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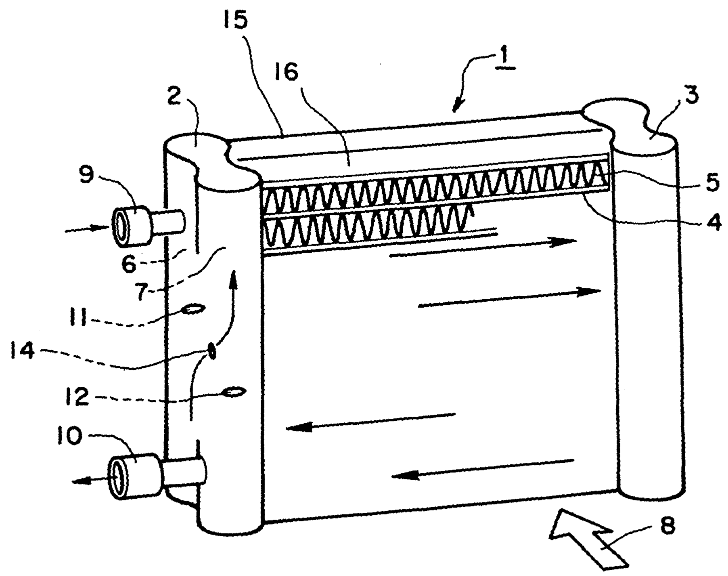
(54) Heat exchanger

(57) A heat exchanger (1) having at least one header (2), the whole of which is integrally formed by extrusion or drawing and in which a plurality of fluid passages are provided in parallel to each other and parted from each other, and a plurality of tubes (4), characterized in that a first partition (11) is provided in a first fluid passage, a second partition (12) is provided in a second fluid passage at a position different from a position of the first partition (11) in a fluid passage extending direction, and a communication path (14) is provided to a partition wall parting the first and second passages from each other at a position between the first and second partitions (11, 12) to communicate the first and second passages with each other. A counter flow structure suitable for a heat exchanger using carbon dioxide refrigerant can be easily realized at a simple assembling work and a high processing accuracy.

FIG. 1



Description

[0001] The present invention relates to a heat exchanger, and, more specifically, to a heat exchanger suitable as a radiator and the like used in a refrigeration cycle using carbon dioxide as its refrigerant.

[0002] Carbon dioxide has been paid attention to as a refrigerant to be substituted for a fleon group refrigerant which has been used in a refrigeration cycle. In a case of using carbon dioxide as refrigerant, various alterations are required also with respect to the structure of a heat exchanger, as compared with a case where a fleon group refrigerant has been used.

[0003] For example, in a heat exchanger for carbon dioxide, it is known that a flow of refrigerant called "counter flow" is effective, from the viewpoint of the property that carbon dioxide does not condense (for example, JP-A-2001-147095 and JP-A-2004-77079). Namely, in the refrigeration cycle of fleon group refrigerant, because the refrigerant is in a gas/liquid mixing phase condition over almost the entire area of the condensing route, the temperature of the refrigerant is maintained at its condensing temperature. Therefore, by employing a so-called cross-flow type heat exchanger, in which the condensing route is disposed at a snaking form along a plane perpendicular to a flow direction of outside air for heat exchange, a sufficiently great temperature difference between the air for cooling and the refrigerant can be ensured over the entire area of the condensing route, and a high efficiency of heat exchange can be achieved. On the other hand, in a refrigeration cycle using carbon dioxide as its refrigerant, because the refrigerant operates at a supercritical condition which does not accompany a phase change particularly in a radiation process of a high-pressure circuit side, the refrigerant temperature gradually reduces as proceeding from the entrance side to the exit side of the radiation route. In a cross-flow type heat exchanger, because air for cooling having a substantially constant temperature is introduced over the entire area of the radiation route, in a case where this cross-flow type heat exchanger is used as a gas cooler (a radiator) and the like of a refrigeration cycle for refrigerant of carbon dioxide, the temperature difference between the refrigerant and the air for cooling becomes great at the entrance side of the route and becomes small at the exit side of the route, and a high efficiency for heat exchange cannot be obtained as a whole. Accordingly, as described above, by using a so-called counter-flow type heat exchanger, the temperature difference between air for cooling and refrigerant can be ensured sufficiently great over the entire area of the route, and the efficiency for heat exchange can be increased.

[0004] Further, because the refrigerant of carbon dioxide is to be used at a high pressure from the property thereof, a high pressure resistance is required to a header and the like of the heat exchanger. As a header structure satisfying such a high pressure-resistance performance, it is known that a structure of a header formed integrally by extrusion or drawing is effective, and in particular, it is known that, even in a case where twin fluid (refrigerant) passages are formed in a single header, while a high pressure-resistance performance can be ensured, the processing performance for production also can be improved (for example, JP-A-11-226685).

[0005] However, this JP-A-11-226685 only discloses a structure wherein merely parallel refrigerant flows are simultaneously formed in a direction across the flow direction of outside air for heat exchange. Further, although the above-described JP-A-2004-77079 discloses a structure of counter flow, it only shows a structure wherein the refrigerant flows merely at a snaking condition in the heat exchanger core portions which are disposed adjacent to each other relative to the flow direction of outside air for heat exchange, and therefore, it is difficult to say that this JP-A-2004-77079 shows an optimum formation of refrigerant flow on a viewpoint of heat exchange performance. On the other hand, in the above-described JP-A-2001-147095, because the refrigerant flows so as to go and return in the respective insides of the heat exchanger core portions disposed adjacent to each other, it is possible to obtain a high efficiency for heat exchange performance as the entire heat exchanger.

[0006] In the structure of this JP-A-2001-147095, however, the headers of one heat exchanger core portion are formed separately from the headers of the other heat exchanger core portion disposed adjacent to the above-described one heat exchanger core portion, both headers are communicated by an exterior pipe, and therefore, in such a structure, not only a high pressure-resistance performance as in JP-A-11-226685 cannot be expected, but also the assembling work of the entire heat exchanger becomes complicated. Further, because the respective headers are made independently, dispersion on processing may occur in the dimension and pitch of the tube insertion holes.

[0007] It would be desirable to provide a heat exchanger which can realize an optimum counter-flow structure for use of carbon dioxide refrigerant with simple assembling work, simple processing and high processing accuracy, while particularly ensuring a high pressure-resistance performance of a header portion.

