(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 924 004 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
23.06.1999 Bulletin 1999/25

(51) Int. Cl.[6]: **B21C 37/06**

(21) Application number: **98123722.5**

(22) Date of filing: **14.12.1998**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **16.12.1997 IT MI972777**

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(54) Method and machine for shaping the edges of bent pieces

(57) A method and a machine for shaping the edges (12, 13) of a roll bent metal piece (10), more particularly tubular or annular members (10) from a metal sheet or a sectional bar; the flat or non-curved longitudinal edges (12, 13) of the roll bent metal piece (10) are subjected to a roll shaping step of making it move forwards with one or both edges (12, 13) clamped between opposing shaping elements (25, 26); the shaping elements are rotatably supported to act on the internal and on the external surfaces respectively of the bent piece (10) in order to provide the flat edges (12,13) of the same bent piece (10) with the required circular shape.

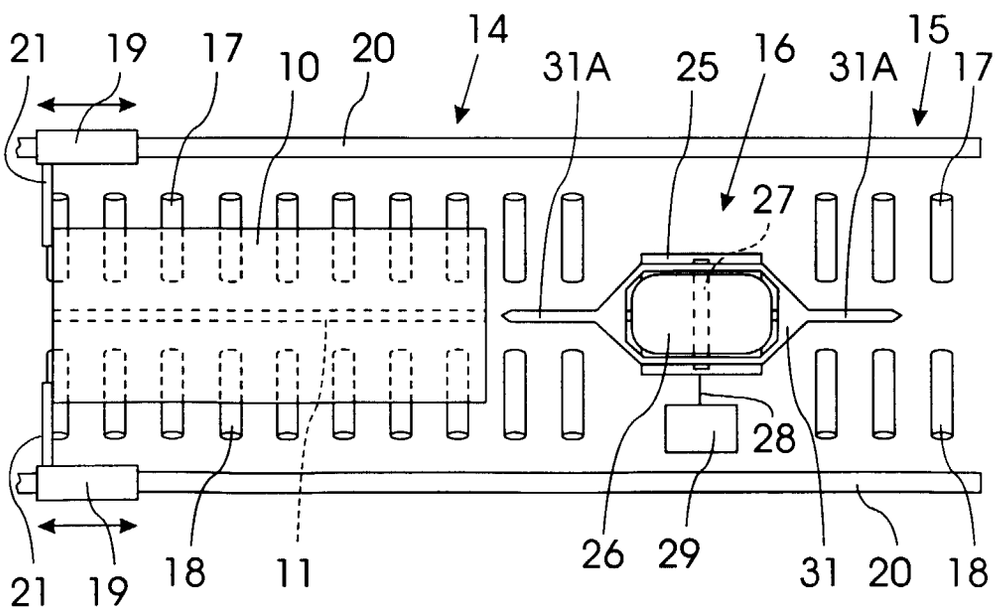

Fig. 2

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to a method and to a machine for shaping the edges of roll bent metal pieces, so as to provide one or both of them with the required form or curved shape.

[0002] More particularly the invention is aimed at a method and at a machine whereby it is possible to shape the flat, or non-curved edges of the longitudinal slot which remains in a roll bent tubular member from a metal sheet, or from a metal sectional bar, so as to give the tubular member a perfectly circular shape.

STATE OF THE ART

[0003] For the purposes of the present invention, the term "roll bent piece" refers to any metal piece having a substantially circular profile, for example a tubular or semi-tubular member obtained by a simple roll bending operation; purely by way of an example, the invention will be described hereinbelow with reference to the shaping of the edges of roll bent tubular members.

[0004] As is known, all machines for roll bending metal sheets and/or sectional bars, hereinafter referred to more simply as "bending machine", are characterised in that they do not succeed in totally bending the metal sheet or sectional bar, leaving a flat, or non-curved, leading and trailing sections, at the side edges which border a longitudinal slot in the tubular member produced in this way.

[0005] By taking, for example, the bending of a metal sheet, the result is that a flat or non-curved band of varying width remains on the side edges which border the longitudinal slot of the bent tubular member, and which constitute the leading part of the metal sheet to be inserted between the bending rollers and respectively the end part at completion of bending.

[0006] The width of these flat bands in a roll bent member depends in general on the thickness of the metal sheet, as well as the features of the bending machine.

[0007] It is highly penalising, in terms of costs, size and geometry of the machine, to try to force bending of the edges of the metal sheet on a normal bending machine to the limit, in some cases even being impossible to perform.

