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(54) **Automatic reinforcing rod and/or wire head and tail bending unit for bending machines and/or arc-welded steelmesh forming machines**

(57) The present invention relates to an automatic bending unit suitable for bending the heads and tails of reinforcing rods and/or wires of homogeneous and non-homogeneous cross section for automatic bending machines and/or automatic machines for forming arc-welded steel mesh before the mesh arc-welding unit. It includes a rocking-lever device (10) and/or other devices serving as bending templates positioned according to the type of bends to make, head or tail, driven by an appropriate oscillating hydraulic cylinder (5) and/or cam and/or other equivalent device, positioned and controlled in coordination with another cylinder (15) with a counteracting function (16) that presses the reinforcing rod (1) and/or wire to be bent in the fulcrum position.

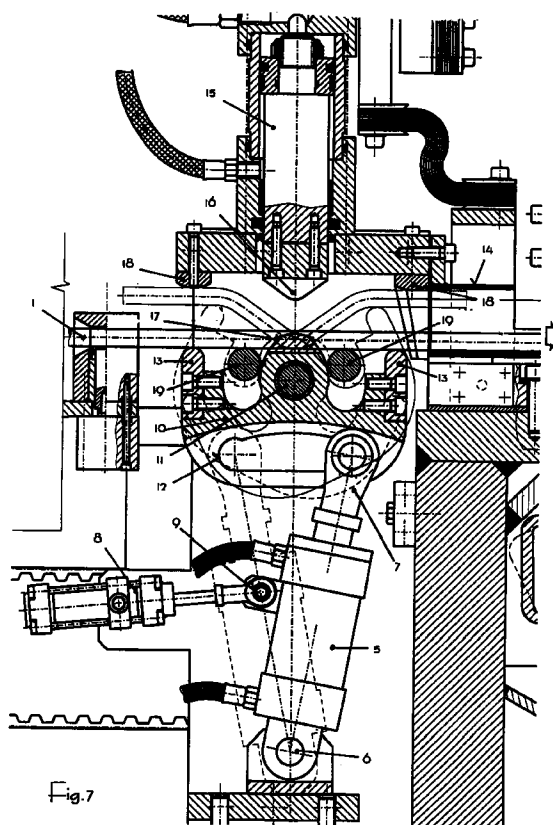


Fig. 7

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Description

The present patent relates to an automatic bending unit suitable for the head and tail bending of reinforcing rod and/or wire of homogeneous and non-homogeneous cross section, for automatic bending machines and/or automatic machines for the formation of arc-welded steel mesh before the mesh arc-welding unit.

The unit includes a rocking-lever device and/or other devices serving as bending templates positioned according to the type of bends to make, head or tail, driven by an appropriate oscillating hydraulic cylinder and/or cam and/or other equivalent device, positioned and controlled in coordination with another device with a counteracting function that presses in the fulcrum position the reinforcing rod and/or wire to be bent.

Bending units for the heads or tails of bar and rod iron used in automatic bending machines are known in the present state of the art; however, no similar bending units on automatic machines for the construction of arc-welded steel mesh are known.

In general, these known units have rather large dimensions so that they are not suitable for machines used for the formation of arc-welded steel mesh, also because at times the reinforcing rods in the mesh are set at a rather close pitch. Accordingly, the objective of this invention is a mechanical unit which is driven advantageously, but not necessarily by a hydraulic system, and controlled automatically, by means known to those skilled in the art, that is very compact and thus makes it possible to be used side by side with a plurality of other similar units, each of said units operating on reinforcing rods set at different pitches according to the geometrical characteristics of the steel mesh being fabricated.

This unit is built to meet the requirements of plants or machines for the construction of arc-welded steel mesh, however it can also be used on other automatic bending machines where there is the requirement of carrying out bends of approximately 10° to 90°, at the heads or tails of reinforcing rods or wires.

