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DESCRIPTION

Description

[0001] This invention relates to an arm with two or more hooks, designed to be used as equipment on telehandlers or other self-propelled operating machines.

[0002] There are prior art arms with two or more hooks which have a plurality of hooks distributed along the respective supporting beam, designed to be cantilever mounted on the distal end of the telescopic operating arm of a telehandler.

[0003] Each hook is designed to support a respective load, with a different weight from that of the other hooks, for example 25 tonnes instead of 13 tonnes or 18 tonnes and so on.

[0004] Although the prior art arms with two or more hooks are very useful equipment for certain applications, they are not, however, without limits.

[0005] For example, it may happen that the operator estimates incorrectly the weight of a load to be lifted or confuses which is the correct hook to be used for a certain weight, with the consequence of attaching the load to a hook set up to bear a lower weight; in these circumstances, there is a risk of detachment of the load from the arm during lifting or damage to the arm. Moreover, it often happens that a very bulky load is connected to the arm by attaching it to two hooks, for example by a chain; in effect, if the load weighs 18 tonnes and is, for example, quite long, such as a concrete pipe, it can be hung simultaneously from a 25 tonne hook and a 13 tonne hook. However, since in certain circumstances it is not easy for the operator to estimate where the barycentre of the load is located, it may happen that a load connected to two hooks bears more on the hook set up to support the minor weight, which may result in the same consequences indicated above for the incorrect estimation of the load and for the mistake in the hook to be used. CN 206 553 065 U discloses an arm according to the preamble of claim 1. It also discloses a method of using said arm.

[0006] The technical purpose which forms the basis of the invention is therefore to propose an arm with two or more hooks and a method for using an arm with two or more hooks which is able to overcome the limitations of the prior art. This purpose is achieved by using the arm made according to claim 1 and by the method actuated according to claim 17.

[0007] Further features and advantages of the invention are more apparent in the detailed description below, with reference to a preferred, non-limiting, embodiment of an arm with two or more hooks according to the invention as illustrated in the accompanying drawings, in which:

- Figure 1 is a side view of an arm according to the invention;
- Figure 2 is a side view of a telehandler which mounts the proposed arm;
- Figure 3 is a schematic representation of an electronic processing unit according to the invention;
- Figure 4 is a schematic representation of the processing unit according to a specific embodiment.

[0008] With reference to the accompanying drawings, the numeral 1 denotes an arm with two or more hooks made according to the invention.

[0009] The proposed arm 1 includes a supporting beam 10 designed to be connected to the coupling device 21 with which the distal end of the operating arm 20 of a telehandler 2 is equipped.

[0010] As shown in Figure 1, the beam 10 is equipped, distributed along its length and at its lower side, with several hooks 11, 12, 13, each set up to support a respective load, that is to say, a respective maximum weight value of the load.

[0011] More in detail, the maximum weight which can be supported by one of the hooks 11, 12, 13 is different from that of the other two and, typically, decreases as the hook moves towards the distal end; for example, in the case of arms with three hooks 1 such as that shown in the drawings, the innermost hook could support 25 tonnes, the intermediate 18 tonnes and the outermost 13 tonnes (which are clearly example values).

[0012] According to an important aspect of the invention, shown schematically in Figure 2, a relative load sensor is connected to at least one of the hooks 11, 12, 13, but preferably to all the hooks 11, 12, 13.

[0013] More in detail, as schematically shown in Figure 1, each hook 11, 12, 13 may be connected to a respective load sensor 31, 32, 33 which measures the weight of the load which is supported by the hook 11, 12, 13 and consequently produces a load signal representing the measurements taken. The sensors 31, 32, 33 are preferably included in the beam 10 or are positioned between beam 10 and hooks 11, 12, 13.

[0014] In practice, the arm with two or more hooks 1 according to the invention is able to measure the weight which actually bears on each of the hooks 11, 12, 13 and this allows it to overcome all the limitations of the prior art, as will be clearly explained in the description of the operation of the invention. The invention is also configured as a fastening system for telehandlers or other self-propelled operating machines, which, as well as comprising the arm with two or more hooks 1 proposed, also includes an electronic processing unit 4 connected to the load sensors and designed to receive and process the above-mentioned load signals.