[0008] A heat exchanger according to the present invention has at least one header, the whole of which is integrally formed by extrusion or drawing and in which a plurality of fluid passages are provided in parallel to each other and parted from each other, and a plurality of tubes which are connected to the header so that an end of each of which communicates with each of the fluid passages, and is characterized in that a first partition is provided in a first fluid passage which is one of fluid passages adjacent to each other in the header, a second partition is provided in a second fluid passage which is the other of the fluid passages adjacent to each other at a position different from a position of the first partition in a fluid passage extending direction, and a communication path is provided to a partition wall parting the first and second passages from each other at a position between the first and second partitions to communicate the first and second passages with each other.

[0009] In this heat exchanger, since a plurality of fluid passages (for example, two fluid passages) parted from each other by a partition wall are formed so as to extend in parallel to each other in a single header which is integrally formed by extrusion or drawing (that is, a molding method capable of easily molding a header accurately at a uniform predetermined thickness), as compared with a case where headers each having a fluid passage are formed separately, a high pressure resistance can be easily ensured, and because tube insertion holes may be processed relative to a single header, the dimension and pitch of the tube insertion holes can be processed at a higher accuracy, and the dimensional accuracy as the whole of the heat exchanger can be increased.

[0010] Further, since the first and second partitions are provided to the first and second fluid passages adjacent to each other, respectively, a route structure where fluid can go and return can be employed for each of a first heat exchanger core portion formed by using the first fluid passage and a second heat exchanger core portion formed by using the second fluid passage, and a high heat exchange performance can be achieved as the entire heat exchanger.

[0011] Further, since the first partition and the second partition are disposed so as to shift from each other in the fluid passage extending direction, and the communication path is provided to the partition wall between the first and second passages at a position between the first and second partitions, an external communication path becomes unnecessary, and a desirable heat exchanger can be realized by a simple assembling work. In particular, even in a case where a plurality of heat exchanger core portions, each of which comprises a plurality of tubes arranged in parallel to each other and fluid passages in headers communicated to both ends of the tubes, are disposed adjacent to each other in a flow direction of outside air for heat exchange, and fluid flows in the heat exchanger core portions disposed adjacent to each other so as to form a counter flow relative to the flow direction of outside air for heat exchange, a target counter-flow type heat exchanger can be realized easily and surely. Namely, a counte'r-flow type heat exchanger optimum for a refrigeration cycle using fluid of carbon dioxide can be realized.

[0012] The above-described communication path may be provided by post-processing of the header from outside (for example, by carrying out hole-opening processing or cutting from the outer surface side of the header, and processing a through hole and the like, functioning as the communication path, on the above-described partition wall), and an opening formed on the outer surface of the header by this post-processing may be closed by providing a lid member or welding. Namely, by processing from outside of the header, a desirable communication path can be easily provided.

[0013] Further, in the present invention, in addition to the above-described structure, a structure may be employed wherein a pipe reinforcing portion extending up to an inlet pipe for introducing fluid into the header or an outlet pipe for discharging fluid from the header to support the inlet pipe or the outlet pipe is provided integrally with a partition member forming the first or second partition. Alternatively, a structure may be employed wherein a pipe reinforcing portion extending up to an inlet pipe for introducing fluid into the header or an outlet pipe for discharging fluid from the header to support the inlet pipe or the outlet pipe is provided integrally with the above-described lid member. Thus, it is possible to reinforce the inlet pipe or the outlet pipe by utilizing the partition member or the lid member, and the strength of the heat exchanger may be increased as a whole.

[0014] Another heat exchanger according to the present invention has at least one header, the whole of which is integrally formed by extrusion or drawing and in which a plurality of fluid passages are provided in parallel to each other and parted from each other, and a plurality of tubes which are connected to the header so that an end of each of which communicates with each of the fluid passages, and is characterized in that a first partition is provided in a first fluid passage which is one of fluid passages adjacent to each other in the header, a second partition is provided in a second fluid passage which is the other of the fluid passages adjacent to each other at a position different from a position of the first partition in a fluid passage extending direction, and a communication path is processed relative to a partition wall parting the first and second passages from each other at a position between the first and second partitions to communicate the first and second passages with each other, together with processing of a tube insertion hole in the header.

[0015] Also in this heat exchanger, similarly to the aforementioned heat exchanger according to the present invention, since a plurality of fluid passages (for example, two fluid passages) parted from each other by a partition wall are formed so as to extend in parallel to each other in a single header which is integrally formed by extrusion or drawing (that is, a molding method capable of easily molding a header accurately at a uniform predetermined thickness), as compared with a case where headers each having a fluid passage are formed separately, a high pressure resistance can be easily ensured, and because tube insertion holes may be processed relative to a single header, the dimension and pitch of the tube insertion holes can be processed at a higher accuracy, and the dimensional accuracy as the whole of the heat exchanger can be increased.

[0016] Further, since the first and second partitions are provided to the first and second fluid passages adjacent to each other, respectively, a route structure where fluid can go and return can be employed for each of a first heat exchanger core portion formed by using the first fluid passage and a second heat exchanger core portion formed by using the second fluid passage, and a high heat exchange performance can be achieved as the entire heat exchanger.

[0017] Further, since the first partition and the second partition are disposed so as to shift from each other in the fluid passage extending direction, and the communication path is provided to the partition wall between the first and second passages at a position between the first and second partitions, an external communication path becomes unnecessary, and a desirable heat exchanger can be realized by a simple assembling work. In particular, even in a case where a plurality of heat exchanger core portions, each of which comprises a plurality of tubes arranged in parallel to each other and fluid passages in headers communicated to both ends of the tubes, are disposed adjacent to each other in a flow direction of outside air for heat exchange, and fluid flows in the heat exchanger core portions disposed adjacent to each other so as to form a counter flow relative to the flow direction of outside air for heat exchange, a target counter-flow type heat exchanger can be realized easily and surely. Namely, a counter-flow type heat exchanger optimum for a refrigeration cycle using fluid of carbon dioxide can be realized.

