June 10, 1958 W. B. COLLINS 2,838,119

MULTIPURPOSE OIL WELL TOOL

Filed Aug. 25, 1954

Fig. 1.

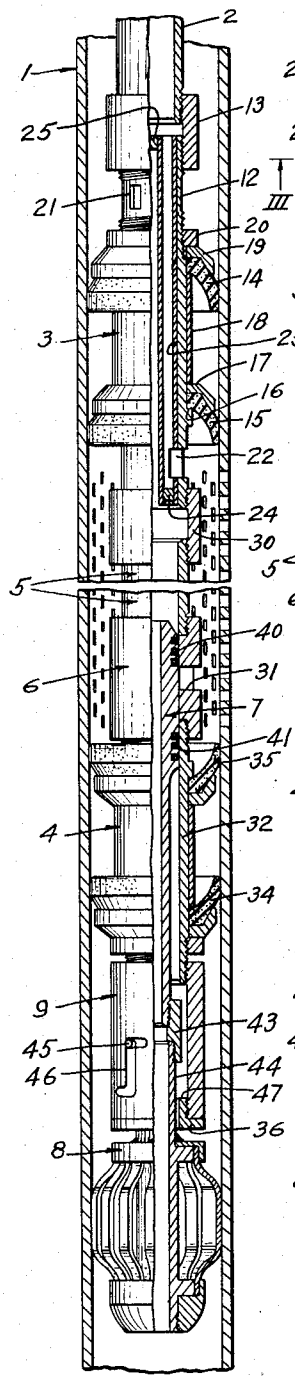
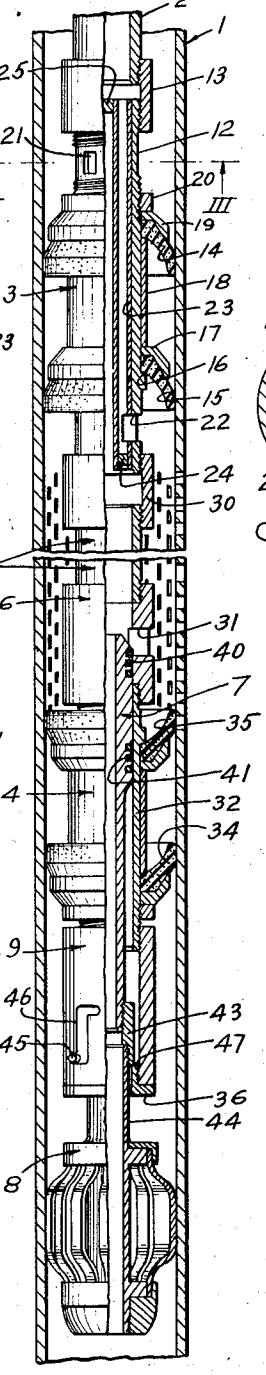



Fig. 2.



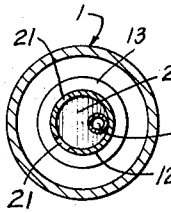




Fig. 3.

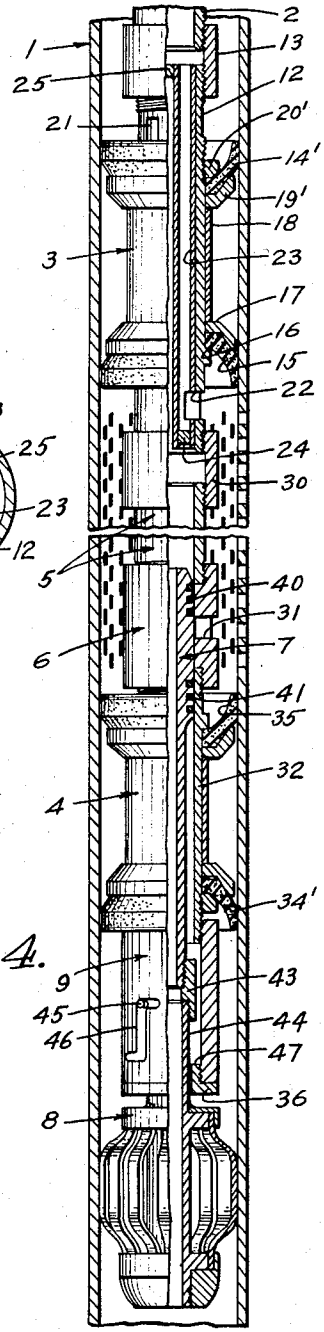



Fig. 4.