[0015] In the present description, the electronic processing unit 4 will be presented as being subdivided into separate functional modules solely for the purpose of describing the functions clearly and completely.

[0016] In practice, such processing unit 4 may be constituted by a single electronic device, if necessary also of the type commonly present on this type of machine, suitably programmed to perform the functions described; the various modules can correspond to hardware units and/or software routines forming part of the programmed device.

[0017] Alternatively or in addition, the functions can be performed by a plurality of electronic devices on which the above-mentioned functional modules can be distributed.

[0018] In general, the processing unit 4 may have one or more microprocessors or microcontrollers for execution of the instructions contained in the memory modules and the above-mentioned functional modules may also be distributed on a plurality of local or remote calculators based on the architecture of the network in which they reside.

[0019] Thanks to the use of the sensors 31, 32, 33 and the processing unit 4, the invention makes it possible to intervene manually or automatically to avoid the risks illustrated during the discussion of the prior art.

[0020] Below, the manual mode of intervention will be described first and then the automatic method, bearing in mind that the use of the two methods and therefore the relative technical details is not mutually exclusive.

[0021] First at all, it should be noted that the telehandler 2 for which the invention is intended to be used, includes a frame or carriage 22 carried by driving wheels 23 which directly mounts the driver's cab 24 or mounts a tower or rotary frame on which the cab is located.

[0022] The telehandler 2 includes an electro-hydraulic distributor 25 which controls the various hydraulic actuators 26, 27 of the invention (see the schematic representation of Figure 3).

[0023] The above-mentioned operating arm 20 is telescopic and is hinged to the carriage 22 or to the tower at its proximal end, whilst at its distal end it is equipped with the coupling device 21, which has already been mentioned above, which allows the removable coupling of the equipment, including the arm 1 according to the invention.

[0024] For the purpose of moving the arm 20 there are several hydraulic actuators 26, 27, shown schematically in Figure 3, connected to the distributor 25, in particular for the lifting and the lowering of the arm, extending and shortening the arm and, if necessary, for the functionality of the apparatus. To be precise, there is a first actuator 26, preferably a hydraulic cylinder, for the oscillation of the arm 20 about the hinge, that is to say, for the lowering and the lifting.

[0025] Moreover, inside the segments slidably inserted one in the other which define the telescopic arm 20, there is at least a second elongation / retraction actuator 27, connected to the segments, which preferably consists of a hydraulic cylinder.

[0026] Inside the cab 24 there are the commands, of per se known type, with which the operator can control both the translation of the vehicle 2 and the movements of the operating arm 20, acting on the hydraulic distributor 25 which receives the electrical control signals from the commands.

[0027] The invention may include a communication device 5 connected to the processing unit 4 and designed to provide to the operator with information relative to the loads supported by the arm 1.

[0028] In practice, in the cab 24 of the telehandler 2 or on a mobile device available to the operator, such as a remote control, there may be an interface or other means designed to communicate information which allow the operator to know the actual weight which bears on a specific hook of the arm 1. Consider, for example, a display unit 5 where numerical or graphical indexes allow the operator to understand which hooks 11, 12, 13 are engaged and with what weight, as well as other information such as the maximum load which can be supported by each hook or other information; moreover, it is also possible that this communication device 5 is able to produce other visual or audio signals to make known to the operator the operating condition of the arm 1.

[0029] The processing unit 4 then comprises an information module 41 which is configured for producing information signals which are a function of the measurements of the above-mentioned sensors 31, 32, 33.

[0030] These signals are designed to control the communication device 5, for example the above-mentioned display, in such a way that they show the operator the load data measured using the sensors 31, 32, 33.

[0031] This first type of operation of the system according to the invention may allow the operator to immediately understand if an error has been made in estimating the load which must be attached to a certain hook 11, 12, 13 or if hook for a load of a certain weight has been incorrectly identified or if a load has been suspended on two different hooks and the weight bears more on the weaker one.

[0032] However, the invention advantageously provides other measures for improving the effectiveness and efficiency of use of the arm with two or more hooks 1.

[0033] In fact, the processing unit 4 can comprise a threshold module 42 configured for checking, for one or more hooks 11, 12, 13, whether the load carried by them exceeds or not a respective risk threshold as a function of the maximum weight value which they are designed to support.

