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(54) Pipe handling apparatus and method.

(57) Apparatus for use with a drilling rig having a derrick mounted over a bore hole including support means (29,89,121) to support an upper section of pipe (49) in a generally upright position offset from the axis of said bore hole; second support means (120) to position a lower section of pipe in a generally upright and end to end relationship with said upper section; and means (33-36) offset from said axis for coupling said sections of pipe to form a pipe stand and for subsequently uncoupling such sections to break down the stand.

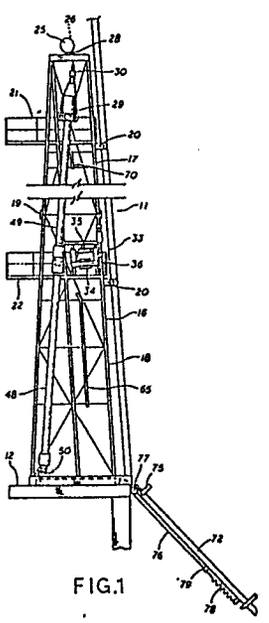

FIG.1

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Description

PIPE HANDLING APPARATUS AND METHOD

This invention relates to an apparatus for use in combination with a derrick mounted over a bore hole and is adapted for assembling and disassembling stands of pipe, casing, or tubing being supported by the derrick. It has particular application in the drilling of bore holes, the various operations carried on in bore holes, in removing or changing casing or tubing, or in working over pre-existing wells and the like: in short, in any operation which calls for tubular goods to be made up or broken down, and/or taken up from or laid down onto a pipe rack.

The method contemplated by this invention permits rapid assembling and disassembling of such stands of tubular goods without interfering with bore hole operations.

It is to be understood that in describing this invention the use of the word "pipe" is intended to include not just pipe only, but all goods of a generally tubular nature, whether pipe, tubing, casing, tool joints or other tubular goods. Its use is therefore as a convenience and not a limitation. Similarly, the term "drilling rig" is intended to include not just drilling rigs but all rigs with derricks, regardless of whether such rigs are used for drilling, production, workover, or other purposes, and such term is similarly used as a convenience and not as a limitation.

During the movement of pipe into and out of a bore hole, as for example, during movement of drill pipe into and out of a well being drilled, it has been common practice to utilize a drilling rig having a derrick mounted over the bore hole with a rotary table mounted on the floor of the derrick for rotating the drill pipe during the actual drilling operation. In order to save time in the assembly and disassembly of the drill string, it has been common practice to remove the drill pipe in stands of two or preferably three sections of pipe, which stands are supported by the derrick and may subsequently be re-run into the bore hole or removed from the derrick.

However, there is a problem in disassembling the pipe stands whereby the entire operation may be quickly and conveniently carried out. Heretofore, it has been common practice to disassemble the pipe stands by lowering the lower end of the pipe stand into the bore hole and then by the means of power tongs and operation of the rotary table, to spin out the bottom section of the pipe stand, which bottom section is thereafter removed by a separate line attached thereto. This operation is quite time consuming and also ties up the usual components of the drilling rig to prevent actual drilling or other operations.

The prior art contains many examples of the variety of the attempts at solving this problem. For example, U.S. Patent No. 3,194,313, Fanshawe, discloses a means of continuously pulling the drill pipe from the hole with successive sections being removed immediately above the bore hole while the string is being continuously elevated, but this involves the storage of heavy sections at a considerable elevation above the drill floor, an obvious hazard to the workmen below.

U.S. Patent No. 3,404,741, Gheorge et al., discloses a system for continuous pulling or insertion involving a pair of carefully synchronized lifts and the transfer, prior to the insertion operation, of the pipe from a groundlevel rack to another horizontal rack located mid-way up the derrick.

U.S. Patent No. 4,423,994, Schefers et al., discloses specialized apparatus involving pairs of block and tackle systems supported separately by rotatable and elevatable cranks, each pair of which appears to operate simultaneously.

According to the present invention there is provided apparatus for use with a drilling rig having a derrick mounted over a bore hole including support means to support a stand of pipe sections in a generally upright position offset from the axis of the bore hole and means offset from said axis for uncoupling the lowermost pipe section of said stand therefrom.

The invention also provides apparatus for use with a drilling rig having a derrick mounted over a bore hole including support means to support an upper section of pipe in a generally upright position offset from the axis of said bore hole; second support means to position a lower section of pipe in a generally upright and end to end relationship with said upper section; and means offset from said axis for coupling said sections of pipe to form a pipe stand and for subsequently uncoupling such sections to break down the stand.

Similarly the invention provides the method of disassembling a pipe stand in a derrick which is over a bore hole by supporting the stand in a generally upright position offset from the axis of said bore hole; and uncoupling the lowermost pipe section of said stand using means offset from said axis.

The invention also provides a method of assembling a pipe stand in a derrick which is over a bore hole by supporting an upper section of pipe in a generally upright position spaced apart from the axis of said bore hole; positioning a lower section of pipe in a generally upright position below said first section and in end to end relationship therewith; and coupling said sections together to form a pipe stand.

In another aspect the invention provides apparatus for transferring pipe sections to and from a derrick over a borehole, the derrick having a main elevator generally operable on the bore hole axis and the apparatus including an upwardly extending track located within the derrick, and offset from the bore hole axis, a lifting arrangement having means to engage the end of a pipe section and movable along the track so as to raise the pipe section up on to the derrick or let it down therefrom, so that the pipe section can, when raised, be subsequently handled to a position over the bore hole axis and aligned with the main elevator.

The invention can provide an improved method and apparatus for rapidly and safely making up and/or breaking up stands of tubular goods for

movement into or out of a borehole.

The invention can eliminate the need for thread protectors and for the manual labor formerly required to put such thread protectors on and off, and can provide non-manual means for removing drill pipe from the drilling floor, and to protect the threaded ends while so doing.

The invention will be more clearly understood from the following description which is given by way of example only with reference to the accompanying drawings in which:

Figure 1 is a partial side elevation view, generally schematic, showing one preferred embodiment of the apparatus of this invention mounted in a conventional drilling rig derrick.

Figure 2 is a partial front elevation view on a somewhat enlarged scale of the apparatus shown in Figure 1.

Figure 3 is a view similar to Figure 1, but showing a stand of pipe after it has been moved to the uncoupling position.

Figure 4 is a view similar to Figure 3, but showing the lowermost section of pipe stand shortly after being uncoupled.

Figure 5 is a side elevation view of carriage means mounted on the derrick floor for receiving the lower end of the pipe stand and which is adapted for movement to a dumping position.

Figure 6 is a cross-sectional view generally taken at line 6-6 of Figure 5.

Figure 7 is a top plan view generally taken at line 7-7 of Figure 5.

Figure 8 is a cross-sectional view generally taken at line 8-8 of Figure 3 showing one embodiment of the uncoupling means and which means may be used for coupling purposes.

Figure 9 is a partial vertical sectional view generally taken along lines 9-9 of Figure 8.

Figure 10 is a cross-sectional view generally taken at line 10-10 of Figure 3 and showing one embodiment of the slide means.

Figure 11 is a side elevation view of one embodiment of the apparatus shown mounted in combination with a jackknife type derrick.

Figure 12 is a generally side elevation view of another embodiment of the invention shown mounted in a conventional derrick.

Figure 13 is a partial side elevation view of still another emeobiment of the invention.

Figure 14 is a side elevation view of another embodiment illustrating a preferred orientation for the carriage track and the use of the apparatus with a laydown trough.

Figure 15 is an isometric view of one embodiment of the laydown carriage.

Figure 16 is a side plan view of the laydown carriage illustrated in Figure 15 illustrating its orientation within a rig or within an auxiallary tower.

Figures 17 and 18, respectively, are front elevation and top partial section views of the laydown carriage.

Figure 19 is a generally horizontal sectional view of one embodiment of safety means.

Figures 20 and 21 are sequence illustrations of the safety means of Figure 19 illustrating the operation of the safety means during pickup and lay down, respectively.

Referring now to Figures 1 and 2 in particular, a standard drilling rig is shown which includes a standard type derrick 11 and having derrick floor 12, conventional draw works generally designated by the numeral 13 and a conventional rotary table (not shown) mounted on a derrick floor 12 and positioned over a bore hole (not shown). Derrick 11 is provided with the usual crown block and traveling block (not shown) for moving or transporting pipe such as drill pipe into and out of the bore hole.

The apparatus of this invention, which is adapted for use in combination with aforesaid drilling rig, in one embodiment, includes a pipe handling tower generally designated by the numeral 16 mounted in this embodiment inside of and attached to one side of derrick 11 and is comprised of upper section 17 and lower section 18 held together by pin connectors 19. Tower 18 is connected to derrick 11 by any conventional means, as for example, straps 20. In addition, tower 18 is provided with upper monkey board 21 and lower monkey board 22, each of which is adapted for supporting a derrick man thereon. The upper end of top section 17 is provided with hydraulic draw works in the form of hydraulic motor 25 which drives drum 26 connected to drive shaft 27, with drum 26 having steel cable 28 wound thereon and supporting a clamp-on type elevator 29 through spring and swivel 30. Elevator 29 is of the conventional type and is adapted for opening and closing about a section of pipe below the tool joint thereof. It is to be understood that tower 16 will normally be taller than the tallest pipe stand which is to be handled thereby but, if desired, may be on the order of the height of one section of pipe by utilizing the projecting high line now found on many large rigs. Further, cable 28 may conveniently be 1/2 inch steel cable. Further, the aforesaid draw works is supplied with hydraulic fluid from any convenient source and may be operated remotely from a control panel (not shown) mounted on lower monkey board 22, for example. Drum 26 may conveniently be a 10 inch drum with 120 feet of cable capacity.

This embodiment of the apparatus also includes uncoupling means spaced apart from the vertical axis of the well bore hole for uncoupling the lowermost section of the pipe stand while the pipe stand is being supported by elevator 29. These uncoupling means are generally shown by the numeral 33, and conveniently take the form of power tongs 34 and associated back up tong 35 thereabove, both of which are mounted in tongs frame 36, the details of which are best seen in Figures 8 and 9. Frame 36 is adapted for generally vertical up and down movement on guide rails 37 connected to tower 16 by any conventional means, as for example, by cross members 38. The right side of frame 36, as viewed in Figures 8 and 9, is provided with a generally horizontally extending lug 39, which is attached to the lower end of piston rod 40, which is connected to piston 41, carried in hydraulic cylinder 42, the upper end of which is connected to tower 16

in any convenient manner. Hence, by application of hydraulic fluid to opposite ends of cylinder 42, frame 36, and hence, power tong 34 and back up tong 35, are adapted for generally up and down vertical movement so that the uncoupling means may be moved to be adjacent the top coupling of the lowermost section of pipe. Power tong 34 is provided with swing gate 54 which is opened whereby the pipe joint to be uncoupled or coupled can be moved into power tongs 34, and gate 45 can thereafter be closed thereabout. Similarly, back up tong 35 has a swing gate 46 which also opens to receive the stand of drill pipe thereinto.

