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(54) Safety drive unit, in particular for the movement of protection screens in manufacturing machines and protection screen for automatic manufacturing machines

(57) Safety drive unit, in particular for the movement of protection screens in manufacturing machines the said unit comprising at least one drive motor (25, 26) that drives a support of the motion (7) of an element of cover and/or protection (5, 205). According to the invention, the transmission between the drive motor (25, 26) and the protection screen (5, 205) is formed by a pair of helical gears (22, 23) engaged between each other with the corresponding external helical threads (122, 122', 123, 123'), the said helical gears (22, 23) being made in such a manner, that the rotation of the helical drive gear (23) in the two directions engages the rotation in the two directions of the other helical driven gear (22), whereas a rotation of the driven helical gear (22) engages a locking underpinning of the same in or with the helical drive gear (23) which prevents the rotation. The invention relates also to a protection screen equipped with such a drive unit.

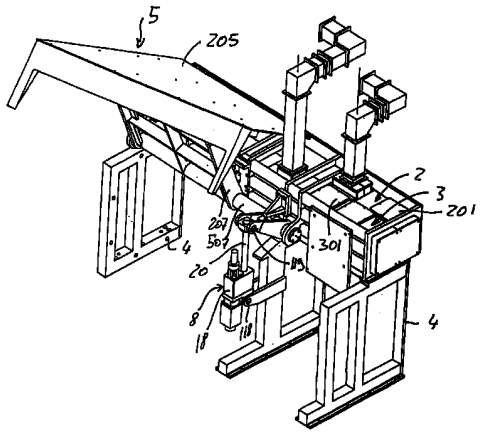

Fig. 2

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Description

[0001] The invention relates to a drive unit, of safety in particular for moving protection screens in manufacturing machines, as for example machines for the processing of tobacco and/or packing of cigarettes, or similar, the said group comprising at least one drive motor that drives a support of the motion of an element of cover and/or protection.

[0002] The protection screens, in particular in the automatic machines are at present of great importance for the protection against accidents of the operators, as well as for the screening of the noise produced by the machines themselves. This entails the necessity of constructing protection screens as for example guards that are always more sturdy, ergonomically integrated with the machine, that have to be easily and rapidly moved from the position of closure to the one of opening. The attempt to satisfy all these requirements has lead to noticeable increase in weight and to avoid the use of elements of protection of a traditional sash type, for making the same in form of covers that can be raised and lowered.

[0003] With reference to a preceding application of the same titular having the filing number of SV98A000033, the protection screens are in the form of angled covers or angled walls that extend themselves in the closed position in such a manner as to cover the front side of the machine as well as the top one, thus substantially completely separating towards the outside the accessible sides of the working units of the machine. For the purpose of obtaining a modularity and a movement such as to reduce the encumbrances, these protection screens are restrained in a moveable manner to a support structure of the machine by means of supports in form of an articulated quadrilateral, of a substantially trapezoidal shape in particular a rectangular trapeze.

[0004] The protection screens are notably heavy and require therefore means that effectively prevent a return of the same to the lowered position of closure when they are taken to the open position for access to the working units of the machine.

[0005] Obviously it is possible to anticipate the use of mechanical locking means that are activated by the operators themselves. Once activated these means solve in a perfect manner to keep the screens in the open position. Never the less the necessity still remains of an active intervention of activation by the operator, that for reasons of laziness, haste or ignorance can omit the activation of the locking means. In these conditions the notable weight of the raised screens can force a non suitable transmission also if this is of a reversible type, with consequences that can limit themselves to a damaging of the means of movement of the screens up to the injury of the operator.

[0006] It is also possible to provide for automatic locking means that enter into operation at the moment the open position of the corresponding protection screen is reached. Never the less in this case the said automatic mechanism require very complex and costly constructions if one wants to provide for the automatic locking in position also for the intermediate positions. Furthermore also in their most simple version it is necessary to provide for different working units that contribute to detect the position of the screens and activate the means, for the reason there is always a danger of malfunction of the installation for automatically locking in position that without additional means of signaling can also remain ignored by the operator.

[0007] The invention has the scope of perfecting a unit for the movement in particular of protection screens of the type described at the beginning in such a manner whereby intervention of the operator is not necessary to ensure the locking in the raised position of the screens themselves and thus avoiding also the use of mechanisms external to the transmission also if of an automatic type, the whole thanks to relative simple and low cost means relative to the traditional automatic means.

[0008] The invention attains the above aims with a unit of the type described at the beginning in which the transmission between the drive motor and the protection screen is formed by a pair of helical gears engaged between each other with the corresponding external helical threads, said helical gears being made in such a manner, whereby the rotation of the helical drive gear in the two directions involves the rotation of the other driven helical gear in the two directions, whereas the rotation of the driven helical gear activated in one of the two directions engages a locking underpinning of the same in the or with the helical drive gear that prevents the rotation the drive gear being dynamically connected to the drive motor and the driven gear dynamically connected to the protection screen.

[0009] This type of gear is known for example with the denomination "twinworm from a previous publication of the inventor B. Popper of the Nicholas Chironis Associate editor". This type of gear is based substantially on the difference in pitch of the two helical gears.

[0010] Eventually also the diameters can be different contributing to obtaining a preestablished transmission ratio.

[0011] According to the invention the helical gears are designed with their own helical thread such, that the axes of the same extend themselves parallel to each other.

[0012] Furthermore, to allow a greater resistance of self-locking and of transmission, the invention provides that each helical gear be formed by two halves each with its own helical thread and the said helical threads being symmetrical between each other relative to the mean plane transversal to the axis of rotation.

[0013] The two symmetrical threads are separated by an intermediate section without thread.

[0014] According to a further feature, the output shaft of the transmission acts on an additional transmis-

sion of the threaded rod and nut type that transmits the motion to the parts of the mobile suspension of the screens.

[0015] In this case, the drive shaft on which the drive gear is fitted is laterally offset with regards to the driven shaft and allows the connection of the same to two motors each coupled to one of the opposite ends of the said drive shaft.

[0016] Advantageously one of the two motors consists of an electric motor and is the main motor, whereas the other motor is the emergency motor and consists preferably of a motor of the pneumatic type.