[0034] For example, the threshold may be equal to the maximum weight value which can be supported less a deviation which may be fixed for all the hooks 11, 12, 13 or variable, for example a percentage of the maximum weight or other relation; there could also be a threshold equal to the maximum weight or the upper limit.

[0035] There may be other methods for fixing, calculating or parameterising the deviation.

[0036] The threshold values and any deviations may be recorded in a memory module 43 of the processing unit 4 which may also include other data, parameters and information used by the modules of the processing unit 4. In any case, the above-mentioned information module 41 may be connected to the threshold module 42 and be therefore configured to produce information signals designed to cause the display 5 (or other information device) to produce alarm messages directed to the operator, if the weight carried by one or more hooks 11, 12, 13 has reached or exceeded the respective risk threshold.

[0037] In practice, the operator who is manoeuvring the telehandler 2 in the cab 24 is informed of the fact that there are loads which are excessive relative to the hooks 11, 12, 13 to which they have been connected and that their movement could therefore be dangerous.

[0038] As already mentioned, the telehandler 2 is equipped with an apparatus for controlling the operating arm 2 which includes the hydraulic actuators 26, 27 mounted on the arm and the above-mentioned distributor 25; the invention uses these components for automatically controlling the dangerous conditions connected to the loads suspended from the hooks 11, 12, 13 of the arm 1.

[0039] In effect, in this embodiment, the processing unit 4 includes a control module 44 which is connected to the threshold module 42 and is configured for producing a control signal designed to adjust the operation of the distributor 25, as a function of the checks performed by the threshold module 42.

[0040] In detail, if the load associated with one or more hooks 11, 12, 13 reaches or exceeds the relative threshold, the processing unit 4 may transmit to the distributor 25 a signal which causes the locking of the movements of the arm 20, or it may also produce a control signal designed to make the arm 20 perform only retraction and/or lowering movements.

[0041] The operation of the invention is briefly explained below.

[0042] After the operator has connected one or more loads to the hooks 11, 12, 13 of the arm 1, the operator climbs into the cab 24 to manoeuvre the lifting arm 20 which mounts the arm 1 of the invention using suitable commands. If a load has been connected with an excessive weight to a hook 11, 12, 13, or if the load had has been incorrectly estimated, or an incorrect hook 11, 12, 13 has been used, the system according to the invention signals, for example by means of the display unit 5 and/or a loudspeaker, the potential danger in lifting the load and

carrying it to the destination point.

[0043] The same applies if a significant load attached to two or more hooks 11, 12, 13 has the barycentre which bears more and too much on the hook which has a lower maximum weight limit.

[0044] In addition or alternatively, in the above-mentioned risky conditions, the system prevents the operator from moving the arm 20 by means of the commands in the cab 24.

[0045] The invention is also configured as a method for the safe use of an arm with two or more hooks mounted on or to be mounted on an operating arm 20 of a telehandler 2; in detail, the method may be actuated by means of the arm with two or more hooks 1 described above.

[0046] In general terms, the method comprises the steps of hanging one or more loads from one or more hooks 11, 12, 13 of said arm 1; and measuring the weight of the suspended load or loads.

[0047] Moreover, the method includes steps which correspond to all or some of the functions offered by the arm 1 and by the system according to the invention, as described above.

[0048] More specifically, the method proposed may provide an operator with information representative of the weight of the loads.

[0049] Moreover, there can be the step of checking, for one or more hooks 11, 12, 13, whether the weight of the load carried by them exceeds or not a respective risk threshold as a function of the maximum weight value which they are designed to support.

[0050] In this case, there can advantageously be the step of producing an alarm warning directed to the operator, following the verification that the weight carried by one or more hooks 11, 12, 13 is equal to or greater than the respective above-mentioned risk threshold.

[0051] Moreover, it is possible to adjust the operation of what was defined above as apparatus for controlling the operating arm, which substantially includes the distributor and the hydraulic cylinders of the arm, depending on the fact that the load carried by one or more hooks 11, 12, 13 reaches or exceeds the respective risk threshold.

[0052] More specifically, it may be established that the movements of the arm 20 are blocked when the load carried by one or more hooks 11, 12, 13 has reached or exceeded the respective risk threshold.

