

[54] **WELL DRILL TRANSFER MECHANISM**

[75] Inventor: **George E. Otto**, Torrance, Calif.

[73] Assignee: **Bucyrus-Erie Company**, South Milwaukee, Wis.

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[58] Field of Search.....**175/52, 85; 166/77.5; 214/2.5; 81/57.16, 57.34, 57.36**

[56] **References Cited**

UNITED STATES PATENTS

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Primary Examiner—Ernest R. Purser

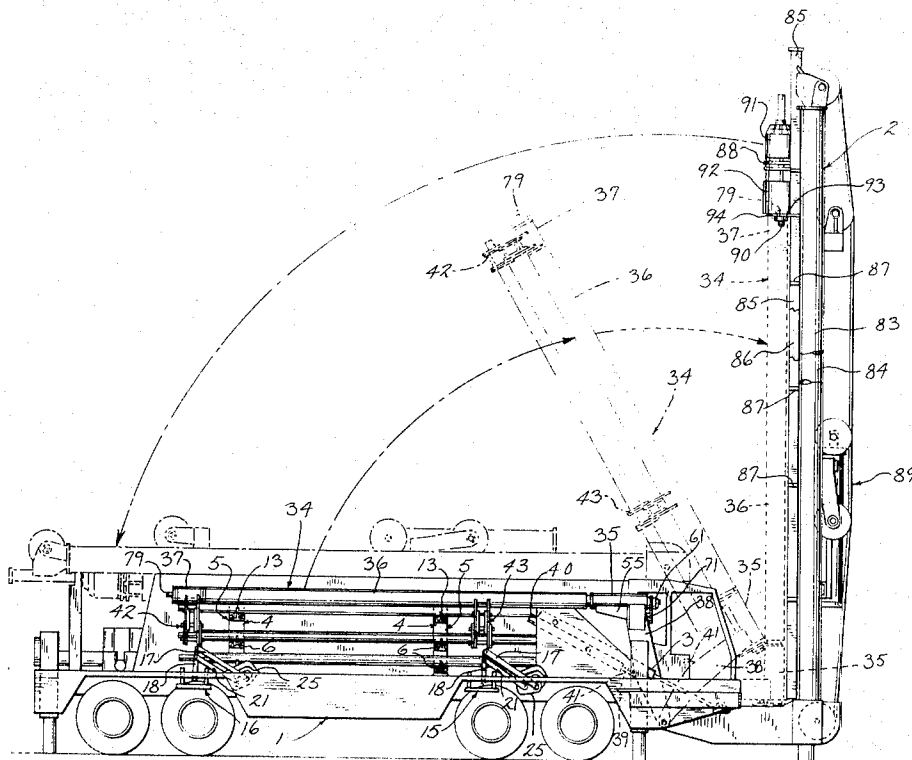
Attorney—Barry E. Sammons et al.

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ABSTRACT

A mast extends vertically from the front of a truck, and supports a drive unit which operates to simultaneously drive a drill pipe and casing segment into a well. Drill pipe segments each with a surrounding casing segment are carried in a three tiered storage rack located along the right side of the truck. A selected drill-casing segment is discharged from the storage rack onto a pair of carriages which lift the selected drill-casing segment to a position where it is picked up by a transfer arm. The transfer arm is pivotally attached to the front of the truck and hydraulically actuated to lift the drill-casing segment to a vertical ready station alongside the mast. The transfer arm is then rotated by a hydraulic motor mounted at its base, swinging the drill-casing segment from the ready station to a drive position over the well where it is connected to the drive unit.

