Jan. 14, 1958 L. B. OBENCHAIN 2,819,803

BOOM FOR CRANES

Filed Oct. 12, 1954 6 Sheets-Sheet 1

FIG. 1.

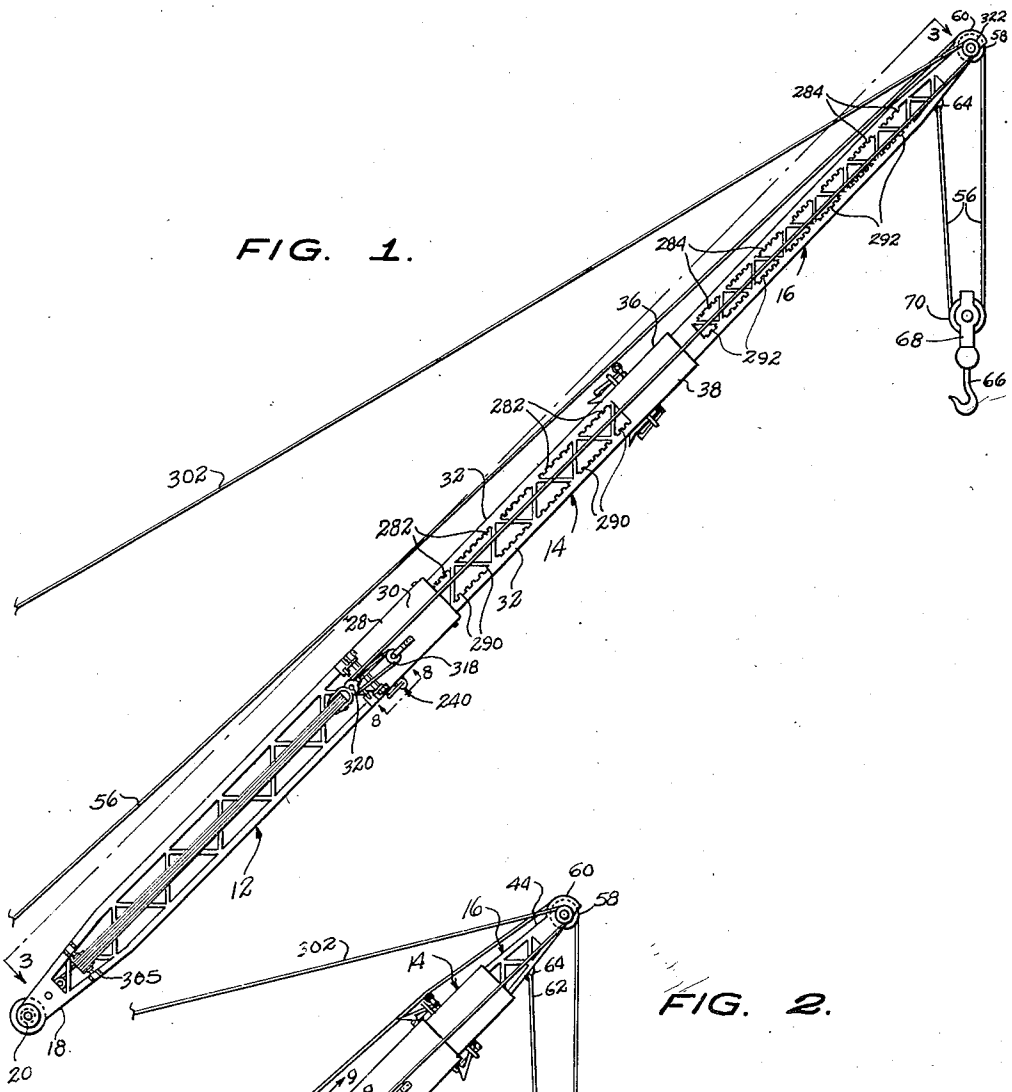
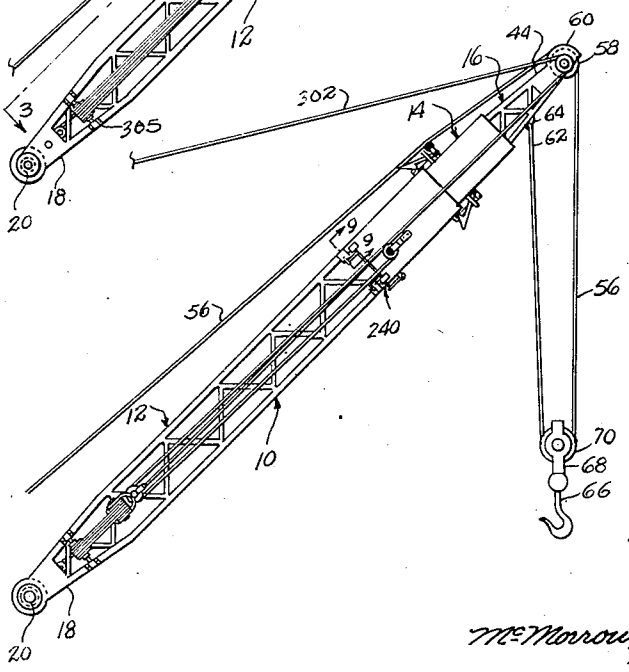


FIG. 2.



INVENTOR.
LEO B. OBENCHAIN,
BY
McMorrow, Berman & Davidson
ATTORNEYS.

Jan. 14, 1958 L. B. OBENCHAIN 2,819,803

BOOM FOR CRANES

Filed Oct. 12, 1954 6 Sheets-Sheet 2

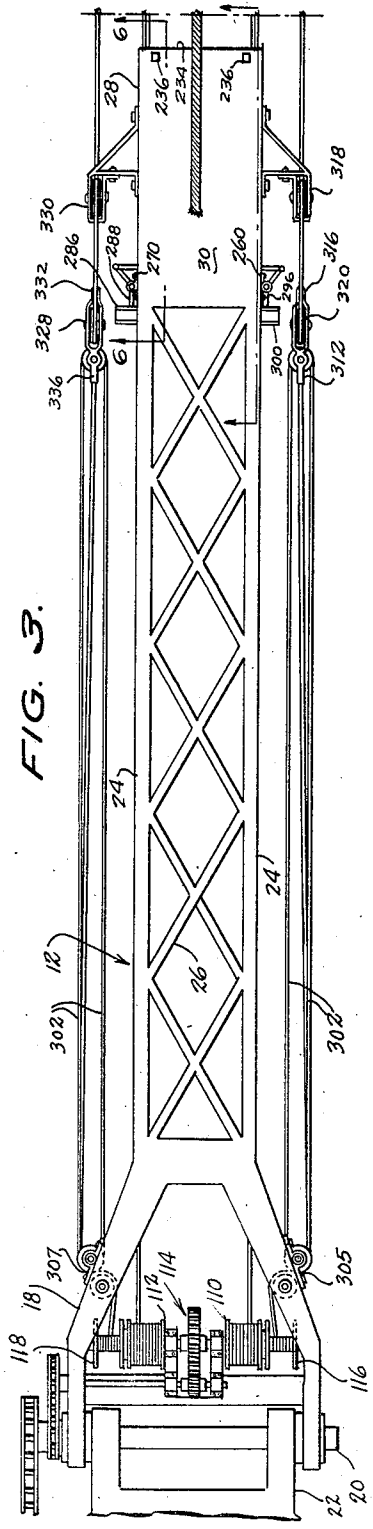


FIG. 3.

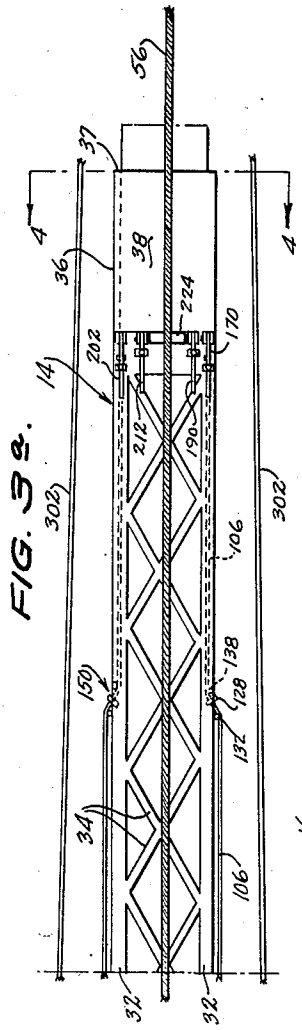


FIG. 3a.

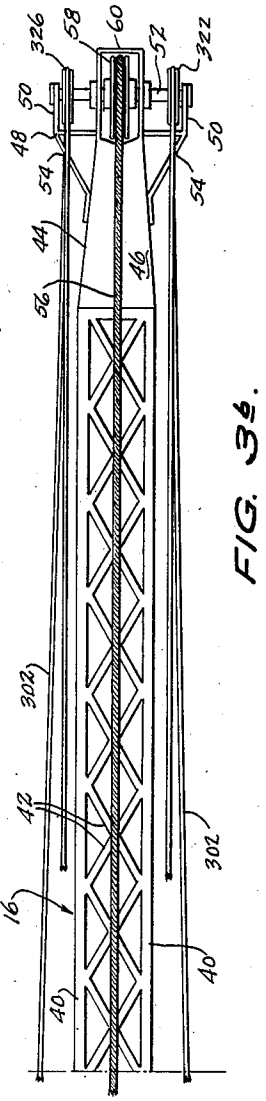


FIG. 3b.

