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

(11) EP 0 811 442 A1

# (12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
**10.12.1997 Bulletin 1997/50**

(51) Int. Cl.[6]: **B21F 27/12**

(21) Application number: **97108887.7**

(22) Date of filing: **03.06.1997**

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

(30) Priority: **07.06.1996 IT BO960306**

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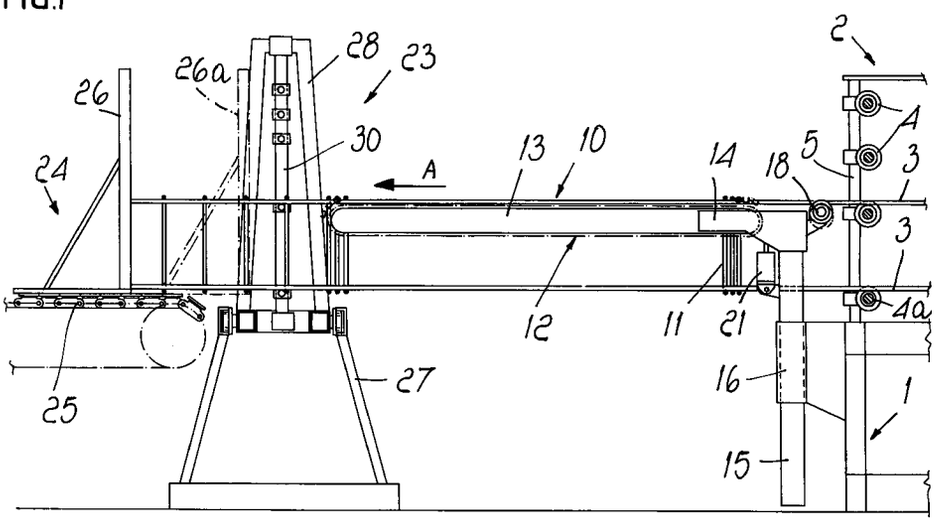
## (54) Apparatus for producing metal cages for reinforced concrete

(57) The apparatus for producing metal cages for reinforced concrete comprises a device (2) for feeding a plurality of longitudinal rods (3), which are arranged horizontally and parallel on at least two superimposed planes, and a unit (10) for distributing a plurality of stirrups meant to be associated with the longitudinal rods (3). The distribution unit (10) is provided with conveyor means which have means for supporting the stirrups (11) so that they are suspended and arranged on respective planes which lie transversely to the feed direction of the longitudinal rods; these means are adapted to be actuated so as to advance in a stepwise manner in order to transfer in succession individual stirrups into uniformly spaced positions on the longitudinal rods. A station (23) for joining the stirrups (11) to the longitudinal rods (3) in order to form a metal cage is located downstream of the distribution unit (10). Means (24) for pulling the metal cage being formed are adapted to be actuated with a stepwise motion which is modulated with the conveyor means of the distribution unit.

FIG.1




EP 0 811 442 A1

## Description

The present invention relates to an apparatus for producing metal cages for reinforced concrete.

It is known that metal cages, constituted by longitudinal rods connected by appropriately spaced transverse stirrups, are commonly used to produce the frame of reinforced concrete pillars and beams. The stirrups usually form a closed path, for example a quadrilateral one, with overlapping ends; the longitudinal rods are inserted in the profile formed by said stirrups, for example at the corners of said profile.

In order to produce these metal cages, the most widespread method entails manually fitting the stirrups on the longitudinal rods, which are clustered and rested on special supports. After appropriately spacing the stirrups from each other, and after manually tracing their position, some of the longitudinal rods are fastened to the upper portion of said stirrups. For example, in the case of the above-mentioned stirrups with quadrilateral profile, two longitudinal rods are fastened at the corners of the upper horizontal side of the profile.

The remaining longitudinal rods are then fitted on the lower portion of the stirrups and these rods, too, are fastened to said stirrups. Additional longitudinal rods can obviously be coupled, according to requirements, to the resulting metal cage, for example in intermediate positions on the vertical portions.

It is quite evident that this constructive solution entails a considerable waste of time and high labor costs in addition to causing limited productivity. All the above-mentioned steps are in fact performed manually by specific personnel.

A considerable execution time is required in particular by the step for positioning the stirrups and the longitudinal rods of the cage.

In order to facilitate the construction of metal cages for reinforced concrete, devices have been proposed which are meant to position the stirrups on the longitudinal rods and accordingly allow to mutually join said stirrups to the longitudinal rods, for example by automatic or manual welding. However, these devices are not free from drawbacks and have considerable operating limitations.

The aim of the present invention is to solve the above problem by providing an apparatus which allows to simply and quickly produce metal cages for reinforced concrete.

Within the scope of this aim, an object of the present invention is to provide an apparatus for producing metal cages for reinforced concrete which is simple in concept, safely reliable in operation, and versatile in use.

This aim and this object are both achieved, according to the invention, by the present apparatus for producing metal cages for reinforced concrete, characterized in that it comprises: a device for feeding a plurality of longitudinal rods, which are arranged horizontally and parallel on at least two superimposed planes; a unit for distributing a plurality of stirrups meant to be associated with said longitudinal rods, which is provided with conveyor means which have means for supporting said stirrups so that they are suspended and arranged on respective planes which lie transversely to the feed direction of said longitudinal rods, said means being adapted to be actuated so as to advance in a stepwise manner in order to transfer in succession individual stirrups into uniformly spaced positions on said longitudinal rods; a station for joining said stirrups to said longitudinal rods in order to form a metal cage; means for pulling said metal cage being formed through said joining station, which are adapted to be actuated with a stepwise motion which is modulated with said conveyor means of said distribution unit.

The details of the invention will become apparent from the detailed description of a preferred embodiment of the apparatus for forming metal cages for reinforced concrete, illustrated only by way of non-limitative example in the accompanying drawings, wherein:

figure 1 is a schematic side view of the apparatus for producing metal cages for reinforced concrete;
figure 2 is an enlarged-scale side view of a portion of said apparatus, at said stirrup distribution unit;
figure 3 is a corresponding top view of a detail of said distribution unit;
figure 4 is a detail view of means for supporting the longitudinal rods in said feeder;
figure 5 is a sectional view of a detail of said supporting means;
figures 6a, 6b, 6c, 6d, 6e and 6f are respective schematic views of different embodiments of said supporting means;
figure 7 is a transverse sectional view of a detail of said distribution unit;
figures 8a, 8b and 8c are schematic side views of said distribution unit during various operating steps;
figure 9 is a schematic front view of the apparatus at said joining station;
figure 10 is a corresponding top view thereof;
figure 11 is an enlarged-scale view of a detail of figure 10;
figures 12 and 13 are, respectively, a front view and an enlarged-scale plan view of a detail of said joining station;
figures 14a, 14b 14c and 14d are respective schematic views of different embodiments of welding means which operate in said joining station;
figure 15 is a schematic perspective view of a particular embodiment of said feeder for the longitudinal rods;
figures 16a and 16b are respective transverse sectional views of said longitudinal rod feeder in two different embodiments;
figure 17 is a schematic side view of a different embodiment of said stirrup distribution unit;
figure 18 is a corresponding transverse sectional view thereof;

figure 19 is a side view of a further embodiment of said stirrup distribution unit;

figure 20 is a plan view thereof;

figure 21 is a side view of grip means which are associated with said stirrup distribution unit;

figure 22 is a schematic perspective view of another stirrup distribution unit;

figure 23 is a transverse sectional view of a different embodiment of said joining station;

figure 24 is a perspective view of a detail of said joining station;

figure 25 is a side view of a particular embodiment of said means for pulling the metal cage being formed;

figure 26 is an enlarged-scale view of a detail of said pulling means.

With reference to the above figures, and particularly initially to figures 1 and 2, the reference numeral 1 generally designates the fixed framework of the apparatus for making metal cages for reinforced concrete according to the present invention.

The fixed framework 1 provides a device 2 for feeding the longitudinal rods 3 meant to form the metal cages. Said longitudinal rods 3 are supplied to the feeder 2 by appropriate loading elements, not shown, which are adapted for example to take said rods from a corresponding magazine; as an alternative, it is possible to cut the longitudinal rods 3 to size from a continuous rod which unwinds from a reel element at said feeder 2.

The feeder 2 has a plurality of rollers 4 for supporting the rods 3 which have a horizontal axis and are supported at different elevations by uprights 5; the elevation of the rollers 4 can be adjusted by means of corresponding couplings 6, except for the lower roller 4a, which has a fixed position.

As shown in detail in figures 4 and 5, the supporting rollers 3 have pairs of rings 7 which are appropriately shaped and are adapted to form corresponding grooves for the engagement of the rods 3. The rings 7 have a mutual spacing which can be adjusted, by means of fixing grub screws 8, according to the diametrical dimensions of the rods 3 to be fed; the grub screws 8 are inserted at slots 9 of the rings 7.

Conveniently, the supporting rollers 4 are movable to allow the descent of the longitudinal rods 3 onto the underlying rollers 4 during the loading of said rods 4; of course, the lower roller 4a cannot move. This can be achieved, for example, by rotating the rollers 4, which are appropriately hinged at one end, about a horizontal axis or a vertical axis, as shown schematically in figures 6a and 6b, respectively in an elevation view and in a plan view, and in which the dashed line 4b indicates the inclined position assumed by said rollers 4 during loading.

The same goal can be achieved by allowing the supporting rollers 4 to slide axially, as shown in the plan view of figure 6c, where the reference numeral 4b again designates the retracted position assumed by said rollers 4 during loading.

As an alternative, it is possible to make only one half 4c of said supporting rollers movable, as shown in the corresponding figures 6d, 6e and 6f; during loading, said half 4c of the rollers can be moved into the position 4b, which is inclined or retracted, in the manner indicated for the whole rollers.

In front of the feeder 2 there is provided a distribution unit 10 for the stirrups 11 which are meant to be associated with the longitudinal rods 3 to form the metal cages.

The distribution unit 10 has a chain conveyor 12 which wraps around a plate 13 which is elongated horizontally on a vertical plane. The plate 13 is supported so as to cantilever out, at one end, by a sort of fork 14 fitted at the top of a post 15 which is slidingly guided through a sleeve 16 rigidly coupled to the fixed framework 1 in order to adjust the vertical position of said plate 13 (see in particular figures 2 and 3).

The fork 14 also supports, on a bracket 17, an additional roller 18 which has a horizontal axis which is parallel to the rollers 4 of the feeder 2; the position of the roller 18 is adjustable by means of a vertical screw element 19 so as to allow to adjust the position of the upper rods 3.

The chain 12 is provided with a plurality of elements 20 for supporting the stirrups 11 which are cradle-shaped and uniformly distributed. The chain 12 is adapted to be actuated, so as to advance in a stepwise manner in the direction indicated by the arrow A, by an adapted actuator 21 which is hinged to the column 15; the actuator 21 is adapted to act on the supporting elements 20 with a sort of escapement mechanism.

The chain 12 also supports a transverse stem 22 which is elongated bilaterally and is adapted to act as a support for said upper rods 3, as shown in detail in figure 7.

Downstream of the distribution unit 10 along the stepwise advancement direction of the chain 12 there is provided a station 23 for joining the stirrups 11 to the longitudinal rods 3, preferably by welding, which is described in greater detail hereinafter.

In front of the welding station 23, a device 24 is provided for pulling the metal cage being formed (figure 1). Said pulling device 24 has a conveyor belt 25 which is arranged longitudinally to the distribution unit 20 and is adapted to be actuated in a stepwise manner in the same direction as the advancement direction A of the distribution unit 10. A frame 26 is fitted on the conveyor belt 25, and the front stirrup of the cage being formed is adapted to be rigidly coupled to said frame, for example by means of conventional fastenings. The frame 26 can move rigidly with the conveyor belt 25 during the advancement step; during the return step, the frame 26 can be disengaged from the conveyor belt 25 or, as an alternative, the direction of actuation of said conveyor belt 25 can be made reversible.

The welding station 23 is provided with a base

framework 27 which is arranged transversely to the distribution unit 10 of the stirrups 11 and on which two mutually opposite carriages 28, are provided with wheels 29, can move symmetrically (see figures 9 and 10). The carriages 28 are provided with respective uprights 30 on which a plurality of welding units 31 is fitted at different and appropriately adjustable elevations. The welding units 31 are adapted to weld respective longitudinal rods 3 inside the stirrups 11.

The position of the carriages 28 can be adjusted independently for each carriage by means of respective shafts 32 which are arranged longitudinally with respect to the base framework 27 and can be actuated by means of corresponding handwheels 33. Respective actuators 34 are axially rigidly coupled to the shafts 32 and are preferably constituted by cylinders with two telescoping stems, which are meant to symmetrically move the carriages 28 that support the welding units 31 among three different operating positions, as will become apparent hereinafter.

Said welding units 31 are adapted to cooperate with a respective pin 35 which has a conical tip and is arranged so that its axis is horizontal and transverse with respect to the longitudinal plane of the apparatus and is meant to act as a locator for the stirrup 11 being welded.

As shown in detail in figure 11, the pin 35 is rotatably fitted, by means of rolling bearings 36, on a support 37 which is slidingly mounted on the upright 30 of the carriage 28 and can be locked in the intended position by means of a screw element 38. The support 37 is also provided, by means of an articulated coupling 39, with a corresponding welder 40 which is arranged so as to be conveniently at an angle with respect to the corresponding pin 35.

