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(11)

EP 1 270 110 A2

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
02.01.2003 Bulletin 2003/01

(51) Int Cl.7: **B21F 27/12**

(21) Application number: **02013704.8**

(22) Date of filing: **20.06.2002**

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

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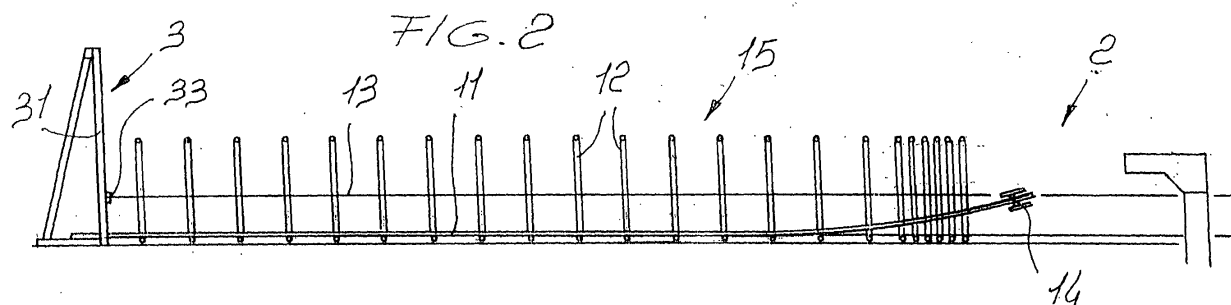
(30) Priority: **22.06.2001 IT BO20010398**

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(54) **Method and device for forming metal frames for reinforced concrete and metal frame formed therewith**

(57) The method for forming metal frames for reinforced concrete entails arranging stirrups (12) with a closed or open profile so that they are substantially ordered and adjacent in a magazine (2) and fixing to each

one of the stirrups (12), which are spaced appropriately, at least one internal longitudinal rod (11, 13), so as to form a frame or lattice (15) that is intermediate with respect to the final formation of a frame.



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Description

[0001] The present invention relates to a method and a device for forming metal frames for reinforced concrete and to the metal frame obtained therewith.

[0002] It is known that metal frames, formed by longitudinal rods mutually connected by appropriately spaced transverse stirrups, are commonly used in order to form the reinforcement of pillars and beams made of reinforced concrete. The stirrups usually form a closed path, for example a quadrilateral one, with overlapping ends. The longitudinal rods are inserted into the profile formed by the stirrups, for example at the corners of the profile.

[0003] Currently, the most commonly used method for forming these metal frames entails the manual insertion of the stirrups on the longitudinal rods, which are grouped and supported on supports. After mutually spacing the stirrups and after manually marking their position, some of the rods are tied to the upper portion of the stirrups. For example, in the case of the above mentioned stirrups with a quadrilateral profile, two longitudinal rods are tied at the corners of the upper horizontal side of the profile.

[0004] The remaining longitudinal rods are then inserted on the lower portion of the stirrups and also tied to the stirrups. According to requirements, additional longitudinal rods can of course be coupled to the metal frame thus formed, for example in intermediate positions on the vertical portions.

[0005] It is quite evident that this constructive solution entails a considerable waste of time and high labor costs in addition to limited productivity. All the above described steps are in fact performed manually by assigned personnel.

[0006] A considerable execution time is required particularly both by the step of placing the stirrups and the longitudinal rods of the frame, and by the step of fixing the rods to the stirrups.

[0007] Another method in use entails the formation of panels made of electrically welded net. The longitudinal rods are normally added to the structure thus formed and fixed in the above described manner. Use of electrically welded net reduces the use of labor for tying, but has the considerable limitation that it is only suitable for frames having simple shapes and requires cutting the net panels to size, with a considerable waste of material and time.

[0008] Devices for manufacturing reinforcement frames by tying or welding structural rods to stirrups are disclosed in WO-A-87/05544 and WO-A-85/05053.

[0009] EP-0667195, in the name of this Applicant, discloses a method for forming metal frames for reinforced concrete that entails first of all forming a lattice constituted by stirrups having a closed profile which are arranged on appropriately spaced parallel planes and are fixed to at least two longitudinal rods that are welded externally to the stirrups. A series of rods is then coupled

to the lattice, inserted inside the stirrups and tied to at least some of the stirrups.

[0010] The layer of cement covering the metal frame at the external rods is reduced in those locations.

[0011] The aim of the present invention is to solve the cited problems, by providing a method that allows to form metal frames for reinforced concrete, simply and rapidly.

[0012] An object of the present invention is to provide a device that allows to automate the production of metal frames for reinforced concrete and has a structure that is simple in concept, safely reliable in operation, and versatile in use.

[0013] A further object of the present invention is to provide a metal frame for reinforced concrete that can be formed simply and rapidly with any geometry.

[0014] This aim and these objects are achieved, according to the invention, by a method and by a device, as claimed in the appended claims.

[0015] Further characteristics and advantages of the invention will become better apparent from the description of a method and of preferred embodiments of the device, for forming metal frames for reinforced concrete, illustrated only by way of non-limitative example in the accompanying drawings, wherein:

Figure 1 is a schematic side view of a device for forming metal frames for reinforced concrete according to the present invention;

Figure 2 is an identical side view of the device according to the invention in a subsequent step of operation;

Figures 3 and 4 are identical schematic side views of a different embodiment of the device according to the invention in successive steps of operation;

Figure 5 is a schematic side view of a further embodiment of the device according to the invention;

Figure 6 is a perspective view of a magazine for feeding the stirrups;

Figure 7 is a side view of the magazine and of the region for joining the longitudinal rods to the stirrups in order to form the lattice that is intermediate with respect to the final execution of a frame;

Figures 8 and 9 are a side view and a corresponding plan view of a welding means that joins the longitudinal rods to the stirrups;

Figure 10 is a schematic side view of a station for joining the longitudinal rods to the stirrups, having a different embodiment of the welding means;

Figure 11 is a side view of the welding means, taken along the plane XI-XI of Figure 10;

Figure 12 is a schematic side view of another embodiment of the welding means;

Figures 13 and 14 are a side view and a corresponding plan view of a welding means that operates according to the layout of Figure 12;

Figure 15 is an enlarged-scale sectional view of a detail of the welding means, taken along the plane

XV-XV of Figure 13;

Figure 16 is a perspective view of a portion of a metal frame formed by virtue of the device according to the invention;

Figure 17 is a perspective view of a particular embodiment of the lattice used to form the metal frame; Figure 18 is a front view of another embodiment of the frame;

Figure 19 is a side view of the magazine for feeding the stirrups and of the region where the longitudinal rods are joined to the stirrups and where a means for the advancement of the lattice by pushing is provided;

Figures 20a, 20b, 20c, and 20d are schematic longitudinal sectional views of a clamp means for the advancement of the lattice in successive operating steps;

Figures 21a and 21b are longitudinal sectional views of an additional clamp means for the advancement of the lattice in different operating steps;

Figure 22 is a schematic side view of another embodiment of the device according to the invention.

[0016] With particular reference to the above figures, the reference numeral 1 generally designates the device for forming metal frames 10 for reinforced concrete according to the present invention.

[0017] The metal frames 10 have a plurality of longitudinal rods 11 connected by transverse stirrups 12 that have a closed or open profile and are appropriately spaced. More specifically, the rods 11, used to form the frames 10, are constituted by structural longitudinal bars, i.e., by bars whose diameter is usually larger than the diameter of the stirrups, which in reinforced concrete frames are specified precisely and strictly by the designer of the structure, according to the currently applicable standards. As specified hereinafter, the frames 10 are constituted by an intermediate lattice 15, formed by brackets connected by one or more internal auxiliary wires. Inside the lattice 15 all the structural bars 11 are fixed to at least some of the stirrups 12, as planned by the designer of the reinforced concrete structure.

[0018] The device 1 includes a magazine 2 for feeding the stirrups 12, which is shown in Figure 6. The magazine 2 has a sort of framework formed by two posts 21 that rise from a fixed worktable 20. Two cross-members 22 and 23 are supported horizontally between the posts 21 and are arranged at different heights. At least the lower cross-member 23 has a position that can be adjusted by a motion means 24 constituted for example by a worm screw shaft with which a corresponding female thread member is coupled. The worm screw shaft is actuated by a gearmotor 25.

[0019] Two arms 26 are supported so that they can slide, by means of corresponding bushes, on the upper cross-member 20. The arms are arranged longitudinally side by side and act as a support for the stirrups 12. Furthermore, a plurality of longitudinal tubular members

27 can be supported on the cross-members 22 and 23 so that they can slide by means of corresponding bushes. The tubular members 27 act as guides for the auxiliary rods 13, specified hereinafter, so that the auxiliary rods, during their advancement motion, do not tend to drag undesirably the stirrups, which might even become entangled with the auxiliary rods.

[0020] In the illustrated case there are, for example, two auxiliary rod guiding tubes 27 on the lower cross-member 23 and there is an additional tube 27 on the upper cross-member 22, in a central position between the stirrup supporting arms 26. The stirrup supporting arms 26 and the auxiliary rod guiding tubes 27 have positions that can be adjusted independently by means of corresponding motion members, constituted for example by a worm screw shaft with which an optional corresponding female thread member is coupled. The arms 26 and the tubular members 27 can be formed by a single member that acts as a support for the stirrups 12 and as a guide for the auxiliary rods 13.

[0021] In front of the magazine 2, along the advancement direction designated by A in Figure 1, there is a member 3 for pulling one or more disposable longitudinal auxiliary or service rods 13. These auxiliary rods 13 are constituted by rods that have any cross-section and preferably have a narrow diameter with respect to the diameters of the rods specified by designers to form frames for reinforced concrete reinforcements, possibly not provided in the structure calculated by the designer and used only to facilitate assembly. In particular, the auxiliary rods 13 have a diameter preferably between 4 and 6 mm, for economical reasons. This is generally less than the thickness of the stirrups 12, which usually have a diameter between 6 and 16 mm.

[0022] It should be noted that the auxiliary function of the auxiliary rods 13 is not linked to their diameter. In particular, if the auxiliary rods have the same diameter of the structural bars and their positioning with respect of the stirrup, the auxiliary rods will be regarded as structural substitutes of the structural bars. The supporting function may also be performed also by straight or shaped structural bars. In such particular case, the structural bars, also function as auxiliary rods. Substantially, the auxiliary rods or auxiliary bars provide a connection for the correct spacing and for the positioning of the stirrups 12 in order to constitute an intermediate lattice 15, which is then completed by inserting and fixing, even partially, the structural bars 11 with respect to the stirrups 12.

[0023] The traction unit 3 is constituted by a movable frame 31, which is mounted, so that it can slide on a guiding means 32 that runs longitudinally to the device, on a finished-product worktable 30 and is provided with a grip means 33 for gripping a front end of the auxiliary rods 13 or of the auxiliary bars.

[0024] The structural bars 11 are arranged inside the stirrups 12 along the guide 32 and are rigidly coupled to the stirrups 12 in order to form the metal frame 10. The

structural bars 11 can be retained at a rear end by respective clamp units 14 arranged at the magazine 2; as an alternative, the clamp units 14 can be arranged at the front end of the structural bars 11.

[0025] According to a further embodiment, shown in Figures 3 and 4, the structural bars 11 are supported by carriages 5 that can move, with or without being motorized, along the guide 32. The carriages 5 are provided with a roller supporting means constituted by rollers 50 arranged at different heights, for example in adjustable positions, for slidably supporting the bars 11, retained at the rear end by the respective clamp units 14.

