Oct. 22, 1968 A. B. BAUMSTIMLER 3,406,757

WELL CLEAN-OUT TOOL

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FIG. 3.

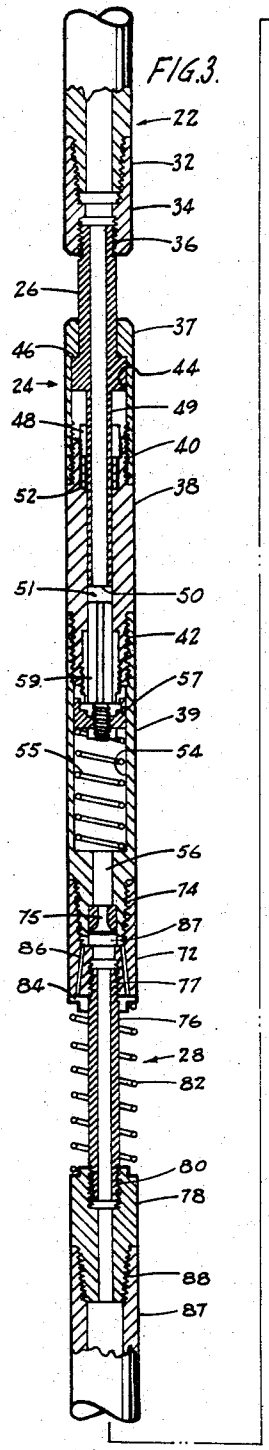


FIG. 2.

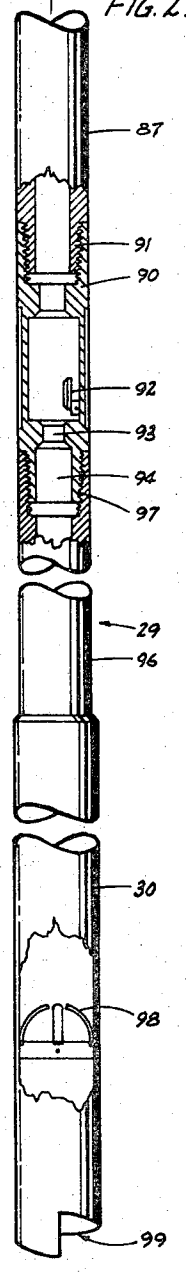
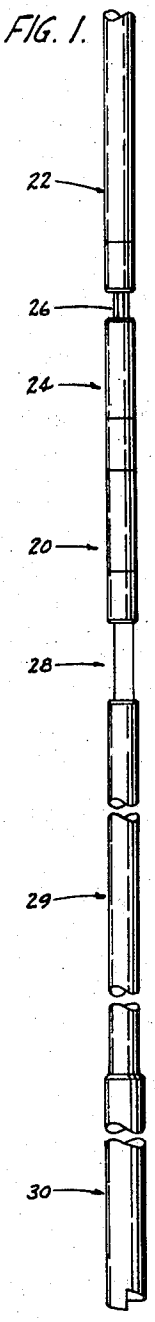


FIG. 1.



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FIG. 5

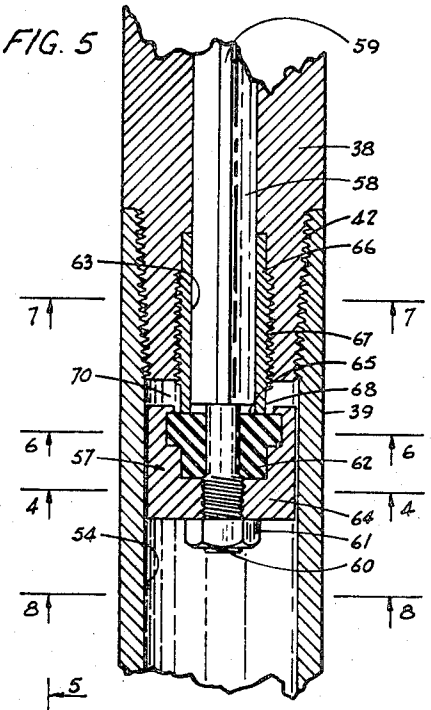


FIG. 4.

