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(54) **METHOD AND APPARATUS FOR FOLDING METAL RODS IN BARS**

VERFAHREN UND VORRICHTUNG ZUM FALTEN VON METALLSTÄBEN IN STANGEN

PROCÉDÉ ET APPAREIL PERMETTANT DE PLIER DES TIGES DE MÉTAL EN BARRES

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Description

Technical Field

[0001] The present invention regards a method and an apparatus for folding metal rods in bars, in particular iron rods obtained through cutting from bars or reels.

Background Art

[0002] It has been known to use iron rods folded at the opposed ends, known as "shaped", to realize reinforcements for reinforced concrete. To realize such products, apparatuses, which put the ends of the iron rod, straight or prestraightened, through a suitable series of foldings, are generally used. More in particular, folding apparatuses called "shaping robot" are actually known, which allow to realize shaped products starting from metal rods already cut at a determined length suited to the dimension of the shaped profiles to be obtained.

[0003] Such apparatuses usually comprise a feeding way with motorized rollers, used for feeding the bars to be shaped, means for transferring or loading the bars, manual, automatic or semiautomatic, and a couple of folding units, each carrying a folding head designed to the shaping of a respective end of the loaded bars.

[0004] In particular, each folding head comprises a fold tool normally consisting in a central fold mandrel and in an excentric folding pin, further to an abutment that prevents the piece being worked from moving.

[0005] In alternative, according to a known solution, the fold tool consists in a couple of shapes that serve also as abutments during the folding step always performed by an excentric pin.

[0006] For example the patent EP 0 648 577 A1 discloses an apparatus for shaping bars according to the preamble of claim 4, comprising automatic load means suitable to pick up the bars to be shaped from support slits and to deposit the same bars on two automated folding machines, suitable to carry out a shaping cycle on the same bars.

[0007] In the traditional apparatuses, each folding head is anyway constrained to the folding unit, which is fixed or mobile in direction longitudinal to the axis of the bar to be shaped. Apparatuses are known wherein a folding unit is fixed, while the other one is mobile. Apparatuses are known as well, with a functioning similar to what has been described, wherein both folding units are mobile.

[0008] Such apparatuses of the known type generally present a considerable bulk, which comparable with the maximal lengths of the bars to be shaped. As an example, so the known apparatuses can extend till 12, 18 or also 24 meters, according to the raw materials to be worked, the required maximal length of which can vary according to the country.

[0009] Nevertheless it frequently occurs in the specific field that the need is felt, of working a great quantity of

rods having a considerably reduced length with respect to the maximal length of the used raw material and folded at only one end. To such an aim it is preferred to dedicate a suitable shaping apparatus, with a reduced longitudinal extension, usually between 5 and 7 meters, and so less bulky with respect to the traditional apparatuses. But such apparatuses, dedicated to the so-called "short" pieces, represent additional costs for the productive plants, as they do not enable to shape the profiles with a maximal length and at both opposite ends. The need also exists of folding so-called "long" pieces at only one end, yet leaving one folding unit unused, so wasting room and productive resources.

[0010] Therefore the known apparatuses do not fully satisfy the requirements of the specific field, as they are not able to offer the required versatility and oblige to have more apparatuses available, each dedicated exclusively to short pieces or to long pieces, with the necessity of considerable space which is not always available.

Disclosure

[0011] The task of the present invention is that of solving the problems cited in the background art, devising a method and an apparatus for folding metal rods in bars that allows to perform, in a versatile manner, the folding of rods of any dimension, with folds at one end or at both ends, optimizing the space occupied and the productivity.

[0012] Within such a task, it is a further scope of the present invention to provide an apparatus that performs the cited folding of rods and the like with a simple and functional structure, provided with a surely reliable functioning and with a great flexibility of use.

[0013] The cited scopes are attained, according to the invention, by the method according to claim 1, as well as by the apparatus according to claim 4.

[0014] The apparatus for folding metal rods which accomplishes the method according to the invention basically comprises a first folding bench and a supplementary folding bench, aligned and independent along one same longitudinal direction.

[0015] Such a longitudinal direction is parallel and arranged at the side of a common line for feeding the rods or bars, suitable to feed even at the same time the first folding bench and the supplementary folding bench.

[0016] In such a way it is possible to enable the performing of a first folding cycle and of a supplementary folding cycle, in a simultaneous way, synchronous or not, starting from bars fed on the same feeding line, the fed bars being prearranged respectively according to a predetermined number, destined to the first folding cycle, and according to a supplementary predetermined number, destined to the supplementary folding cycle.

[0017] The bars of the predetermined number can be of equal or different length with respect to the bars of the supplementary predetermined number. Instead, the bars inside each number to be folded, predetermined or supplementary predetermined, obviously have the same di-

mensional features.

[0018] In practice the apparatus warrants the required versatility as it has a couple of folding benches at its disposal, which can be operated in line, at the side of the feeding line, independently and at the same time, and, if needed, which can be coupled in the movements as if they were a unique bench.

[0019] In this way it is possible to perform at the same time on the same apparatus two different work cycles of pieces folded at only one end or shaped, that is folded at both ends, so-called "short", prearranging the aforesaid folding benches at such a reciprocal distance as to enable the positioning of the respective predetermined and supplementary predetermined numbers of bars to be folded in the respective work cycle.

[0020] More precisely, the method and the apparatus according to the invention allow to work pieces folded at only one end, by using the provided folding benches, independently from each other, to produce at the same time pieces of such a type, so doubling the productivity with respect to the known methods and apparatuses.

[0021] The same folding benches can work in an independent or combined and coordinated manner, to work pieces that require folds at both ends.

[0022] The first folding bench and the supplementary folding bench respectively comprise a first fold unit and a supplementary fold unit.

[0023] Each fold unit comprises a folding head provided with an excentric folding pin mobile about a central fold tool, for folding the respective predetermined or supplementary predetermined number of bars that are interposed between the excentric folding pin and the central fold tool.

[0024] Between the first fold unit of the first folding bench and the supplementary fold unit of the supplementary folding bench is interposed an intermediate handling group, with double handling, for preferably end portions of the bars.

[0025] The intermediate handling group is a double handling group as it can handle portions of the predetermined number of bars and of the supplementary predetermined number of bars.

[0026] More precisely, the aforesaid intermediate handling group for the bars can engage at the same time respective portions of bars of the predetermined number and respective portions of bars of the supplementary predetermined number, cooperating with both the first fold unit of the first folding bench and with the supplementary unit of the supplementary folding group, exactly for folding respectively the predetermined number of bars and the supplementary predetermined number of bars.

[0027] It is provided that the cited intermediate handling group to be mobile with respect to and between the first fold unit and the supplementary fold unit, according to a direction parallel to the line for feeding the bars.

[0028] The cited intermediate handling group so shapes double handling means.

[0029] Practically the group comprises first handling

means for portions, preferably end portions, of the predetermined number of bars and second handling means for portions, preferably end portions, of the supplementary predetermined number of bars.

[0030] The group is mobile according to a relative motion, relatively to each fold unit provided, along the above said longitudinal direction, parallel to the feeding line to cooperate with both fold units, the first fold unit and the supplementary fold unit.

[0031] The intermediate handling group with double handling means is basically suitable to cooperate, at one side, with the first fold unit for folding the cited predetermined number of bars, and at the other side, with the supplementary fold unit to cooperate as well to the folding of the supplementary predetermined number of bars, by engaging respective portions of the bars.

[0032] It is to be observed that the intermediate handling group is mobile with respect to the first fold unit and to the supplementary fold unit, in a way as to allow the moving and/or anyway the correct placing of the respective numbers of bars to be worked, with respect to the fold members.

[0033] It is also to be observed that the intermediate handling group is a group separated and autonomous from the fold units and from the respective folding heads, even though it cooperates in an autonomous way therewith.

[0034] The apparatus is basically very compact, as each folding bench provided is given by the combination of a fold unit provided with folding members and with respective handling means for portions of the bars, shaped by the intermediate handling group.

[0035] As an example the intermediate handling group can comprise a unique structure which can perform the double handling of the bars, that is the handling of the bars at two opposite sides, according to the aforesaid longitudinal direction.

[0036] For example the above said intermediate structure can carry a first and a second reference or abutment wall, each one being oriented and mobile according to a relative motion, relatively to a respective fold unit of a respective folding bench.

[0037] Alternatively the intermediate handling structure can carry a first handling member and a second handling member, which can be actuated in an autonomous manner, the same structure being mobile according to a relative motion, with respect to the fold units, and each cited handling member being suitable to engage autonomously respective portions, preferably end portions, of the bars being worked or any point thereof, on one side through the first folding bench and on the other side through the supplementary folding bench.

[0038] In alternative to the unique handling structure, the intermediate group can be split into a first handling group, represented by a first structure carrying the first cited handling member, and into a second handling group carrying the second cited handling member.

[0039] The first fold unit and the supplementary fold

unit are therefore mobile with respect to the intermediate handling group, in a way as to allow the folding of any portion of the bars being worked, for each work cycle being performed downstream of the same feeding line or way.

[0040] The intermediate group can be fixed or mobile, as also one or both fold units provided can be. In particular, in case the first fold unit and the supplementary fold unit are both mobile, the intermediate handling group can be mounted fixed. Also in such a case, yet, the intermediate group has to be considered mobile according to a relative motion, with respect to both fold units.

[0041] According to a particular aspect of the invention, the previously mentioned intermediate handling group, which works between the first fold unit and the supplementary fold unit, can be advantageously realized through at least a further fold unit, preferably through two further fold units.

[0042] In such a case, the previously mentioned handling that qualifies the cited group has to be understood as a bar engaging activity that comprises the folding of the end portions of the same bars.

[0043] Practically, in such a case the first folding bench of the apparatus is associated with or comprises, further to the cited first fold unit, a second fold unit carrying a respective folding head, for serving as intermediate group for handling the bars, in particular for folding a respective end of the bars of the predetermined group.

[0044] Similarly, the supplementary folding bench can be associated with or comprise, further to the supplementary fold unit or first supplementary fold unit, also a second supplementary fold unit, in a thoroughly similar way as the first folding bench.

[0045] According to such a particular aspect of the invention, then the second supplementary fold unit and the cited second fold unit are qualified and serve as intermediate handling group between the above said first fold unit and said supplementary fold unit.

[0046] According to a further aspect of the invention, one fold unit can be arranged fixed with respect to the feeding line, while the other one or the other cooperating ones can be arranged mobile in a way parallel to the feeding line of the bars.

[0047] At least one fold unit can usefully comprise a mobile reference member, which can be operated on the respective folding plane, to carry out the double function of taking the bars into a reference position so-called "zero machine" and of re-aligning the bars which could have undergone slight reciprocal displacements after the first alignment step accomplished on the feeding line, following the transfer onto the respective folding bench. More precisely, such a reference member is mobile alternatively between a submerged position with respect to the folding plane and an active position, emerged from the folding plane, to serve as an alignment abutment.

[0048] According to a particular aspect of the invention, it is possible to provide that the apparatus comprises, for each folding bench, an autonomous group for loading

and/or unloading the bars, so as to optimize the flexibility of the apparatus and to enable different work times in both folding stations.

[0049] The feeding line can provide independent actuation members for each folding bench as well, for example in the case of a roller way or roller conveyor, independent motor drives for each tract of roller conveyor.

[0050] The apparatus and the method in hand therefore result advantageous as they enable to minimize, for the same productive yield, the space occupied and the structural complexity of the installation. In fact in the space usually occupied for a machine suitable to shape maximal length pieces, performing only one operating cycle at a time, two even different cycles can be performed instead at the same time, folding at one or both ends, without precluding the possibility of working maximal length pieces, substantially equal to the whole longitudinal extension of the apparatus, also with folds at both ends.

[0051] In fact the method and the apparatus according to the invention allow to alternate without any limit phases with two folding cycles at a time and phases with only one folding cycle at a time, downstream of the same feeding line. In such a case, for example, it is possible to feed a predetermined number of bars, that is only one group of the same type and length, so that such bars are folded at opposite ends through the previously mentioned folding cycle, respectively by means of the first fold unit and of the supplementary fold unit.

Description of Drawings

[0052] Details of the invention shall be more apparent from the detailed description of a preferred embodiment of the apparatus for folding metal rods in bars according to the invention, illustrated for indicative purposes in the attached drawings, wherein:

figure 1 shows a plan schematical view of the apparatus according to the invention;

figures 2a and 2b respectively show a front view of a detail of the apparatus illustrated in figure 1, according to a first embodiment and to a second embodiment respectively;

figures 3, 4, 5 and 6 respectively show the apparatus according to the invention according to further embodiments;

figures 1a, 3a, 4a, 5a, 6a show products which can be realized by means of the apparatuses illustrated in figures 1, 3, 4, 5 and 6, respectively;

figures 7 and 8 respectively show a plan view and a perspective view of the apparatus for folding metal rods in bars according to the invention, according to a different embodiment;

figures from 9 to 12 respectively show a plan view and a perspective view of the same apparatus illustrated in figures 7 and 8 in further operating procedures;

figures 13 and 13A, 14 and 14A, 15 and 15A, 16 and 16A respectively show a scheme plan view of the same apparatus illustrated in figures 7 and 8 in different operating procedures and the products obtained through each operating procedure.

Best mode

[0053] With particular reference to such figures, the apparatus for folding rods in bars 2, in particular iron rods for reinforced concrete, is indicated in its totality with 1.

[0054] The apparatus 1 comprises a feeding line 3 for the bars 2, a first folding bench 100 and a supplementary folding bench 200, aligned and which can be operated independently along a longitudinal direction arranged at the side of the feeding line 3 (see figure 1).

[0055] The feeding line 3 preferably comprises a motorized roller conveyor suitable to longitudinally receive the bars 2 destined to be folded through the folding benches 100, 200 placed downstream. The roller conveyor 3 can receive longitudinally the bars 2 to be fed, according to the direction indicated by the arrow A, or transversely, according to the direction indicated by the arrows B, through suitable transfer means (see figure 1). More precisely the roller conveyor 3 has a longitudinal extension substantially equal to the maximum length of the bars 2 to be worked, so as to be able to support a bundle of bars 2 or single bars 2 of maximum length, arranged on the same roller conveyor 3 according to a longitudinal orientation.

