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(54) **BENDING APPARATUS FOR BAR-LIKE METAL SECTIONS**

BIEGEVORRICHTUNG FÜR STABARTIGE METALLTEILE

APPAREIL DE CINTRAGE POUR DES SECTIONS METALLIQUES EN FORME DE BARRES

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Description

Technical field

[0001] The present invention relates to a bending apparatus for bar-like metal sections according to the preamble of claim 1. Such an apparatus is for example disclosed in JP-A-06047448.

Background Art

[0002] It is known that shaped irons, which are used for example for reinforcing bars, are usually obtained by means of apparatuses which submit roll-shaped or bar-like iron rods to a suitable chain of bending operations. In particular bending apparatuses are currently known, which permit to realize large quantities of different products such as shaped products, open or closed stirrups, polygonal bent shapes and the like.

[0003] These apparatuses usually provide one bending assembly at least, carrying a bending head provided with a bending tool constituted as a rule by a bending mandrel 8 and by an eccentric bending pin 10 together with a stopping element 90 which prevents any displacement of the section 2 in process of working, as it is illustrated in fig. 16a, 16b.

[0004] According to a known solution the bending tool is alternatively constituted by a couple of templates 80 which further serve as stopping element during the bending operation performed by the eccentric pin 10, as illustrated in fig. 17a, 17b.

[0005] Anyway these bending heads are constrained to a bending bench, which can be fixed or longitudinally movable as to the axis of the bar to be bent. As the following description and claims are concerned, the cited condition can be considered occurring as referred to any known bending tool.

[0006] The bars to be bent are commonly transferred on a roller table which is positioned near the bending station and then fed by hand or in semiautomatic or completely automatic way on to a working area. Each bar (one or more at the same time) is therefore positioned at the bending tool and moved or kept by means of a pincers-shaped device. In particular this pincers-shaped device, which is suitable for moving or keeping and, if necessary, transversally centring the bar as to the bending tool, can be arranged on the same bending bench or between this one and the feeding area upstream; alternatively it shapes an autonomous device which can be fixed or provided with handling means.

[0007] A specific problem occurring in the concerned technical field relates to the necessity of bending the bars very near to their end, and in particular of carrying out opposite bends by 180° by rotating the eccentric bending pin in opposite rotational directions.

[0008] In fact the apparatuses of known type do not allow to carry out bends at such ending portions of the bar, that have an extent inferior than the fixed distance

between the bending tool and the pincers-shaped device used to seize the metal section. As the pincers-shaped device cannot overcome the bending head, it is forced to stop sideways to this unit.

[0009] Moreover the bending templates of known type cannot carry out any bend by 180° on both ends of the metal section, while the mandrels of known type need a new positioning of the stopping element for bending the opposite end. In fact for bending a bar by any angular rate it is required that the eccentric bending pin effects a rotation around the bending tool, which overcomes the actual bend to be obtained, so as to counterbalance the rate of elastic deformation, usually called "spring-back" effect of the material, which appears when the bending tool stops effecting the deforming action on the section. Consequently to realize bends by 180° the bending tool must be able to effect rotations around the bending mandrel greater than the straight angle.

[0010] Therefore it is evident that the known bending apparatuses show some critical aspects when realizing this type of 180° bends at both ends of the same section by means of the same bending head. Actually these bends could be effected by two different machines, but without solving the huge problem constituted by the fact that the respective two end hooks couldn't be realized at a smaller distance than the distance lying between the bending centres of the two machines when brought nearest. This means that the minimum distance between the hooks which can be realized at the opposite ends of a section depends on the size of the bending machine and of any other device possibly interposed between them (mobile supports, dragging pincers, etc.). Normally on the current machines this minimum size is not less than 1,5 m.

[0011] Moreover in case the bending head comprises a couple of bending templates fitted to reverse the bending rotational direction up to 180°, it is not possible to realize bends at both opposite ends of the section, as it can be inferred from fig. 17a, 17b.

[0012] It results likewise difficult to effect bends at both opposite ends of the section by means of bending heads having separate stopping element (see fig. 16a, 16b). In this case it is necessary to modify the positioning of the separate stopping element and moreover the stopping element would hinder the required approach of the moving device for realizing very short pieces.

Disclosure of Invention

[0013] The aim of the present invention is to overcome the cited problems of the background art, by devising a bending apparatus for bar-like metal sections which allows to automatically realize the bending of sections and the like at their ends and, in particular up to 180° angles even at very close distances as to the preceding bends.

[0014] Within this aim a further scope of the present invention is to devise an apparatus able to accomplish the cited automatic bending of sections and the like, with

simple structure, reliable function and versatile use.

[0015] The cited aims are achieved according to the present invention by the bending apparatus for bar-like metal sections according to the features of claim 1.

Brief description of drawings

[0016] Description details of the invention shall be further evident in the illustrations of a preferred embodiment of the bending apparatus for bar-like metal sections, illustrated in the guideline drawings attached and wherein:

figure 1 illustrates a top view of a bending apparatus for bar-like metal sections;
 figures 2, 3, 3a, 4, 4a illustrate the same top view of this apparatus in subsequent bending steps;
 the figure 5 illustrates a perspective view of a transferring device of the apparatus operating during said bending steps;
 figure 6 illustrates a top view of the same transferring device associated to the cited bending assembly;
 figures 7, 8 illustrate respective perspective views of a bending tool of the same apparatus with stopping means according to the present invention;
 figures 9, 10, 11, 12 illustrate respective front views of the apparatus in subsequent steps of loading and unloading metal sections;
 figure 13 illustrates a front view of the same apparatus in a respective step of loading and unloading, accomplished by an alternative loading device;
 figure 14 illustrates a perspective view of the apparatus in process of working an elongated section;
 figure 14a illustrates an enlarged view of the detail A of fig. 14;
 figure 15 illustrates a perspective view of the apparatus in process of working a short section;
 figure 15a illustrates an enlarged view of the detail A of fig. 15;
 figures 16a and 16b illustrate a bending tool of known type constituted by a cylindrical mandrel, a bending pin and a stopping element;
 figures 17a and 17b illustrate a bending tool of known type constituted by a couple of templates and by a bending pin.

Best Mode for Carrying out the Invention

[0017] With reference to such figures, 1 refers to the bending apparatus for bar-like metal sections 2, for example cut form bars or rolls.

[0018] The apparatus 1 is provided with a bending assembly 3 served by a feeding assembly 4 and by a loading and unloading assembly 5 for the bent sections 2.

[0019] The bending assembly 3 is substantially constituted by a bending head 6 constrained to a bench-shaped frame 7. In particular this bending head 6 comprises a bending mandrel 8, mechanical stopping means 9 and an eccentric pin 10 suited to accomplish alternate angular

runs around the bending mandrel 8 (see in particular fig. 5, 6). In the illustrated embodiment the bending assembly 3 comprises only one bending head 6, but it is possible to provide that more than one bending heads work in the same apparatus 1.

[0020] The bending mandrel 8 substantially shapes a preferably cylindrical pin constrained at one base to a fixed disc 11 constrained in turn to the frame 7 in preferably horizontal position.

[0021] In the illustrated case, the bending mandrel 8 is positioned at the rotational centre of the circular trajectory of the pin 10; but it is alternatively possible to provide that, according to need, the bending mandrel 8 is positioned away from said rotational centre of the pin 10.

[0022] The stopping means 9 are positioned sideways as to the bending mandrel 8. The stopping means 9 shape an operational surface 12, preferably flat, suited to be struck by the section 2 at one directrix. This operational surface 12 is positioned orthogonal as to the fixed disc 11 and parallel to the feeding direction of the sections 2 to the bending head 6.

[0023] The operational surface 12 is positioned inside the circular trajectory accomplished by said eccentric pin 10, on a secant plane to this circular trajectory, so as to be struck at least at one respective portion by the metal sections 2 in process of working, depending on the rotational direction of the eccentric pin 10.

[0024] The operational surface 12 is positioned at a distance from the bending mandrel 8 which is substantially equal to the thickness of the metal sections 2 in process of working.

[0025] In particular the distance between the operational surface 12 of the stopping means 9 and the central mandrel 8 is suitable for defining a crossing central area 13 through which the sections 2 to be bent are longitudinally advanced. To be more precise, in the illustrated case, the operational surface 12 results protruding on the right and on the left as to said crossing central area 13 or, in a more advantageous way, is symmetric as to said central area 13, so that the previously cited opposite struck portions are substantially symmetric. According to the illustrated embodiment the stopping means 9 further provide for a curved surface 14 opposite to the operational surface 12 and positioned at the edge of the fixed disc 11, so as to be substantially lunette-like shaped. In order to adjust the distance between the stopping means 9 and the central mandrel 8, thus calibrating the crossing central area 13 depending on the cross-section of the metal sections 2, it is preferable that the stopping means 9 are constituted by a fixed body shaping the curved surface 14 and by an interchangeable spacer 15 carrying the operational surface 12; the body 14 and the spacer 15 are, for instance, connectable by means of a prismatic coupling (see fig. 7 and 8).

[0026] The fixed disc 11 is associated in idle way to a rotating disc 16, under which the eccentric pin 10 is adjustably constrained. In particular the rotating disc 16 is

provided with a plurality of holes 17 positioned along a series of radii 17, in order to adjust the positioning of the eccentric pin 10.

[0027] The rotating disc 16 is operated in rotation by actuator means of known type, not illustrated, so as to enable the eccentric pin 10 to accomplish alternate angular runs substantially around the central mandrel 8. In practice the eccentric pin 10 is able to bend a portion of the section 2 protruding from the crossing central area 13 bounded by the outline of the mandrel 8 and by the operational surface 12 of the stopping means 9.

[0028] According to the illustrated embodiment it is further present the feeding assembly 4, laterally approached to the frame 7 carrying the bending assembly 3 (in particular see fig. 9, 10, 12, 13). According to different embodiments it is also possible to provide that the bending assembly 3 is directly served by a straightening and/or shearing machine or unit with no need of any feeding assembly 4. In this case the feeding direction of the sections 2 to the bending operation can differ from the illustrated case, though involving no substantial change as to the apparatus according to the invention.

[0029] In case it should be provided, the feeding assembly 4 can be advantageously provided with a roller plane 18 constrained to the fixed frame 19, on which the sections 2 are positioned with the axis orthogonal to the axis of the same rollers. To be more precise, the sections 2 to be bent are suited to be longitudinally translated from an inlet position to a final position, at which they are headed, preferably bounded by a fixed stopping element and placed on one side of the bending assembly 3. This translation occurs thanks to the rotation of the rollers of the plane 18, operated for instance by means of a belt or chain drive, wrapped around a couple of pulleys or gear-wheels driven by a motor drive.

[0030] At the cited final translational position the roller plane 18 is juxtaposed to a small preferably idle roller table 20, fixed to a protruding bracket 21, in turn constrained to the frame 19. This roller table 20 is preferably less extended in transversal direction than the roller plane 18 is, as it is suited to support only the sections 2 intended to be bent in the same bending cycle. According to the illustrated case a couple of sections 2 are positioned on the roller table 20 (see fig. 9). Furthermore it is worth noting that the roller table 20 is positioned between the roller plane 18 and the bending assembly 3.

[0031] A longitudinal tracking device 22 is further constrained to the same wall of the frame 19, on which the bracket 21 carrying the roller table 20 is fixed, which is suited to drag a transferring device 23 at suitable phase relationship. The transferring device 23 shapes a body 24 carrying a couple of protruding arms 25, suited to be operated in alternative opening and closing motion by actuator means not illustrated, for example by a fluid-dynamic cylinder or by an electromagnet, preferably contained inside the body 24, so as to realize a couple of jaws. It is sufficient that only one of the arms 25 is mobile, for instance pivoted on the body 24, so as to rotate to-

wards opening or closing as to the arm remaining fixed.

[0032] The protruding arms 25 provide, at their free end, gripping tools 26 suitable for intercepting and in case retaining a terminal portion of the sections 2 to be bent (fig. 5 and 6). The gripping tools 26 are constituted by a couple of jaws preferably having a tall and open shape so as to be able to seize the sections 2 both in front, by a terminal portion, and sideways by an intermediate portion (fig. 14). Moreover the gripping tools 26 comprise respective end stop plates 27 orthogonally protruding from the arms 25, suitable for pushing the sections 2 by their end portion.

[0033] On the opposite side as to the protruding arms 25, the body 24 is fixed to a first plate 28 coupled in turn with a second plate 29 by the interposition of elastic means 30 associated to respective screw-type fastening means 31. In practice these means 30, 31 have the function to adjust the inclination of the longitudinal axis of the transferring device 23 as to the axis of the sections 2 fed to the bending head 6.

[0034] The second plate 29 is in turn constrained by means of threaded sleeves 32 to transversal centring means 33, for example of worm gear type, for instance operated manually by means of the crank 34 (see fig. 6). These transversal centring means 33 are suited to enable the transversal adjustment of the positioning of the transferring device 23 in order to centre it in the crossing central area 13.

[0035] The transversal centring means 33 are furthermore constrained by means of sleeves 35 to a supporting arm 36 orthogonally carried by the cited longitudinal tracking device 22.

[0036] This longitudinal tracking device 22 comprises a supporting plate 37 vertically positioned and carried sliding in longitudinal direction by means of a trolley 38 positioned at the top of the same. This trolley 38 substantially provides opposite little rollers 39 suited to roll along a longitudinal track 40 fixed to the frame 19. At the lower side of the trolley 38 the supporting plate 37 provides further supporting means 41 coupled with the frame 19 by means of known rolling means.

[0037] The supporting plate 37 is, as a rule, operated in alternate motion of approach and in case also of withdrawal as to the bending assembly 3, upon control of a motor drive 42 by means of linear drive means, for example of chain- or rack- type. According to the illustrated case this motor drive 42 is lowerly fixed to the supporting plate 37 at one side of the frame 19 and under the roller table 20.

