

Aug. 4, 1964

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3,143,220

APPARATUS FOR HANDLING PIPE

Filed Jan. 3, 1961

3 Sheets--Sheet 1

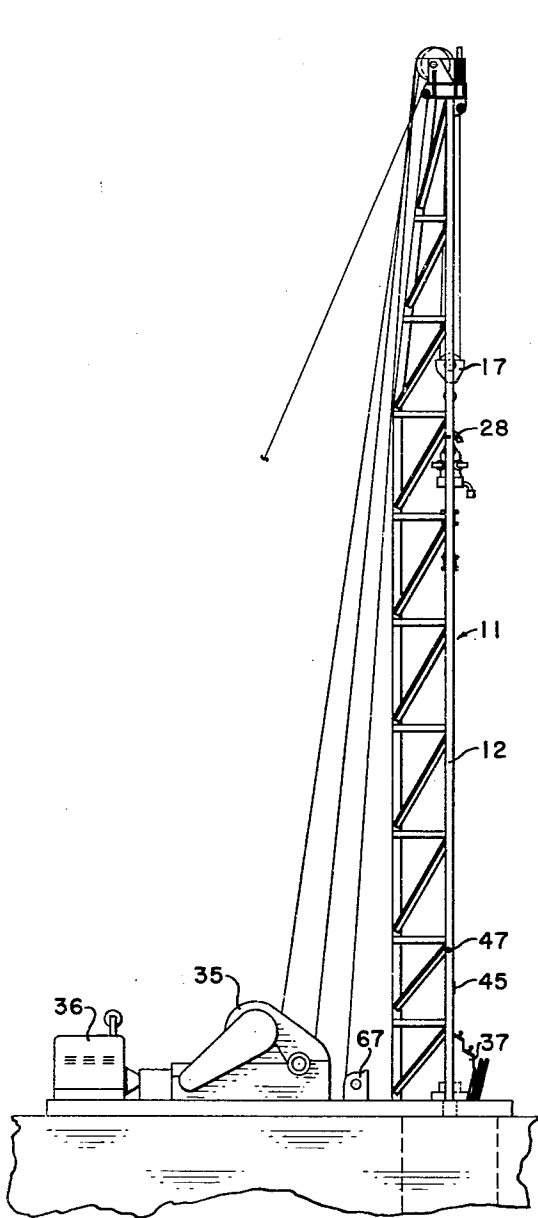


FIG. 1

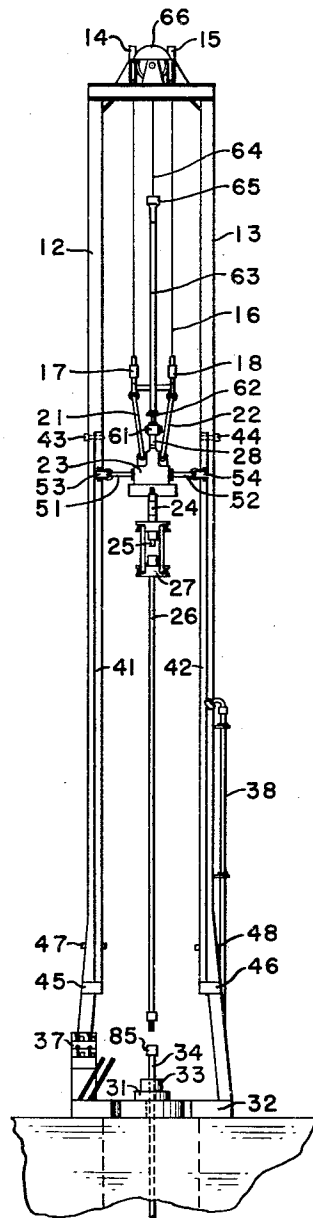


FIG. 2

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3 Sheets-Sheet 2

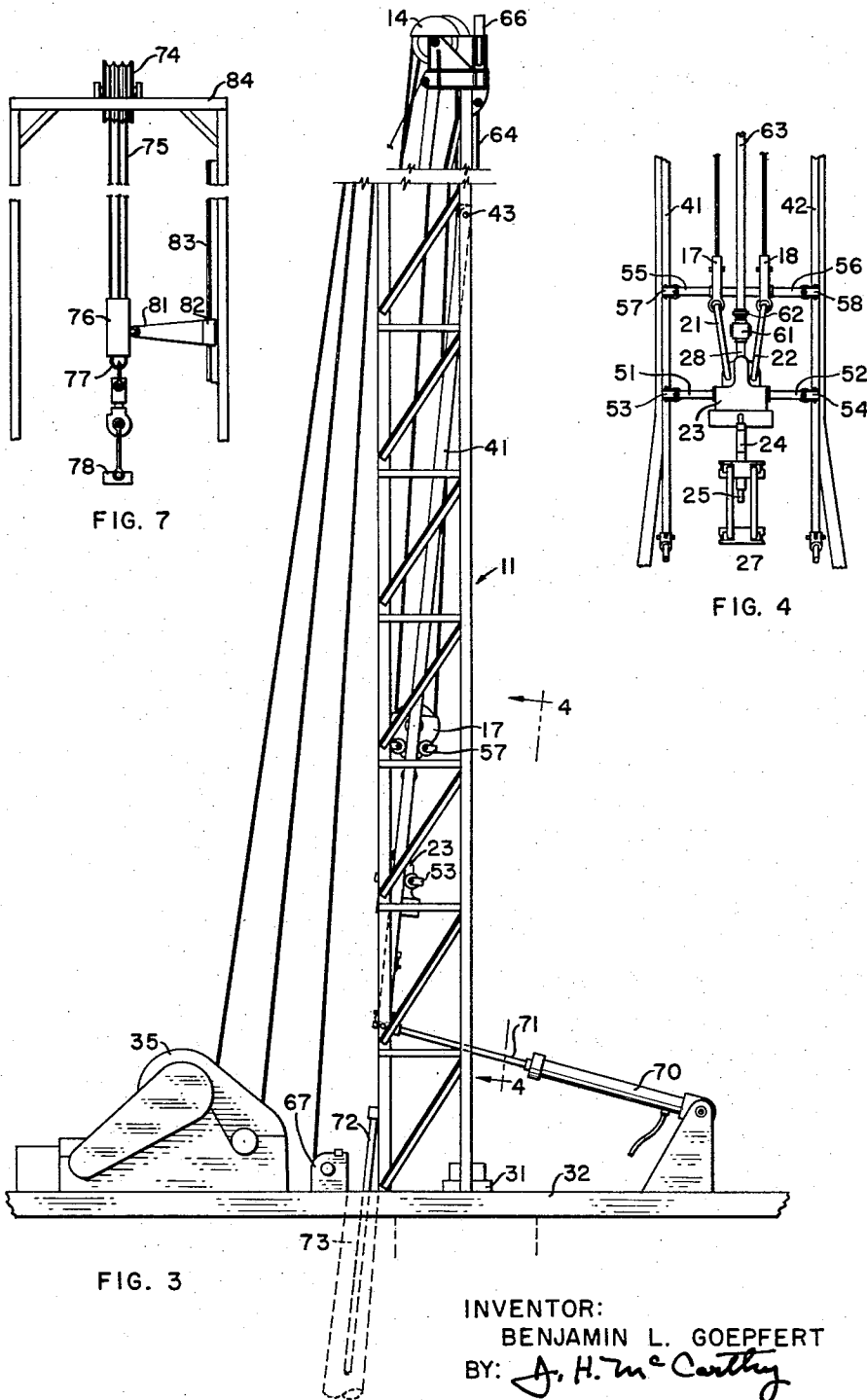


FIG. 3

FIG. 4

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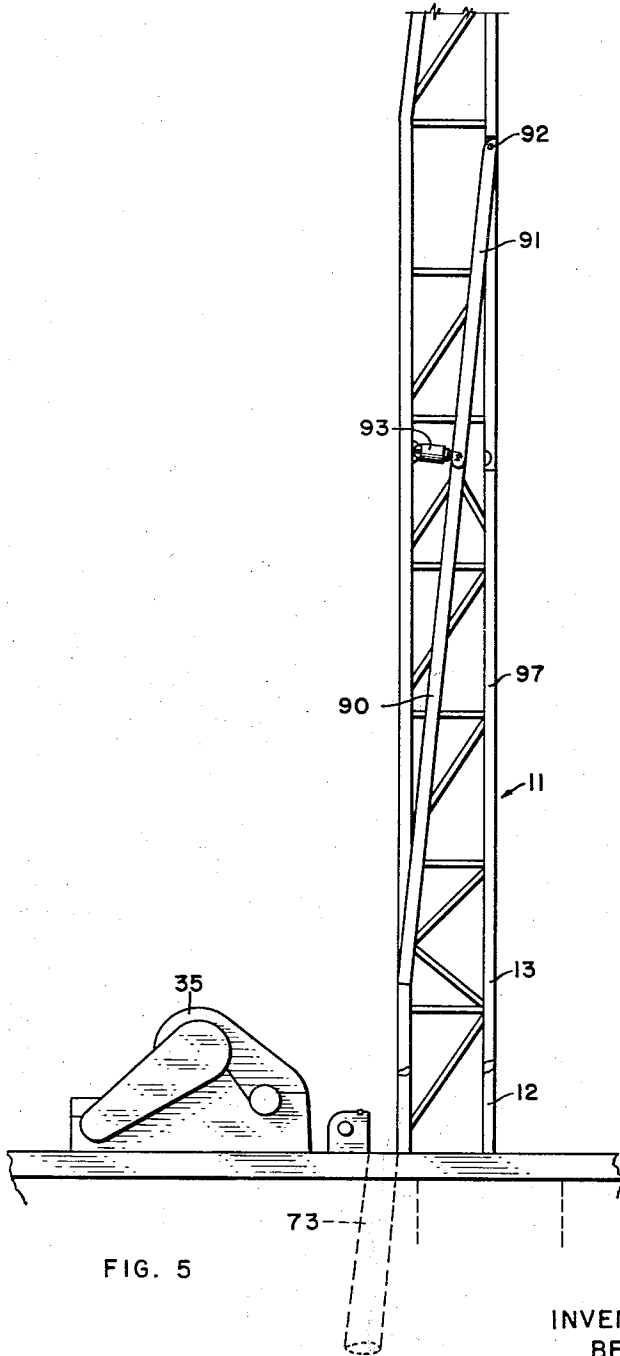


FIG. 5

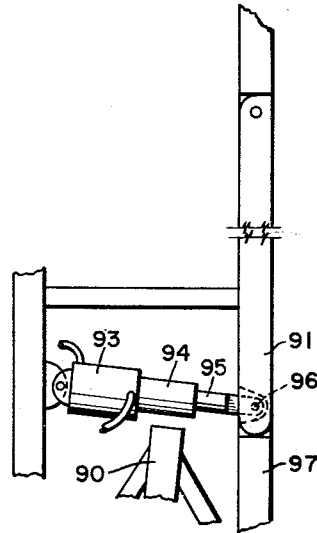


FIG. 6

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1

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3,143,220

APPARATUS FOR HANDLING PIPE

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The present invention relates to a method and apparatus for handling drill pipe in a derrick while drilling a well or coring a formation, and pertains more particularly to a method of supporting a travelling block within a well derrick while hoisting sections of pipe within the derrick and running them down into a well.