[0056] Therefore, if the bars 2 to be worked do not present a maximum longitudinal extension, the roller conveyor 3 is suitable to receive on a corresponding portion a predetermined number 2a of bars 2 suited to be folded by the first folding bench 100, and a supplementary predetermined number 2b of bars 2 on a remaining portion, suited to be folded by the supplementary folding bench 200, as better described in the following.

[0057] Practically, if the transfer of the above said bars 2 to the roller conveyor 3 occurs transversely, the roller conveyor 3 can receive the predetermined number 2a of bars 2 and the supplementary predetermined number 2b of bars 2 even at the same time. Otherwise, if the transfer to the roller conveyor 3 occurs longitudinally, as previously disclosed, the above said distinct bundles of bars 2 can be received by the roller conveyor 3 in sequence.

[0058] The roller conveyor 3 also comprises alignment means 7 to warrant the correct alignment of the fed bars 2. The alignment means 7 preferably shape a flat abutment wall arranged in a fixed manner at the end of the roller conveyor 3.

[0059] The roller conveyor 3 preferably comprises supplementary alignment means 70, suitable to ensure the correct placement of the supplementary bars 2 suited to be folded through the supplementary folding bench 200. In particular the supplementary alignment means 70, which are thoroughly similar to the alignment means 7, can be mounted mobile alternatively foldaway, to allow

the roller conveyor 3 to receive the bars longitudinally.

[0060] It is further to be noted that the motorized rollers which move and take the ends of the bars 2 in abutment against the above said alignment means 7 and the supplementary alignment means 70, when provided, can be grouped at will in relation to the length of the bars 2 being worked, so as to operate in an autonomous manner and serve each the first folding bench 100 and the supplementary folding bench 200, according to the requirements of the productive cycle.

[0061] The first folding bench 100 comprises, according to the embodiment illustrated in figure 1, a first fold unit 110 arranged at the side of the roller conveyor 3 and carrying a folding head 4.

[0062] The supplementary folding bench 200 comprises a respective supplementary fold unit 210, arranged as well at the side of the roller conveyor 3 and carrying a folding head 4.

[0063] Each folding head 4 can be of any type. For example the folding head 4 can carry a couple of shapes and an excentric folding pin, mobile about the couple of shapes for folding the material interposed between the same shapes. Otherwise, for example, the folding head 4 can provide a fold tool consisting in a central fold mandrel 42 associated with the excentric fold pin 41, further to a fixed abutment suitable to block in a suitable way the piece during the working phase.

[0064] The first fold unit 110 and the supplementary fold unit 210 are arranged mobile with respect to each other, along a longitudinal direction substantially parallel to the longitudinal extension of the feeding line 3, whereon the bars 2 to be folded are longitudinally arranged, according to the predetermined number 2a and the supplementary predetermined number 2b, respectively.

[0065] In the illustrated case the fold units 110, 210 are arranged mobile with respect to each other on rails, not illustrated in the figures for the sake of simplicity, in order to enable the positioning and the folding of bars 2 of any length, in particular to obtain shaped bars 2' with one folded end (see figure 1) or with both ends folded. Alternatively, further configurations can be provided, as described in the following.

[0066] Moreover each folding bench 100, 200 can be provided with autonomous load means for loading the predetermined number 2a of bars 2 to the folding bench 100 and for loading the supplementary predetermined number 2b of bars 2 to the supplementary folding bench 200.

[0067] The apparatus also comprises an intermediate handling group 120 for handling the end portions of the bars 2, with a double handling, interposed between the first fold unit 110 and the supplementary fold unit 210, independent and mobile with respect to the same units along the cited longitudinal direction parallel to the feeding line 3. The intermediate group 120 is suitable to engage an end portion of the predetermined number 2a of bars 2 as well as an end portion of the supplementary predetermined number 2b of bars 2. More precisely the

aforesaid end portions of the bars 2 engaged by the intermediate group 120 are opposite to respective end portions of the same bars 2, engaged by the folding heads 4 of the first fold unit 110 and of the supplementary fold unit 210.

[0068] In other words, the intermediate group 120 has bilateral handling means, thus acting on the bars 2 being worked on the first fold unit 110 as well as on the bars 2 being worked on the supplementary fold unit 210.

[0069] The intermediate group 120 is basically suitable to cooperate in the first folding bench 100, for folding the predetermined number 2a of bars 2, as well as in the supplementary folding bench 200, for folding the supplementary predetermined number 2b of bars 2, in such a way as to enable the performing of folding cycles simultaneously on the first folding bench 100 and on the supplementary folding bench 200.

[0070] The intermediate group 120 is suitable to handle the ends of the bars 2 to drive the portions of bars 2 to be folded to the respective folding heads 4.

[0071] To such an aim the intermediate group 120 is made mobile with respect to the first folding bench 100 and to the supplementary folding bench 200.

[0072] The intermediate group 120a can comprise for example a first pliers member 121 and a second pliers member 122 carried by the same support structure 130. The first pliers member 121 and the second pliers member 122 are placed side by side along the longitudinal direction, parallel to the feeding line 3, to block the end of the bars 2 of the predetermined number 2a and the end of the bars 2 of the supplementary predetermined number 2b respectively. Preferably the first pliers member 121 and the second pliers member 122 can be operated in an autonomous way, further than, as an example, being able to engage bars 2 with different diameters at the same time.

[0073] Alternatively the intermediate group 120b can comprise, for example, a support member 123 shaping a first abutment wall 124a, in order to contrast, in abutment, the ends of the predetermined number 2a of bars 2, and a second abutment wall 124b, opposite to the first abutment wall 124a, to contrast, in abutment, the ends of the supplementary predetermined number 2b of bars 2 (see figures 2a and 2b).

[0074] In any case, the intermediate group 120 is suitable to provide the reference necessary for positioning the bars 2, for folding these latter by means of the folding bench 100 and of the supplementary folding bench 200.

[0075] Alternatively, the intermediate group 120 can be fixed, while the first fold unit 110 and the supplementary fold unit 210 can be mobile along the same longitudinal direction, to enable the positioning and consequently the folding of bars 2 of any dimension, which are fed from the feeding line 3. Again, as an alternative, one of the fold units can be fixed, while the intermediate group 120 and the remaining fold unit can be mobile, still in order to fold the bars 2 according to two folding cycles at the same time.

[0076] In order to allow the correct positioning of the bars 2 with respect to the fold members, the folding head 4 of the fold units 110, 210 can be preferably provided with integrated grip members 43, arranged upstream of the fold members 41, 42, to engage the bars 2 in proximity of the section to be folded.

[0077] Moreover at least one folding head 4 can also comprise an alignment member 44 that can be operated upon control, integrated to the fold unit as well, for example partially hidden with respect to the plane of the folding head 4, to serve as an alignment abutment for the bars in proximity of the section to be folded.

[0078] The functioning of the apparatus according to the invention can be understood from the previous description.

[0079] The apparatus 1 can work bundles of metal rods having different lengths at the same time, the sum of which is not longer than the longitudinal extension of the feeding line 3, or whose length is substantially equal to half the longitudinal extension of the feeding line 3. Practically, the apparatus 1 is prearranged to perform at the same time two folding cycles, activating both the first folding bench 100 and the supplementary folding bench 200 (see figure 1).

[0080] Single bars or respective bundles of bars 2 to be folded are then transferred, for example from a suitable store, to the roller conveyor 3, longitudinally occupying a corresponding portion.

[0081] The first folding bench 100 can be suited to shape the predetermined number 2a of bars 2, while the supplementary folding bench 200 can be set up for working, according to an even different operating cycle, a supplementary predetermined number 2b of bars 2, equal or different in number, diameter and length with respect to the bars 2 of the predetermined number 2a.

[0082] As an example, in the case illustrated in figure 1, the first folding bench 100 is suitable to shape at each cycle one bar 2, while the supplementary bench 200 a supplementary number 2b equal to two. Obviously, it is possible to provide folding cycles suitable to work different numbers of bars.

[0083] With reference to figure 1, the fold units 110, 210 are reciprocally positioned, in a way as to enable the folding of the bars by means of the folding heads 4.

[0084] The load means of each folding bench 100, 200 are activated, in a way as to load the respective bundles or predetermined numbers of bars 2a, 2b to be shaped on the folding heads 4. Practically the bars 2 are engaged at one end by the intermediate group 120, and at the opposite end by the members of the respective folding head 4.

[0085] At last both folding benches placed side by side are then operated to follow at the same time two shaping cycles on the same apparatus 1. In order to complete such cycles, the intermediate group 120, the first fold unit 110 and the supplementary fold unit 210 can be reciprocally positioned again more times, so as to allow the performing of successive folds. In particular, the intermedi-

ate group 120 enables to engage the ends of the bars 2, taking the same close to the folding heads 4 of the respective fold units 110, 210. In such a way the group 120 makes it possible to realize shaped pieces with the same folding head 4.

[0086] It is to be noted that the apparatus 1 according to the invention can work at the same time bundles of bars of different lengths. In particular, a portion of the apparatus can work bars 2 which are shorter than the half of the roller conveyor 3, for example through the first folding bench 100, while the remaining portion of the apparatus 1 can then work bars 2 which are longer than the half of the roller conveyor 3, with the remaining folding bench 200.

[0087] In this case, the first fold unit 110 and the intermediate group 120 are arranged reciprocally closer in a corresponding manner, to work the bars 2 in a reduced area at the side of the roller conveyor 3, while the supplementary fold unit 210 of the supplementary folding bench 200 and the same intermediate group 120 are arranged reciprocally distanced in a corresponding manner to house the longer bars 2.

[0088] At this point the bars 2, according to the respective predetermined numbers 2a, 2b, are loaded on both folding heads 4 so as to be shaped, as previously described, thus accomplishing two folding cycles at the same time.

[0089] According to a further operating mode, not illustrated, it is possible to set up the apparatus 1 in a way as to operate only one folding bench 100, 200. For example one of the fold units 110, 210 can be approached to the end of the roller conveyor 3 in inactive position, while the remaining fold unit and the intermediate group 120 can be reciprocally distanced so as to receive the bundle of bars 2 to be shaped, for example in a way as to extend further than the centre line of the apparatus 1, or viceversa.

[0090] According to a further embodiment illustrated in figure 3 it is possible to provide that the intermediate group to be split in two, comprising a first intermediate group 125 and a second intermediate group 126, functionally totally similar to the unique intermediate group 120 previously disclosed. In such a case, each intermediate group 125, 126 provides for example an autonomous pliers member or positioning member for the bars 2, suitable to cooperate with the respective folding head 4 of the first folding bench 100, and of the supplementary folding bench 200, respectively. When, as in this case, each intermediate group 125, 126 provides an autonomous pliers member, said member can grasp any portion of the respective group or predetermined number of bars, not necessarily the end, so as, for example, to reduce the flexion of the bars being worked.

[0091] Each intermediate group 125, 126 basically serves a respective folding head 4, to enable the positioning of a respective group of bars 2 to be folded. Preferably the intermediate groups 125, 126 are mobile in longitudinal direction, being for example provided that

the first fold unit 110 to be fixed, while the supplementary fold unit 210 to be mobile in the same longitudinal direction. In such a case it is appropriate that the alignment member 44 which can be operated, previously cited, is provided for each folding head 4 (see figure 3). The apparatus 1 therefore allows to obtain products which are folded and shaped according two folding cycles at the same time (see figure 3a).

[0092] Alternatively both fold units 110, 210 can be provided mobile (see figures 4 and 5) in order to accomplish products which are folded and shaped indifferently (see figures 4a and 5a).

[0093] Furthermore, it is useful that the feeding line 3 is provided with a double motor drive, each serving a folding bench 100, 200 and subjected to a respective abutment member, for aligning the bars 2 to be transferred to each bench.

[0094] In particular in figure 5 is schematized a further embodiment, totally similar to the one previously disclosed, but in which the feeding line 3 is structurally subdivided in two portions, each provided with an autonomous motor drive. In such case each folding bench 100, 200 is therefore preferably suitable to work at one end of the feeding line 3. For each portion of the line 3 is further provided an abutment member which can be operated, for aligning the bars 2 to be fed, suitable to cooperate with the corresponding alignment member 7, 70 arranged at the ends of the line 3.

[0095] According to a further version, illustrated in figure 6, the apparatus can comprise a mobile fold unit, for example the first unit 110, arranged fixed, served by the respective intermediate group 125 mobile with respect thereto in the longitudinal direction, while the remaining fold unit 210 and the respective second intermediate group 126 are both mobile in the same longitudinal direction. In this case it will be possible to arrange the fold unit 210 at the end or at any other position considered more suitable, and it will be possible to realize the relative motion between the supplementary fold unit 210 and the respective second intermediate group 126 following the movement of both or of one of them.

[0096] According to a further version of the apparatus, illustrated in the figures from 7 to 16, it is possible to provide that the aforesaid intermediate group, operating between the first fold unit and the supplementary fold unit, to be realized through one or more further fold units. In such a case, the aforesaid handling can then consist in one or more folding actions on end portions of the bars 2.

[0097] More precisely, in such a case the first folding bench 10 of the apparatus 1 comprises, further to the cited first fold unit 11, a second fold unit 12, carrying a respective folding head 4, which functions as an intermediate group for handling the bars 2, in particular for folding a respective end of the bars of the predetermined group 2a.

[0098] The first fold unit 11 and the second fold unit 12 are arranged mobile with respect to each other, along a

longitudinal direction substantially parallel to the longitudinal extension of the feeding line 3, whereon the bars 2 to be folded are arranged longitudinally.

[0099] Preferably the first fold unit 11 is arranged fixed at one end of the roller conveyor 3, while the second fold unit 12 is arranged mobile on rails 5, in a way as to enable the positioning and the folding of bars 2 of any length, in particular to obtain shaped bars 2' particularly with both ends folded (see figure 13A). Alternatively, both fold units 11, 12 can be mobile on the rails 5.

