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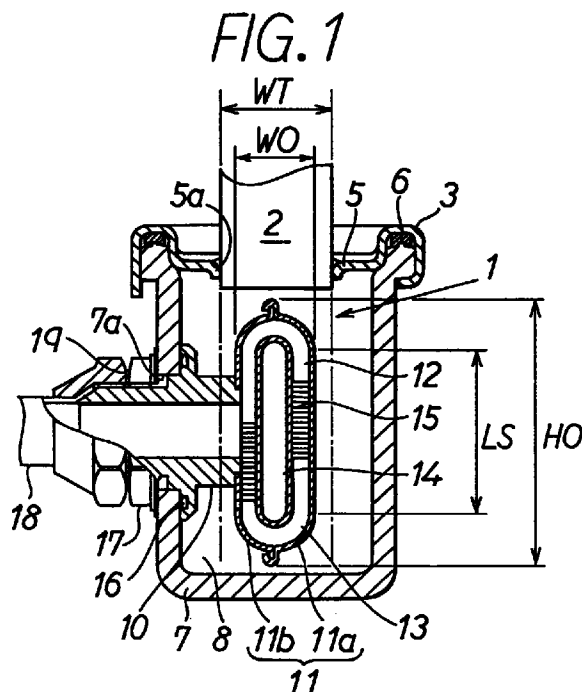
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(54) Heat exchanger having a double pipe construction

(57) An outer cylindrical pipe (11) forming a double pipe type oil cooler (1) is disposed within lines extending from both outer surfaces of each tube (2), which defines the width dimension of the tube (2). That is, the double pipe type oil cooler (1) is located at a position where the flow speed of cooling water is maximum. Thereby, as the cooling water flows from the tube (2) is used efficiently for cooling, the cooling performance of the oil cooler (1) is further improved. Further, the double pipe type oil cooler (1) is formed into flat shaped double pipe in which the longitudinal axis thereof is more than twice as long as the latitudinal axis thereof, and the latitudinal axis of the oil cooler (1) is smaller than the width dimension of the tube (2).



Description

BACKGROUND OF THE INVENTION

1. Field of the Invention:

The present invention relates to a heat exchanger applied to an oil cooler installed in a vehicle radiator and having a double pipe construction, in which a circle-like fluid passage through which a second fluid flows to be heat exchanged with first fluid is formed thereinside.

2. Description of Related Art:

Conventionally, as shown in FIGS. 10 and 11, a double pipe type oil cooler 100 is well known. This oil cooler 100 is installed in a lower tank 102 of a vehicle radiator for cooling vehicle engine cooling water. This oil cooler 100 cools lubrication oil by carrying out heat exchange between the cooling water introduced from a tube 103 of the radiator and the lubrication oil flowing in the oil cooler 100.

The oil cooler 100 includes an outer cylindrical pipe 104, an inner cylindrical pipe 105, an oil passage 106, an inner fin 107 provided in the oil passage 106, and a connecting member 109 for connecting the outer cylindrical pipe 104 to an external connecting pipe 108. The outside wall surface of the outer cylindrical pipe 104 contacts the cooling water flowing from the tube 103. The inner cylindrical pipe 105 is disposed inside the outer cylindrical pipe 104, and the center axis of the inner cylindrical pipe 105 is concentric to that of the outer cylindrical pipe 104. The oil passage 106 is formed between the outer cylindrical pipe 104 and the inner cylindrical pipe 105. The lubrication-oil flows into the oil cooler 100 through the connecting pipe 108 and circulates therein.

In the conventional oil cooler 100, as shown in FIGS. 10 and 11, the diameter of the oil cooler 100 is set larger than the width (WT) of the tube 103, for attaining a sufficient radiation area. Therefore, the cooling water stagnates around the lower portion of the oil cooler 100. Thus, the cooling water flow speed decreases around the lower portion of the oil cooler 100, and the cooling water side heat transmitting efficiency is lessened. Further, in the conventional oil cooler, the cooling water flow flowing from the tube 103 into the lower tank 102 is not used efficiently for improving the cooling performance of the oil cooler 100.

Here, JP-U-58-46969 discloses a double pipe type oil cooler installed in a radiator tank, which includes cross sectional 8-shaped outer and inner cylindrical pipes. However, in this reference, no relation between the radiator tube and the oil cooler is disclosed.

JP-U-58-524623 discloses a double pipe type oil cooler that is installed into a radiator tank, and that includes cross sectional flat or rectangular shaped outer and inner cylindrical pipes. In this double pipe type oil

cooler, the longitudinal axis of the oil cooler is arranged perpendicularly relative to the cooling water flow direction flowing from the tube, and the latitudinal axis thereof is arranged along the cooling water flow direction. Therefore, the cooling water stagnates around the bottom portion of the oil cooler. Thus, the cooling water flow speed decreases around the bottom portion of the oil cooler and the cooling water side heat transmitting efficiency is lessened. That is, the cooling water flowing from the tube into the radiator tank is not used efficiently. Further, when the radiating area thereof is set the same as the conventional cylindrical double pipe type oil cooler, the width dimension of the tank needs to be large, and the width dimension of the radiator is made large.