Most oil and gas wells are drilled by the rotary drilling method wherein a drill bit is rotated at the end of the drill string or stem within the well borehole by means of some suitable drive mechanism, such for example, as a rotary table positioned on the operating floor of the derrick, or by a hydraulic turbine or electric motor mounted in the drill string at any desired distance above the drill bit. Generally, a circulating fluid, either a gas or a liquid, is circulated down the drill string during drilling operations to flush the cuttings from the well and carry out the other well known functions of drilling muds.

When using this method of drilling wells, additional sections of pipe are added to the drill string as the well gets deeper. These extra sections of drill pipe may have been previously stacked within the derrick prior to use or may be hoisted into the derrick one at a time as they are needed. The selected method usually depends upon the size and construction of the derrick, a heavy-duty derrick being able to support many lengths of pipe within its framework whereas a light-weight or portable derrick can only support one or a few lengths of pipe at a time.

Drilling operations are commonly carried out by employing a derrick provided with a crown block with fall lines depending therefrom and supporting a travelling block which is generally provided with an elevator for grasping and supporting the upper end of a pipe section or pipe string. A hoisting mechanism, known as the draw-works, is attached to the free end of the fall lines and serves to raise and lower the travelling block along the vertical axis of the derrick. At the time when a section or stand of pipe is being added or removed from the top of the drill string, the rest of the drill string positioned within the well borehole is supported by means of slips which are set in the rotary table of the derrick in a manner well known to the art.

