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Oliver

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[54] **WELL FISHING APPARATUS**

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[51] **Int. Cl.** **E21b 31/08**

[58] **Field of Search** 166/99, 311, 312, 222, 166/223; 175/25, 38, 60, 65, 54, 72, 237, 243, 308–312, 317–320

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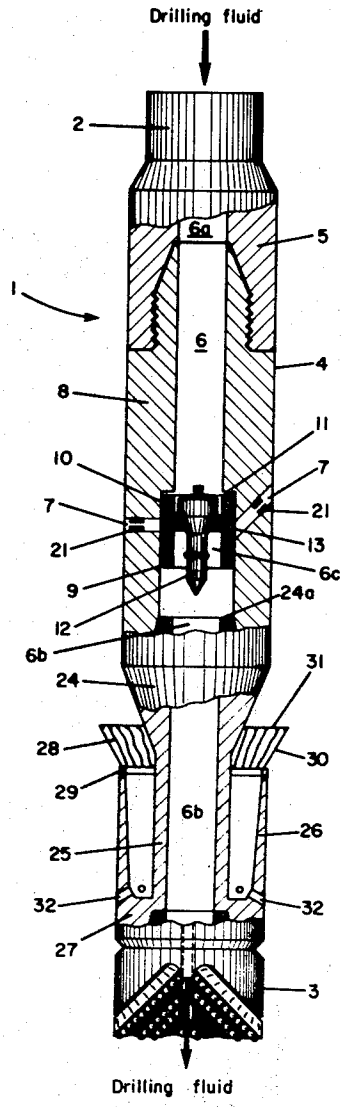
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[57] **ABSTRACT**

A fishing tool which can be used for dislodging and collecting junk from the walls of a well bore. The tool can be located in a drilling string above a bit, and streams of drilling fluid are jetted outwardly against the wall of the bore to dislodge junk which resides in or upon the wall. A junk basket is located on the tool above the bit, and junk is thus basketed before it falls to the bottom of the hole.

