THIS OPINION WAS NOT WRITTEN FOR PUBLICATION

The opinion in support of the decision being entered today (1) was not written for publication in a law journal and (2) is not binding precedent of the Board.

Paper No. 40 (90/003,323)
Paper No. 33 (90/003,635)

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte Recurrent Solutions Ltd. Partnership

Appeal No. 97-3174
Reexamination Control Nos. 90/003,323[1] and 90/003,635[2]

HEARD: September 18, 1997

Before FRANKFORT, BARRETT and PAK, Administrative Patent Judges.

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[1] Request filed January 24, 1994, Control No. 90/003,323, for the Reexamination of Patent No. 4,839,039, issued June 13, 1989, based on application Serial No. 06/834,741, filed February 28, 1986.

[2] Request filed November 10, 1994, Control No. 90/003,635, for the Reexamination of Patent No. 4,839,039, issued June 13, 1989, based on application Serial No. 06/834,741, filed February 28, 1986.

FRANKFORT, Administrative Patent Judge.

DECISION ON APPEAL

This is a decision on appeal from the examiner's final rejection of claims 1, 5/1, 18, 24, 37 and 5/37 in this merged Reexamination proceeding identified by Control Nos. 90/003,323 and 90/003,635 for U.S. Patent No. 4,839,039, issued on June 13, 1989.[3] The original patent included claims 1 through 36. Claim 37 was added in a first Reexamination proceeding of the subject patent filed by the patent owner Recurrent Solutions Limited Partnership on April 5, 1993 and identified by Control No. 90/003,010. In the Reexamination Certificate, issued on February 22, 1994, following the first Reexamination, it is noted that the patentability of original patent claims 25 through 30 was confirmed, that claims 1, 2, 5, 9, 12, 19, 20, 22-24, 31-33 and 36 were determined to be patentable as amended, that claims 3, 4, 6-8, 10, 11, 13-18, 21, 34 and 35, dependent on an amended claim, were determined to be patentable, and that newly added claim 37 was also determined to be patentable. A

[3] As noted on the face of the patent, the portion of the term of this patent subsequent to June 4, 2002 has been disclaimed.

copy of the Reexamination Certificate issued on February 22, 1994 is attached as Appendix A. The second (90/003,323) and third (90/003,635) Reexamination requests involved in this merged Reexamination proceeding were each filed by or on behalf of Toto, Ltd. In these proceedings, claims 1, 20, 23 and 25 have been amended and claims 21 and 36 have been canceled. A new claim 38 has also been added during the present Reexamination proceedings.

Appellant's invention relates generally to an add-on device for converting a conventional manual faucet to an automatic faucet. Claims 1, 18, 24 and 37 are representative of the claimed subject matter. A copy of these claims, as they appear in the Appendix to appellant's brief, is attached to this decision as Appendix B.[4]

[4] We note that the copy of the claims found in the Appendix to appellant's brief is not in the format required by 37 CFR § 1.121(f) and MPEP § 2250.

The references of record relied upon by the examiner in rejections of the appealed claims under 35 U.S.C. § 103 are:

Waterman	921,760	May 18, 1909
Forbes	3,670,167	June 13, 1972
Acklin et al. (Acklin)	4,645,094	Feb. 24, 1987
Fujita et al. (Japan '442)	52-31442	Jan. 11, 1974
Wada (Japan '076)	58-28076	Feb. 18, 1983

Additional references relied upon by this panel of the Board in new rejections of the appealed claims entered infra under 37 CFR § 1.196(b) are:[5]

Bremner et al. (Bremner)	3,203,447	Aug. 31, 1965
Weinberg	3,379,214	Apr. 23, 1968
Sturman ('239)	3,683,239	Aug. 8, 1972
Dalferth (German Offenlegungsschrift)	2,533,527	Jan. 27, 1977
Ikenaga et al. (Japan '183)	59-126183	July 20, 1984

Another reference of record relied upon by this panel of the Board in a recommended rejection of claims 23 and 38 under 37 CFR § 1.196(d) is:

[5] Of the references applied by this panel of the Board, only Sturman U.S. Patent No. 3,683,239 issued August 8, 1972 and Bremner U.S. Patent No. 3,203,447 issued August 31, 1965 are newly cited for the first time. All of the other references relied upon in the rejections under 37 CFR § 1.196(b) are of record.

Coward (Published British Application)	2,076,117	Nov. 25, 1981

Claims 1 and 5/1 stand rejected under 35 U.S.C. § 103 as being unpatentable over Japan '442 in view of Forbes and Acklin or Japan '076.

Claim 18 stands rejected under 35 U.S.C. § 103 as being unpatentable over Japan '442 in view of Forbes and Acklin or Japan '076 as applied to claim 1 above, and further in view of Waterman.

Claims 24, 37 and 5/37 stand rejected under 35 U.S.C. § 103 as being unpatentable over Japan '442 in view of Waterman.

Rather than reiterate the examiner's explanation of the above-noted rejections and the conflicting viewpoints advanced by the examiner and appellant regarding those rejections, we make reference to the examiner's answer (mailed April 1, 1997) for the examiner's complete reasoning in support of these rejections, and to appellant's brief (filed February 19, 1997) for appellant's arguments thereagainst.

OPINION

In reaching our decision in this appeal, we have given careful consideration to appellant's specification and claims, to the applied prior art references, and to the respective positions articulated by appellant and the examiner. As a consequence of this review, we have made the determinations which follow.

We turn first to independent claim 24, which we view as being the broadest claim on appeal. This claim defines an automatic flow-control device that includes 1) a fluid conduit; 2) an electric valve interposed in the conduit and operable by application of control signals thereto to switch between an open state, in which the valve permits fluid flow through the conduit, and a closed state, in which the valve prevents flow through the conduit, with this valve being expressly identified as a latching valve;[6] and 3) a sensor circuit operable for sensing the presence

[6] As indicated in the body of claim 24, a latching valve is an electric valve (actually an electromagnetically actuated solenoid operated valve) which requires power only to change state so that it remains in its open state when no power is applied to it in its open state, and it remains in its closed state when no power is applied to it in its closed state. That is, a latching type valve requires the application of power to switch it from one state to another, but it requires no power to keep it in either state. Thus, this type of valve has very low power requirements, is economical to operate, and is suitable for use in an installation relying on a battery or batteries for operating power.

of objects in a target region near the device outlet and for applying control signals to the valve means [sic, latching valve] to control flow of fluid through the conduit in response to at least one predetermined characteristic of the sensed object.

What is immediately apparent from a careful review of claim 24 on appeal is that this claim is in no way limited to an add-on device for converting a conventional manual faucet to an automatic faucet and that this claim does not limit the device defined therein to an object-sensor-based flow-control system relying on battery power, as the arguments in appellant's brief at pages 5-17 seem to imply. Instead, claim 24 is broadly directed to any automatic flow control device which includes a conduit, an electric latching valve controlling the flow of fluid through the conduit and a sensor circuit for sensing the presence of objects in a target region near the device outlet and for applying control signals to the latching valve to control the flow of fluid through the conduit in response to at least one

predetermined characteristic of the sensed object. In short, this claim defines an object-sensor-based flow-control device which utilizes a latching type valve instead of a more conventional non-latching type solenoid operated valve.

