July 16, 1963 O. W. HAHN 3,097,749

BOOM STABILIZING AND SAFETY CONTROL APPARATUS

Filed Jan. 25, 1962 3 Sheets-Sheet 1

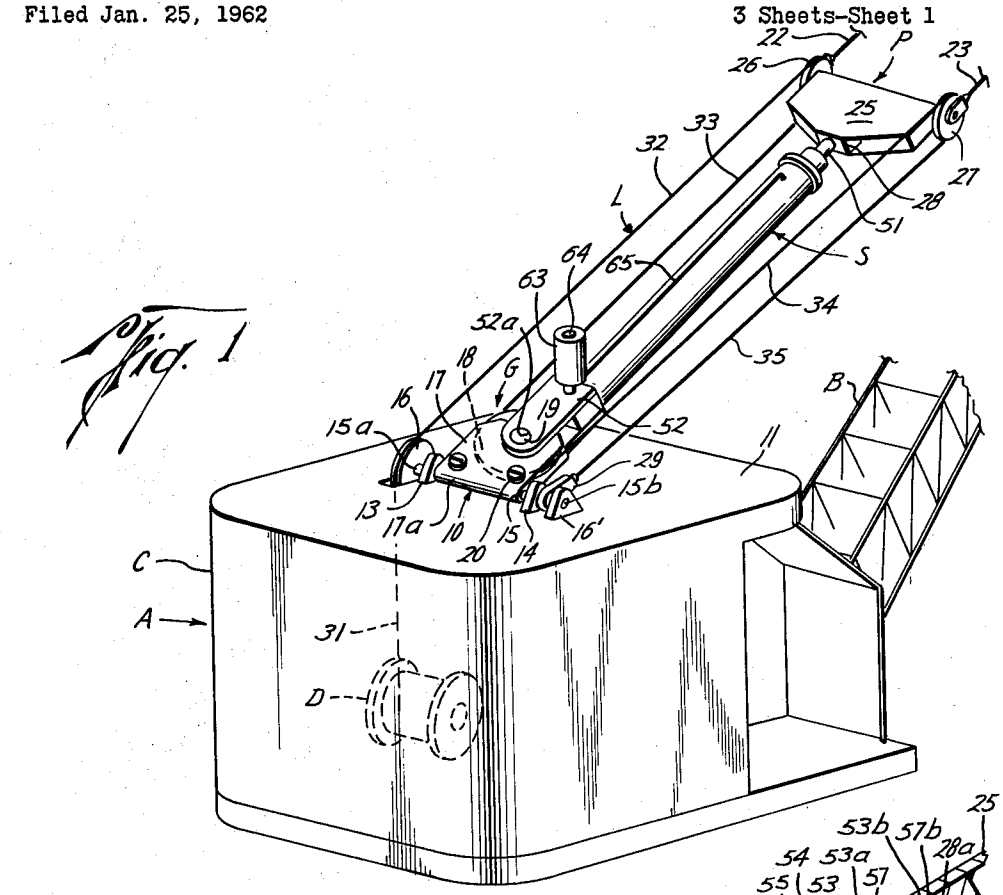


Fig. 1

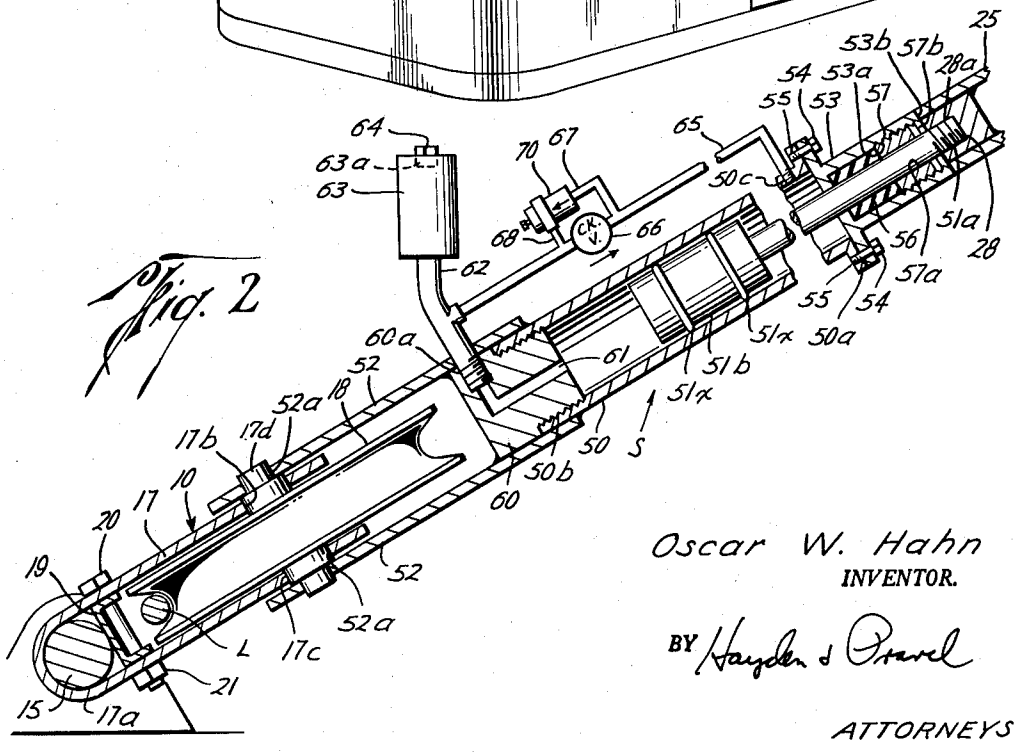


Fig. 2

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BOOM STABILIZING AND SAFETY CONTROL APPARATUS

