Jan. 24, 1950 H. J. WOOLSLAYER ET AL 2,495,563

OIL WELL MAST STRUCTURE AND ERECTION METHOD

Filed Feb. 6, 1948

4 Sheets-Sheet 1

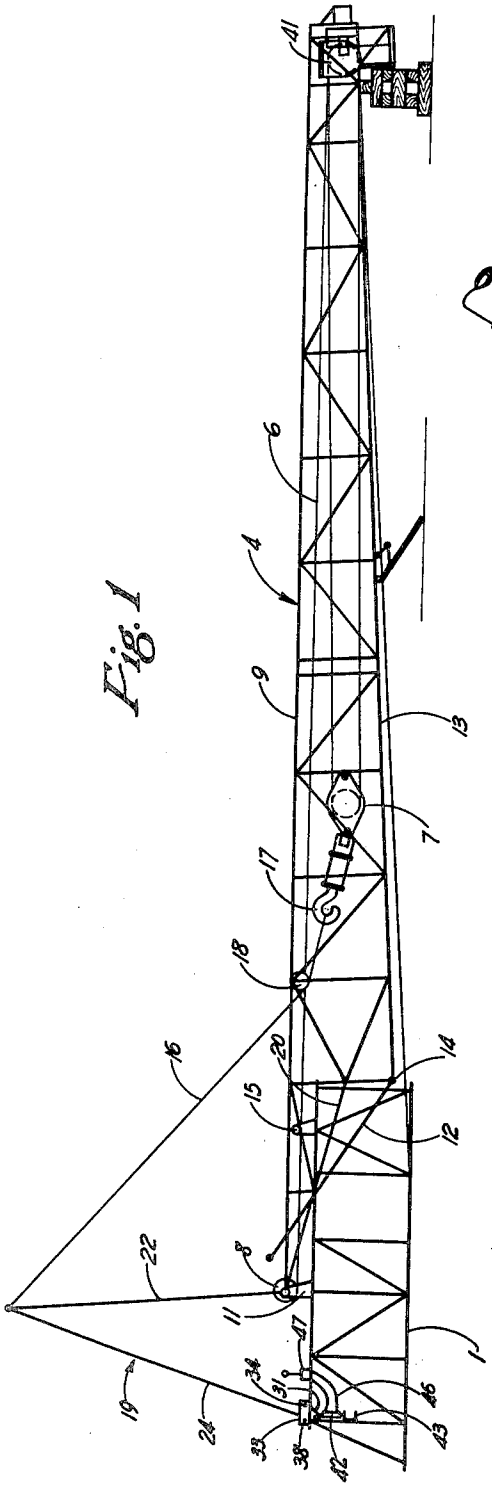


Fig. 1

