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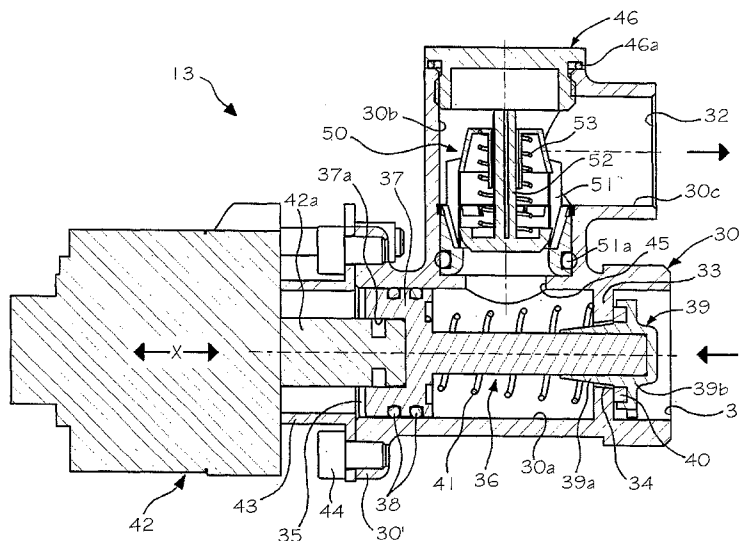
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(54) Title: SANITARY VALVE, WATER-SUPPLY DEVICE USING SAID VALVE AND SYSTEM FOR MANAGING AND DISTRIBUTING WATER WITHIN A BUILDING THAT USES SAID DEVICE



(57) Abstract: A tap comprises electrical valve means, a supply outlet for a flow of water, control means, which are operatively connected to the valve means, and means for issuing commands, which are in signal communication with the control means and can be actuated by a user in order to set the characteristics desired for the flow of water to be supplied. The valve means comprise valve devices (13) having a linear stepper actuator (42) with an actuation shaft (42a) with to-and-fro axial motion, coupled in a relationship of thrust to an open/close member (36), the latter being mounted so that it can translate linearly between two limit positions. The tap can form part of a water-distribution system.

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"Sanitary valve, water-supply device using said valve and system for managing and distributing water within a building that uses said device"

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TEXT OF THE DESCRIPTION

The present invention relates in general to sanitary valves, i.e., for systems for distributing and supplying water within buildings and systems for room heating and air conditioning. The invention has been developed with particular reference to electronically controlled taps, as well as to systems for fluid distribution within dwellings for residential use, in which said valves and taps find an advantageous application.

An electronic tap and a distribution system of the type indicated are known, for example, from the Italian patent application No. TO2003A000826 filed in the name of the present applicant.

15 The tap described in the aforesaid document uses, in order to regulate the temperature and/or flowrate of the water supplied, a pair of proportional solenoid valves, i.e., valves in which the variation of the electric current sent to the coil of a solenoid enables different positions of a corresponding movable core to be obtained. As is known, operation of said valves is of a servo-assisted or servo-controlled type, in the sense that the pressure of the liquid being controlled is exploited both to maintain the valve in the closed condition and to determine passage thereof into an open condition. Briefly, the shutter or open/close member of a proportional valve is constituted by a membrane. A peripheral portion of the membrane is fixed within a valve body having an inlet and an outlet, with a central portion of the membrane itself that operates in a fluid-tight way on a valve seat provided between said inlet and said outlet. The membrane has a series of calibrated holes and a central passage, said holes setting in fluid communication the inlet of the valve with a control chamber, delimited between the membrane itself and an internal region of the valve body, in which the movable core of the solenoid is operative, on the opposite side with respect to the valve seat. With the solenoid valve closed, the movable core occludes the central passage of the membrane, and the liquid under pressure at inlet to the valve reaches the control chamber via the calibrated holes. The higher pressure in the control chamber thus forces the membrane into the position of closing of the valve seat. When the solenoid is supplied, the movable core recedes with respect to the normal resting

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position, opening the central passage of the membrane. This enables the outlet of the valve to be brought to the same pressure as the control chamber in such a way that, under the thrust of the liquid entering the valve, the membrane can displace into a position of opening of the valve seat.

5 The present applicant has noted that said valves are distinguished by inertias of operation that can have an adverse effect on the precision of the regulation and that possible variations in the pressure of the liquid entering the valve affect the quality of operation of the system.

10 In a possible alternative implementation provided in the aforesaid document, the solenoid valves are of an ON/OFF type, with electrical supply regulated using the pulse-width-modulation (PWM) technique. In this case, the flows of hot and cold water are regulated by means of a succession of simple actions of opening and closing of the respective solenoid valves, modulating the opening time of each of them with respect to the closing time, within a given reference period. In said
15 solution, control of the system is relatively simplified with respect to the previous case. ON/OFF solenoid valves have, however, substantially the same structure as the proportional valves referred to above, and hence are affected by the same drawbacks as regards possible imprecisions of regulation, due to inertias of operation and variations of the inlet pressure.

20 Another known technique having the purpose of enabling regulation of the flowrate and/or temperature in a device or in a distribution system of the type referred to herein is described in the document No. IT-B-1 149 793. In said solution, regulation of the flow of water to each single appliance is effected by means of two sets of solenoid valves, where the inlets of the valves of one set are
25 connected to a hot-water manifold, whilst the inlets of the valves of the second set are connected to a cold-water manifold. The outlets of the valves of the two sets are, instead, connected to one and the same pipe that takes the water to the corresponding appliance. The solenoid valves of each set (for example four) have
30 different sections of passage and can be actuated individually or else in combination, to obtain a flow with the desired characteristics. If on the one hand said solution enables simplification to a certain extent of the control of the system, it involves, however, the use of numerous solenoid valves for one and the same sanitary appliance, with the corresponding costs and significant encumbrance.

35 The known solutions referred to above do not consequently enable satisfactory results to be obtained in terms of precision of regulation, particularly

in the long term. The known solutions likewise prove complicated either from the standpoint of construction or from the standpoint of management of operation of the solenoid valves.

5 In general terms, a purpose of the present invention is to provide valve device for a tap and/or a distribution system of the type referred to that enables a high precision in regulation of the temperature and/or flowrate of the liquid distributed and/or supplied to be achieved.

10 Another purpose of the invention is to provide a valve device, a tap and a system of the type referred to that is simple and economically advantageous to produce, at the same time guaranteeing a high operative reliability in the long term.

15 The above and other purposes are achieved, according to the present invention, by a valve device, a water-supply device and by a system for managing and distributing water within a building having the characteristics specified in the annexed claims. The claims form an integral part of the technical teaching provided herein in relation to the invention.

The detailed description of the invention will be supported by the annexed plate of drawings, which is provided purely by way of explanatory and non-limiting example and in which:

- 20 - Figure 1 is a general diagram of a system for the distribution of water that uses three water-supply devices built according to the present invention;
- Figure 2 is a plan view of a water-control unit used in the system of Figure 1;
- 25 - Figure 3 is a schematic cross section of an electrical valve according to the invention, which can be integrated, if need be, in the water-control unit of Figure 2;
- Figure 4 is a schematic front view of a user interface of a device according to the invention; and
- 30 - Figure 5 is a schematic cross-sectional view of the user interface of Figure 5.

Illustrated schematically in Figure 1 is a system for the distribution of water within buildings, in which the sanitary valve and the water-supply device or tap according to the invention are of advantageous application. Figure 1 refers to the supply of water to three appliances present in a bathroom, but the valve and the system are applicable to a different number of appliances, of various types, even

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located in different premises, without modifying the principle of operation described in what follows. For instance, the valve and the distribution system according to the invention can be used for thermo-sanitary appliances also differing from taps, such as radiators or fan-coils.

5 Management of the flows of water to various sanitary appliances is concentrated in a single water-control unit. Said water-control unit, designated by 1, is connected to two water pipes for supplying hot water and cold water, designated, respectively, by 2 and 3. Branching off from the water-control unit 1 is a plurality of pipes 4A, 4B, 4C, each of which is designed to supply respective
10 supply outlets A or A', B, C, installed on the respective appliances. In the case of the figures, the aforesaid appliances are a bathtub 5, a bidet 6, and a wash-basin 7. In the example, moreover, the bathtub 5 is equipped with a tap according to the invention having both a fixed supply outlet A and a shower head A'. In this installation, the water coming from the pipe 4A is directed towards the supply
15 outlet selected by the user (A or else A') via a deviation device 8, controlled by a respective control circuit. Said deviation device can be provided, for example, via systems of solenoid valves or with some other known technique.

