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APPARATUS FOR HANDLING PIPE IN A DERRICK

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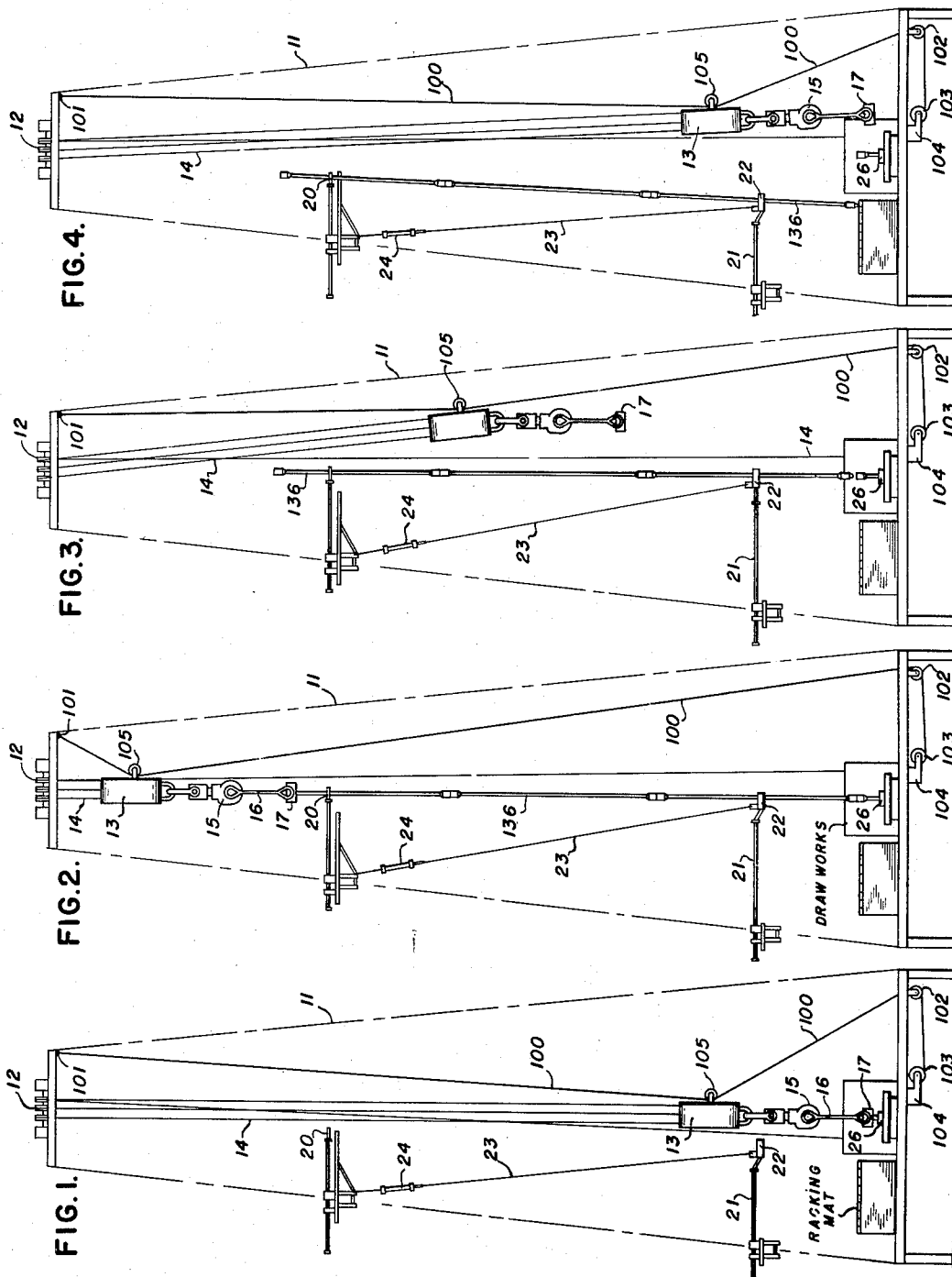


FIG. 4.

FIG. 3.

FIG. 2.

FIG. 1.

