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(54) **HEAT PUMP SYSTEM FOR AN ELECTRICAL HOUSEHOLD APPLIANCE, AND AN ELECTRICAL HOUSEHOLD APPLIANCE COMPRISING A HEAT PUMP SYSTEM**

(57) A heat pump system for an electrical household appliance comprising an evaporator, a condenser and a compressor having a housing with a housing top surface on which an evaporation tray rests to collect condensation water, wherein the evaporation tray has a tray bottom surface shaped with a geometry substantially corresponding to the geometry of the housing top surface and having at least one spacing element to keep a distance (d) between the tray bottom surface and the housing top surface, wherein the at least one spacing element is elastic at least in part in such a manner that it exerts pressure against the housing top surface to reduce vibrations from the evaporation tray.

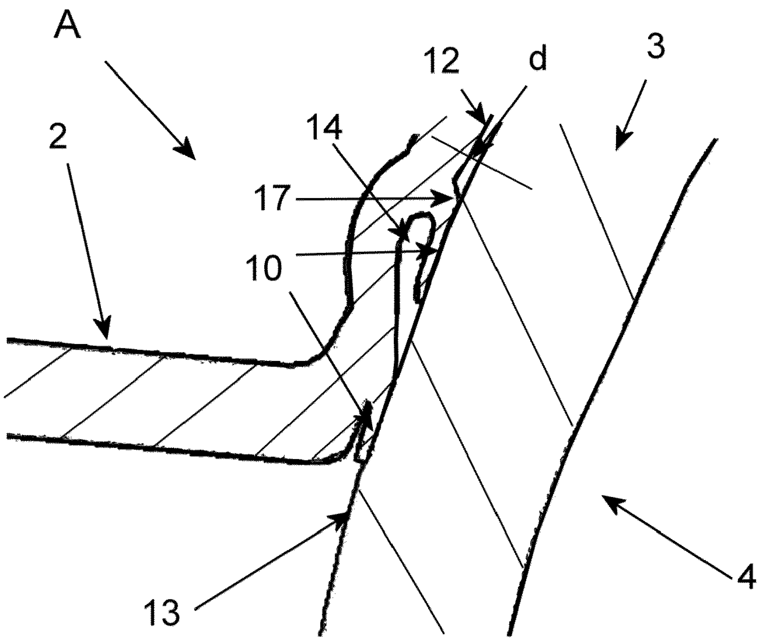

Fig.9

Processed by Luminess, 75001 PARIS (FR)

Description

[0001] The invention relates to a heat pump system for an electrical household appliance comprising a condenser, an evaporator, a compressor and an evaporation tray to receive condensed water in said system and evaporate it by making use of the residual heat from the compressor. Said evaporation tray rests on the compressor of the heat pump system to make use of its residual heat to the extent possible and evaporate the water received in the evaporation tray. Furthermore, the invention relates to an electrical household appliance comprising a heat pump system according to the invention.

[0002] Electrical household appliances including a heat pump system can be equipped with a draining device to discharge the water condensed in the area close to the evaporator. Heat pump systems usually exchange heat with process fluids to make use of the heat generated in the condenser to heat the process fluid and/or the cold generated in the evaporator to cool down the process fluid. This process fluid is usually air. In these systems, the water contained in the process fluid (due to the humidity of the same) mainly condenses in the areas close to the evaporator as a consequence of the low temperatures of the same and this condensed water needs to be evacuated from the system. One of the ways in which this water can be evacuated is by collecting it in an evaporation tray that rests on the compressor of the heat pump system to make use of the residual heat of the same.

[0003] Document US20090056362A1 describes a compressor arrangement comprising a support, an evaporation tray, which can be inserted into the support in a series of sliding guides up to a final position, and a compressor, in which the separation between the evaporation tray and the compressor is bigger in the final position of each sliding guide than in at least another location of the sliding guide. Said document describes that, to achieve the highest possible evaporating performance, it is useful to arrange the evaporation tray as close as possible to the compressor. Furthermore, the document describes that the evaporation tray and the compressor should not contact each other, since the evaporation tray would otherwise form a resonance box amplifying the noises from the compressor.

[0004] In this manner, a situation arises in which, if the evaporation tray is contacting the compressor, the noise generated by the compressor while functioning is amplified but, if the evaporation tray is arranged much further away from the compressor, the potential of the residual heat emitted by the compressor is not entirely used to evaporate the water contained in the evaporation tray.

[0005] Consequently, a heat pump system with an evaporation tray not amplifying the noises generated by the compressor is required, in which, in addition to this, the residual heat emitted by the compressor is used as much as possible to evaporate the biggest possible water amount contained in the evaporation tray.

[0006] Therefore, it is an object of the present invention to provide a heat pump system comprising an evaporation tray resting on the compressor in such a manner that the noise generated by the compressor is not amplified by the same and that the residual heat generated by the compressor is used to the greatest possible extent to evaporate the water contained in the evaporation tray.

[0007] The object of the invention is a heat pump system for an electrical household appliance comprising an evaporator, a condenser and a compressor having a housing with a housing top surface on which an evaporation tray rests to collect condensation water, wherein the evaporation tray has a tray bottom surface shaped with a geometry substantially corresponding to the geometry of the housing top surface and having at least one spacing element to keep a distance "d" between the tray bottom surface and the housing top surface, wherein the at least one spacing element is elastic at least in part in such a manner that it exerts pressure against the housing top surface to reduce vibrations from the evaporation tray.

[0008] This configuration has the advantage to be able to absorb the differences that may exist between the geometry of the tray bottom surface and that of the housing top surface. In this manner, the evaporation tray comprises at least one spacing element exerting pressure against the compressor, since the at least one spacing element is deformed and exerts pressure against the housing top surface in such a manner that the position of the evaporation tray on the top housing of the compressor is kept, a distance "d" between both of them being thereby maintained. In this way, the residual heat of the compressor is used to the greatest possible extent to evaporate the water contained in the evaporation tray and to avoid, or at least reduce, the vibrations of the evaporation tray.

[0009] A heat pump system is understood to be a thermal machine taking heat from a cold space and transferring it into a warmer one by means of a mechanical work. A heat pump system comprises at least one condenser, one evaporator and one compressor. In most cases, it also comprises a capillary tube and a dehydrating filter.

[0010] The refrigerant in a gaseous state flowing out of the evaporator through the return tube is absorbed by the compressor. The compressor is usually composed of an electric motor and a piston to compress the refrigerant. In the compressor, the refrigerant is compressed and heated. The refrigerant, after flowing out of the compressor, enters the condenser being hot, where the refrigerant begins to cool down. Along the condenser, the refrigerant cools down and condenses and, when flowing out of the condenser, the refrigerant is almost entirely liquid. For this reason, the condenser is also known as the hot focus of the heat pump system, since it emits heat.

[0011] Subsequently, the refrigerant flows preferably through a dehydrating filter. The dehydrating filter is an element containing a material able to absorb water. It is here where the water and/or humidity that might have penetrated the system is retained, which needs to be eliminated before the refrigerant reaches the capillary, since humidity may cause obstructions in the capillary as a consequence of the frozen water that might have entered the system. The next element flowed through by the refrigerant is the capillary tube. The capillary, which is a tube having a very small inner diameter, makes the liquid refrigerant coming from the dehydrating filter start to evaporate at its outlet (which is the evaporator inlet). The refrigerant starting to evaporate at the end of the capillary flows into the evaporator. Since the diameter of the evaporator tubes is much bigger than that of the capillary, the pressure drops and the evaporation occurs. The evaporation of the refrigerant gas makes it absorb heat from the environment surrounding it and, therefore, the evaporator is the cold focus of the heat pump system, since it is at very low temperatures and, for this reason, it is able to absorb heat.

[0012] Finally, the refrigerant flows back in a gaseous state to the compressor through the return tube and, here, it would start to flow through the entire circuit again.

[0013] Therefore, the heat pump system comprises a compressor driving the refrigerant gas through a circuit towards a condenser, which is the hot focus of the system. Then, it flows towards and evaporator, which is the cold focus of the system and, finally, it flows back to the compressor to start the cycle again. The heat from the condenser and of the cold from the evaporator can be utilised in different ways in different electrical household appliances, the most typical one being the heat exchange with a process fluid, which is generally air.

[0014] So, for example in the case of household refrigerating appliances, air is driven, which contacts the evaporator to cool down said air current up to the desired temperature and this air flows into the compartments in which the elements to be cooled down and/or frozen are arranged. In the case of household fridges and freezers, these elements are food to be cooled down or frozen in many cases. Meanwhile, the condenser evacuates the heat from inside said compartments towards the outside.

