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(54) Method and device for sorting products

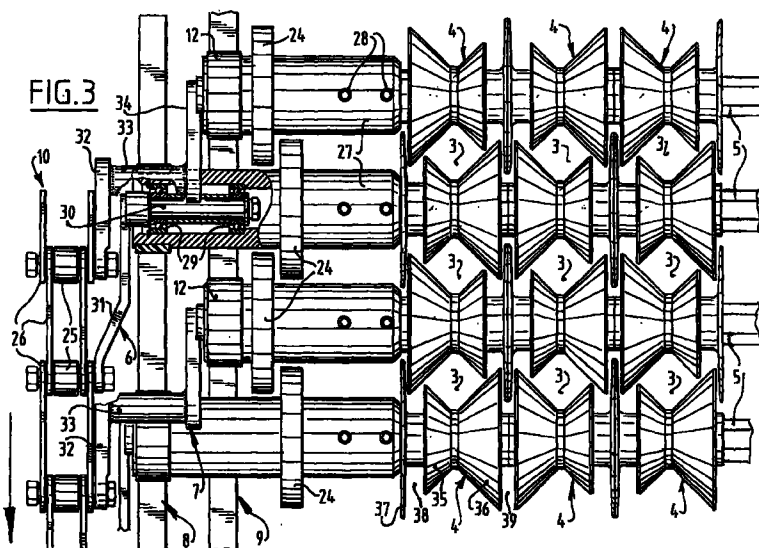
(57) The invention relates to a method for sorting agricultural products to size by transporting the products roughly horizontally and herein placing the products successively in register with successive sorting openings which co-displace with the products in the transporting direction and therein become larger. According to the invention the shape of the openings herein remains the same as the dimensions thereof increase.

The invention also relates to an apparatus for performing this method provided with means for transporting the products, which transporting means are adapted for uniformly supported transport of the products and

are provided with openings (3) of constant form, the dimensions of which increase in the transporting direction and which are movable in the transporting direction.

The transport means comprise transporting elements (4) which support the products and which are movable relative to each other in the transporting direction.

These transporting elements (4) can be rotatable and take the form of bodies of revolution and for instance take a diabolo form, wherein the successive diabolo-shaped transporting elements are at least partly mutually engaging.



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Description

[0001] The invention relates to a method for sorting a collection of products to size, in particular agricultural products, by transporting the products at an angle to the direction of fall and herein placing the products successively in register with successive sorting openings which co-displace with the products in the transporting direction and therein become larger. Such a method is known, for instance from DE-A-2 704 639 and is used in the sorting of potatoes into a large number of size classes.

[0002] The sorting of such products to size is important because the larger products are generally easier for end users to handle and therefore represent a higher value. In practice products such as potatoes are sorted at the moment by being carried over an unevenly moving conveyor which is provided with a large number of openings. The dimensions of these openings herein increase in the transporting direction so that in the first instance only the smaller products will fall through the openings and, as the products are transported further, increasingly larger products will drop through the openings in the conveyor. Different collecting containers are herein placed under the conveyor for the different formats of selected products.

[0003] This classic method has a number of drawbacks. The uneven, shaking transport of the products thus often results in damage thereto, while in addition products will often come to lie during this movement in too small an opening in which they then remain lodged. This results in the sorting apparatus used to perform this method becoming blocked and the openings having to be cleared by hand, which results in loss of time because the sorting apparatus often has to be stopped for this purpose. Furthermore, the products taken out of the openings will generally be damaged such that they are no longer suitable for further processing and thus only form waste.

[0004] In the stated document DE-A-2 704 639 an improved method for sorting products has therefore already been proposed wherein these drawbacks do not occur. According to this earlier proposal the products are continuously supported during transport by transport elements which are moved horizontally forward and which therein move gradually apart so that the openings therebetween become increasingly larger. Because the products are thus transported as it were on the edges of the openings, wherein the openings under the products slowly open up more and more until the products fall therethrough, a very uniform movement of the products takes place, wherein the risk of damage thereto is avoided as far as possible. Products will moreover not become lodged in the openings since these become increasingly larger so that eventually every product is automatically released and falls through the opening. The sorting operation need therefore never be interrupted in order to clear blocked openings, whereby the

handling speed is considerably increased.

[0005] The invention now has for its object to further improve a method of the above described type. This is achieved according to the invention in that the shape of the openings remains substantially the same as the dimensions thereof increase. In this manner the products can be sorted with very great precision.

[0006] Because products are generally sorted into determined size classes, it is recommended that the dimensions of the openings increase in stepwise manner. A clear distinction is thus obtained between different product classes.

[0007] The invention further relates to an apparatus for sorting a collection of products to size, in particular agricultural products, which apparatus is provided with means for transporting the products at an angle to the direction of fall, which transporting means are adapted for uniformly supported transport of products and are provided with openings which are movable in the transporting direction and the dimensions of which increase in the transporting direction. Such an apparatus is likewise known from DE-A-2 704 639. A sorting apparatus is described herein having two surfaces with rotatable rods which are each provided with rollers whereby slightly diabolo-shaped elements are created. The rods are suspended between transporting chains, wherein a part of the rods is fixedly connected to the chains and another part is suspended from the chains via brackets with a vertically running slot. These latter rods are supported by guide tracks which run downward in stepped manner relative to the guide tracks of the upper rods. The lower rods hereby drop increasingly further away between the upper rods whereby the intermediate space becomes increasingly larger and increasingly larger products are therefore selected.

[0008] The invention now has for its object to improve such a sorting apparatus such that the above described method can be performed therewith. This is achieved according to the invention in that the openings in the transport means have a substantially constant form.

[0009] The transport means advantageously comprise transporting elements which support the products and which are movable relative to each other in the transporting direction. By moving the transporting elements apart increasingly larger openings are thus formed therebetween, wherein the transporting elements function as edges of these openings.

[0010] The transporting elements are preferably rotatable and take the form of bodies of revolution. The products are hereby kept in motion during transport, whereby they are prevented from becoming lodged between the transporting elements. The transporting elements herein advantageously take a diabolo form, whereby regularly formed, in particular square openings are therefore defined between successive transporting elements. Such square sorting openings are generally prescribed by trade conventions and weights and measures legislation. The diabolo shape of the transporting

elements moreover ensures that the form of the openings is also retained when the transporting elements are moved apart.

[0011] In order to prevent the regular shape of the openings being lost when the transporting elements are moved apart, the successive diabolo-shaped transporting elements are preferably at least partly mutually engaging. The creation of gaps between these transporting elements is hereby prevented. A large mutual adjustability of the transporting elements is achieved herein when the diabolo-shaped transporting elements are embodied asymmetrically transversely of the transporting direction and each comprise a larger and a smaller part, and the successive diabolo-shaped transporting elements face in each case in opposing directions. The transporting elements can thus be moved very closely against each other to form a small sorting size, wherein the smaller part of the one diabolo then lies opposite the larger part of the other diabolo.

[0012] Each diabolo-shaped transporting element is otherwise preferably formed by a number of segments releasably connected to each other. In this manner the width of the transporting elements, and therewith the sorting size, can be varied simply by adding or removing segments.

[0013] In order to vary the intermediate space between the transporting elements, these latter are preferably connected to pivot arms driven in the transporting direction and are guided along at least one track, the distance of which from the track along which the pivot arms are driven varies in the transporting direction. Due to this variation in distance the pivot arms are set more steeply or less steeply as seen in the transporting direction, whereby the distance between the transporting elements therefore increases. The pivot arms are preferably embodied here as pulling arms and the successive transporting elements are carried alternately over different guide tracks, the mutual distance of which increases in the transporting direction. In this manner the transporting elements are therefore pulled forward by the pivot arms and in view of the loads acting thereon this is recommended rather than a push drive. The guide tracks can herein be located on either side of the drive path. In order to enable adjustment of the sorting size the position of at least a part of the guide track or tracks is preferably adjustable.