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APPARATUS FOR HANDLING PIPE IN A DERRICK

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Divided and this application November 3, 1951, Serial No. 254,783

4 Claims. (Cl. 214—2.5)

This application is a division of Serial No. 149,514, filed March 14, 1950. Said Serial No. 149,514 is directed to apparatus including a drilling derrick with an elongated rail mounted substantially upright in the derrick while the present application is directed to a drilling derrick with a cable member mounted substantially upright in the derrick with at least one end of the cable fixed to the derrick and with power means operatively connected to the cable to slacken it or render it taut; the rail and the cable, respectively, in the two types of apparatus being operatively connected to the travelling block in the drilling derrick for selectively constraining the travelling block in a laterally offset path.

The present invention is directed to apparatus adapted for handling pipe in a derrick. More particularly, the invention is directed to apparatus adapted for handling vertical lengths of pipe.

In the drilling of oil wells and in other well boring operations in which vertical lengths of pipe, known as stands, are employed, it is frequently necessary to suspend the drilling operation and to pull the pipe from the hole. This may be necessary, for example, when the drill bit becomes worn and it is necessary to replace it. When such operations are required, a considerable amount of time is lost due to the fact that the pipe must be pulled from the hole. When it is considered that deep wells of as much as 10,000 feet in depth may require over 100 stands of pipe of 90 feet in length, it will be seen that it is a tedious and time-consuming operation to pull the pipe from the hole, replace the drill bit and return the pipe in the hole before the drilling operations may be resumed. When the pipe is being pulled out of the hole the travelling block is performing a useful function, but once a stand of pipe is out of the hole and is being broken loose from the drill pipe, the travelling block is idle and must remain in the top of the derrick until the stand has been moved out of the path of the travelling block and racked in a suitable racking position. The empty travelling block is then allowed to descend to bring up another stand and the operation is repeated. The amount of time consumed each time a length of pipe is brought up, broken loose and moved back, approximates 30 to 55 seconds. During this time the travelling block is still in the top of the derrick while the pipe stand is being moved out of position. Considering the handling of 90 to 100 or more pipe stands of 90 feet in length, it will be seen that valuable time is irretrievably lost.

It is, therefore, a general object of the present invention to provide an improved apparatus adapted to be used in a derrick which allows the travelling block or main load carrying member to traverse the height of the derrick while a pipe stand is being manipulated within the path of free suspension of the travelling block.

Another object of the present invention is to provide apparatus for controlling the path of travel of the unloaded travelling block as it is raised and lowered in a derrick.

Another object of the present invention is to provide

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apparatus for use in a derrick in conjunction with a travelling block, which enables the travelling block to be raised and lowered in the derrick in substantially uninterrupted sequence during the operation of pulling a string of drill pipe from a well or of running it into the well.

Still another object of the present invention is to provide power-operated apparatus associated with a travelling block and controllable at the will of an operator to permit the travelling block when loaded to be raised or lowered along its path of free suspension at the center-line of the derrick and, when it is unloaded, to move it laterally into and maintain it in an offset path.

A still further object of the present invention is to provide new and useful apparatus to facilitate the handling of vertical lengths of pipe in a derrick.

Other objects will be apparent to those skilled in this art from the following description of several embodiments of the invention, reference being had to the accompanying drawings in which

Figs. 1 to 4, inclusive, are side elevational views showing an embodiment of the present invention and illustrating the various positions assumed by the travelling block during a cycle of operation; and

Fig. 5 is a side elevational view of another embodiment of the invention.

In the various embodiments of the invention identical numerals will be employed to identify identical parts.

In its broad, generic sense our invention contemplates the provision, in a derrick having a main load carrying member or device suspended from the top of the derrick on the center-line thereof, of an elongated guide member of a length at least equal to the length of a stand of pipe to be racked in a derrick. The main load carrying device is operatively connected to the guide member in such manner that when the device is loaded, such as when pulling a string of drill pipe from the well bore or when running the pipe into the well bore, the device is freely suspended on the center-line of the derrick; on the other hand, when the unloaded device is to be raised or lowered in the derrick the operative connection between the device and the guide member is such as to deflect the device laterally from its path of freely suspended travel into an offset path, and to maintain it in such offset path during its travel. The main load carrying member, the guide member, and the runner member operatively connecting the load carrying member to the guide member and the connection therebetween cooperate with the apparatus for supporting and moving a disconnected stand of pipe. Such apparatus for supporting and moving a disconnected stand of pipe includes an auxiliary load carrying member supported in the derrick at a point removed from the center-line thereof and means for moving a vertical stand of pipe laterally in the derrick into or out of racking position. The means for moving a vertical stand of pipe laterally in the derrick may include means for grasping or engaging the outer periphery of a stand of pipe at its upper end or at its upper and lower ends. The several elements of our invention cooperate in handling a section of drill pipe at the locus of the longitudinal axis of the derrick when the travelling block or main load carrying device is unloaded and simultaneously maintains the device in a controlled path of travel offset to one side of the longitudinal axis while it is moved from one vertically spaced point to another.

