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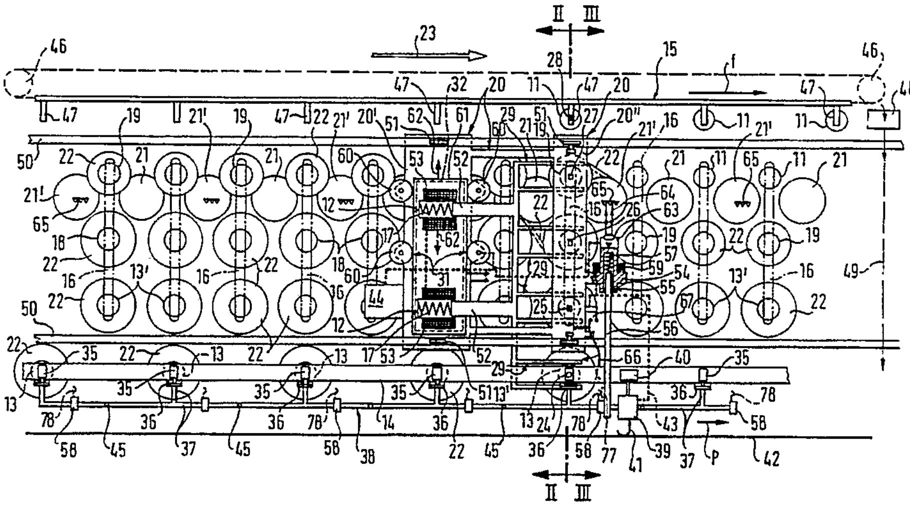
(54) **Transporting packages of spinnable strand in and to the creel of a textile machine.**

(57) Roving packages (22) suspended on carriers are transported by a trolley (38) to a ring spinning machine for transfer to the creel of the machine. The creel comprises paths (16) at right angles to the machine length and a central conveyor (15). A robot (20) effects transfer of packages from the trolley (38) to the paths, movement of packages (22) along the paths and transfer of exhausted packages to the central conveyor (15), which moves them to a station (48) at which they can be returned to the trolley.

Fig.1



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This invention relates to a transport installation for transporting packages or package carriers to and within a textile machine, in particular a spinning machine. Packages and package carriers may in the following description be referred to simply as "carriers" because for the purposes of this invention it is not important whether the installation is operating upon a full package or an empty package carrier.

In our European patent application No. 88116282 of 1 October 1988 (corresponding with the U.S. patent application serial No. 07/259249 of 18 October 1988 and Japanese patent application No. 63-255026) and in our European patent application No. 89101255 of 25 January 1990 (corresponding with U.S. patent application serial No. 07/308405 of 9 February 1989 and Japanese patent application No. 1-27730) we have illustrated adventagous solution for transporting roving packages to and within a ring spinning machine. In particular, the solutions foresee a transport system for delivering roving packages to a ring spinning machine and a conveying system for conveying packages within the machine. In solutions of this kind, there is necessarily a large number of connecting points between the transport system and the conveying system within the machine.

It is the object of this invention to enable adventagous solutions for the problem of transfer of packages and package carriers between the transport system and the conveying system.

The invention provides a transport installation for transporting packages or package carriers to and within a textile machine comprising a transport means for moving the packages and/or the carriers around or along the machine and a conveying system for moving the packages and/or the carriers within the machine and with a plurality of connecting locations for transfer of packages and/or carriers between the conveying system and the transport means and with a travelling switching means which is movable along and/or around the machine and is selectably operable for transferring a package and/or a package carrier at a selected connecting location.

The transport installation is preferably in the form of an overhead conveyer installation for example of the type shown in West German patent specification No. 3601832.

In accordance with one embodiment, the invention can provide a spinning machine, in particular a ring spinning machine, with a rail system extending along the spinning positions on which tube transport trolleys can travel. These trolleys can be loaded with tubes acting as carriers for packages of sliver or roving wound in a spinning preparation machine for example a roving frame. The trolleys carry these packages to the creel of the spinning machine which is so arranged that the trolleys can be stopped adjacent each spinning position where a package is required in order to transfer a package into the creel. Before this step, an empty tube or partially unwound package can be removed from the creel. The tube and package transporting trolley can be provided with a tube transfer device which travels with the trolley and transfers a package into the creel when the trolley stops at a spinning position. The basic principle of this embodiment therefore lies in the construction of the tube and package transporting trolley itself to enable transfer of packages from the trolley to the creel. However, in a large mill (with an extensive transport network, many spinning machines and therefore a large number of transport trolleys), this arrangement will not always be acceptable.

In alternative embodiments, therefore, the travelling switching or transfer device is not associated with the transport trolley but with the spinning machine. The switching or transfer device can then be brought into operating relationship with a given trolley after the trolley itself has been moved into a predetermined relationship with the spinning machine (and therefore with the switching or transfer devices associated with that machine).

In the preferred embodiments of the invention the switching or transfer device (which can also be referred to as a "handling robot") associated with a spinning machine is integrated into the previously by mentioned conveying system for conveying packages and/or package carriers within that machine in that the switching or transfer device is adapted not only to cause transfer of a full package into the creel (or transfer of an empty package carrier out of the creel) but is also adapted to move or to cause movement of packages and/or carriers within the creel.

The preferred form of conveying system within the creel comprises a plurality of paths arranged at an angle (preferably at a right angle) to the length of the machine and each adapted to carry at least one package for delivering a spinnable strand to a spinning position of the machine associated with that particular path. The machine itself may be a "double-sided" machine, that is comprising two rows of spinning positions each extending longitudinally of the machine and facing outwardly in opposite direction from a central region of the machine. The conveying system may further comprise a conveying means extending longitudinally of the machine in this central region thereof. The switching or transfer device (handling robot) may be adapted to tranfer packages and/or carriers also between the central conveying device and the transverse paths associated with respective spinning positions.

In a conventional ring spinning machine the creel is normally provided on supports above the machine. The packages are suspended from the creel so as to be disposed above head - height relative to a ground level which is common to the machine itself and to the human machine operators. The spinning positions, which may have to be serviced by the operators, are provided between this ground level and the creel. Service personnel may be replaced by automatically operating tenders for tending the individual spinning positions, and such tenders are also normally arranged to run on rails at or about ground level relative to the machine.

The transport system for delivering packages to the machine and removing carriers from the machine is preferably adapted to deliver to and remove from the machine at about creel height. A switching or transfer device (handling robot) in accordance with this invention is preferably adapted to lie between the transport system and the creel, or to be provided immediately above or immediately below the creel thereby causing a minimum of interference with access to the spinning positions themselves and to the run of spinnable material out of the creel into those spinning positions.

A switching or transfer device (handling robot) in accordance with this invention may be adapted to move a full package onto a transverse path within the creel of the spinning machine while simultaneously moving packages and/or carriers already present on that path. However, this simultaneously movement of the newly arriving package and the already present packages/carriers is not essential to the invention. Each package/carrier may be moved individually so that a complete transfer operation involves a sequence of package/carrier movements, or the packages/carriers may be moved in groups (for example in pairs) the packages/carriers of an individual group being moved simultaneously.

Various embodiments of the invention will now be described with reference to the accompanying drawings, in which:

Figure 1 shows a schematic plan view of a portion of a ring spinning machine in accordance with this invention,

Figure 2 shows a section through a further embodiment basically along the section lines II-II in Figure 1,

Figure 3 shows a schematic sectioned elevation of a further embodiment of a ring spinning machine with rows of spinning positions arranged on both sides of the longitudinal central plane of the machine, the section again being taken basically in accordance with the section lines III-III of Figure 1,

Figure 4 is a schematic plan view of a further embodiment of a ring spinning machine in accordance with the invention, the spinning positions being omitted in this case,

Figure 5 shows a section on the lines V-V in Figure 4,

Figure 6 shows a section in accordance with the lines VI-VI in Figure 4,

Figure 7 shows a plan view similar to Figure 4 of a further embodiment,

Figure 8 shows a plan view of tubes located in the creel of a ring spinning machine on two adjacent transverse supports, the tubes being shown at different processing stages and with sensors to determine how much spinnable material is provided on each tube,

Figure 9 shows an elevation of part of a tube transfer carriage with sensors to determine the amount of spinnable material on a tube,

Figure 10 shows a section taken on the lines X-X in figure 7,

Figure 11 shows a vertical section of a part of a ring spinning machine with a tube shifting carriage in accordance with a further embodiment,

Figure 12 shows a perspective view of a transverse support of the embodiment in accordance with Figure 11,

Figure 13 shows a schematic representation of a further embodiment,

Figure 14 A and B together show a handling robot for handling elements shown in Figure 13,

Figure 15 shows a schematic plan view of a part of a transport installation in accordance with this invention in and adjacent a ring spinning machine,

Figure 16 shows a schematic plan view of a variant of the arrangement shown in Figure 1,

Figure 17 shows a schematic representation of one possibility of transferring packages or package carriers by means of a travelling switching or transfer device in accordance with this invention,

Figure 18 shows a schematic representation of a second possiblity for performing such transfer,

Figure 19 shows a schematic partial plan view of a ring spinning machine with a rail running along one side thereof and carrying a tube transport trolley,

Figure 20 shows a similar schematic view of a further embodiment,

Figure 21 shows a schematic overall plan view of a ring spinning machine similar to that shown in Figure 15 but with additional detail,

Figure 22 shows a schematic cross-section through a ring spinning machine and creel showing in full lines a generally conventional arrangement with dotted lines modifications which are associated with the present invention, and

Figure 23 shows a diagram of a ring spinning machine with part of a transport network for delivering packages to and removing package carriers from the machine.

The general principles underlying the invention will firstly be explained with reference to Figure 22 and the diagrammatic representations in Figures 15 - 18 and 23. Various possible embodiments for practical realisation of these underlying principles will then be explained in detail with reference to the other Figures of the drawings.

General principles

Figure 22 shows in longitudinal elevation a ring spinning machine 220 supported by feet 222 on the floor 224 of the spinning room. The machine comprises a frame work made up of transverse supports ("Samsons") 226 carrying longitudinal elements which extend along the whole length of the machine. The machine is symmetrical about a central longitudinal plane CP that is, the machine is "double-sided" with two rows of spinning positions facing outwardly in opposite directions from this central plane. Each spinning position comprises a drafting section 228 and spindle unit 230 with thread guiding elements 232 between the drafting section and the spindle unit. Each spinning position can be of generally conventional construction, and is therefore illustrated only in general outline in Figure 22 without any detail.

Suitable drive arrangements are provided for both the drafting section 228 and the spindle unit 230. The machine also comprises a pneumatic system including a suction channel 234 extending longitudinally thereof and having branch tubes (not shown) communicating with respective spinning positions to collect waste material therefrom. At each end of the machine (not shown) there is an appropriate end head in which working elements common to all spinning positions of the machine (for example centralised drive, control and pneumatic systems) are located. A modern machine will normally be provided with an automatically operating doffer for removing completed yarn packages from the spindle units 230 and replacing them with fresh tubes ready for winding of new yarn packages. However, since such doffing arrangements form no part of the present invention, they have been omitted from Figure 22.

A modern ring spinning machine includes a large number of spinning positions, for example 1000 to 1200 such positions equally divided between the two rows on opposite sides of plane CP. Service personnel or a service tender for tending the individual spinning positions can stand (be supported) on floor 224 and can move freely along the machine with good access to the individual spinning positions.

Material to be spun in the spinning position is provided from a so-called creel 236 supported by vertical posts 238 firmly secured in the machine frame. The creel 236 comprises transverse supports 248, there being one such support 240 for each pair of adjacent spinning positions. The supports 240 extend outwardly in a form of cantilever beams from the central support posts 238 so that each support 240 has a free outer end. In a conventional ring spinning machine, each support 240 normally carries two suspension devices 242 on which roving tubes 244 are suspended to hang freely from the respective suspension device 242. When it is first mounted in the creel 236, each tube 244 carries a package 246 of roving to be spun in a respective spinning position associated with that particular transverse support 240. Roving withdrawn from this package is passed over suitable guides, for example longitudinal guide rods 248 mounted on the support posts 238, so as to run from the respective packages over the associated guides into the individual drafting sections 228. The run of roving has been omitted from Figure 22 in order to maintain clarity of the overall illustration and because this arrangement is well-known to the man skilled in the spinning art.

This specification refers to "roving packages", that is packages of slightly twisted strand prepared on a roving frame. However, the invention is clearly not limited to machines based on a roving feed. Ring twisting machines, for example, take yarn packages as infeed.

In order to maintain the service area immediately adjacent the spinning positions clear, the creel is normally disposed so that the suspended packages are held above head height for service personnel or above any region which has to be crossed by a service tender.

In accordance with the principles disclosed in the above-mentoned European patent application No. 88116282 and European patent application No. 89101255, it is now proposed to convert the conventional supports 240 into transverse paths along which roving packages and/or package tubes can be moved to and from a delivery system transporting the packages and/or tubes to and from the ring spinning machine. This has been indicated diagrammatically in Figure 22 by dotted line modifications of the conventional arrangement. These modifications include a central conveying region immediately adjacent the plane CP. In this central conveying region 250, empty tubes (or at least almost completely unwound packages 252) can be conveyed longitudinally of the machine. On an outermost conveying path 256, packages 254 newly delivered to the machine can be moved around the machine or at least along each longitudinal face thereof. In accordance with preferred embodiments, European patent application No. 89101255, each transverse path 240 is extended as indicated in dotted lines at 258 to provide space for a reserve position such that a newly delivered full package 254 can be moved from the outermost conveying path 256 into a reserve position of an individual transverse path while the working positions (illustrated in full lines) are still occupied by at least partially wound packages delivering strand to the respective spinning positions.

The arrangements for performing the various transverse movements immediately described above are the subject of the present invention and will subsequently described in further detail with reference to the various Figures of the drawings. Before that, however, certain general layout principles will be discussed with reference to Figures 15 -18 and 23.

In Figure 18, reference numeral 300 indicates a ring spinning machine with a creel comprising a central path B extending in the longitudinal direction of the machine and the plurality of transverse rails (transverse paths) Q. For clarity of illustration of the principle, only twelve such transverse paths Q have been shown in Figure 15. Since, however, each transverse rail Q is associated with one spinning position or (preferably) two adjacent spinning positions, very many such transverse rails have to be provided in a modern ring spinning machine, for example between 500 and 600 per machine side.

Roving packages from a non-illustrated roving frame group are delivered to the ring spinning machine 300 via a transport network in the form of an overhead conveyor installtion. In Figure 15, only a small portion of this network has been illustrated, namely two straight transport rails 314, 316 on respecitve sides of the machine 300 and a curved rail WS which joins the main rails 314, 314 at one end of the machine.

Package transport carriages TW run on this network and bring roving packages from the roving frame group to this particular ring spinning machine (amongst other such machines). They also take back empty package carriers from the spinning machine to the roving frame group. In the following description, it will be assumed that the packages pass along the transverse rails Q to the central path B and that the empty package carriers are passed via an additional transverse rail QZ from the central path to the transport carriages TW. This mode of movement is not absolutely necessary - the packages could be distributed via the central path B onto the transverse rails Q and be transferred from each transverse rail Q to the transport carriage TW. Furthermore, feed of packages to the machine, or removal of package carriers from the machine, could be effected via an extension of the central path B (as indicated in dotted lines) thereby making the additional transverse rail QZ superfluous.

Whichever variant is selected, there are a large number of connection locations between the transverse rails Q and the main rails 314, 316 of the transport network. These connection locations are indicated in Figure 1 by small circles and the reference symbols VS. It would be possible to provide an individual switch device for each connection location in order to enable the transfer of packages or carriers at these connection locations. However, this invention is intended to provide an alternative solution.

In a first variant (Figure 15) each transport carriage TW carries its own (travelling) switching device W along with it. This switching device can also be referred to as a transfer device or more generally as a handling robot. When the switching device W arrives at a selected connection location VS, it can be used to effect transfer of packages or carriers at this connection location. Various possibilities for performing this function will be outlined in connection with Figures 17 and 18 and subsequently described in further detail with reference to Figures 19 -21.

However, in the embodiment in accordance with the Figure 15, it is necessary to provide each transport carriage with its own switchng device W. As already indicated in the introduction to this specification, such an arrangement is not necessarily desirable in a large spinning mill with an extensive transport installation. Figure 16 therefore illustrates schematically an alternative solution in accordance with which the ring spinning machine (here indicated by the reference numeral 400) is provided with an additional rail ZS and a "switching carriage" WW can run on this additional rail ZS.

The switching carriage WW can move with a transport carriage TW around the ring spinning machine 400. For this purpose, a temporary connection (coupling) can be effected between the transport carriage and the switching carriage WW so that only one of these carriages has to be driven. However, both of the carriages TW and WW could be driven independently from each other and these carriages could even move independently around the ring spinning machine 400. The switching carriage WW could, for example, be prepositioned at a selected connection location VS before the transport carriage TW arrives at this location.

The arrangement can be so selected that the switching carriage WW is associated with the particular ring spinning machine and remains continuously on the additional rail ZS adjacent this particular ring spinning machine. A switching carriage WW of this kind could be controlled by an autonomously operating machine control (not shown) of the ring spinning machine 400. The arrangement could, however, alternatively be so selected that the additional rail ZS is integrated into the transport network of the complete installation so that the switching carriage is directed from the complete installation to the selected ring spinning machine 400 as and when necessary.

In the illustration according to Figure 16, the opportunity has been taken to illustrate at alternative arrangement for the movements of the packages or carriers within the ring spinning machine itself. In this case, it is been assumed that the packages pass by way of a delivery rail LS onto the central path B of the ring spinning machine 400 and are distributed from the central path onto the transverse rails Q. In this case, the connection location associated within an individual path Q serves merely to transfer empty package carriers to the transport carriage TW. This variant of movements within the ring spinning machine is, however, not directly concerned with the invention itself and is illustrated merely to show a possibility which can be exploited by means of transfer arrangements in accordance with this invention. The principles in accordance with this invention bring advantages in combination with all variants of movements within the ring spinning machine itself.