It is to be understood that power tong 34 and back up tong 35 may be of conventional design. If the power tong is a casing or a tubing tong, it will normally contain its own means to spin the pipe. However, if it is a pipe tong, it normally will be able only to break out or make up the pipe but will not contain the means to spin the pipe to a completely separated position. In that case, separate spinning means, such as the spinner, 43, will be required. However, it will be noted that the back up tongs are mounted on top of the power tongs such that the bottom section of the pipe stand is rotated relative to the balance of the pipe stand in uncoupling and during coupling in this particular embodiment.

During coupling and uncoupling operation of means 33, power tong 34 is adapted to engage and rotate the top coupling or tool joint of the lowermost pipe section 48 of the pipe stand, and back up tong 35 is adapted to engage and secure from rotation the tool joint on the lower end of the pipe section immediately thereabove.

The apparatus of this invention may also include means for engaging a portion of the pipe stand, and which, in combination with the elevator means, is adapted to move the lowermost section of the pipe stand into engagement with the uncoupling means, whereby the uncoupling means can uncouple the lowermost section of the stand. The preferred embodiment for these means is in the form of a carriage generally designated by the numeral 50 mounted on the derrick floor 12, said carriage being adapted to move generally laterally to a dump position at predetermined times, as will be explained hereinafter. Further, carriage 50 is adapted to receive the lower end of the lowermost section of pipe in the pipe stand.

Referring specifically to Figures 5,6 and 7, carriage 50 generally includes a pipe cup 51 having an open ended recess therein, which recess may be covered with a hard rubber material or the like to prevent damage to the pin end of pipe section 48 supported therein.

Cup 51 has mounted thereon, by suitable axes, four wheels 52, which are adapted for generally horizontal movement on spaced apart tracks 53 mounted on derrick floor 12. As best seen in the right sides of Figures 5 and 7, tracks 53 are provided with inclined portions 54. Power means are provided for traversing carriage 50 generally horizontally along tracks 53 and portions 54 such that when carriage 50 reaches portions 54, cup 51 will be generally described as in the dump position. The power means for accomplishing this generally horizontal traverse may be in the form of a reversible hydraulic motor and sprocket assembly generally designated by the numeral 55, which is adapted to engage and operate drive chain 56, which is connected to a bottom portion of cup 51 and is adapted for passage over sprockets 58, 59, 60, 61 and 62. Hence, by operation of motor and sprocket 55, pipe cup 51 may be made to move or traverse along tracks 53 and portions 54 from the receiving position, which will generally be to the left, as shown in Figures 5 and 7, to the dumping position, which is generally to the right in Figures 5 and 7.

The apparatus of the invention may also include safety means in the form of slide means for guiding uncoupled sections away from the floor of the derrick after the uncoupling operation, which slide means may also conveniently help support the pipe stand or sections of pipe making up the pipe stand during assembly or disassembly thereof. One form of slide means is a slide operably connected to tower 16 below the uncoupling means, with at least a portion of the slide including a member adapted for swinging movement about a generally vertical axis, and also adapted to swing in one direction to allow passage of the pipe stand therepast in movement of the pipe stand into engagement with the coupling means and to swing in another direction to the slide position for providing a slide to direct uncoupled sections of pipe from the derrick. One form of these slide means is in the form of a slide generally designated by the numeral 65, the details of which are best shown in Figure 10. Slide 65, in the embodiment shown, is comprised of two pivoted spring loaded doors 66, which are generally arcuate in cross-section and which, in the closed position, form a curved uniform slide surface extending generally vertically in tower 16. Doors 66 are pivoted on pivot pins 67, which are connected to supports 68, which are attached to tower 16 in any convenient manner.

Doors 66 are adapted to swing to the dotted position shown in Figure 10 when pipe stand 49 is passed therethrough. Since doors 66 are biased to the closed position, they thereafter assume the position shown in solid lines where pipe stand 49 may be supported thereby, as shown in solid lines. Doors 66 act additionally to guide uncoupled pipe sections out of the derrick as best shown in Figure 4.

The apparatus may also include upper spring loaded doors generally designated by the numeral 70, whose operation, construction and connection to tower 16 is the same as slide 65, and helps support the upper portion of pipe stand 49.

The apparatus may also include restraining means for engaging and restraining the movement of the uncoupled sections of pipe from the derrick after uncoupling thereof. This restraining means is in the form of inclined pipe trough 72, having the upper end thereof adjacent to derrick floor 12.

Trough 72 is provided with what is conveniently described as second carriage means mounted thereon for engaging the lower end of the uncoupled pipe sections, with the said carriage means including means for controlling the downward rate of travel

thereof relative to trough 72. These carriage means may be in the form of cupped shaped member 75 connected to cable 76 running over pulley 77 and attached to the bottom side of trough 72 to side dog 79, which is adapted to be biased downwardly by spring 78 connected to the lower bottom side of trough 72. In the preferred embodiment, pulley 77 will be connected to a hydromatic brake which may be set to various weights on the order of the weight of the member being laid down. Member 75 is adapted to receive therein the lower end of a pipe section 48, as shown in Figure 4, and to restrain the downward movement thereof under the force of gravity. When member 75 reaches the lower end of trough 72, trip means (not shown) are engaged thereby diverting the pipe section 48 therefrom, at which point cup 75 is released for return to the upper position under the force of spring 78. During the upward movement of member 75, hydromatic brake operating on pulley 77 is adapted to release.

In operation, during the disassembly of pipe stands being supported by derrick 11, elevator 29 is clamped about the upper end of pipe stand 49 and thereafter elevator 29 is raised by operation of hydraulic motor 25. With pipe stand 49 thus raised off the derrick floor, the lower end of lower pipe section 48 is placed in the receiver of pipe cup 51 of carriage 50 in the receiving position shown in Figure 1. Thereafter, carriage 50 is traversed to the right, as shown in Figure 1, by operation of hydraulic motor and sprocket 55, until carriage 50 comes to rest at the position shown in Figure 3. During this horizontal traverse of carriage 50, pipe stand 49 is drawn through slide 65 and upper doors 70 and to engagement with the uncoupling means 33, all as shown in Figure 3. Uncoupling means 33 is then adjusted upwardly or downwardly to the position shown in Figure 9 and thereafter operated 10 to unscrew pipe section 48 from the balance of pipe stand 49. Upon uncoupling of section 48, carriage 50 is then moved to the dump position described above, at which point stand 48 slides thereoff and is guided out of the derrick by slide 65, with section 48 moving 15 downwardly generally in the direction of the arrows shown in Figure 4 under the force of gravity. The lower end of section 48 engages cup member 75, which restrains the downward movement of section 48 to the laydown position. When cup member 75 reaches the downward position, pipe section 48 is then released and the cup member 75 then moves to the raised position, ready to receive the lower end of another section of pipe. While carriage 50 is being moved to the dump position, elevator 29 is lowered, and the lower end of the remaining pipe stand is then placed in carriage 50 in the position once again shown in Figure 3, and the remaining sections of the pipe stand are uncoupled and removed from the derrick in the same manner as described above.

During makeup operations, that is, when pipe stands are being preassembled for transportation into the well bore, the operation of the apparatus is generally the reverse of the foregoing description with one notable exception. During the assembling of pipe stands, additional elevator means are pvorided for supporting the lowermost section of pipe being added to the pipe stand. That is to say, elevator 29 would be attached to the upper end of an upper section of pipe and drawn upwardly in tower 16 to the position such that the lower end of that particular pipe section was adjacent to the back up tong 35. Thereafter, the rig catline, or a line operated by an air hoist, or the like, is operated to draw another line (not shown) over another pulley (not shown) mounted in tower 16 above uncoupling means 33, and second elevators are attached to this additional line. This second elevator is then attached to the upper end of another section of pipe which is to be added to the stand, which section is then raised in tower 16 to the position such that the upper end thereof is adjacent to back up tong 35 and in an end to end relationship with the section of pipe supported thereabove. Power tong 36 is then operated in reverse direction, as compared with the uncoupling operation, such that the two sections of pipe are coupled together. Thereafter, the pipe stand is raised further by raising elevator 29 and a third section added thereto in the same manner. Thereafter, slide 65 and doors 70 are opened either by hand or by hydraulic means (not shown) to provide a clear path for the movement of the pipe stand to the left, as viewed in Figure 3. Thereafter, carriage 50 is moved to the left to the initial starting position and the assembled pipe stand removed therefrom by operation of the derrick draw works, or the like.

Referring now to Figure 11, another embodiment of the apparatus of this invention is shown mounted adjacent to a jackknife type derrick 81 having conventional draw works 82, drilling floor 83, and crown block 84.

The apparatus of this invention includes pipe laydown tower 85, which corresponds with tower 16 of the Figure 1 embodiment, and is provided with upper monkey board 86 and lower monkey board 87, which correspond respectively with monkey boards 21 and 22 of the Figure 1 embodiment. In addition, tower 85 is provided with draw works 88 and elevator 89 which correspond respectively with the draw works and elevator 29 of Figure 1. This embodiment also has spring doors 90 and 91 which correspond respectively with doors 70 and slide 65 of Figure 1. It also has coupling and uncoupling means 92 which correspond with means 33 of Figure 1 and carriage 93 which corresponds with carriage 50. Carriage 93 is adapted for running on the tracks 94, which tracks are similar to tracks 53, but which may extend outside the base of tower 85 so as to be spaced near the rotating table.

The operation of the embodiment shown in Figure 11 is the same as that shown in Figures 1-10, and this embodiment may be used for making up pipe stands in the same fashion.

Referring now to Figure 12, a still further embodiment of the apparatus of this invention is shown. Standard derrick 101 is shown with standard crown block 102 and draw works 103 and rotary table 104 mounted on drilling floor 105, with well bore 106 shown extending therebelow.

Two pipe stands 107 and 108 are shown in derrick 101, along with pipe laydown tower 110, which is

similar to towers 16 and 85 of the other embodiments, but may be somewhat shorter and without its own separate draw works mounted on the top thereof. Instead, this embodiment is provided with two powered drums 112 and 113 mounted on floor 105 and operated by hydraulic motors or the like, with drum 112 having steel cable 115 wound thereon and drum 113 having cable 116 wound thereon. Cable 115 runs upwardly through derrick 101 and over one of a pair of pulleys 118 mounted at the top of derrick 101 and has connected thereto elevator 120. Similarly, line 116 runs over one of the pulleys 118 and is connected to elevator 121. Elevators 120 and 121 are similar to elevator 29, shown in the Figure 1-10 embodiment.

