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HYDRAULIC TYPE JUNK BASKET FOR WELLS

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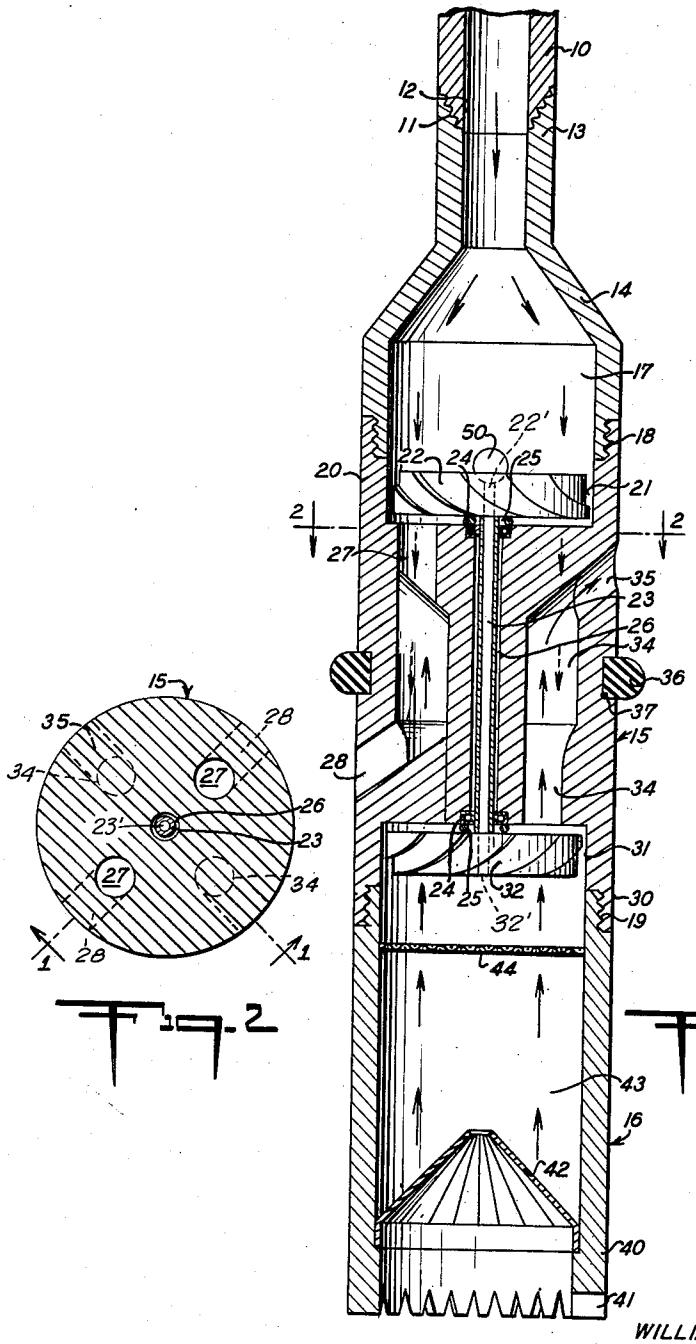


Fig. 2

Fig. 1

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HYDRAULIC TYPE JUNK BASKET FOR WELLS

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This invention relates to well tools and is particularly concerned with collection and removal of large and heavy pieces of material from the bottom of the well bore, such as broken drill parts, packer pieces, large formation fragments, and the like, known as "junk" as well as for the retrieving of drilling fish.

Junk baskets and junk catches have long been commonly used in oil well drilling practices for the removal of oil tool and drill string fragments and large formation pieces which, because of size or weight, may not be readily and freely floated upwardly through the annulus between drill string and well bore by the upward flow of drilling mud or like fluid forced downwardly through the drill string. For the most part, such junk retrievers were dependent upon mechanical or magnetic means or normal formation fluid pressure for inducing entry of the junk within the chamber provided therefor in the tool. Magnetic means are, of course, costly and limited in use to the retrieving of magnetically responsive pieces. Mechanical engaging or grappling means are inclined to be complicated in both construction and operation and frequently successful in operation, only after prolonged manipulations of the drill string and/or control means extending downwardly therethrough. Dependence upon formation fluid pressure for flowing the junk into the retrieving tools is obviously unsatisfactory, since such pressures vary under different conditions and cannot be relied upon.

