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(54) Crane with a winch and a traction control device

(57) The device is applied to a crane having a tower (1) to which a main boom (1a, 1b) is connected, and one or more hydraulic extendable sections (2, 3, 4, 5) moved by hydraulic actuators (2a, 3a, 4a, 5a), and a winch (10) on which a cable (11) is wound, the cable (11) having a hook (12) connected to an end. The winch (10) is solidly constrained to a frame (13) which can make small movements with respect to the crane structure. The movements are opposed by means for detecting, of known type, which generate a signal that is proportional to stresses generated on the cable (11) and which commands activation of actuators operating movements of the boom and sections of the crane.

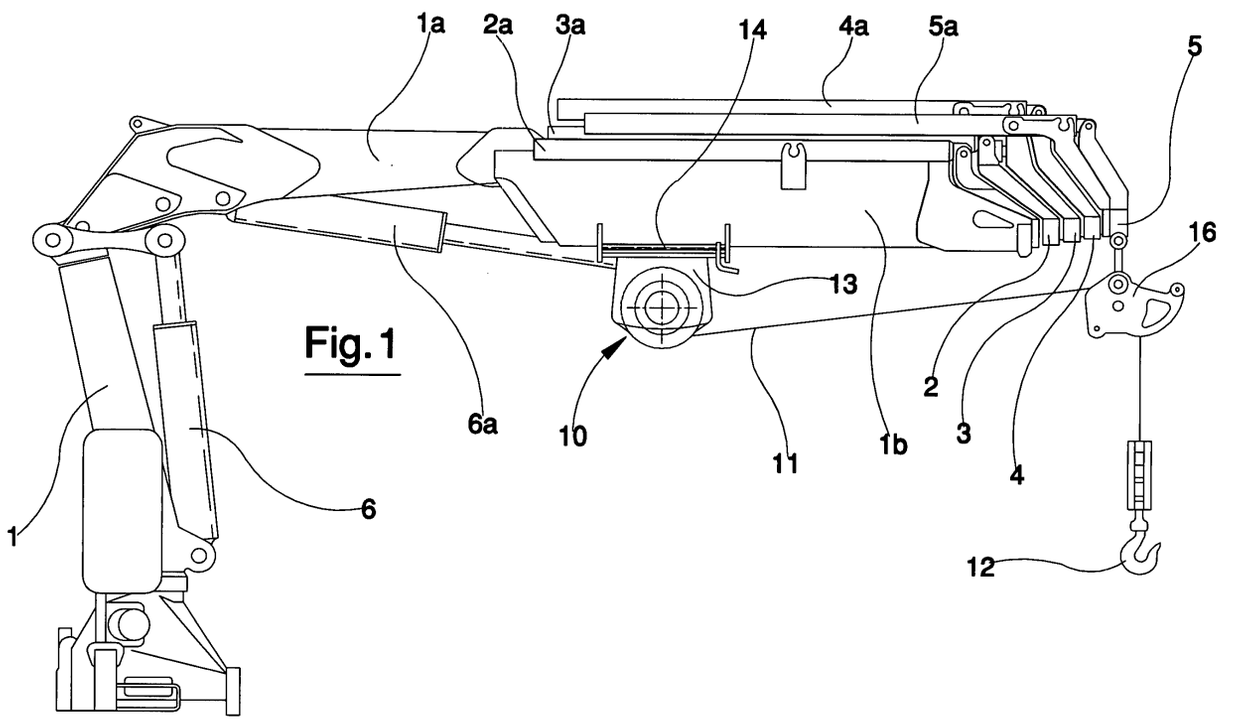


Fig. 1

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Description

[0001] The invention is usefully applicable in particular on cranes mounted on self-propelling vehicles provided with a tower to which a main boom and one or more sections which are extended and retracted by hydraulic cylinders.

[0002] These cranes are often equipped with a winch, fixed to the structure of the crane (generally to the main boom) on which a cable is wound; generally there is a hook on the end of the cable.

[0003] In case of need, a pulley is connected to the end of the final extendable section, which the cable passes into so that the hook can be used (moved by the winch via the cable) for lifting loads.

[0004] These winches are usually equipped with hydraulic cable tension limiter hydraulic systems. When the systems intervene they arrest the flow of oil causing rotation of the winch and the winding of the cable; this happens when an excessive load is lifted and the pressure limit imposed for this purpose is reached, or the rated tension of the cable is reached during its winding.