Mounted in a position corresponding to each appliance 5, 6, 7 is a device for control of supply of the water, designated by 9, forming part of the respective tap
20 according to the invention. Each device 9 is preferably prearranged for enabling selection of the desired flowrate and temperature of the water by the user, maintenance of the desired conditions of supply, and – in the case of appliances with a number of supply outlets – selection of the supply outlet to be activated. A possible embodiment of a control device 9 will be described in what follows. It is
25 clear that, for uses that differ from the one here represented, the devices 9 could be of a different conception, for example embodied by electronic thermostats in case of the use of the valve according to the invention in a domestic heating system, wherein the appliances can be radiators or fan-cols.

The water-control unit 1, represented in Figure 2, comprises a box or
30 container 10, preferably made of plastic material and equipped with a lid (not represented). Defined in the box 10 are two distinct chambers, designated by 10a and 10b, isolated from one another. Mounted within the chamber 10a are two main manifolds 11 and 12, connected respectively to the ducts 2 and 3, with interposition of hand-controlled opening/closing taps, designated by 2a and 3a.
35 Upstream of the manifolds 2 and 3 there can be conveniently provided also

respective filters, designated by 2b, 3b. Preferably, connected to the manifold 3, with interposition of a lockshield 3c, is an auxiliary manifold 3d, having two or more outlets 3f, for supply of possible appliances that require just cold water (a washing machine, a toilet, etc.).

5 For each appliance 5, 6, 7 that is to be supplied with hot, cold, or mixed water, the water-control unit 1 comprises a pair of valve devices according to the invention, both belonging to a tap according to the invention, whose inlets are connected one to the manifold 11 and the other to the manifold 12. In Figure 2 just two of said devices are shown, designated by 13 and 14 (hot-water side and cold-
10 water side, respectively). It should be noted that, in the case exemplified in Figure 2, the water-control unit 1 comprises four pairs of valve devices 13, 14, even though in Figure 1 just three appliances are present, and hence three taps according to the invention. It may hence be assumed that the fourth pair of valve devices 13, 14 visible in Figure 2 is provided for supplying an appliance set in
15 premises different from the bathroom, for example the sink of a kitchen. Implementation of the devices 13, 14 will be described in what follows.

The outlets of each device 13, 14 are connected, by means of respective unions, to a common pipe 16, in which the possible mixing between hot and cold water is carried out. Each pipe 16 has a single intermediate outlet union 17,
20 connected to which is a flexible pipe 18, to which a respective pipe 4A, 4B, 4C is in turn designed to be connected (Figure 1) for supplying the water to the supply outlet of the tap of a respective appliance. Mounted in a position corresponding to the union 17 is a temperature sensor 19, of a type in itself known (for example a thermocouple), the values detected by which are used by the control system of the
25 tap to verify whether the condition of temperature of the water at outlet from the common pipe 16 has been reached and/or to make sure that it is maintained.

Housed in the chamber 10b of the container 10 are electronic cards 20 having the task of controlling and/or supplying the electrical/electronic components of the various valve devices and taps according to the invention.
30 Represented schematically in the non-limiting example of Figure 2 are two cards 20, each of which is responsible for management of two respective pairs of devices 13, 14. The cards 20, which can be implemented with any currently known technique and are equipped with a microcontroller and nonvolatile-memory means, are supplied at low voltage, via a power-supply unit 21, connected
35 to the electric-power mains. Operation of the system, even in the absence of mains

voltage, is guaranteed for a certain period by the presence of a standby battery 22, which can be recharged via the power-supply unit 21. The actuator means of each valve device 13, 14, as well as the control devices 9 are supplied at a low voltage, typically 13 Vac (it may be noted that, for reasons of greater clarity, in Figure 2 the representations of the electrical connections corresponding to the components 9, 13-14 and 19-22 have been omitted).

In the embodiment currently deemed preferential, the single electrical cables coming out of the box 10 are the ones that carry the supply to the control devices 9, whilst the signals that are originated in the devices 9 following upon settings effected by the user are communicated to the part 20 of the control system contained in the box 10 in wireless mode, via a technology in itself known. Of course, alternatively, there is nothing to rule out providing cables for conveying control signals between the devices 9 and the box 10, or else exploiting the same supply cables for conveying signals, via *power-line* techniques.

The control device 9 of each tap is installed in the vicinity of the respective appliance and comprises a user interface and a control circuit, preferably a microprocessor control circuit having nonvolatile-memory means, supplied thanks to a card 20 situated in the box 10. Said user interface is provided for enabling selection of the desired conditions of temperature and/or flowrate of the water, as well as selection of the outlet to be activated, in the case of taps equipped with a number of supply outlets. The circuit referred to, which may also be made with technology in itself known, is substantially prearranged for translating into control signals the manual settings made by the user on the interface, and communicating them to the part 20 of the control system located in the box 10. In the preferred case of wireless communication, of course, the circuit of the device 9 comprises transmitting means, and the control part 20 installed in the box 10 comprises receiving means. In the case where the intention is to implement an exchange of signals between the aforesaid parts of the control system of the device 9 and the water-control unit 1 will both be equipped with means for transmitting and receiving signals.

In the given example, the part 20 of the control system is responsible for issuing commands to the devices 13 and 14 so as to obtain in the respective pipe 4A-4C a flow having a flowrate and temperature corresponding to the ones selected on the corresponding control device 9. As mentioned previously, for this purpose, the control system 20 uses, when necessary, also the information detected

by the temperature sensor 19 concerned.

Illustrated in Figure 3 with a schematic cross-sectional view is a valve device 13 according to the invention, where it is taken for granted that the device 14 is of similar construction.

5 As will emerge from what follows, according to the main aspect of the invention, the device 13, 14 comprises a linear stepper actuator having an actuation shaft with alternative axial motion (to-and-fro), the shaft being operatively coupled at least in a thrust relationship to an open/close member, the latter being mounted so that it can translate linearly in a respective valve body
10 between two limit positions.

The device 13 comprises a valve body 30, for example made of brass, defined within which is a duct having an inlet 31 and an outlet 32. Set between the inlet and the outlet is a valve seat, which comprises a transverse wall 33 of the internal duct, or diaphragm, in which a port 34 is formed for passage of the water.
15 In the case exemplified, the port 34 is shaped like a truncated cone, with the end of larger diameter facing the inlet 31.

The diaphragm 33 is formed in a first axially extensive portion of duct 30a, having an open end 35, which, in the case exemplified, is opposite and coaxial to the inlet 31. In said first duct portion 30a, which develops downstream of the diaphragm 33 (with reference to the direction of the fluid), is slidably mounted an
20 open/close member or shutter, designated as a whole by 36.

The shutter 36 has a respective rigid main body, for example made of brass, which extends in the aforesaid duct portion 30a, coaxially thereto. The body of the open/close member has a first substantially cylindrical flange-shaped end,
25 designated by 37. Formed in the circumferential wall of the flange 37 are seats for gaskets 38, preferably of an O-ring type, designed to exert a radial seal with respect to the internal surface of the duct portion 30a. The length of the open/close member 36 is such that, even in the condition illustrated where the device 13 is closed, a part of its body passes through the port 34, coaxially thereto. The second
30 end of the body of the open/close member, opposite to the flange 37, hence projects beyond the port 34, in a region of the duct portion 30a that is upstream of the diaphragm 33. It may be noted that the gaskets 38 could possibly be housed in grooves of the body 30. In an alternative embodiment (not represented), one or more gaskets having the same function as the gaskets 38, but of smaller diameter,
35 are associated to the shaft 42a instead of to the open/close member 36. In this

variant, mounted in a position corresponding to the opening 35 of the duct portion 30a is a seal plug, having an axially extensive central passage, in which a portion of the shaft 42a is inserted so that it passes through. Formed on said portion of the shaft are grooves that house the aforesaid gaskets, which thus ensure radial sealing with respect to the axial passage of the plug (of course, the length of the passage and the position of the gaskets on the shaft 42a are a function of the travel allowed for the shaft itself). In this variant then, the shaft is longer than the one represented in Figure 3, and its leading end projects directly into the duct portion 30a so as to push the open/close member 36. In this embodiment, the body of the open/close member 36 can be without the flange part 37 and the corresponding seat 37a.