In the case of multiple side-by-side use, for example with each unit arranged vertically, each unit is independently controlled and operates individually on the corresponding reinforcing rod or wire. In this manner, the mesh being formed can have the rods with the ends bent even if it does not have an even geometrical configuration, for example for peripherally shaped mesh and/or mesh with shaped internal voids (particularly in the fabrication of prefabricated elements for construction purposes).

The invention consists essentially, in a preferred but not exclusive embodiment, of a two-position, rocking-lever, bidirectional template pivoted in the middle on a pin that is orthogonal to the direction of progress of the reinforcing rod to be bent. On the template are cut one or more wire paths and it contains, parallel to the pivot pin, at a position equidistant from the same pin, two

opposite bending stopper elements.

Said bending template or lever is also provided, in its lower part, with a lever-operated power device driven and rotated by two hydraulic cylinders to provide the pushing and thus the bending action in the desired direction of head and/or tail bending.

The pushing cylinder is pivoted at a point below the middle point of the template and is guided in its two points of action by another cylinder that acts by means of a lever system directly on its hinging axis or by means of an arm, guiding the cylinder in its proper operating direction.

On the template, and precisely on its upper surface, run the reinforcing rods of various diameters orthogonally thereto; in addition, to achieve the best bending results it is necessary to have a counteracting element that locks the reinforcing rods in position in order to provide the bend starting point. This is provided by a shaped counteracting element opposite the template and driven by an appropriate hydraulic cylinder coordinated and cooperating with the movement of the bending cylinder. In addition, fixed bending stopper elements are provided both below and above the path of the reinforcing rod.

Therefore, the reinforcing rod head and/or tail bending phases are carried out (automatically) after having prepared the ends to be bent above the rocking template or other bending lever suitable for the purpose:

- first, the oscillating pressing cylinder is positioned at an angle suitable for carrying out one of the two types of bends (head or tail), and at the same time there is the positioning of the opposing upper cylinder, counteracting the wire or reinforcing rod;
- the bend is carried out with the template at the desired angle;
- all the devices (template and counteracting element) are returned to the position for preparing a new cycle and at the same time allow the normal progress of the straight reinforcing rod in the subsequent mesh arc-welding phase.

The unit according to the present invention is particularly suitable, thanks to its compactness and small size, for being integrated in automatic machines for making arc-welded steel mesh, and precisely downstream of the wire or reinforcing rod straightening unit and upstream of the automatic mesh arc-welding unit.

In particular, the rocking-lever bending template can be shaped in the wire path part in a manner such as to be able to operate on a single reinforcing rod or on a plurality of rods, with one or more individual seats, or with wider seats suitable for containing a plurality of reinforcing rods side by side or slightly separated and parallel to each other.

Another possible variation according to the present invention consists in the fact that the bidirectional template can be validly substituted, while providing the

same functions, with other bending levers in individual units independent of each other, and each capable of operating on one or more reinforcing rods even for bends of only one type.

A further variation of the present invention consists of the fact that it is possible to use any technique of construction known to those skilled in the art for making the force-applying device (e.g., of hydraulic and/or mechanical and/or pneumatic type) and its automation to achieve the advantageous objectives of the invention.

One embodiment of the present invention is illustrated by way of preferred example but not by way of limitation in the five tables of drawings attached hereto, wherein:

- Fig. 1 illustrates in a partial lateral view a reinforcing rod bent at the head and tail ends, with both ends bent downward;
- Fig. 2 illustrates in a partial lateral view a reinforcing rod bent upward at the head end and downward at the tail end;
- Fig. 3 is a perspective view of an arc-welded steel mesh of shaped form, with internal voids and with the longitudinal reinforcing rods bent downward at the head and tail ends;
- Fig. 4 illustrates in a partial lateral view a reinforcing rod with the head end bent downward and the tail end bent upward;
- Fig. 5 illustrates in a partial lateral view a reinforcing rod with the head and tail ends bent upward;
- Fig. 6 is a perspective view of an arc-welded steel mesh of shaped form, with internal voids and with the longitudinal reinforcing rods bent upwardly at the head and tail ends;
- Fig. 7 is a front elevation of the bending unit for head and tail reinforcing rods, showing all the operating devices in a first embodiment of the technical construction, installed upstream of the mesh automatic arc-welding unit;
- Fig. 8 is a transversal cross-sectional view of a bank of three bending units of Fig. 7 set side by side and each operating on two wires or reinforcing rods;
- Fig. 9 is a front elevation of a second alternative operating embodiment of the bending unit.

