April 4, 1944. J. C. CONRAD 2,346,066

OVERLOAD AND RADIUS INDICATOR FOR CRANES

Filed Oct. 12, 1942 2 Sheets-Sheet 1

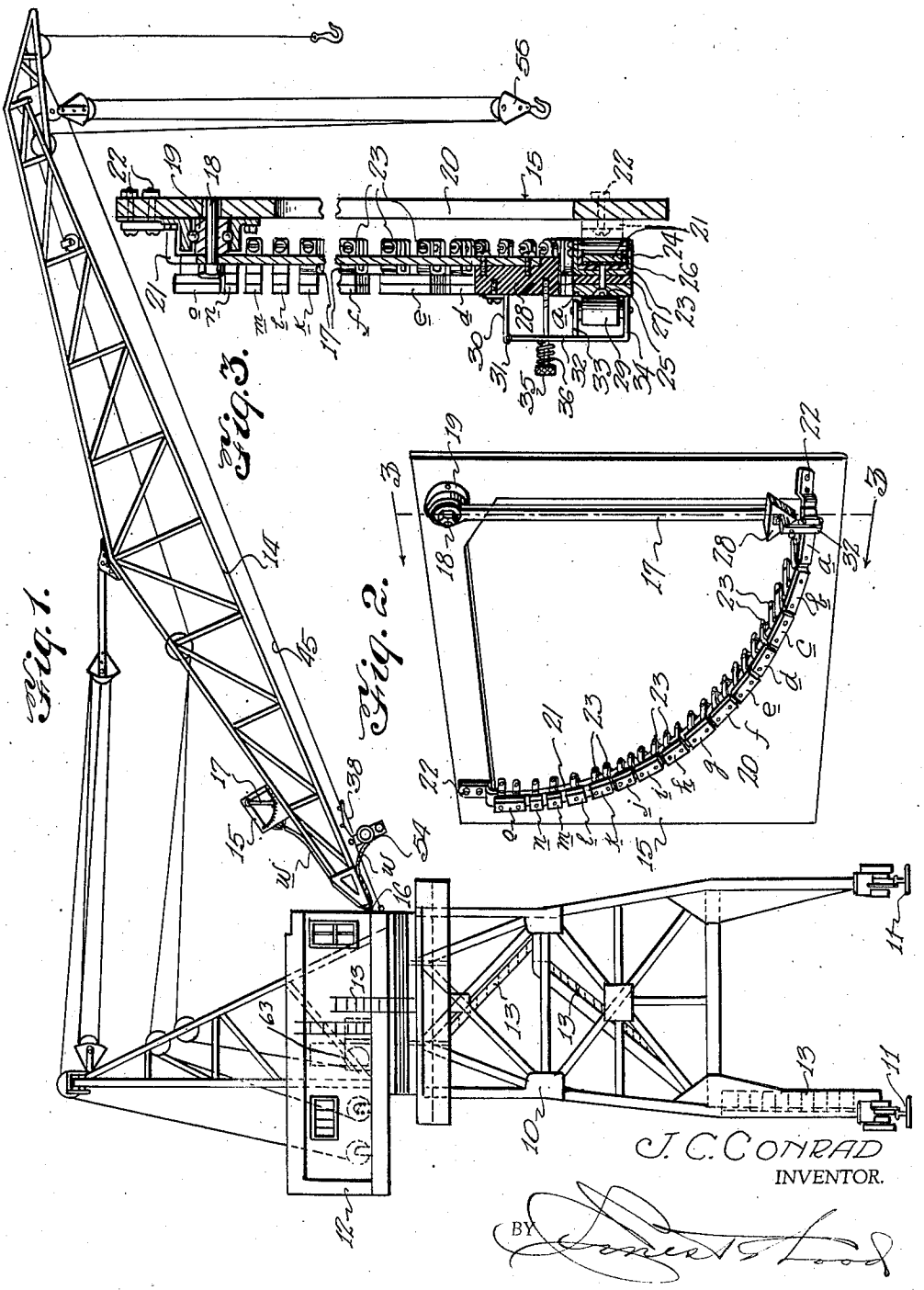


Fig. 1.

Fig. 3.

Fig. 2.