Figure 17 shows a first possibility for performing a transfer operation to or from a transport carriage TW at a selected connection location VSA (according to Figure 1 or Figure 2). The transport carriage TW is fitted with its own rail section TWS. The package carriers ST are coupled with the rail TWS and are also movable along that rail. The full packages are suspended on these package carriers ST. The travelling switching device W (integrated with the transport carriage TW) or WW (provided on an individual carriage) has a rail section SV. When the switching devices have been appropriately positioned, the rail section SV is aligned with the transverse rail Q at the connection location VSA and with the rail WS of the carriage TW. The appropriate positioning can, for example, be achieved as and when necessary for example be means of an abutment A.

It is now assumed that the transport carriage TW does not stop to enable transfer of packages but continues its movements in the direction indicated by the arrow in Figure 3. The travelling switching device W or WW cannot follow the movement of the transport carriage TW, however, because it is held back in its transfer position by the abutment A. There is therefore a relative movement between the transport carriage TW and the switching device W or WW, as indicated by the dotted line arrow P in Figure 17. This relative movement can now be exploited for transfer of a package (or a package carrier) from the transport carriage to the switching device W or WW, whereupon the delivered package can be further directed onto the transverse rail Q. The switching device W or WW can then be released by the abutment A for further movement with the transport carriage (or independently thereof). If the switching device W is carried along by the transport carriage TW, then the mounting (not shown) for the switching device W must enable the relative movement P, for example by means of a short slider mounting on the transport carriage.

Figure 18 shows the further possibility in accordance with which the transport carriage TW stops for transfer of package carriers ST at a connection location VSA. The rail arrangement TWS, SW, Q is the same as that shown in Figure 17. In this case, the transport carriage TW is provided with a delivery means for example a piston and cylinder unit (not shown) in order to deliver package carriers (packages) via the thus created switching connection onto the transverse rail Q.

It will be appreciated that taking up of package carriers from a trasverse rail Q can be carried out in principle in the same way regardless of whether a system in accordance with Figure 17 or Figure 18 is selected.

Figure 23 shows an overhead conveyor 405 forming part of a transfer network leading from a roving frame 406 (forming part of a non-illustrated group of such roving frames) via a points system 407 into an overhead conveyor 411 associated with a respective ring spinning machine 410 and encircling that machine. The overhead conveyor 411 therefore extends along both longitudinal sides of the machine 410. Between the end head 412 and the drive head 413 of the machine 410 there is a creel made up of creel paths 416 in the form of rails which are arranged at a disposition at right angles to the central plane 417 of the machine as viewed in plan. The rails 416 are preferably horizontal but they can also exhibit a small angle to the horizontal when viewed in a vertical plane and they lead through the "operating" (or "working") positions of the packages 418 (first operating position) and the packages 419 (second operating position) while also supporting respective reserve packages 420. It is of course possible to provide one points arrangement for each side of the machine. In this case, two separate overhead conveyors would be provided, one for each longitudinal side of the ring spinning machine 410.

A package transport means 423 (for example a train of carriages with intermediate links along its length, not shown) can be driven on the overhead conveyor 405 and on the conveyor 411 by means of a motor drive for example by means of a friction roll drive or by means of a chain drive, for example in accordance with German specification No. 3728843. This train brings full packages 424 from the transfer conveyor 405 onto the transport conveyor 411.

In a preferred arrangement, each full package is built up on a support tube which is suspended from the package transport means by a suspension element (an example of which is shown at 36 in Figures 5 and 6). The package remains connected with this suspension throughout all movement to be described in this specification.

Specific embodiment

The first group of embodiments to be described operating in accordance with the principle generally illustrated in Figure 15, that is with a switching device provided on the transport carriage itself.

Figure 21 shows a ring spinning machine 311 having a plurality of spinning positions 312 with a uniform spindle gauge, that is mutual spacing of adjacent spindles and having a drive head 336 at one end of the machine and a further end head 337 at the other end. For each pair of spinning positions 312 on each machine side there is a respective transverse rail 333 on which in each case two working tubes 315′, 315″ and a reserve tube 315 can be arranged in a row. The two working tubes 315′, 315″ feed (by means of the strands 338 indicated in dotted lines) respective spinning positions 312 associated with the transverse rail 333.

In the interests of clarity of illustration, the tubes 315, 315′, 315″ have been represented only on two of the transverse rails 333 shown in Figure 21. The remaining transverse rails 333 carry tubes similarly arranged.

Along the machine and the round one end thereof there is a rail 313 coming from a transport network between the ring spinning machine and a group of roving frames. As schematically illustrated, tube transport train 414 is mounted in this rail 313 and carries a plurality of tubes 315 fully wound with roving. Preferably, the tubes are suspended downwardly from the tube transport train 414 which is formed as a trolley. A tube transfer device 318 is provided on the tube transport train 414 and will be subsequently further described with reference to Figures 19 and 20.

In the central region of the machine there is an empty tube conveying means 317 which can, for example, be formed as a conveyor belt having a reciprocable run (not shown in Figure 21 in order to simplify the illustration). The empty tubes to be returned are indicated at 336.

At the lower end of the ring spinning machine 311 as viewed in Figure 21, but before the end head 337, there is a transverse rail 333′ arranged parallel to the transverse rails 333. The transverse rail 333′ forms part of a transverse return device 335 by means of which the empty tubes 336 are taken from the empty tube conveying means 317 and are successively conveyed outwardly where the empty tubes 336 are transferred by means of the tube transfer device 318 into the tube transport train 314 which has in the meantime been emptied of its fully wound tubes 315.

Before re-loading of the train 414 with empty tubes, the fully wound tubes 315 carried by this train out of the transport network are unloaded successively to the individual transverse rails 333 of the creel 316. This is performed in that the tube transfer device 318 is brought into alignment with respective transverse rails 333 and then preferably the front fully wound tube 315 in the train 314 is transferred onto the transverse rail 333. As preparation for this step, an empty tube 311 has previously been transferred onto the tube conveying means 317 and the two neighbouring tubes 315, 315′ have been moved through one pitch, that is the mutual spacing of the working positions inwardly towards the central plane of the machine. In this way, the working package 315′ is moved into the position vacated by the previous working tube 315″ which has been removed as an empty tube (336). The reserve fully wound tube 315 at the entry end of the transverse rail 333 is moved into the position vacated by the working tube 315′. The strand of roving provided by the reserve full tube is connected, as indicated at 338, with the associated spinning position 312. By this means, space is created for feeding of a fully wound tube 315 from the transport train 414.

In accordance with the arrangement illustrated in Figure 19, the transport train 414 is supported by means of rollers 339 on the rail 313. Preferably, the schematically illustrated transport train 414 is provided in the form of a trolley, which is suspended from the rail 13 and from which the fully wound tubes 315 hang freely downwardly. For this purpose, the transport train 414 is provided in its longitudinal direction with a tube support rail 319 on which the fully wound tubes 315 are movable in the longitudinal direction in an appropriate manner while being suspended therefrom. The tube support rail 319 has a straight section 319‴ extending in a longitudinal direction of the transport train 14 and a curved rail section 319′ in its front region and adjoining thereon a transversely extending section 319″. The latter located on a tube transfer device 318 which is provided at the front end of the transport train 414.

Suitable abutments 325 at the upper ends of the fully wound tubes 315 can be engaged by entrainment fingers 322 which are connected by means of a rod 340 with a drive device 321a which operates for example pneumatically. Upon suitable pressurization of the drive device 321a, the rod 340 is moved in a forward direction whereupon the fully wound tubes are pushed forwardly on the straight rail section 319‴ within the transport train 414. In this way, the front fully wound tube 315 passes into the region of the curved rail section 319′ along which the full tube 315 is guided. In the course of this movement, an extendable pivot finger, which is rotatable by means of a servomotor 323, engages the abutment 325 from the same side as the entrainment fingers 322. Due to the subsequent pivotal movement of the pivot finger 324, the fully wound tube 315 is carried along onto the end of the transversely extended rail section 319″. The transport train 414, or tube transfer device 318, is now aligned with a spinning position 312 in such manner that a fully wound tube from the straight transverse rail section 319″ can be transferred onto the transverse rail 333 in the creel 316 of the ring spinning machine 311. On that rail, the fully wound tube can be moved by a non-illustrated transverse means or manually into the position 311 which corresponds to the reserve position.

In distinction to the arrangement illustrated in Figure 21, the embodiment shown in Figure 19 comprises for each spinning position 312 only one associated transverse rail 333 so that only one working tube 315′ and reserve tube 315 are provided on that rail. The tube transport system in Figure 19 can however be employed just as well with an arrangement in accordance with Figure 21.

The empty tubes 336 are guided by means of the tube conveying means 317 to the end of the machines where they are reloaded into the emptied transport train 414 at 335. This re-loading operation is carried out in the reverse sense to the feed operation for fully wound tubes 315. The transport train 414 is then returned via the rail 313 (Figure 21) into the transport network and from there to a roving frame.

In the embodiment according to Figure 20, the tube transfer device 318 comprises a transfer carriage 326 for the fully wound tubes which is mounted on the tube transport train 414 so as to be movable in the longitudinal direction thereon. For this purpose, a guide rod 342 can be provided on the transport train 414 being arranged in a guide bore 343 extending in a direction corresponding to the direction of the rail arrangement 313 within the transfer carriage 326. A relatively weak spring 331 pushes the transfer carriage 327 in a forwardly direction into engagment with an abutment 332 in the front region of the tube transport train 414.

In a first variant of this embodiment, the transfer carriage 326 which is movable in the longitudinal direction relative to the transport train 414, has a transverse rail 328 which extends between the fully wound tube 315 with which the tube transfer device 318 is aligned, and the transverse rail 333 onto which the fully wound tube 315 is to be transferred into the vacated location 341. The transfer carriage 326 also comprises a mechanical tube shifting device 327 which (in the manner schematically indicated in dotted lines) engages a fully wound tube 315 aligned therewith, brings this into engagement with the transverse rail 318 and moves the tube along that rail onto the transverse rail 333 of the spinning position 312 which is to be supplied with material. The conveying movement can be continued to the position 341 at which the fully wound tube 315 is to be arranged as a reserve package.

Another alternative lies in the use of a curved rail section 329 (indicated in dotted lines), the curve section 329′ of which is located in the region of the currently foremost fully wound tube 315. The curved rail portion 329′ extends into a straight transverse rail section 329″ which (in a similar manner to the transverse rail 328) can be brought into alignment with a transverse rail 333. In this case, the tube shifting device 317 must shift the foremost fully wound tube 315 along the curved rail 329 onto the transverse rail 333 into the position 341 in the manner also indicated dotted lines.

In order to effect a relative movement between the transfer carriage 326 and the transport train 414, a reciprocable abutment 330 is provided at each spinning position 312. The abutment 330 comes into engagement with the transfer carriage 326 in the manner apparent from Figure 20 during travel of the transport train in the direction indicated by the arrow as soon as the transverse rail 328 (or in the case of the other embodiment, the transverse rail section 329″(comes into alignment with the transverse rail 333 to be supplied. The foremost fully wound tube 315 on the transport train 414, can now be unloaded.

As soon as this has been effected, the transport train 414 (which can be motorised or driven by extraneous means) can be moved forward after removal of the abutment 330 at the already supplied spinning position 312. The forward movement continuous until the transfer carriage 326 comes into engagement with an abutment 330 at the next spinning position which has to be supplied with material. When that happens, the transverse rail 328, or the transverse rail section 329″, is aligned once again with the transverse rail 333 which has to be supplied in this transfer operation. However, in order to enable a fully wound tube 315 to be transferred, the transport train 414 must travel slightly further so that the transfer carriage 326 shifts relative to the transport train 414 through a distance sufficient to bring the transverse rail 328 or curved rail 329 into alignment with the foremost fully wound tube still remaining in the transport train 414. When that has been achieved, the tube shifting device 327 carries through the operation to transfer a fully wound package onto the relevant transverse rail 333.

This operation is repeated until the transport train 414 is empty.

When this stage is reached, the transport train 414 travels to the transverse return device 335 indicated in dotted lines, where the train 414 is brought to a halt by engagement of the transfer carriage 326 with the extended abutment 330′. After an empty tube 336 has been conveyed into the front position of the transport train 414 by the tube transfer device 327 operating in the reverse sense in relation to an unloading operation, the transport train 414 moves through one step until the transfer carriage 326 comes into alignment with the second empty position on the train 414 whereupon the next empty tube 336 can be reloaded. This operation is repeated until the train 414 has been completely reloaded with empty tubes 336.

The train is then sent back into the transport network and from there to the roving frame along the rail 313 in the manner apparent from Figure 21.

Package handling robot

As already indicated, in most cases it will be preferred to provide the package handling robot in association with the spinning machine, rather than in association with the transport trains which run in the network as a whole. It is then necessary to bring a "machine robot" into working relationship with a train which has itself been brought into a working relationship with the machine. Various possiblities for this purpose will be dealt with subsequently in this description. Firstly, however, various adventageous forms of handling robot will be described with reference to Figures 1 - 14.

In accordance with Figure 1, a ring spinning machine comprises similarly formed spinning positions 21, 21′ (schematically illustrated) of uniform gauge. In front of the spinning positions, a package feed means 14 (in the form of a rail) extends parallel to the longitudinal direction 23 of the machine. Carriages 36 are suspended from this rail by means of rollers 35 and are arranged at uniform spacing along the rail. The individual carriages 36 are joined by means of a rod 37 (indicated only schematically) to form a package transport train or trolley 38. Each carriage 36 carries below the rail 14 a tube 13 suspended vertically therefrom and wound with roving 22 to former package. The rod 37 also carries a motor 39 which engages the rail 14 by way of a friction wheel 40. The current supply to the motor 39 is effected in a manner indicated only schematically by way of a current take-up 41 which engages a bus 42 extending along the machine. The bus is energised with a suitable supply voltage.

The motor 39 is connected by way of a control lead 43 (indicated in dotted lines) to an electronic control 44. The control lead 43 passes in manner subsequently to be described via contacts 77, 78 from the train 38 onto a tube transfer carriage 20. By way of the same lead, further electrical assemblies, which will also be described subsequently, are also connected to the electronic control unit. By way of this control lead 44, the motor 39 can be selectively switched on and off. The rod 37 is provided with joints 45 having vertical pivot axes in order to enable a movement of the train around curved sections of the rail 14.

Behind the spinning positions 21, 21′ there is an empty tube conveying means 15 in the form of a conveyor belt that runs over divertor rolls 46 indicated by dotted lines. This belt can be moved in a stepwise manner in the direction of the arrow f.

Empty tube support elements 47 are located on the conveyor belt 15 with uniform spacing thereon. Empty tubes 11 can be suspended from these elements 47 with vertically disposed longitudinal axes of the tubes in order to be conveyed to an empty tube return station 48. This station removes tubes 11 arriving at an end of the conveyor belt 15 from their carrier elements 47 and conveys them back to the carriages 36 of the transport train 38, which in the meantime has been emptied of its full packages (this is indicated by the dotted arrow 49).

The empty tube return station 48 is served in the illustrated embodiment by the same transfer carriage 20 which moves the tubes 13, in a manner to be subsequently described, onto the empty tube conveyor 15. However, this is not an essential feature of the invention. The return of the tubes from the conveyor 15 to the transport train can be effected by a machanism specifically provided at the station 48 and operating independly of the carriage 20.

The movement of the conveyor belt 15 is discontinuous so that the belt can be stopped temporarily at any desired position.

The spinning positions are arranged in pairs 21, 21′ with the positions of a pair being arranged next to each other. For each, pair, there is a respective tranverse support 16 arranged between the adjacent spinning positions of the pair and preferably above them. The transverse supports 16 extend parallel to each other in a creel. Each transverse support 16 carries in a row extending from the rail 14 to the conveyor belt 15 in the following sequence:

- a reserve tube 13′ fully wound with roving 22,
- a first working tube 18 completely or partly

wound with roving 22, and

- a second working tube 19 partly wound with roving 22 or empty (unwound).

These tubes are arranged at uniform spacing along the respective transverse support 16.

Preferably, the tubes 13′, 18, 19 are mounted from below on the transverse support 16 by way of suitable support elements.

Between the rail 14 and the conveyor 15 there is a further pair of rails 50 extending parallel to the machine longitudinal direction 23. A tube transfer carriage 20 is arranged for movement in the lòngitudinal direction 23 of the machine on these rails 50, for example by means of rollers. The carriage 20 can for example be supported by means of rollers 51 on the rail pair 50. Two rods 52 extend from the part 20″ of the carriage 20 to the front portion 20′ which is arranged above one of the transverse supports 16. The rods 52 carry fork-shaped tube gripping means 29 which can be brought into gripping engagement with the tubes 13′, 18, 19 below the front portion 20″ (being illustrated in this condition).

The rods 52 engage in shifting chambers 12 of the rearwood portion 20′ of the carriage 20 and are biased by springs 17 in the direction of the front portion 20′ of the carriage 20. Electromagnets 53, which are also controlled by the electronic control unit 44 (dotted line) when suitably supplied with current, enable withdrawal of the tube gripping means (previously brought into engagement with the tubes 13′, 18, 19) against the force of the sping 17 so that these means are no longer in engagement with the relevant tubes.

An entrainment means 54 extends forwardly from the front portion 20″ of the carriage 20 and carries slidably an entrainment rod 56 extending parallel to the transverse supports 16 in a transverse bore 55. Normally, the entrainment rod 56 is extended by a compression spring 57 into the entrainment position apparent from Figure 1, in which it extends in front of entrainment abutments 58 secured to the rod 37. Each abutment 58 is associated with a respective carriage 36 being positioned exactly relative to its associated carriage.

An electromagnet 59 which is also connected to the electronic control unit 44 (dotted line) when suitably supplied with current draws the entrainment rod 56 against the bias generated by the spring 57 through a distance such that the entrainment rod 56 comes out of engagement with the corresponding entrainment abutment 58.

A transverse moving device 31 is provided on the rear portion 20′ of the carriage 20. This device comprises transverse shifting rolls 60 which can also be suitably driven under the control of the electronic control unit 44 (dotted line) and which are rotatably mounted on the rearward portion 20′. The device further comprises a transverse carriage 61 arranged between the rolls 60 and movable thereon in the transverse direction. The carriage 61 comprises the above-mentioned shifting chambers 12 and the rods 52 which are reciprocable in the longitudinal direction 23 of the machine.

A lifting and lowering means 32 (indicated in dotted lines) can also be arranged on the transverse carriage 61. The rods 32 and the tube gripping means 29 connected therewith are liftable and lowerable within predetermined limits not only reciprocably in the direction of the arrow 62 but also in directions at right angles to the plane of the drawing.

