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(54) **Heat-exchanging means**

(57) Heat-exchanging means comprises pipe means (1) provided with first pipe means (2) suitable for receiving a first fluid and located inside second pipe means (3) suitable for receiving a second fluid, between said first pipe means (2) and said second pipe means (3) interspace means (4) being defined; strip means (5) is further provided that is positioned in said interspace means (4). The pipe means (1) is provided with projecting means (7) comprising protrusion means (7) having a shape that is substantially elongated along a direction (Z) wherein said pipe means (1) extends.

The projecting means (7) comprises first projecting means (7a) and second projecting means (7b) that are staggered in relation to one another.

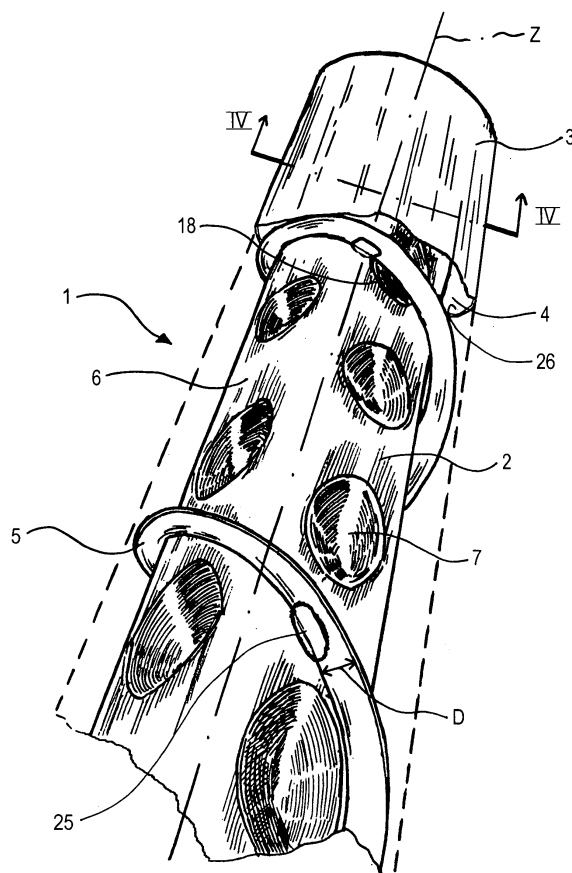


Fig. 1

Description

[0001] The invention relates to heat-exchanging means, for example usable in the food industry, in particular in the wine industry.

[0002] To transform the grapes into wine, first of all the mass of grapes that still have grape stalks and berries has to be pressed. The grapes are pressed by devices called filter presses that squeeze the mass of grapes in order to separate the solid part thereof, which is called marc and consists essentially of grape seeds, grape skins and grape stalks, from the liquid part, which is called must.

[0003] The must is subsequently subjected to an operation called vinification, in which the sugars contained therein ferment. At this point, the must is suitable for receiving the subsequent treatments for obtaining the desired finished product, namely the wine.

[0004] During the pressing step, which may last for several hours in such a way as to delicately process the grapes and obtain a qualitatively satisfactory product, the temperature of the must may increase in an undesired manner. If this occurs, the must, by fermenting prematurely, will produce wine of inferior quality.

[0005] In the winemaking process, it is thus necessary to install heat exchangers that prevent the premature fermentation of the must and ensure better quality of the finished product by appropriately decreasing the temperature of the must.

[0006] Heat exchangers are known comprising an external pipe inside which an internal pipe is arranged that extends in a manner that is coaxial to the external pipe. Between the internal pipe and the external pipe an interspace is defined in which a cooling fluid is made to circulate. In the internal pipe, on the other hand, the must circulates, which may not yet have been separated from the solid part.

[0007] In particular, heat exchangers are known in which the internal pipe comprises, on a limited portion of the surface thereof, a plurality of protrusions projecting inside it. A remaining portion of the surface of this pipe is on the other hand devoid of protrusions and defines a smooth region suitable for being operationally positioned in a lower region of the known exchangers.

[0008] The protrusions are arranged for increasing the contact surface between the must and the cooling fluid and constitute irregularities due to which the must tends to move with turbulent flow, so as to improve heat exchange. The smooth region on the other hand ensures that possible must residues that deposit in this region can easily be removed by means of washing devices.

[0009] A drawback of the above disclosed exchangers is that in use the internal pipe, weighed down by the must circulating therein, can flex inside the external pipe. This greatly decreases the efficiency of the heat exchange, because the cross section of the portion of interspace that is near the zone of greatest flexing decreases significantly. In order to limit this drawback, it is necessary

to increase the thickness of the walls of the internal pipe, thereby increasing manufacturing costs and reducing the efficiency of the heat exchange.

[0010] Furthermore, the internal pipe, weighed down by the must, may get damaged, being subjected to flexional stress that may in extreme cases cause breakage.

[0011] This implies that known exchangers may not be provided with very long pipes, which lessens the effectiveness of the heat exchange.

[0012] Furthermore, in the above disclosed exchangers, excessively turbulent flows may be created inside the must, due to the arrangement and the shape of the protrusions of the internal pipe. These flows may inappropriately mistreat the skins and the berries suspended in the must, dissolving prematurely the substances initially contained in the skin, which irremediably jeopardises the finished product.

