Oct. 28, 1952 J. W. MENHALL 2,615,585

WELL DERRICK, RIG, AND PIPE RACKING APPARATUS

Filed June 27, 1947 4 Sheets-Sheet 1

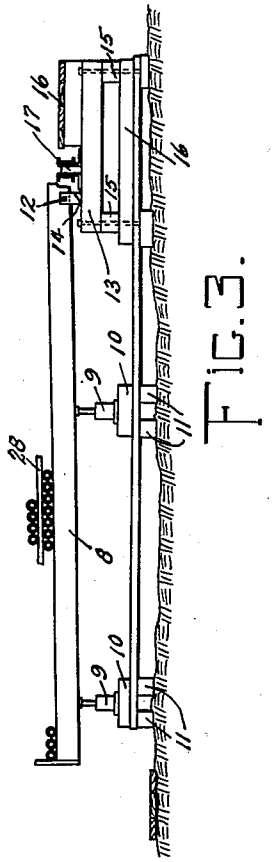


FIG. 3.

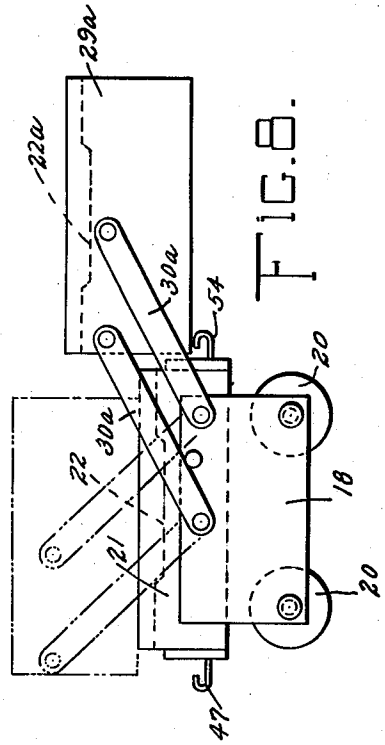


FIG. 8.

FIG. 1.

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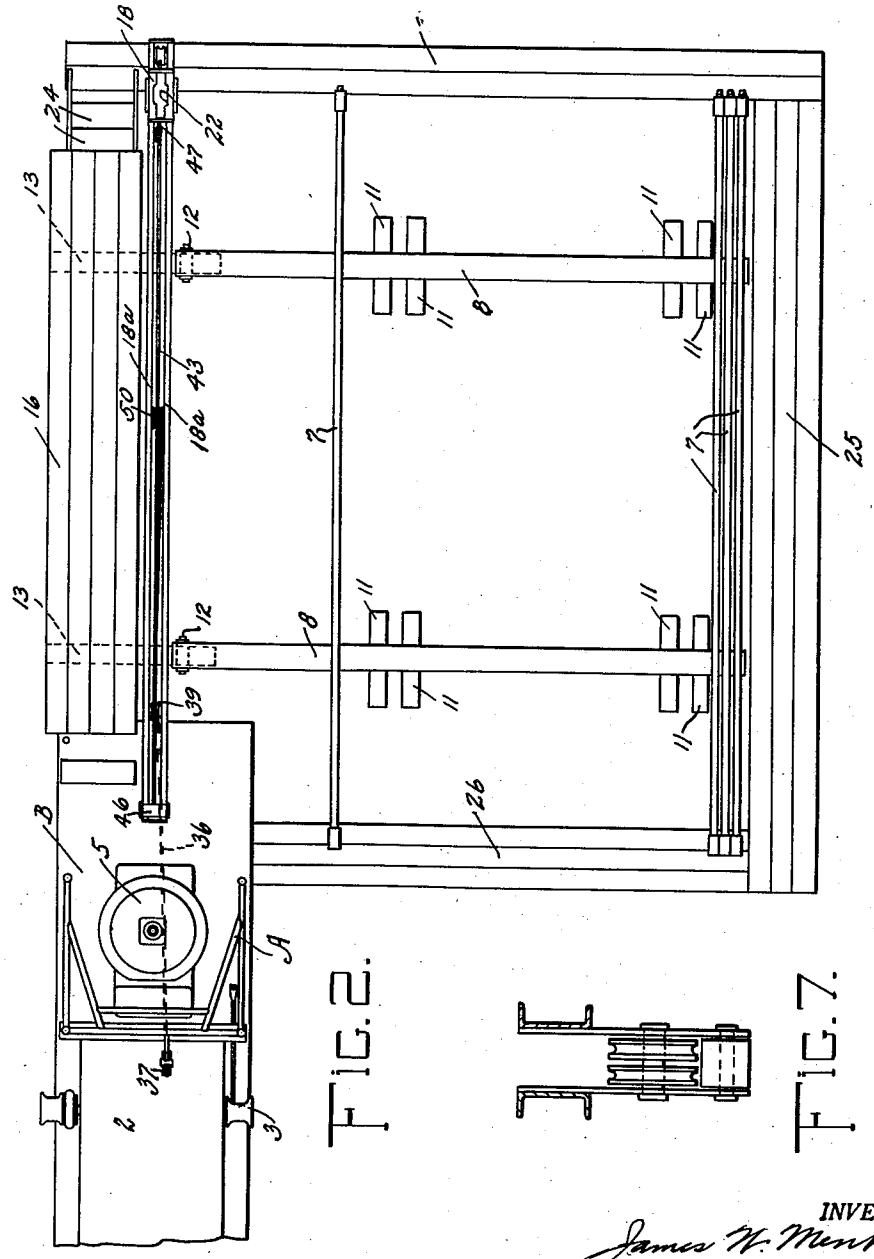


