

(19)



Europäisches Patentamt

European Patent Office

Office européen des brevets



(11)

EP 0 879 208 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:

07.04.2004 Bulletin 2004/15

(21) Application number: **97901526.0**

(22) Date of filing: **07.02.1997**

(51) Int Cl.7: **B66C 23/90**

(86) International application number:
PCT/DK1997/000054

(87) International publication number:
WO 1997/029038 (14.08.1997 Gazette 1997/35)

(54) **A HYDRAULIC BOOM CRANE WITH LOAD CONTROL SYSTEM**

HYDRAULISCHER AUSLEGERKRAN MIT LASTSTEUERSYSTEM

GRUE HYDRAULIQUE A FLECHE AVEC SYSTEME DE COMMANDE DE CHARGE

(84) Designated Contracting States:
AT BE DE DK ES FI FR GB IT NL PT SE

(30) Priority: **07.02.1996 DK 12396**

(43) Date of publication of application:
25.11.1998 Bulletin 1998/48

(73) Proprietor: **Hojbjerg Maskinfabrik A/S**
8270 Hojbjerg (DK)

(72) Inventors:
• **BRAENDGAARD, Gudmund**
DK-8660 Skanderborg (DK)

• **SORENSEN, Jan**
DK-9600 Ars (DK)

(74) Representative: **Brock-Nannestad, George et al**
Patent Tactics,
Resedavej 40
2820 Gentofte (DK)

(56) References cited:
EP-A- 0 708 053 **DE-A- 4 219 369**
US-A- 4 516 116

EP 0 879 208 B1

Note: Within nine months from the publication of the mention of the grant of the European patent, any person may give notice to the European Patent Office of opposition to the European patent granted. Notice of opposition shall be filed in a written reasoned statement. It shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

Description

[0001] The present invention concerns a hydraulic boom crane of the kind including a boom pivotable relative to a base about one end in a vertical plane by a hydraulic main lifting cylinder, at least one signal emitter in the form of a pressure transducer being associated with the main lifting cylinder and connected to a control unit such that any loading exceeding the nominal loading causes said control unit to inhibit operating functions of the crane.

[0002] The nominal load of cranes is determined with a certain safety margin depending on how great a moment may be absorbed by the turning point of the crane, i.e. the bearing supporting the crane, and which then is transmitted to the support of the bearing, e.g. the chassis of a lorry, and in that connection to possibly extended supporting legs without the crane tipping over.

[0003] The known load control systems for use in hydraulically driven cranes are of the kind mounted as accessories on e.g. a lorry or definite mobile cranes. The known load control systems may comprise at least one or more pressure transducers provided on the hydraulic cylinders of the crane. The pressure transducers are connected to a control unit connected with controllable valves in connection with the control valve block of the crane. A such load control system is known from EP 0 708 053 A1, where the control unit is arranged in such a way that it by a registered maximum allowable pressure registered by a sensor placed on the main cylinder of the crane blocks for all further manoeuvring of the crane by its control valve block. However, the blocking may subsequently be deactivated in a short period (3-5 sec.) by a manually controlled liberating element, so that it is possible to get out of an otherwise "impossible lifting situation". An "impossible lifting situation" may be defined in that any movement of the crane boom allowed by the control system with the intention of reducing the load will be impossible in practice because of the physical circumstances in the ongoing lift so that the only possibility of getting out of this lifting situation is a deactivation of the load control system in a short pre-determined period, wherein a forced increase of the load is possible. The said load control system also comprise acoustic and visual signal emitters coming into action at different load levels about the maximum allowable load level for the crane.

[0004] FR-A-2592368 discloses a hydraulic boom crane of the kind including a boom pivotable relative to a base about one end in a vertical plane by a hydraulic main lifting cylinder and including at least one relevant signal emitter connected to a control unit which in case of loading the crane in excess of its nominal load produces limitations on the functional capability of the crane whereby the relevant signal emitter consists of a pressure transducer connected to the control unit arranged in such way that in case of a transgression of the nominal loading established for the crane in question will pro-

duce a marked or total functional limitation.

[0005] DE-A-4219369 discloses a crane with a load control system, which, in case of loading the crane in excess of its nominal load ("erster Schwelle"), produces limitations on the functional capability of the crane in a period of time determined by the control unit (limitations are cancelled by the control unit as soon as a reset-button has been actuated by the operator, after which the crane may be loaded up to an acceptable maximum ("zweiter Schwelle"), the transgression of which will cause the control unit to make the crane inoperable.

[0006] Other load control systems may furthermore comprise position indicators on the boom sections to be pivoted in a vertical plane, besides the pressure transducers on the hydraulic cylinders, and which are also connected to the control unit. The signals from the position indicators are used in the control unit for indicating whether a movement of the pivotable parts of the boom in a desired direction will cause an increased load on the crane. The control of the load with position indicators works in the way that the control unit at a registered maximum allowable load of the crane (the nominal load) ensures that the operator of the crane cannot perform load increasing operations as the control unit at the activation of the previously mentioned controllable valves is hindering such movements of the boom. However, the control unit allows all movements of the boom that by experience cause an immediate reduction of the moment load in proportion to the maximum allowable moment load of the crane, e.g. a reduction of the distance between the load and the turning point of the crane in an operation wherein the length of the boom is reduced.

