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CAPACITOR FOR AIR CONDITIONING
SYSTEMS**(30) **Foreign Application Priority Data**

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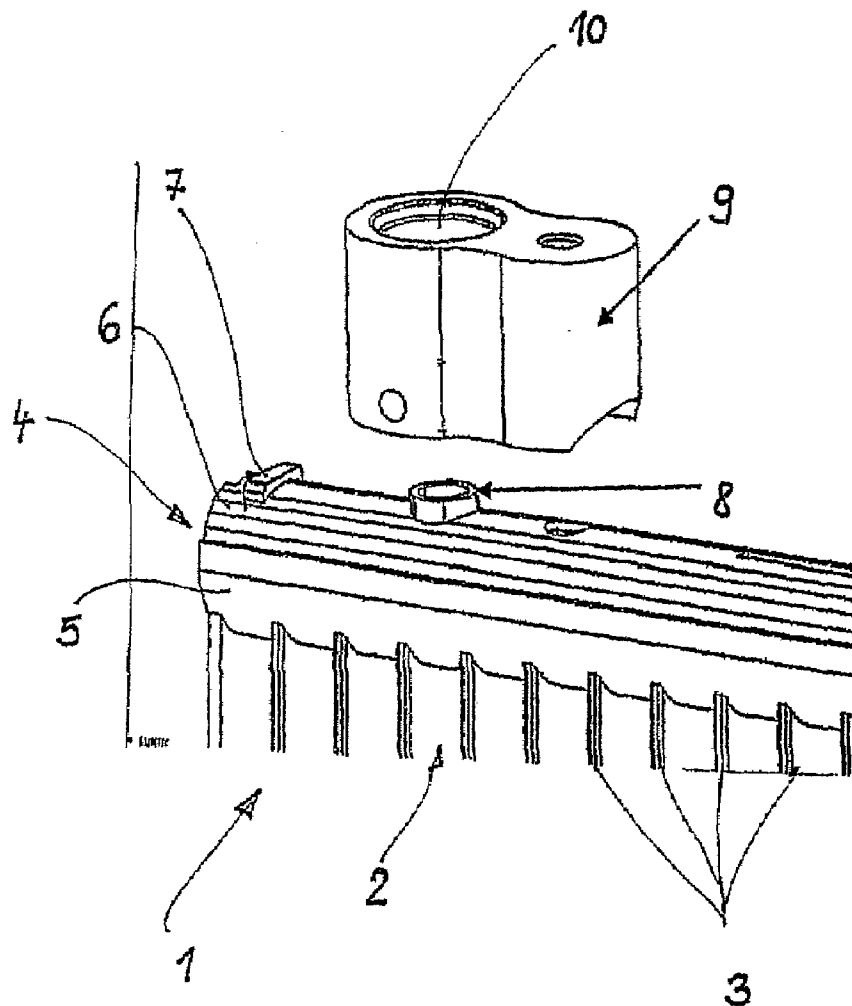
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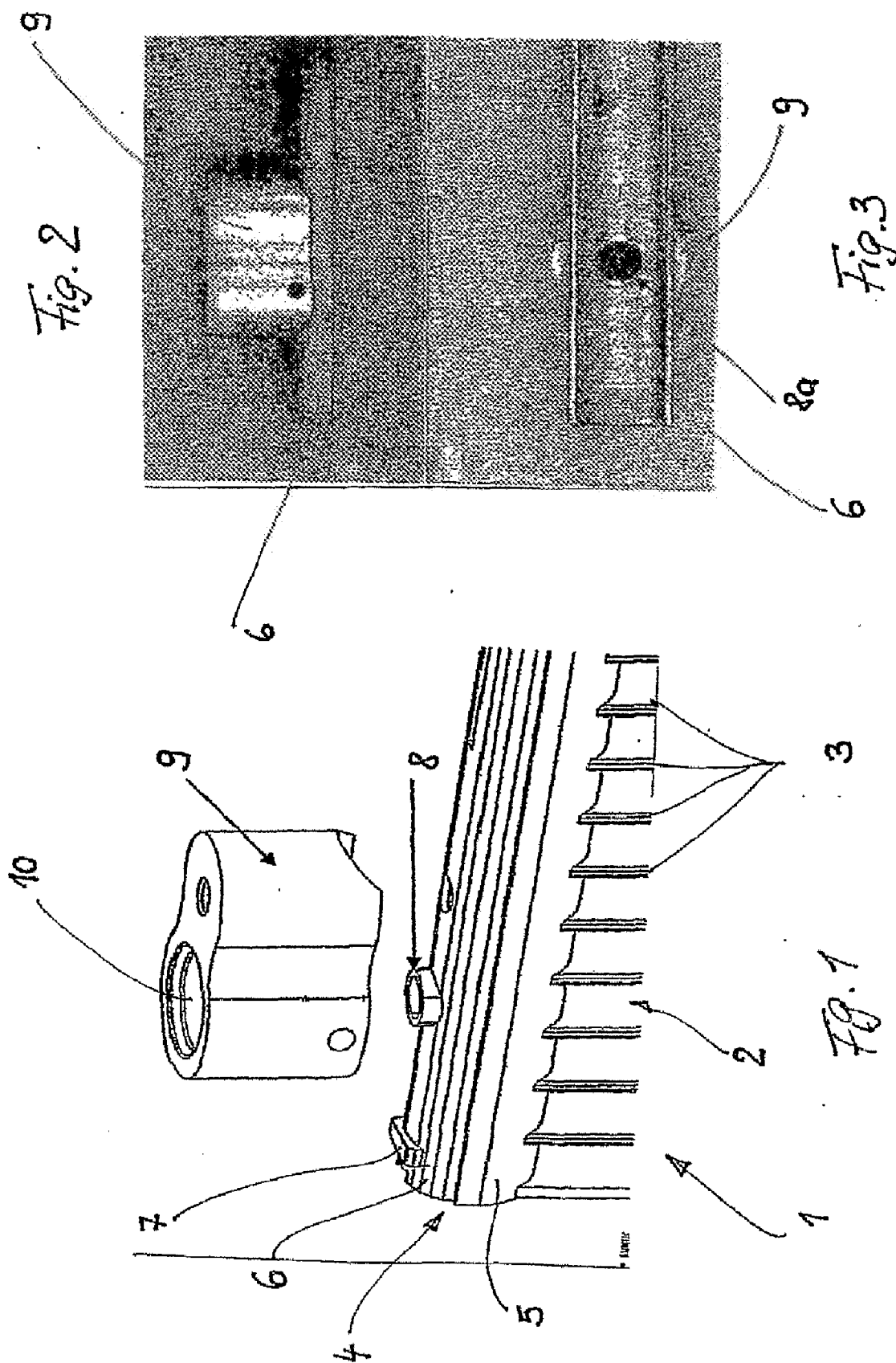
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F28F 9/04 (2006.01)**B21D 53/08** (2006.01)(52) **U.S. Cl.** **165/178; 29/890.043**(57) **ABSTRACT**