25 Claims, 5 Drawing Figures



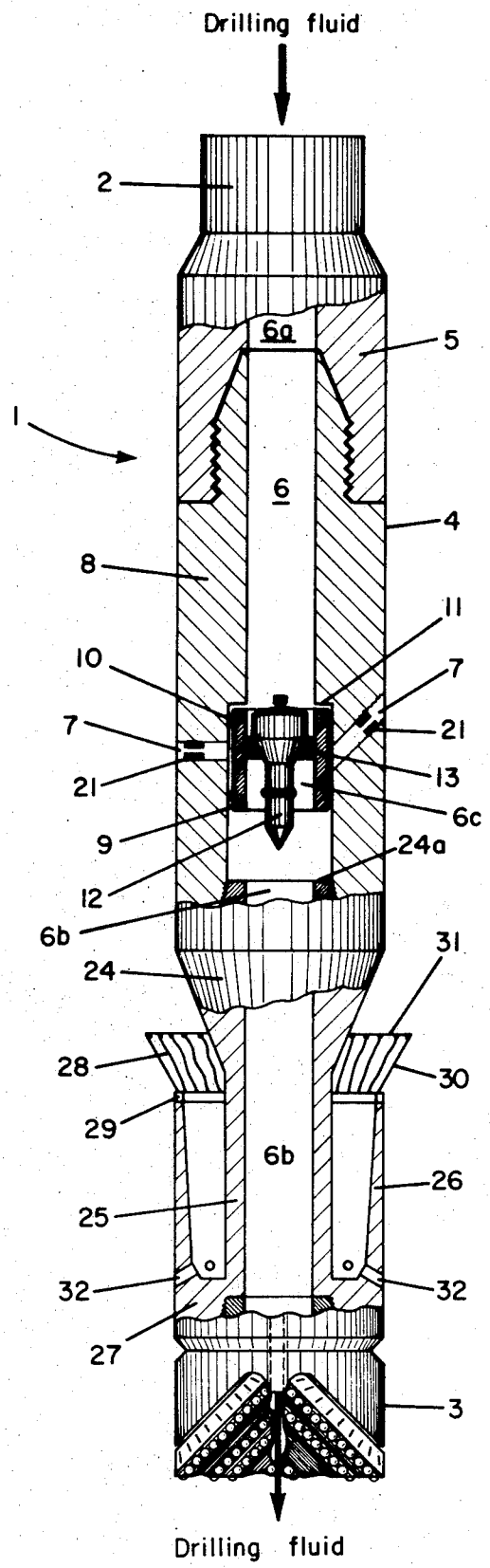

Drilling fluid
2
6a
5
1
6
4
8
11
10
7
7
21
21
13
6c
9
24a
12
6b
31
24
28
30
29
6b
26
25
32
32
27
3
Drilling fluid

