



(19)

Europäisches Patentamt

European Patent Office

Office européen des brevets



(11)

EP 0 745 821 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
04.12.1996 Bulletin 1996/49

(51) Int. Cl.⁶: **F28F 9/02**

(21) Application number: **96108486.0**

(22) Date of filing: **28.05.1996**

(84) Designated Contracting States:
DE FR GB IT SE

(30) Priority: **30.05.1995 JP 154034/95**

(71) Applicant: **SANDEN CORPORATION**
Isesaki-shi Gunma, 372 (JP)

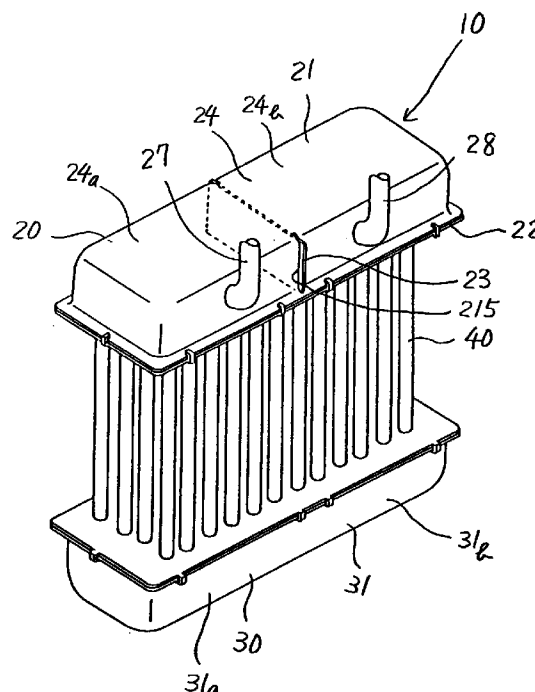
(72) Inventor: **Tsunoda, Masataka,**
c/o Sanden Corporation
Isesaki-shi, Gunma, 372 (JP)

(74) Representative: **Prüfer, Lutz H., Dipl.-Phys. et al**
PRÜFER & PARTNER,
Patentanwälte,
Harthäuser Strasse 25d
81545 München (DE)

(54) Heat exchanger with divided header tank

(57) A heat exchanger includes upper (20) and lower (30) header tanks which are spaced from each other, and a plurality of pipe members (40) which connect the upper and lower header tanks in fluid communication. At least one header tank (20) has a sidewall (213), which has at least two sides. A slit (215) is formed in each of the sides. A partitioning plate (23) penetrates across the header tank (20) through both slits (215) such that the opposite longitudinal ends are respectively engagedly received within the slits.

Fig. 3



EP 0 745 821 A1

Description

FIELD OF THE INVENTION

This invention generally relates to a heat exchanger and, more particularly, to a heat exchanger having a divided header tank.

BACKGROUND OF THE INVENTION

Heat exchangers are well known and exist in a variety of configurations. For example, Japanese Utility Model Application Publication No. 62-8585 ("JU'585") and Japanese Patent Application Publication No. 4-225796 ("JP'796") disclose shell-and-tube heat exchangers.

Such heat exchangers typically include a pair of header tanks, at least one of which is divided into two or more sections. With reference to Fig. 1, for example, a shell-and-tube heat exchanger 10' disclosed in JU'585 includes upper and lower shells or header tanks 11 and 12 which are vertically spaced from each other, a plurality of pipe members 13 which link the pair of header tanks 11 and 12 in fluid communication, and a plurality of corrugated fin members 14 which are fixedly disposed within the intervening spaces defined between the adjacent pipe members 13. The upper header tank 11 includes a slit 111 centrally formed through a top end portion thereof for penetration of a plate member 15. The slit 111 extends along substantially the entire lateral length of the top end portion of the upper header tank 11. After penetration through the slit 111, the plate member 15 is disposed within the upper header tank 11, so that an inner hollow space 110 of the upper header tank 11 is divided into a first and second sections 110a and 110b.

First and second circular holes 16 and 17 are formed at the top end portion of the upper header tank 11 at locations corresponding to the first and second sections 110a and 110b, respectively. One end of an inlet pipe 18 is fixedly received within the first circular hole 16 so as to link the first section 110a of the inner hollow space 110 of the upper header tank 11 with a first external element (not shown) in fluid communication. Similarly, one end of an outlet pipe 19 is fixedly received within the second circular hole 17 so as to link the second section 110b of the inner hollow space 110 of the upper header tank 11 with a second external element (not shown) in fluid communication.

During operation of the above-constructed heat exchanger 10', a first heat exchange medium flowing from the first external element (not shown) is conducted into the first section 110a of the inner hollow space 110 of the upper header tank 11 through the inlet pipe 18. The first heat exchange medium then dispersedly flows downwardly through a first group of the pipe members 13, which correspond to the first section 110a. The first heat exchange medium exchanges heat with a second heat exchange medium (e.g., air) passing through the

corrugated fin members 14 of the heat exchanger 10'. The first heat exchange medium then flows into a first area 120a of an inner hollow space 120 of the lower header tank 12. First area 120a of inner hollow space 120 corresponds to first section 110a of inner hollow space 110.

The first heat exchange medium then flows into a second area 120b of the inner hollow space 120 of the lower header tank 12. Second area 120b of inner hollow space 120 corresponds to second section 110b of inner hollow space 110. In this configuration hollow space 120 is not partitioned and areas 120a and 120b are in direct fluid communication. The first heat exchange medium then dispersedly flows upwardly through a second group of the pipe members 13, which correspond to the second section 110b of the inner hollow space 110. As this occurs, the first heat exchange medium again exchanges heat with the second heat exchange medium flowing through the corrugated fin members 14. The first heat exchange medium then flows into the second section 110b of the inner hollow space 110 of the upper header tank 11, and is then conducted to the second external element (not shown) through the outlet pipe 19.

In a process of assembling the heat exchanger 10', the plate member 15 is inserted into the inner hollow space 110 of the upper header tank 11 through the slit 111, such that the plate member 15 is parallel to a plane which is perpendicular to a longitudinal axis of the upper header tank 11. When a lower end of the plate member 15 comes into contact with an inner bottom end surface of the upper header tank 11, the insertion of the plate member 15 into the inner hollow space 110 through the slit 111 is terminated, and a top end portion of the plate member 15 is fitly received within the slit 111. Thus, in the assembly process of the heat exchanger 10', the plate member 15 is arranged to be fitly disposed within the upper header tank 11 in an upright posture.

However, during the assembly process, since the upright posture of the plate member 15 is maintained by only an engagement between the slit 111 and the top end portion of the plate member 15, the plate member 15 can easily lose its upright posture if the heat exchanger 10' receives an external impact force. This may create one or more defective air gaps between a peripheral edge of the plate member 15 and the inner surface of the upper header tank 11. This may also create one or more defective air gaps at an inner periphery of the slit 111.

Therefore, even if the plate 15 is subsequently affixed to the upper header tank 11 by an affixing process (e.g., a brazing process), the above-mentioned defective air gaps may still exist. Accordingly, during operation of the heat exchanger 10', a portion of the first heat exchange medium can directly flow (through the defective air gaps) from the first section 110a to the second section 110b of the inner hollow space 110 of the upper header tank 11. Also, the first heat exchange

medium may leak from the inner hollow space 110 to the exterior of the heat exchanger 10'.

In order to eliminate the above-mentioned drawbacks, JP'796 uses a modified upper header tank in its heat exchanger. With reference to Fig. 2, the upper header tank 11 includes a U-shaped plate member 150 disposed within a central portion thereof. The U-shaped plate member 150 includes a partitioning portion 151, a stabilizing portion 152 and a curved connecting portion 153 connecting the partitioning portion 151 and the stabilizing portion 152 at their top end regions. The partitioning portion 151 is shaped to be substantially similar to a lateral cross section of the inner hollow space 110 of the upper header tank 11. The stabilizing portion 152 is spaced from the partitioning portion 151 and is arranged to be substantially parallel thereto.