JP-U-59-71071 discloses a double pipe type oil cooler installed in a radiator tank, which includes cross sectional elliptic shaped outer and inner cylindrical pipes. Further, JP-A-3-233129 discloses a double pipe type oil cooler which includes cross sectional substantially U-shaped outer and inner cylindrical pipes. In these oil coolers, as the diameter of the oil cooler is larger than the width of the radiator tube, the position of maximum cooling water flow speed is not used efficiently for cooling.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a double pipe type heat exchanger in which an entire heat exchanging performance is further improved without reducing a heat transmitting area. Another object of the present invention is to minimize the size of an upstream side fluid passage, like a tube, and a downstream side fluid passage, like a downstream side tank.

According to a first aspect of the present invention, a double pipe type heat exchanger is disposed within lines extending from both sides of an upstream side fluid passage, which defines the width dimension thereof. That is, the double pipe type heat exchanger is located at a position where the flow speed of a first fluid is a maximum. Thereby, as the first fluid flows from the upstream side fluid passage and is used efficiently for heat exchanging, the heat exchanging performance of the entire double pipe type heat exchanger is further improved.

According to a second aspect of the present invention, a double pipe type heat exchanger is formed into a flat shaped double pipe in which the longitudinal axis thereof is more twice as long as the latitudinal axis thereof, and the latitudinal axis of the heat exchanger is smaller than the width dimension of an upstream side fluid passage. Thus, the outside wall surface area of the double pipe type heat exchanger contacting the cooling water can be made large. Thereby, though the latitudinal axis of the heat exchanger is set to be smaller than the width dimension of the upstream side fluid passage, the heat exchanging performance of the entire heat

exchanger is maintained.

BRIEF DESCRIPTION OF THE DRAWINGS

Additional objects and advantages of the present invention will be more readily apparent from the following detailed description of preferred embodiments thereof when taken together with the accompanying drawings in which:

FIG. 1 is a cross sectional view showing a double pipe type oil cooler in a first embodiment, installed in a lower tank of a vehicle radiator;

FIG. 2 is a cross sectional view showing a cooling water flow with respect to the oil cooler in the first embodiment;

FIG. 3 is a plan view showing the double pipe type oil cooler according to the first embodiment;

FIG. 4 is a front view showing the double pipe type oil cooler according to the first embodiment;

FIG. 5 is a partial cross sectional view showing the double pipe type oil cooler according to the first embodiment;

FIG. 6 is a cross sectional view showing a double pipe type oil cooler in a second embodiment, installed in a lower tank of a vehicle radiator;

FIGS. 7A, 7B are cross sectional views showing double pipe type oil coolers in modifications;

FIGS. 8A, 8B are cross sectional views showing double pipe type oil coolers in modifications;

FIG. 9A is a cross sectional view showing the double pipe type oil cooler in the first embodiment;

FIGS. 9B, 9C are cross section views showing double pipe type oil coolers in modifications;

FIG. 10 is a cross sectional view showing a prior art double type oil cooler installed in a lower tank of a vehicle radiator; and

FIG. 11 is a cross sectional view showing a cooling water flow with respect to the prior art oil cooler.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

(First Embodiment)

Referring to FIGS. 1 and 2, a double pipe type oil cooler 1 according to a first embodiment cools lubrication oil for a vehicle engine by carrying out heat exchange between the lubrication oil and cooling water for the vehicle engine. The double pipe type oil cooler 1 is installed in a lower tank 3 of a vehicle radiator. The lower tank 3 is connected to the lower ends of a plurality of tubes 2 of the radiator disposed at the position, where the radiator is likely to receive an air generated by running dynamic pressure of the vehicle.

Each tube 2 is made of a metal, such as an aluminum alloy, that has superior heat transmitting performance, and that is formed into a flat oval shape. The tube

2 forms an upstream side cooling water passage 4 through which the cooling water flows downwardly. When the cooling water flows through the upstream side cooling water passage 4, the cooling water is heat exchanged with the air passing by the outside surface of the tube 2 and is cooled. A corrugated fin (not illustrated) is provided between each pair of adjacent tubes 2 for improving the heat transmitting performance.

A lower tank 3 includes a core plate 5 made of aluminum alloy, a capsule 7 made of resin, and a downstream side cooling water passage 8 into which the cooling water flows from the plural tubes 2. The capsule 7 is fixed to the core plate 5 by crimping, through a sealing member 6 such as rubber packing.

The core plate 5 includes a plurality of insertion holes 5a into which the downstream side ends of the plural tubes 2 are inserted. The downstream side ends of the tubes 2 are brazed with the core plate 5. The capsule 7 is made of resin such as nylon and formed into vessel-shape, that is, the cross sectional shape thereof is formed into a substantially U-shaped configuration. The capsule 7 includes two circle-shaped insertion holes 7a into which a nipple 10 of the oil cooler 1 is inserted. The insertion holes 7 are formed on the side wall of the capsule 7. Here, the capsule 7 may be made of metal.

The structure of the double-pipe type oil cooler 1 will be described in more detail with reference to FIGS. 1-5. The double-pipe type oil cooler 1 includes two nipples 10 as connecting members, an outer cylindrical pipe 11, an inner cylindrical pipe 12, an oil passage 13 through which the lubrication oil circulates, a cooling water passage 14 through which the cooling water circulates, and an inner fin 15. The outer cylindrical pipe 11 is formed to separate into double members 11a, 11b, and is connected to the nipple 10. The inner cylindrical pipe 12 is provided inside the outer cylindrical pipe 11. The oil passage 13 is formed between the outer cylindrical pipe 11 and the inner cylindrical pipe 12. The cooling water passage 14 is formed inside the inner cylindrical pipe 12. The inner fin 15 is disposed inside the oil passage 13.