FIG. 2.

FIG. 7.

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WELL DERRICK, RIG, AND PIPE RACKING APPARATUS

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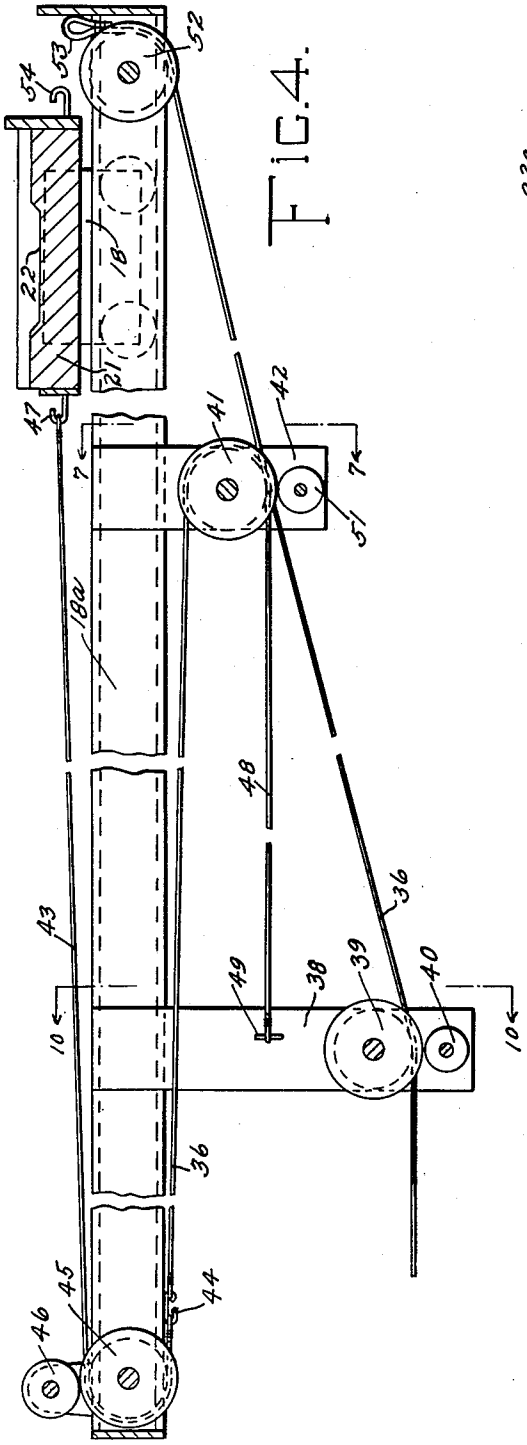


Fig. 4.