Operation of the apparatus for forming metal cages for reinforced concrete is easily understandable from the above description.

The longitudinal rods 3 meant to form the metal cage are first loaded into the feeder 2. Said rods 3 are arranged so as to rest on the rollers 4 and are positioned appropriately according to the geometry of the cage to be formed.

In particular, the lower roller 4a has a fixed position, whilst the elevation of the upper rollers 4 can be adjusted on the uprights 5 of the feeder 2. The rings 7 furthermore allow to adjust the position of the rods 3 along the rollers 4. The number and position of said rods 3 depends of course on the type of metal cage to be formed.

The rods 3 are then moved longitudinally so as to enter the stirrups 11, which are arranged side by side on the distribution unit 10. It should be noted that the upper rods 3 are arranged on a horizontal plane which lies directly below the resting plane of the stirrups 11 formed by the supporting elements 20 of the distribution unit 10; said upper rods furthermore rest on the additional roller 18, whose position can be adjusted according to the diametrical dimensions of said rods, as shown by the dashed line 18a in figure 2, so as to allow the exact approach of said upper rods to the corresponding upper portion of the stirrups 11.

The stirrups 11 meant to form the metal cage are first loaded onto the supporting elements 20 of the distribution unit 10, starting from the free end thereof, by actuating the chain conveyor 12 in reverse with respect to the active stroke. This operation is preferably performed manually by the operator.

In practice, the loaded distribution unit 10 provides a sort of magazine for the stirrups 11 to be fed to the welding station 23. The stepwise advancement of the chain conveyor 12 of the distribution unit 10 in the direction A then feeds the individual stirrups 11 to the welding station 23.

Once the insertion of the longitudinal rods 3 through the stirrups 11 supported by the distribution unit 10 has been completed, the front end of said rods 3 is welded to the first one of said stirrups 11. Said first stirrup is then rigidly coupled, for example through conventional fastenings, to the movable frame 26 supported by the conveyor belt 25 of the pulling device 24. Of course, during this step the frame 26 is adjacent to the welding station 23, in the position shown by the dashed line 26a in figure 1.

Therefore, by actuating the stepwise advancement of the traction device 24, the corresponding advancement of the cage being formed through the welding station 23 is produced. This advancement is in a suitable phase relationship with the advancement of the chain conveyor 12 of the distribution unit 10, which is actuated by the actuator 21 and causes the sequential feeding of the individual stirrups 11 to the welding station 23.

The stepwise advancement of the pulling device 24 is conveniently modulated according to the intended distance between the stirrups 11 along the longitudinal rods 3 of the metal cage.

It should be noted that the upper rods 3 are appropriately supported, at the distribution unit 10, by the transverse stem 22, which protrudes bilaterally from the chain 12, as shown schematically in figures 8a, 8b and 8c. This allows, in particular, to have an adequate support for said rods 3 even after they leave the supporting rollers 4.

At the welding station 23, the stirrup 11 fed by the distribution unit 10 is placed in abutment against the pins 35 arranged in adjustable positions on the uprights 30 of the mutually opposite carriages 28 (see figures 9 and 10). The pins 35 are conveniently arranged adjacent to respective longitudinal rods 3 which engage the inner corners and the lateral portions of the stirrup 11.

The carriages 28 are moved by the corresponding actuators 34, so as to define three different operating positions; specifically, a retracted position of the pins 35 for the passage of the cage being formed; an intermediate position for the abutment of said pins 35 against the stirrup 11 to be welded, which is fed by the distribution unit 10; and an advanced position for welding on the part of the corresponding welders 40. In this last posi-

tion, the stirrup 11 is clamped between the longitudinal rods 3, resting on the pins 35, and a collar 35a which is formed by said pins 35 (figure 11).

For a more stable grip of the stirrup 11 to be welded, it is possible to use two mutually opposite auxiliary grip elements 41 which are actuated by corresponding actuators 42 along a horizontal axis which lies transversely to the advancement direction of the cage, as shown in figures 12 and 13. Said auxiliary grip elements 41 form a sort of fork with asymmetric prongs 43a and 43b between which it is possible to lock a corresponding lateral portion of the stirrup 11 to be welded. This solution is particularly advantageous, for example, if the metal cage has a plurality of longitudinal rods 3 arranged along the upper and lower portions of the stirrups 11.

The activation of the welders 40 causes the welding of the longitudinal rods 3 inside the stirrup 11 arranged in abutment against the pins 35, at the station 23. This welding occurs conventionally, by means of adapted weld material.

In the case shown in figures 10 and 11, the welders 40 act on the horizontal plane of advancement of the longitudinal rods 3. However, the welders might act on a vertical plane which lies transversely to the longitudinal axis of the apparatus, as shown in figures 14a, 14b, 14c and 14d.

In particular, in the case shown in figure 14a, there is provided a double set of welders 40 supported along vertical axes by a pair of cross-members 44 and 45, respectively an upper one and a lower one; the cross-members 44 and 45 can move symmetrically along posts 46 which are rigidly coupled to the base framework of the welding station, under the actuation of respective actuators 47. This solution is specifically provided for the formation of metal cages having a plurality of longitudinal rods 3 arranged along the upper and lower portions of the stirrups 11.

The solution illustrated in figure 14b provides for a double set of welders 40 which are supported along inclined axes on said transverse vertical plane and can move symmetrically, so as to weld longitudinal rods 3 arranged along the lateral portions of the stirrups 11.

In figures 14c and 14d, the same welds are provided by means of a single pair of welders 40 which are supported by movement elements, not shown, which are adapted to move said welders between a retracted position 40a and an advanced position 40b for welding; in the retracted position 40a, said movement elements shift the welders along a corresponding portion of the stirrup 11.

Of course, in a simplified embodiment of the apparatus it is possible to provide for the manual execution of the welds by the operator. The coupling of the stirrups to the longitudinal rods might also be performed in said station 23 through conventional fastenings.

To conclude, the apparatus according to the invention allows to quickly and easily produce metal cages for reinforced concrete, with an evident simplification of the steps for preparing the cage, avoiding in particular the manual tracing of the position of the stirrups and their positioning.

This is achieved in particular by the distribution unit, which separates and automatically feeds the stirrups to the welding region in an appropriate sequence.

The apparatus allows to automatically weld the longitudinal rods along all the sides of the stirrups or only on one or more sides. The longitudinal rods can also be arranged so as to rest on various horizontal planes which can be adjusted at will by means of the supporting rollers 4 of the feeder.

It should be noted that the metal cage being formed does not slide on benches or the like, with the risk of deforming the stirrups, but is moved while resting on the belt 25, which cooperates with the frame 26 to pull said cage.

Figures 15, 16a and 16b illustrate a particular embodiment of the device for feeding the longitudinal rods 3 meant to form the metal cages, in which the supporting rollers 4 of said rods 3 are cantilevered out from the uprights 5.

The rollers 4 whose vertical position can be adjusted are supported by bars 50 which are arranged longitudinally with respect to the feeder and are rigidly coupled to the couplings 6 of the uprights 5; the bars 50 can be actuated by means of a plurality of actuators 51 which have a vertical axis.

The rollers 4 protrude above the roller conveyor constituted by the rollers 4a, which have a fixed position and can be fed with the rods 3 by means of a magazine 52 of said rods 3 which is arranged to the side of the feeder, at the free end of said rollers 4.

In the embodiment illustrated in figure 16a, the rollers 4 cantilever out from a single side of the uprights 5; in the embodiment of figure 16b, instead, the rollers 4 protrude bilaterally with respect to the uprights 5. In this second case, there are of course two different magazines 52 for the longitudinal rods 3 to be fed to said rollers 4.

Figures 17 and 18 illustrate a different embodiment of the distribution unit 10 for the stirrups 11, in which the chain conveyor 12 cooperates with a second chain conveyor 53 which winds around a plate 54 which is elongated horizontally on the same vertical plane as the plate 13 of the chain conveyor 12.

The plate 54 is supported so as to cantilever out at one end on the same vertical plane as the plate 13.

The second chain 53 supports a plurality of supporting elements for the stirrups 11, which are again designated by the reference numeral 20 for the sake of clarity and are similar to those supported by the first chain 12. The chain 53 is actuated so as to advance in a stepwise manner and in step with the chain 12, in the same direction A as said chain 12.

In this embodiment, the stirrups 11 supported in a suspended condition by the first chain 12 engage, at the lower portion, the supporting elements 20 of the second chain 53.

In order to allow the distribution of large stirrups 11, the distribution unit 10 is conveniently provided with a first pair of chain elements 12, 12a arranged side by side and with a second pair of chain elements 53, 53a which are likewise arranged side by side on the same vertical planes as the chains 12, 12a, as shown in figure 18.

Conveniently, the chains 12, 12a which cooperate to support the stirrups 11 have supporting elements 20, 20a of different dimensions so as to increase the versatility of the distribution unit 10. In particular, the chain 12 on its own allows to support stirrups of limited dimensions.

In the embodiment illustrated in figure 19, the stirrups 11 are instead conveyed between an upper chain element 55 and a lower chain element 56 which move on corresponding plates 57 and 58 supported in a cantilevered manner on the same vertical plane. The stirrups 11 are gripped between the mutually opposite supporting elements 20 supported by said chains 55 and 56. In this case, of course, the lower chain element 56 is actuated in a direction B which is opposite to the direction A of the upper chain 55.

As an alternative, said contrarotating chains 55 and 56 can be arranged so that they are co-planar on a horizontal plane. In this case, the stirrups 11 are gripped by the supporting elements 20 at the lateral portions of said stirrups.

The supporting elements of the stirrups 11 can furthermore be provided by means of profiles 59 which are supported, proximate to the opposite ends, by two side-by-side chains 60, as shown in figure 20. The chains 60 are supported by a frame 61 which is supported in a cantilevered manner on a pair of posts 62 and can slide under the actuation of adapted drive elements to adjust the position of the distribution unit.

The fact should be noted that the contrarotating-chain distribution unit 55 and 56 does not interfere with the internal profile of the stirrups 11 and can be used in an optimum manner even to convey shaped or bent longitudinal rods. In this case, the rollers 4 of the feeder are conveniently magnetized so as to support said rods in a suspended configuration.

At the exit from the distribution unit 10, particularly of the type constituted by an upper chain element 55 and a lower chain element 56, a transfer element 63 is conveniently provided which is adapted to appropriately space the stirrups 11 by a preset pitch.

The transfer element 63 has two mutually opposite grip elements 64 which are actuated by corresponding actuators 65 along a horizontal axis which lies transversely to the cage advancement direction, as shown in figure 21. Said grip elements 64 form a sort of fork with asymmetrical prongs 64a, 64b, between which a corresponding lateral portion of the stirrup 11 to be transferred can be locked.

The actuators 65 are in turn supported so that they move longitudinally with respect to the cage being formed by additional corresponding actuators 66 which are arranged in a parallel configuration to the side of the chain elements 55 and 56.

The transverse actuators 65 are adapted to move the grip elements 64 between a closer position for gripping the stirrups 11 and a spaced disengagement position, whilst the longitudinal actuators 66 are adapted to move said grip elements 64 rigidly with the corresponding actuators 65 between a retracted position and an advanced position in said advancement direction A.

In practice, the grip elements 64, arranged in the retracted grip position, sequentially receive a stirrup 11 which exits from the distribution unit 10; said stirrup 11 is pushed into abutment against the elongated prongs 64a of said grip elements 64. Then the longitudinal actuators 66 are activated and move the stirrup 11 into the advanced position, designated by the reference numeral 63a in figure 21; the subsequent activation of the transverse actuators 65, by placing the grip elements 64 in the disengagement position 63b, causes the release of the stirrup 11 transferred at the welding station.

Of course, the extent of the stroke actuated by the longitudinal actuators 66 determines the pitch between the transferred stirrups 11.

Figure 22 illustrates a distribution element for the stirrups 11 which is constituted by two comb-shaped linkages 67 which are articulated at their ends to corresponding pairs of cranks 68 rotatably supported on corresponding shafts 69. The linkages 67 are adapted to cooperate with a corresponding pair of fixed rods 70, which are likewise comb-shaped.

The stirrups 11 to be distributed are arranged so that they rest between the teeth of the comb formed by the fixed rods 70. At each turn of the cranks 68, the linkages 67 raise said stirrups 11 between the teeth of the corresponding comb and move them forward by one step on said fixed rods 70.

However, it is possible to use distribution units for the stirrups 11 which are of a different kind, for example using screw-conveyor elements and the like.

In the welding station illustrated in figures 23 and 24, the welder 40 cooperates with a sort of clamp 71 which is meant to move the rods 3 to be welded to the stirrups 11 mutually closer. Said clamp 71 is substantially constituted by a fork 72 with two curved prongs which is pivoted on a pivot 73, along an axis which is longitudinally parallel to said rods 3, to a frame 74 which is rigidly coupled to the stem of a first actuator 75 which has a vertical axis. The frame 74 forms, in a downward region, a shoulder 76 which has an appropriately rounded profile and is adapted to be placed in abutment against the stirrups 11 to clamp the longitudinal rods 3 during welding.

