United States Patent [19]

Becker et al.

[11] **3,771,667**

[45] **Nov. 13, 1973**

[54] **MOMENT MONITORING SYSTEM FOR BOOM-CABLE TYPE CRANES**

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[52] **U.S. Cl.** ..... **212/39 R,** 340/267 C

[51] **Int. Cl.** **B66c 13/48**

[58] **Field of Search** ..... 212/39 R, 39 I, 39 MS; 340/267 C

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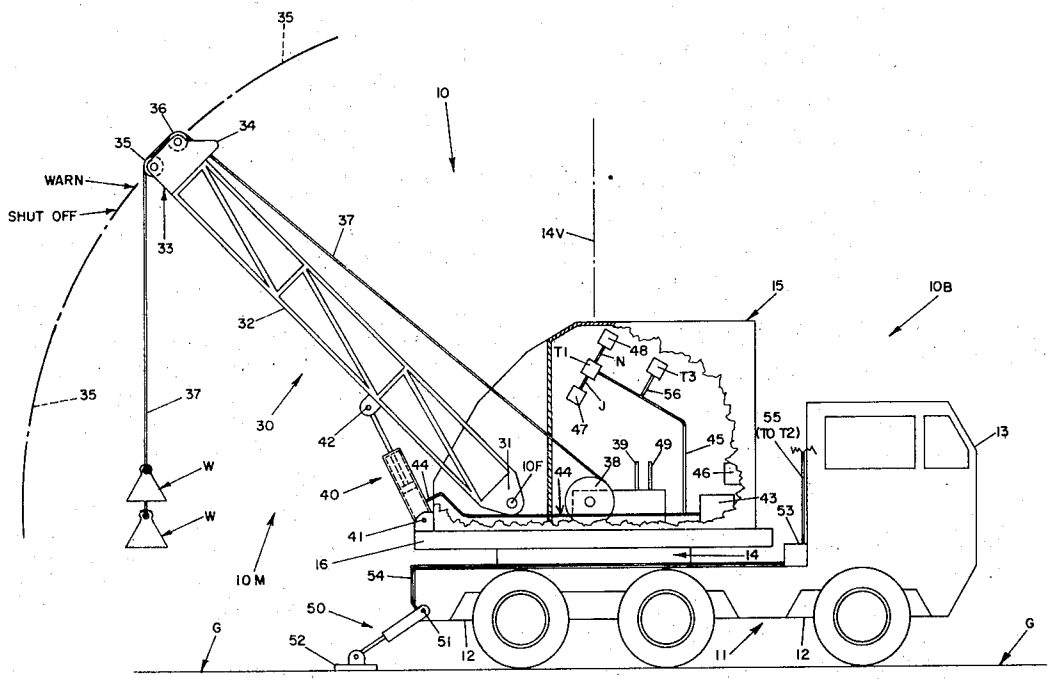
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Assistant Examiner—H. S. Lane
Attorney—George R. Nimmer

[57] **ABSTRACT**

Cranes, forklift trucks, and other burden manipulation apparatus generally comprise an elongate boom or other burden member of controllably variable moment with respect to the normally stably supported weighty base member of the apparatus. The present invention discloses a moment monitoring system so as to caution or apprise the apparatus operator that the burden member moment has attained an arbitrarily prescribed subcritical-level which is somewhat below the moment critical-level (i.e., the burden moment at which the base member and the entire apparatus is rendered unstable and inoperative). The moment monitoring system generally comprises sensing means of the variable liquid pressure type to sense when the controllably variable burden has attained the selected subcritical-level, said sensing means actuatably extending from the apparatus burden member to the base member thereof and being connected through a hydraulic-electrical transducer to caution the apparatus operator of said subcritical-level and allow him to take moment-reducing corrective action. If the operator fails to take corrective action at the moment subcritical-level, the apparatus burden manipulation power can be made to automatically shut-off at the burden moment proxcritical-level, thus averting disaster.

5 Claims, 8 Drawing Figures



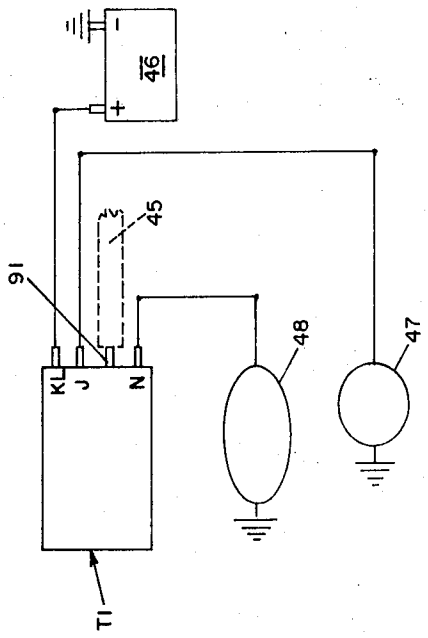

46
91
45
48
47
K1
J
N
T1

FIG. 1A

10B
13
G
12
11
15
55
(TO T2)
53
43
14
45
46
T3
56
49
48
N
J
39
38
47
T1
44
14V
10F
31
10
12
51
44
54
37
42
40
41
16
50
52
35
34
30
32
10M
G
36
33
37
W
W
35
WARN
SHUT OFF
35