[0008] In order to avoid this disadvantage, use is currently made of some techniques: for example the side edges of the metal sheet or of the original sectional bar are previously bent, on a bending press, before inserting it in the roll bending machine.

[0009] This preliminary operation, which must in any case be performed on a dedicated machine, often moving the metal sheet from one department to the other of the same production workshop, makes insertion of the metal sheet in a bending machine and the start of the bending operation not very easy.

[0010] Another solution consists of cutting the longitudinal non-curved edges from the tubular member, after the bending phase. Cutting straight edges on a tubular or curved member is extremely difficult to carry out, as well as expensive in that the tubular members produced in this way must be subjected to a subsequent bending operation in order to close the two edges of the wide slot which remains after cutting the two flat or non-curved bands.

[0011] Whereas in the first case the width of the metal sheet must correspond substantially to the peripheral outline of the tubular member to be formed, in the second case it is necessary to start from a metal sheet of greater width, with a consequent waste of material, in order to obtain the nominal diameter of the tubular member to be formed.

[0012] As a final solution it is accepted that the two flat edges of the curved tubular member are retained, which member therefore has poor precision and a "drop" shape, not perfectly cylindrical, due to the two flat edges remaining in the finished piece.

OBJECTS OF THE INVENTION

[0013] The general object of the present invention is to avoid the disadvantages referred above, providing a method and a machine whereby it is no longer necessary to previously bend the edges of the metal sheet or of the sectional bar, or cut them later, in this way achieving a great saving in time and material.

[0014] A further object of the present invention is to provide a method and a machine for performing final shaping of the side edges existing in a curved metal piece, at the end of a bending operation, through a final shaping phase of the flat edges which can be performed subsequently to usual bending operation, performing said final shaping phase by means of a specially dedicated machine which allows the edges of the bent piece to be curved with a greater precision compared to what is possible with a standard bending machine.

[0015] A further object of the present invention is to provide a machine for shaping the flat edges of tubular or semi-tubular, annular or partially bent members, as defined above, which can be adapted to shape the edges of members, even of different diameters.

BRIEF DESCRIPTION OF THE INVENTION

[0016] The above can be achieved by means of a method for shaping the flat edges of a roll bent piece, in accordance with claim 1, and respectively by means of a roll shaping machine according to claim 4.

[0017] For the purposes of the present description, the term "tubular" hereinafter refers to any piece with a cylindrical shape, irrespective of its axial length, obtained by roll bending from a metal sheet or from a sectional bar.

[0018] According to the invention a method and a machine have therefore been provided for shaping the longitudinal edges of a roll bent metal piece, whereby the metal piece, after a bending phase, is subjected to roll shaping phase of the flat longitudinal edges, making it move forwards gradually with one or both edges placed between opposing roll shaping members, rotatably supported in contact with the internal and respectively with the external surfaces of the bent metal piece, maintaining them pressed against said flat edges to be shaped.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] The method and some embodiments of a machine according to the invention, will be illustrated in greater detail hereinunder with reference to the accompanying drawings, in which:

- Fig. 1 is a perspective view of a bent tubular member, before the shaping phase of the edges;
- Fig. 2 is a top view of the machine according to a first embodiment;
- Fig. 3 is a side view of the machine of Figure 2;
- Fig. 4 is a cross sectional view along line 4-4 of Figure 3, before the shaping phase of the edges;
- Fig. 5 is a sectional view similar to that of Figure 4, during the shaping phase of the edges;
- Fig. 6 shows another embodiment of the machine, provided with shaping pieces which can be adjusted according to the diameter of the bent member.

DETAILED DESCRIPTION OF THE INVENTION

[0020] With reference to Figures 1 to 5, the general features of the method and of the machine according to the invention will be now described.

[0021] Figure 1 shows a perspective view of a roll bent tubular member, denoted overall by reference number 10, having a longitudinal slot 11 delimited by flat side edges, not curved, denoted by reference numbers 12 and 13 respectively.

[0022] In order to confer to the tubular member 10 a perfectly cylindrical shape, restricting the width of the slot 11 to a minimum, according to the present invention, after roll bending of the metal sheet, the flat edges 12 and 13 of the tubular member are shaped by a subsequent rolling operation of the edges, which provides the tubular member 10 with a perfectly circular profile.

[0023] In this respect the machine for shaping edges, shown schematically in Figures 2 to 5 of the accompanying drawings, can be used.