Tower 110 is provided with a single monkey board 123 which is mounted adjacent to coupling and uncoupling means 124 which is simmilar to uncoupling and coupling means 33 of Figure 1-10. This embodiment also includes a carriage 125, which is similar to carriage 50 of the Figures 1-10 embodiment, which is mounted on tracks 126, which are similar to tracks 53. This embodiment also includes an inclined trough 127 which may be similar to trough 72 of Figures 1-10 embodiment. In addition, return line 128 is connected between an upper portion of derrick 101 and monkey board 123, as shown, which line is useful during assembly of pipe stands, as will be explained hereinafter.

During disassembly operations, that is, when pipe stands are being disassembled and removed from derrick 101, elevator 120 is attached to the upper end of a stand of pipe, such as stand 107, as shown, which stand is then moved to the position which is occupied by stand 108 by operation of carriage 125 and the elevator at the top thereof. Thereafter, uncoupling means 124 is operated to disconnect the lower pipe section from stand 108 and it drops by gravity force from the derrick in the same manner as with the previous embodiiment. Thereafter, elevator 121 is lowered to permit the uncoupling of the next section of pipe which is then dropped from the derrick by gravity force in the same manner as before. By having both elevators 120 and 121, operation may be speeded up. When elevators 120 and 121 are empty, they may be attached to line 128 for movement thereon between the spaced points of connection thereof.

In addition, elevators 120 and 121 may be used for making up stands in the same manner as described with respect to the previous embodiments. That is to say, elevator 121 is attached to the upper end of a section of pipe and is thereafter elevated such that the lower end of pipe is adjacent to coupling and uncoupling means 124. Elevator 120 is connected to the upper end of another section of pipe to be added to the lower end thereof, which section is raised to a generally upright position therewith. Thereafter, the coupling and uncoupling means 124 is operated to thread the two sections together, at which point elevator 121 is raised and elevator 120 connected to another section of pipe to be added to the bottom of the stand. Elevators 120 and 121 are raised and lowered by operations of drums 112 and 113.

It is to be understood that two or more of the apparatuses of this invention may be operated, either in series or in parallel,in connection with one drilling rig or derrick which further facilitates the ease and speed with which drill pipe stands may be assembled and disassembled. In such an instance, it may be preferable to "stack" such additional units above the lowermost unit so that three joints could be disassembled simultaneously and lowered almost simultaneously.

Figure 13 shows a further embodiment of the invention which is similar to the Figure 12 embodiment, but which is adapted for handling longer pipe sections which are 45 feet long, for example, as distinguished from 30 foot sections. Here, derrick 141 is shown with tower 142 mounted therein, which tower corresponds with tower 110 of the Figure 12 embodiment and the operation thereof is the same. However, in this instance, addi tional guide means have been provided for guiding pipe sections, such as pipe sections 143, from the derrick. In this instance, a pair of spaced apart and tapered and adjustable spring loaded rollers 144 have been mounted between a pair of angle bars 145, the upper ends of which are connected to a pair of spaced apart upper cross bars 146, and the lower ends of which are connected to lower cross bars 147. Bars 146 and 147 have horizontally spaced apart bolt holes therein for adjusting the angle at which cross bars 145 are supported. During the laying down of a pipe section, such as pipe section 143, rollers 144 additionally support the longer pipe sections and additionally help restrain the downward movement thereof under the force of gravity.

Figure 14 shows alternative embodiments of a laydown trough apparatus and of means for lowering the disassembled pipe; either or both of these alternative embodiments may be used in any of the arrangements heretofore described.

In the embodiment of Figure 14, a much more nearly horizontal laydown trough 150 is supported near each end by supports 151 depending from pulleys 152 in turn depending from cable 153. Cable 153 may be conveniently supported at one end by a pulley 154 supported by a post 155 inserted in the mousehole 156 and at its other end by a powered reel (not shown) which will permit take up of the cable 153. If the elevation of the powered reel is variable, it is readily seen that the angle of the trough 150 with respect to the drilling floor may be readily varied. Also, the angle of such trough at the end opposite the drilling floor, and the elevation thereof, may be readily varied with respect to the horizon, a pipe stand, truck or other reference. Further, if pulleys 152 are tethered to a continuous cable 153, the horizontal position of laydown trough 150 may be varied by operation of the powered reel to permit discharge of the pipe at the location desired. If cable 153 is not continuous and pulleys 152 are not tethered thereto, an additional line (not shown) to trough 150 will be needed. Said line may be connected to suitable take-up means near the rig floor, and will serve to secure said trough while the pipe joint is being loaded therein, at which point it may then be paid out to allow the trough and pipe to reach the desired location for unloading. Subse-

quent to unloading, said line may then be taken up to return said trough to its former position near the rig floor for receiving another joint.

Additionally, laydown trough 150 may contain a shock pad 151 which may in turn be connected to a coil spring 158 or other suitable device for absorbing the shock from the moving pipe. By having the supporting cables 151 situated near the ends of trough 150, the joint to be laid down will be situated in said trough intermediate said cables and may be readily discharged to one side by manual or powered means.

Also shown in the embodiment of Figure 14 is the track 160 shown attached to the tower 85. Said track is intended to support the elevator carriage means 161 better shown in Figures 15-18. It is to be understood that the upper end of track 160 and the carriage means 161 are shown in the embodiment of Figure 14 for clarity at a lower elevation than is contemplated in practice.

In this embodiment, said elevator carriage means comprises a carriage plate 162 supporting four wheels or rollers 163. Track 160 may consist of a pair of channel-shaped members 164 adapted to receive rollers 163. It is contemplated that said carriage plate will be oriented in a near-vertical position and will travel in a near-vertical plane. Said carriage plate also supports swing plate 165 by means of any convenient pivot means such as pins 166 and dogs 167. Said carriage plate may be maintained in a near-horizontal position by means of biasing springs or other convenient means (not shown) intermediate said carriage plate and said swing plate. Supported by said swing plate 165 are elevator jaws 168 which may pivot upon pivot pin 169. Said jaws are operated by arms 170 connected to opposite ends of hydraulic cylinder 171 also supported by said swing plate 165. Said hydraulic cylinder may be operated by means of a hydraulic motor (not shown) conveniently situated on a support brace of the tower near the tongs previously described and connected to said cylinder by means of hydraulic hoses 172. The entire elevator carriage 161 may be raised or lowered by any convenient means such as chain 173 attached thereto and to sprocket 174 and hydraulic motor 175. Preferably, jaws 168 will be aligned with the tong means and spinner means previously described.

In operation, said elevator carriage means will be caused to engage a joint, during a disassembly operation, immediately after breakout and lower said joint onto the pipe-receiving carriage which will convey the lower end of said joint to the dump position. Simultaneously, said elevator carriage means will lower said joint, with the elevator jaws and swing plate pivoting as the pipe joint takes on a more nearly horizontal position. When the elevator carriage reaches its lowermost position, which is about two to four feet above the elevation of the drill floor in this embodiment, the operator may cause the jaws to be opened and the pipe dropped the remaining short distance, preferably into the laydown trough previously described. At that point, the elevator carriage will return to its uppermost position, either automatically or by operator control, as desired, where it will be ready to engage the next joint.

Of course the elevator of Figs 15 to 18 can be used in reverse, in bringing single lengths of pipe into the derrick to be joined together to form stands of pipes. In such a case the above sequence is performed in the reverse order, and the elevator jaws grip a pipe propelled up into the rig wherein the elevator raises the pipe to the vicinity of the coupling means.

Figure 19 displays another embodiment of the safety means which may be employed to isolate the drill floor from the makeup and breakout operations. In this embodment, double-acting spring hinges 180 may be attached to the frame 181 by any convenient means such as flat-headed bolts 182, pins, rivets, or even by welding. Removable pin 183 is used to secure the outer portion of hinge 180 from rotation during the laydown procedure, and is removed during the pickup or makeup procedure. During laydown, removable stop block 185 may be attached to arcuate safety doors 186. As may be readily seen from Figs. 19 and 21, during laydown the safety doors can be easily swung in the direction away from the borehole but cannot be opened, even by a falling pipe joint, in the other direction. Similarly, from Figs. 19 and 20, it may be readily seen that the doors may be opened in the other direction during pickup; it is contemplated that the spring hinges will be strong enough to prevent the doors from opening when struck by a falling joint. In this instance, the doors may be opened when forced by the powered carriage which may be used to transport the joint or stand toward the borehole. If still greater security is desired during makeup operations, hydraulic cylinders may be attached to said doors so as to prevent their being opened by a falling joint yet opened when desired.

Claims

1. Apparatus for use with a drilling rig having a derrick mounted over a bore hole including support means (29,89,121) to support a stand of pipe sections (48,49) in a generally upright position (33-36) offset from the axis of the bore hole and means offset from said axis for uncoupling the lowermost pipe section of said stand therefrom.

2. Apparatus for use with a drilling rig having a derrick mounted over a bore hole including support means (29,89,121) to support an upper section of pipe (49) in a generally upright position offset from the axis of said bore hole; second support means (120) to position a lower section of pipe in a generally upright and end to end relationship with said upper section; and means (33-36) offset from said axis for coupling said sections of pipe to form a pipe stand and for subsequently uncoupling such sections to break down the stand.

3. Apparatus according to claim 2, wherein said second support means (120) is an elevator.

4. Apparatus according to claim 1, 2 or 3,

wherein the support means (121) is an elevator.

5. Apparatus according to any preceding claim including: means (50) for engaging a lowermost portion of a said stand of pipe (48,49) and adapted to move the stand in and out of engagement with said coupling/uncoupling means (33-36).

6. Apparatus according to claim 5, wherein said means (50) for engaging a portion of a said stand includes a carriage (50) to be mounted near the floor of the derrick and to engage the lower end of a said stand of pipe, said carriage being mounted to move laterally of the bore hole.

7. Apparatus according to any preceding claim, including a member (65) connected to the derrick and adapted for swinging movement about a generally vertical axis and being free to swing to one position to allow a said stand (48,49) of pipe to move therepast in movement of said stand into engagement with said uncoupling means (33-36), and to another position to form a slide.

8. Apparatus according to claim 6 and claim 7, wherein the member (65) is below the uncoupling means (33-36) and acts as a slide to guide an uncoupled section while the lower end of said uncoupled section is moved laterally to a dumping position by the carriage (50).

9. Apparatus according to any preceding claim, including safety means (70) for isolating said stand (48,49) from the area around a rotary on the derrick floor, said safety means including means for allowing movement of the stand therepast in one direction and for preventing undesired movement of the stand therepast in the opposite direction.

10. Apparatus according to any preceding claim, including restraining means for controlling the movement of uncoupled sections of pipe from said derrick after uncoupling thereof, said restraining means including an inclined pipe trough (72) having the upper end thereof adjacent the floor of said derrick.