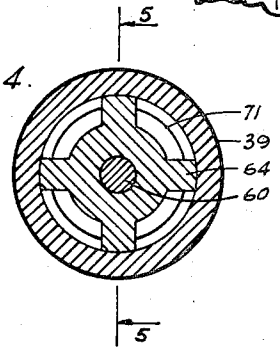


FIG. 6.

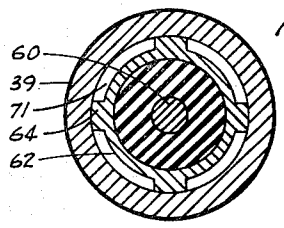


FIG. 7.

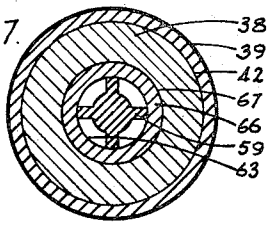
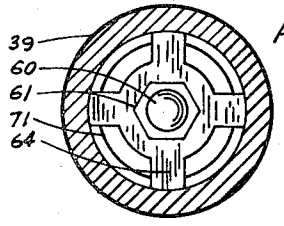


FIG. 8.



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WELL CLEAN-OUT TOOL

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Filed July 19, 1967, Ser. No. 654,453
7 Claims. (Cl. 166—99)

ABSTRACT OF THE DISCLOSURE

A well clean-out tool for retrieving junk or undesired objects from the bottom of a well. The tool may be run into an oil well or the like by a drill pipe or a wire line, and includes a junk section at the lower end thereof, a chamber having a check valve associated therewith, a relief valve for controlling the internal pressure of the tool, and a metering device in the form of an orifice which is interposed between the relief valve and valve unit. The valve unit is actuated by a splined lost-motion coupling device which is interposed between the valve element of the valve unit and the drill pipe. The splined lost motion coupling enables rotation of the drill stem to impart rotational motion to the tool which in turn centers the junk at the bottom of the hole with respect to the inlet to the junk section.

Background

Various well clean-out tools are known in the art. Many devices of the prior art are adapted for use in shallow water wells and the like and generally depend upon the reciprocatory action of the drill stem, or the cable tool, to cause any loose debris to be admixed with the well fluid, whereupon the debris, along with the fluid, flows into the tool. The lower extremity of the tool is generally provided with a check valve which is upset to the open position when the tool strikes the bottom of the bore hole.

Well clean-out tools for the same general purposes of the instant invention are also known. These tools depend upon the pressure differential between the bottom of the bore hole and the interior of the tool to provide the means by which the debris, along with the well fluid, is forced into the tool. Generally, these devices are actuated by a motion of the drill stem which upsets a valve arrangement to thereby allow a sudden surge of fluid to flow into the device. The valve arrangement associated with tools of the prior art do not always perform satisfactorily inasmuch as a suitable seal has been lacking and accordingly, as the tool is returned to the surface, a substantial amount of the debris is lost from the tool.

In some tools of the prior art, the long column of fluid contained therewithin presents a sufficient liquid head to cause leakage from the tool as it is returned to the surface. Furthermore, in high pressure (or very deep) wells, the fluid flow into the tool occurs with an excessive release of energy thereby causing the tool to "jump" off the bottom, whereby junk or debris fails to enter the junk section of the tool. This is especially so when a wire line is used to run the tool into the hole.

Summary

The present invention includes a well clean-out tool having a valve unit at the upper extremity thereof which is directly actuated by reciprocatory motion of the drill tubing or the like. The valve unit includes a resilient valve element which is urged or biased into seating relationship against a replaceable seat member. The internal pressure of the tool is controlled by a relief valve in order to prevent damage to the tool when coming out of the hole. The relief valve is spaced apart from the valve unit to provide a fluid containing chamber therebetween. A metering device in the form of an orifice is interposed between the valve unit and the relief valve in order to control sudden pressure surges. Spaced apart from and located below the relief valve is a third valve which provides a third fluid chamber. An enlarged chamber having a junk basket near the inlet or entrance of the tool forms the terminal end of the device and provides the tool with means by which large debris may be trapped within the device. The valve is actuated by a splined lost motion coupling which enables reciprocatory motion of the drill stem to upset the valve to the opened position, while at the same time allows the drill stem to impart rotational motion to the entire tool in order to center any junk contained in the bottom of the hole with respect to the junk basket.