Fig. 1

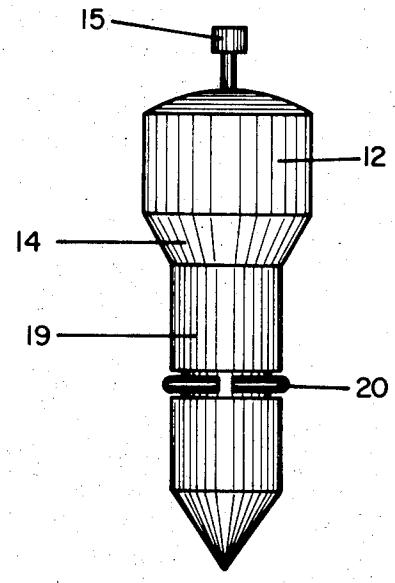


Fig. 2

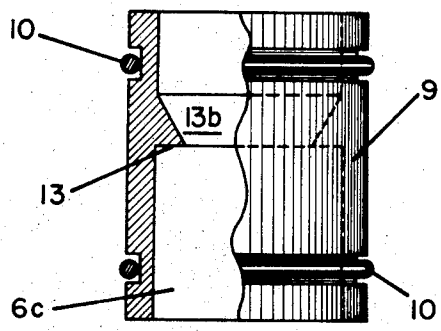


Fig. 3

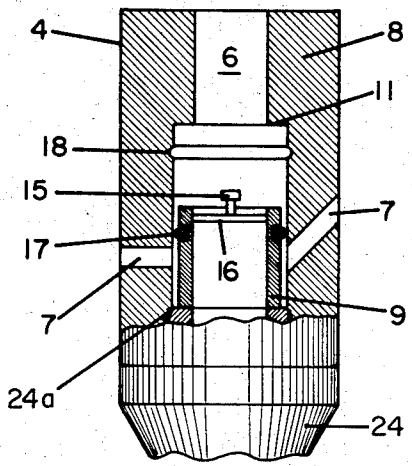


Fig. 4

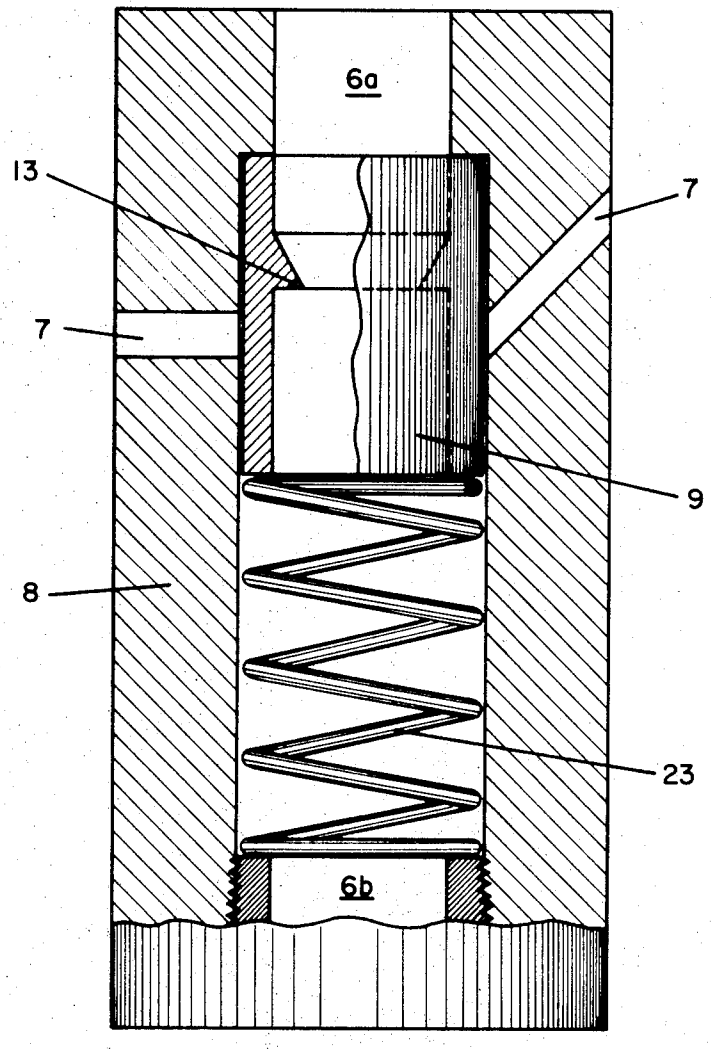


Fig. 5

WELL FISHING APPARATUS

BACKGROUND OF THE INVENTION

The present invention pertains to the drilling of wells and more particularly to removal of objects from a well bore which interfere with or disrupt the drilling operation. More specifically, this invention pertains to methods of fishing a well for removal of junk or debris by means of an improved fishing tool.

When a well is being drilled it is not uncommon for the bit to encounter objects which slow drilling progress and which can also damage or destroy the bit unless removed from the hole. Examples of such objects are fragments from the bit itself such as broken teeth, pieces of cement, large hard fragments of the formation being drilled which break loose instead of being cut into small pieces by the bit, and miscellaneous other stone-like or scrap metal objects. These materials are commonly referred to as "junk" and are "fished" from the hole by means of a "fishing tool."

Current practices for fishing a well assume that all junk which is encountered originated at the bottom of the hole. Present fishing tools therefore amount to coring devices which cut at the outside of the hole to produce a core wherein the junk is contained and retrieved when the tool is withdrawn from the well. It has now been discovered, however, that junk encountered by the bit does not always originate from the bottom, but may initially reside in the wall of the well bore, or upon a ledge thereon, and becomes dislodged during tripping of the drill pipe back and forth through the hole, so that it is thus knocked loose and falls to the bottom. Consequently, this dislodged junk does not find its way to the bottom until sometime after the drill bit has passed the point where the junk initially resided. When it was previously suspected that junk was lodged within or resting upon the wall of the bore hole, drill pipe was sometimes worked up and down in the hole to knock the junk to the bottom, but this method was not always effective and was also very time consuming and expensive since it required subsequent lowering of the string all the way to the bottom with the bit removed for recovery of the junk with the type of tool previously mentioned.

A need has thus been recognized for effectively removing junk from the wall of a well bore, while also obviating the necessity of fishing it from the bottom once it has been dislodged from the wall.

SUMMARY OF THE INVENTION

It is therefore an object of this invention to provide for fishing of a well so that the aforementioned problems associated with junk which resides along the sides of the hole are at least substantially obviated.

Other objects and advantages of the present invention will become apparent from the following description and the appended claims.

In accordance with the present invention, a stream of fluid is jetted in an outward direction from a locus between the top and bottom of a well bore. The jetted fluid is forcefully impinged against the wall of the bore hole, thus dislodging junk which resides or rests on the wall. The dislodged junk is then collected in a basket on the tool before it falls to the bottom of the bore.

The invention can be carried out by means of a fishing tool which comprises a tubular body section threadably connectible at the upper end to a drilling string, a longitudinal fluid passageway in the body section of the tool which leads from the upper end thereof, a fluid channel which extends through the side wall of the body section from the passageway therein to the outside, and a basket attached to the tool for catching junk which is dislodged from the wall of the hole by jetting of the fluid.

Once installed in the string, the tool is lowered into a bore hole to one or more points where junk is suspect to reside on or in the wall of the hole. Any suitable fluid, e.g. drilling mud, is then pumped down the string and forced out of the channel in the body of the tool to effect outward jetting of the fluid and forceful impingement thereof against the wall of the hole. Junk is knocked loose by the momentum of the jetted stream of fluid and removal of junk is additionally facilitated in softer deposits by the erroding action of the fluid streams.

