PORTABLE DRILLING MAST STRUCTURE

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This invention relates to oil well drilling masts, and more particularly to a collapsible mast permanently mounted on a portable base.

When a well drilling mast is permanently mounted on a portable base along with the drawworks and engines, there are certain limitations on load dimensions that have to be observed before the unit can be moved over highways. During transportation the mast must be in substantially horizontal or reclinable position, so the drawworks and engines should be located below it. Also, during transportation the gin pole likewise should be disposed in a reclinable position, in which it will not project materially above the reclinable mast. In raising such a mast to upright position by means of a sling connected with the gin pole and with the drilling line that passes over the crown block to the drawworks, the operator has to be very careful to disconnect the power from the drilling line at just the right moment. If he stops too soon, the power is in position for attachment to the gin pole. If he does not stop soon enough, he may pull the mast too far and break a cable or even cause the mast to buckle or "pull in." It is among the objects of this invention to provide a compact mast structure of the character just described in which a reclinable gin pole is automatically swung up into operative position at the beginning of the mast raising operation, in which the mast cannot be swung past the head of the gin pole, in which the operator is given some leeway in the time during which he must cut off the drilling line, and in which the gin pole is lowered automatically at the end of the mast lowering operation.

In accordance with this invention, a reclinable mast extends lengthwise over a portable base, with the top of the mast located above the front end of the base. There are means on the base for pivotally supporting the foot of the mast and also for pivotally supporting the foot of a reclinable gin pole. The foot of the gin pole is behind the foot of the mast. The gin pole extends toward the foot of the mast and has a different width than the adjacent portion of the mast so that the pole can be swung upward along the sides of the reclinable mast, but provision is made for limiting this upward movement. There are cable means connecting the mast behind the top of the reclinable gin pole with the top of the pole, and these means are adapted to be pulled, such as by the drawworks below the mast, for swinging the top of the gin pole backward and up above the reclinable mast and down and up and forward to upright position. The top of the gin pole and the portion of the upright mast adjacent that top when they are in its up position are provided with cooperating guide rollers and tracks shaped to cause the forwardly moving mast to swing past upright position a predetermined distance and then permit it to swing back to that position by gravity to lean against the gin pole. It is while the mast is swinging back by gravity that the operator can stop applying power to the cable means that raise the mast. He therefore has a little leeway in shutting off the power, without leaving the mast short of final position and without danger of pulling it in.

The preferred embodiment of the invention is illustrated in the accompanying drawings, in which Fig. 1 is a side view of the mast structure ready for transportation to a new location or for elevation of the gin pole and mast; Fig. 2 is a side view showing the gin pole and mast swung up into operative position; Fig. 3 is a front view of the structure shown in the preceding figure; Fig. 4 is an enlarged fragmentary vertical section taken on the line IV—IV of Fig. 3; and the fragmentary horizontal sections taken on the lines V—V and VI—VI, respectively, of Fig. 4; and Figs. 7, 8 and 9 are diagrammatic side views showing the mast in three different positions as it is being raised.

Referring to Fig. 1 of the drawings, an oil well mast base 1 is shown which can be skidded from one location to another or placed on a truck trailer for transportation. In fact, the base can be the permanent trailer if desired. Mounted on this base a few feet from one end is the usual rotary table 2 which is driven from the drawworks 3 and engines 4 resting on the central portion of the base. The rotary end of the base will be referred to herein as the front end. Mounted on the base in front and at the sides of the rotary table is a superstructure 6 forming an elevated support section that extends a considerable distance above the level of the top of the drawworks and engines. The upper end of the superstructure is pivotally connected to the feet 7 of a reclinable mast that extends substantially horizontally over the length of the drawworks and engines and rests face up on a support 8 mounted on the back end of the base. The superstructure must be tall enough to allow the mast to pass over the drawworks and engines but not tall enough to exceed the rig height limitations. The front legs 10 of the mast, which are at the upper side of the reclinable mast, are connected by suitable conventional bracing to the rear legs 11 which are at the lower side of the reclinable mast. The rear legs do not extend to the foot of the mast, but terminate near the rear end of the drawworks at what is called the heel of the mast. They are connected by inclined braces 12 to the rear of the base.

Below the heel of the mast and behind the drawworks there is an upright framework 14 which is mounted on the base near its opposite sides. This framework can be braced by braces 15 connecting it with superstructure 6.

6. The upper end of this framework is about on a level with the top of the drawworks and pivotally supports the foot of a gin pole 16 that extends forward over the drawworks and through the upper part of superstructure 6.

6. The top or head of the gin pole does not project appreciably above the level of the upper side of the reclinable mast.