It is therefore a primary object of the present invention to provide a well clean-out tool which is actuated in response to movement of a wire line or a drill string to which the tool may be attached.

Another object of the present invention is the provision of an improved valve assembly for a well clean-out tool.

A still further object of the present invention is the provision of a well clean-out tool which is fabricated into a number of sub-components which enables rapid assembly and disassembly thereof, to thereby expedite cleaning the tool after it has been used in removing debris from a well.

A still further object of the present invention is the provision of a well clean-out tool having means associated therewith which functions in a manner to improve the operation of the tool as well as to protect the various components of the tool from the high pressures associated with a deep well.

Another object of the present invention is the provision of a well clean-out tool having an orifice associated therewith which improves the stability of the tool when it is used in high pressure applications.

A still further object of the present invention is the provision of a hex lost motion coupling which enables reciprocatory or longitudinal motion of the supporting means to upset a valve means, while at the same time allows rotational motion of the supporting means to impart rotational motion to the tool.

The above objects are attained in accordance with the present invention by the provision of a well clean-out tool which is fabricated from a number of subcomponents to provide a junk catching section, a smaller section having a check valve interposed between the junk section and the main valve section, and a main valve section having a valve element therein which is upset to the open position by the action of the drill stem, and which is moved to the closed position by the action of the drill stem. The internal pressure of the tool is determined by a relief valve element. The valve unit includes a splined lost-motion coupling located between the drill stem and the valve stem, and includes a resilient member which is urged into seating relationship against a replaceable valve seat.

Brief description of the drawings

FIGURE 1 is a general view of a well clean-out tool with some parts broken away in order to better illustrate the entire device;

FIGURE 2 is an enlarged fragmentary representation of a portion of the device seen in FIGURE 1, with some parts being broken away so as to disclose the interior thereof, and other parts being broken away and shown in section in order to better describe the details thereof;

FIGURE 3 is also an enlarged fragmentary representation of part of the device seen in FIGURE 1, with some parts being broken away and shown in section in order to better illustrate the details thereof;

FIGURE 4 is a still further enlarged cross-sectional view taken along line 4—4 of FIGURE 5;

FIGURE 5 is a cross-sectional representation taken along line 5—5 of FIGURE 4, with some of the parts being shown in perspective;

FIGURE 6 is a cross-sectional view taken along line 6—6 of FIGURE 5;

FIGURE 7 is a cross-sectional view taken along line 7—7 of FIGURE 5; and,

FIGURE 8 is a partial cross-sectional view taken along line 8—8 of FIGURE 5.

Brief description of the preferred embodiments

FIGURE 1 illustrates an oil well tool as generally indicated by the arrow at numeral **20**, which is attached to the lower terminal end of a drill pipe **22** and includes a first valve section **24**. The valve section is connected to the before mentioned drill pipe or tubing by means of a splined valve actuator **26**, which preferably is hexagonal in cross-section. A relief valve assembly **28** interconnects a trap section **29** with a junk section **30**, with the lower extremity of the junk section providing the inlet to the tool.

Looking now to the details of FIGURES 2 through 8, wherein there is disclosed in greater detail the before mentioned lower terminal end of the drill string **22**, having threads **32** thereon, which rigidly attaches the string to a coupling **34**. The coupling **34** is provided with threads **36** which rigidly engages the before mentioned splined valve actuator **26**. The term "splined" is intended to include any geometrical cross-sectional pattern which precludes relative movement between the actuator and the remainder of the tool.