[0100] Similarly the supplementary folding bench 20 can comprise, further to the supplementary fold unit 21 or first supplementary fold unit, also a second supplementary fold unit 22, in a way totally similar to what has been previously illustrated for the folding bench 10.

[0101] Then, in such a case, also the second supplementary fold unit 22, as well as the second fold unit 12, works as an intermediate handling group between the first fold unit 10 and the supplementary fold unit 21.

[0102] The first supplementary fold unit 21 can be advantageously arranged fixed at the other end of the roller conveyor 3, opposite to the first fold unit 11 preferably fixed, while the second supplementary fold unit 22 can be mounted mobile, sliding on the rails 5, so as to be able to be approached or distanced with respect to the first fold unit 11 and to the first supplementary fold unit 21, according to the production requirements. Alternative both fold units 21, 22 can be provided mobile on the rails 5.

[0103] Practically the fold units 11, 12, 21, 22 of the folding bench 10 and of the supplementary folding bench 20 can be sliding on railways 5 which constitute the prolongation of each other.

[0104] It is important to observe that the first supplementary fold unit 21 and the second supplementary fold unit 22 can be operated independently, to work in cooperation or singularly to help a fold unit 11, 12 of the folding bench 10.

[0105] Moreover each folding bench 10, 20 can be provided with autonomous load means 30 for loading the predetermined number 2a of bars 2 to the folding bench 10 and for loading the supplementary predetermined number 2b of bars 2 to the supplementary folding bench 20 (see figure 8).

[0106] The load means 30 can be realized in a known way through a tilting arm associated with a fixed chute constrained to the fold unit. The fixed chute shapes at the upper side an inclined surface preferably plane, suitable to enable the rolling through gravity of the bars 2 from an upper position to a lower position, at which the same loaded bars 2 result engaged in a central section corresponding to the zone comprised between the folder members of the folding head 4, previously described.

[0107] The tilting arm 30 comprises a load portion that extends beyond a discharge portion. More precisely the load portion is separated by the discharge portion, through a shoulder suitable to prevent the rolling towards the discharge portion of the bars 2 supported by the load

portion. The tilting arm 30 is furthermore pivoted at one side of the folding head 4 on the framework of the fold unit 11, 12, 21, 22.

[0108] An actuator controls the alternated operation of the tilting arm 30 from a lower position substantially horizontal to an upper inclined position. At the cited lower position the load portion stands at a height underneath the roller conveyor 3, in order to load the bars. Following the rotation of the tilting arm 30 the load portion is suitable to rise with respect to the plane of the roller conveyor 3 until the cited upper position, thus lifting the predetermined number 2a of bars 2 or the supplementary predetermined number 2b of bars 2 above the fixed chute of the fold unit. By going on with the lifting of the arm 30, the loaded bars 2 are taken through gravity against the shoulder, thus remaining retained thereby. The subsequent lowering of the tilting arm 30 will take the bars 2 in contact with the inclined surface of the fixed chute constrained to the fold unit, whereon the bars 2 will slide until falling in the excentric central section between the folder members of the folding head 4.

[0109] The functioning of such an embodiment is totally similar to what has been previously described.

[0110] Also in this case both folding benches 10, 20 positioned side by side are basically operated as previously described, to perform, preferably at the same time, two shaping cycles on the same apparatus 1.

[0111] In particular it is to be underlined only that according to a possible operating mode, illustrated schematically in figures 12, and 12A, in a configuration substantially similar to the one previously described, for example overturned, one of the provided fold units can be operated to work pieces which can be obtained with only one folding head 4, for example open or closed stirrups 2' or similar pieces.

[0112] A further operating mode allows to obtain maximum length pieces using a fixed fold unit, for example the first fold unit 11, in cooperation with one of the remaining available fold units of the other folding bench.

[0113] For example figure 15 illustrates the case wherein the first fold unit 11 of the folding bench 10 cooperates with the second fold unit 22, that is intermediate, of the supplementary folding bench 20, for obtaining relatively long shaped pieces 2' (see figure 15A), but having a length shorter than the maximum length possible for the apparatus 1.

[0114] Again, figure 16 illustrates the case wherein the first fold unit 11 of the folding unit 10 cooperates with the first supplementary fold unit 21 of the supplementary folding bench 20, at one end, in order to obtain shaped pieces 2' (see figure 16A) with a length substantially equal to the maximum one possible for the apparatus 1. Obviously, for each illustrated operating mode, it is possible to use the folding bench 10 instead of the supplementary folding bench 20 and vice versa, for obtaining similar combinations of shaped pieces as well as not shaped pieces.

[0115] At last in each one of the described embodi-

ments it is possible to provide further intermediate supports, arranged fixed or mobile between the fold units, for reducing the flexure of the bars being worked. The above said support will result suitably dislocated between the intermediate group 120 and the first folding bench 10, 100, and between the intermediate group 120 and the supplementary folding bench 20, 200.

[0116] The apparatus for folding metal rods in bars according to the invention therefore attains the scope of enabling to operate in an optimal manner the folding of rods in bars, in particular reducing at the maximum the space occupied and optimizing the productive yield.

[0117] In practice, the embodiments of the invention, the materials used, as well as the shape and dimensions, may vary depending on the requirements.

[0118] Should the technical characteristics mentioned in each claim be followed by reference signs, such reference signs were included strictly with the aim of enhancing the understanding of the claims and hence they shall not be deemed restrictive in any manner whatsoever on the scope of each element identified for exemplifying purposes by such reference signs.

Claims

1. Method for folding metal profiles in bars, comprising the steps of:

- a. feeding a predetermined number (2a) of bars (2) and a supplementary predetermined number (2b) of bars (2), aligned on a feeding line (3);
- b. prearranging a first folding bench (10, 100) at one side of said feeding line (3), comprising a first fold unit (11, 110) carrying a folding head (4);
- c. prearranging a supplementary folding bench (20, 200) at one side of said feeding line (3), comprising a supplementary fold unit (21, 210) carrying a respective folding head (4), said first fold unit (11, 110) and said supplementary fold unit (21, 210) being aligned along a longitudinal direction parallel and placed at one side of said feeding line (3);
- d. prearranging an intermediate group (12, 22, 120) for double handling, suitable to engage at the same time through first handling means portions of said predetermined number (2a) of bars and through second handling means portions of said predetermined supplementary number (2b) of bars (2), being said intermediate group (12, 22, 120) interposed mobile with relative motion, relatively to said first fold unit (11, 110) and to said supplementary fold unit (21, 210), along said longitudinal direction;
- e. positioning along said longitudinal direction said first fold unit (11, 110) according to said relative motion, relatively to said intermediate group (12, 22, 120), so as to receive, interposed,

said predetermined number (2a) of bars;

f. positioning along said longitudinal direction said supplementary fold unit (21, 210) according to said relative motion, relatively to said intermediate group (22, 120), so as to receive, interposed, said supplementary predetermined number (2b) of bars (2);

g. transferring from said feeding line (3) said predetermined number of bars (2a) to said first folding bench (10, 100), engaging opposed ends of said transferred bars (2), through said intermediate group (12, 120) and said first fold unit (11, 110);

h. transferring from said feeding line (3) said supplementary predetermined number (2b) of bars (2) to said supplementary folding bench (20, 200), engaging opposed ends of said transferred bars (2), through said intermediate group (12, 120) and said supplementary fold unit (21, 210);

i. performing the folding of said predetermined number (2a) of bars (2) through said first fold unit (11, 110) and at the same time performing the folding of said supplementary predetermined number (2b) of bars (2) through said supplementary fold unit (21, 210).

2. Method according to claim 1, **characterized in that** said step of e.) positioning along said longitudinal direction said first fold unit (11, 110) according to said relative motion occurs, being said first fold unit (11, 110) fixed, and **in that** said step of f.) positioning along said longitudinal direction said supplementary fold unit (21, 210) according to said relative motion occurs, being said supplementary fold unit (21, 210) mobile along said longitudinal direction, said intermediate group (120) comprising, in turn, a first group (12, 125) mobile serving said first unit (11, 110) and a second group (22, 126) mobile serving said supplementary fold unit (21, 210).

3. Method according to claim 1 or 2, **characterized in that** it provides to alternate the sequence of steps a. to i. with a sequence of steps in which it is provided:

- l. to feed a determined number of bars (2) to said feeding line (3);
- m. to position said first fold unit (11, 110) and said supplementary fold unit (21, 210) relatively one another, so as to receive between them said determined number of bars (2) for performing their folding at opposed edges;
- n. to transfer said determined number of bars (2) between said first fold unit (11, 110) and said supplementary fold unit (21, 210), supporting a median portion of said determined number of bars (2) through said intermediate group (120);
- o. to perform a folding cycle of said determined

number of bars (2), folding one end of said bars (2) through said first fold unit (110) and an opposed end through said supplementary fold unit (210).

4. Apparatus for folding metal profiles in bars comprising a feeding line (3) suitable to receive said bars (2), a first folding bench (10, 100) prearranged at one side of said feeding line (3), comprising a first fold unit (11, 110) carrying a folding head (4) for performing a respective folding cycle on a predetermined number (2a) of said bars (2), said apparatus being **characterized in that** it comprises a supplementary folding bench (20, 200) provided with a supplementary fold unit (21, 210) carrying a respective folding head (4) for folding a supplementary predetermined number (2b) of bars (2), and an intermediate group (12, 22, 120) for double handling, carrying first handling means and second handling means, being able to engage at the same time portions of said predetermined number (2a) and of said supplementary predetermined number (2b) of bars (2), interposed between said first fold unit (11, 110) and said supplementary fold unit (21, 210), said first fold unit (11, 110) and said supplementary fold unit (21, 210) being aligned in a direction longitudinal and at one side of said feeding line (3) and mobile according to a relative motion, relatively to said intermediate group (12, 22, 120), for cooperating to the accomplishment of a supplementary folding cycle performed on said supplementary predetermined number (2b) of said bars (2), simultaneously to the performing of said folding cycle realized by said first folding bench (10, 100) on said predetermined number (2a) of bars (2).
5. Apparatus according to claim 4, **characterized in that** said first and second handling means carried by said intermediate group (12, 22, 120) comprise gripping or alignment means for said ends of said bars (2).
6. Apparatus according to claim 5, **characterized in that** said intermediate group (12, 22, 120) is mobile between said first fold unit (11, 110) and said supplementary fold unit (21, 210).
7. Apparatus according to claim 5 or 6, **characterized in that** said intermediate group (120a) shapes a first pliers member (121) and a second pliers member (122), carried by the same support structure (130), serving said first pliers member (120) said first fold unit (110) and serving said second pliers member (122) said supplementary fold unit (210).
8. Apparatus according to claim 5 or 6, **characterized in that** said intermediate group (120b) comprises an abutment member (123) carried by a support structure (130), carrying a first abutment wall (124a) for

serving as abutment for said predetermined number of bars (2a) and an opposed abutment wall (124b) for serving as abutment for said supplementary predetermined number of bars (2b).

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9. Apparatus according to one of claims 4 to 6, **characterized in that** said intermediate group is split in two, comprising a first intermediate group (12, 125) and a second intermediate group (22, 126), said first intermediate group (12, 125) being suitable to cooperate with said first fold unit (11, 110) of said first folding bench (10, 100), and being said second intermediate group (22, 126) suitable to cooperate with said supplementary fold unit (21, 210) of said supplementary folding bench (20, 200).
10. Apparatus according to one of claims 4 to 9, **characterized in that** said intermediate handling group (120), operating between said first fold unit (11) and said supplementary fold unit (21) is realized through at least one second fold unit (12), carrying a respective folding head, said first folding bench (10) being associated with said second fold unit (12), mobile relatively to said first fold unit (11) and to said supplementary fold unit (21), at one side of said feeding line (3) in said longitudinal direction, for folding a respective end of the predetermined number (2a) of bars (2) or of the supplementary predetermined number (2b) of bars (2).
11. Apparatus according to claim 10, **characterized in that** said intermediate handling group (120), operating between said first fold unit (11) and said supplementary fold unit (21) is further realized through a second supplementary fold unit (22), carrying a respective folding head, said supplementary folding bench (20) being associated with said second supplementary fold unit (22), mobile relatively to said first fold unit (11) and to said supplementary fold unit (21), at one side of said feeding line (3) in said longitudinal direction, for folding a respective end of the predetermined number (2a) of bars (2) or of the supplementary predetermined number (2b) of bars (2).
12. Apparatus according to one of claims 4 to 11, **characterized in that** at least one between said first fold unit (11, 110) and said supplementary fold unit (21, 210) is mobile along said longitudinal direction.
13. Apparatus according to one of claims 4 to 12, **characterized in that** said first fold unit (11, 110) and said supplementary fold unit (21, 210) are both mobile relatively to said feeding line (3), along said longitudinal direction.
14. Apparatus according to one of claims 4 to 12, **characterized in that** said first fold unit (11, 110) of said folding bench (10, 100) is arranged fixed at one end

of said feeding line (3).

