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(57) Sammendrag:
A manifold (40) for a for heating system. The manifold comprises an elongated tubular housing (44), the housing (44) is provided with a manifold outlet (43), a plurality of sockets (42) for connection to respective return lines of circuits (I,II,III,IV) in the floor heating system, the sockets (42) having a lumen and being arranged to extend through a wall of the housing (44), a plurality of flow control valves (1), each flow control valve (1) being associated with one of the sockets (42), the flow control valves (1) comprise a pressure regulating arrangement configured for maintaining a substantially constant differential pressure between a first pressure (P1) in the control valve (1) and a second pressure (P2) in the control valve (1), the flow control valves (1) comprise an inlet in fluidic connection with the socket associated with the flow control valve (1) concerned, and at least one outlet (7) in fluidic connection with the manifold outlet (43), the flow control valves (1) comprise an elongated body (4), with a first longitudinal end sealingly engaging a socket (42) and a second longitudinal end for coupling to an actuator (48).

Fortsættes...

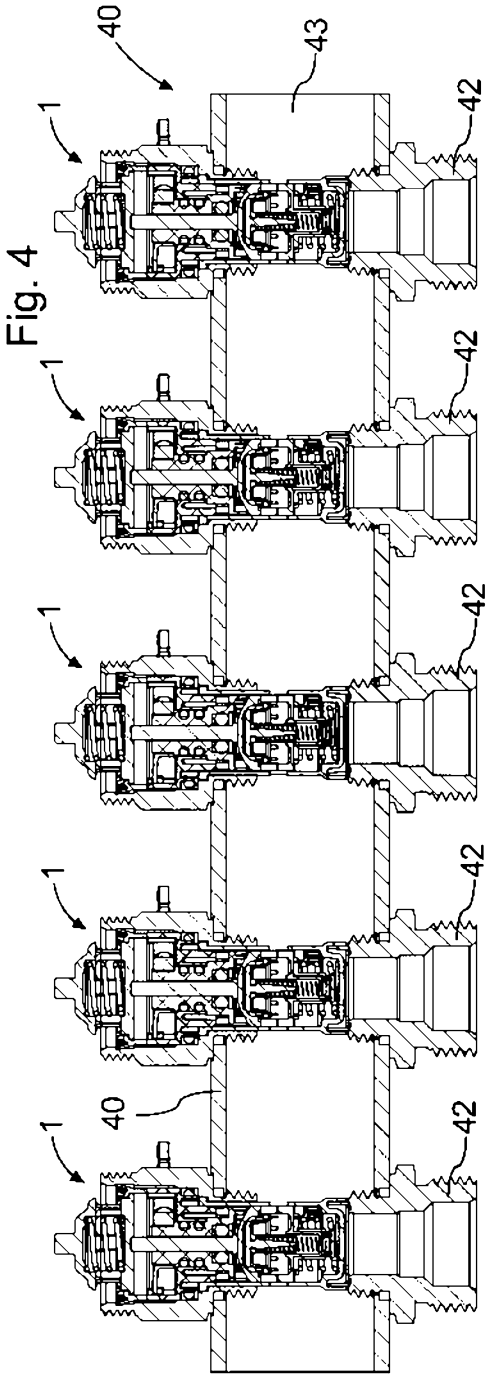


Fig. 4

MANIFOLD FOR A HEATING AND/OR COOLING SYSTEM AND HEATING AND/OR COOLING SYSTEM

TECHNICAL FIELD

The disclosure relates to a manifold with control valves for a heating and/or cooling installation of a building, ship or plant and to a heating and/or cooling installation of the building, ship or plant.

BACKGROUND

Buildings are provided with heating and/or cooling systems (HVAC) that include a plurality of individual circuits that each require a flow of heating or cooling liquid through the individual circuit concerned. An individual circuit can be a loop in a floor heating system that covers a particular area, a loop in a sealing cooling system that covers a particular area, a loop including one or more space heating radiators and combinations thereof. Even for relatively small buildings such as domestic housing the number of individual circuits is normally more than five and often more in the region of ten individual circuits. In order to ensure good climatization and efficient use of energy it is required that the circuits are well balanced, i.e. it is avoided that certain individual circuits receive too much flow path others received too little flow. The cooling or heating liquid, typically water needs to be distributed through the heating system in a predetermined calculated way that takes into account the characteristics of each individual circuit. To balance such a heating and/or cooling system in accordance with the predetermined distribution, a flow control valve is placed in the return line of each individual circuit. Often, a plurality of flow

control valves is arranged in a manifold for ease of installation and maintenance, e.g. all the return lines of the floor heating system of a particular floor in the house are connected to a single manifold comprising flow control valve for each return line. The flow control valves can be provided with electrically operated actuators that can open and close the flow control valve associated therewith.

WO2011006559 discloses a manifold with a pre-adjustable flow-rate controller for heating systems, comprising a housing, which has a heating medium feed connection, a heating medium drain connection, and a pre-adjustment connection, and comprising a rate regulating insert, which changes the flow cross-section for the heating medium depending on the pressure in the rate regulating insert. In this manifold the flow rate is not independent of the pressure differential and this manifold does not provide the accuracy required for contemporary high efficiency flooring systems.

Consequently, there is a need for a floor heating system and a manifold for such a floor heating system that overcomes or at least reduces the problems indicated above.

SUMMARY

The foregoing and other objects are achieved by the features of the independent claims. Further implementation forms are apparent from the dependent claims, the description and the figures.

According to a first aspect, there is provided a manifold for a for heating system with a plurality of circuits, the manifold comprising an elongated tubular housing, the

housing being provided with: a manifold outlet, a plurality of sockets for connection to respective return lines of circuits of the floor heating system, the sockets having a lumen and being arranged to extend through a wall of the housing , and a plurality of flow control valves , each flow control valve being associated with one of the sockets, the flow control valves comprising: an elongated body, with a first longitudinal end that sealingly engages a socket and a second longitudinal end for coupling to an actuator, an inlet in fluidic connection with the socket associated with the flow control valve concerned, and at least one outlet in fluidic connection with the manifold outlet, and a pressure regulating arrangement configured for maintaining a substantially constant differential pressure between a first pressure in the control valve and a second pressure in the control valve.

By providing a floor heating manifold with a plurality of constant differential pressure control valves in the pressure drop across an adjustable opening in such valves can be controlled accurately and thus, the flow setting becomes directly correlated to the size of the adjustable opening and thus, the flow can be controlled more accurately.

According to a possible implementation of the first aspect the control valve is provided with an inlet opening at the second axial end, the inlet opening being in fluidic communication with a lumen in the socket.

According to a possible implementation of the first aspect the control valve is provided with at least one outlet opening that is in fluidic communication with the interior of the tubular housing.

According to a possible implementation of the first aspect the manifold further comprises a flow area regulator for regulating a flow area of at least one variable size entry opening through which the liquid flowing through the control valve from the inlet opening to the outlet opening must pass.

According to a possible implementation of the first aspect the arrangement for maintaining a constant differential pressure maintains a constant differential pressure over the adjustable size opening.

According to a possible implementation of the first aspect a portion of the control valve projects through an opening in the tubular body opposite to a socket.

According to a possible implementation of the first aspect a portion of a socket projects through an opening in the tubular body.

According to a possible implementation of the first aspect the first end of the valve body is threadedly coupled to the socket.

According to a possible implementation of the first aspect the second longitudinal end protrudes from the tubular body, the second longitudinal end preferably being provided with coupling means for coupling to an actuator, preferably a linear actuator.

According to a possible implementation of the first aspect the manifold comprises a linear actuator coupled to each control valve.

According to a second aspect there is provided a floor heating system comprising a manifold according to the first aspect or any possible implementation thereof, the manifold being connected to the return end of a plurality of individual floor heating circuits.

According to a possible implementation of the second aspect the floor heating system comprises a feed conduit and a return conduit, the outlet of the manifold being connected to the return conduit and the inlet ends of the plurality of individual floor heating circuits being connected to a second manifold, an inlet of the second manifold being connected to the feed conduit.