[0015] The heat pump system can be used to dry wet objects contained in a compartment as well. In this case, an air current is circulated through the condenser. This causes the air heating. The warm air flows into the compartment containing the wet objects to be dried and contacts the wet objects contained in the compartment. This makes warm air absorb humidity from these wet objects. This warm air is driven towards the evaporator, where it cools down and the humidity contained in the same remains condensed in said evaporator, so that the process fluid starts the cycle again. Dryers and/or washing machines with a drying function to dry clothes contained in their drum usually feature this drying form. It is also usual to use this air current to dry the dishes contained inside a dishwasher.

[0016] In the same manner, a heat pump system can be used to heat a house in winter or to cool it in summer. For this, the air direction is inverted in such a manner that air flows into the house from the evaporator in summer to reduce the temperature inside the house or air flows in from the condenser in winter to increase the temperature inside the house.

[0017] The evaporation tray rests on the compressor to make use of the residual heat of the same to the greatest possible extent. The compressor compresses the refrigerant. This makes the temperature of the compressor and of its housing increase while it is working and this is the heat that is used to evaporate the water contained in the evaporation tray.

[0018] Compressors usually have a housing, wherein the housing top surface has a convex geometry and the housing top surface is one of the warmest areas of the same and this is the reason why the tray bottom surface rests on the housing top surface.

[0019] In order to make use of the residual heat of the compressor as much as possible, the distance "d" between the tray bottom surface and the housing top surface is made the smallest possible. The distance "d" preferably amounts to 0 mm, 0.1 mm, 0.2 mm, 0.3 mm, 0.4 mm, 0.5 mm, 0.6 mm, 0.7 mm, 0.8 mm, 0.9 mm, 1 mm, 1.1 mm, 1.2 mm, 1.3 mm, 1.4 mm, 1.5 mm, 1.6 mm, 1.7 mm, 1.8 mm, 1.9 mm or 2 mm.

[0020] The geometry of the tray bottom surface corresponds substantially to the geometry of the housing top surface to increase the surface receiving residual heat and to be able to evaporate the highest possible amount of condensed water in the shortest possible time. In this case, it is substantially utilised for definition purposes that both the tray bottom surface and the housing top surface have the same geometry but, due to the manufacturing processes of the same, the materials used to produce them or the existence of different suppliers or moulds of the same, there are small differences between both geometries attributable and inherent to the own production processes, the different materials, different suppliers, different moulds.

[0021] The tray bottom surface comprises at least one spacing element, which is elastic at least in part in such a manner that it exerts pressure against the housing top surface to reduce and/or avoid vibrations from the evaporation tray. Depending on the geometry of the tray bottom surface and of the housing top surface as well as on the differences between them that might exist, as many spacing elements as required, in different sizes and in different positions, can be provided to guarantee the necessary pressure to keep the evaporation tray resting on the housing of the compressor, while making use of the heat, and to avoid or reduce the vibrations of the evaporation tray.

[0022] Furthermore, the evaporation tray can be fixed to the compressor by other additional fixing means.

[0023] In a preferred embodiment, the tray bottom surface has at least three spacing elements in such a manner that the distance "d" between the tray bottom surface and the housing top surface is kept.

[0024] This embodiment is particularly advantageous, since it can be guaranteed in this manner that all the spacing elements contact the housing top surface.

[0025] Although the geometry of the tray bottom surface and that of the housing top surface is the same, there will always be small differences inherent to their manufacturing processes, utilised materials or different suppliers or moulds, reason for which having three spacing elements is particularly advantageous, since they are able to adapt to these minimum differences more easily. Furthermore, since the spacing elements can be arranged at any point of the tray bottom surface, they can be arranged at the detected most critical locations depending on the geometry of the own tray bottom surface or the production processes of the tray bottom surface or of the housing top surface or on the different moulds or suppliers both of the compressor and the evaporation tray.

[0026] In another preferred embodiment, the spacing elements protrude from a protruding area of the tray bottom surface and have a sheet-like and/or threadlike geometry.

[0027] The spacing elements need to be elastic at least in part to be able to be deformed and exert pressure against the housing top surface. This embodiment has the advantage that two spacing element geometries particularly advantageous to favour this elasticity and capacity to adapt to different and complex geometries are described.

[0028] In the case of a sheet-like geometry, two of the dimensions are bigger than the third dimension. This geometry is particularly advantageous when it is intended to arrange few spacing elements on the tray bottom surface and/or in addition they are required to exert a higher force against the housing top surface. In the case of the sheet-like geometry, the protruding area preferably has a quadrangular section.

[0029] In the case of the threadlike geometry, two of the dimensions are smaller than the third dimension. In this case, the spacing elements have an elongated shape with a preferably circular or elliptic section to favour their manufacturing. This geometry is particularly advantageous when it is intended to arrange many spacing elements along the tray bottom surface and/or in addition they do not need to exert a high force against the housing top surface. Furthermore, this geometry has the advantage that it is the most flexible geometry out of both of them. This helps ensure that they exert pressure against the housing top surface and, in addition, if critical points are detected in which it is not easy to keep the distance "d" in a constant manner, new spacing elements that help guarantee that said distance "d" is kept can be added in that area. In the case of the threadlike geometry, the protruding area has a preferably circular or elliptic section but other sections such as triangular, rectangular or an n-sided polygon are possible as well and fall within the scope of the invention.

[0030] It is obvious that the tray bottom surface can comprise alternating sheet-like and threadlike spacing elements. This configuration is particularly advantageous for complicated geometries having recesses and protrusions in the same. The sheet-like spacing elements are placed in the area in which they are required to exert more pressure against the housing top surface, while the threadlike spacing elements can be arranged in an area in which less pressure is required to be exerted. A distribution of spacing elements along the tray bottom surface alternating sheet-like spacing elements and threadlike spacing elements is included in the scope of the invention.

[0031] In a preferred embodiment, the tray bottom surface is substantially concave forming a receptacle.

[0032] This embodiment is particularly advantageous, since compressors usually are a standard component with a housing having a convex housing top surface, while evaporation trays are usually adapted both to the available space and the housing top surface of the compressor. Furthermore, this geometry of the tray bottom surface builds a receptacle encapsulating the top housing of the compressor, which usually is the hottest area of the same and through which the compressor discharges its residual heat. This makes this geometry be particularly advantageous to maximise the use of the residual heat generated by the compressor. In this manner, the evaporation rate of the water contained in the evaporation tray is accelerated. It is also a preferred configuration that the tray bottom surface generates a receptacle encapsulating a substantial part of the housing top surface of the compressor. The bigger the encapsulated area is, the more residual heat will be used and, therefore, the higher the evaporation rate of the water contained in the evaporation tray will be. In the case of a geometry of the tray bottom surface encapsulating the housing top surface, the tray bottom surface ends at an edge of a tray bottom surface, which is the area in which the tray bottom surface starts to extend in the opposite direction to the housing top surface. The geometry of the top surface of the evaporation tray does not need to correspond to the geometry of the tray bottom surface. In fact, the top surface of the evaporation tray preferably has a receptacle geometry as well to be able to contain the condensed water.

[0033] In a preferred embodiment, the tray bottom surface has a recess area adjacent to the protruding area and in the direction of deformation of the spacing element.

[0034] This embodiment has the advantage that the deformation of the spacing elements is favoured. The spacing elements will be deformed at least partially due to their elastic part to exert pressure against the housing top surface. During this deformation of the elastic part of the spacing element, there is a risk of collision of the same against the tray bottom surface and of the deformation of the same being limited. By generating this recess area, it is guaranteed that the spacing element is deformed as much as required to exert pressure against the housing top surface without colliding against the tray bottom surface and the distance "d" between the tray bottom surface and the housing top surface is kept.

[0035] The spacing elements can be deformed out of or into the receptacle forming the tray bottom surface. For this reason, the recess area can be located out of or into the receptacle as well in the area adjacent to the protruding area.

[0036] In another preferred embodiment, the spacing elements are deformed out of the receptacle.

[0037] It is a preferred configuration that the spacing elements are deformed out of the receptacle formed by the tray bottom surface and the recess area is also located in the outer area adjacent to the protruding area of the spacing element. This configuration is advantageous to facilitate the direction of deformation of the spacing elements. Since the evaporation tray will rest on the compressor from its top, the natural direction of deformation of the spacing elements extends out of the receptacle formed by the tray bottom surface. Therefore, the performance of the function of the spacing elements is facilitated.

[0038] In a preferred embodiment, the spacing elements are equidistant from each other.

[0039] This embodiment has the advantage that all of the spacing elements can be dimensioned to exert the same force or a very similar force. Furthermore, this configuration is advantageous to facilitate that the evaporation tray rests on the compressor. In addition, this configuration has the advantage that a matrix of spacing elements can be arranged at multiple points or areas. This helps keep the distance "d" within the desired range.

