

Nov. 17, 1959

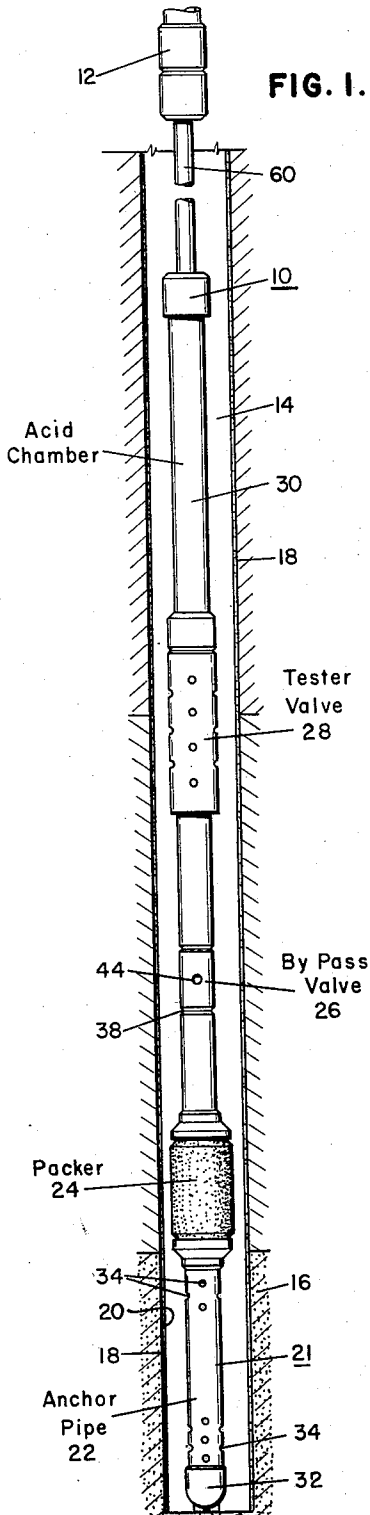
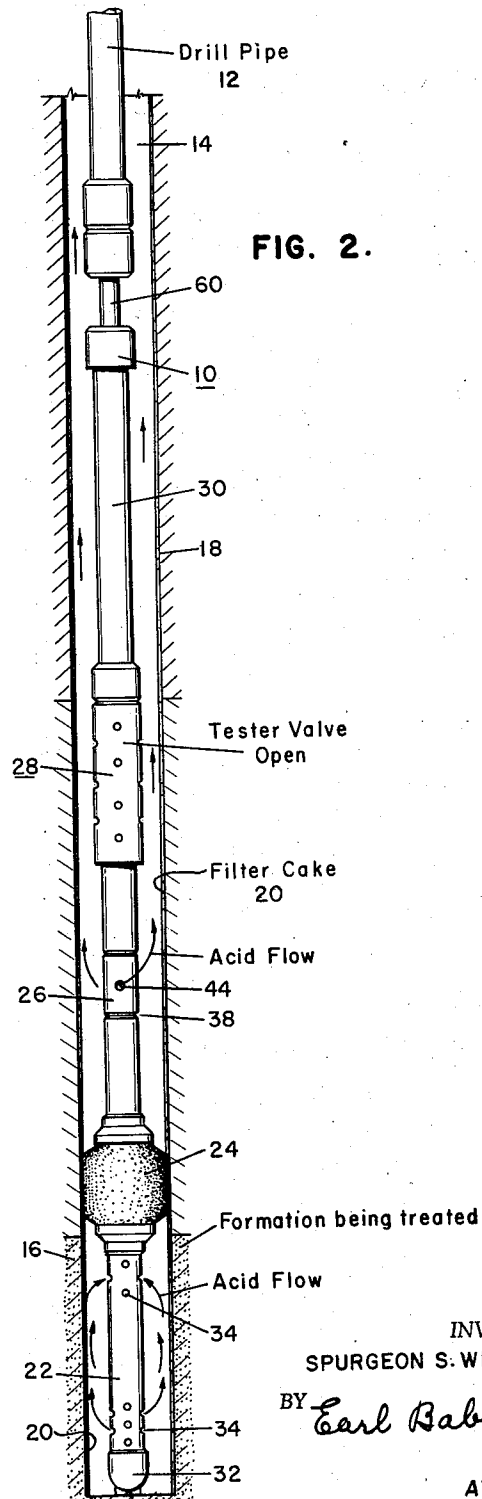
S. S. WESTBROOK

2,913,053

FORMATION CLEANER

Filed April 15, 1957

2 Sheets-Sheet 1



INVENTOR.
SPURGEON S. WESTBROOK,

BY *Earl Babcock*

ATTORNEY.

