May 9, 1944. H. N. EKBOM ET AL 2,348,285

RETRACTABLE MAST

Filed May 26, 1941 2 Sheets-Sheet 1

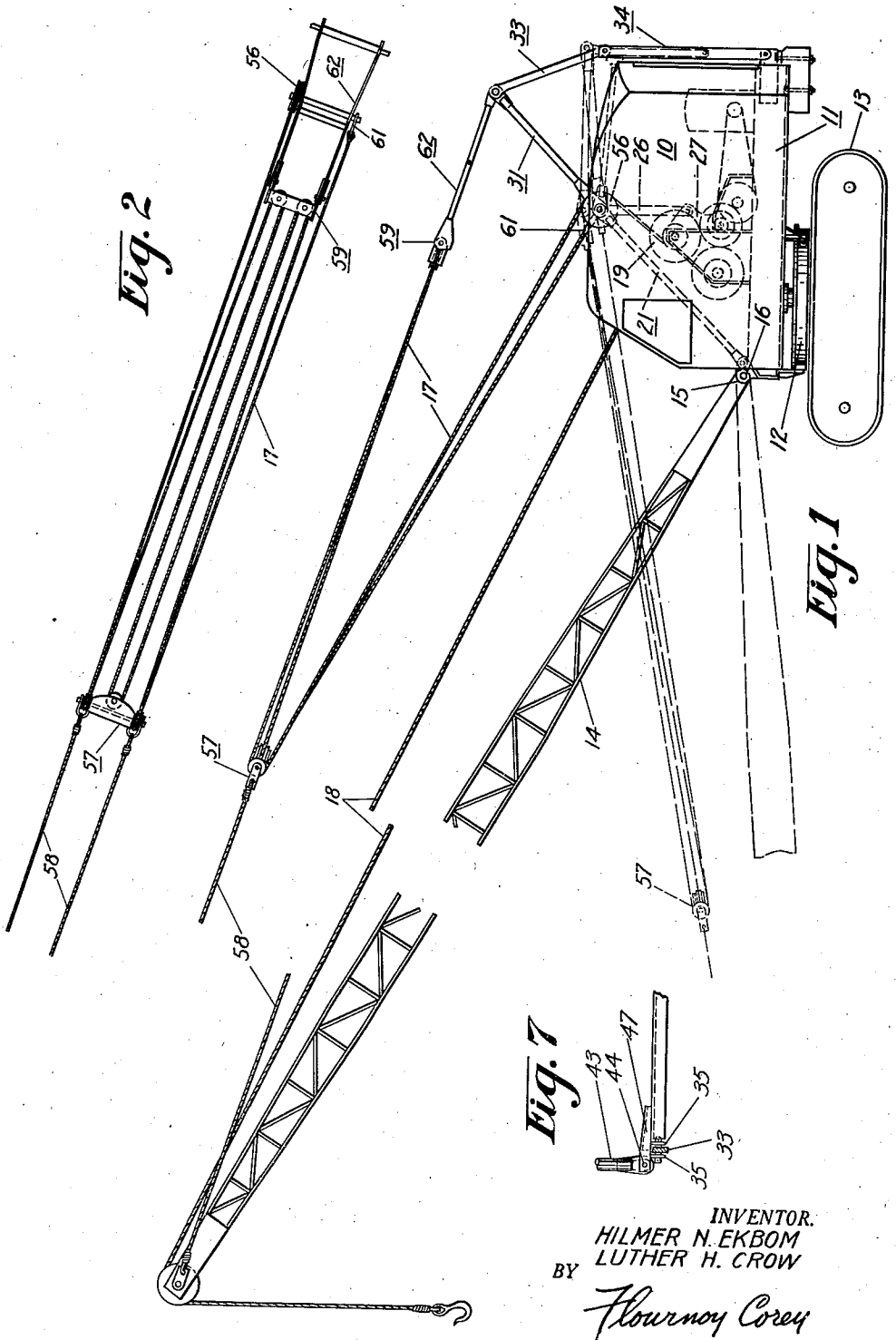


Fig. 2

Fig. 1

Fig. 7

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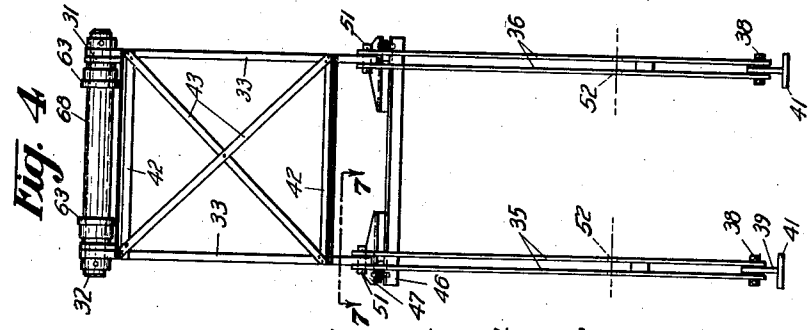