[0026] According to a further embodiment shown in Figure 5, the structural bars 11 are supported by a supporting means constituted by rollers 34 mounted on the frame of the traction unit 3, on which there are the above mentioned means 33 for gripping the front end of the auxiliary rods 13.

[0027] The auxiliary rods 13, or auxiliary bars, are provided cut to size or are alternatively unwound from reels. In this second case, the auxiliary rods 13, or auxiliary bars, are fed to the work area of the device after passing through corresponding roller-type straightening units 6 (see Figures 5 and 7). Optionally, the machine can also be provided with a cropping unit for automatically cutting each auxiliary rod.

[0028] A station 4 for joining the auxiliary rods 13, or auxiliary bars is arranged between the magazine 2 and the traction unit 3, substantially at the feed position of the stirrups 12.

[0029] Welding units 40 operate in the joining station 4, acting along a welding axis that lies transversely to the advancement direction A, and weld respective auxiliary rods 13 inside the stirrups 12, so as to provide a lattice 15 that constitutes an intermediate step with respect to the final formation of a frame 10.

[0030] The lattice 15 is in fact constituted by a metallic structure formed by the stirrups 12 joined by the auxiliary rods 13 or by part of the structural bars 11 provided by the design, which are termed auxiliary or service bars for the sake of clarity. The stirrups 12 are arranged on parallel planes that are evenly spaced according to the design specifications of the reinforced concrete structure.

[0031] The welding units 40 respectively provide a first welder 41, supported by an arm 42 made of insulating material arranged inside the stirrups 12, in a longitudinal direction, and a second welder 43, which can be actuated in a transverse direction by means of an actuator 44, as shown in Figures 8 and 9.

[0032] A sort of clamp 45 cooperates with the first welder 41 and clamps the auxiliary rods 13, or auxiliary bars, and the stirrups 12 to be welded between the welders 41 and 43. The clamp 45 is substantially constituted by a fork with two curved prongs, which is pivoted on a pivot 46 along an axis that is longitudinally parallel to the auxiliary rods 13, on a frame 47 that is rigidly coupled to the stem of the actuator 44, to which the second weld-

er 43 is also fixed. The stem of a second actuator 49, hinged to the frame 47, is also articulated to the fork 45 on a pivot 48 that is parallel to the fulcrum pivot 46.

[0033] By means of the actuator 44, the movable welder 43 is placed in abutment against the stirrup 12, on its outer side. Then the fork 45 is rotated by means of the second actuator 49 starting from a disengagement position, indicated by the dashed line 45a in Figure 8, so as to move the auxiliary rod 13 to be welded closer to the stirrup 12, ensuring an appropriate clamping force during welding.

[0034] In the embodiment shown in Figures 10 and 11, the clamp, again designated by the reference numeral 45, is pivoted on the pivot 46 to a slider 60, which can move, by means of guiding rollers 61, on a plane that is oblique with respect to the longitudinal axis of the auxiliary rods 13. The clamp 45 is actuated, starting from the disengagement position 45a, by an actuator 49 supported by the slider 60. The clamp 45 has, at its free end, the first welder 41, while the second welder 43 is fixed to the front of the slider 60.

[0035] Finally, according to the additional solution shown schematically in Figure 12, the welding units have a movable welder 62 that protrudes at an angle from a stem 63 that can move axially in a direction that lies transversely to the longitudinal auxiliary rods 13 between a retracted disengagement position 62a and a maximum advancement position 62b. The stem 63 can also rotate angularly so as to engage the auxiliary rods 13 to be welded.

[0036] In practice, starting from the retracted disengagement position 62a, first the welder 62 is moved into the maximum advancement position 62b inside the stirrup 12; this is followed by the angular rotation of the stem 63 and by a partial retraction stroke, in order to clamp the auxiliary rod 13 on the stirrup 12, in abutment with an external welder 64. The maximum advancement position 62b acts as an abutment for positioning the stirrups.

[0037] The use of welders that can move in a transverse direction for insertion in the stirrups 12 arises from the need to clear the welding plane during the advancement of the lattice being formed.

[0038] As shown in Figures 13 and 14, the angular rotation of the movable welder 62 can be performed by a gear pair 65, constituted by a gear 65a, which is fixed in axial alignment with the stem 63, and by a rack 65b, which can move under the actuation of an actuator 66. The stem 63 is supported rotatably through a body 67, to which the fixed welder 64 is rigidly coupled. Moreover, the stem 63 is rigidly coupled to a slider 68, which can be actuated longitudinally to the stem 63 by a corresponding actuator 69. The body 67 and the actuators 66 and 69 are supported by a plate 160, to which an electric transformer 161 is also fixed in order to supply electric power to the welders 62 and 64, which are of the resistance type. In the illustrated case, the angular rotation of the movable welder 62 is preferably equal to

135° (see Figure 15).

[0039] It should be noted that whatever solution is used, the clamp can be mounted in a floating configuration, so that it does not deform the stirrups during clamping, even if the stirrups have size variations along the length of the component or if they are not adjusted very precisely.

[0040] The system for fixing the auxiliary rods 13 can be in any case of any kind, both automatic and manual, particularly resistance welding, induction welding, flash welding, with or without added material, tying, seaming, adhesive bonding and the like.

[0041] The method for forming metal frames for reinforced concrete, by means of the described device, comprises forming first a lattice 15 constituted by stirrups 12 having a closed or open profile, arranged on spaced parallel planes and mutually connected by one or more longitudinal auxiliary rods 13 welded inside the stirrups 12 or by part of the structural bars 11. The other structural bars 11 are fixed, after or during the formation of the lattice 15, to at least some of the stirrups 12 of the lattice 15.

[0042] In this manner, at the end of the cycle one obtains the finished frame 10 or more simply the intermediate lattice 15, inside which the structural bars 11 may be already present and can be fixed subsequently to some of the stirrups 12 in order to obtain the finished frame 10.

[0043] In the case shown in Figure 16, the stirrups 12 form a substantially rectangular profile and are mutually connected by three auxiliary rods 13, which are arranged respectively in a central position on the lateral portions and on the lower portion of the stirrups 12. This configuration corresponds for example to the configuration obtained by the device shown in Figures 1 and 2. The shape of the stirrups 12 can of course be any, even a highly complex one.

[0044] The stirrups 12, forming the metal frame, are loaded beforehand on the arms 26 of the magazine 2 (Figure 6). The stirrups 12 are then fed in succession, one at a time, to the joining station 4, where welding to the auxiliary rods 13 is performed. Optionally, the stirrups 12 can be fed automatically by a stirrup bending machine or by a feeder. The stirrups 12 can also be inserted from outside without the aid of a loader if the lattice is formed by means of at least one external auxiliary rod.

[0045] The stirrups 12, fed by the magazine 2, are fed by making them contact the auxiliary rods 13 fixed beforehand to the frame 31 of the traction unit 3, which is arranged initially adjacent to the joining station 4 (see Figure 7).

[0046] The activation of the welding units 40 welds the auxiliary rods 13, which are arranged inside the stirrup 12 arranged at the joining station 4.

[0047] The stepwise advancement of the traction unit 3, which is modulated depending on the intended distance between the stirrups 12, causes the traction of the

auxiliary rods 13 and the corresponding advancement of the stirrup 12 welded to them.

[0048] The mutual distance between the stirrups 12 is not necessarily constant but can change along the longitudinal extension of the lattice 15, depending on the different requirements.

[0049] It should be noted that since the auxiliary rods 13 are thin with respect to the stirrups 12, the stirrups are not damaged by the welding step, which may instead produce the local melting only of the auxiliary rods 13 that are thinner than the welded joint if the welder is incorrectly adjusted.

[0050] The resulting lattice can be used to form the metal frame 10, particularly by rigidly coupling inside the stirrups 12 the conventional structural bars 11 optionally provided along the device and retained at the rear by virtue of the clamp units 14. The clamp units 14 release the bars 11 after the formation of the lattice 15 has been completed, i.e., at the end of the advancement stroke of the traction unit 3.

[0051] It is also possible to partially drag the bars 11 to prevent the formation of protruding tails at the end of the lattice 15 if the presence of such tails is not required for subsequent coupling requirements of the metal frame 10.

[0052] The structural bars 11 can also be made to advance stepwise, while forming the lattice 15, by connecting the auxiliary rods 13 to the traction member 3. This connection can be achieved by rigidly coupling the bars 11 to the stirrups 12 or to the auxiliary rods 13 or to the frame 31, of the traction unit 3.

[0053] In order to obtain the finished frame 10, it should be noted that it is sufficient to rigidly couple the bars 11 to only some of the stirrups 12 of the lattice 15, for example by means of conventional ties 16 or by means of any other coupling means.

[0054] Clearly, the fact of being able to fix the bars 11 to only some of the stirrups 12 allows a significant time saving in forming the frame 10, because while in the conventional system it is necessary to fix all the stirrups to the longitudinal bars in order to keep the stirrups at the intended distance, according to the present invention the stirrups 12 are instead already fixed and spaced by means of the welding with the internal auxiliary rods 13 or the auxiliary bars of the lattice 15 and therefore the ties are required only to keep the longitudinal bars 11 in position.

[0055] The internal position of the auxiliary rods allows to have no reduction of the so-called cover to reinforcement, i.e., the distance between the outer surface of the concrete casting and the iron of the frame, and this is advantageous especially when the cover is particularly low, as in the case of prefabricated components. The size of the cover is in fact proportional to the corrosion protection that it ensures. The protection against corrosion, provided by the covering material is in fact proportional to its thickness.

[0056] It should also be stressed that the use of the

described device clearly entails increasing benefits as the complexity of the stirrups to be connected in order to form the metal frame increases.

[0057] In the case shown in Figure 17, for example, the lattice 15 is obtained starting from stirrups that form two rectangles 12a and 12b that are elongated in perpendicular directions. The stirrups are connected by a number of auxiliary rods 13 arranged inside these rectangles 12a and 12b. These stirrups are used, for example, to form the lattice by means of the device shown in Figures 3 and 4, which is provided with the carriages 5 adapted to support the longitudinal auxiliary rods 13 at two different heights on the rollers 50. These carriages 5 are of course moved by the advancement of the traction unit 3 until the bars 11 are released.

[0058] In the case shown in Figure 18, the lattice is instead provided by stirrups that form a double rectangle 12c and 12d having a constant height and an appropriately differentiated width and are connected by longitudinal auxiliary rods 13.

[0059] In these cases also, the metal frame 10 is completed by rigidly coupling the longitudinal structural bars 11 inside the stirrups. This operation can occur during the formation of the intermediate lattice 15 or at the end of the formation of the lattice 15. In Figure 18, the longitudinal bars 11 are shown laid flat on the lower portion of the stirrups, as they appear during the formation of the lattice 15 by means of the device of Figures 1 and 2.

[0060] As an alternative, the lattice 15 being formed might be made to advance stepwise by means of pusher units 35, as shown in Figure 19. These pusher units 35 have, for example, a pusher 36 that is supported at the end of the stem of a longitudinal actuator 37 and is adapted to engage at the rear a stirrup 12 of the lattice 15.

