Dec. 26, 1944. E. D. NEWKIRK 2,365,900

MAST

Filed July 1, 1942

Fig. 1.

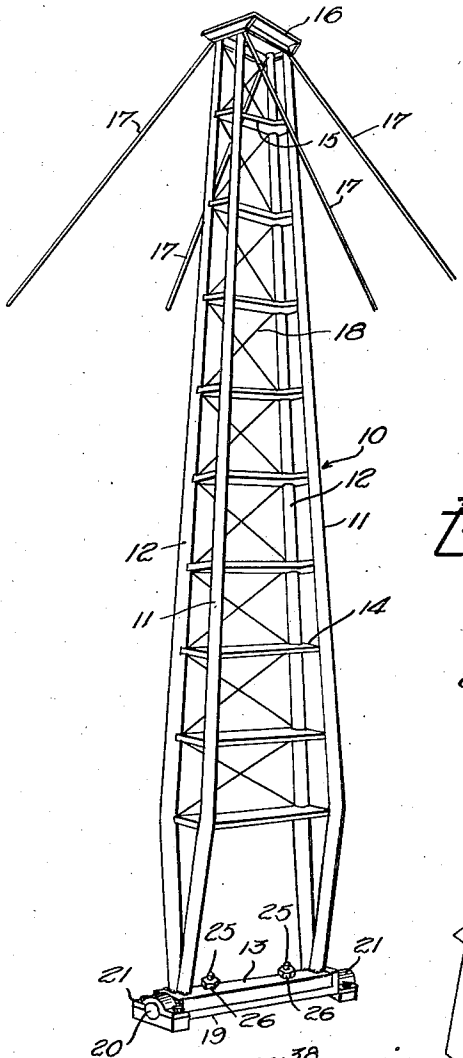


Fig. 2.

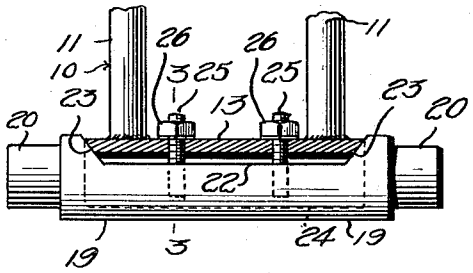


Fig. 3.

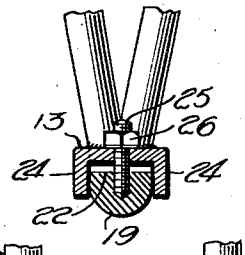


Fig. 4.

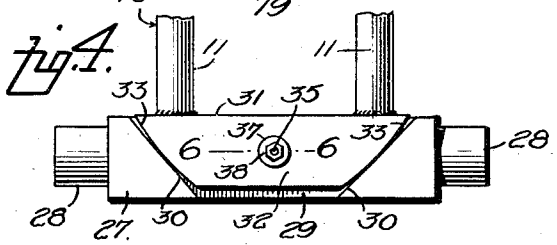


Fig. 5.

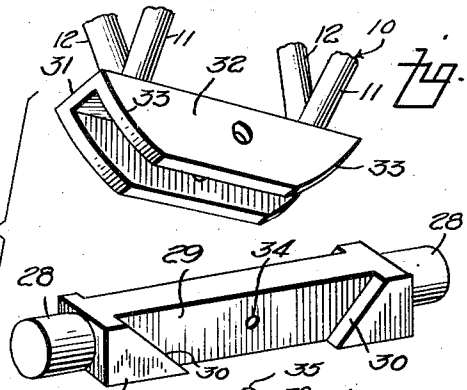


Fig. 6.

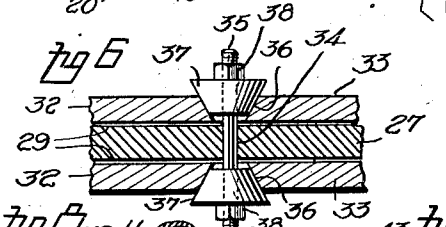


Fig. 7.

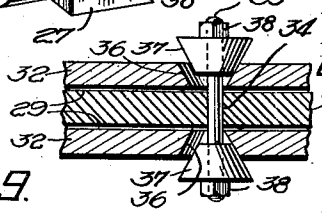


Fig. 8.