Fixed on the second end of the body of the open/close member 36 is a hollow sealing and adjustment head 39, having a portion with an external shape like a truncated cone 39a and a flange portion 39b. The head 39 can be made of brass or plastic material and can be fixed to the main body of the open/close member via a threaded coupling.

The cavity of the head 39 receives a terminal part of the body of the open/close member 36, with the portion shaped like a truncated cone 39a that extends through the port 34, coaxially thereto. As will emerge clearly from what follows, the portion shaped like a truncated cone 39a is movable through the port 34, according to the displacements of the open/close member 36 in order to enable regulation of the flow of water. The dimensions of the portion 39a and of the port 34 are preferably such that, in any position of opening of the open/close member 36 (or even in the closed condition, as illustrated in the figures), an interstice is in any case present between them.

In the flange portion 39b, which in any position of the open/close member 36 is located upstream of the diaphragm 33, there is defined a housing for a front-seal gasket 40. Said gasket 40 is designed to operate in a fluid-tight way on the valve seat, and in particular on the surface of the diaphragm 33 facing upstream, towards the inlet 31 of the body 30. The gasket 40, of an annular shape, exerts its own front sealing action on the region of the respective surface of the diaphragm that surrounds the port 34. In the case exemplified, the gasket 40 has a quadrangular cross section. The gasket 40 can be directly overmoulded on the head 39, when the latter is made of plastic material.

In the embodiment currently deemed preferential, the valve device 13 comprises at least one elastic means that forces the open/close member 36 into a

predetermined position. In the example illustrated, said elastic means is represented by a helical spring 41, which forces the open/close member 36 towards the respective position of closing, in which the gasket 40 performs the aforesaid front sealing action with respect to the diaphragm 33. The spring 41, which is a volute spring, extends axially within the duct portion 30a, coaxially to the open/close member 36, and has the respective end of smaller diameter resting on the flange 37 - which is preferably equipped with a suitably designed seat, as may be seen in the figure - whilst its end of larger diameter rests upon the surface of the diaphragm 33 facing downstream with respect to the inlet 31.

In a position corresponding to the opening 35 of the duct portion 30a, the valve body 30 has a respective flange part 30', anchored to which is a reversible actuator of the valve device 13, designated by 42. The actuator 42 is mounted by means of a respective intermediate flange 43, fixed to the flange part 30' of the valve body 30, for example via screws 44. The aforesaid intermediate flange 43 also fulfils the function of providing a mechanical end-of-travel aimed at preventing any risk of the open/close member 36 sliding out of the duct portion 30a.

In the preferred embodiment, the actuator 42 is constituted by a linear electric stepper motor, particularly of the lead-screw type (lead-screw linear stepping motor). The modalities of construction and control of motors of this type are known and do not call for any detailed description herein. It will here suffice to recall (see, for example, for reference the document No. JP-A-6081925) that the structure of said motors comprises a stator and a rotor. The rotor comprises a lead screw, operatively coupled to a surface thread of an actuation shaft, the latter being constrained in the body of the motor so as not to be able to rotate (for example, via a grooved or splined axial coupling between the shaft and a corresponding guide, or else via a radial pin of the shaft engaged in an axial guide of the body of the motor). With said arrangement, the angular movement of the rotor determines a linear displacement of the actuation shaft. Counting of the steps is effected electronically by the control system of the motor.

Motors of the type referred to, currently used for applications different from that of the present invention, present the advantage of having contained dimensions, for example with maximum axial encumbrance (shaft retracted) and lateral encumbrance (flange area) of approximately 5.5 x 5.5 cm, as well as enabling useful travels of the corresponding shaft that are suitable for the

application proposed herein, for example of approximately 1.5 cm. Notwithstanding the contained dimensions, moreover, said linear motors enable development of forces of thrust (up to 100 N) and of maintenance (up to 150 N) more than sufficient for obtaining the desired positioning of the open/close member 36 in contrast to the pressure of the water in the inlet of the valve body 30 (typically of approximately 3 bar).

A linear motor substantially having the aforesaid characteristics is the one distinguished by the code No. PL35L-024-XGD6 of Minebea – Matsushita Motor Corporation, currently used for adjustment of the optical axis of headlights of motor vehicles (the reader is referred to the descriptive documentation of said product for further details on its characteristics and modalities of driving/control). Said motor, tested by the present applicant, has proven suitable for the application proposed herein, guaranteeing proper operation of the valve devices 13, 14 even in the most unfavourable conditions envisaged by the standards currently in force (water pressure at 5 bar).

The motor 42 is represented just schematically in Figure 3, with the corresponding pin or actuation shaft 42a linearly movable in a predefined direction, for performing controllable stepping travels in two opposite directions, as indicated by the arrow X.

In the embodiment currently deemed preferential, the shaft 42a and the open/close member 36 are coupled to one another just in a relationship of thrust, i.e., they are not fixed to one another. For this reason, during its travels of advance (towards the right, as viewed in Figure 3), the shaft 42a pushes the open/close member 36 in order to open the port 34, whilst, during its travels of recession (towards the left, as viewed in Figure 3), the shaft 42a does not exert any pulling action on the open/close member 36, return of the latter towards the position of closing of the port 34 being caused by the spring 41. In the phases of closing of the port 34, the receding shaft 42a basically fulfils the function of preventing sudden movements of the open/close member towards the closing condition.

The above type of coupling prevents the risk of the open/close member 36 exerting radial stresses on the shaft 42a, which could have an adverse effect on operation of the motor 42, above all in the long term. The coupling proposed is not moreover affected by any possible play between the parts and is thus simplified, guaranteeing in any case the necessary precision of operation of the system. It is pointed out on the other hand that, according to possible variant

embodiments, the shaft and the open/close member can be coupled either in a relationship of thrust and in a relationship of pulling action. In said variants, the shaft 42a is fixed to the open/close member 36, either directly or with interposition of suitable connection/transmission means, so as to operate by exerting a pushing and a pulling action on the open/close member itself. The use of an elastic means that forces the open/close member into a respective limit position is hence not strictly necessary in such cases.

In the example represented in the figure, coupling just in a thrust relationship provides for an axial seat or cavity 37a in the flange 37 of the open/close member 36, freely inserted in which is an end part of the shaft 42a of the motor 42. Preferably, the shapes of the sections of the seat 37a and of the corresponding part of shaft 42a are substantially complementary, but without any interference between the parts. Said embodiment appears preferable in so far as it guarantees the substantial coaxiality between the shaft 42a and the open/close member 36, but it is clear that the type of coupling in a thrust relationship could differ from what is exemplified herein (for example, with an arrangement substantially opposite to the one illustrated, with the shaft 42 provided with a head formed in which is at least one seat that receives freely at least one pin projecting axially from the flange 37, or again with the shaft 42 that pushes simply on one end of a flange 37 without any seat 37a, etc.).

Starting from the closed condition illustrated in Figure 3, actuation of the motor 42 determines linear translation of the shaft 42a, and hence advance of the open/close member 36. Following upon the movement, the gasket 40 moves away from the diaphragm 33, enabling the water to start to flow through the interstice existing between the portion 39a of the head 39 and the peripheral surface of the port 34. The displacement of the part 39a with respect to the port 34 causes – given the truncated-cone shapes of the two elements – a variation in the section of passage represented by the aforesaid interstice, and hence a variation in the flowrate of water admitted to the duct portion 30a. The shape of a truncated cone enables also an effect of self-centring between the port 34 and the corresponding head 39 to be guaranteed.

According to a further preferred characteristic of the invention, downstream of the open/close member 36 and of the corresponding duct portion 30a a non-return valve is operative, which, in the non-limiting example illustrated, is mounted directly in the valve body 30.

For the above purpose, in an intermediate region of the peripheral wall of the duct portion 30a a passage 45 is formed, in communication with a second portion 30b of the duct inside the body 30. Housed in the duct portion 30b, substantially orthogonal to the portion 30a, is the aforesaid non-return valve, designated as a whole by 50. Departing orthogonally from the duct portion 30b is a further duct portion 30c, substantially parallel to the first portion 30a, which forms the outlet 32 of the valve body 30.