Fig. 4

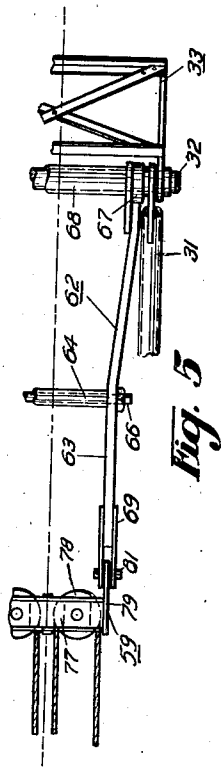


Fig. 5

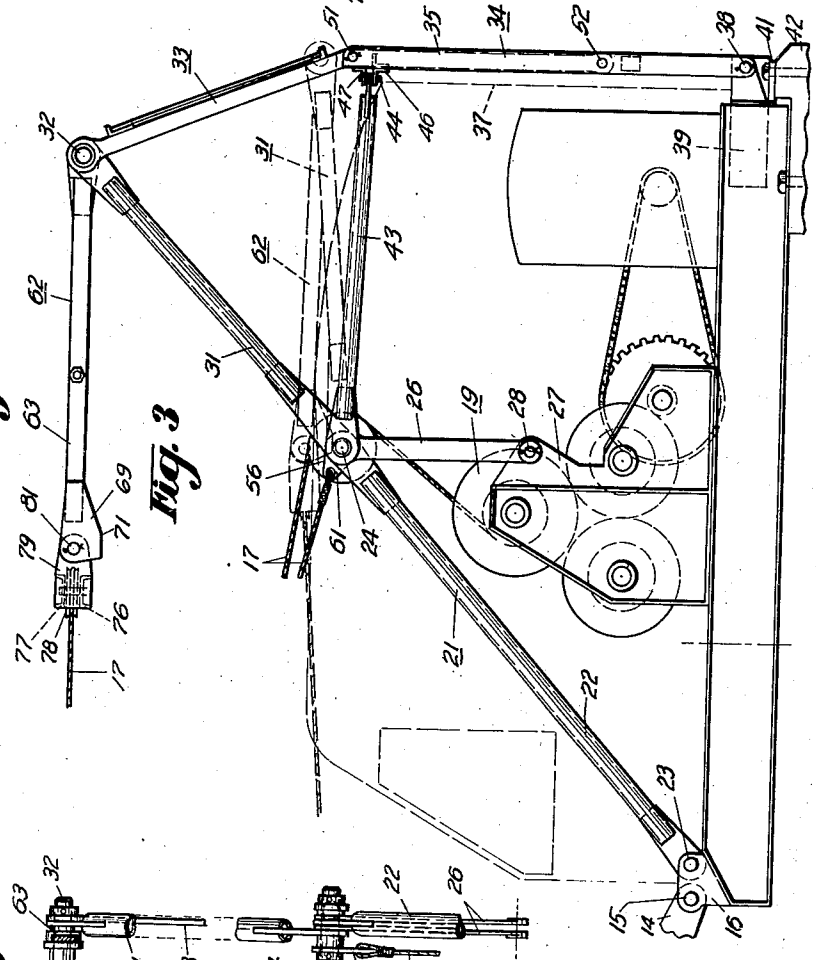


Fig. 3

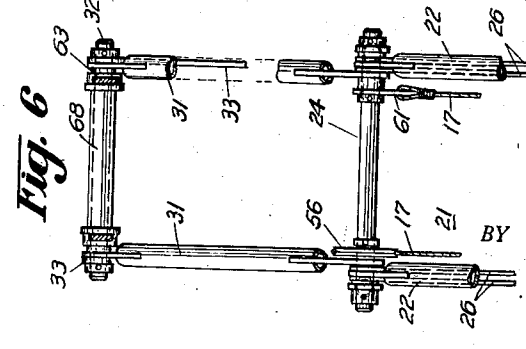


Fig. 6

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2,348,285

RETRACTABLE MAST

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Application May 26, 1941, Serial No. 395,260

3 Claims. (Cl. 212—59)

This invention relates to power driven cranes and shovels and the like, and has particular relation to a retractable mast for supporting the boom assembly of such devices.