The invention relates to a heat exchanger, in particular a capacitor (1) for an air conditioning system, in particular in motor vehicles. Said heat exchanger comprises at least one collector pipe (4) and at least one connection flange (9) which has a material connection with the collector pipe (4) and communicates therewith. The collector pipe (4) comprises a collar (8) and the connection flange (9) comprises a boring (10) wherein the collar (8) can be connected in front of the material fit. The invention is characterised in that the collar (8) can be fixed by a reshaping by means of a stamp having a polygonal cross-section.

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HEAT EXCHANGER, IN PARTICULAR CAPACITOR FOR AIR CONDITIONING SYSTEMS

[0001] The invention relates to a heat exchanger, in particular for air conditioning systems, in particular of motor vehicles as per the preamble of patent claim 1—known from EP 1 439 367 A1. The invention also relates to a method for producing a heat exchanger as per the preamble of patent claim 5.

[0002] Condensers for air conditioning systems of motor vehicles are nowadays produced entirely from aluminum parts and are brazed. A condenser is composed substantially of a condenser block which is constructed from flat tubes and corrugated fins, and collecting tubes which are arranged at both sides of the block and are connected in a communicating manner to the tubes of the condenser block. The collecting tubes and the flat tubes of the condenser are traversed by a refrigerant which is supplied to the condenser from a refrigerant circuit via connecting flanges and is extracted again via said connecting flanges. The connecting flanges are pre-manufactured separate parts which are on the one hand connected to a collecting tube of the condenser and on the other hand are connected to a refrigerant line.