[0013] Furthermore, known heat exchangers require significant flow rates of cooling liquid to obtain an efficient heat exchange, with consequent increased costs to be borne, due to the interspace that has a reduced section at the points wherein the internal pipe flexes.

[0014] An object of the invention is to improve heat-exchanging means, particularly those used in the food industry and above all in the winemaking industry.

[0015] Another object is to make heat-exchanging means provided with pipes for the transit of fluids that are sufficiently stiff.

[0016] A further object is to make heat-exchanging means provided with walls having thin thickness.

[0017] A further object is to obtain heat-exchanging means that may have a greater extension in length than known ones.

[0018] A still further object is to make heat-exchanging means that requires reduced flow rates of cooling fluid.

[0019] Still another object is to obtain heat-exchanging means of moderate cost and that are easy to make.

[0020] Still another object is to provide heat-exchanging means that gently processes the fluid the temperature of which it is desired to vary.

[0021] In a first aspect of the invention, heat-exchanging means is provided comprising pipe means provided with first pipe means suitable for receiving a first fluid and located inside second pipe means suitable for receiving a second fluid, between said first pipe means and said second pipe means interspace means being defined, characterised in that strip means is further provided that is positioned in said interspace means.

[0022] Owing to this aspect of the invention, it is possible to make pipe means of significant length, thus increasing the heat-exchange surface and consequently improving the efficiency of the heat-exchanging means.

[0023] In fact, the strip means interposed between the first pipe means and the second pipe means enables the stiffness of the first pipe means to be increased, thus preventing the first pipe means from getting deformed when it is traversed by the first fluid.

[0024] It is thus possible to make first pipe means of

limited thickness that enable the efficacy of the heat exchange to be further increased and the manufacturing costs of the pipe means to be lowered.

[0025] In an embodiment, the second fluid is a cooling fluid.

[0026] By shaping the strip means appropriately it is possible to force the cooling fluid to travel along non-rectilinear trajectories, thus increasing the contact time between the fluid and the first pipe means. In this way, the heat exchange is improved and the flow rate of cooling fluid is reduced that is necessary for cooling the first fluid.

[0027] In a second aspect of the invention, heat-exchanging means is provided comprising pipe means extending along a direction and provided with projecting means, characterised in that said projecting means comprises protrusion means having a shape that is substantially elongated along said direction.

[0028] In a third aspect of the invention, heat-exchanging means is provided comprising pipe means provided with projecting means, said projecting means comprising first projecting means and second projecting means, characterised in that said first projecting means and said second projecting means are staggered with respect to one another.

[0029] The projecting means enables the heat-exchange surface to be increased, improving the efficiency of the exchanging means. Furthermore, owing to the second and the third aspect of the invention, it is possible to make heat-exchanging means that is suitable for being traversed by fluids and which enables these fluids to be stirred in a relatively delicate manner. This both prevents undesired thermal gradients from forming inside the pipe means and possible delicate parts contained in the fluids from getting damaged.

[0030] The arrangement of the projecting means further enables the pipe means to be cleaned easily.

[0031] The invention can be better understood and implemented with reference to the attached drawings, which illustrate an exemplifying and non-limitative embodiment thereof, in which:

Figure 1 is a fragmentary perspective view of pipe means of a heat exchanger;

Figure 2 is a perspective view of a first pipe of the pipe means shown in Figure 1;

Figure 3 is a schematic section taken along the plane III-III of Figure 2;

Figure 4 is a schematic section taken along the plane IV-IV of Figure 1;

Figure 5 is a perspective view of a device for making protrusions in the first pipe in Figure 2;

Figure 6 is a schematic section of the device in Figure 5 during operation.

[0032] With reference to Figure 1, there is shown pipe means 1 of a heat exchanger that is usable for cooling a fluid, for example must in the winemaking industry.

[0033] The pipe means 1 comprises a first pipe 2, in which the must is circulated and a second pipe 3 arranged for containing the first pipe 2.

[0034] Between the first pipe 2 and the second pipe 3, which are substantially coaxial, an interspace 4 is defined that is arranged for being traversed, in use, by a cooling fluid, for example glycol.

[0035] With reference to Figure 2, there is shown the first pipe 2 used in the pipe means 1. The first pipe 2 is externally delimited by a surface 6, on which there is obtained a plurality of protrusions 7 that protrude inside first pipe 2. The protrusions 7 enable the thermal exchange surface to be increased and the efficiency of the heat exchanger to be improved accordingly.

[0036] Each protrusion 7 substantially has the shape of a semi-ellipsoid with a greater axis parallel to a direction Z along which the first pipe 2 extends.

[0037] The protrusions 7 are arranged along orderly rows that extend along the direction Z. In the illustrated example, four rows of protrusions 7 are provided that are spaced from one another by an angle of about 90°. Of these four rows, in Figure 2 only a first row 20, provided with first protrusions 7a, and a second row 21, provided with second protrusions 7b, are visible. The first protrusions 7a are staggered with respect to the second protrusions 7b along the direction Z. A similar arrangement of the protrusions 7 is also provided in the two rows that are not visible in Figure 2.

