March 21, 1961 M. L. CONRAD 2,975,910

CRANE BOOM

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FIG. 1

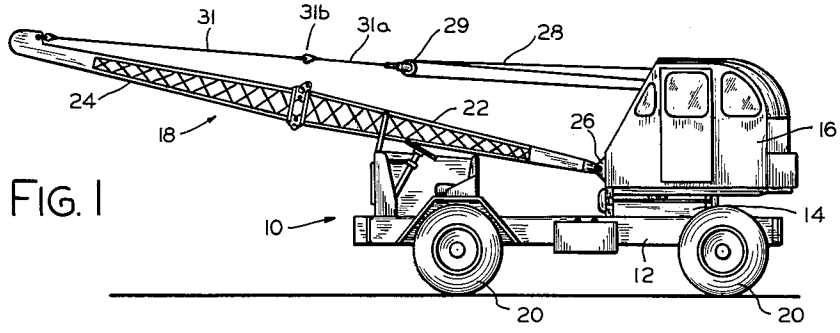


FIG. 2

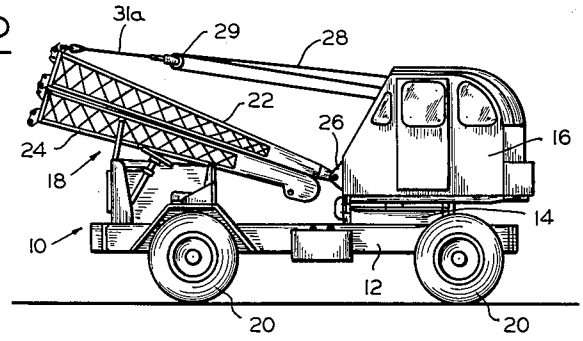
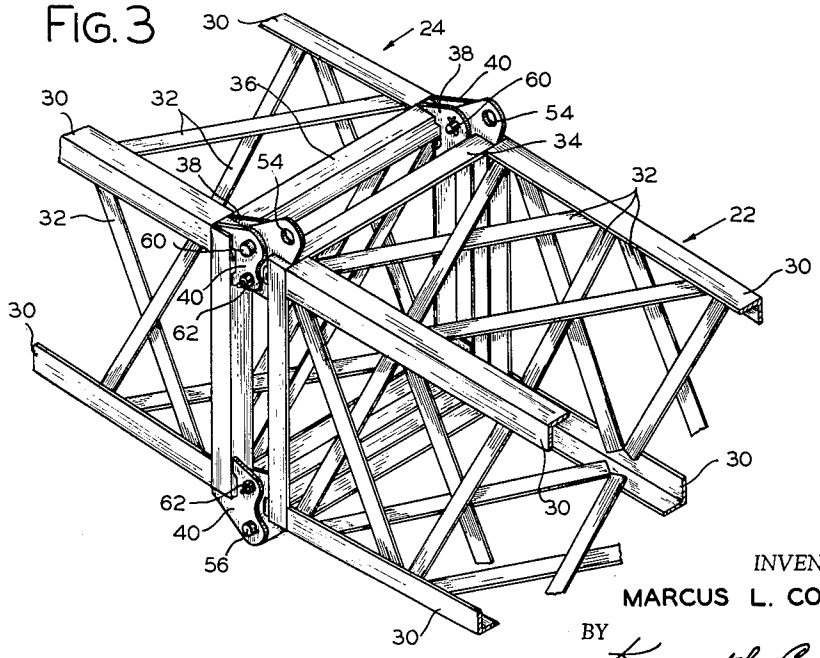


