This invention relates to portable drilling rigs and particularly to such a rig having a telescoping and foldable mast carried by a trailer frame and wherein the mast may be moved from erected to lowered position on said trailer frame for transportation.

Portable drilling rigs of the above general description have been known heretofore but such rigs have been unsatisfactory in certain respects and for certain purposes. A rig of this type is often used for servicing, such as cleaning out wells that have been previously drilled and in productive operation for a period of time. Customarily such wells are provided with more or less permanent surface installations including large numbers of valves, T-connections and pipes above the surface of the ground at the mouth of the well. Such installations often extend to a height of four to six feet. A portable rig suitable for servicing such a well should be of such construction that it can be placed in position adjacent the surface installations with all parts thereof clear of said structures. Such a rig should be capable of being put into operation without the dismantling of such permanent structures.

The rig of the present invention was designed with the above problems in mind and includes a trailer or semi-trailer frame having a mast pivoted thereto adjacent the rear end thereof which mast may be swung to an erected position without any portion of the base thereof swinging beyond the rearmost extremity of the trailer frame during erecting movements. The rig of the present invention is so designed that a rotary table and its supporting frame may be supported thereby at a sufficient height to completely clear the usual surface installations at the well being serviced.

It is an object of this invention to provide a portable drilling rig of simple construction and yet efficient in operation.

It is another object of this invention to provide a portable drilling rig carried by a trailer frame in which the same frame is readily adapted to be supported directly by the ground during operation to thus relieve the wheels of the added weight and to provide a stable base.

Another object of this invention is to provide a portable drilling rig having a pivoted mast which may be swung from horizontal to vertical position without any portion thereof "sweeping" beyond the boundaries of the trailer frame.

It is a still further object of this invention to provide a portable drilling rig in which hydraulic cushioning means are provided to gently ease a pivoted mast to its final erected position and to assist in starting the mast from said erected position for lowering thereof.

It is a still further object of this invention to provide a portable drilling rig that may be set up over an existing well having permanent surface installations wherein all parts of the drilling rig are supported clear of said installations.

Further objects and advantages of this invention will appear to those skilled in the art as the following description proceeds with reference to the accompanying drawings wherein:

Figure 1 is a side elevational view of an embodiment of the present invention in position over a well;

Figure 2 is a fragmentary side elevation of the rig of Figure 1 with the mast still in lowered position;

Figure 3 is a view similar to Figure 2 but showing the mast in partially erected position;

Figure 4 is a view similar to Figures 2 and 3 but showing the mast in completely erected position;

Figure 5 is an end view, as seen from the left of Figure 3, of the rig with the mast partially erected;

Figure 6 is a plan view, taken substantially along the line 6—6 of Figure 1 showing the trailer frame in elevation and certain portions of the mast in section; and

Figure 7 is a sectional view taken substantially along the line 7—7 of Figure 1 and showing the racking platform and pipe rack in plan.

The drilling rig of the present invention comprises a main trailer frame of suitable configuration supported by a plurality of wheels. Although the embodiment illustrated is shown as being supported by the wheels, it is to be understood that other means, such as endless tread carriages, may be provided instead of wheels, to support the frame for road movement. If desired, the forward end of the frame could be supported by additional wheels similar to those shown at 2 or additional endless tread carriages to make the frame a self-supporting full trailer rather than the semi-trailer shown. A mast comprising a lower section 8 and an upper section 6 is pivoted to the trailer frame at 7. The upper section 6 of the mast is of smaller sectional dimension than the lower section 8 and extends into said lower section in telescoping relation thereto (Fig. 7).
whereby it may be extended to the position shown in Figure 1 or lowered within the section 5 to reduce the length of the mast before lowering to the trailer. The dotted line showing of Figure 1 indicates the position occupied by the mast when telescopeically collapsed and lowered for road travel. In its lowered position, the mast is supported at the forward end of the trailer by a suitable support 8 carried by the trailer frame 1. If desired, the support 8 may be made adjustable in height whereby to accommodate trucks or tractors 4 of different overall height.

A racking platform 9 is pivoted as at 10 to the upper end portion of the lower mast section 5 whereby it may be swung to the extended position shown in Figure 1 when the mast is erected and may be supported in that position as by such mean as tubular brace 11 extending from the outer edge thereof to the lower mast section. If desired, other well-known means could be provided for supporting the platform 9 in extended position.

Telescopic hydraulic jacks 12 are pivoted at 13 to the frame 1 and at 14 to the lower mast section 5 and extend thereof. The telescopic jacks 12 comprise hollow tubular sections telescopeically related and fit within each other in a fluidtight manner whereby the admission of fluid under pressure to the interior of the jacks will cause extension of the sections and effect lifting of the mast from its lowered position.

The hydraulic jack contemplated is of known construction and need not be described in greater detail. When the mast is in lowered position on the frame 1, the jacks 12 will be collapsed to their fullest extent and will occupy the position indicated in Figure 2. Two such jacks are provided, one on each side of the frame 1 and extending to laterally opposite sides of the mast frame. Fluid under pressure is supplied to the jacks by means of any suitable high pressure oil pump or the like (not shown).