Each nipple 10 is inserted into the insertion hole 7a of the capsule 7, and a seal member 16 such as an O-ring is disposed between the nipple 10 and the inside wall of the capsule 7. An outer peripheral screw portion 19 is formed at the outer periphery of a cylindrical pipe portion protruding from the outside wall of the capsule 7. A nut 17 and an external connecting pipe 18 are screwed on the outer peripheral screw portion 19. Here, there are two external connecting pipes 18. One is an inlet side external connecting pipe 18, and the other is an outlet side external connecting pipe 18.

The inlet side external connecting pipe 18 connects to the oil cooler 1 and a torque converter (not illustrated) of a vehicle automatic transmission. The outlet side external connecting pipe 18 connects to an oil-pump or an oil pan (not illustrated). Here, the oil flows from the

torque converter, through the oil cooler 1, and into the oil pump or the oil pan, or flows from the oil pump or the oil pan, through the oil cooler 1, and into the torque converter.

The outer cylindrical pipe 11 is made of metal, such as an aluminum alloy or brass, and formed into a flat shape. The outer cylindrical pipe 11 is formed by crimp-connecting a pair of saucer-like metal plates 11a, 11b facing each other at the outer peripheries thereof. The metal plates 11a, 11b include concave portions, and these concave portions face each other. The outer cylindrical pipe 11 is formed into a configuration that is oval in cross-section, the longitudinal axis direction of which is along the cooling water flow direction from the tube 2 to the lower tank 3. That is, the latitudinal axis of the oval shape is perpendicular to the cooling water flow direction.

The longitudinal axis length (HO) is more twice as long as the latitudinal axis length (WO). For example, in the present embodiment, HO is 3.4 times as long as WO. Referring to FIGS. 2 and 4, the upper and lower ends of the outer cylindrical pipe 11 are formed into an arc-like portion 20, and the center portion of the outer cylindrical pipe 11 is formed into a generally portion 21 having a length LS. The outer peripheral pipe 11 is disposed inside the downstream side cooling water passage 8 in the lower tank 3 in such a manner that a crimp portion 22 is located on the center axis of the tube 2. The outer cylindrical pipe 11 is fixed to the nipple 10 such that the outer cylindrical pipe 11 is located within lines (dotted chain lines in FIG. 1) extending from the outer surfaces of the tube 2. The width dimension WT between these lines is the width dimension of the tube 2 (for example, the outer diameter of the tube 2).

The inner cylindrical pipe 12 is made of a metal, such as an aluminum alloy or brass, and formed into an oval shape that is concentric to the outer cylindrical pipe 11. The oil passage 13 is formed into an oval ring shape, and between the outer and inner cylindrical pipes 11, 12. The cooling water passage 14 opens at both ends of the inner cylindrical pipe 11 in the rowing direction of the plural tubes 2. The cooling water flowing in the downstream side cooling water passage 8 flows through the cooling water passage 14. The inner fin 15 is disposed in the oil passage 13 for improving the oil side heat transmitting efficiency.

Operation of the first embodiment will be described with reference to FIGS. 1-5.

When the oil pump is driven by the vehicle engine, the lubrication oil flows through the inlet side external connecting pipe 18, and into the oil passage 13. The lubrication oil circulates in the oil passage 13, heat exchanges with the cooling water, and flows out of the oil cooler 1 through the outlet side external connecting pipe 18. Here, as the inner fin 15 is provided inside the oil passage 13, the oil side heat transmitting efficiency is high.

When the water pump is driven by the vehicle

engine, the cooling water flowing from the water jacket of the vehicle engine flows into the upper tank of the radiator. The cooling water is distributed into each tube 2, and flows through the tube 2 while being cooled by heat exchanging with cooling air. After that, the cooling water flows from the lower end of the tube 2 and into the lower tank 3.

The cooling water is evenly divided by the crimp portion 22 of the oil cooler 1 into both sides of the outer cylindrical pipe 11. The oil cooler 1 is disposed at the position where the flow speed of the cooling water is maximum, and has the straight portion 21. Thus, the cooling water contacting the outside wall surface of the outer cylindrical pipe 11 flows smoothly without stagnating. Thereby, water side heat transmitting efficiency is further improved, and the lubrication-oil circulating in the oil passage 13 is cooled efficiently.

As described above, in the present embodiment, the oil cooler 1 is located at the position where the flow speed of the cooling water is maximum. That is, the oil cooler 1 is disposed within lines extending from the outer surfaces of the tube 2. The width dimension WT between these lines is the width dimension of the tube 2 (for example, the outer diameter of the tube 2). As the cooling water flowing from each tube 2 is used efficiently for cooling, the radiating performance of the entire oil cooler 1 is further improved.

The oil cooler 1 is formed into an oval flat shaped double pipe in which the longitudinal axis (HO) is more than twice as long as the latitudinal axis (WO), and the latitudinal axis of the oil cooler 1 is smaller than the outer diameter of the tube 2. Thus, the outside wall surface area contacting the cooling water can be made large. Thereby, though the latitudinal axis (WO) of the oil cooler 1 is set to be smaller than the outer diameter (WT) of the tube 2, the radiating performance of the oil cooler 1 is maintained.