The stem of a second actuator 78 which has a vertical axis and is rigidly coupled to said frame 74 is furthermore articulated to the fork 72 on a pivot 77 which is parallel to the fulcrum pivot 73.

The first actuator 75 is supported by a carriage 80 which is slidingly supported on a horizontal guiding

stem 81 which is rigidly coupled to the framework of the welding station. The guiding stem 81 is in turn slidingly mounted, at its end, by means of corresponding sleeves 82, on a pair of posts 83 of said framework. The carriage 80 is actuated by an adapted drive element 84.

Two vertically opposite grooved guides 85 are furthermore rigidly coupled to the carriage 80, and corresponding pairs of rollers 79, rotatably supported by the frame 74, can slide therein.

By means of the carriage 80, the frame 74 is moved into position above the stirrup 11 to be welded and then lowered, through the activation of the first actuator 75, until it abuts against the shoulder 76 on said stirrup 11. An adapted angular rotation of the fork 72 is then actuated by means of the second actuator 78 and moves the longitudinal rod 3 to be welded towards said stirrup 11, ensuring an appropriate clamping force. Welding is then performed by means of the welder 41.

Finally, figures 25 and 26 illustrate a different embodiment of the device for pulling the metal cage being formed, which is provided with a hook 86 which is oscillatably mounted on a pivot 87 at the end of the stem of an actuator 88 which acts along a horizontal axis which is longitudinal with respect to the advancement direction of the cage being formed. The hook 86 is actuated by a spring 89 to be arranged in a position which is transverse to said stem of the actuator 88.

The hook 86 is adapted to engage, in a rearward position, the lower portion of a stirrup 11 of the cage being formed and to be pulled, and to cause the stepwise advancement of said cage under the actuation of the actuator 88. During the return stroke produced by said actuator 88, the hook 86 rotates into the lowered position 86a, in contrast with the elastic action of the spring 89, so as to move beyond the stirrup 11 to be engaged for the subsequent pulling action.

In the practical execution of the invention, the materials employed, as well as the shape and the dimensions, may be any according to requirements.

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

## Claims

1. An apparatus for producing metal cages for reinforced concrete, characterized in that it comprises: a device for feeding a plurality of longitudinal rods, which are arranged horizontally and parallel on at least two superimposed planes; a unit for distributing a plurality of stirrups meant to be associated with said longitudinal rods, which is provided with conveyor means which have means for supporting said stirrups so that they are suspended and arranged on respective planes which lie transversely to the feed direction of said longitudinal rods, said means being adapted to be actuated so as to advance in a stepwise manner in order to transfer in succession individual stirrups into uniformly spaced positions on said longitudinal rods; a station for joining said stirrups to said longitudinal rods in order to form a metal cage; means for pulling said metal cage being formed through said joining station, said means being adapted to be actuated with a stepwise motion which is modulated with said conveyor means of said distribution unit.

2. An apparatus according to claim 1, characterized in that said distribution unit is provided with chain conveyors which wind around a vertical plate which is elongated longitudinally to said feed direction of said rods and is supported in a cantilevered manner, at an end which is adjacent to said feeder, by means whose vertical position can be adjusted, said chain means being provided with said supporting means for said stirrups, said supporting means being uniformly distributed on said chain means.

3. An apparatus according to claim 1, characterized in that said conveyors of said distribution unit are adapted to be actuated so as to advance in a stepwise manner by an alternate actuator which acts with a sort of escapement mechanism.

4. An apparatus according to claim 1, characterized in that said feeder is provided with a plurality of rollers for supporting said longitudinal rods, said rollers being supported with horizontal axes which lie transversely to said feed direction of said longitudinal rods, on said superimposed planes, in a position whose elevation can be adjusted, said rollers supporting pairs of shaped rings which have an adjustable mutual distance and are adapted to form corresponding grooves for engaging said longitudinal rods.

5. An apparatus according to claim 4, characterized in that said supporting rollers are adapted to be movable, during the loading of said longitudinal rods, so as to allow the descent of said longitudinal rods onto the underlying supporting rollers.

6. An apparatus according to claim 1, characterized in that said joining station has two mutually opposite carriages which can move symmetrically on a base framework transversely to the longitudinal axis of said distribution unit of said stirrups, said carriages being provided with welding means which are adapted to be arranged adjacent to said stirrups in order to weld said longitudinal rods inside said stirrups.

7. An apparatus according to claim 6, characterized in

that said carriages support, at different and appropriately adjustable heights, a plurality of pins whose axis is arranged along said transverse direction, said pins being adapted to act as a locator for said stirrups being welded, said carriages being actuatable among a retracted position of said pins for the passage of the cage being formed, an intermediate position for the abutment of said pins against the stirrup to be welded, and an advanced welding position.

**8.** An apparatus according to claim 6, characterized in that said carriages support respective grip elements which are arranged along said transverse direction and form a sort of fork with asymmetrical prongs, between which a corresponding lateral portion of said stirrups to be welded can be locked.

**9.** An apparatus according to claim 1, characterized in that said traction means are provided with a conveyor belt which is arranged longitudinally to said distribution unit, is adapted to be actuated in a stepwise manner, and is provided with a frame to which the front stirrup of said cage being formed can be rigidly coupled.

**10.** An apparatus according to claim 1, characterized in that said distribution unit is provided, in a position which is adjacent to said feeder, with a roller for supporting said longitudinal rods which are arranged on an upper plane which lies directly below the supporting plane of said stirrups, which is formed by said supporting means of said distribution unit, said roller being supported with a horizontal axis which lies transversely to said feed direction by means whose elevation can be adjusted.

**11.** An apparatus according to claim 1, characterized in that said conveyor means of said distribution unit support at least one transverse stem which is elongated bilaterally and is adapted to act as a support for said longitudinal rods arranged on an upper plane.

**12.** An apparatus according to claim 1, characterized in that said feeder is provided with a plurality of rollers for supporting said longitudinal rods which are supported in a cantilevered manner at least on one side of corresponding uprights, with an elevation which can be adjusted, above corresponding rollers which have a fixed position, and are adapted to be fed with said longitudinal rods by means of a magazine for said longitudinal rods which is arranged to the side of said feeder, at the free end of said rollers.

**13.** An apparatus according to claim 1, characterized in that said distribution unit has first and second chain conveyor means which are provided with corresponding supporting means which are adapted to engage opposite parallel portions of said stirrups.

**14.** An apparatus according to claim 13, characterized in that said first and second chain conveyor means are actuated synchronously in opposite directions and are adapted to retain said stirrups between mutually opposite supporting means.

**15.** An apparatus according to claim 1, characterized in that said distribution unit is provided with means for supporting said stirrups which are provided by means of profiles which are supported, proximate to the opposite ends, by two side-by-side chain elements supported by a frame whose elevation can be adjusted.

**16.** An apparatus according to claim 1, characterized in that said distribution unit has, at the region where it exits from said conveyor means, an element for transferring said stirrups to said joining station which is provided with two mutually opposite grip elements which are adapted to be actuated by corresponding actuators along a horizontal axis which lies transversely to the advancement direction of said stirrups, between a closer position for gripping said stirrups and a spaced disengagement position, said actuators being in turn supported so as to move, along a direction which is longitudinal to said advancement direction, by additional actuators, between a retracted position and an advanced position towards said joining station.

**17.** An apparatus according to claim 16, characterized in that said grip elements form a sort of fork with asymmetrical prongs, between which a corresponding lateral portion of said stirrups to be transferred can be locked.

**18.** An apparatus according to claim 1, characterized in that said distribution unit is provided with a pair of comb-shaped linkages which are articulated, at their ends, to corresponding pairs of cranks and are adapted to cooperate with a corresponding pair of fixed rods which are likewise comb-shaped.

**19.** An apparatus according to claim 1, characterized in that said joining station is provided with a clamp which is adapted to clamp said longitudinal rods to said stirrups to be welded, said clamp being pivoted, about an axis which is longitudinally parallel to said rods, to a frame which is rigidly coupled to the stem of a first actuator which has a vertical axis, which forms, in a downward direction, a shoulder which is adapted to be moved into abutment against said stirrups and is articulated, along an axis which is parallel to said fulcrum, to the stem of a second actuator which has a vertical axis and is rigidly coupled to said frame.

**20.** An apparatus according to claim 1, characterized in that said pulling means are provided with a hook which is adapted to engage, in a rearward region, the lower portion of a stirrup of said metal cage being formed and is oscillatably mounted, in contrast with elastic means, at the end of the stem of an actuator which acts along a horizontal axis which lies longitudinally to the advancement direction of said cage being formed.