[0038] The loading and unloading assembly 5 for the sections 2 comprises a fixed slipway 43 and a swinging arm 44, which in case acts in combination with an auxiliary loading device 45. The fixed slipway 43 substantially shapes a fixed arm carried overhanging by the frame 7 of the bending assembly 3, upperly carrying an inclined surface 46, preferably flat, suitable to enable the sections 2 to roll by gravity from an upper position to a lower position, at which the same sections 2 result engaged in

the crossing central area 13 previously described.

[0039] The swinging arm 44 comprises a loading portion 47 extending beyond an unloading portion 48. To be more precise, the loading portion 47 is separated from the unloading portion 48 by means of a shoulder 49 suited to prevent the sections 2 from rolling towards the unloading portion 48, while lying on the loading portion 47. Moreover the swinging arm 44 is pivoted to the frame 7 at the axis 50 positioned laterally to the bending assembly 3, on opposite side as to the feeding assembly 4.

[0040] A motor drive or actuator means of known type, not illustrated, controls the alternate operation of the swinging arm 44 from a lowered position, substantially horizontal, to an inclined lifted position. By the cited lowered position the loading portion 47 is situated beneath the idle roller table 20 (fig. 9). Upon rotation of the swinging arm 44 around the axis 50, the loading portion 47 is suited to raise as regards to the level of the roller table 20 up to the cited lifted position, thus lifting the rods over the fixed slipway 43. While the arm 44 keeps on raising, the rods beat by gravity against the shoulder 49 (fig. 10). By this intermediate raised configuration, the said loading portion 47 is suited to be positioned in a substantially parallel way as to the inclined surface 46 of the fixed slipway 43. By raising of the swinging arm 44, thanks to the same motion, the sections 2 bent in the previous working cycle are unloaded and, as said before, the sections to be bent in the subsequent working cycle are simultaneously lifted. The subsequent lowering of the swinging arm 44 leads the sections 2 to the contact with the inclined surface 46 of the fixed slipway 43 (fig. 11), on which the sections 2 slip down to fall onto the central area 13 between the stopping means 9 and the mandrel 8 (fig. 12).

[0041] It is worth noting that the loading portion 47 is connected to the unloading portion 48 by means of a hinge 51. In practice the loading portion 47 result active and in particular in solid with the unloading portion 48 when known blocking means, not illustrated, are inserted, thus preventing any swinging motion; on the contrary it results inactive and in particular swinging around the hinge 51 by its own weight, when these blocking means are disconnected. This disconnection is needed to avoid any interference with the sections 2, when they are lifted by the auxiliary loading device 45, or with the device 45 itself (fig. 13).

[0042] The auxiliary loading device 45 comprises a horizontal mobile frame 52 suitable for supporting the sections 2 to be bent at respective spaced out portions and for translating between a lowered configuration, beneath the roller plane 18, and a lifted configuration for the transfer of the sections 2 directly to the fixed slipway 43.

[0043] To be more precise the mobile frame 52 is suited to be translated upon control at alternate motion by a linear actuator 53 articulated to the frame 19 and to a lever 54 solid with a shaft 55 supported by the frame 19. The shaft 55 solidly carries a lever assembly 56 lowerly

articulated to the mobile frame 52 at a fixed axle 57. A chain drive 58 wrapped around a couple of gear wheels 59, 60, respectively solid with the shaft 55 and the fixed axle 57, converts the rotation of the shaft 55 into the rotation in opposite direction of the fixed axle 57, so that the mobile frame 52 is always kept in horizontal position.

[0044] A mobile storing structure 61 suitable for receiving and sorting the bent sections 2 is preferably juxtaposed downstream to the bending assembly 3. This mobile storing structure 61 preferably shapes a frame sliding in longitudinal direction by means of rolling means 63 on tracks 62 fixed to the floor.

[0045] According to the illustrated case the mobile storing structure 61 comprises a first space 64 and a second space 65 separated by dividing means 66 for the sorted lodging of respective bent sections 2. A swinging slipway 67 is upperly pivoted to the dividing means 66 and is suited to suitably close the first space 64. In particular this swinging slipway 67 is, for example, manually operated between a closing position for the first space 64 and a lifted position suited to allow the sections 2 to fall into the same space 64 beneath. It is worth noting that in the closed configuration the swinging slipway 67 appears inclined and in connection with the loading portion 48 of the swinging arm 44, in order to permit the transfer by falling of the bent sections 2 to the second space 65 (see fig. 11).

[0046] The functioning of the bending apparatus for bar-like metal sections according to the invention is described as follows.

[0047] In a first feeding phase, the sections 2 to be bent lie on the roller plane 18 of the feeding assembly 4 at an inlet position. In particular the sections 2 are positioned with axis orthogonal to the axis of the rollers.

[0048] Upon control of the operational means of the roller plane 18, the sections 2 advance in longitudinal direction till they halt against a reference stopping element, so that all sections 2 can be juxtaposed to the same reference surface, at the final configuration sideways to the bending assembly 3. Subsequently the operator transfers by rolling just the quantity of still straight sections 2 onto the roller table 20, which is necessary to accomplish one bending cycle by means of the bending head 6 (see fig. 9). During the previous bending cycle the same quantity of sections 2 has been bent and therefore stops at the bending head 6.

[0049] At this moment the swinging arm 44, carrying active the loading portion 47, is lifted from the lowered configuration beneath the roller table 20. Thanks to this lifting the loading portion 47 first engages lowerly the sections 2 lying on the roller table 20, then it lifts them and tilts till it overcomes the inclined surface 46 of the fixed slipway 43. At the same time the unloading portion 48 of the swinging arm 44 lowerly engages the bent sections 2 and lifts them. Thanks to the inclination reached at the lifted configuration, the unloading portion 48 functions as slipway for the bent sections 2, which thus slip towards the mobile storing structure 61 (see fig. 10).

[0050] On the contrary the sections 2 lying on the loading portion 47 are kept on it thanks to the presence of the shoulder 49, which separates the loading area from the unloading area on the swinging arm 44.

[0051] During the subsequent phase, the swinging arm 44 is lowered, during this motion, onto an intermediate position, at which the inclined surface 46 of the fixed slipway 43 lowerly engages the sections 2 to be bent. As a consequence while the loading portion 47 keeps on lowering, the sections 2 to be bent lean on the fixed slipway 43.

[0052] During the same phase the bent sections 2 slide from the unloading portion 48 to the mobile storing structure 61. According to the illustrated case (fig. 11) the swinging slipway 67 appears in the closed configuration and so the bent sections 2 slide on it towards the second space 65. Should this swinging slipway 67 be in lifted configuration it is evident that the bent sections 2 would fall directly onto the first space 64.

[0053] During the subsequent phase the sections 2 to be bent, lying on the fixed slipway 43, roll downwards thanks to the inclined surface 46 down to the crossing central area 13 of the bending head 6 (see fig. 12).

[0054] During this phase the transferring device 23, suitably centred by means of the transversal centring means 33 and the screw-type fastening means 31, is juxtaposed to the bending head 6 thanks to the operation of the motor drive 42. Once the terminal portion of the sections 2 is reached, the protruding arms 25 are suitably closed, so that the gripping tools 26 intercept and in case retain the terminal portion itself. In this configuration the end stop plates 27 are suited to stop the terminal portion of the sections 2, so as, during the subsequent approaching motion of the transferring device 23, they are suited to push them towards the bending head 6, in suitable phase relationship as to the bending operation and in controlled way (see fig. 1). During this phase the eccentric pin 10 is in rest configuration or in a configuration not interfering with the sections 2.

[0055] During the subsequent bending phase the eccentric pin 10 is rotated around the mandrel 8, while the stopping means 9 function as end stop for the sections 2, so as to accomplish a first bend (fig. 2). The transferring device 23 keeps fixed while, during this phase, it retains the terminal portion of the sections 2. It is worth noting that according to the illustrated case the bend occurs by clockwise rotation of the eccentric pin 10.

[0056] After the eccentric pin 10 has come back to the rest configuration, the transferring device 23 is furthermore brought near in order to push the intercepted portion of the sections 2 till the edge of the fixed disc 11. So a portion which is very close to the terminal one is inserted into the crossing central area 13 in order to be bent (see fig. 3, 3a).

[0057] Finally a second bending operation is accomplished through a further angular run of the eccentric pin 10. According to the case illustrated in fig. 4, this rotation is clockwise and, in particular, the operational surface 12

stops the sections 2 by its left portion as regards to the central area 13. The transferring device 23 keeps fixed at the edge of the fixed disc 16 in order to intercept the terminal portion of the previously pushed sections 2.

[0058] As it is illustrated in fig. 4a, the same eccentric pin 10 can accomplish bending operations by anticlockwise angular runs too. In this case the jaws 25 are opened out, the transferring device 23 is withdrawn in longitudinal direction from the bending head 6 so that it cannot interfere with the anticlockwise angular run of the eccentric pin 10. In process of bending, the sections 2 are steadily stopped by the stopping means 9 which, in this case, oppose the right portion of the operational surface 12, as regards to the central area 13. The latter solution advantageously allows to manufacture pieces with their last bent positioned closer to the end portion than by means of the previously described solution. In fact by this solution the curve is obtained from the end portion instead of an intermediate one.

[0059] Should elongated sections be worked, after the automatic or manual loading operation, the operator takes the section to a stop against a suitable stopping element, in order to position its front end portion with respect to a point of reference or to a zero point. This stopping element is usually represented by a mobile stick positioned on the frame carrying the bending assembly 3. Otherwise it can occur that the operator has to position the centre of the section in centrally positioned pincers.

[0060] The cycle goes on with the tightening of the sections by the gripping tools 26 of the transferring device 23. It is worth noting that in this case the jaws of the gripping tools 26 work by the upper portion and seize the section by a definite point determined by the apparatus managing program. (see fig. 14 and 14a). On the contrary should short sections be worked, as it is illustrated for example in fig. 15 and 15a, the gripping tools 26 of the transferring device 23 seize the section to be bent by a rear end. This rear end of the section is first positioned by the operator against stopping elements carried by the same transferring device 23, preferably positioned between both jaws of the gripping tools 26. The rear end of the section to be bent is tightened by the said gripping tools 26 of the transferring device 23. Then the advance is operated upon control of the same transferring device 23 so as to translate the section 2 in process of working in longitudinal direction, in suitable phase relationship as to the bending operation of the same section 2, accomplished by the bending assembly 3. So the first bend is made, by the angular displacement of the eccentric pin 10; when the desired bend is obtained, the eccentric pin 10 comes back to the initial position.

[0061] The cited phases repeat in order to accomplish further bents up to the completion of the bent piece. It is worth observing that even the last bend can be accomplished according to the described sequence, thanks to the fact that the gripping tools 26 can overcome the bending assembly 3 and can be brought near very close the bending head 6.

[0062] Should the last side of the bent piece to be obtained be even shorter than it can be realized by the previous sequence, the described phases are repeated until the completion of the penultimate bent. At this point the working cycle is halted and the intervention of the operator is required, for example advised by the emission of a suitable acoustic and/or visual signal, in order to retain the section in process of working on a plane; as an alternative to the manual support, it is possible to provide for further gripping means, for example of magnetic type, suitable for seizing the sections or simply for suitable supporting means.

[0063] The cycle goes on by controlling the opening of the gripping tools 26 of the transferring device 23 in order to release the rear end of the section in process of working and the withdrawal of the same gripping tools 26 for avoiding any interference during the accomplishment of the last bend. So the eccentric pin 10 is free to rotate in opposite direction up to obtain the desired bend (see fig. 4a). After any further gripping means have opened, the bent piece is finally unloaded in automatic or manual way.

[0064] In the end, should elongated sections be bent, which require a last bend of very small size, as it typical occurs in case of "big stirrups" having sides up to 1,5-2,5 metres, the working operation is accomplished by tightening a controlled portion of the section to be bent by means of the gripping tools 26 of the transferring device 23, as previously described, till the accomplishment of the penultimate bend. At this point the working cycle is halted and the section 2 in process of working is retained, engaged between the bending mandrel 8 and the eccentric pin 10, which in turn is halted in an active position, that is before the eccentric pin 10 starts its run back. Then the jaws of the gripping tools 26 of the transferring device 23 are opened out in order to release the previously seized portion of the section and the same gripping tools 26 are withdrawn till they engage the rear end of the section. After the gripping tools 26 have tightened the rear end of the section, the eccentric pin 10 is taken to an inactive position in order to let the section free. The transferring device 23 is operated again to advance in order to have the section translate in longitudinal direction, in suitable phase relationship with respect to the accomplishment of the latter bend.

[0065] For working elongated sections, it is alternatively possible to provide that the gripping tools 26 are substituted by a simple end stop device, carried by the transferring device 23, and able to overcome the frame of the bending assembly 3 in order to push the sections in process of working till a position very close to the bending head 6. In this case, after the rear end of the section to be bent has been positioned against said end stop device, the controlled advance of the transferring device 23 is operated, in order to translate the section, pushed by the same end stop device, in longitudinal direction, in suitable phase relationship with respect to the bending operation of section portions, until the last bend is completed.

[0066] The apparatus provides for a further way of loading the sections 2 onto the bending head 6, that is through the auxiliary loading device 45. The auxiliary loading device 45 lifts the mobile frame 52 thanks to the operation of the linear actuator 53, picks up the sections 2 to be bent and takes them close to the fixed slipway 43 (fig. 13). In particular the blocking means for the loading portion 47 of the swinging arm 44 are disconnected and consequently this portion is inactive. To be more precise, only the unloading portion 48 is active, while the loading portion 47 swings beneath the swinging arm 44 by its own weight. After the sections 2 have come on the fixed slipway 43, they are bent as previously described.

[0067] The apparatus according to the invention reaches the aim of operating the bending of sections and the like in automatic way, at their ends and, in particular, up to 180° angles in bending opposite directions.

[0068] This result is mainly due to the presence of the transferring device 23, which provides for setting side by side the end portions of the sections 2 to be bent to the bending head 6 in a very close way.