[0014] Finally, the invention also relates to a diabolo-shaped transporting element for use in a sorting apparatus as described above.

[0015] The invention will now be elucidated on the basis of an embodiment, wherein reference is made to the annexed drawing, in which:

figure 1 shows a partly cut-away side view of a sorting apparatus according to the invention;

figure 2 is a schematic perspective view of a part of the sorting apparatus along the arrow II in figure 1;

figure 3 shows a partly sectional top view of a part

of the apparatus along the arrow III in figure 1;

figure 4 is a schematically extended top view of the transporting elements of the sorting apparatus;

figure 5 shows in schematic top view the increase in the distance between two successive transporting elements;

figure 6 is a partly cut-away perspective view of the mechanism for adjusting the sorting size of the sorting apparatus;

figure 7 shows a second embodiment of the diabolo-shaped transporting elements;

figures 8A and 8B show views of the segments of the diabolo-shaped transporting elements in disassembled situation; and

figure 9 is a perspective view of a second embodiment of the sorting apparatus.

[0016] A sorting apparatus 1 (figure 1) comprises means 2 for transport at an angle to the direction of fall or the vertical of products (not shown here) which must be sorted to size. Transporting means 2, which are adapted for uniformly supported transport of the products, have openings 3 which are movable in transporting direction T and the dimensions of which moreover increase in transporting direction T. The openings are herein formed between transporting elements 4 by which the products are supported during transport. These transporting elements 4 are movable relative to each other as seen in transporting direction T whereby the dimensions of the openings 3 formed therebetween can be varied. Transporting elements 4 are further rotatable and take the form of a body of revolution, in the shown example a diabolo shape. Owing to this shape two successive transporting elements 4 define in each case a regularly formed opening 3 which in the shown example is practically square.

[0017] In order to vary the mutual distance between successive transporting elements 4 the shafts 5 of transporting elements 4 are connected to the outer ends of pivot arms 6 respectively 7, the other ends of which are connected to a drive chain 10. Shafts 5 of transporting elements 4 are herein further provided with guide elements, in the shown embodiment guide rollers 11 respectively 12, with which they are carried along an associated guide track 8 respectively 9. The distance between these guide tracks 8, 9 and the path described by drive chain 10 increases as seen in the transporting direction since one of the guide tracks 8 is displaced stepwise upward and the other guide track 9 is displaced stepwise downward. The upper pivot arms 6 hereby pivot increasingly further upward, while lower pivot arms 7 are pivoted increasingly further downward. The space between the successive transporting elements 4, i.e. the centre-to-centre distance d between the rotation shafts 5 thereof, therefore becomes increasingly larger as seen in the transporting direction T, so that increasingly larger sorting openings 3 are thus formed. This is shown clearly in figure 4 which in fact

shows a plan view of the spaces actually running in a zigzag between successive rows of transporting elements 4.

[0018] As stated, the drive of pivot arms 6, 7 and thereby of shafts 5 with the rows of transporting elements 4 arranged thereon takes place by means of a chain 10. This chain is trained over two chain wheels (not shown here) which are mounted for rotation round respective shafts 71 and 72 in frame 17 of sorting apparatus 1. The chain wheel mounted on shaft 71 is herein driven via a drive chain 15 by a motor 16 fixed onto frame 17.

[0019] Mounted coaxially with the chain wheels on shafts 71, 72 are reversing rollers 13, 14 over which the guide rollers of shafts 5 with the transporting elements 4 are guided at the transition from the transport part to the return part of the apparatus and vice versa. In the return part of the apparatus two separate guide tracks 23 are herein provided along which guide rollers 24 of shafts 5 can run. Guide rollers 11 and 12 are herein held clear of this return track 23, whereby they wear less. Because return rollers 24 moreover have a considerably larger diameter than the rollers 11, 12 operating in the transport part, shafts 5 with transporting elements 4 thereon will rotate less rapidly in the return part than in the transport part, which increases the lifespan of the associated bearings. The return rollers of relatively large diameter moreover function as guard, whereby dirt and dust from the products for sorting is prevented from reaching the various rotating and moving components of the apparatus.

[0020] Each shaft 5 supports a row of diablo-shaped transporting elements 4. These transporting elements 4 are mounted non-rotatably on shaft 5, for instance in that shaft 5 and the associated central opening in transporting elements 4 have a non-round, in the shown embodiment hexagonal, cross-section (figure 3). Shaft 5 is received at both its ends in a sleeve 27 and fixed therein by means of fixing elements, in this case socket screws. Sleeve 27 is provided on its side remote from transporting elements 4 with two bearings 29 arranged therein whereby sleeve 27 and therewith shaft 5 and transporting elements 4 are mounted rotatably on a shaft stub 30 which is fixed to the end of one of the pivot arms 6, 7. The other end of pivot arms 6, 7 is connected to drive chain 10. Pivot arms 6, 7 are herein pivotable in each case round a shaft 25 by which two adjoining links 26 of the drive chain are connected. The form of pivot arms 6, 7 is chosen such that the successive shafts 5 with transporting elements 4 do not make mutual contact when the associated guide tracks 8, 9 move apart. For this purpose the upper pivot arms 6 are provided with a part 31 directed at an angle to transporting elements 4, while the lower pivot arms 7 are embodied in the form of a crank. These lower arms 7 have a part 32 adjacent to chains 10 and directed obliquely upward, a transverse connecting part 33 which spans the upper guide track 8 and a part 34 directed obliquely downward

which connects transverse part 33 to shaft stub 30. Due to this configuration each pivot arm 6, 7 is in all circumstances held clear of the other pivot arm and the shaft with transporting elements connected thereto.

[0021] As stated, regularly formed, in particular square openings 3 are defined by the choice of diablo-shaped transporting elements 4. In order to ensure a wide adjustment range and herein still retain the main form of openings 3, the diabolos 3 are embodied asymmetrically. Each diablo has a relatively small, frusto-conical part 35 and a similarly shaped larger part 36. Further arranged herein at some distance from the smaller part 35 is an end disc 37 which together with the smaller part 35 bounds a peripheral groove 38. The diabolos 4 on successive shafts 5 face in each case in opposing directions so that the small part 35 of the one diablo lies opposite the larger part 36 of the following diablo. The larger part 36 of the one diablo 4 hereby engages as it were in the groove 38 of the other diablo 4. Shafts 5 can thus be moved very closely towards each other without the diablo-shaped transporting elements 4 making mutual contact, wherein, as stated, a square opening 3 is defined between the diabolos (figure 5). This square shape is herein retained even when shafts 5 with diabolos 4 thereon are moved further apart, as shown by the dashed lines in figure 5B.

[0022] The adjustment range of diabolos 4 can be increased still further by embodying these in the form of a number of separate segments 35, 36, 37 and 76 (figure 8A) which are pushed onto shaft 5 adjacently of each other. In the shown embodiment an end disc 37 respectively 76 is thus arranged herein on either side of diablo 4 whereby a groove 38 respectively 77 is therefore also defined on either side. Diablo 4 can now be enlarged in simple manner by placing a filler ring 78 between the two frusto-conical segments 35, 36 (figure 8B). In this manner larger products can thus be sorted by also choosing a larger distance between successive shafts 5.

[0023] Another possibility enabling sorting of large products, and particularly obtaining a large sorting range, is to place two sorting apparatuses in series 1L and 1S (figure 9). Sorting apparatus 1L for large products herein has a first sorting stage 79 where the small products which must be further sorted to size in the second sorting apparatus 1S are separated from the larger products.

