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APPARATUS AND METHOD FOR MULTIPLE WELL DRILLING

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5 Sheets-Sheet 1

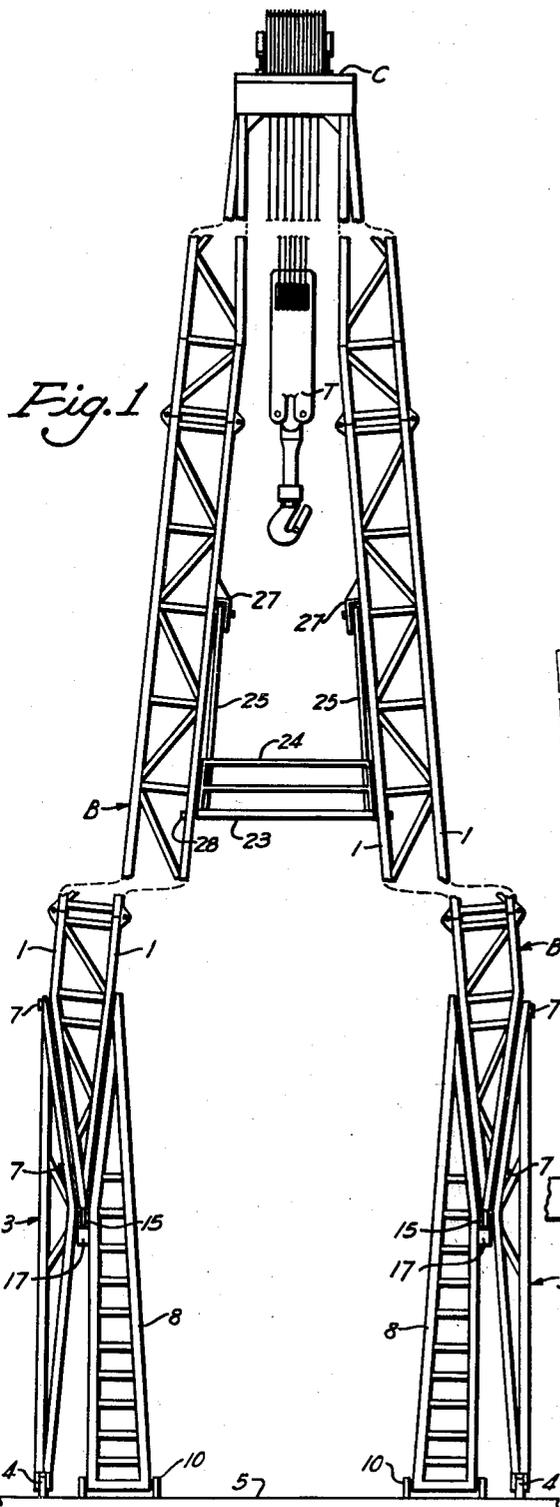