[0005] It can occur, however, that following the movement of the boom or the sections of the crane, a load is lifted which is superior to what is admitted by the cable tension rating, or an endrun impact of the hook with the winch can take place, with a consequent increase of the cable tension and a possible exceeding of the rated tension values of the cable. In these cases the hydraulic tension limiter systems on the winch do not intervene as the increase in cable tension is not caused by the movement of the winch.

[0006] To obviate this drawback strainmeters have been used to detect elastic deformation in the winch structure caused by the increase in tension in the cable (it is obviously not possible to detect with ease the deformation of the cable itself); the meters then transmit a signal which is proportional to the deformations. These systems have not however provided satisfactory results as the structures of the cranes can be elastically deformed by other stresses too, for example those arising during the movement of the sections not consequent to the tension on the cable winch; the signal the stressmeters transmit is not always proportional to the cable tension and does not provide a certain indication of the state of tension.

[0007] The main aim of the present invention is to remedy the above-cited drawbacks by providing a device which provides a signal which is certainly proportional to the tension the cable of a crane winch is subjected to.

[0008] An advantage of the present invention is that it provides a device which is economical and applicable to existing cranes.

[0009] These aims and advantages and others besides are all attained by the invention as it is characterised in the claims that follow.

[0010] Further characteristics and advantages of the present invention will better emerge from the detailed description that follows of some preferred but non-exclusive embodiments of the invention, illustrated purely by way of nonlimiting examples in the accompanying figures of the drawings, in which:

figure 1 is a schematic view in vertical elevation of a crane equipping a winch;
figure 2 is a section according to line II-II of figure 1;
figure 3 is a schematic view in vertical elevation and in enlarged scale, with some parts sectioned, of a winch with a first embodiment of the device;
figure 4 is a schematic front view of the device of figure 3;
figure 5 is a schematic view in vertical elevation and in enlarged scale, with some parts sectioned, of a winch with a second embodiment of the device;
figure 6 is a schematic view in vertical elevation and in enlarged scale, with some parts sectioned, of a winch with a fifth embodiment of the device;
figure 7 is a schematic view in vertical elevation and in enlarged scale, with some parts sectioned, of a winch with a third embodiment of the device;
figure 8 is a schematic front view, with some parts sectioned, of the device of figure 7;
figure 9 is a schematic view in vertical elevation and in enlarged scale, with some parts sectioned, of a winch with a fourth embodiment of the device;
figure 10 is a schematic front view, with some parts sectioned, of the device of figure 9.

[0011] The device of the invention is particularly applicable to cranes having a tower 1 to which one or more hydraulic sections are connected in order to enable the crane to rotate in a vertical plane. In the figures, four sections are indicated, respectively 2,3, 4 and 5. The illustrated crane also has a main boom, made in two parts 1a and 1b and supported by a first hydraulic jack 6 connected to the tower 1, to which the hydraulic sections are connected, supported by a second jack 6a. The movement in the vertical plane of the crane booms is achieved by actuating the jacks 6 and 6a, while extension of the hydraulic sections is caused by actuating the hydraulic cylinders 2a, 3a, 4a and 5a.

[0012] The crane is provided with a winch 10, connected to the main boom of the crane 8 in particular to part 1b of the main boom) on which winch 10 a cable 11 is wound, which cable 11 has a hook 12 at an end thereof.

[0013] For using the winch 10, a pulley 16 is connected to the end of the final extendible section, through which the cable 11 is made to pass so that the hook 12 can be used, by action of the winch 10 via the cable 11, and thus loads can be hoisted.

[0014] The winch 10 is provided with a hydraulic system for limiting the cable tension. This system, not illustrated and of known type, intervenes by arresting oil flow which causes the rotation of the winch 10 and the wind-

ing of the cable should, following a hoisting of an excess weight, the rated tension limit of the cable during the winding be exceeded.

[0015] The foregoing is a description of the normal prior art in the field of crane construction. The following may be applied to cranes either equipping or not a main boom, such as the crane illustrated, and a various number of hydraulic sections.

