Feb. 6, 1940. R. E. LJUNGKULL 2,189,212

CRANE

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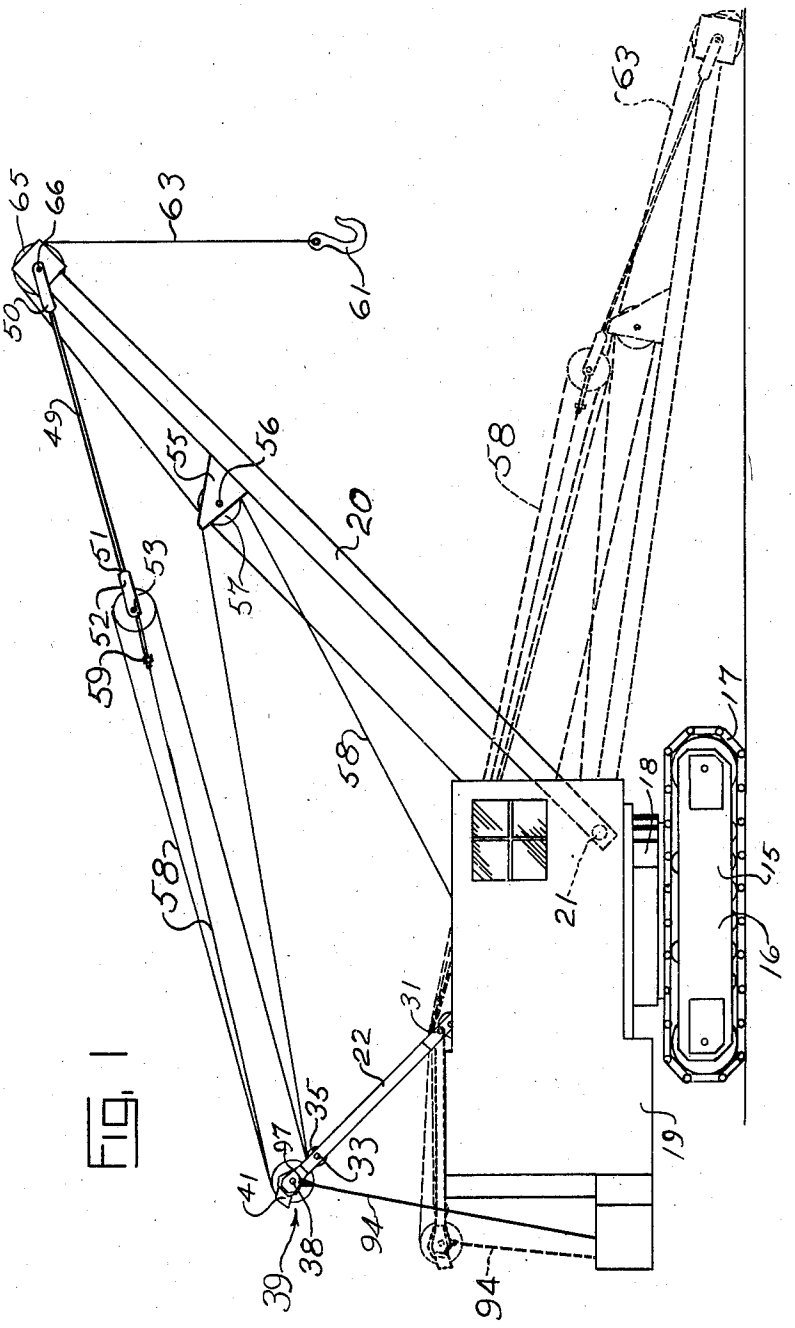


FIG. 1

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CRANE

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FIG. 2

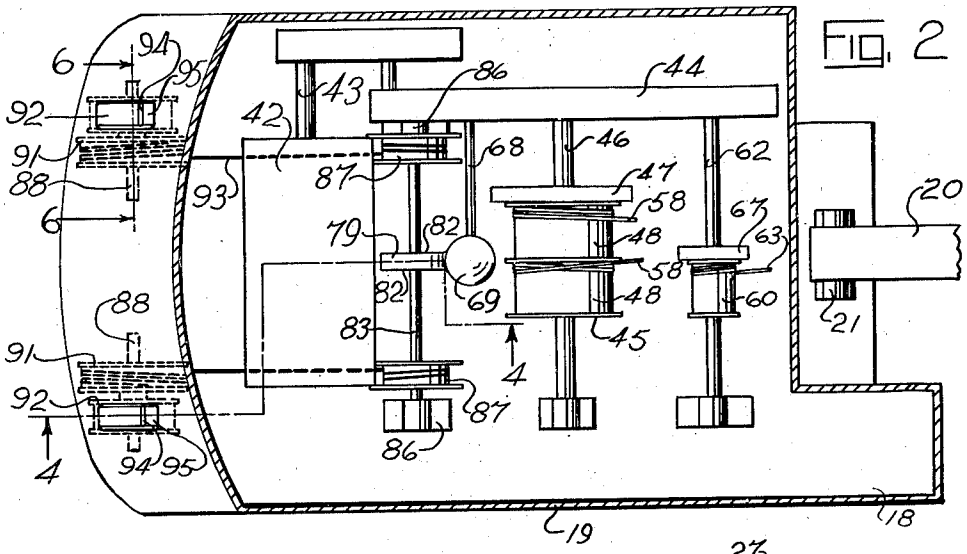


FIG. 3

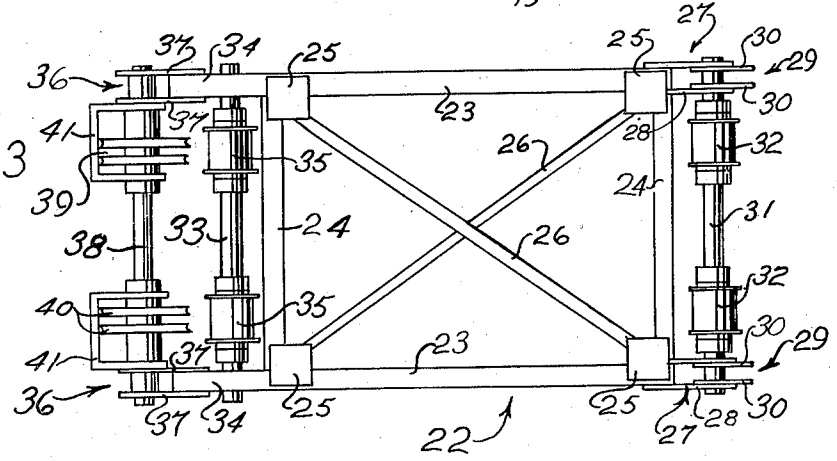
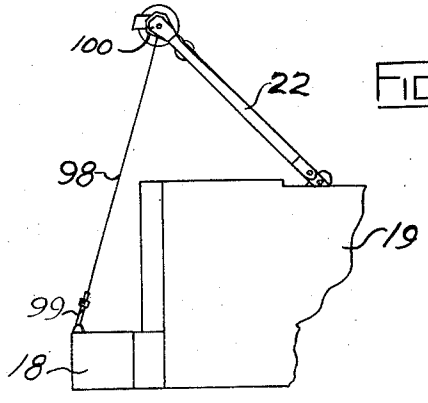


