

June 24, 1958

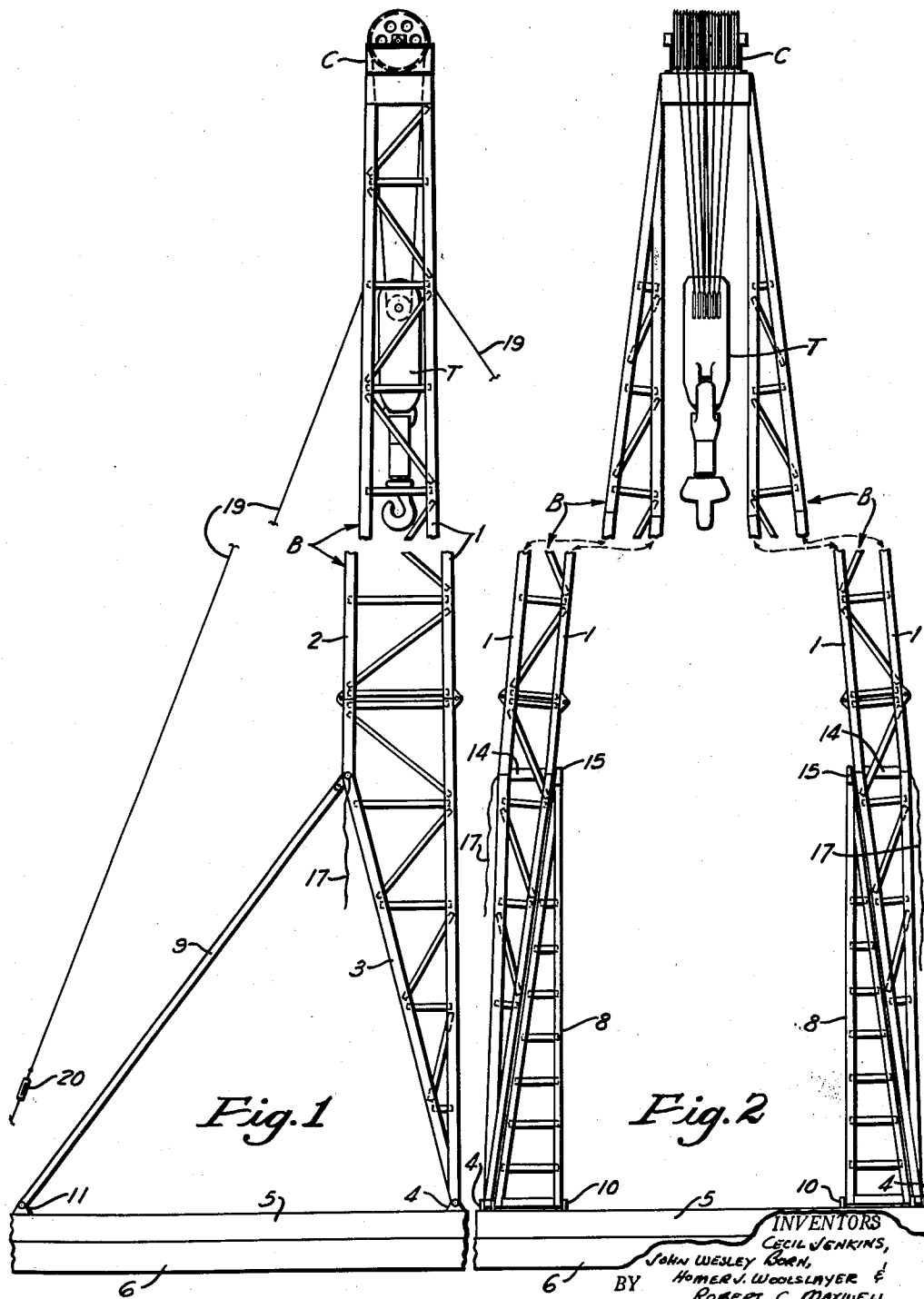
C. JENKINS ET AL

2,840,197

MULTIPLE WELL DRILLING APPARATUS AND METHOD

Filed Oct. 19, 1955

5 Sheets-Sheet 1



INVENTORS
CECIL JENKINS,
JOHN WESLEY BORN,
HOMER J. WOOLSLAY &
ROBERT C. MAXWELL
BY
Brown, Critchlow, Hick & Fleckham
THEIR ATTORNEYS