When the radiating area of the oil cooler 1 is the same as the conventional cylindrical shaped double pipe oil cooler, because the longitudinal axis length (HO) along the longitudinal direction of the tube 2 is more than twice as long as the latitudinal axis length (WO) perpendicular to the longitudinal direction of the tube 2, the width dimensions of the tube 2 and the lower tank 3 are maintained, thereby maintaining the width dimension of the radiator. Here, when the width dimension of the lower tank 3 is set substantially the same as that of the tube 2, the oil cooler 1 can be disposed inside the downstream side tank. As a result, the width dimension of the downstream side tank, such as a lower tank 3, can be downsized, thereby downsizing the width dimension of the radiator.

In the present embodiment, the oil cooler 1 is disposed inside the lower tank 3 of the down-flow type radiator. However, the oil cooler 1 may be provided inside the downstream side tank of a cross-flow type radiator instead. The flow speed of the cooling water flowing from each tube in the cross-flow type radiator is higher

than that in the down-flow type radiator, because the number of tubes in the cross-flow type radiator is smaller than that of the down-flow type radiator. Further, when an engine load is high, the flow speed of the cooling water flowing from each tube is high, because the flow amount of the cooling water circulating in the radiator increases. Therefore, when the oil cooler 1 of the present embodiment is used under these conditions, the cooling water side heat transmitting efficiency is improved more than under the condition in the present embodiment, and the radiating performance of the entire oil cooler 1 is further improved.

(Second Embodiment)

According to a second embodiment, as shown in FIG. 6, the double pipe type oil cooler 1 is installed in the lower tank 3 of the radiator.

In the second embodiment, the oil cooler 1 is disposed inside the lower tank 3 of the down flow type radiator in which the tubes 2 are arranged in two rows in a front and rear direction of the vehicle. Here, the inner fin provided in the oil passage 13 is not illustrated in FIG. 6. The latitudinal axis length (WO) of the oil cooler 1 is set shorter than the width length (WT) of the tubes 2 arranged in two rows. The oil cooler 1 is disposed inside the lower tank 3 in such a manner that the outer cylindrical pipe 11 is located within lines (one dotted chain lines in FIG. 6) extending from the outside surfaces of the tubes 2. The width dimension WT between these lines is the width dimension between the outside surfaces of the tubes 2 arranged in two rows. The upper end lower ends of the oil cooler 1 are formed into a shape that is half elliptic in cross section.

(Modifications)

In the above embodiment, the heat exchanger of the present invention is applied to an oil cooler for cooling the torque converter oil of the vehicle automatic transmission. In addition, the heat exchanger may be applied for cooling lubrication-oil for an engine installed into a vehicle, ship, air-plane, or railroad vehicle.

Further, the heat exchanger of the present invention may be applied to a refrigerant condenser to carry out a heat exchange between the refrigerant and cooling medium for condensing the refrigerant, or a refrigerant evaporator to carry out a heat exchange between the refrigerant and heating medium for evaporating the refrigerant. The heat exchanger may be applied for carrying out a heat exchange between a first gas flowing outside the outer cylindrical pipe and a second gas flowing inside the outer cylindrical pipe, and may be applied for heat exchanging between a liquid flowing outside the outer cylindrical pipe and a gas flowing inside the outer cylindrical pipe.

In the above-described embodiments, the oil cooler 1 is formed into an oval shape in cross section. How-

ever, as shown in FIGS. 7A, 7B, the oil cooler 1 may instead be formed into a semi-elliptical shape having a straight portion 21, or into a simple elliptical cross-sectional shape.

Further, as shown in FIGS. 8A, 8B, the oil cooler 1 may be formed into a pentagonal shape having a straight portion 21, or a triangular shape having a straight portion 21 in cross section. Further, the oil cooler 1 may be formed into other polygon shapes such as a rectangular-shape.

In the above-described embodiments, the oil cooler 1 is, as shown in FIG. 9A, located within the outer diameter (WT) of the tube 2. However, as shown in FIG. 9B, the oil cooler 1 may be located within the inner diameter (WT) of the tube 2 instead. That is, the width dimension of the tube 2 may be based on either the outer diameter or the inner diameter of the tube 2.

Further, as shown in FIG. 9C, the width dimension (WT) may be based on the width of lines elongating from the center of the wall forming the tube 2 in the thickness direction thereof. Here, when the downstream side end of the tube 2 is expanded as shown in FIG. 9C, it is preferable that the width dimension of the tube 2 is based on the outer diameter of the tube 2, because the cooling water flows from the downstream side end of the tube 2 into the lower tank 3 while expanding.

The above-described embodiments disclose, as an example, a double pipe type oil cooler 1 installed in a vehicle radiator in which a tube 2 is used as an upstream side cooling water passage pipe, and a lower tank 3 is used as a downstream side cooling water passage pipe. In addition, this heat exchanger may be applied to a triple pipe type heat exchanger (triple pipe type oil cooler) having an inlet side passage as the upstream side passage and an outermost cylindrical pipe as the downstream side passage.

Further, a metal pipe, resin pipe or rubber hose may be used as the upstream side passage. A metal tank, tube, oil-pan shaped vessel, metal pipe or resin pipe may be used as the downstream side passage. Here, the upstream side passage may be formed into a circular, polygonal, or flat shape such as an ellipse, an oval, a rectangle or the like.