15. Apparatus according to one of claims 4 to 14, **characterized in that** said second fold unit (12) is arranged mobile along said longitudinal direction. 5
16. Apparatus according to one of claims 4 to 15, **characterized in that** at least one said fold unit (11, 110, 21, 210, 12, 22) carries an alignment member (44) which can be operated upon control, for serving as an abutment for the bars (2) in proximity of the section to be folded. 10
17. Apparatus according to one of the previous claims, **characterized in that** said feeding line (3) is realized through a roller conveyor with motorized rollers, whose activation can be grouped in variable longitudinal manner, according to the length of the bars (2) to be fed to the respective folding bench (10, 20, 100, 200) positioned downstream. 15 20
18. Apparatus according to one of the previous claims, **characterized in that** it comprises means for loading said bars to said folding benches (10, 20, 100, 200), independent for said first folding bench (10, 100) and for said supplementary folding bench (20, 200), and/or means for discharging said folded bars (2'), independent for said first folding bench (10, 100) and for said supplementary folding bench (20, 200). 25 30

Patentansprüche

1. Verfahren zum Biegen von Metallprofilen in Barren, das folgende Phasen umfasst: 35
 - a. Zuführung einer vorgegebenen Anzahl (2a) an Barren (2) und einer zusätzlichen vorgegebenen Anzahl (2b) an Barren (2), die auf einer Zuführlinie (3) ausgerichtet sind; 40
 - b. Einrichtung eines ersten Biegetisches (10, 100) an der Seite der genannten Zuführlinie (3), der eine erste Biegeeinheit umfasst (11, 110) die mit einem Biegekopf (4) ausgestattet ist; 45
 - c. Einrichtung eines zusätzlichen Biegetisches (20, 200) an der Seite der genannten Zuführlinie (3), der eine zusätzliche Biegeeinheit umfasst (21, 210) die mit einem jeweiligen Biegekopf (4) ausgestattet ist, wobei genannte erste Biegeeinheit (11, 110) und genannte zusätzliche Biegeeinheit (21, 210) entlang einer parallelen Längsrichtung und seitlich an genannter Zuführlinie (3) ausgerichtet sind; 50
 - d. Einrichtung einer Zwischengruppe (12, 22, 120) mit doppelter Handhabung, die geeignet ist, gleichzeitig mittels ersten Handhabungsmitteln an Portionen genannter vorgegebener Anzahl (2a) an Barren und mittels zweiten Hand-

habungsmitteln an Portionen genannter vorgegebener zusätzlicher Anzahl (2b) an Barren (2) anzugreifen, wobei genannte Zwischengruppe (12, 22, 120) mit der entsprechenden Bewegung in Bezug auf genannte erste Biegeeinheit (11, 110) und genannte zusätzliche Biegeeinheit (21, 210) beweglich entlang genannter Längsrichtung zwischenangeordnet ist;
e. Positionierung genannter erster Biegeeinheit (11, 110) mittels genannter entsprechender Bewegung in Bezug auf genannte Zwischengruppe (12, 22, 120) entlang genannter Längsrichtung, sodass, zwischenangeordnet, genannte vorgegebene Anzahl (2a) an Barren (2) aufgenommen wird;
f. Positionierung genannter zusätzlicher Biegeeinheit (21, 210) mittels genannter entsprechender Bewegung in Bezug auf genannte Zwischengruppe (22, 120) entlang genannter Längsrichtung, sodass, zwischenangeordnet, genannte vorgegebene zusätzliche Anzahl (2b) an Barren (2) aufgenommen wird;
g. Übertragung genannter vorgegebener Anzahl an Barren (2a) von genannter Zuführlinie (3) zu genanntem erstem Biegetisch (10, 100), wobei die entgegengesetzten Enden genannter übertragener Barren (2) mittels genannter Zwischengruppe (12, 120) und genannter erster Biegeeinheit (11, 110) angegriffen werden;
h. Übertragung genannter zusätzlicher vorgegebener Anzahl (2b) an Barren (2) von genannter Zuführlinie (3) zu genanntem zusätzlichem Biegetisch (20, 200), wobei die entgegengesetzten Portionen genannter übertragener Barren (2) mittels genannter Zwischengruppe (12, 120) und genannter zusätzlicher Biegeeinheit (21, 210) angegriffen werden;
i. Durchführung des Biegens genannter vorgegebener Anzahl (2a) an Barren (2) mittels genannter erster Biegeeinheit (11, 110) und gleichzeitig des Biegens genannter zusätzlicher vorgegebener Anzahl (2b) an Barren (2) mittels genannter zusätzlicher Biegeeinheit (21, 210).

2. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** genannte Phase e.) - Positionierung genannter erster Biegeeinheit (11, 110) mittels genannter entsprechender Bewegung - erfolgt, indem genannte erste Biegeeinheit (11, 110) fix ist, und dadurch, dass genannte Phase f.) - Positionierung genannter zusätzlicher Biegeeinheit (21, 210) mittels genannter entsprechender Bewegung - erfolgt, indem genannte zusätzliche Biegeeinheit (21, 210) entlang genannter Längsrichtung beweglich ist, wobei genannte Zwischengruppe (120) ihrerseits eine erste bewegliche Gruppe (12, 125) im Dienst genannter erster Einheit (11, 110) und eine zweite bewegliche Gruppe (22, 126) im Dienst genannter zu-

sätzlicher Biegeeinheit (21, 210) umfasst.

3. Verfahren nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** die Abwechslung der Abfolge der Phasen von a. bis i. und einer Abfolge von Phasen vorgesehen ist, in der vorgesehen ist:

l. eine vorgegebene Anzahl an Barren (2) an genannte Zuführlinie (3) zuzuführen;
 m. genannte erste Biegeeinheit (11, 110) und genannte zusätzliche Biegeeinheit (21, 210) jeweils so zu einander anzuordnen, dass zwischen ihnen genannte vorgegebene Anzahl an Barren (2) aufgenommen wird, um das Biegen an entgegengesetzten Enden durchzuführen;
 n. genannte vorgegebene Anzahl an Barren (2) zwischen genannte erste Biegeeinheit (11, 110) und genannte zusätzliche Biegeeinheit (21, 210) zu übertragen, indem eine mittlere Portion genannter vorgegebener Anzahl an Barren (2) mittels genannter Zwischengruppe (120) getragen wird;
 o. einen Biegezyklus an genannter vorgegebener Anzahl an Barren (2) durchzuführen, indem ein Ende genannter Barren (2) mittels genannter erster Biegeeinheit (110) und ein entgegengesetztes Ende mittels genannter zusätzlicher Biegeeinheit (210) gebogen werden.

4. Vorrichtung zum Biegen von Metallprofilen in Barren, die folgendes umfasst: eine für die Aufnahme genannter Barren (2) geeignete Zuführlinie (3), einen ersten Biegetisch (10, 100) der an der Seite genannter Zuführlinie (3) angeordnet ist und eine erste Biegeeinheit (11, 110) umfasst, die mit einem Biegekopf (4) ausgestattet ist, um einen jeweiligen Biegezyklus an einer vorgegebenen Anzahl (2a) genannter Barren (2) durchzuführen, wobei genannte Vorrichtung **dadurch gekennzeichnet** wird, dass sie einen zusätzlichen Biegetisch (20, 200) umfasst, der mit einer zusätzlichen Biegeeinheit (21, 210) versehen ist, die mit einem jeweiligen Biegekopf (4) zum Biegen einer vorgegebenen zusätzlichen Anzahl (2b) an Barren (2) ausgestattet ist, und eine Zwischengruppe (12, 22, 120) mit doppelter Handhabung, die mit ersten Handhabungsmitteln und zweiten Handhabungsmitteln ausgestattet ist, die in der Lage sind, gleichzeitig Portionen genannter vorgegebener Anzahl (2a) und genannter zusätzlicher vorgegebener Anzahl (2b) an Barren (2) anzugreifen, die zwischen genannter erster Biegeeinheit (11, 110) und genannter zusätzlicher Biegeeinheit (21, 210) zwischenangeordnet ist, wobei genannte erste Biegeeinheit (11, 110) und genannte zusätzliche Biegeeinheit (21, 210) in einer parallelen Längsrichtung und seitlich an genannter Zuführlinie (3) ausgerichtet sind und nach einer entsprechenden Bewegung in Bezug auf genannte Zwischengruppe

(12, 22, 120) beweglich sind, um an der Durchführung eines zusätzlichen Biegezyklus an genannter zusätzlicher vorgegebener Anzahl (2b) genannter Barren (2) gleichzeitig mit der Durchführung des genannten von genanntem erstem Biegetisch (10, 100) an genannter vorgegebener Anzahl (2a) an Barren (2) ausgeführten Biegezyklus mitzuwirken.

5. Vorrichtung nach Anspruch 4, **dadurch gekennzeichnet, dass** genannte erste und zweite Handhabungsmittel, mit denen genannte Zwischengruppe (12, 22, 120) ausgestattet sind, Greifmittel oder Ausrichtungsmittel für genannte Enden genannter Barren (2) umfassen.
6. Vorrichtung nach Anspruch 5, **dadurch gekennzeichnet, dass** genannte Zwischengruppe (12, 22, 120) zwischen genannter erster Biegeeinheit (11, 110) und genannter zusätzlicher Biegeeinheit (21, 210) beweglich ist.
7. Vorrichtung nach Anspruch 5 oder 6, **dadurch gekennzeichnet, dass** genannte Zwischengruppe (120a) ein erstes Zangenteil (121) und ein zweites Zangenteil (122) ausbildet, mit denen die Tragstruktur (130) ausgestattet ist, wobei genanntes erstes Zangenteil (121) im Dienst genannter erster Biegeeinheit (110) und genanntes zweites Zangenteil (122) im Dienst genannter zusätzlicher Biegeeinheit (210) steht.
8. Vorrichtung nach Anspruch 5 oder 6, **dadurch gekennzeichnet, dass** genannte Zwischengruppe (120b) ein Anschlagelement (123) umfasst, das an einer Tragstruktur (130) angebracht ist, die mit einer ersten Anschlagwand (124a) ausgestattet ist, um als Anschlag für genannte vorgegebene Anzahl an Barren (2a) zu dienen, sowie mit einer entgegengesetzten Anschlagwand (124b) ausgestattet ist, um als Anschlag für genannte vorgegebene zusätzliche Anzahl an Barren (2b) zu dienen.
9. Vorrichtung nach einem der Ansprüche 4 bis 6, **dadurch gekennzeichnet, dass** genannte Zwischengruppe zweigeteilt ist, indem sie eine erste Zwischengruppe (12, 125) und eine zweite Zwischengruppe (22, 126) umfasst, wobei genannte erste Zwischengruppe (12, 125) geeignet ist, um mit genannter erster Biegeeinheit (11, 110) des genannten ersten Biegetisches (10, 100) zusammenzuarbeiten, und genannte zweite Zwischengruppe (22, 126) geeignet ist, um mit genannter zusätzlicher Biegeeinheit (21, 210) der genannten zusätzlichen Biegeeinheit (20, 200) zusammenzuarbeiten.
10. Vorrichtung nach einem der Ansprüche 4 bis 9, **dadurch gekennzeichnet, dass** genannte Handhabungszwischengruppe (120), die zwischen genannter

ter erster Biegeeinheit (11) und genannter zusätzlicher Biegeeinheit (21) wirkt, mittels mindestens einer zweiten Biegeeinheit (12) gefertigt ist, die mit einem jeweiligen Biegekopf ausgestattet ist, wobei genannter erster Biegetisch (10) mit genannter zweiter Biegeeinheit (12), die in Bezug auf genannte erste Biegeeinheit (11) und auf genannte zusätzliche Biegeeinheit (21) an der Seite genannter Zuführlinie (3) in genannter Längsrichtung beweglich ist, zum Biegen eines jeweiligen Endes der vorgegebenen Anzahl (2a) an Barren (2) oder der vorgegebenen zusätzlichen Anzahl (2b) an Barren (2) verbunden ist.

11. Vorrichtung nach Anspruch 10, **dadurch gekennzeichnet, dass** genannte Handhabungszwischengruppe (120), die zwischen genannter erster Biegeeinheit (11) und genannter zusätzlicher Biegeeinheit (21) wirkt, zusätzlich mittels einer zusätzlichen zweiten Biegeeinheit (22) gefertigt ist, die mit einem jeweiligen Biegekopf ausgestattet ist, wobei genannter zusätzlicher Biegetisch (20) mit genannter zusätzlicher zweiter Biegeeinheit (22), die in Bezug auf genannte erste Biegeeinheit (11) und genannte zusätzliche Biegeeinheit (21) an der Seite genannter Zuführlinie (3) in genannter Längsrichtung beweglich ist, zum Biegen eines jeweiligen Endes der vorgegebenen Anzahl (2a) an Barren (2) oder der vorgegebenen zusätzlichen Anzahl (2b) an Barren (2) verbunden ist.
12. Vorrichtung nach einem der Ansprüche 4 bis 11, **dadurch gekennzeichnet, dass** mindestens eine unter genannter erster Biegeeinheit (11, 110) und genannter zusätzlicher Biegeeinheit (21, 210) entlang genannter Längsrichtung beweglich ist.
13. Vorrichtung nach einem der Ansprüche 4 bis 12, **dadurch gekennzeichnet, dass** genannte erste Biegeeinheit (11, 110) und genannte zusätzliche Biegeeinheit (21, 210) beide in Bezug auf genannte Zuführlinie (3) entlang genannter Längsrichtung beweglich sind.
14. Vorrichtung nach einem der Ansprüche 4 bis 12, **dadurch gekennzeichnet, dass** genannte erste Biegeeinheit (11, 110) des genannten Biegetisches (10, 100) fix an einem Ende genannter Zuführlinie (3) angeordnet ist.
15. Vorrichtung nach einem der Ansprüche 4 bis 14, **dadurch gekennzeichnet, dass** genannte zweite Biegeeinheit (12) beweglich entlang genannter Längsrichtung angeordnet ist.
16. Vorrichtung nach einem der Ansprüche 4 bis 15, **dadurch gekennzeichnet, dass** mindestens eine genannte Biegeeinheit (11, 110, 21, 210, 12, 22) mit

einem auf Befehl aktivierbaren Ausrichtungsorgan (44) versehen ist, das als Anschlag für die Barren (2) in der Nähe der zu biegenden Portionen dienen soll.

17. Vorrichtung nach einem der vorherigen Ansprüche, **dadurch gekennzeichnet, dass** genannte Zuführlinie (3) mittels eines Rollenförderers mit motorisch angetriebenen Rollen gefertigt ist, deren Aktivierung je nach der Länge der Barren (2), die zum jeweiligen nachgelagerten Biegetisch (10, 20, 100, 200) gefördert werden müssen, auf längs veränderliche Art gruppiert werden kann.
18. Vorrichtung nach einem der vorherigen Ansprüche, **dadurch gekennzeichnet, dass** sie Lademittel genannte Barren auf genannte Biegetische (10, 20, 100, 200) umfasst, die für genannten ersten Biegetisch (10, 100) und für genannte zusätzliche Biegeeinheit (20, 200) unabhängig sind, und/oder Entlademittel genannter gebogener Barren (2') umfasst, die für genannten ersten Biegetisch (10, 100) und für genannte zusätzliche Biegeeinheit (20, 200) unabhängig sind.