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C. JENKINS ET AL

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5 Sheets-Sheet 2

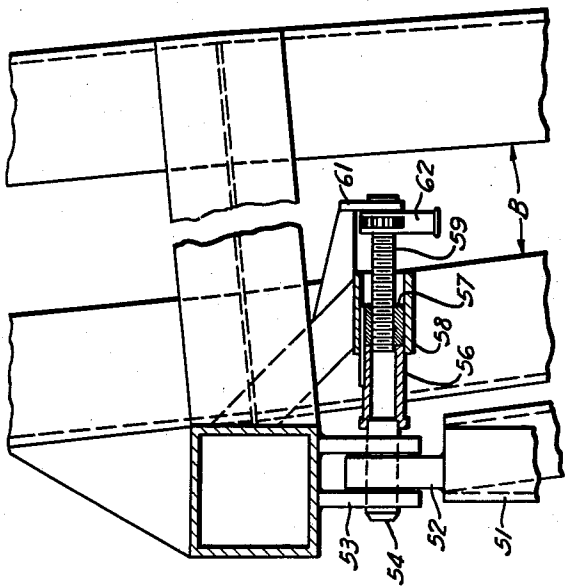


Fig. 15

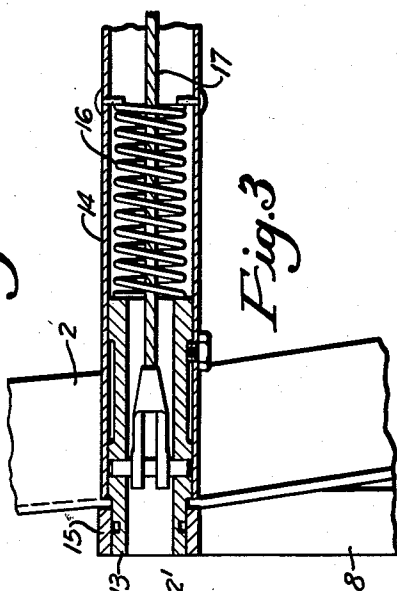


Fig. 3

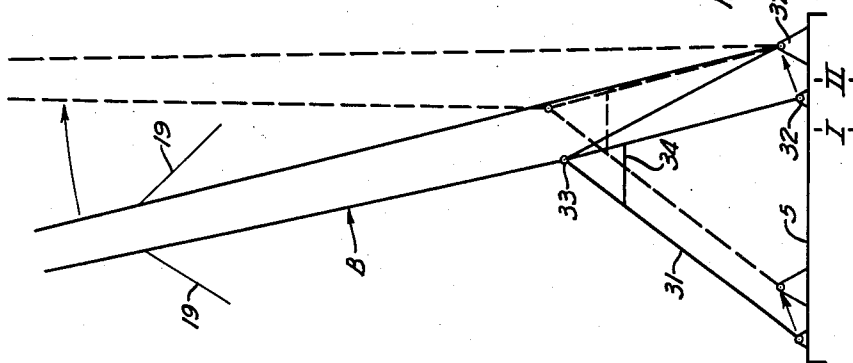


Fig. 11

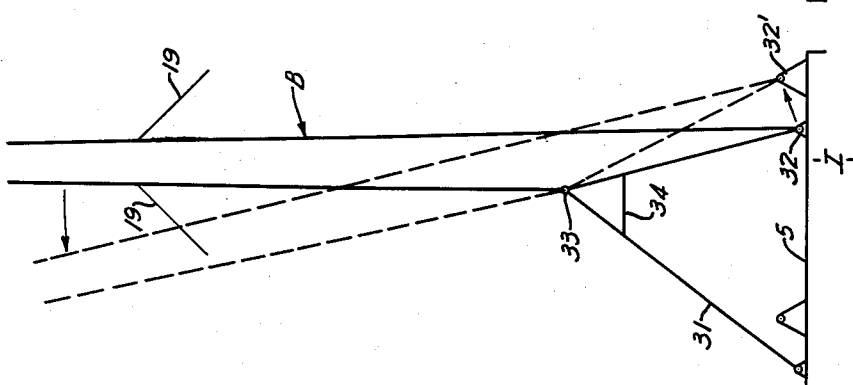


Fig. 10

INVENTORS
CECIL JENKINS, JOHN WESLEY BORN
