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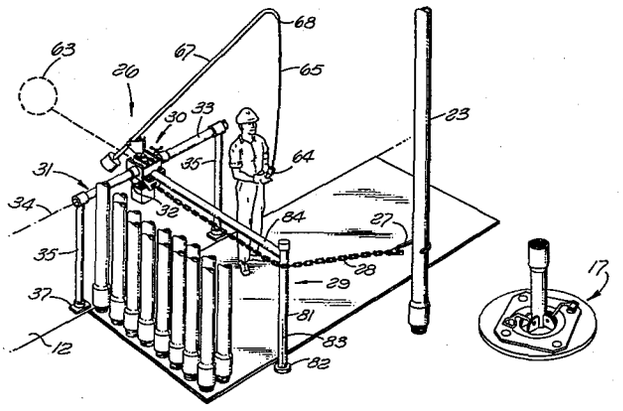
(54) Well pipe handling apparatus.

(57) A unit for moving a series of lengths of drill pipe between an active position of alignment with a well axis and laterally offset inactive positions, and including an elongated preferably flexible element (28) adapted to be connected to a pipe section (23) and exert a pulling force thereagainst in a manner moving it past a guide structure (29) to the desired inactive position. The guide structure (29) may be connected to a carriage (30) which is ovable to shift the guide structure for racking pipes in a series of different rows.



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WELL PIPE HANDLING APPARATUS

Background of the Invention

This invention relates to improved apparatus for handling well pipe when a drill string is being removed from or lowered back into a well.

Whenever it becomes necessary during drilling of a well to remove the drill string from the well, for a change of bit or any other reason, this 'round trip' operation requires separation of the string into a series of sections which are temporarily stored in vertical condition at a side of the rig and are then successively lowered back into the well for further drilling. The stored vertical sections may be aligned in rows, with the upper ends of the pipes being held in predetermined positions by a locating rack. The lower ends of the pipe sections are in most instances swung manually from a position of alignment with the well axis to their inactive storage locations, or vice versa. Because of the amount of weight involved in each of the pipe stands, however, such manual movement of the stands renders the conventional handling procedures very difficult, unnecessarily time consuming, and dangerous to personnel on the rig floor.

Summary of the Invention

The present invention provides a tool for assisting in this round tripping operation by mechanically moving sections of the drill string in either direction between a position of alignment with the well axis and inactive temporarily stored positions at the side of the well. The apparatus provides effective and positive control of

the movement of the well pipe sections, but does so with an extremely simple structure which can be supplied at relatively low cost, and is very straightforward and reliable in its operation. Further, the apparatus is designed to avoid interference with other operations on the rig, and may be converted to reduced dimension condition at an edge of the rig floor when not in use.

The device includes a chain or other similar elongated element which is adapted to be connected at one end to a section of drill pipe, and will function by longitudinal movement of the element to exert a pulling force on the pipe section moving it from the location of the well axis toward an inactive storage position. In conjunction with this chain, the apparatus includes a guide structure past which the pipe sections are pulled, and which directs the pipe sections toward their inactive positions. The guide structure may be constructed to align the stored pipes in a series of rows, and for this purpose may be attached to a carriage which is movable along a support element to different positions for forming the different rows. A power unit exerts pulling force on the chain to move the pipe sections to their stored positions, or can release the chain for reverse longitudinal movement in allowing the sections to return to the well axis. The guide structure may include a vertically extending post which the chain moves past in pulling the pipe sections to their storage locations, with a generally horizontally extending member preferably being connected to the post and acting to engage and align the sections in stored condition.

Brief Description of the Drawings

The above and other features and objects of the invention will be better understood from the following detailed description of the typical embodiment illustrated in the accompanying drawings in which:

Fig. 1 represents somewhat diagrammatically a well drilling rig having a pipe handling tool constructed in accordance with the present invention;

Fig. 2 is a perspective view of the tool;

Fig. 3 is a plan view of the device;

Fig. 4 is an enlarged fragmentary vertical section taken on line 4-4 of Fig. 3; and

Figs. 5 and 6 are enlarged fragmentary vertical sections taken on lines 5-5 and 6-6 respectively, of Fig. 3.

