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(54) **Method and apparatus for forming refrigerator condensers**

(57) Method for forming the vertical borders of a condenser (1), comprising the phases of shaping said borders, defining a vertical stripe (6) extending along at least one of said borders and free of conduits for the circulation of refrigerant medium, and forming a recess (2) of adequate width and depth along said stripe (6) so as to pull in from the inner area of the blank a portion of the surface thereof, so that, after said forming operation, the overall width of the condenser (1) is reduced to a pre-determined value.

Provided are also two vertical stripes (20;21) of a pre-established width along and inside the vertical borders, which are also free of conduits for the circulation of the refrigerant medium, while two appropriately shaped configurations (24;25) oriented towards the back wall of the refrigerator are formed so as to be symmetrical with respect to the median plane orthogonal to the condenser; each such shaped configuration has two distinct surfaces (26;27) extending parallelly to the plane of the condenser (1), arranged at respective different distances from said plane.

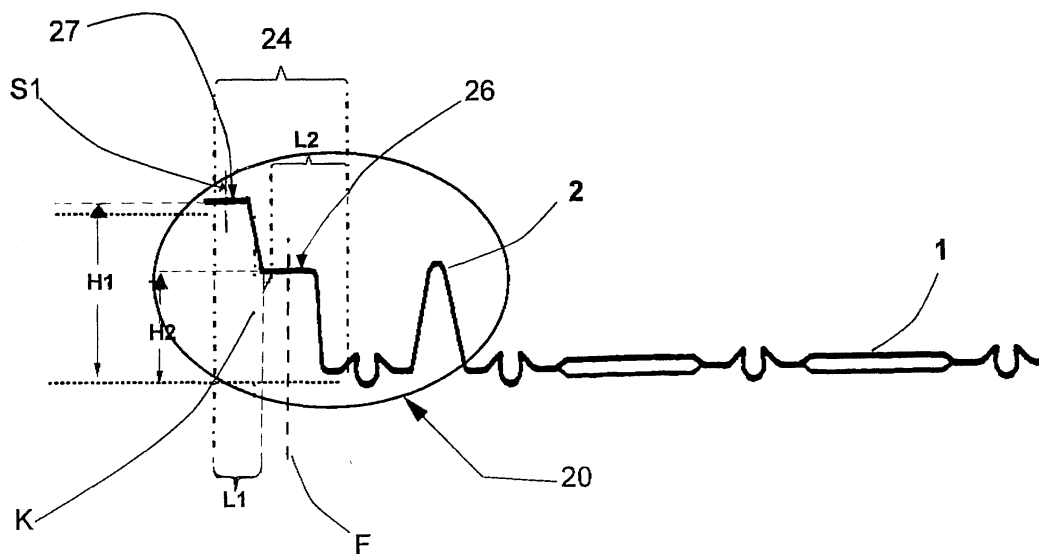


FIG.2

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Description

[0001] The present invention refers to a method of a particular kind for the adjustment of the width and the height of a sheet-metal condenser or heat exchanger obtained by roll-forming a sheet-metal plate or blank.

[0002] Refrigerators are generally known to have a width that varies in accordance with both market-driven and technical requirements.

[0003] Furthermore, the depth of the same refrigerators is determined, further to the particular market requirements which the products are intended to comply with, by the need for an appropriate space to be provided on the rear side of the back wall of the refrigerator for the condenser to be mounted there.

[0004] Such a condenser generally has, in its central portion, a plane pattern, which is duly formed so as to provide there both the channels, in which the conduits carrying the refrigerant gas to be condensed are inserted, and the radiant elements intended to improve the heat dissipation capacity of the structure of the condenser.

[0005] These condensers are commonly known to be attached to the back wall of the refrigerator casing by providing appropriate side shoulders at the sides of said condensers, ie. by forming usually vertical zones that are variously shaped so as to be able to a twofold purpose, ie. perform both as an attachment element for fastening the condenser to the back wall of the refrigerator, and as spacers that are so shaped as to enable the condenser, upon being mounted, to place itself at a desired distance from the back wall of the refrigerator in order to form a ventilation shaft whose characteristics depend on the type of refrigerator and the installation thereof.

[0006] In particular, built-in refrigerators, owing to them having to be inserted in cabinet structures that usually constitute a niche, place definite requirements as far as the need is concerned for their condensers to be adequately ventilated, so that they usually require condensers that must be specifically designed as far as not only their width is concerned, but also the distance that these condensers must have from the back wall of the refrigerator casing.

[0007] Therefore, all these requirements join together to give rise to the need for a whole diversified range of sheet-metal blanks to be manufactured and/or anyway handled within a single and same manufacturing unit, so as to be able to produce from such blanks respective condensers that are correspondingly diversified in both their width and their depth, ie. distance from the back wall of the respective refrigerators.

[0008] It can be readily appreciated that such a circumstance commands a real proliferation in the various types and sizes of blanks needed, with obvious consequences in terms of complexity and costs in managing the production and handling of such blanks.

[0009] It therefore is a purpose of the present invention to do away with the above described drawbacks in

a fully radical manner by acting on the manufacturing process and making use of special equipment so as to enable different types of heat exchangers to be produced starting from a single type of blank, through an appropriate folding operation along the borders thereof, so as to bring about an appropriate width of the sheet-metal blank and enable in this way the resulting condenser to be adapted to the desired width, and an associated cutting operation of the borders of the blank, as previously folded in said appropriate manner, in such a way as to enable said borders to ensure the desired distance of the condenser from the back wall of the respective refrigerator.

[0010] Features and advantages of the present invention will anyway be more readily understood from the description that is given below by way of nonlimiting example with reference to the accompanying drawings, in which:

- Figure 1 is a rear elevational view of a condenser according to the present invention;
- Figure 2 is a cross-sectional view of a portion of said condenser along the cross-section plane A - A;
- Figures 3, 4 and 5 are respective cross-sectional views as shown in Figure 2, but referring to respective variants of the condenser illustrated in Figure 1;
- Figure 6 is an enlarged view of a portion of Figure 2;
- Figure 7 is a symbolical perspective view of a portion of the condenser illustrated in Figure 2;
- Figure 8 is a symbolical perspective view of a portion of the condenser illustrated in Figure 5;
- Figure 9 is a symbolical perspective view of a machine adapted to carry out a manufacturing process according to the method of the present invention;
- Figure 10 is a cross-sectional view of the respective first four pairs of contoured forming rolls illustrated in Figure 9;
- Figure 11 is a cross-sectional view of the last four remaining respective pairs of contoured forming rolls illustrated in Figure 9, along with the cross-sectional view of a pair of rolls adapted to section the condenser in accordance with the method of the present invention.

[0011] In the following description reference will be made to a condenser for a household-type refrigerator provided with a vertical back wall and, as a result, also with a condenser arranged vertically close to the respective back wall. The terms of width, height and depth of the condenser will therefore be generally used through-

out this description, but it shall be appreciated that these terms are solely used in order to more effectively illustrate the described example of embodiment and are by no means intended to limit the scope of the invention which is solely defined by the appended claims.

[0012] As this has already been told above, the method according to the present invention originates from the need of using sheet-metal blanks having the same width to produce condensers having different widths.

[0013] To this purpose, it has been found that the width of a sheet-metal blank can be reduced, albeit within certain limits, by producing one or more appropriate constant-width foldings in a direction which is orthogonal to the direction of the blank along which said dimension has to be reduced.

