Jan. 14, 1936. A. E. JOHNSON 2,027,734

ROTARY WELL DRILLING APPARATUS

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Fig. 1.

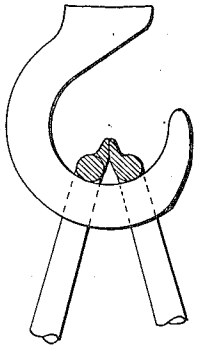
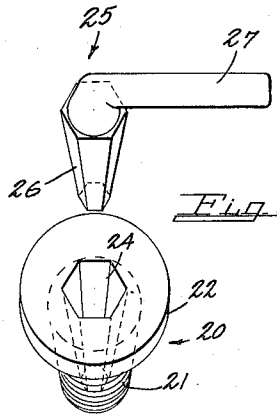
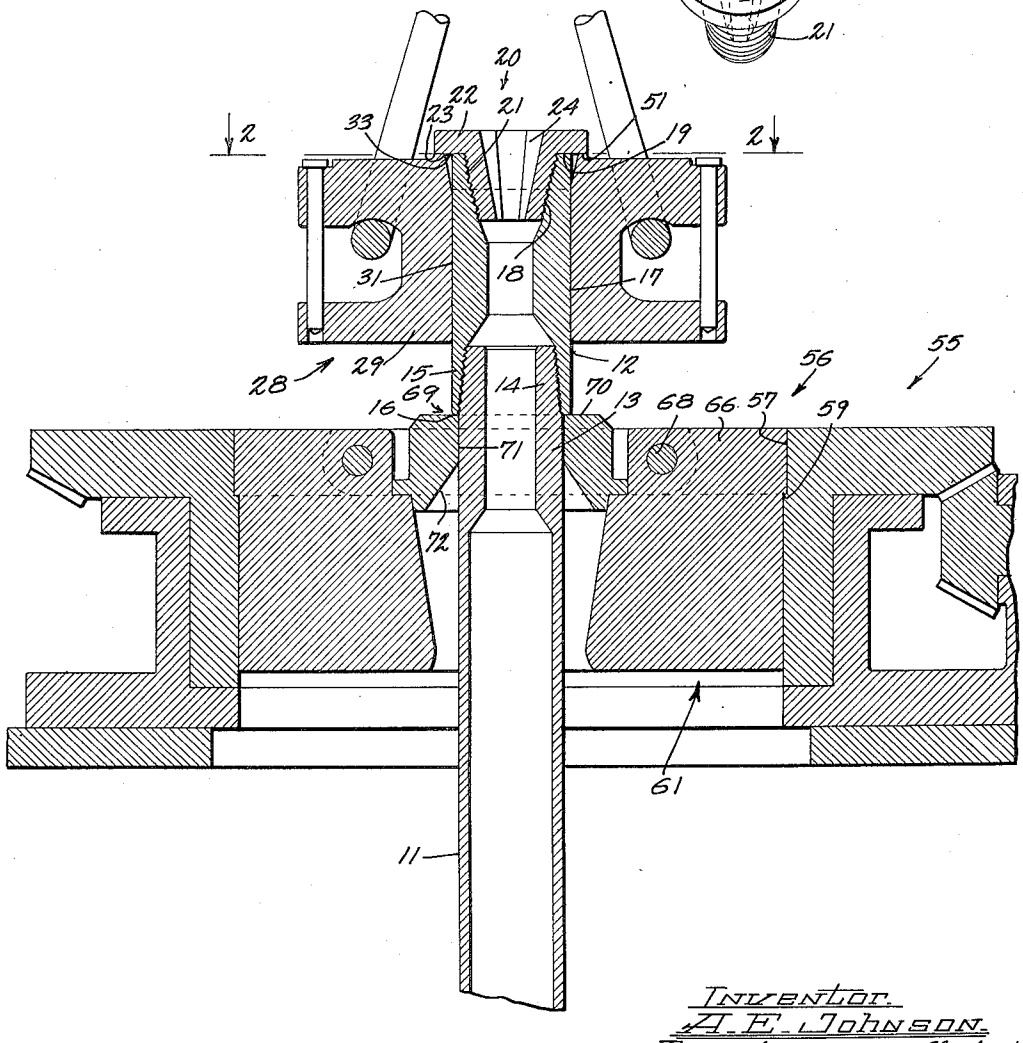


Fig. 3.





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Fig. 2.