According to a possible implementation of the first or second aspect the control valve comprises a pressure regulating arrangement configured for maintaining a substantially constant differential pressure between a first pressure P1 in the control valve and a second pressure P2 in the control valve, the pressure regulating arrangement comprises a movable throttle member that is urged by the first pressure to increase the flow resistance posed by the pressure regulating arrangement and that is urged by a resilient member and by the second pressure P2 to decrease the flow resistance posed by the pressure regulating arrangement, the movable throttle member comprising a rolling diaphragm that interacts with a plurality of exit openings, the rolling diaphragm having a circular circumference attached to an annular body that is arranged in the control valve, the plurality of exit openings being formed radially through the annular body, characterized by at least one pressure communication channel extending in the annular body for communicating the

first pressure P1 from a first location in the control valve on one axial side of the rolling diaphragm to a second location in the control valve on the other axial side of the rolling diaphragm.

In a possible implementation of the first or second aspect the pressure communication channel opens to two axially spaced openings in the annular body.

In a possible implementation of the first or second aspect the exit openings 18 are axially extending elongated openings, and wherein the pressure communication channel axially extends between two axially extending exit openings.

In a possible implementation of the first or second aspect the control valve comprises a plurality of pressure communication channels, each pressure communication channel of the plurality extending between two axially extending exit openings.

In a possible implementation of the first or second aspect the plurality of exit openings are circumferentially distributed over the circumference of the annular body.

In a possible implementation of the first or second aspect the rolling diaphragm comprises a continuous body of material.

In a possible implementation of the first or second aspect the rolling diaphragm does not have any through going openings.

In a possible implementation of the first or second aspect the control valve further comprises a flow area regulator for regulating a flow area of at least one variable size entry opening through which the liquid flowing through the control valve from an inlet opening to an outlet opening must pass.

In a possible implementation of the first or second aspect the control valve comprises an elongated, preferably rotation symmetric, valve body with opposite first and second longitudinal ends, the first end being provided with a with a closable inlet opening.

In a possible implementation of the first or second aspect control valve comprising an elongated, preferably rotation symmetric, valve body with opposite first- and second longitudinal ends, the first longitudinal end being provided with an inlet opening, a pressure regulating arrangement configured for maintaining a substantially constant differential pressure between a first pressure P1 in the control valve and a second pressure P2 in the control valve, the pressure regulating arrangement comprises a movable throttle member that is urged by the first pressure P1 to increase the flow resistance posed by the pressure regulating arrangement and that is urged by a resilient member and by the second pressure P2 to decrease the flow resistance posed by the pressure regulating arrangement, the movable throttle member comprising a rolling diaphragm that interacts with a plurality of exit openings, the rolling diaphragm having a circular circumference attached to an annular body, the plurality of exit openings being formed radially through the annular body, the annular body being slidably disposed in a cylindrical portion of the

valve housing for allowing axial movement and rotational movement of the annular body relative to the valve housing.

According to a possible implementation of the first or second aspect the annular body fits sealingly inside the cylindrical portion.

In a possible implementation of the first or second aspect the control valve comprises a closing member movable arranged to move axially in unison with the annular body, the closing member being configured to sealingly close the inlet opening in a first axial portion of the annular body and to allow fluid passage through the inlet opening in a second axial position of the annular body.

According to a possible implementation of the first or second aspect the closing member comprises a cylindrical part extending axially from the annular body towards the inlet opening.

According to a possible implementation of the first or second aspect the annular body has two opposite axial ends, wherein the axial end of the annular body closest to inlet opening comprises a disk-shaped element provided with at least one first regulation opening.

According to a possible implementation of the first or second aspect the disk-shaped element forms a bottom of the annular body.

According to a possible implementation of the first or second aspect the control valve comprises a plate member with at least one second regulation opening for interacting with the first regulation opening, one side of the plate

member being in contact with the side of the disk shaped element closest to the inlet opening, the plate member, being arranged to move axially in unison with the annular body and the plate member being rotationally immovable relative to the cylindrical portion of the valve body, whereby a greater or smaller overlap may be established between the at least one first regulation opening and the at least one second regulation opening by the rotation of the annular body relative to the valve body.

According to a possible implementation of the first or second aspect the cylindrical portion is connected to the plate member.

According to a possible implementation of the first or second aspect the control valve comprises a membrane support member for supporting and engaging a central portion of the rolling membrane, and a helical spring, the helical spring acting on the support member to urge the rolling membrane in a direction that reduces the throttling effect of the rolling membrane.

According to a possible implementation of the first or second aspect the control valve comprises a mechanism connected to the annular body for adjusting the rotational position of the annular body relative to the valve body, the mechanism being configured for adjusting the rotational position manually or with an actuator.

According to a possible implementation of the first or second aspect the control valve comprises a mechanism connected to the annular body for adjusting the axial position of the annular body relative to the valve housing,

the mechanism being configured for adjusting the axial position manually or with an actuator.

According to a possible implementation of the first or second aspect the annular body comprises least one pressure communication channel extending in the annular body for communicating the first pressure P1 from a first location in the control valve on one axial side of the rolling diaphragm to a second location in the control valve on the other axial side of the rolling diaphragm.

These and other aspects will be apparent from and the embodiment(s) described below.

BRIEF DESCRIPTION OF THE DRAWINGS

In the following detailed portion of the present disclosure, the aspects, embodiments and implementations will be explained in more detail with reference to the example embodiments shown in the drawings, in which:

Figs. 1 and 2 show a manifold for a floor heating or ceiling cooling system with a plurality of control valves of Figs. 8 and 9,

Figs. 3 and 4 show the manifold and control valves of Figs. 1 and 2 in cross-sectional and longitudinal-sectional view, respectively,

Figs. 5 and 6 are cross-and longitudinal-sectional views of another manifold for a floor heating system with a control valve,

Fig. 7 is a diagrammatic representation of a floor heating system with a manifold control valves including the actuators associated with the control valves,

Figs. 8 and 9 are different side views of a control valve,

Figs 10,11 and 13 are longitudinal-sectional views of the control valve of Figs. 8 and 9,

Fig. 12 is a cross-sectional view of the control valve of Figs. 8 and 9,

Fig. 14 is a longitudinal-sectional view of a functional element of Figs. 8 and 9, the functional element including a constant pressure differential function and a flow area adjustment function,

Fig. 15 is an enlarged detail of Fig. 14,

Fig. 16 is an exploded view of the valve of Figs. 8 and 9,

Fig. 17 is an enlarged longitudinal-sectional view of the valve of Fig. 8 and 9 in an open position, but with internal thread instead of external threat for coupling an actuator to the control valve, and

Fig. 18 is an enlarged longitudinal-sectional view of the valve of Fig. 17 in a closed position,

DETAILED DESCRIPTION

A manifold 40 for e.g. a floor heating system is described with reference to Figs. 1 to 6. A floor heating system comprising the manifold 40 is described with reference to Fig. 7. A control valve 1 for use in the manifold 40 is described in detail with reference to Figs. 8 to 18.

The manifold 40 is configured to be connected to control the flow of a floor heating system with a plurality of circuits I,II,III,IV,V. The manifold 40 has an elongated tubular housing 44, of conventional material and has a hollow interior.

Either of the longitudinal ends of the housing 44 functions as an outlet 43 (outlet opening) with the opposite longitudinal end being closed by a plug (not shown).

The housing 44 is provided with plurality of sockets 42 for connection to respective return lines of circuits I,II,III,IV,V of the floor heating system.

The sockets 42 are provided with a lumen through which liquid (e.g. water) can flow through the socket 42 from one end to the other. The sockets 42 are provided with external thread or alternatively internal thread for engaging the coupling means for coupling the socket 42 to the return lines of the circuits. The socket 42 is also be provided with external thread for engaging a threaded hole in the housing 44 to install the socket 42 sealingly in the housing 44. However, it is understood that other conventional ways of securing the socket 42 in the housing 44 could be used. When installed in the housing 44 the socket 42 extends through a wall of the housing 44 and protrudes into the hollow interior of the housing 44.

The end of the socket 42 that protrudes into the housing 44 is configured to sealingly engage a first longitudinal end of a control valve 1.