5 Claims, 9 Drawing Figures



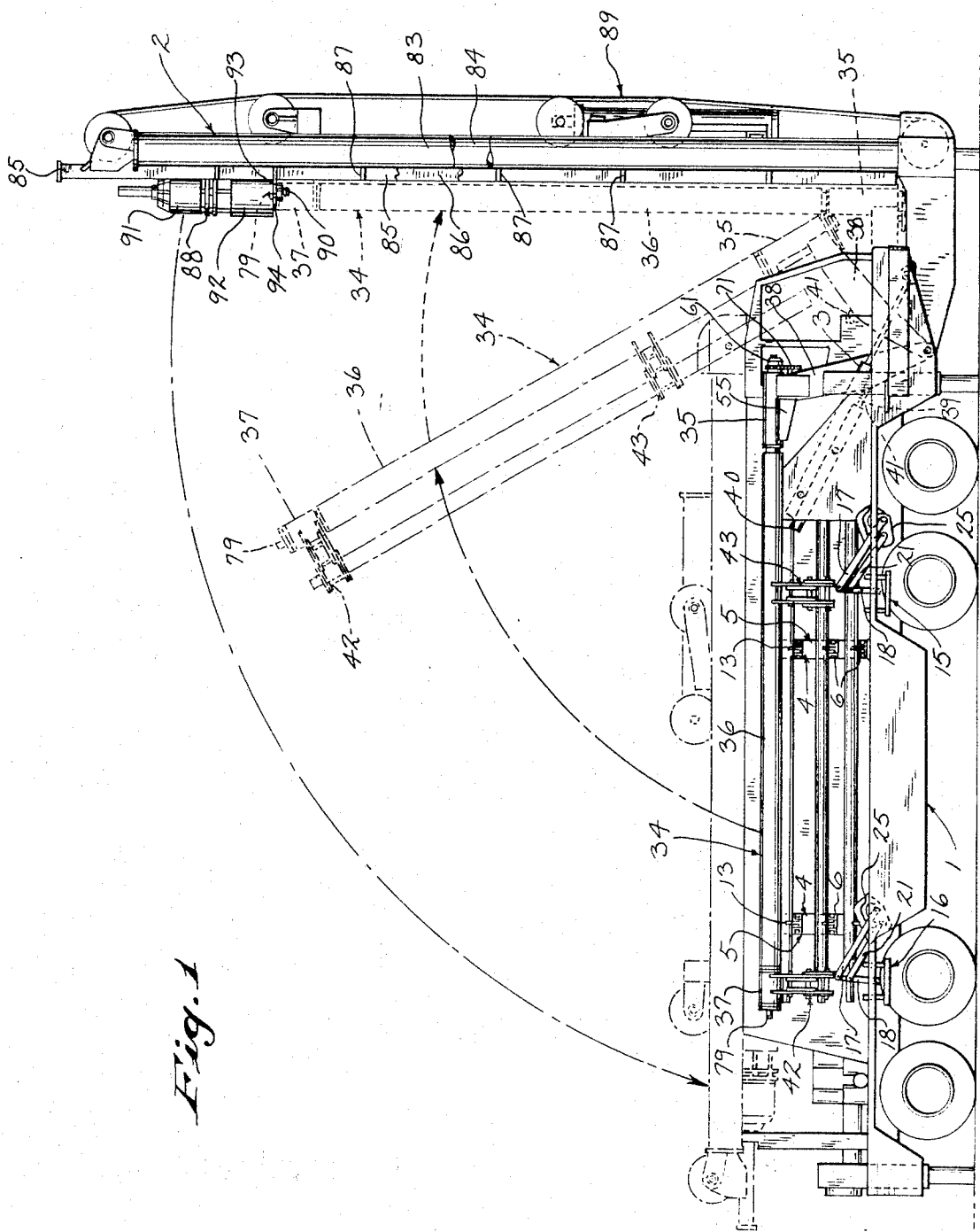
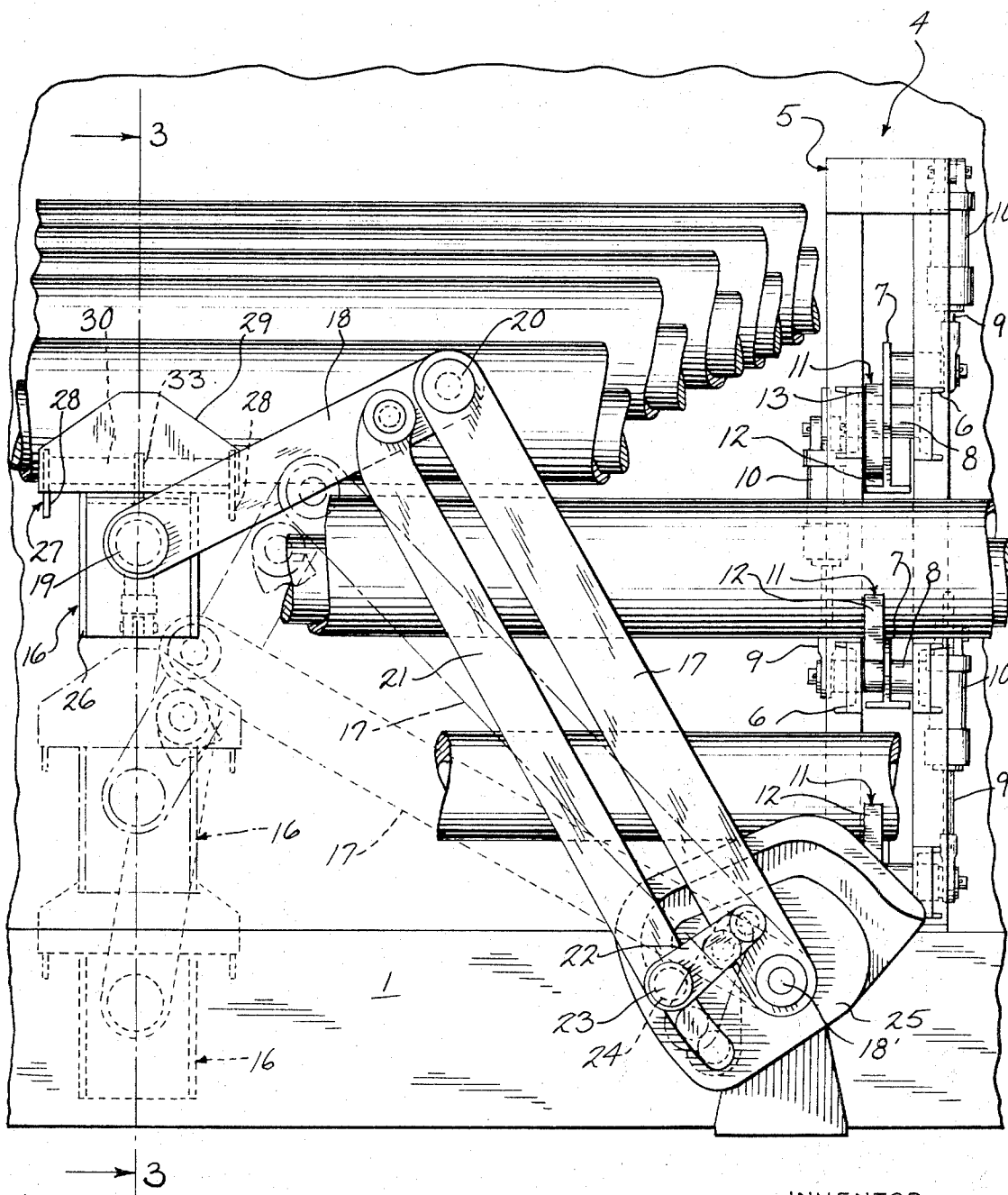