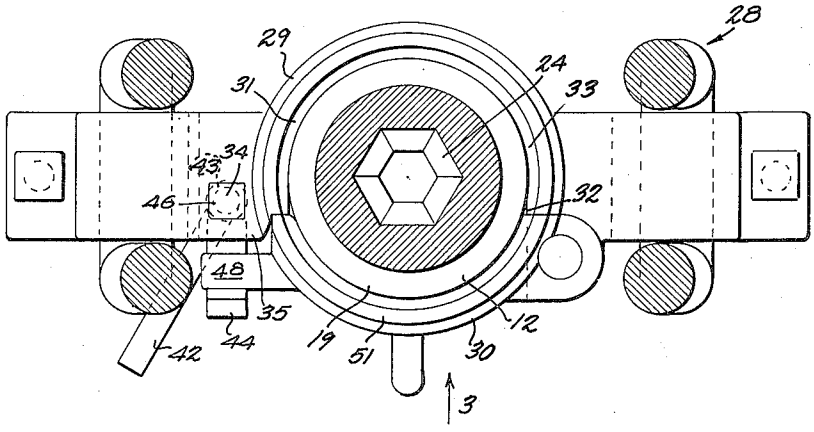


Fig. 3.

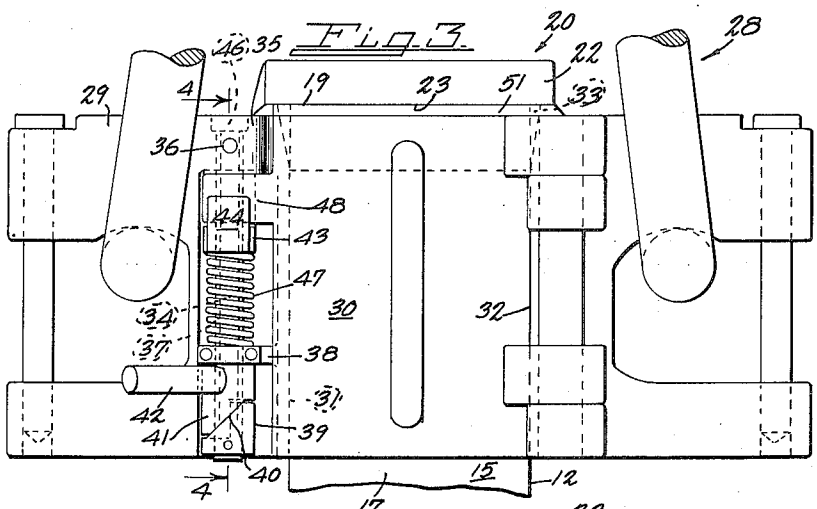
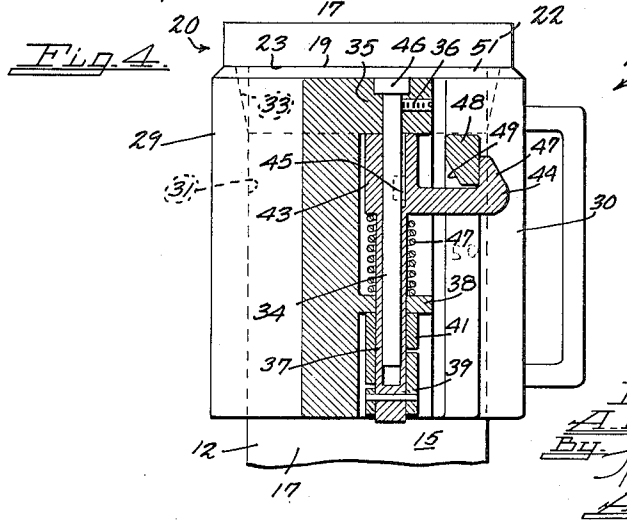


Fig. 4.



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Fig. 6.

