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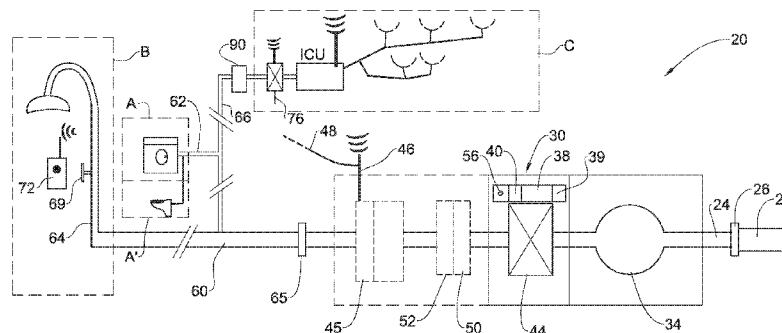


Fig. 1

(57) Abstract: A fluid flow system comprising a supply line, a fluid control unit and at least one end user; wherein fluid flow through the system is facilitated only upon a certified verification signal generated by the end-user and certifying said verification signal by the fluid control unit.

A FLUID FLOW SYSTEM AND METHOD

TECHNOLOGICAL FIELD

The present disclosed subject matter is directed at a system and method configured for communicating through a fluid supply system. More particularly the disclosure is concerned with generating recognizable signaling between a fluid control
5 unit and an end user.

Acknowledgement of the above references herein is not to be inferred as meaning that these are in any way relevant to the patentability of the presently disclosed subject matter.

BACKGROUND

10 Fluid flow systems, such as urban or domestic water supply systems, gas supply systems in a plant, etc., may require authentication of an end-user in order to confirm fluid consumption through the respective system, by the a particular end-user, and to verify that consumption by the end-user is intentional and recognizable by a fluid control unit of the fluid flow system.

15 The term *end-user* as used herein in the specification and claims denotes any fluid consuming device fitted at a fluid flow system. For example, an end-user can be an open ended hose (fitted or not with a nozzle/spout), an irrigation unit or irrigation line, a water supply unit such as a toilet, shower, sink and the like, etc.

The term *deterministic end-user* as used herein in the specification and claims
20 denotes an end-user configured for consumption of a predetermined amount of fluid. Alternatively, this term can be used for designating an end-user configured for consuming fluid at predetermined times or intervals. Examples of deterministic end-users are a dishwasher, a laundry machine and the like, a controlled/computerized irrigation line, etc.

GENERAL DESCRIPTION

According to the present disclosure there is provided a fluid flow system comprising a supply line, a fluid control unit and at least one end user; wherein fluid flow through the system is facilitated only upon a certified verification signal generated by the end-user and certifying said verification signal by the fluid control unit.

The term *fluid control unit* as used herein in the specification and claims denotes a controller configured for associated with a fluid system comprising a supply line being in flow communication with a fluid supply source and configured for supplying fluid to one or more end-users, said controller configured for recognizing/monitoring fluid flow and/or consumption through the fluid system. The fluid control unit can be useful in determining whether fluid flow is deliberate (i.e. intended) or not.

According to one particular embodiment, the verification signal is generated responsive to a query signal generated by the fluid control unit.

At the absence of a certified verification signal, the fluid control unit is configured for generating a shutoff signal to a valve articulated with the fluid flow system, to thereby terminate fluid flow to the end-user. Accordingly, if a certified verification signal is generated by the end-user, the valve will remain open.

According to another aspect of the present disclosure there is provided a fluid control unit for use in conjunction with a fluid flow system, said fluid control unit configured for facilitating fluid flow through an end-user of the system only upon receiving a certified verification signal generated by the end-user. Fluid flow is facilitated through a valve controlled by the fluid control unit.

According to one particular embodiment, the fluid control unit is configured for generating a query signal and upon receiving a verification signal generated responsive to said query signal, the fluid control unit will facilitate fluid flow through the fluid flow system.

According to yet an aspect of the present disclosure there is provided a signaling method between a fluid control unit and an end-user.

A signaling method can comprise the following steps:

Providing a fluid flow system comprising a supply line coupleable to a main fluid supply line, a fluid control unit, a flow valve governed by the fluid control unit, and at least one end-user;

Consuming fluid through the at least one end-user, with the flow valve at an open position thereof;

Generating a verification signal by said at least one end-user;

Transferring said verification signal to the fluid control unit; and

5 Certifying the verification signal by the fluid control unit and determining whether to maintain the valve open.

The verification signal can be generated before or during fluid consumption.

According to an embodiment of the disclosed method, the verification signal is generated responsive to a query signal generated by the fluid control unit.

10 According to even yet an aspect of the present disclosure there is provided a signaling system between a fluid control unit and an end-user.

By one other aspect of the present disclosure there is provided a device configured for generating a verification signal, for use in conjunction with a fluid supply system according to the disclosure.

15 Any one or more of the following features, designs and configurations can be associated with a fluid flow system and/or a fluid control unit and the method according to the present disclosure, independent or in different combinations:

- The communicating signals between the end-user and the fluid control unit can be symmetric, i.e. the query signal and the verification signal can be of
20 the same nature. Namely, the query signal and the verification signal can be identical to one another or be of the same nature but however have a different signal pattern;
- A signal in direction from the fluid control unit to end-user is referred to as an outgoing signal, or a query signal;
- 25 • A signal in direction from the end-user to the fluid control unit is referred to as an incoming signal, or a verification signal;
- A first one of the query signal and the verification signal can be generated upon fluid consumption through the fluid flow system;
- The verification signal can be generated responsive to a query signal
30 generated by the fluid control unit;
- The verification signal can be generated spontaneously by the end-user, namely without a query signal generated by the fluid control unit;

