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(54) Apparatus for lifting and moving objects

(57) Apparatus (10) for lifting and moving an object, comprising a lifting member (18) provided with at least a cable (19) to support the object, and associated with translation means able to move the lifting member (18) horizontally together with the cable (19); in the apparatus a command device is provided for commanding the translation means (11-14, 16-17) which comprises a plurality of contact elements (25) disposed, angularly off-set, around a substantially vertical segment of the cable (19) and associated with corresponding load cells (27) able to detect the thrust of the cable (19) on the contact elements (25) following an external impulse determined by the inclination and thrust of the cable (19) in a set direction caused by an operator; the load cells (27) are able to generate an electric signal to drive the translation means (11-14, 16-17) according to the thrust detected by the load cells (27), to determine a horizontal displacement of the lifting member (18) and of the cable (19) in the set direction.

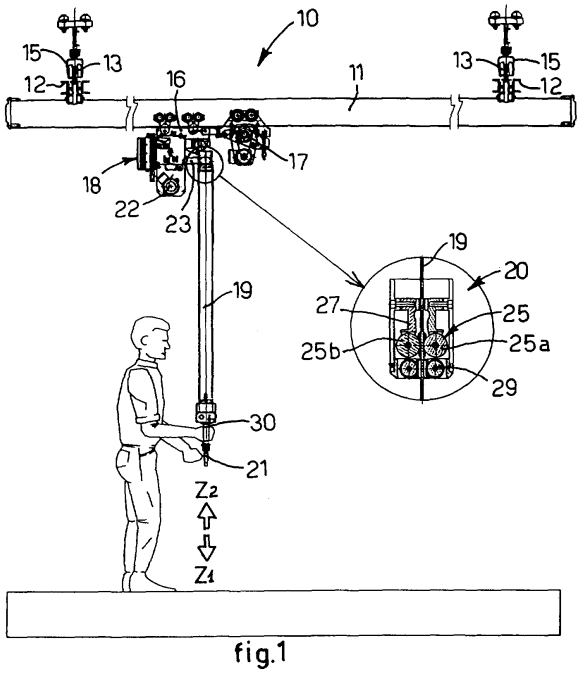

fig.1

EP 1 666 400 A2

Description

FIELD OF THE INVENTION

[0001] The present invention concerns an apparatus for lifting and moving objects, comprising a girder, of the type mobile on relative guides, of the fixed type, or pivoted, along which girder a slider is mounted, able to slide and equipped with a cable-type lifting member, such as a hoist or suchlike.

BACKGROUND OF THE INVENTION

[0002] Apparatuses for lifting and moving objects are known, comprising a supporting girder, for example mobile on relative guides orthogonal thereto, along which girder a slider is mounted able to slide and equipped with a hoist, a winch or similar cable-type lifting member, provided at the end with a hook to constrain the objects to be moved.

[0003] The displacements of the girder and slider are generally performed by means of a push-button panel, or a remote control, able to control the relative movement members.

[0004] This known apparatus has various disadvantages, however, connected to its lack of accuracy and to its complexity in maneuvering the objects, and thus entails possible errors in positioning and the risk of accidents and injuries.

[0005] One purpose of the present invention is to achieve an apparatus for lifting and moving objects wherein the command device allows the operator to perform, with considerable accuracy and in a simple and intuitive manner, all the maneuvers needed for a correct displacement of the objects, using his hands to guide the objects, without needing to press buttons or manipulate levers.

[0006] Another purpose of the present invention is to achieve an apparatus which allows to effect the lifting and movement of objects without the inertia and friction typical of apparatuses of a traditional type, especially in the steps when movement is started or stopped.

[0007] Another purpose is to achieve an apparatus for lifting and moving objects which is safe and reliable substantially under any condition of use.

[0008] The Applicant has devised and embodied the present invention to overcome the shortcomings of the state of the art, in order to achieve the above purposes and to obtain other advantages.

SUMMARY OF THE INVENTION

[0009] The present invention is set forth and characterized essentially in the main claim, while the dependent claims describe other innovative characteristics of the invention.

[0010] The apparatus for lifting and moving objects according to the invention comprises a lifting member provided with at least a cable able to support the objects and associated with translation means able to make it move horizontally together with the cable along one or two axes, or around one or two axes.

[0011] The apparatus is also provided with a device to command the translation means, comprising a plurality of contact elements disposed, angularly off-set, around a substantially vertical segment of the cable and associated with corresponding load cells.

[0012] The load cells are able to detect the thrust exerted by the cable on the relative contact elements when the operator sets the inclination of the cable in a desired direction.

[0013] In consideration of the fact that the greater the weight of the object to be moved, the more tense the cable is, the thrust detected by the load cells, given the same force exerted by the operator, is proportional to the weight of said object.

[0014] According to the thrust detected, the load cells are able to generate a proportional electric signal to drive said translation means, in order to determine a horizontal displacement of the lifting member, and hence of the cable, in the direction set by the operator.

[0015] In a preferential embodiment, the translation means is able to move the lifting member horizontally in four directions, in twos opposite and orthogonal with respect to each other, and the command device comprises four contact elements disposed at 90° one from the other around the cable, so that each of them is directed in one of said directions; in this embodiment, each of the load cells is able to generate an electric signal to drive the translation means in order to determine a displacement of the lifting member in the direction in which the relative contact element is oriented.