FIG. 1

FIG. 2

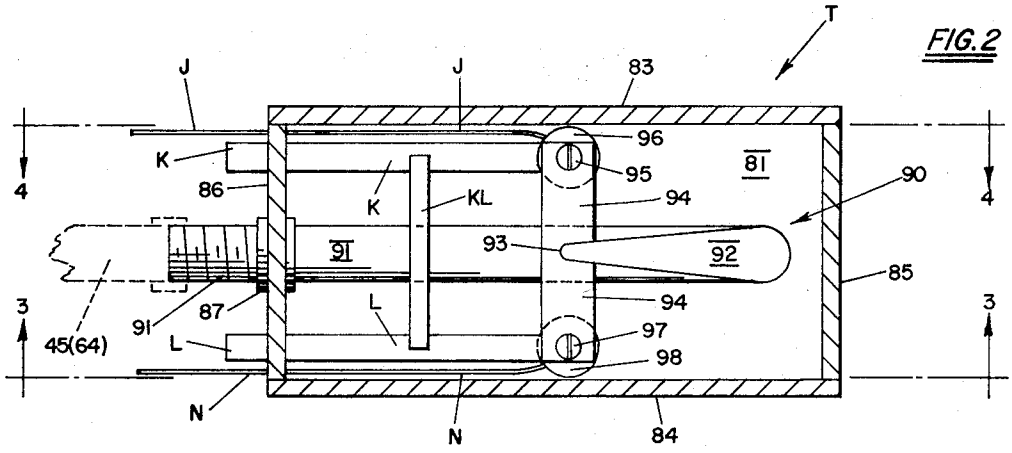


FIG. 3

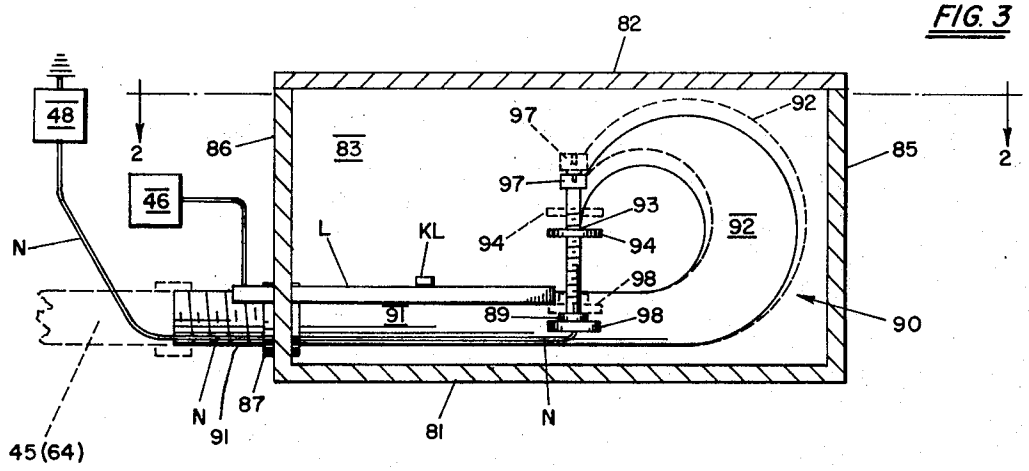
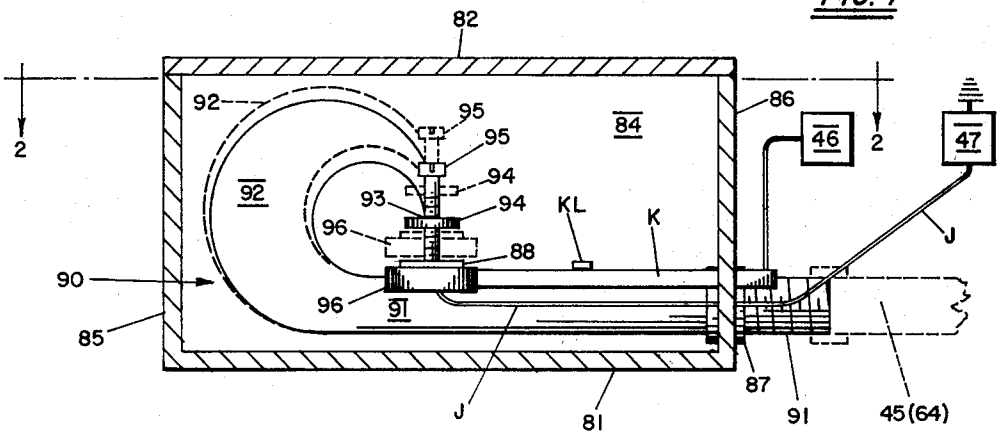


