

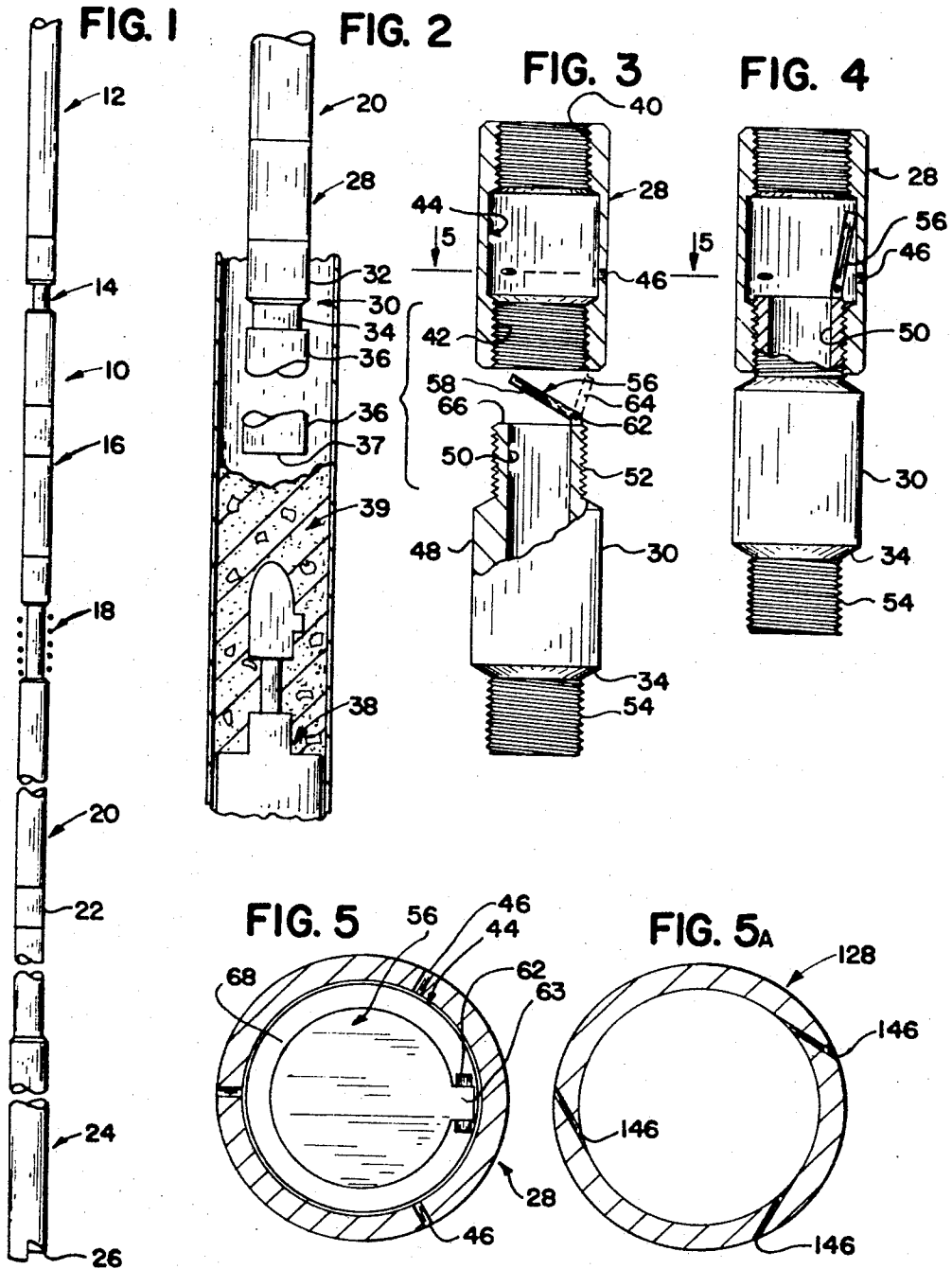
May 27, 1969

A. B. BAUMSTIMLER
METHOD AND APPARATUS FOR SIMULTANEOUSLY CLEANING
A WELL AND REMOVING A DOWNHOLE TOOL

3,446,283

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Sheet 1 of 2



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FIG. 6

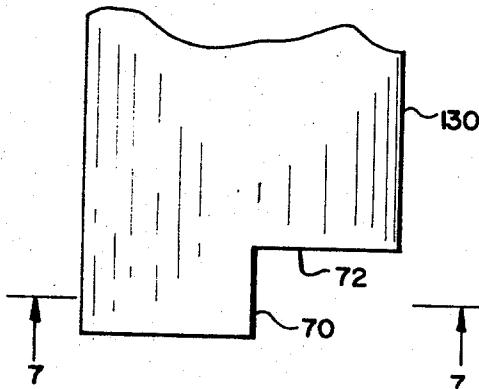


FIG. 8

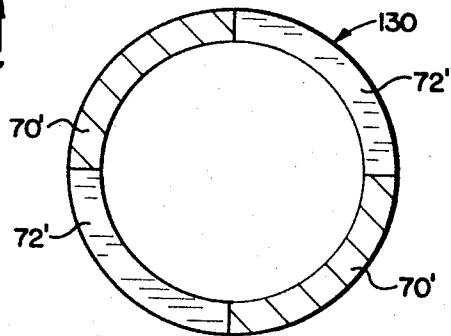


FIG. 7

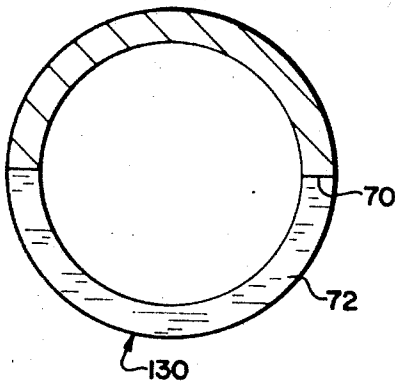
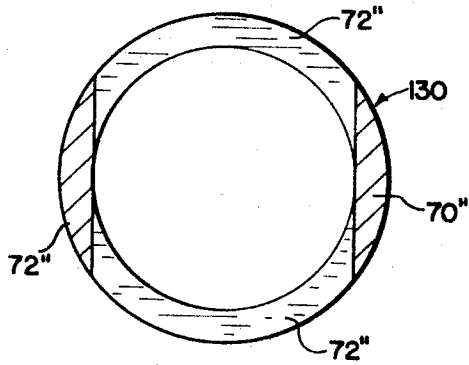


FIG. 9



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METHOD AND APPARATUS FOR SIMULTANEOUSLY CLEANING A WELL AND REMOVING A DOWNHOLE TOOL

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Continuation-in-part of application Ser. No. 654,453, July 19, 1967. This application Jan. 2, 1968, Ser. No. 694,926

Int. Cl. E21b 37/00, 31/08, 27/00

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11 Claims

ABSTRACT OF THE DISCLOSURE

A hydrostatic sand retriever in the form of a downhole tool string for cleaning the bottom of a borehole and for retrieving a downhole removable tool in a single round trip into the well. The tool string is preferably attached to the depending end of a drill or tubing string. The downhole tool string is comprised of a well cleanout tool having a telescopingly actuated relief valve which controls a sand catching valve means associated with the lowermost portion of the string and which accommodates a downhole tool retriever at the lower terminal end thereof. The assembled downhole tool string is lowered into the well in the usual manner until the retriever contacts debris which covers the downhole removable tool. Further downward movement of the downhole tool string actuates the telescoping relief valve associated with the well clean out tool to the open position to thereby cause a flow of debris thereinto as the retriever is lowered into contact with the downhole removable tool. Engagement of the downhole tool retriever with the removable downhole tool enables the entire downhole tool string along with the removable downhole tool to be lifted from the well, all in a single round trip.

Cross reference to related application

This is a continuation-in-part of my previously filed patent application entitled, "Well Cleanout Tool," filed July 19, 1967, Ser. No. 654,453, now Patent No. 340,757.

Background of the invention

Well cleanout tools are known in the art. In my previously filed patent application, Ser. No. 654,453, filed July 19, 1967 and entitled "Well Cleanout Tool," of which this patent application is a continuation in part, there is set forth therein a well cleanout tool which can be lowered into a well by utilizing either a drill string or a wire line, all in a manner so as to enable removal of debris which may be located in a well. The details of this tool are therefore available to those who are not familiar with the operation of this type apparatus, part of which forms the subject of the present invention.

