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(54) **Variable power device for a uniform heating of fluids**

(57) A variable power device for a uniform heating of fluids, comprising an outer tube (10), which is connected to a fitting or flange (14) for connecting the power supply and grounding cables (21) and to one or more fluid distribution connectors (24, 26), said outer tube (10) enclosing a first drilled heat sink (13), made of conductive material, within which a first hollow space (11) and a wire-type or layer-type resistor (12), embedded within an in-

sulating layer, are inserted, In this way, the resistor (12) is not directly connected with the fluid, but it is directly connected with said first heat sink (13) and therefore it is possible to distribute heat from said first heat sink (13) to the fluid in correspondence with a large surface, while said first heat sink (13) also maintains a low temperature at the fluid contact surface.

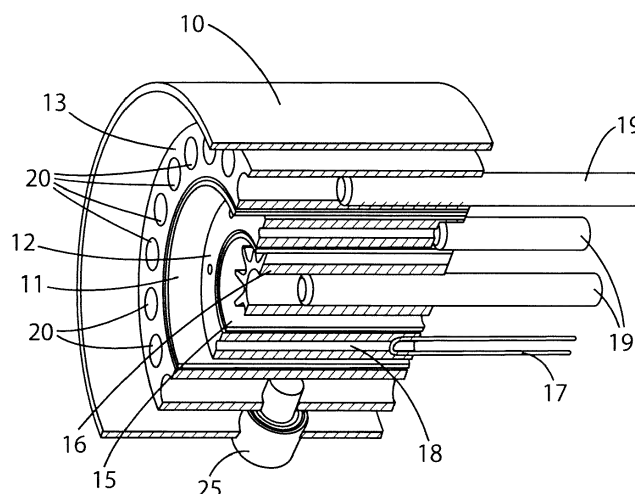


Fig. 4

Description

[0001] The present invention generally relates to a variable power device for a uniform heating of fluids.

[0002] More particularly, the invention concerns a resistor device which is suitably realized and has a considerable exchange surface with the fluid, so as to obtain an instantaneous and homogeneous heating of the fluid passing within the structure, thus maximizing the load losses and also saving in terms of space and/or dimensions.

[0003] The hot water for sanitary use is normally obtained by passing cold water through a plate heat exchanger, inside which a hot fluid is sent through a secondary circuit of the exchanger, in order to maintain a substantially constant temperature of the fluid at the output.

[0004] In fact, for such sanitary uses, it is preferable to maintain the temperature of the output water usually between 55 °C and 60 °C, and, for many applications, it is also preferable to directly heat the output fluid flow, so as to avoid the use of holding tanks.

[0005] As previously mentioned, the use of plate heat exchangers makes it possible to obtain a heat exchange rather efficient and allows to provide a considerable amount of hot fluid, however employing a minimal amount of fluid that is stored inside the heat exchanger.

[0006] However, one of the major drawbacks in the use of heat exchangers for supplying fluids and, in particular, for supplying hot water is the fact that for each new opening of the tap the water comes out, for a certain period of time, at a temperature substantially higher than the predetermined value, and this drawback can constitute a danger for the user.

[0007] This is because the heating fluid which is sent inside the heat exchanger must have a temperature of about 10°C-20°C higher than the predetermined value of temperature of the water coming out from the tap, and because, when the tap is closed, the water contained in the heat exchanger is brought to the temperature of the heating fluid, when the tap is reopened, the output water has, for a certain time interval, a temperature higher by 10°C-20°C than the predetermined value of 55°C-60 °C.

[0008] This drawback can be limited by using a hot water tank or container (such as a pipe) placed between the heat exchanger and the tap; however, said pipe is rather cumbersome and has substantially high production costs, which would be advisable to reduce or eliminate.

[0009] Moreover, when said tank or pipe is used, the water which comes to the tap, when said tap is opened and after a certain period of time since the last drawing of hot water, will be substantially cold.

[0010] The present invention is therefore devoted to overcome the above mentioned drawbacks of the prior art and, in particular, the main object of the invention is to provide a variable power device for a uniform heating of fluids, which is configured for instantaneously provid-

ing a uniformly heated water flow to one or more users, at a predetermined value of temperature, which is controlled and substantially homogeneous.