In most well derricks the travelling block is free to move up and down along the vertical axis of the derrick and to move horizontally a distance until it hits the framework of the derrick. Thus, in a windy location or in a derrick which is mounted on an unstable base, such as a floating vessel on the surface of the ocean, the travelling block is able to sway from one side to another within the derrick whenever it is not secured to the top of the drill string. This creates a hazardous situation within the derrick whether the travelling block is moving up and down by itself or with a section of pipe secured to the lower end thereof.

It is therefore a primary object of the present invention to provide an apparatus for rigidly supporting a travelling block when moving along the vertical axis of the derrick either during drilling operations or when adding or removing sections of pipe from the drill string.

A further object of the present invention is to provide travelling block support means within a derrick which may be selectively positioned either vertically within a derrick over a well bore or in an offset position at an angle to the well bore during pipe handling operations.

Another object of the present invention is to provide

pipe handling apparatus whereby the travelling block within a derrick is lowered to a point near the operating platform thereof prior to being secured to another section of pipe to be added to a drill string, the travelling block being rigidly supported at all times as it is raised within the derrick with an additional pipe section and then lowered in the derrick after the extra pipe section has been secured to the top of a drill string and then drilled into the borehole.

Still another object of the present invention is to provide a method for adding additional lengths of pipe to a drill string in a well without having to stack pipe within a swaying derrick on an unstable base such as a floating drilling barge on the surface of the water.

These and other objects of this invention will be understood from the following description taken with reference to the drawing, wherein:

FIGURES 1 and 2 are side and front views of a derrick having vertically-positioned guide track means for supporting a travelling block and a power swivel attached thereto;

FIGURE 3 is a side view of the derrick of FIGURE 1 illustrating the guide track for the travelling block and power swivel positioned in an offset manner to be in line with a pipe well in the operating floor of the derrick in which one or more sections of pipe may be positioned;

FIGURE 4 is a view taken along the line 4—4 of FIGURE 3 showing another support arrangement for a split block and a power swivel;

FIGURE 5 is a schematic view of a derrick with the near legs and guide track cut away to illustrate the location of another form of guide track and switching mechanism on the far leg of the derrick;

FIGURE 6 is a view in enlarged detail of the switching mechanism of FIGURE 5 with the movable section of track positioned vertically; and,

FIGURE 7 is a schematic view of an alternative arrangement for supporting a travelling block without a power swivel attached thereto.

Referring to FIGURES 1 and 2 of the drawing, a derrick 11 is shown as being provided with two leg truss members 12 and 13 positioned in spaced relationship and supporting a crown block which in this particular embodiment is formed by a pair of sheaves 14 and 15 mounted in spaced relationship with each other. Suspended from fall lines 16 running through the split-sheave crown block 14—15, is a split-sheave travelling block 17—18. Secured to the travelling block 17—18 by means of a pair of elevator links 21 and 22 is a power swivel 23 of any suitable design. The short power shaft 24 extending downwardly from the power swivel 23 is provided with threads 25 which may be connected into the top of a section of pipe 25. If desired, an elevator 27 may be employed to lift a pipe section instead of the threaded joint 25 of the power swivel. The power swivel may be any suitable prime mover means but is preferably in the form of a hydraulic pump powered by means of a hydraulic fluid which is pumped into the unit through a nozzle 28. The power swivel produces torque necessary for rotating a drill string without using a rotary table or a Kelley. However, if desired, the derrick 11 may be provided with a conventional rotary table 31 positioned on the floor of the operating platform 32 in a conventional manner. Slips 33 are provided at the top of the rotary table 31 for supporting a drill string 34 suspended within a well. The derrick is also equipped with suitable hoist mechanisms 35 having prime mover means 36 and suitable controls 37 therefor. A mud circulating line 38 may be provided up along the side of the derrick with a flexible hose line (not shown) connecting the top of the mud line conduit 38 to inlet nozzle 28 of the power swivel 23.

Vertically mounted within the derrick 11 are a pair of

3

tracks 41 and 42 which are pivotally secured at their upper ends by means of pivot pins 43 and 44. The lower ends of the tracks 41 and 42 (FIGURE 2) are normally freely movable but are prevented from moving to one side of the vertical position by any suitable stop means such as plates 45 and 46. Anchoring means such as pins 47 and 48 may be employed if desired but they are not generally necessary as the positioning means for moving the tracks 41 and 42, described hereinbelow, serves to anchor the tracks in a fixed position. The length of the movable portion of the tracks 41 and 42 is preferably at least equal to the length of a section of pipe to be handled in the derrick although the derrick will operate in its designed manner with the length of the tracks being considerably shorter. The power swivel 23 (FIGURE 2) is provided with a pair of arms 51 and 52 supporting runners 53 and 54 at the ends thereof for slidably engaging the tracks 41 and 42 for vertical movement therealong while preventing any movement in a horizontal plane. Additionally, as shown in FIGURE 4, the travelling block 17-18 may be provided with a pair of arms 55 and 56 together with runners 57 and 58 which are slidably mounted on the tracks 41 and 42.

