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(54) A frigorie accumulator

(57) The frigorie accumulator (1) comprises a housing (2) which defines in its interior a region (10; 10a, 10b) for holding a frigorie storage substance such as a eutectic solution, and at least one duct (6a, 6b; 15) which extends in a heat-exchange relationship with the housing (2) and can contain a refrigerant fluid for removing calories from the storage substance held in the housing (2) until it brings about freezing thereof.

The housing (2) comprises:

a substantially tubular, extruded profiled section (3), made of a thermally conductive material, defining first heat-exchange walls (5a) between the region (10; 10a, 10b) and the environment outside the housing (2), and second heat-exchange walls (5b) between the region (10; 10a, 10b) and the refrigerant fluid contained in the duct (6a, 6b; 15), and

a first end closure element and a second end closure element (4a, 4b) which can be connected in a fluid-tight manner to the ends of the extruded profiled section (3).

FIG. 1

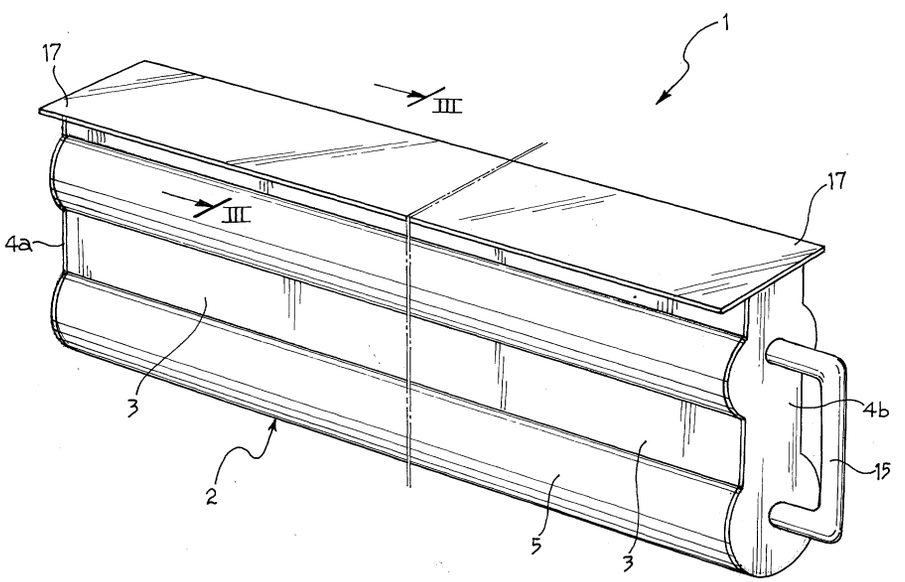

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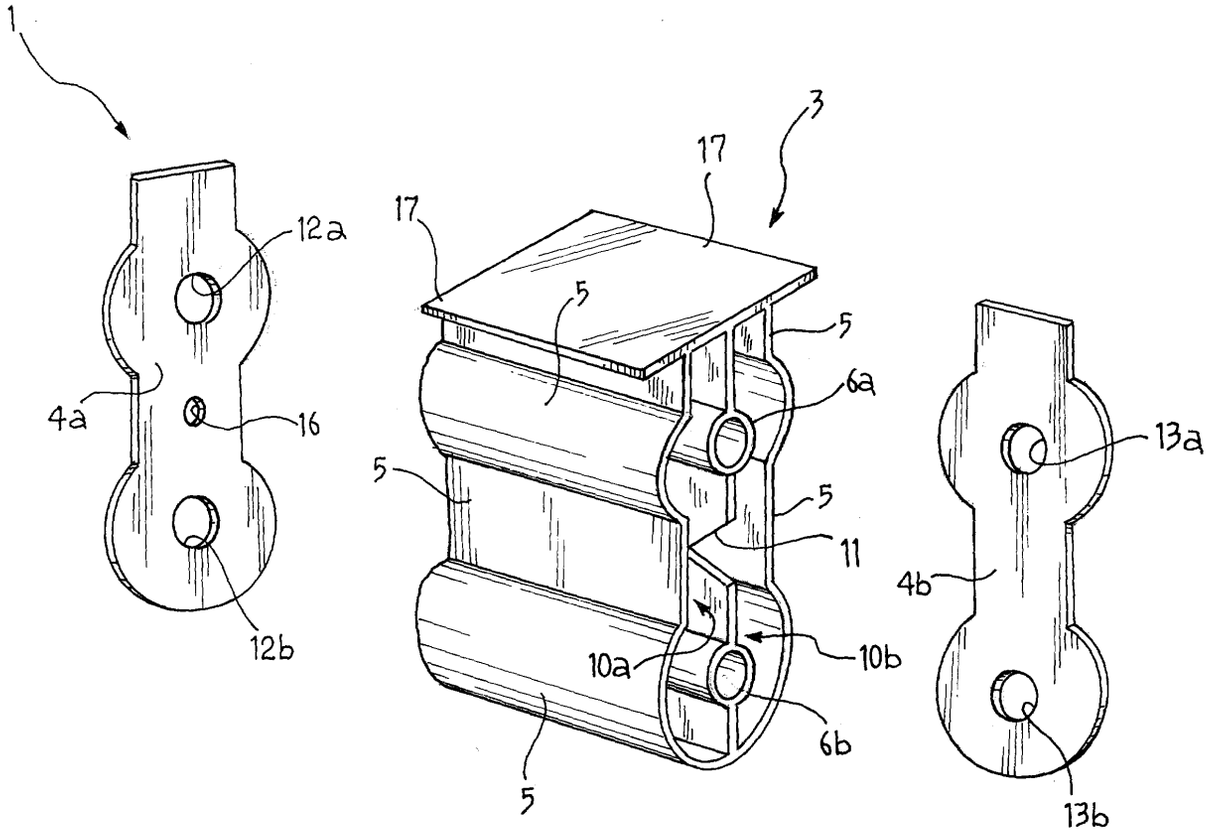
FIG. 2



Description

[0001] The present invention relates to a frigorie or cold accumulator.

[0002] More specifically, the subject of the invention is a frigorie accumulator comprising:

a housing which defines in its interior a region for holding a frigorie storage substance such as a eutectic solution, and

at least one duct which extends at least partly in a heat-exchange relationship with the region inside the housing and can contain a refrigerant fluid for removing calories from the substance held in said region of the housing until it brings about freezing thereof.

[0003] Frigorie accumulators of this type are used, for example, as refrigeration units in the cells of refrigerated delivery vans which are used for the short-range transport and distribution of products at low temperature such as ice creams, frozen foods and the like, and so-called "fresh" products.

[0004] Frigorie accumulators of this type according to the prior art are produced substantially in two main types which are distinguished by the material which is used predominantly for their manufacture.

[0005] A first type of accumulator, which is made of plastics material, has a low weight but suffers from problems of reliability. Plastics materials in fact present problems when they are subjected to low operating temperatures, to considerable expansions/contractions, and to vibrations during transportation.

[0006] Accumulators of a second type, which are made of stainless steel, have good reliability and optimal behaviour at low temperatures but are quite expensive with regard both to the material used and to the operations that are necessary during manufacture.

[0007] An object of the present invention is to provide a frigorie accumulator which can be produced easily and inexpensively and which has optimal operative efficiency and good reliability.

[0008] This object is achieved, according to the invention, by a frigorie accumulator of the type specified above which is characterized primarily in that the housing comprises:

a substantially tubular, extruded profiled section, made of a thermally conductive material, defining at least one first heat-exchange wall between the region inside the housing and the environment outside the housing, and at least one second heat-exchange wall between the region inside the housing and the refrigerant fluid contained in said duct; and

a first end closure element and a second end closure element which can be connected in a fluid-tight manner to the ends of the extruded profiled section.