The manifold 40 is provided with a plurality of flow control valves 1, with the number of control valves corresponding to the number of circuits of the floor heating system. Thus, each flow control valve 1 is associated with one of the sockets 42.

Each of the flow control valves 1 has an elongated body 4, with a first longitudinal end that sealingly engages a socket 42 and a second longitudinal end for coupling to an actuator 48.

The flow control valves 1 are provided with an inlet 9 in fluidic connection with the socket 42 associated with the flow control valve 1 concerned, and at least one outlet 7 in fluidic connection with the manifold outlet 43.

The flow control valves 1 are also provided with a pressure regulating arrangement configured for maintaining a substantially constant differential pressure between a first pressure P1 in the control valve 1 and a second pressure P2 in the control valve 1.

The control valves 1 are provided with an axial inlet opening 9 at their first axial end. The axial inlet opening 9 is in fluidic communication with the lumen in the socket 42. The control valves 1 are also provided with at least one outlet opening 7 that is in fluidic communication with the interior of the tubular housing 44.

The control valves 1 comprise a flow area regulator for regulating a flow area of at least one variable size entry opening through which the liquid flowing through the control valve 1 from the inlet opening 9 to the outlet opening 7 must pass. The arrangement for maintaining a constant differential pressure maintains a constant differential pressure over the adjustable size opening.

A portion of the control valve 1 protrudes into the tubular housing 44 through an opening in the tubular body 44. The opening through which the control valve projects 1 is arranged directly opposite to a socket 42. A portion of a socket 42 projects through an opening in the tubular housing 44 to the first longitudinal of the control valve 1.

In an embodiment shown in Figs. 1 to 4 the first longitudinal end of the control valve 1 abuts sealingly with the end of the socket 42 that projects into the housing 44. Hereto, the first longitudinal end of the control valve 1 is flat so that it matches the flat end of the socket 42. The axial inlet opening 9 is arranged centrally in the flat end of the control valve 1. In this embodiment, the control valve 1 is provided with external threat that engages a threaded hole in the tubular housing 44.

In embodiment shown in Figs. 5 and 6, the first longitudinal end of the control valve 1 is provided with thread and the portion of the socket 42 that projects into the tubular housing 44 is provided with matching thread and the control valve 1 is in threaded connection with the socket 42. The first longitudinal end of the control valve 1 may be provided with internal thread and the portion of the socket 42 protruding into the tubular housing 44 may be provided with external thread. However, the threaded arrangement may also be applied vice versa with the internal thread on the socket and the external thread on the first longitudinal end of the control valve 1.

The second longitudinal end of the control valve 1 protrudes from the tubular body 44. An activator 6 protrudes from the valve body 2 at the second longitudinal end of the control valve 1. The second longitudinal end is provided with coupling means, such as e.g. thread for coupling to thread of an actuator 48, such as e.g. a linear actuator 48. The linear actuator 48 is in an embodiment a provided with an electronic control unit that is configured to operate the control valve 1 in accordance with the flow characteristics of the control valve 1. However, also a

simple on/off type actuator 48 can be used for controlling the position of the control valve 1.

The floor heating system comprises a manifold 40 connected to the return end of a plurality of individual floor heating circuits I,II,III,IV. The floor heating system further comprises a feed conduit 52 and a return conduit 54. The outlet 43 of the manifold 40 is connected to the return conduit 54

The inlet ends of the plurality of individual floor heating circuits I,II,III,IV are connected to a second manifold 50. An inlet of the second manifold 50 is connected to the feed conduit 52. The second manifold 50 is provided with units 56, which units 56 can either be simple plugs, flow indicators or simple manually operated on off valves.

The feed conduit 52 is provided with a feed pump 51 and the feed conduit 52 and return conduit 54 are connected to a heating unit or to cooling equipment.

The control valve 1 is described in greater detail with reference to Figs. 8 to 18. The control valve 1 comprises a valve body 2. The valve body 2 is generally rotation symmetric and comprises a part with a hexagonal outer contour and a cylindrical part 4. It should though be noted that the part with the hexagonal order does not need to have a hexagonal outer shape, the skilled person is familiar with other suitable shapes, such as e.g. a simple cylindrical shape.

The valve body 2 is at or near one of its longitudinal ends provided with thread for coupling with a linear actuator provided with corresponding thread, such as an electric

actuator (not shown). The valve body 2 is also provided with thread for engaging thread of a housing or body, such as a manifold 40. Both the cylindrical part 4 and the part with the hexagonal outer have a hollow interior in which most of the components of the control valve 1 are arranged.

An axially movable activator 6 protrudes from the longitudinal end of the valve body 2 where the thread for coupling to an actuator is provided. The activator 6 protrudes from the valve body 2 for engaging an actuator (not shown). The activator 6 is arranged in to parts with a helical spring 38 therebetween in order to avoid application of excessive force to the components in control valve 1 by an actuator.

The opposite longitudinal end is part of the cylindrical part 4. The opposite longitudinal end is provided with an axial inlet opening 9. The cylindrical part 4 is provided with one or more radial outlet openings 7. The control valve 1 controls the flow from the axial inlet opening 9 to the radial outlet opening(s) 7.

Hereto, the control valve 1 comprises an arrangement for maintaining a constant differential pressure and an arrangement for adjusting the size of an adjustable size opening. In an embodiment the arrangement for maintaining the constant differential pressure maintains a constant differential pressure over the adjustable size opening.

An annular body 11 is disposed slidably inside the cylindrical portion 4 of the valve body 2, such that the annular body can rotate relative to the valve body 2 and move in the axial direction relative to the valve body 2.

The fit between the annular body 11 and the cylindrical portion 4 is such that it is substantially sealing.

The differential pressure control function comprises a throttling member in the form of a rolling diaphragm 16. The rolling diaphragm 16 has a circular outer circumference that is secured to the annular body 11. The rolling diaphragm is supported by a diaphragm support member 14. A helical spring 20 acts on the diaphragm support member 14 and urges the rolling diaphragm 16 in a direction that reduces the throttling effect of the rolling diaphragm 16.

The annular body 11 is provided with a plurality of exit openings 18. The exit openings 18 extend radially through the annular body 11. The exit openings 18 can be formed as longitudinal slits that extend axially. The exit openings 18 are preferably circumferentially evenly distributed over the annular body 11.

The axial end of the annular body 11 closest to the axial inlet opening 9 is closed off by a bottom in the form of a disc member 15. The disc member 15 is provided with one or more first regulation openings 26.

The axial end of the annular body 11 furthest from the axial inlet opening is provided with a cover 12. The cover 12 is provided with a number of through going openings for pressure equalization.

The bottom with the disc member 15 is rigidly connected to annular body 11 and can be formed as an integral part of the annular body 11. The cover 12 is rigidly connected to the annular body 11.

A central cylindrical portion extends from the disc member 15 and is in an embodiment and integral part of the annular body 11. The central cylindrical portion serves as a shaft for a cylindrical part 22. The cylindrical part 22 moves axially in unison with the annular body 11 and is rotatably suspended from the annular body 11. The cylindrical part 22 is provided with a closing member 29. The closing member 29 is configured to be able sealingly close the axial inlet opening 9. Hereto, the closing member 29 is advantageously the provided with an O-ring. The closing member 29 essentially consists of a cylindrical body that sealingly fits in the circular outline of the axial inlet opening 9.

The cylindrical part 22 can move axially relative to the valve body 2. However, the cylindrical part 22 it is prevented from a rotational movement relative to the valve body 2.

Thus, the annular body 11 and the cylindrical part 22 form together an axially movable unit 10. Figs. 14 and 15 show the unit 10 in detail. Fig. 17 shows the axially movable unit 10 in a position where the closing member 29 does not close the axial inlet opening 9 and Fig. 18 shows the axially movable unit 10 in a position where the closing member 29 sealingly closes the inlet opening 9. Thus, in the position shown in Fig. 18 the control valve is completely closed and does not have any leakage.