In the special apparatus shown in FIGURE 2 of the drawing, the vertical opening through the power swivel 23 is provided with a valve 61 and a union 62 thereabove for connecting a lubricator 63 to the top of the power swivel 23. By means of the lubricator, a core barrel (not shown) which has taken a core in the drill string 26 just above the drill bit (not shown) at the bottom of the well may be retrieved by a wire line 64 and pulled up into the lubricator 63 after which the valve 61 would be closed and the union 62 opened to allow the core barrel with the core contained therein to be extracted from the bottom of the lubricator 63. The lubricator 63 is preferably provided with a wire line stripper 65 at the top thereof for cleaning the wire line 64 as it emerges from the lubricator 63 and prior to passing over the special sheave 66. A special auxiliary hoist 67 is provided for handling the wire line 64 (FIGURE 3).

In FIGURE 3, the movable tracks 41 and 42 are illustrated as being provided with power-actuated positioning means which may be either mechanically, electrically, hydraulically, or pneumatically operated but preferably take the form of a piston (not shown) within a cylinder 70 from which a piston rod 71 is extendible, the outer end of the piston rod being preferably pivotally secured to the lower end of the movable track 41. The piston-operated positioning device engages the lower end of the movable track for alternatively maintaining it generally in each of two substantially fixed positions, one of the positions being along the normal path of the travelling block within the derrick and the other of the positions being along an offset path. It can also be positioned at any intermediate point. In the particular arrangement shown in FIGURE 3 of the drawing, the offset path is substantially in line with the upper end of an additional section of pipe 72 which is shown as being positioned in a pipe well or rat hole 73 extending through the operating floor 32 of the derrick. Additional sections of pipe 72 may be positioned in the well by any other suitable pipe handling mechanism, or, in the event that small-diameter pipe is being employed to core a formation, the extra section 72 of pipe may be manually installed in the well 73. The walls of the pipe well 73 are preferably slanted in a manner so as to serve as support and guide means for the section of pipe as it is being withdrawn from the well by means of the elevators 27 (FIGURE 4). In the event that the derrick of the present invention is being employed on a floating vessel, the well 73 would extend into the hull of the vessel thus lowering the center of gravity of the boat by taking out of the derrick additional sections of pipe which would normally stand upright within the derrick in a conventional manner. While the derrick of the present invention has

4

been shown as being provided with power-operated positioning devices for the track 41, it is readily apparent that in an emergency, the lower end of the movable tracks 41 and 42 could be moved manually.

In FIGURE 7 a conventional crown block 74 is shown as being provided with fall lines 75 for suspending a conventional travelling block 76 from which depend a hook 77 and an elevator 78. The travelling block 76 is provided with an arm 81 and runner 82 for engaging a track 83 mounted on one leg of the derrick 84.

In the operation of the derrick of the present invention for running pipe into a well, for illustration purposes it will be assumed that a portion of a drill string 34 is suspended by means of slips 33 from a rotary table 31 and depends within the well or core hole being drilled (as shown in FIGURE 2). While the drill string 34 is being either drilled or lowered into the borehole of the well, at least one additional section of pipe 72 (FIGURE 3) is positioned in a pipe well or rat hole 73, as illustrated. With the drill string 34 (FIGURE 2) suspended in the rotary table 31, the power swivel 23 would be in its lowermost position on the tracks 41 and 42 and the threaded joint 25 of its power shaft 24 would then be disconnected from the tool joint 85 at the top of the drill string 34. A power swivel 23 and its travelling block 17-18 would be moved substantially horizontally in a short arc together with movable tracks 41 and 42 by means of the power-actuated positioning device 70-71 (FIGURE 3). It is preferred that movement of the tracks 41 and 42 together with power swivel 23 and travelling block 17-18 takes place when the power swivel 23 and travelling block 17-18 are in their lowermost position on the tracks 41 and 42, thus reducing the center of gravity of the equipment which tends to reduce the sway of the derrick in the event that it is mounted on the deck of a movable vessel.