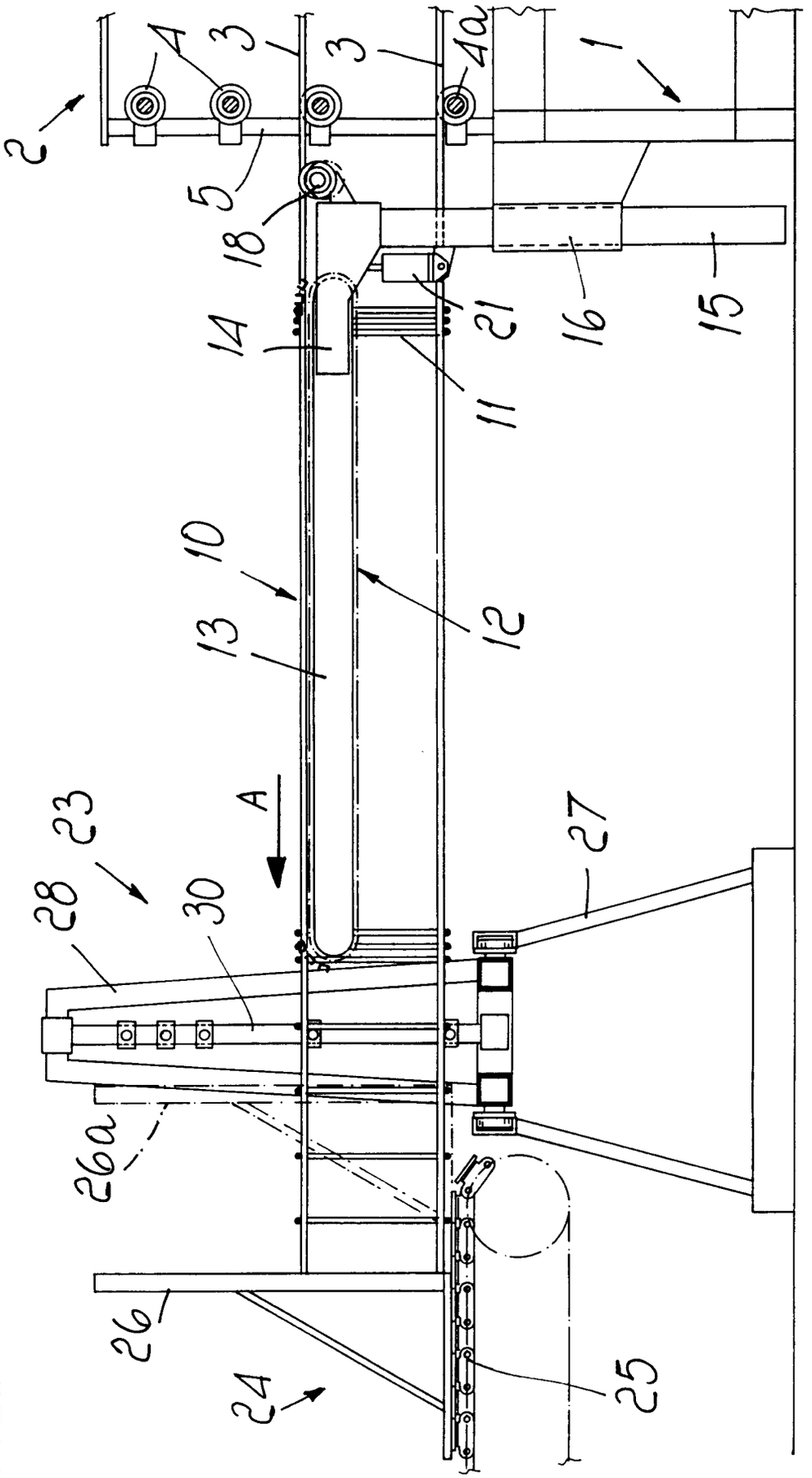



FIG.1

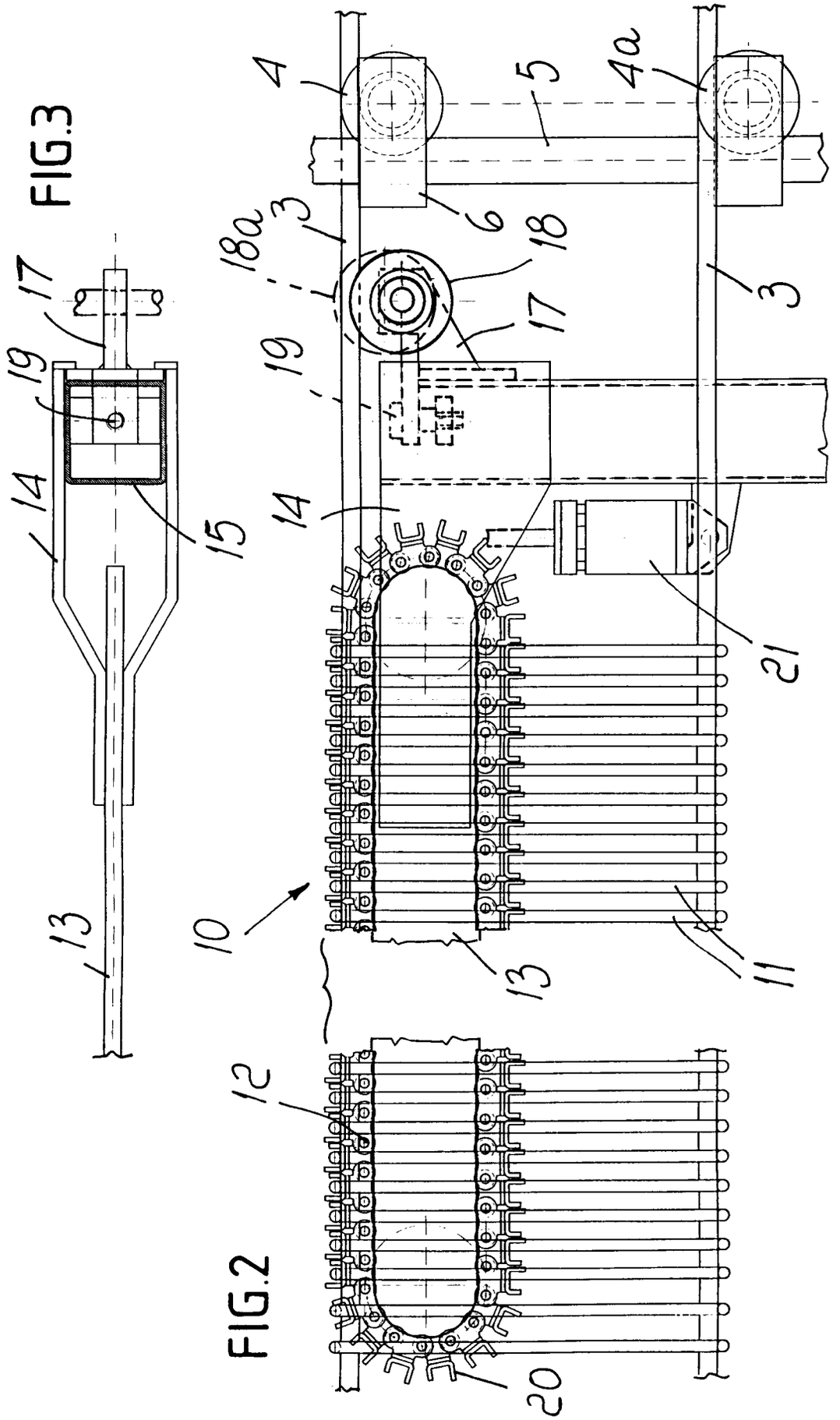



FIG.3

FIG.2

FIG.6a

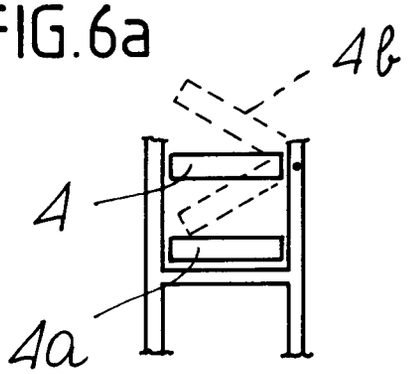



FIG.6d

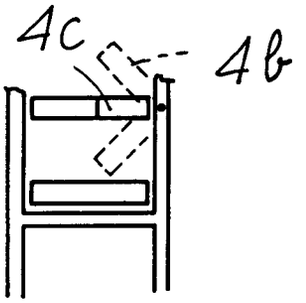



FIG.6b

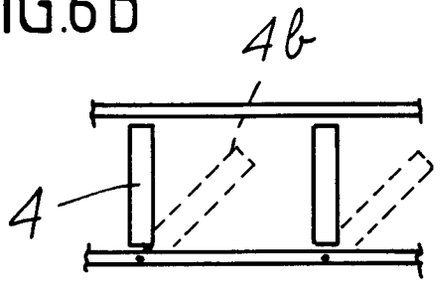



FIG.6e

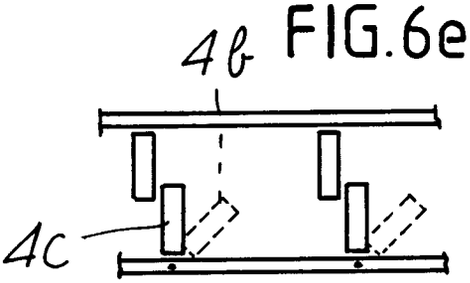



FIG.6c

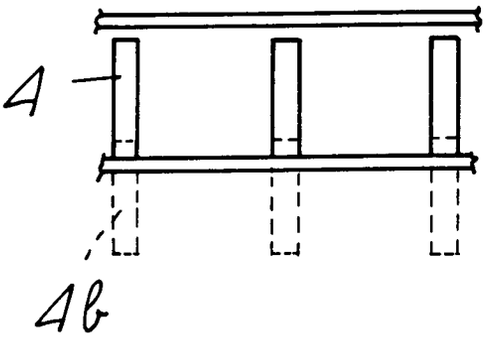
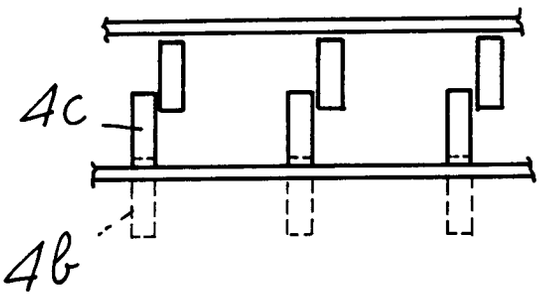