[0038] As shown in Figure 4, two opposite rows of protrusions 7 define pairs 8 of facing protrusions, each pair 8 being rotated by approximately 90° with respect to the further pairs that precede it or follow it along the direction Z. Each pair 8 enables a narrowing 10 to be achieved inside the first pipe 2, as shown in Figure 3. The narrowings 10 divert the fluid streams 9 of the must contained in the first pipe 2 with respect to a rectilinear trajectory that these streams would follow in the absence of the narrowings 10. In particular, if a longitudinal section of the type shown in Figure 3 is considered, it is noted that the fluid streams 9 approach one another near the pairs 8 of protrusions 7. As the latter are staggered, a three-dimensional movement of the fluid streams 9 is generated that enables the must to be mixed, ensuring even distribution of the temperature of the must.

[0039] As the narrowings 10 cause the section inside the first pipe 2 to vary, the speed of the must is increased with the same flow rate, which contributes to generating a motion having a certain turbulence. Nevertheless, owing to the shape of the protrusions 7, the motion of the must is not such as to damage possible berries and/or skins arranged in the inside thereof. The protrusions 7 are in fact arranged along the direction Z wherein the must moves and are delimited by surfaces devoid of corners. This enables excessively violent blows to be avoided that could break the berries and/or the skins, releasing the substances contained therein prematurely.

[0040] The pairs 8 of protrusions that are staggered between one another further cooperate in creating a ten-

sional state inside the first pipe 2 that increases the stiffness thereof and consequently the resistance to flexure.

[0041] Between two rows of adjacent protrusions 7 passage zones 12 are defined that are substantially smooth, i.e. devoid of protrusions 7. Within the heat exchanger, the first pipe 2 is positioned in such a way that one of the passage zones 12 is arranged in a lower region of the first pipe 2, as shown in Figure 4. In this way it is possible, after using the heat exchanger, to eliminate the residues of must from the first pipe 2 simply by sending a first jet of water inside the first pipe 2. As the passage zone 12 is positioned below, the must is prevented from stagnating between the adjacent protrusions 7.

[0042] As shown in Figure 1, the first pipe 2 is furthermore provided with a strip 5 wound substantially as a helix on the surface 6 of the first pipe 2, in such a way that a lesser side of the strip 5 is in contact with the surface 6. In other words, the strip 5 projects outside the surface 6 substantially perpendicular to the latter.

[0043] The first pipe 2 and the strip 5 may both be made of metal material, for example stainless steel. In this case, the strip 5 can be associated with the first pipe 2 by means of welding points 25.

[0044] The strip 5 is arranged for supporting the first pipe 2 inside the second pipe 3, eliminating the possibility that the first pipe 2, when it is traversed by the must, flexes inside the second pipe 3. For this purpose, the strip 5 is provided with a dimension D, which is transversal with respect to the direction Z and substantially the same as the distance in use between the surface 6 that externally delimits the first pipe 2 and a further surface 26 that internally delimits the second pipe 3. Inside the heat exchanger, the strip 5 is thus in contact with the first pipe 2, to which it is welded, and in a position very near the further surface 26 of the second pipe 3. If, during operation, the first pipe 2 tends to flex due to the weight of the must, the strip 5 comes into contact with the further surface 26 of the second pipe 3. This prevents the first pipe 2 from being deformed further even if the first pipe 2 is provided with a very thin thickness.

[0045] In order to prevent the second pipe 3 from getting deformed in turn, it is possible to use respective supporting means that supports the second pipe 3 from the outside.

[0046] Furthermore, the strip 5 gives greater stiffness to the assembly comprising the first pipe 2 and the second pipe 3, enabling very long pipes having thin thicknesses to be obtained.

[0047] The strip 5 forces the cooling liquid to run through a spiral path that increases the turbulence and improves the thermal exchange. It should be noted that, with the same flow rate, a smaller quantity of cooling liquid can be used compared with known exchangers inasmuch as by forcing the cooling liquid to travel along a spiral path the contact time with the surface 6 of the first pipe 2 is increased, accentuating the heat exchange.

[0048] The strip 5 can furthermore be wound on the first pipe 2 at one or more protrusions 7. If this occurs,

between the strip 5 and the underlying protrusion 7 an opening 18 is defined that is shown in Figure 1, inside which the cooling fluid can pass. Turbulence is thus generated that further improves the heat exchange.

[0049] In the example in Figure 1, the strip 5 is wound as a helix around the first pipe 2. It is nevertheless possible to shape the strip 5 interposed between the first pipe 2 and the second pipe 3 also according to geometries different from the helical geometry. For example, several strips 5 can be used that extend along the direction Z in a curvilinear manner so as to define a tortuous path for the cooling fluid.

[0050] The protrusions 7 are obtained by means of a device 11 shown in Figure 5, that is suitable for being used in presses that are not shown.

[0051] The device 11 is provided with two die elements, comprising a first die element 13 and a second die element 16, having a substantially hollow semicylindrical shape and provided with respective punches 14 opposite one another. The first die element 13 and the second die element 16, when arranged in an operating configuration shown in Figure 5, define in the interior thereof a passage 17 suitable for receiving a pipe. The first die element 13 is surmounted by a fixing device 15 arranged for retaining the first die element 13 on a press that is not shown. To the first die element 13 the second die element 16 is opposed, which has a shape that is substantially similar to that of the first die element 13. When it is desired to make a pair 8 of protrusions, the device 11 is fixed on the press by means of the fixing device 15.