[0014] With reference to Figures 1, 2, 5, 6, 7 and 8, a sheet-metal blank to be converted into a condenser 1 having a pre-established width, so as to be able to correctly fit against the back wall of the refrigerator on which it has to be mounted, may be reduced in its width by providing a groove-like recess 2 having a desired width and depth, wherein such a recess, which may be provided after forming the "jalousie"-like heat dissipation elements of the condenser, must be made by making use of a kind of sheet-metal forming process that is capable of at least partly pulling in the material required to make such a groove-like recess from the remaining portion of the width of the condenser, which is therefore narrowed and can in this way be practically brought down to the actually desired width, provided that the characteristics of said groove-like recess are brought about in an appropriate manner, as this is anyway within the capability of all those skilled in the art.

[0015] It is obvious that such a recess may also not be the only and single one, but can on the contrary be formed along with other similar groove-like recesses, especially if the width of the blank has to be reduced to quite a considerable extent and it is not possible for too deep recesses to be formed.

[0016] Furthermore, in the absolutely common case that, in view of improving heat dissipation, the conduit 5 of the refrigerant medium is arranged in a coil-like manner, according to a generally known pattern as illustrated in Figure 1, so as to therefore use up most of the width of the condenser, it becomes necessary for one or more vertical stripes 6 to be provided, included in said condenser, in which said recesses may then be formed and which, for this reason, must be arranged along the borders of the condenser or, anyway, laterally with respect to the development pattern of said coil. In fact, it is only in this case that it is then possible for said recesses to be formed there without incurring the risk of affecting said refrigerant conduit; in any other case, forming these recesses would in fact involve also a deformation of said conduit which would obviously be damaged and suffer some kind of impairment.

[0017] Furthermore, in order to ensure greater flexibility in carrying out the method, said recesses may be

provided also in a zone of the condenser which is taken up by the heat dissipation elements, which are generally obtained by perforating and processing the related portion of the blank so as to obtain the so-called "jalousies" or "louver-blinds", as far as these heat dissipation elements do not of course include any portion or tract of the refrigerant medium conduit 5 arranged there.

[0018] To this purpose, it has been found that the most suitable technologies in view of obtaining said groove-like recesses in a complete, i.e. finished condenser are represented by the deep-drawing or the punching techniques, as appropriately performed by machines and tooling and equipment in general that can be readily thought about by those skilled in the art.

[0019] It has also been observed that said recess 2 can be more readily and easily formed, as far as not only a greater manufacturing convenience, but also a more accurate pull-in effect in retracting the sheet-metal material is concerned, when it is in the shape of a V, as this is shown in the Figures and, more particularly, in Figure 6.

[0020] It proves furthermore advantageous if said recess is formed on the side of the condenser that is intended to face the back wall of the respective refrigerator appliance, so as to be able to use the space of the ventilation shaft defined by the condenser itself and said back wall of the refrigerator, without taking up any further space towards the external zone on the rear, which would actually cause the overall dimensions of the appliance to increase beyond any acceptable value, especially if the refrigerator is going to be installed and used in a built-in application.

[0021] The above described manufacturing method can on the other hand be advantageously integrated with or, under certain circumstances, even replaced by a second, completely different method that is aimed at obtaining condensers having borders of differing depth, so as to enable the respective condensers to be installed at differing distance from the back walls of the refrigerators which they are intended to be associated with.

[0022] Through this second method the possibility is also given for the width of the condenser to be adjusted along with the depth thereof, as this will clearly emerge from the following description, and this is actually why these methods are partially replaceable with each other.

[0023] With reference to Figures 2, 3, 4, 7, 8, 9, 10 and 11, said second method involves, as in the previously described case, the definition of two vertical stripes 20, 21 of a pre-established width extending along respective vertical borders and arranged internally with respect thereto, wherein no section or tract of the refrigerant medium conduit is present in these stripes.

[0024] The actual core of the method consists in creating on said two vertical stripes, preferably by means of successive-step folding, two profiles 24, 25 oriented towards the back wall of the refrigerator, symmetrical with respect to the median plane orthogonal to said con-

denser, and extending parallel to said borders.

[0025] Each one of these profiles has at least two distinct surfaces 26, 27 running parallel to the plane of the condenser and arranged at different distances H 1 and H2, respectively, from that plane.

[0026] As illustrated in particular in Figures 2 and 4, when seen in their cross-section along a plane that is orthogonal to the plane of the condenser and also to said stripes, said profiles appear as having, on each side, a stair-like contour.

[0027] In fact, the surface 27 that is most distant from the plane of the condenser is arranged externally with respect to the surface 26 that is closer to said plane.

[0028] Furthermore, these two surfaces have respective widths L1 and L2 that are constant, so as to ensure an easy application thereof against the back wall of the refrigerator, while the respective axes of symmetry S1 and S2 must be parallel owing to the reason indicated below.

[0029] In fact, if the condenser is used as illustrated in Figure 4, said condenser will obviously have its original, overall width, while the distance of the plane of the condenser from the back wall of the refrigerator will be, consistently with said Figure, equal to the distance of said surface 27.

[0030] If said condenser, as formed in the above described manner, is on the contrary sectioned with a cut performed along the cross-section plane F cutting the stripe of said profile in correspondence of a line (which in the cross-sectional views appearing in the Figures is represented by the point K) situated on the nearer surface 26, a condenser will be obtained, whose cross-section is illustrated in Figure 3, corresponding to Figure 4 that illustrates the same condenser before such a cutting operation.

[0031] It can be clearly appreciated that with such a cutting operation a condenser is obtained, from the original one, whose width is now smaller than the original width, while the distance of the plane of the condenser from the back wall of the refrigerator will be, consistently with the Figure, equal to the distance of said surface 26.

[0032] It is therefore natural that, by the combination of a particular forming of the borders of the condenser into a stair-like contour and a possible subsequent sectioning of said borders, the possibility is created for condensers having different widths, and even different depths, to be obtained from a same blank.

[0033] At this point, all those skilled in the art will be able to understand how, with the present teaching, it is actually possible to obtain, from a same blank, condensers that differ solely for their width, if the cutting is done for example only within the surface 27, thereby making it only narrower, without therefore reducing the depth of the condenser.

[0034] Similarly, it will be possible for the application of the present invention to be extended by also providing stair-like contours of the borders of the condenser featuring three or more steps.

[0035] As far as the border forming process is concerned, a forming technique has been identified, which calls for the use of a machine, illustrated in Figures 9, 10 and 11, which is adapted to roll-form the borders of the condenser so as to fashion them in the above described manner.

[0036] This machine is preferably constituted by a plurality of working stations 30, each one of them constituted by a pair of revolving conifing rolls 31, 32 adapted to fold a side of the condenser, and a symmetrical pair of rolls 33 and 34 adapted to fold the opposite side of the condenser.

[0037] The rolls of each such pair of rolls have naturally matching working contours and, during the revolution thereof, they adhere along the common generatrix which varies continually. During the revolution, the border of the condenser is conveyed into the contact zone of each pair of rolls, so that this operation practically ensures both the conveyance of the condenser and the folding of the borders thereof.

[0038] The borders are fashioned, ie. formed into their ultimate shape through a plurality of working stations 30, each one of which is provided with a double pair (right side and left side) of conifing rolls. Each pair only produces a part of the whole amount of forming work needed to produce the required deformation effect, which is therefore obtained through a successive sequence of distinct progressive forming operations, wherein each such operation is carried out by a respective single pair of specifically intended rolls.

