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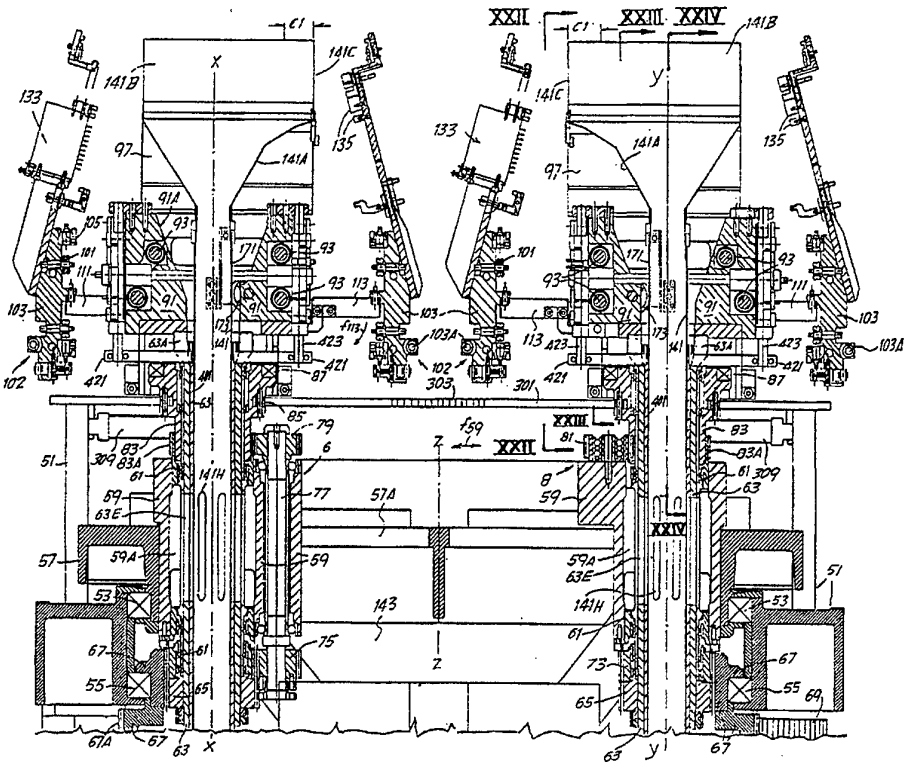
(54) Title: KNITTING MACHINE FOR THE PRODUCTION OF TIGHTS (PANTIHOSE) AND THE LIKE

(57) Abstract

A central moving element with a platform (57) is capable of rotating about Z-Z; on it, two epicycloidal moving elements (6-8) are mounted symmetrically and slidably and rotatably about X-X and Y-Y, each having a double needle plate (97); the two double needle plates (97) may be abutted against and aligned with each other to form an extended double needle plate for knitting the body; in each of the two double needle plates (97) during the formation of the legs, certain needles (C1) at the ends designed to be abutted against each other in the joining of the two double needle plates (97) are excluded from operation; the said needles are brought into operation at the time of the joining and formation of the extended double needle plate, so as to start the operation with the fabrics joined and to continue it and form the body with all the needles; chains (102) with links (103) carrying knitting elements are carried by rectilinear guides; curved guides (111) at the outer ends remain fixed, while curved guides (113) at the ends of the two double needle plates (97) designed to be abutted against each other are lowered at the time of the joining of the double needle plates.



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Description

Knitting machine for the production of tights (pantihose) and the like

Technical field

The present invention refers to a knitting machine, and more particularly to a knitting machine for the production of tights, pantihoses and similar articles of manufacture. In the production of tights, the usual technique provides for the separate production of two equal leg portions which are subsequently cut and sewn together to form a complete tight. This process requires time and the result is a tight with a seam running across the body of the finished article. Attempts have been made to solve this problem by means of machines able to produce the complete finished article, i.e. avoiding the subsequent sewing of the two leg portions together.

Background art

The invention relates to a machine improved with respect to that described in Italian Patent application No. FI 91 A 26 filed 31.01.91) and in the corresponding foreign patent applications, including European Patent Application No. 92830027.6 filed 24.01.1992 (publication n. 0552588; U.S. Patent No. 5.226.297 filed 28.01.1992; Canadian Patent application No. 2.060.343-7 filed 30.01.1992; People's Republic of China Patent application No. 92100666.7 filed 30.01.1992; Japanese Patent application No. 9.457/92 filed 22.01.1992; USSR Patent application No. 5010968.12 filed 30.01.1992 and others.

The knitting machine described in the said preceding patents, for the production of tights (pantihose) and the like, comprises: a central moving element capable of rotating about its central axis; two epicycloidal moving elements mounted symmetrically on the said central moving element and rotating about their own shafts which are out of alignment with the central axis; on each of the said epicycloidal moving

elements, a rectilinear double needle plate; along each needle plate, rectilinear guide means for chain sections comprising travelling links with textile components - including cams, selectors and thread guides - capable of interacting with needles and under-needles of the corresponding rectilinear double needle plate; means of causing the rotation of the said two epicycloidal moving elements for the knitting of each of the two legs on the corresponding double needle plate while the central moving element is stationary; curved guide means to supplement in an annular way the rectilinear guide means for the said travelling links around the rectilinear double needle plates of each epicycloidal moving element; means of causing the rotation of the said central moving element for the knitting of the body with the rotation of the whole central moving element, the two rectilinear double needle plates being aligned with each other; an intermediate segment of double needle plates which is combined with the aligned double needle plates, to create an extended double needle plate for the knitting of the body; and means for retaining the chain sections with travelling links in a position generally fixed with respect to the rotating epicycloidal moving elements and with respect to the rotating central moving element.

Disclosure of the Invention

The object of the invention is to simplify the preceding machine, to make it more efficient as a textile machine and to improve it, as will be clearly understood from the following text, particularly by eliminating the intermediate segment of double needle plates.

The machine according to the invention can also produce individual articles in the form of socks or stockings (in addition to tights) and in fact the simplified machine may be dedicated to the production of these articles only.

Essentially, in the machine according to the invention:

- the said two epicycloidal moving elements are carried by supports which are longitudinally slidable on the said central moving element - comprising a platform - to carry the two double needle plates, butted against each other and aligned with each other, to form an extended double needle plate for knitting the body, while the said rectilinear guides for the travelling links carried by the said slides on the epicycloidal moving elements are designed to fit together and provide the guide for the chain sections along the said extended double needle plate;
- selection means are provided to exclude from the operation, in each of the two double needle plates of the epicycloidal moving elements, during the formation of the legs, certain needles at the ends designed to be butted against each other in the joining of the two double needle plates; the said needles are brought into operation at the time of joining and formation of the extended double needle plate, so as to start the operation with the fabrics joined, and to continue it and form the body with all the needles; and
- the said curved guide means at the said ends of the two double needle plates designed to be butted against other can be withdrawn and excluded at the time of the joining of the said two double needle plates.

The double needle plates are advantageously mounted slidably on guide means orthogonal to them; in this way a limited temporary separation of the needle plates may be obtained, particularly at the end of the production of the body along the double hem at the waistline, to facilitate the removal of the finished

article when it is released from the needles. In this case, the said curved guide means are flexible, to follow the needle plates during their temporary separation. In this version, it is advantageous to make the chain sections comprising links which are hinged together in very long vertical axes without play and which are consequently vertically rigid, and the said links form carriages with wheels with horizontal axes and grooves interacting with the said rectilinear guide means and with the said curved guide means.

Further characteristics of the invention are specified in the secondary claims.

Brief description of the drawings

The invention will be more clearly understood from the description and the attached drawing which shows a non-restrictive practical example of the invention. In the drawing:

Figs. 1, 2 and 3 are schematic views of various phases of the production of an article in the form of tights (pantihose);

Figs. 4, 5 and 6 are highly diagrammatic perspective views of the previously mentioned stages and portions of the machine in the said stages of production;

Figs. 7 and 8, 9 and 10, and 11 are highly diagrammatic plan views of the principal components of the machine at various stages of an operating cycle;

Figs. 12, 12A, 13, and 14 are schematic sections - that in Fig. 12 being more complete and Figs. 12A, 13, and 14 being enlarged and partial - of two configurations of the operating areas with needle plates and needles for the formation of the seams, the configuration for tubular knitting and the configuration for the release of the finished article;

Figs. 15 and 16 are functional diagrams for identification of the various sections of the needle plates with needles in operation at the various stages of a cycle for forming an article;

Figs. 17 and 18 are diagrammatic perspective views of components of the machine at two stages of production, for the formation of the legs and of the body respectively;

Figs. 19, 19A and 19B show a vertical section in a plane orthogonal to the plane of symmetry of the double needle plates and two partial enlargements of Fig. 19;

Figs. 20, 20A and 20B show a vertical section in a plane of symmetry of the double needle plates aligned and separated for the formation of the legs, and two partial enlargements of Fig. 20;

Figs. 21, 21A and 21B are similar to Figs. 20, 20A and 20B, but with the needle plates butted against each other in the configuration for the formation of the body;

Figs. 22, 23 and 24 are a further partial enlargement of Fig. 19 as an enlarged section approximately through XXII-XXII in Fig. 20A, and sections, similarly enlarged, approximately through XXIII-XXIII and XXIV-XXIV in Fig. 20A;

Figs. 25 and 26 are further partial enlargements of Figs. 20 and 21;

Fig. 27 shows a local vertical section approximately through XXVII-XXVII in Fig. 21B;

Fig. 28 shows, in a diagrammatic view and vertical section and separately, components designed to separate the needle plates and bring them back together;

Figs. 29 and 30 show horizontal sections at an intermediate level of two of the needle plates for the formation of a leg, and of the extended needle plate;

Figs. 31, 32 and 33A, 33B show schematic plan views at the level of the inlet components of a pneumatic tensioning system in the configurations of the double needle plates in which they are approaching and butted against each other to form double needle plates for the working of the body, and two partial

enlargements of Figs. 31 and 32;

Fig. 34 shows an enlarged local horizontal section approximately through XXXIII-XXXIII in Fig. 19B;

Figs. 35, 36 and 37 show a partial horizontal section approximately through XXXV-XXXV in Fig. 19, with the components in these illustrated in the two configurations for the working of the legs and body respectively, and an enlarged detail of Fig. 36;

Fig. 38 shows separately, in vertical section, some of the components shown in Figs. 35 and 36;

Figs. 39, 39A and 40 show a partial vertical section which illustrates the principal driving components, an enlarged detail of Fig. 39, and a section through XL-XL in Fig. 39A;

Fig. 41 shows a vertical section of a detail of the components for removing a curved section of chain track;

Figs. 42, 43, 43A and 43B show a horizontal section at various levels of a section of chain with travelling links and of the corresponding guide means, in a configuration for the knitting of a leg, and - at a reduced size - of two coupled sections of chain and of the corresponding guide means in a configuration for the knitting of the body, with two enlarged portions of Fig. 43; and

Figs. 44 to 49 show various geometrical views and sections of parts of a section of chain with travelling links for the knitting components, and in meshing relationship with a driving ring gear.

Best Mode for Carrying out the Invention

Figs. 1 to 16 illustrate in a highly schematic way the operating principle of the machine in question, to make an article M as illustrated in Fig. 3, the sequence of production stages being indicated in Figs. 1 to 3. In particular, in the said article M, MG indicates the legs; MB indicates the body or corset; BB the double hem - usually elastic - at the waistline; P

indicates the lines of seams or closure of the tubular fabric to form the toes, which are formed with a certain shaping obtained by progressive insertion of needles after the formation of the initial seam line B with intersecting needles; and C indicates a seam line similar to the lines P, which is formed at the crutch or area of joining of the two legs MG for the start of formation of the body or corset MB. The seam lines P of the toes and the seam line C indicated above extend transversely in the finished article, as already specified in the above-mentioned preceding patents.

Two pairs of rectilinear needle plates 1, 2 and 3, 4 are provided for the formation of the two legs MG, with the needles inclined upwardly and together as shown in Figs. 12 to 14; in this way a seam line such as P and C may be formed by the interaction of the needles of the two needle plates to engage a single thread simultaneously; tubular knitting is then continued with the needles of one needle plate which operate independently of the needles of the other needle plate, and with threads F which at any time are engaged only by the needles of a single needle plate, as shown in Fig. 13. This textile method is well known, but will be described in greater detail with reference to Figs. 12 to 14. For working the legs MG of the articles, not all the needles of the pairs of needle plates 1, 2 and 3, 4 are used, but only the needles of an area G (see, in particular, Figs. 15 and 16) which form the majority of the needles present in each pair of needle plates, with the exception of a short terminal group of needles C1 (Fig. 15) for the purposes stated below. For working the individual legs MG, each pair of needle plates 1, 2 and 3, 4 is made to rotate about its axis X-X and Y-Y respectively, while the two axes are relatively remote from each other. The two needle plates of each pair form part of an epicycloidal moving element which comprises a support indicated schematically by 6 for the needle plates 1 and 2, and

by 8 for the needle plates 3 and 4. The two epicycloidal moving elements with the two supports 6 and 8 rotate together with the pairs of needle plates 1, 2 and 3, 4 for the formation of the corresponding leg MG. For the knitting - in a way similar to that specified in the preceding patents - sections of chain, indicated schematically by 12 and 14, are provided, and each of them is guided along an annular trajectory with sections of rectilinear guides 16-18 corresponding to the individual needle plates, each section of chain moving along its annular path in a configuration which is kept stationary on average during the rotation of the corresponding needle plates about the corresponding axes X-X and Y-Y; in this way the tubular fabric is formed with the textile components carried by the individual chains 12 and 14 respectively. The numbers 16A, 16B and 18A, 18B indicate two curved sections of the tracks for the chains 12 and 14, which connect the rectilinear sections 16 and 18 respectively of the said tracks, parallel to and slightly outside the corresponding needle plates 1, 2 and 3, 4 respectively. The two curved sections 16A and 18A can be removed from operation, for example and in particular downwards, for the purposes stated below. After the two legs MG have been completed on the two needle plates 1, 2 and 3, 4, then, by means of the rotation (about the separated axes X-X and Y-Y) of the pairs of needle plates 1, 2 and 3, 4 and of the corresponding epicycloidal moving elements 6 and 8, the curved sections 16A and 18A of the tracks for the sections of chain 12 and 14 respectively are removed, and the pairs of needle plates 1, 2 and 3, 4 are aligned and then joined and butted against each other, as shown by the comparison between Figs. 4 and 5, 8 and 9, and 15 and 16. This joining and butting together of the pairs of needle plates 1, 2 and 3, 4 is obtained by the sliding of the epicycloidal moving elements 6 and 8 respectively on guide means provided on a central moving element 20,

comprising a platform which is indicated in Figs. 7 to 11; the joining and butting together of the needle plates take place with an orientation of the needle plates such that the two hitherto inactive groups of needles C1 of the various needle plates are joined. The joining and butting together of the pairs of needle plates 1, 2 and 3, 4 by movement of the epicycloidal moving elements 6 and 8 respectively on the guides of the platform 20 forms an extended double needle plate from the needle plates 1, 3 and 2, 4 respectively; the guides 16 and 18 are butted against each other and together with the sections 16B and 18B form a track around this extended double needle plate for the chain sections 12 and 14; the chain sections 12 and 14 are butted against each other to basically form a continuous chain which extends around the extended rectilinear double needle plate 1, 3; 2, 4, the curved parts 16A and 18A of the chain tracks being excluded. The two groups of needles C1 form a group of needles as indicated by C2 in Fig. 16.

In these conditions of formation of an extended rectilinear double needle plate 1, 3; 2, 4, the formation of the body or corset MB is started, with the rotation of the central moving element 20 and of the said extended rectilinear double needle plate about a central axis Z-Z, while the two chain sections 12, 14 are driven in reverse so that they remain substantially stationary. In this way the seam line C is formed with the needles of the group C2 which are next to the two terminal groups C1, C1 of the two double needle plates 1, 2 and 3, 4, the said terminal groups C1, C1 of needles becoming adjacent with the joining of the pairs of needle plates 1, 2 and 3, 4 to form the group C2. The needles of the two groups C1 joined are initially driven, as shown in Figs. 12 and 12A, so that they pick up the thread or threads supplied to them to form the seam line C between the two legs, while the needles of the sections G, which have formed the two legs MG,

continue their independent working to form the fabric along each of the two needle plates. As soon as the seam line C between the legs at the crutch of the article M is completed with one or more rows of stitches, the needles and the textile components cover the whole of the front B (Fig. 16) to form a tubular fabric of size greater than that of the legs, in other words to form the body or corset MB; in practice, the annular extension (twice B) of the article in the area MB corresponds to the sum of the four areas G and the four areas C1 of the needles of the four needle plates 1, 2 and 3, 4. On completion of the formation of the body or corset MB, the terminal finish BB is also formed in a conventional way and in practice consists of a double elastic hem or other equivalent, after which the article is released.

For the removal of the completed article, in particular in the presence of the terminal double hem BB of the corset or body MB of the article M, and also in certain cases for other reasons during the formation of the article, it may be necessary to separate from each other the opposed and joined needle plates, such as the needle plates 1, 2 and the needle plates 3, 4, or the extended needle plates 1, 3 and 2, 4. This mutual separation is shown in Figs. 11 and 14 for comparison with the corresponding preceding figures. For this purpose, the opposing needle plates are guided along guide means which are perpendicular to the plane of symmetry of the pairs of needle plates such as 1, 2 and 3, 4 respectively, by the method which will be described subsequently. In particular, the curved sections 16A, 16B and 18A, 18B of the guides for the chain sections 12 and 14 are made flexible, to follow the expansion (which is very limited) between the two opposing needle plates. This flexibility of the curved sections 16A, 16B and 18A, 18B is accompanied by a substantial rigidity in the vertical plane of the chain sections 12, 14, for example by the method illustrated

subsequently. In this way relative movement is permitted between the extended needle plates 1, 3 and 2, 4 which rotate about the axis Z-Z and the pair of chain sections 12 and 14 which are retained in a substantially stationary position.

Following the above summary of the concept on which the machine in question is based, a possible version for such a machine will now be described with reference to Figs. 17 to 48.

The number 51 indicates in a general way a frame on which are mounted two large-diameter bearings 53 and 55, normally of the roller type; the bearing 53 supports a platform 57 so that it can rotate about a central axis (corresponding to the axis Z-Z in the preceding diagrams), this platform being the principal component of the central moving element rotating about Z-Z. This platform 57 (corresponding to 20 in the preceding diagrams), by means of slotted apertures 57A and rectilinear guide means 57B (normally in the form of ball bearings) engages, slidably along a diameter passing through the central axis Z-Z, two supports 59 for the epicycloidal moving elements 6 and 8 described previously; these two supports 59 are slidable so that they can be moved together and apart on the platform 57; the two supports 59 forming part of the epicycloidal moving elements 6 and 8 are moved together and apart as shown by the double arrow f59. Each support 59 has mounted on it by means of bearings 61 a tubular column 63 which is integral with a pinion 65 at its base. When the two epicycloidal moving elements 6 and 8 are separated, the two pinions 65 of the corresponding tubular columns 63 both engage simultaneously with the lower internal toothing of a driving ring gear 67, which is mounted on the bearing 55; this driving ring 67 has external toothing 67A which engages with the pinion 69 of a main driving motor 71 (Figs. 20 and 39). Each tubular column 63 has at its top one of the two pairs of needle plates such

as 1, 2 and 3, 4 in the initial diagrams. On each tubular column 63 there is mounted a free-running pinion 73 which engages with the upper internal toothing of the driving ring 67. Each of the free-running pinions 73 engages with a corresponding pinion 75 carried by a shaft 77 mounted on the corresponding support 59 parallel to and independent of the tubular column 63; at the upper end, the shaft 77 carries (Figs. 20, 21, 37) a pinion 79, which engages with an idle wheel 81. A free-running sleeve 83 provided with toothing 83A engaging with the toothing of the idle wheel 81 is mounted on the tubular column 63 by means of bearings; in the upper part, the sleeve 83 has toothing 85 (formed by a set of rollers sunk into an annular slot in the sleeve) and involute toothing 87 for the purposes stated below. The transmission 73, 75, 77, 79, 81, 83A is made in such a way that the sleeve 83 rotates in the opposite direction to the tubular column 63, to drive the corresponding chain section (such as 12, 14) in such a way as to keep it substantially in a stationary position, while the tubular column 63 rotates and causes the double needle plates of the corresponding epicycloidal moving element to rotate when the two legs are to be formed.

For the formation of the legs, the platform 57 is locked with a suitable key, and the motor 71 with the pinion 69, which acts on the external toothing 67A of the ring 67, produces a rotation such that the two pinions 65 cause the two tubular columns 63 to rotate in one direction, while the corresponding sleeves 83 are made to rotate in the opposite direction.

At its enlarged upper end 63A, the tubular column 63 of each of the two epicycloidal moving elements 6 and 8 engages with a profiled needle plate support member 91, which then rotates together with the tubular column 63 during the formation of the legs MG. Each of these profiled support members 91 has a large, substantially wedge-shaped central recess 91A, and

engages rigidly with four cylindrical guides 93 (Figs. 21A, 23) projecting horizontally and on opposite sides from the central portion of the profiled member 91, to support slidably (on opposite sides of the profiled member 91) supporting bodies 95, which are also profiled, for the needle plates and for the rectilinear sliding guides of the two chain sections. In particular, these supporting bodies 95 engage at their tops with the two needle plates 97 inclined towards each other and upwards, for the needle beds and for other textile components of a substantially conventional type. Each of the two supporting bodies 95 forms two opposing rectilinear guides 99, horizontal and parallel to the needle plates 97, which correspond to the guides 16 and 18 in the initial diagrams; these rectilinear guides consist of rectilinear projections 99 facing in opposite directions, in other words one upwards and one downwards, on each side, and consequently on each of the supporting bodies 95; these projections are in the form of blades, in other words prisms, and are used to guide wheels 101 on the chain sections 102, equivalent to 12 and 14. In particular, each travelling link 103 of the chain sections 102 (see also Figs. 42 to 49) is fitted with two wheels 101 with grooved rims, engaging with the guide projections 99. Each chain link 103 is extended vertically to carry the wheels 101 with horizontal axes spaced apart and operating on the two opposing projections 99 and to form joints 105A and 105B (upper and lower) with vertical axes and spaced apart, for connection to adjacent links 103. The links 103 have, externally with respect to the axes of the vertical joints 105A, 105B and with respect to the guide planes defined by the projections 99 and the wheels 101, bearing blocks 103A which can make contact with the corresponding bearing blocks of the adjacent links along the rectilinear sections of the path of the chain sections as identified by the projections 99 of the rectilinear

guides parallel to the needle plates; these bearing blocks 103A have adjusting screws. With these arrangements all play is eliminated both in the horizontal direction and in the vertical direction of the chain sections, with the design of the links with the joints 105A, 105B separated and with the adjustable bearing blocks 103A between the links. In a position intermediate between the wheels 101, each chain link 103 has a roller 107 with a vertical axle, which is mounted so that it projects downwards adjacent to a wall 109 formed by the link itself; a limited gap is formed between the said wall 109 and the said roller 107; this gap is positioned substantially within the geometrical plane delimited by the prismatic projections 99. The ends of a curved strip 111, which extends between the two profiled bodies 95, to complete the guide for the chain section 102 between the said projections 99 which interact with the wheels 101, engage with the two supporting bodies 95 - which are movable with respect to each other along the guides 93 - in the plane in which the projections 99 lie; this curved strip 111 is deformable, to provide the connection in any configuration of joining or withdrawal - always relatively limited - between the profiled bodies 95 and consequently between the needle plates 97; the strip 111 operates only to guide the links 103 of the chain sections 102 in the radial direction, in other words horizontally, being enclosed between the rollers 107 and the walls 109 of the links 103 which are located along the connection formed by the curved strip 111, while the rigidity of the chain in the vertical direction is ensured by the structure of the links 103 of the chain as described above. The connection formed by the strip 111 is that which is located outside the needle plates extended by the coupling of the pairs of needle plates 97, which correspond to the needle plates 1, 2 and 3, 4 in the initial diagrams; essentially, each curved guide 111

corresponds to the guide 16B and 18B in the initial diagrams. The ends of a further flexible strip guide 113 (corresponding to the curved guides 16A and 18A in the initial diagrams) engage with two pieces 115, which are hinged (see in particular Figs. 25, 26, 41) by means of coaxial pins 117 to the two profiled bodies 95 which form the guides 99 for the corresponding links 103 of the chain section 102; the two pieces 115 are operated simultaneously by the method indicated below, to move the corresponding strip 113 as shown by the arrow f113 from the raised position, substantially symmetrical to that of the fixed strip 111, to an excluded and lowered position as shown by the arrow f113, about the pins 117. This is done by means of link means 119, operated as described below. In this way the curved connecting strip 113 may be removed from the operation by lowering, as disclosed previously in the diagrams in the initial figures with respect to the curved connections 16A and 18A, when the needle plates 97 are aligned and butted against each other in alignment to form the extended needle plates for working the body.

Under the lower hinge 105B, each of the links 103 of the chain sections 102 has a horizontally movable elastic tooth capable of interacting with the toothing 87. More particularly, each link 103 has formed in it a transverse prismatic seat which slidably houses a tooth 123; the said tooth 123 has externally a roller 125 and internally a wedge-shaped part 123A capable of penetrating between the profiled teeth 87 of the toothing 87 formed by the sleeve 83. The tooth 123 is pushed outwards by a spring 127 hooked to a pin 129 which is engaged with the link 103 and passes through the housing for the tooth 123 within a slot 131 formed in the said tooth 123; the wheel 125 of each tooth 123 can interact with a wall 91C formed by a frame 91E integral with the profiled member 91; this frame 91E extends from opposite sides of the member 91 to form

the two walls 91C, which act on the wheels 125 of the elastic teeth 123 to push them and position them exactly in engagement with the toothing 87, with respect to which the walls 91C remain in a fixed position, regardless of the movements which the chain section 102 formed by the links 103 may undergo as a result of the movements of the supporting bodies 95 and consequently of the projections 99 and of the chains 102 along the horizontal guides 93. Regardless of the more or less close relative position of the supporting bodies 95 and consequently of the chains 102 formed by the links 103, the teeth 123 are always in engagement with the chain toothing 87 without any play.

As described previously, the transmission between the ring 67 and the pinion 65 causes the rotation of the tubular column 63, and consequently the whole assembly carried by the profiled member 91, also forming the walls 91C, rotates in one direction, while the transmission 73, 75, 79, 81, 83A causes the sleeve 93 and consequently the toothing 87 to rotate in the opposite direction. Therefore, while the epicycloidal moving element of which the profiled member 91 forms part rotates about the axis X-X or Y-Y, the chain toothing 87 rotates in the opposite direction in such conditions that, by the effect of the engagement of the teeth 123 with the toothing 87, the chain section 102 (formed by the links 103) runs in the opposite direction on the guides formed by the rectilinear projections 99 and by the curved strips 111 and 113, thus remaining in a substantially fixed position in space, while still adapting to the relative configuration of the guides with which the chain section is slidably engaged. The needle plates 97 are fitted on the profiled member 91 as stated previously, by means of the corresponding supporting bodies 95, and therefore the two needle plates 97 (which correspond to the pairs of needle plates 1, 2 and 3, 4 in the initial diagrams) also rotate together with the tubular column

63. The chain section formed by the links 103 carries the textile components designed to interact with the selection needles and under-needles and the other elements combined with the needle plates 97. In the drawings, by way of example, the number 133 indicates in a general way an electromagnetic selector for the control of the under-needles while the number 135 indicates the cam and cam follower for the operation of the heels of the needles, with an arrangement known per se. The relative movement between the needle plates and the chain section causes the relative sliding of the textile elements such as 133 and 135 with respect to the needle plates 97 and the needles connected to them; in this way the necessary conditions are obtained for the operation of the needles and the selection required for the partial and increased needle elevation operations, in order to obtain the formation of the article.