Description of the Preferred Embodiment

The well drilling rig 10 represented in Fig. 1 includes a derrick 11 and rig floor 12 supported by a substructure 13 from the ground 14. The drill string 15 is driven rotatively about a vertical axis 16 by a rotary table 17 to drill the well 18. The string may be suspended by travelling block 19 which is actuated upwardly and downwardly relative to crown block 20 by a line 21 actuated by the draw works 22. In Fig. 1, the rig is illustrated in a condition in which an upper stand or section 23 of the drill pipe has been detached from the rest of the string and is suspended from the travelling block by an elevator 24. During a round trip of the string out of and then back into the hole, individual stands or sections 23 are unscrewed separately from the string and then moved laterally from the full line position of the section 23 in Fig. 1 to positions 23' offset to a side of but parallel to the well axis (broken lines in Fig. 1), in which positions the removed stands are racked in vertically extending parallel condition with their upper ends being retained and located by a 'finger board' device 25. In accordance with the present invention, the lower ends of the pipe sections may be moved to their laterally offset positions, or returned to active positions of alignment with the well axis, by a pipe handling unit 26 embodying the invention which is supported on the well floor at a side of the well axis.

Referring now to Fig. 2, the unit 26 includes a preferably hook shaped device 27 for engaging and acting against the lower end of a section of pipe 23, with movement of this hook 27 being effected by an elongated

flexible element 28 desirably taking the form of a chain. A guide structure 29 directs the chain and pipe to and from vertically racked condition, and is connected to a carriage 30 for movement therewith relative to a stationary support 31. A power actuated winch 32 mounted to and movable with the carriage pulls chain 28 longitudinally, or releases it for reverse longitudinal movement, to move the pipe.

Support 31 may take the form of a horizontal externally cylindrical rigid pipe 33 extending along an axis 34 and supported by two parallel vertical legs 35 which may be formed of externally cylindrical pipe of the same type utilized in formation of horizontal member 33. The legs may be connected to member 33 by two tubular sleeves or bushings 36 and 36' which are welded to the upper ends of the legs and are centered about axis 34. Member 33 is a close sliding fit within cylindrical sleeves 36 and 36' to locate member 33 and guide it for axial retracting movement along axis 34 between the full line active position of Fig. 3, and the broken line inactive position. The lower ends of legs 35 may be removably inserted downwardly into, and be located and supported by, two cylindrical sockets 37 welded to the rig floor 12 (Fig. 4). Sockets 37 act to effectively retain support structure 31 in the illustrated fixed active position on the rig, while permitting support 31 to be detached from the sockets by upward movement of the support in order to enable storage of the entire unit 26 at a different location if desired.

Member 33 has an annular flange 39 at its left end as viewed in Fig. 3, of a diameter greater than the internal diameter of sleeves 36 and 36', to limit rightward movement of member 33 in the Fig. 3 full line position. Leftward movement of member 33 in that position is limited by a pin 40 which is insertible downwardly through openings at diametrically opposite locations in member 33 and has a head 41 at its upper end supporting the pin and engageable with sleeve 36' to retain member 33 therein. As will be understood, removal of pin 41 from member

33 frees the latter for axial movement to its broken line inactive position of Fig. 3.

Carriage 30 may be formed of a number of parts welded or otherwise rigidly secured together, typically including a series of parallel vertical plates 42 disposed perpendicular to axis 34, with a tube 43 extending through aligned openings in those plates 42 and welded externally thereto. Tube 43 may be internally cylindrical and of a diameter just slightly greater than the external diameter of member 33, to be guided for movement along axis 34 relative to member 33. Two additional parallel vertical plates 44 and 45 may extend parallel to axis 34 and be welded to the front and rear edges of plates 42 to form an integrated rigid structure including the parts 42, 43, 44 and 45. A clamp 46 is connected to one end of tube 43, and is tightenable against member 33 to releasably lock the carriage in any set position along and relative to member 33. Clamp 46 may include an essentially annular body 47 which is internally cylindrical and of a normal diameter just slightly greater than the external diameter of member 33, and which is retained against rotation relative to tube 43 by a bolt 48 extending through aligned openings in two adjacent similar lugs 49 and 50 formed on parts 47 and 43 respectively. At a location diametrically opposite that at which bolt 48 is positioned, clamping ring 47 is interrupted (at 51 in Fig. 6), with spaced parallel flanges 52 projecting outwardly from opposite ends of ring 47. A clamping screw 53 threadedly engages one of the flanges 52 at 54, and extends through an unthreaded bore in the other flange at 154, and has an annular enlarged diameter portion 153 above the upper flange as viewed in Fig. 6, which clamps the flanges 52 together upon rotation of the screw to tighten ring 45 against member 33 and thus lock the carriage in any set position. The screw is manually rotatable by a handle 55, which may be secured rigidly to the screw in any convenient manner, as by positioning the handle about an upper portion of the screw above enlargement 153 and retaining the handle thereon by a nut 253. A bottom nut 353 may be welded onto the

lower end of the screw to prevent complete removal of the screw from flanges 52.