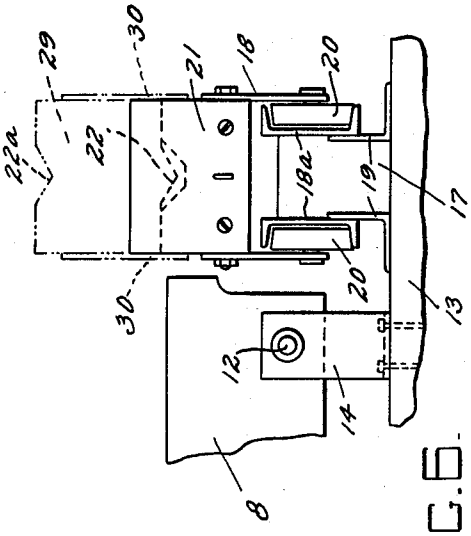


Fig. 6.

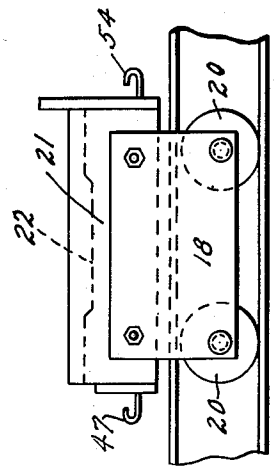


Fig. 5.

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WELL DERRICK, RIG, AND PIPE RACKING APPARATUS

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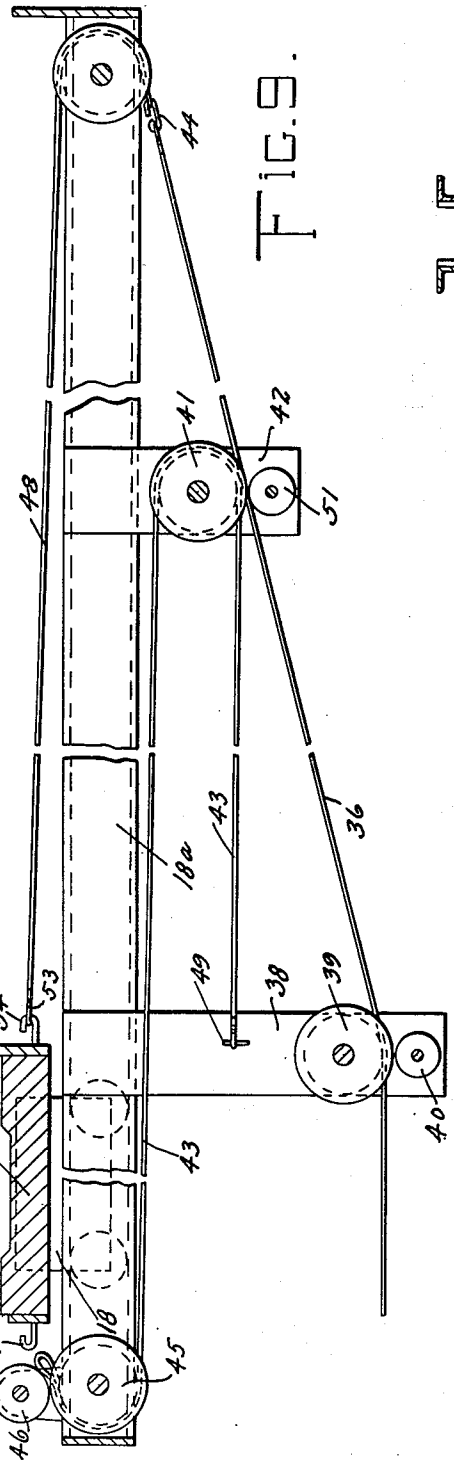


FIG. 9.