FIG. 3



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FIG. 4

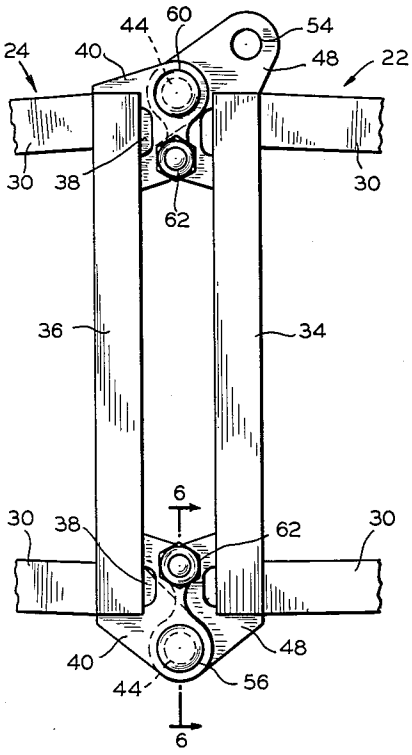


FIG. 5

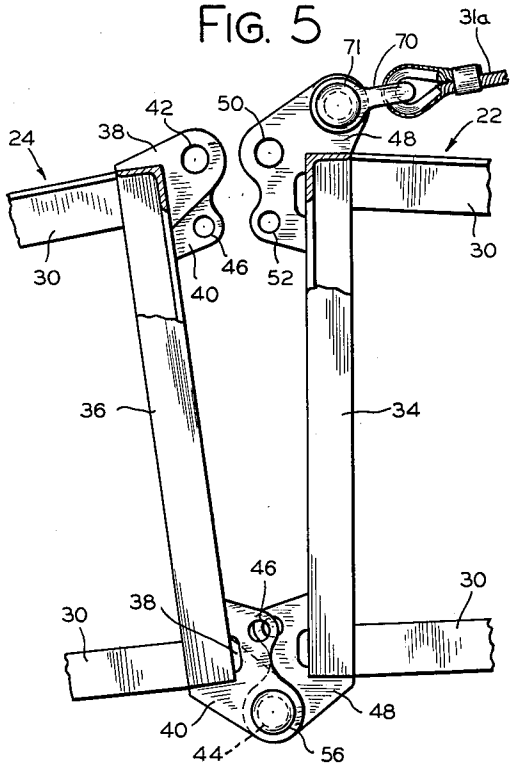
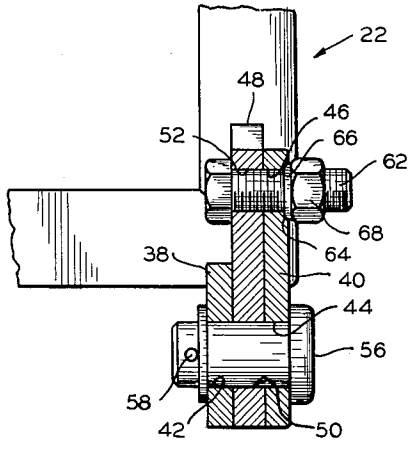


FIG. 6



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CRANE BOOM

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10 Claims. (Cl. 212—144)

This invention relates to power cranes and similar devices and generally to an improved boom construction for power cranes, and more particularly to a foldable boom construction which can be reduced in length for convenience in transportation of the crane and can be quickly and easily extended for use.

The demand for high speed, low cost transportation for power cranes, shovels and the like has resulted in mounting these units, including the booms, upon motor trucks. Due to the length of boom required to properly effect the functions performed by power cranes and the like, the conventional boom when extended projects out a substantial distance from the motor truck. When transporting such a boom from place to place in extended position the motor truck may be unstable, particularly under adverse conditions such as uneven road surfaces and high winds. It is difficult to maneuver a truck with extended boom in traffic and around sharp curves or corners. Moreover, the applicable laws and regulations may in some cases preclude the movement on a public street or highway of such a machine.

I am cognizant of the fact that various structures have previously been proposed to eliminate the above-mentioned disadvantages. Common among such structures is the sectional boom construction whereby different sections of a boom of the general type specified may be detachably connected together end to end by means of a number of longitudinally extending bolts inserted through flange plates at the corners of each of the boom sections. A structure of this type is exemplified by that shown in U.S. Patent No. 1,941,952. While such a structure provides a construction which is rigid and resistant to buckling stresses it has the disadvantage that prior to transit from place to place the boom must be dismantled and the sections separately handled. The boom must then be reassembled and bolted together preparatory to operation at the new location. This procedure requires the services of a number of workers and is both time consuming and costly.

