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HYDRAULIC DRILLING AND CASING SETTING TOOL

Filed Dec. 4, 1963

Fig. 1.

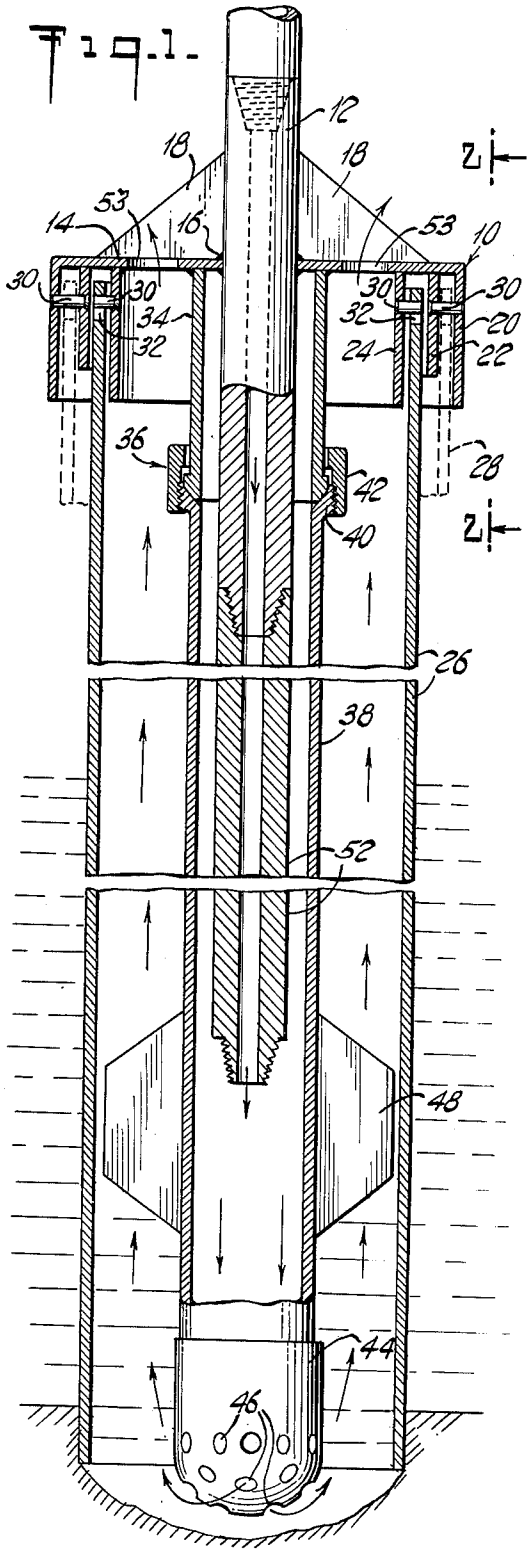


Fig. 2.

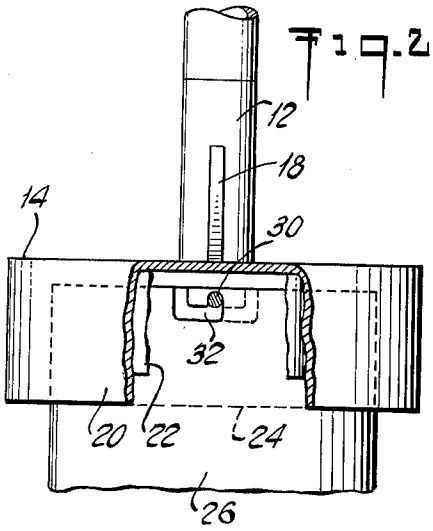
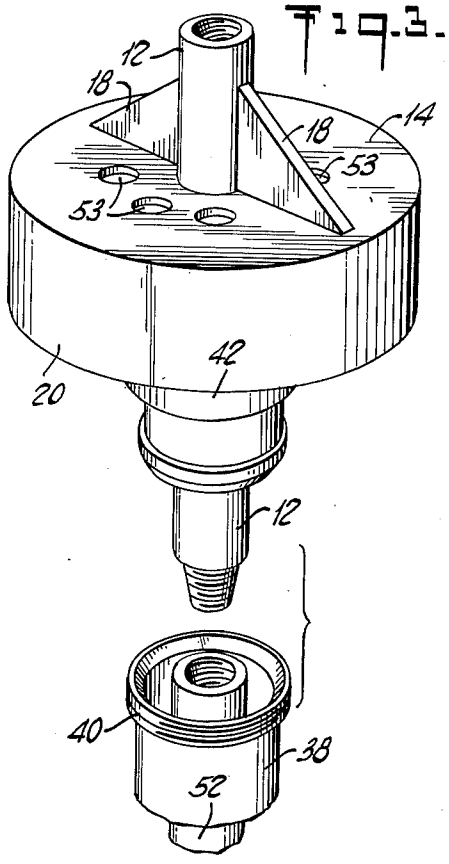