[0039] By mere way of example, Figures 10 and 11 illustrate cross-sectional views, along a plane passing through the axes of the rolls, the profiles of seven pairs of respective conifing rolls arranged in a successive sequence as indicated by the related reference numerals.

[0040] Finally, if an external portion of said particular border profiles has to be sectioned in view of obtaining the afore described effect of reducing both the width and the depth of the condenser, a further station may suitably be provided to include two symmetrical pairs of rolls 41, 42 provided with appropriate wedge-shaped portions 43, 44, respectively, which are adapted to engage the just fashioned borders of the passingthrough condenser and section it to the desired width and depth.

Claims

1. Method for forming the vertical borders of a condenser (1) obtained from the processing of a sheet-metal blank and preferably used in conjunction with refrigeration appliances, comprising the step of shaping said borders so that, when attached to the back wall of the respective refrigeration appliance, said condenser is mounted at a pre-determined distance from said respective back wall, and the step of providing heat dissipation elements in the internal surface of said sheet-metal blank, **characterized in**

that it is capable of producing condensers having different widths and different depths of said borders by using sheet-metal blanks having the same width.

2. Method according to claim 1, **characterized in that** it also comprises the steps of:

- defining one or more vertical stripes (6) of a pre-established width along at least one of said vertical borders, arranged internally with respect to said borders, and free of any conduit (5) for the circulation of refrigerant medium;
- forming a groove-like recess (2) of appropriate width and depth along the whole height of at least one of said vertical stripes, adapted to pull in from the inner area of said blank a portion of the surface thereof, so that after said forming operation the overall width of the condenser is reduced to a pre-determined value.

3. Method according to claim 2, **characterized in that** said groove-like recess is obtained by means of a deep-drawing or a punching operation.

4. Method according to claim 2 or 3, **characterized in that** the cross-section of said groove-like recess (2) is in the shape of a V.

5. Method according to any of the preceding claims, **characterized in that** said groove-like recess is provided on the side of said condenser which is oriented towards the respective back wall.

6. Method according to any of the preceding claims, **characterized in that** it also comprises the steps of:

- defining two vertical stripes (20) of a pre-established width along respective ones of said vertical borders and arranged internally with respect thereto, in which said stripes are free of conduits for the circulation of the refrigerant medium;
- forming two profiles (24, 25) on said two vertical stripes, which are oriented towards the back wall of the refrigerator, are symmetric with respect to the median plane orthogonal to said condenser, and extend parallel to said borders.

7. Method according to claim 6, **characterized in that** each one of said profiles has at least two distinct surfaces (26, 27) extending parallel to the plane of the condenser and arranged at respectively different distances (H1, H2) from said plane.

8. Method according to claim 7, **characterized in that** the surface (27) that is more distant from said plane of said condenser is situated externally with respect

to the surface (26) that is closer to the same plane.

9. Method according to claim 8, **characterized in that** said two distinct surfaces (26, 27) have respective constant widths (L1, L2) and the respective axes of symmetry (S1, S2) are parallel.

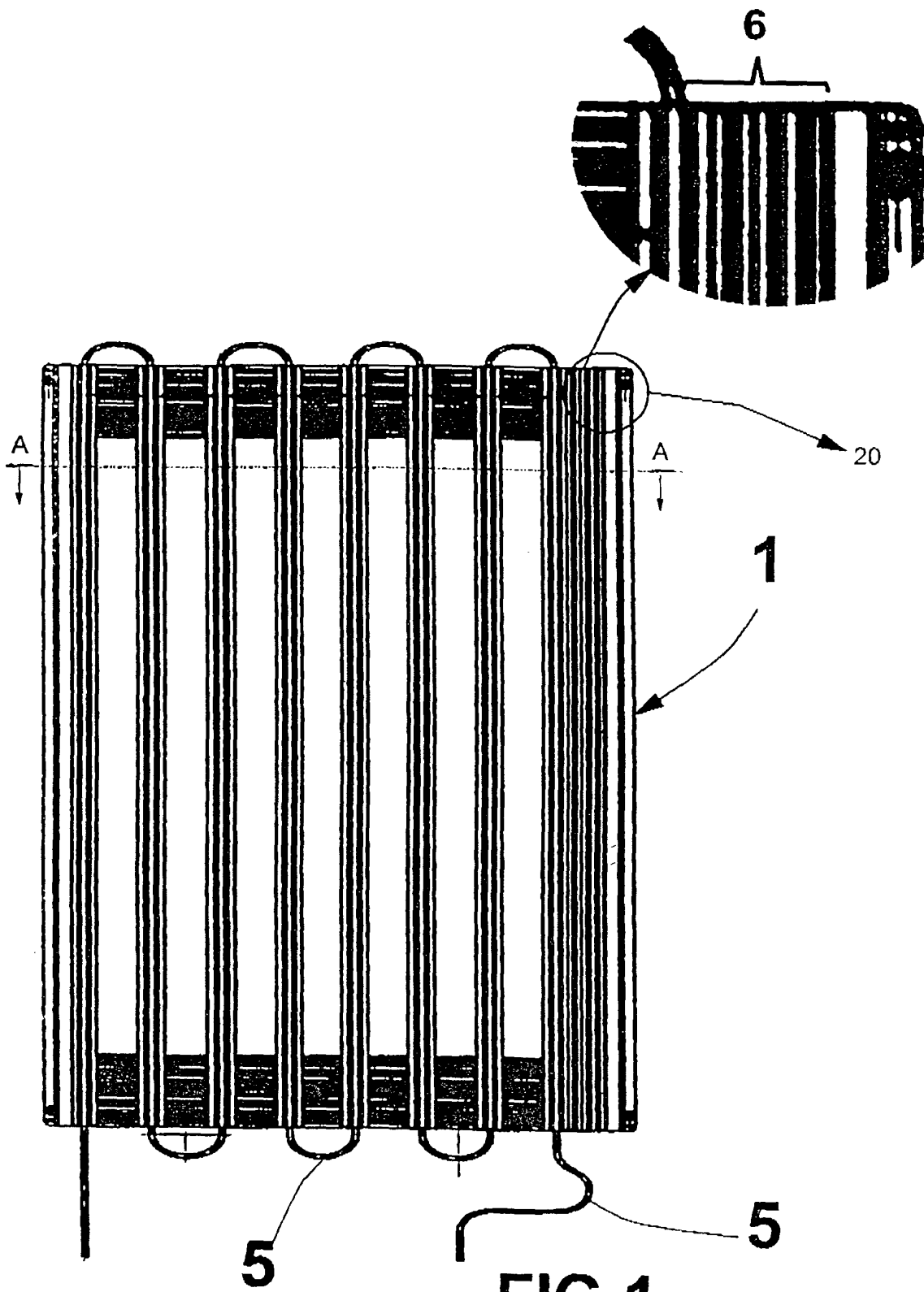
10. Method according to any of the preceding claims 6 to 9, **characterized in that** said symmetric profiles (24, 25) are produced by a roll-forming operation performed on a roll-forming conifing machine.

11. Method according to claim 10, **characterized in that** said roll-forming conifing machine is provided with a plurality of stations (30), in which each such station is provided with two symmetrically arranged pairs of mutually coupled conifing rolls (31, 32; 33, 34) and is adapted to simultaneously roll-form opposite portions of said stripes.

12. Method according to claim 11, **characterized in that** said stations are provided in a series arrangement with respect to each other, and that said condenser is conveyed so as to move continually in a successive sequence through said plurality of conifing stations (30).

13. Method according to claim 11 or 12, **characterized in that** each such station is adapted to only produce a part of the entire deformation work needed to define said distinct surfaces (26, 27).

