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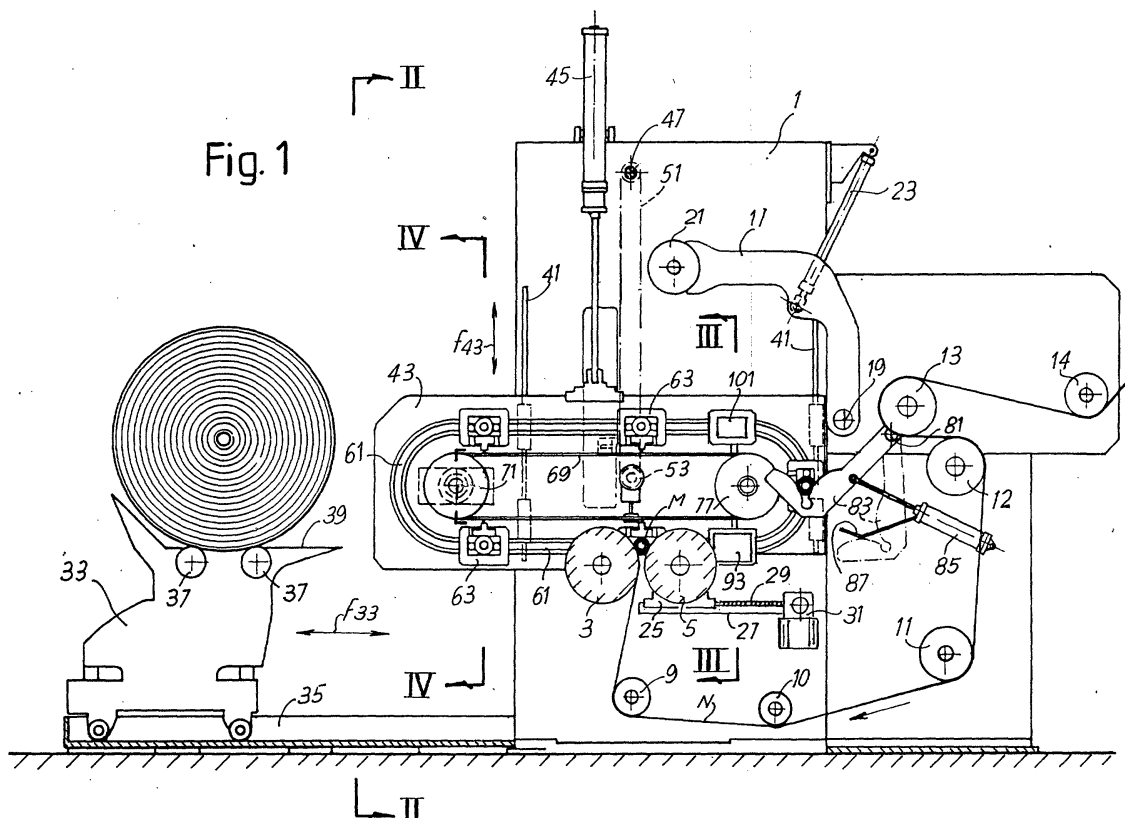
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(54) **Rewinding machine with flanks carrying mating center moving along a closed path**

(57) The rewinding machine includes: at least a first and a second winding cylinder (3, 5), whose axes are parallel, defining a winding cradle (7) in which said reels of web (N) are formed, and mating centers (65) for engaging and withholding the winding mandrels (M, M1, M2) on which the reels are formed in the winding cradle. It is further provided a pair of lateral flanks (43), on each

of which a corresponding guide (61) defining a closed path is arranged, along which guide a plurality of said mating centers (65) are movably arranged. Each mating center associated to one of said flanks is aligned with a corresponding mating center associated to the other of said flanks. It is further provided a drive system to move the mating centers along each of said guides.



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Description

Technical field

[0001] The invention relates to a rewinding machine for the production of web reels. More in detail, the invention relates to a rewinding machine of the type comprising:

- at least a first and a second winding cylinder, whose axes are parallel, defining a winding cradle in which said reels of web are formed, and
- mating centers for engaging and withholding winding mandrels on which the reels are formed in the winding cradle.

[0002] The invention also relates to a method for the production of reels of web.

State of the Art

[0003] Operations concerning winding or rewinding web are required in the sector 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 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. In this way, a plurality of reels is produced with one single rewinding cycle, each reel being less high than the initial web width and, if required, the reels can also be of different heights. The winding mandrel on which the winding cores are fitted 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 reciprocal axial length may be either variable or different - receive corresponding strips of web obtained by longitudinally cutting the web from the parent reel.

[0005] The rolls or reels are developed in sequence. The finished 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 tempo-

rarily interrupted to replace the completed 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 dimensions 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. The production rate is consequently relatively high. The phase in which the finished reel or roll is exchanged with a new winding mandrel is the phase of the winding cycle which mostly slows down the overall production rate. In this phase, in these machines, the feeding speed of the web is considerable reduced and in certain cases feeding is stopped for a short time. The machine gradually returns to running speed after unloading the reel and introducing the new winding mandrel.

[0008] Reducing the time required for the exchange operation is consequently crucial for reducing the winding cycle time.

Objects and summary of the invention

[0009] Object of the invention is to provide a rewinding machine of the aforesaid type in which the rewinding cycle speed can be increased and particularly in which the exchange time, i.e. the time required to replace the finished reel or roll with a new winding mandrel, is reduced.

[0010] This and other objects and advantages, which will be clear those skilled in the art in the text that follows, are essentially obtained by a rewinding machine of the above mentioned type, comprising a pair of lateral flanks, on each of which a corresponding guide defining a closed path is arranged, along which a plurality of said mating centers are movably arranged. The mating centers are arranged on the two flanks so that each mating center carried by one of said flanks corresponds to and is axially aligned with a mating center carried by the other of said flanks. A system is also provided to drive the mating centers along each of the guides.

[0011] In this arrangement, a first pair of mating centers engages a reel or roll under formation and a second pair of mating centers engages a new mandrel simultaneously. The finished reel can be conveyed from the winding cradle to the unloading area and simultaneously the new mandrel can be conveyed from a loading area to the winding cradle by moving the pairs of mating centers along the closed path. This leads to a considerable increase in the total rewinding cycle speed due to the reduction of the time required to exchange the reel or roll with a finished mandrel.

[0012] In addition to increasing the production cycle speed, the rewinding machine according to the invention provides a number of additional advantages. Such advantages include improved control of the reel during the unloading phase and more accurate control of the web cutting phase for forming the trailing end of the finished reel and the leading end of the web to be used for

winding a new reel to be formed on the new mandrel.

[0013] Currently, the finished reel or roll is ejected from the winding cradle, typically defined by a pair of winding cylinders, by pushing and rolling. The reel is then positioned in an unloading device in a position which is not exactly repeatable at each cycle with consequently possible difficulties in the web cutting phase for starting the winding of the following reel.

[0014] In a practical embodiment of the invention, each mating center can be carried by a respective carriage which slides on the guide of the corresponding flank.

[0015] Furthermore, advantageously, it can be foreseen that the path defined by said guides extends from a first mandrel engagement position to a second finished reel unloading position; said winding cradle being arranged between said first and said second position.

[0016] In a practical and advantageous embodiment, the handling system comprises a continuous flexible member onto which the mating centers associated to the respective flanks are secured on each flank. Moreover, a drive is provided for moving said flexible member. Each motor can drive two flexible members. In this case, the movements of the mating centers on the two flanks will be synchronized by means of an appropriate mechanical transmission. Alternatively, two separate motors can be used and synchronized electronically by means of a control unit, i.e. using an electric axis. This solution presents the advantage of avoiding the presence of cumbersome mechanical members between the two flanks.

[0017] Other arrangements of the members moving the mating centers along the path defined by the guides on the two flanks can be envisaged. For example, in principle, the mating centers can each be equipped with an actuator which controls the movement along the guide with a suitable control for synchronizing the movement of each mating center.

[0018] In an advantageous embodiment of the machine according to the invention, a taker-in is provided to insert the winding mandrels moving from a collection position of the winding mandrels to a release position of the winding mandrels, in correspondence with the position in which the mandrels are engaged by the mating centers. The taker-in may consist of a pivoting member but might also be made in a different way. For example, the winding mandrels could be inserted axially, i.e. with a movement parallel to their axis inside a fixed support, such as a cradle or other. The mandrels can be collected from this location by the mating centers as they move along said closed path. Alternatively, the taker-in can be equipped with an insertion movement which is not pivoting, e.g. by translating from a mandrel collection position to a mandrel release position.

[0019] The winding cylinders can be made so that during the winding phase the axis of the reel or roll (and consequently of the winding mandrel) is always in the same position. This can be obtained in a way which is

known per se employing mobile axis winding cylinders with a vertical movement component so that the winding cradle is gradually lowered according to the increased diameter of the reel. In this case, the two flanks can be fixed and the mating centers can be held constantly at the same height for the entire reel winding phase. Conversely, if the winding cylinder axis is fixed or if the winding cylinders move in such a way that the axis of the reel being formed is provided with a gradual vertical or slanted raising movement, the flanks will also be vertically mobile and actuator means will be provided to control the upwards and downwards movement of said flanks according to the diameter of the reel. Synchronization means will be advantageously provided for the vertical movement of the flanks also in this case.

[0020] In general, the two winding cylinders can be mobile one with respect to the other and can be opened, e.g. one can have a fixed axis and the other a mobile axis according to a horizontal trajectory. This increases the supporting base of the reel as it gradually increases in diameter during the winding operation. In this case, the axis of the reel will follow a more or less complex trajectory with a movement which has a vertical component and a horizontal component. The trajectory followed by the axis of the reel changes according to the characteristics of the product (specifically its thickness) and the working conditions of the machine. The movement can be made by the mating centers by forming a complexly shaped guide according to the trajectory of the reel axis or preferably by combining a gradual raising movement of the flanks to a translating movement of the mating centers along a portion of the closed path which can simply be a straight horizontal portion.

