March 21, 1950 M. A. RYAN 2,501,411

COMBINATION WELL TOOL

Filed Oct. 27, 1947

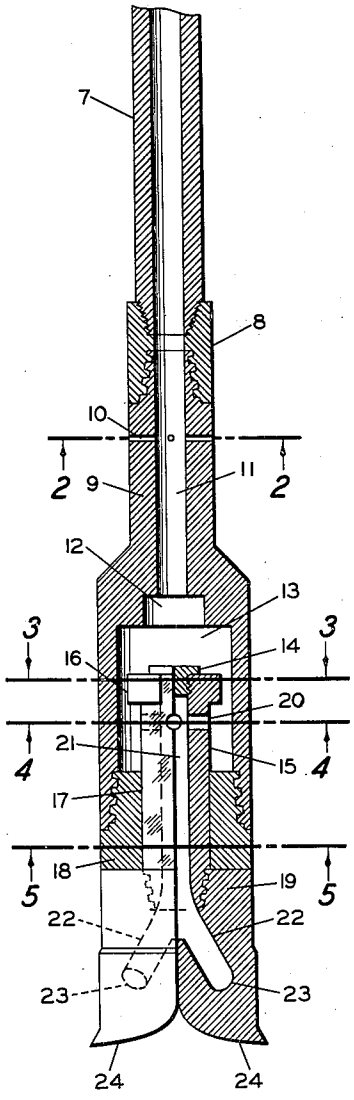


FIG. 1

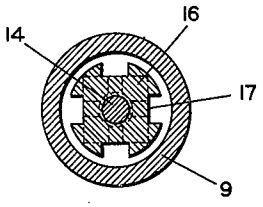


FIG. 3

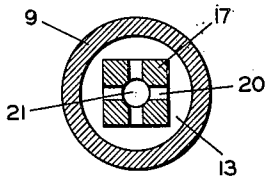


FIG. 4

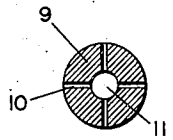


FIG. 2

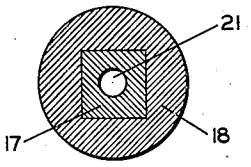


FIG. 5

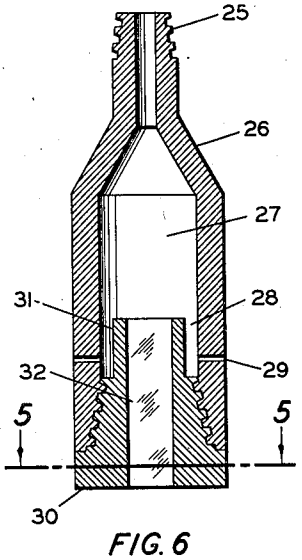


FIG. 6

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COMBINATION WELL TOOL

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3 Claims. (Cl. 255—61)

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This invention relates to well drilling and jetting tools. In a more specific modification it relates to a well drilling and jetting tool with which drilling may be done with circulation down the drill stem and up around the outside of the drill stem or by reverse circulation and with which the jetting may be done by direct circulation at any time by raising the bit a small distance above the bottom of the hole.

It is very useful in the drilling of wells and in the redrilling and/or cleaning of wells to be able to force a fine high powered hydraulic jet against the walls of the well to dislodge and wash down material adherring to the same. Difficulties have been experienced with prior art tools in that in order to jet, either the drill string must be removed which takes a long time and has a swabbing action which is destructive of the well, or else considerable time and difficulty is experienced in dropping some sort of plug down the drill stem and in retrieving the same when the jetting is finished and drilling is to be resumed. While in theory a plug may be manipulated up and down the inside of the drill stem, in practice such plugs often times hang up which may cause serious difficulty ranging from disassembling the entire drill stem to a twist off of the drill stem and resulting fishing job to recover the lower end of the same. In all events considerable time is consumed in making the changeover from drilling to jetting and vice versa.

One object of the present invention is to provide a tool which can be used in rotary well drilling operations to drill a well by reverse circulation, or by normal circulation, whichever is preferred, and to jet the well with a radial jet.