In a process of assembling the heat exchanger of JP'796, the U-shaped plate member 150 is disposed within a central region of the upper header tank 11, such that a lower end of the partitioning portion 151 and a lower end of the stabilizing portion 152 are in contact with an inner bottom end surface of the upper header tank 11. In this configuration, the portions 151 and 152 stabilize each other. The curved connecting portion 153 is fixedly secured to the top end portion of the upper header tank 11 by a screw 154, such that the partitioning portion 151 is arranged to be fitly disposed within the upper header tank 11 in an upright posture.

Accordingly, in a subsequent step of affixing the U-shaped plate member to the upper header tank 11 (e.g., by a brazing process), a peripheral edge of the partitioning portion 151 is sealingly and fixedly connected to an inner surface of the upper header tank 11 without air gaps, which defectively link the first section 110a with the second section 110b.

Nevertheless the heat exchanger of JP'796 has several shortcomings. For example, in assembling the heat exchanger of JP'796, complicated press work is required to prepare the U-shaped plate member 150, and the weight of the heat exchanger is unnecessarily increased due to the existence of the stabilizing portion 152 and connecting portion 153. Other shortcomings exist in the prior art.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide a heat exchanger through which a heat exchange medium is properly conducted.

It is a further objective of the present invention to provide a heat exchanger having a header tank divided into one or more sections without defective air gaps which allow the direct flow of a heat exchange medium from one section to another.

It is a further objective of the present invention to provide a heat exchanger having a header tank divided into one or more sections without defective air gaps which allow a heat exchange medium to leak to the exterior of the heat exchanger.

It is a further objective of the present invention to provide a heat exchanger having a partitioned header tank, while reducing the amount of materials required to assemble the heat exchanger.

In order to achieve these and other objectives, a heat exchanger is provided which includes a first header tank, a second header tank spaced from the first header tank, and a plurality of pipe members connecting the first header tank to the second header tank in fluid communication. At least one of the header tanks has a top end portion, a bottom end portion spaced from the top end portion, and a sidewall portion. The at least one header tank defines an inner hollow space therein. The heat exchanger also includes means for partitioning the inner hollow space of the at least one header tank into a plurality of sections. The partitioning means includes first and second slits formed in the sidewall portion. The partitioning means further includes a partitioning plate having first and second end portions. A portion of the partitioning plate is fitly disposed within the at least one header tank by penetrating the at least one header tank through the first and second slits, such that the first and second end portions of the partitioning plate are engagedly received within the first and second slits, respectively.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a longitudinal cross-sectional view of a heat exchanger in accordance with the prior art.

Figure 2 is a partial perspective view of a heat exchanger in accordance with the prior art.

Fig. 3 is a perspective view of a heat exchanger in accordance with a first embodiment of the present invention.

Fig. 4 is an enlarged perspective view of the header tank of the heat exchanger of Fig. 3.

Fig. 5 is a cross-sectional view taken along plane V in Fig. 4.

Fig. 6 is an enlarged fragmentary sectional view of the header tank of Fig. 4.

Fig. 7 is a perspective view of a header tank and a disengaged partitioning plate.

Fig. 8 is a perspective view of a header tank, an engaged partitioning plate and a separate plate portion.

Fig. 9 is a cross-sectional view of a header tank and partitioning plate in accordance with a second embodiment of the present invention.

Fig. 10 is a cross-sectional view of a header tank and partitioning plate in accordance with a third embodiment of the present invention.

Fig. 11 is a cross-sectional view of a header tank and partitioning plate in accordance with a fourth embodiment of the present invention.

Fig. 12 is a cross-sectional view of a header tank and partitioning plate in accordance with a fifth embodiment of the present invention.

Fig. 13 is a cross-sectional view of a header tank and partitioning plate in accordance with a sixth embodiment of the present invention.

Fig. 14 is a cross-sectional view of a header tank and partitioning plate in accordance with a seventh embodiment of the present invention.

Fig. 15 is a perspective view of a header tank in accordance with an eighth embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

An overall construction of a heat exchanger in accordance with a first embodiment of the present invention is described in detail below with reference to Figs. 3 through 6. The heat exchanger described is a shell-and-tube type heat exchanger constructed to perform as an evaporator of a refrigerant circuit of an automotive air conditioning system. However, the invention is not so limited.

With reference to Figs. 3-6, a heat exchanger 10 comprises an upper header tank 20, a lower header tank 30 which is vertically spaced from the upper header 20, and a plurality of pipe members 40 which link the upper and lower header tanks 20 and 30 in fluid communication. The pipe members 40 are arranged to be diagonally aligned with one another. However, pipe members 40 may be arranged in other configurations. Preferably, upper and lower header tanks 20 and 30, and pipe members 40 are made of, for example, aluminum or an aluminum alloy. However, other suitable materials may be used.

Upper header tank 20 comprises a cup-shaped member 21, having a generally rectangular parallelepiped shape, and a rectangular plate member 22. Cup-shaped member 21 includes a top portion 212 and a sidewall portion 213. Sidewall portion 213 includes a pair of first side portions 213a each having a first longitudinal length, and a pair of second side portions 213b each having a second longitudinal length which is greater than the first longitudinal length. An outwardly extending flange portion 211 is formed about an entire periphery of an opening end of the cup-shaped member 21. Rectangular plate member 22 comprises a plurality of small projections 221 formed at predetermined intervals about an entire peripheral edge thereof. A plurality of circular holes 222 are formed through rectangular plate member 22 so as to fitly receive a top end portion of corresponding pipe members 40. The entire peripheral region of the rectangular plate member 22 is fixedly and sealingly connected to the flange portion 211 of cup-shaped member 21 by, for example, brazing, so that an opening end of the cup-shaped member 21 is sealingly covered by the rectangular plate member 22.

A pair of slits 215 are formed at a central region of the pair of second side portions 213b, respectively along the entire vertical length thereof. Of course, the slits may be formed at any longitudinal position along

second side portions 213b to obtain the desired division of an inner hollow space 24 defined by cup-shaped member 21 and rear plate member 22. A rectangular partitioning plate 23 made of, for example, aluminum or an aluminum alloy is arranged to penetrate across the upper header tank 20 through the pair of slits 215 such that the opposite longitudinal end portions of partitioning plate 23 slightly outwardly project from a outer surface of the pair of second side portions 213b, respectively. The opposite longitudinal end portions of partitioning plate 23 are then fixedly and sealingly connected to an inner surface of the pair of slits 215 by, for example, brazing. As a result, an inner hollow space 24 of upper header tank 20 defined by cup-shaped member 21 and rectangular plate member 22 is divided into first and second sections 24a and 24b by partitioning plate 23. Partitioning plate 23 can have other shapes and can be made of other suitable materials. Also, partitioning plate 23 does not, in all cases, have to project slightly from the outer surface of second side portions 213b.

As shown in Fig. 4, first and second circular holes 25 and 26 are formed through one of the pair of second side portions 213b at locations corresponding to the first and second sections 24a and 24b, respectively. One end of an inlet pipe 27 made of, for example, aluminum or an aluminum alloy is fixedly connected to an inner peripheral surface of first circular hole 25 by, for example, brazing so as to link the first section 24a of the inner hollow space 24 with one external element (e.g., a condenser not shown), of a refrigerant circuit. Similarly, one end of an outlet pipe 28 is fixedly connected to an inner peripheral surface of the second circular hole 26 so as to link the second section 24b of inner hollow space 24 with another external element (e.g., a compressor not shown), of the refrigerant circuit.

Construction of the lower header tank 30 may be similar to that of the upper header tank 20 other than providing a partitioning plate and the inlet and outlet pipes. Therefore, a further explanation of lower header tank 30 is omitted. It should be noted that lower header tank 30 may have a partitioning plate if upper header tank 20 has more than one partitioning plate. This would allow more than one up and down cycle of the first heat exchange medium.

