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**(54) HEAT EXCHANGER HAVING BAFFLED MANIFOLDS**

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(56) References cited:

**WO-A2-2006/083451**

**WO-A2-2008/048505**

**US-A- 2 555 055**

**US-A- 4 079 782**

**US-A- 4 524 823**

**US-A- 5 203 407**

**US-A1- 2005 045 312**

**US-A1- 2005 132 744**

**US-A1- 2006 102 332**

**US-A1- 2007 039 724**

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## Description

### BACKGROUND OF THE INVENTION

#### 1. Field of the Invention

**[0001]** The present disclosure relates to heat exchangers. More particularly, the present disclosure relates to heat exchangers having baffled manifolds.

**[0002]** Document WO 2008/048505, which can be considered as the closest prior art, is state of the art according to Art. 54(3) EPC. The subject-matter of claim 1 differs from the heat exchanger disclosed in this document in that it comprises one or more baffles within the outside of the second manifold, the baffles being configured to ensure that the fluid enters the plurality of parallel channels of the second pass as substantially homogeneous two-phase mixture.

#### 2. Description of Prior Art

**[0003]** Refrigeration systems are well known in the art and ubiquitous in such industries as food service, chemical, residential and commercial cooling, and automotive. On a larger scale, heat exchangers are required for office buildings and for residential purposes. Lack of efficiency is a great concern with such systems.

**[0004]** Traditional refrigeration cycles, or air conditioners, include a compressor, a condenser, an expansion valve, an evaporator, and a refrigerant whose evaporation creates the cool temperature. In some refrigeration systems, the evaporator and condenser are heat exchangers having a series of parallel channels, which provide parallel refrigerant paths. When the refrigerant passes through the expansion valve, a pressure and temperature drop occurs.

**[0005]** In many refrigerant vapor-compression systems, as the refrigerant passes through the expansion valve, a portion of the fluid expands to a vapor phase, while a second portion of the fluid remains in a liquid phase. The resulting two-phase fluid can cause maldistribution in the evaporator. As used herein, the term "maldistribution" of two-phase fluid shall mean that one phase of the fluid (e.g., liquid-phase) predominantly flows through a particular portion of the evaporator, while that the other phase of the fluid (e.g., vapor-phase) predominantly flows through a different portion of the evaporator.

**[0006]** It has been determined by the present disclosure that maldistribution of the two-phase fluid is a common problem with heat exchangers that use parallel refrigerant paths, resulting in poor heat exchanger efficiency. For heat exchangers that have relatively few parallel refrigerant paths (typically 20 or less), even distribution of the two-phase fluid is achieved through a distribution device that individually feeds each parallel refrigerant path. However, for heat exchanges with many parallel refrigerant paths (typically more than 20), individual distribution to each parallel refrigerant path is often not prac-

tical. In most cases, a simple inlet header is used, which can lead to significant refrigerant maldistribution to the heat exchanger. Additionally, gravity and the increase in overall volume as the flow transitions from the expansion device to the inlet header also act to cause the liquid-phase and vapor-phase to separate, causing maldistribution to the heat exchanger.

**[0007]** Previously, it has been proposed by U.S. Patent No. 7,143,605 to include a distributor tube positioned within the inlet manifold to reduce maldistribution. While the distributor tube has proven to be helpful to reduce maldistribution, the maldistribution of the liquid-phase and vapor-phase within the heat exchanger remains problematic.

**[0008]** Therefore, there exists a need for heat exchangers that overcome, alleviate, and/or mitigate one or more of the aforementioned and other deleterious effects of prior art heat exchangers.

**[0009]** WO 2006/083451 discloses a heat exchanger with perforated plate header.

### SUMMARY OF THE INVENTION

**[0010]** In accordance with the present invention there is provided a heat exchanger as set forth in claim 1.

**[0011]** The above-described and other features and advantages of the present disclosure will be appreciated and understood by those skilled in the art from the following detailed description, drawings, and appended claims.

### BRIEF DESCRIPTION OF THE DRAWINGS

#### **[0012]**

FIG. 1 is a sectional view of an exemplary embodiment of heat exchanger with a manifold having baffles according to the present disclosure;

FIG. 2 is a close-up view of a first alternate exemplary embodiment of the manifold of FIG. 1;

FIG. 3 is a close-up view of a second alternate exemplary embodiment of the manifold of FIG. 1;

FIG. 4 is a sectional view of an alternate heat exchanger with a manifold,

FIG. 5 is a sectional view of an alternate exemplary embodiment of a heat exchanger with a manifold according to the present disclosure; and

FIG. 6 illustrates an exemplary embodiment of a refrigeration circuit having a pair of heat exchangers according to the present disclosure.

## DETAILED DESCRIPTION OF THE INVENTION

**[0013]** Referring now to the figures and in particular to FIG. 1, an exemplary embodiment of parallel path heat exchanger according to the present disclosure is shown and is generally referred to by reference numeral 10. Heat exchanger 10 includes one or more baffles 12 within one or more manifolds 18, 20. Advantageously, baffles 12 are configured to limit the movement of the fluid along an axis (A) of manifold 18, 20, which mitigates separation of the two-phase fluid and ensures uniform distribution within the channels of heat exchanger 10.

**[0014]** For purposes of clarity, FIG. 1 illustrates heat exchanger 10 as a multipass heat exchanger having a first pass 14 and a second pass 16. Of course, it is contemplated by the present disclosure for baffles 12 to find equal use with any parallel path heat exchanger having more than two passes.

**[0015]** Heat exchanger 10 includes a first manifold 18 and a second manifold 20 that are in fluid communication with one another by way of a plurality of parallel channels 22. In the illustrated embodiment, heat exchanger 10 is a micro-channel heat exchanger having a plurality of micro-channels 22. However, it is contemplated by the present disclosure for baffles 12 to find equal use with any type of parallel path heat exchanger having channels 22 of any desired size.

**[0016]** First manifold 18 includes a first partition 24-1 and second manifold 20 includes a second partition 24-2. Partitions 24-1, 24-2 are configured to separate manifolds 18, 20 and channels 22 into first pass 14 and second pass 16, respectively, along a line 26. Partition 24-1 divides first manifold 18 into an inlet side 28 and an outlet side 30. Similarly, partition 24-2 divides second manifold 20 into an inlet side 32 and an outlet side 34.

**[0017]** Heat exchanger 10 includes a distribution insert 36 within inlet side 28 of first manifold 18. Further, heat exchanger 10 includes a collection insert 38 within outlet side 32 of second manifold 20 and a distribution insert 40 within inlet side 34 of second manifold 20. In the illustrated embodiment, collection insert 38 and distribution insert 40 are shown as one unitary member. However, it is contemplated by the present disclosure for collection and distribution inserts 38, 40 to be separate items.

**[0018]** Heat exchanger 10 finds particular use with a fluid 42, such as a refrigerant of a vapor-compression or air conditioning circuit. Fluid 42 can be a single-phase fluid or a two-phase fluid. Thus, fluid 42 traveling through heat exchanger 10 can be in a vapor-phase and/or a liquid-phase. In the illustrated embodiment, the flow of fluid 26 is represented by one or more directional arrows.

