June 13, 1961 R. L. AITKEN 2,988,040

MEANS FOR ACTUATING SAFE LOAD INDICATING DEVICES FOR CRANES OR THE LIKE

Filed Feb. 9, 1959 3 Sheets-Sheet 1

Fig. 1.

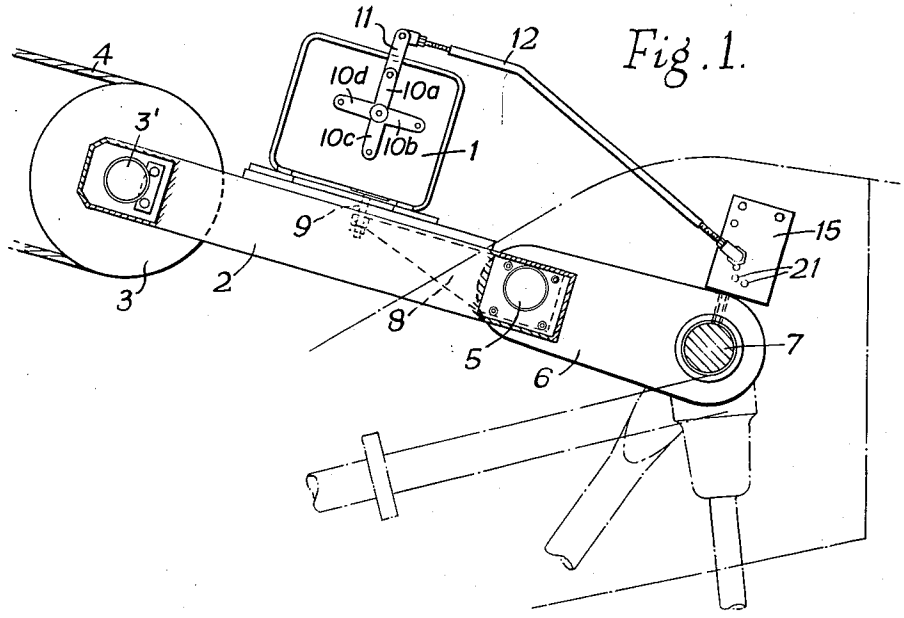


Fig. 2.

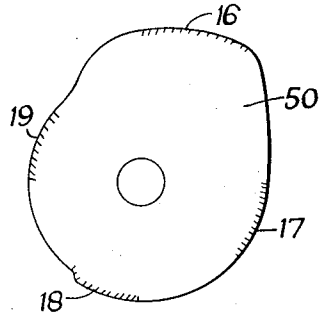


Fig. 3.

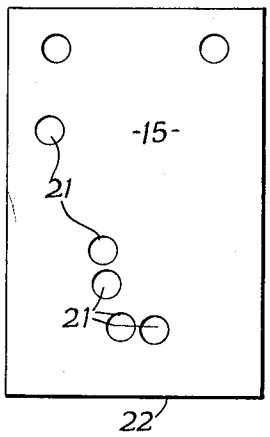


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Fig. 4.

