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(54) **HEAT EXCHANGER**

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(57) **ABSTRACT**

The invention relates to a heat exchanger with a first collector (10), in which chambers (44, 46), separated by at least one longitudinal separating wall, are formed and comprising a tube-fin or tube block (14), with tubes (16), or tubed devices opening into the first collector (10), fixed to the longitudinal separating wall (42), said longitudinal separating wall (42), comprising slots (50), whereby tubes (16) or tubed devices in the block (14) comprise slots (54) or shoulders, each of which is positioned in the region of a corresponding slot (36) of the longitudinal separating wall (42) and a method for production of a heat exchanger.

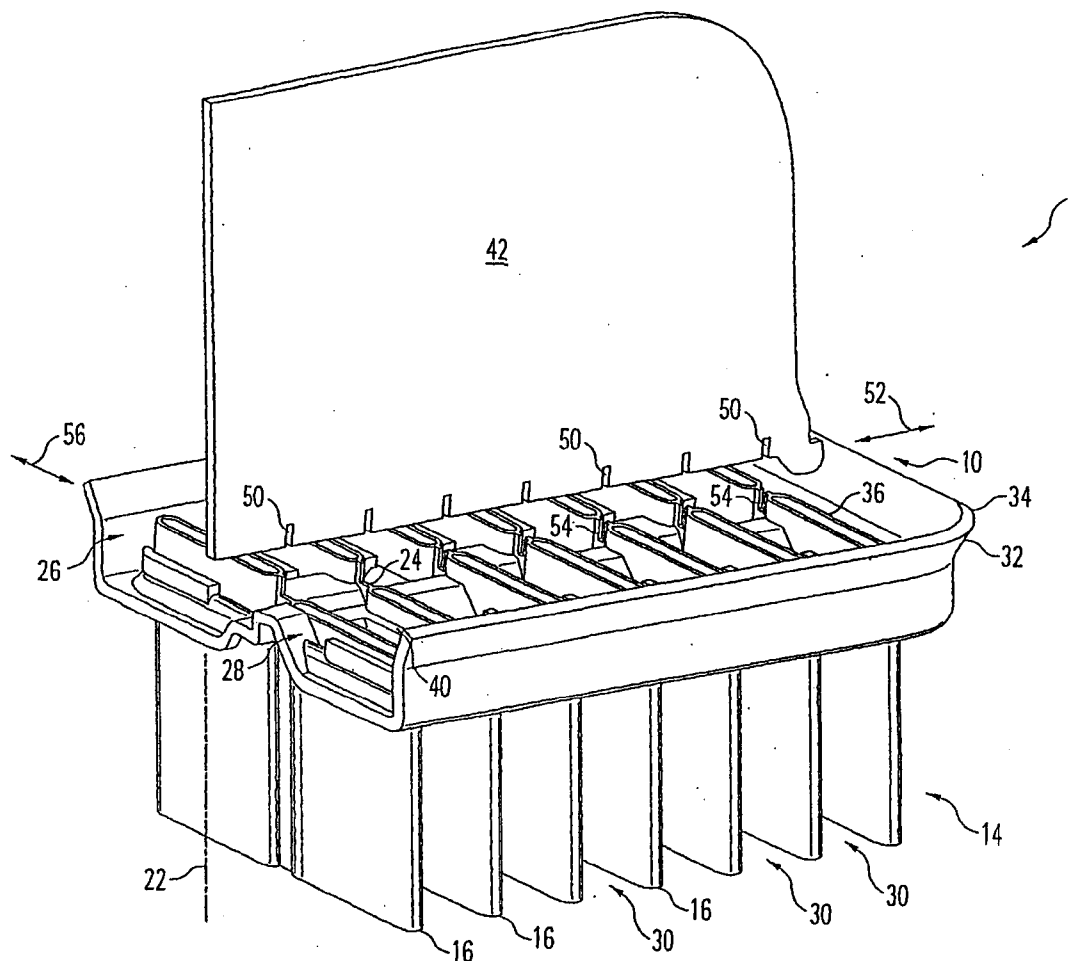
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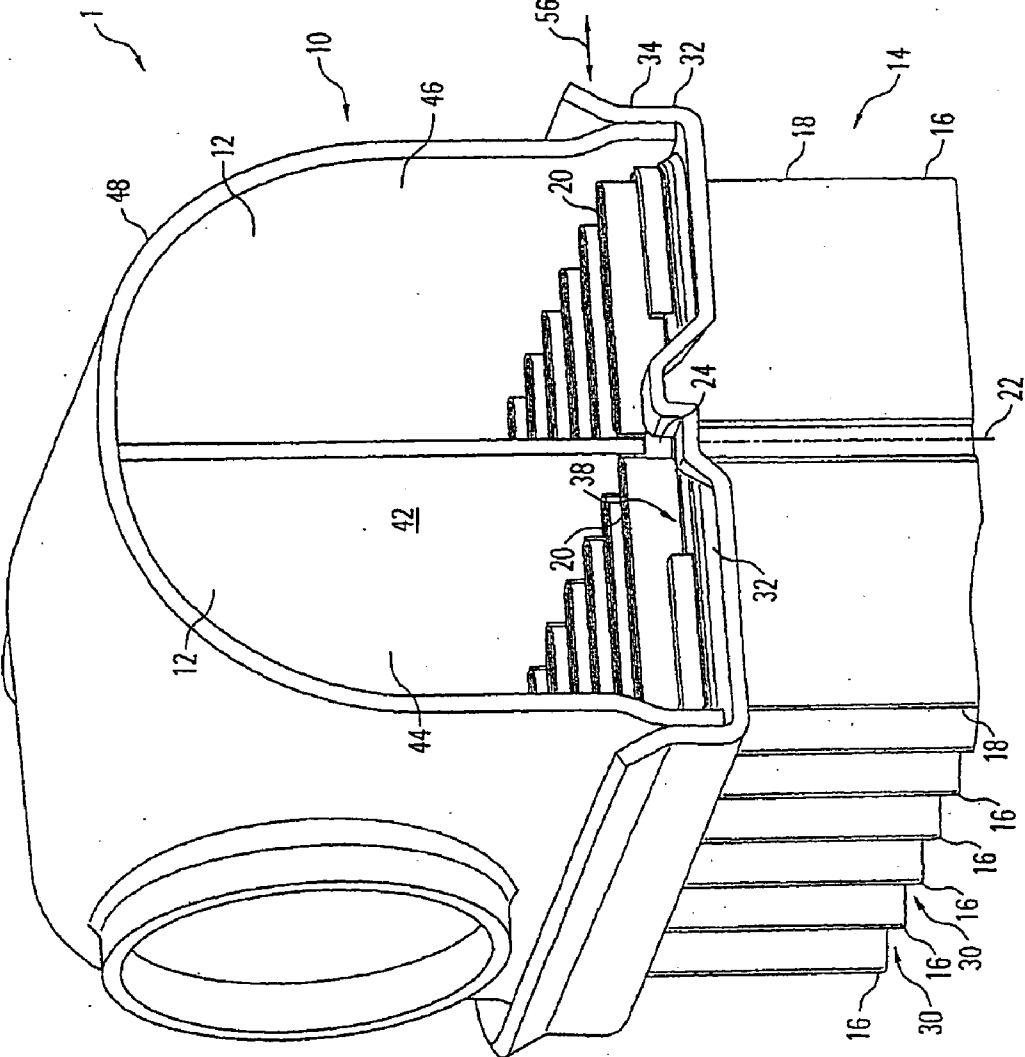


