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(54) **Tubular device for the transit of a heat exchange fluid particularly for heat exchangers, and a liquid/gas heat exchanger, particularly for boilers,comprising a series of tubular devices**

Rohrförmige Einrichtung für den Transit einer Wärmeträgerflüssigkeit, insbesondere für Wärmetauscher, und ein Gas/Flüssigkeit Wärmetauscher, insbesondere für Boilers, mit einer Serie rohrförmiger Einrichtungen

Dispositif tubulaire pour le transit d'un fluide caloporteur particulièrement pour les échangeurs de chaleur, et un échangeur de chaleur gaz/liquide, particulièrement pour les chaudières, comprenant une série de dispositifs tubulaires

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Description

[0001] The present invention refers to a tubular device for the transit of a heat exchange fluid particularly for heat exchangers. The invention also refers to a liquid/gas heat exchanger, particularly for boilers, comprising a series of such tubular devices.

[0002] Nowadays, liquid/gas heat exchangers, particularly for boilers, with excellent yield are known and widespread and they meet with great satisfaction from installers. Such boilers comprise a passage chamber for a first heat exchange fluid, crossed by passage ducts for a second heat exchange fluid, the particularity of which lies in the fact that at least part of such ducts is provided by a plurality of tubes, each of which has a cross section with a profile that is formed by a plurality of lobes arranged in a substantially radial direction.

[0003] The particular shape of such tubes makes it possible to considerably increase the turbulence of the gas that has to cross them, compared with tubes with a circular or a lenticular cross section.

[0004] Nonetheless, such tubes with a lobar cross section may be improved.

[0005] Indeed, insofar as the blending zones between two successive lobes of a tube are close to the axis of the tube, around such axis a channel always remains from which the hot gas escapes without having optimally washed around the internal surfaces of the channels with a lobar cross section of the tube, and thus having substantially yielded very little of the heat it possesses.

[0006] In addition, such known tubes, precisely because they present a cross section that is very narrow at the center, are difficult to clean and relatively prone to clogging. Document US 2008/0029243 A1 discloses such tubes with a lobar cross-section that is very narrow at the center.

[0007] A heat exchange tube for a heat exchanger is known from US 2 445 471. The tube has a pleated surface and is provided, inside, with a core that forces gas or fluid passing through the tube into radially outward projecting interstices formed by the pleated outer wall of the tube. US 2 445 471 discloses a tubular device for the transit of a heat exchange fluid, particularly for heat exchangers, comprising a tube that has at least one portion of its cross-section with a profile that is formed by a plurality of lobes arranged in a substantially radial direction, such that it comprises a removable rod-like flow redirection element inserted in the axial space between the blending portions between two successive lobes, and designed to redirect laterally the flow of heat exchange fluid introduced in said tube toward the heat exchange channels of said tube that have a lobate cross-section.

[0008] The aim of the present invention is to provide a tubular device for the transit of a heat exchange fluid, particularly for heat exchangers, that is capable of overcoming the drawbacks of tubes with a lobar cross section of the known type.

[0009] Within this aim, an object of the invention is to provide a liquid/gas heat exchanger, particularly for boilers, fitted with a plurality of tubular devices.

[0010] Another object of the invention is to provide a tubular device in which the gas that crosses it is subjected to a turbulence that improves the heat exchange compared to what can be achieved with tubes of the known type.

[0011] Another object of the invention is to provide a tubular device that is easy to clean.

[0012] Another object of the invention is to device a liquid/gas heat exchanger of greater yield than similar exchangers of the known type.

[0013] A further object of the invention is to provide a tubular device for the transit of a heat exchange fluid, particularly for heat exchangers, and a liquid/gas heat exchanger particularly for boilers, comprising a series of such tubular devices, structurally simple and easy to use, which can be made using known systems and technologies,

[0014] This aiim, as well as these and other objects which will become better apparent hereinafter, are achieved by a tubular device for the transit of a heat exchange fluid, particularly for heat exchangers, according to the invention, that has the features set forth in claim 1.

[0015] Advantageously, a liquid/gas heat exchanger, particularly for boilers, comprises a passage chamber for a first heat exchange fluid and passage ducts for a second heat exchange fluid, said passage chamber being crossed by said passage ducts, and is characterised in that at least part of said passage ducts are formed by a plurality of tubular devices according to the invention.