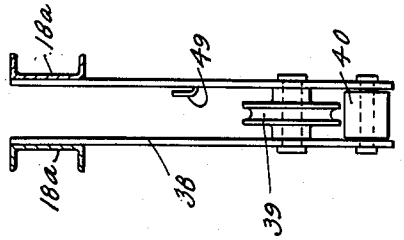


FIG. 10.



FIG. 11.

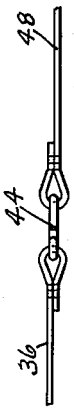


FIG. 12.

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UNITED STATES PATENT OFFICE

2,615,585

WELL DERRICK, RIG, AND PIPE RACKING APPARATUS

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Application June 27, 1947, Serial No. 757,419

2 Claims. (Cl. 214—1)

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My present invention involves improvements in the oil well drilling rigs and my improvements relate particularly to the provision of novel means for racking the sections of the drilling pipe as the drilling pipe is pulled out of the hole, and for facilitating the re-assemblage of the string of pipe sections as the drill pipe is put back in the hole.

In the art of rotary drilling of oil wells it is necessary to have many lengths or sections of drill pipe so that, as drilling goes deeper, lengths or sections may be added to the string of pipe used to drive the drill pin. The pipe sections of the drill pipe must be arranged, or "racked," in such a way that they are easily and quickly moved into line above the well and screwed into the drill pipe below in the customary manner.

When it becomes necessary to "make a trip" out of and back into the hole to change a bit or for some other purpose, each length or section of drill pipe must be unscrewed and racked as the pipe is withdrawn from the hole, preferably racked where it can be most quickly, safely and conveniently brought back over the well. At the present time it is quite customary to employ a "derrick man" who, at such times of making a trip out of and back into the hole, stands on a platform on the well derrick which platform is somewhat less than a pipe length or pipe section length above the well where, with the help of the men below, he swings the pipe sections forward out of the working space and with the lower end of each pipe section on the floor and the upper end inclined slightly outward and resting in retaining guides in the said racking platform. When re-assembling the string of drill pipe the above operation in respect to the sections is reversed.

In the carrying out of my present invention I employ a novel system and apparatus for racking the pipe involving the laying of each pipe section down in a horizontal plane on a racking base comprised of suitable sills, as such section is detached from the string of pipe being withdrawn from the hole. The re-assembling operation of connecting the pipe sections involves the picking up, in the carrying out of my invented apparatus, of the pipe sections individually so as to bring them into line with the hole and the drill pipe already emplaced in the latter, for the operation of screwing the picked-up section brought to the string of pipe sections in said hole.

My system and apparatus for racking the drill pipe is particularly designed with a view, if possible, of eliminating the need for one of the derrick men now commonly employed, thereby to reduce the cost of the handling of the pipe sections by saving the expense involved in the labor of such derrick man.

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One of the special novel features of my invention lies in associating with the horizontal racking means or base composed of supporting sills for the pipe sections, a trolley or carriage adapted to move forward and from the base of the derrick, which carriage by supporting one end of a pipe section being removed from the drill string, or being replaced in assembled condition with said string of other section, will facilitate the laying down and picking up of each pipe section as it is handled for a trip out of the hole or the re-assembly of the string of drill pipe sections.

My invention further involves a special pipe of horizontal rack comprising the sills previously referred to, wherein the said sills are adapted to be inclined in opposite directions in respect to their length, whereby in the removing of the drill sections and racking of the same on the trip out of the hole the sections may be laid horizontally, and by initial manual effort caused to roll down the inclinations of the pre-set sills in a direction away from the carriage previously referred to and the track on which the said carriage operates. By reversal of the inclination of the sills from the positions assumed thereby when the trip out for the drill string is being performed, the sills may be caused to act to effect gravity movement of the sections of the drill pipe, in a direction toward the carriage which is to assist in the movement of the section of pipe back to their positions vertically aligned above the hole, and ready to be screwed on to sections already disposed in the hole, after the customary operation.