[0024] These small products herein drop onto a short belt conveyor 80 co-displacing with transporting elements 4 and then fall via a slide track 81 onto a lower-lying belt conveyor 82 extending under the first sorting apparatus 1L. This belt conveyor 82 carries the small products to a booster conveyor 83, whereby they are transferred via a slide track 84 to the beginning of the second sorting apparatus 1S. Here the products are then sorted to (stepwise increasing) size in successive sorting stages 85, 86 and 87 and subsequently discharged via associated cross conveyors 88, 89 and 90.

[0025] The larger products which have passed through the pre-sorting stage 79 are carried in the first sorting apparatus 1L successively along two further sorting stages 91 and 92 and sorted to size therein, whereafter they are discharged by cross conveyors 93 and 94.

[0026] With a suitable choice of the distance between shafts 5 and of the dimensions of diabolos 4 both sorting apparatuses 1L and 1S can be adapted precisely to the dimensions of the products for sorting.

[0027] In order enable moving apart of guide tracks 8, 9 and thereby the successive rows of transporting elements 4, the guide tracks 8, 9 are formed by a number of segments 8A-8D and 9A-9D mutually connected by means of hinges 69, 70. These segments can be displaced in vertical direction by means of an adjusting mechanism 75 (figure 6), of which the apparatus comprises three in the shown embodiment. Each adjusting mechanism 75 is operated by means of a handwheel 40 which is connected to a shaft 45 mounted rotatably in an opening in a cover strip 47 of frame 17 and a bearing bush 48 received in a cross beam 49 of the frame. Shaft 45 is provided with a threaded part 46, the purpose of which is explained below. Arranged on the underside of the shaft is a chain wheel 50 over which a chain 51 is guided. This chain 51 is guided successively over chain wheels 52, 53R, 54R, 55R 56L, 55L, 54L, 53L and 57 and subsequently led back again to the chain wheel 50 operated by handwheel 40. Chain wheels 52, 55, 56 and 57 herein function solely as guide wheels, while chain wheels 53 and 54 are respectively connected to screw spindles 58 and 59 for adjusting guide tracks 9 and 8. Each screw spindle 58, 59 is herein mounted for rotation in a longitudinal beam 60, 61 of frame 17 and has a threaded part 62 respectively 63. Threaded parts 62, 63 are each received in a threaded bush 64, 65, which bushes 64, 65 are each connected to one of the guide tracks 9, 8.

[0028] When handwheel 40 is now turned in the direction indicated by arrow R1, chain wheel 50 rotates in the direction of arrow R2, whereby chain 51 is displaced and herein drives chain wheels 53R, 54R rotatingly in the respective directions RD and RU. The rotation of chain wheel 53R in direction RD results in threaded part 62 being rotated further into threaded bush 64R. Because spindle 58 is fixed in vertical direction, this results in threaded bush 64R being moved downward in the direction of arrow D, carrying with it the segment 9A of guide track 9 connected thereto. The rotation of chain wheel 54R in the direction RU simultaneously results in threaded part 63 being moved downward in bush 65, which results in bush 65 moving upward as according to arrow U, carrying with it the segment 8A of guide track 8. Segments 8A, 9A of guide tracks 8, 9 are thus moved apart from their rest position in which they lie level, whereby the openings 3 between the successive rows of transporting elements 4 become larger.

[0029] The operation of the apparatus is now as fol-

lows: A collection of products for sorting, for instance potatoes, is tipped onto the conveyor belt 2 of apparatus 1 on the infeed side, in the shown embodiment on the left-hand side of figure 1 or figure 4. Apparatus 1 is herein driven by motor 16, whereby the products are transported in the direction of arrow T. As a result of the rotation movement of the diablo-shaped transporting elements the products are herein turned such that each two successive transporting elements 4 eventually support a single product. In principle this product remains lying between two transporting elements 4 until the opening 3 therebetween becomes so large that the product drops therethrough. The product is therefore fully supported up to the moment that it is selected. The risk of damage to the product is hereby very small. Because transporting elements 4 continue to move increasingly further apart as seen in the transporting direction T, it will moreover never be possible for the product to become lodged between these transporting elements. No blockage of the sorting apparatus therefore occurs, so that it will not have to be stopped for the interim.

[0030] When, depending on its dimensions, the product finally drops through opening 3 in stage 18, 19 or 20, it is guided by inclining walls 22 onto a cross conveyor 41, 42 or 43, by which the thus sorted products are discharged to respective collecting containers or crates. Products which have still not been selected after passing over sorting stage 20 are designated "oversized" and will generally fall in the last stage 21 through the openings which at that moment are very large and be discharged by a cross conveyor 44. Should some products then still not have fallen through the opening, they will roll off the transporting elements 4 at the end of the track when they reach reversing roller 12 and come to lie at the end of the machine. Because transporting elements 4 are driven in constant rotation, there is no danger in this case either of the products becoming lodged between two successive transporting elements 4.

[0031] The desired size of the sorted products can easily be adjusted per stage by rotating the associated hand-wheel 40. A nut 66 arranged on the threaded part 46 of shaft 45 and provided with a protruding finger 67 arranged in a slot 68 will then herein be moved up and downward along threaded part 46, this movement forming a measure for the adjusted sorting size. A calibration can be arranged for this purpose along the edge of slot 68, wherein finger 67 functions as indicating instrument. The settings could of course also be performed automatically using electronically controlled adjusting motors.

[0032] Although the invention is elucidated above with reference to an embodiment, it will be apparent to the skilled person that it is not limited thereto and can be modified in many ways. Only one of the guide tracks 8, 9 would thus need to be height-adjustable to achieve the desired enlargement of the openings 3 between transporting elements 4. Other methods can also be

envisaged to increase the distance between successive transporting elements 4. The shafts 5 with transporting elements 4 could for instance be transferred from a first relatively slow-running drive chain to a second quicker running drive chain, whereby the space between successive shafts with transporting elements would likewise increase. By placing one after the other a number of drive chains moving at increasing speed a number of successive sorting stages could thus be formed with increasing openings between the transporting elements. The scope of the invention is therefore determined solely by the appended claims.

Claims

1. Method for sorting a collection of products to size, in particular agricultural products, by transporting the products at an angle to the direction of fall and herein placing the products successively in register with successive sorting openings which co-displace with the products in the transporting direction and therein become larger, **characterized in that** the shape of the openings remains substantially the same as the dimensions thereof increase.
2. Method as claimed in claim 1, **characterized in that** the dimensions of the openings increase in stepwise manner.
3. Method as claimed in either of the foregoing claims, **characterized in that** the openings are formed between transporting elements which support the products and which move relative to each other during transport.
4. Apparatus for sorting a collection of products to size, in particular agricultural products, provided with means for transporting the products at an angle to the direction of fall, which transporting means are adapted for uniformly supported transport of the products and are provided with openings which are movable in the transporting direction and the dimensions of which increase in the transporting direction, **characterized in that** the openings in the transport means have a substantially constant form.
5. Sorting apparatus as claimed in claim 4, **characterized in that** the transport means comprise transporting elements which support the products and which are movable relative to each other in the transporting direction.
6. Sorting apparatus as claimed in claim 5, **characterized in that** the transporting elements are rotatable and take the form of bodies of revolution.
7. Sorting apparatus as claimed in claim 6, **characterized in that** the transporting elements take a diabolo form.
8. Sorting apparatus as claimed in claim 7, **characterized in that** successive diabolo-shaped transporting elements are at least partly mutually engaging.
9. Sorting apparatus as claimed in claim 8, **characterized in that** the diabolo-shaped transporting elements are embodied asymmetrically transversely of the transporting direction and each comprise a larger and a smaller part, and the successive diabolo-shaped transporting elements face in each case in opposing directions.
10. Sorting apparatus as claimed in any of the claims 7-9, **characterized in that** each diabolo-shaped transporting element is formed by a number of segments releasably connected to each other.
11. Sorting apparatus as claimed in any of the claims 5-10, **characterized in that** the transporting elements are connected to pivot arms driven in the transporting direction and are guided along at least one track, the distance of which relative to the track along which the pivot arms are driven varies in the transporting direction.
12. Sorting apparatus as claimed in claim 11, **characterized in that** the pivot arms are pulling arms and successive transporting elements are carried alternately over different guide tracks.
13. Sorting apparatus as claimed in claim 12, **characterized in that** the guide tracks are located on either side of the drive path.
14. Sorting apparatus as claimed in any of the claims 11-13, **characterized in that** the position of at least a part of the guide track or tracks is adjustable.
15. Diabolo-shaped transporting element evidently intended for use in a sorting apparatus as claimed in any of the claims 7-14.