Claims

1. A double pipe type heat exchanger (1) disposed in a downstream side fluid passage (8) into which a first fluid flows from an upstream side fluid passage (4), which includes a ring like-passage (13) through which a second fluid to be heat exchanged with the first fluid flows, wherein

said double pipe type heat exchanger (1) is disposed within lines extending from both sides of said upstream side fluid passage (4), which defines a width of said upstream side fluid passage (4),

said double pipe type heat exchanger (1) is formed into a shape that is flat in cross section, and has a longitudinal direction length that is perpendicular to a width direction of said upstream side fluid passage is longer than a latitudinal direction length thereof, and the latitudinal direction length of said double pipe type heat exchanger (1) is shorter than a width dimension of said upstream side fluid passage (4).

2. A double pipe type heat exchanger (1) according to claim 1, wherein said double pipe type heat exchanger (1) is formed into a polygonal cross-sectional shape, which has a longitudinal axis along a flow-direction of the first fluid flowing from said upstream side fluid passage (4) into said downstream side fluid passage (8) and a latitudinal axis perpendicular to the flow-direction of the first fluid.
3. A double pipe type heat exchanger (1) according to claim 1, wherein said double pipe type heat exchanger (1) is formed into an elliptical cross-sectional shape, which has a longitudinal axis along a flow-direction of the first fluid flowing from said upstream side fluid passage (4) into said downstream side fluid passage (8), and a latitudinal axis perpendicular to the flow-direction of the first fluid.
4. A heat double pipe type heat exchanger (1) according to claim 1, wherein said double pipe type heat exchanger (1) is formed into an oval cross-sectional shape, which has a longitudinal axis along a flow-direction of the first fluid flowing from said upstream side fluid passage (4) into said downstream side fluid passage (8), and a latitudinal axis perpendicular to the flow-direction of the first fluid.
5. A double pipe type heat exchanger (1) according to claim 2, wherein said longitudinal axis is more than twice as long as said latitudinal axis.
6. A double pipe type heat exchanger (1) according to claim 1, wherein

said upstream side fluid passage (4) includes a plurality of tubes (2) forming an upstream side cooling water passage (4) therein, said downstream side fluid passage (8) includes a downstream side tank (3) into which a cooling water flows as the first fluid, and which forms a downstream side cooling water passage (8) a volume thereof is larger than that of said upstream side cooling water passage (4), said double pipe type heat exchanger (1) is used as a double pipe type oil cooler (1) disposed in a rowing direction of said plurality of

tubes (2),

said double pipe type oil cooler (1) includes an elliptically shaped outer cylindrical pipe (11) as an outside wall surface thereof that contacts the cooling water, an elliptically shaped inner cylindrical pipe (12) disposed inside said outer cylindrical pipe (11), a center axis of which is concentric to a center axis of said outer cylindrical pipe (11), an oil passage (13) formed between said outer cylindrical pipe (11) and said inner cylindrical pipe (12) and performing as said ring like-passage (13), and a connecting portion for connecting said outer cylindrical pipe (11) to an external connecting pipe (18).

7. A double pipe type heat exchanger (1) according to claim 6, wherein

said outer cylindrical pipe (11) is formed by crimp-connecting a pair of saucer-like plates (11a, 11b) facing each other at outer peripheries thereof, and said plates (11a, 11b) include concave portions facing each other, and said outer cylindrical pipe (11) is disposed in said downstream side tank (3) in such a manner that a crimp portion (22) thereof is located on a center axis of said tube (2).