Other elements connected to the chain section links to obtain the feed of threads and the other operations, are indicated in Figs. 12 to 14 and described below.

During the formation of the legs MG, as stated previously, the two supports 59 with the elements connected to them, in particular the pairs of needle plates 97 (corresponding to the needle plates 1, 2 and 3, 4) are separated from each other along the guides 57A of the platform 57 which remains stationary; in the separated configuration of the two supports 59, the gears 65 and 73 are engaged and caused to rotate by the driving ring 67.

During the formation of the legs MG, the legs must be kept under tension, and for this purpose there is provided inside each column 63 a suction tube 141, which rotates with the tubular column 63 and which can slide with respect to it in the axial direction by the method stated below; this suction tube 141 has at its top a connecting profile 141A for a suction slot 141B

extending under the two needle plates 97 and between them, to house the article during the formation of the corresponding leg MG and to keep it under tension by mechanical means of a known type or preferably by means of a suction current of air which creates a suction current from a manifold 143 through a flexible duct 145 which is curved to join a cavity 59A of the corresponding support 59 and from this cavity inside the suction tube 141 through slots 63E in the tubular column 63 and gridded slots 141H in the suction tube 141; in this way the article being formed is kept pneumatically under tension and held against the gridded slots 141H during its formation. The suction tube 141 is open at the lower end and is fitted with a connecting sleeve 141L and with a shutter 147 with flat sectors or equivalent; the two shutters must remain closed during the formation of the article and therefore, when suction is to be applied for pneumatic provision of tension through the manifold 143 and the flexible ducts 145, while one of these two shutters 147 must be open for the suction, conveyance and removal of the finished article through a corresponding suction tube 141, following interruption of the suction from the manifold 143 and the ducts 145; the pneumatic force for the removal is exerted through a connector 149 for the pneumatic conveyor, which is located at the position which each support 59 for the rotating epicycloidal moving elements must have assumed during the formation of the body or corset, for the mutual approach of the axes X-X and Y-Y of the two epicycloidal moving elements 6 and 8 and for the formation of the body; each connector 149 can be elevated by actuators 150 and is connected to a duct 151 for the removal of the article by the effect of a pneumatic force applied at the correct time by means which are not illustrated and are activated at the correct time to force the finished article through the suction tube 141, the connectors 141L, 149, and the

duct 151. Blowing may be provided from the opposite connector 149, to facilitate the pneumatic transport of the finished article.

As stated previously, after the formation of the two legs MG, and for the formation of the seam line C and consequently of the body or corset MB, the two supports 59 of the two epicycloidal moving elements 6 and 8 must be brought towards each other with their axes X-X and Y-Y towards the central axis Z-Z of the machine about which the platform 57 can rotate by the method stated below. The movements of the two supports 59 in the direction of the double arrows f59 are produced by a method stated below. When the two epicycloidal moving elements 6 and 8 are joined, it is necessary to remove the curved tracks 113 which face each other in the aligned configuration of the needle plates 97, so that these needle plates can be joined; to lower the suction slots 141B and the suction tubes 141 for the reasons stated below; and to centre exactly the upper parts of the epicycloidal moving elements 6 and 8, and in particular those of the corresponding profiled supporting members 91 which form the frames 91C, 91E respectively. Consequently these frames 91E (see in particular Fig. 30) have on the inner side 91E1 - in the configuration of alignment of the needle plates for joining - a set of pins 91K and corresponding sockets, to ensure reciprocal centring when the two sides 91E1 of the frames 91E of the profiled members 91 are joined, so as to ensure the alignment and stability of the coupling between the upper parts of the rotating epicycloidal moving elements 6 and 8 which must cease their independent rotation to ensure the alignment and formation of the extended needle plates, which rotate with the platform 57 for the formation of the body MB.

For the formation of the body, the article, which is wider than the two legs MG, must also be kept under tension; it is therefore necessary to provide

pneumatic tensioning which is substantially uniform over the whole extension of the extended needle plates formed by the butting together of the needle plates 97. For this purpose, the suction tubes 141 and the corresponding profiles 141A and slots 141B are lowered, this being permitted by the presence of the cavities 91A formed by the profiled members 91; the lowered configuration of the suction systems 141, 141A, 141B is illustrated in Figs. 21, 21A, 26. In addition to the lowering, the internal walls of the suction slots 141B, and consequently the walls 141C which come into contact with the approach of the supports 59, must be removed; these walls 141C are therefore extended in the form of flaps which can rotate (see also Figs. 31, 32, 33A, 33B) about vertical axes 141E by the action of appendages 141F, which, when the two slots 141B are joined, push the arms 141G of the opposite flap 141C. With this removal of the flap walls 141C, the suction slot formed by the two suction slots 141B joined together becomes continuous and deep over the whole longitudinal extension of the double extended needle plate produced by the joining of the two pairs of needle plates 97 which have formed the legs.

Each of the two suction tubes 141, which can slide axially within the corresponding column 63, carries (see in particular Figs. 25, 41, 42) a rack 171 parallel to the corresponding tube 141, which engages with a gear wheel 173 carried by a shaft 175A; this shaft is slidably coupled to a coaxial shaft 175B; the two shafts are carried by the two supporting bodies 95. The two shafts are integral with crank discs 176 on whose eccentric pins 177 the links 119 are pivoted. With this arrangement of the rack 171, the gear wheel 173 of the shafts 175 and the links 119, the lowering of the corresponding suction tube 141 causes the return of the members 115 about the axis defined by the pins 117, and consequently the lowering, at the correct time, and the withdrawal of the corresponding flexible

strip track 113 which is located at the ends of the needle plates 97 which are butted against each other when the two supports 59 are joined. These withdrawal movements of the curved tracks 113 are made simultaneous with the lowering of the suction slots 141A, 141B and of the suction tubes 141, so that the pneumatic tensioning of the article can be provided during the formation of the body. The lowering of the tubes 141, which takes place (by the method stated below) simultaneously with the joining of the two epicycloidal moving elements 6 and 8 and consequently their two supports 59, brings the connecting sleeves 141E into alignment and against the connectors 149 which are located under the tubes 141, to provide a pneumatic connection between the tubes 141 and the removal ducts 151; on completion of the formation of the article and the release of the article, one of these ducts will be activated for the pneumatic suction and removal of the article, with simultaneous opening of the corresponding sector shutter 147.

A description will now be given of the method by which the supports 59 of the epicycloidal moving elements 6 and 8 are made to slide on the platform 57 to bring them together and to separate them, in order to join and butt against each other, or to separate, the pairs of needle plates 97, in other words the pairs of needle plates 1, 2 and 3, 4 in the initial diagrams. As can be seen in particular in Figs. 19, 19B, 19A, 33, a motor 201, switched on at the correct time, drives, through a bevel gear 203 and an axial geared or friction clutch 205 (controlled by an actuator 206 carried by the fixed structure 1), a vertical shaft 207 which runs beside the central axis Z-Z of the machine. The shaft 207 runs to two gearboxes 209, 211 constructed with pairs of helicoidal gears 213, 215 with orthogonal axes; each gearbox 209 and 211 causes the rotation of a horizontal shaft 217 and 219 respectively. The two shafts 217 and 219 extend from

opposite sides of the boxes 209, 211 respectively, with two sections in the form of a reverse threaded bar; to each of the two reverse threaded bars there is coupled a corresponding threaded bush, 221 for the shaft 217 and 223 for the shaft 219. The bushes 223 are directly integral with the supports 59 so as to move them along the guides 57B of the platform 57. The threaded bushes 221, coupled to the lower shaft 217 (see Fig. 33), carry pins 227 with rollers 228, by means of which pins the said bushes 221 are engaged with two blocks 231 which can slide between two plates 233, which are provided with slotted cams 241 in which the rollers 228 slide; in short, the bushes 221 (Figs. 33 and 27) are connected to the two blocks 231 which can slide between the two plates 233. The plates 233 project from a central bush 235. This central bush 235 is mounted on bearings 237 so that it can rotate about a column 239 carried centrally by the frame 51. Because of what has been stated previously, the lower shaft 217 forming the two reverse threaded bars can move the blocks 231 between the two plates 233 to bring them together or apart, simultaneously with the joining and separating of the two supports 59 which are traversed along the ball race guides 57B of the bushes 223. The two plates 233 have cams with through slots 241, which are designed to cause the raising and lowering of the suction tubes 141 and of the elements connected to them, and in particular the suction slots 141B; this provides the transverse movement of the blocks 231 driven by the shaft 217 simultaneously with the movement of the supports 59 by the shaft 219. In particular, when the two epicycloidal moving elements 6 and 8 approach the central axis Z-Z of the machine for the butting of the needle plates, the cams 241, by means of the rollers 228 interacting with them, cause the lowering of the suction tubes 141 and of the elements connected to them and consequently the suction slots 141B and the racks 171, to provide the operations

described previously. The reverse movement of withdrawal of the two epicycloidal moving elements causes the reverse movement of the mouths 141B and of the racks 171 and consequently the return of the curved guides 113 to the raised horizontal position for the activation of the operation of the chain sections for the formation of the legs.

The platform 57 must be held against the rotation on its bearing 53 during the formation of the legs, but must be driven in rotation for the formation of the body or corset MB. To lock the platform 57 to the frame 51 and to release it from the frame to enable it to rotate, an actuator 251 is provided (Figs. 39, 39A, 40) with two sliders 253 slidable in housings 254 on the frame 51; two corresponding pins 255 are slidable on the platform 57; the two pins 255 form part of a moving element 257 slidable on the platform 57 and pushed towards the actuator 251 by a spring 258 so that terminal toothing on an appendage 257B engages with the internal upper toothing of the ring gear 67. When the actuator 251 is activated, it pushes the two sliders 253 into the sockets of the pins 255, locking the platform 57, while the pins 255 and the moving element 257 are pushed by the sliders against the action of the spring 258, disengaging the toothed appendage 257B from the internal upper toothing of the ring gear 67. Thus the platform 57 is locked and the ring gear 67 can rotate. When the action of the actuator 251 ceases, the sliders 253 are withdrawn from the sockets of the pins 255 and the moving element 257 pushed by the spring 258 causes the toothed appendage 257B to engage with the ring gear 67 whose rotation causes the platform 57 to rotate.

The platform 57 can therefore start its rotation at the correct time when the needle plates 97 have been joined and butted against each other with the mutual approach to the axis Z-Z of the two epicycloidal moving elements 6 and 8, including the supports 59 and

the elements connected to them. Simultaneously with this, the two epicycloidal moving elements and with them the tubular columns 63 interrupt the rotation, while the sleeves 83, owing to the separation of the gears 65 and 73 from the driving ring 67, remain free.

The rotation of the platform 57 causes the rotation of the extended double needle plates formed by the butting together of the needle plates 97, in other words of the needle plates 1, 2 and 3, 4 in the initial diagrams. When the needle plates are butted against each other, the straight guides 99 of the supporting bodies 95 for the needle plates 97 are also butted against each other, and the two chain sections 102 formed by the links 103 and indicated by 12 and 14 in the initial diagrams are butted against each other; the extension of the sliding guides of the links 103 of the chain 102 is now formed by the straight edges 99 and by the flexible curved tracks 111 which remain external to the butted pairs of straight edges; this extension is greater than, or rather corresponds to the sum of the chain sections 102, so that in practice a continuous chain is formed along the track which now surrounds the extended double needle plate formed by the method stated. In this configuration, it is also necessary to hold still the continuous chain which carries the knitting elements, while the central moving element, with the platform 57 and with the two helicoidal moving elements prevented from rotating, rotates about the central axis Z-Z, causing the extended needle plates to rotate. To ensure that the chain is held against the rotation, and consequently to make the needle plates slide with respect to the knitting elements carried by the chains, in the approached configuration of the two epicycloidal moving elements the chains are held in the way described below, with particular reference also to Figs. 35 to 38. At the level of the toothing 85 formed by the rollers engaged in the annular groove of the sleeve 83, there is a pair of plates 301, which form

two opposing internal toothed sectors 303 with their centre on the axis Z-Z; these two toothed sectors 303 are spaced apart so that they permit the movement of the supports 59 to bring them together from the separated position in which the legs are formed to the approached position for the formation of the extended double needle plate and consequently for the formation of the body or corset with the rotation of the platform 57. On one of the said plates 301 there are hinged at 305 two arms 307 which may be moved by corresponding actuators 309 and each of which carries a further sector of internal toothing 311; these two sectors 311 are moved from a removed position to a position of combination with the toothed internal sectors 303, to form a continuous internal ring gear 303, 311, 303, 311 after the two epicycloidal moving elements 6 and 8 and consequently the two supports 59 have been approached and joined together. When formed, the said internal ring gear 303, 311 can interact with the roller toothing 85 of the two sleeves 83. When the platform 57 starts its rotation, the sleeves 83 are moved in the direction of rotation of the platform 57 and thus roll, with their roller toothing 85, inside the internal ring gear 303, 311, causing the sleeves 83 to rotate in the opposite direction to the platform; the external toothing 87 of the sleeves 83 therefore also rotates in the opposite direction to the platform. The number of teeth in the internal toothing 303, 311, 303, 311 is equal to the number of links in the chain formed by the sum of the two chain sections 102 indicated by 12 and 14 in the initial diagrams, and consequently to the number of chain links 103 of the chain formed after the joining of the two epicycloidal moving elements 6 and 8. It follows from this that, with each rotation of the platform 57 and therefore of the extended double needle plates formed by the needle plates 97, the toothing 87 causes the continuous chain formed by the two chain sections 102 to slide in the opposite direction, so

that the needle plates rotate and the continuous chain formed by the two chain sections is held against the rotation; thus the needle plates slide in front of the knitting elements carried by the links 103 of the chain, to permit the knitting of the body or corset MB and subsequently of the terminal elastic hem BB, to then permit the release of the finished article and its suction through one of the suction tubes 141, whose shutter 147 has been opened to activate the suction for pneumatic removal of the completed article, which is drawn from the other suction tube 141 which is cut off from the tensioning suction.

Clearly, movements which are the reverse of those described for the succession of the stages of working of an article are used to return to the preceding conditions and consequently to the separation of the two epicycloidal moving elements 6 and 8 and therefore of the supports 59 with the elements connected to them, to the locking of the platform 57, to the re-elevation of the suction tubes 141 and consequently of the suction slots 141B, to the re-closing of the flaps 151C (whose opening, in other words removal, has permitted the pneumatic tensioning of the corset MB along the joined slots 141B), to the re-opening at the correct time of the sectors 111, to the re-activation of the rotation of the columns 63, and other operations.

It has already been mentioned, with reference to the initial diagrams, that in certain stages of the textile working and in particular at the end of the formation of the terminal hem BB and for the discharge of the article and consequently of the terminal hem between the two needle plates which are kept joined as closely as possible for the tubular knitting, a separation, in other words a widening, of the two opposing needle plates of the pairs of needle plates, is advisable. The method by which these needle plates are moved, by the sliding of the supporting bodies 95

and consequently of the needle plates 97 along the horizontal transverse guides 93 carried by the profiled supporting member 91 integral with the tubular column 63, 63A of each of the epicycloidal moving elements 6 and 8, will now be described.

Inside each of the tubular columns 63, between the column and the suction tube 141, there is a further operating tube 401, which is slidable axially, but independently of the suction tube 141, inside the tubular column 63; this operating tube 401 is also provided with slots next to the gridded slots 141C of the suction tube 141, to provide suction through the cavity 59A of the support 59 for the pneumatic tensioning of the article during knitting. Each of the operating tubes 401 terminates below in a ring 403 which is fitted with bearings inside a block 405 which can move transversely along tubular guides 407 carried by a frame 409. The blocks 405, and consequently the rings 403, can therefore follow the movements of approaching and withdrawal of the two epicycloidal moving elements 6 and 8, while they can be moved upwards and downwards by an operating system described below, which acts on the frame 409. This frame 409 has a central core 411, which is engaged, on roller bearings 412, with the upper end of a cylindrical slider 413 which can slide within the central column 239 rising from the base of the frame 1. This cylindrical slider 413 has at its bottom a threaded bush 415, which is engaged in a vertical threaded shaft 417, rotated by a bevel gear 419 driven at the correct time by an actuator; the slider 413 and consequently the threaded bush 415 can slide but cannot rotate with respect to the column 239, and therefore the rotation of the threaded shaft 417 causes the raising and lowering of the cylindrical slider 413 and with this of the frame 409 and of the blocks 405 and consequently of the rings 403 and of the operating tube 401 which move upwards and downwards under the control of the actuator

acting on the gear 419. All this is designed, as mentioned, to causing the mutual separation and approach of the two needle plates carried by the two epicycloidal moving elements 6, 8 and also of the extended needle plates formed by the butting against each other of the two needle plates 97 (indicated by 1, 3 and 2, 4 in the initial diagrams). The frame 409, together with the elements connected to it, can rotate about the cylindrical slider 413 owing to the presence of the bearings 412.

At the upper end, each of the two operating tubes 401 has a cross-piece 421 in the form of a T, extending parallel to the needle plates 97. At its ends, each cross-piece 421 engages, via columns 423, two sliders 425, which are guided in a vertically slidable way in suitable guides formed at the lateral ends of the profiled supporting member 91 mounted on the corresponding tubular columns 63, 63A. Two pairs of links 427 are hinged on each slider 425 and form articulated connecting parallelograms between the slider 425 and the supporting bodies 95 which carry the needle plates 97 and which slide on the horizontal transverse guides 93. Thus the movement of the sliders 425 under the control of the operating tubes 401 causes, in a symmetrical way and for all the supporting bodies 95, a movement of withdrawal and approach and thus a corresponding movement of the needle plates 97. To ensure the simultaneity of the movements and to ensure that the needle plates remain parallel, the movements of the sliders 425 may be combined, possibly by providing on the sliders racks 425A which engage with pinions 429 made integral in rotation by shafts 431. From the foregoing description, it is clear that the operation of an actuator which moves the bevelled pinion 419 causes the approach or withdrawal at the correct time of the two needle plates for the requirements of knitting, and in particular to make the double elastic hem BB of the article pass between the

needle plates, at the end of the article's formation, and to facilitate the fall of the said finished article which is sucked by the suction tube 141 whose shutter 147 is open when the tube 141 has been lowered for the formation of the body and its tensioning during formation and consequently when the bush 141E is engaged with the connector 149 of the pneumatic conveyor duct.

Knitting elements carried by the travelling links 103 of the chain sections 102 and designed to interact with the needles carried by the needle plates will now be described. It must be stated initially that the knitting elements are substantially of a know type and operate in a way known to those skilled in the art. These knitting elements may be extended to obtain special working, such as the formation of designs and patterns on the fabric of the legs and also on the fabric of the body, which is produced as a uniform fabric which is not traversed by the seams between two joined articles, as is the case in conventional tights. The textile elements of the machine - in the components of the needle plates, such as the needles and the under-needles or selectors (jacks), and in the components carried by the travelling links of the chain section - may be such that the article can be shaped in an anatomical way, for example by forming longer stitches in the back part of the garment as worn, by an appropriate variation at the correct time of the position of some of the needle-lowering cams, in other words of the stitch-forming cams, in order to increase the rear dimensions in the area of the gluteus. The formation of a reinforcing gusset and/or reinforced heels may also be provided by the use of "beating" thread guides, in other words thread guides operated so that they enter the thread supply position and leave this position cyclically, in association with appropriate means of thread cutting at the start and end of the formation of rows of stitches with double

thread. The concepts of all these systems are well known and can be adapted simply to the machine in question.

In the drawing, and particularly in Figs. 12 to 14 and Figs. 22 to 26, the numbers 501 and 502 indicate the needles of the needle plates 1 and 2, to which are hinged small levers or jacks 503, 504 with concealed lugs for lowering the needles under the action of stitch cams such as 506 and 507; the numbers 508 and 509 indicate under-needles or selectors, with selection lugs interacting with the magnetic selectors 133 and with a lifting cam such as 511 to select the needles in various ways (1:1; 1:2; 1:3, or to form patterns). The numbers 513 and 515, 515A indicate movable thread guides for supplying thread to the needles. All these mechanisms are known per se. In Fig. 12, which is a section of the machine in which the needles (in both needle plates) are shown in the position of preparation of what is known as the comb for the formation of the seam interlacing P or C, the needle 501 is shown in the highest position where it has to remain during the subsequent formation of the interlacing; the needles 501 are disposed with a 2:1 selection, or with other selections; the remaining needles (not illustrated) of the same needle plate are also raised and then descend under the stitch- forming cam, taking the thread from the thread guide 513. The needle 502 of the opposite needle plate 2 is shown in the phase of descent under the action of the stitch cam 506 and takes the thread from the thread guide 515; all the other needles of the same needle plate operate in the same way. Fig. 12A shows the phase of formation of the interlacing for the said seam in the crutch area C; the needle 501 with the others in a 2:1 selection remains high to act as a comb, since the jack with the concealed lug 503 cannot be lowered by the stitch cam 507 because its lug is inserted in the sliding grooves of the needle plate; in this phase the remaining needles of the same needle

plate 1 are also raised and then made to descend with the stitch cam 507, since the lugs of their corresponding jacks 503 are not inserted in the grooves; these needles take the thread from the thread guide 513; this enables the thread to be transported from one end of the needle plate to the other without creating a bridge of unknitted thread. In the opposite needle plate 2, conversely, the needles 502, also in a 2:1 selection or equivalent, physically knit the joining interlacing between the two parts of what will be the tubular fabric to be formed subsequently; the needles 502 are shown in the phase of descent under the action of the stitch cam 506; they therefore have the lugs of their corresponding oscillating jacks 504 in the active position. In their stitch formation phase, the needles 502 also deposit the thread of the thread guide 501 (which is raised) on to the shanks of the needles 515, thus forming a joining interlacing such as P or C. In the same needle plate 2, the other needles excluded from the 2:1 selection are not raised and therefore remain inactive in this phase.

Fig. 13 shows the formation of the tubular fabric with its two sides MG1 and MG2, each of which is formed on one of the two opposing needle plates.

Fig. 14 shows the formation of the part of the elastic hem BB at the border of the body MB; inside the tube MB, there will be seen two other tubes which form the said hem BB. This process is also part of the known art; the said hem is normally formed, because of the exclusion of two out of three or three out of four needles (or another selection) from the operation, in such a way that the first needles hold the bushes located on them, while the progressive working of the others forms the pockets which constitute the hem BB. The needle plates 1 and 2 are slightly separated from each other to facilitate the dropping of the finished article, at the moment when the hem BB is released by the needles which have formed it.

It is to be understood that the drawing shows only an example provided solely as a practical demonstration of the invention, and that this invention may be varied in its forms and arrangements without thereby departing from the scope of the guiding concept of the invention. The presence of reference numbers in the enclosed claims has the purpose of facilitating the reading of the claims with reference to the description and to the drawing, and does not limit the scope of protection represented by the claims.

CLAIMS

1. Knitting machine for the production of tights (pantihose) and the like, comprising: a central moving element capable of rotating about its central axis; two rotating epicycloidal moving elements, mounted symmetrically on the said central moving element, with shafts out of alignment with the central axis; on each of the said epicycloidal moving elements, a rectilinear double needle plate with needles converging towards the working area; along each needle plate, rectilinear guide means for chain sections comprising travelling links with textile components - including cams, selectors and thread guides - capable of interacting with needles and under-needles of the corresponding rectilinear double needle plate; means of causing the rotation of the said two epicycloidal moving elements for the knitting of each of the two legs on the corresponding double needle plate while the central moving element is stationary; curved guide means to supplement in an annular way the rectilinear guide means for the said travelling links around the rectilinear double needle plates of each epicycloidal moving element; means of causing the rotation of the said central moving element for the knitting of the body with the rotation of the whole central moving element, the two rectilinear double needle plates being aligned with each other; and means for retaining the chain sections with travelling links in a position generally fixed with respect to the rotating epicycloidal moving elements and with respect to the rotating central moving element; the said machine being characterized in that:

- the said two epicycloidal moving elements (6, 8) are carried by supports (59) which are longitudinally slidable on the said central moving element comprising a platform (57) to butt against each other and align with each

other the two double needle plates (1, 2; 3, 4; 97) to form an extended double needle plate for knitting the body, while the said rectilinear guides (16, 18; 99) for the travelling links (103), carried by the said slides on the epicycloidal moving elements (6, 8), are designed to fit together and provide the guide for the chain sections (12, 14; 102) along the said extended double needle plate;

- selection means are provided to exclude from the operation, in each of the two double needle plates (1, 2; 3, 4; 97) of the epicycloidal moving elements, during the formation of the legs, certain needles (C1) at the ends designed to be butted against each other in the joining of the two double needle plates (1, 2; 3, 4; 97), the said needles being brought into operation at the time of joining and formation of the extended double needle plate, so as to start the operation with the fabrics joined (C) and to continue it and form the body (MB) with all the needles; and

- the said curved guide means (16A, 18A; 113) at the said ends of the two double needle plates (1, 2; 3, 4; 97) designed to be butted against each other can be withdrawn and excluded at the time of the joining of the said two double needle plates.

2. Knitting machine for the production of tights (pantihose), stockings, socks, and the like, comprising at least one rectilinear double needle plate with needles converging towards the working area, to work tubular articles, particularly those with a closed end; and, around the said double needle plate, annular guide means for chain sections comprising travelling links with textile components - including cams, selectors and thread guides - capable of interacting with needles and under-needles of the rectilinear double needle plate,

characterized in that the two needle plates (95, 97) are mounted slidably on guide means (93) orthogonal to them, to permit a limited temporary separation of the needle plates, particularly at the end of the production of the body along the double hem (BB) at the waistline.

3. Machine according to Claim 1 or 2, characterized in that it comprises flexible curved guide means (16A, 18A; 16B, 18B; 111, 113), to follow the needle plates during their temporary separation.

4. Machine according to Claim 3, characterized in that chain sections (12, 14; 102), carrying textile elements interacting with the needle plates, comprise links (103) which are very long vertically and hinged together with vertical axes without play and which are consequently vertically rigid, and in that the said links form carriages (103) with wheels (101) with horizontal axes and grooves interacting with the said rectilinear guide means (99) and with the said flexible curved guide means (111, 113).

5. Machine according to at least one of the preceding claims, characterized in that it comprises, on the links (103) of the chain sections, external adjustable flaps (103A) which interact to stiffen the chain in the rectilinear sections.

6. Machine according to at least Claim 1, characterized in that it comprises, in combination, an actuator (201) with a transmission (203, 205, 207, 209, 211) to cause on two vertically separated levels the symmetrical movement of the said slidable supports (59) carrying the two epicycloidal moving elements (6, 8), particularly with reverse threaded bar means (217, 219).

7. Machine according to at least one of Claims 1 and 6, characterized in that it comprises, on the said epicycloidal moving elements (6, 8), tubes (141) for the pneumatic suction of the article being formed, these tubes being vertically movable and having suction

profiles and slots (141B) at their tops, which are connected and aligned with the joining of the said sliadable supports (59) of the epicycloidal moving elements (6, 8); and means for causing the lowering of the said suction tubes (141) with the joining of the said supports (59).

8. Machine according to Claim 7, characterized in that the said operating means comprise symmetrical cam profiles (241) capable of causing the lowering of the said suction tubes (141) with the joining of the said supports (59) carrying the epicycloidal moving elements.

