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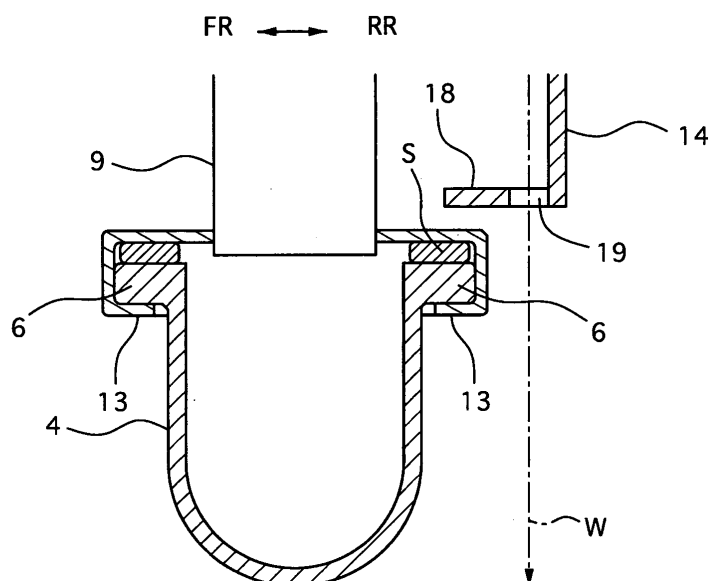
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(54) **Fan shroud structure**

(57) A fan shroud structure includes a heat exchanger (1) and a fan shroud (2). The heat exchanger (1) has an upper tank (3) and a lower tank (4), and the upper tank (3) and the lower tank (4) sandwich a core part (5) therebetween. The fan shroud (2) is attached to the heat exchanger (1), and the fan shroud (2) has a wall portion

(14) and a flange portion (17, 18, 2a) projecting toward the heat exchanger (1) from an outer circumference of the wall portion (14), and the flange portion including a lower flange portion (18). The lower flange portion (18) is provided with a water discharge outlet (19; 21) for discharging water in the fan shroud (2) outside of the fan shroud (2) through the water discharge outlet (19; 21).

FIG. 6



Description

[0001] The present invention relates to a fan shroud structure which is arranged in front of or behind a heat exchanger mounted on a motor vehicle body.

[0002] A conventional fan shroud structure of this kind is shown in Japanese Patent Application Laid Open Publication No. 2004 - 270648. This conventional fan shroud structure has a fan shroud surrounding a motor fan, and it is arranged in front of or behind a heat exchanger of a motor vehicle including an upper tank and a lower tank, and a core part between the upper and lower tanks. The upper and lower tanks are made of plastic material, while the core part is made of metal such as aluminum.

[0003] The conventional fan shroud structure, however, encounters a problem in that the heat exchanger is damaged due to water which enters the fan shroud and then falls down to the heat exchanger, being introduced through a surface of the heat exchanger.

[0004] Specifically, in a case where the fan shroud is poor in drainage, water is pooled on a lower flange portion of the fan shroud, where some of the water is blown to the heat exchanger, so that flocculated water is liable to generate on outer surfaces of fins and tubes of the core part of the heat exchanger. When the flocculated water freezes thereon, it narrows gaps formed therebetween to decrease the air flow amount passing through the gaps and also to decrease heat conductivity between the air and heat exchange medium such as coolant flowing through the tubes. This deteriorates coolability of the heat exchanger.

[0005] In another case where cryoprotectant, such as glycerol, sprayed on roads enters an interior of the fan shroud while the vehicle is running, it falls down to the heat exchanger along a bottom portion of a fan shroud wall, where calcium chlorite in the cryoprotectant gradually erodes the lower tank to cause cracks therein. This deteriorates durability of the lower tank.

[0006] It is, therefore, the present invention seeks to overcome or ameliorate at least one of the disadvantages of the prior art. An embodiment seeks to provide a fan shroud structure which overcomes the foregoing drawbacks and can prevent a heat exchanger from being damaged due to water which enters a fan shroud and then falls down to the heat exchanger, being introduced along a surface of the heat exchanger.

[0007] According to an aspect of the present invention there is provided a fan shroud structure including a heat exchanger and a fan shroud. The heat exchanger has an upper tank and a lower tank, and the upper tank and the lower tank sandwich a core part therebetween. The fan shroud is attached to the heat exchanger, the fan shroud having a wall portion and a flange portion projecting toward the heat exchanger from an outer circumference of the wall portion, and the flange portion including a lower flange portion. The lower flange portion is provided with a water discharge outlet for discharging water in the fan shroud outside of the fan shroud through the

water discharge outlet.

[0008] Therefore, the fan shroud structure of the present invention can prevent the heat exchanger from being damaged due to water which enters the fan shroud and then falls down to the heat exchanger, being introduced along a surface of the heat exchanger. This improves its durability.

[0009] Preferably, the water discharge outlet is a water discharge hole which passes through the lower flange portion.

[0010] Therefore, the water discharge outlet can be formed easily and at low manufacturing costs.

[0011] Preferably, the lower flange portion is provided with a water discharge groove which is connected with the water discharge outlet.

[0012] Therefore, the water discharge groove can surely guide the water to the water discharge outlet, and can prevent the water from overflowing from the lower flange portion to hit the heat exchanger.

[0013] Preferably, the water discharge groove is slanted so that the water in the water discharge groove flows due to weight of the water to the water discharge outlet.

[0014] Therefore, the slanted water discharge groove can guide the water to the water discharge outlet surely and fast.

[0015] Preferably, the water discharge outlet is connected to a drain pipe which is projected downward from the lower flange portion.

[0016] Therefore, the drain pipe can discharge the water outside from the water discharge outlet without heading the discharged water toward the heat exchanger.

[0017] Preferably, the lower flange portion is located under a lower enlarged cradle portion of the lower tank.

[0018] Therefore, the water discharged from the water discharge outlet can be prevented from hitting the lower enlarged cradle portion, of the lower tank, which is liable to be cracked due to the water and/or cryoprotectant in the water, thereby improving its durability.

[0019] Preferably, the upper tank and the lower tank are made of plastic material.

[0020] Therefore, the upper and lower tanks made of the plastic material can be used, avoiding cracks generated due to any cryoprotectant in the water, which can make the radiator at low manufacturing costs.