[0016] Moreover, in the event of a simultaneous thrust of the cable on two adjacent contact elements, the load cells associated therewith determine the drive of the translation means in order to displace the lifting member in an oblique direction oriented between said two contact elements.

[0017] Advantageously, the translation means contains relative actuators able to be energized proportionally to the entity of the electric signal generated by the load cells.

[0018] In a preferential form of embodiment, the actuators consist of reversing motors able to supply a torque proportional to the electric signal generated by the load cells.

[0019] In this way, when there are heavy objects to be moved, the greater tension of the cable, which as we said translates into a greater thrust detected by the load cells, determines the delivery of a greater torque by the motors, thus allowing to obtain a rapid and prompt reaction in order to move the object and overcome the inertia of the apparatus which is greater in the start-up stages, the stopping stages and when the direction of movement is varied.

[0020] Once the inertia of the start-up stage of move-

ment has been overcome, with the object moving in a substantially constant manner, the lesser tension and hence lesser inclination of the cable detected by the load cells determines the delivery of a lesser torque by the motors, since the latter is sufficient to maintain the constant movement of the object.

[0021] According to a variant, the command device of the translation means comprises contrast means able to limit the maximum inclination of the cable by the operator, in order to prevent the cable from exerting an excessive thrust on the contact elements.

[0022] In a possible embodiment of the invention, the load cells of the command device are connected to an electronic management and control unit of the translation means, or of the relative actuator means.

[0023] Advantageously, the cable of the lifting member is associated with a handgrip by means of which the operator is able to impart to the cable the desired inclination and thrust in order to drive the translation means.

[0024] According to a variant, the handgrip can comprise presence or proximity sensor means, able to enable the drive of the translation means and the lifting member, and command means for the lifting member itself.

[0025] In a preferential form of embodiment, the command means of the lifting member comprises at least a load cell able to detect the axial stresses imparted by the operator to the handgrip and to supply a mating electric signal to drive said lifting member for the selective vertical movement, upwards or downwards, of the cable.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026] These and other characteristics of the present invention will become apparent from the following description of a preferential form of embodiment, given as a non-restrictive example with reference to the attached drawings wherein:

- fig. 1 is a front view of an apparatus for lifting and moving objects according to the present invention;
- fig. 2 shows a plane view of the apparatus in fig. 1;
- fig. 3 shows a three-dimensional view from above of the command device of the apparatus in fig. 1;
- fig. 4 is a three-dimensional view from below of the command device in fig. 3;
- fig. 5 is an elevation view of the command device in fig. 3;
- fig. 6 shows the section from VI to VI of fig. 5;
- fig. 7 shows the section from VII to VII of fig. 5;
- fig. 8 shows the section from VIII to VIIII of fig. 5;
- fig. 9 is a three-dimensional view of a component of the command device in fig. 3;
- fig. 10 is a lateral view of the component in fig. 9;
- fig. 11 shows a variant of the apparatus in fig. 1;
- fig. 12 is a schematic lateral view of the command device in fig. 3 while functioning;
- figs. 13, 14 and 15 show a view from above of three different conditions of use of the command device in fig. 3.

DETAILED DESCRIPTION OF A PREFERENTIAL FORM OF EMBODIMENT

[0027] With reference to the attached figures, the number 10 denotes the apparatus for lifting and moving objects according to the present invention.

[0028] The apparatus 10 comprises a girder 11 associated with two bars 12, each of which is provided with pairs of wheels 13 able to slide along relative rails or runways 15, orthogonal to the girder 11.

[0029] On each bar 12 a motor 14 is mounted, of the reversing type, able to make the wheels 13 rotate in two directions.

[0030] On the girder 11 a slider 16 is mounted, provided on board with a reversing motor 17 by means of which it is able to be moved in two directions along the girder 11.

[0031] The slider 16 is equipped with a lifting member 18, for example a hoist, a winch or suchlike, provided with a cable 19 including at the end a hook 21 to constrain the objects to be moved.

[0032] The lifting member 18 is equipped with a relative motor 22, of the reversing type, by means of which the cable 19 can be selectively wound around a drum.

[0033] A device 20 to command the motors 14 and 17 is associated with the slider 16 by means of a bracket 23, and is able to be managed by the operator by means of the cable 19.

[0034] To be more exact, the command device 20 is connected to an electronic management and control unit, not shown here, able to selectively drive the motors 14, 17 in order to displace the girder 11 along the rails 15 and the slider 16 along the same girder 11, thus achieving the horizontal movement of the lifting member 18, and hence of the objects constrained to the cable 19.

[0035] The command device 20 comprises a containing body 24, through which the cable 19 passes axially, and inside which four wheels 25 are mounted, disposed angled by 90° one with respect to the other (figs. 6 and 8).

[0036] To be more exact, a first wheel 25a and a second wheel 25b, aligned with each other, are disposed parallel to the girder 11, while a third wheel 25c and a fourth wheel 25d are disposed aligned with each other and parallel to the rails 15.

[0037] The wheels 25 are disposed around and in a position close to the cable 19, so as to define for the latter a transit seating 28 with a section slightly greater than that of the cable 19 itself.