Fig. 1

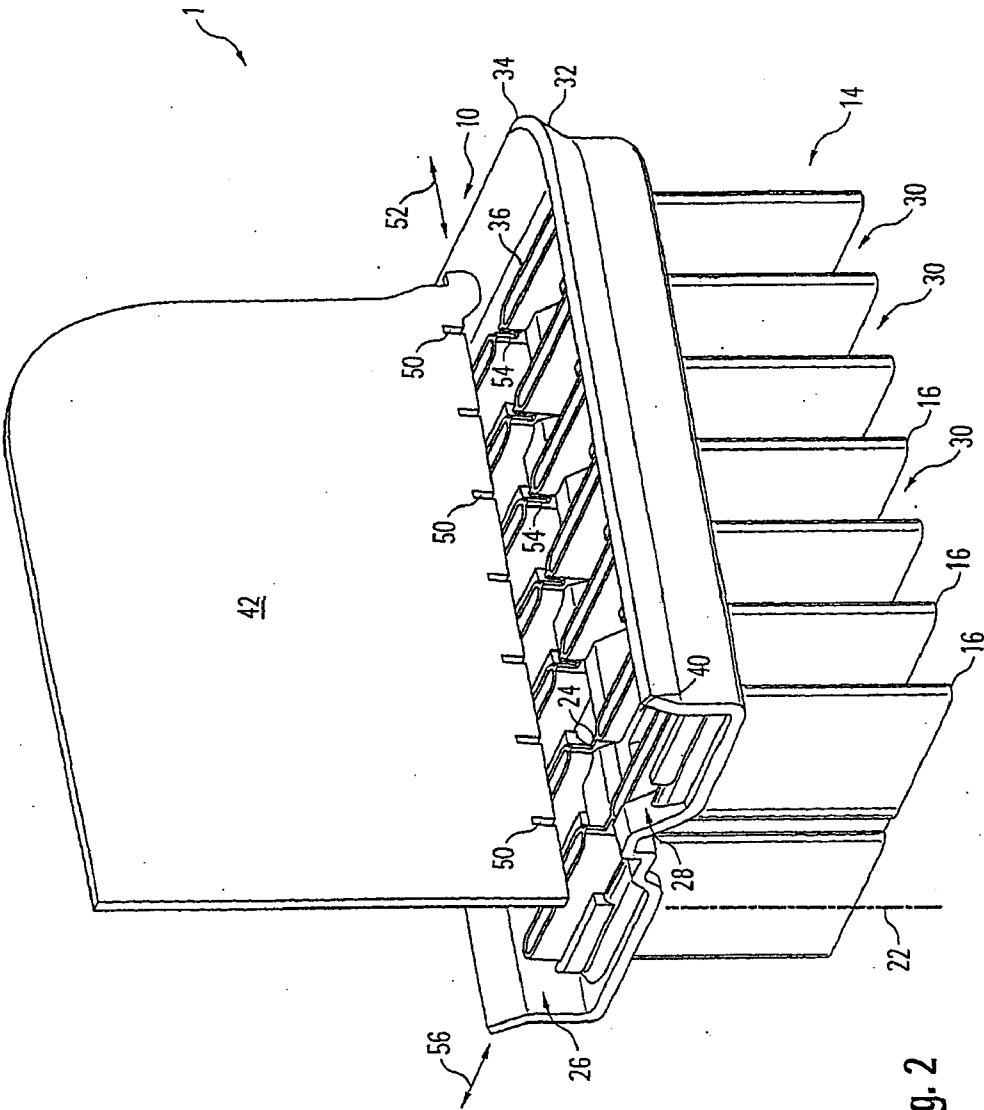


Fig. 2

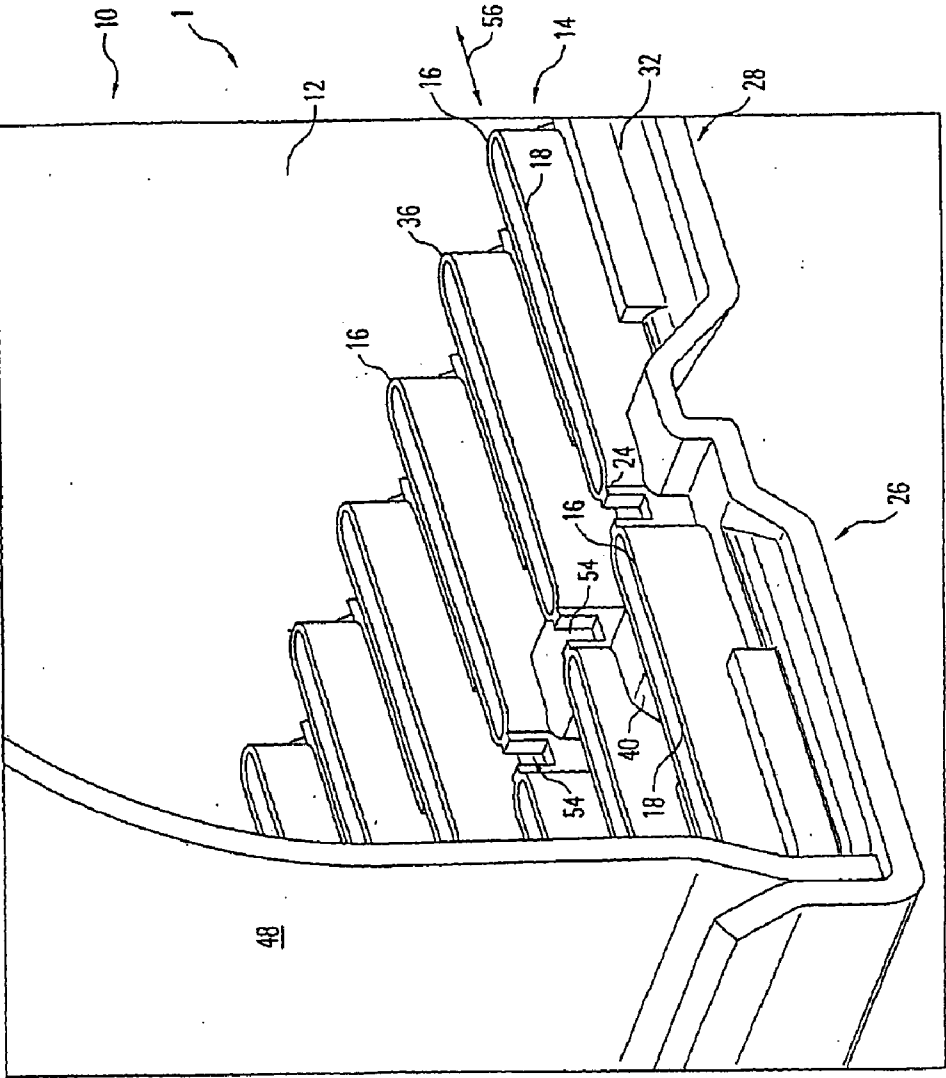


Fig. 3

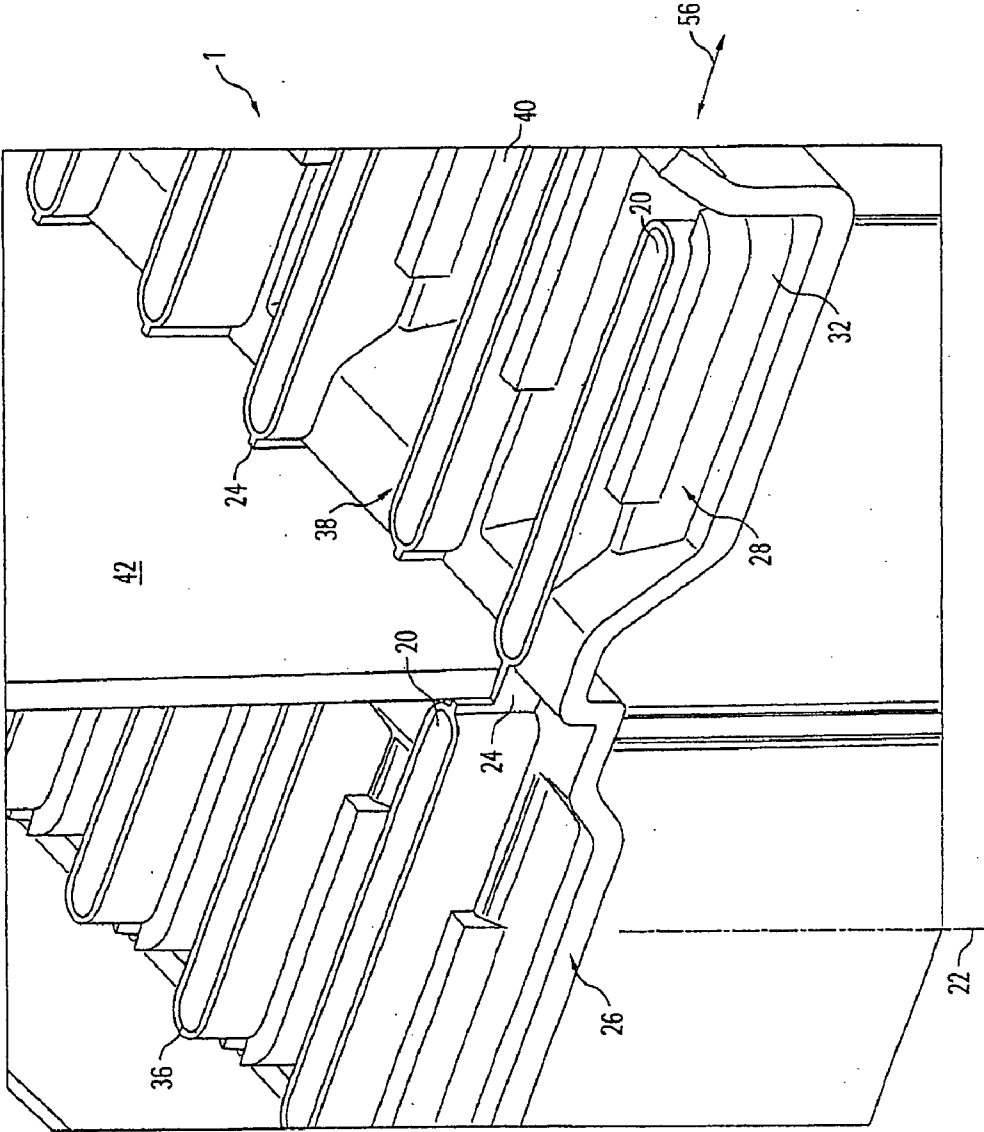


Fig. 4

### HEAT EXCHANGER

[0001] The invention relates to a heat exchanger to be precise in particular to a heat exchanger for a heating system or air-conditioning system of a motor vehicle.

[0002] A heat exchanger for motor vehicles which has a first collector provided with a separately fabricated base is already known, at least to the applicant. In this known heat exchanger, the first collector is divided into chambers by means of a longitudinal dividing wall. The longitudinal dividing wall projects here in the interior of the first collector as far as its base. This known heat exchanger has a tube rib block with a plurality of flat tubes which are formed in one piece and which are plugged, in the region of the first end, into openings in the collector base. These flat tubes each have two component flat tubes, themselves also configured in the manner of a flat tube, which are connected by means of a respective connecting web which is positioned between the component flat tubes. The component flat tubes are flush here at their first end. The respective connecting web of the flat tube is also flush at this first end with the component flat tubes, specifically in such a way that at the first end the termination of the two component flat tubes of the respective identical flat tube and the termination of the connecting web which connects these component flat tubes each lie completely in a plane perpendicular to the longitudinal axis of the flat tube. For each of these connecting webs, the longitudinal dividing wall has a slot on the side facing the tube rib block. The connecting webs are plugged into these slots so that the component flat tubes of the same flat tube open into various chambers in the first collector. In the region of the slots or the webs which are plugged into them, the webs are soldered to the longitudinal dividing wall in such a way that in this region the two chambers of the first collector are sealed with respect to one another. The flat tubes open at their second ends, lying opposite the first ends, into a second collector, a flow connection between the component flat tubes of the respectively identical flat tubes being formed in this second collector. The fluid can then flow into the first component flat tubes via a chamber of the first collector, be deflected in the second collector and flow into the second chamber of the first collector via the second component flat tubes. It has become apparent that the requirements in terms of fabrication technology to manufacture such heat exchangers or similar heat exchangers are extremely stringent.

[0003] The invention is based on the object of providing a heat exchanger which is operationally reliable and can easily be fabricated.