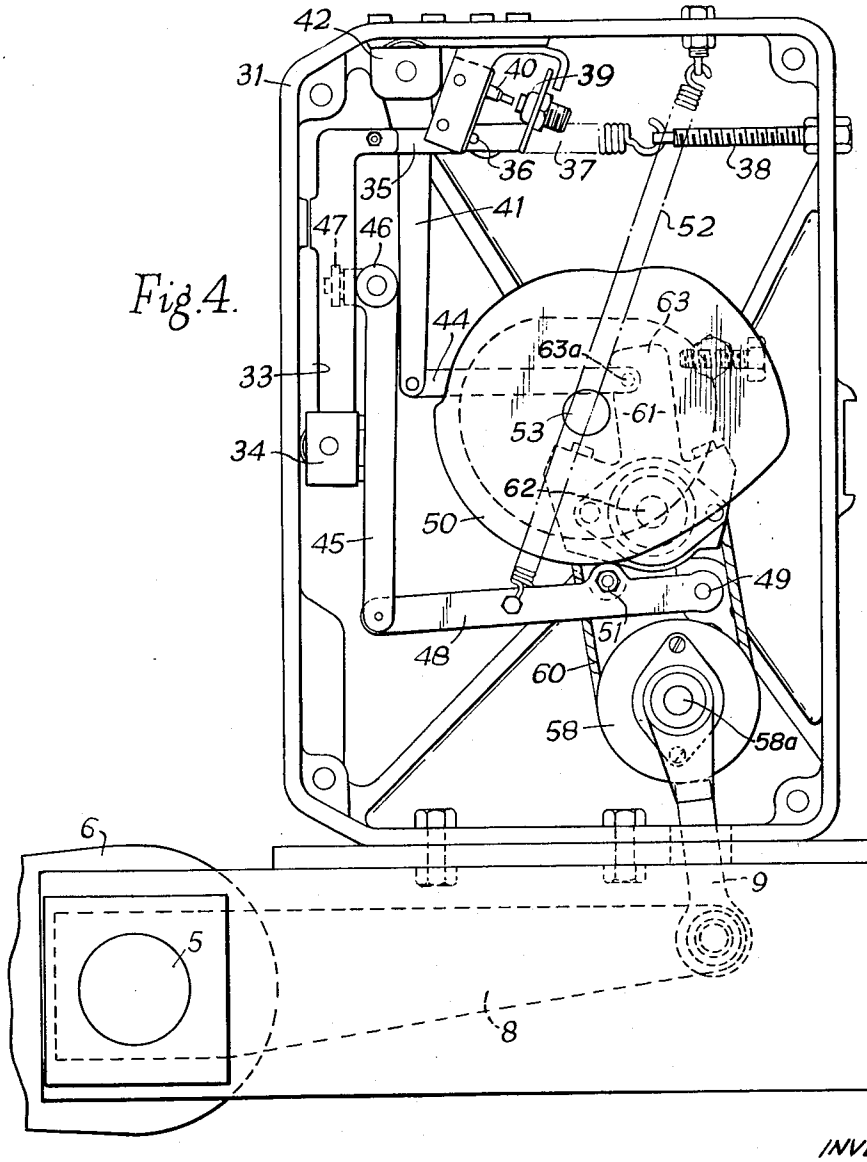


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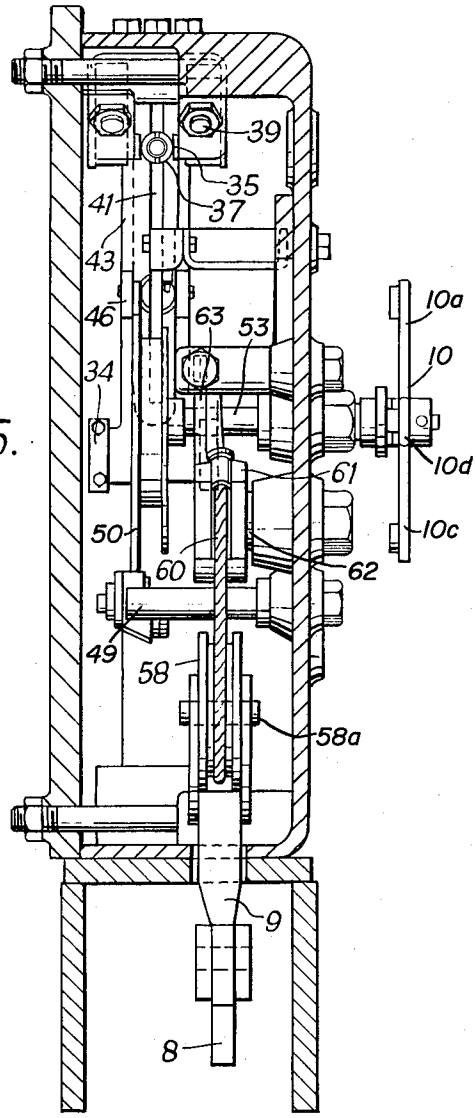
Fig. 5.

