Aug. 3, 1954 A. L. STONE 2,685,378

METHOD FOR HANDLING DRILL PIPE

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FIG. 4.

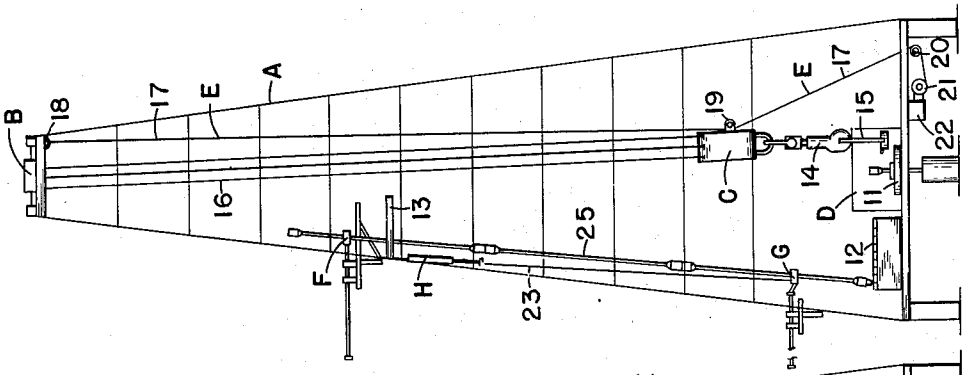

FIG. 3.

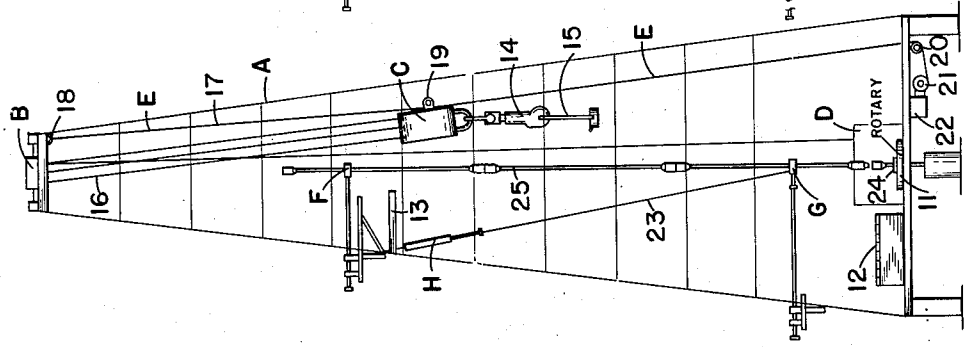

FIG. 2.

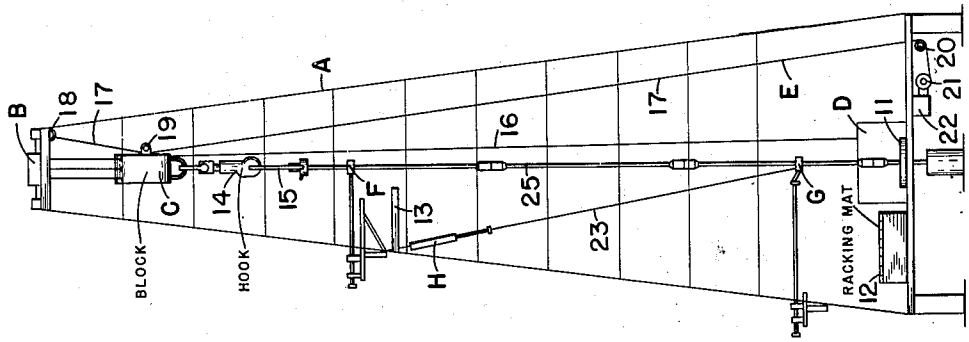

FIG. 1.