A traveling block 17 inside the mast is connected by the usual traveling line 18 with the crown block 19 and with the drawworks drum 20. The hook of the traveling block is hooked onto a sling 21 that is connected to a cable doubled on itself. The sides of the sling extend forward and down around a pair of sheaves 22 journaled on a cross member 23 (Figs. 4 and 5) at the head of the gin pole. From there the sheaves extend to support the mast beneath the mast and has the opposite ends of the sling anchored to the lower ends of a pair of brackets 24 that extend downward from the rear legs of the mast at the heel.

When it is desired to raise the mast, the drawworks drum 20 is rotated to pull traveling block 17 and sling 21 toward the crown block 19. As the sling is pulled, it swings the gin pole upward and backward between the opposite sides of the mast's lower portion, which is free of cross braces. The gin pole is narrow enough to fit between the opposite sides of the mast. When the pole has reached a predetermined inclined position, indicated in broken lines in Fig. 1, its movement is stopped by guy lines 26 connected to superstructure 6 and to fore and aft supports 27 on the base and are rotatably mounted on cross member 23. With the top of the gin pole now located in fixed position above the reclinable mast, further pulling on the sling by the traveling block will cause the sling to pull upward on brackets 24 and thereby swing the mast upward toward the upright operating position shown in Fig. 2.

It is a feature of this invention that the operator of the drawworks does not have to disengage the clutch and apply the brake at a certain instant, in order to stop the mast at a given point, but is allowed a short but adequate period of time during which he can do those things.
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Accordingly, the cross member 23 at the top of the gin pole projects beyond the opposite sides of the pole, and on these projecting ends a pair of flanged guide rollers 30 and 31 are mounted. These rollers in the vicinity of position 31 are rigidly mounted on the opposite inner sides of the bifurcated lower portion of the mast at about the level of the bottom of the gin pole. As the rollers are mounted in a position where they will engage the guide rollers when the mast is swung upward. As shown in Figs. 4 and 6, each track preferably is channel shaped with an opening 34 and a closed portion 35 in the front end of the track. The inclination of the track is inclined from its front end, which is at a front leg of the upright mast, downward toward the brace 12 behind it. The lower end of the track's inclined portion, which is level in front of this brace, is located at a lower level than the adjacent guide roller when the gin pole is in its highest position shown in Fig. 2. The rear portion of each track curves upward from its incline portion and extends upward just far enough to form a pocket which will accommodate the guide roller that is in the track. The closed rear end of the track, which forms the top of the pocket, prevents the roller from moving upward out of it.

When the mast is swung up and forward by the sling as explained above, the mast reaches the position shown in Fig. 4. The front portion of the front end of the gin pole, and then move forward across the guide rollers so that from then on the rollers are in the tracks. As the mast continues to move forward, the inclined portions of the track cause the guides rollers and the track to swing upward and downward a short distance again from its uppermost position shown in broken lines in Fig. 8. This movement of the gin pole continues until the mast reaches a support at the bottom of its support. This is shown in Fig. 8. It will be seen that if the sling continued to pull on the sheaves at the top of the gin pole the guide rollers would be pulled out of the curved portions of the tracks and come against the curved portions of the guide rollers, as shown in connection with Fig. 9. That upward and rearward movement of the gin pole would swing the mast backward a short distance from its broken line position in Fig. 9, to a full line position. The upper portion of the mast in this upward and rearward movement is substantially vertical. The mast then is supported by the gin pole, against the top of which it leans; that is, the rear ends of the tracks lean against the guide rollers in them.

It is an advantage of this invention, however, that after the mast reaches its extreme forward position shown in Fig. 4, it is unnecessary to pull the gin pole up any further because the mast can swing backward by gravity, pushing the rollers up into the pockets at the rear ends of the tracks. Since the mast will swing backward in a manner shown in Fig. 8, the operator of the drawworks is given the length of time that this backward swinging consumes to disengage the clutch of his hoist and to apply the brake. The result is that he is not required to do these things at any precise moment, for he has a period of several seconds in which to do them. He can tell the moment that it is safe for him to stop driving the drawworks drum, because the action of gravity on the mast in the same direction that the sling otherwise would pull it will produce a "running away" action in the drawworks that the operator will sense immediately. As soon as that happens he knows that he can declutch and apply the brake and that he will have several seconds while the mast is swing backward in which to do it. These advantages are obvious.

At a predetermined height of the mast will hold it in the position shown in Figs. 2 and 9, it is preferred to steady the structure by detachably connecting the mast to the gin pole by bolts conveniently by bolting screws from position 33, which are provided to brackets 34 at the head of the mast, to slotted plates 35 fastened to the back of the gin pole near its top. After the mast has been erected, it is then locked from the traveling block and is lashed to the mast in a position where it will not interfere with drilling operations.