FIG. 4



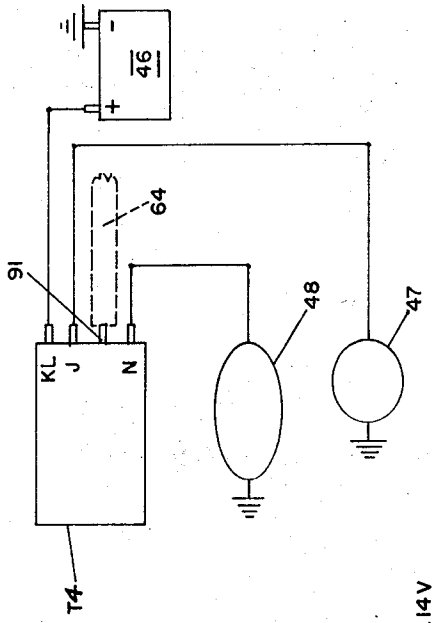
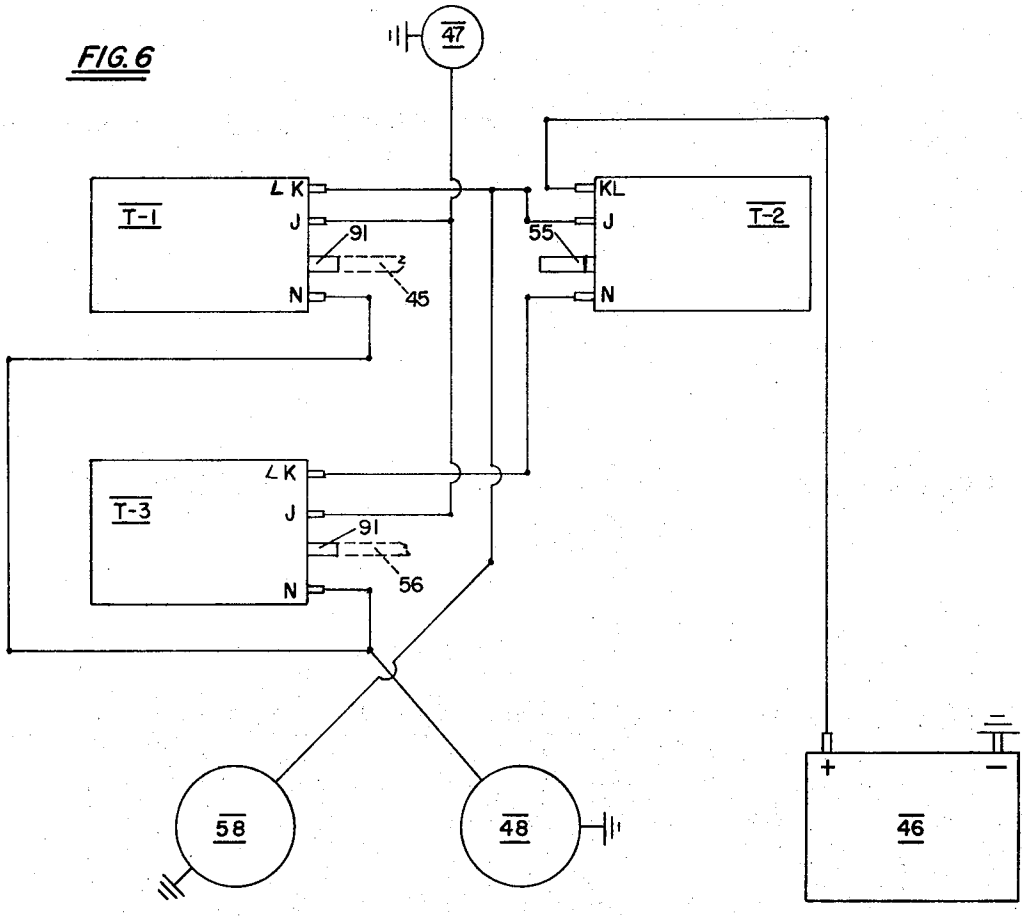