The illustrated ring spinning machine operates in the following manner:

In normal operation, each transverse support 16 carries in a row one full reserve tube 13′, a completely or partially full working tube 18 and partially full or empty (unwound) working tube 19. As indicated in the region of the front portion 20″ of the carriage 20 in Figure 1, the roving 22 is guided from the operating tube 19 to the spinning position 11 located to the right of the transverse support 16, while the roving 22 from the middle operating tube 18 is guided to the spinning position 11 provided to the left of the transverse support 16. This guidance of the roving 22 changes over on the occasion of each of the subsequently described tube shifing operations.

The working tubes 19 carry on average approximately half as much material as the working tubes 18 so that when a working tube 19 has been unwound the associated second working tube 18 is still approximately half full.

If one of the working tubes 19 has been emptied then the tube transfer carriage 20 can be moved along the rail path 50 to the relevant transverse support 16 under the control of the electronic control unit 44 which can be operated by the hand or automatically. This movement is effected by setting the motor 39 in operation so that the transport train 39 is moved along rail 14 while the transfer carriage 20 is carried along by way of the respective abutment 58 and the entrainment rod 56.

A light barrier 63 is mounted on the entrainment member 54 and a light beam 64 from this barrier works together with a reflector 65 provided on every second spinning position 21′. In this way, the electronic control unit 44 receives a signal via the control lead, indicated in dotted lines, on the basis of which the motor 39 can be stopped. The tube transfer carriage 20 is then located in an exactly determined position for the required tube shifting operation. The electronic control unit 44 now causes movement of the rods 52 outwardly so that the tube gripping means 29 engage the tubes

13′, 18, 19 below the front portion 20″ of the carriage 20 and possibly by way of the lifting and lowering means 32 cause a slight lifting or lowering so that they are released from the associated transverse support 16. A further tube gripping means 19′, which extends to a position below the rail 14, and which is also connected with the rods 52, grips and moves in a corresponding manner the fully wound tube 13 which is aligned with the relevant transverse support 16. This tube 13 is thereby released from the associated suspended carriage 36.

Before this operation is carried out, the conveyor belt 15 must have been moved in the direction of the arrow f to a position such that (in addition to the tube gripping means 29, 29′) a vacant tube support element 47 is located in alignment with the relevant transverse support 16. When considering the illustration in Figure 1, therefore, the conveyor belt 15 must be moved through one pitch of the support elements to enable this condition to be achieved.

By means of the electronic control unit 44, the transverse carriage 61 is now moved through one tube pitch in the direction of the arrow 62 drawn in full lines. By this means, the empty (unwound) working tube 19, possibly following an additional operation of the lifting and lowering means 32, is transferred to the adjoining tube support element 47. Simultaneously, the now half full working tube 18 is shifted into the position vacated by the removed working tube 19, the reserve tube 13′ is shifted into the position vacated by the working tube 18 and the fully wound tube 13 is shifted into the position vacated by the former reserve tube 13′.

The rods 32 are thereupon withdrawn by energization of the electromagnets 53 and the transverse carriage 61 is moved back in the direction of the arrow 62 (drawn in dotted lines) into its starting position. A package change-over has thus been completed.

The motor 39 is now set in operation again by the electronic control unit 44. Since the package 13 aligned with the front portion 20″ of the carriage 20 has been transferred onto the transverse support 16, there is no longer a tube on the associated suspended carriage 36. Thus, a spring biased feeler 66 which is pivotably mounted in the front portion 20″ of the carriage 20, can be so turned in the direction of the arrow indicated on the feeler 66 that a contact 67 is closed. This contact is also connected with the electronic control unit 44 by a control lead indicated by dotted lines. In this way, the extension of the entrainment rod 56 outwardly is temporarily blocked.

With the motor 39 in operation, the transport train 38 therefore moves at first independently of the carriage 20 in the direction of the arrow P. Only when the next package of the transport train 38 passes into the region of the front portion 20″ of the carriage 20, does the feeler 66 again come into contact with the roving 22 so that the contact 67 reopened. The electronic control unit 44 then sends a switching-off signal for the electromagnets 59 whereupon the spring 57 can reextend the entrainment rod 56 so that it passes into a position in front of the third abutment 58 considered from the right in Figure 1. Immediately afterwards, this entrainment abutment 58 comes into engagement with the entrainment rod 56 and the tube transfer carriage 20 is now carried along with the train as far as the next pair of spinning positions 21, 21′ where a transfer operation is to be carried out. This can be a pair of spinning positions at which on the basis of corresponding arrangements one of the working tubes 19 has just become empty. The already described operation is then repeated in the same manner.

In this manner, the tube transfer carriage is moved from spinning position pair to spinning position pair until all of the tubes 13 wound with roving 22 and carried by this transport train 38 have been used up (transferred into the creel). Then, at the end of the machine as indicated at 49, the empty tubes 11 are successively suspended onto the emptied carriages 36 of the transport train 38, whereupon the train 38 can be returned to the transport network and from there to a roving frame where it is again loaded with fully wound tubes (packages). For the purposes of returning the empty tubes 11 to the train 38, the tube transfer carriage 20 can again be used.

It is an essential feature of the embodiment in accordance with figure 1 that, in the working position of the transfer carriage 20, not only do the tube support positions 25, 26, 27 for the tubes 13′, 18, 19 have uniform spacing but also the stand-by position 24 for the fully wound tubes and the empty tube take-up position 28 also have an equal spacing from the adjacent tube support positions. By this means, a single stroke of the transverse carriage 61, corresponding to the spacing of the tubes support positions, suffices to change all tubes in a single movement by means of a single operation on one given transverse support 16.

The connection of the motor 39 by way of the control lead 43 to the electronic control unit 44 can be ensured in practice by arranging an electrical control contact 77 in the end portion of the entrainment rod 56. The control contact 77 comes in to electrically conducting engagement with an opposing contact 78 secured to the entrainment abutment when the extended entrainment rod 56 comes into engagement with the associated entrainment abutment 53. By way of this electrically conducting engagement, an electrical connection (which is not illustrated in detail in Figure 1) is effected between the electronic control unit 44 and the electrical motor 39 on the basis of which the electrical motor 39 receives the required stop and start signals at the right instant.

The individual opposing contacts 78 which are mounted on respective entrainment abutment 58 are connected by non-illustrated leads within the rod 37 to motor 39.

In the following Figures, the same reference numerals indicate elements corresponding to those already described with reference to Figure 1.

Figure 2 shows in front view the rail 14 for delivery of fully wound tubes 13. The package change device further comprises a removal conveying path 15 for removal of empty tubes 11. This conveyor path 15 is arranged in the region of the longitudinal middle plane 34 of the machine. A transverse support 16 extends between the rail 14 and the removable conveyor 15.

All tubes are mounted so as to be suspended from a package carrier 68. The tubes 11, 13 are suspended in the associated suspended carriages 36, 36′ which are individually movable by suitable drive means along the rail 14 and along the removal conveyor 15.

For purposes of changing positions in the region of the transverse support 16, the package support 68 can be gripped by gripper plates 69 forming tube gripping means 29, 29′.

Gripper plate 69 is part of a lifting and lowering mechanism 32 which is secured on the underside of transverse carriage 61 extending parallel to the transverse support 16. The gripper plate 69 comprises a horizontal gripping surface which can engage a package support 68 below an upper collar 70 in order to lift the package carrier 68 along with the associated tube and to position it at a desired location. The gripper plate 69 is secured at the lower end of an adjusting rod 71 which extends in a substantially vertical direction and which is adustable in height by means of a suitable drive provided at its upper end, for example by means of an electromagnetic drive.

Alltogether four lifting and lowering devices 32 are provided on the transverse carriage 61 and are disposed at equal spacing relative to each other, this spacing corresponding to the tube pitch of the creel, that is to the spacing between the working tubes 18, 19 in the creel.

The tube support positions in the creel are indicated once again with the reference numerals 24, 25, 26, 27 and 28.

In accordance with the embodiment according to Figure 2, the transverse support 16 extends with an inclination downwardly in the direction of conveyor 15; the transverse carriage 61 is correspondingly inclined.

The transverse carriage 61 is suspended at its upper surface from a shifting device in the form of a spindle drive 72 which is driven from a first electrical drive 73 by way of a transmission 74. By this means, a precise longitudinal movement of the transverse carriage 61 parallel to the transverse support 16 is enabled. The shifting device can be energised by suitable control means (arrows 75). The spindle drive 72, the first electrical drive 73, the transmission 74 and transverse carriage 61 are suspended on the underside of the carriage 20 which is reciprocably movable on horizontally spaced guide rails 60. These guide rails are stationary and extend in the logitudinal direction of the machine on one of the two sides thereof. Carriage 20 can be provided with a suitable electrical drive 76 which is connected by way of a drag line, or via a wiping contact with a current bus, to a stationary electrical supply network. Control signals provided by the electronic control unit 44 (Figure 1) to the second electrical drive 76 ensure a precise reciprocating movement of the complete assembly along one machine side for the purposes of exact positioning of the carriage 20 in precise alignment with the relevant transverse support 16. By means of the drive 76, the entrainment element 54 in accordance with Figure 1 can be omitted.

In the following paragraphs, the operation of the package change device will be described for changing the position of the packages on the transverse support 16:

The transverse carriage 61 is first located in a stand-by position in which the lifting and lowering means 32 is located in a position illustrated in Figure 2. In that Figure, the two end lifting and lowering means 32 are also illustrated in dotted lines in a somewhat shifted position so that they can be better identified.

In the course of a package change operation, a suspended carriage 36 is located on the rail 14 in exact alignment with the transverse support 16. A package carrier 68 with a full package 13 is suspended from the carriage 36. An empty suspended carriage 36′ is currently located on the removal conveyor 15 in exact alignment with the transverse support 16. For purposes of positioning of the tubes, the transverse carriage 61 is shifted from its initial stand-by position in a longitudinal direction 72 of the transverse support 16 in the direction of the rail 40. This movement being caused by operation of the spindle drive 72.

In the course of this movement, the extended gripper plates 69 engage simultaneously below the collars 70 of the associated package carriers 68. The longitudinal shifting 75 of the transverse carriage 61 is then terminated and all four lifting and lowering means 32 are lifted. The four tubes 30,

$30'$, 18, $19''$ wound with packages are lifted simultaneously and separated from their previous support positions. The previously mentioned packages, which are now freely suspended on the transverse carriage 61, are shifted in the longitudinal direction 75 towards the removal conveyor 15 through one creel pitch, that is through the mutual spacing between two tube support positions. In this way, the empty (unwound) working tube 19 passes onto a suspension element of the carriage $36'$ of the removal conveyor 15. Thereupon, the lifting and lowering mechanisms 32 are lowered and the package carriers 68 are correspondingly located in their new positions.

The package carriers 68 can each be provided with a conical element which ensures self-centering in the new position during the lowering operation. Corresponding self-centering means could also be provided on the lifting and lowering means 32.

The transverse carriage 61 is now moved back into its stand-by position. On the removal side, the empty tube 11 is carried away and on the delivery side, a new full tube 13 is moved into delivery position.

It is also an essential feature of this embodiment, as described, that the tube support positions are equally spaced from each other and that the end support position have the same spacing from the delivery and removal conveyor. It will be readily appreciated, however, that this is not essential to operation of the complete device. One or more of the lifting and lowering means 32 could, for example, be mounted on the transverse carriage 61 in a manner enabling movement of that means 32 in the direction 75 relative to the carriage 61. By this means, the spacing of the lifting and lowering means 32 relative to each other could be changed after the package carriers 68 have been lifted from their respective support position. This would enable adjustment of the spacings of those packages while they are supported on the carriage 61 so as to take account of possible inequalities the relative spacing of the tube support positions themselves.

Furthermore, in the arrangement illustrated in Figure 2, all four package supports 61 are lifted and lowered simultaneously. However, this is also not an essential feature of the invention. At least in those cases where each transverse support 16 is provided with a reserve support position at or adjacent its outer end, the speed with wich an individual package change operation is carried out will not be of the essence of that operation. In the limit therefore, the transverse carriage 61 can be provided with only a single lifting and lowering means 32 which engages with the package supports 68 successively and moves them to the next required support position. In such a case, the single lifting and lowering means 32 would engage firstly with the package carrier 68 for the innermost (empty or unwound) tube so as to move this package carrier from the transverse support 16 onto the removal conveyor 15. The single lifting and lowering means 32 would then move to reposition the package carrier 68 for the still partly wound tube 18 into the vacated innermost tube supporting position, then to move the package carrier 68 for the previous reserve package $13'$ into the position vacated by the tube 18 and finally to move the new reserve tube 13 into the position vacated by the previous reserve tube $13'$. Clearly, in this case it is not nessessary to move the carriage 61 as a whole relative to its support and the drive causing movement in the direction of the arrow 75 can be shifted from the carriage 61 to the lifting and lowering means 32, the elements 61 providing a mere guide and supporting function.

In a compromise solution, the packages can be shifted pairwise, the innermost pair of packages being lifted and lowered simultaneously, followed by a similar (but succeeding) simultaneous lifting and lowering operation for the outermost pair of packages.

In the embodiment according to Figure 3, the transverse support is formed as a rolling slide 16 inclined from the full package delivery path 44 towards the longitudinal center plane of the machine. The tube transfer carriage 20 which has been moved to a position above a predetermined transverse support 16 has lifting and lowering means 32 in the region of the rail 14. These means 32 can lift a fully wound package 13 in the direction of the arrow pointing upwardly from the rail 14 and can then resuspend this tube 13 by movement in the direction of the arrows pointing to the right and downwardly onto the start $15''$ of the downwardly inclined rolling guide rail 16. In the course of this movement, the suspended carriages 36 can also be turned through 90 degrees so that the rolls 35 of the suspended carriages 36 can roll downwardly at an inclination on the roll guide rail 16.

An abutment lever 18 pivotable about a pivot axes 79 is located on the rolling guide rail 60 and is provided with three abutments 33 spaced correspondingly to the reserve tube $13'$ and the working tubes 18, 19. These abutments 33 engage in the position illustrated in Figure 3 either with the roll 35 (working tube 19) or with abutment pins 81 provided on the suspended carriages 37 below the rolling guide rail 16. In the position illustrated in Figure 3, the abutment lever 80 has been swung in a clockwise direction into the illustrated disposition. In this manner, the tubes $13'$, 18, 19 are retained in their working positions.

As soon as the lifting and lowering means 32 has set a full tube 13 onto the start $16''$ of the rolling guide rails 16, an electromagnet 82 within the tube transfer carriage 22 is energised with current. This electromagnet therefore attracts, a permanent magnet 83 which is arranged slightly above the electromagnet and penetrates through the latter. On the lower end of the permanent magnet there is a plunger 34 projecting vertically downwardly from the tube shifting carriage 32. This plunger 34 is moved downwardly along with the permanent magnet 83. The lower end of the plunger 84 engages the upper surface of the abutment lever 80 somewhat to the left of the pivot axes 79 so that when the electromagnet 82 is energised with current the abutment lever 30 is pivoted anticlockwise in the direction of the arrow shown in Figure 3. The abutment lever 80 therefore comes into alignment with the rolling guide rails 16. The abutment 33 then releases the rolls 35 of the working tube 19 and the abutment pins 81 of the suspended carriages 36.

The suspended carriages 36 (at the start 16″ of the rolling guide rails 16, of the reserve tube 13′ and of the working tubes 18, 19) now begin to roll along the rolling guide rail 16 in the direction of the central plane 34 of the machine. At this time, the working tube 19 is completely unwound and the working tube 18 has been partially (for example approximately half) unwound.

As soon as the roller 35 of the suspended carriage 36 of the working tube 19 (or the abutment pins 31 of the two succeeding suspended carriages 36) have passed the abutments 33 in the course of this rolling movement, the current supply to the electromagnet 82 is switched off again by the electronic control 44. Thereupon, a return spring 85 provided at the upper end of the permanent magnet 83 draws plunger 84 upwardly again. The abutment lever 80 then pivots back into the abutment position apparent in Figure 3, because of the larger moment applied by the lever to the right of the pivot axis 79. Now, the roller 35 of the suspended carriage 36 for the half empty working tube 18 runs against the front upper abutment 33 of the abutment lever 80, while the abutment pin 81 of the reserve tube 13′ runs against the lower middle abutment 33 of the abutment lever 80. The abutment pin 81 of the fully wound tube 13, placed at the start 16″ of rolling guide rail 16, runs into engagement with the right hand abutment 33 of the abutment lever 80.

The empty (unwound) working tube 19 rolls over the end 16‴ of the rolling guide rail 16 onto a carrier pin 86 of an upright transport belt 15 which can be moved in a direction at right angles to plane of the drawing in Figure 3.

The working tube 19 has now been converted to an empty tube 11 which has to be carried away by means of the transport belt 15. All tubes 13, 13′, 18, 19 have now been conveyed through one operating step. The carriage 20 can now be moved along to the next transverse rail 16 at which a working tube 19 has become empty and a package change operation has to be carried out.

In accordance with Figures 4 - 6, the tube transfer carriage 22 is moved along with the train by means of an entrainment rod 56′ which engages an intermediate holder 96. The package transport train 38 and the tube transfer carriage 20 are moved in the direction of the arrow A. An initiating device 87 in the form of a pivotable lever is movable with only small play along the external ends of the rails 16. When a tube changing operation has to be carried out, this can be signalled in the following manner by means of an operator assigned to this machine. The operator pivots the reserve tube 13′ slightly and this causes a bar or a pin 88 (Figure 6) to spring outwardly from the end of the rail 16. This pin 88 operates the initiating means 87. This causes a motor 89 to be set in operation which in turn (by way of an excenter disk 90 and a rod 91 acting on a sliding guide 92) causes downward pivotal movement of a tube transfer means in the form of an abutment member 30. In the course of this movement, the abutment member 30 engages the flange 93 (and possibly the vertical support 94) of the transverse support 16′ which is formed as a rail. It is advantageous to enable variable speed drive of the package transport train 38 so that after the initiating device 87 has been operated the drive is switched into crawl operation. This reduces or avoids swinging movement of the tubes 13 on the package transport train 38.