FIG. 10



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CRANE

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Fig. 4

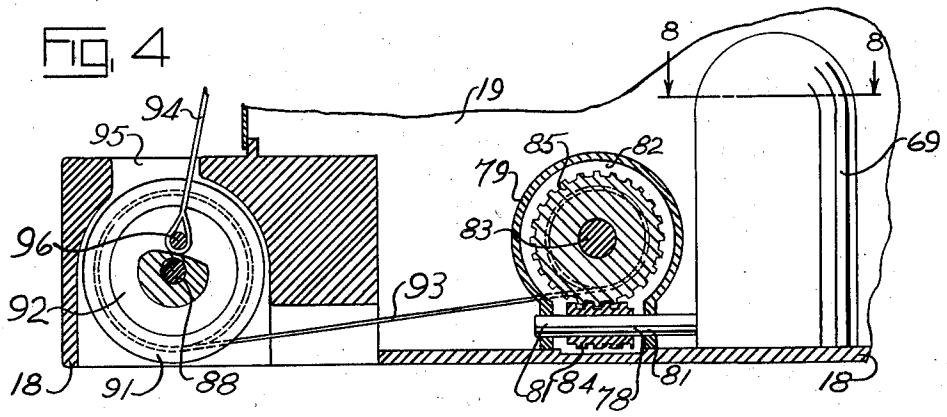


Fig. 5

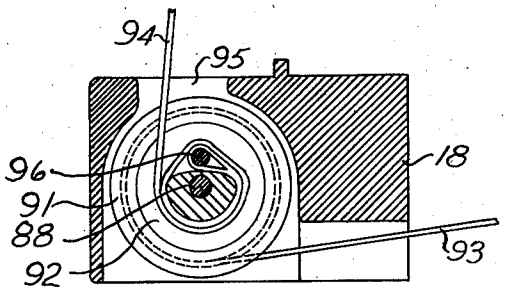
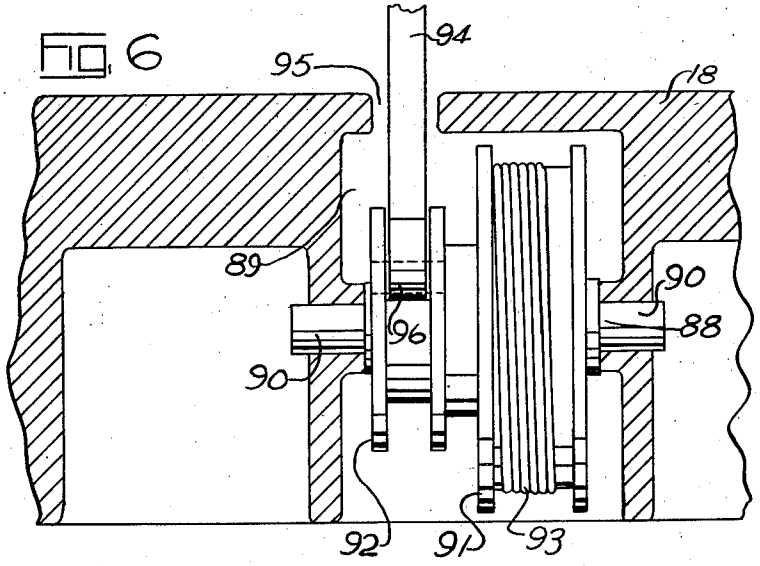