FIG.6f



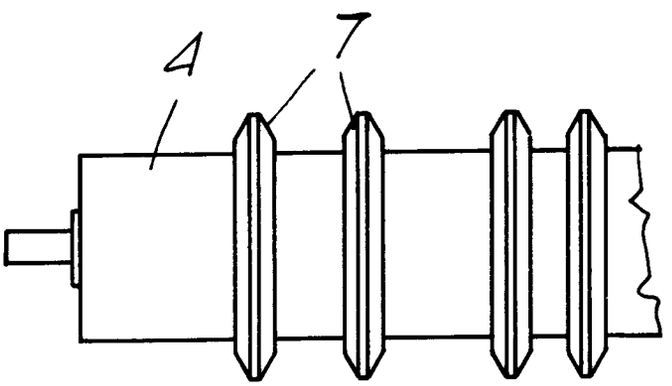




FIG.4

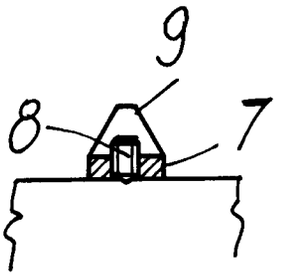



FIG.5

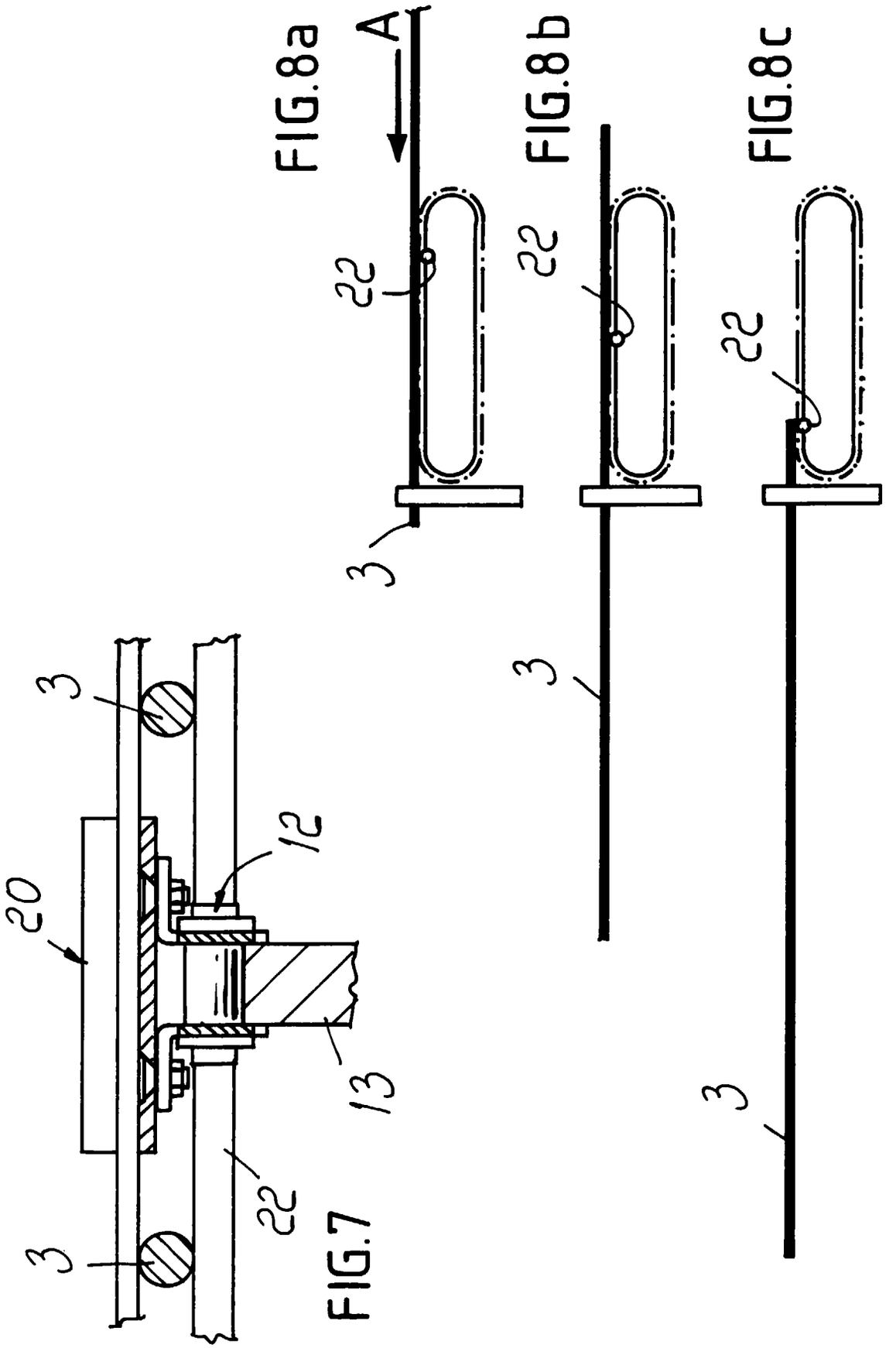



FIG.8a

FIG.8b

FIG.8c

FIG.7

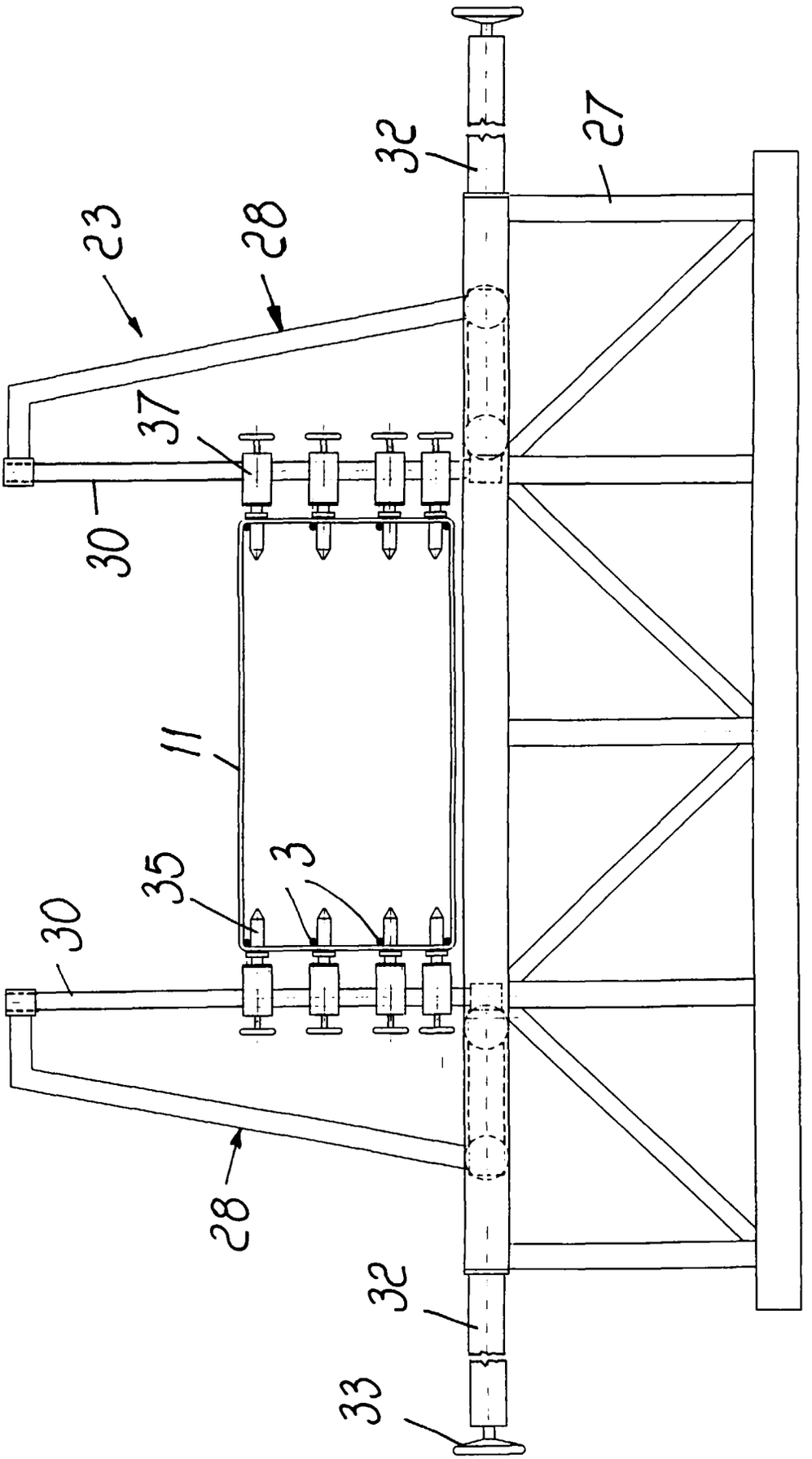



FIG.9

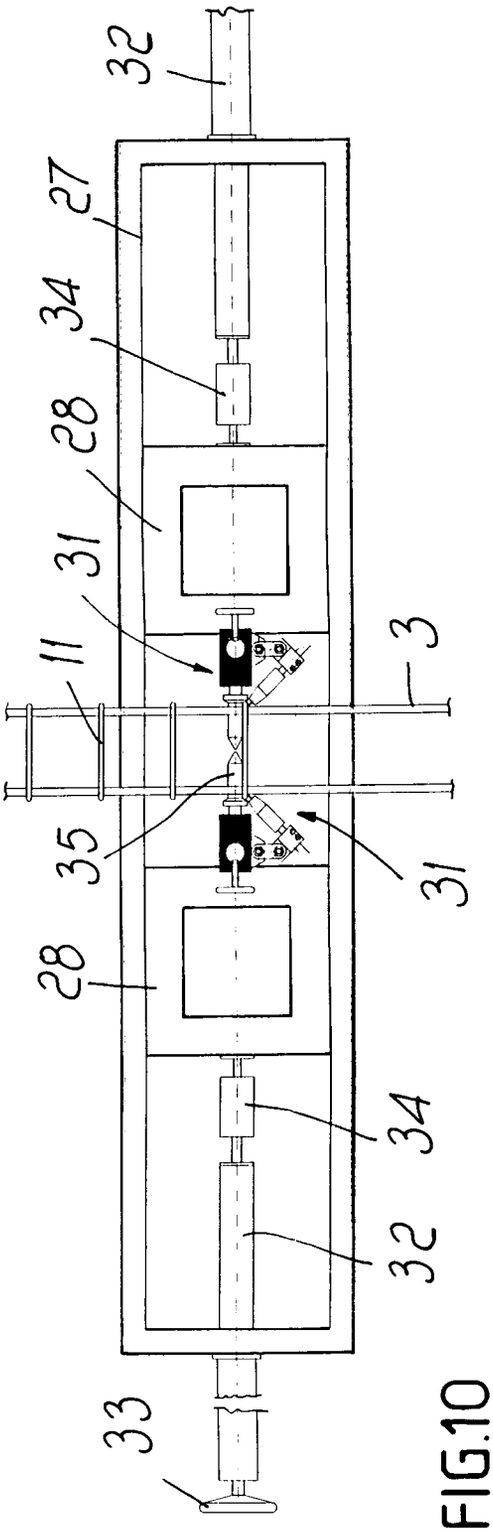



FIG.10

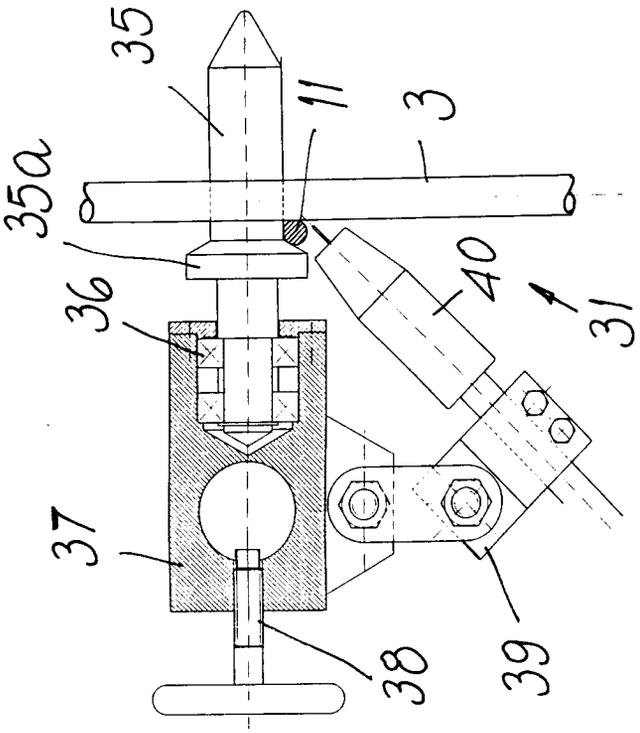



FIG.11

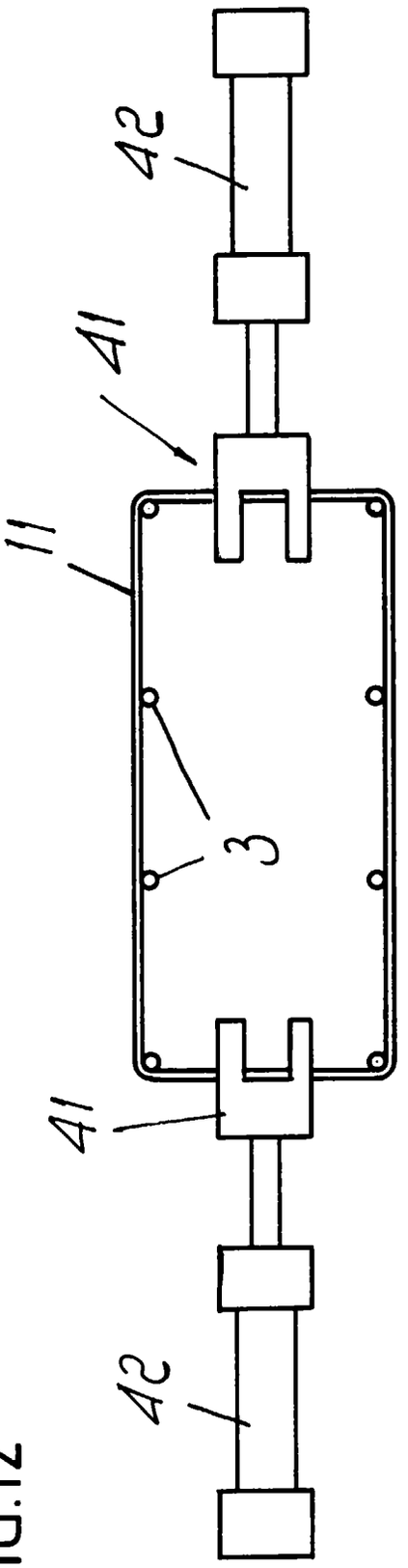