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# MEANS FOR ACTUATING SAFE LOAD INDICATING DEVICES FOR CRANES OR THE LIKE

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5 Claims. (Cl. 116—124)

The present invention relates to cranes and like machines, in which a load is supported from a jib, equipped with a safe-load indicating device adapted to give a visible and/or audible warning when the load imposed on the jib is greater than the safe load for the radius at which the machine is operating. The value of the safe load may be dictated by a number of considerations in addition to the jib loading which will overbalance the crane so that the safe load is not necessarily inversely proportional to the crane operating radius.

A safe-load indicator operates by measuring a load which is related to the actual load on the jib, but is not necessarily equal to it. Thus, it is customary to operate a safe-load indicator by measuring the tension in a part of the derricking ropes or in a part of the hoist rope.

It is already well-known to provide a safe-load indicator attached to the crane jib or other convenient part of the crane and made self-adjusting to allow for variation in the safe load with change in the radius of operation of the crane. Compensation for this factor is usually effected by utilising some linkage connecting the indicator to a part of the crane having movement relative to the indicator when the radius of the load is changed.

It is already known to construct a safe-load indicator in which compensation for the radius at which the crane is working is effected by rotating a cam so as to correspond to the angle at which the jib is set, for example, by securing a link to a fixed anchorage on the crane and to a crank arm connected to the cam. A force derived from the actual crane load is usually applied to a force reduction system and acts against resistance to close an alarm circuit when the load exceeds a predetermined value. The rotation of the cam is effective to adjust a movable fulcrum in the indicator, so as to compensate it in accordance with the actual radius of action of the crane. One such construction of safe-load indicator is described in my British Patent No. 723,070.

In contractors' work it is frequently desired to fit different jib lengths to the same crane. The different lengths are fitted, for example, by bolting removable sections into the middle of the jib, so that the foot and peak of the jib remain unchanged. It is common practice for a different cam for the safe-load indicator to be cut for each jib length. This may give rise to a great deal of time being spent in determining under load test that the contour of cam for use has been correctly cut for each jib length. In addition the use of separate cams leads to operating delays and risk in ensuring that the appropriate cam is used in the safe-load indicator.

The object of the present invention is to provide a crane with a safe-load indicator which employs a single cam face for two or more jib lengths, so that the amount of load testing of the indicator before service is much reduced, and the necessity of changing the cam in the safe-load indicator when the jib is changed in service, is obviated.

This object is achieved by cutting a safe-load indicator cam with opposite end ordinates to suit the maximum safe loads at the maximum and minimum radii arising from the various jib lengths which it is intended should be employed with the crane and providing a means for adjusting the angular movement of the cam in accordance with the jib in use, so that the cam ordinates at minimum and maximum radii for the particular jib in use are appropriate to the maximum safe load of the crane at these points.



According to the present invention a crane or like machine equipped for operation with jibs of different lengths is provided with a safe-load indicator in which a control cam is employed to vary the mechanism so that the jib load, at which a warning indication is given, varies in accordance with the maximum safe-load at the radius of operation of the crane, characterised in that the safe-load indicator uses a single portion of the cam surface for a range of jib lengths and that the movement of the cam is varied for different jib lengths by alteration of the anchorage points of a link connecting the cam to a part of the machine in relation to which the indicator moves. The anchorage points for the link may be provided as a series of appropriately positioned holes in a plate attached to the crane in close proximity to a pivot pin for a frame on which the indicator is mounted. Alternatively a series of anchorage holes may be provided eccentrically in the cam or a member attached to the cam pivot or linkage.

The cam in the safe-load indicator may only be tuned through a quite limited angle of 30–40° between maximum and minimum crane radius.

It is frequently found in practice that if a cam is given the appropriate contour so as to give a warning at the appropriate loading at varying operating radii with a jib of one length, the same cam contour, within practical limits, will be appropriate for use with jibs of similar length on the same crane, if the linkage by which the cam is turned is adjusted in accordance with the principles of the present invention.