The unit 10 is biased to the open position by a helical spring 32. The unit 10 can be moved against the bias of the helical spring 32 by applying force to the activator 6 (e.g. by using an actuator). The force of the activator 6 is transmitted to the cover 12 of the unit 10 by a central

shaft 8. The central shaft 8 is sealed by an O-ring against an insert 37.

The cylindrical part 22 supports a plate member 25. The plate member 25 is urged onto the disc member 15 by the helical spring 32. Thus, the side furthest from the inlet opening 9 of the plate member 25 is pressed onto the side closest to the inlet opening 9 of the disc shaped member 15. The plate member 25 is provided with at least one second regulation opening 24 for interacting with the first regulation opening 26. One side of the plate member 25 is in contact with the side of said disk shaped element 25 closest to said inlet opening 9. The plate element 25 is arranged to move axially in unison with the annular body 11 and the plate element 25 is rotationally immovable relative to the cylindrical portion 4 of the valve body 2. Rotation of the annular body eleven relative to the valve body 2 and thus relative to the plate member 25 establishes a greater or smaller overlap between the at least one first regulation opening 26 and the at least one second regulation opening 24.

Thus, greater or smaller overlap may be established between the at least one first regulation opening 26 and the at least one second regulation opening 24 by the rotation of the annular body 11 relative to the valve body 2. The size of the overlap can be used to determine the flow area of the adjustable opening through which the liquid that flows through the control valve one needs to pass. The differential pressure regulation function ensures that the pressure differential over the adjustable size opening is constant, thereby allowing very precise control of the flow.

Fig. 10 illustrates the areas in the valve where the first pressure P1 resides and the area in the valve where the second pressure P2 resides. Pressure P1 resides in the inlet area of the control valve. Pressure P2 is established through a pressure drop over the adjustable size opening and acts on the same side of the rolling diaphragm 16 as the helical spring 20. Pressure P3 is the pressure at the outlet 7 of the control valve 1 and is established by a pressure drop from the second pressure P2 over the exit openings 18. The threat for coupling the control valve 1 shown in Figs. 1 to 4, 7 and 8 to an actuator is than external threat, whereas the threat for coupling the control valve 1 shown in Figs. 5 and 6 and 8 to 16 is an internal threat. Both types of threat and other coupling means can be used interchangeably for coupling actuator to the control valve 1.

Pressure P1 needs to be communicated to the side of the rolling diaphragm 16 furthest from the axial inlet opening 9. At least one pressure communication channel 28 is provided in the annular body 11 for communicating the first pressure P1 from a position on the axial extremity of the annular body 11 closest to the longitudinal end of the control valve 1 with the inlet opening 9 to a position on the other side of the rolling diaphragm 16. Hereto, at least one pressure communication channel 28 extends substantially axially through the annular body 11. In an embodiment, a pressure communication channel 28 extends axially between two axially extending exit openings 18. The at least one pressure communication channel 28 opens to the axial extremity of the annular body 11 closest to the inlet opening 9, i.e. to the chamber with the first pressure P1.

Thus, liquid can flow from the chamber with the first pressure P1 in the cylindrical portion of 4 and from there into the pressure communication channels 28, regardless of the relative rotational position between the plate member 25 and the annular body 11 and via the communication channel 28 to the opposite side of the rolling diaphragm 16, without the need for any opening in the rolling diaphragm 16. Thus, the rolling diaphragm 16 can be made from a single piece of material without any through going hole in it.

A handle 5 for manual adjustment of the rotational position of the annular body 11 protrudes through a circumferentially extending slot in the valve body 2. The handle 5 engages an interconnecting cylindrical member 3 that is arranged to rotatably move relative to the valve body 2. The interconnecting cylindrical member 3 is sealed against an insert 37 by means of O-rings. The insert 37 is statically disposed in the valve body 2 and sealed against the valve body 2 by an O-ring. The insert 37 is provided with a central bore through which the interconnecting cylindrical member 3 passes with a sealing fit provided by O-rings. This allows the interconnecting cylindrical member 3 to move in the rotationally relative to the valve body 2 in a sealing manner. The interconnecting cylindrical member 3 is connected to a cover 12 of the annular body 11. The cover 12 is rigidly connected to the annular body 11. Rotational movement of the handle 5 is transmitted to the annular body 11 via the interconnecting cylindrical member 3 and the cover 12. The position of the handle 5 is secured against unintentional change of position by a locking member 34.

The central shaft 8 extends through a central bore in the interconnecting cylindric member 3. The central shaft 8

extends axially between the activator 6 and the cover 12 and thus transmits axial force from the activator to the annular body 11. This axial force, that can originate form an electric or other type actuator urges the annular body 11 axially in the direction of the axial inlet opening 9 against the action of the helical spring 32. When sufficient axial force is applied to the activator 6, the annular body 11 together with the cylindrical part 22 with its closing member 29 are pushed towards the axial inlet opening 9 until the closing member 9 engages the inlet opening, thereby closing the inlet opening sealingly. This closed position of the control valve 1 is illustrated in Fig 18. The open position of the control valve 1 where no force is applied to the activator 6 is shown in Fig. 17. The actuator can therefore be a simple “on/off” type linear actuator that either applies a force or does not, although a more sophisticated type of linear actuator that can be commanded to move to a desired position can also be used.

When the control valve 1 is open, the size of the adjustable size opening is adjusted by rotation of the annular body 11 relative to the valve body 2 and thus relative to the plate member 25 so that the overlap between the first regulation opening 26 and the second regulation opening 24 changes.

The pressure drop from the first (inlet) pressure P1 to the second (intermediate) pressure P2 is kept constant by the rolling diaphragm 16 that finds its position under the balance of the pressures and the spring force acting on the rolling diaphragm 16. The flow though the exit openings 18 is restricted to a degree depending on the position of the rolling diaphragm 16 and causes the pressure drop from the

second (intermediate) pressure P2 to the third (outlet) pressure P3.

The control valve 1 is suitable for use in a manifold 40, such as for example a manifold for a floor heating system. Hereto, the control valve 1 is installed in the manifold using the outer thread on the valve body 2 that engages corresponding thread in the manifold 40. The manifold 40 is preferably provided with sockets 42 that engage the longitudinal end of the valve body 2 with the axial inlet opening 9. Thus, the supply of the first pressure P1 can take place through a manifold 42.

In the shown embodiments, the rotational position of the annular body 11 is adjusted manually using the handle 5. However, the rotational position of the annular body 11 may in not shown embodiments be adjusted by an actuator or the like, e.g. under control from an electronic control unit.

The various aspects and implementations has been described in conjunction with various embodiments herein. However, other variations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing the claimed subject-matter, from a study of the drawings, the disclosure, and the appended claims. In the claims, the word “comprising” does not exclude other elements or steps, and the indefinite article “a” or “an” does not exclude a plurality. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measured cannot be used to advantage. The reference signs used in the claims shall not be construed as limiting the scope.

CLAIMS

1. A manifold (40) for a for heating system with a plurality of circuits (I,II,III,IV,V), said manifold (40) comprising an elongated tubular housing (44),

said housing (44) being provided with:

a manifold outlet (43),

a plurality of sockets (42) for connection to respective return lines of circuits (I,II,III,IV,V) of the floor heating system,

said sockets (42) having a lumen and being arranged to extend through a wall of said housing (44), and

a plurality of flow control valves (1), each flow control valve (1) being associated with one of said sockets (42),

said flow control valves (1) comprising:

an elongated body (4), with a first longitudinal end that sealingly engages a socket (42) and a second longitudinal end for coupling to an actuator (48),

an inlet (9) in fluidic connection with the socket (42) associated with the flow control valve (1) concerned, and at least one outlet (7) in fluidic connection with said manifold outlet (43), and

a pressure regulating arrangement configured for maintaining a substantially constant differential pressure

between a first pressure (P1) in said control valve (1) and a second pressure (P2) in said control valve (1).

2. A manifold (40) according to claim 1, wherein said control valve (1) is provided with an inlet opening (9) at said first axial end, said inlet opening (9) being in fluidic communication with a lumen in said socket (42).