Winch 32 may be carried at the underside of carriage 30, for movement therewith, and may be any of various conventional types of power operated units adapted to exert pulling force on chain 28. As seen in Figs. 4 and 5, the winch may include a rigid hollow housing 56 containing a reversible motor represented at 57 driving a wheel 58 having sprocket like irregularities in its outer surface represented at 59 engageable with successive links 60 of chain 28 in a positive drive relation pulling the chain longitudinally in response to rotation of wheel 58. The wheel may be driven at a speed slower than motor 57 through a suitable reduction gear mechanism in the winch. As the chain is pulled by winch 32 away from the well axis and in a direction toward the carriage, the excess chain beyond wheel 58 is directed past a wheel 61 and falls into and is stored within a container 62 suspended from the carriage essentially beneath the location of wheel 58. The motor may be driven by any convenient type of power, preferably compressed air, delivered from a suitable source represented at 63 under the control of a valve assembly 64 which may be held by the operator. This control valve assembly 64 may be carried at the end of a flexible line 65, containing passages for delivering air from source 63 to the valve assembly, and from the valve assembly back through line 65 to motor 57, in a manner enabling the operator by actuation of assembly 64 to start, stop and reverse the direction of rotation of the motor. Winch 32 preferably includes an automatic braking mechanism 66 acting when the motor is stopped to automatically lock wheel 58 in any position to which it has turned.

Flexible line 65 in extending from the motor and carriage toward control valve unit 64 may first, as represented at 65' in Fig. 5, extend toward the lower end of a tubular element 67, and then pass upwardly through that element and out of its curved upper end 68 to unit 64. Tube 67 and line 65 are so designed as to allow an operator

to carry control unit 64 between the location of well axis 16 and all positions of carriage 30, so that he can operate the valves to start, stop and reverse the motor when he is at any of those locations. To enable such movement, the guide tube 67 is preferably mounted by a part 69 for essentially universal swinging movement relative to the carriage. Part 69 may be of U-shaped horizontal section, having a front wall 70 and two parallel vertical side walls 71, with tube 67 received between walls 71 and connected thereto by bearings 72 for relative pivotal movement about a horizontal axis 73. A vertical tubular sleeve 74 is welded to part 69 and mounted movably about a cylindrical vertical post 7 rigidly secured to and projecting upwardly from the body of carriage 30 to mount part 69 and the carried tube 67 for swinging movement about a vertical axis 76 relative to the carriage. The attachment of post 75 to the body of the carriage may be made by welding the post to a horizontal plate 77 which is welded to two or more of the plates 42 of the carriage. A counterweight 167 may be carried about the lower end of tube 67 and be of a weight slightly greater than that required to counterbalance the weight of the upper portion of tube 67 and the connected line 65 so that tube 67 will always return to an approximately directly upwardly projecting condition when released by the operator.

The hook device 27 for engaging and exerting pulling force on pipe 23 may have the configuration represented in Fig. 3, with a portion 78 of the hook being curved to extend approximately 180 degrees about the pipe as shown. The chain is connected to the hook at 79, and the hook is open at one side to provide a throat 80 through which a pipe can move into or out of the hook.

The guide structure 29 which is secured to carriage 30 may include a vertical tubular post 81 formed of a length of internally and externally cylindrical pipe, and having a circular horizontal base plate 82 welded to its lower end for engagement with the rig floor 12. Post 81 may extend directly vertically along an axis 83 parallel to the vertical axis 16 of the well and parallel to the

vertical axis of legs 35 of carriage support 31. Chain 28 engages the outer surface of post 81 as illustrated in Figs. 2 and 3, and is deflected along a curving path in passing the post.

