

Feb. 5, 1963

R. J. BUSHONG ET AL
RETRACTIBLE MAST AND BOOM STOP

3,076,560

Filed April 24, 1961

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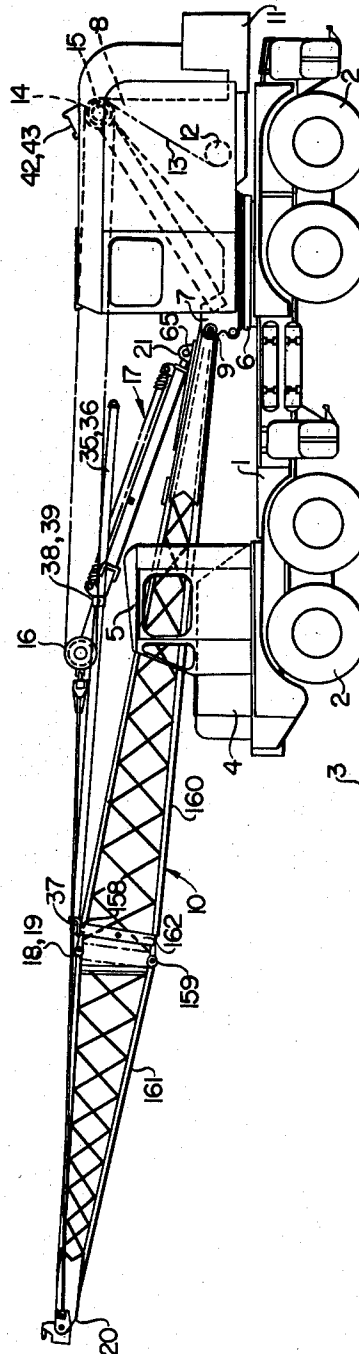


FIG 1

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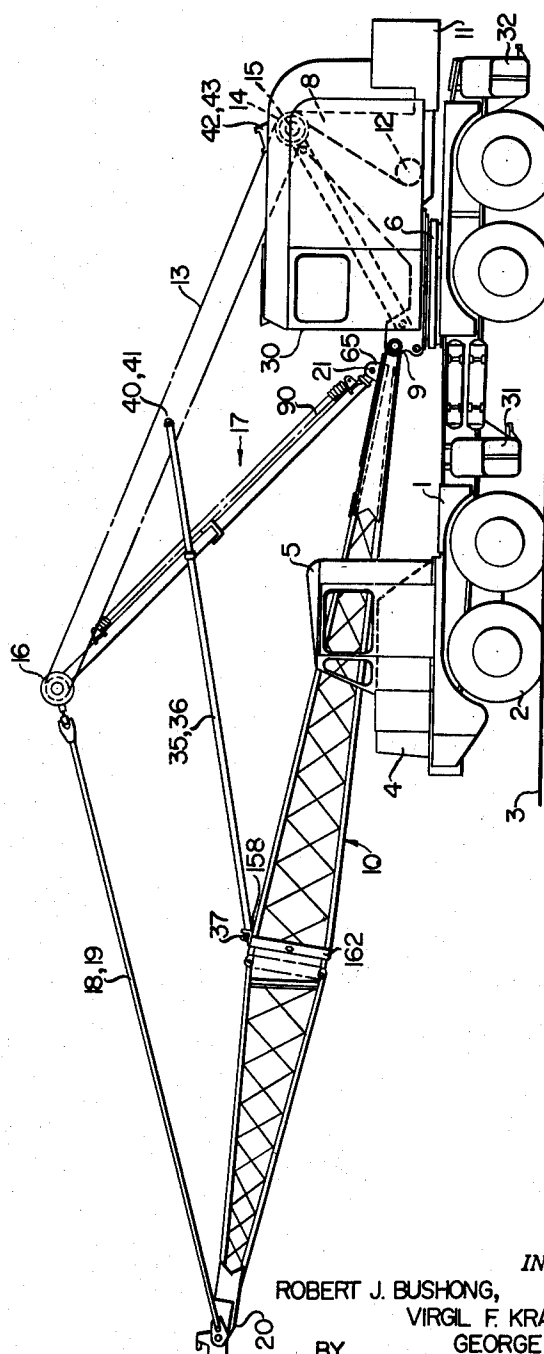


FIG 2

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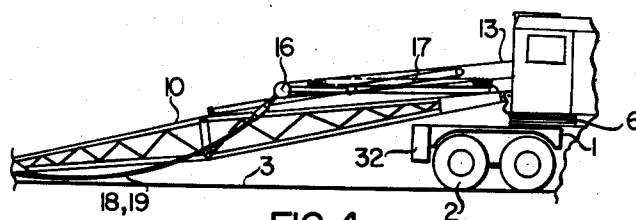


