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(54) **Device for a heat-exchange terminal with a finned assembly**

(57) The present invention relates to a device for a heat exchange terminal with a finned assembly, which makes it possible to simplify the present finned battery, and to improve part of the production process.

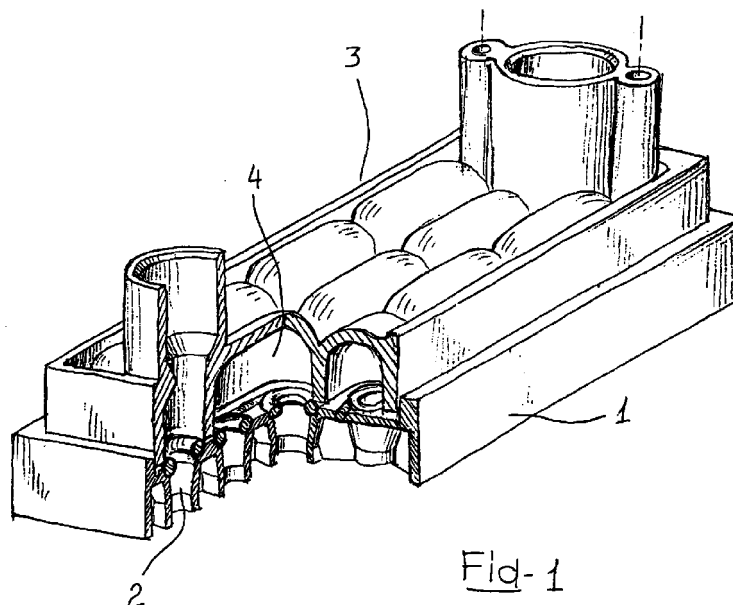
The present invention relates to all types of batteries, including batteries for fan-coils.

The assembly for a heat-exchange terminal comprises:

a head (1), which comprises a plurality of holes (2) which can accommodate respective tubes of the tube bundle;

an end cover (3), which engages in a sealed manner with the head (1);

the said end cover (3) comprising a plurality of ducts (4), each of which puts into fluid communication two or more tubes of the tube bundle.



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Description

[0001] The present invention relates to a device for a heat-exchange terminal with a finned assembly, which makes it possible to simplify the present finned battery, and to improve part of the production process.

[0002] The present invention relates to all types of battery, including batteries for fan-coils.

[0003] At present, all batteries for fan-coils are assembled using conventional components such as:

- copper tubes, hereinafter known as the tube bundle;
- aluminium fins;
- copper U-shaped connection tubes (bends);
- die-cast brass or copper manifolds;
- other items made of galvanized steel plate.

[0004] The normal process for assembly of the heat exchanger consists of securing the assembly of aluminium fins onto the tubes of the tube bundle by means of expansion of the tubes (expanding), and fitting of a corresponding steel support. Copper bends are then fitted, which are designed to join the tubes, in order to form the circuitry of the heat exchanger. The tubes of the tube bundle are normally folded in the shape of a U in order to complete the circuitry together with the bends.

[0005] The terminal of the heat exchanger additionally comprises ducts (manifolds) for intake and output of the fluid, which are braze welded to the tubes of the tube bundle.

[0006] The heat exchanger can additionally be completed by fitting a protection unit which covers the terminal.

[0007] The main disadvantages of the production process consist in the operations which need to be carried out piece by piece and require a considerable amount of time for assembly and welding of the manifolds and bends to the tube bundle.

[0008] Further disadvantages are derived from the use of costly materials such as copper or brass for bends and manifolds, and in that since the series of items which constitute the head of the exchanger are made of metal parts, their weight is considerable.

[0009] The problem which forms the basis of the present invention is to provide a device for a heat-exchanger terminal which has a low cost and weight, and assembly of which is simplified, thus permitting a reduction in the processing times.

[0010] The present invention provides a solution to the above-described problems, by replacing the conventional terminal previously described with a device for a terminal as shown in the drawings, in which the bends/manifolds system is replaced by an end cover.

[0011] The assembly for a heat-exchanger terminal comprises:

- (i) a head which comprises a plurality of holes

which can accommodate the tubes of the tube bundle;

(ii) an end cover which is engaged in a sealed manner with the head;

the said end cover comprising a plurality of ducts, each of which puts into fluid communication two or more tubes of the tube bundle.

[0012] The head is fitted at the mouth of the tubes of the tube bundle, each hole accommodating one tube, and is secured to the tubes by means of expanding.

[0013] The end cover is preferably obtained in a single piece, which comprises a plurality of ducts with a hollow shape; this shape is machined from the thickness of the end cover, starting from the surface of the latter which is designed to come into contact with the head. The depth of the ducts should preferably also be in relation to the diameter of the inner channel of the holes of the head.

[0014] Each duct is used to put into fluid communication two or more tubes of the tube bundle, and consequently the shape of the duct depends on the particular type of circuitry required. For example, in order to put into fluid communication two tubes of the tube bundle which are in the vicinity of one another, an advantageous design of the duct is that shown in Figure 4b, in which the cavity has an elongate profile, with two semi-circular end portions, which are connected by respective straight sections. The radius of curvature of these semi-circular portions advantageously corresponds to, or is slightly larger than, the radius of the holes of the head.

[0015] Other forms of the edges of the ducts of the end cover can be provided, on the understanding, however, that these ducts have edges which can match the holes provided on the head.

[0016] The ducts of the end cover preferably have concave inner walls, such that, between the intake into the duct and the output from it, the fluid travels a curved trajectory, i.e. a trajectory without 90° angles, such as to minimize load losses.

[0017] The end cover can comprise apertures for intake and/or output of the fluid. These apertures are put into fluid communication with one or more holes of the head, depending on the type of circuitry required. Each of these apertures is designed, and has dimensions, such as to accommodate one tube for intake into the exchanger, and one tube for output.

[0018] The end cover and the head can advantageously consist of plastics or die-cast aluminium material, such that they can be obtained by moulding in mono-block pieces. In general, the plastics material has the further advantages of low cost, and of being a light material, which is thus also suitable for applications in which a low cost and/or limited weight of the heat exchanger are essential.

[0019] The plastics material used to produce the head and the end cover according to the present invention will be a heat-resistant material, and will have good capac-

ity for mechanical resistance, such as to resist the temperature and pressure of use. The plastics material suggested is polypropylene, and in particular polypropylene with glass fibre inclusions.

[0020] If the head consists of a plastics material, the front surface of this head, i.e. the surface which is opposite the face which comes into contact with the end cover (rear surface) has ribs in the position of the holes, which ribs are disposed radially relative to the holes, such as to increase the mechanical resistance of the head and guarantee its stability.

[0021] Alternatively, the head can consist of a pre-moulded plate.