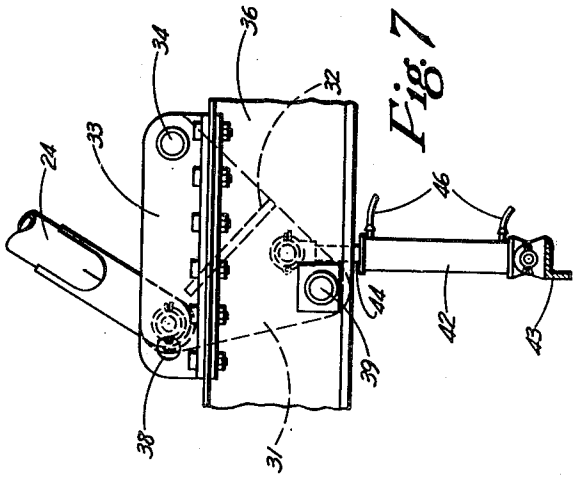


Fig. 7

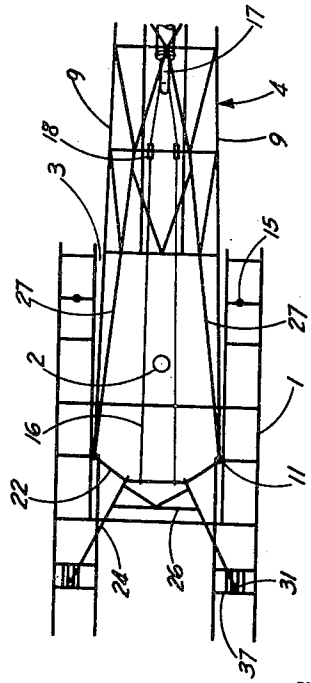


Fig. 2

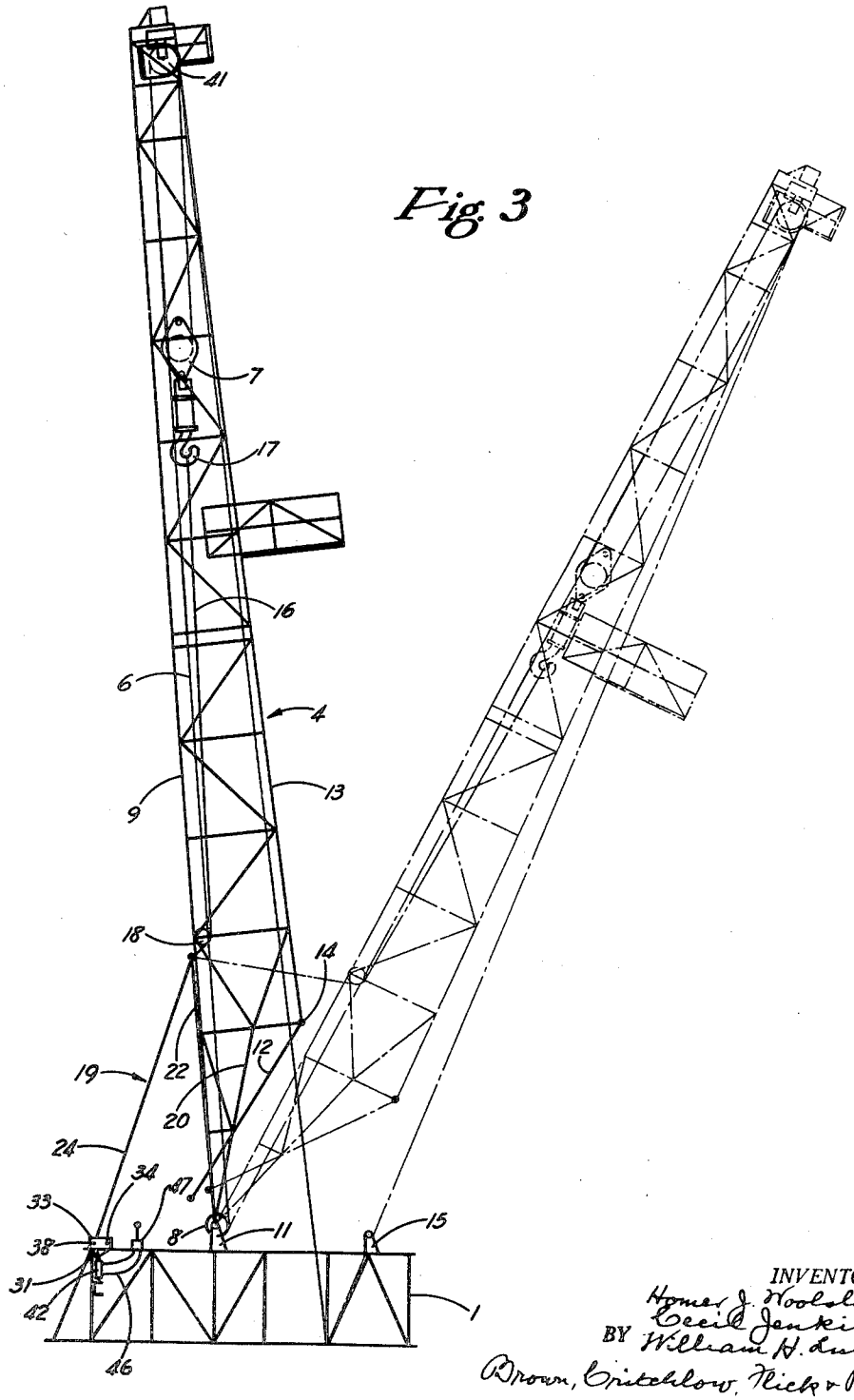
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Fig. 3