[0052] At this point the press is driven that raises the first die element 13 of the device 11 and a smooth pipe, on which it is desired to make the protrusions 7, is introduced inside the passage 17 defined by the first die element 13 and by the second die element 16.

[0053] As shown in Figure 6, by acting on the press the first die element 13 and the second die element 16 approach one another. These elements, by means of the punches 14, make a pair 8 of protrusions.

[0054] In order to make a further pair of protrusions, once the press is released, the pipe is advanced by a preset portion and is rotated by 90°. By driving the press again in a similar manner to what has been disclosed above, a new pair of protrusions is made.

[0055] By repeating the operation along the entire length of the pipe the desired rows of protrusions 7 are obtained.

[0056] It should be noted how simple and inexpensive to build and use the device 11 is, which reduces the costs to be borne for making the desired protrusions.

Claims

1. Heat-exchanging means, comprising pipe means (1) provided with first pipe means (2) suitable for receiving a first fluid and located inside second pipe means

(3) suitable for receiving a second fluid, between said first pipe means (2) and said second pipe means (3) interspace means (4) being defined, **characterised in that** strip means (5) is further provided that is positioned in said interspace means (4).

2. Heat-exchanging means according to claim 1, wherein said first pipe means (2) comprises an external surface (6) with which said strip means (5) is associated.
3. Heat-exchanging means according to claim 2, wherein said strip means (5) is associated with said external surface (6) in such a way as to define a tortuous path for said second fluid.
4. Heat-exchanging means according to claim 2 or 3, wherein said strip means (5) is arranged on said external surface (6) according to a curvilinear conformation.
5. Heat-exchanging means according to any one of claims 2 to 4, wherein said strip means (5) is wound substantially as a helix on said external surface (6).
6. Heat-exchanging means according to any one of claims 2 to 5, wherein said strip means (5) has a lesser side arranged in contact with said external surface (6).
7. Heat-exchanging means according to any one of claims 2 to 6, wherein said strip means (5) projects substantially perpendicularly to said external surface (6).
8. Heat-exchanging means according to any one of claims 2 to 7, wherein said strip means (5) is provided with a dimension (D), which is transversal with respect to said external surface (6) and substantially equal to a distance between said external surface (6) and an internal surface (26) that internally delimits said second pipe means (3).
9. Heat-exchanging means according to any preceding claim, wherein said pipe means (1) extends along a direction (Z) and is provided with projecting means (7).
10. Heat-exchanging means according to claim 9, as appended to any one of claims 2 to 8, wherein said projecting means (7) is obtained on said external surface (6) and projects inside said first pipe means (2).
11. Heat-exchanging means according to claim 9, or 10, wherein said strip means (5) is wound on said first pipe means (2) at at least one of said projecting means (7), so that between said strip means (5) and said projecting means (7) an opening (18) is defined

that is traversable by said second fluid.

12. Heat-exchanging means according to any one of claims 9 to 11, wherein said projecting means comprises protrusion means (7) having a shape that is substantially elongated along said direction (Z).
13. Heat-exchanging means according to claim 12, wherein said elongated shape is a substantially semi-ellipsoid shape.
14. Heat-exchanging means according to any one of claims 9 to 13, wherein said projecting means (7) comprises first projecting means (7a) and second projecting means (7b), said first projecting means (7a) and said second projecting means (7b) being staggered in relation to one another.
15. Heat-exchanging means according to claim 14, wherein said first projecting means (7a) is arranged along a first row (20) extending along said direction (Z) and said second projecting means (7b) is arranged along a second row (21) extending along said direction (Z), said first row (20) being staggered with respect to said second row (21).
16. Heat-exchanging means according to claim 15, wherein between said first row (20) and said second row (21) substantially smooth passage zones (12) are interposed.
17. Heat-exchanging means according to any one of claims 9 to 16, wherein said projecting means (7) is arranged along four rows extending along said direction (Z).
18. Heat-exchanging means according to any one of claims 9 to 17, wherein said projecting means (7) comprises pairs (8) of facing protrusions (7).
19. Heat-exchanging means according to claim 18, wherein said pairs (8) comprise a first pair and a second pair arranged consecutively along said direction (Z), said first pair being rotated around said direction (Z) with respect to said second pair.
20. Heat-exchanging means according to claim 19, wherein said first pair is rotated by approximately 90° with respect to said second pair.
21. Heat-exchanging means, comprising pipe means (2) extending along a direction (Z) and provided with projecting means (7), **characterised in that** said projecting means comprises protrusion means (7) having a shape that is substantially elongated along said direction (Z).
22. Heat-exchanging means according to claim 21,

wherein said pipe means (1) comprises first pipe means (2) located inside second pipe means (3), said projecting means (7) being obtained in an external surface (6) of said first pipe means (2).