[0053] In addition or alternatively, the operating arm 20 may be made to perform retraction and/or lowering movements, when the load carried by one or more hooks 11, 12, 13 has reached or exceeded the respective risk threshold.

[0054] The invention also comprises a further embodiment which allows additional advantages to be obtained.

[0055] In detail, this embodiment makes it possible to automatically vary the load diagram applied by the processing unit to the movements of the operating arm, as a function of the various operating conditions of the arm.

[0056] To be precise, the processing unit 4 firstly includes a plurality of load diagrams recorded in the memory module.

[0057] In this case, the control module is configured for limiting the operational possibilities of the control apparatus 25, 26, 27, on the basis of a load diagram and the processing unit 4 also comprises a selection module 45 configured for automatically selecting from the memory module 43 a load diagram on the basis of signals acquired by suitable sensors.

[0058] It will be understood that in order to maximise the safety and the operational effectiveness of the arm 1, the processing unit 4 can consider one or more of the following parameters relative to the specific operating condition: weight measured by the load sensors, which hook or hooks the load is suspended from, the position of the arm, if it is of the variable configuration type and where the barycentre of the suspended load is located.

[0059] Yet more in detail, the processing unit 4 comprises an identification module, configured to determine which hook(s) is/are stressed by 46 respective loads as a function of the signals produced by the respective load sensors 31, 32, 33; in this case, the selection module 45 is designed to select a relative load diagram from the memory module 43 on the basis of which hook(s) 11, 12, 13 is/are stressed.

[0060] Moreover, the processing unit 4 can comprise a weight module 47 configured for calculating the weight values supported by the hooks as a function of the signals acquired from the load sensors 31, 32, 33; in this case, the selection module 45 is designed to select a load diagram from the memory module 43, based on the weight values measured.

[0061] Further, the processing unit can include a barycentre module 48 configured to calculate a position of the barycentre of a load hanging from the hooks as a function of which the hook(s) are stressed by respective loads and weight values supported by the hooks; in this case, the selection module 45 is designed to select a load diagram from the memory module 43, based on said position of the barycentre.

[0062] The position of the barycentre may be calculated as a function of any reference, preferably integral with the machine.

[0063] If the arm 1 is movable between a plurality of configurations, for example it can be extended and/or rotated, then the system according to the invention includes at least one position sensor (not illustrated) designed to detect the current configuration of the arm 1 and to

transmit a position signal to the processing unit 4.

[0064] In this case, the processing unit 4 includes a position module 49 designed for detecting the configuration of the arm 1 as a function of the position signal and the selection module 45 is designed to select a load diagram from the memory module 43, on the basis of the configuration of the arm 1 detected.

[0065] In practice, the invention overcomes the limitations of the prior art where the choice of the suitable diagram is still left to the operator, depending on the hook which the operator wants to load or the configuration in which the operator wants to use the accessory 1.

[0066] In detail, the invention avoids not only the risks of error in the selection of the load diagram to be applied, but also prevents the operator from using a diagram which is too permissive with respect to the specific operating conditions of the arm.

[0067] For example, when a voluminous load is hung simultaneously on more than one hook 11, 12, 13, the invention prevents the operator from being forced to select a diagram which is or is not safe in order to protect from overloading or from being excessively conservative and causing loss of performance in terms of arm extension and manoeuvring.

[0068] In effect, the processing unit 4 according to the invention makes it possible to immediately know the weight of the loads on each hook 11, 12, 13 and the relative positions and is therefore able to calculate the value of the total load and the actual position of its barycentre, with the result of being able to automatically select the load diagram most suitable for maximising safety and performance.

REFERENCES CITED IN THE DESCRIPTION

Cited references

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Patent documents cited in the description

- [CN206553065U \[0005\]](#)

Patentkrav

5 1. Arm med to eller flere kroge (1), omfattende en støttebjælke (10), der er udformet til at blive forbundet med en betjeningsarm (20) på en teleskoplæsser (2) eller en anden selvkørende betjeningsmaskine, og også omfattende en flerhed af kroge (11, 12, 13), der er fordelt langs bjælken (10) og hver især er udformet til at understøtte en respektive belastning, hvor en eller flere af kroge (11, 12, 13) er forbundet med en belastningssensor (31, 32, 33); hvor armen (1) er **kendetegnet ved, at** støttebjælken (10) er udformet til at blive
10 forbundet med en koblingsindretning (21), med hvilken en distal ende af betjeningsarmen (20) af en teleskoplæsser (2) er udstyret.

