emitting means 1 is energized by an intermittent light-emitting pulse generator 5 which frequency-divides a clock signal produced by a reference clock generator 4 to generate pulses with a suitable first repetition period. Output pulses of the intermittent light-emitting pulse generator 5 are shown in FIG. 2(b).

When a portion of the body of the user approaches the light-emitting means 1, the light-detecting means 2 applies its detected signal to a waveform shaper 6, which then produces a pulse signal shown in FIG. 2(c). FIG. 2(a) shows a period of time in which the toilet is used by the user, and does not represent a signal. The pulse signal from the waveform shaper 6 and a drive signal D for the light-emitting means 1 are ANDed by an AND gate 7, whose output signal is applied to a set terminal 8a of an R-S flip-flop 8. These signals are ANDed by the AND gate 7 in order to remove noise which would otherwise be produced by extraneous light other than the light emitted by the light-emitting means 1. The output signal from the AND gate 7 is equivalent to the signal shown in FIG. 2(c).

The flip-flop 8 holds an output signal from its Q output terminal 8b at a high level during an interval of time, as shown in FIG. 2(e), after the light-

detecting means 2 detects first light until it detects no light. The flip-flop 8 has a reset terminal 8c which is supplied with an output signal from an AND gate 10 which ANDs the drive signal D (FIG. 2(b)) for the light-emitting means 1 and a signal that is produced by inverting the output signal from the waveform shaper 6 with a NOT circuit 9. The signal applied to the reset terminal 8c is shown in FIG. 2(d).

To the Q output terminal of the flip-flop 8, there are connected a frequency divider 11 and a first counter 12. The frequency divider 11 and the first counter 12 are enabled when the output signal from the Q output terminal goes high.

In response to the detection of light by the light-detecting means 2, the frequency divider 11 frequency-divides the reference clock signal to immediately produce auxiliary drive pulses, as shown in FIG. 2(f). The first counter 12 produces a high-level output signal shown in FIG. 2(g) while it is counting a predetermined number (four in this embodiment) of output pulses from the frequency divider 11 in synchronism with the drive pulses (FIG. 2(b)). The output signal from the first counter 12 and the output signal from the frequency divider 11 are ANDed by an AND gate 14. The output signal from the AND gate 14, together with the output signal from the intermittent light-emitting pulse generator 5, is applied through an OR gate 15 to the light-emitting means 1.

The output signal from the AND gate 14 is a pulse signal of a short period (second repetition period), containing four pulses, as shown in FIG. 2(h). The frequency divider 11, the first counter 12, and the AND gate 14 jointly constitute an auxiliary light-emitting actuating means.

A second counter 13 counts output pulses from the AND gate 10. Substantially at the same time that the user leaves the toilet, the second counter 13 counts output pulses (signal A shown in FIG. 2(d)) produced by the AND gate 10, and applies a signal shown in FIG. 2(i) through an AND gate 19 to the faucet actuator circuit 17. The faucet actuator circuit 17 then actuates the faucet to supply water during a predetermined period of time shown in FIG. 2(k). Concurrent with this, the signal level of the Q output terminal of the flip-flop 8 goes low, disabling the frequency divider 11 and resetting the first counter 12. However, if the first counter 12 is producing a high-level output signal when the signal level of the Q output terminal of the flip-flop 8 goes low, that high-level output signal is rendered effective and produced as shown in FIG. 2(g). The first counter 12 is reset after the high-level output signal is produced. The other input terminal of the AND gate 19 is connected to an inhibit time setting circuit 18 which is started at the same time that it receives the signal from the Q output terminal of

the flip-flop 8. The inhibit time setting circuit 18 continuously produces a low-level signal for a predetermined period of time after it receives the signal from the Q output terminal, and thereafter produces a high-level output signal (FIG. 2(j)). If an output signal is produced from the second counter 13 within a very short period of time after a user is detected, then the inhibit time setting circuit 18 regards such a condition as an erroneous detection and inhibits an output signal applied to the faucet actuator circuit 17.

The above arrangement can reliably and quickly detect the user leaving the toilet. Even when the light-detecting means 2 produces a signal corresponding to a detected signal under the influence of noise or the like, the faucet will not be actuated. Therefore, the water supply control system is highly reliable. The adverse effect of noise can be removed without lowering the detection sensitivity of the light-detecting means 2.

The circuit arrangement shown in FIG. 1 may be implemented by a microcomputer 22 having a CPU 23, a memory 24, an I/O 25, etc., as shown in FIG. 3. If such a microcomputer is employed for control, the water supply control may not be limited to the above sequence, but may be controlled according to the flowchart shown in FIG. 4. The flowchart of FIG. 4 will now be described below.

Parameters M, N are initialized in a step 1. The parameter M is a parameter which indicates whether a user has already been detected or not, and the parameter N is a parameter which indicates the number of auxiliary drive pulses. The light-emitting means which is in a standby condition is energized for intermittent light emission in a step 2, and a first timer is started in a step 3, the first timer determining the period of the intermittent light emission. When light is detected in a step 4, steps 5 through 11 are executed for auxiliary light emission. A second timer which determines the period of auxiliary light emission is started in a step 5, and the time set by the second timer is measured in a step 6. The light-emitting means is energized for auxiliary light-emission in a step 7, which is followed by a step 8 that determines whether light is detected or not. If auxiliary light emission is detected by a predetermined number of times (e.g., four times) in a step 9, then the parameter M is set to 1, indicating that a user has been detected. If no light is detected in the step 4 or 8, then a step 12 determines whether a user has already been detected or not. If detected, then steps 13 through 19 are executed for the actuation of the faucet, and water is fed from the faucet for a predetermined period of time until a parameter P that determines a period of time in which to supply water represents a predetermined number Pn.

A water supply control system including a water supply control according to a second embodiment of the present invention will now be described with reference to FIGS. 5 through 8.

The water supply control system according to the second embodiment can mainly be incorporated in an automatic faucet device for a sink or the like which supplies water for a user to wash hands with. FIG. 5 shows a circuit arrangement of the water supply control according to the second embodiment.