[0007] Still, experience shows that crane operators almost always and with success try to circumvent the known load control systems. An example of this is that an operation allowed by the load control system that usually cause a load reduction is utilized for increasing the moment load of the crane beyond the allowed level. This will by example be possible by performing a reduction of the boom length in connection with an "unallowable" lift whereby the load is dragged across the ground over at the beginning and then is lifted off the ground. Such a lift will also cause a very disadvantageous and destructive loading of the support bearing of the crane.

[0008] The load control systems described above are relatively costly since they often comprise up to several pressure transducers and one or more position indicators that by wired connections are connected to the control unit, which again are connected to the control valves in the control valve block. Looking at service procedures the large number of components and wire connections become expensive.

[0009] Common to the known load control system is, however, that they in their own individual way in a rather abrupt way deactivates the functions of the crane completely or partly at the exceeding of the maximum allowable load on the crane, though after a preceding warning from acoustic or visual signal emitters also activated by

the control system. However, the known load control systems easily permit the operator to exceed/override the deactivation of the manoeuvrability of the crane in connection with overload situations which inevitably leads to some indifference towards the load control system, since exceeding the maximum allowable load of the crane do not have any consequence as long as operations take place with more or less virtuosity in the alarm range and with an intrepid use of the said deactivation period preceding a total blocking of the control system. The deeper meaning with the alarm is to call the operator's attention to the fact that operation takes place in a potentially dangerous area and that measures for a return to harmless conditions immediately has to be taken, e.g. that the lorry is driven to a position closer to the burden to be lifted. The operator may then decide to try anyway from the consideration that in the said deactivating period he may come in time to discontinue the alarm creating act if the transgression is so great that it downright may give rise to an ultimate blocking signal.

[0010] This practice results in appreciable problems that may be read from different accident statistics. The crane manufacturers may decide to place the alarm range in a safer distance from the ultimate border, but this will inevitably raise the cost of the crane in proportion to its capacity. An optimum relationship between price and capacity highly presupposes that the operators respect the alarm range according to its purpose and do not make experiments instead by pressing the crane extremely, causing danger for themselves, the machines and other persons in the close surroundings.

[0011] The problem in question is thus not of a purely technical nature, but also involves educational and moral considerations, since previous solutions to the problem have always depended on operator discipline. It has to be acknowledged as a regrettable fact that the time has not yet come for a reasonable expectation of such self-discipline as several other reasons make it attractive for the operators to press the crane to the limit exist, even in already extreme situations and in spite of the hazards belonging to them.

[0012] In the present invention it has been recognized that it is possible by technical means to support a more reliable practice of operation, thus avoiding otherwise superfluous overdimensioning or capacity limits on hydraulic boom cranes. This is achieved according to the invention in that the operating functions inhibited by the control unit comprise substantially all operating functions of the crane, whereby the functions remain inhibited for a delay interval, hereinafter designated the "penalty period", the duration of the penalty period imposed at each succeeding occurrence of excess loading being determined by the control unit according to past loading conditions and whereby if the control units detects a loading level exceeding an absolute maximum limit of the crane, all further operation of the crane is disabled.

[0013] The invention thus involves a kind of psychological counteraction on the part of the crane against an

operator trying to exceed the capacity of the crane into its hazard area. Such a counteraction may be established according to the invention by letting the crane equipment itself produce a capacity reduction of a first or lower safety limit, that is to say by a not very technical but psychological and educationally effective "penalty" to the operator in the form of a more or less total blocking of the crane functions during a certain period of time, e.g. if the operator does not react in an expectedly suitable way after the alarm has been activated the first time, namely by returning the system to a not alarm giving state.

[0014] By giving the operator such a time "penalty" with respect to the use of the crane two important aspects will appear, namely that the operator has to reckon with the impossibility of desired capacity gain by using a slightly or heavily overloaded crane, for example because the time was better used in driving the lorry closer to the burden to be lifted, and that the same operator has to face the surroundings' observation that his heroic struggle with the crane to press it to the outermost simply result in stoppage while maybe an alarm signal audible for the whole congregation is sounded. Hereby the operator has to accept a loss of both crane capacity and personal prestige, and both will act in the direction that the operator will keep to the instructions of the crane manufacturer concerning a temporary operative overloading of the crane.

[0015] Still, there will exist a few operators who want to test the limits of such a system with the anticipation of accepting a short-term "penalty" at a moderate overload, if it is possible then to continue the work with a greater overload. According to the invention this may be counteracted by producing increasing blocking periods for all crane functions for a correspondingly increasing degree of such overload, whereby the operator soon will experience that any attempt to a further increase of the crane capacity will result in that the same capacity is lessened appreciably because of increasing periods of total blockage of the crane functions. In this way the operator has nothing to gain by his attempts to circumvent the security system, while he at the same time by such ineffective circumventing attempts becomes exposed to scorn from the surroundings eo ipso that the crane is standing still after the sounding of an alarm signal.