Fig. 3.



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HYDRAULIC DRILLING AND CASING SETTING TOOL

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9 Claims. (Cl. 175—207)

The present invention is concerned with the boring or forming of sub-surface holes and the simultaneous placement of a well casing in the sub-surface formation and specifically concerns a tool for conveniently effecting this by hydraulic jetting action.

The present invention provides a tool constructed for releasably engaging a tubular casing at one extremity thereof and having a central downwardly extending conduit which is attachable to a drill string or other conduit for suspending the tool and introducing a jetting fluid under pressure. The central conduit is also constructed at its lower end to receive a string of weighted drill collars through which the jetting fluid may pass. Since the drill collars extend vertically downwardly, they perform the function of loading the lower portion of the assembly with a sufficient weight to cause the casing to follow a true vertical path downwardly into the hole formed by the jetting action.

In addition, the lower part of the head carries a coupling for a jetting conduit coaxial with the drill collar assembly and of substantially larger diameter than the drill collars. The jetting conduit when attached to the head is arranged to extend downwardly to a position in the vicinity of the lower extremity of the well casing where it terminates preferably in a jet nozzle or shoe.

Therefore, the annular space between the jetting conduit and the string of the casing provides a selectively restricted, uninterrupted annular space through which the "returns," namely the effluent jetting fluid and the debris of formation particles dislodged by the jet stream, will pass upwardly at a suitable rate to remain in entrainment. Furthermore, restriction of "returns" to the annular space avoids wash out or excessive enlargement of the hole. Appropriate apertures are provided in the tool above this annular space to permit the cuttings and formation debris to pass upwardly and outwardly as the casing moves downwardly into the formation.

The present tool, moreover, is constructed to selectively engage well casings of various diameters by providing radially spaced releasable suspension means which may be interlocked with the axial extremity of various sized well casings. In this way, a single tool is adequate to accommodate and to effect boring with casings of preselected dimension.

It has the particular advantage in driving cased wells in relatively unconsolidated submarine locations where the bore-hole debris is readily scoured away by hydraulic action, and thereafter discharged into the surrounding body of water. After the casing has been jetted to the desired depth the tool can be detached from the casing to permit withdrawal of the jetting string and the weighted collars for reuse in subsequent operations.

The present invention will be more fully understood by reference to the attached drawing wherein FIG. 1 is a vertical sectional elevation through a drilling tool assembly constructed in accordance with the present invention. FIG. 2 is an elevation viewed in the direction of line 2—2 in FIG. 1 with the parts 20 and 22 broken away to show the bayonet slot connection. FIG. 3 is a perspective view of the tool of FIG. 1 indicating the drill collar and jet string arranged in juxtaposition prior to attachment.

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Referring to the drawings, the jetting tool comprises a supporting head 10, having a central tubular conduit formed by a nipple or relatively short length of drill pipe 12, known in the art as a "sub" which passes through and which is fixedly welded to a circular disc 14 as at 16. Gusset plates or brackets 18 welded to the pipe sub 12 and the plate 14 rigidify and stabilize the structure.

The circular periphery of the head or plate 14 is provided with a cylindrical downwardly projecting lip or flange 20. Spaced successively internally and radially to the flange 20 are additional annular walls or flanges 22 and 24 which thereby provide two internal, downwardly facing annular recesses or sleeves for the reception of tubular well casings of different size. For example, as shown in FIG. 1, the inner annular recess formed by flanges 22 and 24 receives a relatively smaller size casing 26, whereas a larger size casing may be alternatively inserted in the outer annular recess as indicated by the reference number 28 in dotted lines.