In perforating a well, a multiplicity of spaced apart apertures are formed in the casing with the apertures being located in close proximity of the oil producing strata. From time to time it has been found advantageous to place a bridge plug below this producing formation and perhaps between other adjacent producing formations in order to enable the treatment of a single oil producing strata. Sometime various chemical, along with small ball sealers and sand, is pumped into the well in order to properly treat a single oil bearing formation to thereby increase the production of the well. This operation is generally referred to as "acidizing" or sometime as "fracturing." After fracturing a well in this manner, the balls along with sand and other debris fall to the bottom of the well. Where a bridge plug is located in a well which cannot be circulated, and below the area or zone which has been treated, several feet of debris in the form of balls, sand, and the like,

cover the removable bridge plug, and accordingly when a bridge plug retriever is run in on a tubing string the J-slot of the retriever is prevented making proper contact with the control bar head of the removable bridge plug because of the column of debris located above the plug. This column sometimes extends thirty to forty feet above the plug and provides an effective barrier which precludes access thereto.

When the bridge plug is thus blocked by sand and debris, sometime it is possible to actuate the retriever by means of the tubing string so as to stir the debris sufficiently to enable lowering the retriever through the stirred up liquid and debris, and into contact with the removable bridge plug. This is not always possible, and accordingly a well cleanout tool must then be utilized, such as the well cleanout tool mentioned in the above parent application. However, two trips into the well are required; the first trip being to remove the debris by means of the well cleanout tool, whereupon the retrieving tool is then run into the bore hole, usually by means of a tubing string, and the bridge plug picked up all in a manner known to those skilled in this particular art.

The extra trip into the well is costly, and sometime more than an entire day will be expended in removing the bridge plug in the above manner.

Summary

This invention relates to a well cleanout tool in combination with a retrieving tool, for retrieving bridge plugs and the like, and a special adapter interposed between the retriever and the cleanout tool which enables a downhole tool string to be assembled for cleaning the bottom of a bore hole and for retrieving a removable downhole tool in a single trip into the well, wherein the well cleanout tool upon contacting a layer of debris located at the bottom of the borehole upsets a relief valve whereupon fluid laden debris flows through or past the retriever, through the sand valve means, and into the cleanout tool. This action enables the lower terminal end of the retriever to be placed in contact with the removable bridge plug, whereupon engagement therebetween enables the removable bridge plug to be brought to the surface of the ground. This combination of tools enables the removal of a bridge plug and the cleaning of the well in a single round trip into the bore hole.

It is therefore a primary object of the present invention to provide a method of simultaneously cleaning the bottom of a bore hole, or oil well, and removing a downhole tool therefrom.

Another object of the present invention is the provision of a method of simultaneously cleaning debris from and removing a bridge plug from a bore hole.

A still further object of the present invention is the provision of an apparatus which enables the simultaneous cleaning of the bottom of a bore hole and the removal of a downhole tool, such as a packer or a bridge plug.

A further object of the present invention is the provision of a string of tools which enables debris to be removed from the bottom of the borehole and a downhole tool to be removed therefrom by making only a single trip into the well.

Another object of the present invention is the provision of a combination well cleanout tool and downhole tool retriever which are connected together in a manner which enables the downhole tool to be freed of debris and the downhole tool removed from the well, all in a single operation.

A further object of the present invention is the provision of a well cleanout tool having an adapter valve thereon which enables a tool retrieving device to be incorporated therewith so as to provide a new combination which enables a well to be cleaned out and a removable

plug to be removed therefrom all in a single trip into the well.

These and other objects are attained in accordance with the present invention by the provision of a combination downhole tool string broadly made substantially in accordance with the objects of the present invention.