The non-return valve 50 can be of any known type. In the schematic example provided, said valve has a respective supporting and guide body 51, which is formed by one or more assembled parts and is mounted in a fixed position within the duct portion 30a. The body 51 is preferably equipped with an annular gasket 51a, operating in a fluid-tight way with respect to the internal surface of the duct portion 30a. Mounted and slidably guided on the body 51 is an open/close member 52, which is forced by a helical spring 53 into a respective closing position. Advantageously, the end of the duct portion 30b opposite to the passage 45 is closed via a removable plug 46, equipped with respective seal means 46a. The presence of the plug 46 enables simple and fast assembly of the valve 50 inside the valve body 30, as well as its inspection. As in the case of the known art, the pressure of a flow that traverses the passage 45 causes raising of the open/close member 52, overcoming the reaction of the spring 53, thus enabling flow of the water into the duct portion 30b and from here to the outlet 32. Instead, a possible pressure of water entering from the outlet 32 tends to press the open/close member 52 into the respective closing position, preventing reflux of water towards the duct portion 30a.

In the exemplified use, the valve 50 fulfils precisely the function of preventing any possible reflux of water in the area in which the open/close member 36 operates, which could jeopardize the quality of the regulations made by the pairs of valve devices 13 and 14.

As explained previously, the inlets 31 of the valve devices 13, 14 are connected to the two supply manifolds 11 and 12, whilst the corresponding outlets 32 are connected to the common pipe 16. Any possible unbalancing of pressure between the two manifolds 11 and 12 could cause a reflux towards the manifold at lower pressure, and hence up to duct portion 30a in which the corresponding open/close member 36 operates, thus preventing, for example, proper mixing between hot and cold water. The non-return valve 50 prevents precisely said

possible drawback, guaranteeing a satisfactory operation of the pair of devices 13 and 14 even in the case of any unbalancing of pressure between the supply manifolds.

5 The working principle of the valve and the tap according to the invention, is the one described in what follows.

When the user makes a selection via the user interface of the device 9, the corresponding control circuit translates the choice made into control signals and communicates it to the corresponding card 20 located in the box 10. The control card 20 consequently enables supply of the water at the temperature and flowrate
10 specified by the selection made by the user, controlling the devices 13 and 14 concerned, to cause flows of hot and cold water, which are a function of the choice made by the user, to reach the respective common pipe 16 in appropriate proportions (obviously, in the case of request for just hot water or just cold water only the device 13 or else the device 14 will be actuated).

15 Counting of the steps of the motor 42 of each device 13, 14, carried out by the respective control electronics starting from the so-called "point zero" of the motor itself, enables the open/close member 36 to be brought each time into a precise position with respect to the port 34, to which there corresponds a given flowrate of water through the interstice existing between the port itself and the
20 portion 39a of the head 39. As the number of steps corresponding to a programmed position is reached, the motor 42 is stopped by the control system 20, with the shaft 42a that maintains the open/close member 36 in position, countering the elastic reaction of the spring 41. At the moment of closing, or in the case where a command is issued for a decrease in the flowrate required of a device 13,
25 14, the motor 42 is actuated in a direction opposite to the previous one, with the shaft 42a that recedes and the spring 41 that pushes the open/close member 36 towards the closing position or the position of lower programmed flowrate.

The information detected via the temperature sensor 16 is used by the control system 20 to check that the desired temperature condition is reached and to
30 make sure that it is maintained. In the case where the value detected by the sensor 16 does not correspond to the desired one, the system 20 modifies, via a control loop, opening of the devices 13 and 14, until the selected condition is reached.

The logic for control of the motor 42, in terms of correspondence between the number of steps and the flowrate for each device 13, 14, and of
35 correspondence between the flowrate for each device 13, 14 and the temperature

of the mixed water, is implemented in the control system 20 by any technique known for the purpose, such as, for example, via look-up tables, fuzzy logic, etc. (by way of indication, in the motor PL35L-024--XGD6 tested by the present applicant, corresponding to each revolution of the shaft are 15 steps of approximately 0.0166 mm each of linear travel of the shaft, and hence
5 approximately 0.249 mm of travel at each revolution).

The stepper motors of the type indicated herein are typically built to guarantee a certain force of thrust at a given nominal supply voltage to be obtained, but are capable of functioning also at lower supply voltages, generating
10 lower forces of thrust. In the embodiment proposed, a minimum voltage is preferably established, lower than the nominal one, at which the motor must in any case guarantee the force necessary for opening the device 13, 14, in due consideration of the fact that the system must occasionally be able to function properly for a certain period even when supplied via the battery 22. With reference
15 to the specific stepper motor identified above, the preferred rated supply voltage of which is 13 V, the aforesaid minimum voltage can be, for example, 10.5 V. Given that the voltage supplied by the battery 22 decreases following upon its use, at 10.5 V the battery is hence considered run down by the control system 20, which will interrupt supply possibly in progress and will prevent any further
20 opening of the devices 13, 14.

Precise operation of the valve devices 13, 14 depends to a certain extent upon the aforesaid "point zero" of the motor 42, i.e., the point from which the motor effectively starts displacing the open/close member 36 and hence setting off opening of the port 34. As explained above, it is from point zero that the control
25 logic of the motor 42 starts counting the steps effectively necessary for carrying out the regulations for opening and/or closing.

In a preferred embodiment of the invention, the search for point zero is carried out exploiting the possibility of varying the driving voltage of the motor, via a control routine implemented in the software that manages operation of the
30 devices 13, 14.

The valve device 13, 14 illustrated in Figure 3 is a reverse-flow device, i.e., the open/close member 36 is normally closed thanks to the presence of the spring 41, which counters opening thereof. In order to enable passage of water from the port 34, it is thus necessary to overcome the elastic reaction of the spring 41,
35 causing a thrust on the open/close member 36 via the shaft 42a. The force

necessary to bring about opening will be lower when the valve is closed and will increase as opening proceeds, on account of the gradual compression of the spring 41.

When the motor 42 is installed, not always is the exact position between the parts guaranteed, on account of possible tolerances, for example in the length of the shaft and/or of the open/close member, or of the anchorage flange. For example, if, following upon installation, the end of the shaft 42a and the bottom of the corresponding seat 37a were to be spaced apart from one another by a few millimetres in the position of device closed, at the moment of regulation of the flowrate there would be numerous ineffective steps of the motor 42, and the precision in the regulation itself would not be the expected one. For said purpose, in an advantageous embodiment, in the control program of the motor 42 the aforesaid calibration routine for identification of point zero is provided.

Said routine is prearranged for issuing commands to the power supply of the motor 42 at a voltage decidedly lower than the rated one, for example 20-30% thereof. In this way, the motor 42, albeit enabling a linear displacement of the corresponding shaft 42a to be obtained, does not have sufficient force to overcome the elastic reaction of the spring 41. On the basis of said consideration, the motor 42 is thus controlled at a reduced voltage, until a certain number of steps is reached to which, in nominal operating conditions, there would correspond a certain travel of the shaft, said "theoretical" travel being certainly greater than the hypothetical distance between the shaft and the open/close member due to the tolerances. For example, if, on account of the tolerances, it is known that the maximum distance of play between the shaft and the open/close member is on average of approximately 3 mm, the motor 42 is made to perform a predefined number of steps to which there would normally correspond a travel of 5 mm of the shaft. In this way, when the point of contact between the shaft 42 and the bottom of the seat 37a is effectively reached (certainly in advance with respect to the aforesaid predefined number of steps), the motor 42 encounters the resistance of the spring 41 and of the pressure of the water that impinges upon the head 39 of the open/close member. Starting from said point, on account of the low force of thrust of the shaft 42a due to supply at a reduced voltage, the shaft no longer manages to advance, and the motor 42 loses the superfluous steps. In practice, counting of the steps, which is carried out electronically, proceeds in any case until the aforesaid predefined number of steps is reached, but without the shaft

advancing any further.

In this way, point zero is identified. From this point on, the possible subsequent steps controlled by driving of the motor at its rated voltage, and hence with normal force, will cause opening of the valve device 13, 14.