15 2. Arm (1) ifølge det foregående krav, hvor hver krog (11, 12, 13) er forbundet med en respektive belastningssensor (31, 32, 33).

20 3. Koblingssystem til en selvkørende betjeningsmaskine omfattende armen (1) ifølge et hvilket som helst af de foregående krav og en elektronisk behandlingsenhed (4) forbundet med belastningssensorerne (31, 32, 33), som er udformet til hver især at frembringe et belastningssignal som funktion af vægten af den belastning, der understøttes af den respektive krog (11, 12, 13).

25 4. System ifølge det foregående krav, omfattende en kommunikationsindretning (5), der er forbundet med behandlingsenheden (4) og udformet til at levere til en operatør af teleskoplæsseren (2) information om den eller de belastninger, der understøttes af armen (1), hvor behandlingsenheden (4) omfatter et informationsmodul (41), der er konfigureret til at frembringe informations signaler, der er udformet til at styre indretningen på en sådan måde, at den viser operatøren belastningsinformation som en funktion af de målinger, der foretages af belastningssensorerne (31, 32, 33).

- 5 **5.** System ifølge krav 3 eller 4, hvor behandlingsenheden (4) omfatter et tærskelmodul (42), der er konfigureret til at kontrollere, for en eller flere kroge (11, 12, 13), om den belastning, de bærer, overstiger eller ej en respektive risiko-tærskel som funktion af den maksimale vægtværdi, som de er udformet til at understøtte.
- 10 **6.** System ifølge krav 4 eller 5, hvor informationsmodulet (41) er underlagt tærskelmodulet (42) og er konfigureret til at frembringe informationssignaler, som er udformet til at frembringe alarmanvarsler til den ovennævnte informations-indretning (5), der rettes til operatøren efter verifikation af, at den vægt, der bæres af en eller flere kroge (11, 12, 13), har nået eller overskredet tærskelværdien.
- 15 **7.** System ifølge krav 5 eller 6, omfattende en indretning (25, 26, 27) til at styre den ovennævnte betjeningsarm (20), hvor behandlingsenheden (4) indbefatter et styremodul (44), der er konfigureret til at frembringe et styresignal, som er udformet til at justere betjeningen af styreindretningen (25, 26, 27) som en funktion af de inspektioner, der udføres af tærskelmodulet (42).
- 20 **8.** System ifølge det foregående krav, hvor styremodulet (44) er konfigureret til at frembringe et styresignal, der er udformet til at blokere bevægelser af armen (20) af styreindretningen (25, 26, 27).
- 25 **9.** System ifølge krav 7 eller 8, hvor styremodulet (44) er konfigureret til at frembringe et styresignal, der er udformet til at få armen (20) til at udføre tilbagetræknings- og/eller sænkebevægelser af styreindretningen (25, 26, 27).
- 30 **10.** System ifølge et hvilket som helst af kravene 7 til 9, hvor styreindretningen indbefatter en elektrohydraulisk fordeler (25), der er udformet til at styre de hydrauliske cylindre (26, 27) til at bevæge armen som en funktion af modtagne

styresignaler.

5 **11.** System ifølge et hvilket som helst af kravene 3 til 10, hvor behandlingsenheden (4) indbefatter: mindst ét hukommelsesmodul (43), hvori er registreret en flerhed af belastningsdiagrammer, og et udvælgelsesmodul (45), der er konfigureret til at vælge fra hukommelsesmodulet (43) et belastningsdiagram baseret på signaler, der er erhvervet fra sensorer (31, 32, 33); hvor styremodulet (44) er konfigureret til at begrænse driftsmulighederne for styreindretningen (25, 26, 27) baseret på det valgte belastningsdiagram.