[0011] Another object of the invention is to provide a variable power device for a uniform heating of fluids, which can be used together with a heat exchanger, in order to obtain an extremely efficient and compact device, suitable to deliver almost instantaneously a water flow which is always uniformly heated.

[0012] Another object of the invention is to provide a variable power device for a uniform heating of fluids, which is able to obtain a total heat exchange circuit, without the use of any fuel tank and/or fluid container, nor any pipe connection between the resistor device and the heat exchanger, thus limiting the overall dimensions and saving in terms of time and/or of water. A further object of the invention is to provide a variable power device for a uniform heating of fluids, which is particularly effective, reliable, convenient and cheap, with respect to the prior art, and which can be used for any new or existing water supply.

[0013] The above mentioned objects and other objects are achieved by a variable power device for a uniform heating of fluids, according to the appended claim 1.

[0014] Further detailed technical features of the device of the invention are given in the dependent claims.

[0015] Advantageously, the device according to the invention allows to quickly heat a fluid flow and to instantly obtain an output flow having a totally controlled and homogeneous temperature, by using a labyrinth-shaped resistor, which works as a heat exchanger within a total heat exchange device; the heat exchange takes place immediately, thus obtaining a consequent and considerable saving in terms of fluid dispensed and of time taken for heating the fluid, with respect to the prior art.

[0016] Furthermore, it is not necessary to use tanks and/or containers for storing the fluid to be heated, nor piping particularly long and/or bulky.

[0017] Finally, the device of the invention is usable in particular for supplying hot water, but can be similarly used for any other private and/or industrial use (for example, as a heat exchanger for plastic materials molding machines) for which it is necessary to have a continuous quantity of fluid at a homogeneous and controlled temperature value.

[0018] Further objects and advantages of the present invention will become more clear from the following description, relating to a preferred embodiment of the variable power device for a uniform heating of fluids, according to the invention, and from the enclosed drawings, in which:

- figure 1 shows a schematic side view of a first embodiment of the variable power device for a uniform heating of fluids, according to the present invention;
- figure 2 shows a schematic side view of a second embodiment of the variable power device for a uniform heating of fluids, according to the present in-

- vention;
- figure 3 shows a schematic side view of a third embodiment of the variable power device for a uniform heating of fluids, according to the present invention;
- figure 4 is a partial perspective and exploded view of a technical detail of the variable power device for a uniform heating of fluids, according to the present invention;
- figure 5 is a schematic longitudinal section view of the variable power device for a uniform heating of fluids of figure 2, according to the present invention;
- figure 6 is a schematic sectional view taken along the line VI-VI of figure 5;
- figure 7 is a partial side view of a further embodiment of the variable power device for a uniform heating of fluids, according to the present invention;
- figure 8 is a top view of the variable power device for a uniform heating of fluids of figure 7, according to the present invention.

[0019] With reference to the mentioned figures, the device according to the invention essentially comprises an outer tube 10 and a first perforated sink element 13, made of conductive material and preferably aluminum, inside which are inserted, starting from the periphery and proceeding towards the center of the device, a first cavity 11, a resistor 12, which is preferably embedded within an insulating layer made of compressed magnesium oxide, a second cavity 15 and a second heat sink element 16, which is star-shaped and made of a conductive material, such as aluminum.

[0020] The heat sink element 16 can also be missing, in which case it is possible to use a circular end plate which contacts the walls of the cavity 15.

[0021] The tube 10 is connected to a further length of tube 14, by means of a ring nut and/or a special flange, for connecting the 3-phase power cables and the grounding cables 21 and the cables 20 for connecting a possible insulating thermocouple.

[0022] Furthermore, said tube 10 can be coupled with one or more connectors 24 for delivering fluids, for example T-type connectors, and/or with a support base 25 for connecting a thermostat (optional) (the support base 25 is placed in particular on a copper pad in contact with the external heat sink element 13).

