Oct. 30, 1951 H. J. WOOLSLAYER ET AL 2,573,528

FOLDING MAST STRUCTURE

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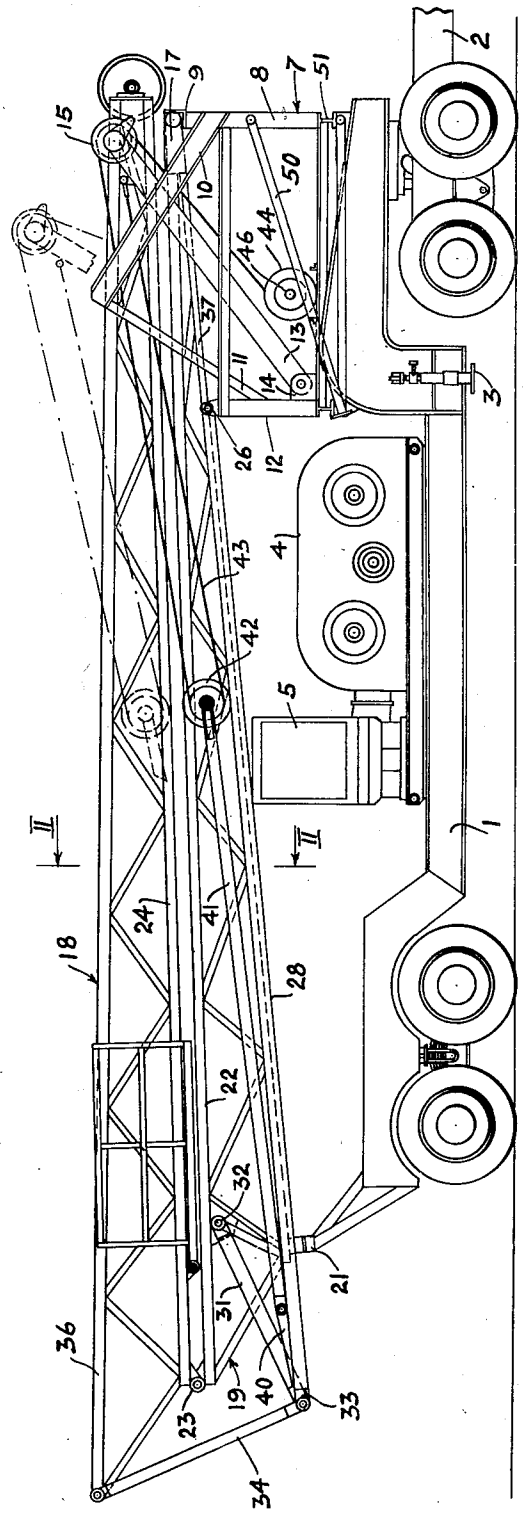


Fig. 1.

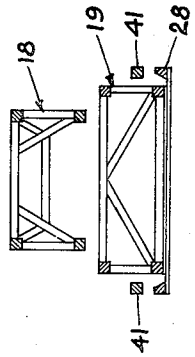


Fig. 2.