Brief description of the drawings

FIGURE 1 is a side elevational view illustrating a well cleanout tool which is the subject matter of another disclosure; and, a part of which is incorporated into the present invention;

FIGURE 2 is a fragmentary partly cross-sectional representation of a combination downhole tool string made in accordance with the present invention, and shown in its operative relationship with respect to a borehole;

FIGURE 3 is an enlarged exploded view of part of the device seen in FIGURE 2, with some parts being cut away and shown in section in order to better illustrate the present invention;

FIGURE 4 is a part cross-sectional view of the device seen in FIGURE 3, with the parts thereof shown in assembled condition;

FIGURE 5 is a cross-sectional view taken along line 5—5 of FIGURE 3, with some additional parts being shown in order to better illustrate the invention;

FIGURE 5A is a cross-sectional view similar to and showing a modification of FIGURE 5;

FIGURE 6 is an enlarged fragmentary elevational view of still another modification of the present invention;

FIGURE 7 is a cross-sectional view of another modification of the tool string of the present invention, taken along line 7—7 of FIGURE 6;

FIGURE 8 is a view similar to FIGURE 7 and showing another modification of the present invention; and

FIGURE 9 is still another modification of the device similar to the one seen in FIGURE 7.

Description of the preferred embodiments

FIGURE 1 shows an apparatus which is used for cleaning debris from boreholes. As seen in FIGURE 1, a well cleanout tool, generally indicated by the arrow at numeral 10, maybe attached to the lower depending end of a drill stem 12, or alternatively may be connected to a wire rope by means of a suitable swivel connection, as is known to those skilled in the art. A relief valve assembly having a splined actuator 14 is attached to a debris containing chamber 20 which enables the valve to be upset when the tool is rested with the lower terminal end thereof bearing upon a supporting surface such as may be formed by debris at the bottom of a borehole or any other surface which enables the spline to move in a manner to telescopingly actuate the relief valve. A sub 22 having a flapper valve therein interconnects the junk basket 24 with the chamber 20 to thereby enable fluid carrying debris to flow into the terminal end 26 of the cleanout tool and into the chamber 20, whereupon debris and fluid settle out within various portions of the cleanout tool, all of which is described in the above copending patent application.

The apparatus disclosed in FIGURE 2 includes the chamber 20 of the well cleanout tool seen in FIGURE 1, however, beginning with the valve housing sub 28, various other tool combinations have been incorporated into the assembly as will hereinafter be explained in sufficient detail so as to enable others skilled in the art to fully comprehend the present invention.

As further seen in FIGURE 2, in conjunction with the remaining figures, the valve housing sub has a threaded upper and lower end which enables the sub to be threadedly connected to chamber 20 and to the valve carrying adaptor 30, with the adaptor threadedly engaging the before mentioned housing. The lower depending end of the adaptor is reduced or enlarged as seen at 34 and provided with threads to enable suitable connection thereof to a retrieving tool 36, hereinafter called the "retriever."

The specific retriever selected for illustration of the present combination is a "Baker" type removable packer retriever tool (Baker model C Retrievable Bridge Plug) which has an inlet passageway 37 and means therewithin adapted to engage the upper terminal end of a removable bridge plug, or packer 38, hereinafter called a removable plug. When the retriever properly engages the upper terminal end of the plug and is pulled in an upward direction, the plug is un-anchored or disengaged from the side-walls of the borehole whereupon the plug along with the retriever and well cleanout tool may all be vertically lifted from the borehole as a single string of tools. As further seen in FIGURE 2, the illustrated bore hole is filled with debris 39 which includes sand, sludge, and balls; all of which was previously used in treating a well, but which covers the plug and prevents removal thereof.

Looking now to the details of FIGURE 3, wherein the before mentioned sand valve is seen to include a housing sub which is shown disengaged from the valve carrying adaptor. The housing sub includes upper and lower female threads 40 and 42 respectively, which are spaced apart by an enlarged chamber 44. Radially extending desanding ports 46 are placed 120° apart and communicate the exterior of the cleanout tool with the chamber 44.

The adapter may be enlarged as indicated at 48 so as to maintain the general profile of the entire cleanout tool. Passageway 50 extends longitudinally through the adapter. The upper and lower threads 52, 54 enable the adapter to threadedly engage the valve housing and the various retriever tools which may be used in conjunction therewith. A flapper valve 56 having a flat face 58 is pivotally journaled at 62 by means of a hinged pivot pin arrangement to thereby enable the valve to be opened to the flow permitting position indicated at 64. The upper terminal end of the adapter is provided with a milled surface which sealingly engages the face of the valve when the flapper valve is in the closed position. The dashed-dot line (near the radial ports 46) indicate the position of the flapper valve 56 when the valve is in the closed position and properly assembled to the housing sub.