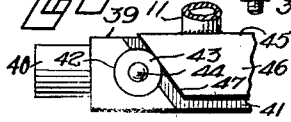
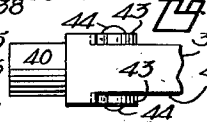


Fig. 9.



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UNITED STATES PATENT OFFICE

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MAST

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Application July 1, 1942, Serial No. 449,298

9 Claims. (Cl. 189—21)

This invention relates to masts, and more particularly to a mast adapted for use with portable oil well drilling rigs.

Portable oil well drilling rigs have been developed which employ masts having sheaves over which the cables pass for the various functions in drilling and servicing the wells. The masts are supported in a position inclined from the vertical so that their upper ends are over the wells with which they are associated. The masts are mounted to swing from a horizontal position to operative position and are supported and anchored in operative positions by means of guy cables secured at their upper ends to the masts and at their lower ends to suitable ground anchors. It is essential, of course, that the upper end of a mast be accurately positioned in vertical alinement with the well and to secure such vertical alinement, the guy cables are adjusted to move the upper end of the mast. The supporting means for the mast usually is in the form of timbers or the like resting upon the surrounding ground, or in the form of a platform structure. Due to the loads supported by a mast of this character, there is always some settling of the ground with a consequent tendency for the mast to become distorted and subjected to very uneven strains. This results quite frequently in the bending or breaking of the mast, thus requiring the use of a mast of much heavier structure than would be called for in accordance with the strains it is necessary to sustain.

An important object of the present invention is to provide a novel mast construction of the type referred to having means associated therewith for permitting movement of the upper end of the mast to aline it with a well without disturbing the equal distribution of the strains through the mast structure.

A further object is to provide a mast of this type which is readily adapted to be supported in bearings to permit it to be swung to its operative position and which is so constructed as to permit relative movement of the mast with respect to the supporting bearings and associated elements to permit the upper end of the mast to be moved to vertically aline it with a well without subjecting the mass to uneven stresses and strains.

A further object is to provide a mast having novel means for connecting it to its supporting structure and wherein such means provides a fixed connection while the mast is being hoisted to operative position, but which may be released after the guy cables are installed to permit the upper end of the mast to be moved to aline it with the well.

Other objects and advantages of the invention will become apparent during the course of the following description.

In the drawing I have shown several embodiments of the invention. In this showing:

Figure 1 is a perspective view of the mast showing the upper ends of the guy cables,

Figure 2 is an enlarged face view of the lower end portion of the mast structure and its supporting trunnions, the mast base being shown in section,

Figure 3 is a transverse section on line 3—3 of Figure 2,

Figure 4 is an enlarged fragmentary side elevation of the lower end of a mast and its supporting trunnions, showing a modified form of the invention,

Fig. 5 is a detail perspective view of the elements of the invention shown in Figure 4, the parts being separated,

Figure 6 is a detail fragmentary sectional view on line 6—6 of Figure 4 showing the parts in normal position,

Figure 7 is a similar view showing the parts in a position they may assume while the mast is in operation,

Figure 8 is a fragmentary side elevation showing a further modified form of the invention, and,

Figure 9 is a plan view of one of the elements of the same.

Referring to Figure 1, the numeral 10 designates a mast as a whole of the type commonly referred to as an A mast. This mast is shown as being provided with front legs 11 and rear legs 12 which converge toward each other at their lower ends and have their lower extremities welded or otherwise secured to a supporting plate 13. Wide beam cross members 14 are preferably welded to all of the legs 11 and 12 to assist in rigidly securing them to each other and these cross members are cut away as at 15 to provide space for the vertical movement of the traveling block employed in connection with the apparatus. A relatively heavy crown plate 16 at the upper end of the legs prevents the top of the mast from being twisted when the guy cables 17 are unevenly tightened. These cables are conventional, of course, and are secured at their lower ends to the ground by any suitable type of anchoring means (not shown). Further rigidity may be added to the mast by any suitable type of bracing, such as the cross braces 18. It will become apparent that the mast per se forms no part of the present

invention and may be of any desired construction.