Dislodging of junk from the wall of the hole can be facilitated still further by jetting at least part of the fluid stream at an angle with respect to the axis of the hole, thus striking the wall at an upward or downward angle rather than perpendicularly. Furthermore, the drilling string can be turned during jetting of the fluid to set up a centrifugal action and, where preferred, the string can also be moved up and/or down to permit washing of an elongated section of the hole.

By locating a junk basket on the tool and thus above the bottom of the hole, junk can be caught before it falls to the bottom, so that additional steps of retrieval at the lower end of the hole are obviated. The tool can also be run in with a bit below the basket so that it is possible to first dislodge and basket the junk and then proceed to drill before the tool and basket are removed from the hole to recover the junk.

The tool can also be constructed in such a manner as to permit its presence in the bore hole at all times without releasing jetted streams of fluid until such is deemed necessary for the removal of junk. For instance, the body section of the tool can further comprise a previously set operable member therein which covers the channel in the wall of the body section when set and which uncovers the channel when operated. Circulation of all of the drilling fluid to a bit carried below the tool can thus be maintained until diversion of at least a portion of the fluid through the fluid channels in the tool is desired. In addition, a sealing seat can be placed in the passageway of the body section of the tool, the purpose of the seat being to receive a matching sealing surface on a flow obstructing member emplaced in the passageway. This permits the passageway in the body section to be shut off below the fluid jetting locus so that the flow of all fluid being pumped down the string is diverted through the channel in the wall of the tool and used at least temporarily for jetting against the wall of the well bore. Subsequently the obstruction in the passageway can be displaced and the fluid jetting channels closed so that flow of fluid past the tool can be resumed, e.g. to a drill bit carried below the tool.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side view, partly in section, of one embodiment of the tool of the present invention.

FIG. 2 is a side view of a weighted dart, or plunger, which can be used to operate a slidable sleeve which covers the channels in the wall of the body section of

the tool, and also to obstruct flow of fluid beyond the tool.

FIG. 3 is a side view, partly in section, of a slidable sleeve which can be used as the present operable member in the tool of FIG. 1 for covering and uncovering the channels in the wall of the body section of the tool.

FIG. 4 is a partly fragimentary and partly sectional side view of another embodiment of the invention wherein the methods of operating the sleeve are different from that shown in FIG. 1.

FIG. 5 is a sectional view of a slidable sleeve as in FIGS. 1 and 3 but which is held in position by means of a tensioned spring.

DESCRIPTION OF PREFERRED EMBODIMENTS

Referring to FIG. 1, a fishing tool is generally represented at 1 and is connected by threads to a drill pipe 2. A basket section of the tool for catching junk is generally represented at 24, being attached by threads to the lower end of the tool. A drilling bit 3 is screwed onto the lower end of the basket section. The fishing tool can thus be made up with the drilling string at the time the bit is to be lowered in the hole, and does not necessarily perform the intended function of jetting fluid until there is need to fish junk from the wall of the hole. The tubular upper body section 4 of the tool is attached at the upper end to a coupling 5 on the drill pipe 2. A passageway 6 for drilling fluid runs through the upper body section 4 and interconnects at the upper and lower ends with fluid passageways 6*a* and 6*b*, which lead, respectively, from the drill string 2 and into the junk basket 24 and the attached bit.

Channels 7 are drilled ducts which extend through the wall 8 of the body section from the passageway 6 to the outside. When the string is lowered into the bore hole these channels are normally covered over by an impervious, axially aligned slidable sleeve frictionally held in place in the passageway 6 by means of O-rings 10 attached to the sleeve in grooves. When merely drilling in the hole and fishing is not required, drilling fluid passes through the central passageway 6*c* of the sleeve which is aligned with the other passageways 6, 6*a* and 6*b*, thus maintaining a flow of drilling fluid to the bit since the channels 7 are blocked off by the sleeve which has been preset in position over the opening of the channels.