A full understanding of the above mentioned special features of improvement embodied in my invention, and other specific novel features of construction of the apparatus employed, will be had upon reference to the following detailed description in conjunction with the accompanying drawings, and in the latter:

Figure 1 is a view in elevation showing certain of the generally employed parts of a drilling rig including the derrick, winch and cat-head supporting frame, the drilling kelly, and the elevator carried by the drawworks for handling the sections of the drill pipe in the trip out of the hole and back into the hole, the special horizontal racking apparatus of my invention being illus-

trated as associated with the above mentioned general features of the drill rig.

Figure 2 is a top plan view generally illustrating the main parts previously referred to as being depicted in Figure 1 of my drawings.

Figure 3 is a view in front elevation of the racking base or sills looking at them as when viewed in a direction looking toward the derrick from the end of the racking means, the jacks used for varying the inclination of the racking sills being also shown in this view and certain of the pipe sections removed from the drill string in the trip out of the hole being disposed on the sills as when the apparatus is being used.

Figure 4 is a longitudinal sectional view taken along the track for the pipe section supporting carriage and showing the cable means which operates the said carriage in an automatic manner for moving the carriage toward and from the derrick base, the parts of the cable means in this view being arranged as when they are connected up for pulling the carriage toward the derrick base.

Figure 5 is a detail fragmentary view in side elevation showing more clearly the carriage mounting upon its track and the arrangement of the cable engaging hooks at opposite ends of the carriage.

Figure 6 is a view of a fragmentary nature looking endwise toward the carriage from the outer end of the track.

Figure 7 is a vertical sectional view taken about on the line 7—7 of Figure 4 looking in the direction of the arrows.

Figure 8 is a view showing a modified form of the carriage in which a swinging spacer block is supported on the latter, shown in full lines in inoperative position and dotted lines in active position.

Figure 9 is a view similar to Figure 4 but illustrating the hook up of the cable apparatus used for operating the carriage as when said carriage is to be pulled automatically outwardly from the derrick in the operation of racking the pipe sections in the trip out of the hole.

Figure 10 is a sectional view taken about on the line 10—10 of Figure 4.

Figure 11 is a fragmentary view showing the detachable connections between certain portions of the cable means.

Figure 12 is a view similar to Figure 11 but showing the cable means of the latter as when looking down thereon.

As seen in Figure 1 there is provided the usual derrick A, open at its front side as seen better in Figure 2, and having the usual draw-works conventional in drill rigs including the cable 1 which is operated from the winch drum, not shown, carried by the winch frame 2 with which winch drum there is associated the usual cat-heads one of which is shown in Figure 1 at 3. The cable 1 as seen in Figure 1 supports the elevator 4, the latter also being of the conventional type.

At the base of the derrick there is mounted the usual rotary table 5 driven by the customary power unit provided for the driving rotation thereof and the construction of the parts above referred to is largely as commonly known today with the exception that the derrick A is not provided with the horizontal racking platform mounted at the upper portion thereof.

As seen in Figure 1 the drill kelly has been disposed in the rat-hole and is designated at 6. Also in this figure the draw-works elevator 4 is shown coupled to a section of the drill pipe designated 7 which section has been unscrewed at its lower end from the drill line and is ready to be manipulated and moved to rack the section horizontally in a manner that will be more fully set forth hereinafter.

The racking means of my present invention are shown best in Figures 1, 2 and 3 of the drawings and comprise primarily the spaced elevated beams or sills 8 located on the open side of the derrick A, spaced from, and extending at right angles to the general longitudinal axis of the drill rig base and enginery of the rig. Preferably I employ two of the transverse racking beams or sills 8 but it will be understood that more than two of these may be utilized should conditions require, this depending primarily upon the length of the pipe sections of the drilling line.

The beams 8 are supported primarily by means of adjustable jacks 9 resting on blocks 10 and 11, the ends of the beams 8 adjacent to the longitudinal axis of the drill rig base being pivotally connected at 12 with stationary cross beams 13 disposed in alignment with the beams 8 and having brackets 14 thereon with which the pivots 12 previously mentioned connect in order to movably attach the beams 8 to the beams 13.