In power driven devices such as lifting cranes, shovels, drag lines and the like in which a boom is pivotally mounted on the forward end of the frame of the device, it is the usual practice to raise and lower the boom by means of a boom hoist cable, operating over a plurality of sheaves to provide the required amount of lifting power, and extending between the outer end of the boom and a fixed anchor point in the framework of the body of the crane, which anchor point is disposed as high as possible above the supporting frame. It is the usual practice to place this fixed anchor point for the boom hoist cable as high as possible within the operator's cab of the crane, usually near the roof line thereof. Thus it will be seen that the angle of incidence between the hoisting cable and the boom hoist is usually limited by the height of the crane cab, and the smaller this angle is, the greater the strain on the boom hoist cable and the boom. Obviously the length of the boom and the load which may be safely carried by the outer end of the boom is determined by the load which the boom hoist cable and the boom may safely carry.

Fixed mast structures, extending well above the cab and providing an anchor point for the cable, have been employed for increasing this angle of the boom hoist cable relative to the boom in order to permit the use of longer booms and to increase the lifting capacity of the boom. Such fixed mast structures, however, are impractical and undesirable since it is usually necessary to entirely remove or dismount such a device from a crane before the crane can pass under bridges, viaducts or the like when it is being transported on the highway. This is, of course, a useless and time-consuming operation.

It is accordingly a general object of our invention to provide an improved mast structure for supporting the booms of cranes and the like.

It is another object of our invention to provide a retractable mast through which the boom hoisting cables may be reeved and secured, which mast may be extended any desired distance above the cab or frame of the vehicle and which may be quickly and easily folded or retracted to reduce the over-all height of the crane structure whereby it may be more readily transported from job to job.

It is another object of our invention to provide a retractable mast structure which may be readily and easily raised or lowered by means of the boom hoisting equipment and without the necessity of employing either auxiliary equipment or manual effort to place the mast in operative position.

It is a further object of our invention to provide a retractable mast of this nature which may be employed in supporting and raising or lowering the boom when the mast is in either its extended or lowered position.

Other and further features and objects of the invention will be more apparent to those skilled in the art upon a consideration of the accompanying drawings and following specifications, wherein is disclosed a single exemplary embodiment of the invention, with the understanding, however, that such changes may be made therein as fall within the scope of the appended claims, without departing from the spirit of the invention.

In said drawings:

Figure 1 is a general view in side elevation of a crane employing a retractable mast constructed in accordance with a preferred embodiment of our invention.

Figure 2 is a view in top elevation of a portion of the retractable mast assembly and illustrating, in particular, the method of rigging the boom hoist line. The view is taken from a plane extending parallel to the plane of the boom hoist lines rather than in a horizontal plane above the machine.

Figure 3 is a view in side elevation of the retractable mast structure and the means employed in mounting it upon the main frame of the crane.

Figure 4 is a view in rear end elevation of the structure shown in Figure 3.

Figure 5 is a fragmentary view in top elevation of the device shown in Figure 3 and illustrating, in particular, the bail to which the boom hoist cable is secured.

Figure 6 is a fragmentary view in front elevation of the device shown in Figure 3 illustrating, in particular, the relationship of the various members of the framework, and

Figure 7 is a fragmentary view, partly in top elevation and partly in section, of the retractable mast anchoring structure as taken on the line 7—7 of Figure 4.

Referring now to the drawings, and to Figure 1 thereof in particular; we have illustrated generally at 10 a power driven crane including a main framework or base 11 mounted for rotation on a turntable or bull ring 12, which turntable is mounted upon a sub-frame and endless or

caterpillar treads 13 in accordance with the usual practice. A boom 14 is pivotally mounted, as indicated at 15, in brackets 16 secured on the forward ends of the main frame members 11. Hoisting drums 19 for the boom-hoist cable 17 and the load hoisting cable 18 are mounted for rotation in a framework 27 which is secured to the main frame 11. The drive and control of these hoisting drums, as well as of the traction drive and steering mechanism, may be provided in any convenient or conventional manner.

The boom supporting mast comprises, in general, a permanent or fixed lower mast structure indicated generally at 21, an upper, retractable mast, indicated generally at 31 pivotally connected at the upper end of the lower mast structure on shaft 24, a cable bail 62 pivotally connected at the upper end of the retractable mast, tension members indicated generally at 33 for positioning and supporting the retractable mast and for carrying the tension load, and a mast anchoring means 34 for properly positioning and securing the tension members of the retractable mast in either raised or lowered position.

