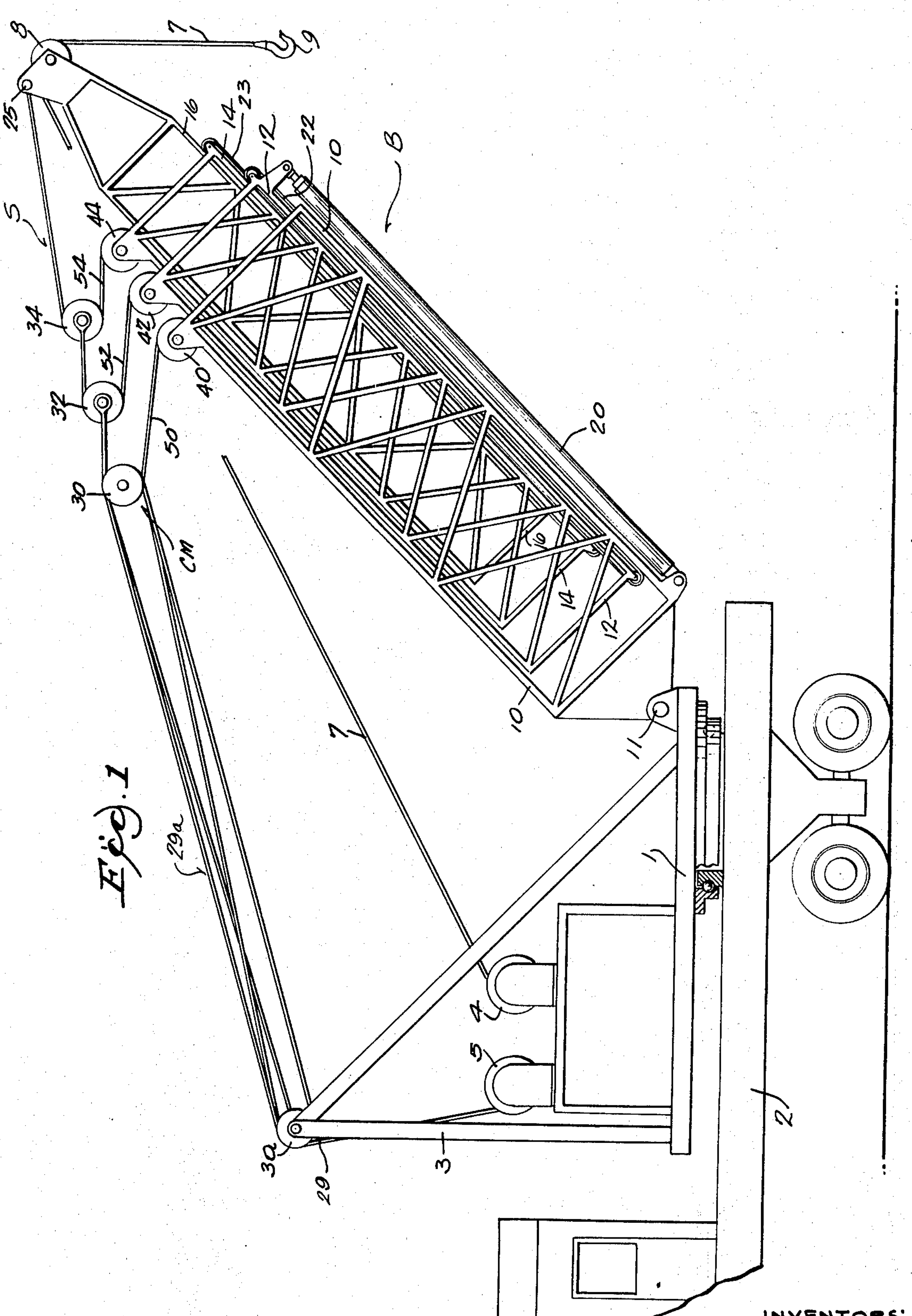
Oct. 20, 1970 R. L. JOHNSTON ET AL 3,534,867
COMPENSATING BOOM HOIST CABLE SYSTEM FOR
A TELESCOPIC BOOM FOR CRANES OR THE LIKE
Filed July 25, 1968 3 Sheets-Sheet 1