Referring to Figures 2 and 3, the numeral 19 designates a supporting unit having trunnions 20 at its ends mounted in any suitable type of bearings 21 (Figure 1) and these bearings may be secured to any suitable supporting structure such as a heavy timber platform constructed to be supported upon the surrounding ground. The top of the supporting unit is recessed as at 22 and the recess has upwardly sloping diverging end surfaces 23 as clearly shown in Figure 2. The plate 13 has its ends contacting with and sloping similar to the surfaces 23, and the bottom of the plate 13 is spaced from the bottom of the recess 22.

The plate 13 is provided at its edges with depending flanges 24 (Figure 3) which straddle the supporting unit 19 to prevent displacement of the plate 13 and the mast structure with respect to the unit 19. Bolts 25 are extended through the plate 13 and into the unit 19 and are provided with nuts 26 by means of which the plate 13 may be anchored with respect to the unit 19. When the nuts 26 are loosened, the plate 13 and consequently the entire mast structure, are adapted to rock with respect to the unit 19.

A somewhat modified form of the invention is shown in Figures 4 to 7 inclusive. The supporting unit is indicated by the numeral 27 and is likewise provided with trunnions 28 at its ends adapted to be supported in the bearings 21. The unit 27 is cut away in opposite faces thereof to form recesses 29 (Figures 4 and 5) and the ends of these recesses have upwardly diverging surfaces 30.

A base plate 31 has the lower ends of the legs 11 and 12 welded thereto as in the form of the invention previously described and is provided with depending side flanges 32 generally similar to the flanges 24 except that their ends 33 are curved as shown in Figures 4 and 5. These curved ends bear against and are supported by the sloped ends 30 of the recesses 29. The body of the supporting unit 27 is provided with an opening 34 (Figures 5, 6 and 7) and this opening receives a heavy bolt 35 of such diameter as to approximately fit the opening 24. Normally in axial alinement with the opening 34 the flanges 32 are provided with conical openings 36 to receive conical heads 37 slidable on the bolt 35. The bolt 35 is provided outwardly of each head 37 with a nut 38. When the apparatus is being installed the parts occupy the positions shown in Figure 6, all endwise movement of the flanges 32 and top plate 31 being prevented. When the device is assembled and the mast is supported by the guy cables the loosening of the nuts 38 will permit the parts to assume the positions shown in Figure 7 if it is necessary for the plate 31 and its flanges 32 to rock with respect to the supporting unit 27.

A slightly modified form of the invention is shown in Figures 8 and 9 wherein a supporting unit 39, having trunnions 40 at its ends is recessed in its sides as at 41, the supporting unit thus being very similar in construction to the unit 27. In the present case, however, each side of the unit is arcuately recessed as at 42 to receive a circular hardened steel element 43. Opposite disks 43 are secured by a fastening element 44 extending through the unit 39. The legs of the mast are secured at their lower ends to a plate 45 having depending side flanges 46 the ends of which are sloped as at 47 and bear against the disks 43 to be supported thereby.

The operation of the form of the invention shown in Figures 1, 2 and 3 is as follows:

The trunnions 20 are mounted in their bearings 21 with the mast structure in a horizontal position, and the bearings are secured to the supporting structure previously prepared for this purpose. The portable well drilling apparatus is then operated to hoist the mast to operative position by passing around the hoisting drum a cable which is suitably connected to the upper end of the mast. While the mast is shown in Figure 1 as being vertical it will be apparent that in the actual operation of the structure as a drilling mast, the structure will be inclined from the vertical so that the sheaves (not shown) at the upper end of the mast will be vertically alined with the well. The cables 17 are then suitably anchored and tightened to support the mast approximately in its proper position.

