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(54) **Apparatus and method for bending a heat exchange assembly**

Vorrichtung und Verfahren zum Biegen von einem Wärmetauscher Zusammenbau

Appareil et procédé de pliage d'un assemblage d'échange thermique

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Description

DESCRIPTION

[0001] This invention concerns an apparatus and a method for bending a finned heat exchange battery according to the preambles of claims 1 and 10.

[0002] A typical heat exchange battery comprises a plurality of parallel fluid tubes having heat exchange fins. The fluid tubes are connected in pairs at one end and have apertures at the opposite end for receiving C-shaped connection elements, known in the art as bends. Such bends are designed to connect separate pairs of tubes, to form a fluid circuit having an inlet, an outlet and a fluid path.

[0003] Heat exchange batteries are designed to be arranged in special housings, with a fan located therein. In order to obtain an appropriate configuration for this purpose, heat exchange batteries undergo bending processes.

[0004] An exemplary apparatus for bending a heat exchange battery is disclosed in document EP 0 927 865. According to this prior art, the heat exchange battery is disposed on a support and conveyor element and bent using a roller and a shaping plate which operate to form successive bending points.

[0005] While this apparatus fulfills the battery bending purpose, it still has a number of drawbacks.

[0006] It shall be noted that the bends are successively formed by a complex mechanism that synchronizes the shaping roller, the bending plates and the support and conveyor element.

[0007] This adds complexity to the bending process, and hence increases the time required for bending operations, as well as the costs of the apparatus and the product thereby obtained.

[0008] A different apparatus for bending a heat exchange battery comprises a shaping roller having a circular section, which is equipped with gripper means for gripping one end of the battery. As the roller rotates, the battery is bent around the roller to substantially conform to the profile of the roller. This arrangement only partially obviates the drawbacks as mentioned with reference to EP 0 927 865. Indeed, the apparatus can only provide heat exchange batteries having a constant radius.

[0009] Thus, it would be desirable to provide an apparatus for bending a heat exchange battery that can provide configurations having multiple bending points, while maintaining a simple and inexpensive construction.

[0010] Therefore, the object of the present invention is to provide an apparatus for bending a heat exchange battery that has such structural and functional features as to fulfill the above needs, while obviating the drawbacks of the prior art.

[0011] This object is fulfilled by an apparatus for bending a heat exchange battery as defined in claim 1.

[0012] Furthermore, this object is fulfilled by a method of bending a heat exchange battery as defined in claim 10.

[0013] Further features and advantages of the apparatus and method for bending a heat exchange battery according to the present invention will result from the following description of one preferred embodiment thereof, which is given by way of illustration and without limitation with reference to the accompanying figures, in which:

- Figure 1 is a diagrammatic view of an apparatus for bending a heat exchange battery of the present invention;
- Figures 2 to 6 show the apparatus of Figure 1, in successive modes,
- Figure 7 is a schematic side plan view of a heat exchange battery to be bent,
- Figure 8 is a schematic plan view of a shaper to be used in the apparatus of Figure 1,
- Figure 9 is a schematic perspective view of a heat exchange battery bent by the apparatus of Figure 1 and the shaper of Figure 8.

[0014] Referring to the annexed figures, numeral 10 designates an apparatus of the present invention for bending a heat exchange battery, such as the heat exchange battery 1 as shown in Figure 7.

[0015] The heat exchange battery 1 comprises a plurality of parallel fluid tubes 2 having heat exchange fins 3.

[0016] The fluid tubes 2 are connected in pairs at a first end 2a, corresponding to a first end 1a of the heat exchange battery 1, where they are connected by curved connecting portions 5, and have apertures 4 at the opposite end 2b, corresponding to a second end 1b of the heat exchange battery 1, for receiving C-shaped connector elements (not shown), known in the art as bends.

[0017] Such bends are designed to connect separate pairs of tubes, to form a fluid circuit having an inlet, an outlet and a fluid path.

[0018] The apparatus 10 comprises a load-bearing structure 11 with a shaper 20 associated therewith (see Figure 8) for rotating about an axis of rotation A-A and having a shaping surface 20a.

[0019] According to one embodiment, the shaping surface 20a has at least two curved shaping portions with different bend radiuses which are joined by a flat shaping portion 24. Thus, the apparatus 10 can provide bent battery configurations with at least two bending points, while maintaining a simple and inexpensive construction.

[0020] In this example, the shaping surface 20a has a first curved shaping portion 21 with a first bend radius r1, second 22 and third 23 curved shaping portions with a second bend radius r2 and a first flat shaping portion 24 extending between the first 21 and second 22 curved shaping portions along a first length 11.

[0021] According to an embodiment, the second bend radius r2 is smaller than the first bend radius r1.

[0022] In order to obtain additional bending points, the shaping surface has a second shaping portion 25 extend-

ing between the second 22 and third 23 curved shaping portions along a second length 12 greater than the first length 11.

[0023] In one embodiment, the shaping surface 20a has a concave-profile portion, whose concavity extends towards the interior of the shaper 20. As used herein, the term concave intends to designate a depression from the shaping surface 20a, wherein the depression extends towards the interior of the shaper 20.

[0024] In this example the concave-profile portion is the second shaping portion 25.

[0025] In order to cause the shaper 20 to rotate about the axis of rotation A-A, the shaper 20 has a hole 26 for receiving a drive shaft 12 extending along the axis of rotation A-A, which is adapted to be rotatably driven about such axis of rotation A-A, rotatably integral with the shaper 20.

[0026] First drive means 30 are connected to the drive shaft 12 for rotating the shaper 20 for winding the heat exchange battery 1 around the shaper 20.

[0027] According to one embodiment, the first drive means 30 include an electric motor having a drive shaft connected to the drive shaft 12 through drive-transfer means.

[0028] The apparatus 10 also comprises first gripper means 40 associated with the shaper 20 for gripping a first end 1a of the heat exchange battery 1.

[0029] According to one embodiment, the first gripper means 40 include a plurality of gripper members 41 which are adapted to engage the apertures 4 of the ends 1a of the heat exchange battery 1.

[0030] In one embodiment, each gripper member 41 comprises a pin adapted to fit into a corresponding aperture 4 of the end 1a of the heat exchange battery 1.

[0031] Advantageously, the pins 41 are mounted to a movable support 42 which can be driven by drive means 15, e.g. pneumatic drive means.

[0032] Second gripper means 50 are provided for gripping the second end 1b of the heat exchange battery 1. The gripper means 50 are movable from and to the shaper 20 in a sliding direction X-X perpendicular to the direction of the axis of rotation A-A.

[0033] Corresponding second drive means 60 are provided to move the second gripper means 50.

[0034] The apparatus 10 further comprises control means (not shown), which are connected to the drive means 30 and 6 for controlling and synchronizing actuation thereof

[0035] According to one embodiment, the second gripper means 50 include a carriage 51 that is mounted to move in the sliding direction X-X and has engagement members 52 for engaging the second end 1b of the heat exchange battery 1.