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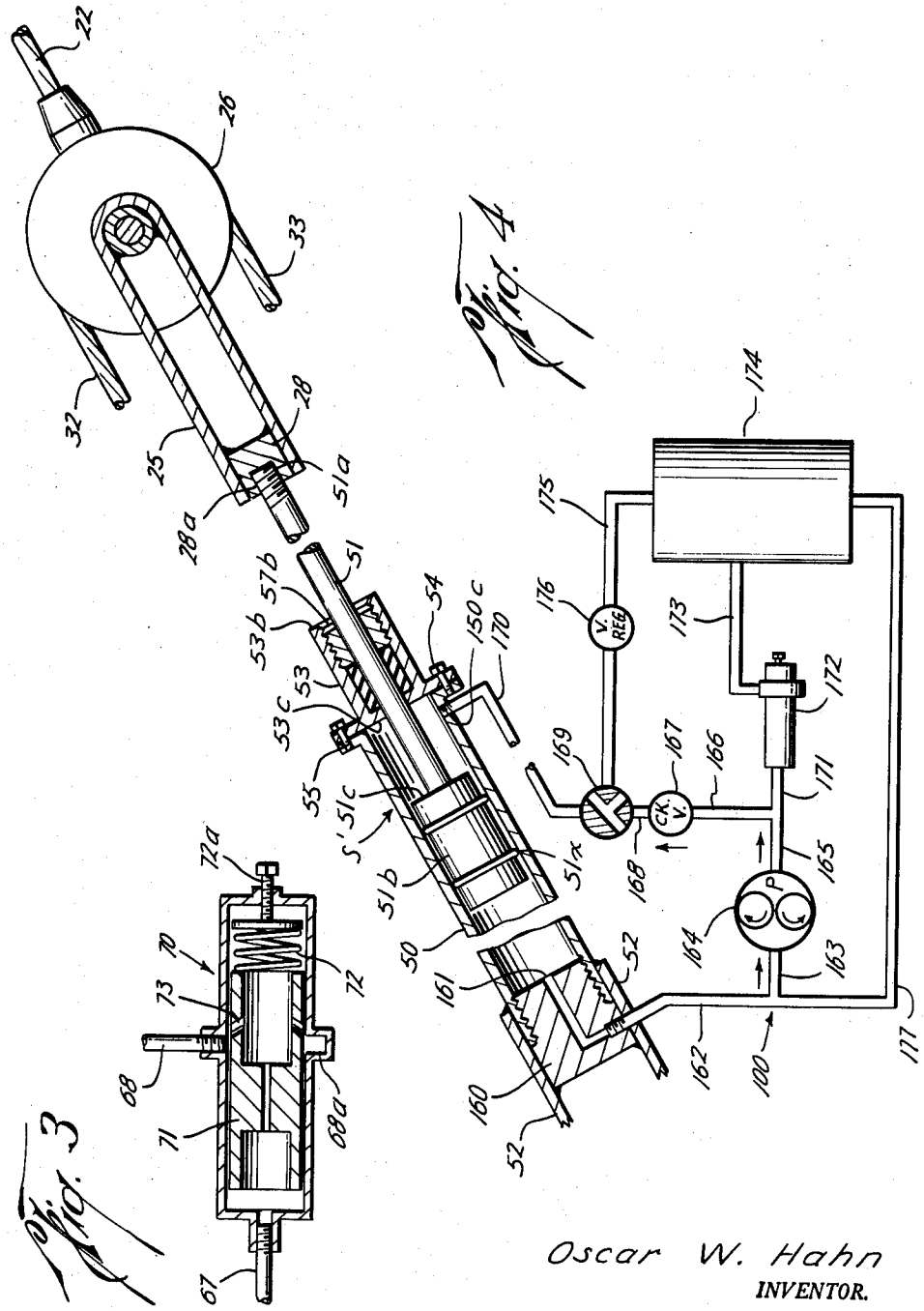


Fig. 3

Fig. 4

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BOOM STABILIZING AND SAFETY CONTROL APPARATUS

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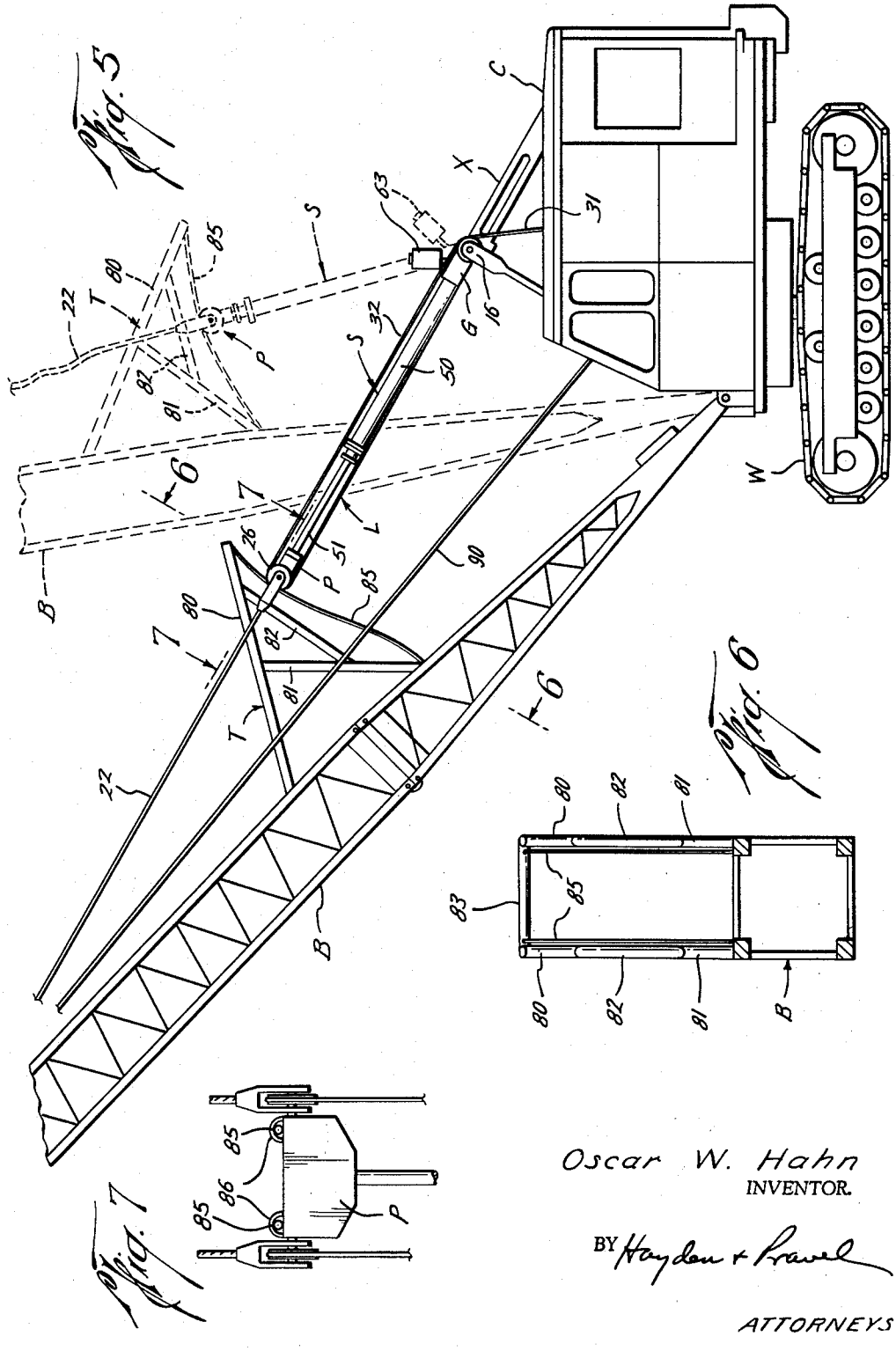


