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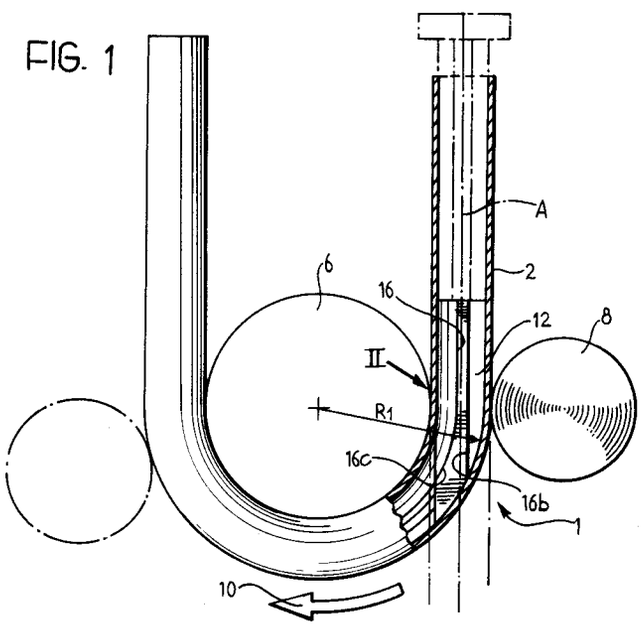
(54) A tool for making U-shaped bends in heat-exchanger tubes having radial fins projecting from the internal walls of the tubes.

(57) The tool for making U-shaped bends in heat-exchanger tubes having radial fins projecting from the internal walls of the tubes (2) comprises a core (12) which is inserted temporarily into an arm of the tube to be bent and which has a cylindrical surface in contact with the internal wall of the tube between each pair of adjacent fins and a plurality of grooves (16) for housing respective fins.

FIG. 1



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The present invention relates to a tool for making U-shaped bends in heat-exchanger tubes having radial fins projecting from the internal walls of the tubes.

A method of bending tubes in order to form so-called "hairpin" bends is known for use with tubes of circular cross-section with smooth internal surfaces. The most widespread system makes use of the rotation of a movable element on an element which acts as a fulcrum, entraining and bending the tube which is interposed between the two elements, with the internal resistance of a restraint core.

Difficulties arise when the internal surface of the tube has ribs or fins and particularly when it is important not to deform the fins during the process.

In order to overcome these difficulties, the subject of the present invention is a tool, characterized in that it comprises a core which is inserted temporarily in an arm of the tube to be bent, and which has a cylindrical surface in contact with the internal wall of the tube between each pair of adjacent fins and a plurality of grooves for housing respective fins. The shape and dimensions of the grooves of the core are determined in a manner such that the insertion of the core, the bending of the tube and the withdrawal of the core from the tube can be achieved easily, without interference and without deformation of the fins.

Further characteristics and advantages of the present invention will become clear in the course of the following detailed description, given purely by way of non-limiting example, with reference to the appended drawings, in which:

Figure 1 is a schematic plan view of a tool for making U-shaped bends in tubes,

Figure 2 is a perspective view of the end portion of the core indicated by the arrow II in Figure 1,

Figure 3 is a schematic section taken on the line III-III of Figure 2, and

Figure 4 is a partial perspective view of the bend region of a finned tube.

With reference to the drawings, a tool for making U-shaped bends in a heat-exchanger tube 2 is generally indicated 1.

As can be seen in Figures 3 and 4, the tube to be bent has a plurality of fins 4 which project from the internal wall of the tube. The fins 4 have the purpose of increasing the turbulence of the liquid inside the tubes and increasing the surface area for the exchange of heat between the tube and the liquid and they considerably increase the efficiency of the heat exchanger.

The radial projection of the fins 4 in relation to the diameter and the thickness of the tube is appreciable (by way of indication, the radial dimension of each fin 4 is more than 10% of the diameter of the tube and is more than double the thickness of the tube wall) and the finned tube is therefore readily distinguishable from so-called splined tubes which have shallow incisions in their internal surfaces.

In the embodiment shown, the tube has four fins but it is intended that it may have any number of fins.

With reference to Figure 1, a tool used to make U-shaped bends in a finned tube comprises a wheel 6 with a fixed axis and a wheel 8 which has a movable axis and performs an arcuate movement around the centre of the wheel 6 with the fixed axis. The tube 2 to be bent is disposed between the wheels 6, 8 and the bending is carried out by moving the wheel 8 in the direction indicated by the arrow 10 in Figure 1.

Before the bending is carried out, a core 12 is inserted in the tube and acts as a restraint during the initial stage of the bending.