FIG 4

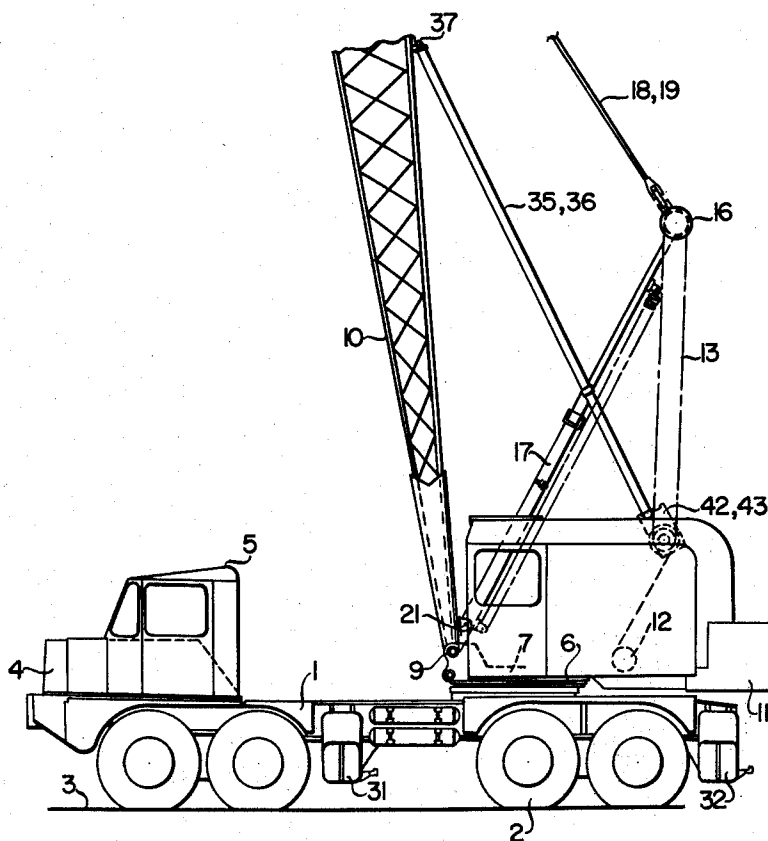


FIG 3

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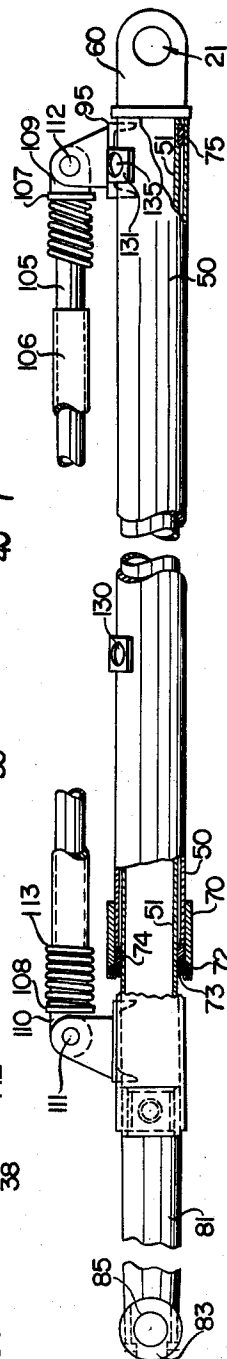
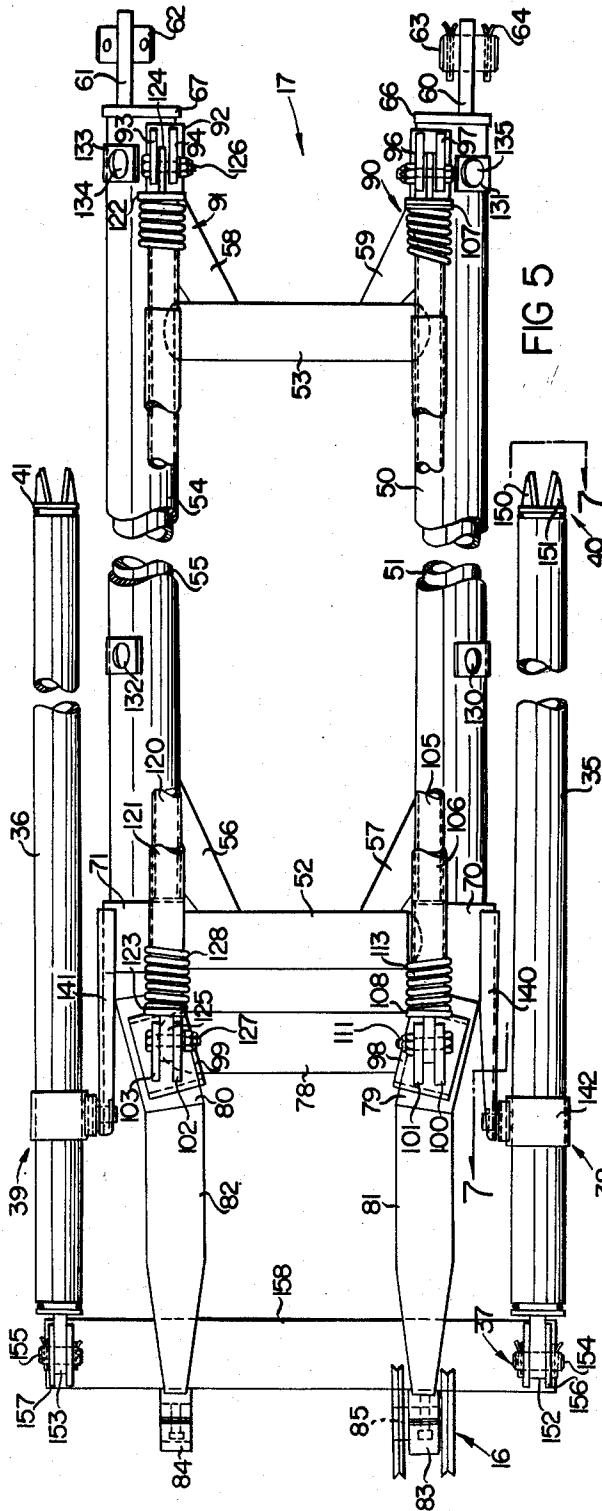
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RETRACTIBLE MAST AND BOOM STOP

