AN ADJUSTABLE LENGTH BOOM HAVING A BOOM HOIST CABLE SYSTEM EXTENDING BETWEEN THE DECK AND THE BOOM SECTIONS, SO THAT THE OUTER END OF THE BOOM IS SUPPORTED FROM THE DECK AND THE BOOM SECTIONS ARE ALSO INDIVIDUALLY SUPPORTED.

BACKGROUND OF THE INVENTION

A boom is supported in an angular position by cables or the like extending from an anchor point on the deck support structure to the upper end of the boom. Thus the boom is prevented from deflecting under load and can be made without being excessively heavy. It is desirable to make these booms as light as possible for the loads to be handled, not only from a standpoint of economy in manufacture, and ease of transportation and handling, but also to increase their load handling capacity for any given boom size.

It is desirable to avoid manually changing the boom hoist cable system between the anchor point and the outer end of the boom when the boom length is changed and it is desired to maintain the boom angle substantially constant. Prior art devices for accomplishing this have been proposed and which use what are commonly referred to as automatically compensating cable systems. Such an arrangement is shown for a two section boom in the U.S. Pat. 2,999,600 issued Sept. 12, 1961; that prior art system, however, cannot be used in a boom with more than two sections.

Another form of prior art, compensating pennant is shown in the U.S. Pat. 2,819,803, issued Jan. 14, 1958, to Obenchain, where a single suspension cable is utilized in a boom having more than two sections.

SUMMARY OF THE INVENTION

The present invention provides an extensible boom having three or more sections and an automatically compensating boom hoist cable system between the anchor point and the outer end of the boom, and which also provides proper tension in the entire cable system. With the present invention, the outer end of the boom is always supported from the anchor point, the boom angle can remain substantially constant regardless of the amount of boom extension, and at the same time the length and therefore tension of individual suspension cables to each individual boom section can be individually set to provide proper cable tension throughout the system. Thus the boom can be provided with the precise amount of support required at any point along its length. Equal tension throughout the entire cable system can thus be provided and thereby prevent any "weak link" in the system.

More specifically, the entire compensating boom hoist cable system includes an individual suspension cable for each boom section, and each cable can be made of such length so as to provide equal tension throughout the boom hoist cable system and also maintain substantial straightness of the boom.
nected between sections 10, 12 and 14, and between sections 12, 14 and 16. If a more complete description of the means for extending and contracting the boom sections is deemed to be either necessary or desirable, reference may be had to the copending U.S. application Ser. No. 747,672 filed July 25, 1968, and entitled, "Flexible Means for Powering a Telescopic Boom in Extending and Contracting Directions." However, for purposes of this disclosure, this means, per se, may be of any conventional and well known form, such as additional hydraulic cylinder and piston means, and further reference to it is not believed necessary or desirable.

In accordance with the present invention, a novel boom hoist cable system S is provided for supporting the adjustable length boom, and by means of which it is not necessary to manually adjust the cable system when the length of the boom is to be changed and it is desired to maintain approximately the same boom angle.

This automatically compensating boom hoist cable system S extends generally between the anchor point on the deck, which point in effect is the idler sheave 3e on the deck, and the outer end of the boom, as at 25. With this system the length of the boom is always supported from the anchor point, regardless of the length of the boom, and the boom angle can remain essentially constant.

The cable system includes boom lift line 29 and its receive 39a connected to winch S which is trained over idler sheave 3e and then extended forwardly where it is fixed to a pulley means 30. Additional pulley means 32 and 34 are provided and all are similar, a description of one will suffice. For purposes of illustrating the invention, as shown clearly in FIG. 6, the pulley means have been shown as having a pair of pulleys journalled on a shaft. One such pulley means is provided for each boom section 10, 12 and are located generally adjacent to but spaced upwardly from their respective boom section. Thus, a series of pulley means 30, 32 and 34 are provided, one respectively, for boom sections 10, 12 and 14.

The outermost section 16 commonly referred to as the boom tip, requires no such pulley means.

Each boom section 10, 12 and 14 also have respective sheave means 40, 42 and 44 journalled on and adjacent their outer or forward end. While the term sheave has been used for purposes of describing the invention, the term includes pulleys, rollers, drums or the like. As shown in FIG. 6, the sheave means for each section may comprise a pair of sheaves, one sheave on each end of a shaft which in turn is mounted on the end of the section.

Individual suspension cables 50, 52 and 54 are provided, one for each set of pulley means and sheave means 30, 40; 32, 42; and 34, 44 respectively.

The lift cable 29, the series of pulley means 30, 32 and 34, and portions of the cables 50, 52 and 54 together form a main boom hoist cable means CM which extends generally from the anchor point 3e to the boom tip 25 and at an acute angle to the boom B.

The suspension cables thus extend from the main cable means CM, one cable being connected to its respective boom section by being trained around its respective boom section sheave. Thus the suspension cables act to individually support their respective boom section, as will appear. The tension in each cable can also be adjusted, as will appear, to equalize the tension throughout the cable system.

The suspension cables are anchored at their lower or rear ends to the adjoining telescopic boom section. For example, cables 50, 52 and 54 are anchored, respectively, adjacent the rear ends of boom sections 12, 14 and 16, as at anchor points 12e, 14e and 16c.