With reference to Figures 1-3, the core 12 is constituted by a rigid body with cylindrical surfaces 14 which are disposed in contact with the internal wall of the tube between each pair of adjacent fins. The core 12 has a plurality of grooves 16 which house respective fins 4. The dimensions of the grooves are slightly larger than those of the fins of the tube so as to leave the fins free during the bending process.

In the embodiment shown in the drawings, the core 12 has four grooves 16, a first pair of which are diametrally opposed and lie in the plane of the bending of the tube. Of this first pair of grooves, the one situated on the outside of the bend in the tube has an end portion 16a (Figure 2) which extends over a toroidal surface 18 defined by a curvature R1 in the bending plane (Figures 1 and 2) and by a curvature R2 in the plane perpendicular to the bending plane and having the same radius as the internal surface of the tube 2.

A second pair of grooves 16, also diametrally opposed, are situated in a plane perpendicular to the bending plane. The grooves of this second pair have flared end portions with first walls 16b situated outside the centre line of the bonding of the tube (indicated A in Figure 1) which are straight and second walls 16c which have curved profiles and are situated inside the centre line of the bending of the tube.

The particular shape of the core 12 allows the hairpin-shaped tube to be withdrawn easily upon completion of the bending and enables the tube to be bent without damage to the fins.

Claims

1. A tool for making U-shaped bends in heat-exchanger tubes having radial fins (4) projecting from the internal walls of the tubes (2),

characterized in that it comprises a core (12) which is inserted temporarily in an arm of the tube to be bent (2) and which has a cylindrical surface (14) in contact with the internal wall of the tube (2) between each pair of adjacent fins and a plurality of grooves (16) for housing respective fins (4).

2. A tool according to Claim 1, characterized in that the core (12) has a first pair of grooves which lie in the bending plane and of which the one situated on the outside of the bend in the tube has an end portion (16a) which extends over a toroidal surface (18).

3. A tool according to Claim 2, characterized in that the core (12) has a second pair of grooves (16) situated in a plane perpendicular to the bending plane, the grooves of the second pair having flared ends with first straight walls (16b) situated outside the centre line (A) of the bending of the tube and second walls (16c) which have curved profiles and are situated inside the centre line (A) of the bending of the tube.