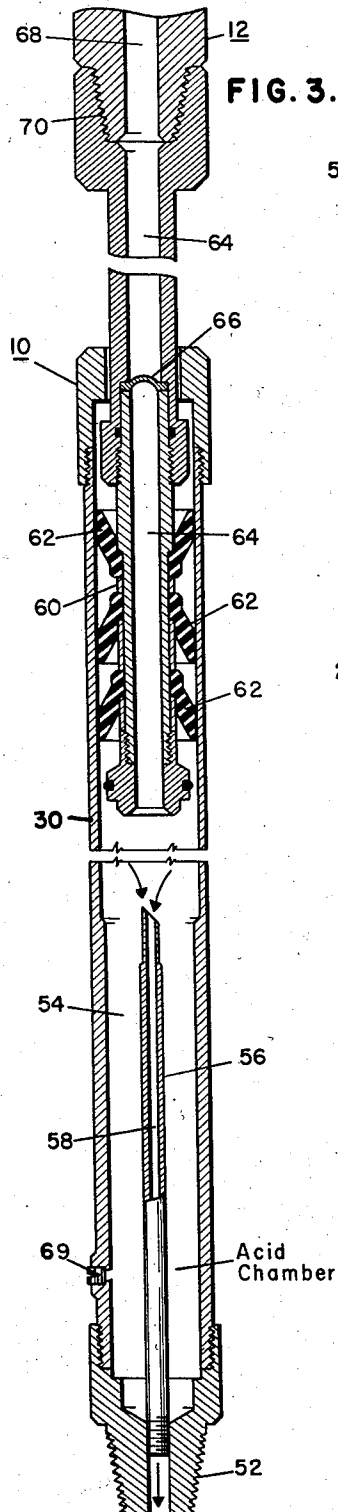
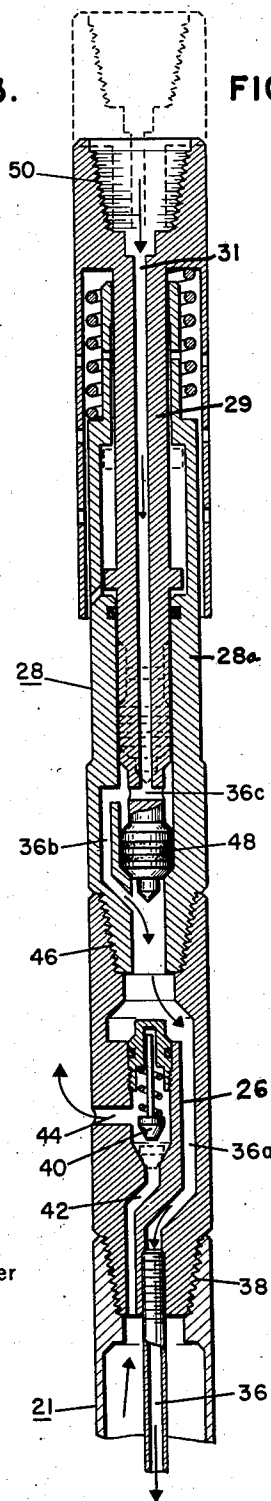
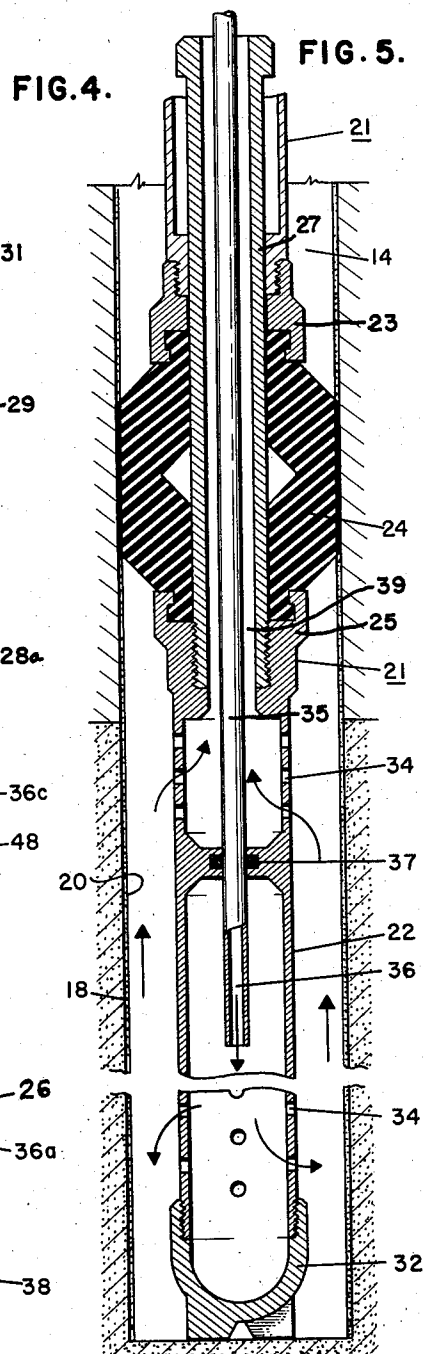
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INVENTOR.
SPURGEON S. WESTBROOK,
BY *Earl Babcock*
ATTORNEY.