Fig. 5

Fig. 6

Fig. 7

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BOOM STABILIZING AND SAFETY CONTROL APPARATUS

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18 Claims. (Cl. 212—59)

The present invention relates to a new and improved device for stabilizing booms used on draglines, cranes, and other similar lifting and hoisting devices, and more particularly to a new and improved hydraulic safety control boom stabilizer.

This application is a continuation-in-part of my copending application, Serial No. 95,550, now abandoned.

Crane booms or the like are normally constructed to handle compression loads. They are supported at one end, the foot or heel, and are actuated at the load bearing end. Such cranes and the like are not usually adapted to withstand any appreciable bending or transverse force at intermediate points. To construct or build a boom of the strength necessary to withstand such force or forces would require so much additional weight, as to make the crane and boom unstable at the lengths and operating radii of booms presently being used.

One of the disadvantages of prior art crane and boom devices is that the stops, which are presently being used to prevent upward movement of the boom beyond a certain point, are highly ineffective. Normally, present day boom stops intersect the angle formed by the boom and A-frame and/or gantry of the crane and connect to some mid-point on the boom. If the boom stop is constructed of relatively strong materials, i.e., constructed of materials of greater strength than the boom, it is not unlikely that a bending movement sufficiently strong to damage the boom will occur when the boom is raised to the stop position. Because of such structural limitations, present day stops are normally constructed of somewhat flimsy materials, i.e. constructed of materials of considerably less strength than that of the boom. Unless extreme caution is exercised by the operator of the crane, as the boom is powered back or moved upwardly, the boom stop will be deformed or bent. Such boom stop construction merely permits an alert operator to be warned as the boom is powered back or raised, but they do not prevent a pulling of the boom back over the operator's cab. Further, should the boom fall freely forward, as happens when a cable breaks, such a stop can do nothing to prevent such free-fall, and damage to the boom will occur. The apparatus of the present invention is particularly adapted to overcome the above disadvantages as well as others.

It is an important object of the present invention to provide a new and improved stop which positively stops or limits backward or upward movement of the boom over the operator's cab of a crane or the like without damage to either the boom or the stop.

Another object of the present invention is to provide a new and improved boom stop wherein the stop is positioned in line between the A-frame or gantry and the pendant bridle of a crane and the in-line meeting of the acting force, coupled with sufficient structural strength of the boom stop, with no stress being applied to the boom itself, enables an actual snubbing of the power-up action of the crane at any predetermined point without damage to the boom.

Still another object of the present invention is to provide a new and improved boom safety control device wherein a boom may be lowered at a pre-set controlled rate of speed to thereby prevent damage to such boom resulting from falling of the boom because of a broken cable, defective brakes, or other faulty mechanism or failure in the operation of the boom cables.

A further object of the present invention is to provide a new and improved boom stop which prevents a forward free-fall of the boom in the event of a failure of one or more of the cables for raising the boom.

Yet a further object of the present invention is to provide a new and improved hydraulically operated safety control device for booms and especially for cable operated booms.

Another object of the present invention is to provide a new and improved hydraulically operated safety control device for crane booms wherein the crane boom may be lowered or raised hydraulically at regulated or predetermined speeds independently of boom hoist and boom hoist line operations.

A particular object of this invention is to provide a new and improved apparatus for preventing topping or backlashing of a crane boom such as might occur due to the dropping of a load from the boom or due to water or wave action if the boom is used on a barge.

It is a specific object of this invention to provide a new and improved safety apparatus for use with a cable actuated boom wherein such apparatus has means therewith for: (1) preventing a forward free-fall of the boom in the event of a cable, operator, or equipment failure; (2) preventing a powering of the boom back over the cab or operator with the cables; and (3) preventing a backlashing or topping of the boom when the load is dropped or other external forces act on the boom.

The construction designed to carry out the invention will be hereinafter described, together with other features thereof.