[0021] In principle, the rewinding machine can have only two lower winding cylinders arranged side-by-side, either mobile or fixed as illustrated above, to withhold the reel under formation. Preferably, in a way which is known per se, the rewinding machine comprises a third cylinder whose axis is parallel to the first and the second winding cylinder arranged over the winding cradle and mobile to allow for the increased diameter of the reel developing between said first, second and third cylinder. This arrangement improves reel guidance. Advantageously, the third cylinder is carried by a pair of pivoting arms whose fulcrum is in a position which does not interfere with the flanks (which may be mobile) carrying the guides which define the closed path followed by the mating centers. The third cylinder can be idle or preferably driven with a peripheral speed which is essentially equal to the peripheral speed of the first and the second winding cylinder, it being understood (in a way that is known per se) that the three cylinders can have slightly different peripheral speeds to obtain the required degree of compactness in winding the reels.

[0022] A variable number of mating centers can be provided along each of two guides carried by said flanks also according to the type of movement adopted. The number of mating centers on each side will appropriately

be equal to at least three and preferably equal to five.

[0023] When the machine is provided with a taker-in for inserting the winding mandrels, it can advantageously present a winding mandrel resting cradle whose geometry corresponds to that of the winding cradle in the initial winding phase. As clearly described in the example of embodiment that follows, this arrangement ensures correct handling without the need for adjustments in the presence of mandrels with variable diameters.

[0024] According to a possible form of embodiment of the rewinding machine according to the invention, electric or pneumatic distribution means are associated to each flank, since the mating centers approach and distance the mandrel and may be provided with control sensors. Furthermore, the mating centers can either be idle or driven. A motor is associated to each of said mating centers in the second case, e.g. an electric motor, to turn them. The motor is powered by said electric distribution means.

[0025] The distribution means can comprise a rotating distributor for each flank arranged inside the path defined by the guide along which the mating centers move and one or more flexible members towards said mating centers. Preferably, however, an electrical distribution box and a pneumatic distribution box can slide along each of said guides; said electrical distribution box and said pneumatic distribution box can be connected by means of flexible members to a distributor arranged inside the path defined by the guides along which the mating centers and said boxes move; and said boxes can be connected to the mating centers via flexible pneumatic and electric connections.

[0026] The invention also relates to a method for the production of reels of web wound on winding mandrels in which:

- a first winding mandrel is inserted in a winding cradle and a predetermined amount of web is wound upon it to form a reel, the ends of said first mandrel being engaged by a pair of mating centers;
- the finished reel is unloaded from the winding cradle and
- a second winding mandrel is inserted in said winding cradle.

[0027] Characteristically, the method according to the invention comprises the following phases:

- engaging the first winding mandrel in a collection area by means of a first pair of mating centers;
- transferring the first winding mandrel by means of said mating centers to said winding cradle;
- when the reel has been completed, transferring the finished reel with said first pair of mating centers from said winding cradle to an unloading area;
- after transferring said first winding mandrel to the winding cradle (e.g. while winding said reel), engaging a second winding mandrel with a second pair of

mating centers in said collection area;

- when said reel is removed from the winding cradle, inserting the second winding mandrel in said winding cradle with said second pair of mating centers;
- transferring the first pair of mating centers towards the collection area of the winding mandrels.

[0028] Additional advantageous characteristics and embodiments of the machine according to the invention are set forth in the annexed claims.

Brief description of the drawings

[0029] The invention will be better understood following the description and the enclosed drawing, which shows a non-limitative practical embodiment of the invention. In the drawing, in which identical parts have the same reference numerals, it is shown the following:

- Figure 1 is a schematic cross-sectional view according to I-I in figure 1 of a machine according to the invention;
- Figure 2 is a view according to II-II in figure 1;
- Figure 3 is a cross-sectional view according to III-III in figure 1;
- Figure 4 is a cross-sectional view IV-IV in figure 1;
- Figure 5 is a front view from inside the machine of one of the flanks with the pneumatic and electric distribution means;
- Figure 6 is a partial cross-sectional view according to VI-VI in figure 5; and
- Figures 7A-7F show the winding cycle in sequence.

Detailed description of a preferred embodiment of the invention

[0030] Above and in the following description, reference is made 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 arranged side-by-side which simultaneously receive the same length of web by winding strips of web obtained by longitudinally cutting the single incoming web, since the winding cycle can be carried out on tubular cores axially aligned on the mandrel. Consequently, in the present description and in the attached claims 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 rewinding machine comprises a fixed structure 1 with two lateral flanks fastened to the base. The fixed structure 1 carries a pair of winding cylinders 3, 5 whose axes are parallel defining a winding cradle 7 in which the winding mandrels are arranged with one or more cores made of cardboard, plastic or other suitable material fitted upon them. The cores are fitted and secured on the mandrels by expansion of the mandrels in a way which is known per se in a station outside the rewinding machine.

[0032] Cylinders 3, 5 are motor driven (in a way which is known per se) to turn the winding reel. The web N is turned around winding cylinder 3 which is supplied along a feeding path defined by rollers 9, 10, 11, 12, 13, 14 from a parent reel (not shown). Blades (not shown) are arranged along the feeding path. The blade cuts the web N in the longitudinal direction into strips corresponding (in terms of dimension and position) to the longitudinal dimension and the position of the tubular winding cores inserted on the winding mandrels which are inserted in the winding cradle 7 as described below.

[0033] The structure 1 also supports a pair of arms 17 pivoting at 19 on the structure 1. The pair of arms supports a third winding cylinder 21. The latter can either be idle or driven and rests on the top of the reel under formation, such that in the winding cradle the reel rests on the lower winding cylinders 3, 5 and is controlled and withheld by the third winding cylinder 21. Reference numeral 23 indicates the cylinder-piston actuators which control the pivoting movement of the arms 17 on the fulcrum 19 for gradually raising the upper mobile winding cylinder 21 while the reel under formation grows in diameter and for lowering it towards the cradle 7 at the beginning of a new winding cycle after unloading the finished reel and inserting a new mandrel in the winding cradle 7.

[0034] In the example shown, the winding cylinder 3 has a fixed axis and the supports are integral with the structure 1 while the axis of the winding cylinder 5 is mobile in the horizontal direction for the purposes explained below. For this purpose, the supports are mounted on carriages 25 which slide on horizontal guides 27 integral with the two flanks of the fixed structure 1. A threaded bar 29 and an actuator 31 control the movement of the carriages 25 along the guides 27 to approach and distance the winding cylinder 5 with respect to the winding cylinder 3.

[0035] A mobile carriage 33 is arranged on the opposite side of the rewinding machine with respect to the web N feeding path. The carriage 33 moves along rails 35 integral with the base and equipped with a pair of resting rollers 37 for distancing the finished reels or rolls from the rewinding machine. Reference f33 indicates the approaching and distancing movement of the carriage 33 with respect to the winding area defined by the winding cylinders 3, 5. The carriage is also equipped with a rolling plane 39 on which the reels to be distanced are received.

[0036] Vertical guides 41 on which the respective flanks 43 slide are integral with each of the two sides of the structure 1 on the side facing the inside of the machine. The two flanks 43 are reciprocally parallel and vertically mobile along the guides 41. Consequently, the two flanks can move on planes which are parallel to the median plane of the rewinding machine according to the double arrow f43. The upwards and downwards movement of the flanks 43 is controlled by a pair of cylinder-piston actuators 45 in which the cylinder is fastened to

the structure 1. A synchronization system comprising a transversal shaft 47 supported by the flanks of the fixed structure 1 to synchronize the movements of the two flanks avoiding the possibility of non identical movements in the vertical direction. Two toothed pulleys 49 are fitted near the two ends of the transversal shaft 47 which project outside the flanks of the structure 1. Respective toothed belts 51 turn on the pulleys, each of which additionally turns on a respective second toothed pulley 53 carried by the respective flank. Each toothed belt 51 is fastened in point 55 to the corresponding flank. In this way, the two flanks 43 are forced to move identically along the vertical guides 41.

[0037] A linear guide 61 defining a closed path is provided on each said flank 43. In the example shown, the path consists of two reciprocally parallel straight sections whose ends are joined by two semicircular sections of the path.

[0038] A plurality of carriages 63 slides along each linear guide 61. Five carriages for each linear guide 61 and consequently for each flank 43 are provided in the example shown. The carriages 63 are reciprocally arranged at an equal distance along the path defined by the guide 61. Each carries a mating center 65 intended to engage one end of the winding mandrels. The mating centers 65 can have any possible configuration and, in general, move axially to approach and distance the winding mandrels and present expandable heads 67 to be fastened onto the mandrels. Other types of gripping members can be used instead of expandable heads. Alternatively, single mating centers can be used, which are inserted in the mandrels without additional tightening effect. This solution is particularly suitable if the mating centers are not motor driven.

[0039] According to the arrangement of the carriages 63 and the respective mating centers 65 on the two flanks 43, a mating center on one side corresponds to a mating center on the opposite side, the mating centers being axially aligned to engage a respective winding mandrel held parallel to the axes of the winding cylinders 3, 5, 21.

[0040] The carriages 63 associated to each side 43 are fastened to a toothed belt 68 (or other equivalent flexible member) turning on two toothed pulleys 71, 73. The toothed pulley 71 on each flank 43 is driven by a stepper motor 75 or other suitable actuator for accurately controlling the movement of the pulley 71 and consequently of the various carriages 63 which are fastened to the corresponding toothed belt 68 by means of a controlling program. The two motors 75 associated to the two flanks 43 are joined together by an electrical axis, i.e. are controlled by a central unit so that the two pulleys 71 and the two toothed belts 68 are moved in a perfectly synchronized way. In the example shown, the motors 75 are on the opposite side of the flanks 43 with respect to the side on which the guides 61, the carriages 63 with the mating centers 65 and the pulleys 71, 73 with the toothed belt 68 are arranged.