Another object of the invention is to provide a tool capable of carrying out the above object in which the operator can switch from drilling to jetting operations and vice versa in minimum time without removing tools from the well and without waiting for plugs to travel the length of the drill stem or being retrieved.

Another object is to provide a well drilling and jetting tool in which there is a complete and positive shut off of circulation to the bit while jetting and yet when drilling the drilling fluid is transmitted directly to or from the point adjacent the cutting elements on the cutting head of the drill bit so that the same may be kept clean.

A further object is to provide a simple and rugged device with minimum number of moving parts which will be trouble free and foolproof in operation, inexpensive in construction and easy to assemble.

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Numerous other objects and advantages will be apparent upon reading the accompanying specification, claims and drawings.

In the drawings:

Figure 1 is a cross sectional elevation of a well drilling and jetting tool embodying the present invention with the drill bit quarter sawed to show details of construction.

Figure 2 is a cross section taken along the line 2—2 of Figure 1 looking in the direction indicated.

Figure 3 is a cross section taken along the line 3—3 of Figure 1 looking in the direction indicated.

Figure 4 is a cross section taken along the line 4—4 of Figure 1 looking in the direction indicated.

Figure 5 is a cross section taken along the line 5—5 of Figure 1 looking in the direction indicated.

Figure 6 is a cross sectional view of a modified form of a portion of a well drilling and jetting tool embodying my invention.

In Figure 1 a conventional drill stem 7 preferably provided with conventional tool joints 8 is attached to a sub 9 having one or more(but preferably not more than 4) relatively small diameter radial jet holes 10. While the sub may have a bore which is an extension of bore 11 and still embody the present invention it is preferred to enlarge bore 11 and this is done for purposes of illustration by a plurality of stepped bores 12 and 13 although the enlargement could be by means of a tapered bore as shown in Figure 6. A bull plug or blank 14 closes the top of a tubular drill bit shank 15 having a retaining head (or lugs) 16 and a non-circular (preferably square) section 17 which is slideable coupled to and driven in rotation by a correspondingly shaped element 18 preferably closely fitting 17. As shown in the drawing element 18 has a square hole fitting square shank 17. Part 8 can be replaced by a heavy drill collar (not shown).

Element 18 is in effect a lower portion of reduced internal cross sectional area of drill stem 7, 8 and 9 because its bore is of smaller diameter than bore 13 and in some instances may be the same size as bore 11 of drill stem 7. Element 18 is preferably secured to 9 by suitable threads as shown but obviously throughout the entire invention different well known means of securing parts together may be substituted without invention. Threads are preferred over welding because of ease of disassembly although often times threads may be tacked together in assemblage by a small spot weld between the parts if desired. This is not preferred, however, as it is customary to rely on rotation of the drill stem

in one direction only to maintain the threads in assembled relation.

Attached to shank 17 is a cutting head 19 and parts 16, 17 and 19 constitute a drill bit. Bit cooling and washing fluid is supplied down drill stem 7 in normal circulation through passages 11, chamber 13 through holes 20 and passages 21 and 22 which last passages communicate with the face of the bit through openings 23 adjacent the cutting elements or blades 24.

Figure 2 shows jet holes 10 to be of relatively small diameter compared to the diameter of bore 11 of drill stem 9.

Figure 3 shows how a retaining head, or lug 16, provides clearance for fluid past the same by means of slots between lugs 16 of the retaining head. Obviously head 16 could be a continuous enlargement of square shank 17 and the drilling fluid could pass in the annular space between 16 and 9. Obviously lug 16 could be extended to contact or slide on 9 and rely entirely on the slots between the lugs to allow the fluid to pass. The form shown is preferred but is not the only type that may be used as the only function of lug 16 is to prevent bit 19 from falling out of the bottom of the drill stem when the drill stem is raised. The form shown of lug 16 is preferred because it will stir up, crush or destroy any formation cuttings that get into chamber 13 better than the other suggested forms for retaining head 16.

Figure 4 illustrates the form which holes 20 may take in providing access to hole 21. Holes 20 and element 18 act as a valve.