As noted above, the examiner has rejected claim 24, along with claims 37 and 5/37, under 35 U.S.C. § 103 as being unpatentable over Japan '442 in view of Waterman. Independent claim 37 is more limited than claim 24 in that it defines a

flow-control device specifically for controlling the flow of fluid through a faucet, wherein the device comprises a housing having a device inlet and a device outlet; a fluid conduit disposed in the housing for conducting fluid from the inlet to the outlet; mounting means on the housing "for mounting the device on the faucet with the device inlet in fluid communication with the faucet outlet and the conduit disposed outside the faucet"; and sealing means for sealing the device inlet to the faucet outlet so that fluid can flow from the faucet only by flowing through the flow-control device. Like claim 24, claim 37 also includes recitation of an electric latching valve interposed in the conduit and operable by application of control signals

thereto to switch between an open state, in which the valve permits fluid flow through the conduit, and a closed state, in which the valve prevents flow through the conduit; and a sensor circuit operable for sensing the presence of objects in a target region near the device outlet and for applying control signals to the valve means [sic, latching valve] to control the flow of fluid through the conduit in response to at least one predetermined characteristic of the sensed object.

Holding our consideration of the examiner's § 103 rejection of claims 24, 37 and 5/37 in abeyance, under the authority provided by 37 CFR § 1.196(b) we enter the following new grounds of rejection against claims 24, 37 and 5/37:

Claim 24 is rejected under 35 U.S.C. § 103 as being unpatentable over Dalferth or Forbes in view of Weinberg or Sturman '239. Both Dalferth and Forbes disclose automatic fluid flow control devices that are fully responsive to that set forth in appellant's claim 24 on appeal with the exception that neither Dalferth nor Forbes discloses a "latching valve" as required in appellant's claim 24. In this regard, we note that Dalferth discloses an automatic flow control device which includes a conduit

(16, 17) having an inlet (at 15) and an outlet (18), a solenoid-controlled electric valve (20, 22) interposed in the conduit and operable by application of control signals thereto to switch between an open state, in which the valve permits fluid flow through the conduit, and a closed state, in which the valve prevents flow through the conduit, and a sensor circuit (associated with elements 26, 27) for sensing the presence of objects in a target region near the device outlet and for applying control signals to the electric valve to control flow of fluid through the conduit in response to at least one predetermined characteristic of the sensed object.

Forbes likewise discloses an automatic flow control device which includes a conduit having an inlet (at the "WATER SUPPLY" seen in Fig. 4) and an outlet at the spout (SP), a solenoid-controlled electric valve (SV) interposed in the conduit and operable by application of control signals thereto to switch between an open state, in which the valve permits fluid flow through the conduit, and a closed state, in which the valve prevents flow through the conduit, and a sensor circuit (Figure 6) for sensing the presence of objects in a target region (LP_1, LP_2 as seen in Fig. 4) near the device outlet and for applying

control signals to the electric valve to control flow of fluid through the conduit in response to at least one predetermined characteristic of the sensed object. While the automatic flow control device of Dalferth is indicated to be connectable to house power via a power cord (31) to be received in a power outlet, Forbes teaches (col. 3, lines 18-21) that electrical power for operation of the flow control device therein may be from a conventional AC power source or a source of DC voltage such as a battery or a series of batteries. Neither Dalferth nor Forbes describes the particular form of electric solenoid valve used in the automatic flow control devices therein,

although it is apparent from their disclosures that each of these devices uses a conventional non-latching type of solenoid valve.

Weinberg discloses a latching type solenoid valve wherein the valve requires power only to change state so that it remains in its open state when no power is applied to it in its open state, and it remains in its closed state when no power is applied to it in its closed state. Weinberg discloses (col. 1, lines 27-54) that such an electromagnetically actuated latching

type valve is "exceptionally stable" in either an open or closed flow control position, that the valve has a rugged construction which is economically manufactured, and that this valve is "particularly suited to be incorporated in fluid control systems . . . requiring compact control devices providing reliable operation in regulating fluid flow." In addition, it is noted in Weinberg (col. 5, lines 28-39) that the valve is "economical to operate under low power requirements" and is adapted for remote control operation in various types of fluid control systems having need for dependable high speed positioning of the valve member.

Sturman '239 discloses a self-latching solenoid actuator which may be used to actuate a valve of a fluid flow control system. Sturman '239 notes (col. 2, lines 9-13) that solenoids of the latching variety are "highly efficient as compared to the non-latching solenoids" since power is not required to maintain the solenoid in the actuated position after actuation has occurred. It is additionally indicated that

> it should be noted that because of the improved efficiency of a latching solenoid over a solenoid of the non-latching variety, smaller solenoids may be used for a specific application without resulting in overheating

> of the solenoid. Thus, such self-latching solenoids have the potential of being substantially cheaper in a given application because of a substantial reduction in size compared to the size of a non-latching solenoid for the same application (col. 2, lines 29-37).

While Sturman '239 also indicates (col. 1) that other well-known solenoid actuated valves in fluid flow control systems may be operated directly from a 115 volt power source, it is noted that the self-latching solenoid actuated valve contemplated by the invention therein is intended to be used in applications where the source of power is limited, such as, in applications where the solenoid is to be operated by batteries. In this regard, Sturman '239 notes the advantage that

> [t]o decrease the power dissipation by the solenoid, particularly in applications where the solenoid is to be retained in the actuated position for significant time periods, latching systems are used in conjunction with the solenoids so that the solenoids may be actuated by a relatively short term pulse to the solenoid coil and latched in the actuated position without requiring further electrical power application to the solenoid. Later, upon application of a short unlatching signal, the latching system is released and a return spring returns the solenoid plunger to the fully extended position. Thus, the sole-

> noid is actuated and latched for an indefinitely long period by the application of only a short duration pulse of electrical energy and may be unlatched for an indefinite period by a similar unlatching pulse of electrical energy (col. 1, lines 26-41).

It is our opinion, after a consideration of the combined teachings of the applied references, that it would have been obvious to one of ordinary skill in the art at the time of appellant's invention to substitute a latching type electric valve as described in Weinberg or Sturman '239 for the solenoid operated valves disclosed in the fluid flow control systems of either Dalferth or Forbes. With particular regard to Dalferth, we consider that the artisan would have been motivated to make such a substitution in the faucet mounted flow control device therein so as to take advantage of the reduced size of the more compact latching type of electric valve, its exceptional stability, its economical operation under low power requirements, and its lower cost of manufacture, as described in both Weinberg and Sturman '239. As for Forbes, we consider that a person of ordinary skill in the art would have been led to make the sub-

stitution for the same reasons as advanced above, and for the additional reason that both Forbes and Sturman '239 expressly recognize the operation of fluid flow control solenoid valves by use of battery power, with Sturman '239 specifically pointing out the high efficiency and very low total energy withdrawal from the battery associated with the latching type of solenoid valve vis-à-vis a conventional non-latching type of solenoid controlled valve.