Fig. 6



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FIG. 7

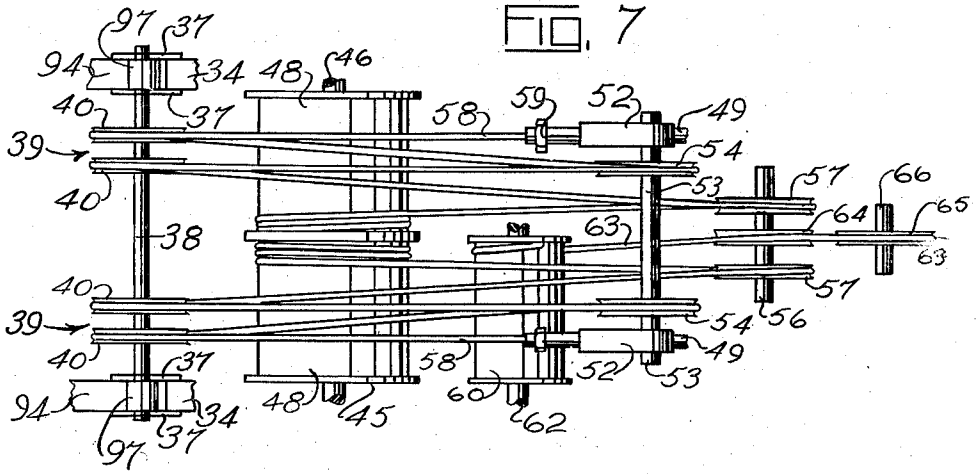


FIG. 9

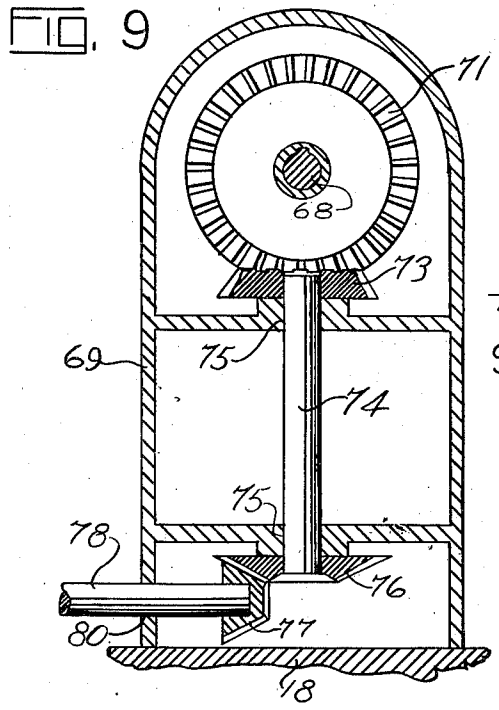
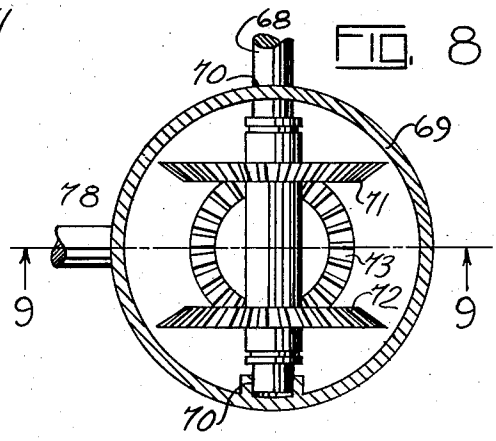


FIG. 8



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UNITED STATES PATENT OFFICE

2,189,212

CRANE

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Application August 1, 1938, Serial No. 222,416

22 Claims. (Cl. 212—59)

This invention relates to a crane or like machine of the character adapted to travel over the ground, or on rails, and equipped with mechanism for hoisting, swinging and/or excavating, etc.

The broad object of the invention is to provide a crane, or like machine, which will include a collapsible mast or strut adapted to be lowered or depressed when lowering or depressing of the collapsible mast or strut is necessary or desirable, as, for example, when the crane, or like machine, desirably should be made to pass under an overhead clearance lower or less than the overall height of the mast or strut of said crane when positioned for most satisfactory and efficient operation of the boom of the crane, or when the crane, or like machine, is to be shipped either for freight or truck or transported under its own power.

Although the principles of the invention are applicable to any crane, or like machine, of the general nature as hereinbefore briefly set forth, in the disclosure as made the crane includes a collapsible high mast or strut primarily or more particularly designed to render the crane useful to the accomplishment of erection work. Occasionally, when a crane now of commerce including a permanent high mast is employed to the accomplishment of erection work, overhead clearances beneath which the crane is required to travel are too low to allow passage of the permanent high mast of said crane. On erection jobs or work long booms are ordinarily preferable and are sometimes necessary, and when a long boom is employed it is quite desirable that a high mast also be utilized, both to the purpose that the mast will be at more advantageous lifting relation with respect to the boom so that the portion of the weight of the boom required to be supported by the mast will be reduced and to the purpose that the tension on the boom suspension will be reduced. Needless to say, a crane useful for erection work and including a permanent high mast usually has overall height too great to be shipped or transported with its mast applied. Rather, it is customary to ship or transport cranes, or like machines, of the present general character with their masts detached, the masts being erected to their working positions after the cranes, or like machines, have reached the locations where they are to be put to use.

More explicitly, it is an object of the invention to provide a crane, or like machine, which will usually include a comparatively high collapsible mast or strut adapted to be lowered or depressed on the job, as when it is desirable to move the crane under or past an overhead obstruction, or adapted to be lowered or depressed when the crane is to be shipped or transported under its own power.

A further object is to provide a crane, or like machine, which will include a collapsible mast or strut adapted to be lowered or depressed when this is intentional in very simple and easy manner and without removal of the collapsible mast or strut, or any part thereof, from the crane, or like machine.

A further object is to provide a crane, or like machine, which will include a collapsible mast or strut and mechanism for maintaining the collapsible mast or strut at any desired elevation which in a particular instance may be selected.

A further object is to provide a crane, or like machine, which will include a collapsible mast or strut and mechanism for adjusting the collapsible mast or strut vertically, upwardly and downwardly, upon the crane and for maintaining said collapsible mast or strut at any selected elevation to which it may be adjusted, including a completely collapsed position for the mast or strut, as, for example, a horizontal position upon the customary cab of said crane, or like machine.

And a further object is to provide a crane, or like machine, which will include a collapsible or movable mast or strut and novel and improved mechanism for adjusting the collapsible or movable mast or strut vertically, upwardly and downwardly, upon the crane and for maintaining said collapsible or movable mast or strut at any selected elevation to which adjusted.

With the above objects in view, as well as others which will appear as the specification proceeds, the invention comprises the construction, arrangement and combination of parts as now to be fully described and as hereinafter to be specifically claimed, it being understood that the disclosure herein is merely illustrative and intended in no way in a limiting sense, changes in details of construction and arrangement of parts being permissible so long as within the spirit of the invention and the scope of the claims which follow.

In the accompanying drawings forming a part of this specification,

Fig. 1 is a side elevational view of a crane made according to the invention;

Fig. 2 is an enlarged sectional plan view of the crane of Fig. 1, parts being omitted and broken away;

Fig. 3 is a plan view, on the scale of Fig. 2, of a collapsible or movable mast or strut of the crane of Fig. 1;

Fig. 4 is an enlarged sectional view, taken on line 4—4 in Fig. 2;

Fig. 5 is a sectional view corresponding with the disclosure of Fig. 4 but showing operating mechanism for the collapsible mast or strut of the crane as when said mast or strut is in a lowered position;

Fig. 6 is an enlarged sectional view, taken on line 6—6 in Fig. 2;

Fig. 7 is a diagrammatic view in plan detailing features of the crane;

Fig. 8 is an enlarged sectional view, taken on line 8—8 in Fig. 4;

Fig. 9 is a sectional view, taken as on line 9—9 in Fig. 8; and

Fig. 10 is a fragmentary side elevational view of a crane including a collapsible mast or strut made according to the invention and controlled in a manner different from that in which the collapsible mast or strut of the crane of Fig. 1 is manipulated.

With respect to the drawings and the numerals of reference thereon, the crane, or like machine, as disclosed includes a tractor 15 of ordinary or preferred construction having a body 16 and a tread 17. The tractor 15 is adapted to be propelled in ordinary or preferred manner forming no part of the invention. Insofar as the novel and improved crane here presented is concerned, the tractor 15 could as well be a car body or truck.