[0061] Accordingly, the movement of the pusher 36 in the advanced position 36a actuated by the actuator 37 causes the advancement of the lattice 15 by a step that is equal to the stroke of the stem of the actuator 37. The pusher 36 is conveniently pivoted on the stem of the actuator 37, at a pivot 38, so as to rotate in an inclined position 36b, during the return stroke, in order to avoid interfering with the lattice. It is obviously possible to provide a pusher proximate to each auxiliary rod 13 in order to move the lattice 15 being formed in a more uniform and balanced manner. It is possible to use similar known kinds of pusher system, such as for example actuation wheels and the like or any other means suitable for the purpose.

[0062] Figures 20a, 20b, 20c and 20d illustrate an additional means for the stepwise advancement of the lattice 15 with actuation by pushing, which are constituted by clamp units 7 that are arranged at a worktable 70 (Figure 6) of the bars 11, to the rear of the magazine 2 of the stirrups 12, and act on the auxiliary rods for joining the stirrups of the lattice. The clamp units 7 have a jaw 71 that can move in a longitudinal direction and engages the inner surface of a clamping cone 72, which can move

in turn in a longitudinal direction independently of the jaw 71.

[0063] At rest, the clamp 7 is open and allows the insertion of an auxiliary rod through it (Figure 20a). The partial advancement of the jaw 71 in abutment against the internal surface of the cone 72 causes the clamping 72 of the jaw 71 on the auxiliary rod (Figure 20b). Then the advancement of the clamp 7 is actuated over a pre-set stroke so as to cause the corresponding advancement of the lattice (Figure 20c). At the end of the advancement stroke of the clamp 7, the jaw 71 is released and returned to the initial retracted position (Figure 20d). The subsequent return of the clamping cone 72 into the retracted position restores the initial conditions in order to perform a subsequent stepwise advancement stroke of the lattice.

[0064] In the embodiment shown in Figures 21a and 21b, the clamp units 7 have a sleeve 73 through which the auxiliary rod to be fed passes. The sleeve 73 forms a conical portion 74, which engages a complementarily shaped clamping cone 75 that is fixed to a supporting body 76. The sleeve 73 is actuated by a helical spring 77, which pushes the conical portion 74 into contact with the clamping cone 75. The conical portion 74 has a transverse hole for accommodating a clamping ball 78 that abuts against the internal surface of the cone 75.

[0065] The relative motion of the clamping cone 75 with respect to the sleeve 73, when actuated, causes the engagement of the conical portion 74 with the internal surface of the cone 75 or, vice versa, their mutual separation. In the engagement position, the clamping ball 78 is pushed by the cone 75 into its seat, so as to clamp the rod and accordingly allow its movement (Figure 21a). In the mutual separation position, the rod is instead able to slide freely and no traction occurs during the return stroke (Figure 21 b).

[0066] In summary, the method and the device according to the invention allow to simply and rapidly manufacture metal frames, for reinforced concrete, having any geometry.

[0067] In particular, the resulting time saving relates, as mentioned, both to the step for preparing the frame, avoiding the manual marking of the position of the stirrups and their positioning, and the step for tying the longitudinal bars, because of the reduced number of ties that are possibly necessary.

[0068] According to a further embodiment of the method according to the invention, shown in Figure 22, the structural bars 11 can be fixed, for example by welding or tying, to the first stirrup 12 of the lattice 15 being formed, so as to allow the lattice 15, which advances stepwise, to pull the bars 11. This advancement can be interrupted temporarily to fix the structural bars 11 to other stirrups 12.

[0069] In this manner, the finished frame is obtained at the end of the cycle normally required to form the intermediate lattice 15, avoiding the final step of forming the frame that consists in fixing the structural bars 11 to

some of the stirrups 12 of the lattice 15 composed of stirrups 12 and auxiliary rods 13 or auxiliary bars.

[0070] The fixing of the structural bars 11 to the stirrups 12, during the formation of the lattice 15, can be automatic or manual. Automatic fixing, both by welding and by tying, naturally requires the presence of a specific means of a known or specifically studied type.

[0071] In particular, if one wishes to use resistance welding, in order to avoid possible damage of the stirrups 12 and consequently also of the structural bars 11 it is conveniently possible to use disposable stirrups inserted in the pack of stirrups 12 meant to form the lattice 15. These disposable stirrups have a considerably smaller diameter than the structural bars 11 and are alternated and appropriately spaced with respect to the conventional stirrups 12, so as to allow correct fixing to the bars 11, which in this case occurs exclusively at the disposable stirrups.

[0072] Since the disposable stirrups are thinner than the structural bars 11, they protect them against overheating or reduction in resisting cross-section; however, despite acting as a "sacrificial" component, they still achieve the result of fixing the structural bars 11 to the rest of the lattice 15, which is per se sufficiently rigid. The disposable stirrups can optionally have the same diameter as the normal stirrups 13 provided in the structure, usually with a significantly smaller diameter than the structural bars 11, to the full advantage of practicality. In this case, the presence of the disposable stirrups ensures the integrity of the stirrups planned in the calculation of the structure, to which no structural bars are welded, avoiding any danger of damage due to incorrect adjustment.

[0073] In the practical embodiment of the invention, the materials used, as well as the shape and the dimensions, may be any according to requirements.

Claims

1. A method for forming metal frames for reinforced concrete, **characterized in that** it comprises the steps of:

- (a) arranging stirrups (12) with a closed or open profile so that they are substantially ordered and adjacent in a magazine (2);
- (b) fixing at least one longitudinal rod (11, 13) to each one of said stirrups (12), which are spaced appropriately, so as to form a lattice (15) that is intermediate with respect to the final formation of a frame (10).

2. The method according to claim 1, **characterized in that** after said step of:

- (a) arranging stirrups (12) with a closed or open profile so that they are substantially ordered

and adjacent in a magazine (2);

it comprises:

- (a1) inserting at least one longitudinal auxiliary rod (13) in said stirrups (12); and
- (b1) fixing said stirrups (12) to said auxiliary rod (13), making it advance correspondingly stepwise in order to appropriately space said stirrups (12) along said auxiliary rod (13), in order to form said lattice (15) that is intermediate with respect to the final formation of a frame (10).

3. The method according to the preceding claims, **characterized in that** it comprises the additional steps of:

- (a2) inserting a plurality of longitudinal structural bars (11) inside said lattice (15); and
- (b2) fixing said structural bars (11) to some of said stirrups (12).

4. The method according to the preceding claims, **characterized in that** said step (a2) for inserting said longitudinal structural bars (11) inside said lattice (15) is performed during the formation of said lattice (15), so that said structural bars (11) are inserted in said lattice (15) at the end of its formation.

5. The method according to the preceding claims, **characterized in that** said structural bars (11) are made to advance stepwise during the formation of said lattice (15) by connection to a means (3) for pulling said auxiliary rods (13).

6. The method according to the preceding claims, **characterized in that** said structural bars (11) are made to advance stepwise during the formation of said lattice (15) by connection to a first stirrup (12) of said lattice (15).

7. The method according to the preceding claims, **characterized in that** it comprises the additional step of:

- (a3) positioning said structural bars (11) so that they are rigidly coupled in the initial part that lies opposite the region for forming said lattice (15); and
- (b3) forming on said structural bars (11) said lattice (15), so as to cause the relative advancement of said lattice (15) on said bars (11).

8. The method according to the preceding claims, **characterized in that** it comprises fixing said structural bars (11) to a first stirrup (12) of said lattice (15) being formed, in order to allow said structural bars (11) to be moved by said lattice (15) that ad-

vances stepwise, and **in that** said advancement of the lattice (15) is interrupted temporarily in order to fix said structural bars (11) to other stirrups (12) in order to obtain said frame (10) at the end of the cycle.

9. The method according to the preceding claims, **characterized in that** it comprises fixing said structural bars (11) to a plurality of disposable stirrups that have a smaller diameter than the structural bars (11) and are inserted in the pack of said stirrups (12) meant to form said lattice (15) at suitable intervals, so as to avoid damage to said stirrups (12) and said structural bars (11).
10. The method according to the preceding claims, **characterized in that** said step (b2) for fixing said structural bars (11) to said stirrups (12) is performed by welding or tying.
11. The method according to the preceding claims, **characterized in that** it entails feeding said stirrups (12) to a joining station (4) in which said auxiliary rods (13) are welded to said stirrups (12).
12. A metal frame for reinforced concrete, comprising stirrups (12) that have a closed or open profile and are arranged on spaced parallel planes and longitudinal structural bars (11) inserted in said stirrups (12) and fixed thereto, **characterized in that** it is constituted by means of a lattice structure (15) formed by said stirrups (12) having a closed or open profile, which are mutually connected by means of at least one longitudinal auxiliary rod (13) that is welded on the inside of said stirrups (12), said structural bars (11) being fixed to at least some of said stirrups (12) of said lattice (15).
13. The frame according to claim 14, **characterized in that** said auxiliary rods (13) have a diameter between 4 and 6 mm, which is smaller than the diameter of said stirrups (12).
14. The frame according to the preceding claims, **characterized in that** it comprises a plurality of disposable stirrups that have a smaller diameter than said structural bars (11), are inserted in the pack of said stirrups (12), meant to form said lattice (15), and are fixed to said structural bars (11), at appropriate intervals, so as to avoid damage to said stirrups (12) and to said structural bars (11).
15. A lattice to be included in the metal frame for reinforced concrete, according to the preceding claims, comprising stirrups (12) that have a closed or open profile and are arranged on appropriately spaced parallel planes, **characterized in that** it further comprises at least one auxiliary rod (13) that is

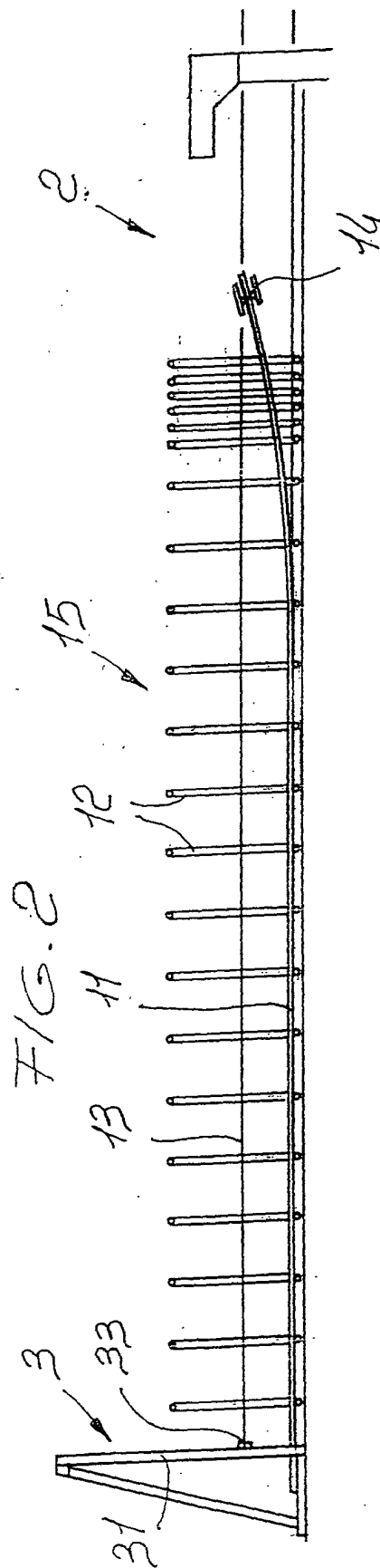
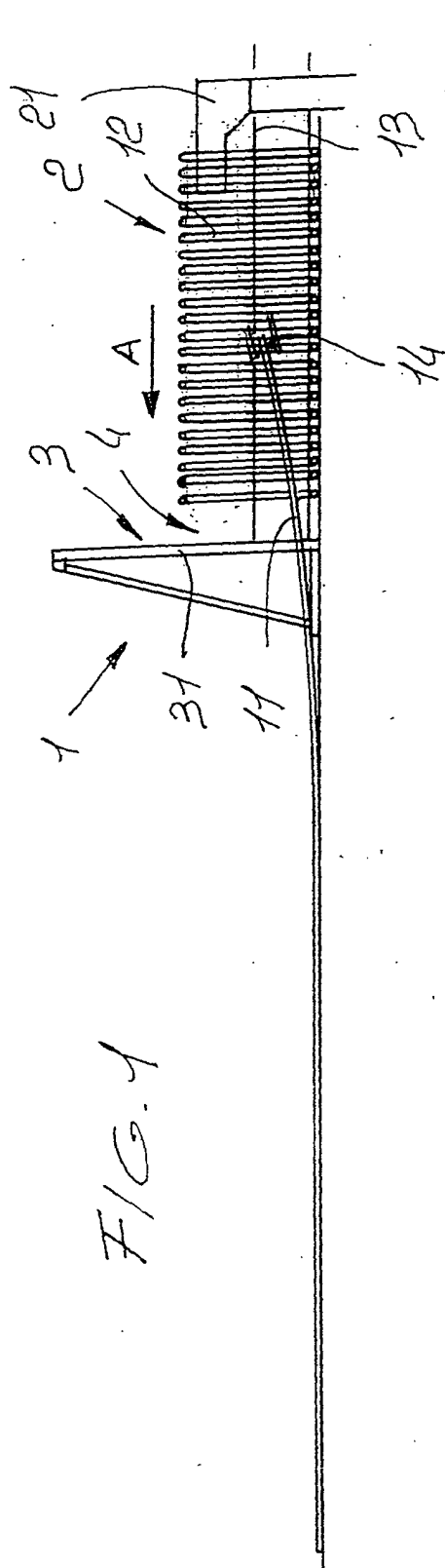
welded on the inside and/or outside of said stirrups (12) for the mutual spacing and fixing of said stirrups (12) at the required distances.