9. Machine according to Claim 7 or 8, characterized in that each of the said suction tubes (141) is associated with a transmission (171, 173, 119) capable of causing the rotation - about a horizontal axis (117) - of supports (115) carrying the corresponding movable curved guide (113).

10. Machine according to at least one of the preceding claims, characterized in that it comprises, in combination, on each epicycloidal moving element (6, 8), a sleeve (83) with toothing (87) to drive the corresponding chain section (102), rotating in the opposite direction to that of the epicycloidal moving element, this toothing (87) engaging with the chain section to drive it in the opposite direction to the direction of rotation of the epicycloidal moving element and of the needle plates; on the said chain section, teeth (123A) elastically projecting towards the said toothing; and walls (91C) in a fixed position on the said moving element, to engage, without play, with the said teeth (123A) on the said moving element, in any configuration of relative separation of the two needle plates (97).

11. Machine according to at least one of the preceding claims, characterized in that it comprises, integrally with the said sleeve (83), toothing (85), and on the fixed frame an internal ring gear with

sectors (303, 311) which can be combined after the joining of the two epicycloidal moving elements (6, 8); the said toothing (85) running along the said internal ring gear with sectors (303, 311) with the rotation of the central moving element with the platform (57), to drive the chain sections in the opposite direction to that of the central moving element (57) and thus to hold them in a substantially stationary configuration.

12. Machine according to at least Claim 2, characterized in that it comprises an operating system (417, 413, 409, 403) with pushing elements (401) on the two epicycloidal moving elements, each of which pushing elements (401) acts on hinged parallelogram systems (425, 427) for the simultaneous and symmetrical movement of the needle plates.

13. Machine according to at least one of the preceding claims, characterized in that it comprises, on each of the two epicycloidal moving elements, a tubular column (63) and an operating tube (401) for the separation of the needle plates and a suction tube (141) which tubes are coaxial and rotatable with the tubular column (63) and can be moved vertically independently.

14. Machine according to at least one of the preceding claims, characterized in that it comprises a single motor (71) which drives a ring (67) with internal toothing for the alternating rotation of the epicycloidal moving elements (6, 8) and of the central moving element with the platform (57).

15. Machine according to Claim 7, characterized in that the two suction slots (141B) have - at the ends joined when the configuration for the knitting of the body is reached - a lateral flap wall (141C) which is excluded with the joining of the two needle plates.

16. Machine according to at least one of the preceding claims, characterized in that it comprises, on each of the epicycloidal moving elements (6, 8), coaxial tubular elements (63, 401, 85) to carry out

required operations and operate suction ducts.

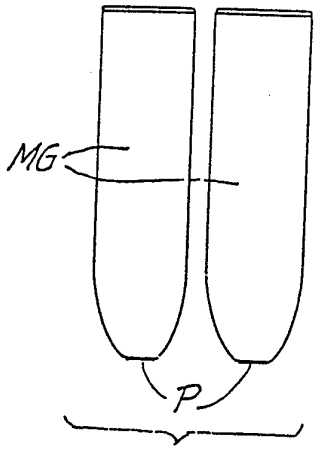


FIG. 1

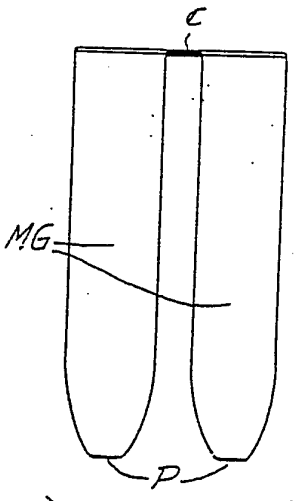


FIG. 2

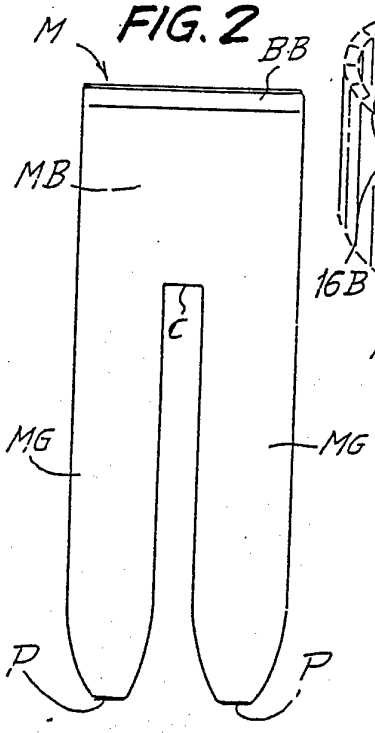


FIG. 3

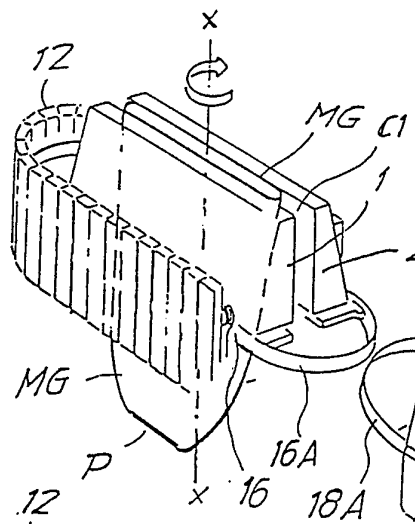


FIG. 4

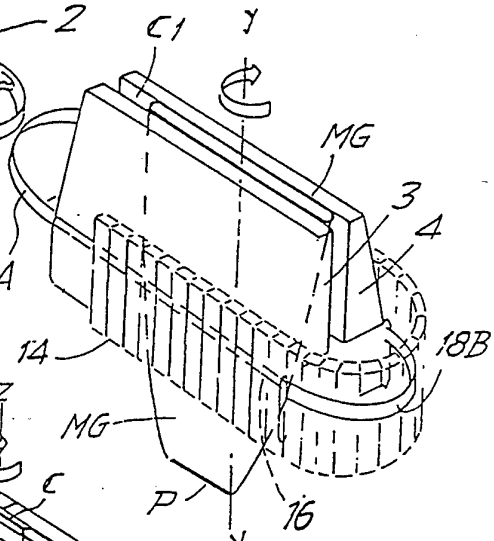
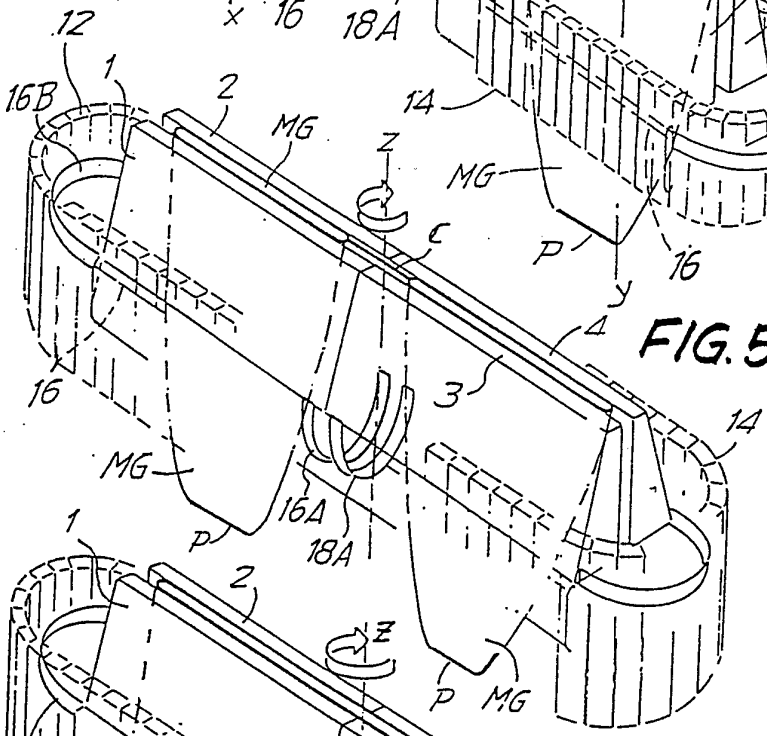


FIG. 5



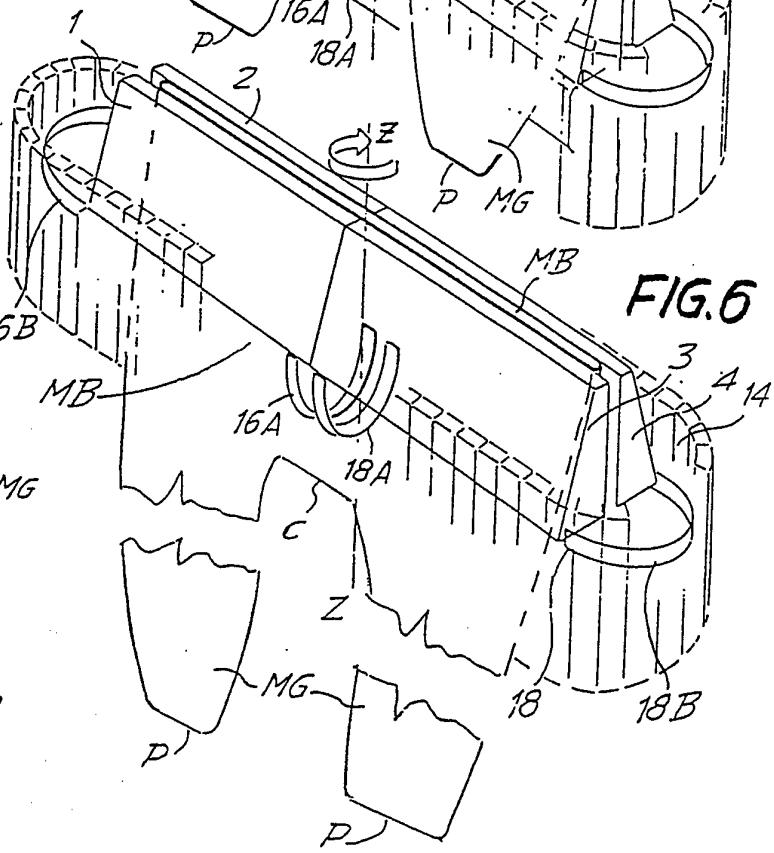


FIG. 6

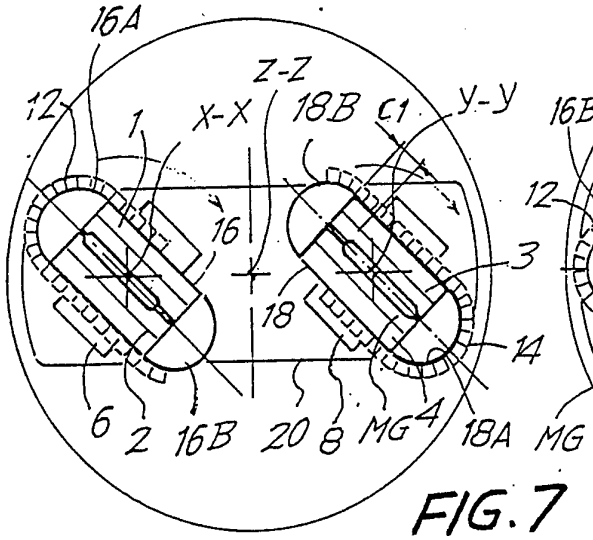


FIG.7

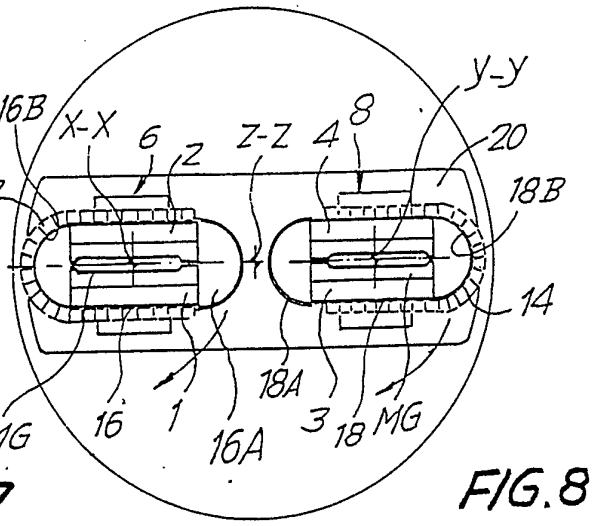


FIG.8

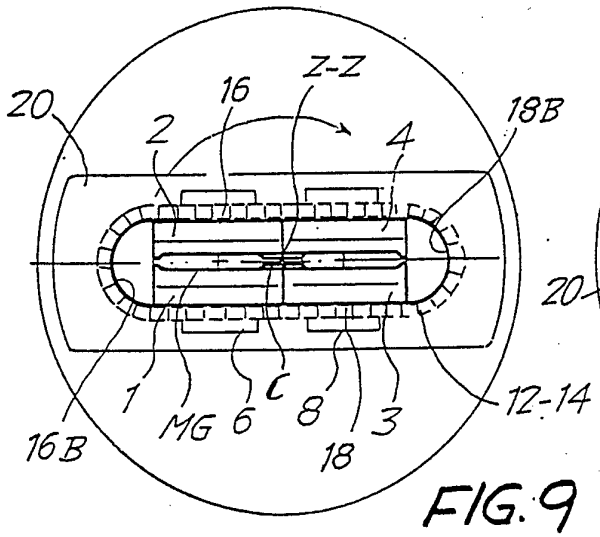


FIG.9

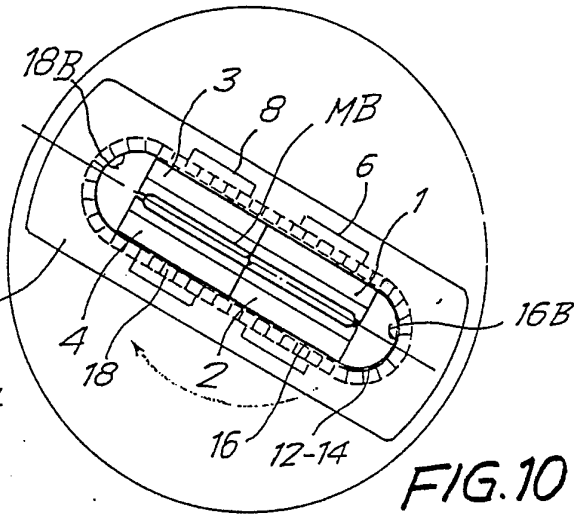


FIG.10

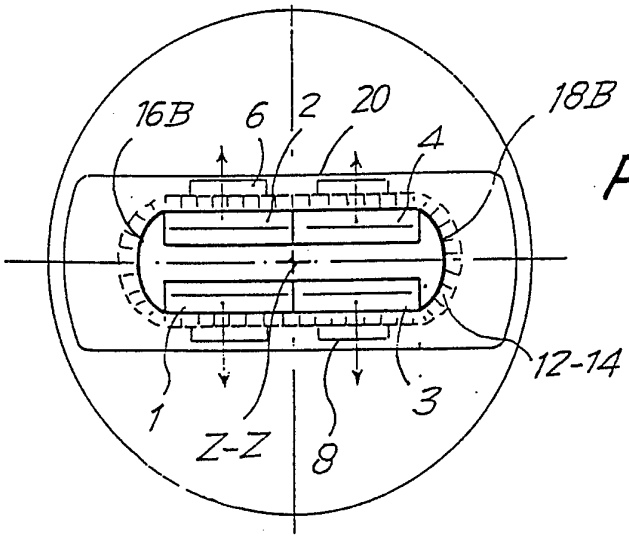


FIG.11

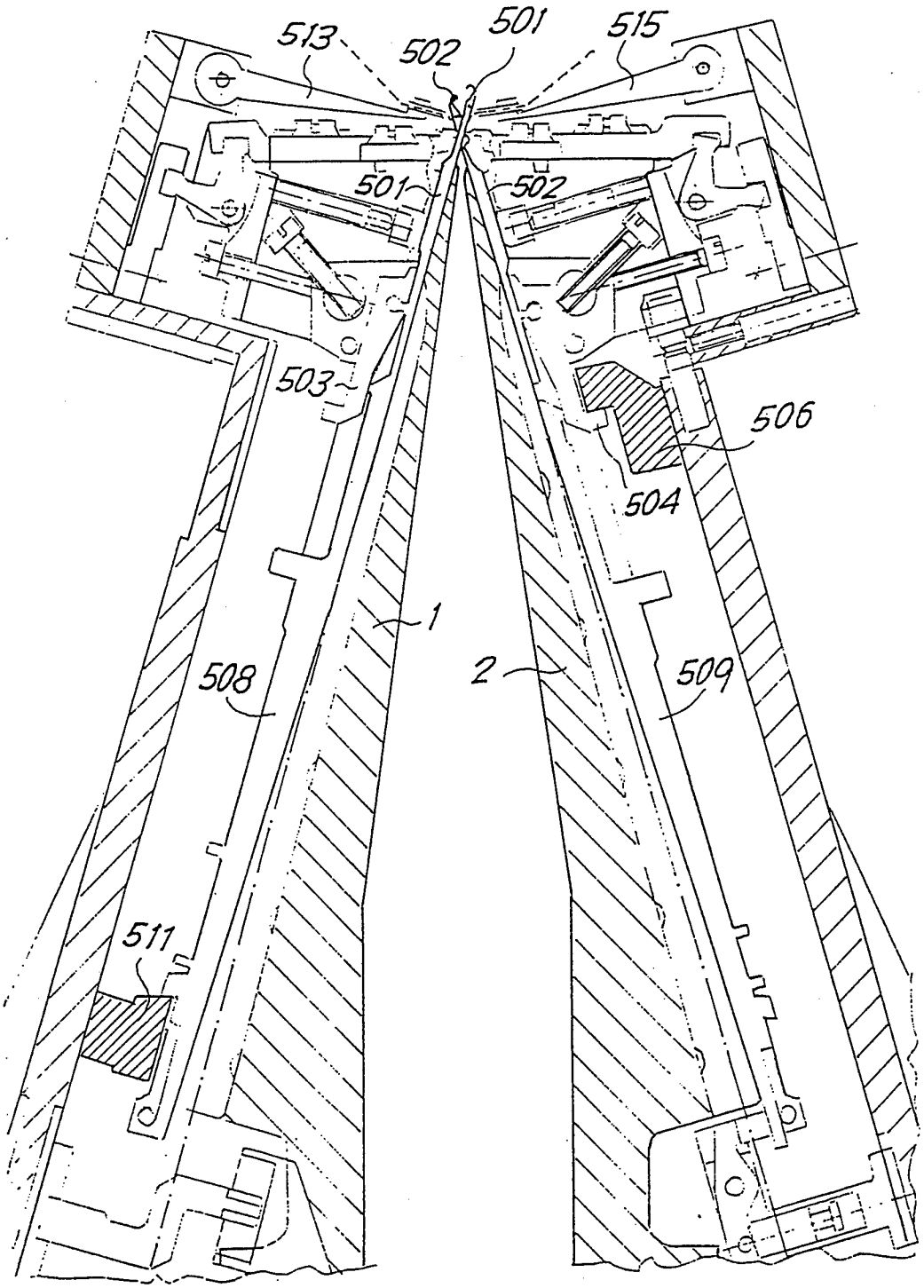


FIG. 12

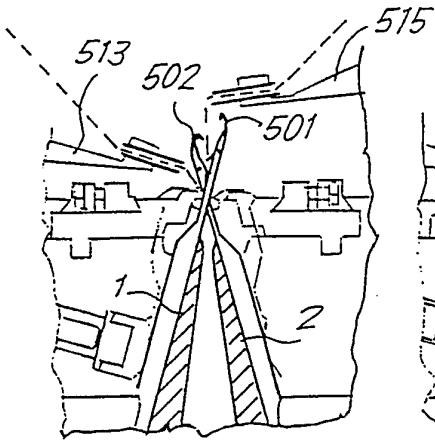


FIG.12A

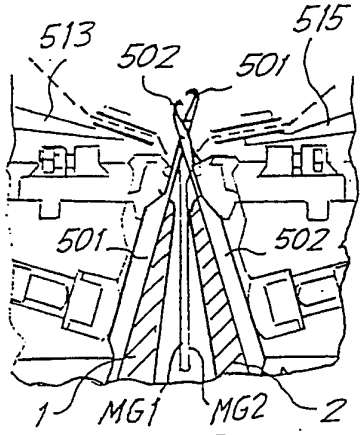


FIG. 13

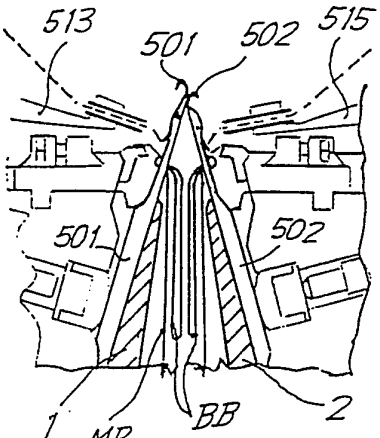
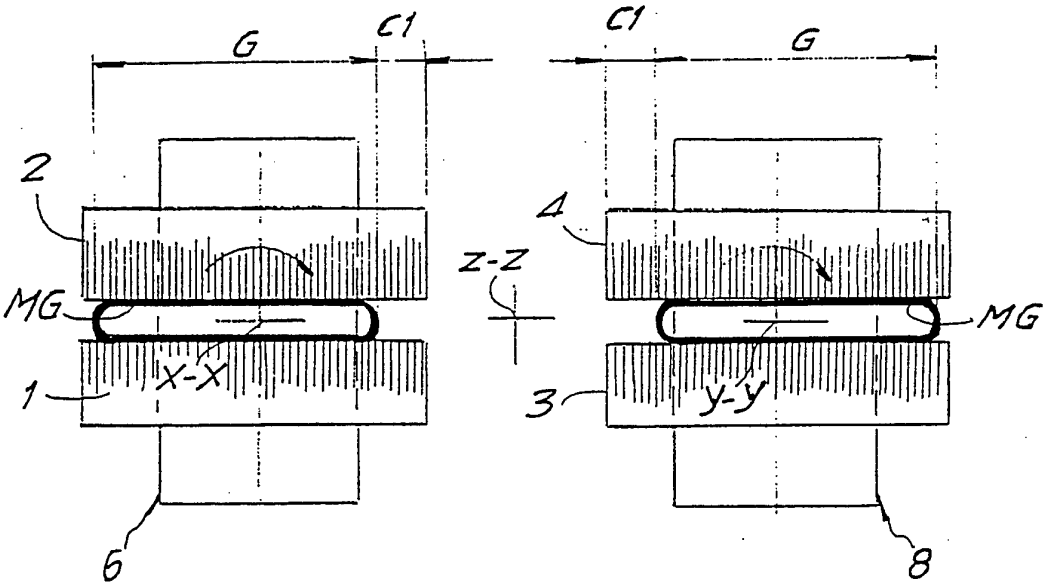


FIG. 14

FIG. 15



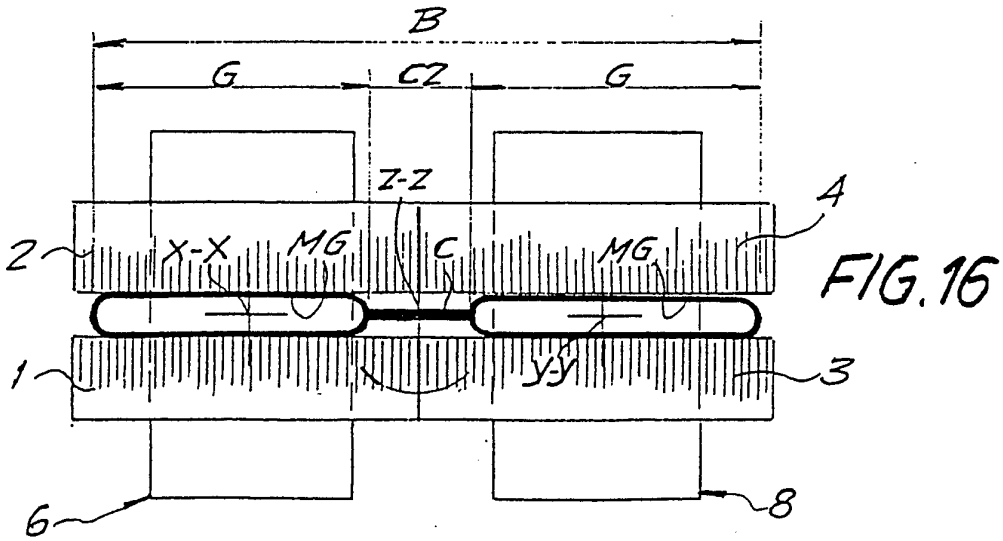
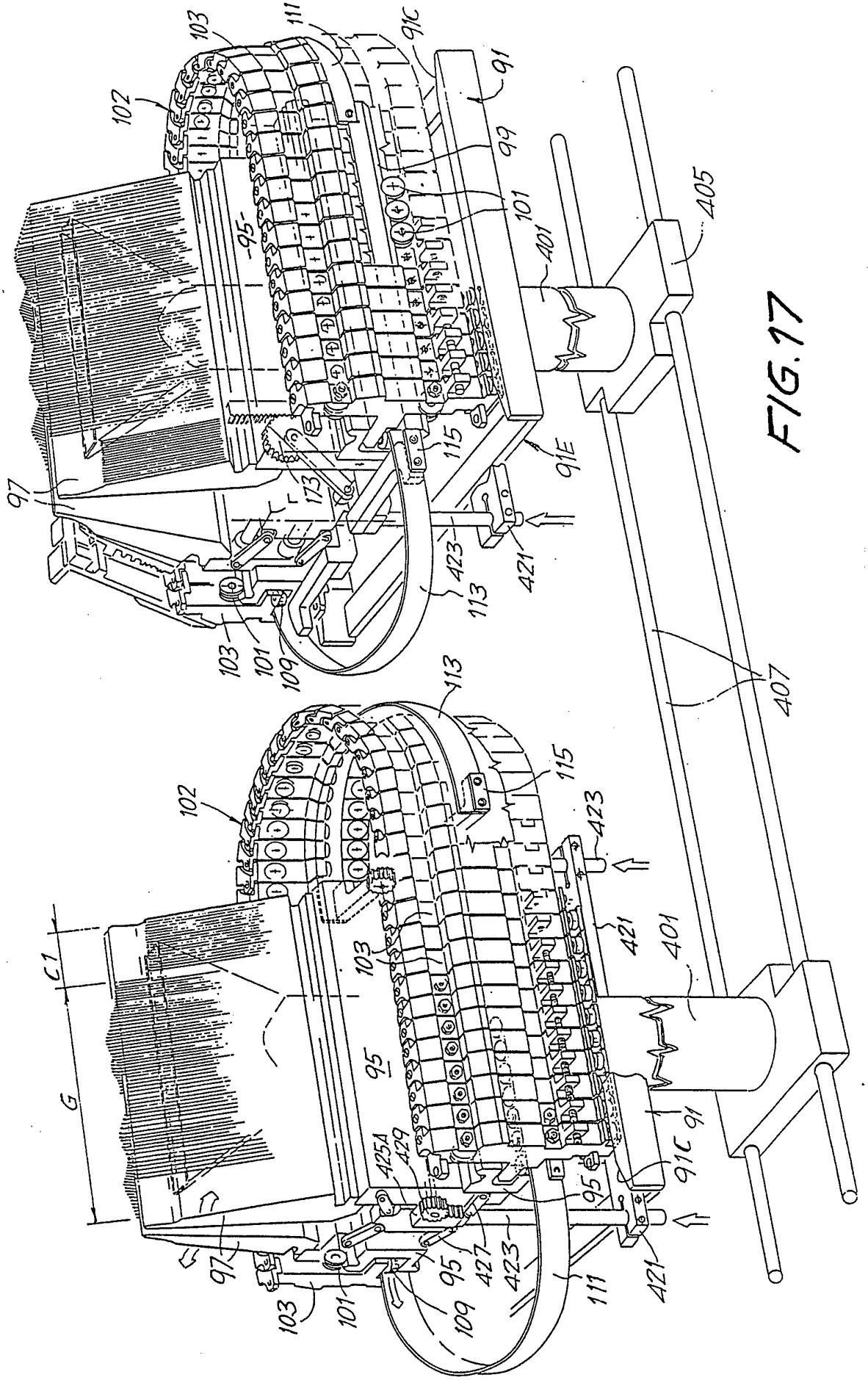


