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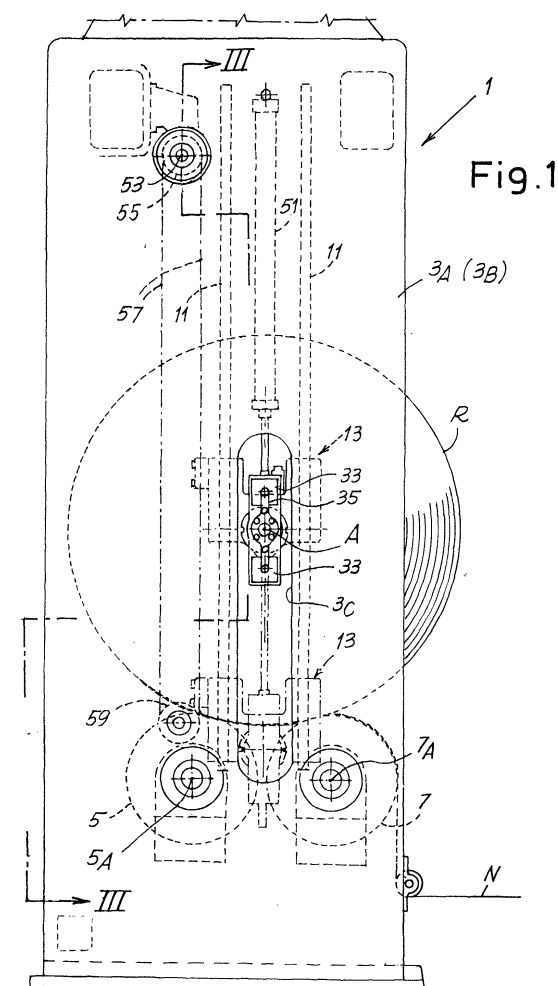
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(54) **Rewinding machine with means for axially pulling the winding mandrel**

(57) The rewinding machine comprises a winding cradle (8) on which a reel (R) under formation rests. The reel is formed on a winding mandrel which is withheld by a pair of mating centers (17) carried by mobile slides (13). The mating centers engage the ends of the winding mandrel (M) and pull the mandrel (M) during the reel winding cycle.



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Description

Technical field

[0001] The invention relates to a rewinding machine for the production of reels of web wound on winding mandrels, e.g. paper, tissue paper, non-woven material and similar products in sheet or tape form. More particularly, the invention relates to a peripheral rewinding machine, of the type comprising a winding cradle, formed e.g. by two winding rollers, on which a reel under formation rests, and a pair of mating centers carried by mobile slides which engage the ends of the winding mandrel and are lifted gradually from the winding cradle formed by the winding rollers.

[0002] The invention also relates to a peripheral winding method, i.e. a method in which the web is wound on reels under formation by contact with winding members, e.g. rotary winding rollers.

State of the art

[0003] Web winding or rewinding operations are required in the field of non-woven processing, e.g. in the production of reels of semifinished materials intended for the production of sanitary towels, diapers and the like, and also in the production of paper, e.g. for the production of rolls of toilet paper, kitchen paper or similar, for the production of reels for supplying folding machines for the production of napkins, paper handkerchiefs and similar disposable products.

[0004] The web production process is continuous and the web is wound on large diameter parent reels. These parent reels are later unreeled and the web is rewound on smaller diameters reels or rolls. For some applications, the web is cut longitudinally and continuously and wound on winding cores, which can be made of cardboard, plastic or other suitable material, the core being fitted and aligned on a winding mandrel. The winding mandrel is expandable, e.g. pneumatically or in any other equivalent way, to secure the winding cores onto it in the required positions. The various tubular cores - whose axial length can be identical or different - receive corresponding strips of web obtained by longitudinally cutting the web from the parent reel.

[0005] The rolls or reels are wound in sequence. The completed reel is unloaded from the winding cradle, e.g. formed by two winding rollers arranged side-by-side, and replaced with a new winding mandrel onto which the winding cores were previously secured.

[0006] A rewinding machine of this type is described in EP-A-0747308. Another example of rewinding machine of this type is described in EP-A-1070675. Additional examples of peripheral rewinding machine of the start-stop type, i.e. in which the supply of web is temporarily interrupted to replace the formed reel with another winding mandrel, are described in GB-A-2268476, DE-C-3836367, EP-A-0640544.

[0007] These rewinding machines must be capable of winding reels or rolls whose diameters may be large at considerably high winding speeds. Typically, the web is fed at speeds exceeding 1000 meters per minute, also in the order of 2000 meters per minute.

[0008] Controlling the reel may be very difficult at such speeds. Such difficulties are particularly due to the fact that the winding mandrels, on which the cores where the web reels will be wound are inserted and blocked, are heavy in weight and tend to deflect by effect of their own weight. Other reported problems refer to eccentricity of the winding cores and winding mandrel inserted inside the cores. Both the eccentricity and the deflection generate strong vibrations at the high winding speed which is typical of these machines. During the winding phase the reels tend to vibrate in a horizontal direction which is orthogonal to their own axis. The vibrations will be higher when softer material is wound. The vibrations are more relevant when several reels or rolls are wound side-by-side on a single mandrel. Furthermore, the critical rotation speeds of the assembly formed by the mandrel and the reel being wound are relatively low and cannot be exceeded due to evident problems of dynamics.

Object and summary of the invention

[0009] Object of the invention is to provide a rewinding machine of the aforesaid type which is capable of either overcoming or limiting the aforementioned shortcomings and particularly which is capable of reaching particularly high winding speed thanks to winding mandrel control.

[0010] These and other objects and advantages, which will be clear to those skilled in the art by the text that follows, are essentially obtained by a rewinding machine comprising a winding cradle, on which a reel under formation is supported, and a pair of mating centers carried by mobile slides which engage the ends of the winding mandrel, in which at least one of the mating centers is associated to tensioning members which pull the winding mandrel when it is engaged by the mating centers.