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15 **12.** System ifølge det foregående krav, hvor behandlingsenheden (4) omfatter et identifikationsmodul, der er konfigureret til at bestemme, hvilken eller hvilke kroge er belastet af (46) respektive belastninger som funktion af de signaler, der frembringes af de respektive belastningssensorer (31, 32, 33), hvilket udvælgelsesmodul er udformet til at vælge et relativt belastningsdiagram fra hukommelsesmodulet (43) på grundlag af hvilken eller hvilke kroge (11, 12, 13), der belastes.

20 **13.** System ifølge krav 11 eller 12, hvor behandlingsenheden (4) omfatter et vægtmodul (47), der er konfigureret til at beregne de vægtværdier, der understøttes af krogene som funktion af de signaler, der er modtaget fra belastningssensorerne (31, 32, 33), hvor udvælgelsesmodulet (45) er udformet til at vælge et belastningsdiagram fra hukommelsesmodulet (43), baseret på de målte vægtværdier.

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30 **14.** System ifølge krav 12 og 13, hvor behandlingsenheden (4) indbefatter et barycenter-modul (48), der er konfigureret til at beregne en position af barycentret af en belastning, der hænger fra krogene, som en funktion af hvilken eller hvilke kroge, der lastes af respektive belastninger, og vægtværdier understøttet af krogene, hvor udvælgelsesmodulet (45) er udformet til at vælge et belastningsdiagram fra hukommelsesmodulet (43) baseret på barycentrets

position.

15. System ifølge et hvilket som helst af kravene 11 til 14, hvor armen (1) er bevægelig mellem en flerhed af konfigurationer, for eksempel er den udtrækkelig eller roterbar, og systemet omfatter mindst én positionssensor, der er udformet til at detektere den aktuelle konfiguration af armen (1) og til at sende et positionssignal til behandlingsenheden (4), hvor behandlingsenheden (4) omfatter et positionsmodul (49), der er udformet til at detektere konfigurationen af armen (1) som en funktion af positionssignalet, hvor udvælgelsesmodulet (45) er udformet til at vælge et belastningsdiagram fra hukommelsesmodulet (43) baseret på den detekterede konfiguration af armen (1).

16. Teleskoplæsser (2), der er udstyret med et system ifølge et hvilket som helst af kravene 3 til 15.

17. Fremgangsmåde til anvendelse af en arm med flere kroge (1), som er monteret på eller skal monteres på en betjeningsarm (20) af en teleskoplæsser (2), og som også er forsynet med en støttebjælke (10), der er udformet til at forbindes med en koblingsanordning (21), med hvilken en distal ende af betjeningsarmen (20) på en teleskoplæsser (2) er udstyret, hvor krogene (11, 12, 13) er fordelt langs støttebjælken (10) og hver især er udformet til at understøtte en respektive belastning, og hvor fremgangsmåden omfatter følgende trin:

ophængning af en eller flere belastninger fra en eller flere kroge (11, 12, 13) på armen (1); og
detektering af vægten af den eller de ophængte belastninger.

18. Fremgangsmåde ifølge det foregående krav, hvor en operatør forsynes med information, der repræsenterer vægten af belastningen eller belastningerne.

19. Fremgangsmåde ifølge krav 17 eller 18, omfattende trinnet med at kontrollere, for en eller flere kroge (11, 12, 13), om den belastning, de bærer, overstiger eller ej en respektive risikotærskel som funktion af den maksimale vægtværdi, som de er udformet til at understøtte.

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20. Fremgangsmåde ifølge krav 18 og 19, omfattende trinnet med at frembringe en alarmanvarsel rettet til operatøren efter verifikationen af, at den vægt, der bæres af en eller flere kroge (11, 12, 13), er lig med eller større end den respektive ovennævnte risikotærskel.

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21. Fremgangsmåde ifølge krav 17, hvor der er tilvejebragt en indretning til styring af den ovennævnte betjeningsarm (20), hvilken fremgangsmåde omfatter trinnet med at justere betjeningen af en styreindretning (25, 26, 27) af armen (20) i overensstemmelse med, om den belastning, der bæres af en eller flere kroge (11, 12, 13), når eller overskrider den respektive risikotærskel.

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22. Fremgangsmåde ifølge det foregående krav, hvor armens (20) bevægelser blokeres af styreindretningen (25, 26, 27), når den belastning, der bæres af en eller flere kroge (11, 12, 13), har nået eller overskredet den respektive risikotærskel.