After engagement of the abutment member 30 against the rail 16, a transverse shifting motor 30′ is activated and this rotates the threaded spindle 31′ by way of a chain 30″. The abutment member 30 is thereby moved in a direction towards the central plane 34 of the machine. The abutment member 30 is provided with a shifting rod 95 which has three grippers 29′. These grippers 29′ come into entrainment contact with respective suspension elements 36 and shift the tubes 13, 18, 19 through one position. Tube 19 therefore passes onto the carrying pin 86 of the removal conveyor belt 15 and the place at which the reserve tube 13, was previously located becomes empty.

The package transport train 38 still engages (with an intermediate holder 96) the spring biased entrainment rod 56′ and forces this into the position illustrated in dotted lines. The suspension element 36 is moved by a spring biased displacement head 97 of a dog-leg lever 98 onto a curved intermediate rail section 99. Section 99 is fixedly mounted on tube transfer carriage 20 and is aligned with the relevant rail 16. At this stage, a further, pivotally supported displacement motor 100 is activated and pivots the dog-leg lever 98 by means of a threaded spindle 101 so that the suspension element 36, together with the full package 13, is moved from the curved rail intermediate rail section 99 onto the rail 16 into the position immediately vacated by the reserve tube 13′. The abutment member 30 still lies in engagement with the rail 16.

After the shifting rod 95 has moved all tubes 13′, 18, 19 through one position, the abutment member 30 is pivoted upwardly slightly and moved away from the central plane 34 of the machine. The slight upward pivotal movement enables the return movement of the gripper 29′ along the newly positioned packages 13′ and 18.

In order to ensure that the abutment member 30 stays in engagement with the flange 93 on rail 16 during the return movement, the flange 51 and the corresponding parts of the abutment member 30 have the same radius 102. The shifting rod 95 can also be formed as a telescopic element with spring biasing if a predetermined sequence of engagement times is required for the grippers 29′.

The drag lever 56′, which has roller 103 running on a cam 104 having a curved portion, is still pressed in the direction of the arrow A by the package transport means 38 in opposition to the spring loading. If the drag lever 56′ is moved still further in the direction A then a lever 56′ pivots towards the central plane 34 of the machine (because of the curve in cam 104) and thus enables the continued movement of the intermediate holder 96 (that is of the package transport train 38) after removal of the suspension element 36. Under the spring bias, the drag lever 56′ then moves back into the position illustrated in full lines. The succeeding intermediate holder 96 carrying a fully wound tube 13 again comes into contact with the drag lever 36′ due to the movement of the package transport train 38. In this manner, the tube tranfer carriage 20, after each transfer operation, moves through one carrying position backwards relative to the package transport train 38. When the last fully wound tube 13 has been moved onto a rail 16, the tube transfer carriage 20 remains stationary (left behind by the train).

The manner in which the empty tubes 11 pass from the removal conveyor 15 back to the package transport train 38 will not be described in detail. The limb 105 of the drag lever 56′, which comes into contact with the intermediate holder portion 96, has a length such that the package transport train 38 together with the tube transferring carriage coupled therewith can travel easily without tipping around the non-illustrated curves of the rail 14.

All movement sequences (that is, the transfer of the fully wound tube 13 via the curved intermediate rail section 99, the lowering and the subsequent raising of the abutment member 30, the conveying of the tubes 13′, 18, 19 along the rail 16 and the return of the gripper 29′) are controlled electrically and are carried out by electro-mechanical means. They are therefore independent of the movement of the package transport train 38. Hence, it is also possible to maintain the package transport train 38 stationary during the package transferring operation. Coordination of this operation is ensured by the electronic control unit 44. Electrical current can be provided by one or more current bus bars 106 by means of a slider contact 107 on the tube transfer carriage 20.

Figure 7 shows a further embodiment of a tube transfer carriage 20 which is self-driven by means of a motor 108 coupled with at least one roller 51. Electrical current is supplied to all motors arranged on the tube transfer carriage 20 from an accumulator 109 which can be periodically recharged by means of a charging station 83A arranged at one of the curves of the rail 14 (Figure 23). Furthermore, the curved intermediate rail section 99 in accordance with Figure 4 is replaced by a straight intermediate rail section 110. In place of this straight intermediate rail section 110, either the length of the rails 16 of the creel can be extended or the rail 14 of the package transport train 38 can be disposed closer to the transverse rails 16, so that the rails 16 extend into the immediate neighbourhood of the package transport train 38.

The limbs 111 of the suspension elements 36 according to Figures 4 and 5 now have a disposition rotated through 90 degrees relative to the disposition shown in Figures 4 and 5 (compare Figure 5 with Figure 10). While in the embodiment in accordance with Figure 4, the longitudinal axis of the carrier element 36 is subjected to a change of direction in the course of the transfer movement from the package transport train 38 onto the rail 16, this is no longer the case in the embodiment according to Figure 7. This simplifies the return of the empty tubes (on the removal conveyor 15) via a rail onto the package transport train 38 at one end of the machine. The pusher rod 95 now has four grippers 29′ and the movement sequence is simplified. In a movement at right angles to the rail 14, the tubes 13′, 18 and 19 are moved in a direction towards the central plane 34 of the machine and the fully wound tube 13 aligned with the corresponding rail 16 is moved from the package transport train 38 onto the rail 16. In the course of the same movement, the tube 19 is moved onto the conveying pin 86 of the conveyor 15. As previously indicated in connection with Figure 2, however, it is not essential to shift all of these tubes simultaneously in one stroke. The required plurality of shifting movements for the packages and tubes associated with a single transverse support 16 can be carried out sequentially.

Inversely, in the course of return movement of the empty tubes 11, a right-angle movement can be carried out from the conveyor pin 86 via the return rail 16 onto the package transport train 38. Accordingly, the tube transfer carriage 20 can, in accordance with this invention, also be used for return transport of empty tubes 11 onto the package transport train 38 so that an additional tube return mechanism can be avoided. In this case also, the displacement motor 100, the threaded spindle 101 and the dog-leg lever 98 illustrated in Figure 4 can be omitted.

The advantage of an electrically-operated tube transfer carriage 20 lies in the fact that all appropriate types of motors and sensors can be used thereon. Also, the electronic control unit 44 can transmit signals to a central control, that is defects can be registered in accordance with number, type and position. Also, various modes of operation can be applied in practice.

In the embodiment according to Figure 7, the package transport train 38 is not self-driven. The tube transfer carriage 20 can carry along the package transport train 38 by means of a friction roll 112 (Figure 7) or a gear wheel 113 (Figure 10). Additionally, it is possible to arrange for movement of the tube transfer carriage 20 relative to the package transport train 38. A motor 114 drives the friction roll 112 or the gear wheel 113 and can operate as a servomotor. In this way, it is possible to position the tube transfer carriage 20 even without the abutment member of Figure 4. The abutment member 30 is however retained in the form of a shifting member.

A sensor 115 is provided to detect whether the intermediate rail section 96 is carrying a suspension element 36. If not, a re-load instruction can be provided to the shifting member 30. Thereupon, the motor 114 moves the package transport train 38 through one position (possibly with the aid of a stationary friction roll 116) and the next empty tube 11 can be conveyed back onto the package transport train 38.

While the initiating device 87 in the embodiment in accordance with Figure 4 is in the form of a mechanical means, a sensor means 117 is provided for this purpose in the embodiment in Figure 7 (see also Figure 8) and operates in the following manner:

In normal operation, one strand 22 is withdrawn from each of the packages 18 and 19 and these strands are guided via a diverting rod 118 (Figure 8, left) which is provided with grooves. If the package 19 becomes empty, the strand 22 from the reserve, fully wound tube 13′ is laid by the operator or automatically in the groove of the diverting rod 118 (Figure 8, right). The packages 13′ and 18 now remain in use over a relatively long period in the course of which they are however moved towards the central plane 34 of the machine. The initiating means 117, which has a sensing range corresponding to the tube length, responds to the presence of the strand 22. A further possibility lies in the use of a sensor 119 which is directed to the presence of the strand 22 on the working tube 19. Another form of a sensing means, providing the initiating means, involves sensors 120 (Figure 9) which preferably are arranged in pairs to detect the diameter of the roving package on the package 19.

An effective operating procedure lies in moving the tube transfer carriage 20 alone, without the package transport train 38, along the rails and determining by means of the sensors 117, 119 or 120 the rails 16 at which a package change is required. This data is stored in the electronic control unit 44 and transmitted if necessary to a central control. In accordance with these signals, a package transport train 38 can be directed to the ring spinning machine from the transport network between the ring spinning section and the roving frame section.

In accordance with a further possible embodiment, the tube transfer carriage 20 can couple to the front end of the package transport train 38 at the first creel rail 16 at which a transfer operation is required (for example by means of a non-illustrated entrainment lever, or by means of the gear wheel 113). Fully wound tubes 13 can then be directed from the package transport train 30 successively onto the creel rails 16 at which a change operation is required and which have previously been registered and stored in the databank of the electronic control unit 44. When the last fully wound tube 13 is reached on the package transport train 38, the tube transfer carriage 20 can again transmit a signal to the central control indicating that the train 38 no longer carries any fully wound tubes. The reloading operation can then be initiated in accordance with which the tube transfer carriage 20 is guided to the rail 16 serving for the re-loading operation and the conveyor belt 15 is set in operation.

In order to avoid the necessety to set the package transport train 38 into operation each time and to align it each time with a creel rail 16 at which a position change operation is required, another operation can be used. In accordance with this operation, the package transport train 38 (loaded for example with sixty fully wound tubes 13) is guided by means of suitable switching link out of the transport network onto the transport suspension rail 14 and is positioned along the first sixty creel rails 16. In accordance with the data stored in the electronic control unit 44, the tube transfer carriage 20 now transfers from the package transport train 38 those fully wound tubes 13 which lie in alignment with rails 16 at which a package change operation is required. As soon as this section of sixty creel rails 16 has been served, the tube transfer carriage 20 can move the package transport train 38 to the next following section.

The package transport train 38 now no longer contains a continuous row of fully wound packages 13. However, this is not a basic disadvantage since a sensor 121 (Figure 10) of the tube transfer carriage 20 can establish automatically the positions on the package transport train 38 at which fully wound tubes 13 are still present. This can be effected as the carriage 20 moves past the train 38. The carriage 20 then serves all rails 16 within this section which already have a fully wound package 13 aligned with them and which are in need of a package change operation. In the event that a rail 16 in need of a package change operation is aligned with an empty space in the package transport train 38, the tube transfer carriage 20 can cause continued movement of the package transport train 38 (for example by means of the gear wheel 113) until a fully wound tube 13 comes into alignment with the relevant rail 16.

The description up to this point has assumed that the most desirable form of package change operation is based upon a so-called random changing procedure. In accordance with this procedure, the individual transverse supports in the creel are served individually and without any preset sequence or any preset relationship to any other transverse support (but merely dependent upon the sensing of the need for a package changing operation and the availability of a replacement reserve package). There is however an alternative procedure (known as a block changing procedure) in which a complete section of neighbouring transverse supports are served by one package transport train while that train remains stationary in alignment with the relevant section. This mode of operation is only possible if the innermost working packages (those which in the course of the package changing operation will be transferred onto the removal conveyor in a central region of the machine) have all been unwound to a predetermined extent. This minimum unwinding is such that all of these innermost packages can be taken up by the removal conveyor without causing collision (interference) with adjacent portions of the machine while they are located on the central conveyor. In this mode of operation, not all of these innermost packages will be fully unwound at the time of the package transfer. Certain remnant windings will left on at least some of the packages removed by the central conveyor.

A further embodiment of the invention is illustrated in Figure 11. The suspension element 36 is formed as a cylindrcal body. Each creel rail 16 comprises two yokes 122, arranged with a given spacing relative to each other, between which the shaft 123 below the suspension elements 36 can be moved. Recesses 1 to 4 are provided in the yokes 122 and these recesses correspond as a pair to the form of the suspension elements 36. The mounting of the fully wound tubes 13 on package transport train 38 and on the removal conveyor 15 are correspondingly formed as fork-elements.

The removal conveyor 15 is arranged with both runs on one side only of the central plane 34 of the machine. This is an example of a changing operation associated with only one longitudinal side of the ring spinning machine. The tube transfer carriage 20 has a yoke 125 with grippers 29′ in the form of Casablanca-connectors. Alternatively, magnets could be used as another possibility. The yoke 125 and the grippers 29′ grasp the suspension elements 36 centrally and from above.

Upon infeed of fully wound tubes 13 into the transverse path 16 on the creel, packages 13′, 18 and 19 are gripped simultaneously and lifted by means of raising and lowering means 32 which operate pneumatically, hydraulically or (preferably) by electro-mechanical means. The means 32 are mounted in a shifting member 30. By means of rotation of threaded spindle 31′ the tubes are moved through one position (pitch) in the direction towards the central plane 34 of the machine (position B) and are lowered (position C). The lowering movement causes release of the grippers 29′ from the tubes. The tubes are therefore conveyed along the transverse rails of the creel by means of lifting, shifting and lowering. The return of the empty tubes 11 can again be carried out by the tube transfer carriage 20.

Consideration of Figure 11 will show clearly that the transfer operation could be carried out by "pairwise" shifting of the packages with their suspension elements 36. For this purpose, only one raising and lowering means 32 would be needed and it would carry only two grippers 29′ ("half" of the raising and lowering system illustrated in Figure 11). The shifting member 30 would be operated to shift firstly the inner pair of packages 18, 19 and then the outer pair of packages 13, 13′.

It is also possible to provide drive to both the tube transfer carriage 20 and the package transport train 38. By means of the tube transfer carriage 20 supplied with electrical current, instructions can be transmitted to the drive of the package transport train 38.

A sensor, for example infrared or light barrier should be provided on the tube transfer carriage 20 and should be directed towards the space provided for an empty tube on the removal conveyor 15. If an empty tube 11 is located at the relevant position on this conveyor, then no further tube may be transferred onto the relevant transverse path.

The tube transfer carriage in accordance with this invention has two functions to fulfill, namely

a) transfer of a fully wound tube from the package transport train 38 onto the transverse support or transverse rail 16 and,

b) transport of the tubes 13', 18, 19 located on the transverse rail 16 including transfer of an empty tube from the transverse rail 16 onto the removal conveyor 15.

It will be appreciated therefore that the tube transfer carriage could perform firstly the operation in accordance with previously quoted point b) without presence of a package transport train. In this way, an empty space is created at the outer end of the creel, that is of the relevant transverse rail 16. The tube transfer carriage can perform the movement in accordance with point a) above after carrying out the movement in accordance with point b). In the course of performing the operation according to point a), the tube transfer carriage 20 can store a signal indicating the necessity to perform a movement in accordance with point a). This way, it is possible to avoid the necessity to provide the extending signal pin 88 (Figure 6).

Further, it is conceivable to provide various kinds of robots on one ring spinning machine and in particular one robot which is designed only to perform a movement in accordance with point a) and further robot which is designed only for the movement in accordance with point b).

Toothed belts can be provided in place of the chain drive mentioned above. The electric motors used in this arrangement can basically be provided coaxially with the parts driven thereby.

Figure 13 illustrates an alternative form of suspension element by means of which the packages/tubes can be suspended and guided during shifting movements. The suspension elements 36 shown in Figures 5 and 10 each comprise a gliding shoe defined by limbs 111 (Figure 5) which engages with the rail on the switching means (transfer carriage) and/or in the creel, and additionally a generally T-shaped portion which interengages with the holder 96 on the train. This enables a curved rail section on the switching means to engage within the shoe 111 and "pick" the suspension element (with its package/tube) off the holder 96.

This is not essential. A simplified arrangement is shown in Figure 13. The gliding shoe 511 (shown sectioned) in this case is a generally C-shaped element having a side branch 512 to carry the package and a longitudinally extending slot 513. The holder 514 is a bar having at least one cantilevered rail section 516 projecting laterally in a direction towards the creel rail 16 as the train (with holder 514) is moved past the creel.

Rail section 524 in Figure 13 is a straight rail section carried by rods 522 from the tube transfer carriage 520. The rods 528 fit within the slot 513 of shoe 511. As will be readily apparent from Figure 13, as soon as the rail sections 514, 524 are aligned with each other and with a rail 16 (with rail section 524 bridging the gap between rail section 514 and rail 16), shoe 513 can be moved over the bridge provided by rail 524 onto the selected creel rail 16.

It will also be readily apparent from Figure 13 that the rail section 524 on the carriage is not essential; rail 16 could simply to be extended to terminate sufficiently close to rail section 516 to enable the shoe 543 itself to bridge the gap while being adequately guided by the rails.

A retaining means is desirable to retain the shoe 513 in a desired position on rail section 516 and also in desired working or operating positions on rail 16. The retaining means could in each case comprise, for example, a pair of resilient or spring loaded elements 510 which normally project outwardly from the rail in which they are mounted, and engage in front of and behind the shoe while it is in the desired position. Preferably, it is not necessary to "operate" these elements other than by applying an adequate force to the shoe urging it along the rail. Each resilient or spring loaded element can then be pressed inwardly as the shoe passes over it and will spring outwardly again as soon as it is released by the shoe.

It will further be apparent from Figure 13 that the sliding movement of the shoe 513 can be caused by a pusher engaging (for example) the side branch 512 (or another non-illustrated branch provided for that purpose, or even behind the shoe 513 itself). An arrangement suitable for this purpose is shown in Figure 14A and B. Parts already described in relation to Figure 13 bear the same numerals in Figure 14.

The carriage 520 in Figure 14A is suspended from rails 530 extending in the longitudinal direction of the machine above the level of the creel rails 16. Carriage 520 carries on its underside a linear guideway 532 for a T-shaped slider 534 having a depending leg 536 at each end (see also Figure 14B). These legs support a worm gear 538 which is fixed against rotation about its own longitudinal axis.

A runner 540 is fitted on the spindle 538 between the legs 536 and this runner carries a reversible motor 542 having a gear (not indicated) meshing with the worm gear 538 so that when the motor is energised, the runner 540 moves in one direction or the other along the worm gear depending upon the direction of rotation of the motor shaft.

Runner 540 itself carries a depending arm 544 with a forwardly projecting finger 546 to engage the branch 512 on gliding shoe 511, so that the shoe is moved along the rail sections 516 and 524 and along the rail 16 as the runner 540 moves along its support spindle 538. To enable movement of the finger 546 past the branch 512 as the runner moves to the left in Figure 14B (in order to "collect" the gliding shoe), the arm 544 can be withdrawably mounted on the runner 540, for example by means of an electromagnet 548 (Figure 14A) with a spring bias (not shown) urging the arm into the extended position. The electromagnet can be operated as the runner moves to the left (as viewed in Figure 14B) so that a movable core (not shown) of the electromagnet is drawn back against the spring bias and withdraws the finger sufficiently to enable it to pass the branch 512 without interference.