5 In order to store the position of point zero two solutions are possible.

In a first solution, after point zero has been reached as explained above, the routine issues a command for a rotation of the motor 42 in a direction opposite to the previous one, by supplying the motor at a rated voltage such as to cause recession of the shaft 42a until the position of "shaft-in", i.e., of completely retracted shaft, is reached (it may be noted that the motor is equipped with an internal end-of-travel). In said phase, the number of steps used for passing from point zero to the shaft-in position is counted, and said number is stored in the control program of the motor 42. In this way, there is in practice identified the number of "filling-in" steps necessary for passing, that is, from the position of shaft-in to the position of point zero. In the event of subsequent regulations of the flowrate that must be carried out via the device 13 or 14, the control system will then know that, starting from the shaft-in position, the motor 42 will have partially performed a certain number of filling-in steps (for example, if the system knows that to reach the flowrate "x" the shaft must perform 100 useful steps starting from point zero, and the number of filling-in steps stored is equal to 55, the system itself will stop the movement of advance of the shaft 42 when the number of 155 steps counted starting from the shaft-in position is reached).

In a second possible embodiment, the aforesaid routine is prearranged for modifying at least one parameter of the control program of the motor, in order that the position corresponding to point zero – identified as explained above – will be assumed as position of minimum of the shaft 42a. In practice, at the end of execution of the routine, the point zero is stored in the system as "step zero", i.e., as resting position of the shaft, in which the device 13, 14 is closed. For the purposes of the subsequent normal actuations, the control system will hence count just the steps effected starting from said step zero to control advance of the shaft 41a. The movement of maximum recession of the shaft 42a, in the course of the normal actuations, will be interrupted once the aforesaid step zero is reached.

The parameters stored and/or modified via the aforesaid routine remain valid up to a new execution of the routine itself, the initial step of which always envisages the search for the (new) point zero. For the purposes of said search, the

routine will preliminarily issue a command to the motor in order to bring the shaft into the shaft-in position. This will be followed by supply at a reduced voltage for the aforesaid predefined number of steps aimed at identifying point zero, as explained above.

5 The process of self-calibration described above involves an actuation of the motor 42 in conditions of load, at least in the phase of identification of point zero. Even though the motor is perfectly able to withstand the temporary stresses that intervene in said phase, the frequency of execution of the self-calibration routine is preferably reduced. The process can in any case be performed not just at the
10 moment of installation of the valve device 13, 14, but also periodically, to recover any possible play that may arise during normal operation. For said purpose, then, the control system can be conveniently programmed for issuing commands in an autonomous way to the aforesaid routine after a certain number of actuations of the device 13, 14 (for example, every 100 actuations), preferably in idle times. The
15 control system 20 could possibly provides for a suitable pushbutton for issuing a command for execution of the routine.

 The principle of self-calibration set forth above can be also used for identifying the point of closing of the section of passage of the water in the case of a valve device with operation opposite to the previous one, i.e., in which the shaft
20 42a maintains a linear open/close member in a closed position, where in said position a gasket of the open/close member bears upon a valve seat in order to bring about closing of the port for passage of the water (as in the case of a traditional screw valve). In this case, the system formed by the open/close member and the gasket is certainly brought into a bearing condition with modalities similar
25 the previous ones (supply at a reduced voltage for an “excessive” number of steps, with loss of some of said steps after the closing position has been reached), thus identifying the closing point. In this variant, the operations of calibration are preferably to be carried out with the water system empty, evaluating the voltage to be applied to the motor 42 so as to have a force sufficient to obtain the right
30 compression of the seal gasket of the open/close member. In the case where a spring is used to ensure sealing, the system is in a condition similar to that of the first case described above.

 In a possible embodiment, the devices 9 are made using the technology of so-called “touch screens” of a capacitive type. Said technology envisages that any
35 dielectric material (ceramic, glass, plastic, wood, stone, etc.) can become a touch-

sensitive element, thanks to the insertion of appropriate sensors. In this way, it is possible to provide, for example, a touch screen having a plate made of glass or other transparent material, behind which the aforesaid sensors are applied. A proper arrangement of the sensors guarantees the presence of a number of "keys" necessary for selection of all the functions envisaged, according to the principle set forth above. This type of implementation can be conveniently used also for transforming a small area of a mirror (rendered transparent) into a sensitive area, using it as touch screen behind which to position the control device 9.

In said embodiment a touch screen is provided made up of a thin board made of plastic provided, via positioning of the capacitive sensors, with some keys for guaranteeing the main functions (for example, increase and decrease of temperature and flowrate, choice of supply outlet, etc.). Display of the conditions selected is made via combinations of light emitters, turning-on and/or colouring of which indicates the values of temperature and flowrate selected or the other functions chosen.

An embodiment of the type described above is exemplified in Figure 4, highlighted in which is a possible schematic representation of the front part of the aforesaid board, designated by 60. The keys, designated by 61a and 61b, each formed by a respective capacitive sensor, are designed to enable increase and decrease of the supply temperature, whilst the keys 62a and 62b, also formed by capacitive sensors, perform the same functions in regard to the flowrate of the water supplied, between a minimum value and a maximum value (corresponding, respectively, to closed tap and supply at the maximum flowrate allowed). Said keys, obtained by positioning the corresponding capacitive sensors on the rear surface of the board 60, can be altogether transparent to view, and their presence can be indicated by LEDs in corresponding positions, set underneath the board 30 and the sensors.

In the space comprised between the keys 61a and 61b, in the part set underneath the board 60 and the sensors, LEDs are provided, which indicate, by turning on, the temperature selected from amongst the values available. Said indication is displayed via lighting-up of boxes 63 that extend between the keys 61a and 61b and that indicate intuitively the value of temperature selected. The aforesaid LEDs or boxes can have a colouring that varies from blue to red, in order to highlight more intuitively the value of temperature selected. Likewise, between the keys 62a and 62b, in the part set underneath the board 60 and the

sensors, there are associated LEDs for lighting up boxes 64 that indicate the value of flowrate selected from amongst the ones available. The boxes 33, 34 could possibly be replaced by a single box extending longitudinally between the respective regulation keys.

5 Shown in Figure 5 is a purely indicative cross section of parts of a control device 9 that integrates the board 60 of Figure 4, on the surface of which silk-screen prints or else parts in relief SE are provided, indicating the positions of the keys 61a-61b, 62a-62b and of the boxes 62, 63. LE' designates the LEDs used for highlighting the regulation keys, and LE'' designates the LEDs for highlighting the
10 selections made, positioned underneath the board 60. The capacitive sensors, designated by SC, and the LEDs are connected to the control circuit of the device 9, here designated as a whole by CC. As has been said, the capacitive sensors SC are made using, and operate according to, any known technique, for example the one described in the document No. US 6 452 514, the contents of which in this
15 connection are to be considered incorporated herein. Of course the part of selection/display or interface of the device represented in Figures 4 and 5 is purely indicative, in so far as it could be made according to numerous other variants. If so desired, of course, other keys may be provided, for example for starting and stopping supply, or else for selection of a desired supply outlet, in the case of
20 appliances such as the shower 5 of Figure 1.

 In the above description, the invention has been described with reference to a system for water distribution and management. The invention is in any case clearly adaptable also to just one sanitary appliance, with modalities similar to the ones described in the Italian patent application filed in the name of the present
25 applicant referred to above. In this case, a box can, for example, be provided of dimensions decidedly contained with respect to the box 10, which contains just one device 13 and just one device 14, connected to respective pipes for supplying hot and cold water, and to a common pipe 16 equipped with the temperature sensor 19. The aforesaid box envisages in this case just one outlet pipe, which
30 terminates in the supply outlet concerned or in the device 8 of Figure 1. Moreover present within the box, which may be wall-mounted in the vicinity of the sanitary appliance or directly thereon, is a corresponding supply and control card, with possible power supply 21 and standby battery 22.

 Clearly, for hydro-sanitary or thermo-sanitary applications in which only a
35 flow or flow-rate adjustment is required, it will be sufficient a single valve device

according to the invention.

Practical tests conducted by the present applicant have made it possible to ascertain that the valve device, tap and the system described enable the purposes set forth to be effectively achieved, guaranteeing a high precision in the regulations of temperature and/or flowrate of the water supplied in an extremely wide range of conditions of use, this being achieved with simple and economically advantageous means.

It is clear that numerous variants are possible to the system described by way of example, without thereby departing from the scope of the invention.

10 In a possible variant, the user interface of the device 9 is made in such a way that, to a single operation of setting by a user there will correspond generation of two variables or values for control of the desired flow of water, and in particular the flowrate and the temperature. An example of said embodiment is described, for instance, in the aforesaid Italian patent application filed in the name of the present applicant.