[0038] In normal conditions, that is, when it is disposed substantially vertical, the cable 19 does not contact any of the wheels 25 whereas, if inclined with respect to the vertical, it contacts one or more wheels 25.

[0039] The pins or shafts 26 of the wheels 25, orthogonal with respect to the cable 19, are mounted on the fork-like end 27a (figs. 9 and 10) of respective load cells 27 fixed inside the containing body 24.

[0040] Each load cell 27 is able to detect the force

transmitted by the cable 19, disposed in an inclined position, to the relative wheel 25 and to send an electric output signal proportional to said force to the management and control unit of the motors 14 and 17.

[0041] To be more exact, the load cell 27 of the first wheel 25a is able to transmit to the management and control unit an electric signal to drive the motor 17, to determine the displacement of the slider 16 in a direction X_1 along the girder 11, while the load cell 27 of the second wheel 25b is able to transmit to the management and control unit a signal to drive the motor 17 to determine the displacement of the slider 16 in a direction X_2, opposite direction X_1 (figs. 2 and 13).

[0042] The load cells 27 of the third wheel 25c and of the fourth wheel 25d on the contrary are able to transmit to the management and control unit a signal to drive the motors 14 in order to displace the girder 11 along the rails 15 respectively in a direction Y_1 and in a direction Y_{21} opposite each other (figs. 2 and 14).

[0043] According to the invention, the management and control unit of the motors 14 and 17 is able to vary the torque of the latter in relation to the entity of the signal received from the load cells 27.

[0044] Under the wheels 25 there are an equal number of rollers 29, also disposed at 90° from each other around the cable 19, but more detached from it with respect to the wheels 25.

[0045] The rollers 29 function as contrast and safety elements, in order to limit the possibility of oscillation of the cable 19 and to define an angle α of maximum inclination thereof which limits the entity of the forces acting on the wheels 25, and hence of the outlet signal transmitted by the cell loads 27.

[0046] At the lower end of the cable 19 there is a handgrip 30 by means of which the operator can displace the cable 19 in order to manage the command device 20, as will be explained hereafter (fig. 1).

[0047] The handgrip 30 is advantageously provided with a photocell device able to selectively activate, only when it detects the operator's hand, the management and control unit of the motors 14 and 17, thus guaranteeing that any accidental starting of the motors 14 and 17 is impossible.

[0048] According to a variant, instead of the photocell device, there are sensors of other types, that is, levers, pressure commands or suchlike.

[0049] Advantageously, the handgrip 30 is associated with a load cell able to detect the vertical thrust, upwards or downwards, exerted by the operator on it, and to transmit a mating electric signal to the motor 22 of the lifting member 18 in order to determine respectively the winding or unwinding of the cable 19.

[0050] In this way, the torque supplied by the motor 22 is modulated according to the entity of the electric signal transmitted by the load cell.

[0051] According to a variant, shown in fig. 11, the handgrip 30 is off-center with respect to the cable 19 and is fixed to an extension arm 31 associated with the lower end of the cable 19.

[0052] This allows a better maneuverability of the cable 19 by the operator in the presence of bulky objects to be moved.

[0053] The motors 14 and 17 are advantageously associated with displacement transducers, for example of the encoder type, able to emit a mating signal in order to stop the motors 14 and 17 when the girder 11 and the slider 16 have reached pre-defined end-of-travel points.

[0054] In this way a safe operating area is delimited for the movement apparatus 10, inside which the horizontal displacement of the lifting member 18 can take place.

[0055] According to a variant, instead of the displacement transducers, other sensor means can be provided, for example photocells or suchlike.

[0056] The apparatus according to the invention functions as follows.

[0057] Once the object to be moved has been identified, the operator takes hold of the handgrip 30, determining the activation of the management and control unit of the motors 14 and 17; then he exerts a slight horizontal pulling or pushing action on the handgrip 30, in the direction of the object to be moved.

[0058] In this way the cable 19 is inclined with respect to the vertical and comes into contact with one or more wheels 25, exerting thereon a thrust which is detected by the relative load cells 27.

[0059] The specific load cells 27 which are involved transmit the relative signal to the management and control unit, which determines the drive of the corresponding motor 14 and/or 17 and hence the translation of the girder 11 with respect to the rails 15 and/or the slider 16 along the girder 11 in a direction concordant with the action of pulling/pushing exerted by the operator, until the hook 21 is taken above the object to be moved.

[0060] If a movement of the lifting member 18 is to be made diagonally, for example in the direction "W_1", the operator pushes the cable 19 in said direction, so that it contacts both the first wheel 25a and also the third wheel 25c, simultaneously determining the drive of the motor 17, in order to translate the slider 16 in the direction "X_1", and the drive of the motors 14 in order to displace the girder 11 in the direction "Y_1" (figs. 2 and 15).

[0061] Once the hook 21 is above the object to be displaced, the operator pulls the handgrip 30 downwards, that is, in direction Z_1 (fig. 1) so as to load the associated load cell and determine the drive of the motor 22 in order to unwind the cable 19 and allow the hook 21 to be constrained to the object.

[0062] Subsequently, the operator exerts on the handgrip 30 a thrust upwards which, detected by the associated load cell, determines a re-winding of the cable 19 in order to lift the object.