[0009] The accumulator according to the invention can advantageously be made of aluminium or alloys thereof and is therefore very light.

[0010] Moreover, these materials have an extremely high coefficient of thermal conductivity (of the order of 200 W/m °K), clearly greater than that of plastics materials (typically of the order of 0.2 W/m °K) and of stainless steel (typically of the order of 16 W/m °K). The frigorie accumulator according to the invention is consequently characterized by good operative efficiency: thermal conductivity is extremely uniform along the accumulator and the rate of freezing of the storage substance is optimal.

[0011] The accumulator according to the invention is also very reliable since, in practice, no relative movement takes place between constituent parts in the longitudinal direction (corresponding to the direction of extrusion of the profiled element in the accumulator).

[0012] Further characteristics and advantages of the invention will become clear from the following detailed description which is given purely by way of non-limiting example, with reference to the enclosed drawings, in which:

Figure 1 is a perspective view of a frigorie accumulator according to the invention;

Figure 2 is a partially-sectioned, partial, exploded, perspective view of the frigorie accumulator according to Figure 1;

Figure 3 is a cross-section taken on the line III-III of Figure 1;

Figure 3a is a partial view, sectioned substantially on the line IIIa-IIIa of Figure 3;

Figure 3b is a view similar to that of Figure 3a and shows a variant;

Figures 4 to 8 are cross-sections similar to that shown in Figure 3 and show further variants;

Figures 9 and 10 are sectioned views relating to further variants; and

Figure 11 is a perspective view of an end closure element relating to the variant shown in Figure 9.

[0013] A frigorie accumulator according to the invention is generally indicated 1 in Figure 1.

[0014] In the embodiment shown, the accumulator 1 comprises a housing 2 formed by a substantially tubular extruded profiled section 3 to the ends of which respective plate-shaped end closure elements 4a, 4b are welded (see also Figure 2).

[0015] The extruded profiled section 3 and the end elements 4a and 4b are advantageously made of alumin-

ium or alloys thereof.

[0016] With reference to Figures 2 and 3, the extruded profiled section 3 defines a tubular wall 5 having an oblong cross-section.

[0017] The region inside the housing 2, that is, the region delimited by the outer wall 5 of the extruded profiled section 3 and by the end closure elements 4a, 4b, can hold a frigorie storage substance such as a eutectic solution of a type known *per se.*

[0018] In the embodiment shown from Figure 1 to Figure 8, the extruded profiled section 3 has two internal, tubular, shaped portions 6a and 6b which are integral therewith and which form two branches or portions of a duct for a refrigerant fluid, which will be described further below.

[0019] As can be seen in particular in Figures 2 and 3, the internal, tubular, shaped portions 6a and 6b of the extruded profiled section 3 can be interconnected by a longitudinal wall or partition 7 integral with the profiled section. Moreover, said internal, tubular, shaped portions 6a and 6b can be connected to the external wall 5 of the profiled section 3 by means of respective connecting walls or partitions 8 and 9 which are also integral with the profiled section 3.

[0020] The connecting partitions 7, 8 and 9 are preferably coplanar as can be seen, for example, in Figure 3. These partitions divide the region inside the housing 2 into two compartments or chambers, indicated 10a and 10b. An opening defined in at least one connecting partition puts these compartments or chambers 10a, 10b into communication with one another. In the embodiment shown, the opening is in the form of a triangular notch 11 (Figures 2, 3a and 3b) in the intermediate connecting partition 7.

[0021] The end closure elements 4a, 4b of the housing 2 have respective openings 12a, 12b and 13a, 13b (Figure 2) in positions corresponding to the ends of the internal, tubular, shaped portions 6a and 6b of the extruded profiled section 3.

[0022] The end elements 4a and 4b are welded to the ends of the extruded profiled section 3.

[0023] In a first embodiment shown in Figure 3a, these end elements 4a, 4b are placed in abutment with the ends of the profiled section 3 and are welded to said profiled section by TIG or laser welding in the region of their external profiles and of the edges or profiles of their openings 12a, 12b and 13a, 13b.

[0024] In an alternative embodiment to which Figure 3b relates, the end elements 4a, 4b are brazed to the ends of the extruded profiled section 3, after the end edges of the interconnecting partitions 7, 8 and 9 have been milled to allow the end elements 4a, 4b to be inserted in the corresponding end portions of the profiled section 3; the end elements 4a, 4b thus extend inside the external wall 5 of the profiled element and around the ends of the internal tubular shaped portions 6a, 6b.

[0025] With reference to Figure 1, the frigorie accumulator 1 further comprises a U-shaped or C-shaped portion of tubing 15 made of aluminium or an alloy thereof, the ends of which are inserted and welded in the openings of the end closure elements 4a, 4b. The tubing 15 interconnects the internal tubular shaped portions 6a, 6b of the extruded profiled section 3 in series with one another, forming a duct to which a refrigerant fluid for removing calories from the storage substance held in the communicating chambers 10a, 10b can be admitted in operation.

[0026] In the embodiment shown, the tubing 15 is connected to the end closure element 4b and the openings 12a, 12b of the other end element 4a enable the above-described duct to be connected to an external system such as a refrigeration system of a type known *per se.*

[0027] As can be seen from Figure 2, at least one opening 16 is formed in one end element, advantageously in the end element indicated 4a; the opening 16 can be sealed in a fluid-tight manner known per se and enables a frigorie storage substance to be introduced into the region 10a, 10b defined inside the housing 2 of the accumulator.

[0028] The extruded profiled section 3 preferably but not necessarily has, on one side, an integral, flange-like, longitudinal, shaped portion, indicated 17 in the drawings. This shaped portion can be used for the fixing of the frigorie accumulator 1 to a supporting structure such as the wall of a cell of a refrigerated delivery van.

[0029] The external wall 5 of the extruded profiled section 3 may advantageously have external, longitudinal, shaped portions formed integrally in the extrusion for enabling accessory elements to be connected to the accumulator 1.

[0030] By way of example, Figure 4 shows such an external, longitudinal, shaped portion 18 which has a substantially inverted T-shape and can be used for supporting flat cover panels 19.

[0031] In the variant shown in Figure 5, the extruded profiled section 3 has two opposed, longitudinal, shaped portions 20 and 21 which are also substantially T-shaped and enable finned frigorie dispersers, such as that generally indicated 22, to be connected to the accumulator.

[0032] With reference to Figure 6, the extruded profiled element 3 may comprise internal, longitudinal, shaped portions which are formed integrally therewith during the extrusion process and which extend into the region 10a, 10b that is intended to hold the storage substance. Figure 6 shows various substantially fin-like shaped portions of this type, indicated 23.

[0033] The internal, tubular, shaped portions 6a, 6b may also advantageously have respective external, integral, shaped portions which extend into the region 10a, 10b holding the storage substance. Such shaped portions are indicated 24 in Figure 6.

[0034] In the further variant shown in Figure 7, the extruded profiled section 3 has a plurality of integral, external, tubular shaped portions, indicated 25. These shaped portions can be used in order to bring about the

flow of a heating fluid therein, in operation, when the accumulator 1 is to be defrosted.

[0035] In the further variant shown in Figure 8, the extruded profiled element 3 has a plurality of substantially channel-shaped, external, shaped portions 26 in which it is possible to engage, for example, resistive heating devices which can be activated when the accumulator is to be defrosted.

[0036] Figures 9 and 10 show two variants, wherein the tubular portions, or ducts, 6a and 6b are now placed externally to the housing 2. In these drawings, parts and elements already described have again been attributed the same alphanumeric references as were used above.