[0016] In order to safely control pulling on the cable generated not by the rotation of the winch but by the movements of the booms and the extendable sections, which control, as has been mentioned, cannot be done by only using the normal limiter systems the winch is equipped with, the winch is, for reasons which will be better explained hereinafter, fixed with a slight play to the structure of the crane. For this aim the winch 10 is solidly constrained to a frame 13 which is connected with play to guides 14 and 15, fixed to the structure of the crane. The guides 14 and 15 are fixed to the crane structure by connecting plates 40 and 41 which are shaped so that their upper shape can be easily welded to the main boom of the crane. The frame 13 comprises a support plate 45, to which the winch is fixed by front screws 60b and 60c, and back screws 60a and 60d, which engage a frame 18 arranged on the upper part of the winch 10. Two lateral plates 42 and 43 are fixed vertically to the sides of the support plate and are arranged parallel to the connecting plates 40 and 41 and are provided with holes in which the guides 14 and 15 insert.

[0017] This connection system between the winch 10 and the crane structure is normally used in known cranes and is therefore preferable. The connection with play between the winch and the crane structure could however be achieved differently.

[0018] The device comprises means for detecting, of known type, which are excited by the pulling of the cable 11 on the frame 13 and which, by opposing the movements between the frame 13 and the structure of the crane, provide a command signal which is proportional to the stresses generated following contact between the frame and the structure of the crane.

[0019] Thanks to the connection with play the frame is able to perform small movements, generally speaking of the order of a few tenths of a millimetre, generated by pulling the cable; these movements are however opposed by the means for detecting which, following opposition to the movements, generate the command signal. The connection with play has therefore the aim of making the crane not rigidly solidly constrained to the crane structure; further, in this way any eventual deformations of the crane structure due to movements of the booms or the sections (and not to the pull on the cable) do not get transferred to the winch and therefore do not generate stresses that influence the signal generated by the means for detecting.

[0020] In some embodiments of the device, the means for detecting comprise at least one load cell, of known type, which generates an electric command signal which is proportional to the compression, generated by the traction on the cable 11, to which the cell is subjected following its compression between the frame 13 and the crane structure.

[0021] In a first embodiment a load cell 20 is provided, located between the connecting plate 40 and the side plate 42 which are in a position comprised between the winch 10 and the pulley 16. In this embodiment the cell 20 opposes and stops the frame 13 from moving along the guides; in this way the pull on the cable causes a compression force between the plate 42 and the plate 40 of the load cell 20 which therefore generates a signal which is proportional to the entity of the compression.

[0022] In a second embodiment of the device, a pivot 50 is provided, arranged between the connecting plate 41 and the side plate 43 which are in an external position to the zone comprised between the winch 10 and the pulley 16 (the opposite plates to the plates 40 and 42 of the first embodiment). The pivot, fixed to the plate 43, is slidable with respect to the plate 41 and is provided with a stop 52, arranged on the external part of the plate 41, which has the function of constraining. This embodiment includes a load cell 21 arranged between the stop 52 and the plate 41.

[0023] In the second embodiment the load cell 21 opposes and prevents the frame 13 from moving along the guides. Thus the pulling of the cable causes a compression stress on the load cell 21 between the plate 41 and the stop 52, which load cell 21 thus generates a signal which is proportional to the entity of the compression force.

[0024] In a third embodiment of the invention the means for detecting can be a load cell 23 or a linear transducer 23a which are fixed to the frame 18 of the winch 10 in such a way as to be in contact with the lower part of the support plate 45; the load cell 23 or the transducer 23a are arranged between the back screws 60a and 60d.

[0025] In the third embodiment, the frame 13 can perform small movements of elastic deformation. If the cell is a load cell 23, it opposes the small movements, so that a pull of the cable causes flexion of the frame 18 and a consequent compression force on the load cell 23, located between the frame 18 and the lower part of the support plate 45, the load cell 23 then emitting a signal which is proportional to the entity of the compression force.

[0026] In cases where the linear transducer 23a is present, the transducer moves following the small movements; in this way a pull on the cable causes flexion of the frame 18 and the transducer 23a measures the change in distance between the frame 18 and the lower part of the support plate 45, thus generating a signal which is proportional to the entity of the change.