[0041] A taker-in 83 is arranged on the inlet side of the web N of the fixed structure 1 and pivots in point 81 for inserting the winding mandrels with the respective tubular cores fitted and fastened to them. The taker-in 83 pivots on the axis 81. The pivoting movement is controlled by a cylinder-piston actuator 85 or by a pair of actuators symmetrically arranged on the two flanks of the machine. The structure 1 carries in addition a V-section fixed duct 87 in which the winding mandrels and tubular cores fitted and fastened on them are axially inserted. The duct 87 presents a comb structure so that the taker-in 83, also presenting a comb structure, can penetrate inside it.

[0042] In its lower position, the taker-in 83 is partially arranged under the resting surface of the duct 87 so that a mandrel with the respective tubular cores can be inserted axially along the duct. Once the mandrel is positioned in the duct 87, the taker-in can pivot upwards thus picking up the mandrel and bringing it in a position in which it can be engaged by the mating centers 65 which move along the flanks 43 and carried towards the winding cradle.

[0043] Alternatively, the duct 87 can be omitted. In this case, the taker-in 83 can be made of continuous profiles inside of being comb-like. The mandrel can thus be axially inserted in the cradle defined by the taker-in 83 when this is in the lower position, shown with a dotted line in figure 1. An appropriate shape will be adopted for the taker-in to prevent the mandrel from dropping from the taker-in.

[0044] As shown in the drawing, the taker-in 83 presents a profile defined by two circular cylindrical surface sections corresponding to the profile of the winding cradle formed by the two cylinders 3, 5 when they are in the maximum approach position. This allows the use of mandrels with various diameters without needing adjustments, as clearly appears in the following description of machine operation.

[0045] The operation of the rewinding machine described above will now be illustrated with reference to the sequence in figures 7A-7F. In figure 7A, the five carriages carried by the flank 43 and shown therein are indicated by reference numerals 63A, 63B, 63C, 63D, 63E. Carriage 63A with the respective mating center is arranged in correspondence with the cradle 7 defined by the winding cylinders 3, 5 which are in the maximum approach position. The mating center 65 of the carriage 63A and the mating center, which is axially aligned therewith of the corresponding carriage carried by the other flank engage a winding mandrel M with the respective tubular cores fitted on it. The mating centers of the carriages in position 63E have unloaded the previously formed roll, which was already removed. The mating centers carried by the carriages in position 63B are aligned in correspondence with the top position of the taker-in 83 which contains the winding mandrel M1 which will be inserted in the winding cradle during the following cycle. The taker-in 83 could actually be still in

the lowered position and take the mandrel M1 from the duct 87 at a later instant. The reel or roll made during the previous cycle could also still be inside the machine supported by the mating centers carried by the carriages 63E or may have been unloaded onto the carriage 33 and the latter may still be near the pair of winding cylinders 3, 5.

[0046] The winding cycle starts in the conditions illustrated in figure 7A. The web N is wound on the winding mandrel M on the tubular cores, which are fitted and fastened on the mandrel. The mating centers which engage the mandrel M in the winding cradle could be motor driven to turn with the mandrel but this is not necessary. The torque for turning the mandrel and consequently winding the web is provided by winding cylinders 3 and 5 (which are motor driven). The upper winding cylinder 21 is lowered and taken into contact with the winding mandrel in the cradle between the winding cylinders 3 and 5 when a suitable number of turns of web have been formed on the mandrel.

[0047] Progressively, as the web N is wound around the winding mandrel M, the machine goes from the arrangement shown in figure 7A to the arrangement shown in figure 7B which differs from the previous arrangement for the upwards movement of the upper winding cylinder 21 and the corresponding upwards movement of the flanks 43 due to the upwards movement of the axis of the reel under formation. This figure shows how the new winding mandrel M1 being lifted by the taker-in 83 is engaged by the mating centers carried by the carriages 63B and the taker-in is lowered again to take a new mandrel.

[0048] In figure 7C, the diameter of the reel R has increased again. In order to provide a large resting base for the reel R, the winding cylinder 5 was distanced from the winding cylinder 3 with a horizontal movement, causing the winding cradle 7 to widen in size. This causes the need to translate the mating centers of the carriages 63A horizontally in addition to vertically to follow the increasing diameter of the reel R. This causes a corresponding movement along the linear guide 61 of the other two carriages (all reciprocally bound to the toothed belt 68) but does not cause problems because the following winding mandrel M1 has already been engaged by the mating centers in position 63B while the previous reel has been unloaded by the mating centers carried by the carriages 63E. A new winding mandrel M2 will have been introduced in the duct 65 in the meantime for the next winding cycle.

[0049] In figure 7D, the winding cylinder 5 appears additionally distanced from the winding cylinder 3 and the reel R has increased in diameter again reaching its final dimension. The upper winding cylinder 21 is additionally raised. The flanks 43 are raised to follow the upwards movement of the axis of the reel R and consequently of the winding mandrel M while the carriages carrying the mating centers are translated to follow the movement in the horizontal direction of the axis of the reel following

the opening of the winding cylinders 3, 5.

[0050] In figure 7E, the finished reel R has been transferred from the winding cradle to the carriage 33. For this purpose, the flanks 43 have been slightly risen to permit the translation of the reel R by moving the carriages 63A towards the carriage 33. The plane 39 of the carriage 33 is taken to a position which is approximately tangent to the winding cylinder 3 and the mating centers of the carriages 63A are taken over the resting rollers 37 of the carriage 33. The translation of the carriages 63A causes the translation of all the other carriages 63 so that, for example, the carriages 63B are moved above the winding cradle 7 which in the meantime has newly decreased in size because the winding cylinder 5 has approached again the winding cylinder 3. The upper winding cylinder 21 was raised to allow the passage of the finished reel.

[0051] In figure 7F, the carriage 33 was distanced from the winding cylinders after that the reel R was deposited by the mating centers carried by the carriages 63A which were reciprocally distanced for this purpose. Cutting means (not shown, and known per se) are used to transversally cut the web N between the winding cradle 7 and the finished reel R. The leading edge of the web which is thus formed is anchored to the tubular cores fitted on the mandrel M1 which is then introduced in the winding cradle 7. The flanks 43 are lowered to take the mandrel M1 engaged by the mating centers of the carriages 63B in the winding cradle in contact with the winding cylinders 3, 5. This downwards movement also takes the mating centers of the carriages 63C into correspondence with the taker-in 83 which in the meantime was raised to take and lift the winding mandrel M2 from the duct 87 to the position where it is engaged by the mating centers of the carriages 63C.

[0052] Figure 7F - as figure 7A - shows an instant of the winding cycle in which the mating centers engaging the mandrel which is in the winding cradle 7 and the mating centers engaging the mandrel intended for the following cycle are in a position which depends on the diametrical dimension of the winding mandrels, or more precisely on the diametrical dimension of the tubular cores fitted and fastened onto them. Thanks to the particular configuration of the taker-in 83, which presents a profile that copies that of the winding cradle in this configuration, it is sufficient to adjust the position of the mating centers with respect to the winding cylinders 3, 5 to automatically obtain the correct position of the mating centers with respect to the seat defined by the sections which form the taker-in 83 as the diameter of the tubular cores varies.

[0053] From the description above, it is clear that the unloading phase of finished reel R and the introduction of a new winding mandrel in the cradle 7 is much faster than what occurs in rewinding machines of the traditional type. This reduces the overall duration of a winding cycle. Furthermore, the finished reel R is controlled and guided until it reaches the rollers 37 of the carriage 33

and this facilitates the unloading operations of the reel and the cutting of the web because the position which the reel R assumes on the carriage 33 is always accurately repeatable.

[0054] It is clear from what has been described above, that the mating centers 65 and the respective heads 67 are mobile. Particularly, the mating centers are provided with approaching and distancing movement with respect to the winding mandrels for gripping and releasing and with a fastening movement, e.g. expansion of the heads 67, to fasten the winding mandrel which is used at the time by a pair of mating centers. As mentioned, the mating centers may be motor driven. This means that electrical signals must be provided to the mating centers for the control units which operate the mechanical members (e.g. solenoid valves or other). The possibility of sending or receiving electrical signals to and from the mating centers obtained via sensors, e.g. enabling signals for carrying out the various functions of the cycle in sequence. Finally, the mechanical members must be operated via pneumatic or hydraulic controls, reasons for which compressed air or other pressurized fluid must be supplied to the mating centers.

[0055] For this purpose, in the illustrated embodiment, a rotary compressed air and electrical signal distributor is required to operate the mechanical members arranged inside the closed path defined by the linear guide 61 of each flank 43 in a position which is slightly central with respect to said path. The rotating distributor and the connection means to the electric and pneumatic line to the various mating centers are indicated only in figures 3, 5 and 6, while they are substantially omitted in the remaining figures of the drawing for the sake of clarity.

[0056] The rotating distributor is generally indicated with reference numeral 91. The rotating distributor is connected by means of at least an electric wire to an electric unit 93 fitted on a carriage 94 sliding on the same guide 61 on which the carriages 63, carrying the mating centers 65, slide. The carriage 94 can also be fastened to the corresponding toothed belt 68. Reference numeral 95 indicates a flexible channel in which the electric wire is arranged, one end of the channel being connected to the rotating distributor 91 and the opposite end to the electric unit carriage 94. The electric wire is not shown in the drawing for the sake of simplicity.