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Fig. 4.

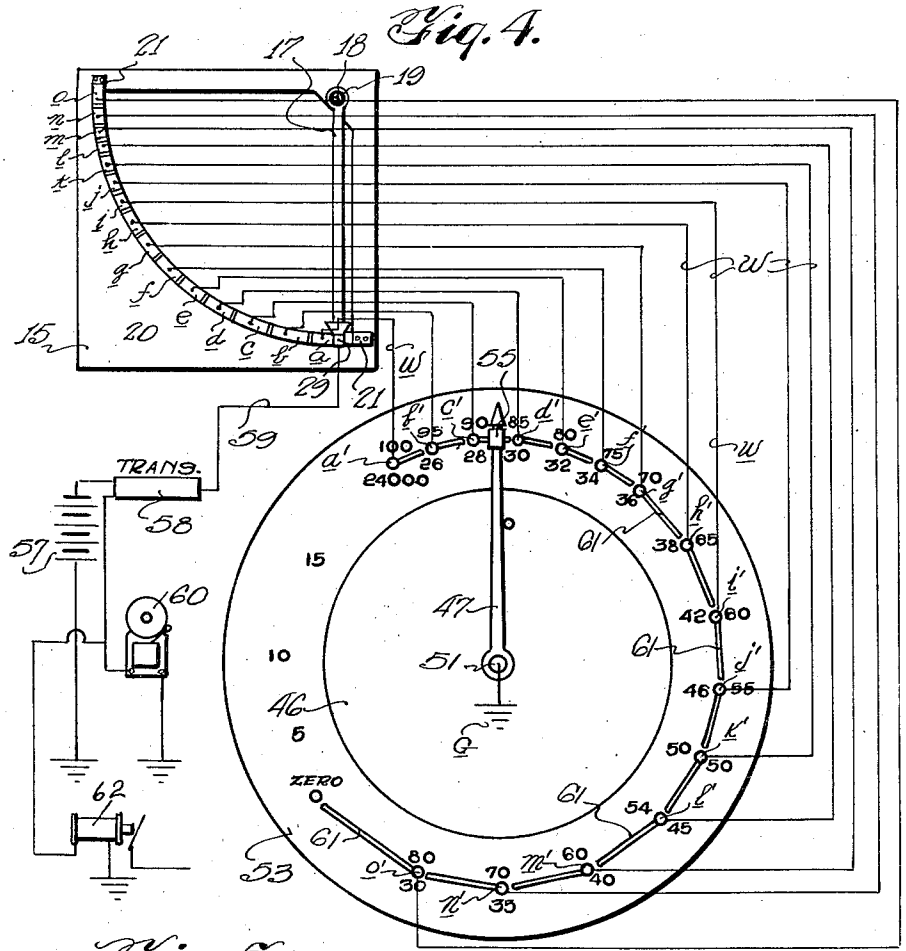



Fig. 5.

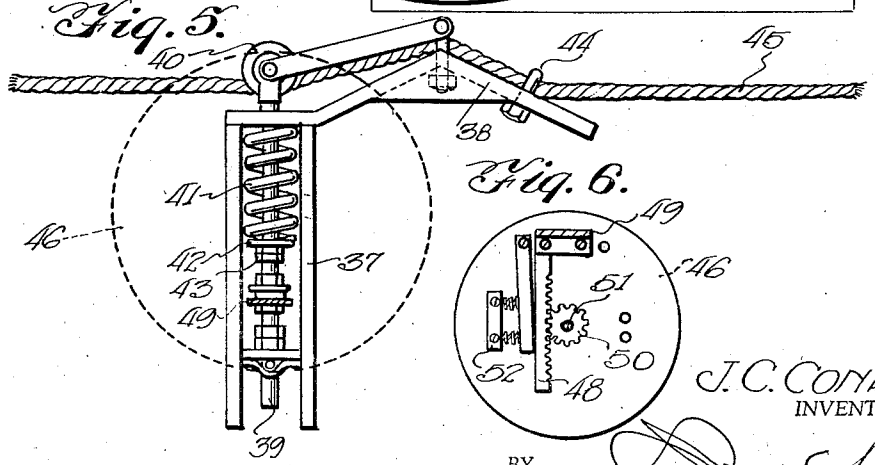


Fig. 6.