INVENTOR.
LEO B. OBENCHAIN,
BY
McMorrow, Berman & Davidson
ATTORNEYS.

Jan. 14, 1958 L. B. OBENCHAIN 2,819,803

BOOM FOR CRANES

Filed Oct. 12, 1954 6 Sheets-Sheet 3

FIG. 4.

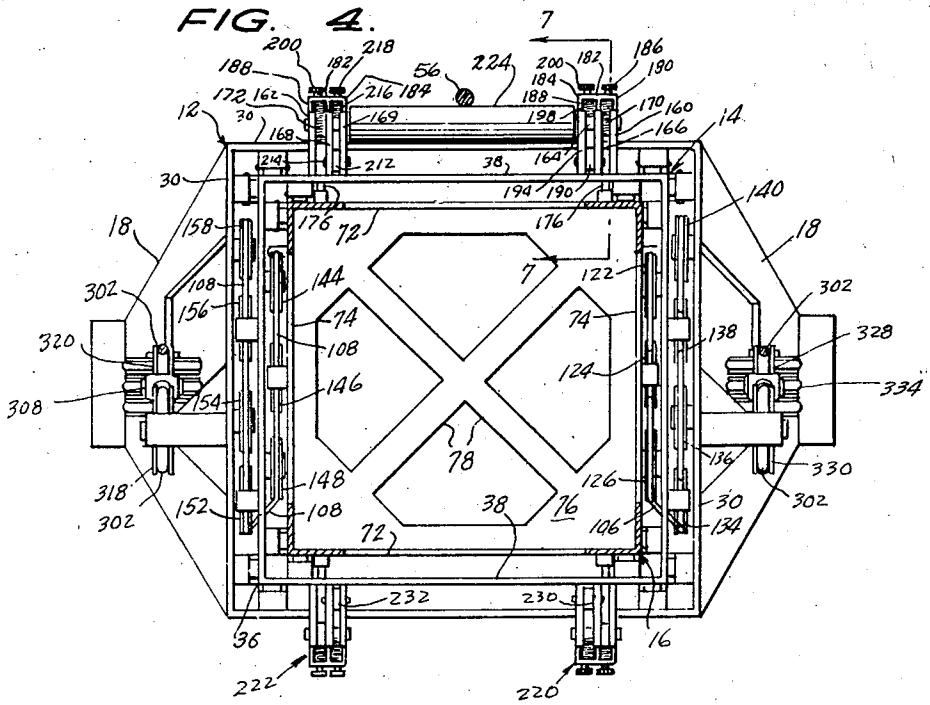


FIG. 7.

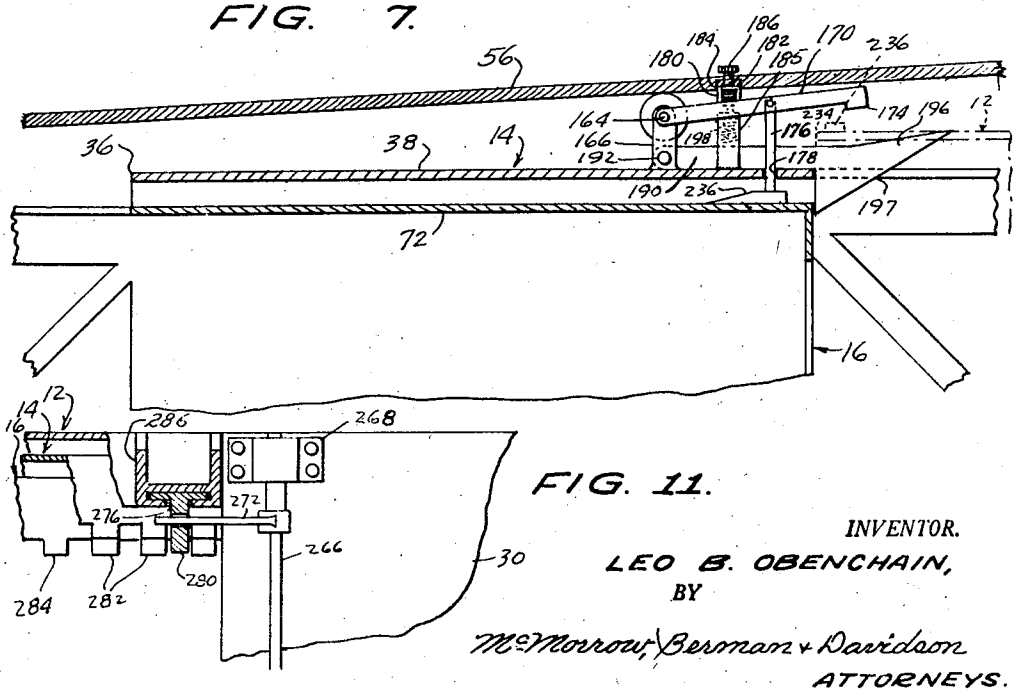


FIG. 11.

INVENTOR.
LEO B. OBENCHAIN,
BY
McMorrow, Berman & Davidson
ATTORNEYS.

Jan. 14, 1958 L. B. OBENCHAIN 2,819,803

BOOM FOR CRANES

Filed Oct. 12, 1954 6 Sheets-Sheet 4

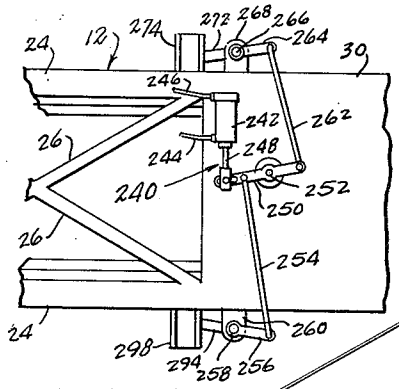


FIG. 8.

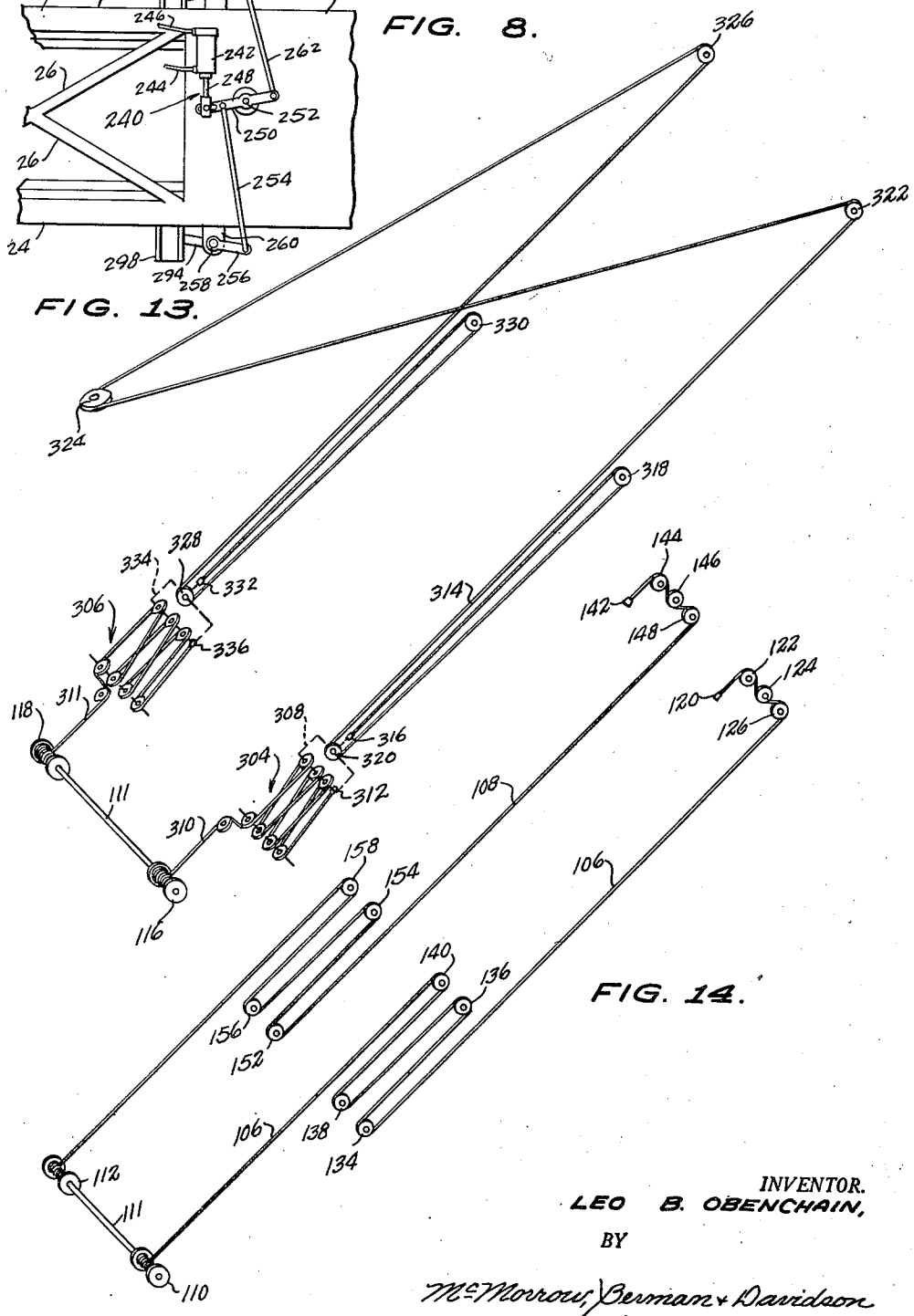


FIG. 13.