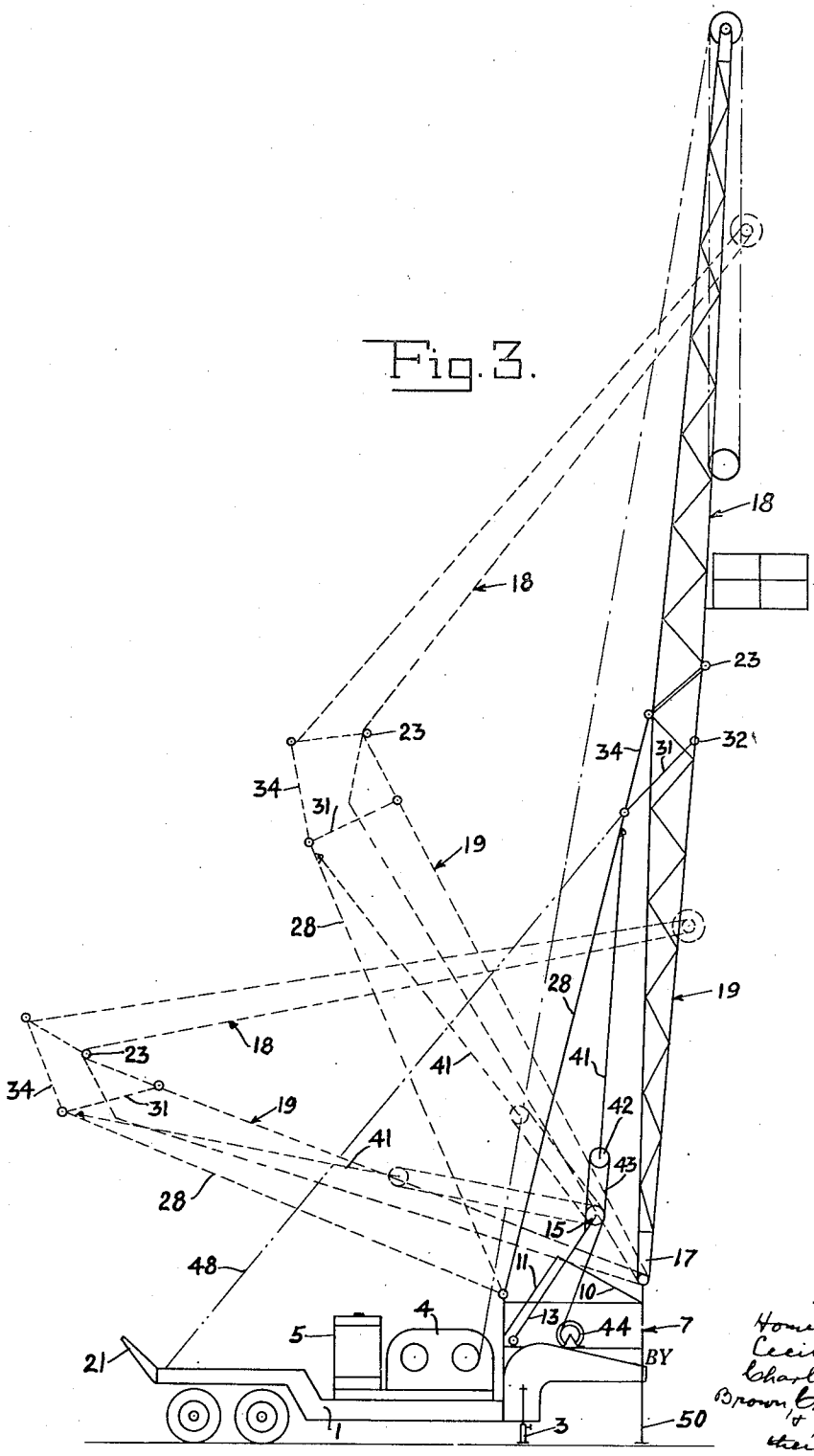
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Fig. 3.



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Fig. 4.

