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(71) Applicant: **Sanden Corporation**
**Isesaki-shi,**
**Gunma 372-8502 (JP)**

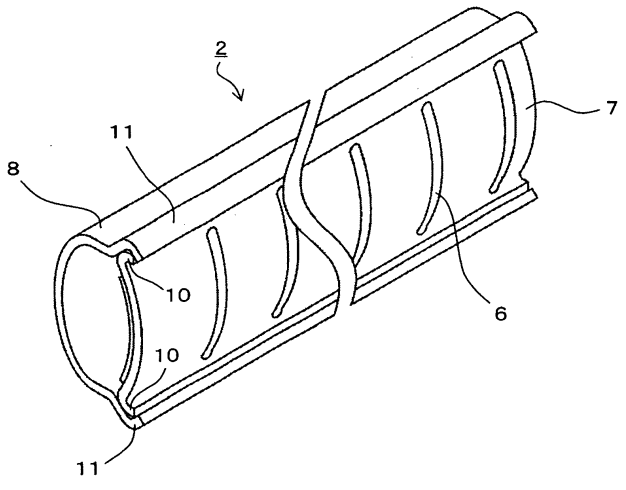
(72) Inventors:
- **Itou, Masahiro**
  **Isesaki-shi**
  **Gunma 372-8502 (JP)**
- **Shinagawa, Kazuhiro**
  **Isesaki-shi**
  **Gunma 372-8502 (JP)**
- **Yabata, Toshihiko**
  **Isesaki-shi**
  **Gunma 372-8502 (JP)**
- **Iino, Yusuke**
  **Isesaki-shi**
  **Gunma 372-8502 (JP)**

(74) Representative: **Feldmeier, Jürgen et al**
**Prüfer & Partner GbR**
**Patentanwälte**
**Sohnckestrasse 12**
**81479 München (DE)**

## (54) Heat exchanger

(57) In a heat exchanger (1) having tubes (3) and a header (2), the header (2) comprises a header plate (7) and a header cover (8), the closed structure in cross section of the header (2) is formed by inserting the header plate (7) into the header cover (8) and fitting both side edge portions (10) of the header plate (7) into the header cover (8), and at least one side edge portion (11) of the header cover (8) has a surface inclined relatively to the insertion direction of the header plate (7) for guiding a side edge portion (10) of the header plate (7). In this header structure, an apparatus for manufacturing the header can be simplified, a defect of a product such as a failure of brazing can be prevented, the operation for assembling the header plate (7) and the header cover (8) before brazing can be facilitated, and the design freedom can be increased.

**FIG. 2**

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## Description

**[0001]** The present invention relates to a heat exchanger, and specifically, to a structure of a header portion of the heat exchanger.

**[0002]** As a structure of a header portion of a conventional heat exchanger, as shown in Fig. 5, known is a structure wherein a header 104 is formed by assembling a tank forming member 101 (a header cover) formed as an arc shape in cross section and a tube attaching member 103 (a header plate) connected with tubes 102 (for example, Japanese Patent 3,026,754). In this header 104, although tank forming member 101 and tube attaching member 103 are brazed to each other, a plurality of holding parts 105 bent and projected are provided along a longitudinal direction of header 104 (a direction perpendicular to a sheet plane of Fig. 5) and temporary fixing is employed by caulking these holding parts 105.

**[0003]** Further, another structure of a header portion of a conventional heat exchanger, also known is a structure wherein a connecting portion is formed by bending a side edge portion of a header plate, an enlarged width portion is formed on a side edge portion of a header cover so as to cover the connecting portion of the header plate from outside, and the side edge portion of the header plate and the side edge portion of the header cover are connected to each other by brazing (for example, JP-A-2005-233570).