[0040] In a preferred embodiment, the evaporation tray is made of a plastic material.

[0041] This embodiment has the advantage that the plastic material can be adapted to almost any geometry and therefore facilitates that the tray bottom surface can "copy" the geometry of the housing top surface. Furthermore, it has the advantage that it is relatively easy to generate the spacing elements with a sheet-like and/or threadlike geometry during the injection process of the evaporation tray. In addition, this configuration has the advantage that the recess area can be easily generated in the direction of deformation of the spacing elements, since they can be easily removed in this manner during the demoulding process of the plastic evaporation tray.

[0042] Preferably, the evaporation tray is made of a plastic material including but not limited to polystyrene, ABS, polypropylene, polypropylene with talc, polypropylene with fibre glass, polycarbonate, polyamide and/or polybutylene terephthalate.

[0043] Furthermore, the invention relates to an electrical household appliance comprising a heat pump system according to any of the above-described embodiments.

[0044] Some examples of electrical household appliances comprising a heat pump system according to the invention are, for example, refrigerators, freezers and/or appliances combining a refrigerating zone with a freezing zone, as well as washing machines and/or dryers with a heat pump system to assist the drying, dishwashers with a heat pump system to assist the drying and air conditioning equipment.

[0045] Refrigerating, freezing and/or combined appliances (also named combi appliances), which have at least one refrigerating zone and at least one freezing zone, comprise a heat pump system comprising at least one compressor, one condenser, one evaporator and a circuit through which the refrigerant element is circulated leading the refrigerant from the compressor to the condenser, from the condenser to the evaporator and from the evaporator back to the compressor. On the other hand, a circuit with a process fluid is generated, said process fluid generally being air, which, in the case of these refrigerating appliances, flows through the evaporator to carry the generated cold into the cavity to cool down. This is the typical case of fridges, freezers and combined fridge-freezers to preserve food.

[0046] In this type of refrigerating appliances, there is a process air circuit extending through or next to the evaporator to be cooled down and cool down the cavities containing the objects and/or food to be refrigerated and/or frozen. Due to the low temperatures of the evaporator, the humidity contained in the air condenses and this condensed water is evacuated from inside the fridge and led and collected in the evaporation tray. Furthermore, some of these refrigerating appliances comprise a heating element arranged near the evaporator to defrost the water frozen on the walls of the same due to the low temperatures of the evaporator. This defrosted water is also led to and collected in the evaporation tray along with the rest of the condensation water. It is advantageous for the heat pump system to be according to any of the above-described embodiments to optimise the water evaporation, reduce the vibrations of the evaporation tray and, in this manner, not to amplify the noise generated by the compressor.

[0047] In the case of washing machines and/or dishwashers and/or dryers with a heat pump system assisting the drying function, the heat pump system comprises at least one compressor, one condenser, one evaporator and a circuit through which the refrigerant element is circulated leading the refrigerant from the compressor to the condenser, from the condenser to the evaporator and from the evaporator back to the compressor. In these appliances, it is usual to have a process fluid, generally air, which is circulated towards the condenser, where this process fluid is heated up. Then, the process fluid is circulated up to the cavity in which the clothes or dishes to be dried are arranged and it captures humidity from these elements and is led towards the evaporator, where its temperature drops and a great part of the humidity contained in the same condenses due to the cold in the evaporator. Afterwards, the process fluid is circulated again to the condenser to start the cycle again. This condensed water near the evaporator can be pumped out or led and collected in a condensation tray resting on the compressor to be evaporated by means of the residual heat of the compressor. It is advantageous for the heat pump system to be according to any of the above-described embodiments to optimise the water evaporation, reduce the vibrations of the evaporation tray and, in this manner, not to amplify the noise generated by the compressor.

[0048] In air conditioning equipment with a heat pump system, the heat pump system works in an analogous manner, i.e. this comprises at least one compressor, one condenser, one evaporator and a circuit through which a refrigerant element circulates. The refrigerant element flows out of the compressor in a gaseous state and at a high temperature and circulates towards the condenser, where the refrigerant element starts to be converted into a liquid state and its temperature is reduced until it reaches the evaporator in a gaseous state and at a very low temperature and returns to the compressor to start the cycle again. In these appliances, it is usual to have a process fluid, generally air, which is circulated through the evaporator if it is intended to reduce the environmental temperature and this cold air is emitted to the room to be refrigerated, while, if it is intended to increase the temperature, the process fluid is circulated through the condenser, where its temperature increases and this process fluid, generally air, is emitted to the room to be heated. In any of both cases, condensed water is generated when the process fluid flows through the evaporator and it is advantageous for the heat pump system to be according to any of the above-described embodiments to optimise the water evaporation, reduce the vibrations of the evaporation tray and, in this manner, not to amplify the noise generated by the compressor.

[0049] In a preferred embodiment according to the invention, it is a refrigerating appliance comprising a heat pump system according to any of the above-described embodiments.

[0050] Refrigerating, freezing and/or combined appliances (also named combi appliances), which have at least one refrigerating zone and at least one freezing zone, comprise a heat pump system comprising at least one compressor, one condenser, one evaporator and a circuit through which the refrigerant element is circulated leading the refrigerant from the compressor to the condenser, from the condenser to the evaporator and from the evaporator back to the compressor. On the other hand, a circuit with a process fluid is generated, said process fluid generally being air, which, in the case of these refrigerating appliances, flows through the evaporator to carry the generated cold into the cavity to cool down. This is the typical case of fridges, freezers and combined fridge-freezers to preserve food or other elements.

[0051] In this type of refrigerating appliances, there is a process fluid circuit extending through or next to the evaporator to be cooled down and cool down the cavities containing the food to be refrigerated and/or frozen. Due to the low temperatures of the evaporator, the humidity contained in the fluid (generally air) condenses and this condensed water is evacuated from inside the fridge and led and collected in the evaporation tray. Furthermore, some of these refrigerating appliances comprise a heating element arranged near the evaporator to defrost the water frozen on the walls of the same due to the low temperatures of the evaporator. This defrosted water is also led to and collected in the evaporation tray along with the rest of the condensation water. It is advantageous for the heat pump system to be according to any of the above-described embodiments to optimise the water evaporation and not to amplify the noise generated by the compressor.

[0052] In a preferred embodiment according to the invention, the water collected in the evaporation tray is condensed due to the cold generated by the evaporator.

[0053] Preferably, when air is used as a process fluid for usages such as to refrigerate food preserving spaces or to dry clothes or dishes contained in washing spaces, the area in which the highest amount of water condenses is always near the evaporator due to the low temperatures of the same. This makes the water contained in the circulating air condense both on the walls of the own evaporator and on the walls close to the evaporator of the tube through which air circulates. And this is the water that needs to be evacuated from the air circuit to optimise the function to be performed by the air as the process fluid, either to cool down a space such as in the case of refrigerating appliances or air conditioning systems or to assist the drying function such as in the case of washer-dryers, dryers or dishwashers. In these cases, it is particularly advantageous for the heat pump system to be according to any of the above-described embodiments to optimise the water evaporation and not to amplify the noise generated by the compressor.

[0054] Aspects and embodiments of the invention are subsequently described based on schematic drawings, in which

- figure 1 shows schematically a heat pump system according to the state of the art;
- figure 2 shows schematically an evaporation tray resting on a compressor according to the state of the art;
- figure 3 shows a schematic section of the evaporation tray resting on the compressor according to the state of the art;
- figure 4 is a detailed view of the area A marked in figure 3;
- figure 5 shows a detail of an evaporation tray according to the invention;
- figure 6 shows a detailed view of the area A of an evaporation tray resting on a compressor according to the invention;
- figure 7 shows a detail of another evaporation tray according to the invention;
- figure 8 shows a detailed view of the area A of another evaporation tray resting on a compressor

according to the invention;

figure 9 shows a detailed view of the area A of another evaporation tray resting on a compressor according to the invention;

figure 10 shows the bottom view of an evaporation tray according to the invention;

figure 11 shows the bottom view of another evaporation tray according to the invention;

figure 12 shows the bottom view of another evaporation tray according to the invention;

figure 13 shows the bottom view of another evaporation tray according to the invention;

figure 14 shows the bottom view of another evaporation tray according to the invention.

