July 7, 1964 E. C. BREKELBAUM ETAL 3,139,988

INDICATOR FOR CRANES AND THE LIKE

Filed July 24, 1962 2 Sheets-Sheet 1

FIG 1

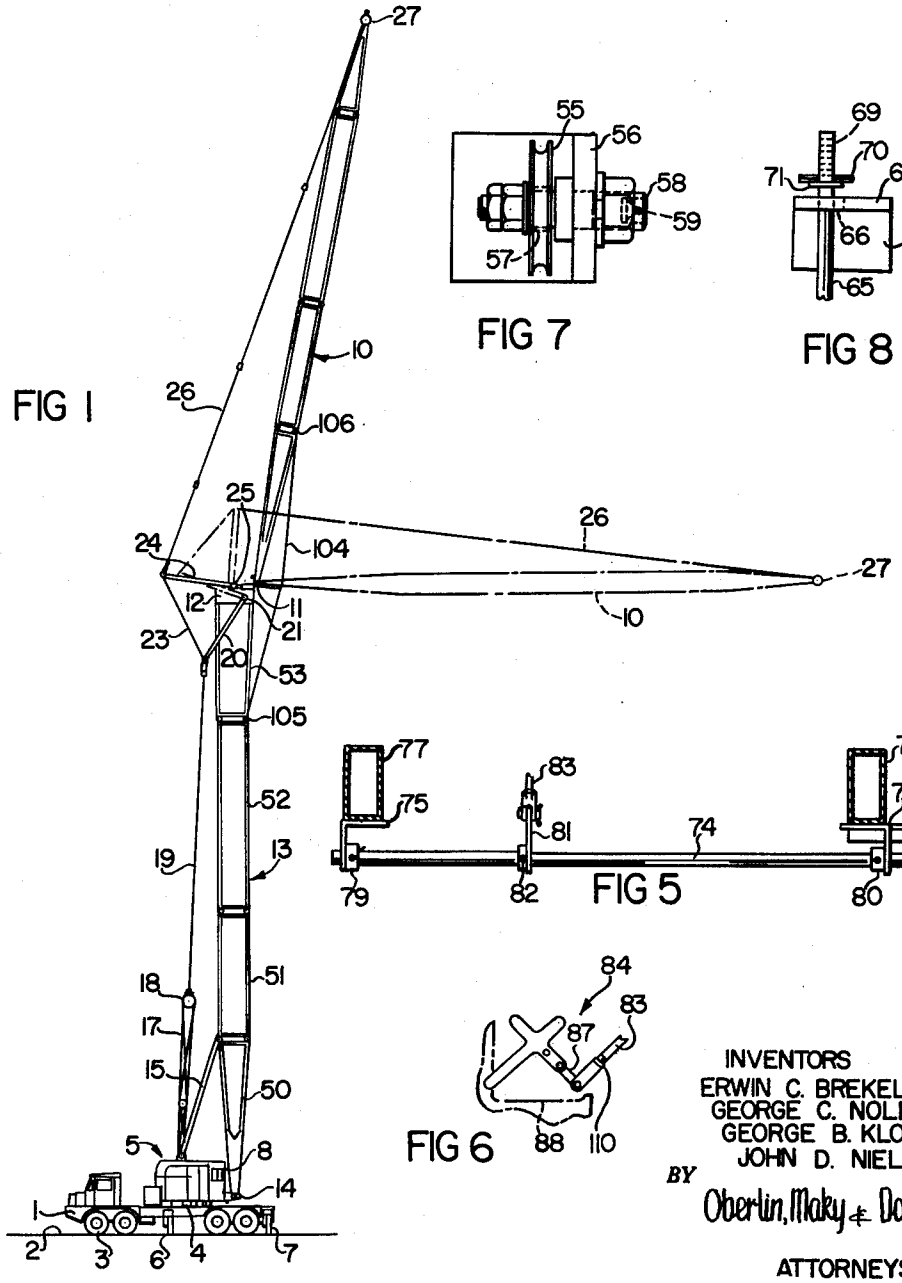


FIG 7

FIG 8

FIG 5

FIG 6



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