3. A manifold according to claim 1 or 2, wherein said control valve (1) is provided with at least one outlet opening (7) that is in fluidic communication with the interior of said tubular housing (44).

4. A manifold (40) according to any one of claims 1 to 3, further comprising a flow area regulator for regulating a flow area of at least one variable size entry opening through which the liquid flowing through the control valve (1) from the inlet opening (9) to the outlet opening (7) must pass.

5. A manifold (40) according to claim 4, wherein in said arrangement for maintaining a constant differential pressure maintains a constant differential pressure over said adjustable size opening.

6. A manifold according to any one of claims 1 to 3, wherein a portion of said control valve (1) protrudes through an opening in said tubular body (44) opposite to a socket (42).

7. A manifold according to claim 6, wherein a portion of a socket (42) projects through an opening in said tubular body.

8. A manifold according to claim 7, wherein said first end of said valve body (4) is threadedly coupled to said socket (42).

9. A manifold (40) according to any one of claims 1 to 8, wherein the second longitudinal end protrudes from said tubular body (44), said second longitudinal end preferably being provided with coupling means for coupling to an actuator (48), preferably a linear actuator (48).

10. A manifold according to any one of claims 1 to 9, comprising a linear actuator (48) coupled to each control valve (1).

11. A floor heating system comprising a manifold (40) according to any one of claims 1 to 10, said manifold being connected to the return end of a plurality of individual floor heating circuits (I,II,III,IV).

12. A floor heating system according to claim 11, further comprising a feed conduit (52) and a return conduit (54), the outlet of said manifold (40) being connected to said return conduit and the inlet ends of said plurality of individual floor heating circuits (I,II,III,IV) being connected to a second manifold (50), an inlet of said second manifold being connected to said feed conduit (52).