Connected to vertical post 81, the guide structure also includes a horizontal guide element 84, which may take the form of an externally cylindrical straight rigid pipe extending along a horizontal axis 85 perpendicular to axis 83 and to axis 34. A first end of guide 84 is welded or otherwise rigidly secured to post 81 near the upper end of the post. The opposite end of guide member 84 is secured rigidly to carriage 30, at least during operation of the mechanism, but may if desired be detachable from the carriage, and/or be movable relative to the carriage to a retracted position when not in use. For this purpose, the inner end of member 84 may carry two connector lugs 86 projecting in opposite horizontal directions therefrom and containing openings through which two connector pins 87 can extend downwardly. Each of these pins also extends vertically through aligned openings in two connector lugs 88 projecting from the vertical front wall 44 of the carriage. When both of the pins 87 are in place, member 84 is connected rigidly to the carriage in the full line position of Fig. 3. If one pin is removed, the member 84 can be swung about the other pin to a retracted position near and parallel to axis 34 (broken line position 84' of Fig. 3). If both pins are removed, member 84 and the connected post 81 are completely detached from the carriage and can be removed to any desired storage location.

In the operative condition of the apparatus, guide tube 84 is so located that its axis 85 does not intersect vertical axis 16 of the well, but rather is offset to the left of axis 16 as viewed in Fig. 3. This relationship assures that chain 28 will be held against post 81 as it extends about that post.

To describe a cycle of use of the tool, assume that all of the well pipe is initially in the hole, and that it is desired to remove the drill string in sections from the

well and stack those sections vertically at a side of the well. For stacking a first series of such sections, the carriage 30 and connected guide structure 29 including post 81 and horizontal member 84 may be in the position illustrated in broken lines at 84" in Fig. 3. While in this position, an initial one of the drill pipe sections 23 may be connected to hook device 27, and the motor of winch 32 may then be energized to pull chain 28 longitudinally toward the winch location. The hook and pipe first move along an angular path toward post 81, and then after passing the post are pulled directly toward the carriage essentially parallel to axis 85. Member 84 guides the pipe along the path indicated by arrow 89 in Fig. 3 and to the location 23'. During such movement, the pipe section is of course suspended by the travelling block, and its upper end is directed into engagement with upper locating unit 25. After a first section has been moved to the position 23', the hook device 24 is detached therefrom, and the chain is pulled back to the well axis to engage a next successive pipe, which is similarly pulled by the chain and winch past the guide post 81 and along guide 84 to a vertical location adjacent the first pipe, as represented at 23'' in Fig. 3. Additional pipes are similarly pulled to successive positions, all being guided and located by element 84, to form a first row R of racked pipe sections.

After this first row has been completed, clamp 46 is released to allow movement of the carriage and guide structure a short distance to the right in Fig. 3, with the carriage then being locked in that second set position, in which the guide structure is located to direct a second series of pipe sections along the guide structure to form a second row R_1 of vertically stacked pipes parallel to and closely adjacent row R. Additional rows R_2, R_3, etc. of the vertically stacked pipes are formed with the carriage moved to and locked in a series of different set positions along horizontal support member 33. Ultimately, a final series of drill pipe sections are aligned to form a last row of stacked pipe with the carriage and guide structure

in the full line position of Fig. 3, and with the carriage at the end of its range of travel along member 33.

When it is desired to reverse the process and return the drill string into the hole, such return is commenced with the apparatus in the full line condition of Fig. 3, and with the pipes being returned to the well axis in reverse order. Thus, the pipe section designated 28n in Fig. 3 is first engaged with hook device 27, and as the pipe is lifted slightly upwardly by the travelling block and the upper end of the pipe is moved toward the well axis, the operator actuates valve assembly 64 to engergize the motor of winch 32 in a direction enabling the chain to move longitudinally away from the winch rather than toward it. The weight of the suspended drill pipe section exerts a pulling force on the chain causing it to feed out gradually from the winch with resultant movement of the pipe section 23n past vertical post 81 and back to a position of alignment with the well axis, for connection into the string. The hook device 27 is then detached from the pipe section and connected to a next successive pipe section in the final row of such sections, with the winch being operated in a take-up direction far enough to relieve any slack in the chain, after which the winch is reversed to gradually release the second pipe section for movement along the guide structure and back to the well axis. In this manner, all of the pipe sections in the righthand row of Fig. 3 are successively connected back into the string, with each such section being guided along element 84 and past post 81 before being permitted to advance directly toward the well axis. After the last pipe section in the righthand row in Fig. 3 has been connected into the string, the carriage is moved to the left for engagement with the next successive row, to connect the sections of that row back into the string, with this operation being repeated for all of the rows until the entire string has been reassembled.