HARVEY J. WOOLSLAYER & ROBERT C. MAXWELL
BY

Brown, Critchlow, Flick & Preklam
THEIR ATTORNEYS

June 24, 1958

C. JENKINS ET AL

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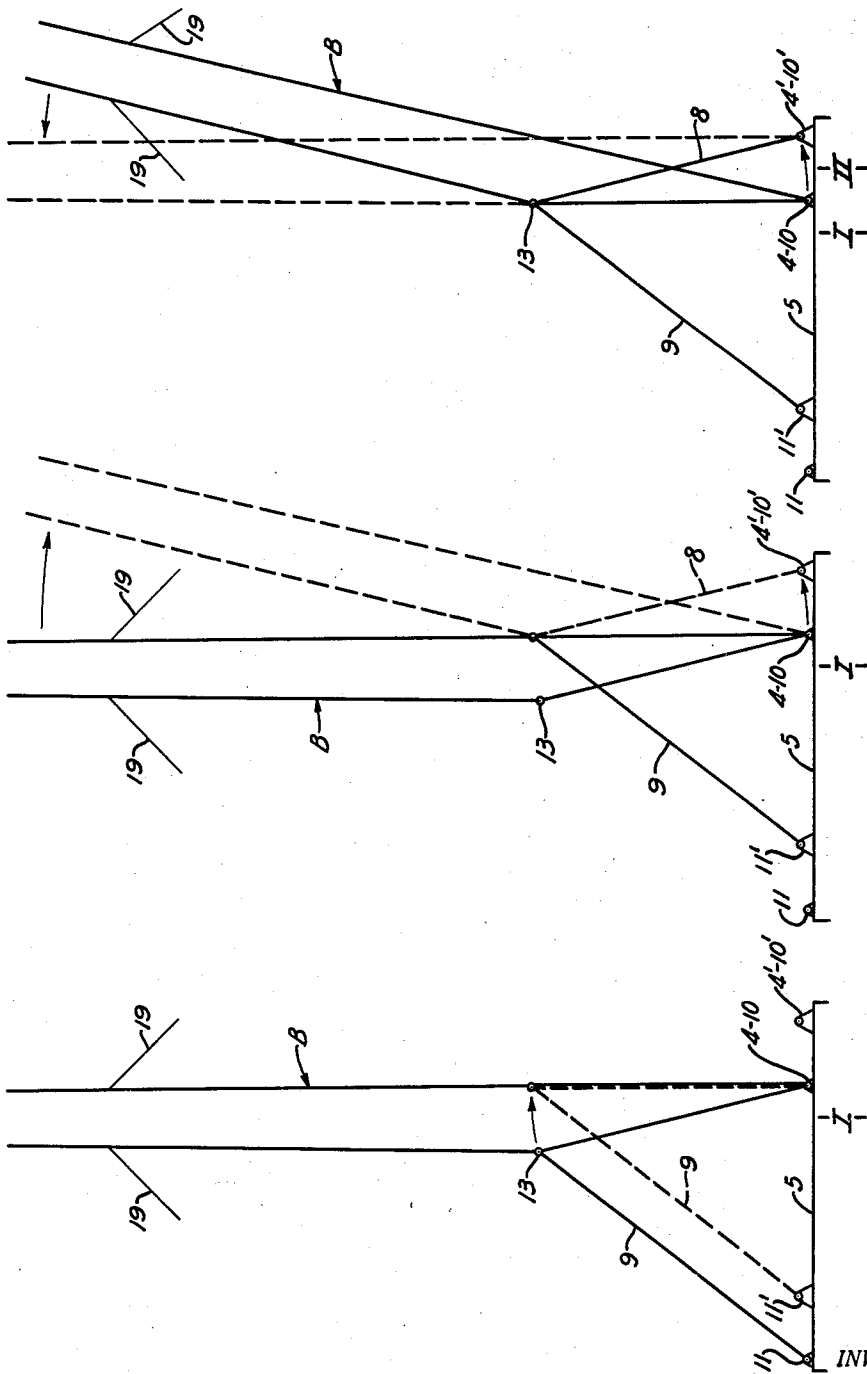


Fig. 6

Fig. 5

Fig. 4

INVENTORS
CECIL JENKINS, JOHN WESLEY BORN,
HOMER J. WOODSLAYER & ROBERT C. MAXWELL
BY
Brown, Critchlow, Hick & Peckham
THEIR ATTORNEYS