15 In an advantageous embodiment, the supply manifolds 11 and 12 are provided, at their ends opposite to the water pipes 2 and 3, with respective devices, designated by 70 and 71 in Figure 2, designed to prevent any possible water hammers, and the consequent risks of damage for the valve devices 13, 14 and the possible filters 2b, 3b. Said devices 70, 71 can each, for example, comprise a membrane that gives out onto the internal duct of the respective manifold, said membrane being countered by a helical spring.

20 In a possible implementation, the cables that connect the box 10 to the device 9 of a respective appliance can be integrated or associated to the pipe designed to carry the water to the same appliance. For said purpose appropriate ducts can be provided, formed by an outer sheath and within which are already inserted both the water pipe and the electrical cable or cables, or else mechanical components can be used, such as clips made of plastic material, which will enable fixing of the electrical cable or cables to the water pipe.

CLAIMS

1. A sanitary valve device, comprising:
- a valve body (30) having an inlet (31), an outlet (32) and a valve seat (33, 34) in a position intermediate between said inlet and outlet (31, 32);
 - 5 - an open/close member (36) co-operating with the valve seat (33, 34) and mounted in the valve body (30) for being displaceable at least between two limit positions with respect to the valve seat (33, 34), namely between a position of closing and a position of maximum opening; and
 - an electrically supplied actuator (40),
- 10 wherein the actuator can be controlled via control means (20) for causing displacement of the open/close member (36) and enabling the open/close member itself to assume and maintain a plurality of positions intermediate between said limit positions,
- characterized in that the actuator is a linear stepper actuator (42) having an
- 15 actuation shaft (42a) with alternative axial motion, the shaft being operatively coupled in a relationship of thrust to the open/close member (36), the latter being mounted to translate linearly in the valve body (30) between said limit positions.
2. The device according to Claim 1, further comprising an elastic member (41) mounted in the valve body (30) and operative for forcing the open/close
- 20 member (36) into one of said limit positions, namely a closed position, the actuation shaft (42a) being operative for pushing the open/close member (36) towards the other of said limit positions, namely a position of maximum opening.
3. The device according to Claim 2, wherein the actuation shaft (42a) is operatively coupled in just a relationship of thrust to the open/close member (36).
- 25 4. The device according to one or more of the preceding claims, wherein the actuator comprises an electric lead-screw linear stepper motor (42), i.e., a motor having a stator, a rotor, means for converting an angular movement of the rotor into an axial movement of the actuation shaft (42a), and means for constraining the actuation shaft (42a) to axial movement.
- 30 5. The device according to one or more of the preceding claims, further comprising at least one non-return valve (50) mounted downstream of the valve seat (33, 34).
6. The device according to one or more of Claims 1 to 5, wherein at least one of the actuation shaft (42a) and the open/close member (36) has seal means
- 35 (38, 40) or else co-operates with seal means in a fixed position.

7. The device according to Claim 6, wherein the seal means (38, 40) comprise a front-seal gasket (40) of the open/close member (36), which is able to co-operate with the valve seat (33, 34).

8. The device according to Claim 6, wherein the seal means (38, 40) comprise:

- one or more radial-seal gaskets (38), particularly of an O-ring type, which is/are carried by the open/close member (36) and is/are able to co-operate with a peripheral surface of a first axially extended duct portion (30a) formed in the valve body (30), in which the open/close member is linearly movable; and/or

- one or more radial-seal gaskets, particularly of an O-ring type, which is/are carried by the actuation shaft (42a) and is/are able to co-operate with a surface of an axial passage formed in an closing element of an axially extended duct portion (30a) formed in the valve body (30), in which the open/close member (36) is linearly movable.

9. The device according to one or more of Claims 1 to 5, wherein the open/close member (36) is axially extended and is movable in a first axially extended duct portion (30a) formed in the valve body (30), the first duct portion (30a) being open at an end (35) opposite to the valve seat (33, 34).

10 The device according to Claims 6 and 9, wherein the open/close member (36) has a body having:

- a first end part (37), designed to couple with the actuation shaft (42a), having at least one radial-seal gasket (38); and

- a second end part, to which at least one front-seal gasket (40) is associated.

11. The device according to one or more of Claims 1 to 5, wherein the valve seat (33, 34) comprises a transverse wall (33) of an axially extended duct portion in which the open/close member (36) is mounted movable, in said wall (33) there being formed a port (34).

12. The device according to Claim 11, wherein the open/close member (36) extends at least in part through the port (34) and is at least in part movable through the latter.

13. The device according to Claim 11, wherein the port (34) has a section substantially shaped like a truncated cone.

14. The device according to Claims 12 and 13, wherein the open/close member (36) has a part substantially configured like a truncated cone, which is

able to be received in the port (34).

15. The device according to Claim 12, wherein the open/close member (36) has a front-seal gasket (40) adapted to co-operate with a surface of said wall (33) facing the inlet (31) of the valve body (30).

5 16. The device according to Claim 14, wherein said part belongs to a removable component of the open/close member (36), defining a positioning seat for a front-seal gasket (40).

10 17. The device according to Claims 3 and 11, wherein the elastic element comprises a helical spring (41) substantially coaxial to the open/close member (36), the spring (41) having an end resting on a flange part (37) of the open/close member (36) and the opposite end resting on said wall (33).

18. The device according to Claim 10, wherein formed in said first end part (37) is an axial cavity (37a), in which a respective end part of the actuation shaft (42a) is freely inserted.

15 19. The device according to one or more of Claims 1 to 5, wherein the actuator (42) is fixed to the valve body (30) via a connection flange (43), the latter also forming a mechanical end-of-travel for the open/close member (36).

20 20. The device according to Claims 5 and 9, wherein formed in an intermediate region of a peripheral wall of the first duct portion (30a) is a passage (45) in communication with a second axially extended duct portion (30b), in which the non-return valve (50) is mounted, the second duct portion (30b) being substantially orthogonal to the first duct portion (30a) and extending upstream of said outlet (32).

25 21. The device according to Claim 20, wherein the second duct portion (30b) is closed by a plug (46) at the respective end opposite to said passage (45).

22. The device according to at least one of Claims 1 to 5, further comprising temperature-sensor means (19) in signal communication with the control means (20).

30 23. The device according to one or more of Claims 1 to 5, further comprising manual selection means (9) in signal communication with the control means (20).

24. The device according to Claim 23, wherein the selection means (9) are in signal communication with the control means (20) in wireless mode.

35 25. The device according to Claim 3, wherein the control means (20) are pre-arranged for executing a procedure of calibration, aimed at identification of

the exact point starting from which the actuation shaft (42a) starts to displace the open/close member (36).

26. The device according to Claim 25, wherein said procedure comprises at least the step of supplying the actuator (42) at a voltage lower than a rated voltage, for a predefined number of steps.

27. The device according to Claim 26, wherein said procedure further comprises the step of storing at least a piece of information representing the position reached by the actuation shaft (42a) at the end of said predefined number of steps, said information being subsequently used by the control means (20) in the course of normal actuations of the actuator (42) during flowrate and/or temperature adjustments.

28. The device according to Claim 30, wherein the control means (20) are pre-arranged for carrying out said procedure periodically.

29. The device according to Claim 1, wherein the actuating shaft (42a) is operatively coupled either in a relationship of thrust and in a relationship of pulling action with the open/close member (36).

30. The device according to one or more of the preceding Claims characterized in that it is part of at least one of a tap system, a system for water distribution within buildings, a room heating and/or air conditioning system.

31. A water-supply device for a sanitary appliance (5; 6; 7), in particular a tap for wash-basins, sinks, bathtubs, showers and the like, provided for being connected to at least one of a source for supplying hot water (2) and a source for supplying cold water (3), the device comprising:

- electrical valve means (13, 14), which may be controlled for obtaining a flow of water;

- a supply outlet (A, A'; B; C) for the flow of water, in fluid communication with the valve means (13, 14);

- electronic control means (20), operatively connected to the valve means (13, 14) to enable control thereof;

- selection means (9), in signal communication with the control means (20), which can be controlled by a user for the purposes of setting at least one of a value of temperature and a value of rate of the flow of water,

wherein the valve means comprises at least one valve device (13, 14) according to one or more of Claims 1 to 30.

32. The device according to Claim 31, comprising two of said valve

devices (13, 14), each having the inlet (31) of the valve body (30) in fluid communication with a respective source of water (2, 3), the outlets of the valve bodies (30) of the two devices (13, 14) being connected to one and the same mixing pipe (16) in fluid communication with the supply outlet (A, A'; B; C).