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United States Patent Office 2,838,119 Patented June 10, 1958



2,838,119

# MULTIPURPOSE OIL WELL TOOL

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Application August 25, 1954, Serial No. 452,157

2 Claims. (Cl. 166—146)

This invention pertains to a well treating tool adapted to be connected to a string of pipe or tubing and lowered into a casing, the tool being provided with suitable upper and lower packer cup assemblies adapted to isolate a space within the casing, a permanent unobstructed fluid conduit communicating the interior of the pipe string with such space, a by-pass passageway communicating the interior of the casing below the tool with space above the tool and exteriorly of the pipe string, and a simple, selectively operable means whereby the space between the packing cup assemblies can be placed in communication with the interior of the casing above and below the tool.

The tool of the present invention is notable for its simplicity of construction and assembly, adaptability to efficient and economical manufacture, and applicability to numerous oil field operations which can be performed rapidly, certainly and effectively.

In some oil fields restrictions are imposed upon the ratio of gas to oil produced. Although it is suspected that certain strata or zones produce more gas than others, prior testing methods were time consuming and necessitated the use of highly specialized equipment. A well in such field may also be assumed to be of a character which can be acid treated to good advantage. Acid treatment requires an entirely different tool and normally such well would be acid treated before testing for production characteristics of different zones therein. After such tests are conducted, it may be deemed desirable to cement off a zone producing excessive amounts of gas, and again a third and different tool would be employed. In such prior practice at least three different tools would be used and much time consumed in raising and lowering the tools on the string of pipe. In contradistinction to this cumbersome and inconvenient prior procedure, all of the operations of acid treatment, testing and cementing can be performed in sequence with the single tool of the present invention, without repeatedly lowering and raising the tool. The overall time consumed in performing such consecutive operations can be reduced from several days to a matter of hours only.

The above exemplifies but a few of the uses and advantages of the tool described hereinafter. In addition to acid treatment, the tool of the present invention is capable of being employed in many other treating operations such as, for example, the cleaning of perforations in slotted casing, for the introduction of materials into a strata for the purpose of increasing porosity thereof and liberating oil therefrom, in backwashing operations and in various other procedures known to those familiar in drilling and production techniques.

An object of the present invention is to disclose and provide a simple and effective multipurpose tool capable of being used in numerous oil field operations.

A further object of the invention is to disclose and provide a multipurpose well treating tool adapted to be connected to a string of pipe or tubing and lowered into a



casing for the performance of various testing and treating or cementing operations.

A still further object of the invention is to disclose and provide a multipurpose tool capable of being lowered into a well hole or casing, such tool including a permanent, unobstructed fluid by-pass from zones below the tool to space above the tool so as to facilitate the raising and lowering of a tool through a body of fluid in a well hole or casing, such tool being provided with a selectively operable means whereby a particular zone in the well hole or casing may be treated or tested.

These and various other objects, uses and advantages of the present invention will become apparent to those skilled in the art from the following detailed description of exemplary forms embodying the combinations of elements and constructions contemplated by the present invention. For purposes of illustration and facilitating explanation, reference will be had to the appended drawings in which:

Fig. 1 is a side elevation partly in section of a tool embodying the invention, such tool attached to the lower end of a string of pipe and positioned within a casing.

Fig. 2 is a side elevation partly in section of the tool illustrated in Fig. 1, showing the mandrel selectively moved to open ports communicating with the space between packer cup assemblies.

Fig. 3 is a transverse section taken along the plane III—III in Fig. 2.

Fig. 4 is a side elevation partly in section of a slightly modified arrangement.

The multipurpose tool shown in Figs. 1, 2 and 3 is illustrated as being located within a casing 1 of a well hole, the tool itself being attached to the lower end of a string of pipe or tubing 2. The major components of the tool comprise an upper packer cup assembly generally indicated at 3, a lower packer cup assembly indicated at 4, a tubular spacer 5 and ported coupling collar 6 between the two cup assemblies. A longitudinally movable mandrel or open-ended tubular control means 7 is adapted to cooperate with the ports in the collar 6, such mandrel extending downwardly to beyond the lower packer cup assembly 4, the lower end of the mandrel being preferably provided with a centralizing device 8, and a means for controllably limiting and positioning the mandrel is indicated at 9.

It will be noted that the entire device is substantially tubular. The upper portion may comprise a tubular element 12 which is externally threaded so as to permit its attachment to the lower end of pipe 2 by means of a connecting collar 13. Such tubular element 12 may carry the packing cups 14 and 15, such cups being shown facing downwardly and outwardly towards the intermediate spacer 5, the cups being preferably made of resilient, flexible rubber composition or the like and mounted upon the tubular element 12 in any desired fashion. As illustrated, the cup 15 is shown being held between a shoulder 16 and a backing ring 17, such backing ring being spaced from cup 14 by a spacing member 18. The cup 14 is held in position between the spacing member 18 and its backing ring 19, the backing ring being locked in position by collar 20 threaded onto tubular element 12. A radial port or ports 21 communicate the interior of tubular element 12 and the tool with the space above the tool and between the casing 1 and pipe string 2.