Figure 5 shows the drive connection between elements 17 and 18 which is preferably by means of square cross sectional engagement although other non-circular cross sectional engagement will give good results but will not be quite as rugged. The corners of 17 and 18 are preferably rounded or filleted with a small radius in order to reduce strains and stresses.

In Figure 6 threads 25 screw into a joint similar to 8 so that body 26 replaces body 9 of Figure 1. Body 26 has a bore 27 and space 28 leading to jet holes 29 and in place of drive member 18 drive member 30 is provided with a lip 31 extending above jet holes 29 and provided with a square hole 32 for driving engagement with 17 of Figure 1.

Operation

Figure 1 shows the well drilling and jetting tool in its drilling position. The drill stem 7 is rotated in the usual manner and as blades 24 are on the bottom of the hole, holes 20 stay inside of space 13 so that drilling fluid can be circulated in reverse circulation down the well around stem 7 in through openings 23, 21, 20, 13 and 12 and up bore 11 to the surface of the ground. If desired, normal circulation can be used instead, in which case the drilling fluid comes down bore 11 through 12, 13, 20 and 21 and out openings 23 and back up the well to the surface around drill stem 7. While either normal or reverse circulation can be used in either drilling a new well or cleaning out an old one it is generally considered preferable to use reverse circulation in cleaning out an old well and normal circulation in drilling a new well. My tool, however, allows either type of circuation so that the driller may use either type in either a new or old well which makes the tool more versatile.

During these drilling operations some drilling fluid will pass through jet holes 10, but as they are small in comparison to the other passages

there will be relatively little flow through holes 10 and as the pressure at opposite ends of hole 10 will not vary greatly the fluid will not pass through holes 10 fast enough to give any jetting action. As shank 17 is fairly closely fitted by element 18 hardly any fluid will pass between the same but all of the fluid will use passage 21 instead.

As all the threads in this device are of the same hand depending on the proposed direction of rotation (preferably drill stem 7 is always rotated clockwise and all threads are right hand threads) and as element 18 is splined to shank 17 by a square slideable connection there is a positive drive at all times on blades 24 from drill stem 7.

Upon raising the drill stem 7 holes 20 pass down into 18 and circulation is immediately stopped through passage 21. If the drilling fluid is forced down bore 11 it will emerge from holes 10 as a stiff radial jet which will wash the wall with considerable force as the reduction of diameter from the relatively large area of 11 to the small area of holes 10 results in powerful jetting action and due to the constriction of holes 10 there will be much less pressure outside the holes than inside the holes so that high velocity will be attained by the jet.

An important feature of the invention is that the jetting action takes place immediately upon raising the drill stem a short distance which is a great advantage over devices requiring lengthy manipulations or waiting for elements to take their place. Another advantage is that while jetting none of the liquid passes into the bit and yet after jetting while raising the drill stem and lowering the same the tool is ready to drill almost instantaneously after the drill bit is placed on the bottom again.

Another operational advantage is that liquid passing down the drill stem passes internally through passage 21 and does not get in the space between 17 and 18. This becomes additionally important during reverse circulation when cuttings are entering holes 23 and passing up through drill stem 7. Such cuttings might easily cause trouble if they entered between 17 and 18. During direct circulation of the drilling fluid (by drilling fluid it is understood that a liquid containing suspended solid material such as clay is generally used although other drilling fluids known to the prior art may be employed) the drilling fluid emerges from holes 23 adjacent cutting elements 24 where it is best adapted to clean the same and during reverse circulation holes 23 are similarly positioned where they are best adapted to pick up the cuttings from blades 24.

While fishtail bit blades 24 have been shown in the illustrated embodiment of Figure 1 for purposes of illustration, primarily because they are easy to draw, not only fishtail blades can be used in the invention as roller cutters, roller cone cutters, disk bits, drag bits and all the other cutting elements of the prior art may be employed on the cutting head 19 without invention and the device will still embody the present invention. Preferably holes 23 will be positioned adjacent whatever cutting surfaces are employed and the exact design of passages 22 and holes 23 may be varied in an obvious manner to be adjacent to these other types of cutting surfaces.