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5 Sheets-Sheet 4



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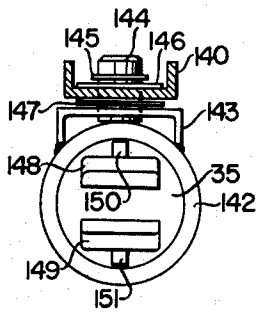


FIG 7

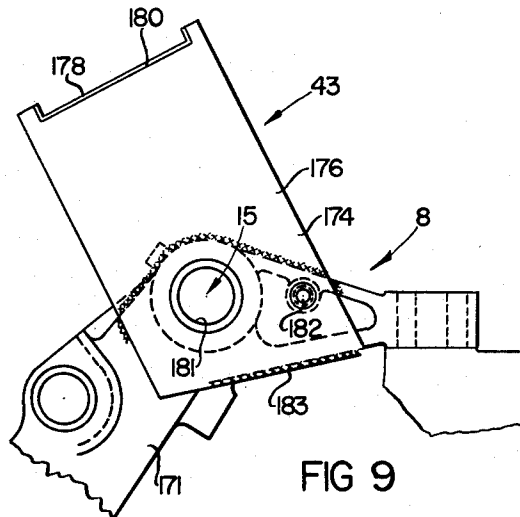


FIG 9

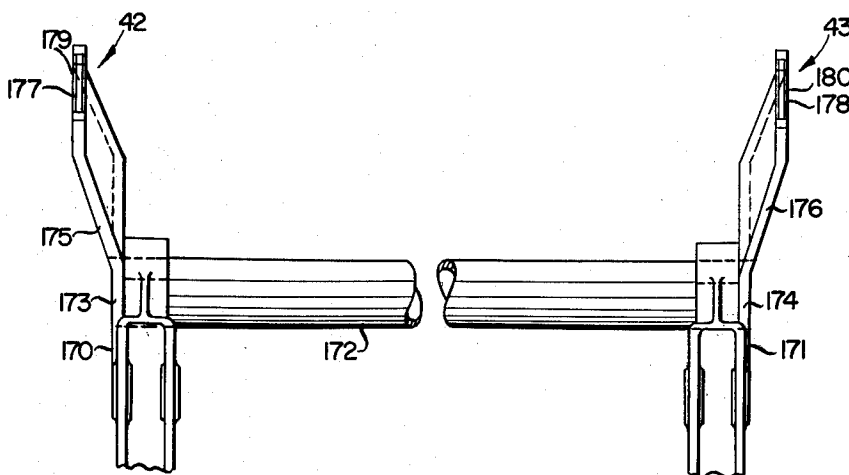


FIG 8

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RETRACTIBLE MAST AND BOOM STOP

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10 Claims. (Cl. 212-59)

This invention relates generally, as indicated, to a retractible mast and boom stop and more particularly to a highly mobile crane or the like incorporating the features of both a retractible mast and a rigid boom stop.