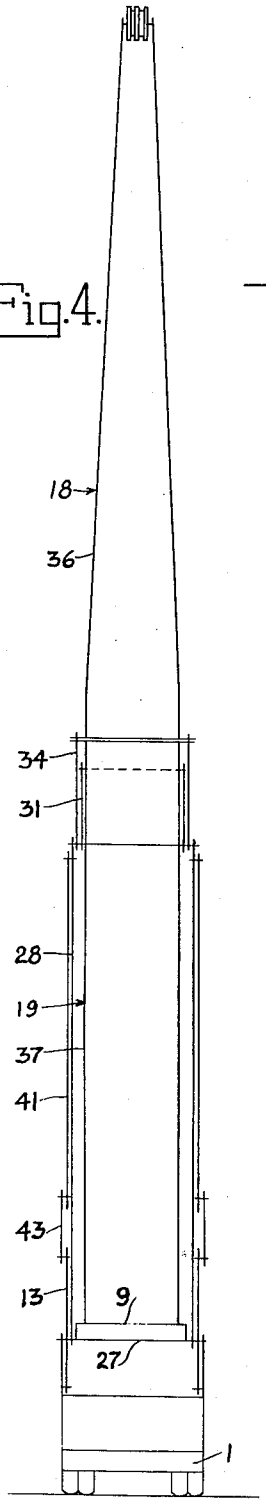
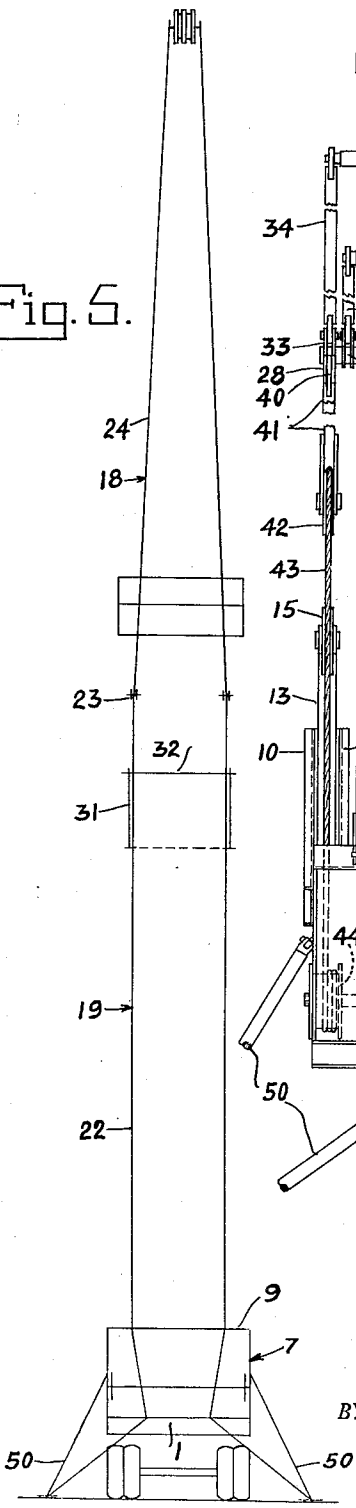


Fig. 5.



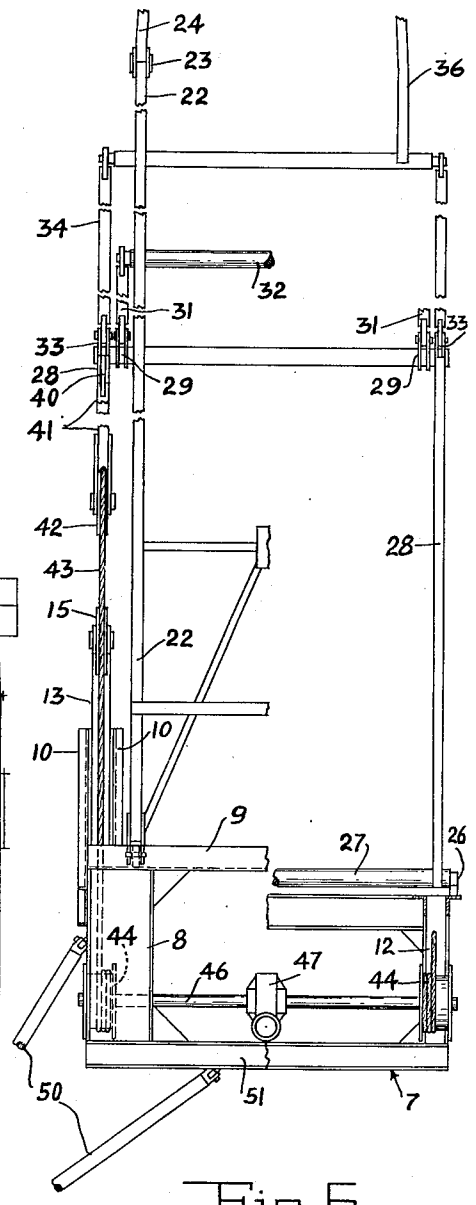


Fig. 6.

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FOLDING MAST STRUCTURE

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Application November 10, 1950, Serial No. 195,104

13 Claims. (Cl. 189—15)

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This invention relates to portable masts, and more particularly to oil well masts that can be folded into horizontal sections for transportation from one location to another without being disassembled.

It is among the objects of this invention to provide a mast structure in which the mast can be permanently mounted on a vehicle, in which the hoist and power unit also are mounted on the vehicle, in which the mast can be folded in reclining position on the vehicle for transportation, in which the mast can be easily raised and lowered by the equipment on the vehicle, and in which a tall mast can be folded into short enough horizontal sections to be within highway load limit regulations.