46
64
91
48
47
KL
J
N
T4

FIG. 5A

10B
13
G
12
11
15
46
18
14
67
68
69
39
38
14V
48
N
J
47
T4
60
64
61
17
10F
31
63
62
37
10
67
67
16
32
10M
35
34A
34
36
33
37
W
W
35
WARN
SHUT OFF
35

FIG. 5

FIG. 6



MOMENT MONITORING SYSTEM FOR BOOM-CABLE TYPE CRANES

Cranes, forklift trucks, "tuggers," fire-ladder trucks, elongate boom service vehicles, etc., are sometimes generally referred to as "normally stable burden manipulation apparatus of the controllably variable moment type." For such class of apparatus, there is a weighty base member normally stably supported upon the earth or other suitable underlying substrate whereby at apparatus stable conditions the base member extends vertically along an upright-axis and the apparatus center-of-gravity is encompassed within the base member. Such apparatus class further comprises a burden member laterally offset from the base member upright-axis and supported by the underlying substrate through the base member. If the operator allows the burden moment to become too great with respect to the base member upright-axis, the apparatus center-of-gravity will be shifted too far laterally; the base member and the entire apparatus will no longer be stably supported upon the underlying substrate, but rather might topple-over or otherwise be rendered inoperative. Sometimes the burden member moment is determined by constant lateral distance and variable load, as exemplified by "tuggers." Or, the burden member moment can be determined by constant load and variable lateral distance from the base member upright-axis, such as in the case of fire-trucks with extensible oblique ladders. And, for analagous situations to forklift trucks and cranes, the burden member moment is determined by variable load and variable distance from the base upright-axis. In any of the said three sub-classes of controllably variable burden moment apparatus, the operator must be very attentive to the manner in which he controlls the powered burden manipulation least its moment becomes so great as to render the apparatus unstable and inoperative. For example, there are many recorded histories of operating cranes and forklift trucks where the burden moment with respect to the upright-axis had reached the critical-level and the apparatus toppled thereby injuring the apparatus operator. Attainment of the moment critical-level happens not only to unskilled and inattentive operators, but can also be caused by non-operator factors such as mis-labeled loads, mis-functioning lateral distance controls, uneven substrates, etc.

It is accordingly the general object of the present invention to provide a moment monitoring or surveilance system for cranes, forklift trucks, and other kinds burden manipulation apparatus, the system cautioning or otherwise apprising the apparatus operator that the burden member has attained an arbitrarily prescribed subcritical-level which is near to, but safely less then, the critical-level moment which would render the apparatus unstable.

It is a specific object to provide a moment monitoring system for various kinds of burden manipulation apparatus wherein the system provides an audible or visual warning to the operator whenever the burden moment has attained a selected subcritical-level. It is an ancillary object to provide moment monitoring systems wherein, if the operator fails to heed or to take moment-reduction corrective action at the subcritical-level, the system at a proxcritical-level automatically shuts-off the power to the apparatus burden manipulation.

It is another object to provide moment monitoring systems for burden manipulation apparatus of various burden manipulation means, such as through driven cables, hydraulic power, etc. Exemplifying this object are hydraulic or cable types cranes of various sophistication, hydraulic or cable type forklifts.

It is yet another object to provide moment monitoring systems admirably adapted for cranes of various design and sophistication, as well as for other burden manipulation apparatus.

With the above and other objects and advantages in view, which will become more apparent as this description proceeds, the moment monitoring system for burden manipulation type apparatuses generally comprises sensing means of the variable liquid pressure type to sense when the controllably variable moment burden has attained an arbitrarily prescribed subcritical-level, said variable liquid pressure sensing means actuatably extending from the apparatus burden member to the base member thereof, said liquid pressure sensing means being connected through a hydraulic-electrical transducer to apprise the apparatus operator that the prescribed subcritical-level of burden moment has been attained whereby he might take corrective action to decrease the burden moment and prevent the base member and the entire apparatus from being rendered unstable and inoperative.

In the drawing, wherein like characters refer to like parts in the several views, and in which:

FIG. 1 is a side elevational view of a typical burden manipulation apparatus with which the moment monitoring or surveilance system of the present invention might be employed, herein a crane wherein the elongate pivotal boom is angularly controlled with a hydraulic cylinder.

FIG. 1A is a simplified circuit diagram schematically indicating for FIG. 1 primary functions of the monitoring system hydraulic-electrical transducer.

FIG. 2 is a top plan view of a respresentative form of a hydraulic-electrical transducer which might be utilized for the burden moment monitoring systems, including the systems of FIGS. 1 and 5.