FIG. 1

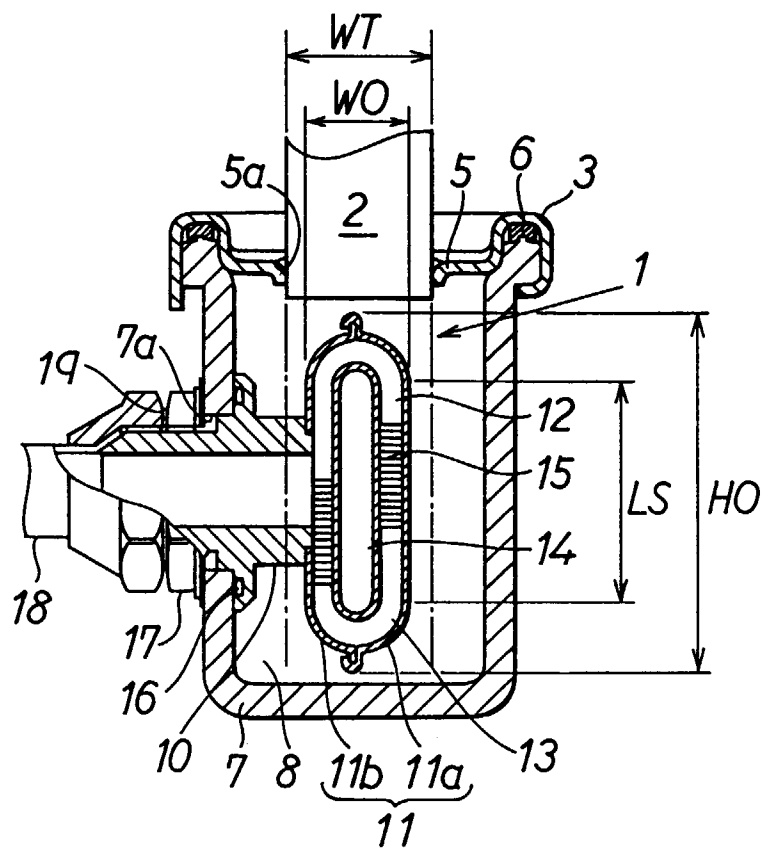


FIG. 2

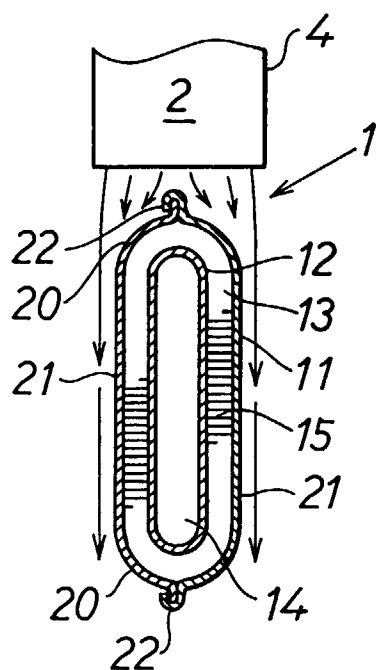


FIG. 3

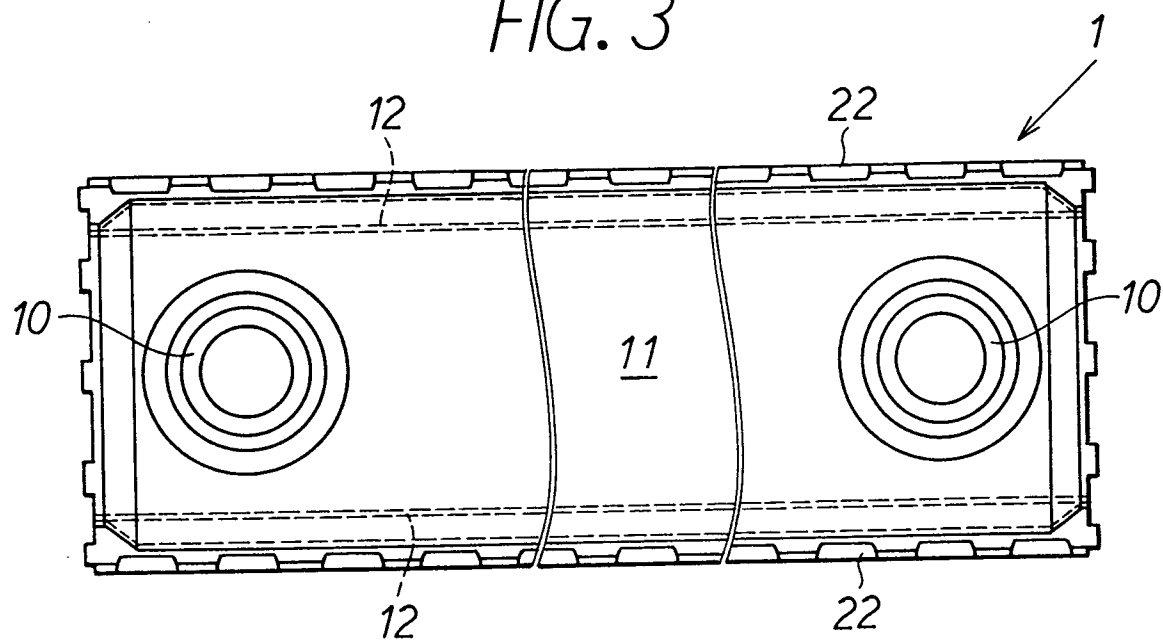


FIG. 4

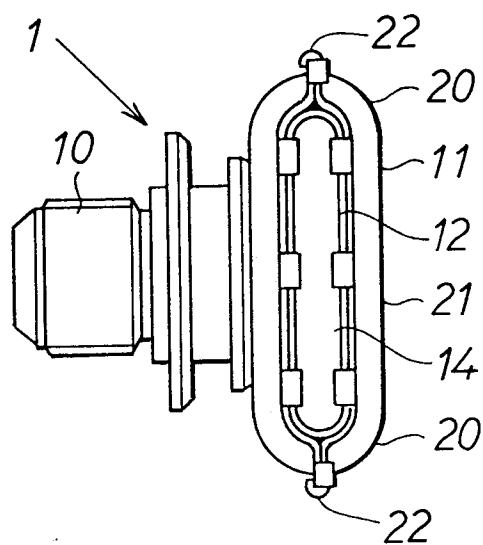


FIG. 5

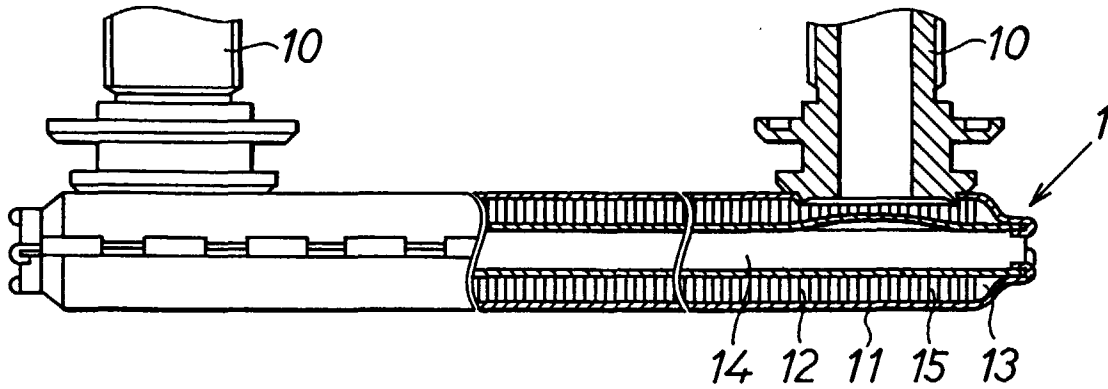