In FIG. 1, the sleeve 9 is thus shown in the preset position whereby the channels 7 are covered over. The passageway 6 in the vicinity of the sleeve is recessed for a distance in excess of the sleeve length to permit the sliding thereof when operated and to provide a chamber which accommodates the thickness of the sleeve wall, the latter feature tending to preserve the diameter of the fluid passageway 6 while also forming a shoulder 11 at the top of the chamber which serves as an upper stop for the sleeve. The upper edge 24*a* of the basket section 24 serves as a lower stop for the sleeve.

For washing the side of a bore hole in order to dislodge and recover junk in or upon the wall of the hole, channels 7 are uncovered to at least partly divert flow of fluid out of the drilling string and into the bore hole through the channels. Uncovering of the channels by a covering sleeve can be accomplished in various ways, and two apparatus arrangements intended for this purpose are shown in the drawings. FIGS. 1–3 illustrate use of a weighted dart, or plunger, which is dropped into the drilling string for displacing the sleeve downwardly to uncover the channels 7, and FIG. 4 illustrates use of a sleeve which normally covers the channels when the sleeve is bottomed, but which can be lifted by wire line to uncover the channels.

Referring to FIGS. 1–3, the dart 12 is dropped into the drilling string from the surface when jetting of drilling fluid from channels 7 is desired for removal of junk from the wall of the hole. As soon as the dart is dropped, pressurization of the drilling fluid can be resumed. The momentum of the falling dart may in itself be sufficient to drive the sleeve downward below the channels 7, but in any event both dart and sleeve are constructed so as to form a piston which can be driven downward by pumping pressure when engaged as shown in the drawing.

More specifically, the sleeve 9 comprises an attached or integral ring 13 which projects into the central passageway 6*c* and is axially aligned therewith. With the sleeve shown, the ring is machine beveled to provide an upper tapered sealing surface 13*b*. The upper part of the dart 12 is provided with a matched bevel 14, so that when the dart and the sleeve are engaged as in FIG. 1, flow of fluid past the sleeve is effectively obstructed. Therefore, elevation of pumping pressure on the drilling fluid will displace the dart and sleeve downwardly and thus uncover the channels 7 when dart and sleeve are mated as in FIG. 1.

FIG. 4 illustrates a different arrangement wherein the sleeve is normally bottomed against the lower stop 24*a* for covering of the channels 7. When there is need to divert drilling fluid into the well hole for dislodging and fishing junk from the wall of the hole, a wire line tool is lowered which engages a latch 15 on a rod 16 which extends inside the sleeve from one side to the other. The sleeve is then raised against the upper stop 11 by means of a wire line tool. A snap ring 17 which extends around the sleeve and is attached thereto in a groove engages a latching groove 18 in the wall of the passageway and thus holds the sleeve in an elevated position. The wire line is then pulled loose from the sleeve and the latter remains in place by engagement of the snap ring with the latching groove. Should it become desirable to again cover up channels 7 once the sleeve has been shifted to uncover them, e.g. after jetting of fluid against the wall of the well bore and collection of junk in the basket section, the sleeve can be relocated over the channels by an action taken at the surface. When using a sleeve and dart arrangement as shown in FIGS. 1–3, the lower spindle 19 of the dart is provided with a snap ring 20 attached in a groove so that upon entry of the dart into the sleeve the snap ring is compressed by the ring 13 into its recess, thus permitting the bevel 14 on the dart to abut the ring bevel 13*b*. However, when the dart is pulled upward through the sleeve, sufficient resistance is provided by the flat under surface of the ring to effect upward sliding of the sleeve before the ring 20 is compressed. Once the sleeve is topped against the upper stop 11, the snap ring can then be compressed by upward tugging and the dart withdrawn from the sleeve. Using an arrangement as shown in FIG. 4, the sleeve can be lowered to again cover the channels by bumping it downward with a weight on a wire line.

In FIGS. 1 and 4, the sleeve 9 is shown held in a preset position over the channels 7 by frictional means, i.e. O-rings. FIG. 5 illustrates use of a tensioned spring to

hold the sleeve in the preset position. Using such an arrangement, the sleeve is held up by spring **23** until displaced by the dart **12.** With the dart in place the sleeve can be held down and channels **7** kept open until the dart is removed with a wire line.

