AUTOMATIC CRANE BOOM STOP ABOUT A VERTICAL AXIS

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ABSTRACT OF THE DISCLOSURE

A device for limiting the rotation of a crane boom extending from a platform rotatably mounted on a base in which a pair of movement-limiting wedges are secured to the base and engage a sensor mounted on the platform of the crane. The sensor includes valves which actuate hydraulic or pneumatic actuators connected with the means energizing the drive means for rotating the cab, the boom, and the platform. The hydraulic or pneumatic actuators return the means, such as a swing lever, to its neutral position in which the drive means are de-energized and the brakes are set.

This invention relates to devices for automatically stopping the movement of boom cranes about their vertical axes and, more particularly, to a device constructed to act on manually operable lever engaging and disengaging drive means of the crane rotating the boom about the vertical axis.

The principal object of this invention is to prevent movement of a boom crane about its vertical axis beyond adjustable fixed points to prevent the boom from contacting hazardous objects such as electric overhead cables. In accordance therewith, the present invention provides drive means arresting means for limiting the rotation of a platform of the crane which is movable supported on a base and has a boom extending from the platform. Manually operable means actuate and de-actuate the drive means and are connected with a fluid actuator for moving the manually operable means from its drive means actuating position. Valve means in flow communication with the fluid actuator and a fluid source to thereby selectively move the manually operable means from its actuating to its de-actuating position. Sensed means connected with the platform and the valve means is provided for actuating the valve means and cooperate with a limit member secured to the base and positioned to cause the de-actuation of the drive means by the fluid actuator at predetermined positions of the platform on the base.

The danger of contact between the crane boom and electric cables or other hazards is thereby taken out of the hands of the operator, and such contact is prevented even if the attention of the operator is temporarily distracted from the hazard.

A further object is to produce a device of the character described which may be attached to the present crane structure without materially altering its construction or operation. Another object is to provide a device of the character described which is economical to manufacture and install.

A still further object is to produce a device of the character described which cannot be bypassed by the operator after the device has been set for a particular job being performed.

Brief description of the drawing

FIG. 1 is a side view of a crane constructed according to the present invention;

FIG. 2 is an enlarged fragmentary cross section of a view taken on line 2—2 of FIG. 1;

FIG. 3 is a fragmentary side elevation of the crane shown in FIG. 2;

FIG. 4 is an enlarged side elevation of a modified form of a sliding cam mounted on the base of the crane; and

FIG. 5 is a schematic view showing the automatic stop device of the present invention connected to swing control lever of the crane.

Description of the preferred embodiment

Referring to FIG. 1, a boom crane 8 is mounted on a base 10 which may be provided with tracks 12 for transporting the crane over ground 14 and includes a vertically disposed kingpin 16 about which a platform 18 is supported by roller bearings 20 which can rotate. Mounted on the platform is a cab 22 having drive means 24 including a pinion 26 engaged with a ring gear 27 concentric about the kingpin for rotating the platform and the cab. The drive means includes brakes (not shown) and a clutch (not shown) which are actuated by a pivotally mounted manually operated swing lever 28 (shown in FIG. 5) coupled with the drive means by a connecting member 29. A conventional boom 30 extends generally upwardly and outwardly from the platform, mounts a pulley 32 at its free end, and suspends a load-carrying cable 34 which terminates in a load hook 36.

Referring to FIGS. 2 through 4, a ring 38 provided with a plurality of spaced-apart apertures 40 is secured to platform 18 and is concentric about kingpin 16. A pair of each-opposing wedges 42 and 44 are conventionally secured to the ring, positioned in apertures thereof, and engage wheels 46 secured to plungers 48 forming part of sensing means 50. The opposite ends of the plungers are connected with pistons (not shown) of valves 52 and 53. Springs 54 bias the plungers towards ring 38 so that wheels must contact wedges 42 and 44 when platform 18 rotates about kingpin 16. After the initial contact of the wheels with the wedges the plungers are moved upwardly towards the valves in opposition to the spring force.