[0017] The drive unit according to what previously described apart from offering in a simple and automatic manner the locking in any position of lifting of the screen driven by the same allows also the activation in case of a breakdown of the main motor or lack of electrical power. Furthermore such unit is constructively of very limited dimensions and avoids problems of encumbrance, whereas it can be mounted in an analogous manner to any known linear actuator, also in an articulated manner to its two opposite ends of the box of the unit and of the nut sliding on the threaded rod.

[0018] This allows for the use with a protection screen that is mounted vertically movable in the two directions and forward and backward with regards to the front side of the machine thanks to a device of articulation in form of an articulated trapeze.

[0019] In this case, in correspondence to one of the axes of articulation, preferably the axis of articulation lower than the stationary support structure a transmission shaft is provided with a radial arm to which a second axis is articulated in an oscillating manner according to an axis parallel to the transmission shaft in form of a threaded nut sliding on a threaded rod, whereas the transmission box is articulated to an additional part of the support structure of the machine in manner oscillating around an axis parallel to the axis of articulation of the threaded nut.

[0020] Thanks to the considerable compactness of the transmission, with the two motors the pair of helical gears, the threaded rod and the threaded nut, it is possible to sub-divide a protection cover of a machine into individual screens each of which has a separate device of articulated suspension to the support structure of the machine in combination with its own drive unit.

[0021] This is particularly advantageous in a modular machine in which the same is sub-divided in individual prefabricated modules, each of which carries a preestablished number of working units together with its own support structure and its own drive units and its section of cover, the said parts being made for each module in a manner to connect to the adjacent prefabricated modules.

[0022] The invention has additional features that are subject of the claims below.

[0023] The features of the invention and the advantageous derived therefrom are evidenced in greater detail from the following description of an executive example illustrated as a non limiting title in the attached drawings , in which:

The Fig. 1 illustrates a view in perspective of a machine formed by a plurality of base frame modules in form of a table with protection screens and safety drive units according to the invention.

The Figs. 2 and 3 illustrate a detail relative to the protection screen associated with one of the modules of the machine according to Fig. 1 with the screen raised and with the screen lowered.

The Fig. 4 is a view in perspective of an enlarged detail of the suspension device in form of an articulated trapeze of the protection screen according to the Figs. 2 and 3.

The Fig. 5 illustrates a section according to a through plane for the axes of the output and input shafts of the drive unit according to the invention.

The Fig. 6 illustrates in a lateral view the detail relative to the two helical gears of the device according to the invention.

The Figs. 7 and 9 illustrate a lateral view of a module of the machine schematized according to the preceding Figures with the protection screen in an open position, in an intermediate open position and in a closed position.

[0024] With reference to the Fig. 1 a machine according to the invention, in particular a machine for processing tobacco and more specifically a machine for packing cigarettes has a support bed of the individual manufacturing units made in shape of a table 1. This framework in form of a table 1 is of the type for example described in the patent EP816714 of the same titular. In this construction, the manufacturing units, the transmission units and the drive units are made prefabricated each in form of an independent modular element with an own support structure or box, which is provided with preestablished mounting means to, on or inside the framework in form of a table.

[0025] In this case, in the example illustrated the modular unit of manufacture, of transmission and of drive are not illustrated in detail, as they are not part of the present invention. The framework in form of a table is instead sub-divided into individual modular elements 101, 201, 301, transversally to the longitudinal extension of the machine, according to what described in a preceding application of the titular having the number SV98A0003.

[0026] With reference to an additional feature of the invention, apart from the base framework in form of a table 1 sub-divided in modules 101, 201, 301, the machine according to the invention has at least one channel, in particular two channels of distribution of the cables, conduits or other lines of supply, of control or for other functions. This or these channels 2, 3 extend themselves advantageously in a position of non interfer-

ence and in a preferential manner along the rear longitudinal side of the machine, in special manner in a position on top, or in any case in the area of the maximum top encumbrance of the machine.

[0027] The channels of distribution 2, 3 are supported in this case by risers 4 that are provided in pairs on the opposite side ends of each module 101, 201, 301 of the framework in form of a table 1. Therefore adjacent modules 101, 201, 301 have also adjacent risers 4.

[0028] A removable cover 5 is mounted to a longitudinal beam that is segmented substantially corresponding to the modular segments of the channels 2, 3 and is parallel to the channel or channels 2, 3 themselves and extends itself substantially at the level of said channels, or that is advantageously formed by the same channels 2, 3. Also this cover 5 is made modular, or is formed by individual segments of covers that complete themselves in order to form a single cover and that are divided between each other in a manner corresponding to the modules 101, 201, 301 of the framework in form of a table 1. Each module 101, 201, 301 of the framework in form of a table 1 has therefore its part of the cover 205. This can also be previously mounted to the corresponding part of the beam or channel 201, 301, 202, 302, 103, 303, before the reciprocal assembly of the modules 101,201, 301 of the framework in form of a bed 1.

[0029] With reference to rear and top position of the support beam of the segments 205 of the cover 5, the said cover 5 and the corresponding modules are made with a shape substantially in form of a L with a branch 305 substantially horizontal and above that covers the machine on top and a vertical branch 405 that covers the front part and that can extend itself up to the level of the plane of the modules 101, 201, 301 of the framework in form of a table 1, or if necessary down to the ground.

[0030] With reference to the Figs. 1, 2, and 3, the individual modules of the protection screens or of the cover 205 are formed in two parts, that is a top part separated from the vertical or substantially vertical part designed to overlap on the front side and that is mounted in a removable manner to the top part. In the Figs. 1 to 3, the said front part substantially vertical is not illustrated to allow for a better view of the additional constructive elements.

[0031] The segments of the protection cover are fitted to the corresponding segment of the beam or channel 103, 203, 303, in a manner folding upwards. In particular, the segments 205 of the cover are supported cantilevered from the front of the segment of the beam of the channel 103, 203, 303 and are articulated in an oscillating manner around an horizontal axis.