The invention will be more readily understood from a reading of the following specification and by reference to the accompanying drawings forming a part thereof, wherein an example of the invention is shown and wherein:

FIG. 1 is an isometric view of the device of the present invention in position on a hoisting apparatus such as a dragline;

FIG. 2 is a partial sectional view of the device of the present invention and the means for connecting the device to a boom;

FIG. 3 is a sectional view illustrating one type of pressure relief valve used with the device of the present invention;

FIG. 4 is a partial sectional view of the present invention with an alternate hydraulic system;

FIG. 5 is an elevation illustrating the specific part of the apparatus for preventing topping or backlashing of the boom, with the solid lines indicating the boom in a forward position and the dotted lines indicating the boom in its stopped rearward position;

FIG. 6 is a view taken on line 6—6 of FIG. 5 to illustrate further details of the apparatus of this invention, and

FIG. 7 is a view taken on line 7—7 of FIG. 5 to also illustrate further details of the stop mechanism of this invention.

Cranes and other similar load-lifting apparatus normally employ a pivoted boom which is raised or lowered by means of a hoisting cable which is wound on a winch or drum.

Not infrequently the crane operator accidentally powers back too much or raises the boom too high. This may cause serious damage to the boom as it is deformed or bent over the cab of the crane. The safety of the operator himself is also jeopardized by such action. A similar result may also occur if a load line breaks whereby the boom is actually whipped upwardly. Should the working cable or line holding the boom itself break, the boom will fall freely to the ground. This too can result in a substantial amount of damage to the boom to say noth-

ing of endangering the lives of any persons who might happen to be on the ground under the boom.

The present invention provides a boom stop which positively limits the upward movement of the boom and eliminates damage to the cab, boom and operator, and also provides a safety control for lowering the boom sufficiently slowly to prevent damage to the boom which might result from a free fall.

It should be noted that the most practical operational method for a boom stop to effectively stop a moving boom is to meet the force "in-line" or approaching "in-line." The "in-line" path is any part of a line extending between the A-frame or gantry sheaves and the boom point.

The boom stabilizer or stop of the present invention is positioned between the pendant bridle and the A-frame bridle on a hoisting apparatus such as a dragline and therefore substantially in the "in-line" path as will be more fully explained hereinafter.

Referring now to the drawings, and more especially to FIG. 1, the boom stabilizing device is indicated generally at S and is illustrated in position on a crane operated hoisting apparatus such as a dragline or the like indicated generally at A. The apparatus A is partially shown and is seen to include the cab C with a portion of the pivotal boom B connected thereto and the boom hoisting lines L which are controlled by means of the drum D. The hoisting lines L are also connected to the pendant bridle means P and the gantry means G, all in a manner well known in the art. The boom stabilizer S is positioned between the gantry means G and the pendant means P in a parallel relationship with the boom hoisting lines L, the details of which will be explained hereinafter.

The gantry means G is seen to include the bail block assembly **10** which is pivotally mounted on the top **11** of the cab C by means of the pillow blocks **13** and **14** or other suitable shaft support means which support the shaft **15**. The shaft **15** extends sufficiently on either side of the blocks **13** and **14** to enable the sheave or wheel **16** to be rotatably mounted on one end **15***a* and the other end **15***b* to extend to the pillow block or support member **16'**. The shaft **15** extends through the lower end **17***a* of the block weldment **17** of the bail block assembly **10**. A sheave **18** is pivotally mounted within the U-shaped member **17** by any suitable means such as the pin **17***d*. Suitable openings **17***b* and **17***c* are positioned in the U-shaped member **17** for receiving the pin **17***d*. A channel member **19**, which is best seen in FIG. 2, is positioned in the U-shaped support member **17** between the sheave **18** and the pivot pin or shaft **15**. The channel member **19** is held in position by any suitable means such as the bolts **20** and nuts **21**. The channel member **19** prevents pulling the sheave **18** into contact with the shaft **15** by preventing a rearward or downward movement of the member **17** on the pivot pin **15**, while still permitting a pivoting or rotational movement of the member **17** about the pin **15**.

It can be appreciated that various types of gantry means, A-frames or other similar devices may be used without departing from the scope of the invention. Nearly every manufacturer of hoisting apparatus employs a differently constructed gantry means. The particular gantry means G, illustrated in FIGS. 1 and 2, is merely illustrative and is not intended to limit the boom stabilizer S.

The pendant bridle means P is connected to the pendant lines **22** and **23** (partially shown) which are connected to the upper end of the boom B in a manner well known in the art. The bridle means P includes the pendant cross-member or bail **25** which has the rotatably mounted sheaves **26** and **27** on either side thereof for receiving the boom hoisting lines L. The pendant means P also has an attachment means **28** which is adapted to receive the piston rod **51** of the boom stabilizing device S. The attachment means **28** is illustrated as being welded to the bail or body **25** and has a threaded opening **28***a* therein which is adapted to receive the threaded end portion **51***a* of the piston rod **51**. Any other suitable connection means may be used to attach the piston rod **51** to the bail **25** without departing from the scope of the invention.

As in the case of the gantry means as stated above, numerous types of pendant means or pendant bridles are found in the art. The particular pendant means P illustrated in FIG. 1 is by way of illustration only, and the present invention is not limited to any particular type of pendant means or pendant bridle.

The boom hoisting lines L are rotated on the drum D and extend therefrom at **31**, over the wheel **16**, and around the wheel **26** of the pendant means P thereby forming the lines **32** and **33**, with the line **33** extending around the sheave **18** to the wheel **27** of the pendant bridle P forming the line **34** and around the wheel **27** to the end connection means **29** which is pivotally mounted on the shaft **15** between pillow blocks **14** and **16'**, to form the line **35**. By rotating the drum D, the hoisting lines L are either shortened or lengthened to thereby raise or lower the boom B in a manner well known in the art.

The manner in which the boom hoisting or working lines are connected to the drum, gantry or A-frame, pendant bridle and the like may also be varied without departing from the scope of the present invention. The method of connecting or joining the boom hoisting or working lines L, as seen in FIG. 1, is for illustrative purposes only.