[0024] The machine, in the example shown, substantially comprises a supporting frame for a first conveyor 14 on the inlet side for the tubular member 10, a second conveyor 15 on the opposite or outlet side for the tubular member 10 formed, and a roll shaping device 16 for shaping the edges 12 and 13 of the tubular member 10, provided in an intermediate position between the two conveyors 14 and 15; the machine also comprises drive means for pushing or driving the tubular member 10 as described hereinunder.

[0025] The two conveyors 14 and 15 can be of any suitable type; for example they can consist of two sets of slanted idle rollers 17 and 18, arranged in a V shape, or of powered rollers acting to move the tubular member 10 forwards, towards and through the roll shaping device 16 for shaping the edges of the tubular member 10, or to move it along the conveyors themselves. The V or slanted arrangement of the rollers also provides a suitable means for guiding and angular orientation of the tubular member 10.

[0026] In the case of use of idle rollers, it is necessary to provide drive means of any suitable type for pushing or driving the tubular member 10, placed on one or both sides of the machine. The drive means can consist, for example, of slides 19 moving along longitudinal guides 20 which extends on a respective side parallel to the longitudinal axis of the machine. Each slide 19 is provided with an arm 21 which engages against the rear edge of the tubular member 10 to push it and make it move forwards on the inlet conveyor 14 towards the shaping device 16, through the latter and on the outlet conveyor 15.

[0027] Each slide 19 can be reciprocated in both directions along the guide 20 in any appropriate way, for example by providing a chain drive system, not shown, wherein the chains to drive the two slides 19 are connected to each other and synchronised by means of a mechanical shaft, an electric shaft or in any other suitable way.

[0028] The shaping device 16, as shown in Figures 2 and 3, and in particular in Figures 4 and 5, comprises a lower shaping member 25 and an upper shaping member 26, both capable of rotating around their own horizontal axis 27 and 28. The two axes 27 and 28 are arranged parallel one to the other, in a cross direction to the longitudinal axis of the shaping machine.

[0029] One of the rollers, for example the lower roller 25, is connected to a respective drive motor 29, not shown, and is supported in a fixed position by the frame 30 of the machine, while the other roller, or upper roller 26, is movably supported in a vertical direction in order to be moved towards and away from the lower roller 25. Moreover the movable roller 26 is supported to rotate idly by a frame 31 sliding in vertical guides 32.

[0030] The frame 31 has a substantially rectangular shape and is formed by two flat cross sides 31A, and by two longitudinal sides 31B. The cross sides 31A have a reduced thickness in order to pass through the longitudinal slot 11 of the tubular member 10, in any case such as to resist the thrust which must be exerted in order to press the upper shaping roller 26 against the lower shaping roller 25 with the necessary pressure force for shaping the flat edges 12 and 13 of the tubular member

10, while the latter is made to move forwards through the same shaping device 16.

[0031] The rising and lowering movement of the frame 31 with the upper shaping roller 26 and the necessary thrust of the roller 26 against the roller 25 can be obtained by any suitable drive means, for example by providing double-acting hydraulic cylinders 33 connected to the lower side 31B of the frame 31, as indicated schematically in Figure 3.

[0032] As shown further in the details of Figures 4 and 5, in accordance with a first embodiment of a machine for shaping edges according to the invention, the shaping device 16 comprises a lower shaping roller 25 in the form of a roller having a peripheral groove R1 of concave or circle arc profile in order to adapt against the external surface of the tubular member 10. It also comprises an upper shaping roller 26 of a convex profile, or barrel shaped, in order to adapt to the internal surface of the tubular member 10 to shape its flat edges 12 and 13 when they are clamped and tightly compressed between the two shaping rollers 25 and 26.

[0033] The radii of curvature of both shaping rollers 25 and 26, according to cases and needs, may correspond one to the other or differ one from the other and from the radii of curvature of the internal and external surfaces of the tubular member 10.

[0034] If we indicate the following:

Ri = internal radius of curvature of the tubular member 10;
Re = external radius of curvature of the tubular member 10;
R1 = radius of curvature of the lower shaping roller 25;
R2 = radius of curvature of the upper shaping roller 26;

so that an appropriate or required bending of the flat edges 12 and 13 of the tubular member 10 is obtained, in general the conditions indicated below must be fulfilled:

1) $R1 \geq Re$
2) $R2 \leq Ri$

where $Ri > R2$ or $R1 < R2$ according to whether the rotational axis 28 of the roller 26 placed on the internal side of the roll bent member 10 is co-planar or spaced from the longitudinal axis of the same tubular member.