As shown in FIG. 5, the water supply control system comprises a light-emitting means 1 such as a photodiode or the like, a light-detecting means 2 such as a phototransistor or the like for detecting light emitted from the light-emitting means 1 and reflected by a portion of the body of a user, such as a hand of the user, a faucet actuator circuit 17 for actuating a faucet 20 to supply water for the user to wash hands with, and a control means 3. Therefore, the circuit arrangement shown in FIG. 5 is somewhat similar to the circuit arrangement according to the first embodiment shown in FIG. 1. Normally, the light-emitting means 1 is energized by an intermittent light-emitting pulse generator 5 which frequency-divides a clock signal produced by a reference clock generator 4 to generate pulses with a suitable long first repetition period. Output pulses or drive pulses of the intermittent light-emitting pulse generator 5 are shown in FIG. 6(b).

When a hand or the like of the user approaches the light-emitting means 1, a portion of the light from the light-emitting means 1 is reflected by the hand, and the light-detecting means 2 detects the reflected light and produces a detected signal. The detected signal is applied to a waveform shaper 6, which then produces a pulse signal shown in FIG. 6(c).

FIG. 6(a) shows a period of time in which the sink is used by the user, and does not represent a signal.

The pulse signal from the waveform shaper 6 and a drive signal D for the light-emitting means 1 are ANDed by an AND gate 7, whose output signal is applied to a set terminal 8a of an R-S flip-flop 8. These signals are ANDed by the AND gate 7 in order to remove noise which would otherwise be produced by extraneous light other than the light emitted by the light-emitting means 1. The output signal from the AND gate 7 is equivalent to the signal shown in FIG. 6(c).

The flip-flop 8 holds an output signal from its Q output terminal 8b at a high level during an interval of time, as shown in FIG. 6(e), after the light-detecting means 2 detects first light until it detects no light. The flip-flop 8 has a reset terminal 8c which is supplied with an output signal from an

AND gate 10 which ANDs the drive signal D (FIG. 6(b)) for the light-emitting means 1 and a signal that is produced by inverting the output signal from the waveform shaper 6 with a NOT circuit 9. The signal applied to the reset terminal 8c is shown in FIG. 6(d).

To the Q output terminal of the flip-flop 8, there are connected a frequency divider 11, a first counter 12, and a second counter 16. The frequency divider 11, the first counter 12, and the second counter 16 are enabled when the output signal from the Q output terminal goes high.

In response to the detection of reflected light by the light-detecting means 2, the frequency divider 11 frequency-divides the reference clock signal to immediately produce auxiliary drive pulses, as shown in FIG. 6(f). The first counter 12 produces a high-level output signal shown in FIG. 6(g) while it is counting a predetermined number (four in this embodiment) of output pulses from the frequency divider 11 in synchronism with the drive pulses at long first repetition periods (FIG. 6(b)). The output signal from the first counter 12 and the output signal from the frequency divider 11 are ANDed by an AND gate 14. The output signal from the AND gate 14, together with the output signal from the intermittent light-emitting pulse generator 5, is applied through an OR gate 15 to the light-emitting means 1.

The output signal from the AND gate 14 is a pulse signal of a short period (second repetition period), containing four pulses, as shown in FIG. 6(h). The frequency divider 11, the first counter 12, and the AND gate 14 jointly constitute an auxiliary light-emitting actuating means, as with the first embodiment.

The second counter 16 counts the number of times in which reflected light is detected by the light-detecting means 2 when the light-emitting means 1 is energized by the auxiliary light-emitting actuating means. When the count of the second counter 16 reaches a prescribed number (e.g., four in this embodiment), the second counter 16 produces a high-level signal as shown in FIG. 6(i), and energizes the faucet actuator circuit 17 until it is reset by a pulse B in the signal shown in FIG. 6(d).

The faucet actuator circuit 17 then actuates a solenoid-operated valve (not shown) to enable a faucet 20 to supply water.

If the count of the second counter 16 does not reach the prescribed number, then the faucet actuator circuit 17 is not energized. In this case, the second counter 16 counts a light-detecting signal due to a pulse which is produced by the auxiliary light-emitting actuating means in response to a detected signal due to the light produced by a next drive pulse. When the count becomes 4, the faucet actuator circuit 17 is energized. If the light

produced by a next drive pulse is not detected, the first and second counters are reset by the pulse signal shown in FIG. 6(d), and the water supply control system returns to a normal standby condition (waiting for a user). Therefore, the second counter 16 serves as a decision means in this embodiment.

With the above arrangement, even when the light-detecting means 2 produces a signal corresponding to a detected signal under the influence of noise or the like, the faucet will not be actuated. Therefore, the water supply control system is highly reliable. The adverse effect of noise can be removed without lowering the detection sensitivity of the light-detecting means 2.

If the frequency divider 11, the first counter 12, etc. are reset using the output signal (FIG. 6(i)) of the second counter 16, then the output signal shown in FIG. 6(g) becomes a signal shown in FIG. 6(j), and the output signals shown in FIGS. 6(f), (h) become a signal shown in FIG. 6(k).

The water supply control according to the second embodiment should not be limited to the circuit arrangement shown in FIG. 5, but may be implemented by a microcomputer 22 having a CPU 23, a memory 24, an I/O 25, etc., as shown in FIG. 3. If such a microcomputer is employed for control, the water supply control system may be controlled according to the flowchart shown in FIG. 7 or 8.

The flowchart of FIG. 7 will now be described below. Parameters M, N are initialized in respective steps 1, 2. The parameter M is a parameter which indicates whether a faucet is open or not, and the parameter N is a parameter which indicates the number of auxiliary drive pulses.

The light-emitting means is energized in a step 3, and a first timer is started in a step 4, the first timer determining the long period of the drive pulses shown in FIG. 6(b). The time set by the first timer is measured in a step 5. If light is detected in a step 5, then steps 6 through 11 are executed in order to energize the auxiliary light-emitting actuating means. A second timer serves to measure the short period of auxiliary drive pulses. After a predetermined number of auxiliary drive pulses have been detected in a step 10, the faucet is opened in a step 13 only when it is not opened in a step 12, and the parameter M is set to 1 in a step 14.