In power cranes, shovels and the like, masts are generally employed to obtain a high angle of incidence between the boom pendants and the boom thereby to obtain maximum lifting capacities. However, in cranes of the type mounted on a truck or carrier chassis for highway movement, the mast must still be used to support the boom in its travel position, but such generally constitutes an obstacle in that the mast exceeds the overall height of the machine and the machine will thus not clear highway bridges, underpasses, overhead wires, and the like. Heretofore, with retractible masts it has generally been necessary to change the pendant connections at the peak of the mast in order to obtain the reduced travel clearance.

Moreover, in machines of the type employing a mast of the type disclosed in the present invention, it becomes difficult to provide a positive stop between the boom and the turntable or frame of the crane. Ordinarily, cranes will be provided with automatic boom stops which will stop the hoisting mechanism when the boom reaches a maximum safe elevation. However, if a load should suddenly be dropped through the parting of a cable or the like, the crane boom has a tendency to react and swing backwardly over the cab and this can cause the crane to upset as well as other damage or personnel injury. Accordingly a positive or rigid abutment between the boom and the frame or turntable bed is to be highly desired from the standpoint of safety.

It is accordingly a principal object of the present invention to provide a retractible gantry mast for a crane and the like incorporating therein a positive boom stop.

It is another main object to provide a retractible mast gantry for cranes and the like enabling such crane more quickly and simply to be prepared for highway travel.

It is yet another main object to provide a crane having a positive boom stop providing a rigid abutment between the boom in its maximum safe position of elevation and the frame of the turntable or crane bed.

It is a further object to provide a truck or carrier mounted crane which can quickly be prepared for highway travel with the boom extending over the front end of the carrier and without the boom lifting apparatus exceeding the overall height of the machine.

Other objects and advantages of the present invention will become apparent as the following description proceeds.

To the accomplishment of the foregoing and related ends, the invention, then, comprises the features hereinafter fully described and particularly pointed out in the claims, the following description and the annexed drawings setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but a few of the various ways in which the principle of the invention may be employed.

In said annexed drawings:

FIG. 1 is a side elevation of a wheeled carrier mounted crane in accordance with the present invention with the boom extending over the front end in highway travel position;

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FIG. 2 is a side elevation of the crane of FIG. 1 with the mast extended;

FIG. 3 is a fragmentary side elevation illustrating the position of the mast and boom stop in the maximum position of elevation of the boom;

FIG. 4 is a fragmentary side elevation of the crane with the boom on the ground or cribbing illustrating the manner in which the operator can retract the mast to its traveling position;

FIG. 5 is a fragmentary top plan detail view partially broken away of the retractible mast and boom stop;

FIG. 6 is a fragmentary side elevation of the retractible mast of FIG. 1 partially broken away;

FIG. 7 is a detail section taken substantially on the line 7-7 of FIG. 5;

FIG. 8 is a fragmentary view of the structure at the top of the A-frame of the turntable bed which engages the boom stop; and

FIG. 9 is a fragmentary side elevation of the structure of FIG. 8.

Referring now to the annexed drawings and more particularly to FIGS. 1, 2 and 3 thereof, there is illustrated a crane in accordance with the present invention such crane being mounted on a carrier or truck chassis 1 which is mounted on ground engaging wheels 2 for movement over a highway 3 or the like by means of prime mover 4, such carrier being operated by the driver in cab 5. The chassis 1 is provided with a turntable 6 on which is rotatably mounted a crane. The crane is comprised of a turntable bed or frame 7 which includes an A-frame 8. Pivoted to the frame at one end as shown at 9 is a boom 10. At the opposite end of the frame is a removable counterweight 11 adapted to balance the weight of the boom and its load about the centerline of the turntable 6. Hoisting mechanism in the form of a conventional drum hoist 12 and boom derricking cable 13 is employed to raise and lower the boom 10. The derricking cable 13 extends about sheaves 14 at the peak 15 of the A-frame 8 and about sheaves 16 mounted on the peak of retractible mast gantry 17. The peak of such mast gantry is connected by pendants 18, 19 to the peak 20 of the boom 10. The foot of the mast gantry 17 is pivoted to the main boom adjacent the foot 9 as shown at 21. Thus the derricking cable 13 will hold the peak of the mast 17 in the position shown keeping the pendants 18, 19 taut to support the peak 20 of the boom 10 in the traveling position over the front end of the carrier 1 so that the crane can readily traverse the highway 3. It is noted that the peak of the mast gantry 17 does not extend beyond the overall height of the crane to present obstacles for clearance of highway underpasses, bridges, traffic lights, overhead wires, etc.