It will be noted that tubular element 12 is also provided with a radial port 22 extending into the space between the upper and lower packer cup assemblies 3 and 4. The port 12 is in communication with a permanent, unobstructed fluid conduit 23 which is closed at its lower end as indicated at 24 and open at the upper end, thereby

permitting communication between the interior of pipe string 2 and the space between the packer cup assemblies. The upper end of tubular element 12 is blocked or closed by a partition 25, except for the open end of fluid conduit 23.

The space between upper and lower packer cup assemblies 3 and 4 may differ from but a few feet to thirty or even sixty feet depending upon the thickness of the formation being tested, cemented or treated. In order to impart adaptability to the tool a spacer 5 of any desired length is connected to the lower end of element 12 by means of coupling collar 30, the lower end of such spacer 5 being firmly connected to the ported coupling collar 6 provided with one or more radial ports 31.

The lower cup assembly 4 is provided with cups 34 and 35 carried by a tubular element 32, these cups preferably being inclined outwardly and upwardly so as to face the cups of the upper packer cup assembly 3 and resist any pressure which may be generated within the space between such assembly. The cups 34 and 35 may be carried by the tubular element 32 by the use of the construction previously described for the upper packer cup assembly or they may be removably mounted thereon in any other desired manner.

The lower end of the tubular element 32 is threadedly connected to a limiting and positioning sleeve 9, the lower end of said sleeve being provided with a stop gland 36 adapted to slidably contact the port control mandrel generally indicated at 7.

The port control mandrel is hollow and tubular and is preferably provided with an upper portion of increased thickness provided with a plurality of circumferential grooves adapted to receive a set of upper O rings 40 and a set of longitudinally spaced lower O rings 41, these two sets of O rings being spaced a distance appreciably greater than the height of port 31, and being adapted to slidably and sealingly contact the interior surface of the ported coupling collar 6 and tubular element 32. Instead of O rings the upper part of the port control mandrel 7 may carry many other desired type of sealing rings adapted to provide a sliding, fluid-tight connection between the mandrel and the internal walls of the ported collar 6 and element 32.

The lower portion of port control mandrel 7 is threadedly connected to a stop collar 43 which connects the upper portion of such mandrel with a lower extension 44 extending below the tool and the positioning sleeve 9. The extension 44 is shown provided with a friction-type centralizer 8. The stop collar 43 may also carry a radially extending guide pin 45 protruding into a Z slot 46 formed in the positioning sleeve 9, such pin permitting the port control mandrel to assume two positions, one in which the mandrel closes port 31 and another in which such port is open as indicated in Fig. 2. It is also to be noted that in the open position the connected stop collar 43 abuts the upwardly directed shoulder 47 of the stop gland 36.

It is also to be noted that the entire port control mandrel including its extension is tubular and hollow, thereby providing an unobstructed fluid by-pass communicating the interior of the casing 1 below the entire tool with the interior of the casing above the tool through the port or ports 21. It will be evident therefore that the entire tool may be readily lowered into a well hole or casing filled with oil or other fluid without encountering any difficulty, the liquid from below the tool by-passing the tool through the mandrel spacer 5, tubular element 12 and port 21.

The mechanical operation of the tool is extremely simple. After the tool has been lowered into a proper position in a well hole while in the position illustrated in Fig. 1, it is only necessary to partially rotate the string of pipe so as to bring the pin into alignment with the vertical portion of Z slot 46 and then slightly raise the string of pipe in order to open port 31, the friction-type centralizer 8 holding the mandrel 7 so as to permit relative movement between the mandrel and the body of the tool. In order to close port 31 the operations are simply reversed.

It will be noted that any desired fluid may be pumped down the drill pipe 2 (when the port control mandrel is in closed position as shown in Fig. 1) and such treating fluid may be caused to pass through port 22 into the space between upper and lower packer cup assemblies. Various treating media, acids and the like may thus be forced into the well hole or through the perforations of the casing into the formation. When the port control mandrel 7 is in port open position (Fig. 2), any desired fluid can be pumped down the pipe 2, discharged into the space between packer cup assembly and spacer 5 and such treating fluid may be circulated back to the surface if desired through port 31, the body of the tool and port 21 into the space surrounding drill pipe 2 above the tool. Moreover, it will be evident to those skilled in the art that when it is desired to test a particular zone or formation into which the tool has been lowered in port closed position as shown in Fig. 1, the oil, gas or other fluid entering the casing through the perforations between upper and lower packer cup assemblies 3 and 4 will find its way through port 22 and conduit 23 to the interior of the string of pipe 2 without contamination with any gas or liquid either within the casing or from any other zone feeding such casing. After such test has been completed and without removing the tool from the well hole, cement can be pumped down through the string of pipe 2 and the particular zone cemented off if desired.