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2,346,066

## OVERLOAD AND RADIUS INDICATOR FOR CRANES

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Application October 12, 1942, Serial No. 461,689

6 Claims. (Cl. 177—311)

This invention relates to cranes, derricks and other similar heavy lifting apparatus and it has particular reference to electro-mechanically actuated overload signalling devices for the booms of heavy duty cranes.

The principal object of the invention is to provide pendulum means, associated with a frame mounted on the boom of a crane, which frame is provided with arcuately arranged, electrical contacts over which said pendulum travels during changes in the working radius of the boom and further, the provision of weight indicating means having electrical contacts corresponding to those of said frame and electrically connected through audible or visible signalling means whereby the crane operator receives a warning when the load exceeds the boom capacity at a given radius.

Another object of the invention is to provide a boom radius and load indicator for cranes which will eliminate any likelihood that the crane will be overturned by overloading, by reason of the advance warning given the operator through the medium of a dial over which moves a pointer, the latter serving the dual purpose of indicating to the operator the radius of the boom and the load at various positions in the boom radius. Moreover, while these factors are visible to the operator, provision is made through electrical means for audibly warning the operator against picking up a load when the boom is not in working radius with the load.

Another object of the invention is to provide a warning to insure against lengthening the boom radius while the load remains constant, said means consisting in equipping each dial contact with an extension to occupy intervening spaces between the contacts so that there will be no "dead spots" in the range of the contact pointer moving over the dial.

Another object of the invention is to provide means for effecting electrical association between the boom radius indicator herein mentioned and the load indicator described in applicant's U. S. Letters Patent issued September 7, 1937, No. 2,092,303 which translates for visual interpretation in pounds the force required to straighten the dead line of a load supporting mechanism and through this combination, the invention seeks to provide a much needed safety feature for cranes, especially of the type at present employed in ship building.

With the foregoing objects as paramount, the invention has particular reference to certain features of accomplishment, to become manifest as the description proceeds, taken in connection with the accompanying drawings, wherein:

Figure 1 is a side elevational view of a crane of the Gantry type.

Figure 2 is a detail perspective view of an electrical contact panel carrying a pendulum adapted to be mounted upon and actuated by the movements of the boom.

Figure 3 is a broken section taken on line 3—3 on Figure 2.

Figure 4 is a diagrammatic view of the electrical wiring connecting the contacts of the panel with those of the indicator dial.

Figure 5 is a detail view of the tensiometer or load responsive mechanism, and

Figure 6 is a detail view showing the manner in which reciprocating motion of the strain rod of the tensiometer is converted into rotative motion for actuating the pointer on the dial.

Continuing with a more detailed description of the drawings, reference is primarily made to Figure 1 wherein 10 denotes the supporting frame work of the crane which, in the case of the type of crane illustrated, is mounted for transportation on rails 11. Access to the cab 12 is had by way of the stairway 13, the said cab being revolubly mounted atop the frame 10 in the usual manner. This crane, being of conventional and well known construction, a detailed description of its construction will be unnecessary and only the elements thereof directly affected by the present invention will be specifically included in this description.

The boom 14 is somewhat greater in length than the height of the frame, usually about 100 feet in this type of crane and its capacity is calculated to be 80,000 pounds at a radius of 30 feet. The load capacity, of course, diminishes as the boom is moved toward 180°, in which position the load capacity approximates 24,000 pounds, and any excess of this capacity is dangerous in that the entire structure may be overturned.

The present invention provides a plate or frame 15, illustrated in detail in Figures 2 and 3 which will be referred to also as a contact panel inasmuch as it carries a multiplicity of electrical contacts *a* to *o*, which will be described in detail presently. This panel 15 is rigidly mounted on the boom 14, preferably at a convenient point adjacent its fulcrum 16 and is provided with a gravity pendulum 17, suspended from a pin 18 (Figure 3) to which it is connected through a bearing assembly 19. It is, of course, obvious that the pendulum 17 will remain at all times ver-

tical irrespective of any change in the radius of the boom 14, however slight it may be.