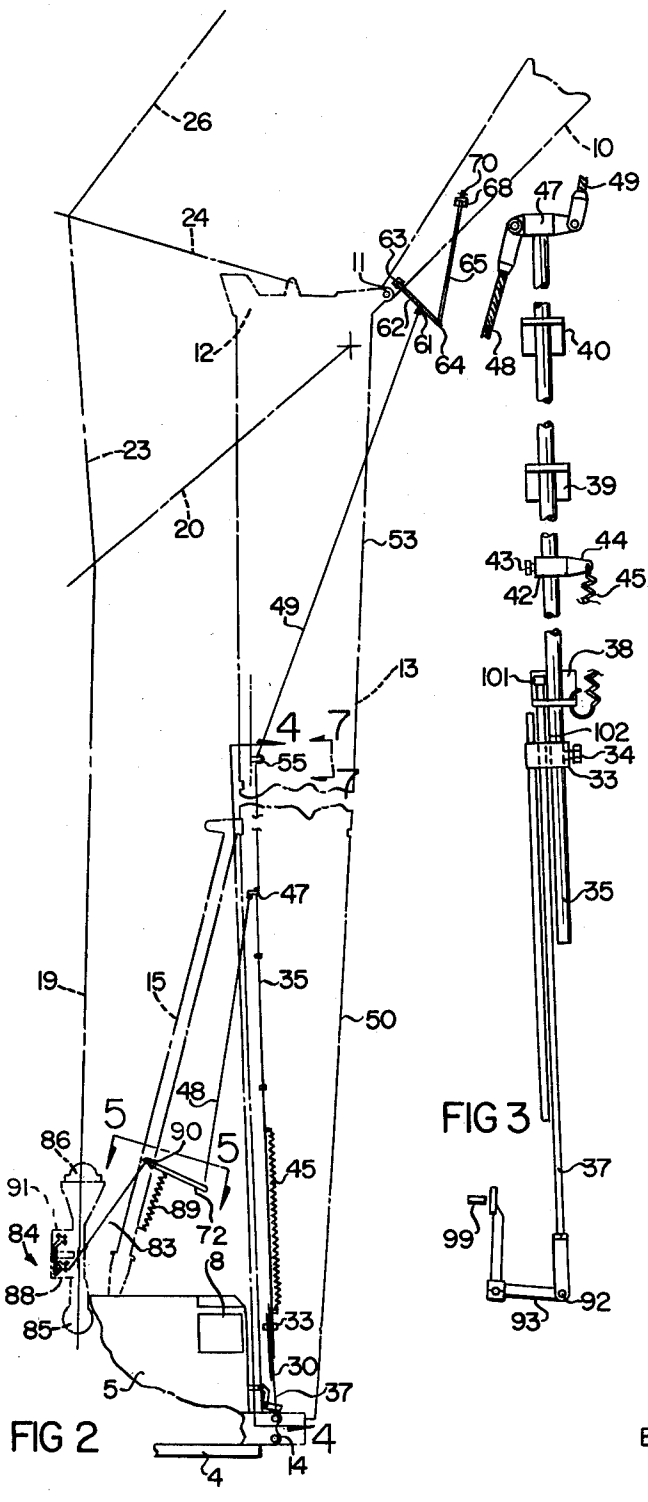


FIG 2

FIG 3

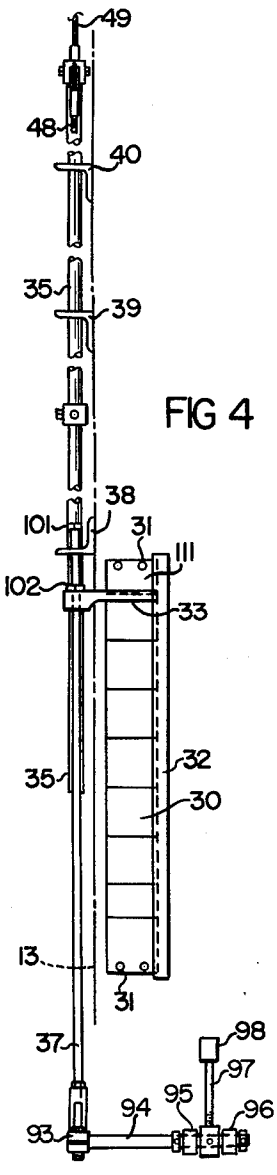


FIG 4

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United States Patent Office 3,139,988 Patented July 7, 1964