[0011] In this way, the winding mandrel is pulled during the winding process, or at least during a phase of the winding process. This may contribute to reducing or eliminating the deflection caused by its own weight and to correct eccentricity by either reducing or eliminating it. The critical speed of the mandrel is increased. This means that working at higher rotation speed is possible and consequently the web can be fed faster. In practice, the tension control applied to the mandrel is operated according to the applied force and not to position. In this way, the mandrel is kept pulled also when the flanks of the machine are mechanically deformed.

[0012] According to a practical embodiment of the invention, the rewinding machine presents tensioning members associated to each of said mating centers, even though actually it can be foreseen that only one of

the tensioning members be provided with an actuator which applies a traction force on the mandrel.

[0013] Advantageously, each mating center may present a gripping head which engages the respective end of the winding mandrel. Gripping can be obtained inside the mandrel, in an axial hole. In this case, the head will be of the expandable type. Gripping may, however, be obtained on the outside of the mandrel, e.g. on an oversized neck or collar which is engaged by a head which grips the mandrel from the outside.

[0014] In a possible advantageous embodiment, the tensioning members comprise on at least one of said slides, at least one actuator for approaching the respective mating center to the end of the winding mandrel and pulling the winding mandrel by pulling the mating center in the opposite direction with respect to the direction of approach to the winding mandrel. Preferably, each mating center is associated to at least one actuator. Furthermore, advantageously, two actuators are associated to each mating center to obtain more balanced force.

[0015] When both mating centers are associated to one or more respective actuators, the actuator or actuators of both may be advantageously used to approach the heads to the ends of the mandrels; the actuator or actuators of one mating center only pull the mandrel while the other mating center will cooperate with an abutment which determines the axial position that the mandrel must assume during the winding process. The symmetric arrangement of the two mating centers with respective actuators and reference abutments on both slides means that either one or the other of the mating centers can be used alternatively for axial referencing.

[0016] Although the heads and the mating centers may be motor driven, advantageously and preferably, the heads are idly mounted, e.g. in a body of the mating center which can be sliding housed in a sleeve integral with the respective slide. A rotating manifold can be used to feed the pressurized fluid to actuate the heads which grip the mandrel. Electrical operation may be used alternatively.

[0017] The invention also relates to a method for producing reels of web wound on winding mandrels in which: a winding mandrel is inserted in a winding cradle; a quantity of said web is wound on said winding mandrel which is turned in said winding cradle to form a reel; and the reel thus formed is unloaded from the winding cradle, characterized in that said winding mandrel is put under traction for at least one part of the rewinding process of said web on said winding mandrel.

[0018] Additional advantageous characteristics and embodiments of the machine and the method according to the invention are set forth in the annexed claims.

Brief description of the drawings

[0019] The invention will be better understood following the description and the accompanying drawings, showing a non-limitative practical example of the inven-

tion itself. In the drawings, where identical parts are indicated with the same reference numerals:

- Figure 1 is a lateral view according to the line I-I in figure 3 of the rewinding machine limited to the members which are relevant for this description only,
- Figure 2 is a cross-sectional view according to the plane II-II in figure 3 in an intermediate position between the two flanks of the rewinding machine,
- Figure 3 is a view and partial cross-sectional view according to III-III in figure 1,
- Figure 4 is a top view of a slide with respective mating center and other members carried by the slide,
- Figure 5 is a longitudinal sectional view according to V-V in figure 4 and
- Figure 6 is a longitudinal sectional view similar to that of figure 5 of a different position of the members carried by the slide.

Detailed description of a preferred embodiment of the invention

[0020] In figures 1 and 2, the essential elements of the rewinding machine for understanding the invention are shown. Other components which are known and which are not relevant for understanding the invention are omitted.

[0021] The rewinding machine, generically indicated with reference numeral 1, presents two parallel vertical flanks 3A, 3B between which two winding rollers 5, 7 are arranged. The winding rollers present two parallel rotating axes 5A and 7A, respectively. The two winding rollers 5 and 7 form a winding cradle 8 in which a winding mandrel M is either inserted or arranged with the respective tubular cores which are inserted and secured onto it in a way which is known per se. Both the mandrel insertion means and the finished reel extraction means are not illustrated because they are not relevant for the invention and known the skilled in the field, neither are the members which cut the web at the end of the winding operation of a reel and before winding the following reel, for the same reasons.

[0022] Guides 11 are fixed on the inner side of the two flanks 3A, 3B, on which guides respective slides, generally indicated with reference numeral 13, slide. The two slides 13 are reciprocally symmetric. Only one of them will be described in below with particular reference to figures 4, 5 and 6. The slide 13 presents a block 13A on which shoes 13B are fitted for sliding on the guides 11. The block 13A carries a sleeve 15 which supports the respective mating center inside, generally indicated by reference numeral 17. The latter presents an expandable head 19 carried by the end of a spindle 21 which is coaxial to a body 23 of the mating center 17, which in turn is slidingly housed inside the sleeve 15. Reference numeral 25 indicates the journals of the spindle 21 carrying the expandable head 19.

[0023] The flanks 3A and 3B present windows 3C through which the sleeve 15, integral with the slide 13, protudes, so that the slide 13 is on one side of the respective flank while the members carried by the sleeve 15, especially the plate 31 and the actuators 33 with the slider 35, are on the opposite side of said flank.

[0024] The spindle 21 is perforated to allow the passage of a control fluid to the head 19. The fluid is supplied via a rotating manifold 27 arranged on the opposite end of the spindle 21 with respect to the end carrying the head 19. Air or other pressurized fluid is supplied to the manifold 27 via a flexible conduit (not shown) to control the expansion of the head 19 for the purposes herein described.