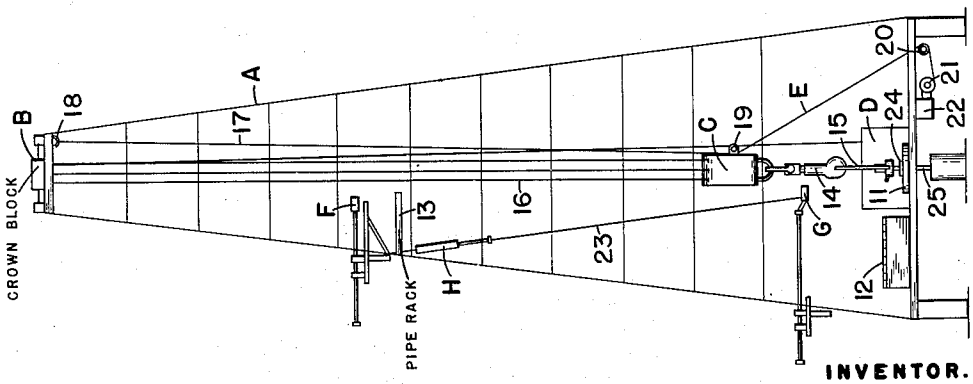

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FIG. 5.

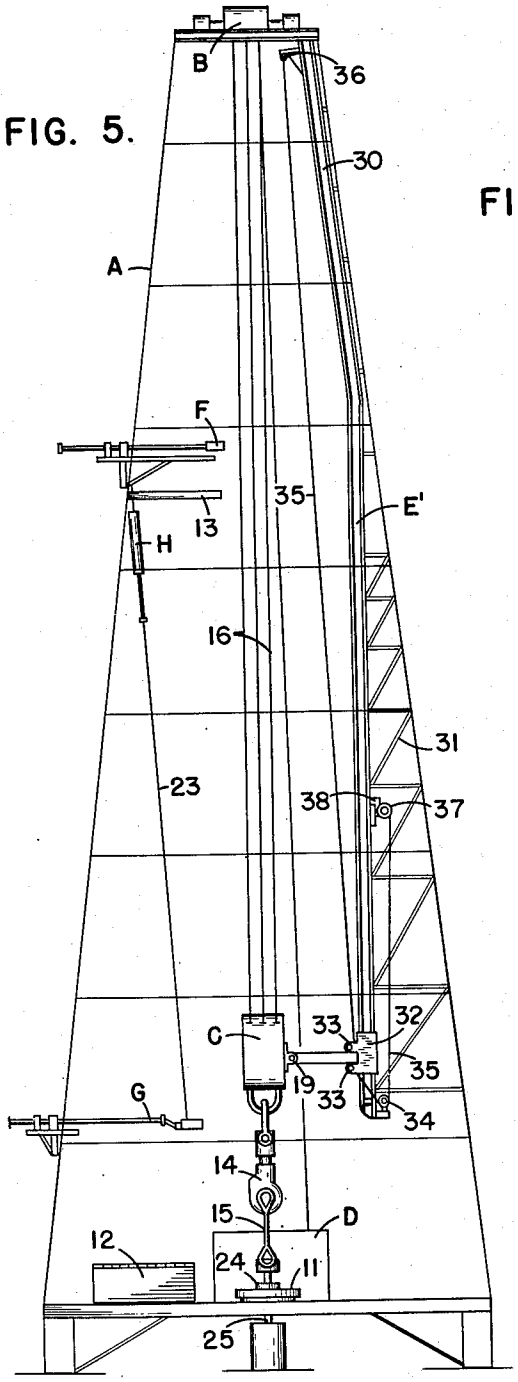
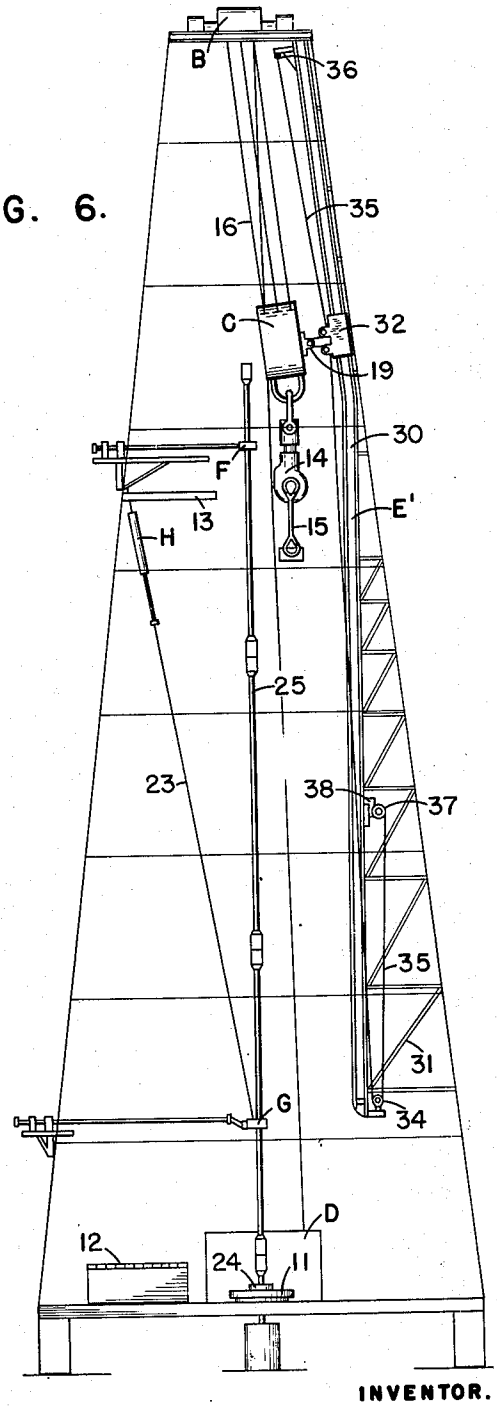