One construction made in accordance with the present invention is hereinafter described with reference to the accompanying drawings wherein:

FIGURE 1 is a side view showing the method of mounting a safe-load indicator in accordance with the invention.

FIGURE 2 shows a cam for use in the safe-load indicator.

FIGURE 3 shows the anchor plates in greater detail on an enlarged scale.

FIGURE 4 is a side view of a safe-load indicator from the opposite side to that shown in FIG. 2.

FIGURE 5 is an end view of the load indicator of FIGURE 4.

In FIGURE 1 a safe-load indicator 1 is carried on one frame member 2 of a pair of frame members 2 and 6, and frame member 2 carries a pulley 3 around which one part of the derricking rope 4 passes, so that the tension in the frame member 2 is always indicative of the load on the jib. The frame member 2 is pivoted on a pin 5 to the other frame member 6 of the pair of frame members, which in turn is pivotally mounted on a main frame pin 7 of a third member which constitutes the framework of the crane.

A force indicative of the load in the derricking rope is applied to the indicator 1 by means of an arm 8 fixed to pin 5 which, due to the positioning of pin 5 at a point on the same side of a center line between the axle 3' for pulley 3 and pin 7 as the indicator 1 exerts a tension on a link 9 as a result of the tension force in the frames 2 and 6 which tends to bring the center of the pivot 5 into line with the centers of pivot 7 and of the spindle of the pulley 3.

The construction of the indicator 1 is shown in FIGURES 4 and 5. The moving parts which form the operating device for the indicator are contained in a casing 31. A lever 33 is mounted so as to lie in a normal position substantially parallel with the side of the casing. The

lever 33 is pivoted in a bracket 34 on the side of the casing. This first lever 33 comprises in fact a pair of parallel levers, each of which has an end portion 35. A pin 36 passing through the two end portions 35 acts as an attachment for one end of a tension spring 37. The end of the spring 37 is attached to an adjustable anchorage 38 to permit the spring tension to be adjusted. The ends 35 of the lever 33 each carry a contact 39 adapted to make contact with a corresponding stationary contact 40 of a microswitch on reaching a predetermined angular position of the lever 33. The contacts are set so that one switch is closed slightly before the other. The first switch to close activates a circuit which gives warning that the safe limit has nearly been reached, whilst the second switch to close activates a circuit giving warning of actual danger. A second lever 41 is employed to apply a deflecting force to the lever 33. The lever 41 is pivotally mounted in a bracket 42. The adjacent surfaces of the members forming the lever 33 and of the lever 41 are flat and each of the three members lies in parallel planes slightly displaced from each other, the lever 41 lying off the central plane of the lever 33. The lever 41 is attached to a compression link 44 which is adapted to apply a load to it to produce a turning moment in the opposite sense to that produced by the spring 37 on the lever 33.

The load applied to the compression link 44 is indicative of the load applied to the jib and since this load is to be applied to the lever 33 to overcome the constant force of the spring 37 to close the alarm circuit on reaching the safe loading of the crane, means must be provided for varying the moment applied to the lever 33 for any given loading of the lever 41, so as to apply the necessary variation corresponding to the angle of the jib of the crane. The two levers 33 and 41 are compounded for this purpose by means of a moving link member 45 which carries rollers 46, which bear against the opposed flat surfaces of the levers 33 and 41. The alignment of the link member 45 is maintained by a roller 47, engaging between the two members of the lever 33. The longitudinal position of the link member 45 is controlled through a vertical link 48 which is pivotally connected to one end of the link member 45 at one end and pivoted to the casing 31 by a pivot pin 49 at its other end. The angular position of the control link 48, which determines the position of the rollers 46 between the compounded levers 33 and 41, is controlled by a rotatable cam member 50, which engages with a cam follower 51 carried by the control link 48, the control link 48 being biased towards the cam 50 by a tension spring 52 or in any other suitable manner. The control cam 50 is keyed to a spindle 53 which carries a lever 10 on a part of the spindle external of the casing 31. The lever 10 is attached to a fixed part of the crane by a line 11 and a rod 12 so that as the jib inclination varies, the cam 50 is rotated relative to the casing 31.