The engagement of bottom plate 82 of the guide structure with the rig floor is such as to enable plate 82 to move freely to different positions on the rig floor as

the carriage 30 and the connected guide structure are shifted to different positions along axis 34.

When it is desired that the device 26 be retracted to an inactive condition in which it will not interfere with performance of other operations on the rig floor, this conversion may be effected by removing pin 40 from the right end of the member 33 in Fig. 3, so that member 33 and carriage 30 can be moved to their broken line positions of Fig. 3. Also, one of the pins 87 can be removed to permit member 84 and the connected post 81 to be pivoted about the other pin 87 to a position near and parallel to member 33. Alternatively member 84 and post 81 can be detached completely from the carriage, or the entire unit 26 can be removed bodily from the rig by lifting legs 35 upwardly out of their mounting sockets 37.

While a certain specific embodiment of the present invention has been disclosed as typical, the invention is of course not limited to his particular form, but rather is applicable broadly to all such variations as fall within the scope of the appended claims.

CLAIMS

1. Apparatus comprising an elongated element adapted to be connected to a well pipe and exert a pulling force thereagainst, and a power unit for pulling said element longitudinally to move the pipe; characterized by a guide structure past which the pipe moves as it is pulled by said elongated element, and which is constructed to engage the pipe during movement thereof between an active position of alignment with the axis of a well and an inactive position offset to a side of the axis, and acting to guide the pipe to said inactive position.

2. Apparatus as claimed in claim 1, in which said guide structure includes a generally horizontal member along which the pipe moves and which directs a series of said pipes to aligned adjacent positions along said member.

3. Apparatus as claimed in either claim 1 or claim 2, in which said guide structure includes a generally vertical post offset from said axis and past which said element extends, in engagement with the post, to pull the pipe past the post.

4. Apparatus as claimed in any of the preceding claims, in which said guide structure is movable to different positions to direct different pipes pulled from the well axis to different inactive positions at a side of the axis.

5. Apparatus as claimed in any of the preceding claims, including a carriage connected to said guide structure, and a support mounting said carriage and the connected guide structure and said power unit for movement between different positions to locate different ones of said pipes at different inactive positions.

6. Apparatus as claimed in claim 1, in which said guide structure includes a generally vertical post past which said element is pulled, and a member extending generally horizontally from said post and along which a series of said well pipes move and adjacent which said pipes are received after movement past said post, and there being a carriage connected to said member, and a

support along which said carriage is movable to shift said generally horizontal member and said post between different positions for aligning different series of said pipes in a number of rows.

7. Apparatus as claimed in claim 6, in which said power unit is mounted to and movable with said carriage.

8. Apparatus as claimed in any of claims 5 through 7, in which said support is elongated and mounted for longitudinal movement between an active position and a retracted position.

9. Apparatus as claimed in any of claims 6 through 8, including a connection attaching said generally horizontally extending member to said carriage for movement relative thereto to an inactive position when not in use.

10. Apparatus as claimed in any of the preceding claims, including a control for said power unit and a structure to which said control is connected and mounted for swinging movement to different positions to allow actuation of the control from different positions on the rig floor.

11. Apparatus as claimed in claim 10, in which said structure includes an upwardly projecting arm to which said control is connected and which is mounted for vertical and horizontal swinging movement.