[0025] A plate 31 is secured outside the sleeve 15, developed on a plane which is orthogonal to the axis of the mating center 17 and whose shape is approximately rectangular. Two cylinder-piston actuators 33 are fastened to the plate 31, parallel to the axis A-A of the mating center and arranged in diametrically opposite positions with respect to said axis, respectively over it and under it.

[0026] The rods 33A of the cylinder-piston actuator 33 are fastened to a slider 35 which is integral with a connecting member 37 which connects the slider 35 to the body 23 of the mating center 17. In this way, as appears by comparing figures 5 and 6, the actuators 33 are firstly used to approach and distance the head 19 carried by the mating center 17 with respect to a winding mandrel, indicated with reference M, which is in the winding cradle formed by the winding rollers 5 and 7. The winding spindle M presents a hollow end tang M1 in which the head 19 fits. The head expands and engages the winding mandrel M.

[0027] A stop is formed outside the sleeve 15 by a pair of ring nuts 39 with which elements 41 which are integral with the slider 35 cooperate. The stop 39 is adjustable and arranged so that it determines the axial position in which the winding mandrel M must assume in the winding cradle formed by the winding rollers 5 and 7 when the mating center 37 is in the position shown in figure 6.

[0028] The slides 13 are fastened to respective vertical cylinder-piston actuators 51 which control the lifting and lowering movement of the slides. In order to ensure that the two slides 13 on the two flanks 3A, 3B are moved synchronously being at the same height in any instant, in this embodiment a movement synchronization mechanism is provided comprising a transversal shaft 53 supported by the flanks 3A and 3B on which toothed pulleys or gears 55 are fitted (near and inside the flanks). Flexible members 57 turn on the gears or toothed pulleys. The flexible members additionally turn on another gear or toothed pulley 59, idly supported on the respective flank at a lower height slightly over the winding rollers 5 and 7. The two flexible members 57 are fastened in point 61 to the respective slides 13 so that each of the latter move synchronously without the two cylinder-piston actuators 51 needing to perform particularly accurate

movements. Alternatively, different types of mechanisms can be used to raise and lower the slides 13, e. g. threaded bar mechanisms as those described in EP-A-0747308.

[0029] By means of the actuators 51, the slides 13 and the respective mating centers 17 move vertically in the direction of the double arrow f13 (figures 1, 2, 3) between a minimum height indicated by the dotted line and a higher position. The first position is that assumed by the axis A-A of the mating centers when they are engaged on the winding mandrel M and the latter with the winding cores fitted on it is in the winding cradle defined by the winding reels 5 and 7 in the initial winding phase before the web is wound on the winding cores. The upper position, indicated with a solid line in figures 1 and 2, corresponds to the maximum height which can be reached by the slides 13 when the reel under formation (indicated by reference R) reaches its final diameter, i. e. when the required amount of web N has been wound on it.

[0030] The rewinding machine described to this point works as follows. Reference is made in this description to the formation of a reel on the winding mandrel. In actual fact, the reel under formation can be formed by a plurality of single reels side-by-side which simultaneously receive the same length of web, since the winding cycle can be carried out on tubular cores axially aligned on the mandrel by winding strips of web obtained by longitudinally cutting a single incoming web. Consequently, the term "reel" can herein indicate a single reel or a plurality of axially aligned reels formed at the same time in general.

[0031] The mandrel M with the respective cores is inserted in the winding cradle defined between the winding rollers 5 and 7 when the winding operation must be started on a new winding mandrel M with the winding cores fitted and secured to it by expansion of the mandrel (this operation is carried out in a separate station with respect to the rewinding machine). This operation is carried out in a way which is known per se after removing the reel R formed in the previous cycle from the winding cradle. The operation concerning transversally cutting the web and winding the first turn of web on the winding cores fitted on the mandrel is also carried out in a known way.

[0032] The mandrel M is arranged axially between the flanks 3A, 3B in the desired position by means of one of the two mating centers 17. This operation is required because, as mentioned above, several winding cores A (one of which is schematically shown in figure 3) is fitted on the winding mandrel M. The winding cores generally present variable longitudinal dimensions and must be aligned with respect to the strips of web N cut upstream with respect to the winding zone so that the strips are wound on the pertinent tubular cores A.

[0033] One of the two mating centers 17 is moved from the initial position shown in figure 5 to the position shown in figure 6 defined by the stops 39 against which

the elements 41 integral with the cursor 35 secured to the body 23 of the mating center 17 rests. The mating center slides inside the sleeve 15 to insert the expandable head 19 in the tang M1 of the mandrel M which is in the winding cradle, whereby pushing the mandrel M to the final position defined by the stops 39. At this point, the other mating center 17, which is symmetric with respect to the previous mating center and arranged on the opposite end of the mandrel M on the other flank of the machine is axially moved to make the expandable head 19 penetrate inside the other tang M1 of the winding mandrel M.

[0034] When both the heads 19 are inserted in the tangs M1 of the winding mandrel M, the heads are expanded by means of the fluid fed via the rotating manifold 27 to axially engage the winding mandrel M. After this operation, having securely fastened the ends of the winding mandrel M on the counterpoised mating centers 17, the mating center 17 which is not used to axially position the mandrel M is pulled in the opposite direction with respect to that which made the head 19 fit into the tang M1 of the winding mandrel M, i.e. it is distanced by elongating the corresponding cylinder-piston actuators 33. This pulls the winding mandrel M with the advantages and for the purposes described above. Tension is advantageously maintained for the entire winding cycle, i.e. for all the time needed to develop the reel or roll on the mandrel.

[0035] The web M can start being wound in a suitable instant after axially positioning the mandrel by means of the stops 39 of one of the two mating centers.