FIG. 6.



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METHOD FOR HANDLING DRILL PIPE

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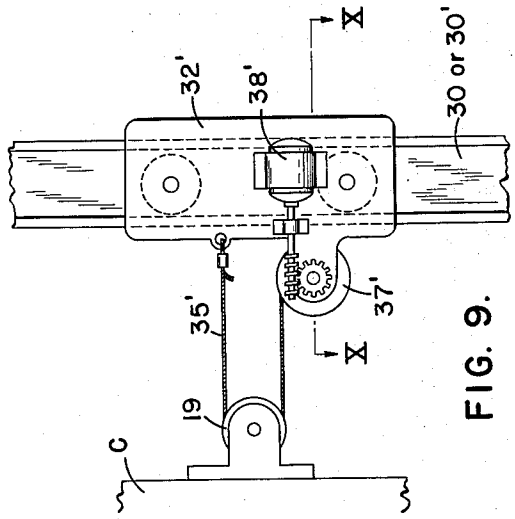

FIG. 9.

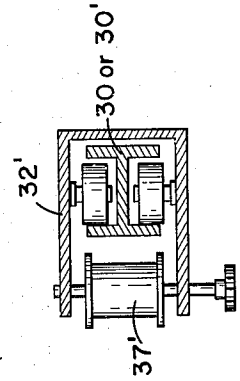

FIG. 10.

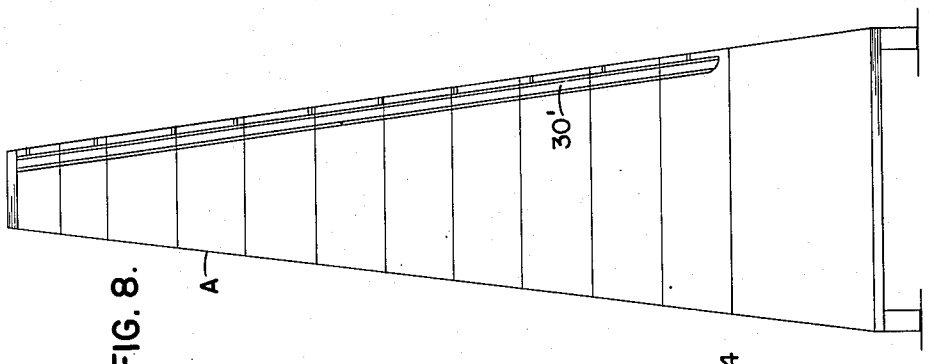

FIG. 8.