The first valve section **24** includes an upper cylindrical member **37**, a centrally located cylindrical member **38**, and a lower cylindrical member **39**. Members **37** and **38** are threadedly secured to each other by means of threads **40**. Members **38** and **39** are secured together by means of threads **42**. The valve actuator is held attached to the first valve section by means of enlargement **44**. The enlargement **44** reciprocates between the limits provided by upper and lower stop means **46** and **48** respectively. Depending from the enlargement **44** is a polished section **49** which terminates at **50**. The polished portion of the valve actuator reciprocates within a packing gland **52** which is held suitably tightened by the before mentioned stop means **48**, which therefore also serves as a packing nut. Accordingly, the valve actuator **26** is reciprocatingly received by the first valve section **24** wherein the actuator guidably reciprocates within section **37**, packing nut **48**, packing **52**, and the drilled passageway of member **38**. Since the hex shaped valve actuator is slidably received in close fitting tolerance by a female member **37** having an internally hex shaped passageway therein, rotational motion of drill stem **22** imparts rotational motion to the tool. While the illustrated actuator is preferably hex shaped, it should be understood that any splined connection will serve this same purpose, as pointed out above.

The lower member of the first valve section includes an enlarged passageway **54** which houses compressed spring **55**. The passageway reduces in diameter at **56** in order to provide a chamber within which a valve element **57** may be reciprocated as well as providing a cage for the spring. Other purposes of the chamber will be explained in greater detail later on.

The valve element **57** includes a valve stem **58** which is in the form of a cross, with each arm of the cross radiating from the stem as seen at **59**. The valve stem reduces to a rod having a threaded depending end **60** which receives a nut **61** thereon. A resilient valve member **62** is held captive within a finned housing **64**. The force exerted by the nut forces the housing **64** and the stem **58** against the resilient valve member **62**, and spring **55** urges the assembly in an upward direction to thereby force the face **65** against the lower terminal end portion of removable valve seat assembly **66**. Assembly **66** is secured to the central member **38** by means of threads **67** to thereby enable rapid replacement thereof when the seat has become worn. The valve engaging seat is on the lower depending end portion of the seat assembly as seen at **68**. Accordingly, an annulus **70** is provided between the valve element **57** and the centrally located member **38**. A passageway is therefore formed between the chamber **54** and the annulus **70** by means of the passageway **71** located between the radiating fins which form a part of the housing **64**.

The resilient valve member is comprised of a replaceable neoprene rubber seat which is resistant to the deleterious effects of the oil, gas, and mud generally encountered in bore holes. The resilient member is preferred to metals since small debris caught between the face and seat will not prevent the valve from properly seating. The rubber seat is also resistant to the cutting action or erosion which may be encountered in deep wells as a result of fluid carried debris flowing between the valve seat and the valve member.

The lower section of the first valve section is threadedly connected to a second valve section **72** by means of threaded connection **74**. An orifice **75** is removably received within the lower terminal end portion of member **39** to regulate the flow of fluid into chamber **54**. The second valve section **72** is rigidly attached to the reduced member **76** by means of the threaded connection **77**. The opposite end of member **76** is fastened to the sub-assembly **78** by means of the threaded connection **80**. The upper extremity of the sub-assembly is provided with the illustrated shoulder which maintains spring **82** in properly aligned relationship. The spring **82** biases a valve element **84** in the upward direction and with a predetermined force to thereby seat the valve element against the illustrated multiplicity of radially spaced passageways **86** which interconnect the passageway **87** (located below the orifice) with the bore hole. Accordingly, the force exerted by spring **82** determines the magnitude of the pressure differential between chamber **87** and the ambient.

The sub-assembly **78** is connected to the tubing **87** by means of the threads **88**. Tubing **87** threadedly engages a check valve carrying member **90** by means of threads **91**. The check valve is seen at **92** and cooperates with a valve seat **93** to thereby enable fluid flow in an upward direction while precluding fluid flow in a downward direction. The valve seat enlarges in a downward direction into a passageway **94** which enlarges still again into a passageway located in the junk section **96**. The junk section **96** is connected to the tubing **90** by means of the threaded connection seen at numeral **97**. A junk basket **98**, the details of which are known in the art, is suitably attached within the junk section as seen at **98**. The inlet to the apparatus is generally indicated by the arrow at numeral **99**.