[0036] Since the two slides 13 and the respective mating centers 17 are configured in a symmetrical way, they can both be used alternatively for axially positioning the mandrel and for axially tensioning it. The possibility is not ruled out that the two mating centers are configured in a different way so that one can always only be used for axially positioning the mandrel while the other can only be used for tensioning it. The actuators 33 associated to the mating center 17 used for axial positioning and not for tensioning the mandrel remain essentially inactivated and the reaction to the traction force on the mandrel M is released on the slide 13 via the sleeve 15.

[0037] It is noted that the drawing is provided by the way of an example only and that numerous changes can be implemented to the construction and embodiments of the invention herein envisaged without departing from the scope of the present invention. The presence of reference numerals in the annexed claims has the purpose of facilitating comprehension of the claims with reference to the description and does not limit the scope of protection represented by the claims.

Claims

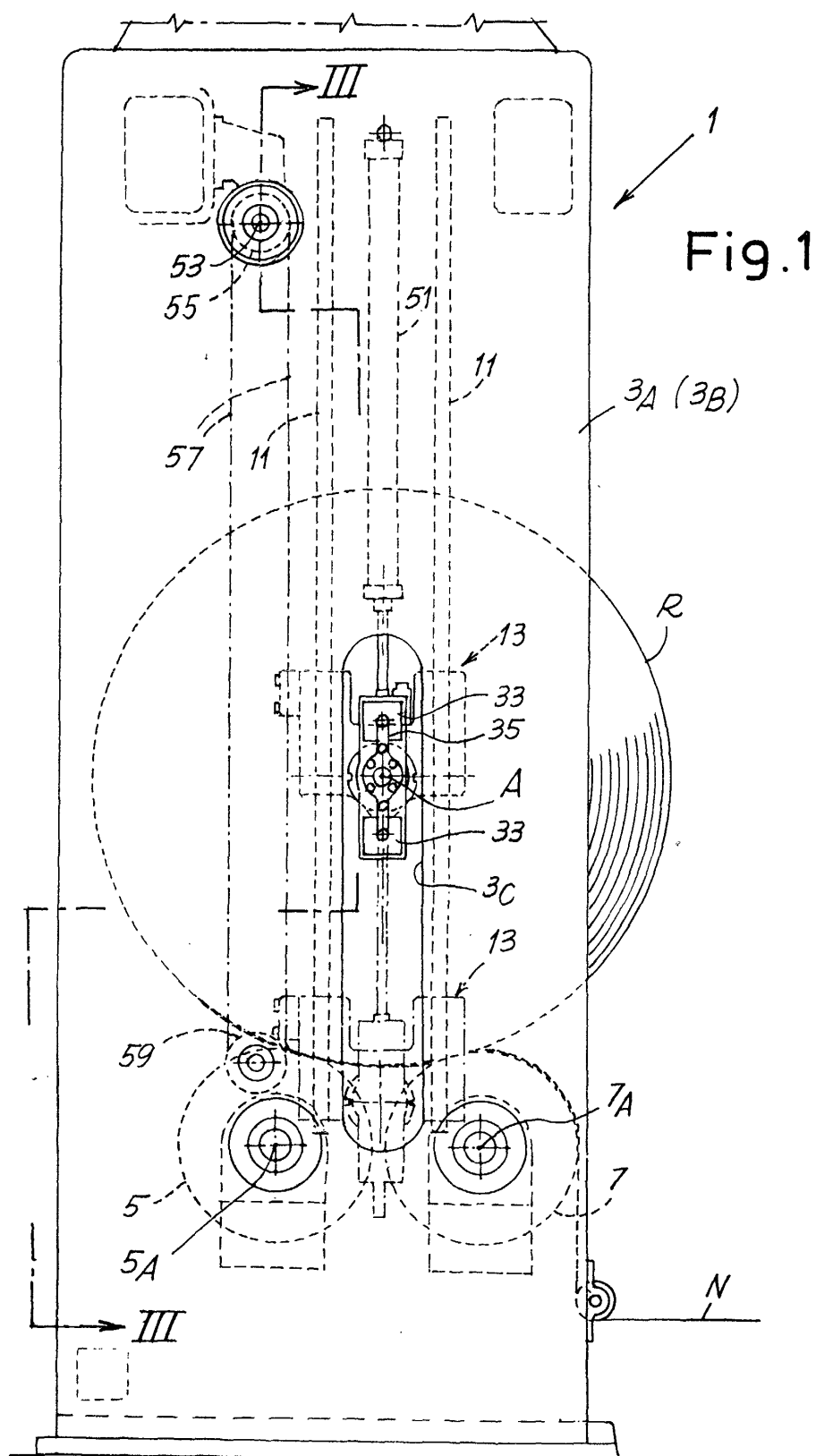
1. A rewinding machine for the production of reels of web wound on winding mandrels comprising a