As is shown in the above figures, the hydraulic bending unit for the head (2) and tail (3) ends of reinforcing rods (1) and/or wire for bending machines and/or automatic machines for the formation of arc-welded mesh is arranged vertically and consists of a very compact mechanical-hydraulic apparatus designed to allow the side-by-side arrangement of a plurality of the individual units and thus to operate simultaneously on a plurality of reinforcing rods (1), advancing horizontally, for the subsequent formation of the arc-welded mesh (4). The individual or multiple unit is integrated in the arc-welded steel mesh production line, downstream of the rod straightening unit and upstream of the automatic

welding unit that welds the mesh wires perpendicularly to each other. In this position, it can be easily anchored to the structure of the machine or it can be built independently, with its own base and frame forming a self-standing machine.

Said unit, in a first embodiment, is arranged vertically so as to operate perpendicularly to the direction of progress of the reinforcing rods (1). In the lower part, the hydraulic cylinder (5) is hinged at its lower end (6) and can be swung by another hydraulic cylinder (8) that acts directly on the former at (9). At the upper end of the cylinder, the stem attachment (7) is hinged to the through guide (12) of the rocking template (10) which is itself pivoted on the central pivot (11) placed perpendicularly to the direction of progress of the reinforcing rod (1). The template (10) is of symmetrical type with respect to the constraining pin (11) and is provided with opposite equidistant stopper elements (13) that will be the points at which the rod bending force acts. In effect, the cylinder (5) can operate in a position on the right or on the left of the pivot pin of the template (10), and in this manner the template will move upward on the right or on the left, imparting the action of force on the straight reinforcing rod to be bent. The reinforcing rod (1) is guided upstream and downstream inside a special guide (14) or channel having the shape of a vertical oval that allows the vertical movement of the reinforcing rod. Opposed to the template (10) is another hydraulic cylinder (15), which is vertically mounted and provided with downward moving piston, having the function of a counteracting element, provided with a shaping rod (16) which meets the upper circular part (17) or the template (10), for positioning the reinforcing rod (1) and favouring the bending phase in the desired shape. In the upper part of the bending zone are provided two counteracting stopper elements (18) that are equidistant with respect to the horizontal pivotal axis of the template (10), and perpendicular with respect to the direction of progress of the reinforcing rod to be bent. On the lower part of the unit, equidistant and parallel to the pivot (11) of the template (10) are provided two other stopper elements (19), which are themselves perpendicular to the path of the reinforcing rods to be bent. They have the function of counteracting elements, downstream or upstream, for the reinforcing rods during the bending phase and at the same time serve to guide the reinforcing rods inside the channel (14).

The unit, comprised of three hydraulic cylinders (5, 8, 15), is programmed, powered and controlled with known techniques, with the object of carrying out shaped bends, at angles from 10° to 90°, on the head or tail of reinforcing rods that will make up the arc-welded steel mesh.

Hereafter is described, by way of example, a reinforcing rod head bending cycle with upward curve by means of the bending unit described above:

- the wire or reinforcing rod (or rods) (1) is advanced

automatically up to the point at which the bend is carried out;

- the hydraulic cylinder (8) positions the stem (7) of the cylinder (5) so that the head bend can be carried out, or the curve to the right with respect to the pivot pin (11);
- the cylinder (15) is actuated so that the shaping rod (16) mates with the top part (17) of the template (10), and the reinforcing rod (1) is locked in position;
- then there is the pushing action of the cylinder (5) on the right branch of the template (10), that bends said reinforcing rod, the end or end portion of which is simultaneously bent since the stopper element (18) counteracts the natural position of the reinforcing rod, and also the stopper element (19) on the left of the pivot pin (11) prevents the rotation of the reinforcing rod. In this manner the reinforcing rod (1) is constrained at two points (19), (16) and (18) and the action of the lever (13) of the template (10) produces a forwardly inclined bend with the end or remaining part of the reinforcing rod parallel;
- when the bend is completed, the upper cylinder (15) returns to the rest position, the counteracting shaping rod (16) is drawn back and the stem (7) of the cylinder (5) is drawn back, with the template returning to a horizontal position (10). This cycle is intended to favour the smooth advancing of the shaped reinforcing rod and prepare the unit for a new identical or different cycle.