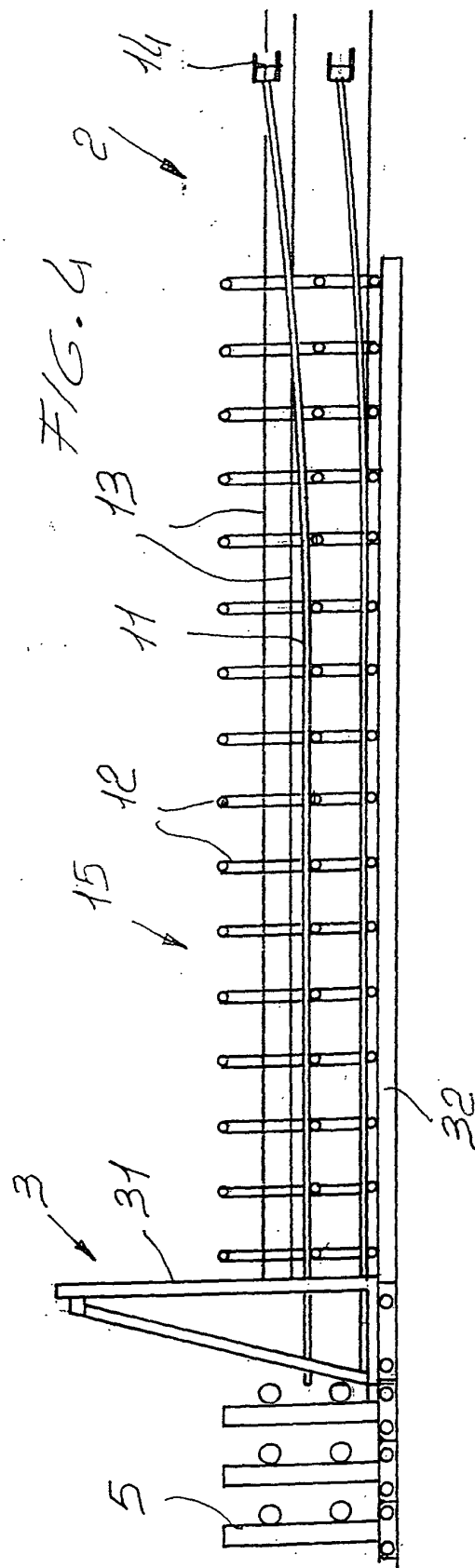
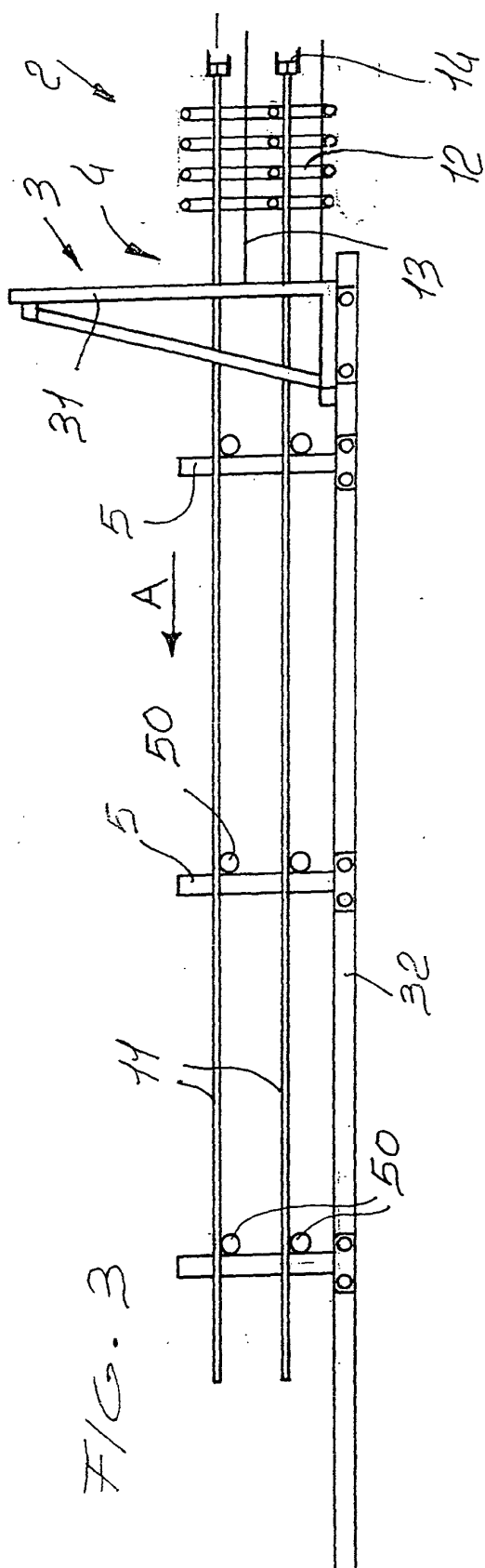
- 5 16. A device for forming metal frames for reinforced concrete, **characterized in that** it comprises a magazine (2) for a plurality of stirrups (12) arranged in an orderly fashion and mutually adjacent on respective planes that lie transversely to an advancement direction (A), suitable to allow the automatic or manual transfer in succession of the individual stirrups (12) into a feed position; a means (3) for pulling at least one longitudinal rod (11, 13), which is arranged inside said stirrups (12) along said advancement direction (A); a station (4) for joining said rod (11, 13) to said stirrups (12), in said feeding position, for forming a lattice (15) constituted by said stirrups (12), which are arranged on parallel planes, are uniformly spaced, and are mutually connected by said longitudinal rod (11, 13).
- 10 17. The device according to claim 16, **characterized in that** said rod is constituted by an auxiliary rod (13) whose diameter is smaller than the thickness of said stirrups (12).
- 15 18. The device according to the preceding claims, **characterized in that** said traction means (3) has a moving frame (31) that is mounted slidingly on a guiding means (32) that runs longitudinally and is provided with a means (33) for gripping a front end of said auxiliary rods (13), said moving frame (31) being suitable to be actuated in a stepwise fashion.
- 20 19. The device according to the preceding claims, **characterized in that** said joining station (4) is provided with a welding means (40) suitable to weld said auxiliary rods (13) inside said stirrups (12), acting along a welding axis that lies transversely to said advancement direction (A).
- 25 20. The device according to the preceding claims, **characterized in that** said welding means (40) has a first welder (41), which is supported by an arm (42) made of insulating material which is arranged inside said stirrups (12) along a longitudinal direction, and a second welder (43), which can be actuated transversely by an actuation means (44).
- 30 21. The device according to the preceding claims, **characterized in that** a clamp means (45) is suitable to cooperate with said first welder (41) and to clamp said auxiliary rods (13) and said stirrups (12) to be welded between said welders (41, 43), said clamp means (45) comprising a fork with two curved prongs which is pivoted about an axis (46) that is longitudinally parallel to said auxiliary rods (13) and is suitable to be actuated by an additional actuation
- 35 40 45 50 55

means (49).

22. The device according to the preceding claims, **characterized in that** said welding means (40) provides a first welder (41), which is supported by a clamp means (45) suitable to be actuated so as to oscillate on a plane that is oblique with respect to said longitudinal direction, and a second welder (43), which is supported by a slider (60) on which said clamp means (45) is pivoted. 5
23. The device according to the preceding claims, **characterized in that** said welding units (40) have a movable welder (62) that protrudes at an angle from a stem (63) that can move axially in a direction that is transverse to said longitudinal auxiliary rods (13) between a retracted disengagement position (62a) and a maximum advancement position (62b), is also suitable to perform a partial retraction stroke in order to clamp said auxiliary rods (13) on said stirrup (12), and can perform an angular rotation so as to engage said auxiliary rods (13) to be welded. 10 15 20
24. The device according to the preceding claims, **characterized in that** said movable welder (62) can perform an angular rotation by means of a gear system (65) that comprises a gear (65a) that is fixed in axial alignment with said stem (63) and can move axially by virtue of a slider (68) that is fixed to said stem (63) and is suitable to be actuated in a longitudinal direction with respect to said stem (63) by an actuation means (69). 25 30
25. The device according to the preceding claims, **characterized in that** said traction means (3) is provided with a supporting means with rollers (34) suitable to slidingly support respective longitudinal structural bars (11) that are arranged inside said stirrups (12) and are retained at a rear end by respective clamp units (14). 35 40
26. The device according to the preceding claims, **characterized in that** it comprises a plurality of carriages (5) that can move along a guiding means (32), in front of said traction means (3), and are provided with a supporting means with rollers (50) for slidingly supporting corresponding structural bars (11) that are arranged inside said stirrups (12) and are retained at a rear end by respective clamp units (14). 45 50
27. The device according to the preceding claims, **characterized in that** it comprises a pusher means for the stepwise advancement of said lattice (15) which is constituted by clamp units (7) arranged at a worktable (70) of said structural bars (11), to the rear of said magazine (2) of the stirrups (12), and suitable to act on the rods for joining said stirrups (12) of the lattice. 55

28. The device according to the preceding claims, **characterized in that** said clamp units (7) have a jaw (71) that can move in a longitudinal direction and is suitable to engage the internal surface of a clamping cone (72), which in turn can move in a longitudinal direction independently of said jaw (71), in order to clamp a rod inserted through said jaw (71).
29. The device according to the preceding claims, **characterized in that** said clamp units (7) have a sleeve (73) that forms a conical portion (74) that is suitable to engage, under the thrust of an elastic means (77), a complementarily shaped clamping cone (75) that is provided with a relative motion with respect to said sleeve (73), said conical portion (74) having a seat for accommodating a clamping ball (78) that is suitable to abut against the inner surface of said cone (75) in order to lock a rod inserted through said sleeve (73).
30. The device according to the preceding claims, **characterized in that** said magazine (2) has, in adjustable positions, a longitudinal supporting means (26) that is suitable to support said stirrups (12) and longitudinal tubular members (27) that are suitable to act as a guide for said auxiliary rods (13).
31. The device for forming metal frames for reinforced concrete, **characterized in that** it comprises a magazine (2) for a plurality of stirrups (12) that are arranged in an orderly fashion and are adjacent on respective planes that lie transversely to an advancement direction (A), said magazine allowing the storage and automatic or manual transfer in succession of the individual stirrups (12) into a feed position; a means (3) for pulling a plurality of longitudinal bars (11) arranged inside said stirrups (12) along said advancement direction (A); a station (4) for joining said longitudinal bars (11) to said stirrups (12), on a same plane, in said feeder position, in order to form a frame constituted by said stirrups (12) arranged on parallel planes and regularly spaced and mutually connected by said longitudinal bars (11).