INVENTORS:
ROGER L. JOHNSTON
DAVID G. GHYSELS
BY: James E. Nilles
ATTORNEY

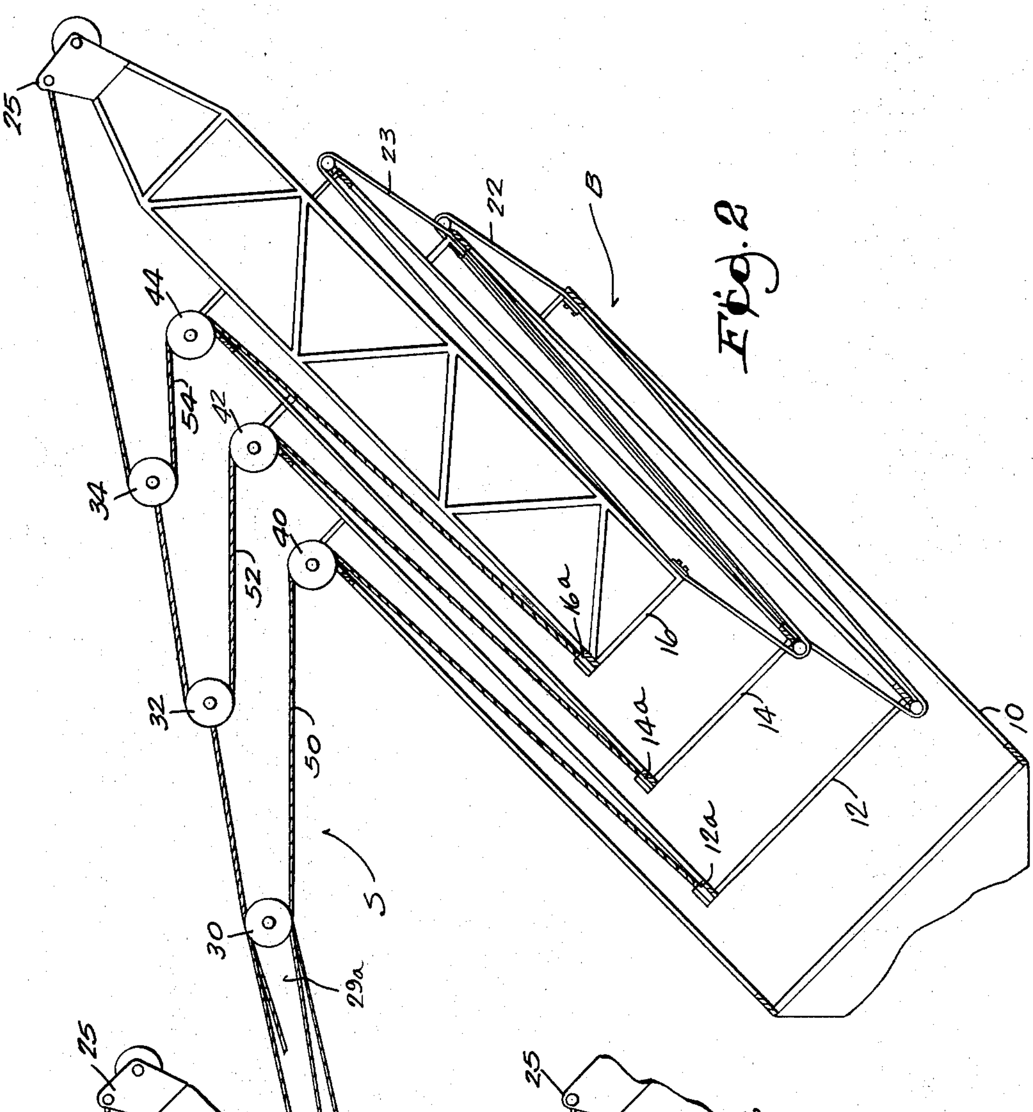


Fig. 2

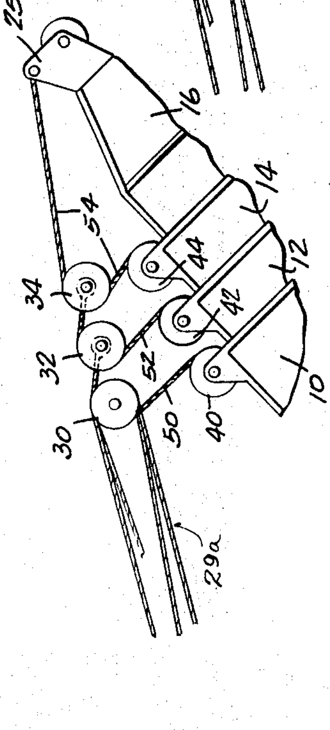


Fig. 4

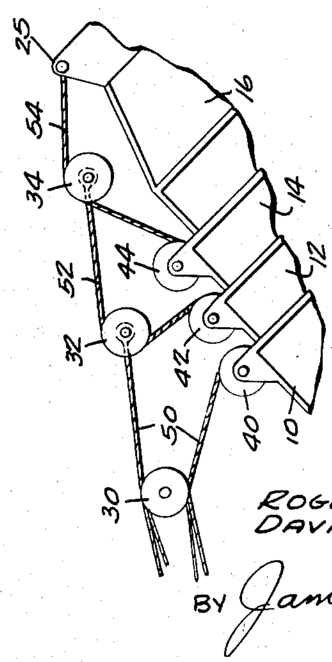


Fig. 5

INVENTORS:
ROGER L. JOHNSTON
DAVID G. GHYSELS
BY James E. Nilles
ATTORNEY