[0018] The above-described communication path may be formed extremely easily by cutting away a part of the partition wall by utilizing the processing of the tube insertion hole of the header. Although an opening of the header extending from the outer surface of the header to a communication path forming portion of the partition wall is formed in this processing of the tube insertion hole, a portion except the communication path in the opening of the header formed by the processing of the tube insertion hole may be closed by a tube itself inserted into the opening. Namely, while a necessary seal structure relative to the first and second fluid passages can be achieved by utilizing the tube itself, a desirable communication path between both fluid passages can be surely formed.

[0019] Thus, in the present invention, a heat exchanger, which has a high pressure-resistance performance and can realize an optimum counter-flow structure particularly in a case using refrigerant of carbon dioxide with simple processing and assembling work and at a high processing accuracy, can be provided.

[0020] Further features and advantages of the present invention will be understood from the following detailed description of the preferred embodiments of the present invention with reference to the accompanying figures, of which:

Fig. 1 is a schematic perspective view of a heat exchanger according to an embodiment of the present invention.
Figs. 2A and 2B are cross-sectional views of headers of the heat exchanger depicted in Fig. 1, each showing an example of a cross-sectional form of a header.
Fig. 3 is a cross-sectional view of a header, showing an example of a method for forming a communication path in the header.
Fig. 4 is a partial perspective view of a header, showing an example of a method for closing an opening on an outer surface of the header after processing of a communication path and providing partitions.
Fig. 5 is a partial, vertical sectional view of a header, showing a structure around a communication path.
Fig. 6 is a cross-sectional view of a header and a lid member, showing another example of a method for forming a communication path in the header.
Fig. 7 is a perspective view of the portion depicted in Fig. 6.
Fig. 8 is a cross-sectional view of a header after inserting and fixing the lid member.
Fig. 9 is a perspective view of a partition portion of a header and a partition member formed integrally with a pipe reinforcing portion, showing an example of a method for reinforcing an inlet pipe.
Fig. 10 is a perspective view of a portion around an inlet pipe after attaching the partition member formed integrally with the pipe reinforcing portion depicted in Fig. 9.
Fig. I 1 is a cross-sectional view of a header, showing an example of a method for processing a tube insertion hole at a communication path forming portion according to another embodiment of the present invention.
Fig. 12 is a cross-sectional view of the header depicted in Fig. 11, showing a state inserted with a tube into an opening depicted in Fig. 11.
Fig. 13 is a cross-sectional view of the header depicted in Fig. 11, showing an example of a tube insertion hole at a portion where a corrimunication path is not formed.
Fig. 14 is a cross-sectional view of the header depicted in Fig. 13, showing a state inserted with a tube into an opening depicted in Fig. 13.
Fig. 15 is a partial perspective view of a header, showing an example of a method for providing partitions.
Fig. 16 is a partial, vertical sectional view of a header, showing a structure around a communication path.

[0021] Fig. 1 depicts a heat exchanger 1 according to an embodiment of the present invention. Heat exchanger 1 comprises a pair of headers 2, 3, a plurality of tubes 4 both ends of each of which are communicated with the respective headers 2, 3, and fins 5 disposed between tubes 4. As depicted in Fig. 2, each of headers 2, 3 is integrally formed as a whole by extrusion or drawing, it is formed as a structure wherein a plurality of fluid passages 6, 7 (in this embodiment, two fluid passages) extend in parallel to each other in the header at a condition where the passages are parted from each other, and the cross section thereof is formed as a shape of glasses as shown in Figs. 2A and 2B. Among two headers 2, 3, in one header 2, an inlet pipe 9 for introducing fluid (for example, refrigerant) into fluid passage 6 (a first fluid passage) positioned at a downstream side relative to flow direction 8 of outside air for heat exchange, and an outlet pipe 1 0 for discharging the fluid from fluid passage 7 (a second fluid passage) positioned at an upstream side relative to flow direction 8 of outside air for heat exchange, are provided, respectively. A first partition 11 is provided in first fluid passage 6, and a second partition 12 is provided in second fluid passage 7, respectively. A communication path 14 communicating between first and second fluid passages 6, 7 is provided to a partition wall 13 (shown in Fig. 3) parting first fluid passage 6 from second fluid passage 7 at a position between both partitions 11, 12. The inside of each tube 4 is divided into an interior passage communicating with the side of first fluid passage 6 and an interior passage communicating with the side of second fluid passage 7, and the fluid flows independently in the respective interior passages. Namely, one heat exchanger core portion 15 is formed at a downstream side of flow direction 8 of outside air for heat exchange by the one-side interior passages of a plurality of tubes 4 disposed in parallel to each other and first fluid passages 6 of headers 2, 3 communicated to both ends of the interior passages of the tubes 4, the other heat exchanger core portion 16 is formed at an upstream side of flow direction 8 of outside air for heat exchange by the other-side interior passages of the plurality of tubes 4 and second fluid passages 7 of headers 2, 3 communicated to both ends of the interior passages of the tubes 4, and these heat exchanger core portions 15, 16 are disposed adjacent to each other in the flow direction 8 of outside air for heat exchange.

[0022] In heat exchanger I thus constructed, fluid (for example, refrigerant) flows in the heat exchanger 1 as shown by the arrows in Fig. 1. Namely, fluid introduced from inlet pipe 9 is sent from first fluid passage 6 positioned at an upper portion of header 2 into first fluid passage 6 positioned at an upper portion of header 3 through one-side interior passages of tubes 4 disposed at an upper portion of heat exchanger core portion 15 positioned at a downstream side in flow direction 8 of outside air for heat exchange, and after the fluid flows downward in first fluid passage 6 of header 3, the fluid is returned from first fluid passage 6 positioned at a lower portion of header 3 into first fluid passage 6 positioned at a lower portion of header 2 through one-side interior passages of tubes 4 disposed at a lower portion of heat exchanger core portion 15. The fluid returned into first fluid passage 6 of header 2 is sent into second fluid passage 7 positioned at an upper portion of header 2 through communication path 14, and from there, sent into second fluid passage 7 positioned at an upper portion of header 3 through the other-side interior passages of tubes 4 disposed at an upper portion of heat exchanger core portion 16 positioned at an upstream side in flow direction 8 of outside air for heat exchange, and after the fluid flows downward in second fluid passage 7 of header 3, the fluid is returned from second fluid passage 7 positioned at a lower portion of header 3 into second fluid passage 7 positioned at a lower portion of header 2 through the other-side interior passages of tubes 4 disposed at a lower portion of heat exchanger core portion 16, and then, the fluid is discharged from outlet pipe 10. Thus, the fluid goes and returns in heat exchanger core portion 15 positioned at a downstream side in flow direction 8 of outside air for heat exchange, and thereafter, it goes and returns in heat exchanger core portion 16 positioned at an upstream side in flow direction 8 of outside air for heat exchange. Therefore, as viewed as the whole of heat exchanger 1, the flow of fluid forms a counter flow relative to flow direction 8 of outside air for heat exchange.