FIG. 14.

INVENTOR.
LEO B. OBENCHAIN,
BY
McMorrow, Berman & Davidson
ATTORNEYS.

Jan. 14, 1958 L. B. OBENCHAIN 2,819,803

BOOM FOR CRANES

Filed Oct. 12, 1954 6 Sheets-Sheet 5

FIG. 12.

FIG. 5.

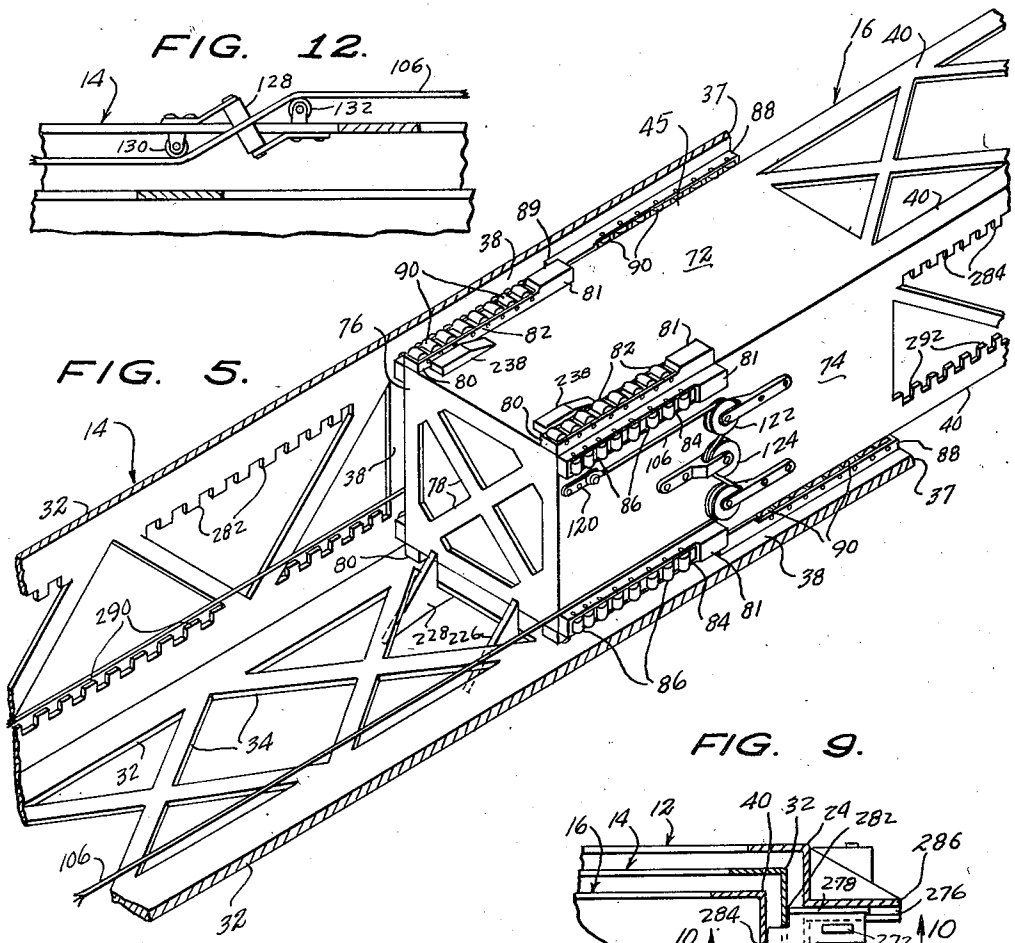


FIG. 9.

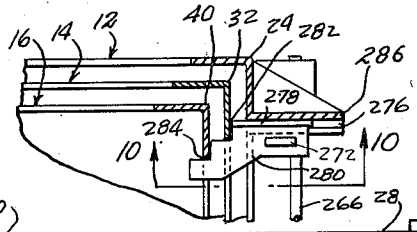


FIG. 6.

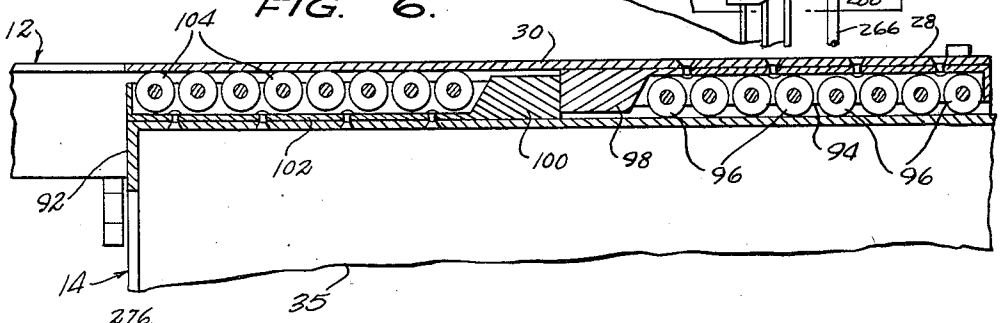
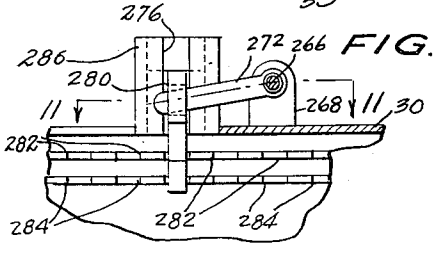


FIG. 10.



INVENTOR.
LEO B. OBENCHAIN,
BY
McMorrow, Berman + Davidson
ATTORNEYS.

Jan. 14, 1958 L. B. OBENCHAIN 2,819,803

BOOM FOR CRANES

Filed Oct. 12, 1954 6 Sheets-Sheet 6

FIG. 15.

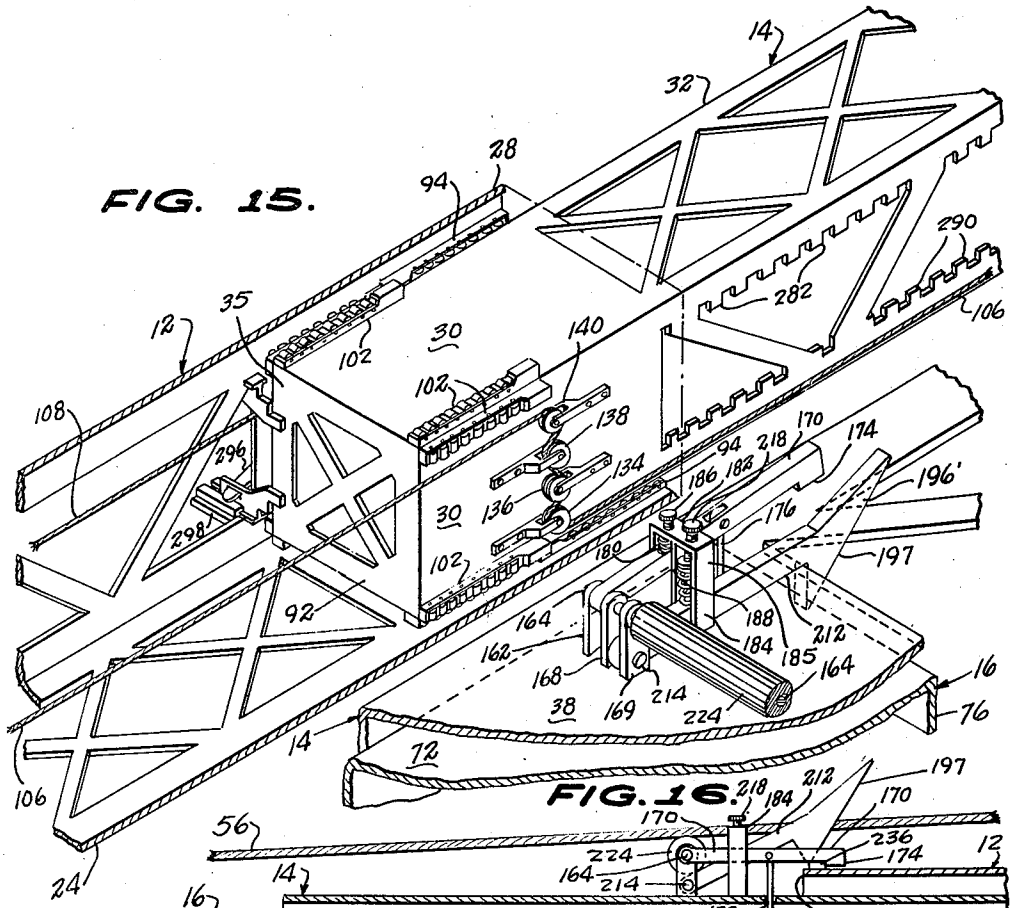


FIG. 16.