[0004] According to the invention, in particular a heat exchanger according to claim 1 or according to claim 3 is proposed. In addition, according to the invention, in particular a method for manufacturing a heat exchanger as claimed in claim 18 is provided. Preferred embodiments are the subject matter of the subclaims.

[0005] According to the invention, in particular a heat exchanger is provided having a first collector and a tube rib block or tube block. By means of a longitudinal dividing wall arranged in the first collector, separate chambers are formed in the first collector. The tube rib block or tube block, referred to below for short as block, has a plurality of tubes or tube devices which open into the first collector. These tubes or tube devices are secured to the longitudinal dividing wall. They are preferably soldered there. The longitudinal

dividing wall has slots, specifically in particular slots which are arranged on the side facing the tube block and have an open side. The tubes or tube devices which open into the first collector are preferably plugged into a tube bottom or into (through) openings in a tube base. Such a tube base is particularly preferably fabricated separately from the rest of the collector and soldered to it, for example. According to the invention, there is, provision in particular for the tubes or tube devices of the block to have slots or shoulders which are each positioned in the region of a respective slot in the longitudinal dividing wall. These may be in particular such that an overlap, preferably a complete overlap, is produced. In one particularly preferred embodiment, this overlap is produced in the direction of the longitudinal axes of the tubes or tube devices, and in particular, transverse with respect thereto. It is preferred in particular that the depth of the slots—viewed in particular in the direction of the longitudinal axis of the tubes—of the two slots which are assigned to one another, that is to say in each case of one slot in the tube or the tube device and one slot in the longitudinal dividing wall—is larger than the height of the chamber which is located in this direction and which is formed by the interaction of such slots or in each case one slot in a tube or tube device and one slot in the dividing wall.

[0006] In one preferred embodiment there is provision for a plurality of tubes or for all the tubes to have a plurality of ducts or component tubes or chambers which are spaced apart with respect to the longitudinal axis. It is particularly preferred here that such different ducts or component tubes or chambers open into different chambers in the first collector which are separated by means of the longitudinal dividing wall.

[0007] The tubes of the tube rib block which can also be referred to as connecting tubes, are preferably each configured in one piece.