It will be appreciated that devices other than a sleeve could be employed as a covering member which could be previously set over the channels **7** and later operated by an action taken at the surface to uncover the members, e.g. valves can be installed which automatically open when pumping pressure is raised above a certain level. In addition, obstructing members other than a dart of plunger could be used for shutting off flow of fluid through the passageway below the channels, e.g. a normally unseated disc or valve associated with the sleeve which is moved to an open or closed condition depending upon the position of the sleeve in the passageway.

It will also be appreciated that the previously described apparatus inside the body section of the tool for uncovering and recovering the channels **7,** and also the obstruction member such as the plunger for blocking flow of fluid below the channels, is optional equipment, since the channels can in some instances be left open throughout the whole time that the string is in the hole. However, it will generally be desirable to be able to control flow through the channels while the string is in the hole so that dislodging and fishing of junk can be carried out at will with a drilling bit in place.

One feature necessary for practicing the invention is a means for basketing junk which is located on the tool above the bit and thus above the bottom of the hole. In FIG. **1,** the basket section of the tool is generally represented at **24** and is located between the upper section having the channels **7** therein and the drilling bit **3** at the lower end. The basket surrounds an inwardly tapered lower tubular body section **25** of smaller diameter than the upper body section **4** of the tool. The basket shown comprises a bucket **26** having a bottom **27** which is contiguous with the tubular section **25.** A flexible funnel **28** is attached at its lower end to the rim **29** of the bucket. Through attachment to the bucket the funnel thus becomes contiguous with the tubular section **25** to form a basket in which junk is trapped when it is dislodged from the wall of the bore hole.

The funnel **28,** being flexible, can be sized somewhat larger than the diameter of the body section of the tool and also larger than the bore hole so that it becomes compressed when lowered into the hole and thus caused to fit tightly therein. To advantage the funnel can be made of reinforced rubber and provided with metal stays **30** to continuously urge the upper rim **31** against the wall of the hole when compressed. The bucket can be provided with drain holes **32** to facilitate the gathering of junk therein when the whole tool is moved upward.

As shown in the drawings, more than one channel **7** can be bored through the wall of the body section. In addition, one or more of the channels **7** can be inclined for jetting fluid at an angle against the wall of the bore hole, and removable nozzles **21** can be installed in the channels to facilitate regulation of the velocity at which the streams are jetted against the wall. Velocity of fluid jetting and the resulting impingement force thereof against the wall of the hole can also be controlled by regulating the rate at which fluid is pumped to the tool.

During operation, fluid jets outwardly from the channels **7** as streams which forcefully impinge against the side wall of the bore hole. This process is continued until junk is knocked loose and caught in the basket. During the fishing process the drill string carrying the tool is preferably rotated and can also be moved up and down at the same time if such is preferred.

As previously indicated, the tool can be installed in the hole above a bit prior to drilling, and fishing can be carried out subsequent to one or more phases of drilling, e.g. when coming out of the hole to change or replace the type of bit being used. In such a case, the stream of fluid from the jetting locus above the bit can be kept shut off during drilling, and then turned on prior to traversal of the bit in the hole. Therefore, drilling mud which is ordinarily pumped to the point being drilled can be diverted and jetted against the wall of the hole from the jetting locus instead as the string is withdrawn from the hole, thus precleaning the hole wall prior to subsequent relowering of the string. Although particular description has been given to location of the fishing tool directly above the drilling bit, it will be appreciated that the tool and, hence, the locus for jetting of fluid could be located higher up in the drilling string when it would be preferable to do so.

In FIG. **1,** the basket section of the tool is shown in a location above the bit and below the locus for jetting of fluid from the tool, i.e. channels **7.** It will be understood, however, that the basket section can also be located on the tool above the channels **7** or, for that matter, a basket can be located both above and below the channels. Whether to locate the basket above and/or below the jetting locus depends upon the size, weight, shape, etc. of the suspected or known junk to be fished. Larger, heavier pieces may not be carried upward by the flow of fluid, and once dislodged will fall into a basket located below the jetting locus. On the other hand smaller, lighter pieces of junk can be carried upward and away from the jets of fluid so that they are suspended and hence never fall back into a basket located below the jets. In the latter case, therefore, a basket located above the jets is a suitable adaption for catching junk which becomes suspended in the jetted fluid, and baskets can be located both above and below the jets when preferred for catching relatively light and heavy fractions of junk.