Said tractor or equivalent 15 supports a platform or deck 18 which is rotatable upon the tractor in a customary or preferred way also forming no part of the invention. The rotatable platform or deck 18 comprises the floor or base of a cab 19 of the crane.

A boom upon the rotatable platform or deck 18, which boom may be of usual construction, is designated 20, and is pivoted upon an end portion of the rotatable platform or deck as at 21.

The cab 19 supports a collapsible or movable mast or strut, denoted generally at 22. Said mast or strut 22 is of the novel and improved construction and is mounted upon the crane in the novel and improved manner as now to be described.

Spaced apart, longitudinally extending frame members of the mast or strut 22 are represented 23, and spaced apart, transversely extending frame members of said mast or strut are indicated 24. The longitudinal frame members 23 and the transverse frame members 24 are interconnected to provide a rectilinear structure or frame which is reinforced by gusset members 25 at the locations of jointure of the longitudinal and transverse frame members and is also reinforced by oblique strengthening members 26. All of the longitudinal frame members 23, the transverse frame members 24, the gusset members 25 and the oblique strengthening members 26 are welded, or otherwise secured, into an integral construction.

The inner or lower end of the collapsible mast or strut 22 includes spaced apart sets 27 of integral arms extending away from said inner or lower end of the frame of said mast or strut and alined with the longitudinal frame members 23 thereof. More explicitly, each set 27 of arms includes spaced apart arms 28 integral with the inner or lower transverse frame member 24 and alined with and constituting an extension of a longitudinal frame member 23. The cab 19 includes spaced apart sets 29 of arms integral with and upstanding from upper portions of the side walls of said cab. More explicitly, each set 29 of arms includes spaced apart arms 30 integral with the upper marginal portions of a side wall of the cab and disposed between spaced apart arms 28 at the same side of the collapsible mast or strut 22. The arms 28 and 30 include overlapping parts thereof in a vertical plane passed transversely through the cab 19 and parallel to the axis 21 for the boom, and said arms 28 and 30 are situated at the side of the boom axis opposite the boom, or rearwardly of said boom, desirably in considerably spaced relation to said boom axis.

A transverse shaft 31 having its opposite end portions mounted in openings through said overlapping parts of the arms 28 and 30 of the different sets 27 and 29 of arms constitutes means pivotally supporting the collapsible mast or strut upon the cab 19 of the crane. Said mast or strut extends rearwardly of the cab from its axis 31 and is disposed obliquely upwardly when in use and horizontally as shown when completely collapsed.

The transverse shaft 31 supports spaced apart rollers 32 for a purpose to be set forth. A transverse shaft 33, situated in spaced relation to the transverse shaft 31, has its opposite end portions mounted in outer or upper extensions 34 of the longitudinal frame members 23, at the rear of the rear transverse frame member 24, and said transverse shaft 33 supports spaced apart rollers 35, including a roller 35 in alinement longitudinally of the collapsible mast or strut 22 with each roller 32 upon the transverse shaft 31. The rollers 35 are for the same general purpose as are the rollers 32.

The outer or upper end of the collapsible mast or strut includes spaced apart sets 36 of integral arms extending away from the outer or upper ends of the extensions 34 and alined with the longitudinal frame members 23 and the sets 27 and 29 of arms. More explicitly, each set 36 of arms includes spaced apart arms 37 integral with the outer or upper end of the extension 34 alined therewith and also alined with the corresponding longitudinal frame member 23.

A transverse shaft 38 has its opposite end portions mounted in openings through the arms 37 of the different sets 36 of arms, and said transverse shaft 38 supports spaced apart sets 39 of sheaves 40, each set 39 of sheaves including a pair of sheaves 40 in alinement longitudinally of the collapsible mast or strut 22 with a roller 32 upon the transverse shaft 31 and with a roller 35 upon the transverse shaft 33. Cable guards, one for the sheaves 40 of each set 39 of sheaves, are designated 41.

The rotatable platform or deck 18 suitably supports a power plant or prime mover, which is as disclosed constituted as an internal combustion engine 42. The internal combustion engine includes a driven shaft 43 which drives gearing (not shown) included in a gear casing 44.

A double-drum 45 for manipulating the boom 20 is conveniently mounted upon the rotatable platform or deck 18 and is suitably actuatable, independently of other mechanism of the machine, through the instrumentality of a rotatable shaft 46 which is adapted to be driven by mechanism within the gear casing 44. A brake of usual construction for the double-drum 45 is denoted 47. Said double-drum 45 is constituted as a pair

of rigidly connected, axially alined drums, each designated 48, which extend transversely of the rotatable platform or deck, including a drum 48 substantially in alinement longitudinally of said rotatable platform or deck with each set 39 of sheaves 40. The double-drum 45 including the axially alined drums 48, 48 is as disclosed situated in spaced relation to the axis 21 for the boom 20 and near and below the axis 31 for the collapsible mast or strut 22. The boom manipulating double-drum 45 may desirably be of that type known as high speed boom hoists for raising and lowering the boom.

Short cables 49, one at each side of the boom and only one cable 49 being shown, have their outer ends secured to the boom point as at 50. The inner ends of the cables 49 are suitably secured, as at 51, to spaced apart plate members 52, including a plate member 52 adjacent each side of the machine. A transverse shaft 53 having its opposite end portions mounted in said plate members 52 supports spaced apart sheaves 54, including a sheave 54 substantially in alinement longitudinally of the crane with each set 39 of sheaves 40.

An intermediate portion of the boom 20 supports spaced apart plates 55, only one plate 55 being disclosed. In turn, said plates 55 support a short transverse shaft 56, and the shaft 56 supports spaced apart sheaves 57, including a sheave 57 in substantial alinement longitudinally of the crane with each drum 48 of the double-drum 45.

Duplicate cables 58 are for the purpose of accomplishing hoisting or raising and lowering operations of the boom 20. As disclosed, each cable 58 has one of its ends suitably secured to one of the alined drums 48 of the double-drum 45. Thence each cable 58 extends upwardly from its drum 48 about the sheave 57 alining with said drum. Thence each cable 58 extends about a sheave 40 of the set 39 of sheaves at the corresponding side of the machine. Thence each cable 58 extends about the sheave 54 at the corresponding side of the machine. Thence each cable 58 extends about the other sheave 40 of the set 39 of sheaves at the corresponding side of the machine, and the end of each cable 58 opposite the end thereof secured to a drum 48 is attached, as at 59, to the plate member 52 at the corresponding side of the machine.

