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

(11) EP 0 943 379 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
22.09.1999 Bulletin 1999/38

(51) Int. Cl.[6]: **B21D 11/12**

(21) Application number: **99104039.5**

(22) Date of filing: **16.03.1999**

(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: **20.03.1998 IT BO980178**

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(54) Method for automatically bending metal profiled elements and the like, and machine for performing the method

(57) A method for automatically bending metal profiled elements, particularly iron rods for reinforced concrete, consisting in feeding the profiled elements (2) to be cropped along a feed line (3), in order to bend a front end (2a) of the profiled elements in a first bending position arranged along the feed line. The advancement of the profiled elements is then actuated in order to make their front part rest on a guiding channel (16), and then the profiled elements (2) are cropped to a length which also includes the rear part to be bent. The rear part of the cropped profiled elements is shifted into a second bending position which lies above the feed line (3), by a limited extent which is sufficient to move past the space occupied by the mechanical elements arranged to the rear of the first bending position. Finally, the profiled elements are subjected to a measured longitudinal movement and a rear end (2b) of the profiled elements is bent in the second upper bending position.

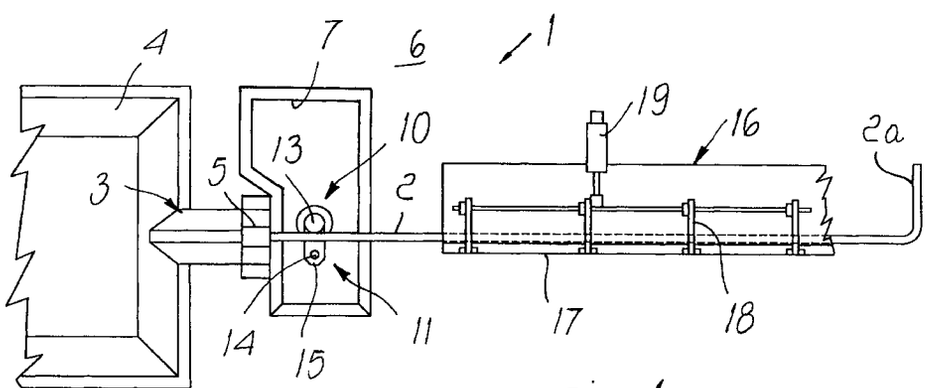

Fig. 1

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Description

[0001] The present invention relates to a method for automatically bending metal profiled elements, particularly iron rods for reinforced concrete and the like, and to a machine which allows to perform the method automatically or semiautomatically.

[0002] It is known that metal profiled elements used for example to form reinforced-concrete flames are generally obtained by means of devices which subject the iron rods to an appropriate number of bending actions. In particular, so-called stirrup bending machines are known which allow to produce stirrups and the like in different shapes, such as those shown for example in Figures 8a, 8b and 8c and designated by the reference numerals 20a, 20b and 20c for the sake of clarity. These machines have, in addition to suitable elements for straightening the iron rods, a feeder unit, suitable bending elements, and a cropping unit. Said units can be combined into a single machine or, as an alternative, their functions can be mutually integrated or separated and assigned to separate auxiliary units.

[0003] The bending elements usually have a bending head, for example of the type shown in Figure 7; said bending head has a central pivot or spindle 13 and a bending pivot 14 which is supported eccentrically by a bending arm 15 which can rotate with respect to the axis of said central pivot 13.

[0004] In order to perform bendings on opposite sides with respect to the axis of the iron rods to be bent, the bending head must be of the so-called bidirectional type, i.e., it must be able to perform the working movement in mutually opposite directions. This means that the positions of the central pivot and of the bending pivot must be reversed with respect to the axis of the iron rods to be bent. In order to move said bending elements, the machine is capable of producing the vertical translatory motion of the bending head and a movement at right angles to the working surface, so as to allow said bending head to retract and then protrude again after moving past the rods to be bent.

[0005] This vertical translatory motion is in any case still limited to the sum of the diameters of the rod and of the pivot 13.

[0006] Generally speaking, the above-cited machines have the characteristic that they support and handle the metal profiled elements being bent while leaving them attached to the raw material during the treatment. In order to support the weight of the resulting item, avoiding permanent deformations due to the weight thereof, the machines often have a channel which acts as a support for the advancing items, so as to allow to produce straight bars and shaped elements having considerable dimensions, i.e., heavier than allowed by the rigidity of the raw material. The channel has a bottom which can be opened to discharge the item at the end of the process.

[0007] Said channel is capable of receiving, in addition to the bars, most stirrups that have bends only in their front part, and is accordingly produced with a height which allows to accommodate commonly manufactured shaped items. In order to allow to produce large stirrups, which are taller than ordinary stirrups, the channel is open upward in an initial portion, so that the item is capable of protruding from said channel during production.

[0008] By virtue of the above-described refinements, stirrup bending machines allow to produce most of the items required in the field being considered, which are generally constituted by bars which have one or more bends at a single end, of the type shown in Figures 8d and 8e, in which said bent bars are designated by the reference numerals 20d and 20e respectively.

[0009] However, there are other kinds of shaped element which, owing to their nature and dimensions, cannot be manufactured by conventional stirrup bending machines, particularly because they exceed 2-2.5 meters and require bends at both ends, such as the elements designated by the reference numerals 20f, 20g and 20h and shown in Figures 8f, 8g and 8h.

[0010] It is not possible to produce such shaped elements because even with the aid of said supporting channel, during the formation of the bend in the rear part the length of the item, and accordingly its weight, are such as to deform it permanently and irreparably.

[0011] In order to provide said shaped elements bent at both ends, other machines are known which have two or more bending heads or other elements which considerably increase the level of constructive complexity and accordingly have high costs.

