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(54) A non-replaceable filter assembly for a vehicle condenser having an upper subcooling section

(57) A filter assembly for a condenser for vehicles, comprising a tubular container (10) having a fluid inlet (17) and a fluid outlet (18) formed on its side wall (11), and connectable to a condensing section (SC) and to a sub-cooling section (SSR) of the condenser, respectively, in which the fluid outlet is located in use above the fluid inlet; and a filter cartridge (20) comprising a cage-shaped support structure (21) of plastic material.

The ends (13, 14) of the container (10) are closed by caps bonded thereto. The support structure is located in use near to the upper end (13) of the container (10), and comprises a peripheral edge (25d) sealingly engaging the side wall (11) of the container (10) between fluid inlet and outlet (17, 18), and a base (24) through which a communication opening (24d) is formed. The filter cartridge further comprises a refrigerant flow pipe (27) connected to the communication opening and extending toward the lower end (14) of the container (10).

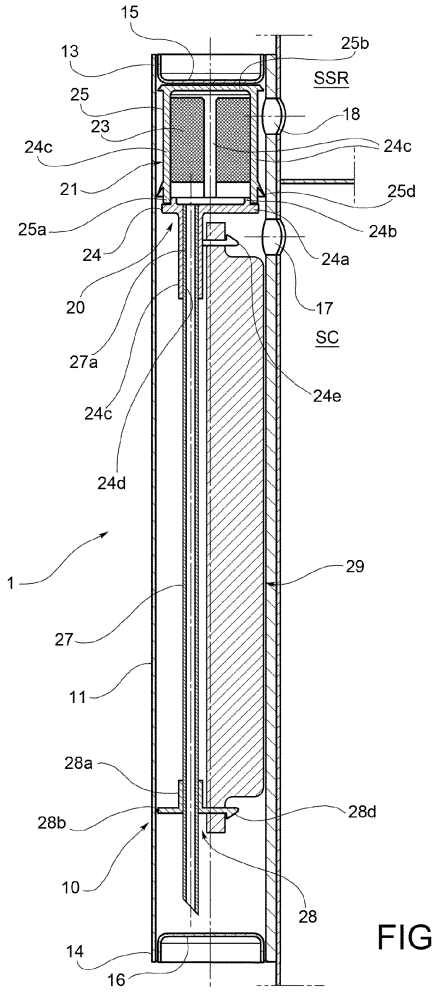

FIG. 1

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Description

[0001] The present invention generally relates to air-conditioning systems. More particularly, the present invention relates to a filter assembly for a condenser for vehicles, comprising

a tubular container having a side wall and opposite ends closed by respective caps, said container having a fluid inlet and a fluid outlet formed on its side wall, and connectable to a condensing section and to a sub-cooling section of the condenser, respectively, in which said fluid outlet is located in use at a greater height than said fluid inlet; and

a filter cartridge housed within the tubular container, said filter cartridge comprising a cage-shaped support structure of plastic material, and a particle filtering medium carried by said cage-shaped part.

[0002] The condensing section of the condenser acts to cool the high temperature, high pressure gaseous cooling fluid sent by the compressor, and to cause the condensation thereof into a liquid cooling fluid. The sub-cooling section acts to further cool the liquid cooling fluid in order to increase its enthalpy. The container of the filter assembly acts as an accumulator to separate the gaseous and liquid coolants coming from the condensing section, and to ensure that only liquid coolant comes to the sub-cooling section. By using a particle filter and a dehydrating material, the filter assembly further provides to remove moisture and foreign materials from the coolant.

[0003] Typically, the sub-cooling section is located in use below the condensing section. Due to the downward recirculation of hot air in the front part of the motor vehicles, there is sometimes the need to place, instead, the sub-cooling section above the condensing section.

[0004] Solutions for condensers with an upper sub-cooling section provided with replaceable filter assemblies are present in the market. Due to cost and coolant loss reduction reasons, however, there is the need to develop solutions with irreplaceable filter assemblies.

[0005] Therefore, an object of the present invention is to propose a filter assembly suitable for a condenser with upper sub-cooling section, which furthermore is irreplaceable.

[0006] Such an object is achieved according to the invention by a filter assembly of the above-defined type, in which

said caps are both bonded to the respective ends of the container;

said support structure is located in use near to the upper end of the container, and comprises a peripheral edge sealingly engaging the side wall of the container at an intermediate height between fluid inlet and outlet, and a base through which a communication opening is formed; and

said filter cartridge further comprises a refrigerant flow pipe connected at one end to said communication opening and extending toward the lower end of the container.

[0007] The construction of the filter assembly according the invention ensures that all the coolant passes through the filter mesh (particulate removal) without any coolant loss.