- At the absence of a verification signal, either responsive to a query signal generated by the fluid control unit or as a first signal generated by the end-user upon consuming fluid, the fluid control unit can generate one or more reminder query signals, whereby at the event of failure to generate a responsive verification signal, the fluid control unit can generate a control signal to close a flow valve associated with the respective non-responding end-user;
- Either one or both of the query signal and the verification signal can be for example a recognizable sequence of flow pulsations through the fluid;
- Either one or both of the query signal and the verification signal can be for example a recognizable acoustic signal over a piping of the fluid flow system;
- Either one or both of the query signal and the verification signal can be for example a recognizable acoustic signal generated by a signal generator configured for generating a query signal or a verification signal, and transmitting the signal, through wire or wireless communication, to a receiver configured at the either or both the end-user and the fluid control unit, respectively;
- The signal generator can be an external acoustic generator, stationary or portable, configured for generating a sequence of acoustic pulses such as knocks, tunes, etc.;
- The verification signal can be generated by a flow-altering unit mounted on the supply line in association with the end-user and configured for temporarily altering fluid flow pattern through the line in compliance with a predetermined signal. For example, the altering fluid flow pattern can be decreasing the flow rate through the line and gradually increasing, however at a predefined pattern, such as step function, sinusoidal functions, etc.;
- The flow-altering unit can be an autonomous device (e.g. a mechanical flow governing unit) or cooperating in conjunction with a controller element;
- The verification signal can be generated by an individual cooperating with an end-user (e.g. while opening a tap, taking a shower, watering the garden, etc.), wherein the verification signal can be for example a sequence of several rapidly repeated closing/opening the faucet. This would signal to the fluid control unit that the end-user is 'under control', namely that fluid (water in the

particular example) is intentionally consumed by the individual, and that it is not an unintentional fluid consumption such as pipe burst' and the like;

- The control unit can be configured for determining whether fluid flow through the fluid system is authorized or occurs unwillingly, e.g. as a result of a leak in piping, failure/error/malfunctioning of an end-user, system unintentionally opened or unintentionally left at an open state, etc.;
- Generating the verification signal can be performed automatically or manually;
- The verification signal can be generated within the system or externally;
- The control unit can be configured with a user interface for setting it at different operative positions;
- The control unit can be configured with a clock and calendar;
- A verification signal generator, according to a particular configuration, can comprise a housing fitted with an inlet port and an outlet port with a fluid chamber in-between said inlet port and outlet port, a flow regulator configured to facilitate fluid flow into the fluid chamber at a substantially constant flow rate, and a flow restriction device configured to facilitate flow through the verification signal generator only upon pressure buildup within the fluid chamber to a predetermined value;
- The verification signal generator can be configured such that the flow regulator is replaceable to obtain different flow rates into the fluid chamber;
- The verification signal generator can be configured such that the pressure threshold required to open the flow restriction device is controllable.

BRIEF DESCRIPTION OF THE DRAWINGS

In order to better understand the subject matter that is disclosed herein and to exemplify how it may be carried out in practice, embodiments will now be described, by way of non-limiting examples only, with reference to the accompanying drawings, in which:

Fig. 1 is a schematic representation of a fluid flow system according to an example of the present disclosure, associated with a domestic water supply system;

Figs. 2A to 2F are different examples of signaling schemes between a fluid control unit and end-users, useful in the example of Fig. 1; and

Fig. 3A is an example of a verification signal generator for use in conjunction with a fluid flow system according to the present disclosure, the verification signal generator illustrated at a closed position thereof; and

Fig. 3B illustrates the verification signal generator of Fig. 3A at an open position thereof.

DETAILED DESCRIPTION OF EMBODIMENTS

Attention is first directed to Fig. 1 of the drawings schematically illustrating a fluid system generally designated **20**, representing a domestic water supply system. The fluid system **20** comprises an inlet supply line **24** coupleable through coupler device **26** to a mains upstream supply line **28**. A fluid control assembly generally designated **30** is fitted on the supply line **24** and comprises a metering unit **34**, a control unit **38** associated with a power source **40** and a valve **44** which in the present example is an electrically operated valve controlled by the control unit **38**.

The control unit **38** is associated with a flow/pressure sensor associated with the control unit **38**, as will be explained herein below.

The valve can be open/closed (i.e. an on/off) type valve, or a valve configurable between gradually closed/open positions. The valve can be a hydraulic valve, a pneumatic valve, etc.,

According to one example, the fluid control assembly can further be configured with a communication unit **45** with a transceiver module **46** i.e. a wireless communication module with an antenna, and/or a wired communication port **48**. The purpose of the communication unit **45** and how it can serve with a system according to the present disclosure will become apparent hereinafter.

The fluid control assembly **30** can further be configured with a variety of fluid/liquid flow governing devices, integral with or articulated with the system. Such governing devices can be for example a UFR (Unmeasured Flow Reducer) device **50**, a backflow preventer **52**, and the like. The fluid control assembly **30** can be a block unit or it can be configured with a main block unit and one or more attachable modules.

In addition, the fluid control assembly **30** can be configured with an alerting module **56** for informing a control center, an individual and the like regarding the situation of the system. The alerting module can be for example a cellular communication module and the like, wherein pre-programmed messages can be transmitted, indicative of the status and functioning of the fluid system **20**.

Reverting to the control unit **38**, it is a decision-making system configured for deciding whether fluid flow downstream within the fluid system is a planed event, namely the result of willful consumption by an individual or as a result of controlled consumption however approved and determined. Thus, the control unit **38** is configured for preventing unintentional fluid consumption through by an end user of the fluid system. This is performed by closing a valve associated with the control unit **38**. The decision-making of the control unit can be based on pre-programmed parameters and/or on acquired parameters upon use of the system.