In accordance with this invention an upright mast is pivotally connected at its lower end to a support, such as to one end of a truck trailer. The central part of the mast is hinged at its front side to form upper and lower sections which are adapted to fold upon themselves in substantially horizontal position with the lower section extending along the support. A toggle, formed from a long brace and a short brace hinged together, has the long brace pivoted to the support behind the lower end of the mast. The short brace is pivoted to the lower section of the mast near its upper end. Manually controlled pulling means are connected with the upper part of the long brace and with the support between that brace and the mast for exerting downward tension on the upper part of the long brace. Behind the short brace of the toggle there is a third brace which is pivotally connected with the toggle and with the upper section of the mast below the level at which the two sections of the mast are hinged together. When the tension means are operated to release the downward tension on the upper part of the long brace so that the hinged ends of the mast sections can be swung rearward, the third brace controls tilting of the upper section forward and downward toward horizontal position, while the tension means and toggle control swinging of the lower section down onto the support. In this way the mast is swung down and folded in reclining position on the support. It is raised by merely pulling on the upper part of the long brace by the tension means.

The preferred embodiment of this invention is illustrated in the accompanying drawings, in which Fig. 1 is a side view of the folded mast mounted on a truck trailer; Fig. 2 is a vertical section through the folded mast taken on the

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line II—II of Fig. 1; Fig. 3 is a diagrammatic side view of the mast in upright position and showing it in broken lines in intermediate positions; Figs. 4 and 5 are rear and front views respectively, of the mast structure shown in Fig. 3, but with the cross bracing omitted to avoid confusion; and Fig. 6 is a fragmentary front view of the lower portion of the upright mast, with the right hand half of the figure broken away to show the long brace and its support.

Referring to Fig. 1 of the drawings, a truck trailer 1 with a sunken central portion is shown connected to the rear end of a truck 2. Near its front end, the trailer carries jacks 3 for supporting it when disconnected from the truck. Mounted on the central portion of the trailer is a power unit consisting of drawworks 4 and a driving engine 5. In front of the power unit, the trailer supports a heavy framework 7 having a pair of front posts 8 connected at their upper ends by a horizontal cross member 9. Extending backward and upward from the upper end of each of these posts is a pair of laterally spaced, inclined channels 10, the upper ends of which are braced by an inclined brace 11 that is supported by the adjacent rear post 12 of the framework. Between the channels of each pair, there is a boom or gin pole 13 which extends from a point above the channels backward and downward to a bracket 14 in the lower rear corner of the framework, where the gin pole is pivoted. The gin poles can swing up and down between front cross member 9 and suitable stops between the upper ends of each pair of channels 10. The upper end of each gin pole supports a sheave 15 above the framework.

Pivotally connected to framework cross member 9 near its opposite ends are the feet 17 of a mast, as shown in Figs. 1 and 6. The mast is shown in Fig. 1 as being divided substantially midway between its ends into upper and lower sections 18 and 19 that lie one above the other in substantially horizontal position. The lower section 19 is supported by framework 7, from which it extends backward across the drawworks and engine, and by a pedestal 21 supported by the rear end of the trailer. The rear ends of the upper legs 22 of the lower section of the mast are connected by hinges 23 to the rear ends of the lower legs 24 of the upper section, so that when the mast is unfolded and swung up into the upright position shown in Fig. 3 the legs of the two sections will be in alignment with each

other The legs 22 that are hinged together form the front legs of the upright mast.

The rear posts 12 of framework 7 support a pair of brackets 26, in which a horizontal shaft 27 is rotatably mounted. Rigidly mounted on this shaft near the brackets are the front ends of the opposite sides of a long structural steel brace 28 that extends backward beneath the reclining mast and beyond mast hinges 23. The sides of this brace may be connected by suitable cross bracing, which has been omitted from the drawings for the sake of clarity. The rear cross member of this brace (Fig. 6) supports a pair of brackets 29, to which the lower ends of a pair of links 31 are pivotally connected. The links are inclined forward and upward on opposite sides of the reclining mast, and have their upper ends pivotally mounted on the opposite ends of a shaft 32 that is rigidly mounted in the lower section of the mast near its upper legs and in front of the leg hinges. The links and shaft form a short brace, and the two braces together form a toggle for swinging the lower section of the mast upward when the toggle is swung upward.