11. Apparatus according to claim 10, wherein said trough has a carriage (75) mounted thereon for engaging the lower end of said uncoupled pipe sections (48), means (77) for controlling the downward rate of travel of said carriage and means for returning said carriage to the top of said trough after each uncoupled section of pipe is removed therefrom.

12. Apparatus according to any preceding claim, wherein said coupling/uncoupling means (33-36) is movable up and down.

13. Apparatus according to any preceding claim, including lifting means (160,161) in the derrick to control movement of pipe sections (49) on to and off the derrick.

14. Apparatus according to claim 13, wherein the lifting means includes a carriage (161) movable along an upright track (164) and having pipe engaging grippers (168).

15. The method of disassembling a pipe stand in a derrick which is over a bore hole by supporting the stand in a generally upright position offset from the axis of said bore hole; and uncoupling the lowermost pipe section of said stand using means offset from said axis.

16. A method of assembling a pipe stand in a derrick which is over a bore hole by supporting an upper section of pipe in a generally upright position spaced apart from the axis of said bore hole; positioning a lower section of pipe in a generally upright position below said first section and in end to end relationship therewith; and coupling said sections together to form a pipe stand.

17. Apparatus for transferring pipe sections to and from a derrick over a borehole, the derrick having a main elevator generally operable on the bore hole axis and the apparatus including an upwardly extending track (164) located within the derrick, and offset from the bore hole axis, a lifting arrangement (161) having means (168) to engage the end of a pipe section and movable along the track so as to raise the pipe section up on to the derrick or let it down therefrom, so that the pipe section can, when raised, be subsequently handled to a position over the bore hole axis and aligned with the main elevator.

18. Apparatus according to claim 17, wherein the track (164) is a double track with a carriage (161) therebetween having a wheeled engagement with track, the carriage supporting a swing plate (165) biassed to a generally horizontal position and supporting jaws (168) to engage a pipe section.

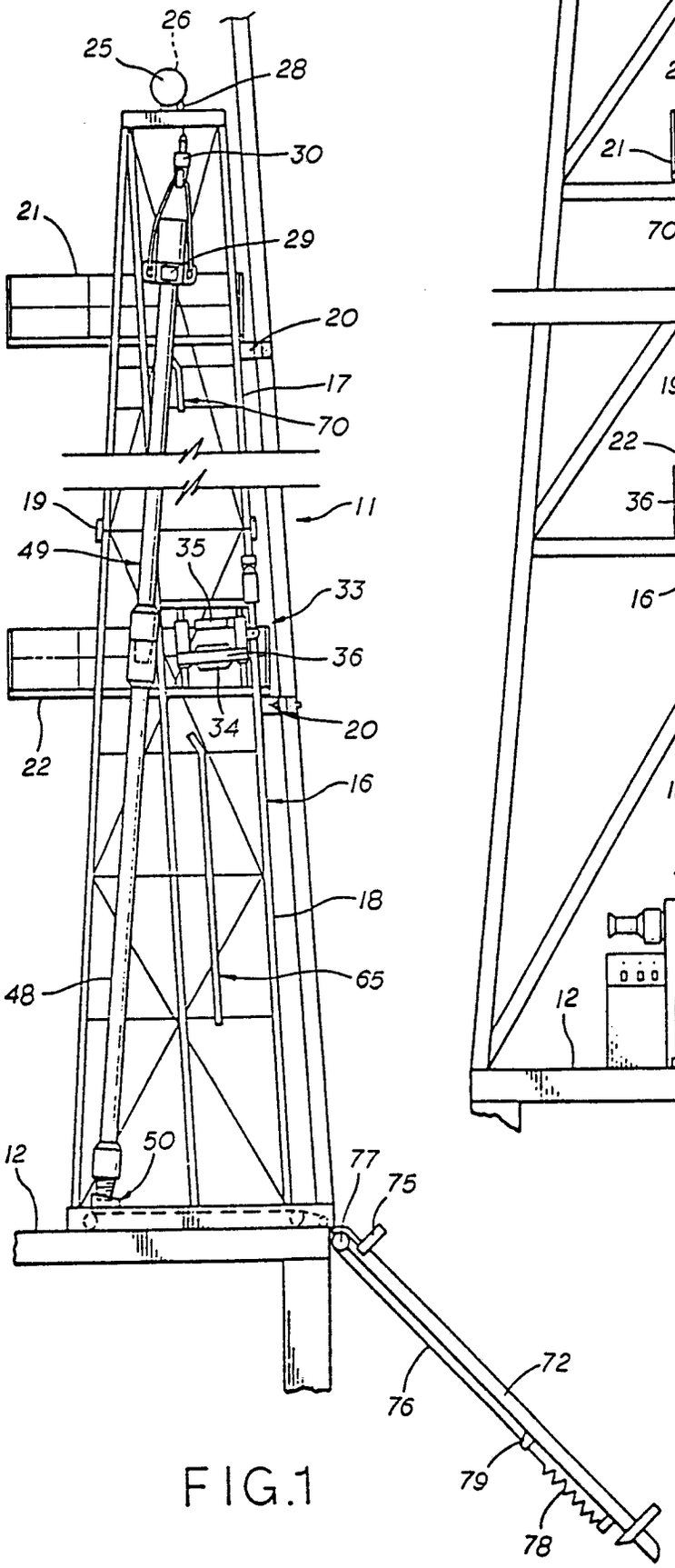
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FIG.1

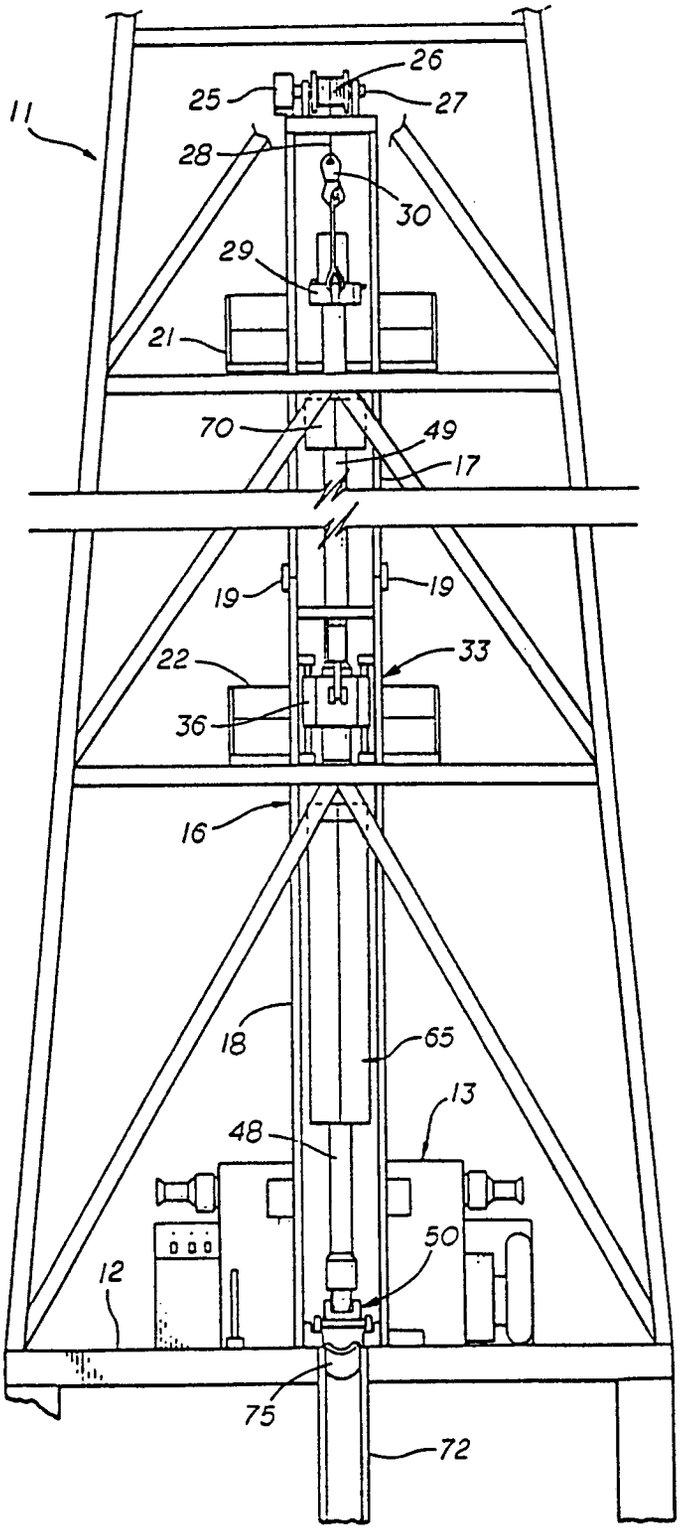
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FIG.2

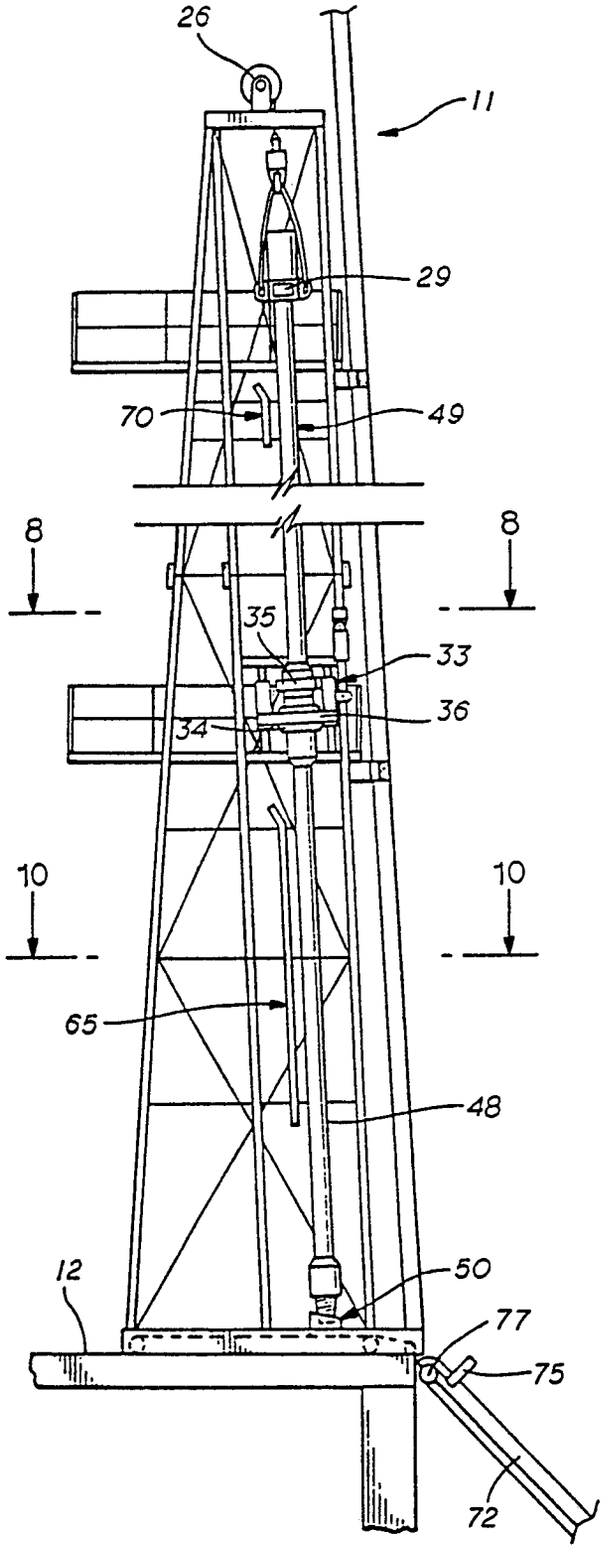
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FIG.3