[0023] In this heat exchanger 1, each of headers 2, 3 is integrally formed by extrusion or drawing with a cross-sectional shape having first and second fluid passages 6, 7 therein. Because of integral forming, the wall forming first and second fluid passages 6, 7 is formed at a uniform thickness easily and accurately, and high pressure-resistance performance and strength of headers 2, 3 can be easily realized. In particular, a high pressure-resistance performance required in a case where carbon dioxide refrigerant is used can be easily achieved. Further, the holes for inserting tubes 4 each having separated interior passages can be formed by processing tube insertion holes relative to a single header 2 or 3 having first and second fluid passages 6, 7, and therefore, the tube insertion holes can be processed at a high accuracy in dimension and pitch. As a result, the dimensional accuracy of the whole of heat exchanger 1 may be increased.

[0024] Further, since the fluid flows so as to go and return in each of heat exchanger core portions 15, 16 disposed adjacent to each other, a high heat exchange performance can be obtained as the whole of heat exchanger 1. Since this flow route of the fluid is formed as a route for sending the fluid from heat exchanger core portion 15 positioned at a downstream side in flow direction 8 of outside air for heat exchange to heat exchanger core portion 16 positioned at an upstream side in flow direction 8 of outside air for heat exchange, a counter flow optimum for a case where carbon dioxide refrigerant is used can be efficiently achieved by heat exchanger 1 having a compact structure.

[0025] Communication path 14 necessary for forming such a counter flow can be provided easily by a method shown in Figs. 3 to 5 or a method shown in Figs. 6 to 8. In the method shown in Figs. 3 to 5, as depicted in Fig. 3, header 2 is processed from outside, especially, holes are processed from outside, and a through hole is formed on partition wall 13 and this hole is provided as communication path 14. In this processing for opening a hole, although a through hole 17 is formed also on the outer surface of header 2, this through hole 17 may be closed with an appropriate lid member 18 or may be welded after closing, as shown in Figs. 4 and 5. Depending upon the size of through hole 17, it is possible to close merely by welding without using lid member 18. In the example shown in the figures, although only one communication path 14 is provided, as needed, a plurality of communication paths may be provided. In a case of a plurality of communication paths, it is preferred that the communication paths are arranged in the longitudinal direction of header 2, relative to partition wall 13 positioned between first and second partitions 11, 12. By providing a plurality of communication paths, an amount of fluid necessary and enough to be communicated can be ensured. With respect to first and second partitions 11, 12, by a conventional method as shown in Figs. 4 and 5, after spaces 19, 20 for installing partitions are formed by cutting and the like, partition members 21, 22 are inserted into the spaces 19, 20 and fixed, and gaps may be closed by welding and the like, and thus, the first and second partitions 11, 12 can be easily provided.

[0026] In the method shown in Figs. 6 to 8, as depicted in Figs. 6 and 7, a portion around first and second fluid passages 6, 7 and partition wall 13 are partially cut away from outside of header 2 by processing of cutting and the like, and a lid member 24 is inserted into and fixed in a space 23 formed by the cutting so as to close a portion of the space 23 corresponding to the outer wall of header 2, or welded after the insertion. By providing lid member 24, as depicted in Fig. 8, while predetermined first and second fluid passages 6, 7 are formed, therebetween a communication path 25 is formed. The size of the cross section of this communication path 25 may be appropriately changed as needed, and further, the number of the communication paths may be appropriately set as needed.

[0027] In this embodiment, as described above, since lid member 18 or 24 and partition members 21, 22 are inserted and fixed from outside in order to form communication path 14 or 25 and first and second partitions 11, 12, it is possible to give a function for reinforcing inlet and outlet pipes 9, 10 to these members. Namely, it is possible to give a function as a bracket for reinforcing inlet and outlet pipes 9, 10.

[0028] For example, as an example of a case where inlet pipe 9 is reinforced by using a partition member for forming first partition 11 is shown in Figs. 9 and 10, a partition member 31 is formed as a member extending up to inlet pipe 9, a pipe reinforcing portion 32 for supporting inlet pipe 9 is provided at a one end thereof to reinforce the inlet pipe 9, and the other end thereof is inserted into and fixed in partition installing space 19 to form first partition 11. Namely, this partition member 31 is formed as a pipe reinforcing portion integrally formed type partition member. A similar structure can be employed for the side of outlet pipe 10 though it is not depicted. Further, it is also possible to give such a pipe reinforcing function to lid member 18 or 24 closing the opening after forming communication path 14 or 25.

[0029] Figs. 11 to 16 show an example of a method for making a heat exchanger according to another embodiment of the present invention. In this embodiment, a communication path, similar to communication path 14 shown in Fig. 1, necessary for forming a counter flow optimum for a case where carbon dioxide refrigerant is used, can be provided easily by a simple method utilizing the processing of tube insertion hole, as shown in Figs. 11 to 16.

[0030] As depicted in Fig. 11, when a tube insertion hole is processed on header 2, and when an opening 41 for tube insertion is formed in header 2 from outside, the cutting is carried out up to a portion for forming communication path 14, and in this portion, the communication path 14 for communicating between first and second fluid passages 6, 7 is formed. As depicted in Fig. 12, an end of tube 4 is inserted into opening 41 provided as a tube insertion hole, and fixed (welded as needed), and by closing a portion except communication path 14, a sealability necessary for first and second fluid passages 6, 7 can be given. The portion corresponding to communication path 14 is not closed by the end of tube 4, and the portion is left as it is as the communication path 14 having a necessary area of cross section. Thus, it is possible to form communication path 14 extremely easily by utilizing the processing of tube insertion hole and without providing a particular member for closing.