[0037] In the variant of Figure 9, a frigorie accumulator 1 is shown that has an extruded profiled section 3 which does not have the longitudinal partition 7 or the connecting partitions 8 and 9, but which defines a single region, generally indicated 10, inside the housing 2. The extruded profiled section 3 comprises first heat-exchange walls 5a between the region 10 inside the housing 2 and the outside environment, and second heat-exchange walls 5b between the region 10 and the refrigerant fluid contained in the duct 6a, 6b.

[0038] These second heat-exchange walls 5b are channel-shaped wall portions which are open towards the environment outside the profiled section 3, and can receive portions of the duct 6a, 6b which can advantageously be disposed on opposite sides of the profiled section 3.

[0039] In contrast with the embodiments shown in Figures 1 to 8, the above-mentioned duct portions 6a, 6b facing the second heat-exchange walls 5b are not welded at their ends to U-shaped or C-shaped tubing portions 15, since the duct 6a, 6b can advantageously be formed in a single piece as a coil, because it is outside the extruded profiled section 3.

[0040] The duct 6a, 6b can thus easily be disconnected from the housing 2 and is particularly safe in the event of perforation or damage since it cannot cause refrigerant fluid, which is generally subjected to high working pressure, to leak into the region 10 inside the profiled section 3.

[0041] Figure 9 also shows a retaining element 31 which can hold the duct portion 6b in contact with the associated channel-like heat-exchange wall 5b, in a profile 34 of the retaining element 31.

[0042] Advantageously, the retaining element 31 may be made of thermally conductive material and may be connected to the profiled section 3 by means of hooked portions 32 which can snap-engage corresponding shaped engagement portions 33 that are present on the outside of the housing 2.

[0043] Figure 10 shows a variant similar to that shown in Figure 9 in which the portions 6a, 6b of the duct are situated in the vicinity of a side 35 of the profiled section 3 which is remote from the flange-like shaped portion 17 and is provided with end appendages 36 which help to hold the duct portions 6a, 6b in contact with the second heat-exchange wall 5b.

[0044] Figure 11 shows a preferred embodiment of the end closure elements 4a, 4b, particularly for the variant shown in Figure 9.

[0045] The end element 4a, like the end element 4b, may advantageously be fixed to the extruded profiled section 3 by mechanical means such as, for example, screws (not shown) fitted in corresponding holes 40 formed in the peripheral end of the end element 4a and of the profiled section 3. The fluid-tightness of the housing 2 is advantageously ensured by the interposition of a seal (not shown) between the end element 4a and the profiled section 3.
Alternatively, the fluid-tightness of the housing 2 can be achieved by means of silicones or other sealing means.

[0046] This variant of the end elements 4a, 4b is particularly advantageous: welding of the elements 4a, 4b to the profiled section 3 is thus avoided since the welding operation may be problematical owing to the nature of aluminium and of its alloys which are generally used for the manufacture of the housing 2 because of its above-mentioned thermal conductivity properties.

[0047] Naturally, the principle of the invention remaining the same, the forms of embodiment and details of construction may be varied widely with respect to those described and illustrated purely by way of non-limiting example, without thereby departing from the scope of the invention as defined in the appended claims.

Claims

1. A frigorie accumulator (1) comprising:

a housing (2) which defines in its interior a region (10; 10a, 10b) for holding a frigorie storage substance such as a eutectic solution,
at least one duct (6a, 6b; 15) which extends at least partly in a heat-exchange relationship with the region (10; 10a, 10b) inside the housing (2) and can contain a refrigerant fluid for removing calories from the storage substance held in said region (10; 10a, 10b) of the housing (2) until it brings about freezing thereof,
the accumulator (1) being **characterized in that** the housing (2) comprises:

a substantially tubular, extruded profiled section (3) made of a thermally conductive material, defining at least one first heat-exchange wall (5a) between the region (10; 10a, 10b) inside the housing (2) and the environment outside the housing (2) and at least one second heat-exchange wall (5b) between the region (10; 10a, 10b) inside the housing and the refrigerant fluid contained in said duct (6a, 6b; 15), and
a first end closure element and a second

end closure element (4a, 4b), which can be connected in a fluid-tight manner to the ends of the extruded profiled section (3).

2. A frigorie accumulator according to Claim 1 in which the extruded profiled section (3) defines an external, tubular wall (5) which delimits the internal region (10a, 10b), and in which said at least one second heat-exchange wall (5b) is constituted by at least one internal, tubular, shaped portion (6a, 6b) which is integral with the external wall (5) and which forms at least one (first) portion of said duct (6a, 6b; 15).

3. A frigorie accumulator according to Claim 2 in which said profiled section (3) has two integral, internal, tubular, shaped portions (6a, 6b) which form two portions of said duct (6a, 6b; 15) and which extend parallel to one another and are spaced apart.

4. A frigorie accumulator according to Claim 3 in which said internal, tubular, shaped portions (6a, 6b) are interconnected by a longitudinal wall or partition (7) integral with the extruded profiled section (3).

5. A frigorie accumulator according to Claim 4 in which said internal, tubular, shaped portions (6a, 6b) are connected to the external wall (5) of the extruded profiled section (3) by means of respective connecting walls or partitions (8, 9) which are integral with the profiled section (3).

6. A frigorie accumulator according to Claim 4 or Claim 5 in which the connecting partition or partitions (7, 8, 9) divide the region inside the housing (2) into two compartments or chambers (10a, 10b) ; there being defined in at least one connecting partition (7) an opening (11) which puts said compartments or chambers (10a, 10b) into communication with one another.

7. A frigorie accumulator according to any one of Claims 2 to 6 in which the end closure elements (4a, 4b) are plate-shaped elements having respective openings (12a, 12b; 13a, 13b) in positions corresponding to the ends of said internal, tubular, shaped portion or shaped portions (6a, 6b) of the extruded profiled section (3); the end closure elements (4a, 4b) being welded to the ends of the profiled section (3).

8. A frigorie accumulator according to any one of the preceding claims in which the extruded profiled section and the end closure elements (4a, 4b) are made of aluminium or an alloy of aluminium.

9. A frigorie accumulator according to Claim 7 or Claim 8 in which the end elements (4a, 4b) are placed in abutment with the ends of the extruded profiled element (3) and are welded to the profiled section (3) by TIG or laser welding in the region of their outer profiles and of the edges of the said openings (12a, 12b; 13a, 13b).

10. A frigorie accumulator according to Claim 7 or Claim 8 in which the end closure elements (4a, 4b) of said extruded profiled section (3) are brazed to the ends of said profiled section.

11. A frigorie accumulator according to Claim 3 and one or more of Claims 4 to 10, further comprising a U-shaped or C-shaped tubing portion (15) the ends of which are inserted and welded in corresponding openings of an end closure element (4b) of the profiled section (3), so as to interconnect the internal, tubular, shaped portions (6a, 6b) of the profiled section (3) in series with one another.

12. A frigorie accumulator according to Claim 1 in which the at least one second heat-exchange wall (5b) is a channel-shaped wall portion of the profiled section (3), which is open towards the environment outside the extruded profiled section (3) and can receive a portion of the duct (6a; 6b).

13. A frigorie accumulator according to Claim 12 in which the extruded profiled section (3) has two channel-shaped wall portions (5b) which can receive respective portions of the duct (6a; 6b) and are disposed on opposite sides of the extruded profiled section (3).

14. A frigorie accumulator according to Claim 12 or Claim 13 in which at least one retaining element (31), connected to the extruded profiled section (3), is associated with the at least one second channel-shaped heat-exchange portion (5b) and can hold the associated duct portion (6b) in said second heat-exchange wall (5b).

15. A frigorie accumulator according to Claim 14 in which the retaining element (31) is made of thermally conductive material.

16. A frigorie accumulator according to any one of Claims 12 to 15 in which the end closure elements (4a, 4b) are connected to the profiled section (3) by fixing and sealing means.

17. A frigorie accumulator according to Claim 16 in which the fixing and sealing means comprise screws which can engage respective holes (40) that are present in the end elements (4a, 4b) and in the profiled section (3).