Another common type of construction is one in which adjacent boom sections can be folded one upon the other simply and quickly for transit without removing them from the motor truck superstructure. Adjoining sections are provided with pivotal hinges at the bottom corners for folding the boom back on itself to reduce the overall length. When extended the boom is secured at the corners by means of removable pins. A structure of this latter type is exemplified by that shown in U.S. Patent 2,529,454. While this type of structure provides a convenient means of reducing the overall length of the boom it has the great disadvantage that over a period of time the securing pins (which carry all the load during operation) tend to become worn and/or loose, especially when the boom is subjected to substantial shock loading such as when used for dragline or other similar operations.

It is a primary object of the present invention to provide a boom construction which has all of the advantages

of the known types just discussed, without the attendant disadvantages. That is, a boom structure having adjacent sections hingedly connected to be folded for transit but at the same time provided with means for rigidly securing the sections together in operative position such that the boom is of equal strength to a non-folding boom of equal dimensions.

It is a further object of the present invention to provide a boom structure which may optionally be secured in operative position by means of different types of securing devices depending upon the manner in which the boom is to be used.

A further and more specific object of the present invention is to provide a boom structure wherein adjacent boom sections are provided with hinge pins about which the sections may be folded upon one another and self-aligning means for rigidly securing the boom sections in extended operative position.

A still further object of the invention is to provide a boom structure having means for pivotally connecting the boom sections together and cooperating means for rigidly securing the sections in operative position, the first means comprising transversely extending hinge pins, and the second means comprising either transversely extending pins or bolts, together with further means for assuring alignment of the first and second means whereby the operating load is equally divided.

The above and other objects and advantages of the present invention and the invention itself will be apparent from a consideration of the following description and the drawings wherein:

Figure 1 is an elevational view of a truck crane provided with a relatively long boom made in accordance with this invention, the boom being shown in the extended or operative position;

Figure 2 is an elevational view similar to Figure 1; but, showing the boom in its folded or in transit position;

Figure 3 is an enlarged fragmentary isometric view of the boom illustrating the inboard and outboard sections of the boom joined together in the extended or boom operative position;

Figure 4 is an enlarged fragmentary elevational view of the inboard and outboard sections of the boom joined together in the extended or boom operative position;

Figure 5 is a fragmentary elevational view similar to Figure 4 and partly in cross-section showing the inboard and outboard sections of the boom partially separated by rotation about a hinge pin; and

Figure 6 is an enlarged fragmentary sectional view taken along the line 6—6 of Figure 4 and illustrating the manner in which the corners of the inboard and outboard boom sections are joined together in the boom operative position.

Similar characters of reference indicate corresponding parts throughout the several views and referring now to same, particularly Figure 1, a mobile crane of the type contemplated by this invention comprises a truck vehicle generally indicated by reference numeral **10** having a load-handling unit mounted thereon. The truck vehicle **10** includes a frame **12** having a base **14** upon which the crane superstructure **16**, including a boom **18**, is suitably mounted for rotational movement. The superstructure **16** houses a suitable power source, cable drums, and controls (not shown). The truck vehicle **10** is preferably equipped with pneumatic tires **20** and may be moved from one job to another at regular motor truck speed and considerably faster than a crane of the endless tread type which is usually transported on a flat car or specially designed motor truck or trailer.

The boom **18** comprises two sections, an inboard section **22** and an outboard section **24**. The inboard section **22** is pivotally attached to the superstructure or cab **16**

by a boom hinge 26, as is well known in the art. The outer end of the boom 18 is supported and its angular position is controlled by means of the usual hoisting cables 28 reeved through suitable sheaves 29 at the end of pennant cables 31 (there are preferably two of these although only one is visible in this drawing), the cables 28 being secured to a hoist drum (not shown) in cab 16 and operated in the usual manner from the said power source in the cab.