A single drum 60 for manipulating a hoisting hook 61, or other member substituted for said hoisting hook to the accomplishment of the like or a different purpose, is conveniently mounted upon the rotatable platform or deck 18 and is suitably actuatable, also independently of other mechanism of the machine, through the instrumentality of a rotatable shaft 62 which is adapted to be driven by mechanism within the gear casing 44. A cable 63 has its inner end attached to the drum 60 and leads from said drum over a middle sheave 64 upon the shaft 56 and over a sheave 65 upon a shaft 66, which shaft 66 is suitably mounted in the upper or outer end portion of the boom, to said hoisting hook 61. A brake for the single drum 60 is represented 67.

The machine includes mechanism through the instrumentality of which the collapsible mast or strut 22 can be swung vertically, upwardly and downwardly, about its axis 31 and can be maintained at any oblique position or elevation to which it may be adjusted against the action of the weight of the boom, which will, when said boom is supported from said collapsible mast or strut by means of the duplicate cables 58, have tendency toward swinging the collapsible mast or strut upwardly and forwardly. Said mechanism includes provision for causing the mast or strut 22 to be completely collapsed when this is intentional, to a horizontal position in the disclosed embodiment, as when the duplicate cables 58 are slack and the boom 20 is in a lowered position and is not being supported by said cables 58.

The mechanism for manipulating the collapsible mast or strut includes a rotatable horizontal shaft 68 adapted to be driven in a single direction by gearing in the gear casing 44. A vertical dome shape housing 69 is suitably supported upon the rotatable platform or deck 18 and is as shown situated between the internal combustion engine 42 and the double-drum 45. The driven shaft 68 has its outer portion conveniently mounted, as at 70, in side walls of the dome shape housing 69, and said shaft 68 suitably supports oppositely disposed bevel gears, represented 71 and 72, respectively, each normally loose on the driven shaft 68. Each bevel gear 71 and 72 is in mesh with a bevel gear 73 fixed upon the upper end of a vertical shaft 74 mounted in bearings 75 at the interior of the housing 69 and supported by said housing. The lower end of said vertical shaft 74 fixedly carries a bevel gear 76 which meshes with a pinion 77 fixed upon a horizontal shaft 78 which extends outwardly from the housing 69 through a lower portion of a wall of said housing and enters the lower portion of a second, smaller housing 79. As disclosed, the horizontal shaft 78 is mounted, as at 80, in a wall of the housing 69 and is mounted, as at 81, in spaced apart, parallel walls of the smaller housing 79. The horizontal shaft 78 extends longitudinally of the rotatable platform or deck 18 in direction away from the double-drum 45 and toward the internal combustion engine 42.

The second, smaller housing 79 is of general cylindrical shape at location above the horizontal shaft 78 and includes spaced apart, parallel, vertical end walls 82 which are disposed longitudinally of the rotatable platform or deck. A horizontal transverse shaft 83 has an intermediate portion thereof rotatably mounted in said end walls 82 of said housing 79 and opposite end portions of the horizontal transverse shaft 83 extend considerable distances outwardly beyond the end walls 82. A worm 84 fixed upon the horizontal shaft 78 and situated within the housing 79 meshes with a worm gear 85 fixed upon the horizontal transverse shaft 83 and also situated within said housing 79, above said worm 84.

The opposite ends of the horizontal transverse shaft 83 are rotatably mounted in spaced apart bearings 86 upon the rotatable platform or deck 18, and adjacent each bearing 86 said shaft 83 fixedly carries a drum 87. That is to say, spaced apart drums, each denoted 87, are fixedly secured upon the shaft 83, including a drum 87 adjacent each side of the rotatable platform or deck 18.

A pair of spaced apart, horizontal transverse shafts, each denoted 88, including a shaft 88 adjacent each side of the rotatable platform or deck 18 and adjacent the end of said platform or deck opposite the boom 20, are mounted in the platform or deck as best disclosed in

Fig. 6. That is, said platform or deck includes cut-away portions 89, one surrounding or housing each shaft 88, and the opposite ends of each of said shafts 88 are mounted, as at 90, in spaced apart bearings which the platform or deck provides or supplies.

Each shaft 88 supports a drum unit consisting of a larger drum 91 and a smaller drum 92 integral with each other and adapted to be rotated together. More explicitly, there are two larger drums 91, one upon each shaft 88 and in alinement longitudinally of the rotatable platform or deck 18 with a drum 87, and there are two smaller drums 92, one integral with each larger drum 91 at the outer side thereof as shown. The construction incorporates two cables 93, including a cable 93 extending between drums 87 and 91 at each side of the machine and having its opposite ends, respectively, secured to said drums.

Each smaller drum 92 is substantially in the vertical plane of a set 36 of arms 37 upon the outer or upper end of an extension 34 of a longitudinal frame member 23 of the collapsible mast or strut, and the construction incorporates two cables 94, including a cable 94 extending upwardly through each of two clearance slots 95 in the rotatable platform or deck 18, including a clearance slot 95 above each smaller drum 92, from said smaller drum. The lower end of each cable 94 is secured, as at 96, to its corresponding drum 92, and the upper end of each cable 94 is secured, as at 97, to a portion of the shaft 38 located between the spaced apart arms 37 at the same side of the machine. The cables 94 may desirably be flat. For instance, they could be braided cables, so-called. The end of each cable 94 secured to each smaller drum 92, as well as the end of each cable 94 secured to the shaft 38, can be fastened in any ordinary or preferred manner, as by splicing the end to be attached of the cable and looping said end about the part to which it is to be secured.

The collapsible mast or strut disclosed in Fig. 10 may be of the construction as already set forth and similarly mounted upon the cab 19. In the present instance, however, the mechanism before described for manipulating said collapsible mast or strut is omitted. Instead, each of two single limit cables 98, only one being shown, has its lower end secured, as at 99, to a portion of the rotatable platform or deck below the collapsible mast or strut and its upper end secured, as at 100, to the upper or outer sheave axle, such as 38, of said collapsible mast or strut.