[0023] The described structure allows to provide, according to the present invention, a plurality of possible points of temperature control, by using, for example, a safety thermocouple 17, placed on the resistive wire or layer 18, within the resistor 12, and a plurality of containment elements 19 of respective bulbs placed inside the star-shaped heat sink 16, within the resistor 12 and on the external heat sink 13, in contact with the fluid.

[0024] In particular, depending on the application, the variable power device for a uniform heating of fluids, according to the present invention, provides firstly the entry of the fluid F1 from a lower side connector 24, the passage of the fluid F1 between the inner walls of the tube

10 and the outer walls of the resistor 12 and, finally, the output of the fluid F1 by an upper connector 26, which is opposite to the tube length 14 carrying the power cables 21.

[0025] In this case (shown in detail in the attached figure 1), the fluid temperature is equal to 200°C or 300°C and the flow rate is over 200 l./min. (so-called "mono-flow" or single circuit).

[0026] Alternatively, when the fluid F2 enters through a top side connector 24, said fluid F2 takes a first path in a given direction, between the inner walls of the tube 10 and the outer walls of the resistor 12, until the bottom of the pipe 10 which is provided in correspondence of the tube length 14, and, then, a second path, in a direction opposite to the first direction, within the openings or holes 20 provided in the external heat sink element 13, before exiting from the upper connector 26.

[0027] In this case (shown in detail in the appended figures 2 and 5), it is possible to reach fluid temperatures of 200°C or 300 °C and flow rates from 100 to 200 l./min. (so-called "bi-flow" or double circuit), with the further possibility of having a modulated double power.

[0028] Still alternatively, it is possible to provide that the fluid inlet F3 takes place in correspondence of an upper side connector 24, so that said fluid F3 flows in a first given direction, between the inner walls of the tube 10 and the outer walls of the resistor 12, until the bottom of the tube, then flows in a direction opposite to the above direction, within the openings or holes 20 provided in the resistor 12, up to the other end of the tube, and then again according to the above mentioned first direction, in contact with the central star shaped heat sink element 16, and finally goes out from a central conduit 22 connected to a lower side connector 24.

[0029] In the latter case (shown in detail in the appended figure 3), it is possible to reach a fluid temperature of 200°C and flow rates of 90 l./min. (so-called "tri-flow" circuit or triple).

[0030] As clearly shown in the enclosed figure 4, the peculiarity of the heating device for fluids of the present invention is constituted by the fact that the resistor 12 does not contact the fluid, but it directly contacts the external heat sink 13 and the central heat sink 16 (optional); this means that the heat is distributed by the heat sink element 13, 16 to the fluid in correspondence with a very large surface, while the heat sink element 13, 16 also maintains a low temperature at the surface which contacts the fluid.

[0031] Therefore, an extended heat exchange surface is obtained, thus maximizing the pressure drop and maintaining a compact size of the structure, while avoiding, at the same time, a direct contact between the fluid and the resistor 12.

[0032] This allows to bring the entire amount of the fluid, almost immediately, at a predetermined temperature value (determined by the power of the resistor 12), which is homogeneous and controlled, and to obtain an output flow which is always uniformly heated.

[0033] The device of the present invention is therefore a temperature "calibrator" and is able to cause high savings of time (so that the fluid can reach a given and controlled temperature value) and of fluid, since it is not necessary to use a containment tank for collecting the fluid to be heated. Finally, the structural composition of the device allows to avoid the complete destruction of the resistor even when an interruption of the fluid flow occurs, because the metal mass of the external structure is intimately attached to the annular resistor 12.

[0034] The resistive structure thus obtained may also be advantageously coupled with a suitable heat exchanger for applications which require an electric heating together with an effective heat dissipation (such as, for example, the temperature control units of the plastic molding machines); in this case, the tube 10 is inserted inside a shaped container or packaging, which is preferably made of stainless steel, by means of a prismatic block and a fixing flange.

[0035] According to a further embodiment of the present invention, which is shown in particular in the enclosed figures 7 and 8, the external heat sink 13 can be formed by a tube bundle that includes a plurality of hollow sections (the cavities of the hollow sections identify and constitute the above mentioned openings 20) and each of said hollow sections has a same predetermined section, such as a circular, rectangular or squared section; in particular, each of said hollow sections has a trapezoidal section and is laterally placed next to one another so as to obtain a maximum contact surface.