Fig. 1

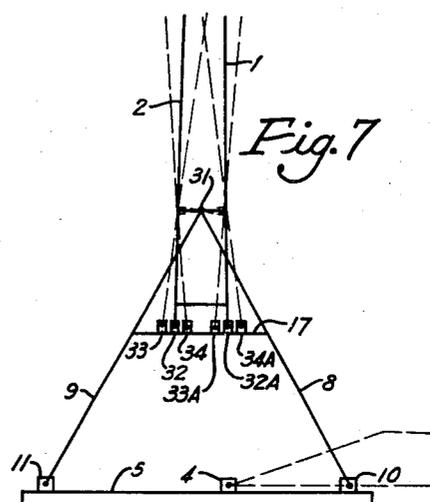


Fig. 7

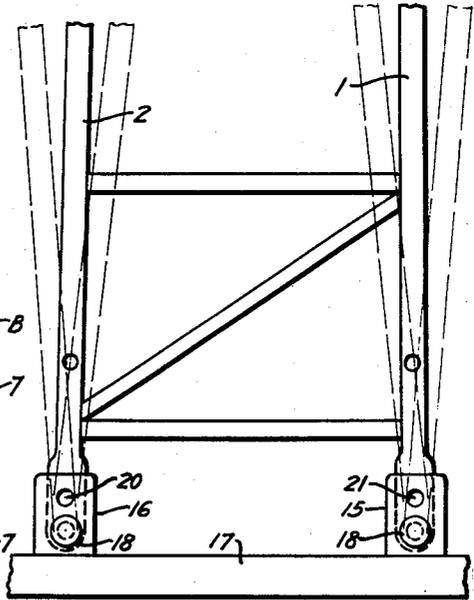


Fig. 3

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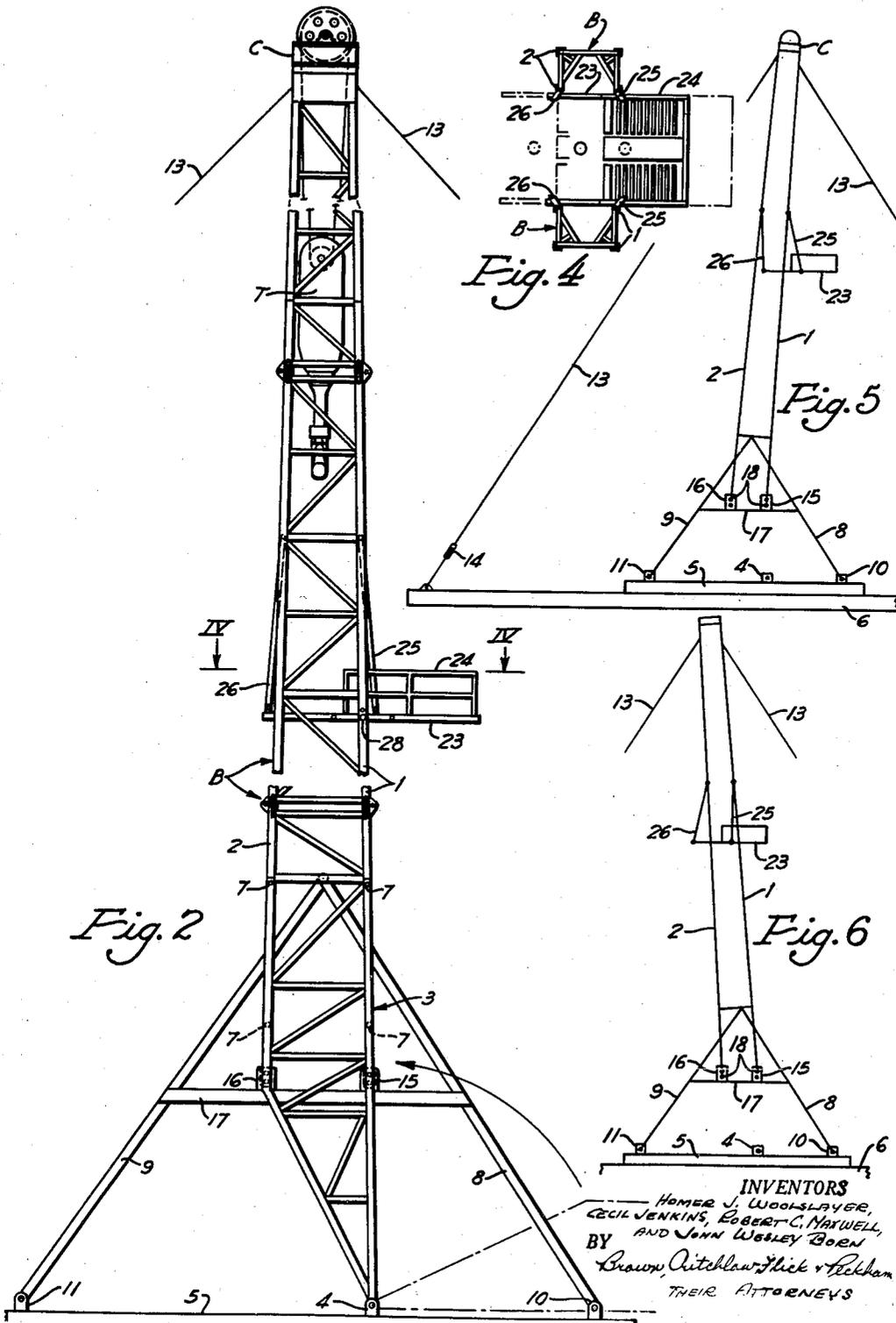