FIG. 16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102
91
99
101
401
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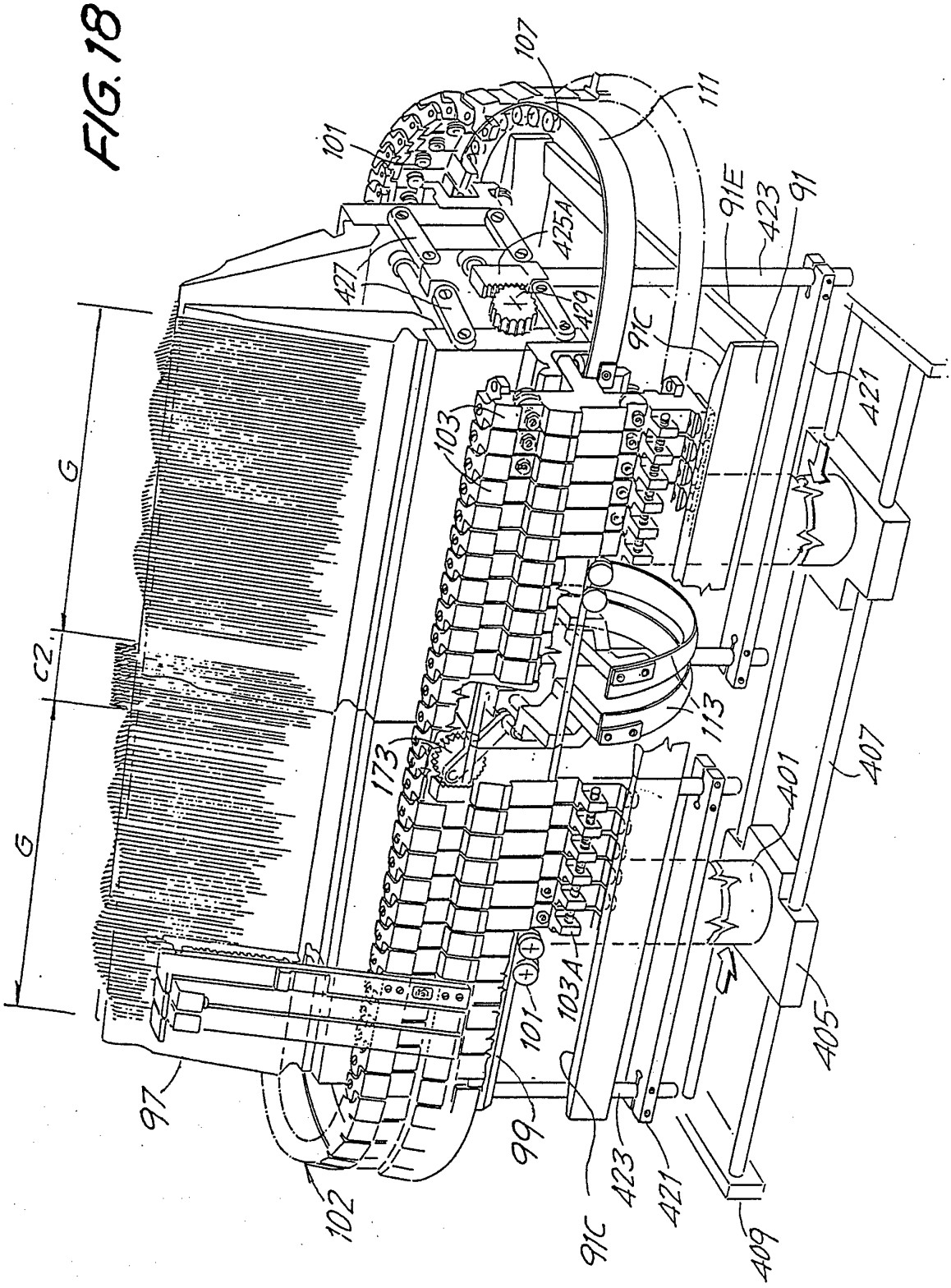
91E
423
421
113
109
407
C1
G
95
427
111

FIG.17

FIG. 18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91C
421
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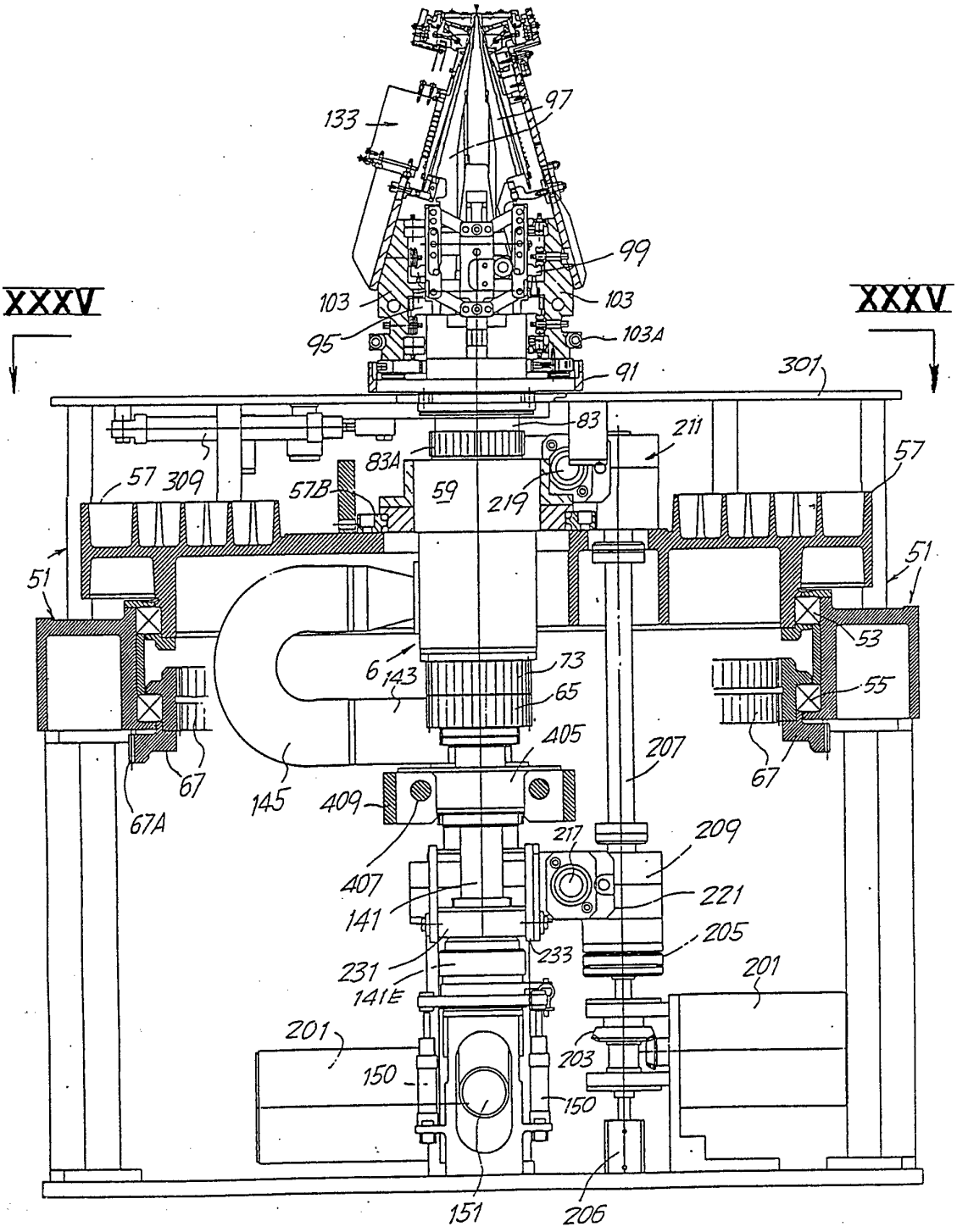
97
99
423
421
102
91C
409

FIG. 19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XXXV
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99
103
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95
103A
91
301
83
211
83A
57
309
57B
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219
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51
51
53
6
143
73
65
55
405
207
67
67A
67
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141
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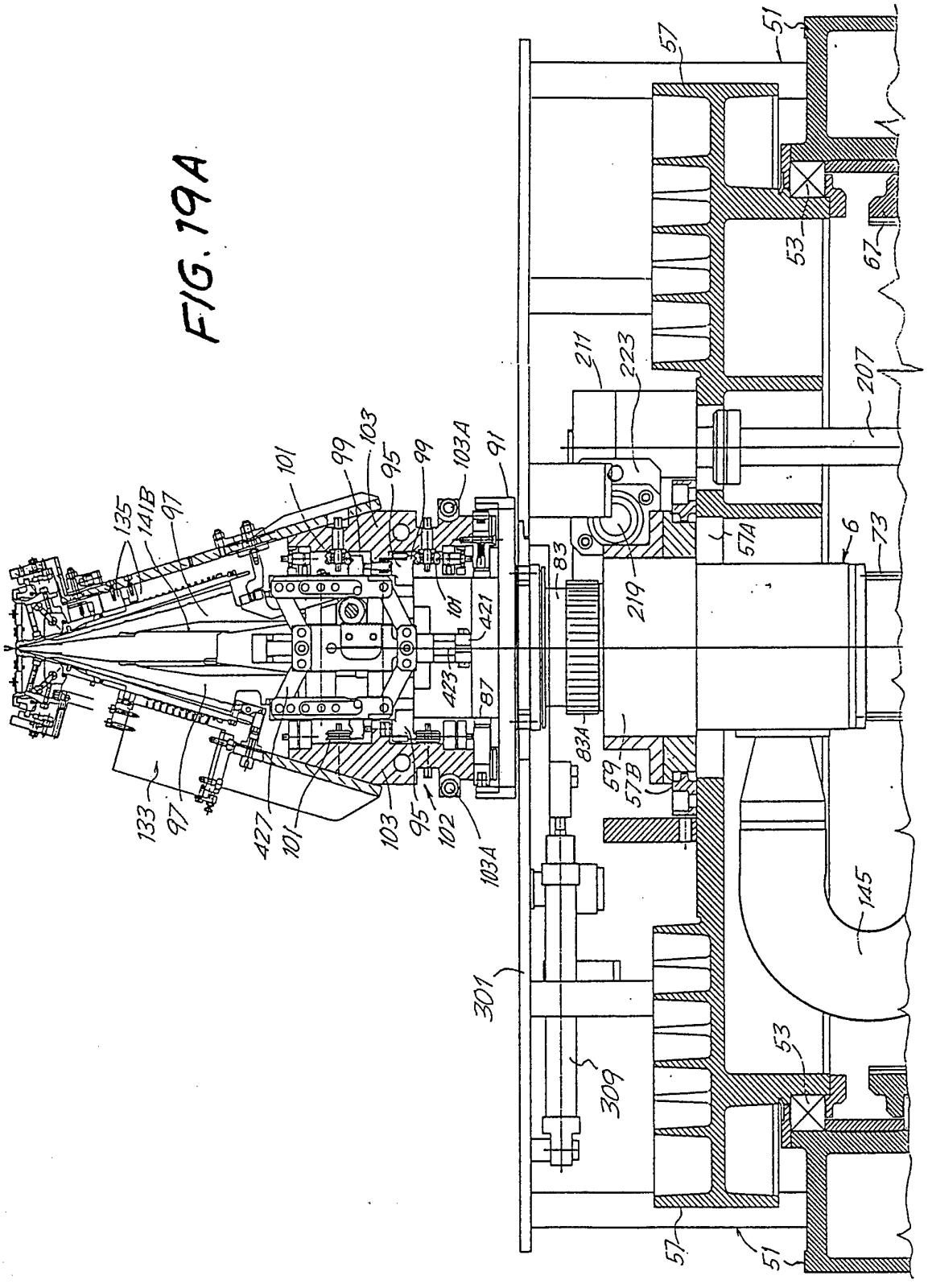
201
141E
201
203
150
150
151
206

FIG. 19A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53
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211
223
207
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83
219
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57B
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133
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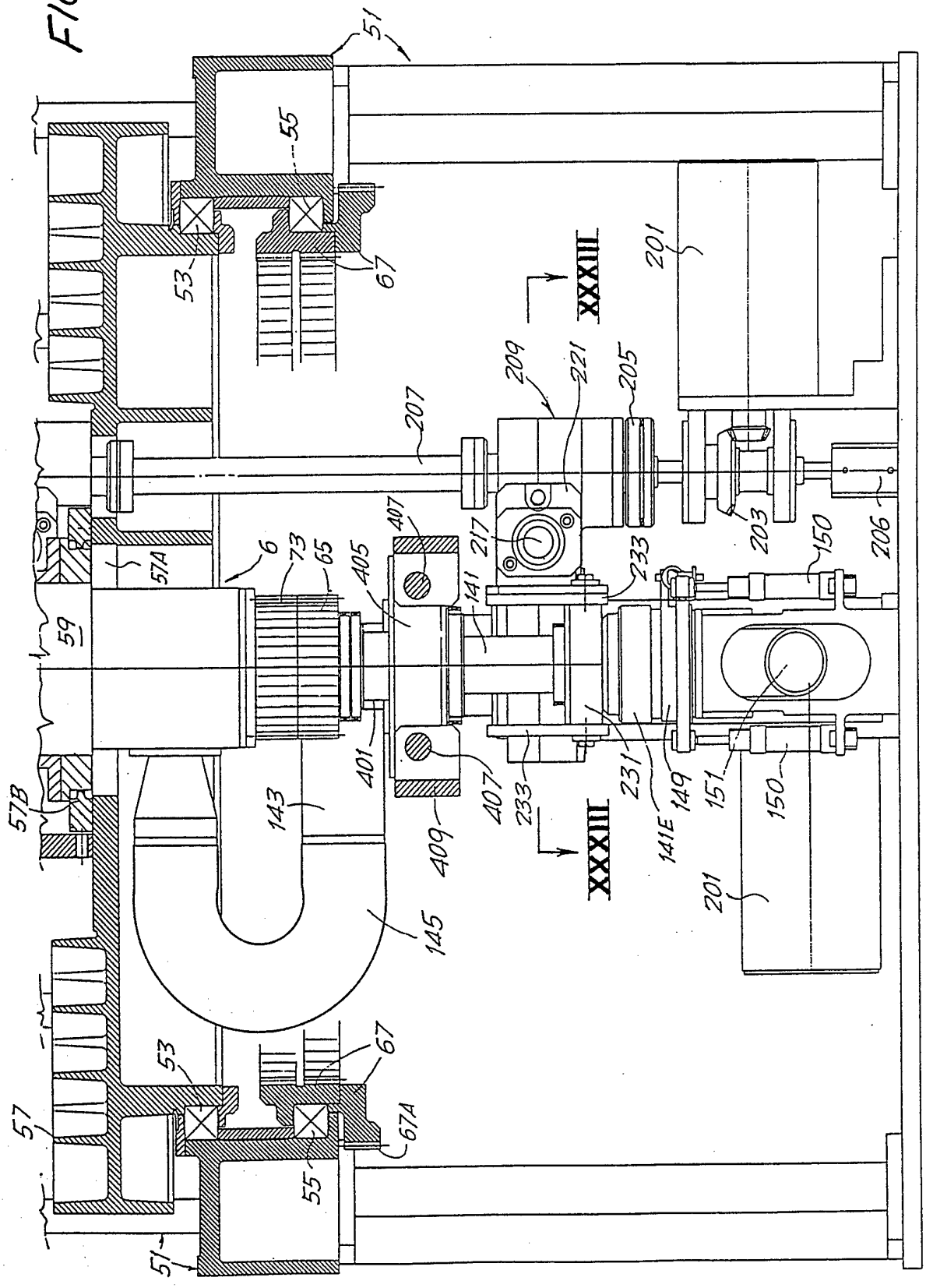
427
101
103
95
102
103A

FIG. 19B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55
53
67
XXXIII
201
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205
207
203
150
206
217
233
57A
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141
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57B
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409
145
231
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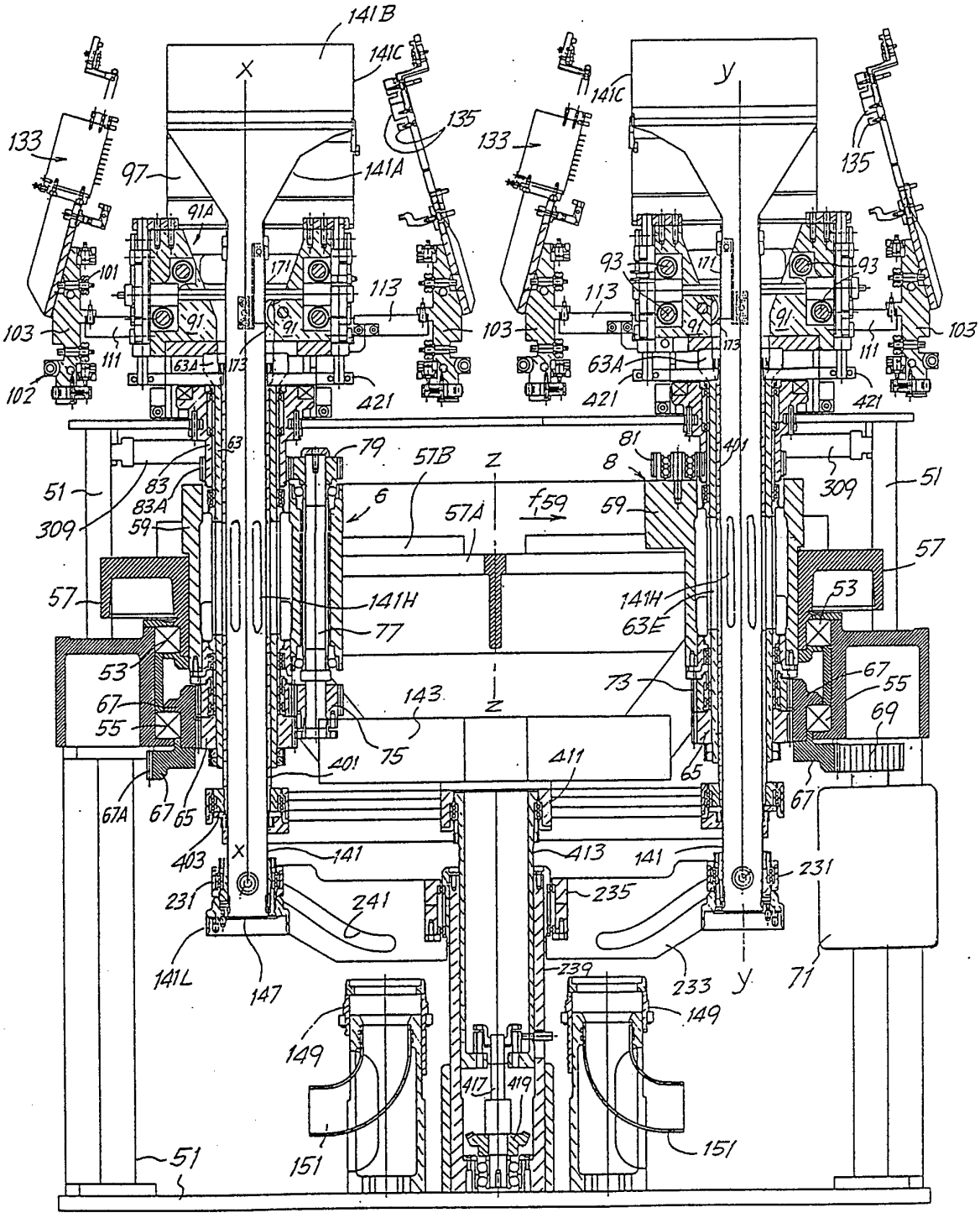
151
141E
67A
57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Y
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113
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63A
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79
57B
Z
81
8
401
309
51
83
83A
59
6
57A
59
57
53
141H
77
63E
67
55
69
73
143
75
401
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413
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233
71
141L
147
149
417
419
151

FIG. 20

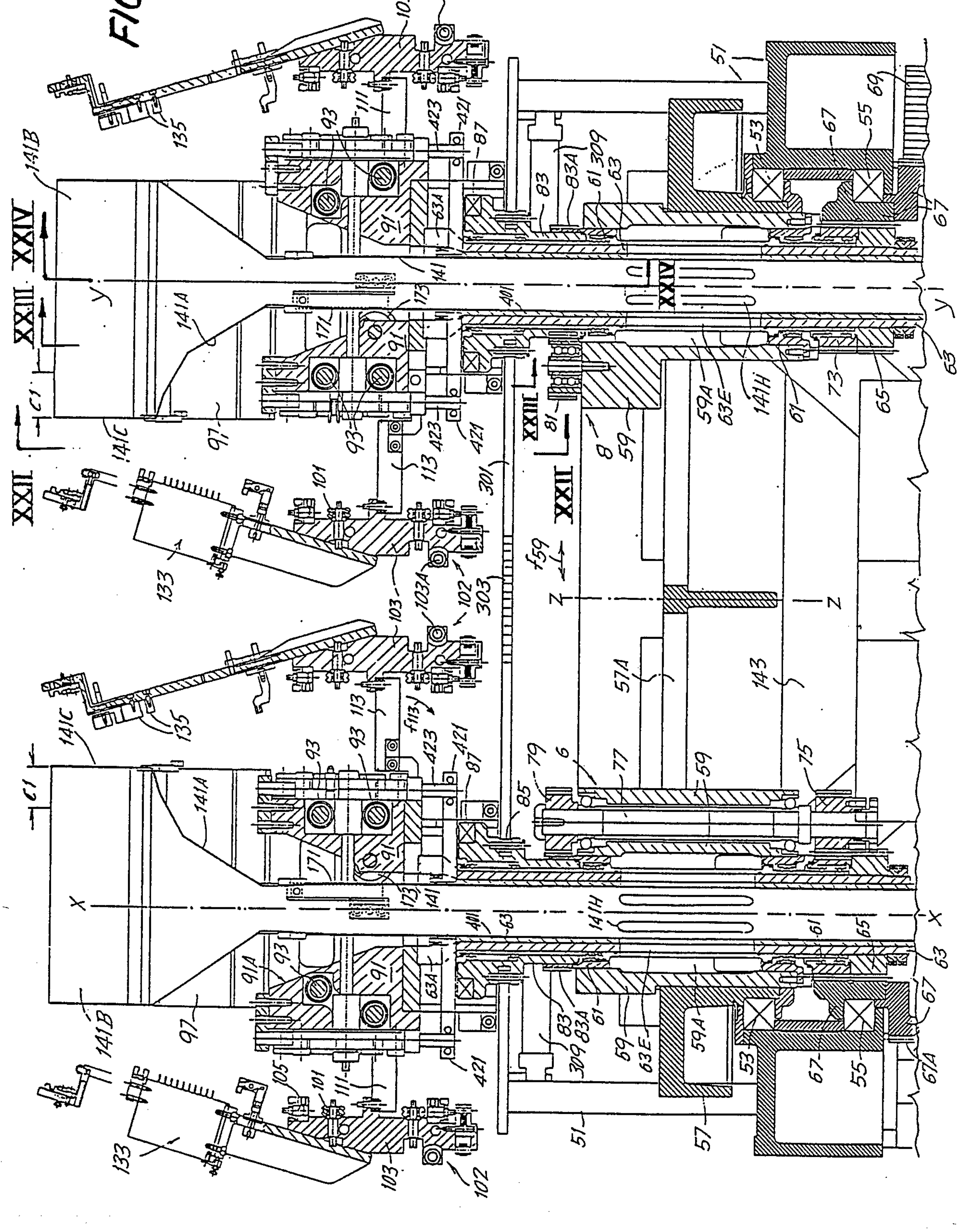
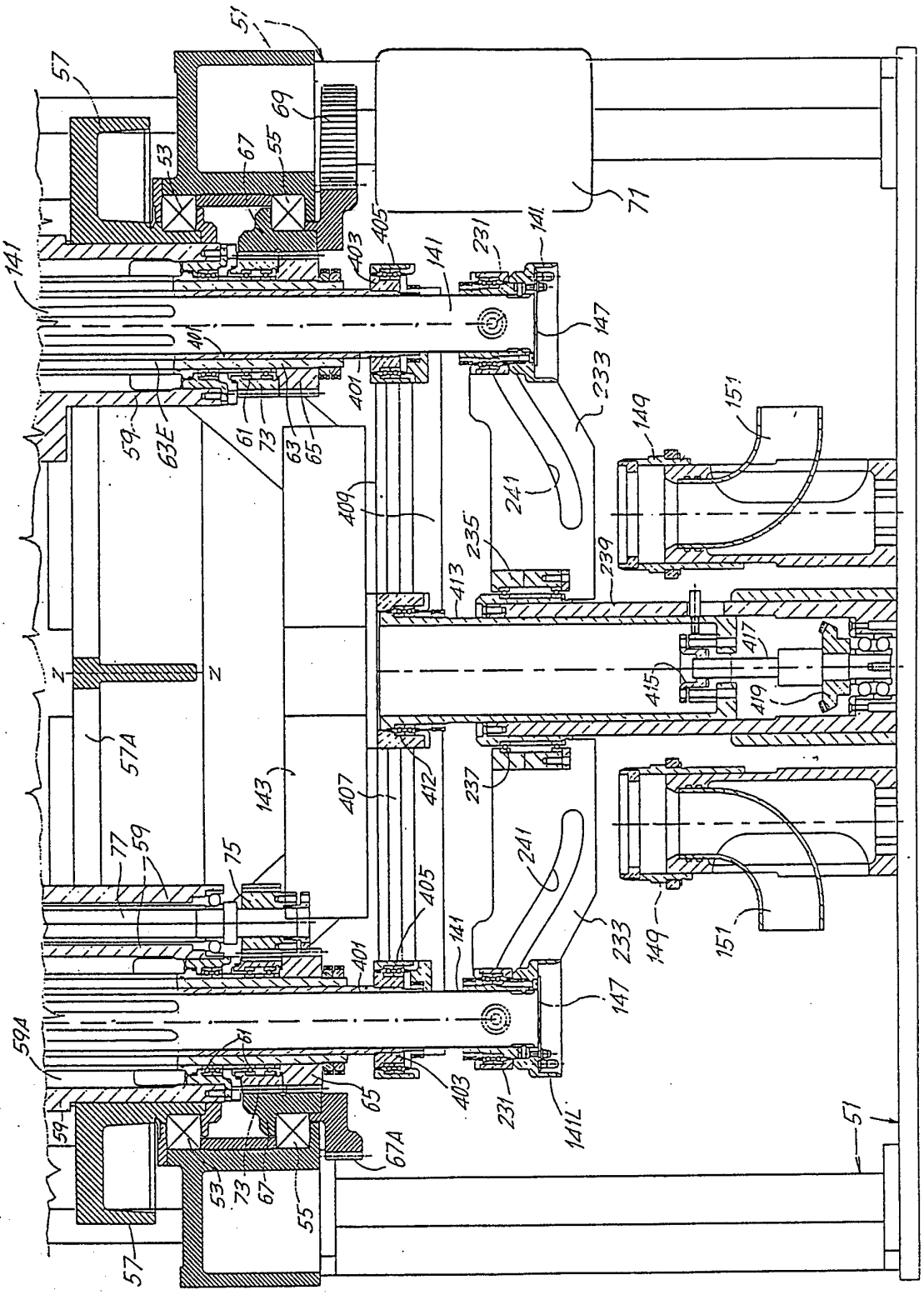