[0036] In one embodiment, the engagement members 52 include a plurality of teeth which are designed to fit into the curved connecting portions 5 of the second end 1b of the heat exchange battery 1.

[0037] Advantageously, the carriage 51 comprises a slider 53 that is mounted to a guide element 54 to slide in the sliding direction X-X and a support plate 55 that is mounted to said slider 53 for swinging movement about an axis of oscillation parallel to the axis of rotation A-A of the shaper.

[0038] Particularly, the support plate 55 is connected to drive means (not shown), which allow the support plate 55 to swing relative to the slider 53 to change the inclination thereof to a horizontal plane.

[0039] This will optimize the process for bending the heat exchange battery 1 while maintaining the proper tension and angle of incidence of the portions of the heat exchange battery 1 that, as the shaper 20 rotates, successively engage corresponding portions of the shaper 20.

[0040] The support plate 55 defines a support surface 55a for a portion of the second end 1b of the heat exchange battery 1 and has the engagement members 52. In this example, the engagement members 52 extend perpendicular to the plane defined by the support plate 55.

[0041] The second drive means 60 include a drive chain 61 connected to the slider 53 which passes through at least on pulley, in this example the pulley 62.

[0042] The second drive means 60 also include a pneumatic piston 63 which is connected to the pulley 62 to move the pulley 62 in the sliding direction X-X, thereby moving the slider 53 of the carriage 51 in the sliding direction X-X.

[0043] According to one embodiment, the guide element 54 is mounted to pivot about an axis of rotation parallel to the axis of rotation A-A of said shaper 20.

[0044] In one embodiment, the guide element 54 has a first end 54a which is coupled to a pivot 56 integral with the load-bearing structure 11 and extends along the axis of rotation A-A and a second end 54b which is connected to third drive means 70 to move the guide element 54 and cause such guide element 54 to pivot about the axis of rotation A-A relative to the pivot 56.

[0045] According to one embodiment, the third drive means 70 include a pneumatic piston 71 which is connected to the second end 54b of the guide element 54 to cause said guide element 54 to pivot about the axis of rotation A-A relative to the pivot 56.

[0046] The apparatus 10 also comprises compensating means 80 for pressing a portion of the heat exchange battery 1 towards the concave-profile portion of the shaper 20.

[0047] This will allow springback of the portion of the heat exchange battery 1 to compensate for any convexity formed as the heat exchanger 1 winds on the rotating shaper 20.

[0048] Particularly, this will allow the performance of bending processes that can provide bent heat exchange batteries having long straight sections between portions with small bend radiuses.

[0049] In this case, at the straight section of the shaper between portions with large bend radiuses, convexities

will be formed due to the elasticity of the metal material that forms the tubes and fins of the heat exchanger.

[0050] In this example, the compensating means 80 press a portion of the heat exchange battery 1 towards the second concave shaping portion 25 of the shaper 20 (see Figures 4 and 5).

[0051] According to one embodiment, the compensating means 80 include a member 81 movable from and to the shaper 20 and having an abutment element 82 for pressing the portion of the heat exchange battery towards the concave-profile portion of the shaper 20, in this example the second concave shaping portion 25 of the shaper 20.

[0052] Fourth drive means 90 are provided to move the movable member 81.

[0053] According to one embodiment, the fourth drive means 90 include a pneumatic piston. In this example, the piston is represented by the movable member 81. Otherwise, the piston may be connected to the movable member 81.

[0054] Therefore, for the bending process of the present invention, a heat exchange battery 1 to be bent and a shaper 20 rotating about the axis of rotation A-A is provided.

[0055] Then, the first end 1a of the heat exchange battery 1 is fixed to the shaper 20, and the second end 1b is fixed to the first gripper means 40.

[0056] According to one embodiment, the pins 41 are introduced into the apertures 4 of the end 1a of the heat exchange battery 1, whereas the curved connecting portions 5 are fitted on the teeth 52 of the carriage 51.

[0057] Now, the shaper 20 is rotated about the axis of rotation A-A to wind the heat exchange battery 1 around the shaper 20 and the carriage 51 is driven to move in the sliding direction X-X. Such movement pushes the pins 41 into the apertures 4 until the pins 41 engage by interference fit the tubes 2 of the exchanger to grip them. Then, during bending, the carriage 51 switches from a pushing element mode to a driven element mode, e.g. by changing the operating mode of the drive means 60.

[0058] At the end of the bending operation, the pins 41 are disengaged from the apertures 4 by pneumatic cylinder 15 which pushes the support 42 of the pins 41 away from the apertures 4 of the heat exchanger 1.

[0059] As mentioned above, in this example, the shaping surface 20a has a first curved shaping portion 21 with a first bend radius r1, second 22 and third 23 curved shaping portions with a second bend radius r2 smaller than the first bend radius r1, a first flat shaping portion 24 extending between the first 21 and second 22 curved shaping portions along a first length 11 and a second concave shaping portion 25 extending between the second 22 and third 23 curved shaping portions along a second length 12 greater than the first length 11.

[0060] In this case, as the shaper 20 rotates, it bends the heat exchange battery 1 at three points, to provide a bent heat exchange battery 100 (see Figure 9) that has a first curved portion 101 with a first bend radius R1, second 102 and third 103 curved portions with a second bend radius R2 smaller than the first bend radius R1, a first flat portion 104 extending between the first 101 and second 102 curved portions along a first length L1 and a second flat portion 105 extending between the second 102 and third 103 curved portions along a second length L2 greater than the first length L1.

[0061] In this example, during the bending steps, the compensating means 80 press the portion 105 of the bent heat exchange battery 100 towards the second flat shaping portion 25 of the shaper 20 (see Figures 4 and 5) to compensate for the convexity created during bending and cause the latter to spring back to the flat position.

[0062] It shall be noted that, during bending of the heat exchange battery 1, the relative inclination of the support plate 55 and the guide element 54 and the inclination of both to the horizontal plane may be changed to optimize bending of the heat exchange battery 1.

[0063] For this purpose, the control means are connected with corresponding drive means for driving the support plate 55 and the guide element 54 as well as with the drive means for rotating the shaper 20 and moving the carriage 51.

[0064] It will be appreciated from the above that the apparatus of the present invention obviates prior art drawbacks.

[0065] Those skilled in the art will obviously appreciate that a number of changes and variants may be made to the apparatus of the invention as described hereinbefore to meet specific needs, without departure from the scope of the invention, as defined in the following claims.