Fig. 1

INVENTOR
GEORGE E. OTTO

BY
Barry C. Sammons
ATTORNEY

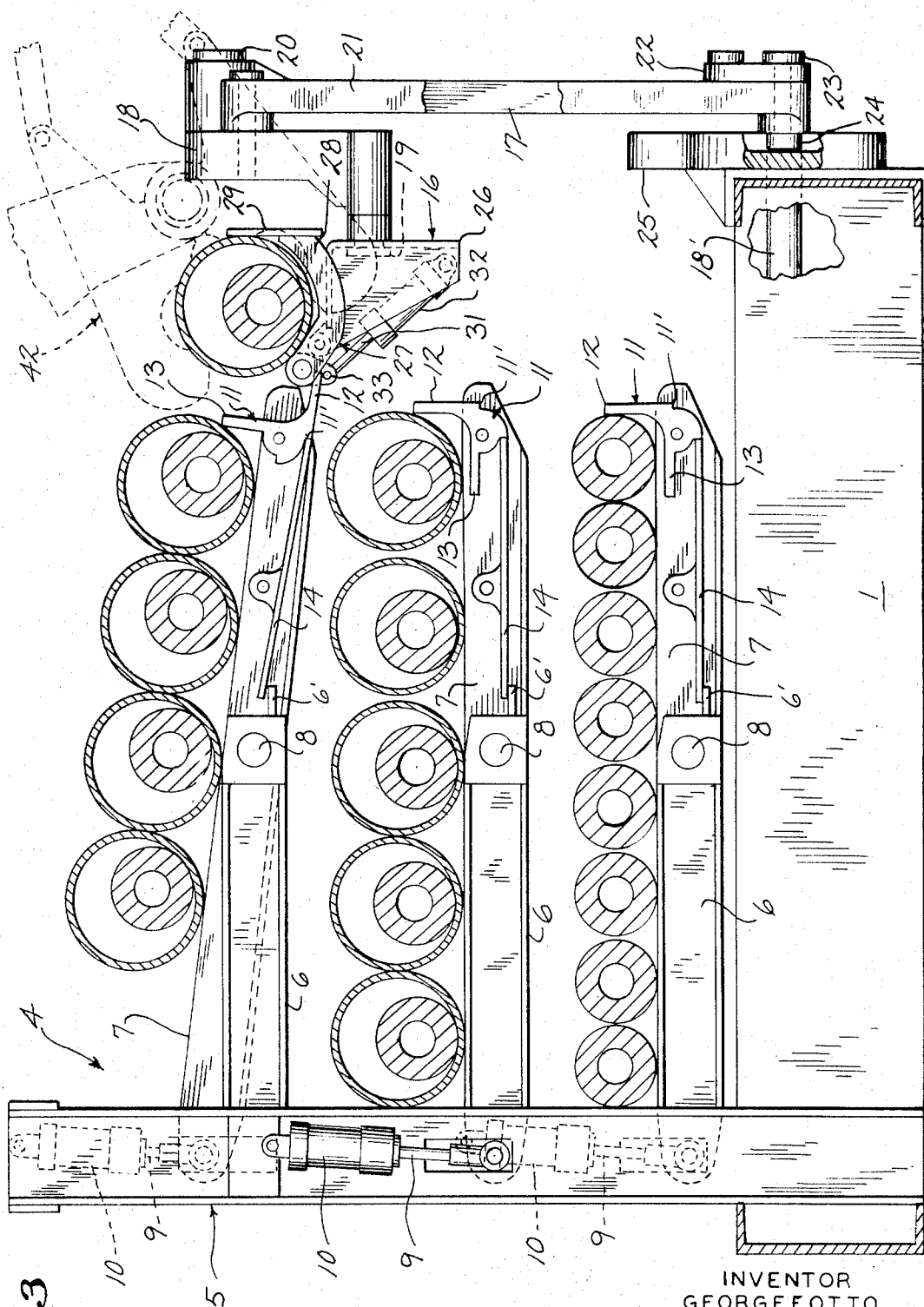
Fig. 2



INVENTOR
GEORGE E. OTTO

BY

Barry & Sammons
ATTORNEY



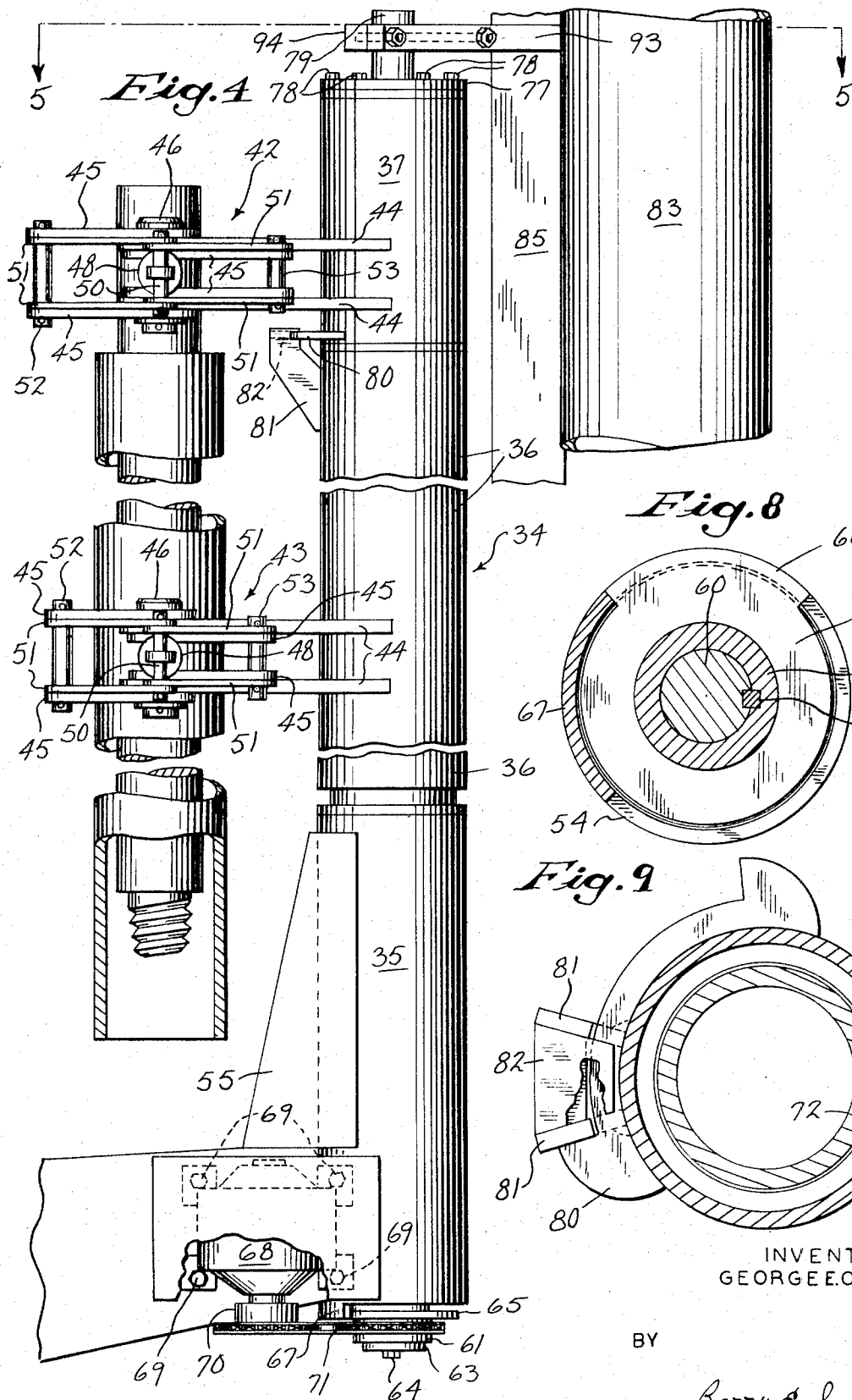
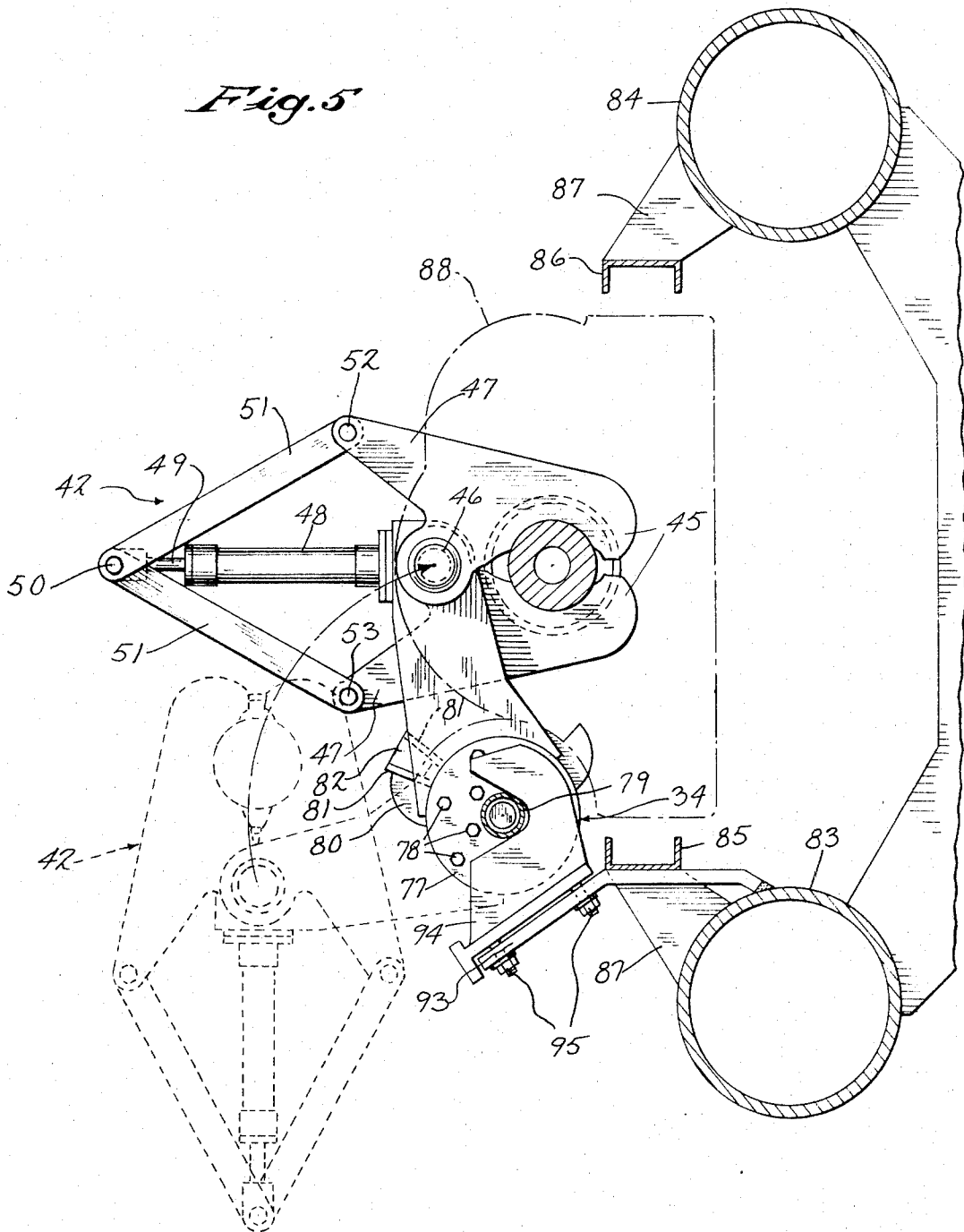


Fig. 5



INVENTOR
GEORGE E. OTTO

BY

Barry & Sammons
ATTORNEY

WELL DRILL TRANSFER MECHANISM

BACKGROUND OF THE INVENTION

The field of the invention is drilling machines used to drill water, gas, and oil wells, in formations of the type requiring the insertion of a casing into the well to prevent the sides of the well from collapsing and, or prevent the entrance of contaminants into the well.

In the present drilling operations it is standard practice to first drill the well and then insert the casing. Drill pipe segments are successively raised to vertical, attached to the preceding drill pipe segment and driven downward by a rotary drive unit. When drilling is completed, the drill pipe is removed from the well and casing segments are successively raised to the vertical, joined together and lowered into the well.

The method and apparatus presently used to drill wells is both time consuming and costly. To drill the well, individual drill pipe segments are hoisted up to the vertical drill mast by means of a block and tackle arrangement. They are then either used immediately or as disclosed in U.S. Pat. No. 3,212,593, are stored with several other drill pipe segments in the vertical position, from which position they are easily transferred for subsequent use. In either case, drilling is repeatedly stopped each time it is necessary to raise drill pipe segments to the vertical and attach them to the preceding drill pipe segment. When the desired depth is reached, the procedure is reversed by withdrawing the drill string from the well and detaching drill pipe segments. Repeated delays are again encountered as drill pipe segments are detached and lowered from the mast back to their storage position. After the drill string is completely removed, individual casing segments are successively hoisted to the vertical, as was done in the drilling procedure, and inserted into the well.