The electromagnet 548 can be deenergised as the runner begins to move to the right (considered relative to Figure 14B) whereupon the finger 546 engages the branch 512 (as shown in Figure 14A) and pushes the gliding shoe 511 along the rail section.

Figure 14B is intended to demonstrate that only a single pusher is needed to perform all of the operations needed at one creel rail. For example, the movement range S of the finger 546 along the spindle 538 may be just enough to move the shoe through the maximum distance that it has to shift in a single changeover operation. The slider 534 therefore has to be moved along its guideway 532 to enable successive shoe shifts to be performed firstly at the inner end of the creel rail 16 (to the right in Figure 14B) and then outwardly along the rail. Figure 14B therefore also shows the slider in broken lines at the inner end of the guideway 532 where the runner is able to shift a shoe 511 (not shown) from the creel rail 16 (Figure 14A) onto the pin 47 of conveyer 15 (Figure 13).

Due to the need to avoid interference with support structures for the various working elements of the creel and the longitudinal conveyor bringing the packages to the machine, guideway 532 cannot be extended as far as conveyor 15 and bar 514, so that the slider 534 has to cantilever out from the end of the guideway at each end position. A linear electric motor could be used to give the required movement of the slider 534, but alternatives will also be readily available.

The slider 534 (with its worm gear 538) can be extended to extend over more than one working position in the creel (while located in an end position to serve the bar holder 514 or the conveyor 15). In that case, it will be necessary to employ a position control to determine the position of the runner along the spindle 538. If the slider is made long enough to extend over all working positions, then all shoes 511 on or intended for a given creel rail can be moved simultaneously. Furthermore, it will not then be necessary to provide individual runners 540 unless the mutual spacing of the shoes 511 has to be changed as they are moved from the outer end to the inner end of a creel rail.

If carriage 520 carries a bridging rail section 524 as shown in Figure 13, then the carriage can "patrol" with arm 544 aligned with the gap between rail sections 516 on the train and the ends of creel rails 16. However, if there is no such gap, or if not all runners can be aligned with the gap, then the assembly carrying the finger 546 will have to be raisably and lowerably mounted on carriage 520 to avoid interference with rails 16 during patrolling of the carriage.

Where two robots are provided (as mentioned above), one such robot can be integrated into the package conveying apparatus of the machine itself. This apparatus further comprises the creel rails (acting as guides and temporary supports), the central (receiving) conveyor and (possibly) a train re-loading mechanism (this is not necessary where the robot itself performs the re-loading operation). The other robot then acts as a mere interface between the transport means and the conveying apparatus of the machine. Such a robot could be adapted to serve a plurality of machines (with inter-linked rail systems for the "interface" robot). A robot of this type would not necessarily have a rail system of its own, but could run on the main transport rails attaching itself (for example) to the "head" of a train when the latter reaches a specific machine.

However the division of functions could also be arranged in the "reverse" sense, that is a special robot within the machine conveying apparatus could transfer packages to the removal conveyor, while another robot could both effect transfer, into the creel and movement of packages within the creel.

Timing of the changeover operation in relation to the "running time" of an individual package is very important. It will be seen from Figure 22 that the central conveyor cannot accept packages of remnant windings above a certain diameter. The robot performing transfer onto the removal conveyor can therefore be provided with a sensor (for example as shown in Figure 9) which prevents a transfer when the diameter of the inner package on the rail is above a predetermined limit (even if the transfer has been "signalled" by some separate means). Preferably, this sensor is also used to initiate a transfer from the innermost working position to the removal conveyor.

Transfer to the removal conveyor is not necessarily "linked" to transfer of a new reserve package into the creel. Due to the long running time of feed packages in a ring spinning machine (more than 30 hours), there will be plenty of time to replace a former reserve package which has been converted into a working package. The creel should, however, then be arranged to permit spinning of material fed from a working package located (temporarily) in the reserve position.

A transfer into the creel necessitates the availability of a fresh reserve package, which is not under the sole control of the machine. Transfer within the creel, on the other hand, can be carried out under the control of the machine together with its associated robot. Where these transfers are not simultaneous, the need for a transfer into the creel could (for example be signalled by a sensor responsive to the presence of absence of a package in the reserve position. It is not necessary to provide two separate robots in order to operate in this way. A single robot may be selectively operable in two modes, one mode enabling transfer of packages within the creel and the other mode enabling transfer of a package into the creel.

The illustrated embodiments are all based on an arrangement in which the train is brought into alignment with a rail to be supplied with a fresh package. However, where the (or a) robot is separately movable and controllable, the presence of the train (transport means) at the time of a transfer into the creel is not necessary. The train could, for example, be delivered to a predetermined station relative to the machine, and the handling robot (or at least the "interface" robot) could be required to "fetch" a package from this station as and when necessary. This robot could even carry its own (small) store of packages to reduce the need for frequent return to the station. This station could of course also provide the station at which empty tubes (or remnant packages) are reloaded onto the train.

The system could, for example, be arranged to operate so that a robot first "patrols" the creel and performs transfers within the creel, and then performs replacement runs (between the train at the predetermined station and the vacated reserve positions within the creel).

A system of this type can be realised in practice without major modification of the illustrated embodiments at least as far as those embodiments permit non-simultaneous transfers. Taking the arrangement shown in Figure 13 by way of example, a package carried by a shoe 511 on the train located at the said station can be transferred firstly to the intermediate rail section 524 on the robot. This rail section now provides a temporary store while the robot (carrying the package) is moved from the station to the selected rail requiring a replacement package. Upon arrival at that rail the transfer to the rail is performed as already described (except of course that the transfer movement is somewhat shorter in this case).

The robot could, for example, be formed with a plurality of temporary storage rail sections selectively alignable with creel rails, for example generally as shown in the "Weichenanordnung" in accordance with European patent application No. 311958, but without the convergence of the rail sections shown in that application. This plurality of rail sections then provides the temporary store referred to above.

Claims

1. A conveying installation for conveying a package or package carrier in and to a textile machine with a transport means for moving the carrier along or around the machine, a conveying system for conveying a package or a package carrier within the machine and with a plurality of connection locations for transfer of carriers between the transport means and the conveying system and a travelling switching or transfer means which also travels around or along the machine and is selectively operable for transfer of carriers at a predetermined connection location, wherein the switching means can travel along or around the machine independently of the transport means.

2. A conveying installation for conveying a package or package carrier in and to a textile machine with a transport means for moving the carrier along or around the machine, a conveying system for conveying a package or a package carrier within the machine and with a plurality of connection locations for transfer of carriers between the transport means and the conveying system and a travelling switching or transfer means which also travels around or along the machine and is selectively operable for transfer of carriers at a predetermined connection location, wherein moving means is provided for moving the package carrier during transfer at a predetermined connection location so that the transfer can be performed where there is no relative movement between the transport means and the connection location.

3. A conveying installation for conveying a package or package carrier in and to a textile machine with a transport means for moving the carrier along or around the machine, a conveying system for conveying a package or a package carrier within the machine and with a plurality of connection locations for transfer of carriers between the transport means and the conveying system and a travelling switching or transfer means which also travels around or along the machine and is selectively operable for transfer of carriers at a

predetermined connection location, wherein the connection locations are at the ends of conveying paths within the machine and each package carrier has a suspension means adapted to move along a selected one of the said conveying paths and also on a corresponding path section on the transport means, and the switching means is provided with a path section adapted to be aligned with a path section on the transport means and with a conveying path and to bridge a gap between them to enable transfer of the said carrier between the selected conveying path and the selected path section of the transport means.

4. A conveying installation for conveying a package or package carrier in and to a textile machine with a transport means for moving the carrier along or around the machine, a conveying system for conveying a package or a package carrier within the machine and with a plurality of connection locations for transfer of carriers between the transport means and the conveying system and a travelling switching or transfer means which also travels around or along the machine and is selectively operable for transfer of carriers at a predetermined connection location, wherein the switching means is adapted not only to perform transfer of carriers at a selected connection location but also to cause movement of carriers within the machine and is thereby integrated into the said conveying system of the machine.

5. Equipment for changing roving packages at a spinning machine with a transport path extending along the machine on which a carrier train having carriers bearing roving packages is travelable and with a plurality of creel paths arranged at an angle to the central plane of the machine and leading at least through the operating positions of the packages in the creel of the spinning machine, and with a take-up path for empty packages located near the central plane of the machine and with a device for transferring packages between the transport path and a creel path characterised in that the device comprises at least one robot which is movable in the region of the creel path parallel to the transport path and in that either the robot is driven and the carrier train is dragged along or that both the robot and the carrier train are driven.

6. Equipment according to claim 5 characterized in that each longitudinal side of the ring spinning machine has associated therewith a straight transport path or an encircling transport path is associated with both longitudinal sides of the machine.

7. Equipment according to claim 6 or claim 7 characterized in that electrical motor means are provided on the robot for performing at least one of the following movements, namely: changing the packages from the carrier train to the rail and vice versa, vertical pivoting of a shifting member, further conveying of the packages along the rail, shifting of a package from the rail onto the take-up path and vice versa, further movement of the robot itself, and further characterised in that an electrical control device is provided for coordinating these movements.

8. Equipment according to one or more of the preceding claims characterised in that the robot is supplied with electrical current via at least one current bus or from a rechargable accumulator provided on the robot itself.

9. Equipment according to claim 7 characterised in that an initiator for initiating a package change operation comprises a mechanical or a sensor means.

10. Equipment according to claim 9 characterized in that the sensor means is directed to the approximately horizontally extending strand from the reserve package or from the package of the first operating position, or onto the package in the first operating position.

11. Equipment according to one or more of the preceding claims characterised in that the robot has a straight intermediate path section bridging a gap between the creel path and the carrier train.

12. Equipment according to one or more of the preceding claims characterised in that at least one creel path is provided for return transport of the empty tubes to the carrier train.

13. Equipment according to one or more of the preceding claims characterised in that the robot has a sensor which detects the presence of a package on the carrier train.

14. Equipment according to one or more of the preceding claims charaoterised in that the creel paths are rails over which the packages are moved or that the creel paths are support elements along which the packages can moved stepwise from one position to the next.

15. Method for performing a position changing operation characterised in that a robot for performing transfer of full or empty packages between a carrier train and a creel path moves along the creel independently of the carrier train while detecting the conditions of packages in the creel and storing data representing positions at which package changes are required and that subsequently the carrier train is moved by the robot along the creel.

16. Equipment according to any one of claims 5 to 15 characterised in that all packages lying in a row along one creel path and on the carrier train are moved simultaneously.

17. Equipment according to any one of claims 5 to 14 or claim 16 characterised in that the longitudinal axes of the package carriers undergo a change of direction of movement in the course of transfer from the carrier train onto the rails.

18. Equipment according to any one of claims 1 to 17 characterised in that the robot is adapted also to effect return movement of empty packages onto the carrier train.

19. A spinning machine, especially a ring spinning machine, with a plurality of spinning positions arranged at constant spacing next to each other, at each of which an operating tube carrying the roving to be spun is so arranged that the roving is continuously supplied to the spinning process at the relevant spinning position, with a transverse support extending substantially at right angles to the longitudinal direction of the machine for supporting at least one and preferably two operating tubes and a reserve tube in a row and with respective constant spacing, with a fully wound tube delivery conveying means extending parallel to the longitudinal direction of the machine and preferably located with a spacing in front of the spinning positions for delivering of tubes fully wound with roving for example from a roving frame to the individual transverse supports, and with an empty tube removal conveying means extending parallel to the machine longitudinal direction and located preferably with a spacing behind the spinning positions for removing of empty tubes, whereby in the event that a first operating tube becomes empty this tube is transferred from the transverse support to the removal conveying means for the empty tubes such that the next, second operating tube can be placed at the position vacated by the previously mentioned removed operating tube and the reserve tube can placed in the position vacated by the aforementioned second operating tube, the reserve tube being convertible to an operating tube by connection of the roving on the reserve tube to the spinning position previously served by the said removed, empty operating tube and finally a fully wound tube is transferred from the said delivery conveying means to the position vacated by the said reserve tube, thereby itself becoming a reserve tube, characterised in that a tube transfer carriage is provided for movement along the machine parallel to the said conveying means, being movable to each transverse support and being stopable there, said carriage comprising a tube handling apparatus adapted to shift simultaneously an empty tube located on the transverse support, an operating tube located on the transverse support, a reserve tube located on the transverse support and a fully wound tube transported to a position in front of the said transverse support by the delivery conveying means, said shifting movement being effected in a direction towards the removal conveying means, the empty tube being transferred to the said removal conveyor means and the remaining tubes being placed at the respective positions vacated along the transverse support.

20. A spinning machine in accordance with claim 19 characterised in that the transverse support has three tube supporting positions arranged in a row with equal spacing.

21. A spinning machine in accordance with claim 19 or 20 characterised in that when the said conveying means are aligned with one of the said transverse supports, a total of four or five equally spaced tube supporting positions are arranged next to each other in a row containing the said transverse support.

22. A spinning machine according to one of claim 19 - 21 characterised in that tube gripping means are provided on the said carriage with a spacing equal to that of the tubes, there being one gripping means for each tube or tube carrier mounted on the support.

23. A spinning machine according to claim 22 characterised in that the tube gripping means can be brought into gripping engagement with the tubes or tube carriers from the side or from above and by means of a shifting device can be moved through one tube pitch while moving the said tubes in order to transfer them into the next succeeding positions, whereupon the tube gripping means are withdrawable from engagement with the tubes or tube carriers.

24. A spinning machine according to claim 23 characterised in that the tube gripping means comprise raising and lowering means which raise the tubes from the delivery conveying means or the transverse support before performance of shifting movement and lower the tubes onto the transverse support or removal conveyor means after the shifting movement.

25. A spinning machine in accordance with one of claim 19 -23 characterised in that the transverse support is formed as a tube sliding rail.

26. A spinning machine according to claim 25 characterised in that the tube gripping means are formed as entrainment devices.

27. A spinning machine according to claim 25 characterised in that the tube sliding rail extends downwardly at an angle from the delivery conveyor to the removal conveyor in such manner that the tube or tube carriers arranged thereon slide or roll downwardly under the effect of gravity and in that movable abutments determine the tube support positions.

28. A spinning machine according to one of claims 22 - 27 characterised in that a further tube gripping means is provided for the fully wound tube or the carrier therefor aligned with the transverse support.

29. A spinning machine according to one of claims 22 - 27 characterised in that tube gripping means are provided only for tubes or tube carriers arranged on the transverse support and a separate

tube transfer means is provided for a fully wound tube arranged on the delivery conveyor adjacent the transverse support.

30. A spinning machine, especially a ring spinning machine, with a rail system extending along the spinning positions, on which system tube transport trains coming from a spinning preparation machine, especially from a flyer, and loaded with tubes fully wound with spinnable strand can be delivered to the creel of the ring spinning machine, the train being stopable at each spinning position at which a fully wound tube is required in order to transfer a fully wound tube into the creel at that position after an empty tube has been removed therefrom characterised in that a tube transfer device is mounted on the tube transport train, the tube transfer device being movable with the tube transport train and being operable to transfer a fully wound tube into the creel when the train is stopped at at spinning position.

31. A spinning machine according to claim 30 characterised in that the tube transport train is itself provided with a tube support rail preferably extending parallel to the said rail system and preferably being curved in a direction towards the creel at the front end of the train, drive means provided on the train being adapted to cause movement of the fully wound tubes to the creel.

32. A spinning machine according to claim 31 characterised in that a pneumatic piston and cylinder unit is provided as the drive means.

33. A spinning machine according to claim 30 characterised in that the tube transfer device comprises a transfer carriage mounted on the train and movable thereon parallel to the rail system, the said carriage comprising a tube shifting device operable when aligned with a tube on the train to move that tube from the train into the creel.

34. A spinning machine according to claim 33 characterised in that the transfer carriage carries a transverse rail which can be brought into alignment with a spinning position.

35. A spinning machine according to claim 33 characterised in that the transfer carriage comprises a curved rail with a rail section adjoining a full package and a transverse section directed towards the spinning positions, and in that the tube transfer mechanism transfers the package located at the start of the curved rail section via the curved rail section and the transverse section into the creel.

36. A spinning machine according to any one of claims 30 -35 characterised in that each spinning position or each pair of spinning positions has a transverse rail associated therewith on which the reserve and working tubes for the respective spinning position are suspended or arranged, and that the tube holding rail of the train and the transverse rail on the tube transfer device can be brought into alignment with a selected transverse rail in the creel.

37. A spinning machine according to any one of claims 30 -36 characterised in that a tube removal conveyor is provided, preferably in the central region of the machine to convey empty tubes to one machine end.

38. A spinning machine according to claim 37 characterised in that at least at the said end of the machine a transverse return device is provided to return empty tubes to the train.