[0036] Finally, always according to the above mentioned embodiment of the invention, the internal heat sink 16 can also be constituted by a tube bundle, which includes a plurality of hollow sections having the same characteristics as those mentioned in the case of the external heat sink 13; as already mentioned, the internal heat sink 16 and, therefore, its tube bundle can also be missed, in which case a cover cap or plug is provided on the bottom of the structure.

[0037] The technical features of the variable power device, which is the object of the present invention, are therefore clear from the above description, as well as the related advantages.

[0038] It is also clear that many other variations may be made to the device of the invention, without departing from the principles of novelty and inventive step according to the appended claims, as well as it is clear that the materials, forms and dimensions of the technical details, as shown and described, may be any according to requirements and that they can be replaced with other equivalents.

Claims

1. Variable power device for a uniform heating of fluids, **characterized in that** said device comprises an outer tube (10), which is connected to a fitting or flange

(14) for connecting the power supply and grounding cables (21) and to one or more fluid distribution connectors (24, 26), said outer tube (10) enclosing a first drilled heat sink (13), made of conductive material, within which a first hollow space (11) and a wire-type or layer-type resistive element (12), embedded within an insulating layer, are inserted, wherein said resistive element (12), which is not directly in contact with the fluid, directly contacts said first heat sink (13), in order to distribute heat from said first heat sink (13) to the fluid in correspondence with a large surface, said first heat sink (13) also maintaining a low temperature at the fluid contact surface.

2. Variable power device as claimed in claim 1, **characterized in that** a second hollow space (15) is provided close to said resistive element (12) and at least one second heat sink (16), made of a conductive material, or a cap or stopper, placed into contact with the walls of said second hollow space (15), is provided inside the tube (10).
3. Variable power device as claimed in at least one of the preceding claims, **characterized in that** said tube (10) is connected to at least one support base (25) of at least one thermostat, said base (25) being placed on a pad of conductive material which contacts said first heat sink (13).
4. Variable power device as claimed in at least one of the preceding claims, **characterized in that** at least a safety thermocouple (17) is placed on a resistive wire or layer (18) of said wire-type or layer-type resistive element (12).
5. Variable power device as claimed in at least one of the preceding claims, **characterized in that** a plurality of casings (19) containing respective bulbs for a temperature control are placed within said second heat sink (16), within said resistive element (12) and on said first heat sink (13) and within the fluid.
6. Variable power device as claimed in at least one of the preceding claims, **characterized in that** said fluid (F1) flows within said tube (10) through one of said distribution connectors (24, 26) and between the inner walls of said tube (10) and the outer walls of said resistive element (12), said fluid exiting from said tube (10) through the distribution connectors (24, 26).
7. Variable power device as claimed in at least one of the preceding claims, **characterized in that** said fluid (F2) flows within said tube (10) through one of said distribution connectors (24, 26) and flows at first between the inner walls of said tube (10) and the outer walls of said resistive element (12) according to a first direction and up to a first end portion of the tube

(10) and then flows according to a second direction, opposite to said first direction, and through openings or holes (20) provided on said first heat sink (13), said fluid finally exiting from said tube (10) through one of said distribution connectors (24, 26).

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8. Variable power device as claimed in at least one of the preceding claims, **characterized in that** said fluid (F3) flows within the tube (10) through one of said distribution connectors (24, 26) and flows at first between the inner walls of said tube (10) and the outer walls of said resistive element (12) according to a first direction and up to a first end portion of the tube (10) and then flows according to a second direction, opposite to said first direction, up to a second end portion of the tube (10), which is opposite to said first end portion of the tube (10), said fluid flowing again according to said first direction and in contact with said second heat sink (16) and finally exiting from said tube (10) through a central duct (22) which is connected to one of said distribution connectors (24, 26).
9. Variable power device as claimed in at least one of the preceding claims, **characterized in that** said first heat sink (13) is constituted by a tube bundle, which includes a plurality of hollow sections, each of which has the same prefixed section and, in particular, a trapezoidal section, so that said sections laterally adhere one to each other, thus obtaining a large contact area.
10. Variable power device as claimed in at least one of the preceding claims, **characterized in that** said second heat sink (16) is constituted by a tube bundle, which includes a plurality of hollow sections, each of which has the same prefixed section and, in particular, a trapezoidal section, so that said sections laterally adhere one to each other, thus obtaining a large contact area.