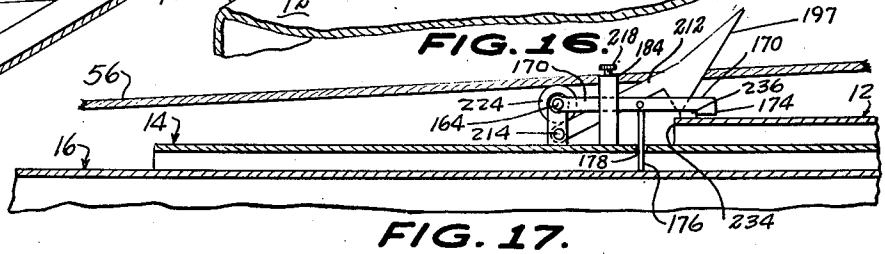


FIG. 17.

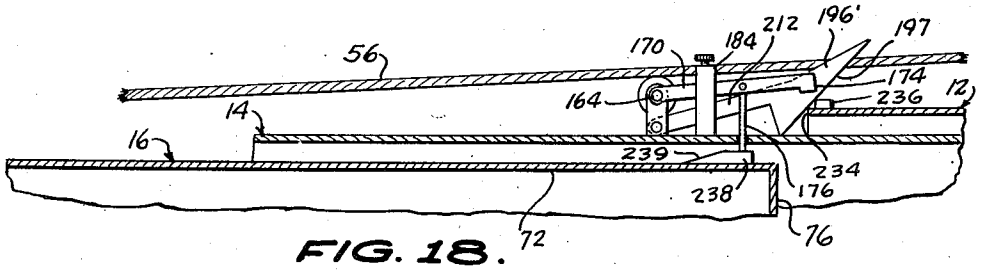


FIG. 18.

INVENTOR.
LEO B. OBENCHAIN,
BY
McMorrow, Berman & Davidson
ATTORNEYS.

United States Patent Office

2,819,803

Patented Jan. 14, 1958

2,819,803

BOOM FOR CRANES

Leo B. Obenchain, Oceanway, Fla.

Application October 12, 1954, Serial No. 461,861

7 Claims. (Cl. 212—55)

This invention relates to cranes and more particularly to a boom construction for cranes.

It is the principal object of this invention to provide a boom for cranes that is adjustable in length at the option of the crane operator. Heretofore it has been necessary to put sections in the boom when the boom was required to have a longer length than normal, and the process of lengthening the boom involved a considerable amount of time and the work of a crew of men. Further, after the boom was lengthened in the usual manner, it was at times found to be too long to boom up in the place where it was needed, thus more time was lost in completing the job since the length of the boom would necessarily have to be changed to shorten its length. Hence, this invention is designed to provide a boom so constructed as to overcome the difficulties and drawbacks of the booms heretofore in use and which will automatically and selectively extend to the desired length at the will of the crane operator.

Another object of this invention is to provide a boom for cranes which may be readily collapsed when the crane is travelling from job to job over the road.

Another and still further object of this invention is to provide a boom which may employ a plurality of telescoping sections so that its total extended length is dependent only upon the number of telescoping sections employed in its construction.

Yet another object of this invention is to provide a boom for cranes which may be used at any selected point in its length of extension and in which the pennant lines are extended as the length of the boom increases and such pennant lines being shortened when the boom is telescoped or retracted.

Another and still further object of this invention is to provide a boom having positive locking means whereby the boom may be selectively retained in any position in its extensible length and yet be rigid enough to perform the work intended, and in which the locks are so constructed as to operate automatically to release the telescoping sections of the boom when it is desired to change the boom length or to collapse or retract the boom.

Still another object of this invention is to provide a crane boom which may be extended or shortened in length without materially effecting the angle of the boom in relation to the crane to which it is attached and in which the boom may be raised or lowered in the conventional manner regardless of its overall length.

A still further object of this invention is to provide a crane boom which may be applied to any of the existing cranes without undue modification of the crane structure. Thus, the boom of this invention has an universal application to all makes of cranes.

Other objects and advantages will become apparent from a consideration of the following detailed description, forming the specification, and taken in conjunction with the accompanying drawings, in which:

Figure 1 is a side elevational view of a boom embodying this invention shown in its fully extended position;

Figure 2 is a side elevational view similar to Figure 1 but showing the boom in its fully retracted or collapsed condition;

Figure 3, Figure 3*a*, and Figure 3*b* constitute a top plan view of the boom shown in Figure 1, on a somewhat enlarged scale, the consecutive figures being consecutive sections of the boom;

Figure 4 is a transverse cross sectional view taken on line 4—4 of Figure 3*a*;

Figure 5 is a fragmentary perspective of the juncture of the outermost and intermediate boom sections in their fully extended position, partially broken away and shown on a somewhat enlarged scale;

Figure 6 is a cross sectional view taken substantially on line 6—6 of Figure 3;

Figure 7 is a sectional view taken on line 7—7 of Figure 4;

Figure 8 is a fragmentary bottom plan view showing the hydraulically operated boom section latching mechanism;

Figure 9 is a fragmentary cross sectional view taken substantially on line 9—9 of Figure 2 showing a portion of the latching mechanism of Figure 8 with the boom sections in their retracted or telescoping position;

Figure 10 is a cross sectional view taken on line 10—10 of Figure 9;

Figure 11 is a cross sectional view taken on line 11—11 of Figure 10;

Figure 12 is a side elevational view, partially in section, showing the cross over for the retracting line of the boom carried by the intermediate boom section;

Figure 13 is a schematic view showing the layout of the boom pennant line;

Figure 14 is a schematic or diagrammatic view showing the layout of the boom extending line;

Figure 15 is a fragmentary perspective view of the base and intermediate sections in the fully extended position, partially broken away and on a somewhat enlarged scale;

Figure 16 a fragmentary perspective view, on an enlarged scale, showing the end section in its fully extended position and the latching device for holding it in the extended position shown;

Figure 17 is a side elevational view of the latching device with the boom sections shown in cross section and in their fully retracted positions; and

Figure 18 is a view similar to Figure 17, but showing the relative position of the elements of the latching device of Figures 16 and 17 with the boom sections in an intermediate position of retraction.

With continued reference to the drawings, there is shown in a boom, generally indicated at **10**, which includes a series of telescopic sections **12**, **14** and **16**, indicated by general reference numerals.

The boom section, generally indicated at **12**, may be referred to as the base section, and is provided with a forked end **18**, the legs of which are hingedly mounted on a shaft **20** journaled in a bearing bracket **22** secured upon the crane (not shown) to which the boom **10** is to be applied. Thus, the boom **10** is mounted on the crane for movement in a vertical arcuate path about a horizontal axis defined by the shaft **20**.

That portion of the boom base section **12** which extends outwardly from the forked end **18** in a direction away from the bearing bracket **22** is made up of angle sections **24** extending longitudinally and in spaced parallel relation to each other to provide a rectangular box-like structural element with a lattice work **26** which acts as a brace between the angle sections **24**. The end of the base boom section **12** remote from the forked end **18**, indicated at **28**, is formed of solid plates **30** which enclose respective sides of the box formation at this end.

The boom section **14**, which has one end thereof tele-

scopically received within the end 18 of the base section, may be referred to as an intermediate boom section, and is similarly constructed of angle irons or sections 32 braced by lattice work 34 extending between the angle sections to form a box structure. The end 36 of the intermediate section 14 remote from the end 35 thereof received in the end 28 of the base section 12 is formed with solid plates 38, each of these plates extending between the respective angle irons or sections 32 so as to form a solid box-like structure at the end 36.

The boom section, generally indicated at 16, may be referred to as the end section and has one end 45 thereof telescopically received within the end 36 of the intermediate boom section and extends longitudinally therefrom. The end section 16 is likewise made up of angle irons or sections 40 with a lattice work 42 braced between the angle irons or sections 40 to provide a box-like structural member. The end 44 of the end section 16 remote from the end 45 thereof telescopically received in the end 36 of the intermediate section, is constructed with solid side plates 46 extending between the angle sections 40, with each of the side plates 46 in converging relation as they extend away from the end of the section received in the preceding or intermediate section, to provide a head upon which a U-shaped bearing bracket 48 has its base or bight secured at the terminal end thereof. The opposite spaced parallel legs 50 extend longitudinally of the end section 16 and outwardly therefrom and have opposite ends of a shaft 52 journaled therein. The bearing bracket 48 has additional support by a provision of a pair of braces 54 extending from opposite sides of the head or end 44 and secured to the bracket 48 at the juncture of the base or bight thereof, which extends transversely of the head 44, and the legs 50 thereof extending outwardly from the base or bight at opposite ends thereof.