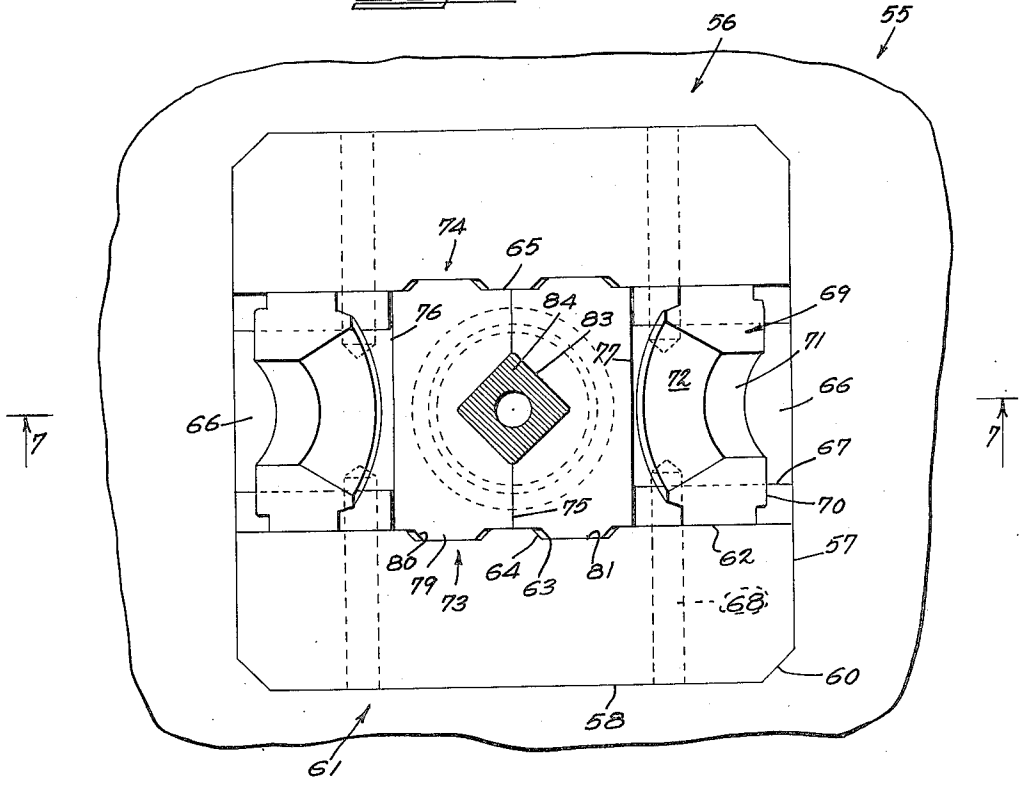
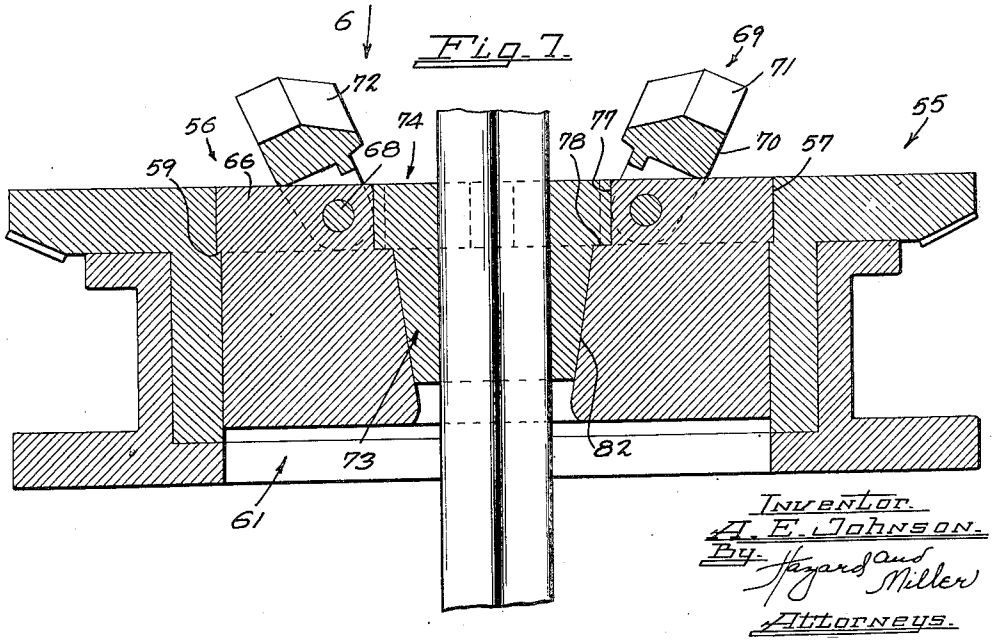


Fig. 7.



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Fig. 8.

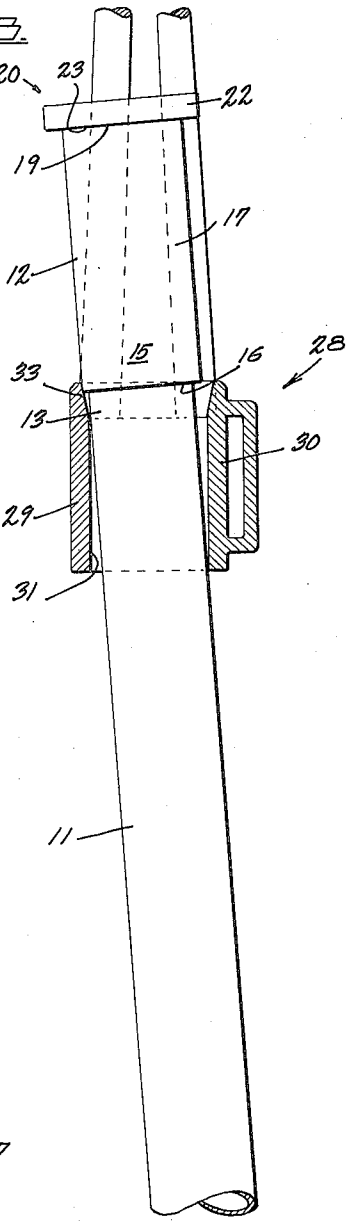


Fig. 9.