[0008] According to a preferred embodiment of the invention, the filter cartridge further comprises a spacer member fitted on said refrigerant flow pipe, said spacer member comprising a bush portion and a projecting portion for engaging the side wall of the container.

[0009] Advantageously, such an arrangement ensures that the pipe of the filter cartridge is always in the proper operative position. From the manufacturing process point of view, this allows sealing by welding (in particular, TIG welding) the container of the filter assembly without the risk of damaging the filter cartridge, as well as promoting the installation of the filter cartridge inside the container.

[0010] According to a further embodiment of the invention, the base of the support structure has a hook formation provided for a bag containing a dehydrating material to be hanged thereon, and the spacer member has also a hook formation, provided as a second anchoring point for said bag containing dehydrating material.

[0011] Advantageously, such an arrangement avoids movements of the dehydrating material bag during the vehicle ride.

[0012] Furthermore, it is the object of the invention a method for assembling a filter assembly to a condenser for vehicles, **characterized in that** it comprises the steps of:

providing a condenser body comprising a condensing section and a sub-cooling section, located in use above the condensing section;

providing a tubular container having a side wall and having a fluid inlet and a fluid outlet formed on said side wall;

brazing said tubular container to the condenser body in such a way as that said fluid inlet and fluid outlet are connected to the condensing section and to the sub-cooling section of the condenser, respectively, an upper end of the container being closed by a cap bonded thereto;

providing a filter cartridge comprising a cage-shaped support structure of plastic material, and a particle filtering medium carried by said support structure, in which said support structure comprises a base through which a communication opening is formed, and a refrigerant flow pipe connected at one end to said communication opening;

positioning said filter cartridge in the tubular container, by inserting it through the lower end thereof, in such a way as that a peripheral edge of the support structure sealingly engages the side wall of the container at an intermediate height between fluid inlet and outlet, and that said refrigerant flow pipe extends toward the lower end of the container; and

closing the lower end of the container with a cap, and sealing it by welding.

[0013] Preferred embodiments of the invention are defined in the dependent claims, which are to be meant as an integral part of the present description.

[0014] Further characteristics and advantages of the filter assembly according the invention will be more clearly understood by the following detailed description of an embodiment of the finding, given with reference to the appended drawings, given by way of illustrative, nonlimiting example only, in which

Fig. 1 is a longitudinal sectional view of a filter assembly according to the invention;
Figs. 2 and 3 are perspective and longitudinal sectional views, respectively, of a part of a filter cartridge of the filter assembly of Fig. 1;
Figs. 4 to 6 are perspective views of a component of the filter cartridge, according to different embodiments of the invention; and
Figs. 7 to 9 are longitudinal sectional views of a filter assembly according to the invention applied to a condenser, in different manufacturing steps.

[0015] With reference to Figs. 1 to 3, a filter assembly for a condenser for vehicles is generally indicated with 1.

[0016] The filter assembly 1 comprises a tubular container 10 having a side wall 11 and opposite ends 13, 14 closed by respective caps 15, 16. In the use condition represented in Fig. 1, the ends 13, 14 of the container 10 are the upper end and the lower end of the container 10, respectively.

[0017] The caps 15, 16 are both bonded, in particular, brazed or welded, to the respective ends 13, 14 of the container 10, so as to seal such ends against cooling fluid losses.

[0018] Furthermore, the container 10 has a fluid inlet 17 and a fluid outlet 18 formed on its side wall 11, connectable to a condensing section SC and to a sub-cooling section SSR of the condenser, respectively. The sub-cooling section SSR of the condenser is located above the condensing section SC, so that the fluid outlet 18 is located at a greater height than the fluid inlet 17.

[0019] The filter assembly 1 further comprises a filter cartridge 20 housed within the tubular container 10. The filter cartridge 20 comprises a cage-shaped support structure 21 of plastic material, and a particle filtering medium 23 carried by the support structure 21.

[0020] The support structure 21 is located near to the upper end 13 of the container 11, preferably abutting against the cap 15 of the upper end 13, and substantially comprises a base 24 and a cage frame 25 bonded, in particular, welded or glued, to the base 22.

[0021] In the illustrated example, the base 24 of the support structure 21 comprises a disc- or plate-shaped main portion 24a, along the perimeter of which a centering rib 24b is formed, projecting from a face of the main portion 24a towards the cage frame 25.

[0022] On the opposite face of the base main portion 24a, a sleeve portion 24c is formed, through which a communication opening 24d is formed, which fluidically connects an upper portion of the container inner cavity with a lower portion of such a cavity.