A pair of clutches (not shown) are for the purpose of separately clutching the bevel gears 71 and 72 to the driven shaft 68. The clutching arrangement will be such that both of the bevel gears 71 and 72 will be loose upon said shaft 68, or either said bevel gear 71 or said bevel gear 72, but not both of the bevel gears at once, will be clutched to the shaft 68. Evidently, when the bevel gear 71 is clutched to said driven shaft 68 and said shaft is rotated the bevel gear 73, with the parts driven thereby, will be rotated in one direction, and when the bevel gear 72 is clutched to said driven shaft 68 and the shaft is rotated said bevel gear 73, with the parts driven thereby, will be rotated in opposite direction. Rotation of the larger drums 91, 91, and with them the smaller drums 92, 92, obviously will cause the collapsible mast or strut to be swung downwardly, through the instrumentality of the cables 94, when said drums 91, 91 and 92, 92 are rotated in direction to cause said cables 94 to be wound upon the drums 92, and rotation of the drums 91, 91 and 92, 92 will allow the weight of the boom 20 when suspended from said collapsible mast or strut to cause the mast or strut to be swung upwardly when said drums are rotated in direction to cause the cables 94 to be unwound from said drums 92. Evidently, the worm and worm gear drive, including the worm 84 and the worm gear 85, will cause the collapsible mast or strut 22 to be maintained at any oblique position or elevation to which adjusted against the action of the weight of the boom when suspended from said collapsible mast or strut tending to cause the mast or strut to be swung upwardly toward vertical position. Stated differently, the weight of the boom when suspended from the collapsible mast or strut 22 by the cables 58 has tendency toward swinging said collapsible mast or strut upwardly, said weight of the boom thus causing the cables 94, 94 to be taut, and the worm and worm gear drive, which controls said collapsible mast or strut 22 through the instrumentality of the shaft 83, the drums 87, the cables 93, the drums 91 and 92 and the cables 94, maintains the collapsible mast or strut at adjusted position or elevation against the tendency of the weight of the boom to swing said collapsible mast or strut upwardly and forwardly.

With the collapsible mast or strut at fixed oblique position or elevation, it will be evident that rotation of the double-drum 45 in one direction will cause the boom to be raised by shortening of the cables 58, and that rotation of said double-drum in opposite direction will permit said boom to be lowered by lengthening of said cables 58. It is the purpose of the rollers 32, 32 and 35, 35 to protect or guard the cables 58, both when the collapsible mast or strut 22 is in working position and is in collapsed position. In dotted lines in Fig. 1 said collapsible mast or strut is shown in collapsed position, down against the top or upper portion of the cab 19.

It will be apparent that by rotation of the smaller drums 92 in one direction the collapsible mast or strut 22 will be swung downwardly to cause the boom when suspended from said mast or strut to be swung upwardly, when the length of each cable 58 remains fixed, and that by rotation of said smaller drums in opposite direction said collapsible mast or strut will be swung upwardly due to downward swinging movement of said boom when suspended from the collapsible mast or strut.

The crane as illustrated and described can be operated in various manners when in use. When the machine approaches an overhead clearance which is too low for passage of the collapsible mast or strut, this latter readily can be lowered in the manner as set forth, and after the overhead obstruction is passed said collapsible mast or strut just as readily can be again raised. When the crane or machine is to be shipped the boom 20 can be lowered by lengthening of the cables 58 to cause said boom to rest upon the floor of a freight car or truck, and, with said cables 58 slack, the collapsible mast or strut 22 will be or can be moved or collapsed down against the top of a cab, such as 19, or other structure, as said boom and said mast or strut are disclosed in dotted lines in Fig. 1, and retained in collapsed position. When the crane or machine is to be transported under its own power, the boom 20 and the collapsible mast or strut 22 can, obviously, each be situated at any desired higher or lower elevation.

While the structure disclosed in Fig. 10 does not include mechanism for manipulating the collapsible mast or strut, said structure does include means for controlling said collapsible mast or strut by maintaining it at desired elevated oblique position when in use and at collapsed position when this is intentional. That is to say, the limit line cables 98 maintain the collapsible mast or strut in proper elevated oblique position when supporting the boom of the crane, and said collapsible mast or strut is adapted to fall by gravity to the upper surface or top of the cab, such as 19, or other structure, when cables, such as 58, for supporting said boom from the collapsible mast or strut are caused to be slack while the boom is supported independently of the mast or strut, as by the floor of a freight car or truck or by the ground.

What is claimed is:

1. A crane comprising a supporting structure adapted to be propelled, a boom pivotally mounted upon said supporting structure and extending therefrom normally in oblique relation to the ground, a mast having an inner portion thereof pivotally secured to said supporting structure and an outer portion thereof normally in oblique relation to the ground and slanting upwardly in direction away from said boom, a boom suspension for supporting an outer portion of said boom from an outer portion of said mast, means between said supporting structure and an outer portion of said mast for accomplishing vertical swinging adjustment of said mast and for maintaining the mast at fixed oblique elevation, and mechanism upon said supporting structure for manipulating said means.

2. A crane comprising a supporting structure adapted to be propelled, a boom pivotally mounted upon said supporting structure and extending therefrom normally in oblique relation to the ground, a mast having an inner portion thereof pivotally secured to said supporting structure and an outer portion thereof normally in oblique relation to the ground and slanting upwardly in direction away from said boom, a boom suspension constituted as a cable extending between an upper portion of said mast and an upper portion of said boom for supporting the boom from the mast, and means secured to an outer portion of said mast and including a worm and worm gear drive for accomplishing vertical swinging adjustment of said mast and for maintaining the mast at fixed oblique elevation.

3. A crane comprising a supporting structure adapted to be propelled, a boom pivotally mounted upon said supporting structure and extending therefrom normally in oblique relation to the ground, a mast having an inner portion thereof pivotally secured to said supporting structure and an outer portion thereof normally in oblique relation to the ground and slanting upwardly in direction away from said boom, a boom suspension constituted as a cable extending between an upper portion of said mast and an upper portion of said boom for supporting the boom from the mast, and means for accomplishing vertical swinging adjustment of said mast and for maintaining the mast at fixed oblique elevation, said means including a drum carried by said supporting structure and adapted to be rotated selectively in either direction, a cable secured to said drum and to an outer portion of said mast, and mechanism for maintaining said drum at any position to which turned against tendency of the weight of said boom to cause the drum to be rotated.