FIG.12

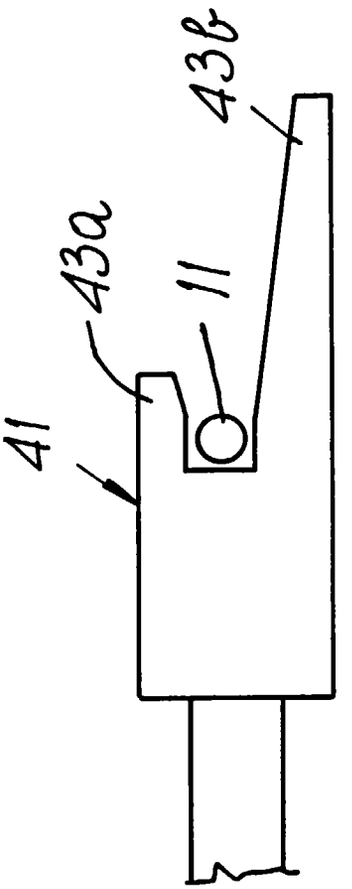



FIG.13

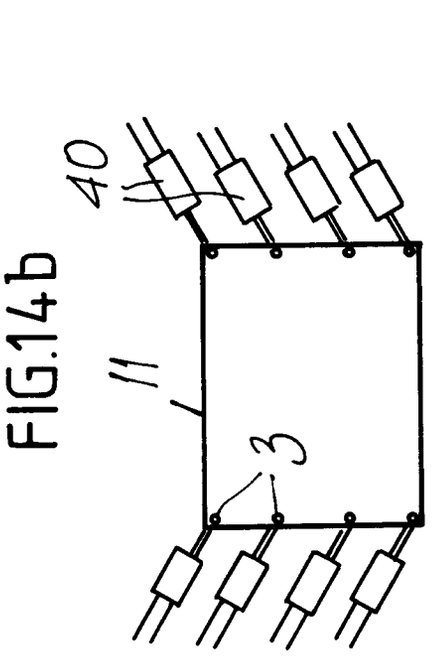



FIG.14b

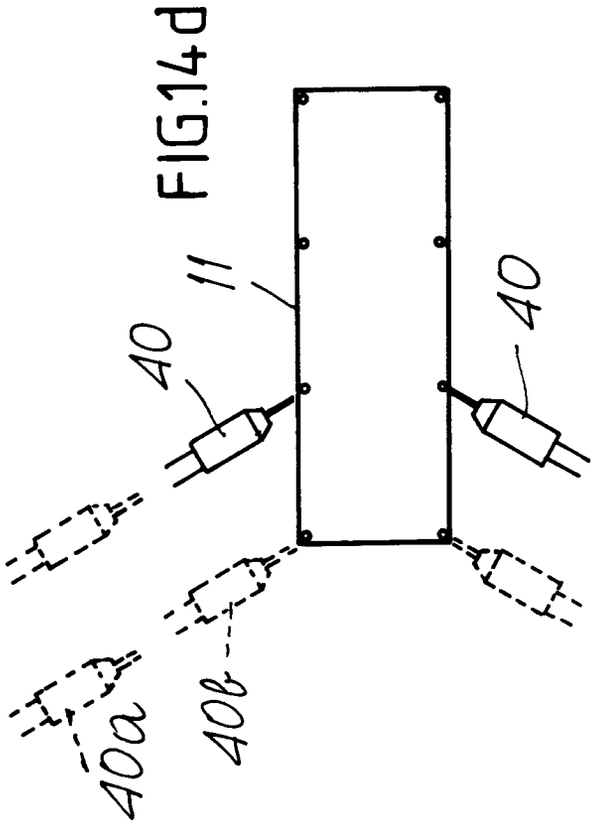



FIG.14d

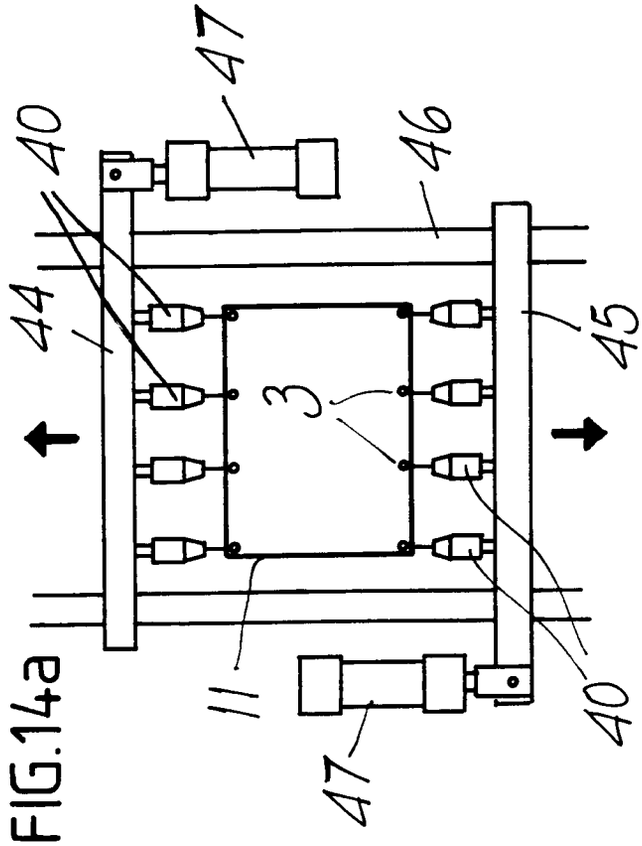



FIG.14a

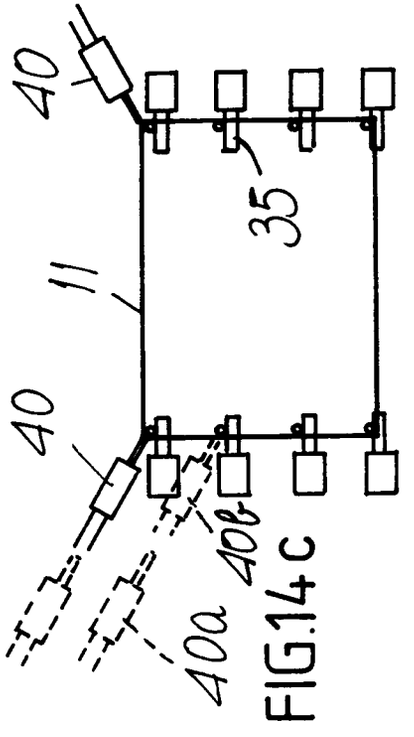



FIG.14c

FIG.15

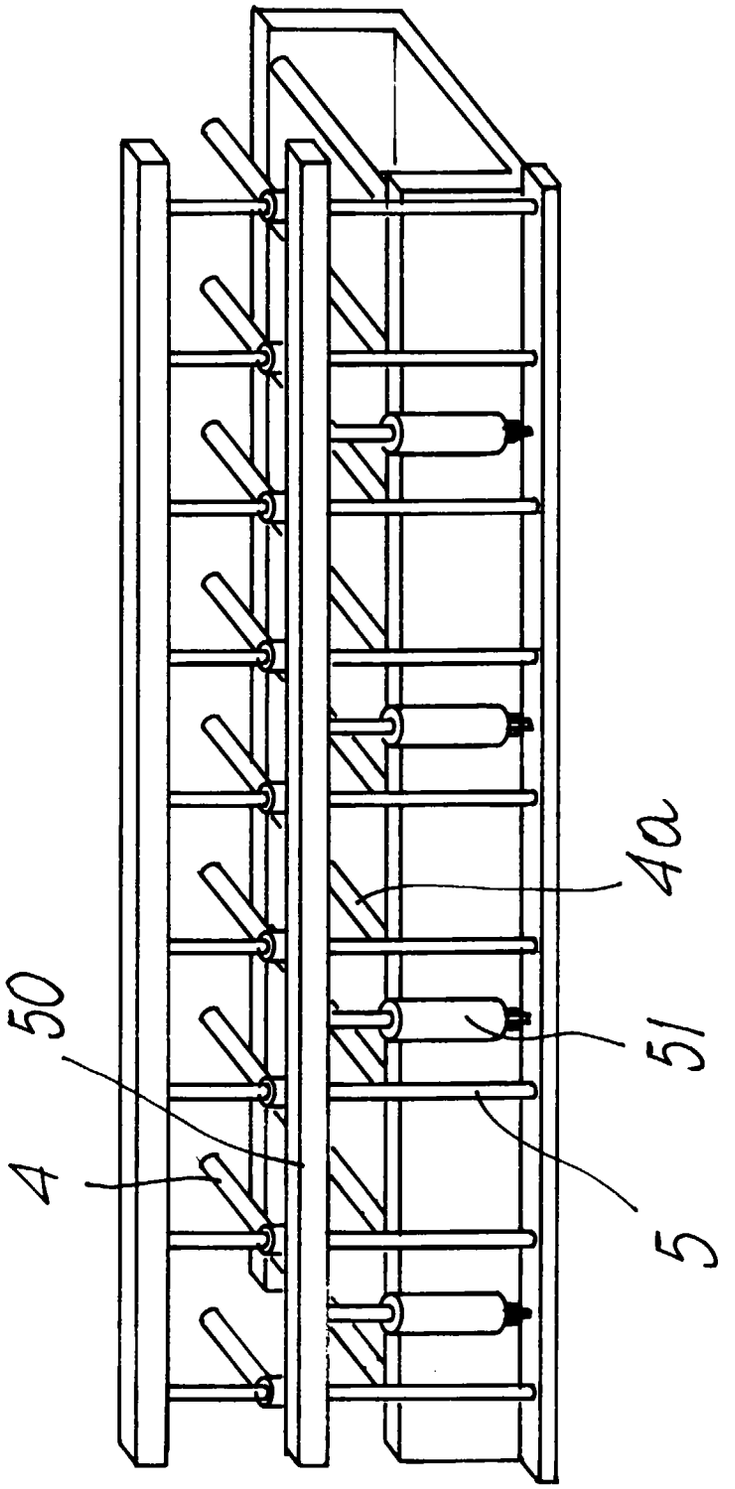
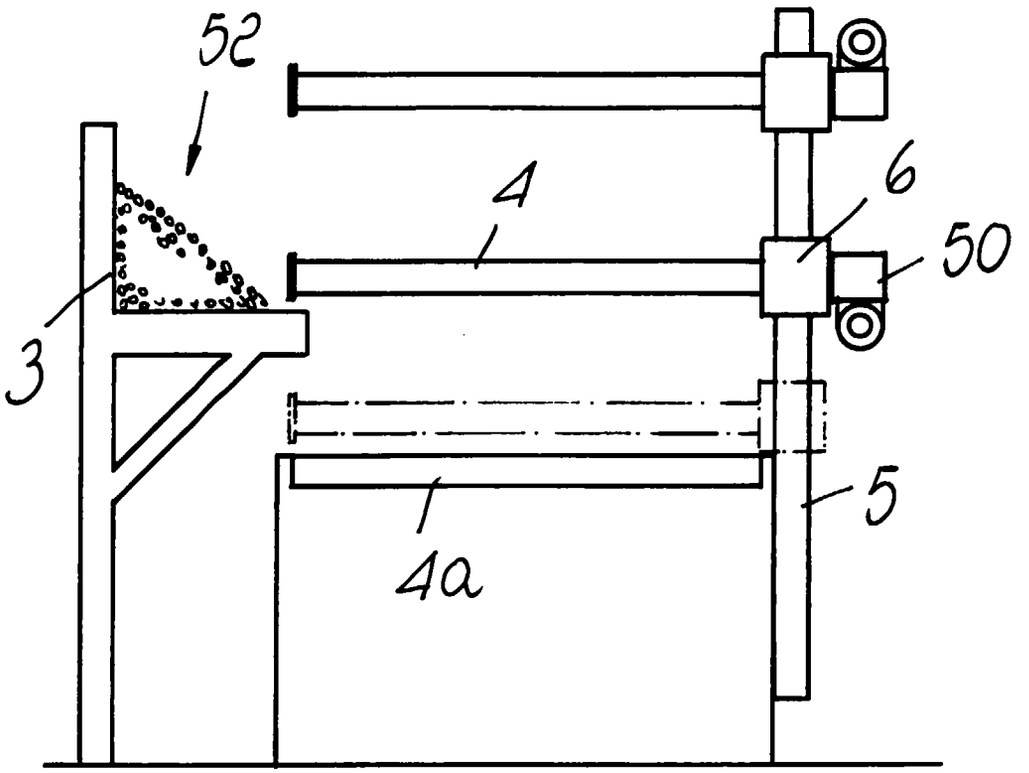