The rear end of long brace 28 also carries a pair of brackets 33 that are pivoted to the lower end of a third structural steel brace 34. The upper end of this brace is pivoted to the rear ends of the upper legs 36 of the upper section of the mast behind the toggle joint. It will be observed that these upper legs extend backward beyond the mast hinges to create leverage, and that the lower legs 37 of the lower section of the mast, which align with the upper legs when the mast is upright to form the rear legs of the mast, are shorter than the lower section of the hinged legs by an equal amount. In other words, when the mast is upright as shown in Fig. 3, its two sections overlap each other along an inclined plane extending from the front leg hinges down to the point where the upper and lower sections of the rear legs come together.

The opposite sides of the long toggle brace 28 shown in Fig. 1, are provided, a short distance in front of its rear end, with upwardly projecting plates 40 that are pivotally connected to the rear ends of a pair of long links 41 which extend forward along the opposite sides of the lower section of the mast. The front end of each of these links carries a sheave 42. A cable 43 is anchored to the upper part of each gin pole 13 and extends back and up around the sheave 42 on the same side of the mast, and then forward and down around the gin pole sheave 15 to a winch 44 mounted on one end of a shaft 46 journaled in the bottom of the framework. The shaft can be driven in any suitable manner through a transmission 47 at the center of the shaft.

The two winches are rotated in unison by shaft 46 in order to reel in the two cables 43 simultaneously. When this is done, the cables first pull the two gin poles 13 upward and backward as far as they will go, and then pull sheaves 42 forward toward the gin pole sheaves. When the gin pole sheaves are in their upper position they are located above the reclining mast, as shown in broken lines in Fig. 1, so the cables pull upward and forward on sheaves 42. This tension lifts the rear end of long brace 28 and thereby starts to straighten the toggle, which swings the rear ends of the two reclining mast sections upward. As the toggle is pulled upward in this manner, the toggle joint moves closer to the foot of the mast so that the rear short brace 34 pulls downward on the hinged end of the upper section of the mast and thereby swings the free end of the upper section upward away from the lower section to unfold the mast, as shown in the broken line positions of the mast in Fig. 3. This continues until the upper section is in line with the lower section and the rear short brace preferably is in alignment with the long brace of the toggle, as shown in full lines in Fig. 3. This alignment of braces 28 and 34, plus the tension on cables 43, will hold the mast upright until the cable tension is relieved sufficiently to allow the toggle joint to be pulled rearward slightly by means of a line 48 connected to it. Then, as the cables are reeled off the winches, the mast will swing backward. At the same time, the upper section will swing down toward the lower section, this movement being controlled by the rear short brace 34. After the folded mast comes to rest on pedestal 21, further slackening of the cables will permit gin poles 13 to swing forward by gravity and thus lower their sheaves 15 to a level no higher than the rest of the apparatus, as shown in Fig. 1.

When the mast is about to be erected, jacks 3 are lowered to take part of the weight of the front end of the trailer and to permit the truck to be driven away from it. Also, outrigging arms 50, hinged to front posts 8 of framework 7 and to a cross member 51 on which the posts rest, are swung down from their raised position shown in Fig. 1 to the position shown in Figs. 3, 5 and 6. In the latter position the free ends of the arms engage the ground and help to take the weight of the mast structure and also to steady it.

When the mast is erect, braces 28, 31 and 34 function as a brace to hold the mast upright. Because of this, the mast can be made thinner than otherwise, and its overall thickness or height in folded position is reduced accordingly. Also, this bracing system makes unnecessary the use of guy wires which generally have to be secured to portable masts at mid height.

The mast disclosed herein can be permanently mounted on a truck trailer, along with the power unit for the mast. It can be erected with a minimum of labor without recourse to auxiliary equipment. The height and length of the load on the trailer is maintained within highway regulations. The particular system of toggle and links disclosed herein permits the mast to be hinged substantially midway between its ends so that the folded mast will be as short as possible.