**[0004]** In the structure disclosed in Japanese Patent 3,026,754, however, a process and an apparatus for caulking the holding parts are required, and because a distortion is liable to occur around the caulking portion of the header when the holding parts are caulked, such a distortion may cause a failure of brazing. Further, because the holding parts are required to be disposed at a predetermined interval in the longitudinal direction of the header, the total length of the header cannot be designed freely, and because the design must be carried out in consideration of the positions of the holding parts, design freedom may be decreased. Furthermore, in order to ensure a good property of brazing, the connecting portions of the header plate and the header cover must be formed at a high accuracy, and therefore, additional molds are required. In particular, additional molds for providing holding parts are required.

**[0005]** On the other hand, in the structure disclosed in JP-A-2005-233570, although it is necessary to insert the header plate into the header cover when the side edge portion of the header plate and the side edge portion of the header cover are fitted to each other before brazing, the header structure is formed as a structure which is relatively difficult to easily carry out this insertion, and consequently, a high accuracy is required for each fitting portion. Further, when the enlarged width portion with a predetermined shape is formed by bending on the side edge portion of the header cover, totally three times of bending operation are required, and for the bending operation, a large number of molds are required.

**[0006]** Accordingly, it would be desirable to provide a header structure of a heat exchanger in which an apparatus for manufacturing can be simplified including a decrease of the number of molds, a defect of a product such as a failure of brazing can be prevented from occurring, the operation for assembling a header plate and a header cover before brazing can be facilitated, and the design freedom can be increased.

**[0007]** A heat exchanger according to the present invention has tubes in which heat exchange medium flows and a header to which ends of the tubes are connected, and is characterized in that the header comprises a header plate to which ends of the tubes are connected and a header cover which opens in one direction, a closed structure in cross section of the header is formed by inserting the header plate from an opening portion of the header cover into the header cover and fitting both side edge portions of the header plate into the header cover, and at least one side edge portion of the header cover has a surface inclined relatively to an insertion direction of the header plate for guiding a side edge portion of the header plate.

**[0008]** In the above-described fitting of the header plate into the header cover, a relative fitting operation may be carried out. Namely, as an actual operation, the header plate may be moved relatively to the header cover in the direction for inserting and fitting the header plate into the header cover, or the header cover may be moved relatively to the header plate so that the header cover is fitted onto the outside of both side edge portions of the header plate.

**[0009]** In such a structure of the heat exchanger according to the present invention, since the side edge portion of the header cover has an inclined surface for guiding the side edge portion of the header plate, the side edge portion of the header plate is smoothly guided along the inclined surface when the header plate is inserted into the header cover, and the side edge portion of the header plate is fitted into a predetermined position of the header cover easily and accurately. Namely, the side edge portion of the header cover, in particular, the inclined surface provided thereon, is used as a guide for assembling the header plate and the header cover. In this guiding, as described later, the side edge portion of the header cover is slightly deformed elastically so that the distance between both side edge portions of the header cover is slightly enlarged, after the side edge portion of the header plate is fitted into a predetermined position of the header cover, the side edge portion of the header cover which has been elastically deformed is returned to its original position, and the desired, predetermined formation for fitting the side edge portion of the header plate into the header cover can be maintained by utilizing the elastically returning force. In such a fitting operation, a predetermined formation for the fitting becomes possible by merely inserting the header plate into the header cover, and a so-called one touch fitting becomes possible. Therefore, it becomes possible to keep

the predetermined header structure before brazing without employing the caulking operation by using holding parts as in the conventional structure, and it becomes possible to simplify the header structure, to simplify the apparatus for manufacturing by making caulking operation unnecessary, and to prevent occurrence of defects of products due to caulking operation. Further, because it is not necessary to provide holding parts at a predetermined interval, restriction on design can be greatly relieved, and the design freedom can be greatly increased.

**[0010]** In this heat exchanger according to the present invention, the inclined surface can be formed by cutting a side edge of the header cover obliquely relatively to the insertion direction of the header plate. Alternatively, or together with the cutting, the inclined surface can be formed by bending the side edge portion of the header cover obliquely relatively to the insertion direction of the header plate. In any case, the inclined surface for guiding the side edge portion of the header plate can be very easily formed on the side edge portion of the header cover.

