(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 541 956 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
15.06.2005 Bulletin 2005/24

(51) Int Cl.[7]: **F28F 9/02**

(21) Application number: **04292911.7**

(22) Date of filing: **08.12.2004**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR LV MK YU

(30) Priority: **08.12.2003 JP 2003409278**

(71) Applicant: **Calsonic Kansei Corporation**
Tokyo 164-8602 (JP)

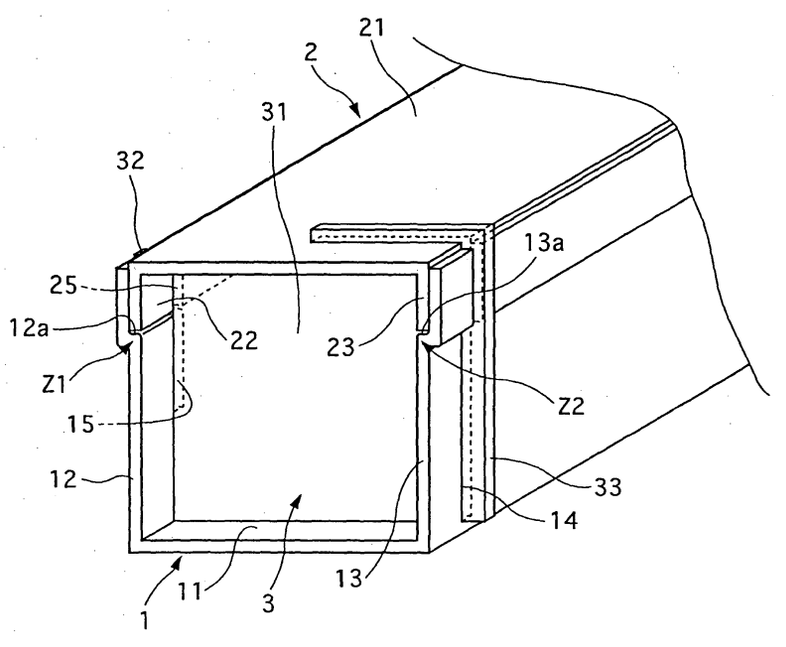
(72) Inventors:
- **Nakajima, Shiro, Calsonic Kansei Corporation**
  Nakano-ku Tokyo 164-8602 (JP)
- **Kimura, Satoshi, Calsonic Kansei Corporation**
  Nakano-ku Tokyo 164-8602 (JP)
- **Okura, Hiroyuki, Calsonic Kansei Corporation**
  Nakano-ku Tokyo 164-8602 (JP)
- **Tochigi, Kenji, Calsonic Kansei Corporation**
  Nakano-ku Tokyo 164-8602 (JP)
- **Miyasaka, Shinichi,**
  Calsonic Kansei Corporation
  Nakano-ku Tokyo 164-8602 (JP)

(74) Representative: **Intès, Didier Gérard André et al**
Cabinet Beau de Loménie,
158, rue de l'Université
75340 Paris Cedex 07 (FR)

(54) Tank structure

(57) In a tank structure of a heat exchanger, at least one of a first tank member (1) and a second tank member (2) which have substantially U-shaped cross sections has, in coupling portions thereof, bent portions (Z1, Z2) made of bent plate materials. The first tank member (1) and the second tank member (2) have first slits to fourth slits (14, 24, 15, 25) that are formed at least in the bent portions (Z1, Z2) near end faces. End face closing members (3) have main portions (31) capable of closing end-face openings formed by the first and second tank members (1, 2), and the main portions (31) have on outer peripheries thereof integrally formed first lock portions (33) and second lock portions (32) inserted in and locked by the slits (14, 24, 15, 25) to cover gaps formed between the first and second tank members (1, 2).

F I G. 2



EP 1 541 956 A2

Description

[0001] The present invention relates to a tank structure formed of a plurality of members that are assembled and fixed together by brazing or others.

[0002] Japanese Patent Application Laid-open No. Hei 11-118386 discloses a conventional tank structure of a heat exchanger of this type. For example, as shown in FIG. 7A, FIG. 7B, FIG. 8, and FIG. 9, this tank structure is composed of: a first tank member 101 with a substantially U-shaped cross section having a bottom to which a tube is attached; a second tank member 102 with a substantially U-shaped cross section to close a longitudinal opening of the first tank member 101; and end-face closing members 103 to close end-face openings that are formed on both end sides in the longitudinal direction of a cylinder formed by the first and second tank members 101 and 102. The first tank member 101 has at edge portions of its sidewalls 101a and 101a outwardly projecting catch steps 101b that are in contact with sidewalls 102a and 102a of the second tank member 102 so as to and catch edge faces of them. Bent portions Z and Z bent to have a substantially crank-shaped cross section are formed from the catch steps 101b to extend along outer surfaces of the sidewall portions 102a and 102a of the second tank member 102, thereby covering these sidewall portions 102a and 102a.

[0003] The end-face closing members 103 have main portions 103a capable of closing the end-face openings formed by the first and second tank members 101 and 102, and each of the main portions 103a has protruding lock portions 103b and 103b formed integrally therewith on center portions of upper and lower edges of the main portion 103a. The lock portions 103b and 103b are inserted in fitting holes 101c and 102c formed in bottoms of the first and second tank members 101 and 102 so as to be locked to them.

[0004] The tank structure of the heat exchanger of this type, however, has the following problems ascribable to the structure such that the bent portions (bent portions Z and Z with a substantially crank-shaped cross section) made of plate materials are formed in one of the tank members (sidewalls 101a and 101a) constituting coupling portions between the first and second tank members 101 and 102, and the first and second tank members 101 and 102 are assembled together with edge faces of the other tank member (sidewalls 102a and 102a) being in contact with the bent portions Z and Z.

[0005] Specifically, as shown in FIG. 7B, one of the tank members 101 and 102 is bent, for example the first tank member 101, rounded portions R1, R2 are formed in an inner corner and an outer corner of each bent portion Z of the tank member 101, respectively. Consequently, when sidewalls (102a and 102a) of the other member, for example the second tank member 102, are brought into contact with the bent portions Z and Z of the first tank member 101, corners of the other tank member 102 are in contact with and are caught by the rounded portions R1, and gaps h and h are formed between the both tank members 101 and 102. This may possibly result in poor brazing properties of these sidewall portions 101a and 102a. In particular, the gaps h, which can not be closed by the end-face closing members 103 and 103, will be a cause of leakage from end faces. In order to avoid this leakage, it requires careful inspection of the brazing portions, resulting in a high cost.

[0006] In order to solve the problems, it is an object of the present invention to provide a tank structure capable of compensating poor brazing properties even in a tank having tank members, one of which is made of plate member formed with bent portions to couple the other tank member.

[0007] According to the invention, provided is a tank structure comprising: a first tank member that has a substantially U-shaped cross section having a bottom portion and first and second sidewall portions connecting with both sides of the bottom portion; a second tank member that has a substantially U-shaped cross section having third and fourth sidewall portions to partially overlap with the first and second sidewall portions of the first tank member respectively and a bottom portion to close a longitudinal opening of the first tank member when the first and second tank members are assembled and fixed together with each other; and end-face closing members closing end-face openings on both end sides of the first and second tank members in a longitudinal direction of a cylinder formed by the first and second tank members, wherein the first tank member is made of plate materials and bent to be formed on the first and second sidewall portions thereof with bent portions to receive the third and fourth sidewall portions of the second tank member respectively; the first tank member having slits that are formed on the first and second sidewall portions to extend from end portions of the first and second sidewall portions toward the bottom portion through the bent portions; and said end-face closing members having main portions capable of closing the end-face openings of the first and second tank members, and the main portions being formed on outer peripheries thereof integrally with lock portions that are inserted in and locked by the slits of the first tank member so as to contact with the bent portions of said first tank member and the third and fourth sidewall portions of said second tank member and cover gaps formed between the bent portions and end portions of the third and fourth sidewall portions.