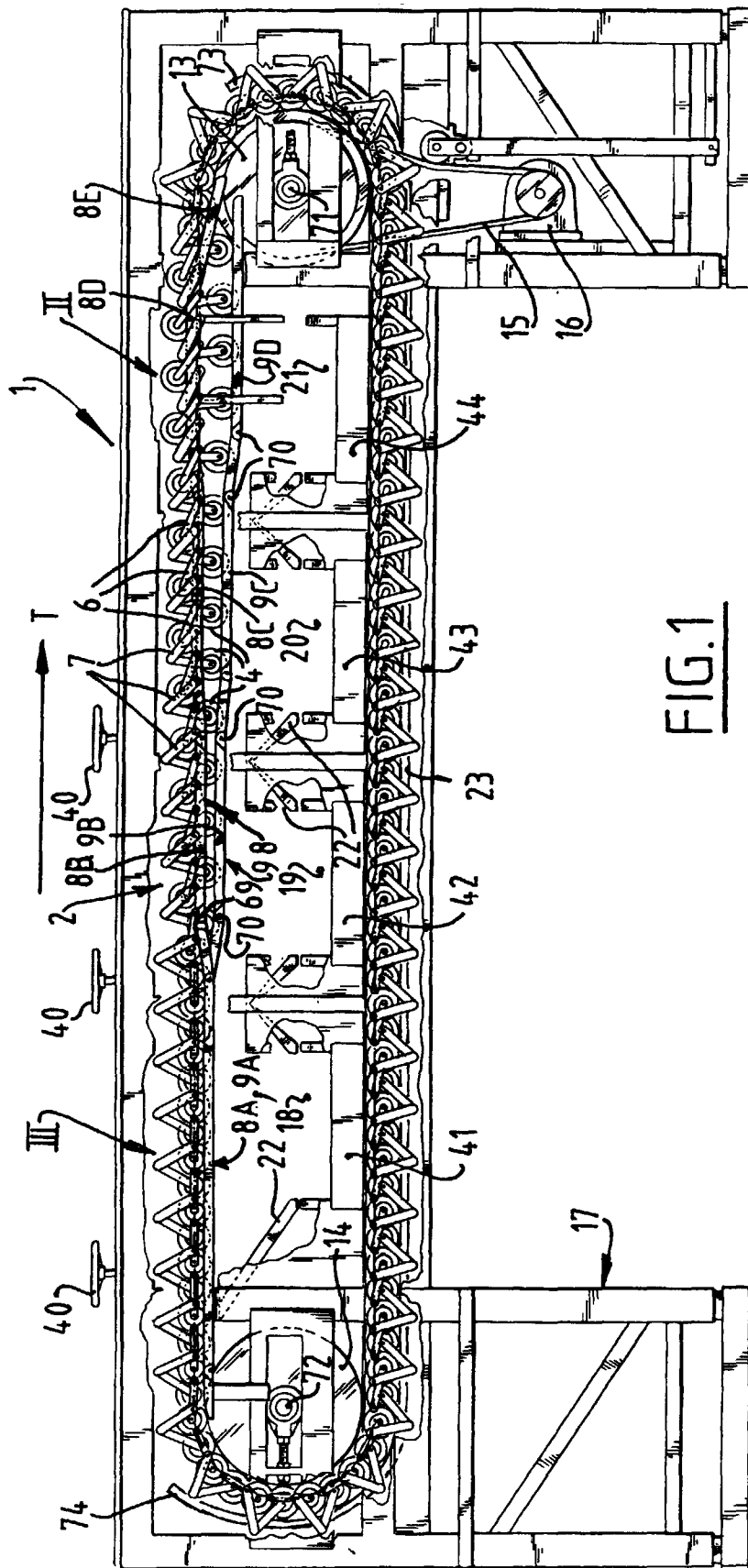
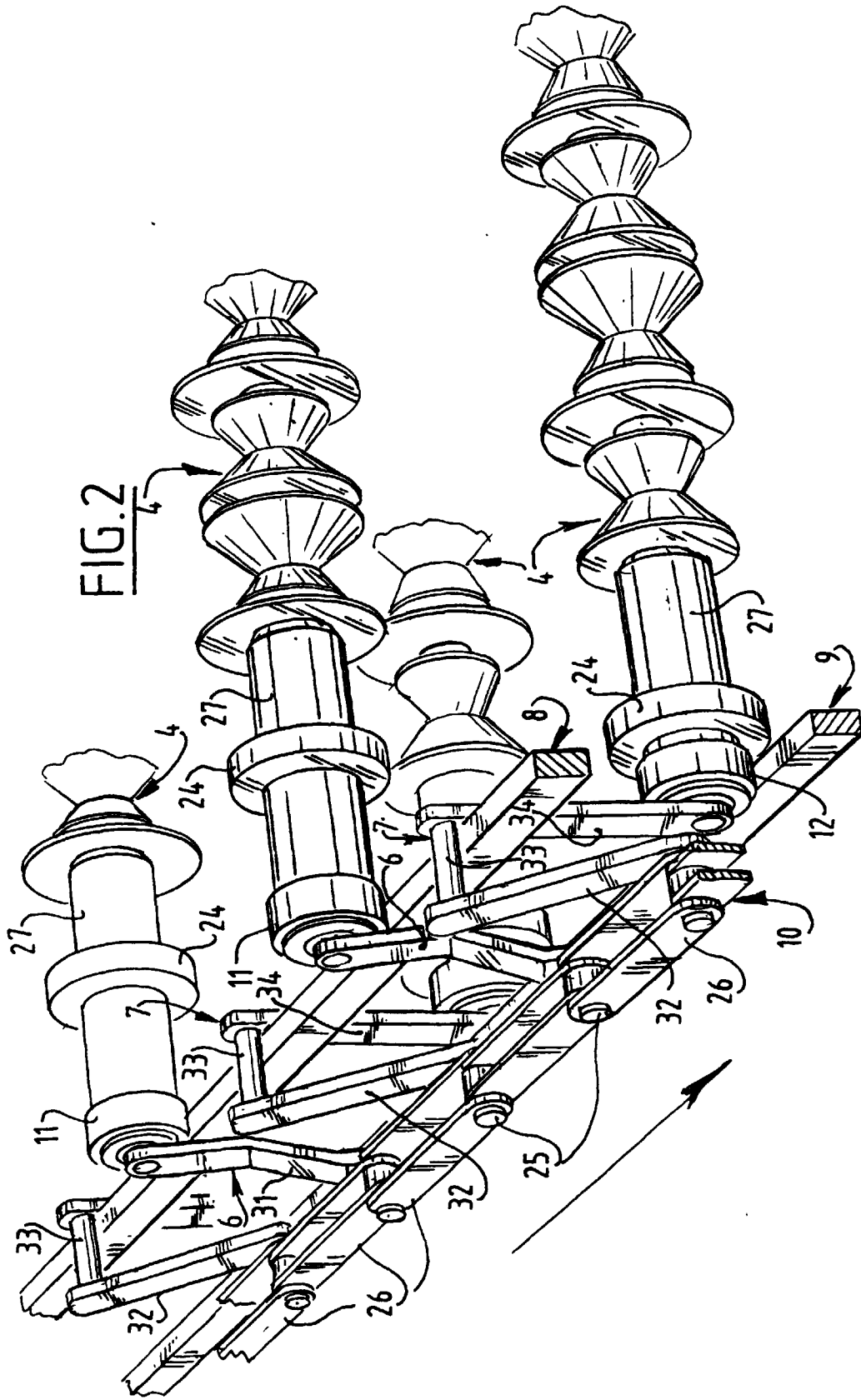