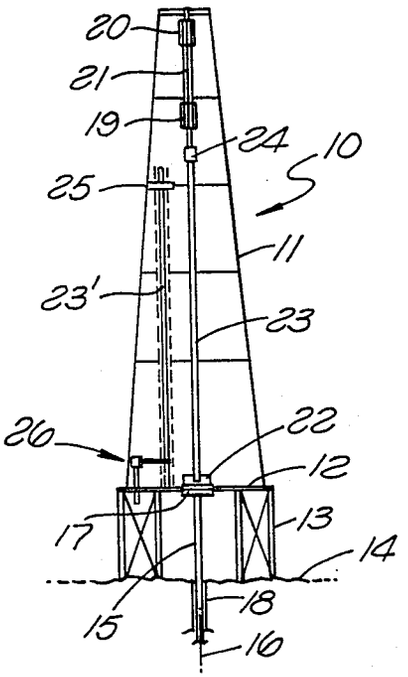

FIG. 1

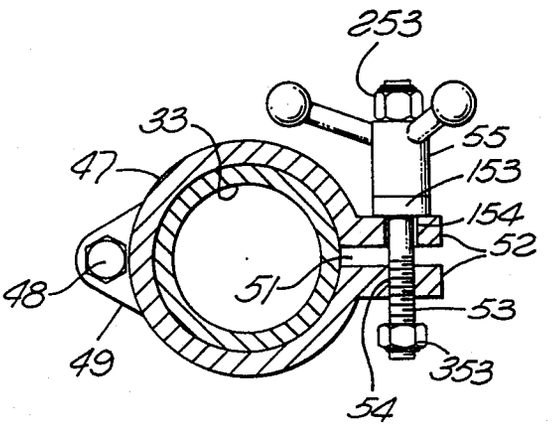

FIG. 6

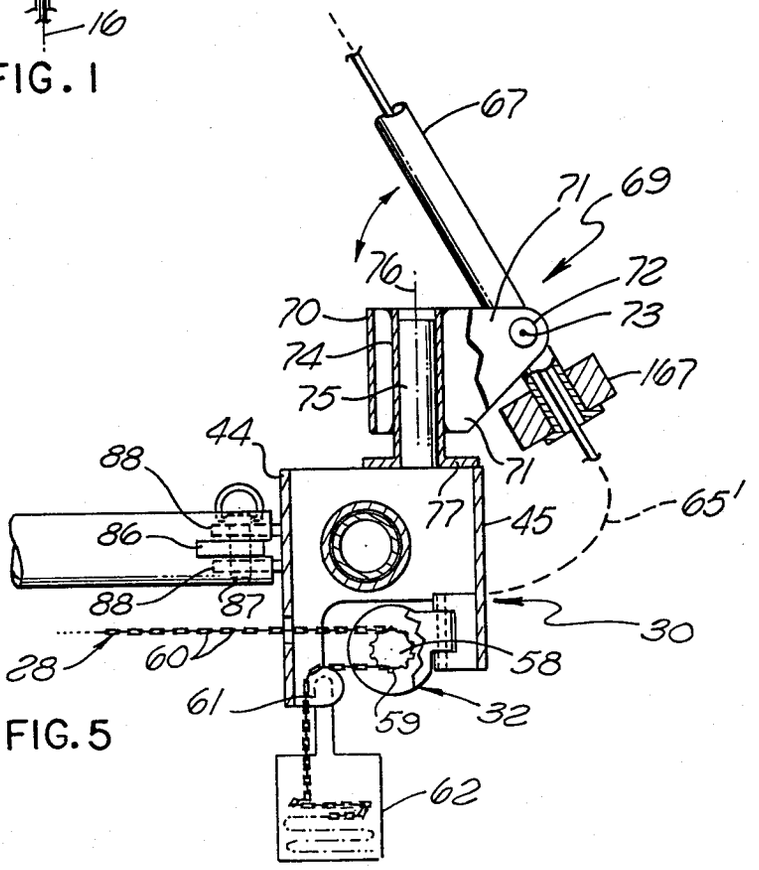

FIG. 5