[0063] Then, keeping his hand on the handgrip 30, the operator pushes the cable 19 in the direction in which the object is to be moved, so that the load cells 27 involved transmit a relative signal to the management and

control unit of the motors 14 and 17, determining a mating movement of the girder 11 and/or of the slider 16 in order to displace the object itself.

[0064] Obviously, during the whole operation of moving the object, the push/pull action exerted by the operator on the handgrip 30 can occur in such a manner as to determine simultaneously a displacement of the cable 19 both in horizontal directions (X_1, X_2, Y_1, Y_2, W_1...) and also in vertical directions (Z_1, Z_2).

[0065] According to a characteristic feature of the present invention, in this step the management and control unit determines the activation of the motors 14 and/or 17 with a torque proportional to the intensity of the signal received from the relative load cells 27, which signal is proportional to the weight of the object, thus allowing to perform the displacement of the latter at a speed that is always adequate.

[0066] In this way the energy consumption of the apparatus 10 is also limited in relation to the objects to be moved.

[0067] In this step the presence of the rollers 29 prevents an excessive stress of the load cells 27, allowing to keep them functionally integral and at the same time preventing too brusque movements, for example by the application of an excessive force by the operator when the objects are of limited weight.

[0068] The displacement of the object continues until, by means of the handgrip 30, the operator exerts the push/pull action on the cable 19.

[0069] Once the point where the object is to be located has been reached, the operator returns the cable 19 to the vertical position, detaching it from the wheels 25. In this condition, the load cells 27, no longer stressed, interrupt the sending of their signal to the management and control unit of the motors 14 and 17, thus causing them to stop.

[0070] At this point, if the object to be moved is on a higher plane than the place where it is to be located, the operator can unwind the cable 19 by pulling the handgrip 30 downwards, in order to deposit the object in its seating.

[0071] The invention therefore allows to carry out the displacement of objects, even heavy and bulky, with a minimum force effort on the part of the operator. By keeping his hand on the handgrip 30, he only has to impart to the cable 19 the direction of displacement desired, and is assisted in his movements by a mating and adequate functioning, in terms of direction of rotation and torque supplied, of the motors 14, 17 and 22, thus guaranteeing optimum operating conditions always, and adequate for the weight of the objects to be moved.

[0072] It is clear, however, that modifications and/or additions of parts may be made to the apparatus for lifting and moving objects 10 as described heretofore, without departing from the field and scope of the present invention.

[0073] For example, instead of the wheels 25 or the rollers 29, other functionally similar elements could be provided.

[0074] Or the activation of the motor 22 of the lifting member can occur in a different way, for example by means of suitable buttons provided on the handgrip 30.

[0075] It is also clear that, although the present invention has been described with reference to specific examples, a person of skill in the art shall certainly be able to achieve many other equivalent forms of apparatus for lifting and moving objects, having the characteristics as set forth in the claims and hence all coming within the field of protection defined thereby.

Claims

1. Apparatus for lifting and moving an object, comprising a lifting member (18) provided with at least a cable (19) able to support said object, and associated with translation means (11-14, 16-17) able to move said lifting member (18) horizontally together with said cable (19), wherein at least a command device is provided for commanding said translation means (11-14, 16-17), **characterized in that** said command device (20) comprises a plurality of contact elements (25) disposed, angularly off-set, around a substantially vertical segment of said cable (19) and associated with corresponding load cells (27) able to detect the thrust of said cable (19) on said contact elements (25) following an external impulse determined by the inclination and thrust of said cable (19) in a set direction caused by an operator, said load cells (27) being able to generate an electric signal to drive said translation means (11-14, 16-17) according to the thrust detected by said load cells (27), to determine a horizontal displacement of said lifting member (18) and of said cable (19) in said set direction.

2. Apparatus as in claim 1, wherein said translation means (11-14, 16-17) is able to move said lifting member (18) horizontally, in four directions (X_1, X_2, Y_1, Y_2) in twos opposite and orthogonal with respect to each other, **characterized in that** there are four of said contact elements (25) disposed around said cable (19) at 90° one from the other, so that each of said contact elements (25) is oriented in one of said directions (X_1, X_2, Y_1, Y_2), and **in that** each of said load cells (27) is able to generate an electric signal to drive said translation means (11-14, 16-17), to determine a displacement of said lifting member (18) and of said cable (19) in the direction in which the relative contact element (25a, 25b, 25c, 25d) is oriented.

3. Apparatus as in claim 2, wherein said translation means (11-14, 16-17) comprises at least a first group (16-17) able to move said lifting member (18) horizontally in a first direction (X_1) and a second direction (X_2) opposite each other, and a second group

(11-14) able to move said lifting member (18) in a third direction (Y_1) and a fourth direction (Y_2) opposite each other and orthogonal to said first direction (X_1) and second direction (X_2), **characterized in that** the thrust of said cable (19) on a first contact element (25a) and on a second contact element (25b), opposite each other, is able to determine the drive of said first group (16-17) to move said lifting member (18) respectively in said first direction (X_1) and in said second direction (X_2), while the thrust of said cable (19) on a third contact element (25c) and on a fourth contact element (25d), opposite each other, is able to determine the drive of said second group (11-14) to move said lifting member (18) respectively in said third direction (Y_1) and in said fourth direction (Y_2), and **in that** the simultaneous thrust of said cable (19) on two of said contact elements (25), adjacent to each other, is able to determine the simultaneous drive of said first group (16-17) and of said second group (11-14) to move said lifting member (18) in an oblique direction (W_1) oriented between said two contact elements (25).