The boom of the unit may be of a length such as, for example, 30 feet with the inboard section 22 being 16 feet and the outboard section 24 being 14 feet. When the boom 18 is extended as shown in Figure 1 it is obvious that the maneuverability of the truck vehicle 10 will be somewhat hampered by the length of boom extending outwardly therefrom. Referring now to Figure 2, it may be seen that when the outboard section 24 of the boom 18 is folded back upon the inboard section 22, a compact arrangement is provided thereby making the vehicle more stable and maneuverable.

Referring now to Figure 3, it may be seen that the boom sections 22 and 24 are each of fabricated truss construction comprising four spaced longitudinally extending angle frame members 30 interconnected by diagonal braces 32 to provide a box-like boom structure.

The ends of each of the boom sections, at the joint therebetween comprise substantially square end frame members 34 and 36 to which are secured, conveniently by welding, the longitudinal frame members 30. A pair of plates 38, 40 are secured, as by welding, to each corner of the frame 36 at the end of the outboard boom section 24. The innermost or smaller plate 38 of each pair (see Figures 4–6) is provided with a single aperture 42, and the outermost or larger plate 40 of each pair is provided with vertically aligned spaced apertures 44 and 46. The apertures 42 and the apertures 44 are in alignment transversely of the boom.

Attached adjacent to each corner of the end frame 34 of the inboard boom section 22 is a single plate 48. The plates 48 attached to the inboard boom section are designed to fit between the pairs of plates 38, 40 carried by the outboard boom section 24. As may be seen, the plates 48 are each provided with vertically aligned (when the boom is horizontal) apertures 50 and 52, the apertures 50 being transversely aligned with apertures 42 and 44 in the plates 38 and 40, respectively, and the apertures 52 being transversely aligned with the apertures 46 in the plates 40. The upper plates 48 are somewhat larger than the lower plates 48 and are provided with an additional aperture 54 for purposes to be described later. The plates 38, 40 and 48 are all of substantial thickness and have a coacting surface area sufficiently large to maintain the two sections of the boom in proper alignment during the folding and unfolding operations.

The two boom sections 22 and 24 are pivotally secured together by means of headed pins 56, each pin passing through the transversely aligned apertures 42, 44 and 50 in the lower coacting plates 38, 40 and 48. The pins 56 form the axles permitting relative rotation of the two boom sections during the folding and unfolding operation. Each of the pins 56 is prevented from falling out by individual pins 58 (Figure 6) which may be either cotter pins or tapered pins as is well known.

In the boom operative position the boom sections 22 and 24 may be held together firmly and in longitudinal alignment by means of additional pins 60, similar to pins 56, or they may be of the tapered type. The pins 60 are passed through the transversely aligned apertures 42, 44 and 50 in the upper coacting plates 38, 40 and 48. This type of connection of the two boom sections may be adequate for some types of operations wherein the boom is not subjected to high buckling stresses or extreme shock loading such as, for example, steel erection.

By simply removing the pins 60, the outer boom section 24 is free to rotate about the pins 56. It is pointed out that the pins 56 are located outside of the main structure of the boom, that is, the rotational axis through pins 56 lies below a horizontally disposed plane passing through the lower angle bars 30 of a boom section. This construction affords substantially 180° pivotal movement of the outboard boom section whereby the outboard boom section 24 may be folded completely underneath the inboard boom section 22, as shown in Figure 2.

When the boom is to be used under conditions which may impart extreme shock loading such as, for example, dragline operations, the above-described pin connection between boom sections is not considered adequate inasmuch as the pins carry all of the load during operation and may tend to become loose under shock. In order to provide a convenient means of assuring adequate connection and support of the boom sections under this type of operating condition, the two boom sections may be additionally secured together by means of nut-receiving bolts 62. The bolts 62 are each passed through the transversely aligned apertures 52 and 46 in the plates 48 and 40, respectively.

As may be seen upon inspection of Figure 6, each plate 40, on its outboard side, is provided with an annular recess 64 about the aperture 46 which is shaped to receive the shouldered portion 66 of a nut 68. The portion 66 is shaped as a portion of a sphere similar to the conventional lug-nut as used on vehicle wheels. This constructional arrangement serves as an aid in properly aligning the bolts so as to draw the plates 40 and 48 into compressional engagement and also to assure that all of the bolts 62 together with the pins 56 and 60 are in vertical alignment.