FIG. 6

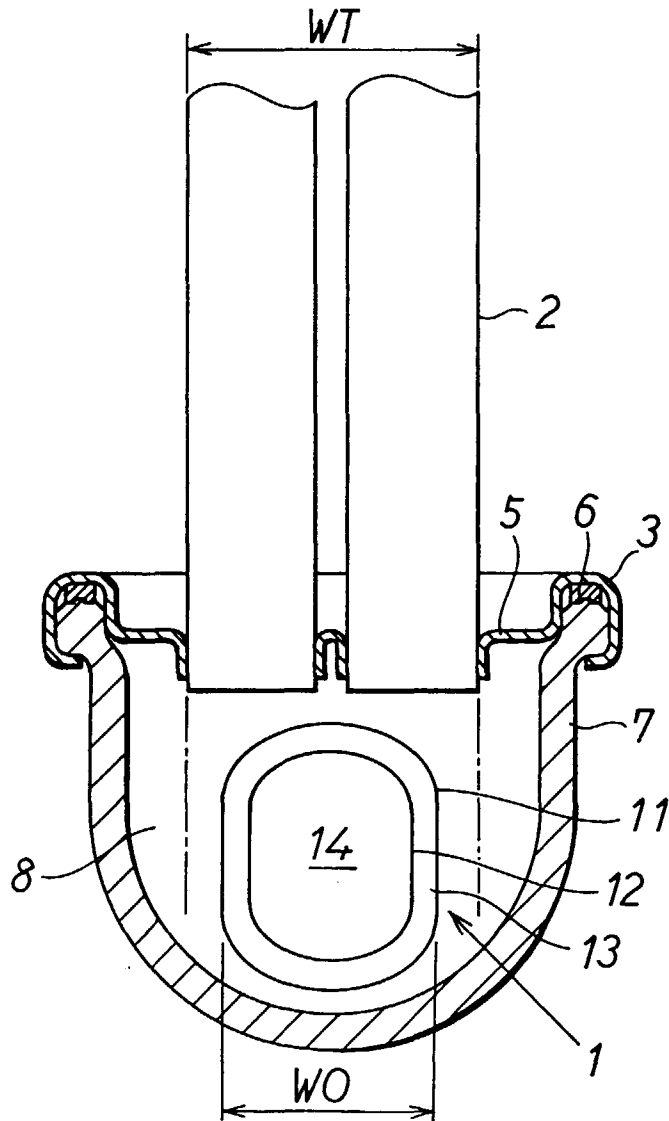


FIG. 7A

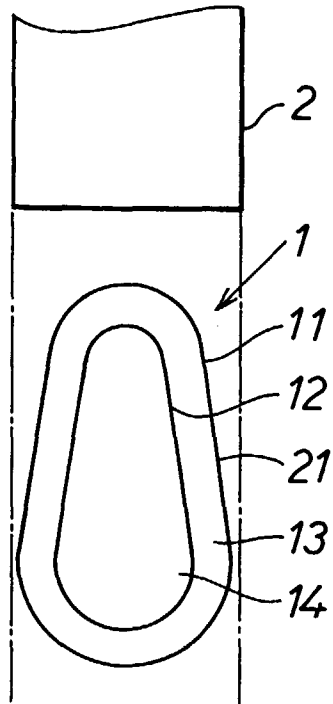


FIG. 7B

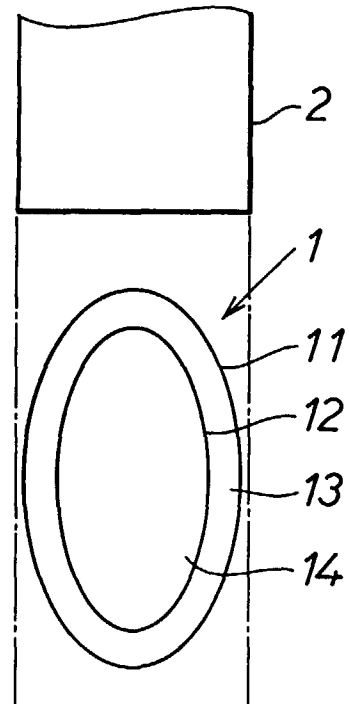


FIG. 8A

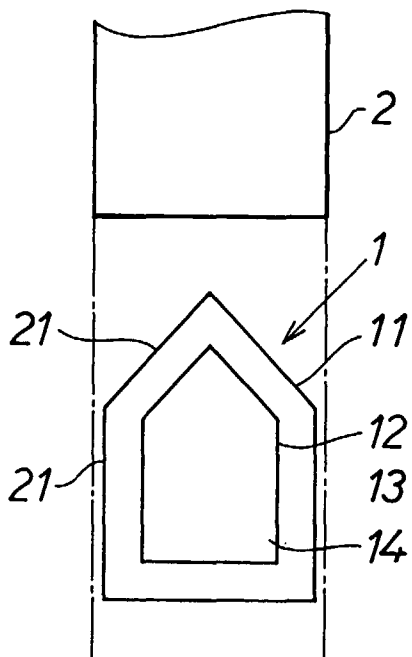


FIG. 8B

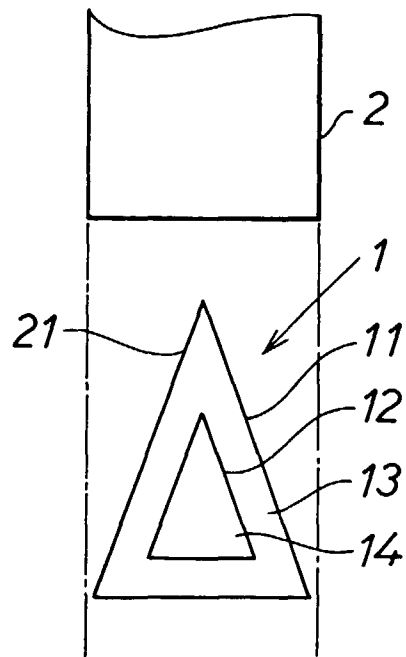