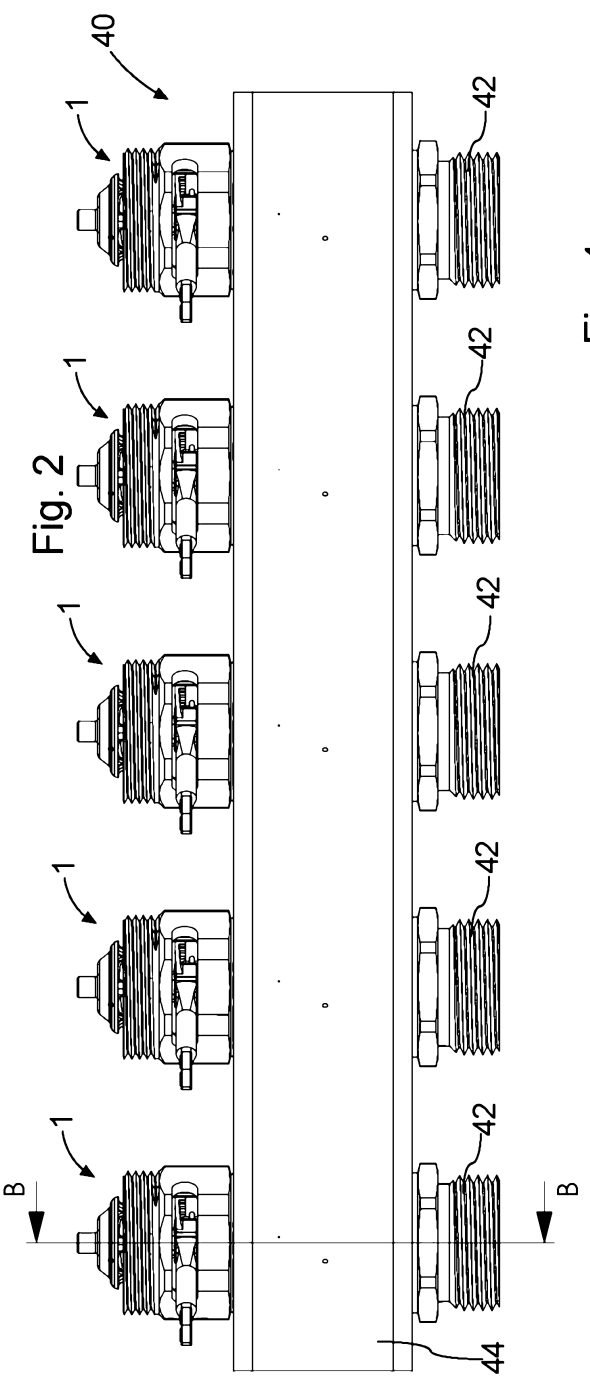


Fig. 1

Fig. 2

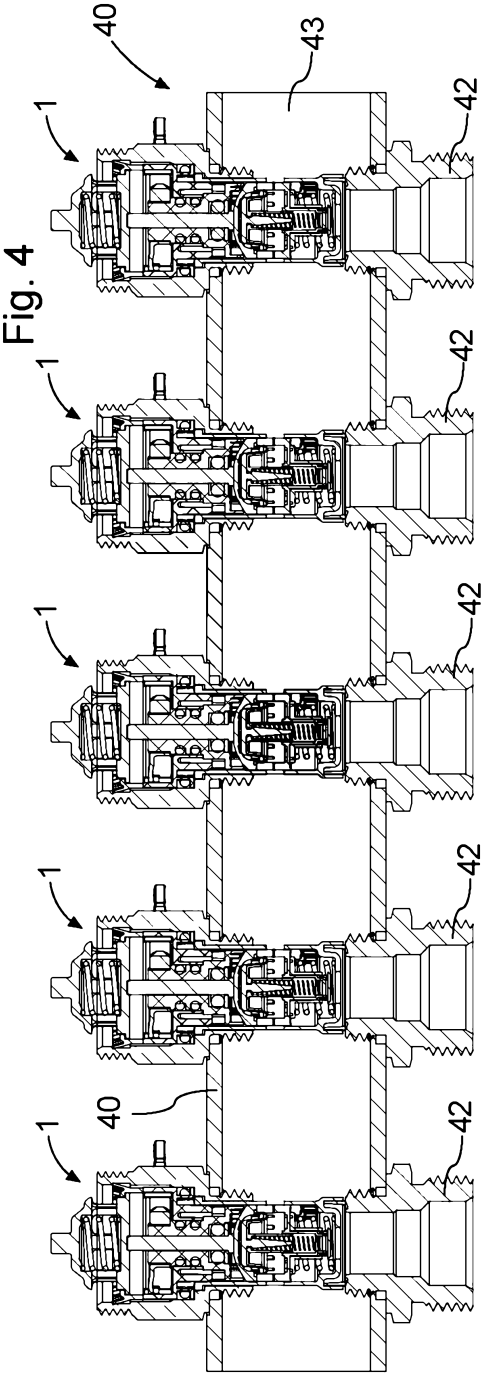


Fig. 4

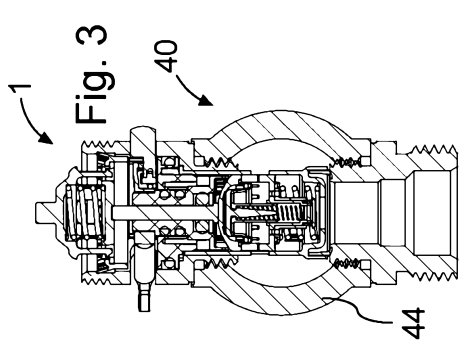


Fig. 3

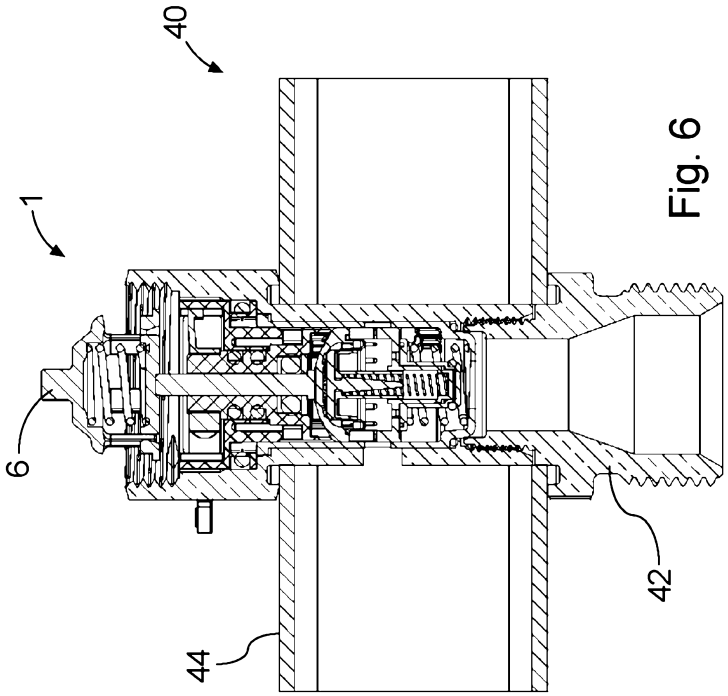


Fig. 6

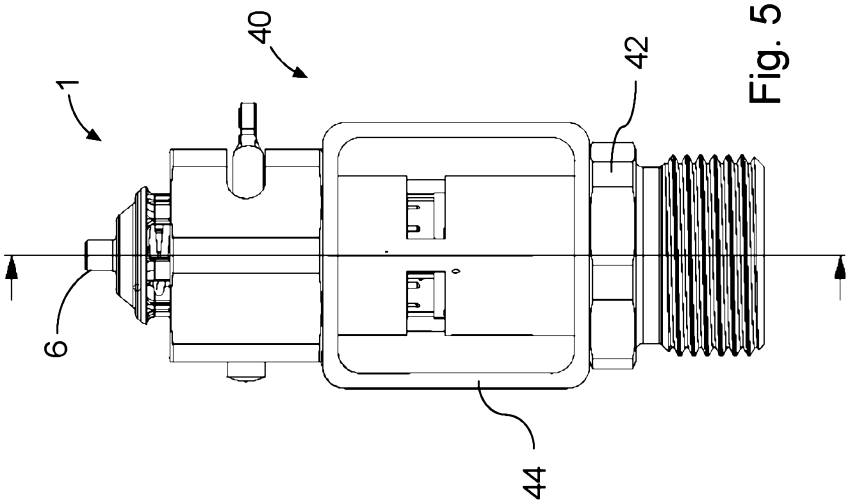
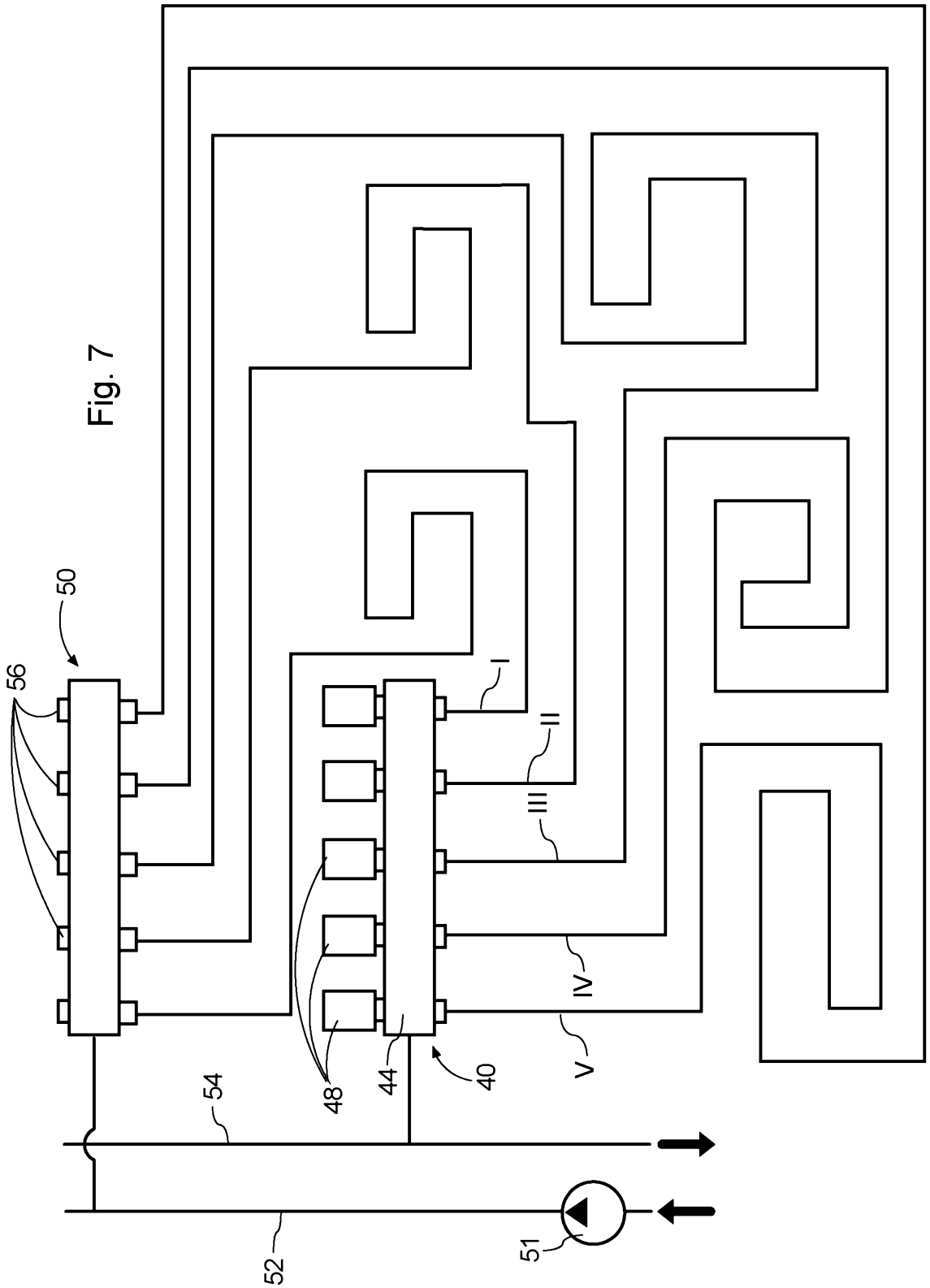