**[0019]** Distribution insert 36 includes a plurality of openings 44 defined therein. Openings 44 place distribution insert 36 in fluid communication with inlet side 28 of first manifold 18. Collection insert 38 includes a plurality of openings 46 defined therein. Openings 46 place collection insert 38 in fluid communication with outlet side 32 of second manifold 20. Distribution insert 40 includes

a plurality of openings 48 defined therein. Openings 48 place distribution insert 40 in fluid communication with inlet side 34 of second manifold 20.

**[0020]** During use, fluid 42 enters heat exchanger 10 through distribution insert 36 within inlet side 28 of first manifold 18. The fluid 42 is prevented from flowing from inlet side 28 to outlet side 30 by partition 24-1. Rather, distribution insert 36 distributes fluid 42 into inlet side 28 of first manifold 18 through openings 44.

**[0021]** It has been determined by the present disclosure that distribution insert 36 assists in passing fluid 42 in a substantially homogeneous state to inlet side 28 of first manifold 18. More particularly, it has been determined that distribution insert 36 assists in mixing fluid 42 so that the fluid within inlet side 28 of first manifold 18 is a substantially homogeneous mixture of liquid-phase fluid and vapor-phase fluid.

**[0022]** Openings 44 are preferably of variable size to effectively mix and distribute fluid 42 flowing into inlet side 28 of first manifold 18. Openings 44 can have a dimension that can be uniform across distribution insert 36, or the dimension of the openings can increase in size in a direction from first pass 14 to second pass 16. For example, openings 44 can increase in dimension further downstream of the fluid flow path can achieve a greater degree of fluid distribution.

**[0023]** Within inlet side 28, baffles 12 are configured to limit the movement of fluid 42 within the inlet side 28 of first manifold 18. More specifically, and without wishing to be bound by any particular theory, it has been determined by the present disclosure that the liquid and vapor phases of fluid 42 can be separated by the fluidic forces within heat exchanger 10 such that these forces can cause one of the two phases to be forced towards partition 24-1. This movement of fluid 42 along the axis of first manifold 18 towards partition 24-1 can be limited by baffles 12. Thus, baffles 12 assist in mitigating maldistribution of fluid 42 within channels 22 of first pass 14.

**[0024]** In sum, heat exchanger 10 includes a mixing device, illustrated as distribution insert 36, to effectively mix fluid 42 as the fluid enters inlet side 28 so that both phases of the fluid are in a substantially homogeneous two-phase mixture within inlet side 28. Further, heat exchanger 10 includes one or more baffles 12 (two shown) to prevent the fluidic forces within inlet side 28 from separating the two phases from one another and forcing one of the two phases towards partition 24-1. In this manner, baffles 12 ensure that fluid 42 enters channels 22 of first pass 14 in the substantially homogeneous two-phase mixture, which mitigates maldistribution of the fluid within the channels.

**[0025]** Fluid 42 enters channels 22 from inlet side 28 of first manifold 18, flows through the channels and exits the channels into outlet side 32 of second manifold 20. Here, fluid 42 is prevented from flowing directly to inlet side 34 of second manifold 20 by partition 24-2.

**[0026]** Rather, fluid 42 flows from outlet side 32 to collection insert 38 through openings 46. Then, fluid 42 flows

from collection insert 38 to distribution insert 40. In this manner, fluid 42 flows from first pass 14 across line 26 into second pass 16. Next, fluid 42 flows from distribution insert 40 through openings 48 into inlet side 34 of second manifold 20.

**[0027]** It has been determined by the present disclosure that collection insert 38 and distribution insert 40 assists in passing fluid 42 in a substantially homogeneous two-phase state to inlet side 34 of second manifold 20. More specifically, collection insert 38 and distribution insert 40 each mix fluid 42 as the fluid passes there-through.

**[0028]** Baffles 12 within second manifold 20 are configured to limit the movement of fluid 42 within inlet side 34 along the axis (A) of the second manifold. Thus, baffles 12 can also assist in mitigating maldistribution of fluid 42 within channels 22 of second pass 16.

**[0029]** Fluid 42 enters channels 22 from inlet side 34 of second manifold 20, flows through the channels and exits the channels into outlet side 30 of first manifold 18. In the illustrated embodiment where heat exchanger 10 is a two-pass exchanger, fluid 42 flows out of the heat exchanger. However, it is contemplated by the present disclosure for heat exchanger 10 to have more than two passes 14, 16, such that fluid 42 flowing from second manifold 20 can enter a third pass (not shown) of channels.

**[0030]** An alternate embodiment of heat exchanger 10 having baffles 12 is shown in FIG. 2. For purposes of clarity, only relevant portions of heat exchanger 10 are shown. Here, openings 44 in distribution insert 36 are illustrated directing fluid 42 in a direction substantially perpendicular (e.g., about ninety degrees) to the direction of flow through channels 22. By way of contrast, distribution insert 36 is illustrated in FIG. 1 having openings 44 directing fluid 42 in a direction substantially parallel (e.g., about zero degrees) to the direction of flow through channels 22.

**[0031]** As such, it is contemplated by the present disclosure for heat exchanger 10 to have distribution insert 36 with openings 44 at any desired angle with respect to the direction of flow through channels 22. For example, it is contemplated for heat exchanger 10 to have distribution insert 36 with openings 44 at an angle such as zero degrees (FIG. 1), ninety degrees (FIG. 2), and angle there between, as well as any angle more than ninety degrees. Furthermore, it is contemplated for the angle of openings 44 to differ from one another such that some openings may have one angle, while other openings have a different angle.

**[0032]** Also shown in the embodiment of FIG. 2, distribution insert 36 is shown as a closed ended tube having an end-cap 50 adjacent partition 24-1, whereas the embodiment of distribution insert 36 shown in FIG. 1 is illustrated as an open ended tube connected to partition 24-1.

**[0033]** Referring now to FIG. 3, another exemplary embodiment of heat exchanger 10 having baffles 12 is shown. Again, only the relevant portions of heat exchanger

er 10 are shown. Here, distribution insert 36 is defined by a first wall 52 and a second wall 54, where the first wall is independent of first manifold 18, but the second wall is common with the first manifold. Further, distribution insert 36 is defined by partition 24-1. In contrast, the embodiments of distribution insert 36 shown in FIGS. 1 and 2 have no walls in common with first manifold 18.

**[0034]** Referring now to FIG. 4, still another heat exchanger 10 having baffles 12 is shown. This heat exchanger 10, which falls outside the scope of the present invention, includes distributing inserts 36 and 40 as described with respect to the embodiment of FIG. 1. However, this heat exchanger 10 lacks collection insert 38 within outlet side 32 of second manifold 20 as in FIG. 1. Rather, heat exchanger 10 illustrated in FIG. 4 includes an external collection-distributor 56.

**[0035]** External collection-distributor 56 is in fluid communication with outlet side 32 of second manifold 20 via one or more ports 58 (only one shown). Further, external collection-distributor 56 is in fluid communication with inlet side 34 of second manifold 20 via one or more ports 60 (three shown).

**[0036]** In this manner, fluid 42 enters channels 22 from inlet side 28 of first manifold 18, flows through the channels and exits the channels into outlet side 32 of second manifold 20. Here, fluid 42 is prevented from flowing directly to inlet side 34 of second manifold 20 by partition 24-2.