[0023] The cage frame 25 comprises an annular portion 25a coupled to the centering rib 24b of the base 24, a top portion 25b, the edge of which engages the side wall 11 of the container 10, and a plurality of bar portions 24c interconnecting the annular portion 25a and the top portion 25b of the cage frame. Side openings facing the side wall 11 of the container are then defined between successive bar portions, and in particular on the fluid outlet 18. The filtering medium is located at the bar portions 24c, arranged so as to completely cover the openings between the bar portions 24c.

[0024] A sealing lip portion is formed at the annular portion 25a of the cage frame 25, defining a peripheral edge 25d sealingly engaging the side wall 11 of the container 10 at an intermediate height between fluid inlet 17 and fluid outlet 18. According to an alternative, non-illustrated implementation mode, the above-mentioned peripheral edge could be formed on the base 24 of the support structure 21. The interference between the peripheral edge 25d and the side wall 11 also acts to keep the cage frame 25 in place relative to the container 10.

[0025] The filter cartridge 20 further comprises a refrigerant flow pipe 27 connected at one end 27a to the communication opening 24d and extending toward the lower end 14 of the container 10. The refrigerant flow pipe 27 directly connects the container 10 bottom to the inner space of the cage-shaped support structure 21.

[0026] The above-described arrangement makes so that all the coolant exiting the container 10 towards the sub-cooling section SSR through the fluid outlet 18 passes from the pipe 27 through the communication opening 24d and then through the filtering medium 23 for the removal of possible undesired particles, without any losses.

[0027] With reference also to the Figs. 4 and 5, the filter cartridge 20 further comprises a spacer member 28 fitted on the refrigerant flow pipe 27. The spacer member 28 avoids that the free end of the pipe 27, due to unexpected deflections of the pipe, is brought too near to the side wall, with the generation of undesired narrowings of the flow passage.

[0028] The spacer member 28 comprises a bush portion 28a suitable to be fitted on the refrigerant flow pipe 27, and a projecting portion 28b formed on the outer surface of the bush portion and suitable to engage the side wall 11 of the container 10, thus maintaining the proper operative position of the pipe 27. In the example illustrated in Fig. 4, the projecting portion 28b is plate- or dish-shaped, while, in the example of Fig. 5, it comprises a plurality of angularly spaced noses 28c.

[0029] The filter cartridge 20 further comprises a bag 29 of permeable material, containing a dehydrating material. Such a bag is hung at one end thereof to a hook formation 24e formed on the sleeve portion 24c of the base 24 of the support structure 21.

[0030] Preferably, a further hook formation 28d is

formed on the spacer member 28, provided as a second anchoring point for said bag containing dehydrating material. In the example illustrated in Fig. 6, the hook formation 28d is formed on an edge of the dish-shaped projecting portion 28b. According to an alternative, non-illustrated implementation mode, the hook formation could be formed on the bush portion 28a of the spacer member 28, manufactured for example in the shape represented in Fig. 4 or in that of Fig. 5.

[0031] The provision of hook formations ensures that the bag 29 is kept in its proper position in spite of the vibrations generated during the vehicle ride.

[0032] With reference to the Figs. 7 to 9, a method for assembling the filter assembly 1 to a condenser for vehicles is now described.

[0033] First, a condenser body CC is provided, comprising a condensing section SC and a sub-cooling section SSR, located in use above the condensing section SC.

[0034] Furthermore, the tubular container 10 without the filter cartridge 20 is provided.

[0035] Then, the tubular container 11 is brazed to the condenser body CC in such a way as that fluid inlet 17 and fluid outlet 18 are connected to the condensing section SC and to the sub-cooling section SSR of the condenser, respectively. In Fig. 7 it can be observed that the condensing section SC and the sub-cooling section SSR are connected to the fluid inlet 17 and to the fluid outlet 18, respectively, through respective distributors. Furthermore, the upper end 13 of the container 11 is closed by the cap 15 bonded thereto.

[0036] Then, the pre-assembled filter cartridge 20 is placed in the tubular container 11, by inserting it through the lower end 14 thereof, in such a way as that the peripheral edge 25d of the support structure 21 sealingly engages the side wall 11 of the container 10 at an intermediate height between fluid inlet 17 and fluid outlet 18 (preferably, the filter cartridge 20 is inserted so as to abut the support structure 21 against the cap 15 of the container upper end 13) and that the refrigerant flow pipe 27 extends toward the lower end 14 of the container 10 (Fig. 8).

[0037] Finally, the lower end 14 of the container 10 is closed with the respective cap 16, and it is sealed by welding, in particular, TIG welding.