FIG. 20A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233
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401
59
63E
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63
65
409
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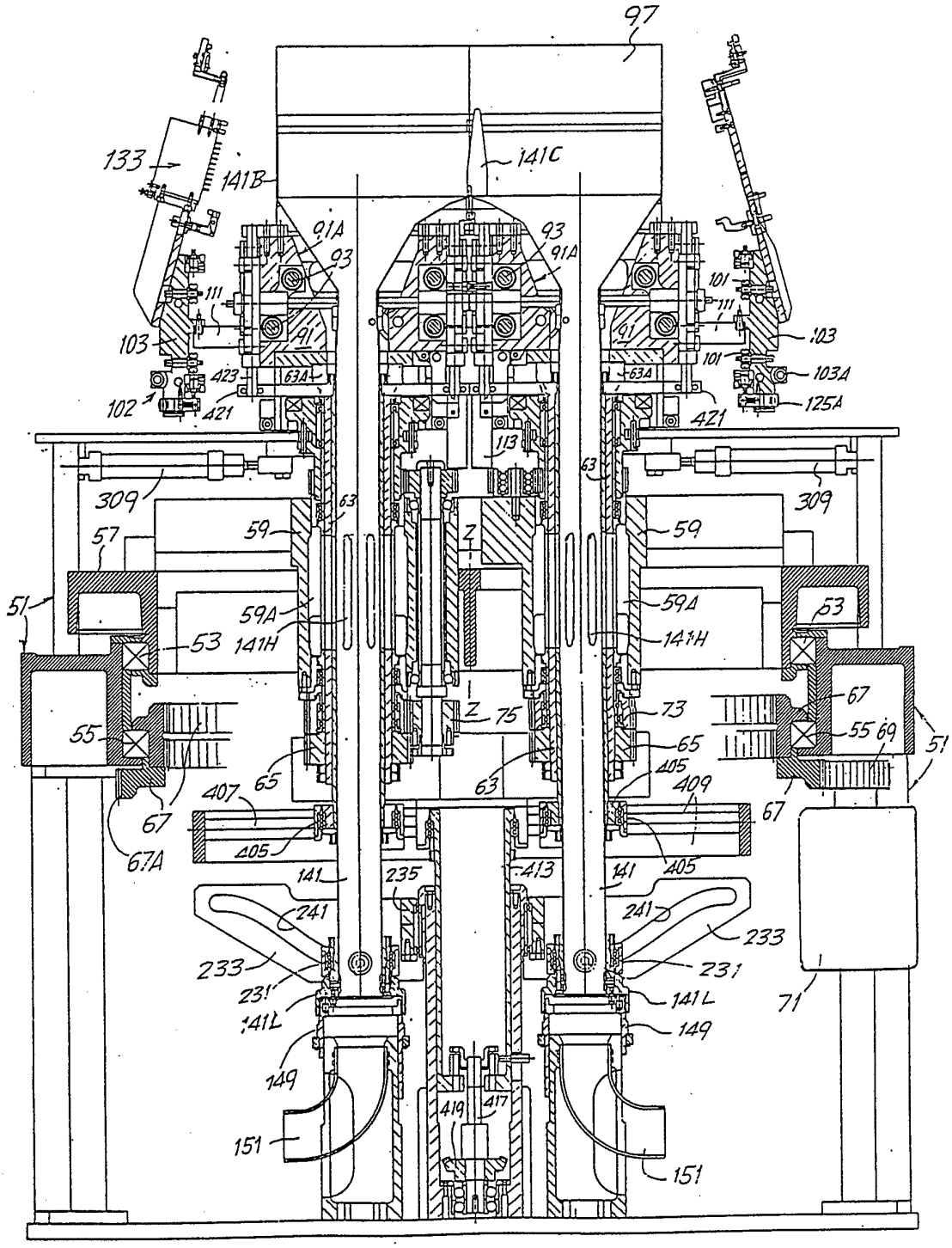
407
412
237
77
75
59A
57

FIG. 20B

FIG. 21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111
103
423
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102
421
101
103A
125A
113
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59
57
51
59A
141H
53
55
Z
75
73
67
65
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67A
141
235
413
241
233
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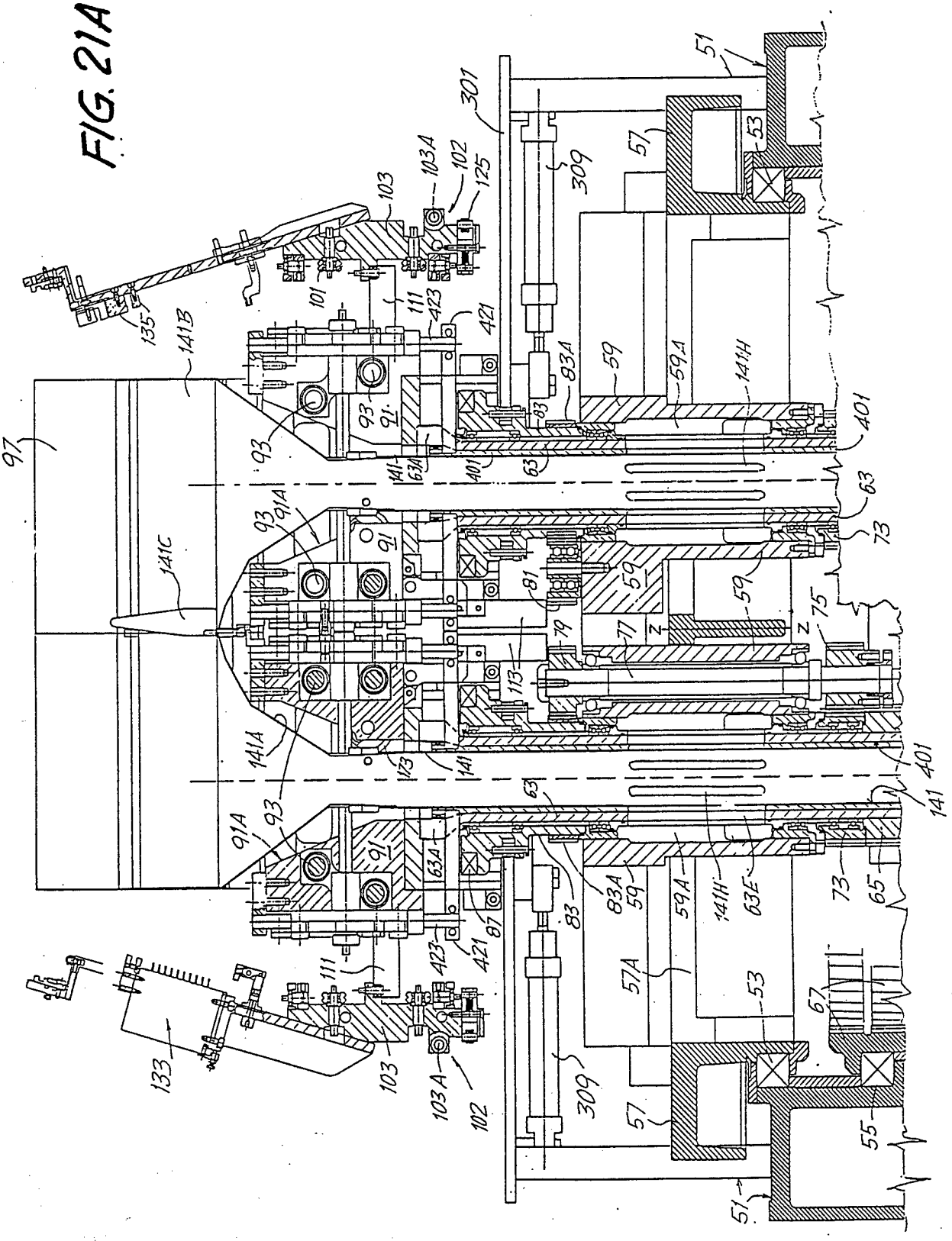
141L
149
151
419
417
71

FIG. 21A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309
57
57A
53
59
59A
141H
141I
141II
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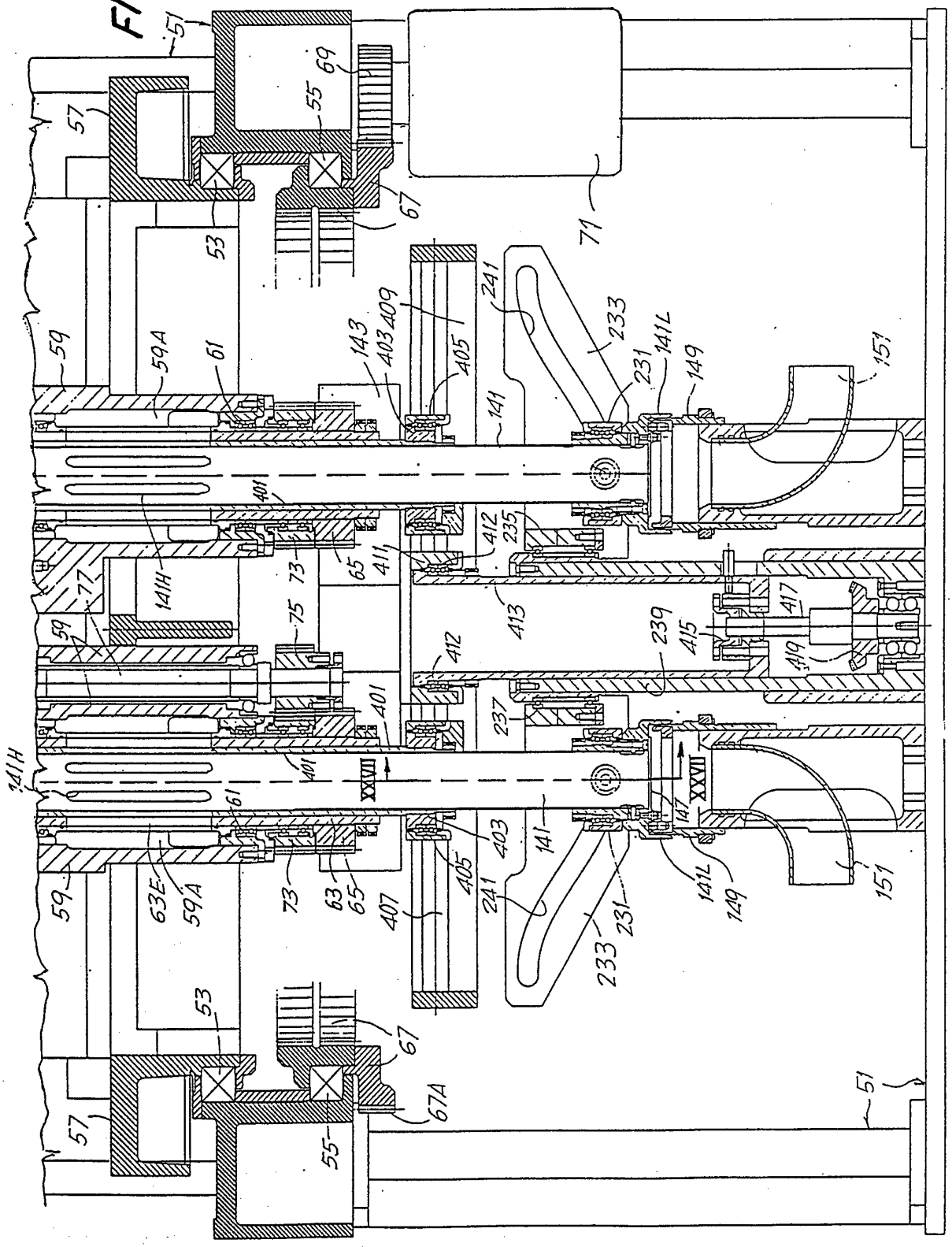
83A
81
79
77
113
173
141
401
73
75
65
67
55
51

FIG. 21B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412
235
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XXVIII
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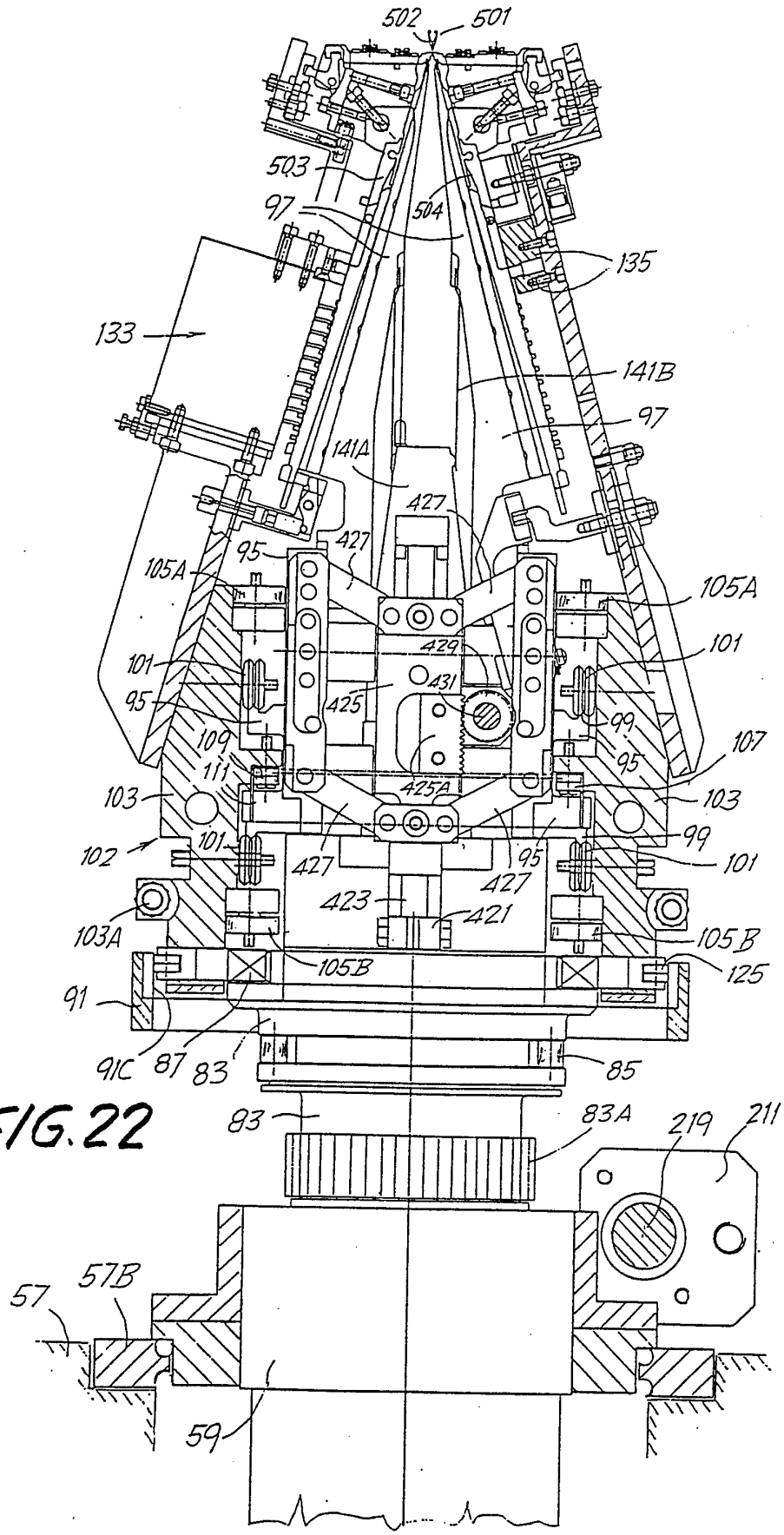
63E
63
407
67A
55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425A
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101
427
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83A
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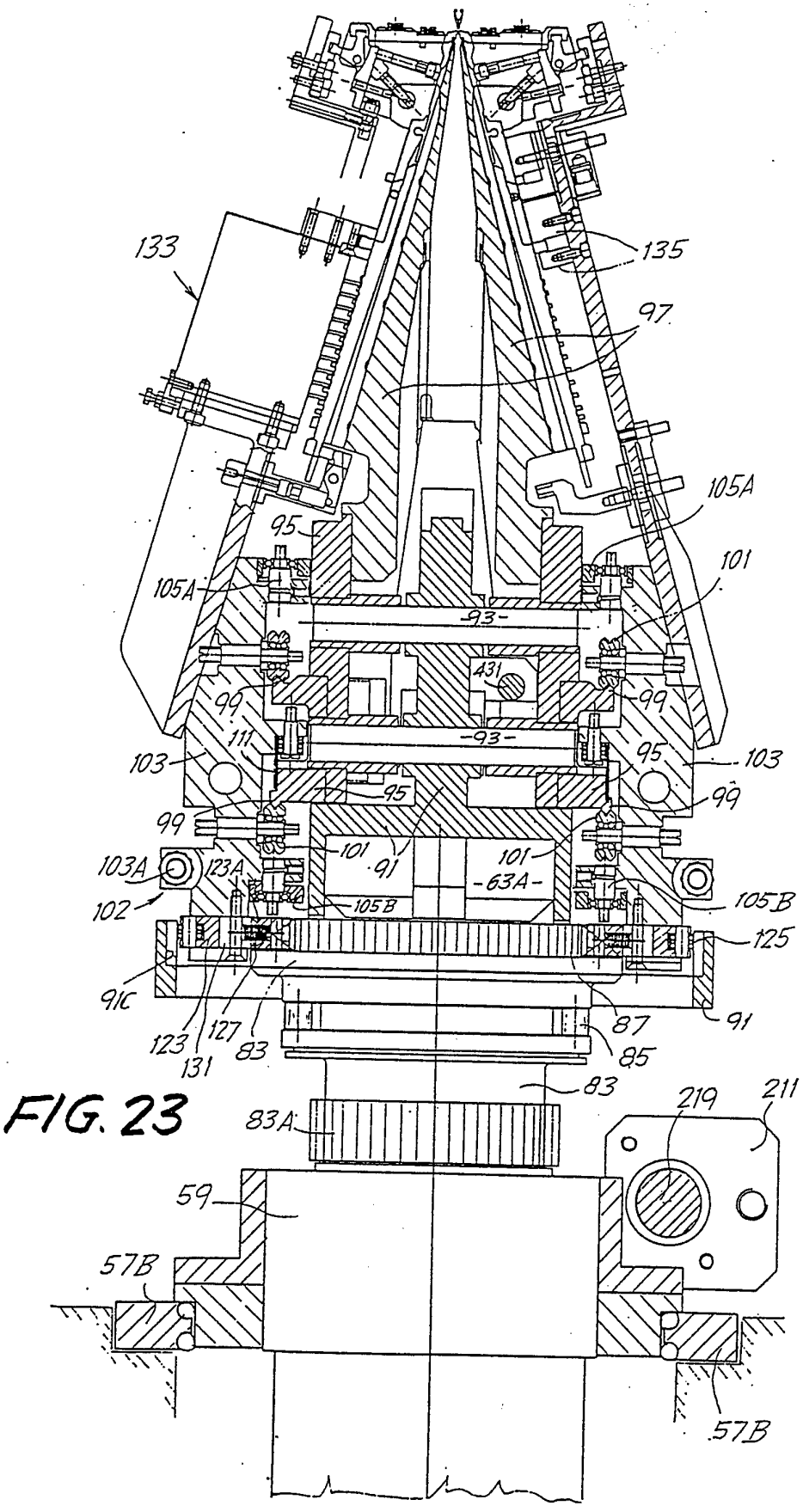
57B
59

FIG. 22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87
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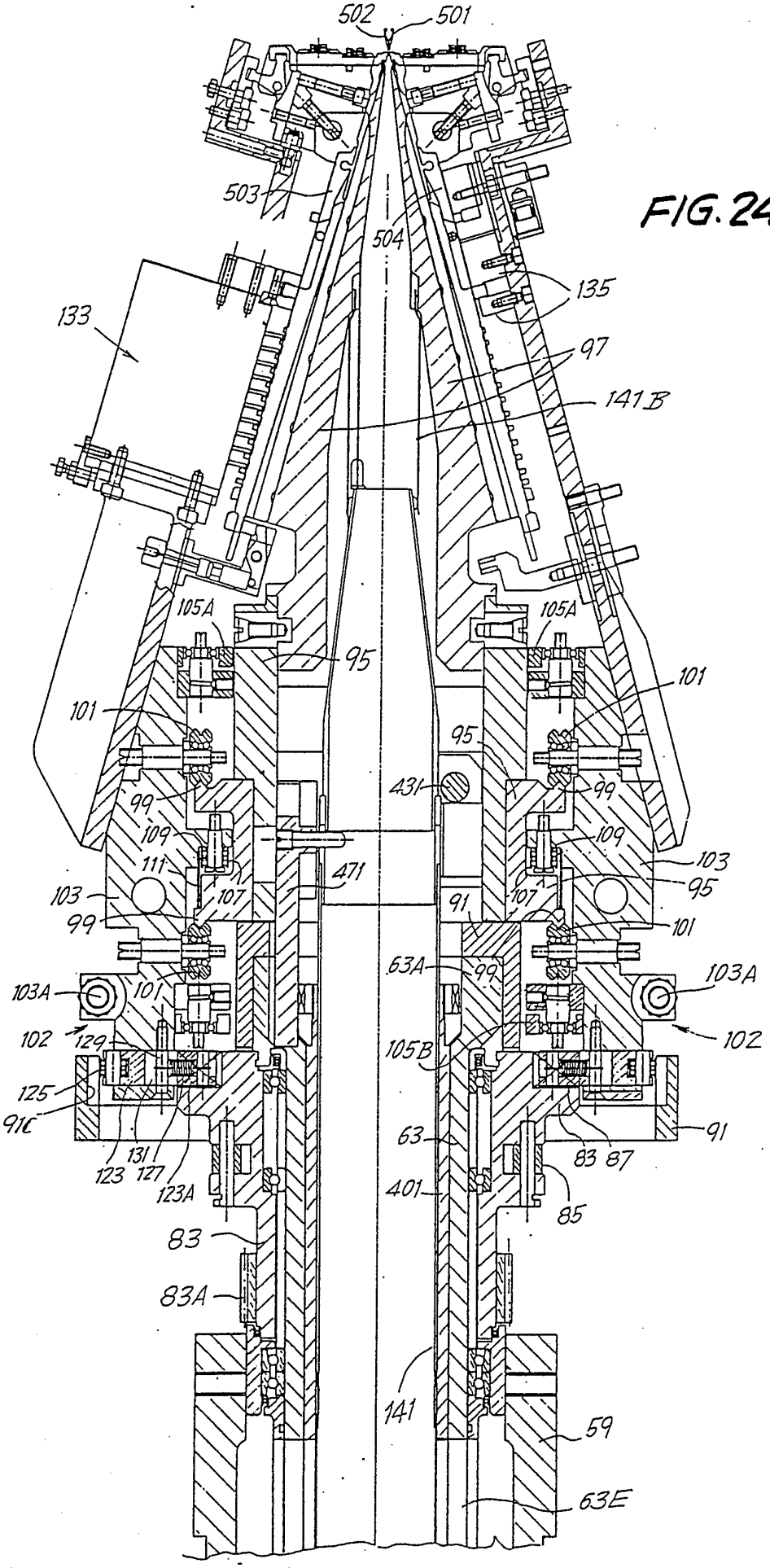
83
83A
219
211
59
57B
57B

FIG. 23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103
95
107
107
91
99
101
63A
99
103A
103A
101
102
129
105B
102
125
91C
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123A
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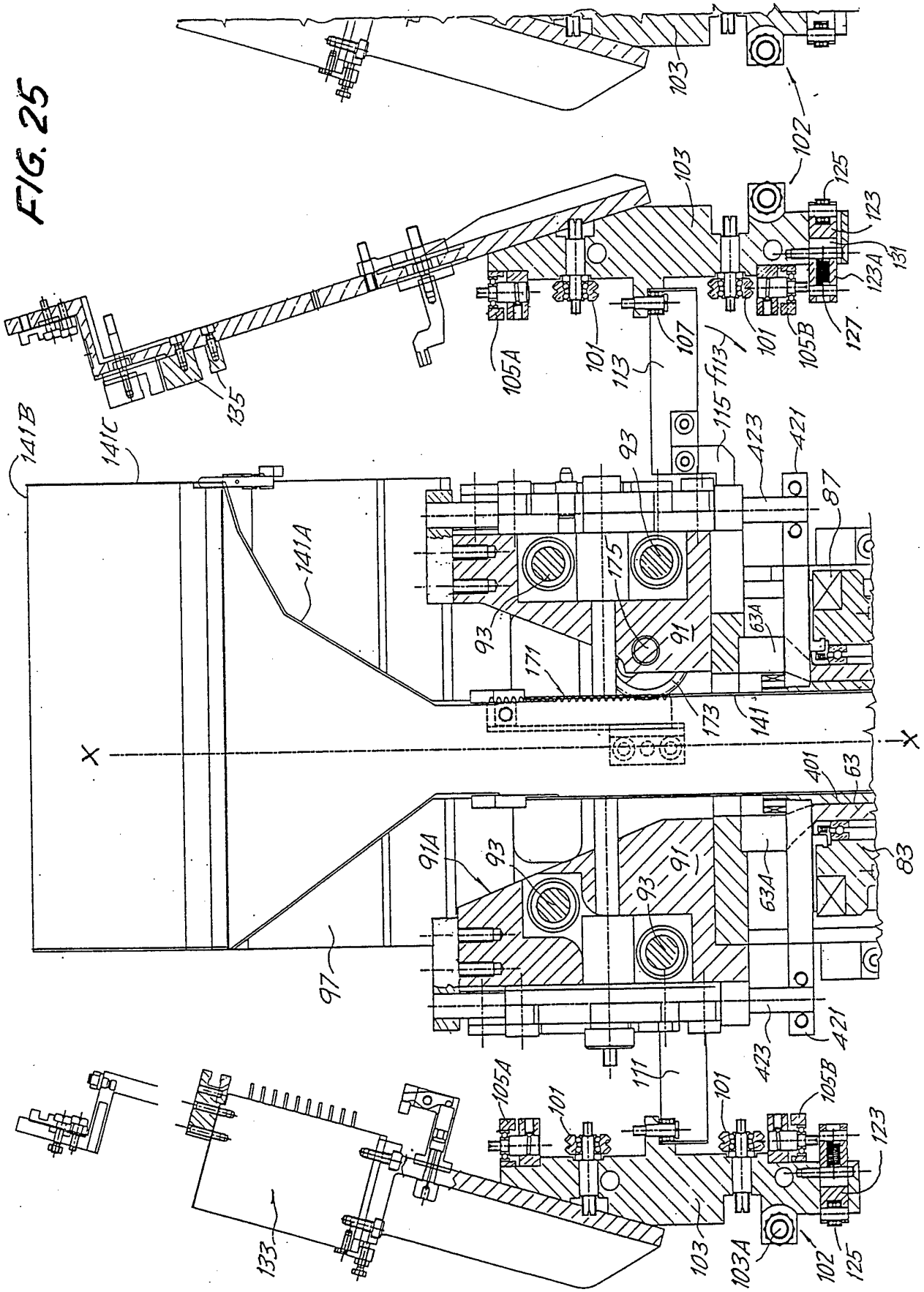
85
401
83
83A
141
59
63E