Claims

1. An apparatus (10) for bending a finned heat exchange battery (1), comprising:

- a shaper (20) which is adapted to pivot about an axis of rotation (A-A), said shaper (20) having a shaping surface (20a),
- first gripper means (40) associated with said shaper (20) for gripping a first end (1a) of a heat exchange battery (1),
- second gripper means (50) for gripping a second end (1b) of the heat exchange battery (1), said second gripper means (50) being movable from and to said shaper (20) in a sliding direction (X-X) perpendicular to said axis of rotation (A-A),
- first drive means (30) for rotating said shaper (20) for winding said heat exchange battery (1) around said shaper (20),
- second drive means (60) for moving said second gripper means (50) in said sliding direction (X-X),

characterized in that

- said shaping surface (20a) has at least two curved shaping portions (21, 22) which have different bend radiuses (r1, r2) and which are joined by a flat shaping portion (24).

2. An apparatus (10) as claimed in claim 1, wherein said shaping surface (20a) has a concave-profile portion, whose concavity extends toward the interior of said shaper (20).

3. An apparatus (10) as claimed in claim 2, comprising compensating means (80) for pressing a portion of said heat exchange battery (1) into said concave-profile portion of the shaping surface (20a).

4. An apparatus (10) as claimed in claim 3, wherein said compensating means (80) include a member (81) movable from and to said shaper (20) and having an abutment element (82) for pressing said portion of the heat exchange battery into said concave-profile portion of the shaper.

5. An apparatus (10) as claimed in any preceding claim, wherein said second gripper means (50) include a carriage (51) that is mounted to move in said sliding direction (X-X) and has engagement means (52) for engaging said second end (1b) of the heat exchange battery (1).

6. An apparatus (10) as claimed in claim 5, wherein:

- said carriage (51) comprises a slider (53) that is mounted to a guide element (54) to slide in said sliding direction (X-X) and a support plate (55) that is mounted to said slider (53) for swinging movement about an axis of oscillation parallel to said axis of rotation (A-A), said support plate (55) defining a support surface (55a) for an end portion of the heat exchange battery and having said engagement elements (52).

7. An apparatus (10) as claimed in claim 6, wherein said guide element (54) is mounted to pivot about an axis of rotation parallel to the axis of rotation of said shaper (20).

8. An apparatus (10) as claimed in claim 6 or 7, wherein said guide element (54) has a first end (54a) coupled to a pivot (56) that extends along said axis of rotation (A-A) and a second end (54b) connected to third drive means (70) for moving said guide element and cause said guide element to pivot about said axis of rotation.

9. An apparatus (10) as claimed in any preceding claim, wherein said shaping surface (20a) has a first curved shaping portion (21) with a first bend radius (r1), second (22) and third (23) curved shaping portions with a second bend radius (r2) smaller than the first bend radius (r1), a first flat shaping portion (24) extending between the first (21) and second (22) curved shaping portions along a first length (11) and a second flat shaping portion (25) extending between the second (22) and third (23) curved shaping portions along a second length (12) greater than the first length (11).

10. A process (10) for bending a finned heat exchange battery (1) comprising the steps of:

- providing a heat exchange battery (1) to be bent,
- providing a shaper, pivoting about an axis of rotation, said shaper having a shaping surface with at least two curved shaping portions (21, 22) which have different bend radiuses (r1, r2) and which are joined by a flat shaping portion (24),
- fixing a first end (1a) of said heat exchange battery (1) to said shaper (20),
- fixing a second end (1b) of said heat exchange battery (1) to gripper means (50) movable from and to said shaper (20) in a sliding direction (X-X) perpendicular to said axis of rotation (A-A),
- rotating said shaper (20) about said axis of rotation to wind said heat exchange battery (1) about said shaper (20) and bend said heat exchange batter (100) in at least two bending points.

11. A process as claimed in claim 10, wherein said shaping surface (20a) has a concave-profile portion, whose concavity extends toward the interior of said shaper (20), said process including the step of pressing a portion of the heat exchange battery (1) toward the concave-profile portion of the shaper.

Patentansprüche

1. Vorrichtung (10) zum Biegen eines lamellierten Wärmetauschregisters (1), umfassend:

- einen Former (20), der dazu eingerichtet ist, sich um eine Drehachse (A-A) zu drehen, wobei dieser Former (20) eine Formfläche (20a) aufweist,
- mit dem Former (20) verbundene erste Greifermittel (40) zum Greifen eines ersten Endes (1a) eines Wärmetauschregisters (1),
- zweite Greifermittel (50) zum Greifen eines zweiten Endes (1b) des Wärmetauschregisters (1), wobei diese zweiten Greifermittel (50) in einer zur Drehachse (A-A) perpendikularen Verschieberichtung (X-X) vom Former (20) weg und zu ihm hin beweglich sind,
- erste Antriebsmittel (30) zum Drehen des For-

mers (20) zum Winden des Wärmetauschregisters (1) um den Former (20),
- zweite Antriebsmittel (60) zum Bewegen der Greifermittel (50) in der Verschieberichtung (X-X),

dadurch gekennzeichnet, dass

- die Formfläche (20a) mindestens zwei gekrümmte Formabschnitte (21, 22) aufweist, die unterschiedliche Biegeradien (r1, r2) haben und durch einen planen Formabschnitt (24) verbunden sind.

2. Vorrichtung (10) nach Anspruch 1, bei der die Formfläche (20a) einen Abschnitt mit einem konkaven Profil aufweist, dessen Konkavität sich zum Innern des Formers (20) hin erstreckt.

3. Vorrichtung (10) nach Anspruch 2, die Ausgleichsmittel (80) zum Pressen eines Abschnitts des Wärmetauschregisters (1) in den Abschnitt mit dem konkaven Profil der Formfläche (20a) umfasst.

4. Vorrichtung (10) nach Anspruch 3, bei der die Ausgleichsmittel (80) ein Glied (81) umfassen, das vom Former (20) weg und zu ihm hin bewegt werden kann und ein Stoßelement (82) zum Pressen des besagten Abschnitts des Wärmetauschregisters in den Abschnitt mit dem konkaven Profil des Formers aufweist.

5. Vorrichtung (10) nach einem der vorherigen Ansprüche, bei der die zweiten Greifermittel (50) einen Schlitten (51) umfassen, der zum Bewegen in die Verschieberichtung (X-X) montiert ist und Eingriffsmittel (52) zum Ineingriffnehmen des zweiten Endes (1 b) des Wärmetauschregisters (1) aufweist.

6. Vorrichtung (10) nach Anspruch 5, bei der:

- der Schlitten (51) einen Schieber (53), der zum Gleiten in der Verschieberichtung (X-X) an ein Führungselement (54) montiert ist, und eine Tragplatte (55) umfasst, die für eine Schwingbewegung um eine zur Drehachse (A-A) parallele Schwingungsachse an den Schieber (53) montiert ist, wobei diese Tragplatte (55) eine Auflagefläche (55a) für einen Endabschnitt des Wärmetauschregisters definiert und die Eingriffselemente (52) aufweist.

7. Vorrichtung (10) nach Anspruch 6, bei der das Führungselement (54) zum Drehen um eine zur Drehachse des Formers (20) parallele Drehachse montiert ist.