[0008] In addition, the invention provides in particular a heat exchanger which has a first collector and a tube rib block or tube block. The first collector here has a base, in particular fabricated separately. In addition, in this first collector at least one longitudinal dividing wall is provided in order to form separate chambers in the interior of the collector. In addition, in this embodiment there is provision for the block to have tubes which are configured in one piece and which, for example, are each respectively oriented parallel to one another. These tubes each have at least two chambers or ducts or component tubes which are arranged spaced apart in the perpendicular direction in relation to the respective longitudinal axis of the tube. These ducts or chambers or component tubes can, for example, be spaced apart in such a way that the distance is formed by the wall thickness of the ducts or component tubes. It is also possible to provide that an additional distance is produced with respect to the latter, it being possible to achieve said distance, for example by means of a web or the like. In addition, in this embodiment, there is provision, in particular for the tubes to be plugged with their first ends into the base of the first collector in such a way that in each case two different ducts or component tubes or chambers of the respective same tube open into different chambers of the collector which are separated by the longitudinal dividing wall of the collector. In addition, in this embodiment, there is provision in particular, for the longitudinal dividing wall to be provided with slots on the side facing the base in the region of

the tubes. In addition, there is provision here, in particular, for the tubes to be provided with in each case at least one slot or shoulder in the region of their first ends, between the ducts or component tubes or chambers of the tubes which open into various chambers.

[0009] There is particularly preferably provision for the dividing wall and the tubes of the block to be arranged with such a configuration that slots in the dividing wall are each arranged in the region of a slot in a tube of the block. There is provision in particular, for the slots in the dividing wall and the slots in the tubes to respectively cover or overlap one another, to be precise in particular viewed in the direction of the longitudinal axes of the tube and/or transversely thereto.

[0010] The invention forms an underlying basis for a multiplicity of advantageous embodiments, such as, in particular, will become clear from the preferred embodiments and developments explained below.

[0011] In one particularly preferred embodiment of the invention there is provision for the tubes to each have two ducts or component tubes between which a web, in which in each case a slot is provided in the tube, is arranged, these slots which are provided in the tubes each forming a cavity with a slot in the dividing wall, the width of the slots in the dividing wall also corresponding essentially to the width of the webs in the tubes, and the width of the slots in the tubes corresponding essentially to the wall thickness of the dividing wall, and there being in addition provision that the dividing wall and the tubes are each positioned so far in the direction of the respective other part that the cavity in the region of the respectively open sides of the slots is essentially closed off by means of the other slot or the wall lying opposite the open side of the other slot.

[0012] In one preferred embodiment, the tubes are each configured in one piece. It is also preferred for tubes to have, between their tube ducts or component tubes, a web in which the slot or shoulder is provided in the region of the first tube end. However, it is also possible to provide that the slots in the tubes are each bounded at least partially in the lateral direction by wall sections which bound the ducts or the component tubes provided in the tubes.

[0013] In one preferred embodiment, the direction determined by the direction of the slot widths of the slots in the dividing wall is essentially perpendicular to the direction which is determined by the slot widths of the slots in the tubes of the block. There is particular provision for the slot width of the slots provided in the dividing wall to correspond in each case essentially to the material thickness of the tube which is respectively assigned to this slot, in the region of the tube which bounds the tube slot in the tube. In particular it is possible to provide here that the slot width of the slots provided in the dividing wall correspond essentially to the wall thickness of the respective web which is provided between ducts or component tubes of a respective tube. It is also preferred that the slot width of the slots provided in the tubes corresponds in each case essentially to the wall thickness of the dividing wall which is produced in the region of the slots of the dividing wall. The wall thickness of the dividing wall can also be constant throughout.

[0014] The tubes are preferably soldered to the dividing wall. In one particularly preferred embodiment, the corresponding solder points are provided along the slots which

are provided in the tubes, as well as along the slots which are provided in the dividing wall, or are provided along the corresponding boundaries of these slots. It is possible to provide that solder points are provided completely along the aforesaid boundaries of the slots. However, it is particularly preferred that these solder points are at least provided in such a way that the chambers, separated by means of the dividing wall, in the first collector are sealed with respect to one another in the region of the slots.

[0015] It is particularly preferred for the overlap between the two slot areas and the respective slot area of the end slot in the flat tubes and the slot in the dividing wall to be such that it corresponds at least to the length of the slot in the dividing wall. In each case a cavity is preferably formed by means of a respective slot in the longitudinal dividing wall and a respective slot in the tube. It is possible to provide for this cavity to be such that the cavity is completely sealed after the soldering process. However, it is also possible to provide that such a cavity is only partially sealed after the soldering process, specifically in such a way that the chambers, separated by the dividing wall, in the first collector are sealed with respect to one another in the region of the respective slots.

[0016] In one preferred embodiment there is provision that the respectively open end of the slots which are provided in the tubes is positioned further in the direction of the dividing wall, viewed from the respective tube, than the end of this dividing wall slot lying opposite the open end of the slot in the dividing wall in the same direction. It is also preferred—in particular in combination with the abovementioned embodiment—that the respectively open end of the slot in the dividing wall be positioned further in the direction of the respective tube, viewed from the dividing wall, than the end of this tube slot lying opposite the open end of the slot in this tube. It is therefore possible in particular in this way to form a type of cavity which is particularly preferably essentially closed and whose height is smaller—viewed in the respective direction of the slot depth, than the slot depth of the slot in a tube which forms this cavity, and is smaller than the depth of the other slot which forms this cavity in the dividing wall. In particular with such an embodiment, there is particularly preferably provision for the slot widths of the slots in the dividing wall as well as the slot widths of the slots in the tube to be matched to one another in such a way that a reliable and fluidtight connection is produced between the flat tube and the dividing wall in this area. There is particularly preferably provision for the solder gaps which are formed around this chamber to be less than 0.4 mm, preferably less than 0.3 mm, and particularly preferably less than 0.2 mm.

[0017] In a preferred embodiment, the tubes are embodied as flat tubes, to be precise in particular as double or multiple flat tubes. There is therefore in particular provision for the tubes to be embodied as flat tubes and to have a plurality of ducts which are arranged adjacent to or spaced apart from these tubes transversely with respect to their longitudinal axis. Such ducts of the respective tube are particularly preferably oriented parallel to one another. These ducts are preferably formed in component flat tubes which are also embodied, for example, in the manner of flat tubes.

[0018] In a particularly preferred embodiment, a plurality of rows of tubes are formed by means of such ducts or

component tubes of the tubes. For example, it is possible to provide for the tubes each to have two or three or even more ducts and for two or three or more than three rows of tubes to be correspondingly formed by these ducts or component tubes. It is also preferred that intermediate spaces for an airflow be formed between adjacent tubes. There is preferably provision for precisely one medium to flow through the tube system and for heat to be transferred between this medium and air flowing through intermediate spaces between the tubes. In one particularly preferred embodiment, there is provision for the tubes to open into a second collector at the second ends which are opposite the first ends of these tubes. It is possible to provide, for example, that in the second collector of this type precisely one chamber is formed so that the medium flows from the first chamber of the first collector through ducts in the tubes, which form a first row of tubes, and into the second collector, to be deflected there and to flow back via a second row of tubes formed by second ducts of the tubes, and into the first collector, specifically into the second chamber of the first collector.

[0019] However, according to the invention other connection configurations are possible or preferred. For example, it is possible to provide for more than two chambers to be formed in the first collector. This may be done in such a way, for example, that more than two longitudinal dividing walls are provided and one or more longitudinal dividing walls—arranged offset—are also provided in the second collector so that the medium is conducted through the heat exchanger in a sinuous form. However, according to the invention more complicated connection configurations are also preferred. For this purpose it is possible, for example, also to provide dividing walls which are arranged transversely with respect to the longitudinal dividing walls.