[0008] Preferably, the second tank member has slits to overlap at least partially with the slits of said first tank member and extend from the end portions of the third and fourth sidewall portions toward the bottom portion of the second tank member, and the lock portions are inserted in and locked by the slits of the first and second tank members.

[0009] Preferably, the slits of the first tank member are made up of first slits formed to extend from the bottom

portion thereof to end portion of the first sidewall portion of the first tank member through the bent portion thereof and second slits formed to extend from an intermediate position to the end portion of the second sidewall portion through the bent portion thereof, and the slits of the second tank member being made up of third slits formed to extend from the end portion of the third sidewall portion thereof to an intermediate portion of the bottom portion of the second tank member and fourth slits formed to extend from the end portion of the fourth sidewall portion to the bottom portion of said second tank member, the third and fourth slits overlapping at least partially with the first and second slits of the first tank member when the first and second tank members are assembled with each other.

[0010] Preferably, the slits of the first tank member are made up of fifth slits formed to extend from end portions to intermediate positions of the first and second sidewall portions through the bent portions thereof, and the slits of the second tank member is made up of sixth slits formed to extend from the end portions of the third and fourth sidewall portions toward the bottom portion of the second tank member, the six slits overlapping at least partially with the fifth slits of the first tank member when the first and second tank members are assembled with each other.

[0011] Preferably, the slits of the first tank member are made up of fifth slits formed to extend from the end portions to intermediate positions of the first and second sidewall portions of the first tank member through the bent portions thereof, and the slits of the second tank member is made up with third slits formed to extend from the end portions to intermediate positions of the third and fourth sidewall portions of the second member, the third slits overlapping partially with the fifth slits of the first tank member when the first and second tank members are assembled with each other.

[0012] Preferably, the slits of the first tank member are made up of fifth slits formed to extend from the end portions to intermediate positions of the first and second sidewall portions of the first tank member through the bent portions thereof, and the slits of the second tank member is made up of third slits formed to extend from the end portion to an intermediate position of the third sidewall portions of the second member and fourth slits formed to extend from end portions of the fourth sidewall portion to the bottom portion of the second tank member, the third and fourth slits overlapping at least partially with the fifth slits of the first tank member when the first and second tank members are assembled with each other.

[0013] In this tank structure, the first tank member has the slits that are formed on at least the bent portions to extend along the sidewall portions, and the lock portions integrally formed on the outer peripheries of the end-face closing members are inserted in and locked by the slits to cover the gaps between the first and second tank members. Therefore, even when the gaps are formed in the coupling portions between the first tank member and the second tank member, the lock portions of the end-face closing members block these gaps to avoid a leakage from the gaps.

[0014] This structure can produce an effect that the end-face closing members can compensate poor brazing properties even when bent portions made of plate materials are formed in coupling portions between the first and second tank members of the tank.

[0015] The objects, features and advantages of the present invention will become apparent as the description proceeds when taken in conjunction with the accompanying drawings, in which:

FIG. 1A is a front view showing a tank structure of a heat exchanger of a first embodiment according to the present invention, and FIG. 1B is an enlarged view of the E1 portion in FIG. 1B;

FIG. 2 is a perspective view showing the tank structure of the heat exchanger of the first embodiment shown in FIG. 1A;

FIG. 3 is an exploded view showing a first and second tank members and a end-face closing member of the tank structure of the heat exchanger of the first embodiment shown in FIGS. 1A and 2;

FIG. 4A is a front view showing a tank structure of a heat exchanger of a second embodiment according to the present invention, and FIG. 4B is an enlarged view of the E2 portion in FIG. 4A;

FIG. 5 is a perspective view showing the tank structure of the heat exchanger of the second embodiment shown in FIG. 4A;

FIG. 6 is an exploded view showing a first and second tank members and a end-face closing member of the tank structure of the heat exchanger of the second embodiment shown in FIGS. 4A and 5;

FIG. 7A is a front view showing a conventional tank structure of a heat exchanger according to a prior art, and FIG. 7B is an enlarged view of the E3 portion in FIG. 4A;

FIG. 8 is a perspective view showing the conventional tank structure of the heat exchanger of the second embodiment shown in FIG. 7A; and

FIG. 9 is an exploded view showing a first and second tank members and a end-face closing member of the conventional tank structure of the heat exchanger shown in FIGS. 7A and 8.

[0016] Hereinafter, embodiments of the present invention will be described with reference to the accom-

panying drawings.

[0017] First, a tank structure of a first embodiment will be described with reference to the accompanying drawings of FIGS. 1A to 3. In this embodiment, the tank structure is used for a heat exchanger of a motor vehicle.

[0018] As shown in FIG. 1A, FIG. 1B, FIG. 2, and FIG. 3, the tank structure of the heat exchanger of the first embodiment includes: a first tank member 1 that has a substantially U-shaped cross section having sidewall portions 12 and 13 and bottom portion 11 to which a tube is attached; a second tank member 2 that has a substantially U-shaped cross section having sidewall portions 22 and 23 and a bottom portion 21 to close a longitudinal opening of the first tank member 1; and two end-face closing members 3 to close end-face openings of a cylinder formed by the first tank member 1 and the second tank member 2.

[0019] Note that one of the sidewall portions 12 and 13 of the first tank member 1 corresponds to a first sidewall portion of the present invention, while the other one of them corresponds to a second sidewall portion of the present invention. One of the sidewall portions 22 and 23 of the second tank member 2 corresponds to a third sidewall portion of the present invention, while the other one of them corresponds to a fourth sidewall portion of the present invention

[0020] As shown in FIGS. 1A and 1B, the first tank member 1 has catch steps 12a and 13a formed in edge portions of the sidewall portions 12 and 13 thereof to project outwardly, and the catch steps 12a and 13a are in contact with and catch edge portions of the sidewall portions 22 and 23 bending from the bottom portion 21 of the second member 2. Bent portions Z1 and Z2 bent are formed to have a substantially crank-shaped cross section from the catch steps 12a and 13a to extend along outer faces of the sidewall portions 22 and 23 of the second tank member 2, thereby covering these portions 22 and 23.

[0021] The first tank member 1 also has first slits 14 that are formed in the sidewall portions 12 and 13 from the bottom portion 11 of the first tank member 1 to extend along the entire length of the sidewall portion 13 in a direction along the sidewall portions 12 and 13. The second tank member 2 has third slits 24 that partially overlap with the first slits 14 and extend along the sidewall portion 23 up to the intermediate position of the bottom portion 21.

[0022] The first tank member 1 also has second slits 15 that are formed on the other sidewall portion 12 near the end-face openings to extend in the direction of the sidewall portions 12 and 13 from the bottom portion 11 to positions beyond at least the catch step 12a. The second tank member 2 has fourth slits 25 that partially overlap with the second slits 15 and extend along the entire length of the other sidewall portion 22.

[0023] The end-face closing members 3 have main portions 31 capable of closing the end-face openings formed by the first and second tank members 1 and 2. The main portions 31 are integrally formed with first lock portions 33 and second lock portions 32 on outer peripheries thereof, the first lock portions 33 being inserted in and locked by the first and third slits 14 and 24, and the second lock portions 32 being inserted in and locked by the second and fourth slits 15 and 25.

[0024] Next, operations and advantages of the tank structure according to the first embodiment will be described.

[0025] The tank of the first embodiment structured as described above is assembled by following the procedure described below.