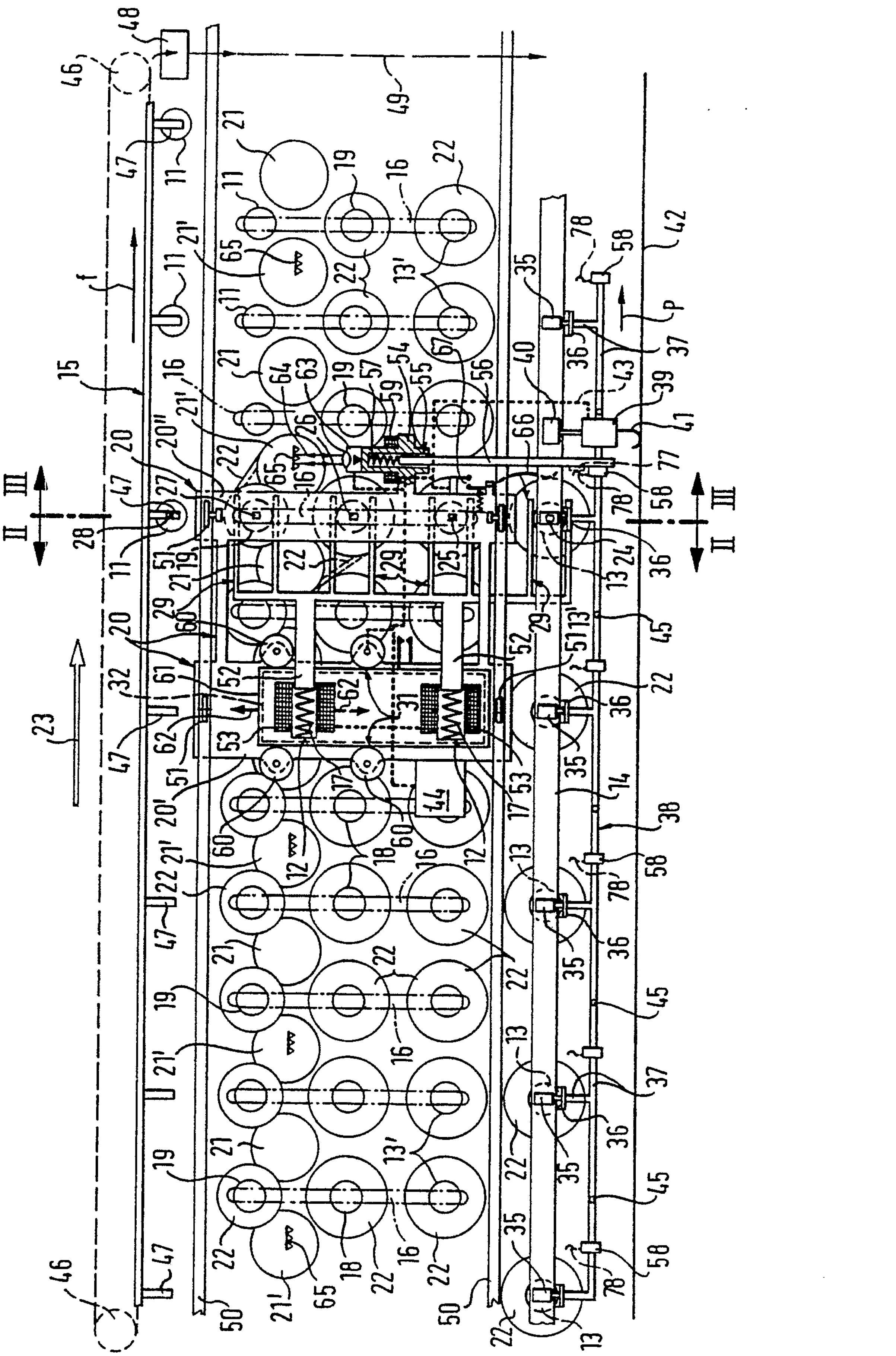

Fig. 1

Fig. 2

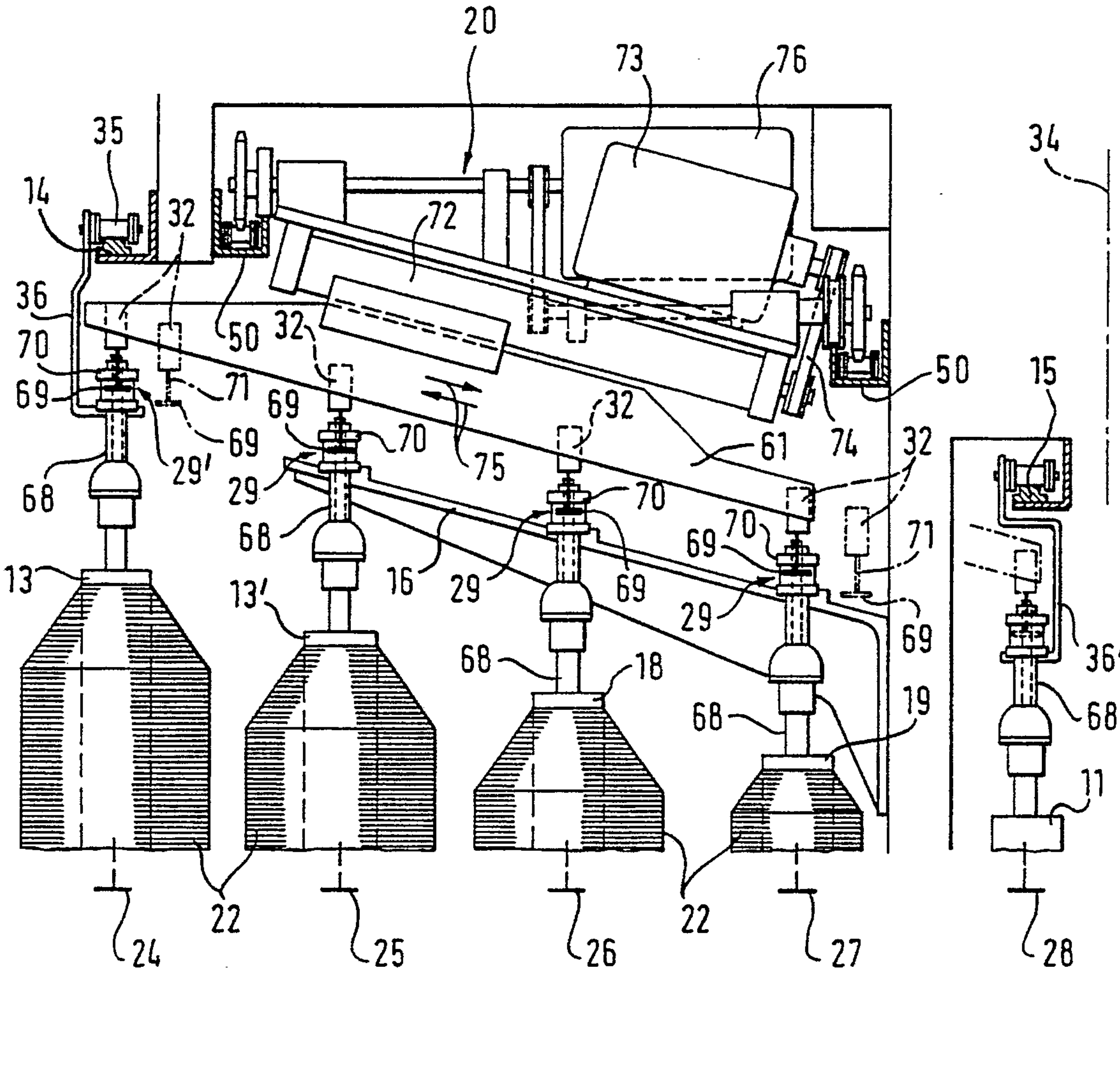
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Fig. 3

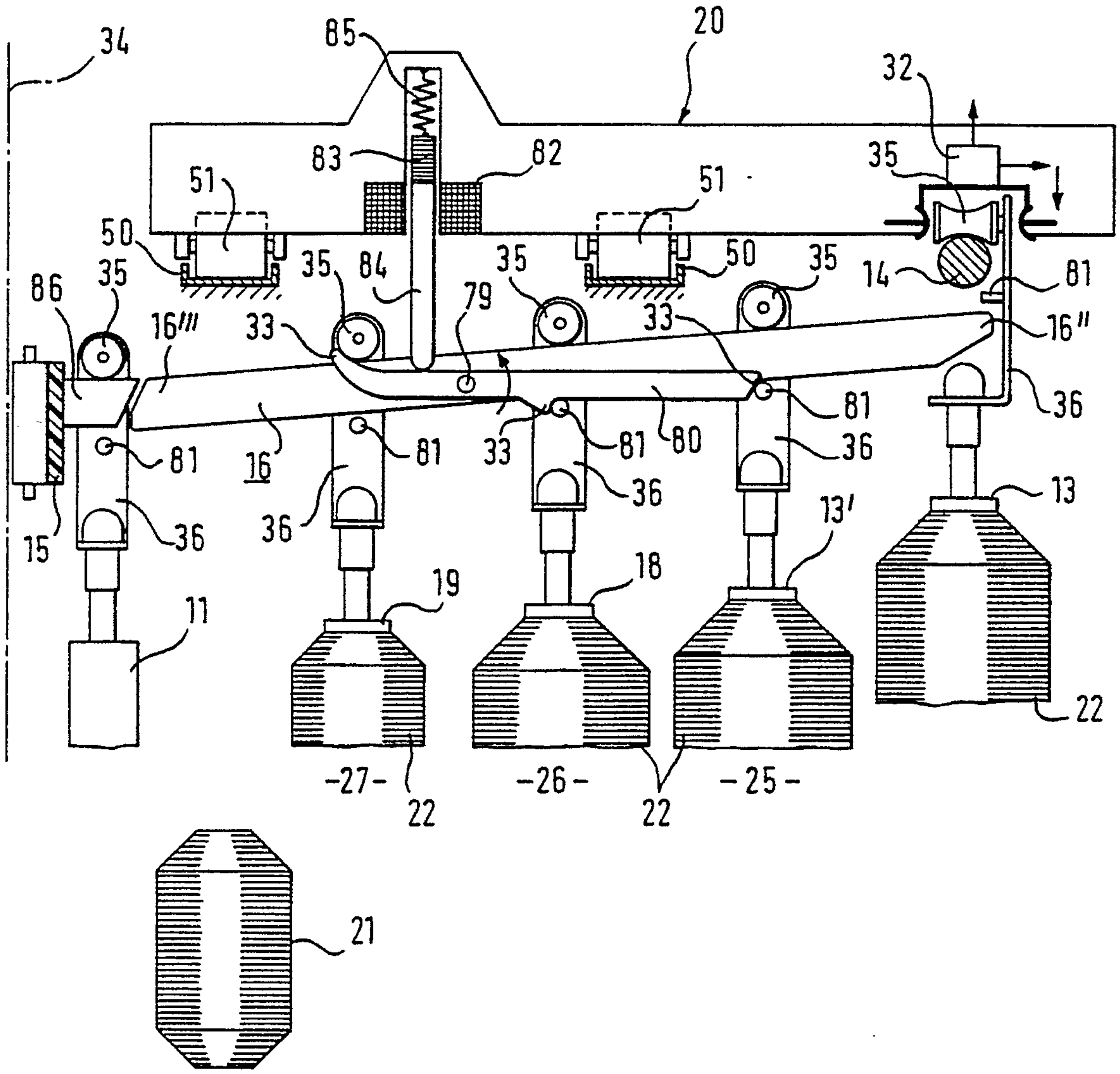
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Fig. 4

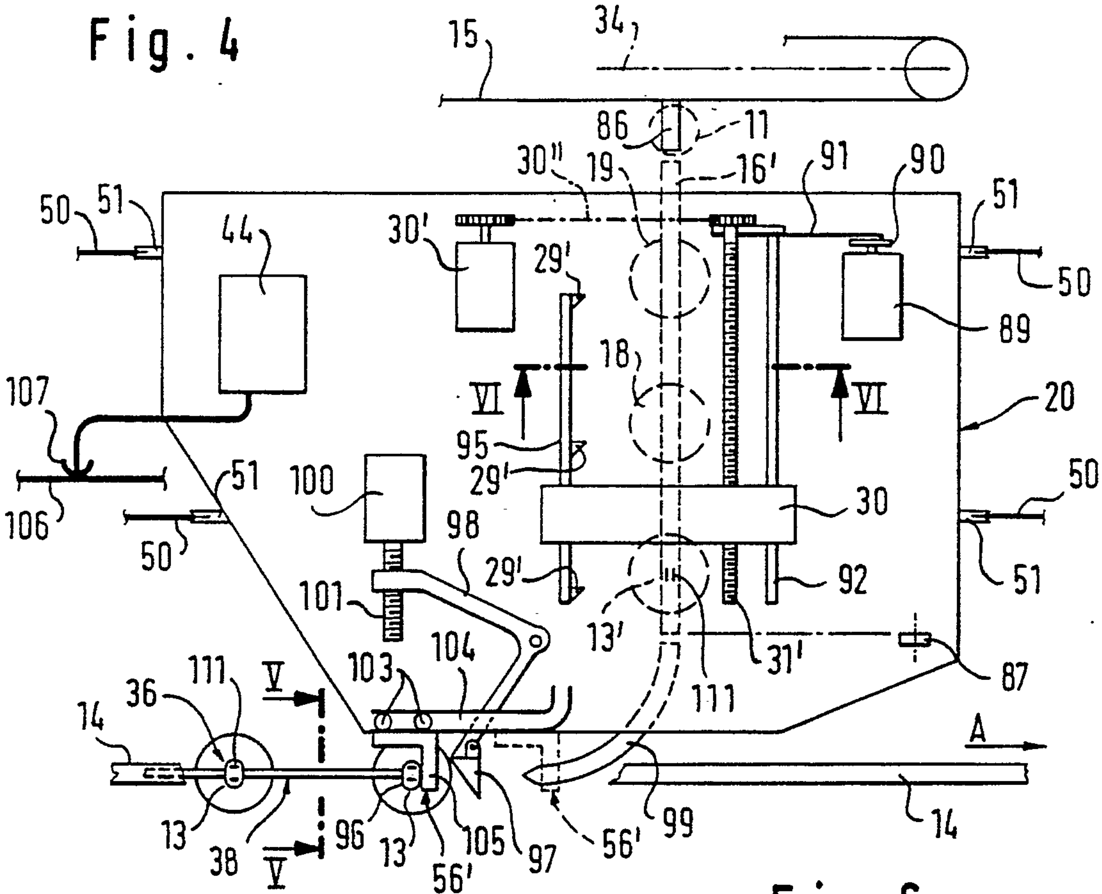
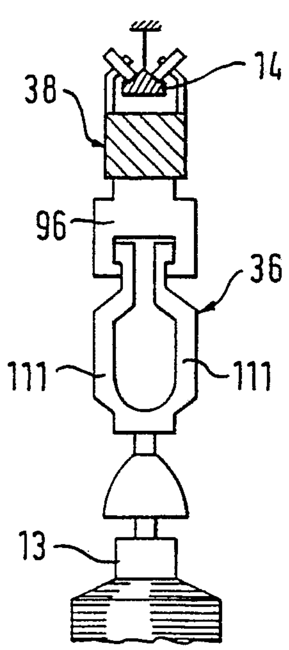