**[0037]** Rather, fluid 42 flows from outlet side 32 to external collection-distributor 56 through openings 58. Then, fluid 42 flows through external collection-distributor 56 from first pass 14 across line 26 into second pass 16. Next, fluid 42 flows from external collection-distributor 56 through openings 60 into distribution insert 40, which further mixes fluid 42 as the fluid flows from the distribution insert through openings 48 into inlet side 34 of second manifold 20. As discussed above, baffles 12 within second manifold 20 are configured to limit the movement of fluid 42 along axis A of the second manifold. Thus, baffles 12 can also assist in mitigating maldistribution of fluid 42 within channels 22 of second pass 16.

**[0038]** External collection-distributor 56 assists in passing fluid 42 in a substantially homogeneous state to inlet side 34 of second manifold 20. The combination of external collection-distributor 56 along with distribution insert 40 adds an additional mixing stage as compared to the embodiment of FIG. 1. Specifically, external collection-distributor 56 includes a first portion 62 within first pass 14 (i.e., to the left of line 26) and a second portion 64 within second pass 16 (i.e., to the right of line 26). Here, first portion 62 functions in a manner similar to collection insert 38 of FIG. 1, while second portion 64 functions in a manner similar to distribution insert 40 of FIG. 1. Since the embodiment of FIG. 4 includes first portion 62, second portion 64, and distribution insert 40, this embodiment of heat exchanger 10 provides one additional mixing stage of fluid 42 as compared to the embodiment of FIG. 1.

**[0039]** Referring now to FIG. 5, another embodiment of heat exchanger 10 is shown.

**[0040]** In this embodiment, first manifold 18 includes inlet port 66 and outlet port 68 that are configured so that the flow of fluid 42 is in a direction substantially parallel (e.g., about zero degrees) to the flow of fluid through channels 22. By way of contrast, heat exchanger 10 illustrated in FIG. 1 having ports 66, 68 directing fluid 42 in a direction substantially perpendicular (e.g., about ninety degrees) to the direction of flow through channels 22. Furthermore, it is contemplated by the present disclosure for heat exchanger 10 to have ports 66, 68 at any desired angle with respect to the direction of flow through channels 22. For example, it is contemplated for heat exchanger 10 to have one or both ports 66, 68 at an angle selected from the group consisting of zero degrees, ninety degrees, and any combinations thereof.

**[0041]** Also illustrated in this embodiment, first manifold 18 includes collection insert 38 within outlet side 30 of the first manifold. Collection insert 38 within outlet side 30 of first manifold 18 functions as described with respect to collection insert 38 within outlet side 32 of second manifold 20 of the embodiment of FIG. 1. Accordingly, heat exchanger 10 in the embodiment of FIG. 5 provides for additional mixing of fluid 42 before the fluid exits the heat exchanger.

**[0042]** Also illustrated in this embodiment, heat exchanger 10 includes a second collection-distributor 70 at second manifold 20. Second collection-distributor 70 is in fluid communication with collection insert 38 via one or more (only one shown) openings 72 and with distributing insert 40 via one or more (only one shown) openings 74. In addition, partition 24-2 includes an extension 76 preventing direction fluid communication between collection insert 38 and distributing insert 40. Thus, heat exchanger 10 in the embodiment of FIG. 5 provides for additional mixing stages within second manifold 20 as compared to the embodiment of FIG. 1.

**[0043]** Advantageously, heat exchanger 10 finds use in any refrigeration circuit. For example, and referring now to FIG. 6, heat exchanger 10 is shown in use in a refrigeration circuit 80. Here, refrigeration circuit 80 has an evaporator 82 and a condenser 84. Advantageously, heat exchanger 10 can find use as evaporator 82, as condenser 84, or both.

**[0044]** Heat exchanger 10 can be arranged within circuit 80 so that the plurality of channels 22 are arranged in any desired manner. In some embodiments, heat exchanger 10 can be arranged within circuit 80 so that channels 22 are vertically arranged. In this manner, heat exchanger 10 can be arranged within circuit 80 so that refrigerant 42 flows through the channels in an up-and-down manner. In other embodiments, heat exchanger 10 can be arranged within circuit 80 so that channels 22 are horizontally arranged. In this manner, heat exchanger 10 can be arranged within circuit 80 so that refrigerant flows through channels 22 in a side-to-side manner.

**[0045]** Circuit 80 can find use in any vapor-compres-

sion device such as, but not limited to, an air conditioner, a heat pump, a dehumidifier, a refrigerator, a freezer, and others. For example, circuit 80 can find use in an air conditioner in a vehicle such as, but not limited to, an automobile, a truck, a ship, an airplane, and other mobile vehicles. Further, circuit 80 can find use in an air conditioner in a stationary conditioning device such as that used in a refrigerator, freezer, home air conditioner, or commercial air conditioner, a chiller unit, and others.

**[0046]** As described herein, heat exchanger 10 includes parallel channels 22 in fluid communication with one another via a pair of manifolds 18, 20. One or more of the manifolds can include mixing devices (e.g., inserts 36, 38, 40, 56, 70) to keep fluid 42 passing through heat exchanger 10 in a substantially uniform two-phase mixture. Advantageously, heat exchanger 10 also includes one or more baffles 12 within one or more of the manifolds 18, 20. The baffles 12 prevent movement of fluid 22 along the axis of the manifolds 18, 20 so that fluid 42 remains in the uniform two-phase mixture when entering channels 22.

**[0047]** It should also be noted that the terms "first", "second", "third", "upper", "lower", and the like may be used herein to modify various elements. These modifiers do not imply a spatial, sequential, or hierarchical order to the modified elements unless specifically stated.

## Claims

1. A heat exchanger (10) for a fluid having a vapor-phase and a liquid-phase, comprising:

- a first manifold (18);
- a second manifold (20);
- a plurality of parallel channels (22) being in fluid communication with said first and second manifolds (18, 20);
- a first partition (24-1) defined within said first manifold (18) so that said plurality of parallel channels (22) define a first pass (14) in fluid communication with an inlet side (28) of said first manifold (18) and a second pass (16) in fluid communication with an outlet side (30) of said first manifold (18);
- a mixing device being configured to mix the fluid (42) flowing into said first manifold (18) so that the fluid (42) is a substantially homogeneous two-phase mixture of the vapor and liquid phases;
- one or more baffles (12) within said first manifold (18), said one or more baffles (12) being configured to ensure that the fluid (42) enters said plurality of parallel channels (22) as the substantially homogeneous two-phase mixture;
- a second partition (24-2) defined within said second manifold (20) so that said first pass (14) is in fluid communication with an inlet side (32) of