The beams 13 form a part of a track and platform supporting structure which includes suitable supporting sills 15 and 16 disposed below the beams 13, said supporting structure forming a mounting means for cat-walk or platform 16 and the track 17 on which a carriage is adapted to move longitudinally for a purpose to be hereafter described, said carriage being designated 18. The track 17 is seen best in Figure 6 and is shown as comprised of spaced U-channels 18a attached to opposite sides of the main body portion 17 of the track, said body portion 17 in turn being carried by angle plates or bars 19 at opposite sides thereof and directly secured to the beams 13 previously referred to.

The carriage 18 is composed of a suitable frame having at opposite sides thereof the rollers or wheels 20 which operate in the channels of the track members 18a previously referred to. The carriage 18 is freely movable lengthwise of the members 18a of the track structure so the carriage may approach the derrick or move away from the derrick dependent upon the direction of operation of said carriage relatively to said derrick. On the frame of the carriage 18 is supported a wood block 21 having in its upper side or base a seat or recess 22 for receiving and positioning the screw end of each pipe section of the drilling line in the operation of handling said sections for racking and unracking in accordance with the operation of my invention.

A series of catwalks 23, 25, 26 is provided for the usual purposes.

It will be seen that according to Figure 3 the racking beams 8 have an inclination downwardly and outwardly away from the track 17. This inclination is obtained by suitable adjustment of the jacks 9 availed of, as later will be pointed out, to facilitate gravitative rolling of pipe sections from the point of removal thereof from the carriage 18 to the ends of the racking beams 8 remote from the track 17. This operation is of course desirable for saving manual labor, in the handling of the pipe sections of the drilling line when the sections are being removed in the trip out of the drilling line. On the other hand when the trip in is being affected it is desirable that the racking beams 8 be adjusted so that they in-

cline in a direction toward the track 17, for producing gravitative rolling of the pipe sections toward the track and the carriage mounted thereon for the purpose later to be described.

Referring to Figures 1, 2 and 3 primarily it is contemplated now to describe the operation of withdrawing the pipe sections of the drilling line from the hole, for the purpose of racking these sections in a trip out of the drilling line. With the above in mind the drill rig crew will operate the rig and racking apparatus after the following manner. The drill kelly 6 will be disconnected from the top of the drill line or pipe in the customary way and placed in the rat-hole, somewhat after the manner depicted in Figure 1. The drill line being anchored in place by the slips 27 above the table 5, after the top section has been hoisted into the derrick superstructure by the draw works cable 1 and elevator 4, the crew men will unscrew the said top section shown at 7 in Figure 1 in the customary way, from the anchored drill line below. When the section 7 is unscrewed a floor man or men at the base of the derrick will shift this section outwardly at its lower end as shown by dotted lines in Figure 1, while the section is suspended by means of the elevator 4, until the lower screw end of the section 7 is above the recess 22 of the carriage block 21. Thereafter further lowering of the pipe sections causes the carriage 18 to move outwardly, and the pipe section moves from the position shown in approximately vertical lines in Figure 1 to the lower horizontal position illustrated by dotted lines in the same figure, the carriage 18 meanwhile moving from a position on the track 17 adjacent to the derrick A to a position near the outer end of the track or that remote from the derrick.

When the carriage 18 has reached the last mentioned position, a floor man on the catwalk 23 adjacent to the outer end of the track 17, will grab the screw end of the pipe section 7 and by manual effort will roll this pipe section from its position above and in alignment with the track 7, laterally on to the ends of the racking beams 8 adjacent to the beams 13 whereupon the said pipe section will roll gravitatively toward and to the ends of the beams 8 remote from the catwalk 16.

The above operation is carried out for each section. If desired or necessary the sections may be racked in tiers as shown in Figure 3 by use of boards 28.