4. Apparatus as in any claim hereinbefore, wherein said translation means (11-14, 16-17) comprises relative actuator means (14, 17), **characterized in that** said load cells (27) are able to generate an electric signal of an entity proportional to the thrust detected, and **in that** said actuator means (14, 17) is able to be energized in proportion to said electric signal.

5. Apparatus as in claim 4, wherein said actuators (14, 17) comprise at least a first motor, **characterized in that** said first motor is able to supply a torque proportional to the electric signal generated by said load cells (27).

6. Apparatus as in any claim hereinbefore, **characterized in that** each of said contact elements (25) comprises a wheel having a shaft (26) disposed orthogonal to the vertical segment of said cable (19) and constrained to the end of a relative load cell (27).

7. Apparatus as in any claim hereinbefore, **characterized in that** said load cells (27) are connected to an electronic control unit for said translation means (11-14, 16-17).

8. Apparatus as in any claim hereinbefore, **characterized in that** said command device (20) comprises contrast means (29) able to limit the maximum inclination of said cable (19) to a defined angle (α), in order to prevent said cable (19) from exerting an excessive thrust on said contact elements (25).

9. Apparatus as in claim 8, **characterized in that** said contrast means comprises a plurality of rollers (29) disposed below said contact elements (25) on which said cable (19) is able to be disposed in abutment.

10. Apparatus as in claim 9, **characterized in that** said rollers (29) are disposed at a greater distance from the vertical segment of said cable (19) with respect to said contact elements (25).

11. Apparatus as in any claim hereinbefore, **characterized in that** it comprises at least a handgrip (30) by means of which said operator is able to impart the inclination to said cable (19).

12. Apparatus as in claim 11, **characterized in that** said handgrip (30) comprises presence sensor means, or proximity sensor means, able to enable the drive of at least said translation means (11-14, 16-17).

13. Apparatus as in claim 11 or 12, wherein said handgrip comprises further command means for said lifting member (18), **characterized in that** said further command means comprises at least a further load cell able to detect the axial stresses imparted to said cable (19) by said operator and to supply a mating electric signal to drive said lifting member (18) for selective vertical movement, upwards or downwards, of said cable (19).

14. Apparatus as in claim 13, wherein said lifting member comprises at least a second motor (22) able to rotate a drum for winding/unwinding said cable (19), **characterized in that** said second motor (22) is able to supply a torque proportional to the entity of the electric signal supplied by said further load cell.

15. Apparatus as in any claim from 11 to 14, **characterized in that** said handgrip (30) is associated with an extension arm (31) which connects it to said cable (19).

16. Apparatus as in any claim hereinbefore, **characterized in that** said translation means (11-14, 16-17) is able to cooperate with mating end-of-travel means defining a limit area inside which said lifting member (18) is able to move horizontally.

17. Apparatus as in claim 16, wherein said translation means (11-14, 16-17) comprises relative actuator means (14, 17), **characterized in that** said end-of-travel means consists of displacement transducers associated with said actuator means (14, 17).

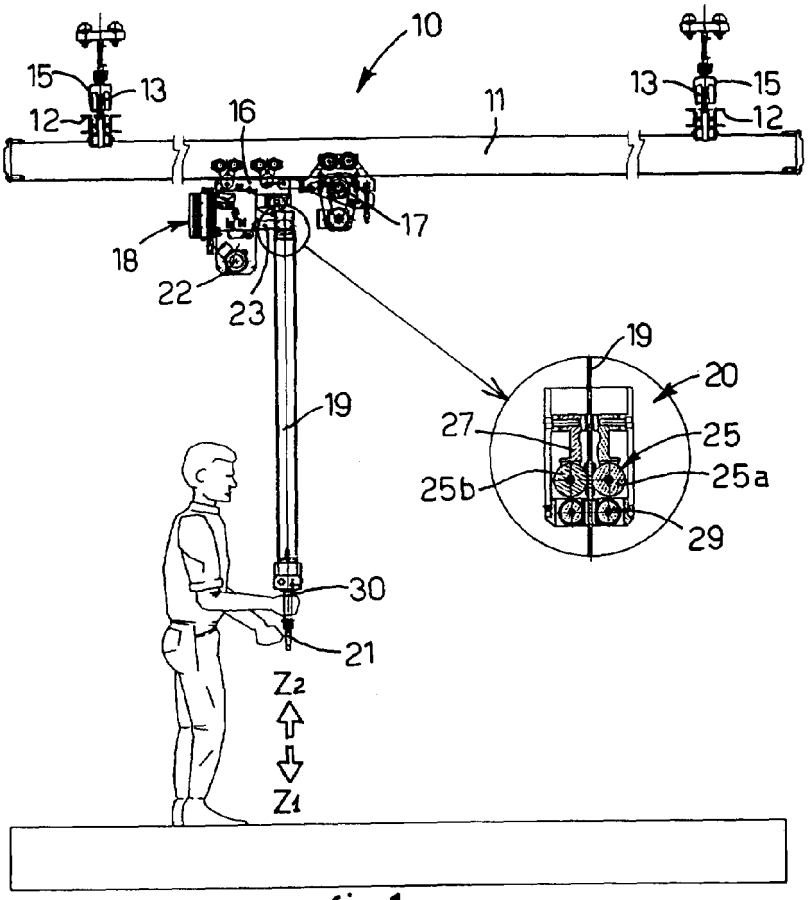
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fig.1