- said second manifold (20) and said second pass (16) is in fluid communication with an outlet side (34) of said second manifold (20), said inlet and outlet sides (32, 34) of said second manifold (20) being in fluid communication;  
 a collection insert (38) within said inlet side (32) of said second manifold (20), said collection insert (38) configured to mix the fluid (42) flowing from said inlet side (32) of said second manifold (20) to form the substantially homogeneous two-phase mixture;  
 a second distribution insert (40) within said outlet side (34) of said second manifold (20), said second distribution insert (40) being configured to mix the fluid (42) flowing into said outlet side (34) of said second manifold (20) from said inlet side (32) of said second manifold (20) so that the fluid (42) is the substantially homogeneous two-phase mixture; and  
 one or more second baffles (12) within said outlet side (34) of said second manifold (20), said one or more baffles (12) being configured to ensure that the fluid (42) enters said plurality of parallel channels (22) of said second pass (16) as the substantially homogeneous two-phase mixture.
2. The heat exchanger (10) as in claim 1, wherein the mixing device comprises a distributing insert (36) being disposed within said first manifold (18) and wherein said distributing insert (36) comprises a plurality of openings (44) having a selected angle with respect to a fluid flow direction through said plurality of parallel channels (22).
  3. The heat exchanger (10) as in claim 1, wherein said collection insert (38) is in fluid communication with said second distribution insert (40).
  4. The heat exchanger (10) as in claim 1, wherein said collection insert (38) is internal to said second manifold (20), and further comprising a second collection-distributor (56) placing said collection insert (38) in fluid communication with said second distribution insert (40).
  5. The heat exchanger (10) as in claim 1, wherein said inlet side (28) of said first manifold (18) is divided along an axis (26) from said outlet side (30) of said first manifold (18) by said first partition (24-1) and wherein said first pass (14) of parallel channels (22) is in fluid communication with said inlet side (28) of said first manifold (18) and said second manifold (20) and said second pass (16) of parallel channels (22) is in fluid communication with said outlet side (30) of said first manifold (18) and said second manifold (20).
  6. The heat exchanger (10) as in claim 5, wherein said mixing device comprises a distribution insert (36) within said inlet side (28) of said first manifold (18), said distribution insert (36) comprising a plurality of openings (44) being configured to mix the fluid (42) flowing into said inlet side (28) of said first manifold (18) so that the fluid (42) is a substantially homogeneous two-phase mixture of the vapor and liquid phases.
  7. The heat exchanger (10) as in claim 6, wherein said one or more baffles (12) are within said inlet side (28) of said first manifold (18).
  8. The heat exchanger (10) as in claim 6, wherein said distribution insert (36) comprises a plurality of openings having a dimension that is uniform across said distribution insert (36).
  9. The heat exchanger (10) as in claim 6, wherein said distribution insert (36) comprises a plurality of openings having a dimension that increase in size in a direction from said first pass (14) to said second pass (16).
  10. The heat exchanger (10) as in claim 1, wherein said inlet side (32) of said second manifold (20) is divided along said axis (26) from said outlet side (34) of said second manifold (20) by said second partition (24-2), said one or more second baffles (12) within said outlet side (34) of said second manifold (20) being configured to prevent movement of the fluid (42) within said outlet side (34) of said second manifold (20) along said axis (26).
  11. The heat exchanger (10) as in claim 1, wherein said first manifold (18) comprises an inlet port (66) and an outlet port (68), said inlet and outlet ports (66, 68) being configured so that flow of the fluid (42) through said inlet and outlet ports (66, 68) is in a direction substantially parallel to flow of the fluid (42) through said plurality of parallel channels (22).
  12. The heat exchanger (10) as in claim 1, wherein said first manifold (18) comprises an inlet port (66) and an outlet port (68), said inlet and outlet ports (66, 68) being configured so that flow of the fluid (42) through said inlet and outlet ports (66, 68) is in a direction substantially perpendicular to flow of the fluid (42) through said plurality of parallel channels (22).

#### Patentansprüche

1. Wärmetauscher (10) für ein Fluid, das eine Dampfphase und eine Flüssigphase aufweist; umfassend:  
 einen ersten Verteiler (18);

einen zweiten Verteiler (20);  
 eine Vielzahl von parallelen Kanälen (22), die mit dem ersten und zweiten Verteiler (18, 20) in Fluidverbindung stehen;  
 eine erste Trennwand (24-1), die im ersten Verteiler (18) definiert ist, sodass die Vielzahl von parallelen Kanälen (22) einen ersten Durchlass (14), der mit einer Einlassseite (28) des ersten Verteilers (18) in Fluidverbindung steht, und einen zweiten Durchlass (16), der mit einer Auslassseite (30) des ersten Verteilers (18) in Fluidverbindung steht, definieren;  
 eine Mischvorrichtung, die konfiguriert ist, um das Fluid (42), das in den ersten Verteiler (18) fließt, derart zu mischen, dass das Fluid (42) ein im Wesentlichen homogenes Zweiphasengemisch der Dampf- und Flüssigphasen ist;  
 eine oder mehrere Prallflächen (12) im ersten Verteiler (18), wobei die eine oder mehreren Prallflächen (12) konfiguriert ist/sind, um sicherzustellen, dass das Fluid (42) als das im Wesentlichen homogene Zweiphasengemisch in die Vielzahl von parallelen Kanälen (22) eintritt;  
 eine zweite Trennwand (24-2), die im zweiten Verteiler (20) definiert ist, sodass der erste Durchlass (14) mit einer Einlassseite (32) des zweiten Verteilers (20) in Fluidverbindung steht und der zweite Durchlass (16) mit einer Auslassseite (34) des zweiten Verteilers (20) in Fluidverbindung steht, wobei die Einlass- und Auslassseiten (32, 34) des zweiten Verteilers (20) in Fluidverbindung stehen;  
 einen Sammeleinsatz (38) in der Einlassseite (32) des zweiten Verteilers (20), wobei der Sammeleinlass (38) konfiguriert ist, um das Fluid (42), das von der Einlassseite (32) des zweiten Verteilers (20) fließt, derart zu mischen, dass es das im Wesentlichen homogene Zweiphasengemisch bildet;  
 einen zweiten Verteilungseinsatz (40) in der Auslassseite (34) des zweiten Verteilers (20), wobei der zweite Verteilungseinsatz (40) konfiguriert ist, um das Fluid (42), das in die Auslassseite (34) des zweiten Verteilers (20) von der Einlassseite (32) des zweiten Verteilers (20) fließt, derart zu mischen, dass das Fluid (42) das im Wesentlichen homogene Zweiphasengemisch ist; und  
 eine oder mehrere zweite Prallflächen (12) in der Auslassseite (34) des zweiten Verteilers (20), wobei die eine oder mehreren Prallflächen (12) konfiguriert ist/sind, um sicherzustellen, dass das Fluid (42) als das im Wesentlichen homogene Zweiphasengemisch in die Vielzahl von parallelen Kanälen (22) des zweiten Durchlasses (16) eintritt.

2. Wärmetauscher (10) nach Anspruch 1, wobei die

Mischvorrichtung einen Verteilungseinsatz (36) umfasst, der im ersten Verteiler (18) angeordnet ist, und wobei der Verteilungseinsatz (36) eine Vielzahl von Öffnungen (44) umfasst, die einen ausgewählten Winkel im Verhältnis zu einer Fluidströmungsrichtung durch die Vielzahl von parallelen Kanälen (22) aufweisen.

3. Wärmetauscher (10) nach Anspruch 1, wobei der Sammeleinsatz (38) mit dem zweiten Verteilungseinsatz (40) in Fluidverbindung steht.

4. Wärmetauscher (10) nach Anspruch 1, wobei sich der Sammeleinsatz (38) im zweiten Verteiler (20) befindet, und ferner umfassend einen zweiten Sammelverteiler (56), der den Sammeleinsatz (38) mit dem zweiten Verteilungseinsatz (40) in Fluidverbindung bringt.

5. Wärmetauscher (10) nach Anspruch 1, wobei die Einlassseite (28) des ersten Verteilers (18) entlang einer Achse (26) durch die erste Trennwand (24-1) von der Auslassseite (30) des ersten Verteilers (18) getrennt ist und wobei der erste Durchlass (14) paralleler Kanäle (22) mit der Einlassseite (28) des ersten Verteilers (18) in Fluidverbindung steht und der zweite Verteiler (20) und der zweite Durchlass (16) paralleler Kanäle (22) mit der Auslassseite (30) des ersten Verteilers (18) und des zweiten Verteilers (20) in Fluidverbindung steht.