Revendications

1. Méthode pour le pliage de profilés métalliques en barres, comprenant les étapes de :
 - a. alimenter un nombre prédéterminé (2a) de barres (2) et un nombre prédéterminé supplémentaire (2b) de barres (2) en ligne sur une voie d'alimentation (3) ;
 - b. pré-équiper un premier banc de pliage (10, 100) latéralement par rapport à ladite voie d'alimentation (3), comprenant une première unité de pliage (11, 110) portant une tête de pliage (4) ;
 - c. pré-équiper un banc de pliage supplémentaire (20, 200) latéralement par rapport à ladite voie d'alimentation (3), comprenant une unité de pliage supplémentaire (21, 210) portant une respective tête de pliage (4), ladite première unité de pliage (11, 110) et ladite unité de pliage supplémentaire (21, 210) étant alignées le long d'une direction longitudinale parallèle et à côté de ladite voie d'alimentation (3) ;
 - d. pré-équiper un groupe intermédiaire (12, 22, 120) à double manipulation, apte à engager simultanément au moyen des premiers moyens de manipulation des portions dudit nombre prédéterminé (2a) de barres et au moyen des seconds moyens de manipulation des portions dudit nombre prédéterminé supplémentaire (2b) de barres (2), ledit groupe intermédiaire (12, 22, 120) étant interposé mobile avec mouvement

- relatif, relativement à ladite première unité de pliage (11, 110) et à ladite unité de pliage supplémentaire (21, 210), le long de ladite direction longitudinale ;
- e. positionner le long de ladite direction longitudinale ladite première unité de pliage (11, 110) au moyen dudit mouvement relatif, relativement audit groupe intermédiaire (12, 22, 120), de façon à recevoir interposé ledit nombre prédéterminé (2a) de barres (2) ;
- f. positionner le long de ladite direction longitudinale ladite unité de pliage supplémentaire (21, 210) au moyen dudit mouvement relatif, relativement audit groupe intermédiaire (22, 120), de façon à recevoir interposé ledit nombre prédéterminé supplémentaire (2b) de barres (2) ;
- g. transférer de ladite voie d'alimentation (3) ledit nombre prédéterminé de barres (2a) audit premier banc de pliage (10, 100), en engageant les extrémités opposées desdites barres (2) transférées, au moyen dudit groupe intermédiaire (12, 120) et de ladite première unité de pliage (11, 110) ;
- h. transférer de ladite voie d'alimentation (3) ledit nombre prédéterminé supplémentaire (2b) de barres (2) audit banc de pliage supplémentaire (20, 200), en engageant portions opposées desdites barres (2) transférées, au moyen dudit groupe intermédiaire (12, 120) et de ladite première unité de pliage supplémentaire (21, 210) ;
- i. effectuer le pliage dudit nombre prédéterminé (2a) de barres (2) au moyen de ladite première unité de pliage (11, 110) et simultanément effectuer le pliage dudit nombre prédéterminé supplémentaire (2b) de barres (2) au moyen de ladite unité de pliage supplémentaire (21, 210).
2. Méthode selon la revendication 1, **caractérisée en ce que** ladite phase de e.) positionner le long de ladite direction longitudinale ladite première unité de pliage (11, 110) au moyen dudit mouvement relatif, s'effectue, étant la première unité de pliage (11, 110) fixe et **en ce que** ladite phase de f). positionner le long de ladite direction longitudinale ladite unité de pliage supplémentaire (21, 210) au moyen dudit mouvement relatif, s'effectue, étant ladite unité de pliage supplémentaire (21, 210) mobile le long de ladite direction longitudinale, ledit groupe intermédiaire (120) comprenant à son tour un premier groupe (12, 125) mobile au service de ladite première unité (11, 110) et un second groupe (22, 126) mobile au service de ladite unité de pliage supplémentaire (21, 210).
3. Méthode selon la revendication 1 ou 2, **caractérisée en ce qu'elle** prévoit d'alterner la succession des phases allant de a. à i. et une succession de phases où il est prévu de :
- l. alimenter un nombre déterminé de barres (2) à ladite voie d'alimentation (3) ;
- m. positionner ladite première unité de pliage (11, 110) et ladite unité de pliage supplémentaire (21, 210) relativement l'une à l'autre, de façon à recevoir entre elles ledit nombre déterminé de barres (2) pour en effectuer le pliage à extrémités opposées ;
- n. transférer ledit nombre déterminé de barres (2) entre ladite première unité de pliage (11, 110) et ladite unité de pliage supplémentaire (21, 210), en supportant une portion médiane dudit nombre déterminé de barres (2) au moyen dudit groupe intermédiaire (120)
- o. effectuer un cycle de pliage sur ledit nombre déterminé de barres (2), en pliant une extrémité desdites barres (2) au moyen de ladite première unité de pliage (110) et une extrémité opposée au moyen de ladite unité de pliage supplémentaire (210).
4. Appareil pour le pliage de profilés métalliques en barres comprenant une voie d'alimentation (3) apte à recevoir lesdites barres (2), un premier banc de pliage (10, 100) prévu latéralement par rapport à ladite voie d'alimentation (3), comprenant une première unité de pliage (11, 110) portant une tête de pliage (4) pour réaliser un cycle de pliage respectif sur un nombre prédéterminé (2a) desdites barres (2), ledit appareil étant **caractérisé en ce qu'il** comprend un banc de pliage supplémentaire (20, 200) équipé d'une unité de pliage supplémentaire (21, 210) portant une tête de pliage respective (4) pour le pliage d'un nombre prédéterminé supplémentaire (2b) de barres (2), et un groupe intermédiaire (12, 22, 120) à double manipulation, portant les premiers moyens de manipulation et les seconds moyens de manipulation, en mesure d'engager simultanément des portions dudit nombre prédéterminé (2a) et dudit nombre prédéterminé supplémentaire (2b) de barres (2), interposé entre ladite première unité de pliage (11, 110) et ladite unité de pliage supplémentaire (21, 210), ladite première unité de pliage (11, 110) et ladite unité de pliage supplémentaire (21, 210) étant alignées dans une direction longitudinale parallèle et à côté de ladite voie d'alimentation (3) et mobiles selon un mouvement relatif, relativement audit groupe intermédiaire (12, 22, 120), pour coopérer à la réalisation d'un cycle de pliage supplémentaire sur ledit nombre prédéterminé supplémentaire (2b) desdites barres (2), simultanément à l'exécution dudit cycle de pliage réalisé par ledit premier banc de pliage (10, 100) sur ledit nombre prédéterminé (2a) de barres (2).
5. Appareil selon la revendication 4, **caractérisé en ce que** lesdits premiers et seconds moyens de manipulation portés par ledit groupe intermédiaire (12,

- 22, 120) comprennent des moyens de préhension ou d'alignement pour lesdites extrémités desdites barres (2).
6. Appareil selon la revendication 5, **caractérisé en ce que** ledit groupe intermédiaire (12, 22, 120) est mobile entre ladite première unité de pliage (11, 110) et ladite unité de pliage supplémentaire (21, 210). 5
 7. Appareil selon la revendication 5 ou 6, **caractérisé en ce que** ledit groupe intermédiaire (120a) conforme un premier organe à pince (121) et un second organe à pince (122) portés par la même structure de support (130), étant ledit premier organe à pince (121) au service de ladite première unité de pliage (110) et ledit second organe à pince (122) au service de ladite unité de pliage supplémentaire (210). 10 15
 8. Appareil selon la revendication 5 ou 6, **caractérisé en ce que** ledit groupe intermédiaire (20b) comprend un organe de butée (123) porté par une structure de support (130), portant une première paroi de butée (124a) pour faire fonction de butée sur ledit nombre prédéterminé de barres (2a) et une paroi de butée opposée (124b) pour faire fonction de butée sur ledit nombre prédéterminé supplémentaire de barres (2b). 20 25
 9. Appareil selon l'une quelconque des revendications 4 à 6, **caractérisé en ce que** ledit groupe intermédiaire est dédoublé, comprenant un premier groupe intermédiaire (12, 125) et un second groupe intermédiaire (22, 126), ledit premier groupe intermédiaire (12, 125) étant apte à coopérer avec ladite première unité de pliage (11, 110) dudit premier banc de pliage (10, 100), et étant ledit second groupe intermédiaire (22, 126) apte à coopérer avec ladite unité de pliage supplémentaire (21, 210) dudit banc de pliage supplémentaire (20, 200). 30
 10. Appareil selon l'une quelconque des revendications 4 à 9, **caractérisé en ce que** ledit groupe intermédiaire (120) de manipulation, agissant entre ladite première unité de pliage (11) et ladite unité de pliage supplémentaire (21) est réalisé au moyen d'au moins une seconde unité de pliage (12), portant une respective tête de pliage, ledit premier banc de pliage (10) étant associé à ladite seconde unité de pliage (12), mobile relativement à ladite première unité de pliage (11) et à ladite unité de pliage supplémentaire (21), latéralement par rapport à ladite voie d'alimentation (3) dans ladite direction longitudinale, pour le pliage d'une respective extrémité du nombre prédéterminé (2a) de barres (2) ou du nombre prédéterminé supplémentaire (2b) de barres (2). 35 40 45 50
 11. Appareil selon la revendication 10, **caractérisé en ce que** ledit groupe intermédiaire (120) de manipulation, agissant entre ladite première unité de pliage (11) et ladite unité de pliage supplémentaire (21) est réalisé ultérieurement au moyen d'une seconde unité de pliage supplémentaire (22), portant une respective tête de pliage, ledit premier banc de pliage supplémentaire (20) étant associé à ladite seconde unité de pliage supplémentaire (22), mobile relativement à ladite première unité de pliage (11) et à ladite unité de pliage supplémentaire (21), latéralement par rapport à ladite voie d'alimentation (3) dans ladite direction longitudinale, pour le pliage d'une respective extrémité du nombre prédéterminé (2a) de barres (2) ou du nombre prédéterminé supplémentaire (2b) de barres (2). 55
 12. Appareil selon l'une quelconque des revendications 4 à 11, **caractérisé en ce que** au moins l'une parmi ladite première unité de pliage (11, 110) et ladite unité de pliage supplémentaire (21, 210) est mobile le long de ladite direction longitudinale.
 13. Appareil selon l'une quelconque des revendications 4 à 12, **caractérisé en ce que** ladite première unité de pliage (11, 110) et ladite unité de pliage supplémentaire (21, 210) sont toutes deux mobiles relativement à ladite voie d'alimentation (3), le long de ladite direction longitudinale.
 14. Appareil selon l'une quelconque des revendications 4 à 12, **caractérisé en ce que** ladite première unité de pliage (11, 110) dudit banc de pliage (10, 100) est disposée fixée au niveau de l'une des extrémités de ladite voie d'alimentation (3).
 15. Appareil selon l'une quelconque des revendications 4 à 14, **caractérisé en ce que** ladite seconde unité de pliage (12) est disposée mobile le long de ladite direction longitudinale.
 16. Appareil selon l'une quelconque des revendications 4 à 15, **caractérisé en ce qu'**au moins l'une desdites unités de pliage (11, 110, 21, 210, 12, 22) porte un organe d'alignement activable (44) par commande pour faire fonction de butée des barres (2) à proximité de la portion à plier.
 17. Appareil selon l'une quelconque des revendications précédentes, **caractérisé en ce que** ladite voie d'alimentation (3) est réalisée au moyen d'un convoyeur à rouleaux motorisés, dont l'exécution est groupable de façon variable au niveau longitudinal, en raison de la longueur des barres (2) à alimenter au banc de pliage respectif (10, 20, 100, 200) disposé en aval.
 18. Appareil selon l'une quelconque des revendications précédentes, **caractérisé en ce qu'il** comprend des moyens de chargement desdites barres auxdits bancs de pliage (10, 20, 100, 200) indépendants

pour ledit premier banc de pliage (10, 100) et pour ledit banc de pliage supplémentaire (20, 200) et/ou des moyens de déchargement desdites barres pliées (2) indépendants pour ledit premier banc de pliage (10, 100) et pour ledit banc de pliage supplémentaire (20, 200). 5