SUMMARY OF THE INVENTION

The present invention comprises an apparatus for transferring drill pipe segments, each accompanied by a surrounding casing segment, from a storage rack to a vertical drilling position directly over the well. The transfer mechanism includes a means of selecting and removing a drill-casing segment from the storage rack; carriage means for receiving the selected drill-casing segment and placing it in a pick station; and a transfer arm pivotally attached to the truck near the base of the drill mast operable to grasp the selected drill-casing segment in the pick station, hoist it to a vertical ready station adjacent the drill mast, and swing the drill-casing segment from the ready station to the drilling position directly over the well.

The transfer arm includes a pedestal portion which pivotally attached to the truck, a body portion rotatably attached to the pedestal, and a cap portion rotatably attached to the body and forming the top end of the transfer arm. A lower mandible attached to the body of the transfer arm grasps the casing segment and an upper mandible attached to the cap portion of the transfer arm grasps the drill pipe segment. Rotation of the transfer arm body swings both mandibles, moving the drill-casing segment from the ready station to the drilling position.

A general object of the invention is to provide a means of selecting a drill-casing segment from a storage rack on the truck and transferring the combined seg-

ments to a vertical drive position directly over the well and under the drive unit.

Another object of the invention is to provide a transfer means to accomplish the method disclosed in the co-pending application Ser. No. 173,522 and entitled "Well Drilling Method." More particularly, the invention provides a means of simultaneously transferring a drilling segment with a surrounding casing segment from a storage rack on the truck to a vertical ready station alongside the mast where it will not interfere with the drilling operation and is in position for rapid transfer to the drive unit.

Still another object of the invention is to provide a means of rapidly transferring the drill-casing segment from the ready station to the drilling position, retaining the drill-casing segment in this position while it is being attached to the drive unit, releasing the drill-casing segment upon command, and swinging clear when the transfer is completed.

Still another object of the invention is to provide a transfer arm which will retain the drill-casing segment in the drive position until it is attached to a drive unit such as the drive unit disclosed in the co-pending application Ser. No. 173,523 and entitled "Drilling Apparatus." The drill pipe segment is held by the upper mandible which operates to release the drill pipe segment and swing clear after its attachment to the drive unit, while the lower mandible separately holds the casing segment until its subsequent attachment to the drill unit.

A further object of the invention is to provide a means of rapidly transferring drill pipe segments from a vertical drive position to a storage rack.

The foregoing and other objects and advantages of the invention will appear from the following description. In the description reference is made to the accompanying drawings which form a part hereof, and in which there is shown by way of illustration and not of limitation a preferred embodiment of the invention. Such embodiment does not represent the full scope of the invention, but rather the invention may be employed in many different embodiments, and reference is made to the claims herein for interpreting the breadth of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a view in elevation of a drilling rig incorporating the transfer mechanism of the present invention,

FIG. 2 is a partial view in elevation of the storage rack and unloading means which form a part of the present invention,

FIG. 3 is a view in cross section of the storage rack and unloading means of FIG. 2 taken on the plane 3—3,

FIG. 4 is a partial view in elevation of a transfer arm which forms a part of the present invention,

FIG. 5 is a view in cross section of the transfer arm of FIG. 4 and the mast taken on the plane 5—5,

FIG. 6 is a view in elevation with parts cut away of the lower end of the transfer arm of FIG. 4,

FIG. 7 is an elevation view with parts cut away of the top end of the transfer arm of FIG. 4,

FIG. 8 is a view in cross section of the lower end of the transfer arm of FIG. 6 taken on the plane 8—8, and

FIG. 9 is a view in cross section of the top end of the transfer arm of FIG. 7 taken on the plane 9—9.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A mobile drilling rig incorporating the transfer mechanism of the present invention is shown in FIG. 1. The rig includes a wheeled truck 1 having a mast 2 attached to the front of the truck 1, and driven by a pair of hydraulic cylinders 3 between an upright drilling position and a horizontal traveling position (shown in phantom in FIG. 1). The drilling rig is described more fully in the co-pending application Ser. No. 173,519 and entitled "Mobile Drilling Unit."

Located on the top right side of the truck 1 is a storage rack 4 containing drill and casing segments. When ready for use, each drill segment is inserted into a casing segment with a portion of the drill exposed out the back or top end of the casing segment. The storage rack 4 is comprised of identical fore and aft supporting structures which support the stored drill-casing segments.

Referring to FIGS. 2 and 3, the two supporting structures of the storage rack 4 each include an upright base portion 5 firmly attached to and extending upward from the bed of the truck 1. Three tiers are formed on each structure by three brackets 6 which attach and extend outward from each base 5 in cantilevered fashion. Pivotaly attached to the end of each bracket 6 is a rocker arm 7. Each attachment is secured by means of a pin 8 passed through a hole in the end of the bracket 6 and through a hole located at the midpoint of the attached rocker arm 7. The outer end of each rocker arm 7 extends well beyond the outer end of its supporting bracket 6, and its other end extends into the interior of the base 5 where it connects to a rod 9 associated with one of six unload cylinders 10. The blind end of each cylinder 10 is pivotaly attached to the base 5 and each cylinder 10 is operable to raise or lower the inner end of its attached rocker arm 7 causing it to tilt. The unload cylinders 10 are hydraulically operated in pairs, one on each supporting structure of the store rack 4, and both on the same tier, thus discharging a drill-casing segment stored on the tier by rolling it off the outer end of the rocker arms 7, or receiving drill pipe segments loaded onto the outer end of the rocker arms 7.