[0026] In a first step, as shown in FIG. 3, the first tank member 1, the second tank member 2, and the end-face closing members 3 are prepared after their formation. Then, the second tank member 2 is put on the first tank member 1 to close the longitudinal opening of the first tank member 1. Specifically, in this state, the edge faces of the sidewall portions 22 and 23 of the second tank member 2 are in contact with and are caught by the catch steps 12a and 13a of the sidewall portions 12 and 13 of the first tank member 1, as shown in FIG. 1A, FIG. 1B, and FIG. 2. In this case, in the bent portions Z1 and Z2 made of plate materials, the gaps h and h are formed at both sides between the catch steps 12a and 13a and the edges of the sidewall portions 22 and 23, where poor brazing may happen to be caused. This poor brazing comes from the reason that rounded portions R1 and R2 are formed in an inner corner and an outer corner of each of the bent portions Z1 and Z2 in order to form the catch steps 12a and 13a in a bent shape, and consequently, when the edge faces of the sidewall portions 22 and 23 are brought in contact with the catch steps 12a and 13a, outer corners of the edge faces are in contact with and are caught by the rounded portions R1. However, a subsequent second step will solve the problem of leakage and the like from the gaps h and h caused by poor brazing properties of these portions.

[0027] In the second step, as shown in FIG. 3, the end-face closing members 3 are inserted from the first and third slits 14 and 24 formed in the sidewall portions 13 and 23 of the first and second tank members 1 and 2, respectively. As shown in FIG. 1A and FIG. 2, when the second lock portions 32 of the end-face closing members 3 are inserted in and locked by the third and fourth slits 15 and 25 and the end openings of the tank are closed by the main portions 31 of the end-face closing members 3, the assembly is completed, and at this time, the first lock portions 33 of the end-face closing members 3 are inserted in and locked by the first and third slits 14 and 24.

[0028] Even when the gaps h and h are formed between the catch steps 12a and 13a and sidewall portions 22 and 23 in the bent portions Z1 and Z2, the gaps h and h are thus blocked by the second and first lock portions 32 and 33 which are inserted in and locked by the third and fourth slits 15 and 25 which are formed in the bent portions Z1 and the first and third slits 14 and 24

which are formed in the bent portions Z2.

[0029] In a third step, in the assembly state shown in FIG. 1A and FIG. 2, the assembled structure is brazed in a heat treating furnace, so that contact portions of the members are fixedly coupled by brazing fillers. In particular, end portions of the first and third slits 14 and 24 and the first lock portions 33 in the bent portions Z2 and end portions of the second and fourth slits 15 and 25 and the second lock portions 32 in the bent portions Z1 are integrally joined by the brazing, so that the gaps h and h are completely closed.

[0030] Consequently, even when the bent portions Z1 and Z2 made of plate materials are formed in coupling portions between the first and second tank members 1 and 2 of the tank, the end-face closing members 3 can compensate poor brazing properties. This can produce an effect of preventing leakage from the gaps h and h of the first and second tank members 1 and 2.

[0031] Next, a tank structure of a second embodiment according to the present invention will be described with the accompanying drawings of FIGS. 4A to 6. In this embodiment, the same reference numerals or symbols are used to designate the same components as those in the first embodiment, and only what are different will be described.

[0032] As shown in FIG. 4A to FIG. 6, in a tank structure of a heat exchanger of the second embodiment, a first tank member 1 has fifth slits 16 and 17 that are formed on sidewall portions 13 and 12 thereof and extend from positions of the sidewall portions 13 and 12 nearer to its bottom portion 11 compared to catch steps 13a and 12a in a direction along the sidewall portions 13 and 12 to reach positions beyond at least the catch steps 13a and 12a. Sixth slits 26 and 27 continuing from the fifth slits 16 and 17 respectively are formed along the entire lengths of sidewall portions 23, 22 of the second tank members 2.

[0033] End face closing members 3 have main portions 21 capable of closing end openings formed by the first tank member 1 and the second tank member 2. The main portions 21 is integrally formed with first lock portions 33 and second lock portions 32 on outer peripheries thereof, the first lock portions 33 being inserted in and locked by the fifth and sixth slits 16 and 26 and the second lock portions 32 being inserted in and locked by the fifth and sixth slits 17 and 27.

[0034] Next, operations and advantages of the tank structure according to the second embodiment will be described.

[0035] The tank structure of the second embodiment described above is assembled by following the procedure described below.

[0036] In a first step, as shown in FIG. 6, the first tank member 1, the second tank member 2, and the end-face closing members 3 are prepared after their formation. Then, the end-face closing members 3 are inserted from an opening side of the first tank member 1. As shown in FIG. 4A, FIG. 4B, and Fig. 5, in the state in which the first and second lock portions 33 and 32 of the end-face closing members 3 are inserted in and locked by the fifth slits 16 and 17 respectively and the main portions 31 of the end-face closing members 3 close the end-face openings of the first tank member 1, the first and second lock portions 33 and 32 are inserted in and locked by the fifth slits 16 and 17.

[0037] In a second step, as shown in FIG. 6, the second tank member 2 is put on the first tank member 1 to close the longitudinal opening of the first tank member 1. At this time, as shown in FIG. 4A and FIG. 5, the first and second lock portions 33 and 32 of the end-face closing members 3 are inserted in and locked by the sixth slits 26 and 27 formed in the sidewall portions 23 and 22.

[0038] In this state, as shown in FIG. 4A and FIG. 5, edges of the sidewall portions 22 and 23 of the second tank member 2 are in contact with and are caught by catch steps 12a and 13a of the sidewall portions 12 and 13 of the first tank member 1. However, as described above, rounded portions R1, R2 are made of plate materials to have an inner corner and an outer corner of each of bent portions Z1 and Z2 in order to form the catch steps 12a and 13a in a bent shape, and consequently, when the edge faces of the sidewall portions 22 and 23 are brought in contact with the catch steps 12a and 13a, outer corners of the edge faces are in contact with and are caught by the rounded portions R1. Accordingly, gaps h and h are formed between the catch steps 12a and 13a and the edge faces of the sidewall portions 22 and 23 in the bent portions Z1 and Z2, where poor brazing may happen to be caused. However, a subsequent second step will solve the problem of leakage and the like from the gaps h and h caused by the poor brazing properties of these brazing portions.

[0039] Even when the gaps h and h are formed between the catch steps 12a and 13a and the sidewall portions 22 and 23 in the bent portions Z1 and Z2, the gaps h and h are thus blocked by the first and second lock portions 33 and 32 inserted in and locked by the fifth slits 16 and 17 and the sixth slits 26 and 27 formed in the bent portions Z2 and Z1.

[0040] In a third step, in the assembly state shown in FIG. 4A and FIG. 5, the assembled structure is brazed in a heat treating furnace, so that contact portions of the members are fixedly coupled by brazing fillers. In particular, end portions of the fifth and sixth slits 16 and 26 and the first lock portions 33 in the bent portions Z2 and end portions of the fifth and sixth slits 17 and 27 and the second lock portions 32 in the bent portions Z1 are integrally joined by the brazing, so that the gaps h and h are completely closed.

[0041] Consequently, even when the bent portions Z1 and Z2 made of plate materials are formed in coupling portions between the first and second tank members 1 and 2 of the tank, the end-face closing members 3 can compensate poor brazing properties. This can produce an effect of preventing leakage from the gaps h and h of the first and second tank members 1 and 2.

[0042] Moreover, compared with the tank structure of the first embodiment, the tank structure of the second embodiment can provide additional effects of more reliable sealability since the number of slits is smaller and of improved assemblability since the end-face closing members 3 and the second tank member 2 are assembled to the first tank member 1 in the same direction.

[0043] Hitherto, the embodiments of the present invention have been described, but the present invention is not limited to the embodiments described above. All design changes and so on not departing from the spirit of the present invention are to be included in the present invention.

[0044] For example, though the embodiments have described examples where the bent portions in one of the first and second tank members, which are in contact with the edge faces of the other tank member, have a substantially crank-shaped cross section, but the present invention is applicable to a case where a bent portion has a cross section in a different shape such as in a substantially L-shape or in a substantial U-shape.