It will be apparent that the operation just described will be carried out with the parts in the normal positions shown in Figure 2 with the nuts 26 tightened under which conditions the mast structure and the supporting unit 19 will be fixed with respect to each other. The nuts 26 are then loosened to a substantial extent whereupon the cables 17 may be suitably adjusted to properly position the upper end of the mast with respect to the well. Assuming that the upper end of the mast will have been arranged slightly to one side of a position in vertical alinement with the well, the adjustment of the guy cables will have been accomplished by imparting rocking movement of the mast with respect to its supporting unit 19 while the latter will remain in its same position with the trunnions 20 in the bearings 21. The rocking movement of the mast in a plane coincident with the longitudinal axis of the unit 19 takes place by one end of the plate 13 sliding upwardly along its sloping supporting face 23 while the other end of the plate 13 slides downwardly with respect to its supporting face 23. Thus it will be apparent that the loosening of the nuts 26 will permit the mast to be swung in one direction or the other in the plane referred to while the structure is adapted to turn about the axis of the trunnions 20 for movement of the mast perpendicular to the axis of the supporting unit. While the engagement of the ends of the plate 13 with the sloping faces 23 permits rocking movement of the lower end of the mast from the unit supporting unit 19 when the nuts 26 are loosened, it will be apparent that there can be no displacement of the lower ends of the mast from the unit 19 because of the straddling of this unit by the flanges 24. The nuts 26 accordingly are left loose during the drilling and servicing operations, the unit 19 serving solely to support the weight and the vertical loads imparted to the masts without serving to anchor the mast as to its position. The latter function is performed solely by the cables 17. Accordingly it will be apparent that the mast is adapted to assume adjusted positions with respect to the unit 19 to properly position it with respect to the well without introducing any uneven strains in the mast structure. In other words, neither trunnion or its bearing 21 and neither side of the mast is ever subjected to greater strains than the corresponding elements at the other side of the mast. This arrangement permits the use of a lighter mast structure and substantially eliminates any danger of the buckling of the mast.

The operation of the form of the invention shown in Figures 4 to 7 inclusive is similar to

that previously described. The nuts 38 are tightened until the guy cables are in position, whereupon the nuts are substantially loosened, thus permitting the mast to rock endwise with respect to the unit 27. This rocking movement takes place with the curved ends 33 of the flanges 32 sliding over the sloping surfaces 30 and while such rocking movement misalines the conical openings 36 (Figures 6 and 7) with respect to the opening 34, such movement is permitted since the conical heads 37 are free to slide outwardly from the recesses 36. The relative positions of the parts when the mast structure is swung in one direction longitudinally of the supporting unit 27 is shown in Figure 7.

In the form of the invention shown in Figures 8 and 9 the operation takes place in a similar manner. Any suitable means (not shown) such as the bolts 25 (Figure 2) or the bolts 35 and associated elements (Figures 6 and 7) may be employed for fixing the plate 45 with respect to the unit 39 until the mast is supported by the guy cables. The means for securing the plate 45 to the unit 39 is then loosened whereupon the mast structure is adapted to rock in a direction longitudinally of the unit 39 with the sloping edges 47 of the flanges 46 sliding over the disks 43.

From the foregoing it will be apparent that the present structure eliminates serious faults previously encountered in mast structures of this general type. Masts heavier than are theoretically necessary are commonly employed because of the previous impossibility of uniformly distributing stresses and strains, and even with such excessively heavy structures failures are not insured against. The present apparatus does not add appreciably to the cost of the mast structure as a whole because of the adjusting means employed and, in fact, reduces the over all cost for the reason that a lighter mast structure can be employed. The upper end of the mast is free to be moved in any direction by adjusting the cables 17 without subjecting the mast structure or the supporting means therefor to any uneven and destructive strains.

It is to be understood that the forms of the invention herewith shown and described are to be taken as preferred examples of the same and that various changes in the shapes, size and arrangement of parts may be resorted to without departing from the spirit of the invention or the scope of the subjoined claims.

I claim:

1. A mast construction comprising a base unit, means for supporting said base unit for turning movement on a given single axis, a mast unit wholly supported by said base unit, and releaseable means for rigidly securing said units to each other, said units having coacting spaced engaging portions constructed and arranged whereby said mast unit is movable in a plane substantially coincident with said axis when said securing means is released while said mast is supported by said spaced engaging portions.

2. A mast construction comprising a base unit having coaxial trunnions adapted to be mounted in bearings whereby it may turn on the axis of said trunnions, a mast unit wholly supported on said base unit, and releaseable bolt means for rigidly securing said mast unit to said base unit, said units having spaced coacting contacting portions constructed and arranged to provide for rocking movement of said mast unit relative to said base unit in a plane coincident with the axis of said trunnions when said bolt means is released while said mast is supported by said spaced coacting portions.