A portion of an assembly process of the heat exchanger 10 will now be described in detail with reference to Figs. 7 and 8. As illustrated in Fig. 7, partitioning plate 23 is arranged to penetrate across upper header tank 20 through the pair of slits 215 such that the opposite longitudinal end portions thereof slightly outwardly project from the outer surface of the pair of second side portions 213b, respectively. A thickness "t" of partitioning plate 23 is designed to be about equal to a width "w" of the slits 215, and a height "h" of partitioning plate 23 is designed to be about equal to a vertical depth of cup-shaped member 21. Accordingly, the opposite longitudinal end portions of the partitioning plate 23 are fitly engaged with the inner surfaces of the pair of slits 215.

As a result, partitioning plate 23 is arranged to have a stable upright posture across upper header tank 20. Next, as illustrated in Fig. 8, rectangular plate member 22 and cup-shaped member 21 are arranged such that the entire peripheral region of rectangular plate member 22 and flange portion 211 of cup-shaped member 21 are aligned and mated with each other. Further, though only one circular hole 222 is illustrated in Fig. 8, a plurality of holes 222 are preferably formed and arranged so as to correspond to an arrangement of a plurality of pipe members 40. Finally, as best shown in Fig. 4, a plurality of projections 221 are bent upwardly and then inwardly in generally right angles such that the flange portion 211 and the peripheral region of rectangular plate 22 are temporarily, firmly secured to each other. As a result, opposed vertical edges of partitioning plate 23 are fitly sandwiched by cup-shaped member 21 and rectangular plate member 22.

After the assembly process is complete, a brazing process is performed. The mating surfaces between partitioning plate 23 and cup-shaped member 21, between cup-shaped member 21 and rectangular plate member 22, and between partitioning plate 23 and rectangular plate member 22 are brazed to be fixedly and sealingly connected to each other.

During operation of the above-constructed heat exchanger 10, a first heat exchange medium, such as a refrigerant flowing from the condenser (not shown), is conducted into first section 24a of inner hollow space 24 of upper header tank 20 through the inlet pipe 27. The first heat exchange medium then dispersedly flows downwardly through a first group of pipe members 40 corresponding to first section 24a. First heat exchange medium exchanges heat with external air passing through the heat exchanger 10. In this heat exchanging operation, the heat of the air is absorbed by the refrigerant so that the refrigerant is vaporized and the air is cooled. The refrigerant then flows into a first area 31a of an inner hollow space 31 of the lower header tank 30. First area 31a corresponds to first section 24a. The first heat exchange medium then flows to a second area 31b of the inner hollow space 31. Second area 31b corresponds to second section 24b. Then, the first heat exchange medium dispersedly flows upwardly through a second group of pipe members 40 corresponding to the second section 24b of inner hollow space 24 of upper header tank 20. Consequently, heat is again exchanged with external air passing through the heat exchanger 10. In this heat exchanging operation, the heat of the air is again absorbed by the refrigerant so that the refrigerant is vaporized and the air is cooled. The first heat exchange medium then flows into second section 24b of inner hollow space 24 and is conducted to the refrigerant compressor (not shown) through the outlet pipe 28.

According to this embodiment of the present invention, since the opposite longitudinal end portions of partitioning plate 23 fitly engage with the pair of slits 215, respectively, the upright posture of partitioning plate 23

is firmly maintained even if the heat exchanger 10 receives an external impact force during the assembly process thereof. This is because there are two spaced apart lines of intersection between the partitioning plate and the header tank. These two lines of intersection exist at the regions where the respective end portions of the partitioning plate intersect the wall of the header tank (i.e., at slits 215). This is in contrast to the prior art in which there is either no line of intersection (e.g., JP'796) or only one line of intersection (e.g., JU'585). As a result, no defective air gaps are created during assembly between partitioning plate 23 and cup-shaped member 21, between partitioning plate 23 and rectangular plate member 22 or at the periphery of slits 215. Accordingly, after the subsequent brazing process, the mating surfaces between partitioning plate 23 and cup-shaped member 21, and between partitioning plate 23 and rectangular plate member 22 are fixedly and sealingly connected to each other with no defective air gaps therebetween. Therefore, detective short-circuited refrigerant flow in the heat exchanger 10, as mentioned in connection with the prior art, is prevented. In addition, since partitioning plate 23 has a simple configuration (e.g., a rectangular shape), no complicated press work is required to prepare the partitioning plate 23. Also, an unnecessary increase in the weight of the heat exchanger is prevented.

Figs. 9-15 illustrate heat exchangers in accordance with second through eighth embodiments of the present invention, respectively. In Figs. 9-15, the same numerals are used to denote similar corresponding elements and a detailed explanation thereof is omitted.

With reference to Fig. 9, a heat exchanger in accordance with a second embodiment of the present invention comprises upper header tank 20 including cup-shaped member 21 and a rectangular partitioning plate 33. Partitioning plate 33 includes a pair of projections 33a, which are preferably formed at a lower half portion of the opposite longitudinal ends thereof, respectively. The cup-shaped member 21 further includes a pair of slits 315 which are centrally formed through a lower half region of the pair of second side portions 213b, respectively along a vertical direction of the second side portions 213b.

Partitioning plate 33 is arranged to penetrate across the upper header tank 20 through the pair of slits 315 such that the pair of projections 33a slightly outwardly project from the outer surface of the pair of second side portions 213b, respectively. A thickness of the partitioning plate 33 is preferably designed to be about equal to a width of the slits 315, and a height " h_1 " of projections 33a of partitioning plate 33 is designed to be about equal to a length " l_1 " of the slits 315. Accordingly, the end portions of the pair of projections 33a of partitioning plate 33 are fitly engaged with the pair of slits 315, respectively. As a result, partitioning plate 33 has a stable upright posture across the upper header tank 20 during an assembly process of the heat exchanger.

Further, although not illustrated in Fig. 9, rectangular plate member 22 includes a plurality of small projections 221 as shown in Fig. 8. Accordingly, the flange portion 211 of cup-shaped member 21 and the periphery of rectangular plate member 22 are temporarily, firmly secured to each other by means of bending the projections 221 during assembly of the heat exchanger.

With reference to Fig. 10, a heat exchanger in accordance with a third embodiment of the present invention comprises an upper header tank 40. Upper header tank 40 includes a pair of cup-shaped members 21 which are each similar to that of the previously-described embodiments. The flange portions 211 of the pair of cup-shaped members 21 are aligned and mated with one another, and are fixedly connected to each other by, for example, brazing. Therefore, the respective pairs of second side portions 213b of the pair of cup-shaped members 21 form a pair of composite side portions 44 of upper header tank 40.

Each of the pair of cup-shaped members 21 includes the pair of slits 215 similar to those of the first embodiment. The pair of slits 215 of one of the pair of cup-shaped members 21 are preferably aligned with the corresponding pair of slits 215 of the other cup-shaped member 21 when the cup-shaped members 21 are fixedly connected to each other. Therefore, the pairs of slits 215 of the pair of cup-shaped members 21 form a pair of composite slits 415 which bend along substantially the entire vertical length of the pair of composite side portions 44 of the upper header tank 40, respectively.

A partitioning plate 43 penetrates across the upper header tank 40 through the composite slits 415 such that the opposite longitudinal end portions thereof slightly outwardly project from an outer surface of the pair of composite side portions 44 of the upper header tank 40, respectively. A thickness of partitioning plate 43 is designed to be about equal to a width of slits 415, and a height "h₂" of partitioning plate 43 is designed to be about equal to a length "l₂" of the slits 415. Accordingly, the opposite longitudinal end portions of the partitioning plate 43 are fitly engaged with the pair of slits 415, respectively. As a result, the partitioning plate 43 has a stable upright posture across the upper header tank 40 during an assembly process of the heat exchanger.

With reference to Fig. 11, a heat exchanger in accordance with a fourth embodiment of the present invention comprises an upper header tank 40 similar to that illustrated in Fig. 10. The heat exchanger also comprises a rectangular partitioning plate 53. Partitioning plate 53 includes a pair of projections 53a preferably formed at a vertically central portion of the opposite longitudinal ends thereof, respectively. Each of the pair of cup-shaped members 21 of the upper header tank 40 includes a pair of slits 315 similar to that of the cup-shaped portions illustrated in Fig. 9. The pair of slits 315 of one of the pair of cup-shaped members 21 are aligned with the corresponding pair of slits 315 of the other cup-shaped member 21 when the cup-shaped

members 21 are fixedly connected to each other. Therefore, the pair of slits 315 of each of the pair of cup-shaped members 21 form a pair of composite slits 515 in the pair of composite side portions 44 of the upper header tank 40, respectively.