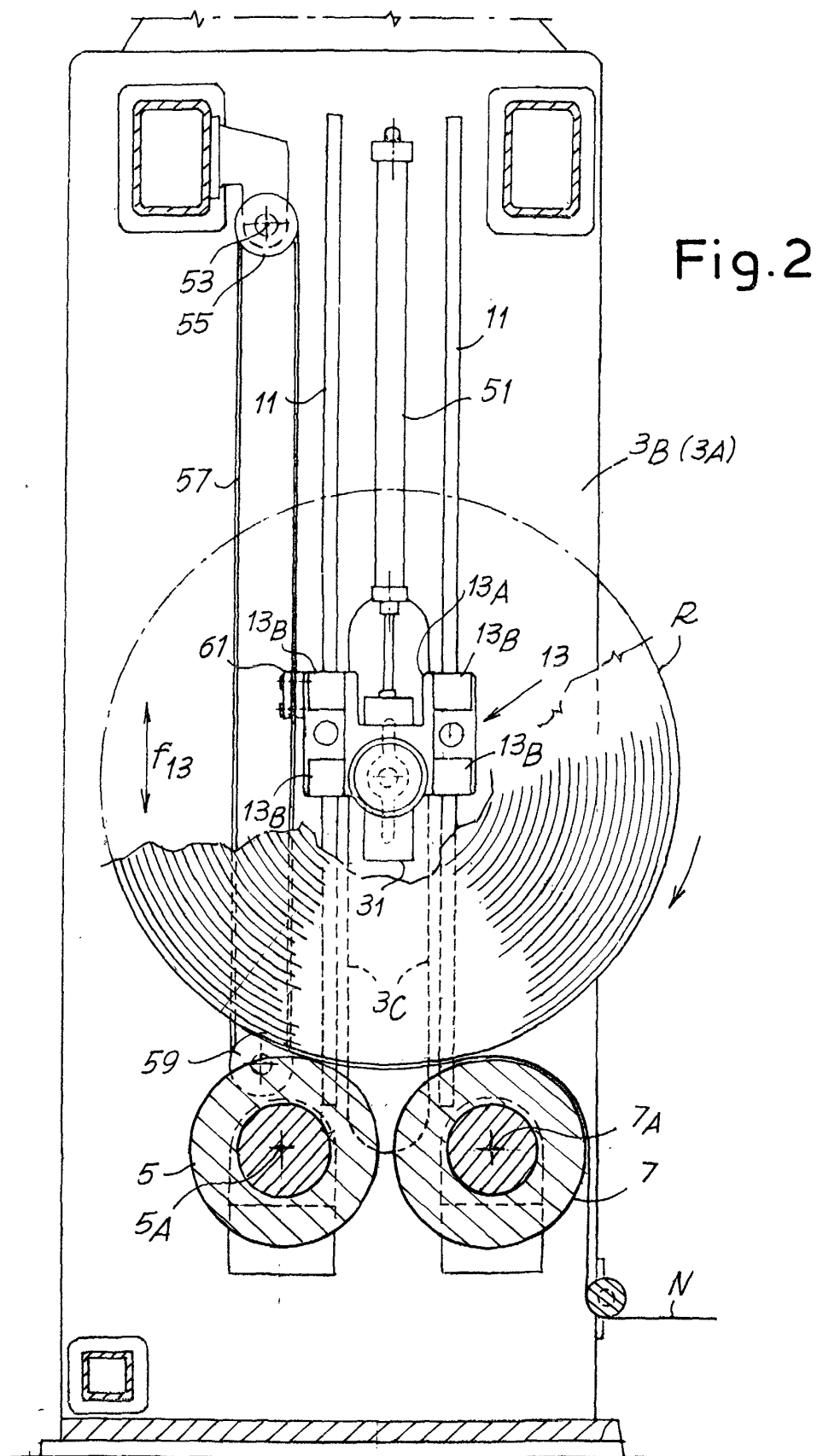
winding cradle (8), on which a reel under formation rests, and a pair of mating centers (17) carried by mobile slides (13) which mating centers engage the ends of the winding mandrel (M),

characterized in that at least one of said mating centers is associated to tensioning members (33) which pull the winding mandrel (M) when it is engaged by the mating centers.

2. Rewinding machine according to claim 1, **characterized in that** said tensioning members are associated to both of said mating centers.
3. Rewinding machine according to claim 1 or 2, **characterized in that** each of said mating centers (17) comprises a gripping head (19) which engages the respective end (M1) of the winding mandrel (M).
4. Rewinding machine according to claim 3, **characterized in that** said heads are expandable and are inserted inside the respective ends of the winding mandrel.
5. Rewinding machine according to one or more of the preceding claims, **characterized in that** said tensioning members comprise, on at least one of said slides, at least one actuator (33) to move the respective mating center to the end of the winding mandrel and apply tension to the winding mandrel by pulling the mating center in the opposite direction with respect to the approach direction towards the winding mandrel.
6. Rewinding machine according to claim 5, **characterized in that** at least one slide carries two actuators (33) to approach the mating center to the winding mandrel and pull the mating center in the opposite direction, said actuators being arranged in diametrically opposite positions with respect to the axis of the mating center.
7. Rewinding machine according to claim 5 or 6, **characterized in that** both slides carry at least one actuator (33) and **in that** the actuator of one of said slides pulls the mandrel, the actuator of the other slide solely serving to approach the respective mating center to the winding mandrel.
8. Rewinding machine according to one or more of the preceding claims, **characterized in that** stops (39) are associated to at least one of said two slides to define the position of the winding mandrel.
9. Rewinding machine according to claim 8, **characterized in that** stops (39) are associated to both of said two slides to define the position of the winding mandrel.