The operating procedure is similar, but with the actuation of the left part of the template, to carry out the bend for shaping the tail of the reinforcing rod upwardly.

On the other hand, to bend the reinforcing rod downwardly with respect to its forward movement it is necessary to reverse the bending direction of the template. In fact, for head bending it is necessary to actuate the left part of the template (10), while for tail bending it is necessary to actuate the right part.

The following describes a possible variation of the force-applying device used for bending the reinforcing rod (1) using another technical mechanical embodiment starting from the bending lever (26) pivoted at (27) and having the equidistant stopper elements (28). On the lever (26), on the same middle axis, is pivoted the shackle joint (25) and on the pin (24) is articulated the shaping rod of the hydraulic cylinder (23), which is hinged in turn at (22) and is swung in the three positions (for right bending, left bending or central idle position) by means of the arm (21) driven by the hydraulic cylinder (20) or by another means suitable for the purpose.

The operating cycle is similar to that previously described for the first embodiment.

Claims

1. Automatic unit for bending the head and tail of reinforcing rods and/or wires for automatic bending

machines and/or automatic machines for the formation of arc-welded steel mesh (4) before the mesh arc-welding unit, characterized in that, in the case of machines for the formation of arc-welded steel mesh, the unit is located immediately before the automatic arc-welding unit, and comprises:

- at least one rocking-lever template (10) pivoted at (11), of symmetrical type with bending stopper elements (13) equidistant from the pivot axis, having in the lower part a through groove (12) with two end loops, within which slides the head pin (7) of a hydraulic cylinder (5). Said template has its oscillation axis (11) orthogonal with respect to the direction of progress of the reinforcing rod above it (1), in addition, parallel and symmetrical thereto are provided two fixed stopper elements (19), below the reinforcing rod, with a function of guide and anti-rotation elements for the same during the bending operation;
- an oscillating hydraulic cylinder (5) pivoted at its bottom (6) and made to swing to the two end pushing positions on the template (10) (rightward or leftward) by another hydraulic cylinder (8, 9);
- vertically above the axis (11) of the template (10) in a counteracting position another fixed hydraulic cylinder (15) having a downwardly moving stem with a shaping rod (16) opposed to the bending area (17) of the template (10). On the lower part of the support of said cylinder, toward the bending area, two fixed stopper elements (18) symmetrical with respect to the axis of movement of the stem with shaping rod (16);
- upstream and downstream, arranged orthogonally to the unit, one or more parallel channels (14), of ovoid shape with a vertical axis, serving as guides for the reinforcing rod (1), to allow the "S" shaped double bending of the reinforcing rods;
- programming, actuation and control unit of known technology for coordinating and cooperating the movements of the hydraulic cylinders in their various functions.

Said unit operates in what follows for the head and/or tail bending of the reinforcing rod:

- a) First, the upper cylinder (15) has the stem with the shaped rod (16) in drawn back position. The template (10) is in the neutral position with the bending stopper elements (13) lower than the reinforcing rod running surface (1); the lower cylinder (5) is with its own stem in a drawn-back position and the actuation axis in one of the two possible stations (on the right or

on the left of the template);

b) The reinforcing rod to be bent is moved forward orthogonally with respect to the template, which is in the horizontal position, by the amount desired to carry out an "S" shaped double bend at the head or tail;

c) When the type of bend, whether head (2) or tail (3), is chosen, the bending cylinder (5) hinged at (6) and with the stem oscillating inside the slotted seat (12) of the template (10) is positioned by the lateral cylinder (8) either in the position at the right or in the position at the left of the template;