A partitioning plate 53 penetrates across the upper header tank 40 through composite slits 515 such that an end portion of each of the pair of projections 53a thereof slightly outwardly projects from an outer surface of the pair of composite side portions 44. A thickness of the partitioning plate 53 is designed to be about equal to a width of the slits 515, and a height "h₃" of the projections 53a of the partitioning plate 53 is designed to be about equal to a vertical length "l₃" of the slits 515. Accordingly, the end portions of the pair of the projections 53a of the partitioning plate 53 are each fitly engaged with one of the pair of composite slits 515. As a result, partitioning plate 53 has a stable upright posture across the upper header tank 40 during assembly of the heat exchanger.

Further, though not illustrated in Figs. 10 and 11, one or both of the pair cup-shaped members 21 includes a plurality of small projections 221 (similar to that shown in Fig. 8) formed about periphery of the flange portion 211 thereof. Accordingly, the flange portions 211 of the pair of cup-shaped members 21 are temporarily, firmly secured to each other by means of bending the projections 221 during the assembly process.

With reference to Fig. 12, a heat exchanger in accordance with a fifth embodiment of the present invention comprises an upper header tank 60 having a generally rectangular parallelepiped shape. Upper header tank 60 includes first and second cup-shaped members 61 and 62 which are each generally rectangular parallelepiped in shape. The heat exchanger also comprises a rectangular partitioning plate 63. An opening end portion of the first cup-shaped member 61 is fixedly received within an opening end portion of the second cup-shaped member 62. Alternatively, second cup-shaped member 62 could be sized to be received within the opening end of first cup-shaped member 61. Upper header tank 60 includes composite side portions 64 comprised of the respective side portions of cup-shaped members 61 and 62. A pair of composite slits 615 are centrally formed through a central region of the opposite composite side portions 64 of the upper header tank 60, respectively along a vertical direction of composite side portions 64.

Partitioning plate 63 includes a pair of projections 63a which are preferably centrally formed at the opposite longitudinal ends thereof. Partitioning plate 63 penetrates across the upper header tank 60 through the composite slits 615 such that an end portion of each of the pair of projections 63a thereof slightly outwardly projects from an outer surface of one of the pair of composite side portions 64 of the upper header tank 60. A thickness of partitioning plate 63 is designed to be about equal to a width of one of composite slits 615, and

a height "h₄" of projections 63a of partitioning plate 63 is designed to be about equal to a vertical length "l₄" of composite slits 615. Accordingly, each end portion of the pair of projections 63a of the partitioning plate 63 is fitly engaged with one of the pair of composite slits 615. As a result, partitioning plate 63 has a stable upright posture across the upper header tank 60 during assembly of the heat exchanger.

With reference to Fig. 13, a heat exchanger in accordance with a sixth embodiment of the present invention comprises an upper header tank 70 having a generally rectangular parallelepiped shape. The upper header tank 70 includes first and second cup-shaped members 71 and 72 which are generally rectangular parallelepiped in shape. The heat exchanger also comprises a rectangular partitioning plate 73. An opening end portion of the first cup-shaped member 71 is fixedly received within an opening end portion of the second cup-shaped member 72 to form a faucet joint. Alternatively, second cup-shaped member 72 could be sized to be received within the opening end of first cup-shaped member 71. Composite side portions 74 are formed similar to previously-described embodiments. A pair of composite slits 715 are preferably centrally formed through opposite composite side portions 74 of the upper header tank 70, respectively, in a vertical direction.

Partitioning plate 73 includes a pair of projections 73a which are preferably centrally formed at opposite longitudinal ends thereof, respectively. Partitioning plate 73 penetrates across the upper header tank 70 through composite slits 715, such that an end portion of each of the pair of projections 73a thereof slightly outwardly projects from an outer surface of one of the pair of composite side portions 74. A thickness of partitioning plate 73 is designed to be about equal to a width of composite slits 715, and a height "h₅" of projections 73a of partitioning plate 73 is designed to be about equal to a length "l₅" of the slits 715. Accordingly, each of the end portions of the pair of the projections 73a of partitioning plate 73 is fitly engaged with one of the pair of slits 715. As a result, partitioning plate 73 has a stable upright posture across the upper header tank 60 during assembly of the heat exchanger.

With reference to Fig. 14, a heat exchanger in accordance with a seventh embodiment of the present invention comprises an upper header tank 80 which is similar to the upper header tank 20 shown in Fig. 5. However, no small projections 221 are formed about the periphery of rectangular plate member 22. In a process of assembling the heat exchanger of this embodiment, the entire peripheral region of the rectangular plate member 22 is bent upwardly, so that the entire flange portion 211 of the cup-shaped member 21 and the entire peripheral region of the rectangular plate member 22 are temporarily, firmly secured to each other.

With reference to Fig. 15, a heat exchanger in accordance with an eighth embodiment of the present invention comprises an upper header tank 90 which

includes rectangular plate member 22 and a channel member 91. The channel member 91 includes a top portion 911 and a pair of side portions 912 which extend downwardly from the opposite lateral ends of the top portion 911. The top portion 911 and the pair of side portions 912 are arranged to be generally perpendicular to each other. A lower end region of each of the side portions 912 is bent outwardly so that flange regions 912a are formed.

A pair of slits 915 are formed at a preferably central region of the pair of side portions 912 of the channel member 91, respectively, along the entire vertical length of the side portions 912. Similarly, a pair of slits 913 are formed at one longitudinal end region of the pair of side portions 912 of the channel member 91, respectively, along the entire vertical length of the side portions 912, and a pair of slits 914 are formed at the other longitudinal end region of the pair of side portions 912 of the channel member 91, respectively, along the entire vertical length of the side portions 912.

A rectangular partitioning plate member 93 penetrates across the upper header tank 90 through the slits 915, such that the opposite longitudinal end portions thereof slightly outwardly project from an outer surface of the pair of side portions 912 of the channel member 90. As a result, the partitioning plate 93 has a stable upright posture across the upper header tank 90 during assembly of the heat exchanger. A first rectangular end plate 94 penetrates across the upper header tank 90 through the slits 913 such that the opposite longitudinal end portions thereof slightly outwardly project from the outer surface of the pair of side portions 912 of the channel member 90. Similarly, a second rectangular end plate 95 penetrates across the upper header tank 90 through the slits 914 such that the opposite longitudinal end portions thereof slightly outwardly project from an outer surface of the pair of side portions 912 of the channel member 90, respectively.

In the second through eighth embodiments, the manufacturing process and operation of the heat exchanger is substantially similar to those of the heat exchanger 10 of the first embodiment so that a detailed explanation thereof is unnecessary.

This invention has been described in detail in connection with the preferred embodiments. These embodiments, however, are merely for example only and the invention is not restricted thereto. It will be easily understood by those having ordinary skill in the art that other variations and modifications can be readily made within the scope and spirit of this invention as defined by the appended claims. For example, as previously discussed, more partitioning plates can be used in the upper header tank to divide the upper header tank into more than two sections. In this configuration, the corresponding lower header tank is preferably divided by partitioning plates into a number of sections which is one less than the number of sections of the upper header tank. Such a configuration allows for the pipe members

to be arranged such that the first heat exchange medium can cycle up and down more than once.

Claims

1. A heat exchanger comprising:

a first header tank (20), a second header tank (30) spaced from the first header tank, wherein at least one of the header tanks (20) comprises a top end portion (212), a bottom end portion spaced from the top end portion, and a sidewall portion (213) connecting the top and bottom end portions, so that a hollow space (24) is defined within the at least one header tank; a plurality of pipe members (40) connecting the first header tank (20) to the second header tank (30) in fluid communication; and a partitioning plate (23) intersecting the sidewall portion (213) to form at least two lines of intersection between the partitioning plate (23) and the sidewall portion (213).