10. Rewinding machine according to claim 3, **characterized in that** said heads are idly mounted.
11. Rewinding machine according to one or more of the preceding claims, **characterized in that** each slide carries a sleeve (15) in which a body (23) of said mating center (17) slides. 5
12. Rewinding machine according to claim 10 and 11, **characterized in that** a shaft (21) carrying the respective head (19) is supported inside the body (23) of each mating center (17). 10
13. Rewinding machine according to claim 12, **characterized in that** a rotating manifold (27) is associated to said shaft for feeding an operating fluid to the respective head (19). 15
14. Rewinding machine according to one of the claims from 11 to 13, **characterized in that** at least one of said sleeves presents a respective stop (39) for a slider (35) which is fastened to the respective head (19). 20
15. Rewinding machine according to claim 14, **characterized in that** both of said sleeves presents a respective stop for a slider which is fastened to the respective head. 25
16. Rewinding machine according to claims 13 and 14 or 13 and 15, **characterized in that** said slider (35) presents an external element (41) which cooperates with said stop (39) and an internal connection member (37) secured to the body (23) of the respective mating center. 30
17. Rewinding machine according to claim 16, **characterized in that** said rotating manifold (27) is arranged inside said connection member. 35
18. Rewinding machine according to one or more of the preceding claims, **characterized in that** said slides are guided on vertical guides (11) integral with the fixed flanks (3A, 3B) of the machine. 40
19. Rewinding machine according to one or more of the preceding claims, **characterized in that** said slides (13) are associated to actuators (51) which controls upwards travel with respect to said winding cradle (8). 45
20. Rewinding machine according to one or more of the preceding claims, **characterized in that** it comprises means for synchronizing the movement of said slides (13). 50
21. Method for producing reels (R) of web (N) wound on winding mandrels (M) in which: a winding mandrel is inserted in a winding cradle (8); a quantity of said web is wound on said winding mandrel which is turned in said winding cradle to form a reel (R); and the reel thus formed is unloaded from the winding cradle, **characterized in that** said winding mandrel is pulled for at least one part of the winding process of said web on said winding mandrel.
22. Method according to claim 21, **characterized in that** one or more tubular cores are fitted and secured onto said winding mandrel, the cores being aligned along the axis of the mandrel and the web being wound on said tubular cores.
23. Method according to claim 21 or 22, **characterized in that** the ends of the winding mandrel (M) are engaged by respective mating centers (17) and a force is applied to said mating centers (17) which tends to reciprocally distance them.
24. Method according to claim 23, **characterized by** axially positioning said winding mandrel by means of an approaching movement of one of said mating centers and by pulling said winding mandrel longitudinally by means of a distancing movement of the other of said mating centers.
25. Method according to claim 23 or 24, **characterized in that** said mating centers are engaged to the mandrel by means of the respective gripping heads.
26. Method according to claim 25, **characterized in that** said heads are inserted in the ends of the mandrel and engaged to the mandrel by expansion.
27. Method according to one or more of the claim 21 to 26, **characterized in that** said mating centers are guided along vertical guides.
28. Method according to claim 27, **characterized in that** said mating centers are gradually raised during the winding cycle by means of respective actuators. 55