The loading of the lever 41 through the link 44 is applied through the link 9 which is attached to the spindle 58*a* of a sheave 58. A short length 60 of wire rope passes around the sheave 58 and has its two ends anchored to the ends of a pivoted member 61, which is pivoted slightly eccentrically at 62, so that as the load on the link 9 increases, it tensions the wire rope 60 and this in turn, because of its eccentric mounting, causes the pivoted member 61 to turn. A crank 63 attached to or forming part of the pivoted member 61 is linked in turn to the lever 41 of the compound lever system by the thrust link 44 to which crank 63 is pivoted on pivot 63*a*.

The cam member 50 is provided with four different cam surfaces arranged at 90° to each other. The cam spindle 53 is provided with a lever 10 having four radial arms 10*a*, 10*b*, 10*c* and 10*d*, which may be alternatively attached to a link 11, which is in turn connected by a cam control rod 12 to an anchor pivot held in an anchor plate 15. The cam surface which is operative at any moment to act on the cam follower 51 depends on which of the arms of the lever 10 is connected to the link 11.



The indicator system shown in the drawings is primarily intended for use on a wheeled crane. As is well-known, the safe load of such a crane depends on whether the outriggers of the crane are blocked or unblocked, the safe load in the unblocked condition being considerably lower.

The cam 50 shown in FIGURE 2 has separate working surfaces indicated respectively at 16, 17, 18 and 19, the cam surface 16 being employed for the control of the indicator with jibs ranging from 30 to 80 feet with the crane in the unblocked condition. The surface 19 is employed with the crane in the blocked condition with the jibs of 30, 40 or 50 foot length, the surface 18 with a 60 foot jib and the surface 17 with jibs of 70 or 80 foot length with the crane in the blocked condition.

In conjunction with this shaping of the cam, the cam control rod 12 is anchored in an anchor plate 15 by a bolt located in a hole appropriate to the length of the jib. A series of anchorage holes 21 are shown, each one of which is appropriate for a particular jib length, and separate holes for the same jib lengths may also be required for the crane in the blocked or unblocked condition. Preferably, however, the cam faces 16, 17, 18 and 19 are so cut that the hole 21 for a particular jib length is effective, irrespective of whether the crane is in the blocked or unblocked condition. The plate 15 is shown enlarged in FIGURE 3 and is designed to be fixed so that its edge 22 is at a predetermined distance and angularity in relation to the main frame pivot pin 7. Owing to the different disposition of each hole to the main frame pivot, the portion of the cam 50 in contact with the cam follower 51 at a given jib inclination and also the angular movement of the cam throughout the working range of each length of jib will be different. The position of these holes can be selected by calculation or experiment.

In an alternative form the plate 15 can have a single hole for connection of the control rod 12 and the link 11 be replaced by a circular disc having a series of holes in different positions corresponding to the various holes 21 on the plate 15 so that the change in anchorage of rod 12 to suit different jib lengths takes place at the indicator and not at plate 15.

In an improved form a second indicator 1 can be also carried on links 2, a balancing beam being arranged between the end of link 8 and the strikers 9 on each indicator and in this way separate indicators can be used to deal with entirely different conditions; e.g for main jib loads or for the lighter loads carried on an extension jib at the end of the main jib.

It will be appreciated that the indicator shown in FIGURES 4 and 5 is illustrated by way of example. The present invention is applicable to any form of indicator in which a cam is employed as a control for the indicator to compensate for changes in operating radius.