4. A crane comprising a supporting structure adapted to be propelled, a boom pivotally mounted upon said supporting structure and extending therefrom normally in oblique relation to the ground, a mast having an inner portion thereof pivotally secured to said supporting structure and an outer portion thereof normally in oblique relation to the ground and slanting upwardly in direction away from said boom, a boom suspension constituted as a cable extending between an upper portion of said mast and an upper portion of said boom for supporting the boom from the mast, and means for accomplishing vertical swinging adjustment of said mast and for maintaining the mast at fixed oblique elevation, said means including a drum carried by said supporting structure and adapted to be rotated selectively in either direction, a cable secured to said drum and to an outer portion of said mast, and mechanism including a worm and worm gear drive for maintaining said drum at any position to which turned against tendency of the weight of said boom to cause the drum to be rotated.

5. A crane comprising a supporting structure adapted to be propelled, a boom pivotally mounted upon said supporting structure and extending therefrom normally in oblique relation to the ground, a mast having an inner portion thereof pivotally secured to said supporting structure and an outer portion thereof normally in oblique relation to the ground and slanting upwardly in direction away from said boom, a boom suspension constituted as a cable extending between an upper portion of said mast and an upper portion of said boom for supporting the boom from the mast, and means for accomplishing vertical swinging adjustment of said mast and for maintaining the mast at fixed oblique elevation, said means including a drum carried by said supporting structure and adapted to be rotated selectively in either direction, a cable secured to said drum and to an outer portion of said mast, a second, larger drum rigid and alined with said drum, a third drum, a cable secured between said second and third drums, and mechanism including a worm and worm gear drive for maintaining all of said drums in fixed position against tendency of the weight of the boom to cause the drums to be rotated.

6. A crane comprising a supporting structure, a boom pivotally mounted upon said supporting structure and extending therefrom normally in oblique relation to the ground, a mast having an inner portion thereof pivotally secured to said supporting structure and an outer portion thereof normally in oblique relation to the ground and slanting upwardly in direction away from said boom, a boom suspension for supporting an outer portion of said boom from an outer portion of said mast, and means between said supporting structure and an outer portion of said mast and including a worm and gear connection for accomplishing vertical adjustment of said mast and for maintaining the mast at fixed oblique elevation.

7. In a machine of the character described, a supporting structure, a boom pivotally mounted upon said supporting structure and extending therefrom, a mast pivotally mounted upon said supporting structure at location in spaced relation to the boom, said mast and boom being in angular relation to each other and inner portions of the mast and boom being closer to-

gether than are outer portions of said mast and boom, means spaced from said inner portions of the mast and boom supporting the boom from the mast, means for accomplishing vertical swinging movement of said mast and for maintaining said mast at any selected one of a plurality of different oblique positions, and mechanism upon said supporting structure for manipulating said means.

8. In a machine of the character described, a supporting structure, a boom pivotally mounted upon said supporting structure and extending therefrom, a mast pivotally mounted upon said supporting structure at location in spaced relation to the boom, said mast and boom being in spaced angular relation to each other and inner portions of the mast and boom being closer together than are outer portions of the mast and boom, means spaced from said inner portions of the mast and boom suspending the boom from the mast, and means including a worm and gear connection for accomplishing vertical swinging movement of the mast.

9. In a machine of the character described, a supporting structure, a boom pivotally mounted upon said supporting structure and extending therefrom, a mast pivotally mounted upon said supporting structure at location in spaced relation to the boom, said mast and boom being in angular relation to each other and inner portions of the mast and boom being closer together than are outer portions of said mast and boom, means spaced from said inner portions of the mast and boom suspending the boom from the mast, and means including a worm and gear drive for accomplishing vertical swinging adjustment of said mast and for maintaining the mast at fixed oblique elevation.

10. In a machine of the character described, a supporting structure, a boom pivotally mounted upon said supporting structure, a mast pivotally mounted upon said supporting structure, said mast and said boom being in angular relation to each other and inner portions of the mast and boom, respectively, being in closer relation to each other than are outer portions of said mast and boom, respectively, and said mast normally slanting obliquely upwardly in direction away from its pivotal support and away from said boom, a boom suspension constituted as a cable extending between sheaves upon outer portions of said mast and said boom, respectively, for supporting the boom from the mast, said boom being adapted to be released from supported relation to said mast as by lengthening of said cable, and means including a worm and gear connection for maintaining the mast while slanting obliquely upwardly from the boom at fixed elevation against tendency of the weight of said boom when suspended from the mast toward causing said mast to be swung upwardly toward said boom, said mast being movable to lowered position upon release of said boom from supported relation to the mast.

11. In a machine of the character described, a supporting structure, a boom pivotally mounted upon said supporting structure, a mast pivotally mounted upon said supporting structure, said mast and said boom being in angular relation to each other and inner portions of the mast and boom, respectively, being in closer relation to each other than are outer portions of said mast and boom, respectively, and said mast normally slanting upwardly in direction away from said boom, a boom suspension between outer portions of said mast and said boom for supporting the boom from the mast, and means including a worm and gear connection for accomplishing vertical swinging adjustment of said mast and for maintaining the mast at fixed elevation against tendency of the weight of said boom when suspended from the mast toward causing said mast to be swung in direction toward said boom.

12. In a machine of the character described, a supporting structure, a boom pivotally mounted upon said supporting structure, a mast pivotally mounted upon said supporting structure, said mast and said boom being in angular relation to each other and inner portions of the mast and boom, respectively, being closer together than are outer portions of said mast and boom, respectively, and said mast normally slanting obliquely upwardly in direction away from its pivotal support and away from said boom, a boom suspension constituted as a cable extending between sheaves upon outer portions of said mast and said boom, respectively, for supporting the boom from the mast, said boom being adapted to be released from supported relation to said mast as by lengthening of said cable, and means including a worm and gear drive for accomplishing vertical swinging adjustment of said mast and for maintaining the mast while slanting obliquely upwardly from the boom at fixed elevation against tendency of the weight of said boom when suspended from the mast toward causing said mast to be swung upwardly toward said boom, said mast being movable to lowered position upon release of said boom from supported relation to the mast.

13. A crane comprising a supporting structure adapted to be propelled, a boom pivotally mounted upon said supporting structure and extending therefrom normally in oblique relation to the ground, a mast having an inner portion thereof pivotally secured to said supporting structure and an outer portion thereof normally in oblique relation to the ground and slanting upwardly in direction away from said boom, a boom suspension constituted as a cable extending between an upper portion of said mast and an upper portion of said boom for supporting the boom from the mast, means secured to said mast for accomplishing vertical swinging adjustment of said mast and for maintaining the mast at any selected one of a plurality of different oblique positions, and mechanism upon said supporting structure for manipulating said means.