23. Heat-exchanging means according to claim 22, wherein said projecting means (7) projects inside said first pipe means (2).
24. Heat-exchanging means according to any one of claims 21 to 23, wherein said projecting means (7) substantially has a semi-ellipsoid shape.
25. Heat-exchanging means according to any one of claims 21 to 24, wherein said projecting means (7) comprises first projecting means (7a) and second projecting means (7b), said first projecting means (7a) and said second projecting means (7b) being staggered in relation to one another.
26. Heat-exchanging means according to claim 25, wherein said first projecting means (7a) is arranged along a first row (20) extending along said direction (Z) and said second projecting means (7b) is arranged along a second row (21) extending along said direction (Z), said first row (20) being staggered with respect to said second row.
27. Heat-exchanging means according to claim 26, wherein substantially smooth passage zones (12) are interposed between said first row (20) and said second row (21).
28. Heat-exchanging means according to any one of claims 21 to 27, wherein said projecting means (7) is arranged along four rows extending along said direction (Z).
29. Heat-exchanging means according to any one of claims 21 to 28, wherein said projecting means (7) comprises pairs (8) of facing protrusions (7).
30. Heat-exchanging means according to claim 29, wherein said pairs (8) comprise a first pair and a second pair arranged consecutively along said direction (Z), said first pair being rotated around said direction (Z) with respect to said second pair.
31. Heat-exchanging means according to claim 30, wherein said first pair is rotated by approximately 90° with respect to said second pair.
32. Heat-exchanging means, comprising pipe means (2) provided with projecting means (7), said projecting means (7) comprising first projecting means (7a) and second projecting means (7b), **characterised in that** said first projecting means (7a) and said second projecting means (7b) are staggered with respect to

one another.

33. Heat-exchanging means according to claim 32, wherein said pipe means comprises first pipe means (2) located inside second pipe means (3), said projecting means (7) being obtained in an external surface (6) of said first pipe means (2).
34. Heat-exchanging means according to claim 33, wherein said projecting means (7) projects inside said first pipe means (2).
35. Heat-exchanging means according to any one of claims 32 to 34, wherein said first projecting means (7a) is arranged along a first row (20) extending along a direction (Z) wherein said pipe means (1) extends and said second projecting means (7b) is arranged along a second row (21) extending along said direction (Z), said first row (20) being staggered with respect to said second row.
36. Heat-exchanging means according to claim 35, wherein substantially smooth passage zones (12) are interposed between said first row (20) and said second row (21).
37. Heat-exchanging means according to any one of claims 32 to 36, wherein said projecting means (7) is arranged along four rows extending along said direction (Z).
38. Heat-exchanging means according to any one of claims 32 to 37, wherein said projecting means (7) comprises pairs (8) of facing protrusions (7).
39. Heat-exchanging means according to claim 38, as appended to claim 35 or 36, or to claim 37 as appended to claim 35 or 36, wherein said pairs (8) comprise a first pair and a second pair arranged consecutively along said direction (Z), said first pair being rotated around said direction (Z) with respect to said second pair.
40. Heat-exchanging means according to claim 39, wherein said first pair is rotated by approximately 90° with respect to said second pair.
41. Use of heat-exchanging means according to any one of claims 1 to 40 for cooling must.