[0012] In order to overcome the above-mentioned limitations of conventional stirrup bending machines, said bending machines, in addition to being provided with the elements suitable for bending the profiled elements in the rear part, require the presence of elements which allow the longitudinal movement of the item being treated after it has been cropped off the raw material. Moreover, during the longitudinal backward movement it is necessary to move beyond the obstacle constituted by the space occupied by the mechanical elements located in front of the bending elements, which inherently protrude from the working surface. This entails a further increase in the structural and operating complexity of the machine and in the associated costs in order to allow machining operations which are, in quantitative terms, a substantially small part of normal production.

[0013] In practice, this entails frequently renouncing the acquisition of very complicated and expensive machines, limiting production only to shaped profiled elements which can be obtained with machines which are simpler in concept, such as conventional stirrup bending machines.

[0014] The aim of the present invention is to solve the above-described problem, by providing a method which allows to perform, very cheaply and simply, the automatic or semiautomatic bending of metal profiled ele-

ments having various shapes, particularly very long profiled elements provided with bends at both ends.

[0015] Within the scope of this aim, an object of the present invention is to perform the above method by means of a machine, particularly of the stirrup bending type, whose structure is simple in concept, safely reliable in operation and versatile in use.

[0016] This aim and this object are both achieved, according to the invention, by the present method for automatically bending metal profiled elements, particularly iron rods for reinforced concrete, characterized in that it consists in feeding the profiled elements to be cropped along a feed line, in order to bend a front end of said profiled elements in a first bending position arranged along said feed line; in actuating the advancement of said profiled elements to make their front part, which protrudes with respect to said first bending position, rest on a guiding channel; in cropping to size said profiled elements to a length which also includes the rear part to be bent; in shifting the rear part of said profiled elements cropped to size in a second bending position which lies above said feed line, by a limited extent which is sufficient to move past the space occupied by the mechanical elements arranged to the rear of said first bending position; in performing the measured longitudinal movement of said profiled elements; and in bending a rear end of said profiled elements in said second bending position located above said feed line.

[0017] The details of the invention will become apparent from the detailed description of a preferred embodiment of a machine for bending metal profiled elements, illustrated only by way of non-limitative example in the accompanying drawings, wherein:

Figure 1 is a schematic side view of a machine for the automatic bending of metal profiled elements, operating according to the method of the invention;
Figures 2 and 3 are identical schematic side views of the machine during successive operating steps;
Figures 4, 5 and 6 are corresponding schematic side views of the machine according to the invention in different embodiments;
Figure 7 is an enlarged-scale side view of bending means of the machine according to the invention;
Figures 8a, 8b, 8c, 8d, 8e, 8f, 8g and 8h are views of different types of metal profiled element.

[0018] With particular reference to the above figures, the reference numeral 1 generally designates the machine for bending metal profiled elements 2, for example iron rods for reinforced concrete and the like, hereinafter termed rods for the sake of simplicity.

[0019] The machine 1 has a line 3 for feeding the rods 2 to be bent. The rods 2 are fed by conventional elements, not shown, which are arranged in an initial region of the machine, the housing 4 of which is partially shown. At the outlet of said feeder elements, along the feed line 3, there is a cropping unit 5 which is also of a known type.

[0020] The machine is provided with bending means which are suitable to bend the ends of the rods 2. Said bending means are constituted by a bending unit 10, which can move between a first bending position 11 (Figure 1), at the bending line 3, and a second bending position 12 (Figure 2), which lies above said lower position for feeding the rods 2.

[0021] The bending unit 10 is substantially constituted, in a per se known manner, by a cylindrical head which can be actuated so as to rotate and is provided with a central pivot 13 and with a bending pivot 14 which is supported eccentrically by a bending arm 15 which can rotate rigidly with respect to said head about the axis of said central pivot 13.

[0022] The bending unit 10 acts at a working surface formed by a front bed 6; said bed 6 has an opening 7 from which the head of the bending unit 10 protrudes. The opening 7 is preferably formed at a recessed region of the bed 6 which has suitably inclined side walls.

[0023] At the lower position, along the feed line 3, the machine has a channel 16 which is suitable to receive, during an operating step, the portion of the rods 2 that protrudes in front of the bending means 10.

[0024] The channel 16 has a bottom 17 which can be opened by means of a lever system 18 which is actuated by an actuator 19.

[0025] The method that can be performed by means of the described machine for bending the rods 2, particularly for producing very long items, initially entails forming the required bends in the front part 2a of the profiled element. Then the feeder assembly is activated and feeds the rod 2 by the entire extent required to form the item and by an extent which corresponds to the length of the part to be subsequently bent in the rear region; the rod rests on the channel 16 for the part that protrudes forward with respect to the bending means 10 (Figure 1).

[0026] The rod is then cropped to the chosen size by means of the cutting unit 5.

[0027] In this step, the bending means 10 are prepared in the correct position for performing the bends in the rear part, i.e., so that the central pivot 13 lies above the rod 2 and the bending pivot 14 lies below it (Figure 1 again). For this purpose, the bending means 10 move at right angles to the working surface 6, so as to retract with respect to said surface 6, and then protrude again after moving beyond the rod to be bent. In the retracted position, the arm 15 is rotated from the front side, indicated by the arc A in Figure 7 and in which the front part 2a of the rod is bent, to the rear side, indicated by the arc P and in which the rear part 2b of the rod is bent.

[0028] The bending unit 10 is then moved into the upper position 12, raising the rear part of the rod (Figure 2). In this position, the rear part of the rod is inclined and curved due to its elasticity and to its own weight, and therefore the electronic management devices with which the machine is equipped must provide for an

automatic compensation of the bending angle, which can be optionally modified for this purpose by the intervention of the operator in order to achieve the intended final result.