FIG. 9A

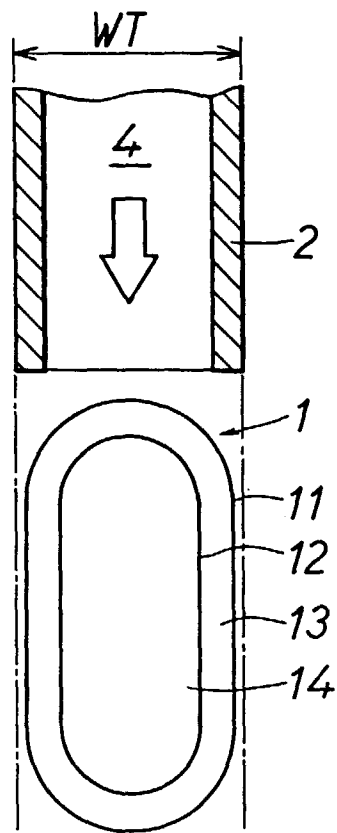


FIG. 9B

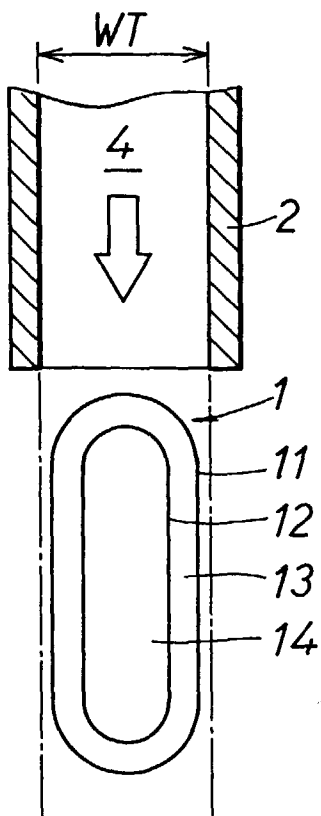


FIG. 9C

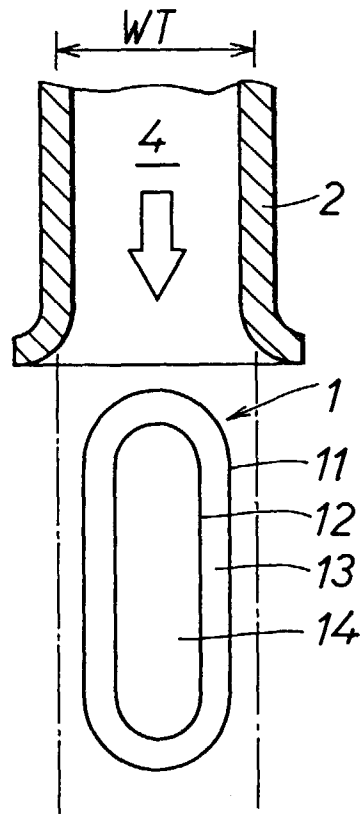


FIG. 10 PRIOR ART

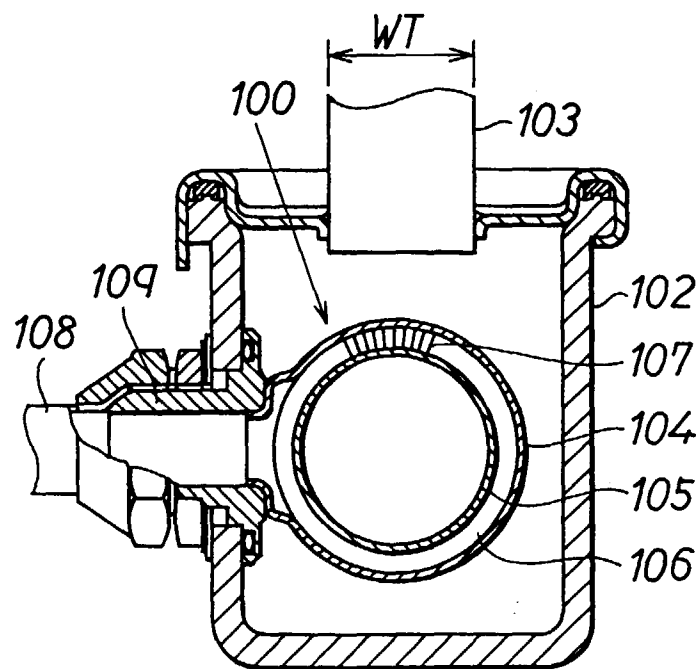


FIG. 11 PRIOR ART