A branching supply line **60** is coupled to the fluid control assembly **30** through coupler **65**, and downstream splits into three sub-supply lines, namely:

a first sub-supply line **62** extending towards a first end-user, namely a washing machine designated **A** , a toilet with a cistern designated **A'**, representative of a so-called deterministic end-user, as will be explained hereinafter;

a second sub-supply line **64** extending towards a second end-user, namely a shower unit designated **B**; and

a third sub-supply line **66** extending towards a third end-user, namely an irrigation setup designated **C**, fitted with an irrigation control unit (ICU) as will be referred to hereinafter with further detail.

Further reference is made to the first end-user **A** representing a so-called deterministic end-user, namely a domestic appliance (washing machine in the particular example) programmed to operate with a known water consumption scheme (i.e. fixed amount of water consumed at regular and predictable flow rates and intervals). Thus, it is unlikely that such an appliance will excite the control unit to generate a query signal (as will be explained herein below).

The flow consumption scheme for the deterministic end-user **A** (washing machine) is schematically represented in Fig. 2A:

t_0 to t_1 – initial filling the washing machine drum with water; Consuming at Q_1 rate;

t_1 to t_2 – begin washing process;

t_2 to t_3 – adding water to the drum; Consuming at Q_2 rate;

t_3 to t_4 – completing washing process, draining washing water;

t_4 to t_5 – filling fresh water into the drum for rinsing; Consuming at Q_3 rate.

5 Such a scheme can be recognized or preloaded or programmed into the control unit **38**, so as not to excite the control unit to generate a query signal. Otherwise, such a scheme can be recognized as a verification signal (see hereinafter with reference to Fig. 2F)

10 The toile cistern designated **A'** is also representative of a so-called deterministic end-user, as it is appreciated that though a toilet cistern may be operated during night hours; however flushing the toilet is a deterministic event, namely requiring a preset amount of water and also lasts for a substantially short duration). Thus, in this case too, it is unlikely that flushing the toilet will excite the control unit to generate a query signal.

15 Fig. 2B schematically illustrates a flow scheme for such an event (toilet flushing), where water is consumed at a single instance, at a constant flow rate Q_1 for a short duration t_0 to t_1 . In this case the control unit will not generate a query signal, despite occurrence at an unusual time of the day.

20 Turning now to the second example directed to end-user **B**, representative of a man-operative faucet such as a shower/bath tap, garden hose and the like. It is appreciated that under normal operative conditions such end-users are typically not operated during certain hours of the day (e.g. not at the wee hours of the night), and further that water consumption through such faucets is typically of irregular scheme.

25 If such consumption takes place during 'normal' household hours, the control unit **38** interprets it as an approved event and will not generate a query signal (see below). Though, under certain circumstances a query signal may be generated, when the control unit **38** is set to 'away' mode, indicating that water consumption (apart for example irrigation, as will be discussed herein below) is not approved and the valve **44** should be closed.

30 However, at the event of someone consuming water at an unexpected time or irregular time for that household (e.g. taking a shower or watering the garden in the middle of the night), the control unit **38** will be excited in order to determine that water consumption is not a result of a pipe burst or other fault.

With further reference being made to Fig. 2C, once the control unit **38** is at its operative mode and at the event of water consumption Q_1 taking place at an unexpected time of the day, the control unit is excited at t_1 and a query signal **QS** is generated in the form of repeated flow fluctuations (in the present example two rapid fluctuations at t_2 and t_3 , almost shut down at water flow $Q_2 - Q_3$) for significantly short durations, almost like a pulse through the water, however sufficient for sensing by the individual taking a shower or otherwise using water.

Once the query signal **QS** is generated, the control unit **38** anticipates receipt of reply, namely a verification signal **VS** to be generated by the individual within a time frame ΔT . The verification signal **VS** is generated by the individual by three rapid consecutive closing of the tap **69**, taking place at t_4 , t_5 and t_6 . By doing so, a flow/pressure sensor **39** associated with the control unit **38** senses the flow fluctuations willingly generated by the user, whereby said fluctuations are recognized by the control unit as a verification signal **VS** and is certified so that further water consumption at desired flow rate Q_c can be un-interruptedly consumed.

Attention is directed to Fig. 2D. If the individual fail to reply to the initial query signal QS_1 (of moderate intensity extending between flow rates $Q_1 - Q_2$), namely timely generate a verification signal **VS** within the prescribed time frame ΔT , the control unit **38** can be configured for repeating the verification procedure by repeating the query signal QS_2 , identical to the previous sequence or intensified as in the present example (flow rate extending between flow rates $Q_1 - Q_3$ and more distinct), in order to attract attention of the individual. The individual in turn generates a verification signal **VS** within the prescribed time frame ΔT , so that further water consumption at desired flow rate can be un-interruptedly consumed. At the event of failure to generate a certified verification signal **VS**, the control unit **38** will generate a signal to close the valve **44** (assuming consumption is the result of a fault, e.g. a pipe burst and the like).

Figure 2E is representative of a different scenario, wherein a user opens a tap **69** (or other water consuming end-user device) and spontaneously generates a predetermined verification signal **VS** in the form of a sequence of consecutive opening/closing of the tap **69**, resulting in flow fluctuations between $Q_1 - Q_2$. As long as the verification signal **VS** is generated within a predetermined period t_1 from the time the tap was opened at t_0 , the verification signal **VS** is certified by the control unit **38** so

that further water consumption at desired flow rate Q_3 can be un-interruptedly consumed.

Alternative to generating a verification signal **VS** by pulsating through the running water as explained hereinabove, a verification signal can be generated by a signal inducer **72** in the form of recognizable signal generator. Signal inducer **72** can be a push-button device transmitting a digital code, an audio string, etc.,. Once activated by an individual, a verification signal recognizable by the control unit **38** is received by communication unit **45** (either wireless through the transceiver module **46** or through wired communication port **48**). The signal inducer **72** can be a stationary device associated with a particular end-user (e.g. shower **B**, garden hose, swimming pool filling valve, etc.), or it can be portable and carryable by an individual.