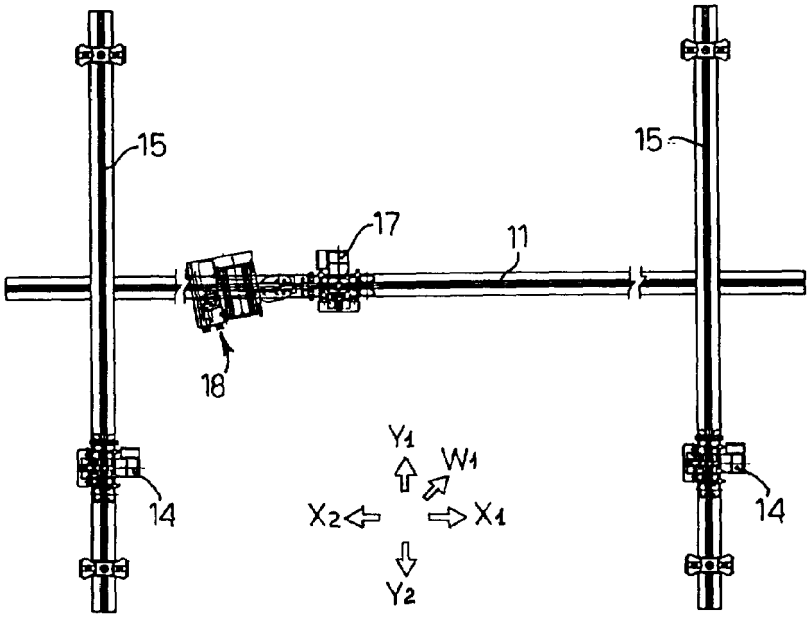
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fig. 2