To prevent the discharge of an entire supply of drill-casing segments on a tilted tier, a retainer 11 is rotatably attached to the outer end of each rocker arm 7. As shown in FIG. 3, the retainers 11 each have two arms 12 and 13 extending radially outward at a 90 degree angle. A trip bar 14 is rotatably attached to the side of the rocker arm 7 and operates against a ratchet 11' on the retainer 11 to prevent its rotation when the rocker arm 7 is level. The arm 12 extends upward to retain the stored drill-casing segments on the storage rack 4. When the rocker arm 7 is tilted, the trip bar 14 is rotated by a flange 6' extending from the end of the bracket 6 and the retainer 11 is allowed to rotate 90° as the outboard drill-casing segment rolls off, bringing the arm 13 into an upright attitude. One drill-casing segment is thus allowed to roll off and the rest are retained by the upright arm 13. A bias spring (not shown) rotates the retainer 11 back to its cocked position when the rocker arm 7 is again leveled.

As shown in FIGS. 2 and 3, the selected drill-casing segment is discharged from the storage rack 4 onto fore and aft carriages 15 and 16. The carriages 15 and 16

are each supported and positioned by a crank arm 17 which forms one side of a parallelogram linkage. The lower end of each crank arm 17 is rotatably attached to the right side of the truck bed 1 and each is securely fastened to a drive shaft 18' which extends underneath and across the truck bed 1, and is rotated by a hydraulic motor (not shown in the drawings). Connection of the carriages 15 and 16 are identical and consequently only the connection of the after carriage 16 will be described herein. The carriage 16 is rotatably connected to the end of a carriage arm 18 by means of a pin 19. The other end of the carriage arm 18 is rotatably connected to the top end of the crank arm 17 by a pin 20 and forms a second side of the parallelogram linkage. The top end of a cam arm 21 is rotatably connected to the carriage arm 18 intermediate its ends and forms the third side of the parallelogram opposite the crank arm 17. A cam linkage 22 is rotatably connected to both the crank arm 17 a short distance above the latter's connection to the drive shaft 18' and to the bottom end of the cam arm 21 to form the fourth side of the parallelogram. The connection of the cam arm 21 to the cam linkage 22 is provided by a pin 23, the inboard end of which is enlarged to form a cam follower 24. The cam follower 24 is retained within a curved groove formed in the outboard side of a cam 25. The cam 25 is securely mounted to the truck bed 1, inboard and at the base of the crank arm 17.

The crank arms 17 are rotated by the drive shafts 18', and the carriages 15 and 16 are translated vertically to one of three unload positions outboard and slightly below the tiers of the storage rack 4. As the crank arms 17 pivot about their lower ends, the cam followers 24 are guided along the grooves in the cams 25 and the action of the parallelogram linkage causes the carriage arms 18 to swing about their rotational connection with the top ends of the crank arms 17 to impart a vertical motion to the carriages 15 and 16.

The carriages 15 and 16 are not only designed to receive the unloaded drill-casing segments, but are also designed to reload the drill segments withdrawn from the well at the completion of drilling. Referring again to FIGS. 2 and 3 showing the after carriage 16, it includes a frame 26 rotatably connected to the end of the carriage arm 18 by the pin 19. A cradle 27 formed by spaced, parallel, crescent-shaped arms 28 welded to a side plate 29 is pivotaly attached to the top of the carriage frame 26. The inboard ends of the cradle arms 28 (the ends opposite the side plate 29) are joined by a bar 30, which bar 30 is connected to the rod 31 of a load cylinder 32 by a link 33. The blind end of the cylinder 32 is pivotaly attached to the carriage frame 26. When the rod 31 is fully extended the cradle 27 rests on top of the carriage frame 26 in a position to receive and hold a drill-casing segment. When the cylinder 32 is operated the rod 31 is retracted pulling the inboard ends of the cradle arms 28 downward, causing the outboard ends and side plate 29 to swing upward around its pivotal connection with the carriage frame 26 to reload a drill segment onto an adjacent tier of the storage rack 4.

A selected drill-casing segment is raised from its horizontal position on the carriages 15 and 16 to a vertical ready station alongside the mast 2 by a transfer arm 34. As shown in FIGS. 1 and 4, the transfer arm 34 is comprised of three cylindrical-shaped sections one on top of the other; a pedestal section 35, a body section 36,

and a cap section 37. A pivot arm 38 is fastened to the pedestal section 35 and extends substantially perpendicular from the axis of the transfer arm 34. The end of the pivot arm 38 rotatably attaches to the front of the truck bed 1, and a rod 39 of a hydraulic cylinder 40 is rotatably attached to a flange 41 extending upward from the pivot arm 38 intermediate its ends. The cylinder 40 is trunion mounted between a pair of ears extending upward from the truck bed 1. Actuation of the hydraulic cylinder 40 pivots the transfer arm 34 from a horizontal pick position to a vertical ready position, the latter position shown in phantom in FIG. 1.

As shown in FIGS. 1, 4 and 5, the drill and casing segments are picked up by means of an upper mandible 42 attached to the cap section 37, and a lower mandible 43 attached to the body section 36. The drill and casing segments are manually aligned in the storage rack 4 such that when they are unloaded onto the carriages 15 and 16 and raised to the pick station, the upper mandible 42 grasps the top end of the drill segment and the lower mandible 43 grasps the lower end of the casing segment. The mandibles 42 and 43 are of identical construction and are each attached to the transfer arm 34 by means of two spaced, parallel brackets 44 extending radially outward from the transfer arm 34. Two pairs of jaws 45 are rotatably connected to the ends of the brackets 44 by means of a king-pin 46. Each pair of jaws 45 has a mouth formed by opposing concave surfaces which clamp tightly around a drill or casing segment. Each jaw 45 has an integral lever arm 47 which extends away from the jaw mouth and radially outward from the king-pin 46. The blind end of a clamping cylinder 48 is securely fastened to the brackets 44 and extends radially outward from the king-pin 46 on the side directly opposite the center of the jaw mouth. Its rod 49 connects to an apex pin 50. Four links 51 extend from the apex pin 50 to the ends of the four lever arms 47. Two of the links 51 extend along one side of the cylinder 48 and attach to two of the lever arms 47 by means of a hinge pin 52, and the other two links 51 extend along the opposite side of the cylinder 48 and attach to the other two lever arms 47 by means of a second hinge pin 53. When the rod 49 is extended from the cylinder 48, the links 51 act to swing the lever arms 47 about the king-pin 46 thus opening the jaws 45 and releasing the casing or drill segment retained in them. Conversely, when the apex pin 50 is drawn towards the king-pin 46 by the clamping cylinder 48, the jaws 45 are closed to tightly grasp a drill or casing segment passing through their mouth.