[0057] The electric unit 93 is connected in series to the carriages 63 and from here to the various mating centers carried by the carriages by means of electric wires arranged in flexible channels 97. Each channel 97 joins a carriage 63 to an adjacent carriage. In this way, the electrical signals supplied via the rotating distributor 91 reach all the mating centers on the respective flank 43.

[0058] A compressed flexible air conduit also passes in the channel 95. The compressed air line is also passed to a pneumatic unit 101 and to all the carriages 63 and finally to the respective mating centers 65 via

channels 99 which are parallel to channels 97. In this way, the compressed air reaches all the mating centers and the respective actuators which are controlled by the compressed air with control signals distributed along the electrical line which from the rotating distributor 91 reaches the electric unit 93 and from here all the carriages 63.

[0059] In the example described above, the winding cylinders 3, 5 are reciprocally mobile to increase the resting base during the winding cycle as the diameter of the reel R under formation increases. This characteristic is advantageous specifically for reels R whose final diameter is particularly high. The machine can be programmed so that the winding rollers only open and close if the diameter of the reel exceeds a certain value. The opening movement can be controlled, for example, according to the amount of wound web determined by means of an encoder associated to one of the cylinders or rollers arranged along the material path or also to one of the two winding cylinders. Alternatively, the diameter can be controlled and the cylinders can be opened according to the respective signal.

[0060] Since the opening of the winding cylinders is required to make the winding operation more stable either eliminating or limiting reel vibrations, according to a possible form of embodiment, opening movement control of the two cylinders can be consequent to a signal from load cells associated to the mating center supports 65. When these load cells or other equivalent sensors detect a vibration exceeding a predetermined threshold value, the rewinding machine control unit controls the gradual opening of the cylinders 3, 5 until the detected vibration is again reduced to an acceptable value.

[0061] It is noted that the drawing shows just one embodiment of the invention, which may vary in shapes and arrangements, 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 preceding description and the annexed drawings and does not limit its scope of protection.

Claims

1. A rewinding machine for the production of reels (R) or web (N) comprising:

- at least a first and a second winding cylinder (3, 5), whose axes are parallel, defining a winding cradle (7) in which said reels of web (N) are formed, and
- mating centers (65) for engaging and withholding the winding mandrels (M, M1, M2) on which the reels are formed in the winding cradle

characterized by a pair of lateral flanks (43), on

each of which a corresponding guide (61) defining a closed path is arranged, along which guide a plurality of said mating centers (65) are mobility arranged; each mating center associated to one of said flanks being aligned with a corresponding mating center associated to the other of said flanks; a drive system being provided to move the mating centers along each of said guides.

2. Rewinding machine according to claim 1, **characterized in that** said drive system comprises, for each side, a continuous flexible member (68) onto which the mating centers (65) associated to the respective flank are fastened; a drive (75) being provided to move said flexible member.
3. Rewinding machine according to claim 1 or 2, **characterized in that** each of said mating centers (65) is carried by a respective carriage (63), which slides along the guide (61) of the corresponding flank.
4. Rewinding machine according to one or more of the preceding claims, **characterized in that** the path defined by said guides extends from a first mandrel engagement position to a second unloading position of the completed reels; said winding cradle being arranged between said first and said second position.
5. Rewinding machine according to claim 4, **characterized in that** it comprises a taker-in (83) to insert the winding mandrels moving from a collection position of the winding mandrels to a release position of the winding mandrels, in correspondence with the position in which the mandrels are engaged by the mating centers.
6. Rewinding machine according to one or more of the preceding claims, **characterized in that** said flanks are vertically mobile and that actuator means (45) are provided to control the upwards and downwards movements of said flanks.
7. Rewinding machine according to claim 6, **characterized in that** it comprises synchronizing means (47, 49, 51, 53) of the vertical movement of the flanks.
8. Rewinding machine according to one or more of the preceding claims, **characterized in that** said two winding cylinders (3, 5) are reciprocally mobile and can be opened.
9. Rewinding machine according to claim 8, **characterized in that** said two winding cylinders are reciprocally mobile in a direction which is essentially horizontal of alignment of the respective axis of rotation.

10. Rewinding machine according to claim 9, **characterized in that** the axis of one of said winding cylinders is fixed while the other of said winding cylinders is mobile and translates in a horizontal direction which is orthogonal to its axis, for approaching and distancing the fixed axis winding cylinder. 5
11. Rewinding machine according to one or more of the preceding claims, **characterized in that** it comprises a third cylinder (21) whose axis is parallel to the first and to the second winding cylinder arranged over the winding cradle and mobile to allow for the increasing diameter of the developing reel between said first, second and third cylinders. 10
12. Rewinding machine according to claim 11, **characterized in that** said third cylinder (21) is carried by a pair of oscillating pair of arms (17). 15
13. Rewinding machine according to one or more of the preceding claims, **characterized in that** at least three mating centers are arranged along each of said guides. 20
14. Rewinding machine according to one or more of the preceding claims, **characterized in that** at least five equally distant mating centers are arranged along each of said guides. 25
15. Rewinding machine according to at least claim 5, **characterized in that** said taker-in (83) presents a winding mandrel resting cradle whose geometry corresponds to the geometry of the winding cradle in the initial winding phase. 30
16. Rewinding machine according to claim 15, **characterized in that** said resting cradle is defined by at least two straight circular cylindrical surface sections arranged side-by-side. 35
17. Rewinding machine according to claim 6, **characterized in that** each of said flanks is associated to a cylinder-piston actuator (45) which controls the movement in the vertical direction. 40
18. Rewinding machine according to one or more of the preceding claims, **characterized in that** electric and pneumatic distribution means (91-101) are associated to said mating centers on each flank. 45
19. Rewinding machine according to claim 18, **characterized in that** said electric and pneumatic distribution means comprise a rotating distributor (91) arranged inside the path defined by the guide (61) along which the mating centers move and one or more flexible conduits towards said mating centers. 50
20. Rewinding machine according to claim 18, **characterized in that**: an electrical distribution box (93) and a pneumatic distribution box (101) slide along each of said guides (61); that said electrical distribution box and said pneumatic distribution box are connected by means of a flexible member (95) to a distributor (91) arranged inside the path defined by the guide (61) along which the mating centers (65) and said boxes move; and that said boxes are connected to the mating centers via flexible pneumatic and electric connections (95, 97). 55
21. Rewinding machine according to at least one of claims 8 to 10, **characterized in that** sensors are associated to at least some of said mating centers to detect vibrations of the winding mandrel and **in that** the reciprocal distancing movement of the first and the second winding cylinder is controlled according to the signal of said sensors.
22. Method for the production of reels (R) of web (N) wound on winding mandrels in which:
- a first winding mandrel (M) is inserted in a winding cradle (7) and a predetermined amount of web is wound upon it to form a reel, the ends of said first mandrel being engaged by a pair of mating centers;
 - the finished reel is unloaded from the winding cradle and
 - a second winding mandrel (M1) is inserted in said winding cradle
- characterized by:**
- engaging the first winding mandrel (M) in a collection area by means of a first pair of mating centers;
 - transferring the first winding mandrel by means of said mating centers to said winding cradle;
 - when the reel is finished, transferring the reel with said first pair of mating centers from said winding cradle to an unloading area;
 - after transferring said first winding mandrel to the winding cradle, engaging a second winding mandrel with a second pair of mating centers in said collection area;
 - when said reel is removed from the winding cradle, inserting the second winding mandrel in said winding cradle with said second pair of mating centers;
 - transferring the first pair of mating centers towards the collection area of the winding mandrels.