FIG. 3 is a sectional elevational view taken along line 3—3 of FIG. 2.

FIG. 4 is a sectional elevational view taken along line 4—4 of FIG. 2.

FIG. 5 is a side elevational view of another kind of typical burden manipulation apparatus with which the moment monitoring systems of the present invention might be employed, herein a crane wherein the elongate pivotal boom is angularly controlled with a drum-wound cable.

FIG. 5A is a simplified circuit diagram similar to FIG. 1A schematically indicating for FIG. 5 primary functions of the monitoring system hydraulic-electrical transducer.

FIG. 6 is a circuit diagram similar to FIG. 1A, but wherein a typical crane is provided with outrigger stabilizers for the apparatus base member.

FIG. 1 illustrates a typical apparatus of the burden manipulation class with which the moment monitoring system concept of the present invention might be employed. Such typical apparatus (e.g. as crane 10), comprises a weighty base member (herein generally referred to as 10B) normally stably supported upon a suitable underlying substrate (e.g., earth's surface G) whereby at apparatus stable conditions the base mem-

ber extends vertically along an upright-axis (14V). The selected typical apparatus further comprises a burden member (herein generally referred to 10M) laterally offset from the base member upright-axis and supported by the underlying substrate wholly through the base member. Burden member 10M comprises an elongate boom 30 having its butt end 31 pivotably attached at 10F to the base member carriage portion 15 and further comprises a load (as weights W) depending from the boom tip 33 whereby said burden member exhibits a moment, horizontally distance measured from the base member upright-axis (14V), and dependent upon the combination of load W plus the weight of boom 30. Thus, as boom 30 pivots about 10F and its tip portion circumscribes arcuate locus 35, the burden moment is adapted to increase and even to the critical-level extent where the base member is rendered unstable with respect to its substrate (G) thereby rendering the apparatus inoperative or even toppled. The moment monitoring system of the present invention is intended to caution the apparatus operator whenever the moment attains an arbitrarily prescribed subcritical-level, as by first "warning" him and (if necessary) by a subsequent automatic "shutoff" for the apparatus burden manipulation power. The monitoring system generally comprises sensing means of the variable liquid type and extending from the apparatus burden member to the base member so as to sense when the burden moment has attained an arbitrarily prescribed subcritical-level, and also comprises a hydraulic-electrical transducer actuatably connected to the sensing means to caution the apparatus operator that the prescribed subcritical-level has been attained.

FIGS. 2–4 illustrate a representative form of a hydraulic-electrical transducer, sometimes hereinafter referred to generally as "transducer" or T, which is adapted to convert the delta-pressure sensing means into the operator cautioning means. Transducer T comprises a housing herein having six rectangular panels, including four upright panels, a horizontal floor-panel 81, and a horizontal removable roof-panel 82. Among the four upright panels is included a left-panel 83, a right-panel 84, a rear-panel 85, and a front panel 86. Positioned between panels 83 and 84 is a pressure-spring 90 of the Bourdon-Tube type and including a generally horizontal leading portion 91 intersecting front-panel 86 (and secured thereat with collar 87), said pressure-spring extending rearwardly therefrom parallel to housing floor-panel 81 toward rear-panel 85. Pressure-spring 90 also includes a generally C-shaped portion 92 having a progressively decreasing tubular diameter terminating at the pressure-spring narrowed trailing-end 93, a horizontal bar 94 being rigidly attached to trail-end 93. Thus, as the variable liquid pressure sensing means is introduced into the tubular pressure-spring 90 through its larger diameter leading portion 91, (as indicated at connections 45 and 64) progressively higher liquid pressures will cause the trailing-end 93 and bar 94 to elevate progressively higher above floor-panel 81 and bar 94 remains parallel to 81. As will be pointed out, progressively higher elevations for the pressure-spring trailing-end 93 is sensed electrically through relatively movable contacts so as to caution the apparatus operator relative to the burden moment.