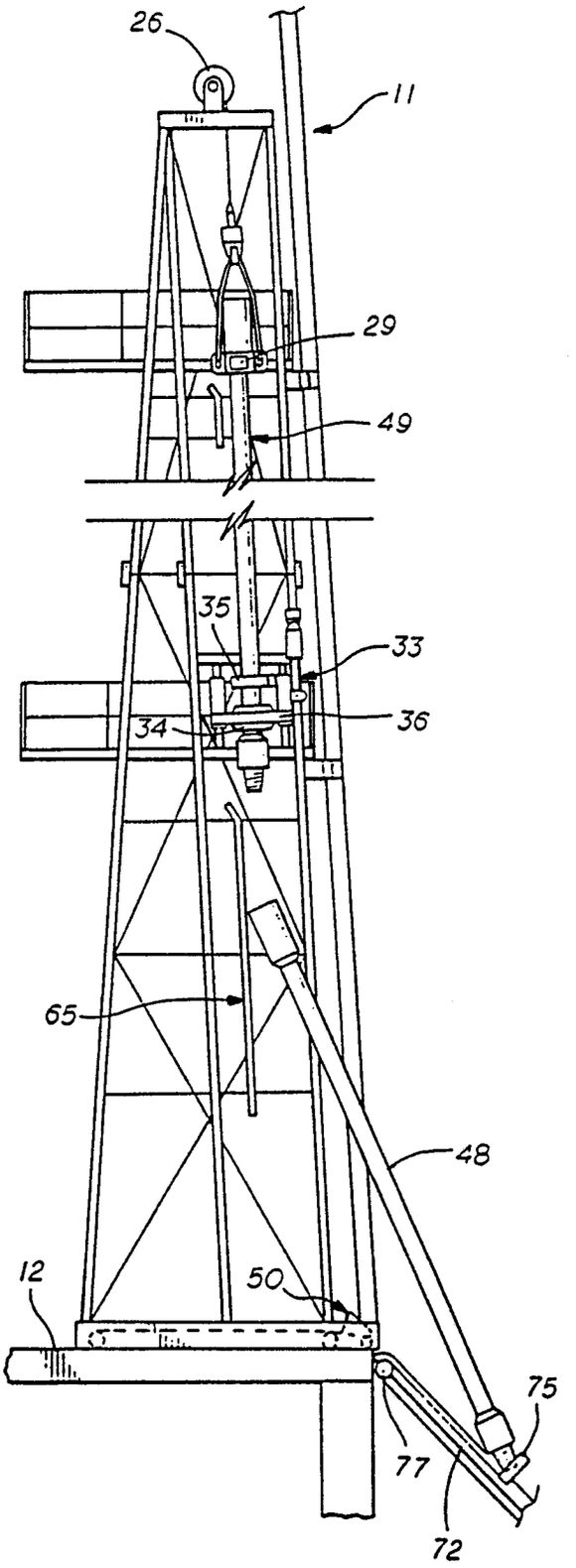
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FIG.4