FIG. 1



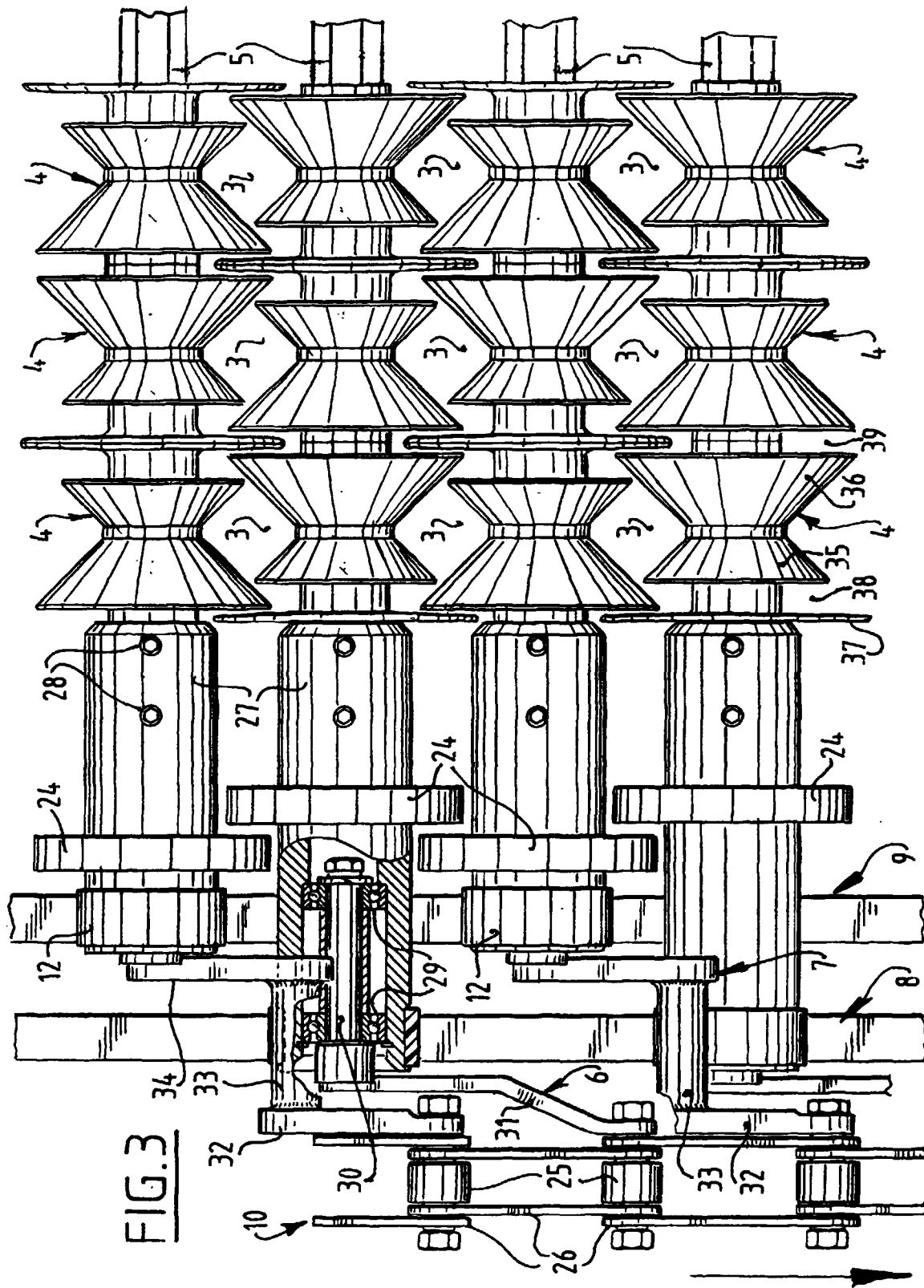
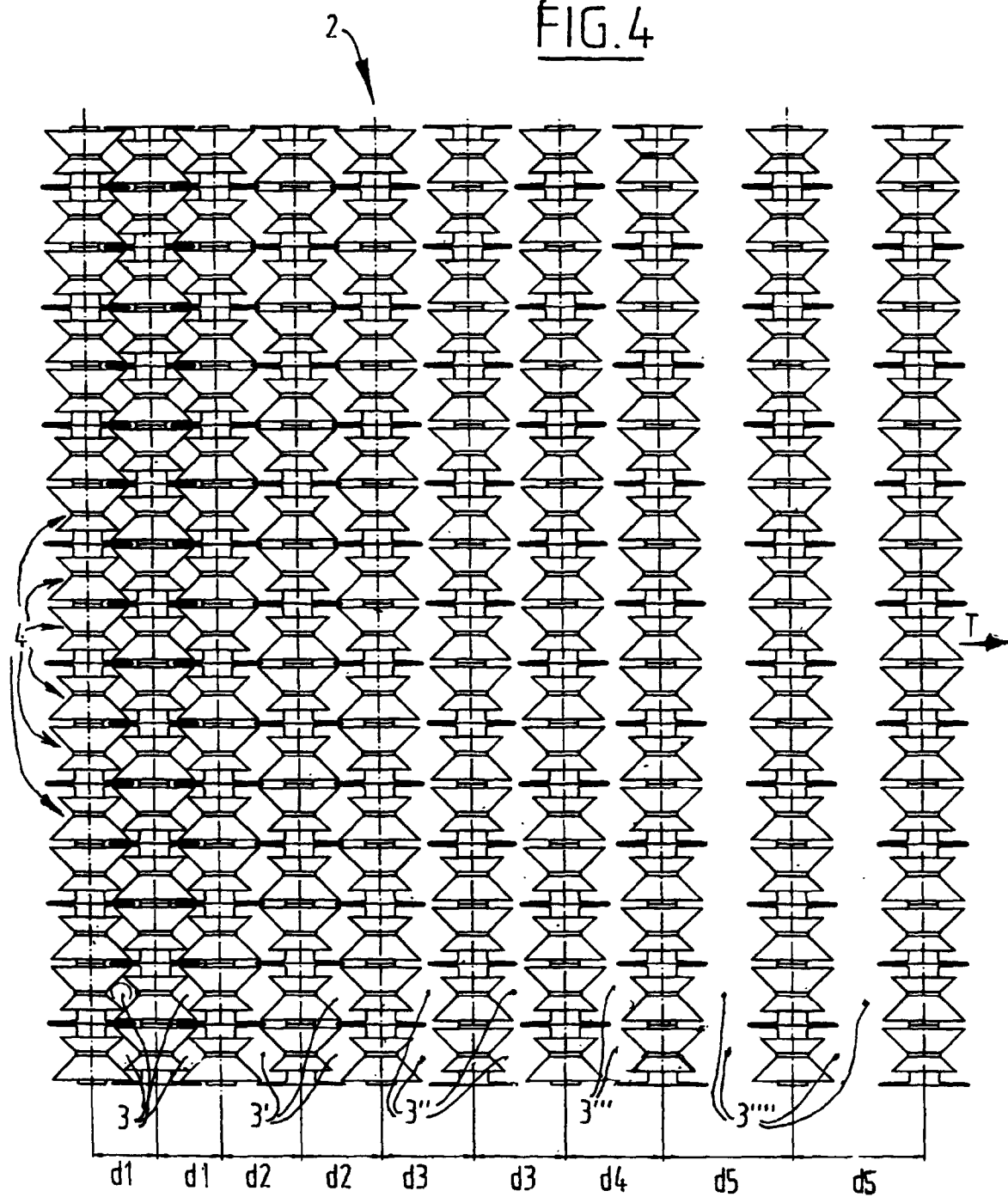