When the tracks 41 and 42 are in their vertical offset position, as illustrated in FIGURE 3, they are substantially in line with the extra section of pipe 72 stored in the rat hole 73. The travelling block 17-18 and the power swivel 23 are lowered slightly so that the elevator 27 (FIGURE 4) or the threaded section 24 of the power swivel 23 may be connected to the top of the pipe section 72. The travelling block 17-18 and the power swivel 23 (FIGURE 3) are then raised along their offset vertical tracks 41 and 42 by means of the hoist 35 plus pulling the extra pipe section 72 out of the rat hole 73 and up into the derrick 11. The lower end of the pipe section 72 is allowed to swing to a vertical position within the derrick 11 while the shaft 71 of the piston-actuated positioning device 70 is retracted to pull the movable tracks 41 and 42 back to vertical position as shown in FIGURES 1 and 2. At that time the power swivel 23 and its travelling block 17-18 are then lowered slightly, in the event that the elevator 27 has been used, so as to connect the lower end of the added pipe section 26 (FIGURE 2) to the tool joint 85 at the top of the drill string suspended in the well. Drilling operations are then resumed, as by the drill string 34 being rotated by means of the power swivel 23 (FIGURE 2) or by means of the rotary table 31 in which case a Kelley would be used at the upper end of the drill string.

In another arrangement of the derrick of the present invention, instead of moving the entire movable track 41 and 42, as shown in FIGURE 2, the derrick may be provided with a pair of offset tracks 90 (FIGURE 5) fixedly secured within the derrick to the truss member 13 forming one of the legs of the derrick. For ease of illustration, only one track 90 is shown. The upper portion 91 of the offset track 90 is pivoted by means of a pin 92 to the derrick and is provided with a suitable positioning device, preferably of the piston type, at the lower end thereof for moving the switching portion 91 of the offset track from its offset position, illustrated in FIGURE 5, to a vertical position shown in FIGURE 6. As shown

5

in FIGURE 6, the positioning device 93 may comprise a hydraulically-actuated device having a pair of extendible concentric piston rods 94 and 95 with the outer end of the piston rod 95 being pivotally connected to the movable portion of the track 91 by means of a pin 96. Thus, the movable portion of track 91 forms a switching mechanism which may be of any desired construction and which may be very small in size or several feet in length. In the operation of this arrangement of the derrick, a travelling block moving on guide arms and runners would have to be raised to the top of the vertical tracks 97 and onto the switching portion of track 91 before being moved to the offset position shown in FIGURE 5. With the switching portion of the track 91 in its offset position, a travelling block and its elevator or power swivel could be lowered down the offset track 91 to pick up an additional section of pipe (not shown) which would be positioned in the rat hole 73.

In the derrick of the present invention the combination of the travelling block 17-18 and a pipe securing device, such for example as an elevator or the threaded joint of the power shaft of the power swivel, may be considered for purposes of the claims appended hereto as a travelling block assembly. This term also applies to any combination of a travelling block and any suitable pipe securing means with or without the addition of a power swivel or with or without elevators.

I claim as my invention:

1. Apparatus for use in a derrick having a travelling block assembly suspended on fall lines from the upper end of the derrick and an elevator secured to the travelling block assembly for movement therewith, said apparatus comprising

a fixedly-positioned crown block at the top of said derrick,

6

elongated rigid track means mounted substantially vertically within said derrick on opposite sides of the centerline thereof,

runner means mounted on each of said travelling block assembly and engaging said track means for guided movement therealong,

a travelling block assembly including a power swivel secured to and between said runner means,

a lower unitary portion of each of said rigid track means being pivotally mounted near the upper end thereof within said derrick with the lower end being movable between two fixed positions horizontally offset from each other near the lower portion of said derrick,

said movable portion of said rigid track means being fixedly mounted at its upper end against vertical movement relating to said derrick and being of a length at least that of a length of pipe to be handled in said derrick, and

power-actuated laterally-extendible positioning means engaging said movable portion of said track means for alternatively maintaining said portion in each of two substantially fixed positions, one of said positions being along the normal path of said travelling block assembly within said derrick, and the other of said positions being along an offset path.

2. The apparatus of claim 1 including an elevator carried by said travelling block assembly for engaging pipe.

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