[0016] Further characteristics and advantages of the invention will become better apparent from the following detailed description of three preferred, but not exclusive, embodiments of the tubular device for the transit of a heat exchange fluid, particularly for heat exchangers according to the invention, as well as of a liquid/gas heat exchanger fitted with a plurality of said tubular devices, illustrated by way of non-limiting example in the accompanying drawings, wherein:

- Figure 1 is a perspective view of a tube of the tubular device according to the invention in a first embodiment thereof;
- Figure 2 is a longitudinal sectional view of the tubular device according to the invention of Figure 1;
- Figure 3 is a transverse sectional view, taken along the line III-III of Figure 2, of the tubular device according to the invention in its first embodiment;
- Figure 4 is a transverse sectional view, taken along the line IV-IV of Figure 2, of the tubular device according to the invention in its first embodiment;
- Figure 5 is a transverse sectional view, taken along the line V-V of Figure 2, of the tubular device according to the invention in its first embodiment;
- Figure 6 is a view of a tubular device;
- Figure 7 is a view of another tubular device;
- Figure 8 is a side sectional view of a heat exchanger

according to the invention, fitted with tubular devices according to the invention;

- Figure 9 is a transverse sectional view of the exchanger according to the invention, taken along the line IX-IX of Figure 8.

[0017] The embodiments of figures 6-7 are not covered by the presently claimed invention. They are examples of possible tube configurations that are useful for understanding the invention.

[0018] A tubular device for the transit of a heat exchange fluid, particularly for heat exchangers, according to the invention, is shown in a first embodiment thereof in Figures 1 through 5, and is designated therein by the reference numeral 10.

[0019] The tubular device 10 is of the type comprising a tube 11 having a series of tube portions 11a, 11b and following, each of which in cross section 12 (Figure 4) has a profile that is formed by three lobes 13, 14 and 15, arranged in a substantially radial direction.

[0020] The tubular device 10 according to the invention comprises a removable rod-like flow redirection element 16 inserted in the axial space between the blending zones 17, 18 and 19 between two successive lobes.

[0021] The rod-like element 16 is designed to redirect laterally the flow of heat exchange fluid introduced into the tube 11, toward the heat exchange channels 20, 21, 22 of the same tube portion 11a, 11b, 11c and following, of the tube 11 having a lobar cross section.

[0022] The portions 11a, 11b and following are made in such a way that the cross sections of two successive tube portions 11a, 11b and following are rotated with respect to the axis of the tube 11 by a certain angle, for example 60° as shown by the cross section 12a in Figure 5, of the tube portion 11b, and with respect to the cross section 12 in Figure 4, of the tube portion 11a.

[0023] The rod-like redirection element 16 has a contoured grip end 23, clearly visible in Figure 2, for the extraction of the rod-like element 16 from the tube 11, for cleaning the tube 11.

[0024] In such first embodiment of the tubular device 10 according to the invention described up to now, the tube 11 has a cross section that comprises three lobes 13, 14 and 15 arranged substantially at 120 sexagesimal degrees with respect to each other.

[0025] It should be appreciated that the lobes, in alternative embodiments, can also be different in number.

[0026] In such first embodiment of the tubular device 10 according to the invention described up to now by way of non-limiting example of the invention, the tube 11 has a rectilinear longitudinal extension, and the portions 11a, 11b and following with a cross section 12 that comprises three lobes alternate with portions 11e, 11f and following with a cross section that is substantially circular, as can be seen in Figures 1 and 2.

[0027] In a second embodiment, not part of the invention, schematically shown in Figure 6, the tubular device according to the invention, indicated therein with the reference numeral 110, comprises a tube 111 with a cross section that comprises three lobes, with continuous rectilinear longitudinal extension, with no portions having a circular cross section.

[0028] The corresponding rod-like element 116 with the contoured grip end 123 is schematically shown inside the tube 111.

[0029] In a third embodiment of the tubular device, not according to the invention, indicated in Figure 7 with the reference numeral 210, the tube 211 has a helical longitudinal extension.

[0030] The tube 11, as well as 111 and 211, have end portions 24 and 25 that are substantially cylindrical, and therefore relatively simple to be welded onto.

[0031] Figure 3 shows a cross section 12b of a first end 24.

[0032] The tube 11, 111, 211 can easily be obtained by processing involving pressing of a metal tube.

[0033] The rod-like element 16 and 116 can be obtained from a metal bar. The invention also refers to a liquid/gas heat exchanger, designated in Figures 8 and 9 with the reference numeral 30.

[0034] The exchanger 30, particularly for boilers for example powered by diesel fuel or by co-generation, comprises a passage chamber 35 for a first heat exchange fluid, crossed by passage ducts 32 for a second heat exchange fluid.

[0035] Part of such ducts is provided by a plurality of tubular devices 10 or 110 or 210 as described above.

[0036] The exchanger 30 comprises a main external body 33 containing an intake chamber for the gas 34, which forms, together with the main body 33, the passage chamber 35 for a first heat exchange fluid.