Claims 24, 37 and 5/37 are rejected under 35 U.S.C. § 103 as being unpatentable over Japan '442 in view of Weinberg or Sturman '239. Japan '442 discloses a flow-control device specifically for controlling the flow of fluid through a water faucet (2), wherein the device comprises a housing (1) having a device inlet and a device outlet; a fluid conduit disposed in the housing for conducting fluid from the inlet to the outlet; mounting means (3) on the housing for mounting the device on the faucet with the device inlet in fluid communication with the

faucet outlet and the conduit disposed outside the faucet; sealing means (34, 35) for sealing the device inlet to the faucet outlet so that fluid can flow from the faucet only by flowing

through the flow-control device; an electric solenoid operated valve (4) interposed in the conduit and operable by application of control signals thereto to switch between an open state, in which the valve permits fluid flow through the conduit, and a closed state, in which the valve prevents flow through the conduit; and a sensor circuit associated with an antenna (8) operable for sensing the presence of objects in a target region near the device outlet and for applying control signals to the electric valve to control flow of fluid through the conduit in response to at least one predetermined characteristic of the sensed object. Like the automatic fluid flow control devices of Dalferth and Forbes, described supra, Japan '442 lacks any disclosure of using a latching valve as the electric valve controlling fluid flow through the device.

However, as above, we rely on Weinberg or Sturman '239 to supply a teaching in the art of fluid flow control devices of an electromagnetically actuated latching type valve and of the advantages associated therewith over a conventional solenoid

operated valve of the type apparently used in Japan '442. For essentially the same reasons as expressed above, we are of the view that it would have been obvious to one of ordinary skill in the art at the time of appellant's invention to substitute a latching type electric valve as described in Weinberg or Sturman '239 for the solenoid operated valve in the fluid flow control system of Japan '442. Again, the reduced size of the compact latching type of electric valve, its exceptional stability, its economical operation under low power requirements, and its lower cost of manufacture, as described in both Weinberg and Sturman '239, along with its potential for efficient use of battery power (as made clear in Sturman '239) would have, in our opinion, led one of ordinary skill in the art to have made the substitution in the faucet mounted fluid flow control device of Japan '442.

Returning now to the examiner's rejection of claims 24, 37 and 5/37, we note that the examiner has relied upon the electrically operated latching type valve of Waterman to modify the fluid flow control device of Japan '442, urging that one of ordinary skill in the art would have found it obvious

> to have utilized, in the ('442) device, a latching type valve as the electromagnetic valve employed, in view of Waterman, in order

> to have a valve actuator and valve mechanism which is reliable in action and not prone to malfunction through wear and tear and also since such type of valve actuator and valve mechanism is known as being readily adaptable to direct retrofitting to the end of a pipe (see especially page 1, lines 72-79 and lines 77-79 in particular) when installed with a coupling (answer, page 7).

Appellant's arguments in the brief (pages 5-17 and 20) focus on the merits of the flow control system disclosed in the patent under Reexamination and particularly that aspect of the invention which involves the efficient use of battery power for the object-sensor-based flow control device with its latching type valve. Appellant points out that both object-sensor-based flow control devices that are battery powered and a latching valve's energy-conservation characteristics have been known for many years, but that no one in the field of object-sensor-based flow control systems had thought of appellant's way of extending battery life, despite the long existence of the latching valve, and despite efforts at battery use that extended over decades (brief, pages 9-11 and 20). Appellant also makes certain obser-vations and arguments concerning the disclosure of Waterman vis-

à-vis its purportedly lacking any statements of advantages of latching valves over non-latching valves (brief, pages 11-16).

Additionally, appellant asserts (brief, page 17) that the examiner has ignored evidence of commercial success submitted during the proceedings.

We have considered appellant's arguments and find them to be unpersuasive. As noted above, neither independent claim 24 nor independent claim 37 is in any way limited to using batteries as the source of power for the flow control devices defined therein. Thus, the predominant part of appellant's argument with regard to these claims is not persuasive due to the fact that it is not commensurate in scope with the claimed subject matter. As for the portion of the arguments directed specifically at Waterman, we must agree with the examiner that the disclosure of Waterman at column 1, lines 9-37, would have provided adequate motivation for one of ordinary skill in the art at the time of appellant's invention to substitute a latching type of electrically operated valve for the electromagnetic valve (4) of Japan '442. In this regard, we are firmly of the belief that it would have been self-evident to the person of ordinary skill in the art

that the latching valve of Waterman would be advantageous due to its economical operation resulting from its low power requirements and due to Waterman's description of the valve as being

"absolutely reliable in action" and as not getting out of order from wear, or catch, or otherwise becoming deranged. The mere fact that both Japan '442 and Waterman would require running wire for providing power (e.g., house power) to the solenoid valves disclosed therein is not, as urged by appellant, evidence that the invention defined in appellant's claims 24, 37 and 5/37 is patentable. We again point out that those claims do not in any way require the electric valves therein to be operated by a battery, to be part of a self-contained unit, or in any manner whatsoever otherwise exclude an electric valve of the general type shown in Japan '442 and Waterman which must be connected to house power in order to function as disclosed. In other words, there is nothing set forth in appellant's claims 24, 37 and 5/37 on appeal which would preclude the latching valve recited therein from being connected to house power via wiring in the same manner that the valves of Japan '442 and Waterman are connected to house power.

As for the evidence of commercial success provided by appellant and the assertion (brief, page 17) that this evidence "solidly supports claim 24's patentability," we have reviewed the declaration by Joel S. Novak (executed on October 10, 1995) and find that it fails to provide any nexus with the invention as defined in claim 24 on appeal. The declaration, refers to eliminating the need for an electrician to connect the flow control device to building power lines, the benefit of extending battery life for the four AA-sized batteries used in the OPTIMA PLUS retrofit kit to approximately three years, and the advantage of permitting installation in only six or seven minutes by a single plumber or a maintenance person with only a little experience. However, none of these specific advantages has anything to do with the invention as broadly defined in claim 24 on appeal, since claim 24 is in no way limited to a flow control device which is battery operated, which is part of a self-contained unit, or which is necessarily easy (i.e., quick) to install. With regard to the assertion that Sloan has had sales "well into the millions in 1993," we note that sales figures alone are of no moment when there has been no nexus established between the sales and the features of the claimed invention. See In re Huang,

100 F.3d 135, 140, 40 USPQ2d 1685, 1689 (Fed. Cir. 1996); In re Baxter Travenol Lab., 952 F.2d 388, 392, 21 USPQ2d 1281, 1285 (Fed. Cir. 1991; and Kansas Jack, Inc. v. Kuhn, 719 F.2d 1144, 1151, 219 USPQ 857, 861 (Fed. Cir. 1983).