[0021] The objects, features and advantages of the present invention will become apparent as the description proceeds when taken in conjunction with the accompanying drawings, in which:

FIG. 1 is an exploded rear perspective view showing a fan shroud structure, according to a first embodiment of the present invention, having a radiator and a fan shroud to be attached on a rear side of the radiator;

FIG. 2 is a rear perspective view showing the radiator and the fan shroud of the first embodiment;

FIG. 3 is an exploded and enlarged perspective rear view, seen from below the heat exchanger, showing a lower tank and a lower tube plate provided on a lower portion of a core part of the radiator shown in FIGS. 1 and 2;

FIG. 4 is an enlarged perspective rear view, seen from below the heat exchanger, showing the lower tank and the lower tube plate provided on the lower portion of the core part of the radiator shown in FIGS. 1 and 2 in a state where they are assembled with each other;

FIG. 5 is an enlarged perspective front view showing a lower left portion of the fan shroud of the first embodiment;

FIG. 6 is an enlarged cross-sectional side view, taken along a line S6 - S6 in FIG. 2, showing the fan shroud provided with a water discharge hole, and a coupling structure, of the lower tank and the lower tube plate, which is arranged in front of the fan shroud;

FIG. 7 is a rear view of a fan shroud structure, of a second embodiment according to the present invention, having a radiator and a fan shroud with a pair of water discharge pipes at a lower flange portion of the fan shroud;

FIG. 8 is an enlarged cross sectional side view, taken along a line S8 - S8 in FIG. 7, showing the water discharge pipe provided on the lower flange portion of the fan shroud, and a coupling structure between a lower tank of a radiator and a lower tube plate of a core part thereof; and

FIG. 9 is an enlarged cross sectional side view showing a fan shroud structure, of a third embodiment according to the present invention, having a fan shroud, which is formed with a lower flange portion provided with a water discharge hole, and a coupling structure of a lower tank of a radiator and a lower tube plate of a core part thereof.

[0022] Throughout the following detailed description, similar reference characters and numbers refer to similar elements in all figures of the drawings, and their descriptions are omitted for eliminating duplication.

[0023] A fan shroud structure of a first embodiment of the present invention will be described with reference to the accompanying drawings. In the drawings, "FF" means "forward" and "RR" means "rearward", for example when the structure is mounted in a vehicle. "Upper" and "lower" and similar terms may also be defined as where the structure is mounted in a vehicle.

[0024] Referring to FIGS. 1 and 2, there is shown the fan shroud structure including a radiator 1 which func-

tions as a heat exchanger and a fan shroud 2 which is attached behind the radiator 1.

[0025] The radiator 1 includes an upper tank 3, a lower tank 4 and a core part 5 arranged between the upper tank 3 and the lower tank 4.

[0026] The upper tank 3 and the lower tank 4 are integrally made of plastic material such as 66 nylon (polyamide 66), being formed like a box with a barrel roof portion and an enlarged rectangular cradle portion 6 shown in FIGS. 3 and 4. The upper tank 3 is provided with an inlet pipe P1 protruding backward from its right rear side surface to be connected with a pipe for receiving coolant, as heat exchanger medium, from a not-shown engine, while the lower tank 4 is provided with an outlet pipe P2 protruding backward from its left rear side surface to be connected with a pipe with a not-shown thermostat for supplying the coolant to the engine therethrough. The upper tank 3 is also formed at its rear surface with a pair of bolt holes 3b and 3b for fixing an upper portion of the fan shroud 2, while the lower tank 4 is also formed with a pair of projecting-portion receiving portions 4b and 4b for fixing a lower portion of the fan shroud 2.

[0027] The rectangular cradle portion of upper tank 3 opens downward, and the rectangular cradle portion 6 of the lower tank 4 opens upward. These rectangular cradle portions 6 are partially inserted into openings of an upper tube plate 7 and a lower tube plate 8, respectively, being fixed therewith by their bended nail portions 13, as shown in FIG. 4, with a sealing member S located therebetween as shown in FIG. 6. FIG. 4 shows only the lower tank 4 and the lower tube plate 8, while the upper tank 3 and the upper tube plate 7 are fixed with each other similarly to the lower ones shown in FIG 4, except that the upper ones and the lower ones are symmetric to each other.

[0028] The upper tube plate 7 and the lower tube plate 8 are connected with each other at their left and right end portions through a left reinforcement member 11 and a right reinforcement member 12; respectively, so that they can surround the core part 5.

[0029] The core part 5 includes a plurality of flat tubes 9 having a separation plate therein and a plurality of corrugated fins 10, where the tubes 9 and fins 10 are arranged vertically and alternately to each other.

[0030] The upper and lower tube plates 7 and 8, tubes 9, the fins 10, and the left and right reinforcement members 11 and 12 are made of aluminum. A clad layer, namely a blazing sheet, is placed on at least one side part of parts, connecting with each other, of the core part 5. The parts are temporally assembled to form the core part 5, and they are heat-treated in a not-shown heating furnace so that they are blazed to be fixed with one another, and then the core part 5 is attached with the upper and lower tanks 3 and 4.

[0031] The fan shroud 2 is made of plastic material to have a wall portion 14 in a rectangular box shape so that the wall portion 14 opens forward and is formed at its center with a fan ring portion 15 having a circular cylinder

shape and protruding backward from the wall portion 14. In the fan ring portion 15, a fan 16 and its not-shown electric motor are located. The fan shroud 2 is provided with a pair of fixing portions 17b and 17b, with through-holes 17a and 17a, at positions corresponding to those of bolt holes 3a and 3a, which project from upward from an upper flange portion 17 of the fan shroud 2. Accordingly, the fan shroud 2 can be attached on the rear upper side portion of the radiator 1 by not-shown bolts passing through the through-holes 17a of the fan shroud 2 and screwed into the bolt holes 3 a and 3 a of the radiator 1.

[0032] The fan shroud 2 is also provided with a pair of projecting portions 18a and 18a, which project downward from a lower flange portion 18 of the fan shroud 2 and are insertable into the projecting-portion receiving portions 4b and 4b of the lower tank 4 of the radiator 1, at positions corresponding to those of projecting-portion receiving portions 18a and 18a. The upper and lower flange portions 17 and 18 are integrally connected with each other at their right and left end portions through right and left side flange portions 2a and 2a, respectively. Accordingly, the fan shroud 2 can be attached on the rear lower side portion of the radiator 1 only by insert of the projecting portion 18a and 18a of the fan shroud 2 into the projecting-portion receiving portions 4b and 4b of the radiator 1.