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OIL WELL MAST STRUCTURE AND ERECTION METHOD

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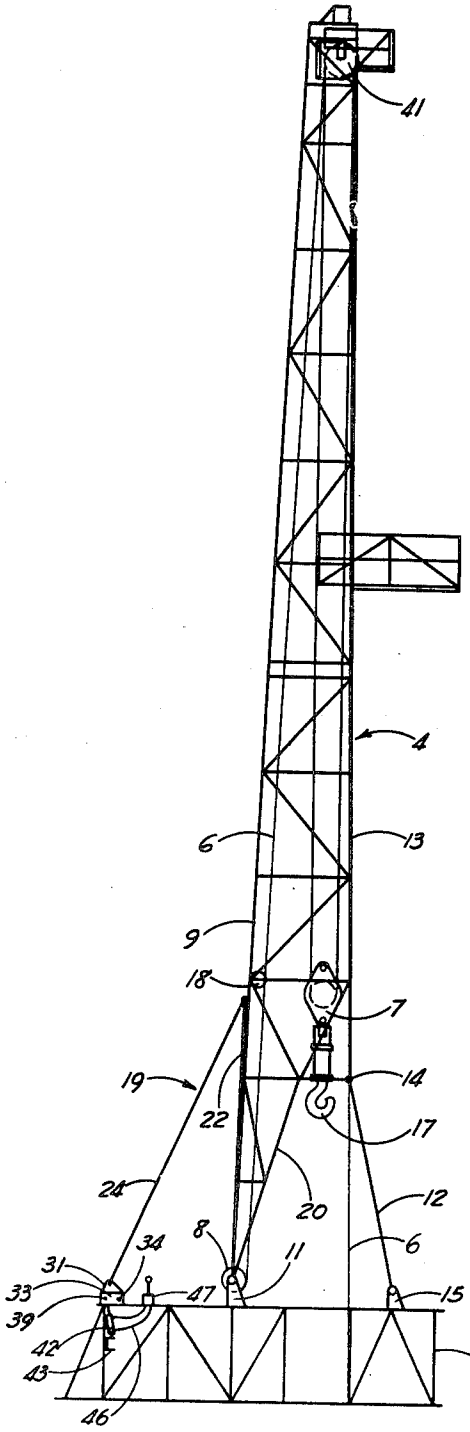


Fig. 4

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OIL WELL MAST STRUCTURE AND ERECTION METHOD

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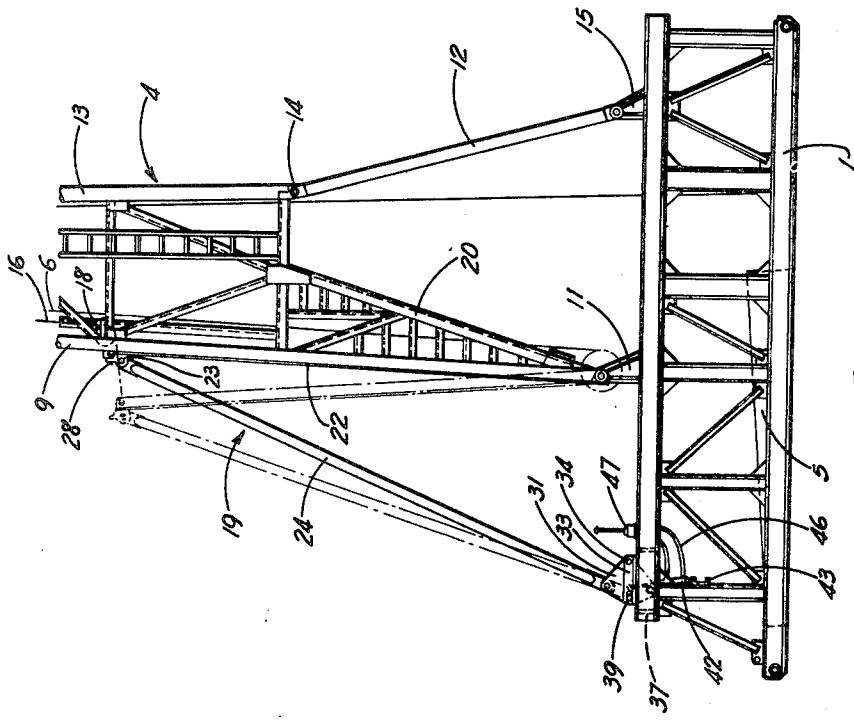