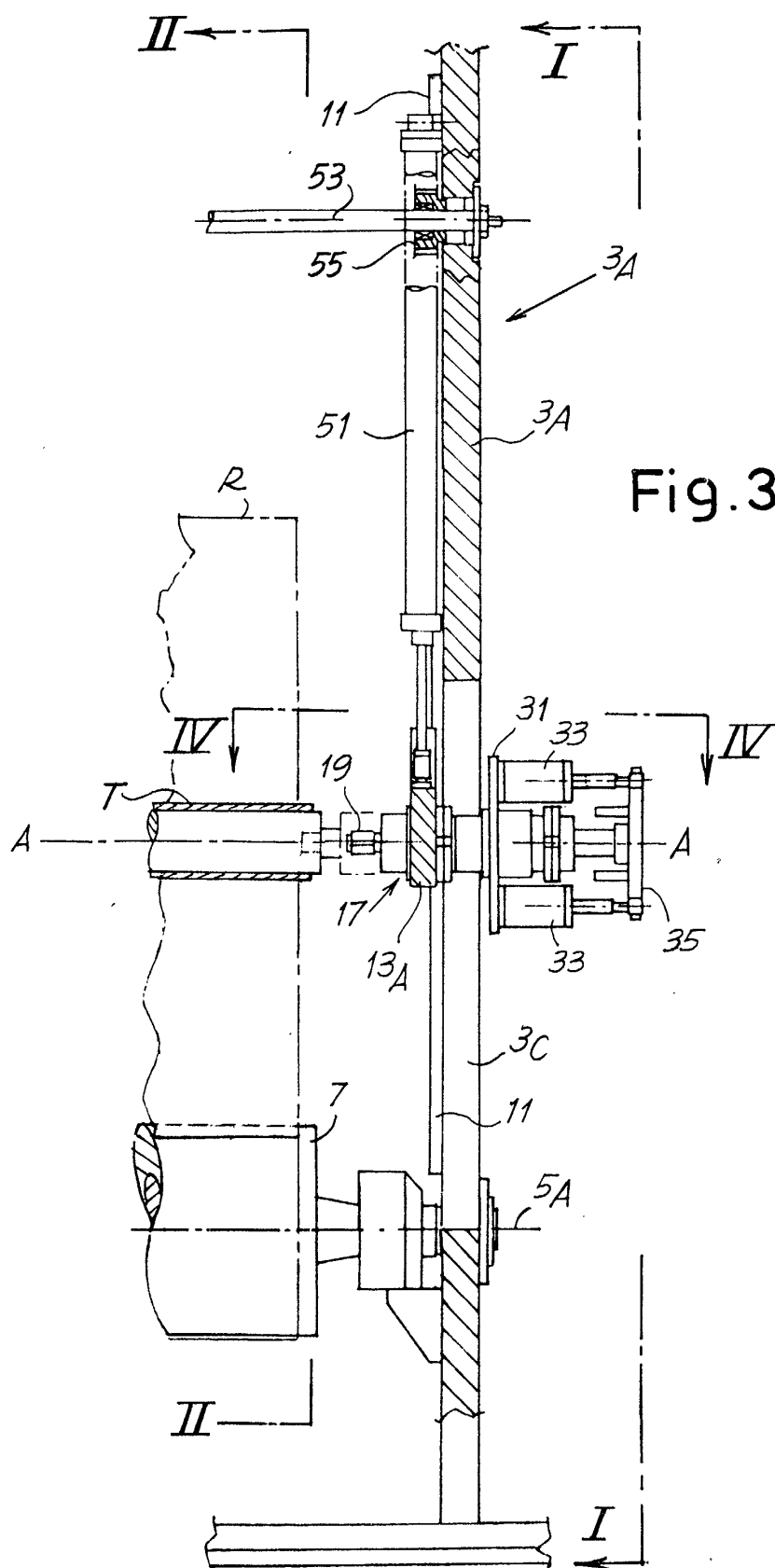
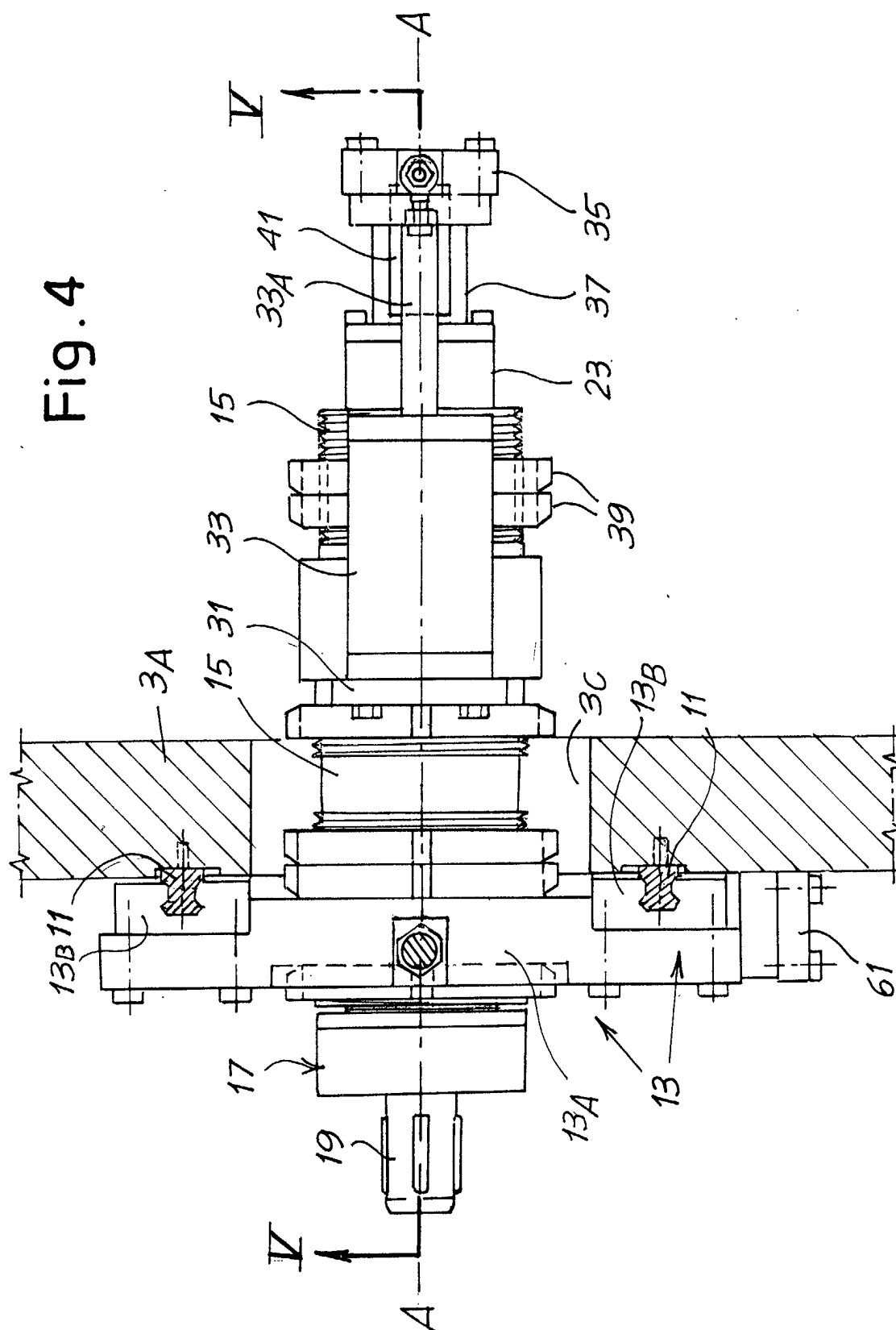
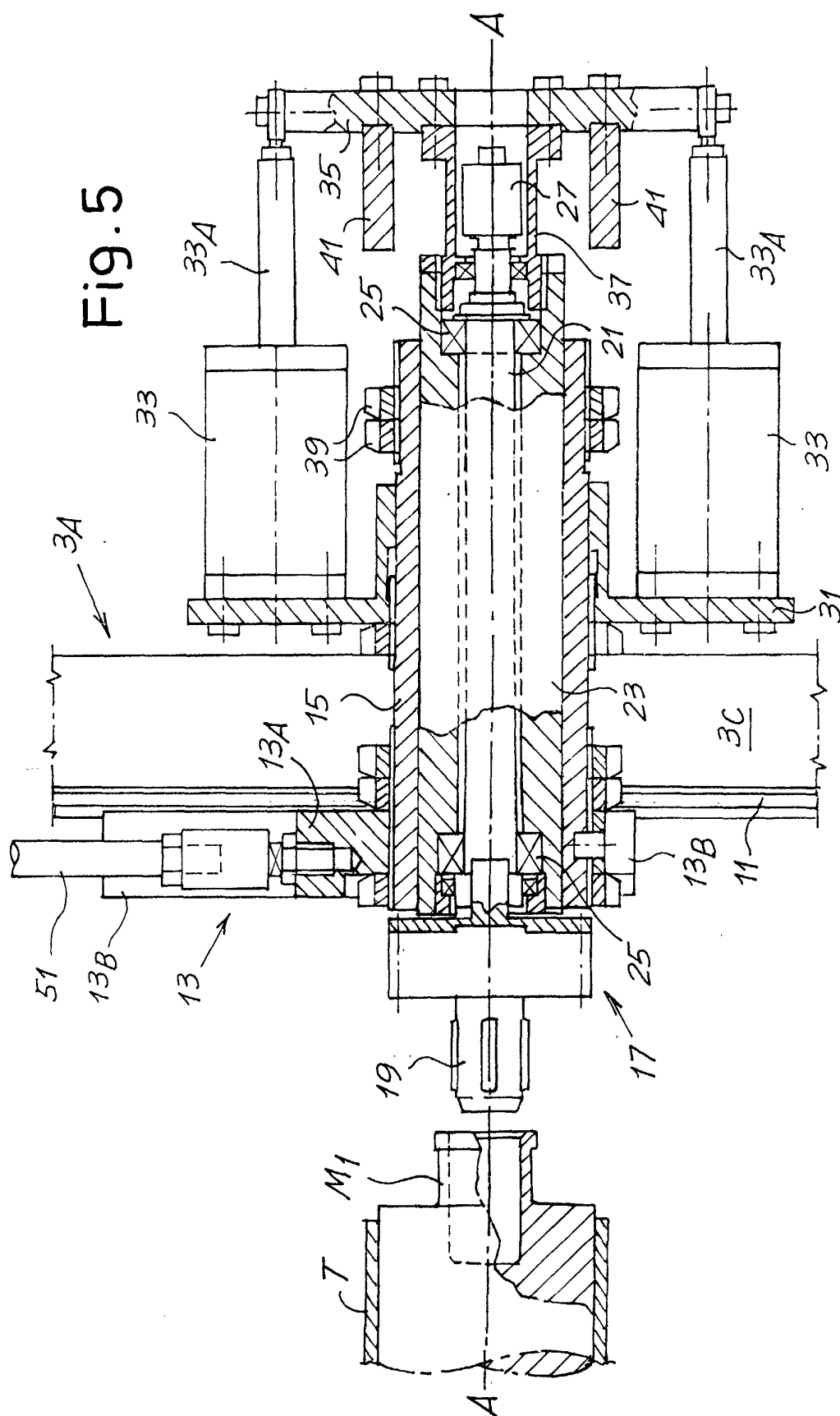