[0069] Moreover the stopping means 9 allow to operate bends according to opposite bending directions, by exerting an effective stopping action on respective portions of the sections 2.

[0070] Therefore the apparatus advantageously allows to accomplish different types of bends by the same bending head 6, while for this aim the known apparatuses require at least a couple of bending devices; in particular the apparatus reaches the aim of accomplishing bends very close to the section ends, which cannot be realized by the known apparatuses. The known apparatuses need to halt in order to substitute the central templates or the separate stopping elements. On the contrary the bending assembly 3 can realize bends up to 180°, the so-called "hooks", on both section ends with no need to replace the stopping means.

[0071] It is evident that the apparatus according to the invention widens the range of products which can be realized and optimizes the working times, by reducing the duration of the halts. For this reason and for the structural simplicity it results less expensive than the usual apparatuses.

[0072] The apparatus according to the invention is very versatile as it allows to bend sections 2 of any diameter and size. In fact the crossing central area 13 can be easily adjusted to the diameter of the sections simply substituting the interchangeable spacer 15. Moreover the sections 2 with reduced longitudinal dimensions can be perfectly bent thanks to the transferring device 23.

[0073] A special feature of the apparatus is the fact that it is served by automatic loading and unloading devices suited to facilitate the operations, otherwise manual, of loading the bending head 6 and of unloading the bent sections 2. In particular the mobile storing structure 61 enables both the storing and the transfer of the bent sections. These devices avoid manual operations which could be dangerous as well as exhausting.

[0074] Materials adopted for the actual realization of the invention, as well as their shapes and sizes, can be various, depending on the requirements.

[0075] 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 scope of each element identified by way of example by such reference signs.

Claims

1. Bending apparatus for bar-like metal sections comprising at least a bending assembly (3) provided with a bending mandrel (8) and with an eccentric bending pin (10) for bending the sections (2), suited to accomplish angular runs around said mandrel (8), comprising a transferring device (23) suited to longitudinally translate the metal sections (2) in process of working and to be set side by side to said bending assembly (3), by overcoming the frame (7) of said bending assembly (3), in order to insert a portion of said metal sections (2) in a crossing central area (13) defined between said bending mandrel (8) and stopping means (9) positioned sideways as to said bending mandrel (8);
wherein said stopping means (9) shape an operational surface (12) inside the circular trajectory accomplished by said eccentric pin (10), on a secant plane to said circular trajectory, so as to be struck at least at one respective portion, depending on the rotational direction of said eccentric pin (10), by said metal sections (2) in process of working;
characterized in that said stopping means (9) are constituted by a fixed body and by an interchangeable spacer (15) shaping said operational surface (12) and suited to be associated with said fixed body itself.
2. Bending apparatus according to claim 1, **characterized in that** said transferring device (23) shapes a body (24) which carries in motion end stop means (27) suitable for pushing said sections (2) by an end portion.
3. Bending apparatus according to claim 2, **characterized in that** said end stop means (27) suitable for pushing said sections (2) shape a sort of drawer.
4. Bending apparatus according to claim 1, **characterized in that** said transferring device (23) shapes a body (24) carrying a couple of protruding arms (25), suited to be operated in alternative opening and closing motion by respective actuator means.
5. Bending apparatus according to claim 4, **characterized in that** said protruding arms (25), at their free ends, provide gripping tools (26) suitable for intercepting and retaining a terminal portion of said sections (2) to be bent.
6. Bending apparatus according to claim 5, **characterized in that** said gripping tools (26) are constituted by a couple of jaws having a tall and open shape so as to be able to seize said sections (2) both in front, by a terminal portion, and sideways by an intermediate portion.
7. Bending apparatus according to claim 1, **characterized in that** said transferring device (23) has adjustable inclination as to the axis of said sections (2) fed to said bending assembly (3), being said transferring device (23) fixed by the interposition of elastic means (30) associated with screw-type fastening means (31).
8. Bending apparatus according to claim 1, **characterized in that** said transferring device (23) is constrained by means of transversal centring means (33) in order to allow the transversal adjustment of the positioning of the axis of the sections (2) to be bent as to the bending devices.
9. Bending apparatus according to claim 1, **characterized in that** said transferring device (23) is operated in discontinuous motion of approach and withdrawal as to said bending assembly (3), upon control of a motor drive (42) by means of linear drive means of known type.
10. Bending apparatus according to claim 1, **characterized in that** said transferring device (23) is carried by a longitudinal tracking device (22), comprising a supporting plate (37) sliding in longitudinal direction along a longitudinal track (40) by means of a trolley (38) and supporting means (41).
11. Bending apparatus according to claim 1, **characterized in that** said operational surface (12) of said stopping means (9) is positioned at a distance from said bending mandrel (8) which is substantially equal to the thickness of said metal sections (2) in process of working.
12. Bending apparatus according to claim 1, **characterized in that** said stopping means (9) have such a fixed position opposite to said bending mandrel (8) that no displacement is required in order to bend both ends of said sections (2).
13. Bending apparatus according to claim 1, **characterized in that** said operational surface (12) is substantially symmetrical as to said crossing central area (13).

14. Bending apparatus according to claim 1, **characterized in that** it comprises a feeding assembly (4) for said sections (2), shaping a motorized roller plane (18) suitable for feeding said sections (2) in longitudinal direction.
15. Bending apparatus according to claim 14, **characterized in that** said feeding assembly (4) comprises an idle roller table (20), sideways juxtaposed to said bending assembly (3).
16. Bending apparatus according to claim 1, **characterized in that** it comprises a loading and unloading assembly (5) constituted by a fixed slipway (43) for feeding the sections (2) to said bending assembly (3) and by a swinging arm (44) laterally pivoted to said bending assembly (3), mobile between a lowered position beneath said bending assembly (3) and an inclined lifted position for unloading said sections (2).
17. Bending apparatus according to claim 16, **characterized in that** said fixed slipway (43) substantially shapes a fixed arm carried overhanging said bending assembly (3), upperly carrying an inclined surface (46) preferably flat, suitable to enable the sections (2) to roll by gravity from an upper position to a lower position, at which said sections (2) result inserted in said crossing central area (13).
18. Bending apparatus according to claim 16, **characterized in that** said swinging arm (44) comprises a loading portion (47) separated from an unloading portion (48) by means of a shoulder (49), being said loading portion (47) associated with said unloading portion (48) by means of a hinge (51), suited to be suitably blocked by blocking means.
19. Bending apparatus according to claim 14; **characterized in that** it comprises an auxiliary loading device (45) comprising a horizontal mobile frame (52) suitable for receiving said sections (2) to be bent and to translate between a lowered configuration, beneath said roller plane (18), and a lifted configuration for the transfer of said sections (2) to said bending assembly (3).

Patentansprüche

1. Biegevorrichtung für stabartige Metallabschnitte, mindestens eine Biegeanordnung (3) umfassend, die mit einem Biegedorn (8) und mit einem exzentrischen Biegebolzen (10) zum Biegen der Abschnitte (2) ausgestattet und dafür geeignet ist, winkelförmige Umläufe um den Dorn (8) auszuführen, eine Überführungseinrichtung (23) umfassend, die dafür geeignet ist, die Metallabschnitte (2) im Arbeitspro-

zess in Längsrichtung zu verrücken und neben die Biegeanordnung (3) gesetzt zu werden, indem der Rahmen (7) der Biegeanordnung (3) überwunden wird, um einen Teil der Metallabschnitte (2) in einen Durchquerungsmittelbereich (13) einzusetzen, der zwischen dem Dorn (8) und Anschlagmitteln (9) definiert ist, die seitlich des Biegedorns (8) angeordnet sind, wobei die Anschlagmittel (9) an einer Sekantenebene zur kreisförmigen Bewegungsbahn eine Wirkfläche (12) im Inneren der kreisförmigen Bewegungsbahn bilden, die durch den exzentrischen Bolzen (10) ausgeführt wird, so dass die Metallabschnitte (2) im Arbeitsprozess, abhängig von der Drehbewegung des exzentrischen Bolzens (10), mindestens an einem entsprechenden Teil auftreffen, **dadurch gekennzeichnet, dass** die Anschlagmittel (9) von einem feststehenden Körper und einem austauschbaren Abstandshalter (15) gebildet sind, der die Wirkfläche (12) bildet und dafür geeignet ist, mit dem feststehenden Körper selbst verbunden zu sein.

2. Biegevorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** die Überführungseinrichtung (23) einen Körper (24) bildet, der bewegliche Endanschlagsmittel (27) trägt, die zum Schieben der Abschnitte (2) an einem Endabschnitt geeignet ist.
3. Biegevorrichtung nach Anspruch 2, **dadurch gekennzeichnet, dass** die Endanschlagsmittel (27), die zum Schieben der Abschnitte (2) geeignet sind, eine Art Schubeinheit bilden.
4. Biegevorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** die Überführungseinrichtung (23) einen Körper (24) bildet, der ein Paar hervorstehender Arme (25) trägt, die dazu geeignet sind, durch entsprechende Betätigungsmittel in einer abwechselnden Öffnungs- und Verschlussbewegung betrieben zu werden.
5. Biegevorrichtung nach Anspruch 4, **dadurch gekennzeichnet, dass** die hervorstehenden Arme (25) an ihren freien Enden Greifwerkzeuge (26) bereitstellen, die dazu geeignet sind, einen Endteil der zu biegenden Abschnitte (2) aufzufangen und zu halten.
6. Biegevorrichtung nach Anspruch 5, **dadurch gekennzeichnet, dass** die Greifwerkzeuge (26) von einem Paar Klemmbacken gebildet werden, die eine weite und offene Form aufweisen, so dass sie in der Lage sind, die Abschnitte (2) sowohl vorn an ihrem Endteil als auch seitlich an einem Zwischenteil zu ergreifen.
7. Biegevorrichtung nach Anspruch 1, **dadurch ge-**

- kennzeichnet, dass** die Überführungseinrichtung (23) eine in Bezug auf die Achse der Abschnitte (2), die der Biegeanordnung (3) zugeführt werden, einstellbare Neigung aufweist, wobei die Überführungseinrichtung (23) durch den Einschub elastischer Mittel (30), die mit schraubenähnlichen Befestigungsmitteln (31) angebracht sind, befestigt ist.
8. Biegevorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** die Überführungseinrichtung (23) mittels quer verlaufender Zentrierungsmittel (33) eingespannt ist, um die Einstellung der Anordnung der Achse der an den Biegeeinrichtungen zu biegenden Abschnitte (2) in Querrichtung zu ermöglichen.
9. Biegevorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** die Überführungseinrichtung (23) in diskontinuierlicher Bewegung des Anrückens und Zurückziehens in Bezug auf die Biegeanordnung (3) durch Steuerung eines Motorantriebes (42) mit Hilfe linearer Antriebsmittel bekannter Art betrieben wird.
10. Biegevorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** die Überführungseinrichtung (23) von einer längsgerichteten Spureinrichtung (22) getragen wird, die eine Stützplatte (37) umfasst, die mit Hilfe eines Spurwagens (38) und Stützmitteln (41) in Längsrichtung eine längsgerichtete Spur (40) entlanggleitet.
11. Biegevorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** die Wirkfläche (12) der Anschlagmittel (9) in einem Abstand zum Biegedorn (8) angeordnet ist, der im Wesentlichen gleich der Dicke der Metallabschnitte (2) im Arbeitsprozess ist.
12. Biegevorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** die Anschlagmittel (9) eine feststehende Position gegenüber dem Biegedorn (8) aufweisen, so dass keine Verlagerung erforderlich ist, um beide Enden der Abschnitte (2) zu biegen.
13. Biegevorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** die Wirkfläche (12) in Bezug auf den Durchquerungsbereich (13) im Wesentlichen symmetrisch ist.
14. Biegevorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** sie eine Zufuhranordnung (4) für die Abschnitte (2) umfasst, die einen mit Motor betriebene Rollebene (18) bildet und für die Zufuhr der Abschnitte (2) in Längsrichtung geeignet ist.
15. Biegevorrichtung nach Anspruch 14, **dadurch gekennzeichnet, dass** die Zufuhranordnung (4) einen nicht angetriebenen Rollgang (20) umfasst, der seitlich an der Biegeanordnung (3) bereitgestellt ist.
16. Biegevorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** sie eine Be- und Entladeanordnung (5) umfasst, die von einem feststehenden Gleitweg (43) für die Zufuhr der Abschnitte (2) zur Biegeanordnung (3) und einem Schwenkarm (44) gebildet ist, der seitlich an die Biegeanordnung (3) angelenkt und zwischen einer abgesenkten Position unter der Biegeanordnung (3) und einer geneigten angehobenen Position zum Entladen der Abschnitte (2) beweglich ist.
17. Biegevorrichtung nach Anspruch 16, **dadurch gekennzeichnet, dass** der feststehende Gleitweg (43) im Wesentlichen einen feststehenden Arm bildet, der die Biegeanordnung (3) überhängend getragen wird und obenauf eine geneigte Fläche (46) trägt, vorzugsweise eben, die dazu geeignet ist, das Rollen der Abschnitte (2) von einer oberen Position zu einer unteren Position, an der die Abschnitte (2) im Ergebnis in den Durchquerungsbereich (13) eingeführt sind, durch Schwerkraft zu ermöglichen.
18. Biegevorrichtung nach Anspruch 16, **dadurch gekennzeichnet, dass** der Schwenkarm (44) einen Beladeteil (47) umfasst, der von einem Entladeteil (48) mit Hilfe eines Absatzes (49) getrennt ist, wobei der Beladeteil (47) mit dem Entladeteil (48) mit Hilfe eines Gelenks (51) verbunden ist, das dazu geeignet ist, durch Arretiermittel geeignet arretiert zu werden.
19. Biegevorrichtung nach Anspruch 14, **dadurch gekennzeichnet, dass** sie eine Hilfsbeladeeinrichtung (45) umfasst, die einen horizontal beweglichen Rahmen (52) umfasst, der für die Aufnahme der zu biegenden Abschnitte (2) geeignet ist und zwischen einer abgesenkten Gestaltung unter der Rollebene (18) und einer angehobenen Gestaltung für die Überführung der Abschnitte (2) zur Biegeanordnung (3) verrückt werden kann.