FIG. 24

FIG. 25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97
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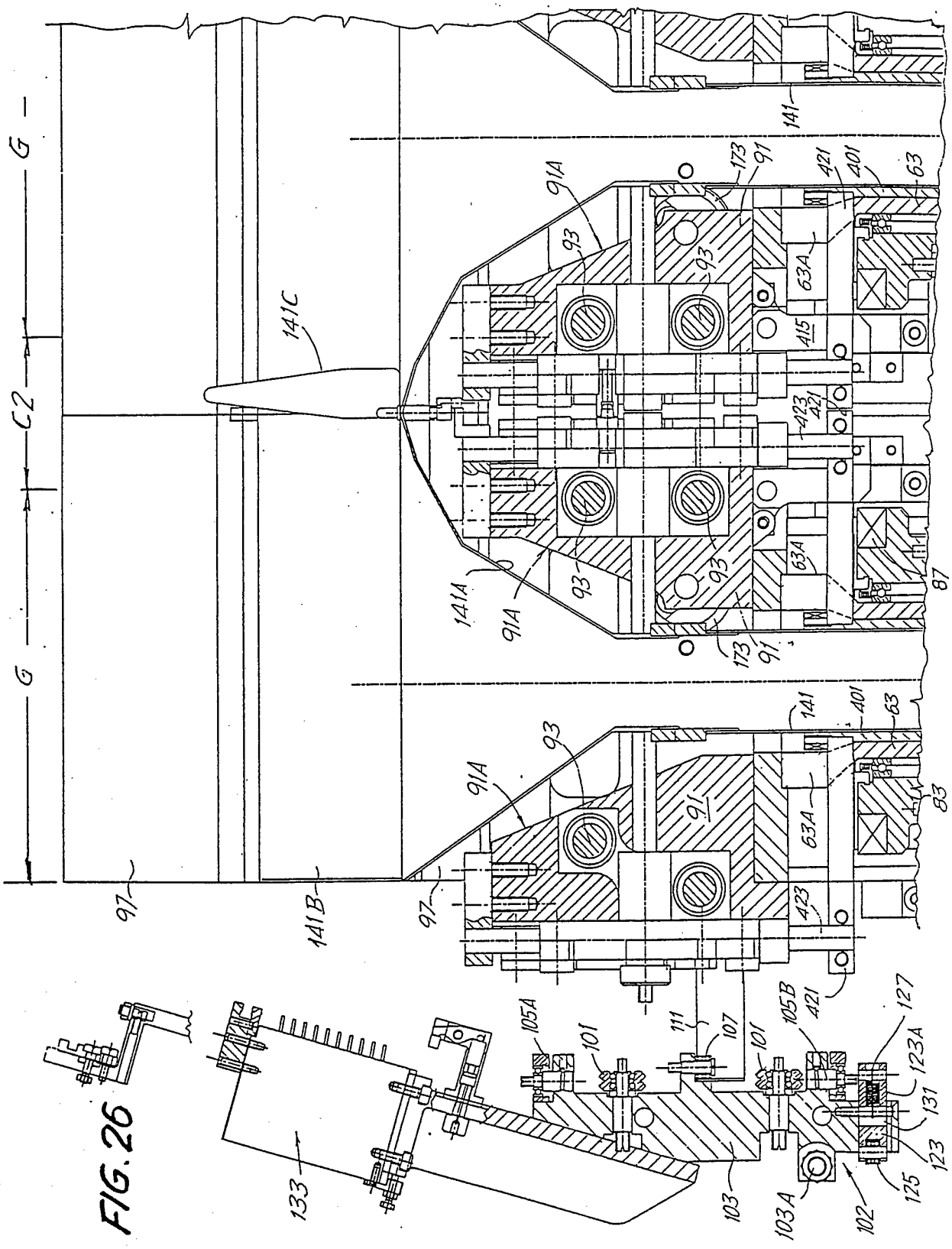
103A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63A
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141C
423
141A
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105B
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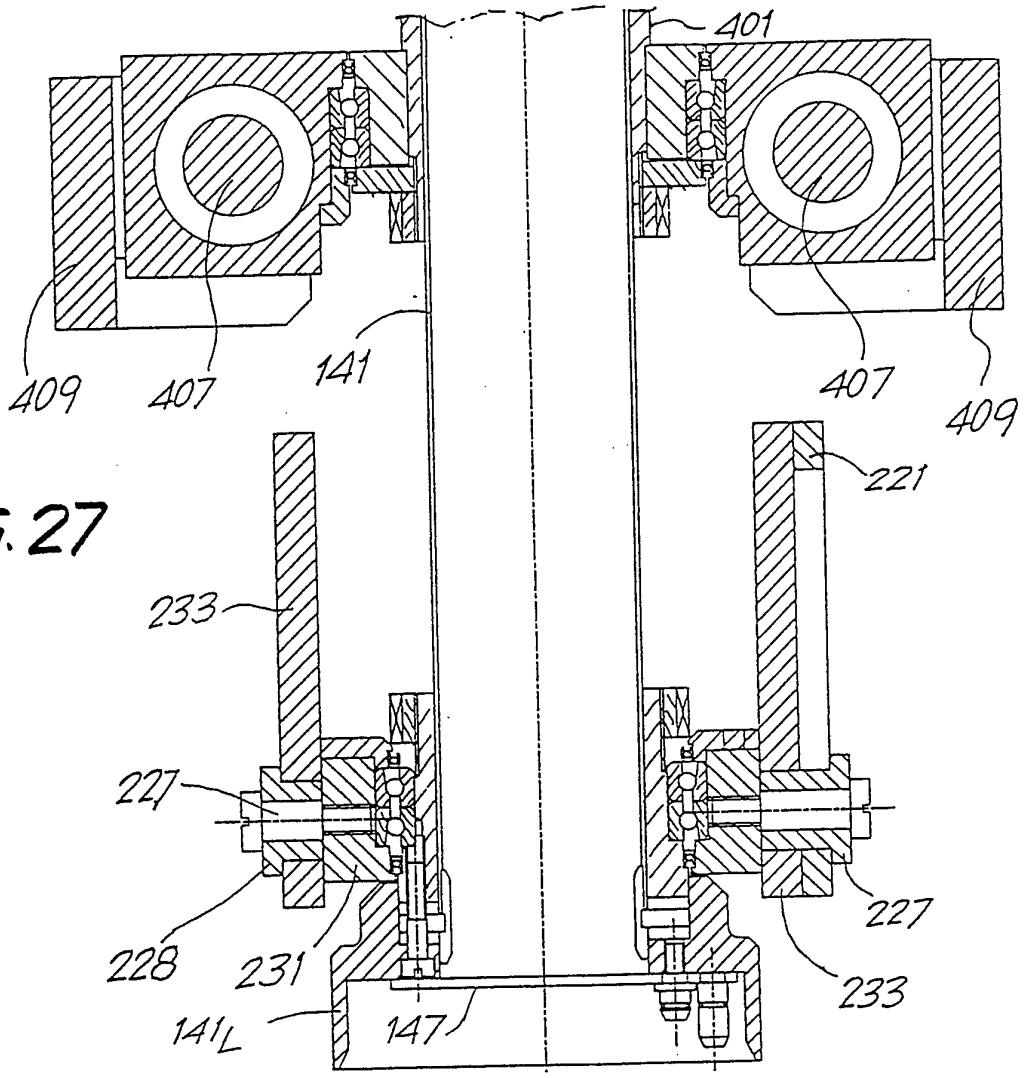
123A
131
123
125
103
103A
102
133

FIG. 26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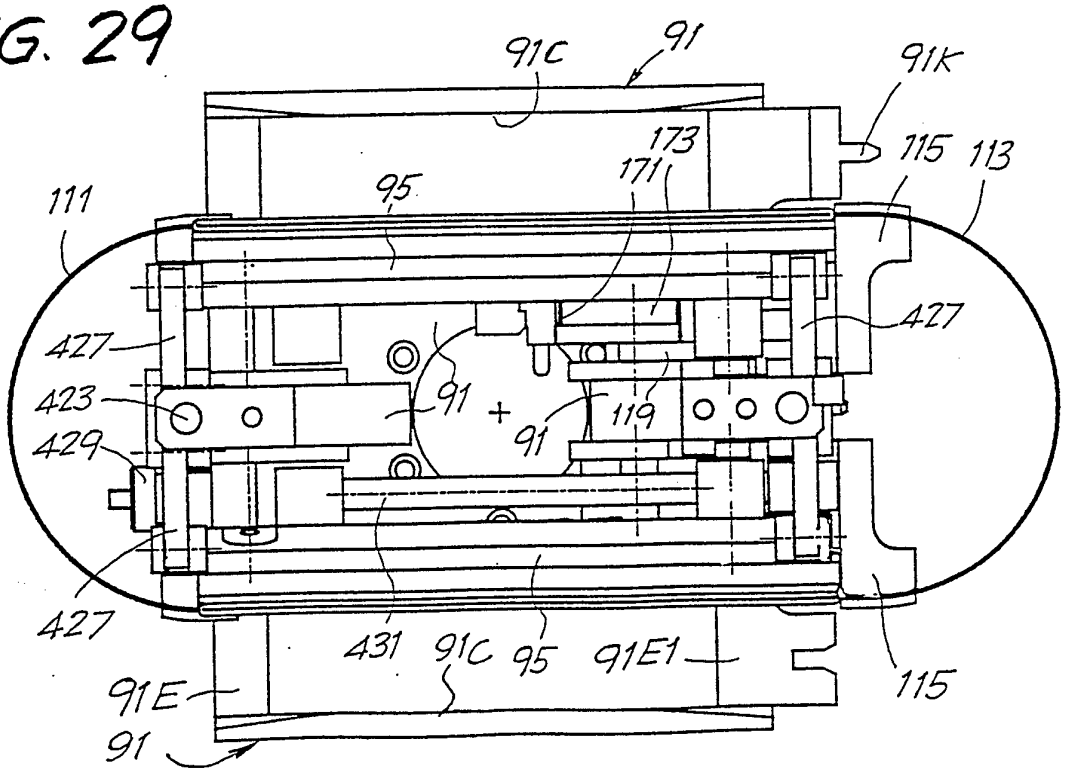
231
233
141L
147

FIG. 27

FIG. 29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91C
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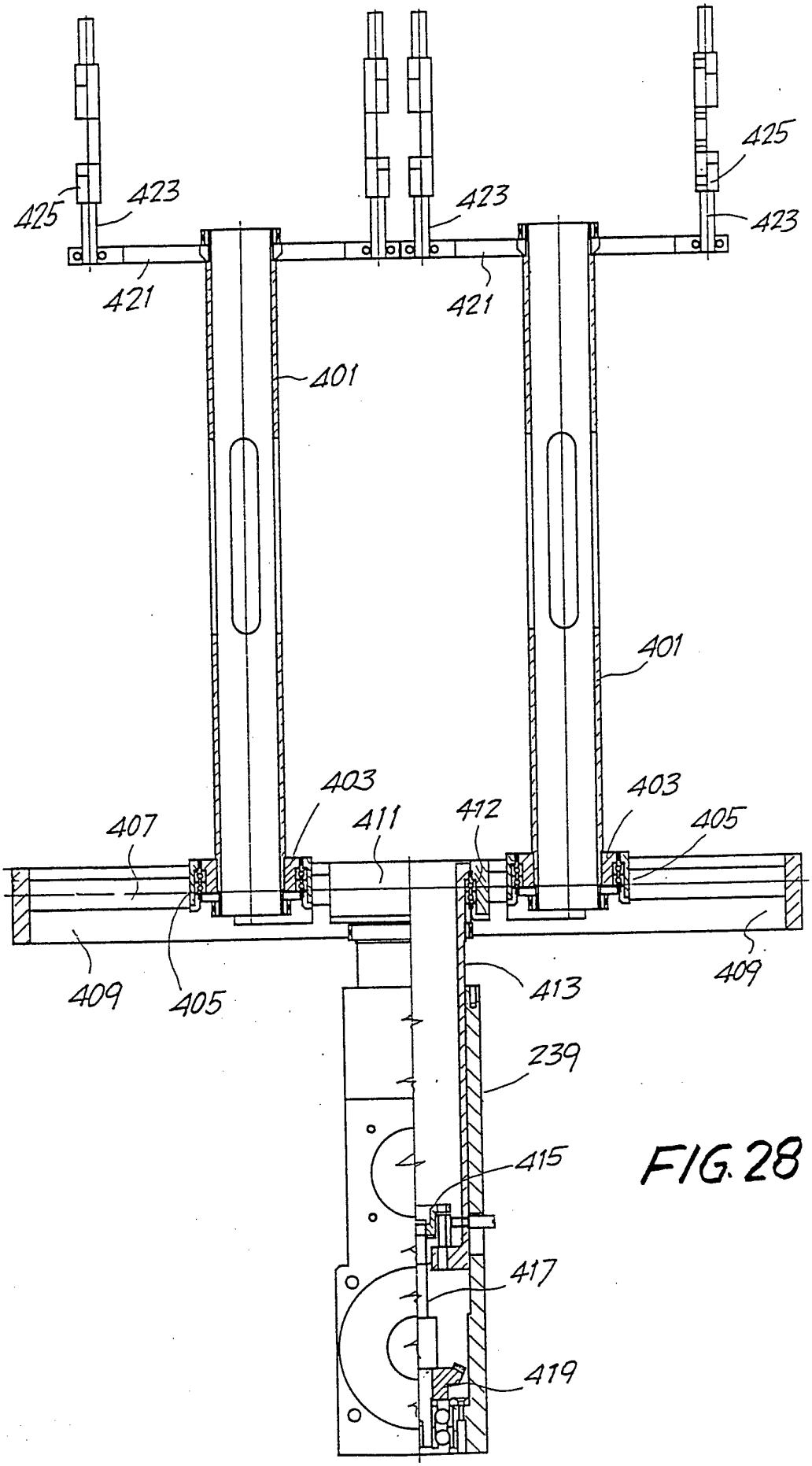
91E1
115
91E
91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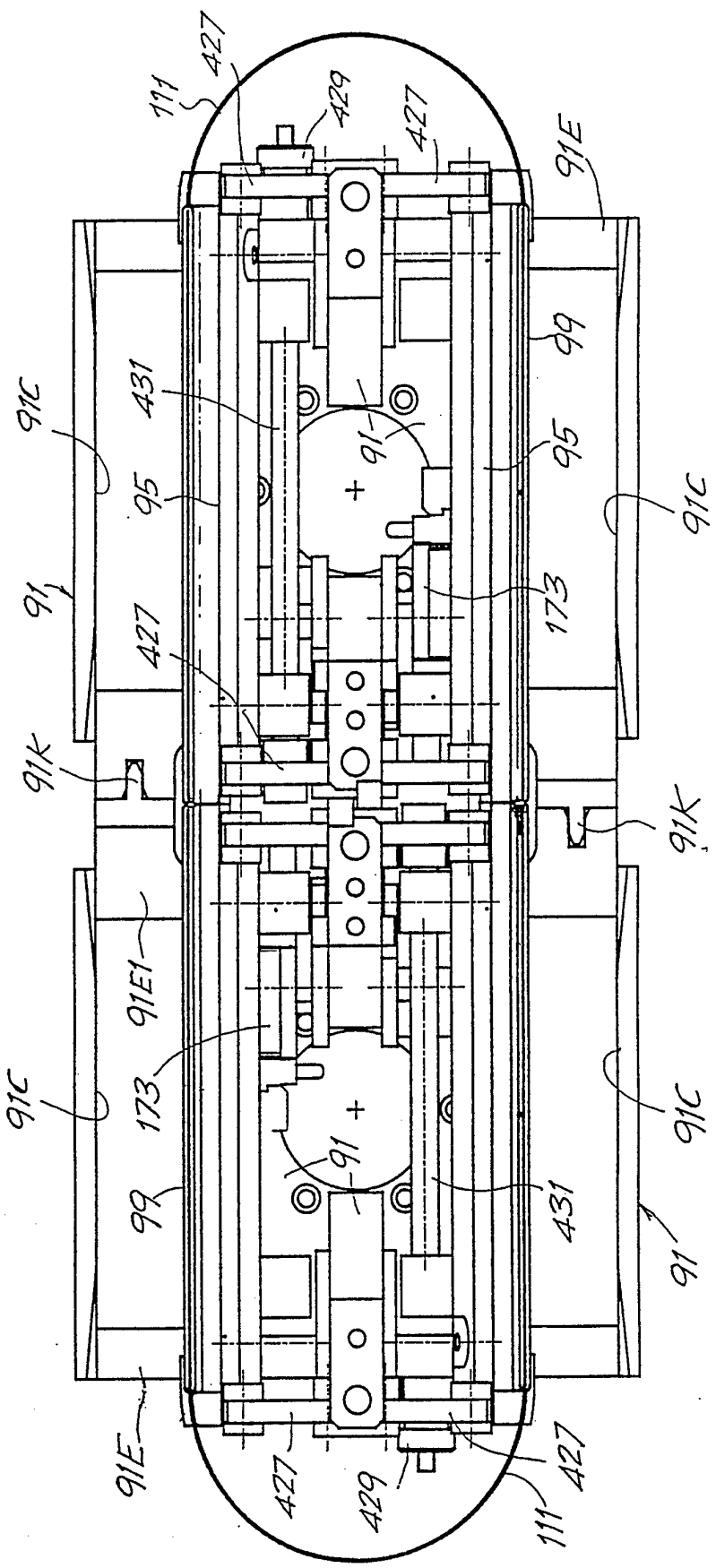
415
417
419

FIG. 28

FIG. 30


111
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91C
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91C
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91C
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91E
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427
111

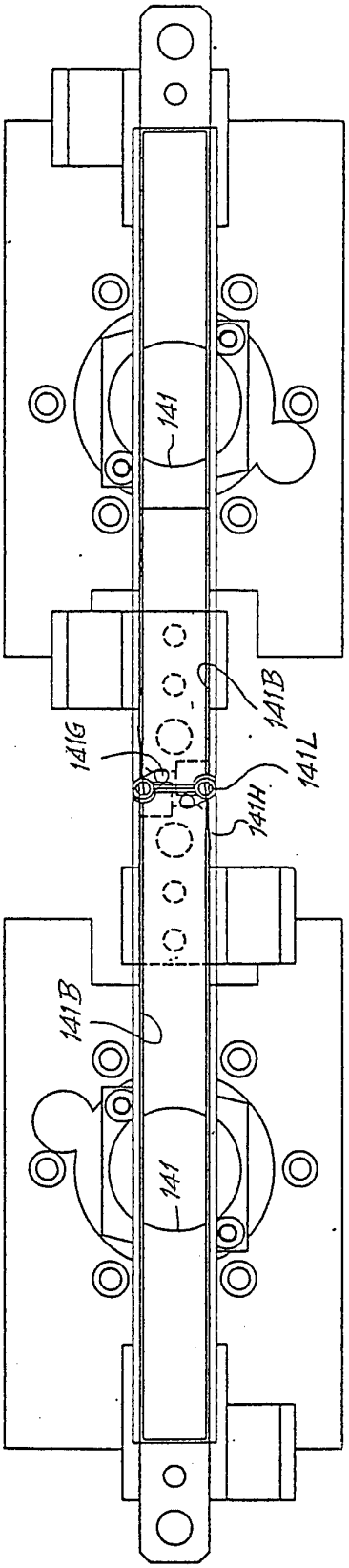
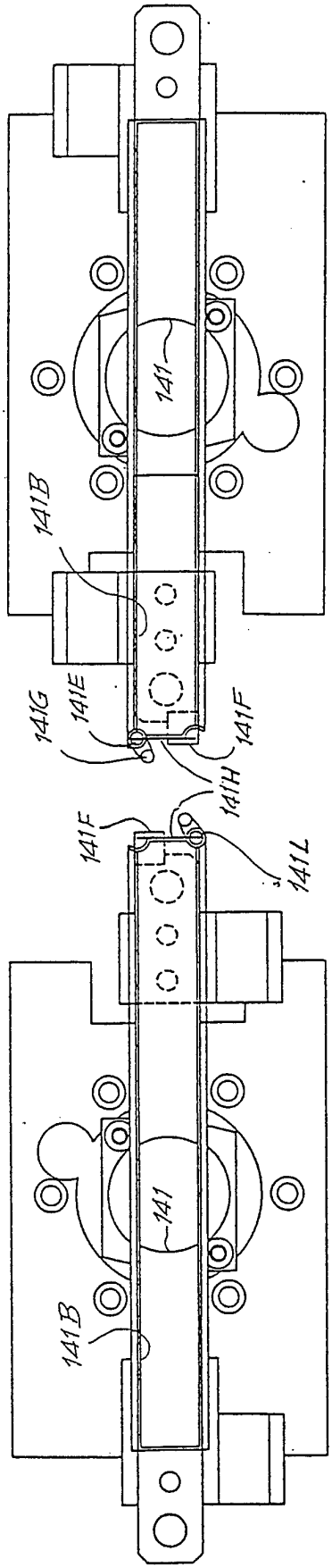

141
141G
141B
141L
141H
141B
141

FIG. 32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141H
141F
141L
141
141B

FIG. 31

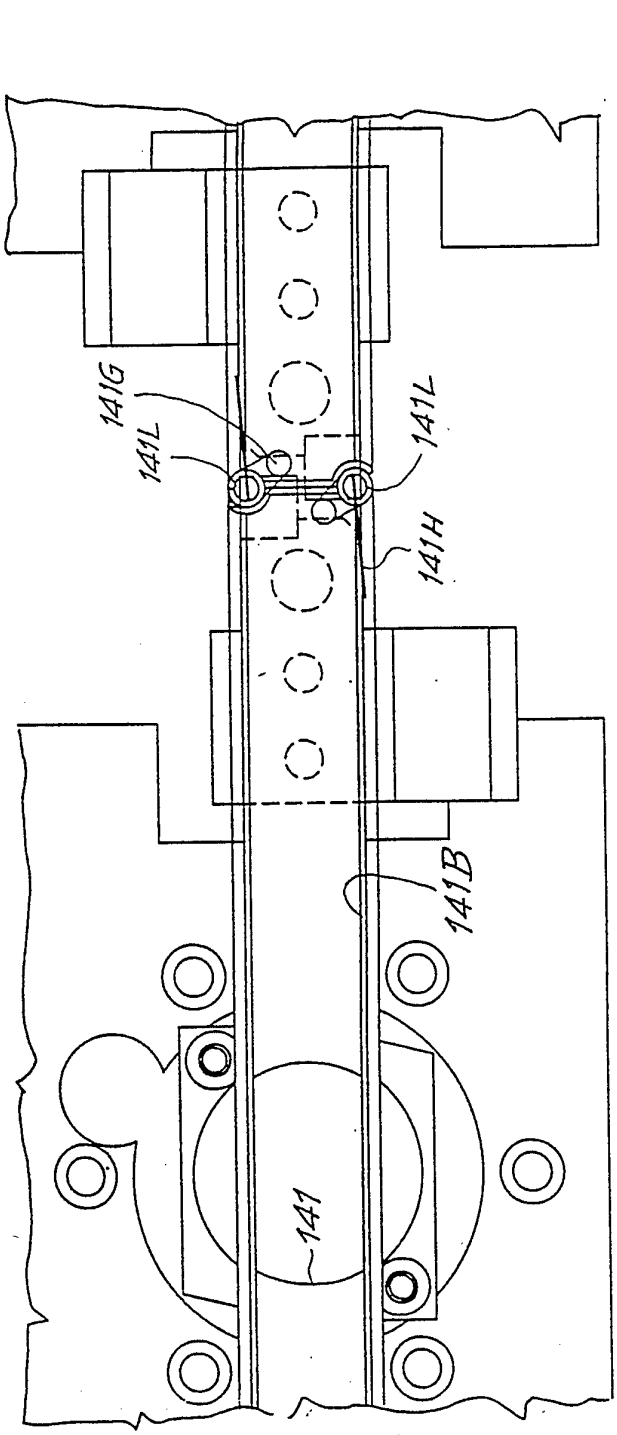


FIG.33B

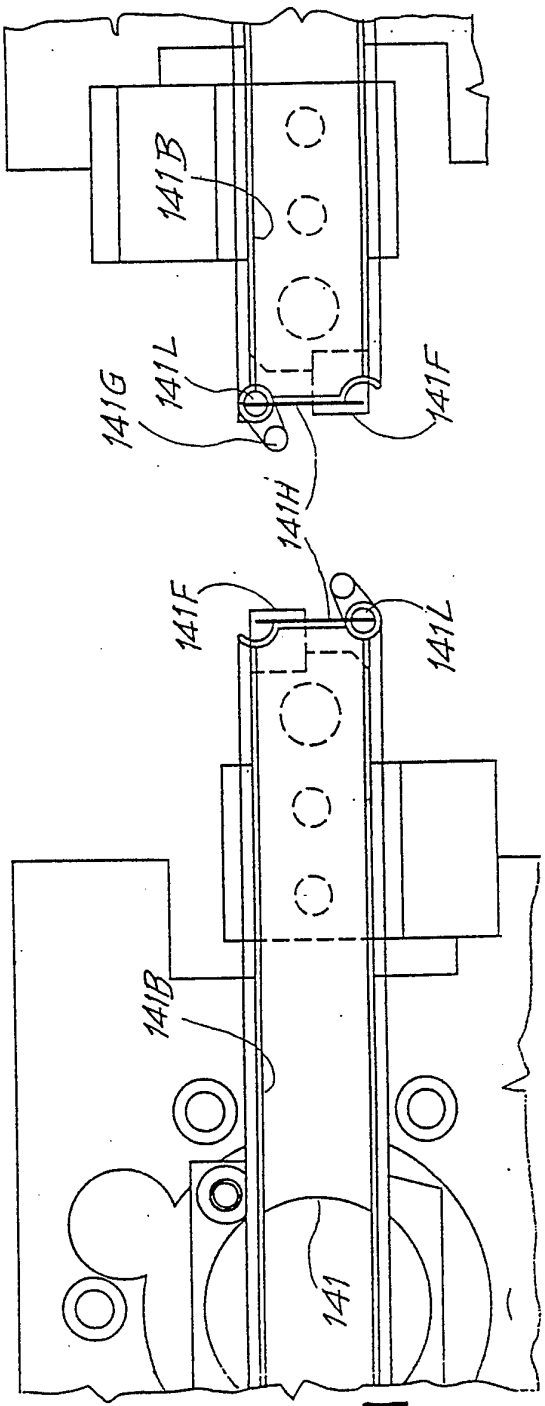
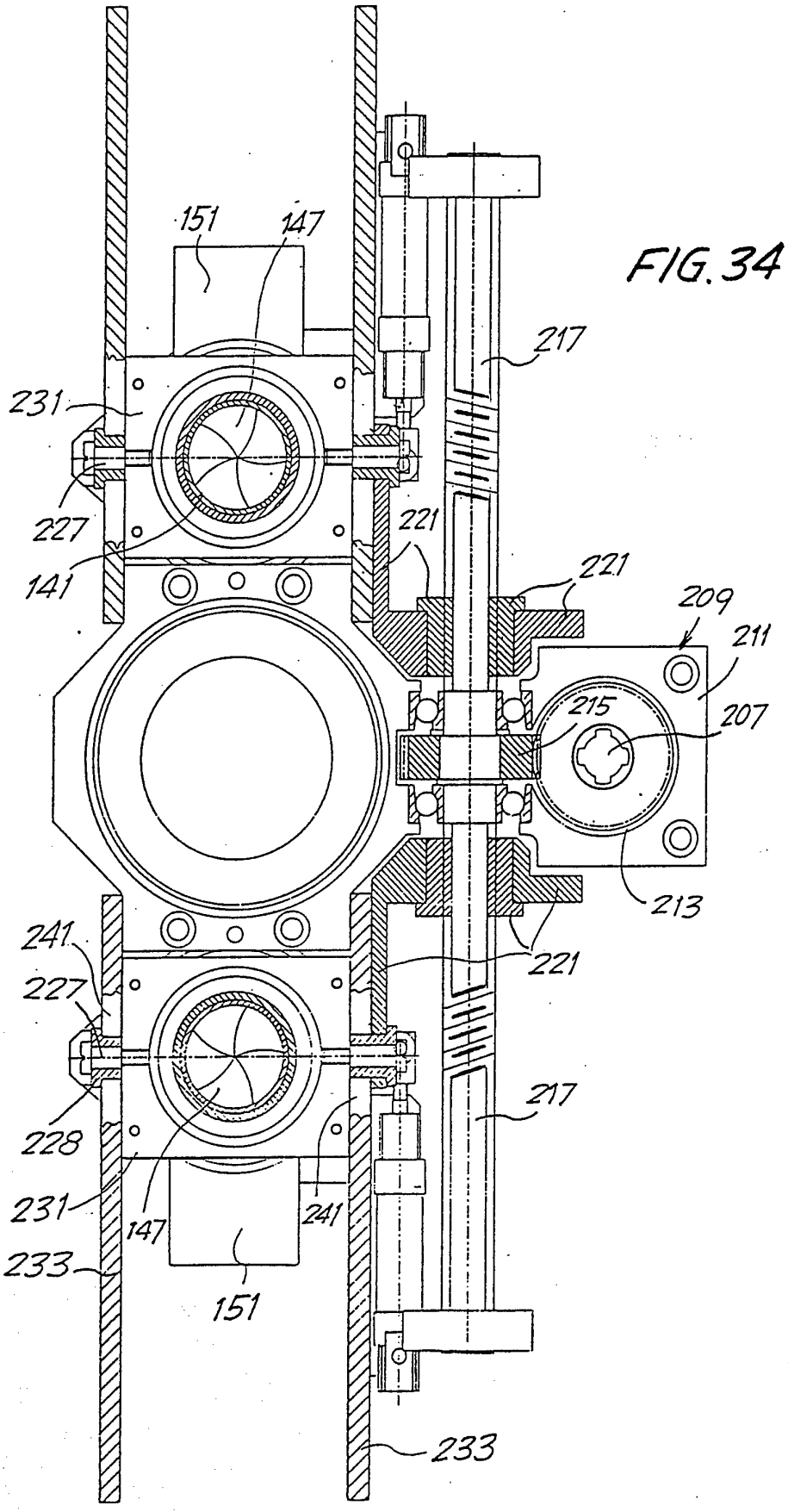