FIG.16 a



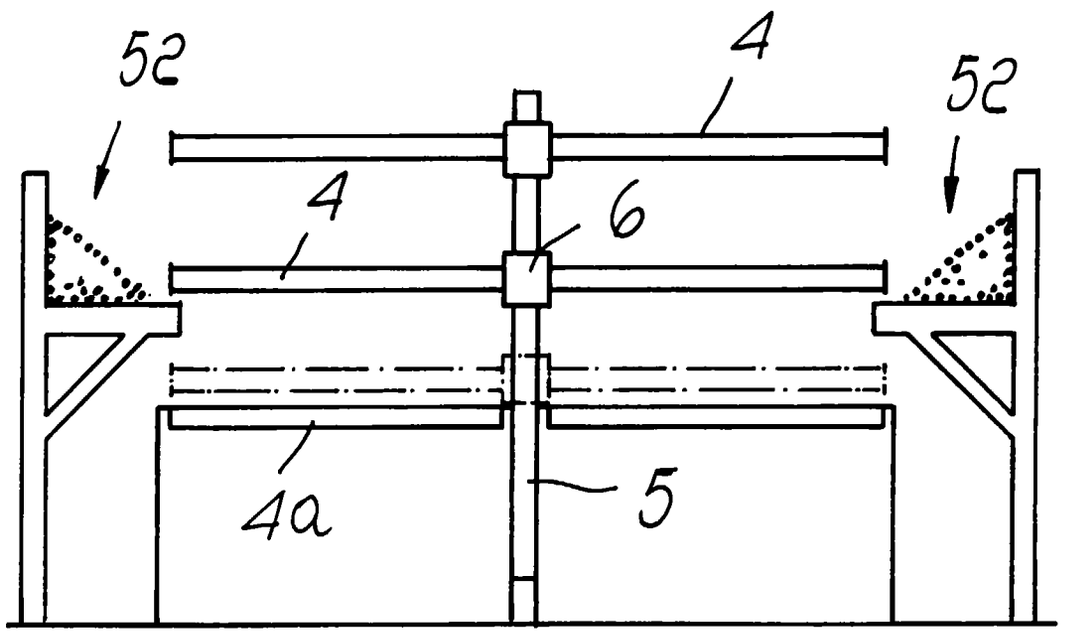




FIG.16 b

FIG.17

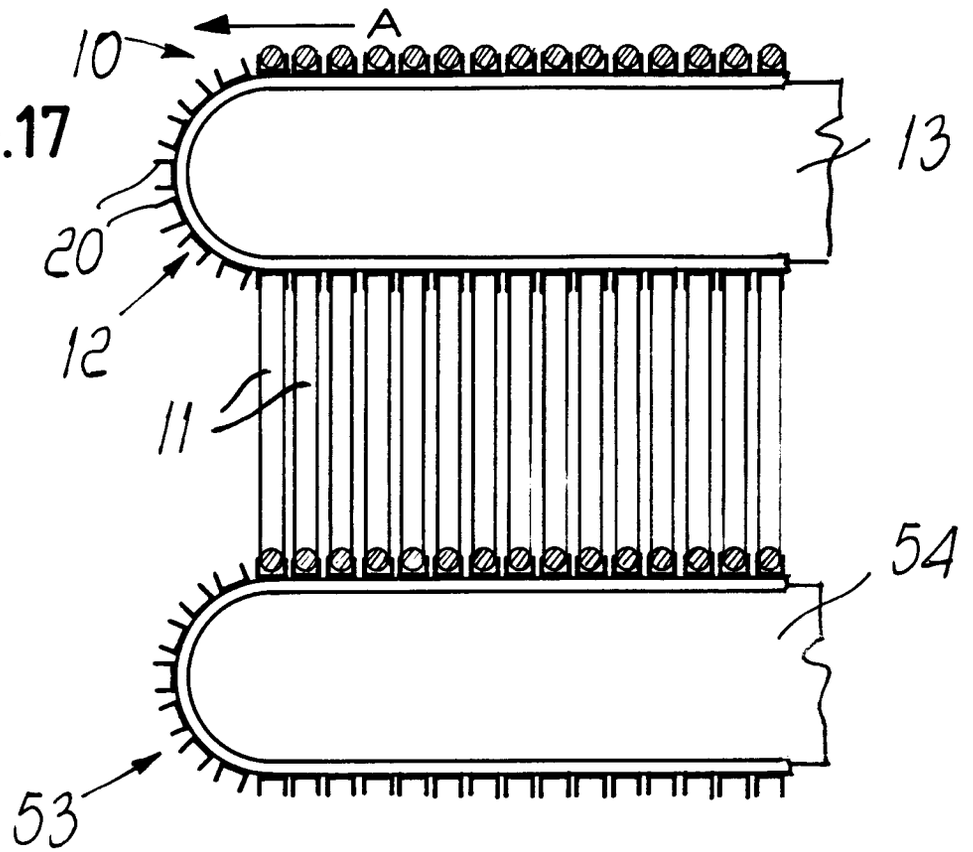



FIG.18

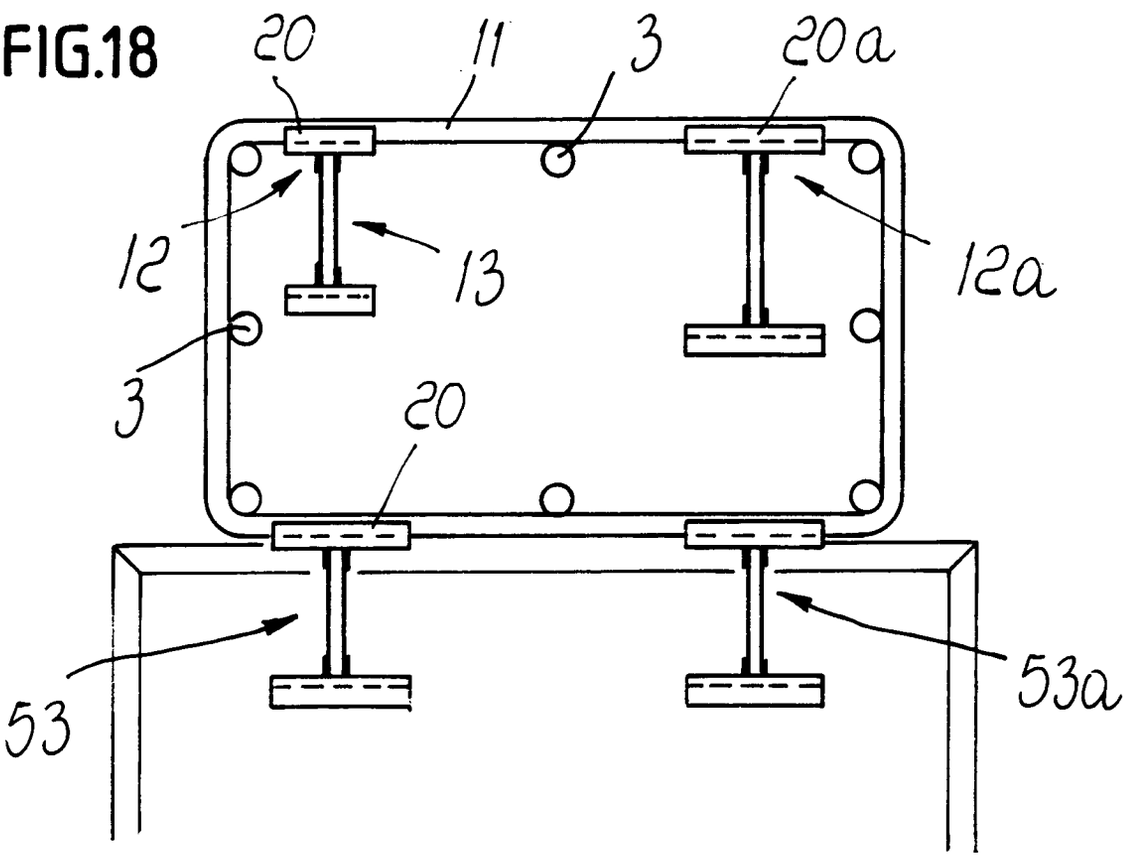
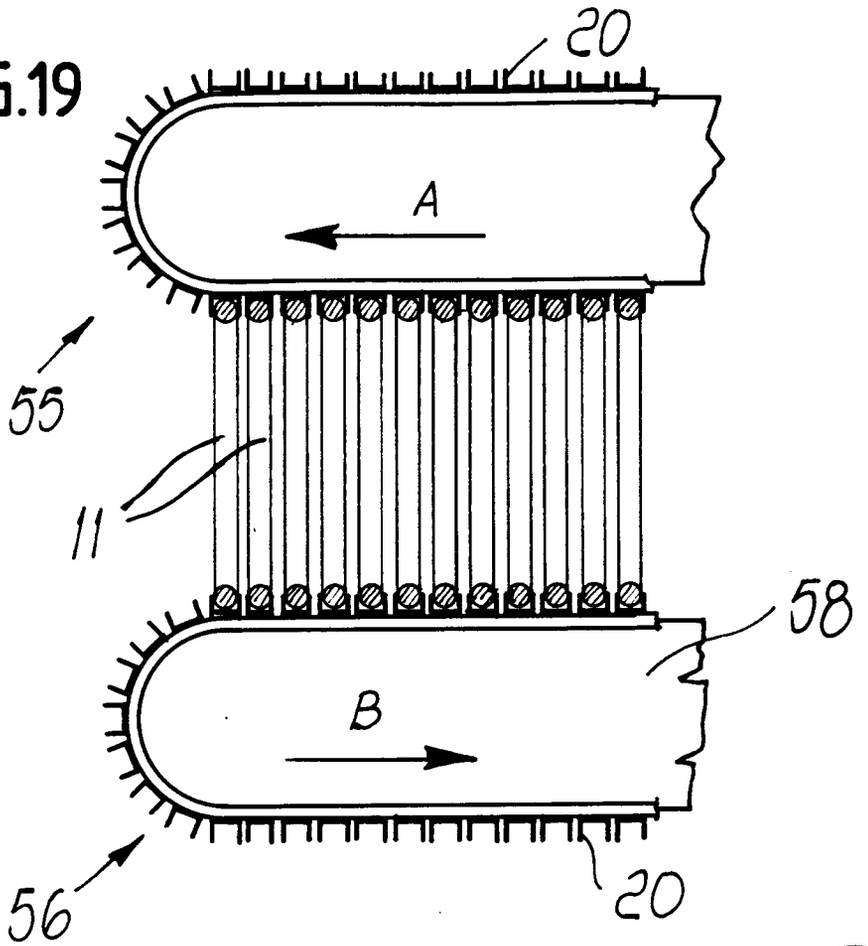