Fig. 6

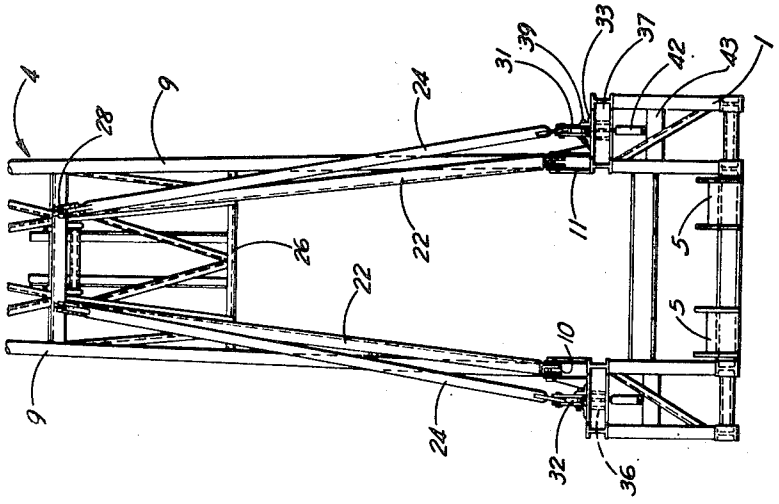


Fig. 5

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OIL WELL MAST STRUCTURE AND ERECTION METHOD

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Application February 6, 1948, Serial No. 6,764

9 Claims. (Cl. 189—15)

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This invention relates to oil well drilling apparatus in which a mast is hinged to a substructure so that the mast can be swung from a prone position on the ground to an upright drilling position.

In Patent No. 2,332,479 oil well drilling apparatus is shown which includes a substructure provided with a bay that straddles a well, a mast that is hinged to the substructure behind the bay and which in its lower position extends forward out of the bay, and a gin pole mounted on the substructure behind the mast for raising and lowering it. That patent recites the advantages of such apparatus. The present invention relates to the structure shown in that patent, but improves it in such a way that the mast can be raised to drilling position in an easier, faster, and safer manner.

In accordance with this invention a mast, adapted to be disposed in a prone position with its front side down, has the lower end of its rear side hinged to a substructure to permit the mast to be swung up to an upright position. A gin pole is mounted on the substructure behind the mast, and the lower end of the front side of the gin pole is hinged to the substructure beside the hinged end of the mast. Also, the front side of the gin pole is inclined rearwardly while the mast is being raised, whereby the mast must be swung back past its balance point before it strikes the gin pole. This permits the mast to be raised quickly, because as soon as the mast has passed through its balance point it can be allowed to settle by gravity against the gin pole. Otherwise, the mast would have to be pulled back against the gin pole by the hoisting line, an operation which requires considerable skill and must be done slowly because the pulling must be stopped the moment the mast engages the gin pole to avoid toppling the mast over backwards. As soon as the mast has settled against the rearwardly inclined gin pole in accordance with the present invention, the two can be fastened together. The lower end of the rear side of the gin pole then is raised in order to swing the gin pole and upright mast forward together until the mast has been returned to a forwardly unbalanced drilling position. This preferably is done by jacks operatively connected to the rear legs of the gin pole. The front of the mast then is supported, such as by pivoted front legs, from the substructure so that the mast will be self-supporting. The side of the mast next to the ground when the mast is prone is referred to herein for convenience as the front, but that side could just as well be called the back without affecting the invention.