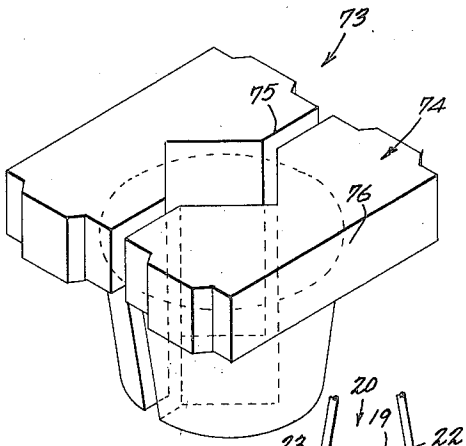
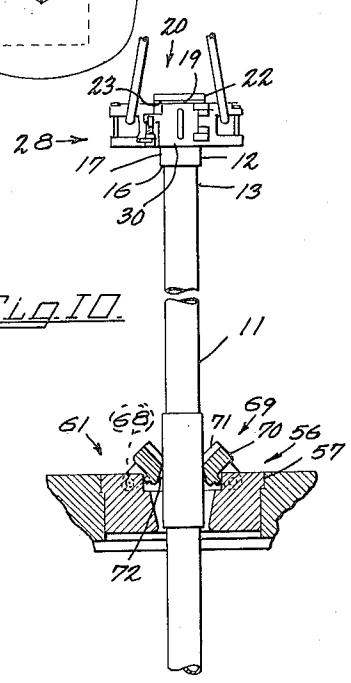


Fig. 10.



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UNITED STATES PATENT OFFICE

2,027,734

ROTARY WELL DRILLING APPARATUS

Arthur E. Johnson, Taft, Calif., assignor of one-half to Hazard & Miller, Los Angeles, Calif., a partnership composed of Herman Miller and Fred H. Miller

Application April 28, 1932, Serial No. 607,989

23 Claims. (Cl. 255—28)

My invention relates to different features in connection with rotary well drilling apparatus in which the drill string is supported while being lowered and raised from a well by a positive and non-frictional support, that is, distinguishing from the type of slips which engage the drill pipe by a frictional action. This latter type of support is detrimental to the pipe, and on account of injury to the pipe, to a certain extent prohibits the drilling of deep wells. My invention may be considered as a further development of my patent application filed December 25, 1930, for Rotary well drilling apparatus, Serial No. 504,661, matured to Patent No. 1,983,545, issued December 11, 1934.

This case in one feature of my invention, that is, relating to the running in and pulling out of the drill string, supports the string in the rotary table or master bushing by lugs which engage a right angular shoulder, such shoulder being transverse to the axial line of the drill string. In order that the elevator may ride upwardly over such transverse shoulder I form the elevator with an internal beveled passage, the bevel riding up over the squared shoulder when the elevator is latched on the pipe to engage a right angular elevator shoulder.

An object and feature of my invention to obtain the simplified construction is to use a tool joint coupling with a squared transverse shoulder at the bottom, this being utilized for supporting a drill string by means of tiltable lugs in a master bushing and the elevator shoulders are formed on a removable plug which fits in the upper box of the tool joint. This plug has a lateral flange which may be engaged by the elevator, such flange forming an elevator shoulder. The plug is designed so that it may be readily threaded in and out of the tool joint, and in running in the well the plugs are removed from the tool joint supported on the rotary table when another stand is being connected to the drill string. When the drill string is being removed from the well the plugs may be left in the tool joint while the stands are stacked in the well derrick.

Another feature of my invention in regard to the plugs is forming these with an irregular, such as an hexagonal, tapered interior to be engaged by a wrench having a lever handle of suitable length. This wrench allows ready screwing up and unscrewing of the plug from the tool joint.

Another feature of my invention relates to the elevator used in connection with the tool joint and the special plug. This elevator has a beveled or flared upper inner edge, that is, on the upper edge of the vertical passage through the elevator, this flare or bevel being sufficient to permit the elevator to slide upwardly over the squared transverse shoulder tool joint. Such bevel should be sufficient to engage the outside of the tool joint when the stand of drill pipe is at an angle to the vertical as when stacked in a derrick and the elevator is swung to one side of the derrick to engage the string for hoisting and running the stand in the well. This bevel or flare is formed so that when the lower part of the elevator engages a drill pipe having a tool joint coupling secured to the top thereof the flared or beveled portion is forced outwardly allowing the elevator to ride upwardly over the tool joint to engage the plug which is threaded therein at the upper end.