Having considered the respective positions of the examiner and appellant and all of the evidence of obviousness and non-obviousness relied upon, we will sustain the examiner's rejection of claims 24 and 37 based on Japan '442 and Waterman. With respect to dependent claim 5/37, appellant's brief (page 4) indicates that "[a]ppellant agrees that it is appropriate to consider the rejections of claims 5/37 and 37 on the basis of claim 37 alone." Thus, given our determination with regard to claim 37, it is clear that claim 5/37 also falls and that the examiner's rejection thereof is likewise sustained.

The next of the examiner's rejections for our review is that of claims 1 and 5/1 under 35 U.S.C. § 103 based on Japan '442 in view of Forbes and Acklin or Japan '076. Claim 1, in contrast to independent claims 24 and 37 discussed above, does not require the use of a latching valve, but instead merely recites "an electric valve" for controlling flow through the

conduit of the device, and is otherwise directed to the aspect of appellant's invention wherein the add-on device for controlling flow through a faucet is self-contained in a housing which is sized to be supported by and on a faucet, and wherein the electric power source for providing power to the electric valve and the sensor circuit is "mounted in the housing and sized to be contained completely therein."

Looking to Japan '442, we see that this reference discloses a flow-control device for controlling the flow of fluid through a water faucet (2), wherein the device comprises a housing (1) having a device inlet and a device outlet, wherein the housing is sized to be supported by the faucet; a fluid conduit disposed in the housing for conducting fluid from the inlet to the outlet; a mounting means or coupling member (3) on the housing for mounting the device on the faucet with the device inlet in fluid communication with the faucet outlet and the conduit disposed outside the faucet; sealing means (34, 35) for sealing the device inlet to the faucet outlet so that fluid can flow from the faucet only by flowing through the flow-control device; an electric solenoid operated valve (4) interposed in the conduit and operable by application of control signals thereto to

switch between an open state, in which the valve permits fluid flow through the conduit, and a closed state, in which the valve prevents flow through the conduit; and a sensor circuit associated with an antenna (8) operable for sensing the presence of objects in a target region near the device outlet (11) and for

applying control signals to the electric valve to control flow of fluid through the conduit in response to at least one predetermined characteristic of the sensed object. What Japan '442 lacks with respect to the subject matter of appellant's claims 1 and 5/1 is an electric power source for providing power to the electric valve and the sensor circuit which is "mounted in the housing and sized to be contained completely therein." In Japan '442 it appears that the electric power source is external to the housing (1) and is connected to the coil (5) of the electric valve (4) via a post or posts (unnumbered) passing through the housing as seen in Figure 1 of this reference.

To provide for the above-noted deficiency in Japan '442 the examiner has turned to the teachings of Forbes and Acklin or Japan '076, indicating that Forbes provides a teaching of a

device for controlling the flow of fluid through a faucet (SP) via a flow control device having an object sensor controlled valve (SV) that may be powered either by a rectified source of DC voltage derived from a conventional AC power source, or by a battery or a series of batteries. See Figures 4-6 of Forbes and column 3, lines 14-21. Acklin and Japan '076 are relied upon for a teaching that in the field of fluid flow control devices it was

known to those of ordinary skill in the art at the time of appellant's invention to have a self-contained unit wherein the electric valve, the sensor circuit and the electric power source for providing power to the electric valve and the sensor circuit are mounted in a single housing, with the power source, in particular, being sized to be contained completely within the housing. See Figure 3 of Acklin, wherein the battery (14), the sensor circuit (18) and the electric valve (15, 16)[7] are contained

[7] We recognize that Acklin indicates that the solenoid mechanism (15) of this object-sensor-based flow-control device is of the bistable or latching type and that such a valve is used in conjunction with the battery (14) therein because it requires a minimum of electrical power to operate and thereby saves a great deal of electrical energy from the battery (col. 3, lines 9-20), thereby facilitating the achievement of the objective (col. 1, lines 40-44) of allowing the use of relatively small disposable or rechargeable batteries and allowing the placement of the fluid
(continued...)

entirely within the lower portion of the housing. See also, Japan '076 wherein a flow control device mounted on the hose or conduit (23) includes a housing (6) which entirely contains a signal receiver or sensor circuit, an electric valve and a battery.

In the examiner's view, it would have been obvious to one of ordinary skill in the art at the time of appellant's invention, based on the teachings of the applied references, to have modified the flow control device of Japan '442 by employing a battery or batteries as the power source in place of the conventional AC power source apparently used therein, following the teachings of Forbes, to thereby further facilitate system retrofitting and minimize installation problems. The examiner

[7](...continued)
dispenser essentially anywhere. However, we note that the appellant has utilized a declaration under 37 CFR § 1.131 (filed January 20, 1995) to swear behind the effective date of the Acklin reference with regard to its use of a latching valve in the environment of an object-sensor-based flow-control device, which is basically the subject matter of appellant's claims 24, 37 and 5/37 on appeal. However, Acklin has not been removed as a reference against claims 1 and 5/1. See the examiner's office action mailed May 7, 1996.

has further determined that it would have been obvious to the person of ordinary skill in the art to have modified the flow control device of Japan '442 by installing such a battery or batteries inside the housing (1), in view of the teachings of Acklin or Japan '076, to thereby provide the flexibility of allowing installation of the device almost anywhere.

Like the examiner, based on our consideration of the collective teachings of the applied prior art, we conclude that it would have been obvious to one of ordinary skill in the art at the time of appellant's invention to have modified the flow

control device of Japan '442 in the manner set forth above to thereby result in an add-on device for controlling flow through a faucet which is self-contained in a housing sized to be supported by and on the faucet and wherein the electric power source for providing power to the electric valve and the sensor circuit is mounted in the housing and sized to be contained completely therein. Using batteries as the power source in an object-sensor-based flow-control device is clearly taught or suggested in Forbes, with Acklin or Japan '076 providing an equally clear teaching or suggestion of installing a battery or batteries

inside the housing of a fluid flow control device to thereby provide the flexibility of allowing installation of the device almost anywhere.

Appellant's arguments (brief, pages 17-19) have been considered, however, we do not share appellant's view that the facts that Japan '442 did not use a self-contained battery and that Japan '442 and Acklin were in existence for some years prior to appellant's invention, necessarily leads to the "logical conclusion" that appellant's invention was not obvious, or that the examiner engaged in impermissible hindsight in combining the teachings of the references in the manner discussed above.

Accordingly, we sustain the examiner's rejection of claims 1 and 5/1 under 35 U.S.C. § 103 based on Japan '442 in view of Forbes and Acklin or Japan '076.

We, however, will not sustain the examiner's rejection of claim 18 under 35 U.S.C. § 103 as being unpatentable over Japan '442 in view of Forbes and Acklin or Japan '076 as applied to claim 1 above, and further in view of Waterman. Like the appellant, we are of the opinion that the examiner has here

engaged in the use of impermissible hindsight in attempting to substitute the latching valve of Waterman for the electric valve used in the particular environment of an add-on, object-sensor-based flow-control device for controlling fluid flow through a faucet, wherein the device is enclosed in a self-contained housing which is sized to be supported by and on a faucet, and wherein the electric power source for the device is a battery or batteries mounted in the housing and sized to be contained completely therein.