Revendications

1. Appareil de cintrage pour des sections métalliques en forme de barres comprenant au moins un groupe de cintrage (3) doté d'un mandrin de cintrage (8) et d'une épingle excentrique (10) de cintrage des sections (2) propre à accomplir une course angulaire autour dudit mandrin de cintrage (8), comprenant un dispositif de transfert (23) propre à opérer la translation en direction longitudinale des sections (2) métalliques en cours de traitement et qui peut être rapproché côte à côte audit groupe de cintrage (3), surmontant la plaque d'assise (7) dudit groupe de cintrage (3), pour introduire une portion des mêmes sections (2) métalliques au niveau d'une section cen-

- trale (13) de passage définie entre ledit mandrin de cintrage (8) et des moyens d'arrêt (9) positionnés latéralement par rapport audit mandrin de cintrage (8);
dans lequel lesdits moyens d'arrêt (9) présentent une surface opérationnelle (12) disposée à l'intérieur de la trajectoire circulaire suivie par ladite épingle excentrique (10), sur un plan sécant ladite trajectoire circulaire, de manière à arrêter lesdites sections (2) métalliques en cours de traitement au moins avec une portion respective en fonction du sens de rotation de ladite épingle excentrique (10);
caractérisé en ce que lesdits moyens d'arrêt (9) sont constitués d'un corps fixe et d'une épaisseur (15) interchangeable qui forme ladite surface opérationnelle (12) et propre à être associée au même corps fixe.
2. Appareil de cintrage selon la revendication 1, **caractérisée en ce que** ledit dispositif de transfert (23) forme un corps (24) qui porte en mouvement des moyens de butée (27) propres à pousser lesdites sections (2) au niveau d'une portion d'extrémité.
 3. Appareil de cintrage selon la revendication 2, **caractérisé en ce que** lesdits moyens de butée (27) propres à pousser lesdites sections (2) forment une sorte de caisse.
 4. Appareil de cintrage selon la revendication 1, **caractérisé en ce que** ledit dispositif de transfert (23) forme un corps (24) qui porte une paire de bras en saillie (25), propres à être actionnés en mouvement alternatif relatif d'ouverture et fermeture par des moyens actionneurs respectifs.
 5. Appareil de cintrage selon la revendication 4, **caractérisé en ce que** lesdits bras en saillie (25) prévoient à leur extrémité libre des moyens de préhension (26) propres à intercepter et retenir une portion terminale desdites sections (2) à cintrer.
 6. Appareil de cintrage selon la revendication 5, **caractérisé en ce que** lesdits moyens de préhension (26) consistent en une paire de mâchoires ayant une conformation haute et ouverte de façon à pouvoir agripper lesdites sections (2) aussi bien en tête au niveau d'une portion terminale, que de côté au niveau d'une portion intermédiaire.
 7. Appareil de cintrage selon la revendication 1, **caractérisé en ce que** ledit dispositif de transfert (23) a une inclinaison réglable par rapport à l'axe desdites sections (2) alimentées audit groupe de cintrage (3), ledit dispositif de transfert (23) étant fixé au moyen de l'interposition de moyens élastiques (30) associés à des moyens de fixation à vis (31).
 8. Appareil de cintrage selon la revendication 1, **caractérisé en ce que** ledit dispositif de transfert (23) est contraint par des moyens de centrage transversal (33) pour permettre le réglage transversal du positionnement de l'axe desdites sections (2) à cintrer par rapport aux dispositifs de cintrage.
 9. Appareil de cintrage selon la revendication 1, **caractérisé en ce que** ledit dispositif de transfert (23) est actionné en mouvement discontinu de rapprochement et éloignement par rapport audit groupe de cintrage (3) sous commande d'un organe moteur (42) à travers des moyens de transmission linéaire de type connu.
 10. Appareil de cintrage selon la revendication 1, **caractérisé en ce que** ledit dispositif de transfert (23) est porté par un dispositif de guide longitudinal (22), comprenant une plaque de support (37) coulissant en direction longitudinale le long d'un guide longitudinal (40) au moyen d'un chariot (38) et de moyens de support (41).
 11. Appareil de cintrage selon la revendication 1, **caractérisé en ce que** ladite surface opérationnelle (12) des moyens d'arrêt (9) est disposée à une distance dudit mandrin de cintrage (8) qui est essentiellement égale à l'épaisseur desdites sections (2) métalliques en cours de traitement.
 12. Appareil de cintrage selon la revendication 1, **caractérisé en ce que** lesdits moyens d'arrêt (9) ont une position fixe opposée audit mandrin de cintrage (8) de sorte qu'aucun déplacement n'est requis pour cintrer les deux extrémités desdites sections (2).
 13. Appareil de cintrage selon la revendication 1, **caractérisé en ce que** ladite surface opérationnelle (12) est essentiellement symétrique par rapport à ladite section centrale (13) de passage.
 14. Appareil de cintrage selon la revendication 1, **caractérisé en ce qu'il** comprend un groupe d'alimentation (4) desdites sections (2) formant un plan à galets (18) motorisé propre à alimenter lesdites sections (2) en direction longitudinale.
 15. Appareil de cintrage selon la revendication 14, **caractérisé en ce que** ledit groupe d'alimentation (4) comprend une table à rouleaux (20) qui tourne à vide accostée latéralement audit groupe de cintrage (3).
 16. Appareil de cintrage selon la revendication 1, **caractérisé en ce qu'il** comprend un groupe de chargement et déchargement (5) constitué par une glissière fixe (43) pour l'alimentation desdites sections (2) audit groupe de cintrage (3) et par un bras oscillant (44) qui pivote latéralement audit groupe de cintrage

(3), mobile entre une position abaissée en dessous dudit groupe de cintrage (3) et une position soulevée inclinée pour le déchargement desdites sections (2).

17. Appareil de cintrage selon la revendication 16, **caractérisé en ce que** ladite glissière fixe (43) forme essentiellement un bras fixe porté en saillie par ledit groupe de cintrage (3), portant à la partie supérieure une surface inclinée (46) préférablement plate, propre à permettre le roulement par gravité desdites sections (2) depuis une position supérieure vers une position inférieure au niveau de laquelle lesdites sections (2) résultent introduites dans ladite section centrale (13) de passage. 5 10
18. Appareil de cintrage selon la revendication 16, **caractérisé en ce que** ledit bras oscillant (44) comprend une portion de chargement (47) séparée d'une portion de déchargement (48) au moyen d'un épaulement (49), ladite portion de chargement (47) étant associée à ladite portion de déchargement (48) par une charnière (51), propre à être opportunément bloquée par des moyens de blocage. 15 20
19. Appareil de cintrage selon la revendication 14, **caractérisé en ce qu'il** comprend un dispositif auxiliaire de chargement (45) comprenant un cadre mobile (52) horizontal propre à recevoir lesdites sections (2) à cintrer et à opérer la translation entre une configuration abaissée, en dessous dudit plan à gâlets (18), et une configuration soulevée pour le transfert desdites sections (2) audit groupe de cintrage (3). 25 30