As seen in FIGURE 5A, the adapter 128 may be modified whereby the inlet desanding ports 146 are arranged tangentially with respect to the inside peripheral wall surface of the adapter, and spaced 120° apart with respect to each other.

The lower terminal end of the adapter can alternatively be fabricated into a drill by means of the illustrated vertically and horizontally extending cuts 70 and 72 which form a drilling "shoe." The shoe, which is preferably fabricated by modifying the lowermost portion of the adapter into the illustrated configuration indicated by numeral 130 in FIGURES 6-9, may be provided with high abrasive material, such as brazed tungsten carbide.

Looking now to the details of FIGURE 7, wherein there is seen various modifications of the shoe previously illustrated in FIGURE 6, including two cut-outs 72' which leave two spaced apart high abrasive surfaces or shoes 70'. FIGURE 9 generally corresponds to the embodiment of FIGURE 6, which has already been explained in ample detail. FIGURE 9 is fabricated by providing two vertical cut-outs 72'' which leaves two spaced apart shoes 70'' which may have the lower depending ends or surfaces thereof provided with the before mentioned high abrasive material.

Operation

The operation of the device as set forth in FIGURE 1 is amply covered in the parent patent application, and therefore requires no further explanation.

In operation of the embodiments of FIGURES 2 through 5, a retriever which is adapted to cooperate with a removable downhole tool, such as a removable bridge plug, is suitably attached to the depending end of the illustrated well cleanout tool. A housing sub 28 cooperates with an adapter 30 to provide a sand valve means, and at the same time provides a means which attaches the

retriever to the lower terminal end of the well cleanout tool.

Assuming the assembled string of tools to be in the illustrated configuration set forth in FIGURE 2, and that the string has been lowered into a borehole by utilizing a string of tubing, and assuming at least twenty feet of debris 39 to be overlying a removable bridge plug 38, it can readily be seen that the retriever cannot properly engage the upper terminal end, or control bar head, of the bridge plug until the debris which overlies the control bar head has been removed from the borehole.

Removal of the debris is accomplished by lowering the string of tools until the lower terminal end of the retriever rests against the upper surface of the debris to thereby enable the telescopically actuated relief valve of the cleanout tool to be moved to the open position. This causes fluid along with debris to flow into the tool, thereby removing a substantial portion of the column of debris. As soon as a substantial portion of the column of the debris enters the cleanout tool, the weight of the tool causes the relief valve to telescopically return to the closed position whereupon the clean out action ceases. The tool must now be lowered again and another portion of the column of the debris will then be removed as soon as the relief valve is again upset by the action of the retriever causing the splined connection 18 to move the relief valve of the cleanout tool to the flow position.

As debris continues to enter chamber 20, a substantial column of debris will be left above the sand valve 56. Should the driller or wire line operator permit the downward digging action of the tool to cease for a sufficient amount of time, the debris will maintain the sand valve in the closed position, even though the splined connection opens the relief valve. This undesirable action is obviated by the provision of the illustrated radially disposed passageways 46 or 146. As soon as the relief valve is opened, flow of fluid enters the passageways 46 or 146 to thereby cause a strong flow of fluid in the immediate vicinity of the flapper valve element of the sand valve, thereby cleaning the topmost portion of the sand valve of debris to enable it to further open, whereupon another portion of the column of debris is again stirred and placed into suspension with the fluid. This action of lowering the tool into the borehole continually removes the debris until the upper terminal end of the retrievable plug is uncovered, whereupon further lowering of the tool enables the internal J-slot of the retriever to engage the control bar head of the removable packer, after which the entire assembly is lifted from the borehole.

When the assembly of FIGURE 2 is run into the borehole by using the terminal end of a drill string in order to support the hydrostatic sand retriever, it is sometime advantageous to provide the lower terminal end of the apparatus with various drilling configurations, also called a shoe. As seen in FIGURES 6-9, the shoe may be fabricated in a step-off configuration to thereby provide sharp edges which drill as well as stir the debris as the drill string is rotated. The multiple cut-outs provide the depending end of the string of tools with different cutting actions.