In its specific sense it is contemplated that in the present application it is within the scope of the invention being described and claimed to interconnect the travelling block and the runner in fixed laterally spaced relation, and to move the travelling block laterally from its path of free suspension at the derrick center-line into an offset path

by changing the path of travel of the runner. This may be accomplished by changing the configuration of the guide member.

In Figs. 1 to 4 a conventional derrick, indicated as 11, is provided with the usual crown block 12 from which a conventional travelling block 13 is suspended by a drilling line 14. The crown block 12 is so positioned as normally to support the travelling block for movement along the centerline of the derrick and it is thus obvious in accordance with conventional practice that the travelling block must be maintained in the upper portion of the derrick in idle condition while a stand of pipe is disposed at the center-line of the derrick; also according to conventional practice the travelling block and the conventional hook 15, elevator links 16 and elevator 17 are used to support each stand of pipe while racking or unracking it in the derrick and while making up or breaking out the stand from the drill string. As stated previously, the use of this heavy duty equipment to handle relatively light loads such as single stands of drill pipe and the enforced idleness of this equipment while the stands are being made up or broken out result in considerable lost time which could be saved if it were possible for the unloaded travelling block to be raised or lowered while the pipe stand is being made up or broken out and racked or unracked, as the case may be, by other apparatus which cooperates with the travelling block. In Figs. 1 to 4 there are shown an upper pipe racker 20 and a lower pipe racker 21 each having at its inner extremity means for engaging the upper and lower portions of a stand of pipe. In this instance the upper racker 20 is provided with pipe engaging means which merely embraces the pipe to control its lateral movement without supporting the weight of the pipe and the lower racker 21 is provided with pipe engaging means in the form of an auxiliary elevator 22 which grips the pipe to support the weight thereof. The auxiliary elevator 22 is supported by a cable 23 the upper extremity of which is connected to the piston of a fluid actuated lifting cylinder 24. The provision of the pipe rackers 20 and 21 and the auxiliary elevator 22 would make it possible to raise or lower the unloaded travelling block in the derrick immediately after the weight of the drill string is transferred from the block to the usual pipe slips 26, were it not for the fact that the stand of pipe disposed at the center-line of the derrick is directly in the path of free suspension of the travelling block. To overcome this obstacle and make it possible to raise or lower the unloaded travelling block while the pipe stand is being made up or broken out and racked or unracked, as the case may be, we have provided means for moving the travelling block laterally into an offset path and for maintaining it in such path while it is being raised or lowered in the derrick.

In Figs. 1 to 4, the guide member is shown as a flexible element such as a cable 100, the upper extremity of which is anchored in the upper portion of the derrick 11 at 101. The lower portion of the cable 100 passes over a sheave 102 mounted beneath the derrick floor and onto a drum 103 having a driving motor 104. In this instance the runner may comprise a roller 105, which is journaled on the side of the travelling block 13 and which engages and travels along the cable 100. It will be noted by reference to Figs. 1 and 2 that by energizing the motor 104 in a direction to unwind a short length of the cable 100 from the drum 103, the cable is slackened sufficiently to enable the travelling block to be raised or lowered along the center-line of the derrick while still being operatively connected to the cable 100 by the roller 105. When it is desired to move the unloaded travelling block laterally into an offset path, the motor 104 is energized in a direction to remove the slack in the cable 100, thus providing a substantially straight trackway for the roller 105 effective to constrain the travelling block to

move in a path offset laterally from the derrick centerline, as shown in Fig. 3.