June 24, 1958

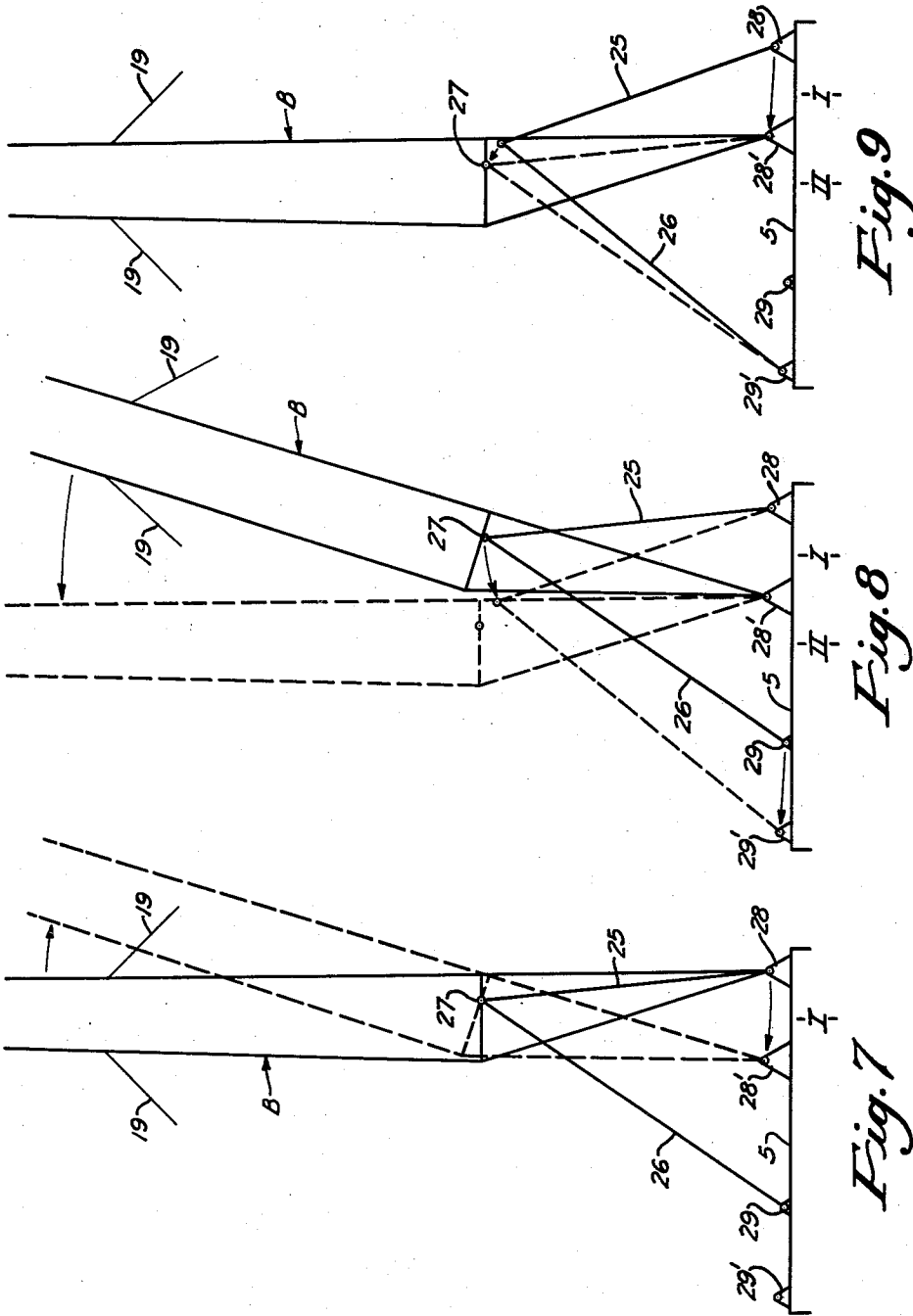
C. JENKINS ET AL

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5 Sheets-Sheet 4



INVENTORS

CECIL JENKINS, JOHN WESLEY BORN,
HOMER J. WOODSLYMER & ROBERT C. MAXWELL
BY

Brown, Citchlow, Hick & Peckham

THEIR ATTORNEYS

June 24, 1958

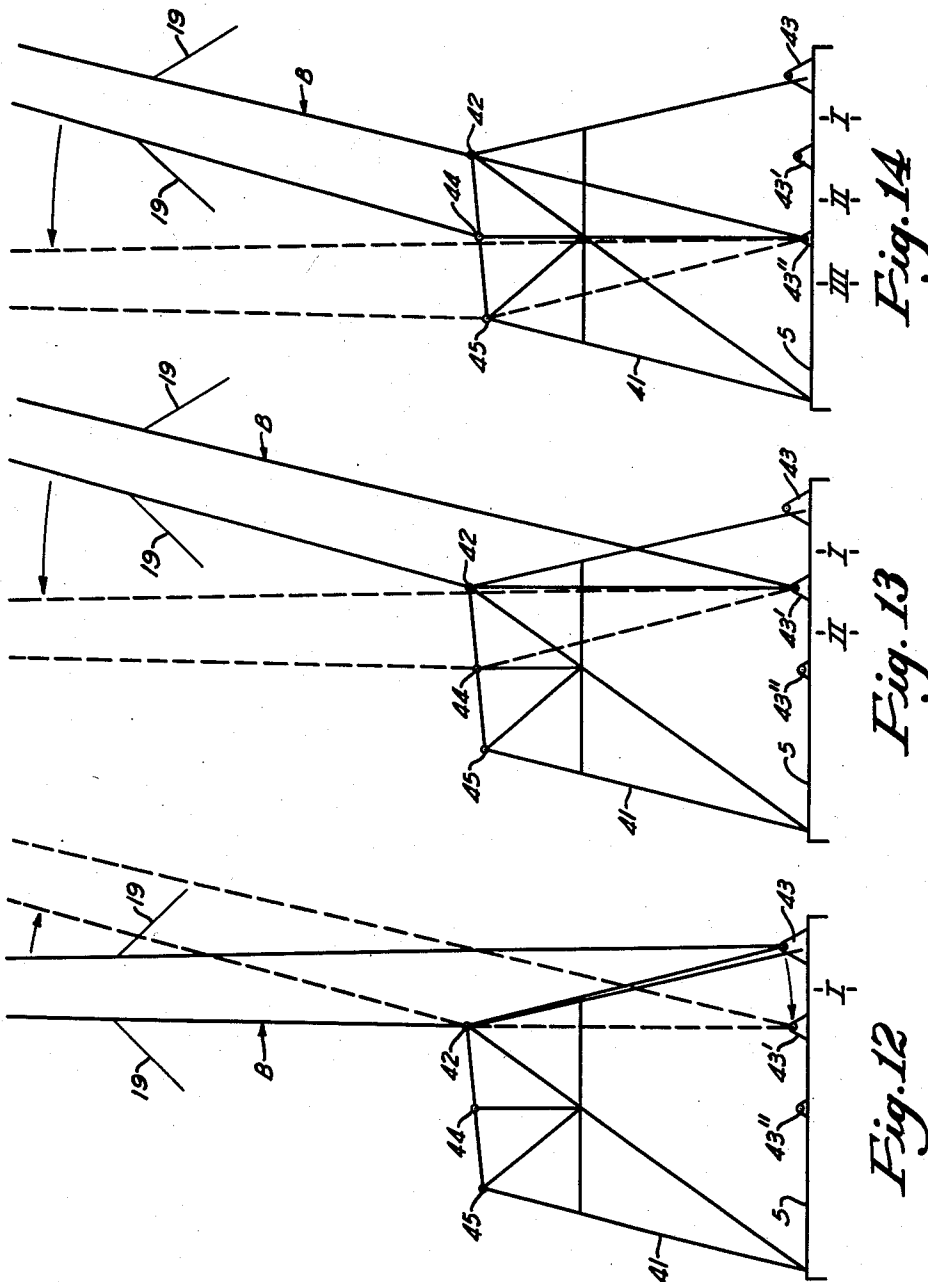
C. JENKINS ET AL

2,840,197

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Filed Oct. 19, 1955

5 Sheets-Sheet 5



INVENTORS
CECIL JENKINS, JOHN WESLEY BORN,
HOMER J. WOOLSLAYE & ROBERT C. MARWELL
BY
BROWN, Cutchlow, Flick & Leckham
THEIR ATTORNEYS

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2,840,197

MULTIPLE WELL DRILLING APPARATUS AND METHOD

Cecil Jenkins, John Wesley Born, Homer J. Woolslayer, and Robert C. Maxwell, Tulsa, Okla., assignors to Lee C. Moore Corporation, Pittsburgh, Pa., a corporation of Pennsylvania

Application October 19, 1955, Serial No. 541,468

19 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 two 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 offshore 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 mast can readily be moved along the base from 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 connection on the base for the lower end of the mast and another pivotal connection for the mast at the top of the gin pole. After a well has been drilled, the mast is tilted on one of those pivotal connections and then it is swung upright again on the other pivotal connection. In this way the mast can be moved or walked along the base in a straight line to drill one well after another. The mast and gin pole are connected together at each well. The gin pole may be movable along the base independently of the mast or be carried by it, or the gin pole may be made large enough to permit it to remain in one position while the mast is walked along the base.

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

Fig. 3 is an enlarged detail in section of the pivotal connection between the mast and the top of the gin pole;

Figs. 4, 5 and 6 are schematic views illustrating how the mast and gin pole are moved along the base from one well to another;

Figs. 7, 8 and 9 are similar views of a modification;

Figs. 10 and 11 are schematic views of a further embodiment;

Figs. 12, 13 and 14 are similar views of a still further modification; and

Fig. 15 is an enlarged detail of another type of pivotal connection between mast and gin pole.

Referring to Figs. 1 and 2 of the drawings, the mast preferably is formed from two laterally spaced booms B that are inclined upwardly towards each other and support a crown block C, from which a traveling block T is suspended. Each boom may have a pair of front legs 1 that come together at their lower ends, and a pair of rear legs 2, the lower ends of which terminate a considerable distance above the foot of the boom. The lower ends of these rear legs are connected by diagonal braces 3 with the lower ends of the front legs. The two feet of the mast are pivotally mounted or hinged in shoes 4 supported by a suitable base 5 which generally will be mounted on a larger platform 6. 