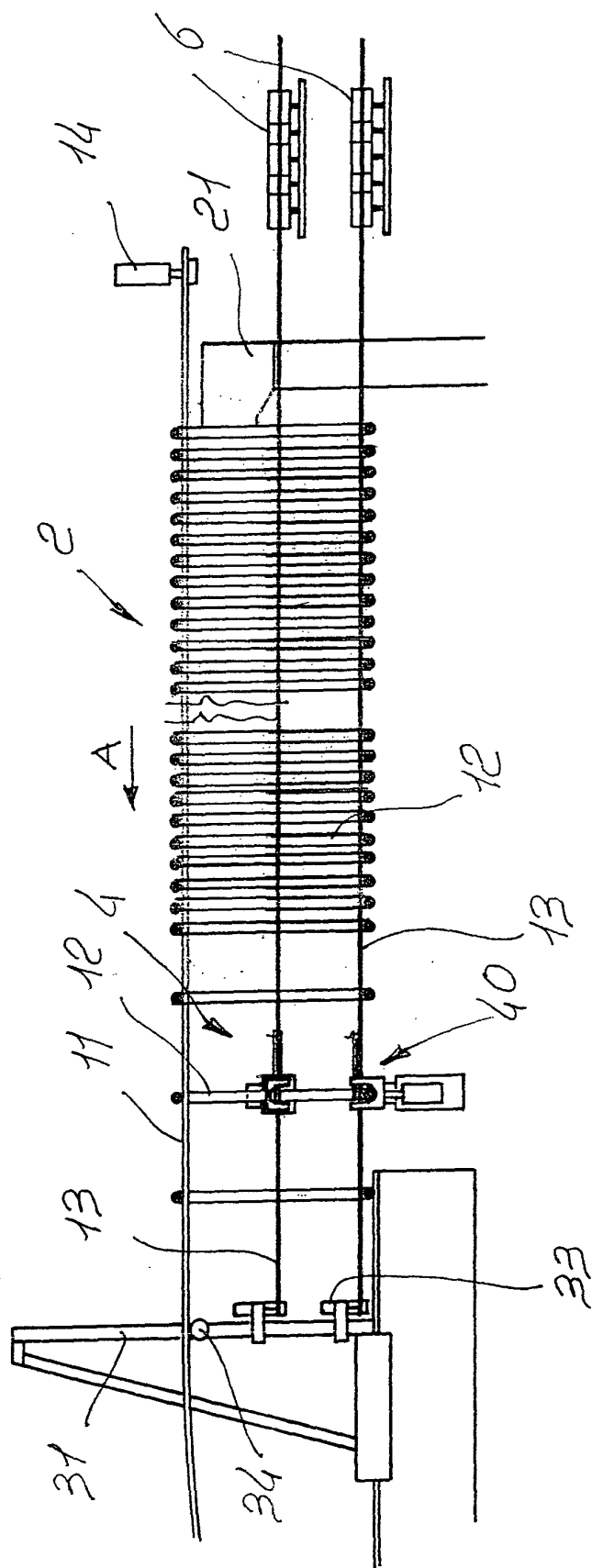


FIG. 5

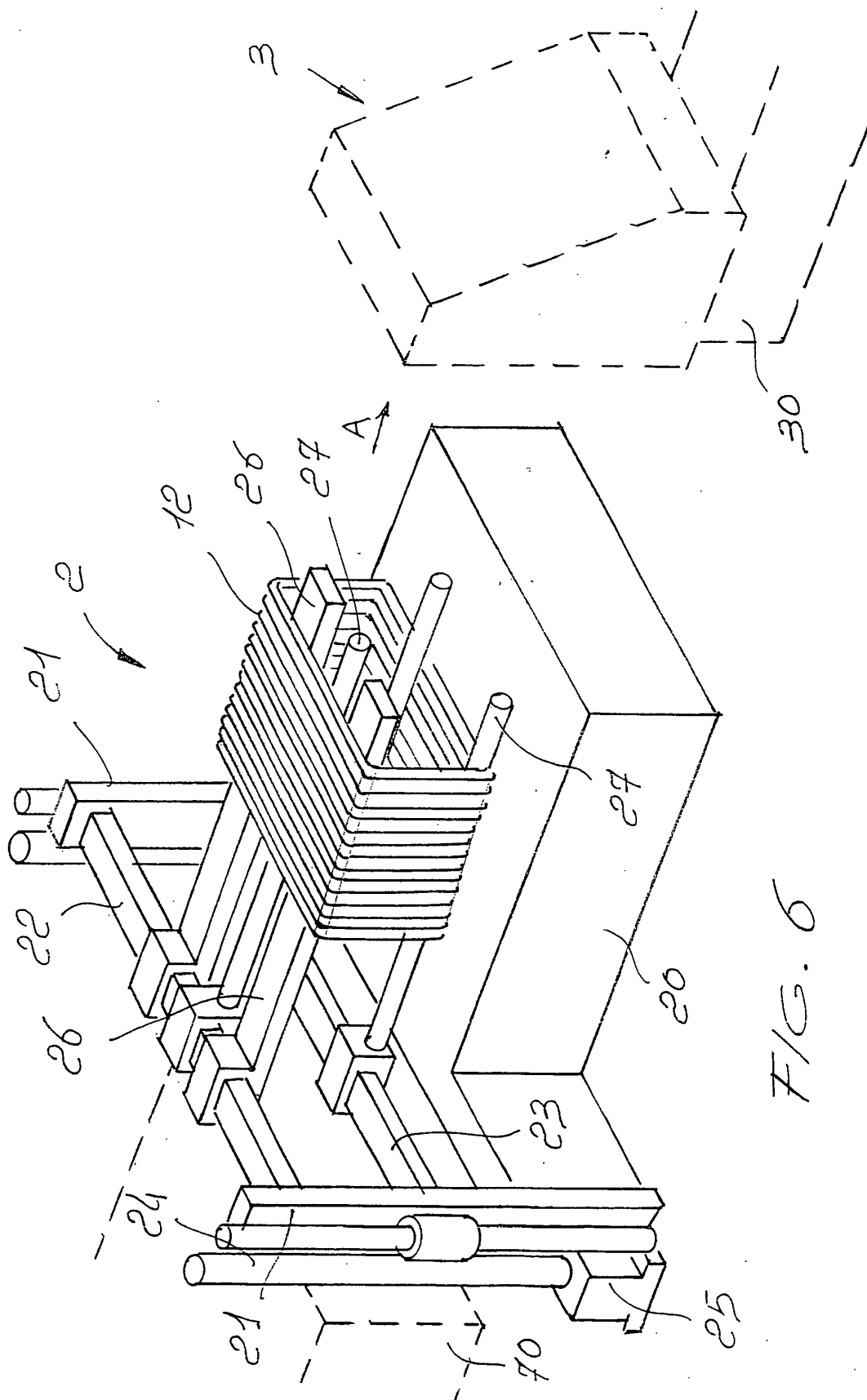
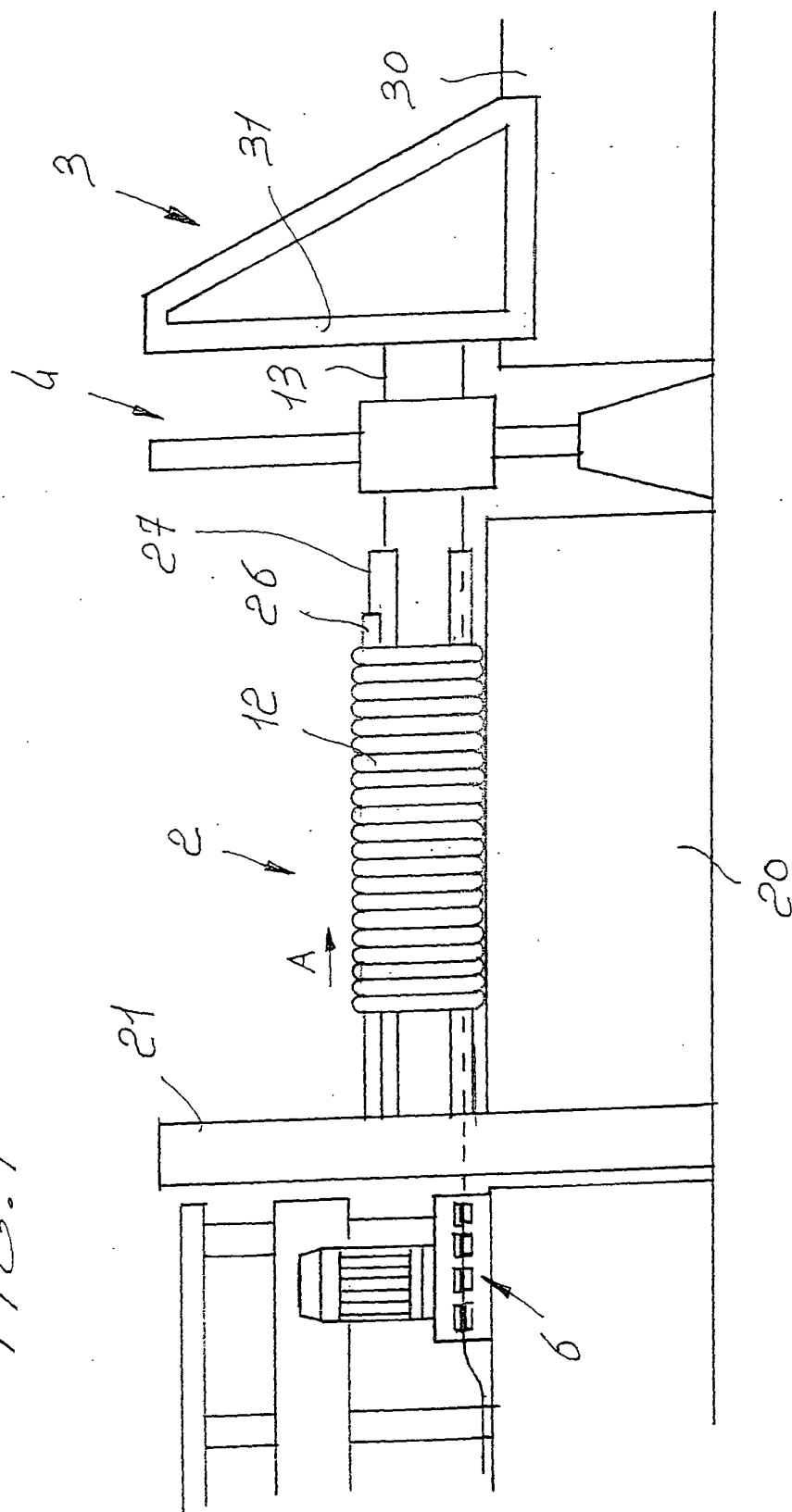
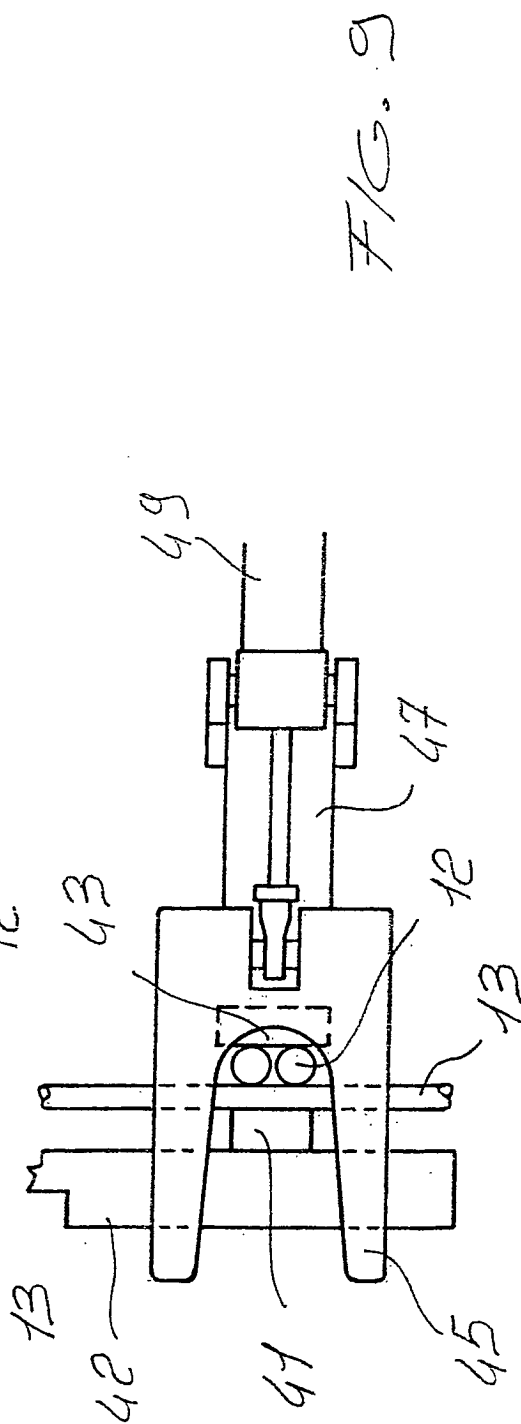