[0029] As an alternative, the rod 2 can be raised manually by the operator, who inserts it between the central pivot 13 and the bending pivot 14.

[0030] In practice, the rod 2 is raised at the rear by a limited extent which is sufficient to clear the rod from the space occupied by the mechanical elements arranged to the rear of the bending means 10.

[0031] In both cases it is preferable to make the bending arm 15 perform an angular rotation, during the translatory stroke of the bending unit 10, from a vertical position to an inclined position which is substantially perpendicular to the tangent to the curve formed by the rod in the point of contact with the central pivot 13 (see Figure 2 again).

[0032] At this point, the operator stops the machine and intervenes manually by making the semifinished part slide longitudinally by the appropriate extent (optionally suggested by the electronic processing means of the machine), as shown by the portion 2c shown in dashed lines in Figure 3, using any suitable system for this purpose, such as graduated rods 24 (Figure 6) which are fixed or etched onto the working surface of the machine, register marks, abutments and the like.

[0033] The operator then starts the machine, which forms the bend in the rear part 2b (Figure 3).

[0034] If the item to be provided requires more than one bend in its rear part, the machine stops again to allow to operator to retract the rod again by the appropriate extent, subsequently resuming the cycle until the shape is completed.

[0035] It should be noted that the illustrated solution allows to form the rear bends only in an upward direction, since the abutment for bending is constituted by the bottom 17 of the channel 16 which lies in front of the bending means 10, without the intervention of auxiliary elements. More specifically, the abutment action performed by said bottom 17 is provided by simple contact restraint reaction and therefore only in an upward direction.

[0036] According to a different embodiment, shown in Figure 4, the operator manually inserts locators 26 in corresponding holes formed in the working surface 6, in front of the bending means 10, preferably close to said bending elements. In this manner it is possible to overcome the limitation constituted by the fact that it is possible to form the rear bends only in an upward direction, since said locators 26, by being arranged above and below the rod 2, also allow to form downward bends.

[0037] It is of course possible for the locator pins 26 to be normally arranged inside the surface 6 and to protrude from it when necessary, the corresponding retraction and protrusion movements being determined by suitable actuators.

[0038] Figure 5 illustrates another embodiment, in which the bottom of the channel 16, which has a conveniently elongated shape, is provided with a rear part 27 which is arranged adjacent to the bending means 10 and can be inclined at a suitable hinge 21; the inclination is performed by the operator directly after the lifting of the rod 2, through a suitable cam mechanism or automatically by means of an actuator 22.

[0039] In this manner, the rear upper lip of the channel 16 acts as a locator during bending. The elongation of the channel 16, or as an alternative the possibility to make it movable in a longitudinal direction so as to move toward the bending means as much as possible, arises from the need to minimize the distance between the central pivot 13 and the bottom 17 of said channel 16 during the bending of the rear part of the profiled elements, while said bottom 17 must be spaced or open when the machine forms bends in the front part of the profiled elements or when forming ordinary stirrups.

[0040] According to the embodiment shown in Figure 6, the channel 16 has, on the bottom 17 and at the rear end arranged adjacent to the bending means 10, locator means 23 which are constituted for example by a shim element or eccentric element which is suitable to be interposed automatically or manually in order to reestablish the contact between the rod 2 and the bottom of said channel 16, which is no longer provided due to the upward motion of the rod 2, after the translatory motion of the rear part of said rod 2 into the second upper bending position (reference should be made to the enlarged-scale view of the detail R of Figure 6, where the dashed line 23a designates the deactivated position of said locator means 23). The channel 16, or only its bottom 17, preferably have a considerable extension, so as to be as close as possible to the pivot 13 of the bending means 10, so that it can act as a locator with a minimal inclination of the rod in the rear part, particularly if a compact cutting element 5 is used.

[0041] In summary, the method and the machine according to the invention allow to perform very simply and at low cost the automatic or semiautomatic bending of metal profiled elements in different shapes, particularly profiled elements of considerable length and provided with bends at both ends, such as for example those shown in Figures 8f, 8g and 8h.

[0042] The fact is stressed that this result has been achieved by means of a structurally simple machine of the same type as conventional stirrup bending machines, without the aid of complicated additional elements.

[0043] The bends formed in the rear part of the profiled elements have a precision which, despite being slightly lower than the precision of the front bends owing to the curvature applied to the rear part of the rods being bent, is fully within the tolerance range normally accepted in the field.

[0044] In the practical embodiment of the invention, the materials employed, as well as the shapes and the

dimensions, may be any according to requirements.

[0045] The disclosures in Italian Patent Application No. BO98A000178 from which this application claims priority are incorporated herein by reference.

[0046] Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly, such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

Claims

1. A method for automatically bending metal profiled elements, particularly iron rods for reinforced concrete, characterized in that it consists in feeding the profiled elements to be cropped along a feed line, in order to bend a front end of said profiled elements in a first bending position arranged along said feed line; in actuating the advancement of said profiled elements to make their front part, which protrudes with respect to said first bending position, rest on a guiding channel; in cropping to size said profiled elements to a length which also includes the rear part to be bent; in shifting the rear part of said profiled elements cropped to size in a second bending position which lies above said feed line, by a limited extent which is sufficient to move past the space occupied by the mechanical elements arranged to the rear of said first bending position; in performing the measured longitudinal movement of said profiled elements; and in bending a rear end of said profiled elements in said second bending position located above said feed line.

2. The method according to claim 1, characterized in that it comprises producing the translatory motion of said rear part of the profiled elements in said second upper bending position either manually or with the aid of bending means which move between said first bending position arranged along said feed line and said upper bending position.