FIG.19



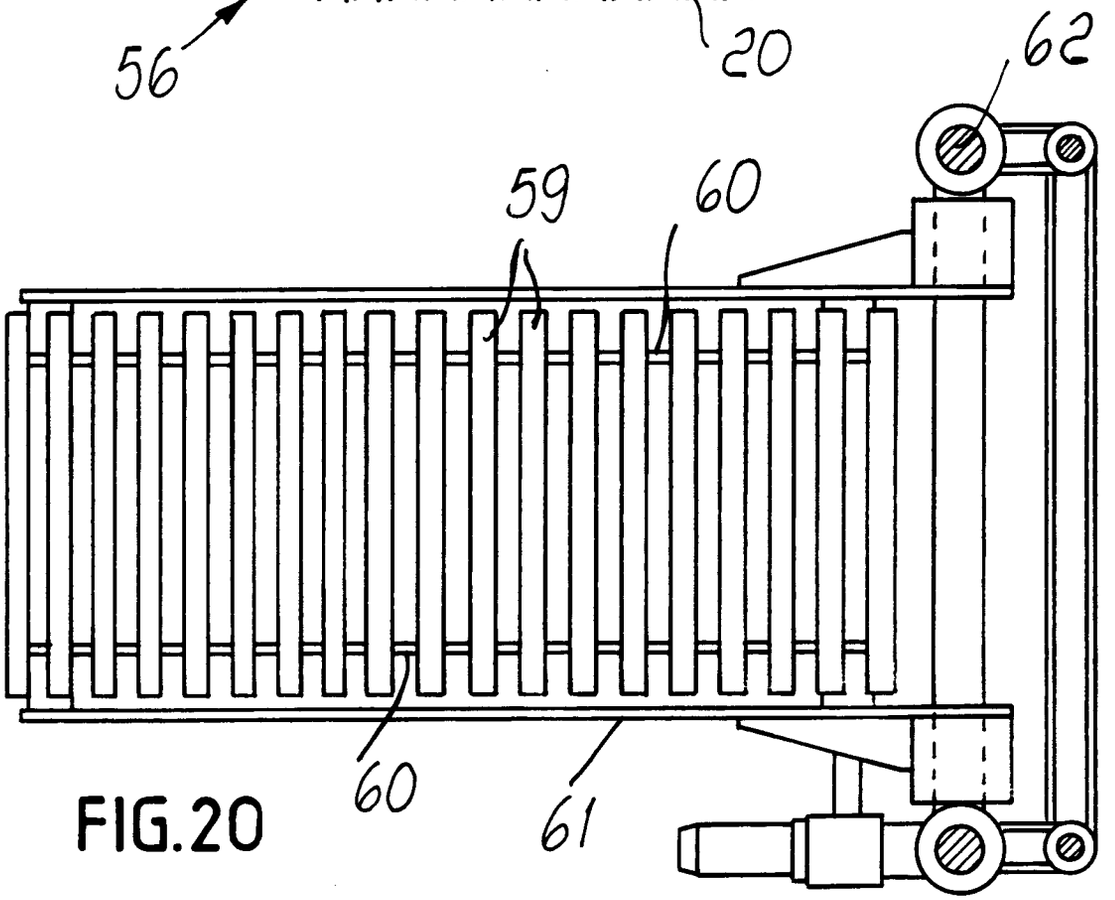




FIG.20

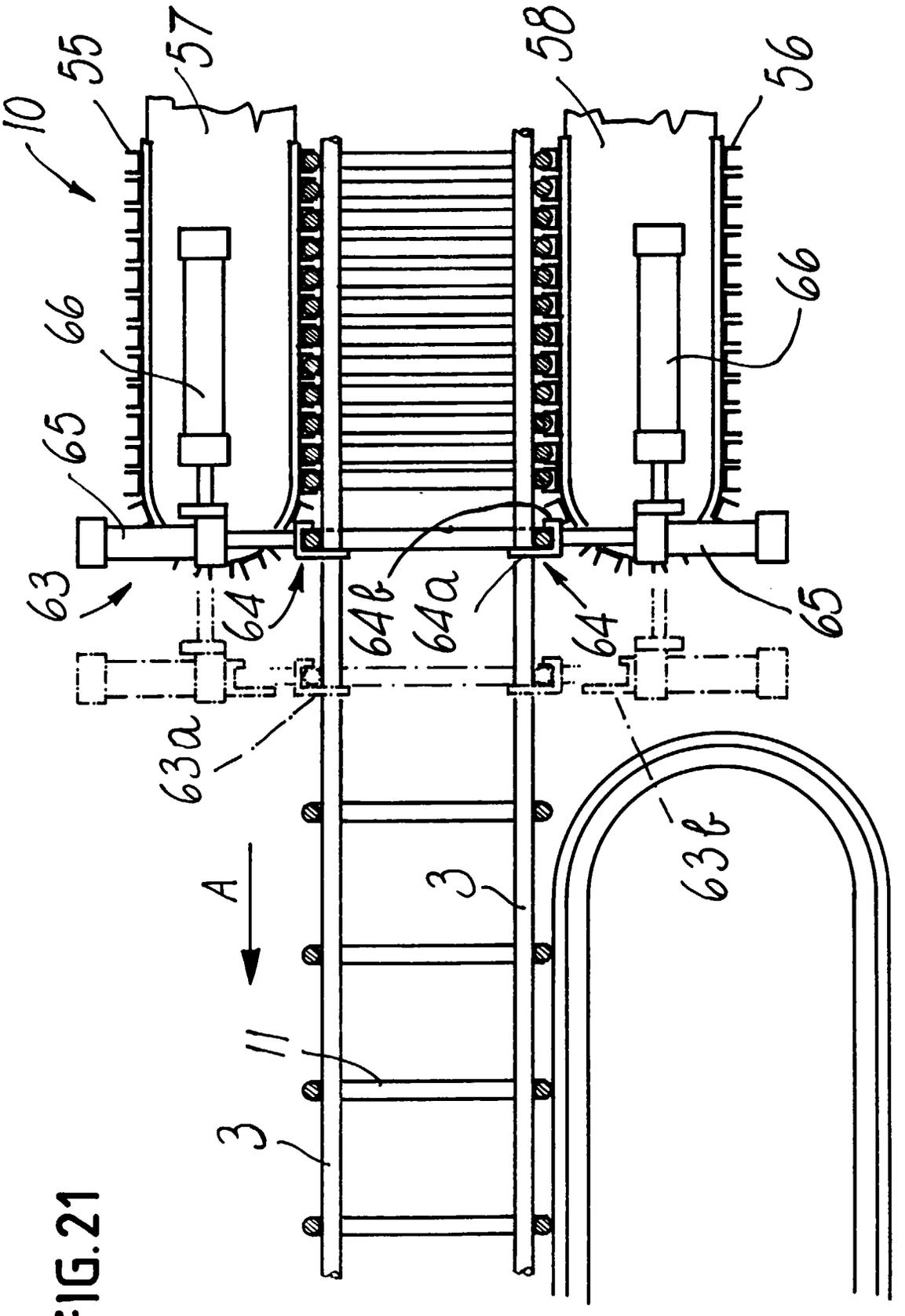



FIG.21

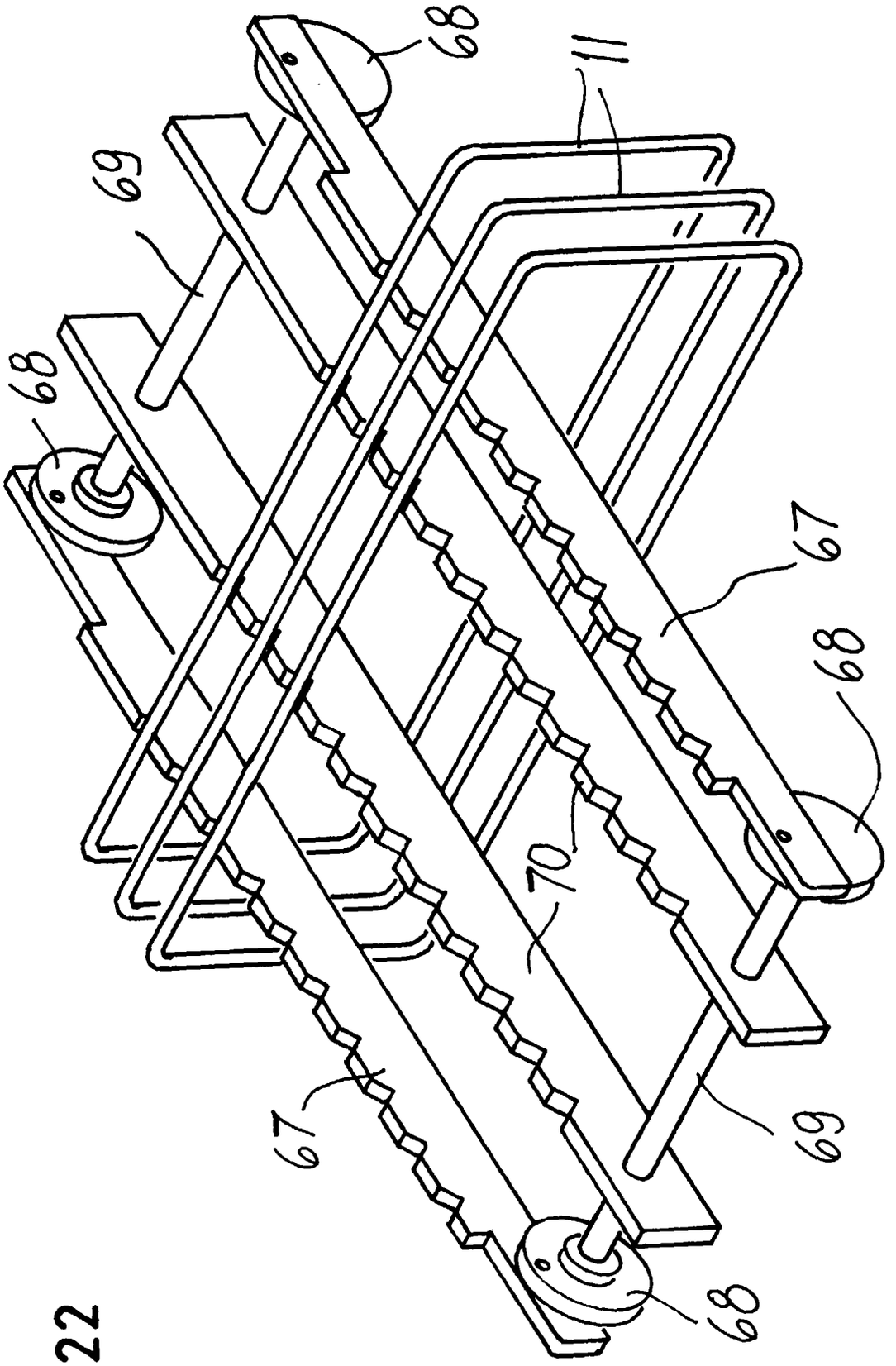



FIG.22

FIG.23

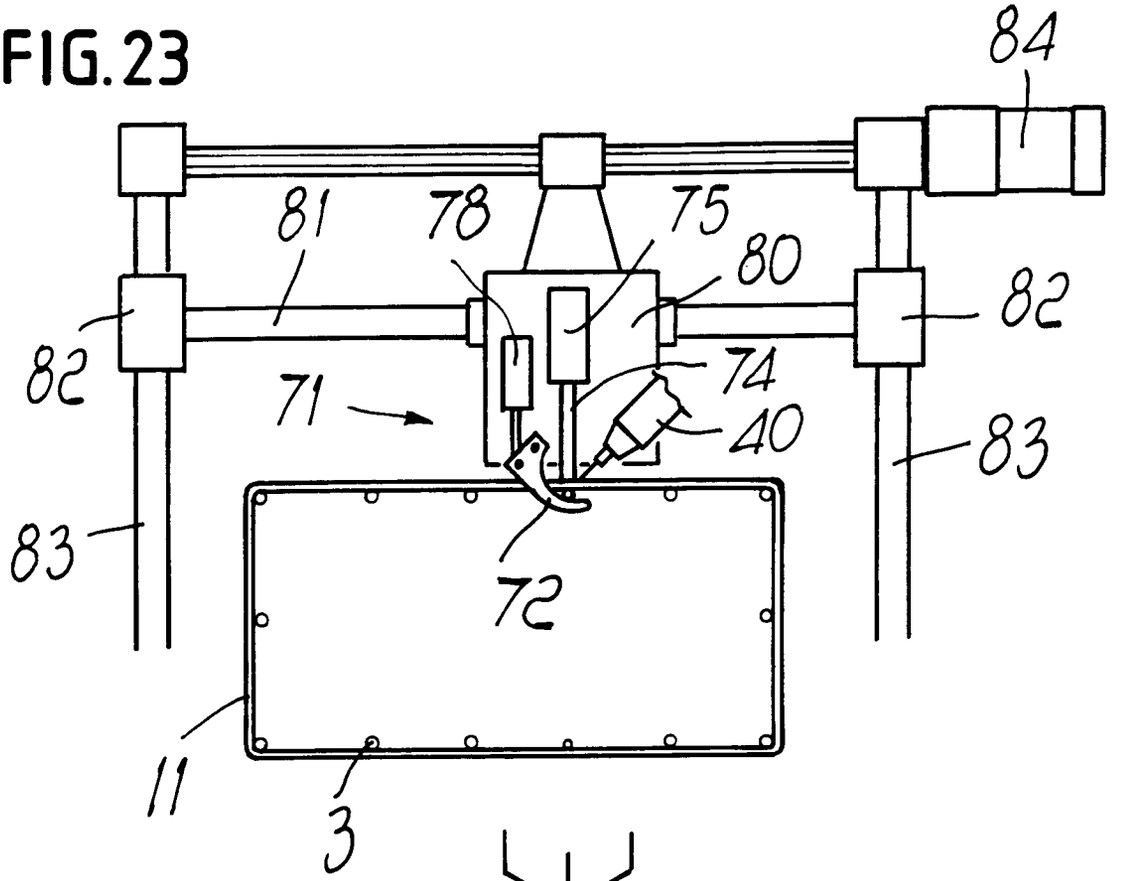

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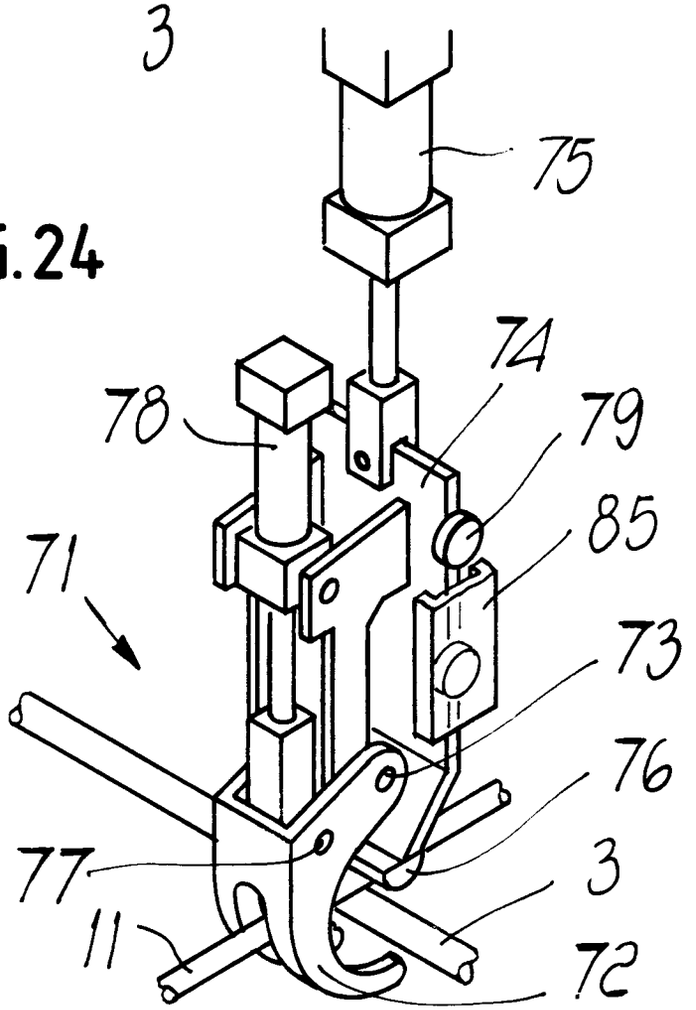
FIG.24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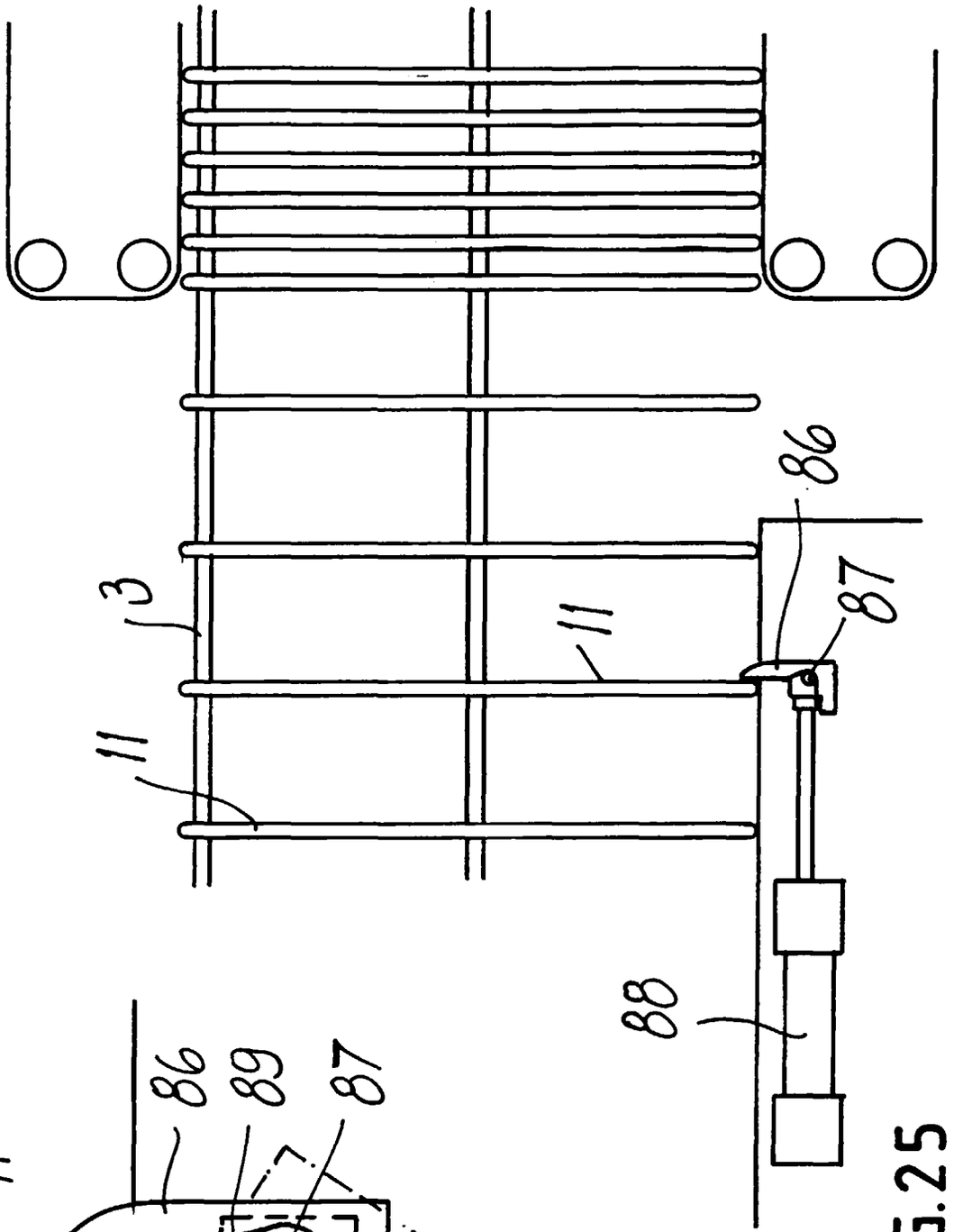


FIG.25

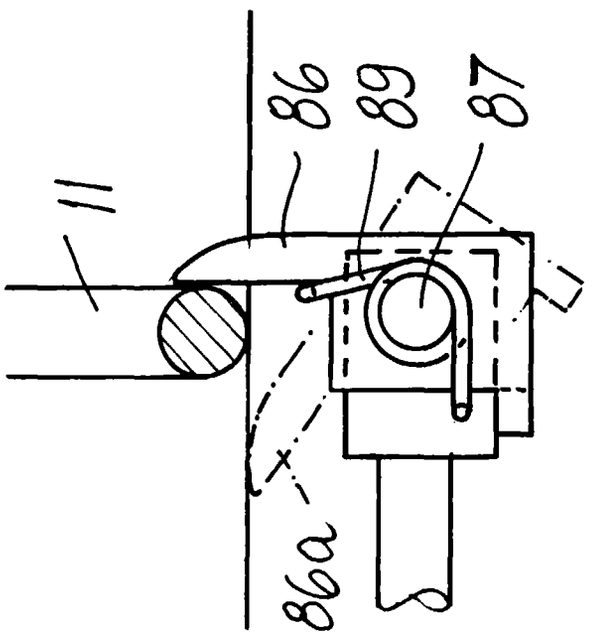


FIG.26

European Patent Office

# EUROPEAN SEARCH REPORT

Application Number
EP 97 10 8887

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (Int.Cl.6) |
|---|---|---|---|
| X<br>A | FR 2 543 462 A (DAVUM ARMATURES) 5 October 1984<br>* page 3, line 29 - page 6, line 2; figures *<br>--- | 1-3,9, 10,13-15<br>4,5,12, 20 | B21F27/12 |
| A | DE 33 24 678 A (LECHTENBOEHMER HANS) 17 January 1985<br>--- | | |
| A | PATENT ABSTRACTS OF JAPAN<br>vol. 013, no. 163 (M-816), 19 April 1989<br>& JP 64 002751 A (TAISEI CORP), 6 January 1989,<br>* abstract *<br>----- | | |
| | | | TECHNICAL FIELDS SEARCHED (Int.Cl.6)<br>B21F |

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| THE HAGUE | 22 September 1997 | Barrow, J |

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
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L : document cited for other reasons

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