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(54) ORIENTABLE FLUID DISTRIBUTION ELEMENT FOR A RADIATOR

(57) The invention proposes a fluid distribution element (1) for a radiator with a valve assembly (40), comprising : a central member (C) configured to be mounted on a seat (S) of the valve within the valve assembly (40), and at least one partition (A, B) positioned on one side of the central member (C) and configured to be placed in an outlet passage (F, R) of the valve assembly (40). Moreover, a kit for the installation and/or subsequent adjustment of a fluid distribution element (1) in a valve assembly (40) is proposed which comprises the fluid distribution element (1) and a positioning and adjustment tool (13) configured to engage with the fluid distribution element (1) in such a way as to enable a unique rotational orientation between the tool (13) and the element (1).

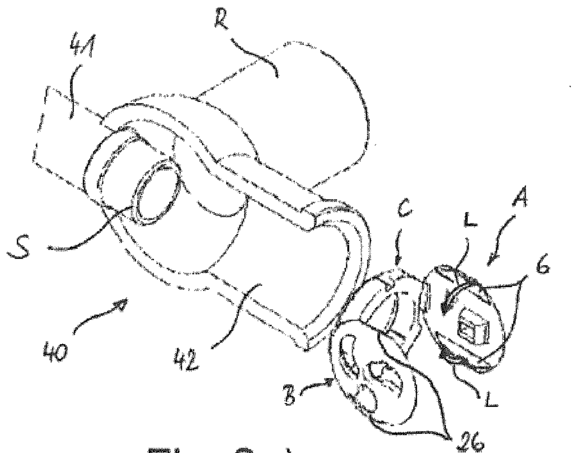

Fig. 2a)

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Description

TECHNICAL FIELD

[0001] The present invention relates to an element configured to distribute fluid inside a radiator for heating rooms and suitable for being inserted in a valve assembly of a new or pre-existing radiator, as well as said valve assembly and said radiator.

BACKGROUND OF THE INVENTION

[0002] In recent years, radiators for heating rooms have become widespread which consist of two or more panels connected to each other and filled more or less sequentially with a heat exchange fluid which, in independent or centralised heating systems, is essentially water, with the aim of improving, according to need, the thermal radiation, or the transfer of heat to the room by convection, of the front or rear panel of the radiator.

[0003] For example, in the case of medium and low temperatures where only relatively low heating capacities and hence relatively low outlet water temperatures are required, it can be desirable for the front panel, facing the room, to heat up more than the rear panel, thus favouring the emission of heat to the room by radiation rather than by convection, so that the radiator will not seem cold and unwelcoming to the user. On the other hand, for example in rooms where small children stay, one will wish to avoid excessive heating of the front panel and prefer the rear one to heat the room or adjacent rooms. To enable this partialisation (division) of flow, which gives priority to one or the other panel, there are known partitions which are pre-inserted in the valve assembly of the radiator, or in the radiator itself, during the radiator manufacturing stage and have the sole task of creating restrictions on the outlet side towards the panel that must heat up more slowly or remain at a lower temperature, whilst the passage from the valve assembly to the other panel maintains the maximum original cross-section area. Although this partialisation of flow, combined with the variable flow rate of fluid toward the different panels, has made it possible to differentiate the heating between panels, a problem that is nonetheless encountered lies in the fact that the partialisation in panels with a valve cannot be inverted after the manufacturing stage because it is not possible to access the site where the partition is located within the valve assembly due to the "T" shape of the latter. In other words, it is not possible to give priority to another radiator panel rather than the one the radiator was conceived for by inserting the partition in one of the couplings of the valve assembly. Moreover, the flow of the fluid inside the panels is difficult to regulate and, due to the high velocity of the fluid output from the control valve of the system, the time for which the fluid remains is generally too short to enable an optimal heat exchange between the heating fluid and the radiator panels.

Summary of the invention

[0004] The basic idea of the invention thus lies in the fact of configuring a fluid distribution element which provides the functionality of a partition, i.e. it creates a restriction on the outlet side towards a panel that must heat up more slowly or remain at a lower temperature, but simultaneously enables a selection, even once the radiator is installed, of which panel the restriction must be effected for. Moreover, the invention is able to significantly decrease the flow velocity of the fluid by creating a turbulent motion in the fluid entering into circulation inside the radiator in order to favour a significant increase in the heat exchange.

[0005] For this purpose, the invention proposes an element for the distribution of fluid inside a radiator for heating rooms having the features of claim 1 below. Moreover, it proposes a kit for installing and/or subsequently adjusting a fluid distribution element in a valve assembly having the features of claim 12, as well as an associated valve assembly according to claim 14. Preferred embodiments of the invention are described in the respective subordinate claims.

[0006] According to the invention, a fluid distribution element for a radiator with a valve assembly comprises a central member configured to be mounted on a valve seat within the valve assembly itself, and at least one partition positioned on one side of the central member and configured to be placed in an outlet passage of the valve assembly. The central member, once mounted, is capable of being rotated about the valve seat and the partition is configured to change position and be placed in another outlet passage of the valve assembly. In this manner the user can modify (for example vary or invert) the partialisation of flow by changing the coupling where the partitions are placed, thereby giving priority to a panel other than the one originally configured at the time of installation.

[0007] Preferably, the distribution element comprises two partitions positioned respectively on opposite sides of the central member and configured to be placed in a respective outlet passage of the valve assembly, at least one of the partitions comprising one or more openings for the passage of fluid, wherein one or more openings of at least one of the partitions is an opening for slowing flow which has a size and shape such as to induce a reduction in the velocity of the fluid as it passes through the opening. By providing an opening for slowing flow in at least one of the partitions one obtains a flow that enters the respective panel of the radiator with a flow velocity that is lower than the outlet flow velocity of the thermostatic valve, and also than a flow that passes through a traditional partition. The conventional holes, which are substantially throttle elements and only narrow the fluid passage cross section, cause the velocity to increase as a result of the Venturi effect and thus lead to a shorter presence and a less effective heat exchange. With the distribution element according to the present invention, by contrast, one obtains a longer presence of the fluid inside a preferred radiator part, depending on the orientation of the fluid distribution element, and consequently a significant increase in the heat exchange. It should be noted that the valve seat is substantially defined by the end of the outlet tube on the inlet side of the valve assembly.

[0008] Preferably, the one or more openings of at least one of the partitions is an opening that has a size and shape such as to induce turbulence in the fluid as it passes through the opening. Unlike the laminar flow favoured by the passage through the throttle element of conventional partitions, turbulent flow has a lower average velocity. In addition to the reduction in velocity, turbulent motion also favours the heat exchange between the fluid and the radiator, since the water molecules also exhibit a motion transversal to the average flow direction, thus increasing friction and facilitating the contact of more areas of the fluid with the metal surfaces of the radiator.

[0009] In a preferred variant, the partition comprises openings for slowing flow in the form concentric circle segments, which can preferably have a non-constant cross section in the direction of passage of the fluid. For example, the cross section can be initially narrowed and then enlarged.

[0010] In another preferred variant, the partition comprises openings for slowing flow that are separated by fins, a surface of which has a convex portion followed, in the direction of flow, by a concave portion. The overall surface of the fins thus has the effect of diverting the flow from a straight trajectory through the opening (as does the rear spoiler of a sports car), and the openings thus induce a helical motion in each of the respective flows passing through the individual openings, which results in a turbulent mixing of the fluid during and after its passage through the partition. Moreover, the extent of the fins, in the direction of the flow through the openings, is preferably greater than the thickness of the partition.

[0011] In another preferred variant, the partition comprises circular openings for slowing flow whose inner walls comprise a helically shaped groove. Preferably, the side of the groove turned against the direction of flow is perpendicular to the direction of flow. The fluid entering the opening is forced, at least in part, to follow the groove, thus generating a helical motion in the fluid passing through the opening which results in a reduction in velocity and creation of turbulence in the flow.

[0012] In another preferred variant, the partition comprises an opening with a substantially spiral-shaped section. The wall of the opening on the inner side of the spiral is substantially straight and parallel to the direction of flow, whilst the opposite wall, on the outer side of the spiral, comprises an inclined portion followed, in the direction of flow, by a straight portion parallel to the direction of flow. As the fluid passes through the opening, a vorticity is created in the flow which results in a turbulent motion after the passage through the partition and causes a slowing in the flow velocity of the fluid, compared to the valve outlet velocity present before the partition.