[0045] The bent portions may be bent inwardly to receive end portions of the sidewall portions of the second tank member, although they are bent outwardly in the above described embodiments. In this case, the slits may be formed only on the sidewall portion of the first tank member, so that the slits of the second tank member can be eliminated.

[0046] The bent portions may be formed only on the second tank member 1 instead of the first tank member 2, or both on the first and second tank members 1 and 2.

[0047] The first and second tank members 1 and 2 are assembled and fixed by brazing, while they may be fixed by welding, or by both brazing and welding. In the latter case, the gaps between the first and second tank members 1 and 2 are preferably covered by brazing.

[0048] The above described tank structures are not limited for a heat exchanger of a motor vehicle. It can be used for other tank structure, such as oil tank and others.

[0049] Note that a first tank member of the present invention corresponds to one of the first tank member 1 and the second tank member 2 of the embodiments, while a second tank member corresponds to the other one of them. The words "first" and "second" in the embodiments are used only for convenient.

[0050] The first, second, and fifth slits of the first tank members and the third, fourth, and sixth slits of the second tank members of the embodiments may be formed by other combinations of them. This can bring the tank to be built for purpose: a low cost, easy manufacturing, and its strength, and others.

[0051] For example, the slits of the first tank member may be made up of fifth slits formed to extend from the end portions to intermediate positions of the first and second sidewall portions of the first tank member through the bent portions thereof, and the slits of the second tank member may be made up with seventh slits, similar to the third slits, formed to extend from the end portions to intermediate positions of the third and fourth sidewall portions of the second member so that the seventh slits overlap partially with the fifth slits of the first tank member when the first and second tank members are assembled with each other.

[0052] In addition, the slits of the first tank member is made up of fifth slits formed to extend from the end portions to intermediate positions of the first and second sidewall portions of the first tank member through the bent portions thereof, and the slits of the second tank member being made up of eighth slits, similar to the third slips, formed to extend from the end portion to an intermediate position of the third sidewall portions of the second member and ninth slits, similar to the fourth slits, formed to extend from end portions of the fourth sidewall portion to the bottom portion of the second tank member so that the eighth and ninth slits overlap at least partially with the fifth slits of the first tank member when the first and second tank members are assembled with each other.

Claims

1. A tank structure comprising:

a first tank member (1) that has a substantially U-shaped cross section having a bottom portion (11) and first and second sidewall portions (12, 13) connecting with both sides of the bottom portion (11);

a second tank member (2) that has a substantially U-shaped cross section having third and fourth sidewall portions (22, 23), to partially overlap with the first and second sidewall portions (13, 12) of said first tank member (1) respectively, and a bottom portion (21) to close a longitudinal opening of said first tank member (1) when said first and second tank members (1, 2) are assembled and fixed together with each other; and

end-face closing members (3, 3) closing end-face openings on both end sides of said first and second tank members (1, 2) in a longitudinal direction of a cylinder formed by said first and second tank members (1, 2),

characterized in that said first tank member (1) is made of plate materials and bent to be formed on the first and second sidewall portions (13, 12) thereof with bent portions (Z1, Z2) to receive the third and fourth sidewall portions (22, 23) of said second tank member (2) respectively;
said first tank member (1) having slits (14, 15; 16, 17) that are formed on the first and second sidewall

portions (12, 13, 22, 23) to extend from end portions of the first and second sidewall portions (13, 12) toward the bottom portion (11) through the bent portions (Z1, Z2); and

said end-face closing members (3, 3) having main portions (31, 31) capable of closing the end-face openings of said first and second tank members (1, 2), and the main portions (31, 31) being formed, on outer peripheries thereof, integrally with lock portions (32, 33) that are inserted in and locked by the slits (14, 15; 16, 17) of said first tank member (1) so as to contact with the bent portions (Z1, Z2) of said first tank member (1) and the third and fourth sidewall portions (22, 23) of said second tank member (2) and cover gaps (h, h) formed between the bent portions (Z1, Z2) and end portions of the third and fourth sidewall portions (22, 23).

2. The tank structure according to claim 1,
wherein said second tank member (2) has slits (24, 25; 26, 27) to overlap at least partially with the slits (14, 15; 16, 17) of said first tank member (1) and extend from the end portions of the third and fourth sidewall portions (22, 23) toward the bottom portion (21) of said second tank member (2), the lock portions (32, 33) being inserted in and locked by the slits (14, 15, 16, 17, 24, 25, 26, 27) of said first and second tank members (2).

3. The tank structure according to claim 2,
wherein the slits (14, 15) of said first tank member (1) are made up of first slits (14) formed to extend from the bottom portion (11) thereof to end portion of the first sidewall portion (13) of said first tank member (1) through the bent portion (Z2) thereof and second slits (15) formed to extend from an intermediate position to the end portion of the second sidewall portion (12) through the bent portion (Z1) thereof, and

the slits (24, 25) of said second tank member (2) being made up of third slits (24) formed to extend from the end portion of the third sidewall portion (23) thereof to an intermediate portion of the bottom portion (21) of said second tank member (2) and fourth slits (25) formed to extend from the end portion of the fourth sidewall portion (22) to the bottom portion (21) of said second tank member (2), the third and fourth slits (24, 25) overlapping at least partially with the first and second slits (14, 15) of said first tank member (1) when said first and second tank members(1, 2) are assembled with each other.

4. The tank structure according to claim 2,
wherein the slits (16, 17) of said first tank member (1) are made up of fifth slits (16, 17) formed to extend from end portions to intermediate positions of the first and second sidewall portions (13, 12) through the bent portions (Z1, Z2) thereof, and

the slits (26, 27) of said second tank member (2) being made up of sixth slits (26, 27) formed to extend from the end portions of the third and fourth sidewall portions (23, 22) toward the bottom portion (21) of said second tank member (2), the six slits (26, 27) overlapping at least partially with the fifth slits (16, 17) of said first tank member (1) when said first and second tank members (1, 2) are assembled with each other.

5. The tank structure according to claim 2,
wherein the slits (16, 17) of said first tank member (1) are made up of fifth slits (16, 17) formed to extend from the end portions to intermediate positions of the first and second sidewall portions (13, 12) of said first tank member (1) through the bent portions (Z1, Z2) thereof, and

the slits of said second tank member (2) being made up with seventh slits formed to extend from the end portions to intermediate positions of the third and fourth sidewall portions (23, 22) of said second member (2), the seventh slits overlapping partially with the fifth slits (16, 17) of said first tank member 81) when said first and second tank members (1, 2) are assembled with each other.

6. The tank structure according to claim 2,
wherein the slits (16, 17) of said first tank member (1) are made up of fifth slits (16, 17) formed to extend from the end portions to intermediate positions of the first and second sidewall portions (13, 12) of said first tank member (1) through the bent portions (Z1, Z2) thereof, and

the slits of said second tank member (2) being made up of eighth slits (24) formed to extend from the end portion to an intermediate position of the third sidewall portions (23) of said second member (2) and ninth slits formed to extend from end portions of the fourth sidewall portion (22) to the bottom portion (21) of said second tank member (2), the eighth and ninth slits overlapping at least partially with the fifth slits (16, 17) of said first tank member (1) when said first and second tank members (1, 2) are assembled with each other.