By virtue of the construction disclosed hereinabove the accurately sized bolt and pin apertures on the respective boom sections are registered in accurate alignment whereby all of the bolts and pins share equally in the load imparted to the boom 18 and maintain the boom equally as rigid as a non-folding boom of equal dimension under all operating conditions.

As previously mentioned, the upper plates 48 are provided with additional apertures 54. These apertures are utilized in folding the boom for transit. In order to provide for the folding operation the pennant cables 31 preferably include short portions 31*a* which can be detached at joint 31*b* from the remainder of the pennant cables. To prepare for folding the boom the portions 31*a* of the pennant cables are detached from the remainder of the pennant cables and then attached to the inboard section 22 of the boom by means of clevises 70 and pins 71, each pin 71 being inserted through an aperture 54 as indicated by the single pin which is visible in Figure 5 of the drawing.

The operation and function of the various parts described above will be apparent from the following detailed description of the boom folding operation.

The crane operator first lowers the boom 18 to a point where the outboard section 24 is supported by any convenient means or it may rest upon the ground. This is normally done with the crane cab 16 and the boom rotated to a position in which the front of the truck will not interfere with such operation. In other words, the position shown in Figures 1 and 2 is not used for this particular operation, but after the folding has been accomplished the cab is rotated to the position of Figure 2 for transit. Next, the bolts 62 and/or the upper pins 60 are removed and the portions 31*a* of the pennant cables are connected to apertures 54 by clevises 70 and pins 71.

The crane operator now raises the boom by taking up the boom hoist cable 28 on the power drum whereby the boom sections 22 and 24 separate as shown in Figure 5. The taking up of the inboard section 22 is continued until it reaches a nearly vertical position whereupon the outboard section 24 will be folded back upon the inboard section. The two boom sections then may be secured

together by any convenient means. The operator then lowers the boom and rotates it to the position shown in Figure 2 which is the in transit position.

This operation of folding the boom by use of the crane power is fairly simple and the average operator can readily master the technique.

When the crane provided with the boom structure of the present invention reaches the new site of operations the boom is unfolded and placed into operation in a matter of a few minutes by reversing the procedure set forth above with respect to the folding operation.

While only a two section boom has been illustrated and described herein, it is obvious that the invention is not restricted to a two section boom. Any number of sections may be provided to form a boom of desired length. Each section may be provided with pin only or pin and bolt connecting means as described. Thus, the boom may be folded at any sectional joint. As a practical matter, however, with most truck cranes, sections in addition to the inboard section and one outboard section are normally removed and handled separately to reduce the overall length.

Having now described the invention, its utility and time-saving features should be readily apparent. Often the time during which a crane is employed in actual service is only a matter of a few hours. With most conventional boom constructions the task of dismantling and reassembling the boom consumes an amount of time comparable with the actual working hours of the crane, or, if the boom is of the foldable type, it is not flexible in its adaptation to all types of operation. It should be apparent that a boom constructed in accordance with this invention can be assembled for operation or folded for transit purposes in a matter of minutes and with a minimum number of workers. There is no need to remove any of the operating components as is the case when the boom is dismantled in accordance with prior practice.

Although but one particular embodiment of the present invention has been shown and described herein, it is obvious that various modifications may be made without departing from the spirit of the invention. It should be understood, therefore, that I do not intend to be limited to the particular embodiment shown, nor otherwise than by the terms of the appended claims.

I claim:

1. A boom construction comprising a plurality of adjoining sections, at least two of said adjoining sections having end frame portions in confronting relation, one of said end frames having pairs of spaced vertically extending plates thereon cooperating with single vertically extending plates on the other of said end frames, each of the said pairs of plates comprising a larger plate and a smaller plate and the said single plates being located respectively between the said pairs of plates, pivotal means extending through aligned apertures in each set of said plates, and securing means extending through aligned apertures in said single plates and the larger plate only of each of said pairs of plates.