[0013] Preferably, both partitions comprise one or more fluid passage openings. In this manner one can obtain a distribution and control of the water in both panels of the radiator according to ratios that are freely definable on the basis of the size and conformation of the openings in the respective partitions.

[0014] Preferably, the one or more turbulence openings have adjacent fins that follow the perimeter of the opening itself. With these fins, which project from and/or penetrate the plane of the opening and are suitably positioned around the perimeter of the opening, a turbulent motion is induced inside the heat transfer fluid in a particularly effective manner. In order to further increase said turbulent motion, the adjacent fins preferably have a variable profile. Variable profile means a change in profile in terms of height along the extent of the adjacent fin relative to the plane of the partition or a change in profile along the plane of the partition. This variable profile further influences the flow arriving at the partition and reinforces the turbulence generated by the adjacent fin. The openings with fins are not, however, the only solution for inducing turbulence. The invention also envisages openings in the form of a series of slots, a plurality of square-shaped openings with dimensions below 2 mm (per side of the square opening), openings in the form of concentric circle segments, openings in the form of a circle sector ("slice of pie"), and hemispherical openings, all configured so as to induce a turbulent motion inside the heat transfer fluid in a particularly effective manner.

[0015] The partitions can be made up completely or partially of materials that are different from and/or integrated with each other, all falling within the scope of existing science and the prior art.

[0016] The one or more openings of one or both partitions can have identical sizes and/or shapes. In other embodiments, however, it is envisaged that the sizes and/or shapes are different from one another, with the advantage of making the control, regulation, partialisation, motion (laminar or turbulent) and flow velocities of the heat transfer fluid inside the radiator particularly flexible.

[0017] In a preferred embodiment, the one or more partitions each have a shaped protrusion which extends perpendicularly to the respective partition and in which the shaped protrusion is conformed so as to enter into contact and interact with a regulating valve. Upon the insertion of the valve in the valve assembly, in which the fluid distribution element is located, there is therefore an effect whereby screwing the valve into the valve assembly will cause the inner end of the valve to push the fluid distribution element onto its seat (for example, on the end of the outlet tube) and place it in the correct, desired position relative to the seat and outlet couplings.

[0018] In a preferred embodiment, the shaped protrusion comprises an inclined guiding surface configured to centre and push the partitions axially and radially into the predefined desired position, by means of the regulating valve itself, on an axis with the central member, an axial thrust surface perpendicular to the partition configured to be pushed by the valve in an axial direction and a radial thrust surface perpendicular to the partition configured to be pushed by the valve (for example by its distal end) in the direction of the seat housing the partitions on the inner part of the outlet passage of the valve assembly. The angle of the inclined guiding and pushing surface is to be understood as relative to the plane of the partition. With this particular conformation of the surfaces of the protrusion one obtains a further advantage in that, upon the insertion of the valve, not only is the fluid distribution element positioned correctly, but it is also guided by the inclined surface and positioned on the seat as the valve is inserted without there being any risk of the distribution element becoming jammed. Moreover, with the radial thrust surface one obtains a perfect positioning of the partitions on the outlet couplings of the valve assembly. In this manner the partition rests upon the outlet coupling in a perfectly adherent manner, assuring a perimeter seal and allowing the heat transfer fluid to pass solely through the openings provided in the distribution element.

[0019] In a preferred embodiment, the central member is a ring-shaped member configured to be fitted over the perimeter of the valve seat of the valve assembly. Conveniently, the ring-shaped member is thus fitted over the perimeter of the outlet tube on the inlet side of the valve assembly. In particular, the ring shape enables the central member to be fitted and perfectly centred on the perimeter of the valve seat (of the outlet tube), thus ensuring in particular that both it and the partition or the two partitions of the distribution element are placed and act in the desired position as well as with assured precision. Moreover, it facilitates the rotation of the central member once mounted, thus helping in the operation of varying or changing the preference in terms of flow from one panel to the other.

[0020] In such a case it is particularly preferred for the ring-shaped member to have, on its inner perimeter, wedge-shaped fins configured to engage the valve seat of the valve assembly (the outlet tube on the inlet side of the valve assembly) in such a way as to centre the fluid distribution element in position relative to the valve seat within the valve assembly, in any case permitting a rotation of the fluid distribution element about an axis of the valve upon the application of a rotational force on the ring-shaped member. The fins thus cooperate in the perfect positioning and stability of the central member on the valve seat and hence of the fluid distribution element within the valve assembly in any orientation that is subsequently set and can be set.

[0021] Preferably, in a further preferred embodiment, the ring-shaped member has, on its outer perimeter, anchorage recesses and unidirectional orientation guides, configured to be engaged by corresponding protrusions of a positioning and insertion tool. With these recesses and guides it is possible to use a corresponding insertion tool with which the fluid distribution element of the invention can be inserted in a unique, predetermined orientation. The tool can also be used subsequently, i.e. when the fluid distribution element is already in position within the valve assembly and may have already been used in operation, engaging the central ring-shaped member of the element with a unique orientation, in such a way as to always know with certainty what orientation it has and be able to change it in a given manner, continuously, by rotating the distribution element by means of a pushing tool. This tool can therefore also be called a "pushing and rotating tool".

[0022] According to another embodiment of the fluid distribution element, the one or more partitions are preferably substantially circular in shape and comprise opposite flattened perimeter zones. In this manner the insertion of the fluid distribution element inside the threaded passages of the valve assembly is facilitated, as the partitions would otherwise not be able to be inserted because of their size when they are pushed or rotated in the valve assembly.

[0023] Preferably, hollows are formed in the one or more partitions to reduce the cross section (i.e., the thickness) of the material of the partitions in the flattened perimeter zones. This solution serves to elasticise and optimise adherence precisely in the zones of the partitions where they come into contact with the inner walls of the valve assembly and where a watertight seal is achieved, as well as upon insertion of the fluid distribution element.

[0024] In this context, it is moreover preferable that the one or more partitions be connected to the central member by means of a respective hinge, which enables the respective partition to take on a perpendicular orientation relative to the central member. This will facilitate the correct positioning of the distribution element at the time of application. The hinge preferably has incisions that facilitate the folding of the hinge itself.

[0025] Finally, in a preferred embodiment, at least one of the partitions is provided with vent openings suitably located on the upper and lower perimeters of the partition. In this manner, any air present in the radiator circuit can be made to escape irrespective of the installation and/or subsequent orientation of the fluid distribution element of the invention.

[0026] Moreover, the invention proposes a kit for the installation and/or subsequent adjustment of a fluid distribution element in a valve assembly, comprising:

the fluid distribution element according to one of the previously explained embodiments, and a positioning tool configured to engage with the fluid distribution element in such as a manner as to enable a unique rotational orientation between the tool and element. This solution makes it possible not only to set the orientation of the distribution element, but also to modify a previously defined orientation of the internal flow thereof and/or make it reversible, by inverting the positioning of the partitions. As the distribution element can be extracted by means of the tool, it is also possible, where desired, to modify, by means of a suitable modification of the openings in the partition/partitions, or by replacing the element, and/or of cancelling, by the neutral orientation or extraction thereof, the predefined (preset) orientation of the flow. Moreover, the same solution makes it possible to introduce the definition of an orientation of flow in pre-existing radiators / valve assemblies where this was not originally envisaged or allowed at the time of their manufacture.

[0027] Preferably, the tool comprises, at its distal end, a pusher ring for contacting and pushing the central member of the distribution element and pins or protrusions configured to engage with the central member in a unique orientation, preferably with the anchorage recess and orientation guides. The configuration of the ring that pushes the ring-shaped central member serves to assure an exact positioning, preventing the central member from becoming jammed, while the pins assure that the distribution element takes on the desired orientation.

[0028] Finally, the invention also proposes a valve assembly of a radiator with a valve seat, a first outlet coupling and a second outlet coupling, and comprising the fluid distribution element according to one of the embodiments described hereinabove, wherein the central member is inserted on the valve seat and the one or more partitions are each inserted in a respective outlet coupling, the fluid distribution element being rotatable about an axis coinciding with that of the valve seat in such a way as to modify and/or invert the position of the one or more partitions and/or set them in a neutral intermediate position.