**[0011]** Further, it is preferred that a space for fitting of the side edge portion of the header plate is formed on the side edge portion of the header cover by bending the side edge portion of the header cover. By forming the space with a predetermined shape, the side edge portion of the header plate may be stored in a predetermined position at a high accuracy merely by being inserted into the header cover, it may be easily fitted at a predetermined formation relatively to the side edge portion of the header cover, and the predetermined fitting formation may be maintained stably. Further, by forming the space with a predetermined shape, even if a small gap exists in the space after the fitting, the gap can be easily filled by brazing, and a good brazing condition between the header cover and the header plate can be easily ensured.

**[0012]** In a case where such a space for fitting is formed, for example, a structure may be employed wherein a bent portion on the side edge portion of the header cover has a first bending portion bent toward outside of the header cover and a second bending portion bent toward inside of the header cover. Because such a bending structure can be achieved by totally two times of bending operations, the number of bending operations can be decreased as compared with the structure in the aforementioned JP-A-2005-233570 which requires totally three times of bending operations, and the number of molds for bending operations can also be decreased. As the bending direction of each bending portion, for example, the first bending portion may be bent obliquely relatively to the insertion direction of the header plate, and the second bending portion may be bent in a direction returned from the bending direction of the first bending portion, obliquely relatively to the insertion direction of the header plate. By such a bending operation, the above-described desirable space for fitting may be easily formed.

**[0013]** With respect to the header plate side, a fitting portion on the side edge portion of the header plate fitted into the header cover may be formed easily at a desirable form by bending the side edge portion of the header plate. In this case, it is preferred that the fitting portion on the side edge portion of the header plate fitted into the header cover is formed by bending the side edge portion of the header plate toward a side of a heat exchanger core. If bent toward a side opposite the heat exchanger core, it becomes difficult to guide the side edge portion of the header plate along the inclined surface of the header cover side. Further, if a bending portion for forming this fitting portion is formed in a curved shape, easier guiding along the inclined surface may be achieved, and easier operation for the insertion and the fitting of the header plate may be achieved.

**[0014]** After both side edge portions of the header plate are fitted into the header cover at a predetermined formation before brazing as described above, the header plate and the header cover are brazed to each other, and a header having a predetermined sealability can be completed. This brazing may be carried out at a time in a furnace, together with the heat exchanger core portion.

**[0015]** Such a heat exchanger according to the present invention is suitable, in particular, as a condenser. Further, it is suitable as a heat exchanger used for an air conditioning system for vehicles, which requires efficiency for mass production and cost down greatly.

**[0016]** Thus, in the heat exchanger according to the present invention, the assembling of the header plate and the header cover can be facilitated, the header structure before brazing can be kept in a predetermined form even if caulking operation due to holding parts is not carried out as in the conventional structure, the number of bending processes (the number of molds) for processing the header cover can be decreased, and the design freedom can be increased.

**[0017]** Further objects, features, and advantages of the present invention will be understood from the following detailed description of preferred embodiments of the present invention with reference to the accompanying figures.

**[0018]** Embodiments of the invention now are described with reference to the accompanying figures, which are given by way of example only, and are not intended to limit the present invention.

**[0019]** Fig. 1 is a perspective view of a heat exchanger according to an embodiment of the present invention.

**[0020]** Fig. 2 is an enlarged, partial, perspective view of a header of the heat exchanger depicted in Fig. 1.

**[0021]** Figs. 3A and 3B are cross-sectional views showing a process for manufacturing the header depicted in Fig. 2.

**[0022]** Fig. 4 is a cross-sectional view of a header of a heat exchanger according to another embodiment of the present invention.