Another feature of my invention in relation to the elevator is in the construction of the gate or door and latch for the gate. The gate is mounted on a vertical hinge pin, and a sliding latch hook upwardly pressed by a spring is used to engage a latch arm on the gate to hold the gate in a locked position. This latch hook may be positively raised and lowered by a cam block rotating on a vertical axis and turned by a horizontally moving handle, this cam block causing the downward retraction of the latch hook and compressing the spring of the latch. This construction also provides for latching of the gate by slamming the gate closed. In this action the latch arm on the gate forces the latch hook downwardly until the hook engages the outside of the arm. The hook then secures the arm with the gate in its closed position.

Another feature of my invention relates to the type of Kelly bushing and the master bushing used together in the rotary table. In order to reduce the number of surfaces which require to be machined and to prevent both the master bushing and the Kelly bushing from being worn out of shape due to the intermittent torque stresses transmitted between the master bushing and the Kelly bushing, I provide both of these with comparatively short machined faces which come into contact and leave a clearance on each side of these faces. This construction is preferably done by forming lateral vertical grooves in the master bushing on each side of the lugs for suspending the drill string (which lugs may be formed somewhat of the same construction as my patent application above mentioned). The Kelly bushing, which is formed in two parts with a vertical joint, has projecting vertical bosses which fit in the grooves of the master bushing. The torque stresses for rotating the drill string are

transmitted from the rotary table through the grooved faces of the master bushing and the bosses of the Kelly bushing.

My invention is illustrated in connection with the accompanying drawings, in which:

Fig. 1 is a vertical section through a rotary table, a master bushing, and a section of a drill string, with the tool joint, plug, and elevator in section.

Fig. 2 is a horizontal section on the line 2—2 of Fig. 1 in the direction of the arrows, showing part of the plug and elevator.

Fig. 3 is an elevation taken in the direction of the arrow 3 of Fig. 2.

Fig. 4 is a vertical section on the line 4—4 of Fig. 3 in the direction of the arrows.

Fig. 5 is a perspective view of the plug and the wrench or threading plug.

Fig. 6 is a plan taken in the direction of the arrow 6 of Fig. 7, illustrating the construction of the Kelly and master bushing.

Fig. 7 is a vertical section on the line 7—7 of Fig. 6 in the direction of the arrows.

Fig. 8 is a section of the drill pipe stand, with an elevator shown in vertical section.

Fig. 9 is a perspective view of the Kelly bushing.

Fig. 10 is a diagram of part of a drill string, showing the action of the suspension lugs.

Referring first to the drill string construction, this illustrates a drill pipe 11 having a tool joint coupling 12 secured thereto. This is attached in the usual manner by the upper end 13 of the pipe being upset to increase its diameter and having a threaded pin 14 which engages in a box 15 of the coupling. This coupling has a squared transverse shoulder 16 at the mouth, such shoulder being at right angles to the axis of the drill pipe coupling. The coupling has a cylindrical outide surface 17 and at the top is also provided with a box thread 18 and a transverse shoulder 19. An elevator plug designated 20 has a tapered threaded section 21 threading in the box 18 of the coupling and has a horizontal flange 22 with a lower shoulder 23. This shoulder rests on the transverse shoulder 19 of the coupling. The flange is of sufficient diameter to extend a considerable distance beyond the periphery of the coupling. The plug is provided with a wrench socket 24, this being illustrated as hexagonal and tapering downwardly. The plug is indicated as having a perforation from top to bottom. A wrench 25 has a plug 26 formed of the proper shape to fit in the wrench socket 24. This is illustrated as hexagonal and tapering. The wrench has a hand operating bar 27 of sufficient length to give a good leverage for threading the plug in and out of the coupling. The shoulder 23 of the plug extending beyond the coupling is designated herein as an elevator shoulder as it is engaged by the elevator, and the shoulder 16 on the bottom of the coupling is designated as a suspension shoulder.

The elevator designated by the assembly numeral 28 has a body structure 29 with a gate 30 at the front. The gate when closed and the body of the elevator have a cylindrical opening 31 from top to bottom except for the parallel sections 32 to allow entry of the drill pipe and tool coupling. A characteristic of my invention is that this passage through the elevator has an outward flare or bevel 33 at the top, this bevel being both in the body structure and in the gate.