In a well which cannot be circulated in order to place the debris into liquid suspension, it is necessary to partially fill the casing with liquid to thereby provide a hydrostatic head. This expedient produces a pressure drop across the telescopically actuated valve. The hydrostatic sand retriever can now be run into the hole until the retriever bottoms upon the debris, thereby sliding the splined connection at 14 together to telescopically actuate the hydrostatic valve. This action permits the liquid bearing debris to flow into the inlet 37 of the retriever. The retriever has a hollow passageway which communicates with passageway 50 of the sand valve assembly. The pressure differential allows the liquid and debris to force the sand valve member 56 to the full open position (FIGURE 4) whereupon the flow continues through

chamber 20, the telescopically actuated valve, and into the tubing or drill stem.

In order to uncover the flapper valve, the radially disposed passageways 46 are arranged about the uppermost surface of the closed flapper valve to thereby enable a relatively small volume of fluid to flow thereacross, thereby uncovering the flapper valve and allowing it to move to the full open position of FIGURE 4. The enlarged flow passageway at 44 permits the flapper valve element 56 to attain the full opened position to thereby enable maximum flow of debris through the tool.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications of the invention 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 method of removing a downhole tool from a borehole wherein the tool is inaccessible because of debris lying thereabove, comprising the following steps:

- (1) attaching means for removing debris to a downhole tool retriever;
- (2) simultaneously running the downhole retriever and means for removing debris into the borehole where the bottom-most part of the retriever is brought to bear against the debris;
- (3) flowing the debris into the means for removing debris;
- (4) engaging the downhole tool with the retriever after removal of the debris has been accomplished;
- (5) lifting the downhole tool, retriever, and means for removing debris from the borehole in a single operation.

2. The method of claim 1 wherein the means for removing debris includes;

- (6) a chamber for storing the debris;
- (7) flow control means which is moved to the flow permitting position upon the means for removing the retriever being brought to bear against a supporting surface.

3. A downhole tool string for cleaning the bottom of a borehole and for retrieving a downhole tool in a single trip into the well; a well cleanout tool having an inlet, an outlet end, with the outlet end adapted to be connected to the terminal end of a support means; said cleanout tool having a relief valve means and a chamber for containing debris therein, wherein the relief valve means is moved to a flow permitting position when the lower extremity of the cleanout tool is rested against a supporting surface to thereby permit flow through the inlet and into the chamber; the improvement comprising:

- a removable tool retriever;
- means mounting said retriever on the lower depending end of said cleanout tool;
- means forming a flow passageway between the lower terminal end of said retriever and said cleanout tool inlet, whereby;
- when the retrieving tool is brought to rest on the debris, the valve means is moved to the open position to thereby cause debris to be transferred from the bottom of the borehole and into the chamber, and to enable the retriever to engage and remove the downhole tool after the debris has been removed.

4. The combination of claim 3 wherein an adapter means interconnects said retriever to the cleanout tool; said adapter means including a housing having a second valve means therein;

- said second valve means being actuated from the open to the closed position in response to the opening of said relief valve.
5. The improvement of claim 4 wherein said housing includes a port which communicates the upper portion of said second valve means with the bore hole.

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6. The improvement of claim 4 wherein said housing includes a port which communicates the upper portion of said second valve means with the bore hole; and said ports are arranged tangentially with respect to the inside peripheral wall surface of said housing.

7. The improvement of claim 4 wherein said housing includes a port which communicates the upper portion of said second valve means with the bore hole; and said ports are arranged in a radial direction with respect to the longitudinal axis of said chamber.

8. The improvement of claim 3 wherein said retriever is an integral part of and forms the lower depending end of said adapter.

9. The improvement of claim 3 wherein the lower portion of said adapter is further provided with a drilling shoe.

10. The improvement of claim 9 wherein said drilling shoe is provided with spaced apart cut-outs to thereby

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provide a depending shoe and further including means forming high abrasion material thereon.

11. The improvement of claim 3 wherein said retriever is an integral part of said lower depending end of said adapter.

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U.S. Cl. X.R.

166—99, 162

Disclaimer

3,446,283.—*August B. Baumstimler*, Odessa, Tex. METHOD AND APPARATUS FOR SIMULTANEOUSLY CLEANING A WELL AND REMOVING A DOWNHOLE TOOL. Patent dated May 27, 1969. Disclaimer filed Jan. 30, 1984, by the *inventor*.

Hereby enters this disclaimer to claims 1, 2, 3 and 4 of said patent.

[*Official Gazette May 15, 1984.*]