**[0023]** Fig. 5 is a cross-sectional view of a header of a conventional heat exchanger.

[Explanation of symbols]

**[0024]**

1: heat exchanger
2, 23: header
3: tube
6: tube insertion hole
7, 21: header plate
8, 22: header cover
9: opening portion
10, 25: side edge portion of header plate
11, 24: side edge portion of header cover
12: insertion direction of header plate
13, 26: inclined surface
14: space
15: first bending portion
16: second bending portion

**[0025]** Hereinafter, desirable embodiments of the present invention will be explained referring to the drawings.

**[0026]** Figs. 1-3 depict a heat exchanger according to an embodiment of the present invention, and show a heat exchanger, for example, used for an air conditioning system for vehicles, for example, as a condenser. In Fig. 1, heat exchanger 1 has a pair of headers 2, a plurality of tubes 3 which are arranged in parallel to each other between headers 2 so as to communicate between headers 2 and in which heat exchange medium (for example, refrigerant) flows, and an inlet block 4 for introducing the heat exchange medium into heat exchanger 1 and an outlet block 5 for discharging the heat exchange medium from heat exchanger 1 which are connected to one of headers 2.

**[0027]** In this embodiment, header 2 is constructed as depicted in Figs. 2 and 3. Header 2 has a header plate 7 which has a plurality of tube insertion holes 6 into that the ends of tubes 3 are inserted and to which the ends of tubes 3 are connected by inserting the ends of tubes 3 into tube insertion holes 6, and a header cover 8 which opens in one direction (at one side toward header plate 7). Header 2 having a closed structure in cross section is formed by relatively inserting header plate 7 into header cover 8 from an opening portion 9 of header cover 8 and fitting both side edge portions 10 of header plate 7 into both side edge portions I 1 of header cover 8. On at least one side edge portion 11 of header cover 8 (in this embodiment, on both side edge portions 11), a surface 13 inclined relatively to an insertion direction 12 of header plate 7 is formed for guiding side edge portion 10 of header plate 7.

**[0028]** In this embodiment, inclined surface 13 is formed by bending side edge portion 11 of header cover 8 obliquely relatively to insertion direction 12 of header plate 7. Further, a space 14 having a predetermined shape for fitting of side edge portion 10 of header plate 7 is formed on side edge portion 11 of header cover 8 by bending side edge portion 11 of header cover 8, and into this space 14, side edge portion 10 of header plate 7 is fitted at a predetermined formation, as shown in Figs. 3A and 3B. Because side edge portion 10 of header plate 7 is fitted into space 14 with a predetermined shape at a predetermined formation, even if a small gap exists, the gap is easily filled by brazing, a good brazing condition between header cover 8 and header plate 7 is easily ensured. This space 14 with a predetermined shape is formed by bending side edge portion 11 of header cover 8 two times, the side edge portion 11 has a first bending portion 15 bent toward outside of header cover 8 and a second bending portion 16 bent toward inside of header cover 8. First bending portion 15 is bent obliquely relatively to insertion direction 12 of header plate 7, and second bending portion 16 is bent in a direction returned from the bending direction of first bending portion 15, obliquely relatively to insertion direction 12 of header plate 7. This bending structure can be achieved by totally two times of bending operations, and therefore, the number of bending operations can be decreased as compared with the structure in the aforementioned JP-A-2005-233570 which requires totally three times of bending operations, and the number of molds for bending operations can also be decreased.

**[0029]** Side edge portion 10 of header plate 7 is formed in a curved shape by being bent toward the side of the heat exchanger core (the side of tubes 3 in Fig. 1), and the tip side portion of the curved shape forms the portion fitted into the above-described space 14 of header cover 8. By bending side edge portion 10 of header plate 7 toward the side of the heat exchanger core so as to form a curved shape convex toward the side of header cover 8, the guiding by inclined surface 13 is carried out more easily and more smoothly.