[0020] With respect to configurations with a plurality of longitudinal dividing walls it is to be noted that in such a case according to the invention these further longitudinal dividing walls can also be of slotted design and can interact with the correspondingly slotted tubes in the sense of the invention, that is to say as is explained by way of example with respect to a slotted longitudinal dividing wall and corresponding slotted tubes.

[0021] The base of the first collector is preferably manufactured separately from the rest of this collector which can be, for example, of hood-like design.

[0022] The rest of the collector, which is, for example of hood-like design can be fabricated in one piece or be composed of a plurality of parts. There is in particular provision for this rest of the collector, which is also referred to as an upper part, and the base of the collector to bound an essentially sealed space in which, however, if appropriate one or more feed openings for inflowing medium and one or more discharge openings for outflowing medium are provided and into which, of course, tubes of the block open.

[0023] For example, it is possible to provide for the upper part, such as the hood, of the first collector, to be soldered in a sealed fashion to the base of this first collector. The base of the first collector can have, for example, a curved flange. This flange can, for example, be bent in the side facing away from the tube rib block or tube block or extend in this direction. In this context it is possible, in particular, to provide that in the region of this flange the base is soldered

to the rest of the collector or of the upper part of the collector. The soldering in the region of the slots and/or other locations can be carried out, in particular, with solder plating or in a soldering furnace.

[0024] According to one method according to the invention for manufacturing a heat exchanger, such as, for example, a heat exchanger according to the invention, there is provision in particular for the tubes of the block to be inserted into openings which are provided in the base of the collector, or vice versa. The base of the collector is separated here from the rest of the collector or the upper part of the collector. In one preferred embodiment there is provision that after the tubes have been inserted in the region or in the vicinity of their first ends they are widened. This widening can occur in particular at the locations at which the tubes penetrate the collector base and/or on the side facing the interior of the collector. It is possible to provide for the tubes to be subsequently soldered to the collector base. This can also take place at a later time.

[0025] In a second step which is separate from the above-mentioned step or steps, the first step, there is provision in particular for the dividing wall to be inserted into the first collector. For this purpose it is possible to provide, for example, for mechanical securing devices such as projections or the like to be provided in the first collector. It is also possible to provide for the dividing wall to be secured there in some other way. It is also possible to provide for the dividing wall to be soldered directly to the first collector in this step. However, this soldering process can also be carried out at a later time. During the insertion process there is in particular provision for the collector base to be separated from the collector or the rest of the collector or the upper part of the collector.

[0026] The abovementioned first step and the abovementioned second step can essentially be carried out in any desired sequence or chronologically in parallel or overlapping.

[0027] In the third step there is in particular provision for the assembly to be combined with the tubes and the collector base on the one hand and the assembly with the rest of the collector or the upper part of the collector and that of the dividing wall on the other. This combination is carried out in such a way that the slots or tubes are respectively positioned in the region of an assigned slot in the dividing wall, specifically preferably so as to form a cavity. The configuration or the arrangement of the slots and the relative position of the slots can in particular be such as is also described at another location in this disclosure.

[0028] It is also possible to provide that after the first assembly and the second assembly are joined or plugged together, the tube ends which face away from the first collector, the second ends of the tubes, are plugged into a second collector, which can, for example, also have a collector base as well as an upper part of the collector. Here too it is possible to provide for the tubes in the collector base to be widened after the insertion process. However, it is also possible to provide for such a connection to be made to the second collector before the first and second assemblies are joined together.

[0029] In one preferred embodiment, the collector base or bases are soldered to the rest of the collector, that is to say

the upper part of the collector, and the dividing wall, or if a plurality of them are present, the dividing walls are soldered to the collector and the tubes to the collector base or the collector bases and the tubes to the dividing wall. The soldering of the tubes and to the dividing wall is carried out in particular in the region of the respective slots in the tubes and dividing wall.

[0030] It is possible to provide for this soldering to take place at the end, that is to say after all the individual parts or assemblies have been assembled. The soldering can be carried out in particular by means of solder plating or in a soldering furnace.

[0031] A slot is preferably a material recess, shaped in whatever way, which particularly preferably extends through a material or a wall section such as a web or a dividing wall.

[0032] The invention forms the basis of a plurality of advantageous configurations. For example, in the case of the heat exchanger described at the beginning, which has a configuration which is previously known—to the applicant—and to which no document specification is given, the problem can occur that if, on the one hand the tubes are firstly plugged into the collector base and on the other hand, the dividing wall is plugged into the rest of the collector and these two assemblies are then subsequently joined together, there is no tight seal between the chambers which are formed in the collector. It is thus possible, if the tubes have been plugged at least to a certain extent too far into the collector base, or the tubes cannot have completely insignificant length tolerances, that the collector base may not project sufficiently far against the rest of the collector. This may, for example be due to the fact that the tubes abut against the dividing wall in its slots as a result of said tubes being inserted too far or as a result of excessive length tolerances with the result that in this abutting position the collector base is not positioned sufficiently close to the rest of the collector. On the other hand, when the tubes are not inserted sufficiently far into the collector or when corresponding length tolerances have an effect, the tubes may, at least to a certain extent, not project sufficiently far into the slots in the dividing wall so that undesired or excessively large openings are formed in the chambers which during the soldering process cannot be readily closed, or only at considerable effort. Given the abovementioned configurations such problems can give rise to rejects. In order to avoid such problems, a considerable expenditure on fabrication technology is necessary on the abovementioned configurations.

[0033] The basis of the invention is thus to avoid such problems. This does not need to mean that these problems are avoided or largely avoided with each embodiment according to the invention. However, in particular preferred embodiments show that the invention forms, for example, a basis for avoiding or reducing such problems.

[0034] An exemplary embodiment of the invention will be explained below by reference to the figures, and is not intended to restrict the invention. In the figures:

[0035] FIG. 1 shows an exemplary heat exchanger according to the invention in a schematic, partial view;

[0036] FIG. 2 shows the embodiment according to FIG. 1 from a tilted viewing angle in a partially exploded view, with the first collector or a part of the first collector not being illustrated;

[0037] FIG. 3 shows an enlarged detail from the illustration according to FIG. 1, the longitudinal dividing wall being removed in order to illustrate better the slots in the tubes; and

[0038] FIG. 4 shows an enlarged detail from the configuration according to FIG. 1 from a tilted viewing angle.

[0039] The heat exchanger 1 has a first collector 10, the interior 12 of which is shown in FIG. 1, and a tube or tube rib block 14.

[0040] This block 14 has a multiplicity of flat tubes 16. These flat tubes 16 are configured in such a way that each of these flat tubes 16 has, strictly speaking, two flat tubes 18 or component flat tubes 18 and two ducts 20 are formed in each of these flat tubes 16 and are arranged spaced apart perpendicularly to the longitudinal axis 22 of the flat tube. There is provision here for the flat tube 16 to be configured in one piece so that the two component flat tubes 18 or the sections of the flat tube 16 having the ducts 20 are connected in one piece. In the embodiment according to FIG. 1 there is provision for the component flat tubes 18 of the same flat tube 16 to be arranged essentially in such a way that the planes extending through the component flat tubes 18 of the same flat tube 16 are essentially parallel or congruent.

[0041] In each case a web 24 which can, for example extend along the respective entire tube length over the longitudinal axis 22 of said flat tube, and connects the component flat tubes 18 of a respective flat tube 16 to one another integrally is arranged between the respective component flat tubes 18 of a respective flat tube 16. It is also possible to provide for such a web 24 not to extend along the entire length of the flat tube.