[0033] As shown in FIGS. 1 and 5, the lower flange portion 18 of the fan shroud 2 is provided with a plurality of first water discharge holes 19 in a rectangular shape so that they are arranged in line, leaving a predetermined space between adjacent holes, near and in front of a bottom edge of the wall portion 14. Incidentally, their configurations, formation positions and the number can be set appropriately. The first water discharge hole 19 corresponds to a water discharge outlet of the present invention.

[0034] An inner surface of the lower flange portion 18 may be slanted to decrease its height from its front portion toward its rear portion so that water entering the fan shroud 2 can be easily flow down to the first water discharge holes 19.

[0035] In order to assemble the radiator 1 and the fan shroud 2 with each other, as shown in FIGS. 1 and 2, the fan shroud 2 is brought behind the radiator 1, and then the projecting portions 18a and 18a of the fan shroud 2 are inserted into the projecting-portion receiving portions 4b and 4b of the radiator 1. After this insert operation, the bolts are inserted into the through-holes 17b and 17b to pass therethrough and be screwed into the bolt-holes 3a and 3a of the radiator.

[0036] When they are assembled with each other, front end portions of the upper, lower, right and left side flange portions 17, 18, 2a and 2a of the fan shroud 2 are contacted with or are placed very closely to an outer circumferential portion of the core part 5 so as to seal gaps formed therebetween, thereby effectively guiding the air passing through the radiator 1 toward the fan 16.

[0037] The operation and advantages of the fan shroud

structure of the first embodiment will be described.

[0038] The coolant is outputted from a water jacket provided in the engine at a temperature of approximately 110 °C to enter the upper tank 3 through the inlet pipe P1, and then it flows in the tubes 9 of the core part 5, where it is cooled down to a temperature of approximately 90 °C by the air flow, running through gaps between the fins 10 and the tubes 10, which is generated by the fan 16 and/or generated when the vehicle runs. The coolant passing through the core part 5 enters the lower tank 4, and then it is discharged to be introduced to the water jacket to circulate.

[0039] In the above operation, the air flow passes through the core part 5 of the radiator 1 to be headed toward the fan shroud 2. The cryoprotectant W which is carried in the fan shroud 2 by the air flow hits the front surface of the wall portion 14 and falls down due to its own weight toward the lower flange portion 18 of the fan shroud 2. This cryoprotectant W further falls down through the water discharge hole 19, which is formed on the lower flange portion 18, and is discharged outside, as indicated by an alternate long and short line in FIG. 6. Therefore, the water discharge hole 19 can prevent the cryoprotectant W fallen down to the lower flange portion 18 from adhering thereto, which prevents cracks in the lower tank 4 due to the calcium chloride in the cryoprotectant W.

[0040] Accordingly, it is unnecessary for the lower tank 4 to use expensive plastic material having resistance properties against the cryoprotectant W, such as 12 nylon (polyamide 12) and 612 nylon (polyamide 612), so that it is blended with 66 nylon. This enables the lower tank 4 to be manufactured by using material at lower cost, improving its durability thereof.

[0041] In addition, the water discharge hole 19 can also discharge rain water, snowmelt, car wash water, and the like which enter the fan shroud 2 as well as the cryoprotectant W. Therefore, generation of flocculated water on the outer surfaces of the fins 10 and the tubes 9 are suppressed, which can suppress reduction in the air flow amount passing through the core part 5.

[0042] As described above, the fan shroud structure of the first embodiment can prevent the radiator 1 from being damaged due to the water which enters the fan shroud 2 and then falls down to the radiator 1, being introduced along the surface of the heat exchanger 1.

[0043] Next, a fan shroud structure of a second embodiment of the present invention will be described with reference to the accompanying drawings.

[0044] As shown in FIGS. 7 and 8, in the fan shroud structure of the second embodiment, a lower tank 4 is provided with an outlet pipe P2 at a center position in a lateral direction of the lower tank 4 instead of at a left end side position thereof in the first embodiment. A fan shroud 2 has a lower flange portion 18 which protrudes forward from a wall portion 14 to have an inversion letter of "V". The lower flange portion 18 is formed with a water discharge groove 20, which is formed to be slanted from its

highest center portion toward a right end portion and a left end portion thereof in the lateral direction. At the right and left end portions of the water discharge groove 20, right and left second water discharge holes 21 are provided, respectively, instead of the first water discharge holes arranged in the lateral direction in the first embodiment. The second water discharge hole 21 corresponds to the water discharge outlet of the present invention.

[0045] The second water discharge holes 21 are connected with right and left drain pipes 22 extending downward from an outer surface of the lower flange portion 18. The lengths of the drain pipes 22 are set appropriately according to a height of the lower tank 4 and so forth.

[0046] In addition, the lower flange portion 18 is also provided with a projecting wall portion 23 which projects forward-obliquely upward from the lower flange portion 18 to form a front surface of the water discharge groove 20.

[0047] The lower flange portion 18 has an under covering wall portion 24 projecting from the outer surface of the lower flange portion 18 so as to cover a gap formed between the lower tank 4 and the slanted outer surface of the lower flange portion 18.

[0048] The other parts are constructed similarly to those of the first embodiment, and descriptions thereof are omitted herein to reduce duplication.

[0049] The fan shroud structure of the second embodiment is thus constructed, and accordingly it works to obtain the advantages as follows.

[0050] When water enters the fan shroud 2, it falls down due to its own weight toward the lower flange portion 18 to be received in the water discharge groove 20. The water moves toward the right end portion and/or the left end portion of the water discharge groove 20, and then it is discharged outside through the second water discharge holes 21 and the drain pipes 22, as indicated by an alternate long and short line in FIG. 8. If the water contains cryoprotectant W, it is also discharged outside with the water.

[0051] Therefore, the fan shroud structure of the second embodiment can obtain the advantages similar to those of the first embodiment.

[0052] In addition, in this discharge operation, the projecting wall portion 23 enables the water discharge groove 20 to have a sufficient depth for avoiding overflow of the water therefrom, thereby the lower tank 4 being kept away from the water flowing in the water discharge groove 20. Further, the drain pipes 22 enables the water in the water discharge groove 20 to be discharged outside at a position lower than that of the first water discharge holes, which can suppress hits of the water, which is discharged from the drain pipes 22, against the lower tank 4.

[0053] Next, a fan shroud structure of a third embodiment of the present invention will be described with reference to the accompanying drawing.

[0054] As shown in FIG. 9, in the fan shroud structure of the third embodiment, a wall portion 14 of a fan shroud 2 is extend downward under a lower tube plate 8 fixed

with a lower tank 4. A lower flange portion 18 is projected forward from the wall portion 14, and it is provided with a plurality of first water discharge holes 19. The first water discharge holes 19 are formed in a rectangular shape so that they are arranged in line, leaving a predetermined space between adjacent holes, near and in front of a bottom edge of the wall portion 14.