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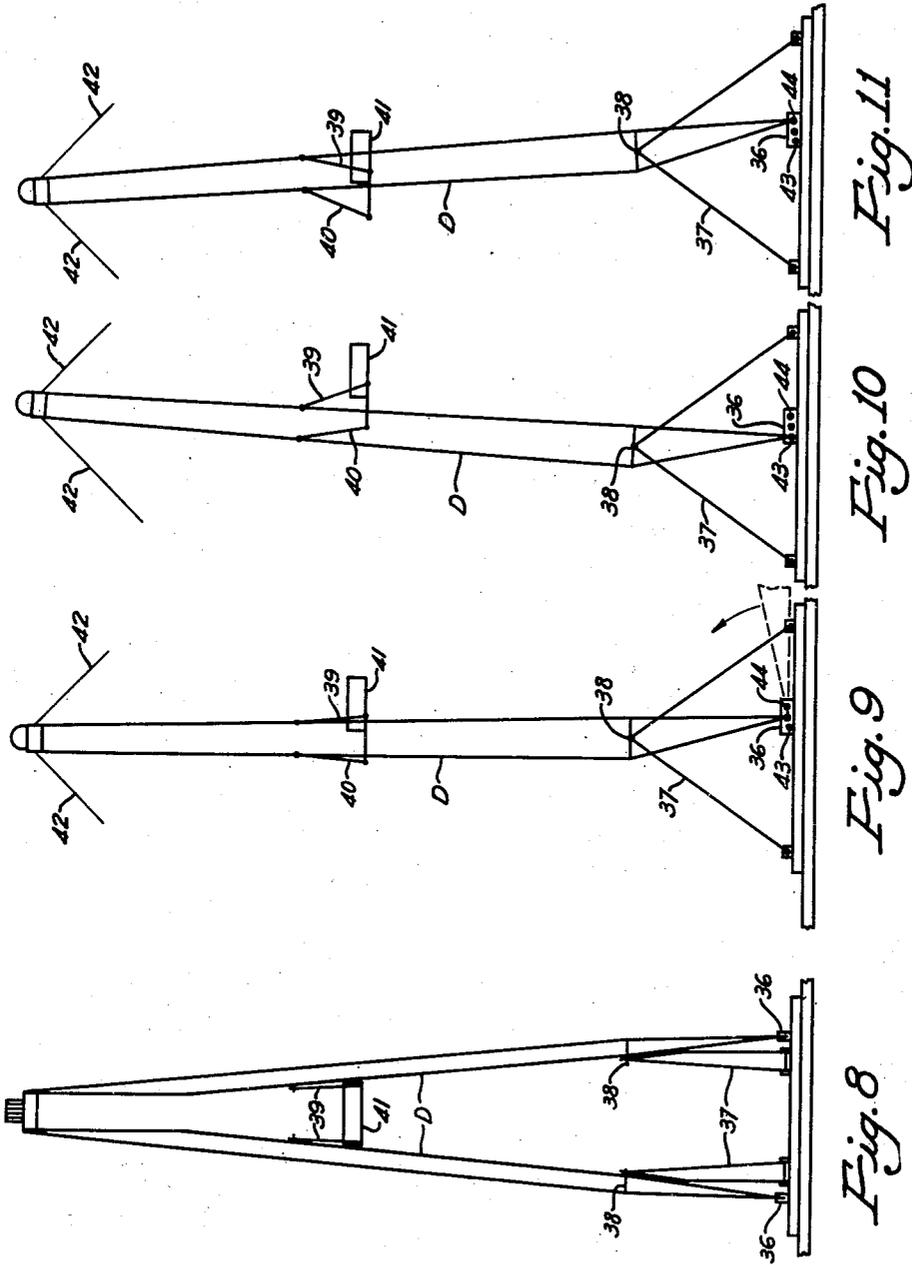
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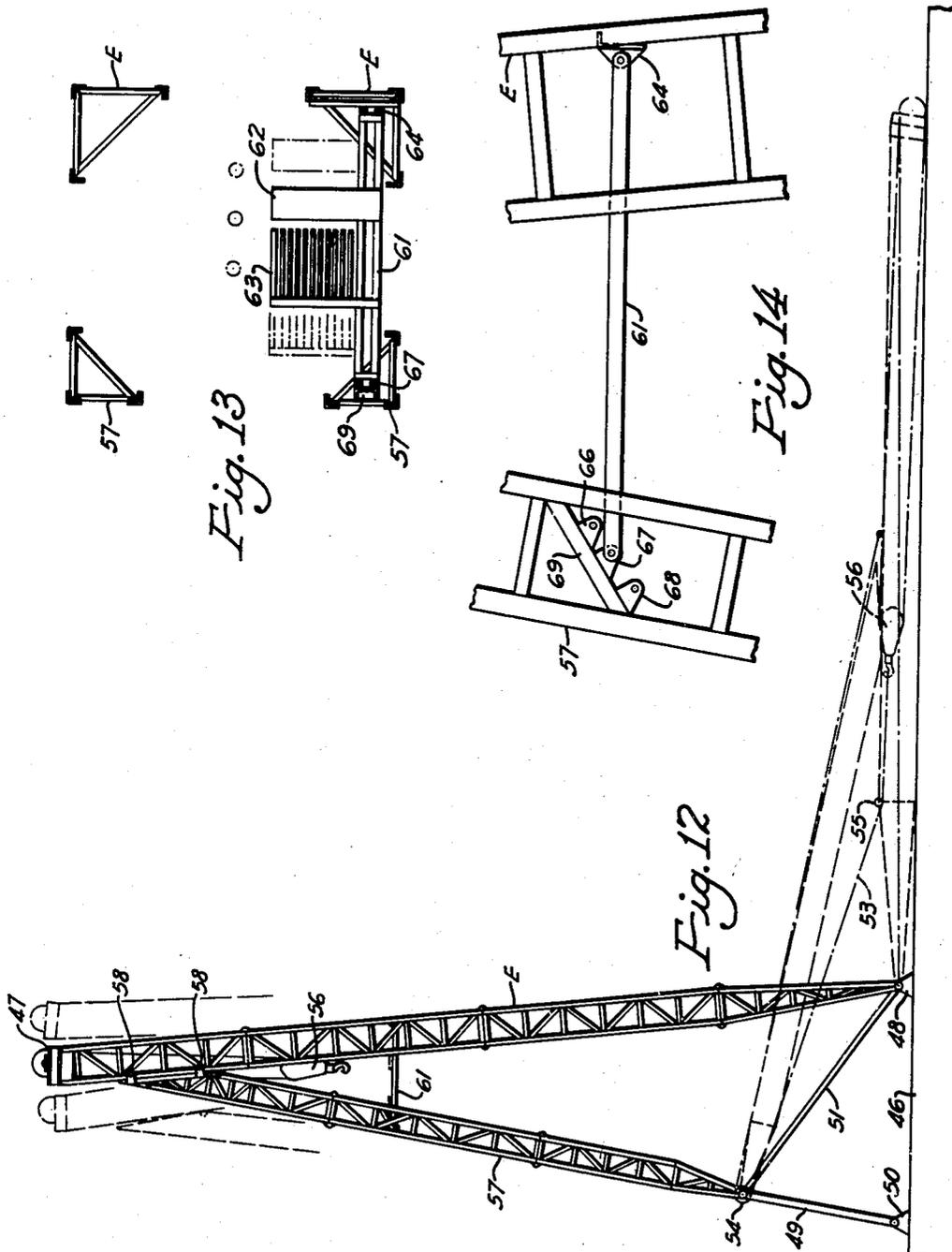