If no light is detected in the step 5 or 9, then a step 16 determines whether the faucet has been opened or not so far. If not opened ($M = 0$), then control goes to the step 15. If opened ($M = 1$), then the faucet is closed, and the parameter M is set to 0 for initialization, and the above process is repeated.

FIG. 8 shows a modified flowchart of an operation sequence which is similar to the operation

sequence shown in FIG. 7. Details of the flowchart shown in FIG. 8 will not be described below. A parameter L in FIG. 8 represents the number of times in which light produced by an auxiliary light-emitting pulse is detected.

A water supply control system including a water supply control according to a third embodiment of the present invention will now be described with reference to FIGS. 9 through 11.

The water supply control according to the third embodiment can effectively be incorporated in an automatic flushing device for a toilet or the like in a bathroom.

FIG. 9 shows a circuit arrangement of the water supply control according to the third embodiment. The water supply control system comprises a light-emitting means 301 such as a photodiode or the like, a light-detecting means 302 such as a phototransistor or the like for detecting light emitted from the light-emitting means 1 and reflected by a portion of the body of a user, a faucet actuator circuit 309 for actuating a faucet (not shown) to supply water to a toilet or the like after the it has been used by a user, and a control means 303.

Normally or in a standby condition, a drive pulse generating means 304 in the control means 303 generates a periodic pulse signal with a first repetition period for the pulses as shown in FIG. 10(b), which is applied to the light-emitting means 301 to emit light. When a detected signal shown in FIG. 10(c) is produced by the light-detecting means 302, a first auxiliary pulse generating means 305 in the control means 303 generates a plurality of (e.g., four in this embodiment) of pulses (FIG. 10(d)) at a second repetition period shorter than the first repetition period of the drive pulses, based on a first pulse signal 305a. The generated pulses are applied to the light-emitting means 301 to emit light. In this embodiment, the first auxiliary pulse generating means 305 serves as a first auxiliary light-emitting actuating means.

FIG. 10(a) does not represent a signal, but shows a period of time in which the user is in the vicinity of the light-emitting means 301 (e.g., a period of time in which the user uses the toilet).

A first decision means 306 in the control means 303 counts the number of times in which light is detected by the light-detecting means 302, among four light emissions of the first auxiliary pulse generating means 305. If the count is greater than a predetermined number (four in this embodiment), then the first decision means 306 determines that the detection by the light-detecting means 302 of reflected light produced by the drive pulses (FIG. 10(b)) is not caused by noise or the like, but by a user. The first decision means 306 now applies a decision signal S1 to a second

auxiliary pulse generating means 307.

The second auxiliary pulse generating means 307 is brought into a standby condition by the output signal from the first decision means 306. After detecting the user based on both the drive pulses (FIG. 10(b)) and the output signal (FIG. 10(c)) from the light-detecting means 302, and responsive to a first pulse signal (FIG. 10(e)) when no user is detected, the second auxiliary pulse generating means 307 generates a plurality of (e.g., four in this embodiment) pulses at the same short period as the period of pulses from the first auxiliary pulse generating means 305. The generated pulses are applied to the light-emitting means 301 to emit light. The second auxiliary pulse generating means 307 serves as a second auxiliary light-emitting actuating means.

A second decision means 308 in the control means 303 counts the number of times in which light is detected by the light-detecting means 302, among four light emissions of the second auxiliary pulse generating means 307. If the count is smaller than a predetermined number (e.g., zero in this embodiment), then the second decision means 308 determines that the user has left the toilet, and energizes the faucet actuator circuit 309 for a predetermined period of time as shown in FIG. 10(g) to flush the toilet, for example.

As with the first embodiment, the water supply control according to the third embodiment may be implemented by a microcomputer 22 having a CPU 23, a memory 24, an I/O (input and output circuit) 25, etc., as shown in FIG. 3. If such a microcomputer is employed for control, the water supply control system may be controlled according to the flowchart shown in FIG. 11.

The flowchart of FIG. 11 will now be described below. Parameters J, K, L, M, N are initialized in a step 1. The parameter J is a parameter which indicates the number of times in which the first auxiliary pulse generating means 305 is energized, i.e., the number of pulses shown in FIG. 10(d)). The parameter K is a parameter which indicates the number of times in which the second auxiliary pulse generating means 307 is energized. The parameter L is a parameter which indicates the number of times in which reflected light that is emitted by the first auxiliary pulse generating means 305 is detected by the light-detecting means 302. The parameter M is a parameter which indicates the number of times in which light emitted by the second auxiliary pulse generating means 307 is detected by the light-detecting means 302. The parameter N is a parameter which indicates whether a user has already been detected or not.

The light-emitting means 301 is energized in a step 2, and a first timer is started in a step 3, the first timer determining the period of the drive

pulses shown in FIG. 10(b). The time set by the first timer is measured in a step 15. If light is detected in a step 4, then it is determined in a step 5 whether a user has already been detected or not. If detected ($N = 1$), then control goes to the step 15. If not detected ($N = 0$), then steps 6 through 12 are executed to energize the first auxiliary pulse generating means 305. A second timer serves to determine the period of first auxiliary drive pulses. When the light emission due to four auxiliary pulses is completed in a step 11, a step 13 compares the number of times L in which light is detected by the light-detecting means 302 with a constant L_m (four in this embodiment). Only when the condition $L \geq L_m$ is met, it is regarded that a user is detected for the first time, and the parameter N is set to 1 in a step 14. If the above condition is not met, the light detected by the light-detecting means 302 is regarded as being caused by noise, and control goes to the step 15.

If no light is detected in the step 4, then a step 16 determines whether a user has been detected or not so far. If not detected, control goes to the step 15. If detected, then steps 17 through 23 are executed in order to energize the second auxiliary pulse generating means 307.

The second timer serves to determine a period for the generation of auxiliary pulses, as described above. When the light emission due to four auxiliary pulses is completed in a step 22, a step 24 compares the number of times M in which light is detected by the light-detecting means 302 with a constant M_m (zero in this embodiment). Only when the condition $M \leq M_m$ is met, it is regarded that the user has left, and the faucet is opened in a step 25. In the step 25, the first timer is started, and the number of times P in which the time set by the first timer is up or elapsed is compared with a constant P_m , until $P = P_m$. When the condition $P = P_m$ is met, the faucet is closed. Then, the parameters K, M, N are initialized in a step 26. If the condition $P = P_m$ is not met, it is determined that the user is still present, and control goes to the step 15. After elapse of a certain period of time, the parameters J, L are initialized in a step 27. Control then goes back to the step 2 to repeat the above process.