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The preferred embodiment of the invention is illustrated in the accompanying drawings in which the first four figures are line drawings. Fig. 1 is a side view of our drilling apparatus showing the mast in its lowered position extending along the ground; Fig. 2 is a fragmentary plan view of the lower portion of the mast attached to the substructure; Fig. 3 is a side view of the upright mast tilted back against the rearwardly tilted gin pole, with the mast also shown in broken lines in an intermediate position; Fig. 4 is a side view showing the mast in drilling position; Fig. 5 is an enlarged fragmentary rear view of the lower part of the drilling apparatus just after the front legs of the mast have been connected to the substructure; Fig. 6 is a side view of Fig. 5, showing the position of the rearwardly tilted gin pole in broken lines; and Fig. 7 is an enlarged side view of part of the gin pole tilting apparatus in lowered position.

Referring to the drawings, a structural steel substructure 1 rests on the ground over the well 2 that is to be drilled. Such a substructure generally is several feet high, and has an open area 3, as shown in Fig. 2, that surrounds the well and extends out through what we shall call the front end of the substructure. The bifurcated substructure thus formed therefore straddles the well, but its open front end may be closed temporarily by removable braces (not shown) when the mast 4 is in the upright drilling position shown in Fig. 4. The portion of the substructure directly behind the well is formed for receiving the usual drawworks by which the drilling line 6 that supports the traveling block 7 in the mast is reeled in and out. The drawworks can be mounted on a truck trailer which is backed up ramps 5 (Figs. 5 and 6) and then tilted into horizontal position. To avoid complicating the drawings unnecessarily, only the drawworks drum 8 on which line 6 is wound is indicated in operative position in Figs. 1, 3, 4 and 6. The mast is mounted on top of the substructure with its rear legs 9 provided with bifurcated feet 10 (Fig. 5) detachably pivoted in shoes 11 projecting upward from the substructure at the opposite ends of drum 8. The lower portion 12 of each front leg of the mast is connected to its upper portion 13 by a hinged joint 14. This permits lower portions 12 to be swung backward and forward relative to the rigid upper portions of the front legs. The lower ends of the front legs are detachably mounted in shoes 15 on the substructure a considerable distance in front of the front face of

the mast and somewhat outwardly beyond its sides. With this arrangement, as much working space is provided within the base of the mast in front of the well as behind it.

When it is desired to take down the mast and transport it to a new location, a sling 16 is looped over the hook 17 of the traveling block. The sides of the sling extend down under sheaves 18 mounted in the lower part of the mast, and out to the top of a gin pole 19 mounted on the substructure directly behind the mast. Line 6 then is tightened to hold the mast while its front legs are disconnected from shoes 15 and the mast is disconnected from the gin pole. Pivoted leg portions 12 may be swung back across inclined braces 20 at the lower end of the mast to get them out of the way. The weight of the mast then is supported by shoes 11 and sling 16 while the mast is swung forward and down to the ground by unwinding the line from the drawworks drum so that the traveling block can descend in the mast. The open area 3 or bay in the front of the substructure permits the lower portion of the mast to enter the substructure so that the mast will be close to the ground and can be separated easily into its component prefabricated sections and also disconnected from shoes 11.

The structure described thus far and the method of lowering the mast are essentially the same as disclosed in Patent No. 2,332,479 mentioned at the beginning of this specification. The manner of elevating the mast from its lowered position, however, has been improved, so some of the structure has been changed to permit this improvement to take place. As mentioned previously, the object of this invention is to allow the mast to be pulled up to and just through its balance point, and then to permit it to settle back against gin pole 19 by gravity in order to avoid having to pull the mast by the line 6 until it strikes the gin pole, which might result in the mast being pulled over backward if the line is not slackened at the right moment. Accordingly, the bifurcated lower ends of the front legs 22 of the gin pole are hinged to the substructure, preferably by shoes 11 in which they straddle mast feet 10, and legs 22 have brackets 23 (Fig. 6) at their upper ends hinged to the upper ends of the rear legs 24 of the gin pole. The upper portions of the front legs of the gin pole are connected rigidly by a spreader truss 26 (Fig. 5), to the top of which the ends of sling 16 are attached. These front legs preferably are formed from angle bars, and they converge upward and seat against a pair of similarly converging braces 27 (Fig. 2) mounted in the back side of the mast. When the mast is upright, it is detachably connected to the gin pole by eye-bolts 28 that swing down into notches in brackets 23. The lower ends of the rear legs of the gin pole are spaced farther apart than the front legs to increase the working space around the drawworks.