FIG.33A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217
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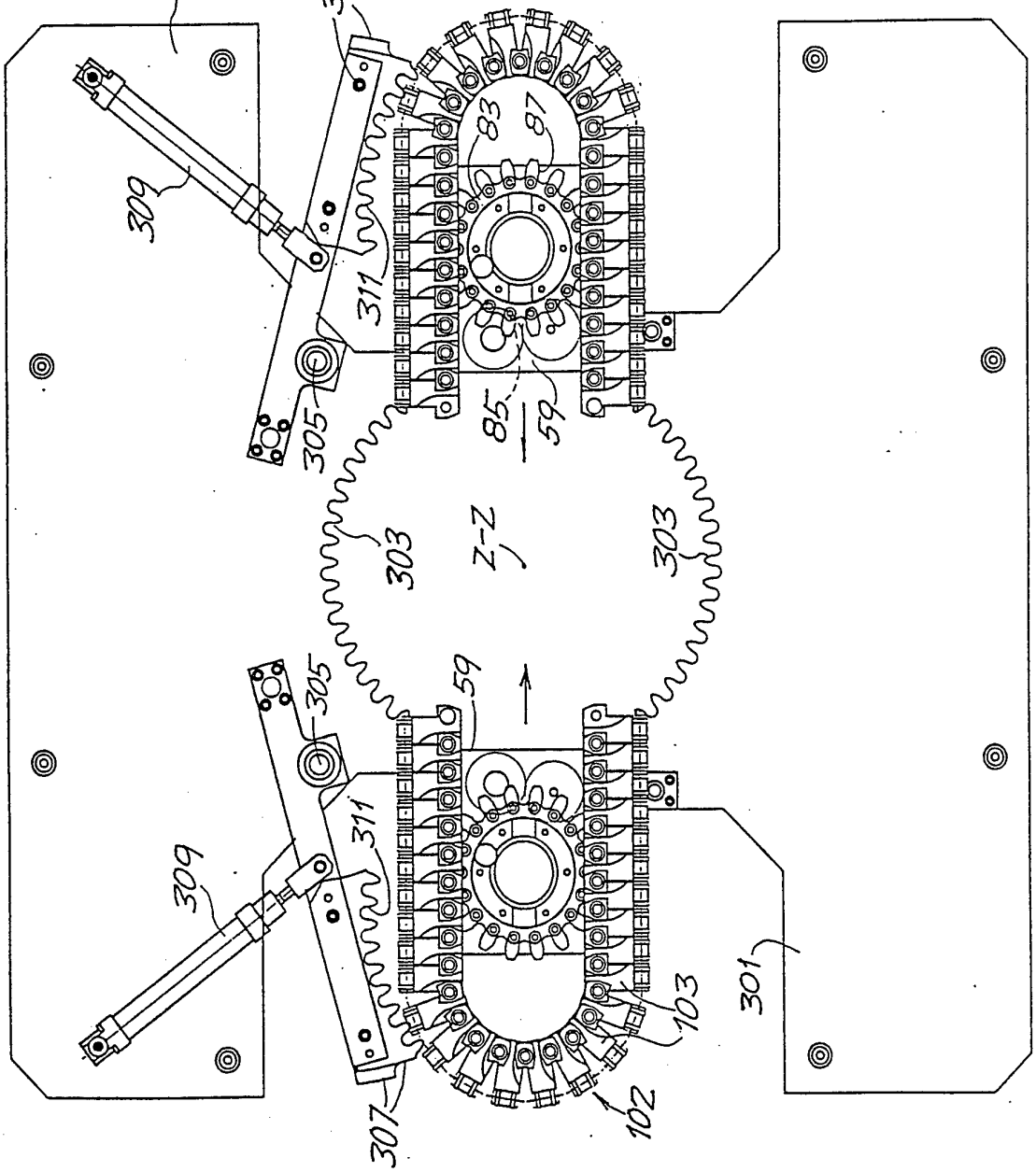
FIG. 34

FIG. 35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Z-Z
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307
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102
301

FIG. 36

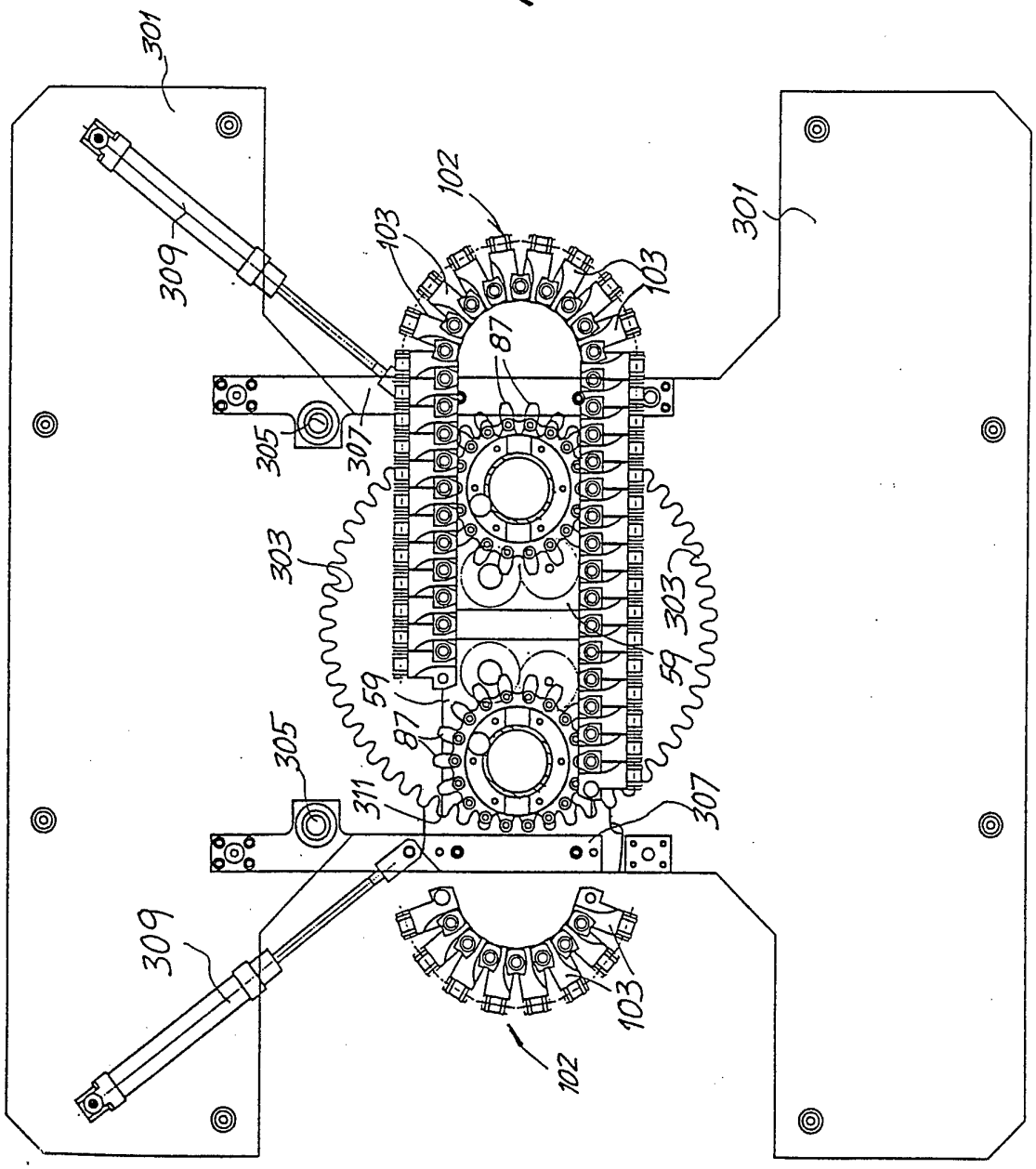
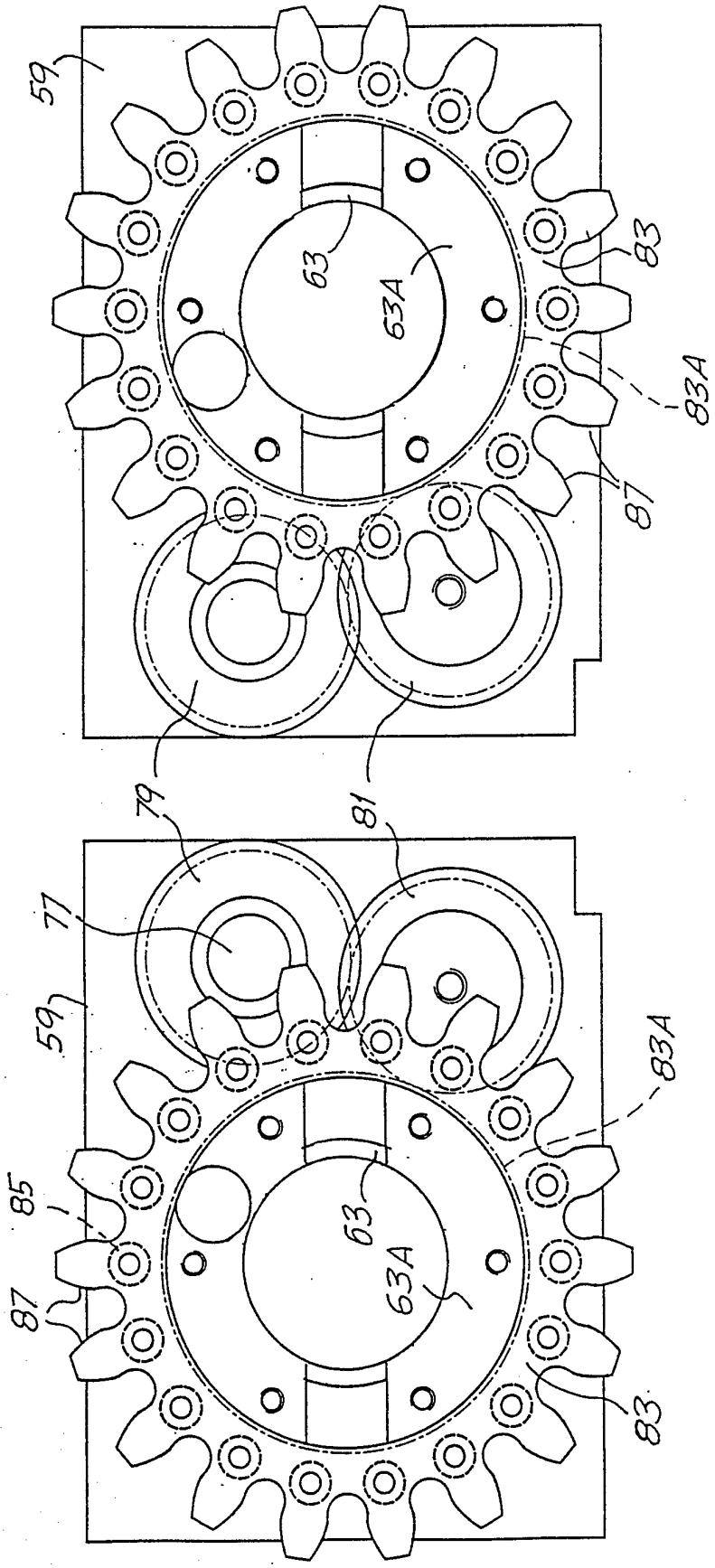