A water supply control according to a fourth embodiment of the present invention will now be described with reference to FIGS. 12 through 14. As with the water supply control system according to the second embodiment, the water supply control according to the fourth embodiment can effectively be incorporated in an automatic faucet device for supplying washing water for users.

FIG. 12 shows a circuit arrangement of the water supply control according to the fourth embodiment. The water supply control comprises a light-emitting means 401 such as a photodiode or

the like, a light-detecting means 402 such as a phototransistor or the like for detecting light emitted from the light-emitting means 1 and reflected by a portion of the body of a user, such as a hand or the like, a faucet actuator circuit 409 for actuating a faucet to supply washing water when a user has been detected, and a control means 403.

Normally or in a standby condition, a drive pulse generating means 404 in the control means 403 generates a periodic pulse signal shown in FIG. 13(b), which is applied to the light-emitting means 401 to emit light. When a detected signal shown in FIG. 13(c) is produced by the light-detecting means 402, a first auxiliary pulse generating means 405 in the control means 403 generates a plurality of (e.g., four in this embodiment) of pulses (FIG. 13(d)) at a period shorter than the period of the drive pulses, based on a first pulse signal 405a. The generated pulses are applied to the light-emitting means 401 to emit light. In this embodiment, the first auxiliary pulse generating means 405 serves as a first auxiliary light-emitting actuating means.

FIG. 13(a) does not represent a signal, but shows a period of time in which the user's hand or the like is in the vicinity of the light-emitting means 401.

A first decision means 406 in the control means 403 counts the number of times in which light is detected by the light-detecting means 402, among four light emissions of the first auxiliary pulse generating means 405. If the count is greater than a predetermined number (four in this embodiment), then the first decision means 406 determines that the detection by the light-detecting means 402 of reflected light produced by the drive pulses (FIG. 13(b)) is not caused by noise or the like, but by a user. The first decision means 406 now applies a decision signal S2 to the faucet actuator circuit 409 which opens a faucet (not shown) to supply water, and also applies the decision signal S2 to a second auxiliary pulse generating means 407.

The second auxiliary pulse generating means 407 is brought into a standby condition by the output signal from the first decision means 406. After detecting the user based on both the drive pulses (FIG. 13(b)) and the output signal (FIG. 13(c)) from the light-detecting means 402, and responsive to a first pulse signal (FIG. 13(e)) when no user is detected, the second auxiliary pulse generating means 407 generates a plurality of (e.g., four in this embodiment) pulses at the same short period as the period of pulses from the first auxiliary pulse generating means 405. The generated pulses are applied to the light-emitting means 401 to emit light. The second auxiliary pulse generating means 407 serves as a second auxiliary light-

emitting means.

A second decision means 408 in the control means 403 counts the number of times in which light is detected by the light-detecting means 402, among four light emissions of the second auxiliary pulse generating means 407. If the count is smaller than a predetermined number (e.g., zero in this embodiment), then the second decision means 408 determines that the user has left the faucet, and applies its decision signal to the faucet actuator circuit 409, thereby closing the faucet. FIG. 13(g) shows a period of time in which the faucet is opened by the faucet actuator circuit.

The water supply control according to the fourth embodiment may be implemented by a microcomputer 22 having a CPU 23, a memory 24, an I/O (input and output circuit) 25, etc., as shown in FIG. 3. If such a microcomputer is employed for control, the water supply control system may be controlled according to the flowchart shown in FIG. 14.

The flowchart flowchart of FIG. 14 will now be described below. Parameters J, K, L, M, N are initialized in a step 1. The parameter J is a parameter which indicates the number of times in which the first auxiliary pulse generating means 405 is energized, i.e., the number of pulses shown in FIG. 13(d)). The parameter K is a parameter which indicates the number of times in which the second auxiliary pulse generating means 407 is energized. The parameter L is a parameter which indicates the number of times in which reflected light that is emitted by the first auxiliary pulse generating means 405 is detected by the light-detecting means 402. The parameter M is a parameter which indicates the number of times in which light emitted by the second auxiliary pulse generating means 407 is detected by the light-detecting means 402. The parameter N is a parameter which indicates whether a user has already been detected or not.

The light-emitting means 401 is energized in a step 2, and a first timer is started in a step 3, the first timer determining the period of the drive pulses shown in FIG. 13(b). The time set by the first timer is measured in a step 16. If light is detected in a step 4, then it is determined in a step 5 whether a user has already been detected or not. If detected (N = 1), then control goes to the step 16. If not detected (N = 0), then steps 6 through 12 are executed to energize the first auxiliary pulse generating means 405. A second timer serves to determine the period of first auxiliary drive pulses, and the time set by the second timer is measured in a step 7. When the light emission due to four auxiliary pulses is completed in a step 11, a step 13 compares the number of times L in which light is detected by the light-detecting means 402 with a

constant L_m (four in this embodiment). Only when the condition $L \geq L_m$ is met, it is regarded that a user is detected for the first time, and the faucet is opened in a step 14, and the parameter N is set to 1 in a step 15. If the above condition is not met, the light detected by the light-detecting means 402 is regarded as being caused by noise, and control goes to the step 16.

If no light is detected in the step 4, then a step 17 determines whether a user has been detected or not so far. If not detected, control goes to the step 16. If detected, then steps 18 through 24 are executed in order to energize the second auxiliary pulse generating means 407.

The second timer serves to determine a period for the generation of auxiliary pulses, as described above. When the light emission due to four auxiliary pulses is completed in a step 23, a step 25 compares the number of times M in which light is detected by the light-detecting means 402 with a constant M_m (zero in this embodiment). Only when the condition $M \leq M_m$ is met, it is regarded that the user has left, and the faucet is closed in a step 26. Then, the parameters K , M , N are initialized in a step 27. If the above condition is not met, it is determined that the user is still present, and control goes to the step 16. After elapse of a certain period of time, the parameters J , L are initialized in a step 28. Control then goes back to the step 2 to repeat the above process.