[0055] The other parts are constructed similarly to those of the first embodiment, and descriptions thereof are omitted herein to reduce duplication.

[0056] The fan shroud structure of the third embodiment is thus constructed, and accordingly it works to obtain the advantages as follows.

[0057] When water enters the fan shroud 2, it falls down due to its own weight toward the lower flange portion 18. The water is discharged outside through the first water discharge holes 19, as indicated by an alternate long and short line in FIG. 8. If the water contains cryoprotectant W, it is also discharged outside with the water.

[0058] Therefore, the fan shroud structure of the third embodiment can obtain the advantages similar to those of the first embodiment.

[0059] Since the lower flange portion 18 with the first water discharge holes 19 is located under the lower tube plate 8, a root portion 30 of an enlarged rectangular cradle portion 6 formed on a lower tank 4, where is liable to be cracked, can be protected from being cracked due to water and cryoprotectant W.

[0060] While there have been particularly shown and described with reference to preferred embodiments thereof, it will be understood that various modifications may be made therein.

[0061] For example, the water discharge outlet is not limited to a through-hole as seen in the first to the third embodiments, while it may be formed as a groove which opens at its end.

[0062] Further, positions, the number and configurations of the first and second water discharge holes 19 and 21 may be set appropriately.

[0063] In the first to third embodiment, the fan shrouds are arranged behind the radiator 1, while a fan shroud may be arranged in front of the radiator 1. In this case, the flange portion of the fan shroud is projected backward.

[0064] The upper and lower tanks may be made of material different from plastic material.

Claims

1. A fan shroud structure comprising:

a heat exchanger (1) which has an upper tank (3) and a lower tank (4), the upper tank (3) and the lower tank (4) sandwiching a core part (5) therebetween; and

a fan shroud (2) which is attached to the heat exchanger (1), the fan shroud (2) having a wall

portion (14) and a flange portion (17, 18, 2a) projecting toward the heat exchanger (1) from an outer circumference of the wall portion (14), and the flange portion (17, 18, 2a) including a lower flange portion (18), wherein
 the lower flange portion (18) is provided with a water discharge outlet (19; 21) for discharging water in the fan shroud (2) outside of the fan shroud (2) through the water discharge outlet (19; 21).

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2. The fan shroud structure according to claim 1, wherein
 the water discharge outlet is a water discharge hole (19; 21) which passes through the lower flange portion (18).
3. The fan shroud structure according to claim 1 or claim 2, wherein
 the lower flange portion (1) is provided with a water discharge groove (20) which is connected with the water discharge outlet (19; 21).
4. The fan shroud structure according to claim 3, wherein
 the water discharge groove (20) is slanted so that the water in the water discharge groove (20) flows due to weight of the water to the water discharge outlet (19; 21).
5. The fan shroud structure according to claim 4, wherein
 the water discharge outlet (19; 21) is connected to a drain pipe (22) which is projected downward from the lower flange portion (18).
6. The fan shroud structure according to claim 5, wherein
 the lower flange portion (18) is located under a lower enlarged cradle portion (6) of the lower tank (4).
7. The fan shroud structure according to claim 6, wherein
 the upper tank (3) and the lower tank (4) are made of plastic material.