FIG. 37



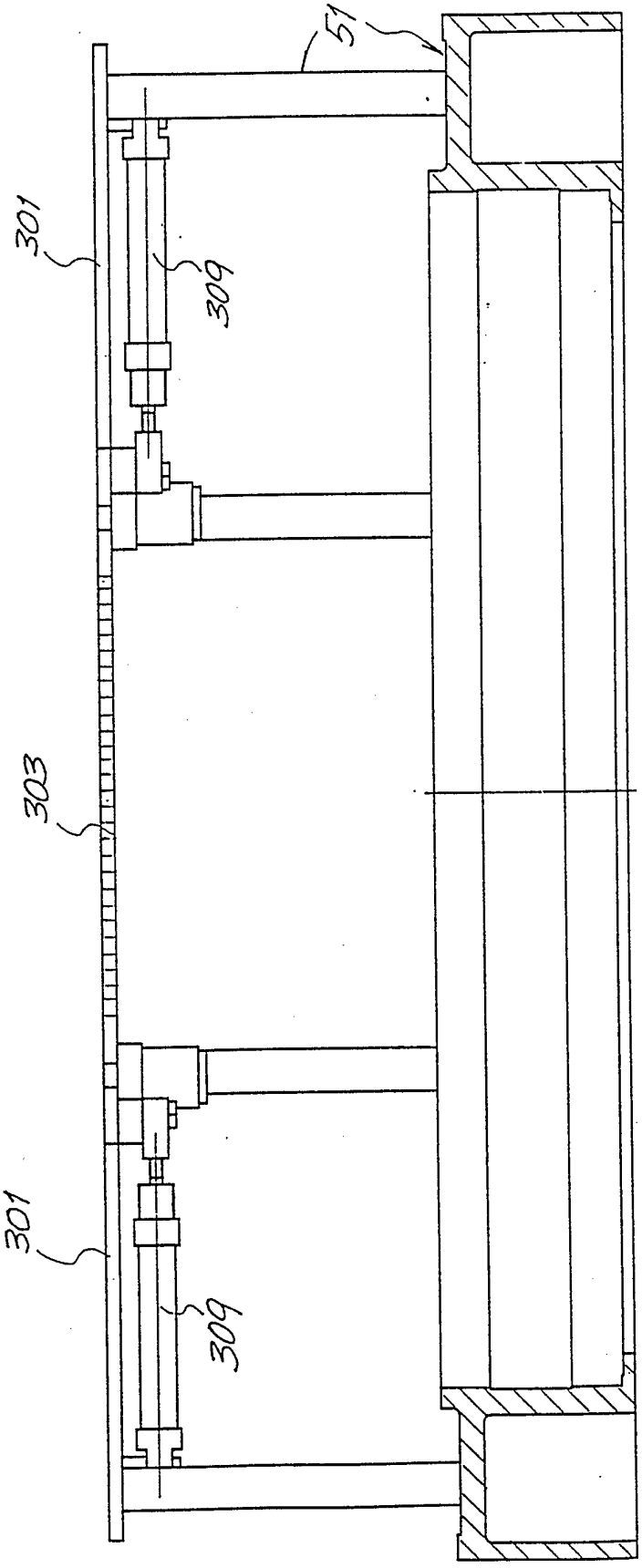


FIG. 38

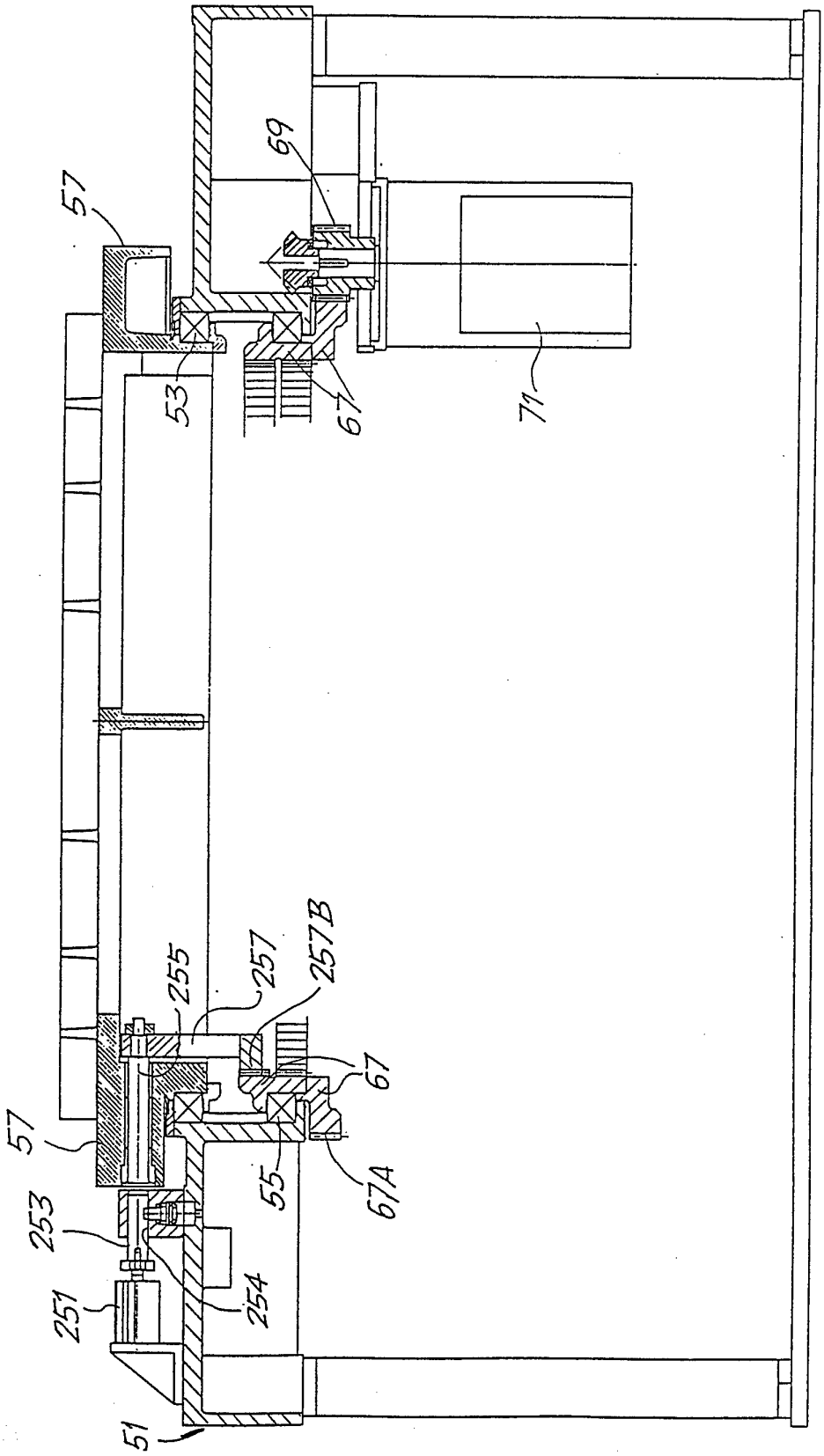


FIG. 39

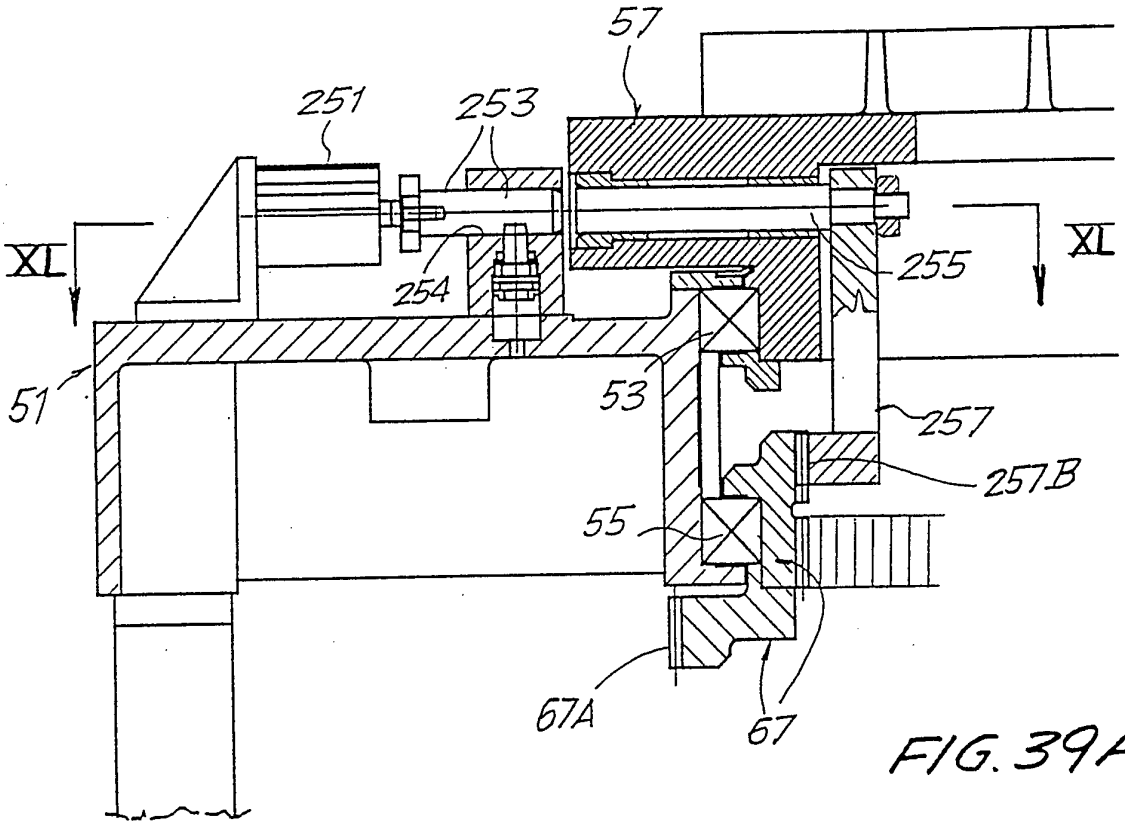


FIG. 39A

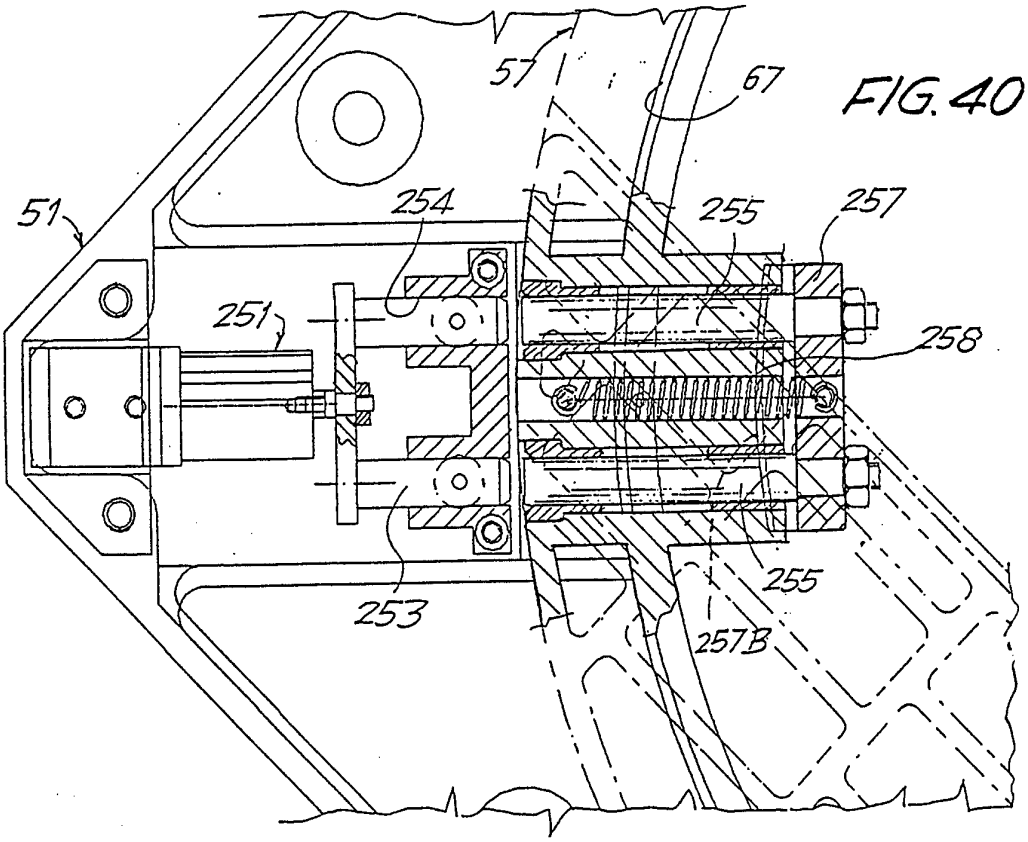


FIG. 40

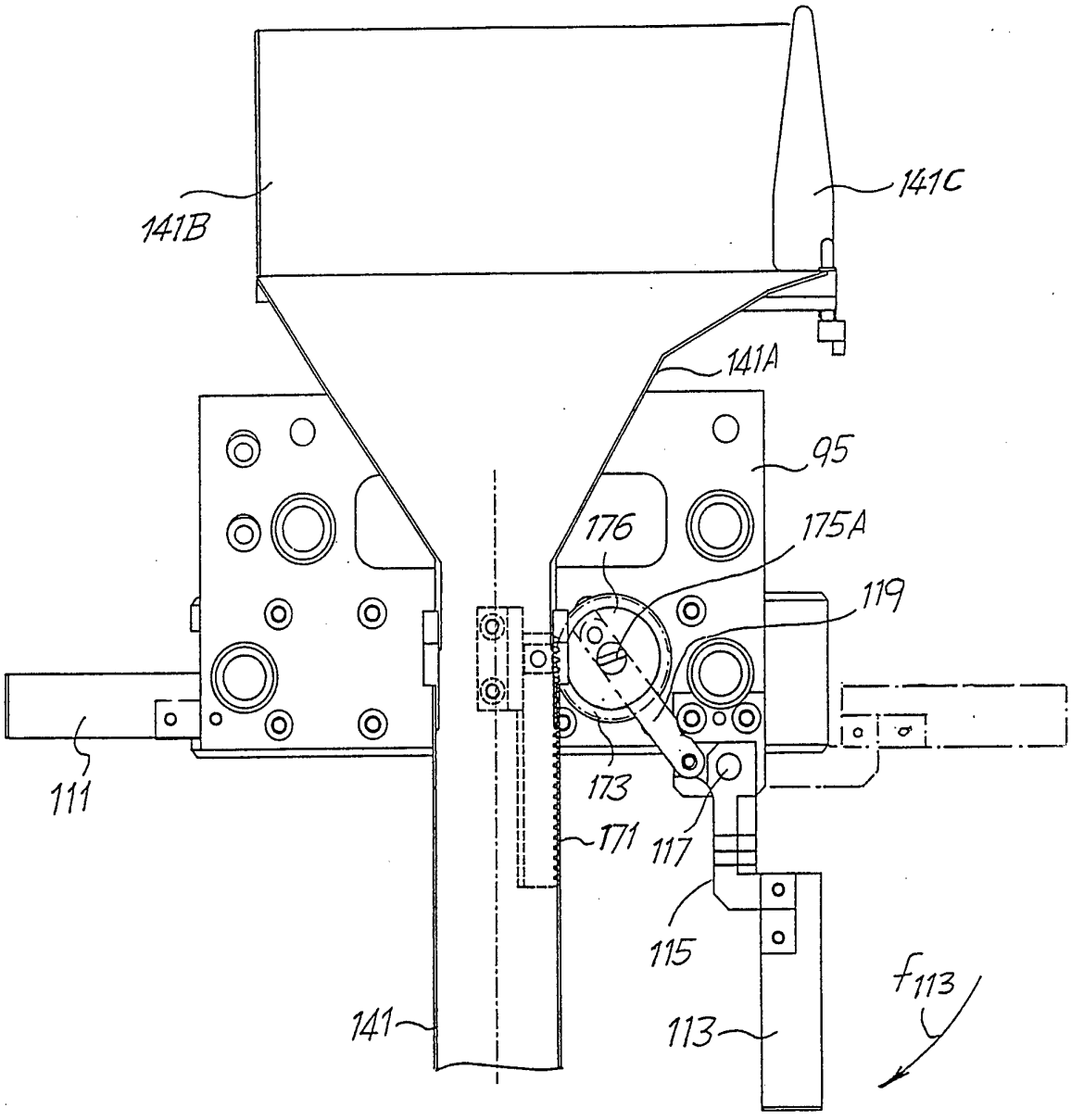
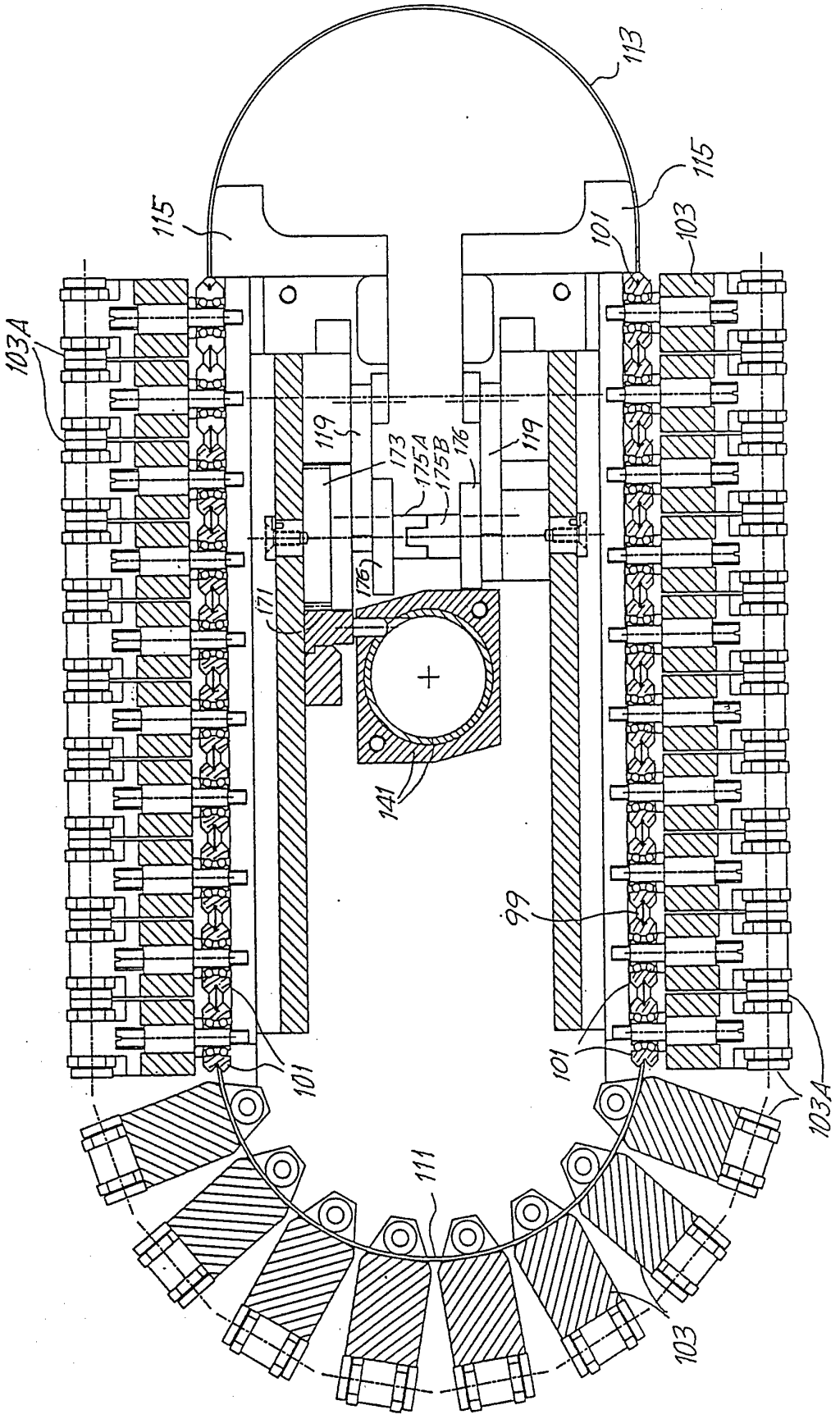


FIG. 41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115
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103A
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173
175A
175B
176
119
176
171
141
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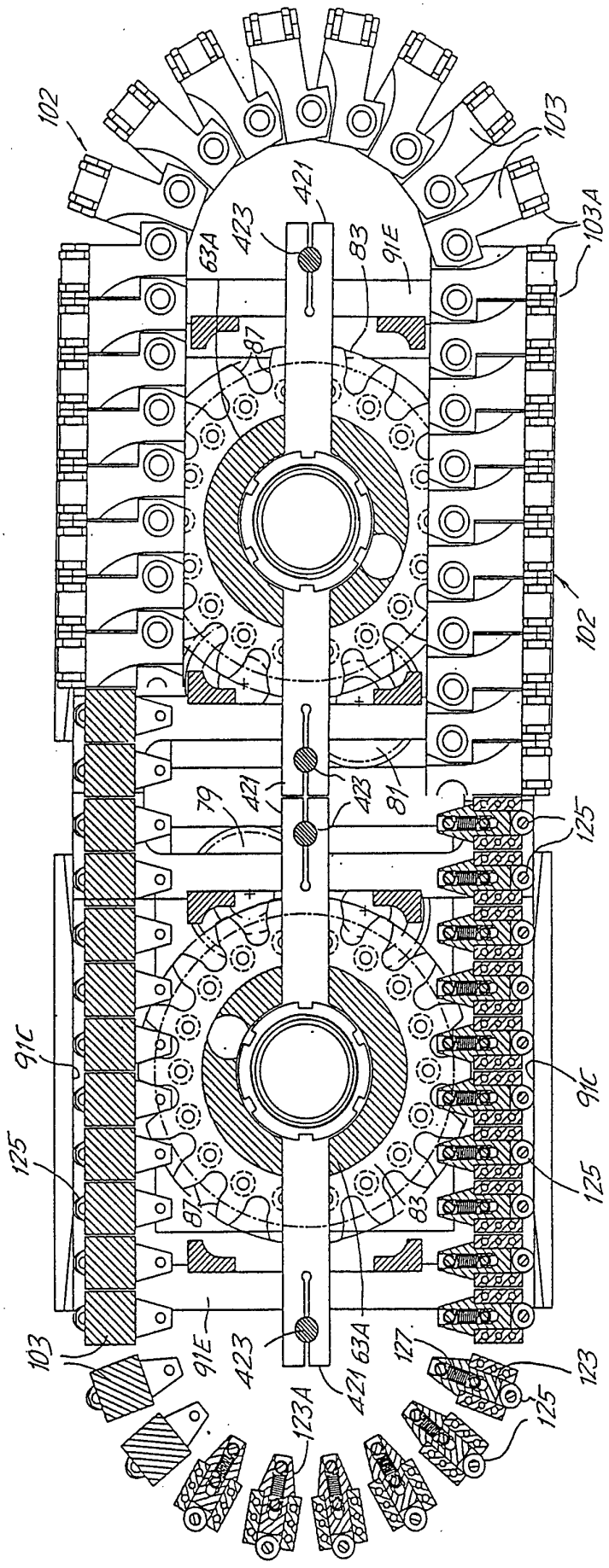
101
101
103A
111
103

FIG.42


102
103
421
423
63A
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91E
103A
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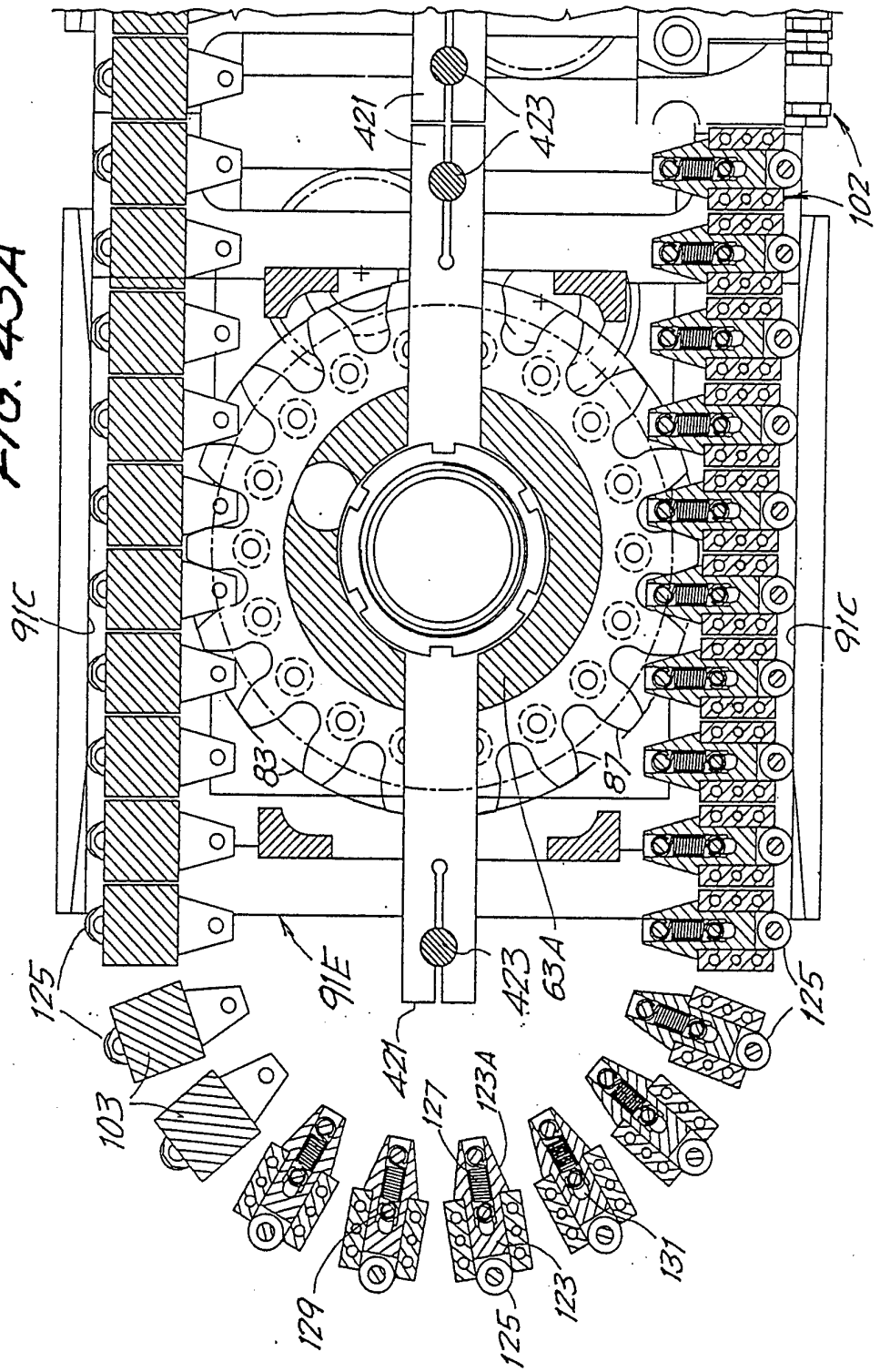
102
79
421
423
81
125
91C
125
91C
125
87
83
103
91E
423
63A
421
127
123
123A
125

FIG. 43

FIG. 43A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103
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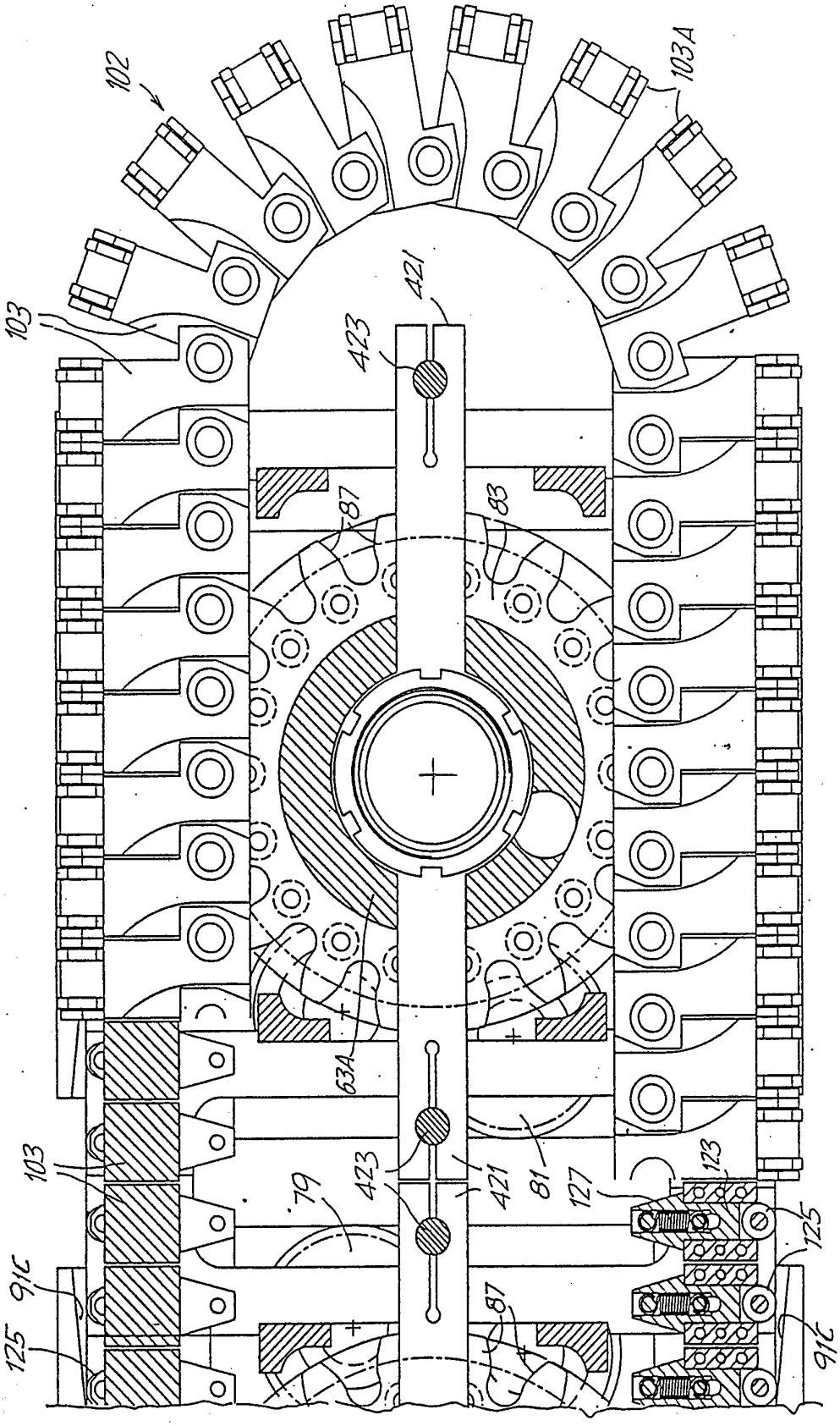
123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103A
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63A
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423
421
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91C
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91C

FIG. 43B

FIG. 44

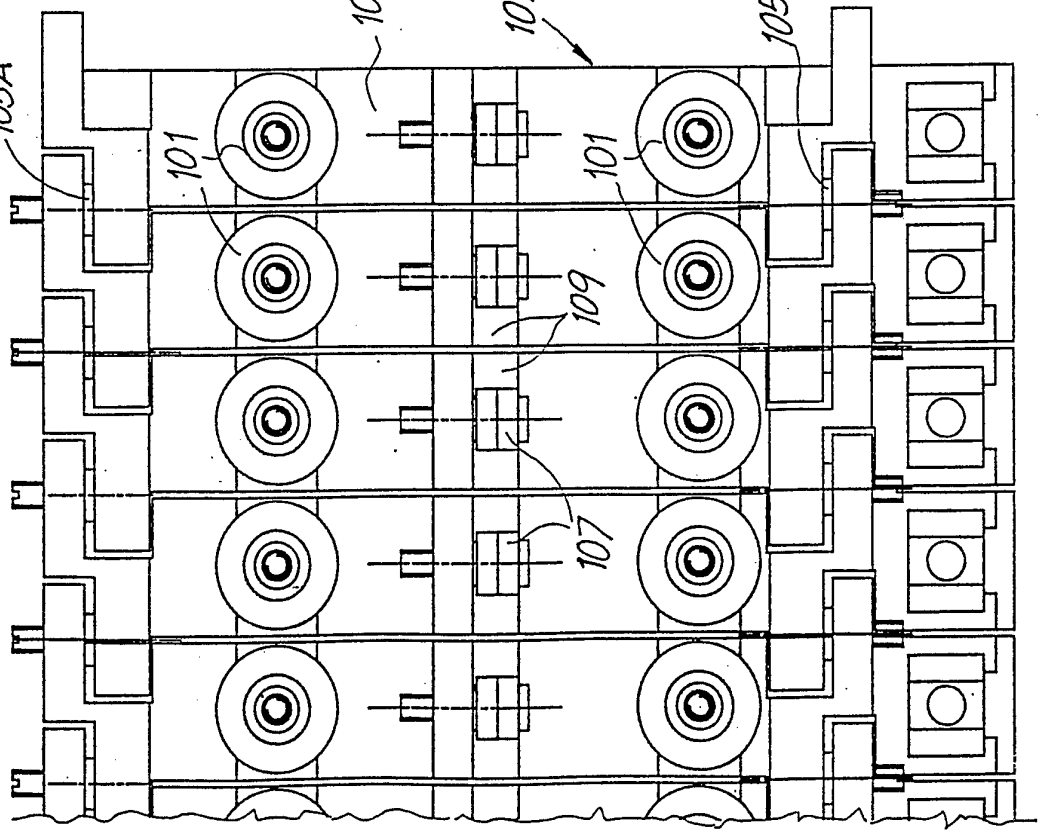


FIG. 45

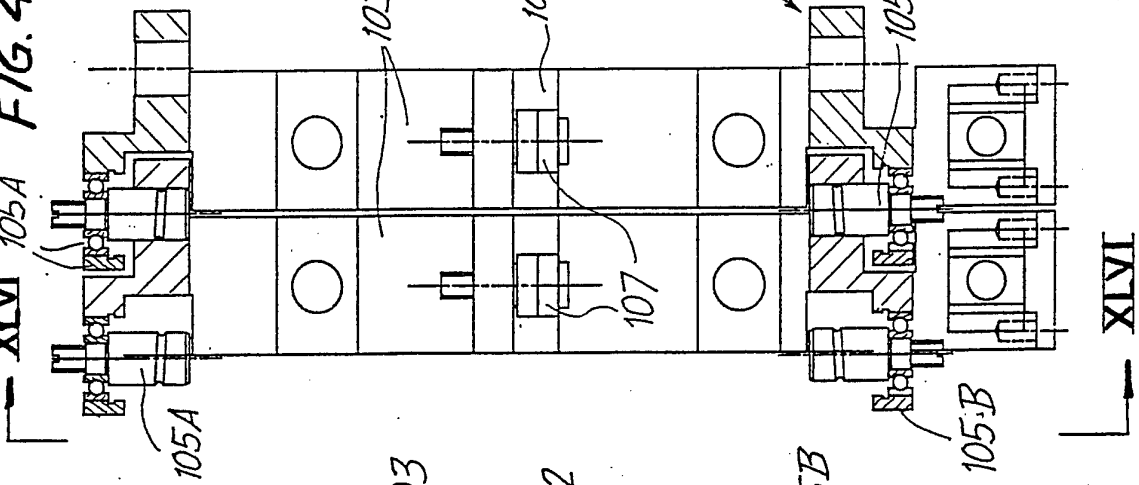


FIG. 46

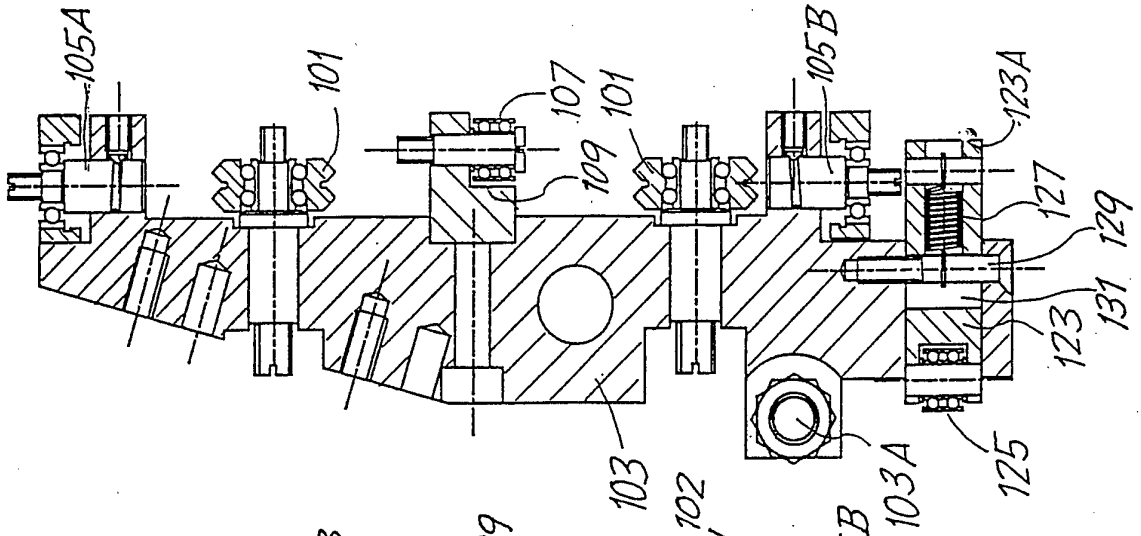


FIG. 47

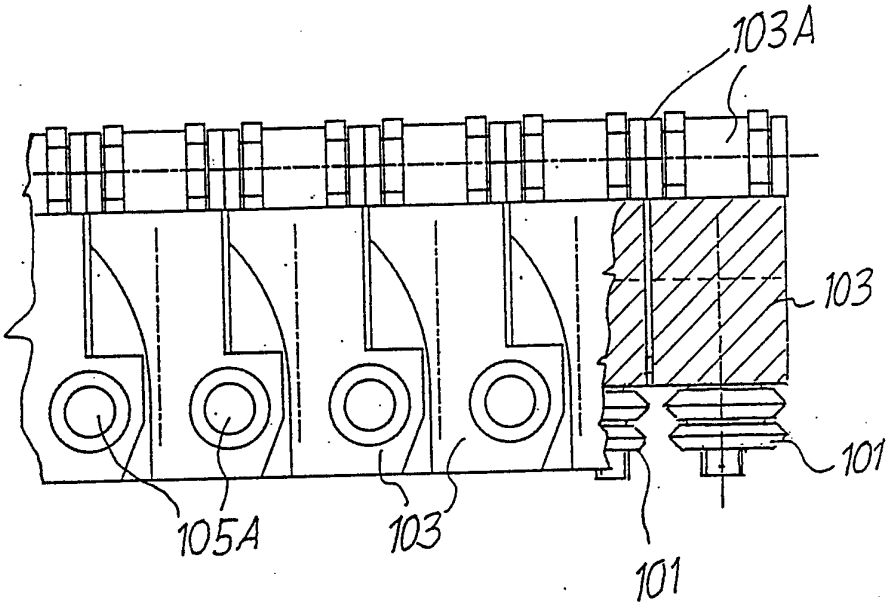
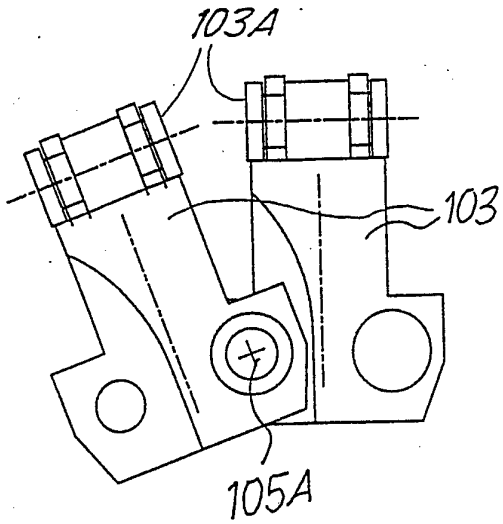


FIG. 48



INTERNATIONAL SEARCH REPORT

International application No.
PCT/IT 94/00087

A. CLASSIFICATION OF SUBJECT MATTER
IPC 5 D04B9/46

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 5 D04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A,P	EP,A,0 552 588 (LAMBDA S.R.L.) 28 July 1993 cited in the application	
A	EP,A,0 412 944 (LAMBDA S.R.L.) 13 February 1991	
A	DE,B,11 38 883 (WEISSBACH) 31 October 1962	

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
14 October 1994	27.10.94

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Van Gelder, P

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/IT 94/00087

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		JP-A-	5195383	03-08-93
		US-A-	5226297	13-07-93
EP-A-0412944	13-02-91	AT-T-	105880	15-06-94
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		CN-A-	1049386	20-02-91
		CZ-A-	9003959	19-01-94
		DE-D-	69008972	23-06-94
		DE-T-	69008972	01-09-94
		ES-T-	2054320	01-08-94
		JP-A-	3076852	02-04-91
		US-A-	5127240	07-07-92
DE-B-1138883		NONE		