14. Method according to claim 12 or 13, **characterized in that**, after having been so conveyed through said roll-forming stations, said condenser is conveyed into a cutting station comprising two symmetric pairs of rolls (41, 42) provided with means adapted to cut said two profiles to equal heights that are definable selectively with respect to the plane of said condenser.



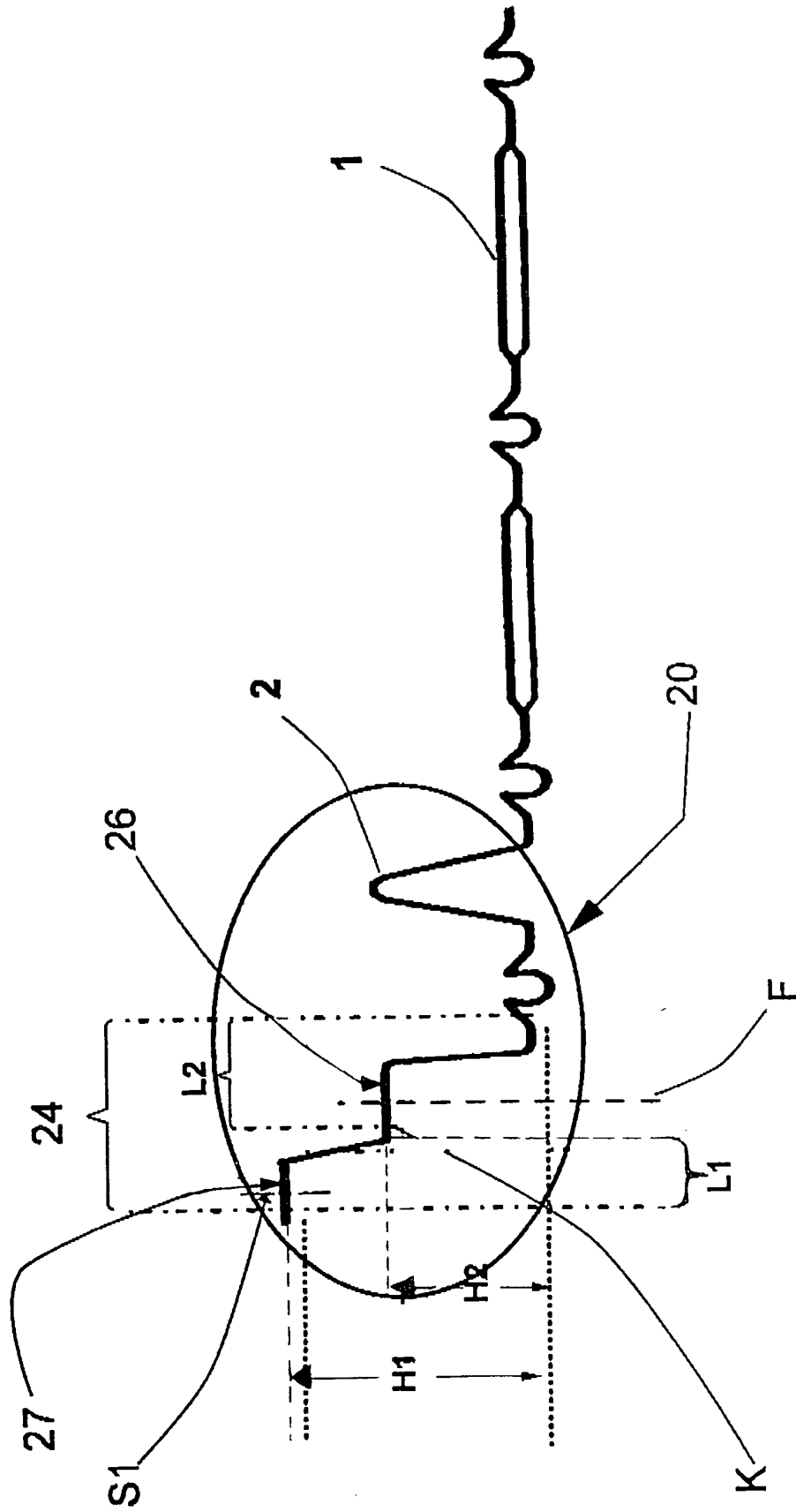


FIG. 2

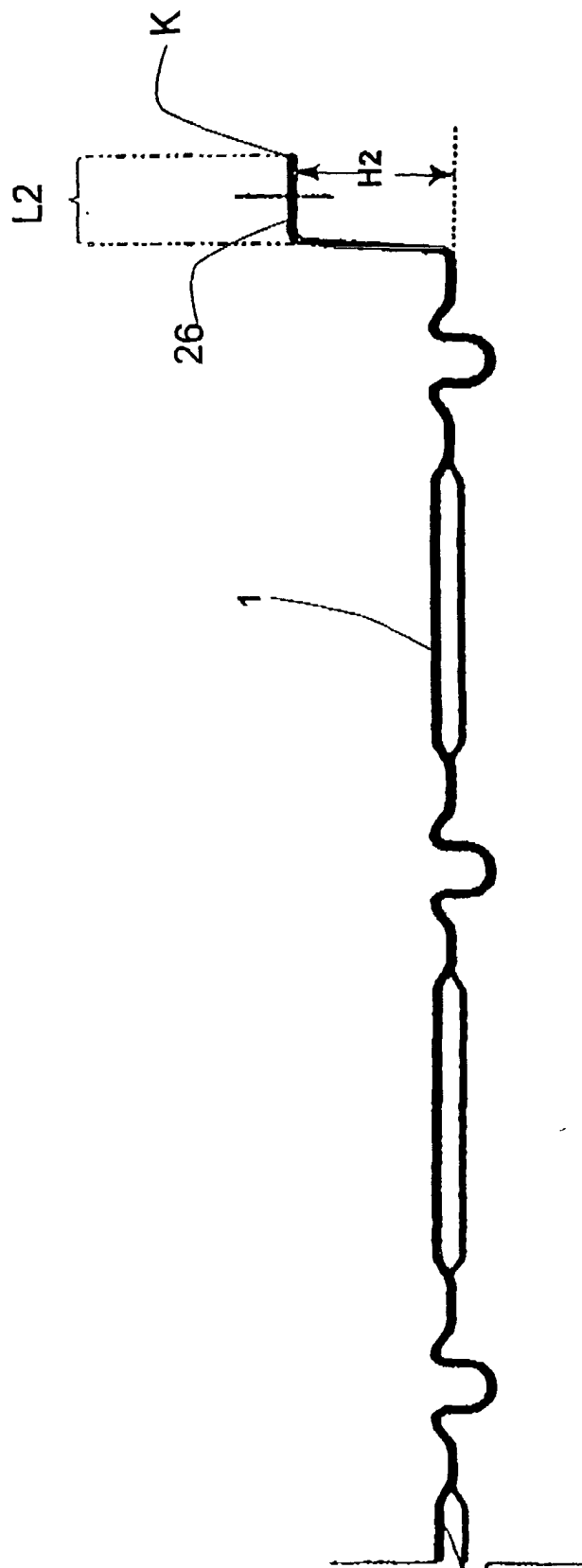


FIG.3

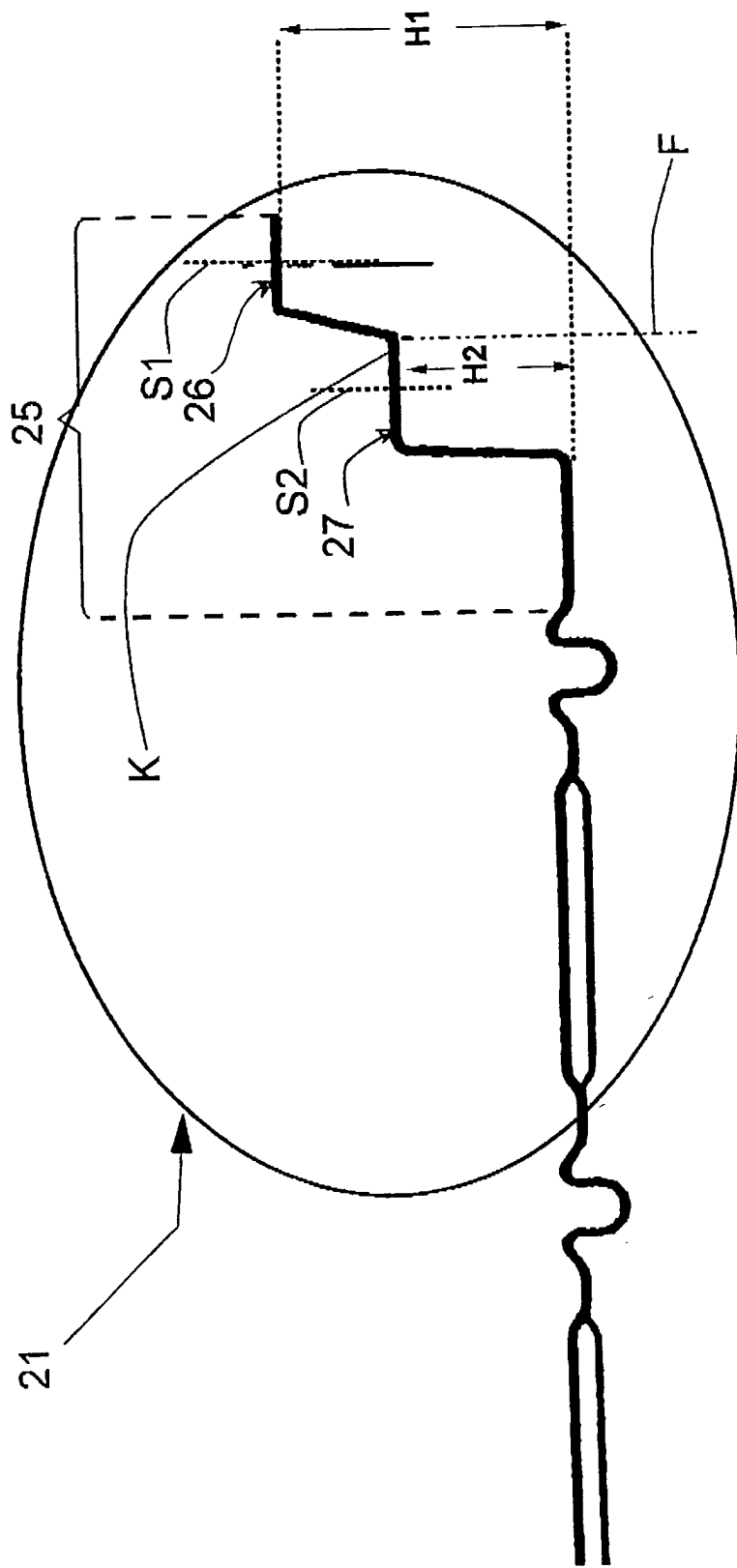


FIG. 4

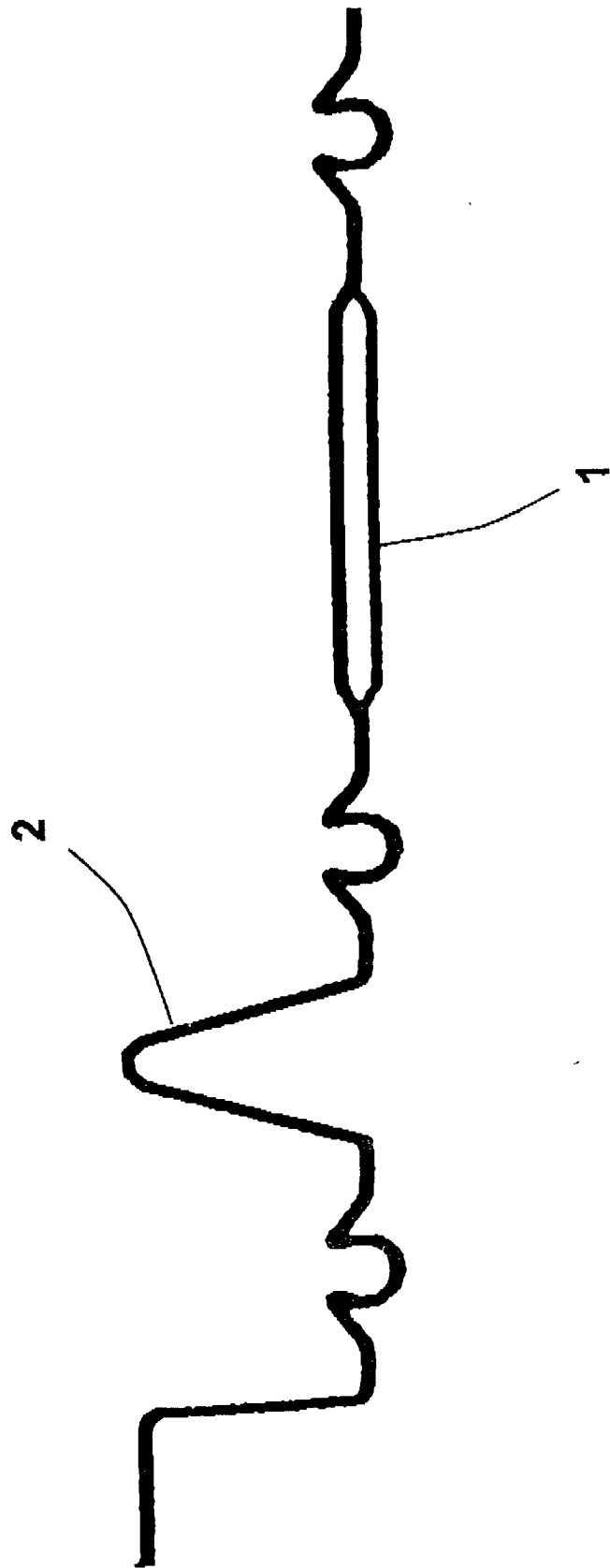


FIG.5

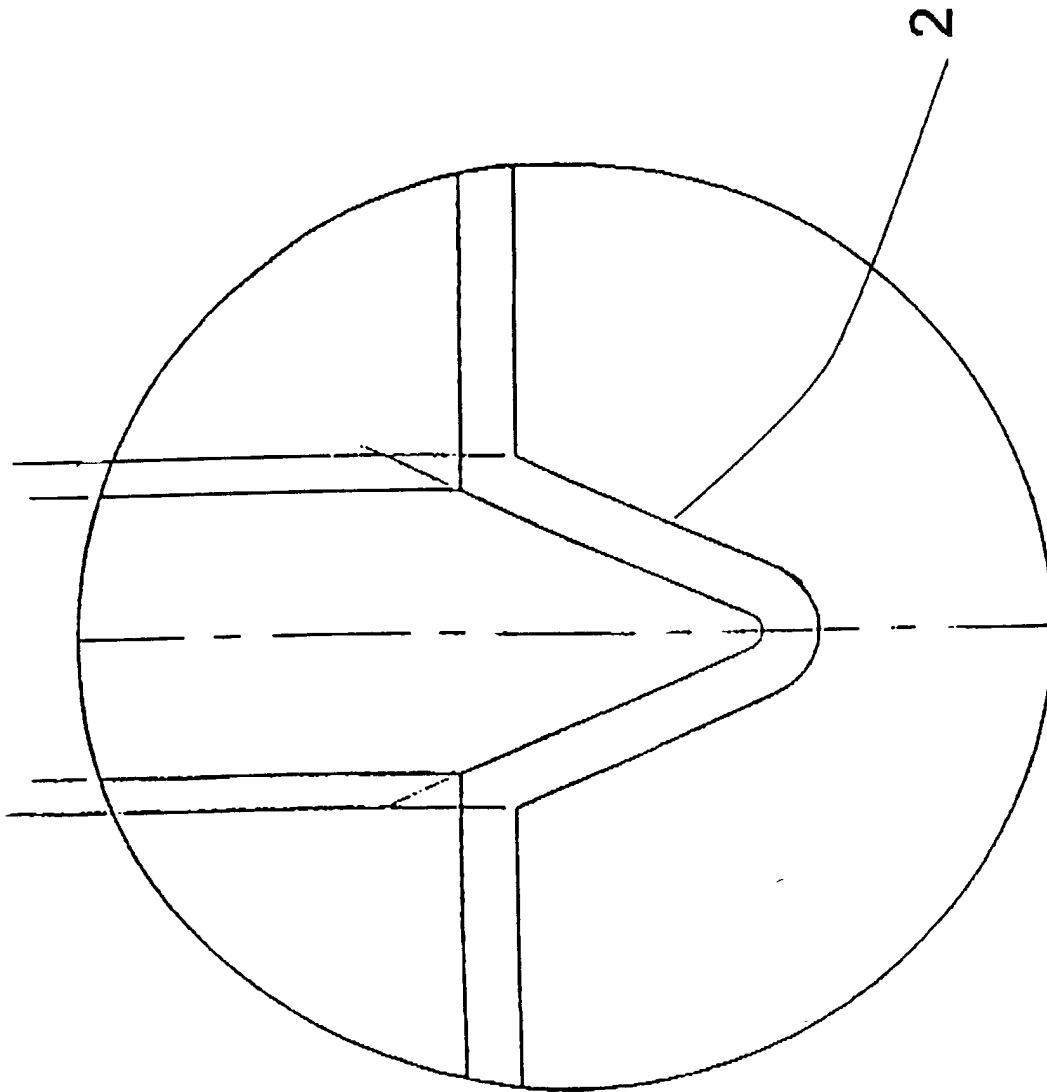


FIG. 6

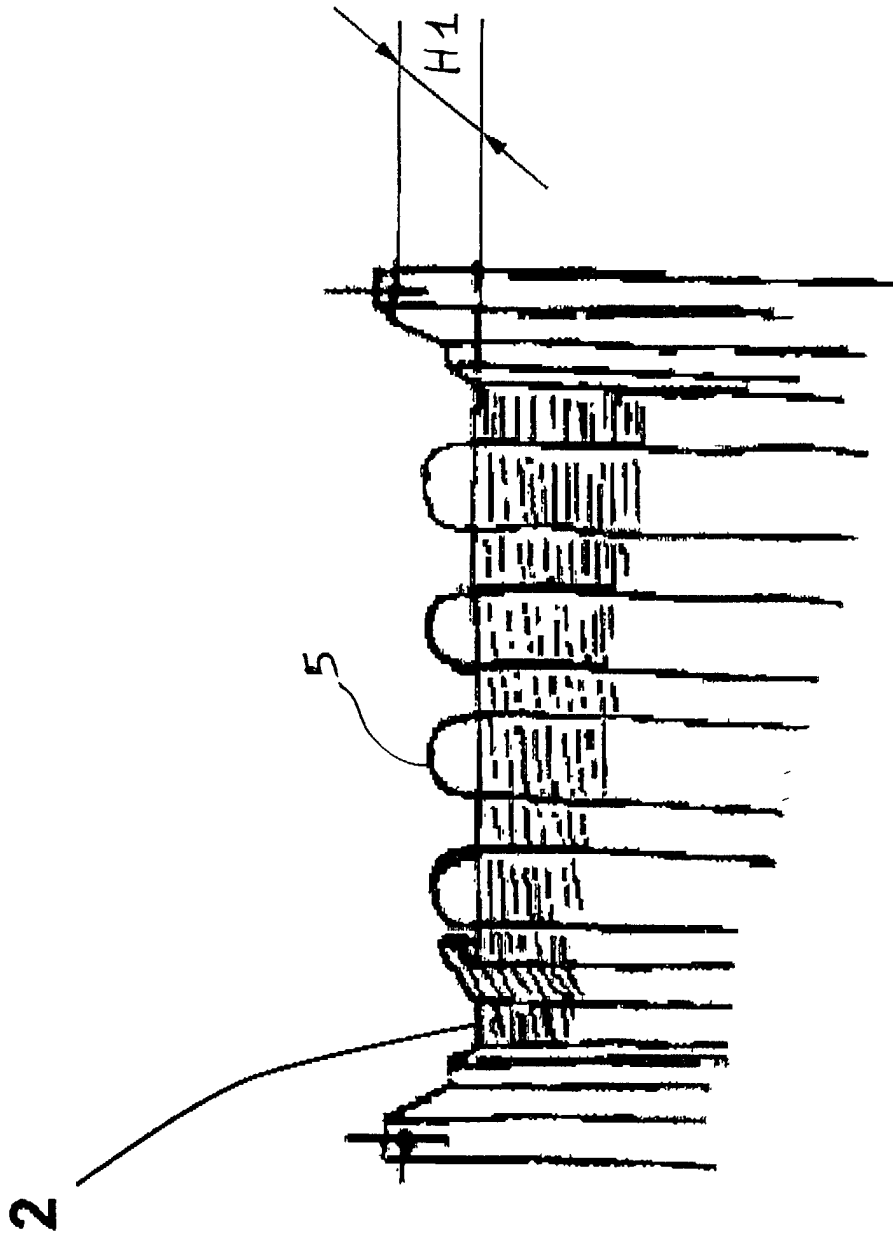


FIG.7

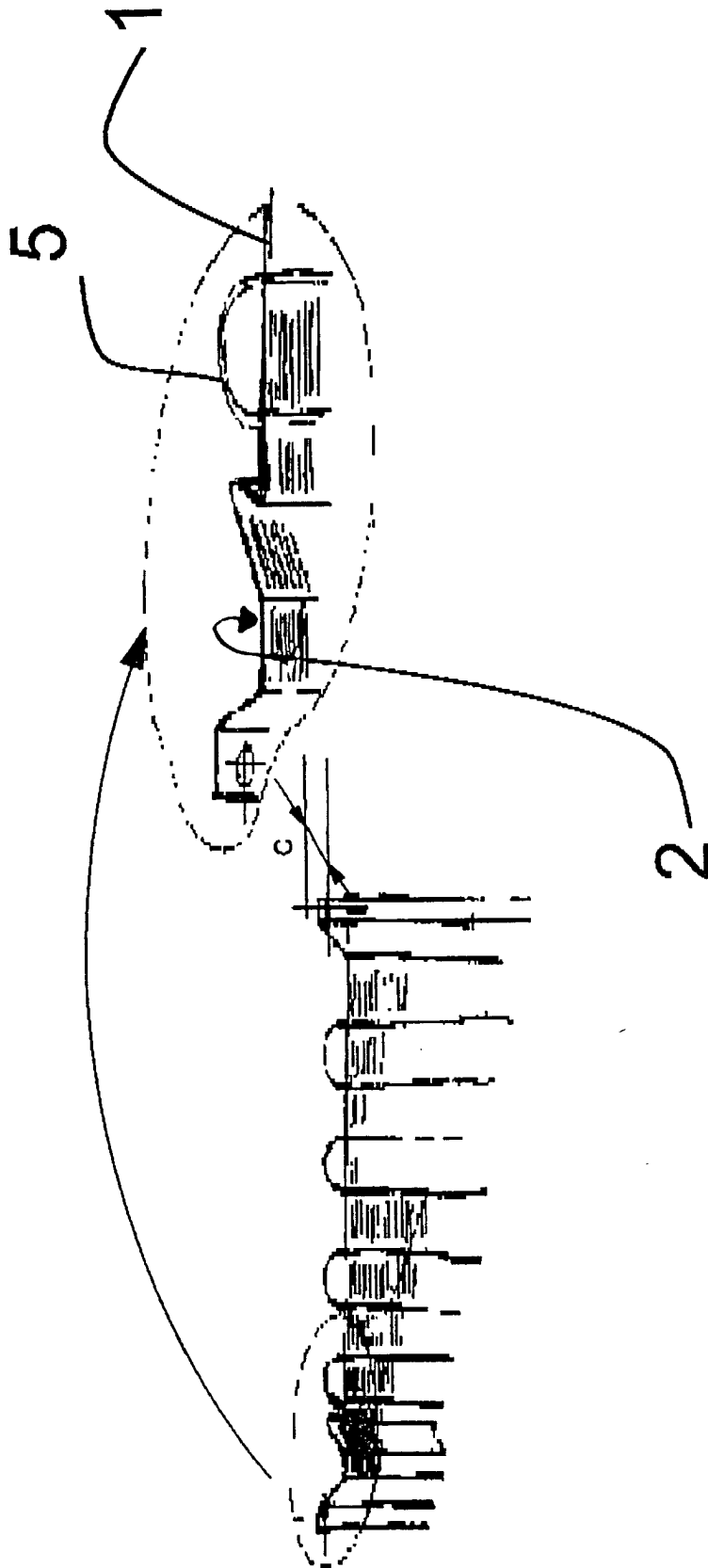


FIG.8