Brief description of the drawings

[0029]

Figures 1a) and **1c)** show front perspective views;
Figures 1b) and **1d)** show rear ones of the distribution element according to a first embodiment of the invention with one partition only,
Figures 1e) and **1f)** show a respectively front and rear perspective view of a second embodiment of the distribution element of the invention with two partitions, and
Figure 1g) shows a sectional view of a partition of the distribution element of Figures 1c)-1f) according to the invention;
Figure 2a) shows a perspective view of a valve assembly and of the distribution element of Fig. 1 in an insertion orientation, and **Figure 2b)** shows a cross section of the threaded coupling of the valve assembly while the distribution element of Figure 2a) is being inserted and pushed toward the valve seat;
Figure 3 shows a partial perspective view of the distribution element of Fig. 1 and of a positioning tool oriented for engagement with said element;
Figure 4a) shows the distribution element of Fig. 1 and the valve assembly prior to insertion, **Figure 4b)** shows the distribution element inserted in an operating position and **Figure 4c)** shows the distribution element while it is being rotated into a new position which inverts the position of the partitions relative to Fig. 4b);
Figure 5a) shows a perspective view of the valve assembly with the distribution element inserted, as in Figure 4b), prior to insertion of the valve into the valve assembly, the **Figure 5b)** shows a sectional view of the valve assembly of Figure 5a), **Figure 5c)** shows a sectional view of the valve assembly in a first step of inserting the valve, and **Figures 5d)** and **5e)** show a sectional and perspective view of the valve assembly in a second step of inserting the valve which rests on the valve seat within the valve assembly;
Figures 6a)-6d) show a perspective view, a plan view, a sectional view along the line Z-Z, and a sectional view of a detail Y of an alternative embodiment of the openings in the partitions;
Figures 7a)-7d) show a perspective view, a plan view, a sectional view along the line Z-Z, and a sectional view of a detail Y of an alternative embodiment of the openings in the partitions;
Figures 8a)-8c) show a perspective view, a plan view, a sectional view along the line Z-Z, and a sectional view of a detail Y of an alternative embodiment of the openings in the partitions;
Figures 9a)-9c) show a perspective view, a plan view and a sectional view along the line Z-Z of an alternative embodiment of the openings in the partitions; and
Figures 10a)-h) show further embodiments of the distribution element according to the invention.

Detailed description

[0030] Figures 1a) and b) show a fluid distribution element 1 according to a first possible embodiment. The distribution element 1 comprises a substantially ring-shaped support member C, which is dimensioned so as to be fitted onto an end of the outlet tube 41 on the inlet side of a valve assembly 40 of a radiator (Figs. 4a)-c)), said end of the tube representing a seat S of the regulating valve within the valve assembly 40 itself. The support member C serves to support a partition A, connected thereto by means of a hinge 31 which comprises, at the point of connection both with the partition A and the central member C, an incision 11 which facilitates the folding of the partition A and of the central member C relative to the hinge 31, so that the partition can easily take on a position both parallel to the plane of extension of the central member C, and perpendicular to that extension, the latter orientation making the distribution element 1 suitable for insertion in a valve assembly 40 through the threaded coupling 42 for the valve (see Figures 4a)-c)).

[0031] The partition A of the distribution element 1 of Figures 1a) and b) comprises a single opening 2, circular in shape in the case represented, whereas the other two openings, or rather holes, provided, indicated in Fig. 1a) with the reference number 2', are blind and can be easily opened and transformed into openings, for example by means of a tool, if it is desired to have a larger passage cross-section area for the heat transfer fluid (hot water). In the example illustrated, there are further provided vent openings (holes) 12 located, for greater effectiveness, on the upper and lower perimeter of the partition A. In fact, if air must be removed from the plumbing circuit filled with water, this air is accumulated at the top of the tubing and can be more easily discharged (pass the partition) if the vent hole 12 is located accordingly. Since the orientation of the partition A can be inverted based on the connection it must be inserted into, the vent holes 12 are provided both on the upper and lower perimeters.

[0032] Figures 1c) and d), on the other hand, illustrate an alternative embodiment wherein the partition B comprises three openings for slowing flow 3, whose function will be described further below with reference to Figures 1e), f) and g). In the preferred embodiment illustrated in Figures 1e) and 1f), there are instead provided two partitions A, B on two opposite sides of the ring-shaped central member C, connected to the central member C by means of respective hinges 31. As in the examples of Figures 1a)-d), at the point of connection with the partitions A, B and with the central member C, the hinges 31 comprise a respective incision 11 which facilitates the folding of the partition A, B and of the central member C relative to the hinge 31. In this manner the distribution element 1 can be easily inserted in a valve assembly 40 by means of the threaded coupling 42 for the valve (see Figures 4a)-c)).

[0033] In the two embodiments illustrated in figures 1c), d), e) and f), the partition B comprises three substantially drop-shaped (as seen in a plan view) openings 38 arranged in the partition in a helical form, i.e. with rotational symmetry around the centre of the partition B. As shown in Figure 1g), the cross section of the openings 3 is variable; for example, it increases for the opening 3 on the left side of figure 1g) and decreases for the opening 3 on the right side, in a substantially conical manner from the inside (part turned toward the valve) of the partition toward the outside (part turned toward the panel). On passing through the two openings, the respective flows of fluid have different velocities which lead to a pressure difference between them, with a consequent increase in viscous friction and subsequent turbulent mixing together of the flows. The shape and size of the openings 3 are therefore such as to induce turbulence in the fluid after its passage through the opening. Thermographic tests performed have shown the distribution of flows and desired temperatures in a wide range of flow rates, but this shape is in no way limiting, since a plurality of alternative shapes for the opening is possible (see Fig. 6).

[0034] The opposite partition A, by contrast, comprises, like the single partition in the example of Fig. 1a), only one opening 2 for the passage of water and two blind openings 2', as well as the vent openings 12, located, for greater effectiveness, on the upper and lower perimeter of the partition A, B.

[0035] Around the openings 3 of the partition B there are adjacent fins with a variable profile 4, which project from the plane of the partition and follow the perimeter of the opening 3 itself, contributing, by virtue of their irregular profile, to generating a turbulent flow during the passage of water through the opening 3. The fins 4 of these two examples have a variable height from the partition, with one part 4a, in particular, lower than the rest of the fin 4 (see Figs. 1c) and e)). This profile imparts a sort of rotation to the water passing through the openings 3, a rotation that is transformed into turbulent motion on the outlet side, thus slowing the flow in the radiator panel downstream of the partition B in a particularly effective manner, thereby increasing the time for which the fluid remains in the panel, hence the heat exchange between fluid and panel and ultimately the heat radiated from the panel.

[0036] Positioned between the individual openings 3 of the partition B there are fins 5 which appropriately divert the flow of fluid and lend it a turbulent motion further enhancing what occurs by virtue of the fins 4 and the shape and size of the openings 3. The fins 5 also have, in this example, a variable profile with a recessed part 5a, clearly visible in Figure 1g).

[0037] In the other partition A, only the opening 2 is a through opening, whilst further pre-prepared openings are also present, indicated in the figure with the reference number 2'; therefore, a ratio is generated between the flow passing through the partition A and partition B. In the present case, as the total cross section of the openings 3 in the partition B is greater than the total cross section of the opening 2 in the partition A, the water is preferentially directed towards one of the panels, which is thus filled with a larger amount of water with a flow at a reduced velocity. In this manner, therefore, two effects of partialising and slowing the flow are combined in such a manner as to be able to determine in advance and in an accurate manner the differentiated heating mode between the two panels.

[0038] The two partitions A, B are substantially circular in shape and, in this example, both comprise flattened zones 26 provided on each partition in diametrically opposite positions, on the top and bottom. Moreover, in these flattened zones 26 there are hollows 6, which reduce the thickness of the material of the partitions A, B, making such portions of a reduced cross section flexible. By virtue of the flattened zones 26 and the flexibility imparted by the hollows 6, these flexible portions can be bent, thus allowing the distribution element to be inserted through the thread for the valve and subsequently positioned within the valve assembly. This flexibility and utility of the flattened zones 26 are indicated with arrows L in Fig. 2a.