Fig. 13

Fig. 14

Fig. 12

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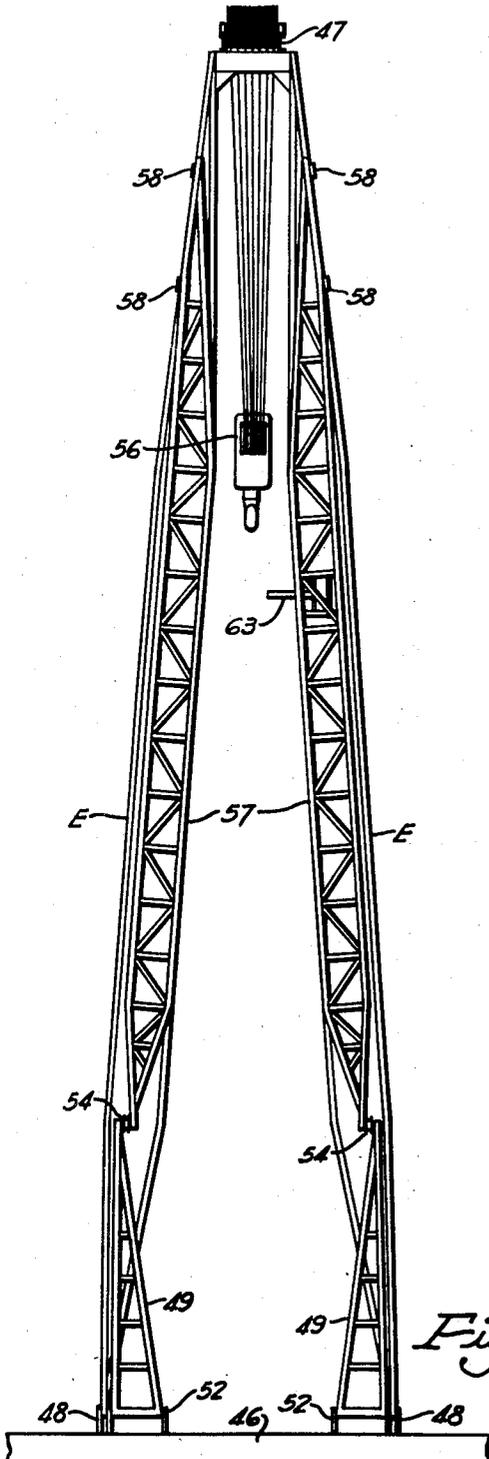