Fig. 5

Fig. 7



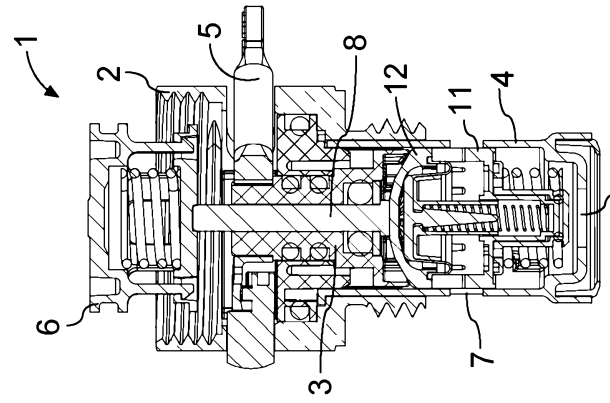


Fig. 10

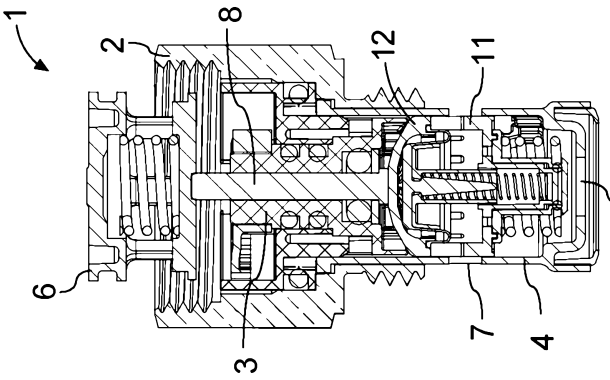


Fig. 9

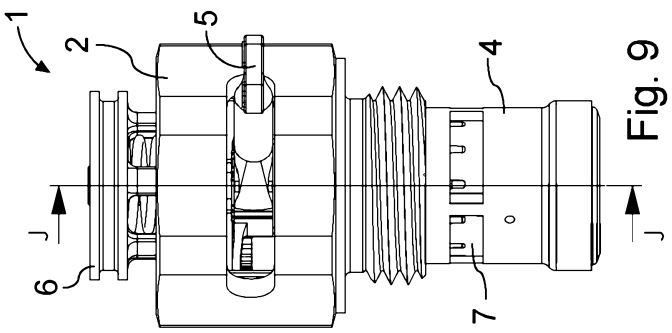


Fig. 8

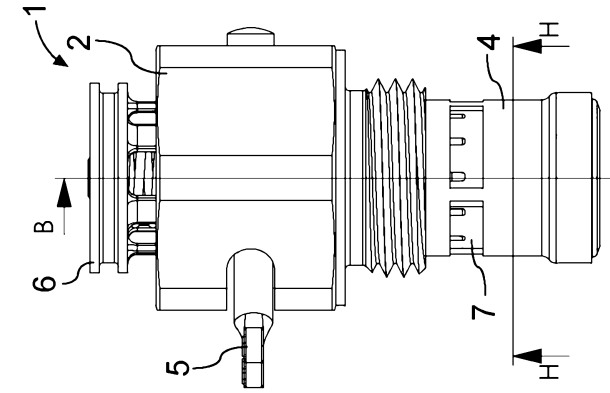


Fig. 11

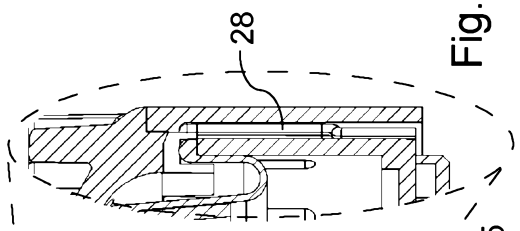


Fig. 15