Referring to FIG. 5, fluid actuators 56 and 57 are positioned adjacent lower end 58 of lever 28 and are secured to platform 18 by brackets 60. In a presently preferred embodiment of this invention, each fluid actuator includes an interiorly disposed membrane (not shown) connected to an outwardly extending rod 62 which is engaged by bell crank 64 pivotally secured to the lever adjacent to the lower end thereof. The actuator is preferably a vacuum actuator having a conduit 66 (67) extending from a vacuum chamber 56c (57a) and connected with a first port 68 (69) of valve 52 (53). The application of a vacuum to the vacuum chamber causes the membrane to retract rod 62 into the actuator so that head 70 of the rod engages the bell crank and pivots lever into its neutral (vertical) position in which connecting member 29 de-energizes the drive means 24 to arrest the rotation of pinion 26 and stop the rotatable movement of platform 18 on the base 10. Pressurized fluid, such as pressurized air or hydraulic fluid, for example, can of course be employed to energize the fluid actuators. The necessary hydraulic connections are well known and are therefore, not further described herein.

Valves 52 and 53 include second ports 72 and 73, respectively, connecting the interior of valve cylinders 74 and 75 with a vacuum source 76 via a conduit 78. The second valve ports are positioned so that the valve pistons (not shown) disposed interiorly of valve cylinders 74 and 75, respectively establish a flow communication between...
the respective first and second ports of the valve when wheels 46 and plungers 48 are biased in opposition to each other by the force from springs 54 towards the valves by their contact with wedges 42 and 44 while the communication between the two valve ports is interrupted when the plungers and wheels are free and not in contact with the wedges. This results in the application of a vacuum to the vacuum chamber of the fluid actuator which is associated with a respective lug of the corresponding port on which contacts a rod 62 and return moving lever 29 to its neutral position.

Turning now to the operation of the automatic stop means of the present invention, boom crane 5 is moved to its working place and the crane is rotated so that boom 30 is adjacent a hazardous object such as an electric overhead cable (not shown). While in that position a wedge, say wedge 42, is positioned on ring 48 so that it engages contact wheel 46 associated with valve 52 and moves the valve piston (not shown) to the position in which ports 68 and 72 are in many communicating. Plunger 48 is moved in the direction moving wheel 46 down along wedge 42 and away from the wedge until the boom again approaches another, or the same, hazardous object, in which position the rotatable movement of the platform is arrested and wedge 44 is positioned on ring 38 in a manner identical to that in which wedge 42 was positioned. The angular spacing of the two wedges is, of course, determined by the position of the hazardous objects that can be contacted by the boom if the platform could be rotated through 360 degrees. It will be noted that the large number of apertures 40 in ring 38 enable the positioning of the wedges wherever necessary so that the magnitude and orientation of the arc through which the platform may rotate can be varied.

The crane is now ready for operation and platform 18 is rotated about kingpin 16 in one or the other direction by moving swing lever 28 to the right or the left (as viewed in FIG. 5) from its neutral, vertical position in which the drive means 24 is de-energized. Under normal circumstances, the operator will move the lever into its neutral position as soon as boom 30 approaches the hazardous object. Should the crane operator inadvertently fail to observe the approaching danger and maintain lever 28 in its drive means actuating position, one of the wheels 46 secured to a plunger 48 is moved towards its associated valve to move the valve piston (not shown) upwardly until the corresponding first and second ports are in communication, This causes the application of a vacuum to the vacuum chamber of one of the fluid actuators which results in the virtually instantaneous retardation of rod 62 into the respective actuator whereby lever 28 is forcefully moved into its neutral position and any further motion of the platform on the base is prevented.