Fig. 15

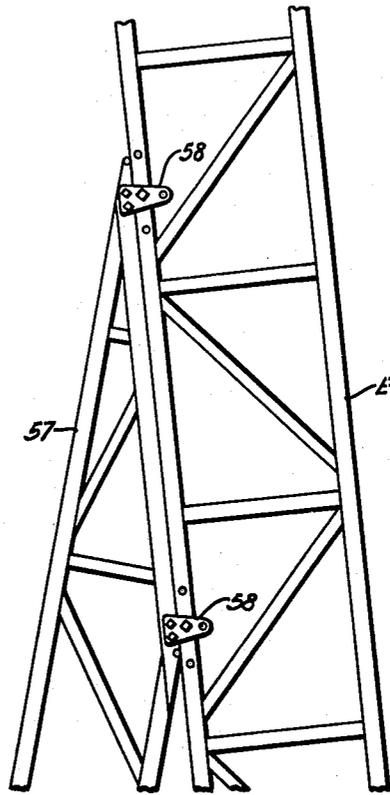


Fig. 16

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APPARATUS AND METHOD FOR MULTIPLE WELL DRILLING

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Application December 23, 1955, Serial No. 555,080

6 Claims. (Cl. 189—11)

This invention relates to the drilling of two or more oil wells close together without moving the base on which the drilling apparatus is mounted.

For many years there have been two general ways of drilling oil wells. One way has been to erect a conventional oil well derrick and drill a well with it, and then either leave the derrick for service work and build a new one for the next well, or dismantle the derrick and rebuild it at the second well. The other system has been to use a portable mast which is moved from one location to another along with its base or substructure and all of the drilling equipment. Recently a new practice has grown up in certain locations, according to which two or more wells are drilled close together without moving the derrick and its base. Modern drilling methods permit wells to be drilled as close as only a few feet apart at their upper ends. As the wells descend they curve away from one another toward the desired underground locations. In such an operation it has been necessary to use a derrick that is large at top and bottom so that the crown block can be shifted to different locations on top of the derrick to position it over the locations of the different wells that are to be drilled within the confines of the bottom of the derrick. This multiple well drilling practice has developed because of the extremely high cost of preparing drilling sites in such locations as off-shore and mountain sides. Such a derrick obviously is a massive and very expensive structure that also has the same objections as conventional derricks used in single well drilling.

It is among the objects of this invention to provide a method and apparatus for drilling a plurality of closely spaced wells without moving the base that supports the drilling equipment, in which a portable mast is used that is no larger than necessary for drilling a single well, and in which the top of the mast can readily be shifted from above one well location to another without lowering the mast.

In accordance with this invention a substructure or base is provided which can be placed in fixed position over the site of a line of two or more wells that are to be drilled. An upright drilling mast is located on the base in position to drill a well. Mounted on the base beside the mast there is a gin pole which is used in raising the mast and supporting it. There is a pivotal support for the mast so that it can be tilted to locate the upper end of the mast in another well-drilling position, in which means are provided for holding the mast. This pivotal support may be either on the gin pole or on the base. When all of the drilling has been completed, the gin pole aids in swinging the mast down to reclining position for removal from the base.

The invention is illustrated in the accompanying drawings in which

Fig. 1 is a front view of our well drilling apparatus; Fig. 2 is a side view thereof;

Fig. 3 is an enlarged fragmentary side view of the portion of the mast attached to the gin pole;

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Fig. 4 is a horizontal section taken on the line IV—IV of Fig. 2;

Figs. 5 and 6 are schematic views illustrating how the mast is tilted into two other well drilling positions;

Fig. 7 is a fragmentary schematic view of a modification;

Fig. 8 is a schematic front view of another embodiment of the invention;

Figs. 9, 10 and 11 are side views showing the mast in three different well drilling positions;

Fig. 12 is a side view of a further modification;

Fig. 13 is an enlarged horizontal section taken on the line XIII—XIII of Fig. 12;

Fig. 14 is an enlarged fragmentary side view of the mast taken at platform level;

Fig. 15 is a rear view of the mast shown in Fig. 12; and

Fig. 16 is an enlarged detail drawing showing the connection between the upper part of a brace and the adjoining boom.

Referring to Figs. 1 and 2 of the drawings, the mast is formed from two laterally spaced booms B that are inclined upwardly toward each other and support a crown block C, from which a travelling block T is suspended. Each boom has a pair of main front legs 1 that come together at their lower ends several feet above the foot of the boom, and a pair of rear legs 2 which likewise come together at their lower ends at the same level. Each boom also includes at its lower end a removable section 3 that extends down below the lower ends of the main legs to a shoe 4 on a suitable base 5 which generally will be mounted on a larger platform 6 (Fig. 5). Each removable section may be secured to the rest of the adjoining boom by bolts 7. The base extends lengthwise of the line of wells that are to be drilled; that is, the base extends forward from the drawworks (not shown) along the line of wells.