[0055] Figure 1 shows schematically a heat pump system 1 according to the state of the art. The heat pump system 1 comprises a compressor 4 compressing the refrigerant. This causes the refrigerant to be heated. The gaseous refrigerant is led up to the condenser 7. In the condenser 7, the refrigerant gas starts to cool down and to condense into a liquid state almost entirely when leaving the condenser 7. Then, the refrigerant flows through a filter 11, also called dehydrating filter, in charge of eliminating the water particles that might have entered the system, so that only the refrigerant in a liquid state keeps on circulating up to reaching a capillary tube 19. The refrigerant flows out of the capillary tube 19 and into the evaporator 8, where, due to the pressure difference with respect to the capillary tube 19, the refrigerant is converted into a gaseous state. The refrigerant needs to absorb heat to be converted into a gaseous state. Therefore, the temperature of the evaporator 8 is very low and this is called the cold focus of the heat pump system 1. The gaseous refrigerant flows through the evaporator 8 and back towards the compressor 4, which compresses it and the cycle starts again.

[0056] Figure 2 shows schematically an evaporation tray 2 resting on a compressor 3 according to the state of the art. The evaporation tray 2 has a tray bottom surface 12 (not seen in this case) resting on the housing top surface 13 of the housing 3 of the compressor 4. Although the tray bottom surface 12 essentially has the same geometry as the housing top surface 13, the distance d between them varies. This causes vibrations in the evaporation tray 2 and, due to them, the noises generated by the compressor 3 are amplified and the residual heat of the compressor 3 cannot be used to the greatest possible extent.

[0057] Figure 3 shows a schematic section of the evaporation tray 2 resting on the compressor 3 from figure 2. Figure 3 shows a compressor 4 having a housing 3, which, in turn, has a housing top surface 13 on which a tray bottom surface 12 of the evaporation tray 2 rests. In the configuration shown in figure 3, despite the fact that the geometry of the tray bottom surface 12 substantially corresponds to the geometry of the housing top surface 13, the distance d between them is not always constant and, as consequence of this, the evaporation tray 2 vibrates and amplifies the noises generated by the compressor 3. Figure 3 shows how the tray bottom surface 12 is substantially concave defining a receptacle 18, which encapsulates the housing 3 of the compressor 4 at least partially. The receptacle 18 has an edge of the tray bottom surface 9, which is the area in which the tray bottom surface 12 starts to extend in the opposite direction to the housing top surface 13 and therefore does not encapsulate the housing 3 of the compressor 4 anymore.

[0058] Figure 4 is a detailed view of the area A marked in figure 3 according to the state of the art. Figure 4 shows how, although the geometry of the tray bottom surface 12 of the evaporation tray 2 substantially corresponds to the geometry of the housing top surface 13 of the housing 3, the distance d between them is not always constant and, as a consequence of this, the evaporation tray 2 vibrates and amplifies the noise generated by the compressor 3.

[0059] Figure 5 shows a detail of an evaporation tray 2 according to the invention. The evaporation tray 2 has a tray bottom surface 12 comprising at least one at least partially elastic spacing element 10. Furthermore, figure 5 shows the edge of the tray bottom surface 9, which is the area in which the tray bottom surface 12 starts to extend in the opposite direction to the housing top surface 13. The edge of the tray bottom surface 9 is at the same time the area in which the receptacle 18 ends and does not encapsulate the housing 3 anymore.

[0060] Figure 6 shows a detailed view of the area A of an evaporation tray 2 resting on a compressor 4 according to the invention. Figure 6 shows how the spacing element 10 is deformed out of the receptacle 18 and towards the edge of the tray bottom surface 9 once the evaporation tray 2 rests on the housing top surface 13 of the housing 3 of the compressor 4. The spacing element 10 exerts pressure against the housing top surface 13 of the housing 3 of the compressor 4. It thereby helps the distance d between the tray bottom surface 12 and the housing top surface 13 be kept. Figure 6 shows just one spacing element 10, which, in this case, has a sheet-like geometry, although it could have a threadlike geometry as well and, in addition to this, the tray bottom surface 12 may have more spacing elements 10 in diverse areas and having diverse geometries to help keep the distance d in such a manner that the evaporation tray 2 does not vibrate or amplify the noise generated by the compressor 4.

[0061] Figure 6 shows a spacing element 10 in the area close to the edge of the evaporation tray bottom surface 9. This is one of the preferred positions for a spacing element 10. The spacing element 10 could have a sheet-like geometry and contact the housing top surface 13 along its entire perimeter or there could be different spacing elements 10 arranged along said perimeter around the housing top surface 13. The position, geometry and number of the spacing elements 10 will depend on the geometry of the tray bottom surface and on the pressure that needs to be exerted by them on the housing top surface 3 to prevent the evaporation tray 2 from vibrating and amplifying the noise generated by the compressor 4.

[0062] Figure 7 shows a detail of another evaporation tray 2 according to the invention. The evaporation tray 2 has a tray bottom surface 12 comprising at least one at least partially elastic spacing element 10. Furthermore, figure 7 shows the edge of the tray bottom surface 9, which is the area in which the tray bottom surface 12 starts to extend in the opposite direction to the housing top surface 13. The spacing element 10 shown in figure 7 is located further away from the edge of the tray bottom surface 9 than that shown in figure 5. Furthermore, the spacing element 10 shown in figure 7 protrudes from a protruding area 17 having a recess area 14 adjacent to the protruding area 17 and in the direction of deformation of the spacing element 10. The edge of the tray bottom surface 9 is at the same time the area in which the receptacle 18 ends and does not encapsulate the housing top surface 13 of the housing 3 (not shown in figure 7) anymore.

[0063] Figure 8 shows a detailed view of the area A of another evaporation tray 2 resting on a compressor 4 according to the invention. Figure 8 shows how the spacing element 10 is deformed out of the receptacle 18 and towards the edge of the tray bottom surface 9 once the evaporation tray 2 rests on the housing top surface 13 of the housing 3 of the compressor 4. The spacing element 10 protrudes from a protruding area 17 and has a recess area 14 adjacent to the protruding area 17 in the direction of deformation of the spacing element 10. The spacing element 10 exerts pressure against the housing top surface 13 of the housing 3 of the compressor 4. It thereby helps the distance d between the tray bottom surface 12 and the housing top surface 13 be kept. Figure 8 shows just one spacing element 10, which, in this case, has a sheet-like geometry, although it could have a threadlike geometry as well and, in addition to this, the tray bottom surface 12 may have more spacing elements 10 in diverse areas and having diverse geometries to help keep the distance d in such a manner that the evaporation tray 2 does not vibrate or amplify the noise generated by the compressor 4.

[0064] Figure 8 shows a spacing element 10 located further away from the edge of the tray bottom surface 9 than the one shown in figure 6. This is also one of the preferred positions for a spacing element 10. The spacing element 10 could have a sheet-like geometry and contact the housing top surface 13 along its entire perimeter or there could be different spacing elements 10 arranged along said perimeter around the housing top surface 13. It is also a preferred configuration that the tray bottom surface 12 has three equidistant spacing elements 10 along a perimeter surrounding the housing top surface 13. The position, geometry and number of the spacing elements 10 will depend on the geometry of the tray bottom surface 12 and on the pressure that needs to be exerted by them on the housing top surface 3 to prevent the evaporation tray 2 from vibrating and amplifying the noise generated by the compressor 4.

[0065] Figure 9 shows a detailed view of the area A of another evaporation tray 2 resting on a compressor 4 according to the invention. Figure 9 shows two spacing elements 10, which are deformed out of the receptacle 18 and towards the edge of the tray bottom surface 9 once the evaporation tray 2 rests on the housing top surface 13 of the housing 3 of the compressor 4. The spacing element 10 located in the top of figure 9 protrudes from a protruding area 17 and has a recess area 14 adjacent to the protruding area 17 in the direction of deformation of the spacing element 10. The spacing element 10 exerts pressure against the housing top surface 13 of the housing 3 of the compressor 4. It thereby helps the distance d between the tray bottom surface 12 and the housing top surface 13 be kept. The spacing element 10 located in the bottom of figure 9 protrudes from a protruding area 17 but has no recess area 14. The spacing element 10 located in the bottom exerts pressure against the housing top surface 13 of the housing 3 of the compressor 4 too. It thereby helps the distance d between the tray bottom surface 12 and the housing top surface 13 be kept. In the detail shown in figure 9, two spacing elements 10 are shown, which have a sheet-like geometry in this case, although they could have a threadlike geometry as well, or one of them could have a threadlike geometry and the other one could have a sheet-like geometry. Furthermore, the tray bottom surface 12 may have more spacing elements 10 in diverse areas and having diverse geometries to help keep the distance d in such a manner that the evaporation tray 2 does not vibrate or amplify the noise generated by the compressor 4.