The raising procedure is just reversed in lowering the mast to a transportation to another location, except that the mast must first be swung forward to the Fig. 8 position by means of a line (not shown) connecting the front of it to a truck winch or the like. The mast then can be permitted to swing backward by gravity while the inclined portions of the tracks move rearwardly across the guide rollers. Of course, tension is kept on the line to control the lowering speed of the mast. When tension is taken off the sling after the mast has been lowered onto back rest 8, the gin pole will swing down to its retracted position as shown in Fig. 9. It is apparent that the unit thus is formed which can be erected again in just a few minutes. The raising and lowering operations are greatly simplified by using the sling to raise and lower the gin pole. The major upward operation that does not require the sling to be removed from the raised gin pole and then attached to the retracted mast.

According to the provisions of the patent statutes, we have explained the principle of our invention and have illustrated and described what we now consider to represent its best embodiment. We have understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

We claim:

1. A well drilling structure comprising a base having front and rear ends, a reeling mast extending lengthwise over the base and having a head and a foot, the foot end of the tracks rearwardly of the front end of the base, means on the base pivotally supporting the foot end of the mast, a reeling gin pole above the base having a top and a foot, the foot end of the gin pole being Means pivotally supporting the foot of the gin pole, the gin pole extending toward the foot end of the mast and being narrower than the adjacent portion of the mast, said portion of the mast being bifurcated to permit the gin pole to be swung upward through it means limiting said upward movement of the gin pole, cable means connecting the mast behind the top of the gin pole with the foot and adapted to be pulled for swinging the top of the gin pole backward and upward the reeling mast and then swinging the mast up and forward to upright position, guide rollers at opposite sides of the top of the gin pole, and tracks at opposite sides of the mast extending forward from its rear side and positioned to have their front ends engage the rollers as the mast approaches upright position, the tracks having downwardly inclined portions connected at their rear ends with upwardly extending portions, whereby the forward moving tracks will swing the top of the gin pole downward slightly and said upwardly extending portions of the tracks will permit the top of the gin pole to move back up to support the mast when the mast is allowed to settle back by gravity after said rollers have reached the lower ends of said inclined portions of the tracks.

2. A well drilling structure comprising a base having front and rear ends, a reeling mast extending lengthwise over the base and having a head and a foot, the foot end of the reeling mast being located above the front end of the base, means on the base pivotally supporting the foot of the mast, a reeling gin pole above the base having a top and a foot, means on the base said mast-supporting means pivotally supporting the foot of the gin pole, the gin pole extending toward the foot of the mast and being narrower than the adjacent portion of the mast, said portion of the mast being bifurcated to permit the gin pole to be swung upward through it, means limiting said upward movement of the gin pole, cable means connecting the mast behind the top of the reeling gin pole with said top and adapted to be pulled for swinging the top of the gin pole backward and upward the reeling mast and then swinging the mast up and forward to upright position, guide rollers projecting from opposite sides of the top of the gin pole, and tracks mounted on the opposite inner sides of said bifurcated portion of the mast, the tracks extending forward from the rear side of the mast and positioned to have their front ends engage the rollers as the mast approaches upright position, the tracks having downwardly inclined portions connected at their rear ends with upwardly extending portions to swing the top of the gin pole downward a short distance when the tracks move forward, the downwardly swinging gin pole causing the mast to swing past upright position a predetermined distance and the last-mentioned upward movement of the gin pole permitting the mast to swing back

3. A well drilling structure comprising a base having front and rear ends, a reeling mast extending lengthwise over the base and having a head and a foot, the foot end of the tracks rearwardly of the front end of the base, means on the base pivotally supporting the foot end of the mast, a reeling gin pole above the base having a top and a foot, the foot end of the gin pole being Means pivotally supporting the foot of the gin pole, the gin pole extending toward the foot end of the mast and being narrower than the adjacent portion of the mast, said portion of the mast being bifurcated to permit the gin pole to be swung upward through it means limiting said upward movement of the gin pole, cable means connecting the mast behind the top of the gin pole with the foot and adapted to be pulled for swinging the top of the gin pole backward and upward the reeling mast and then swinging the mast up and forward to upright position, guide rollers at opposite sides of the top of the gin pole, and tracks at opposite sides of the mast extending forward from its rear side and positioned to have their front ends engage the rollers as the mast approaches upright position, the tracks having downwardly inclined portions connected at their rear ends with upwardly extending portions, whereby the forward moving tracks will swing the top of the gin pole downward slightly and said upwardly extending portions of the tracks will permit the top of the gin pole to move back up to support the mast when the mast is allowed to settle back by gravity after said rollers have reached the lower ends of said inclined portions of the tracks.

