March 3, 1964 R. L. AITKEN 3,123,814

SAFE LOAD INDICATING DEVICES FOR CRANES

Filed Feb. 4, 1963 2 Sheets-Sheet 1

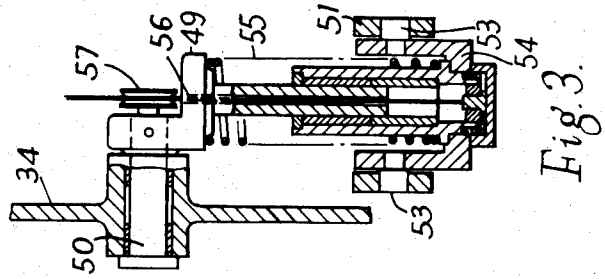

Fig. 3.

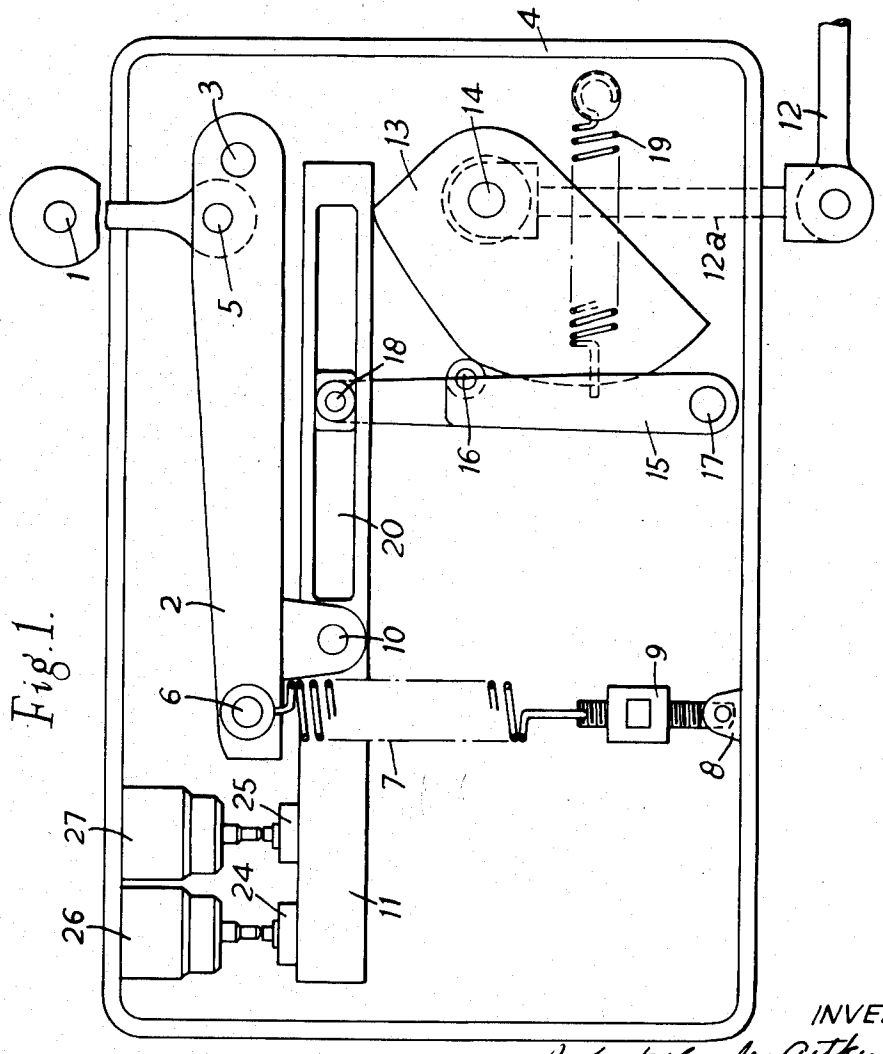

Fig. 1.