[0066] The spacing element 10 located in the bottom is arranged in the same position as the one shown in figure 6 and the spacing element 10 located in the top is arranged in the same position as the one shown in figure 8. These are preferred positions for spacing elements 10. Any of the spacing elements 10 could have a sheet-like geometry and contact an entire perimeter of the housing top surface 13 or they could be different spacing elements 10 arranged along this perimeter around the housing top surface 13. It is also a preferred configuration that the tray bottom surface 12 has three spacing elements 10 equidistant from each other along a perimeter surrounding the housing top surface 13. The position, geometry and number of the spacing elements 10 will depend on the geometry of the tray bottom surface and on the pressure that needs to be exerted by them on the housing top surface 3 to prevent the evaporation tray 2 from vibrating and amplifying the noise generated by the compressor 4.

[0067] Figure 10 shows the bottom view of an evaporation tray 2 according to the invention. The tray bottom surface 12 from figure 10 is concave. Therefore, the receptacle 18 encapsulating the housing top surface 13 is shown when it rests on the same. The receptacle 18 extends up to the edge of the tray bottom surface 9.

The tray bottom surface 12 shown in figure 10 has three spacing elements 10. In this exemplary evaporation tray 2 shown in figure 10, each of the three spacing elements 10 is sheet-shaped continuously extending along the tray bottom surface 12, an elliptical ring being thereby formed. The three shown spacing elements 10 form elliptical rings and are equidistant from each other. Each of the spacing elements 10 with the shape of an elliptical ring surrounds and contacts against the housing top surface 13 along three perimeters contained in three parallel planes at different heights of the receptacle 18.

[0068] Figure 11 shows the bottom view of another evaporation tray 2 according to the invention. The tray bottom surface 12 from figure 11 is concave. Therefore, the receptacle 18 encapsulating the housing top surface 13 is shown when it rests on the same. The receptacle 18 extends up to the edge of the tray bottom surface 9. The tray bottom surface 12 shown in figure 10 has fifteen spacing elements 10. In this exemplary evaporation tray 2 shown in figure 11, each of the spacing elements 10 has a threadlike geometry. The spacing elements 10 can be equidistant from each other and are arranged in such a manner that the five most external spacing elements 10 with respect to the centre of the receptacle 18 are located in such a manner that their respective protruding areas 17 are contained on a plane 5. The five most internal spacing elements 10 with respect to the centre of the receptacle 18 are located in such a manner that their respective protruding areas 17 are contained on a second plane 15, which is parallel to the plane 5 formed by the protruding areas 17 of the most external spacing elements 10. Finally, the other five spacing elements 10 are located in such a manner that their respective protruding areas 17 are contained in a third plane 25 arranged between the plane 5 and the plane 15 and parallel to both of them. This configuration of the spacing elements 10 is described as an illustrative non-limitative example, since they can be located randomly along the tray bottom surface 12.

[0069] Figure 12 shows the bottom view of another evaporation tray 2 according to the invention. The tray bottom surface 12 from figure 12 is concave. Therefore, the receptacle 18 encapsulating the housing top surface 13 is shown when it rests on the same. The receptacle 18 extends up to the edge of the tray bottom surface 9. The tray bottom surface 12 shown in figure 10 has for example five spacing elements 10 equidistant from each other. In this exemplary evaporation tray 2 shown in figure 12, each of the spacing elements 10 is sheet-shaped in such a manner that, if each spacing element 10 extended until being connected to the two spacing elements 10 closest to the same, they would form an elliptical ring. The protruding areas 17 of the spacing elements 10 shown in figure 12 are contained in a same plane 5, although they are shown in this manner just as an illustrative non-limitative example, since they could be not contained in the same plane 5.

[0070] Figure 13 shows the bottom view of another evaporation tray 2 according to the invention. The tray bottom surface 12 from figure 13 is concave. Therefore, the receptacle 18 encapsulating the housing top surface 13 is shown when it rests on the same. The receptacle 18 extends up to the edge of the tray bottom surface 9. The tray bottom surface 12 shown in figure 13 has fifteen spacing elements 10. In this exemplary evaporation tray 2 shown in figure 13, each of the spacing elements 10 has a sheet-like geometry. The spacing elements 10 can be equidistant from each other and are arranged in such a manner that the five most external spacing elements 10 with respect to the centre of the receptacle 18 are located in such a manner that their respective protruding areas 17 are contained on a plane 5. The five most internal spacing elements 10 with respect to the centre of the receptacle 18 are located in such a manner that their respective protruding areas 17 are contained on a second plane 15, which is parallel to the plane 5 formed by the protruding areas 17 of the most external spacing elements 10. Finally, the other five spacing elements 10 are located in such a manner that their respective protruding areas 17 are contained in a third plane 25 arranged between the plane 5 and the plane 15 and parallel to both of them. This configuration of the spacing elements 10 is described as an illustrative non-limitative example, since they can be located randomly along the tray bottom surface 12.

[0071] Figure 14 shows the bottom view of another evaporation tray 2 according to the invention. The tray bottom surface 12 from figure 14 is concave. Therefore, the receptacle 18 encapsulating the housing top surface 13 is shown when it rests on the same. The receptacle 18 extends up to the edge of the tray bottom surface 9. The tray bottom surface 12 shown in figure 14 has five spacing elements 10. In this exemplary evaporation tray 2 shown in figure 14, each of the spacing elements 10 has a threadlike geometry. The spacing elements 10 can be or not equidistant from each other and, in the example shown in figure 14, they are located in such a manner that the five spacing elements 10 are located in such a manner that their respective protruding areas 17 are contained in a plane 5. This configuration of the spacing elements 10 is described as an illustrative non-limitative example, since they can be located randomly along the tray bottom surface 12.

Reference numerals

[0072]

1	heat pump system
2	evaporation tray
3	housing
4	compressor
5	plane
6	electrical household appliance
7	condenser
8	evaporator
9	bottom surface edge of the evaporation tray
10	spacing element

11 filter
12 tray bottom surface
13 housing top surface
14 recess area
15 second plane
16 refrigerating appliance
17 protruding area
18 receptacle
19 capillary tube
25 third plane
d distance
n number

Claims

1. A heat pump system (1) for an electrical household appliance (6) comprising an evaporator (8), a condenser (7) and a compressor (4) having a housing (3) with a housing top surface (13) on which an evaporation tray (2) rests to collect condensation water, wherein the evaporation tray (2) has a tray bottom surface (12) shaped with a geometry substantially corresponding to the geometry of the housing top surface (13) and having at least one spacing element (10) to keep a distance (d) between the tray bottom surface (12) and the housing top surface (13), **characterised in that** the at least one spacing element (10) is elastic at least in part in such a manner that it exerts pressure against the housing top surface (13) to reduce vibrations from the evaporation tray (2).

2. The heat pump system (1) according to claim 1, **characterised in that** the tray bottom surface (12) has at least three spacing elements (10) in such a manner that the distance (d) between the tray bottom surface (12) and the housing top surface (13) is kept.

3. The heat pump system (1) according to any of the preceding claims, **characterised in that** the at least one spacing element (10) protrudes from a protruding area (17) of the tray bottom surface (12) and has a sheet-like and/or threadlike geometry.

4. The heat pump system (1) according to any of the preceding claims, **characterised in that** the tray bottom surface (12) is substantially concave forming a receptacle (18).

5. The heat pump system (1) according to any of claims 3 to 4, **characterised in that** the tray bottom surface (12) has a recess area (14) adjacent to the protruding area (17) and in the direction of deformation of the spacing element (10).

6. The heat pump system (1) according to any of claims 4 to 5, **characterised in that** the spacing elements (10) are deformed in the outer direction of the receptacle (18).

7. The heat pump system (1) according to any of claims 2 to 6, **characterised in that** the spacing elements (10) are equidistant from each other.

8. The heat pump system (1) according to any of the preceding claims, **characterised in that** the evaporation tray (2) is made of a plastic material.

9. An electrical household appliance (6) comprising a heat pump system (1) according to any of claims 1 to 8.

10. A refrigerating appliance (16) comprising a heat pump system (1) according to any of claims 1 to 8.

11. The refrigerating appliance (16) according to claim 10, **characterised in that** the condensation water is condensed due to the cold generated by the evaporator (8).