[0031] With respect to a portion of header 2 in which communication path 14 is not provided, a tube insertion hole 42 is formed at a condition where partition wall 13 is left as depicted in Fig. 13, and as depicted in Fig. 14, an end of tube 4 is inserted so as to come into contact with the partition wall 13 left and fixed (welded as needed), and while the formation of first and second fluid passages 6, 7 parted from each other by partition wall 13 is left, a target communication structure between the respective fluid passages 6, 7 and the respective interior passages in tube 4 can be achieved.

[0032] Although only one communication path 14 is provided in this example, as needed, a plurality of communication paths may be provided. In a case of a plurality of communication paths, it is preferred that the communication paths are arranged in the longitudinal direction of header 2, relative to partition wall 13 positioned between first and second partitions 11, 12, namely, it is preferred to form the plurality of communication paths by utilizing the processing of a plurality of tube insertion holes in this portion. By providing a plurality of communication paths, an amount of fluid necessary and enough to be communicated can be ensured.

[0033] With respect to first and second partitions 11, 12, they may be provided similarly to that shown in Fig. 4. Namely, as depicted in Fig. 15, after spaces 19, 20 for installing partitions are formed by cutting and the like, partition members 21, 22 are inserted into the spaces 19, 20 and fixed, and gaps may be closed by welding and the like, and thus, the first and second partitions 11, 12 can be easily provided.

[0034] As depicted in Fig. 16, by forming communication path 14 by utilizing a tube insertion hole described above, communication path 14 for realizing the flow of fluid shown in Fig. I can be easily provided at a position between first and second partitions 11, 12. The size of the cross section of communication path 14 may be appropriately changed as needed, and more concretely, it is possible to easily change it by adjusting an amount of cutting of partition wall 13 at the time of processing of opening 41.

[0035] Although a case of providing two fluid passages 6, 7 in a single header 2 or 3 is explained in the above-described embodiments, three or more fluid passages may be provided. In such a case, a structure may be employed wherein a partition is provided in a third fluid passage or the following fluid passage, and a further heat exchanger core portion is provided in addition to the above-described heat exchanger core portions 15, 16.

[0036] The heat exchanger according to the present invention has a high pressure-resistance performance and can be manufactured at a high accuracy and a compact structure to form a counter flow formation easily, and therefore, it is suitable particularly as a heat exchanger using carbon dioxide refrigerant.

Claims

1. A heat exchanger having at least one header, the whole of which is integrally formed by extrusion or drawing and in which a plurality of fluid passages are provided in parallel to each other and parted from each other, and a plurality of tubes which are connected to said header so that an end of each of which communicates with each of said fluid passages, **characterized in that** a first partition is provided in a first fluid passage which is one of fluid passages adjacent to each other in said header, a second partition is provided in a second fluid passage which is the other of said fluid passages adjacent to each other at a position different from a position of said first partition in a fluid passage extending direction, and a communication path is provided to a partition wall parting said first and second passages from each other at a position between said first and second partitions to communicate said first and second passages with each other.

2. The heat exchanger according to claim 1, wherein said communication path is provided by post-processing of said header from outside, and an opening formed by said post-processing is closed by providing a lid member or welding.

3. The heat exchanger according to claim 1 or 2, wherein a pipe reinforcing portion extending up to an inlet pipe for introducing fluid into said header or an outlet pipe for discharging fluid from said header to support said inlet pipe or said outlet pipe is provided integrally with a partition member forming said first or second partition.

4. The heat exchanger according to claim 2, wherein a pipe reinforcing portion extending up to an inlet pipe for introducing fluid into said header or an outlet pipe for discharging fluid from said header to support said inlet pipe or said outlet pipe is provided integrally with said lid member.

5. The heat exchanger according to any preceding claim, wherein a plurality of heat exchanger core portions, each of which comprises a plurality of tubes arranged in parallel to each other and fluid passages in headers communicated to both ends of said tubes, are disposed adjacent to each other in a flow direction of outside air for heat exchange, and fluid flows in said heat exchanger core portions disposed adjacent to each other so as to form a counter flow relative to said flow direction of outside air for heat exchange.

6. The heat exchanger according to any preceding claim, wherein fluid used is carbon dioxide.

7. A heat exchanger having at least one header, the whole of which is integrally formed by extrusion or drawing and in which a plurality of fluid passages are provided in parallel to each other and parted from each other, and a plurality of tubes which are connected to said header so that an end of each of which communicates with each of said fluid passages, **characterized in that** a first partition is provided in a first fluid passage which is one of fluid passages adjacent to each other in said header, a second partition is provided in a second fluid passage which is the other of said fluid passages adjacent to each other at a position different from a position of said first partition in a fluid passage extending direction, and a communication path is processed relative to a partition wall parting said first and second passages from each other at a position between said first and second partitions to communicate said first and second passages with each other, together with processing of a tube insertion hole in said header.

8. The heat exchanger according to claim 7, wherein a portion except said communication path in an opening of said header formed by said processing of said tube insertion hole is closed by a tube itself inserted into said opening.

9. The heat exchanger according to claim 7 or 8, wherein a plurality of heat exchanger core portions, each of which comprises a plurality of tubes arranged in parallel to each other and fluid passages in headers communicated to both ends of said tubes, are disposed adjacent to each other in a flow direction of outside air for heat exchange, and fluid flows in said heat exchanger core portions disposed adjacent to each other so as to form a counter flow relative to said flow direction of outside air for heat exchange.

10. The heat exchanger according to any of claims 7 to

9, wherein fluid used is carbon dioxide.