Fig. 6

Fig. 5



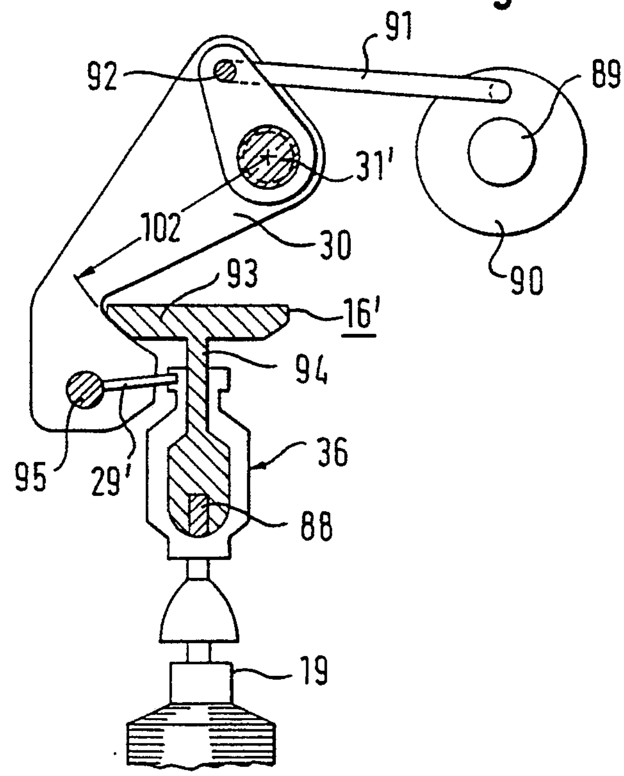


Fig. 7

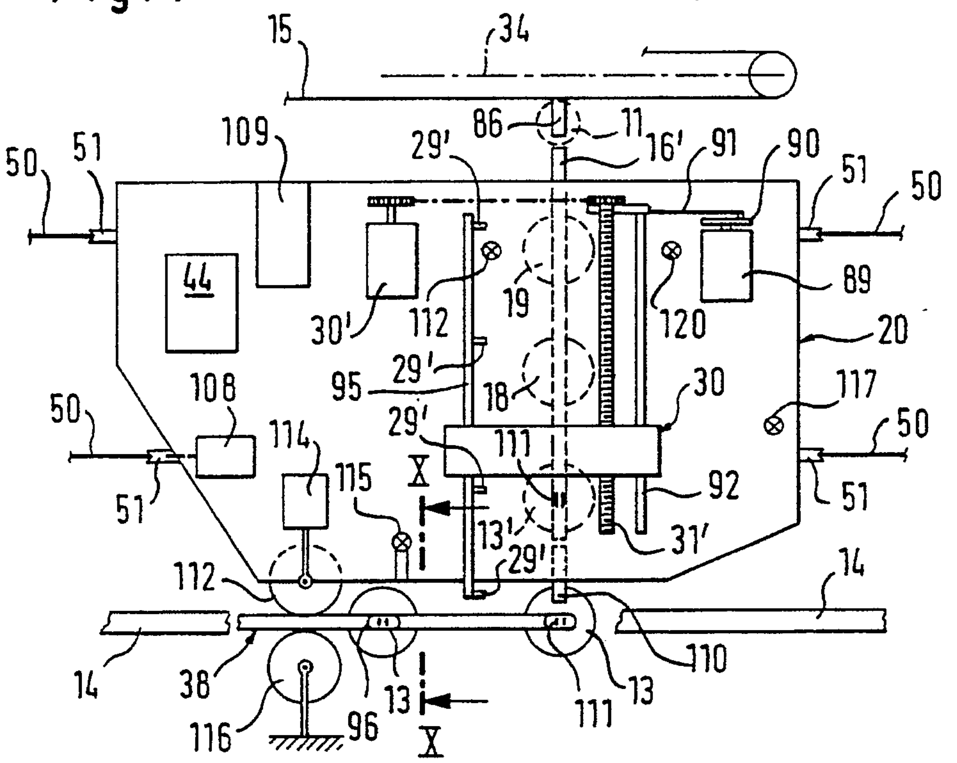


Fig. 8

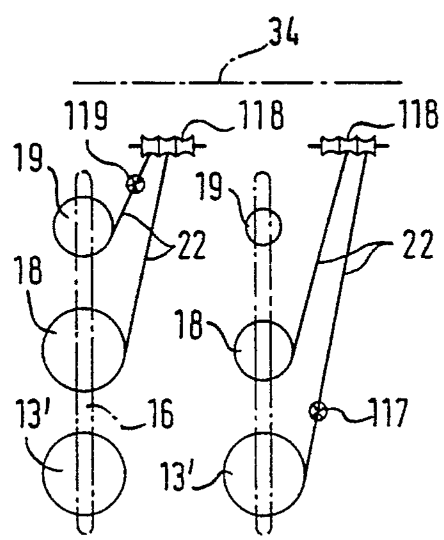


Fig. 9

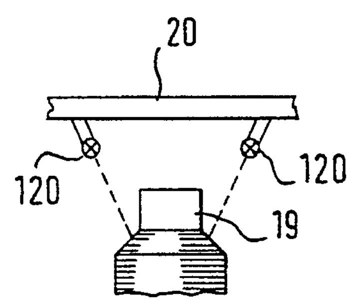


Fig. 10

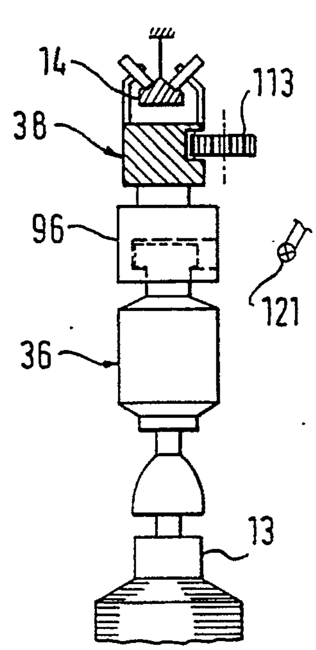


Fig. 11

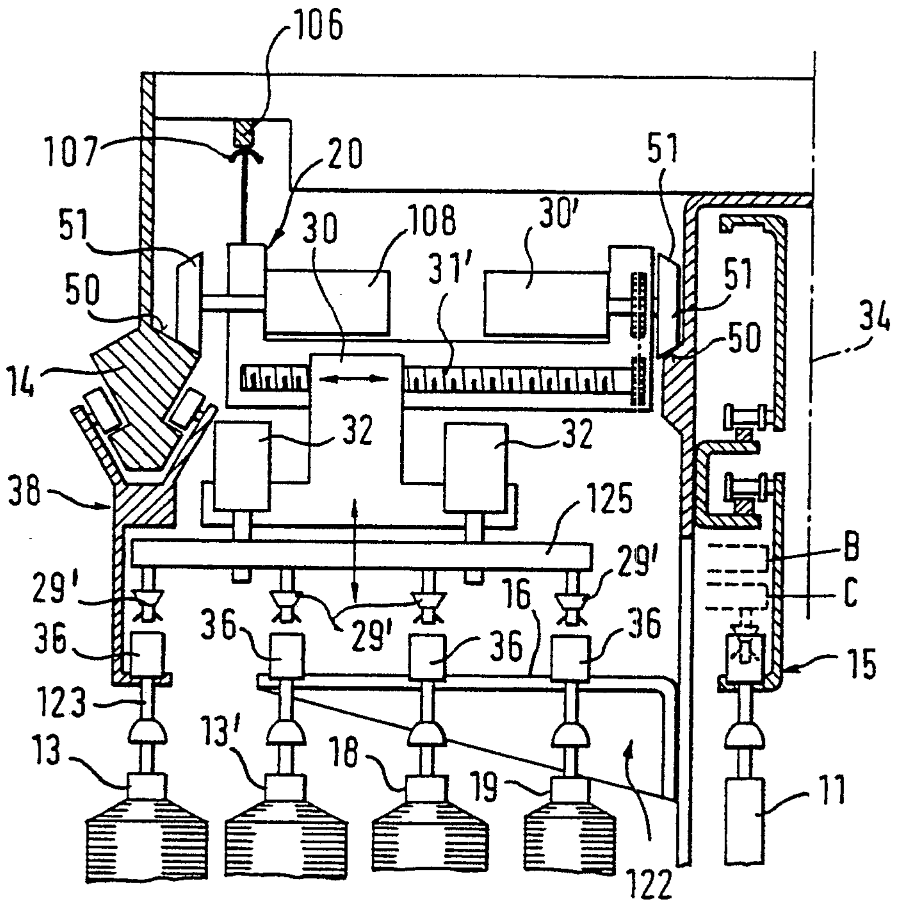

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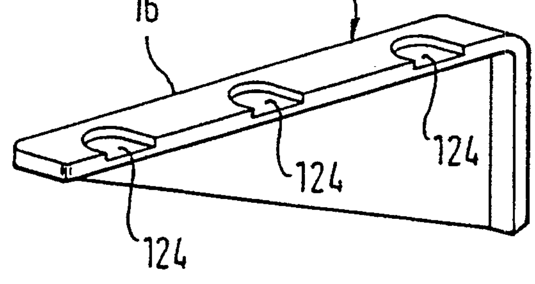
Fig. 12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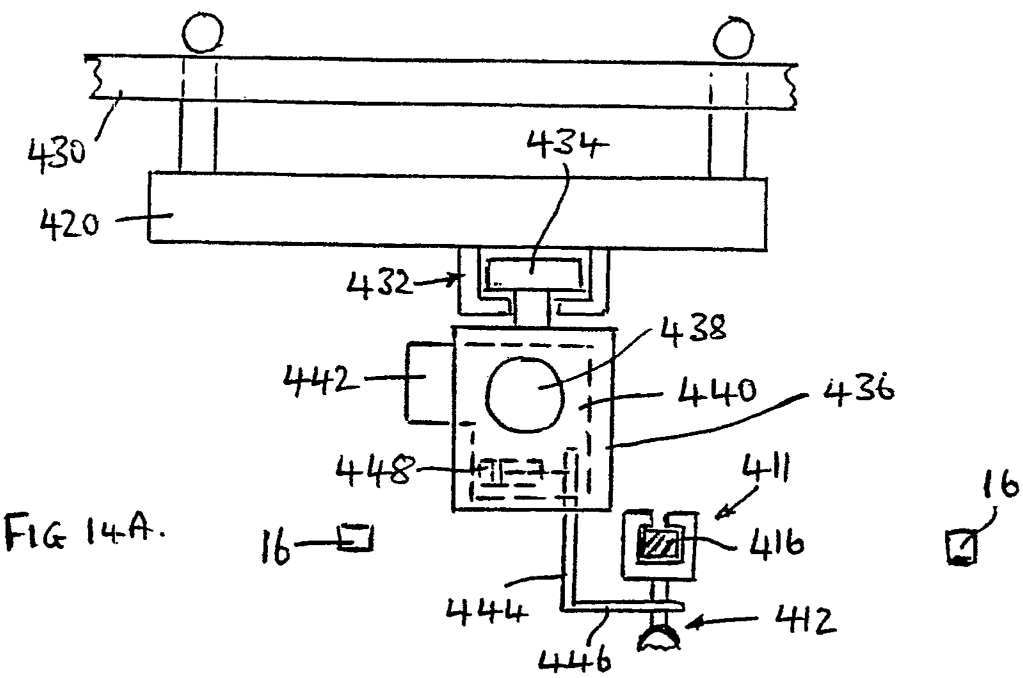

FIG 14A.

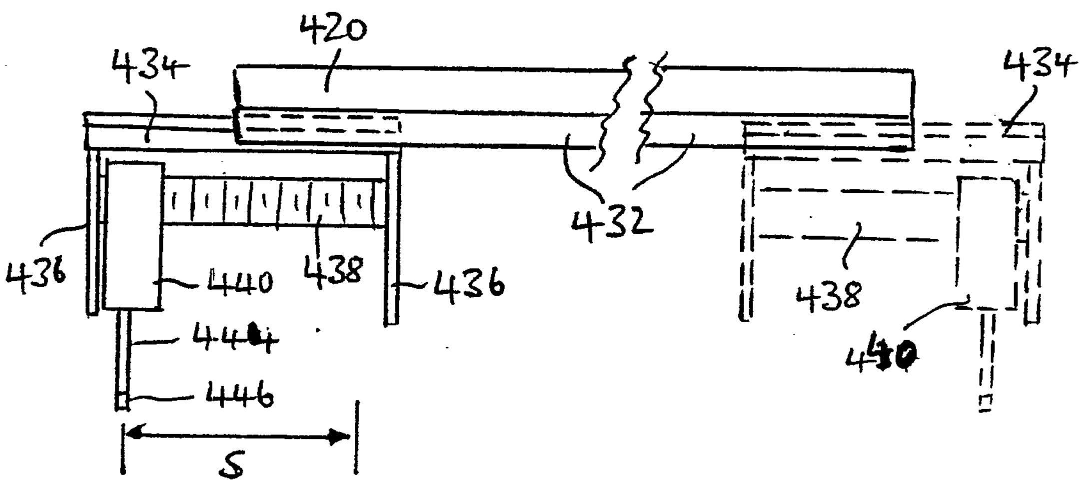

FIG 14B.

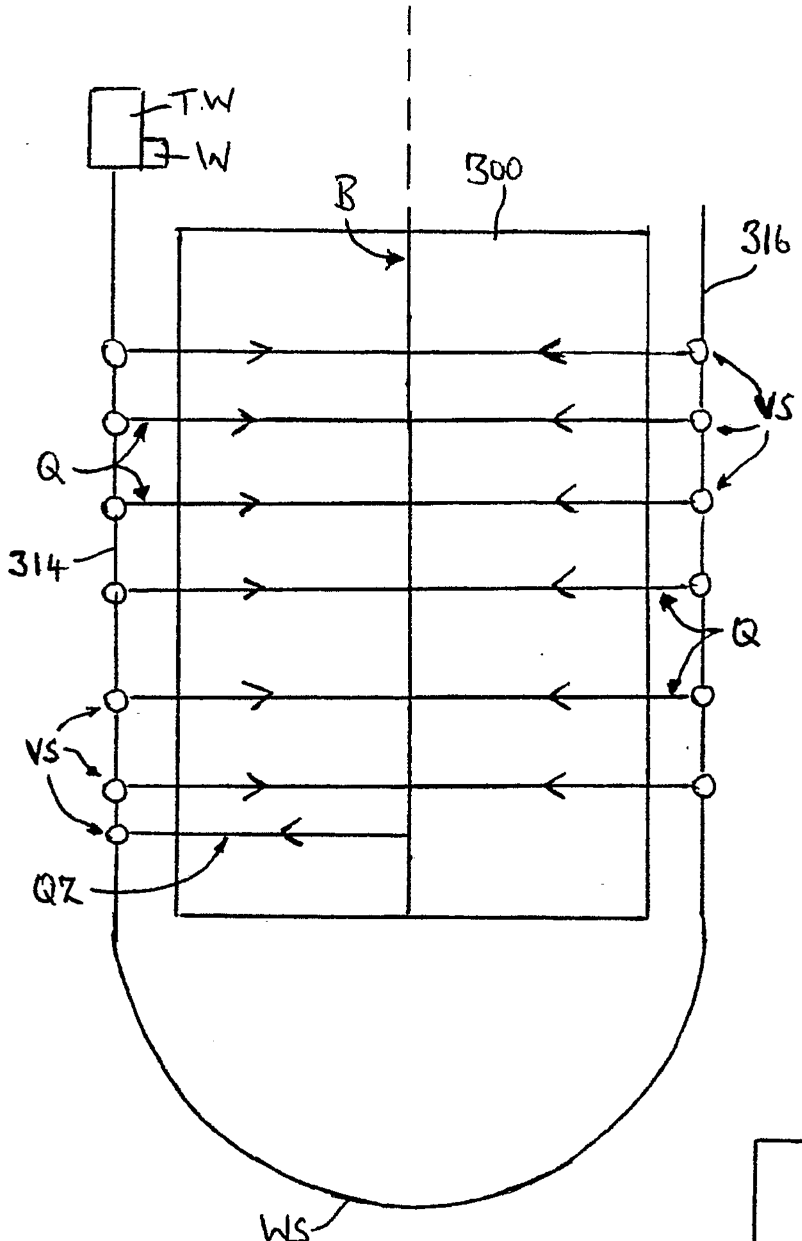

FIG. 15

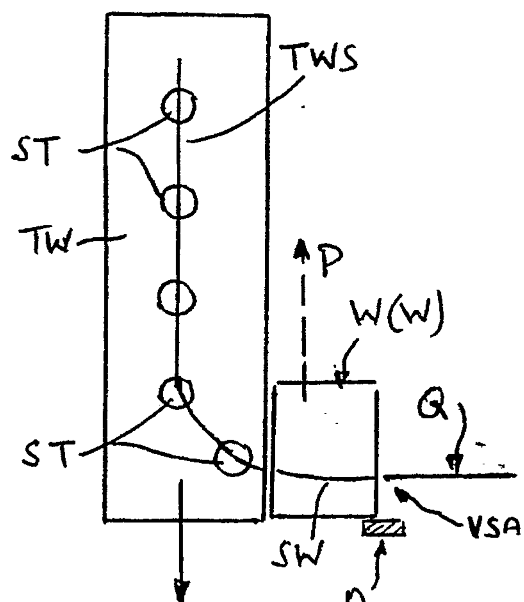

FIG. 17

FIG. 16

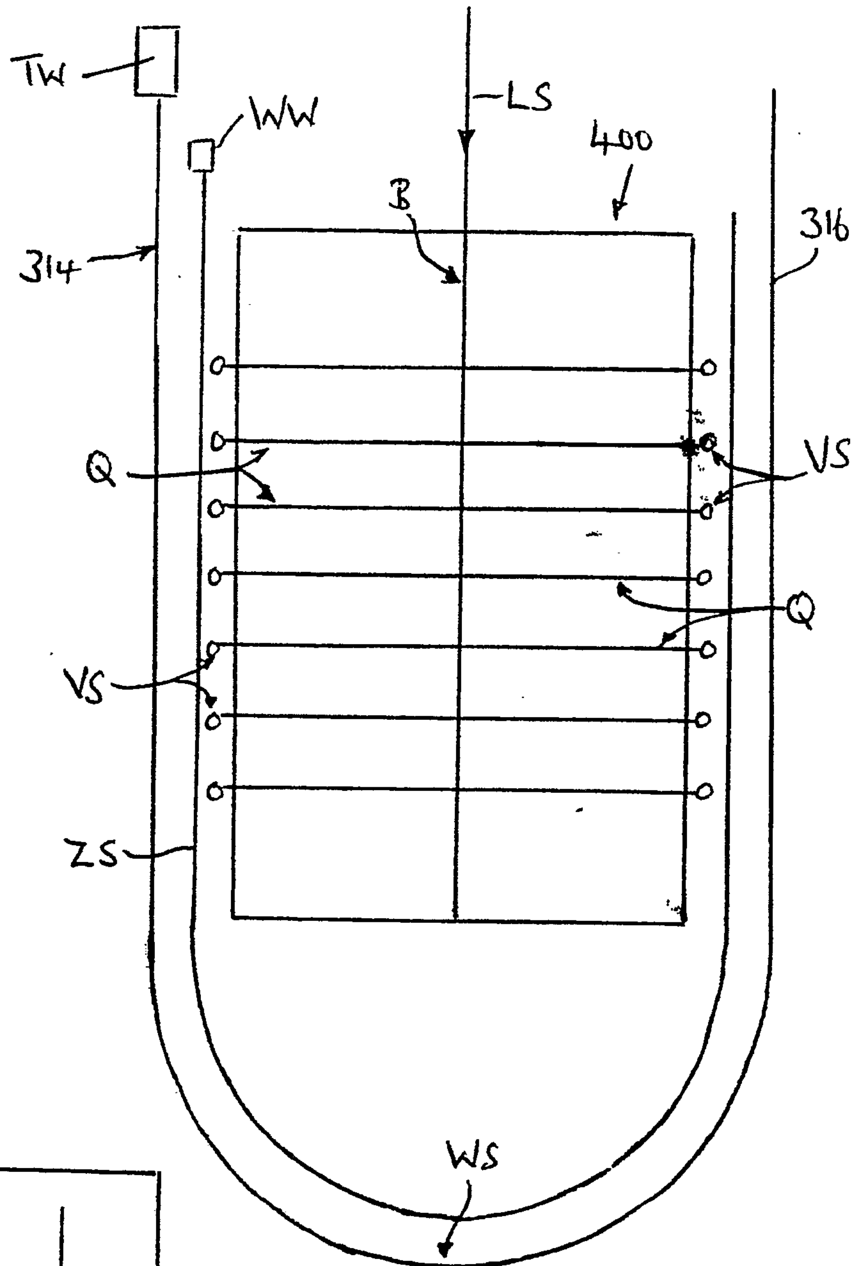

FIG. 18.

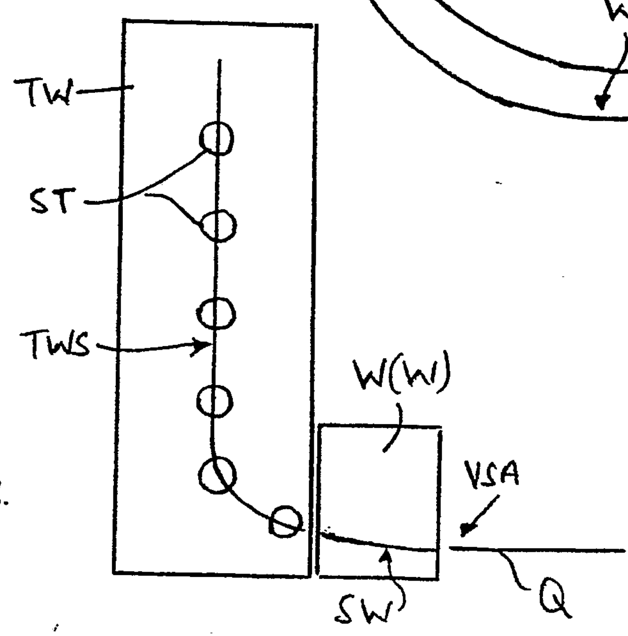

FIG. 19.