Operation

The clean-out tool, when attached to a support means, such as a drill stem **22**, may be run into the well when assembled in the illustrated manner of FIGURE 1. As the inlet **99** strikes the bottom of the bore hole, or the bottom of the casing, the valve actuator **26** will telescope into the cylindrical member **37** and continue in a downward direction to thereby upset the valve assembly when the terminal end **50** abuts the upper terminal end of valve stem **58**. This action causes the valve stem **58** to move in a downward direction against valve spring **55**, which unseats the valve assembly **57** from the face **68** of valve seat **66**, to thereby permit fluid flow to occur into the inlet **99**. Fluid, along with any debris contained therein, enters inlet **99** and flows past the junk basket **98**.

The well fluid and junk flow through check valve **92** and into the passageway provided within member **87**. Junk, consisting of large debris, is caught in section **30** where the junk basket **98** retains the junk therewithin.

The reduced diameter **94** increases the velocity of fluid flow to cause smaller debris which failed to separate from the fluid to flow along with the fluid into member **87**, where some of the debris remains therewithin, depending upon their size and density.

The still further reduced diameter passageway between members **87** and **76** impart additional velocity to the flowing fluid, with the fluid pressure being primarily regulated by the orifice **75**.

The relief valve **84** is preferably circular in appearance and has a face opposite the spring receiving shoulder which seats against radially spaced passageways **86** with a force which is proportional to the compressed spring **82**. Accordingly, the maximum allowable pressure within chamber **87** is controlled by the relief valve. The primary purpose of the relief valve is to relieve the internal pressure of the tool as the tool is removed from the hole. This is especially important in high pressure or deep wells.

The size of the replaceable orifice **75** is selected to control the fluid flow into chamber **54** in accordance with the bottom hole well pressure anticipated to be encountered when the tool is made up. The quick change orifice prevents a sudden surge of fluid into the tool, which might otherwise cause the tool to "jump" off the bottom upon actuation of valve **57**, to thereby leave junk on the bottom of the hole. This action is more likely to occur when the tool is run into the hole on a wire line since the drill stem or chamber above the valve is limited to a small volume. Therefore, in wells having a high bottom hole pressure the fluid flow through the tool causes the inlet to jump off the junk whereby the debris fails to enter the junk section. The orifice prevents this action.

Fluid from orifice **75** is received by chamber **54** where it continues to flow through the passageway **71** (FIGURE 4) of the radially spaced fins **64**, into annulus **70**, between valve seat **68** and valve element face **65**, between the radially spaced fins **59** of valve stem **58**, and into the hollow passageway of the valve actuator **26**. The flow then enters the hollow drill pipe where it is free to flow toward the surface of the ground until the pressure is equalized or until the tool is lifted in an upward direction to close valve **57**.

Closure of the valve unit is effected by raising the drill pipe vertically upward until gravity permits actuator **26** to assume the position illustrated in FIGURE 3. This action permits spring **55** to return valve face **65** into seating engagement against face **68**. The spring **82** maintains passageways **86** closed at all time, and check valve **92** returns to the closed position. Fluid may now drain from the junk section **29** by means of inlet **99** after the tool is lifted free of the fluid surface contained in the well. However, any junk which has entered the tool is entrapped by basket **98** and is held within section **29**. Smaller debris that failed to remain within section **29** will be trapped above check valve **92**. Fluid and exceptionally small debris will be located above the orifice **75**, with some of the debris being left in chamber **54** and other debris being located within the hollow drill pipe.

The debris which returns through relief valve **84** as the tool is returned to the surface is of no import since they are of sufficiently small size to be tolerated by the normal operation of the tool.

The foregoing is considered as illustrative only of the principles of the invention. Further, since modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly all suitable modifications and equivalents may be resorted to, falling within the scope of the invention as claimed.

I claim:

1. A well clean-out tool having an inlet, an outlet, with the outlet adapted to be connected to the terminal end of a supporting means such as a drill pipe, comprising, in combination, a valve unit, a relief valve, a trap, and a junk basket;

means forming a passageway through said tool;

said junk basket being located within said passageway and disposed near said inlet and spaced apart from and below said trap to thereby form a junk containing chamber;

said trap being located in said passageway and including a check valve means disposed below and in spaced apart relationship to said relief valve, to thereby form another junk containing chamber;

said relief valve being located in communication with said passageway and including means controlling fluid pressure within said tool and disposed below and spaced apart from said valve unit;

said valve unit including a valve element and a valve stem connected to said valve element, a valve seat assembly having a face thereon which cooperates with said element to permit fluid flow when moved to a first position, and to prevent fluid flow when moved to a second position; said valve unit being disposed within said tool and near said outlet; and

a valve actuator means depending from said tool and forming the recited means by which said tool is connected to the supporting means, for actuating the valve unit from the opened to the closed position, and vice versa, in accordance with the relative position of the supporting means with respect to the tool, said actuator having means forming a flow path therethrough which is a continuation of said passageway.