[0042] The wall thickness of the web 24 is less in the configuration according to FIG. 1 than the dimension of the component tubes 18 in the corresponding direction. This is in particular such that the web 24 forms a type of taper between the component tubes 18 which bear against it or are adjacent to it.

[0043] The heat exchanger 1 is embodied in two rows. This is in particular such that the first component tubes 18 of the flat tubes 16 form the first row 26 of tubes and the second component tubes 18 of these flat tubes 16 form a second row 28 of tubes. The flat tubes 16 are arranged essentially parallel to one another, to be precise in particular in such a way that the planes extending through the flat tubes 16 are arranged parallel to one another.

[0044] In the embodiment according to FIG. 1 there is provision for intermediate spaces 30 for a through-flow of air to be respectively formed between adjacent flat tubes 16 and, ribs (not illustrated) being arranged in said intermediate spaces 30. Such ribs can, for example, be soldered to the adjacent flat tubes 16 on each side. It is also possible to provide for the ribs, or for some of these ribs, to be soldered only to one adjacent flat tube 16 in each case. It is also possible to provide for separate ribs to be provided between adjacent flat tubes 16 for the different rows 26, 28 of tubes. In addition, it is possible to provide for ribs to be arranged between adjacent flat tubes 16, said ribs extending in both rows of tubes and thus respectively constituting a common rib for both rows 26, 28 of tubes.

[0045] It is also however possible to provide for no ribs to be provided in these intermediate spaces 30. In addition the flat tubes 16 can also be arranged essentially without intermediate spaces.

[0046] On the side facing the block 14, the first collector 10 has a base 32. There is particular provision here for the base 32 to be fabricated separately and to be connected to the rest of the first collector 10, in particular the upper part 48 of the first collector 10, in particular to be soldered. The base 32 has, for example, as shown in FIG. 1, a flange 34 which is bent in the direction of the side facing away from the block 14. The base 32 can, for example be soldered to the rest of the first collector 10, in particular upper part 48, in the region of the flange 34.

[0047] The base 32 is provided with one or more openings for receiving the first ends 36 of the flat tube 16. In the embodiment according to FIG. 1 it is such that a multiplicity of respectively slot-shaped openings 38 which are each intended to receive a flat tube 16 are provided in the base 32, in each case one intermediate web 40 (clearly shown in FIGS. 2 to 4) being provided between adjacent slot-shaped openings 38.

[0048] However, it is alternatively also possible to provide one or more relatively large openings for receiving in each case a plurality of flat tubes 16 (not shown in FIG. 1). The seal in the base region can be formed here, for example, by soldering the tubes in the vicinity of the first end 36 directly one against the other, if no intermediate spaces 30 are provided between the tubes. However, if such intermediate spaces 30 are provided, which is preferably the case, it is possible, for example, to provide corresponding intermediate webs or the like between the tubes 16 in the tube rib block 14 which form the corresponding seal and are soldered, for example, to the tubes 16.

[0049] At their second end lying opposite the first end 36, which is not shown in FIG. 1, the flat tubes 16 can also open or be plugged into a collector or a second collector.

[0050] The first collector 10 has a longitudinal dividing wall 42 which divides the interior space 12 of the first collector 10 into chambers (here into two chambers 44, 46).

[0051] In the embodiment according to FIG. 1, in order to delimit the interior space 12 of the first collector 10 next to the base 32 an upper part 48 is also provided which, for example can be of hood-like design as shown in FIG. 1.

[0052] The longitudinal dividing wall 42 extends from a wall section of the upper part 48, lying opposite the base 32, as far as the base 32.

[0053] In the embodiment according to FIG. 1, the longitudinal dividing wall 42 extends essentially in the direction of the longitudinal axes 22 of the tubes 16, essentially transversely or perpendicularly with respect to the planes extending through these tubes 16.

[0054] The dividing wall 42 is preferably attached to the upper part or the hood 48. It can be soldered there, for example. It can also be provided, in particular as a mounting aid, that projections or the like are provided on the inside of the upper part and the dividing wall 42 is pushed between said projections. The dividing wall 42 is preferably soldered to the upper part or to the hood 48 even if such projections or the like are provided.

[0055] The dividing wall 42 has slots 50 on its side facing the block 14. The dividing wall 42 is therefore a slotted dividing wall.

[0056] These slots 50 are clearly shown in FIG. 2. The width of these slots 50, which is in the direction indicated schematically by the double arrow 52 or in a direction perpendicular to the longitudinal axis 22 of the flat tube 16 perpendicular to the planes formed by the flat tubes or is in the direction of the rows of tubes, corresponds preferably essentially to the wall thickness of the webs 24 which are provided on the tubes 16. It is also possible to provide for the width of the slots 50 to be, in particular slightly, larger than this wall thickness such as for example, approximately 0.4 mm larger or up to approximately 0.4 mm larger. It is also possible to provide other dimensions; the dimension of 0.4 mm to 0.4 mm is however provided in one particularly preferred embodiment, details of which are given below.

[0057] The slots 50 preferably have a rectangular shape, as shown in the figures. However, it is also possible to provide other shapes. The slots 50 are open on the side facing the block 14.

[0058] In the exemplary embodiment there is therefore provision for the slots 50 to be bounded all around by material of the dividing wall 42, apart from their open side and when considered in a plane of the dividing wall 42. The slots are open to the side of this dividing wall plane; the slots are therefore of continuous form.

[0059] The flat tubes 16 are also slotted or have slots 54. These slots 54 are provided in the region of the first end of the flat tubes 16. The slots 54 are open toward the first collector 10.

[0060] In the exemplary embodiment, the slots 54 are provided in the webs 24, which is for example clearly shown in FIG. 3.

[0061] In the exemplary embodiment there is therefore provision for the slots 54 to be bounded all around by material of the webs 24, apart from their open side and when considered in the plane of the webs. To the side of this plane of the webs, the slots are open; the slots are therefore of continuous form. In the exemplary embodiment, the slots 54 have an essentially rectangular shape.

[0062] It is also possible to provide, however, for the slots 54 to be arranged at another location or shaped in some other way or to be bounded by other parts.

[0063] For example, it is possible to provide that the slots 54 of the tubes 16 are not bounded on the side by one web 24 in each case, but rather by walls of the component flat tubes 18.

[0064] For this purpose, it is possible, to provide for the webs 24 not to extend so far in the direction of the first collector 10, as is shown in the figures. It is possible then to provide, for example, for the slots to be bounded by one web in each case on the side lying opposite the open side and by, in each case, one component flat tube on the side, which is not shown in the figures.

[0065] In the exemplary embodiment there is provision for the webs 24 to end flush with the component flat tubes 18 at the first end 36 outside the slotted region. However, it is also possible to provide that, even if the webs are provided with

a slot, the webs project or are set back in the region of the first end 36, which is not shown in the figures. In addition it is possible to provide for the component flat tubes 18 not to end flush with one another at the first end.