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. A folding mast structure comprising a support an upright mast pivotally connected at its lower end to the support, the central part of the mast being hinged at its front side to form upper and lower sections adapted to fold upon themselves in substantially horizontal position with the lower section resting on said support, a toggle formed from a long brace and a short brace hinged together, means pivoting the long brace to said support behind the lower end of the mast, means pivoting the short brace to the lower section of the mast near its upper end, manually controlled means connected with the upper part of said long brace and with said support between the long brace and the mast for

exerting downward tension on the upper part of the long brace, and a third brace behind said short brace pivotally connected with the toggle and the upper section of the mast below the level at which the two sections of the mast are hinged together, whereby when the mast is swung rearward as said tension is released, said third brace will control tilting of the upper section of the mast forward and downward to horizontal position while said tension means and toggle control swinging of the lower section down onto said support.

2. A folding mast structure comprising a support, an upright mast pivotally connected at its lower end to the support, the central part of the mast being hinged at its front side to form upper and lower sections adapted to fold upon themselves in substantially horizontal position with the lower section resting on said support, a toggle formed from a long brace and a short brace hinged together, means pivoting the long brace to said support behind the lower end of the mast, means pivoting the short brace to the lower section of the mast near its upper end, a sheave connected with said support between the long brace and the mast, a cable extending over the sheave, means connecting the cable with the upper part of the long brace, means on said support for exerting tension on the cable to pull it downward, and a third brace behind said short brace pivotally connected with the toggle and the upper section of the mast below the level at which the two sections of the mast are hinged together, whereby when the mast is swung rearward as said tension is released, said third brace will controll tilting of the upper section of the mast forward and downward to horizontal position while said tension means and toggle control swinging of the lower section down onto said support.

3. A folding mast structure comprising a support, an upright mast pivotally connected at its lower end to the support, the central part of the mast being hinged at its front side to form upper and lower sections adapted to fold upon themselves in substantially horizontal position with the lower section resting on said support, a toggle formed from a long brace and a short brace hinged together, means pivoting the long brace to said support behind the lower end of the mast, means pivoting the short brace to the lower section of the mast near its upper end, a pair of sheaves disposed between the lower part of the mast and said long brace on opposite sides of the mast, a pair of gin poles supporting the sheaves and pivoted to opposite sides of the support below them, cables extending over the sheaves, means connecting the cables with the upper part of the long brace, rotatable means on said support for reeling in the cables to pull downward on them, and a third brace behind said short brace pivotally connected with said toggle and the upper section of the mast below the level at which the two sections of the mast are hinged together, whereby when the mast is swung rearward as said cables are paid out, said third brace will control tilting of the upper section of the mast forward and downward toward horizontal position while the cables and toggle control swinging of the lower section down onto said support, said gin poles being adapted to swing downward when the tension on said cables is released.

4. A folding mast structure comprising a support, an upright mast pivotally connected at its lower end to the support, the central part of the mast being hinged at its front side to form upper and lower sections adapted to fold upon themselves in substantially horizontal position with the lower section resting on said support, a toggle formed from a long brace and a short brace hinged together, means pivoting the long brace to said support behind the lower end of the mast, means pivoting the short brace to the lower section of the mast near its upper end, a sheave suspended from the upper part of said long brace between it and the mast, a sheave connected with said support behind the lower end of the mast and below said suspended sheave, a cable connecting said sheaves, means on said support for exerting tension on the cable to hold the upper sheave down near the lower one, and a third brace behind said short brace pivotally connected with the toggle and the upper section of the mast below the level at which the two sections of the mast are hinged together, whereby when the mast is swung rearward as said cable is paid out, said third brace will control tilting of the upper section of the mast forward and downward toward horizontal position while the cable and toggle control swinging of the lower section down onto said support.

5. A folding mast structure comprising a support, an upright mast pivotally connected at its lower end to the support, the central part of the mast being hinged at its front side to form upper and lower sections adapted to fold upon themselves in substantially horizontal position with the lower section resting on said support, a toggle formed from a long brace and a short brace hinged together, means pivoting the long brace to said support behind the lower end of the mast, means pivoting the short brace to the lower section of the mast near its upper end, a pair of links pivotally suspended from the upper part of said long brace between it and the mast on opposite sides of the latter, a sheave carried by the lower end of each link, a pair of sheaves connected with said support behind the lower end of the mast and below said link sheaves, cables connecting the upper and lower sheaves, means on said support for exerting tension on the cables to pull the link sheaves downward, and a third brace behind said short brace pivotally connected with the toggle and the upper section of the mast below the level at which the two sections of the mast are hinged together, whereby when the mast is swung rearward as said cables are paid out, said third brace will control tilting of the upper section of the mast forward and downward toward horizontal position while the cables and toggle control swinging of the lower section down onto said support.