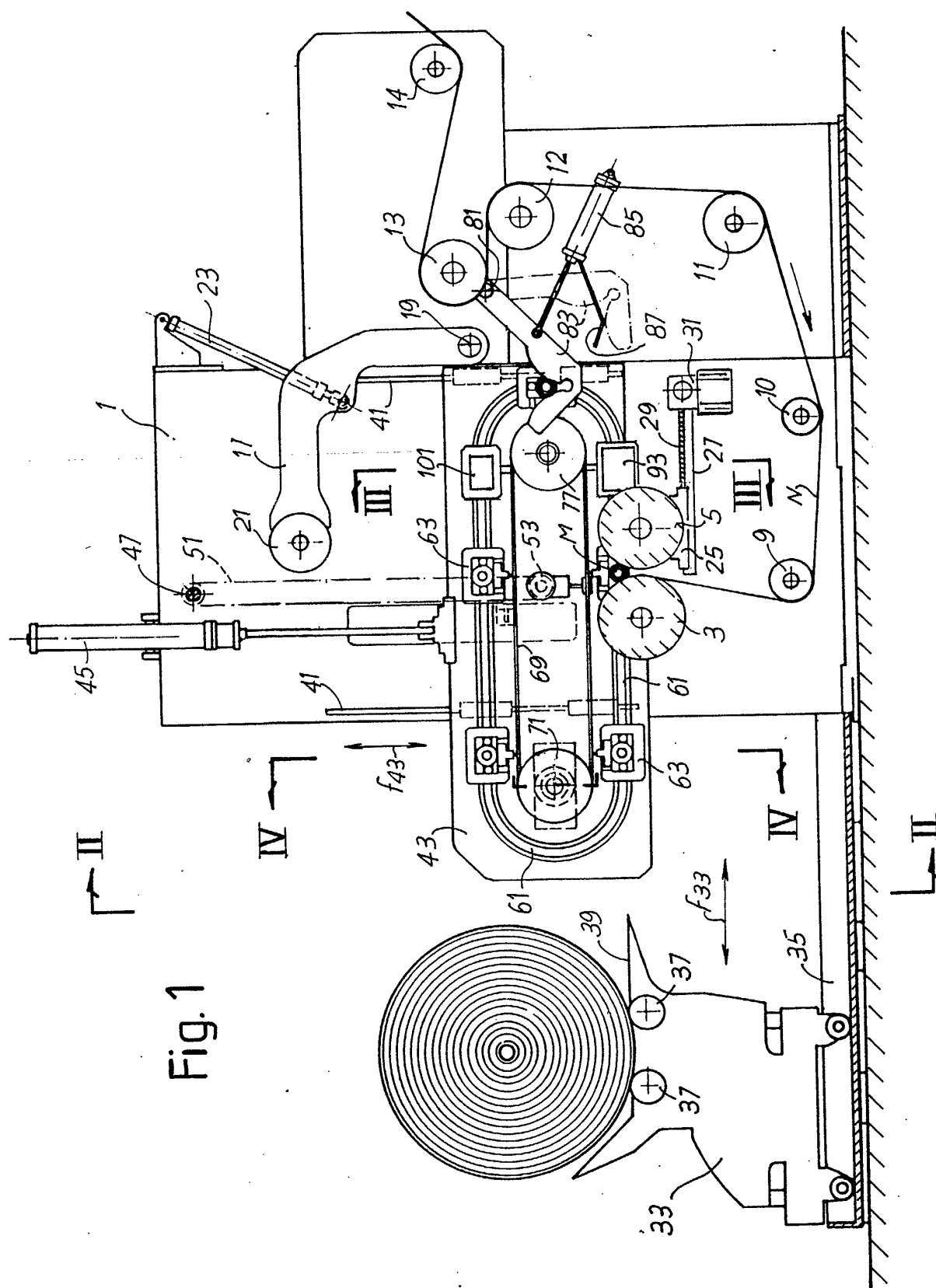
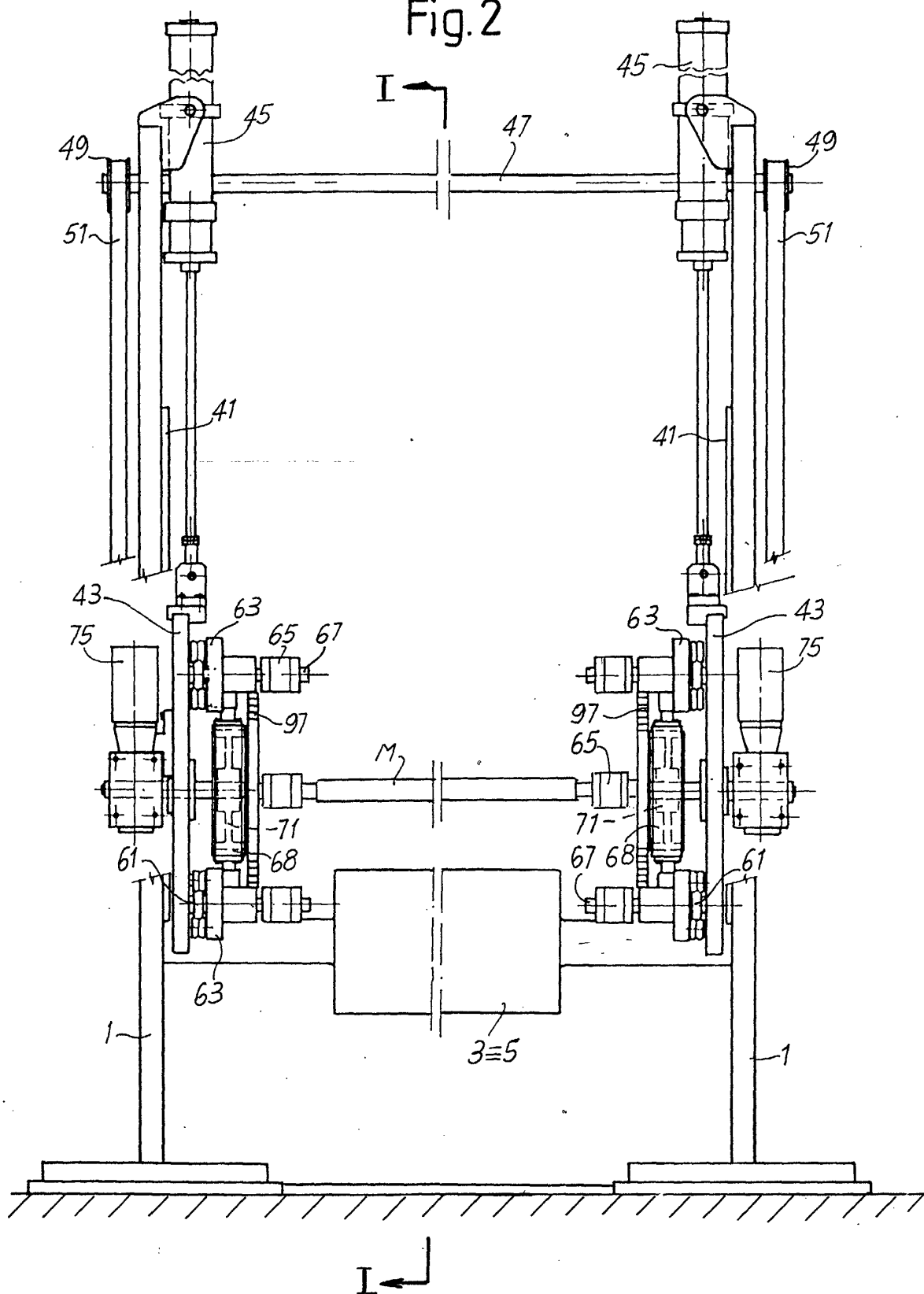