3,139,988

INDICATOR FOR CRANES AND THE LIKE

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Filed July 24, 1962, Ser. No. 212,090
10 Claims. (Cl. 212—39)

This invention relates generally, as indicated, to an indicator for cranes and the like and more particularly to a boom position indicator for cranes of the type wherein the operator is remotely situated from the operating boom. More particularly, this invention constitutes certain improvements in a tower crane as exemplified by the disclosure of the copending application of John I. Jones et al., Serial No. 86,166, entitled "Crane," filed January 31, 1961, now Patent No. 3,083,837.

In such application, there is disclosed the unique tower crane wherein the standard operating crane boom is pivotally attached to the peak of a tower boom fixed to the crane turntable which is mounted on a rubber tire carrier. In such a crane, the standard operating boom is thus elevated by the height of the tower and the foot of the operating boom may then be approximately 100 feet or more above the operator. Such cranes have been found to be particularly advantageous in the erection of buildings and especially in the pouring of concrete for floors or columns in the interior of a building. In such operations, a major portion of the operating boom may be obscured from the direct vision of the operator in addition to being substantially elevated from the operator. Accordingly, it is desirous to have some form of indicator readily visible to the operator which will convey to him the approximate angle of the operating boom which, of course, is a direct factor in the reach or radius of the particular load such as a concrete pouring bucket.

It is accordingly a principal object of the present invention to provide a crane boom position indicator for an operator situated remotely therefrom.

A further principal object is the provision of a crane boom indicator which will convey to the operator the angulator position of the operating boom so that the operator will know approximately where his load is positioned without having direct visual access thereto.

Another object is the provision, in a tower crane of the type having a tower boom with an operating boom pivoted to the peak thereof, of an indicator relating to the operator at the foot of the tower the angular position of the operating boom.

Yet another object is a mechanism directly linked to the operating boom of such a crane which will convey to the operator an approximation of the operating boom angle.

A still further object is the provision of such mechanism which will not only give the operator such visual indication of the operating boom angle, but which will also operate a safety boom hoist throw-out when a maximum boom angle is obtained and which will also operate a safe load indicator, such maximum safe load varying directly with the angle of the operating boom.

Other objects and advantages of the present invention will become apparent as the following description proceeds.

To the accomplishment of the foregoing and related ends, the invention, then, comprises the features hereinafter fully described and particularly pointed out in the claims, the following description and the annexed drawings setting forth in detail a certain illustrative embodiment of the invention, this being indicative, however, of but one of the various ways in which the principle of the invention may be employed.

In said annexed drawings:

FIG. 1 is a side elevation of a tower crane of the type with which the present invention may be employed;

FIG. 2 is a fragmentary side elevation of such crane on a somewhat enlarged scale showing the employment of the present invention with the booms and the reeving system therefor shown in phantom lines;

FIG. 3 is a fragmentary enlarged elevation of a portion of the present invention taken from FIG. 2;

FIG. 4 is an enlarged fragmentary front elevation corresponding to FIG. 3 but taken substantially from the line 4—4 of FIG. 2;

FIG. 5 is an enlarged fragmentary section illustrating the safe load indicating mechanism taken substantially on the line 5—5 of FIG. 2;

FIG. 6 is an enlarged fragmentary detailed view of such safe load indicating mechanism;

FIG. 7 is a detail view taken substantially on the line 7—7 of FIG. 2; and

FIG. 8 is an enlarged fragmentary detailed view illustrating the connection between the support rod and the operating boom.