[0039] On the inner wall (facing towards the inside of the valve assembly 40) of both partitions A, B, there is a shaped protrusion 28, 28', which has the function of centring the partitions A, B as well as the central part C in the respective seats S, 43 within the valve assembly 40 upon the insertion of the thermostatic valve 30 (see Figures 4a and 5a). In this example, the two shaped protrusions 28 and 28' have a slightly different structure; in particular, with reference to Figures 1a and 5b, the shaped protrusion 28 of the partition B comprises an inclined guiding surface 8, whereas the one of the partition A comprises two inclined surfaces 8', separated by a gap 28a'. The surfaces 8 and 8' are both configured to centre and push the partitions A, B axially (in the direction of the valve axis) and radially (direction in relation to the rotational symmetry of the valve), a push that is provoked by the contact between the plug 33 of the valve 30 during the insertion thereof into the valve assembly 40 and the inclined surface 8 as shown in Fig. 5c, which illustrates how the plug 33 comes into contact with the inclined surface 8, thus pushing the distribution element along the direction P, i.e. in both a radial and axial direction. When the thermostatic valve 30 is moved forward and starts to be screwed in, the plug 33 moves beyond the shaped protrusions 28, 28' and is free to interact with the valve seat S.

[0040] Both the shaped protrusion 28 of the partition B and the shaped protrusion 28' of the partition A further comprise an axial thrust surface 9, perpendicular to the plane of the partition, which, when the partitions A, B are in a position perpendicular to the surface of the central member C, is parallel to the central member. The axial thrust surface 9 is configured to be pushed by the distal surface 34a of the body 34 of the valve 30 in an axial direction, thus pushing the central member C into its final position in the valve seat S (Figures 5d and 5e).

[0041] Finally, the shaped protrusion 28 comprises a radial thrust surface 10, parallel to the partition, which is engaged by the lateral surfaces 34b of the body 34 of the valve 30 when the latter is screwed with its thread 32 into the threaded coupling 42 of the valve assembly 40. In this manner the valve 30 pushes the partitions A, B radially and places them in their operating position in the housing seat of the partitions 43 on the inner part of the outlet passage F, R of the valve assembly 40. The shaped protrusion 28', by contrast, comprises two radial thrust surfaces 10 with an analogous function. As the distribution element 1, and in particular the partitions A, B, are made of plastic material (for example nylon) and comprise in addition hollows 6 which make the corresponding portions of the partition flexible, the radial push exerted due to the interaction between the surface 10 and the end of the valve 30 ensures that the partition A, B adheres perfectly to the housing seat 43 and assures the required watertight seal.

[0042] The central member C comprises, on its outer perimeter, anchorage recesses, in the illustrated example two recesses 14 positioned on opposite sides in the upper and lower part of the ring-shaped central member C, as well as two orientation guides 15 positioned on one side of the ring (on the top or bottom), in this case respectively to the left and right of the anchorage recess 14 on the upper perimeter. The anchorage recesses and the orientation guides 15 are both configured to be engaged by corresponding pins 14a, 15a of the positioning and installation tool 13, illustrated in Figure 3. When the tool 13 is inserted into the distribution element 1, the pins 14a, positioned on opposite sides of a circular pusher ring 16, are inserted into the anchorage recesses 14, thus enabling a rotation of the ring-shaped central member C, and hence a choice of the orientation of the two partitions A, B relative to the housing seats 43 of the respective couplings F, R within the valve assembly 40. Given that the unidirectional orientation guides 15 and the respective pins 15a are located on only one side of the ring-shaped central member C and of the pusher ring 16 of the tool 13, the tool 13 can be inserted into the distribution element 1 in a single, unique orientation. Therefore, the installer always has information at his disposal concerning which of the partitions A, B, is positioned in the housing seat 43 of which coupling, F or R. An arrow 18 provided on the handle of the tool 13 can serve to memorise the side (front or rear panel) towards which the opening cross section of the openings 3 is larger and allows a larger flow to pass.

[0043] Finally, the distal surface of the pusher ring 16 rests on the thrust base 20 (axial surface of the ring-shaped central member C) in such a way as to transmit the pushing force evenly onto the central member C towards the seat S of the valve. Moreover, the process of positioning the distribution element 1 is aided by providing wedge-shaped projections 7 on the inner perimeter of the ring-shaped member C, which are configured to engage the valve seat S and ensure centring of the distribution element 1 in position relative to the valve seat S within the valve assembly. The wedge-shaped projections 7 in any case allow the distribution element 1 on the seat S to rotate about the axis of the valve 30 when a rotation force is applied by means of the tool 13.

[0044] Since the two partitions A, B comprise flattened perimeter zones 26 as well as hollows 6, on opposite sides (on the top and bottom) of the partition, which reduce the thickness of the material in the flattened zones, the partitions can be bent and adapted to the cylindrical shape of the passage for the valve (threaded coupling) 42 of the valve assembly 40, as indicated in Fig. 2b. In this manner, both the insertion and removal of the distribution element 1 into / from the valve assembly 40 proves to be particularly easy. This applies both for the embodiment with two partitions A, B and the one with a single partition A, B.

[0045] Figures 4a) to 4c) illustrate the steps of installing and re-orienting the distribution element 1 within the valve assembly 40. In Figure 4a, the tool 13 is inserted into the distribution element 1 and is used to introduce the distribution element 1 through the threaded coupling

42 for the valve and bring it into position on the valve seat S, i.e. to fit the ring-shaped central member C on the end of the outlet tube 41. Via the orientation indicator 18 of the tool 13 it is possible to orient the partitions A, B in such a way that they will be perfectly in position in front of the seats 43 of the couplings F, R connecting with the front and rear panels of the radiator. Such positioning of the distribution element 1, with the two partitions A, B and the central member C in a perfect operating orientation, is illustrated in Figure 4b).

[0046] If, in a period following installation, it should become necessary to change the flow ratios between the front panel and rear panel, it will be possible to replace the distribution element 1 with another distribution element having openings of a different shape and/or size, or else invert the partitions A, B, and thus invert the respective loads of the front and rear panels, by rotating the distribution element 1 with the aid of the tool 13. It will likewise be possible to completely neutralise the effect of the distribution element 1 and hence of the partitions A, B by positioning the partitions in a neutral orientation where they are located in the upper and lower parts of the valve assembly 40. The rotation step is illustrated in Fig. 4c).

[0047] After having installed, re-oriented or changed the distribution element 1 with the aid of the tool 13, one inserts and screws the valve 30 into the threaded coupling 42 of the valve assembly 40. As the body 34 of the valve 30 moves forward, it engages the shaped protrusions 28, in particular the surfaces 8, 9 and 10, centring, in this manner, both the partitions A, B and the central member C, thus assuring a perfect positioning and a perfect seal of all the components of the distribution element 1 (Figures 5c), 5d) and 5e)).

[0048] Figures 6a)-6d) illustrate an alternative embodiment of the openings present in the partitions, here in the partition B. The openings 103 have the form of concentric circle segments, positioned in three circle sectors interrupted by two narrow bridges 105 and two of greater width 105' and 105". On one of the wide bridges 105' there is provided a shaped protrusion 128, which, in this example, lacks the axial thrust surface present in the protrusion 28 of the variant in Figure 1. As can be seen from the plan view in Fig. 6b), the openings 103 do not have a constant cross section on the plane along the segment, but rather become narrower toward the bridge 105". Moreover, the openings 103 have, in the direction of the passage of the fluid F, a cross section that initially narrows between conically inclined surfaces 151 and 152 and then widens again between surfaces 153 and 154. This combination of cross sections along the passage of the fluid through the openings results, after the fluid has passed through the openings into the radiator panel, in a turbulent mixing of the flows corresponding to the individual openings and therefore brings about a slowing of the velocity and increase in the friction of the overall flow with the walls of the radiator, thus improving the heat exchange.