Referring to FIGS. 4 and 6, the pedestal section 35 of the transfer arm 34 is constructed of a sleeve 54 securely welded to the end of the pivot arm 38 and braced substantially perpendicular thereto by means of a plate 55. Attached and contained within the sleeve 54 is a swing shaft 56 rotatably mounted by means of an upper bushing 57 and a lower bushing 58. The swing shaft 56 includes an enlarged crown portion 59 which extends above the top edge of the sleeve 54 and extends into the lower end of the body section 36 to which it is welded. The lower edge of the crown portion 59 rests on the top edge of the upper bushing 57.

As shown in FIGS. 4, 6 and 8, the lower end of the swing shaft 56 is constricted to form a drive shaft 60 which extends out the lower end of the sleeve 54. A sprocket 61 fits tightly around the drive shaft 60 and is secured in place by a key 62 and a retainer cap 63 fas-

tened to the bottom end of the drive shaft 60 by a cap screw 64. Welded to the shaft 60 and sprocket 61, directly above the sprocket 61, is a limit flange 65. As shown best in FIG. 8, the limit flange 65 has a circular rim with a tab 66 extending radially outward therefrom over a 90 degree sector. The limit flange 65 is aligned axially such that its tab 66 clears the bottom edge of the sleeve 54 but engages a swing stop 67 formed by a downward extension of the sleeve 54 over a 90 degree sector of its circumference.

The swing shaft 56 is rotated by a hydraulic swing motor 68 securely fastened to the side of the pivot arm 38 by bolts 69. The swing motor 68 faces downward and rotates a drive sprocket 70. A drive chain 71 links the drive sprocket 70 to the sprocket 61 on the shaft 60.

Referring to FIGS. 4 and 7, the lower end of the sleeve-like body section 36 is securely fastened to the crown 59 of the swing shaft 56, and its top end is constricted to form a neck 72. The cap section 37 of the transfer arm 34 slides over the neck 72 and rests on the shoulder formed by the constriction in the body section 36. A pair of bushings 73 surround the neck 72 and provide a rotary connection between the body section 36 and the cap section 37.

The cap section 37 is rotated with respect to the body section 36 by a hydraulic motor 74 located in the cap section 37. The motor's shaft 75 extends downward through, and attaches to, an annular plate 76 welded into the top end of the body section neck 72. The frame of the hydraulic motor 74 is bolted to a cover 77 attached to the top end of the cap section 37 by means of a bolt 78. A sleeve-like dowel 79 is welded to the cover 77 and extends upward, out the top of the transfer arm 34.

Actuation of the hydraulic motor 74 rotates the cap section 37 independently of the body section 36. As shown in FIGS. 4, 7 and 9, a limit tab 80 is welded to the outside of the cap section near its lower end. The limit tab 80 has a recessed portion which forms a notch that runs nearly its entire length — roughly 110°. A pair of ears 81 are welded to the outside of the body section 36 near its top end and spaced roughly 30° apart. The ears 81 extend upward above the limit tab 80 and ride in the notch thereof when the cap section 37 is rotated. The ears 82 serve as stops which limit the rotation of the cap section 37. A web 82 is welded to and extends between the ears 81 to strengthen them.

As shown in FIGS. 1, 4 and 5, the mast 2 includes two tubular stanchions 83 and 84 connected together in spaced parallel relationship. Extending along the length of each stanchion 83 and 84 are tracks 85 and 86. Each track 85 and 86 is rigidly attached to its respective stanchion 83 and 84 by a plurality of spaced brackets 87. The tracks 85 and 86 run parallel to one another and have a channel-shaped cross section with the open side of each facing the other. A drive unit 88 is propelled along the tracks 85 and 86 by a standard rope and pulley feed assembly 89 attached to the mast 2.

The drive unit 88 has a spindle 90 adapted for attachment to the top end of a standard drill segment. The spindle 90 extends downward from the drive unit 88 and is rotated by a hydraulic motor located in a rotary drive section 91. The drive unit 88 includes a power chuck section 92 suspended below the rotary drive section 91 and around the spindle 90. The chuck section 92 is operable to grasp the upper end of a casing seg-

ment held directly underneath and around the previously attached drill segment. For a detailed description of the structure and operation of the drive unit 88 see the co-pending application Ser. No. 173,523 and entitled "Drilling Apparatus."

Referring to FIGS. 4 and 5, a bracket 93 is welded to the stanchion 83 and track 85 and a brace plate 94 is fastened to the bracket 93 by means of bolts 95. The brace plate 94 contains a V-shaped notch aligned to receive the dowel 79 when the transfer arm 34 is raised to its vertical ready position. The brace plate 94 provides support for the upper end of the transfer arm 34 and brings its top end into alignment with respect to the axis of the drive unit spindle 90. Thus when the mandibles 42 and 43 are swung and the attached drill-casing segment is moved from the ready station to the drilling position, they are aligned directly under the spindle 90.

OPERATION

As shown in FIG. 3, when a drill-casing segment is to be removed from the storage rack 4, the fore and aft carriages 15 and 16 are translated to an unload position slightly below the tier upon which the selected drill-casing segment is located. The unload cylinders 10 for that tier are then operated to tilt the rocker arms 7 and the retainers 11 rotate 90 degrees releasing one drill-casing segment off the ends of the rocker arms 7.

The unloaded drill-casing segment is received and held by the fore and aft carriages 15 and 16. The crank arms 17 are then rotated in a clockwise direction, translating the carriages 15 and 16 upward to place the drill-casing segment in the pick station where it can be reached by the mandibles 42 and 43 on the transfer arm 34. In the preferred embodiment the pick station is also the unload position for the top tier of the storage rack 4. Rotating the crank arms 17 beyond this position not only raises the carriages 15 and 16, but the cams 25 are shaped to also translate them towards the front of the truck 1 to align the protruding top end of the drill segment with the jaws 45 of the upper mandible 42.