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 operative position by a gin pole, which consists of a pair of front legs 8 pivoted at their upper ends to a pair of back legs 9. The front legs of the gin pole are disposed between the mast booms and the lower ends of those legs are pivoted in shoes 10 on an axis concentric with the axis of the mast hinges. The lower ends of the rear legs are pivoted in shoes 11 connected to the base behind the mast. Although the rear legs of the gin pole may be connected by cross braces, such braces are not necessary. Nevertheless, 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 in front of the gin pole by swinging the mast upward on shoes 4 in a well-known manner with the aid of a sling (not shown) secured to the top of the gin pole and attached to the traveling block. When the mast is upright it is connected to the top of the gin pole by suitable removable pivotal means, such as long horizontal pins 13 that slide in sleeves 14 extending through the booms, as shown in Fig. 3. The inner ends of the pins project into collars 15 mounted on top of the gin pole. The pins can be pulled back into the sleeves against the resistance of coil springs 16 therein, by means of lines 17 attached to the pins.

After the mast has been erected into the position shown in Figs. 1 and 4 and a well I has been drilled, the mast and gin pole can be moved forward on the base to drill a second well II (Fig. 6). According to this invention, such a move is accomplished by guy lines 19 attached to the front and back of the upper part of the mast and to suitable anchorage points, such as platform 6. After the lines have been secured in order to hold the mast upright independently of the gin pole, the pivot pins 13 at the top of the gin pole are drawn back into sleeves

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14 to release the gin pole from the mast. The back feet of the gin pole are then disconnected from the base, and the top of the gin pole is swung forward by any suitable means, such as a winch line (not shown) until the front of the gin pole is substantially vertical, as indicated in broken lines in Fig. 4. The rear legs of the pole then are connected again to the base in their new location, in which they are inclined to the same extent as before so that the top of the gin pole will not have to be moved during the next step. The next step is to disconnect the front legs of the gin pole from the base and swing them forward a predetermined distance as shown in broken lines in Fig. 5, and then reconnect them to the base without lowering the head of the gin pole. In this new or second location, the front feet of the gin pole should be the same distance from the rear feet as in the original or first location, but the entire gin pole will be at a slightly higher elevation than before.