4. A well drilling structure comprising a base having front and rear ends, a reeling mast extending lengthwise over the base and having a head and a foot, the foot end of the tracks rearwardly of the front end of the base, means on the base pivotally supporting the foot end of the mast, a reeling gin pole above the base having a top and a foot, the foot end of the gin pole being Means pivotally supporting the foot of the gin pole, the gin pole extending toward the foot end of the mast and being narrower than the adjacent portion of the mast, said portion of the mast being bifurcated to permit the gin pole to be swung upward through it means limiting said upward movement of the gin pole, cable means connecting the mast behind the top of the gin pole with the foot and adapted to be pulled for swinging the top of the gin pole backward and upward the reeling mast and then swinging the mast up and forward to upright position, guide rollers at opposite sides of the top of the gin pole, and tracks at opposite sides of the mast extending forward from its rear side and positioned to have their front ends engage the rollers as the mast approaches upright position, the tracks having downwardly inclined portions connected at their rear ends with upwardly extending portions, whereby the forward moving tracks will swing the top of the gin pole downward slightly and said upwardly extending portions of the tracks will permit the top of the gin pole to move back up to support the mast when the mast is allowed to settle back by gravity after said rollers have reached the lower ends of said inclined portions of the tracks.
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5 to said upright position by gravity to lean against the gin pole.

3. A well drilling structure comprising a base having front and rear ends, a reclining mast extending length-wise over the base and having a head and a foot, the foot of the reclining mast being located above the front end of the base, means on the base pivotally supporting the foot of the mast, a reclining gin pole above the base having a top and a foot, said mast supporting means pivotally supporting the foot of the gin pole and the gin pole extending toward the foot of the mast and being narrower than the adjacent portion of the mast, said portion of the mast being bifurcated to permit the gin pole to be swung upward through it, means limiting said upward movement of the gin pole, sheaves mounted on the top of the gin pole, a sling connected with the lower side of the reclining mast behind the sheaves and forward into the mast, and a travelling block in the mast connected to the sling for pulling it toward the head of the mast to swing the top of the gin pole backward and up above the reclining mast and then swing the mast up and forward to upright position, guide rollers projecting from opposite sides of the top of the gin pole, and tracks mounted on the opposite inner sides of said bifurcated portion of the mast, the tracks extending forward from the rear side of the mast and positioned to have their front ends engage the roller as the mast approaches upright position, the tracks having downwardly inclined portions connected at their rear ends with upwardly extending portions.

6. A well drilling structure comprising a base having front and rear ends, a reclining mast extending length-wise over the base and having a head and a foot, the foot of the reclining mast being located above the front end of the base, means on the base pivotally supporting the foot of the mast, a reclining gin pole above the base having a top and a foot, said mast supporting means pivotally supporting the foot of the gin pole and the gin pole extending toward the foot of the mast and being narrower than the adjacent portion of the mast, said portion of the mast being bifurcated to permit the gin pole to be swung upward through it, means limiting said upward movement of the gin pole, sheaves mounted in the top of the gin pole, a pair of brackets secured to the lower side of the reclining mast and projecting downward therefrom adjacent said gin pole support means, a sling cable having its opposite ends fastened to the lower ends of said brackets, the cable extending back under said sheaves and then up around them and forward into the mast, guide rollers projecting from opposite sides of the top of the gin pole, and tracks mounted on the opposite inner sides of said bifurcated portion of the mast, the tracks extending forward from the rear side of the mast and positioned to have their front ends engage the rollers as the mast approaches upright position, the tracks having downwardly inclined portions connected at their rear ends with upwardly extending portions.

7. A well drilling structure comprising a base having front and rear ends, a reclining mast extending length-wise over the base and having a head and a foot, the foot of the reclining mast being located above the front end of the base, means on the base pivotally supporting the foot of the mast, a reclining gin pole above the base having a top and a foot, said mast supporting means pivotally supporting the foot of the gin pole, drawworks on the base beneath the reclining gin pole, a mast pole extending forward from the foot of the mast and being narrower than the adjacent portion of the mast, said portion of the mast being bifurcated to permit the gin pole to be swung upward through it, means limiting said upward movement of the gin pole, sheaves mounted on the top of the gin pole, a pair of brackets secured to the lower side of the reclining mast and projecting downward therefrom adjacent said gin pole support means, a pair of brackets secured to the lower side of said brackets, the cable extending back under said sheaves and then up around them and forward into the mast, a travelling block in the mast connected to said cable, cable means connecting said block with said drawworks for pulling the block and sling cable toward the head of the mast to swing the top of the gin pole backward and up above the reclining mast and then swing the mast up and forward to upright position, guide rollers projecting from opposite sides of the top of the gin pole, and tracks at opposite sides of the mast extending forward from the rear side of the mast and positioned to have their front ends engage the rollers as the mast approaches upright position, the tracks having downwardly inclined portions connected at their rear ends with upwardly extending portions.

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