[0037] The gas intake chamber 34 is surrounded by a series of heat exchange ducts 36, circular in cross section, and by a series of the tubular devices 10.

[0038] The two series of ducts are arranged on two concentric circumferences.

[0039] The gas is conveyed from the intake chamber 34 to the ducts 36 with circular cross section by means of a first redirection and exchange bottom 37.

[0040] The same gas that exits from the ducts 36 with circular cross section is conveyed to the tubular devices 10 by means of an annular chamber 38 surrounding the inlet of the gas intake chamber 34.

[0041] The exchanger 30 is closed in an upper region by a flange 39 with a hole for the passage of gas, and in a lower region by a second condensation collecting bottom 40 with an inlet 41 for a flue.

[0042] At least one of the flange 39 and the second bottom 40 is designed to be removed for the extraction of the rod-like redirection elements 16 of the tubular devices 10 for cleaning the tubes 11 thereof.

[0043] In practice it has been found that the invention fully achieves the intended aim and objects.

[0044] In particular, with the invention a tubular device has been provided in which the gas that crosses it is subjected to a turbulence that improves the heat ex-

change compared to what can be achieved with tubes of the known type, and consequently a liquid/gas heat exchanger has been devised, particularly for boilers, fitted with a plurality of tubular devices as per the aim of the invention, of improved yield compared to similar exchangers of the known type.

[0045] In addition, as a result of the presence of the removable rod-like element 16, a tubular device has been provided that is easy to clean, since it is sufficient to remove the rod-like element 16 in order to have sufficient space inside the tube 11 to manoeuvre a cleaning instrument.

[0046] Moreover, with the invention a liquid/gas heat exchanger has been devised that has a greater yield than similar exchangers of the known type.

[0047] Further, with the invention a tubular device for the transit of a heat exchange fluid, particularly for heat exchangers, and a liquid/gas heat exchanger, particularly for boilers, comprising a series of such tubular devices, have been devised, that are structurally simple, easy to use, and can be made using known systems and technologies.

[0048] In practice the materials employed, as well as the dimensions and the contingent shapes, may be any according to requirements and to the state of the art.

[0049] Where technical features mentioned in any claim are followed by reference signs, such reference signs have been inserted for the sole purpose of increasing the intelligibility of the claims and accordingly such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

Claims

1. A tubular device (10) for the transit of a heat exchange fluid, particularly for heat exchangers, comprising a tube (11) that has a series of tube portions (11a, 11b, 11c, 11d) each with a cross-section having a profile that is formed by a plurality of lobes arranged in a substantially radial direction, each lobe defining a heat exchange channel (20,21,22) of said tube portion (11a, 11b, 11c, 11d), the cross-sections (12,12a9 of two successive tube portions (11a, 11b, 11c, 11d) being rotated relative to one another with respect to the axis of the tube by a certain angle, and the tubular device (10) comprising a removable rod-like flow redirection element (16) inserted in the axial space between blending portions (17,18,19) between two successive lobes of the cross-section of each tube portion (11a, 11b, 11c, 11d), and designed to redirect laterally the flow of heat exchange fluid introduced into said tube (11) toward the heat exchange channels (20,21, 22) of the tube portions (11a, 11b, 11c, 11d).

2. The device according to claim 1, **characterized in that** said rod-like redirection element (16) has at least one contoured grip end (23) for extraction from said tube (11).

3. The device according to the preceding claims, **characterized in that** said tube portions (11a, 11b, 11c, 11d) have each a cross-section that comprises three lobes (13,14,15) arranged substantially at 120 sexagesimal degrees with respect to each other.

4. The device according to the preceding claims, **characterized in that** said tube (111) has a rectilinear longitudinal extension.

5. The device according to the preceding claims 2, 3 and 4, **characterized in that** said tube portions (11a, 11b, 11c, 11d) alternate with other tube portions (11e, 11f, 11g) having a cross section that is substantially circular.

6. A liquid/gas heat exchanger (30), particularly for boilers, comprising a passage chamber (35) for a first heat exchange fluid and passage ducts (32) for a second heat exchange fluid, said passage chamber (35) being crossed by said passage ducts (32), **characterized in that** at least part of said passage ducts (32) are formed by a plurality of tubular devices (10) as set forth in any of the claims 1-5.