It is therefore among the primary objects of the present invention to provide a novel, simple and improved tool of the character defined including means for inducing the entrance of junk into the junk receiving cavity thereof.

Another generic object of the invention is to provide power means operable by drill string pressure fluid to provide for the movement of tool fragments, formation pieces and the like through and inwardly beyond the retaining member of a junk catcher compartment.

More specifically it is an object of the invention to provide a junk catcher with means for inducing a flow of formation and/or drilling fluid therethrough whereby junk may be entrained by such fluid and delivered to the junk chamber of the catcher.

A further object of the invention is to provide for the incorporation of a fluid impeller means in a junk catcher to be driven by drill string fluid and to induce a fluid circulation causing entry of junk to the catcher.

With these and numerous other objects, features and advantages of the present invention in mind, reference may be had to the following specification taken in conjunction with the accompanying drawings in which:

Fig. 1 is a vertical sectional view of one preferred embodiment of the present invention; and

Fig. 2 is a transverse sectional view taken on the line 2—2 of Fig. 1.

In general terms that form of the invention herein presented by way of example may be characterized as

including a chambered body adapted to be detachably secured to the lower end of a drill string to receive therethrough a flow of drill string fluid. Motor means are mounted within the body to be driven by such flow of drill string fluid and a pump is operable by the motor means for inducing a flow of formation and/or drilling fluid through said body. Within the path of fluid flow, a junk chamber is disposed, preferably provided with a one-way closure permitting entry to the chamber of parts, fragments and pieces of tools, or formations constituting the "junk," the closure being operable to retain such "junk" within the chamber as the tool is retracted.

Referring now to the drawings depicting a specific structural presentation of the inventive concept the drill string to which the present tool is to be removably secured for the junk retrieving operation is indicated by the numeral **10**. The threads **11** of the lowermost drill stem pin **12** are engaged by the internal threads of a tool box portion **13** to provide for the normal threaded coupling and uncoupling of the tool and drill stem. The tool of the present invention is here shown as including an upper section **14** including the internally threaded box **13**, an intermediate motor-pump section **15** and a lower junk chamber section **16**. The upper section **14** expands outwardly from its box portion **13** in bell like fashion to provide a chamber **17** the walls of which are of equal external diameter with the cylindrical intermediate and lower sections. Threaded connections **18** and **19** unite the upper and intermediate sections and the intermediate and lower sections respectively.

The intermediate motor-pump section **15** is relatively solid compared to the chamber forming upper and lower sections **14** and **16**. Adjacent its upper threaded connection **18**, an annular wall **20** is provided defining a rotor area **21** in which is mounted a rotor **22** adapted to be driven by the downward passage thereover of drill string fluid. The rotor **22** is mounted on and for rotation with a hollow rotor-impeller shaft **23** journaled at each end in shaft bearings **24** adjacent fluid packing seals **25**. Shaft **23** extends axially through a central axial bore **26** of the intermediate motor-pump section **15** while on opposite sides thereof, drill string fluid passages **27** extend downward from the rotor area **21** emerging from the sides of the section **15**, as indicated at **28**.