Fig. 1

Fig.2



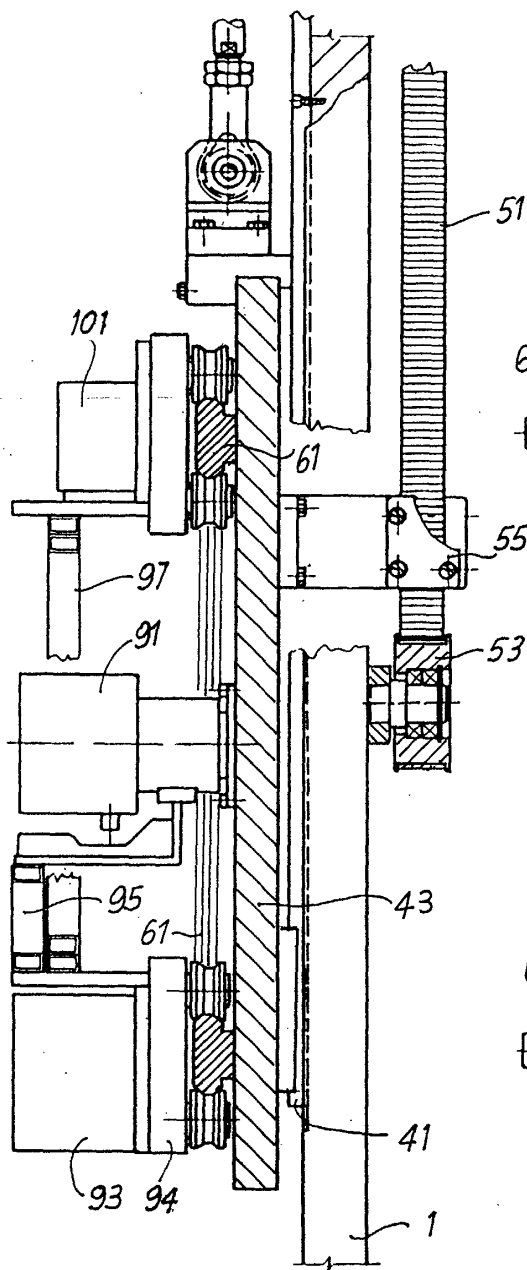


Fig. 3

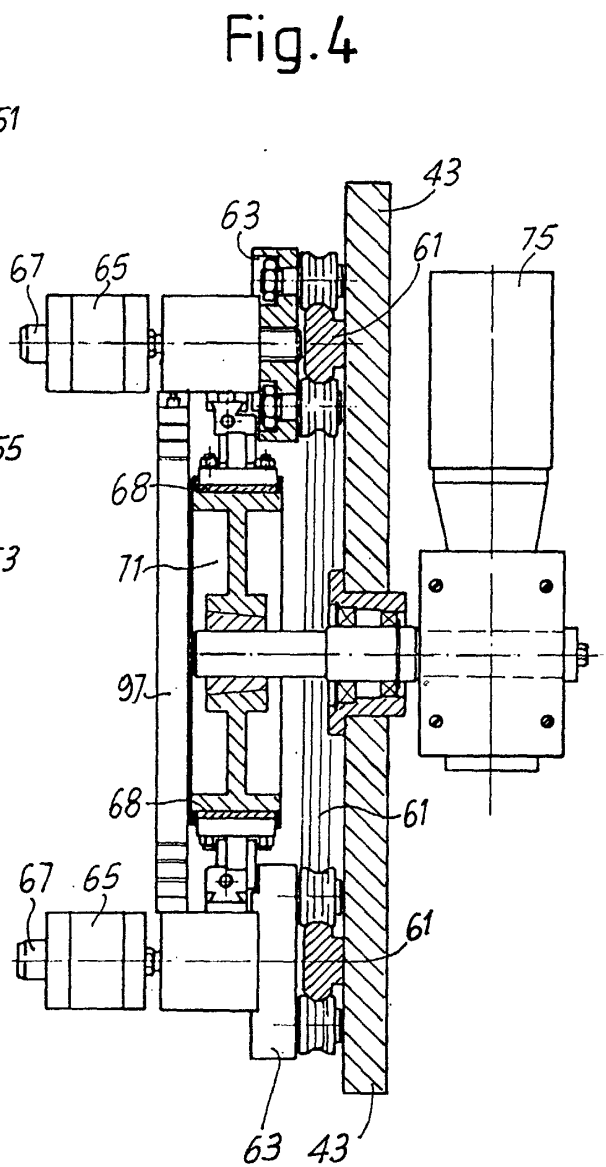


Fig. 4

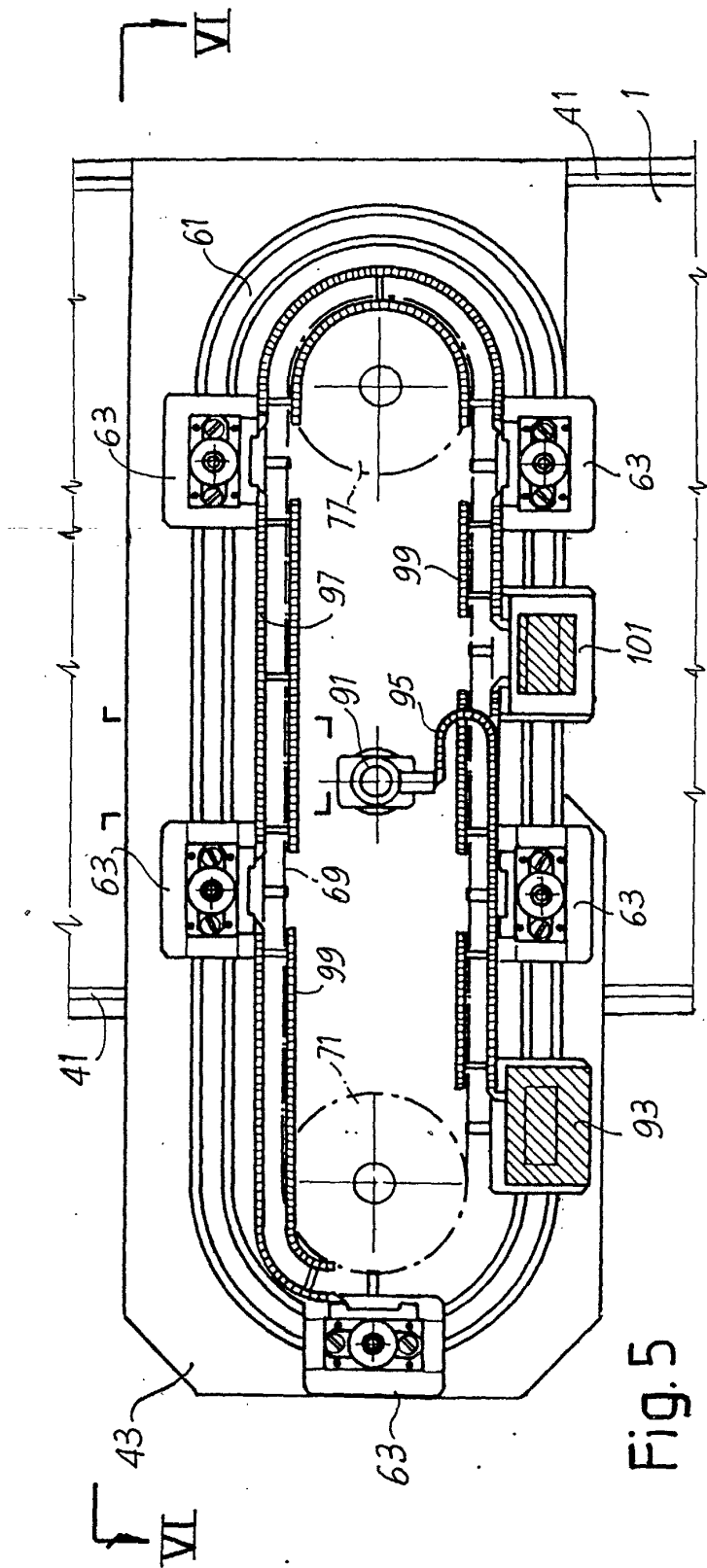