**[0030]** By providing inclined surface 13 for guiding side edge portion 10 of header plate 7 on side edge portion 11 of header cover 8, particularly, on the tip of side edge portion 11, as described above, when header plate 7 is inserted into header cover 8, side edge portion 10 of header plate 7 is guided smoothly along inclined surface 13, and the guided side edge portion 10 of header plate 7 is fitted into a predetermined position of header cover 8, that is, into space 14, easily and accurately. At the time of this guiding, as shown in Figs. 3A and 3B, the distance between both side edge portions 11 of header cover 8 is slightly enlarged elastically by the guided side edge portions 10 of header plate 7, after side edge portions 10 of header plate 7 are fitted into spaces 14, the side edge portions 11 of header cover 8 enlarged in distance are elastically returned to the original positions so as to hold side edge portions 10 of header plate 7 in spaces 14, and by utilizing this elastic returning force, each side edge portion 10 of header plate 7 can be maintained at a predetermined fitting condition. Therefore, even if the caulking operation by using holding parts, as in the conventional structure, is not carried out, it becomes possible to keep the predetermined header structure before brazing.

As a result, it becomes possible to simplify the header structure, to simplify the apparatus for manufacturing by making caulking operation unnecessary, and to prevent occurrence of defects of products due to caulking operation. Further, because it is made unnecessary to provide holding parts at a predetermined interval, restriction on design in the case of providing the holding parts disappears, and the design freedom can be greatly increased.

**[0031]** Header plate 7 and header cover 8 assembled into a predetermined formation as shown in Fig. 2 is brazed, for example, at a time in a furnace together with the heat exchanger core portion, and header 2 having a predetermined closed structure in cross section is completed.

**[0032]** Although inclined surface 13 is formed by bending side edge portion 11 of header cover 8 in the above-described embodiment, alternatively, or together with the bending, the inclined surface may be formed by cutting the side edge of header cover 8 obliquely relatively to insertion direction 12 of header plate 7. For example, as depicted in Fig. 4, in header 23 having header plate 21 and header cover 22, an inclined surface 26 for guiding side edge portion 25 of header plate 21 can be formed by cutting the tip (namely, the side edge) of side edge portion 24 of header cover 22. Also in such a structure, the same operation and advantage as those in the aforementioned embodiment can be obtained.

**[0033]** The structure of the heat exchanger according to the present invention can be applied to any heat exchanger having a header comprising a header plate and a header cover, and particularly, it is suitable as a condenser and as a heat exchanger used in an air conditioning system for vehicles.

## Claims

1. A heat exchanger having tubes in which heat exchange medium flows and a header to which ends of said tubes are connected, **characterized in that** said header comprises a header plate to which ends of said tubes are connected and a header cover which opens in one direction, a closed structure in cross section of said header is formed by inserting said header plate from an opening portion of said header cover into said header cover and fitting both side edge portions of said header plate into said header cover, and at least one side edge portion of said header cover has a surface inclined relatively to an insertion direction of said header plate for guiding a side edge portion of said header plate.

2. The heat exchanger according to claim 1, wherein said inclined surface is formed by cutting a side edge of said header cover obliquely relatively to said insertion direction of said header plate.

3. The heat exchanger according to claim 1 or 2, wherein said inclined surface is formed by bending said side edge portion of said header cover obliquely relatively to said insertion direction of said header plate.

4. The heat exchanger according to any preceding claim, wherein a space for fitting of said side edge portion of said header plate is formed on said side edge portion of said header cover by bending said side edge portion of said header cover.

5. The heat exchanger according to claim 4, wherein a bent portion on said side edge portion of said header cover has a first bending portion bent toward outside of said header cover and a second bending portion bent toward inside of said header cover.

6. The heat exchanger according to claim 5, wherein said first bending portion is bent obliquely relatively to said insertion direction of said header plate.

7. The heat exchanger according to claim 5 or 6, wherein said second bending portion is bent obliquely relatively to said insertion direction of said header plate.

8. The heat exchanger according to any preceding claim, wherein a fitting portion on said side edge portion of said header plate fitted into said header cover is formed by bending said side edge portion of said header plate.