[0049] Another variant of the openings is illustrated in Figures 7a)-7d). Here the partition B comprises three openings 203 separated by fins 205. As can be deduced from the sectional view in Fig. 7c), the extent of the fins 205 in the direction of the flow through the openings is greater than the thickness of the partition B. The fins 205 have an asymmetrical shape, with a convex surface portion 205a followed, in the direction of the flow, by a concave surface portion 205b (Fig. 7a), both surfaces facing towards an opening 203, whilst the opposite surface 205c, facing toward the adjacent opening, is substantially straight and inclined relative to the direction of flow F (Fig. 7d). With this shaping of the surfaces, the fins divert flow from a straight trajectory through the opening (see arrow D in Fig. 7d), thereby inducing a helical motion in each of the respective flows passing through the individual openings 203. In the example, during and after passage through the partition a turbulent mixing of the fluid and hence a slowing of the flow is obtained.

[0050] Figures 8a)-c) show a further variant of the openings. In this example, the partition B comprises three circular openings 303 whose inner walls comprise a helically shaped groove 303a. Unlike a thread, the helical groove 303a of this variant has a side 303b, turned against the direction of flow, substantially perpendicular to the direction of flow. The opposite side 303c is instead inclined (non-perpendicular) relative to the direction of flow. The fluid that passes through the opening 303 is forced, in particular by the perpendicular side 303b, to follow the groove 303a, thus imparting to the flow through each individual opening 303 a helical (spiral) motion that slows down the overall flow and creates turbulence upon the passage through the openings 303. Moreover, the generation of the helical movement of the fluid is facilitated by fins 305, which extend in an undulating manner on one side of the openings 303. The profile of the fins 305 is variable, the height of the fins decreasing from a part with a high profile 305a towards a part with a low profile 305b. The fins 305 thus constitute deflectors which contribute to diverting flow from the regular trajectory, further contributing to the helical motion effect imposed by the openings 303.

[0051] Another variant of the slowing opening is illustrated in Figures 9a)-c). Here, the partition B comprises a single opening 403 with a spiral shape and cross section, inclined walls 403a and straight walls 403b and 403c. Upon the passage of the fluid through the opening, a vorticity in the flow is created which results in a turbulent motion after the passage through the partition and causes a slowing in the flow velocity of the fluid, compared to the valve outlet velocity present before the partition. Finally, Figures 10a - h show various other alternatives for the dimensioning and conformation of the openings 2, 3 in the partitions. The distribution element 1 illustrated in Figure 1 is indicated in Fig. 10a. In Figure 10b, both the partitions A, B have three propeller blade-shaped openings 3 and interposed fins with a variable helical sector profile 5, whereas in Figure 10c both the partitions A, B have only one through opening 2, whereas the other openings 2' are profiled or partially blind, non-through openings.

[0052] In the remaining Figures 10d to 10h, the partition B has three inverted propeller blade-shaped openings (Fig. 10d), in sectors (Fig. 10e), diagonal slits (Fig. 10f), square holes (Fig. 10g) and four concentric circle segments (Fig. 10h), all conformed so as to slow the flow and generate turbulence upon the passage through the openings 3. Si noti che in questo caso le aperture occupano una parte significativa della superficie del setto, di modo che la protrusione sagomata 28 viene preferibilmente prevista solamente sul setto A, come nelle varianti delle Figure 6 e 7. It should be noted that in this case the openings occupy a sizeable part of the surface of the partition, so the shaped protrusion 28 is preferably provided only on the partition A, as in the variants in Figures 6 and 7. Moreover, in the examples in Figs. 10d - 10h, the unidirectional orientation guides 14 of the central member C are offset on opposite positions on the outer perimeter of the central ring-shaped member C.

Claims

1. A fluid distribution element (1) for a radiator with a valve assembly (40), comprising:

   a central member (C) configured to be mounted on a seat (S) of the valve within the valve assembly (40), and
   at least one partition (A, B) positioned on one side of the central member (C) and configured to be placed in an outlet passage (F, R) of the valve assembly (40),

   characterised in that the central member, when mounted, is capable of being rotated about the valve seat and the partition is configured to change position and be placed in another outlet passage (R, F) of the valve assembly (40).

2. The element according to claim 1, comprising two partitions (A, B) positioned respectively on opposite sides of the central member (C) and configured to be placed in an outlet passage (F, R) of the valve assembly (40), at least one of the partitions comprising one or more openings (2, 3) for the passage of fluid,
   wherein the one or more openings (3) of at least one of the partitions (B) is a flow slowing opening (3) which has a size and shape such as to induce a reduction in the velocity of the fluid as it passes through the opening.

3. The element according to one of the preceding claims, wherein the one or more partitions (A, B) each have a shaped protrusion (28, 28') which extends perpendicularly to the respective partition and wherein the shaped protrusion is configured to come into contact and interact with a regulating valve (30).

4. The element according to claim 3, wherein the shaped protrusion comprises an inclined guiding and pushing surface (8) configured to centre and push the partitions axially and radially in the predefined desired position via the regulating valve (30) on an axis with the central member (C), an axial thrust surface (9) perpendicular to the partition (A, B), configured to be pushed by the valve (30) in an axial direction, and a radial thrust surface (10) perpendicular to the partition and configured to be pushed by the valve (30) in the direction of the seat for housing the partitions on the inner part of the outlet passage (F, R) of the valve assembly (40).

5. The element according to one of the preceding claims, wherein the central member (C) is a ring-shaped member configured to be inserted and guided on the perimeter of the valve seat (S) of the valve assembly (40).

6. The element according to claim 5, wherein the ring-shaped member (C) has, on the inner perimeter thereof, wedge-shaped projections (7) configured to engage the valve seat of the valve assembly in such a way as to centre and secure the fluid distribution element in position relative to the valve seat within the valve assembly, whilst permitting in any case an engaged rotation of the fluid distribution element about an axis corresponding to the valve upon the application of a rotational force on the ring-shaped member (C).

7. The element according to claim 5 or 6, wherein the ring-shaped member (C) has, on the outer perimeter thereof, anchorage recesses (14) and unidirectional orientation guides (15), configured to be engaged by corresponding protrusions or pins (14a, 15a) of a positioning tool (13).

8. The element according to one of the preceding claims, wherein the one or more partitions (A, B) are substantially circular and opposite flattened perimeter zones (26).

9. The element according to claim 8, wherein in the one or more partitions (A, B) hollows (6) are formed which reduce the thickness of the material of the partitions in the flattened zones.

10. The element according to one of the preceding claims, wherein the one or more partitions (A, B) are connected to the central member (C) by means of a respective hinge (31) which enables the respective partition (A, B) to take on a perpendicular orientation

relative to the central member (C).

11. The element according to a of the preceding claims, wherein at least one of the partitions (A) is provided with vent openings (12) located on the upper and lower perimeters of the partition.

12. A kit for the installation and/or subsequent adjustment of a fluid distribution element (1) in a valve assembly (40), comprising:

the fluid distribution element (1) according to one of the preceding claims, and
a positioning tool (13) configured to engage with the fluid distribution element (1) in such a way as to enable a unique rotational orientation between the tool (13) and the element (1).

13. The installation kit according to claim 12, wherein the tool (13) comprises, at the distal end thereof, a pusher ring (16) for contacting and pushing the central member (C) of the distribution element (1) and pins or protrusions (14a, 15a) configured to engage with the central member (C) in a unique orientation, preferably with an anchorage recess (14) and the orientation guides (15).

14. A valve assembly (40) for a radiator, with a valve seat (S), a first outlet coupling (F) and a second outlet coupling (R), and comprising the fluid distribution element (1) according to one of claims 1 to 11, wherein the central member (C) is inserted in the valve seat (S) and the one or more partitions (A, B) are each inserted in a respective outlet coupling (F, R), the fluid distribution element (1) being rotatable about an axis coinciding with that of the valve seat in such a way as to modify and/or invert the position of the one or more partitions (A, B) and/or place them in a neutral intermediate position.