18. A frigorie accumulator according to Claim 16 in

which leaktight seals are interposed between the end closure elements (4a, 4b) and the profiled section (3).

19. A frigorie accumulator according to any one of the preceding claims in which an end closure element (4a) of the extruded profiled section (3) has an opening (16) which can be closed in a leaktight manner and which enables the storage substance to be introduced into the region (10; 10a, 10b) defined inside the housing (2).

20. A frigorie accumulator according to any one of the preceding claims in which the extruded profiled section (3) has, on one side, at least one integral, flange-like, shaped portion (17) which can be used for the fixing of the accumulator (1) to a supporting structure.

21. A frigorie accumulator according to any one of the preceding claims in which the extruded profiled section (3) has (first) integral, external, longitudinal, shaped portions (18; 20, 21; 26) for enabling accessory elements such as flat covering panels (19) or finned frigorie dispersers (22) to be connected to the accumulator (1).

22. A frigorie accumulator according to any one of the preceding claims in which the extruded profiled section (3) has second, internal, integral, longitudinal, shaped portions (23) which extend into the region (10; 10a, 10b) that is intended to hold the storage substance.

23. A frigorie accumulator according to any one of Claims 2 to 11 and Claim 22 when dependant on any of the Claims 2 to 11 in which the internal, tubular, shaped portion or shaped portions (6a, 6b) of the extruded profiled section (3) have external, integral, shaped portions (24) which extend into the region (10; 10a, 10b) that is intended to hold the storage substance.

24. A frigorie accumulator according to any one of the preceding claims in which the extruded profiled section (3) has external, longitudinal, tubular, shaped portions (25) which are integral therewith and which permit the flow of a heating fluid for the defrosting of the accumulator (1).

25. A frigorie accumulator according to Claim 21 in which the extruded profiled section (3) has channel-like, external, longitudinal, shaped portions (26) which are integral therewith, and which can hold heating devices for the defrosting of the accumulator (1).