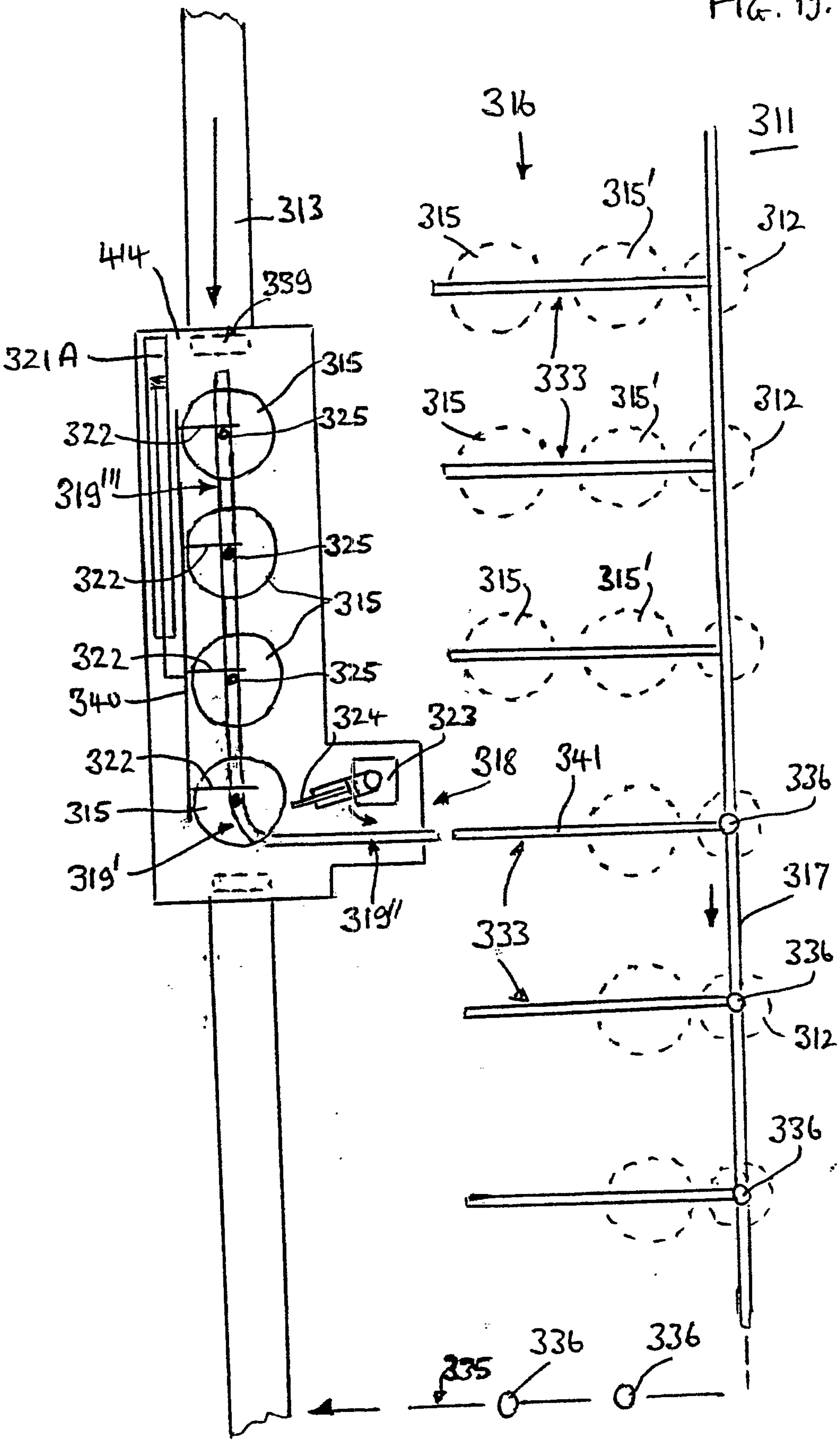
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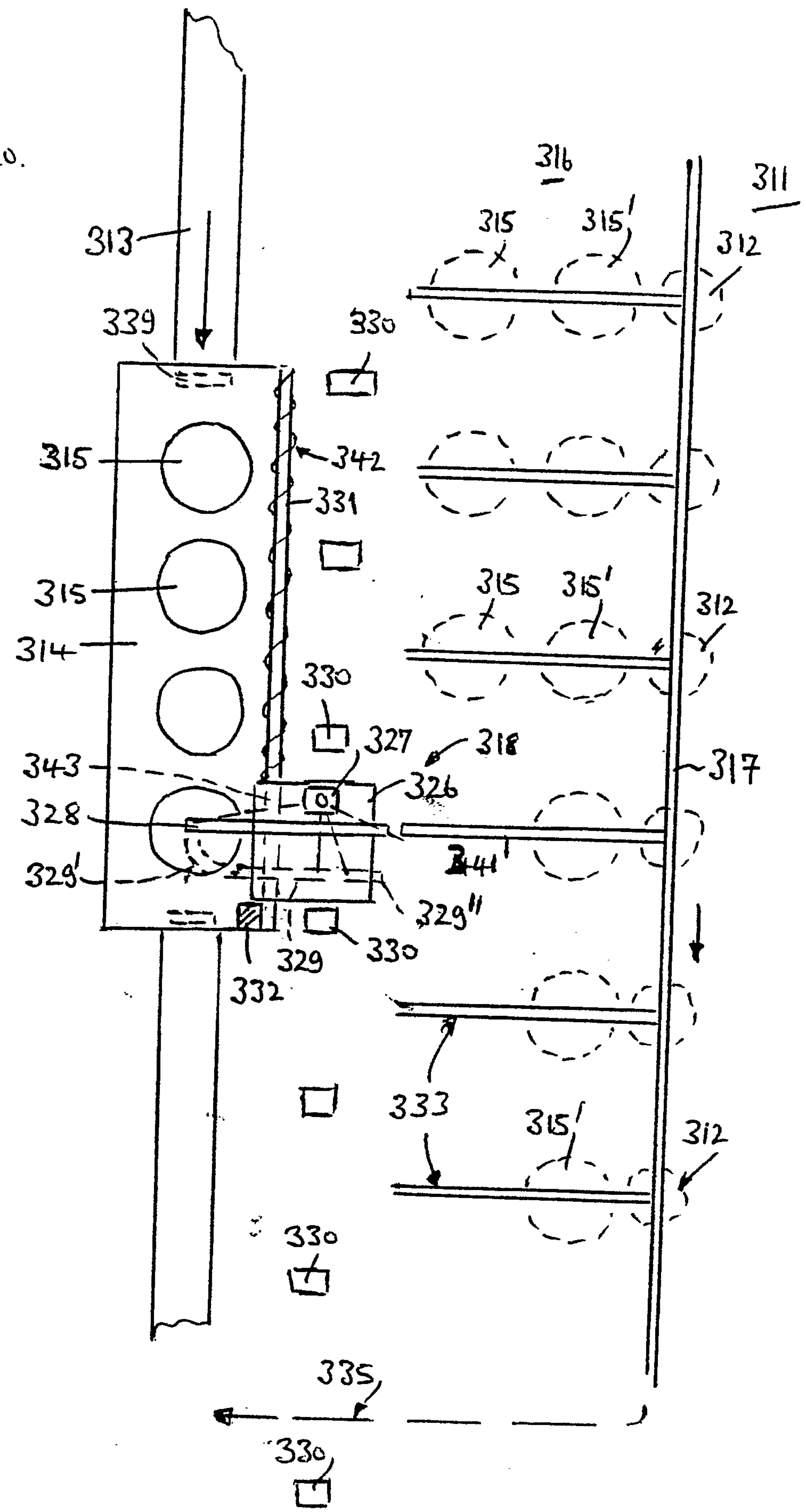
FIG. 20.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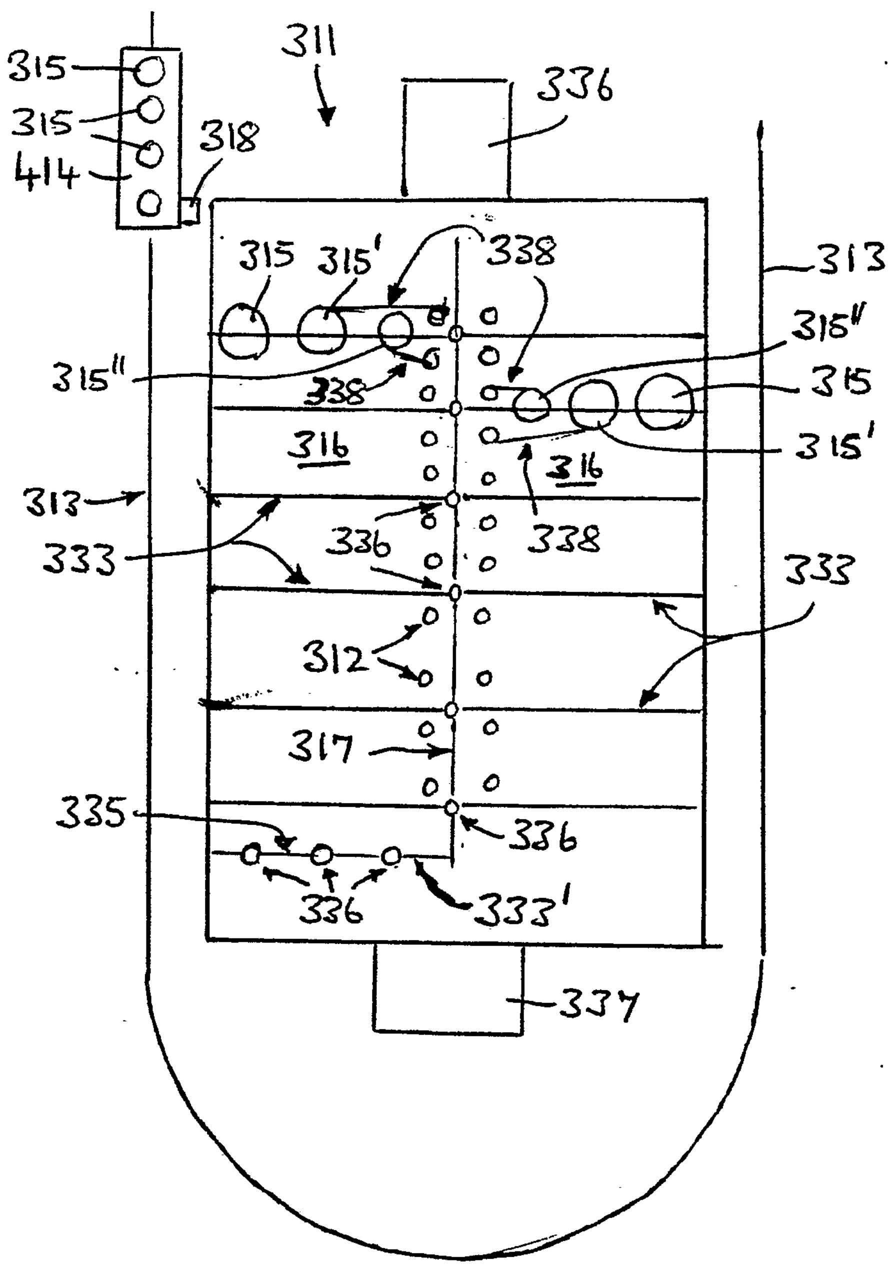
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FIG. 21.

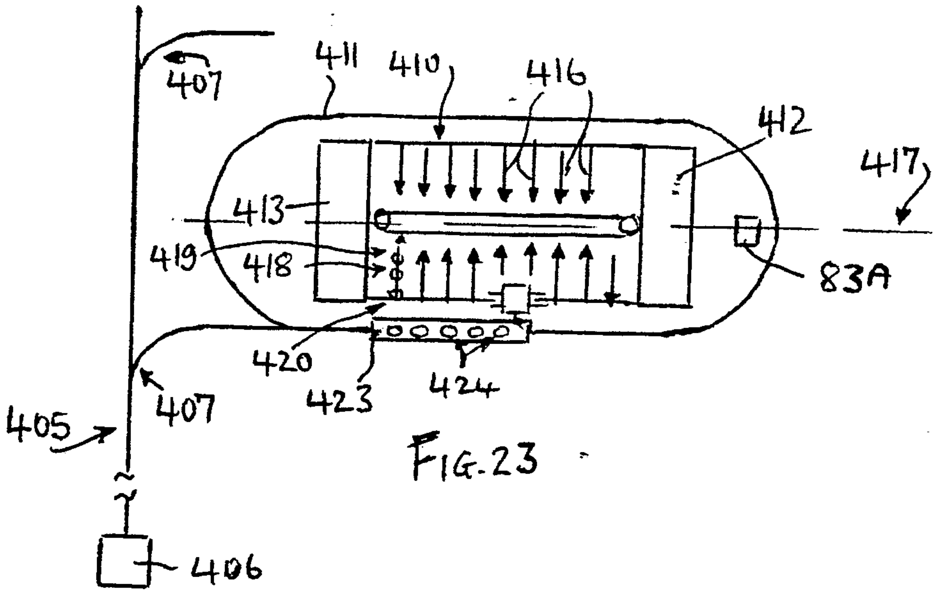
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FIG. 23

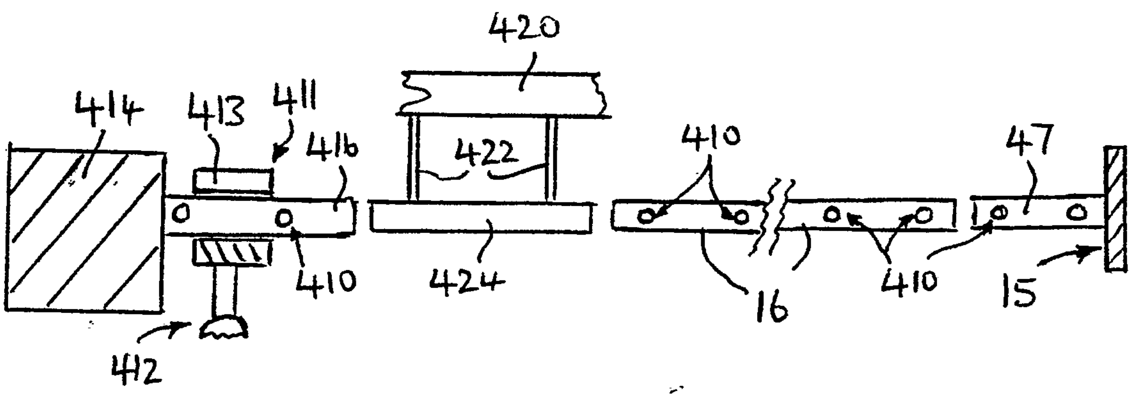
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FIG 13

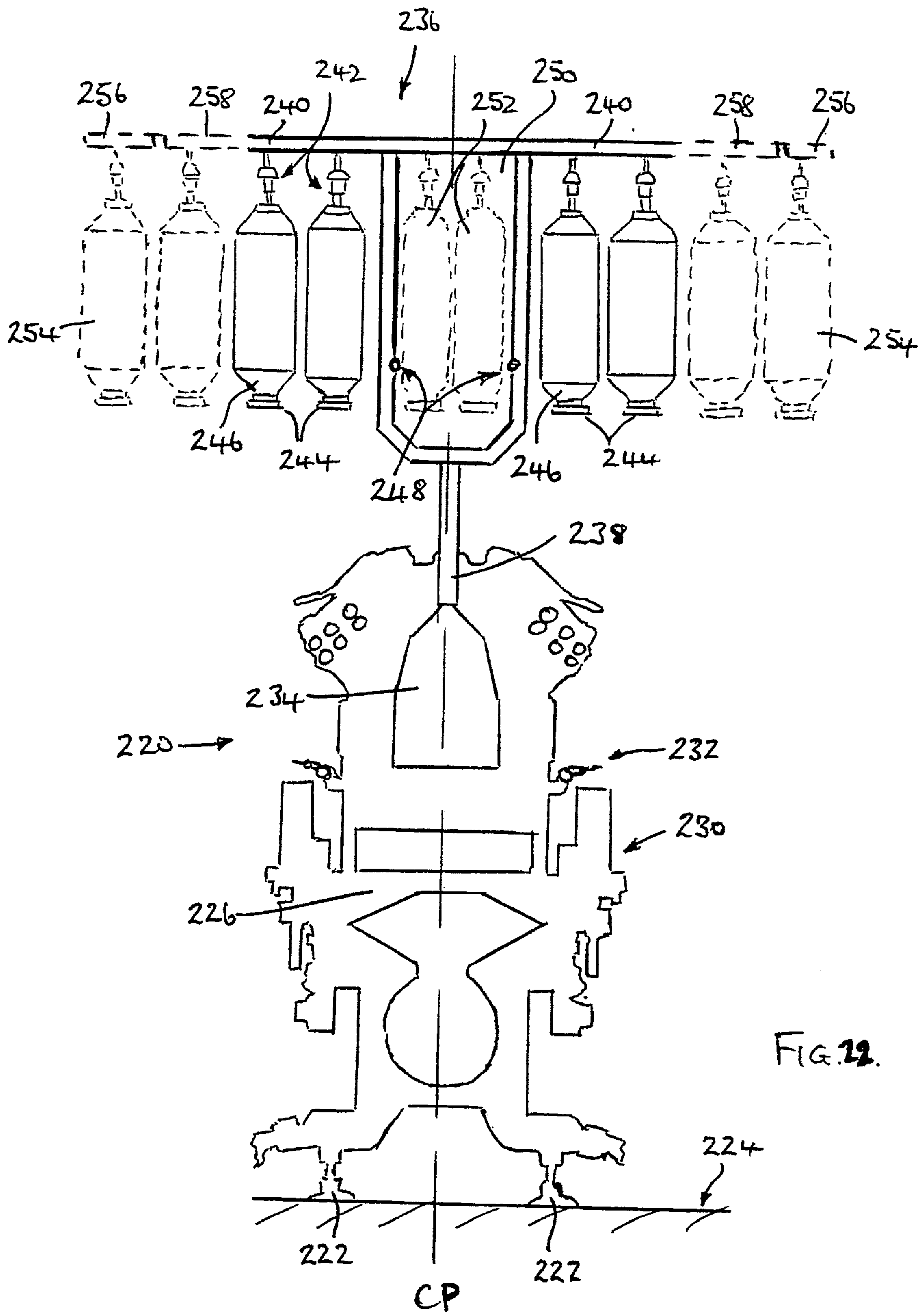
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FIG. 22.

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 90 10 6217

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.5)
A	EP-A-259267 (HOWA MACHINERY LTD.) -----		D01H9/00
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			B65H D01H B65G

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	26 JULY 1990	HOEFER W.D.

CATEGORY OF CITED DOCUMENTS

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