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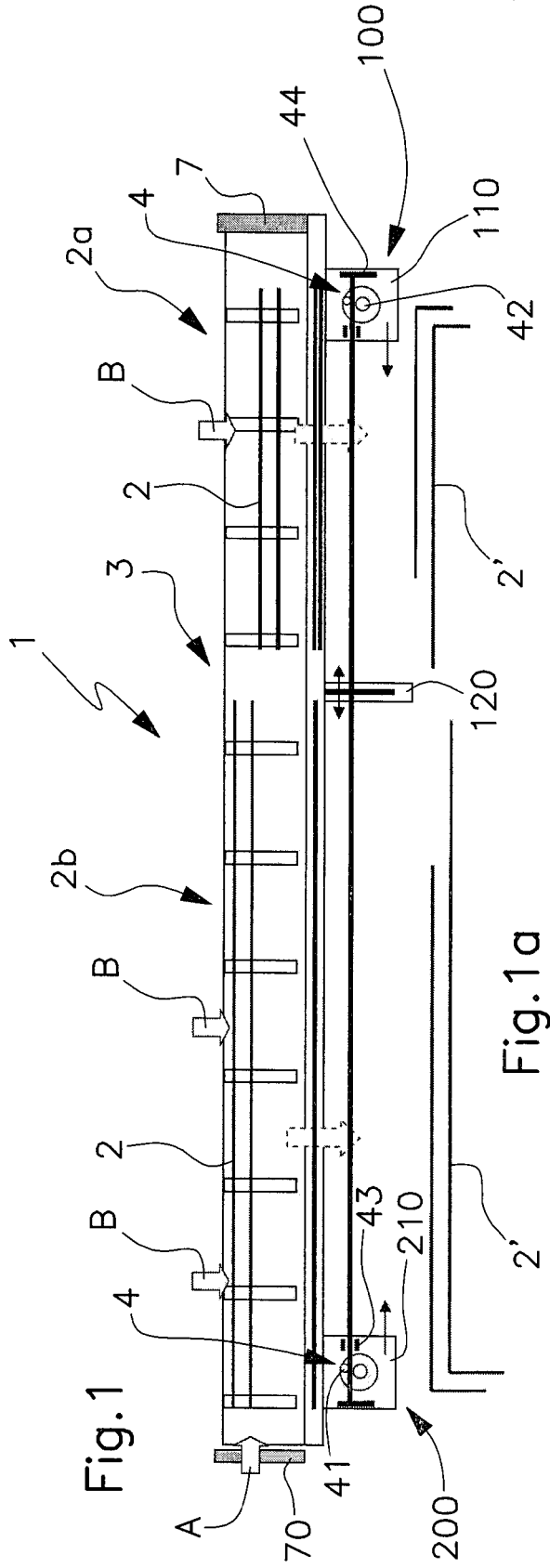
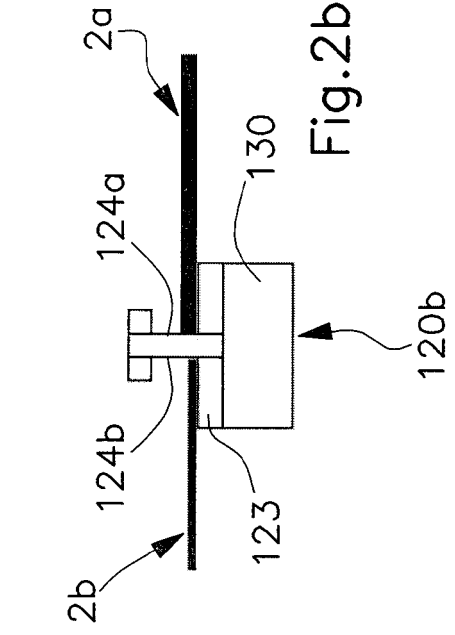
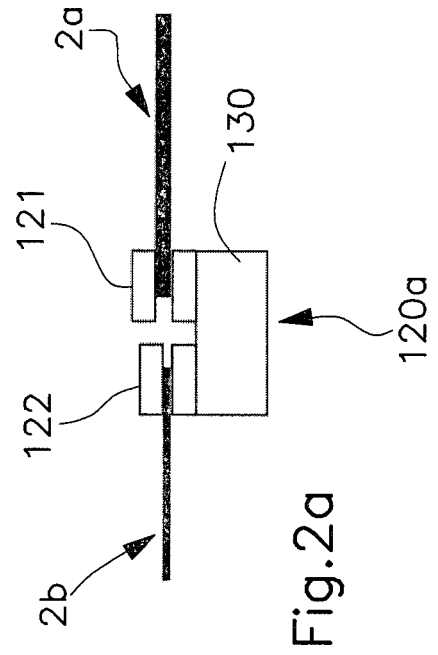


Fig. 1a



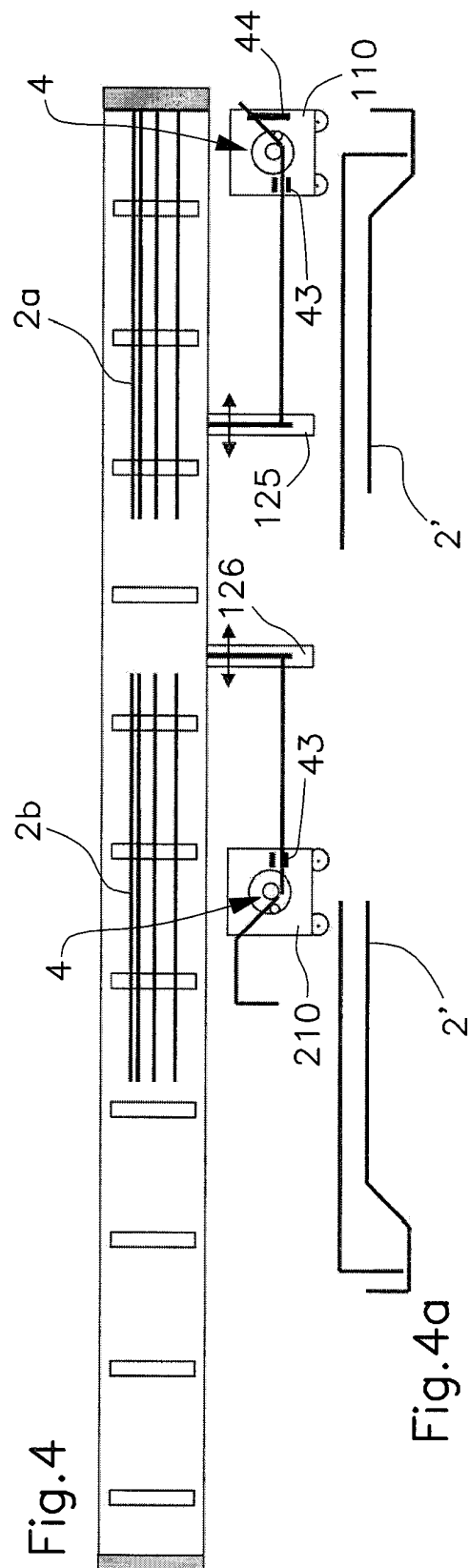
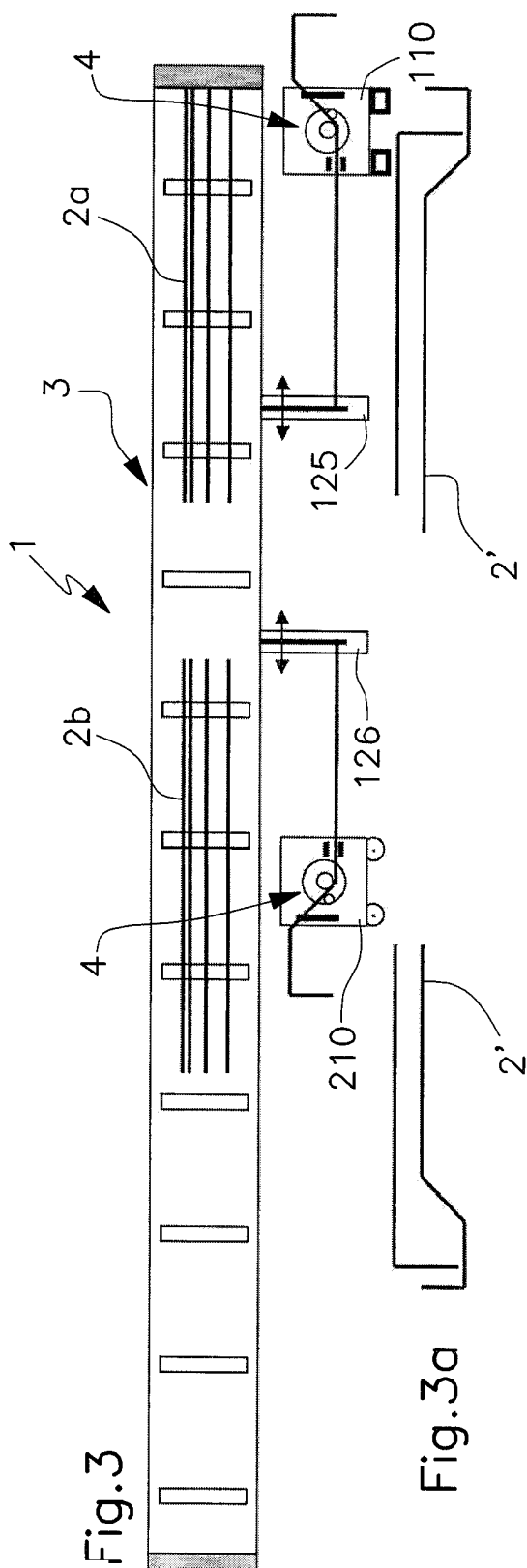


Fig.5

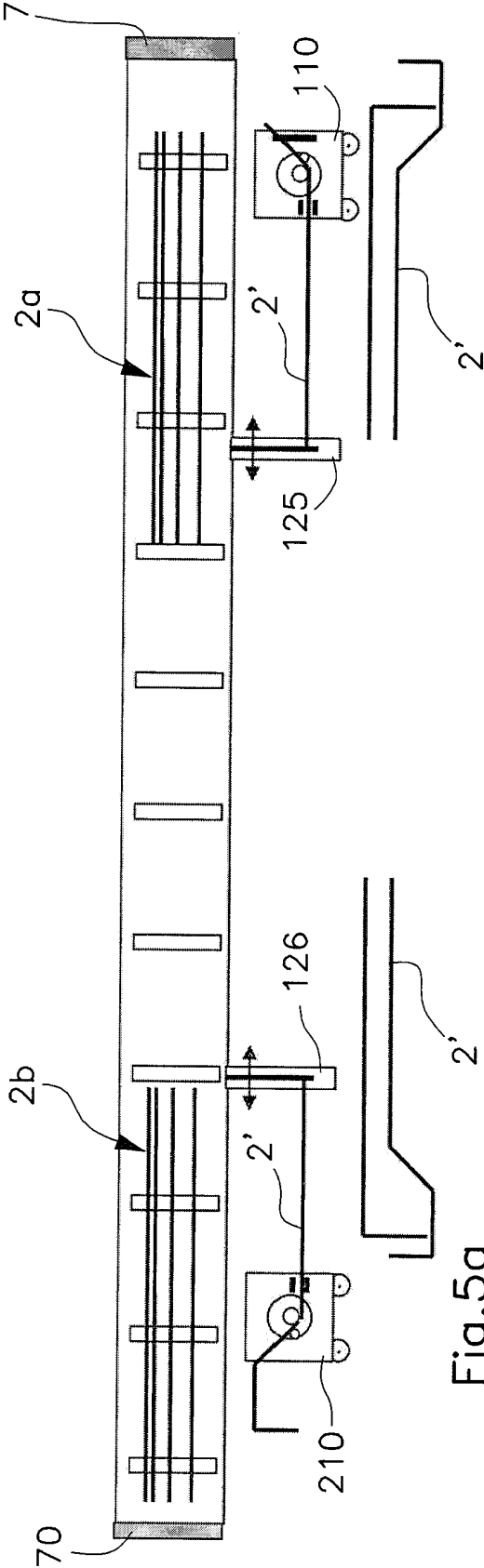
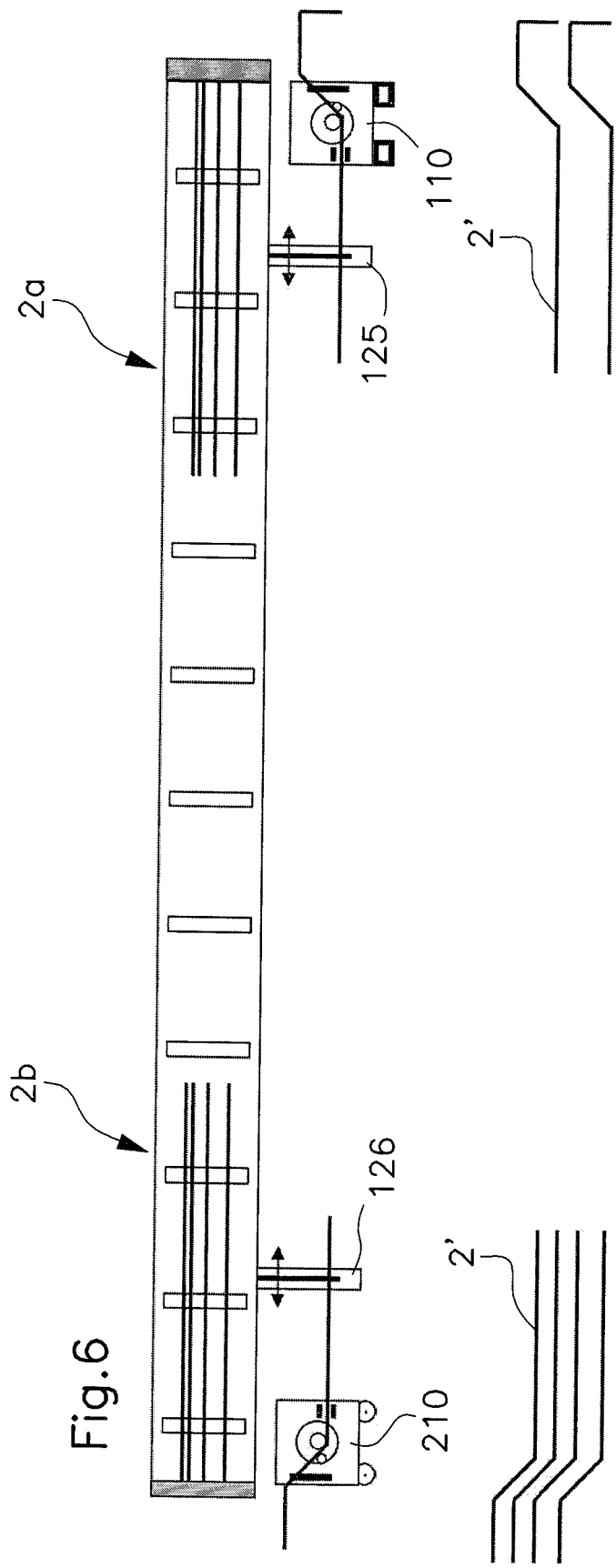