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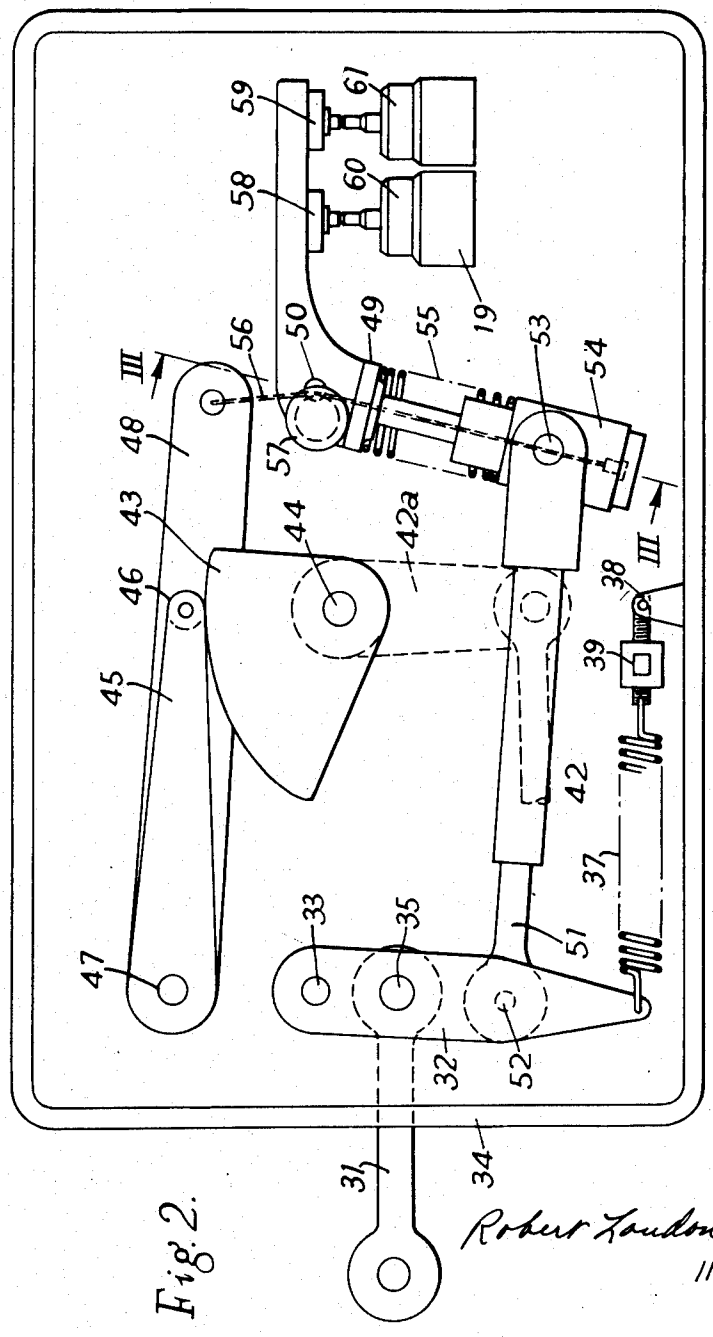

Fig. 2.

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SAFE LOAD INDICATING DEVICES FOR CRANES

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The present invention relates to safe-load indicating devices for the type of apparatus, such as cranes and the like, which is adapted to lift a load suspended from a jib from a point, the effective radius of which in relation to the jib foot, may be varied.

As is well-known the safe load which any particular crane can lift depends upon the jib radius at which the crane is operating.

It is well-known to provide a safe load indicator attached to the crane jib or other convenient part of the crane. Known safe-load indicators are constructed to adjust themselves automatically with changes of jib angle so as to indicate the safe load appropriate to the operating radius.

It should be understood that the term "safe-load" is used herein to define a load which is slightly less than that at which the crane would be damaged under operating conditions. Usually it is slightly less than that at which the crane would overturn, but in some cranes using long, light jibs the jib may buckle at small operating radius at a load less than that required to overturn the crane and this factor must be taken into account in determining the safe load of the crane.

It is, in fact, desirable to arrange that the safe-load indicator will operate two audible or visual warning devices in succession, the first as the safe load is approached and the second as the safe load is reached. It is obviously desirable that the load at which the first indication takes place should bear a substantially constant relation to the safe load, e.g. should always be approximately 90% of the safe load or of the equivalent force on the indicator.

To achieve this result the actuation of the warning devices is preferably effected by deflecting a switch operating member arranged in such manner that its deflection due to the permissible maximum safe loads on the crane at different radii is always the same in spite of the corresponding force on the indicator being different at each different radius of the crane.

Accordingly the present invention provides a safe-load indicator comprising an operating member, adapted to actuate at least one warning device when an actuating portion of said member is brought to a predetermined spacial position, said operating member being mounted on two pivots, said pivots being angularly movable relative to each other and likewise being movable relative to each other lengthwise of the operating member, means causing relative movement between said pivots lengthwise of the operating member so that their relative distance from one another is a function of the inclination of a crane jib, means causing relative angular movement of said pivots so that such relative angular movement is a function of the crane load, said means being arranged to move one of said pivot points through a distance which is substantially proportional to a force derived from the crane load.