Under our authority provided by 37 CFR § 1.196(b), we add the following new ground of rejection against claims 1, 5/1 and 18.

Claims 1, 5/1 and 18 are rejected under 35 U.S.C. § 103 as being unpatentable over Japan '442 in view of Japan '183, Sturman '239 and Bremner. As noted above, what Japan '442 lacks with regard to the subject matter of appellant's claim 1 is any teaching concerning using battery power for the add-on flow control device therein and a teaching of having such a power source mounted in the housing of the device and sized to be contained completely therein. With regard to appellant's

claim 18, Japan '442 additionally lacks a teaching or suggestion of using a latching valve in the add-on flow control device disclosed therein. Japan '183 is relied upon as disclosing an object-sensor-based flow-control device (c) for controlling fluid flow through a faucet (1), wherein the device includes a sensor (E), an electromagnetic valve (D) and a control circuit (F), which elements are powered by a cell (G). As noted on page 4 of the translation, the cell (G) may be either a battery (exchange-type cell) or a solar cell and may be arranged in the case (9) together with the control circuit (F). While Japan '183 recognizes (translation, page 1) that flow control devices of the general type set forth therein are "[c]onventionally . . . connected to commercial AC power," it is noted (translation, page 13) that the battery powered flow control device disclosed therein has several advantages, those being

> [s]ince commercial AC power is not used, it is not necessary to connect the water supply system thereto via wiring, thereby making it extremely simple to install the water supply system. It is also possible to install the water supply system even in place [sic,

places] where commercial AC power is not available.

Like Japan '183, Bremner and Sturman '239 recognize that solenoid operated electromagnetic valves for fluid flow control devices have conventionally been connected to AC power. See column 1, lines 8-21, of Sturman '239 and the embodiment of Figure 13 in Bremner, discussed at column 4, lines 28-38. In addition, both Bremner and Sturman '239 also recognize that there are significant advantages to be gained by having the conventional electromagnetically operated valves of prior art flow control devices be in the form of a latching type solenoid operated valve and by having such devices powered by a battery or batteries. In this regard, we refer back to our discussion of Sturman '239 above, in the new rejections of claims 24, 37, and 5/37, noting that for essentially the same reasons as expressed above, we are of the view that it would have been obvious to one of ordinary skill in the art at the time of appellant's invention

to substitute a latching type electric valve as described in Sturman '239 or Bremner for the solenoid operated valve in the fluid flow control system of Japan '442. Again, the reduced size of the compact latching type of electric valve, its exceptional

stability, its economical operation under low power requirements, and its lower cost of manufacture, as described in both Bremner and Sturman '239, along with its potential for efficient use of battery power (as made clear in both Sturman '239 and Bremner) would have, in our opinion, led one of ordinary skill in the art to have made the substitution in the faucet mounted fluid flow control device of Japan '442 and to have provided power to such device by way of a battery or batteries.

In this rejection, we would also emphasize that while both Bremner and Sturman '239 highlight the extremely compact size, economical manufacturing costs, and quick and easy assembly of their respective latching type flow control valves, Bremner in particular states as an objective of the invention, the provision of an improved electromagnetically operated valve having a "self-contained power source," (col. 1, lines 25-27). More specifically, Bremner discloses (col. 4, lines 13-27) that the electrical actuating circuit with its components may be conveniently

provided as a "compact power pack." As clearly seen in Figure 5, that compact power pack includes batteries (32) which are mounted

in the housing of the device and sized to be contained completely therein.

Given the strong emphasis in both Bremner and Sturman '239 regarding the extremely compact size of a latching type solenoid valve compared to the size of a non-latching form of solenoid operated valve, we are firmly of the view that one of ordinary skill in the art would have found compelling motivation to have made the substitution in the relatively compact add-on flow control device of Japan '442 discussed above, and to have also included a battery or batteries for powering the device, which batteries would be sized to be completely contained within the housing of the device.

In addition to the foregoing new grounds of rejection entered by this panel of the Board, we also exercise our option under 37 CFR § 1.196(d) to include a recommended rejection of allowed claims 23 and 38. A copy of these claims is attached to our decision as Appendix C.

It is recommended that claims 23 and 38 be rejected under 35 U.S.C. § 103 as being unpatentable over Japan '442 in

view of Japan '183, Sturman '239 and Bremner as applied to claim 1 above, and further in view of Coward.

Independent claim 23 is broadly directed to an object-sensor-based flow-control device having an electric valve, a sensor circuit operable for sensing the presence of objects in a target region near the outlet of the device and for controlling the valve in accordance therewith, and further including

> solar cells, electrically connected to the sensor circuit, for converting light to electrical power and supplying the electrical power to the sensor circuit.

Claim 38 depends from claim 1 and is thus directed to the more specifically defined flow control device therein which is mounted on a faucet with the device inlet in fluid communication with the faucet outlet and the conduit of the device disposed outside the faucet, and wherein the device includes an electric power source which is mounted in the housing of the device and sized to be contained completely therein. Claim 38 adds to claim 1 the limitation that the electric power source is a solar cell.

Japan '442, Japan '183, Sturman '239 and Bremner are discussed above and are applied in the same manner as they were with respect to claim 1. Both Japan '183 and Coward disclose, in the environment of remotely located, electrically operated valve type fluid flow control devices, that power for such systems may be provided by batteries, by solar cells, or by a combination thereof. See page 4 of Japan '183, noting particularly that it is indicated therein that the power source (battery or solar cells) may be arranged in the case or housing (9) of the device together with the control circuit. See also Coward, e.g., Figures 1 and 4, and the disclosure thereof at pages 1 and 2, wherein it is noted that the latching type solenoid operated valve therein has very low power requirements and thus may be operated by using only a small power developing solar panel (page 2, lines 7-18), or by a small rechargeable battery which is, in turn, recharged during daytime from a solar panel array (page 1, lines 45-50).

Based on the collective teachings of the applied references, it is our opinion that one of ordinary skill in the art would have found it obvious to provide a remotely located fluid flow control device like that resulting from the combination of

Japan '442, Japan '183, Sturman '239 and Bremner, as discussed above, with a solar cell electrically connected to the sensor circuit, for converting light to electrical power and supplying the electrical power to the sensor circuit, as is clearly suggested in both Japan '183 and Coward.

We recognize that the broader claim 23, which does not require a housing mounted on a faucet, a latching valve, or battery power for the flow control device, might also be rejected under 35 U.S.C. § 103 based on Dalferth or Forbes in view of Sturman '239 or Bremner, further combined with Japan '183 and Coward. Either one of Sturman '239 or Bremner provides clear motivation for substituting a small sized, low power consuming, latching valve for the conventional solenoid valves of either Dalferth or Forbes, and each of these references also suggests that such flow control devices can have utility in remote locations where sources of power are limited. See our discussion of both Sturman '239 and Bremner, above. Japan '183 and Coward, as also discussed above, provide express teachings of a remotely located fluid flow control device employing an electrically operated solenoid valve, wherein the power source for the flow control device is in the form of a solar cell array. We leave

it to the examiner's discretion to consider the merits of such a rejection on return of this proceeding to the examiner's jurisdiction.