Means for releasably interconnecting the end of the casing with the head 10 comprises pins 30 which extend through the sleeves or flanges 20, 22 and 24 at spaced annular points thereabout and are engageable by so-called "J" or bayonet slots 32 in the upper extremity of the casing as shown in FIG. 2 For increased strength a single pin may pass through the three flanges.

Radially intermediate between the conduit sub 12 and the sleeve 24 a coaxial downwardly projecting collar or tubular member 34 terminates in a union, coupling, or clamp connection 36, adapted to receive a jet string of tubing 38. In the present example, the upper extremity of the jet tubing string is preferably provided with a threaded fitting 40 engaged by the lock ring or nut 42 of the union. The lower extremity of the jet string carries a jet shoe 44 or any other suitable form of nozzle fitting suitably perforated as at 46 to direct appropriate streams of fluid into the formation and thereby to hydraulically cut away unconsolidated material and provide a hole for reception of the casing.

It is advantageous to provide the jet tubing string, at points along the length of the casing 26, with annularly spaced radially blades or webs as at 48 which act to centralize the tube in the casing and to stabilize it in coaxial relationship.

In operation, the jetting tool or head is supported from a conventional derrick or drilling rig preferably on a drilling barge or other vessel. This may be accomplished in the present embodiment by means of the usual drill pipe 12 hung from the derrick by means of a swivel and adapted to be raised or lowered, and supplied with jetting fluid under pressure from mud pumps, as desired.

Since the derrick, hoistering equipment, swivel and the like are conventional they have not been shown and it is apparent that other means for supporting the assembly and supplying it with pressurized jetting fluid may be employed.

In operation in an off-shore location, the casing or conductor **26** is made up and suspended from the barge beneath the derrick. The string of jet pipe **38** is thereafter made up and run into the casing where it is suspended by slips at the top of the casing. The drill collar string **52** is similarly made up and run inside the jet string and likewise suspended by slips from the upper extremity of the jet string **38**.

The tool head is then lowered by the derrick into engagement with the drill collar string **52** where the threads are appropriately made up.

With the string of drill collars **52** suspended from the head and its slips removed, the head is then lowered to engage the elements of the union **36**. At this point the collar or lock nut **42** is made up to suspend the jet tubing string **38**. Then after its slips are removed, the head is further lowered until the peripheral sleeves or flanges of the head embrace the upper extremity of the casing with the pins **30** extending in the "J" slots **32** on the casing. By a slight, preferably counterclockwise (in plan) rotational movement of the head, interlocking is completed and the entire assembly may be lifted and lowered as a unit.

It will be observed that in order to permit make-up of the assembly in the manner described, it is advisable that the sub or conduit **12** extend downwardly below the coupling or union **36** a distance sufficient to permit it to be firmly made up by wrenches or tonging tools. Similarly, it is advisable to locate the coupling **36** a substantial distance below the casing attachment flanges, for the same reason.

In use, the drilling pipe **12** and the drill collar **52** is supplied with a high pressure stream of fluid such as sea water, by way of the pressure pumps and the swivel previously mentioned, and is lowered vertically to the bottom where the jets of fluid from the nozzles **46** proceed to erode away bottom formation.

As the casing enters the hole thus made, it will be apparent that the effluent stream of water with entrained debris from the excavation flows upwardly at a substantial rate through the annular space between jet string sub **38** and the casing or conductor **26**. Apertures **53** of substantial diameter in the upper surface or web **14** of the head **10** permit such flow at a rate sufficient to prevent settling of the larger particles so that they are continuously discharged into the surrounding body of water. It will be apparent from the foregoing that the upper surface **14** of the tool or head **10** may take the form of a spider construction allowing major areas of egress for the flowing stream of water where this is desired.

When the assembly has been run to the desired depth in the submarine formation, the head may be readily disengaged by slacking the draw works and rotating the drill pipe **12** in a clockwise direction to disengage the pins **30** from the "J" slots at which time the tool may be freely lifted leaving the casing in place. In fact, drilling in a new location may immediately proceed after picking up a new casing string and proceeding as before.