[0035] Figures 4 and 5 show conditions of equality between R1 and Re and respectively between R2 and Ri, and of coinciding of the curvature centres. However the values of the radii of curvature of the shaping rollers 25 and 26, insofar as referred above, can also differ from the nominal radii of curvature of the internal and external surfaces of the tubular member 10, according to the dimensions of the same tubular member, or the widths of the flat edges 12 and 13, the thickness of the metal sheet used to obtain the tubular member or other constructional and functional features of the same shaping machine.

[0036] The mode of operation of the machine described, in accordance with the method for roll shaping the flat edges of a bent piece, is described hereinbelow again with reference to a tubular member 10. As shown, the tubular member 10 with the two flat edges 12 and 13, that is to say not perfectly curved, is inserted in the machine by means of the inlet conveyor 14, maintaining the longitudinal slot 11 facing downwards, until the front end of the tubular member 10 is brought in contact with the rollers 25 and 26 of the shaping device 16.

[0037] In these conditions, shown in Figure 4, the upper roller 26 is raised or spaced from the lower roller 25 for a length greater than the thickness of the metal sheet of the tubular member 10, to allow its insertion between the two rollers.

[0038] During positioning of the tubular member 10, the slot 11 has to be maintained aligned with the longitudinal axis of the frame 31 supporting the upper roller 26 so that the two cross sides 31A of said frame 31 can pass through the slot 11. This can be achieved by adopting appropriate means for guiding and angular orientation of the tubular member 10.

[0039] As soon as the front end of the tubular member 10 has been positioned between the shaping rollers 25 and 26, the upper roller 26 is lowered by means of the hydraulic cylinders 33, making the two rollers to adopt the working condition shown in Figure 5 further on.

[0040] This relative movement between the two shaping rollers 25 and 26 will cause pressing of the front end of the two flat edges 12 and 13 of the tubular member 10 against the concave surface of the lower roller 25.

[0041] The subsequent driving of the tubular member 10 between the two shaping rollers 25 and 26, by maintaining the correct pressure, will mean that the two edges 12 and 13 will assume the required circular shape along their whole length, thus making the tubular member completely and perfectly curved and eliminating the evident original defect.

[0042] The driving of the tubular member 10 through the shaping device 16 may be performed in any way, for example by means of the lower shaping roller 25 driven by the appropriate electric motor 29, or by the previously described pushing device. The tubular member 10, with perfectly curved edges, coming from the shaping device 16, will continue its forward movement along the outlet conveyor 15 in order to be subsequently unloaded.

[0043] In the case of Figures 1-5 it was assumed that the lower shaping roller 25 was placed at a fixed height, with the upper roller 26 vertically movable, towards and away from the lower roller 25; however the movement of the two shaping rollers could be reversed, maintaining the upper roller 26 in a steady condition, in this case moving the lower roller 25.

[0044] In the case of the previous figures a description

is also given of a special form for the shaping device 16; however, within the scope of the present invention, other specific solutions or variants are possible and which include, for example, the possibility of modifying or adjusting the theoretical radius of curvature of the two shaping members 25 and 26.

[0045] Indeed, in certain cases, it may be preferable to provide a shaping device 16 which adapts to a wide range of diameters or radii of curvature, without being forced to change the shaping rollers 25 and 26 on each occasion.

[0046] In this case it is possible to replace both or only one of the shaping members described previously, for example with the adjustable shaping members of Figure 6. In this case both the lower shaping member 25 and the upper shaping member 26 comprise a plurality of rolling elements 25A, 25B, 25N and 26A, 26B, 26N, angularly spaced along a theoretical circle arc, maintaining the axes of the rolling elements or their profiles tangent to the circles themselves. Each rolling element of the lower shaping member 25 and/or of the upper shaping member 26 is supported in a radially adjustable form in order to vary the reciprocal position or distance, and consequently to vary the radius of the theoretical arc of curvature along which the rolling members 25A-25N and 26A-26N are arranged respectively.

[0047] The adjustment and support of the various rolling members may be performed in any appropriate way, for example as shown for the central rolling element 25B of the lower shaping member 25 in Figure 6. In this case the rolling element 25B is idly rotating supported, by a slider 37 movable along lateral guides 38 attached to the frame 30 of the machine. The slider 37 has in its central piece 37', a threaded hole 39 wherein a threaded pin 40 is screwed and provided at its lower end with a cylindrical head 41 to rotate in a corresponding seating 42 of the support frame 30, in the manner shown. The threaded pin 40 has, in an intermediate position, a hexagonal head 43 whereon an operator can act with a wrench to vary the position of the slider 37 and consequently of the roller 25B.