FIG. 1

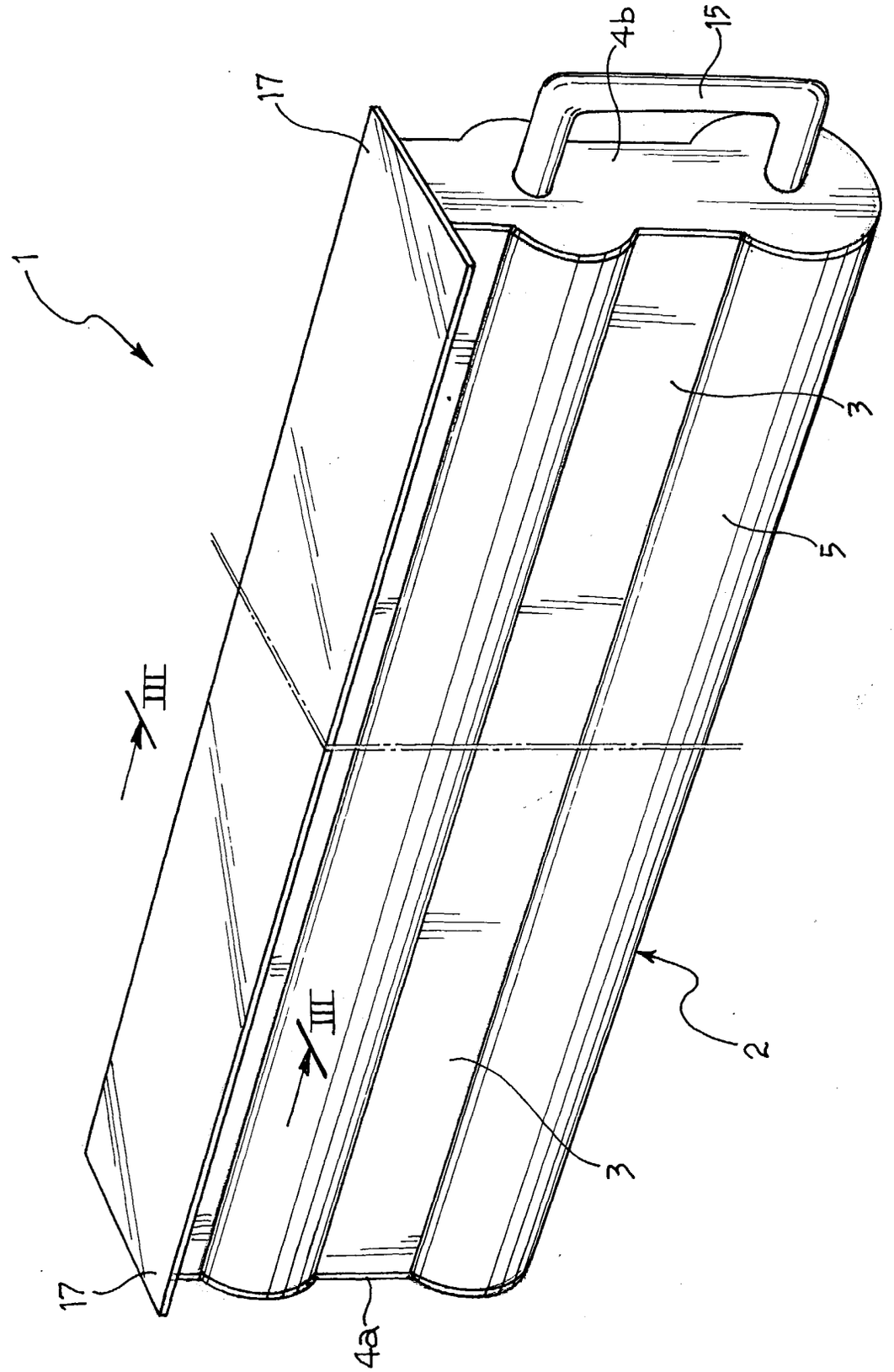


FIG. 2

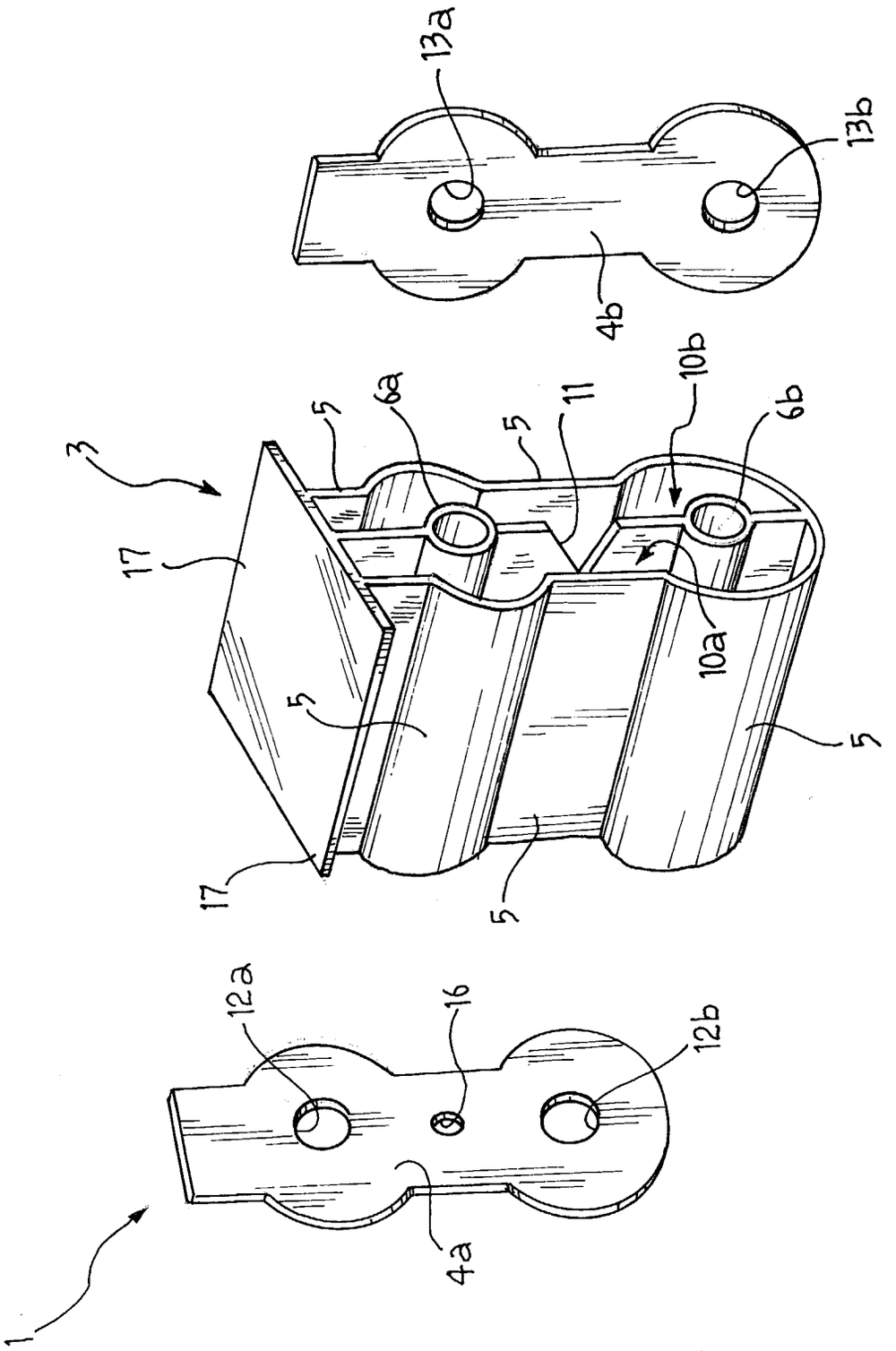


FIG. 4

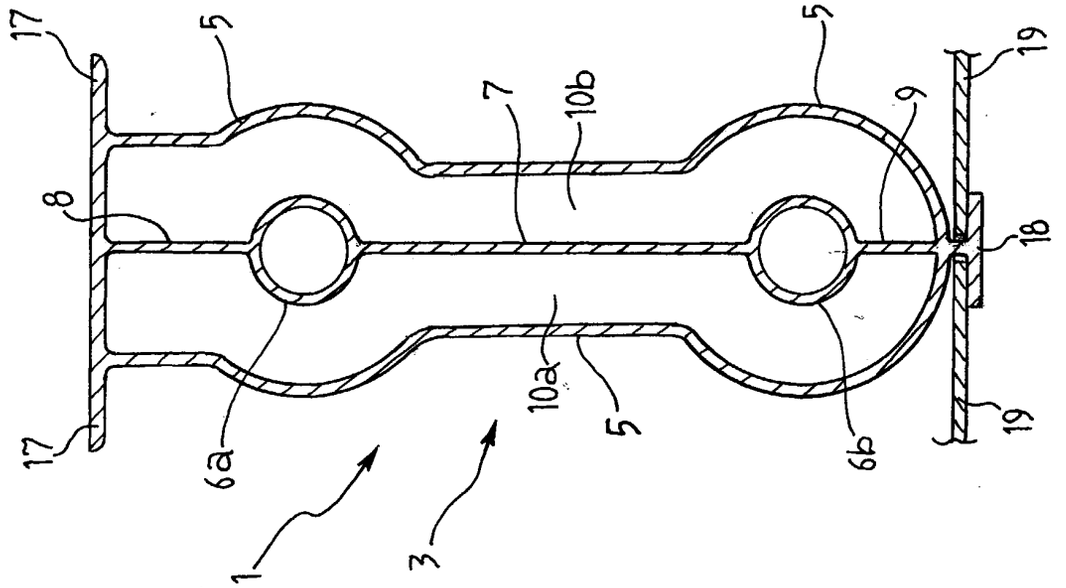

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FIG. 3

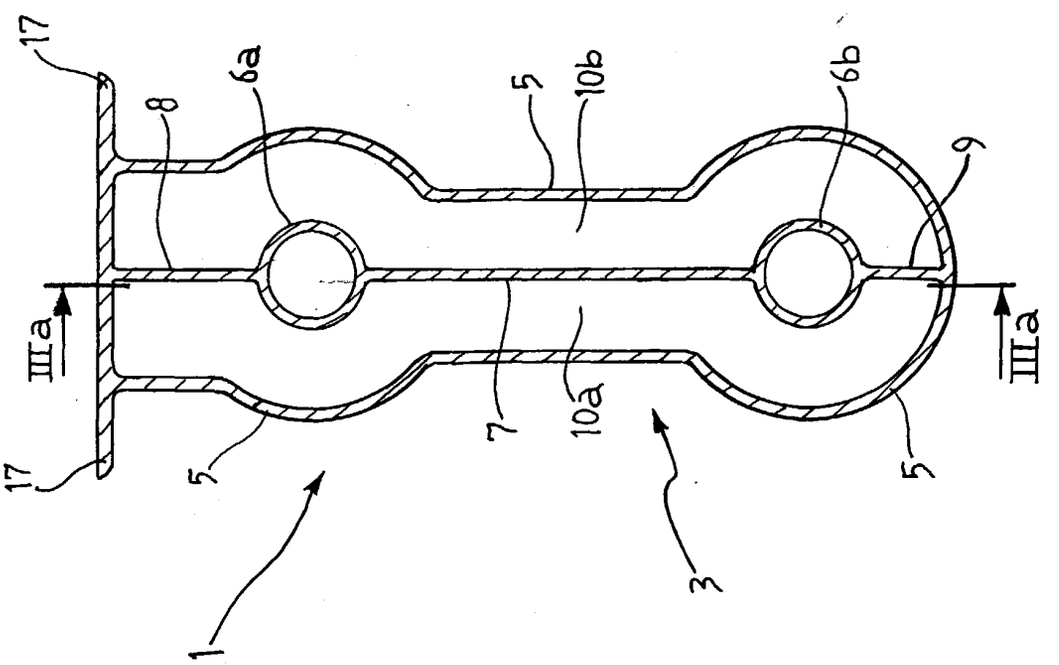
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FIG. 3b

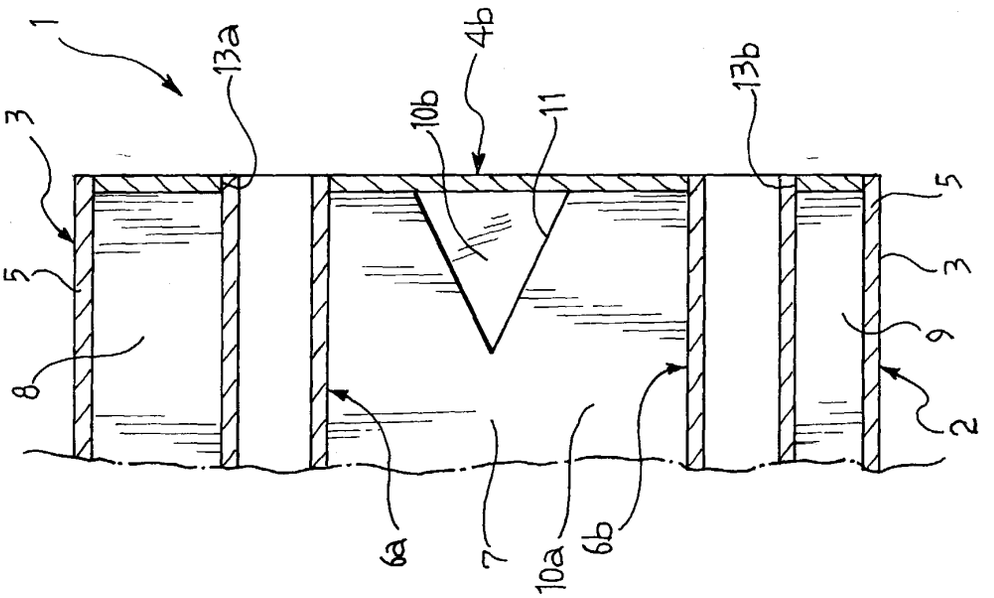
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FIG. 3a