[0022] The process of fitting the heat exchanger is considerably simplified by means of use of the device for a terminal which is the subject of the present invention. In fact, after the step of securing the tube bundle/aluminium fin system onto the head by means of expanding, subsequent assembly of the bends/manifolds system is replaced by fitting of the end cover. The two parts, i.e. the head and cover, can be assembled by being screwed, by pressure, or by means of appropriate reciprocal securing means. This therefore avoids the operations of assembly and welding, piece by piece, of bends and manifolds to the tubes of the tube bundle, thus providing a substantial saving in time and costs.

[0023] Between the head and end cover there are interposed sealing means, preferably made of rubber, which can be fitted together with the head before expansion, or, if these means consist of rubber, they can be pre-moulded onto the head in the position of the holes.

[0024] In another embodiment of the present invention, the end cover consists of at least two parts:

- (a) an end cover as previously described, and
- (b) a seal-pressure plate, which has a plurality of holes provided such as to put each duct of the end cover into fluid communication with two or more holes of the head.

[0025] In particular, the holes of the seal-pressure plate are positioned and dimensioned such as to correspond to, and match, the respective holes of the head.

[0026] The end cover and the seal-pressure plate preferably consist of two separate parts, which are connected to one another in a sealed manner, for example by means of being heat-sealed, glued or screwed.

[0027] The seal-pressure plate can advantageously be made of the same material as the end cover. In this case, the two parts can optionally be heat-sealed.

[0028] The sealing means can consist of various shapes and materials; they preferably consist of a rubber plate which has a plurality of holes, positioned such that they correspond to the holes of the head.

[0029] The device for a terminal can be fitted on a heat exchanger in which the tube bundle consists of tubes folded into a U-shape. In this case, the device for a terminal will be fitted on a single end of the tube bundle,

and the end cover will comprise apertures for intake and output of the fluid.

[0030] Alternatively, the heat exchanger can consist of a bundle of substantially straight tubes, and the device for a terminal will be fitted on both ends of the tube bundle, such as to allow the fluid to circulate.

[0031] In this case, one of the two end covers will comprise the apertures for intake and output of the fluid, or, alternatively, one end cover will comprise the intake aperture, whereas the other will comprise the output aperture for the fluid, depending on the type of circuitry required.

[0032] Further features and advantages of the device for a heat-exchanger head, which is the subject of the present invention, will become more apparent from the following description of some embodiments provided purely by way of non-limiting example with reference to the attached figures, in which:

- Figure 1 represents a perspective view in partial cross-section of the device for a terminal of a heat exchanger according to the invention;
- Figure 2 represents an exploded perspective view of the device in Figure 1;
- Figure 3 represents a perspective view of the head of the device in Figure 2;
- Figure 3a represents a perspective view of the head in Figure 3, according to a different viewpoint;
- Figure 3b represents a view in cross-section according to line IIIb-IIIb in Figure 3;
- Figure 3c represents a view according to the direction A1 of the detail in Figure 3b;
- Figure 4 represents a perspective view of the end cover of the device in Figure 2;
- Figure 4a represents a perspective view of the end cover in Figure 4, according to a different viewpoint;
- Figure 4b represents a view in cross-section according to line IVb-IVb in Figure 4a;
- Figure 5 represents a perspective view in partial cross-section of a second embodiment of the device for a heat-exchanger terminal according to the invention;
- Figure 6 represents an exploded perspective view of the device in Figure 5;
- Figure 6a represents a view in cross-section according to line VIa-VIa in Figure 6;
- Figure 7 represents a perspective view of the seal-pressure plate of the exploded view in Figure 6;
- Figure 7a represents a view in cross-section according to line VIIa-VIIa in Figure 7; and
- Figure 7b represents a view according to the direction A2 of the detail in Figure 7a.

[0033] The first embodiment of the device for a heat-exchange terminal according to the present invention is shown in figures 1, 2, 3, 3a, 3b, 3c, 4, 4a and 4b.

[0034] The device for a terminal comprises a head 1, which is engaged in a sealed manner with the end cover

3. Between the head 1 and the end cover 3, there is interposed a pre-moulded seal 5.

[0035] In the example, the head 1 has a parallelepiped shape, with opposed rear 101 and front 102 end surfaces, with a rectangular shape. The head 1 comprises a plurality of through-holes 2, which distinguish respective channels 105 in the head 1. Each hole 2 has a shape and dimensions such as to engage in a sealed manner with one end of a tube of the tube bundle (not shown).

[0036] The inner channel 105 defined by the holes 2 is interrupted, in the vicinity of the edge of the hole 2 on the rear surface 101, by a shoulder which defines an inner circumference 106 and an outer circumference 107, between which there are contained the seal seats 11 which are complementary to the sealing means. These seal seats 11 are shaped such as to assist the sealing of the said sealing means, when the head 1 and the end cover 3 are engaged.

[0037] The head 1 comprises a plurality of through-holes 103, which are designed to be engaged by known securing means. For example, these holes 103 can be suitable for accommodating securing screws. The rear surface 101 comprises a projecting perimeter edge 104, which delimits a seal seat 6 on the surface itself.

[0038] According to one embodiment of the present invention (Figure 3a), instead of being solid, in the position of the holes 2, the head 1 comprises respective tubular elements which project from the surface 101 and are connected to one another by strengthening ribs, such as to form a substantially alveolar structure. This structure of the front surface 102 is particularly advantageous when the head 1 is made of plastics material.

[0039] The pre-moulded rubber seal 5 consists of a plurality of substantially toroidal rings 501. The thickness of the rings 501 corresponds substantially to the amplitude of the seal seat 11 of the holes 2 of the head 1. The rings 501 can be connected to one another by joining segments 502, in order to facilitate fitting.

[0040] As shown in Figure 4, the end cover 3 has the shape of a parallelepiped with opposed end surfaces, respectively 301 at the front and 302 at the rear. On the front surface 301, hollow ducts 4 are provided in the thickness of the end cover, starting from the front surface 301 of the latter. The depth of these ducts 4 corresponds substantially to the diameter of the inner circumference 106 of the holes 2 of the head 1.

[0041] The ducts 4 have an elongate profile, with two semi-circular end portions, which are connected by respective straight sections. The radius of curvature of the semi-circular portions substantially corresponds to the radius of the inner circumference 106 of the holes 2 of the head 1. The ducts 4 of the end cover 3 preferably have concave inner walls, and can provide the fluid with a flow with a curved trajectory, between the intake and output of the duct, such as to minimize the load losses.