In summary:

We have affirmed the examiner's rejections of claims 1, 5/1, 24, 37 and 5/37 under 35 U.S.C. § 103;

We have reversed the examiner's rejection of claim 18 under 35 U.S.C. § 103;

Under 37 CFR § 1.196(b), we have made new rejections of claims 1, 5/1, 18, 24, 37 and 5/37 under 35 U.S.C. § 103; and

We have recommended, under 37 CFR § 1.196(d), that claims 23 and 38 be rejected under 35 U.S.C. § 103.

A period of two months is set in which the appellant may submit to the Primary Examiner an appropriate amendment, or a showing of facts or reasons, or both, in order to avoid the grounds set forth in the statement of the Board of Patent Appeals

and Interferences under the provisions of 37 CFR § 1.196(d) and/or prosecute further before the Primary Examiner by way of amendment or showing of facts, or both, not previously of record with respect to the new rejection under 37 CFR § 1.196(b) if the appellant so elects.

Upon conclusion of the proceedings before the Primary Examiner on remand, this case should be returned to the Board by the Primary Examiner so that the Board may either adopt its decision as final or render a new decision on all of the claims on appeal, as it may deem appropriate. Such return for this purpose is unnecessary if the application is abandoned expressly or as the result of an unanswered Office action, allowed or again appealed.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 CFR § 1.136(a).

Further proceedings in this case may be taken in accordance with 35 U.S.C. §§ 141 to 145 and § 306, and 37 CFR §§ 1.301 to 1.304. Note also 37 CFR § 1.197(b). If the patent

owner fails to continue prosecution, the reexamination proceeding will be terminated, and a certificate under 35 U.S.C. § 307 and 37 CFR § 1.570 will be issued canceling the patent claims, the rejection of which has been affirmed.

AFFIRMED-IN-PART, 37 CFR § 1.196(b), REMANDED

CHARLES E. FRANKFORT Administrative Patent Judge	)
LEE E. BARRETT Administrative Patent Judge	) BOARD OF PATENT APPEALS AND INTERFERENCES
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APPENDIX A

REEXAMINATION CERTIFICATE (2225th)

United States Patent [19] [11] **B1 4,839,039**

Parsons et al. [45] Certificate Issued * **Feb. 22, 1994**

[54] **AUTOMATIC FLOW-CONTROL DEVICE**

[75] Inventors: **Natan E. Parsons**, Brookline; **Joel S. Novak**, Sudbury, both of Mass.

[73] Assignee: **Recurrent Solutions Limited Partnership**, Cambridge, Mass.

Reexamination Request:
No. 90/003,010, Apr. 5, 1993

Reexamination Certificate for:

Patent No.:	4,839,039
Issued:	Jun. 13, 1989
Appl. No.:	834,741
Filed:	Feb. 28, 1986

[*] Notice: The portion of the term of this patent subsequent to Jun. 4, 2002 has been disclaimed.

[51] **Int. Cl.**[5] **B01D 36/00**; E03C 1/05
[52] **U.S. Cl.** **210/143**; 4/623; 137/551; 137/599; 137/883; 251/129.04; 251/129.06; 222/52; 222/54; 222/189; 367/94; 210/251; 210/422; 210/433.1; 210/460
[58] **Field of Search** 137/551, 599, 883; 4/623; 251/65, 129.04, 129.06; 367/93, 94; 222/52, 54, 189; 210/85, 94, 143, 251, 418, 420, 422, 433.1, 435, 459, 460, 90; 335/253, 254; 323/906; 136/291, 293

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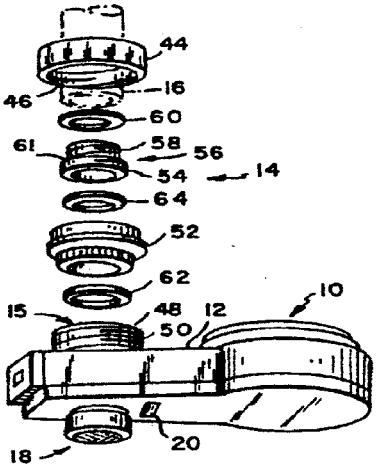
Primary Examiner—Joseph Drodge

[57] **ABSTRACT**

An add-on device (**10**) for converting a conventional manual faucet to an automatic faucet includes a body (**12**) that includes an adapter (**14**) by which the add-on device is mounted onto the outlet of the manual faucet. A conduit (**32**) provides a fluid path from the faucet outlet to a device outlet (**18**), and an electrically operable valve (**30**) is interposed in the conduit (**32**). A control circuit (**26**) operates an ultrasonic transducer (**20**) to sense objects in a target region near the device outlet **18**, and it operates the valve (**30**) to permit water to flow out the device outlet (**18**) when the transducer detects a moving object in the target region.



REEXAMINATION CERTIFICATE ISSUED UNDER 35 U.S.C. 307

THE PATENT IS HEREBY AMENDED AS INDICATED BELOW.

Matter enclosed in heavy brackets [ ] appeared in the patent, but has been deleted and is no longer a part of the patent; matter printed in italics indicates additions made to the patent.

AS A RESULT OF REEXAMINATION, IT HAS BEEN DETERMINED THAT:

The patentability of claims **25–30** is confirmed.

Claims **1, 2, 5, 9, 12, 19, 20, 22–24, 31–33** and **36** are determined to be patentable as amended.

Claims **3, 4, 6–8, 10, 11, 13–18, 21, 34** and **35**, dependent on an amended claim, are determined to be patentable.

New claim **37** is added and determined to be patentable.

1. For controlling the flow of fluid through a faucet, a flow-control device comprising:

A. a housing having a device inlet and a device outlet;

B. a fluid conduit disposed in the housing for conducting fluid from the inlet to the outlet;

C. mounting means on the housing for mounting the device on the faucet with the device inlet in fluid communication with the faucet outlet and the conduit disposed outside the faucet;

D. sealing means for sealing the device inlet to the faucet outlet when the mounting means mounts the housing on the faucet so that fluid can flow from the faucet only by flowing through the flow-control device;

E. an electric valve interposed in the conduit and operable by application of control signals thereto to switch between an open state, in which the valve permits fluid flow through the conduit, and a closed state, in which the valve prevents flow through the conduit;

F. a sensor circuit *operable* for sensing the presence of objects in a target region near the device and for applying control signals to the valve to control flow of fluid through the conduit in response to at least one predetermined characteristic of the sensed object[.]*; and*

G. an electric-power source, mounted in the housing, for providing electric power to the electric valve and the sensor circuit.

2. A flow-control device as defined in claim **1** or *37* wherein the sensor circuit includes means for, in at least one mode of operation, (A) applying control signals to the valve to cause the valve to assume its open state when the sensor circuit senses a moving object and (B) applying control signals to the valve to cause it to assume its closed state when the sensor circuit senses no moving object.