2. The combination of claim **1**, and further including means forming an orifice in said passageway for controlling the flow of fluid from said relief valve to said valve unit.

3. The combination of claim **1** wherein said valve actuator means is connected to actuate said valve stem by a lost motion coupling means;

said valve stem including an elongated member with fins radiating therefrom for forming a fluid flow path, a housing affixed to the terminal end of said stem, said housing having fins radiating therefrom to form a passageway across the housing, and for holding said valve element therein, the outer edge portion of said fins fitting in close tolerance relationship with respect to the inside wall surface which forms said passageway;

whereby, a flow path is formed from said relief valve, through said housing fins, through said valve, through said valve stem fins, and into said last motion coupling.

4. The combination of claim **1**, and further including a lost motion coupling associated with said valve unit, and having a first portion, which includes said valve actuator means, depending from said tool;

an elongated second portion depending from said first portion of said lost motion coupling, said second portion being slidably received in close tolerance relationship within said passageway;

said second portion having an enlargement thereon to thereby form an upper and lower shoulder;

motion limiting means including said upper and lower shoulder for limiting reciprocatory motion of said valve actuator means;

a lower terminal end portion depending from said enlargement and positioned in spaced apart relationship with respect to the upper depending end of said valve stem; whereby:

vertical downward movement of the supporting means enables said valve element to disengage said valve seat face, and vertical upward movement of the supporting means allows said valve element to engage said valve seat face.

5. The combination of claim **1**, and further including

a lost motion coupling forming part of said valve actuator means;

said passageway being splined for a limited distance at the upper terminal end thereof;

said part depending from said tool having an upper terminal end adapted to be affixed to a drill pipe, a splined portion received by said splined passageway, and further including a lower terminal end spaced apart from said valve stem, with a polished elongated portion located between each end;

said polished portion having an enlargement formed thereon and including an upper and lower face;

means, including said upper and lower face, providing motion limiting means whereby said lost motion coupling reciprocates a limited distance within said tool; whereby

said polished portion of said lost motion coupling cooperates with the drill pipe to thereby move the valve stem to permit flow through said tool, and said splined portion of said lost motion coupling enables rotational motion to be imparted to said tool upon rotation of said part depending from said tool.

6. The combination of claim 5, and further including

means forming an orifice, said orifice being removably affixed within said passageway for controlling flow of fluid through said passageway.

7. The combination of claim 5, wherein said valve stem includes an elongated member with fins radiating therefrom for forming a fluid flow path, a housing affixed to the terminal end of said stem, said housing having fins radiating therefrom to form a passageway across the housing, and for holding said valve element therein, the outer edge portion of said fins fitting in close tolerance relationship with respect to the inside wall surface which forms said passageway;

whereby, a flow path is formed from said relief valve, through said housing fins, through said valve, through said valve stem fins, and into said lost motion coupling.

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JAMES A. LEPPINK, *Primary Examiner.*

Disclaimer

3,406,757.—*August B. Baumstimler*, Odessa, Tex. WELL CLEAN-OUT TOOL. Patent dated Oct. 22, 1968. Disclaimer filed June 19, 1978, by the inventor.

Hereby enters this disclaimer to claims 1, 3, 4, 5 and 7 of said patent.

[*Official Gazette August 29, 1978.*]

Dedication

3,406,757.—*August B. Baumstimler,* Odessa, Tex. WELL CLEAN-OUT TOOL. Patent dated Oct. 22, 1968. Dedication filed Jan. 30, 1984, by the inventor.

Hereby dedicates the remaining term of said patent.

[*Official Gazette March 12, 1985.*]