[0042] The end cover 3 can comprise apertures 14 for intake and/or output of the fluid. These apertures 14 are

in fluid communication with one or more holes 2 of the head 1, and preferably with two or three holes 2, according to the type of circuitry required. Each of these apertures has a shape and dimension such as to accommodate one tube for intake or output of the fluid (not shown), respectively into or out of the exchanger. In the example, in the position of each aperture 14, the head 3 comprises cylindrical sleeves 303 which project from the rear surface 302, which sleeves are designed to engage the tubes for intake or output of the fluid.

[0043] The end cover 3 comprises a plurality of through-holes 304, which correspond to the similar holes 103 of the head 1. These holes 304 are designed to be engaged by known securing means. For example, these holes 304 can be suitable for accommodating securing screws.

[0044] In the position of the apertures 14 for intake and/or output of the fluid, the end cover 3 can also have venting pipes 305, which put the respective duct 4 into communication with the exterior. These venting pipes 305 have threaded inner walls, which can accommodate appropriate screw valves.

[0045] A second embodiment of the device for a heat-exchanger terminal which is the subject of the present invention is shown in Figures 5, 6, 6a, 7, 7a and 7b.

[0046] According to this embodiment, the end cover 3 comprises a seal-pressure plate 7, which engages with the front surface 301 of the cover 3. The end cover 3 and the seal-pressure plate 7 preferably consist of two separate parts, which are connected to one another by being heat-sealed, glued or screwed.

[0047] The seal-pressure plate 7 comprises a plurality of holes 8, which are positioned such as to put each duct 4 of the end cover 3 into fluid communication with two or more holes 2 of the head 1.

[0048] On the seal-pressure plate 7, there are provided a rear surface 702, which engages with the front surface 301 of the end cover 3, and a front surface 701, which engages with the rear surface 101 of the head 1. The sealing means 9 are interposed between the surface 101 of the head 1, and the surface 701 of the seal-pressure plate 7.

[0049] The inner duct 703 defined by the holes 8 is interrupted, in the vicinity of the edge of the hole 8 on the lower surface 701, by a shoulder which defines an inner circumference 704 and an outer circumference 705, between which there are contained the seal seats 12, which are complementary to the sealing means. These seal seats 12 ensure centring and positioning of the sealing means, between the head 1 and the seal-pressure plate 7.

[0050] The holes 8 of the seal-pressure plate 7 have a diameter which corresponds substantially to the diameter of the inner circumference 106 of the holes 2 of the head 1.

[0051] The seal-pressure plate 7 comprises a plurality of through-holes 706, which are designed to be engaged by known securing means and which corre-

spond to the similar holes 103, 304 of the head 1 and the end cover 3. For example, these holes 706 can be suitable for accommodating securing screws.

[0052] The seal 9 can be flat and made of rubber, with a plurality of holes 10 positioned such as to correspond to the holes 2, 8 of the head 1 and of the seal-pressure plate 7. The diameter of these holes 10 corresponds substantially to the diameter of the inner circumference 106 of the holes 2 of the head 1. The flat seal 9 has a shape and dimensions such as to be accommodated on the inner surface 6 defined on the upper surface 101 of the head 1.

[0053] In addition, in the position of each hole 10, the flat seal 9 comprises a projecting edge 13 which can be accommodated in the respective complementary seal seats 11, 12 of the holes 2 of the head 1, and of the holes 8 of the seal-pressure plate 7.

[0054] The flat seal 9 can comprise a plurality of holes 901, corresponding to the similar holes 103, 706 of the head 1 and of the seal-pressure plate 7, such as to accommodate securing means.

[0055] Alternatively, in both the embodiments, the end cover 3 and the seal-pressure plate 7 can have a shape and dimensions such as to engage with the seal seat 6 of the rear surface 101 of the head 1, thus being secured by the projecting edge 104. This facilitates both securing of the various parts of the device, and sealing of the latter.

[0056] In the first embodiment of the present invention, the device for a terminal is mounted on the tube bundle of the heat exchanger in the manner described hereinafter.

[0057] The head 1 and the seal 5 are mounted on the ends of the tubes of the exchanger, such that each tube engages with the holes 2 and with the rings 501 of the head 1 and of the seal 5 respectively. The head 1 and the seal 5 are secured to the tubes by expanding.

[0058] The end cover 3 is then secured to the head 1, for example by means of screws.

[0059] In the second embodiment of the present invention, the fitting plan comprises securing of the head 1 on the tubes of the head exchanger as previously described, and accommodation of the seal 9 in the corresponding seat 6. The seal-pressure plate 7 is then placed on the seal 9, and the end cover 3 is secured to this assembly, for example by means of screws.

[0060] The seal-pressure plate 7 can also be secured in advance, for example by being heat-sealed, to the cover 3, before the latter is fitted onto the head 1.

Claims

1. Device for a heat-exchange terminal with a finned assembly, comprising:

a head (1) comprising a plurality of holes (2), which can accommodate respective tubes of

the tube bundle;

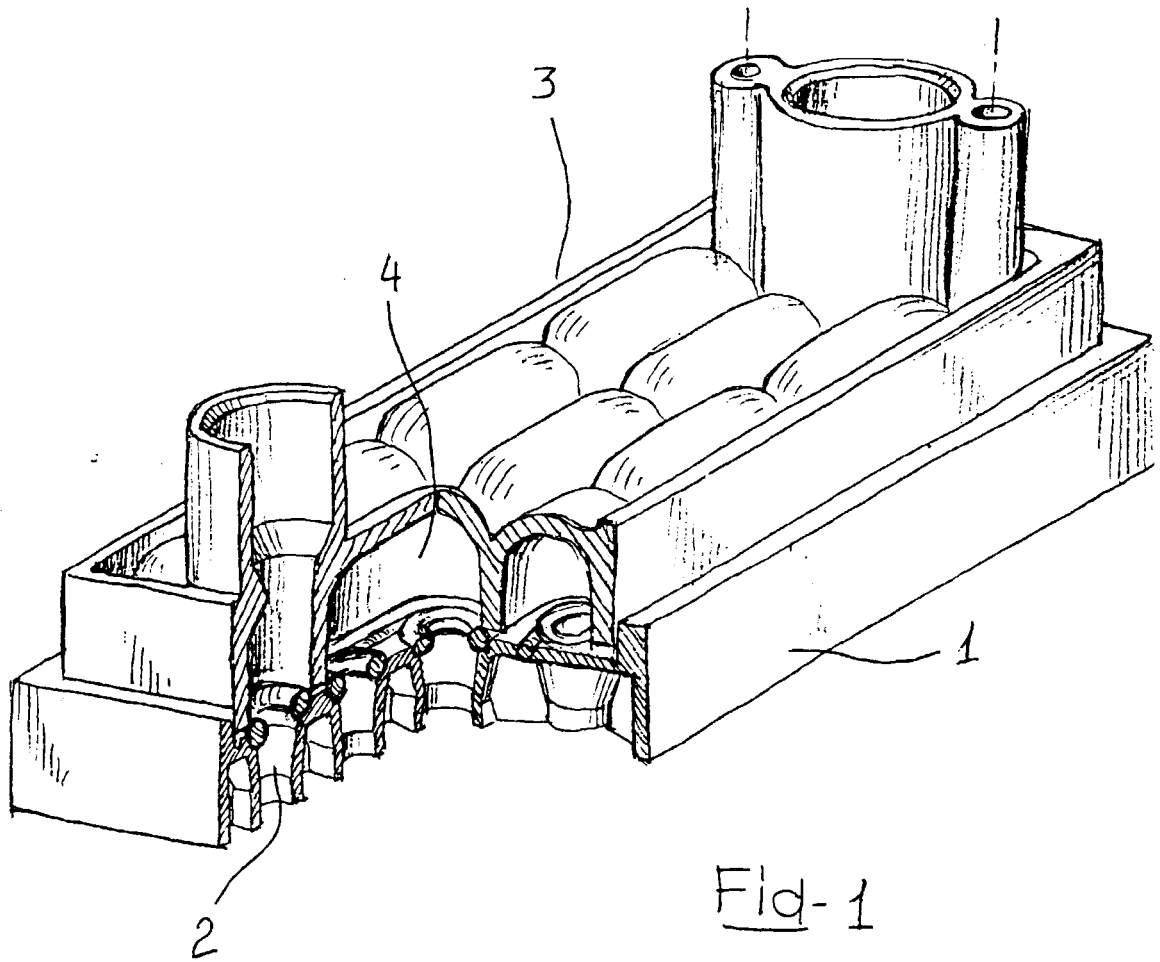
an end cover (3) which engages in a sealed manner with the head (1);