d) Then the cylinder (15) actuates the stem with the shaping rod (16) toward the central part (17) of the rocking-lever template (10). In this manner, the reinforcing rod is locked in horizontal position;

e) The bending cylinder (5) comes into action to partially rotate the template (10) with the stopper element (13) on the reinforcing rod (1), forming a first bend while the end (2 or 3) will impinge against the upper stopper element (18), forming a second bend inverse with respect to the previous one, and at the same time the reinforcing rod is prevented from rotating as it is restrained from below by one of the two lower fixed stopper elements (19). In this manner, the reinforcing rod (1) is substantially bent twice with a single bending movement. The first bend on the reinforcing rod is formed around the shaping rod (16) and the fixed stopper element (19), and the second bend is formed on the stopper element (18) by means of only the radial push on the bending lever (13) of the rocking-lever template (10). The two bends determine an "S" shape of the reinforcing rod, with the end being straight and parallel to the remaining part of the rod.

After every bending phase, the unit is positioned in the rest phase ready to begin a new cycle, either for head or tail bending.

This unit bends the head and/or tail ends of reinforcing rods, with upward and/or downward end bends.

2. Automatic bending unit according to claim one, characterized in that it includes the following mechanical embodiment for what regards the force-applying device for operating the template (26) as an alternative to the template (10). The template (26) (see Fig. 9), being different in form but similar in function, is pivoted at (27) in a symmetrical manner with bending levers (28) and a mid-point pivoting axis for an articulated shackle joint (25), at the other end of which (24) is fastened the hydraulic cylinder (23). The hydraulic cylinder (23) is hinged

at a lower point (22), midway with respect to the template (26), on an arm (21) on which a second hydraulic cylinder (20) or other device operates for swinging the cylinder (23) to the proper position.

There are three positions of the template (26) or bending lever: on the right for a right bend, on the left for a left bend and idle in the horizontal position. Said positions are reached by means of corresponding orientations of the cylinder (23) and the relative shackle joint (25) on the template itself.

3. Automatic bending unit according to claim 1 characterized in that, by means of suitable reinforcing rod guides (14) and appropriate bending seats, both on the template (10) or (26) and on the shaping rod (16), it is capable of operating simultaneously on one or more reinforcing rods (1).
4. Automatic bending unit according to claim 1 characterized in that it is arranged vertically and orthogonally to the direction of progress of the reinforcing rod (1), with the template (10) or (26) in lower position ideal for carrying out the controlled bending.
5. Automatic bending unit according to claim 1 characterized in that it is very compact in thickness, thus allowing the application side by side of a plurality of individual and independent units in parallel to each other and capable of operating in a multiple bank on a wide working range on a plurality of reinforcing rods set parallel and at different pitches according to the type of arc-welded steel mesh (4) to be made (with various widths of the meshes and/or various thicknesses and/or lengths of the reinforcing rods).
6. Automatic bending unit according to claim 1 characterized in that it operates on a single reinforcing rod or wire to be bent, although it may be equipped to operate on a plurality of reinforcing rods at the same time.
7. Automatic bending unit according to claim 1 characterized in that it operates on two reinforcing rods (1) or wires to be bent simultaneously (example Fig. 8) although it may be equipped to operate on a plurality of reinforcing rods at the same time (e.g., wider reinforcing rod seats to permit the passage of a plurality of rods, or more individual reinforcing rod seats, etc.).
8. Automatic bending unit according to claim 1 characterized in that it can be equipped in such manner as to be able to operate simultaneously on a plurality of reinforcing rods, side by side or in other ways.