FIG. 4



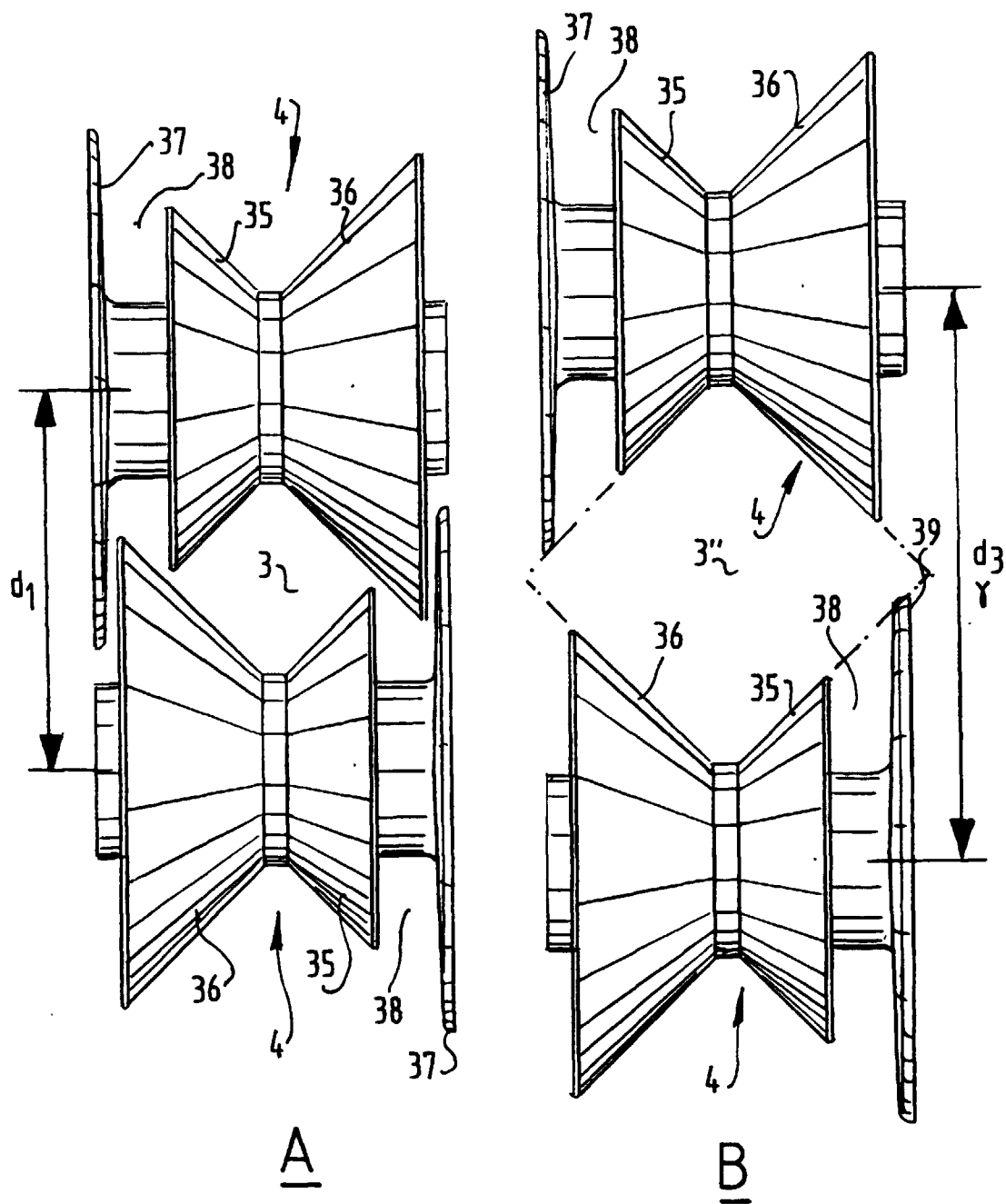
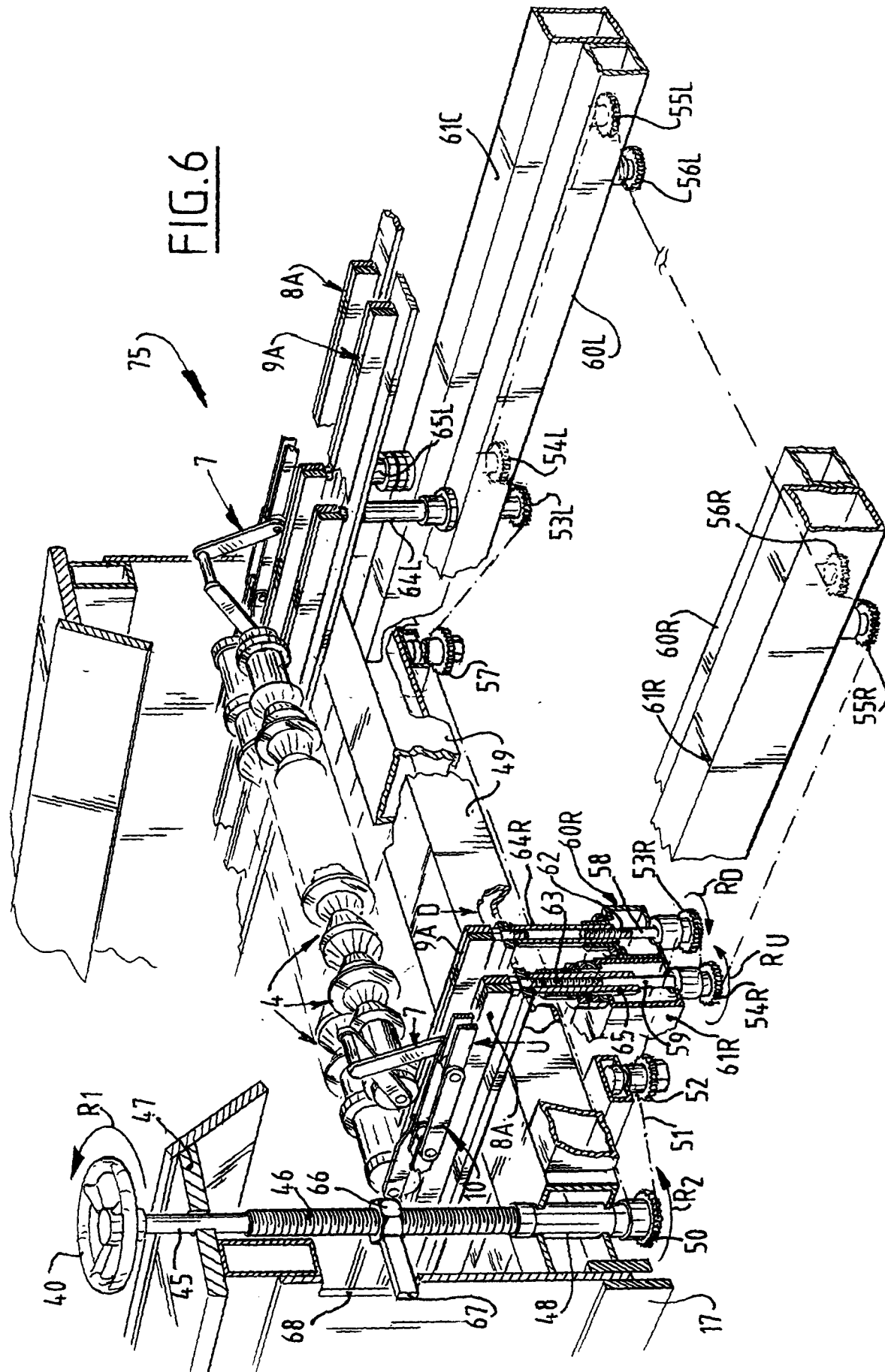