7. The heat exchanger according to claim 6, **characterized in that** it comprises a main external body (33), which contains an intake chamber (34) for said second heat exchange fluid being gas, which forms, together with said main body (33), said passage chamber (35) tor a first heat exchange fluid, said intake chamber (34) for the gas being surrounded by said passage ducts (32) which are formed by a series of heat exchange ducts (36) having a circular cross section and by a series of said tubular devices (10), the gas being conveyed from said intake chamber (34) toward said heat exchange ducts (36) having a circular cross section by means of a first redirection and exchange bottom (37), said gas that exits from said heat exchange ducts (36) having a circular cross section being conveyed to the tubular devices (10) by means of an annular chamber (38) that surrounds the inlet of said intake chamber for the gas (34).

8. The heat exchanger according to claim 7, **characterized in that** it is closed in an upper region by a flange (39) with a hole for the passage of gas and in a lower region by a second condensation collecting bottom (40) with an inlet (41) for a flue, at least one of said flange (39) and said bottom (40) being designed to be removed for extraction of the rod-like redirection elements (16) of the tubular devices (10) for cleaning the tubes (11) thereof.

Patentansprüche

1. Rohrförmige Einrichtung (10) für den Transit eines Wärmetauscherfluids, insbesondere für Wärmetauscher, umfassend ein Rohr (11), mit einer Reihe von Rohrabschnitten (11a, 11b, 11c, 11d), wovon jeder einen Querschnitt mit einem Profil aufweist, das von einer Vielzahl von Schleifen gebildet wird, die im Wesentlichen radial angeordnet sind, wobei jede Schleife einen Wärmetauscherkanal (20, 21, 22) des genannten Rohrabschnittes (11a, 11b, 11c, 11d) definiert, wobei die Querschnitte (12, 12a) von zwei aufeinanderfolgenden Rohrabschnitten (11a, 11b, 11c, 11d) relativ zueinander im Hinblick der Achse des Rohres um einen bestimmten Winkel verdreht sind, und wobei die rohrförmige Einrichtung (10) ein entfernbares, stabartiges, die Strömung umleitendes Element (16) umfasst, welches in den Axialraum zwischen den Übergangsabschnitten (17, 18, 19) zwischen zwei aufeinanderfolgende Schleifen des Querschnitts jedes Rohrabschnittes (11a, 11b, 11c, 11d) eingeführt ist, und dazu bestimmt ist, die Strömung des Wärmetauscherfluids, das in das genannte Rohr (11) eingeleitet wird, seitwärts zu den Wärmetauscherkanälen (20, 21, 22) der Rohrabschnitte (11a, 11b, 11c, 11d) umzuleiten.

2. Einrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** das stabartige Umleitungselement (16) wenigstens ein konturiertes Griffende (23) zur Entnahme aus dem genannten Rohr (11) aufweist.

3. Einrichtung nach den vorstehenden Ansprüchen, **dadurch gekennzeichnet, dass** jeder der genannten Rohrabschnitte (11a, 11b, 11c, 11d) einen Querschnitt besitzt, welcher drei Schleifen (13, 14, 15) umfasst, die im Wesentlichen in 120 Sexagesimalgraden in Bezug aufeinander angeordnet sind.

4. Einrichtung nach den vorstehenden Ansprüchen, **dadurch gekennzeichnet, dass** das Rohr (111) eine geradlinige Längserstreckung aufweist.

5. Einrichtung nach den vorstehenden Ansprüchen 2, 3 und 4, **dadurch gekennzeichnet, dass** sich die genannten Rohrabschnitte (11a, 11b, 11c, 11d) mit anderen Rohrabschnitten (11e, 11f, 11g) abwechseln, welche einen Querschnitt aufweisen, der im Wesentlichen kreisförmig ist.

6. Flüssigkeit/Gas-Wärmetauscher (30), insbesondere für Boiler, umfassend eine Durchtrittskammer (35) für ein erstes Wärmetauscherfluid und Durchtrittsleitungen (32) für ein zweites Wärmetauscherfluid, wobei die genannte Durchtrittskammer (35) von den genannten Durchtrittsleitungen (32) durchquert wird, **dadurch gekennzeichnet, dass** wenigstens die genannten Durchtrittsleitungen (32) von einer Vielzahl von rohrförmigen Einrichtungen (10), wie sie in einem der Ansprüche 1-5 angeführt sind, gebildet werden.