The operation of Figure 6 is the same as that of Figure 1 except that collar 31 allows jets 29 to be below the point at which holes 20 are cut off by 31. A space is left at 28 below holes 29 so

that any cuttings accumulating there may be compressed, upon reversal of circulation as in reverse circulation drilling water coming in holes 29 will aid in preventing material piling up in 28 above holes 29.

While I have shown in the drawings, several particular illustrative forms of my invention, various modifications may be made in the same and in the various features of construction, without materially changing the invention therein, and formal changes may be made in the specific embodiment of the invention described without departing from the spirit or substance of the broad invention, the scope of which is commensurate with the appended claims.

Having described my invention, I claim:

1. A well drilling and jetting tool comprising in combination a drill bit having a cutting head and a retaining head connected together by an extended intermediate non-circular shank of reduced cross sectional area, said retaining head forming a laterally-projecting shoulder at the end of said shank, cutting elements on said cutting head, said bit having an internal passageway therethrough extending from an opening in said cutting head adjacent said cutting elements to an opening in the side of said shank adjacent said retaining head, and a tubular drill stem having a lower portion of reduced internal cross sectional area forming a non-circular bore slidably and non-rotatably engaging said shank along a vertical distance greater than the vertical extent of the opening in the side of said shank but less than the length of said shank below the top of said opening, said lower portion of reduced internal cross sectional area also forming an inwardly projecting shoulder to engage the laterally-extending shoulder of said shank to limit downward movement of said shank through said drill stem, the sliding movement being sufficient to cover the passageway opening in the side of said shank when the opposing shoulders are in engagement and to uncover at least a portion of said opening as said shank rises within said drill stem, said tubular drill stem having a transverse jetting passage extending from the interior to the exterior of said drill stem, said shank and said internal passage forming a valve with said lower portion of said drill stem having an open and a closed position.

2. A well drilling and jetting tool comprising in combination a drill bit having a cutting head, a non-circular shank extending upwardly of said head and having a laterally, outwardly-extending projection at its opposite end, said bit having an internal passageway therethrough from an opening in said cutting head to an opening in the side of said shank adjacent said lateral projection, a tubular drill stem having an inwardly-projecting flange non-rotatably and slidably engaging said shank and closely fitting said shank in all positions, said inward flange having a longitudinal extent greater than the vertical extent of the opening in the side of said shank but less than

the length of said shank below the top of said opening, the lateral projection of said shank being adapted to engage the inwardly projecting flange of said drill stem to limit downward movement of said drill bit, the sliding movement of said shank within said stem being sufficient to cover the passageway opening in the side of said shank when the projection and flange are in engagement and to uncover at least a portion of said opening when the shank rises within the stem, said drill stem having a transverse jetting passage extending from the interior to the exterior of said drill stem.

3. A well drilling and jetting tool comprising in combination a drill stem formed with a longitudinal bore therein, the inner walls of said stem forming a non-circular portion of said bore having an upper shoulder, above which said bore is of greater cross sectional area than in said portion, said stem having a transverse jetting passage extending from the bore above said shoulder to the exterior of the stem, a drill bit having a cutting head and a retaining head connected by an intermediate shank of reduced cross sectional area, at least a portion of said shank being disposed in and closely fitting the cross sectional area of the non-circular portion of said bore, said cutting head being rigidly connected to said shank, said drill bit being thereby non-rotatably connected to said stem for longitudinal sliding movement relative thereto with said retaining head above said shoulder and contacting the same in a first longitudinal position, and with said cutting head below said shoulder and contacting said stem in a second longitudinal position, said drill bit having an internal passage therein extending and communicating from the exterior of said shank below and in the vicinity of said retaining head to the exterior of said cutting head, the extent of relative longitudinal sliding movement between the drill bit and stem being such that said shoulder and said shank form a valve controlling flow through said passage with said passage in communication with the bore above said shoulder in said first position and closed from such communication by said shoulder in said second position.

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