6. A folding mast structure comprising a support, an upright mast pivotally connected at its lower end to the support, the central part of the mast being hinged at its front side to form upper and lower sections adapted to fold upon themselves in substantially horizontal position with the lower section resting on said support, a toggle formed from a long brace and a short brace hinged together, means pivoting the long brace to said support behind the lower end of the mast, the short brace straddling the mast and having its upper end pivotally connected to the front of the lower section of the mast near the upper end of that section, manually controlled means connected with the upper part of said long brace and with said support between the long brace and the mast for exerting downward tension on the upper part of the long brace, and a third brace behind said short brace pivotally connected with

the toggle and the upper section of the mast below the level at which the two sections of the mast are hinged together, whereby when the mast is swung rearward as said tension is released, said third brace will control tilting of the upper section of the mast forward and downward to horizontal position while said tension means and toggle control swinging of the lower section down onto said support.

7. A folding mast structure comprising a support, an upright mast pivotally connected at its lower end to the support, the central part of the mast being hinged at its front side to form upper and lower sections adapted to fold upon themselves in substantially horizontal position with the lower section resting on said support, a toggle formed from a long brace and a short brace hinged together, means pivoting the long brace to said support behind the lower end of the mast, means pivoting the short brace to the lower section of the mast near its upper end, manually controlled means connected with the upper part of said long brace and with said support between the long brace and the mast for exerting downward tension on the upper part of the long brace, and a third brace behind said short brace and substantially in line with the long brace, the third brace being pivotally connected with the toggle joint and the rear side of the upper section of the mast below the level at which the two sections of the mast are hinged together, whereby when the mast is swung rearward as said tension is released, said third brace will control tilting of the upper section of the mast forward and downward toward horizontal position while said tension means and toggle control swinging of the lower section down onto said support.

8. A folding mast structure comprising a support, an upright mast pivotally connected at its lower end to the support, the central part of the mast being hinged at its front side to form upper and lower sections adapted to fold upon themselves in substantially horizontal position with the lower section resting on said support, a toggle formed from a long brace and a short brace hinged together, means pivoting the long brace to said support behind the lower end of the mast, means pivoting the short brace to the lower section of the mast near its upper end, manually controlled means connected with the upper part of said long brace and with said support between the long brace and the mast for exerting downward tension on the upper part of the long brace, and a third brace behind said short brace pivotally connected with the toggle and the upper section of the mast below the level at which the two sections of the mast are hinged together, whereby when the mast is swung rearward as said tension is released, said third brace will control tilting of the upper section of the mast forward and downward to horizontal position while said tension means and toggle control swinging of the lower section down onto said support, and the adjoining ends of the three braces being located behind the lower side of the lower section of the mast when the mast is folded on said support.

9. A folding mast structure comprising a support, an upright mast pivotally connected at its lower end to the support, the central part of the mast being hinged at its front side to form upper and lower sections adapted to fold upon themselves in substantially horizontal position with the lower section resting on said support, a toggle formed from a long brace and a short brace hinged together, means pivoting the long brace to said support behind the lower end of the mast, means pivoting the short brace to the lower section of the mast near its upper end, manually controlled means connected with the upper part of said long brace and with said support between the long brace and the mast for exerting downward tension on the upper part of the long brace, and a third brace behind said short brace pivotally connected with the toggle and the upper section of the mast below the level at which the two sections of the mast are hinged together, whereby when the mast is swung rearward as said tension is released, said third brace will control tilting of the upper section of the mast forward and downward to horizontal position while said tension means and toggle control swinging of the lower section down onto said support, and the adjoining ends of the three braces being located behind the lower side of the lower section of the mast when the mast is folded on said support with said short brace extending forward and upward above the long brace and with said third brace extending rearward and upward to said upper section of the mast.