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2,913,053

FORMATION CLEANER

Spurgeon S. Westbrook, Wichita, Kans., assignor to Halliburton Oil Well Cementing Company, Duncan, Okla., a corporation of Delaware

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1 Claim. (Cl. 166—152)

This invention relates to an apparatus for cleaning the wall of a formation traversed by a well bore before testing such formation.

After an oil well has been drilled to penetrate a formation that is suspected of being capable of producing hydrocarbons, it is desirable to test such formation before any further operations are performed. Methods and apparatuses for testing the productivity of formations in wells are old in the art, one example being the United States Patent to Simmons, No. 1,930,987, granted October 17, 1933.

In the conventional rotary drilling operations a drilling fluid is employed to lubricate the drill bit and to circulate the cuttings out of the well bore. These drilling fluids have many diverse additives of which the types and compositions employed, depend upon the particular conditions involved. In practically all of the drilling fluids used to drill a well bore some of the solids will filter out and coat the walls of the well bore. This coating in many instances may be several inches in thickness, depending upon many variable conditions, such as type of fluid, time involved in drilling, and shut down time. This coating has a very marked tendency to plug the interstices of a formation and either slow down or entirely stop the flow of fluids into a well bore.

In the latter case a test would give the erroneous result that the tested formation had no hydrocarbons, when in fact, as has been demonstrated many times, commercial quantities of hydrocarbons were held back in the formation by the plugging action of the filtered drilling fluids. This condition of complete plugging is especially troublesome in limestone formations.

Therefore, it is the primary object of this invention to provide a method and apparatus which will remove the filtered drilling fluid from the walls of a well bore, at the same time that a string of tools is employed to obtain a test of the formation.

Other objects and advantages of the invention will become apparent from the following description, when taken in connection with the accompanying drawing in which—

Figure 1 is a vertical representation of the component parts of the tool as it is lowered into a well bore.

Figure 2 is a vertical representation of the component parts of the tool placed in a well bore with the packer set and in operative position.

Figure 3 is a vertical sectional view showing the details of the acid chamber and pump assembly.

Figure 4 is a vertical sectional view showing the bypass assembly and a conventional tester tool employed in conjunction with the invention.

Figure 5 is a vertical sectional view of a conventional anchor and packer assembly employed in conjunction with the invention.