According to one particular example, the signal inducer **72** can be configured for generating a sequence of acoustic pulses such as knocks, which when applied over a sound conducting media (e.g. branching supply line **60**), the knocks are picked up by the control unit **38** and are identified as a certified verification signal.

Figure 2E is representative of a different verification signal system, referred to with particular reference to the third sub-supply line **66** extending towards the irrigation setup designated **C**. The irrigation setup is fitted with an irrigation control unit (**ICU**) programmed for irrigation of different zones or configured for remote control activation, and a valve **76** remote controlled by the control unit **38**.

In order to verify an irrigation process, namely to prevent shut down of water supply to the irrigation sub-supply line **66** (by remote closing of the valve **76**), a verification signal is anticipated by the control unit **38**. As explained herein above, the verification signal **VS** can be generated responsive to a query signal **QS** or spontaneously. In the present example, the irrigation control unit (**ICU**) is configured for generating a verification signal **VS** in the form of a distinguished flow pattern as illustrated in Fig. 2F. In the example it is noted that water flow gradually increases along predetermined time intervals with the following pattern:

Within t_1 from start at t_0 flow reaches a flow rate Q_1
 Within a time interval t_3 from t_2 flow gradually reaches a flow rate Q_2
 and at time t_4 water flow increases rapidly to flow rate Q_3 , this being the final flow rate for unlimited or uninterrupted consumption.

The control unit **38** recognizes this flow pattern as a certified verification signal VS and will retain the valve **76** (and valve **44**) at their open position.

Further attention is now directed to Figs. 3A and 3B of the drawings, directed to a verification signal generator generally designated **90**. The verification signal generator is a self maintained, automatic (i.e. autonomous) verification signal generator, which can be used in conjunction with the system disclosed herein above. In particular, a verification signal generator of the prescribed type can be associated with an end-user which typically does not require man operation, such as an irrigation system, a fountain and the like. The verification signal generator **90** is configured for coupling on a supply line providing fluid to the respective end-user. With reference to Fig. 1 of the drawings, the verification signal generator **90** can be fitted at any of the pipe supply or sub-supply segments (**60**, **62**, **64**, and **66**)

The verification signal generator **90** comprises a housing **94** with an inlet port **96** extending into an inlet chamber **97** and coupleable (e.g. by a screw coupler) to an upstream fluid supply pipe segment, and an outlet port **98** coupleable to an upstream fluid supply pipe segment (i.e. extending towards the respective end user). The housing **94** is further configured with a fluid chamber **102** disposed between the inlet port **96** and the outlet port **98**, and a flow regulator **110** which in turn is configured with an inlet opening **112** disposed at the inlet port **96**, and an outlet opening **114** extending into the fluid chamber **102**. The arrangement is such that fluid flow between the inlet port **96** and the fluid chamber **102** is facilitated only through the flow regulator **110**, that owing to a barrier wall **118** disposed between the fluid chamber **102** and the inlet chamber **97**.

The flow regulator **110** is an element configured to facilitate fluid flow therethrough at substantially constant flow rate ($\Delta Q/\Delta T \cong \text{constant}$). Such a device can be similar to an irrigation dripper, i.e. with a labyrinth or other forced flow element, and configured for emitting fluid therethrough at substantially constant flow rates (and substantially regardless of pressure differences).

A normally closed/sealed flow restriction device **120** in the form of a sealing plunger **122** is axially displaceable within the housing **94** between a closed/sealed position (Fig. 3A), and an open position (Fig. 3B). At the closed position the plunger **122** is biased by coiled spring **124** such that a tubular sealing portion **126** of the plunger **122** is sealingly received within a corresponding annular shoulder **130** of the housing **94**, sealing the passage between the flow chamber **102** and the outlet port **98**. At the

open position, the coiled compression spring **124** surrenders and compress (Fig. 3B) so as to facilitate axial displacement of the plunger **122** in direction of arrow **135**, whereby the tubular sealing portion **126** of the plunger **122** disengages from sealing engagement with the annular shoulder **130** of the housing **94**, facilitating fluid flow as indicated by the arrowed lines.

The arrangement is such that when the device **90** is fitted on a supply line and associated with an end user (for example, an irrigation system **C**), water will flow through the third sub-supply line **66** into the normally closed verification signal generator **90** via inlet port **96**, into the flow regulator **110** where only a small amount of initial water flows therethrough, until the fluid chamber fills up (time segment **t₂-t₄** in diagram of Fig. 2F), during which period water flows at low though constant flow rate **Q₁** and **Q₂** until sufficient pressure buildup at the flow chamber **102**, whereupon the force over the surface area **133** of the plunger **122** overcomes the biasing force of the spring **124**, resulting in displacement of the plunger **122** into its open position (Fig. 3B), facilitating flow at high flow rate **Q₃** therethrough (segment **t₄** in Fig. 2F).

Thus, the control unit **38** receives a spontaneous (i.e. autonomously_ generated verification signal in the form of a predefined flow fluctuation pattern through the system, thereby certifying further fluid flow through the system.

The arrangement is such that a unique verification signal generator can be associated with one or more end users, each such device being configured for generating a characterizing flow fluctuation pattern signal representative of the associated end-user, for the control unit to associate and determine flow therethrough, respectively.

The verification signal generator can be configured such that the flow regulator **110** is readily replaceable to obtain different flow rates into the fluid chamber, to facilitate association with different end-users. In addition or instead, the verification signal generator can be configured such that the pressure threshold required to open the flow restriction device is controllable, e.g. by replacing or manipulating the compression spring, by replacing the shape of the plunger, etc.

It is appreciated that one or more valves can be configured throughout a fluid supply system, individually or commonly governed by the control unit, whereby water supply to different zones can be closed, however without interfering with proper operation of other zones.

Whilst in the illustrated example reference is made to a domestic water supply system, it is to be appreciated that the present disclosure can be applicable for any fluid supply system, whether a liquid or a gas supply system, as well as at any scale and purpose, i.e. domestic, urban planet/facility, etc, and however all fall within the scope of
5 the present disclosure.