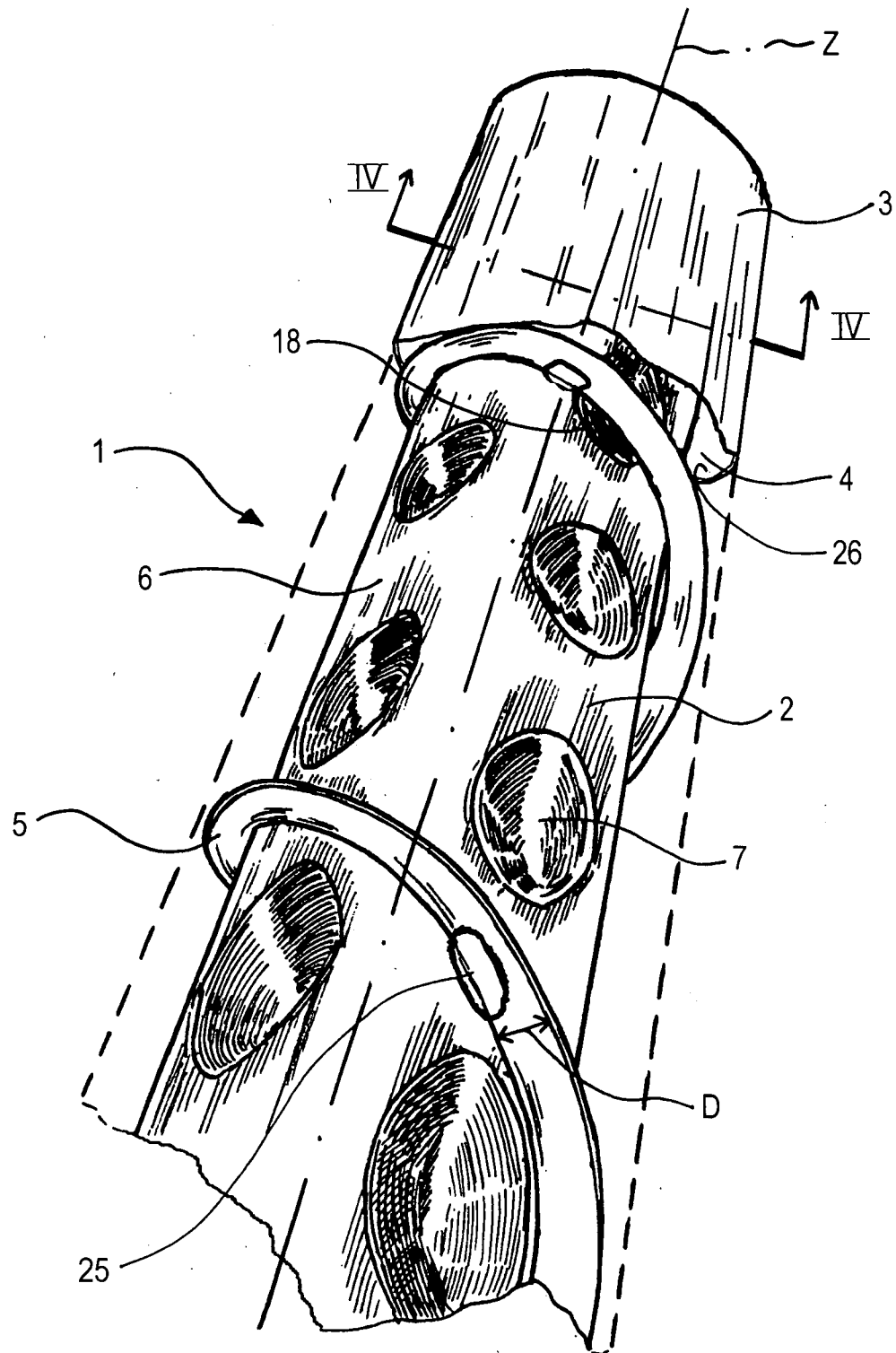


Fig. 1

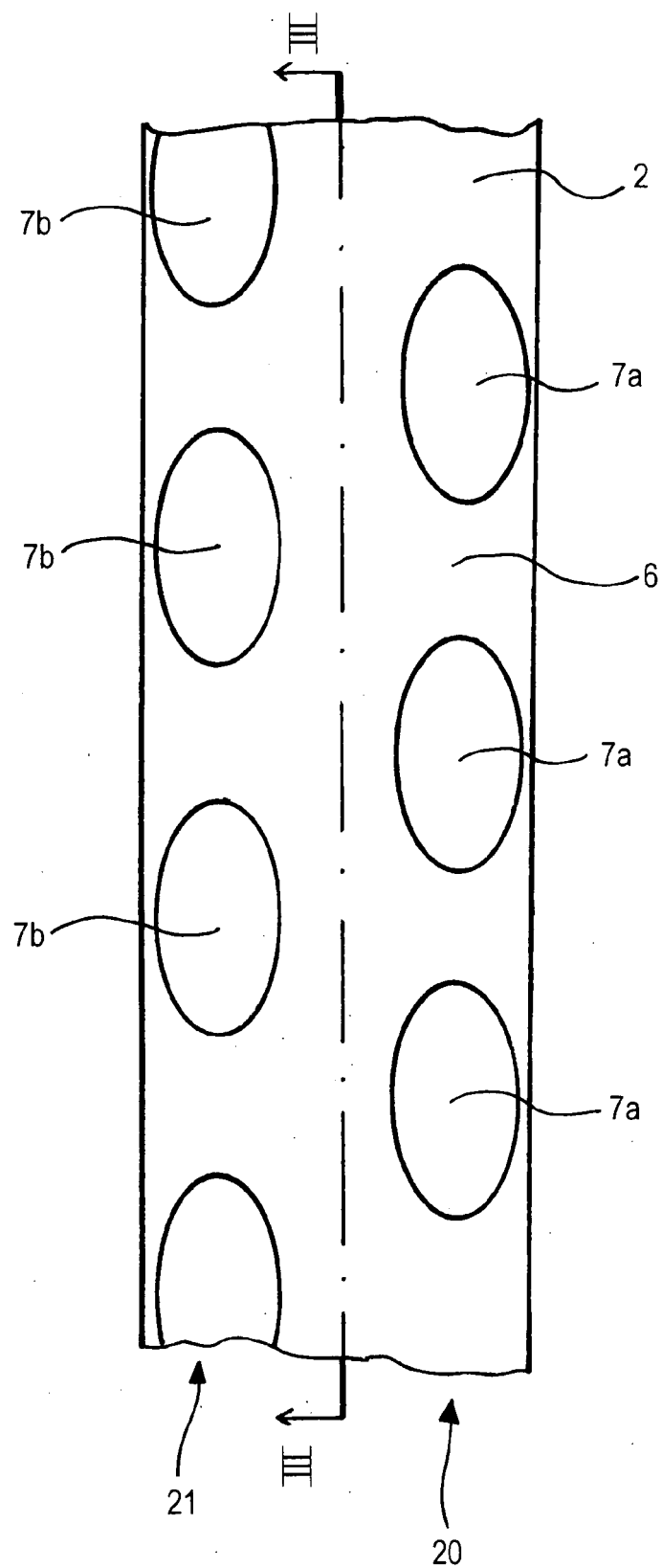