[0027] The third embodiment has been described with the load cell 23 or the linear transducer 23a arranged between the back screws 60a and 60d, but it would be possible to arrange the cell 23 or the transducer 23a be-

tween the front screws 60b and 60c; the only thing that changes is that traction stresses from the cell 23 will be measured (the transducer 23a will still measure a change in the distance, which will be however of opposite entity to the previous one).

[0028] In a fourth embodiment a pair of load cells 22a and 22b are provided, which are each inserted between the heads of the back screws 60a and 60d and the lower part of the frame 18 of the winch 10.

[0029] In the fourth embodiment the frame 18 can make small oscillating movements on the guides, so that the pull of the cable causes flexion in the frame 18 and a consequent compression, between the frame 18 and the heads of the screws 60 and 60d, of the load cells 22a and 22b, which thus generate a signal which is proportional to the entity of the compression.

[0030] In other embodiments of the device of the invention, the means for detecting comprise a traction sensor of known type which generates an electrical command signal which is proportional to the traction generated by the traction on the cable 11.

[0031] In a fifth embodiment the device comprises a dynamometer 30 which is arranged between the connecting plate 41 and the side plate 43, which are in a position which is external of the zone comprised between the winch 10 and the pulley 16. The dynamometer can be of any known type.

[0032] In the fifth embodiment of the device, the pull on the cable causes traction, between the plate 43 and the plate 41, of the dynamometer 30 which therefore generates a signal which is proportional to the entity of the traction.

[0033] The signal generated by the above-described means for detecting is used to command activation of the devices of the crane, which activate the booms or the sections. When the signal exceeds a predetermined value, the signal acts on the devices of the crane which activate the booms or the sections and stop the movement which has generated the compression or traction proportional to the signal. These command systems, as well as the devices which activate the crane, are not illustrated as they are well known by any expert in the field.

[0034] As mentioned herein above, the signal generated by the above-described means for detecting is not influenced by any eventual factors due to structural deformation not deriving from the pull on the cable 11, because the winch is not solidly constrained to the structure of the crane and thus is not influenced by the above-cited factors; it only detects those which derive from a pull on the cable 11.

[0035] The device of the invention also exhibits the considerable advantage of providing a signal which can also be used for determining the entity of the load hoisted by the winch, as the pull on the cable 11 generating the signal is proportional to the weight of the load hoisted.

Claims

1. A traction control device for a winch applied on a crane, in which the crane is of a type having a tower (1) to which a main boom (1a, 1b) is connected, and one or more hydraulic extendable sections (2, 3, 4, 5) moved by hydraulic actuators (2a, 3a, 4a, 5a), the crane also comprising: a winch (10) on which a cable (11) is wound, connected to the main boom (1a, 1b) of the crane; a pulley (16) connected to an end of a final section (5) of the hydraulic extendable sections (2,3, 4, 5), which pulley deviates a direction of the cable (11); a hook (12) connected to an end of the cable (11); **characterised in that** : the winch (10) is solidly associated to a frame (13) connected with play to a structure of the crane; **in that** it comprises means for detecting, of known type, which are activated by a pull of the cable (11) on the frame (13), which means for detecting oppose movements between the frame (13) and the crane structure and provide a command signal, which is proportional to a force generated subsequent to contact between the frame (13) and the crane structure; the command signal commanding an activation of the hydraulic actuators.

2. The device of claim 1, **characterised in that** the means for detecting comprise at least one load cell (20, 21, 22a, 22b, 23) of known type which generates an electric command signal which is proportional to a degree of compression to which the means for detecting is subject to following a compression thereof between the frame (13) and the crane structure, which compression is generated by a traction force on the cable (11).

3. The device of claim 2, **characterised in that**: the frame (13) comprises a support plate (45) to which the winch (10) is fixed, to sides of which winch (10) two side plates (42 and 43) are vertically fixed, which side plates (42 and 43) exhibit holes inserted on guides (14, 15), the guides (14, 15) being fixed to the crane structure by means of connecting plates (40 and 41) arranged parallel to the side plates (42 and 43); the device further comprising a load cell (20) arranged between the connecting plate (40) and the side plate (42) which are in a position comprised between the winch (10) and the pulley (16).