8. Vorrichtung (10) nach Anspruch 6 oder 7, bei der das Führungselement (54) ein mit einem Drehzapfen (56), der sich längs der Drehachse (A-A) erstreckt, verbundenes erstes Ende (54a) und ein zweites Ende (54b) aufweist, das mit dritten Antriebsmitteln (70) verbunden ist, um das Führungselement zu bewegen und die Drehung dieses Führungselements um diese Drehachse zu bewirken.

9. Vorrichtung (10) nach einem der vorherigen Ansprüche, bei der die Formfläche (20a) einen ersten gekrümmten Formabschnitt (21) mit einem ersten Biegeradius (r1), zweite (22) und dritte (23) gekrümmte Formabschnitte mit einem zweiten Biegeradius (r2), der kleiner als der erste Biegeradius (r1) ist, einen ersten planen Formabschnitt (24), der sich zwischen dem ersten (21) und dem zweiten (22) gekrümmten Formabschnitt entlang einer ersten Länge (11) erstreckt, und einen zweiten planen Formabschnitt (25) aufweist, der sich zwischen dem zweiten (22) und dem dritten (23) gekrümmten Formabschnitt entlang einer zweiten Länge (12) erstreckt, die größer als die erste Länge (11) ist.

10. Verfahren (10) zum Biegen eines lamellierten Wärmetauschregisters (1), das die folgenden Schritte umfasst:

- Bereitstellen eines zu biegenden Wärmetauschregisters (1),
- Bereitstellen eines Formers, der sich um eine Drehachse dreht, wobei dieser Former eine Formfläche mit mindestens zwei gekrümmten Formabschnitten (21, 22) aufweist, die unterschiedliche Biegeradien (r1, r2) haben und durch einen planen Formabschnitt (24) verbunden sind,
- Befestigen eines ersten Endes (1a) des Wärmetauschregisters (1) am Former (20),
- Befestigen eines zweiten Endes (1b) des Wärmetauschregisters (1) an Greifermitteln (50), die in einer zur Drehachse (A-A) perpendikularen Verschieberichtung (X-X) vom Former (20) weg und zu ihm hin beweglich sind,
- Drehen des Formers (20) um die Drehachse, um das Wärmetauschregister (1) um den Former (20) zu winden und das Wärmetauschregister (100) an mindestens zwei Biegepunkten zu biegen.

11. Verfahren nach Anspruch 10, bei dem die Formfläche (20a) einen Abschnitt mit einem konkaven Profil aufweist, dessen Konkavität sich zum Innern des Formers (20) hin erstreckt, wobei das Verfahren den Schritt des Pressens eines Abschnitts des Wärmetauschregisters (1) in Richtung des Abschnitts mit dem konkaven Profil des Formers umfasst.

Revendications

1. Dispositif (10) pour plier une batterie d'échange de chaleur à ailettes (1), comprenant :

- un dispositif de mise en forme (20) qui est adapté pour pivoter autour d'un axe de rotation (A-A), ledit dispositif de mise en forme (20) ayant une surface de mise en forme (20a),
- des premiers moyens de préhension (40) associés audit dispositif de mise en forme (20) pour saisir une première extrémité (1a) de la batterie d'échange de chaleur (1),
- des deuxièmes moyens de préhension (50) pour saisir une deuxième extrémité (1b) de la batterie d'échange de chaleur (1), lesdits deuxièmes moyens de préhension (50) étant mobiles de et vers ledit dispositif de mise en forme (20) dans une direction de coulissement (X-X) perpendiculaire audit axe de rotation (A-A),
- des premiers moyens d'entraînement (30) pour faire tourner ledit dispositif de mise en forme (20) pour enrouler ladite batterie d'échange de chaleur (1) autour dudit dispositif de mise en forme (20),
- des deuxièmes moyens d'entraînement (60) pour déplacer lesdits deuxièmes moyens de préhension (50) dans ladite direction de coulissement (X-X),

caractérisé en ce que

- ladite surface de mise en forme (20a) comporte au moins deux portions de mise en forme courbes (21, 22) qui ont des rayons de courbure différents (r1, r2) et qui sont unies par une portion de mise en forme plate (24).

2. Dispositif (10) selon la revendication 1, dans lequel ladite surface de mise en forme (20a) comporte une portion à profil concave, dont la concavité s'étend vers l'intérieur dudit dispositif de mise en forme (20).

3. Dispositif (10) selon la revendication 2, comprenant des moyens de compensation (80) pour presser une portion de ladite batterie d'échange de chaleur (1) dans ladite portion à profil concave de la surface de mise en forme (20a).

4. Dispositif (10) selon la revendication 3, dans lequel lesdits moyens de compensation (80) comprennent un élément (81) mobile de et vers ledit dispositif de mise en forme (20) et ayant un élément de butée (82) pour presser ladite portion de la batterie d'échange de chaleur dans ladite portion à profil concave du dispositif de mise en forme.

5. Dispositif (10) selon l'une quelconque des revendications précédentes, dans lequel lesdits deuxièmes moyens de préhension (50) comprennent un chariot (51) qui est monté pour se déplacer dans ladite direction de coulissement (X-X) et comporte des moyens d'engagement (52) pour engager ladite deuxième extrémité (1b) de la batterie d'échange de chaleur (1).

6. Dispositif (10) selon la revendication 5, dans lequel

- ledit chariot (51) comprend un coulisseau (53) qui est monté sur un élément de guidage (54) pour coulisser dans ladite direction de coulissement (X-X) et une plaque de support (55) qui est montée sur ledit coulisseau (53) pour un mouvement oscillant autour d'un axe d'oscillation parallèle audit axe de rotation (A-A), ladite plaque de support (55) définissant une surface de support (55a) pour une portion d'extrémité de la batterie d'échange de chaleur et comportant lesdits moyens d'engagement (52).

7. Dispositif (10) selon la revendication 6, dans lequel ledit élément de guidage (54) est monté pour pivoter autour d'un axe de rotation parallèle à l'axe de rotation dudit dispositif de mise en forme (20).

8. Dispositif (10) selon la revendication 6 ou 7, dans lequel ledit élément de guidage (54) a une première extrémité (54a) couplée à un pivot (56) qui s'étend suivant ledit axe de rotation (A-A) et une deuxième extrémité (54b) connectée à des troisièmes moyens d'entraînement (70) pour déplacer ledit élément de guidage et forcer ledit élément de guidage à pivoter autour dudit axe de rotation.