CLAIMS:

1. A fluid flow system comprising a supply line, a fluid control unit and at least one end user; wherein fluid flow through the system is facilitated only upon a certified verification signal generated by the end-user and certifying said verification signal by
5 the fluid control unit.
2. A fluid flow system according to claim 1, wherein the verification signal is generated responsive to a query signal generated by the fluid control unit.
3. A fluid flow system according to claim 1, further comprising a valve and wherein at the absence of a certified verification signal the control unit is configured for
10 generating a shutoff signal to the valve to terminate fluid flow to the end-user.
4. A fluid flow system according to claim 2, wherein a first one of the query signal and the verification signal is generated upon fluid consumption through the fluid flow system.
5. A fluid flow system according to claim 2, wherein either one or both of the
15 query signal and the verification signal are a recognizable sequence of flow pulsations through the fluid.
6. A fluid flow system according to claim 2, wherein either one or both of the query signal and the verification signal are a recognizable acoustic signal over a piping of the fluid flow system.
- 20 7. A fluid flow system according to claim 2, wherein either one or both of the query signal and the verification signal are a recognizable acoustic signal generated by a signal generator configured for generating a respective signal, and transmitting it, through a communication arrangement, to a receiver configured at the either or both the end-user and the fluid control unit, respectively.
- 25 8. A fluid flow system according to claim 1, wherein the verification signal is generated by an individual cooperating with an end-user wherein the verification signal is a sequence of manually resulting fluid flow alterations caused by repeated closing/opening a faucet.
9. A fluid control unit for use in conjunction with a fluid flow system, said fluid
30 control unit configured for facilitating fluid flow through an end-user of the fluid flow system only upon receiving a certified verification signal generated by the end-user.

10. A fluid control unit according to claim 9, wherein the control unit is configured for generating a query signal and upon receiving a certified verification signal generated responsive to said query signal, the fluid control unit will facilitate fluid flow through the fluid flow system.
- 5 11. A fluid control unit according to claim 9, comprising a user interface for setting it at different operative positions.
12. A signaling method between a fluid control unit and an end-user comprising the following steps:
- 10 (a) Providing a fluid flow system comprising a supply line coupleable to a main fluid supply line, a fluid control unit, a flow valve governed by the fluid control unit, and at least one end-user;
 - (b) Consuming fluid through the at least one end-user, with the flow valve at an open position thereof;
 - (c) Before or during step (b) generating a verification signal by said at least one
15 end-user;
 - (d) Transferring said verification signal to the fluid control unit; and
 - (e) Certifying the verification signal by the fluid control unit and determining whether to maintain the valve open.
13. A signaling method according to claim 12, wherein the verification signal is
20 generated responsive to a query signal generated by the fluid control unit.
14. A signaling method according to claim 12, wherein at the absence of a verification signal, the fluid control unit is configured for generating one or more reminder query signals, whereby at the event of failure to generate a responsive verification signal, the fluid control unit will generate a control signal to close a flow
25 valve associated with the respective non-responding end-user.
15. A verification signal generator for use in conjunction with a fluid flow system of claim 1, wherein the verification signal generator is a flow-altering unit associated with a supply line or with the respective end-user, and is configured for temporarily altering fluid flow pattern through the line in compliance with a predetermined signal.
- 30 16. A verification signal generator according to claim 15, comprising a housing fitted with an inlet port and an outlet port and a fluid chamber disposed between said inlet port and outlet port, a flow regulator configured to facilitate fluid flow into the fluid chamber at a substantially constant flow rate, and a flow restriction device

configured to facilitate flow through the verification signal generator only upon pressure buildup within the fluid chamber to a predetermined value.

17. A verification signal generator according to claim 16, wherein the flow regulator is replaceable to obtain different flow rates into the fluid chamber.

- 5 **18.** A verification signal generator according to claim 16, wherein the pressure threshold required to open the flow restriction device is controllable.