Fig. 4





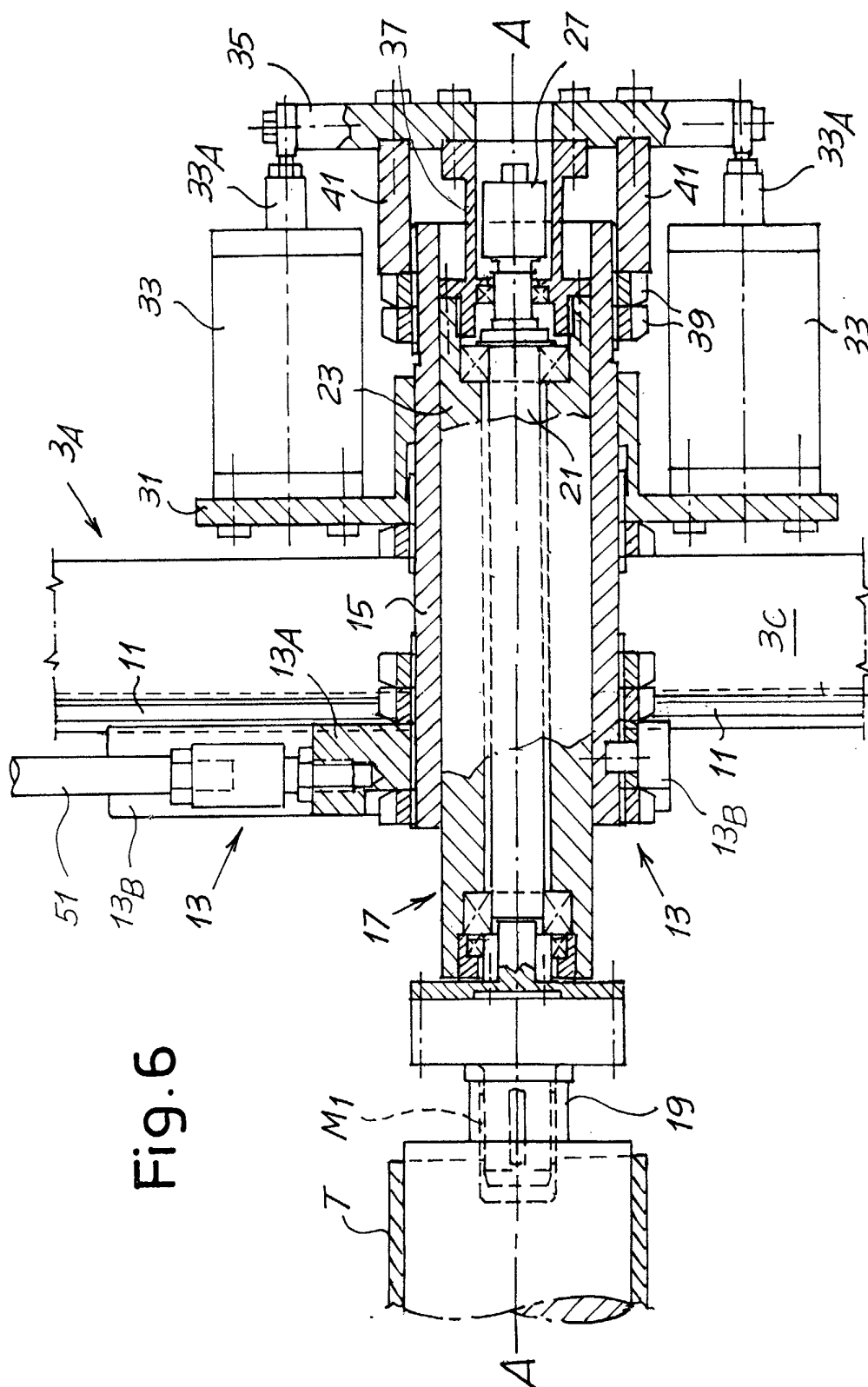


Fig. 6



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EUROPEAN SEARCH REPORT

Application Number
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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
THE HAGUE		21 November 2002	Haaken, W
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EPO FORM 1503 03/92 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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