The hydraulic actuators are sized to exert a sufficient force on lever 28 to overcome the lever's holding force to positively prevent the operator from maintaining the lever in its drive means actuating position. The crane operator is, however, free to move the lever in the other direction to rotate the platform in the opposite direction away from the hazardous object since the energized fluid actuator does not prevent such movement and the other, second actuator remains de-energized. The ensuing rotation of the platform causes the disengagement of rod 46 from wedge 42, thereby causing a return of the valve 52 piston to its original position and of the removal of the vacuum from the vacuum chamber of the energized fluid actuator. This permits the membrane and the associated rods of the fluid actuator to return to their original position, so that the crane operator is again free to move lever 28 in both directions. Continued rotation of the platform in the opposite direction causes the eventual engagement of the other wheel 46 with wedge 44 to again stop the movement of the platform before the crane boom can contact the hazardous object.

Referring to FIG. 4, it is sometimes desirable to limit the rotational movement of the platform and the crane boom with greater accuracy than is obtainable by the use of the apertures in ring 38. To that end an adjustable wedge 80 is slidable movable on a carrier 82 conventionally secured to the ring as by threaded bolt and having a pair of downwardly depending dowel pins 83 and an upwardly extending web 84. The web includes a threaded aperture engaged by a threaded bolt 88 extending into a bore in the wedge and secured to the wedge by a pin 90 engaging a groove 92, on the periphery of the bolt to permit the rotation of the latter. Rotation of the bolt causes slidable movement of the wedge towards or away from the web of the carrier. When mounted on ring 38 the precision positioning of the wedge with respect to wheels 46 on plungers 48, and therewith the precise relative positioning between the platform 18 and base 10 at which the fluid actuators arrest the rotation of the platform, can be adjusted with any desired degree of accuracy.

The safety device of the present invention is adapted for installation on already existing, older cranes, and particularly on swing lever controlled one, without the need for dismantling the crane or its control circuit. Ring 38 can be supplied in two halves to enable its placement about ring gears 27; and the valves 52, 53 and fluid actuators 56, 57 are secured to the base at variable locations. The installation of the fluid circuit does not require the disturbance of already existing circuits, which may result in malfunctions in the circuit if the capacity of portions of all of it is exceeded, and the fluid actuators are connected with the moving levers by simple mechanical linkages.

Having thus described my invention, I claim:

1. In a crane having a base, a platform movably supported on the base and being rotatable thereon about a vertical axis, a boom extending from the platform, drive means for rotating the platform, and manually operable means for actuating and de-actuating the drive means, automatic arresting means for the drive means to limit the rotation of the platform, comprising:

(a) a fluid actuator coupled with the manually operable means for moving the last mentioned means from its drive means actuating to its drive means de-actuating position,

(b) valve means in flow communication with the fluid actuator and a fluid source for selectively connecting and disconnecting the actuator and the source to thereby selectively move the manually operable means from its actuating to its de-actuating position,

(c) sensing means connected with the platform and the valve means for moving the valve means between its actuator and source connecting and disconnecting positions, and

(d) a limit member connected with the base, cooperatively with the sensing means and positioned to cause the de-actuation of the drive means by the fluid actuator at predetermined positions of the platform on the base.

2. Apparatus according to claim 1 wherein the manually operable means comprises a swing lever and the fluid actuator is mechanically connected with the swing lever.

3. Apparatus according to claim 2 wherein the lever is pivotable and the drive means de-actuating position of the lever is disposed between two drive means actuating positions, and including a pair of fluid actuators disposed on opposite sides of the lever and means for mechanically coupling the lever with movable members of the actuators.

4. Apparatus according to any of claims 1, 2, or 3 wherein the limit member comprises a wedge demountable secured to the platform, and the sensing means comprises a plurality biased into engagement with the wedge and connected with the valve means.

5. Apparatus according to claim 4 wherein the wedge is adjustable when secured to the platform to alter the position of the platform on the base when the wedge operates the sensing means.
6. Apparatus according to claim 5 wherein the wedge is slidably disposed on a carrier secured to the platform and includes a threaded member in engagement with the wedge and the carrier for moving the wedge on the carrier.

7. Apparatus according to any of claim 1 or 5 including a ring concentric about the axis of rotation of the platform and having a plurality of spaced apertures engageable by the wedge and permitting the repositioning of the wedge on the ring.

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