The mast is supported in upright (not necessarily vertical) operative position by a gin pole, which consists of a pair of front legs 8 connected at their upper ends to a pair of back legs 9. The upper parts of all of the gin pole legs are disposed between the mast booms. The lower ends of the back legs are mounted in shoes 11 behind the mast. The legs of the gin pole will be referred to herein collectively as the gin pole, even though the opposite sides of the pole are not connected together.

The mast can be raised to upright position from a reclining position, indicated by broken lines in Fig. 2, by swinging the mast upward on its shoes 4 in a well-known manner with the aid of a sling (not shown) connected with the top of the gin pole and attached to the traveling block T. When the mast is upright it can be connected to the top of the gin pole by suitable means to improve the structural rigidity, if desired, but that is not absolutely necessary because guy lines are used anyway in order to obtain the advantages of this invention. The guy lines 13 are connected to the top of the mast and extend forward and backward and down to suitable anchorage points, such as the ends of the platform 6, on which the base is mounted. Suitable means, for example turnbuckles 14, may be provided for lengthening and shortening the lines.

When the mast is swung up into the position shown in Fig. 2, the lower ends of the main legs 1 and 2 of each boom swing into front and rear brackets 15 and 16 mounted on a horizontal supporting beam 17 rigidly connecting the front and rear legs of the gin pole. The legs are then connected to the lower part of these brackets by removable pins 18. After this connection has been made, the removable section 3 of each boom can be disconnected from the rest of the boom and stored away in some other location until it is time to lower the mast. By removing these lower portions of the booms,

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the mast does not in any way obstruct the working area on the base.

Another feature of this invention is that after a well has been drilled, the mast can be tilted either forward or backward to position the crown block over the location of a second well to be drilled. This tilting of the mast is accomplished by the guy lines 13 and turnbuckles. In tilting the mast forward for example, as shown in Fig. 5, the rear guy line is lengthened and the front line is shortened. However, before this can be done the back legs 2 of the mast must be disconnected from the rear supporting brackets 16 so that the mast can swing forward on the pins 18 in the front brackets 15. The mast is tilted until its rear legs can be pinned to the rear brackets through an upper set of holes 20, with which the brackets are provided. The mast then is held by all of the supporting brackets and the guy lines while the second well is drilled in front of the first one.

A third well can be drilled by tilting the mast backward as shown in Fig. 6. This is done after its back legs have first been returned to their original position in the rear brackets 16 and its front legs have been disconnected from the front brackets so that the mast can pivot on the pins 18 in the rear brackets. When the mast has been tilted, its front legs are connected to the upper parts of the front brackets through upper holes 21. Due to the lack of any cross members between the two booms, there are no obstructions to interfere with the drilling lines and the traveling block while the mast is tilted.

Following the drilling of the three wells in the manner just described, the mast is swung upright again and then the removable sections 3 are returned to the base, pivoted to the mast shoes 4 and swung up beside boom legs 1 and 2. As soon as the removable sections have been fastened to those legs by bolts 7, the legs are disconnected from brackets 15 and 16 so that the entire mast can be swung forward and down to the ground for separation from the base.

A further feature of this invention is that regardless of whether the mast is vertical or in its forward or backward tilted position, the racking platform remains horizontal and is located in the correct position relative to the well being drilled. The platform may be constructed in various ways but in general it has a horizontal frame 23 that extends between the booms and in front of the upright mast. The projecting portion of the frame supports a guard rail 24. The frame is suspended by means of front and rear pairs of suspension links 25 and 26 pivotally supported at their upper ends by brackets 27 (Fig. 1) on the inner faces of the booms. The lower ends of the rear pair of links 26 are pivotally connected to the rear end of the platform frame, while the lower ends of the front links 25 are pivotally connected to the frame about midway between its front and rear ends. The two pairs of links are not parallel to each other, but diverge downwardly as shown in Fig. 2. They are disposed at an angle such as to hold the platform level when it swings forward relative to the forwardly tilted mast or backward relative to the rearwardly tilted mast, as shown in Figs. 5 and 6, respectively. This swinging of the platform relative to the mast also locates the platform in the correct position for the well being drilled at the time. While the mast is upright, the platform is held against swinging by removable bolts 28 extending through the front legs of the mast and the sides of the platform frame. These bolts also are used for connecting the platform to the mast after the latter has been tilted in either direction and the platform has swung in or out to the correct position.