The pin **17***d* of the gantry means G is extended sufficiently on either side thereof to enable the boom stabilizing support members **52** to be positioned thereon. Suitable openings **52***a* are positioned in the end of each of the members **52** so that the pin **17***d* may be extended therethrough. Any other suitable connection means may be utilized to connect the apparatus S to the gantry means G. The present invention may be utilized with any standard gantry means G or pendant means P, provided suitable connection means are provided for connecting the boom stabilizer S to the gantry means G and the pendant means P.

The boom stabilizer and safety control device S includes the cylinder **50** in which the piston **51***b* on the piston rod **51** is sealably and slidably positioned therein. The piston **51***b* has suitable seal means such as the O-rings **51***x* positioned thereon. The upper end of the cylinder **50** extends in a flange **50***a* on which the sealing head **53** is adapted to be positioned thereon by any suitable means such as the bolts **54** and nuts **55**. The sealing head **53** may include any suitable packing gland or seal for the rod **51**. As illustrated, the sealing head **53** includes the packing or sealing means **56** which is held in such sealing head **53** by means of a plug **57** having an opening **57***a* therein for receiving the piston rod **51** and which is preferably threaded in the opening **53***a* of the sealing head **53**. The plug **57** may be substantially flush with the end surface **53***b* of the sealing head **53** to provide a stop surface for contact by the means **28**, but in any event, the contact between the attachment means **28** and the head **53** serves as a mechanical stop at the bottom end of the piston stroke.

The cylinder **50** and the piston rod **51** may be of any desired length, depending upon the stroke required for a given crane or dragline. The stroke required is a function of the horizontal and vertical distances from the gantry to the boom heel and is not affected by the length of the boom. The same stabilizer S serves for all lengths of booms for any given crane.

The lower end **50***b* of the cylinder **50** may be threaded for receiving a plug **60**, or such plug **60** may be welded to cylinder **50**. The plug **60** has a passage means **61** therein, one end of which is connected by any suitable connection such as threads **60***a* to a tubular member **62** extending from a surge tank **63** or other suitable fluid supply means. The surge tank **63** may have an opening **63***a* in the top thereof to enable fluid to be placed in the

surge tank 63. A closure cap 64 or other suitable cap means is positioned in the hole 63*a* to close the tank 63 except for the inlet 62 thereto. Although it is generally undesirable, it is possible to use a breather cap instead of the closure cap 64.

The use of the closure cap 64 provides for a confined air or gas pocket in the upper part of the surge tank 63 which is highly advantageous in the operation of the device S on both its upstroke and its downstroke. Because the air space is above the highest part of hydraulic system and the liquid of the system passes into communication with the surge tank 63 on both strokes, any air or gas which gets into the liquid of the system is automatically purged and accumulated in the gas pocket at the upper end of the tank 63. Additionally, the use of a closed surge tank 63 results in a compression of the air or gas in the tank 63 on the downstroke of the piston 51*b* and the immediate creation of sufficient differential pressure to open check valve 66 to assure the immediate flow of the liquid to the area of the cylinder above the piston 51*b*, whereby the creation of a vapor or gas space above the piston 51*b* is avoided. On the upstroke of the piston 51*b*, the compression of the confined gas in the tank 63 assists in the flow of the liquid to the area below the piston 51*b* to be certain that area below the piston 51*b* fills with liquid. Other advantages of the closed hydraulic system will be evident from the rest of the description.

The upper end of the cylinder 50 has an opening 50*c* therein which is adapted to receive the fluid line or tube 65 which is connected to the tubular member 62 by any suitable means. The valve 66 in line 65 is a one-way check valve 66, which operates in the direction as indicated by the arrow when a predetermined pressure differential is acting on the valve. For example, in the usual case, the valve 66 will open for flow in the direction of the arrow (upwardly) when the pressure to the left or below such valve 66 is about five pounds per square inch higher than the pressure in the line 65 to the right or above the valve 66. The use of the closed surge tank 63 provides for such pressure differential to open the valve 66, as previously explained. A bypass line 67 is connected to the line 65 on either side of the check valve 66 and such bypass line 67 has a flow regulator valve 70 positioned therein, which is illustrated in more detail in FIG. 3.

The device S of the present invention, as illustrated in FIG. 2, is in a stop position or a position wherein the boom B is raised to its maximum height. When the connection means 28 is moved to contact the surfaces 53*b* and 57*b* of the sealing head 53 and plug 57, respectively, farther travel of the boom B is prevented. By varying the length of the pendant lines 22 and 23, the maximum height to which the boom B may be raised may be fixed or regulated as desired. Also, when the piston 51*b* reaches its upward limits, i.e., the surface 51*c* is adjacent the surface 53*c* of the sealing head 53, the stabilizer S is stopped in its most extended position. The travel of the boom B downwardly may be stopped by the contact of the rod 51 with the head 53, or other stop means, although generally the stroke of the piston 51*b* is sufficiently long to lower the boom completely to the ground prior to the contact between the rod 51 and the head 53, or other stop means.

The flow regulator 70, as seen in more detail in FIG. 3, is used to maintain a constant flow of fluid at a predetermined rate. The regulator may be one of a type well known in the art of which a simple form thereof is illustrated in FIG. 3. Fluid passing through the line 67 into the valve 70 creates a differential that pushes the sliding valve 71 back against the spring 72. At the same time, the fluid pressure on either side of the sliding valve 71 tends to equalize. Since the spring exerts essentially a constant force, the differential pressure is maintained

substantially constant across the regulator 70 so that the movement of the piston 51*b* is at a substantially constant rate throughout its upward stroke. As the amount of pressure exerted against the valve 71 increases, the valve 71 is urged to the right (FIG. 3) against the spring 72 to cause the passageway 73 to move partially out of alignment with the annular channel 68*a* so as to reduce the size of the passageway 73 through which fluid may flow. The reverse occurs as the pressure decreases to thereby maintain the constant pressure differential above described. For changing the pressure differential, the adjusting screw 72*a* may be threaded in and out, or the spring 72 may be replaced with a spring of a different strength.