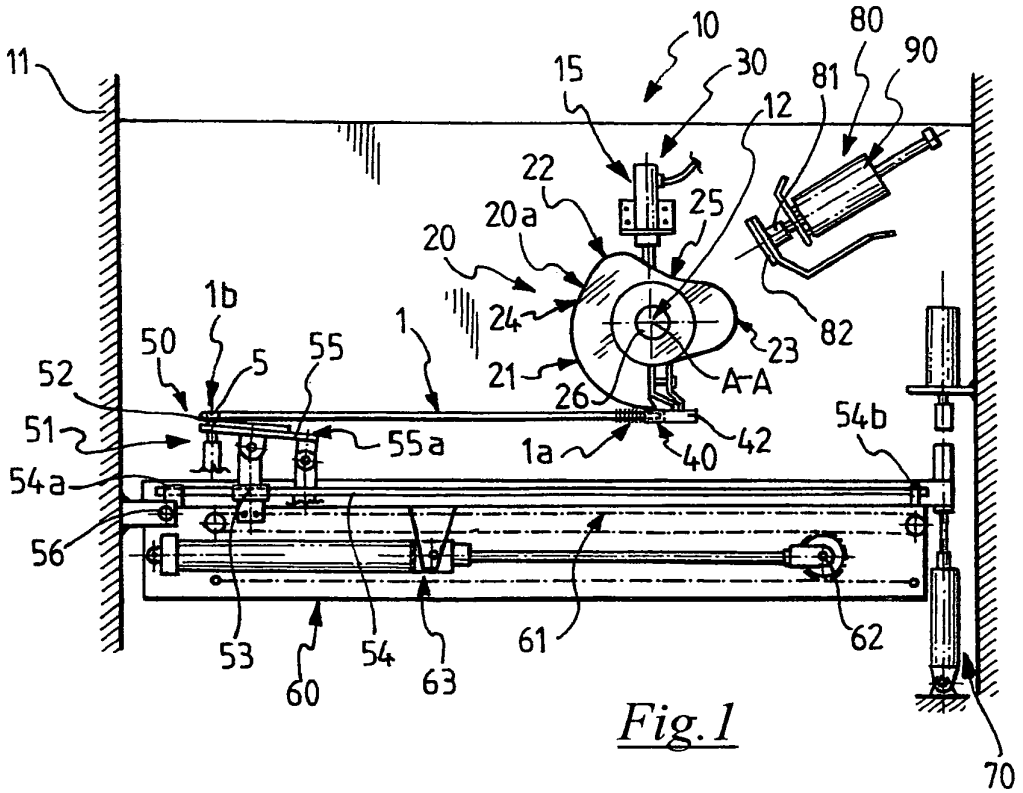
9. Dispositif (10) selon l'une quelconque des revendications précédentes, dans lequel ladite surface de mise en forme (20a) comporte une première portion de mise en forme courbe (21) avec un premier rayon de courbure (r1), des deuxième (22) et troisième (23) portions de mise en forme courbes avec un deuxième rayon de courbure (r2) inférieur au premier rayon de courbure (r1), une première portion de mise en forme plate (24) s'étendant entre les première (21) et deuxième (22) portions de mise en forme courbe suivant une première longueur (11) et une deuxième portion de mise en forme plate (25) s'étendant entre les deuxième (22) et troisième (23) portions de mise en forme courbes suivant une deuxième longueur (12) supérieure à la première longueur (11).

10. Procédé (10) pour plier une batterie d'échange de chaleur à ailettes (1), comprenant les étapes de :

- prédisposition d'une batterie d'échange de chaleur (1) à plier,

- prédisposition d'un dispositif de mise en forme, pivotant autour d'un axe de rotation, ledit dispositif de mise en forme comportant une surface de mise en forme avec au moins deux portions de mise en forme courbes (21, 22) qui ont des rayons de courbure différents (r1, r2) et qui sont unies par une portion de mise en forme plate (24),
- la fixation d'une première extrémité (1a) de ladite batterie d'échange de chaleur (1) audit dispositif de mise en forme (20),
- la fixation d'une deuxième extrémité (1b) de ladite batterie d'échange de chaleur (1) à des moyens de préhension (50) mobiles de et vers ledit dispositif de mise en forme (20) dans une direction de coulissement (X-X) perpendiculaire audit axe de rotation (A-A),
- la rotation dudit dispositif de mise en forme (20) autour dudit axe de rotation pour enrouler ladite batterie d'échange de chaleur (1) autour dudit dispositif de mise en forme (20) et plier ladite batterie d'échange de chaleur (100) en au moins deux points de pliage.

11. Procédé selon la revendication 10, dans lequel ladite surface de mise en forme (20a) comporte une portion à profil concave, dont la concavité s'étend vers l'intérieur dudit dispositif de mise en forme (20), ledit procédé comprenant l'étape de pression d'une portion de la batterie d'échange de chaleur (1) vers la portion à profil concave du dispositif de mise en forme.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12
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90
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20
24
1b
50
5
55
1
23
82
A-A
52
21
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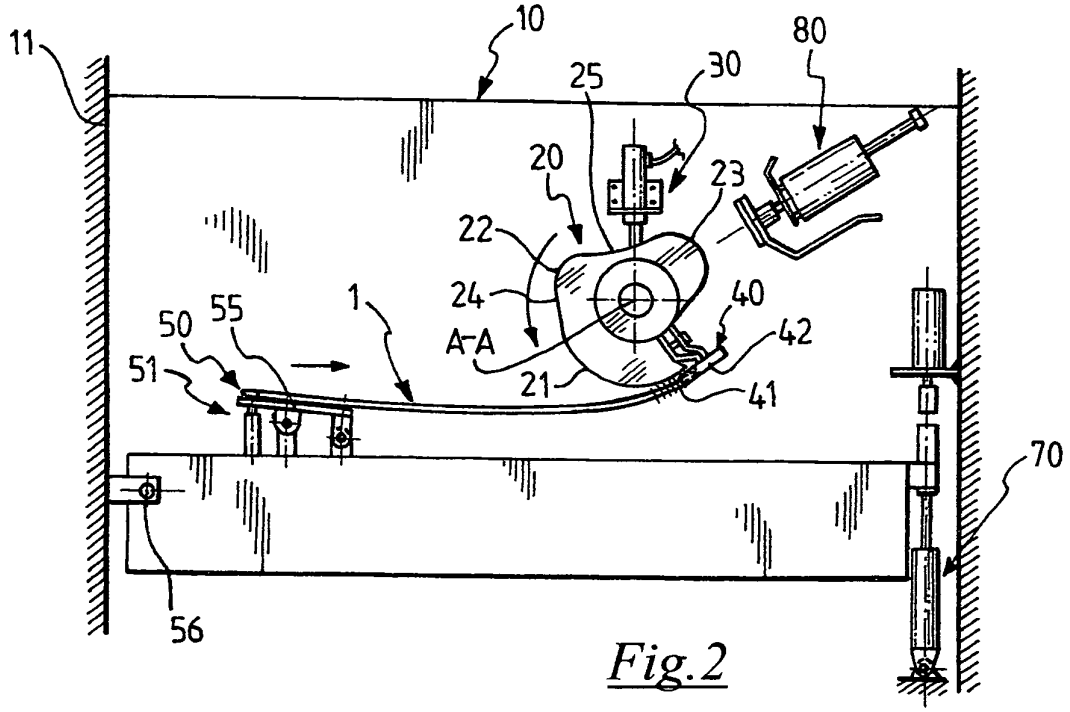
55a
1a
40
42
54b
54a
56
53
60
54
63
61
62
70