[0048] The rolling elements of the two shaping members 25 and 26 can have any position, and also any shape and dimensions, which will obviously have to adapt to the diameters of the pieces to be shaped. It is however advantageous for the lower shaping member 25 to have a central rolling element 25B positioned at the edges 12 and 13 to be bent which rest against the peripheral surface of said central rolling element 25B. This latter must preferably have a concave surface, formed by a peripheral groove, while the remaining rolling elements may have a convex shape, or a cylindrical shape of limited length, such as to rest against a narrow contact band with the internal and external surfaces of the tubular member 10.

[0049] From what has been said and shown it is therefore clear that the invention is aimed at a method and a machine for shaping the straight longitudinal edges of roll bent pieces in order to eliminate the initial defect resulting from a previous bending phase, conferring the required roundness to said edges.

[0050] The intent therefore is that what has been said and shown with reference to the accompanying drawings has been given purely by way of an example of the general principles of the invention, and that other modifications or variations may be made to the entire machine or part thereof, without thereby departing from what is claimed.

Claims

1. Method for shaping longitudinal flat edges (12, 13) of a roll bent metal piece (10), characterised in that, after a previous bending operation for roll bending the metal piece (10), an additional edge shaping step of the flat edges (12, 13) of the rolled piece (10) is performed, making the roll bent piece (10) move forwards keeping at least one of said longitudinal edges (12, 13) clamped between rotating shaping members (25, 26) in contact with the internal and external surface of the roll bent piece (10), while maintaining said shaping members (25, 26) urged against said flat edges (12, 13) for shaping the same.

2. Method for shaping the flat edges of roll bent metal piece (10), according to claim 1, characterised by guiding said roll bent piece (10) during its forward movement through the shaping members (25, 26), maintaining its longitudinal edges constantly orientated in relation to the same shaping pieces.

3. Method for shaping the flat edges of a roll bent metal piece (10) according to claim 2, wherein the bent piece (10) is supported and made to move forwards by means of a conveying device (14, 15), characterised in that said bent piece (10) is guided and angularly orientated by lateral guide means (17, 18).

4. Machine for shaping the side edges (12, 13) of a roll bent metal piece (10), according to the method of the previous claims, characterised by comprising:

   - a support frame (30);
   - an inlet conveyor (14) and an outlet conveyor (15) means for supporting and moving said bent piece (10) along a longitudinal axis if said conveyor means (14, 15);
   - a roll shaping device (16) for shaping the edges (12, 13) of the bent piece (10), provided in an intermediate position between the two conveyors (14, 15) of said conveyor means;
   - guide means (17, 18) for guiding said bent piece (10) with the side edges (12, 13) suitably aligned to the shaping device (16); and

- drive means (19, 21; 29) for moving the roll bent piece (10) forwards along the conveyor device (14, 15) and through the edge roll shaping device (16).

5. Machine for shaping the edges (12, 13) of a roll bent metal piece (10) according to claim 4, characterised in that said conveyor device (14, 15) comprises inlet and outlet conveyors (14, 15) of roller type.

6. Machine for shaping the edges (12, 13) of a roll bent metal piece (10) according to claim 5, characterised in that each of said roller conveyors (14, 15) comprise a first and a second sets of side rollers (17, 18) side by side arranged along the longitudinal axis of the machine, wherein the rollers (17, 18) of each set are slanted towards the longitudinal axis of the machine.

7. Machine for shaping the edges (12, 13) of a roll bent metal piece (10) according to claim 4, characterised in that the shaping device (16) comprises rotatably supported shaping members (25, 26; 25A, 25N; 26A, 26N).

8. Machine for shaping the edges (12, 13) of a roll bent metal piece (10) according to claims 4 and 7, characterised in that the shaping members (25, 26) of the shaping device (16) are relatively movable one in relation to the other, and drive means (33) are provided to move at least one (25) of said shaping members (25, 26).

9. Machine for shaping the edges (12, 13) of a roll bent metal piece (10) according to claim 8, characterised in that one (25) of the shaping members (25, 26) comprises a grooved roller having an arched cross profile to adapt to the external surface of said roll bent piece (10), and in that the other shaping member (26) comprises an arched cross profile to adapt to the internal surface of said roll bent piece (10).