It is a feature of this invention that the lower end of each rear leg 24 of the gin pole is pivotally mounted between a pair of vertical plates 31 rigidly connected by a cross plate 32 and disposed between a pair of brackets 33 mounted on the substructure, as shown in Figs. 5, 6, and 7. The vertical plates preferably are triangular with their front corners connected by pivot pins 34 to the front ends of the brackets, to form shoes that can be swung up and down. The rear gin pole legs are connected to the upper rear corners of these shoes. The brackets 33 are bolted to

the top of short channels 36, the ends of which are fastened to short cross members 37 (Figs. 2 and 5) that are supported by the upper longitudinal beams of the substructure. The lower rear corners of the pivoted shoes are provided with holes that register with holes in the lower part of channels 36 when the shoes are in their lower position, and with holes 38 (Fig. 7) in the rear ends of the brackets when the shoes are in the upper position. A removable pin 39 extending through the aligned holes will hold the shoes in either of their positions to support the rear legs of the gin pole.

When the mast is in its lower position shown in Fig. 1, ready to be swung up to drilling position, the pivoted shoes are swung down to their lower position and the pins 39 inserted in the holes in channels 36 and the lower corners of the shoes, as shown in Fig. 7. When the shoes are in this position the rear gin pole legs pull the upper end of the gin pole backward so that its front legs 22 are inclined rearwardly as shown in Figs. 1 and 3, and in broken lines in Fig. 6. The inclination of the gin pole is such that the elevated mast will have to swing back through its balance point before it can engage the front of the gin pole.

To raise the mast, the drilling line 6 is reeled in by drum 8 to pull traveling block 7 toward the crown block 41 in the top of the mast. This causes sling 16 to lift sheaves 18 and thereby to swing the mast upward through the broken line position shown in Fig. 3. As the mast continues to rise it reaches a point at which it is balanced on shoes 11. As soon as the mast has been pulled back through this balance point the operator stops the drawworks and permits the mast to settle by gravity against the gin pole behind it. If desired, this final backward movement of the mast can be controlled by snubbing lines connected to the front of the mast. As soon as mast braces 27 seat against the front legs of the gin pole the eye-bolts 28 are connected to brackets 23. Then the pivoted shoes are raised to tilt the gin pole and attached mast forward again to locate the mast in drilling position, which is in front of the balance point. Raising of the pivoted shoes preferably is accomplished by double acting hydraulic rams or jacks. The lower end of the cylinder 42 of each jack is pivotally mounted on a cross member 43 in the rear end of the substructure, while the piston rod 44 of the jack projects between the two plates 31 above it. The upper ends of the piston rods are pivotally connected to the plates. The opposite ends of each jack cylinder are connected by hoses 46 to a suitable hand pump 47 mounted on the substructure.

When the gin pole and mast are ready to be tilted forward to drilling position, the locking pins 39 are removed from channels 36, and liquid is pumped into the lower ends of the jack cylinder to swing the pivoted shoes upward. This swings the gin pole forward at a speed controlled by the operators of the pumps. The jacks also keep the mast from swinging forward and falling toward the ground after the mast moves forward through its balance point. When the holes in the lower corners of the shoes register with holes 38 in the rear ends of brackets 33, the locking pins are inserted in these registering holes to support the shoes in their upper position. The lower front legs 12 of the mast then are swung forward and connected to shoes 15 to support the front of the mast.