4. The device of claim 2, **characterised in that**: the frame (13) comprises a support plate (45) to which the winch (10) is fixed, to sides of which winch (10) two side plates (42 and 43) are vertically fixed, which side plates (42 and 43) exhibit holes inserted on guides (14, 15), the guides (14, 15) being fixed to the crane structure by means of connecting plates (40 and 41) arranged parallel to the side

plates (42 and 43); the device further comprising a pivot (50) arranged between the connecting plate (41) and the side plate (43) which are in an external position comprised between the winch (10) and the pulley (16); the pivot (50) being fixed to the plate (43) and inserted with play in the plate (41); the pivot (50) comprising a stop (52) arranged on the pivot (50) externally of the plate (41), the stop (52) keeping a load cell (21) positioned against the plate (41).

5. The device of claim 2, **characterised in that** the frame (13) comprises a support plate (45) to which the winch (10) is fixed by means of front screws (60b, 60c) and back screws (60a, 60d) which engage in a frame (18) of the winch (10), to sides of which winch (10) two side plates (42, 43) are vertically fixed, having holes into which guides (14, 15) are inserted with play, the guides (14, 15) being fixed to the crane structure by means of connecting plates (40 and 41) arranged parallel to the side plates (42, 43); a load cell (23) being fixed to the frame (18) of the winch (10) in contact with a lower part of the support plate (45) in a zone comprised between the back screws (60a, 60d).

6. The device of claim 1, **characterised in that** the frame (13) comprises a support plate (45) to which the winch (10) is fixed by means of front screws (60b, 60c) and back screws (60a, 60d) which engage in a frame (18) of the winch (10), to sides of which winch (10) two side plates (42, 43) are vertically fixed, having holes into which guides (14, 15) are inserted with play, the guides (14, 15) being fixed to the crane structure by means of connecting plates (40 and 41) arranged parallel to the side plates (42, 43); a linear transducer (23a) of known type being fixed to the frame (18) of the winch (10) in contact with a lower part of the support plate (45) in a zone comprised between the back screws (60a, 60d), the linear transducer (23a) generating an electric command signal which is proportional to a change in distance between the frame (18) and the lower part of the support plate (45) generated by a traction force exerted on the cable (11).

7. The device of claim 2, **characterised in that** the frame (13) comprises a support plate (45) to which the winch (10) is fixed by means of front screws (60b, 60c) and back screws (60a, 60d) which engage in a frame (18) of the winch (10), to sides of which winch (10) two side plates (42, 43) are vertically fixed, having holes into which guides (14, 15) are inserted with play, the guides (14, 15) being fixed to the crane structure by means of connecting plates (40 and 41) arranged parallel to the side plates (42, 43); each of a pair of load cells (22a, 22b) being inserted between heads of the back screws (60a, 60d) and a lower part of the frame (18) of the winch (10).

8. The device of claim 1, **characterised in that** the means for detecting comprise at least one traction sensor (30) of known type, which generates an electric command signal which is proportional to a traction force generated between the frame (13) and the fixed crane structure by traction forces on the cable (11).

9. The device of claim 8, **characterised in that** the frame (13) comprises a support plate (45) to which the winch (10) is fixed, to sides of which winch (10) two side plates (42, 43) are vertically fixed, having holes into which guides (14, 15) are inserted with play, the guides (14, 15) being fixed to the crane structure by means of connecting plates (40 and 41) arranged parallel to the side plates (42, 43); a dynamometer (30) being arranged between the connecting plate (41) and the side plate (43) which connecting plate (41) and the side plate (43) are located externally of a zone comprised between the winch (10) and the pulley (16).