9. The heat exchanger according to claim 8, wherein said fitting portion on said side edge portion of said header plate fitted into said header cover is formed by bending said side edge portion of said header plate toward a side of a heat exchanger core.

10. The heat exchanger according to claim 8 or 9, wherein a bending portion for forming said fitting portion is formed in a curved shape.

11. The heat exchanger according to any preceding claim, wherein said header plate and said header cover are brazed to each other after both side edge portions of said header plate are fitted into said header cover.

12. The heat exchanger according to any preceding claim, wherein said heat exchanger is a condenser.

13. The heat exchanger according to any preceding claim, wherein said heat exchanger is a heat exchanger used for an air conditioning system for vehicles.

FIG. 1

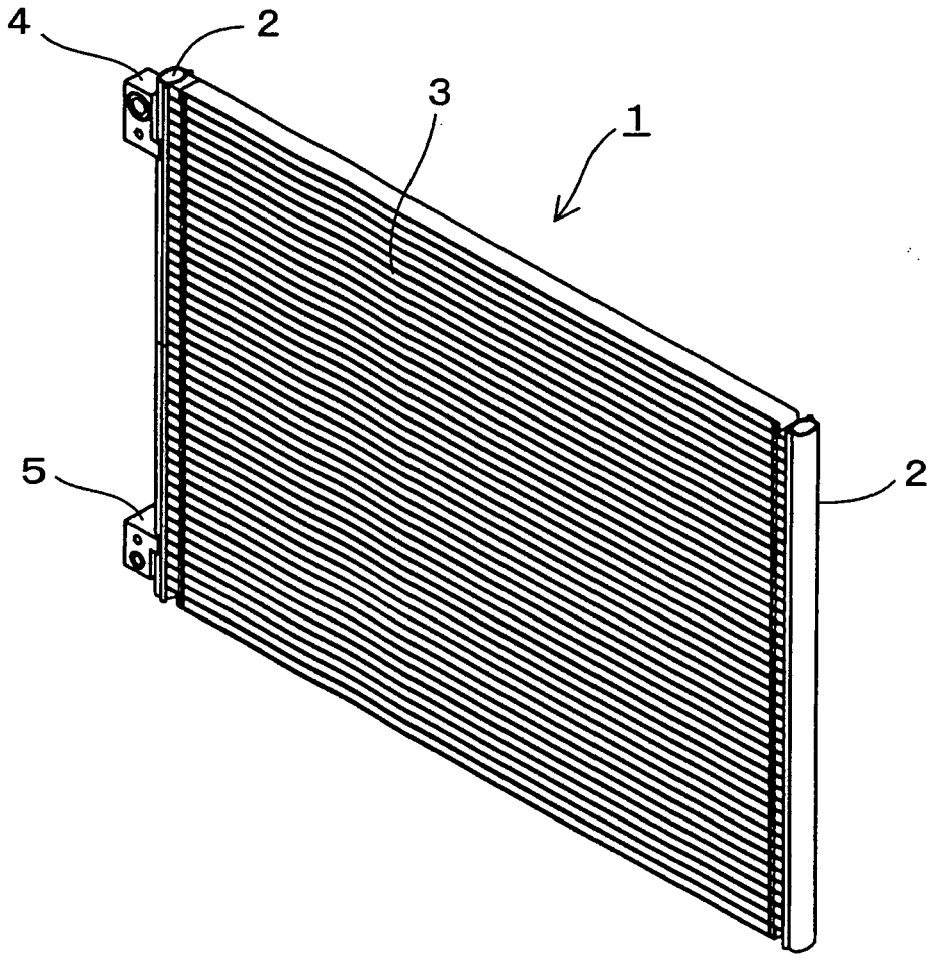


FIG. 2

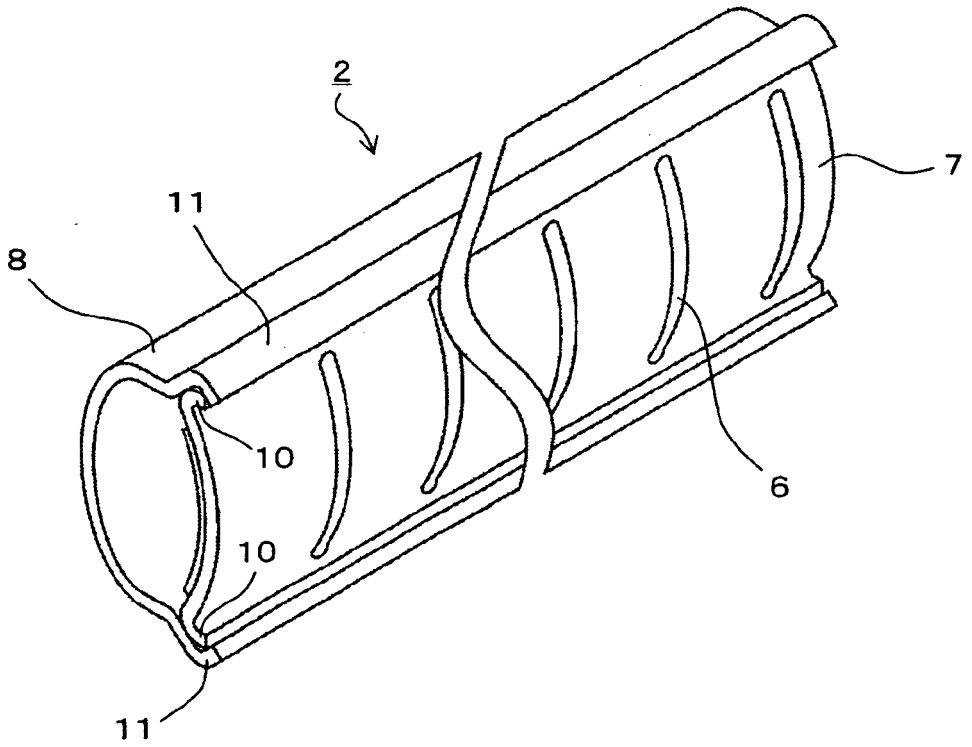



FIG. 3A

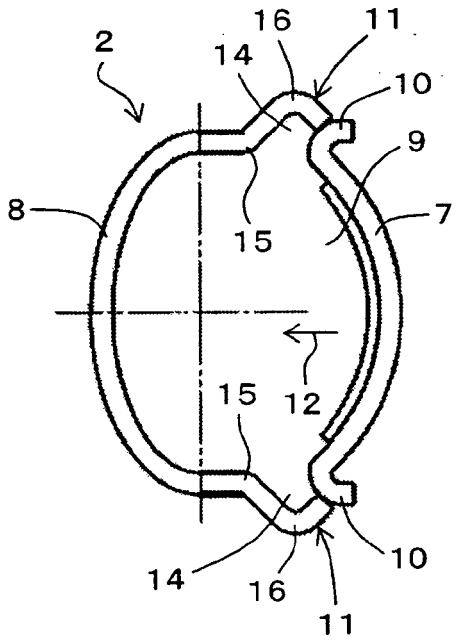



FIG. 3B