The mast is now tilted forward to the broken line position of Fig. 5 by means of the guy lines 19, which may be controlled in any suitable manner. For convenience of illustration, they are shown provided with turnbuckles 20 for lengthening and shortening them. The mast is tilted until pivot pins 13 are opposite the collars at the top of the gin pole, whereupon the pins are projected into the collars to reconnect the mast to the gin pole as shown in full lines in Fig. 6. The pins will register with the collars, because the top of the gin pole was swung through the same arc as the pins. The feet of the mast then are disconnected from the base and the rear guy lines are pulled to swing the mast upright again around its pivotal connections to the top of the gin pole. This moves the feet of the mast forward beside the front feet of the gin pole, and the mast feet are there reconnected to the base. It will be seen that the mast, shown in broken lines in Fig. 6, and the gin pole are now in the same positions relative to each other as they were in Figs. 1 and 4, but both have been moved forward along the base to a location where the second well II can be drilled.

To keep the floor of the base as free of obstructions as possible, it is desirable to leave the shoes 4, 10 and 11 connected to the mast and gin pole during walking of the mast along the base, so the shoes are disconnected from the base in the first location and reconnected to it in the second location. As the gin pole and mast move upward slightly as they move forward, it must be possible to fasten the shoes to the base at different elevations. This can easily be done by providing the base with bolt holes for the shoes at higher elevations in the second location of the mast and gin pole than in their first location. However, in order to illustrate more clearly the different movements of the parts in Figs. 4, 5 and 6, two sets of shoes are shown. One set 4, 10, 11 is in the first or original location of the mast and gin pole and the other set 4', 10', 11' is in second location. Nevertheless, as just explained, in practice only one set of shoes will generally be used and they will be carried along by the mast and gin pole.

The mast moving operation that has just been described can be repeated as many times as desired, depending on the length of the base. Thus, a line of three or more wells can be drilled by this walking mast, all without moving the base. After the last well has been completed, the mast can be swung forward and down to reclining position and then disconnected from the base for transportation to another location. Of course, if the base is skidded sideways on platform 6, a second line of wells can be drilled beside the first line. Beside being able to use a portable one-well 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 either the crown block or the base and without lowering the mast.

In the modification shown in Figs. 7, 8 and 9, the

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upper ends of the front legs 25 of the gin pole are pivotally connected to its back legs 26, and the head of the gin pole is detachably pivoted in any suitable manner at 27 to the opposite sides of the mast between its front and back. After a well I has been drilled by the mast in its original upright position, the feet of the mast are disconnected from the base 5 at 28 and the mast is tilted forward on the top gin pole pivots 27 to the position shown in broken lines in Fig. 7. The feet of the mast then are pivoted to the base again at a point 28' behind the front legs of the gin pole. The mast then is disconnected from the head of the gin pole and swung up to upright position (indicated by broken lines in Fig. 8) by guy lines 19, which hold it in this new location over a second well II while the gin pole is moved back along the base to a second location.

The gin pole is moved preferably by disconnecting its back legs 26 from the base at 29 and pulling them back to a point 29' that is the same distance behind the mast as the back feet of the gin pole were behind the mast when they were at point 29 before the mast was moved. This places the gin pole in the broken line position shown in Fig. 8. The broken line positions of the mast and gin pole in Fig. 8 are shown in full lines in Fig. 9. The front feet of the gin pole are then disconnected from the base, and the top of the pole is pulled backward until those feet can be attached to the base at 28' beside the lower end of the mast, as shown in broken lines in Fig. 9. The mast and the top of the gin pole are then connected together again at 27, and the mast is ready for drilling the second well.

If only two wells are to be drilled in this manner, it is not absolutely necessary that the gin pole be moved, provided the mast is adequately supported by strong guy lines in its second position. Of course, in such a case, the mast would have to be tilted forward for reconnection to the gin pole and then swung up to its original upright position before it could be lowered to reclining position by a sling attached to the top of the gin pole.

In the form of the invention shown in Figs. 10 and 11, the mast and gin pole 31 are not disconnected from each other during the walking of the mast from one location to another along the base 5. Thus, as shown in Fig. 10, after a well I has been drilled the lower end of the mast is disconnected from the base at 32 and then the mast is swung backward on its pivoted connection 33 with the gin pole to the broken line position, by means of guy lines 19. During this movement, the foot of the mast is swung forward so that it can be pivoted to the base at 32'. The gin pole then is disconnected from the base, and the mast and pole are swung forward together to the broken line position of Fig. 11. To prevent the gin pole from collapsing while suspended from the mast, its front and rear legs can be spaced apart by spreaders 34. In its forward position, the gin pole is again connected to the base as shown. This new location of the mast is ahead of the original one and in a position for drilling a second well II.

Another way of using this construction is to disconnect the gin pole from the base and then swing the top of the mast forward to carry the gin pole ahead. The gin pole is again connected to the base and then the mast is swung backward to tilt it up into upright position again in its new location. If it is desired to move in the opposite direction on the base, the mast can be tilted forward on the gin pole, the foot of the mast hinged to the base behind its original location, the gin pole disconnected from the base, the mast then swung to the rear into upright position, and the gin pole which was carried back with the mast then reconnected to the base.