Fig. 5

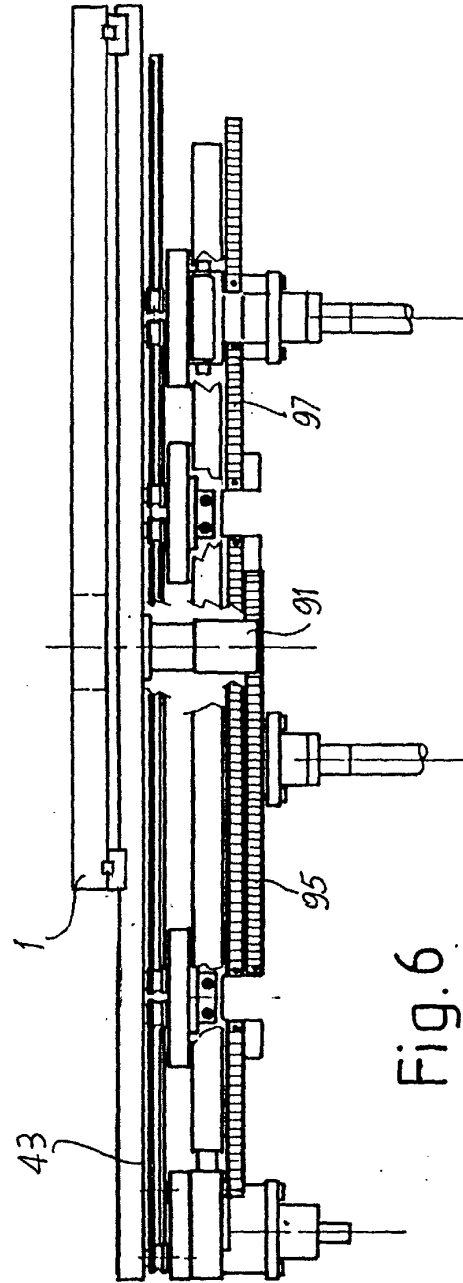


Fig. 6

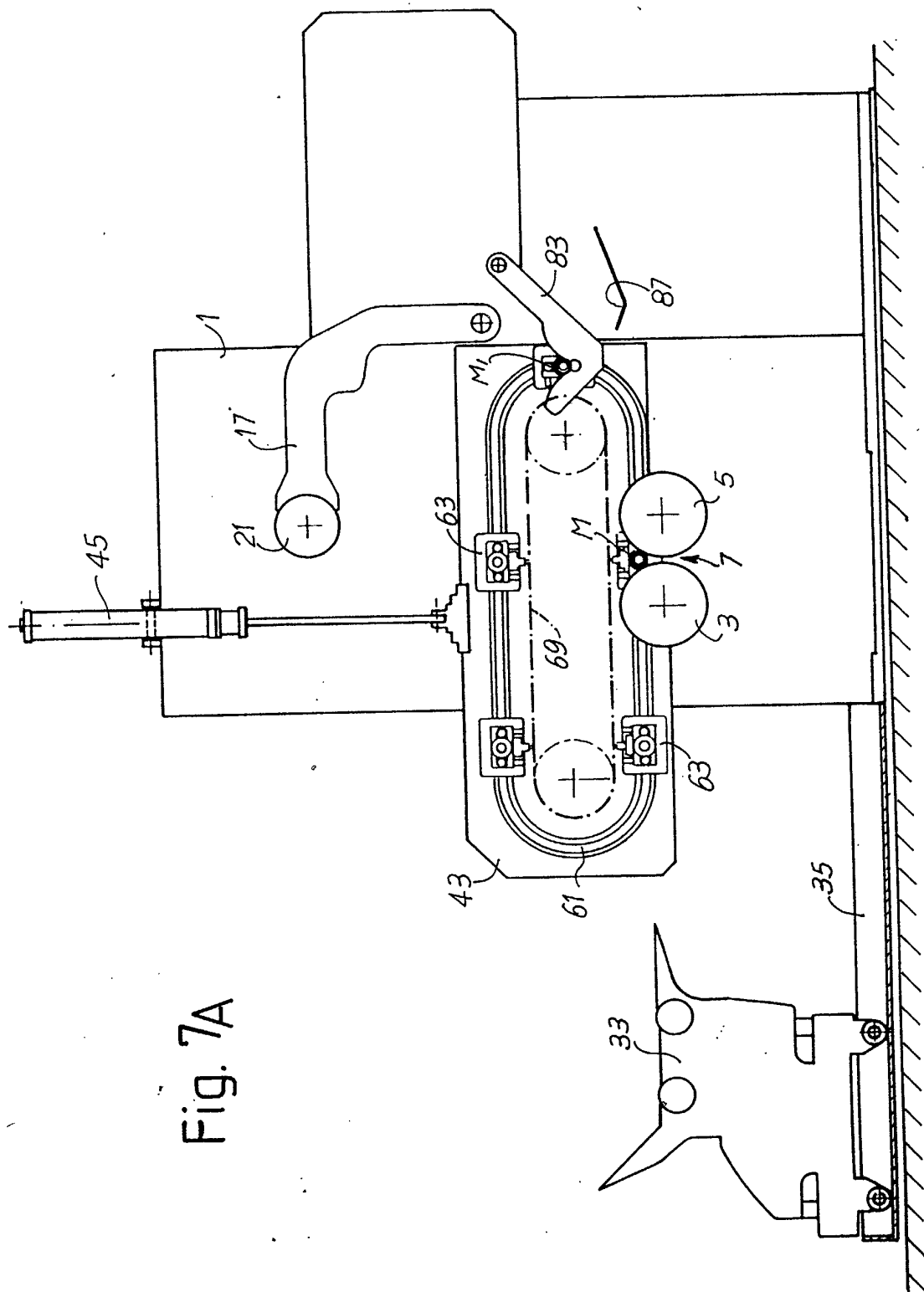
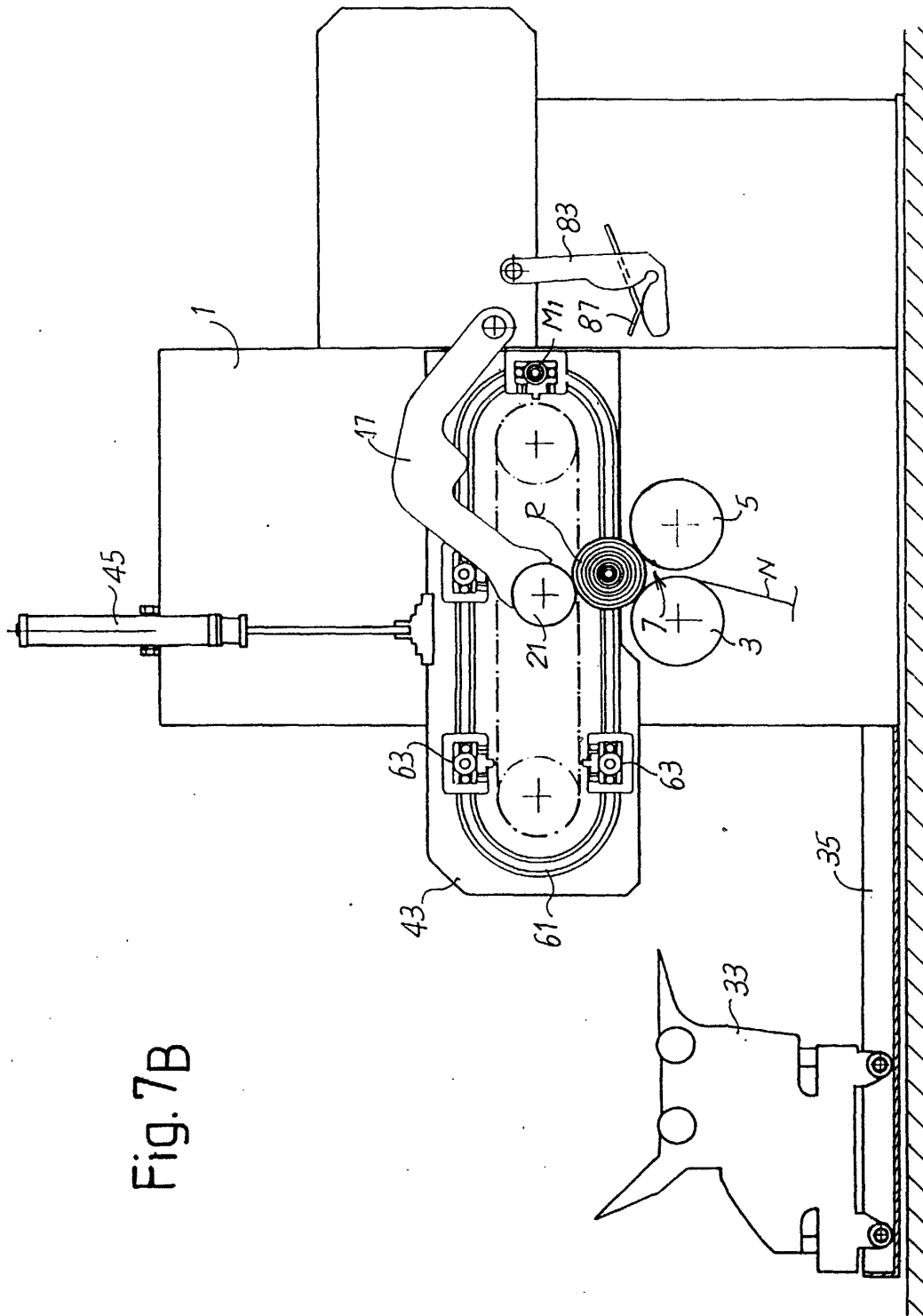