The latch construction of the elevator utilizes a vertical pin 34 which is secured in a lug 35 on the top of the body part of the elevator, this pin being held in place by a set screw 36. A sleeve 37 is slidably mounted on the pin and operates through a bearing lug 38. This sleeve at the bottom has a cam block 39 pinned or otherwise secured thereto, this having an inclined cam surface 40. Loosely mounted on the sleeve there is a rotatable cam block 41 having a complementary cam surface and an operating handle 42. This cam block may rotate on a horizontal plane on the vertical axis of the pin 34. It operates between the bearing lug 38 and the cam block 39. A head block 43 is secured to the upper end of the sleeve and has a latch hook 44 extending laterally therefrom. A key 45 operating in a groove in the pin 34 prevents rotation of the hook. The pin itself is prevented from rotation by having a squared or similar end 46. A compression spring 47 is coiled on the outside of the sleeve and bears on the bearing lug 38 and the under side of the block 43. The outer end of the latch hook has a bevel 47. A latch arm 48 is formed integral with the gate. This has a bevel 49 on its inside face to engage with the bevel 47 of the hook.

When the lever 42 is rotated it presses downwardly on the cam block 39, which pulls down on the sleeve, compressing a spring 50 and pulling the latch hook downwardly. This, therefore, will release the latch arm from such hook for opening the gate. When it is desired to close the gate after encircling a drill pipe, the gate may be swung closed and by its momentum the latch arm 48 depresses the latch hook 44 by the engagement of the beveled surfaces 49 and 47; this action compresses the spring 50 when the latch hook is forced downwardly and as soon as the gate is closed the spring elevates the latch hook to engage the latch arm and to hold the elevator clamp around the drill string.

The bevel flare 33 on the upper portion of the elevator is sufficient so that this beveled portion may ride over the outside of the suspension shoulder so that when a stand is stacked in the derrick in a sloping manner, as illustrated in Fig. 8, and the elevator is clamped around this stand, it being clamped around the pipe section and pulled upwardly to lift the stand, there is no chance for the elevator to rock against the squared suspension shoulder of the tool joint coupling. The elevator rides upwardly over the drill pipe and the coupling until it engages the flange of the plug. It will be noted that the elevator has a slight annular rim 51. The stand of pipe may then be lifted, the plug sustaining the weight of such stand, and the stand may then be connected to the drill string suspended on the elevator, as hereinunder detailed. When a stand has been added and the drill string lowered the length of the stand the plug is removed for connection of the next stand. By this arrangement it will be seen that there is no structure enters the well which need be of larger diameter than the tool joint coupling. In running the drill string out of the well the elevator is clamped around the tool joint coupling after a plug has been threaded in the upper end of such coupling. It will be apparent that by the use of the wrench the plug can be attached and loosened and removed very quickly.

In the drawings I show a rotary table designated generally by the assembly numeral 55. This is illustrated as having a substantially rectangular opening 56 which may be considered as having two vertical ends 57 and two vertical sides 58.

These have a shoulder 59, the corners of which are cut on a bevel 60. The master bushing 61 has outside edges to fit the edges 57, 58, the bevel 60, and the shoulder 59. The master bushing has two internal vertical edges 62, with offset portions 63, these having a bevel 64 joining the edges 62 and 63. This leaves center vertical lugs 65. There are end blocks 66 with side edges 67, and between these blocks extend the pivot pins 68 for the tilting lugs 69, this detail of construction of the tilting lugs being mounted in substantially the same manner as in my patent application above mentioned. In this present case, however, these lugs have a flat upper surface 70 which adjoins the semi-cylindrical surface 71 so that the flat surface engages underneath the squared transverse shoulder 16 at the bottom of the coupling 12. These lugs, therefore, distinguish from the patent application above mentioned in not having a bevel, as the tool joint at the bottom is not beveled. The lugs have a flare 72 which may be utilized to center a drill string in the same manner as described in the above mentioned patent application.

The Kelly bushing designated by the assembly 73 is in two parts 74 with a center joint 75. These are provided with ouside vertical surfaces 76 which fit against the vertical joints 77 of the tool joint and rest on the horizontal shoulder 78. At the side edges the Kelly bushing sections each have a projecting vertical lug 79 with beveled corners 80 which fit in the grooves 81 formed by the offset inside face 63 of the master bushing. The master bushing and the Kelly bushing have tapered surfaces 82 and the Kelly bushing has a squared opening 83 to accommodate the square section of the kelly 84.

By this construction the torque stresses for rotating the kelly are taken by the lugs 79 against the recessed faces of the grooves 81 of the master bushing. It is, hence, only necessary to carefully machine these wearing surfaces, and providing these surfaces prevent distortion of the master bushing and Kelly bushing, which might take place if they had a fitting joint on the line 62. It will be noted that the suspension lugs may be tilted outwardly for inserting of the Kelly bushing and do not need to be removed from the master bushing.