The gin pole 41 shown in Figs. 12, 13 and 14 is not moved along the base 5 with the mast. Instead, it is made of great enough extent lengthwise of the base to permit the mast to be connected to it in different locations. Starting with the forward position of the mast

shown in Fig. 12, after completion of the first well I, the mast may be disconnected from the base and swung forward on its pivotal connection 42 with the gin pole to the broken line position. This moves the foot of the mast back behind the well from shoes 43, where the mast is again hinged to the base at 43'. The mast then is disconnected from the gin pole and swung backward to upright position over the second well II, as indicated in broken lines in Fig. 13. In this position, it is pivotally connected at 44 to the central part of the top of the gin pole. To drill a third well III, the mast is again disconnected from the base and its lower end swung backward behind the second well as shown in full lines in Fig. 14. In this position, the mast is connected to the base at 43" and disconnected from the gin pole at 44. When the mast is swung backward to upright position (shown in broken lines), it will be over the third well, where it can be connected at 45 to the rear end of the top of the gin pole.

In any of these embodiments of the invention, the pivotal connection shown in Fig. 15 can be substituted for the one in Fig. 3. In this modification the top of the gin pole 51 is provided with a perforated lug 52 that projects into a bifurcated bracket 53 carried by the mast boom B. A pivot pin 54 extends through the bracket and lug to connect the mast to the gin pole. The pin is secured in one end of a tube 56, to the opposite end of which a nut 57 is welded. The tube and nut are splined in a horizontal sleeve 58 fastened to the mast. Threaded in the nut is a screw 59 that has its outer end rotatably mounted in a bracket 61 carried by the mast. A ratchet 62 is mounted on the screw for turning it, so that the pin can be withdrawn from the lug and bracket 53 when it is desired to lower the mast or to swing it backward or forward relative to the head of the gin pole.

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. 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, a pivotal connection on the base for the lower end of the mast, a pivotal connection for the mast at the top of the gin pole, and means for tilting the mast lengthwise of the base on one of said pivotal connections and then swinging the mast upright again on the other of said pivotal connections, whereby the mast can be moved lengthwise of the base to drill another well.

2. 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, a pivotal connection on the base for the lower end of the mast, a pivotal connection for the mast at the top of the gin pole, and means for tilting the mast lengthwise of the base on the base pivotal connection and then swinging the mast upright again on the gin pole pivotal connection, whereby the mast can be moved lengthwise of the base to drill another well.

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, a pivotal connection on the base for the lower end of the mast, a pivotal connection for the mast at the top of the gin pole, and means for tilting the mast length-

wise of the base on the gin pole pivotal connection and then swinging the mast upright again on the base pivotal connection, whereby the mast can be moved lengthwise of the base to drill another well.

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, a detachable pivotal connection on the base for the lower end of the mast, a detachable pivotal connection for the mast at the top of the gin pole, and means for tilting the mast lengthwise of the base on one of said pivotal connections while detached from the other pivotal connection and then after detaching the mast from said one connection swinging the mast upright again on the other pivotal connection, whereby the mast can be moved lengthwise of the base to drill another well.

5. 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 detachably mounted in a first location on the base beside the mast, means detachably hinging the lower end of the mast to the base, the mast being adapted to be swung on said hinging means from a reclining position up to said upright position, means detachably pivoting the upright mast to the top of the gin pole, means adapted to detachably connect the gin pole to the base in a second location along the base, and means for holding the mast while the gin pole is disconnected from it and moved lengthwise of the base to said second location and for tilting the mast lengthwise of the base into position to be pivoted to the top of the moved gin pole, 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 after the mast has been swung on its gin pole connection upright in said second location, whereby the mast is movable lengthwise of the base to drill another well.

6. 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 having front and rear pairs of legs supported by the base in a first location, means detachably hinging the lower end of the mast to the base, means detachably pivoting the mast to the top of the gin pole, means for holding the mast to permit the gin pole to be disconnected from it and moved lengthwise of the base a predetermined distance to a second location, means for detachably pivoting the lower ends of the gin pole legs to the base in either location, means pivotally connecting the top of the rear gin pole legs to the top of its front legs to permit first one pair of legs and then the other to be swung from said first to said second location while disconnected from the mast, and means for tilting the mast lengthwise of the base into position to be pivoted again to the top of the gin pole when the latter is in the second location, 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 after the mast has been swung on its gin pole connection upright in said second location, whereby the mast is movable lengthwise of the base to drill another well.

7. Multiple well drilling apparatus according to claim 6, in which the pivotal connection of the front legs of the gin pole to the base in said first location is concentric with the axis of said hinging means.

8. 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

having front and rear pairs of legs supported by the base in a first location, means detachably hinging the lower end of the mast to the base, means detachably pivoting the mast to the top of the gin pole, means for holding the mast upright to permit the gin pole to be disconnected from it and moved forward on the base a predetermined distance to a second location, means for detachably pivoting the lower ends of the gin pole legs to the base in either location, means pivotally connecting the top of the rear gin pole legs to the top of its front legs to permit first one pair of legs and then the other to be swung from said first to said second location while disconnected from the mast, and means for tilting the mast forward into a position to be pivoted again to the top of the gin pole when the latter is in the second location, the base being provided in front of said hinging means with means adapted to receive the lower end of the mast after the mast has been swung on its gin pole connection upright in said second location, whereby the mast is movable forward on the base to drill another well.