A load line 56 has one end thereof secured to a reeling device in the cab of the crane in the usual manner, this connection being conventional and hence not shown, and extends longitudinally of the boom 10 thereabove and is trained about the sheave or pulley wheel 58 secured on the shaft 52 intermediate its ends and within a hood or cover 60 carried by the free or terminal end of the head 44 intermediate the base or bight portion of the bearing bracket 48 and extending longitudinally therefrom. The other end 62 is anchored to the end boom section 14 as at 64 so that a loop is formed between the sheave 58 and the anchor 64 with a load-engaging hook 66 depending from a sheave bracket 68 in which a sheave 70 is rotatably journaled and about which the load line 56 is trained so that the load line 56 may be selectively lowered or raised to correspondingly lower and raise the load-engaging hook 66 so that a load may be engaged by the hook and lifted or raised.

In connection with the end boom section 16, and with particular reference to Figure 5, it will be seen that the end 45 of the end section 16 remote from the end 44 is formed as an elongated, rectangular box member having solid sides provided by solid pairs of plates 72 and 74, with the plates of each pair being in spaced parallel relation and disposed perpendicularly to each other and joined along opposite longitudinal edges. An end plate 76 extends transversely across the end of the box-like end structure 45 remote from the end 44 and is provided with a pair of diagonal cross brace members 78.

The upper and lower, generally horizontally disposed spaced, parallel plates 72 carry on their outer surfaces and along opposite longitudinal edges roller cages 80 which extend longitudinally therealong from the terminal end of the solid plate box end 45, that is from the end thereof in which the end face plate 76 is formed, and for a distance approximately one-half of the longitudinal length of the respective plate 72. Each of the roller cages 80 have a plurality of spaced, transversely journaled rollers 82 therein so as to facilitate the telescopic movement of

the end section 16 into and out of the end 36 of the intermediate section 14. Also, the opposite, generally vertically disposed, spaced plates 74 each carries a similar roller cage 84 along opposite longitudinal edges thereof and extending from the end face plate 76 toward the channel or angle sections 40 and to the same extent or length as the roller cages 80. As in the case of the roller cages 80, the roller cages 84 carry a plurality of spaced rollers 86 which are rotatably journaled therein and disposed transversely thereof.

Each of the plates 38 forming the end 36 of the intermediate section 14, carry adjacent opposite longitudinal edges, a roller cage 88 which extend longitudinally thereof from the terminal end 37 for a distance toward the end 28 of the base section 12 equal to approximately one-half of the distance of the length of the plates 72 and 74 defining the end 45.

Each of the roller cages 88 have spaced, transversely extending rollers 90 journaled therein which are adapted to engage the adjacent faces of the angle sections 40 and the adjacent portion of the plates 72 and 74 of the end section 45. Thus, all of the rollers in the respective cages on both the end and intermediate sections act as antifriction devices to permit ready movement of the section 16 into and out of the intermediate section 14.

The ends of the roller cages 80 remote from the end thereof in coplanar relation with the end face plates 76 is formed as a solid block 81 to define a stop against which a similarly formed stop block 89 (see Figure 5) formed at the end of each of the roller cages 88 at the end thereof remote from the terminal end 37, will be in abutting relation when the sections are fully extended so as to prevent further extension of the end section 16 out of the end 36 of the intermediate section 14. In the fully extended position, as shown in Figure 5, it will be noted that the pairs of plates 72 and 74 defining the end 45 of the end section 16 will be completely within the end 36 of the intermediate section 14, which end is defined by the plates 38.

With reference to Figure 6, it will be seen that the end 35 of the intermediate section remote from the end 36, is similarly constructed as the end 45 of the end section 16, that is, this end is made up of pairs of solid side plates which are disposed in spaced parallel relation to each other and the longitudinal ends of each of the pairs secured along the mating longitudinal edges of the other of these pairs of side plates so as to define a solid sided box-like end section 35. Also, an end face plate 92, similar to the end face plate 76 extends transversely across the terminal or free ends of the solid side plates making up the end portion 35. The plates 30 making up the end 28 of the base section 12 are each provided with a roller cage 94 as shown in Figure 6, disposed along each of the opposite longitudinal edges thereof in the same manner as the roller cages 88 at the end 36 of the intermediate section 14, and each roller cage is provided with a plurality of transversely extending, spaced rollers 96 rotatably journaled therein. Also, as in the case of the roller cages 88, each of the roller cages 94 has formed integrally therewith an end stop block 98 adapted to abut against the stop block 100 formed on each of the roller cages 102 carried by the solid side plates defining the end portion 35 of the intermediate section and extending along opposite longitudinal edges of each of these solid side plates with the end of the roller cages remote from the stop block 100 in coplanar relation with the outer face of the end plate 92. Each of the roller cages 102 carry a plurality of spaced, transversely extending rollers 104 rotatably journaled therein. The rollers 96 in each of the roller cages 94 are adapted to ride upon the adjacent surface of the side members of the intermediate section while the rollers 104 are adapted to ride on the adjacent surfaces of the corresponding side elements of the base section 12. Thus, there is provided antifriction means whereby the extension and retraction of the inter-

mediate section telescopically within the base section **12** will be facilitated. Also, the stop blocks **98** and **100** prevent excessive extension of the intermediate section **14** out of the base section **12**.

In order to effect the extension of the boom sections **14** and **16**, there is provided a pair of cables **106** and **108** (see Figure 14) which define extending means. The extending lines **106** and **108** are adapted to move simultaneously since they are secured at one end upon drums **110** and **112** respectively which are mounted for rotation on the shaft of the winch, generally indicated at **114** but spaced inwardly from the cable drums **116** and **118** also mounted for rotation with the shaft of the winch **114** journaled adjacent opposite ends in the opposite legs of the forked end **18** of the base section. The winch **114** is selectively set in operation through drive means operatively connected to the mechanism of the crane (not shown) at the option of the crane operator. The other end of the line **106** is anchored as at **120** on one of the side plates **74** of the end portion **45** of the end section **16**, as clearly shown in Figure 5. The line or cable **106** is then trained about a pulley wheel or sheave **122** carried by the end section **36** of the intermediate section **14**, and thence about a similar pulley wheel **124** carried by the end portion **45** of the end section **16** and secured by suitable bracket means to the generally vertically disposed side plate **74**. The cable is then passed about a sheave or pulley wheel **126** also carried by the end portion **36** of the intermediate section in the same manner as the pulley wheel or sheave **124** and disposed in spaced relation thereto. The line **106** then extends along the interior of the intermediate section **14** to a cross over roller **128** angularly disposed across one of the generally vertically disposed side members and intermediate the ends of the section **14** so that the line **106** will then extend externally of the boom **10**. This structure is clearly shown in Figure 12 wherein it will be seen that a roller **130** is rotatably journaled in a suitable bracket carried by the side member of the intermediate section **14** and is thence trained over the cross over roller **128** and over a roller **132** rotatably journaled in a suitable bracket carried by the side member of the intermediate section and extending outwardly or externally therefrom adjacent the cross over roller **128** but to the side thereof opposite to the side to which the roller **130** is disposed inwardly of the side member upon which it is carried.

The line **106**, as shown in Figure 15, then extends longitudinally of the intermediate section **14** externally thereof to enter between the telescoping ends **35** and **28** of the intermediate and base sections respectively and is first trained about a pulley wheel or sheave **134** (see Figure 4) carried by one of the substantially vertically disposed side plates of the end portion **35**, and then the line passes around a similar pulley wheel or sheave **136** carried by one of the substantially vertically disposed plates **30** of the base section adjacent the plate upon which the pulley wheel **134** is carried. The line **106** proceeds from the pulley wheel or sheave **136** about another pulley wheel or sheave **138** carried by the same plate of the intermediate end portion **45** as the pulley wheel **134** and in spaced relation thereto, and a pulley wheel or sheave **140** is carried by the same substantially vertically disposed plate **30** as the pulley wheel **136** is mounted upon and which is in spaced parallel relation with the pulley wheel **136**. The line **106** thereof to the cable drum **110** about which it may be then extends longitudinally of the base section **12** internally wound or unwound.