10. Machine for shaping the edges (12, 13) of a roll bent metal piece (10) according to claim 9, characterised in that the radii of curvature of the cross profiles of the two rollers (25, 26) correspond to the internal and external radii of curvature of the roll bent piece (10).

11. Machine for shaping the edges (12, 13) of a roll bent metal piece (10) according to claim 9, characterised in that the radii of curvature of the cross profiles of the two rollers (25, 26) differ from the internal and/or external radii of curvature of the roll bent piece (10).

12. Machine for shaping the edges (12, 13) of a roll bent metal piece (10) according to claim 4, more particularly for shaping the edges (12, 13) along a longitudinal slot (11) of a roll bent tubular member (10), characterised by a shaping member (26) positioned inside the tubular member (10), rotatably supported by a flat frame (31) suitable for passing through said longitudinal slot (11).

13. Machine for shaping the edges (12, 13) of a roll bent metal piece (10) according to claim 12, characterised in that the internal shaping member (26) is supported by a vertically movable frame (31) and in that guide and drive means (32, 33) are provided for moving said frame (31).

14. Machine for shaping the edges (12, 13) of a roll bent metal piece (10) according to claim 4, characterised in that said shaping device (16) comprises facing shaping members (25, 26) each having a plurality of adjacent rolling elements (25A, 25N; 26A, 26N).

15. Machine for shaping the edges (12, 13) of a roll bent metal piece (10) according to claim 14, characterised in that the rolling elements (25A, 25N; 26A, 26N) of each shaping member (25, 26) have their rotational axes arranged along an arched line.

16. Machine for shaping the edges (12, 13) of a roll bent metal piece (10) according to claim 14 or 15, characterised in that the rolling elements (25A, 25N; 26A, 26N) are adjustable in position.

17. Machine for shaping the edges (12, 13) of a roll bent metal piece (10) according to claim 15 or 16, characterised in that said rolling elements (25A, 25N; 26A, 26N) are adjustable in a radial direction.

18. Machine for shaping the edges (12, 13) of a roll bent metal piece (10) according to claim 17 characterised by comprising independent adjusting means for adjusting the position of each of said rolling element (25A, 25N; 26A, 26N), said adjusting means comprising a slider (37) for supporting the rolling element (25B), guide means (38) for the slider (37) and manually actuable drive means (41, 42, 43) to regulate the position of the support slider (37) in respect to the aforementioned guide means (38).

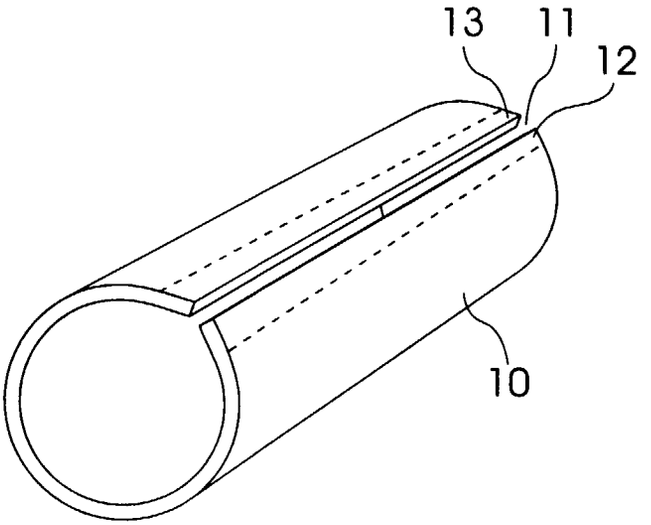
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Fig. 1