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FIG. 1

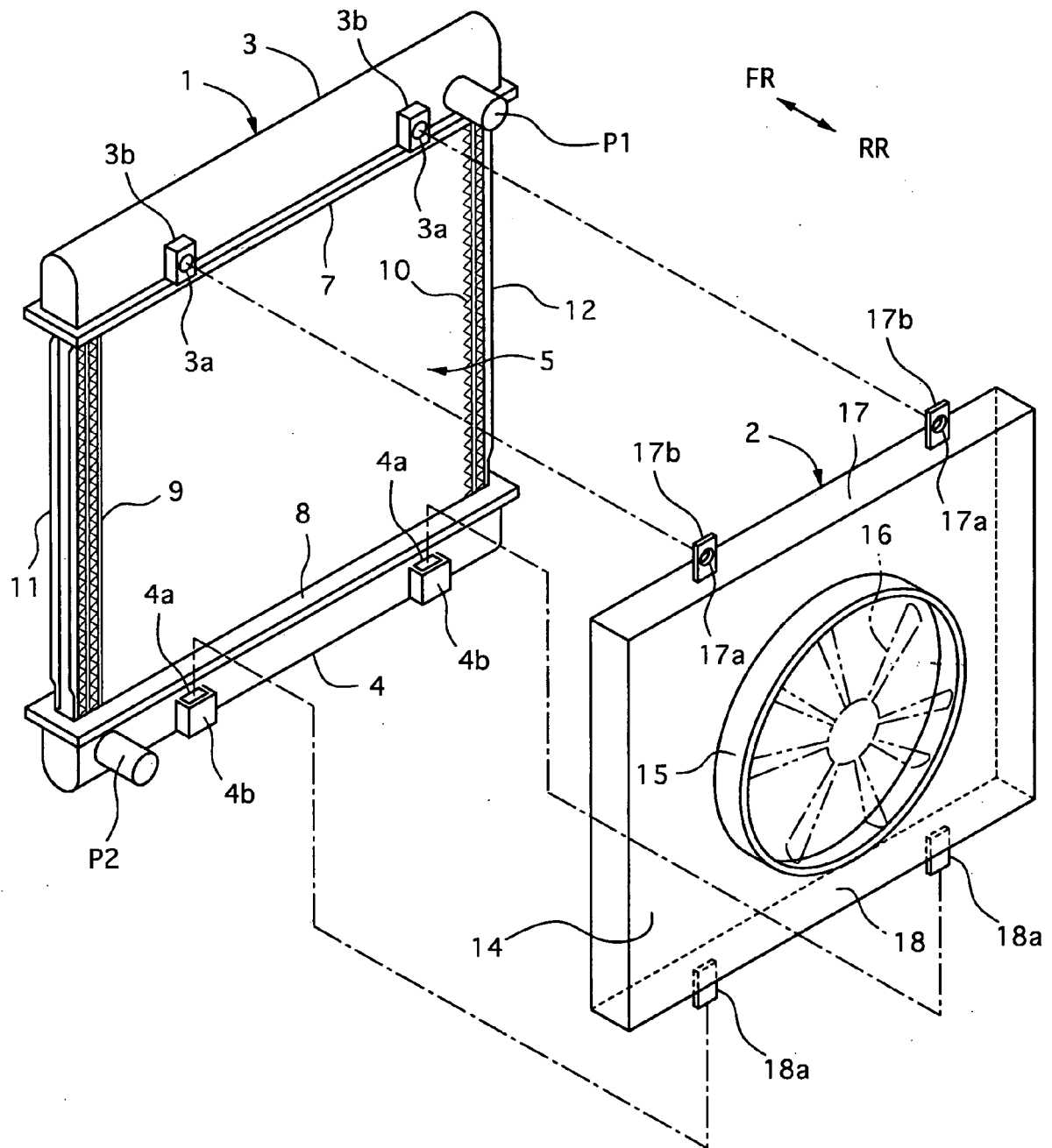


FIG. 2

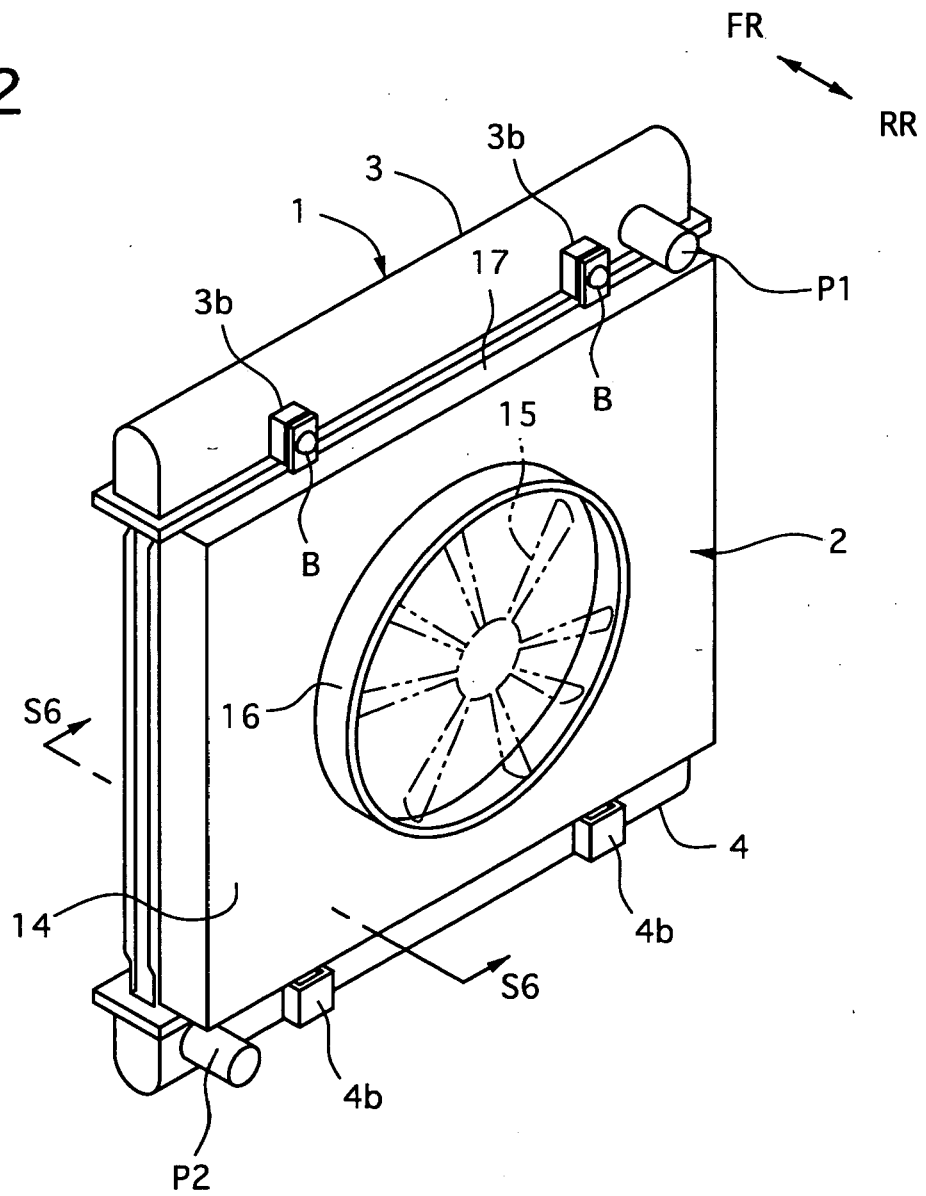