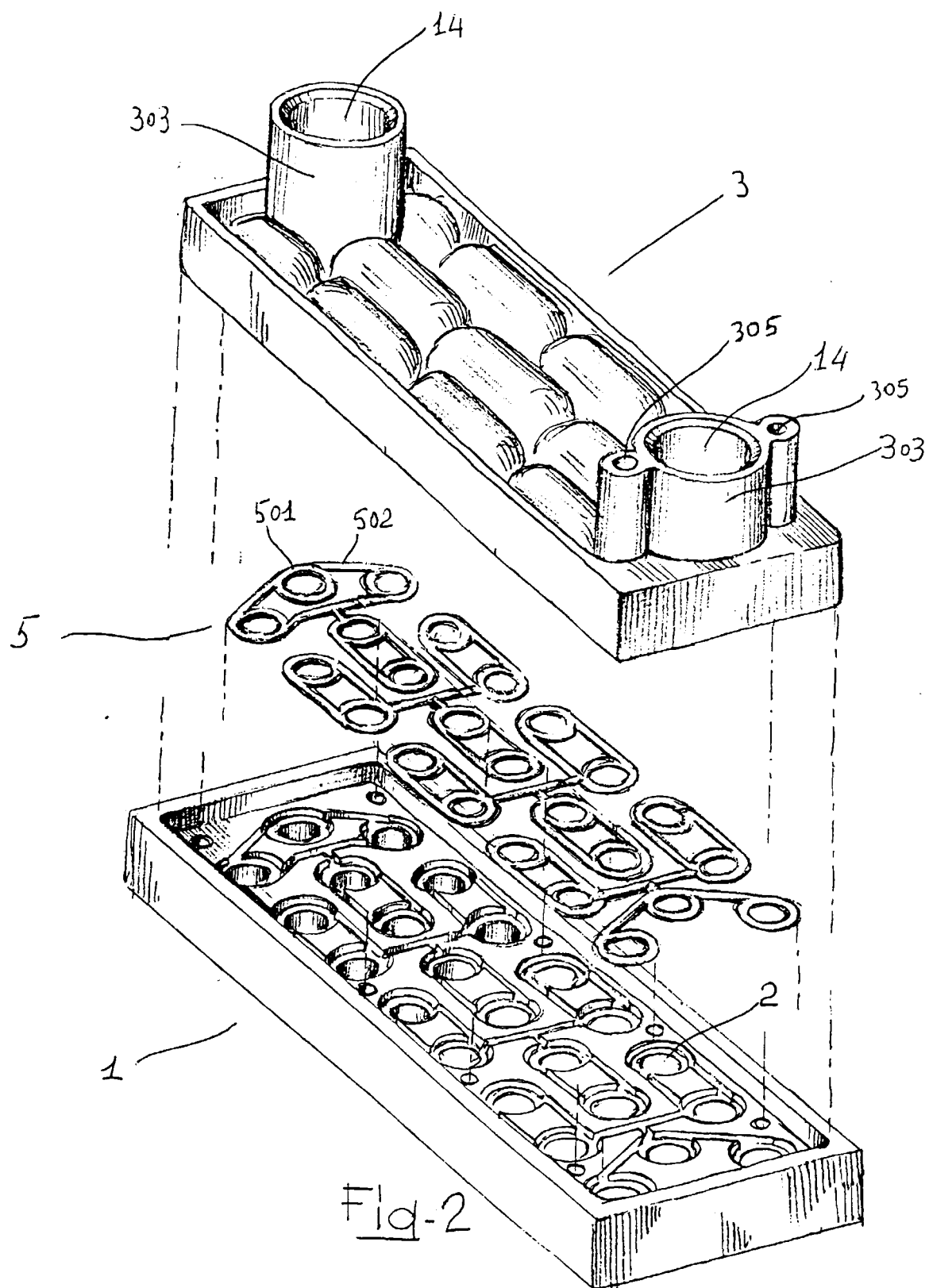
the said end cover (3) comprising a plurality of ducts (4), each of which puts into fluid communication two or more tubes of the tube bundle.