The preferred manner of constructing the lower mast or supporting framework and the retractable mast structure is best shown in Figures 3 to 7, inclusive. The lower mast structure preferably includes a pair of rigid compression members 22 pivotally secured at their lower ends, as at 23, to the brackets 16 near the forward ends of the main frame members 11. These compression members extend upwardly and rearwardly at an angle to the boom and to a point near the roof line of the cab of the crane, the upper ends of these members being provided at that point with a pair of laterally extending openings for the reception of a cross shaft 24. This shaft 24, as well as the compression members, are held firmly in fixed position by means of tension members 26, said tension members being provided with openings at their upper ends for reception over the shaft 24, and openings in their lower ends to provide for pinned connection 28 to the hoisting drum framework 27. These tension members may of course extend downwardly the entire distance to the main frame members 11.

The upper or retractable mast includes a pair of rigid compression members 31 provided with openings in their lower ends for reception for pivotal movement on the shaft 24. The upper ends of these compression members 31 are also provided with openings for the reception of an upper cross shaft 32 on which shaft a pair of spaced, rearwardly and downwardly extending tension members 33 are pivotally mounted.

The anchoring structure 34, to which the tension members 33 may be secured, preferably comprises two pair of strap-members 35 and 36 disposed in spaced relation and extending vertically adjacent the rear wall 37 of the cab. These anchoring members 35 and 36 are secured by means of pins 38 to mounting brackets 39 which may be in the form of flat bars fixedly secured as by welding or riveting to the main frame members 11 and extending beyond the rearmost ends thereof. These mounting brackets are preferably provided with flanges 41 at their lower edges, which flanges may be bolted directly to the crane counter-weight 42 so as to not only aid in supporting the counter-weight, but to transfer a large portion of the boom load directly to the counterweight.

These vertical anchoring members 35 and 36 are held in fixed relation to the fixed mast structure 21 by means of rigid spacing members 43, the forward ends of which are provided with openings for reception on the shaft 24, and the rear ends of which are provided with other openings for pinned connection 44 between transversely extending angle members 46 and 47, which angle members are secured, as by welding, near the upper ends and to the forward edges of the anchor strap members 35 and 36. A detail of this structure is shown in Figure 7.

The lower ends of the upper mast tension members 33 are provided with openings which may be aligned with companion openings in the upper ends of the anchor straps 35 and 36, through which openings the pins 51 may be inserted and secured by cotter keys or the like to support the retractable mast in extended or operating position. These tension members 33 are connected together by transverse braces 42 and diagonal bracing members 43, which members serve to brace the entire upper mast assembly.

The upper mast may be lowered, as will hereinafter be described, upon the removal of the pins 51. Openings 52 are provided in the anchor members 35 and 36 at spaced distances from the upper openings, and the pins 51 may be inserted through these openings and through the openings in the lower ends of the tension members 33 to secure the mast in its lowered position.

The boom hoist cable 17 (Figures 1, 2 and 3), extends from one of the hoist drums 19 upwardly, over the free running sheave 56 which is mounted on the cross shaft 24, and then forwardly to a "block" 57, secured by the boom cables 58 to the outer end of the boom. This boom hoist cable is reeved back and forth over a plurality of sheaves in this "block" 57 and in a companion "block" 59 which is supported from the upper end of the retractable mast, and the end of the cable is brought back and fixedly secured by a lug or strap 61 to the cross shaft 24.

The cable "block" 59, instead of being secured directly to the upper end of the retractable mast, is swingably secured to the cross shaft 32 at the upper end of the mast by means of a bail 62, the structure of which is best shown in Figure 5.

This bail preferably includes a pair of strap-like members 63 spaced apart near their midpoints by the pipe spacing member 64 and secured together by a rod 66 threaded on its ends to receive nuts. These members 63 are provided at their rearward ends with openings which are bushed or provided with collars as indicated at 67, for reception of and for pivotal movement on the cross shaft 32. A short length of pipe 68, also received over this shaft 32, serves to hold these rear ends of the strap members 63 in proper spaced relation. The bail members 63 are provided at their forward ends with companion pairs of spaced plate-like members 69, the lower edges of which project downwardly to provide spacing members which may contact the cross shaft 24 when the retractable boom is lowered, but which will hold the forward end of the bail a spaced distance above the said cross shaft 24.