Fig.5a



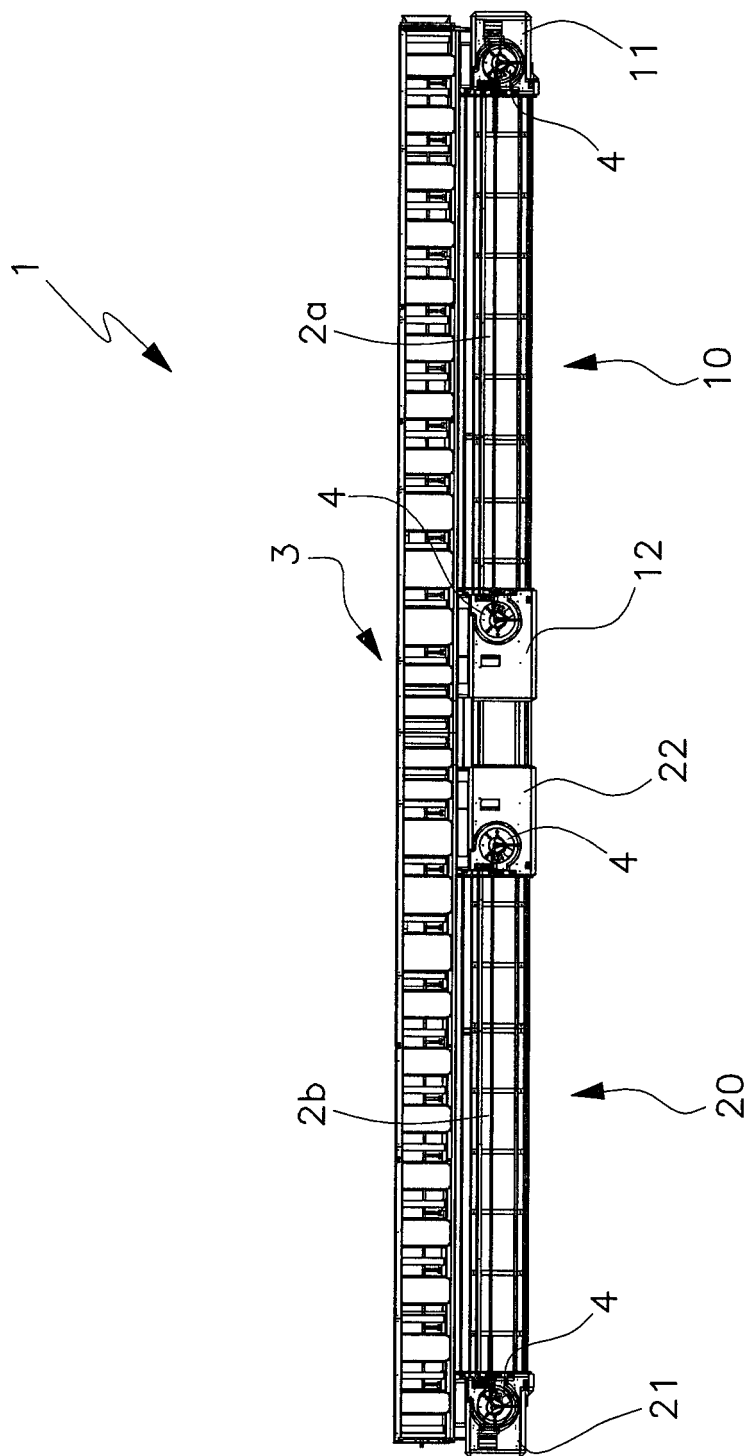


Fig. 7

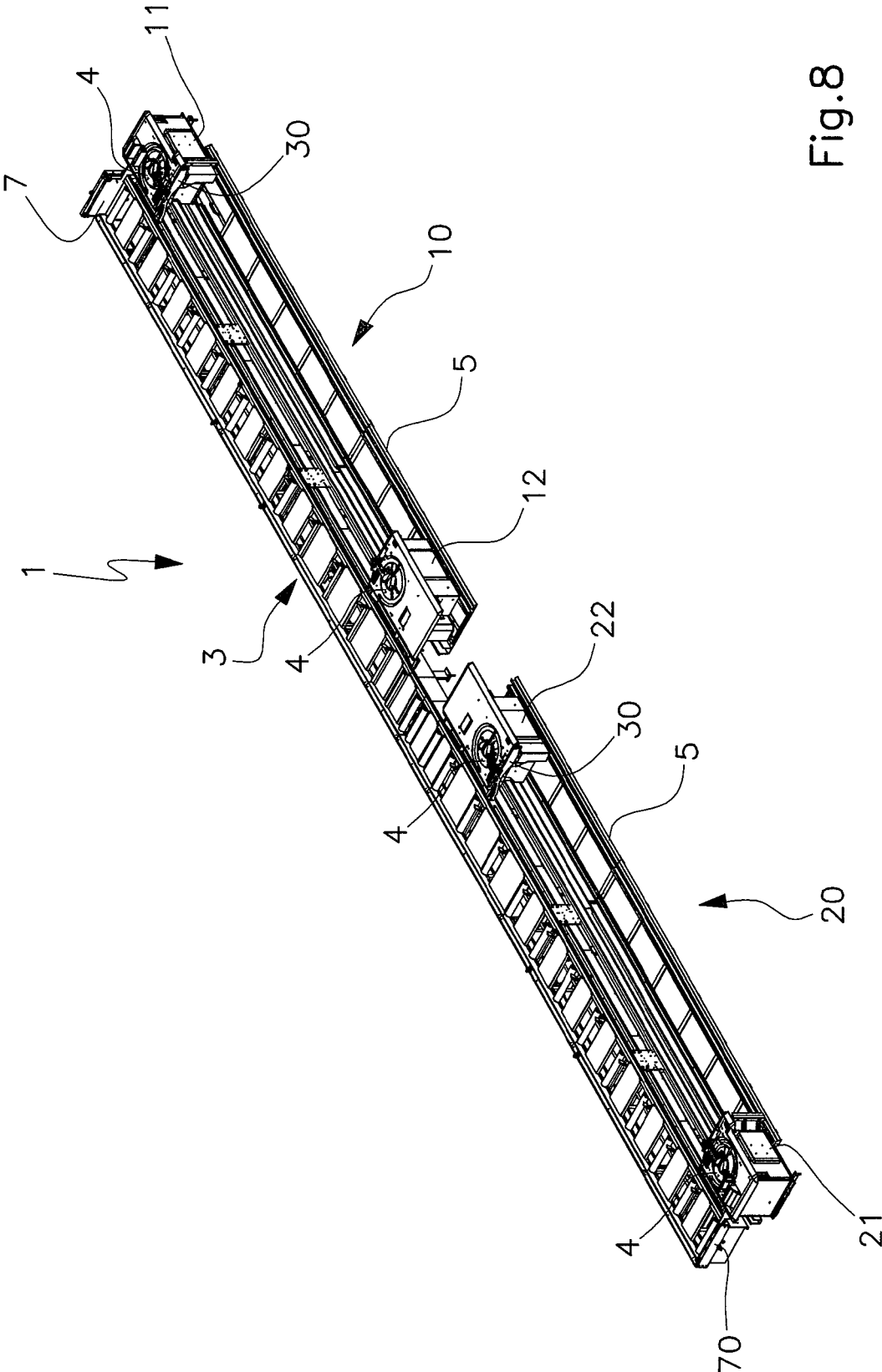
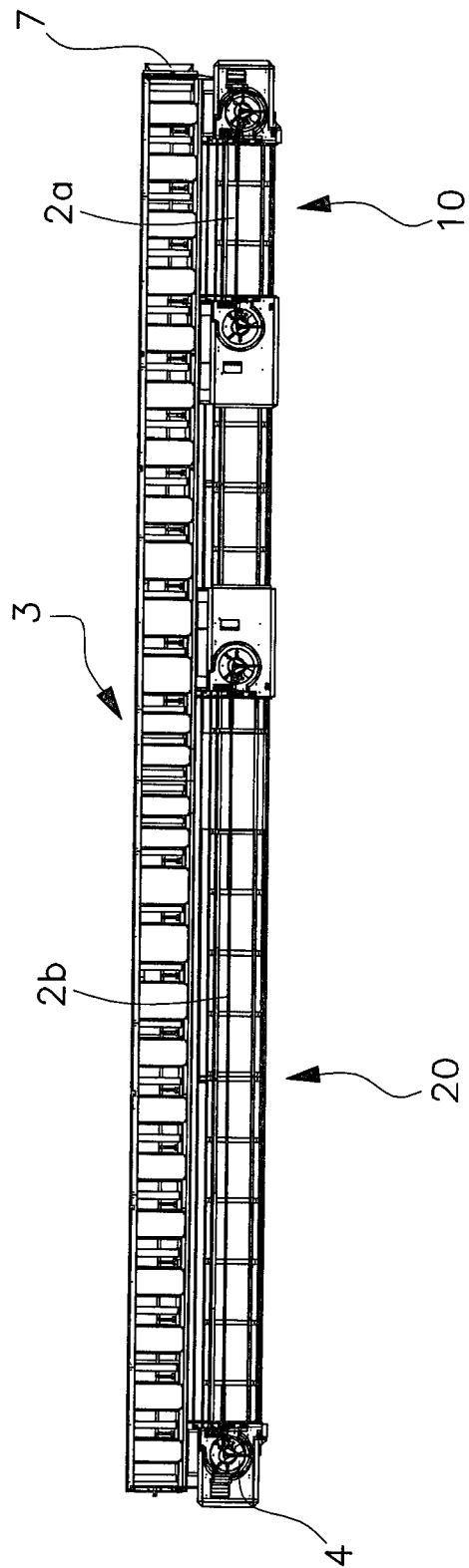