2. The heat exchanger of claim 1, wherein first and second slits (215) are formed in the sidewall portion (213).

3. A heat exchanger comprising:

a first header tank (20) a second header tank (30) spaced from the first header tank (20) wherein at least one of the header tanks (20) comprises a top end portion (212) a bottom end portion spaced from the top end portion, and a sidewall portion (213) connecting the top and bottom end portions, so that a hollow space (24) is defined within the at least one header tank; a plurality of pipe members (40) connecting the first header tank (20) to the second header tank (30) in fluid communication; and means for partitioning the hollow space into a plurality of sections, the partitioning means comprising first and second slits (215) formed in the sidewall portion (213), and a partitioning plate (23) having first and second end portions, a portion of the partitioning plate (23) being fitly disposed within the at least one header tank by penetrating the at least one header tank (20) through the first and second slits (215), such that first and second longitudinal end portions of the partitioning plate (23) are engagedly received within the first and second slits (215), respectively.

4. The heat exchanger of claim 2 or 3, wherein the top end portion and the bottom end portion of the at least one header tank are substantially flat, wherein the sidewall portion (213) comprises a pair

of first side portions (213a) having a first longitudinal length, and a pair of second side portions (213b) having a second longitudinal length which is greater than the first longitudinal length, wherein the first and second slits (215) are formed through the pair of second side portions (213b) respectively, and are formed in a lateral direction of the second side portions (213b), and wherein the partitioning plate (23) is substantially rectangular in shape, preferably the at least one header tank (20) having a substantially rectangular parallelepiped shape.

5. The heat exchanger of one of claims 2 to 4, wherein the at least one header tank (20) comprises:

a cup-shaped member (21) having a closed end which defines the top end portion (212) and a side which defines the sidewall portion, and a plate member (22) which defines the bottom end portion, the plate member (22) being fixedly connected to an opening end of the cup-shaped member (21).

6. The heat exchanger of one of claims 2 to 5, wherein the sidewall portion (213) comprises a pair of side portions (213a, 213b), and wherein the first and second slits (215) are respectively formed through the pair of side portions, and are formed in a lateral direction of the pair of side portions, and extend along a portion of a lateral length of the pair of side portions, preferably along the entire lateral length.

7. The heat exchanger of one of claims 2 to 6, wherein the first and second slits are formed adjacent the bottom end portion.

8. The heat exchanger of one of claims 2 to 4, wherein the at least one header tank (40) comprises a first cup-shaped member (21) and a second cup-shaped member (21), each of the first and second cup-shaped members (21) having a closed end and a side, wherein the first cup-shaped members (21) is fixedly connected to the second cup-shaped member at the opening ends thereof, an opening end portion of the second cup-shaped member (21) preferably being fixedly received within an opening end portion of the first cup-shaped member (21).

9. The heat exchanger of claim 8 wherein the sidewall portion comprises a pair of composite side portions (44) defined by the sides of the cup-shaped members (21), and wherein the first and second slits are respectively formed through the pair of composite side portions (44), and are formed in a lateral direction of the pair of composite side portions (44), and extend along a portion of a lateral length of the pair of composite side portions (44), preferably along

the entire lateral length and/or wherein the first and second slits are formed adjacent the opening ends of both of the cup-shaped members (21).

10. The heat exchanger of claim 8 or 9 wherein the first and second cup-shaped members (21) are fixedly connected together in a faucet joint. 5
11. The heat exchanger of one of claims 2 to 10, wherein the at least one header tank (90) comprises a channel member (91) having a closed end defining the top end portion (911) and a pair of sides (912) defining the sidewall, the pair of sides (912) respectively extending from lateral edges of the closed end, and a plate member (22) fixedly connected to a distal edge of each of the pair of sides (912), 10
- wherein the sidewall has a first pair of end slits (913) respectively formed through one longitudinal end region of the pair of sides (912) and a second pair of end slits (914) formed through an opposite longitudinal end region of the pair of sides (912), 15
- wherein the first and second slits (915) are respectively formed in the pair of sides (912) and are respectively positioned between the first and second pairs of end slits (913, 914), and wherein the heat exchanger further comprises first and second end plates (94, 95) penetrating across the at least one header tank (90) through the first and second pairs of end slits (913, 914), respectively, such that opposite longitudinal ends of the respective first and second end plates (94, 95) are engagedly received within the corresponding pairs of end slits (913, 914). 20
- 25
- 30
- 35
- 40
- 45
- 50
- 55

Fig. 1
(Prior Art)

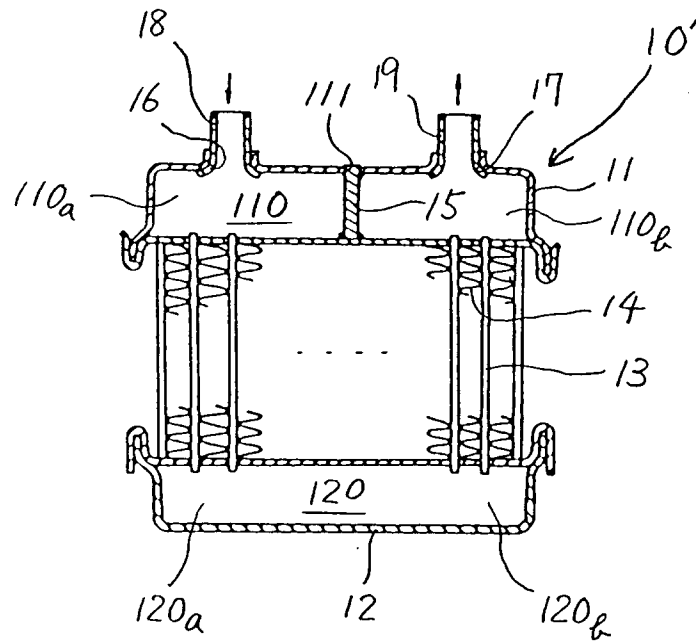


Fig. 2
(Prior Art)