Referring first to Figures 1 and 2 of the drawing the assembled components of the tool 10 are shown attached to the lower end of a string of drill pipe 12 and disposed in a well bore 14. A formation to be treated and tested

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is designated by the numeral 16. The wall 18 of the well bore 14 is covered by a filtrate of the drilling fluid, hereafter called the filter cake 20. The assembled tool 10 consists of an anchor and packer assembly 21, a bypass valve assembly 26, a tester assembly 28 and an acid chamber and pump assembly 30.

As shown in Figure 5 the anchor and packer assembly 21 consists of an anchor member 22 which has a closed lower end 32, adapted to be set on the bottom of the well bore 14 and a conventional mechanical set packer 24 disposed above the anchor 22. The anchor 22 is provided with perforations 34 for the entry or discharge of fluids. The packer 24 is slidably mounted about a tubular mandrel 27. The lower end of the packer 24 is fixed to a shoe member 25 of the anchor 22 and the upper end is attached to a shoe 23 which is slidably mounted about the mandrel 27. Disposed inside of the anchor 22 and the tubular mandrel 27 is a tube 35 having a fluid passageway 36. The tube 35 and the tubular mandrel 27 define an annular passageway 39.

As shown in Figure 4 the anchor and packer assembly 21 is connected to the bypass valve assembly 26 by any conventional means such as the joint 38. Passage of fluids through the entire assembled tool 10 is provided by connecting passageways 36, 36a, 36b, and 36c. The exterior of the passageway 36 is sealed off by a suitable means such as O-rings 37.

The bypass valve assembly 26 contains a conventional check valve 40 which controls the opening and closing of the bypass 42 through the port 44. The bypass valve assembly 26 is connected to the tester assembly 28 by any suitable means, such as the joint 46. In Figure 4 the tester assembly 28 is shown with the valve means 48 in the open position and in the closed or going into the hole position by broken lines. The tester assembly 28 is connected to the acid chamber and pump assembly 30 by any conventional means, such as the joints 50 and 52. The tester assembly 28 is not shown in detail. It is an improved type of which the detailed operation and construction are disclosed in Patent No. 2,740,479 to Schwegman. Only sufficient detail is shown to demonstrate its coaction with the other elements in the invention. As shown in Figure 4 the tester assembly 28 has a stem 29 with a fluid passageway 31 therein. The passageway 31 communicates with the opening in the lower end of the chamber 54. Telescopically mounted about the stem 29 is a body 28a. The body 28a has a fluid passageway 36b which is adapted to be brought into fluid communication with an opening 36c in the stem 29 upon telescoping movement of the body 28a and the stem 29.

The acid chamber and pump assembly 30 is provided with an acid chamber 54, which can be of any desired capacity. Mounted inside the chamber 54 is a hollow spear headed rod 56 having a fluid passageway 58 which connects with the fluid passageway 36c of the tester assembly 28. Disposed interiorly of the assembly 30 is a slidable hollow mandrel 60 on which are mounted flexible cups 62. The hollow portion of the mandrel 60 is designated as a fluid passageway 64 which is maintained closed by a frangible cap 66. Above the cap 66 the passageway 64 communicates with the passageway 68 of the drill pipe 12. The chamber 54 can be filled with acid by any suitable means such as a plug 69. The assembly 30 is attached to the drill pipe 12 by a joint 70.

An illustration of the operation and coaction of the elements of the invention is as follows:

When it is desired to clean the filter cake 20 from the wall 18 of a formation 16 to be tested, the assemblies 21, 26, 28 and 30 are connected together by means of the respective joints 38, 46, 50 and 52, and are attached to the lower end of the drill pipe 12 by the joint 70. The

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entire assembled tool 10 is lowered into the well bore 14 until the closed lower end 32 of the anchor 22 rests on the bottom of the well bore 14.

The acid chamber 54 of the assembly 30 is full of acid. In the present embodiment of the invention approximately 30 gallons of acid are used. However, this amount may be increased or decreased by varying the size of the acid chamber 54.

In view of the construction of the elements of the various assemblies and the interaction thereof, the next steps in the operation of the invention occur successively, but so close together that the resulting events are almost simultaneous.