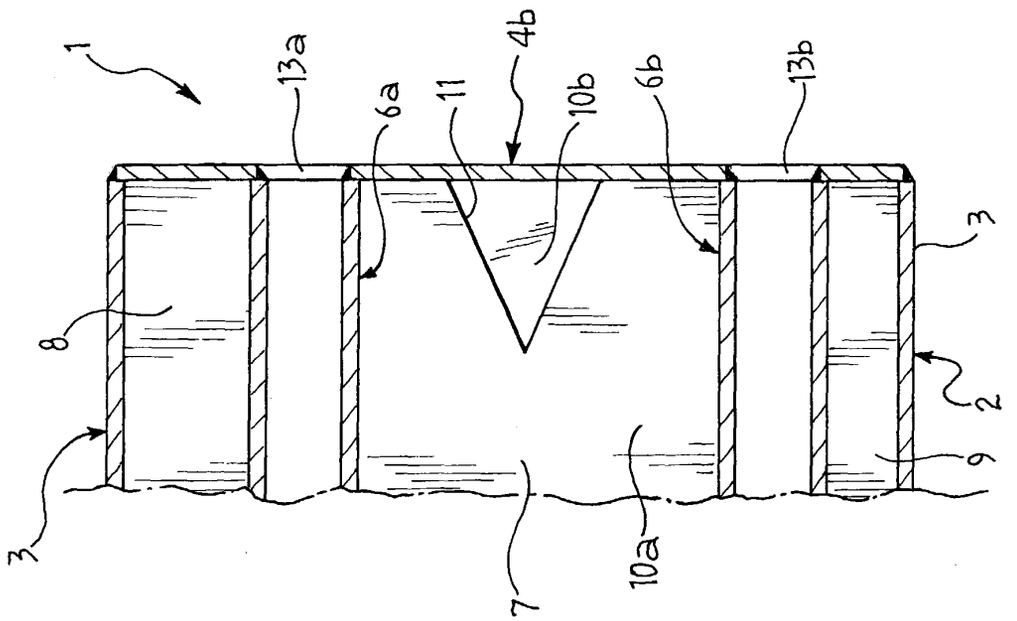
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FIG. 6

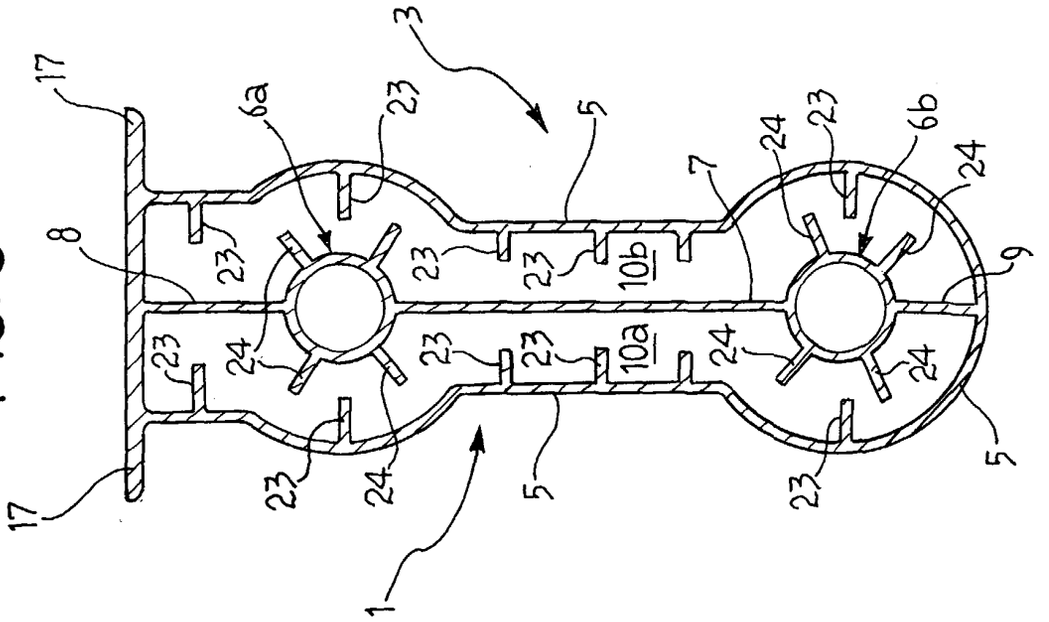
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FIG. 5

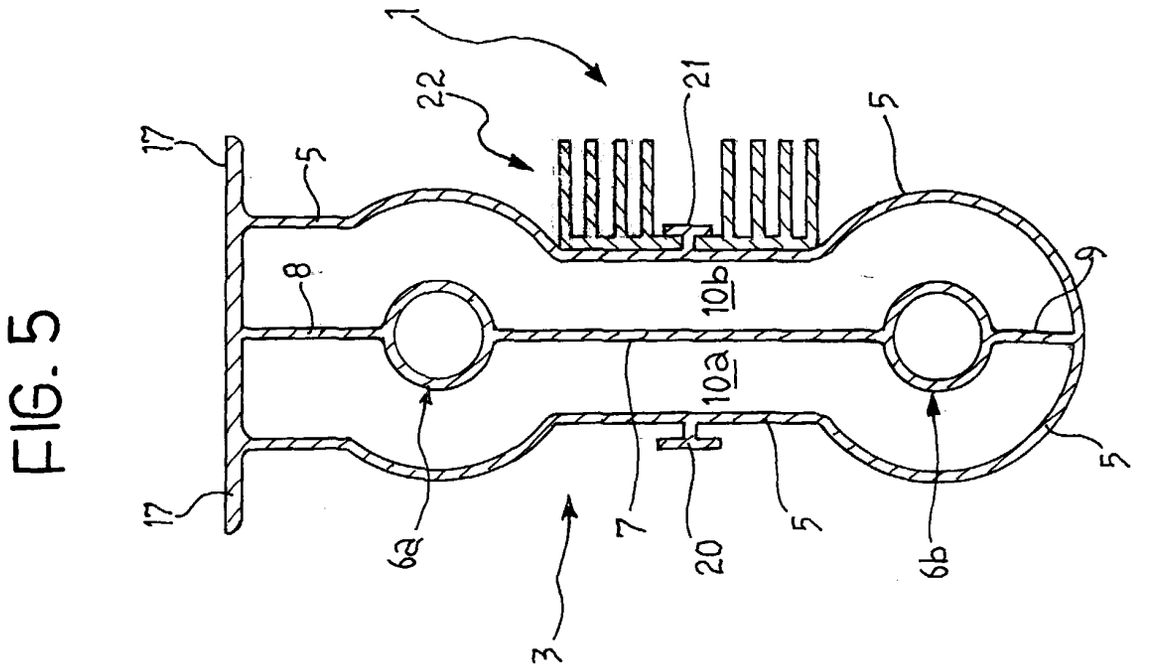
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FIG. 8