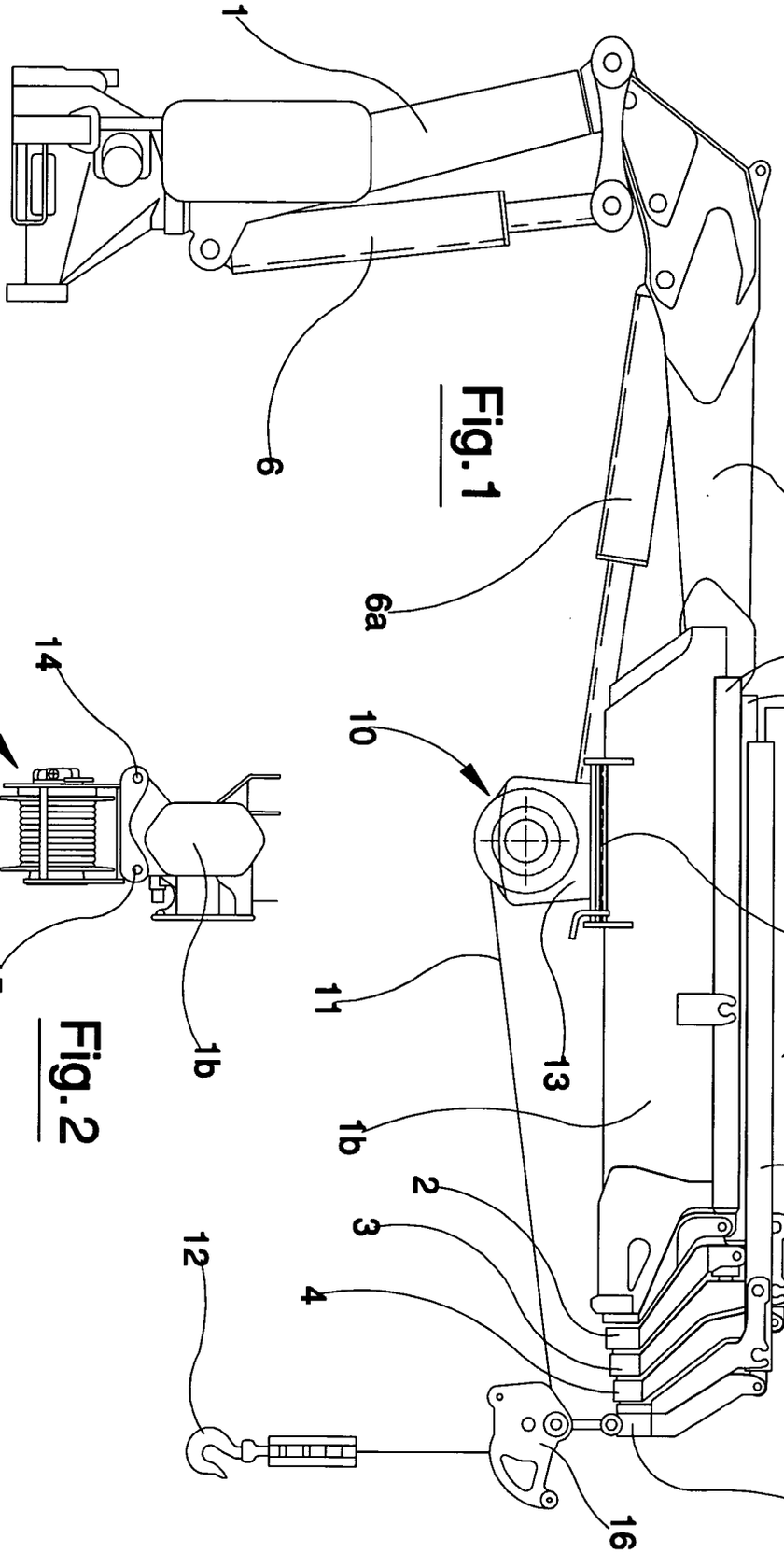


Fig. 1

Fig. 2

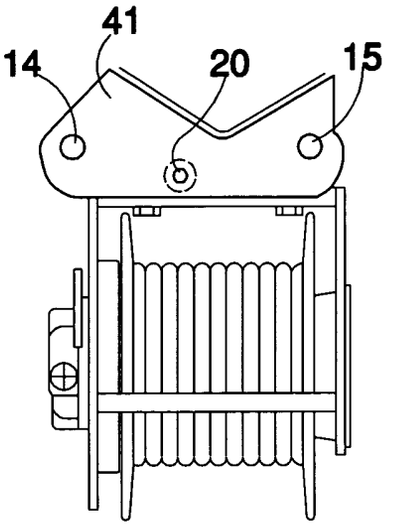


Fig. 4

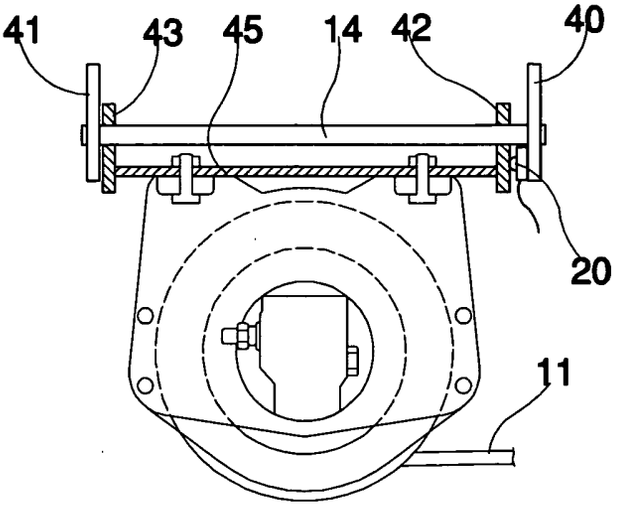


Fig. 3

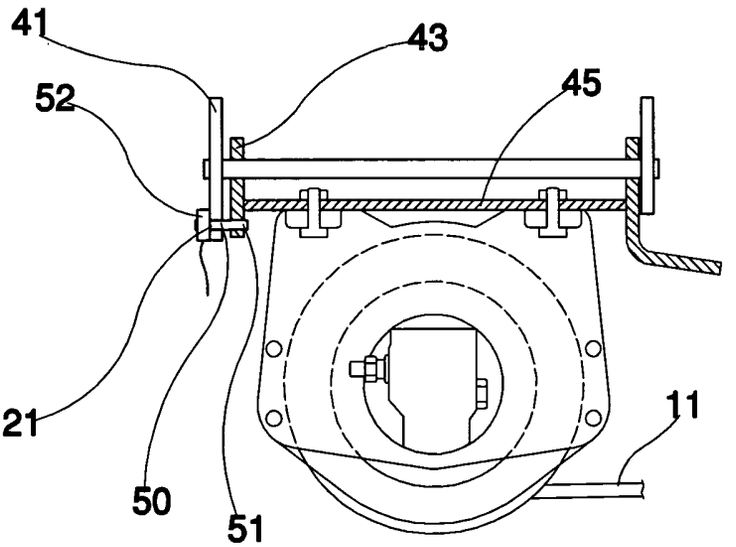


Fig. 5

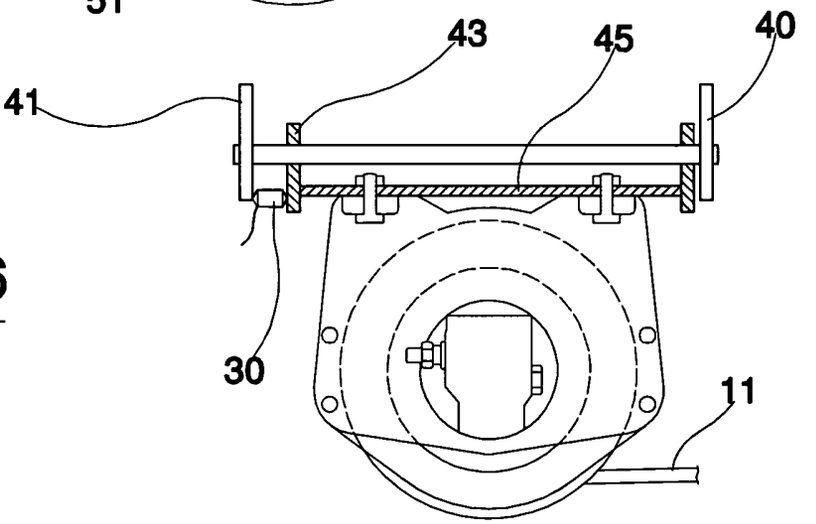


Fig. 6