Similarly, the other extending line **108**, remote from the end secured upon the cable drum **112**, is anchored as at **142** upon the side plate **74** remote from the similar side plate upon which the line **106** is anchored, and is then passed about a pulley or sheave **144** secured to the adjacent side plate **38** of the end portion **36** of the intermediate section **14** then about a similar pulley wheel or sheave **146** carried by the side plate **24** upon which the one end of the line **108** is anchored as at **142**, and the line is then trained about another pulley wheel or sheave **148** secured to the same substantially vertically disposed plate **38** as the pulley wheel **144** and in spaced parallel relation thereto. The line **108** then extends longitudinally of the intermediate section **14** internally thereof to a point intermediate its ends whereat a cross over arrangement, generally indicated at **150**, similar in all respects to the cross over roller **128** and the associated rollers **130** and **132**, so that the line **108** then extends externally of the intermediate section for the remainder of its length and enters between the telescoping ends **35** and **28** of the intermediate and base sections respectively to be first passed about a pulley wheel or sheave **152** carried by the generally vertically disposed side plate which is in spaced parallel relation to the side plate upon which the pulley wheels **134** and **138** are mounted, and thence about a sheave or pulley wheel **154** carried by the adjacent side plate **30** of the end portion **28**. The line **108** continues from around the pulley wheel **154** to be trained about a similar pulley wheel or sheave **156** also mounted on the same vertical plate as the pulley wheel **152** and in spaced parallel relation thereto, the line then continues about the pulley wheel or sheave **158** carried by the same side plate **30** that the pulley wheel **154** is mounted upon and in spaced parallel relation thereto. The line **108** then continues longitudinally of the base section **12** internally thereof to be wound around and secured upon the cable drum **112** which is in spaced relation to the cable drum **110** and mounted for rotation upon the winch shaft **111** of the winch **114**.

Thus, it will be seen that upon operation of the winch so as to cause the lines **106** and **108** to be simultaneously wound thereon, the end section **14** will be caused to extend out of its telescopic arrangement with the intermediate section **14** until it reaches its maximum extent wherein the stop blocks **81** and **89** will be brought into abutting relation preventing further extension of the end section **16**. Upon further operation of the winch **114** so as to simultaneously wind the cables or lines **106** and **108** thereon, the intermediate section **14** will be caused to move outwardly from its telescopic relation to the base section **12** and will continue to so move until the stop blocks **98** and **100** are brought into abutting relation, which will prevent further movement of the intermediate section **14** outwardly from the base section **12**. At this point, the boom **10** will be fully extended.

When the end boom section **16** is in its fully extended position, as shown in Figure 5 for instance, a latching mechanism automatically operates to secure the section **16** in this fully extended position. The latching mechanism includes a pair of spaced, parallel, upstanding posts **160** and **162** carried by the upper, generally horizontally disposed plate **38** defining the end **36** of the intermediate seciton **14** and adjacent the end of the top most plate **38** remote from the end section **16**. A transversely extending shaft **164** is journaled adjacent its opposite ends adjacent the top of the posts **160** and **162** and extends therebetween.

Another similar pair of upstanding posts **166** and **168** are carried by the topmost plate **38** in spaced parallel relation to each other and slightly spaced from the respective posts **160** and **162** inwardly thereof. The shaft **164** is rotatably carried through suitably aligned openings adjacent the top ends of the posts **166** and **168**. Disposed between the adjacent posts **160**, **166** and **162**, **168** are latch arms **170** and **172** respectively which extend laterally therefrom in a direction toward the end **28** of the base section **12** and beyond the adjacent end of the topmost plate **38**.

Each of the latch arms **170** and **172** is provided at its terminal end remote from the end pivotally mounted on the shaft **164** with a downwardly depending boss or projection **174**. Each of the latch arms **170** and **172** is provided with a depending arm actuating rod **176** which has its ends remote from the connection to the respective

latch arm, intermediate the ends of the latch arm, received through an opening 178 in the top, generally horizontally disposed plate 38 and extends therethrough. The rod 176 on each of the latch arms is resiliently urged through the opening 178 by a spring 180 disposed between the top longitudinal edge of the latch arm and the lower surface of the bight portion 182 of a U-shaped bracket 184, with the bight portion 182 extending transversely across the latch arm in spaced relation thereabove and the free ends of the legs of the bracket remote from the bight portion 182 secured on the upper surface of the top plate 38 between the opening 178 and the adjacent posts in which the shaft 164 is journaled. A set screw 186 is threadingly received in the bight 182 in a suitably internally threaded opening transversely therethrough so as to bear against the spring 180 whereby the spring tension can be selectively adjusted. It will be noted that the spring 180 is confined against transverse movement by the upstanding bracket leg 183 and a depending partition plate 188 extending downwardly from the undersurface of the bight portion at its central or midpoint.

An automatically engageable locking arm 190 has one end thereof pivotally mounted upon a pin 192 which is rotatably journaled adjacent its opposite ends in the post 166 and in a similar upstanding post 194 which is in closely spaced parallel relation to the post 166, the pin 192 being disposed adjacent the lower ends of the posts 166 and 194. The free end of the locking arm 190 remote from its pivotal connection 192 is formed with a hook 196 which is adapted to hook behind the end face plate 76 of the end boom section 16 when the end section 16 is fully extended, as shown in Figure 7. The locking arm 190 is urged into engaging relation with the end face plate 76 by a spring 198 disposed between the partition wall 188 and the other leg 185 of the bracket 184 and extending between the lower face of the bight portion 182 and the upper longitudinal edge of the locking arm 190. A set screw 200 is threadingly received in a suitably internally threaded opening transversely through the bight 182 in spaced relation to the set screw 186 so that the set screw 200 will engage the spring 198 and thereby enable the resilient pressure upon the locking arm 190 to be selectively varied.

A locking arm 212 (see Figure 16), similar in all respects to the locking arm 190, is journaled adjacent one end between the post 168 in a similar upstanding post 169 disposed in closely spaced parallel relation, by a transversely extending pin 214 which is journaled adjacent its opposite ends in suitably, axially aligned openings adjacent the lower ends of the upstanding posts 168 and 169. The opposite end of the locking arm 212 is formed in the shape of a hook 196', similar to the hook 196 and adapted to engage behind the end face plate 76 in the same manner as the hook 196 when the end section 16 is in its fully extended position so as to latch the end section in its fully extended position to prevent accidental displacement therefrom.

The locking arm 212 is resiliently urged into its engaging position by a spring 216 maintained against transverse displacement by the adjacent leg of the U-shaped bracket 184 and the partition wall disposed centrally between the depending legs of the U-shaped bracket. The spring 216 extends from the lower surface of the bight portion of the bracket against which it abuts to the upper longitudinal edge of the locking arm 212. A set screw 218 is carried by the bight portion of the bracket in spaced relation to the set screw 210 and it is adapted to engage the spring 216 so that the resilient pressure of the spring upon the locking arm 212 can be selectively set.

A pair of similar latch devices, generally indicated at 220 and 222, similar to the latch devices disposed on the upper one of the solid plates 38 in all respects, is mounted on the lowermost one of the plates 38 of the intermediate section 14 and disposed in similar relation thereto as the elements of the latch devices described in detail on the uppermost plate 38. One principal difference in the structure of the latch devices on the top plate 38 from the latch devices 220 and 222 is seen in the roller 224 rotatably journaled on the shaft 164 longitudinally thereof and extending between the posts 169 and 194, to support the load line 56 so that the load line will be raised above the upper plate 38 and, hence, will not interfere with the operation of the latch devices and will be free to move along the roller 224 when the load line is operated. Since the load line 56 extends along the upper or top side of the boom 10, there is no need for a roller to extend between the latch devices 220 and 222.

Hook portions 226 and 228 of the locking arms 230 and 232 of the respective devices 220 and 222 are clearly shown in Figure 5 as being engaged behind the end face plate 76 of the end boom section 16.

With reference to Figures 16, 17 and 18, the boom sections in moving to their retracted or collapsed position, the angularly disposed leading edge 197 of each of the hooks of the locking arms of the latch devices, defining cam surfaces, will ride upwardly upon the terminal end 234 of the base section 12 so as to be moved about their pivots and out of engagement with the end face plate 76 of the endmost section 16 to permit the collapsing of the boom sections. At the same time, the downwardly depending projections 174 on the latch arms 170 of the latch devices will engage behind a raised boss or keeper 236 provided on the upper and lower plates 30 of the end 28 adjacent the terminal edge or end 234 whereby the intermediate and base sections will be secured together in their fully retracted positions. In order to permit the projections 174 to execute the movement from in front of the keepers 236 to the locking position therebehind, a cam block 238 is provided for each of the latch arms, and each cam block is disposed and carried upon the outer faces of the upper and lower plates 72 on the end section 16. Thus, as the end section 16 is moved so as to extend outwardly from the intermediate section 14, the end of the rods, similar to the rods 176 and 204, will ride upon the inclined surface 239 of the associated cam block and thereby lift the associated latch arm upwardly in its arcuate path of movement against the resilience of the spring associated with the respective latch arm. This will lock sections 12 and 14 together, permitting outward extension of end section 16 first, before the intermediate section 14 can be extended outwardly from the base section 12. The latch arms of the latching devices, there being a pair of latching devices on both the upper and lower sides of the intermediate section 14 adjacent the one end thereof remote from the base section, will be in its disengaged position as shown in Figures 7 and 18, at all times when the endmost boom section 16 is fully extended outwardly from the intermediate section 14, but will return into its latching engagement under the influence of the associated springs as the endmost section is fully retracted within the intermediate section 14.