3. The method according to claim 1, characterized in that it comprises inserting locator means on a working surface which contains said feed line of said profiled elements, in front of said first bending position, and manually producing said measured longitudinal movement of said profiled elements, so as to insert said profiled elements between said locator means.

4. The method according to claim 1, characterized in that it comprises producing the translatory motion of said rear part of the profiled elements in said second upper bending position through the angular rotation of a rear part of said guiding channel which can be inclined.

5. The method according to claim 1, characterized in that it comprises associating with said guiding channel locator means which are suitable to re-establish contact between said profiled elements and the bottom of said guiding channel after the translatory motion of said rear part of said profiled elements in said second upper bending position.

6. A machine for the automatic bending of metal profiled elements, particularly iron rods for reinforced concrete, characterized in that it comprises: a line for feeding the profiled elements to be bent; bending means, which are suitable to bend the ends of said profiled elements and move between a first bending position, arranged along said feed line, in order to bend a front end of said profiled elements, and a second bending position which lies above said feed line, in order to bend a rear end of said profiled elements, said second upper bending position being spaced by a limited extent which is sufficient to move past the space occupied by the mechanical elements arranged to the rear of said first bending position; a guiding channel, which is suitable to accommodate, so that it rests thereon, the portion of said profiled elements that protrudes forward with respect to said first bending position, and acts as a locator during the bending of said rear end of said profiled elements.

7. The machine according to claim 1, characterized in that it comprises locator means which are suitable to be inserted in corresponding holes formed in the working surface, in front of said bending means, substantially close to said bending means, and to receive said profiled elements when said rear part of said profiled elements moves into said second upper bending position, so as to act as upper and lower locator for said profiled elements.

8. The machine according to claim 1, characterized in that the bottom of said guiding channel is provided with a rear part which is arranged adjacent to said bending means and can be inclined at a suitable hinge, by virtue of suitable actuation means, in order to support said profiled elements when said rear part of said profiled elements moves into said second upper bending position.

9. The machine according to claim 1, characterized in that abutment means are associated with said guiding channel and are suitable to re-establish contact between said profiled elements and the bottom of said guiding channel after the translatory motion of said rear part of said profiled elements in said second upper bending position.