FIG. 1

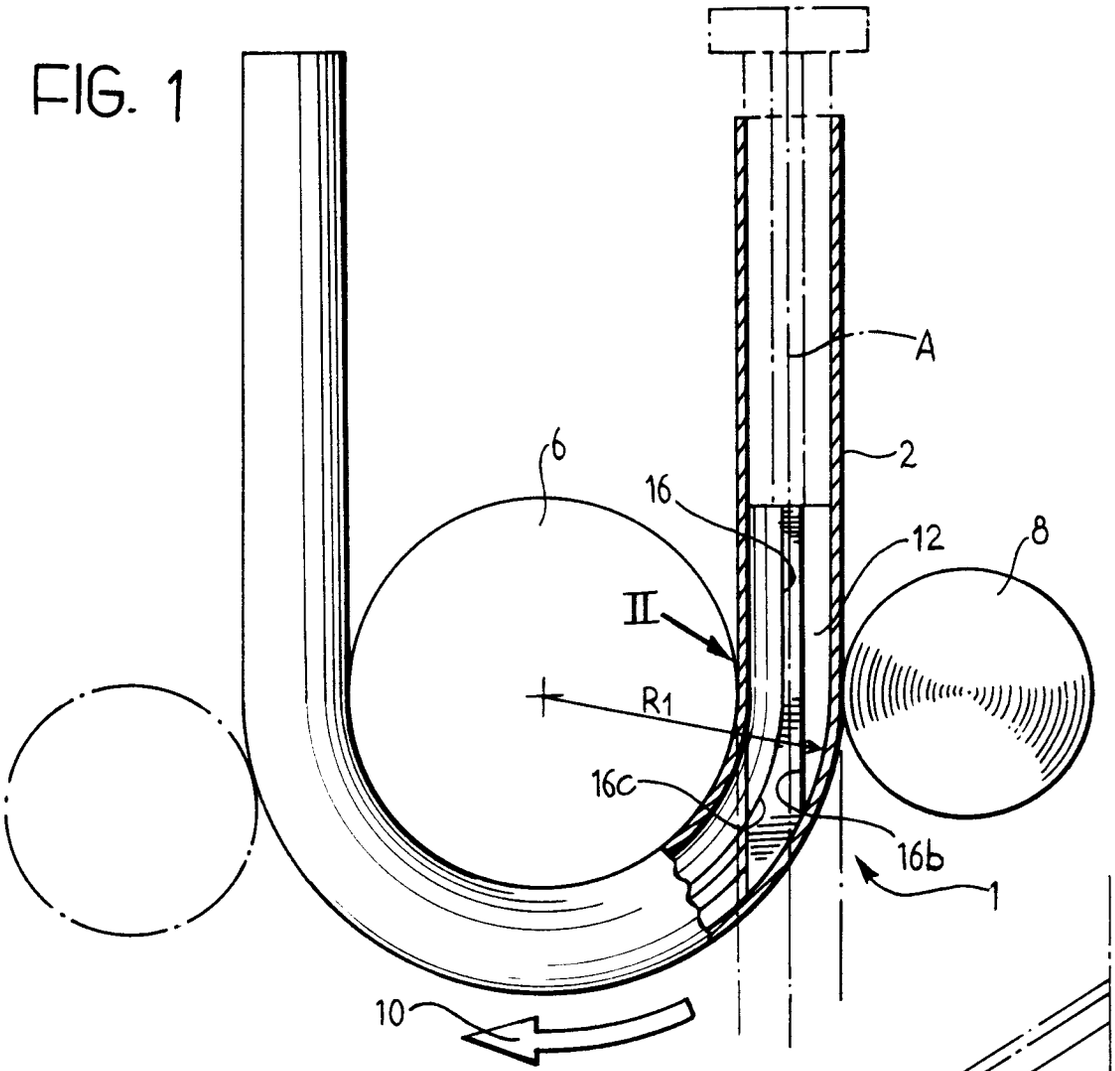

A
2
6
16
12
8
II
R1
16c
16b
1
10

FIG. 2

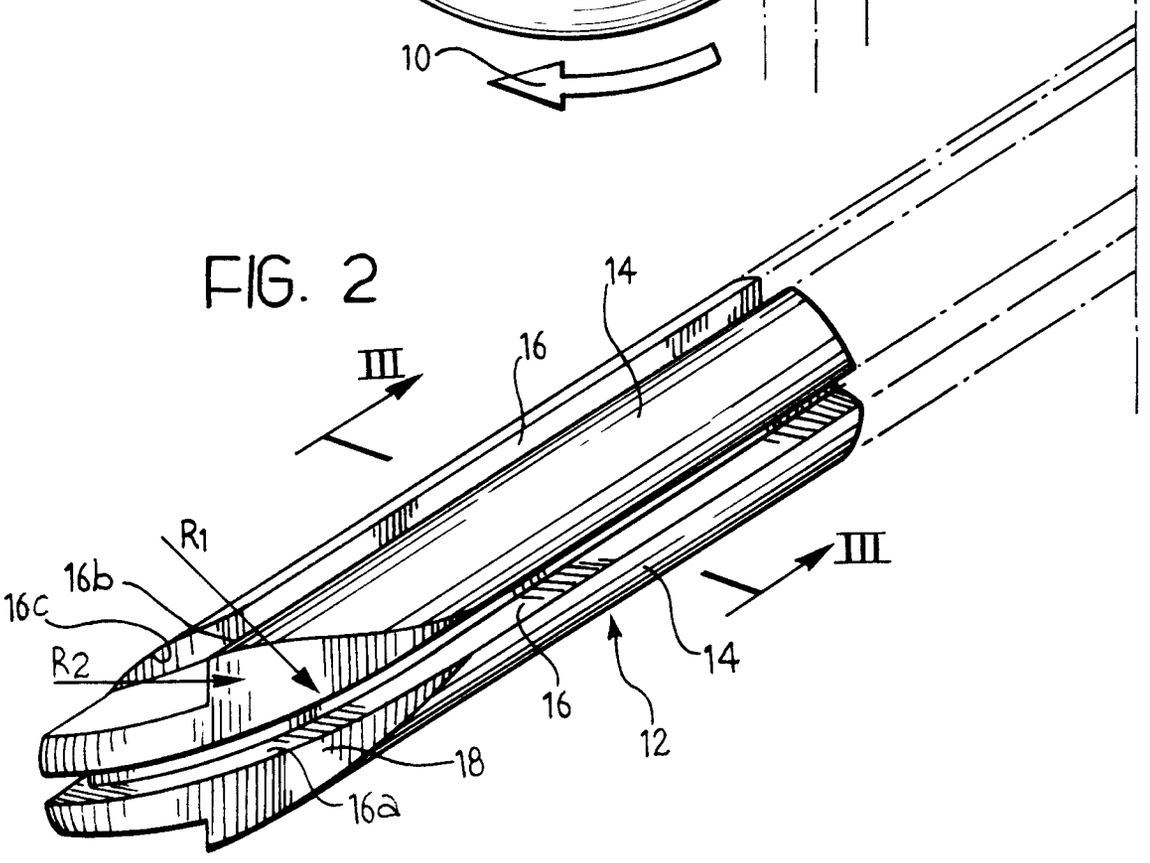

14
III
16
R1
16b
16c
R2
III
14
16
12
18
16a

FIG. 3

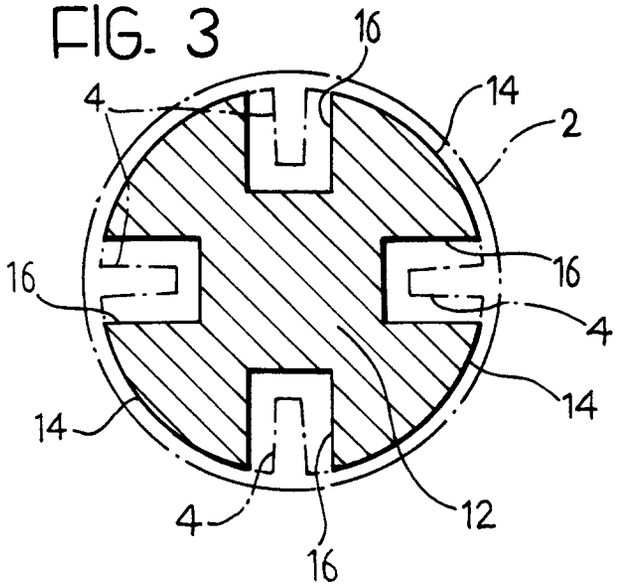
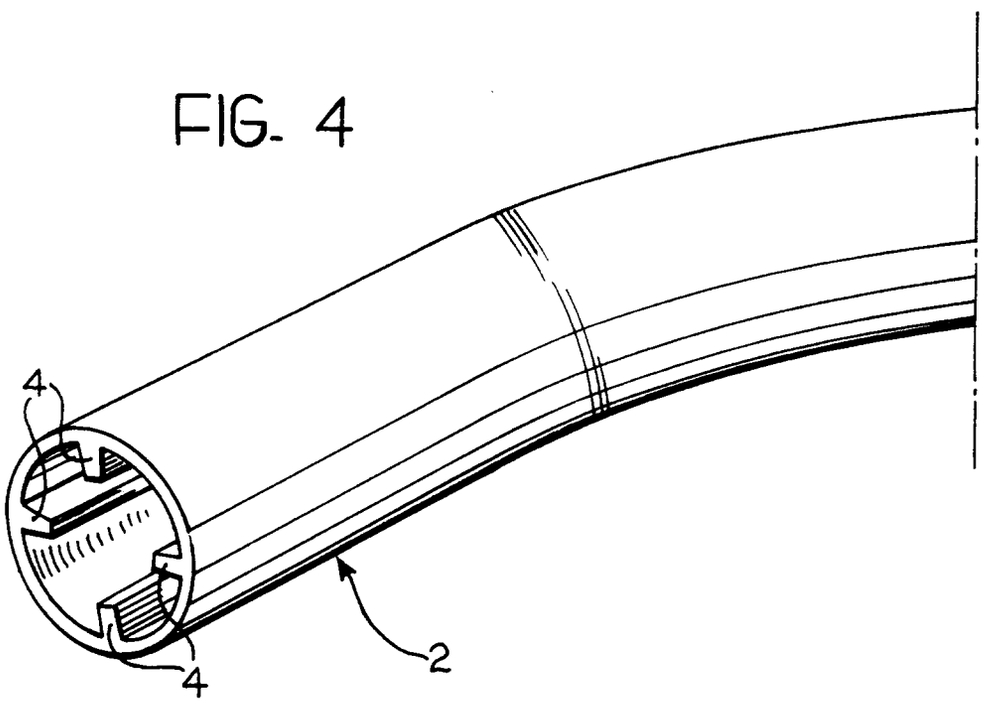


FIG. 4



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EUROPEAN SEARCH REPORT

Application Number
EP 95 10 1548

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	GB-A-557 998 (MORRIS MOTORS) * page 2, line 68 - page 2, line 75; claims; figures 4,5 *	1	B21D9/01
X	FR-A-2 321 345 (SERINOX) * claim 2; figure 3 *	1	
X	US-A-3 561 247 (PFAFMAN) * column 2, line 10 - column 2, line 24; claims *	1	
A	GB-A-2 148 758 (MANSELL THOMAS GOWING)		
A	US-A-3 580 044 (VOSS)		
A	LU-A-68 193 (PIERO CROTTI)		

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

B21D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	12 May 1995	Peeters, L

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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