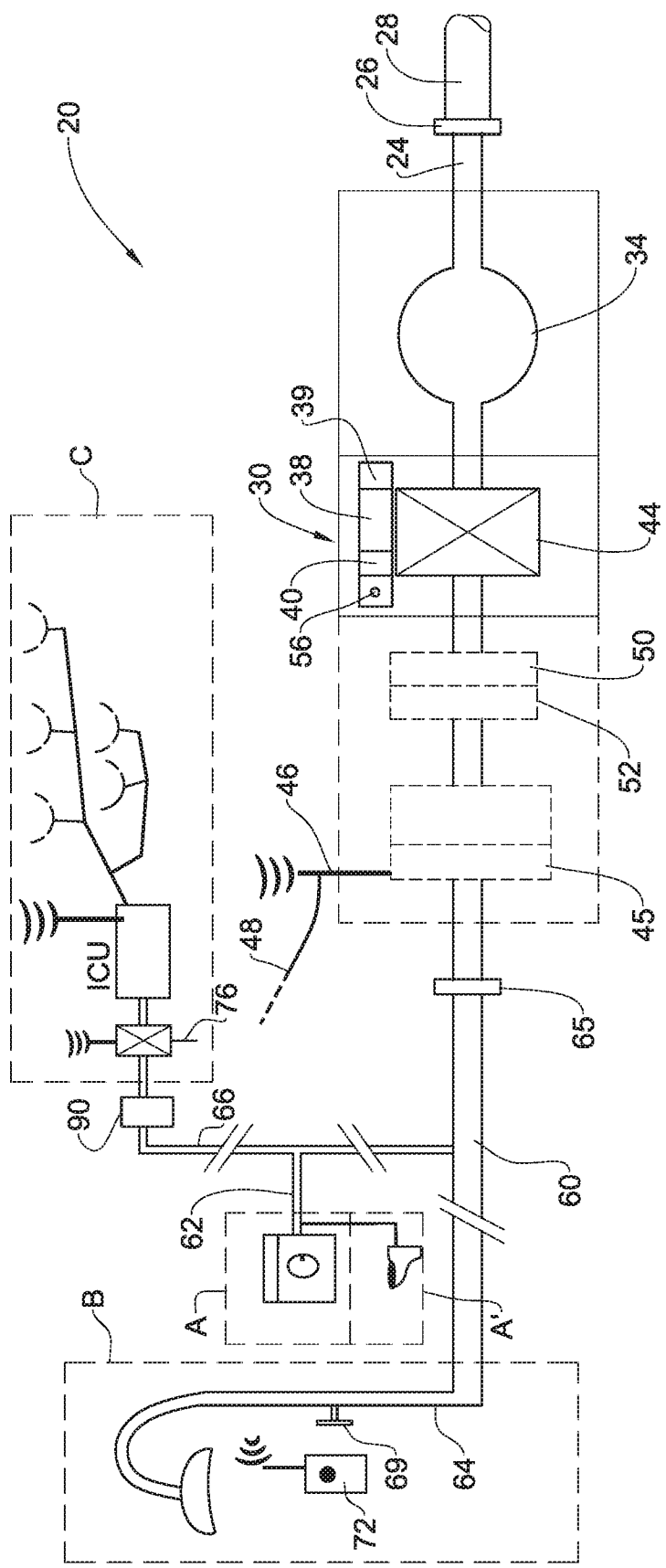


Fig. 1

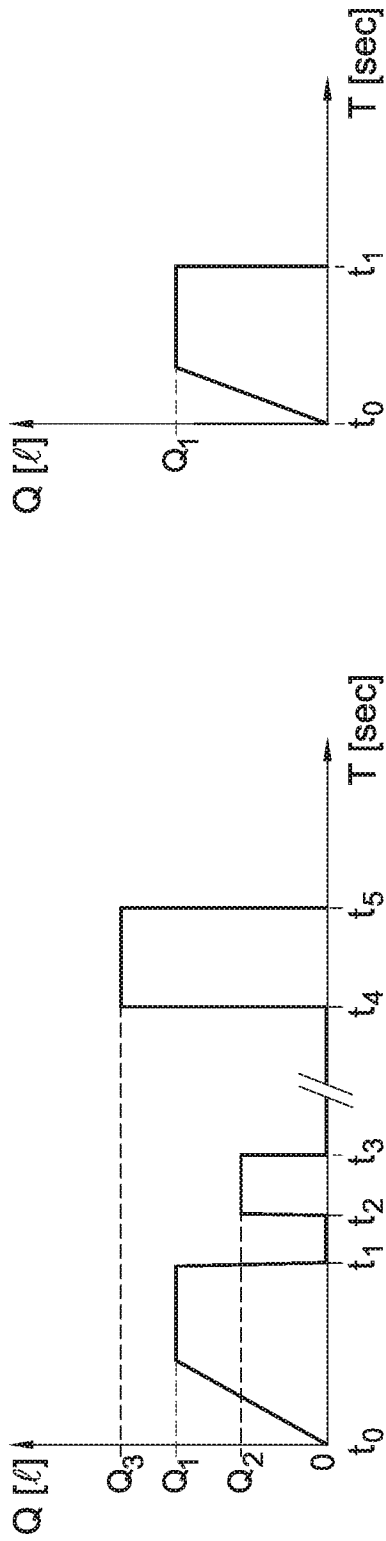


Fig. 2A

Fig. 2B

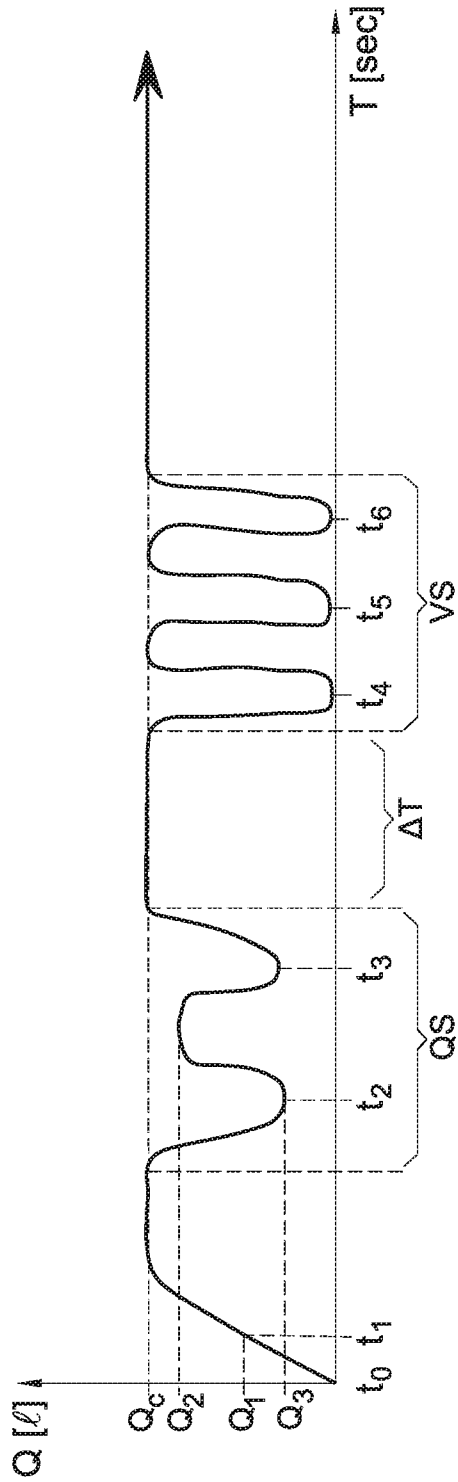


Fig. 2C

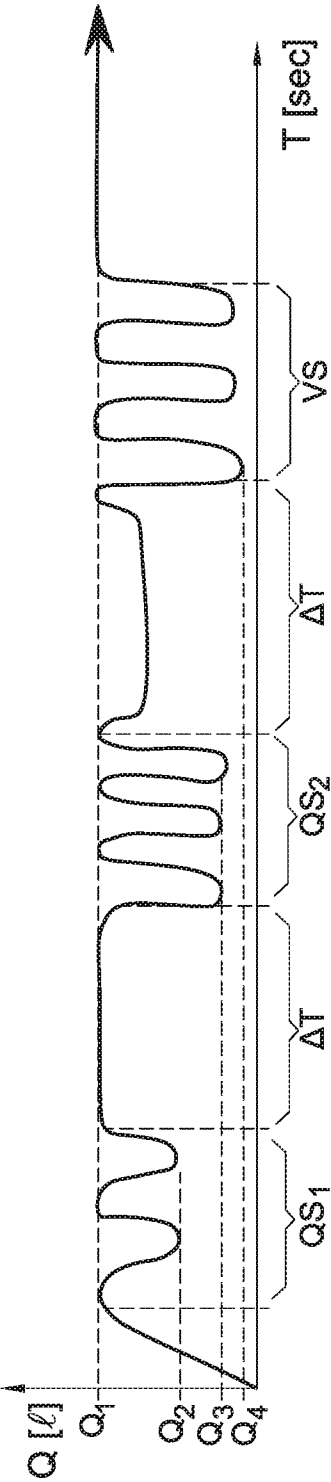