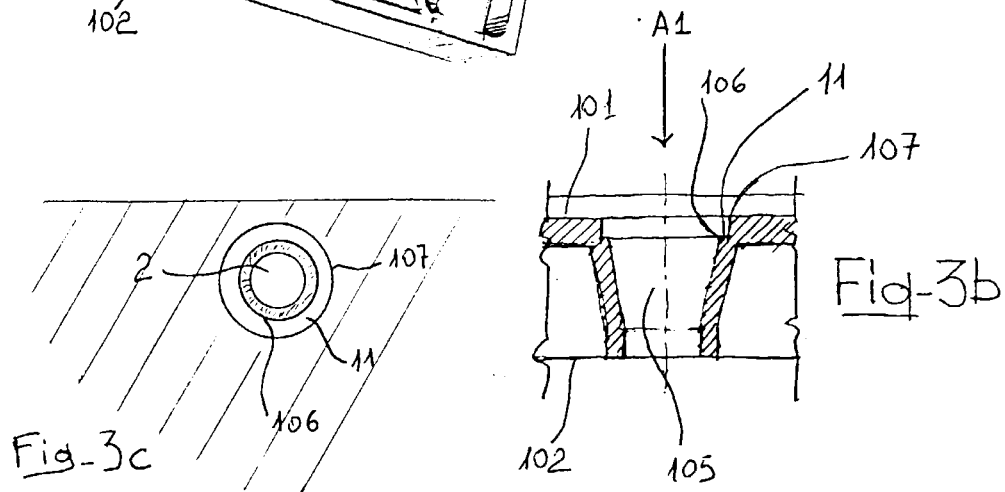
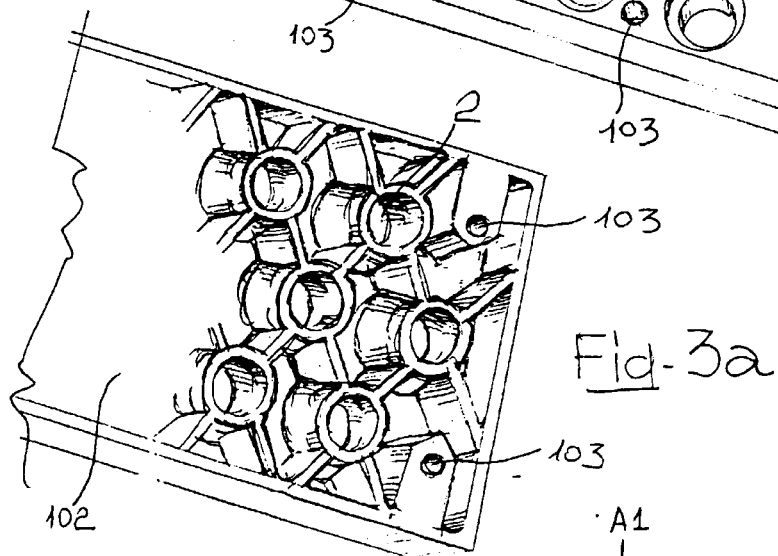
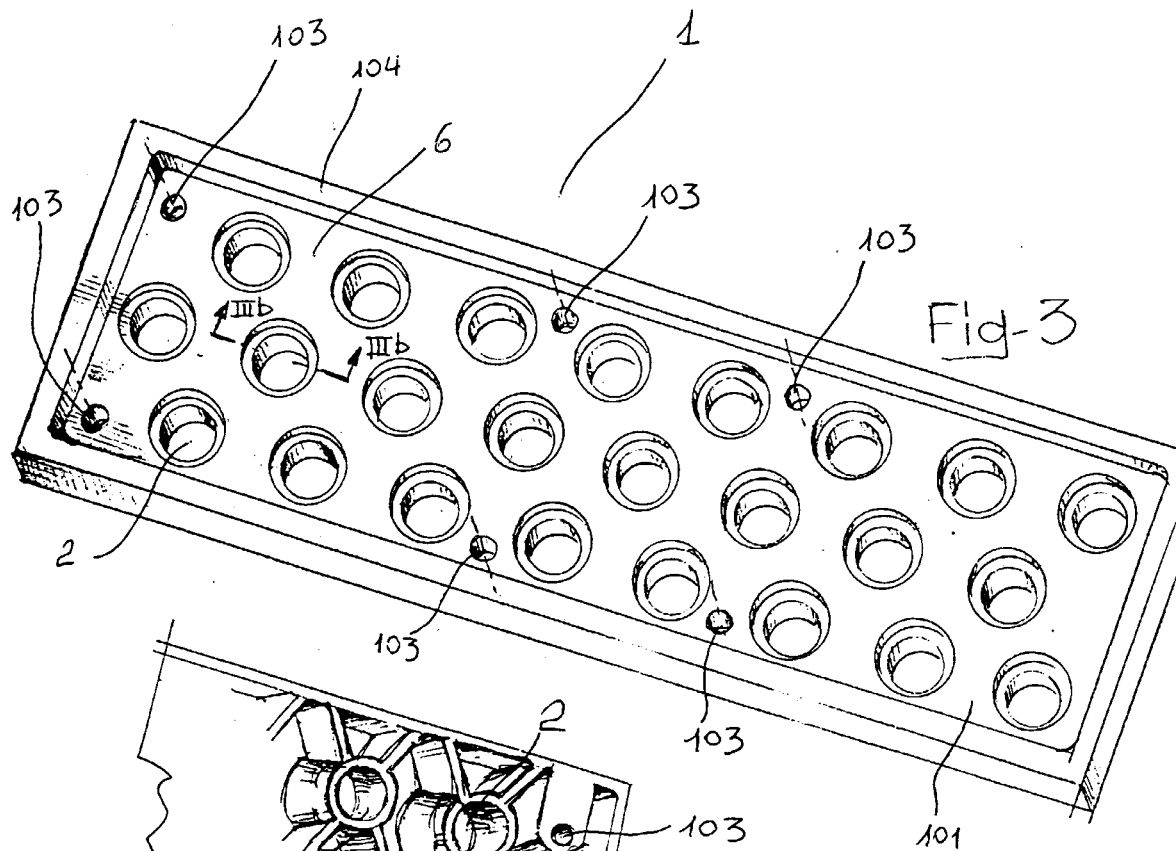
2. Device for a heat-exchange terminal with a finned assembly according to Claim 1, in which the said head (1) is made of heat-resistant plastics material, or die-cast aluminium.
3. Device for a heat-exchange terminal with a finned assembly according to Claim 2, in which the plastics material is polypropylene, or polypropylene with glass fibre inclusions.
4. Device for a heat-exchange terminal with a finned assembly according to Claim 1, in which the said ducts (4) have a depth which corresponds substantially to the diameter of the inner channel (105) of the holes (2) of the head (1).
5. Device for a heat-exchange terminal with a finned assembly according to Claim 1, comprising sealing means to be interposed between the head (1) and the end cover (3).
6. Device for a heat-exchange terminal with a finned assembly according to Claim 5, in which the said sealing means are a pre-moulded rubber seal (5).
7. Device for a heat-exchange terminal with a finned assembly according to Claim 6, in which the head (1) comprises seal seats (6, 11), and in which the said sealing means are shaped such as to be accommodated in the said seal seats (6, 11).
8. Device for a heat-exchange terminal with a finned assembly according to Claim 1, in which the said end cover (3) comprises a seal-pressure plate (7) which has a plurality of holes (8) positioned such as to put each duct (4) of the end cover (3) into fluid communication with two or more holes (2) of the head (1).
9. Device for a heat-exchange terminal with a finned assembly according to Claim 8, in which the holes (8) of the seal-pressure plate (7) are positioned in correspondence with the holes (2) of the head (1).
10. Device for a heat-exchange terminal with a finned assembly according to Claim 8, in which the said sealing means comprise a flat seal (9), which has a plurality of holes (10) positioned in correspondence with the holes (2) of the head (1).
11. Device for a heat-exchange terminal with a finned