In FIGS. 5–7, the apparatus of this invention is shown as including an assembly or means T which works in conjunction with the stabilizer device S to prevent topping or a backlashing of the boom B in the event the load on the boom drops or other external forces act on the boom to cause such topping or backlashing of the boom B.

The boom stabilizer S of FIG. 5 is identical with that illustrated in FIGS. 1 and 2 of the drawings, except that the attachment of the gantry bridle G to the cab C is at an elevated point as compared to that illustrated in FIG. 1. Thus, the top of the A-frame X extends above the top of the cab C as shown in FIG. 5, but otherwise, the mounting of the gantry bridle G is preferably as illustrated in FIG. 1. It is to be noted that the line 32 passes over the sheave 16 in the same manner as FIG. 1 and the portion of the line 31 extending below the sheave 31 passes downwardly into the cab C for operation by a drum or drawworks D (FIG. 1). The cab C in FIG. 5 is also shown with its usual tractor wheel support mechanism W which of course is also utilized with the cab C of FIG. 1.

The backlash preventer means T includes a support frame made up of a plurality of pipes or bars mounted on the boom B. Such frame includes a pair of forward bars or pipes 80 which are welded or secured at their lower ends to the boom B. Rear supports 81 are welded or are otherwise secured to the boom B and to a point intermediate the ends of the forward members 80. Braces 82 are secured by welding or other suitable means between the support members 81 and the forward members 80 to provide for additional strength and bracing. The upper ends of the forward members 80 are preferably interconnected by a horizontal or lateral brace 83. Other suitable bracing extending laterally or diagonally between the members 80, 81 and 82 may also be provided for additional rigidity of the entire framework for the means T.

One or more cables 85, two of which are illustrated, are connected at or near the upper end of the framework, preferably at the upper ends of the members 80 or the brace 83. The lower ends of the cables 85 are connected to the boom B or to the lower ends of the supports 81. Such connections of the cables 85 may be made by welding, clamps or any other suitable means.

The cables 85 are preferably positioned so as to contact the upper or forward end of the pendant bridle P (FIGS. 5 and 7). The cables 85 are maintained in a proper relationship to the pendant bridle P by means of grab members 86. As illustrated in FIG. 7, the grab members 86 are in the form of U-shaped eyelets which are welded or otherwise secured to the bridle P so that the cables 85 may pass therethrough. The grab members 86 are particularly useful for preventing the bridle P from jumping upwardly away from the cables 85 if the cables are used in a normally taut condition rather than in the normally slack condition shown in FIG. 5.

In the use of the apparatus of this invention, the boom stabilizer S is connected "in-line" to the pendant bridle means P and the gantry means G as illustrated in the draw-

ings, and preferably in substantially parallel alignment with the hoisting lines 32, 33, 34 and 35. Oil or other liquid is provided in the hydraulic system so that the surge tank 63 is partially full to leave an air or gas pocket above the liquid. Upon an upward movement of the piston 51*b*, the oil or other liquid flows from the tank 63 and the upper part of the cylinder 50 into the lower part of the cylinder 50 below the piston 51*b* to maintain such area filled with the liquid. On the return stroke, or downward movement of the piston 51*b*, the reverse flow of the oil or other liquid takes place. As previously pointed out, there is an automatic purging of air bubbles from the cylinder 50 during the movement of the piston 51*b* in the cylinder 50.

When the boom B is lowered or boomed down, the piston 51*b* moves upwardly or is pulled towards the sealing head 53. The one-way check valve 66 is closed and fluid above the piston 51*b* is forced into the line 65, into the line 67, through the flow valve 70, through the line 68 and through passageways 62 and 61 into the cylinder 50 below the piston 51*b*. At the same time fluid from surge tank 63 is also flowing through passageway 62 into the cylinder 50. The amount of fluid required from the surge tank 63 is equal to the displacement of the rod 51 being withdrawn from the cylinder 50. As the flow valve regulator 70 has been previously set to allow a specific amount of fluid to pass therethrough, the descent of the boom B is thereby smooth and set at a selected rate. Should one of the cables 31, 32, 33, 34 or 35 of the hoisting lines L break, the free fall of the boom B is prevented because the apparatus S permits only a relatively slow smooth rate of descent of the boom B. The boom stabilizer S also saves wear and tear on the lines L because the lines 31–35 are normally slack during the lowering of the boom B. Also, there is a minimum use of the brake because of the smooth lowering with the apparatus S, thereby further reducing wear on the working lines 31–35.

In booming up operations, or raising the boom B, the piston 51*b* is forced downwardly in the cylinder 50 and forces the fluid below the piston 51*b* into the passageways 61 and 62, through the check valve 66 and into the cylinder 50 via the opening 50*c*. At this time, fluid displaced by the rod 51 will flow into the surge tank 63 through passageway 62. In the absence of such exchange of fluid betwen the cylinder 50 and the surge tank 63, the piston 51*b* would be locked against movement, or gas would be present in the liquid which would cause unrestrained irregular movements of the piston 51*b*, and corresponding irregular jerking movements on the boom B. Preferably, the check valve 66, the passageways 61 and 62, and the opening 50*c* are so constructed that very little restraint to the downward movement of the piston 51*b* occurs during the raising of the boom B with the working lines 31–35.

In the event the load line 90 (FIG. 5) which supports the load on the boom B for raising and lowering same, breaks, causing the load to drop from the boom B, the boom B tends to snap upwardly or rearwardly. Such action is called topping or backlashing, and it often throws the boom B back over the cab C, thus causing great damage to the boom B and also endangering the life of the operator within the cab C. Topping or backlashing may be caused by external forces other than the dropping of the load on line 90. For example, if the boom is mounted on a barge or float, the wave or wind action may produce such effect.