5 33. The device according to Claim 32, wherein each valve device (13, 14) comprises a non-return valve (50) provided for preventing any possible reflux of water towards the respective valve seat (33, 34), through said mixing pipe, in the case of any unbalancing of pressure between said sources of water (2, 3).

10 34. The device according to Claim 32, further comprising temperature-sensor means (19), mounted downstream or at an outlet of the mixing pipe (16) and in signal communication with the control means (20).

15 35. The device according to one or more of Claims 31 to 34, wherein the selection means (9) comprise temperature-selector means (61a, 61b) and flowrate-selector means (62a, 62b), which can be controlled by a user independently of one another.

36. The device according to one or more of Claims 31 to 35, wherein the selection means (9) are pre-arranged in such a way that, to a single operation of setting by a user, there corresponds generation of two control variables of the flow of water, namely, flowrate and temperature.

20 37. The device according to Claim 35, wherein the selector means comprise a plurality of capacitive sensors (SC) associated to a body (60) made of dielectric material (B), for providing therewith selection keys (61a-61b, 62a-62b) that can be operated by the user, for example with a finger of one hand, in which:

25 - at least two first sensors (SC) of said plurality form part of first keys (61a-61b) for setting a value of temperature of the flow of water; and

 - at least two second sensors (SC) of said plurality form part of second keys (62a-62b) for setting a value of rate of flow of water.

30 38. The device according to Claim 37, wherein said body made of dielectric material (60) has a surface, associated to which are capacitive sensors (SC), there facing said surface light-emitting means (LE', LE''), in particular of the LED type, that are able to identify said keys (61a-61b, 62a-62b) and/or highlight selections made via the keys themselves.

35 39. The device according to Claim 35 or Claim 36, wherein the selection means (9) are in signal communication with the control means (20) in wireless mode.

40. A hydro-sanitary system, such as a tap system, a system for the distribution of water within buildings, a room heating and/or air conditioning system for buildings, in particular dwellings for residential use, comprising a water-distribution unit (1) having a plurality of valve devices (13, 14) according to one or more of Claims 1 to 30.

41. The system according to Claim 40, wherein said unit (1) comprises a first manifold (11) connected to a source of hot water (2) and a second manifold (12) connected to a source of cold water (3), the unit (1) further comprising a plurality of pairs of said valve devices (13, 14), one valve device of the pair being connected at inlet to the first manifold (11) and the other valve device of the pair being connected at inlet to the second manifold (12), both valve devices of the pair being connected at outlet to one and the same mixing pipe (16), wherein control means (20) of each supply device are prearranged for controlling the respective valve device (13, 14) to cause a mixing between cold water and hot water coming from said manifolds (11, 12) and obtain a desired flow of mixed water.

42. The system according to Claim 41, wherein associated to at least one said manifold (11, 12) is a safety device (70, 71) against water hammers.

43. A water-distribution unit for a system according to one of Claims 40 to 42, comprising a first manifold (11) for connection to a source of hot water (2), a second manifold (12) for connection to a source of cold water (3) and at least one pair of said valve devices (13, 14).

44. The unit according to Claim 43, comprising a box (10) having two distinct compartments isolated from one another (10a, 10b), there being housed in one compartment at least said manifolds (11, 12) and the valve devices (13, 14), in the other compartment there being housed at least part of the control means (20) and, preferably, a low-voltage power-supply unit (21) and a battery (22).

45. A process of calibration of a valve device according to one or more of Claims 1 to 30, aimed at identification of the exact point starting from which the actuation shaft (42a) starts to displace the open/close member (36), the process comprising at least the step of supplying the actuator (42) at a voltage lower than a rated voltage, for a predefined number of steps.

46. The process according to Claim 45, further comprising at least a step of storing at least a piece of information representing the position reached by the actuation shaft (42a) at the end of said predefined number of steps, said information being subsequently used by the control means (20) in the course of

normal actuations of the actuator (42) during flowrate and/or temperature adjustments.

47. The process according to Claim 45 and/or 46, wherein the step of supplying and the step of storing are carried out periodically.

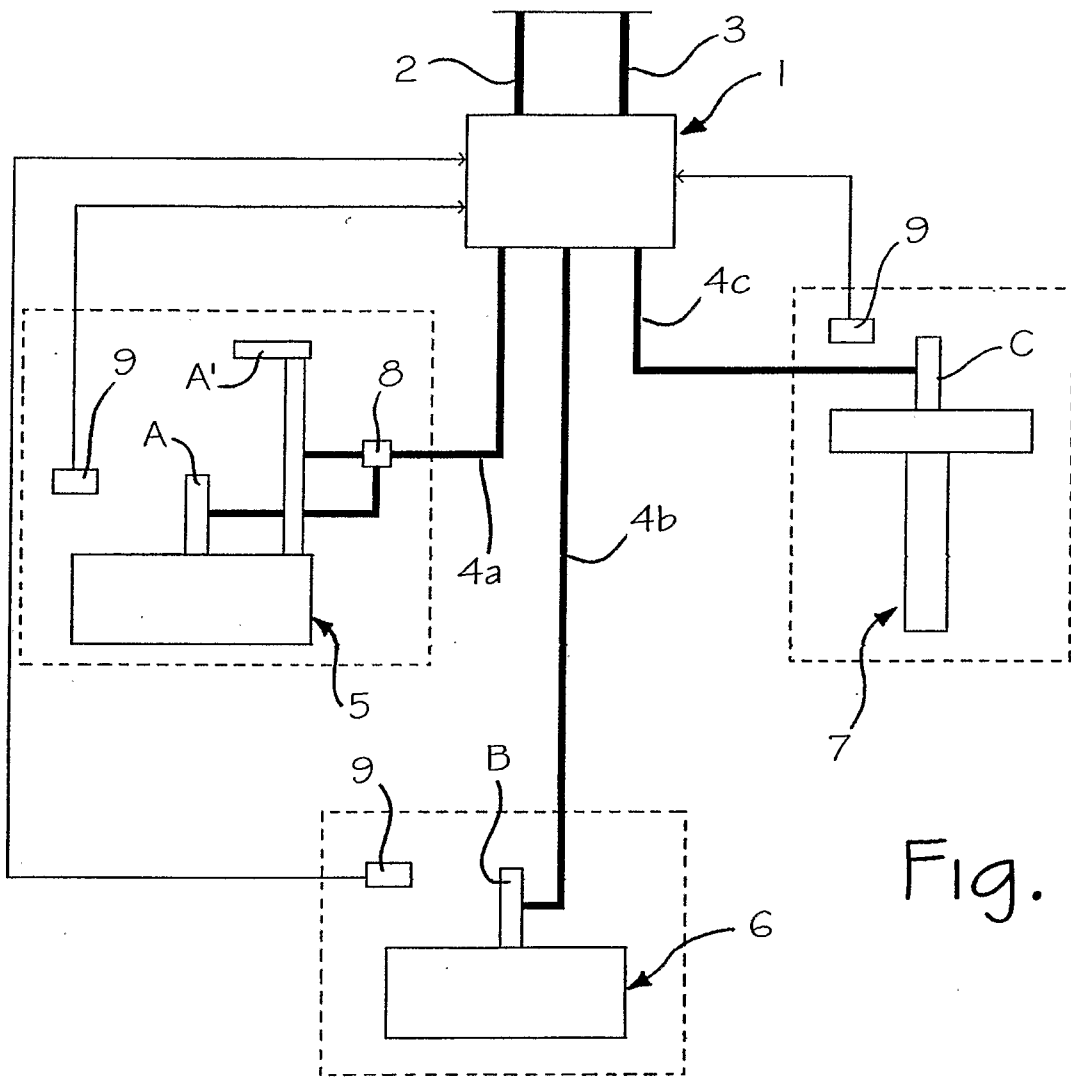
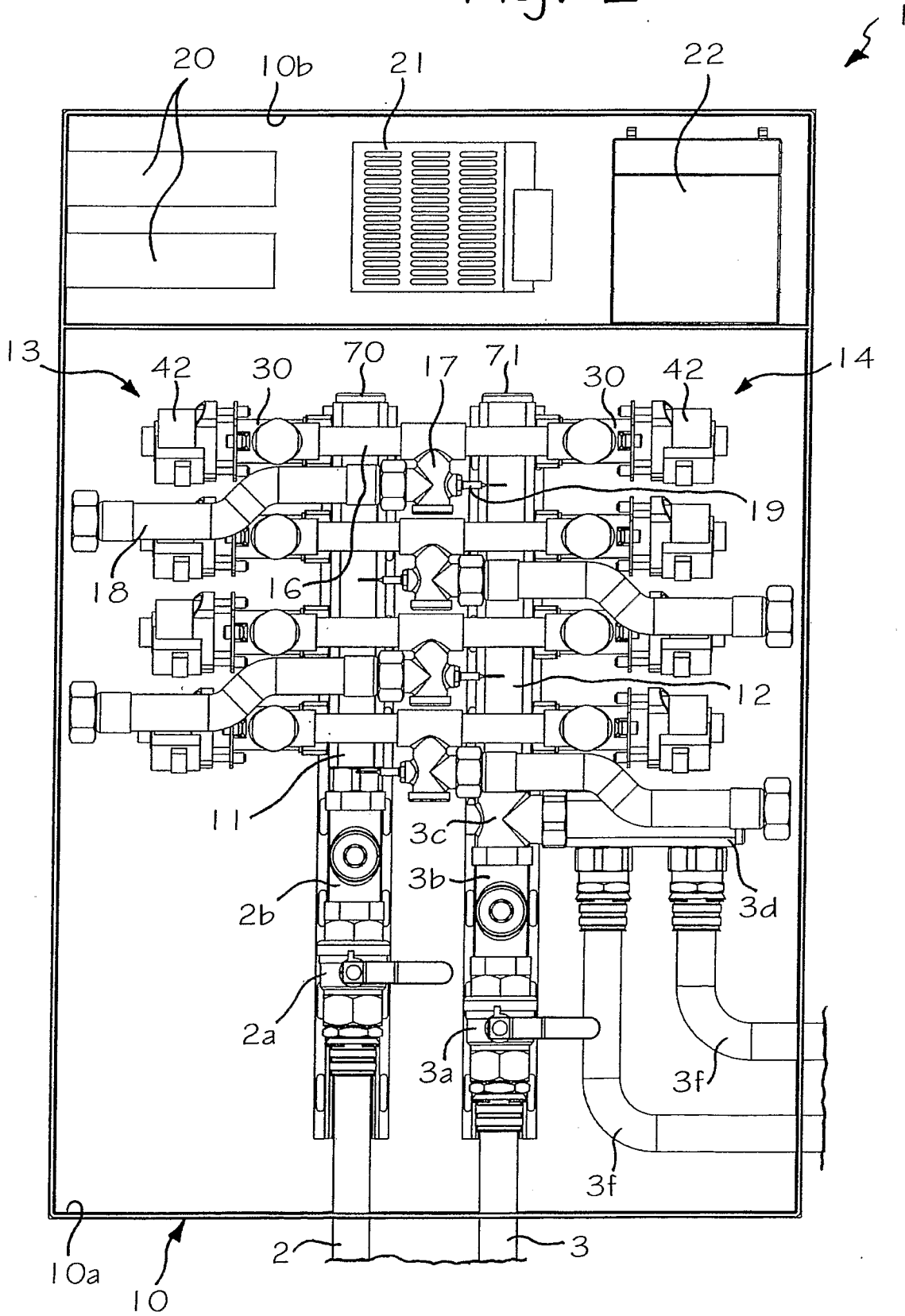