FIG. 1

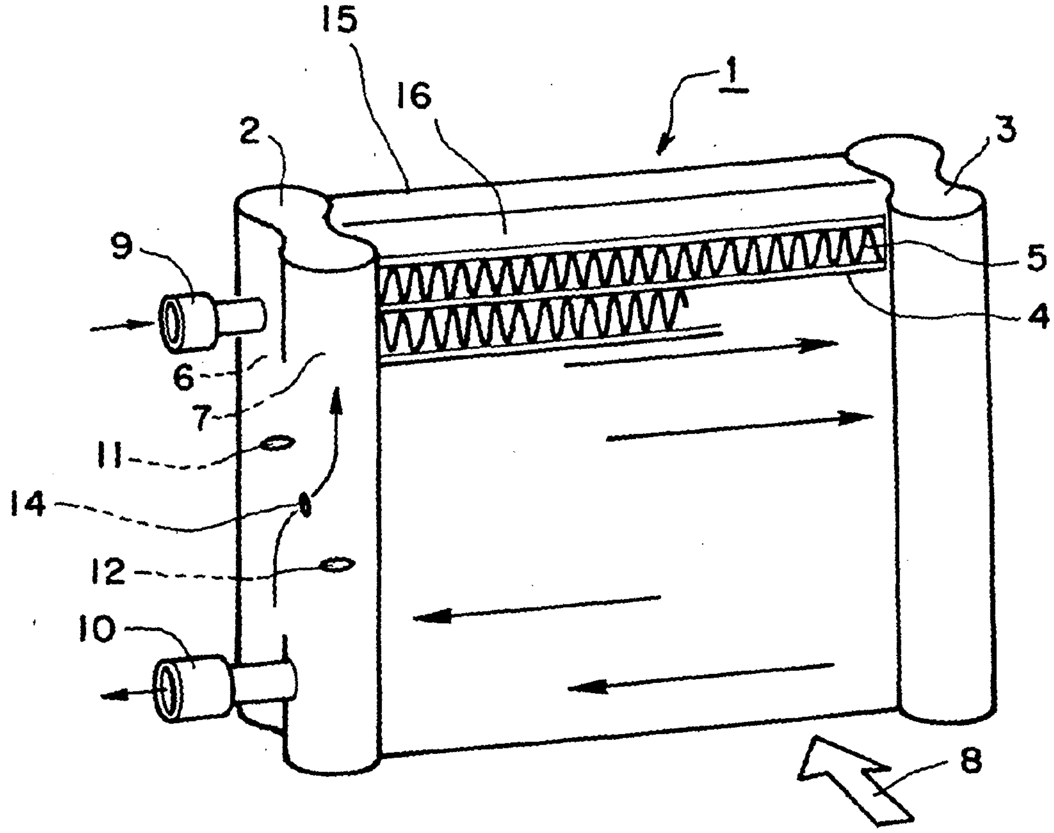


FIG. 2A

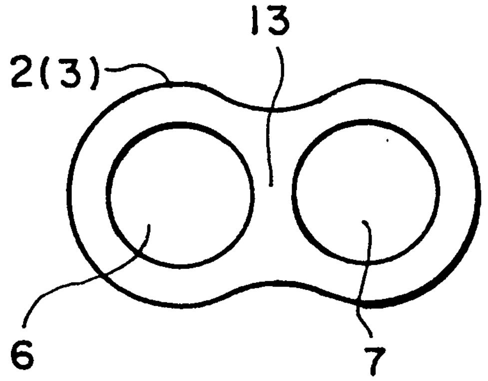


FIG. 2B

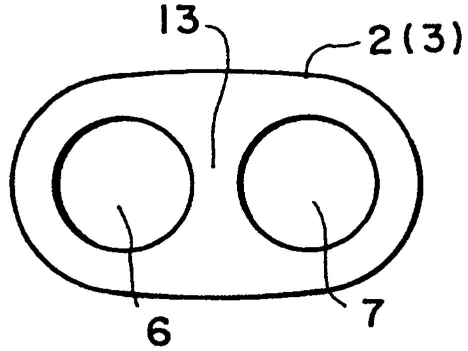


FIG. 3

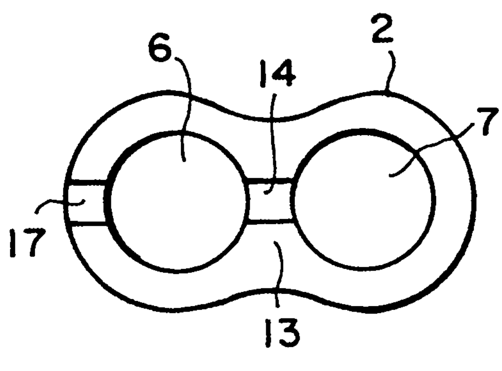


FIG. 4

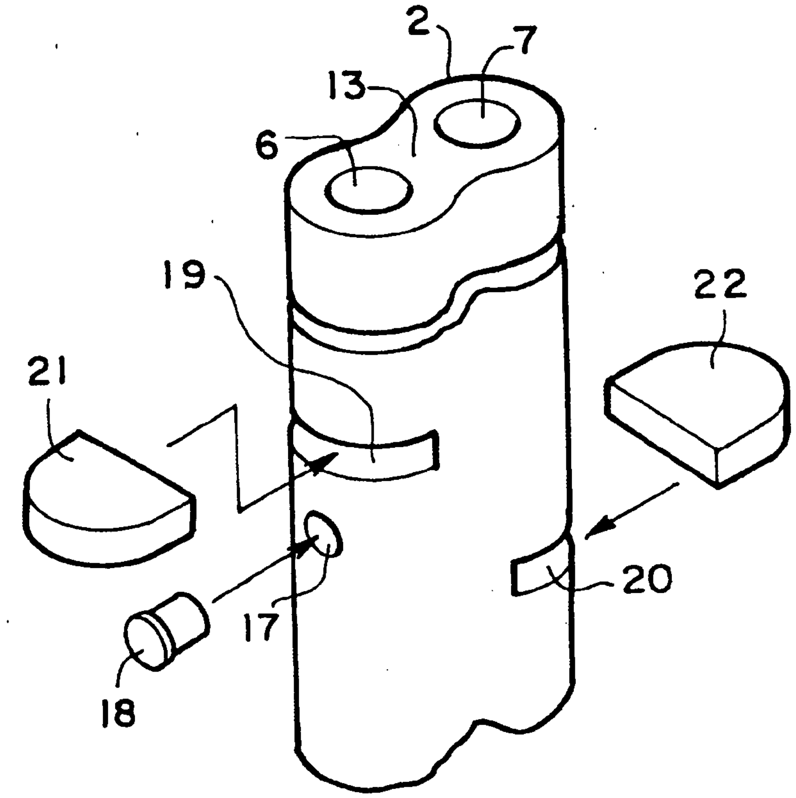


FIG. 5

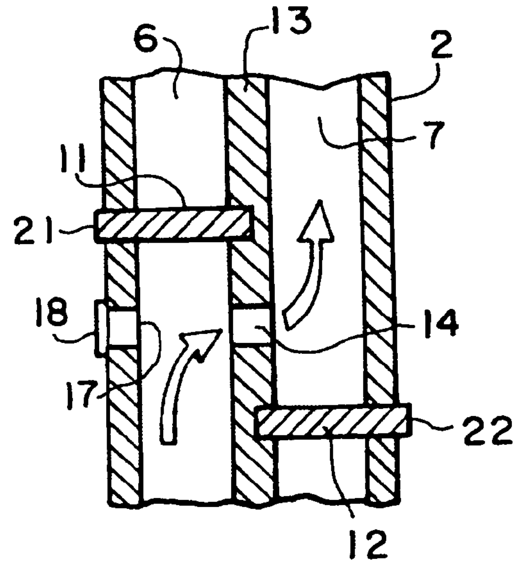


FIG. 6

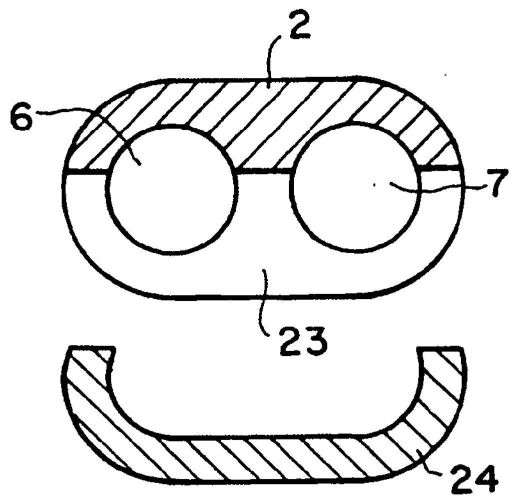


FIG. 7

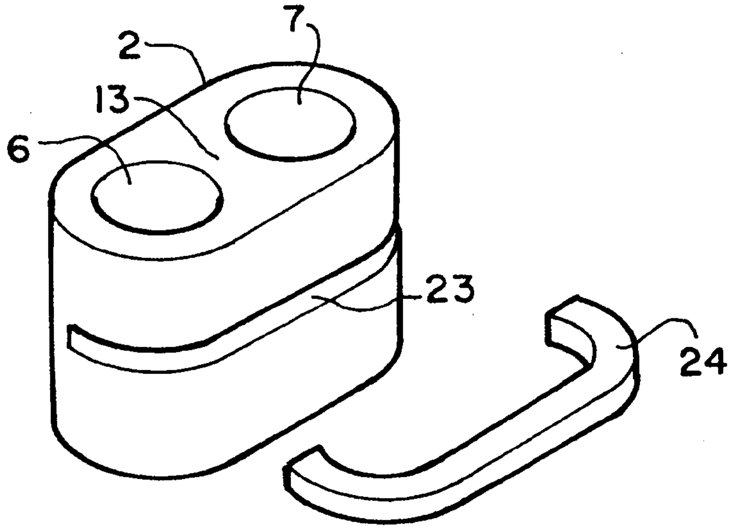


FIG. 8

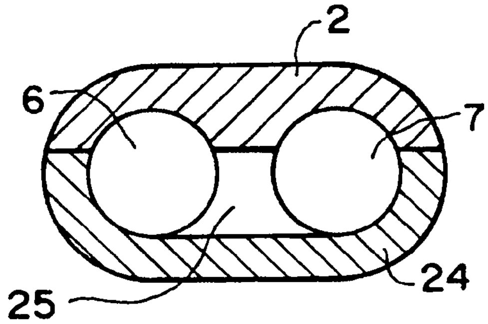


FIG. 9

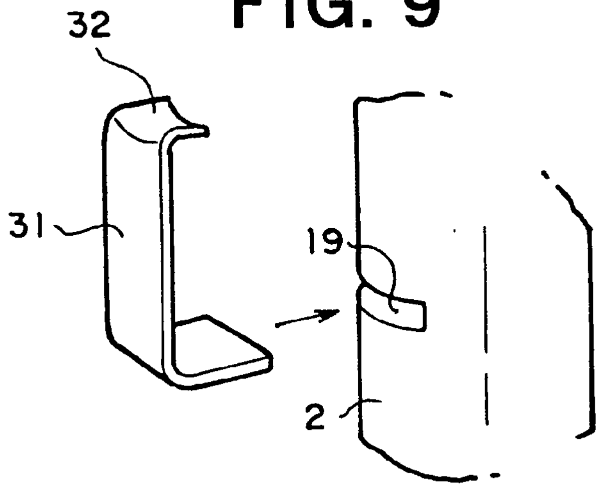


FIG. 10

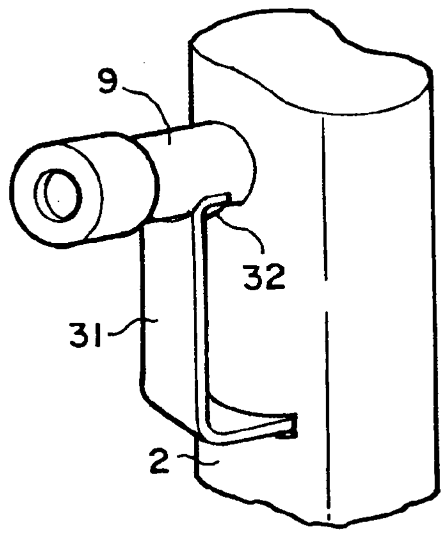


FIG. 11

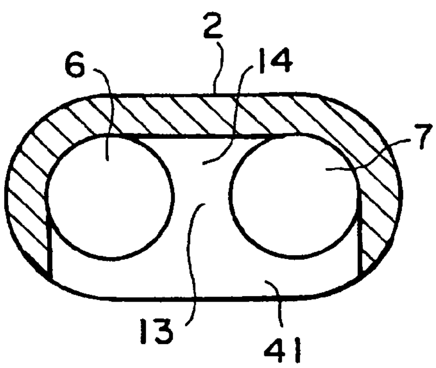


FIG. 12