With this arrangement the operator of the

drawworks does not have to keep reeling in the hoisting line until the mast touches the gin pole, with the danger that if he does not stop the drum the moment contact is made, the mast and gin pole may be pulled over backward. Instead, he is given ample time to stop the drawworks during the interval that the mast is swinging from its balance point back to the rearwardly inclined gin pole. In other words, the operator of the drawworks can stop reeling in the hoisting line before the mast touches the gin pole, and yet the mast will continue to swing back by gravity until it strikes the gin pole. Consequently, the operator need not be so skillful or careful as heretofore, but he can raise the mast faster because he does not have to stop the drawworks drum at the moment the upright mast reaches a given point. He has some leeway which makes this mast much safer to raise.

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. However, we desire to have it understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

We claim:

1. Oil well drilling apparatus comprising a substructure, a mast having front and rear sides and adapted to be disposed in a prone position with its front side down, means hinging the lower end of said rear side to the substructure to permit the mast to be swung from said prone position up to upright position, a gin pole mounted on the substructure behind the mast and having front and rear sides, the lower end of the front side of the gin pole being hinged to the substructure adjacent said hinging means, the front side of the gin pole being inclined rearwardly while the mast is being raised so that the mast must swing back past its balance point before it comes to rest against the gin pole, means for fastening the upright mast to the gin pole and means connected to the lower end of the rear side of the gin pole for swinging the gin pole and upright mast forward together to return the mast to forwardly unbalanced drilling position.

2. Oil well drilling apparatus comprising a substructure, a mast having front and rear sides and adapted to be disposed in a prone position with its front side down, means hinging the lower end of said rear side to the substructure to permit the mast to be swung from said prone position up to upright position, a gin pole mounted on the substructure behind the mast and having front and rear sides, the lower end of the front side of the gin pole being hinged to the substructure adjacent said hinging means, the front side of the gin pole being inclined rearwardly while the mast is being raised so that that mast must swing back past its balance point before it comes to rest against the gin pole, means for fastening the upright mast to the gin pole, hydraulic jack means operatively connected to the lower end of the rear side of the gin pole for swinging the gin pole and upright mast forward together to return the mast to forwardly unbalanced drilling position, and means for supporting the front side of the mast on the substructure after the mast has been moved into said drilling position.

3. Oil well drilling apparatus comprising a substructure, a mast having front and rear sides

and adapted to be disposed in a prone position with its front side down, means hinging the lower end of said rear side to the substructure to permit the mast to be swung from said prone position up to upright position, a gin pole mounted on the substructure behind the mast and having front and rear sides, the lower end of the front side of the gin pole being hinged to the substructure adjacent said hinging means, the front side of the gin pole being inclined rearwardly while the mast is being raised so that the mast must swing back past its balance point before it comes to rest against the gin pole, means for fastening the upright mast to the gin pole, vertical plates pivotally connected to the substructure, means pivotally connecting the lower end of the rear side of the gin pole to said plates behind their pivotal connection to the substructure, jacks for swinging said plates upward to swing the gin pole and upright mast forward together in order to return the mast to forwardly unbalanced drilling position, and means for supporting the front side of the mast on the substructure after the mast has been moved into said drilling position.

4. Oil well drilling apparatus comprising a substructure, a mast having front and rear sides and adapted to be disposed in a prone position with its front side down, means hinging the lower end of said rear side to the substructure to permit the mast to be swung from said prone position up to upright position, a gin pole mounted on the substructure behind the mast and having front and rear pairs of legs, the lower ends of said front legs being hinged to the substructure adjacent said hinging means, said front legs being inclined rearwardly while the mast is being raised so that the mast must swing back past its balance point before it comes to rest against the gin pole, means for fastening the upright mast to the gin pole, a vertical plate pivotally connected at its rear end to the lower end of each rear leg of the gin pole, means pivotally connecting the front end of each plate to the substructure, means for supporting the plates and for swinging them upward to swing the gin pole and upright mast forward together in order to return the mast to forwardly unbalanced drilling position, and means for supporting the front side of the mast on the substructure after the mast has been moved into said drilling position.