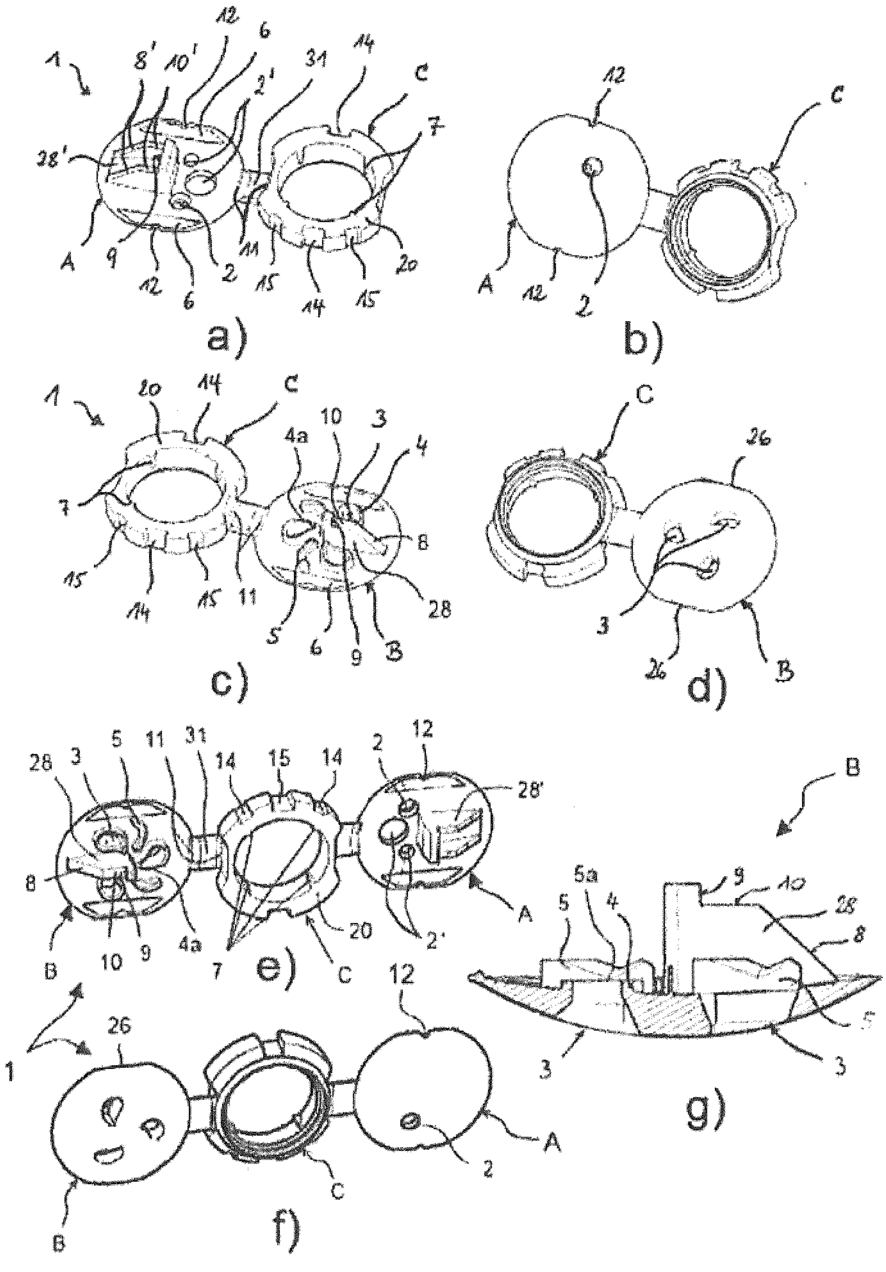


Fig. 1

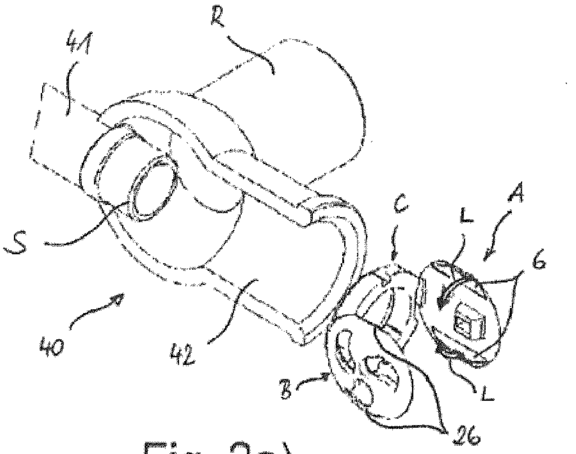


Fig. 2a)

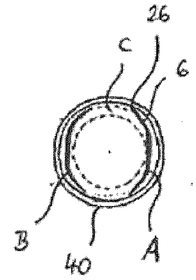


Fig. 2b)

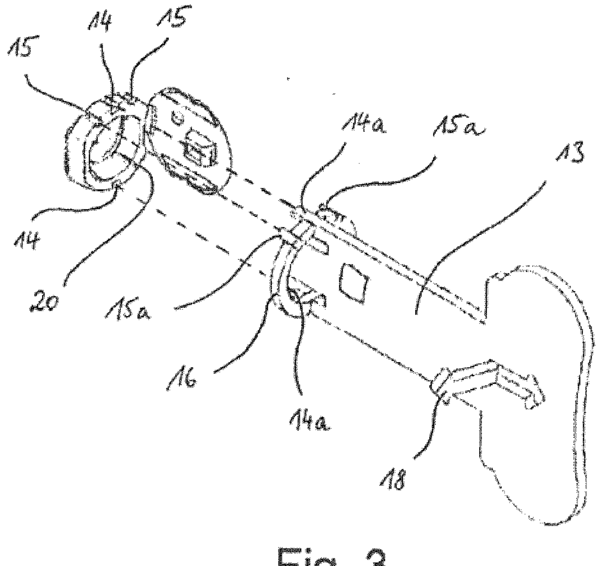


Fig. 3

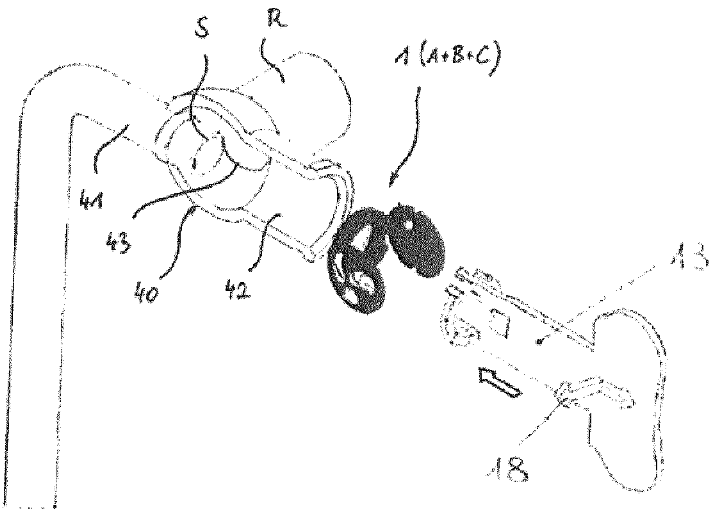


Fig. 4a)

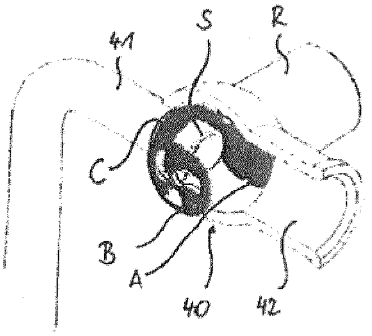


Fig. 4b)

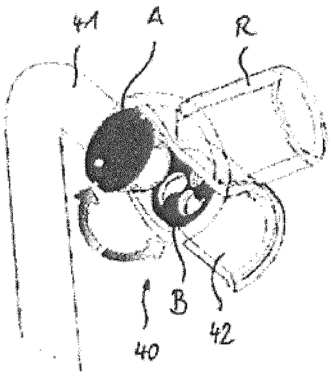


Fig. 4c)