From a practical standpoint, it will be noted that the construction herein described permits inexpensive manufacture and assembly of the tool. It will be evident that the centralizer can be readily removed at will. The entire port control mandrel can be replaced very quickly without disassembly of the entire tool; the packer assemblies can be readily changed; the space between the packer assemblies can be lengthened or shortened by simply changing the length or character of the spacer 5; the entire tool is free from tricky valves, balls, springs and other elements which normally cause trouble in the operation of a piece of equipment of this type.

The device illustrated in Fig. 4 is substantially identical to that shown in Figs. 1–3, differing therefrom only in the position of certain of the packer cup elements. For example, it will be noted that the upper packer cup assembly 3 used in Fig. 4 is composed of a pair of cup elements directed in opposing directions, the upper element 14' being directed upwardly so as to resist downward pressure of fluid within the annulus between the string of pipe 2 and the casing 1, whereas the lower element 15 is directed downwardly so as to resist pressure within the portion of slotted or perforated casing which extends between upper packer cup assembly 3 and the lower packer cup assembly 4. Similarly, the lower packer cup assembly is composed of two packer cup elements oppositely directed so as to most effectively oppose the pressure both below and above such assemblies.

Those skilled in the art will recognize that the tool described hereinabove gives positive control of the port or aperture 31 in the ported collar 6 under any and all conditions of operation. The valve is not dependent upon the existence of relative pressures as in many types of tools employing ball or poppet valves. The presence of very high pressures below the tool will not tend to open port 31, such high pressures being radially and outwardly directed against the inner surface of tubular mandrel 7.

All changes and modifications coming within the appended claims are embraced thereby.

I claim.

1. A positively and selectively operable multipurpose oil well tool comprising: a tubular upper packer cup assembly including means for connecting the same to

a string of pipe; a tubular lower packer cup assembly; a tubular imperforate spacer and a radially ported coupling collar connecting said upper and lower packer cup assemblies; a tubular port control mandrel longitudinally movable within the lower packer cup assembly and slidable within the coupling collar to selectively open and close a radial port in said collar, the tubular mandrel including a lower extension projecting below the lower packer cup assembly, said extension carrying a friction-type centralizer of substantially the same external diameter as said packer cup assemblies, the tubular packer cup assemblies, spacer, ported coupling collar and mandrel providing an axial through bore for the passage of fluid; fixed partition means carried at the upper end of said tool blocking direct communication between the interior of a string of pipe to which said tool may be attached and said through bore; a radial port in said tool below said partition and above the upper packer cup assembly providing an unobstructed bypass passageway for fluid from above the upper packer cup assembly and exteriorly of a pipe string through said through bore to below the lower packer cup assembly; and a permanent, unobstructed fluid conduit through said partition communicating the interior of a pipe string to which the tool is adapted to be connected with the annular space surrounding the spacer and between said packer cup assemblies; said mandrel being selectively movable with respect to said packer cup assemblies and spacer to open and close said ported collar.

2. A multipurpose well treating tool adapted to be connected to a string of pipe and lowered into a casing comprising: an upper packer cup assembly and a lower packer cup assembly adapted to sealingly contact the



inner wall of a casing; a tubular spacer and a radially ported coupling collar connecting said packer cup assemblies; a permanent, unobstructed fluid conduit communicating the interior of a pipe string to which said tool is connected with the space between said packer cup assemblies exteriorly of the spacer and coupling collar; a tubular port control mandrel longitudinally and selectively movable within the ported collar and extending below the lower packer cup assembly; a friction-type centralizer carried by the lower end of the port control mandrel and adapted to frictionally contact a casing; means for limiting longitudinal movement of the port control mandrel between a position in which the radial port of the ported coupling is closed and a position in which such radial port is open and in communication with the interior of the tool; a port communicating the space outside the tool and above the upper packer cup assembly with the interior of the tool, said port cooperating with the tubular mandrel to provide a fluid bypass passageway from a zone below the tool to the annular space above the tool, whereby the tool may be readily lowered through fluid in a casing and a zone between said packer cup assemblies and treated by said permanent fluid conduit.

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