[0032] To be noted is that in the closed condition, the segments 205 of the cover do not exceed the total space in height defined by the top side of the channel 2, 3. Furthermore advantageously the segments of the cover 205 are articulated cantilevered from the front side of the segment of the beam or of the modular segment of the channel 103, 203, 303 thanks to a device of articulation in form of an articulated parallelogram, in particular an articulated trapeze that is illustrated with regards the constructive detail in Fig. 4 and that is illustrated schematically in Figs. 7 to 9. Said articulated trapeze is overall indicated with 7 and that has a mounting plate 107 supported cantilevered by pairs of arms of articulation 207, 307 provided on each front of the plate 107 and articulated respectively in correspondence to the front edge and the rear one of the said plate 107, whereas the opposite extremity of the two arms 207, 307 are articulated in vertical points distanced 407, 507 at the front side of the corresponding segment of the beam of the channel 103, 203, 303. The movement of opening and closure can be obtained in different ways, for example by means of linear actuators or other traditional drive units.

[0033] In the Figs. 7 to 9, a transversal section of a module 101, 201, 301 of the framework in form of a table 1 is illustrated with the columns 4, the channel 2, 3 or a generic beam and with the corresponding module of the cover 205. As is evident the total encumbrance in height of the machine is calibrated on the mean height of a man with his arm raised and furthermore, the fulcra of the device of articulation 7 are illustrated and in dotted lines the arms 207, 307 of the same. The length of the arms and the position of the fulcra is such, that during the angular motion upwards of the cover module 205, the vertical branch of the same carries out at least for a part of the motion a movement substantially rectilinear or vertical or in any case substantially parallel to itself, and with a very much reduced component of outward motion in direction of the front of the machine. The outward motion takes place only and in a limited measure at the end of the angular motion in direction of opening of the cover segment 205. In order to limit the space in front towards the outside, additionally, the long section of the free bottom edge of the segments 205 of the cover is slightly folded inwards for a certain length of the vertical extension of the said vertical branch of the cover 5. This type of motion of opening the cover 5, allows both to limit the space required by the machine, as well as to avoid danger to the operators.

[0034] With reference to the Figs. 1 to 3, 5 and 6, the activation of the motion of each segment of the cover or of the protection screen 5 is obtained with a particular type of linear actuator 8 that is articulated in 108 with its box 18 to a part of the structure of the corresponding module 101, 102,103, whereas it is articulated in 119 with a slider 19 at a radial arm rotary wise integral with the shaft of articulation 7 of the shaft of articulation 507 of the articulated trapeze 7 of suspension of the segment of the screen 5.

The axes of articulation 108 and 119 are parallel to the axis of the shaft of articulation 507 that transmits the motion to the screen 5.

[0035] The slider 19 is formed by a threaded nut engaged on a threaded rod 20 driven rotary wise by a

driven output shaft 21 of the actuator.

[0036] The output shaft has a driven helical gear 22 that engages with a parallel helical drive gear 23 and that is fitted in a manner revolving together with the same on the input shaft 24 of the drive unit 8. The input shaft and the driven helical gear are therefore parallel to the output shaft and to the driven helical gear associated with the same. Therefore the ends of the input shaft 24 become directly accessible, both and in correspondence of the same the input shaft is dynamically connected to a main drive motor 25 and to an additional auxiliary emergency motor 26.

[0037] The main motor 25 is preferably of the electrical type, whereas the auxiliary emergency motor is of the pneumatic type.

[0038] The pair of helical gears 22, 23 is illustrated in more detail in Fig. 6. The two helical gears are of the type based on the concept conceived by B. Popper and of the so called "Twinworm gear". (Nicholas Chironis, Associate editor).

[0039] This type of gear allows to transmit a rotation when the torque is transmitted from the drive gear 23. When instead the torque is transmitted in opposite direction from the driven gear to the one of drive, one has a reciprocal underpinning effect, and therefore effectively preventing the rotation in any direction of rotation. This effect is obtained thanks to the fact the two gears have helical threads 122, 123, with different pitches between each other.

[0040] The pair of helical gears according to the invention have furthermore different diameters and is made according to a perfecting of the above mentioned principle that improves the features of transmission and of automatic locking or irreversibility.

[0041] In fact, each helical gear is formed by two axial segments each of which has a helical thread 122, 123, 122', 123'. The two helical threads 122, 122', and 123, 123' of the two helical gears 22, 223 are made symmetrically identical to each other relative to a median plane transversal to the axis and are interspaced by an intermediate section 222, 223 without thread.

[0042] Thanks to this realization of the pair of gears, when the motion is transmitted to the helical drive gear, the same drags revolving the driven helical gear 22. When instead the rotary motion is applied to the driven helical gear, for example because of the rotation of the threaded rod through the action of the notable weight of the screen segment 5 that weighs down on the threaded nut, the driven gear 22 tends to underpin itself in the drive gear 23, whereby the threaded rod and the output shaft are automatically locked from revolving preventing the descent of the cover because of its own weight and for forcing the drive transmission. The greater the force that acts in direction of rotation of the driven helical gear 2, the greater is the underpinning of the latter with the helical drive gear 23.

[0043] The segment of the protection screen 5 is therefore always firmly locked in position against an accidental return into the position of closure, in any intermediate position of lift and in the completely raised position without requiring automatic installations of control and actuation of devices locking the segment of screen 5 in position or still worse locking means in removable positions and of the manually driven type.

[0044] Naturally, the invention is not limited to what described and illustrated, above all constructively, the whole without abandoning the informative principle described above and claimed below.

Claims

1. Safety drive unit, in particular for the movement of protection screens in the manufacturing machines the said group comprising at least one drive motor (25, 26) that drives a support of motion (7) of an element of cover and/or protection (5, 205), characterized by the fact that the transmission between the drive motor (25, 26) and the protection screen (5, 205) is formed by a pair of helical gears (22, 23) engage between themselves with the corresponding external helical threads (122, 122', 123, 123'), the said helical gears (22, 23) being made in such a manner, whereby the rotation of the helical drive gear (23) in the two directions causes the rotation in the two directions of the other driven helical gear (22), whereas a rotation of the driven helical gear (22) in one of the two directions causes a locking underpinning of the same in or with the helical drive gear (23) that prevents the rotation, the drive gear (23) being dynamically connected to the drive motor (25, 26) and the driven gear (22) dynamically connected to the protection screen.