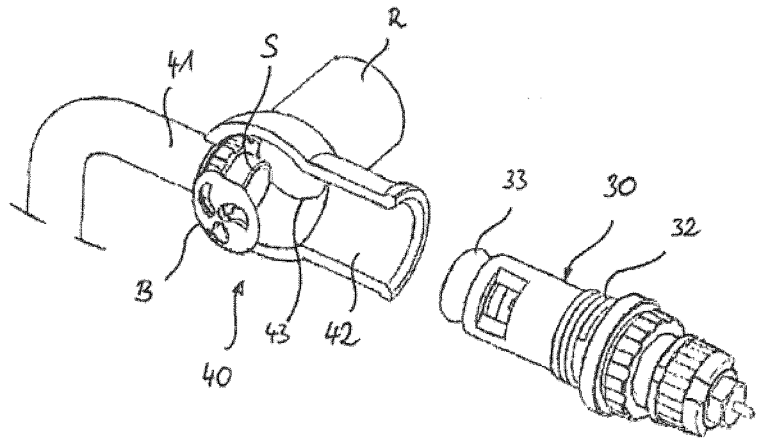


Fig. 5a)

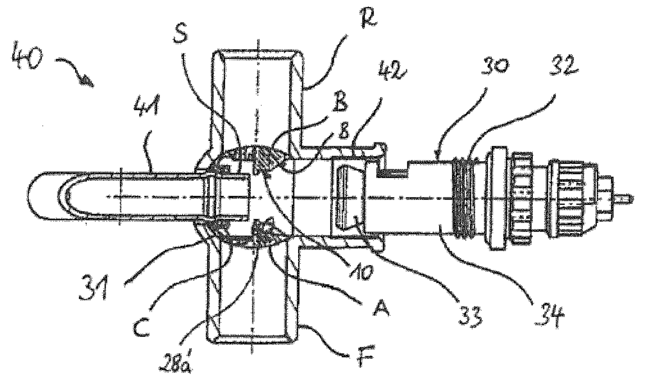


Fig. 5b)

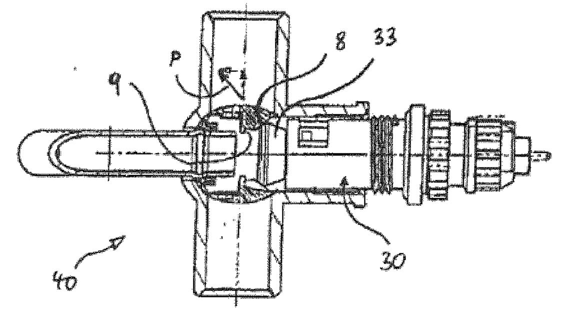


Fig. 5c)

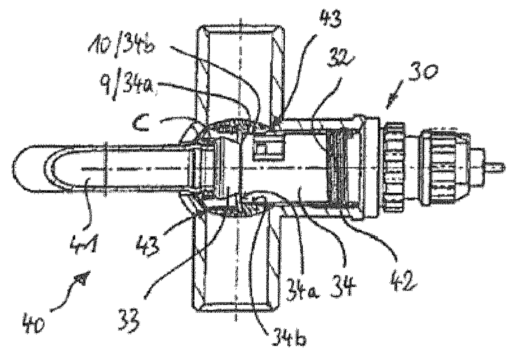


Fig. 5d)

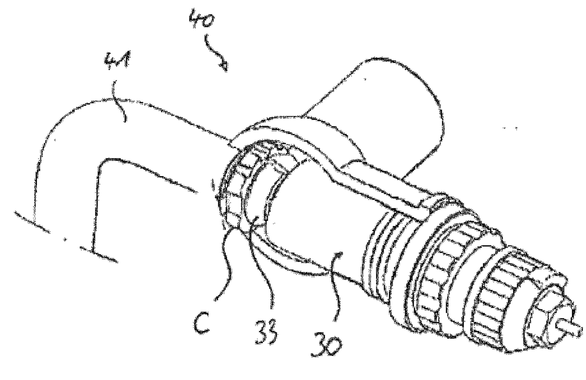


Fig. 5e)

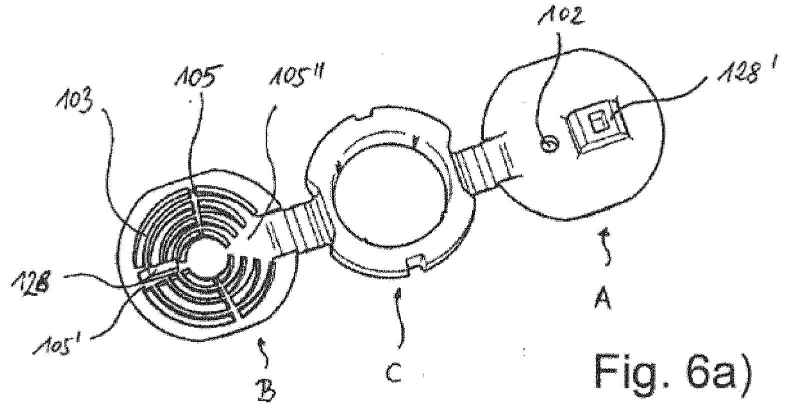


Fig. 6a)

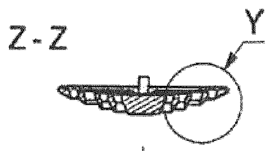


Fig. 6c)

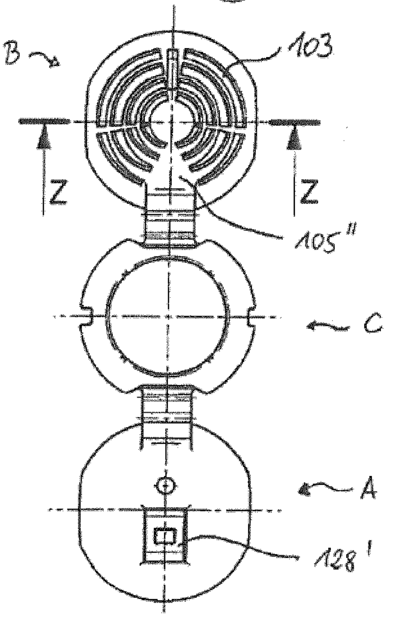


Fig. 6b)

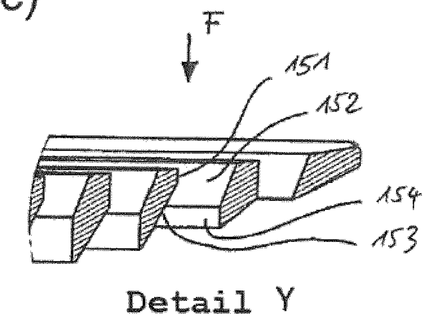


Fig. 6d)

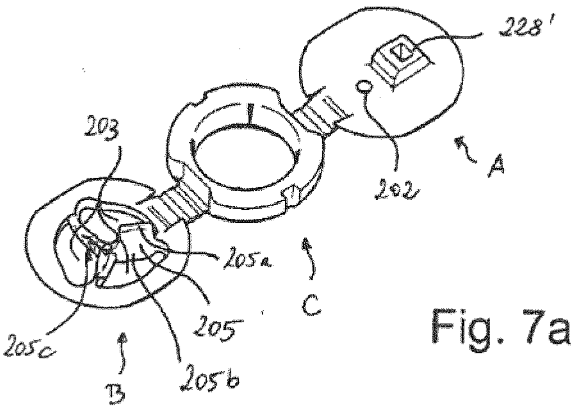


Fig. 7a)

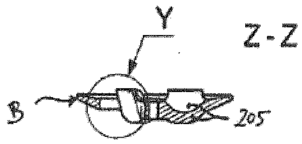
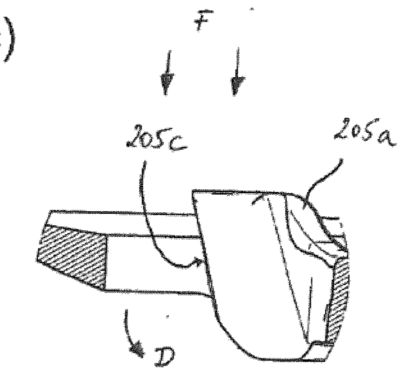


Fig. 7c)



Detail Y

Fig. 7d)