The "block" 59 may be constructed with a pair of spaced opposed channel members 76 and 77 having the sheaves 78 disposed for rotation therebetween. The channel members 76 and 77 are secured as by welding to end plates 79, which end plates have rear extensions receivable between the plate members 69 and to which members the "block" may be secured by means of the pivot pins 81.

The operation and manner of using the device may be better understood from the following description. Assuming that the retractable mast is in extended position, as illustrated in Figures 1 and 3, it will be apparent that the boom may be raised or lowered as desired and may be controlled by the boom hoist cable drum, and that a considerable increase in leverage is afforded in the lifting of the boom by the increase in the angle between the boom hoist cable and the boom. When, however, it is desirable or necessary to reduce the head room required by the vehicle, as when the device is to be moved under a viaduct or across a bridge, the boom may be lowered to the surface of the ground, and as the boom hoist cable becomes slack after the boom reaches the ground, the strain will be removed from the tension members 33 and the attachment pins 51 may be removed. The operator may then continue to slack up on the boom hoist cable, which will permit the retractable mast compression members 31 to sink slowly rearwardly and downwardly, and the tension members to slide downwardly between the spaced straps of the anchor members 35 and 36. When the retractable mast reaches its lowermost position, as indicated by dotted lines in Figures 1 and 3, the lower ends of the tension members 33 may be secured to the anchor straps by means of the pins 51 installed in holes 52. The crane may be operated in the normal manner with the mast in its lowered position, but of course only with a relatively lighter load, and it will be apparent that the bail 62, although adapted to follow the movement of the boom hoist cable, will, itself, come to rest against the cross shaft 24 and thus there will never be any interference between the boom hoist cable and the cross shaft 24 or any of the other supporting framework.

The raising of the retractable mast may be accomplished by reversing the above procedure—that is, by removing the pins 51 and taking up the slack in the boom hoist cable while the boom rests on the ground and until the rear end of the retractable mast is lifted upwardly to the proper height, at which position it may be locked in place by inserting the pins 51 in the proper openings in the anchor straps.

Although we have described a specific embodiment of our invention, it is apparent that modifications thereof may be made by those skilled in the art. Such modifications may be made without departing from the spirit and scope of our invention as set forth in the appended claims.

We claim as our invention:

1. In a crane, a supporting structure, a boom pivotally secured thereto, a lower mast structure secured in substantially fixed relation to the supporting structure, an upper mast structure pivotally secured to the upper end of the lower mast structure for swinging movement in the vertical longitudinal plane of the supporting structure, a bail pivotally secured to the upper end of the upper mast structure and extending forwardly in the direction of the boom, a boom hoist cable extending between the free end of the bail and the boom hoist, rigid means for supporting the upper end of the upper mast structure in either upwardly extended position or in lowered position substantially parallel with the roof of the crane, and spacing means for providing a lengthened lever arm between the point of attachment of the cable and bail and the pivotal mounting point of the upper mast and preventing interference between the boom hoist cables and the upper end of the lower mast structure whereby direct lifting effort is applied to the upper end of the upper mast before the boom is lifted from the ground.

2. In a device of the character described, a mobile supporting structure, a gantry, a shaft mounted in the upper portion of said gantry, a retractable mast pivotally supported by said shaft and extending rearwardly and normally upwardly therefrom and adapted, in retracted position, to lie substantially parallel with the ground, a boom pivotally mounted on the supporting structure, a bail pivotally connected with the free end of the mast, a boom hoist cable operatively connecting the free end of said bail and the boom, the said bail being rigid and of a length at least substantially equal to that of the mast, and means for supporting the free end of said bail in spaced relation to and above the shaft whereby a lever arm, having a length equal to the distance provided by the supporting means between the said shaft and the bail, is provided at an angle to and extending upwardly from the mast at its pivotal mounting point and to which lever arm lifting effort may be applied by the boom hoist cable when the boom is lowered and the mast is in retracted position and below the dead center thereof relative to the said shaft.

3. In a structure of the class described, a base, a mast support on the base, a mast pivotally mounted on the mast support, a rigid tension member to restrain upward and forward movement of the mast, and a tension member support pin-connected to the base and having a plurality of spaced-apart connecting means to permit connection of the tension member to the tension member support in a normal raised working position or in a lowered working position to reduce overall height, the tension members being rigid to support the mast in raised or lowered position whether or not there is a load on the mast and whereby the mast will carry boom load in raised or lowered position.

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