Fig. 1

Fig. 2



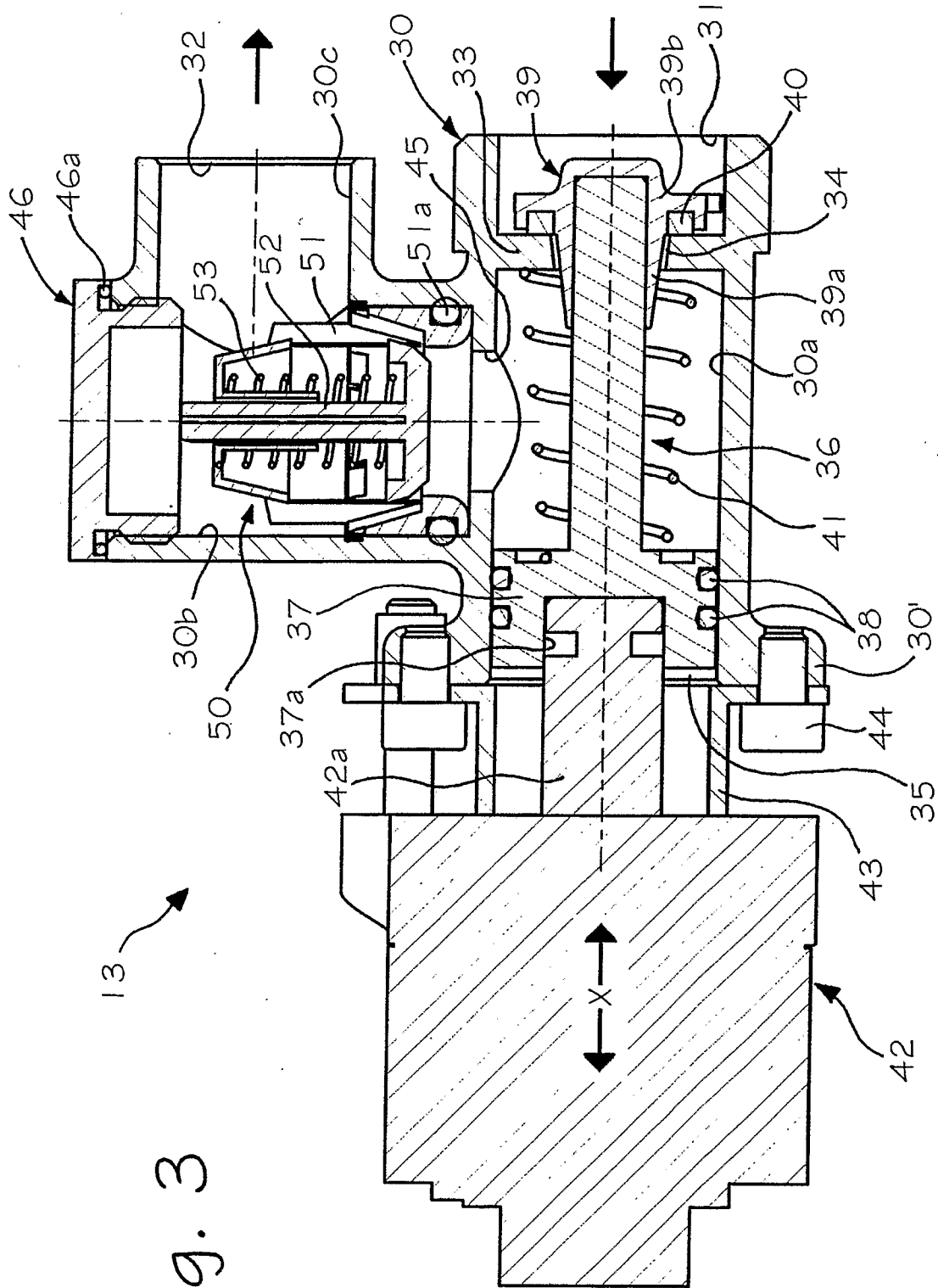


Fig. 3

Fig. 4

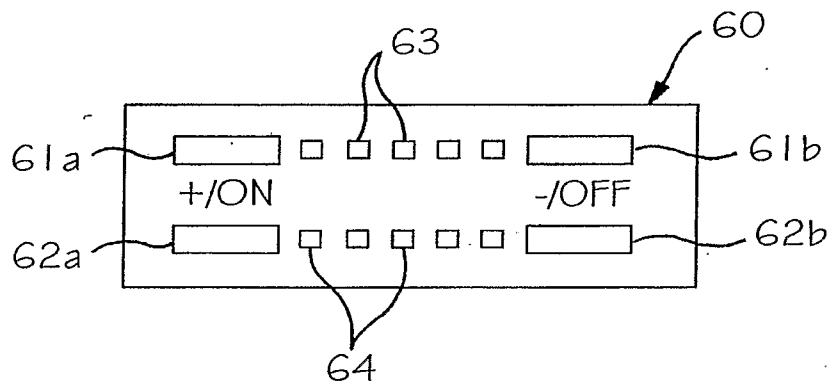


Fig. 5