The panel 15 is not limited to any specific shape but it is preferably formed as shown with a segment of a circle cut therefrom to define an arcuate portion 20 serving as a protection for the assembly of contacts *a*—*o*.

The contacts *a*—*o* are mounted on a bracket consisting of a narrow strap 21, arcuately shaped to correspond to the portion 20 of the panel and whose ends are bent downward, thence parallel with the body thereof and bolted to the panel at 22. Thus, the contacts themselves are spaced outward from the panel proper. In Figure 3 is shown the manner in which the contacts are mounted on the bracket 21. A substantially U-shaped clamp 23 is provided which has a conforming insulator 24 therein. One or more of these clamps is provided for each contact and is secured thereto by means of a bolt or rivet 25. A layer of fibre 26 insulates the inner end of the rivet 25 from the bracket 21 while a fibre strip 27 is interposed between the contact and bracket 21, as shown in Figure 3. Thus, all contacts are insulated from the bracket 21.

Referring now to the construction of the pendulum 17, it is pointed out in Figure 3 that a triangular block 28 is affixed to the free end of the pendulum 17 which serves both as a weight and as an insulator for the roller contact 29. As a weight, it keeps the pendulum 17 perpendicular to the horizontal plane. A bracket 30 is affixed to and extends outward from the block 28 and to the outer end of this bracket is hinged at 31 an arm 32. The roller 29 is pivoted to revolve between an inward projection 33 on the arm and the lower end 34 of the latter, which is bent inwardly, parallel with the projection 33. To insure engagement of the roller 29 with the contacts *a*—*o* at all times, a tensioning device is provided, consisting of a pin 35, passing through an opening in the depending arm 32 and threaded into the fibre block 28. A spring 36 embraces the outer end of the pin and bears against the arm 32, urging the roller 29 against the contacts. By turning the knurled end of the pin, the tension on the spring is increased or decreased as desired.

The foregoing description deals specifically with that phase of the invention through which is made possible the establishment of a circuit through which electrical impulses are passed as the boom 14 is moved through the arc of its working radius. In the description to follow, it will be explained how these impulses are used to apprise the crane operator of the weight of the load supported by the boom and to warn him in the event a load is picked up which surpasses the crane capacity at corresponding radius positions.

Referring now to Figures 5 and 6; the preferred form of tensiometer or weight indicator is shown but which is well known to the art, it being described and claimed in the U. S. Letters Patent, No. 2,092,303 aforesaid. This mechanism consists of a frame 37 having affixed thereto at one end a lateral arm 38, bent at an obtuse angle. Extending axially through the frame and capable of longitudinal movement is a "strain rod" 39, which carries an annularly grooved roller 40 on one end. A heavy duty spring 41 surrounds the rod 39 in the frame 37 and bears at one end against an end of the frame and at the opposite end against a washer 42, mounted on the rod. Adjusting nuts 43 are arranged to provide a stop for the washer and to afford means for altering the tension on the spring 41.

The angular arm 38 has U-bolts 44 thereon by which it is attached to the dead line 45 (Figure 1) of the boom 14, imparting thereto a series of bends when the latter is extended under the grooved roller 40, as shown in Figure 5. When so mounted on the line, any variations in the weight supported thereby which tends to straighten the line, are instantly reflected on the dial 46 which is calibrated to accurately disclose the weight in pounds.

Reciprocating motion of the rod 39 is changed to rotative motion to actuate the pointer 47 (Figure 4) over the dial. This is accomplished in the manner shown in Figure 6, i. e., through a rack 48 affixed to an arm 49 which is secured to the rod 39 to move therewith. As the rod is moved by variations in tension on the dead line 45, the arm 49 is likewise moved to actuate the rack 48. This motion rotates the pinion 50 which is mounted on the pointer shaft 51 to operate the pointer 47. A spring pressed bar 52 holds the rack in mesh with the teeth of the pinion 50.