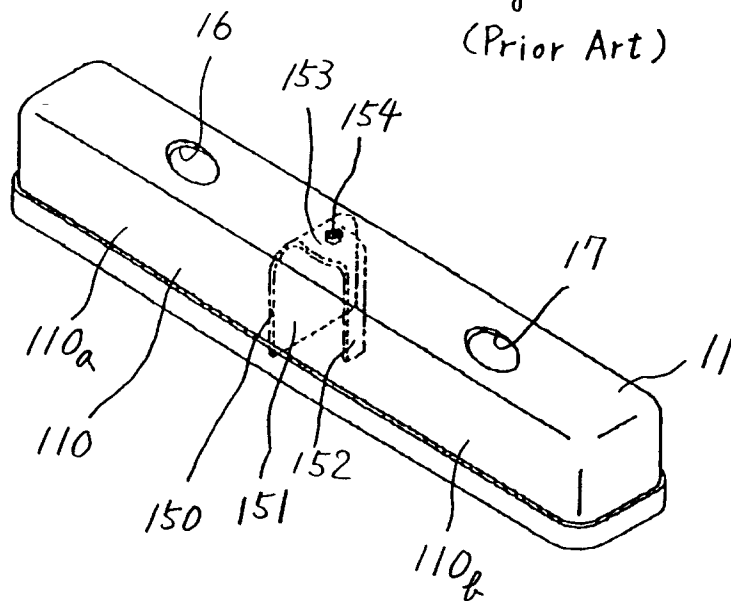


Fig. 3

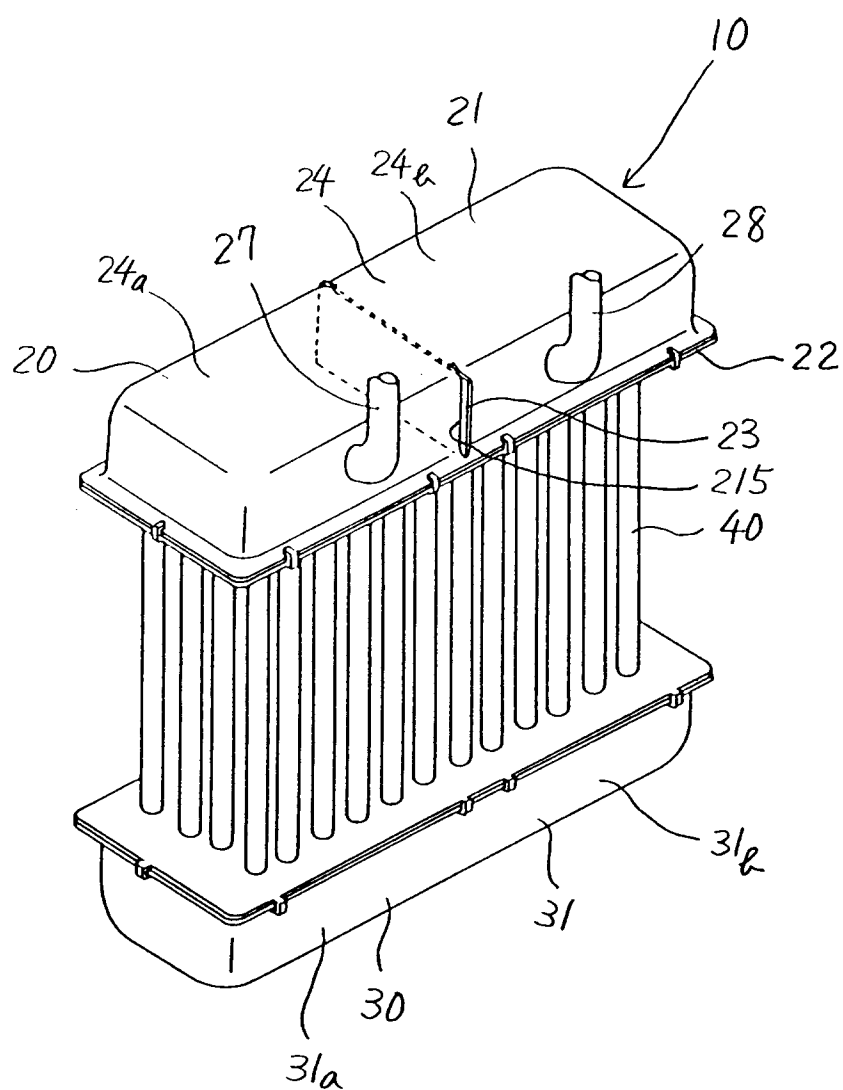


Fig. 4

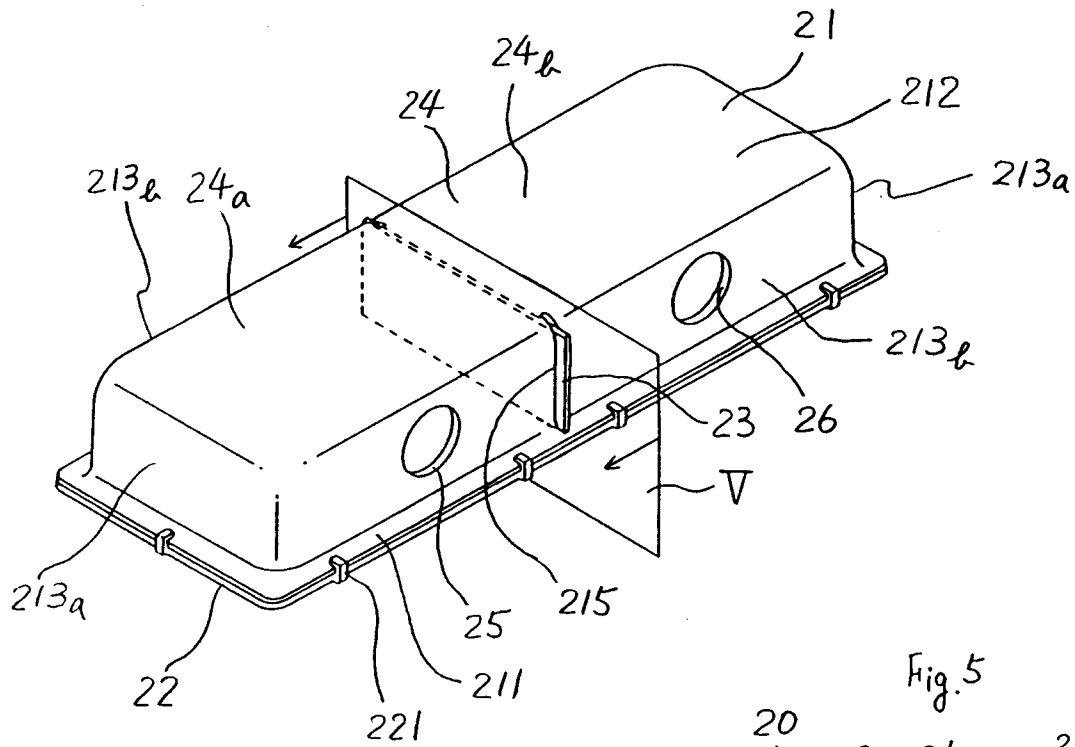


Fig. 5

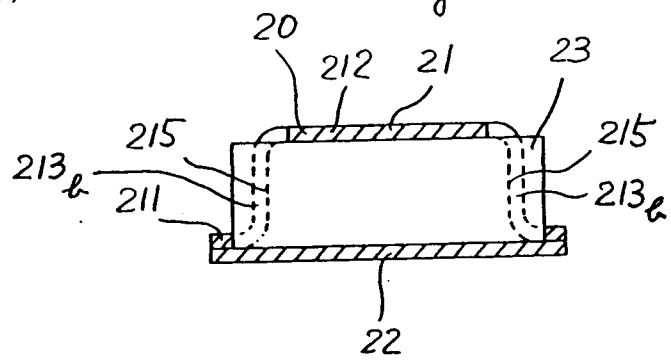
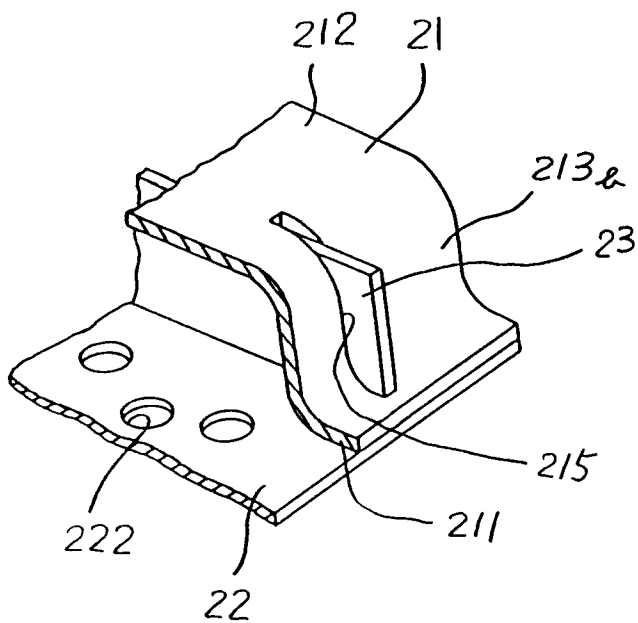