With the present invention, such topping or backlashing is avoided by means of the assembly T mounted on the boom B. Thus, if the load supported by the boom does drop inadvertently and cause such a tendency to backlash or move rearwardly, the boom B will simply swing rearwardly to the dotted line position of FIG. 5, at which time the cables 85 will be drawn tightly into contact with the pendant bridle means P. Such cables 85 provide a cushion since they are flexible. Furthermore, the cables 85 may be bowed as shown in dotted lines in FIG. 5. Such bowing of the cables 85 when they are acting against the pendant bridle P causes an automatic centering of the pendant bridle P between the upper and lower ends of the cables 85. The rearward backlashing action of the boom B is thus absorbed by the resiliency of the cables 85 while providing a positive stop to prevent the movement of the boom B over the top of the cab C. It is also to be noted that the cables 85 act to transmit the rearward movement to the stabilizer S to cause the piston 51*b* to move downwardly to thereby further cushion the rearward movement of the boom B. The downward movement of piston 51*b* is slowed by the air head in the surge tank 63, until finally the mechanical stop by the contact of the means 28 and the head 53 takes place.

It can thus be seen that the preferred form of the invention illustrated in FIGS. 1, 2, and 5–7, provides an apparatus which: (1) prevents topping or backlashing of the boom B when the load on the boom is dropped or other external forces cause such backlashing action; (2) the column strength of the boom stabilizer S prevents a powering back of the boom beyond a substantially vertical position with the cables; and (3) a free fall of the boom B is prevented in the event any of the hoisting lines L break, or in case of a brake or operator failure.

Referring now to FIG. 4, an alternate embodiment S′ of the present invention is illustrated, wherein the device S′ is substantially the same as the device S except that an alternate hydraulic fluid system 100 is used. Principally, the system 100 provides a fluid pump 164 and related structure which makes it possible to force the piston 51*b* downwardly to thereby hydraulically raise the boom B rather than using the lines 31–35 of FIG. 1.

The end plug 160 has a passage means 161 which is in communication with the line 162 which is connected to the line 163 which in turn is connected to the pump 164 and the line 165. A line 166 is connected to the line 165 with the one-way check valve 167 connected thereto and to the line 168, which is in turn connected to the three-way selector valve 169. The selector valve 169 is connected to the line 170 which extends to the opening 150*c* in the upper end of the cylinder 50. The line 165 is also connected to the line 171 which joins the high pressure bypass means 172 with the line 173 and the surge tank 174. A line 175 connects the surge tank 174 with the selector valve 169 and a pressure regulating valve 176 is also positioned in the line 175. The surge tank 174 is further connected to the line 162 by the line 177.

When the three-way selector valve 169 is in a position for establishing fluid flow from the cylinder 50 through line 170 to the regulator 176, the pump 164 is forcing fluid through the lines 165 and 171, into the bypass 172, line 173 and into the surge tank 174. Fluid flows from the surge tank 174 into the line 177 and into the line 162 through the passage means 161 and in the cylinder 50 below the piston 51*b*, to thereby displace any void which might otherwise occur as the piston 51*b* moves upwardly in the cylinder 50 due to the lowering of the boom B. When the three-way selector valve 169 is moved so that the lines 168 and 170 are in communication with each other, fluid is forced directly into the lines 170 and into the cylinder 50 above the piston 51*b* to force the piston 51*b* downwardly in the cylinder 50 to thereby raise the hoisting boom B.

The three-way selector valve 169 may block all three lines 168, 175 and 170 as illustrated in FIG. 4 to lock the piston 51*b* at any desired point to thereby hold the boom B at a selected angle.

It can be appreciated that the present invention relates to a new and improved boom stabilizer and safety control device, which serves to prevent the boom from being powered over the cab with the cables, which prevents topping or backlashing of the boom, and which also provides a means for preventing free fall of the boom in case of cable failure. The apparatus S eliminates considerable wear and tear on the cable itself and also allows the operator of the hoisting apparatus to conduct the

booming apparatus smoothly and with a minimum use of the brake.

One of the advantages of the present invention is the ease with which the apparatus may be mounted on conventional cable operated booms. Once the apparatus is installed, it operates automatically, is self-purging and provides a safety device which protects against the dangers now present in cable operated booms.

Although the device of the present invention has been illustrated in connection with a hoisting apparatus such as a crane having a particular type of gantry means and pendant means, it can be appreciated that the device of the present invention may be used with any other type of cable operated hoisting apparatus employing a boom or the like.

The foregoing disclosure and description of the invention is illustrative and explanatory thereof and various changes in the size, shape and materials, as well as in the details of the illustrated construction, may be made within the scope of the appended claims without departing from the spirit of the invention.

What is claimed is:

1. In a hoisting apparatus having a pivotally mounted boom and a working line connected to a working drum for normally raising and lowering the boom about its pivot, the improvement residing in, a safety apparatus having means therewith for controlling the rate of lowering of the boom in the event the working line breaks or other hoist failure occurs.

2. The structure set forth in claim 1, wherein said means includes a cylinder having a fluid therein, a piston adapted to move back-and-forth in the cylinder, and a surge tank connected with said cylinder for controlling the fluid flow from one end of said cylinder to the other during the displacement thereof by said piston.

3. The structure set forth in claim 1, wherein said means includes a fluid piston means having one end connected to the working line and extending substantially in alignment with the line of force exerted on said working line during the raising of said boom.

4. In a hoisting apparatus having a pivotally mounted boom and a working line for normally raising and lowering the boom about its pivot, the improvement residing in, a safety apparatus having backlash means on said boom, and fluid piston means connected to said working line and engageable with said backlash means for stopping the boom when it is subjected to backlashing action to thereby prevent the boom from pivoting rearwardly beyond a substantially vertical position.