In Fig. 10 I illustrate the action of the suspension lugs elevating a stand of drill pipe. The stand is usually made up of sections of, possibly, three pipe lengths connected by couplings and if these couplings project beyond the periphery of the pipe the upper shoulder engages the lower floor 72 of the suspension lugs and causes these lugs to tilt upwardly slightly. This allows the joints or couplings to pass upwardly. The tool joint on which the string is to be suspended also tilts these up and then when the string is slightly lowered the suspension shoulder on the tool joint coupling engages the upper surface of the suspension lugs. Therefore, these lugs have an automatic action in pulling the pipe out of the hole in that they do not need to be forced inwardly manually by the workmen on the derrick floor to suspend the string of drill pipe while a stand is being uncoupled. However, when a stand is being run in the hole it is necessary to tilt the suspension lugs outwardly their full distance, which is illustrated in Fig. 7, but when it is desired to support the string on the rotary table for coupling an additional stand, it is necessary to force the lugs inwardly, which may be done by the operators kicking these with their feet.

It will be noted that the plug 20 is hollow and thus forms a vent to the coupling and drill pipe. Also, that the non-circular wrench grip socket is formed in this hollow portion of the plug, the socket structure therefore having two functions, one for threading the plug in and out of the coupling, and the other forming an air vent.

Various changes may be made in the details of construction without departing from the spirit or scope of the invention as defined by the appended claims.

I claim:

1. In a well drilling apparatus, the combination of a section of drill pipe having a tool joint coupling at the top, a plug secured to the upper end of the coupling and having a flange extending beyond the periphery of the coupling, the lower edge of the coupling having a shoulder adapted for suspension on a rotary table, and the flange of the plug being adapted to form an elevator shoulder for suspending said section by an elevator.

2. In a well drilling apparatus, the combination of a section of drill pipe having a tool joint coupling at the top, said coupling having a lower transverse suspension shoulder formed substantially at right angles to the axis of the coupling, a plug secured to the upper end of the coupling, said plug having a flange extending laterally beyond the periphery of the coupling and adapted to form an elevator shoulder for engagement by an elevator, the suspension shoulder being adapted to be engaged and supported by a non-frictional support in a rotary table.

3. In a well drilling apparatus, the combination of a section of drill pipe having a tool joint coupling secured to the top, a plug with a lateral flange secured to the upper end of the coupling, said flange extending beyond the periphery of the coupling, and an elevator having an opening beveled at the top to facilitate sliding upwardly over the coupling into engagement with said flange, such flange forming an elevator shoulder.

4. In a well drilling apparatus as claimed in claim 3, the lower end of the coupling having a suspension shoulder formed at substantially right angles to the axis of the coupling and being adapted for engagement in a rotary table by a non-frictional supporting element, said bevel in the elevator being adapted to guide the elevator upwardly over said suspension shoulder.

5. In a well drilling apparatus, the combination of a section of drill pipe having a tool joint coupling with a threaded connection to the top of the pipe, a plug threaded in the upper end of the coupling, said plug having a flange extending laterally beyond the periphery of the coupling and adapted to form an elevator shoulder to be engaged by an elevator.

6. In a well drilling apparatus as claimed in claim 5, said coupling having a suspension shoulder at the lower end extending outwardly beyond the periphery of the section of pipe, such shoulder being at right angles to the axis of the coupling and adapted to suspend a pipe by a non-frictional support.

7. In a well drilling apparatus, the combination of a section of drill pipe having a tool joint coupling at the top, said coupling being threaded to the pipe and having a plug threaded in its upper end, said plug having a flange extending laterally beyond the periphery of the coupling to form a transverse elevator shoulder at right angles to the axis of the plug, an elevator having an opening with a bevel at the top, such bevel being adapted to ride upwardly over the lower end of the

coupling to bring the elevator into engagement with the elevator shoulder of the plug.

8. In a well drilling apparatus as claimed in claim 7, the lower end of the coupling having a suspension shoulder extending beyond the periphery of the pipe and being at right angles to the axis of the coupling, and a rotary table having tiltable lugs with a flat upper surface to engage said suspension shoulder.

9. In a well drilling apparatus, the combination of a section of drill pipe having a tool joint coupling threaded on the upper end, said coupling having a suspension shoulder at the bottom formed at right angles to the axis of the coupling and extending outwardly beyond the periphery of the pipe, a plug threaded in the upper end of the coupling and having a flange extending outwardly beyond the periphery of the coupling, such flange forming an elevator shoulder, an elevator having an opening beveled at the top, said bevel being adapted to engage the suspension shoulder end of the coupling and to guide the elevator upwardly over the coupling into engagement with the elevator shoulder flange of the plug.

10. In a well drilling apparatus as claimed in claim 9, a rotary table having a master bushing therein with a pair of tilting lugs, said lugs having a flat upper surface, means to support the lugs with such surface horizontally, the flat surface engaging the suspension shoulder at the lower end of the coupling.