The mast sections are preferably constructed of tubular alloy metal which may be welded into the form of structure illustrated.

The two forward legs of the mast are pivoted to the trailer frame 1 at 7 and the lower mast section of the two rearmost legs of the section 5 are provided with bearing plates 15 extending generally horizontally when the mast is erected and laterally inwardly toward each other (see Fig. 5). Preferably gussets 10 and diagonal braces 11 and 12 are welded into the structure to properly reinforce the plate 15. Extending downwardly from each of the bearing plates 15 is a projection 16 which forms a support to be engaged by the upper end portions of vertical compression members 17 of the frame 1. The compression members 17 are rigidly carried by the trailer frame 1 and the rear end of each of the compression members 17 is pivotally attached to the frame 1 at 18 and constitute the rearmost portions of the said frame. As shown, and as contemplated, the uppermost surfaces 18 of the compression members 17 are slightly higher than the horizontal axis 1 about which the mast section 5 is pivoted and the lengths of the legs of the mast section 5 are so related that when the projections 16 are resting upon the surfaces 18 of the compression members 17, the mast will be tilted rearwardly so that its upper end is over a point rearwardly of the trailer frame 1. By the construction described, it will be evident that swinging movements of the mast about the axis 1 will cause the members 16 to swing on an arc entirely within the boundaries of the frame 1, thus eliminating the danger of the member 16 engaging and juring any portion of the permanent installations at the surface of the well being serviced.

Each of the vertically extending compression members 17 is further provided with a hydraulic jack or bumper 19 (Fig. 5) near the upper end thereof. Each of the jacks 19 includes an upwardly extending plunger 20 carrying a roller 21 at its upper end. The plungers 20 and rollers 21 are in position directly below a portion of the bearing plates 15 previously described.

As is apparent from Figures 1 to 5, erecting movements of the mast about the axis 1 will result in the mast being swung upwardly until its longitudinal center line is vertical and through said vertical position to the rearwardly tilted position of Figures 1 and 4. The hydraulic jacks 12 will effect controlled movement of the mast to a position where its center of gravity is over the axis 7. Continued movement beyond that position will be outside the control of the jacks 12 since gravity alone would cause the mast to swing suddenly from that position to the position of Figure 1 and considerable damage could result.

To control the movements of the mast about the position where its center of gravity is over the axis 1, the jacks 19 are so conditioned that the plungers 20 are extended upwardly to position the rollers 21 at a sufficient height to engage the bearing plates 15 on the base of the mast at about the time the center of gravity of the mast reaches a position over the axis 1. The rollers 21 will be urged to their uppermost position by the action of a fluid under pressure in the jacks 19. As the bearing plates 15 approach the rollers 21, as above described, means operated by the cylinder 15 of the jacks 12 (not shown) act to open outlets from the cylinders of the jacks 15 to permit the fluid therefrom to escape at a controlled low rate to thereby effect gentle lowering of the front legs of the mast to the positions of Figures 1 and 2 where the projections 16 rest firmly upon the surfaces 18 of the compression members 17. After a job has been completed and preparations made for lowering the mast, fluid will be pumped into the jacks 15 to thereby raise the outer or rearmost legs at the base of the mast section 5 sufficiently to throw the weight of the mast on the jacks 12 which will effect controlled lowering movement of the mast structure.

As pointed out previously, the outermost legs of the mast section 5 rest upon compression members 17; likewise each of the two spaced points along the mast 1 are carried by vertical compression members 22, also rigidly carried by the trailer frame 1. Each of the compression members 17 and 22 extends downwardly toward the ground to a position not far from the surface thereof and a screw jack, or the like, 23 is carried by a bracket 24 near the lowermost end of each of the compression members 17 and 22. As the trailer frame is moved into position adjacent the well to be serviced, bearing elements 25, which may be planks, timbers, or the like, are placed on the ground below the jacks 23 and the said jacks are lowered to engage the upper end of the trailer frame and all of the structures carried thereby. Thus, the weight of the mast and any load carried thereby are transmitted directly to the ground through the compression members 17 and 22. Additional jacks 26 are positioned at spaced points longitudinally of the trailer frame to further assist in supporting the weight thereof to provide a stable base for operation of the rig.

Guy wires or cables 28, 29 and 30 extend from spaced points along the mast to relatively fixed positions on the ground or trailer frame and may
be augmented by laterally extending guys from the mast to the ground, all for the purpose of steadying and rigidifying the mast structure when in operation. The trailer frame is preferably provided with a cross brace (Fig. 5) and brackets or plates 35 attached thereto and to the compression members 11. The brackets or plates 35 are provided with suitable openings to which are attached supporting beams 37 for a table 37. The table 37 of the table 37 is supported by a suitable framework 38 having a platform 39 thereon. The table 37 is adapted to receive a rotary table 40 of known construction with its center directly below the uppermost end of the tilted mast. The dimensions and proportions of the rig are such that the table 37 is supported a substantial distance above the surface of the ground, a distance sufficient to accommodate all of the permanent surface installations usually encountered at wells being serviced.