Fig.1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A-A
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21
41
70
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Fig.2

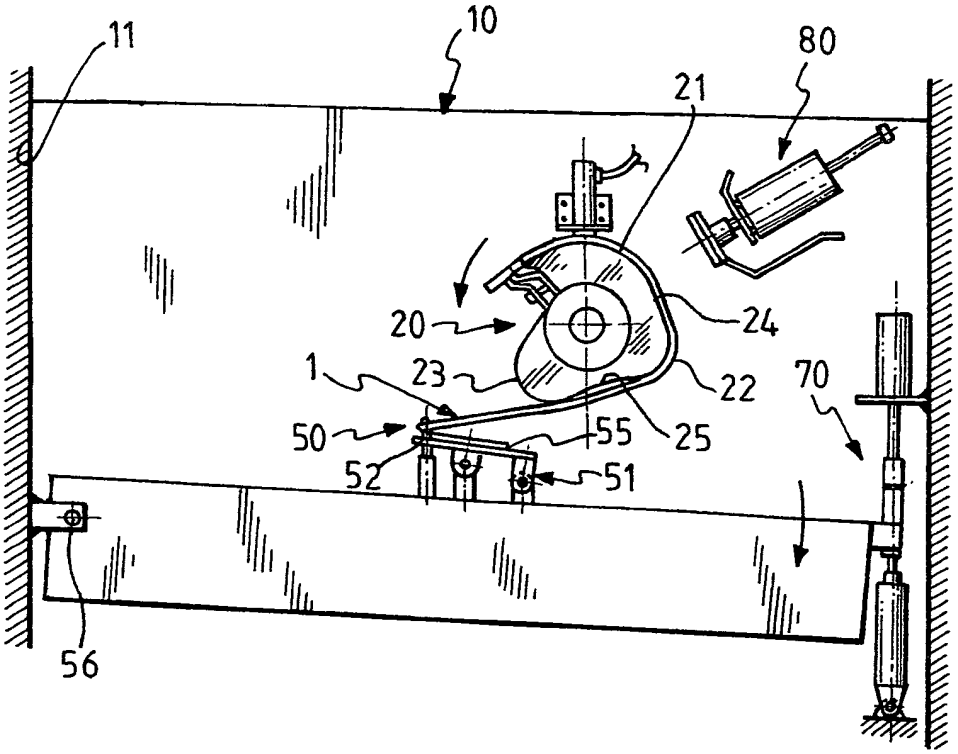
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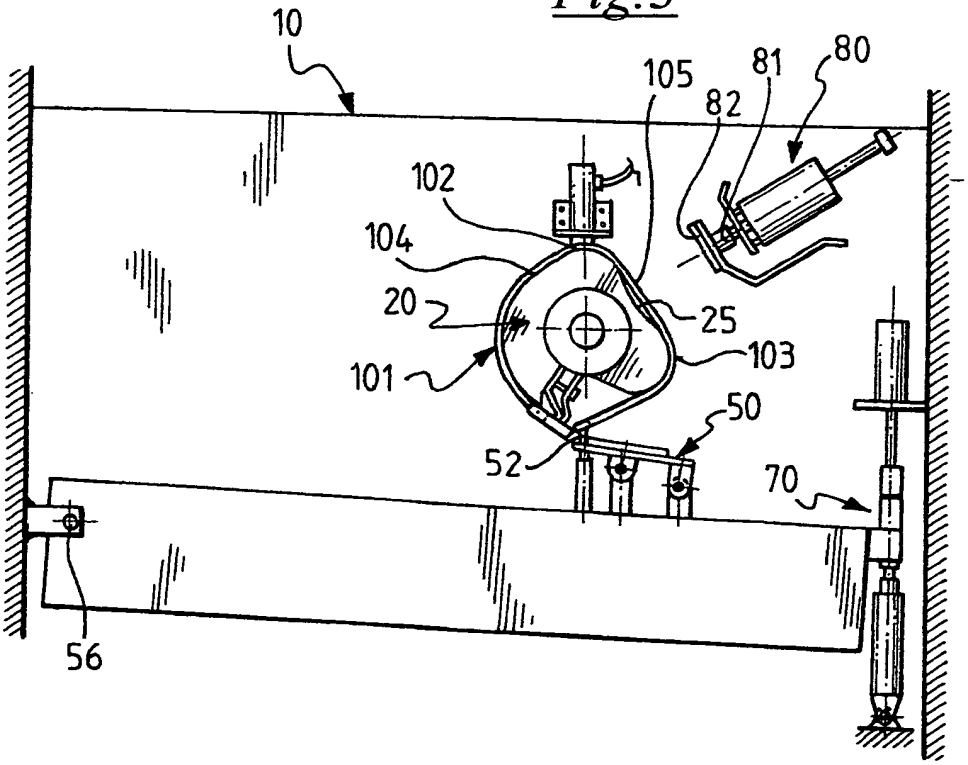
Fig.3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101
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56