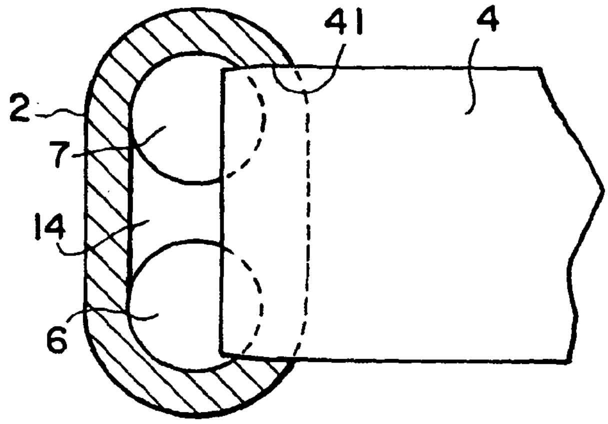


FIG. 13

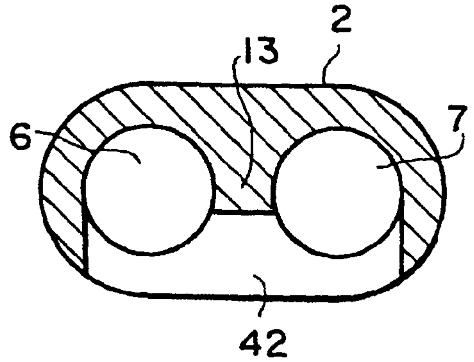


FIG. 14

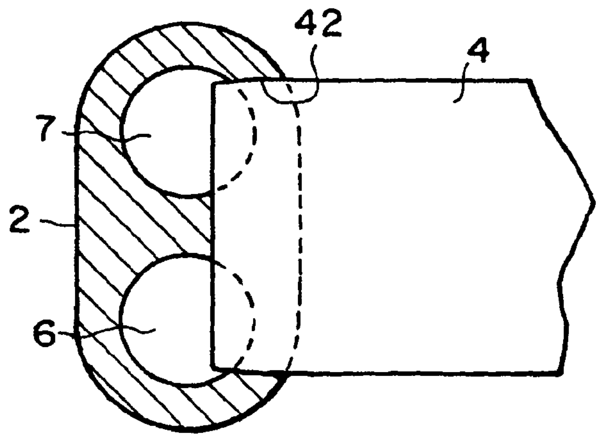


FIG. 15

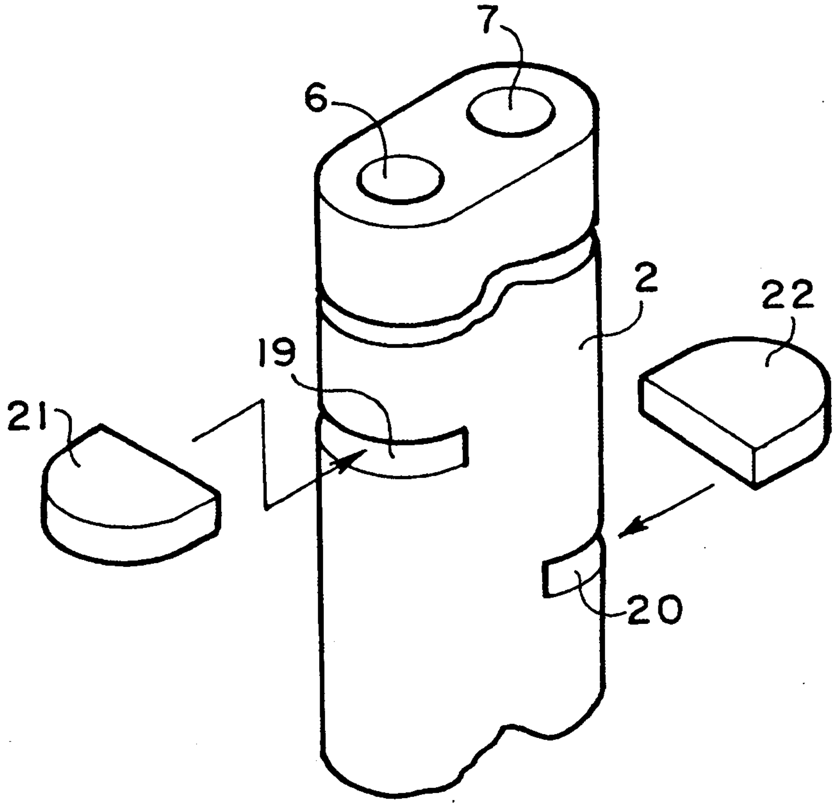
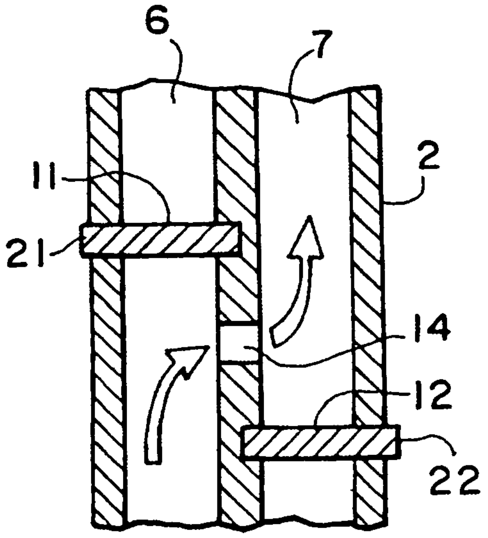


FIG. 16



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EUROPEAN SEARCH REPORT

Application Number
EP 05 25 7011

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 6 189 604 B1 (YAMAUCHI YOSHIYUKI ET AL) 20 February 2001 (2001-02-20) * column 7, line 40 - column 8, line 18; figure 3 * -----	1-6	F28F9/02 F28D1/053
X	US 6 176 303 B1 (KOBAYASHI OSAMU ET AL) 23 January 2001 (2001-01-23) * abstract; figures 3B,3C * * column 2 - column 4 * -----	1,6-10	
X	PATENT ABSTRACTS OF JAPAN vol. 2003, no. 04, 2 April 2003 (2003-04-02) -& JP 2002 372383 A (CALSONIC KANSEI CORP), 26 December 2002 (2002-12-26) * abstract; figure 7 * -----	1-6	
A	PATENT ABSTRACTS OF JAPAN vol. 2000, no. 02, 29 February 2000 (2000-02-29) & JP 11 325784 A (DENSO CORP), 26 November 1999 (1999-11-26) * abstract * -----	1-10	TECHNICAL FIELDS SEARCHED (IPC) F28F F28D
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The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	14 February 2006	Bain, D

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