7. Wärmetauscher nach Anspruch 6, **dadurch gekennzeichnet, dass** er ein äußeres Hauptgehäuse (33) umfasst, welches eine Aufnahmekammer (34) für das genannte zweite Wärmetauscherfluid umfasst, welches Gas ist, die gemeinsam mit dem Hauptgehäuse (33) die genannte Durchtrittskammer (35) für ein erstes Wärmetauscherfluid ausbildet, welche Aufnahmekammer (34) für das Gas von den genannten Durchtrittsleitungen (32) umgeben ist, welche von einer Reihe von Wärmetauscherleitungen (36) mit einem kreisförmigen Querschnitt und von einer Reihe der genannten rohrförmigen Einrichtungen (10) gebildet werden, wobei das Gas von der genannten Aufnahmekammer (34) hin zu den genannten Wärmetauscherleitungen (36) mit einem kreisförmigen Querschnitt mittels eines ersten Umleitungs- und Austauschbodens (37) befördert wird, wobei das Gas, das aus den genannten Wärmetauscherleitungen (36) mit einem kreisförmigen Querschnitt austritt, zu den rohrförmigen Einrichtungen (10) mittels einer ringförmigen Kammer (38) befördert wird, welche das Innere der genannten Aufnahmekammer für das Gas (34) umgibt.

8. Wärmetauscher nach Anspruch 7, **dadurch gekennzeichnet, dass** er in einem oberen Bereich durch einen Flansch (39) mit einer Öffnung zum Durchtritt von Gas und in einem unteren Bereich durch einen zweiten Kondensationssammelboden (40) mit einem Einlass (41) für ein Abzugsrohr verschlossen ist, wobei wenigstens einer, der genannte Flansch (39) oder der genannte Boden (40), dazu bestimmt sind, um zur Entnahme der stabartigen Umleitungselemente (16) der rohrförmigen Einrichtungen (10) zur Reinigung der Rohre (11) entfernt zu werden.

Revendications

1. Dispositif tubulaire (10) pour le transit d'un fluide d'échange de chaleur, en particulier pour des échangeurs de chaleur, comprenant un tube (11) qui comporte une série de parties de tube (11a, 11b, 11c, 11d) chacune avec une section ayant un profil qui est formé par une pluralité de lobes agencés dans une direction sensiblement radiale, chaque lobe définissant un canal d'échange de chaleur (20, 21, 22) de ladite partie de tube (11a, 11b, 11c, 11d), les sections (12, 12a) de deux parties de tube (11a, 11b, 11c, 11d) successives étant tournées l'une par rapport à l'autre par rapport à l'axe du tube d'un certain angle, et le dispositif tubulaire (10) comprenant un élément de redirection d'écoulement similaire à une

tige (16) amovible inséré dans l'espace axial entre les parties de mélange (17, 18, 19) entre deux lobes successifs de la section de chaque partie de tube (11a, 11b, 11c, 11d), et conçu pour rediriger latéralement l'écoulement du fluide d'échange de chaleur introduit dans ledit tube (11) vers les canaux d'échange de chaleur (20, 21, 22) des parties de tube (11a, 11b, 11c, 11d).

2. Dispositif selon la revendication 1, **caractérisé en ce que** ledit élément de redirection d'écoulement similaire à une tige (16) comporte au moins une extrémité de préhension (23) profilée pour son extraction dudit tube (11).

3. Dispositif selon les revendications précédentes, **caractérisé en ce que** lesdites parties de tube (11a, 11b, 11c, 11d) ont chacune une section qui comprend trois lobes (13, 14, 15) agencés sensiblement à 120 degrés sexagésimaux les uns par rapport aux autres.

4. Dispositif selon les revendications précédentes, **caractérisé en ce que** ledit tube (111) comporte une extension longitudinale rectiligne.

5. Dispositif selon les revendications 2, 3 et 4 précédentes, **caractérisé en ce que** lesdites parties de tube (11a, 11b, 11c, 11d) alternent avec d'autres parties de tube (11e, 11f, 11g) ayant une section transversale qui est sensiblement circulaire.

6. Echangeur de chaleur liquide/gaz (30), particulièrement pour des chaudières comprenant une chambre de passage (35) pour un premier fluide d'échange de chaleur et des conduits de passage (32) pour un deuxième fluide d'échange de chaleur, ladite chambre de passage (35) étant traversée par lesdits conduits de passage (32), **caractérisé en ce qu'**au moins une partie desdits conduits de passage (32) est formée par une pluralité de dispositifs tubulaires (10) selon l'une quelconque des revendications 1 à 5.

7. Echangeur de chaleur selon la revendication 6, **caractérisé en ce qu'**il comprend un corps externe principal (33), qui contient une chambre d'admission (34) pour ledit deuxième fluide d'échange de chaleur qui est un gaz, qui forme, avec ledit corps principal (33), ladite chambre de passage (35) pour un premier fluide d'échange de chaleur, ladite chambre d'admission (34) pour le gaz étant entourée par lesdits conduits de passage (32) qui sont formés par une série de conduits d'échange de chaleur (36) ayant une section transversale circulaire et par une série desdits dispositifs tubulaires (10), le gaz étant transporté de ladite chambre d'admission (34) vers lesdits conduits d'échange de chaleur (36) ayant une section transversale circulaire au moyen d'une première partie inférieure de redirection et d'échange (37), ledit gaz qui sort desdits conduits d'échange de chaleur (36) ayant une section transversale circulaire étant transporté vers les dispositifs tubulaires (10) au moyen d'une chambre annulaire (38) qui entoure l'entrée de ladite chambre d'admission pour le gaz (34).