6. Wärmetauscher (10) nach Anspruch 5, wobei die Mischvorrichtung einen Verteilungseinsatz (36) in der Einlassseite (28) des ersten Verteilers (18) umfasst, wobei der Verteilungseinsatz (36) eine Vielzahl von Öffnungen (44) umfasst, die konfiguriert sind, um das Fluid (42), das in die Einlassseite (28) des ersten Verteilers (18) fließt, derart zu mischen, dass das Fluid (42) ein im Wesentlichen homogenes Zweiphasengemisch der Dampf- und Flüssigphasen ist.

7. Wärmetauscher (10) nach Anspruch 6, wobei sich die eine oder mehreren Prallflächen (12) in der Einlassseite (28) des ersten Verteilers (18) befinden.

8. Wärmetauscher (10) nach Anspruch 6, wobei der Verteilungseinsatz (36) eine Vielzahl von Öffnungen umfasst, die eine Abmessung aufweisen, die über den Verteilungseinsatz (36) einheitlich ist.

9. Wärmetauscher (10) nach Anspruch 6, wobei der Verteilungseinsatz (36) eine Vielzahl von Öffnungen aufweist, die eine Abmessung aufweisen, die in einer Richtung vom ersten Durchlass (14) zum zweiten Durchlass (16) in ihrer Größe zunimmt.

10. Wärmetauscher (10) nach Anspruch 1, wobei die Einlassseite (32) des zweiten Verteilers (20) entlang der Achse (26) durch die zweite Trennwand (24-2) von der Auslassseite (34) des zweiten Verteilers (20) getrennt ist, 5  
wobei die eine oder mehreren Prallflächen (12) in der Auslassseite (34) des zweiten Verteilers (20) konfiguriert ist/sind, um die Bewegung des Fluides (42) in der Auslassseite (34) des zweiten Verteilers (20) entlang der Achse (26) zu verhindern. 10
11. Wärmetauscher (10) nach Anspruch 1, wobei der erste Verteiler (18) einen Einlassanschluss (66) und einen Auslassanschluss (68) umfasst, wobei die Einlass- und Auslassanschlüsse (66, 68) derart konfiguriert sind, dass die Strömung des Fluides (42) durch die Einlass- und Auslassanschlüsse (66, 68) in einer Richtung im Wesentlichen parallel zur Strömung des Fluides (42) durch die Vielzahl von parallelen Kanälen (22) verläuft. 15 20
12. Wärmetauscher (10) nach Anspruch 1, wobei der erste Verteiler (18) einen Einlassanschluss (66) und einen Auslassanschluss (68) umfasst, wobei die Einlass- und Auslassanschlüsse (66, 68) derart konfiguriert sind, dass die Strömung des Fluides (42) durch die Einlass- und Auslassanschlüsse (66, 68) in einer Richtung im Wesentlichen lotrecht zur Strömung des Fluides (42) durch die Vielzahl von parallelen Kanälen (22) verläuft. 25 30

## Revendications

1. Échangeur de chaleur (10) pour un fluide présentant une phase de vapeur et une phase de liquide, comprenant: 35  
un premier collecteur (18);  
un second collecteur (20); 40  
une pluralité de canaux parallèles (22) étant en communication fluidique avec lesdits premier et second collecteurs (18, 20) ;  
une première séparation (24-1) définie dans ledit premier collecteur (18) de sorte que ladite pluralité de canaux parallèles (22) définissent une première passe (14) en communication fluidique avec un côté d'entrée (28) dudit premier collecteur (18) et une seconde passe (16) en communication fluidique avec un côté de sortie (30) dudit premier collecteur (18) ; 45  
un dispositif de mélange étant configuré pour mélanger le fluide (42) s'écoulant dans ledit premier collecteur (18) de sorte que le fluide (42) soit un mélange de deux phases sensiblement homogène des phases vapeur et liquide ; 50  
un ou plusieurs déflecteurs (12) dans ledit premier collecteur (18), lesdits un ou plusieurs déflecteurs (12) étant configurés pour assurer que le fluide (42) entre dans ladite pluralité de canaux parallèles (22) comme mélange biphasé sensiblement homogène ;  
une seconde séparation (24-2) définie dans ledit second collecteur (20) de sorte que ladite première passe (14) soit en communication fluidique avec un côté d'entrée (32) dudit second collecteur (20) et ladite seconde passe (16) soit en communication fluidique avec un côté de sortie (34) dudit second collecteur (20), lesdits côtés d'entrée et de sortie (32, 34) dudit second collecteur (20) étant en communication fluidique ;  
un insert de collection (38) dans ledit côté d'entrée (32) dudit second collecteur (20), ledit insert de collection (38) étant configuré pour mélanger le fluide (42) s'écoulant dudit côté d'entrée (32) dudit second collecteur (20) pour former le mélange biphasé sensiblement homogène ;  
un second insert de distribution (40) dans ledit côté de sortie (34) dudit second collecteur (20), ledit second insert de distribution (40) étant configuré pour mélanger le fluide (42) s'écoulant dans ledit côté de sortie (34) dudit second collecteur (20) depuis ledit côté d'entrée (32) dudit second collecteur (20) de sorte que le fluide (42) soit le mélange biphasé sensiblement homogène ; et un ou plusieurs seconds déflecteurs (12) dans ledit côté de sortie (34) dudit second collecteur (20), lesdits un ou plusieurs déflecteurs (12) étant configurés pour assurer que le fluide (42) entre dans ladite pluralité de canaux parallèles (22) de ladite seconde passe (16) comme mélange biphasé sensiblement homogène. 55
2. Échangeur de chaleur (10) selon la revendication 1, dans lequel le dispositif de mélange comprend un insert de distribution (36) étant agencé dans ledit premier collecteur (18) et dans lequel ledit insert de distribution (36) comprend une pluralité d'ouvertures (44) présentant un angle sélectionné par rapport à une direction de flux de fluide passant par ladite pluralité de canaux parallèles (22).
3. Échangeur de chaleur (10) selon la revendication 1, dans lequel ledit insert de collection (38) est en communication fluidique avec ledit second insert de distribution (40).
4. Échangeur de chaleur (10) selon la revendication 1, dans lequel ledit insert de collection (38) est interne audit second collecteur (20), et comprenant en outre un second distributeur de collection (56) plaçant ledit insert de collection (38) en communication fluidique avec ledit second insert de distribution (40).
5. Échangeur de chaleur (10) selon la revendication 1,

dans lequel ledit côté d'entrée (28) dudit premier collecteur (18) est divisé le long d'un axe (26) depuis ledit côté de sortie (30) dudit premier collecteur (18) par ladite première séparation (24-1) et dans lequel ladite première passe (14) de canaux parallèles (22) est en communication fluïdique avec ledit côté d'entrée (28) dudit premier collecteur (18) et dudit second collecteur (20) et ladite seconde passe (16) des canaux parallèles (22) est en communication fluïdique avec ledit côté de sortie (30) dudit premier collecteur (18) et dudit second collecteur (20).