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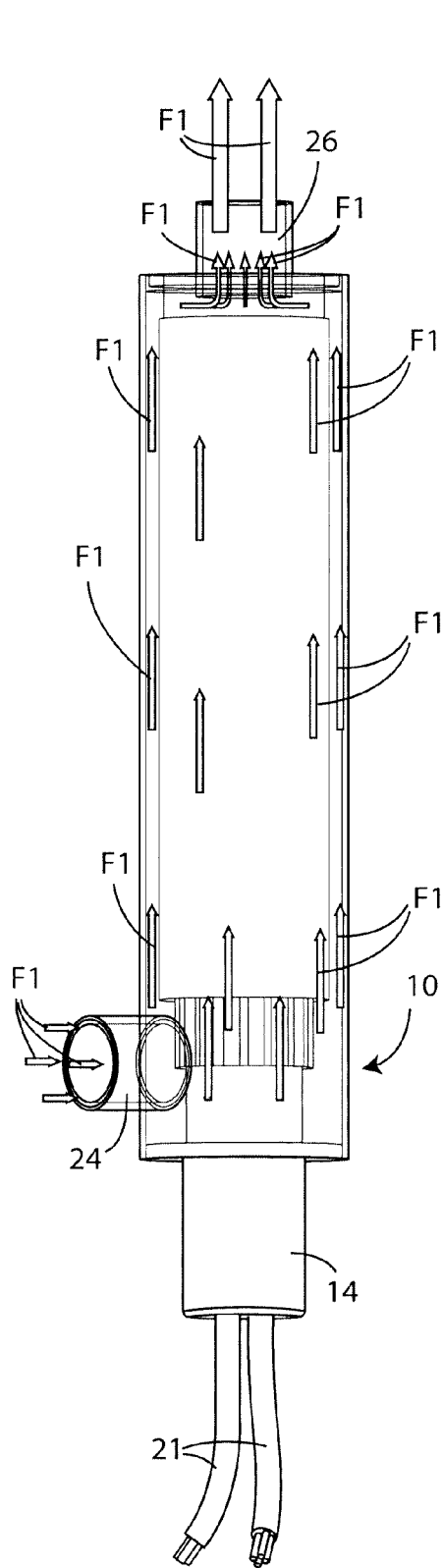