Conveniently a safe-load indicator comprises a lever pivoted at a fixed point, upon which lever the force derived from a crane load is imposed against resilient restoring means to deflect said lever, said operating member being pivotally connected to the lever by a pivot which is immovable lengthwise of said operating member, a second pivot engaging in a track in said operating member for movement lengthwise of said operating member and means for moving said second pivot lengthwise of operating member arranged so that the distance between said pivots is a function of the inclination of the jib of the crane.

In addition this invention provides a safe-load indicator in which the operating member is pivoted on a fixed pivot and has a second pivot movable along a track lengthwise of said operating member and comprising means for moving said second pivot along said track, arranged so that the distance of the second pivot from the first pivot is a function of the jib inclination and means connecting said second pivot to a point on a lever, pivoted to a fixed point, upon which lever the force derived from a crane load is imposed against resilient restoring means to deflect said lever.

The "resilient restoring means" against which the crane force is applied may be a coil spring, in tension or compression, a volume of compressed gas, a compressible block such as a rubber block or any other resilient member against which a load can be applied.

In order that the present invention may be more clearly understood two embodiments will now be described, by way of example, with reference to the following drawings in which:

FIGURE 1 shows a side elevation of one embodiment of the invention,

FIGURE 2 shows a side elevation of another embodiment of the invention, and

FIGURE 3 is a section along the line III—III of FIGURE 2.

A crane loading derived in the conventional manner from the hoist rope, derricking rope or other element, is applied in tension through a link **1** to a lever **2** mounted on pivot **3** in the indicator frame **4**. Link **1** is connected to the lever **2** by a pin **5**. At the end of the lever **2** remote from the pivot **3** a restoring spring **7** is attached at point **6** to the lever **2** and the other end of spring **7** is attached through an adjustment device **9** to a lug **8** mounted on the frame **4**.

An operating member in the form of a lever **11** is pivotally connected with the lever **2** at a first pivot **10** on a lug extending from lever **2**.

A link **12** is connected to a lever **12***a*, which is connected to a cam **13** so as to turn the cam **13** about the axis of a shaft **14** to an appropriate position, the link **12** being moved relative to the frame **4** by change of jib inclination. A double lever **15**, carrying a cam follower **16**, is pivotally mounted on a pin **17** in the frame **4** and a spring **19** connected to the lever **15** holds the cam follower **16** against the cam **13**. At the end of lever **15** remote from the pivot pin **17** is a cross-head **18**, constituting the second pivot of the operating member and slidably mounted in a straight slot **20** in lever **11**. The slot **20** can alternatively be curved but should not conform to the path of cross-head **18**. At the other end of lever **11** there are mounted switch actuating members **24** and **25** arranged respectively to actuate conventional spring-loaded limit switches **26** and **27** mounted on frame **4**.

In operation the crane loading is applied to link **1** and tends to draw up lever **2** against the restoring force from spring **7** and the force exerted by the spring can be adjusted using adjuster **9**. This movement also draws up lever **11** through pivot **10** by which lever **11** is connected to lever **2**. The cross-head **18** moves in the slot **20** to a position appropriate to the jib angle on change of position of the link **12** relative to the frame **4** and so changes the distance between the pivot point **10** and the pivot constituted by the cross-head **18**. Movement of the cross-head **18** alters the angular movement of lever **11** produced by a given crane force applied through

the link which is the operating member and so compounds the loading and crane radius at which switch actuating members **24** and **25** actuate switches **26** and **27**. By suitably positioning the switches and the respective actuating members it can be arranged that a warning is given when the combined effect of crane load and jib angle approach, for example, 90% of the safe load and 100% of the safe load, or, for example, at 110% of the safe load in cases where it is desired to use a switch to stop the crane motors.