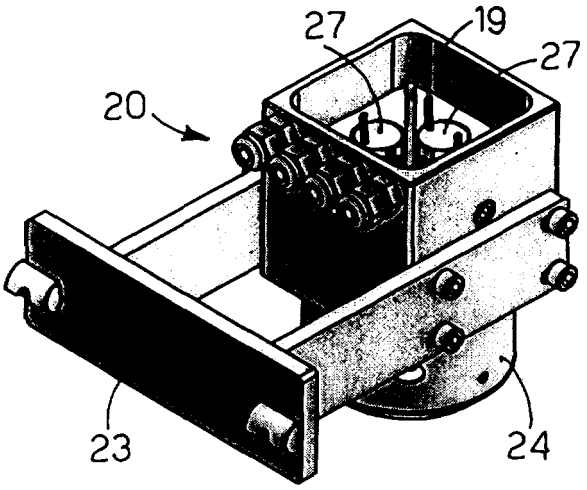

fig. 3

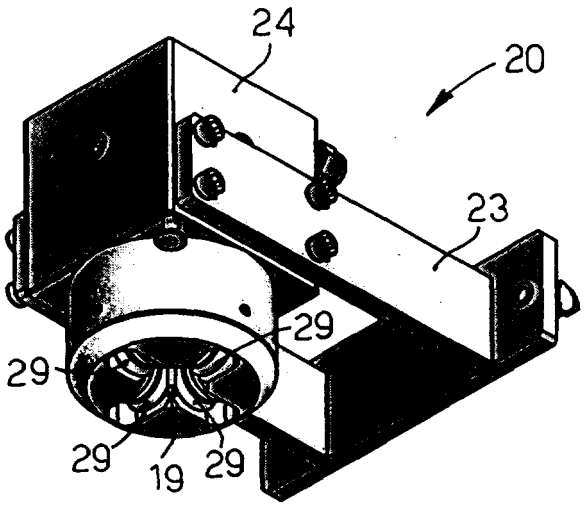

fig. 4

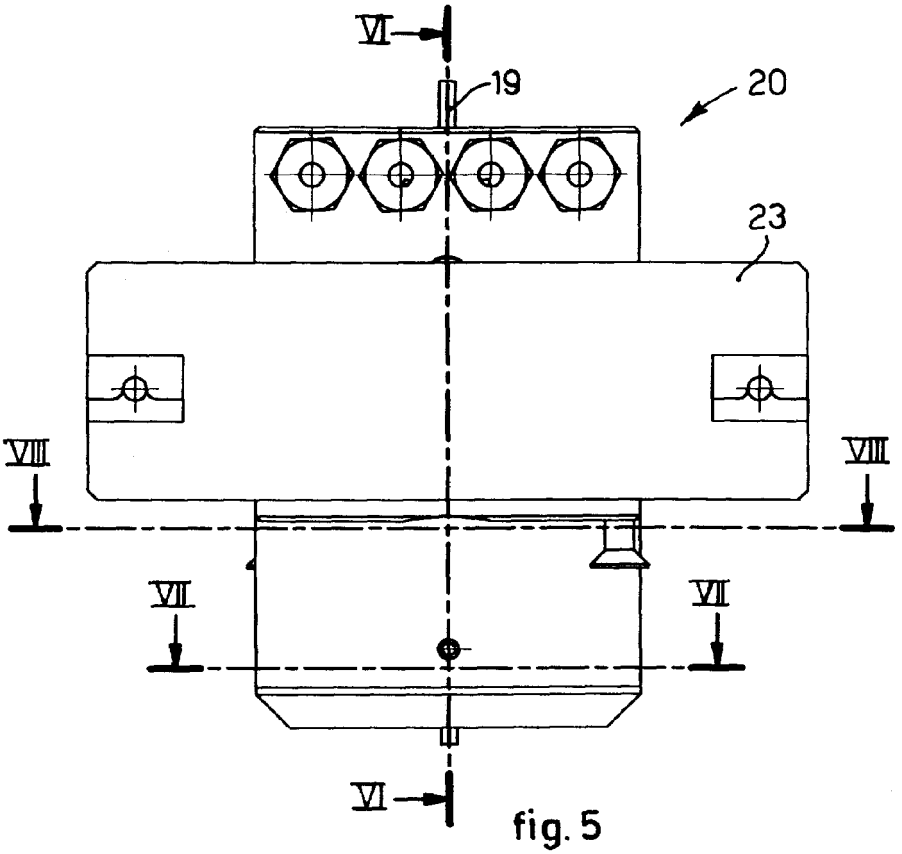
VI
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fig. 5

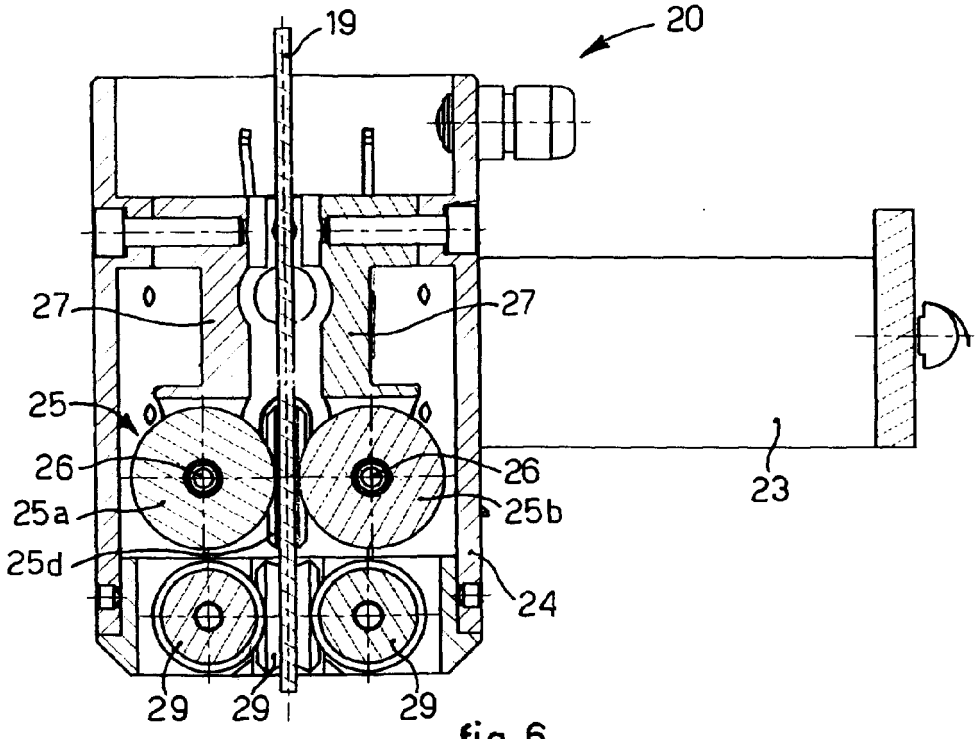
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fig. 6