The cables 50 and 52 are anchored at their upper or forward ends, on the next pulley means outwardly along the boom, namely pulley means 32 and 34, respectively. Cable 54 is anchored at its forward end to the boom tip, as at 25, in the FIGS. 1-5 device.

In the FIG. 6 arrangement, the cables 50, 52 and 54 are also trained around pulleys on the pulley means 32, 34 and 36 respectively, and then extend rearwardly where they are anchored on the shafts of pulley means 30, 32 and 34 respectively. Thus in the FIG. 6 arrangement, an additional pulley means 36 is utilized on the outermost section 16. An additional mechanical advantage is obtained when the cables are anchored as in FIG. 6.

Normally, the cables 50, 52 and 54 are of fixed length for any boom design or length, the cables providing additional reach for the cable means CM as the boom is extended, and vice versa.

The present cable system provides for individual adjustment of the tension in each suspension cable, and for individual and adjustable supporting effect for the boom sections. Thus, variable loading characteristics can be provided for the different boom sections for different loading conditions. This adjustment is accomplished as follows:

The length of the cables 50, 52 and 54 can be changed from that length shown in FIG. 1. When the cables are fully lengthened, for example, as shown in FIG. 4, the pulley means 30, 32 and 34 are more nearly directly above, that is more nearly in vertical alignment, with their respective sheaves 40, 42 and 44. As a result, the cables are acting more nearly at right angles to their boom sections, and thereby provide a greater lifting effect on or support for their respective sections.

When it is desired to vary the lifting effect between the different cables, the pulley means may be moved individually with respect to one another and, if desired in opposite directions. For example, in FIG. 5, the pulley means 30 has been shifted rearwardly, to the left of its sheave 40, by lengthening its pendant cable 50. On the other hand, pulley means 34 has been shifted forwardly, that is to the right of its sheave 44, by shortening its suspension cable 54. Consequently, cable 52 has a greater lifting moment than cables 50 or 54 because it is acting at a more of a right angle to the boom.

Thus the suspension cables can be changed in length for a particular crane design, to thereby vary the distance between their pulley means, and consequently vary the amount of offset displacement between any one pulley means and its respective sheave on the adjacent boom section. In this manner, the supporting effect of a suspension cable on its boom section can be selectively adjusted.

What is claimed is:

1. In a crane, a mounting deck, an extensible and telescopic boom upstanding from the deck at an angle to the perpendicular, the boom having at least a base section, an intermediate section and a third section mounted together for relative telescopic movement, said base section being mounted on said deck, means for extending and contracting said boom sections, and a compensating boom hoist cable system of the type wherein the boom angle remains substantially constant regardless of the amount of boom extension, said system including a main boom hoist cable means extending generally between said deck and the outer end of the boom at an acute angle to said boom, said system also including a series of suspension cables extending from said main boom hoist cable means intermediate the length thereof and one suspension cable being connected to each boom section for individual support thereof.

2. The crane as defined in claim 1 further characterized in that said boom hoist cable means includes a series of pulley means, one located generally adjacent to but spaced upwardly from each section; sheave means mounted on and adjacent the outer end of each section; and each of said suspension cables extends from its respective pulley means and is trained over the respective sheave means on
the adjacent boom section and is then anchored on the rearwardly adjoining telescoped section.

3. The crane defined in claim 2 further characterized in that said suspension cables each also extend from its said respective pulley means over which it is trained and outwardly along the boom to the next pulley means for connection thereto, whereby an automatically compensating boom hoist cable system is formed.

4. The crane set forth in claim 3 further characterized in that said suspension cables can be changed in length to thereby vary the distance between said pulley means and consequently vary the amount of lateral displacement between any one pulley means and its respective sheave means on the adjacent boom section, whereby the supporting effect of a suspension cable on its boom section can be varied.

5. A crane of the type having a mounting deck, an extensible and telescopic boom upstanding from the deck at an angle to the perpendicular, the boom having at least a base section, an intermediate section and a third section mounted together for relative telescopic movement, said base section being mounted on said deck, means for extending and contracting said boom sections, and a main boom hoist cable means extending generally between said deck and the outer end of the boom at an acute angle to said boom, the improvement comprising, said boom hoist cable means including a series of pulley means spaced therealong, one pulley means being located generally adjacent to but spaced upwardly from each section; sheave means mounted on and adjacent the outer end of each section; a series of suspension cables, one suspension cable extending from each pulley means and trained over the respective sheave means on the adjacent boom section and then anchored on the rearwardly adjoining telescoped section, to thereby provide individual support for each boom section.

6. The crane defined in claim 5 further characterized in that some of said suspension cables also extend from its said respective pulley means over which it is trained and outwardly along the boom to the next pulley means for connection thereto, whereby an automatically compensating boom hoist cable system is formed.

7. The crane set forth in claim 6 further characterized in that said suspension cables can be changed in length to thereby vary the distance between said pulley means and consequently vary the amount of lateral displacement between any one pulley means and its respective sheave means on the adjacent boom section, whereby the supporting effect of a suspension cable on its boom section can be varied.

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