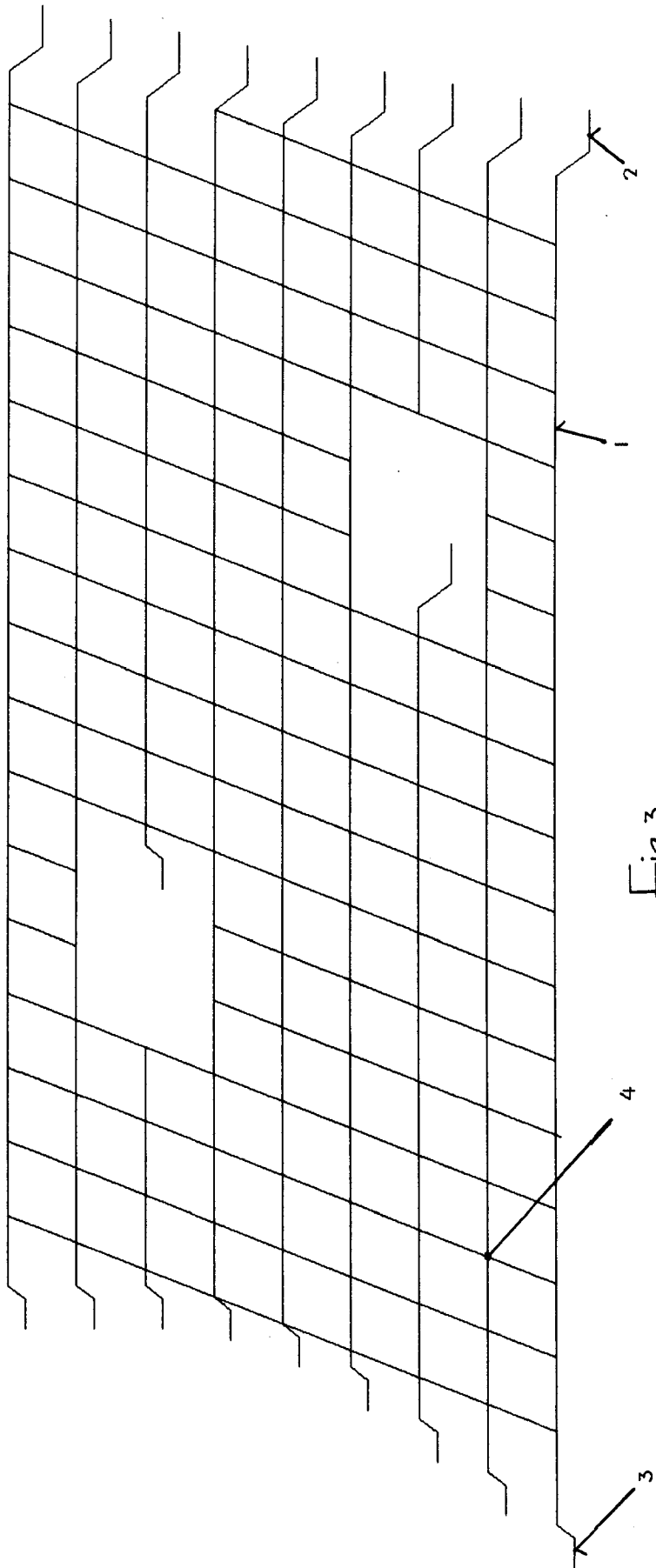


Fig. 3

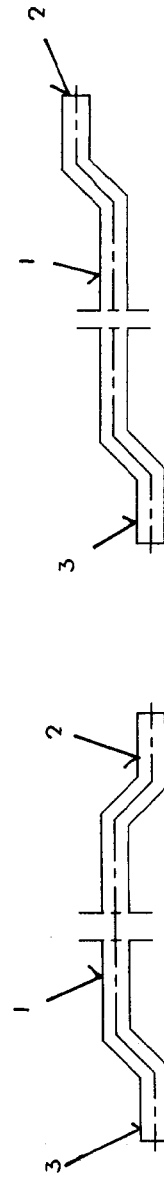


Fig. 1

Fig. 2

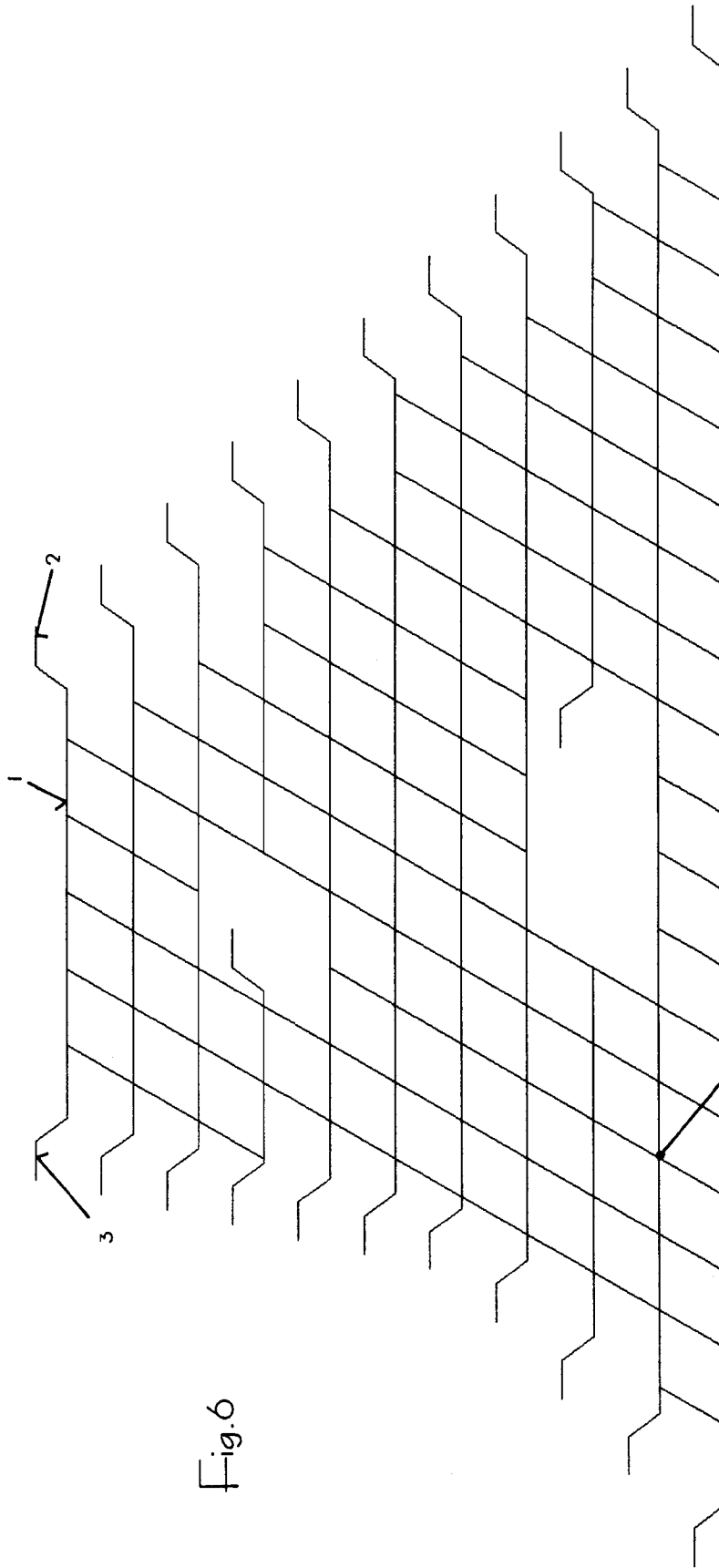


Fig. 6

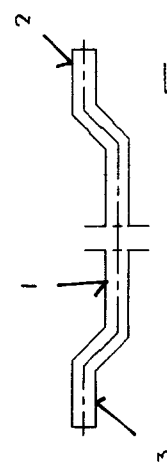


Fig. 5

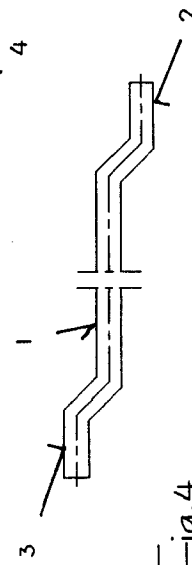


Fig. 4