[0016] Several signal levels may then be introduced by which there is produced increasing "penalty periods", so that the operator will experience a continuously increasing passivity of the crane the more he tries to overload it. At the same time, however, consideration is given to the operator so that the final total blocking of the crane only takes place in quite extreme cases, where the operator in the course of time has had to accept a series of increasing penalty periods and therefore has worked in a quite inefficient way.

[0017] By the invention it has further been realized that for the surveillance of the moment load of the crane it is hereby in reality only necessary to watch the pres-

sure on the main cylinder of the crane supporting the main boom of the crane, since this pressure is an objective measure for the moment acting on support of the crane when using it. Thereby it is possible to indicate a new and more simply arranged load control system that is cheaper in acquisition as well as in service as compared to the known load control systems, and which in addition gives the operator of the crane more degrees of freedom during special lifting situations and a better feeling of the maximum load of the crane.

[0018] By the invention there is thus indicated a new load control system comprising a pressure transducer situated on the main lifting cylinder of the crane and connected to a control unit with the output connected to a by-pass valve, also called "dump valve", controlling the oil supply to the manoeuvring valve block of the crane, which control unit is arranged in such a way that the transgression of the nominal load capability of the crane in question will result in activation of the said "dump valve", so that all the functions of the crane are made inactive in a period of time calculated by the control unit, a so-called penalty period, whereafter the dump valve is deactivated.

[0019] Evidently, the load control system according to the invention does not give any immediate possibility for the crane operator to rectify a transgression of the nominal load of the crane since it is not possible to relieve the load as long as the functions of the control valve block of the crane are deactivated during the penalty period.

[0020] After the expiration of the penalty period that may be rather short at the first transgression the control unit deactivates the dump valve and the crane becomes manoeuvrable again. If the load on the crane is reduced to a level below the nominal load nothing further will happen, i.e. the work may continue freely.

[0021] With the purpose of giving the operator a possibility of remedying any arisen impossible load situations the control unit is arranged in such a way that it allow a further load on the crane to a calculated level (within the safety margin) in excess of the nominal load after the expiration of the penalty period.

[0022] If this calculated level for the load is exceeded the dump valve is activated again by the control unit, this time in an perceptibly longer period of time than the first activation. After the expiration of this so-called penalty period the dump valve is deactivated again.

[0023] If the load on the crane is reduced the control unit will continuously calculate a new, lower value for the maximum allowable load and penalty period in case of a transgression concurrently with the relieving of load until the nominal load is reached. However, if the operator of the crane tries to increase the load during the relieving the control unit will immediately release a new penalty period.

[0024] The load control according to the invention may be programmed with several limits of load levels between the nominal load for the crane and an absolute

acceptable maximum within the safety margin. Transgression of the individual load levels/limits will release an increasing penalty period concurrently with the magnitude and number of transgressions.

[0025] In order to give the operator the possibility of following how much the crane is loaded in relation to the nominal load the cabinet of the control unit may be provided with a percent graduated scale with light diodes that are switched on and off concurrently with a load increase and decrease, respectively.

[0026] In addition, for warning the operator of the crane as well as persons staying within the hazard area of the crane about the nominal load being reached or exceeded, the control unit may also be provided with an acoustic alarm emitting a periodic alarm signal at an existing load between 95% and 100%. During an imposed penalty period at the transgression of the nominal load (100%) a continuous signal is given. Therefore, the operator has to accept that his overloading of the crane is made widely known.

[0027] Furthermore, the control unit may be provided with a logging unit that is registering data in a ring buffer memory for all load transgressing actions with the crane, so that data concerning the latest load transgressing events afterwards may be read from the ring buffer memory on e.g. a hand terminal, and that is registering data concerning the largest registered overloads in another data memory, the latter also being readable on a hand terminal.

[0028] The load control system described in the above being more simple in arrangement as compared to the known load control systems contains thus some increased degrees of freedom and important educational principles.

[0029] The increased degrees of freedom consist in that the operator at the transgression of the nominal load up to an absolute allowable maximum limit within the safety margin and after the expiration of penalty period has the possibility of getting out of an "impossible" lifting situation by utilizing all of the manoeuvring functions of the crane, even with a short-term, smaller load increase allowed after the expiration of a penalty period.

[0030] The educational element consist in that the operator of the crane will be inclined to learn a better perception of the load situations implying transgression of the nominal load of the crane, because the penalty period connected with a transgression of the nominal load will slow down the work procedures in connection with the use of the crane and thereby for the operator as well as for the person or persons cooperating in the work within the hazard area of the crane.

[0031] The invention is explained in more detail in the following with reference to the drawing, where:

Fig. 1 is a perspective view of a hydraulic crane provided with a load control system according to the invention, and

Fig. 2 is a functional example of the load control system.