3. A mast construction comprising a base unit having means for supporting it for turning movement on a given axis, a mast, a plate fixed to the lower end of said mast and having spaced portions directly engaging said base unit whereby the latter supports said mast, and releaseable bolt means for securing said plate to said base unit, said portions of said plate and said base unit being constructed and arranged with respect to each other whereby said mast is rockable in a plane substantially coincident with said axis, while said spaced portions are supported on said base unit and when said bolt means is released.

4. A mast construction comprising a base unit having means for supporting it for turning movement on a given horizontal axis, a mast, a plate fixed to the lower end of said mast, said base unit having upwardly diverging faces engaged by portions of said plate whereby said mast is supported by said base unit, and releaseable bolt means for fixing said plate with respect to said base unit, the portions of said plate engaging said diverging faces being slidable respectively upwardly and downwardly over said faces when said bolt means is released to vary the position of the upper end of said mast approximately in a plane coincident with said axis.

5. A mast construction comprising a horizontal elongated base unit, coaxial trunnions projecting from the ends of said base unit whereby the latter is adapted to be supported for turning movement on a horizontal axis, said base unit having recesses in its sides each provided with upwardly diverging supporting faces, a mast, a plate fixed to the lower end of said mast and provided with depending flanges straddling said base unit and having its ends engaging said supporting faces whereby said plate and said mast are supported thereby, and releaseable bolt means for fixing said plate with respect to said base unit, the ends of said flanges being slidable upwardly and downwardly along the supporting faces adjacent respective ends of said base unit when said bolt means is released.

6. A mast construction comprising a horizontal elongated base unit, coaxial trunnions projecting from the ends of said base unit whereby the latter is adapted to be supported for turning movement on a horizontal axis, said base unit having recesses in its sides each provided with upwardly diverging supporting faces, a mast, a plate fixed to the lower end of said mast and provided with depending flanges straddling said base unit and having its ends engaging said supporting faces whereby said plate and said mast are supported thereby, said base unit being provided with a bolt receiving opening transversely therethrough, a bolt projecting through said opening, said flanges being provided with openings substantially larger than said first named opening, conical heads slidable on said bolt, and a nut threaded on each end of said bolt and engageable with said heads to force them tightly into the openings in said flanges to fix said plate with respect to said base unit.

7. A mast construction comprising a base unit elongated horizontally and having coaxial trunnions projecting from its ends for supporting said unit for turning movement on a horizontal axis, the top of said unit having a horizontally elongated recess provided with upwardly sloping

supporting end surfaces, a mast, a normally horizontal plate fixed to the lower end of said mast and having its ends engaging said supporting faces whereby said plate and said mast are supported thereby, and a bolt projecting downwardly through said plate and said base unit to fix them with respect to each other, the ends of said plate being slidable upwardly and downwardly over the respective supporting faces to provide for movement of the upper end of the mast substantially in the plane of said axis when said bolt is released.

8. A mast construction comprising a horizontally elongated supporting unit having coaxial trunnions projecting from its ends to support said unit for turning movement about a given horizontal axis, a mast, a plate fixed to the bottom of said mast and provided with parallel depending flanges straddling said supporting unit, said unit and said flanges having pairs of engaging faces at each side of said supporting unit and adjacent each end thereof, and releaseable means for fixing said plate with respect to said unit, one face of each pair being convex to facilitate rocking movement of the unit in a plane coincident with said axis when said securing means is released.

9. A mast construction comprising a horizontally elongated supporting unit having coaxial trunnions projecting from its ends to support said unit for turning movement about a given horizontal axis, a mast, a plate fixed to the bottom of said mast and provided with parallel depending flanges, said supporting unit having its sides recessed to receive said flanges and the ends of each recess diverging upwardly and engaging the ends of the corresponding flange to support said plate and the mast, and releaseable securing means for fixing said plate with respect to said supporting unit, the respective ends of said flanges being convex to facilitate sliding movement thereof with respect to the corresponding diverging faces when said securing means is released.

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