14. A crane comprising a supporting structure adapted to be propelled, a boom pivotally mounted upon said supporting structure and extending therefrom normally in oblique relation to the ground, a mast having an inner portion thereof pivotally secured to said supporting structure and an outer portion thereof normally in oblique relation to the ground and slanting upwardly in direction away from said boom, a boom suspension for supporting an outer portion of said boom from a portion of said mast, and means including a connecting line between said supporting structure and said mast and devices upon the supporting structure for manipulating said connecting line for accomplishing vertical swinging adjustment of said mast and for maintaining the mast at fixed oblique elevation.

15. A crane comprising a supporting structure adapted to be propelled, a boom pivotally mounted upon said supporting structure and extending therefrom normally in oblique relation to the ground, a mast having an inner portion thereof

pivotally secured to said supporting structure and an outer portion thereof normally in oblique relation to the ground and slanting upwardly in direction away from said boom, a boom suspension constituted as a cable extending between said mast and said boom for supporting the boom from the mast, and means secured to an outer portion of said mast and including a take-up and let-out device for accomplishing vertical swinging adjustment of said mast and for maintaining the mast at fixed oblique elevation.

16. A crane comprising a supporting structure a boom pivotally mounted upon said supporting structure and extending therefrom normally in oblique relation to the ground, a mast having an inner portion thereof pivotally secured to said supporting structure and an outer portion thereof normally in oblique relation to the ground and slanting upwardly in direction away from said boom, a boom suspension for supporting an outer portion of said boom from an outer portion of said mast, and means between said supporting structure and an outer portion of said mast and including a flexible connecting line and devices for manipulating said connecting line for accomplishing vertical adjustment of said mast and for maintaining the mast at fixed oblique elevation.

17. In a machine of the character described, a supporting structure, a boom pivotally mounted upon said supporting structure and extending therefrom, a mast pivotally mounted upon said supporting structure at location in spaced relation to the boom, said mast and boom being in angular relation to each other and inner portions of the mast and boom being closer together than are outer portions of said mast and boom, means spaced from said inner portions of the mast and boom supporting the boom from the mast, and mechanism for accomplishing vertical swinging movement of said mast and for maintaining said mast at any selected one of a plurality of different oblique positons, said mechanism being constituted as a flexible connecting means between said supporting structure and a portion of said mast spaced from the supporting structure and devices upon the supporting structure for manipulating said flexible connecting means.

18. In a machine of the character described, a supporting structure, a boom pivotally mounted upon said supporting structure and extending therefrom, a mast pivotally mounted upon said supporting structure at location in spaced relation to the boom, said mast and boom being in spaced angular relation to each other and inner portions of the mast and boom being closer together than are outer portions of the mast and boom, means spaced from said inner portions of the mast and boom suspending the boom from the mast, and means including a take-up and let-out device upon said supporting structure for acomplishing vertical swinging adjustment of the mast and for maintaining said mast at any selected one of a plurality of different oblique positions.

19. In a machine of the character described, a supporting structure, a boom pivotally mounted upon said supporting structure, a mast pivotally mounted upon said supporting structure, said mast and said boom being in angular relation to each other and inner portions of the mast and boom, respectively, being in closer relation to each other than are outer portions of the mast and boom, respectively, and said mast normally slanting obliquely upwardly in direction away from its pivotal support and away from said boom, a boom suspension constituted as a cable extending between sheaves upon outer portions of said mast and boom, respectively, for supporting the boom from the mast, said boom being adapted to be released from supported relation to said mast as by lengthening of said cable, and means between said supporting structure and an outer portion of said mast and including a connecting line and devices for manipulating said connecting line for maintaining the mast while slanting upwardly from the boom at fixed elevation against tendency of the weight of said boom when suspended from the mast toward causing said mast to be swung upwardly toward said boom and for accomplishing vertical adjustment of said mast, said mast being movable to lowered position upon release of said boom from supported relation to the mast.

20. In a machine of the character described, a supporting structure, a boom pivotally mounted upon said supporting structure, a mast pivotally mounted upon said supporting structure, said mast and boom being in angular relation to each other and inner portions of the mast and boom, respectively, being in closer relation to each other than are outer portions of said mast and boom, respectively, and said mast normally slanting upwardly in direction away from said boom, a boom suspension between outer portions of said mast and boom for supporting the boom from the mast, and means between said supporting structure and an outer portion of said mast and including a connecting line and devices for manipulating said connecting line for accomplishing vertical swinging adjustment of said mast and for maintaining the mast at fixed elevation against tendency of the weight of said boom when suspended from the mast toward causing said mast to be swung in direction toward said boom.

21. In a machine of the character described, a supporting structure, a boom pivotally mounted upon said supporting structure, a mast pivotally mounted upon said supporting structure, said mast and said boom being in angular relation to each other and inner portions of the mast and boom, respectively, being closer together than are outer portions of said mast and boom, respectively, and said mast normally slanting obliquely upwardly in direction away from its pivotal support and away from said boom, a boom suspension constituted as a cable extending between sheaves upon outer portions of said mast and boom, respectively, for supporting the boom from the mast, said boom being adapted to be released from supported relation to said mast as by lengthening of said cable, and means between said supporting structure and an outer portion of said mast and including a connecting line and devices upon the supporting structure for manipulating said connecting line for accomplishing vertical swinging adjustment of said mast and for maintaining the mast while slanting obliquely upwardly from the boom at fixed elevation against tendency of the weight of said boom when suspended from the mast toward causing said mast to be swung upwardly toward said boom, said means being movable to lowered position upon release of said boom from supported relation to the mast.

22. A crane comprising a supporting structure adapted to be propelled, a boom pivotally mounted upon said supporting structure and ex-

tending therefrom normally in oblique relation to the ground, a mast having an inner portion thereof pivotally secured to said supporting structure and an outer portion thereof normally in oblique relation to the ground and slanting upwardly in direction away from said boom, a boom suspension constituted as a cable extending between an upper portion of said mast and an upper portion of said boom for supporting the boom from the mast, and means between said supporting structure and an outer portion of said mast and including a connecting line and devices upon the supporting structure for manipulating said connecting line for accomplishing vertical swinging adjustment of said mast and for maintaining the mast at any selected one of a plurality of different oblique positions.

ROLF E. LJUNGKULL.