[0032] In Fig. 1 there is shown a hydraulic crane 2 intended for mounting on a vehicle, for example a lorry. The crane comprises a basic frame 4 for mounting on the chassis of the lorry. The basic frame has also laterally extendable girders 5 at the ends of which vertically extendable legs 6 are provided. On the basic frame 4 the column 10 of the crane is supported by the bearing 8. In addition, the bearing carries the support for the main cylinder 12 of the crane that is connected to the main arm 14 of the crane. In continuation of the main arm 14 the bending arm 16 of the crane is provided and in this a number of telescopic arms 18.

[0033] On the main cylinder 12 of the crane there is provided a pressure transducer 20 which by a wire connection 21 transmits an oil pressure signal to a control unit 22. As a consequence of the very quickly varying oil pressures appearing in the main cylinder 12 of the crane and which at the transmission to the control unit will cause "signal confusion", the control unit 22 is provided with a not shown signal receiving block performing filtering, stabilization and compensation of the received oil pressure signal from the pressure transducer 20 before the signal is transmitted to the control unit for further processing.

[0034] The control unit is connected to a by-pass valve 24, in the following called dump valve that is placed on the oil supply pipe for the manoeuvring valve block 25 of the crane, through a wire connection 23, so that the dump valve in its active position will cause that the oil in the supply pipe is returned directly to the hydraulic oil tank through a not shown by-pass pipe and around the manoeuvring valve block 25 whereby manoeuvring of the crane is not possible. In the inactive position of the dump valve the hydraulic oil is supplied to the valve of the manoeuvring valve block whereby it is possible to manoeuvre the crane.

[0035] The control unit 22 comprises a cabinet the front of which is furnished with a number of bulbs 28 placed in conjunction with a percentage scale, one bulb 30 placed by the word "run", an acoustic signal emitter 32, and a stop switch 34.

[0036] The shown scaling indicates the existing load on the crane proportional to the nominal load of the crane in the range between 80 and 100%. At a load below 80% of the nominal load only one bulb 30 opposite the word "run" is lit. At a load on the crane within the range 80-100% the bulbs are lit concurrently with the increased load so that the operator has a possibility of following the development of the existing load of the crane. At a load over 95% of the nominal load the control unit activates the acoustic signal emitter 32, which emits a periodic signal. At a load on the crane corresponding to 100% or more the control unit causes a continuous signal to be sounded from the emitter 32 during the said penalty period.

[0037] The mode of operation of the load control system is explained in the following with basis in the functional example for the load control system shown in Fig. 2, which shows a coordinate system with abscissa indicating time and ordinate indicating the load of the crane proportional to the nominal load of the crane.

[0038] At a load in the range between 0 and 85% of the nominal load the load control system does not react.

[0039] At a load between 85 and 95% the control unit performs a gradual activation of the bulbs 28 opposite the percentage indications on the cabinet of the control unit.

[0040] At the transgression of 95% of the nominal load the control unit activates the acoustic signal emitter 32 so that it gives a periodic signal which at 100% nominal load changes to a continuous signal in connection with the running of a penalty period. At the expiration of a penalty period the signal emitter changes to the periodic signal indicating that the crane functions are active again, but the existing load of the crane is more than 95% of the nominal load.

[0041] If the crane operator attempts to increase the load above 100% the control unit 22 activates the dump valve 24 in the short period of time calculated by the control unit, a so-called penalty period A, cf. Fig. 2, wherein the functions of the crane are paralyzed. After that the load on the crane should be reduced below nominal load capability. The load on the crane may be increased at the expiration of the penalty period A in order to give the operator of the crane the possibility to get out of an adverse lifting situation which is possible up to 102% of nominal load in the given example. If the load is increased in excess of the level determined by the control unit, the control unit activates the dump valve in at penalty period B that is longer than the first period. During this penalty period the control unit calculates a new stop level, e.g. 102.5% of nominal load, and a new and longer penalty period C coming into use if the crane load is increased more than the new stop level.

[0042] In the example shown in Fig. 2 the principle in the development of the length of the penalty period is illustrated as a function of the current load on the crane. The control unit calculates the development in the length of the penalty period in relation to the current load of the crane and the current number of attempts of additional overloading. The control unit 22 further comprises an "override" button 36 which by the operator may be activated in case of an "impossible" lifting situation that has to be rectified immediately. By activating the "override" button it will be possible within the subsequent 5 seconds to perform a smaller load increasing operation with the crane within an interval determined by the load control system, the exceeding of which causes a penalty period of 30 seconds. The "override function" is usable up to the absolutely maximum allowable load level of the crane, whereafter the load control system totally deactivates all of the functions of the crane. In that situation there may possibly be a case of a final adjusting possibility, which however requires the breaking of a seal or

calling of a security inspector.

[0043] It shall be emphasized that by the invention it has been possible to reduce all of the sensor equipment on the crane to the pressure transducer 20 only, but naturally it cannot be precluded that more sensors can be used.