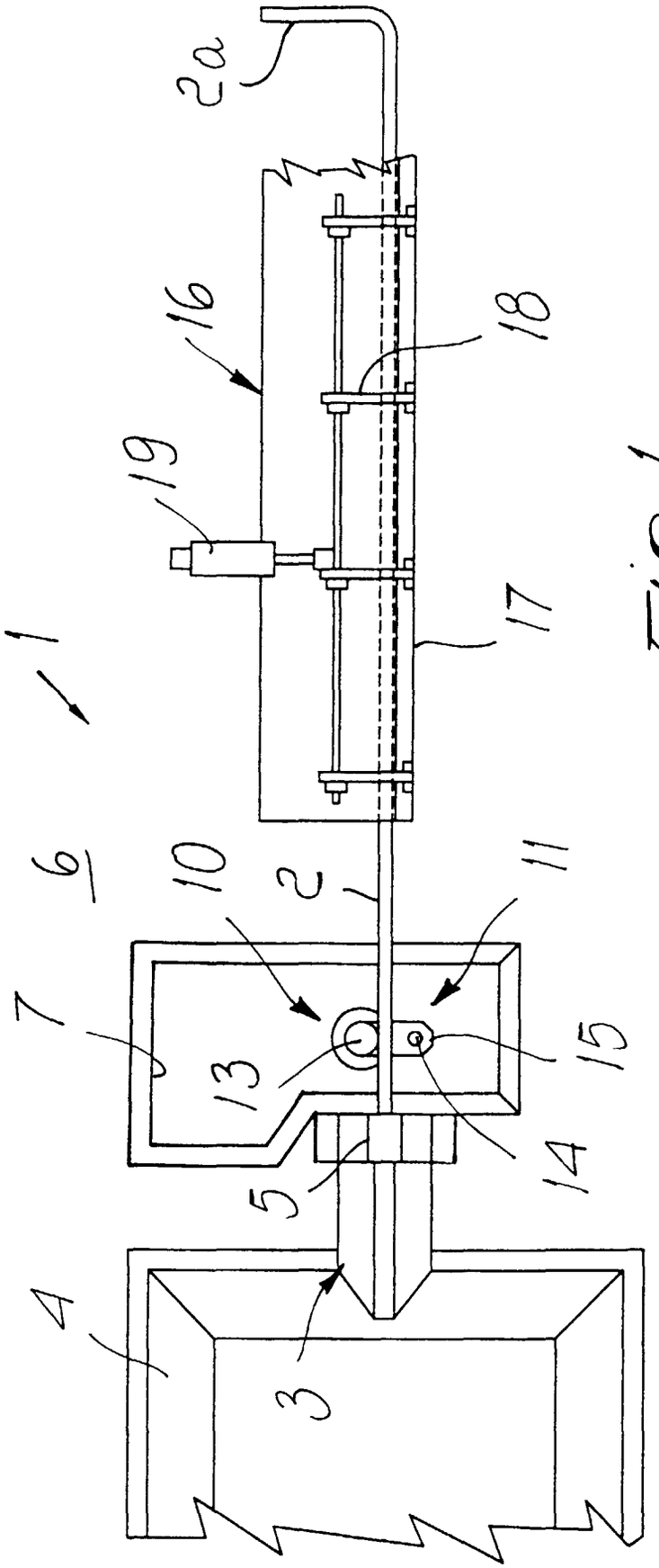

Fig. 1

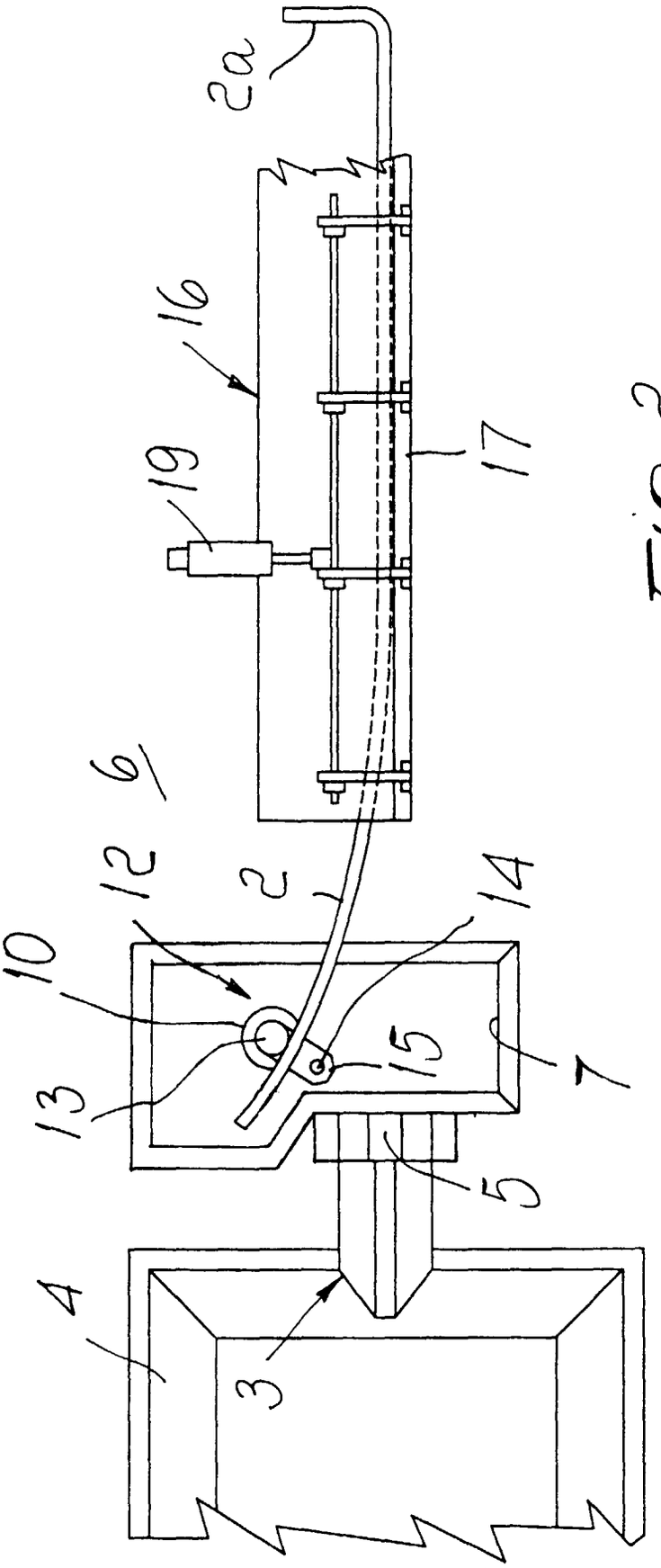

Fig. 2

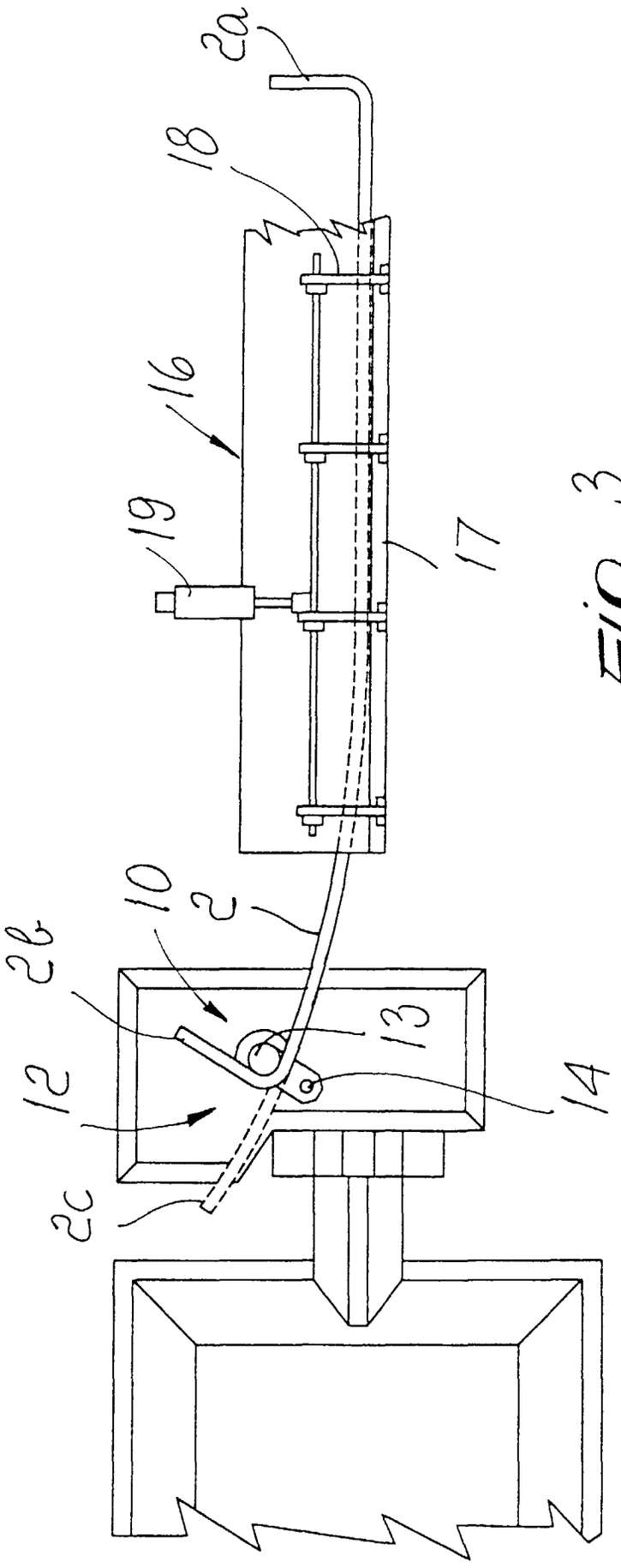

Fig. 3