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23. Fremgangsmåde ifølge krav 21 eller 22, hvor betjeningsarmen (20) er lavet til at udføre tilbagetrækning og/eller sænkebevægelse, når den belastning, der bæres af en eller flere kroge (11, 12, 13), har nået eller overskredet den respektive risikotærskel.

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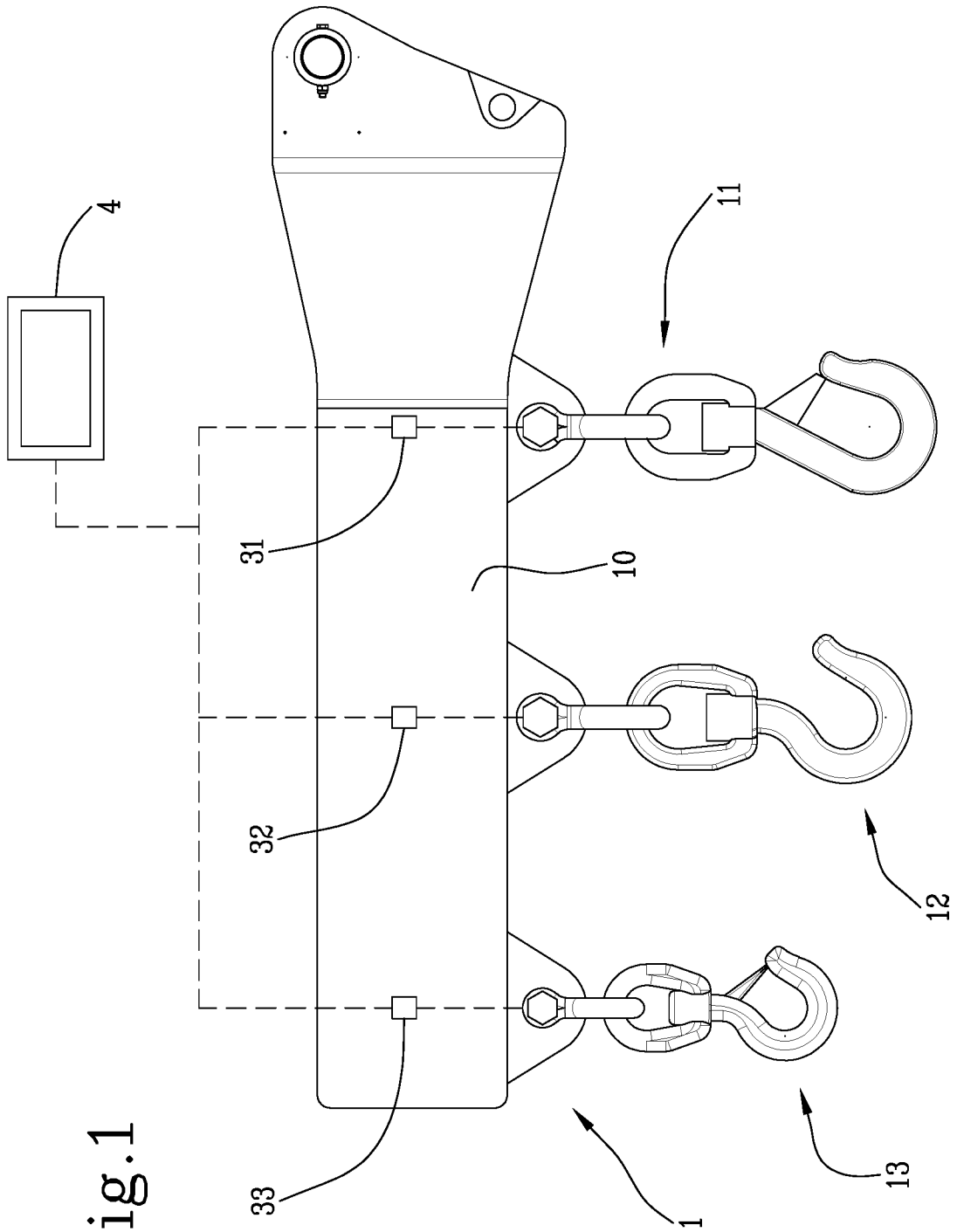


Fig.1

Fig.2