Claims

1. A hydraulic boom crane (2) of the kind including a boom (14) pivotable relative to a base about one end in a vertical plane by a hydraulic main lifting cylinder (12), at least one signal emitter in the form of a pressure transducer being associated with the main lifting cylinder (12) and connected to a control unit (22) such that any loading exceeding the nominal loading causes said control unit (22) to inhibit operating functions of the crane (2), **characterised in that** the operating functions inhibited by the control unit comprise substantially all operating functions of the crane, whereby the functions remain inhibited for a delay interval, hereinafter designated the "penalty period", the duration of the penalty period imposed at each succeeding occurrence of excess loading being determined by the control unit according to past loading conditions and whereby if the control unit detects a loading level exceeding an absolute maximum limit of the crane, all further operation of the crane is disabled.
2. A hydraulic boom crane (2) according to claim 1, **characterised in that** the control unit (22) at the loading of the crane (2) beyond its nominal load up to an acceptable absolute maximum within a safety margin after the expiration of the penalty period allows transgressions of the load causing the last penalty period in intervals in such a way that the transgression of the different levels will activate the functional limitation in a preferably perceptibly increasing penalty period concurrently with the magnitude and the number of the transgressions.
3. A hydraulic boom crane (2) according to claim 1 or 2, **characterised in that** the control unit (22) determines the intervals so that these become continuously smaller concurrently with the number of the load transgressions.
4. A hydraulic boom crane (2) according to any of the claims 1-3, characterised in that concurrently with the reducing of load on the crane down to the nominal load the control unit (22) continuously calculates a new lower value for the maximum allowable load together with a penalty period in case of a transgression thereof, which penalty period is released immediately at an attempt to increase the load.

5. A hydraulic boom crane (2) according to any of the claims 1-4, characterised in that it comprises an "override" function cancelling an imposed penalty period through e.g. 4-10 seconds, within which period a load increase is allowed within a limit determined by the load control system, the transgression of which limit causes an instant passivity of the crane during a separately determined period of e.g. 30 seconds.
6. A hydraulic boom crane (2) according to claim 2 and 5, **characterised in that** the "override" function is active in each of the load increasing intervals up to the absolute maximum allowable load for the crane.
7. A hydraulic boom crane (2) according to any of the claims 1-4, characterised in that the cabinet of the control unit is provided with a percent graduated scale with bulbs (28) that are switched on and off concurrently with a load increase or decrease, respectively, in an upper load range.
8. A hydraulic boom crane (2) according to any of the claims 1-4, characterised in that the control unit in addition comprises an acoustic alarm (32) which during an imposed penalty period at the transgression of the nominal load emit a "penalty signal" audible by the surroundings, and which preferably at an existing load on the crane between 95% and 100% of the nominal load emits an e.g. intermittent alarm signal.
9. A hydraulic boom crane (2) according to any of the claims 1-6, characterised in that the penalty period as a margin as well as a stop level at the loading of the crane in excess of the nominal load is returned to the initial value when the crane load is reduced to a level below the nominal load.
10. A hydraulic boom crane (2) according to any preceding claim, characterised in that the relevant sensor equipment of the crane only consist of a pressure transducer for sensing the pressure in the main cylinder of the crane, and that the control unit preferably is arranged to activate the dump valve of the crane.

Patentansprüche

1. Hydraulischer Auslegerkran (2), einen Ausleger (14) umfassend, den mittels eines hydraulischen Hauptzylinders (12) um ein Ende in einer Vertikalebene drehbar ist, mindestens einen Signalgeber in form eines Druckumformers dem Hauptzylinder (12) verknüpft ist und mit einer Steuerungseinheit (22) verbunden ist, damit jederlei Last, die die nominelle Belastungsfähigkeit überschreitet, die

Steuereinheit (22) so beeinflusst, dass die Arbeitsfunktionen des Krans (2) verhindert werden, **dadurch gekennzeichnet,**

dass die Arbeitsfunktionen die von der Steuereinheit verhindert werden, im wesentlichen alle Arbeitsfunktionen des Krans umfassen, wobei die Funktionen während eines Verspäterungsintervalls, hiernach "Strafperiode" genannt, verhindert verbleiben, wobei die Dauer der Strafperiode, die bei jedes nächste Ereignis einer Überlastung erteilt wird, von der Steuereinheit gemäss frühere Lastverhältnisse, und wobei, falls die Steuereinheit einen Lastpegel, den eine absolute Maximumgrenze des Krans überschreitet detektiert, alles weitere Arbeiten mit dem Kran verhindert wird.