In Figure 16, the locking arm is shown in its locking position engaged behind the end face plate 76 at the end section 16, while the latch arm is disengaged from behind the keeper 236. Figure 17 shows the latch arms 170 in their locking positions behind the keeper 17, when the intermediate boom section 14 is in its fully collapsed position telescopically within the base section 12, and the locking arms in their disengaged positions. Figure 18 shows an intermediate position of the latch device starting the retraction of the end boom section 14, prior to the latching arm assuming the locking position as shown in Figure 17.

Thus, it will be seen that in extending the boom 10, the end section 16 will be fully extended first and then the intermediate section extended. In order to enable the operator to selectively maintain any degree of extension he so desires, a lock mechanism, generally indicated at 240, is carried by the base section 12 on the end 28

thereof and disposed on plates 30 adjacent the ends thereof remote from the intermediate section 14.

The lock mechanism 240 (Figure 8) comprises a hydraulic cylinder 242 selectively operated from the cab of the associated crane through inlet and outlet lines 244 and 246 where the cylinder piston 248 extending outwardly from the cylinder 242 will be caused to move in a rectilinear path. The end of the piston 248 remote from the cylinder 242 is pivotally connected to a pivoted lever 250 adjacent one end thereof by a pin passing through the piston rod 248 adjacent its free end and into an elongated closed slot adjacent the end of the lever 250.

The lever 250 is pivoted intermediate its ends as at 252 for movement in a closed path. A connecting rod 254 is secured to the lever 250 between the pivot 252 and the piston rod 248 and extends laterally therefrom. The other end of the connecting rod 254 is secured to one end of a lever arm 256, the other end of the lever arm 256 being secured upon a laterally extending operating shaft 258 which extends in spaced parallel relation to one of the side plates 30 since the hydraulic cylinder 242 and the lever 250 and connecting rod 254 extend transversely of the lowermost horizontally disposed plate 30 on which they are carried.

The operating shaft 258 is journaled in a pair of spaced, parallel bearing brackets 260 extending perpendicularly outwardly from the vertically disposed side plate 30. Thus, the shaft 258 extends transversely of one of the side plates 30 and is journaled for rotation in the bearing brackets 260.

One end of another connecting rod 262 is secured adjacent the end of the lever 250 remote from its connection to the piston rod 248 and extends laterally therefrom in a direction opposite to the direction in which the connecting rod 254 extends, the other end of the connecting rod 262 extending beyond the solid plate 30 which is in spaced parallel relation to the vertically disposed plate upon which the bearing brackets 260 are mounted. The end of the connecting rod remote from its end secured to the lever 250 is secured adjacent one end of a lever arm 264 which extends laterally from an operating shaft 266 upon which it is secured adjacent its opposite end. The operating shaft 266 is journaled for rotation adjacent the ends of a pair of vertically aligned bearing brackets 268 and 270. Thus, the operating shaft 266 extends in spaced parallel relation with the adjacent vertically disposed plate 30. An operating lever 272 (Figures 9, 10, 11) has one end thereof secured on the shaft 266 adjacent the bearing bracket 268 and extends perpendicularly outwardly therefrom toward a bracket 274 which projects perpendicularly and outwardly from the side plate 30 in spaced parallel relation to the bearing bracket 268 and to the side thereof remote from the side at which one end of the connecting rod 262 is secured upon the lever arm 264.

A bearing bracket 286, similar to bracket 274 and vertically aligned therewith, is provided with a T-shaped slot 276 in which the cross head 278 of a latch plate 280 will ride so that the slot 276 provides a guide for the latch plate 280. The end of the operating lever 272 remote from the end secured on the shaft 266, is received in a generally rectangular opening in the latch plate to thereby define an operative connection whereby the latch plate may be moved in a rectilinear path in the guide slot 276 into and out of with registering spaces between the teeth 282 which depend from the lower longitudinal edge of the uppermost ones of the angle section 32 of the intermediate section 14, and similarly longitudinally spaced depending teeth on the lower longitudinal edges of the upper angle sections 40 of the end boom section 16. The teeth on the upper, spaced parallel angle sections 40 of the end section 16 are identified by the reference 284. This engagement of the latch plate 280 in the spaces between the teeth 282 and 284 at one side of the boom is made possible by the stepped formation provided at the end of the latch plate 280 remote from its operative connection to the operating lever 272 so that the plate 280 will be inserted in the space between selected teeth and maintain the sections 14 and 16 at a predetermined extended position outwardly from the base section 12. It will be noted that the teeth 282 will be offset with respect to the teeth 284, as clearly shown in Figure 9, and the stepped end portion of the latch plate is so formed as to conform to this offset and the space between the slightly offset generally registering openings between the teeth on the respective intermediate and end sections.

The bracket 274 is similarly provided with a latch plate which will ride in a T slot to move in a rectilinear path into intersecting relation with the adjacent teeth 290 and 292, in the manner described in connection with the latch plate 280, and be operatively connected to an operating lever 288, similar to the operating lever 272, which is operatively connected between the operating shaft 266 and the latch plate adjacent the lower end of the shaft remote from the end adjacent which the operating lever 272 is secured.

Thus, as the latch plate 280 enters substantially registering, but slightly offset, spaces between the teeth 282 and 284, the latch plate similar thereto but employed in connection with the bracket 274 and operating lever 288 will similarly engage in the slightly offset spaces between the upwardly extending teeth 290 and 292, which are in opposed relation to the teeth 282 and 284, on the intermediate and end sections of the boom 10 respectively at 290 and 292.

Turning once again to the operating shaft 258 which is disposed on the side of the base section end 28 remote from the side along which the operating shaft 266 extends, it will be noted that a pair of spaced parallel operating levers 294 and 296 extend perpendicularly outwardly from the operating shaft 258 adjacent opposite ends thereof, each of the levers having one end secured to the shaft so as to be movable therewith and the other end operatively connected to a latch plate, similar in all respects to the latch plate 280, which rides in a T slot in the respective brackets 298 and 300 so that the latch plates will also engage in the slightly offset spaces between the respective teeth 282, 284 and 290, 292 on the angle sections 32 and 40 of the intermediate and end sections respectively and at the side thereof remote from the side in which the latch plate 280 is operative.

Thus, upon operation of the hydraulic cylinder 242, the lever 250 will be rocked about its pivot or axis 252 to simultaneously move the connecting rods 254 and 262 in opposite directions and cause rotation of the respective operative shafts 258 and 266 which in turn will cause movement of the respective operating levers carried on these shafts so as to cause movement of the operatively connected latch plates in the guide slots of the associated brackets. Hence, with the boom 10 in its collapsed or retracted position shown in Figure 2, the lock mechanism 240 will have the four latch plates engaged with the respective teeth of the intermediate and end sections of the boom so as to securely maintain the sections in the retracted position and against relative movement. Also, with the boom sections in their fully extended positions, the latch plates will engage behind the end face plate 92 on the end of the intermediate section 14 telescopically entering the base 12, as shown in Figure 15.

In order to cause extension of the boom 10, the operator will first actuate the lock mechanism 240 by actuating the hydraulic cylinder 242 and causing the latch plates to disengage from the teeth of the intermediate and end sections. The operator may then cause the extending lines 106 and 108 to be wound upon the respective drums 110 and 112 and thereby cause movement of the end section 16 outwardly from its telescopic relation to the intermediate section 14. It will be apparent, that the degree of extension of the end section at any point between the fully retracted and fully extended positions

may be selectively maintained by again actuating the lock mechanism **240** so as to cause the latch plates to engage between selective generally registering but slightly offset, teeth on the respective intermediate and end sections. With the section **16** in its fully extended position, upon further winding up of the lines **106** and **108**, the intermediate section will start to move into extended position outwardly from the base section **12** at which time the latch arms **170** and **202** along with the latch arms of the latch devices **220** and **222** will be freed from their associated keepers, and the hooks on the locking arms to fall behind the end face plate **76** of the end section **16** in the manner hereinbefore described so as to rigidly maintain the end section in its fully extended position.

The intermediate section may be extended to any point between its fully retracted and fully extended position by the operation of the lock mechanism **240** so as to engage between the spaces of the teeth **282** and **290** on either side thereof.

Thus, it will be apparent that the boom **10** may be extended to any desired length at the option of the operator with the end section **16** being the first to move out and followed by the intermediate section **14**.

A pennant line **302** has its opposite ends secured upon the cable drums **116** and **118** and extends longitudinally of the boom **10** on opposite sides thereof. The purpose of the pennant line **302** is for the purpose of maintaining the boom **10** at a predetermined angular relation to the crane. It will be noted that the extension or retraction in length of the boom **10** can be accomplished without materially affecting the angular position of the boom. In order to accomplish this, the pennant line **302** is led out from the respective cable drums **116** and **118** at the same rate of speed as the lines **106** and **108** are wound on the drums **110** and **112** since the drums **116** and **118** are secured upon the same winch shaft **111**.