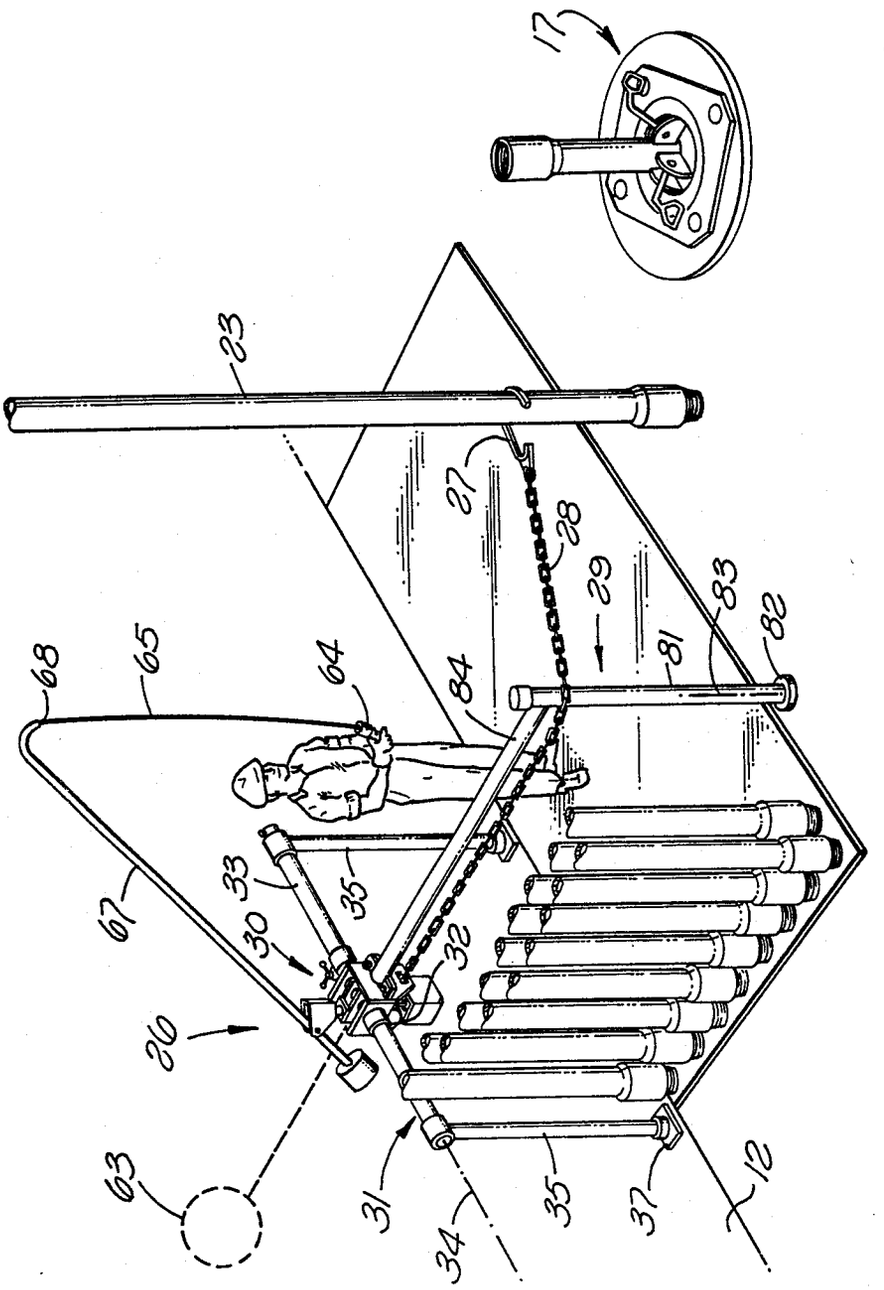

FIG. 2

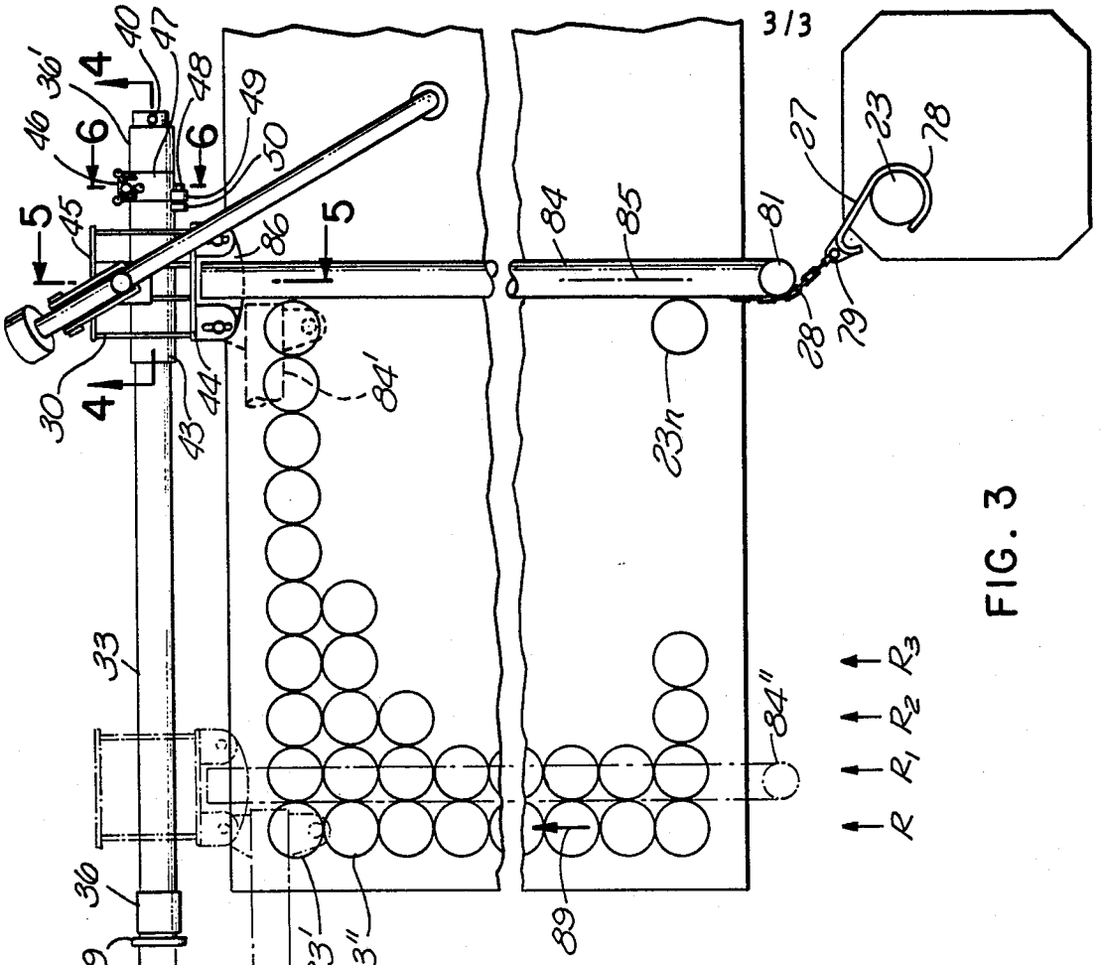
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FIG. 3