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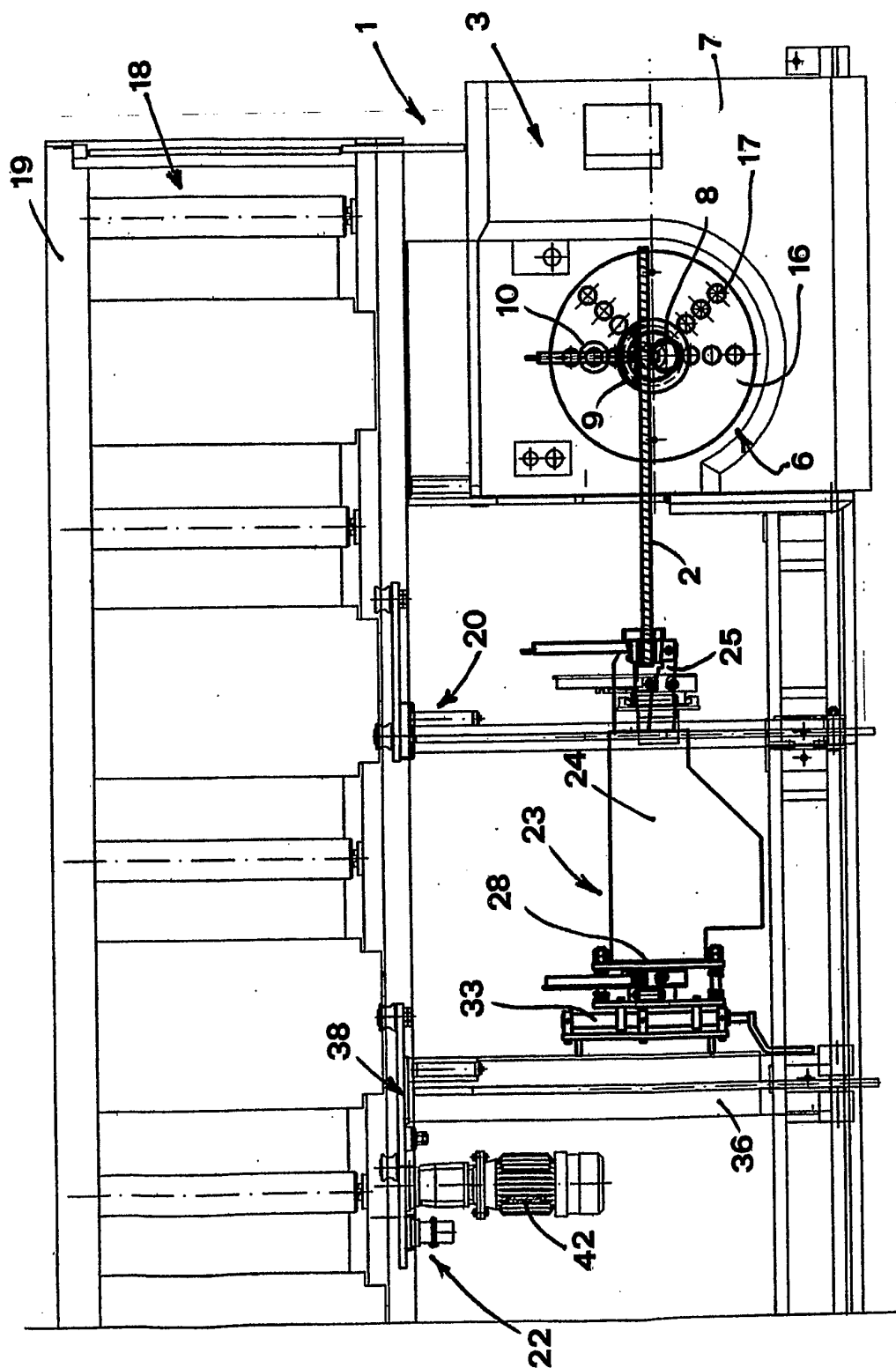
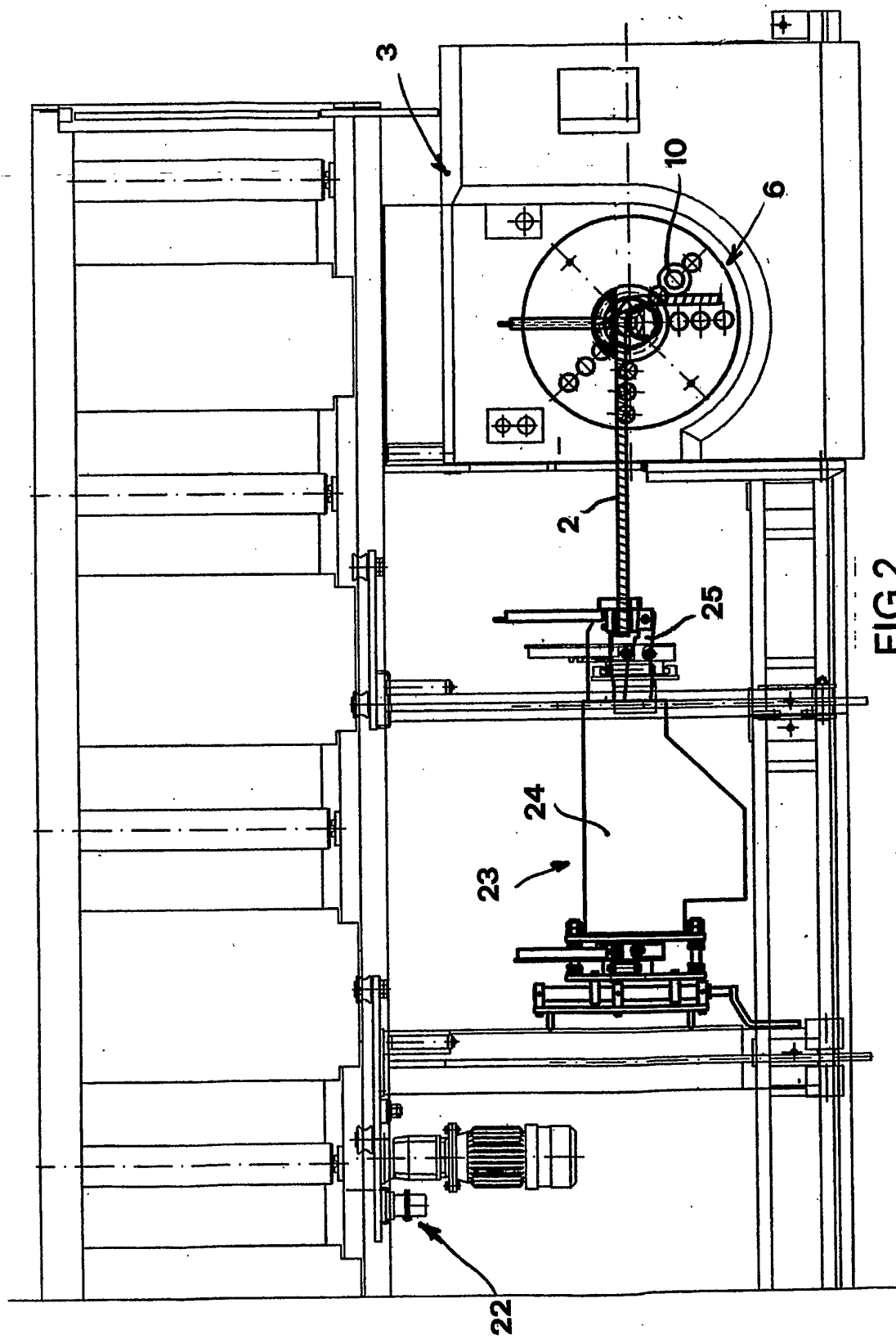
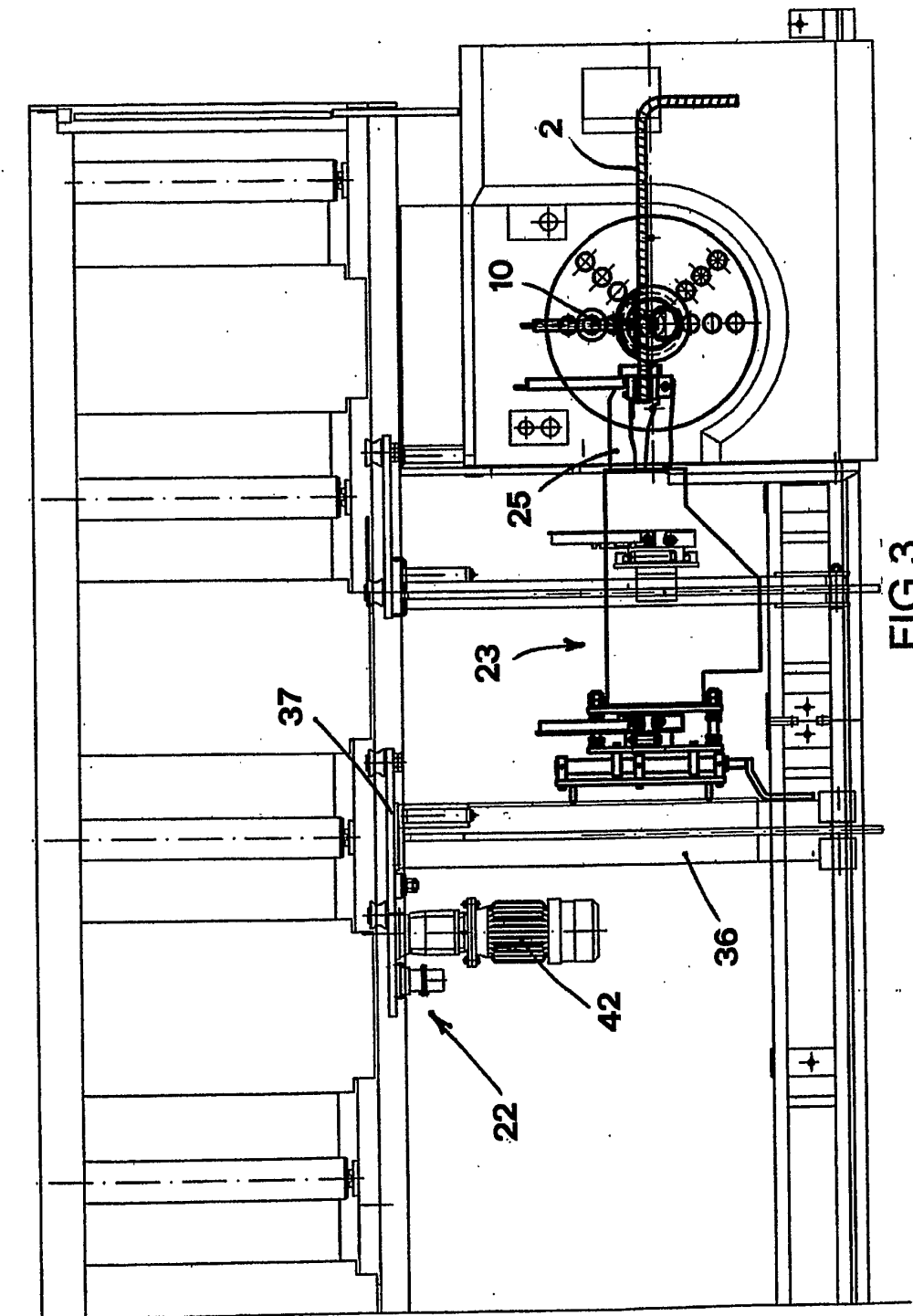
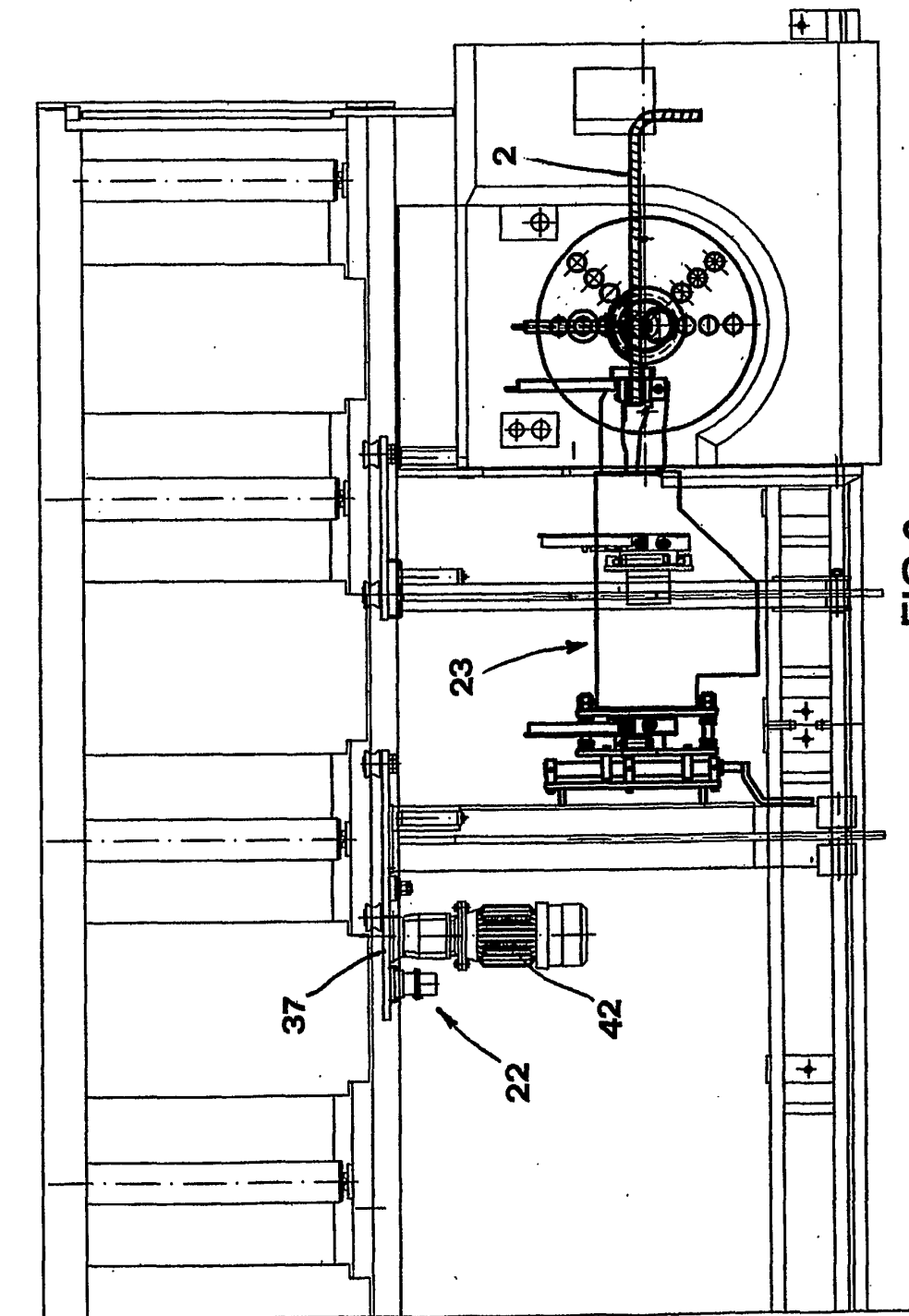
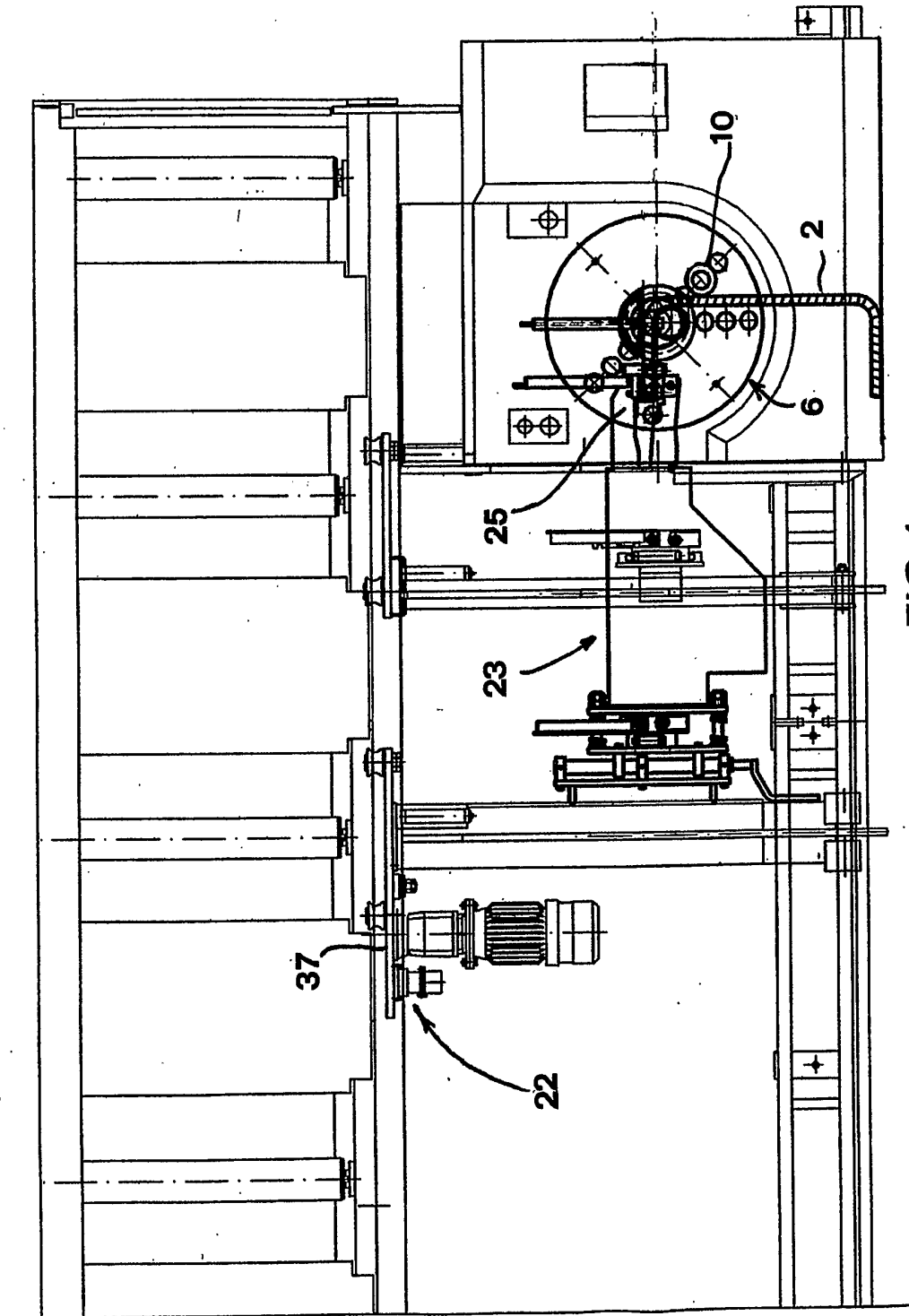