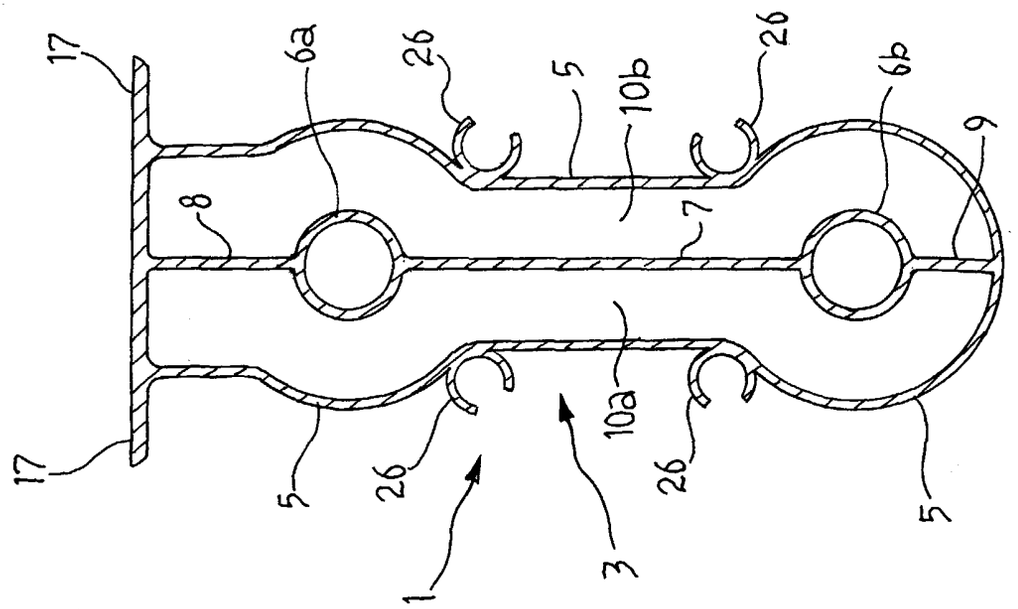
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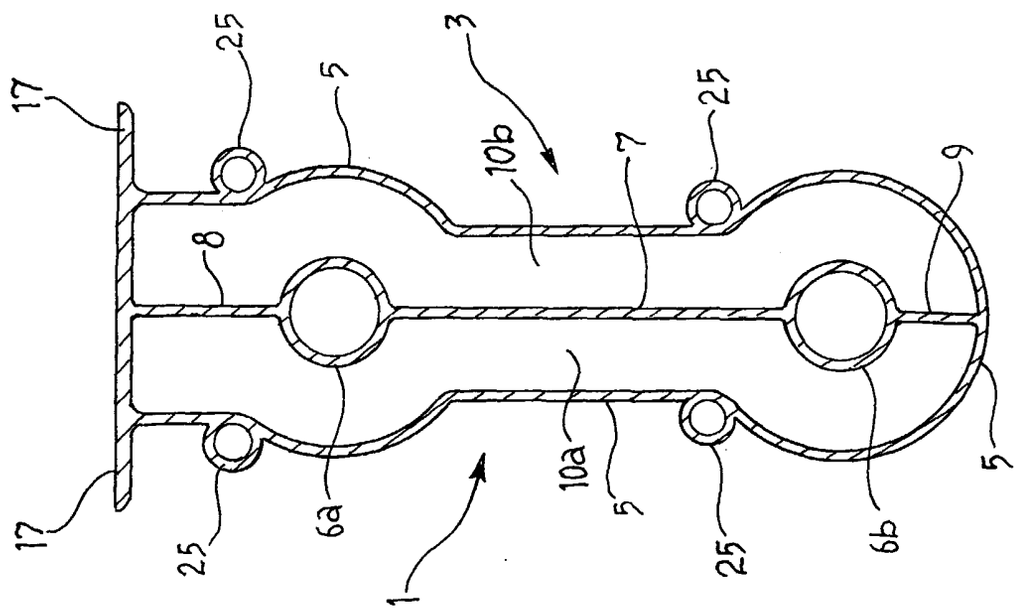
FIG. 7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25
6b
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1

FIG. 9

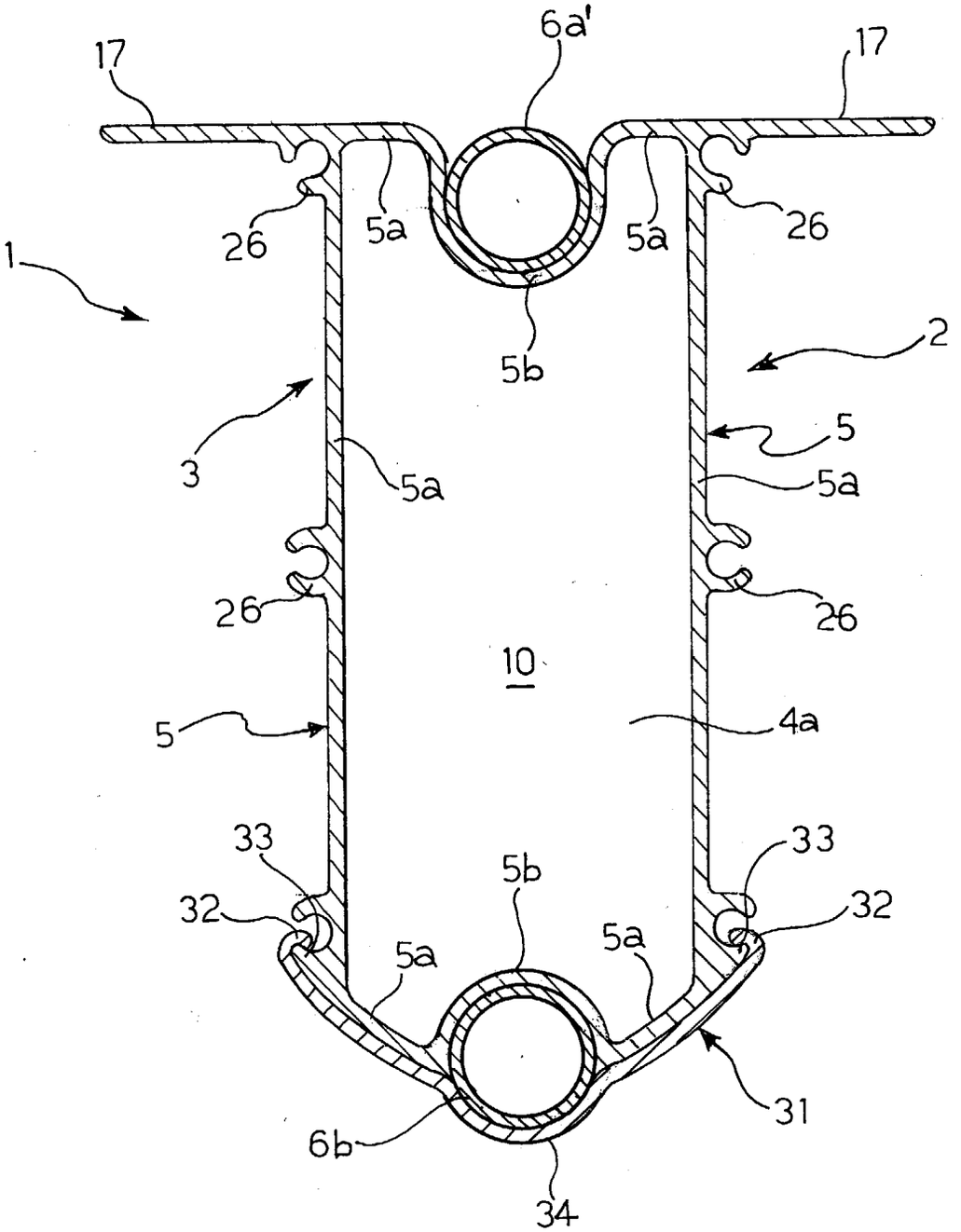

6a'
17
17
26
5a
5a
26
1
2
5b
3
5
5a
5a
26
26
10
5
4a
33
5b
33
32
32
5a
5a
6b
31
34