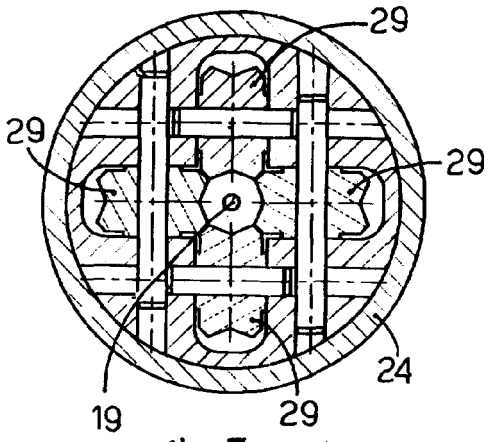

fig. 7

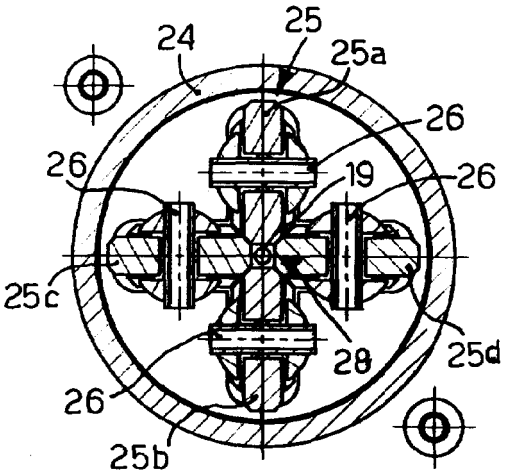

fig. 8

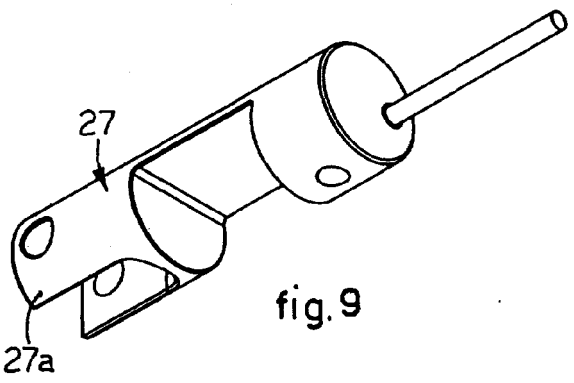

fig. 9

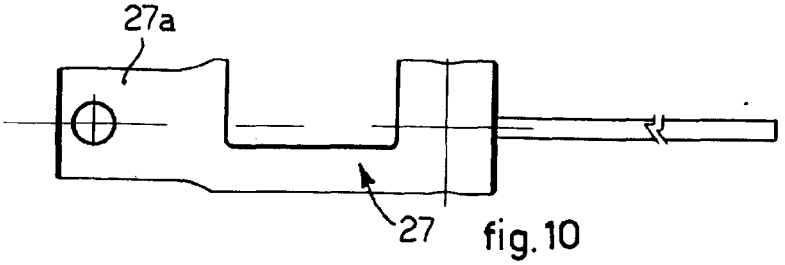

fig. 10

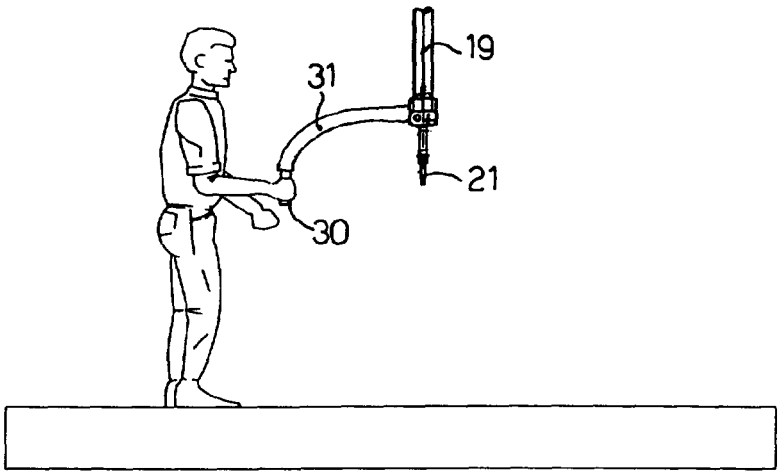

fig. 11

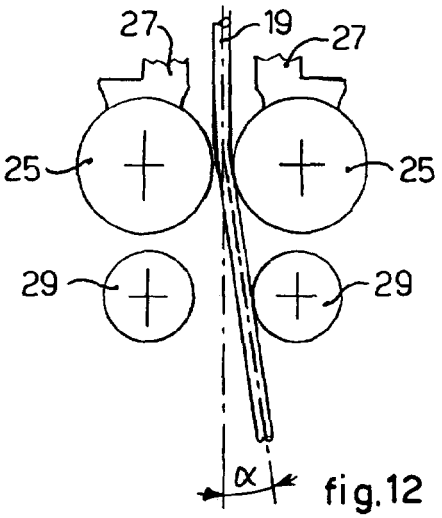

fig.12

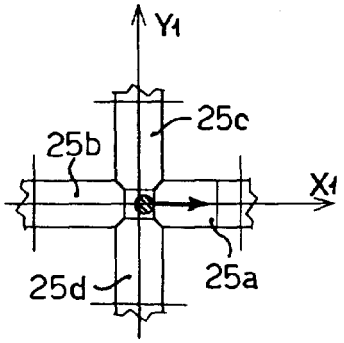

fig.13

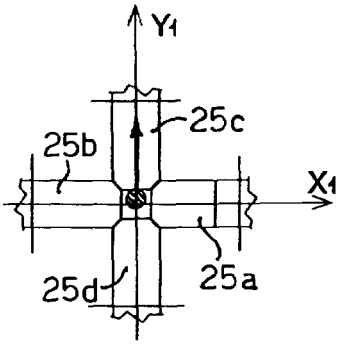

fig. 14

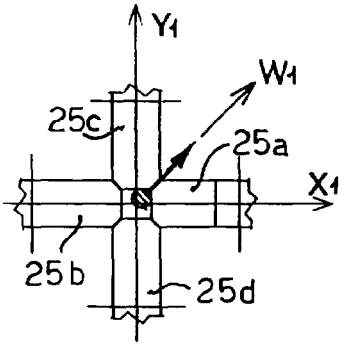

fig. 15