FIG. 1A

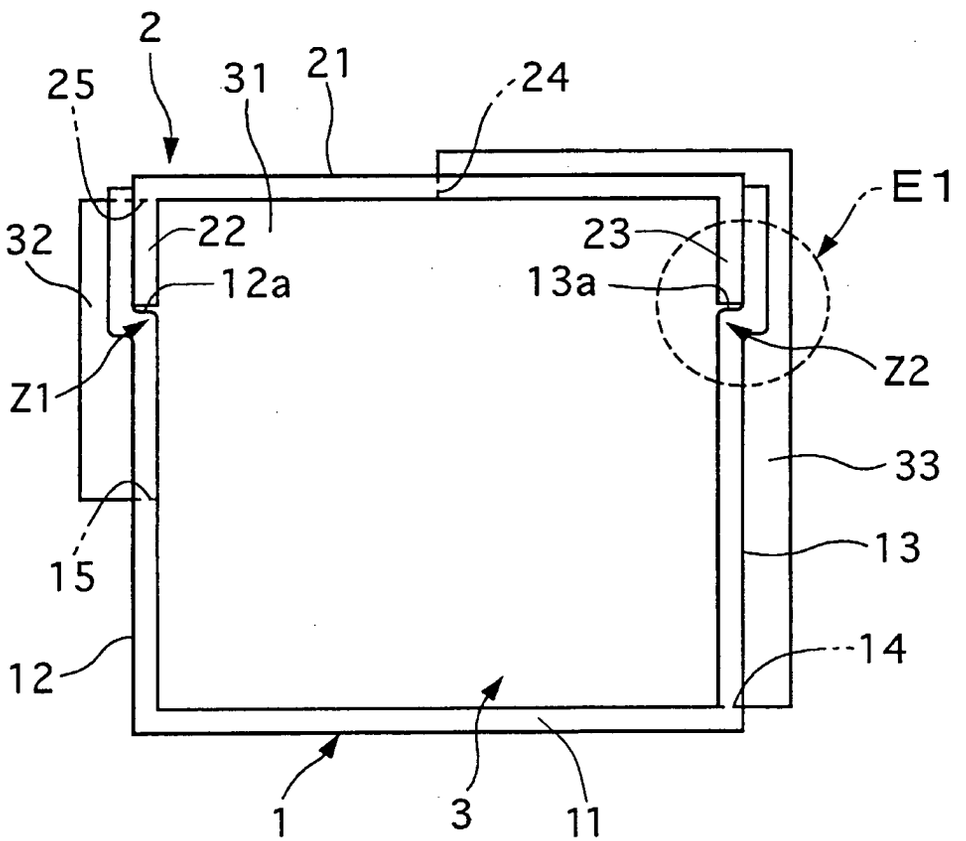


FIG. 1B

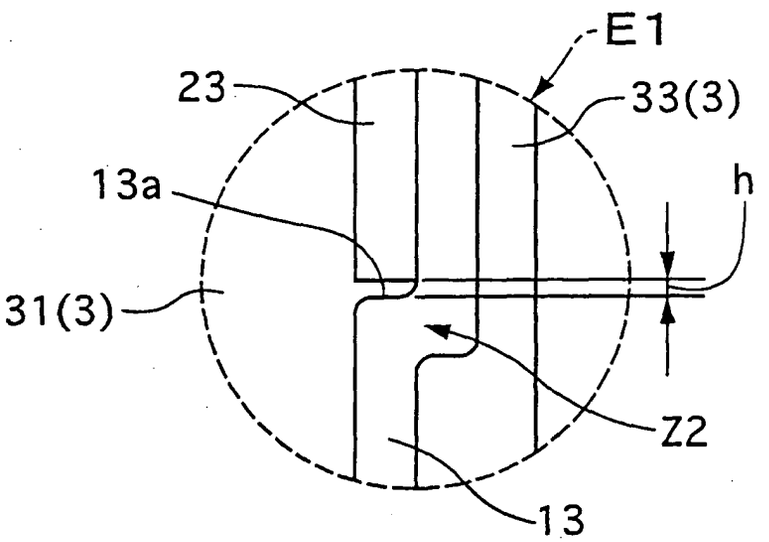


FIG. 2

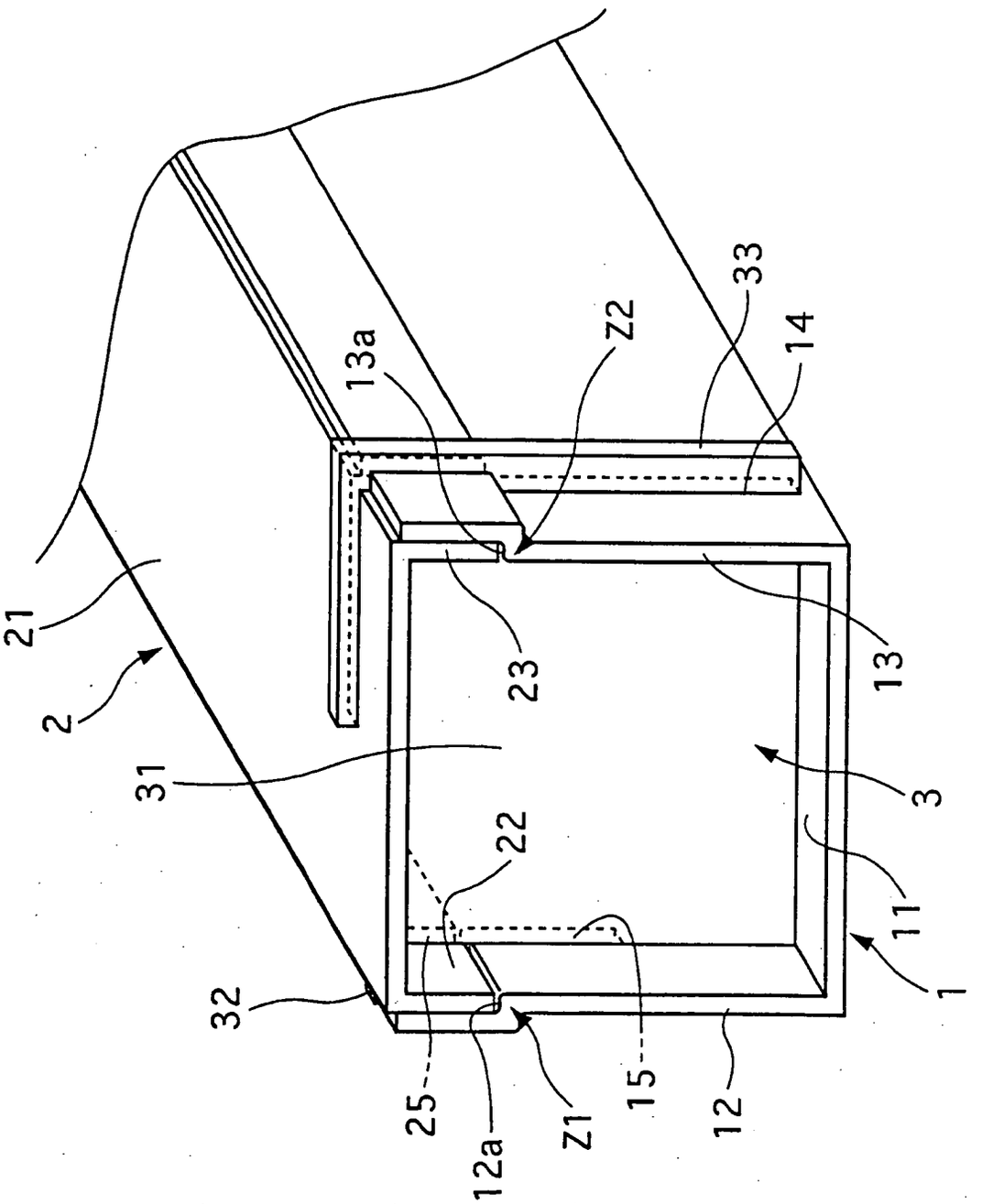