2. Device according to the claim 1, characterized by the fact that such type of a transmission with helical gears (22, 23) is of the type known with the denomination "twinworm gear" and is based on the fact that the helical threads (122, 122', 123, 123') of the two helical gears have different pitches.

3. Device according to the claims 1 and 2, characterized by the fact that the diameters of the threads can be different contributing towards obtaining a preestablished ratio of transmission.

4. Device according to one or more of the preceding claims, characterized by the fact that the helical gears (22, 23) are designed with their own helical thread (122, 122', 123, 123') in such a manner, whereby the axes of the same extend themselves parallel to each other.

5. Device according to one or more of the preceding claims, characterized by the fact that each helical gear (22, 23) is formed by two axial halves each

with its own helical thread (122, 122'. 123, 123') and the said helical threads (122, 122', 123, 123') of the said two halves being symmetrical to each other relative to the mean plane transversal to the axis of rotation , whereas the helical threads (123, 123') of the two halves of an helical gear (23) engages with the helical thread (122, 123) of the associated half of the other helical gear (22).

6. Device according to the claim 5, characterized by the fact that the two symmetrical threads (122, 122', 123, 123') are distanced by an intermediate section without thread (222, 223).

7. Device according to one or more of the preceding claims, characterized by the fact that the output shaft (21) that is integral rotary wise with the driven helical gear (22) drives the threaded rod (20) of a further transmission of a threaded rod and threaded nut (19) that in its turn drives the motion of the protection screen (5, 205).

8. Device according to one or more of the preceding claims characterized by the fact, that the drive shaft (24) on which the drive gear (23) is fitted is laterally offset relative to the driven shaft (21) and two separate motors (25, 26) are connected to the drive shaft (24) each of which is connected rotary wise to one of the two opposite ends of said drive shaft (24).

9. Device according to the claim 8, characterized by the fact that one of the two motors (25) is constituted by an electrical motor and is the main motor, whereas the other motor (26) is the emergency motor and is preferably formed by a motor of the pneumatic type.

10. Device according to one or more of the preceding claims, characterized by the fact that it constitutes a linear actuator (8) with double motors and has an encumbrance such that it can be mounted substantially in the same manner as the usual linear actuators.

11. Device according to the claim 10, characterized by the fact that the box (18) of the device has a seat of articulation (108), whereas the threaded nut (19) sliding on the threaded rod (20) also has joints of articulation (119) for oscillations around axis transversal to the longitudinal axis of the threaded rod (20).

12. Protection screen, comprising a support of motion in form of an articulated parallelogram, in particular of an articulated trapeze (7), characterized by the fact that between a part of a carrying structure to which the screen is associated, and a radial arm driving revolving a transmission shaft (507) of the articulated trapeze, a linear actuator (8) is interposed formed by the drive unit according to one or more of any of the claims 1 to 11.

13. Device according to the claim 12, characterized by the fact that it is sub-divided in more segments of the screen (5) each with articulation on a part of the carrying structure with a trapeze or other articulated quadrilateral (7) and to which is connected its own drive unit (8).

14. Screen according to the claims 12 or 13, characterized by the fact that it comprises a transversal section in shape of a inverted L, the two parts being removable from each other.

15. Screen according to one or more of the preceding claims 12 to 14, characterized by the fact that the drive motion of the movement of the screen (5) of protection is transmitted by the shaft (507) of the articulated quadrilateral (7) coinciding with the lower axis of articulation of the stationary support structure of the cover.