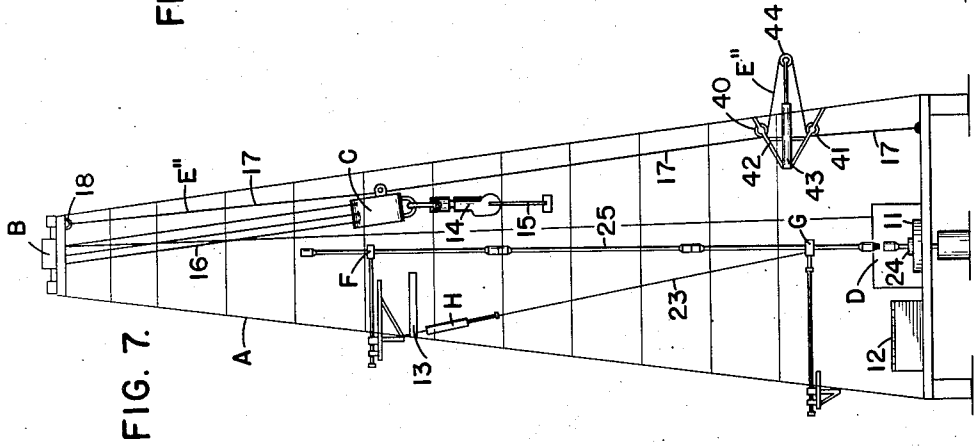

FIG. 7.

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UNITED STATES PATENT OFFICE

2,685,378

METHOD FOR HANDLING DRILL PIPE

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Application August 25, 1949, Serial No. 112,200

3 Claims. (Cl. 214—152)

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The present application is directed to an improved method for handling drill pipe in the derrick of a drilling well.

It is common to drill deep oil and gas wells by the rotary drilling method. When using this method circulating drilling fluid brings the cuttings up from the bottom of the hole, but periodic operations, such as changing the drill bit, requires that the entire string of drill pipe be removed from and subsequently returned into the hole. The lengths of pipe making up the drill stem are connected together by screw thread joints and are disconnected in suitable sections, consisting for example of three lengths of pipe known as strands, which are racked in the drilling derrick while the drill stem is being removed from and returned to the borehole.

It is usual to provide a heavy duty derrick provided with a crown block with a traveling block suspended therefrom by the drilling line. A hoist known as the draw works is attached to the drilling line and serves to raise and lower the traveling block along the vertical axis of the derrick. The conventional method for removing the pipe from the derrick involves the steps of raising the drill stem by means of the heavy traveling block until a stand of pipe is above the rotary table, then setting slips to support the drill pipe while the traveling block is in its upper position, unscrewing the lower end of the stand from the balance of the drill stem, raising it slightly with the traveling block, then as a final operation, racking the pipe by swinging it over to the side of the derrick and lowering it to the floor mat. After the stand has been racked, the traveling block may be disengaged from the stand and started down to repeat the cycle.

When returning the pipe into the borehole the stand of pipe is picked up by the heavy duty traveling block and moved to the center of the derrick, and the lower end is then screwed to the portion of the drill stem in the borehole which is supported by slips. After this operation the drill stem is picked up by the traveling block, the slips released, the drill stem lowered with the traveling block until the end of the added section is a foot or two above the rotary table at which time the slips are set to suspend the drill stem, the traveling block is released from the drill stem and then run up along the vertical axis of the derrick preparatory to lifting another stand of pipe from racking position to the center of the derrick.

When the drill stem is being pulled out of the well or returned into the well, the heavy duty hoisting equipment which includes the traveling

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block, crown block and draw works is used inefficiently. Necessarily, this equipment cannot be used for heavy duty operations while the drilling crew is occupied with the operation of adding or removing a stand of pipe from the drill stem. However, after the drilling crew has performed such an operation, the majority of the drilling crew, which are on the derrick floor, are idle while the unloaded traveling block is being moved into position where it will perform a useful function. That is to say, when coming out of the hole, most of the drilling crew is idle while the empty traveling block is being run downward preparatory to pulling the drill stem to expose another stand. Similarly, when going into the hole, most of the drilling crew is idle while the empty traveling block is being run upward preparatory to lifting another stand of pipe over to the center of the derrick, which operation precedes the steps of attaching the stand to the drill stem and lowering it into the well.