2. Hydraulischer Auslegerkran (2) nach Anspruch 1, **dadurch gekennzeichnet, dass** die Steuereinheit (22) beim Belasten des Krans (2) über die nominelle Belastungsfähigkeit bis zu einem akzeptablen absoluten Maximum innerhalb eines Sicherheitsspielraums nach Auslauf der Strafperiode intervallenweise Überschreitungen der Belastung, die die letzte Strafperiode ausgelöst hat, zulässt, in solcher Weise, dass Überschreitung der verschiedenen Lastpegeln die funktionelle Begrenzung in vorzugsweise spürbar wachsenden Strafperioden in Zusammenhang mit der Grösse und der Anzahl der Überschreitungen aktiviert.
3. Hydraulischer Auslegerkran (2) nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** die Steuereinheit (22) die Intervalle so festlegt, dass die immer kleiner werden in Zusammenhang mit der Anzahl der Überschreitungen.
4. Hydraulischer Auslegerkran (2) nach jeder der Ansprüche 1-3, **dadurch gekennzeichnet, dass** in Zusammenhang mit der Reduktion der Belastung des Krans bis zu der nominellen Belastungsfähigkeit die Steuereinheit (22) laufend einen neuen niedrigeren Wert für die Maximumgrenze zusammen mit einer Strafperiode im Falle einer Überschreitung der Grenze berechnet, welche Strafperiode unmittelbar bei einem Versuch zur Erhöhung der Belastung ausgelöst wird.
5. Hydraulischer Auslegerkran (2) nach jeder der Ansprüche 1-4, **dadurch gekennzeichnet, dass** es eine "Dominierungsfähigkeitsfunktion" umfasst, die eine angelegte Strafperiode für beispielsweise 4-10 Sekunden aufhebt, innerhalb welcher Zeitraum eine Belastungszunahme erlaubt wird, innerhalb einer Grenze, die von der Steuereinheit bestimmt wird, wobei die Überschreitung der Grenze einen augenblicklichen Stillstand des Krans hervorruft während einer gesondert ermittelten Periode von beispielsweise 30 Sekunden.

6. Hydraulischer Auslegerkran (2) nach Anspruch 2 und 5, **dadurch gekennzeichnet, dass** die "Dominierungsfähigkeitsfunktion" in jeder der belastungszunehmenden Perioden bis zu der absoluten Maximumgrenze des Krans aktiv ist.

7. Hydraulischer Auslegerkran (2) nach jeder der Ansprüche 1-4, **dadurch gekennzeichnet, dass** das Gehäuse der Steuereinheit mit einer in Prozent eingeteilten Skala versehen ist mit Lampen (28) die ein-, bzw. ausgeschaltet werden in Zusammenhang mit einer Zu- oder Abnahme der Belastung, in einem oberen Belastungsbereich.

8. Hydraulischer Auslegerkran (2) nach jeder der Ansprüche 1-4, **dadurch gekennzeichnet, dass** die Steuereinheit zusätzlich einen akustischen Alarm (32) umfasst, den während einer angelegten Strafperiode beim Überschreiten der nominellen Belastungsfähigkeit ein in der Umgebung hörbares "Strafsignal" aussendet, wobei vorzugsweise bei einer vorhandenen Kranbelastung zwischen 95% und 100% der nominellen Belastungsfähigkeit ein beispielsweise intermittierendes Alarmsignal aussendet.

9. Hydraulischer Auslegerkran (2) nach jeder der Ansprüche 1-6, **dadurch gekennzeichnet, dass** die Strafperiode als Spielraum sowie als Haltepegel bei der Belastung des Krans hinüber der nominellen Belastung zu den Ausgangswerten zurückgestellt werden, wenn die Kranbelastung unter der nominellen Belastung reduziert wird.

10. Hydraulischer Auslegerkran (2) nach jeder der vorstehenden Ansprüche, **dadurch gekennzeichnet, dass** die relevante Sensorausrüstung des Krans nur aus einem Druckumformer zur Ermittlung des Drucks in dem Hauptzylinder des Krans besteht, und dass die Steuereinheit vorzugsweise zur Aktivierung des Umgehungsventils des Krans eingestellt ist.

45 Revendications

1. Grue (2) hydraulique à flèche du type comprenant une flèche (14) pivotable par un cylindre (12) d'actionnement hydraulique principale autour d'une extrémité dans un plan vertical relative à une base, au moins un émetteur de signaux en forme de transducteur de pression en liaison avec le cylindre d'actionnement principale (12) et connecté à un dispositif de contrôle (22) tel que chaque charge dépassant la charge nominale cause ledit dispositif de contrôle (22) d'empêcher les fonctions opérationnelles de la grue (2),
caractérisée en ce que

les fonctions opérationnelles empêchées par le dispositif de contrôle comprennent essentiellement tous les fonctions opérationnelles de la grue, où les fonctions restent empêchées dans un intervalle de retard, ensuite nommé "la période de punition", la durée de la période de punition appliquée à chaque événement de surcharge étant déterminé par le dispositif de contrôle selon des conditions de charge antérieurs, et où, si le dispositif de contrôle détecte un niveau de charge en excès d'une limite maximum de la grue, tout operation successive de la grue est empêché.