Moving now to FIG. 2, when the crane reaches the site at which it is to be employed, the operator in the cab 30 of the crane will cause the mast 17 to extend to the position shown in FIG. 2 in a manner which will hereinafter be described. It can readily be seen that this extension of the mast 17 permits movement of the sheaves 16 at the peak thereof further away from the boom 10 to increase the angle of incidence between the pendants 18, 19 and the boom 10. In this manner, a greater lifting force can be exerted upon the boom and higher boom capacities are thus obtained. However, it will readily be seen that the mast 17 in its FIG. 2 position will not readily clear overhead wires, underpasses, bridges, traffic lights, etc. and consequently the crane cannot travel distances on a highway with the mast 17 in its FIG. 2 position. When the proper working site has been reached, the operator may set the outriggers 31 and 32 on the frame 1 to provide the proper support for the crane and extend the mast 17 to the position shown for lifting purposes. However, it will be understood that with a short boom, the

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boom can be raised without outriggers. This extension of the mast can easily be accomplished by replacing locking pins as will hereinafter be more particularly described. Actuation of the drum hoist 12 will cause the derricking cable then to shorten the distance between sheaves 15 and 16 to cause the boom 10 to pivot upwardly or swing upwardly about the foot pivot 9.

Referring now additionally to FIG. 3, when the boom 10 reaches its maximum safe elevated position, an automatic stop mechanism will deenergize the braking drum 12 to stop further upward elevation to prevent the boom from tipping backwardly over the cab. If the load should suddenly be released either through failure of the load-lifting mechanism or through the parting of a cable and the like, there is a tendency for the boom to swing backwardly over the crane cab about the pivot 9. Accordingly, merely halting the hoisting mechanism could not prevent the boom from back-lashing or swinging over the cab. Therefore a rigid or positive abutment should be provided between the boom and the frame of the crane itself. In the illustrated embodiment, this positive stop abutment is provided by two elongated boom stops 35 and 36. The boom stop members 35 and 36 are pivotally mounted as shown at 37 on the lowermost section of the boom 10 and extend through trunnions 38, 39 on each side of the mast 17 and such stop members are longitudinally slide guided thereby so that the feet 40, 41 of each stop member 35 and 36 will be guided into proper engagement with specially constructed frame portions 42, 43 at the peak of the A-frame 8 which is part of the turntable bed and frame. The details of the boom stops and mast as well as the boom stop engaging portions of the frame may more clearly be seen in FIGS. 5, 6, 7, 8 and 9.

It can now be seen that in the traveling position of the crane shown more particularly in FIG. 1, the boom stop members 35 and 36 will lie substantially parallel to the mast 17 in its retracted position. In this manner, the positive stop members will be beneath the maximum height of the crane in its traveling position. As the mast is extended as shown in FIG. 2, the stop members will accordingly be raised to the position shown. As the boom is then elevated to the position shown in FIG. 3, the feet 40, 41 of the positive stop members will then be guided by the trunnions 38 and 39 properly to engage the frame portions 42, 43. This then provides a rigid positive stop between the crane frame and the boom to prevent the boom from tipping over backwardly and such stops employ the retractible mast as a guide properly to engage the boom stop members with the crane frame.

Referring now more particularly to FIGS. 5 and 6, there is illustrated the detailed structure of the mast 17 and boom stop members 35 and 36, and it will be seen that the mast 17 is comprised of a pair of telescoping sections on each side thereof. Thus one of said pairs comprises an outer section 50 with an inner section 51 telescoped there-within. The outer section is rigidly joined by transverse frame members 52 and 53 to the outer section 54 of the other parallel pair of sections which is comprised of inner section 55 telescoped within outer section 54. Reinforcing webs 56, 57, 58 and 59 may be employed with the transverse rigidifying members 52 and 53. Apertured plates extend from the base or foot of the outer sections 54 and 50 as shown at 60 and 61 respectively, the apertures therein accommodating pins 62 and 63. Cotter pins 64 may be employed to pin connect the foot of the mast to the upstanding ears 65 adjacent the foot of the boom 10. (Note FIGS. 1 and 2.) The plates 60 and 61 may be secured to end caps 66 and 67 on the ends of the outer sections 50 and 54, there are provided collars 70 and 71 to which the transverse member 52 is secured. As shown more clearly in FIG. 6, an annular retaining ring 72 may be fastened to the end of the collars as by screws or the like, each such ring holding in place a sliding seal 73. Such seal may, for example, be a palmetto flange seal