FIG. 3

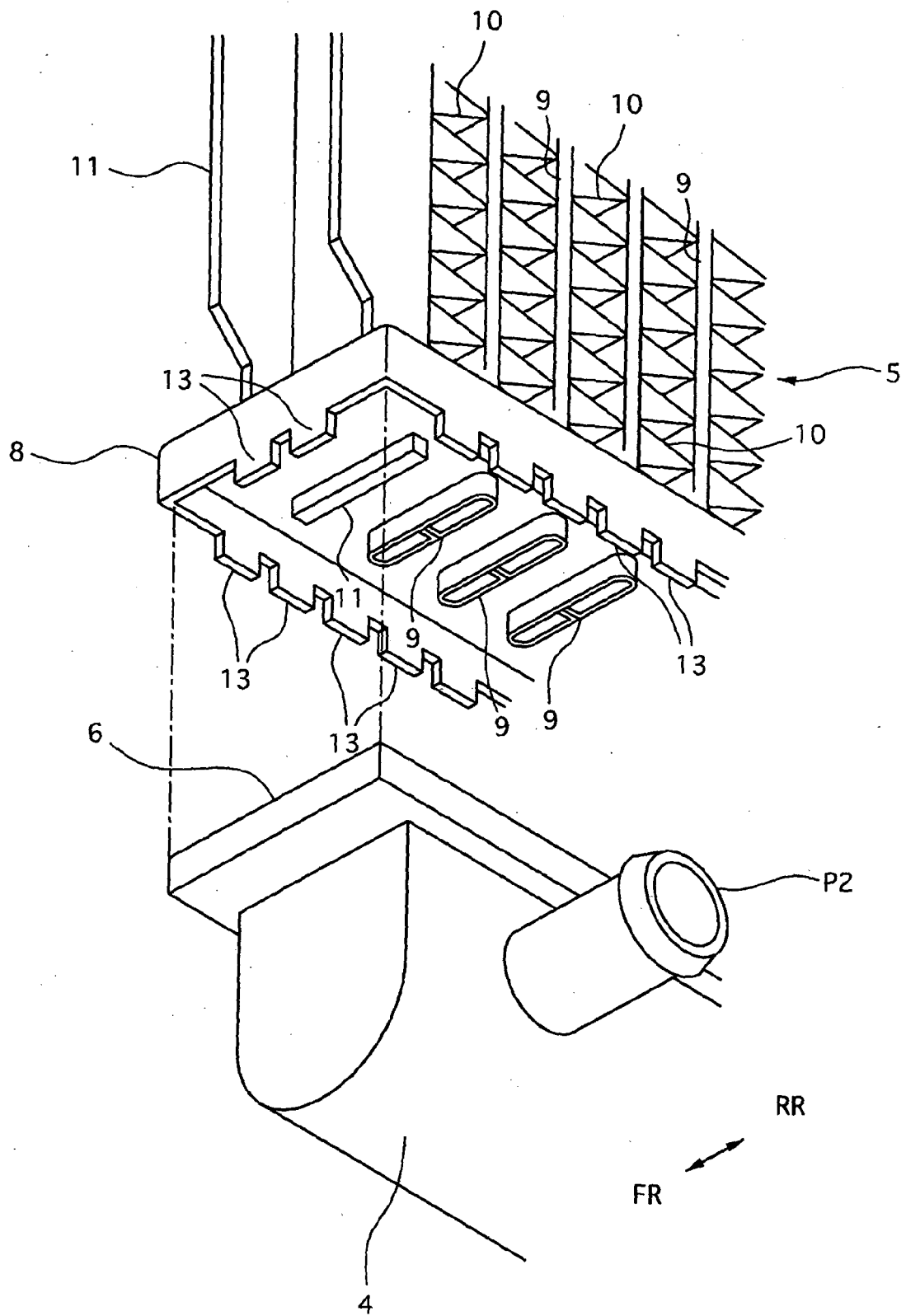


FIG. 4

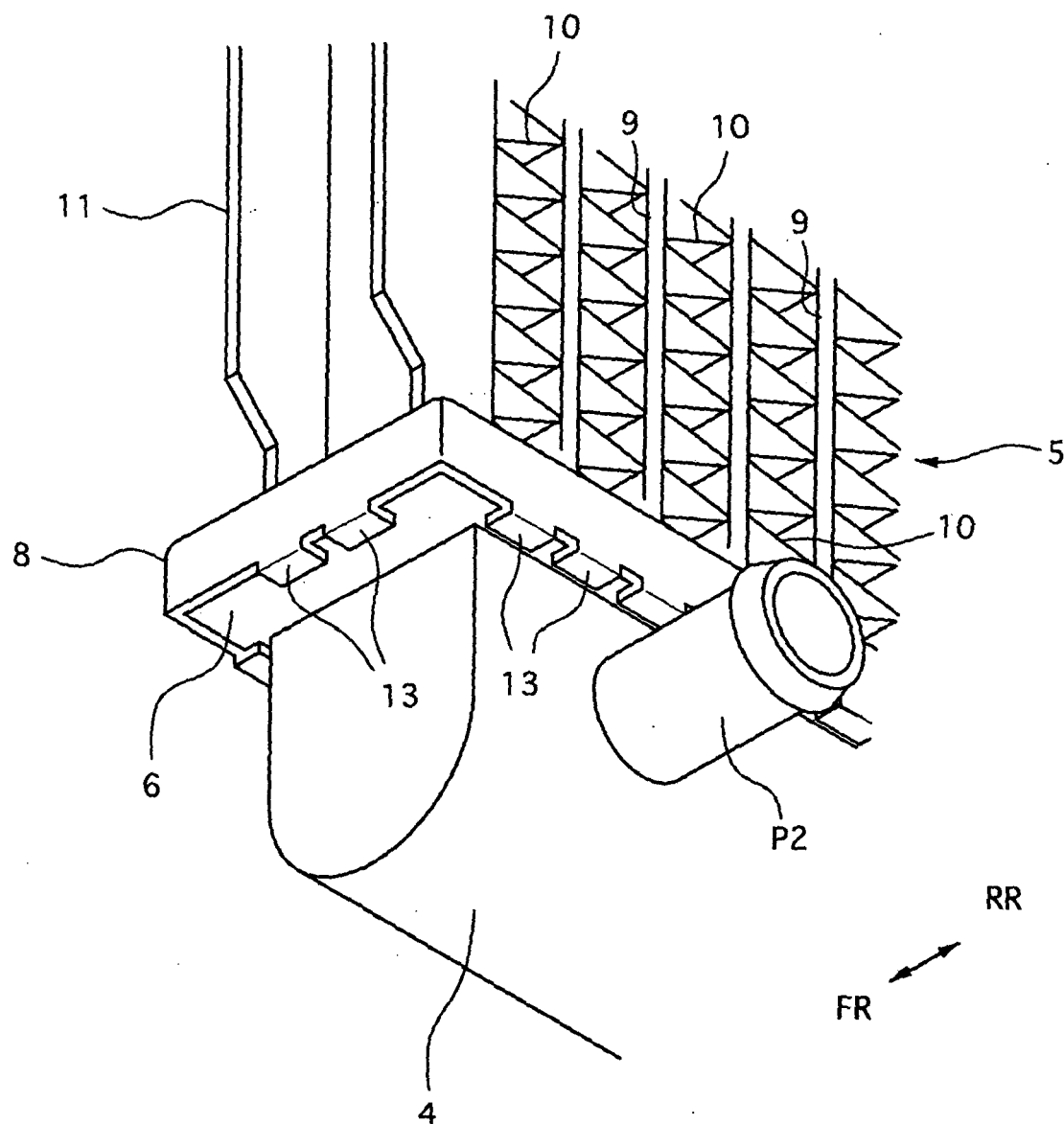


FIG. 5

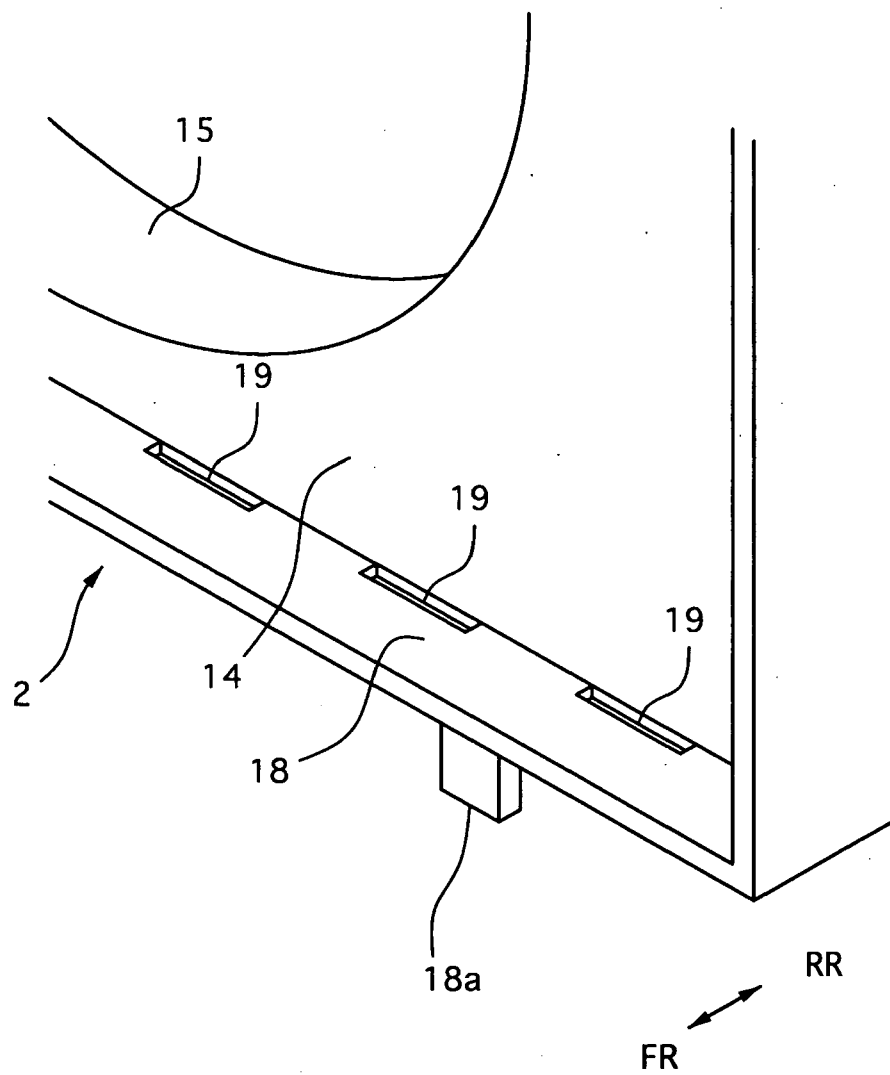