5. In a hoisting apparatus having a pivotally mounted boom and a working line connected to a working drum for normally raising and lowering the boom about its pivot, the improvement residing in, a safety apparatus having stabilizer means therewith for controlling the rate of lowering of the boom in the event the working line breaks, and backlash stop means co-acting with said stabilizer means for stopping any backlashing of the boom.

6. The structure set forth in claim 5, wherein said backlash stop means includes flexible means mounted on the boom and engageable with said stabilizer means for providing a resilient cushioned stopping of the backlashing movement of the boom.

7. The structure set forth in claim 5, wherein said backlash stop means includes a frame supported on the boom, and cable means mounted on said frame, said cable means being engageable with the upper end of said stabilizer means to cause said cable means to tighten and bow when the boom is subjected to a backlashing force, whereby the stabilizer means becomes substantially centrally disposed between the ends of said cable means when the backlash movement of the boom is stopped.

8. In a hoisting apparatus having a boom with a pendant bridle means and a working line connected to the boom wherein the boom is pivotally mounted on a base, the improvement residing in, a safety apparatus for controlling the rate of lowering of the boom including, a hydraulic assembly having a cylinder with a piston slidable therein, one end of said assembly being connected to the base and the other end thereof being connected to the pendant bridle means, and a fluid control system connected with said cylinder for regulating the extension of said hydraulic assembly for thereby controlling the rate of lowering of the boom.

9. In a hoisting apparatus having a boom with a pendant bridle means and a working line connected to the boom wherein the boom is pivotally mounted on a base, the improvement residing in, a safety apparatus for controlling the rate of lowering of the boom including, a hydraulic assembly having a cylinder with a piston slidable therein, one end of said assembly being connected to the base and the other end thereof being connected to the pendant bridle means, and a fluid control system connected with said cylinder for substantially unretarded movement of said piston as it telescopes in said cylinder during the raising of the boom.

10. In a hoisting apparatus having a boom with a pendant bridle means and a working line connected to the boom wherein the boom is pivotally mounted on a base, the improvement residing in, a safety apparatus for controlling the rate of lowering of the boom including, a hydraulic assembly having a cylinder with a piston slidable therein, one end of said assembly being connected to the base and the other end thereof being connected to the pendant bridle means, and a fluid control system connected with said cylinder for regulating the extension of said hydraulic assembly for thereby controlling the rate of lowering of the boom and for permitting substantially unretarded movement of said piston as it telescopes in said cylinder during the raising of the boom.

11. In a hoisting apparatus having a boom with a pendant bridle means and a working line connected to the boom wherein the boom is pivotally mounted on a base, the improvement residing in, a safety apparatus for controlling the rate of lowering of the boom including, a hydraulic assembly having a cylinder with a piston slidable therein, one end of said assembly being connetced to the base and the other end thereof being connected to the pendant bridle means, and a fluid control system connected with said cylinder for controlling the fluid flow from one end of said cylinder to the other during the displacement thereof by said piston, said system including a tank connected to one end of said cylinder for introducing and receiving fluid into said cylinder in accordance with the internal volume changes in said cylinder as said piston reciprocates.

12. In a hoisting apparatus having a boom with a pendant bridle means and a working line connected to the boom wherein the boom is pivotally mounted on a base, the improvement residing in, a safety apparatus for controlling the rate of lowering of the boom including, a hydraulic assembly having a cylinder with a piston slidable therein, one end of said assembly being connected to the base and the other end thereof being connected to the pendant bridle means, a fluid control line connected to said cylinder near its upper and lower ends for circulating fluid during the reciprocating movement of the piston in the cylinder, and a surge tank connected in said control line and having a gas pocket above the liquid level, whereby a purge of gas bubbles in the fluid of the hydraulic assembly is automatically obtained and any gas is collected in said pocket of said surge tank.

13. A safety device for cable operated hoisting booms having pendant lines and bridle means on the upper end of a boom and a gantry bridle means, comprising a hydraulic piston means adapted to be secured between the pendant bridle and the gantry bridle.

14. A boom stabilizer for a cable operated hoisting apparatus for a boom wherein said apparatus has pendant lines and bridle means connected to the outer end of the boom, a gantry bridle means and hoisting lines connected

thereto, comprising a hydraulic piston means including a cylinder connected to said pendant bridle and said gantry bridle, and stop means therewith for mechanically preventing said hoisting lines from powering said boom rearwardly beyond a substantially vertical position.

15. A boom stabilizer and safety control device for positioning on a boom hoisting apparatus having a boom, hoisting cables, a pendant line and bridle means connected to the upper end of the boom, and a bridle means connected to a base, comprising a hydraulic piston means including a cylinder secured to the gantry bridle, a piston for moving fluid in said cylinder, a piston rod connected to said piston on one end and to the pendant bridle on the other end, and fluid control means connected to said cylinder for regulating the rate of speed at which said piston moves in said cylinder during the lowering of said boom.

16. A boom stabilizer and safety control device for positioning on a boom hoisting apparatus having a boom, hoisting cables, with pendant lines and bridle means connected to the upper end of the boom, and a gantry bridle means connected to a base, comprising a hydraulic piston means including a cylinder secured to the gantry bridle, a piston for moving fluid in said cylinder, a piston rod connected to said piston on one end and to the pendant bridle on the other end, and fluid control means connected to said cylinder for substantially unretarded movement of said piston in said cylinder during the raising of the boom and for controlled movement of said piston in said cylinder during the lowering of said boom.

17. A boom stabilizer for a cable operated hoisting apparatus for a boom wherein said apparatus has pendant lines and bridle means connected to the outer end of the boom, a gantry bridle means and hoisting lines connected thereto, comprising a hydraulic piston means including a cylinder connected to said pendant bridle and said gantry bridle, and dampening means connected with said hydraulic piston means for retarding sudden rearward backlashing movement of said boom.

18. The structure set forth in claim 17, wherein said dampening means includes a surge tank connected with said cylinder and having a gas space therein which is compressed as the boom backlashes to cushion such backlash movement.

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