[0038] The spacer member 28 prevents the refrigerant flow pipe from contacting the container side wall during the welding process, which side wall, due to the welding process, reaches a high temperature, thus avoiding an undesired melting of the pipe plastic material. Therefore, the spacer member is of a fiber-reinforced, high softening point plastic material, capable of withstanding the temperatures that are present during the welding process. For example, the spacer member can be in glass-fiber-reinforced PA66. Optionally, the refrigerant flow pipe is also in fiber-reinforced, high softening point plastic material.

[0039] During the insertion of the filter cartridge 20, the hook formations hold the bag 29 of the dehydrating material, making the insertion of the filter cartridge into the container easier. During the welding step, the hook formations further act to keep the bag 29 far from the welding area, thus avoiding that the bag may be damaged by the high temperatures that can be reached therein.

Claims

1. A filter assembly for a condenser for vehicles, comprising

   - a tubular container (10) having a side wall (11) and opposite ends (13, 14) closed by respective caps (15, 16), said container having a fluid inlet (17) and a fluid outlet (18) formed on its side wall (11) and connectable to a condensing section (SC) and to a sub-cooling section (SSR) of the condenser, respectively, wherein said fluid outlet is located in use at a greater height than said fluid inlet; and
   - a filter cartridge (20) housed within the tubular container (11), said filter cartridge comprising a cage-shaped support structure (21) of plastic material, and a particle filtering medium (23) carried by said support structure;

   characterized in that

   said caps are both bonded to the respective ends (13, 14) of the container (10);

   said support structure is located in use near to the upper end (13) of the container (10) and comprises a peripheral edge (25d) sealingly engaging the side wall (11) of the container (10) at an intermediate height between fluid inlet and outlet (17, 18), and a base (24) through which a communication opening (24d) is formed; and

   said filter cartridge further comprises a refrigerant flow pipe (27) connected at one end (27a) to said communication opening and extending toward the lower end (14) of the container (10).

2. An assembly according to claim 1, wherein said support structure further comprises a cage frame (25) carrying the filtering medium (23), said cage frame being bonded to said base.

3. An assembly according to claim 1 or 2, wherein the base (24) of the support structure (21) comprises a sleeve portion (24c) formed as a single piece with said base, inside which one end (27a) of said refrigerant flow pipe is inserted.

4. An assembly according to claim 3, wherein said sleeve portion has a hook formation (24e) provided for a bag (29) containing a dehydrating material to be hanged thereon.

5. An assembly according to any of the preceding claims, wherein said filter cartridge further comprises a spacer member (28) fitted on said refrigerant flow pipe, said spacer member comprising a bush portion (28a) and a projecting portion (28b) for engaging the side wall (11) of the container (10).

6. An assembly according to claim 5, wherein said projecting portion comprises a plurality of angularly spaced noses (28c).

7. An assembly according to claim 5 or 6 as combined with claim 4, wherein said spacer member has a hook formation (28d) provided as a second anchoring point for said bag containing dehydrating material.

8. An assembly according to any of claims 5 to 7, wherein said spacer member is of fiber-reinforced, high softening point plastic material.

9. An assembly according to any of the preceding claims, wherein said refrigerant flow pipe is of fiber-reinforced, high softening point plastic material.