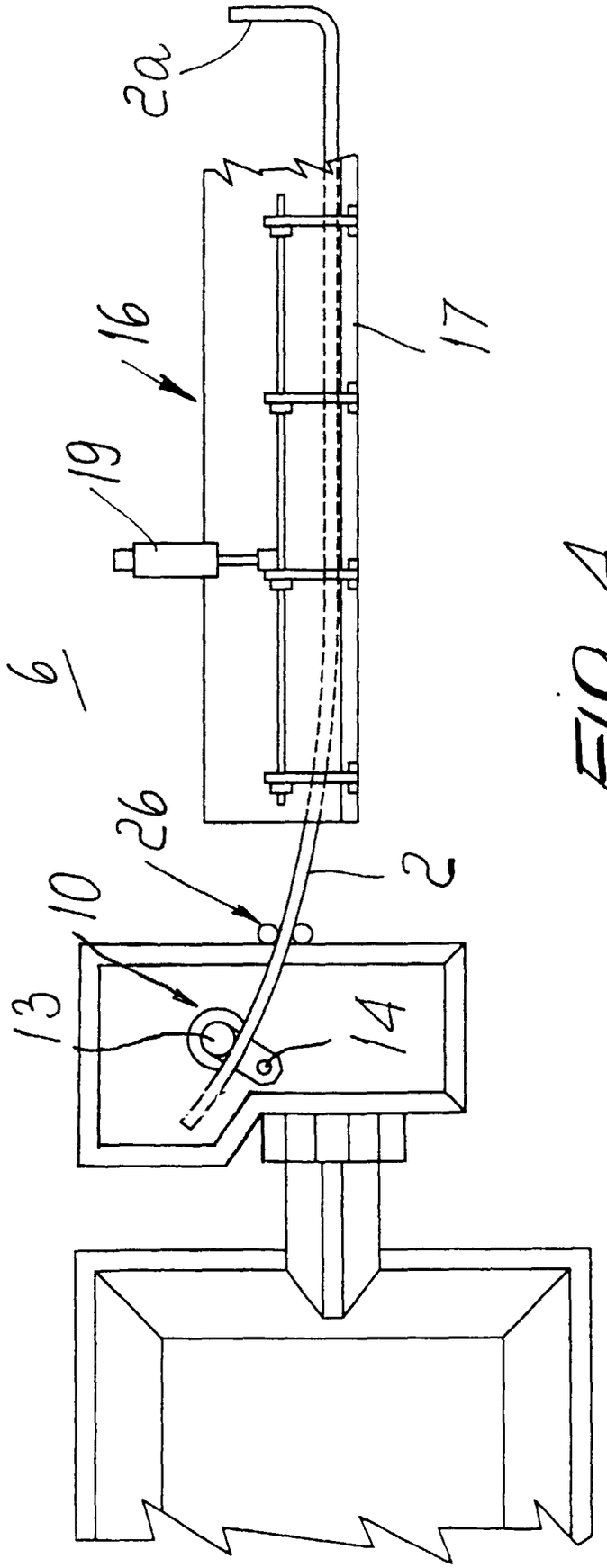

FIG. 4

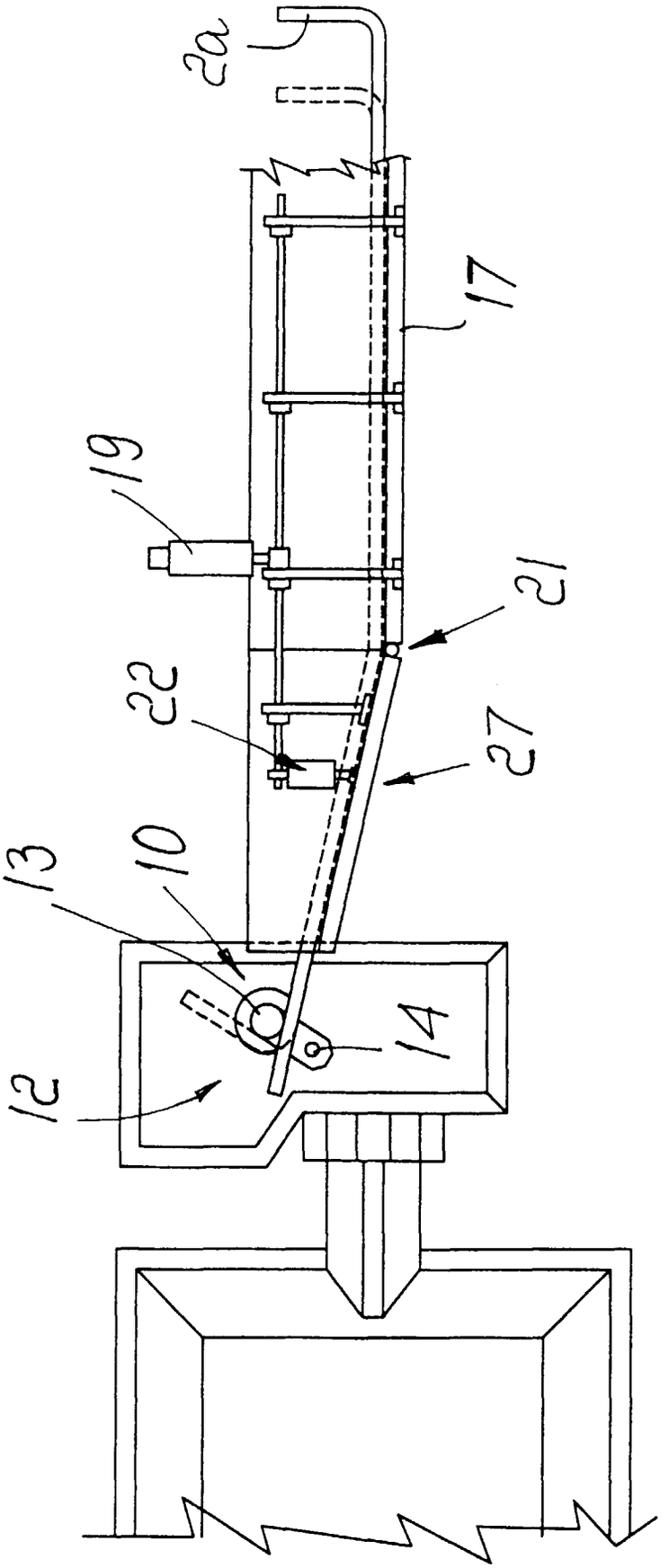

FIG. 5

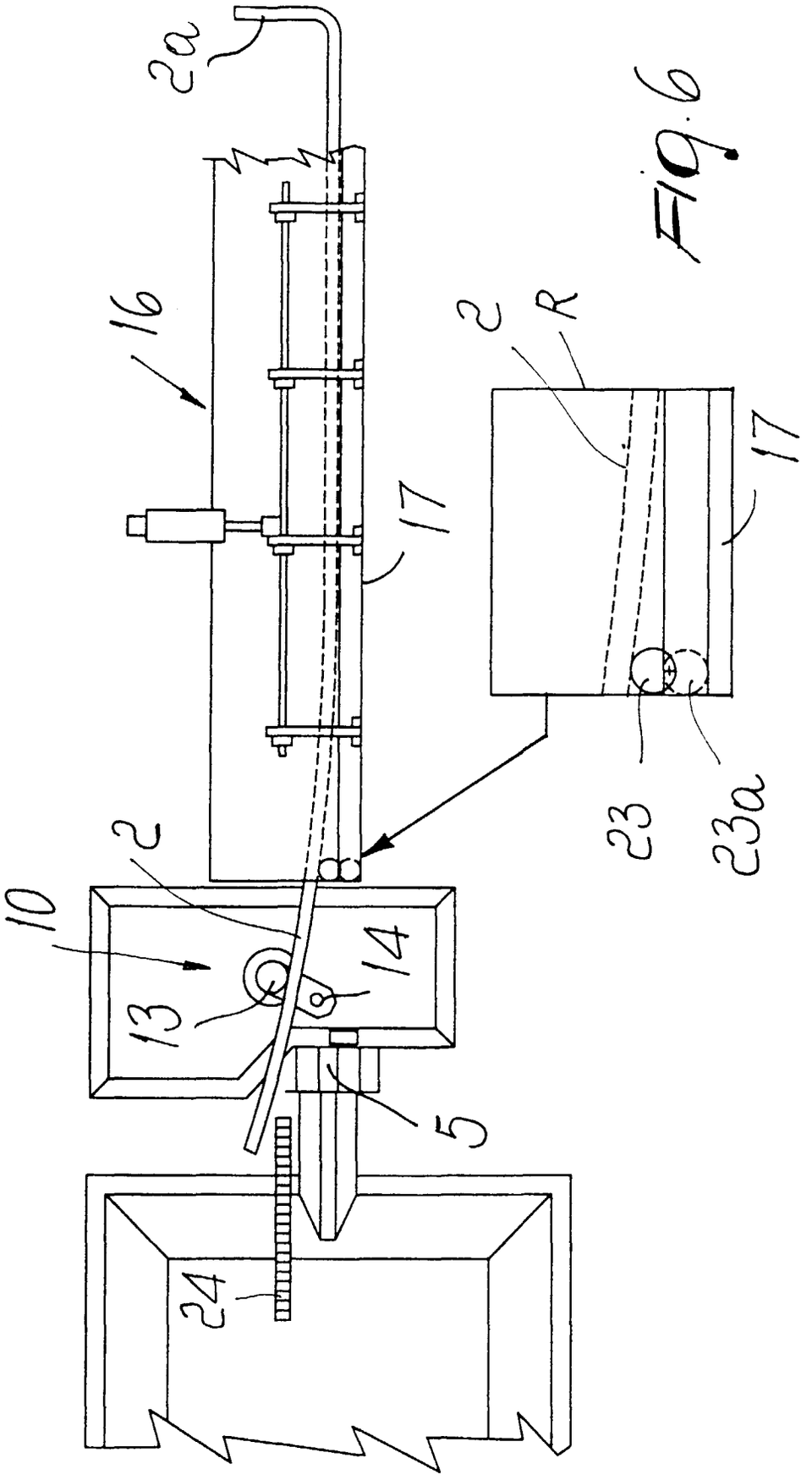

Fig. 6