[0066] The width of the slots 54, essentially in the direction of the double arrow 56 or perpendicular to the direction of extent of the rows 26, 28 of tubes and perpendicular to the longitudinal axis 22 of the flat tubes 16, preferably corresponds essentially to the wall thickness of the longitudinal dividing wall 42 or the wall thickness of this longitudinal dividing wall 42 in the region of its slots 50. It is also possible to provide for the width of the slots 54 to be, in particular, slightly, larger than this wall thickness such as, approximately, 0.4 mm larger or up to approximately 0.4 mm larger. It is also possible to provide other dimensions; the dimension of 0.4 mm to 0.4 mm is however, provided in one particularly preferred configuration, to be precise in particular in combination with a corresponding dimension, or the slots 50, already discussed. This in fact ensures that the soldering gap between the respective tube 16 and the longitudinal dividing wall is less than or equal to 0.2 mm, at least on one respective side. Soldering gaps which are larger than 0.2 mm are in fact frequently critical. However, it is to be noted that of course other, in particular larger, dimensions can also be provided so that the invention is not intended to be restricted to the aforementioned dimensions.

[0067] The slots 54 are each provided in the central end region of the tubes or between different ducts 20 or the two ducts 20 which are formed in a respective flat tube 18. There is in particular provision for these slots 54 to be provided between in each case two component flat tubes 18 of the same flat tube 16.

[0068] As is in particular apparent from viewing FIGS. 1, 2 and 4 together, the slots 50 in the longitudinal dividing wall 42 are each arranged in the region of an assigned slot 54 in a flat tube. This is in particular effected in such a way that there is an overlap between the slots or slot regions in the dividing wall and the flat tube. It is possible to provide here for the (open) end of the respective slot 54—facing the first collector 10—in a respective tube 16 to be positioned further in the direction facing the first collector 10 than the end—located in this direction—of the respectively assigned slot 50 in the longitudinal dividing wall 42. In particular there is provision for the width directions of the slot 50 in the dividing wall 42 and of a slot 54 in a tube 16 to cross over in each case, to be precise in particular at a 90° angle.

[0069] There is in addition preferred provision for the (open) end of the slot 50 which faces the block 14 to be positioned in each case further in the direction of the block 14 than the end of the slot 54 facing the block 14, in the respective tube 16. As a result, in particular through interaction with the slot regions already mentioned, it is possible for a cavity composed of respective slot pairings 50, 54 to be formed. There is provision in particular for the tubes 16 to be soldered to the dividing wall 42 in the region of the slots or the boundaries of these slots. In particular the tubes 16 are soldered to the dividing wall 42 in such a way that the chamber which is separated by the dividing wall in the region of the slots is essentially leak-proof.

[0070] There is provision in particular, as is also shown in the exemplary embodiment for the flat tubes to be plugged so far through the base 32 of the first collector that the end

of the slots 54, facing away from the first collector 10, in the flat tube 16 is positioned on the side of the base 32 facing away from the tube rib block 14. The tubes 16 are particularly preferably pushed through to such an extent that a distance is formed between this end of the slots 54 facing away from the first collector 10 and the base 32.

[0071] Even though this exemplary embodiment is used to explain that the first collector 10 only has two chambers, said collector 10 can also be divided by means of the longitudinal dividing wall 42 and the transverse dividing walls and/or by means of further longitudinal dividing walls into more than two chambers. It is also possible to provide for more than two rows of tubes to be formed in the tube rib block. In particular, it is also possible to provide for a plurality of such longitudinal dividing walls to be respectively slotted and for the flat tubes each to have a plurality of slots, to be precise in particular slots of the abovementioned type.

[0072] The second ends of the flat tubes 16 which face away from the first ends can, for example, also extend into a collector. This may be, for example, a collector which is not divided by means of longitudinal dividing walls.

[0073] The combination of a first collector of the abovementioned type with a second collector which is not divided into chambers by means of longitudinal dividing walls can, for example, be such that fluid flows from a first chamber 26 of the chambers of the first collector 10, through the tubes 16 of a first row 26 of tubes and into the second collector, is deflected there and flows back into the first collector 10 through a second row 28 of the tubes 16, flowing in particular into the second chamber 46 of the said first collector 10.

[0074] It is possible to provide in particular that an inflow opening and an outflow opening are provided in the first collector 10 for the medium flowing through the tube system. For example, the inflow opening can open into a first chamber 44 of the chambers 44, 46 which are separated by the longitudinal dividing wall 42 and the outflow opening can open into the second chamber 46 of these chambers 44, 46.

[0075] A number of preferred steps which can occur when the heat exchanger 1 is manufactured, which is illustrated by way of example, will be explained below. It is possible to provide, for example, that the flat tubes 16 are plugged through the openings 38 in the collector. These flat tubes 16 can, for example, be subsequently widened in order to bring about to a certain extent a secure grip or clamped connection in the openings of the base 32 and/or in order to reduce the dimensions of solder gaps between the flat tubes 16 and the base 32. If appropriate, the flat tubes 16 can then also be soldered to the base 32.

[0076] Independently of this abovementioned step it is possible to provide for the dividing wall 42 to be inserted or plugged into the first collector 10 or the upper part 48 of the first collector. It is possible to provide here, for example, for mechanical projections or the like to ensure a certain grip in this context. It is also possible to provide that the soldering between the dividing wall 42 and upper part 48 is already carried out at this time.

[0077] In the manner mentioned above, it is therefore possible to produce two assemblies. It is possible, for

example, to provide that both the assembly with the base **32** of the first collector **10** and the flat tubes **16**, on the one hand, and the assembly with the rest of the first collector **10** or the upper part **48** in which the dividing wall **42** is arranged, on the other, are joined together or plugged together. This is done in particular in such a way that the slots **54** in the flat tubes **16** are arranged in region of the slots **50** in the longitudinal dividing wall **42**, to be precise in particular in an overlapping fashion, which occurs particularly preferably in the longitudinal direction of the flat tubes **16** and transversely with respect thereto. In particular, this plugging together can be done in such a way that the slots are caused to overlap here. It is possible to provide in particular, and this and/or the abovementioned is in particular also a preferred structural feature of the configuration explained above, the flat tube **16** and the longitudinal dividing wall **42** are moved toward one another to such an extent that a type of cavity is formed respectively by the slots **50**, **54**, the direction of extent of which cavity is smaller viewed in the longitudinal direction of the flat tubes **16** than the dimension of the extent of the slots **50** and of the slots **54** in this direction.

[0078] The unit composed of the two assemblies, and if appropriate of further components such as the joined-on second collector or the like, is then advantageously soldered. This may be done, for example, in a soldering furnace or by means of solder plating. This permits in particular soldering also to be performed at locations which cannot (any longer) be reached by means of a soldering tool or the like, or can only be reached with difficulty, as a result of their position. The—in particular additional—use of other solder methods or other connecting methods such as, for example welding, is also preferred.

[0079] Advantages provided in particular with the exemplary embodiment will now be explained. In this context, a number of exemplary features will also be explained.

[0080] In heat exchangers with a longitudinal dividing wall such as was explained at the beginning as prior art known to the applicant, without reference to documents, the joining process and thus the insertion depth of the flat tubes, divided into the two chambers, can be determined very precisely as a result of the draft through the base or collector so that no gap is produced between the flat tube ends and the slotted dividing walls, or the gap is only of such a size that it, for example, solders in a sealed fashion in a subsequent soldering process in a reliable fashion without gaps. Furthermore, stringent requirements are made of the length precision of the flat tubes owing to the abovementioned problems.

[0081] The slotting or notching of the flat tubes—divided into two chambers—in the central tube end region results in an overlap between the two slot regions of the end slot of the flat tube and the dividing wall slot. If the overlap between the two slot regions is at least of the length of the slot in the dividing wall, which is preferably the case, the further slot length in the flat tubes serves as an additional length tolerance region for the joining process or for compensating length tolerances of the individual flat tubes.