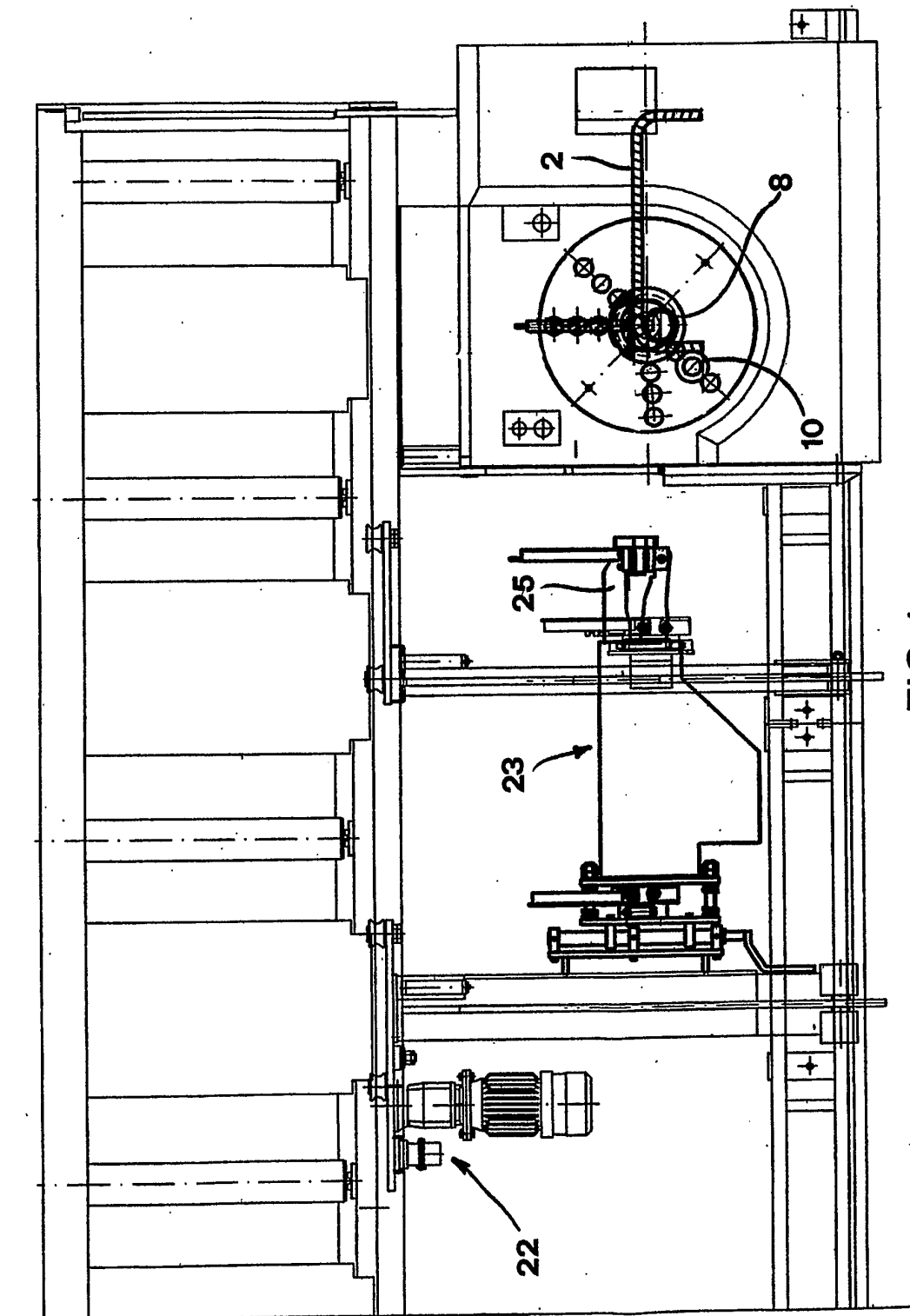
FIG.1











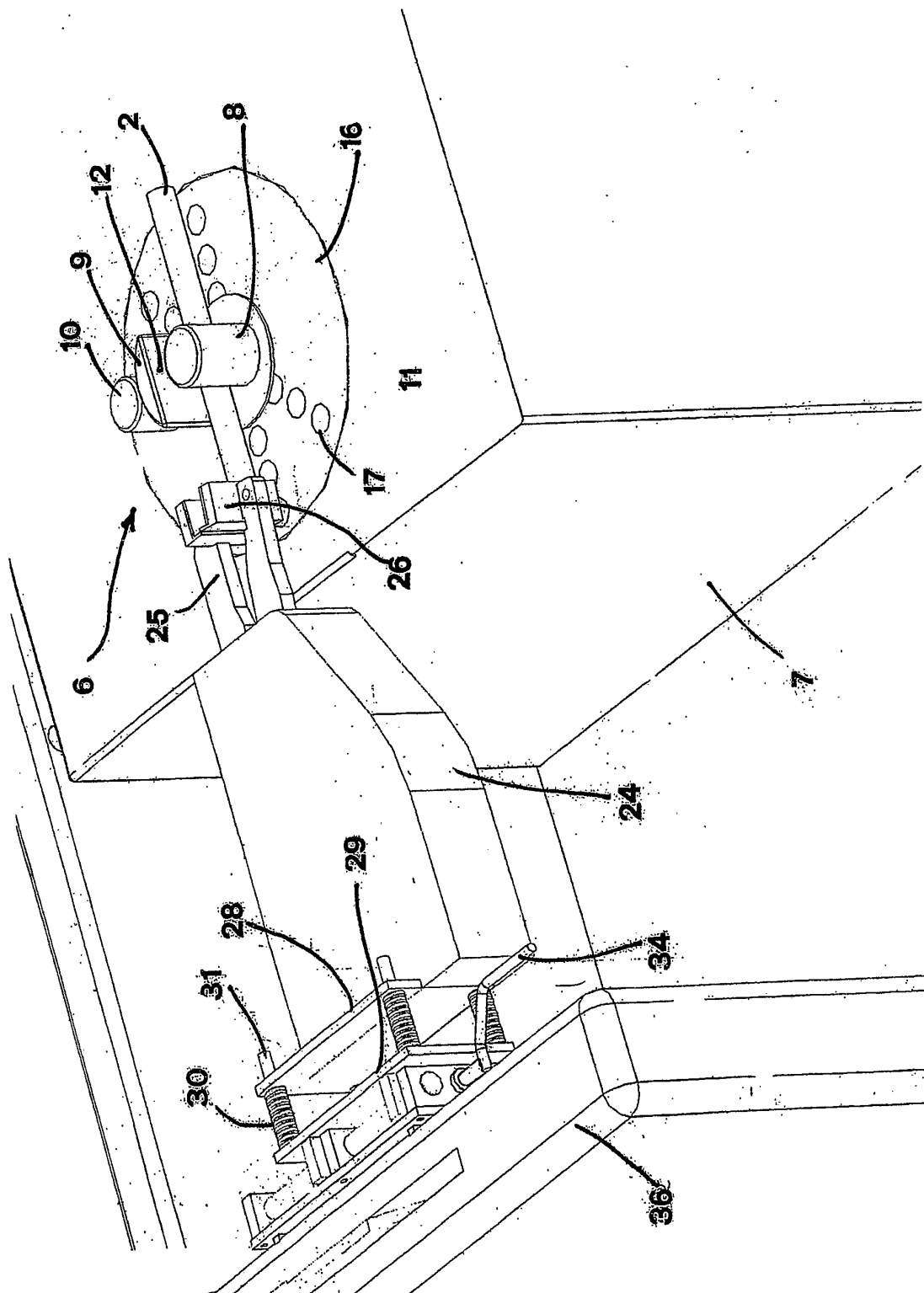


FIG. 5

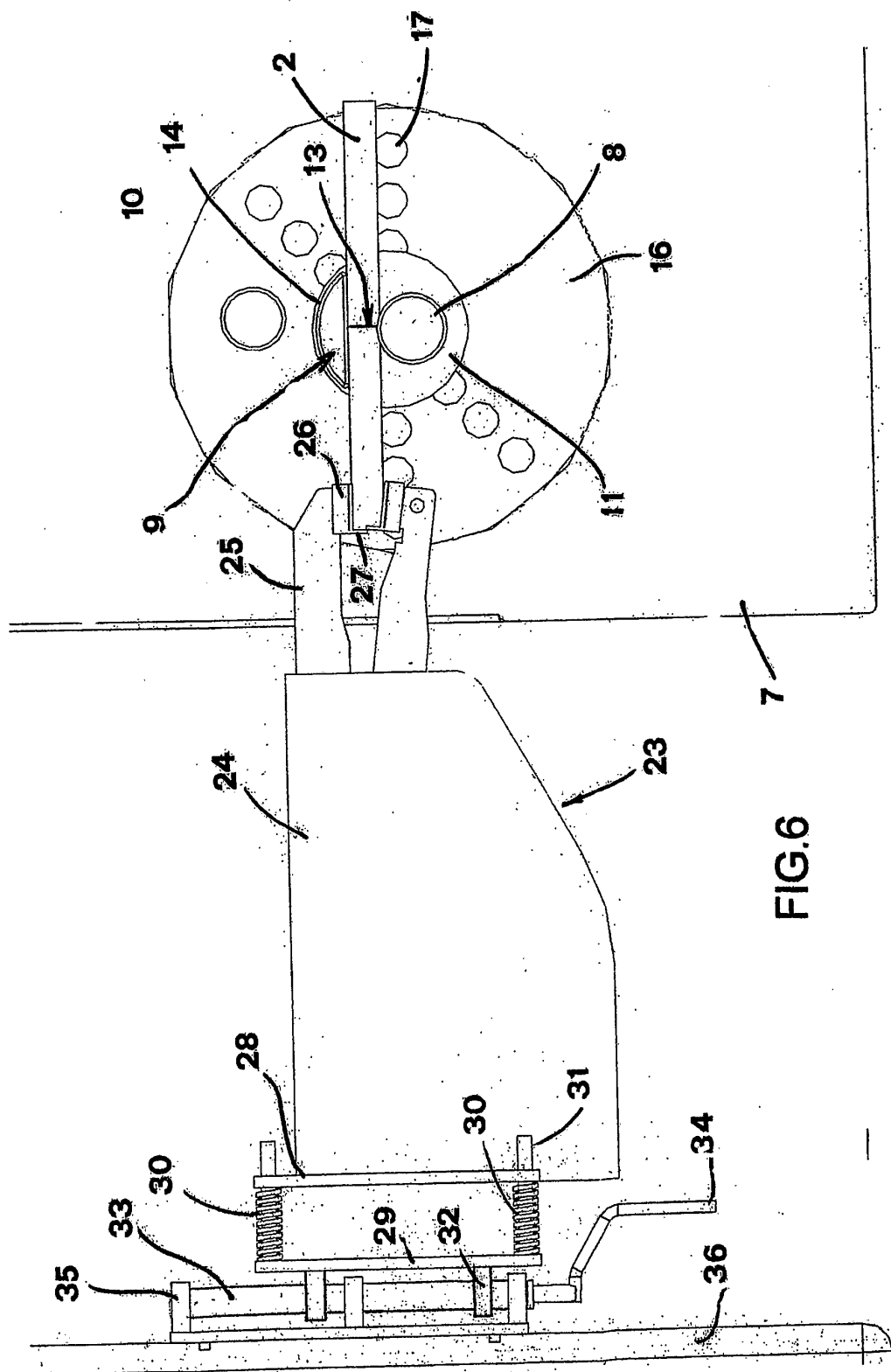


FIG. 6

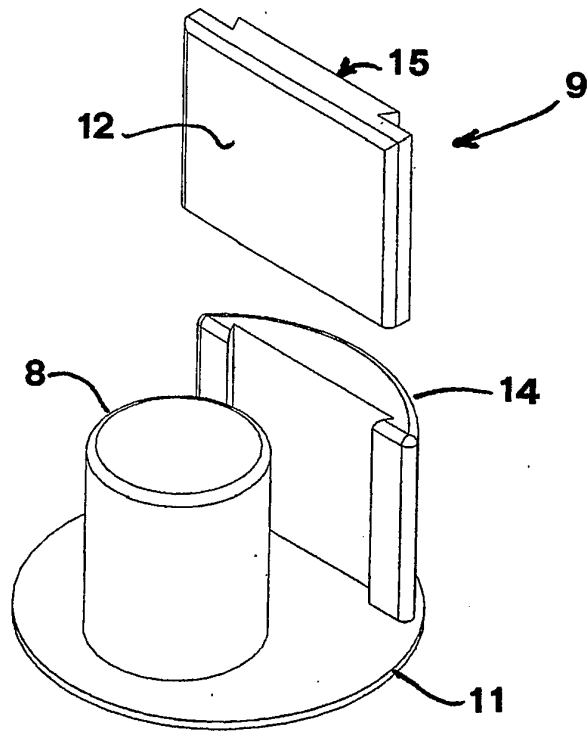


FIG. 7

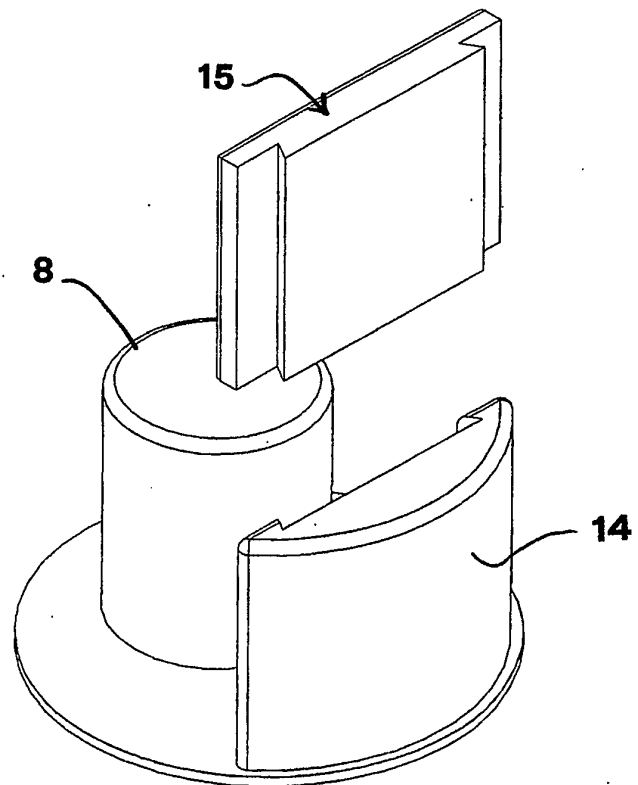


FIG. 8

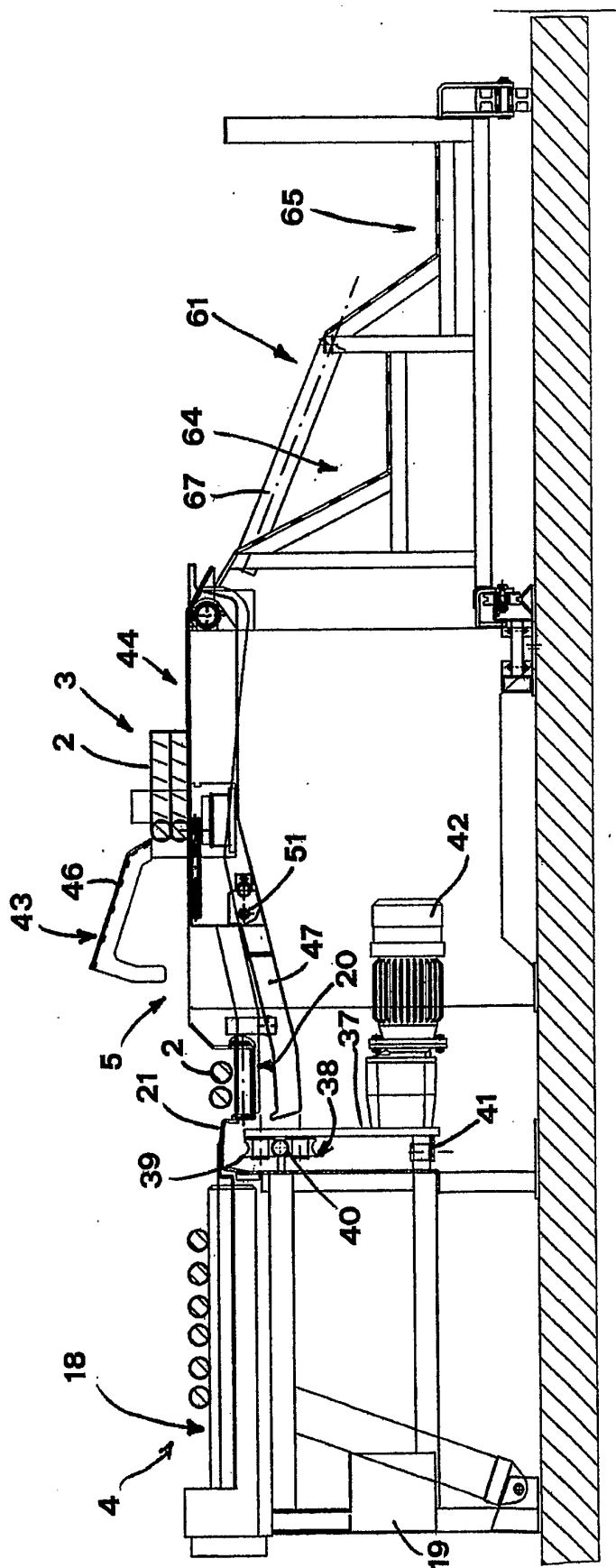
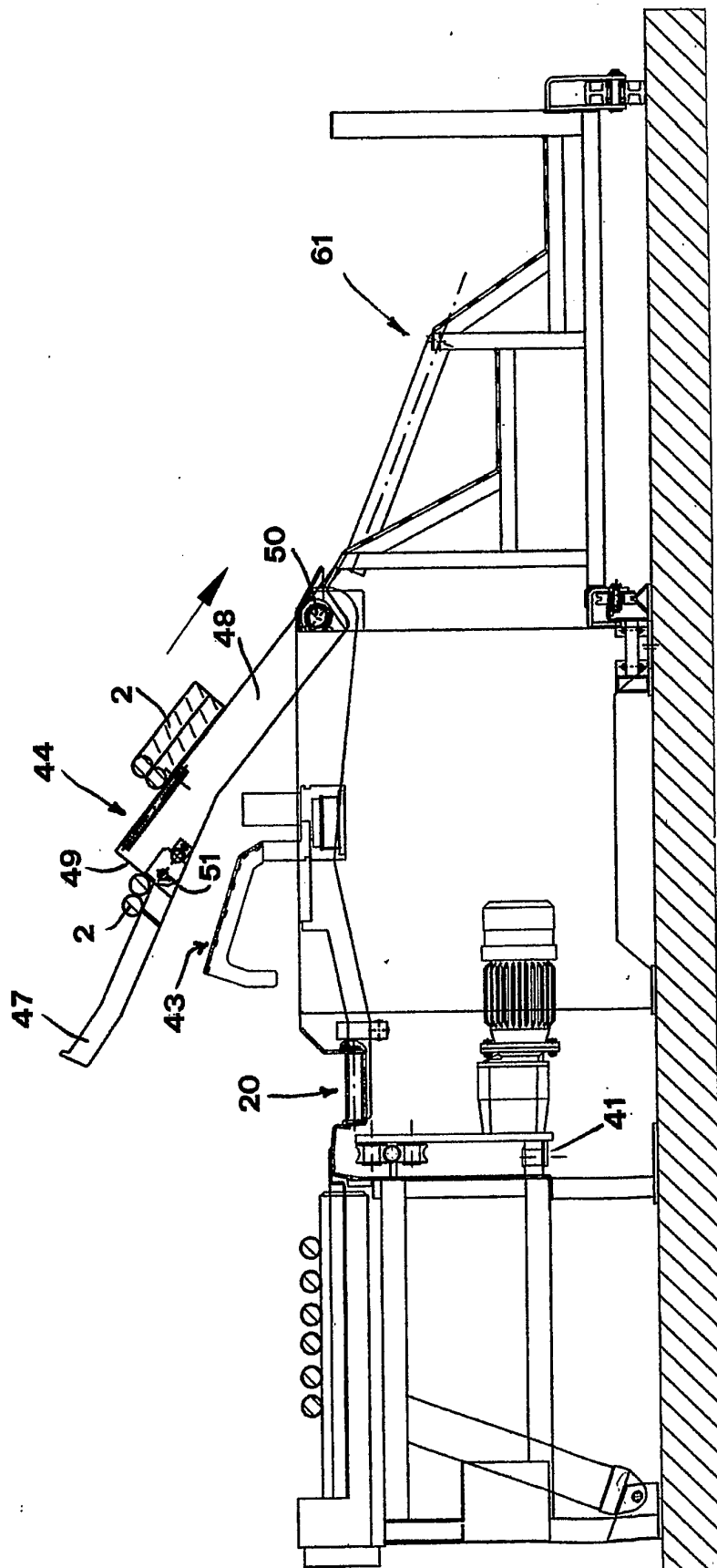