Referring now to the drawings and more particularly to FIG. 1, there is illustrated a tower crane of the type disclosed in the aforementioned Jones et al., application, Serial No. 86,166, now Patent No. 3,083,837. Such a machine comprises essentially a tower attachment for a standard rubber tire mounted crane thus affording a substantial amount of mobility to the crane having substantially increased reach and load capacities especially useful in the construction of buildings. The crane is mounted on a carrier **1** which is supported on the ground **2** by means of rubber tires **3**, such being at least eight in number as shown. On the carrier frame **1**, there is provided a turntable **4** for the crane superstructure generally indicated at **5**. Hydraulically operated outriggers **6** and **7** may be employed quickly and easily to stabilize and level the machine at the desired site of operation. The crane operator will be positioned in the cab **8** within the superstructure **5** and such operator will control the positioning of the standard or operating boom **10**, the foot of which is pivoted at **11** to the peak **12** of the tower boom **13**. The foot of the tower boom is mounted on a special adapter on the superstructure frame as indicated at **14** and a mast **15** may be pin-connected between the tower **13** and the peak of the A-frame in the superstructure **5** rigidly securing the tower in its shown vertical position.

The reeving system shown generally at **17** extends about a harness **18** which is connected to a derricking line **19** which is in turn fixedly connected to the distal end of a lower mast **20** pivoted at **21** to the peak **12** of the tower boom **13**. Pendant **23** connects the distal end of the lower mast **20** with the distal end of the upper mast **24** which is pivoted to the peak **12** of the tower as indicated at **25**. Boom pendants **26** may then be employed to connect the distal end of the upper mast **24** with the peak **27** of the standard operating boom **10**. Reeving system may then be employed to move the operating boom through the operating range from the phantom line position indicated at **29** to the full line position. A load supported from the peak of the standard operating boom may then be spotted on the top of a building under construction by the angular positioning of the operating boom **10**.

It can now be seen that by employment of the tower attachment, the standard operating boom **10**, which would normally be connected to the crane superstructure frame at **14**, has been elevated by the height of the tower. The standard boom then has been displaced substantially from the view of the operator in the cab **8** by the height of the tower. In view of such displacement of the operator from the operating boom, an indicator conveying to the operator the approximate angular position of the op-

erating boom with respect to the tower will simplify the operation of the crane.

Referring now to FIGS. 2, 3 and 4, it will be seen that the crane boom position indicator comprises an indicator plate **30** which extends vertically in front of the operator's cab **8** secured to the tower boom **13** as by suitable fastening means such as screws **31**. The plate may, for example, be secured to one of the vertically extending chords of the tower boom. The indicator plate includes an elongated vertical guide **32** at one side thereof which receives the outer end of indicator **33** held by set screw **34** to vertically extending indicator tube **35**. The indicator **33** may be provided with two vertically extending apertures, one to receive the indicator tube **35** and the other adjacent thereto to receive pull rod **37**. The indicator tube is held firmly to the indicator by the set screw **34** and the pull rod **37** is freely slidable in the aperture in the indicator provided therefor. The indicator tube extends upwardly along the chord of the boom **13** through guide brackets **38**, **39** and **40**. Such brackets may each constitute angle members, one face of which is welded or otherwise secured to the chord of the tower boom and the other face being provided with an aperture slidably accommodating the tube **35** therein. A collar **42** may be secured to the tube **35** by means of set screw or the like fastener **43**, such collar being provided with a hook or the like **44** for one end of a spring **45**. The opposite end of the spring mechanism **45** may be secured to the bracket **38** as indicated, which is, of course, secured to the tower boom. In this manner, the spring **45** will tend continually to pull the tube **35** in a downward direction.

The top of the tube **35** has secured thereto a bracket **47** to which is pin-connected a crane overload indicator operating cable **48** and the main boom indicator operating cable **49**. The cable **49** extends upwardly from the base section **50** of the tower boom **13** through the intermediate sections **51** and **52** into the peak section **53** (note FIG. 1). In such peak section, there is provided a pulley **55** mounted on a bracket **56** and again, such bracket may comprise an angle secured to a chord of the boom. Such pulley **55** may be mounted on a bushing **57** and shaft **58** provided with a grease fitting **59** as shown and secured to the bracket **56** in the manner indicated.