8. Echangeur de chaleur selon la revendication 7, **caractérisé en ce qu'**il est fermé dans une région supérieure par un rebord (39) avec un trou pour le passage de gaz et dans une région inférieure par une deuxième partie inférieure de collecte de condensation (40) avec une entrée (41) pour un gaz de combustion, au moins l'un dudit rebord (39) et de ladite partie inférieure (40) étant conçu pour être retiré pour l'extraction des éléments de redirection similaires à une tige (16) des dispositifs tubulaires (10) pour le nettoyage du tube (11) de ceux-ci.

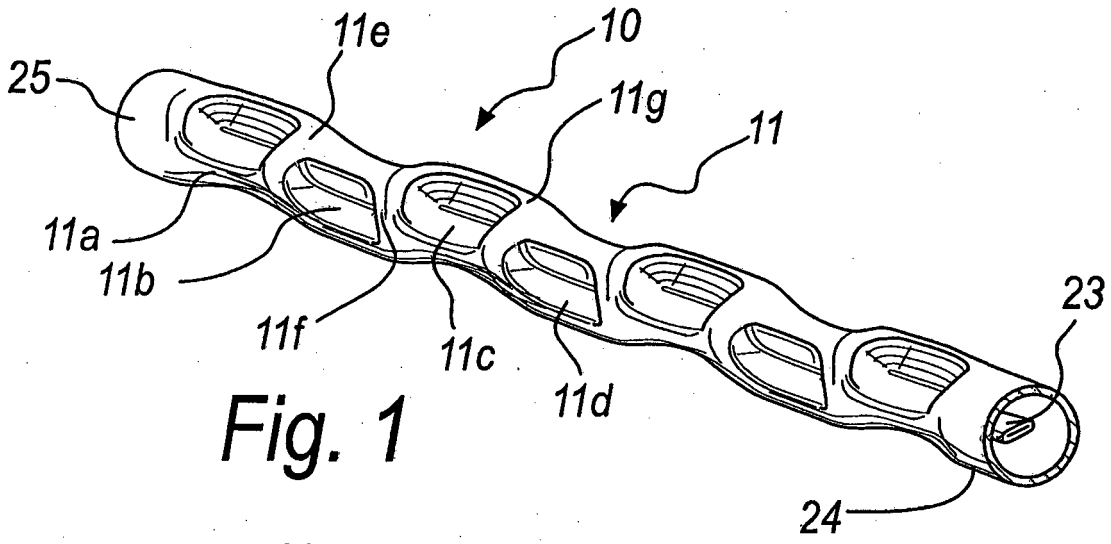

Fig. 1

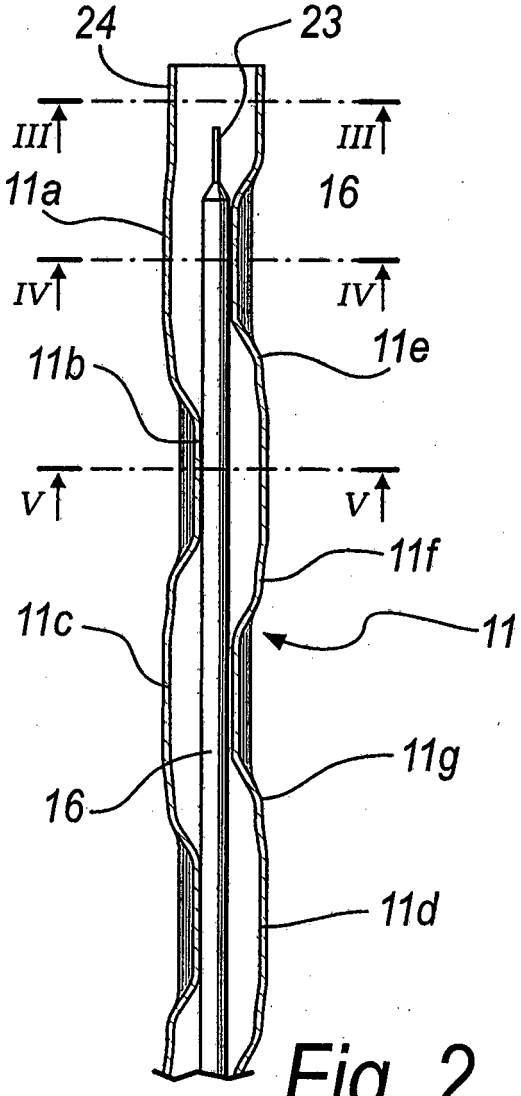

Fig. 2

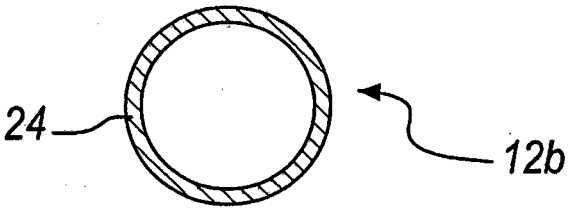

Fig. 3

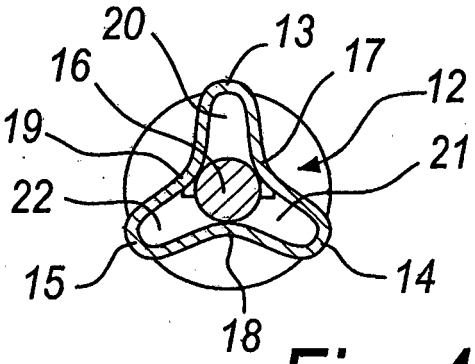