5. A flow-control device as defined in claim **1** *or 37* wherein the conduit is the only fluid path therethrough,

whereby closure of the valve prevents flow of fluid through the faucet.

9. A flow-control device as defined in claim **1** *or 37* wherein:

the flow-control device further includes:

i. a second outlet; and

ii. a soap-dispensing mechanism in fluid communication with the second outlet for containing soap, the soap-dispensing mechanism being operable to dispense soap through the second outlet;

B. the sensor circuit includes means for sensing the presence of objects in a dispenser target region and operating the soap-dispensing mechanism in response to at least one predetermined dispenser-control characteristic of the objects sensed in the dispenser target region.

12. A flow-control device as defined in claim **1** *or 37* further including:

A. a turbine disposed in the conduit for driving of the turbine by flow of water through the conduit; and

B. an electrical generator, connected to the turbine for driving thereby, for generating electric power when the turbine is driven by water flow, the generator being electrically connected to the sensor circuit to supply power thereto.

19. A flow-control device as defined in claim **1** *or 37* wherein:

A. the sensor circuit comprises means for sensing objects by converting electrical power into sensing signals and for operating in at least two modes:

i. a first, active mode, in which the sensor circuit converts a first, relatively high average level of power into a sensor signal and senses objects throughout a first, relatively long, range; and

ii. second, passive mode, in which the sensor circuit converts a second, relatively low average level of power into a sensor signal and senses objects through a second, relatively short, range; and

B. the sensor circuit comprises means for converting from the active mode to the passive mode when it has sensed no moving object having the predetermined characteristic for a predetermined length of time in the first range and for converting back to the active mode when it [sense] *senses* an object in the second range.

20. An automatic flow-control device comprising:

A. a fluid conduit, having an inlet and an outlet, for conducting fluid from its inlet to its outlet;

B. an electrical valve interposed in the conduit and operable by application of control signals thereto to switch between an open state, in which the valve permits fluid flow through the conduit, and a closed state, in which the valve prevents flow in the conduit;

C. a sensor circuit *operable* for sensing the presence of objects in a target region near the device outlet and for applying control signals to the valve to permit flow of fluid through the conduit in response to at least presence of an object within a predetermined presence-mode region within the target region; and

D. a flag movably-mounted for manual movement between an automatic position, in which it is disposed outside of the presence-mode region, and a manual position, in which it is disposed within the presence-mode region, whereby the valve permits fluid flow while the flag is in its manual position.

22. An automatic flow-control device comprising:

A. a fluid conduit, having an inlet and an outlet, for conducting fluid from its inlet to its outlet;

B. an electric valve interposed in the conduit and operable by application of control signals thereto to switch between an open state, in which the valve permits fluid flow through the conduit, and a closed state, in which the valve prevents flow through the conduit;

C. a sensor circuit *operable* for sensing the presence of objects in a target region near the device outlet and for applying control signals to the valve means to control flow of fluid through the conduit in response to at least one predetermined characteristic of the sensed object; and

D. an electrical generator, electrically connected to the sensor circuit and adapted to be driven mechanically, for generating electric power when it is driven mechanically and applying the electric power to the sensor circuit; and

E. a drag turbine disposed in the conduit for driving of the turbine by flow of water through the conduit, the drag turbine being mechanically coupled to the generator to drive it mechanically when the drag turbine is driven by the water flow.

23. An automatic flow-control device comprising:

A. a fluid conduit, having an inlet and an outlet, for conducting fluid from its inlet to its outlet;

B. an electric valve interposed in the conduit and operable by application of control signals thereto to switch between an open state, in which the valve permits fluid flow through the conduit, and a closed state, in which the valve prevents flow through the conduit;

C. a sensor circuit *operable* for sensing the presence of objects in a target region near the device outlet and for applying control signals to the valve means to control flow of fluid through the conduit in response to at least one predetermined characteristic of the sensed object; and

D. solar cells, electrically connected to the sensor circuit, for converting light to electrical power and supplying the electrical power to the sensor circuit.

24. An automatic flow-control device comprising:

A. a fluid conduit, having an inlet and an outlet, for conducting fluid from its inlet to its outlet;

B. an electric valve interposed in the conduit and operable by application of control signals thereto to switch between an open state, in which the valve permits fluid flow through the conduit, and a closed state, in which the valve prevents flow through the conduit, the valve being a latching valve, which requires power only to change state so that it remains in its open state when no power is applied to it in its open state, and it remains in its closed state when no power is applied to it in its closed state; and

C. a sensor circuit *operable* for sensing the presence of objects in a target region near the device outlet and for applying control signals to the valve means to control flow of fluid through the conduit in response to at least one predetermined characteristic of the sensed object.

31. An automatic flow-control device comprising:

A. a fluid conduit, having an inlet and an outlet, for conducting fluid from its inlet to its outlet;

B. an electric valve interposed in the conduit and operable by application of control signals thereto to switch between an open state, in which the valve

permits fluid flow through the conduit, and a closed state, in which the valve prevents flow through the conduit;

C. a sensor circuit *operable* for sensing the presence of objects in a target region near the device outlet and for applying control signals to the valve means to control flow of fluid through the conduit in response to at least one predetermined characteristic of the sensed object;

D. a generator housing that provides an air chamber that is substantially fluid tight above a lower generator level therein so as to prevent air from escaping from the chamber, the air chamber containing a volume of air above the lower generator level;

E. an electrical generator, electrically connected to the sensor circuit and adapted to be driven mechanically, for generating electric power when it is driven mechanically and applying the electric power to the sensor circuit, the generator being disposed in the air chamber above the lower generator level in the volume of air therein; and

F. a turbine disposed in the conduit for driving of the turbine by flow of water through the conduit, the turbine being mechanically coupled to the generator to drive it mechanically when the turbine is driven by the water flow, the turbine being disposed below the generator, whereby the generator is protected from water contact by the pressure of the air surrounding it.

32. An automatic flow-control device comprising:

A. a fluid conduit, having an inlet and an outlet, for conducting fluid from its inlet to its outlet;

B. an electric valve interposed in the conduit and operable by application of control signals thereto to switch between an open state, in which the valve permits fluid flow through the conduit, and a closed state, in which the valve prevents flow through the conduit;

C. a sensor circuit *operable* for sensing the presence of objects in a target region near the device outlet and for applying control signals to the valve means to control flow of fluid through the conduit in response to at least one predetermined characteristic of the sensed object;

D. a turbine disposed in the conduit for driving of the turbine flow of water through the conduit; and

E. a submersible electrical generator, mechanically connected to the turbine for driving thereby and electrically connected to the sensor circuit to supply power thereto, for generating electric power and applying the power to the sensor circuit when the turbine is driven by water flow.