I claim:

1. In a safe-load indicating system for a crane having three members, two of said members being angularly movable relative to each other when a load is exerted on the jib of the crane, and at least one of said two members being movable relative to the third member when the jib of the crane moves relative to the frame of the crane, said crane being equipped for operation with jibs of different lengths and having an indicating means operating device mounted on one of the two of said members, indicating means actuated by the action of said operating device when said operating device is operated beyond a predetermined position, said operating device being operatively connected to the other of the two said members for being operated by relative movement between the two of said members when a load is placed on the crane, said operating device having adjusting means as a part thereof with a cam follower thereon, said indicating means indicating to the crane operator the approach of the crane to a predetermined maximum safe load, that

improvement comprising a cam rotatably mounted relative to said one of the two members and engageable with said cam follower and the angular position of which determines the magnitude of the predetermined load, a rod connecting member fixed to said cam for rotation therewith about the axes of rotation of said cam, and a rod connected between said rod connecting member and said third member, said cam having at least one control surface thereon having a contour such that opposite end ordinates of said control surface are appropriate to the safe loads arising at the maximum and minimum radial positions of a plurality of jib lengths to be employed with the crane, and means connected between one end of said rod and the member to which said one end of said rod is connected and providing a plurality of anchorage points for anchoring said one end of the rod to said means, each anchorage point being appropriate for anchoring the link when a jib of a particular length is employed and positioned, so that when the jib is raised or lowered said one member and said third member are moved relative to each other and the control cam is turned to a position between end ordinates appropriate to the maximum safe load which can be imposed on that particular jib within its range of operating radii and the load at which the indicating means is operated is varied in accordance with the safe load that may be placed on the jib at the operating radius of the crane.

2. In a safe-load indicating system for a crane having three members, two of said members being angularly movable relative to each other when a load is exerted on the the jib of the crane, and at least one of said two members being movable relative to the third member when the jib of the crane moves relative to the frame of the crane, said crane being equipped for operation with jibs of different lengths and having an indicating means operating device mounted on one of the two of said members and said indicating means operating device having a plurality of levers acting on each other and against a spring connected thereto, indicating means actuated by the movement of said levers beyond a predetermined position, said levers being operatively connected to the other of the two of said members for being loaded by relative movement between the two of said members when a load is placed on the crane, one of said levers being movable relative to the other levers for varying the actions of said levers on each other, said one lever having a cam follower thereon, said indicating means indicating to the crane operator the approach of the crane to a predetermined maximum safe load, that improvement comprising a cam rotatably mounted relative to said one of the two members and engageable with said cam follower and the angular position of which determines the



magnitude of the predetermined load, a rod connecting member fixed to said cam for rotation therewith about the axes of rotation of said cam, and a rod connected between said rod connecting member and said third member, said cam having at least one control surface thereon having a contour such that opposite end ordinates of said control surface are appropriate to the safe loads arising at the maximum and minimum radial positions of a plurality of jib lengths to be employed with the crane, and means connected between one end of said rod and the member to which said one end of said rod is connected and providing a plurality of anchorage points for anchoring said one end of the rod to said means, each anchorage point being appropriate for anchoring the link when a jib of a particular length is employed and positioned, so that when the jib is raised or lowered said one member and said third member are moved relative to each other and the control cam is turned to a position between end ordinates appropriate to the maximum safe load which can be imposed on that particular jib within its range of operating radii and the load at which the indicating means is operated is varied in accordance with the safe load that may be placed on the jib at the operating radius of the crane.

3. The improvement as claimed in claim 2, in which said rod connecting member comprises a spindle on which said control cam is mounted, a lever arm structure on said spindle to which said rod is connected, and in which said means providing a plurality of anchorage points comprises an anchorage member secured to a fixed part of the machine, the said anchorage member being provided with said plurality of anchorage points, each of which is appropriate to a particular jib length.

4. The improvement as claimed in claim 3, in which said lever arm structure comprises a plurality of lever arms extending radially outwardly of said spindle, one corresponding to each cam control surface portion for connection to said link to bring the different cam control surface portions into cooperation with said cam follower in accordance with different operating conditions of the machine.

5. The improvement as claimed in claim 3, in which said anchorage member comprises a plate mounted on said third member, the said plate having said anchorage points arranged thereon in a pattern predetermined in accordance with the length of the jib to which it is appropriate.

**References Cited** in the file of this patent

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723,070 Great Britain ---------- Feb. 2, 1955