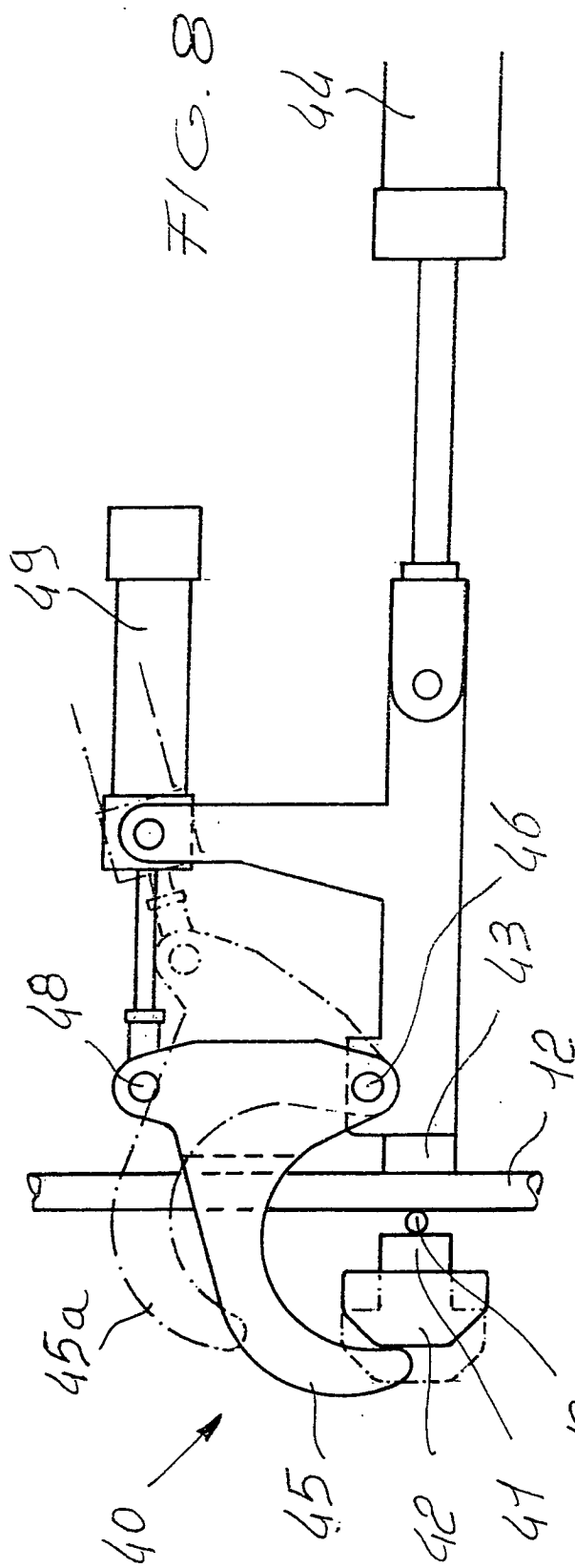
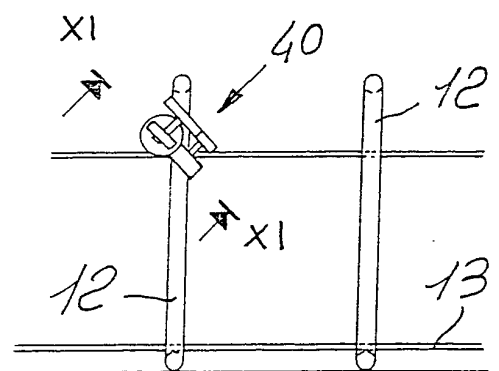
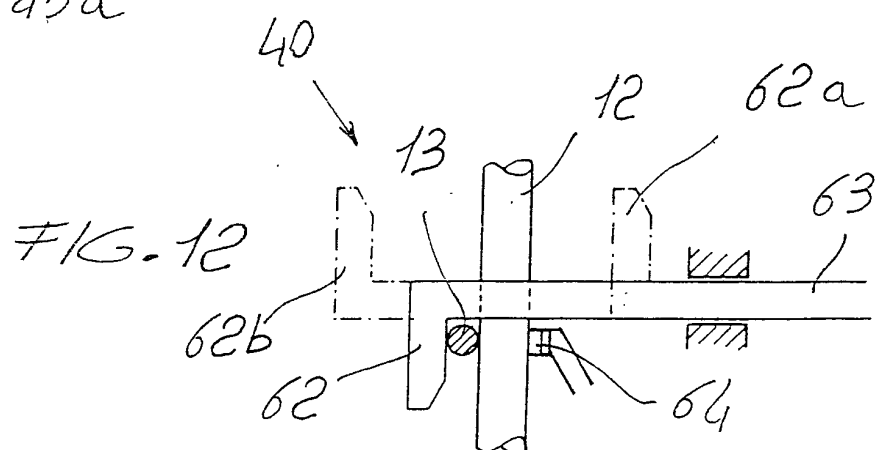
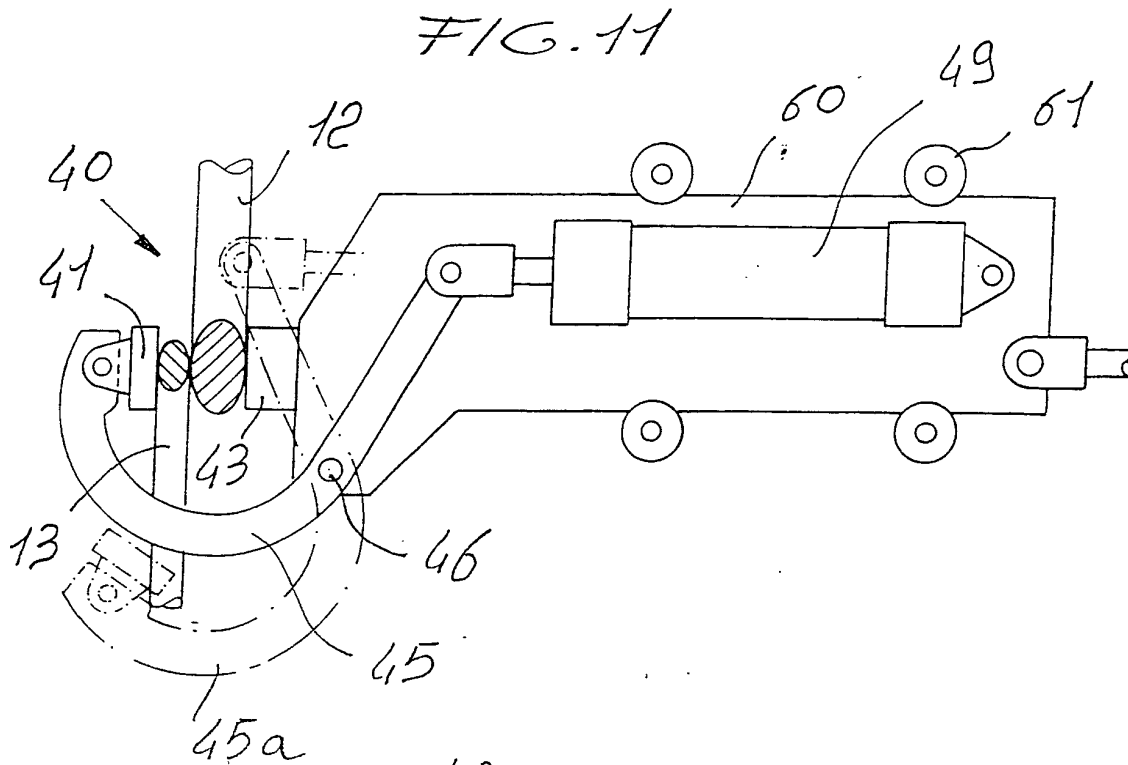