FIG. 5



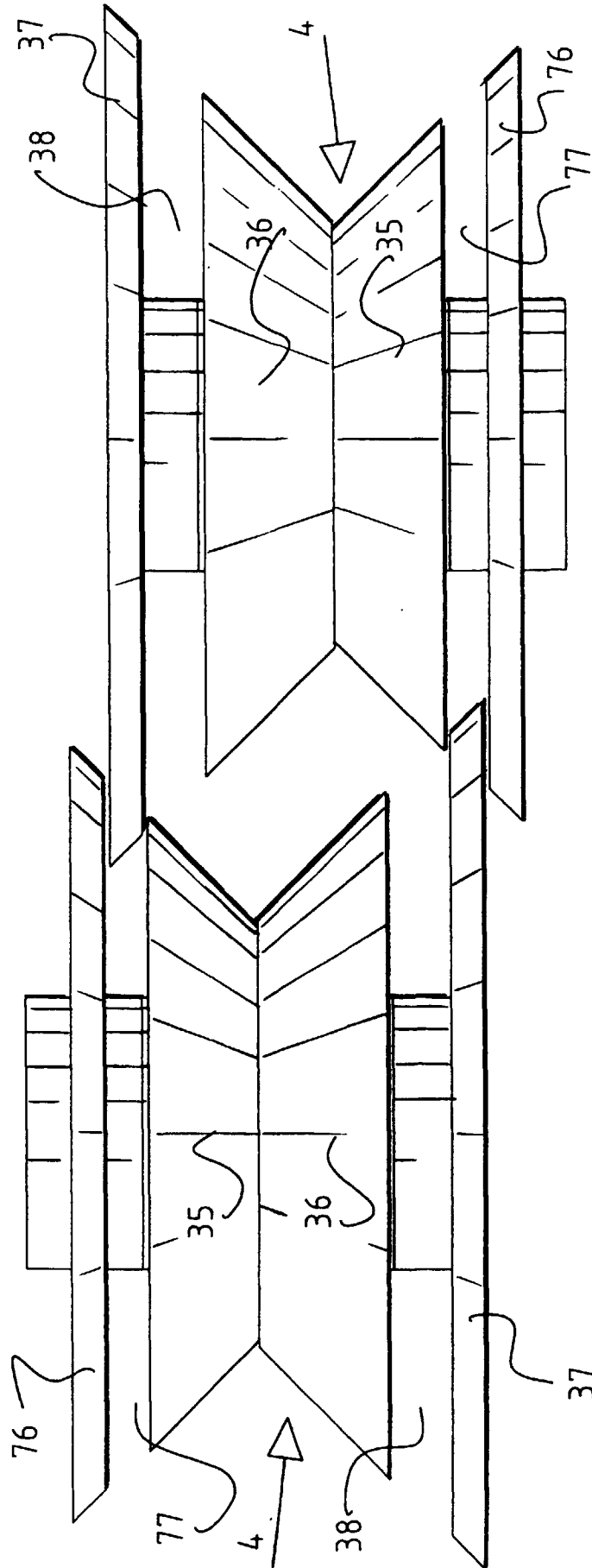
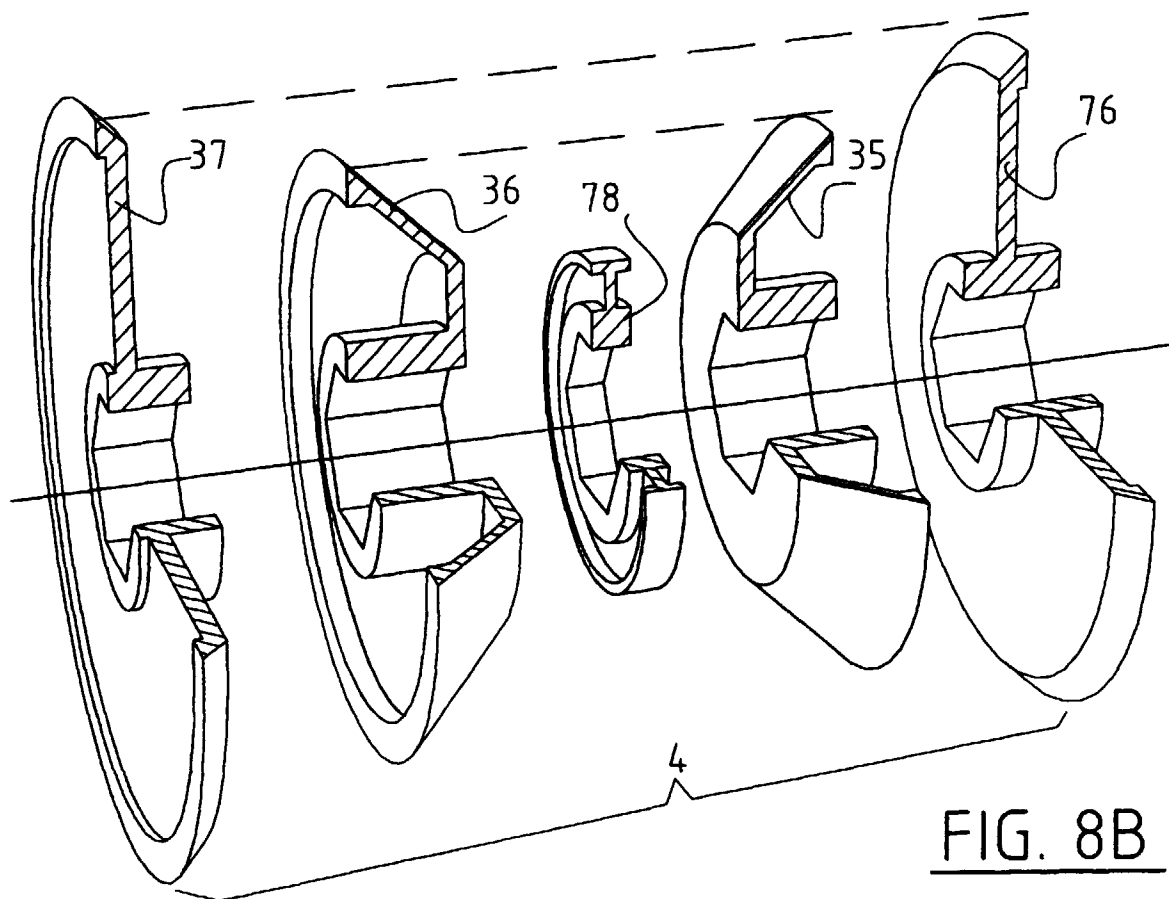
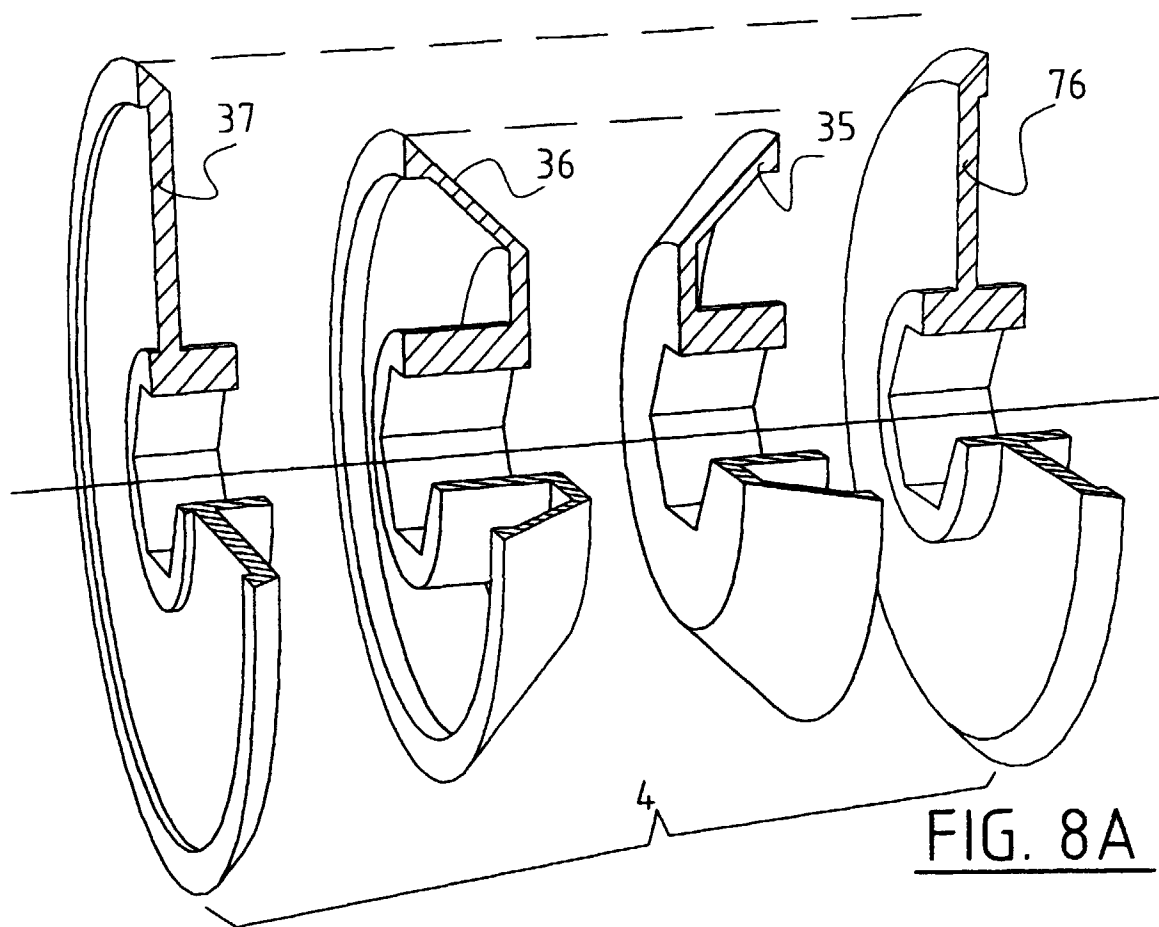