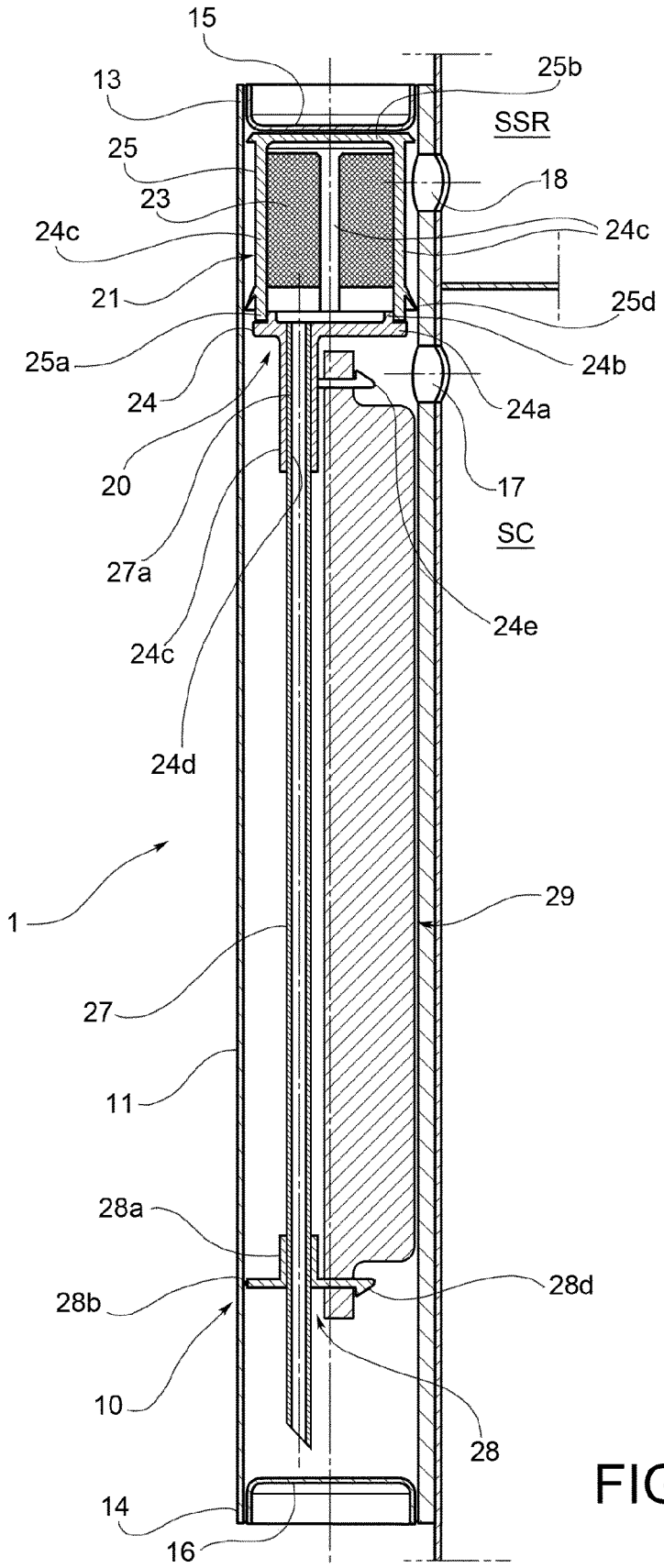
10. A method for assembling a filter assembly to a condenser for vehicles, **characterized in that** it comprises the steps of:

providing a condenser body (CC) comprising a condensing section (SC) and a sub-cooling section (SSR) located in use above the condensing section (SC);
providing a tubular container (10) having a side wall (11) and having a fluid inlet (17) and a fluid outlet (18) formed on said side wall;
brazing said tubular container to the condenser body (CC) in such a way as that said fluid inlet and fluid outlet are connected to the condensing section and to the sub-cooling section of the condenser, respectively, an upper end (13) of the container (10) being closed by a cap (15) bonded thereto;
providing a filter cartridge (20) comprising a cage-shaped support structure (21) of plastic material, and a particle filtering medium (23) carried by said support structure, wherein said support structure comprises a base (24) through which a communication opening (24d) is formed, and a refrigerant flow pipe (27) connected at one end (27a) to said communication opening;
positioning said filter cartridge in the tubular container (10) by inserting it through the lower end (14) of the container, in such a way as that a peripheral edge (25d) of the support structure (21) sealingly engages the side wall (11) of the container (10) at an intermediate height between fluid inlet and outlet (17, 18), and that said refrigerant flow pipe extends toward the lower end (14) of the container (10); and
closing the lower end (14) of the container (10) with a cap (16), and sealing it by welding.

11. A method according to claim 10, wherein the base (24) of the support structure (21) comprises a sleeve portion (24c) formed as a single piece with said base, inside which one end (27a) of said refrigerant flow pipe is inserted, and wherein said sleeve portion has a hook formation (24e) on which a bag (29) containing a dehydrating material is hanged.

12. A method according to claim 10 or 11, wherein said filter cartridge further comprises a spacer member (28) fitted on said refrigerant flow pipe, said spacer member comprising a bush portion (28a) and a projecting portion (28b) engaging the side wall (11) of the container (10) when the filter cartridge (20) is inserted in the container (10).

13. A method according to claim 12 as combined with claim 11, wherein said spacer member has a hook formation (28d) provided as a second anchoring point for said bag containing a dehydrating material.