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keeping dirt and other debris out of the interior of the outer section 50. At the outermost end of the outer section 50 within the collar 70, there is provided a bushing 74 to guide the inner section 51 for telescopic movement within the outer section 50. The bushing 74 will be secured to the outer section whereas the bushing 75 at the foot of the mast is of slightly smaller diameter and is secured to the inner section 51 by a retaining ring or the like. Thus the bushings 74 and 75 provide slide bearing surfaces for the telescopic movement of the inner section 51 within the outer section 50. Similar bushings, retaining ring and seal will, of course, be provided on the parallel telescoping sections 54 and 55.

Thus the lower mast is comprised of the outer sections 50 and 54 held together by the framing members 52 and 53 which are pin connected to the boom 10. The upper mast is comprised of the inner telescoping sections 51 and 55 which are held together by transverse rigidifying member 78 beyond the collars 70 and 71. Also, it will be noted that the inner sections 51 and 55 are bent slightly inwardly as shown at 79 and 80 respectively to form parallel upper mast arms 81 and 82. These sections terminate in caps 83 and 84 to accommodate stub axles 85 therein for supporting the derricking cable sheaves 16. A pair of such sheaves will generally be provided on each of the mast arms 81 and 82. Such caps 83 and 84 will also, of course, provide a connection for the boom pendants 18, 19, not shown in FIG. 5.

In order to extend the mast, each of the parallel telescoping mast sections is provided with spring mechanisms 90 and 91 respectively. Mounted on the outer section 54 is a support 92 to the top surface of which is secured upstanding ears 93 and 94. Similarly, a support plate 95 on the top of outer section 50 provides a support surface for upstanding ears 96 and 97. Support plates 98 and 99 on the bent portions 79 and 80 of the upper mast similarly provide support surfaces for upstanding ears 100 and 101 and 102 and 103 respectively, secured thereto. The upstanding ears provide pin connections for telescoping tubular members with the spring mechanism 90 being comprised of telescoping tubular members 105 and 106 with the respective ends thereof being provided with shoulders 107 and 108 as well as apertured plates 109 and 110 normal thereto. The plates 109 and 110 are provided with apertures aligned with the apertures in the upstanding ears 96, 97, and 100 and 101 with the telescoping tubes being pin connected thereto by the nut and bolt assemblies 111, 112. Positioned over the telescoping tubes 105 and 106 extending between the shoulders 107 and 108 there is provided a series of compression springs 113. In the illustrated embodiment, such springs may include four 62¼ inch free length springs abutting each other and the shoulders 107 and 108 since a single spring of the required length may not be obtainable.

Similarly, the spring mechanism 91 is comprised of telescoping inner and outer tubular sections 120 and 121 with such sections being provided with shoulders 122 and 123 at their ends and apertured plates 124 and 125 respectively which are pin connected by the nut and bolt assemblies 126 and 127 to the respective pairs of upstanding ears 93, 94 and 102, 103. The spring assemblies 128 and 113 will serve to urge the upper mast which includes the inner telescoping sections 51 and 55 outwardly of the lower mast which is comprised essentially of the outer sections 50 and 54. It will, of course, be understood that in place of the spring assemblies, an air or hydraulic cushion or spring may be provided within the telescoping mast itself, with a convenient source of such air being the air under pressure normally available on the carrier.

In order to lock the upper mast in its extended or retracted position, the outer sections 50 and 54 are provided with longitudinally spaced pin holes 130, 131, and 132, 133 respectively. Each of the inner sections 51 and 55 will be provided with pin apertures aligned therewith

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so that shouldered pins 134 and 135 may be inserted selectively in such pin apertures to lock the mast in either its extended or retracted position. The manner of extending and retracting the mast will hereinafter be more fully described.