Proposals have been made for altering this conventional method of handling pipe. See Sheldon, U. S. Patent 2,226,947, issued December 31, 1940. In this patent an unconventional derrick having a double crown block and two traveling blocks is used. With this arrangement the unloaded traveling block moves downwardly while the loaded traveling block moves upwardly when pulling pipe from the well. Similarly, the unloaded traveling block moves upwardly while the loaded traveling block moves downwardly when lowering the drill stem into the well. Two embodiments are disclosed. In one embodiment, the double crown block is shiftable so that the path of travel of the unloaded traveling block is to one side of the vertical axis of the derrick and the double crown block is shifted to move this traveling block to the axis of the derrick when it takes a load. In another embodiment the double crown block is stationary and the two traveling blocks are held in position by guide members attached to the derrick. In both embodiments, heavy duty drilling equipment is used for handling the full weight of the drill stem and also for handling the stands of pipe being racked in the derrick,

The present application is directed to a method for handling drill pipe in a conventional drilling derrick having the usual single crown block and single traveling block which increases the speed with which the drill stem may be withdrawn from and returned into the well.

Other objects and advantages of the present invention may be seen from the following description taken with the drawing in which

Figs. 1, 2, 3, and 4 are a series of figures illustrating one embodiment of the apparatus suitable for the practice of the method of the present application and showing the equipment in several positions;

Figs. 5 and 6 are figures illustrating another embodiment of apparatus suitable for practicing the method of the present application showing the equipment in two different positions;

Fig. 7 is a simplified showing of another embodiment of equipment suitable for practicing the method of the present invention;

Fig. 8 is a simplified view showing another embodiment of equipment which may be substituted for a portion of the apparatus of Figs. 5 and 6;

Fig. 9 is a fragmentary view showing another embodiment of the apparatus which may be substituted for a portion of the apparatus of Figs. 5 and 6 in the practice of the present invention; and

Fig. 10 is a view taken along X—X of Fig. 9.

Turning now specifically to the drawing and first to the embodiment shown in Figs. 1 to 4 a conventional drilling derrick A is provided with a conventional crown block B, traveling block C and draw works D. In addition, a traveling block deflector E, a means F for moving the upper end of sections of drill F, a means G for moving the lower end of sections of drill and lifting means H are mounted in the derrick.

The derrick A is provided with a usual rotary table 11. A racking mat 12 is arranged on the floor of the derrick for receiving the lower ends of sections of drill pipe. A pipe rack 13 is mounted in the derrick for receiving the upper ends of the drill pipe racked in the derrick. Since racking mats and pipe racks are well known to the art, the details of construction of these members are not shown in the drawing.

A hook 14 is suspended from traveling block E and a pipe elevator 15 is suspended from the hook. Heavy duty hooks and elevators for supporting drilling pipe are well known to the art and for the purpose of simplifying the description the details of construction of these members are not shown. Drilling line 16 is arranged to suspend traveling block C from crown block B and in turn is attached to the draw works D.

In the embodiment shown in Figs. 1 to 4 traveling block deflector E consists of a wire line 17 having its upper end secured at the top of derrick A to anchor 18. The wire line is passed through a sheave 19 mounted on the side of traveling block C and then runs over a sheave 20 mounted below the derrick floor. The lower end of line 17 is secured to a reel 21 which may be rotated in either direction at the will of an operator by means of prime mover 22. By unreeling or slackening line 17, traveling block C is allowed to hang at the axis of the derrick as shown in Figs. 1 and 2. By reeling in or tightening line 17 as shown in Fig. 3, the traveling block is pulled from the axis of the derrick to one side thereof. By manipulation of the reel 21 the traveling block may be moved in a controlled manner between the axis and the side of the derrick either while being moved vertically or while being held against vertical movement by the draw works.