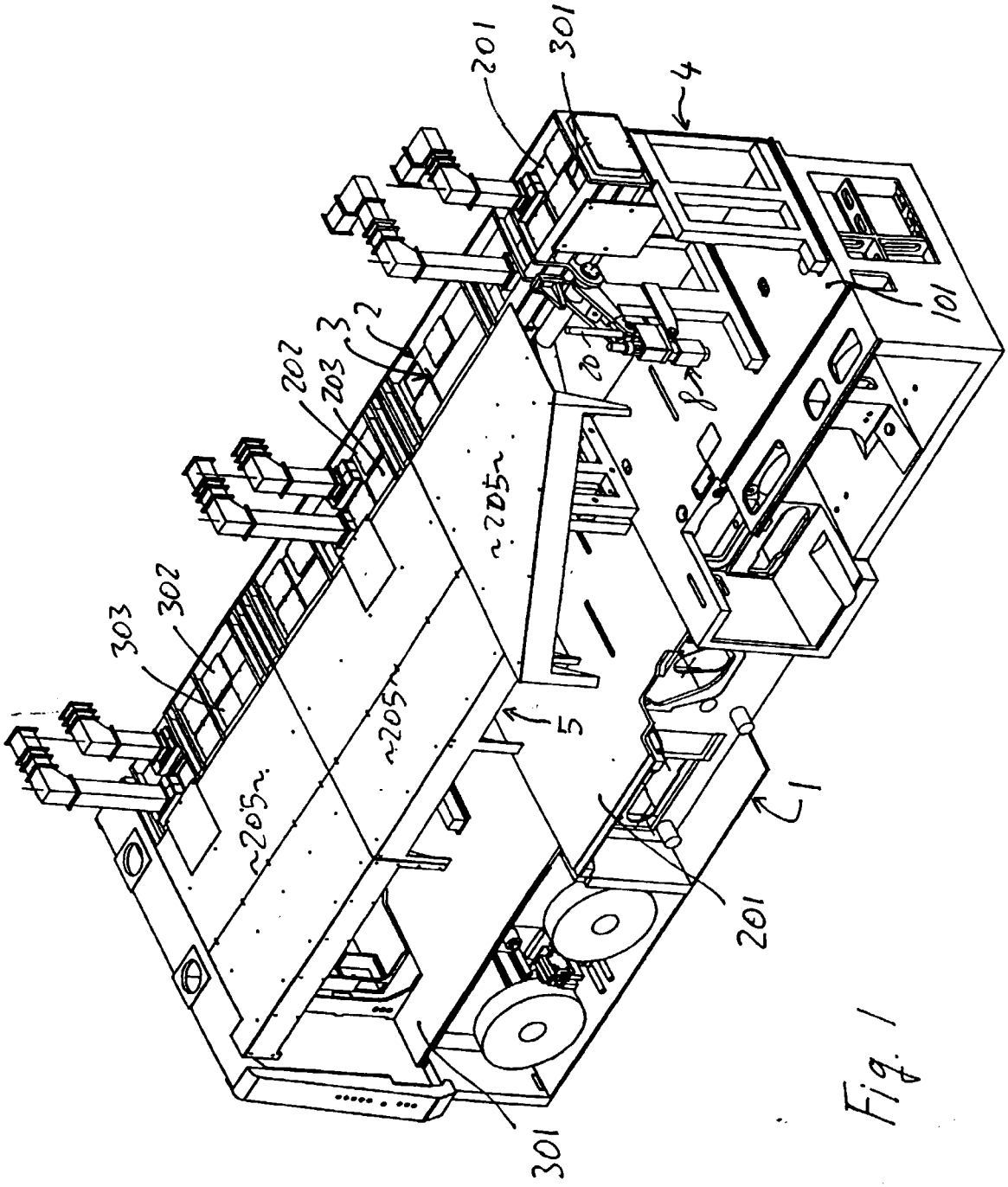

Fig. 1

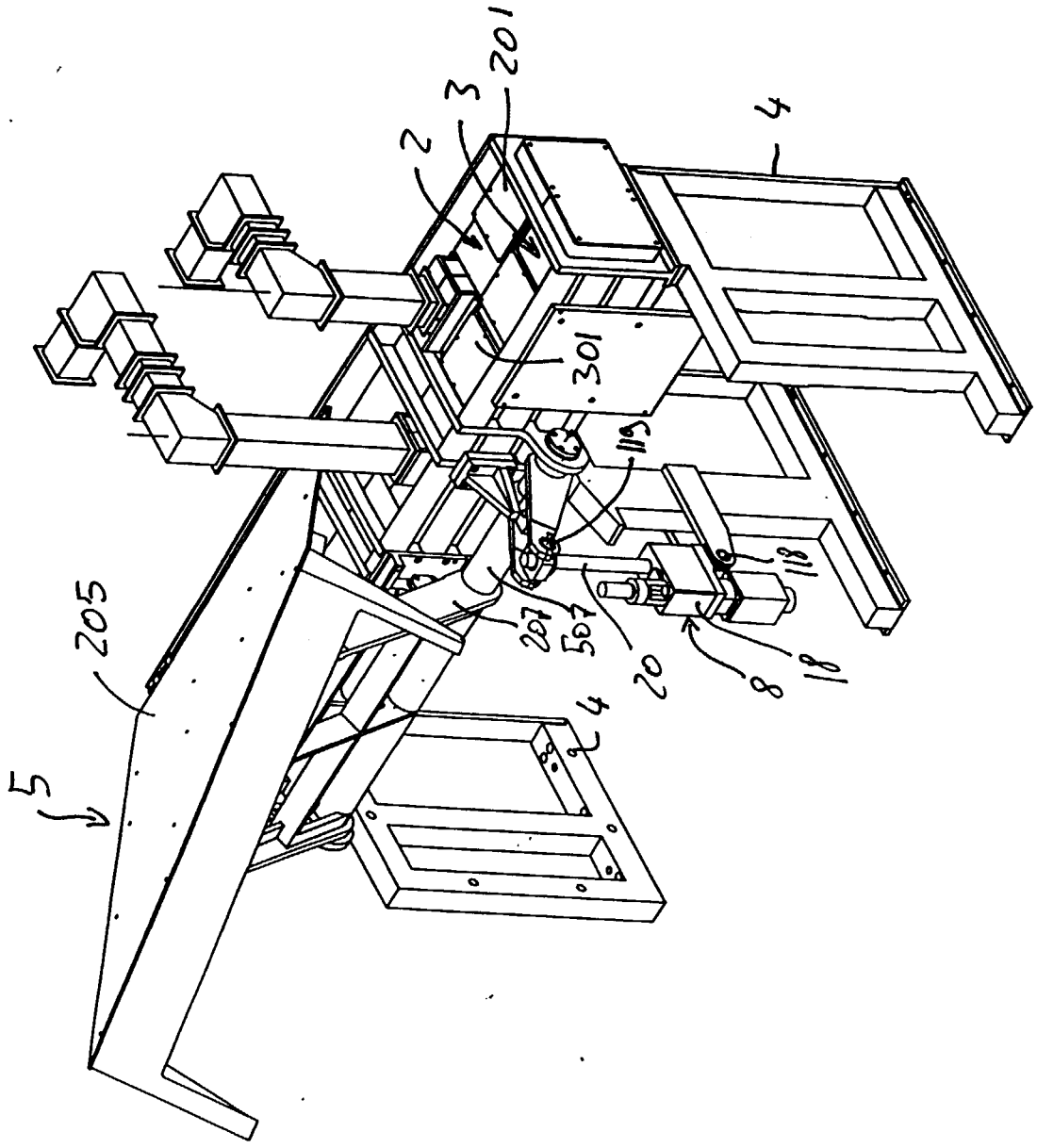

Fig. 2

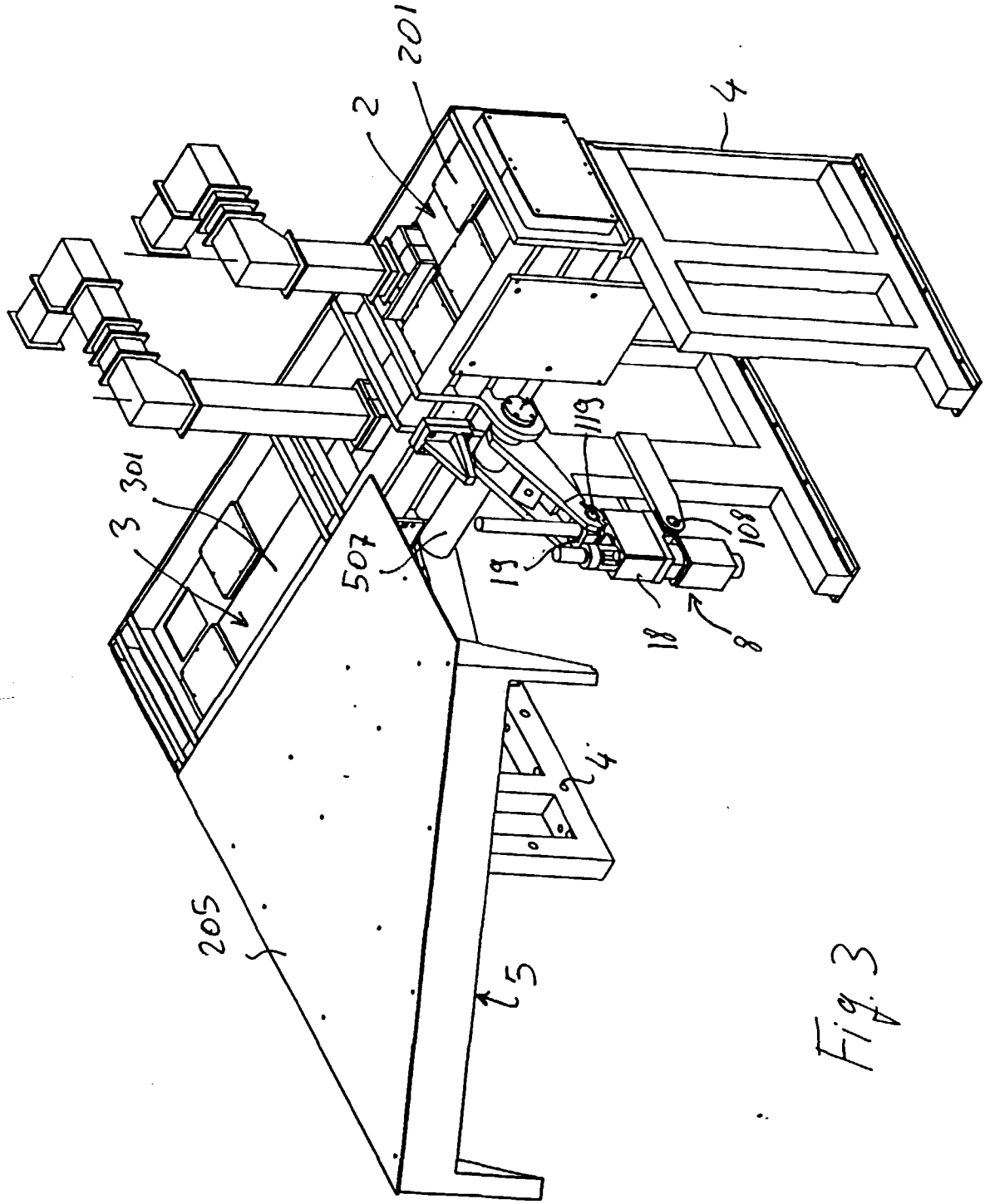

Fig. 3

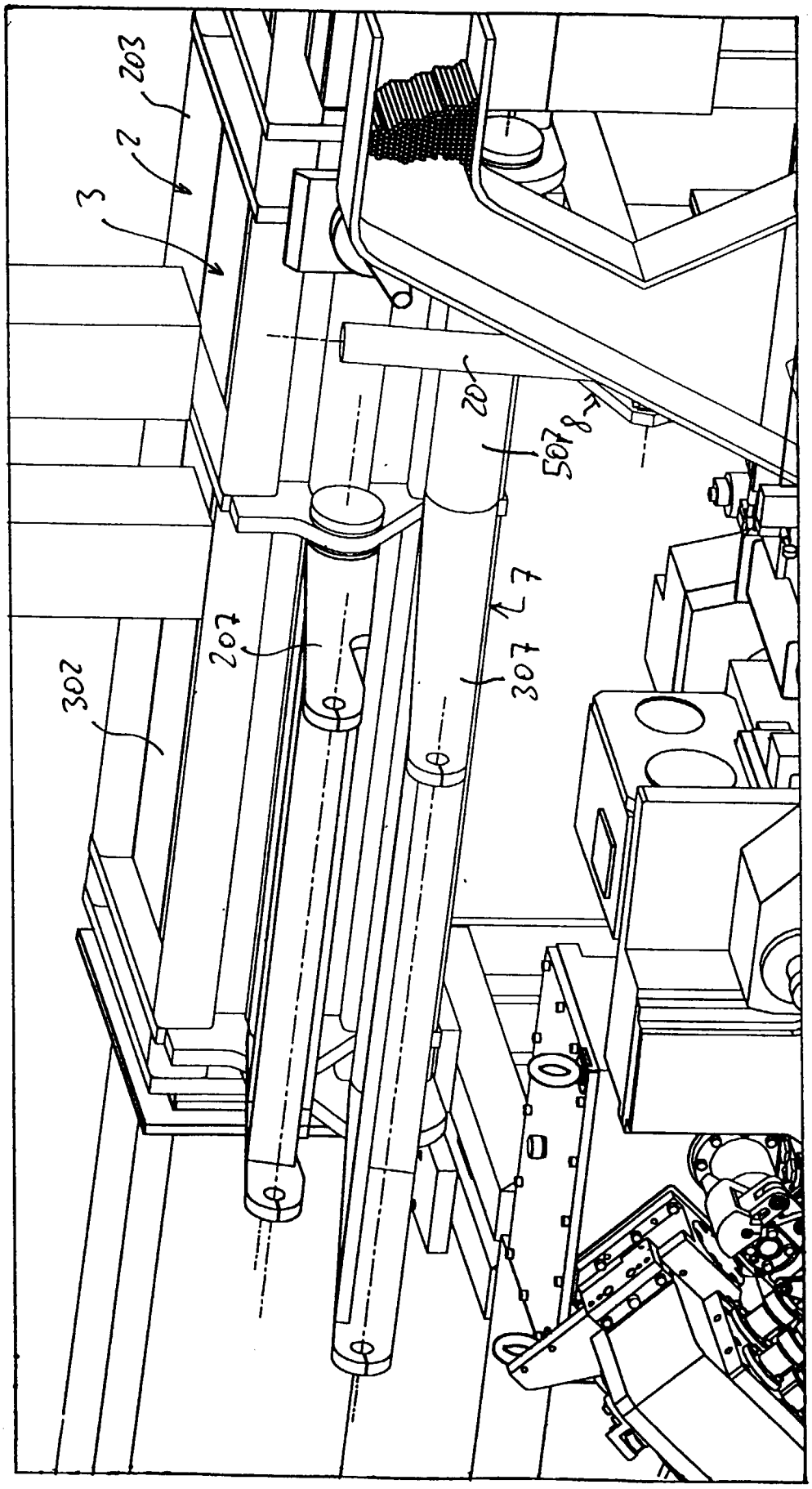

FIG. 4

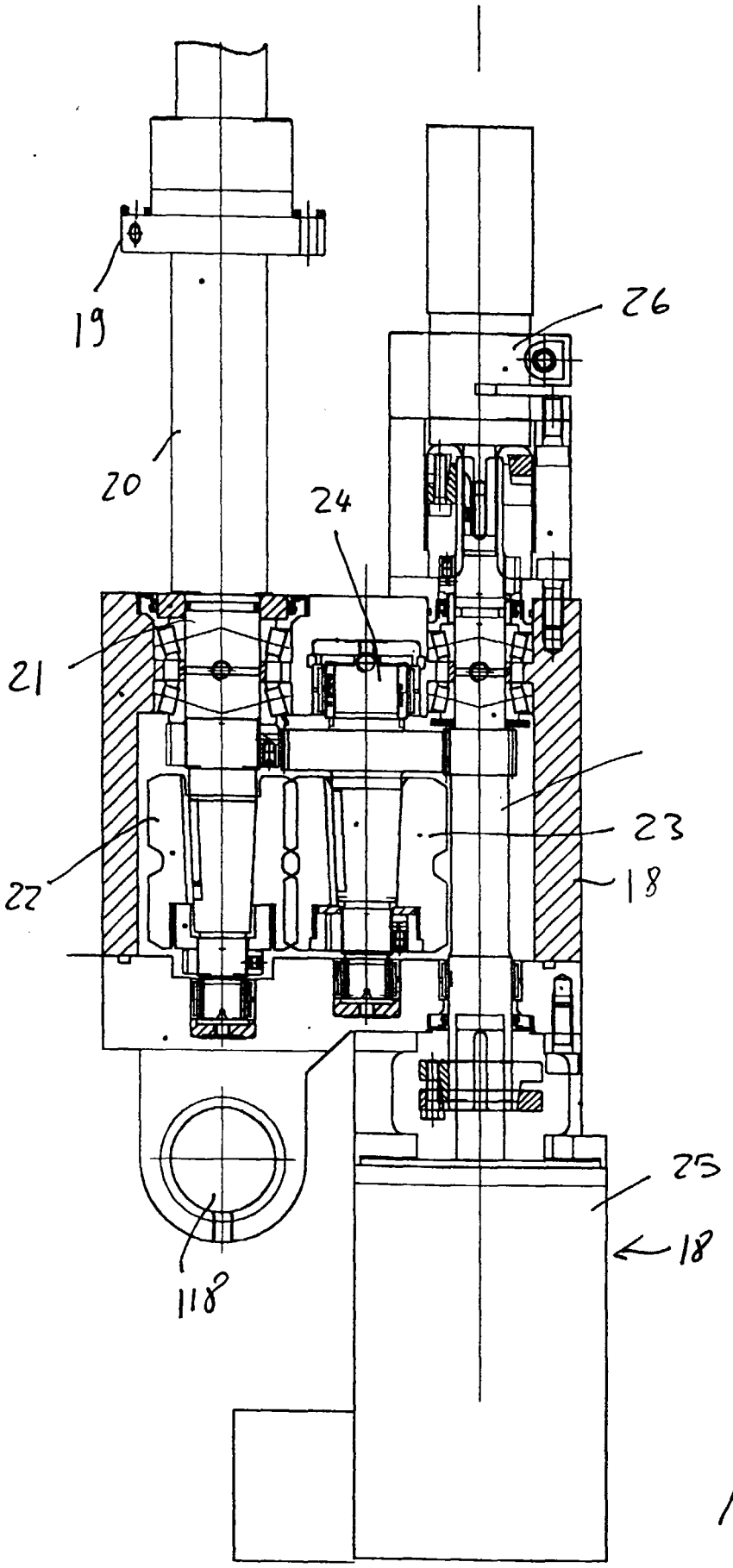

Fig. 5