Fig. 5 illustrates another arrangement generally similar to that shown in Figs. 1 to 4. In lieu of winding the lower end of the cable 100 onto a drum, in the embodiment shown in Fig. 5 both ends of the cable are anchored in the derrick at 101 and 106, respectively. The length of the cable exceeds the distance between the anchor points 101 and 106 by an amount sufficient to provide a bight portion 107 extending between sheaves 108 and 109 mounted in the derrick, and around a movable sheave 110. The sheave 110 is mounted on the end of a piston rod 111 which projects laterally outwardly from a cylinder 112 mounted in the derrick between the sheaves 108 and 109. The travelling block is operatively connected to the cable 100 by a runner which, as in the embodiment shown in Figs. 1 to 4, may be a roller 105 journaled on the side of the travelling block.

It will be evident that upon retraction of the piston rod 111 into the cylinder 112 the cable 100 is slackened, thus permitting the travelling block to be raised or lowered along the centerline of the derrick. When the piston rod is moved outwardly, substantially all of the slack in the cable is transferred to the bight portion 107, thus providing a substantially straight trackway for the roller 105.

From the foregoing descriptions of the various embodiments of the invention, it will be apparent that in each instance there is provided power means operatively connected to the travelling block and operable at will selectively to permit the travelling block to be raised or lowered along its normal path of free suspension at the center-line of the derrick, or to move the unloaded travelling block laterally into an offset path and to maintain it in such path while it is being raised or lowered in the derrick. The provision of apparatus capable of performing this function, in conjunction with other apparatus for supporting and handling the stands of pipe independently of the travelling block, makes it possible to initiate the raising or lowering of the unloaded travelling block immediately upon its disconnection from the drill string and to move it to the opposite side of the derrick while a stand of pipe is being disconnected from the drill stem string and racked, when coming out of the hole, or while it is being unracked and connected to the drill string when going in the hole.

An important part of the present invention is the apparatus for supporting the disconnected stands of pipe while they are being moved between the pipe rack and the center-line of the derrick and while they are being made up or broken out from the drill string. An example of apparatus suitable for this purpose is shown in Figs. 1 to 4 and comprises the previously described upper racker 20, lower racker 21 incorporating an auxiliary elevator 22, suspension line 23 and lifting cylinder 24. Similar apparatus is also shown in the embodiments of Fig. 5. Pipe handling apparatus of the foregoing types form the subject matter of a copending application of Albert L. Stone, Serial No. 5,843 entitled "Apparatus for Racking Pipe in a Derrick," filed February 2, 1948, now abandoned.

The manner in which the apparatus of the present invention may be employed in conjunction with pipe-handling apparatus to reduce substantially the time interval of an operating cycle is best illustrated in Figs. 1 to 4. These figures, when considered from left to right, show steps in the sequence of operations in a cycle of removing a stand from the drill string when coming out of the hole. In Fig. 1 the elevator 17 is engaged with the upper joint of the drill string preparatory to raising the drill string the length of a stand, into the position shown in Fig. 2. During this portion of the cycle the cable 100 is slackened to permit the travelling block 13 to hang freely suspended from the crown block and thus travel along the derrick center-line. Also during this portion of the cycle the rackers 20 and 21 are retracted clear of the path of the travelling block.

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Upon setting the slips 26 in the rotary table to support the drill string, and disconnection of the elevator 17 from the upper end of the string, the motor 104 is energized to cause the drum to wind a portion of the cable 100 thereon, thus tensioning the cable and pulling the travelling block laterally into its offset path. Simultaneously with actuation of the drum 103 the driller releases the brake on the drawworks to allow the travelling block to descend by gravity along its offset path, as indicated in Fig. 3.

Meanwhile the rackers 20 and 21 have been manipulated to engage the stand of pipe 136 while the joint at the lower end thereof is being broken out by the tongs (not shown). The auxiliary elevator 22 supports the weight of the stand through the lifting cylinder 24 and the suspension line 23, and lifts the stand clear of the tool joint box when the joint is broken. The two rackers are then manipulated to move the stand into racked position as shown in Fig. 4. During these tonging and racking operations the unloaded travelling block is being lowered along its offset path, and by the time it has traversed the length of a stand the disconnected stand will have been racked, or at least moved laterally out of the normal path of the travelling block. The cable 100 is then slackened by actuation of the drum 103 to allow the travelling block to assume its freely suspended position at the derrick center-line, permitting the elevator 26 to be latched about the upper end of the drill string preparatory to a repetition of the foregoing cycle.