Fig. 1

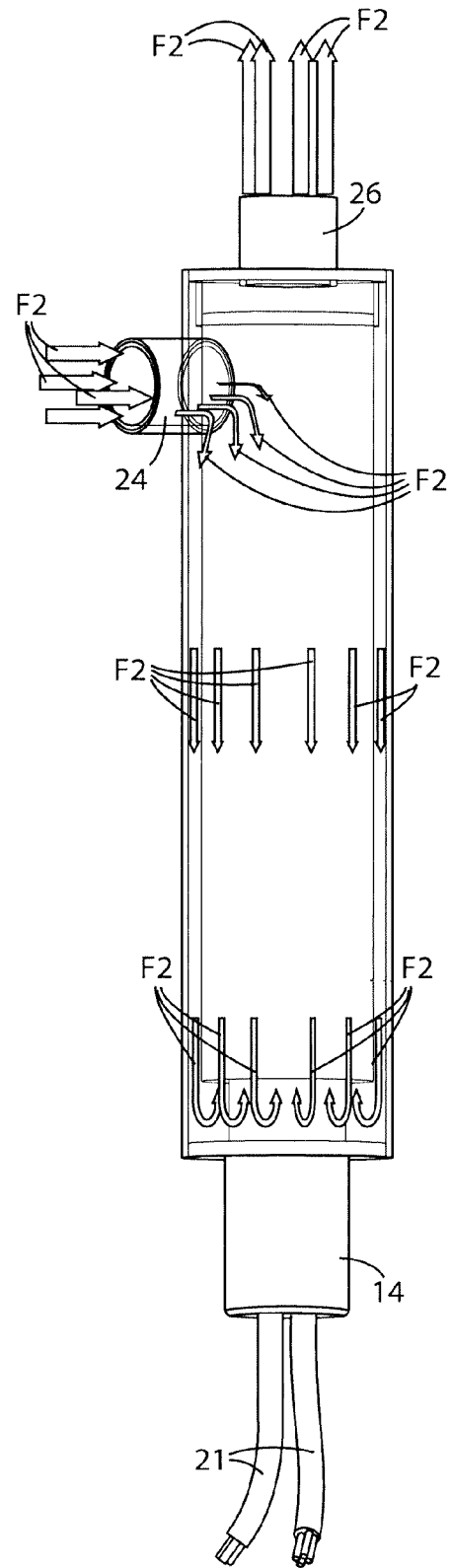


Fig. 2

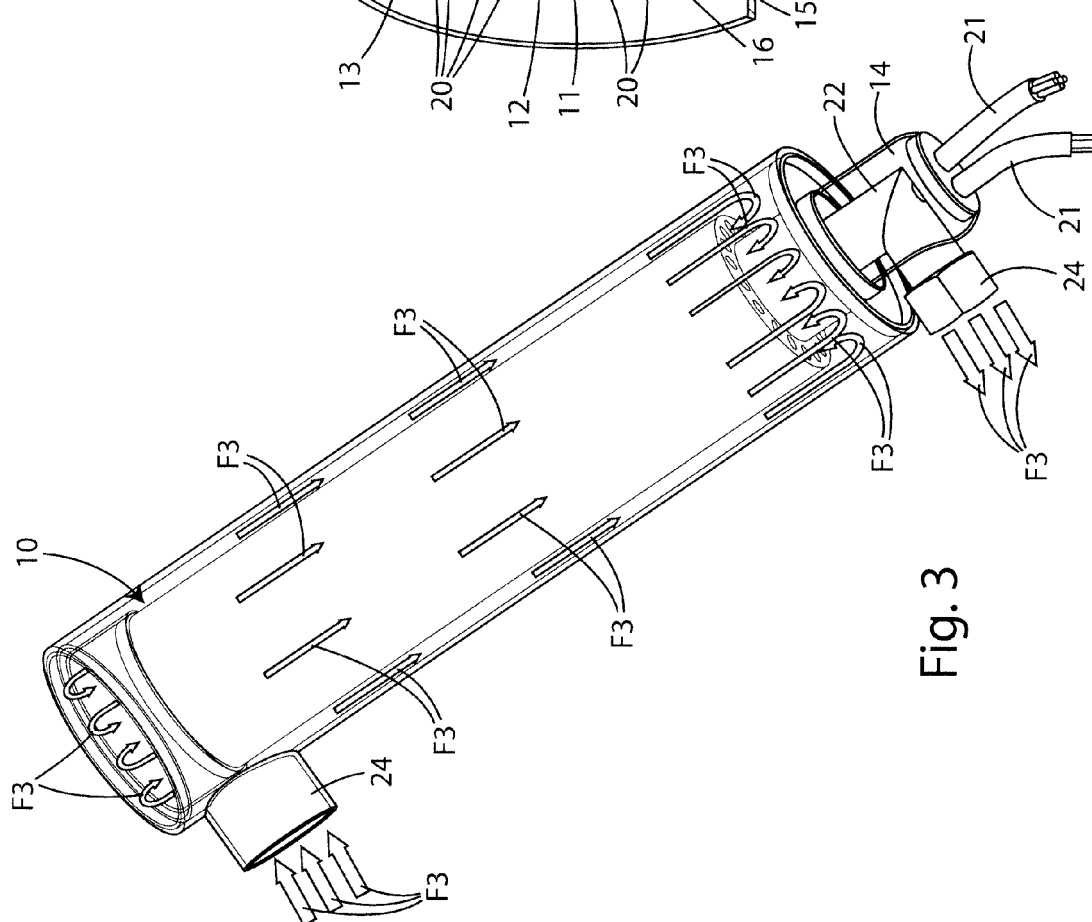


Fig. 3