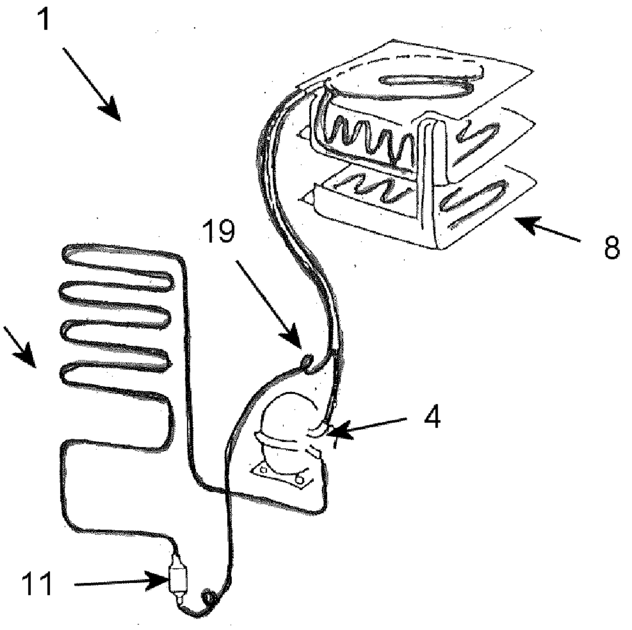

Fig.1

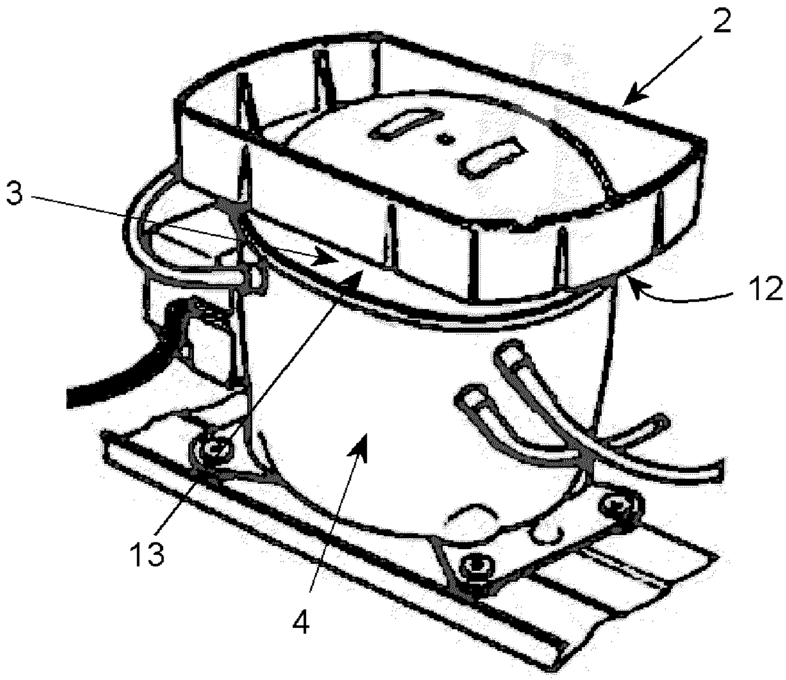

Fig.2

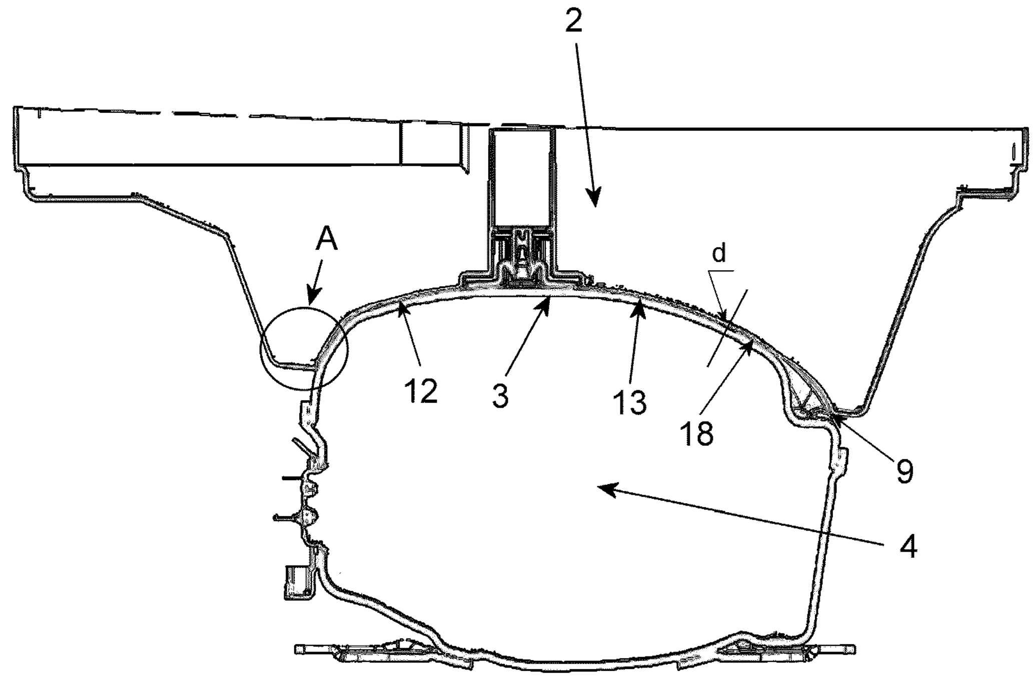

Fig.3

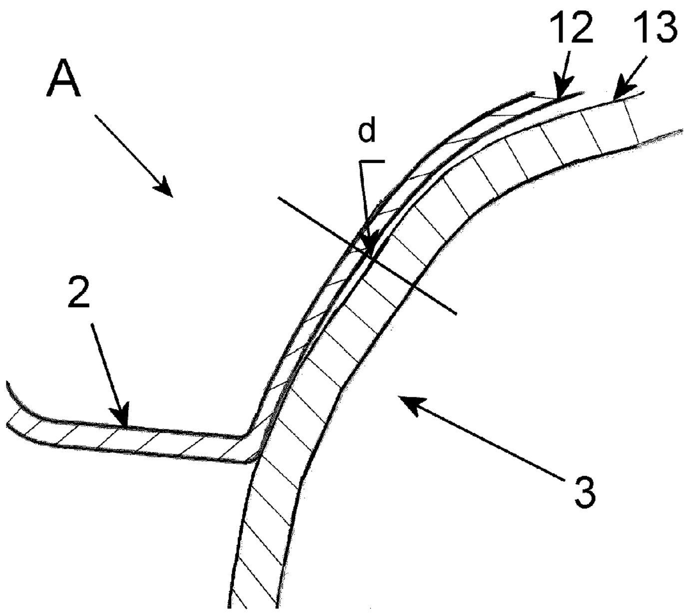

Fig.4

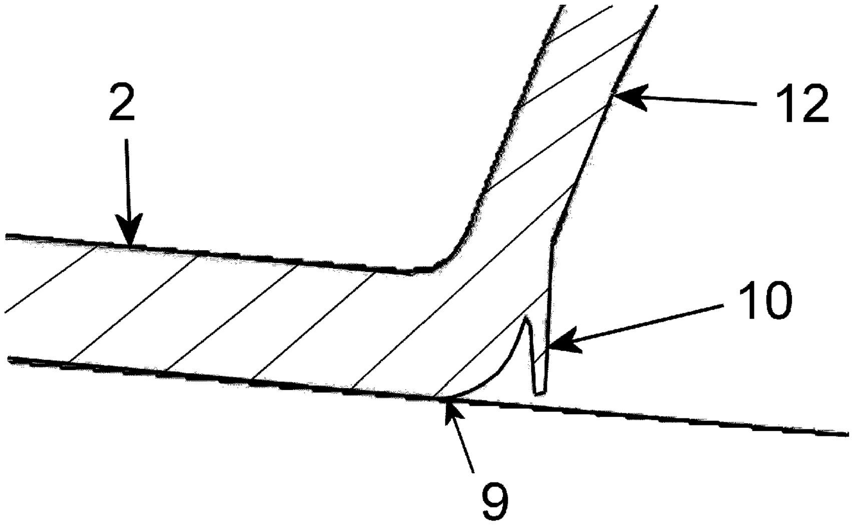

Fig.5

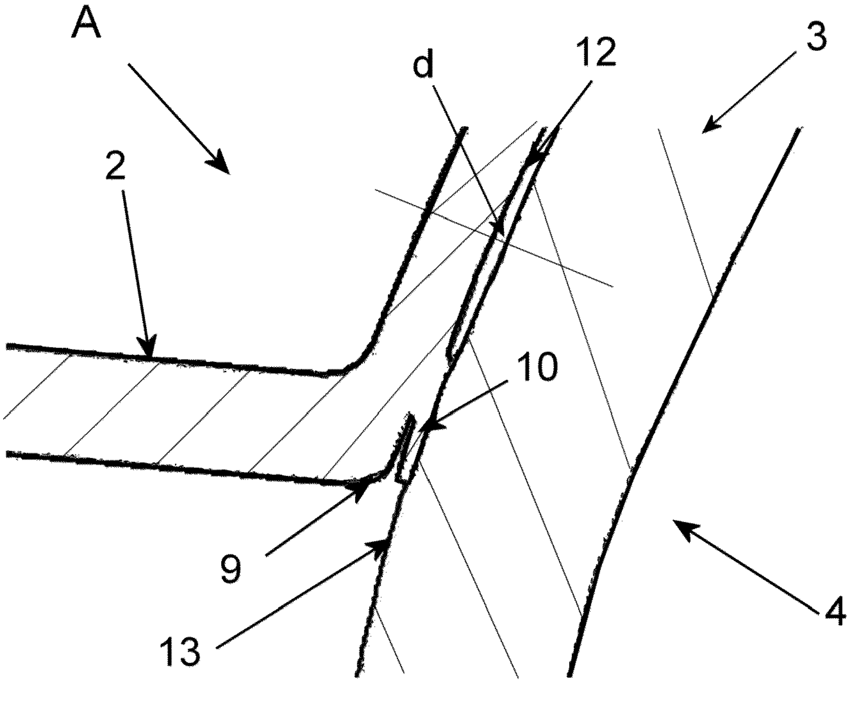

Fig.6

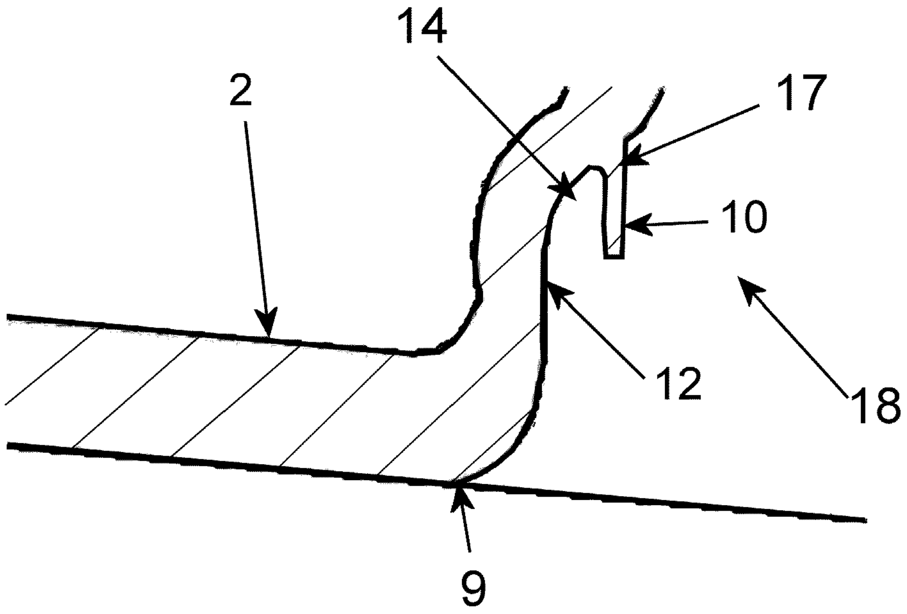

Fig.7

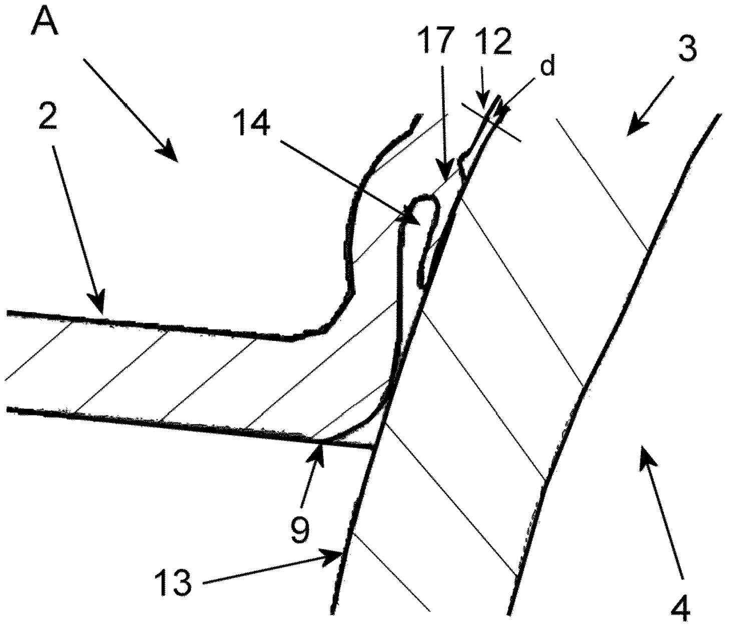

Fig.8

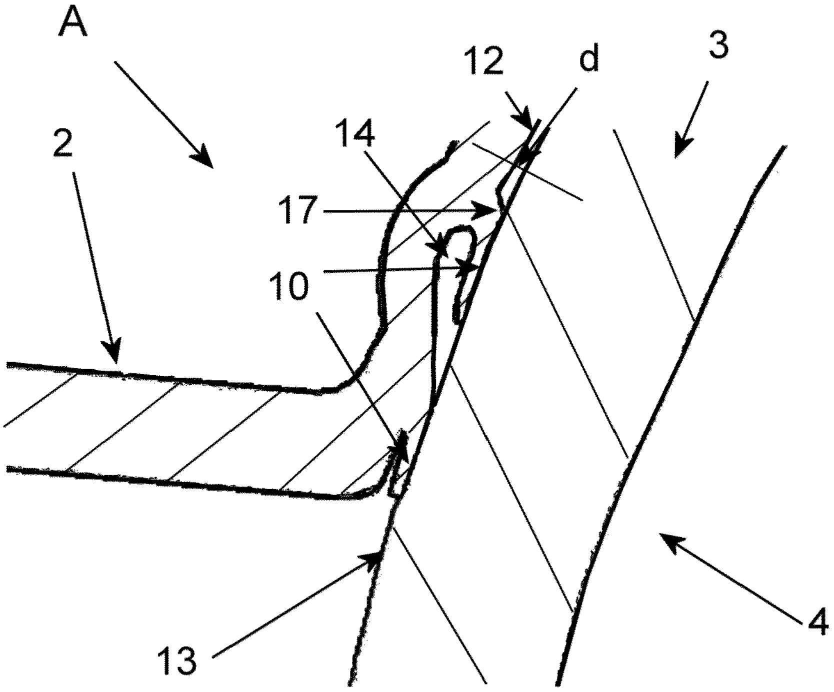

Fig.9

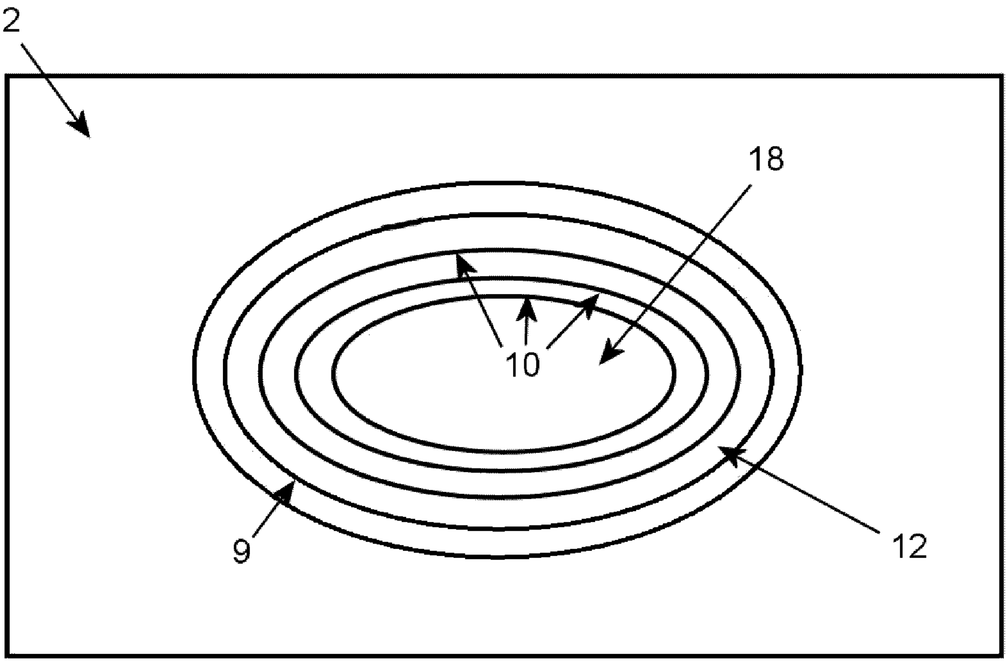

Fig.10

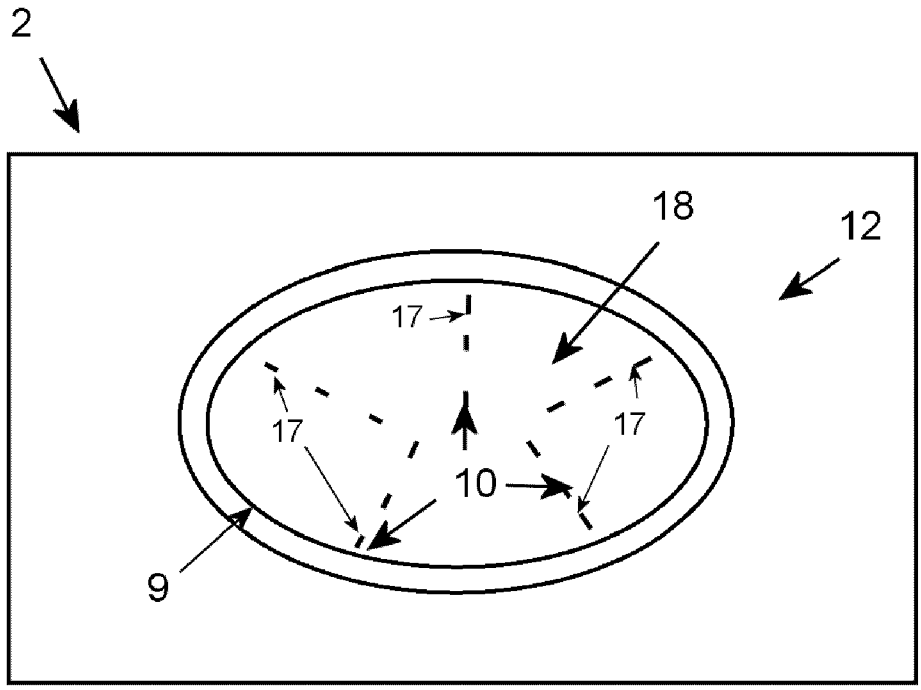