While the transducer T might provide only one signal to the operator, two signal stages at two liquid pressure levels are preferred. For example, the hydraulic-electrical transducer T might include two horizontal electrically conductive contact-plates K and L passing through and maintained at constant elevation by housing front-panel 86. Although constant elevation contact-plates K and L are physically located on opposite sides of pressure-spring 90 whereby screw 95 overlies contact-plate K and screw 97 overlies contact-plate L. The lower end of screw 95 carries an electrical-insulator 88 to which is attached an electrically conductive tall disc 96; an electrical conductor wire J is revolvably or flexibly attached to disc 96 and proceeds therefrom through housing front-panel 86. Similarly, the lower end of screw 97 carries an electrically insulative member 89 to which is attached an electrically conductive short disc 98; an electrical conductor wire N is revolvably or flexibly attached to disc 98 and proceeds therefrom through the housing front-panel 86. Thus, by virtue of the independently adjustable screws 95 and 97, the elevation of the respective electrically conductive discs 96 and 98 with respect to bar 94 can be independently established and the transducer calibrated thereby. For example, the elevation between disc 98 and contact-plate L can be established to be such that: for any liquid pressure change of pressure-spring 90 and a desired finite elevation increase of bar 94 above co-elevation contact-plates K and L, conductor wire N will initiate a warning to the apparatus operator at a subcritical-level moment before conductor wire J will shut-off or disable the moment control power at a proxcritical-level. As will be pointed out later, the transducer T will need to be calibrated for each apparatus class depending upon stability characteristics of its base member and the burden member moment range.

Returning to the apparatus of FIG. 1 for a more detailed description thereof, crane 10 is of the hydraulically actuated type which means that a hydraulic pump 43 provides the powering means for varying the burden moment. The base member 10B for crane apparatus 10 comprises a flat bed truck 11 including cab 13 and a horizontally extending frame 12 having depending wheels whereby the weighty base member is stably supported upon the earth G underlying substrate. Base member 10B further comprises a carriage 15 revolvably supported at 14 upon frame 11 and revolvable about upright-axis 14V, carriage 15 being provided with an operator's seat accessible to operator controls (39, 49). There is a powerably revolvable drum 38 (controlled at 39) for winding load-cable 37 which passes from drum 38 to pulleys 35 and 36 at boom tip portion 33, the load W being attached to load-cable 37. Boom 30 has a controllably variable angle with respect to upright-axis 14V, as through hydraulic cylinder 40 having its casing pivotably attached at 41 to base member frame 11 and its piston pivotably attached at 42 to the boom medial portion 32. The burden member (boom 30 and load W) has a variable moment with respect to the base member upright-axis 14V as the boom angle is made to increase with respect to 14V. Herein the burden member moment variation powering means is the hydraulic pump 43 (controlled by operator lever 49) which is motivated by the base member power-plant (e.g., ignition coil 47). Oil liquid is forced from pump 43 along hose 44 to determine the length of cylinder 40 thereby determining the angularity of pivotal boom 30.

It can be readily appreciated that as the boom 30 angle with respect to upright-axis 14V increases, the increasing moment is exhibited or sensed as increasingly higher liquid pressures in cylinder 40 and in hose 44. For the purposes of the burden moment monitoring system of the present invention, a hose line 45 is employed to communicate with hose line 44 and extends to the pressure-spring leading portion 91 of transducer T1, shown mounted to base member carriage 15. Thus, as the boom 30 angle to upright-axis 14V increases, the increasing burden moment will cause the pressure-spring trailing-end 93 (and attached bar 94) to increase in elevation as indicated in phantom line in FIGS. 3 and 4, thereby elevating movable-contacts 96 and 98. Calibration of transducer T for a burden manipulation apparatus 10 having a critical-level moment of some known foot-pounds value Y might be as follows. First, there is arbitrarily selected some subcritical-value-level less than Y (e.g., 0.90Y foot-pounds), Which needs to be mathematically correlated in Z pounds per square inch through the variable liquid pressure sensing means, e.g., cylinder 40, slide pump 60, etc. Testing equipment (not shown) comprising a liquid reservoir, a pump, and a pressure gauge, is removably attached to the pressure-spring leading portion 91 of the transducer T and the liquid pressure is built-up to the Z p.s.i.(correlating to the selected subcritical-level). At the maintained Z p.s.i. level, one or both of the transducer screws (95,97) is appropriately adjustably calibrated. For example, at Z psi short disc 98 should be arriving at contact-plate L while the lower end of tall disc 96 is at contact-plate K. Then, at the correlated Z-plus p.s.i. for the proxcritical-level, the lower end of disc 96 should be above contact-plate K. A bell, horn, light, or other warning device 48 is attached to base member 15 and electrically connected with wire N to disc 98. An electrical voltage (e.g., battery 46) is attached to base member 15 and electrically connected with wire J to both contact-plate K and L(e.g., through connector-strip KL). The burden moment manipulation powering means (e.g., ignition coil 47) is attached with wire J to disc 96. Thus, if the operator of crane 10 should allow the moment of burden member 10M to reach the subcritical-level, the operator would be cautioned by the warning device 48. If the operator fails to heed the warning and the burden moment attains the proxcritical-level, the burden manipulation powering means (e.g., pump 43 through coil 47) is automatically shutoff. Then, the operator would need to intervene and drop the load (load-cable 37 and W) to G so that the delta-pressure sensing means (e.g., 40,60) becomes reduced and the burden powering means through 47 is re-startable under lower and safer burden moment conditions.