11. In a rotary well drilling apparatus the combination of a string of drill pipe having means constructed for suspension in a rotary table to suspend the drill string, a lifting device removably attached to the pipe and having a laterally projecting elevator flange extending beyond the drill pipe adapted to be engaged by an elevator for raising and lowering the drill string, another and upper pipe attachable to the said pipe after removal of the lifting device.

12. In a rotary well drilling apparatus, the combination in a string of drill pipe of a section of pipe having a coupling means for removably attaching various sections of pipe, a lifting device secured to the coupling means and having a lateral projection extending beyond the coupling means for engagement by an elevator for raising and lowering the drill string, said lifting device being removable for attaching another pipe section to a coupling means.

13. In a rotary well drilling apparatus as claimed in claim 12, the said coupling means having a shoulder projecting beyond a pipe section and adapted for non-frictional suspension of the drill string in a rotary table.

14. In a well drilling apparatus, the combination of a section of drill pipe having a tubular tool joint coupling connected to the top of the pipe, a lifting device secured in the upper end of the coupling and having an elevator flange extending laterally beyond the periphery of the coupling and adapted to form an elevator shoulder to be engaged by an elevator, said lifting device being removable for attachment of another and upper drill pipe to the coupling.

15. In a well drilling apparatus as claimed in claim 14, said coupling having a suspension shoulder of lesser diameter than the flange of the lifting device but of greater diameter than the pipe, said suspension shoulder being adapted to suspend a drill string in a rotary table by a non-frictional suspension.

16. In a well drilling apparatus as claimed in claim 14, said coupling having a suspension shoulder of lesser diameter than the flange of the lifting device but of greater diameter than the pipe, said suspension shoulder being adapted to suspend a drill string in a rotary table by a non-frictional suspension, and an elevator having an opening beveled at the top adapted to slide upwardly over the said suspension shoulder to engage the said elevator shoulder.

17. In a rotary well drilling apparatus, the combination of a string of drill pipe, sections of said string having means for coupling said sections together, parts of a section being constructed for support in a rotary table for suspending the drill string, a lifting device having a threaded attachment to a section, and a non-circular wrench socket concentric with the lifting device for attaching and detaching said device, said device having means to be engaged by an elevator to raise or lower the drill string, said lifting device being removable for attaching another section of drill pipe to the drill string said socket being open at the bottom and forming a vent opening to the drill pipe.

18. In a rotary well drilling apparatus, the combination of a string of drill pipe having means constructed for suspension in a rotary table to suspend the drill string, a lifting device having a threaded attachment to said pipe and having a non-circular wrench grip means, said lifting device having a laterally projecting elevator flange extending beyond the pipe adapted to be engaged by an elevator for raising and lowering the drill string, and another and upper pipe attachable to said pipe after removal of the lifting device.

19. In a rotary well drilling apparatus, the combination of a string of drill pipe, of a section of pipe having a coupling means for removably attaching various sections of the pipe, a lifting device having a wrench grip socket and having a threaded connection with the coupling means, said lifting device having a lateral projection extending beyond the coupling means for engagement by an elevator for raising and lowering the drill string, said lifting device being removable for attaching another pipe section to the coupling means.

20. In a rotary well drilling apparatus as claimed in claim 19, said coupling means having a shoulder at its connection with a pipe section adapted for non-frictional suspension of the drill string in a rotary table, and an elevator having a beveled inner and upper surface adapted to slide over said shoulder to engage the lateral projection on the lifting device.

21. In a rotary well drilling apparatus, the combination of a string of drill pipe of a tubular coupling, means for securing adjacent sections of the string, a hollow lifting device threaded internally to the coupling means and forming a vent to the drill string, said lifting device having a lateral projection for engagement by an elevator for lifting and lowering the drill string, said lifting device being removable for attaching an additional section to said coupling, the hollow portion of said lifting device being shaped to form a non-circular wrench grip socket for threading said device into and out of said coupling.

22. In a well drilling apparatus as claimed in claim 5, the plug having a non-circular wrench socket adapted to be engaged by a wrench for inserting the plug in and removing the plug out of the coupling.

23. In a rotary well drilling apparatus, the combination in a string of drill pipe of a tubular coupling, means for securing adjacent sections of

the string, said coupling means being internally threaded at the upper end, a lifting device threaded externally to engage the internal threads of the coupling means and having a lateral projection for engagement by an elevator for lifting and lowering the drill string, said lifting device being removable for attaching an additional section to the coupling of the drill string, said lifting device having a non-circular wrench socket for threading said device into said coupling, the said coupling having a shoulder projecting beyond a pipe section adapted for non-frictional suspension on a rotary table, and an elevator having an opening beveled at the top adapted to slide upwardly over the said shoulder to engage the lateral projection of the lifting device.

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