FIG. 7







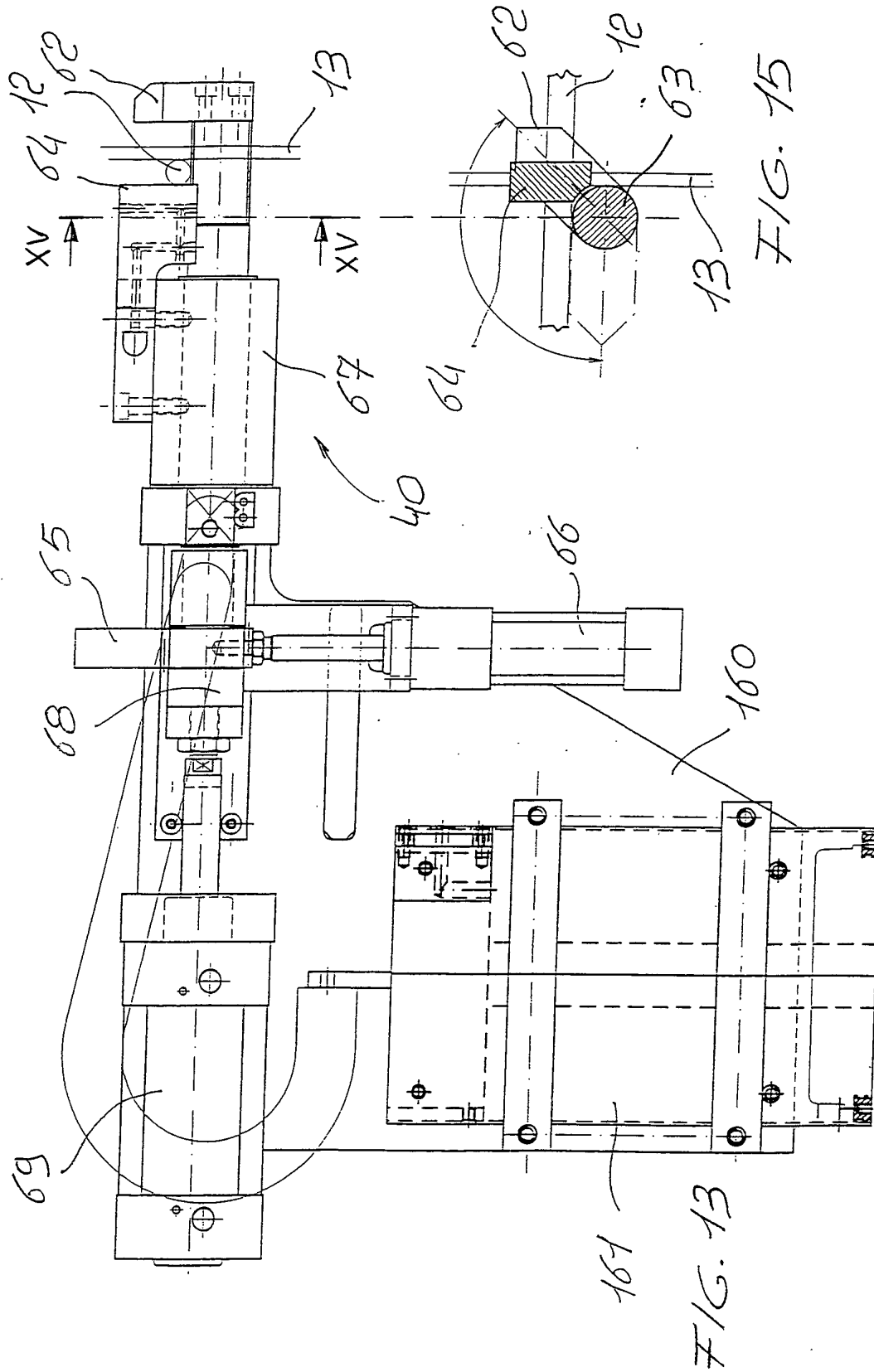
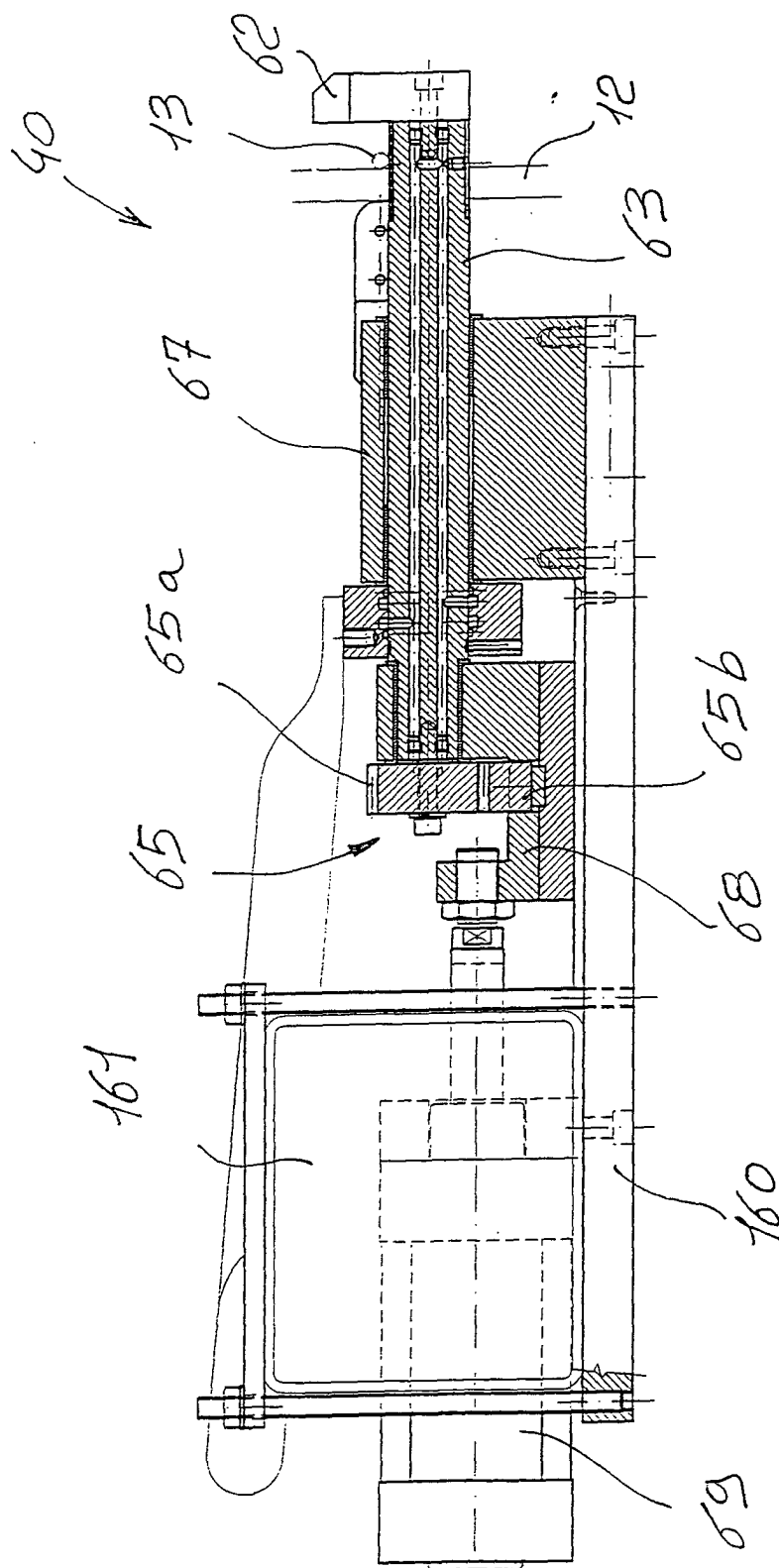