FIG. 7



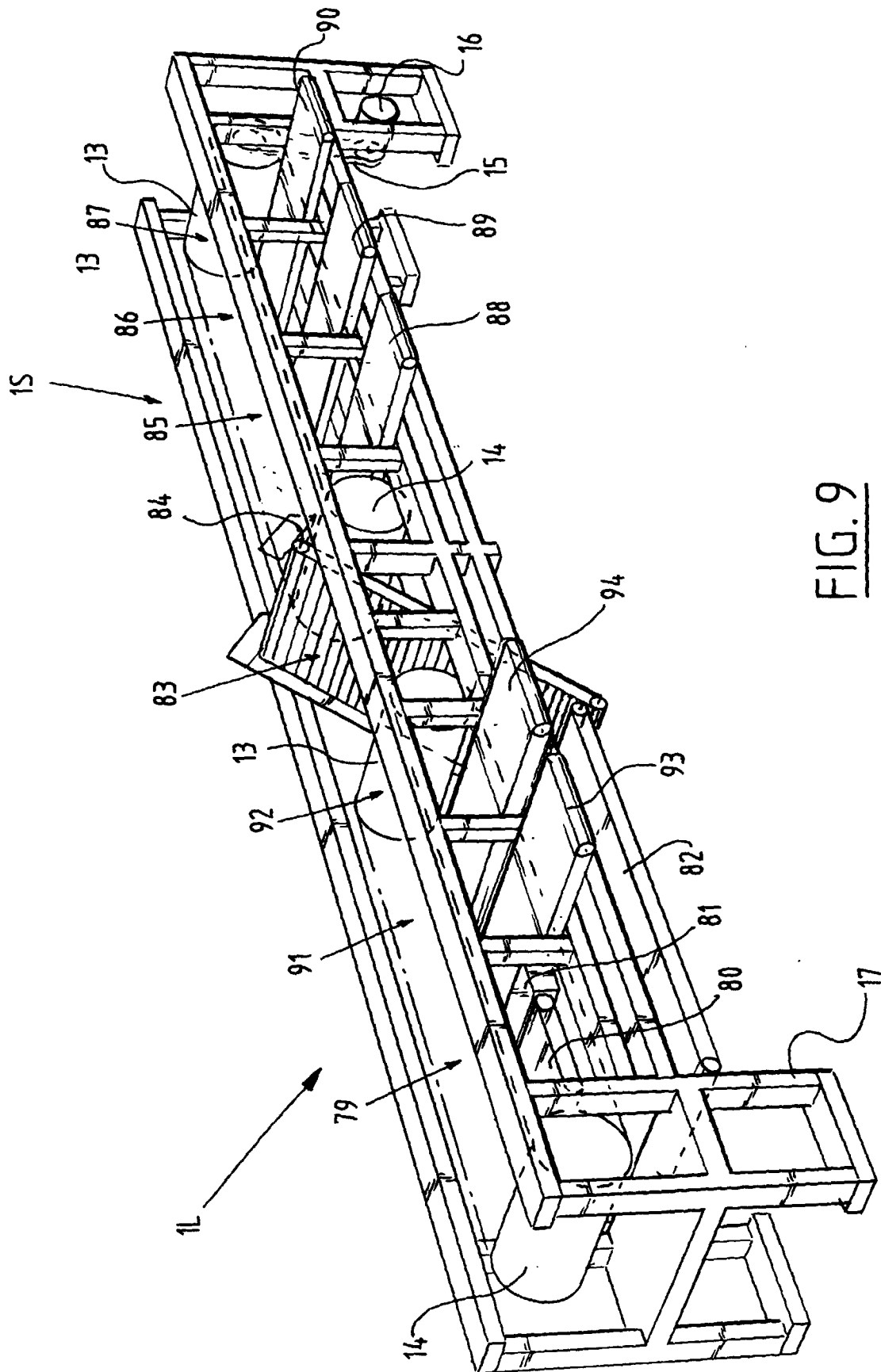


FIG. 9



European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 98 20 3073

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
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			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
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The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
THE HAGUE		26 July 1999	Laval, J
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	
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EPO FORM 1503 03 82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 98 20 3073

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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