Preferably, the jet shoe **44** is located at the lower end of the casing **26** or even slightly above. In any event, positioning it in proximity with the extremity of the casing, avoids circulation of jetting fluid outside the casing, and resulting excessive hole enlargement.

Various other modifications and equivalents of the invention will be apparent from the particular example given above and are contemplated as coming within the spirit and concept of the invention as limited only by the following claims.

I claim:

1. A tool for use in driving and setting a well casing in an underground formation by hydraulic jetting action comprising a supporting head provided with a suspending means to receive and releasably engage the axial extremity of a tubular well casing, an additional suspending means coaxial with said first named suspending means for receiving and releasably engaging the extremity of a well casing of substantially different diameter for suspending such casings in a vertical axis, said head having fixed thereto in coaxial relationship with both said suspending means a drill pipe sub adapted to be supplied with fluid and adapted to be suspended from a drilling derrick, pipe coupling means extending downwardly from said head and being coaxial with and of substantially greater diameter than said drill pipe sub and disposed between both said suspending means and said sub for receiving a jetting pipe, and passageways in said head for permitting outflow of jetting fluid through the annular space between both said suspending means and the pipe coupling means.

2. A tool as defined in claim **1** in which the lower extremity of said drill pipe sub extends substantially below the lower extremity of both said suspending means and is adapted to receive a string of drill collars in vertical coaxial relationship.

3. A tool as defined in claim **2** wherein the pipe coupling means extends axially to an elevation intermediate between both said suspending means and the lower extremity of said drill pipe sub.

4. A tool as defined in claim **1** wherein several of said suspending means are provided each comprising a downwardly extending coaxial flange radially spaced and providing downwardly facing sleeves of substantially different diameter, adapted to receive said casing.

5. In a tool for effecting the hydraulic penetration of a well casing in a sub-surface formation by hydraulic jetting action, a supporting head for suspension from a drilling rig having a central tubular conduit extending downwardly therethrough and adapted to suspend a string of drilling collars from the lower extremity thereof, said head being provided with a downwardly extending tubular member of substantially greater diameter than said drilling collars and being coaxially disposed thereabout, said tubular member having at its lower extremity a pipe coupling means adapted to releasably engage a jetting pipe for vertically supporting said pipe as a downward extension thereof, at least one downwardly extending flange on said head disposed radially outwardly and in coaxial relationship from said tubular member, means on said downwardly extending flange for releasably engaging the end of a well casing for suspending said well casing in a vertical position about said jetting pipe, and passageway means in said head permitting release of jetting fluid from the annular space between the well casing and jetting pipe.

6. A tool assembly for forming a bore hole in a subsurface formation and for effecting the placement of a well casing therein by hydraulic jetting action comprising a supporting head for suspension from a drilling rig, said head having a central tubular conduit extending vertically therethrough, at least one drilling collar, each drilling collar adapted for successive connection to one another, the first drilling collar releasably connected to the lower end of said conduit and suspended therefrom, a downwardly extending radially spaced supporting flange means arranged on said head coaxially with respect to said conduit, and providing a downwardly facing sleeve for receiving the extremity of a well casing, means associated with said sleeve for releasably engaging said well casing to support said casing vertically and in coaxial relationship to said conduit, a tubular jetting conduit of substantially greater diameter than said drilling collars and substantially lesser diameter than said casing coaxially and releasably connected to the lower portion of said head and extending therefrom to the lower extremity of said casing, a jet nozzle connected to the lower end of said tubular jetting conduit, and openings in the upper portion of said head to permit outflow of the jet stream between the casing and said jetting conduit.

7. A tool as provided in claim **6** wherein said jetting conduit connects to said head at a point spaced a sub-

stantial distance vertically above the point of connection of the drill collars to the head and wherein the means for engaging the well casing is arranged a substantial vertical distance thereabove.

8. A tool as defined in claim 6 wherein said jet nozzle is located approximately at the lower extremity of said casing.

9. A tool as defined in claim 6 wherein said supporting flange means comprises a plurality of sleeves, said sleeves being coaxially disposed and radially spaced to selectively receive casings of different diameter.

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