In order to guide the boom stops 35 and 36 into proper engagement with the frame portions 42, 43, each of the collars 70 and 71 is provided with brackets 140 and 141 extending longitudinally outwardly of the mast at the sides thereof and trunnions 38 and 39 are pivotally secured to the outer ends thereof. The trunnion 38 is comprised of a sleeve-like guide 142 (see FIG. 7) through which the boom stop 35 is freely slidable. The sleeve guide is secured to member 143 which is in turn secured to pivot 144 held to the bracket 140 by snap ring 145. Thrust washers 146 and 147 may be provided on the pivot 144 to ensure proper pivotal movement of the sleeve guide 142 about the axis of pivot 144. The member 143 can be secured to the pivot 144 for rotation therewith so that only the snap ring 145 is required to fasten the trunnion to the bracket 140. The trunnion 39 for the boom stop 36 will be identical in form to the trunnion 38. As seen in FIGS. 5 and 7, the tip 40 of the boom stop 35 is provided with guides 148 and 149 each having rigidifying back-up webs 150 and 151 which serve to hold the guide members 148 and 149 in the proper inclined position. These guides ensure that the boom stop will properly seat on the portions 42, 43 of the frame 7.

As seen in FIG. 5, the proximal ends of the boom stops 35 and 36 are provided with apertured plates 152 and 153 respectively which are connected by pins 154 and 155 between pairs of upstanding ears 156 and 157 on hinge plate 158. The hinge pins 154 and 155 thus provide the pivot for the foot of each boom stop as seen more particularly in FIG. 1. The hinge plate 158 is then secured to the boom adjacent the pin connections 159 between boom sections 160 and 161. It will, of course, be understood that practically any number of boom sections may be employed to extend the length of the boom. Side banding members 162 may be employed to secure the hinge plate 158 to the boom 10 in a manner so that it can be readily removed. However, if desired, the hinge plate 158 can be bolted, clamped or welded to the lowermost boom section 160.

Referring now to FIGS. 8 and 9, it will be seen that the peak 15 of the A-frame 8 is comprised of the spaced frame members 170 and 171 with a sheave mounting shaft 172 extending therebetween, sheaves 14 will be mounted on this shaft in the conventional manner to accommodate the derricking cable 13. Welded to the out-sides of the frame members 170 and 171 are boom stop engaging plates 173 and 174. Such plates are outwardly offset as shown at 175 and 176 and are provided with elongated top stop engaging surfaces 177 and 178. Since very accurate tolerances cannot be held in the fabrication of the parts of such crane, the elongated contact surfaces 177 and 178 ensure that the tips of the elongated stop members 35 and 36 will properly engage these plates. The plates are outwardly bent or offset as shown to prevent the tips of the stop members from becoming entangled with the derricking cable 13. If desired, the edges of the stop engaging surfaces 177 and 178 may be slightly beveled as shown at 179 and 180 more readily to engage with the flared guides on the tips 40 and 41 of the boom stop members. When the plates 173 and 174 are secured to the frame portions 170 and 171, the holes 181 and 182 may be fitted with holes in the machine frame. Then, the weld 183 which can, for example, be $\frac{3}{4}$ inch fillet weld, is then employed properly to secure the plates to the machine frame. It will, of course, be understood that instead of the rigid stop shown, such stop may be cushioned by a spring, pneumatic or hydraulic snubbing action. This may be provided in either the frame or the boom stop members.

Referring now to FIG. 4, when it is desired to retract

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the mast to the shorter condition for highway travel, the boom 10 can be lowered so that it rests in a generally horizontal position with the boom head on the ground 3 or suitable cribbing. Continued slackening of the derricking cable 13 will allow the mast 17 to rest on top of the boom. Suitable mast stops may be provided to support the mast on the top of the boom. In this position, the pendants 18, 19 will become slack. The operator then will continue releasing the boom derricking cable 13 until all tension is off the sheaves 16 at the top of the mast. Pins 134 and 135 can then be removed from the apertures 130 and 132 so that the mast is no longer locked in its extended position. The operator will then slowly engage the boom hoist clutch which will allow the boom derricking cables to pull backwardly the upper mast section into the lower mast section against the pressure of spring assemblies 90 and 91. Since the mast and cables are almost parallel to each other, the component of force exerted by the boom derricking cable 13 on the mast will be approximately longitudinally thereof or sufficient to compress the spring assemblies rather than swing the mast upwardly about the pivot 21. The operator will continue to reel in the derricking cable 13 until the apertures in the inner tubular sections are aligned with the apertures 131 and 133 in the lower end of the outer sections so that the operator can replace the pins 134 and 135 in such aligned apertures. Once the mast is in the locked retracted position, continued reel-up of the derricking cable will lift the mast free or to the position shown more clearly in FIG. 1. At this point the mast sheaves act as a floating boom harness which will permit the picking up of the boom 10 and swinging it over the front of the machine into the travel position shown in FIG. 1. The crane is now ready for highway travel and the overall height of the illustrated crane has then been reduced from approximately 20'3" to 13'3" which is sufficient to clear underpasses, wires, etc.