Upper pipe handling means F is adapted for grasping or embracing a section of drill pipe and for moving it in a rectilinear path between the axis of the drilling derrick and the side of the derrick on which this assembly is mounted. Similarly, lower pipe racking assembly G is adapted

for grasping the lower end of a section of drill pipe and for moving it in a rectilinear path between the axis of the derrick and the side thereof. In addition, member G cooperates with lifting means H, which may be a hydraulic cylinder with a piston therein having a wire line 23 attached thereto, to serve an auxiliary elevator capable of lifting a section of drill pipe. Details of construction of devices adapted to be used as assemblies F, G, and H are shown in my copending applications Serial No. 690,946 entitled "Apparatus for Moving Pipe," filed August 16, 1946 and now Patent No. 2,537,607; Serial No. 5,843 entitled "Apparatus for Racking Pipe in a Derrick" filed February 2, 1948 and now abandoned; Serial No. 98,250 entitled "Pipe Racking Apparatus" filed June 10, 1949 and now abandoned, and Serial No. 98,740 entitled "Improved Apparatus for Moving Pipe" filed June 13, 1949 and now Patent No. 2,596,828. Since the construction of members F, G, and H is not in itself a part of the present invention, these details have been omitted from the present case.

The series of Figs. 1, 2, 3, and 4, preceding in sequence to the right from Figs. 1 to 4, illustrate the practice of the method of the present invention when removing the drill stem from the well. In Fig. 1 the heavy duty traveling block E is shown in its lower position with the elevators 15 attached to the drill stem. Slips 24 are shown in position in the rotary for supporting the drill stem. In Fig. 2 the slips have been removed and the drill stem has been pulled upward to expose a stand of pipe. The traveling block moves along the axis of the drilling derrick when pulling the drill stem. Fig. 2 shows the traveling block in its upper position with a stand of the drill stem above the rotary table. When the drill stem has reached this position slips, not shown in Fig. 2, are set in the rotary table to hold the drill pipe. Fig. 3 shows slips 24 set to hold the drill stem. The heavy duty traveling block has been deflected to the side of the derrick and is being moved vertically downwardly at the same time the exposed stand of pipe 25 has been disconnected and is ready to be moved to racking position. Fig. 4 shows the unloaded traveling block near its lower position while the disconnected stand of pipe 25 has been moved over to the side of the derrick and racked with its upper end in rack 13 and its lower end resting on racking mat 12. The heavy duty traveling block C has been allowed to move from the side of the derrick toward the vertical axis thereof and is immediately in the position preceding that shown in Fig. 1 where the elevator 15 will be attached to the exposed end of the drill stem preparatory to pulling the drill stem to expose another stand of drill pipe.

The series of Figs. 1, 2, 3, and 4 also represent the operation of returning the drill stem into the borehole starting at Fig. 4 and going in sequence to the left from Figs. 4 to 1. When considering the figures in this sequence, Fig. 4 illustrates the position of the equipment after slips 24 have been set to hold the drill stem and the elevator 15 has been disconnected therefrom. The traveling block C is being deflected from the vertical axis to the side of derrick A at the same time stand of pipe 25 is being moved from racking position to the axis of the derrick. Fig. 3 shows unloaded traveling block C moving upwardly while deflected to the side of the derrick and stand 25 has been moved to the axis of the derrick and is in a position to be connected to that portion of the

drill stem in the well. Fig. 2 shows traveling block C in its upper position and moved to the axis of the derrick and connected to stand 25. In Fig. 1 stand 25 has been lowered into the borehole and slips 24 have been set to hold the weight of the drill stem so that the elevators 15 may be disconnected from the drill stem and the cycle repeated.