From the pulley **55**, the cable **49** extends upwardly through the peak section **53** of the tower boom **13** and is secured by shackle **61** intermediate the ends of an indicator lever **62**. The indicator lever **62** is freely pivotally mounted on the operating boom **10** adjacent the foot **11** thereof as shown at **63**. The distal end of the lever **62** is pin-connected at **64** to a support rod **65** which extends through an enlarged opening **66** in the flange **67** of bracket **68** secured to the base section of the standard operating boom **10**. A plurality of transverse apertures **69** in the outer end of the support rod **65** accommodate a roll pin or the like **70** providing an adjustably positionable back-up for a washer **71** or the like. In this manner, the operating length of the support rod **65** may be adjusted by positioning the roll pin in any selected one of the various transverse apertures.

Referring now especially to FIGS. 2, 5 and 6, it will be seen that the cable **48** attached to the top of the indicator tube **35** is pin-connected to the distal end of an operating arm **72** which is secured as by a set screw or the like **73** to the end of the overload indicator operating tube **74**. Such tube is mounted in brackets **75** and **76** secured to the rectangular section tubular members **77** and **78** which comprise the mast **15** locking the tower boom to the peak of the A-frame of the superstructure **5**. Collars **79** and **80** secured inside the brackets **75** and **76** by means of set screws or the like serve properly to hold and space the tube with respect to such brackets. A relatively short indicator operating arm **81** may be secured to the tube **74** as by set screw **82** and a rod **83** extending from the distal end of such arm to the overload indicator as shown generally at **84** may be employed to operate the same in response to the angular position of the standard operating boom **10**.

Such overload indicator **84** may, for example, be of the type shown in Aitken U.S. Patent No. 2,988,040 interconnecting, for example, a fixed point **85** of the A-frame and sheave **86** of the reeving **17**. Such overload indicating devices are employed in cranes to give a visible and/or audible warning to the operator when the load imposed upon the crane approaches that which is greater than the safe-load for the particular radius at which the machine is operating. Thus the safe-load is a function of the radius or in other words a function of the angular disposition of the operating boom **10**. The rod **83** connected to the link **87** in the housing **88** may be employed to rotate a cam to adjust a movable fulcrum in the indicator housing to compensate for the radius of the load. Accordingly, as the operating boom elevates to the full line position shown in FIG. 1, the load that can be carried due to the smaller radius greatly increases. Since the indicator measures the tension on line **19**, for example, the safe-load is a function of this tension modified by the operating boom angle. Thus as the angle of the boom changes, the cable **48** and rod **83** and the interconnecting linkages automatically rotate the cam within the indicator housing compensating for the increased or decreased operating radius. A spring **89** may be secured between the operating arm **72** and a bracket **90** to maintain tension on the cable **48** in all operating positions of the mechanism. The second housing **91** shown interconnected to the first housing may contain a cam mechanism for use with over-the-side loads and can selectively be employed instead of the cam mechanism in housing **88**.

It can now be seen that the spring mechanisms **89** and **45** will tend to pull downwardly the cable **49** pivoting the indicator arm lever **62** always in a clockwise direction as viewed in FIG. 2 pulling the rod **65** through the bracket **68** to maintain the washer **71** in engagement with such bracket **68** to maintain the washer **71** in engagement with such bracket. Thus as the angle of the boom **10** changes, the indicator tube **35** will move up and down positioning the indicator **33** along the indicator plate **30** to give the operator a visual indication of the angle of the boom and the operating radius, and such mechanism automatically will operate the cam in the overload indicator **84** changing the maximum safe-load at which a further signal will be transmitted to the operator.