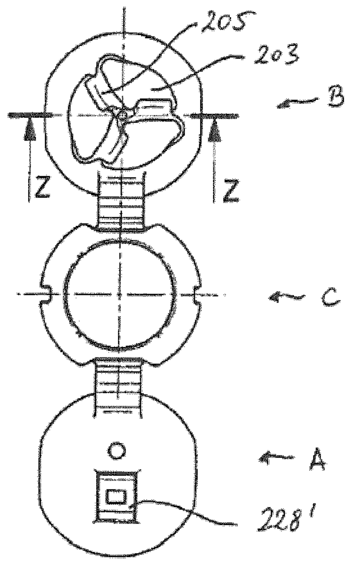


Fig. 7b)

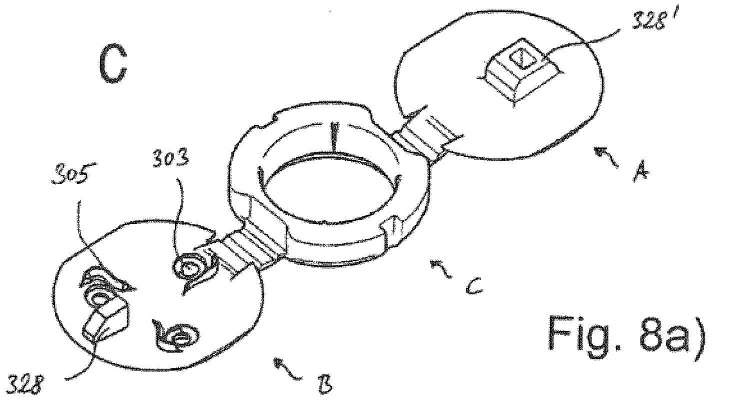


Fig. 8a)

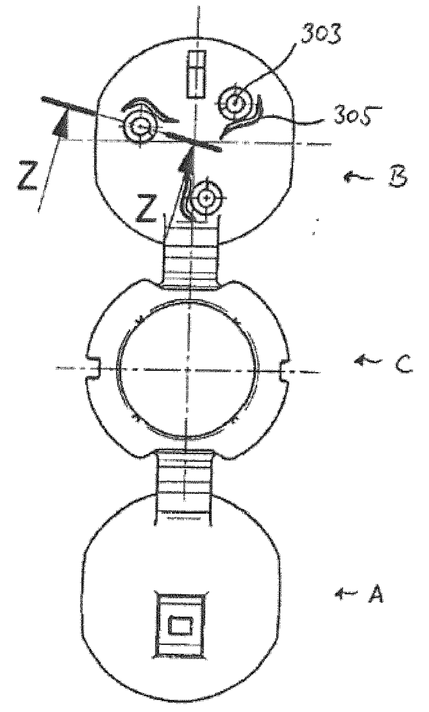


Fig. 8b)

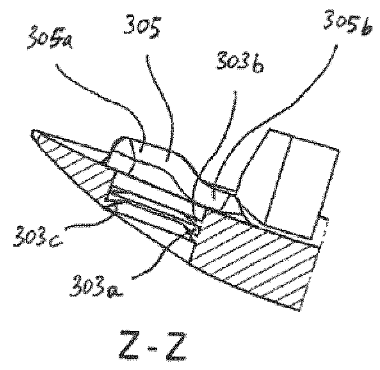


Fig. 8c)

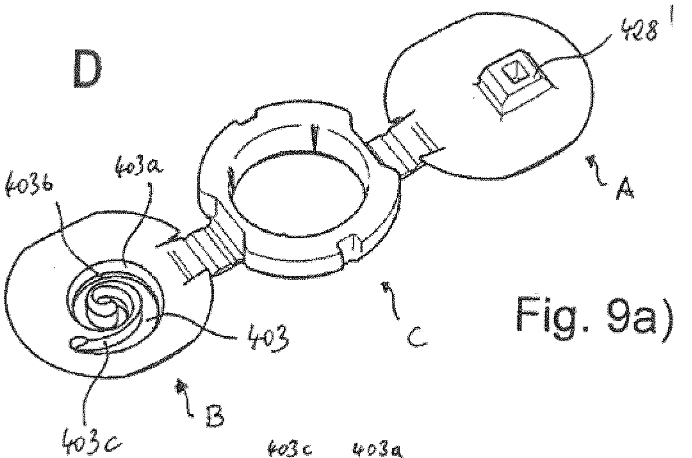
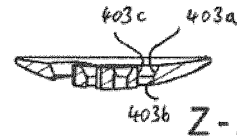


Fig. 9a)



Z - Z

Fig. 9c)

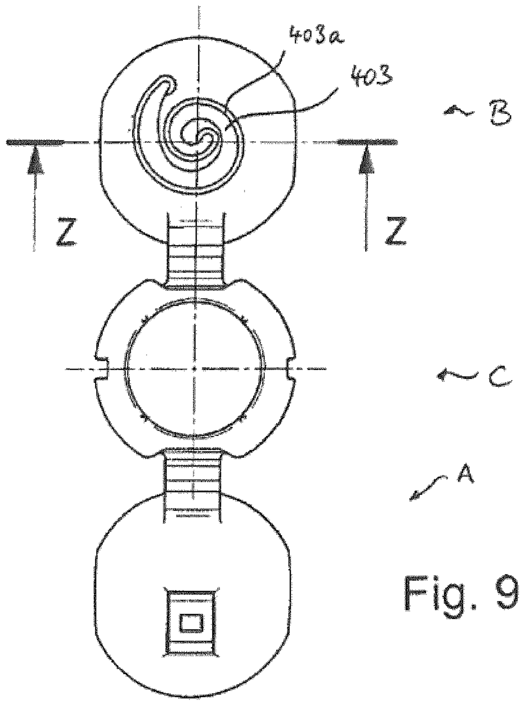


Fig. 9b)

a)
b)
c)
d)
e)
f)
g)
h)

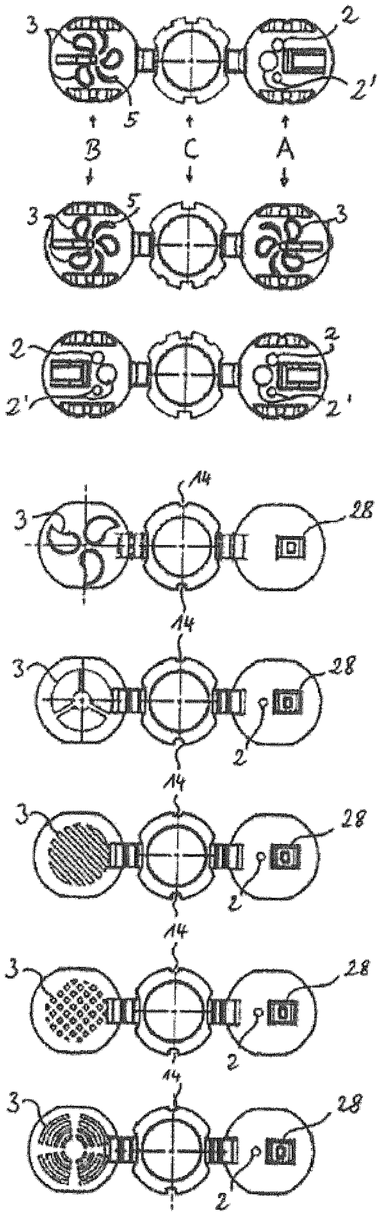


Fig. 10

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EUROPEAN SEARCH REPORT

Application Number
EP 16 17 8676

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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X	EP 2 479 510 A2 (BERG HANS GMBH & CO KG [DE]) 25 July 2012 (2012-07-25) * figures 7,9 * -----	1,12,14	
X	DE 20 2007 010727 U1 (KERMI GMBH [DE]) 27 September 2007 (2007-09-27) * figure 2 * -----	1,12,14	
A	WO 2007/137432 A1 (UNIV WESTERN ONTARIO [CA]; DROUGHT NICHOLAS ANDREW MURRAY [GB]; ROBSON) 6 December 2007 (2007-12-06) * the whole document * -----	1-14	
A	US 2006/065313 A1 (SALERI SEBASTIANO [IT] ET AL) 30 March 2006 (2006-03-30) * the whole document * -----	1-14	TECHNICAL FIELDS SEARCHED (IPC) F28F F24D

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	24 November 2016	Mellado Ramirez, J

CATEGORY OF CITED DOCUMENTS

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