In similar manner, the lower end of the intermediate section **15** is provided with a wall **30** defining an impeller area **31** within which is mounted an impeller **32** secured to the lower protruding end of the rotor-impeller shaft **23**. Formation and/or drilling fluid drawn upwardly by rotation of the impeller **32** with rotation of the rotor **22** passes through fluid passages **34** interposed between drill string fluid passages **27** to emerge from the sides of the section **15** as indicated at **35**. In order to continuously space the walls of the tool from the sides of the well bore or casing to insure freedom of fluid passage through the passages **27** and **34** and from their outlets **28** and **35**, a hard rubber ring **36** is seated within a groove **37** centrally of the intermediate section **15**. The ring **36** does not form a fluid tight seal between the tool and the casing but merely acts as a spacer. Consequently fluid may flow between the tool and the casing.

In the preferred construction here presented the shaft **23** is preferably hollow to provide a passage **23'** communicating with central apertures **22'** and **32'** extending through the rotor **22** and impeller **32** respectively to permit free flow of drill string fluid therethrough as such fluid is forced down the drill string. However, when the device is in its desired location, such flow through the tube is undesirable as precluding proper flow of power fluid to the vanes of the rotor. Thus the center of the upper face of the rotor is formed with a concave depression to

receive a sealing ball **50** which may be dropped down the drill string to seal the shaft against further downward flow therethrough, of the drill string fluid.

The lower section **16** is of generally cylindrical formation, its lower open end **40** being provided with teeth **41** to provide for a circular cutting action as the drill string is rotated, thus permitting the tool to progress downwardly about any junk or fish stem which is to be retrieved. Inwardly spaced from the open end **40** there is mounted a conventional junk trap **42** formed of inwardly directed spring fingers which may flex outwardly towards the section wall to admit junk, but which will return to inter-engaged relation under spring tension to thus constitute a one-way closure for the junk receiving chamber **43** formed thereabout. The upper limits of the chamber are defined by a transversely mounted foraminous screen **44** by which junk is precluded from passage upwardly from the chamber **43** to block or injure the impeller **32**.

In operation, the tool of this invention having been affixed to the drill string **10**, it is lowered to the position at the bottom of the well bore where junk is to be picked up or a fish is to be retrieved. At such location, rotation of the tool with the drill string will cause the teeth **41** to cut into formation and/or accumulated debris to insure ease of inclosure by the lower section **16** of the material to be received thereby. While the tool is stationary or during its rotation and downward drilling motion, drill string fluid is admitted from the string **10** through chamber **17** to the rotor area thus passing over rotor **22** and outwardly through passages **27** to the annulus between tool and well bore or casing. Such passage of drill string fluid provides a firm rotation of the rotor **22** and the shaft **23** affixed thereto. The impeller **32** also affixed to the shaft **23** will thus be rotated with the rotor and shaft and its rotation will induce flow of formation and/or drilling fluid upward through the open end **40** of section **16** and thus through closure **42**, screen **44** and outward through passages **34**. Operation of the rotor **22** and the pump impeller **32** is necessary to induce flow of fluid upwardly into the chamber **43**. This is by reason of the fact that there is a relatively free passage for the flow of fluid between the tool and the casing and consequently in the absence of operation of the pump impeller **32**, there would be little or no fluid flow into the chamber **43**.

It will, of course, be understood that such induced fluid flow will entrain and float with it junk to be entrapped within the chamber between closure and screen. Obviously, the tool is effective for the retrieving of junk forced into the chamber by encompassment as the tool moves downwardly thereover, regardless of induced fluid flow. The tool is also effective to entrap junk caused to flow thereinto by formation pressure irrespective of induced flow by the impeller. It is to be further understood, that while the term "junk" is used to define the usual material entrapped and taken from the well bore, such term is broadly used to include the engagement of fish as well as bits and fragments of tools, drill rods, casing or formation.

Having thus set forth one practical and economic structural embodiment of the invention, it will be understood that the invention is not limited or restricted to the structural embodiment here presented and that numerous changes, modifications and the full use of equivalents may be resorted to in the practice of the invention without departure from the spirit or scope thereof as outlined in the appended claims.