FIG. 3

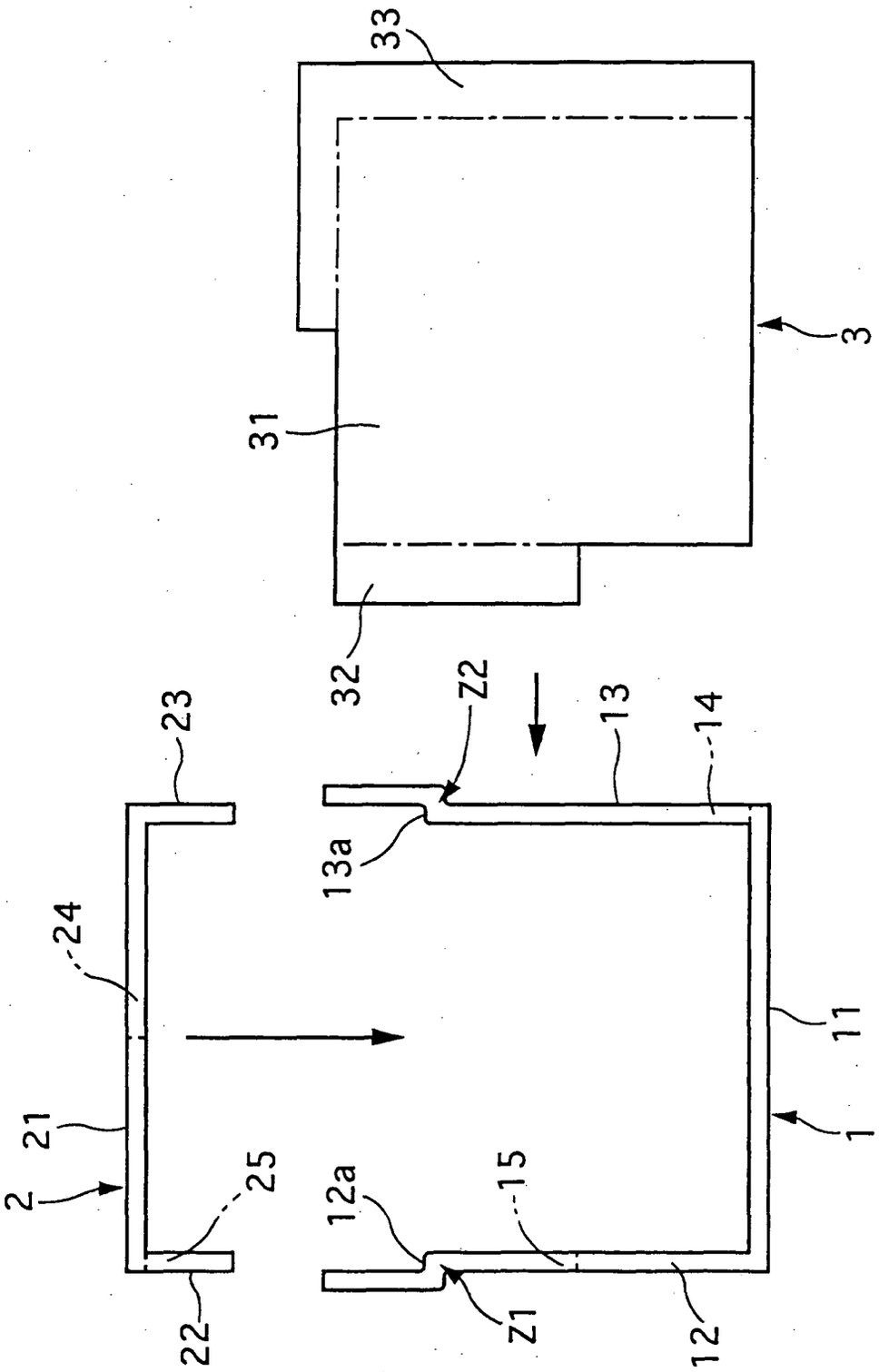


FIG. 4A

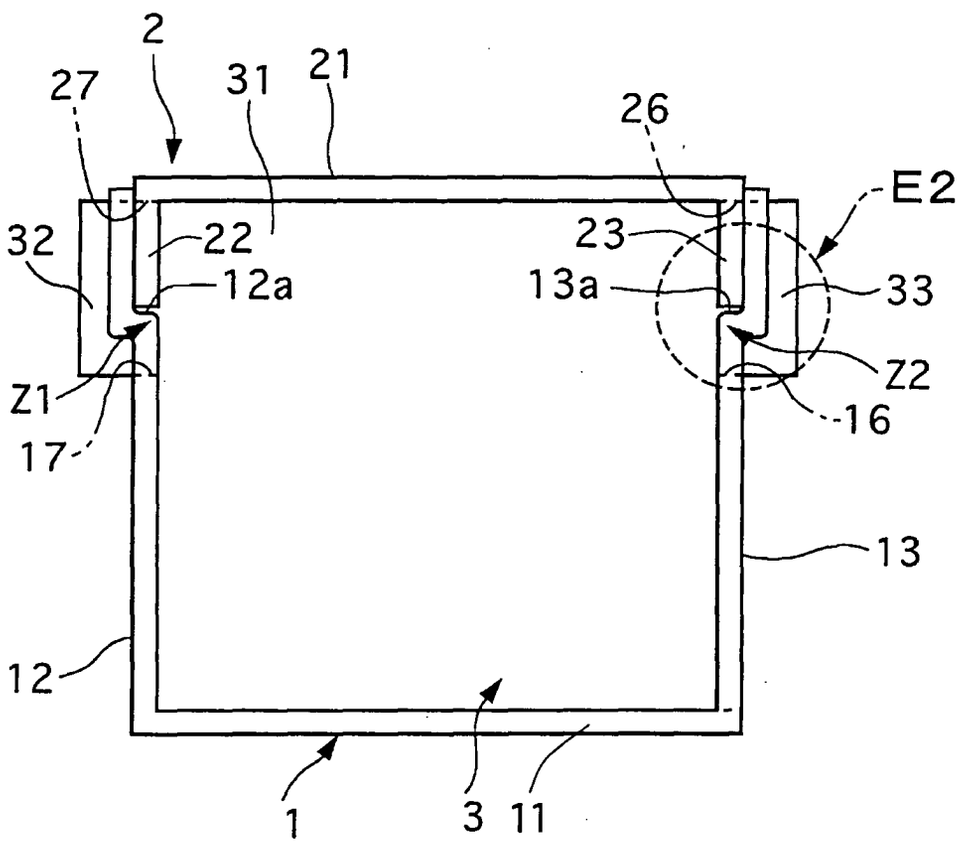


FIG. 4B

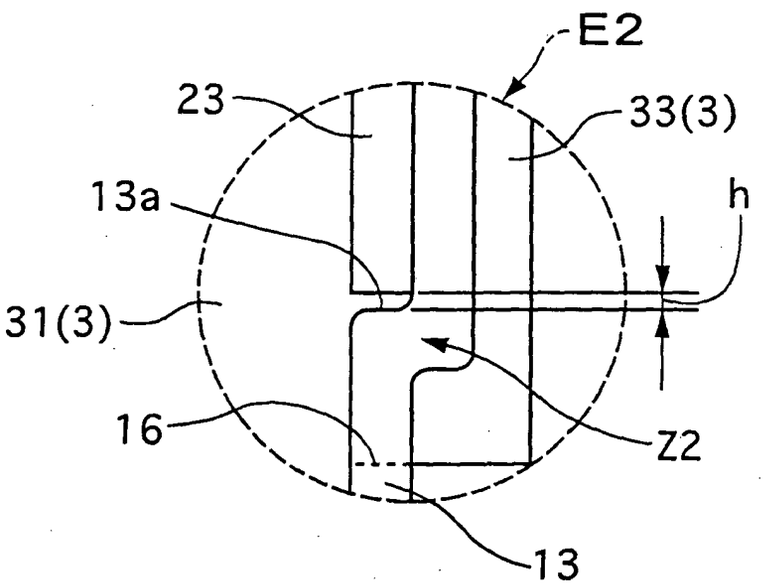