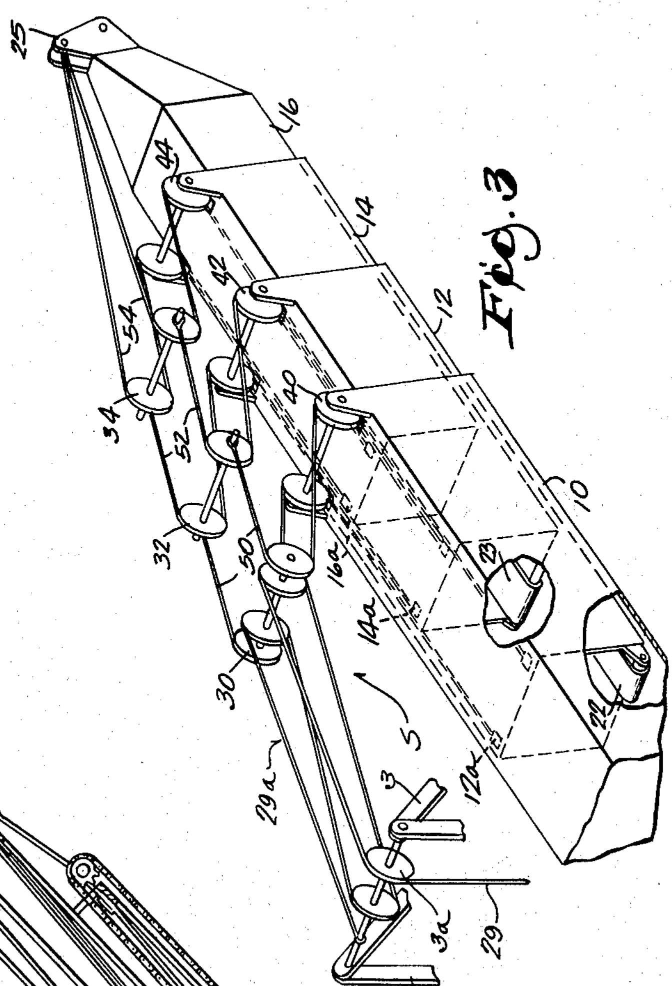


Fig. 3

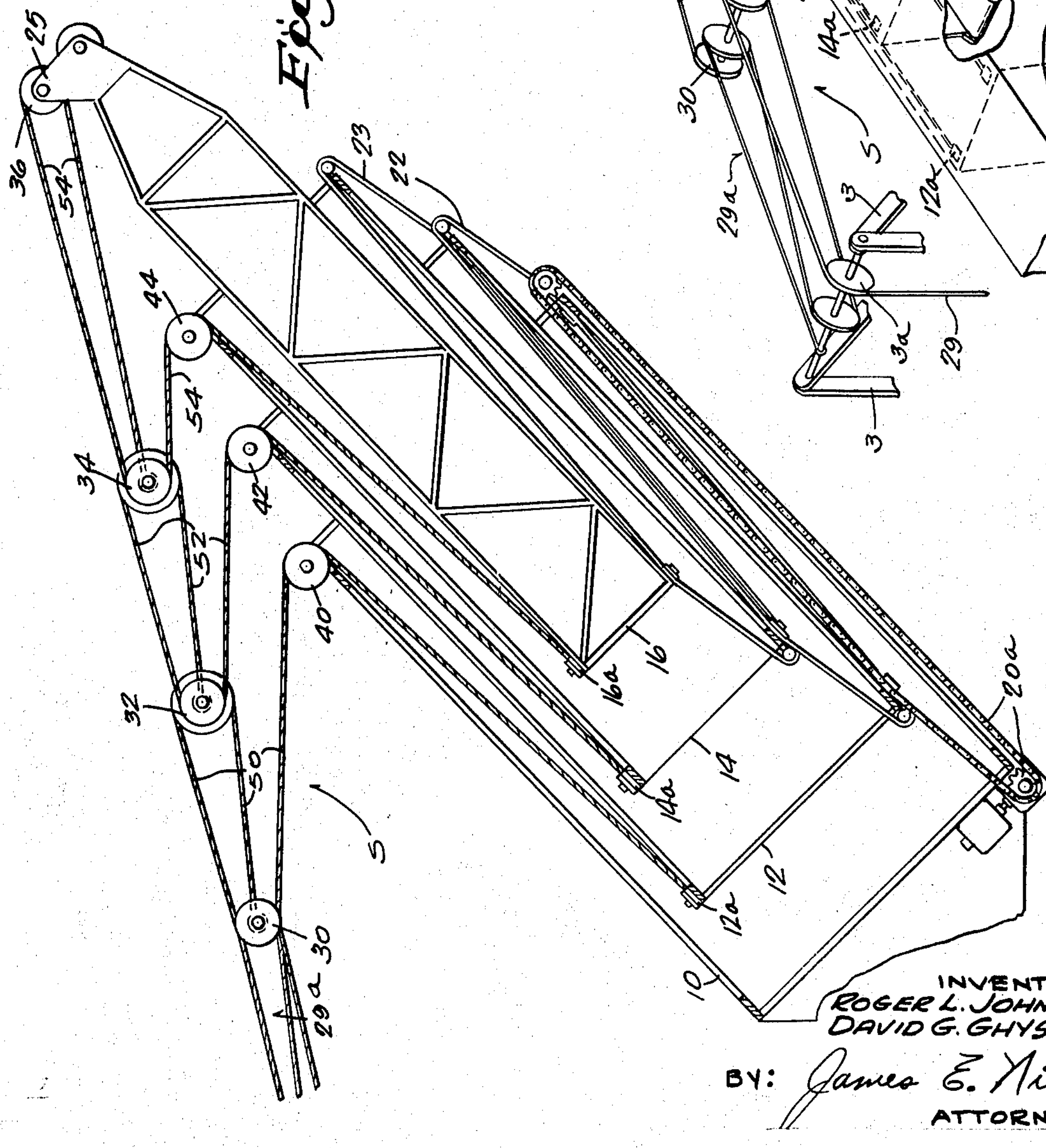


Fig. 6

INVENTORS:
ROGER L. JOHNSTON
DAVID G. GHYSELS

BY: James E. Nilles
ATTORNEY

United States Patent Office

3,534,867

Patented Oct. 20, 1970

1

3,534,867

COMPENSATING BOOM HOIST CABLE SYSTEM FOR A TELESCOPIC BOOM FOR CRANES OR THE LIKE

Roger L. Johnston, Pewaukee, and David G. Ghysels, Oconomowoc, Wis., assignors to Harnischfeger Corporation, Milwaukee, Wis., a corporation of Wisconsin

Filed July 25, 1968, Ser. No. 747,673
Int. Cl. B66c 23/04
U.S. Cl. 212—55 7 Claims

ABSTRACT OF THE DISCLOSURE

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.