Fig.4

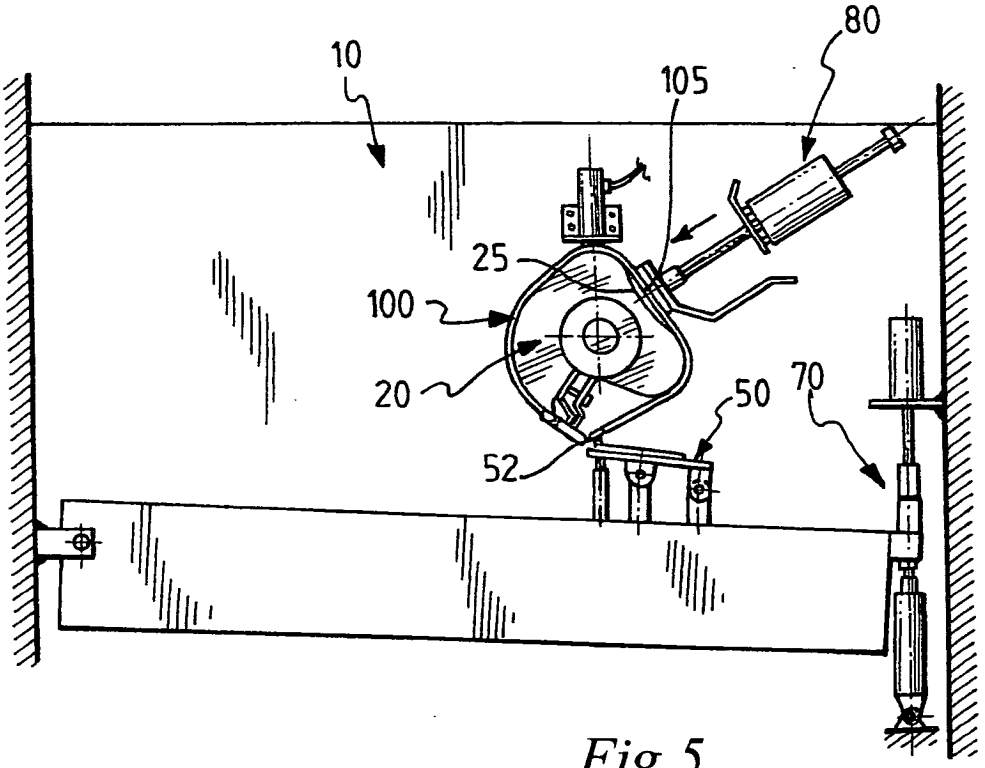

Fig.5

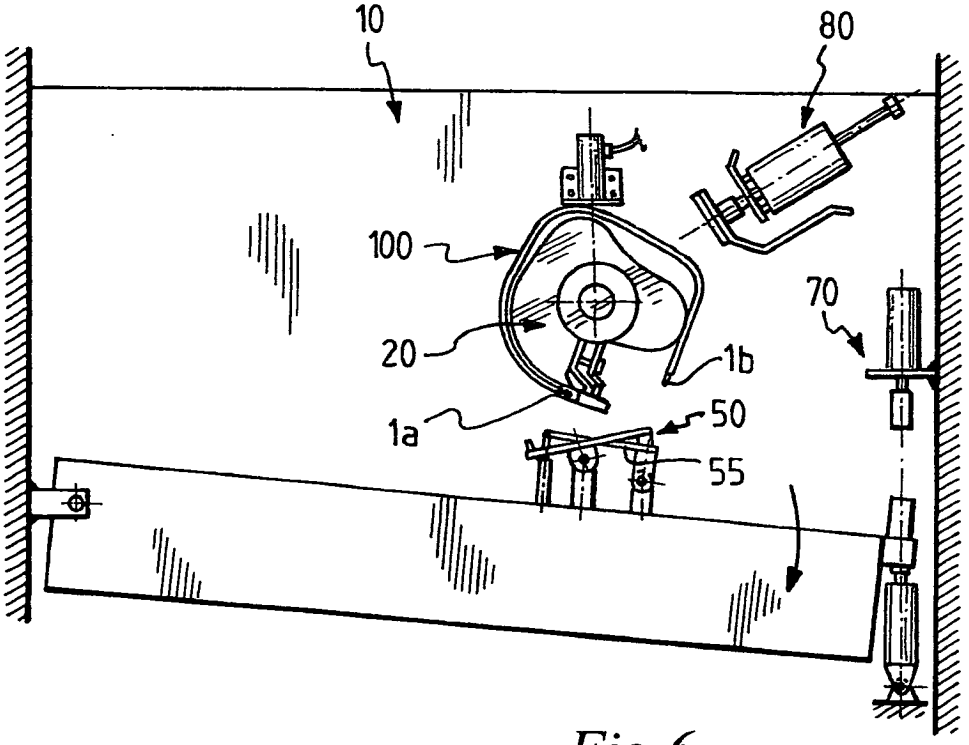

Fig.6

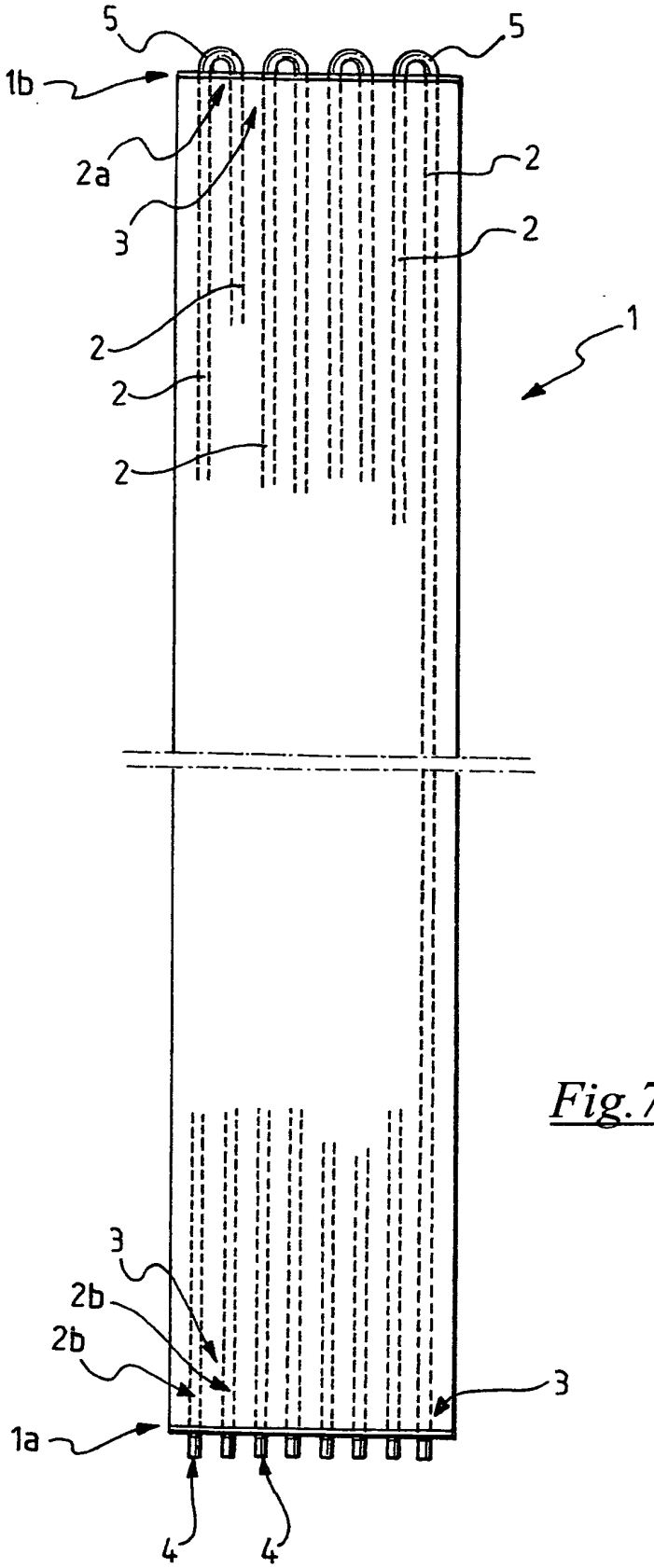

Fig. 7

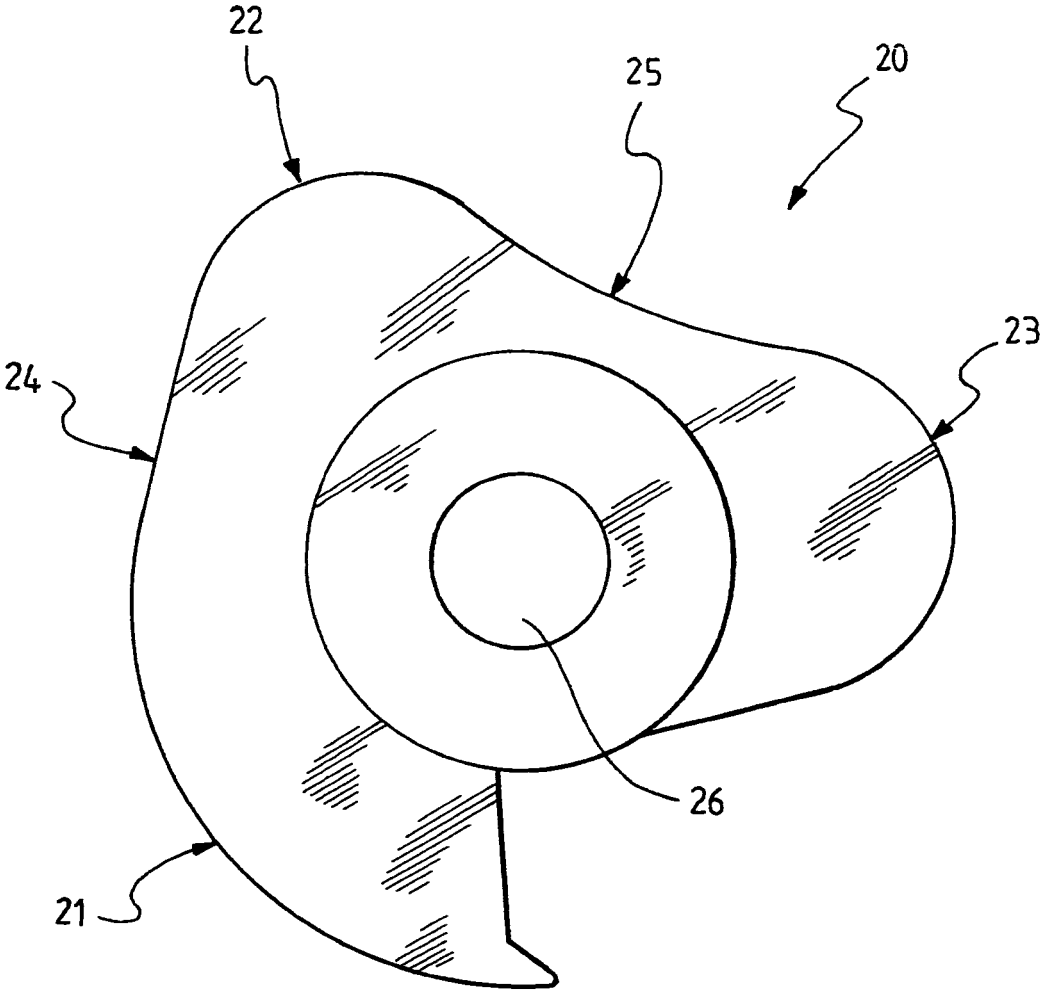