15
13
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SSR
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18
23
24c
24c
21
25d
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24b
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24a
20
17
SC
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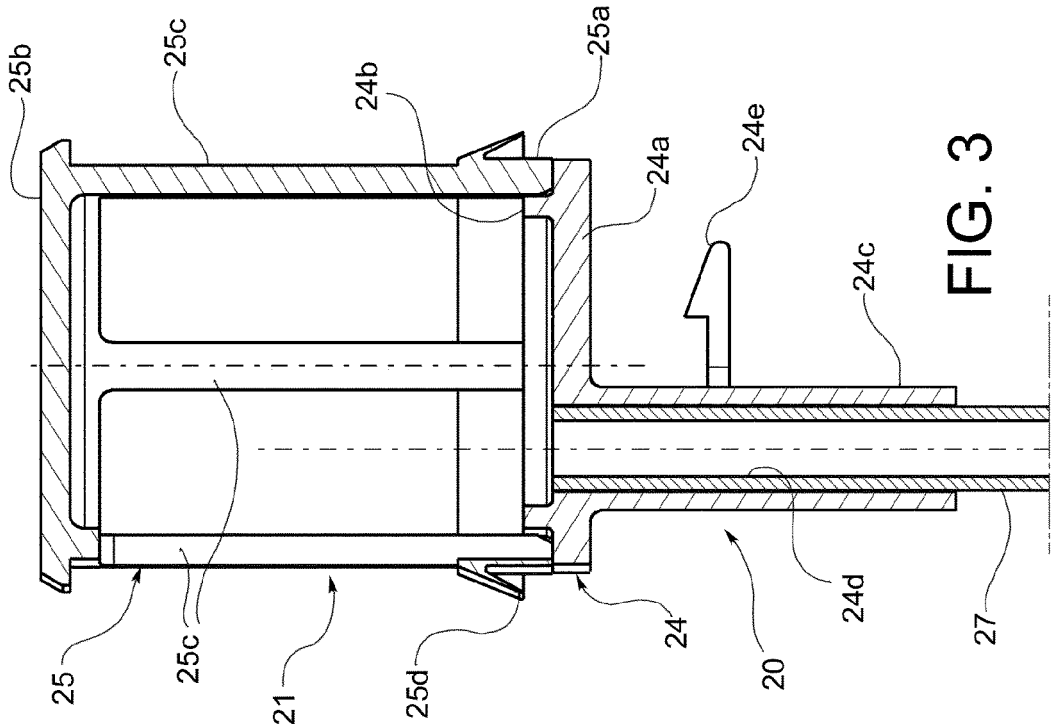
29
27
11
28a
28d
28b
10
28
14
16

FIG. 1


25b
25c
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25a
24a
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24c
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25c
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25d
24
20
24d
27

FIG. 3

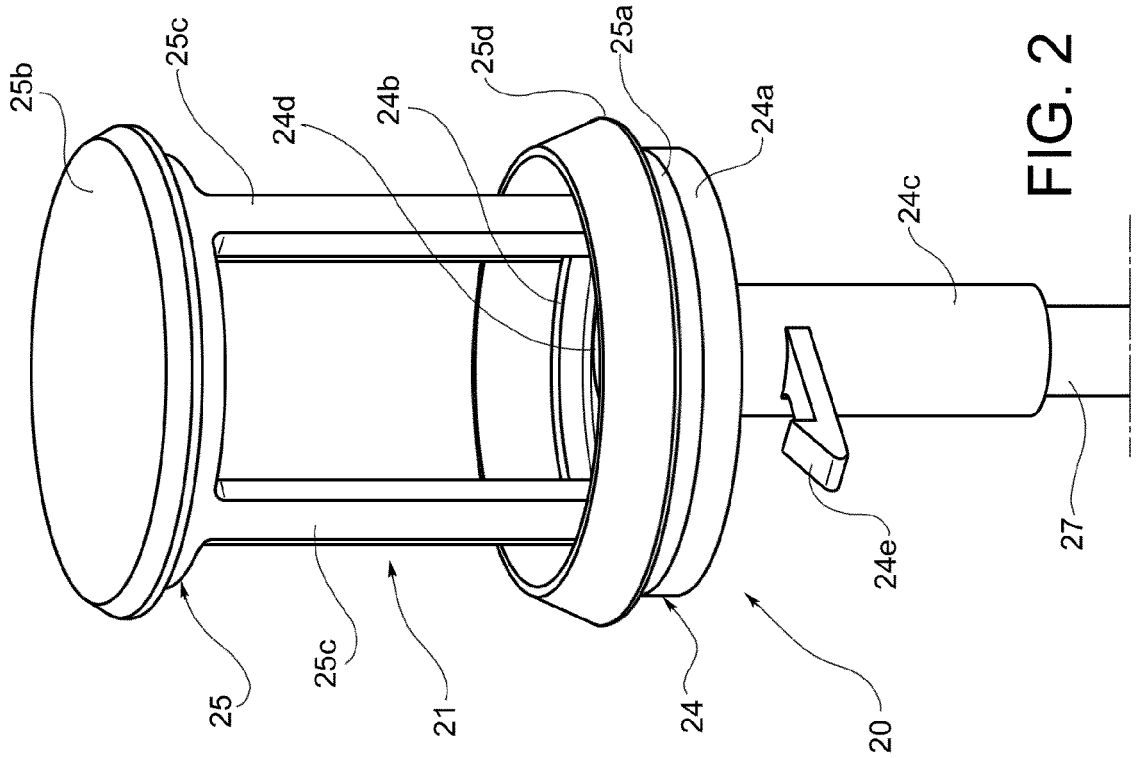
25b
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FIG. 2