10. A folding mast structure comprising a support, an upright mast pivotally connected at its lower end to the support, the central part of the mast being hinged at its front side to form upper and lower sections adapted to fold upon themselves in substantially horizontal position with the lower section resting on said support, a toggle formed from a long brace and a short brace hinged together, means pivoting the long brace to said support behind the lower end of the mast, means pivoting the short brace to the lower section of the mast near its upper end, a pair of sheaves suspended from the upper part of said long brace between it and the mast on opposite sides of the latter, a pair of sheaves below said suspended sheaves, supporting members for the lower pair of sheaves connected with said support and arranged to support those sheaves above the mast when it is folded on the support, cables connecting the upper and lower sheaves, rotatable means on said support for reeling in the cables to pull the upper sheaves downward, and a third brace behind said short brace pivotally connected with the toggle and the rear side of the upper section of the mast below the level at which the two sections of the mast are hinged together, whereby when the mast is swung rearward as said cables are paid out, said third brace will control tilting of the upper section of the mast forward and downward toward horizontal position while the cables and toggle control swinging of the lower section down onto said support.

11. A folding mast structure comprising a support, an upright mast pivotally connected at its lower end to the support, the central part of the mast being hinged at its front side to form upper and lower sections adapted to fold upon themselves in substantially horizontal position with the lower section resting on said support, a toggle formed from a long brace and a short brace hinged together, means pivoting the long brace to said support behind the lower end of the mast, means pivoting the short brace to the lower section of the mast near its upper end, a pair of sheaves suspended from the upper part of said long brace between it and the mast on opposite sides of the latter, a pair of sheaves below said suspended sheaves, a pair of gin poles supporting the lower sheaves and pivoted to op-

posite sides of the support below them, cables connecting the upper and lower sheaves, rotatable means on said support for reeling in the cables to pull the upper sheaves downward, and a third brace behind said short brace pivotally connected with the toggle and the upper section of the mast below the level at which the two sections of the mast are hinged together, whereby when the mast is swung rearward as said cables are paid out, said third brace will control tilting of the upper section of the mast forward and downward toward horizontal position while the cables and toggle control swinging of the lower section down onto said support, said gin poles being adapted to swing downward when the tension on said cables is released.

12. Portable oil well drilling apparatus comprising a wheeled vehicle, a mast-supporting structure mounted on one end of the vehicle, drawworks mounted on the vehicle behind said structure, an upright mast pivotally connected at its lower end to said structure, the central part of the mast being hinged at its front side to form upper and lower sections adapted to fold upon themselves in substantially horizontal position with the lower section extending back across said drawworks, a toggle formed from a long brace and a short brace hinged together, means pivoting the long brace to said structure behind the lower end of the mast, means pivoting the short brace to the upper part of the lower section of the mast, manually controlled means connected with the upper part of said long brace and with said structure between the long brace and the mast for exerting downward tension on the upper part of the long brace, and a third brace behind said short brace pivotally connected with the toggle and the upper section of the mast below the level at which the two sections of the mast are hinged together, whereby when the mast is swung rearward as said tension is released, said third brace will control tilting of the upper section of the mast forward and downward toward horizontal position while said tension means and toggle control swinging of the lower section down onto said vehicle.

13. Portable oil well drilling apparatus comprising a wheeled vehicle, a mast-supporting structure mounted on one end of the vehicle, drawworks mounted on the vehicle behind said structure, an upright mast pivotally connected at its lower end to said structure, the central part of the mast being hinged at its front side to form upper and lower sections adapted to fold upon themselves in substantially horizontal position with the lower section extending back across said drawworks, a toggle formed from a long brace and a short brace hinged together, means pivoting the long brace to said structure behind the lower end of the mast, means pivoting the short brace to the upper part of the lower section of the mast, a pair of links pivotally suspended from the upper part of said long brace between it and the mast on opposite sides of the latter, a sheave carried by the lower end of each link, a pair of sheaves below said link sheaves, a pair of gin poles pivoted to opposite sides of said structure below the lower end of said long brace and inclined forward and upward to support the lower pair of sheaves, cables connecting the upper sheaves with the lower sheaves, rotatable means in said structure for reeling in the cables to pull the upper sheaves downward, and a third brace behind said short brace pivotally connected with the toggle joint and the upper section of the mast below the level at which the two sections of the mast are hinged together, whereby when the mast is swung rearward as said cables are paid out, said third brace will control tilting of the upper section of the mast forward and downward toward horizontal position while the cables and toggle control swinging of the lower section down onto said vehicle, and said gin poles being adapted to swing downward by gravity when the tension on said cables is released.

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No references cited.