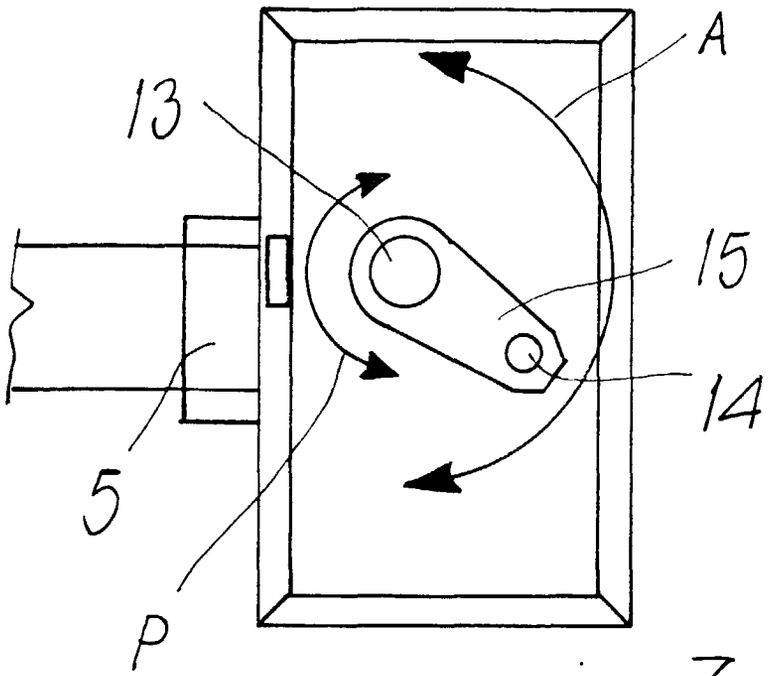

Fig. 7

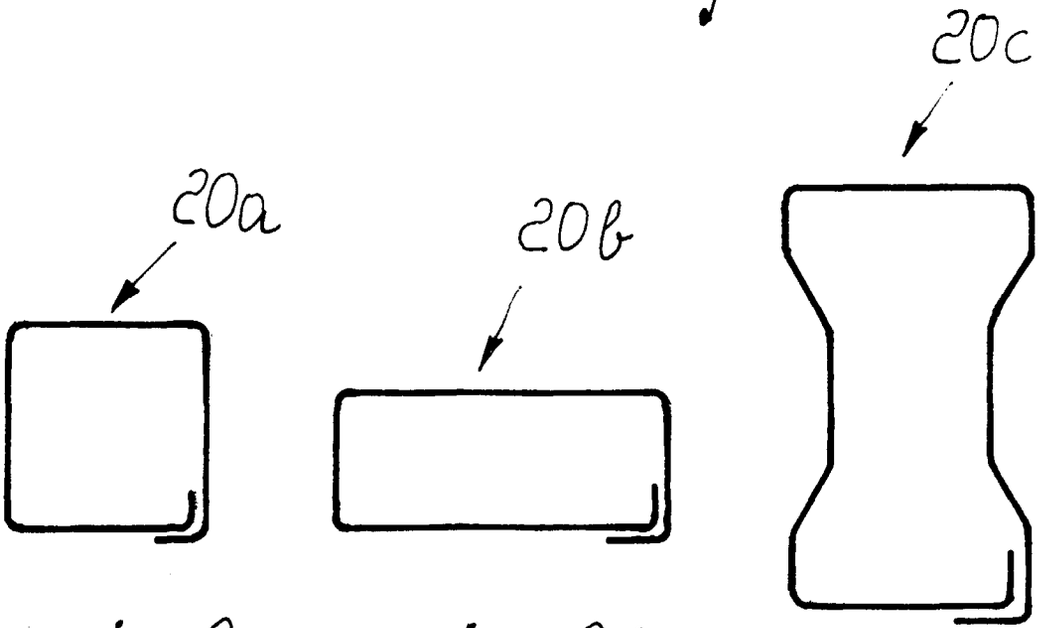

Fig. 8a Fig. 8b Fig. 8c

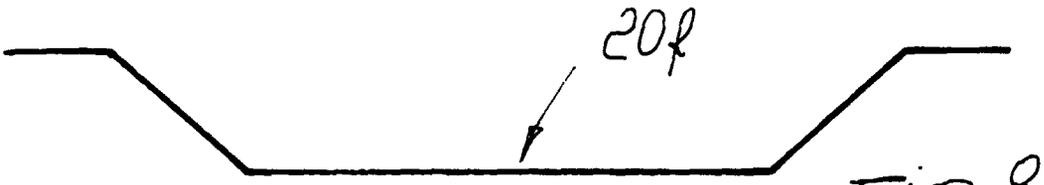

Fig. 8f