FIG. 9



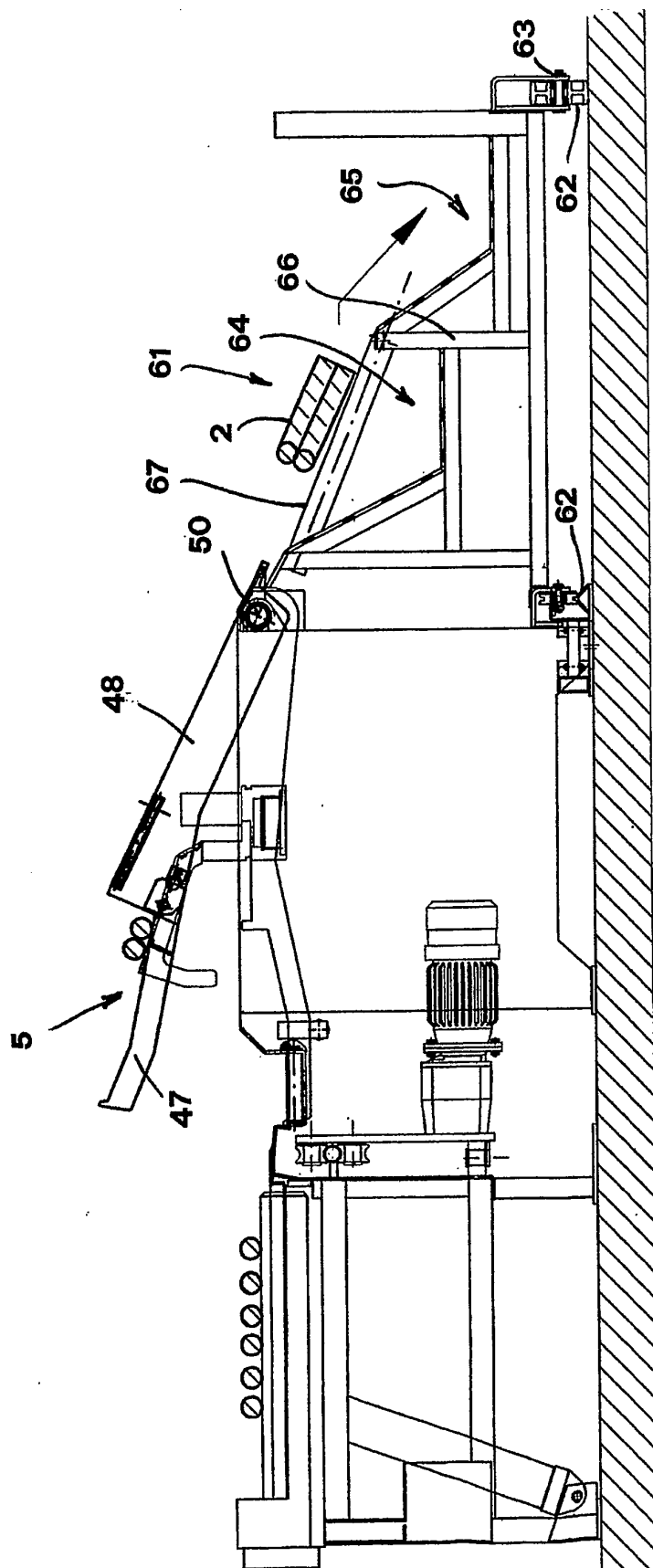


FIG. 11

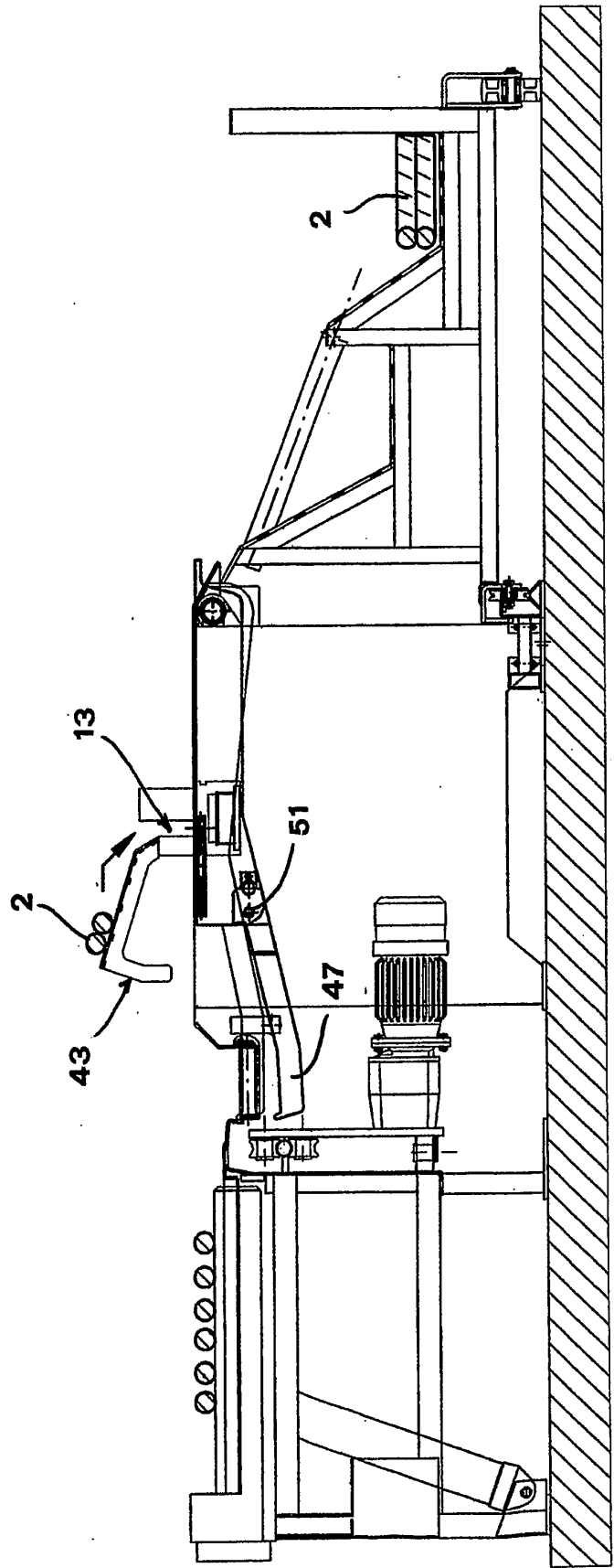


FIG.12

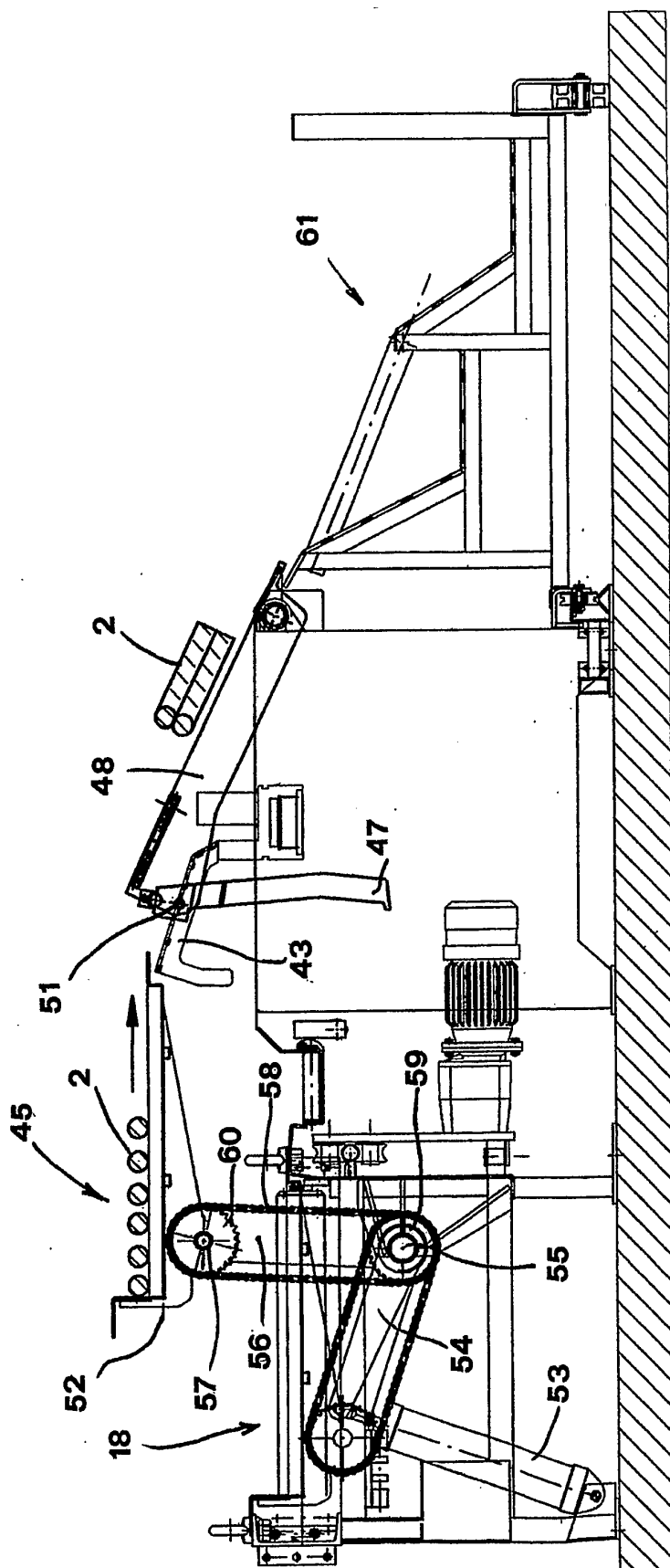


FIG.13

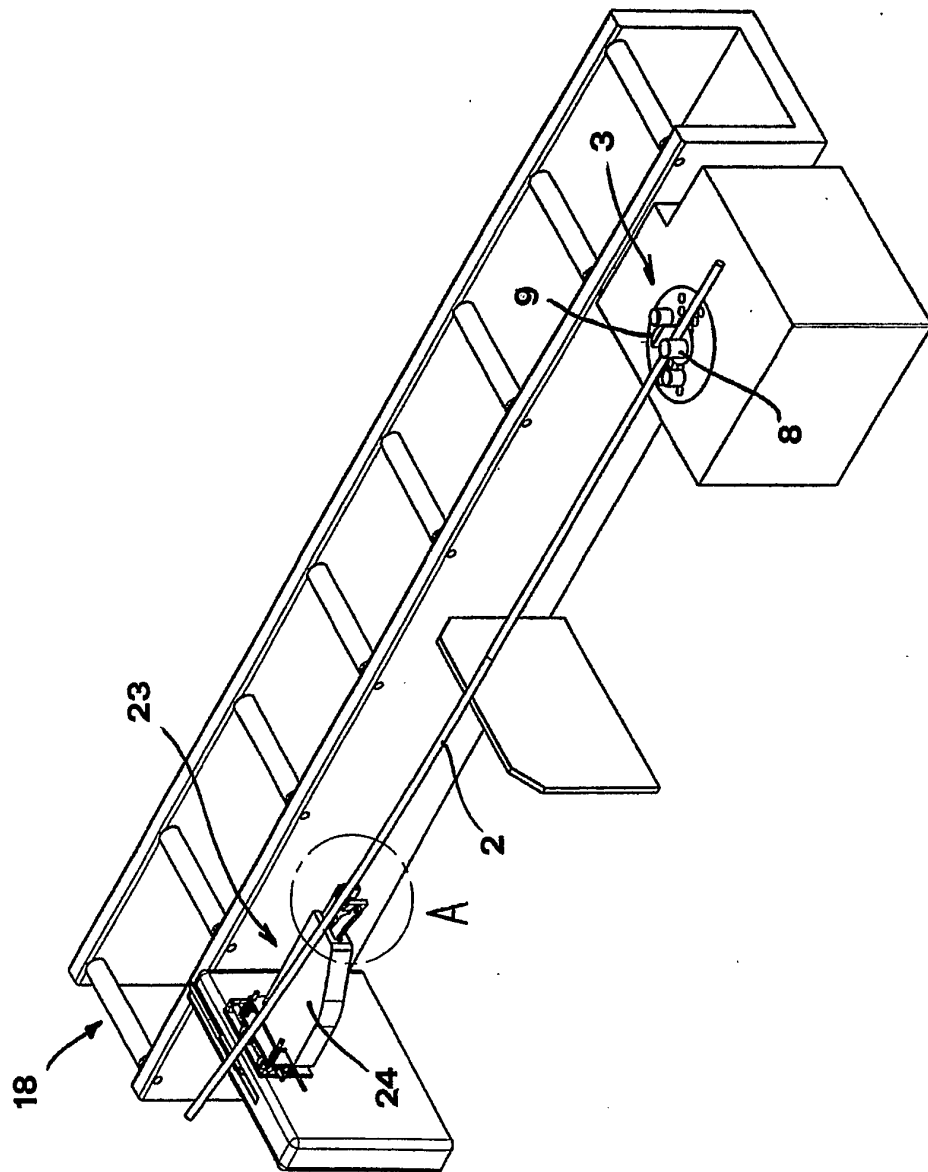
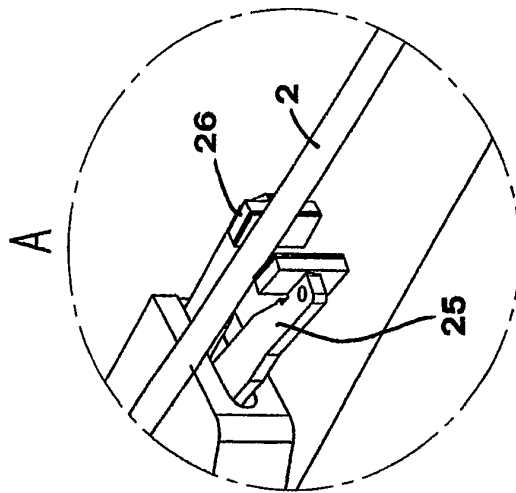


FIG. 14

FIG. 14a



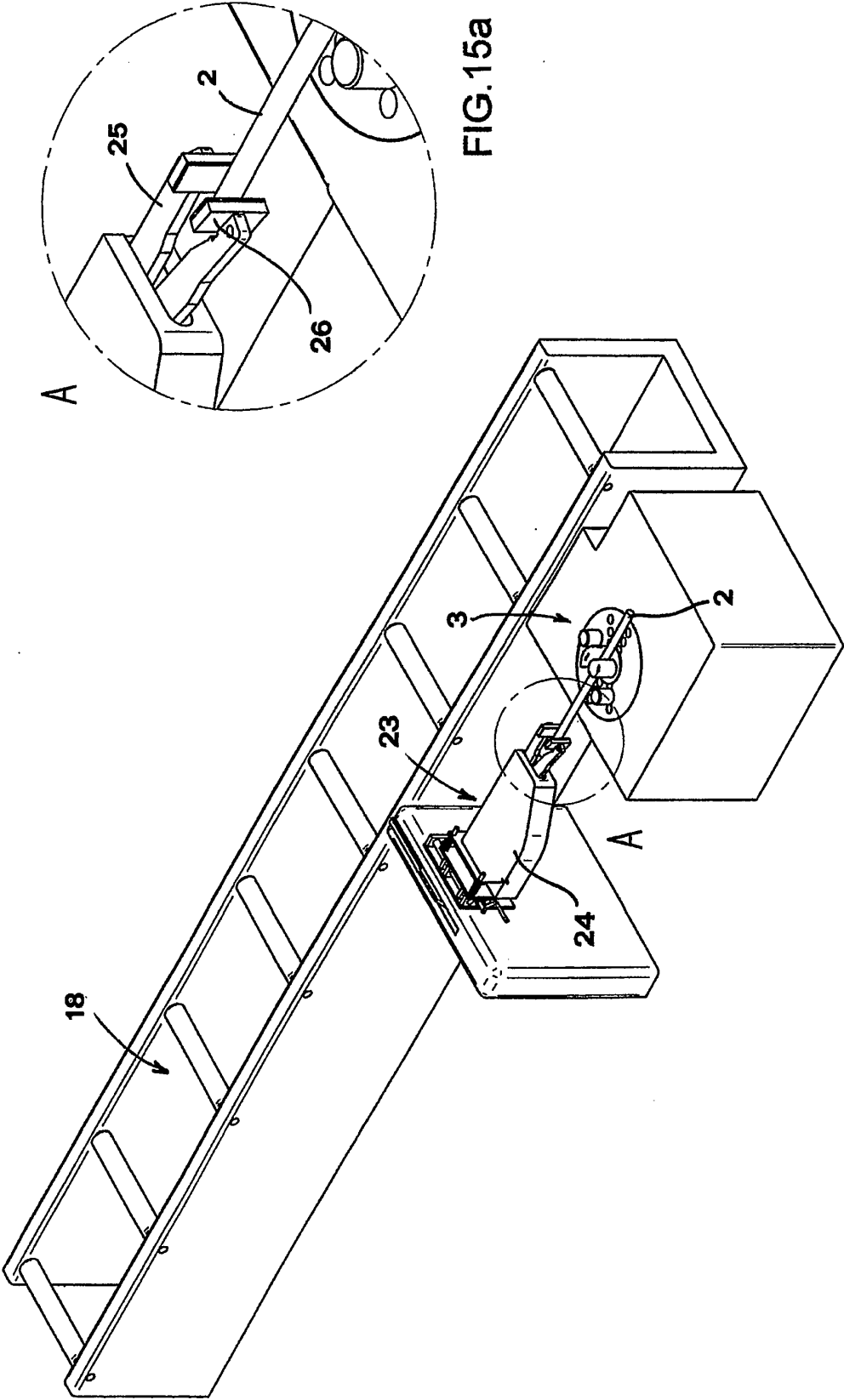