FIG. 6

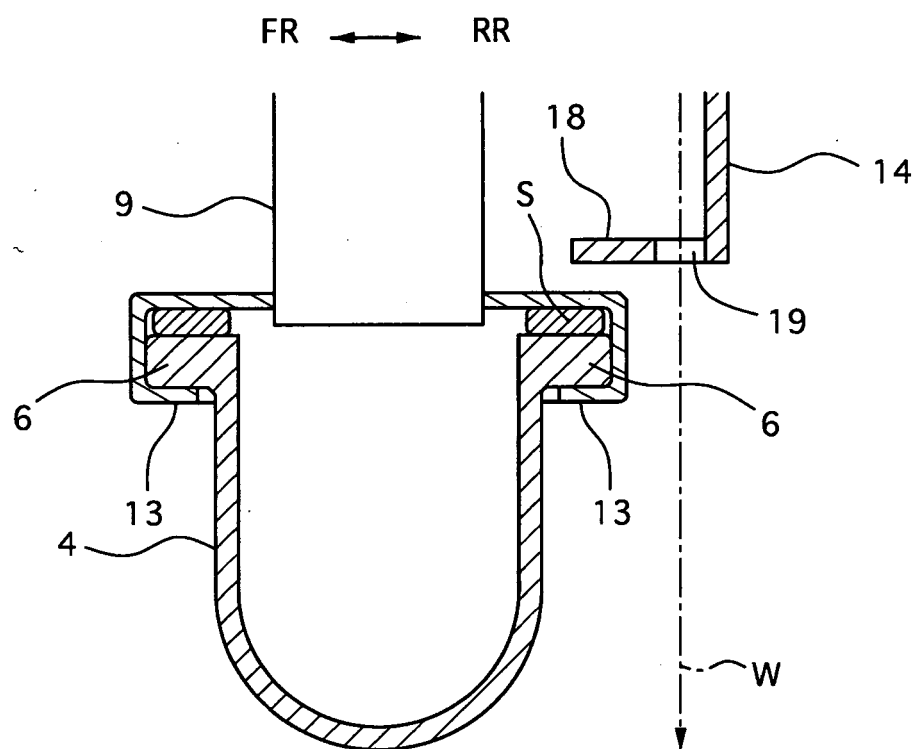


FIG. 7

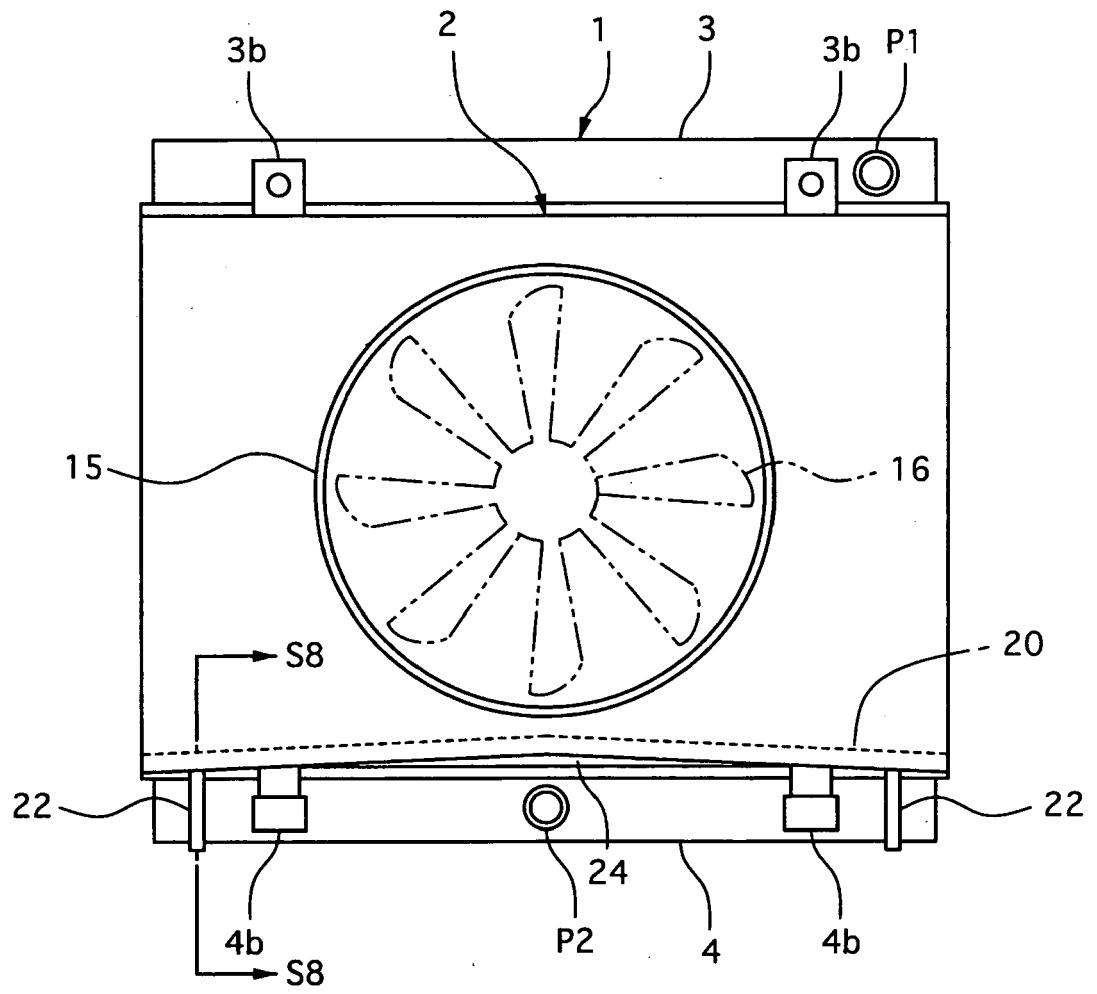


FIG. 8

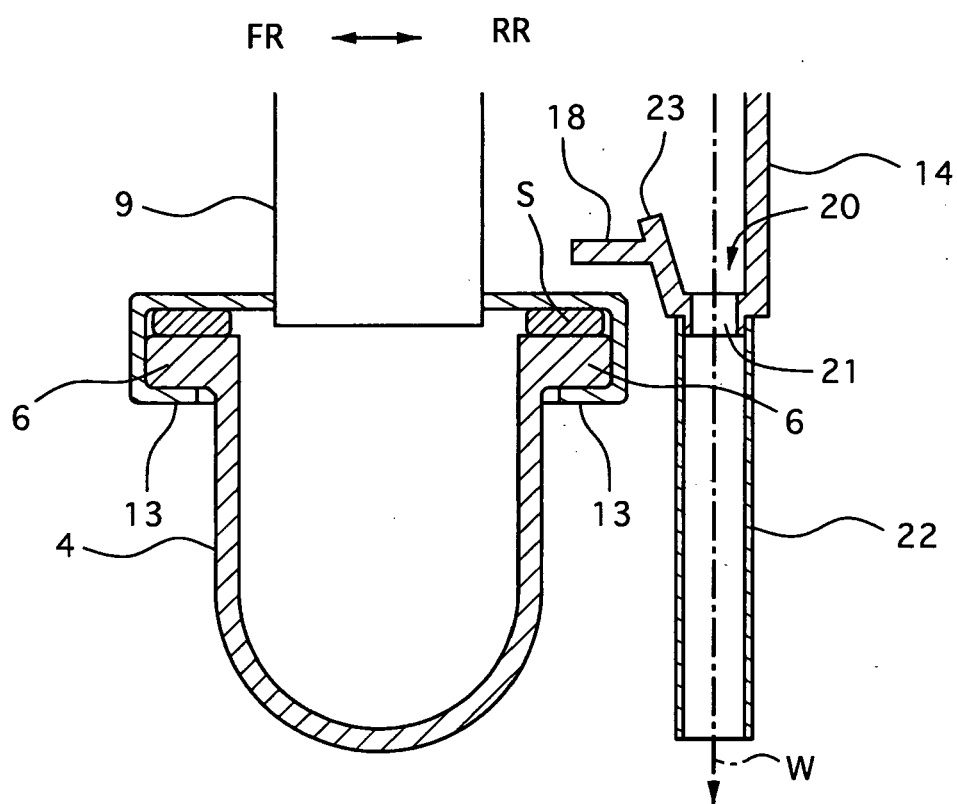