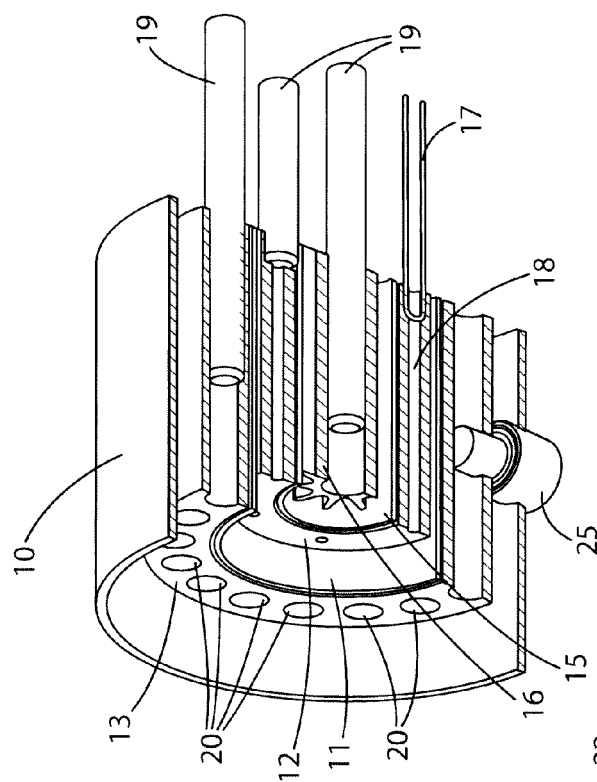


Fig. 4

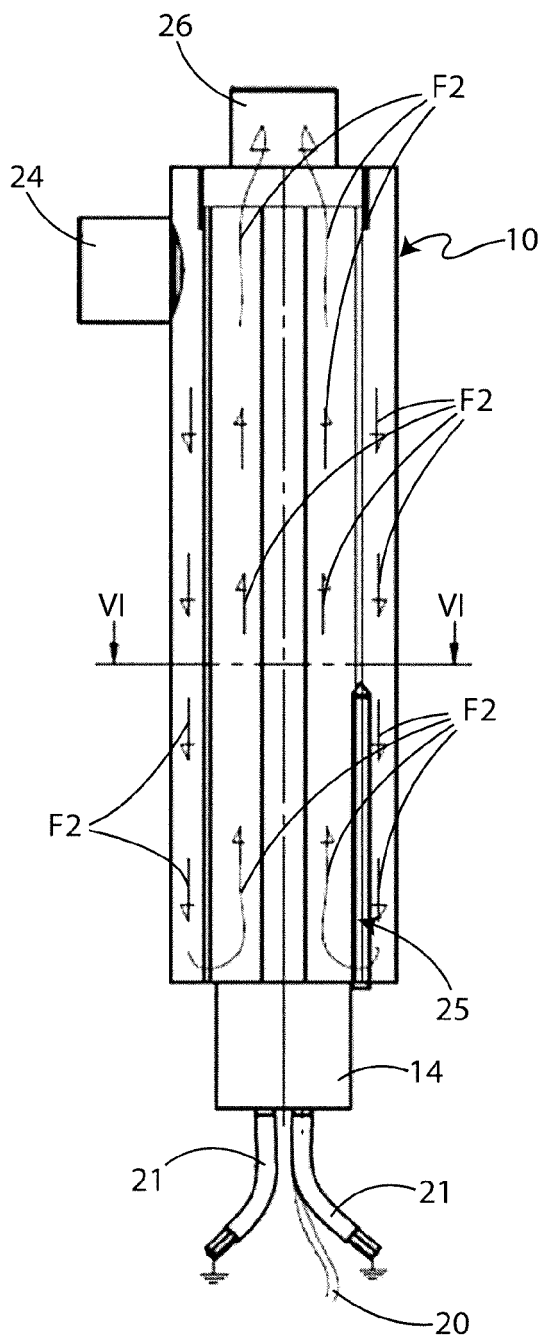


Fig. 5

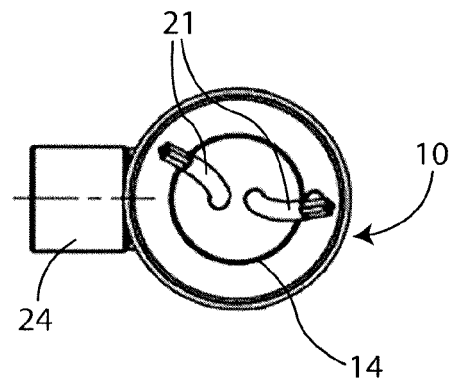