9. 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 having front and rear pairs of legs supported by the base in a first location, means detachably connecting the lower end of the mast to the base, means detachably pivoting the mast to the top of the gin pole, means for tilting the mast forward on its gin pole connection and holding it there while the gin pole is disconnected from the mast and moved backward on the base a predetermined distance to a second location, means for detachably pivoting the lower ends of the gin pole legs to the base in either location, means pivotally connecting the top of the rear gin pole legs to the top of its front legs to permit first one pair of legs and then the other to be swung from said first to said second location while disconnected from the mast, hinging means behind said detachable connecting means for hinging the lower end of the tilted mast to the base, means for swinging the tilted mast backward on said hinging means to upright position for connection again to the top of the gin pole, whereby the mast is movable backward on the base to drill another well.

10. 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 in a first location, means detachably pivoting the lower end of the mast to the base, the mast being adapted to be swung on said pivoting means from a reclining position up to said upright position, means detachably pivoting the upright mast to the top of the gin pole, means adapted to detachably connect the gin pole to the base in a second location along the base, and means for tilting the mast lengthwise of the base on one of said pivoting means and then swinging the mast upright again on the other of said pivoting means, whereby the mast can be moved lengthwise of the base to drill another well, the mast remaining connected to the top of the gin pole during said movement of the mast from said first to said second location in order to carry the gin pole along with it from well to well.

11. 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 in a first location, means detachably pivoting the lower end of the mast to the base, the mast being adapted to be swung on said pivoting means from a reclining position up to said upright position, means detachably pivoting the upright mast to the top of the gin pole, means adapted to detachably connect the gin

pole to the base in a second position along the base, means for tilting the mast lengthwise of the base on said mast pivoting means, means for detachably pivoting the lower end of the tilted mast to the base adjacent said second location of the gin pole, and means for swinging the tilted mast upright again on said last-mentioned pivoting means while the mast and gin pole remain connected together, whereby the gin pole will be carried by the mast to said second location.

12. 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 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 and having an upper part extending lengthwise of the base away from the mast, a set of spaced connections for detachably connecting the lower end of the mast to the base in a plurality of longitudinally spaced locations, a set of spaced connections for detachably connecting the mast to said upper part of the gin pole in a plurality of locations, and means for tilting the mast lengthwise of the base on a first connection in one of said sets to move the mast from a first to a second connection in the other set, and for then swinging the mast upright again on said second connection after disconnection of said first connection in said one set, whereby the mast can be moved lengthwise of the base from one upright location to another.

13. 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 and having an upper part extending lengthwise of the base away from the mast, the base having a plurality of longitudinally spaced pivot points for the lower end of the mast, the upper part of the gin pole having a plurality of pivot points spaced lengthwise of the base, and means detachably pivoting the mast to two of said vertically spaced points, the mast being adapted to be swung about gin pole and base pivot points alternately so that the mast can travel along the base from one well to another.

14. In the method of drilling a line of closely spaced wells from a mast on a base located in fixed position over the site of the wells and extending lengthwise of said line, the steps comprising supporting the mast in upright position to drill the first well, tilting the mast lengthwise of the base to position part of it at a point over an area between the first well and the location for the second well, and then rotating said mast on said point to swing the mast into upright position for drilling the second well.

15. The method of moving an upright oil well drilling mast and its supporting gin pole lengthwise of a supporting base, comprising holding the mast upright independently of the gin pole, disconnecting the gin pole from the mast and moving the gin pole to another location along the base, tilting the mast toward the relocated gin pole, pivoting the tilted mast to the top of the gin pole, and then swinging the bottom of the mast in the same direction that the gin pole was moved, whereby to right the mast.

16. The method of moving an upright oil well drilling mast and its supporting gin pole lengthwise of a supporting base, comprising tilting the mast lengthwise of the base about an axis at the top of the gin pole, disconnecting the gin pole from the tilted mast and supporting the mast independently thereof, moving the disconnected gin pole to another location along the base in the direction opposite to the direction in which the mast was tilted, swinging the tilted mast on its lower end up to upright position, and then connecting the upright mast to the top of the relocated gin pole.

17. The method of moving an upright oil well drilling mast and its supporting gin pole lengthwise of a supporting base, comprising tilting the mast on its lower end

lengthwise of the base to carry the gin pole to a new location along the base, connecting the gin pole to the base in the new location, disconnecting the mast from the base, and swinging the mast to upright position about an axis at the top of the gin pole.

18. The method of moving an upright oil well drilling mast and its supporting gin pole lengthwise of a supporting base, comprising tilting the mast lengthwise of the base about an axis at the top of the gin pole, pivoting the lower end of the tilted mast to the base, disconnecting the tilted mast from the gin pole, swinging the mast on its lower end up to upright position, and then connecting the upright mast to the top of the gin pole at a point spaced lengthwise of the base from said axis.

19. The method of moving an upright oil well drilling mast and its supporting gin pole lengthwise of a supporting base, comprising tilting the mast lengthwise of the base on its lower end after disconnecting the mast from the gin pole, then pivoting the tilted mast to the top of the gin pole, disconnecting the mast from the base, swinging the mast about its gin pole connection to upright position, and connecting the lower end of the upright mast to the base.

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