[0003] U.S. Pat. No. 5,477,919 discloses a condenser for air conditioning systems of motor vehicles in which a refrigerant connecting flange is connected to a collecting tube, with bushes being arranged between the refrigerant flange and the collecting tube, and being soldered to the parts which are to be connected, in order to produce a sealed refrigerant flow duct. Said flange connection entails relatively high production costs on account of the plurality of parts.

[0004] EP 1 150 088 A2 discloses a connection between a refrigerant connecting flange and a collecting tube of a condenser, with the refrigerant flange having an integrally formed connection piece which is inserted into a bore of the collecting tube and is expanded by means of a punch in such a way as to provide fixing and anchoring of the flange on the collecting tube. The soldering of the collecting tube and flange takes place thereafter. Said type of connection is also expensive, in particular on account of the design of the flange.

[0005] The above-cited EP 1 439 367 A1, from which the invention proceeds, discloses (as per the exemplary embodiment of FIG. 6) a connection between a collecting tube and a refrigerant connecting flange, with the collecting tube being of two-part design and having a cover with a molded collar which is inserted into a bore of the connecting flange. Here, a slight force fit is provided in order to fix the connecting flange to the collecting tube. A disadvantage here could be that the force fit is not always sufficient for secure fixing, and that twisting could occur between the connecting flange and the collecting tube about the axis of the collar.

[0006] It is an object of the present invention to configure a heat exchanger of the type specified in the introduction to be more simple and reliable with regard to its production, in particular with regard to the connection between the connecting flange and the collecting tube, and to provide an improved method for fixing the connecting flange to the collecting tube.

[0007] Said object is achieved firstly by the features of patent claim 1. It is provided according to the invention that the collar, which is inserted into a bore of the connecting flange, is plastically deformed by means of a polygonal punch in such a way as to provide fixing. A polygonal punch is to be

understood to mean a deformation or expansion tool which has not a round cross section but rather a polygonal cross section which tapers slightly in the direction of a point. The polygonal punch can for example have three, four or six faces which narrow in the form of a pyramid or truncated pyramid. The collar which is inserted in the connecting flange is deformed with said tool. This obtains the advantage of improved fixing of the connecting flange to the collecting tube. The completed heat exchanger which is prepared for the subsequent soldering can, as a result of the fixing according to the invention, be soldered in a soldering furnace without any further soldering aids, such that a sealed soldered connection between the collar and the connecting flange is obtained.

[0008] In one advantageous embodiment of the invention, the pressing of the polygonal punch into the collar of the collecting tube causes an expansion of the collar relative to the bore of the connecting flange, with intimate contact between the collar and the connecting flange being produced in the region of the polygon corners or edges. Only a partial expansion therefore takes place—in the case of a hexagonal cross section, therefore, only at six corners or edges, in each case offset by 60 degrees about the periphery. This promotes a reliable sealed soldered connection as a result of solder gap formation. After the expansion by means of the polygonal punch, the internal cross section of the collar has a polygonal, preferably a hexagonal cross section—like a hexagon socket.

[0009] In one advantageous embodiment of the invention, the collecting tube is of two-part design, that is to say is formed with a cover and a base part, with the collar being integrally formed on the cover. This results in advantages with regard to the production of the collar and during fixing by means of the polygonal punch.

[0010] The object of the invention is also achieved by means of a method having the features of patent claim 5. It is provided according to the invention that the collar which is formed out of the collecting tube is initially inserted into the bore of the connecting flange, and is subsequently fixed by expansion by means of the polygonal punch. The connecting flange and collecting tube cover are thereafter fixedly connected to one another in a sufficiently fixed manner that soldering can subsequently take place without further auxiliary aids.

[0011] An exemplary embodiment of the invention is illustrated in the drawing and is described in more detail below. In the drawing:

[0012] FIG. 1 shows a detail of a condenser with a connecting flange before its assembly,

[0013] FIG. 2 shows the connecting flange assembled on the collecting tube of the condenser,

[0014] FIG. 3 shows a view from the inside of the collecting tube in the region of the connecting flange.