Fig. 6

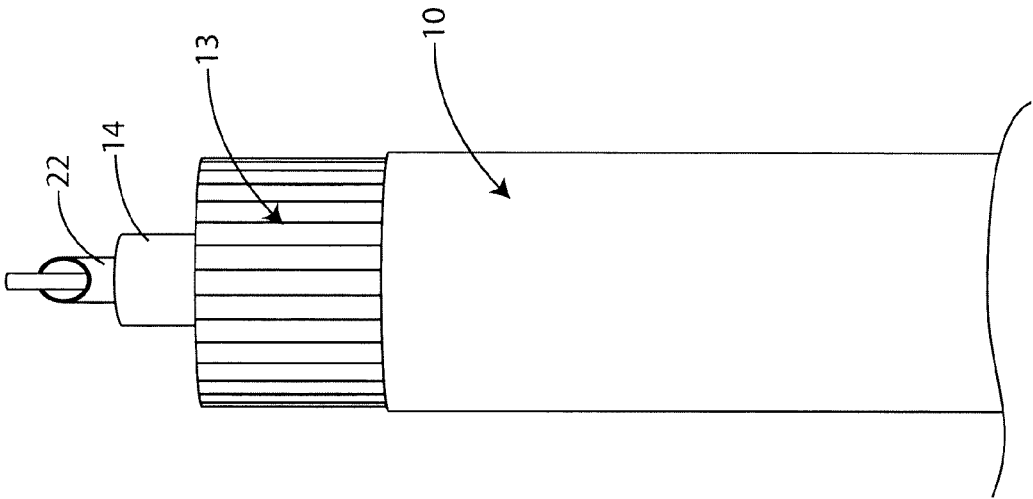


Fig. 7

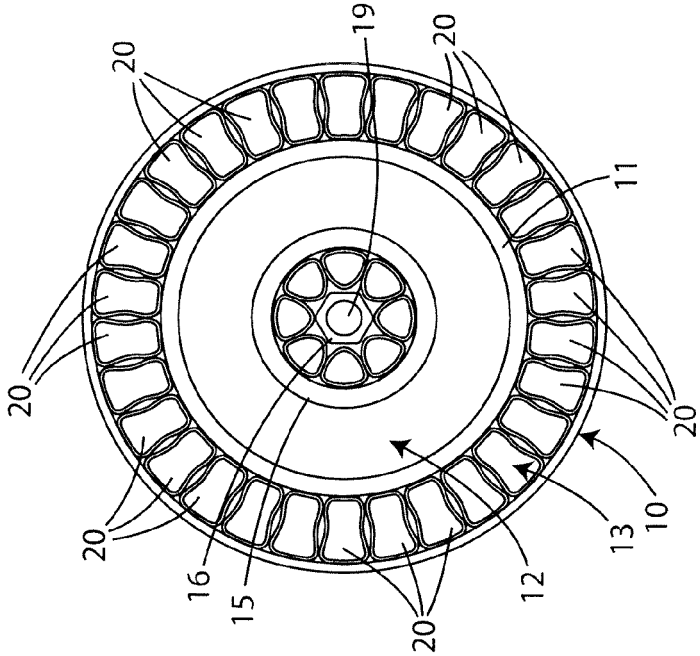


Fig. 8