With the present invention, as described above, the water supply control has its detection sensitivity maintained, is prevented from malfunctioning due to noise, and is highly reliable. Since the light-emitting means is energized at high speed within a short period of time by the auxiliary light-emitting actuating means in each of the above embodiments, the battery or the like is prevented from being unduly consumed. As described above in each of the embodiments, the water supply control according to the present invention, which is capable of economizing water and electric power, may effectively be used with an automatic flushing device for a toilet or the like, or an automatic faucet device for a sink or the like.

Claims

1. A water supply control for an automatic faucet, having light-emitting means (1; 301; 401) for periodically emitting light with a first repetition period in a standby condition, light-detecting means (2; 302; 402) for detecting light emitted from the light-emitting means (1; 301; 401) and reflected from a portion of the body of a user, and for producing a detected signal indicative of whether the light is detected or not, and control means (3; 22; 303, 403) for controlling

a faucet to supply water based on the detected signal from the light-detecting means (2; 302; 402), wherein said control means (3; 22; 303, 403) comprises auxiliary light-emitting actuating means (11, 12, 14; 22; 305, 307; 405, 407) for enabling said light-emitting means (1; 301; 401) on the basis of the detected signal from said light-detecting means (2; 302; 402) to effect a plurality of light-emissions having a second repetition period which is smaller than the first repetition period, and decision means (7-13; 22; 16; 306, 308; 406, 408) for counting the number of times in which the light is detected by said light-detecting means (2; 302; 402), among the light-emissions caused by said auxiliary light-emitting actuating means (11, 12, 14; 22; 305, 307; 405, 407), and for controlling said faucet based on the counted number, characterized in that said auxiliary light-emitting actuating means (11, 12, 14; 22; 305, 307; 405, 407) is adapted to cause a predetermined number of light emissions at the beginning of the first repetition period in response to the detected signal from the light-detecting means (2; 302; 402) and to suppress further light emissions during that period.

2. A water supply control according to claim 1, wherein said auxiliary light-emitting actuating means (11, 12, 14; 22) causes said predetermined number of light emissions, after the presence of a user has been indicated by the detected signal from the light-detecting means, and wherein said decision means (7-13; 22) actuates said faucet to supply water, if the counted number of light emissions caused by said light-emitting actuating means and detected during the respective first repetition period by the light detecting means is equal to or smaller than a predetermined number.

3. A water supply control according to claim 2, wherein a controllable faucet-actuating means (17) is provided for actuating the faucet, and wherein said decision means (7-13; 22) is adapted to apply a faucet-opening control signal to said faucet-actuating means (17) to open the faucet for a predetermined period of time.

4. A water supply control according to claim 2 or 3, wherein said control means (3; 22) further includes a disabling means (18), operable responsive to detection of the user based on the detected signal from said light-detecting means (2), for disabling said decision means (13) unless a predetermined period of time elapses from the detection of the user.



constant L_m (four in this embodiment). Only when the condition $L \geq L_m$ is met, it is regarded that a user is detected for the first time, and the faucet is opened in a step 14, and the parameter N is set to 1 in a step 15. If the above condition is not met, the light detected by the light-detecting means 402 is regarded as being caused by noise, and control goes to the step 16.

If no light is detected in the step 4, then a step 17 determines whether a user has been detected or not so far. If not detected, control goes to the step 16. If detected, then steps 18 through 24 are executed in order to energize the second auxiliary pulse generating means 407.

The second timer serves to determine a period for the generation of auxiliary pulses, as described above. When the light emission due to four auxiliary pulses is completed in a step 23, a step 25 compares the number of times M in which light is detected by the light-detecting means 402 with a constant M_m (zero in this embodiment). Only when the condition $M \leq M_m$ is met, it is regarded that the user has left, and the faucet is closed in a step 26. Then, the parameters K , M , N are initialized in a step 27. If the above condition is not met, it is determined that the user is still present, and control goes to the step 16. After elapse of a certain period of time, the parameters J , L are initialized in a step 28. Control then goes back to the step 2 to repeat the above process.

With the present invention, as described above, the water supply control has its detection sensitivity maintained, is prevented from malfunctioning due to noise, and is highly reliable. Since the light-emitting means is energized at high speed within a short period of time by the auxiliary light-emitting actuating means in each of the above embodiments, the battery or the like is prevented from being unduly consumed. As described above in each of the embodiments, the water supply control according to the present invention, which is capable of economizing water and electric power, may effectively be used with an automatic flushing device for a toilet or the like, or an automatic faucet device for a sink or the like.

Claims

1. A water supply control for an automatic faucet, having light-emitting means (1; 301; 401) for periodically emitting light with a first repetition period in a standby condition, light-detecting means (2; 302; 402) for detecting light emitted from the light-emitting means (1; 301; 401) and reflected from a portion of the body of a user, and for producing a detected signal indicative of whether the light is detected or not, and control means (3; 22; 303, 403) for controlling

a faucet to supply water based on the detected signal from the light-detecting means (2; 302; 402), wherein said control means (3; 22; 303, 403) comprises auxiliary light-emitting actuating means (11, 12, 14; 22; 305, 307; 405, 407) for enabling said light-emitting means (1; 301; 401) on the basis of the detected signal from said light-detecting means (2; 302; 402) to effect a plurality of light-emissions having a second repetition period which is smaller than the first repetition period, and decision means (7-13; 22; 16; 306, 308; 406, 408) for counting the number of times in which the light is detected by said light-detecting means (2; 302; 402), among the light-emissions caused by said auxiliary light-emitting actuating means (11, 12, 14; 22; 305, 307; 405, 407), and for controlling said faucet based on the counted number, characterized in that said auxiliary light-emitting actuating means (11, 12, 14; 22; 305, 307; 405, 407) is adapted to cause a predetermined number of light emissions at the beginning of the first repetition period in response to the detected signal from the light-detecting means (2; 302; 402) and to suppress further light emissions during that period.

2. A water supply control according to claim 1, wherein said auxiliary light-emitting actuating means (11, 12, 14; 22) causes said predetermined number of light emissions, after the presence of a user has been indicated by the detected signal from the light-detecting means, and wherein said decision means (7-13; 22) actuates said faucet to supply water, if the counted number of light emissions caused by said light-emitting actuating means and detected during the respective first repetition period by the light detecting means is equal to or smaller than a predetermined number.