With the apparatus just described, a line of at least three wells can be drilled without moving the base or the gin pole. Of course, if the base is skidded sideways on platform 6, a second line of wells can be drilled beside the first line. In addition to being able to use a portable

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one-well type of mast that can be swung up and down between reclining and upright positions, another advantage of this apparatus is that several wells can be drilled without moving the crown block relative to the mast and without lowering the mast.

In the modification shown in Fig. 7, the mast, while its removable sections are still secured to its lower end, is swung up on shoes 4 to upright position in the same way as described above. The mast then is connected to the top of each side of the gin pole by a removable pivot 31, and the lower ends of the main legs 1 and 2 are connected in spaced brackets 32 and 32A mounted on the supporting beam 17 that connects the front and back legs 8 and 9 of the gin pole. After the removable sections of the mast booms have been taken away, the mast can be used for drilling the first well. To drill a second well in front of the first one, the mast is disconnected from the brackets and then is tilted forward on pivots 31 by guy lines or the like, as previously described. In its tilted position, the lower end of the mast is connected to another set of brackets 33 and 33A on the supporting beams. After the second well has been drilled, the mast can be disconnected from the brackets and swung back on pivots 31 to locate its crown block over the location of a third well behind the first two. In this position, the mast is connected to a third set of brackets 34 or 34A on the supporting beam. To lower the mast after drilling has been completed, the mast is swung upright again, the removed sections are reconnected to shoes 4 and the rest of the mast, the pivotal connection of the mast to the top of the gin pole is removed, and then the mast is swung forward and down to the base 5.

A further embodiment of this invention is disclosed in Figs. 8 to 11. As shown in Fig. 8, the mast has the same general appearance from the front or back as the one shown in Fig. 1, except that the lower parts of the booms D are not removable. Instead, the mast, after it has been swung upwardly on shoes 36 from reclining position, is detachably connected to the top of the opposite sides of the gin pole 37 by removable pivots 38. Suspended between the booms by pivotal links 39 and 40 is a self-leveling racking platform 41 like the one described earlier herein.

After the mast has been used for drilling the first well, it is tilted forward or backward on pivots 38 to drill a second well and then it is tilted in the opposite direction to drill a third well, all as indicated in Figs. 9, 10 and 11. The tilting is accomplished by suitable means such as guy lines 42 attached to the top of the mast, after the foot of the mast has been disconnected from the center holes in shoes 36. When the mast has been tilted forward, its foot is connected to the rear holes 43 in the shoes to help hold the mast. After being tilted in the opposite direction, the foot of the mast is connected to the front holes 44 in the shoes. After all three wells have been drilled, the mast can be swung upright again and reconnected to the center holes of the shoes, following which it is disconnected from the top of the gin pole and swung down to the ground, or the mast can be swung down directly from any one of its three positions. Of course, the shoes shown are only for the purpose of illustrating the invention in general and separate shoes could just as well be used for each of the three positions of the mast, if desired.

It will be observed that in each drilling position of the mast, the racking platform 41 is level and is correctly located relative to the center line of the well being drilled. This particular drilling apparatus accomplishes the same thing as the one first described and does it in a somewhat simpler manner, but the lower parts of the mast booms are not removed and therefore the working space on the base is obstructed more than it is with the first mast.

A still further form of the invention, with which at least three wells can be drilled without moving the base 46, is illustrated in the remaining figures of the drawings. As

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there shown, the mast again is formed from a pair of laterally spaced booms E connected at their upper ends by a crown block 47 and hinged to the base in shoes 48. In this case, however, the gin pole is located behind the mast. It has nearly vertical back legs 49 mounted in rear shoes 50 a considerable distance behind the mast shoes, and inclined front legs 51 that slope down from the top of the rear legs to shoes 52 (Fig. 15) mounted between the mast shoes. The mast may be raised from its dotted line reclining position by a sling 53, attached to the back of the mast and extending back around sheaves 54 carried by the top of the gin pole and then forward again under sheaves 55 mounted in the back of the mast. This lower end of the sling is connected to the traveling block 56 in the mast. When the block is pulled toward the crown block in the usual way by the drawworks (not shown), the mast is swung upward on its shoe 48 to upright operative position, which may be vertical or slightly inclined.

To hold the mast upright, it leans against the upper ends of a pair of trussed braces 57, the lower ends of which are pivoted to the top of the gin pole. The braces are rigidly connected to the upper part of the mast booms to hold them in place, by means of connection plates 58 (Fig. 16) secured to the upper ends of the braces and removably bolted to the booms. The plates are provided with holes that will align with corresponding holes in the booms for each drilling position of the mast.