Fig.11

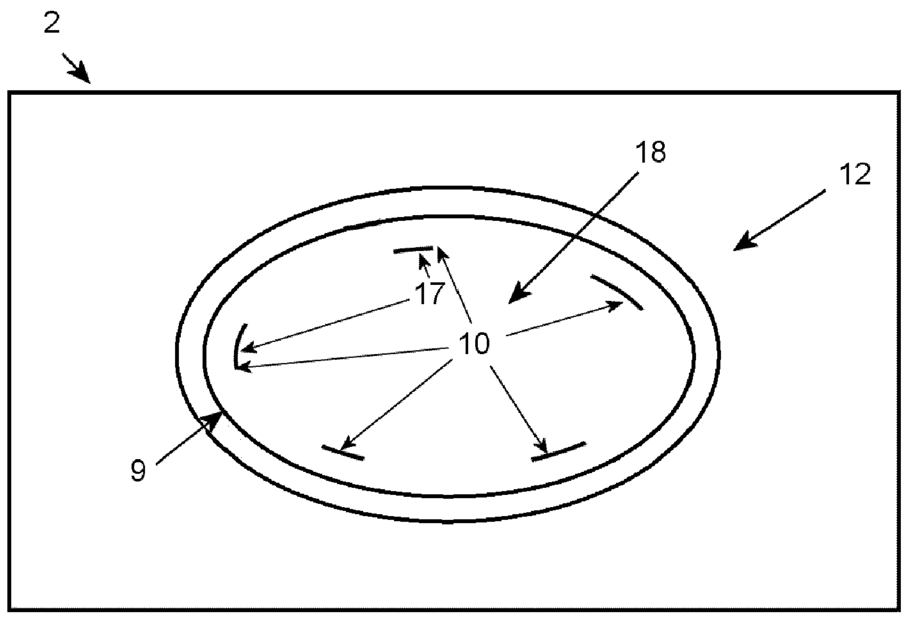

Fig.12

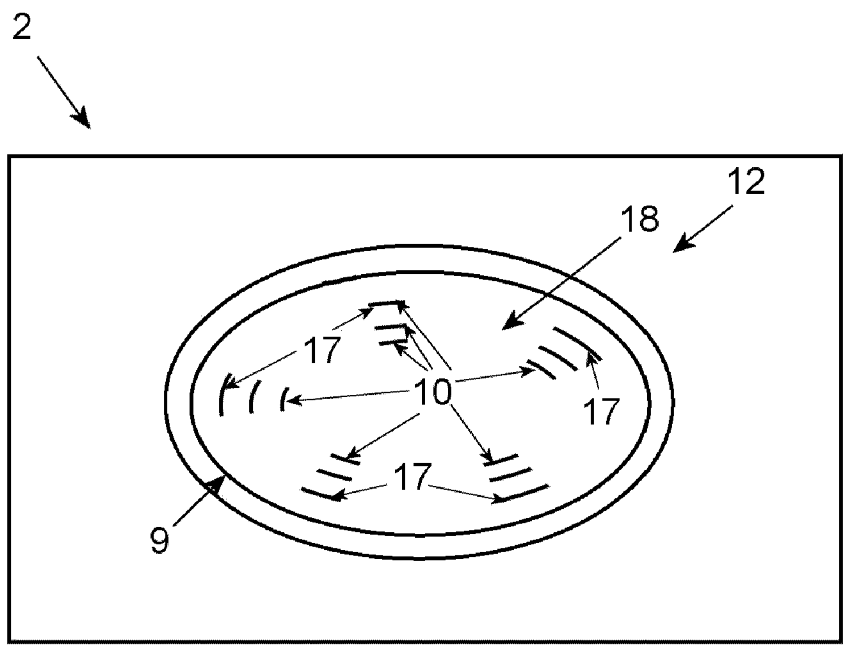

Fig.13

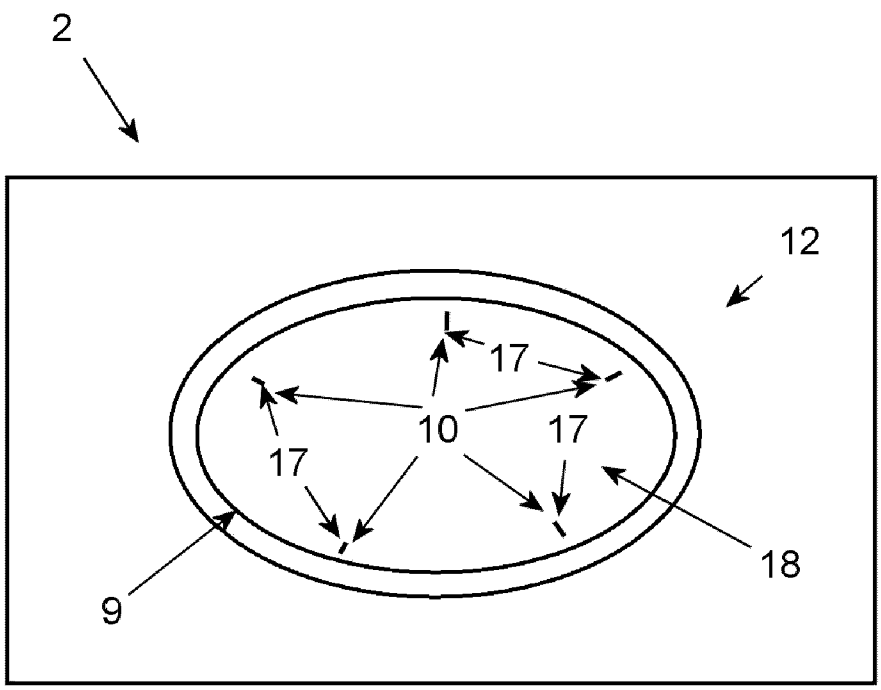

Fig.14

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EUROPEAN SEARCH REPORT

Application Number
EP 23 38 3344

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WO 2015/113981 A1 (ARCELIK AS [TR]) 6 August 2015 (2015-08-06) * figures 1, 2 * -----	1-11	INV. F25B1/00 F25D21/14
X	EP 3 102 898 B1 (ARCELIK AS [TR]) 12 September 2018 (2018-09-12) * columns 2-4; figures 1, 2 * -----	1-11	

TECHNICAL FIELDS SEARCHED (IPC)

F25B
F25D

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	23 April 2024	Amous, Moez

CATEGORY OF CITED DOCUMENTS

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23-04-2024

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2015113981 A1	06-08-2015	NONE	
EP 3102898 B1	12-09-2018	EP 3102898 A1	14-12-2016
		TR 201721791 T3	22-01-2018
		WO 2015113982 A1	06-08-2015

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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