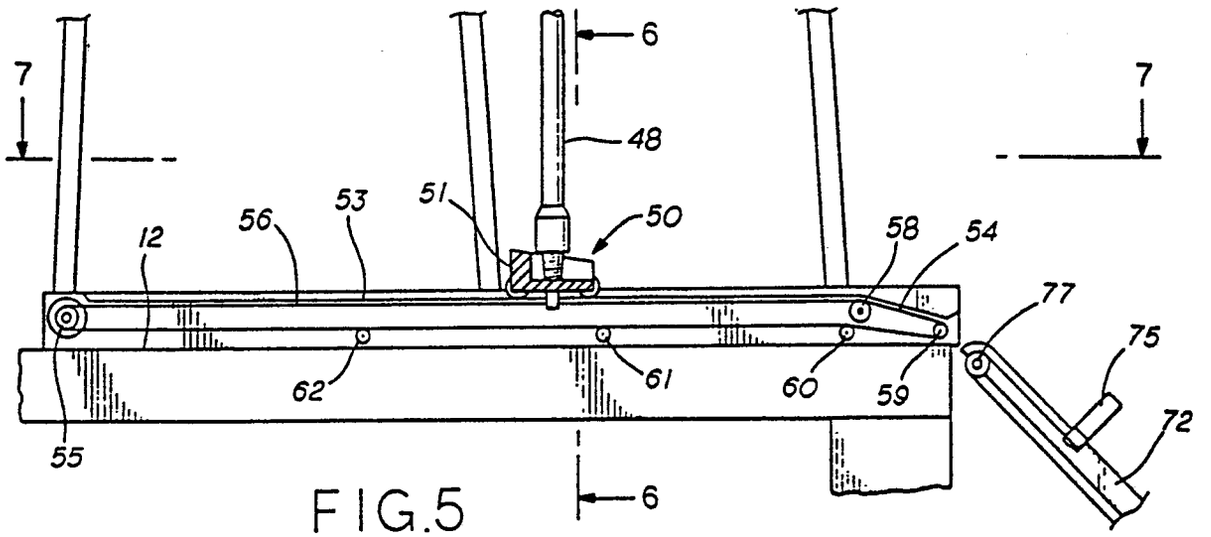


FIG.5

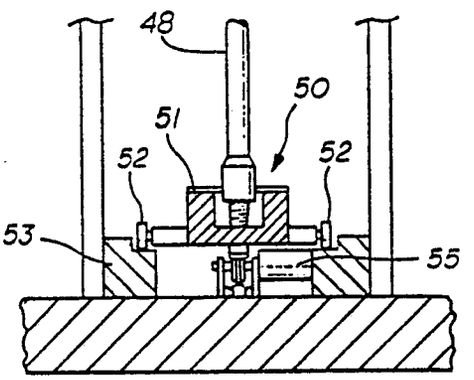


FIG.6

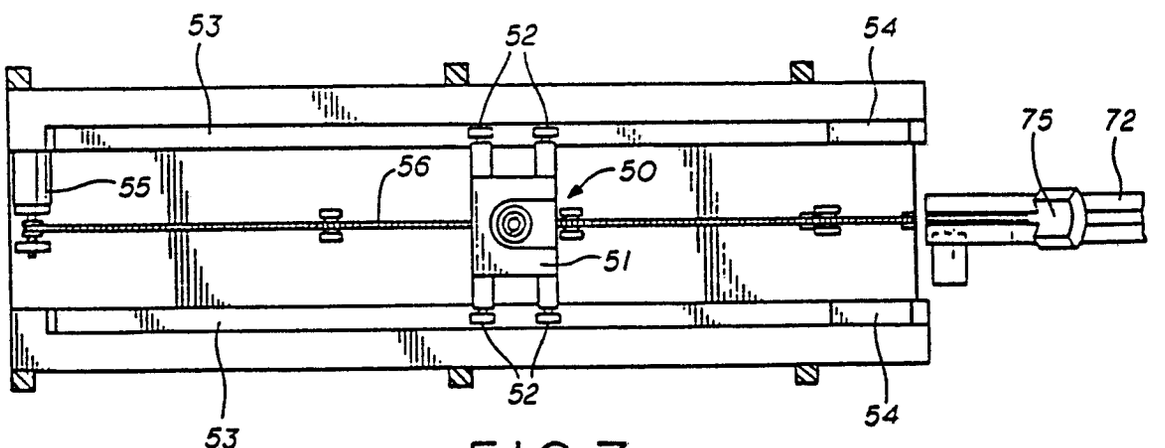


FIG.7

FIG.8

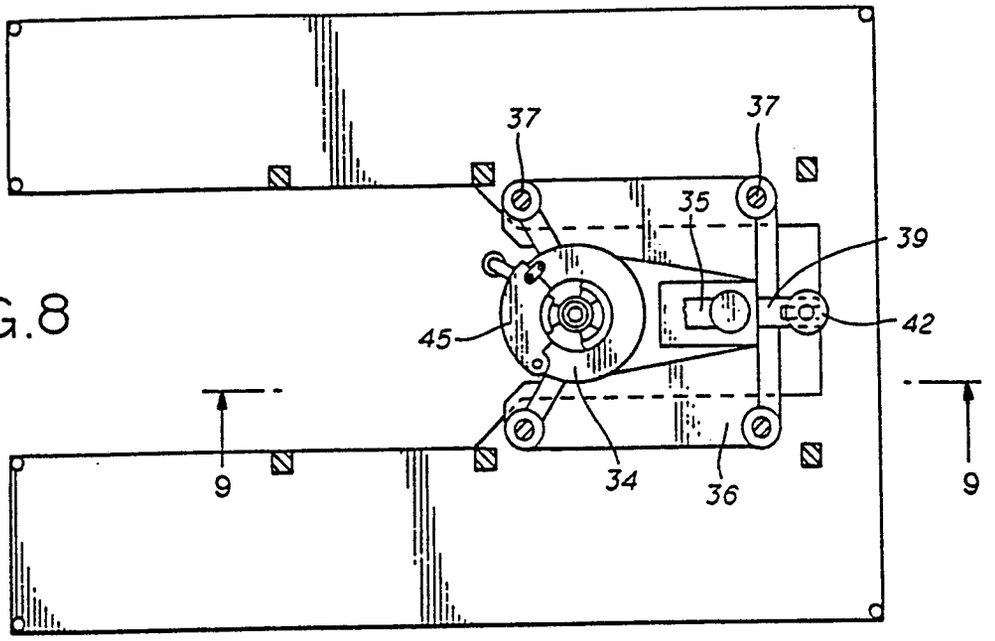


FIG.9

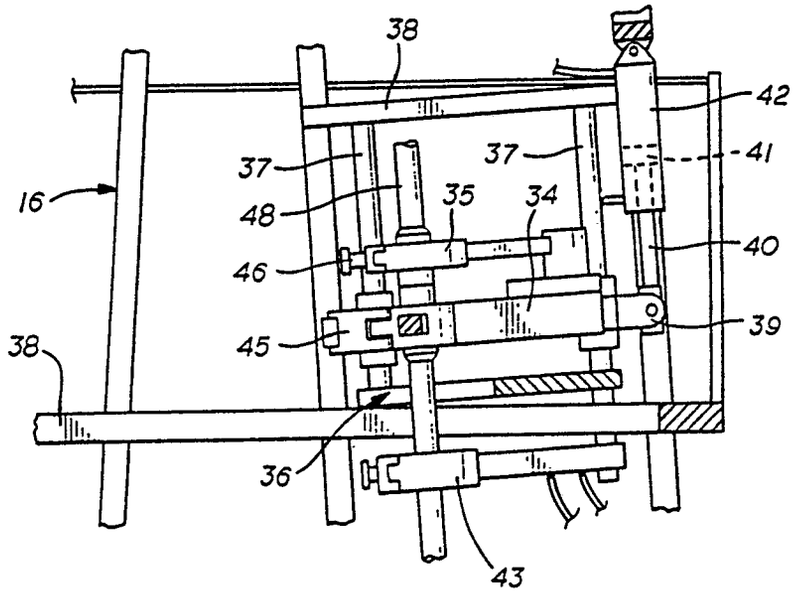
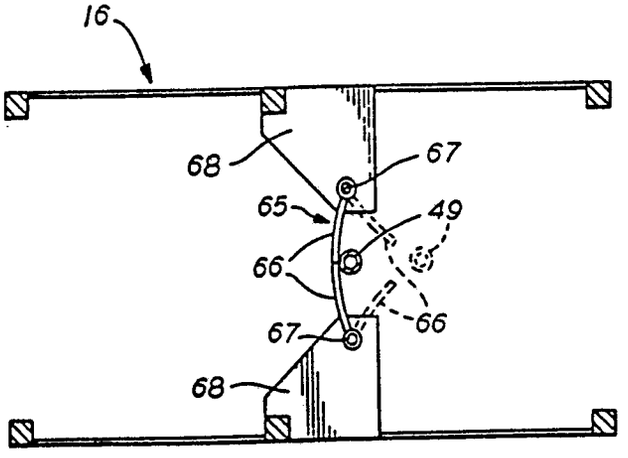