The dial 46 is constructed of metal and is superimposed flush upon a second dial 53 as shown in Figure 4 and both are encased in a housing 54 (Figure 1). The dial 53 is constructed of Bakelite or other non-conducting material and this dial carries a multiplicity of contacts *a'* to *o'* which correspond to the contacts *a* to *o* in the contact panel previously described. The contacts *a'* to *o'* are mounted in the dial 53 and attending each contact is a figure indicative of the boom radius and a corresponding figure indicating the capacity of the boom at the given radius. For example, the known capacity of the boom at 100-foot radius (horizontal) is 24,000 pounds. Accordingly, the contact *a'* on the dial 53 is attended by these figures. The known capacity of the boom at 30 foot radius is 80,000 pounds. Contact *o'* on the dial is accompanied by these figures. All intermediate contacts have associated therewith figures showing known boom capacities at given radii.

Each contact *a'* to *o'* of the dial 53 is connected by an independent wire (*w* for example) to its corresponding contact *a* to *o* of the panel 15 and in order that a circuit may be completed, the pointer 47 carries a sliding contact 55 (Figure 4) which moves from one to the other of the contacts as the weight borne by the boom 14 varies.

In operation, the crane operator maneuvers and boom 14 into position to pick up a load with the load block 56. Since the dead line 45 is threaded through this block, it is brought under tension which has the effect of rotating the pointer 47 over the dial 53, through the weight indicator. Ordinarily, the boom radius is at all times known to the operator but he is not always aware of the weight of a load he is required to lift at a given radius.

Assuming that an object to be hoisted weighs 42,000 pounds and that the boom is set at a 55-foot radius. There will be a margin of safety of approximately five feet in the boom radius and this fact will become immediately apparent to the operator since the pointer 47 will instantly move to contact *i'* on the dial 46 to indicate the weight, 42,000 pounds. There will be no audible signal under such a condition because the position of the boom is not such as to allow the

pendulum 17 to engage the contact *i* in the panel corresponding to contact *i'* in the dial 53.

However, assuming that the load hoisted is 42,000 to 46,000 pounds and that the boom radius has been changed to 60 feet. The pointer 47 will travel to the contact *i'* or slightly past and in so doing an electrical circuit will be established from source 57 (Figure 4), through transformer 58 (in case of 110 v. source) through wire 59 to pendulum roller contact 29; through contact *i*, thence through wire *w'* to dial contact *i'*; through pointer contact 58, pointer 47 to ground at G. An alarm signal 60 is embodied in the circuit thus completed and audibly warns the operator that the load is in excess of that which the boom will safely support at a 60 foot radius, whereupon the operator slacks off and moves his boom to a position where the load can be hoisted with a safe margin.

It will be observed in Figure 4 that each contact *a'* to *o'* is provided with an extension 61, all of the extensions conforming to the circular arrangement of contacts. The practical example given in the foregoing arbitrarily mentions a load weight of 42,000 to 46,000 pounds. In the absence of the contact extension 61, the operator, in attempting to hoist a load weighing 46,000 pounds with a boom radius of 60 feet, would receive no warning signal because the pointer contact 55 would lie intermediate the contacts *i'* and *j'*. Since the extensions 61 serve to bridge the spaces between the contacts, there will be no "dead spots," hence a warning signal will always be given as the pointer passes the danger position on the dial which would, of course, be a contact on the dial in circuit with the panel contact on which the pendulum 17 rests and over which the pointer contact 55 would pass as the pointer moves to indicate the load weight. The warning signal, therefore, will always be given before the boom assumes the total weight of the load, thereby allowing the operator to east off before any damage is done.

In addition to the warning given the operator through the audible signal 60, a further safety measure is provided in a solenoid 62 (Figure 4) whose function is to open the circuit to the crane operating motor 63 (Figure 1), which circuit is fragmentarily indicated in Figure 4 as "motor circuit." Accordingly, should the operator attempt to hoist a load exceeding the capacity of the boom at a given radius, not only will the signal warn the operator but his motor will cease operating by reason of the shutting off of its current through energization of the magnet 62, which opens the circuit to the motor.

It is apparent from the foregoing that each corresponding set of contacts has its own individual circuit and regardless of the position of the boom in its working radius, one of the circuits will be closed when the pointer 47 moves over a dial contact whose complementary panel contact is in engagement with the pendulum roller 29. This does not occur, however, unless the weight to be hoisted exceeds the capacity of the crane at a given boom radius.