FIG. 5

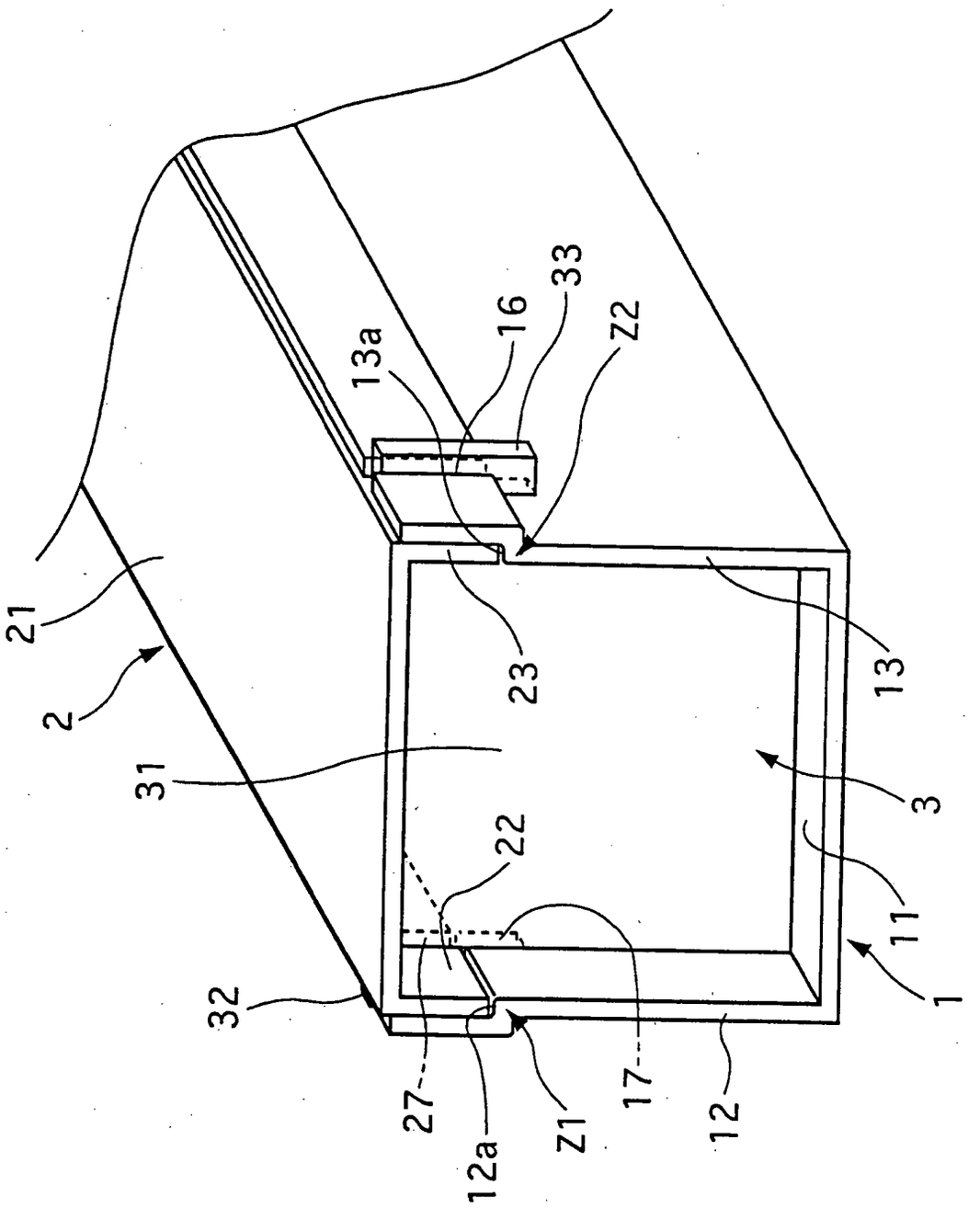


FIG. 6

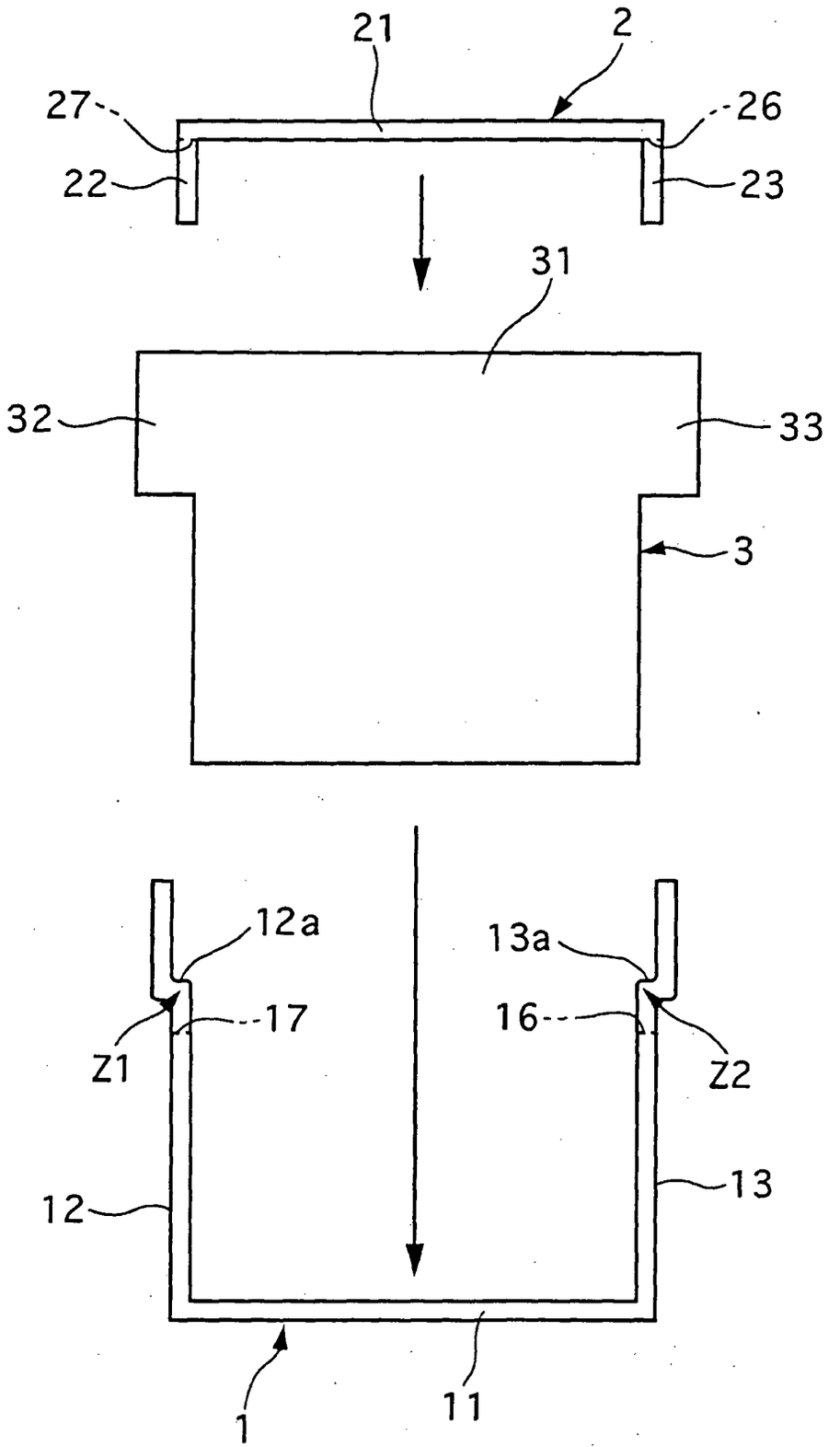


FIG. 7A

PRIOR ART

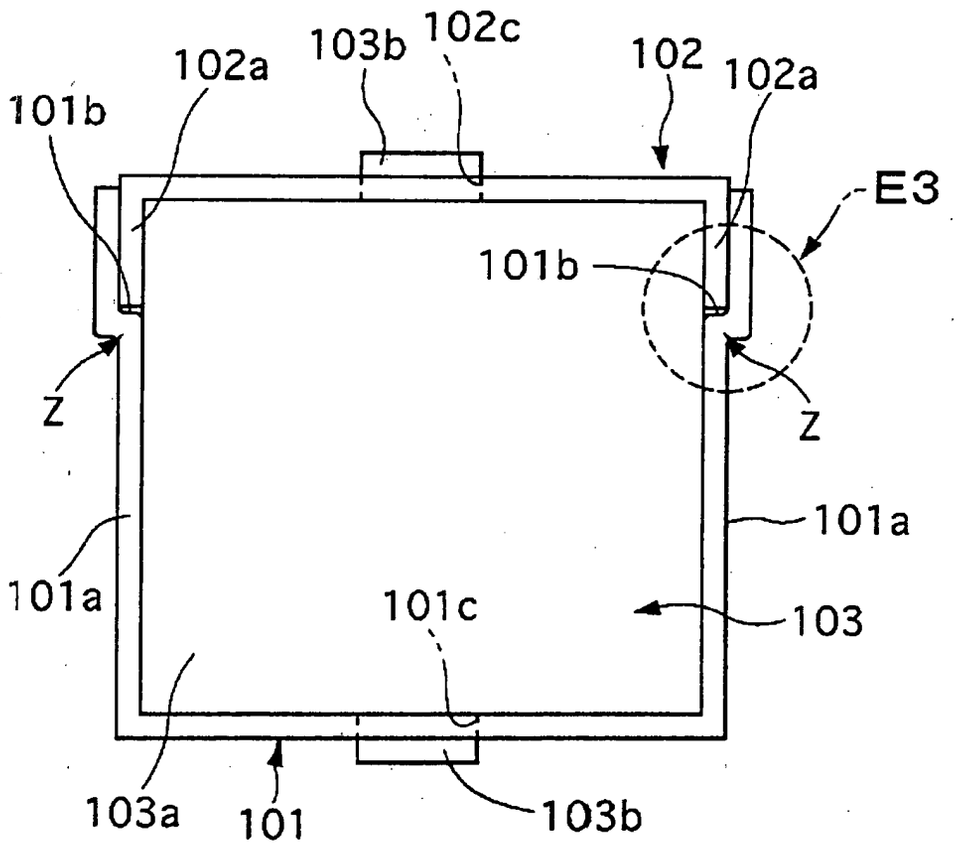