5. Oil well drilling apparatus comprising a substructure, a mast having front and rear sides and adapted to be disposed in a prone position with its front side down, means hinging the lower end of said rear side to the substructure to permit the mast to be swung from said prone position up to upright position, a gin pole mounted on the substructure behind the mast and having front and rear pairs of legs, the lower end of said front legs being hinged to the substructure adjacent said hinging means, said front legs being inclined rearwardly while the mast is being raised so that the mast must swing back past its balance point before it comes to rest against the gin pole, means for fastening the upright mast to the gin pole, a vertical plate pivotally connected at its rear end to the lower end of each rear leg of the gin pole, means pivotally connecting the front end of each plate to the substructure, means for swinging the plates upward to swing the gin pole and upright mast forward together in order to return the mast to forwardly unbalanced drilling position, means for supporting the front side of the mast on the substructure after the mast has

been moved into said drilling position, each plate being provided with a hole near its bottom, and a locking pin removably disposed in said hole for supporting the plate in its upper and lower positions.

6. Oil well drilling apparatus comprising a substructure, a mast having front and rear sides and adapted to be disposed in a prone position with its front side down, means hinging the lower end of said rear side to the substructure to permit the mast to be swung from said prone position up to upright position, a gin pole mounted on the substructure behind the mast and having front and rear pairs of legs, the lower end of said front legs being hinged to the substructure adjacent said hinging means, said front legs being inclined rearwardly while the mast is being raised so that the mast must swing back past its balance point before it comes to rest against the gin pole, means for fastening the upright mast to the gin pole, a pair of spaced parallel brackets rigidly mounted on the substructure adjacent the lower end of each rear leg of the gin pole, a vertical plate disposed between each pair of brackets with the front end of each plate pivotally connected to the front ends of the adjacent brackets, means pivotally connecting the rear end of each plate to the lower end of the adjoining rear leg of the gin pole, and jacks mounted in the substructure and connected to said plates between their ends for swinging the plates upward to tilt the gin pole and upright mast forward together in order to return the mast to forwardly unbalanced drilling position.

7. Oil well drilling apparatus comprising a substructure, a mast having front and rear sides and adapted to be disposed in a prone position with its front side down, means hinging the lower end of said rear side to the substructure to permit the mast to be swung from said prone position up to upright position, a gin pole mounted on the substructure behind the mast and having front and rear pairs of legs, the lower end of said front legs being hinged to the substructure adjacent said hinging means, said front legs being inclined rearwardly while the mast is being raised so that the mast must swing back past its balance point before it comes to rest against the gin pole, means for fastening the upright mast to the gin pole, a pair of spaced parallel brackets adjacent the lower end of each rear leg of the gin pole, the substructure having spaced pairs of supporting members on which the brackets are rigidly mounted, a triangular vertical plate disposed between each pair

of brackets and supporting members and having a front corner pivotally connected to the front ends of the adjacent brackets, means pivotally connecting another corner of each plate to the lower end of the adjoining rear leg of the gin pole, each plate having a lower corner provided with a hole through it, said supporting members having holes aligned with said plate holes, removable pins in said aligned holes for supporting the rear corners of the plates, and jacks mounted in the substructure and connected to the plates between their front and lower corners for swinging the plates upward to tilt the gin pole and upright mast forward together in order to return the mast to forwardly unbalanced drilling position, the rear ends of the brackets being provided with holes that register with said plate holes when the plates are raised, whereby pins can be inserted in said registering holes to support the plates in raised position.

8. The method of raising upright a prone mast that has the rear end of its upper side hinged to a substructure supporting a gin pole behind the mast, comprising tilting the front side of the gin pole rearward, swinging the mast upward and back past its balance point until it engages the inclined gin pole, fastening the upright mast to the gin pole, and tilting the gin pole forward to swing the attached mast forward in order to return the mast to forwardly unbalanced drilling position.

9. The method of raising upright a prone mast that has the rear end of its upper side hinged to a substructure supporting a gin pole behind the mast, comprising tilting the front side of the gin pole rearward, swinging the mast upward and back past its balance point until it engages the inclined gin pole, fastening the upright mast to the gin pole, tilting the gin pole forward to swing the attached mast forward in order to return the mast to forwardly unbalanced drilling position, and then supporting the front side of the mast in that position.

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The following references are of record in the file of this patent:

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