As a further safety measure, the pull rod **37** which extends freely through the indicator **33** is pivotally connected at **92** to an arm **93** clamped to the end of shaft **94**. Such shaft may be mounted on bushings **95** and **96** adjacent the tower boom adapter **14**. Between such bushings, there is mounted a boom throw-out crank **97** having a plate **98** on the end thereof adapted to engage a boom throw-out rod **99** which will force the boom operating lever automatically to kick out to disengage the hoisting mechanism for the boom **10** upon the obtaining of the maximum boom angle. Collars **101** and **102** may be secured to the pull rod on either side of the bracket **38** and it will be seen as the indicator **33** is elevated by the vertical upward movement of the indicator tube **35**, the indicator **33** will engage the collar **102** pulling upwardly the rod **37** to move the arm **93** in a counterclockwise direction as viewed in FIG. 3 to cause the plate **98** to engage the throw-out rod **99** when the boom **10** has obtained its maximum angular elevation disengaging the boom hoist clutch. Kelly stop cables **104** may be connected between the tower boom at **105** and the operating boom at **106** further to ensure that the boom **10** will not be elevated past its full line position.

When erecting or lowering the tower boom **13**, the standard operating boom **10** will be folded to lie adjacent and parallel to such tower. The standard operating boom will also be thus positioned during the movement of the carrier from one position to another at the

particular operating site. This can readily be accomplished without disturbing the indicator operating linkage since the support rod **65** is free to extend through the bracket **68** as the boom **10** is lowered or pivoted downwardly about the boom foot pivot **11**. Thus a lost motion connection is provided between the linkage and the operating boom. As the boom **10** is elevated about the foot **11**, the support rod will assume its position shown in FIG. 2 as the result of the pressure of springs **89** and **45**.

As seen in FIG. 4, the indicator plate **30** may be divided vertically into plate sections which will preferably be each of a different color. For example, reading in ascending order, the various squares may be plain, red, black, yellow, blue, green, white, black, and the uppermost being red. It will, of course, be understood that instead of the square blocks of different colors giving the operator an approximation of the boom angle, a scale may be employed more accurately to measure boom angle and thus the radius. In operation, the operator may by experience know that if the concrete bucket is to be deposited at radius of approximately 40 feet, the indicator will then be positioned between the black and white blocks near the top of the indicator plate by the proper positioning of the boom. The operator by experience will know that the area for pouring of concrete or the like is at approximately the position of one of the particular colored blocks.

To install and set the boom indicator linkage, an adjustment should be made by means of the threaded connection **110** shown in FIG. 6 between the rod and the crane safe-load indicator cam operating linkage. When the proper length of the rod **83** is obtained, all of the indicator linkage will be hooked up and the tower raised and locked in position. The standard operating boom will then be raised to its minimum radius position or the full line position indicated in FIG. 1. In such position, the minimum radius of 30 feet from the centerline of rotation of the turntable to the centerline of the hook block will be obtained. When in this position, the indicator **33** will then be set in the center of the top red block **111** and the set screw **34** may be employed to lock it in place on the indicator tube **35**. The collar **102** will be positioned on the pull rod **37** so that the indicator **33** will force the throw-out rod **99** to kick out the boom lever in cab **8** when the guide or pointer is just entering the red area of the block **111** at the top of the indicator plate. As the indicator or pointer descends along the indicator plate, the pull rod **37** will drop with the top collar **101** supporting the pull rod on the bracket **38**. Thus the pul rod is effective to operate the boom throw-out only as the indicator approaches the top red block with the pull rod **37** freely passing through the indicator during the remaining movement thereof.

It can now be seen that there is provided a boom position indicator for cranes which will present to the operator remotely situated from the operating boom a visual indication of the operating boom angle and thus the load radius. Moreover, the same linkage may be employed to operate the overload indicating mechanism to compensate such mechanism for changes in the boom angle. Also, the same mechanism may be employed with a lost motion connection to force the boom lever to kick out as the boom approaches its maximum elevation.

Other modes of applying the principle of the invention may be employed, change being made as regards the details described, provided the features stated in any of the following claims or the equivalent of such be employed.