Fig.8

Fig.9



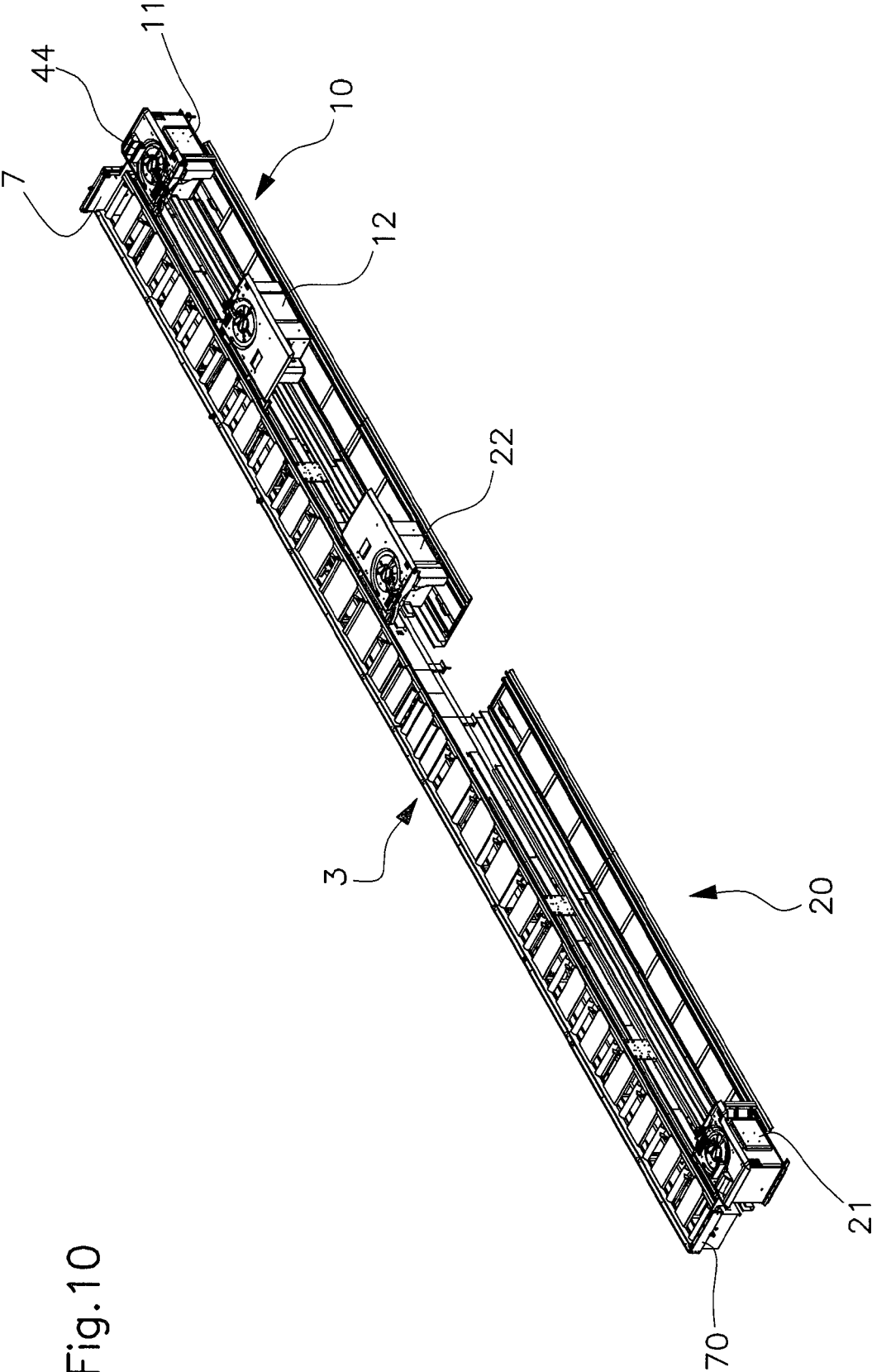


Fig. 10

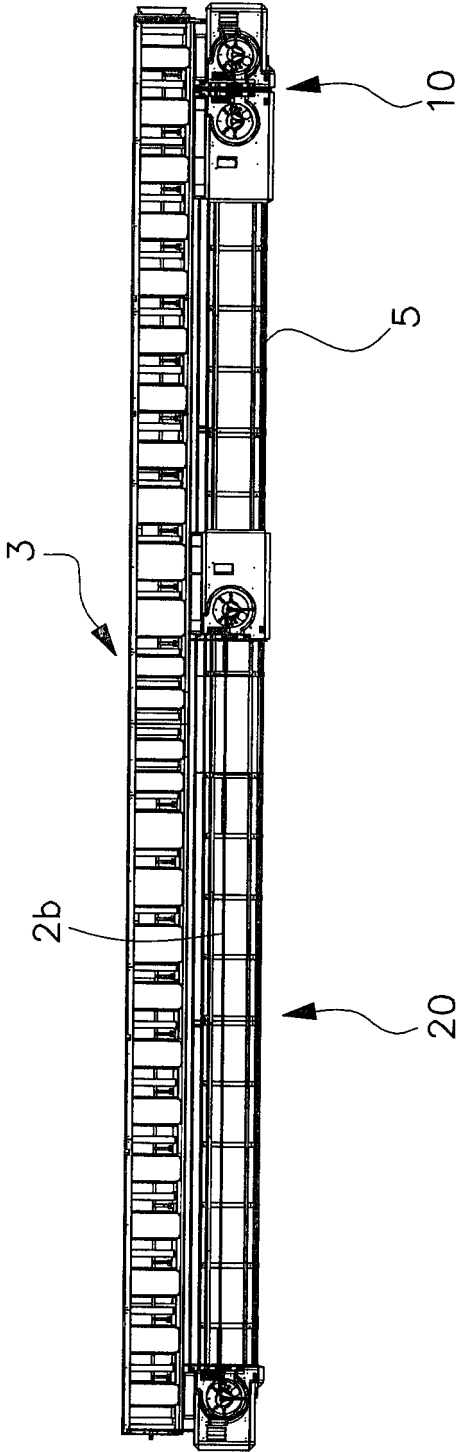


Fig. 11

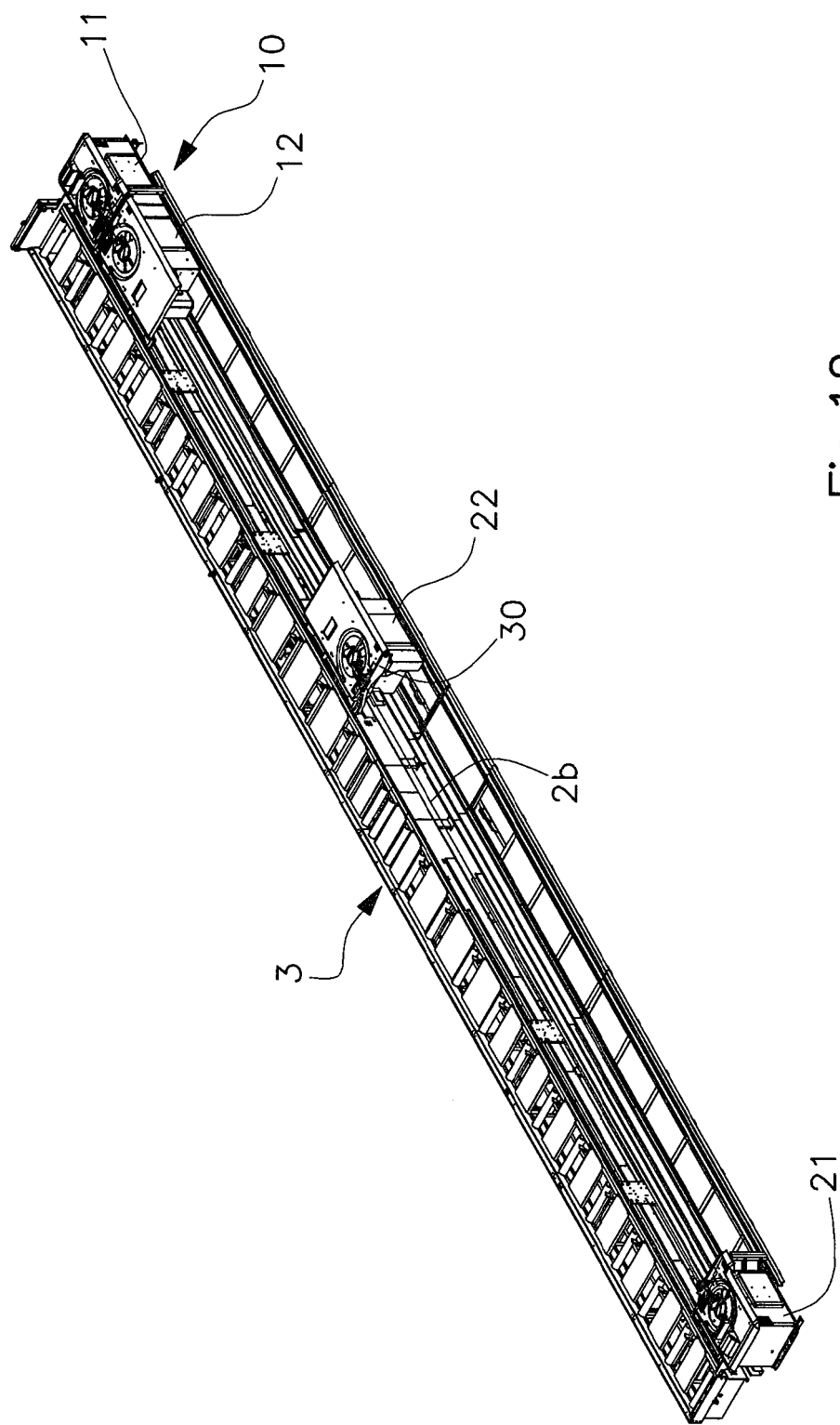


Fig.12

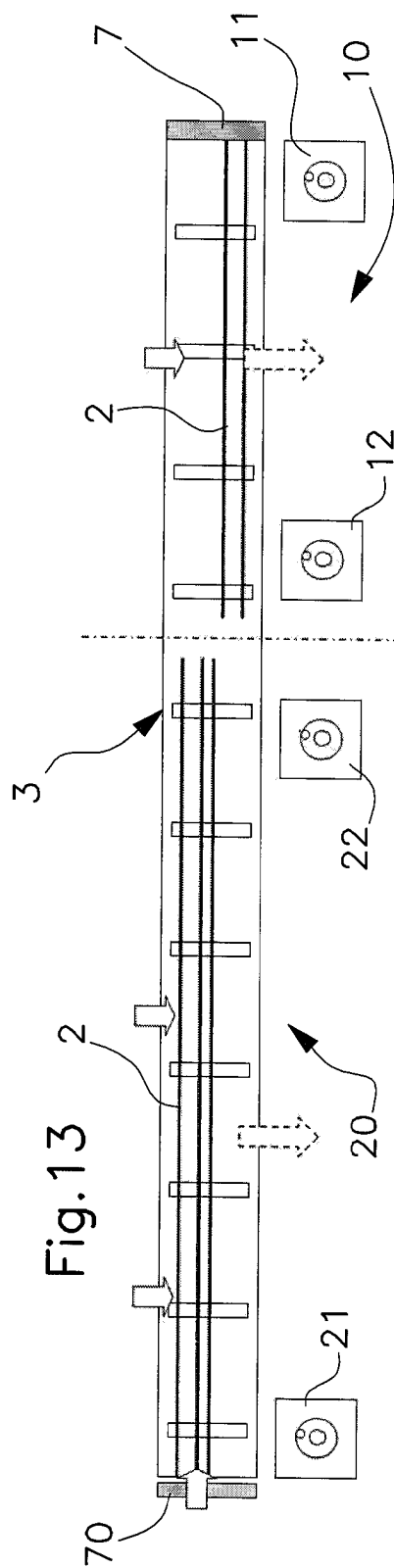


Fig. 13

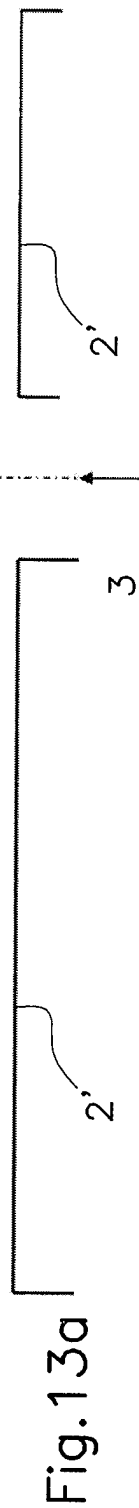


Fig. 13a

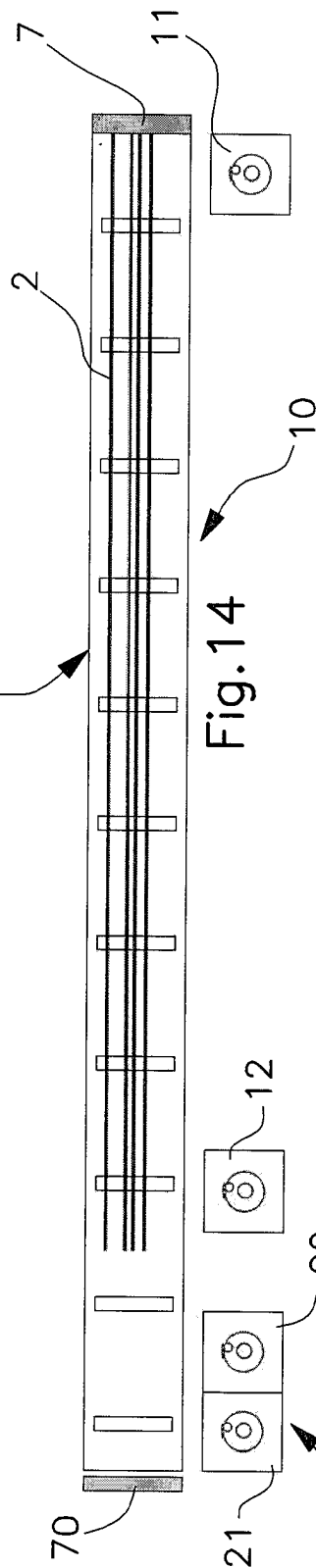


Fig. 14

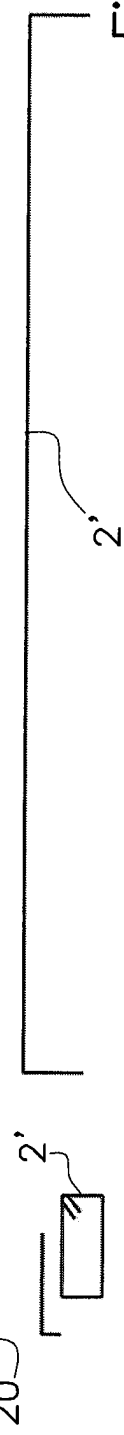


Fig. 14a

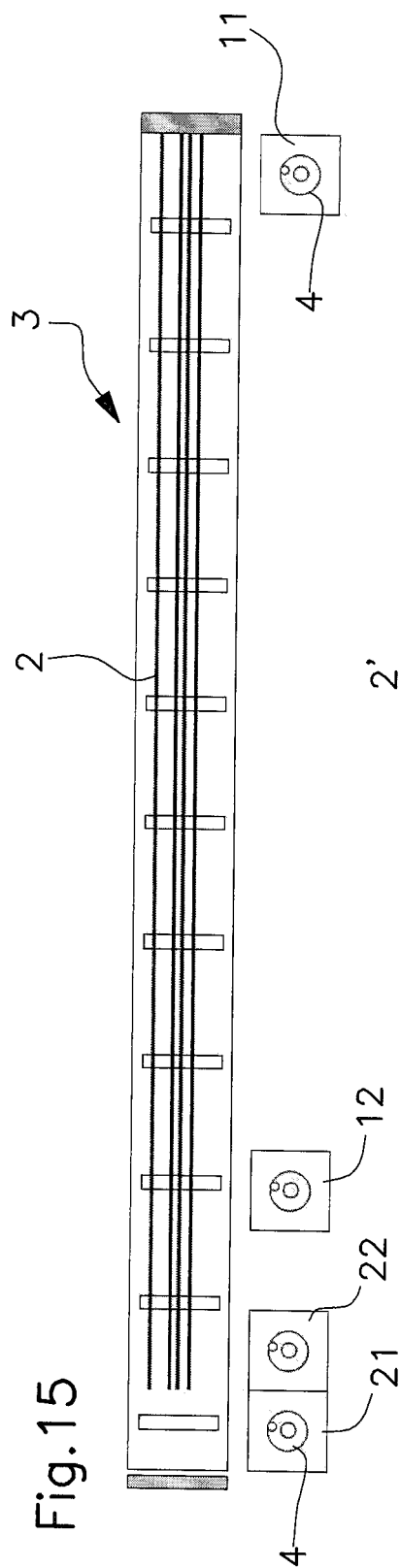


Fig. 15a

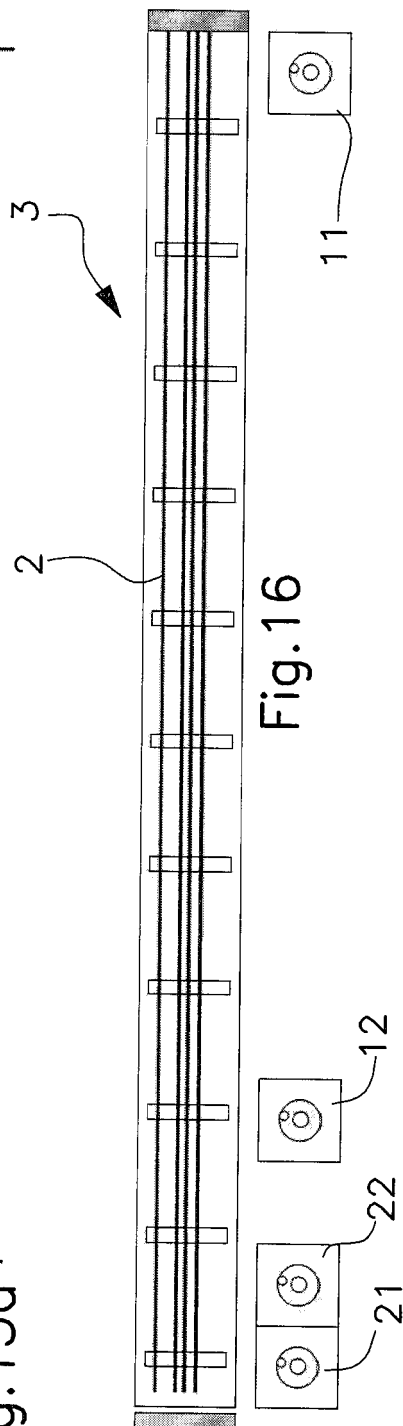


Fig. 16

Fig. 16a

REFERENCES CITED IN THE DESCRIPTION

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