In the indicator shown in FIGURE 2 a crane loading is applied by link **31** and pin **35** to a lever **32** pivotally mounted on pin **33** in the indicator frame **34**. A link **42** is connected to an arm **42***a*, which turns a cam **43** about the axis of a shaft or pin **44**. A cam lever **45**, carrying a cam follower **46** arranged to follow the cam face of cam **43**, is secured to a shaft **47** to which lever **48** is also secured. The lever **48** is secured to one end of a wire **56** which extends to a cross-head **54** on an operating member. The operating member is in the form of a bell-crank lever **49** pivotally mounted on a pin **50** carried in the frame 34 and constituting the first pivot of the operating member. The second pivot of the operating member is constituted by pivot pins **53**, which are carried by the cross-head member **54**, longitudinally slidable on one arm of the bell-crank lever **49**. The cross-head is connected by the pins **53** to a link **51**, which is in turn connected by a pivot pin **52** to the lever **32**. The cross-head **54** is connected by the wire **56** to the lever **48** passing over a pulley **57** arranged so that the wire passes substantially through the axis of the pivot **50**, so that tilting of the lever **50** does not itself cause movement of the cross-head **54**. A helical spring **55** holds the wire **56** taut and causes cam follower **46** to follow the face of cam **43**.

In operation a movement corresponding to the crane load is applied to the cross-head **54** through pins **53** which connect the cross-head with the link **51**. Change of jib angle causes movement of link **42** relative to the frame **34** and thus causes rotation of the cam **43** which is translated through lever **48** and wire **56** to movement of the cross-head **54** lengthwise of the arm of the lever **49** on which it is guided, thus altering the distance between the first and second pivot points of the operating member. Actuating members **58** and **59** are mounted on lever **49** and actuate switches **60** and **61** in the same manner as described with reference to FIGURE 1.

I claim:

1. A safe-load indicator comprising an operating member, adapted to actuate at least one warning device when an actuating portion of said member is brought to a predetermined spacial position, said operating member being mounted on two pivots, said pivots being angularly movable relative to each other and likewise being movable relative to each other lengthwise of the operating member, means causing relative movement between said pivots lengthwise of the operating member so that their relative distance from one another is a function of the inclination of a crane jib, means causing relative angular movement of said pivots so that such relative angular movement is a function of the crane load, said means being arranged to move one of said pivot points through a distance which is substantially proportional to a force derived from the crane load.

2. A safe-load indicator according to claim 1 comprising a lever pivoted at a fixed point, upon which lever the force derived from a crane load is imposed against resilient restoring means to deflect said lever, said operating member being pivotally connected to the lever by a pivot which is immovable lengthwise of said operating member, a second pivot engaging in a track in said operating member for movement lengthwise of said operating member and means for moving said second pivot lengthwise of operating member arranged so that the distance between said pivots is a function of the inclination of the jib of the crane.

3. A safe-load indicator according to claim 2 in which the track in said operating member is in the form of a slot and in which the second pivot is in the form of a cross-head slidably engaging in said slot.

4. A safe-load indicator according to claim 3 in which the cross-head is mounted at one end of a lever pivoted at its other end which lever carries a cam follower, bearing on a cam which is turned in response to change in the inclination of the jib of the crane to move the cross-head lengthwise of the operating member relative to the other pivot.

5. A safe-load indicator according to claim 1 in which the operating member is pivoted on a fixed pivot and has a second pivot movable along a track lengthwise of said operating member and comprising means for moving said second pivot along said track, arranged so that the distance of the second pivot from the first pivot is a function of the jib inclination and means connecting said second pivot to a point on a lever, pivoted to a fixed point, upon which lever the force derived from a crane load is imposed against resilient restoring means to deflect said lever.

6. A safe-load indicator according to claim 5 in which the operating member is in the form of a bell-crank lever one arm of said lever being formed with a track along which said second pivot can be moved.

7. A safe-load indicator according to claim 6 in which means for moving said second pivot lengthwise of said track comprises a pivotally mounted lever carrying a cam follower arranged to bear on a cam movable in response to change of the inclination of the crane jib and a linkage connecting the end of said lever remote from its pivot with the second pivot, said linkage being arranged to maintain said second pivot at a predetermined position lengthwise of said track irrespective of the angular position of said bell-crank lever about the first pivot.

8. A safe-load indicator according to claim 6 in which the second pivot is in the form of a cross-head movable on said other arm said cross-head being carried by a link connected with the lever on which a crane load is imposed.

9. A safe-load indicator according to claim 8 in which the linkage is in the form of an inextensible flexible member passing down an axial guideway in said other arm of the operating member to the cross-head, resilient means holding said flexible member taut.

10. A safe-load indicator as claimed in claim 1 in which the operating member carries two switch actuating members arranged to actuate warning devices respectively at a load a predetermined amount less than the maximum safe load and at said maximum safe load.

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