Turning now to FIG. 5, the crane apparatus shown is of the boom-cable type which means that a boom-cable 67 windable about a drum 68 provides the powering means for varying the burden moment. In particular, the drum 68 is powerably revolvable through the base member power-plant (e.g., including ignition coil 47), the operator being able to control the degree of drum rotation through control lever 69. Boom-cable 67 extends from drum 68 to carriage pulley 18, thence to a pulley 34A carried by the lug 34 of boom tip portion 33, and finally the boom-cable "dead end" is attached to the base member carriage 15 e.g., at lug 17. It can be readily appreciated that as the boom 30 angle with respect to upright-axis 14V increases, the increasing moment is manifested as increasing tension upon boom-cable 67. For the purposes of the moment monitoring system of the present invention, a conventional reciprocatable or slide pump 60 having oil or other flowable liquid therein is interposed as a link for the boom-cable; thus, increases in the burden moment and the boom-cable tension will be exhibited or sensed as increasingly higher liquid pressures in pump 60 and in hose 64. Reciprocatable pump 60 substantially comprises an outer casing 61 (herein attached to carriage lug 17) and further comprises a piston portion 62, the narrowed axial shaft of which remote of casing 61 being attached to boom-cable 67.

Hose 64 passes through the pump casing 61 and proceeds therefrom to the pressure-spring leading portion 91 of transducer T4, which is structurally identical to T1 and mounted to base member 15. Thus, as the boom 30 angle to upright-axis 14V increases, the increasing burden moment will cause the pressure-spring trailing-end 93 (and attached bar 94) to increase in elevation thereby elevating movable-contacts 96 and 98. Accordingly, if the operator through lever 69 were to allow the burden member moment to reach the subcritical-level, the operator would be cautioned by a warning device 48. If the operator fails to heed the warning, and the burden moment attains a proxcritical-level, the burden manipulation powering means (e.g., drum 68 through coil 47) is automatically shutoff. Then, the operator would need to intervene and release the drum 68 and drop the load (load-cable 37 and W) to substrate G so that the delta-pressure sensing means 60 indicates a very low value. Thus, the transducer T allows the power-plant (e.g., coil 47) to be re-started and the operator through lever 69 and drum 68 to abruptly decrease the burden moment. If pump 60 were to leak so as to be substantially devoid of fluid liquid therein, the moment monitoring system would not operate. Hence, there is a liquid pressure indicator, such as pressure-gauge 63, for slide pump 60. To relieve the operator from surveiling pressure-gauge 63, there can be electrical switches on pump 60 to indicate an absence of liquid therein (i.e., piston 62 becomes freely extended from casing 61). In this vein, the electrical circuitry for ignition coil 47 might pass through the proposed electrical switches on pump 60 to disable the burden manipulation power whenever the liquid has been accidentally drained from pump 60.

Oftentimes cranes and other burden manipulation apparatus are provided with "outriggers" which are controllably downwardly extendable from the base member to firmly abut the underlying substrate. Thus, the use of "outriggers" will effectively lower the base member center-of-gravity whereby the burden moment critical-lever is higher. Accordingly, the arbitrarily prescribed subcritical-level and the proxcritical-level can be greater. In this vein, a higher liquid pressure for the monitoring system sensing means is needed to actuate the warning 48 whenever outriggers are engaged; on the other hand, a lower liquid pressure actuates warning 48 whenever outriggers are "up"(i.e., not in use). For example, in the typical crane apparatus situation, and arbitrarily shown in FIG. 1, outrigger 50 is of the hydraulically actuatable type including a casing 51 pivotably attached to the base member frame 11 and an extendable piston portion having a head-end 52 adapted to abut against substrate G. Pump 53 forces

liquid along hose 54 to actuate outrigger 50, the base member power-plant (e.g., through coil 47) powering pump 53. A hose 55 extends from hose 54 to the pressure-spring leading portion 91 of transducer T2 (structurally like T1, T3, T4) which is attached to base member carriage 15. A hose 56 proceeds from hose 45 to the pressure-spring leading portion 91 of transducer T3 which is also attached to carriage 15. As seen in FIG. 6, whenever the outrigger is not in use (i.e., up and not engaged with substrate G) the resultant relatively low pressure in hose 55 and connected to transducer T2 keeps outrigger-light 58 "on," reminding the operator of the outriggers "up" condition. Transducer T3 is calibrated so that relatively low liquid pressures (from hose 56) will make T3 respond electrically as compared to transducer T4 (supplied with delta-liquid pressure from hose 45).