The invention may be provided with suitable engines 41 and 42 mounted directly on the trailer frame and extending longitudinally thereof to enable the device to be constructed with minimum width. The engines are provided with drive means 43 and 44, respectively, to the draw works and rotary table. The draw works may include a drilling drum 45 and a sand line drum 46. The drums referred to, along with a cathead shaft and any other usual draw works elements, are each individually mounted directly on the trailer frame so that the trailer frame serves also as a draw works frame without the necessity of providing a separate frame for the latter purpose mounted directly on the trailer frame and located closely adjacent the mast to enable an operator to be relatively close to the rotary table and well center. The operator or driller normally takes a position relatively close to the said drums in convenient position to operate the controls therefrom. Cables from the drums extend upwardly, as indicated in the drawings, over suitable sheaves 47 at the top of the mast and thence to the block 48 or other equipment. It will be noted that the block 48 extends downwardly from the top of the mast in line with the center line of the well and rotary table 40.

The racking platform 9 is of more or less conventional construction and includes walkways 50, 51 and 52 and railings 53. The side frame elements 54 of the platform are provided with a plurality of adjustable fingers 55, adjustable as to relative spacing to accommodate therebetween the upper end portions of pipe drawn from the well. As each section of pipe is removed from the well an operator on the platform 52 causes the pipe to be swung sidewardly toward the fingers 55 and then lowered to rest upon the table 53. The upper portions of the said pipe sections are then placed in the spaces between fingers 55 to "rack" the pipe sections that have been removed.

Control means 56, comprising clutch controls and brake levers, are grouped adjacent the walkways 50, 51 and 52 close to the cathead drum 45 and 46 where they are readily accessible to an operator of the rig. The rig may also include suitable transmission means 57 for transmitting power to the rotary table 40 and may include catheads 58. As clearly evident from Fig. 6 of the drawings, the winders controlling the cathead, an essential part of the driller's position, are located forwardly of the cathead 58. During most operations involving the cathead drum a catline will extend therefrom toward the platform 37 and clearly such line will extend away from the driller's position without passing his position or extending close to his person. Such an arrangement is clearly advantageous since it eliminates some of the danger of accidents that often result when the catline extends past the driller or operator in close proximity to his person. The table 37, the frame 38, and the platform 39 are not permanently connected to the portable rig described but it is intended that they be transported by some other means, such as a separate truck.

As shown in the drawings, a suitable cover 60 is provided over the draw works and is provided with a pair of openings 61 and 62 through which the cables from the drilling drum and sand line drum extend.

Although a single specific embodiment of the invention has been illustrated and described, it is to be understood that the invention is to include all modifications falling fairly within the scope of the appended claims.

1. In a portable drilling rig, a trailer frame, a mast pivoted to said frame on a horizontal axis adjacent the rear end thereof, said mast having a base portion at its lower extremity, the rear extremities of said base portion resting upon the rear edge of said frame when said mast is erected position, the distance from said axis to the rear extremities of said base portion being substantially equal to the horizontal distance from said axis to the said rear edge of said frame whereby no portion of the base of said mast projects rearwardly beyond said trailer frame during swinging movements of said mast about said axis, said mast extending upwardly and rearwardly, when in said erected position, to position the upper end thereof rearwardly of the rear extremity of said trailer frame.

2. In a portable drilling rig, an elongated trailer frame including vertically extending compression members at the rear extremity thereof, a mast pivoted to said frame on a horizontal axis forwardly of said compression members, said mast having a base portion, the rear extremities of said base portion resting on the tops of said compression members when said mast is in erected position, and extensible hydraulic jacks carried by said compression members, said jacks being extendible to position the upper portions thereof above the said tops of said compression members to engage a portion of said base while above said compression members and to lower said base gently to said members, and rollers on the upper portions of said jacks to engage bearing plates on said mast base portion.

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REFERENCES CITED

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

UNITED STATES PATENTS

<table>
<thead>
<tr>
<th>Number</th>
<th>Name</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>292,825</td>
<td>Kim</td>
<td>Feb. 5, 1884</td>
</tr>
<tr>
<td>2,151,857</td>
<td>Suth</td>
<td>Mar. 21, 1939</td>
</tr>
<tr>
<td>2,176,731</td>
<td>Cleare</td>
<td>Oct. 17, 1939</td>
</tr>
<tr>
<td>2,183,867</td>
<td>Johansen</td>
<td>Dec. 19, 1939</td>
</tr>
<tr>
<td>2,204,716</td>
<td>Woody</td>
<td>June 18, 1940</td>
</tr>
<tr>
<td>2,314,323</td>
<td>Alexander</td>
<td>Jan. 23, 1943</td>
</tr>
<tr>
<td>2,332,479</td>
<td>Woolslayer et al.</td>
<td>Oct. 19, 1943</td>
</tr>
<tr>
<td>2,344,383</td>
<td>Alexander et al.</td>
<td>Mar. 14, 1944</td>
</tr>
<tr>
<td>2,354,922</td>
<td>McEwen et al.</td>
<td>Aug. 1, 1944</td>
</tr>
<tr>
<td>2,495,563</td>
<td>Woolslayer et al.</td>
<td>Jan. 24, 1950</td>
</tr>
</tbody>
</table>