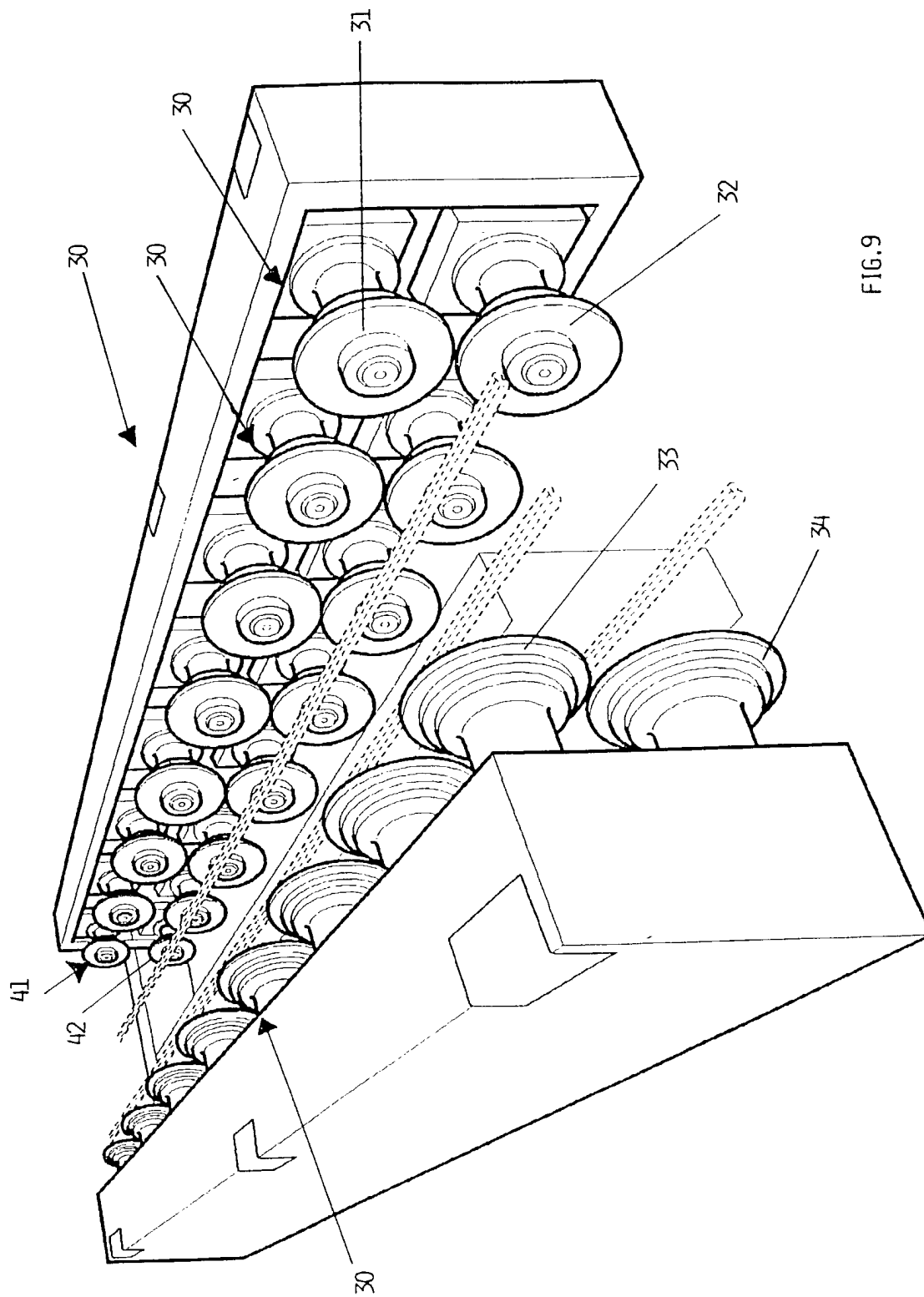


FIG. 9

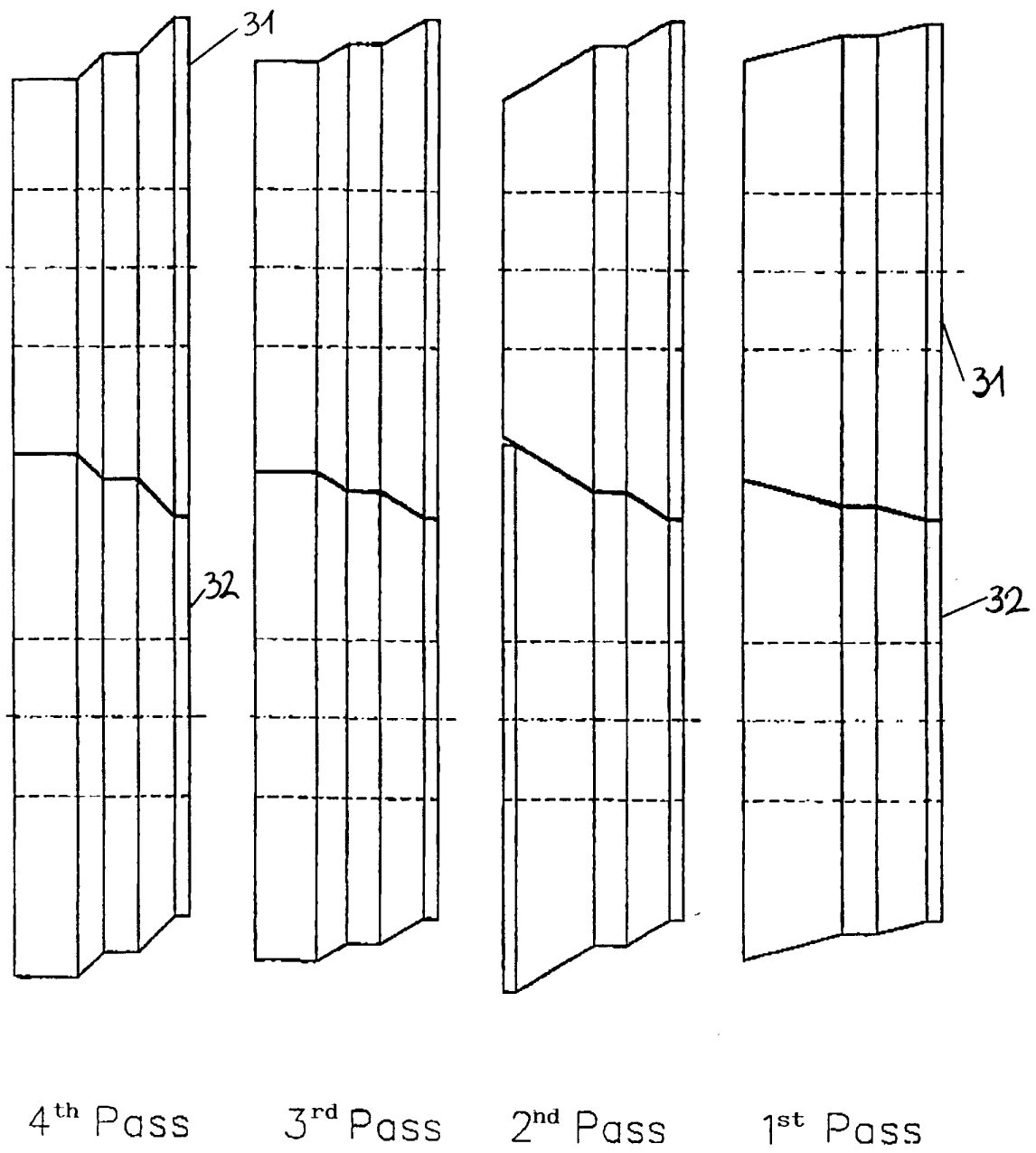


FIG.10

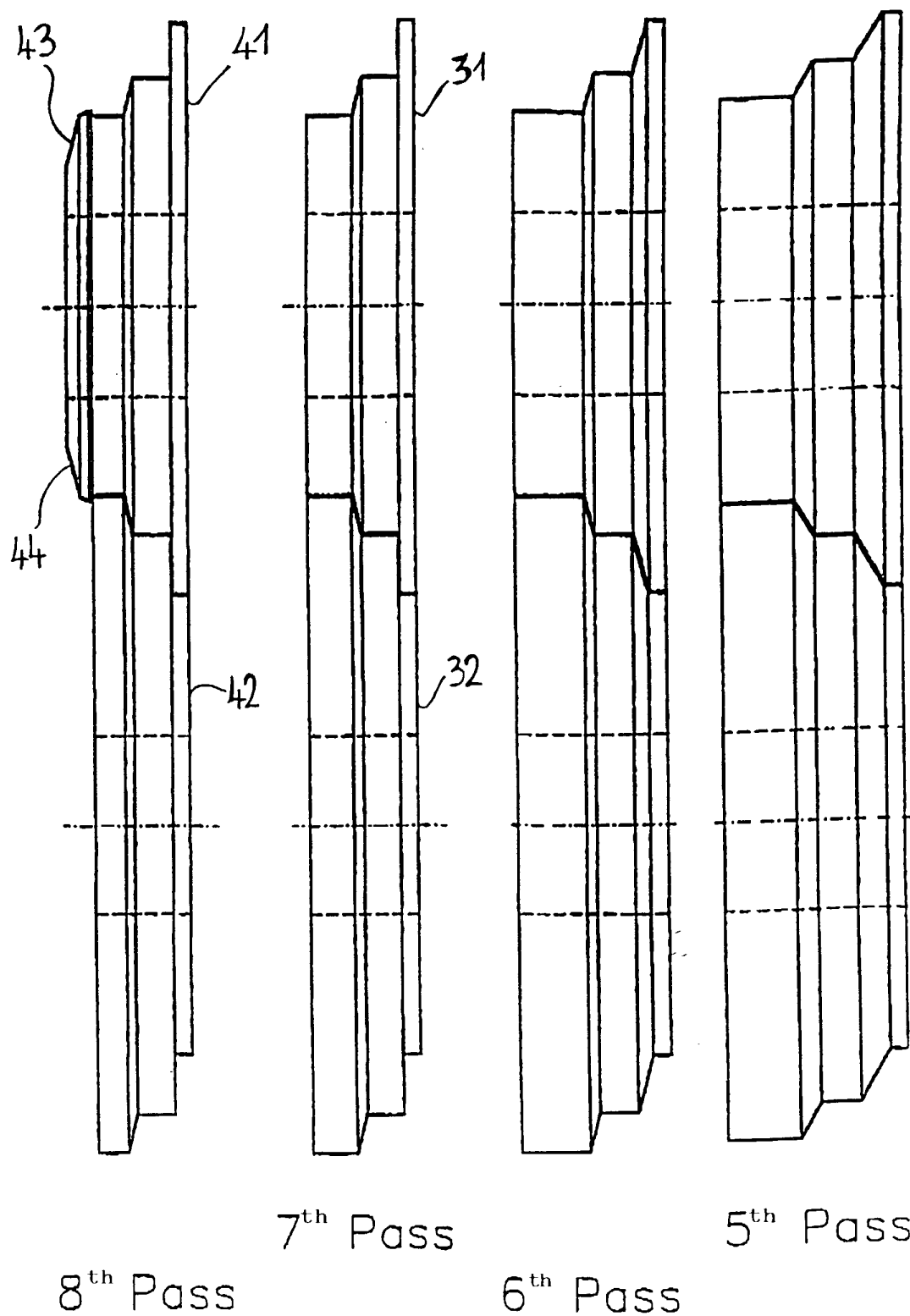


FIG.11



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EUROPEAN SEARCH REPORT

Application Number
EP 00 12 5194

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.7)
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A	* abstract; figures 1-3 * * column 2, line 12 - line 32 *	2, 6	F25B39/04
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A	EP 0 179 646 A (MOONEY BRIAN F) 30 April 1986 (1986-04-30)	1	F28F1/22
	* abstract; figure 1 * * page 1, line 16 - page 2, line 27 * * page 7, line 16 - page 11, line 16 *		B21C37/15

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	* figure 1 * * page 6, paragraph 3 *		

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	* abstract; figures 4,5,7 * * column 3, line 55 - column 4, line 61 *		

The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int.Cl.7) F25D F25B F28F B21C B23P B21D
Place of search		Date of completion of the search	Examiner
THE HAGUE		5 April 2001	Yousufi, S
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