2. Grue (2) hydraulique à flèche selon la revendication 1, **caractérisée en ce que** le dispositif de contrôle (22), quand la charge du grue (2) dépasse la charge nominale jusqu'une limite maximum dans une marge de sécurité, après la fin de la période de punition, permet des dépassements de la charge ayant activé la dernière période de punition dans des intervalles de telle façon que les dépassements des différents niveaux activent la limitation fonctionnelle dans une période de punition préférablement perceptiblement croissant en concordance avec la grandeur et le nombre des dépassements.
3. Grue (2) hydraulique à flèche selon la revendication 1 ou 2, **caractérisée en ce que** le dispositif de contrôle (22) détermine les intervalles telles qu'ils deviennent continûment plus bref en concordance avec le nombre des dépassements de charge.
4. Grue (2) hydraulique à flèche selon une des revendications 1 à 3, **caractérisée en ce qu'en** concordance avec la réduction de la charge sur la grue jusqu'à la charge nominale, continûment le dispositif de contrôle (22) calcule un nouveau valeur plus bas pour la charge permissible maximum, et avec une période de punition dans le cas d'un dépassement, lequel période de punition étant déclanchée immédiatement par un essai d'augmenter la charge.
5. Grue (2) hydraulique à flèche selon une des revendications 1 à 4, **caractérisée en ce qu'elle** comprend une fonction "en mode prioritaire" qui annule une période de punition de par exemple 4-10 secondes, pendant ce temps permettant une augmentation de la charge sous une limite déterminée par le système de contrôle de la charge, le dépassement de cette limite causant une passivité de la grue dans une période séparément déterminé de par exemple 30 secondes.
6. Grue (2) hydraulique à flèche selon la revendication 2 et 5, **caractérisée en ce que** la fonction "en mode prioritaire" est active dans chacun des intervalles d'augmentation de charge jusqu'à la charge permissible maximum du grue.

7. Grue (2) hydraulique à flèche selon une des revendications 1 à 4, **caractérisée en ce que** le boîtier du dispositif de contrôle est fournit d'une échelle divisé en pourcent avec des lampes (28) qui sont mis en ou hors circuit en concordance avec une augmentation ou une réduction de la charge, respectivement, dans une gamme de charges élevée.
8. Grue (2) hydraulique à flèche selon une des revendications 1 à 4, **caractérisée en ce que** le dispositif de contrôle en outre comprend une alarme acoustique (32) qui sonne un "signal de punition" audible dans l'entourage pendant une période de dépassement de la charge nominale, et qui préférablement sonne un signal d'alarme, par exemple intermittent, quand la charge sur la grue est entre 95% et 100% de la charge nominale.
9. Grue (2) hydraulique à flèche selon une des revendications 1 à 6, **caractérisée en ce que** la période de punition comme marge, ainsi que le niveau d'interruption pendant la charge de la grue au dehors de la charge nominale sont retourné à leur valeurs initiales quand la charge de la grue est réduit au-dessous de la charge nominale.
10. Grue (2) hydraulique à flèche selon les revendications précédentes, **caractérisée en ce que** l'équipement essentiel de senseurs ne comprend qu'un transducteur de pression pour mesurer la pression dans le cylindre d'actionnement principale de la grue, et **en ce que** le dispositif de contrôle est préférablement adapté à activer la soupape de dérivation de la grue