Fig. 6



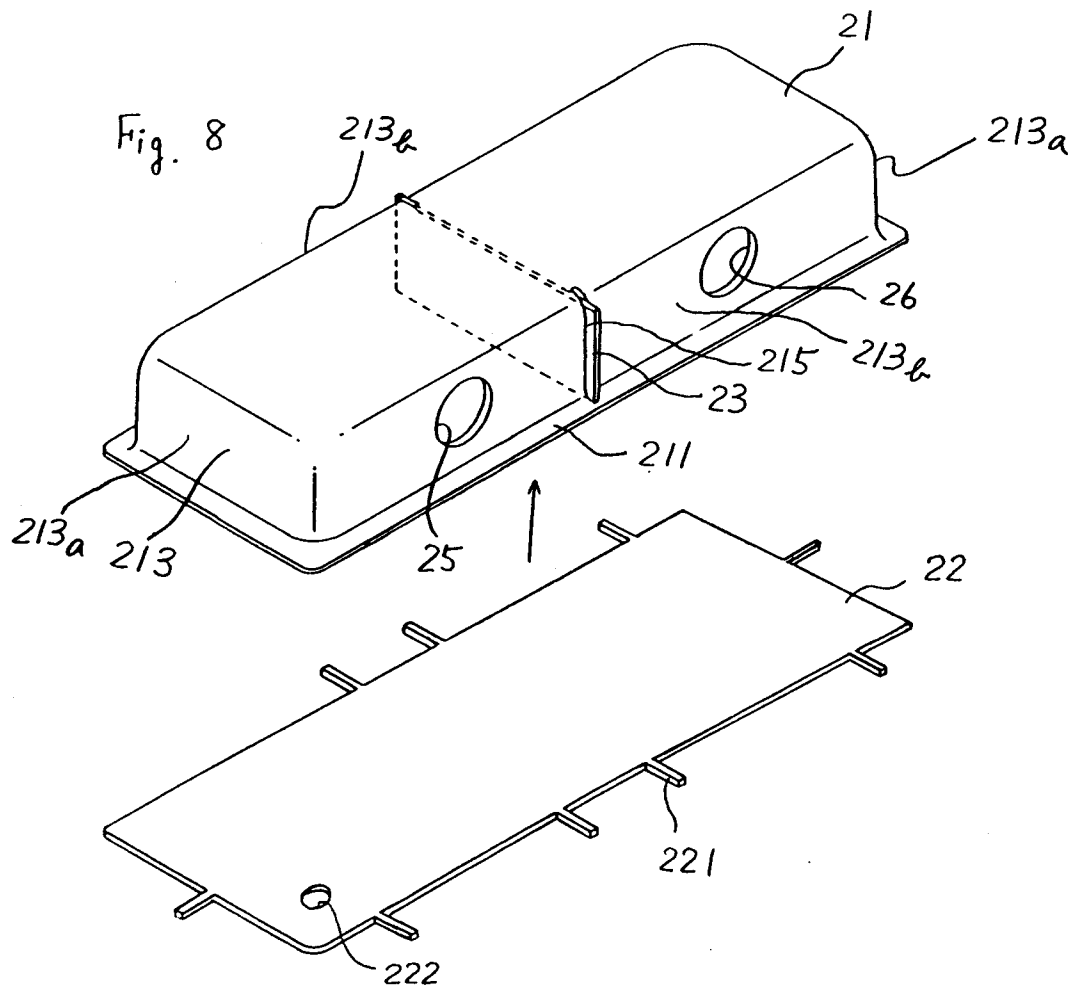
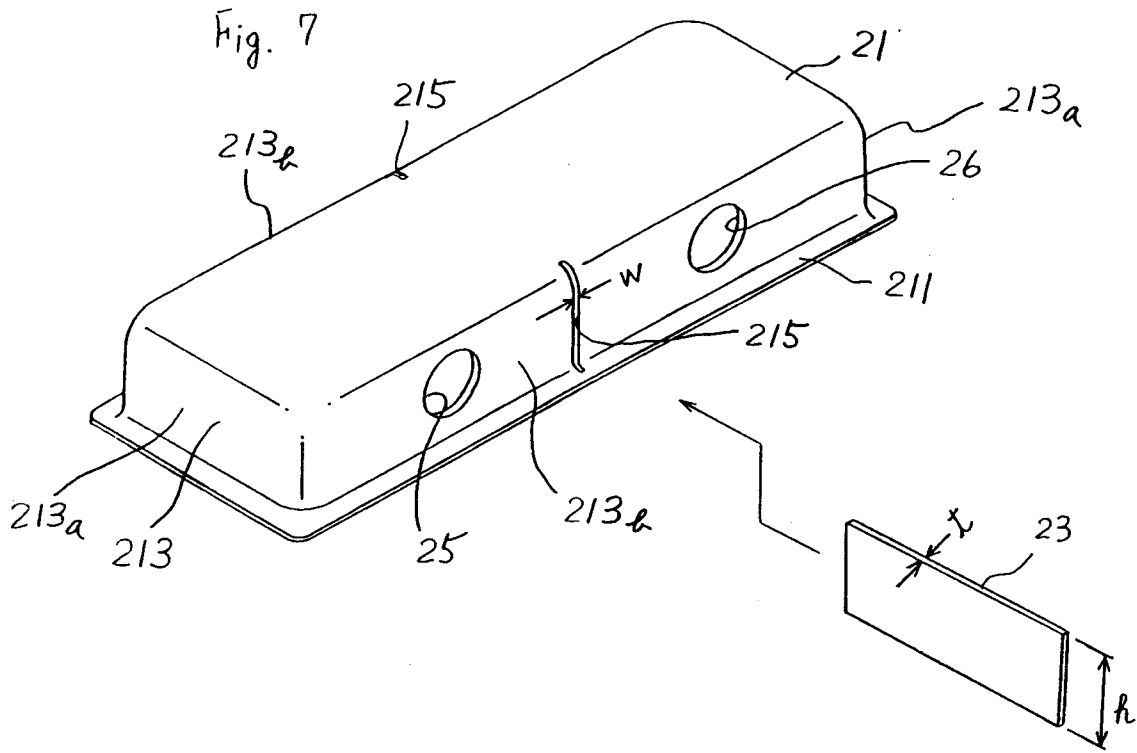


Fig. 9

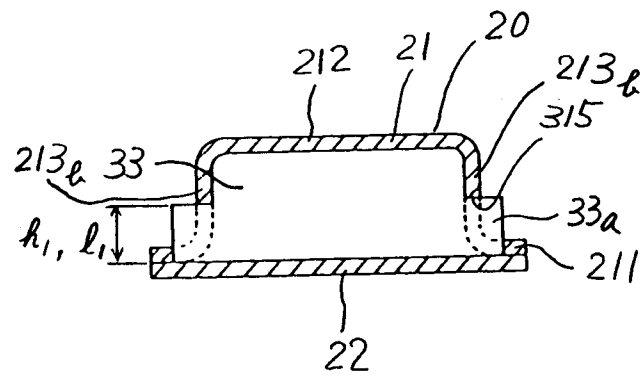


Fig. 10

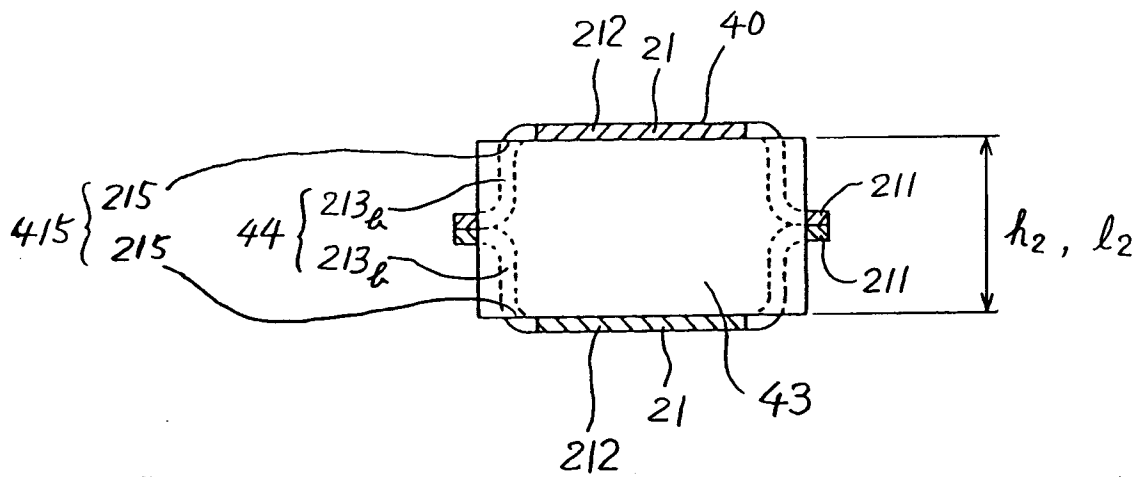
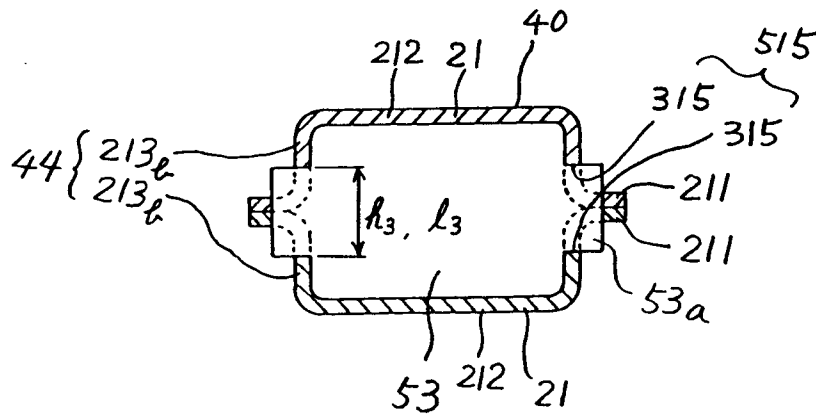