The sequence of steps in an operating cycle of adding a pipe stand to the drill string when going in the hole is the reverse of that just described, and can best be understood by reference to Figs. 1 to 4 in reverse order, proceeding from right to left. Fig. 4 may be considered as representing the beginning of the cycle, with the drill string supported by the pipe slips 26 and with the travelling block being moved laterally into its offset path by actuation of the drum 103 in winding direction. The rackers 20 and 21 and the auxiliary elevator 22 are in position to pick up a stand of pipe 136 from the pipe rack and move it to the center-line of the derrick, as shown in Fig. 3, where it will be coupled to the drill string while the travelling block is being raised along its offset path, as is also indicated in Fig. 3. Fig. 2 may be considered to show the pipe stand 136 coupled to the drill string and the elevator 17 latched onto the upper end of the stand and supporting the drill string, the pipe slips 26 having been removed from the rotary table. The cable 100 has been slackened to allow the travelling block to move into its central, load-supporting position, and the rackers 20 and 21 are about to be detached from the pipe stand and retracted out of the path of the travelling block. In Fig. 1 the travelling block has been lowered along the derrick center-line the length of the pipe stand and the pipe slips 26 have been set, thus completing the cycle. If it be assumed that there are additional stands in the pipe rack to be added to the drill string, the rackers 20 and 21 will have been manipulated into the positions shown in Fig. 4 during lowering of the drill string.

Although the two reverse cycles of operation have been described only with reference to the embodiment of the invention shown in Figs. 1 to 4, it will be understood that the other embodiment illustrated and described herein functions to control the path of movement of the unloaded travelling block to accomplish the same result and produce the same cycles of operation as described above. It will be apparent that by providing apparatus

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embodying this invention a saving of time may be effected which is on the order of 30 to 40 per cent of the time interval of a complete cycle. This is the result of raising or lowering the unloaded travelling block the length of the pipe stand while the tonging and stand-handling operations are being performed. In this manner, the travelling block is raised and lowered in the derrick in substantially uninterrupted sequence, with a pause at each limit of its travel of only sufficient duration to permit setting or releasing the pipe slips and latching or unlatching of the elevator.

What we wish to claim as new and useful and to secure by Letters Patent is:

1. Apparatus for use in a derrick having a travelling block flexibly suspended from the upper end of the derrick at the center line thereof, comprising a cable member adapted to be mounted substantially upright in the derrick and of a length at least that of a stand of pipe to be racked in the derrick with a first end fixed to the derrick, a runner member mounted on said block and engaging said cable member for guided movement therealong and a power device operatively connected to the second end of said cable for varying the effective length thereof thereby selectively to cause said block to travel along a laterally offset path or to permit said block to travel along its path of free suspension.

2. Apparatus for use in a derrick having a travelling block flexibly suspended from the upper end of the derrick at the center line thereof, comprising an elongated cable adapted to be mounted substantially upright in the derrick and of a length at least that of a stand of pipe to be racked in the derrick with its upper and lower ends fixed to upper and lower portions of the derrick respectively, a runner member mounted on said block and engaging said guide member for guided movement therealong, a pair of sheaves mounted in the derrick, a piston and cylinder assembly mounted in the derrick with its axis extending horizontally and between the two sheaves and carrying a third movable sheave with the cable having a bight portion threaded around said two sheaves and over the third movable sheave whereby said piston and cylinder assembly vary the effective length of the bight portion thereby selectively to cause said block to travel along a laterally offset path or to permit said block to travel along its path of free suspension.

3. Apparatus for use in a derrick having a travelling block flexibly suspended from the upper end of the derrick at the center line thereof comprising a cable member adapted to be mounted substantially upright in the derrick and of a length at least that of a stand of pipe to be racked in the derrick, the ends of said cable being fixed to the derrick at upper and lower portions of the derrick, a runner member mounted on said block and engaging said cable member for guided movement therealong, and power means operatively connected to said cable to slacken the cable or to render it taut whereby said block is caused to travel along its path of free suspension or along a laterally offset path.

4. Apparatus in accordance with claim 3 in which the power means comprises a motor.

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