After the drill-casing segment is placed in the pick station, the hydraulic swing motor 68 at the base of the transfer arm 34 is actuated to swing the upper and lower mandibles 42 and 43 downward around the drill-casing segment as shown in phantom in FIG. 3. The clamping cylinders 48 on the mandibles 42 and 43 are then actuated to close the jaws 45 around the drill and casing segments. As shown in FIGS. 1 and 4, the transfer arm 34 is erected to the vertical ready position by extending the rod 39 of the hydraulic cylinder 40. The upper end of the transfer arm 34 is guided into its final ready position by the brace plate 94 and is hydraulically locked in place.

The entire procedure outlined above is accomplished while the drive unit 88 is inserting the previous drill-casing segment in the well. As shown in FIG. 5, the transfer arm 34 retains the selected drill-casing segment in a ready station (shown in phantom lines) clear of the drive unit 88. When the preceding drill-casing segment is completely inserted in the well, the drive unit 88 is detached and hoisted to the top of the mast 2 for connection to the drill-casing segment awaiting in the ready station.

Connection of the drill-casing segment to the drive unit 88 is accomplished first by actuating the hydraulic swing motor 68 to bring the drill-casing segment to the drilling position directly under the spindle 90. The

drive unit 88 is lowered and the spindle 90 rotated to attach itself to the upper end of the drill segment. The clamping cylinder 48 on the upper mandible 42 is then actuated to open the jaws 45 and release the drill segment. The hydraulic motor 74 is operated to rotate the cap section 37, swinging the upper mandibles 42 clear of the drive unit 88. The drive unit 88 is again lowered to attach the upper end of the casing segment to the power chuck section 92. The lower mandibles 43 then release the casing segment and the swing motor 68 is operated to swing the lower mandibles 43 clear of the drive unit 88 so that drilling can commence. Finally, the motor 74 is again actuated to swing the upper mandibles 42 back into alignment with the lower mandibles 43 so another drill-casing segment can be picked up while the discharged one is inserted in the well.

When drilling is completed the drill string is hoisted and segments are detached and transferred back to the storage rack 4. The upper and lower mandibles 42 and 43 are positioned by the motor 74 to grasp a detached drill pipe segment held by the drive unit 88. The drill segment is swung clear of the drive unit 88 and lowered down onto the carriages 15 and 16 awaiting in the pick position. The carriages 15 and 16 translate to one of the unload positions adjacent the storage rack 4 and the load cylinders 32 are actuated to lift the drill segment upward and onto the adjacent storage rack tier. This procedure is accomplished concurrently with the hoisting of another drill segment and the return of the transfer arm 34 to the ready position.

I claim:

1. A transfer mechanism for simultaneously transporting a drill and a surrounding casing segment from a storage position on the drilling rig to a drilling position beneath a drive unit mounted on an upright drilling rig mast, the combination comprising:

selection means on the drilling rig for removing a drill-casing segment from its storage position and placing it in a pick station; and

a transfer arm pivotally attached to the drilling rig and operable to pick the selected drill-casing segment and raise it to a ready station alongside the upright drilling rig mast, said transfer arm also being operable to swing the selected drill-casing segment from the ready station to said drilling position where the drill-casing segment is attached to a drive unit,

wherein the transfer arm includes:

a pedestal section pivotally connected to the drilling rig;

a body section rotatably connected to the pedestal section;

a cap section rotatably connected to the body section;

lower mandibles connected to the body section and operable to grasp a casing segment;

upper mandibles connected to the cap section and operable to grasp a drill segment;

swing drive means connected to the transfer arm and operable to rotate the body and cap sections with respect to the pedestal section to transfer the drill-casing segment from the ready station to the drilling position; and

second drive means connected to the transfer arm and operable to rotate the cap section with respect to the body section to swing the upper mandibles clear of the drive unit.

2. A transfer mechanism for simultaneously transporting a drill and a surrounding casing segment from a storage position on the drilling rig to a drilling position beneath a drive unit mounted on an upright drilling rig mast, the combination comprising:

selection means on the drilling rig for removing a drill-casing segment from its storage position and placing it in a pick station; and

a transfer arm comprised of tubular shaped sections connected end to end and including;

a pedestal section pivotally connected to the drilling rig and having an upper end,

a body section having a lower end rotatably connected to the upper end of the pedestal section,

mandibles connected to the body section and being operable to grasp the selected drill-casing segment, and

swing drive means connected to the transfer arm and being operable to rotate the body section with respect to the pedestal section,

wherein said transfer arm is operable to pivot in a vertical plane between said pick station and a ready station alongside said upright drilling rig mast to pick up the selected drill-casing segment and raise it to said ready station, and wherein said swing drive means is operable to swing the selected drill-casing segment from the ready station to said drilling position.

3. The transfer mechanism as recited in claim 2 wherein the selection means includes:

a multiple tiered storage rack on said drilling rig operable to discharge a drill-casing segment from one

of its tiers; and

carriage means connected to said drilling rig and being operable to move to a selected unload position adjacent said storage rack to receive a drill-casing segment discharged from a tier of the storage rack, and to transfer said discharged drill-casing segment to the pick station.

4. The transfer mechanism as recited in claim 3 in which said storage rack includes a pair of spaced upright base portions which rigidly fasten to said drilling rig, and each tier includes:

a pair of spaced brackets, each rigidly fastened to one of said base portions and extending outward therefrom in cantilevered fashion;

a pair of spaced rocker arms, each pivotally connected to one of said brackets for motion in a vertical plane; and

a pair of unload cylinders, each connected to one of said base portions and its associated rocker arm, wherein a stored drill-casing segment is disposed on said spaced rocker arms and it is removed from storage by the operation of said unload cylinders which tilt said rocker arms to allow said stored drill-casing segment to roll off said tier.

5. The transfer mechanism as recited in claim 3 in which said carriage means includes a pair of spaced carriages each connected through drive means to said drilling rig and each is operable to move in a vertical plane adjacent the storage rack between unload positions adjacent each tier of the storage rack and a pick station.

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