Fig. 2D

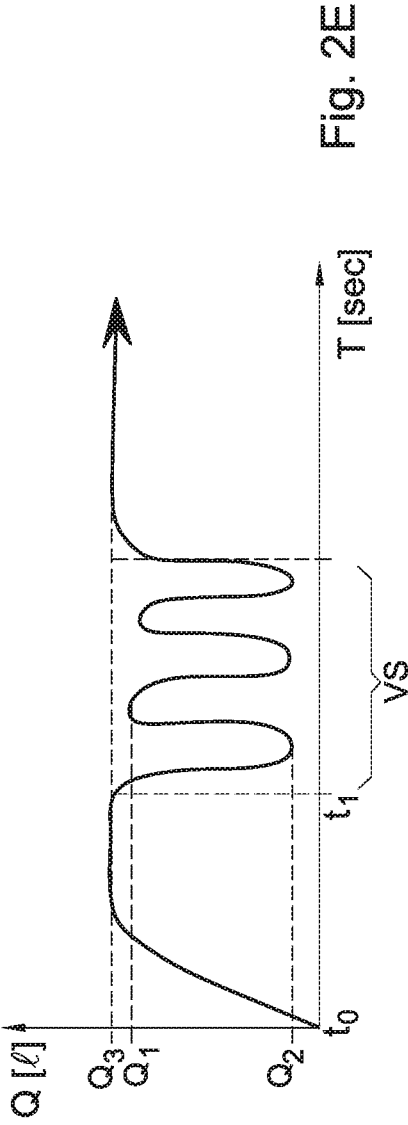


Fig. 2E

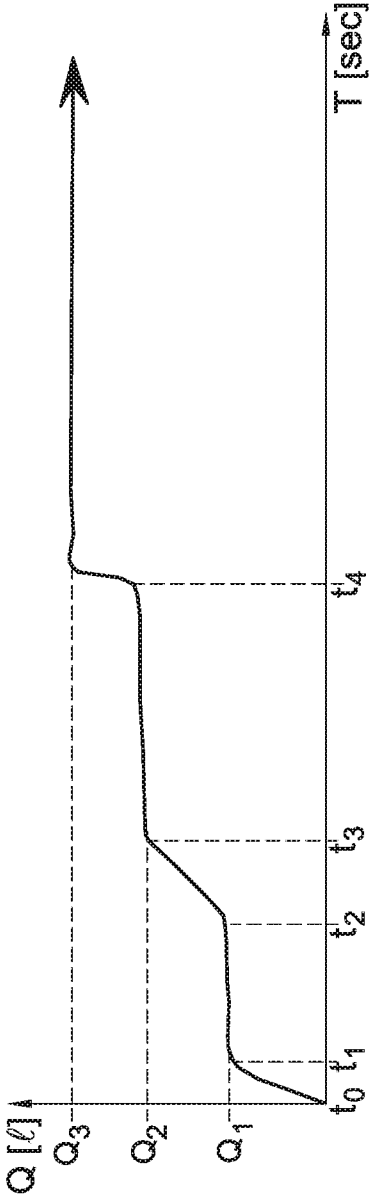


Fig. 2F

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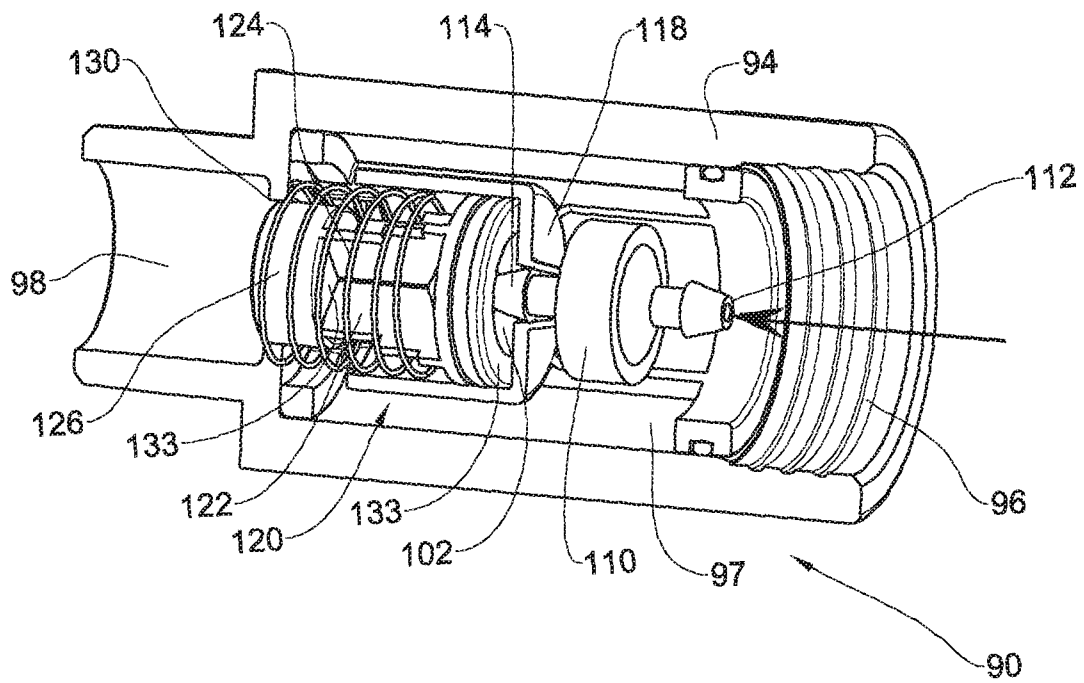