Fig. 11



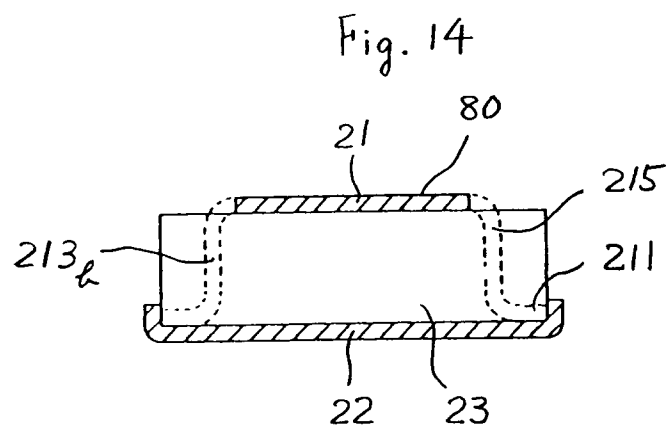
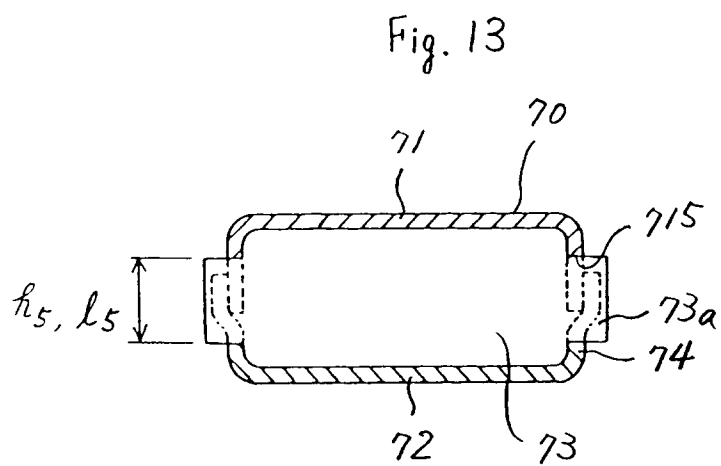
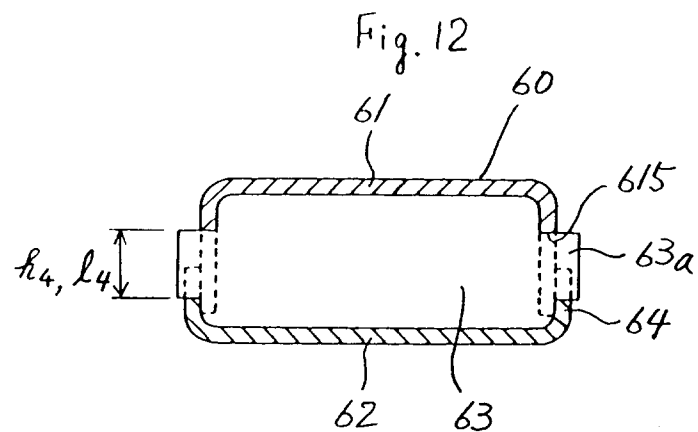
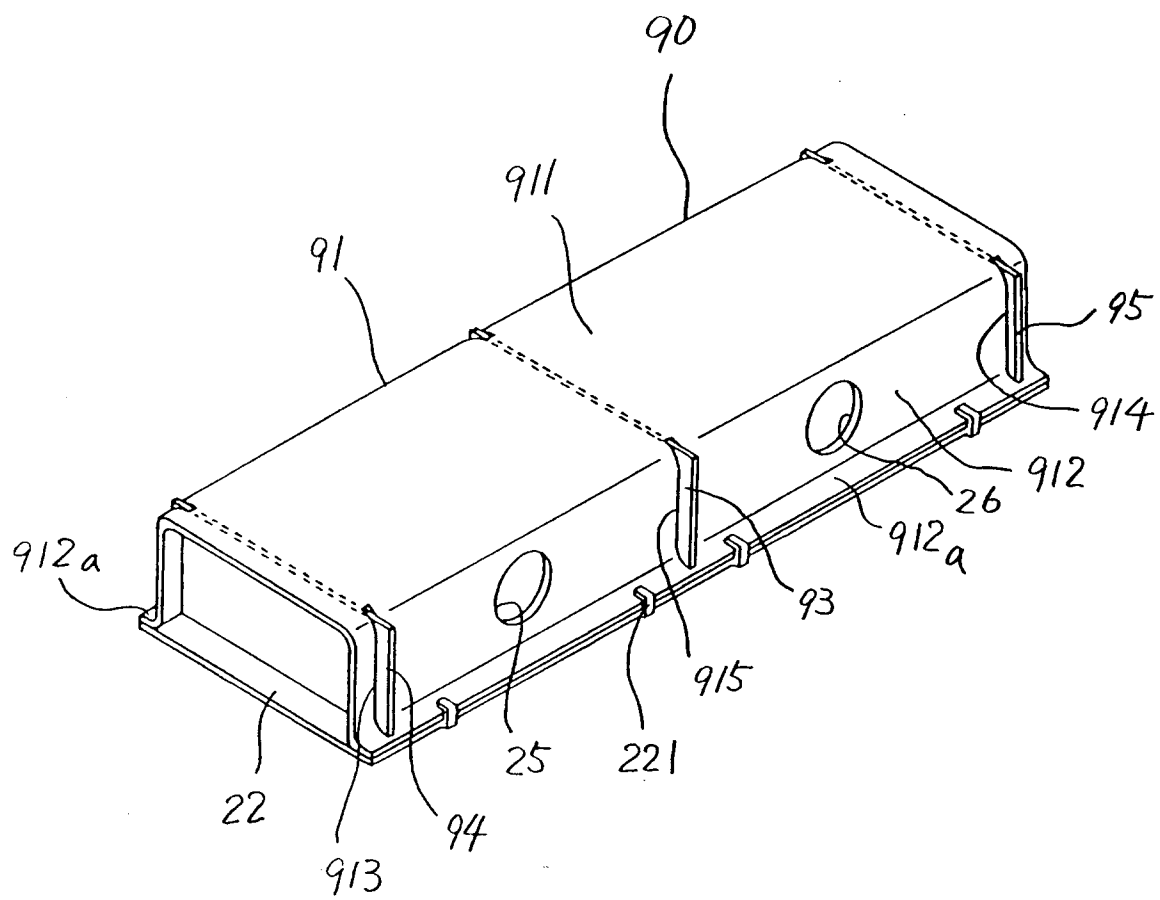


Fig. 15





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 96 10 8486

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	EP-A-0 564 761 (LÄNGERER & REICH GMBH & CO) * column 10, line 10 - column 10, line 20 * * column 11, line 32 - column 12, line 18; figures 1,6 *	1-4,11	F28F9/02
Y	---	5,8	
Y	EP-A-0 379 701 (SÜDDEUTSCHE KÜHLERFABRIK BEHR GMBH & CO KG) * figures 11,12 *	5,8	
A	-----	6,7,9,10	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			F28F
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 21 August 1996	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 (P4/C01)