While the present invention has been described with reference to particular methods, conditions, techniques, materials, apparatus arrangements and the like, it will nonetheless be understood that still other embodiments will become apparent which are within the spirit and scope of the invention defined in the following claims.

What is claimed is:

1. A well fishing tool comprising:

a. a tubular body section threadably connectible at the upper end to a drilling string,

b. a longitudinal fluid passageway in the body section of the tool leading from the upper end thereof,

c. a fluid channel which extends through the side wall of the body section from the passageway therein to the outside, and

d. a junk basket which surrounds the tubular body section of the tool and including a bucket with a bottom that is contiguous with said body section, said bucket comprising an attached flexible funnel which leads into the upper end of the bucket and

which has an open upper rim of larger diameter than the body section of the tool that the bucket surrounds, and whereupon lowering the fishing tool into a bore hole the funnel of the bucket becomes compressed and is thus caused to fit tightly into the bore hole.

2. Apparatus as in claim **1** wherein the portion of the body section surrounded by the basket is inwardly tapered.

3. Apparatus as in claim **1** wherein the lower end of the body section is threadably connectible to members of a drilling string.

4. Apparatus as in claim **1** wherein the junk basket is attached to the tool below the channel through the wall thereof.

5. Apparatus as in claim **1** and further comprising at least one other channel through the wall of the body section of the tool.

6. Apparatus as in claim **5** wherein at least one of the channels projects at an inclined angle with respect to the wall of the body section of the tool.

7. Apparatus as in claim **1** wherein the funnel is rubber.

8. Apparatus as in claim **7** wherein the funnel is reinforced rubber.

9. Apparatus as in claim **7** wherein the funnel is provided with metal stays for urging said upper rim of the funnel against the wall of a bore hole when the funnel is compressed therein.

10. Apparatus as in claim **1** and including a drilling string to which the upper end of the body section of the tool is attached.

11. Apparatus as in claim **10** wherein the body section is attached to the lower end of a drilling string.

12. Apparatus as in claim **11** and further including a member of a drilling string attached to the lower end of the body section of the tool.

13. Apparatus as in claim **1** wherein the fluid passageway extends through the body section of the tool and further comprising:

a. a previously set operable sleeve member inside the body section which covers the channel through the wall of the body section when set and which uncovers the channel when operated, and

b. a seal surface in said sleeve member which receives a matching seal surface on a flow obstructing member emplaced in said sleeve member.

14. Apparatus as in claim **13** and further comprising at least one other channel which extends through the side wall of the body section of the tool, said other channel also being normally covered by the operable member and uncovered upon operation of the member.

15. Apparatus as in claim **14** wherein at least one of the channels projects at an inclined angle with respect to the wall of the tool.

16. Apparatus as in claim **13** wherein the flow obstructing member is a plunger emplaced in said sleeve member.

17. Apparatus as in claim **16** wherein the plunger has an outward projection with a sealing surface which abuts the seal surface of said sleeve member.

18. Apparatus as in claim **16** wherein the plunger is gravity actuated.

19. Apparatus as in claim **18** and further comprising means for retrieving the plunger by wire line.

20. Apparatus as in claim **19** and further comprising a snap ring which couples the plunger and the sleeve member when the plunger is employed in the sleeve member.

21. Apparatus as in claim **13** wherein the operable sleeve member is slidable in the passageway both over and beyond the opening of the channel in the body section of the tool.

22. Apparatus as in claim **21** and further comprising an internal recess in the body section of the tool and the sleeve member is slidable in the recess.

23. Apparatus as in claim **21** and including securing means for holding the sleeve member in its previously set position over the channel in the wall of the body section of the tool.

24. Apparatus as in claim **23** wherein the securing means comprises at least one O-ring fitted into a recess around the outer circumference of the sleeve.

25. Apparatus as in claim **23** wherein the securing means is a tensioned spring which urges against the sleeve in an axial direction.

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