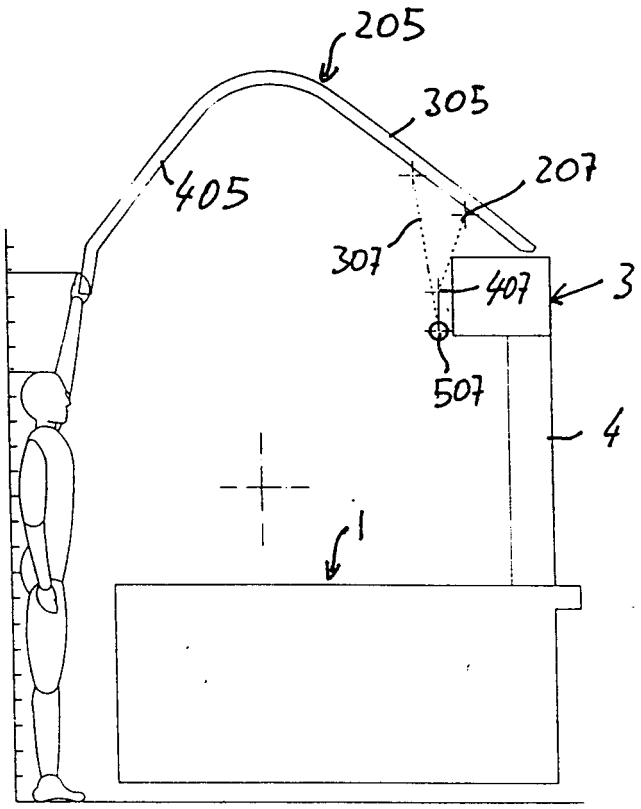

Fig. 7

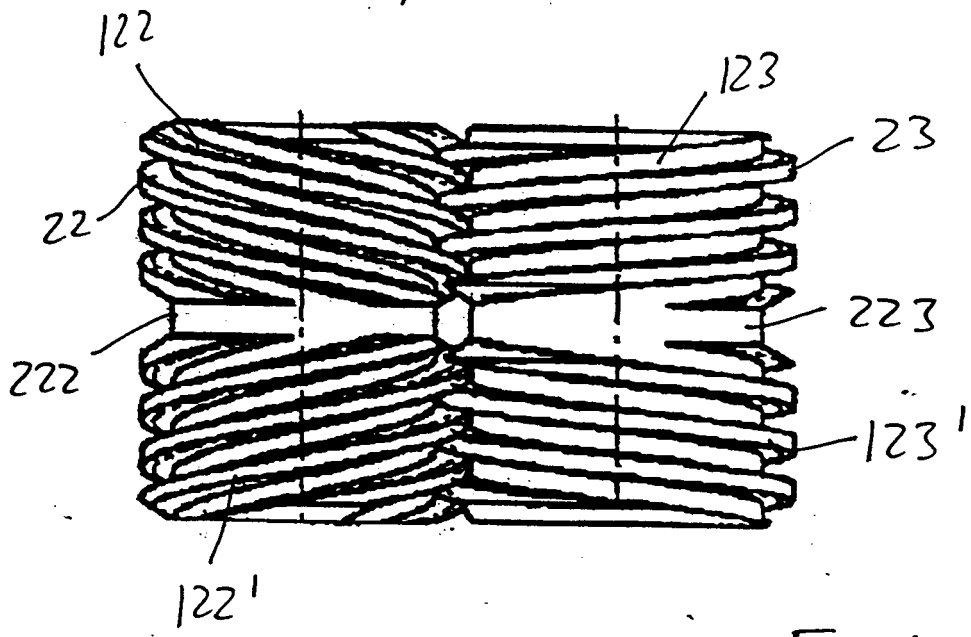

Fig. 6

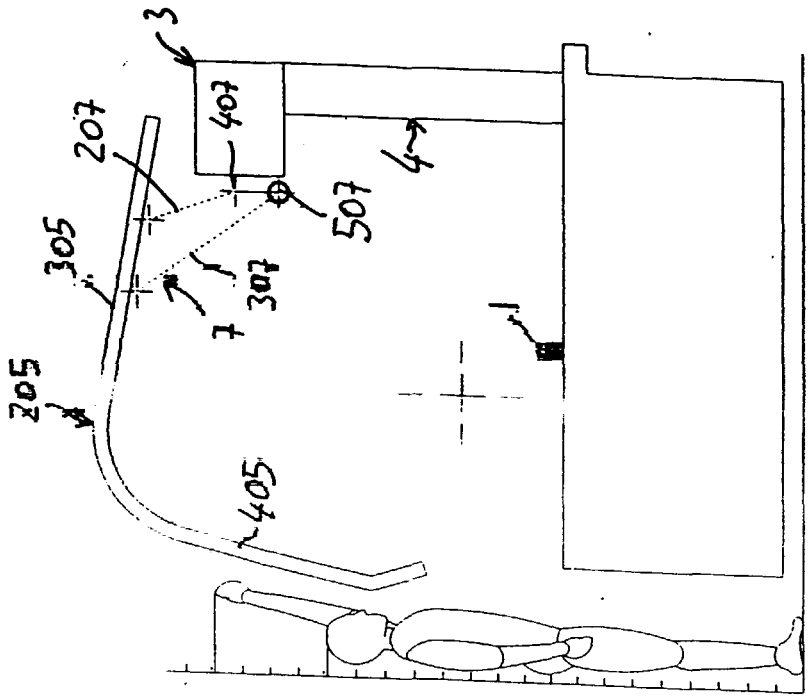
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Fig. 8

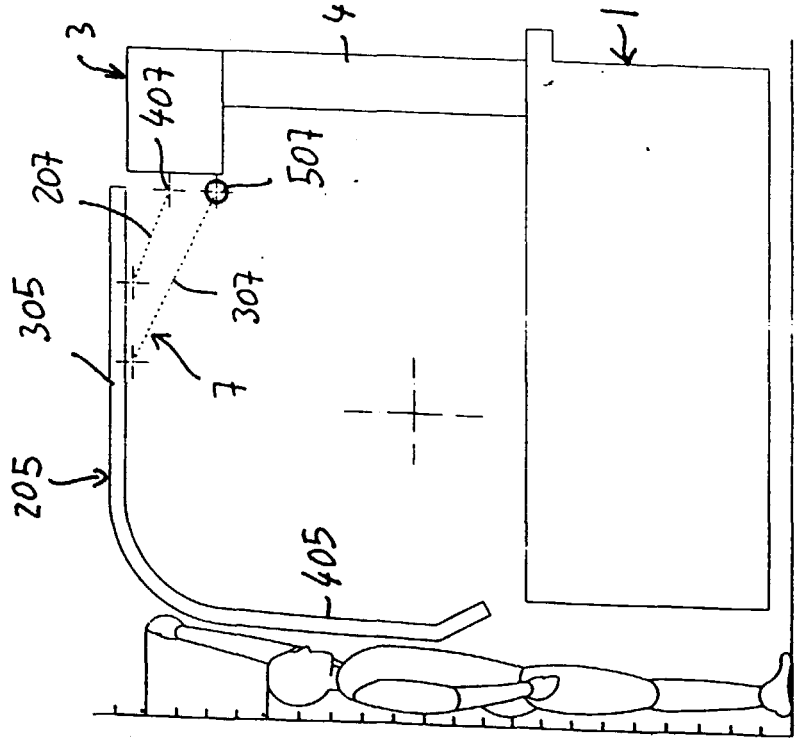
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Fig. 9

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 99 12 0332

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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TECHNICAL FIELDS SEARCHED (Int.Cl.7)

B65B
F16P
F16H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	12 January 2000	Claeys, H

CATEGORY OF CITED DOCUMENTS

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 99 12 0332

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