Fig. 7A

Fig. 7B



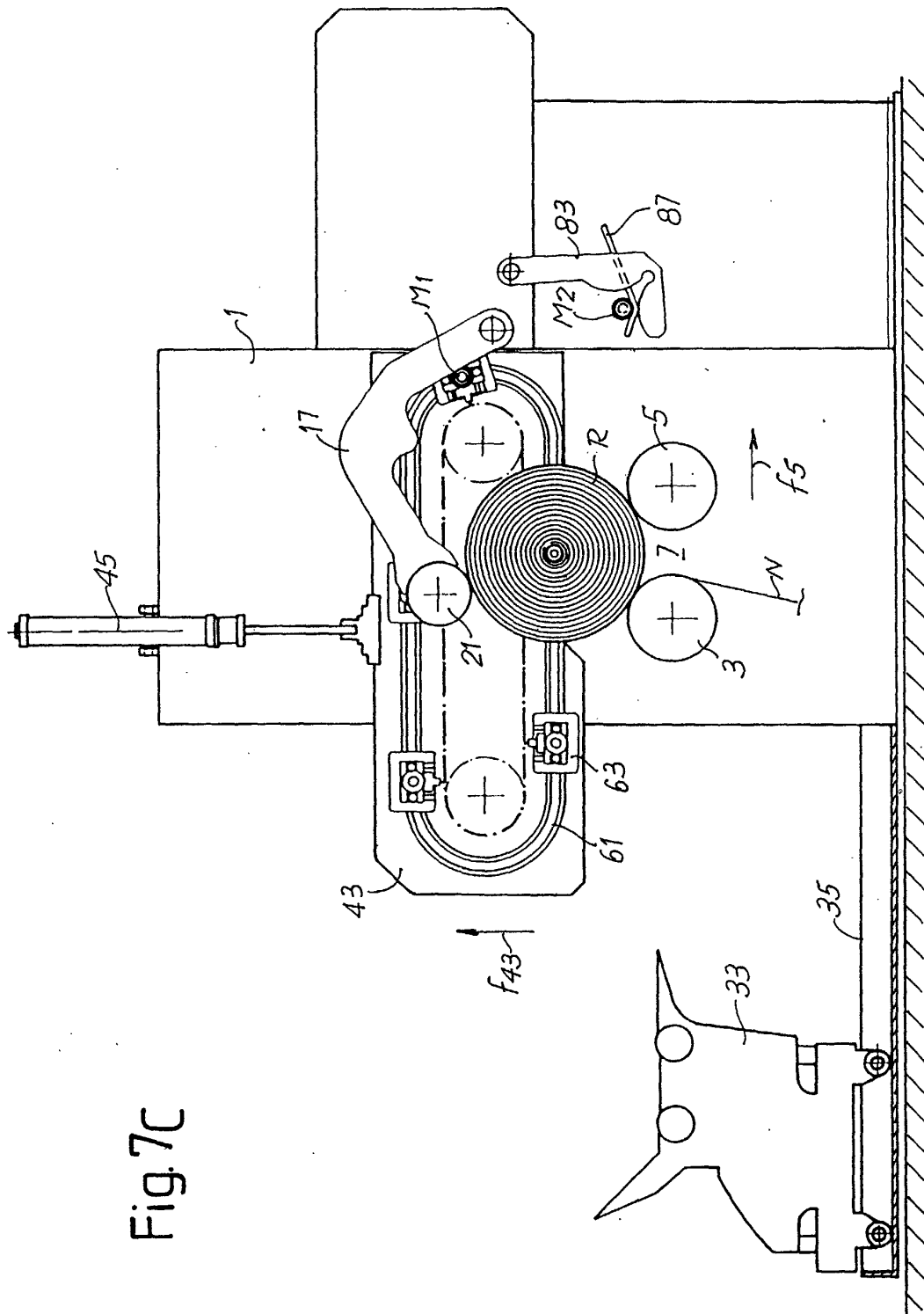


Fig. 7D

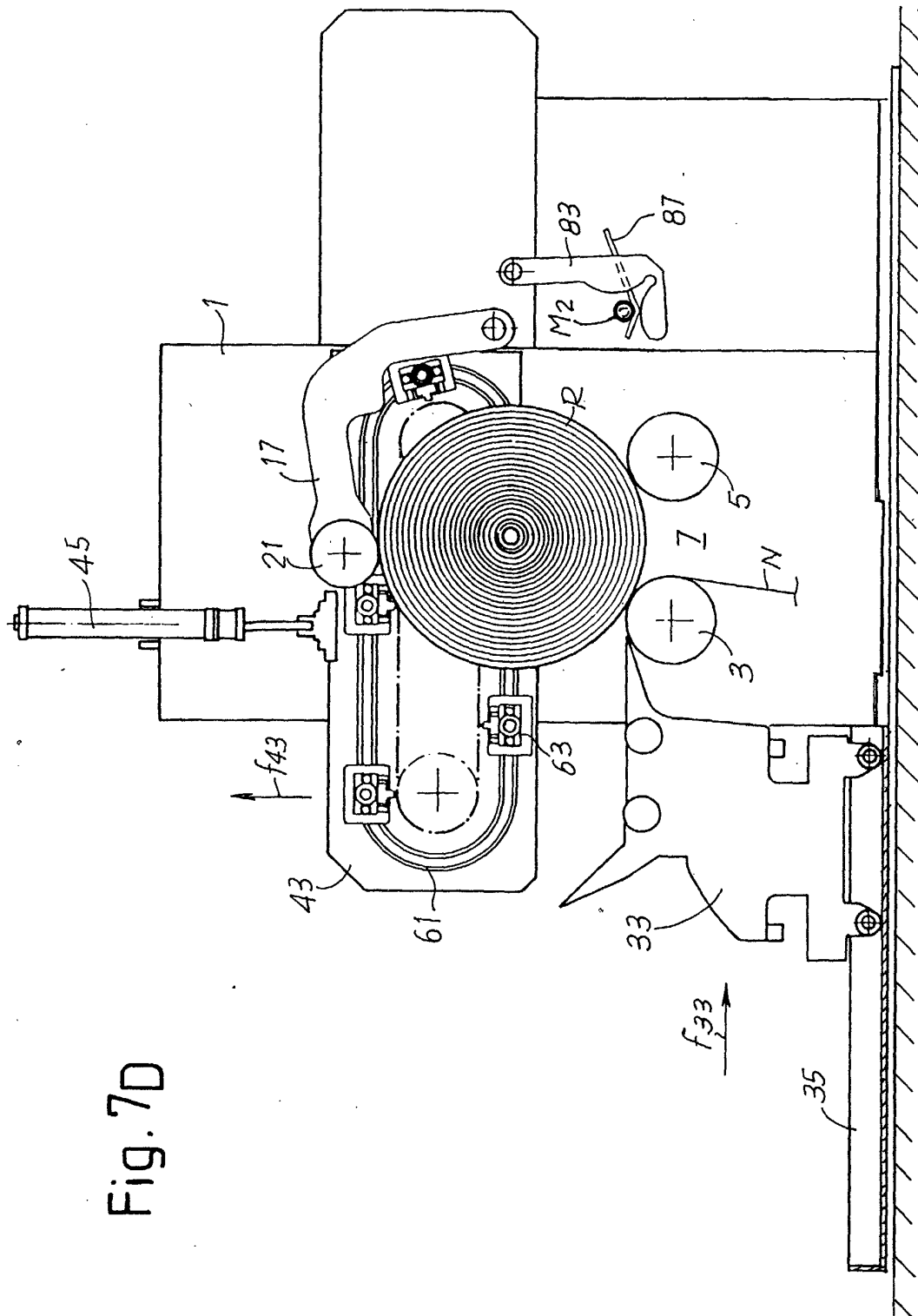


Fig. 7E

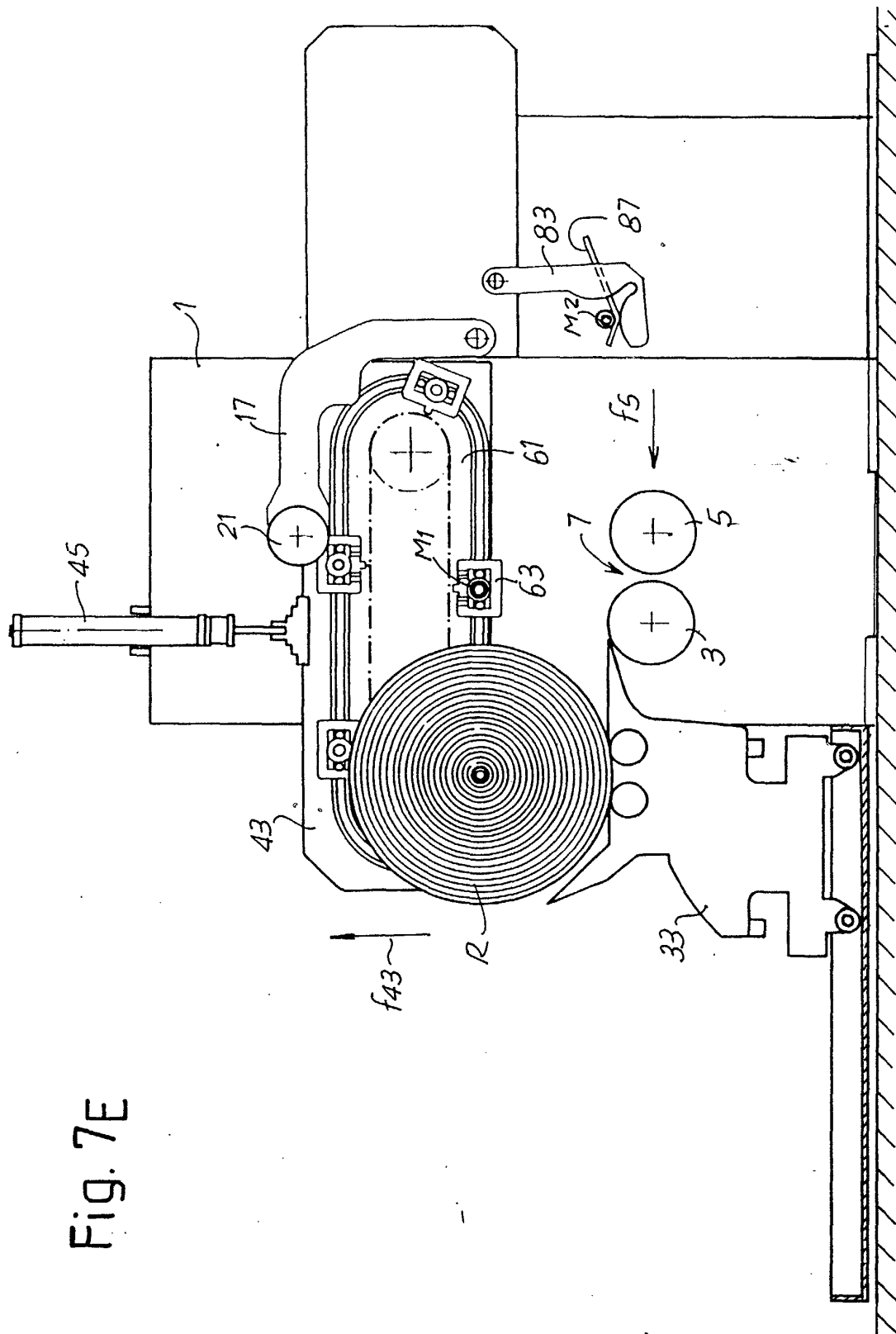
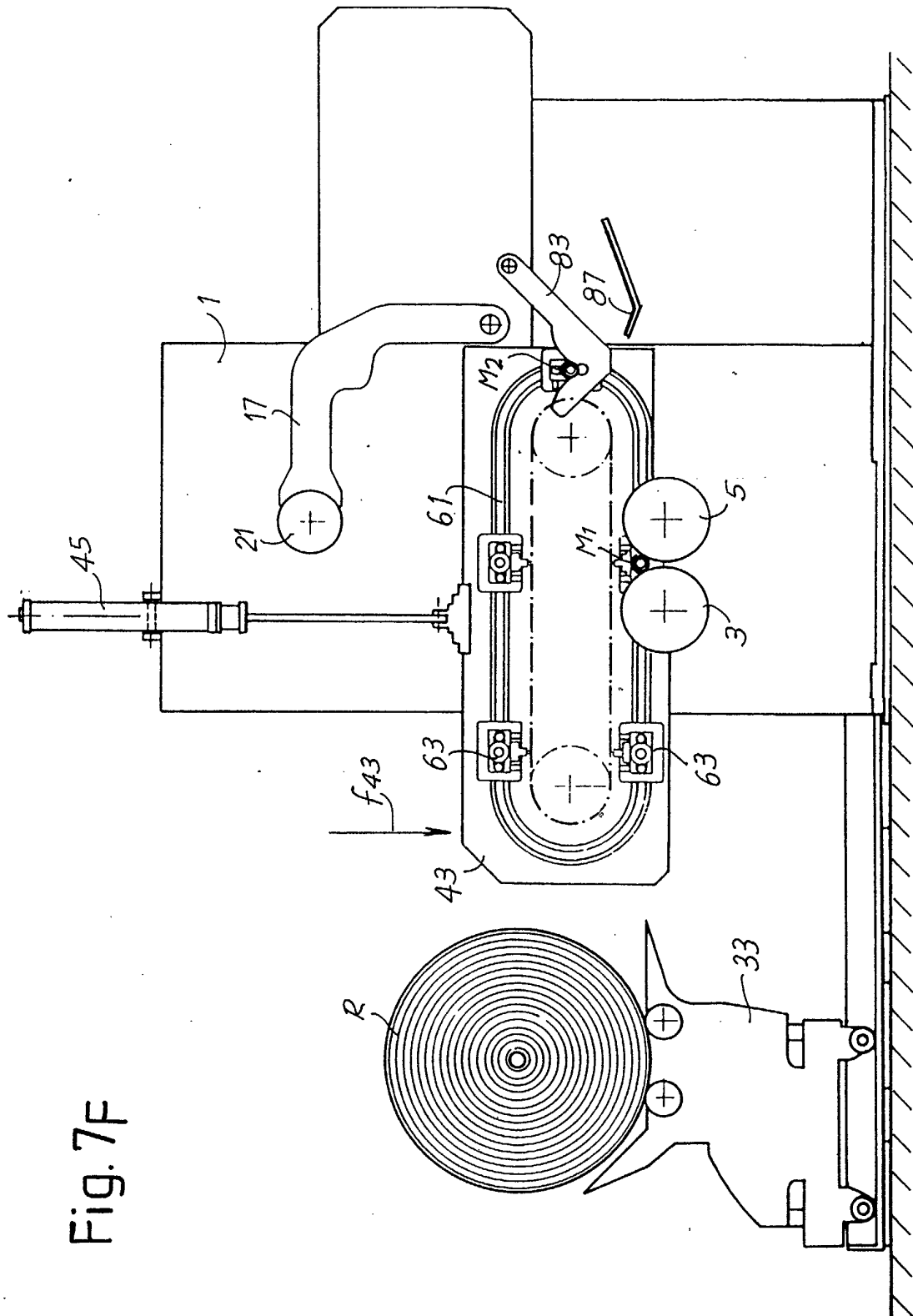


Fig. 7F





European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 02 42 5417

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)
A	US 3 232 549 A (STAMBAUGH FREDERIC P) 1 February 1966 (1966-02-01) * column 3, line 9 - line 31; figures * ---	1,22	B65H18/20
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The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int.Cl.7) B65H
Place of search THE HAGUE		Date of completion of the search 28 November 2002	Examiner Haaken, W
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