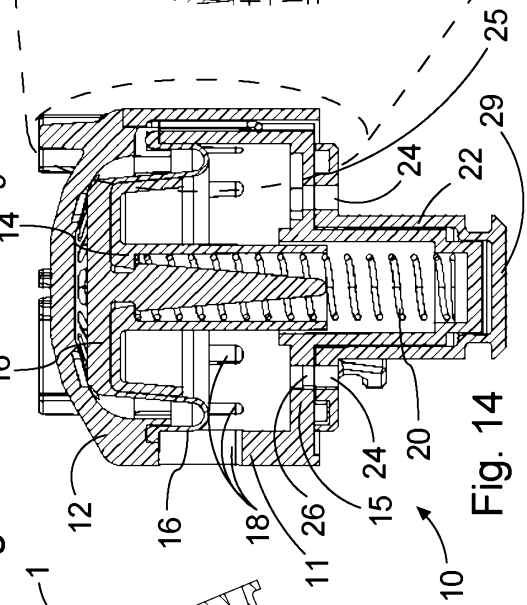


Fig. 14

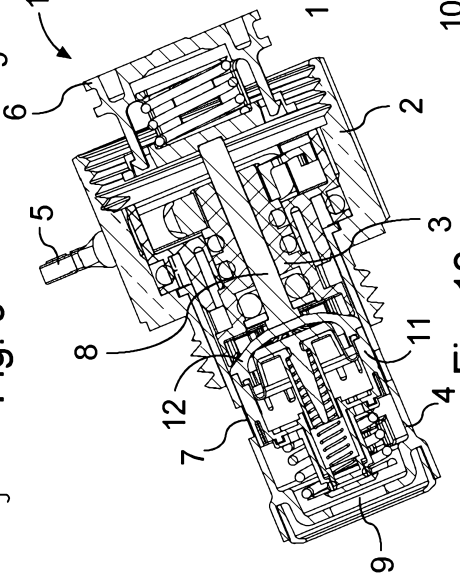


Fig. 13

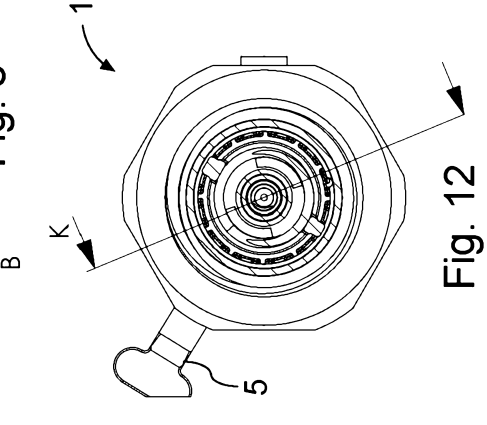


Fig. 12

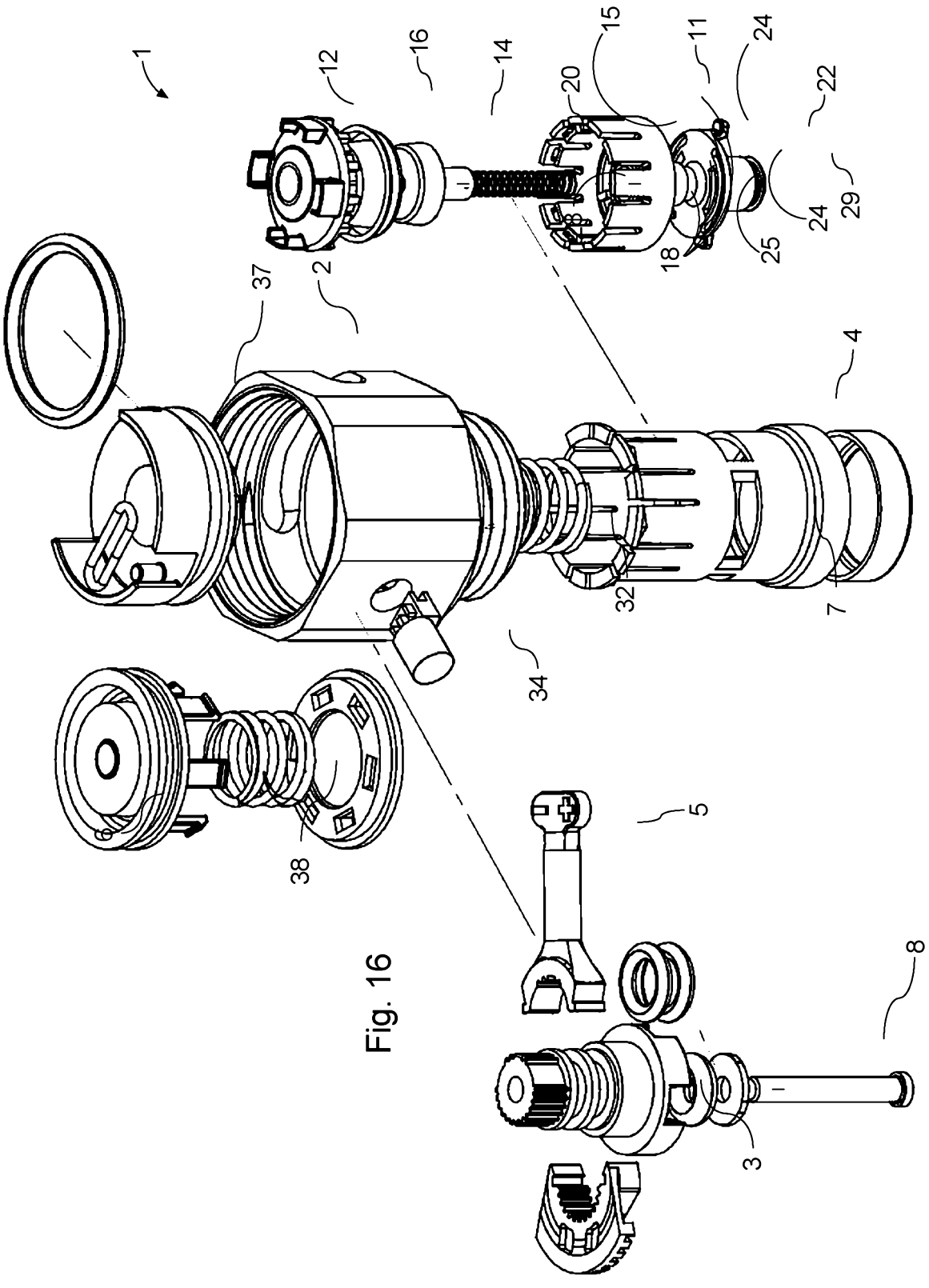


Fig. 16

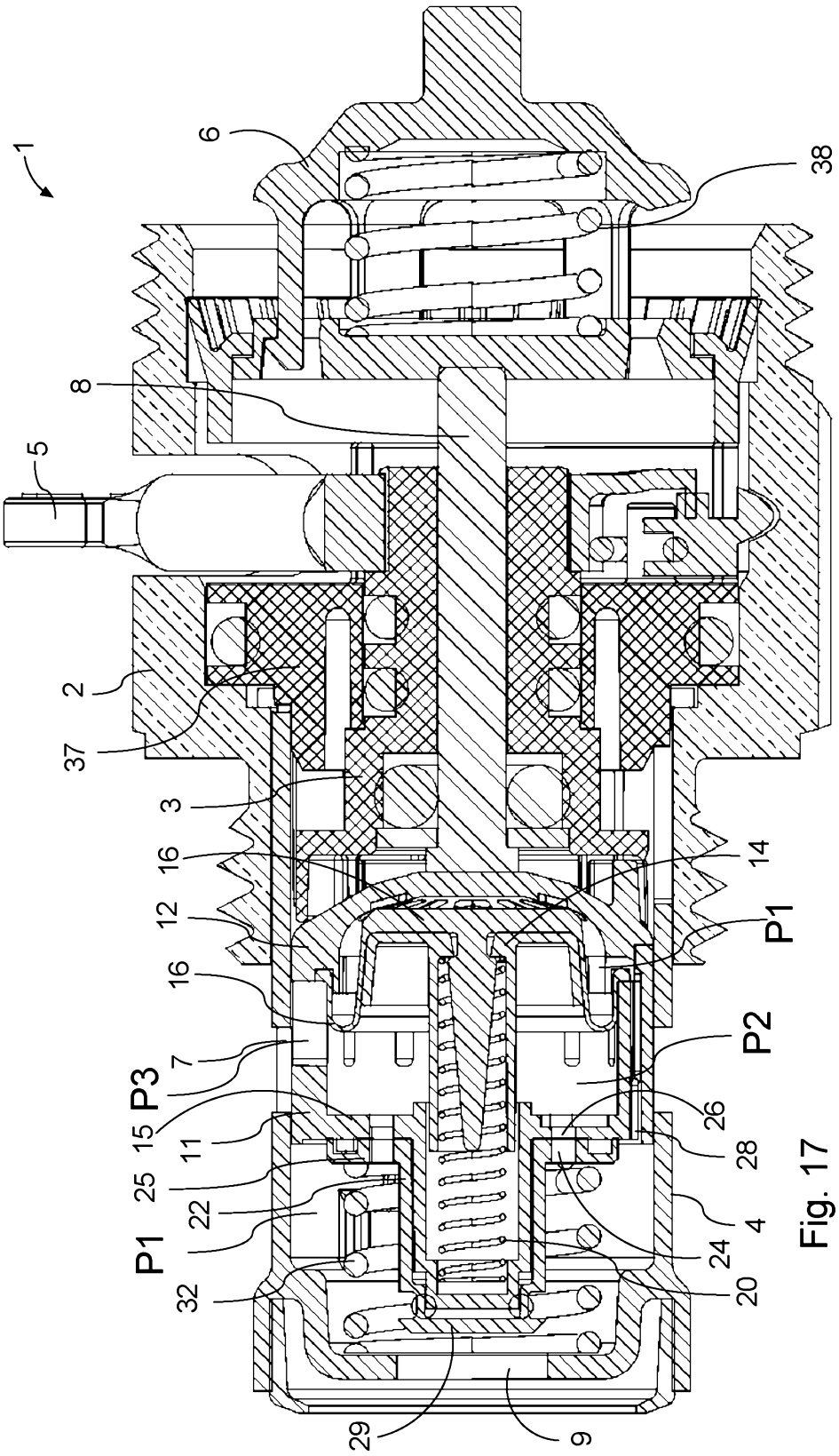


Fig. 17

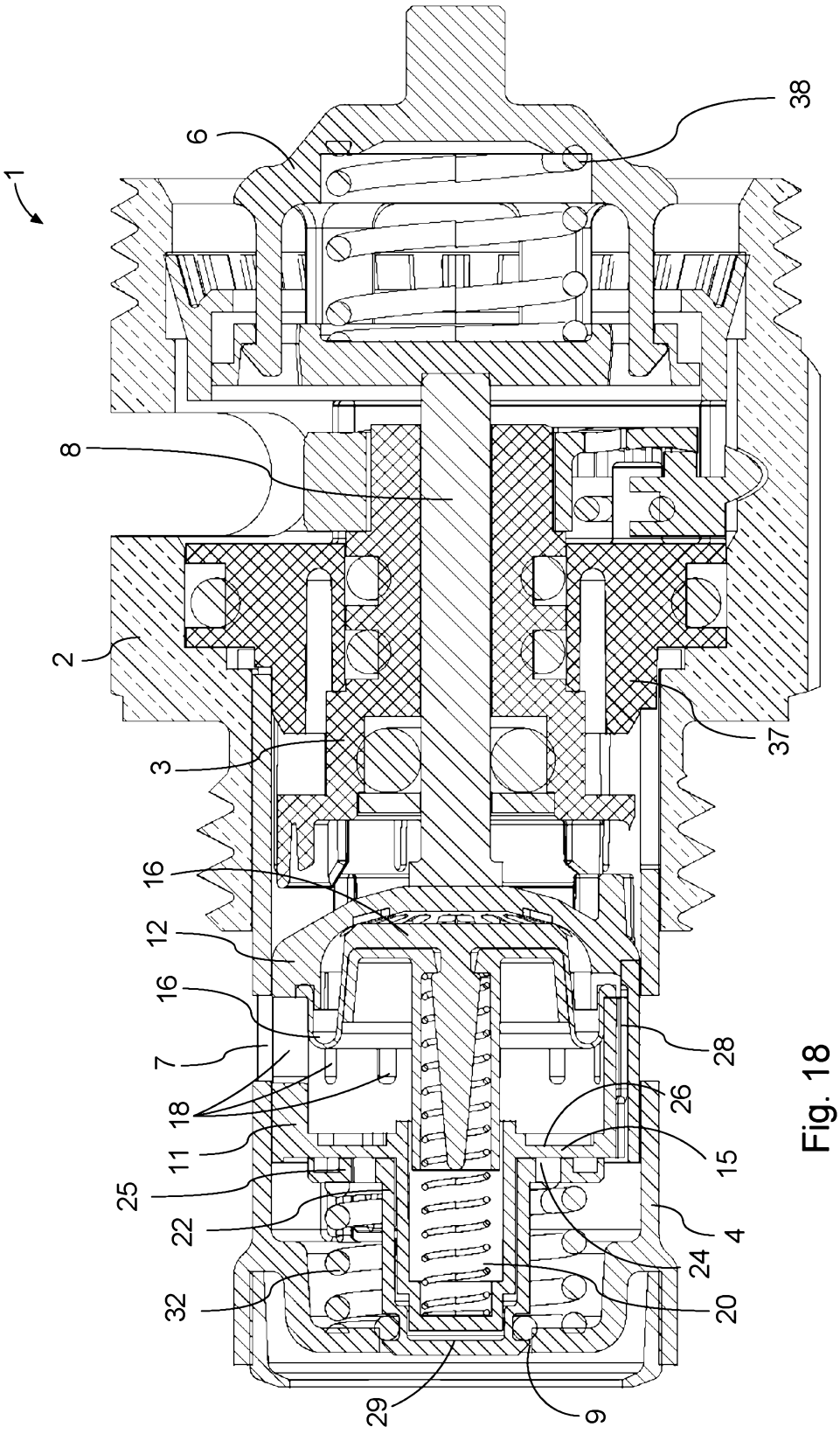


Fig. 18