The line **302** is provided adjacent either end secured upon the respective cable drums **116** and **118** with a pulley or sheave arrangement, generally indicated at **304** and **306** respectively, each of which consists of a plurality of sheaves or pulley rollers in spaced parallel relation and in transversely extending series with four such pulley wheels or sheaves in one row and three similar pulley wheels in spaced relation in another row, the rows being in spaced parallel relation. Considering first the sheave arrangement **304**, it will be seen that the row of three pulleys is secured to a bracket **308** which has provision for rotatably mounting the pulley wheels thereon. Thus the end portion **310** of the pennant line **302** is secured at one end upon the cable drum **116** and then passes through the sheave arrangement **304** and the other end anchored on the bracket **308** as at **312**.

The intermediate portion **314** of the pennant line **302** is anchored at one end as at **316** and then extends longitudinally of the boom **10** to be trained about a pulley wheel or sheave **318** and extending in a reverse direction to be trained about a pulley wheel or sheave **320**. The intermediate pennant line portion **314** then extends in a longitudinal relation to the boom **10** along one side thereof and generally in spaced parallel relation to the extent of the line between the pulley wheels **318** and **320** and is trained about a pulley wheel or sheave **322** carried by the shaft **52** adjacent one end thereof. The line portion **314** then extends from the pulley wheel **322** to a sheave **324** which may be mounted on the cab of the associated crane or upon a suitable standard or support on the crane, in either case this mounting for the sheave **324** is well known. The line portion **314** then extends about the pulley wheel **322** and back around the pulley wheel or sheave **326** mounted on the shaft **52** at the end thereof remote from the end upon which the pulley wheel **322** is mounted, and then extends downwardly toward the base section of the boom longitudinally to be trained about a pulley wheel or sheave **328** carried by the boom **10** and trained thereabout to reverse its direction back toward the end section of the boom **10** and about a pulley wheel or sheave **330** also carried by the boom **10** and again reversing its direction to have the other end thereof anchored as at **332**. The pulley wheel **328** is rotatably carried on a bracket **334**, upon which bracket is also rotatably mounted the series or group of three pulley wheels of the sheave arrangement **306** about which the other end portion **311** of the pennant line **302** is alternately wound with one end of the end line portion **311** being anchored as at **336** on the bracket **334** and the other end thereof secured to the cable drum **118**.

Thus, it will be seen that as the winch **114** as operated so as to wind the lines **106** and **108** thereon, the cable drums **116** and **118** will be operative to rotate in opposite directions so as to let out the pennant line **302**. The drums **116** and **118** rotate, to let off more of the end portions **310** and **311** of the pennant line **302**, it will be seen that the upper group of three pulleys of the respective sheave arrangements **304** and **306** carried by the respective brackets or housings **308** and **334** will move away from the series of four spaced pulley wheels which are fixed upon the opposite legs of the forked end **18**, as at **305** and **307** respectively, and thus permit the pennant line to be lengthened in direct proportion to the length of extension of the boom sections without materially affecting the angular relation between the boom **10** and the crane.

It will now be seen that when the cable drum or winch is put in operation when the boom is in its extended position, that the boom lines are shortened and the end section of the boom will start going out as the line that is being taken in by this movement is taken from the transfer drum and goes through the sheave to the boom lines. Thus the boom lines are lengthened in proportion to the length of travel of the boom and as they are lengthened, the pennant lines are also lengthened by the reduction in the distance between the axially aligned sheaves of the sheave arrangements **304** and **306**. The reverse of this action is encountered when the boom is collapsing.

While there are shown and described the preferred embodiment of the invention it is to be understood that the structure is susceptible to change and modification within the practicability of the invention and therefore should be limited only by the scope of the claims appended hereto.

What is claimed is:

1. A boom for cranes comprising a plurality of telescoping sections including a base section adapted for pivotal connection to a crane, an intermediate section and an end section; an extension means operatively connected to said intermediate and end sections to move them in extended telescopic relation, a lock mechanism carried by said base section and operatively connected to said intermediate and end sections to lock said sections in a selected position in their extending movement, said lock mechanism including a selectively operable hydraulic cylinder, rows of longitudinally spaced teeth on said intermediate and end sections, a plurality of latch plates, a linkage between said cylinders and said latch plates to move said plates into and out of engagement with said teeth upon actuation of said cylinder.

2. A boom for cranes comprising a plurality of telescoping sections including a base section adapted for pivotal connection to a crane, an intermediate section and an end section; an extension means operatively connected to said intermediate section and end sections to move them in extended telescopic relation, a lock mechanism carried by said base section and operatively connected to said intermediate and end sections to lock said sections in a selected position in their extending movement, said lock mechanism including a selectively operable hydraulic cylinder, rows of longitudinally spaced teeth on said intermediate and end sections, a plurality of latch plates, a linkage between said cylinders and said latch plates to move said plates into and out of engagement with said

teeth upon actuation of said cylinder, a latching means carried by said intermediate section for securing said end section in its fully extended position.

3. A boom for cranes comprising a plurality of telescoping sections including a base section adapted for pivotal connection to a crane, an intermediate section and an end section; a extension means operatively connected to said intermediate section and end sections to move them in extended telescopic relation, a lock mechanism carried by said base section and operatively connected to said intermediate and end sections to lock said sections in a selected position in their extending movement, said lock mechanism including a selectively operable hydraulic cylinder, rows of longitudinally spaced teeth on said intermediate and end sections, a plurality of latch plates, a linkage between said cylinders and said teeth plates to move said plates into and out of engagement with said teeth upon actuation of said cylinder, a latching means carried by said intermediate section for securing said end section in its fully extended position, said latching means including a plurality of pivoted locking arms, each of said locking arms having a hook formed at one end thereof adapted to engage behind the end of said end section when said end section is fully extended.

4. A boom for cranes comprising a plurality of telescoping sections including a base section adapted for pivotal connection to a crane, an intermediate section and an end section; an extension means operatively connected to said intermediate section and end sections to move them in extended telescopic relation, a lock mechanism carried by said base section and operatively connected to said intermediate and end sections to lock said sections in a selected position in their extending movement, said lock mechanism including a selectively operable hydraulic cylinder, rows of longitudinally spaced teeth on said intermediate and end sections, a plurality of latch plates, a linkage between said cylinders and said teeth plates to move said plates into and out of engagement with said teeth upon actuation of said cylinder, a latching means carried by said intermediate section for securing said end section in its fully extended position, said latching means including a plurality of pivoted locking arms, each of said locking arms having a hook formed at one end thereof adapted to engage behind the end of said end section when said end section is fully extended, each of said hooks on said locking arms having an inclined edge adapted to contact the end of said base section upon full retraction of said end section to release said locking arm from engagement therewith.

5. A boom for cranes comprising a plurality of telescoping sections including a base section adapted for pivotal connection to a crane, an intermediate section and an end section; an extension means operatively connected to said intermediate section and end sections to move them in extended telescopic relation, a lock mechanism carried by said base section and operatively connected to said intermediate and end sections to lock said sections in a selected position in their extending movement, said lock mechanism including a selectively operable hydraulic cylinder, rows of longitudinally spaced teeth on said intermediate and end sections, a plurality of latch plates, a linkage between said cylinders and said teeth plates to move said plates into and out of engagement with said teeth upon actuation of said cylinder, a latching means carried by said intermediate section for securing said end section in its fully extended position, said latching means including a plurality of pivoted locking arms, each of said locking arms having a hook formed at one end thereof adapted to engage behind the end of said end section when said end section is fully extended, each of said hooks on said locking arms having an inclined edge adapted to contact the end of said base section upon full retraction of said end section to release said locking arm from engagement therewith, spring means operatively connected to each of said locking arms to urge said arms into engagement with said end section, and said locking arms movable against the resilience of said spring means when moved to their released position.

6. A boom for cranes comprising a plurality of telescoping sections including a base section adapted for pivotal connection to a crane, an intermediate section and an end section; an extension means operatively connected to said intermediate and end sections to move them in extended telescopic relation, a lock mechanism carried by said base section and operatively connected to said intermediate and end sections to lock said sections in a selected position in their extending movement, means carried by said intermediate section and operatively connected to said base section for securing these sections together in the retracted position of said intermediate section, and cam means carried by said end section operatively engageable with said last mentioned means to release this means from its engagement with said base section when said end section is in its fully extended position.

7. A boom for cranes comprising a plurality of telescoping sections including a base section adapted for pivotal connection to a crane, an intermediate section and an end section; an extension means operatively connected to said intermediate and end sections to move them in extended telescopic relation, a lock mechanism carried by said base section and operatively connected to said intermediate and end sections to lock said sections in a selected position in their extending movement, said lock mechanism including a selectively operable hydraulic cylinder, rows of longitudinally spaced teeth on said intermediate and end sections, a plurality of latch plates, a linkage between said cylinders and said latch plates to move said plates into and out of engagement with said teeth upon actuation of said cylinder, a pennant line for selectively maintaining a given angular relation between said boom and the crane, said pennant line including sheave arrangements whereby the line can be lengthened as said extension means is actuated to move said intermediate and end sections into extended relation, means carried by said intermediate section and operatively connected to said base section for securing these sections together in the retracted position of said intermediate section, and cam means carried by said end section operatively engageable with said last mentioned means to release this means from its engagement with said base section when said end section is in its fully extended position.

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