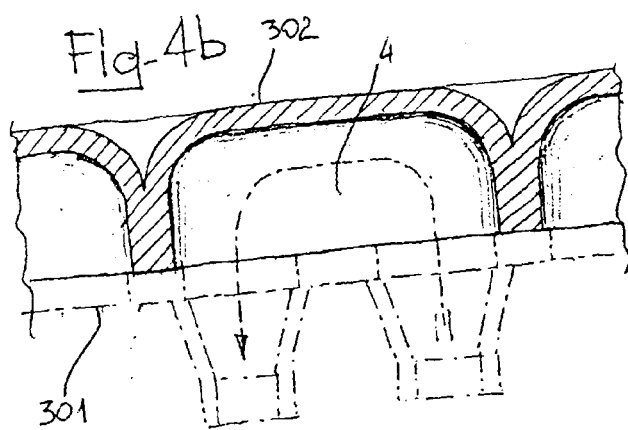
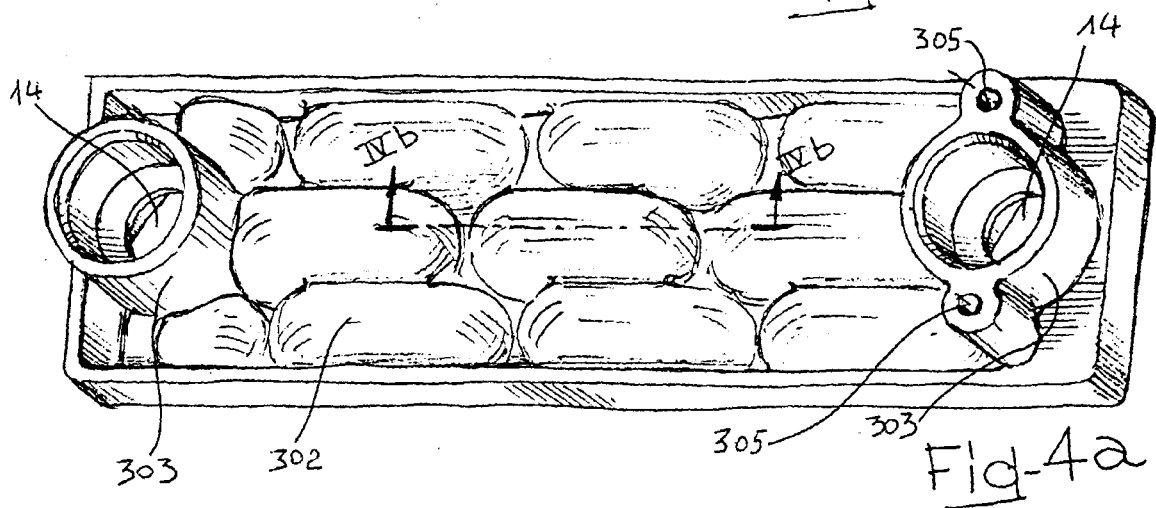
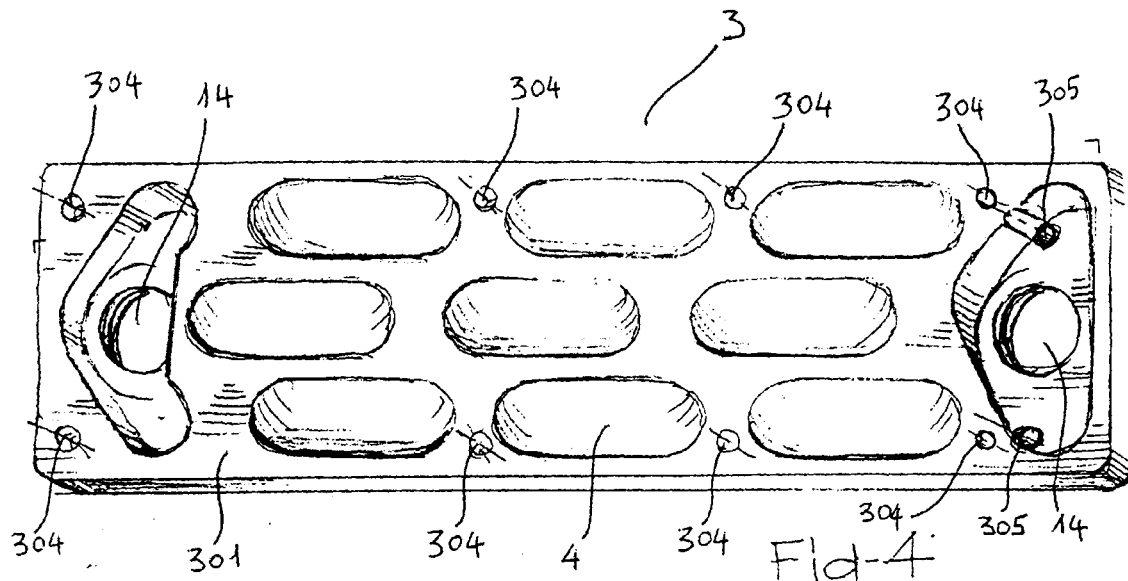
assembly according to Claim 10, in which the said flat seal (9) is accommodated in a seal seat (6) of the head (1).