FIG. 7B

PRIOR ART

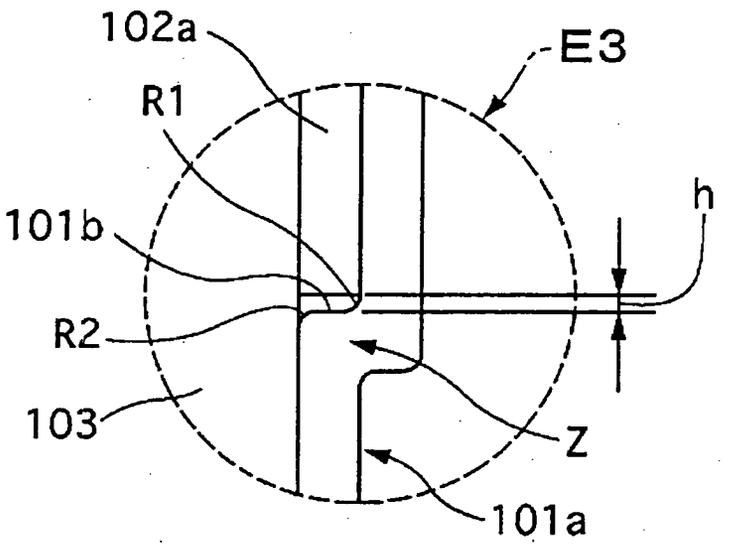


FIG. 8

PRIOR ART

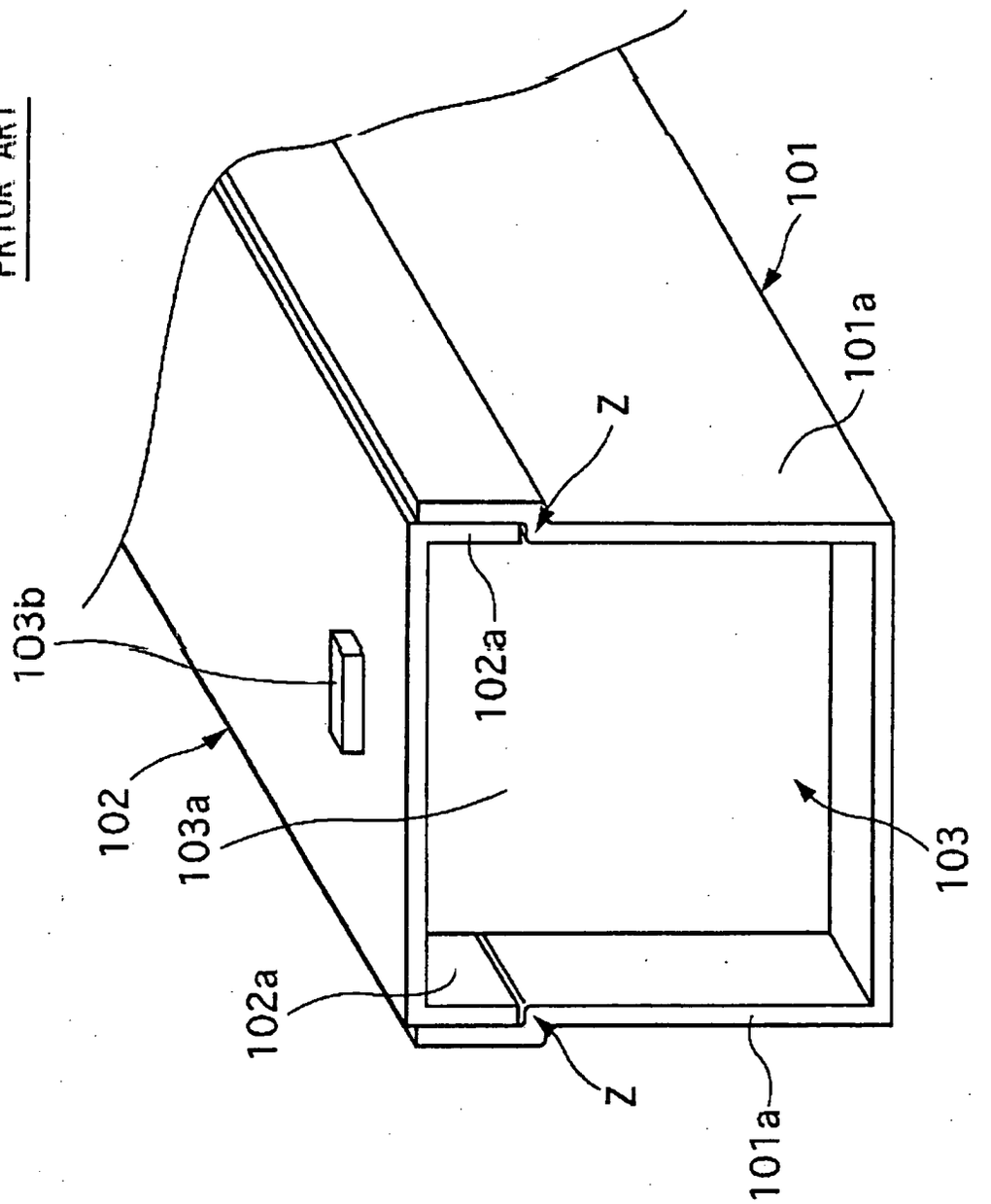


FIG. 9

PRIOR ART