Manifestly, the construction as shown and described is capable of some modification and such modification as may be construed to fall within the scope and meaning of the appended claims is also considered to be within the spirit and intent of the invention.

What is claimed is:

1. An overload signal for cranes including in combination with the boom and dead line of a crane, a panel having thereon an arcuate series of electrical contacts, a wiper contact arranged for movement over said contacts as said boom is vertically actuated, a dial having thereon a circular series of contacts connected in circuit with corresponding contacts of said panel, a boom load exhibiting pointer operable over said dial contacts, means connected to and responsive to variations in tension imposed on said dead line for operating said pointer, a signal circuit and means carried by said wiper and said pointer for closing said circuit through selected corresponding contacts when the hoisted load is in excess of the boom capacity at a given load radius.

2. An overload signal for cranes in combination with the boom and dead line of a crane, an arcuately arranged series of contacts and a wiper arranged to be brought successively into engagement with said contacts when said boom is vertically actuated, a dial having a boom load exhibiting pointer, contacts circularly arranged on said dial corresponding to and in circuit with said arcuate series of contacts, a signal circuit, means connected to and responsive to variations in tension in said dead line for actuating said pointer to exhibit the weight of a load hoisted by said boom and means carried by said wiper and pointer for closing the circuit between selected corresponding contacts to actuate said signal circuit when the hoisted load exceeds the permissible capacity of said boom at a given load radius.

3. A safety apparatus for cranes including in combination with the boom and dead line of a crane, a dial having a pointer thereon, movable over numerals carried by said dial to exhibit the weight of a load hoisted by said boom, a series of contacts on said dial in relation to said numerals and with which said pointer is engaged, means responsive to variations in tension in said dead line for actuating said pointer, an arcuate series of contacts arranged in a panel and connected correspondingly in circuit with said dial contacts, a signal circuit, a wiper adapted to be brought into engagement with said arcuate contacts when said boom is vertically actuated, and means carried by said wiper and said pointer for closing a selected one of said contact circuits and said signal circuit when the hoisted weight exceeds the boom capacity at a given angle.

4. Apparatus of the character described, comprising in combination with the boom and dead line of a crane, a dial, a circular series of contacts on said dial, a pointer movable thereover, means responsive to changes in tension in said dead line to operate said pointer for visibly indicating the load hoisted by said boom, a series of arcuately arranged contacts mounted in a panel in fixed relation to and movable with said boom, each in circuit with a corresponding contact on said dial, a signal circuit, gravity controlled means with which at least one of said arcuate contacts are engageable at any position of said boom to close the circuit to a corresponding dial contact and said signal circuit when said pointer travels thereover to indicate a boom load in excess of the capacity of said boom at a given radius.

5. Apparatus for use in association with hoisting machinery to indicate overloads of a boom in relation to the load radius thereof, a line supporting the boom load, means for visibly exhibiting the weight of said load, means operated through tension imposed on said load supporting line to actuate said exhibiting means, a series of independent and normally open circuits con-

nected to a power circuit, two sets of correspondingly related contacts in said independent circuits, a signal circuit connected in said power circuit, gravity controlled means supported upon said boom and engageable progressively with the contacts in one of said sets when said boom is vertically actuated, and means associated with said weight exhibiting means, operative over the companion set of contacts to close one of said circuits when said gravity controlled means engages a corresponding contact in its respective set, to close said signal circuit.

6. In an electrically actuated load hoisting apparatus, a safety device comprising, in combination with the boom and load supporting line of said apparatus, a panel mounted on said boom having an arcuate series of contacts thereon, a gravity controlled pendulum movable over said contacts as said boom is arcuately operated, a dial having a pointer movable thereover, means mounted upon and actuated by varying tensions in said load supporting line to actuate said pointer to indicate the weight of the load carried by said boom, a series of contacts mounted on said dial corresponding to and electrically connected to said panel contacts, and with which said pointer engages, a current supply circuit, a signal therein, means carried by said pendulum whose engagement with a contact on said panel will close the circuit to actuate said signal when said pointer engages a corresponding contact on said dial to audibly signify a load exceeding the capacity of said boom at a given load radius and means for simultaneously opening the circuit to the boom actuating means to render the same ineffective to actuate said boom.

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