When the two layer system of racking the pipe sections is employed, in order to have the upper layer of pipe sections supported at the screw ends on the carriage 18 in a plane above the lower layer of sections I may apply to the block 21 of the carriage 18 an auxiliary supporting block such as shown in dotted lines in Figure 6 and designated at 29, said block 29 having side plates 30 to fit over the main supporting block 21 in a self-evident manner beings of course detachable from the latter. Again if desired to have the auxiliary supporting block of the carriage 18 permanently connected to the carriage the expedient disclosed in Figure 8 of the drawings may be resorted to in which it will be seen that the auxiliary block designated 29a is attached by permanent links 30a in a pivotal manner to the sides of the carriage, and the auxiliary block 29a under these conditions may be swung into operative position over the block 21, whenever the upper layer of pipe sections is to be disposed upon the lower layer, in the double layer racking method which I have above described. It will of course be understood that the auxiliary block 29 or 29a as the case may be will be provided with a pipe section and receiving recess 22a for performing the same function as the recess 22 previously referred to in connection with the block 21. The block 21 or the block 29, or the block 29a, whichever is used, is preferably made of wood in order that no damage may be caused to the screw end of the pipe section 7 as each pipe section has such end deposited on such block whichever it may be.

Restoring the drill line is obviously effected in the reverse manner from the racking of the section, the carriage 18 being operated in a manner to be set forth subsequently, toward and from the base of the derrick. The jacks 9 and 10 are adjusted to cause the pipe to roll toward the carriage track as each section is removed. The means for controlling the movement of the carriage 18, are set forth hereinbelow.

As seen in Figure 1 on the derrick A in a suitably elevated position is an offstanding arm 31. A pulley block 32 is directly suspended from said arm and below said block 32 is a second pulley block 33 which is directly connected with a weight 34. A carriage operating cable is deadended at one end at 35 on the block 32 and from thence is reaved about the pulleys of the two blocks 33 and 32 and passes from the block 32 downwardly along the back of the derrick A, being designated 36. At the base of the derrick A the cable 36 passes around a sheave 37 shown in dotted line in Figure 1 and thence extends horizontally and in approximate alignment with and below the track 17. A long bracket 38 depends downwardly from the track 17 adjacent to the derrick end of the latter and carries a pulley 39 above a roller 40. The cable 36 after passing under the sheave 37 passes beneath the pulley 39 of bracket 38 and thence extends beneath and partially around one of the sheaves 41 on a short bracket 42 depending from the middle portion of the track 17. Thence the cable 36 extends toward the derrick A from the said sheave or pulley 41 and is connected to a cable part or section 43 by means of an open link coupling member 44. The cable part or section 43 extends around another sheave 45 located at the derrick end of the track 17, a roller 46 being disposed above the sheave 45. The cable section 43 at its end opposite that attached to the link 44 is secured by means of a loop engaging over a hook 47 that is arranged and attached on the end of the carriage 18 that faces the derrick A. The foregoing described arrangement of the cable means thus far set forth is shown in Figure 4.

Figure 4 also shows in addition to the foregoing a dead or idle cable part designated 48 having a loop at one end to engage over a hook 49 on the bracket 38, said cable part 48 extending beneath a second pulley 50 on the short bracket 42, the pulley 50 having the same axis as the pulley 41 previously described. A roller 51 of double length is disposed beneath the two pulleys 41 and 50 as seen in Figure 7. From the pulley 50 the dead or idle cable part 48 illustrated in Figure 4 extends toward the outer end of the track 17 over a pulley 52 at such end and terminates in a loop 53 as seen in Figure 4.

The arrangement of the cable 36 and the cable part 43 as shown in Figure 4 is the active arrangement of these parts of the cable means for producing an automatic movement of the carriage 18 inwardly along the track 17 toward the derrick A in the operation of a trip out of the string of drill pipe sections. The trip out operation of

course contemplates that each drill pipe section such as 7 in Figure 1 will push outwardly on the carriage 18 as the said section is being racked on the beams 8. Obviously under such conditions the carriage 18 travels toward the outer end of the track 17 and the cable means 43 and 36 will raise the weight 34 which normally is sufficiently heavy to cause the carriage 18 to move along the track 17 in one of either of two directions. As soon as the drill pipe section 7 has been racked its weight being removed from the carriage 18 the weight 34 on the derrick which is connected with the cable 36 will effect the return movement of the carriage 18 to the derrick ready for the mounting of the lower end of the next drill pipe section thereon for its racking operation.