From the series of Figs. 1 to 4, inclusive, it will be seen that the heavy duty hoisting equipment is used efficiently when practicing the method of the present case. As soon as the heavy duty traveling block is unloaded it is returned to starting position and by deflecting the heavy duty traveling block from the axis of the derrick while it is being moved from one vertical point in the derrick to another, necessary pipe handling operations at the locus of the longitudinal axis of the derrick are performed by the drilling crew while using light weight equipment commensurate in size with the loads being handled. By performing the operations in this manner the operations of the drilling crew and of the heavy duty hoisting equipment are synchronized.

Another embodiment of apparatus suitable for performing the method of the present application is shown in Figs. 5 and 6. In this embodiment drilling derrick A is provided with crown block B, traveling block C, draw works D, pipe racking assembly F, lower pipe racking assembly G and pipe lifting means H.

The derrick is provided with rotary table 11, racking mat 12 and pipe rack 13. The traveling block C is suspended by drilling line 16. In the embodiment of Figs. 5 and 6 the traveling block C is provided with a deflector E'.

Traveling block deflector E' consists of a track 30 secured to derrick A by structural members 31. Track 30 has its upper end parallel with the derrick, the track having a curve or bend at a point above pipe rack 13 so that its lower portion is vertical. A carriage 32 is mounted on track 30 for slidable movement thereon. Carriage 32 is provided with sheaves 33 and the lower end of track 30 is provided with sheave 34. A pull back cable 35 has its upper end secured to anchor member 36 at the top of derrick A, and is threaded around sheave 33 of carriage 32, sheave 19 of traveling block C, lower sheave 33 of the carriage, then around sheave 34 to reel 37 operated by prime mover 38. The loop or bight in the pull back cable 35 caused by running around sheaves 33, 19 and 34 allows the traveling block C to be moved in a controlled manner between the axis and the side of the derrick either while being moved vertically or while being held against vertical movement by the draw works. When cable 35 is reeled in the loop is reduced in size and the traveling block is pulled close to the carriage as shown in Fig. 6. When the cable 35 is paid out the loop is increased in size and the heavy traveling block C moves to the longitudinal axis of the derrick under the influence of gravity. The carriage 32 can move freely up and down rail 30 as traveling block C moves up and down in the derrick. It will be understood that the embodiment of Figs. 5 and 6 will be used in controlling the position of traveling block C when pulling a stand of drill pipe or when returning a stand of drill pipe into the borehole in exactly the same steps as illustrated for the first described embodiment in the series of Figs. 1 to 4, inclusive. Fig. 5 shows the equipment in a position corresponding to that shown by the equipment of Fig. 1, while Fig. 6 illustrates the traveling block C in a position somewhat between that of the traveling block in Fig. 2 and Fig. 3 in the embodiment of Figs. 1 to 4.

Another embodiment suitable for use when practicing the method of the present application is shown in Fig. 7. In this embodiment the assembly is similar to that of Figs. 1 to 4 with the traveling block pull back E'' provided with a line 17 secured to anchor 18 at the top of derrick A. In this embodiment the mechanism for tightening or releasing the cable consists of sheaves 40, 41 mounted on structural members 42 which are secured to derrick A and a piston and cylinder assembly 43 having a sheave 44 carried by the piston. When cable 17 is released the traveling block C will move to the axis of the derrick and when it is tightened the traveling block is drawn over to the side of the derrick. Accordingly, pipe may be handled in this assembly when removing drill pipe from or returning it into the well in the same manner as previously described in detail in the series of Figs. 1 to 4.

Fig. 8 is a showing of another embodiment of a track which can be substituted for track 30 of Figs. 5 and 6. In Fig. 8 track 30' is straight and extends parallel with the side of the derrick A from its upper to its lower end. It will be understood that in substituting track 30' for track 30 for Figs. 5 and 6, the only difference in operation is that a somewhat larger loop or bight in line 17 (not shown in Fig. 8) will be required when the carriage is on a lower portion of a track.