Fig. 8g

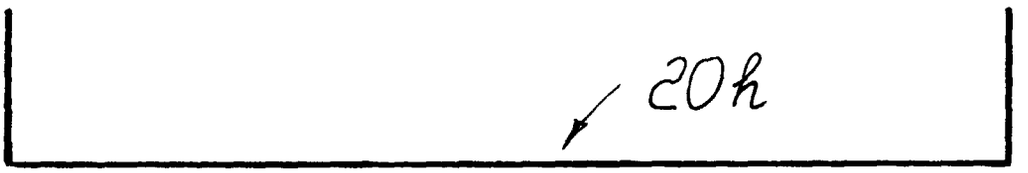

Fig. 8h

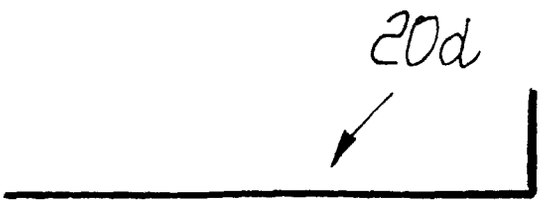

Fig. 8d

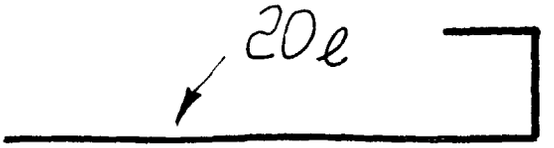

Fig. 8e