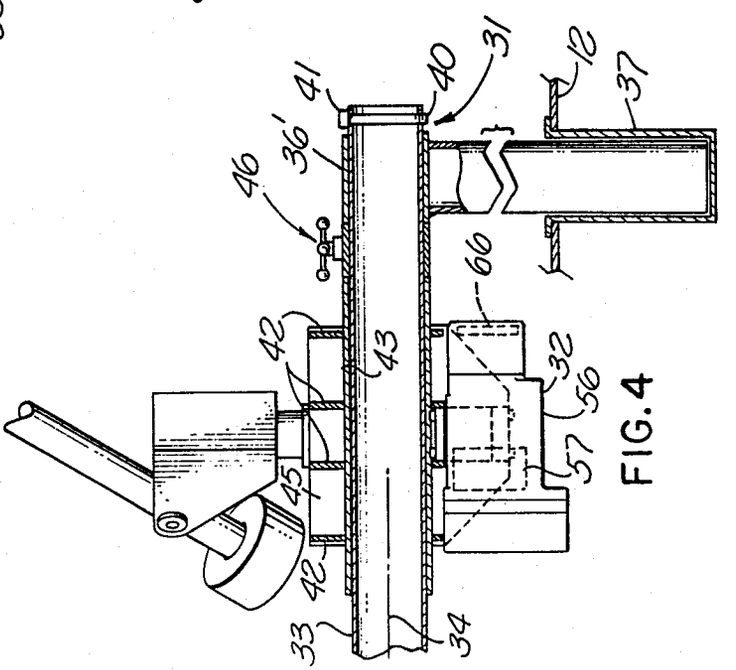
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FIG.4

European Patent Office

EUROPEAN SEARCH REPORT

0117833
Application number

EP 84 63 0014

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
X	US-A-3 533 516 (W. GUIER) * Column 2, line 40 - column 4, line 26; figures 1-4 *	1,2	E 21 B 19/14
A	US-A-1 818 278 (R.W. SILER) * Page 1, line 17 - page 2, line 36; figures 1-4 *	1,4,5	
A	GB-A-1 242 503 (GLOBAL MARINE)		
A	US-A-4 117 941 (R.W. McCLESKEY et al.)		
A	US-A-2 692 059 (T.J. BOLLING)		TECHNICAL FIELDS SEARCHED (Int. Cl. ³)
A	US-A-4 274 778 (P.S. PUTNAM et al.)		E 21 B
A	US-A-4 077 525 (S.R. CALLEGARI et al.)		
A	GB-A- 655 257 (STANDARD OIL)		
A	US-A-2 535 464 (S.T. TISDALE)		

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	18-05-1984	JAUNEZ X.

CATEGORY OF CITED DOCUMENTS

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