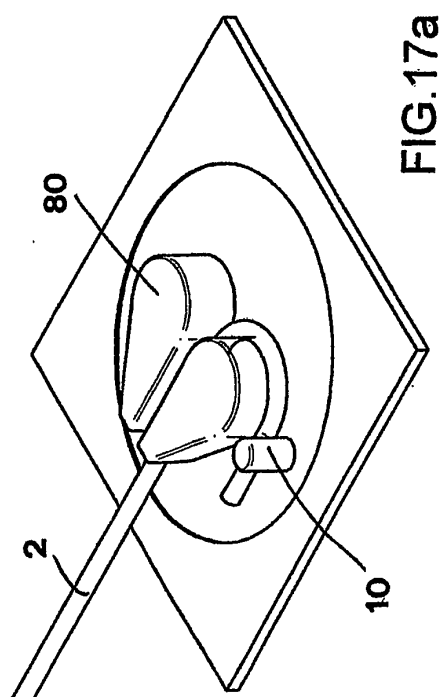
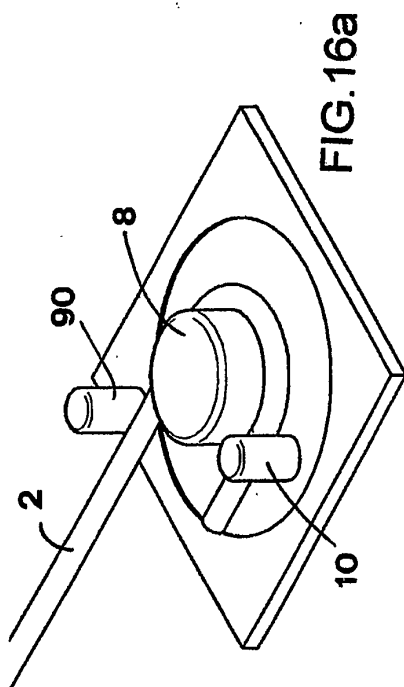
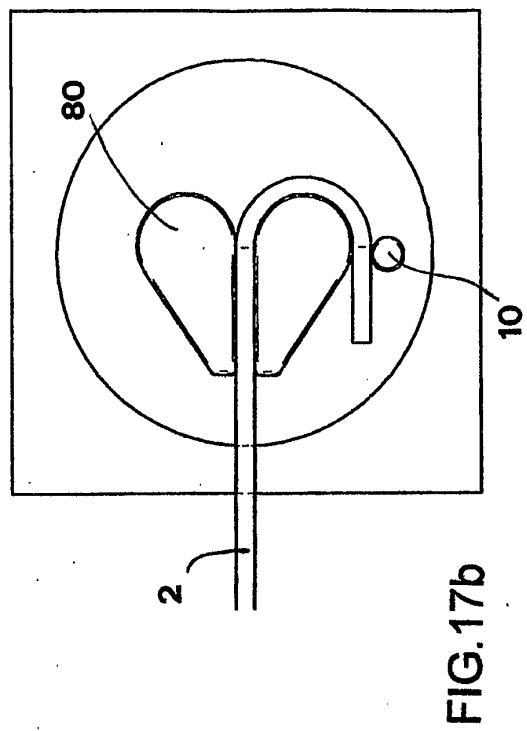
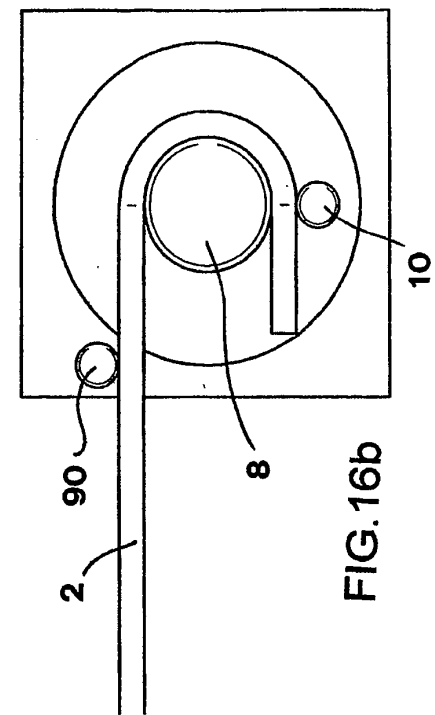


FIG.15a

FIG.15



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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