[0082] The slot width of the flat tubes is here preferably matched to the thickness of the dividing wall in such a way that when the two slots overlap a reliable connection which has a fluid seal is produced between the flat tube and the dividing wall.

[0083] It is even possible, in particular in an extreme case, for a cavity which is sealed from the outside to come about or be produced as a result of the overlap of the slots in the dividing wall and flat tube, and said cavity does not adversely affect the reliable soldering between the dividing wall and flat tube.

[0084] The heat exchanger according to the invention and in particular a heat exchanger according to the invention which is illustrated by way of example by means of the exemplary embodiment can, in particular, be a component of a heating system in a motor vehicle or be intended for such a system.

LIST OF REFERENCE NUMERALS

- [0085] **1** Heat exchanger
- [0086] **10** First collector
- [0087] **12** Interior space of **10**
- [0088] **14** Tube or tube rib block
- [0089] **16** Flat tube
- [0090] **18** Component flat tube of **16**
- [0091] **20** Duct in **16**
- [0092] **22** Longitudinal axis of **16**
- [0093] **24** Web of **16**
- [0094] **26** First row of tubes
- [0095] **28** Second row of tubes
- [0096] **30** Intermediate space
- [0097] **32** Base
- [0098] **34** Flange of **32**
- [0099] **36** First end
- [0100] **38** Slot-shaped opening
- [0101] **40** Intermediate webs
- [0102] **42** Longitudinal dividing wall in **10**
- [0103] **44** First chamber of **12**
- [0104] **46** Second chamber of **12**
- [0105] **48** Upper part of **10**
- [0106] **50** Slots
- [0107] **52** Double arrow
- [0108] **54** Slot in **24** of **16**
- [0109] **56** Double arrow

1. A heat exchanger having a first collector, in which chambers, separated by means of a longitudinal dividing wall, are formed, and having a tube rib or tube block which has tubes or tube devices which open into the first collector and which are secured to the longitudinal dividing wall, the longitudinal dividing wall having slots, wherein tubes or tube devices of the block have slots or shoulders which are each positioned in the region of the respective slots of the longitudinal dividing wall.

2. The heat exchanger as claimed in claim 1, wherein a plurality of tubes or tube devices, or all of said tubes or tube devices, have a plurality of ducts or component tubes or of

chambers which are spaced apart transverse in relation to their longitudinal axis and open into various chambers, separated by means of the longitudinal dividing wall, of the first collector.

3. The heat exchanger as claimed in claim 1, having a first collector and a tube rib or tube block, the first collector having a base and at least one longitudinal dividing wall for forming separate chambers in the interior of the first collector, and the block having tubes, in particular tubes which are formed in one piece and each have at least two chambers or ducts or component tubes which are arranged spaced apart perpendicularly in relation to the respective tube longitudinal axis, the tubes being inserted by their first end into the base of the first collector in such a way that in each case two different ducts of the respective same tube open into different chambers, separated by the longitudinal dividing wall of the collector, of the first collector, and the longitudinal dividing wall being provided on the side facing the base with slots in the region of the tubes, wherein the tubes are provided between the ducts or component tubes which open into the chambers in the region between their first end and a slot or shoulder.

4. The heat exchanger as claimed in claim 3, wherein the dividing wall and tubes of the block are configured and arranged in such a way that slots in the dividing wall are each arranged in the region of a slot in a tube of the block.

5. The heat exchanger as claimed in claim 1, wherein the tubes have a web between the tube ducts, in which web the slot or shoulder is provided in the region of the first tube end.

6. The heat exchanger as claimed in claim 5, wherein the slots in the tubes are provided in the webs in the tubes.

7. The heat exchanger as claimed in claim 1, wherein the slots in the tubes are bounded at least partially in the lateral direction by wall sections which bound ducts provided in the tubes or by wall sections of the component tubes.

8. The heat exchanger as claimed in claim 1, wherein the direction of the slot widths of the slots in the dividing wall extend essentially perpendicularly to the direction of the slot widths of the slots in the tubes of the block.

9. The heat exchanger as claimed in claim 1, wherein the slot width of the slots provided in the dividing wall corresponds in each case essentially to the material thickness, in particular wall thickness of the web, of the tube which is respectively assigned to this web, in the region of the tube which bounds the slot in the tube, or is larger.

10. The heat exchanger as claimed in claim 1, wherein the slot width of the slots provided in the tubes corresponds in each case essentially to the wall thickness of the dividing wall in the region of the slots in the dividing wall, or is larger.

11. The heat exchanger as claimed in claim 1, wherein the tubes are each soldered to the dividing wall in the region of the slots of said tubes or the boundaries of these slots or at least some of these boundaries, specifically in particular in the region of the slots in the dividing wall or the boundaries of these slots in the dividing wall or at least some of these boundaries of the slots in the dividing wall, in such a way that in this region the chambers which are separated by means of the dividing wall are sealed.

12. The heat exchanger as claimed in claim 1, wherein cavities are formed by means of the slots in the longitudinal dividing wall and by means of the slots in the tubes.

13. The heat exchanger as claimed in claim 1, wherein a respective slot in the longitudinal dividing wall and a respective slot in a tube overlap, specifically in particular in such a way that the coverage or overlap is larger—in particular viewed in the longitudinal direction of the tubes, than the length or depth of the respective slot in the longitudinal dividing wall in this direction.

14. The heat exchanger as claimed in claim 1, wherein the tubes are configured as flat tubes.

15. The heat exchanger as claimed in claim 1, wherein ducts of various tubes or the component tubes of the tubes form at least two rows of tubes.

16. The heat exchanger as claimed in claim 1, wherein intermediate spaces for an air flow are formed between adjacent tubes.

17. The heat exchanger as claimed in claim 1, wherein the tubes open with their second ends, facing the first ends, into a second collector.

18. A method for manufacturing a heat exchanger which has a first collector which is provided with a base and in which at least two different chambers are formed by means of at least one longitudinal dividing wall which extends to the base, and which has a tube block or tube rib block with a plurality of tubes, which are in particular arranged in parallel with one another, these tubes being in particular each formed in one piece and having in each case at least two ducts or component tubes which are arranged in particular parallel to one another and open into various chambers of the first collector, a slot being provided in the end region of the tubes facing the first collector between the ducts or component tubes of this respective tube, and the dividing wall being provided with slots in its end region facing the block, having the steps:

the tubes are slid into openings which are provided in the base of the first collector, when the base is separated from the first collector in order to form the first assembly (first step);

the dividing wall is inserted into the first collector, the base of the first collector being separated from the collector during this insertion process in order to produce a second assembly (second step);

the first step being independent of the second step so that no particular sequence is predefined;

the first and second assemblies are assembled in such a way that the slots in the tubes are each positioned in the region of an assigned slot in the dividing wall, specifically in particular so as to form a cavity (third step);

19. The method as claimed in claim 18, wherein after the insertion process into the base of the first collector, the tubes (in the first step) are widened in order to produce a press fit in the base or in order to increase the retaining force of such a press fit or in order to reduce the dimensions of a soldering gap.

20. The method as claimed in claim 18, wherein the first and second assemblies are joined together in the third step in such a way that in particular those slot depths of the slots in the tubes and the slots in the longitudinal dividing wall which are located in the direction of the longitudinal axes of

the tubes are respectively larger than the depth, located in this direction, of the cavity formed respectively between these slots.

21. The method as claimed in claim 18, wherein the longitudinal dividing wall is soldered to the tubes, in each

case in the region of the slots, to be precise in particular in the region of the boundaries of the respective slots.

22. (canceled)

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