[0015] FIG. 1 shows a corner detail of a condenser 1 for an air conditioning system (not illustrated) of a motor vehicle. The condenser 1 has a condenser block 3 which is composed of flat tubes 2 and fins (not illustrated) and which is connected to a collecting tube 4. A further collecting tube on the opposite side of the condenser block is not illustrated. The collecting tube 4 is of two-part design, that is to say it has a base 5 and a cover 6 which have an approximately semi-circular cross section and are placed one into the other. At the end side, the collecting tube 4 is closed off by an end wall 7 and forms a cavity which communicates with the flat tubes 2. A collar 8 is integrally formed out of the cover 6, for example by means of hole-punch embossing.

[0016] Illustrated in the drawing above the collecting tube 4 is a connecting flange 9 which is to be connected to the collecting tube 4. The connecting flange 9 has a through bore 10 which is connected on the one hand to a refrigerant connecting line and on the other hand to the collar 8 of the collecting tube 4. The individual parts 2, 5, 6, 7, 8, 9 which are illustrated in the drawing are composed of aluminum or aluminum alloys and are soldered to one another. In preparation for the soldering process, all the parts are joined together, in particular the connecting flange 9 is placed with its through bore 10 on the collar 8 of the collecting tube 4. Preliminary positioning and centering of the connecting flange 9 on the collecting tube 4 therefore takes place.

[0017] FIG. 2 shows the flange 9 placed on the cover 6 of the collecting tube 4.

[0018] FIG. 3 shows a view of the cover 6 in the direction X, with the flow cross section of the collar 8 appearing as a blackened circular area 8a. It is provided according to the invention that the circular cross section 8a is deformed by means of a polygonal punch (not illustrated), that is to say is in particular expanded in relation to the through bore 10 of the connecting flange 9. A polygonal punch is to be understood to be a mandrel-like tool which has a non-circular, polygonal cross section which tapers in the thrust direction, that is to say is of wedge-shaped or truncated-pyramid-shaped design. In this respect, a deformation of the internal diameter of the collar 8 takes place substantially by means of the polygon edges which dig into the material of the collar 8 and push said material outward, thereby generating pressing. The cross section of the polygonal punch preferably has the shape of a regular hexagon, though more or fewer corners are also possible. As a result of said deformation of the collar, sufficient fixing is obtained between the collecting tube 4 or cover 6 and the connecting flange 9. In this fixed state, the connecting flange 9 and the cover 6 and also the entire condenser 1 can be soldered in one working step in a soldering furnace (not illustrated).

1. A heat exchanger, in particular condenser for air conditioning systems, in particular of motor vehicles, having at least one collecting tube and having at least one connecting

flange which is cohesively joined and connected in a communicating manner to the collecting tube, with the collecting tube having a collar and the connecting flange having a bore in which the collar can be fixed before the cohesive joining, wherein the collar can be fixed by a deforming operation by means of a punch which has a polygonal cross section.

2. The heat exchanger as claimed in claim 1, wherein the collar has an internal cross section which can be expanded against the bore by means of the polygonal punch.

3. The heat exchanger as claimed in claim 1, wherein, the collecting tube is of two-part design and has a base and a cover on which the collar is integrally formed.

4. The heat exchanger as claimed in claim 1, wherein 2, the collar, after the deformation or expansion, has an internal cross section with the shape of a polygon, preferably of a regular hexagon.

5. A method for cohesive joining, in particular for soldering a heat exchanger having at least one collecting tube and a connecting flange which is to be fastened to said collecting tube, wherein a collar is formed out of the collecting tube, in that the connecting flange is positioned on the collecting tube, and the collar is inserted into a bore of the connecting flange, is subsequently deformed by means of a polygonal punch, is thereby fixed and is subsequently soldered in a soldering furnace.

6. The heat exchanger as claimed in claim 2, wherein the collecting tube is of two-part design and has a base and a cover on which the collar is integrally formed.

7. The heat exchanger as claimed in claim 2, wherein the collar, after the deformation or expansion, has an internal cross section with the shape of a polygon, preferably of a regular hexagon.

8. The heat exchanger as claimed in claim 3, wherein the collar, after the deformation or expansion, has an internal cross section with the shape of a polygon, preferably of a regular hexagon.

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