2. A boom construction as specified in claim 1, in which said one end frame has the pairs of spaced vertically extending plates secured adjacent each corner thereof cooperating with single vertically extending plates secured adjacent to each corner of the other of said frames.

3. A boom construction as specified in claim 1, in which the apertures through which said pivotal means extend are located outside the main structure of the said sections, whereby upon removal of said securing means one of said boom sections may be folded back upon the other of said boom sections.

4. A boom construction as specified in claim 1, in which the apertures through which said pivotal means and said securing means extend are vertically aligned on a plane extending parallel to the planes of said frame members.

5. A boom construction as specified in claim 1, in which said securing means comprises nut-receiving bolts adapted to draw the coacting plates into compressional contact with one another.

6. A boom construction as specified in claim 1, in which the aperture in one of the plates through which said securing means extends is provided with an annular recess, said securing means comprising a threaded bolt and nut, said nut having a portion cooperating with said annular recess thereby to properly align said securing means relative to said pivotal means whereby the load on said boom sections is shared between said securing means and said pivotal means.

7. A boom construction of the character described, comprising at least two boom sections, each boom section comprising four longitudinally extending frame members interconnected by diagonal braces, each of the adjoining boom sections having a transversely extending end frame to which said longitudinal frame members are secured, one of said transverse frames having secured thereto at each lower corner thereof a pair of spaced vertically extending plates, one plate of each pair having upper and lower vertically aligned apertures, the other plate of each of said pairs having an aperture aligned with the lower aperture in said one plate, the other of said transverse frames having secured thereto at each lower corner thereof a single vertically extending plate, said single plates being adapted to fit between the coacting paired plates of said one transverse frame, said single plates having upper and lower vertically aligned apertures, a pin extending through the lower apertures and securing means extending through the upper apertures in each coacting set of paired and single plates, said means extending through the upper apertures being adapted to rigidly secure adjoining boom sections together in longitudinal boom operative position by drawing each coacting set of plates into tight compressional engagement, and said pins hingedly connecting said boom sections for pivotal separation upon removal of said securing means.

8. A boom construction as specified in claim 7, including additional coacting sets of paired and single plates at each upper corner for joining said transverse frame members, said additional sets of plates also having apertures similar to those in said lower plates for receiving transversely extending securing means which are vertically aligned with said lower securing means, whereby the load on said boom sections is shared among all of said transversely extending pin and securing means.

9. A foldable boom comprising an inboard section and an outboard section, each section comprising four longitudinally extending frame members interconnected by diagonal cross-braces, a pair of vertically downwardly extending plates secured to each lower side of one boom section, one plate of each of said pairs having upper and lower vertically aligned apertures, the other plate of each of said pairs having an aperture aligned with said lower aperture, single vertically downwardly extending plates secure to each lower side of the other boom section, said single plates adapted to fit between the coacting paired plates on the first boom section and having upper and lower vertically aligned apertures, a pin extending through the lower apertures and a nut-receiving bolt extending through the upper apertures in each coacting set of single and paired plates, said bolts securing the two boom sections together in longitudinal boom operative position, and said pins hingedly connecting said boom sections for pivotal separation upon removal of said bolts.

10. A foldable boom comprising two boom sections, each of the sections comprising four longitudinally extending frame members interconnected by diagonal cross-braces, a pair of vertically extending plates secured adjacent each corner of one of said boom sections, one plate of each of said pairs having spaced inboard and outboard vertically aligned apertures, the other plate of each of said pairs having an aperture transversely aligned with said outboard aperture, single vertically extending plates secured adjacent each corner of the other boom section,

said single plates being adapted to slide between the coacting paired plates on the first boom section and having inboard and outboard vertically aligned apertures, a pin extending through the outboard apertures and securing means extending through the inboard apertures in each coacting set of single and paired plates, said securing means being adapted to draw each coacting set of plates into tight compressional engagement whereby to secure the two boom sections rigidly together in longitudinal

boom operative position, and the pins in the lower sets of coacting single and paired plates hingedly connecting said boom sections for relative rotational separation upon removal of said securing means.

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2,689,656 Przbylski ---------- Sept. 21, 1954