FIG.10



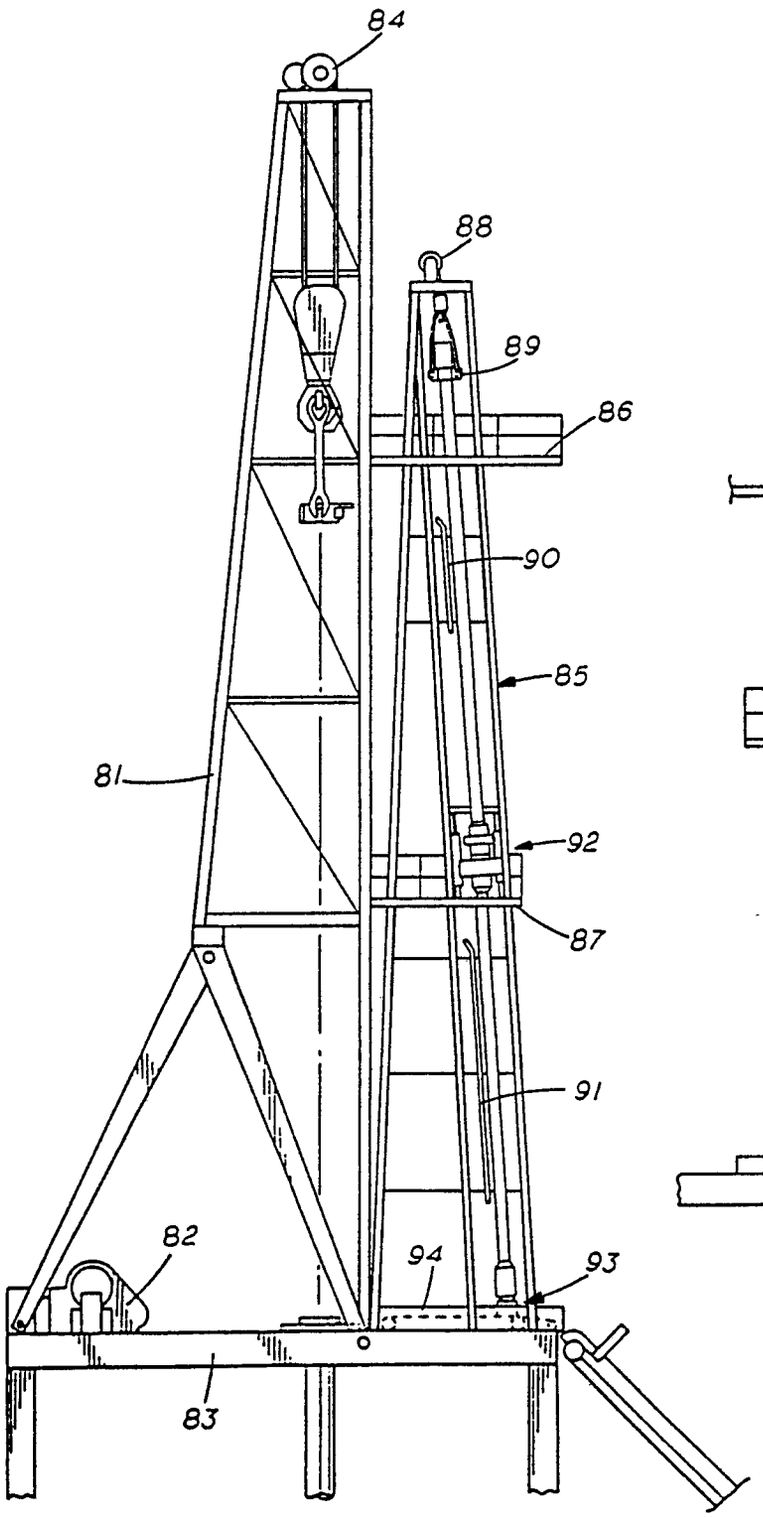


FIG.11

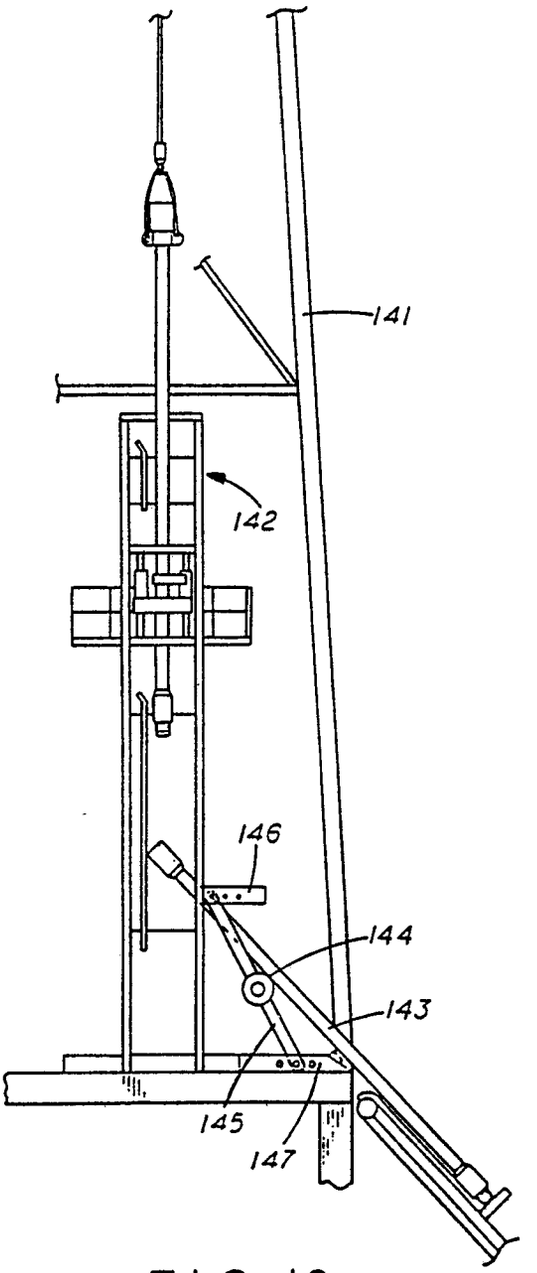


FIG.13

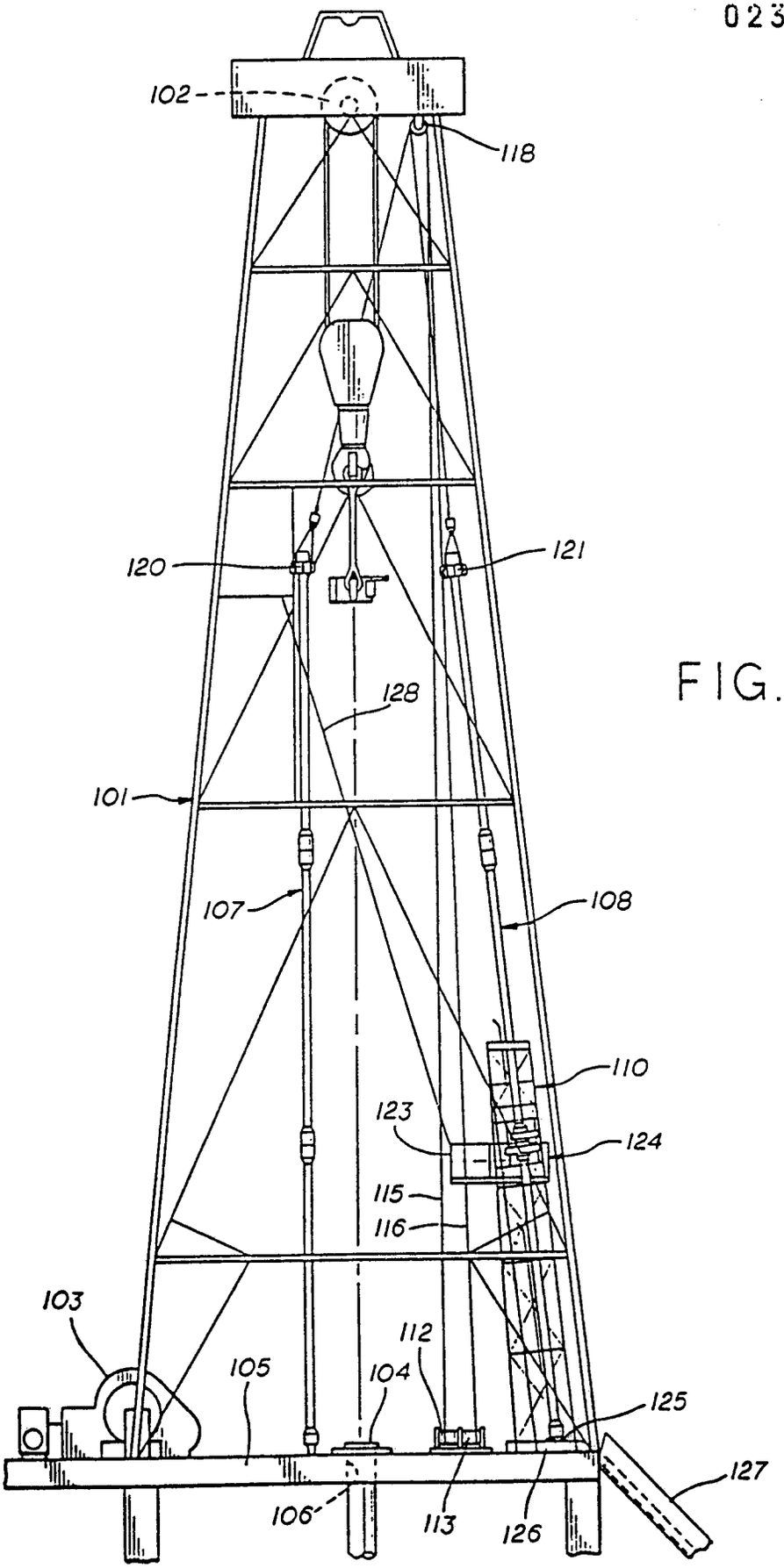

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FIG.12

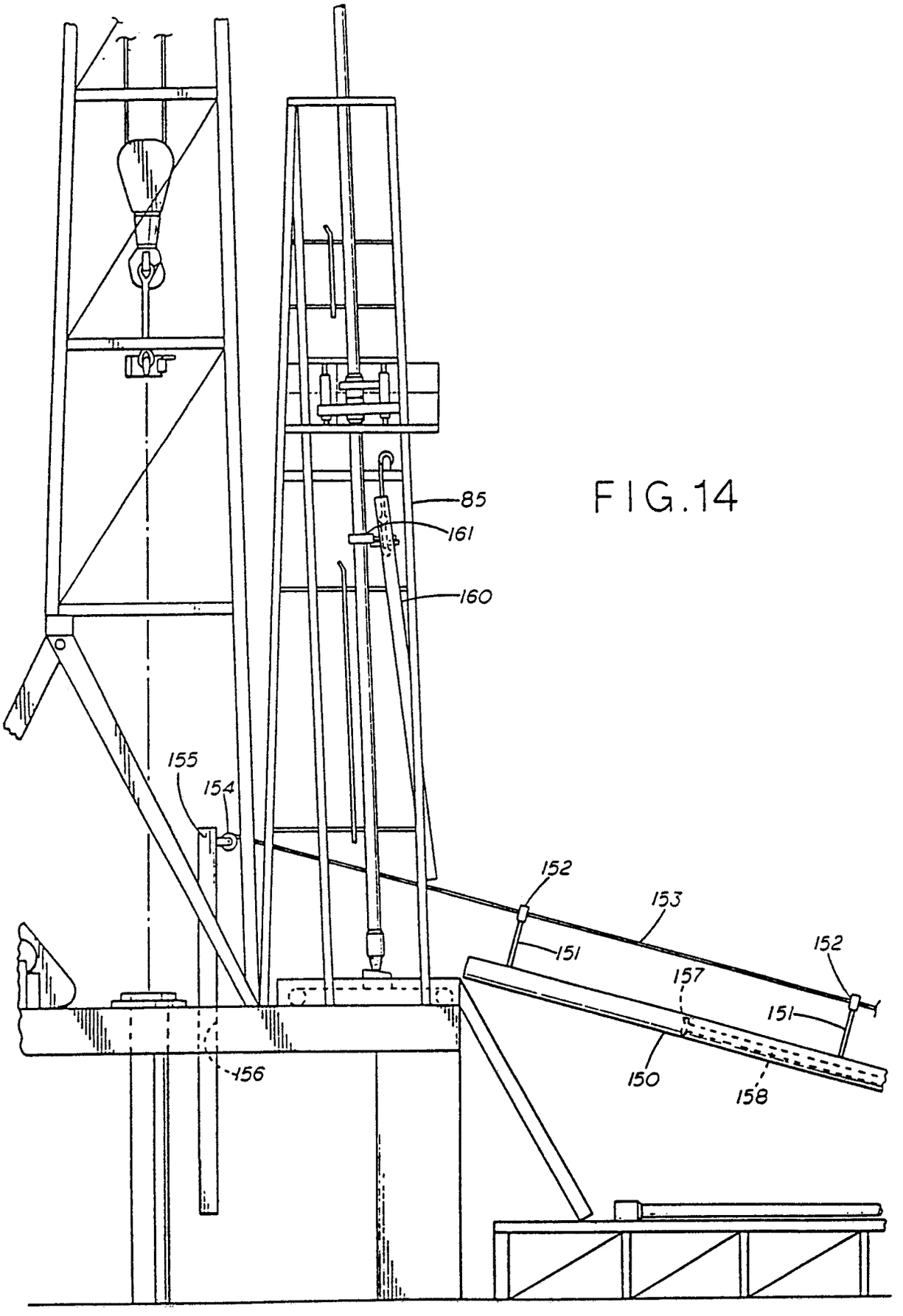

FIG.14

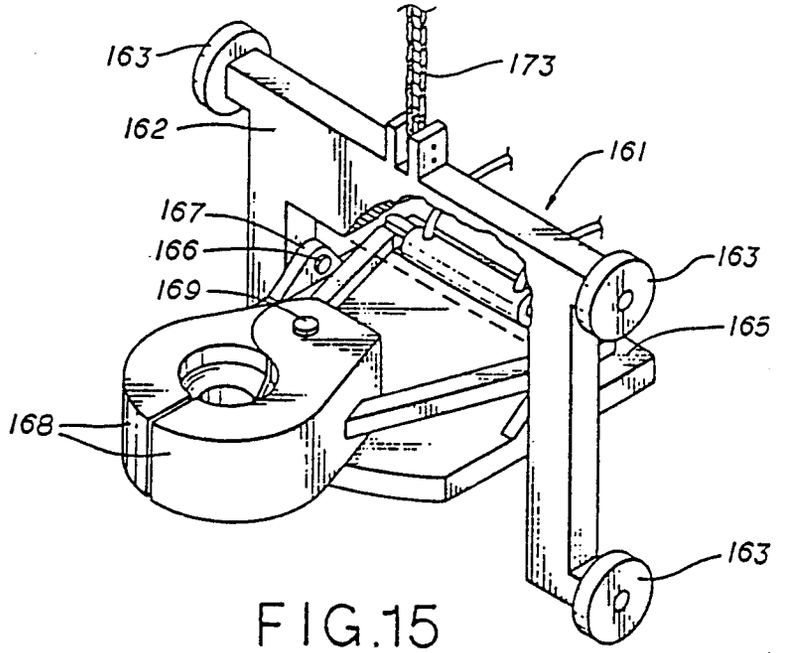
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FIG.15

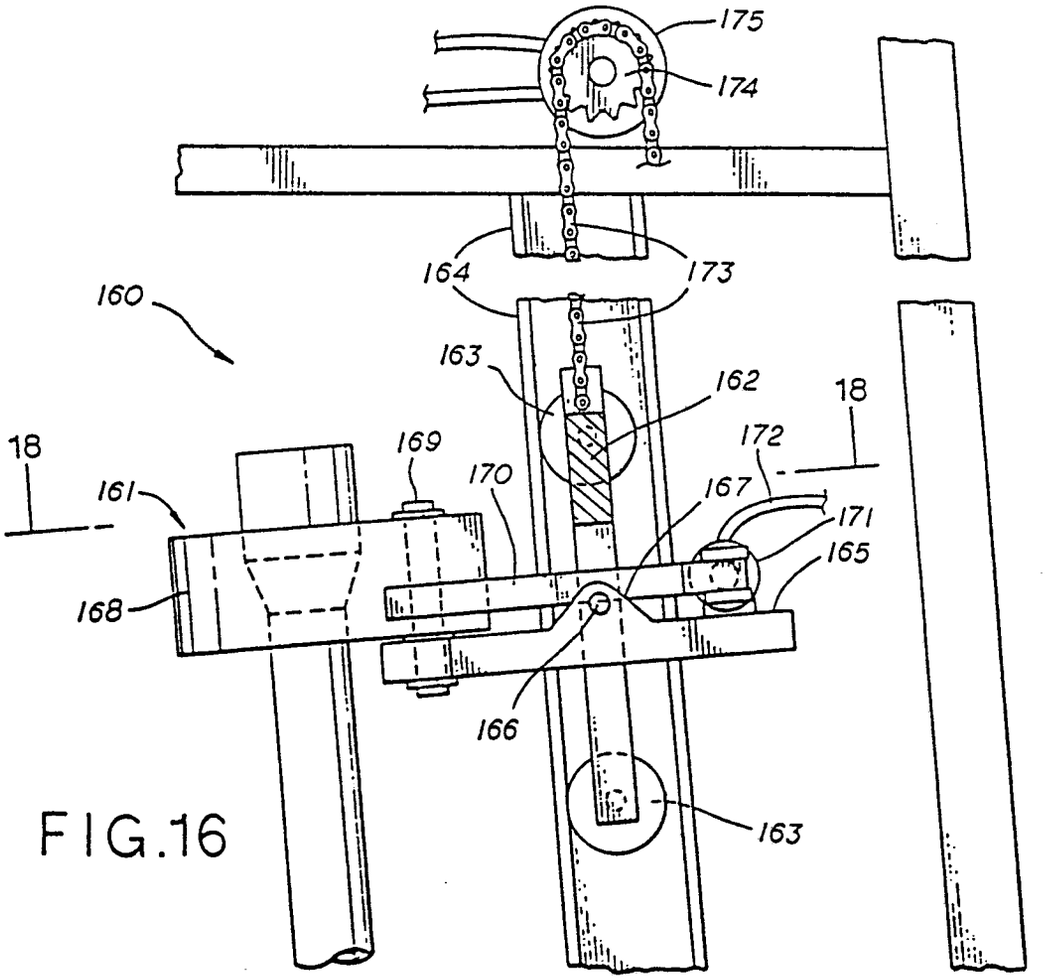
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FIG.16