33. For controlling the flow of fluid through a faucet, a flow-control device comprising:

A. a housing having a device inlet and first and second device outlets;

B. a first fluid conduit disposed in the housing for conducting fluid from the inlet to the outlet;

C. a second fluid conduit disposed in the housing for conducting fluid from the inlet to the second device outlet;

D. mounting means on the housing for mounting the device on the faucet with the device inlet in fluid communication with the faucet outlet;

E. sealing means for sealing the device inlet to the faucet outlet when the mounting means mounts the housing on the faucet so that fluid can flow from

the faucet only by flowing through the flow-control device;

F. an electric valve interposed in the conduit and operable by application of control signals thereto to switch between an open state, in which the valve permits fluid flow through the first conduit, and a closed state, in which the valve prevents flow through the first conduit;

G. a filter element interposed in the second conduit andpresenting enough flow resistance so that fluid does not flow through the second conduit when the valve permits fluid flow in the first conduit, the filter element permitting fluid flow therethrough when the valve is closed so that filtered water flows through the second outlet; and

H. a sensor circuit *operable* for sensing the presence of objects in the vicinity of the second outlet and to close the valve when it senses an object near the second outlet, the flow-control device thereby permitting flow of unfiltered water through the first-mentioned outlet when no object is sensed near the first outlet and directing fluid flow through the filter element so that filtered water issues through the second outlet when an object is near the second outlet.

36. For controlling the flow of fluid through a faucet, a flow-control device comprising:

A. a housing having a device inlet and a device outlet;

B. a fluid conduit disposed in the housing for conducting fluid from the inlet to the outlet;

C. mounting means on the housing for mounting the device on the faucet with the device inlet in fluid communication with the faucet outlet;

D. sealing means for sealing the device inlet to the faucet outlet when the mounting means mounts the housing on the faucet so that fluid can flow from the faucet only by flowing through the flow-control device;

E. an electric valve interposed in the conduit and operable by application of control signals thereto to switch between an open state, in which the valve

permits fluid flow through the conduit, and a closed state, in which the valve prevents flow through the conduit;

F. a sensor circuit *operable* for sensing the presence of objects in a target region near the device and for applying control signals to valve to control flow of fluid through the conduit in response to at least one predetermined characteristic of the sensed object; and

G. solar cells, electrically connected to the sensor circuit, for converting light to electrical power and supplying the electrical power to the sensor circuit.

37. For controlling the flow of fluid through a faucet, a flow-control device comprising:

A. a housing having a device inlet and a device outlet;

B. a fluid conduit disposed in the housing for conducting fluid from the inlet to the outlet;

C. mounting means on the housing for mounting the device on the faucet with the device inlet in fluid communication with the faucet outlet and the conduit disposed outside the faucet;

D. sealing means for sealing the device inlet to the faucet outlet when the mounting means mounts the housing on the faucet so that fluid can flow from the faucet only by flowing through the flow-control device;

E. an electric valve interposed in the conduit and operable by application of control signals thereto to switch between an open state, in which the valve permits fluid flow through the conduit, and a closed state, in which the valve prevents flow through the conduit, the valve being a latching valve, which requires power only to change state so that it remains in its open state when no power is applied to it in its open state and it remains in its closed state when no power is applied to it in its closed state; and

F. a sensor circuit operable for sensing the presence of objects in a target region near the device outlet and for applying control signals to the valve to control flow of fluid through the conduit in response to at least one predetermined characteristic of the sensed object.

* * * * *

APPENDIX B

1. For controlling the flow of fluid through a faucet, a flow-control device comprising:

A. a housing sized to be supported by the faucet having a device inlet and a device outlet;

B. a fluid conduit disposed in the housing for conducting fluid from the inlet to the outlet;

C. mounting means on the housing for mounting the device on the faucet with the device inlet in fluid communication with the faucet outlet and the conduit disposed outside the faucet;

D. sealing means for sealing the device inlet to the faucet outlet when the mounting means mounts the housing on the faucet so that fluid can flow from the faucet only by flowing through the flow-control device;

E. an electric valve interposed in the conduit and operable by application of control signals thereto to switch between an open state, in which the valve permits fluid flow through the conduit, and a closed state, in which the valve permits flow through the conduit;

F. a sensor circuit operable for sensing the presence of objects in a target region near the device and for applying control signals to the valve to control flow of fluid through the conduit in response to at least one predeter-mined characteristic of the sensed object; and

G. an electric-power source, mounted in the housing and sized to be contained completely therein for providing electric power to the electric valve and the sensor circuit.

18. A flow-control device as defined in claim 1 where-in the valve is a latching valve, which requires power only to

change state so that it remains in its open state when no power is applied to it in its open state and remains in its closed state when no power is applied to it in its closed state.

24. An automatic flow-control device comprising:

A. a fluid conduit, having an inlet and an outlet, for conducting fluid from its inlet to its outlet;

B. an electric valve interposed in the conduit and operable by application of control signals thereto to switch between an open state, in which the valve permits fluid flow through the conduit, and a closed state, in which the valve prevents flow through the conduit, the valve being a latching valve, which requires power only to change state so that it remains in its open state when no power is applied to it in its open state, and it remains in its closed state when no power is applied to it in its closed state; and

C. a sensor circuit operable for sensing the presence of objects in a target region near the device outlet and for applying control signals to the valve means to control flow of fluid through the conduit in response to at least one predetermined characteristic of the sensed object.

37. For controlling the flow of fluid through a faucet, a flow-control device comprising:

A. a housing having a device inlet and a device outlet;

B. a fluid conduit disposed in the housing for conducting fluid from the inlet to the outlet;

C. mounting means on the housing for mounting the

device on the faucet with the device inlet in fluid communication with the faucet outlet and the conduit disposed outside the faucet;

D. sealing means for sealing the device inlet to the faucet outlet when the mounting means mounts the housing on the faucet so that fluid can flow from the faucet only by flowing through the flow-control device;

E. an electric valve interposed in the conduit and operable by application of control signals thereto to switch between an open state, in which the valve permits fluid flow through the conduit, and a closed state, in which the valve prevents flow through the conduit, the valve being a latching valve, which requires power only to change state so that it remains in its open state when no power is applied to it in its open state and it remains in its closed state when no power is applied to it in its closed state; and

F. a sensor circuit operable for sensing the presence of objects in a target region near the device outlet and for applying control signals to the valve means to control flow of fluid through the conduit in response to at least one predetermined characteristic of the sensed object.

APPENDIX C

23. An automatic flow-control device comprising:

A. a fluid conduit, having an inlet and an outlet, for conducting fluid from its inlet to its outlet;

B. an electric valve interposed in the conduit and operable by application of control signals thereto to switch between an open state, in which the valve permits fluid flow through the conduit, and a closed state, in which the valve prevents flow through the conduit;

C. a sensor circuit operable for sensing the presence of objects in a target region near the device outlet and for applying control signals to the valve means to control flow of fluid through the conduit in response to at least one predetermined characteristic of the sensed object, the valve being a latching valve, which requires power only to change state so that it remains in its open state when no power is applied to it in its open state, and it remains in its closed state when no power is applied to it in its closed state; and

D. solar cells, electrically connected to the sensor circuit, for converting light to electrical power and supplying the electrical power to the sensor circuit.

38. A flow-control device as defined in claim 1 wherein the electric-power source is a solar cell.