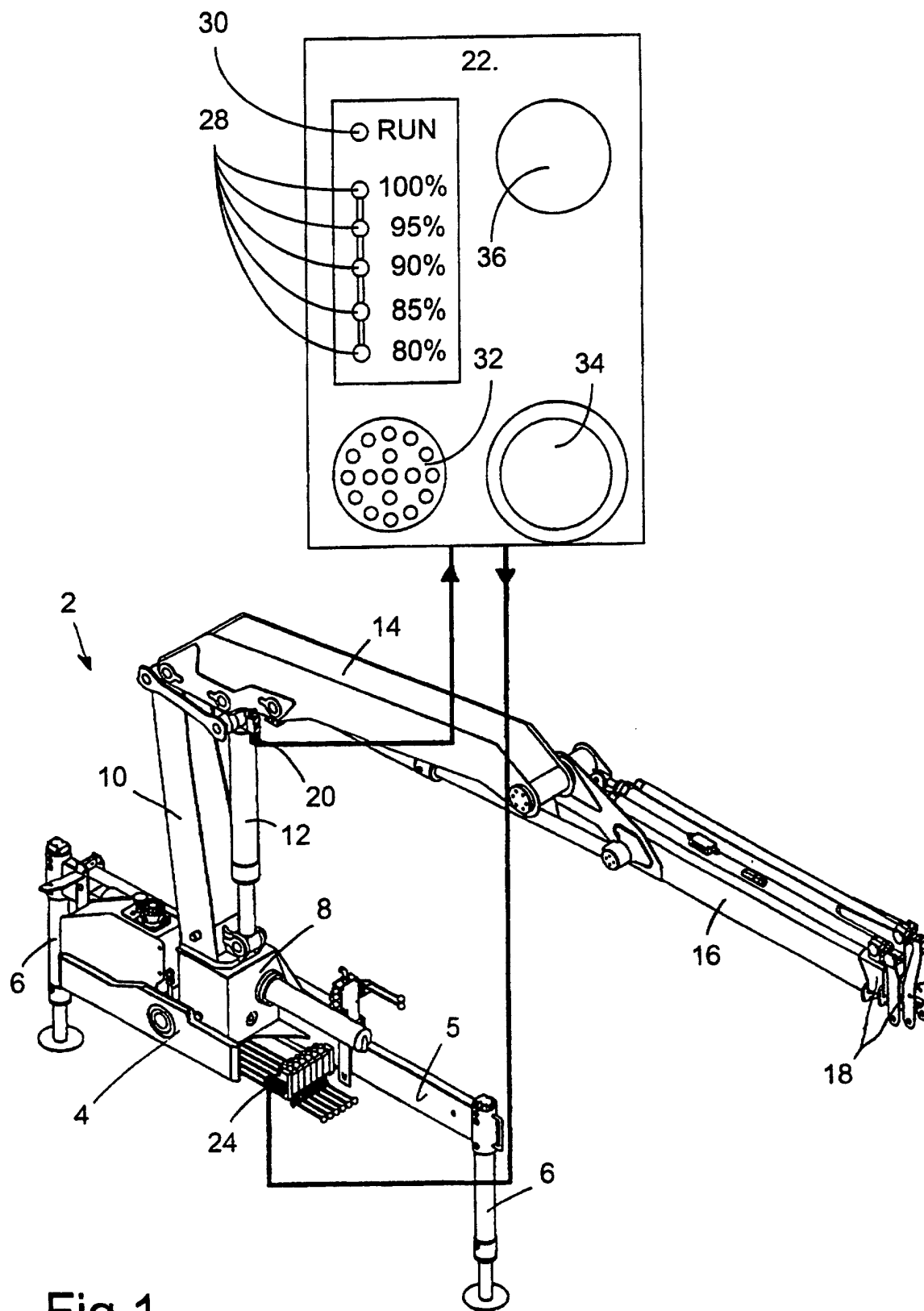


Fig.1

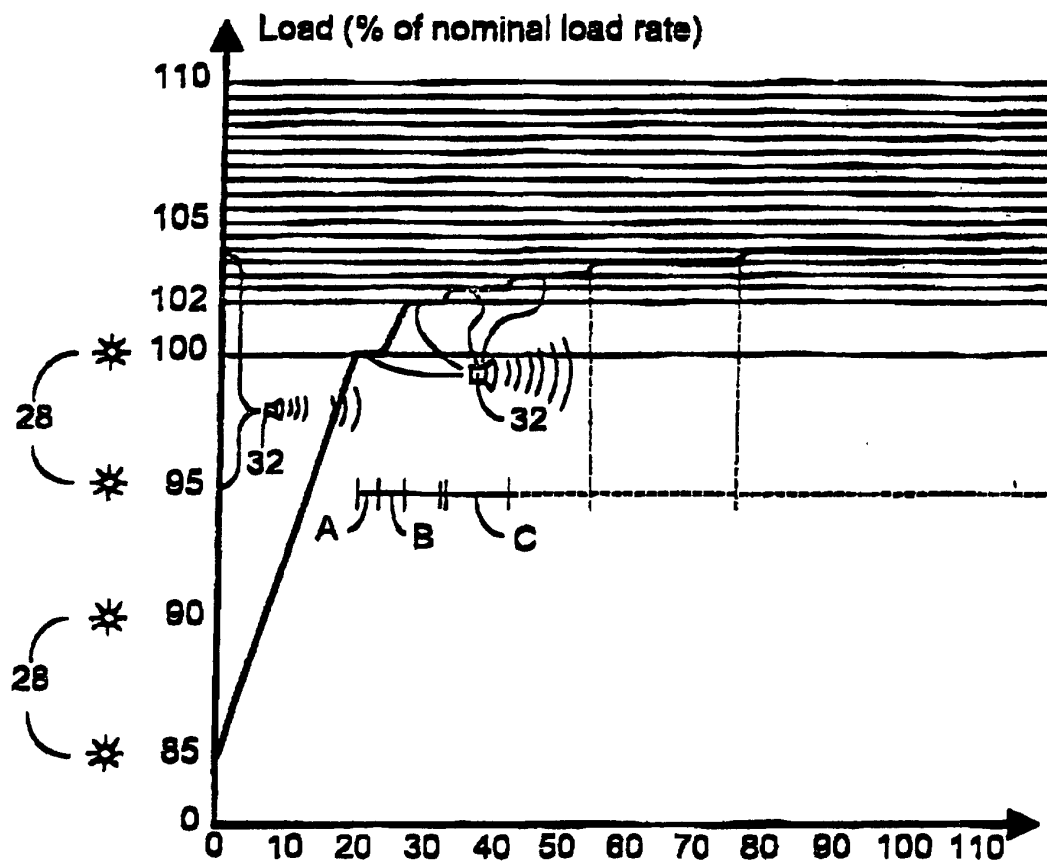


Fig.2