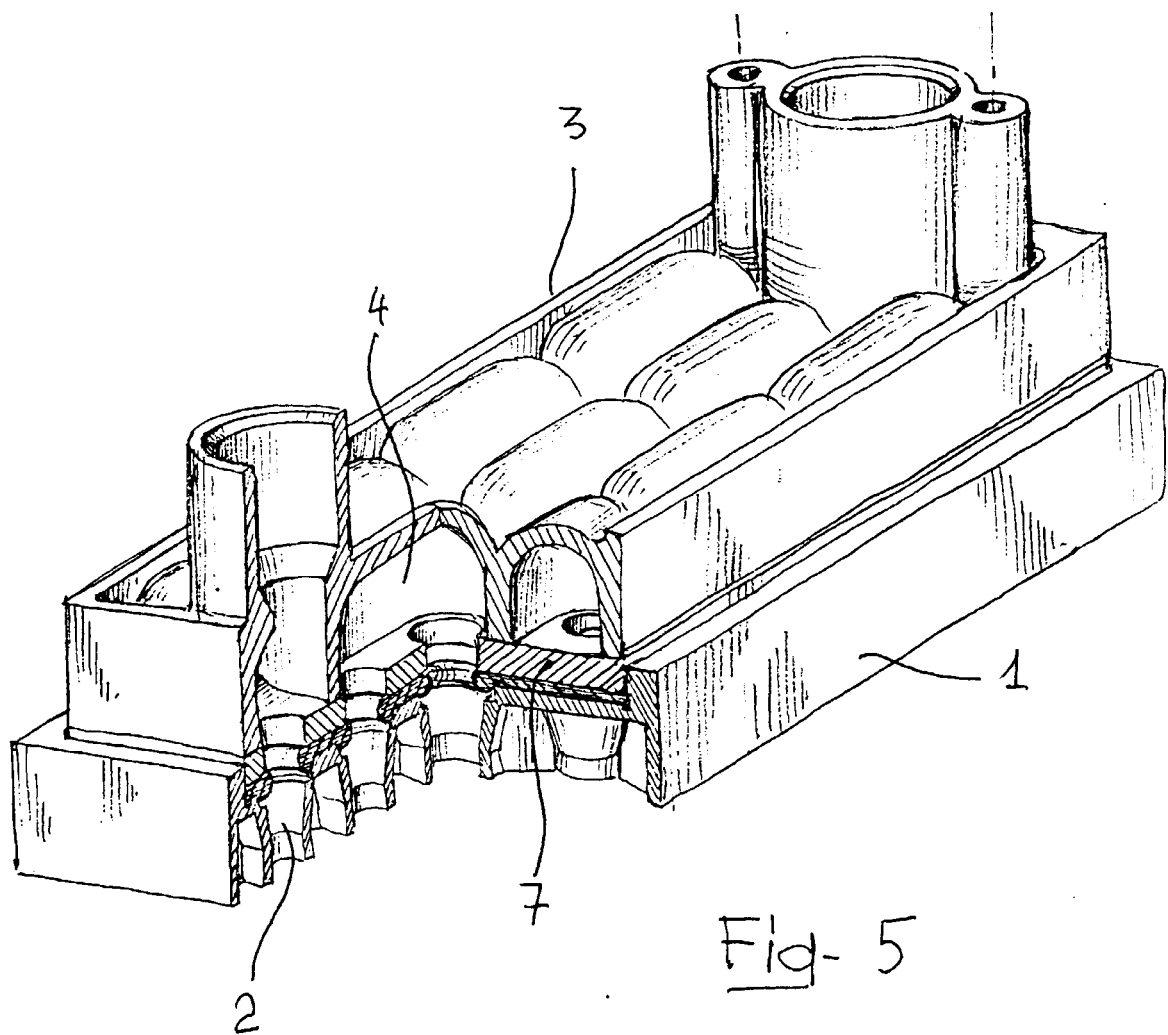
12. Device for a heat-exchange terminal with a finned assembly according to Claim 10, in which, in the position of the holes (10), the flat seal (9) comprises projecting edges (13), which can be accommodated in complementary seal seats (11, 12) of the holes (2) of the head (1), and of the holes (8) of the seal-pressure plate (7). 5 10
13. Device for a heat-exchange terminal with a finned assembly according to Claim 8, in which the said seal-pressure plate (7) is heat sealed to the end cover (3). 15
14. Device for a heat-exchange terminal with a finned assembly according to Claim 1 or Claim 8, in which the end cover (3) comprises apertures (14) for intake and/or output of fluids, each of these apertures (14) being in fluid communication with one or more tubes of the tube bundle. 20
15. Device for a heat-exchange terminal with a finned assembly according to Claim 14, in which each of the said fluid intake and/or output apertures (14) is in fluid communication with two or with three tubes of the tube bundle. 25 30
16. Heat exchanger with a finned assembly, characterized in that at least one end of the tube bundle is connected to a device for a terminal according to any one of Claims 1 to 15. 35
17. Heat exchanger with a finned assembly according to Claim 16, in which the tube bundle consists of U-shaped tubes. 40 45 50 55