It will be understood from the foregoing on the operation of unracking the pipe sections to restore the string of drill pipe to the well hole the carriage 18 is semi-automatically operated to move toward the derrick by the action of the weight of the drill pipe section thereon, so under these conditions namely during the unracking operation it is desirable that the carriage 18 be restored to the outer end of the track 17 after each drill pipe section has been carried to the derrick by the draw works and carriage, and a fresh section is to be brought to the derrick and connected up in the drill line. By simple rearrangement of my cable parts as previously described in conjunction with Figure 4 I am enabled to utilize the weight 34 on the derrick to cause an automatic movement of the carriage 18 outwardly toward the outer end of the track 17 for what I call the unracking operations of the drill pipe or the connecting up of the sections of the latter again in the drill line in the hole of the well.

Figure 9 of my drawings shows the arrangement of the parts of the cable means when the carriage is to be automatically moved toward the outer end of its track 17 and I note that the carriage 18 under these conditions makes use of a hook 54 which is attached at the end thereof remote from the derrick.

In the arrangement of the cable parts in Figure 9 the idle cable 43 becomes now an active cable. Its loop end 53 is attached to the carriage at the hook 54 remote from the derrick A. The end of the cable part 43 previously attached to the hook 49 as seen in Figure 4 is now connected by the open coupling link 44 to the end of the cable 36 previously connected according to Figure 4 by the link 44 to the cable part 43 so that now the operating cable connections according to Figure 9 for pulling the carriage 18 out to the outer end of the track 17 comprise the cable 36 directly attached to the cable part 43, the latter secured to the outer end of the carriage 18. Under the condition of the parts in Figure 9 the cable part 43 an active cable part in Figure 4, becomes an idle cable part according to the adjustment in Figure 9, being unlooped from the hook 47 of the carriage and having its end previously secured to the link 44 carried around the appropriate sheave on the bracket 42 and dead-ended or engaged with the hook 49 of the bracket 38.

From the foregoing it will be seen that by relatively simple adjustment of the cable parts the automatic weight operating means for moving the carriage 18, including said cable parts, may be readily and quickly adjusted so that the weight 34 will act in an efficient manner for producing either the inward movement of the carriage 18 for the racking operations of the drill pipe sections, or the outward movement of said carriage 18 for the unracking operation, the action of the carriage under the control of the cable parts of course being entirely automatic.

According to my invention the construction of my racking apparatus or unit is relatively simple. It is made very largely of standard parts readily obtainable, and the jacking means provided for the rack beams is susceptible of quick operation or adjustment for the racking and unracking operations required to be performed. The pipe sections are disposed upon my racking means conveniently accessible for restoring the drilling line in the hole of the well, and for enabling the racking operations of the pipe sections in a convenient and simple way. By the saving of the labor of at least one man the operation of the drilling rig for twenty-four hours a day may be effected at a tangibly reduced cost for reasons which have previously been pointed out.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States, is:

1. Pipe handling apparatus of the class described, comprising a derrick, elevator means supported by said derrick, a horizontal track extending from said derrick, a pipe rack extending at an angle in a substantially horizontal plane at one side of said track, a carriage movable on said track toward and from said derrick, the rack comprising relatively horizontal beams on which the pipe sections may rest in gathered together condition when delivered from the carriage and elevator, each beam pivotally connected at one end near the said track, and means supporting the beams and adjustable to support the beams fixedly at an inclination upwardly from the track and carriage, or downwardly from the track and carriage, said last means including jacks disposed beneath the beams at positions spaced from the pivotal connections aforesaid.

2. Pipe handling apparatus of the class described, comprising a derrick, elevator means supported by said derrick, a horizontal track extending from said derrick, a pipe rack extending at an angle in a substantially horizontal plane from said track, a carriage movable on said track toward and from said derrick, in which the pipe engaging portion of the carriage is on a level substantially the same as the adjacent top portion of the rack and an auxiliary block of a diameter approximating that of a pipe section handled by the machine superposed on the carriage and movably connected to the carriage to shift to one end of the latter when not in use.

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