FIG. 10

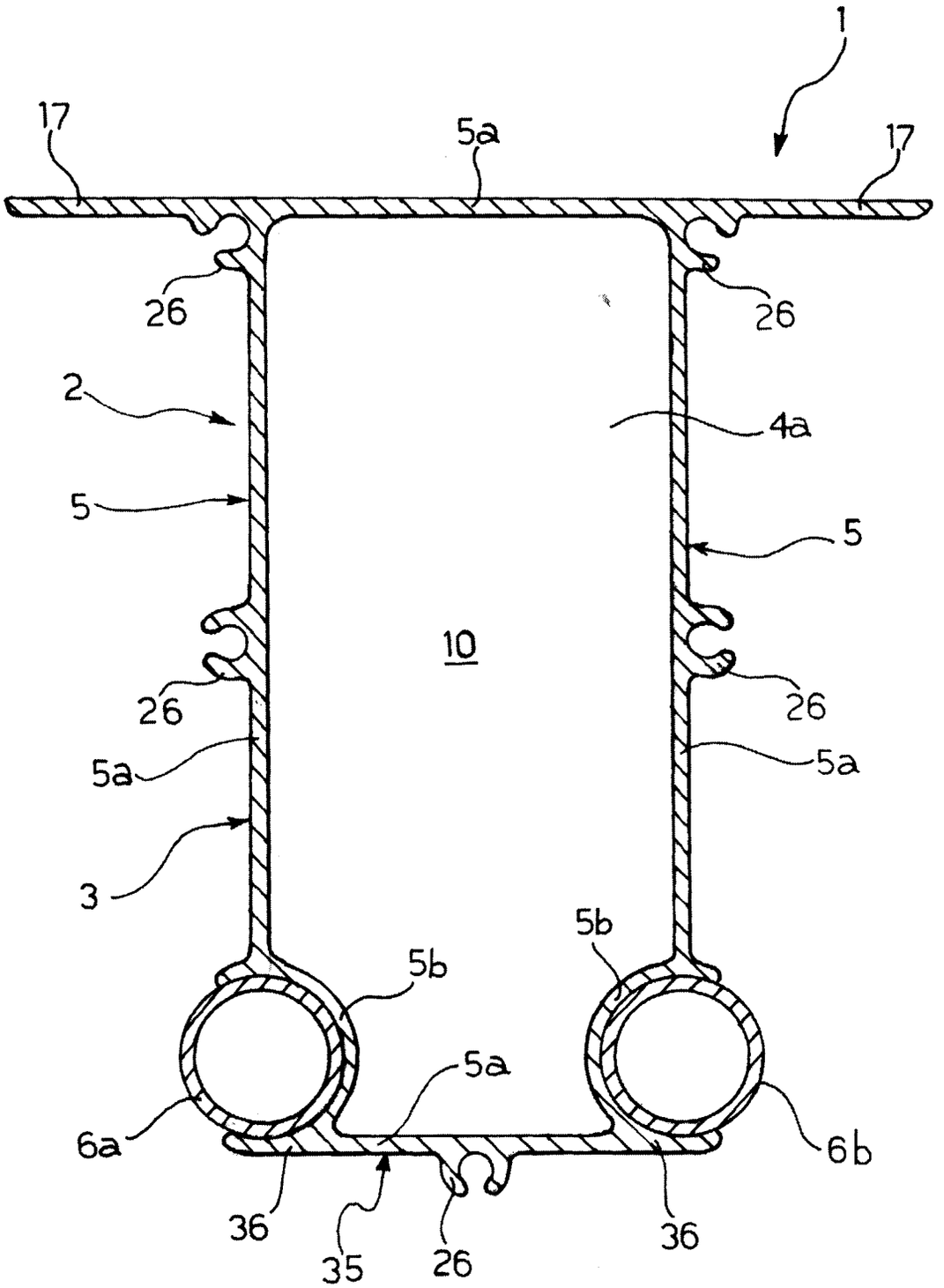
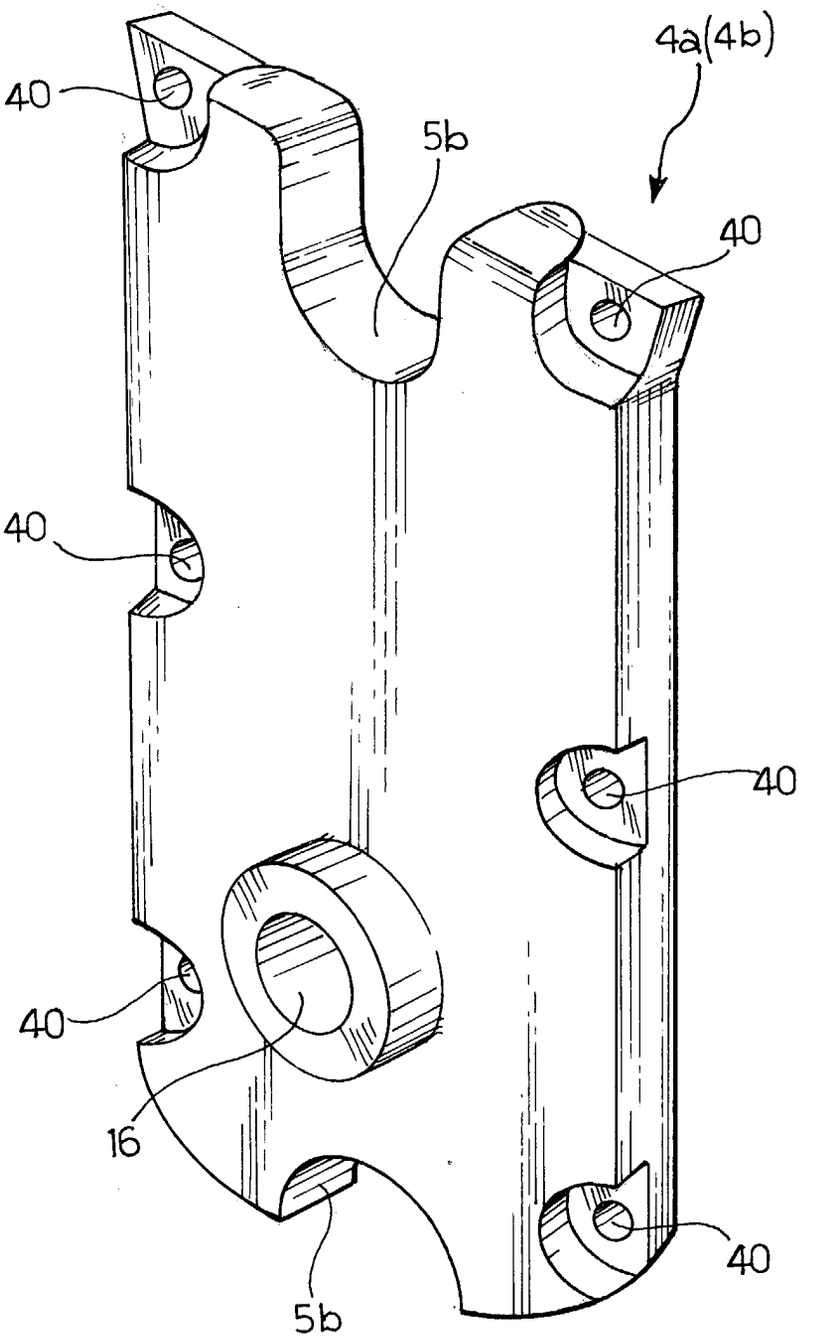


FIG. 11



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EUROPEAN SEARCH REPORT

Application Number
EP 04 01 2973

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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	24 August 2004	Zanotti, L

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