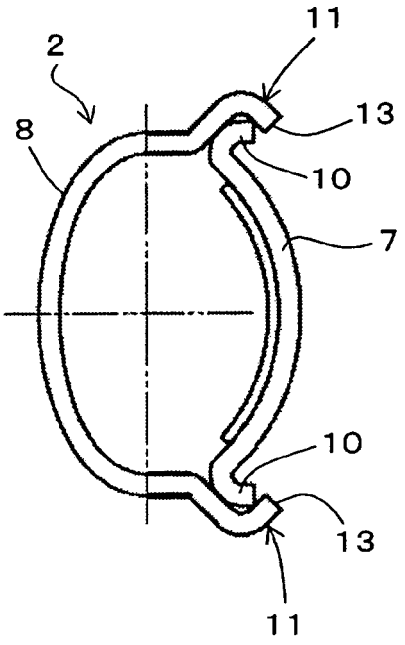


FIG. 4

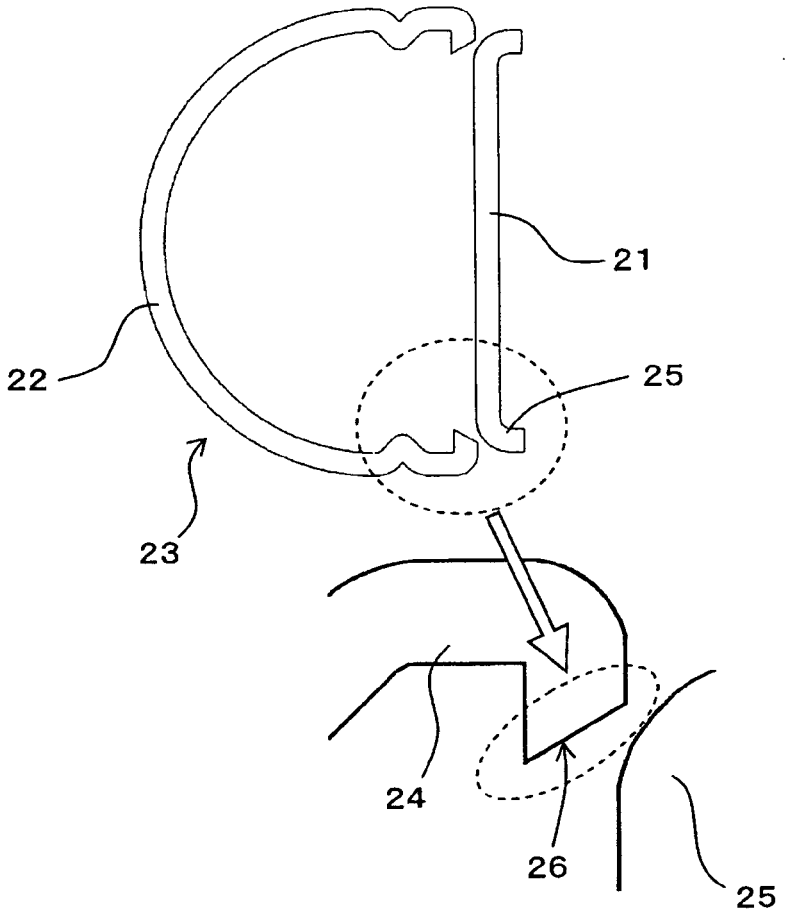
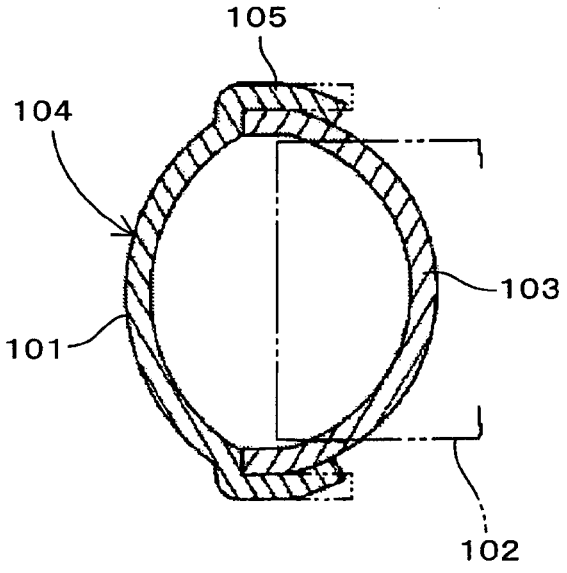



FIG. 5



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Application Number
EP 08 00 3605

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TECHNICAL FIELDS SEARCHED (IPC)

F28F

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
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CATEGORY OF CITED DOCUMENTS

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