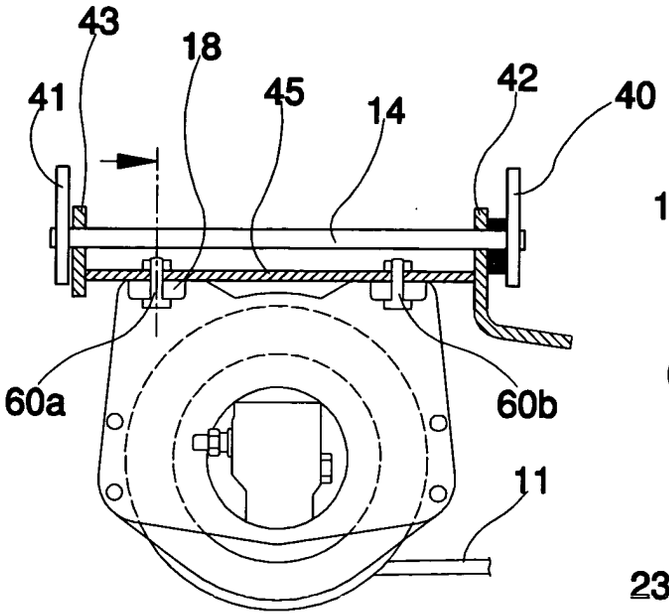


Fig. 7

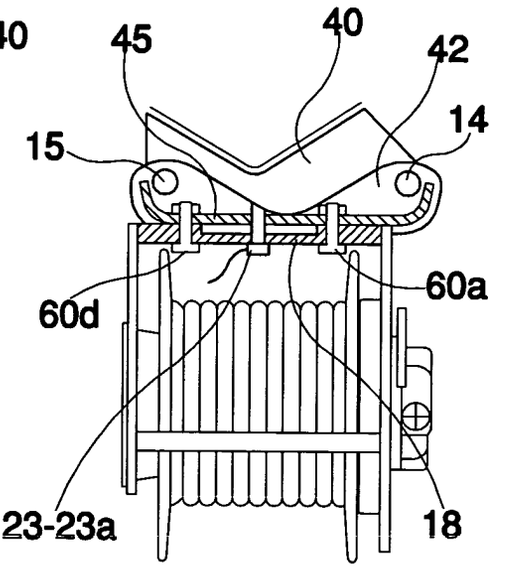


Fig. 8

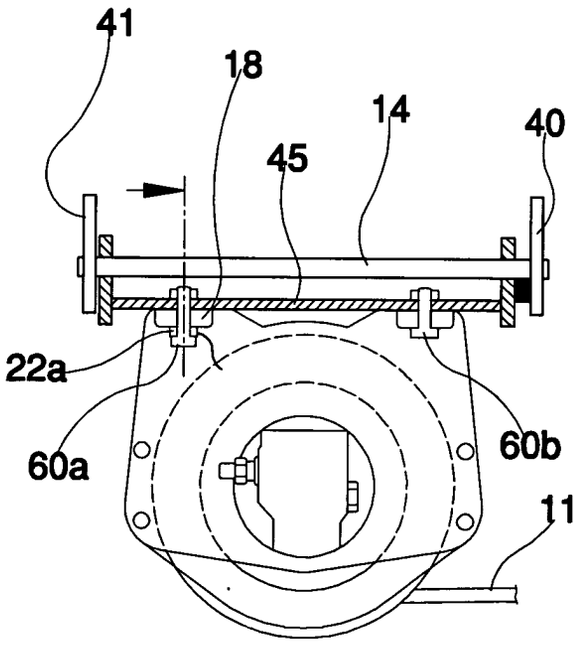


Fig. 9

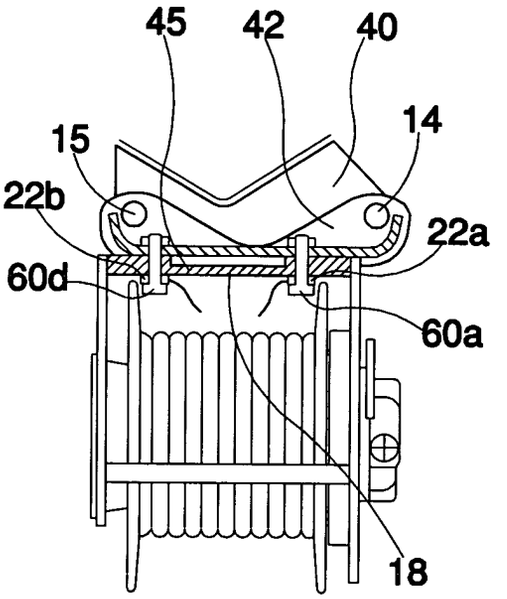


Fig. 10

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 03 42 5403

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TECHNICAL FIELDS SEARCHED (Int.Cl.7)

B66D
B66C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	28 October 2003	Papadimitriou, S

CATEGORY OF CITED DOCUMENTS

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