3. A water supply control according to claim 2, wherein a controllable faucet-actuating means (17) is provided for actuating the faucet, and wherein said decision means (7-13; 22) is adapted to apply a faucet-opening control signal to said faucet-actuating means (17) to open the faucet for a predetermined period of time.

4. A water supply control according to claim 2 or 3, wherein said control means (3; 22) further includes a disabling means (18), operable responsive to detection of the user based on the detected signal from said light-detecting means (2), for disabling said decision means (13) unless a predetermined period of time elapses from the detection of the user.



5. A water supply control according to claim 1, wherein said auxiliary light-emitting actuating means (11, 12, 14; 405, 407) causes said predetermined number of light emissions after the presence of a user has been indicated by the detected signal from the light detecting means, and wherein said decision means (16; 406, 408) actuates said faucet to supply water if the counted number of light emissions caused by said light-emitting actuating means and detected during the respective first repetition period by the light-detecting means is equal to or greater than a predetermined number. 5 10
6. A water supply control according to claim 5, wherein a controllable faucet-actuating means (17; 409) is provided for actuating the faucet, and wherein said decision means (16; 406, 408) applies a faucet opening control signal to said faucet-actuating means (17; 409) to open the faucet. 15 20
7. A water supply control according to claim 6, wherein said decision means (16) applies a faucet-closing control signal to said faucet-actuating means (17) to close the faucet when the detected signal from said light-detecting means (2) changes from a condition indicative of the presence of the user to a condition indicative of the absence of the user. 25 30
8. A water supply control according to claim 6, wherein said auxiliary light-emitting actuating means (405, 407) is also adapted to cause a predetermined number of light emissions at the beginning of the first repetition period and to suppress further light emissions during said period after the detected signal from said light-detecting means (402) has changed from a condition indicative of the presence of the user to a condition indicative of the absence of the user, and wherein said decision means (406, 408) applies a faucet-closing control signal to said faucet-actuating means (409) to close the faucet, if the counted number of light emissions caused by said light-emitting actuating means upon said change of the condition of the detected signal and detected by said light-detecting means during the respective first repetition period is equal to or smaller than a predetermined number. 35 40 45 50
9. A water supply control according to claim 1, wherein a controllable faucet actuating means (309) is provided for actuating the faucet, wherein said auxiliary light-emitting actuating means (305, 307) causes said predetermined number of light emissions at the beginning of

the first repetition period and suppresses further light emissions during said period after the detected signal from said light-detecting means (302) has changed from a condition indicative of the presence of the user to a condition indicative of the absence of the user, and wherein said decision means (306, 308) applies a faucet-opening control signal to said faucet actuating means (309) to open the faucet for a predetermined period of time if the counted number of light emissions caused by said light-emitting actuating means and detected by said light-detecting means during said first repetition period, is equal to or smaller than the predetermined number.

Patentansprüche

1. Wasserausgabesteuerung für einen automatischen Wasserhahn, umfassend ein Lichtemissionsmittel (1; 301; 401) zum periodischen Emittieren von Licht mit einer ersten Wiederholperiode in einem Wartezustand, ein Lichterfassungsmittel (2; 302; 402) zum Erfassen von Licht, das von dem Lichtemissionsmittel (1; 301; 401) emittiert und von einem Körperteil eines Benutzers reflektiert ist, und zum Erzeugen eines Erfassungssignals, das anzeigt, ob das Licht erfaßt wird oder nicht, und ein Steuermittel (3; 22; 303; 403) zum Steuern eines Wasserhahns zur Ausgabe von Wasser auf Basis des Erfassungssignals von dem Lichterfassungsmittel (2; 302; 402), wobei das Steuermittel (3; 22; 303; 403) umfaßt: ein Hilfslichtemissionsbetätigungsmittel (11, 12, 14; 22; 305; 307; 405, 407) zur Freigabe des Lichtemissionsmittels (1; 301; 401) auf Basis des Erfassungssignals von dem Lichterfassungsmittel (2; 302; 402) zum Bewirken einer Mehrzahl von Lichtemissionen mit einer zweiten Wiederholperiode, die kürzer als die erste Wiederholperiode ist, und ein Entscheidungsmittel (7-13; 22; 16; 306, 308; 406, 408) zum Zählen der Anzahl von Malen, mit denen das Licht von dem Lichterfassungsmittel (2; 302; 402) unter den durch das Hilfslichtemissionsbetätigungsmittel (11; 12; 14; 22; 305; 307; 405; 407) bewirkten Lichtemissionen erfaßt wird, und zur Steuerung des Wasserhahns auf Basis der gezählten Anzahl, dadurch gekennzeichnet, daß das Hilfslichtemissionsbetätigungsmittel (11, 12, 14; 22; 305, 307; 405, 407) dazu ausgelegt ist, zu Beginn der ersten Wiederholperiode in Antwort auf das Erfassungssignal von dem Lichterfassungsmittel (2; 302; 402) eine vorbestimmte Anzahl von Lichtemissionen zu bewirken und während dieser Periode wei-



tere Lichtemissionen zu unterdrücken.