Fig. 2

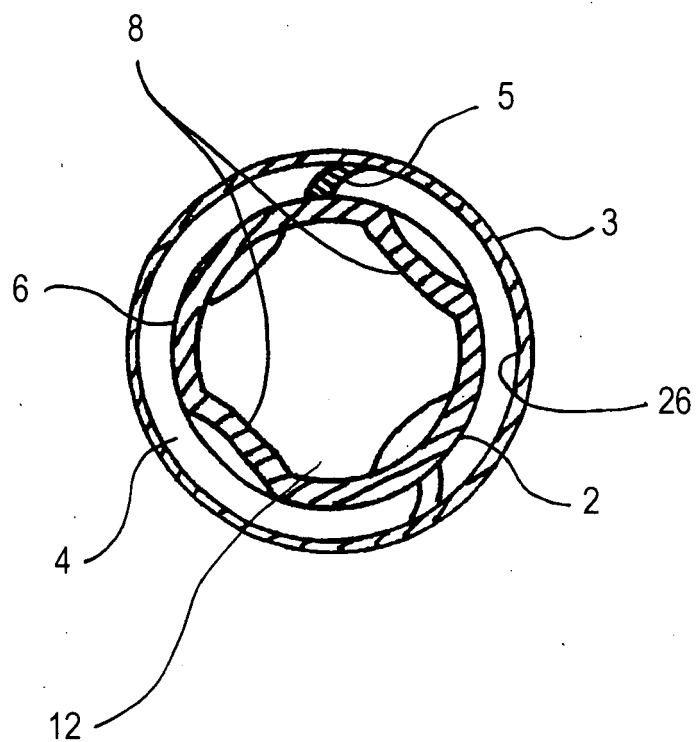
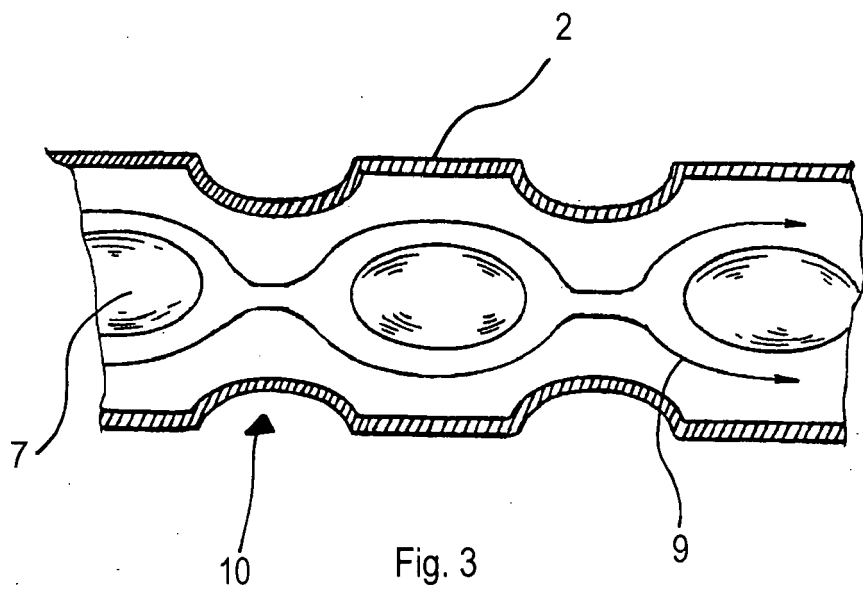