Figs. 9 and 10 show still another embodiment of structure which may be substituted for that of Figs. 5 and 6. Carriage 32' has reel 37' and prime mover 38' mounted directly thereon. Line 35' has one end secured to carriage 32' and is looped around sheave 19 of traveling block C. Any suitable means, not shown in the drawing, may be provided for supplying power to prime mover 38'. By operation of prime mover 38', reel 37' may be rotated either to reel in or reel out line 35' thereby allowing traveling block C either to move along the vertical axis of the derrick or to be deflected laterally away from the axis of the derrick at the option of the operator. It is to be understood that the carriage of Figs. 9 and 10 may be used either with the bent rail of Figs. 5 and 6 or the straight rail of Fig. 9.

While I have disclosed specific embodiments suitable for the practice of the present invention, it will be obvious to a workman skilled in the art that other embodiments may be employed for this purpose.

The advantages of the method of the present application will be obvious to a workman skilled in the art. In the method of the present application the heavy duty hoisting equipment conventionally used, including a conventional derrick, crown block, traveling block and draw works, is employed so that the capital investment in the drilling rig is substantially the same as that heretofore required. By deflecting the heavy duty traveling block so that it is kept away from the axis of the derrick when it is unloaded and being moved between vertically separated points, the drilling crew may perform various necessary pipe handling operations at the locus of the longitudinal axis of the derrick at the same time the unloaded traveling block is being returned to a position preparatory to supporting the heavy load of the drill stem for which it is designed. This allows the operation of

pulling a drill stem or lowering it into the well to be speeded up a minimum of 25 or 30 per cent over the time required when using conventional equipment where the unloaded traveling block remains stationary, while the drilling crew performs pipe handling operations and is moved vertically while the drilling crew is idle.

Having fully described and illustrated the method of the present invention, what I desire to claim as new and useful and to secure by Letters Patent is:

1. In the method of running a sectional drill string into or out of a well, wherein a flexibly suspended travelling block is moved vertically in a derrick in one direction while it supports the drill string and is alternately moved in the opposite direction while it is unloaded, the improvement comprising, controlling the vertical component of movement of the unloaded block by the flexible suspension means while exerting a lateral pull directly on the unloaded block in a predetermined substantially vertical plane which passes through the longitudinal axis of the derrick, whereby to cause said unloaded block to move in a path substantially confined in said plane, the upper and lower ends of said path terminating at the longitudinal axis of the derrick and its intermediate portion being laterally offset from the longitudinal axis of the derrick, and controlling the horizontal component of movement of said unloaded block to maintain it in said path by the continuous exertion of said lateral pull.

2. In the method of running a sectional drill string into or out of a well, wherein a flexibly suspended travelling block is moved vertically in a derrick in one direction while it supports the drill string and is alternately moved in the opposite direction while it is unloaded, the improvement comprising, controlling the vertical component of movement of the unloaded block by the flexible suspension means while exerting a lateral pull directly on the unloaded block in a predetermined substantially vertical plane which passes through the longitudinal axis of the derrick, whereby to cause said unloaded block to move in a path substantially confined in said plane, the upper and lower ends of said path terminating at the longitudinal axis of the derrick and its intermediate portion being laterally offset from the longitudinal axis of the derrick, controlling the horizontal component of movement of said unloaded block to maintain it in said path by the continuous exertion of said lateral pull, and, during the movement of said unloaded block, moving a disconnected pipe section laterally in the derrick toward or away from the side of the derrick opposite the side thereof toward which the block is offset.

3. In the method of running a sectional drill string into or out of a well, wherein a flexibly suspended travelling block is moved vertically in a derrick in one direction while it supports the drill string and is alternately moved in the opposite direction while it is unloaded, the improvement comprising, controlling the vertical component of movement of the unloaded block by the flexible suspension means while exerting a lateral pull directly on the unloaded block in a predetermined substantially vertical plane which passes through the longitudinal axis of the derrick and which extends substantially in the direction of the axes of the block sheaves, whereby to cause said unloaded block to move in a path substantially confined in said plane, the upper and lower ends of said path terminating at the longitudinal axis of the derrick and its intermediate portion being laterally offset from the longitudinal axis of the derrick, and controlling the horizontal component of movement of said unloaded block to maintain it in said path by the continuous exertion of said lateral pull.

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