What is claimed is:

1. A junk catcher comprising an upper section, means on said upper section for threadedly engaging the lower end of a drill string section to support said junk catcher in a well, a fluid chamber in said upper section for receiving drilling fluid from said drill string, a central section secured to the lower end of said upper section, a rotor chamber in the upper end of said central section communicating with said fluid chamber, a rotor disposed

in said rotor chamber, an impeller chamber in the lower end of said central section, an impeller disposed in said impeller chamber, a longitudinally extending hollow shaft rotatably mounted in said central section and fixed to said rotor and said impeller, central apertures extending through said rotor and impeller and communicating with said hollow shaft, removable means for closing the upper end of the aperture in said rotor, fluid passages in said central section extending from said rotor chamber to the exterior of said central section for conducting fluid passing through said rotor from said rotor chamber into said well, other fluid passages in said central section extending from said impeller chamber to the exterior of said central section for conducting fluid passing through said impeller from said impeller chamber into said well, a lower section secured to the lower end of said central section, said lower section being open at the lower end, a junk chamber in said lower section communicating with said impeller chamber, means in said lower section for permitting entry of junk into said junk chamber and for preventing inadvertent removal of junk therefrom and means in said junk chamber for preventing movement of junk into engagement with said impeller whereby upon a downward flow of fluid through said drill string and rotor said impeller will be driven to induce a flow of fluid from said well upwardly into said junk chamber to facilitate movement of junk into said junk chamber.

2. A junk catcher comprising an upper section, means on said upper section for threadedly engaging the lower end of a drill string section to support said junk catcher in a well, a fluid chamber in said upper section for receiving drilling fluid from said drill string, a central section secured to the lower end of said upper section, a rotor chamber in the upper end of said central section communicating with said fluid chamber, a rotor disposed in said rotor chamber, an impeller chamber in the lower end of said central section, an impeller disposed in said impeller chamber, a longitudinally extending hollow shaft rotatably mounted in said central section and fixed to said rotor and said impeller, central apertures extending through said rotor and impeller and communicating with said hollow shaft, removable means for closing the upper end of the aperture in said rotor, fluid passages in said central section extending from said rotor chamber to the exterior of said central section for conducting fluid passing through said rotor from said rotor chamber into said well, other fluid passages in said central section extending from said impeller chamber to the exterior of said central section for conducting fluid passing through said impeller from said impeller chamber into said well, a lower section secured to the lower end of said central section, said lower section being open at the lower end, a junk chamber in said lower section communicating with said impeller chamber and means in said lower section for permitting entry of junk into said junk chamber and for preventing inadvertent removal of junk therefrom whereby upon a downward flow of fluid through said drill string and rotor said impeller will be driven to induce a flow of fluid from said well upwardly into said junk chamber to facilitate movement of junk into said junk chamber.

3. A junk catcher comprising an upper section, means on said upper section for threadedly engaging the lower end of a drill string section to support said junk catcher in a well, a fluid chamber in said upper section for receiving drilling fluid from said drill string, a central section secured to the lower end of said upper section, a rotor chamber in the upper end of said central section communicating with said fluid chamber, a rotor disposed in said rotor chamber, an impeller chamber in the lower end of said central section, an impeller disposed in said impeller chamber, a longitudinally extending shaft rotatably mounted in said central section and fixed to said rotor and said impeller, fluid passages in said central section extending from said rotor chamber to the exterior of said central section for conducting fluid passing through

said rotor from said rotor chamber into said well, other fluid passages in said central section extending from said impeller chamber to the exterior of said central section for conducting fluid passing through said impeller from said impeller chamber into said well, a lower section secured to the lower end of said central section, said lower section being open at the lower end, a junk chamber in said lower section communicating with said impeller chamber and means in said lower section for permitting entry of junk into said junk chamber and for preventing inadvertent removal of junk therefrom whereby upon a downward flow of fluid through said drill string and rotor said impeller will be driven to induce a flow of fluid through said well upwardly into said junk chamber to facilitate movement of junk into said junk chamber.

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