Fig.8

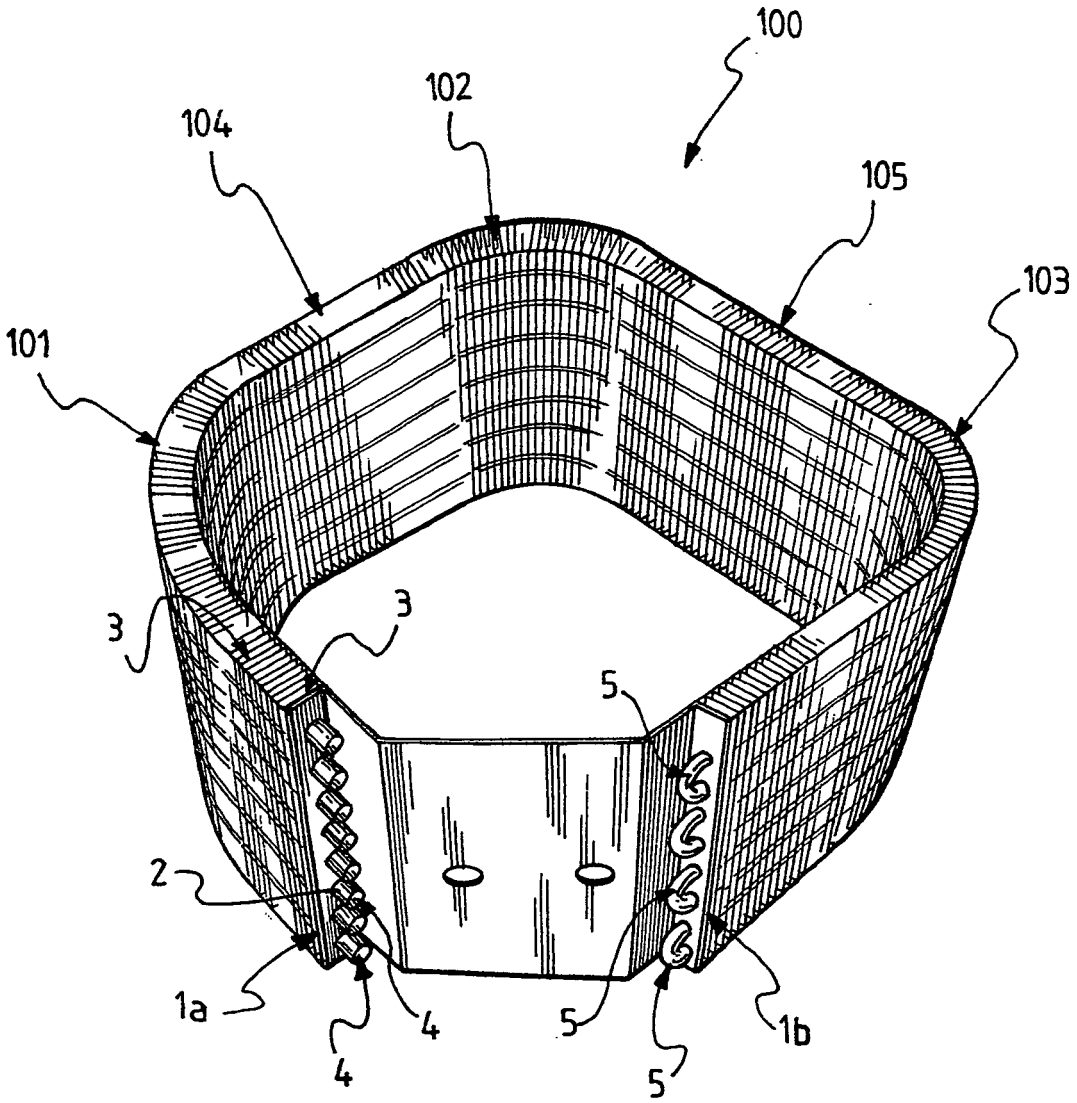

Fig.9

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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