2. Wasserausgabesteuerung nach Anspruch 1, in der das Hilfslichtemissionsbetätigungsmittel (11, 12, 14; 22) die vorbestimmte Anzahl von Lichtemissionen bewirkt, nachdem durch das Erfassungssignal von dem Lichterfassungsmittel die Anwesenheit eines Benutzers angezeigt wurde, und wobei das Entscheidungsmittel (7-13; 22) den Wasserhahn zur Wasserausgabe betätigt, wenn die gezählte Anzahl von Lichtemissionen, die durch das Lichtemissionsbetätigungsmittel bewirkt sind und während der entsprechenden ersten Wiederholperiode durch das Lichterfassungsmittel erfaßt sind, gleich oder kleiner als eine vorbestimmte Anzahl ist.
3. Wasserausgabesteuerung nach Anspruch 2, in der ein steuerbares Wasserhahnbetätigungsmittel (17) zur Betätigung des Wasserhahns vorgesehen ist, und in der das Entscheidungsmittel (7-13; 22) dazu ausgelegt ist, ein Wasserhahnöffnungssteuersignal an das Wasserhahnbetätigungsmittel (17) anzulegen, um den Wasserhahn für eine vorbestimmte Zeitperiode zu öffnen.
4. Wasserausgabesteuerung nach Anspruch 2 oder 3, in der das Steuermittel (3; 22) ein Sperrmittel (18) enthält, das in Antwort auf die Erfassung des Benutzers auf Basis des Erfassungssignals von dem Lichterfassungsmittel (2) betätigbar ist, um das Entscheidungsmittel (13) zu sperren, solange nicht seit der Erfassung des Benutzers eine vorbestimmte Zeitperiode abgelaufen ist.
5. Wasserausgabesteuerung nach Anspruch 1, in der das Hilfslichtemissionsbetätigungsmittel (11, 12, 14; 405; 407) die vorbestimmte Anzahl von Lichtemissionen bewirkt, nachdem die Anwesenheit eines Benutzers durch das Erfassungssignal von dem Lichterfassungsmittel angezeigt wurde, und in der das Entscheidungsmittel (16; 406, 408) den Wasserhahn zur Ausgabe von Wasser betätigt, wenn die gezählte Anzahl von Lichtemissionen, die durch das Lichtemissionsbetätigungsmittel bewirkt sind und während der entsprechenden ersten Wiederholperiode durch das Lichterfassungsmittel erfaßt sind, gleich oder größer als eine vorbestimmte Anzahl ist.
6. Wasserausgabesteuerung nach Anspruch 5, in der das steuerbare Wasserhahnbetätigungsmittel (17; 409) zur Betätigung des Wasserhahns vorgesehen ist, und in der das Entscheidungsmittel (16; 406, 408) ein Wasserhahnöff-

nungssteuersignal an das Wasserhahnbetätigungsmittel (17; 409) anlegt, um den Wasserhahn zu öffnen.

7. Wasserausgabesteuerung nach Anspruch 6, in der das Entscheidungsmittel (16) ein Wasserhahnschließsteuersignal an das Wasserhahnbetätigungsmittel (17) anlegt, um den Wasserhahn zu schließen, wenn sich das Erfassungssignal von dem Lichterfassungsmittel (2) von einem Zustand, der die Anwesenheit des Benutzers anzeigt, in einen Zustand, der die Abwesenheit des Benutzers anzeigt, ändert.
8. Wasserausgabesteuerung nach Anspruch 6, in der das Hilfslichtemissionsbetätigungsmittel (405, 407) auch dazu ausgelegt ist, eine vorbestimmte Anzahl von Lichtemissionen zu Beginn der ersten Wiederholperiode zu bewirken und weitere Lichtemissionen während der Periode zu unterdrücken, nachdem sich das Erfassungssignal von dem Lichterfassungsmittel (402) von einem Zustand, der die Anwesenheit des Benutzers anzeigt, in einen Zustand, der die Abwesenheit des Benutzers anzeigt, geändert hat, und in dem das Entscheidungsmittel (406, 408) ein Wasserhahnschließsteuersignal an das Wasserhahnbetätigungsmittel (409) anlegt, um den Wasserhahn zu schließen, wenn die gezählte Anzahl von Lichtemissionen, die durch das Lichtemissionsbetätigungsmittel bei der Änderung des Zustands des Erfassungssignals bewirkt sind und durch das Lichterfassungsmittel während der entsprechenden ersten Wiederholperiode erfaßt sind, gleich oder kleiner als eine vorbestimmte Anzahl ist.
9. Wasserausgabesteuerung nach Anspruch 1, in der ein steuerbares Wasserhahnbetätigungsmittel (309) zur Betätigung des Wasserhahns vorgesehen ist, und in der das Hilfslichtemissionsbetätigungsmittel (305, 307) die vorbestimmte Anzahl von Lichtemissionen zu Beginn der ersten Wiederholperiode bewirkt und weitere Lichtemissionen während der Periode unterdrückt, nachdem sich das Erfassungssignal von dem Lichterfassungsmittel (302) von einem Zustand, der die Anwesenheit des Benutzers anzeigt, in einen Zustand, der die Abwesenheit des Benutzers anzeigt, geändert hat, und in der das Entscheidungsmittel (306, 308) ein Wasserhahnöffnungssteuersignal an das Wasserhahnbetätigungsmittel (309) anlegt, um den Wasserhahn für eine vorbestimmte Zeitperiode zu öffnen, wenn die gezählte Anzahl von Lichtemissionen, die durch das Lichtemissionsbetätigungsmittel bewirkt sind und durch das Lichterfassungsmittel während der ersten Wie-



derholperiode erfaßt sind, gleich oder kleiner als die vorbestimmte Anzahl ist.

Revendications

1. Commande d'alimentation en eau pour un robinet, comprenant des moyens émettant de la lumière (1 ; 301 ; 401) pour émettre de la lumière, de façon périodique, avec une première période de répétition dans un état d'attente, comprenant des moyens de détection de lumière (2 ; 302 ; 402) pour détecter la lumière émise à partir des moyens émettant de la lumière (1 ; 301 ; 401) et réfléchiée par une partie du corps d'un utilisateur, et pour produire un signal détecté indiquant si la lumière est ou non détectée, et comprenant des moyens de commande (3 ; 22 ; 303, 403) pour commander un robinet pour qu'il fournisse de l'eau sur la base du signal détecté en provenance des moyens de détection de lumière (2 ; 302 ; 402), dans laquelle lesdits moyens de commande (3 ; 22 ; 303, 403) comprennent des moyens auxiliaires de mise en oeuvre d'émission de lumière (11, 12, 14 ; 22 ; 305, 307 ; 405, 407) pour activer lesdits moyens d'émission de lumière (1 ; 301 ; 401) sur la base du signal détecté en provenance desdits moyens de détection de lumière (2 ; 302 ; 402) pour effectuer une pluralité d'émissions de lumière ayant une seconde période de répétition qui est plus petite que la première période de répétition, et comprenant des moyens de décision (7 à 13 ; 22 ; 16 ; 306, 308 ; 406, 408) pour compter le nombre de fois que la lumière est détectée par lesdits moyens de détection de lumière (2 ; 302 ; 402), parmi les émissions de lumière provoquées par lesdits moyens auxiliaires de mise en oeuvre d'émission de lumière (11, 12, 14 ; 22 ; 305, 307 ; 405, 407), et pour commander ledit robinet sur la base du nombre compté, caractérisée en ce que lesdits moyens auxiliaires de mise en oeuvre d'émission de lumière (11, 12, 14 ; 22 ; 305, 307 ; 405, 407) sont conçus pour provoquer un nombre prédéterminé d'émissions de lumière au commencement de la première période de répétition en réponse au signal détecté en provenance des moyens de détection de lumière (2 ; 302 ; 402) et pour supprimer des émissions supplémentaires de lumière pendant cette période.
2. Commande d'alimentation en eau selon la revendication 1, dans laquelle lesdits moyens auxiliaires de mise en oeuvre d'émission de lumière (11, 12, 14 ; 22) provoquent ledit nombre prédéterminé d'émissions de lumière,