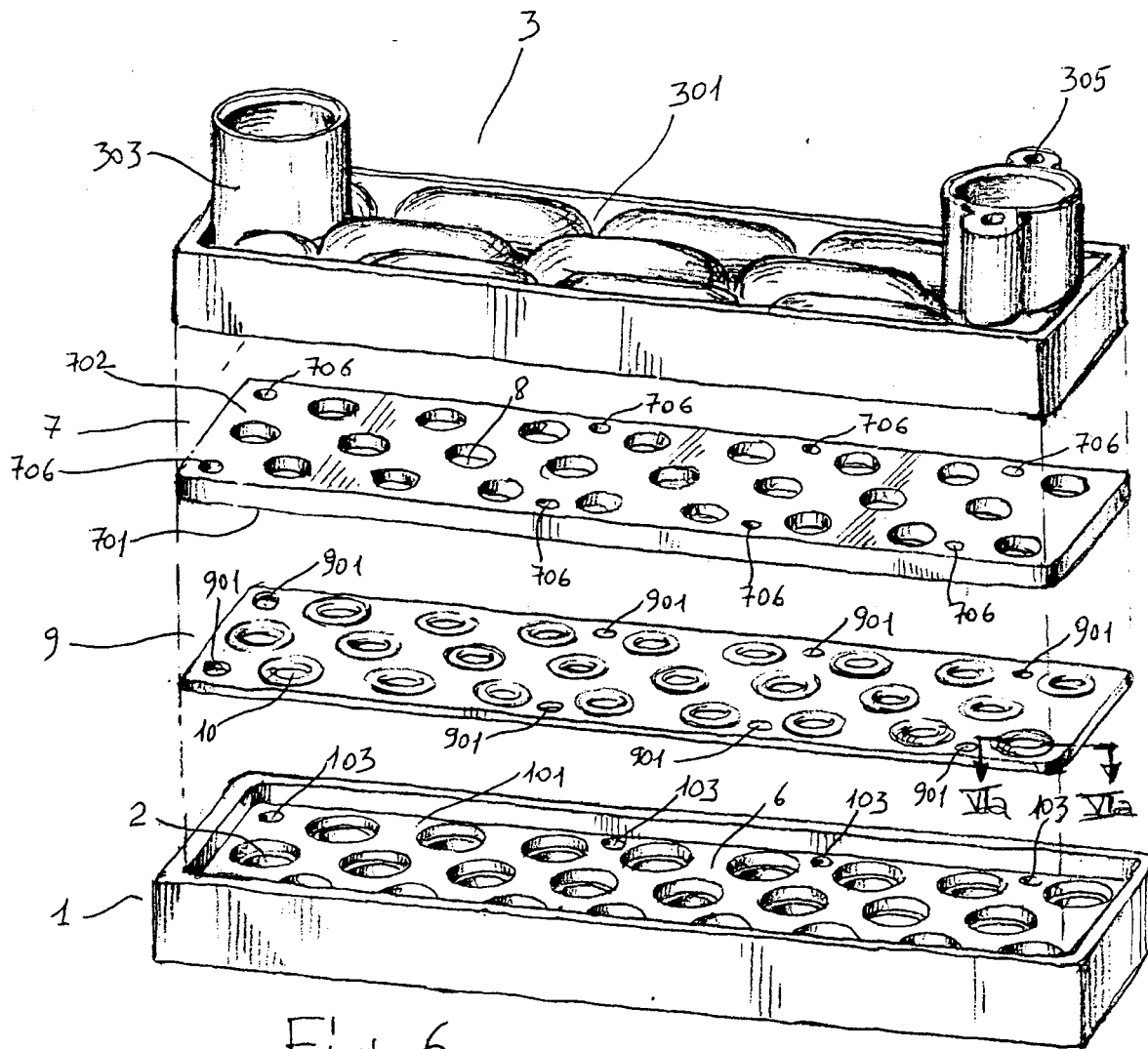


Fig-6

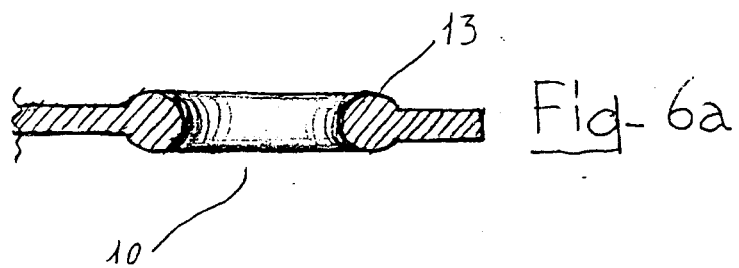
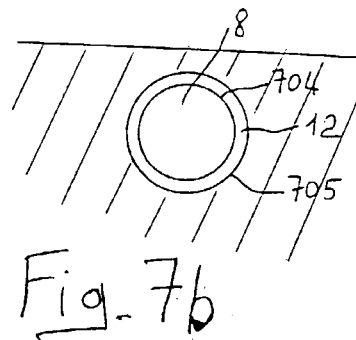
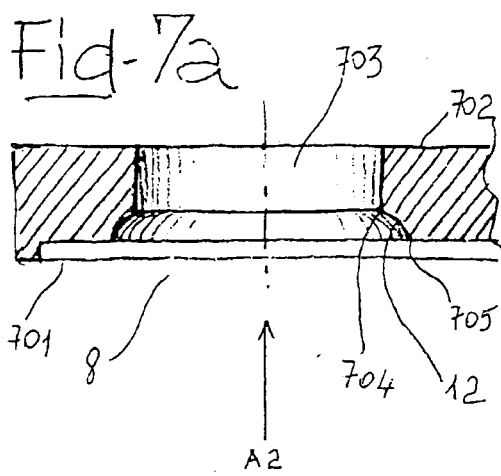
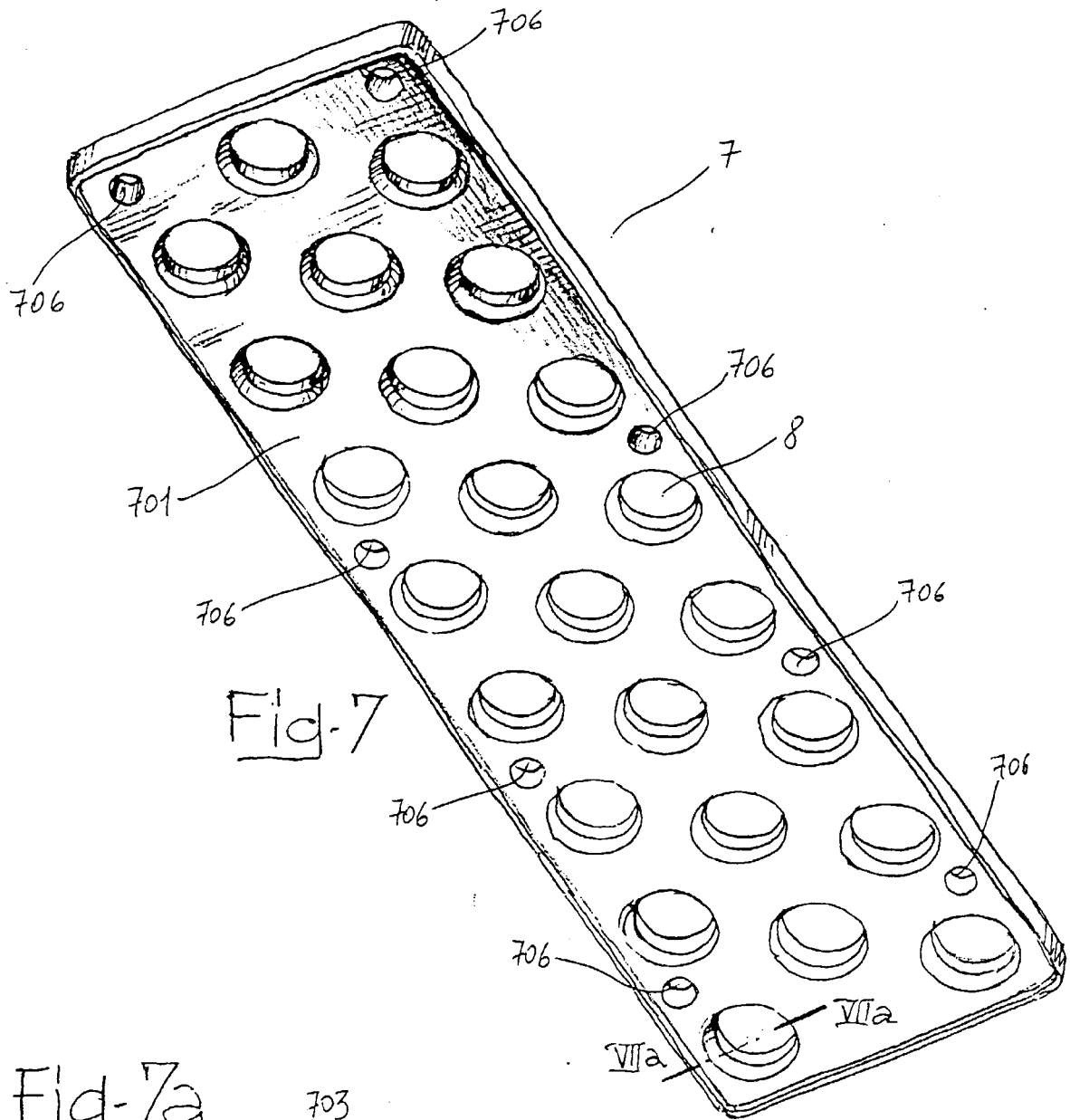


Fig-6a





European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 98 83 0418

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The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 9 December 1998	Examiner Beltzung, F
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03/82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82