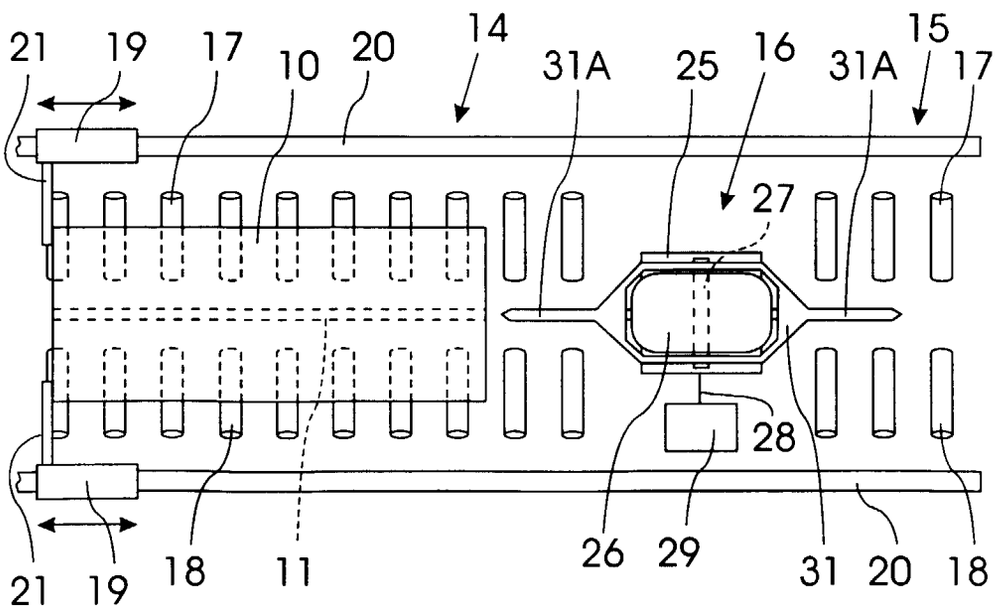
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Fig. 2

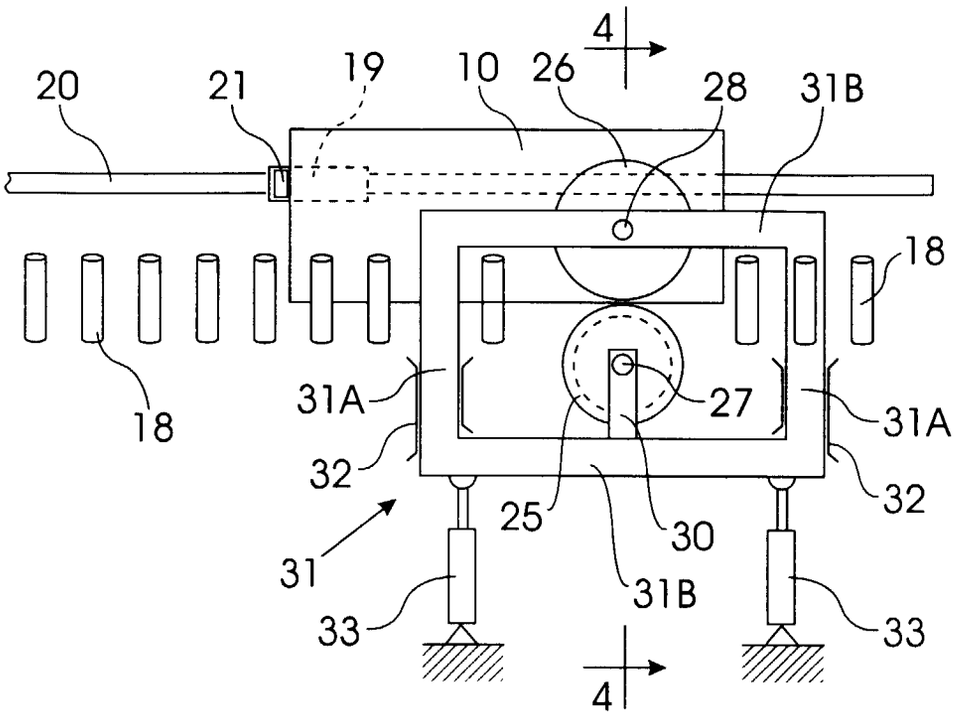
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Fig. 3