The weight of the drill pipe 12 and the assemblies 21, 26, 28 and 30 sets the packer 24 and opens the tester valve means 48 in the conventional manner practiced in present testing operations. That is, the valve means 48 moves from the dotted position to the position as shown in Figure 4. At the same time the weight of the drill pipe 12 is forcing the mandrel 60 of the assembly 30 to move downwardly. The cups 62 mounted on the mandrel 60 act as pistons and displace the acid in the chamber 54 through the fluid passageways 36c, 36b, 36a and 36 and out of the perforations 34 of the anchor 22 into the well bore 14 below the packer 24. The acid dissolves the filter cake 20 on the wall 18 of the formation 16. The resulting dissolved fluid residue passes back through the perforations 34 through the annular passageway 39 into the bypass 42 of the assembly 26, past the one way check valve 40 and into the well bore 14 through the port 44. After the acid is discharged and the resulting dissolved fluid residue is displaced into the well bore 14, hydrostatic pressure in the well bore 14 closes the check valve 40 and prevents well bore fluids from entering the system through the port 44. As the mandrel 60 with the attached cups 62 move downwardly and at the end of the stroke the tip of the hollow rod 56 engages the frangible cap 66 and ruptures it, thereby providing communication between the fluid passageway 64 of the mandrel 60 and the passageway 68 of the drill pipe by means of the fluid passageway 58 of the hollow rod 56. At this stage of the operation of the invention there is complete communication from the cleaned wall 18 of the formation 16 to the drill pipe 12 for the passage of formation fluids. Since the check valve 40 is closed, fluids from the formation can flow through the perforations 34 into the passageway 36 of the stem 29 into passageways 36a and 36b and through the opening 36c into passageway 31, which is connected to the passageway 58 of the spear 56 at joint 52. Disposed in the drill pipe is a suitable formation sample receiving chamber and any desired testing apparatuses, such as temperature and pressure recorders.

From the foregoing description along with a consideration of the figures of the drawing it is readily seen that the present invention provides a unique and novel apparatus adapted to remove a filter cake deposit from the wall of a formation in connection with the making of a test and obtaining a sample of the fluid contents thereof.

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Although the invention has been described in terms of a specific embodiment, it should be understood that this was by way of illustration only and that the invention is not limited thereto. Accordingly, modifications of the invention are contemplated without departing from the spirit of the described invention or the scope of the appended claim.

I claim:

An apparatus for cleaning the surface of a well bore wall and the pores in the formation adjacent thereto and testing the cleaned formation for fluids therein, comprising, in combination, a housing defining a chamber for containing a well bore and a formation cleaning fluid, said chamber being closed at its upper end by a downwardly movable closure comprising a frangible cap and open at its lower end, and having a means to break said frangible cap on downward movement of the movable closure, a tester assembly fixed to the lower end of the housing, comprising a stem having a passageway therein communicating with the opening in the chamber, a body mounted on said stem and having an upper opening adapted to telescopically receive said stem, an opening in the side wall of the stem between its passageway and its exterior, a passageway in the body, the upper end of the body passageway and the side wall opening of the stem being adapted to be brought into registry on telescoping movement of the body and the stem, an anchor and packer assembly connected to said body by a bypass valve assembly, said bypass valve assembly comprising a tubular mandrel fixed to an anchor, said anchor at its upper end fixed to the lower end of a packer and having a plurality of perforations in its walls, a slidable shoe disposed about said tubular mandrel, said slidable shoe fixed to the upper end of said packer and fixed to said bypass valve assembly, said packer adapted to be expanded into engagement with the wall of the well bore upon downward movement of said slidable shoe, a tube disposed in said anchor and said tubular mandrel, said tube being in fluid communication at its upper end with said body and at its lower end with said openings in said anchor, an annular passageway between said tubular mandrel and said tube being in communication at its lower end with the openings in said anchor, and said bypass assembly having a bypass passage with an upwardly opening check valve therein, said bypass passage being adapted to be in open or closed communication with the exterior of said bypass assembly and said annular passageway, defined by said tubular mandrel and said tube, and a passageway in said bypass valve assembly in communication at its upper end with the passageway in said stem and at its lower end with said tube.

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