Fig. 3A

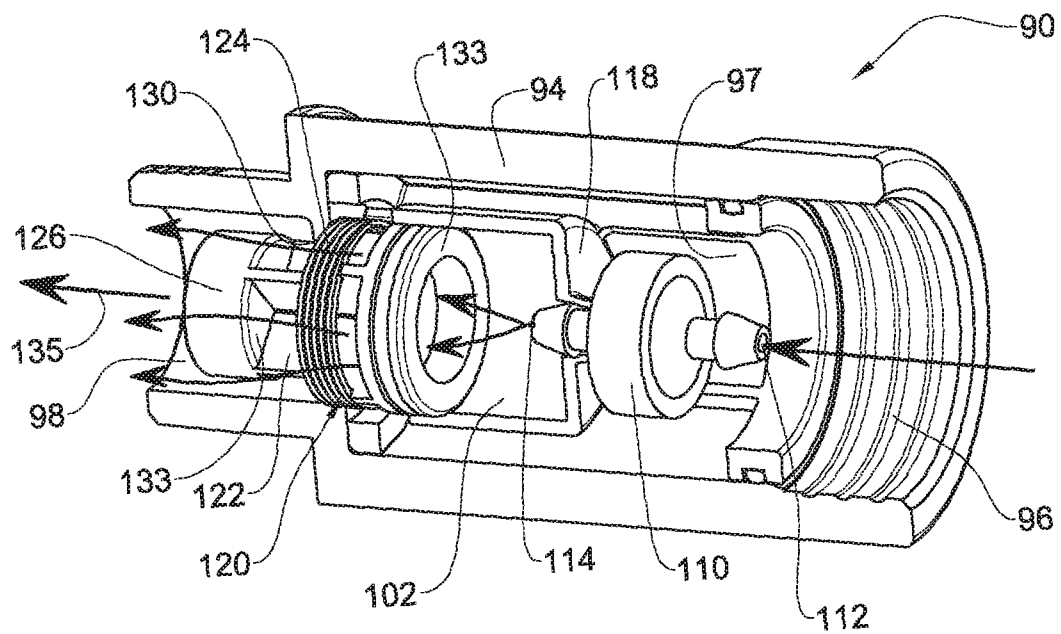


Fig. 3B

INTERNATIONAL SEARCH REPORT

International application No.

PCT/IL2015/050240

A. CLASSIFICATION OF SUBJECT MATTER See extra sheet. According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) IPC (2015.01) E03B 7/07, G01M 3/02, G01M 3/28, G01F 1/00, F01D 11/00, F01D 17/00, F01D 21/00, F16L 55/00, F16K 23/00, F16K 31/02, F16K 37/00, F17D 3/01, F17D 5/02 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) Databases consulted: PATENTSCOPE, Esp@cenet, Google Patents, PatBase Search terms used: Leak and detect* and system and (shutoff OR shut-off OR shut off OR close) and (water OR fluid) and signal and verif* and (puls* OR acoustic* OR ultrasound) and (user OR human) and valve and feedback and (closed loop control system)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6317051 B1 Jeffrey D. Cohen 13 Nov 2011 (2011/11/13) Abstract, column 4 lines 52-62, column 6, lines 35-40	1-5,8-10,12-15
Y	Abstract, column 4 lines 52-62	11
A	US 2007289635 A1 Ghazarian John D 20 Dec 2007 (2007/12/20) All document	1-18
A	US 2010313958 A1 University Of Washington 16 Dec 2010 (2010/12/16) All document	1-18
P,X	US 2014183386 A1 Aqua - Rimat Ltd. 03 Jul 2014 (2014/07/03) All document	1-18
☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 10 Jun 2015		Date of mailing of the international search report 15 Jun 2015
Name and mailing address of the ISA: Israel Patent Office Technology Park, Bldg.5, Malcha, Jerusalem, 9695101, Israel Facsimile No. 972-2-5651616		Authorized officer JOCHNOWITZ Gershon Telephone No. 972-5651775

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/IL2015/050240

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				US	2006124171	A1	15 Jun 2006
				WO	2009017512	A1	05 Feb 2009
US	2010313958	A1	16 Dec 2010	US	2010313958	A1	16 Dec 2010
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				IL	230288	D0	31 Aug 2014

INTERNATIONAL SEARCH REPORT

International application No.

PCT/IL2015/050240

A. CLASSIFICATION OF SUBJECT MATTER:

IPC (2015.01) E03B 7/07, G01M 3/02, G01M 3/28, G01F 1/00, F01D 11/00, F01D 17/00, F01D 21/00, F16L 55/00, F16K 23/00, F16K 31/02, F16K 37/00, F17D 3/01, F17D 5/02