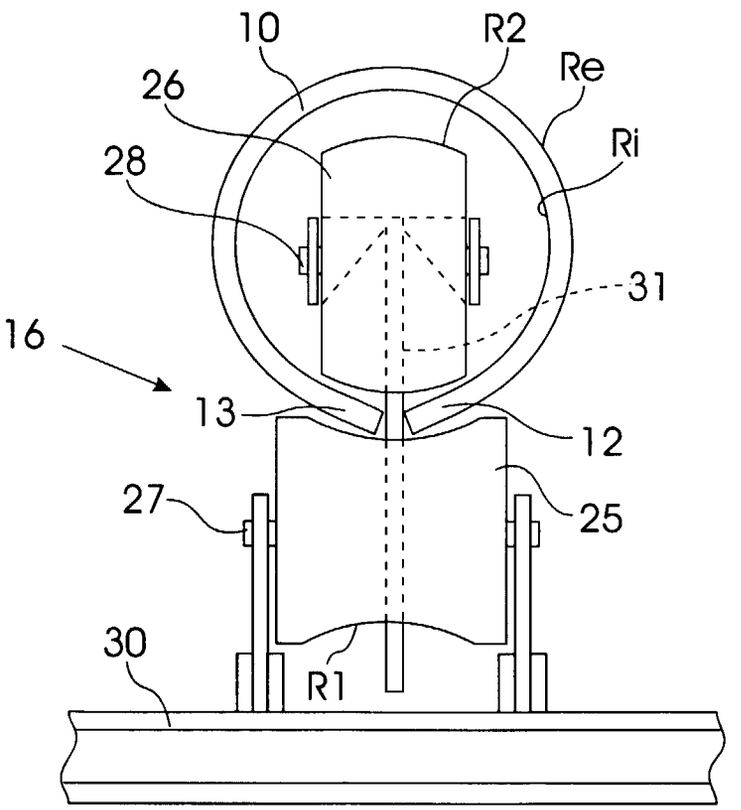
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Fig. 4

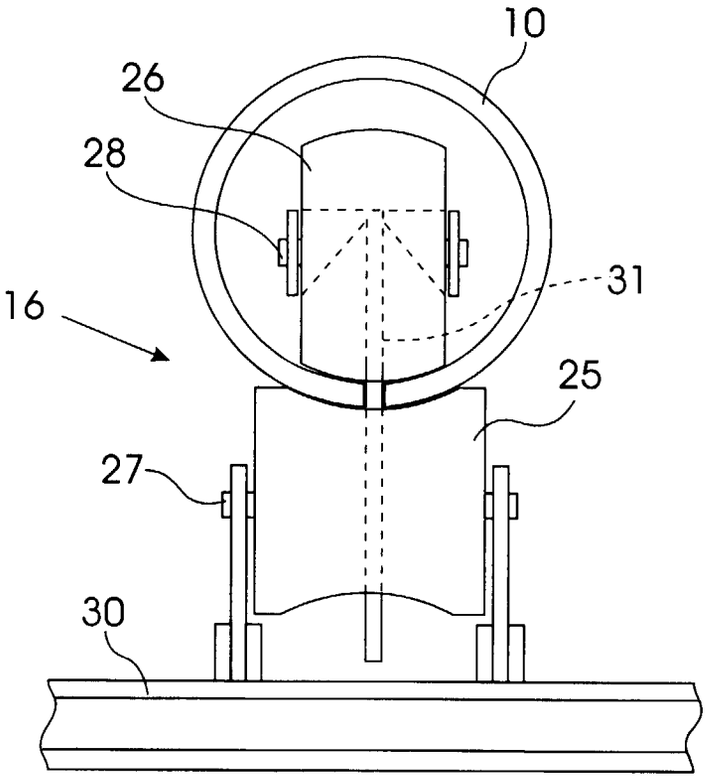
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Fig. 5

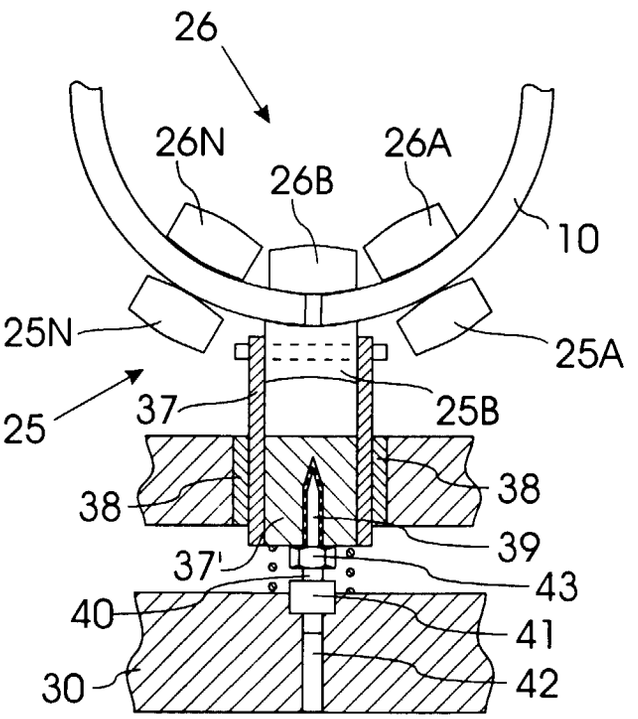
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Fig. 6