6. Échangeur de chaleur (10) selon la revendication 5, dans lequel ledit dispositif de mélange comprend un insert de distribution (36) dans ledit côté d'entrée (28) dudit premier collecteur (18), ledit insert de distribution (36) comprenant une pluralité d'ouvertures (44) étant configuré pour mélanger le fluide (42) s'écoulant dans ledit côté d'entrée (28) dudit premier collecteur (18) de sorte que le fluide (42) soit un mélange biphasé sensiblement homogène des phases vapeur et liquide.
7. Échangeur de chaleur (10) selon la revendication 6, dans lequel lesdits un ou plusieurs déflecteurs (12) sont dans ledit côté d'entrée (28) dudit premier collecteur (18).
8. Échangeur de chaleur (10) selon la revendication 6, dans lequel ledit insert de distribution (36) comprend une pluralité d'ouvertures présentant une dimension qui est uniforme sur ledit insert de distribution (36).
9. Échangeur de chaleur (10) selon la revendication 6, dans lequel ledit insert de distribution (36) comprend une pluralité d'ouvertures présentant une dimension qui augmentent en taille dans une direction de ladite première passe (14) à ladite seconde passe (16).
10. Échangeur de chaleur (10) selon la revendication 1, dans lequel ledit côté d'entrée (32) dudit second collecteur (20) est divisé le long dudit axe (26) dudit côté de sortie (34) dudit second collecteur (20) par ladite seconde séparation (24-2), lesdits un ou plusieurs seconds déflecteurs (12) dans ledit côté de sortie (34) dudit second collecteur (20) étant configurés pour empêcher le mouvement du fluide (42) dans ledit côté de sortie (34) dudit second collecteur (20) le long dudit axe (26).
11. Échangeur de chaleur (10) selon la revendication 1, dans lequel ledit premier collecteur (18) comprend un orifice d'entrée (66) et un orifice de sortie (68), lesdits orifices d'entrée et de sortie (66, 68) étant configurés de sorte que le flux du fluide (42) passant par lesdits orifices d'entrée et de sortie (66, 68) soit dans une direction sensiblement parallèle au flux du

fluide (42) passant par ladite pluralité de canaux parallèles (22).

12. Échangeur de chaleur (10) selon la revendication 1, dans lequel ledit premier collecteur (18) comprend un orifice d'entrée (66) et un orifice de sortie (68), lesdits orifices d'entrée et de sortie (66, 68) étant configurés de sorte que le flux du fluide (42) par lesdits orifices d'entrée et de sortie (66, 68) soit dans une direction sensiblement perpendiculaire au flux du fluide (42) passant par ladite pluralité de canaux parallèles (22).