It is noted that the boom stop members 35 and 36 are lowered from their frame engaging position shown in FIG. 2 to a position almost parallel to the mast and boom as shown in FIGS. 1 and 4 in that they are freely slide guided through the sleeves of trunnions 38 and 39.

To reverse the procedure to raise the boom to change the mast structure from the traveling position of FIG. 1 to the working position of FIG. 2, the turntable can be rotated and the boom lowered again to the ground or cribbing so that it rests in the generally horizontal position of FIG. 4 with the boom head or peak on the ground. The operator can remove the pins 134 and 135 from the pin holes 131 and 133 while maintaining tension on the cable 13. To release the mast from its retracted position the boom hoist brake can then be released gently to pay out the boom derricking cables slowly. The compressed spring assemblies 90 and 91 will then force the upper mast section outwardly to its original extended position wherein the pins 134 and 135 can then be reinserted in the outer pin holes 130 and 132. The boom hoist clutch can then be engaged to take up the derricking cables which will then raise the mast to its FIG. 2 position and the boom stops to their frame engaging position and also to remove the slack from the pendants 18 and 19.

It can now be seen that there is provided a combination mast and boom stop which, when the mast is extended to its working position, boom stops are automatically positioned in their frame engaging position to abut the frame upon the attainment of the maximum safe elevation of the boom. When the mast is retracted to a traveling position, the boom stops automatically fold therewith to be well within the overall height of the machine.

Other modes of applying the principle of the invention may be employed, change being made as regards the details described, provided the features stated in any of the

following claims or the equivalent of such be employed.
We, therefore, particularly point out and distinctly claim as our invention:

1. In combination, a frame, a boom pivoted to said frame for vertical swinging movement about a horizontal axis, a mast pivoted to said boom, a trunnion mounted on said mast a fixed distance from such mast-boom pivot pendants interconnecting the peak of said mast and the peak of said boom, and hoisting means connected to the peak of said mast for vertically swinging said mast and thus said boom, a stop member pivoted to said boom and slide guided by said trunnion, said stop member engaging said frame on maximum elevation of said boom.

2. The combination set forth in claim 1 wherein said stop member and frame include mating engaging portions upon maximum elevation of said boom.

3. In combination, a frame, a boom pivoted to said frame for vertical swinging movement about a horizontal axis, a mast pivoted to said boom, pendants interconnecting the peak of said mast and the peak of said boom, and hoisting means connected to the peak of said mast for thus vertically swinging said boom, a stop member pivoted to said boom and slide guided by said mast, said stop member engaging said frame on maximum elevation of said boom, said stop member comprising an elongated rigid member slidably mounted in a trunnion pivoted to said mast, said stop member and frame including mating engaging portions upon maximum elevation of said boom, and said mast including telescoping sections with said trunnion being mounted on said mast a fixed distance from the foot of said mast but a variable distance from the peak of said mast.

4. The combination set forth in claim 3 wherein said mast includes a pair of parallel telescoping sections, the outermost of said pair of sections being rigidly interconnected and pivoted to said boom, spring means tending to lengthen said mast, and means to lock said mast in extended and retracted position.

5. The combination set forth in claim 4 including parallel stop members pivoted to said boom, and bracket means secured to the outer sides of each said outermost pair of sections, trunnions mounted on each said bracket

means, said stop members being slide guided by said trunnions.

6. The combination set forth in claim 5 wherein said trunnions comprise sleeve-like guides pivoted to said brackets.

7. A retractible mast structure for cranes and the like having a turntable frame and boom pivoted thereto, said mast structure comprising an outer section, an inner section telescoped within said outer section, means resiliently urging said inner section longitudinally outwardly of said outer section to an extended position, and means to lock said mast in extended and retracted positions.

8. A mast as set forth in claim 7 wherein said mast includes parallel rigidly joined inner and outer telescoping sections, a sheave on the outer end of said inner sections, said outer sections being pivotally mounted on said boom, boom hoisting means connected to said sheave, and boom pendants interconnecting said outer end of said inner sections and the peak of said boom.

9. A mast as set forth in claim 8 including brackets mounted on the outer section, trunnions on said brackets, and boom stop members slide guided by said trunnions adapted to provide an abutment between said boom and frame at the maximum safe elevation of said boom.

10. A crane comprising a turntable frame, a boom pivoted to said frame, an extensible mast structure, cable means connecting the peak of said boom and said mast structure, hoisting means connected to said mast to raise said boom, an elongated boom stop member pivoted to said boom, and means on said mast structure operative to pivot said stop member to a frame engaging position upon maximum elevation of said boom.

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