We, therefore, particularly point out and distinctly claim as our invention:

1. A crane comprising an operator's cab, an operating boom adapted to be operated therefrom, an indicator visually accessible to said operator's cab, means responsive to changes in position of said operating boom to move said indicator visually to convey to said operator's cab the position of said boom, a tower, means mounting said operating boom at the peak of said tower, said operator's cab and accordingly said indicator being at the base of said tower and thus substantially removed from said operating boom, and linkage means interconnecting said indicator and said operating boom operative to move said indicator in response to changes in the angular position of said operating boom.

2. A crane comprising an operator's cab, an operating boom adapted to be operated therefrom, an indicator visually accessible to said operator's cab, means responsive to changes in position of said operating boom to move said indicator visually to convey to said operator's cab the position of said boom, a tower, means mounting said operating boom at the peak of said tower, said operator's cab and accordingly said indicator being at the base of said tower and thus substantially removed from said operating boom, linkage means interconnecting said indicator and said operating boom operative to move said indicator in response to changes in the angular position of said operating boom, and lost motion connection means in said linkage whereby said operating boom may be folded to lie parallel to said tower without affecting said linkage.

3. A crane comprising an operator's cab, an operating boom adapted to be operated therefrom, an indicator visually accessible to said operator's cab, means responsive to changes in position of said operating boom to move said indicator visually to convey to said operator's cab the position of said boom, a tower, means mounting said operating boom at the peak of said tower, said operator's cab and accordingly said indicator being at the base of said tower and thus substantially removed from said operating boom, linkage means interconnecting said indicator and said operating boom operative to move said indicator in response to changes in the angular position of said operating boom, and a crane overload indicator, said linkage means being also connected to said overload indicator to vary the maximum permitted load according to the operating boom angle.

4. A crane comprising an operator's cab, an operating boom adapted to be operated therefrom, an indicator visually accessible to said operator's cab, means responsive to changes in position of said operating boom to move said indicator visually to convey to said operator's cab the position of said boom, a tower, means mounting said operating boom at the peak of said tower, said operator's cab and accordingly said indicator being at the base of said tower and thus substantially removed from said operating boom, linkage means interconnecting said indicator and said operating boom operative to move said indicator in response to changes in the angular position of said operating boom, a boom hoist throw-out, and means responsive to the movement of said indicator to a position indicating maximum boom elevation to actuate said boom hoist throw-out to stop the boom hoist mechanism.

5. A crane comprising an operator's cab, an operating boom adapted to be operated therefrom, an indicator visually accessible to said operator's cab, means responsive to changes in position of said operating boom to move said indicator visually to convey to said operator's cab the position of said boom, a tower, means mounting said operating boom at the peak of said tower, said operator's cab being at the base of said tower and thus substantially removed from said operating boom, linkage means interconnecting said indicator and said operating boom operative vertically to move said indicator in response to changes in the angular position of said operating boom, said linkage means comprising a vertically movable indicator tube mounted on said tower, said indicator being secured to said indicator tube and movable therewith, and cable means connecting the top of said indicator tube with said operating boom operative vertically to move

said indicator tube and thus said indicator in response to angular changes in the position of said operating boom.

6. A crane as set forth in claim 5 including spring means operative actively to urge said indicator tube downwardly to maintain said cable under tension.

7. A crane as set forth in claim 6 including lost motion connection means connecting said cable to said operating boom whereby said operating boom may be folded to lie parallel to said tower without affecting said linkage.

8. A crane as set forth in claim 7 including a crane overload indicator, means connecting said indicator tube to said crane overload indicator operative to vary the maximum safe-load in response to changes in the angle of said operating boom.

9. A crane as set forth in claim 8 including a boom hoist throw-out, and means responsive to movement of

said indicator to a position indicating maximum boom elevation to actuate said boom throw-out to stop the boom hoist mechanism.

10. A crane as set forth in claim 9 wherein said last mentioned means comprises a pull rod extending through said indicator, a pre-set collar on said pull rod adapted to be engaged by said indicator to move said pull rod to actuate said boom throw-out.

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