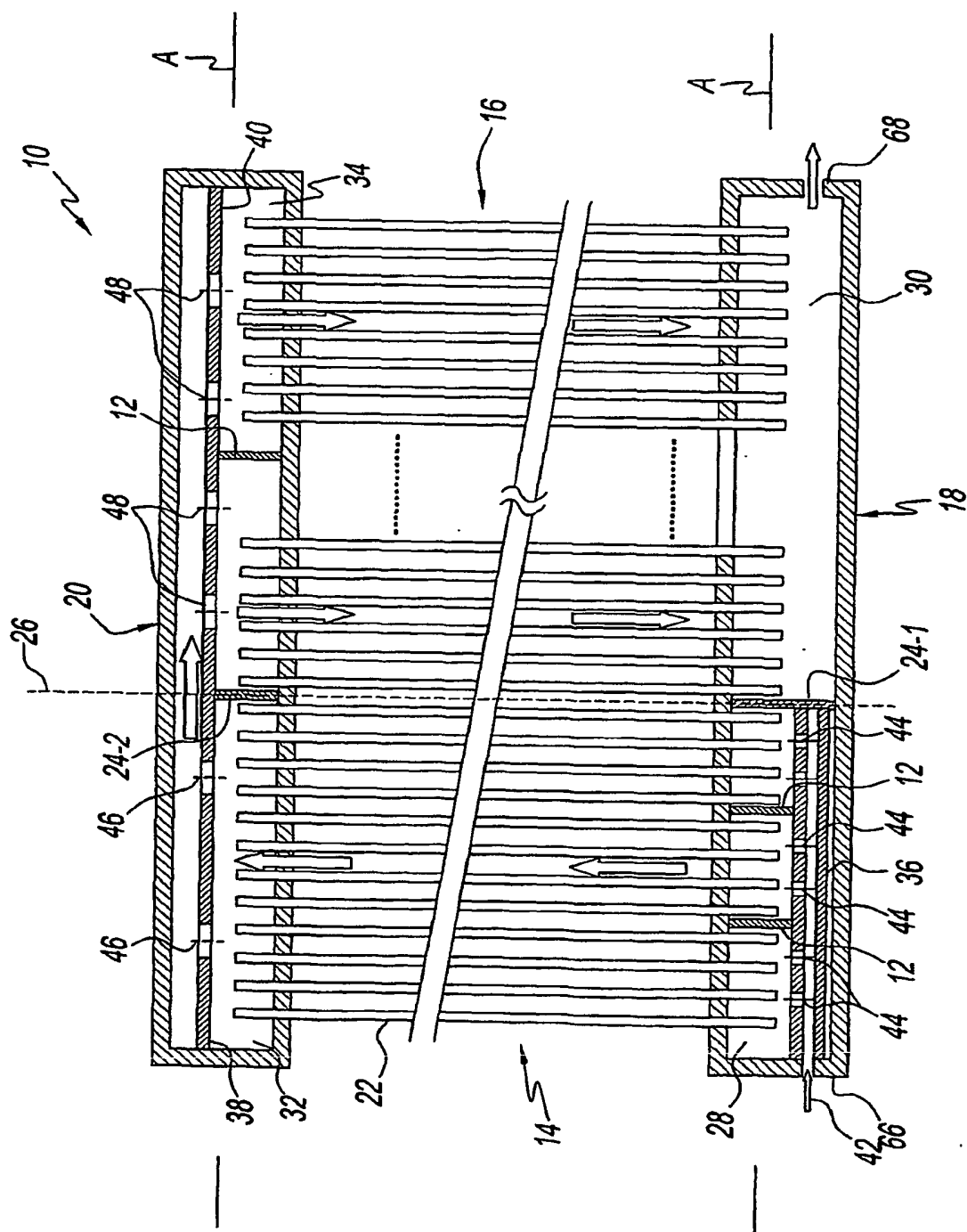


Fig. 1

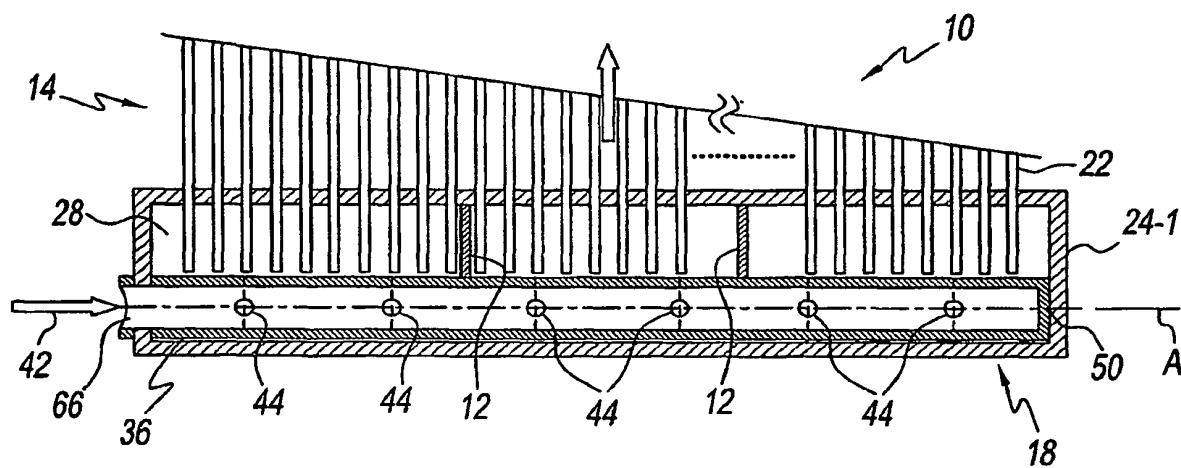


Fig. 2

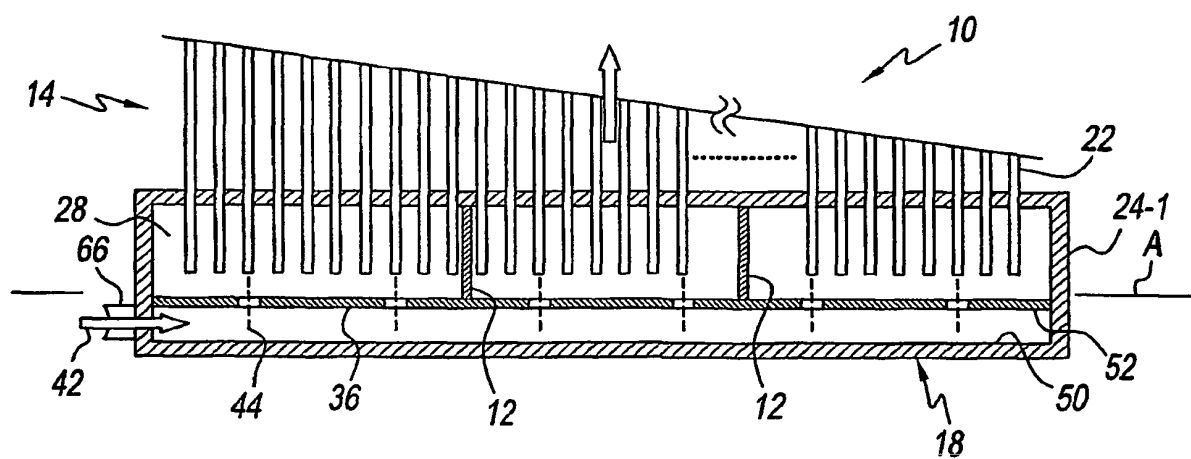
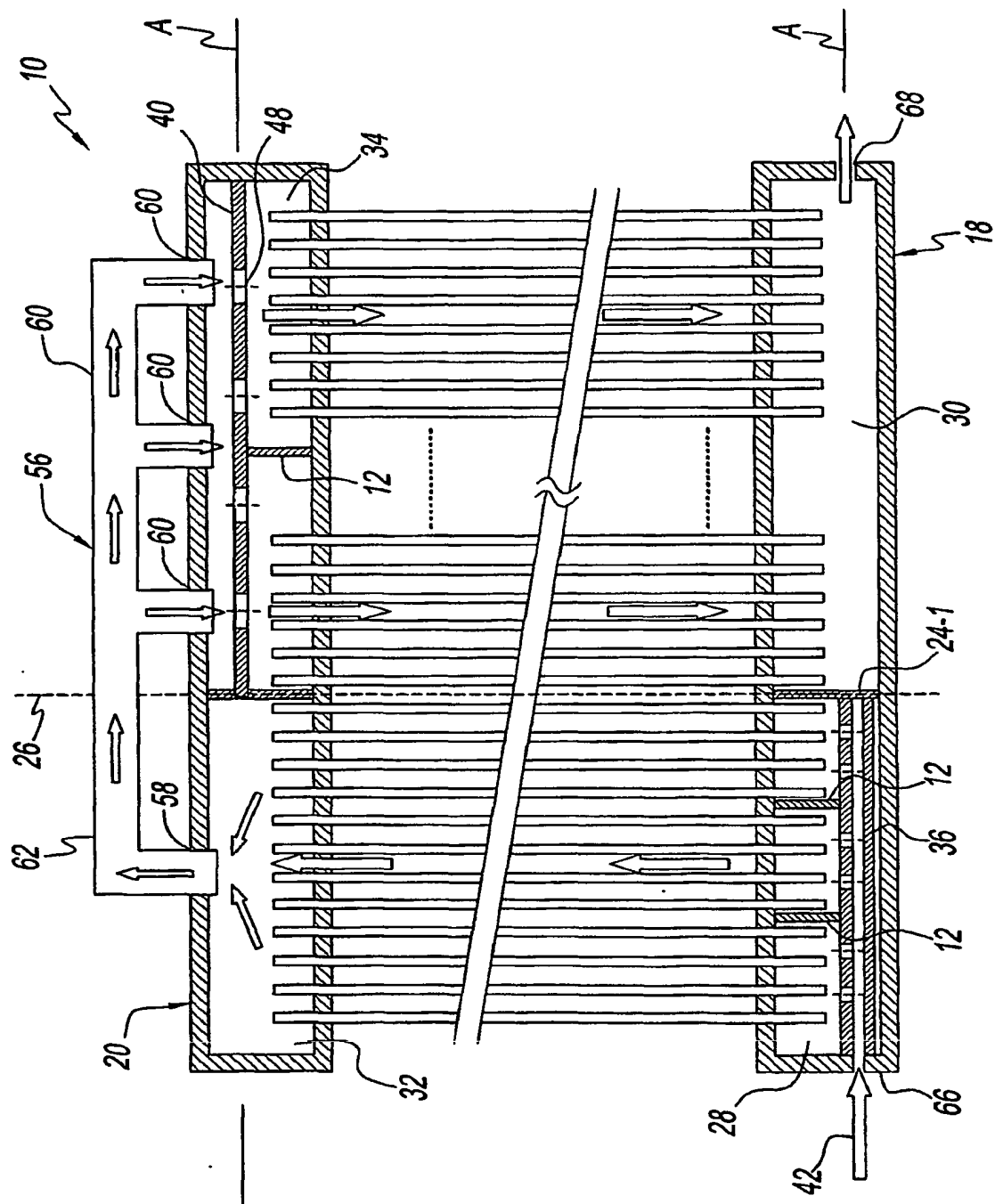