Fig. 4

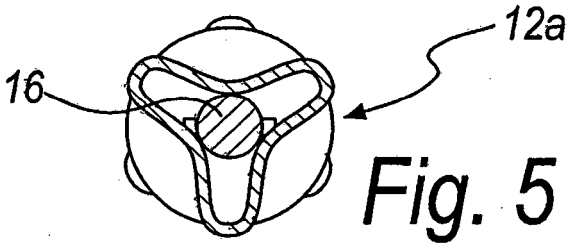

Fig. 5

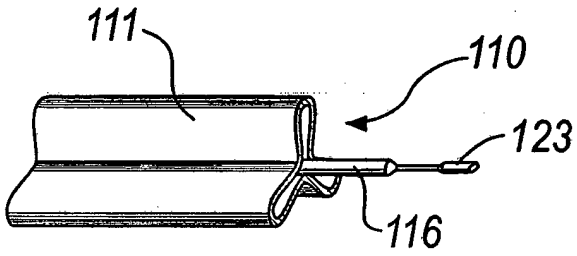

Fig. 6

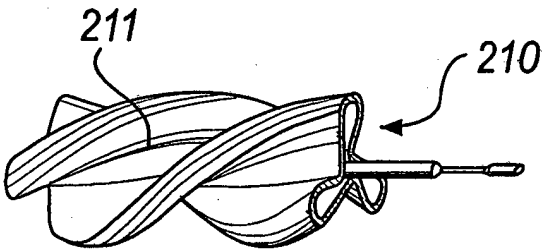

Fig. 7

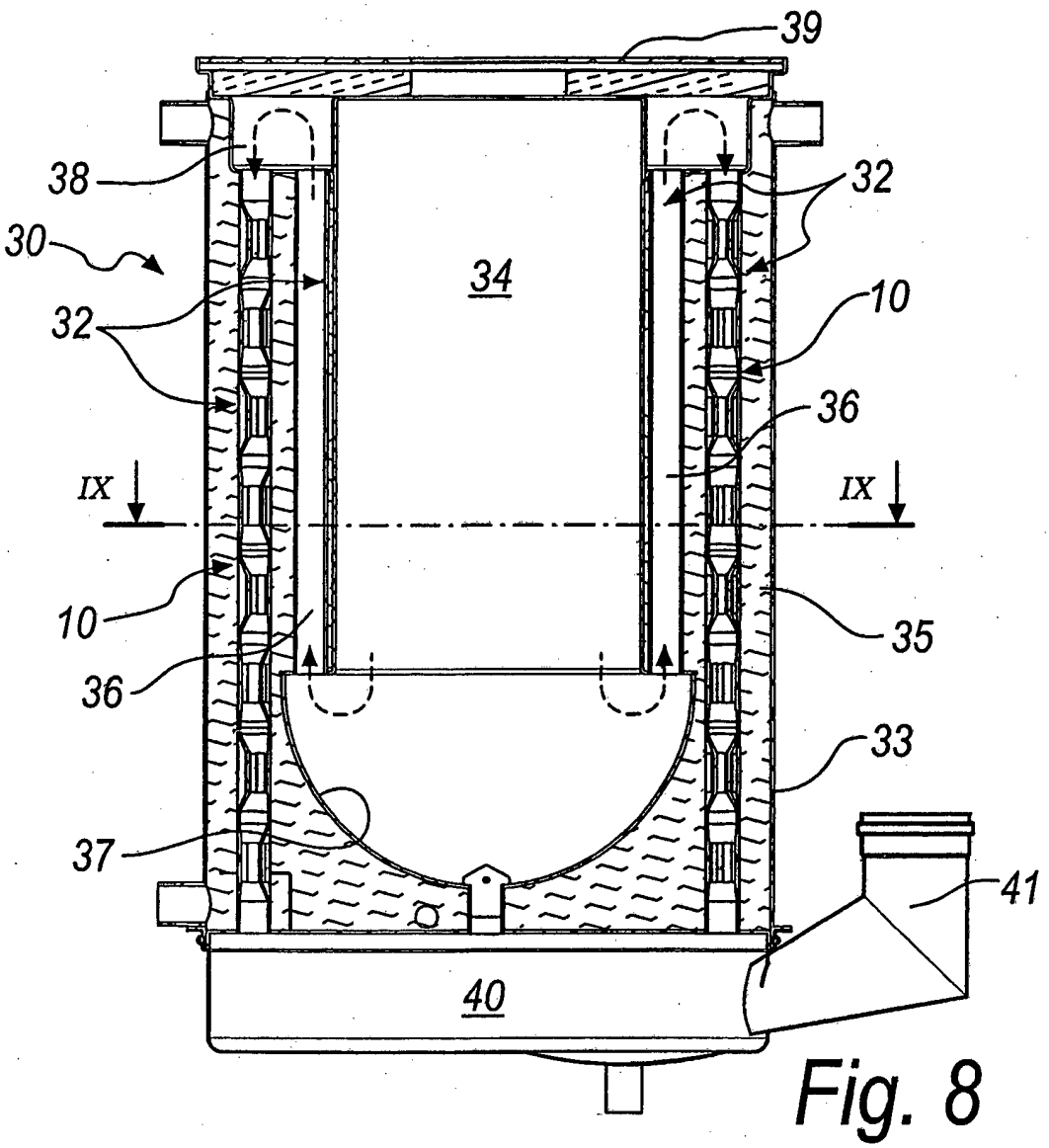

Fig. 8

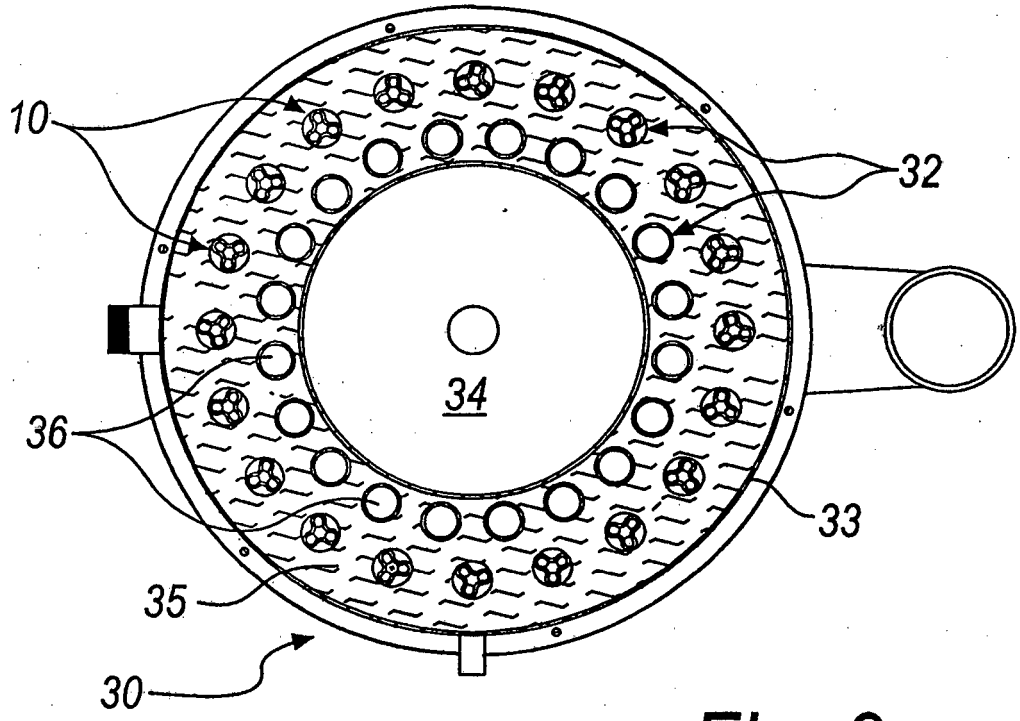

Fig. 9

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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