After the mast has been erected, a racking platform is hoisted up to the proper level and connected to one of the braces and booms. The platform includes a narrow horizontal frame 61 extending lengthwise of the base and from which a footboard 62 and the pipe racking rake 63 project toward the opposite side of the mast. The front end of the frame is pivotally connected at 64 to the adjoining boom, and the rear end of the frame is detachably connected to one of three pairs of brackets 66, 67 and 68 projecting forward from the lower surface of an inclined channel 69 mounted in the adjoining brace 57. The three pairs of brackets are so positioned that when the mast is in the position shown in Fig. 12, the platform frame should be connected to the middle pair. When the mast is swung to its forward position, the platform will be fastened to the upper pair of brackets. The lower pair is used when the mast is drilling the rear well.

Fig. 12 of the drawings shows the mast in a position for drilling a second well. The first well was drilled with the mast in the more vertical dotted line position and with the rake and footboard of the racking platform moved farther forward on the frame, as is indicated in broken lines in Fig. 13. After the first two wells have been drilled, the top of the mast is disconnected from the braces while it is held by a snubbing line, and then the mast is allowed to tilt farther backward to the rear dotted line position in Fig. 12, where it is again secured to the upper ends of the braces. The racking platform is adjusted accordingly for drilling operations in this position of the mast. After all three wells have been drilled and the platform removed, the mast is disconnected from the upper ends of the braces and is pulled forward by the snubbing line until the sling is put under tension. Then the mast is lowered to reclining position by allowing the traveling block to descend in the 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. 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 multiple well drilling derrick comprising a base, an upright mast on the base in a well drilling position, a gin pole mounted in tilt position on the base, means

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pivotally supporting the mast at the top of the gin pole so that the mast can be tilted to locate its upper end in another well drilling position, and means for connecting the foot of the mast to the base in different locations to hold the mast in either upright or tilted position.

2. A multiple well drilling derrick comprising a base, an upright mast on the base in a well drilling position, a racking platform projecting from the front of the mast, the mast being formed from laterally spaced booms joined together at their upper ends, a pivoted support for the mast so that it can be tilted forward and backward to locate the upper end of the mast in other well drilling positions, means connected with the mast for holding it in either upright or tilted position, and links pivoted at their upper ends to the front and back of the mast and at their lower ends to the platform, the front links being farther from the back links at their lower ends than at their upper ends for supporting said platform level in any of said mast positions.

3. Apparatus for drilling a line of closely spaced wells, comprising a base adapted to be placed in fixed position over the site of said wells and extending lengthwise of said line, an upright drilling mast on the base in position to drill a well, a gin pole on the base beside the mast, means detachably hinging the lower end of the mast to the base, and detachable means pivotally connecting the mast to the top of the gin pole to permit the mast to be tilted lengthwise of the base when disconnected from the base, the base being provided at a point spaced lengthwise thereof from said hinging means with means adapted to receive the lower end of the mast when the mast is in a predetermined tilted position, whereby the top of the mast can be located in a plurality of different positions lengthwise of said base for drilling a plurality of wells without moving the base, the mast being adapted to be swung on said hinging means down to reclining position when disconnected from the top of the gin pole.

4. Apparatus for drilling a line of closely spaced wells, comprising a base adapted to be placed in fixed position over the site of said wells and extending lengthwise of said line, an upright drilling mast on the base in position to drill a well, a gin pole on the base beside the mast, means detachably hinging the lower end of the mast to the base, detachable means pivotally connecting the mast to the top of the gin pole to permit the mast to be tilted lengthwise of the base in opposite directions when disconnected from the base, the base being provided at points spaced lengthwise thereof in opposite directions from said hinging means with means adapted to receive the lower end of the mast when the mast is in a predetermined tilted position at either side of its upright position, whereby the top of the mast can be located in a plurality of different positions lengthwise of said base for drilling a plurality of wells without moving the base, a racking platform projecting from the front of the mast and movable backward into the mast, means holding the platform level when the mast is in either of said tilted positions or in upright position, and means for fastening the platform rigidly to the mast in any of said positions.

5. The method of positioning a mast for multiple well drilling, comprising swinging the mast on its lower end from a reclining position up to an upright position for drilling a well, then freeing said lower end and tilting the mast on an axis several feet above its lower end to position its upper end over the location of a second well, and anchoring the lower end of the tilted mast to hold the mast while the second well is being drilled.

6. In the method of drilling a line of closely spaced wells from a mast beside a gin pole on a base located in fixed position over the site of the wells and extending lengthwise of said line, the steps comprising hinging to the base the foot of a reclining mast extending lengthwise of the base, swinging the mast up to upright position, connecting the upright mast to the top of the gin pole to drill

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the first well, disconnecting said foot from the base, tilting the mast on said gin pole connection to position its upper end over the location for the second well, and connecting the foot to the base to hold the mast in said tilted position.

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