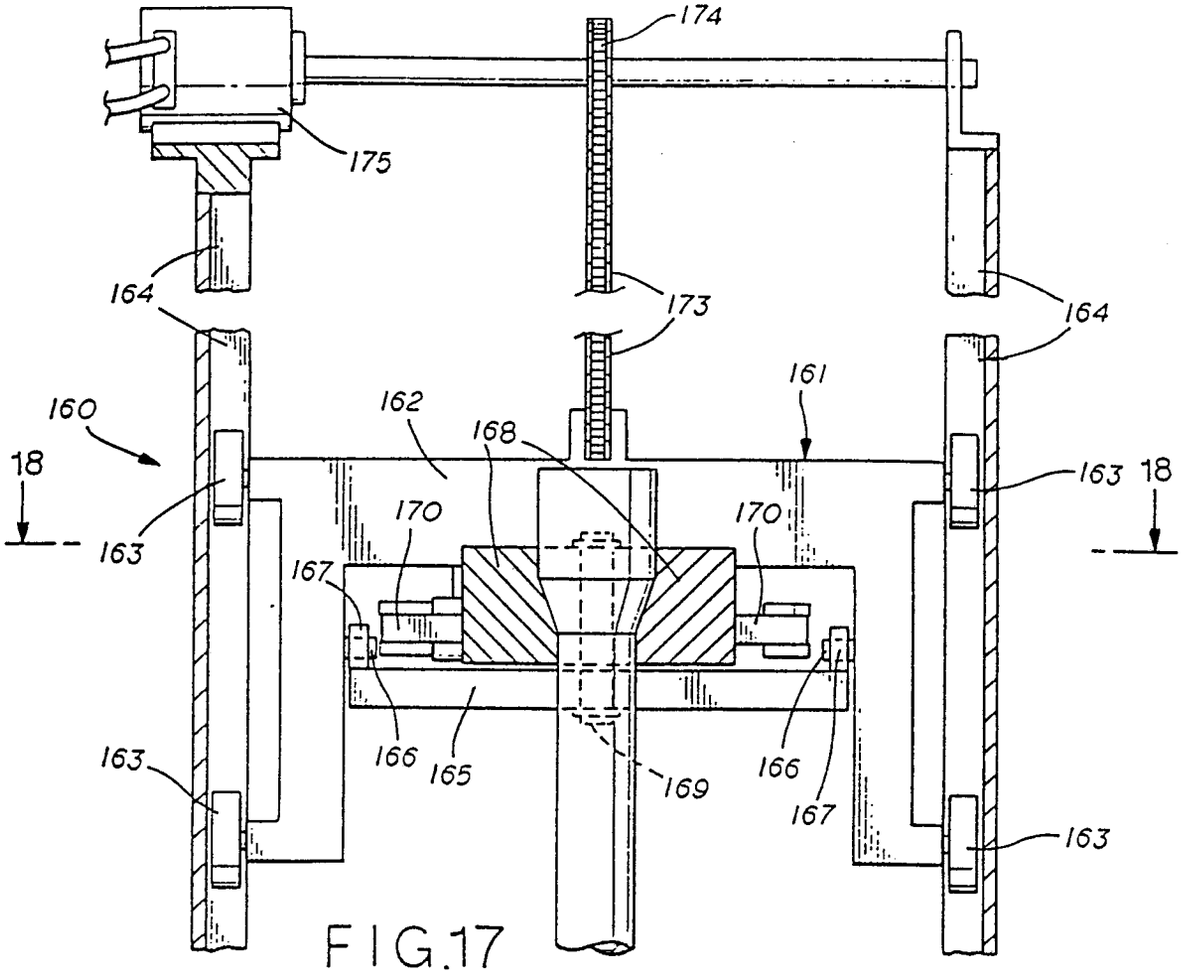
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FIG.17

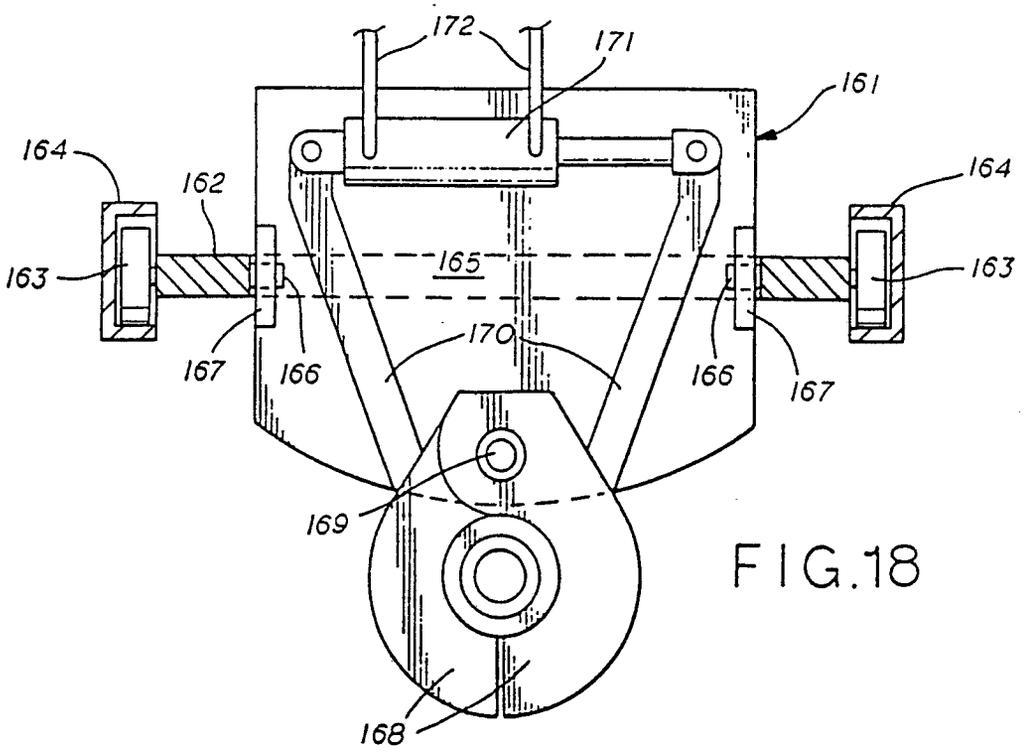
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FIG.18

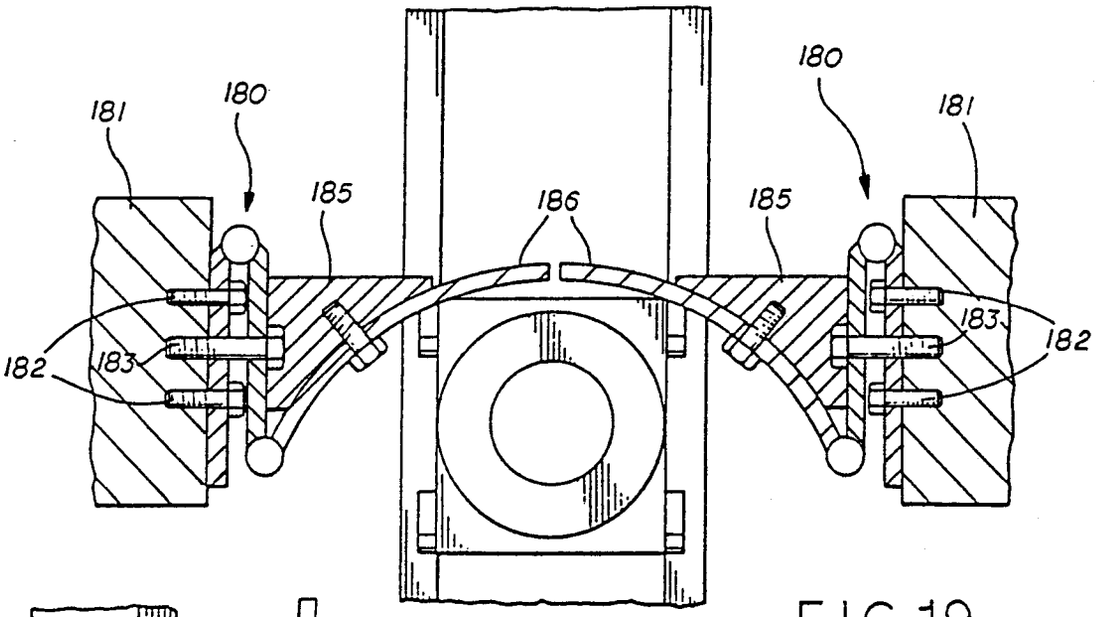

FIG.19

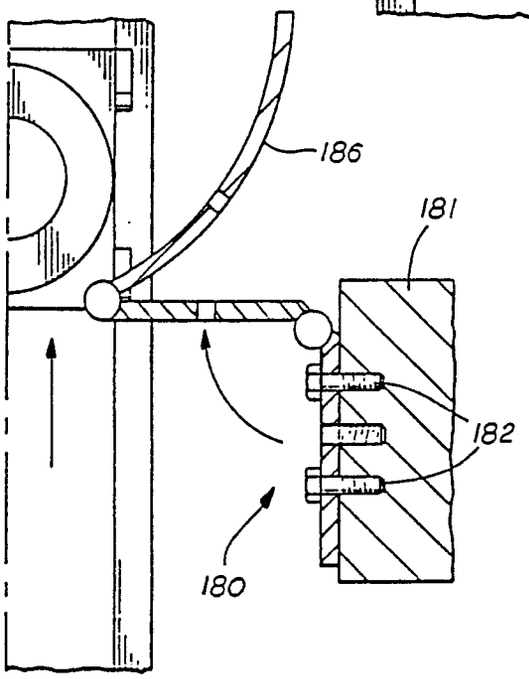

FIG.20

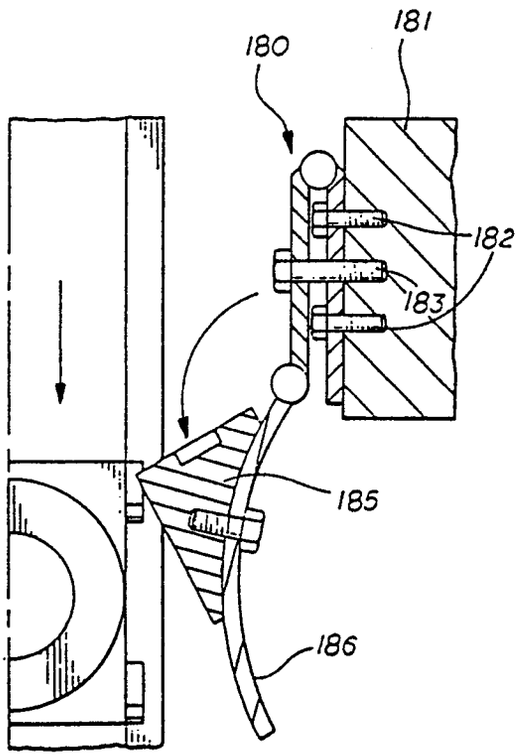

FIG.21