après que la présence d'un utilisateur a été indiquée par le signal détecté en provenance des moyens de détection de lumière, et dans laquelle lesdits moyens de décision (7 à 13 ; 22) mettent en oeuvre ledit robinet pour fournir de l'eau, si le nombre compté d'émissions de lumière, provoquées par lesdits moyens de mise en oeuvre d'émission de lumière et détectées pendant la première période respective de répétition par les moyens de détection de lumière, est inférieur ou égal à un nombre prédéterminé.

3. Commande d'alimentation en eau selon la revendication 2, dans laquelle des moyens de mise en oeuvre de robinet, pouvant être commandés, (17) sont prévus pour mettre en oeuvre le robinet, et dans laquelle lesdits moyens de décision (7 à 13 ; 22) sont conçus pour appliquer un signal de commande d'ouverture de robinet auxdits moyens de mise en oeuvre de robinet (17) pour ouvrir le robinet pendant une période de temps prédéterminée.
4. Commande d'alimentation en eau selon la revendication 2 ou 3, dans laquelle lesdits moyens de commande (3 ; 22) comprennent, de plus, des moyens de désactivation (18), pouvant être mis en oeuvre lors de la détection de l'utilisateur sur la base du signal détecté en provenance desdits moyens de détection de lumière (2), pour désactiver lesdits moyens de décision (13) à moins qu'une période de temps prédéterminée ne s'écoule à partir de la détection de l'utilisateur.
5. Commande d'alimentation en eau selon la revendication 1, dans laquelle lesdits moyens auxiliaires de mise en oeuvre d'émission de lumière (11, 12, 14 ; 405, 407) provoquent ledit nombre prédéterminé d'émissions de lumière après que la présence d'un utilisateur a été indiquée par le signal détecté en provenance des moyens de détection de lumière, et dans laquelle lesdits moyens de décision (16 ; 406, 408) mettent en oeuvre ledit robinet pour qu'il fournisse de l'eau si le nombre compté d'émissions de lumière provoquées par lesdits moyens de mise en oeuvre d'émission de lumière et détectées pendant la première période respective de répétition par les moyens de détection de lumière, est supérieur ou égal à un nombre prédéterminé.
6. Commande d'alimentation en eau selon la revendication 5, dans laquelle des moyens de mise en oeuvre de robinet, pouvant être commandés, (17 ; 409) sont prévus pour mettre en



œuvre le robinet, et dans laquelle lesdits moyens de décision (16 ; 406, 408) appliquent un signal de commande d'ouverture de robinet auxdits moyens de mise en œuvre de robinet (17 ; 409) pour ouvrir le robinet.

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7. Commande d'alimentation en eau selon la revendication 6, dans laquelle lesdits moyens de décision (16) appliquent un signal de commande de fermeture de robinet auxdits moyens de mise en œuvre de robinet (17) pour fermer le robinet lorsque le signal détecté en provenance desdits moyens de détection de lumière (2) passe d'un état indicatif de la présence d'un utilisateur à un état indicatif de l'absence de l'utilisateur.

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8. Commande d'alimentation en eau selon la revendication 6, dans laquelle lesdits moyens auxiliaires de mise en œuvre d'émission de lumière (405, 407) sont également conçus pour provoquer un nombre prédéterminé d'émissions de lumière au commencement de la première période de répétition et pour supprimer des émissions supplémentaires de lumière pendant ladite période après que le signal détecté en provenance desdits moyens de détection (402) est passé d'un état indicatif de la présence de l'utilisateur à un état indicatif de l'absence de l'utilisateur, et dans laquelle lesdits moyens de décision (406, 408) appliquent un signal de fermeture de robinet auxdits moyens de mise en œuvre de robinet (409) pour fermer le robinet, si le nombre compté d'émissions de lumière, provoquées par lesdits moyens de mise en œuvre d'émission de lumière lors dudit changement de l'état du signal détecté et détectées par lesdits moyens de détection de lumière pendant la première période respective de répétition, est inférieur ou égal à un nombre prédéterminé.

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9. Commande d'alimentation en eau selon la revendication 1, dans laquelle des moyens de mise en œuvre de robinet, pouvant être commandés, (309) sont prévus pour mettre en œuvre le robinet, dans laquelle lesdits moyens auxiliaires de mise en œuvre d'émission de lumière (305, 307) provoquent ledit nombre prédéterminé d'émissions de lumière au commencement de la première période de répétition et suppriment des émissions supplémentaires de lumière pendant ladite période après que le signal détecté en provenance desdits moyens de détection de lumière (302) est passé d'un état indicatif de la présence de l'utilisateur à un état indicatif de l'absence de l'utilisateur, et dans laquelle lesdits moyens de déci-

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sion (306, 308) appliquent un signal de commande d'ouverture de robinet auxdits moyens de mise en œuvre de robinet (309) pour ouvrir le robinet pendant une période de temps prédéterminée si le nombre compté d'émissions de lumière, provoquées par lesdits moyens de mise en œuvre d'émission de lumière et détectées par lesdits moyens de détection de lumière pendant ladite première période de répétition, est inférieur ou égal au nombre prédéterminé.