From the foregoing, the construction and operation of the moment monitoring systems will be readily understood and further explanation is believed to be unnecessary. However, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction shown and described, and accordingly, all suitable modifications and equivalents may be resorted to, falling within the scope of the apended claims.

I claim:

1. In a boom-cable type crane burden manipulation apparatus comprising a weighty base member normally stably supported upon a suitable underlying substrate whereby at apparatus stable conditions the base member extends vertically along an upright-axis, said crane further comprising an elongate boom burden member having a tip end located remotely laterally offset from the apparatus base member upright axis and also having a butt end pivotably attached to said base member whereby the elongate boom is supported by the underlying substrate through the weighty base member, said crane apparatus boom-cable being controllably windable about a powerably revolvable drum located at the base member and proceeding from said drum to the boom tip end and thence ultimately connected at the boom-cable dead end to said base-member, said crane apparatus base member also including drum powering means and ancillary operator controls for said revolvable drum thereby permitting selectable burden moment changes with respect to the stable base member upright-axis and upon reaching a critical-level the burden moment will render the base member unstable with respect to the underlying substrate and to the detriment of said crane's stability, the improvement of burden moment monitoring system and comprising:

A. Sensing means of the variable liquid pressure type and comprising a reciprocatable pump interposed as a connector link between the boom-cable dead-end and the apparatus base member and located in the vicinity of the boom butt end and said sensing means also comprising an elongate hose through which is urged increasing magnitudes of liquid pressure from said pump as the boom-cable at increasing burden moment conditions exerts increasing tension upon said pump connector link; and

B. At least one transducer of the hydraulic-electrical type actuatably connected to a stationary hose portion of said variable liquid pressure sensing means, and a warning indicator electrically connected to the transducer to caution the crane apparatus operator and personnel that some prescribed subcritical-level of liquid pressure from the hydraulic pump has been attained whereby the crane operator through said powering means may take corrective action through said revolvable drum to decrease the burden moment and thereby prevent the base member and the entire crane apparatus from being rendered unstably supported on the underlying substrate.

2. The burden moment monitoring system of claim 1 wherein the hydraulic pump is of the internal slidable type that is fully longitudinally extended when there occurrs an absence of liquid therein, said hydraulic pump being also electrically connected through the transducer to the crane drum powering means and to automatically shut-off same whenever the hydraulic pump is substantially devoid of liquid, and wherein the entire hose length from the hydraulic pump connector link to the hydraulic-electrical transducer remains stationary during hydraulic actuation of the transducer by the pump sensing means.

3. The moment monitoring system of claim 1 wherein the operator cautioning means is adapted to occur in two distinct stages, the first stage being as a warning that the arbitrarily prescribed moment subcritical-level has been attained, the second stage at an arbitrarily prescribed proxcritical-level providing automatic shut-off to the powering means for the burden moment variation and occurring if the operator had failed to controllably decrease the burden moment through the powering means therefor, said arbitrarly prescribed proxcritical-level being of intermediate moment value to the subcritical-level and the critical-level.

4. The moment monitoring system of claim 3 wherein the hydraulic-electrical transducer comprises a Bourdon-Tube type pressure-spring having a narrowed trailing-end adapted to change elevation and in degree according to the liquid pressure introduced thereinto, the transducer also comprising for the electrical switch means two pair of electrical contacts and each pair including a stationary-contact of constant elevation and a movable-contact co-movable with the pressure-spring trailing-end, one contacts pair being adjustably calibrated to ensure relative movement therebetween whenever the burden moment attains said subcritical-level whereby operator warning occurs, the other contacts pair being independently adjustably calibrated to ensure relative movement therebetween as the burden moment attains said proxcritical-level whereby burden manipulation power shutoff occurs.

5. The moment monitoring system of claim 1 wherein the crane base member has optional outriggers firmly downwardly abuttable against the earth's surface whereby the crane base member center-of-gravity is lowered during use periods of said outriggers, said outriggers being tied into the warning means so that when outriggers are down against the substrate a higher liquid pressure is required to actuate the warning means than when outriggers are up.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,771,667 Dated November 13, 1973

Inventor(s) James M. Becker et al.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the patent heading, item [76] should read as follows:

-- Inventors: James M. Becker, 5112 North 78th St.

and William E. Jackson, 3762 Ernst St., both of Omaha, Nebr. --.
Zip codes 68134 and 68112, respectively.

Signed and sealed this 30th day of April 1974.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

FORM PO-1050 (10-69)

USCOMM-DC 60376-P69
★ U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334.