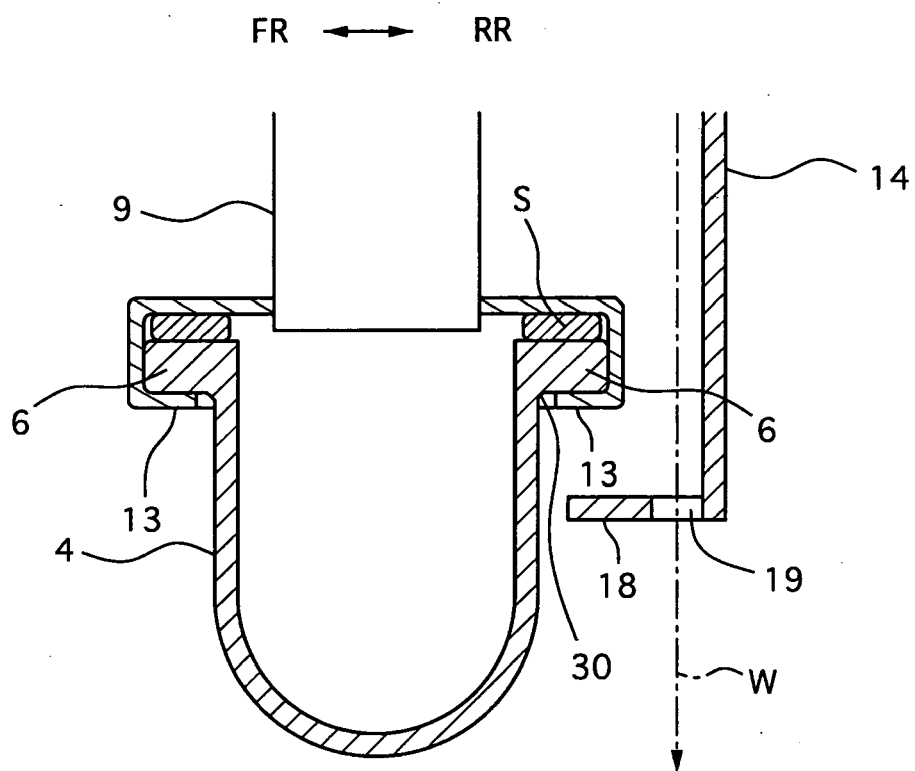


FIG. 9



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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