Fig. 4

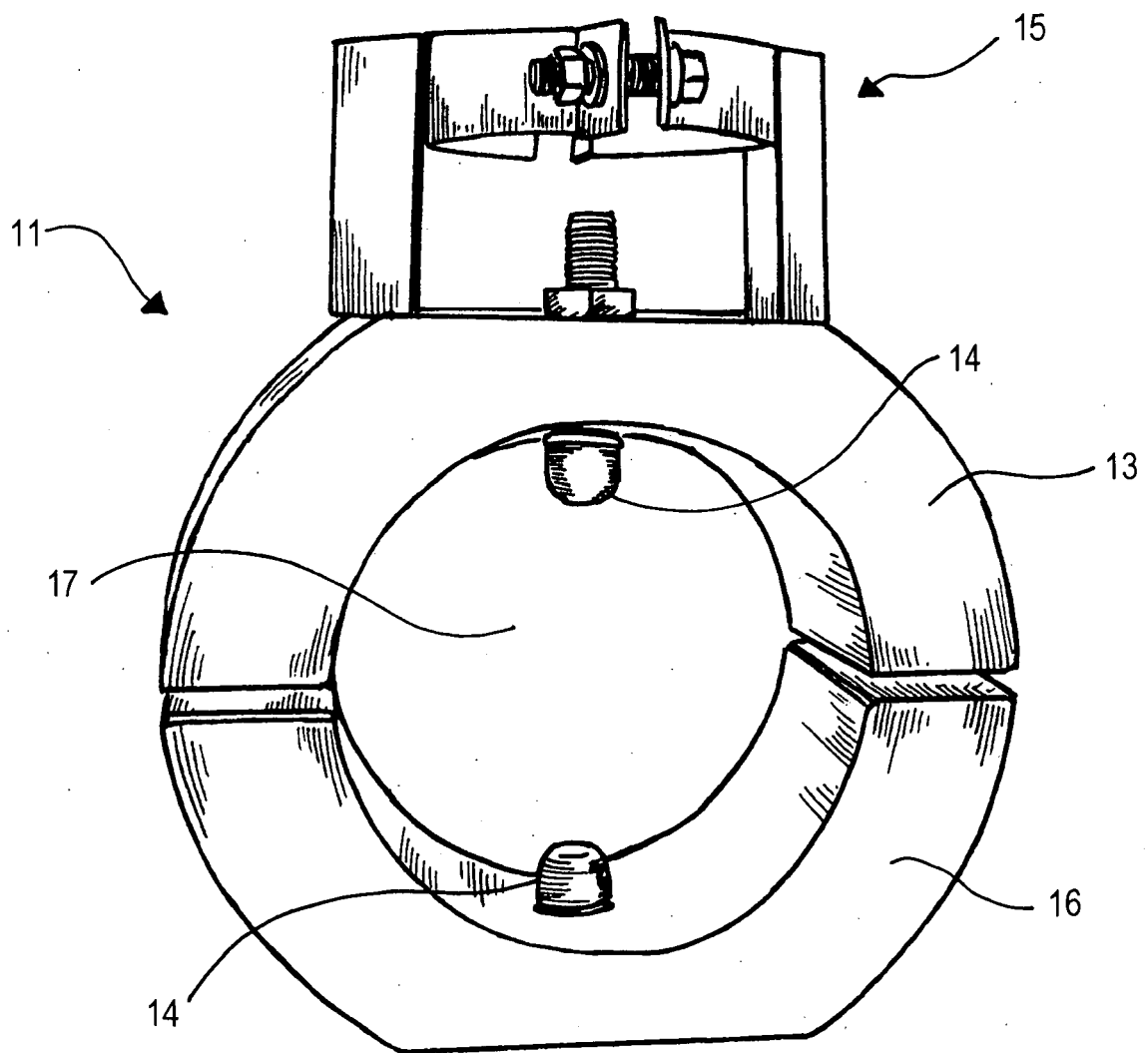


Fig. 5

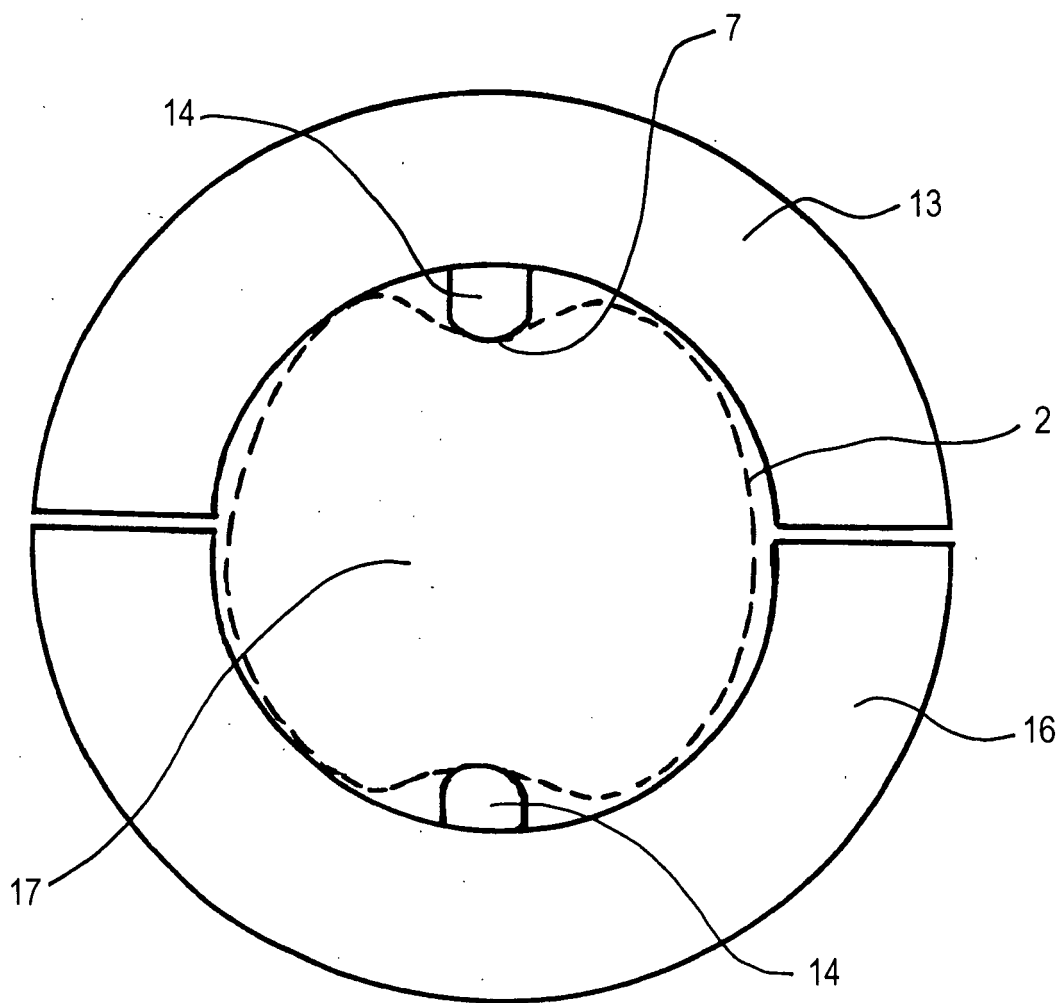


Fig. 6