2

These and other objects and advantages will appear as this disclosure progresses, reference being had to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an elevational view, more or less schematic in nature, of an extensible boom embodying the present invention, the boom being in its contracted position, and showing it as applied to a truck crane;

FIG. 2 is a more or less schematic view of a portion of the FIG. 1 boom, but with the boom in a partially extended position, certain parts being shown as broken away or removed for clarity in the drawing, the view being enlarged from the FIG. 1 scale;

FIG. 3 is a more or less schematic, perspective view of the boom hoist cable system shown in FIGS. 1 and 2;

FIG. 4 is a view similar to FIG. 2, but showing the individual suspension cables adjusted to a different position;

FIG. 5 is a view similar to FIG. 2 but showing the individual suspension cables moved to different individual positions relative to one another;

FIG. 6 is a view similar to FIG. 1, but showing a modification of the manner in which the suspension cables are trained around the pulley means and anchored, and also showing a modified form of power means for extending one section.

DESCRIPTION OF A PREFERRED EMBODIMENT

The boom B made in accordance with the present invention can be used on various vehicles, loading docks or other stationary or movable supports, but it has been shown for purposes of illustrating the invention as being located on a revolving deck **1** of a truck crane **2**. The deck includes an upstanding, rigid part **3** and has conventional power winches **4** and **5** mounted thereon.

The boom may be of three or more telescoping sections, and for purposes of illustrating the invention, a four section boom has been shown. The sections are nested together and can be extended or contracted, being supported one within another by suitable rollers or the like (not shown) in the well known manner. When in use, the boom usually extends upwardly from the deck at an angle to the perpendicular and often is of several hundred feet in length when extended. In order for the boom to accommodate maximum loads, particularly when the boom angle to the ground is small, the boom should be as light in weight as possible, so the boom weight itself does not limit the capacity of the boom, consistent of course with the required strength.

The load line **7** extends from winch **4** and over the boom point sheave **8** at the outer end of the boom, and the load (not shown) is attached (for example) to the hook **9** at the end of the load line **7** (FIG. 1).

The boom includes a base section **10** pivotally mounted for vertically swinging on shaft **11** carried on the deck. The boom also includes an intermediate section **12** telescopingly slidable in section **10**, a third section **14** telescopingly slidable in section **12**, and a fourth section **16** which is telescopingly slidable in section **14** and extends outwardly therefrom where the boom point sheave **8** is journalled.

Means are provided for telescopingly extending and contracting the boom sections. This means for causing extension or contracting of the boom may be of various types and is shown only briefly here in FIG. 1 as a double acting hydraulic cylinder and piston means **20**, or in FIG. 6 as a chain and sprocket means **20***a*, connected between the base and intermediate sections for causing relative movement therebetween. Relative movement between the other sections **12** and **14**, and **14** and **16** is accomplished by flexible means **22** and **23**, respectively, connected 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 *3a* on the deck, and the outer end of the boom, as at **25**. With this system, the outer end 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 reeving ***29a*** connected to winch **5** which is trained over idler sheave *3a* and then extended forwardly where it is fixed to a pulley means **30**. Additional pulley means **32** and **34** are provided and as 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 the 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 also 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 *3a* 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 ***12a***, ***14a*** and ***16a***.

The cables **50** and **52** are anchored at their other 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 all shortened, 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, or to the left of its sheave **40**, by lengthening its pennant 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 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 betwen 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.

References Cited

UNITED STATES PATENTS

1,163,497	12/1915	Andersen	212—55
1,345,304	6/1920	Fied	212—55

HARVEY C. HORNSBY, Primary Examiner

U.S. Cl. X.R.

212—144