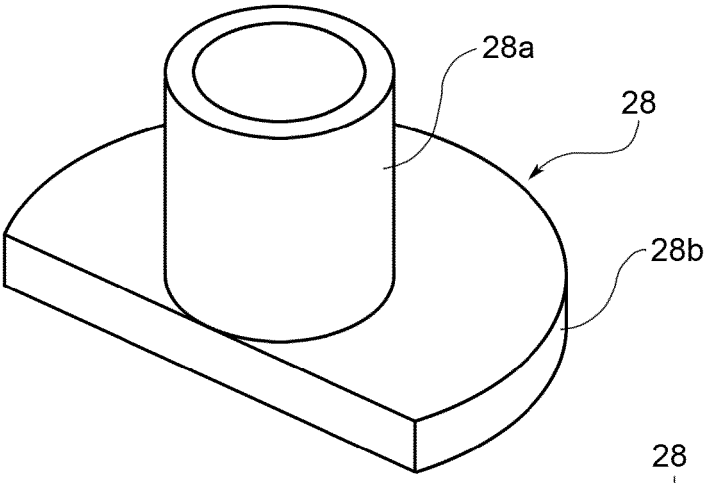

FIG. 4

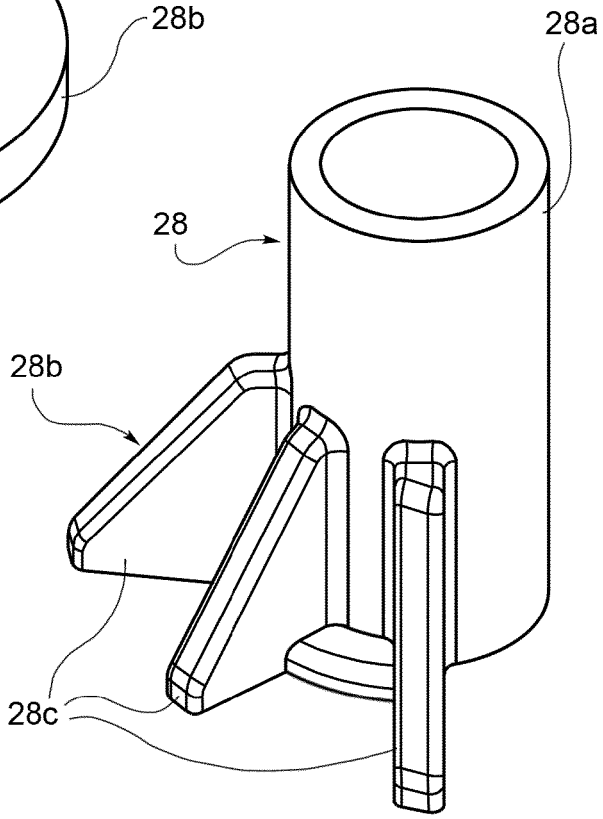

FIG. 5

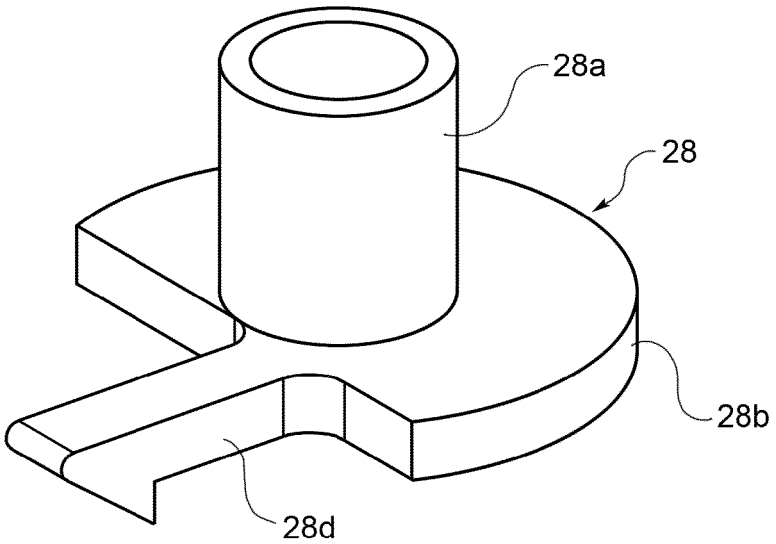

FIG. 6

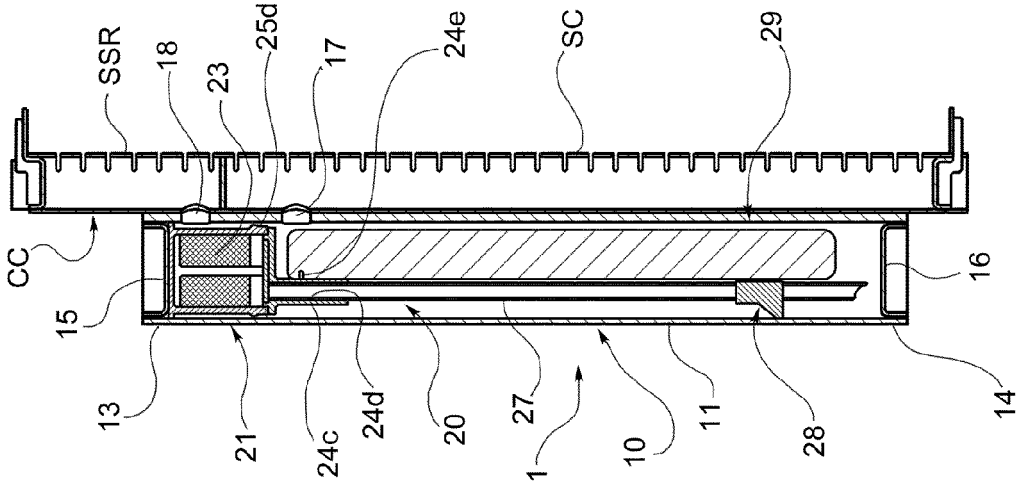

FIG. 9

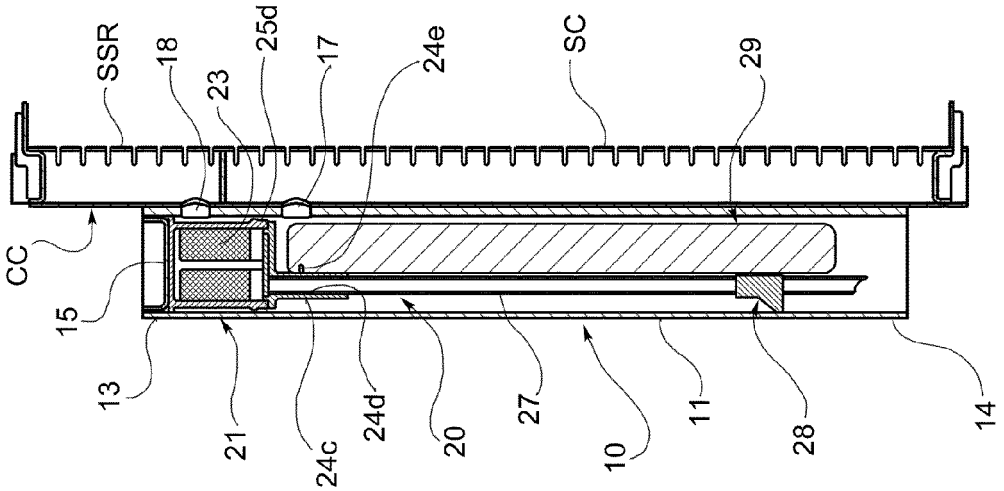

FIG. 8

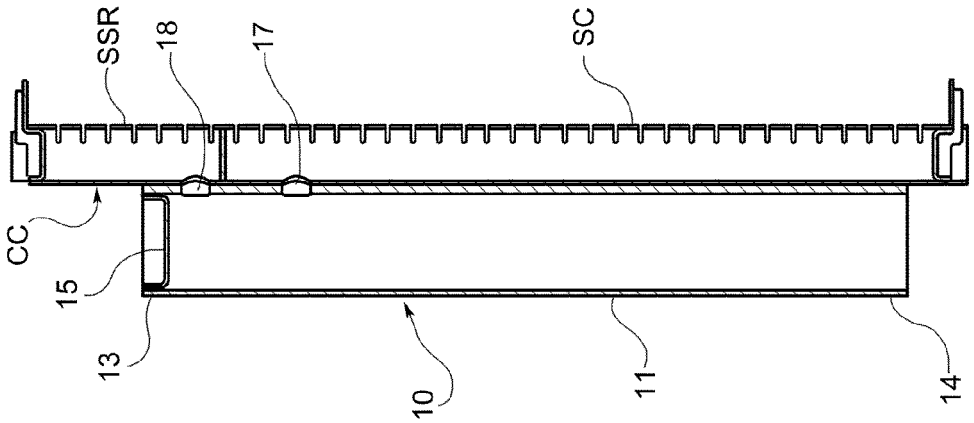

FIG. 7

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EUROPEAN SEARCH REPORT

Application Number
EP 13 15 8114

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	3 June 2013	Szilagyi, Barnabas

CATEGORY OF CITED DOCUMENTS

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