Fig. 3



**Fig. 4**

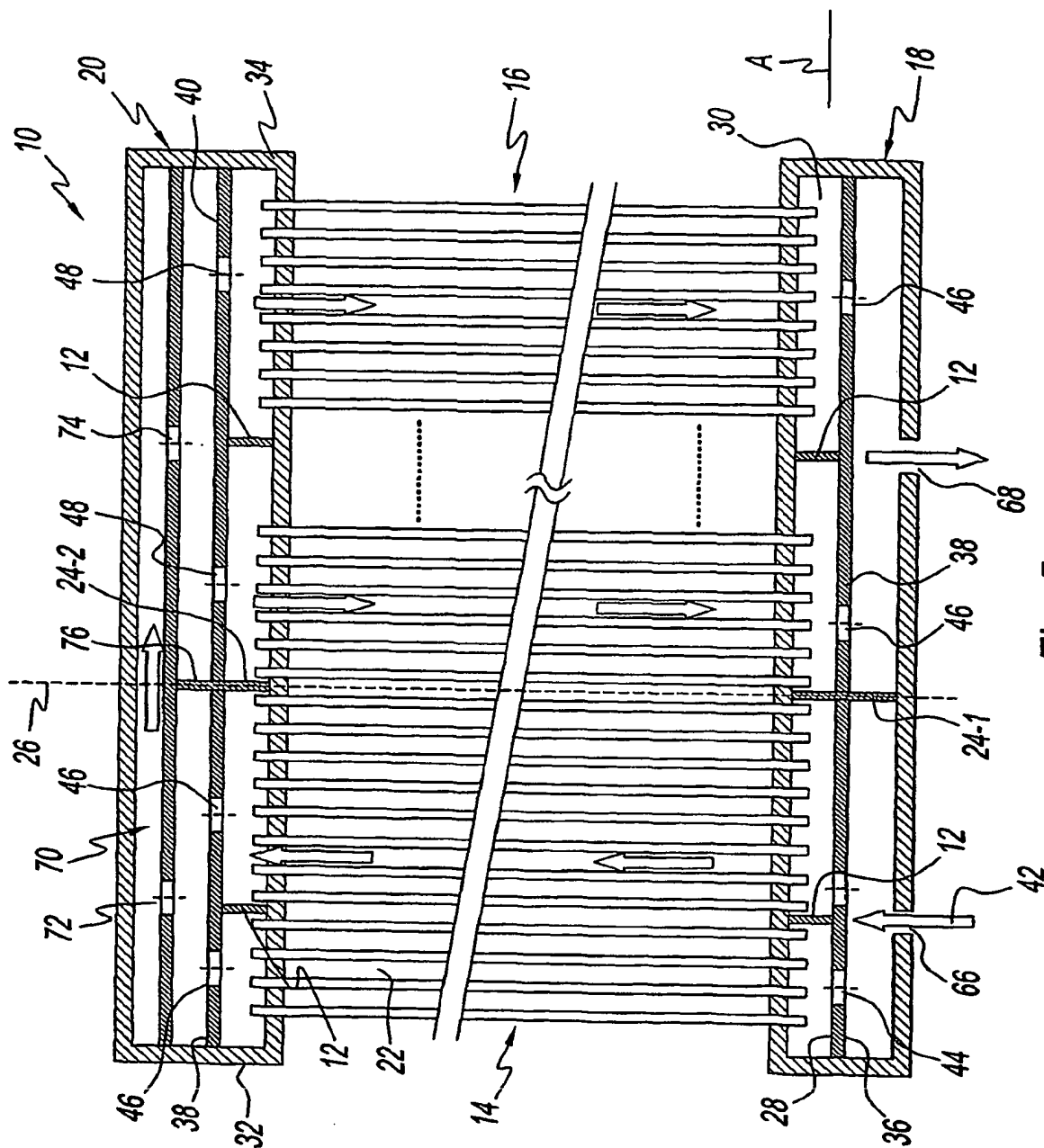


Fig. 5

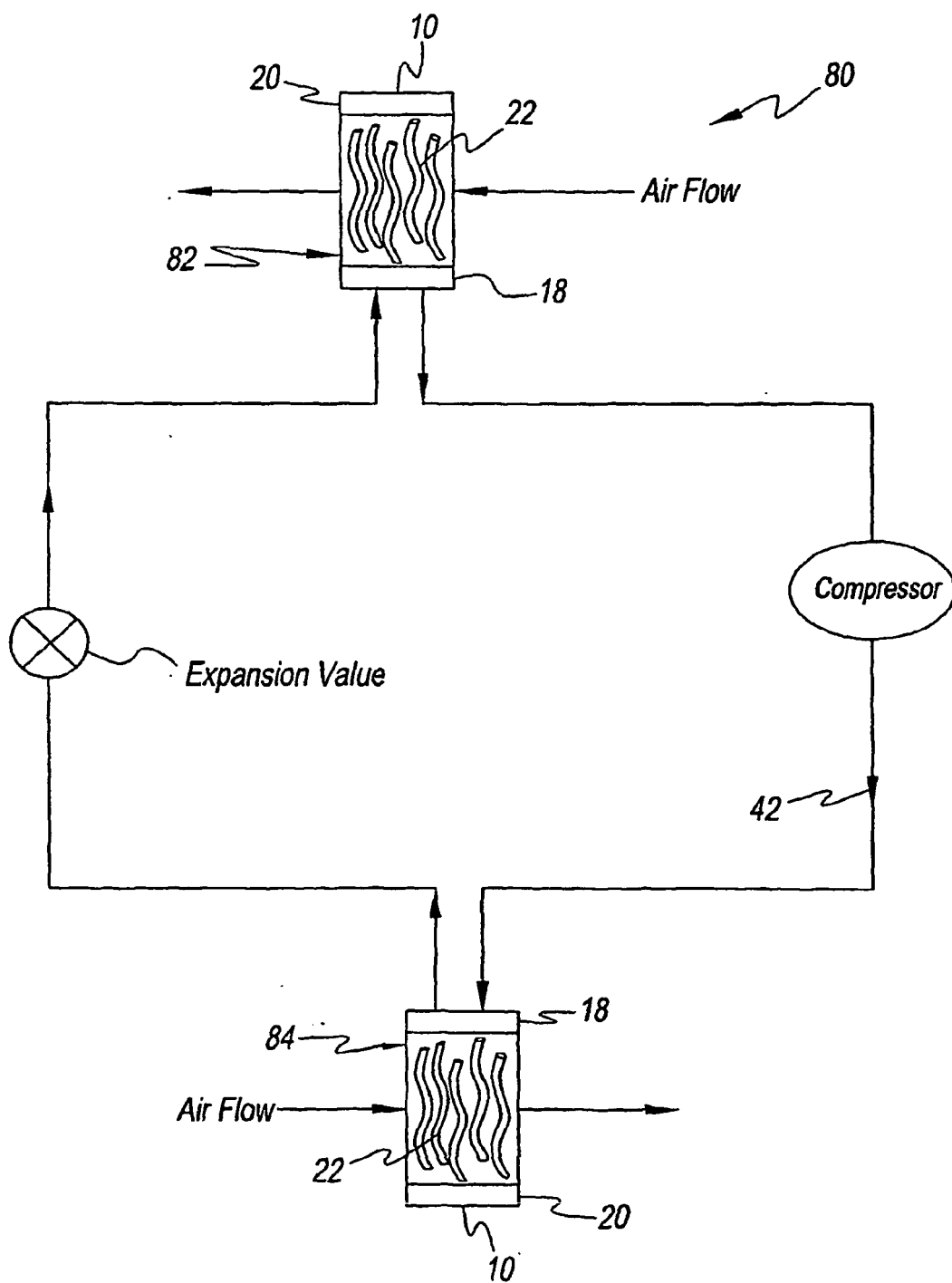


Fig. 6

**REFERENCES CITED IN THE DESCRIPTION**

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**Patent documents cited in the description**

- WO 2008048505 A [0002]
- US 7143605 B [0007]
- WO 2006083451 A [0009]