FIG. 14



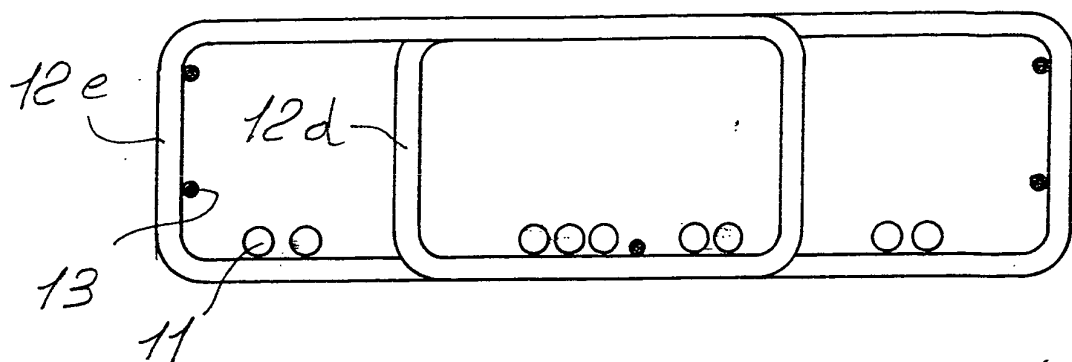


FIG. 18

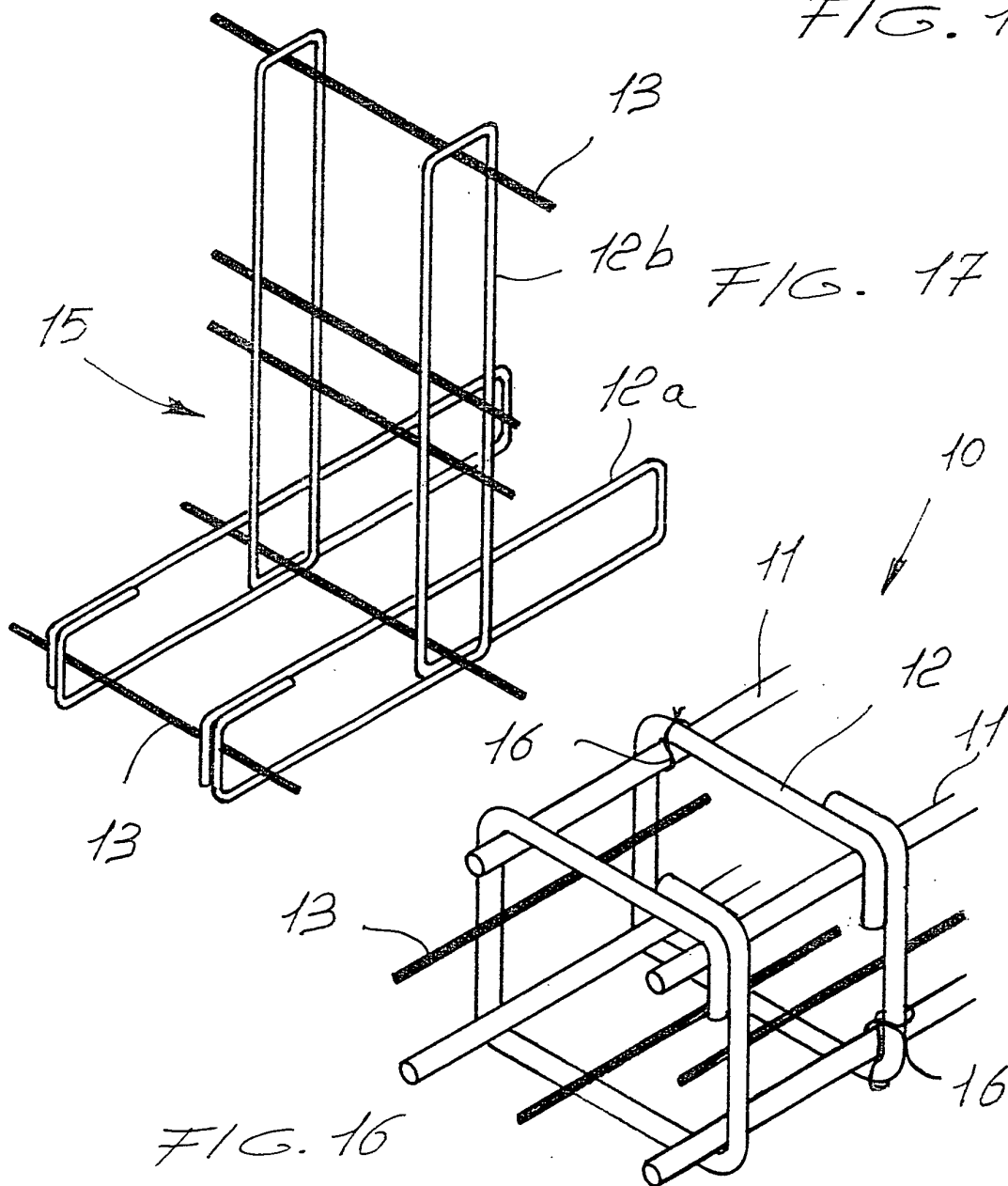
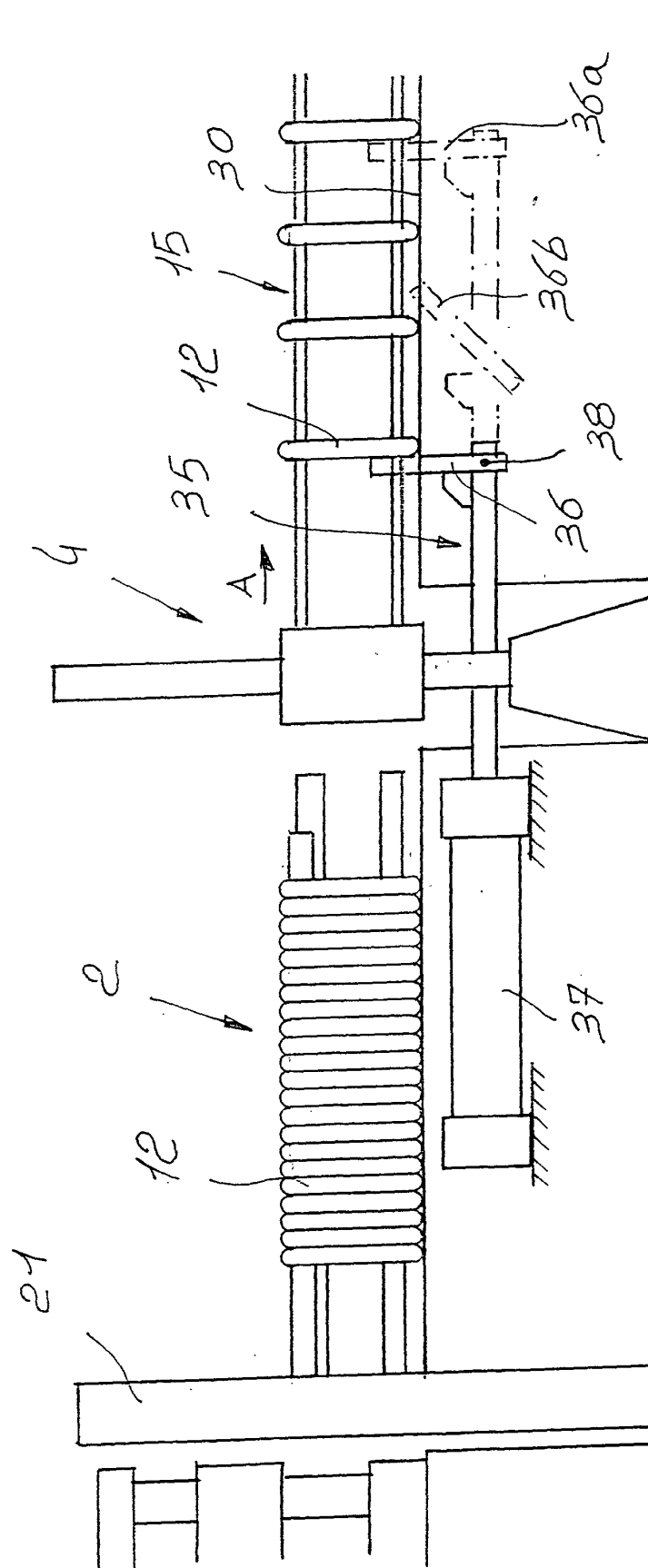


FIG. 19



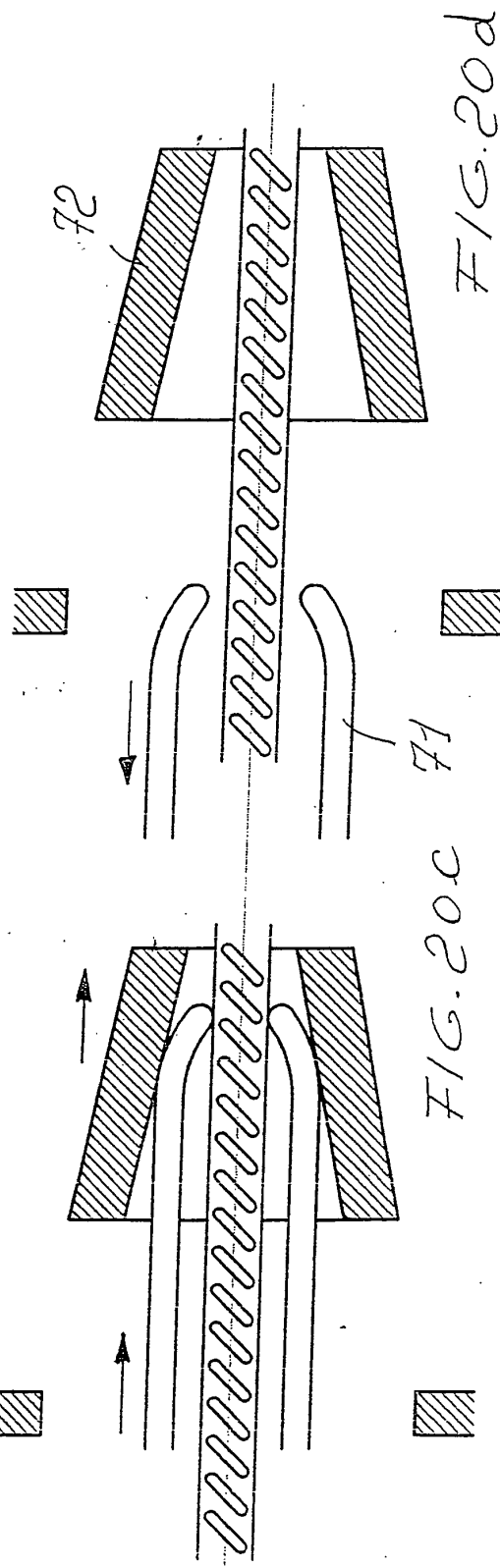
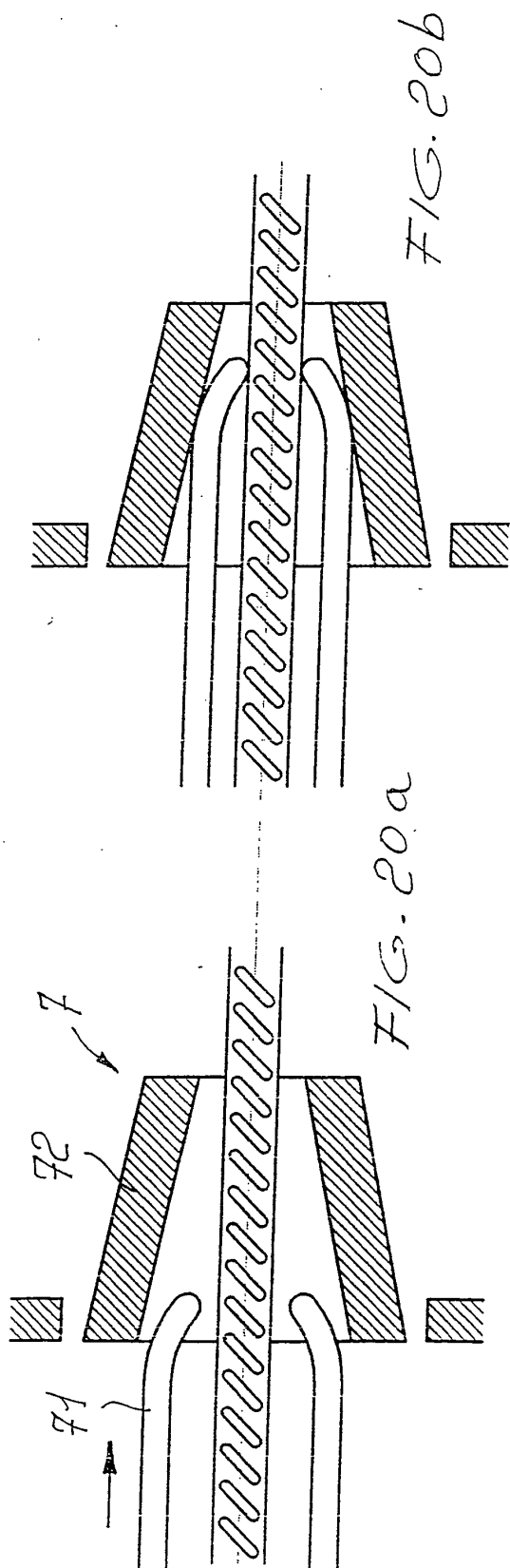


FIG. 21b

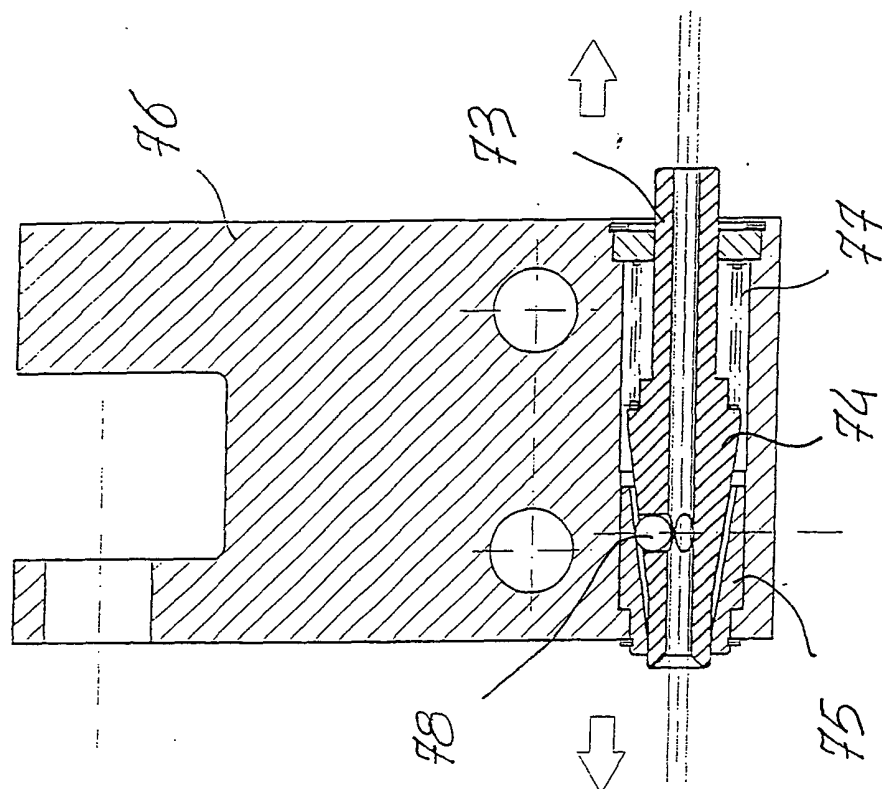


FIG. 21a

