July 8, 1958 E. W. McGAFFEY 2,842,211

OIL WELL TOOL

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Fig. 1

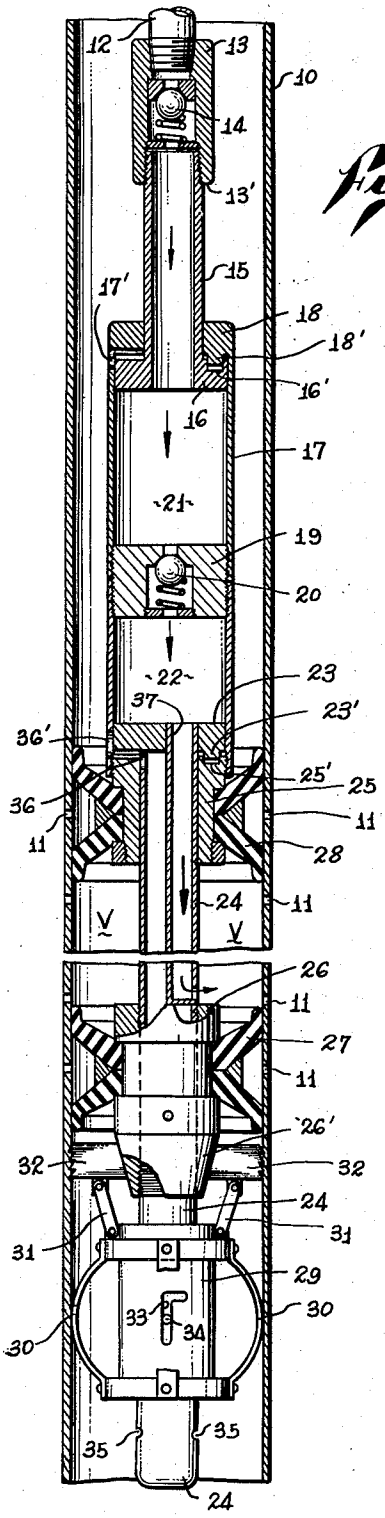
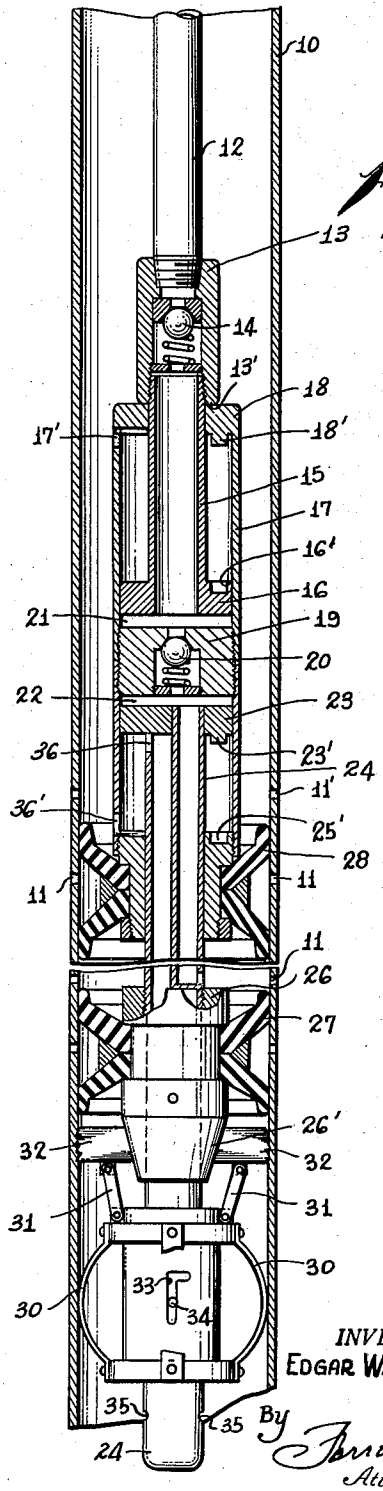



Fig. 2




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Fig. 3

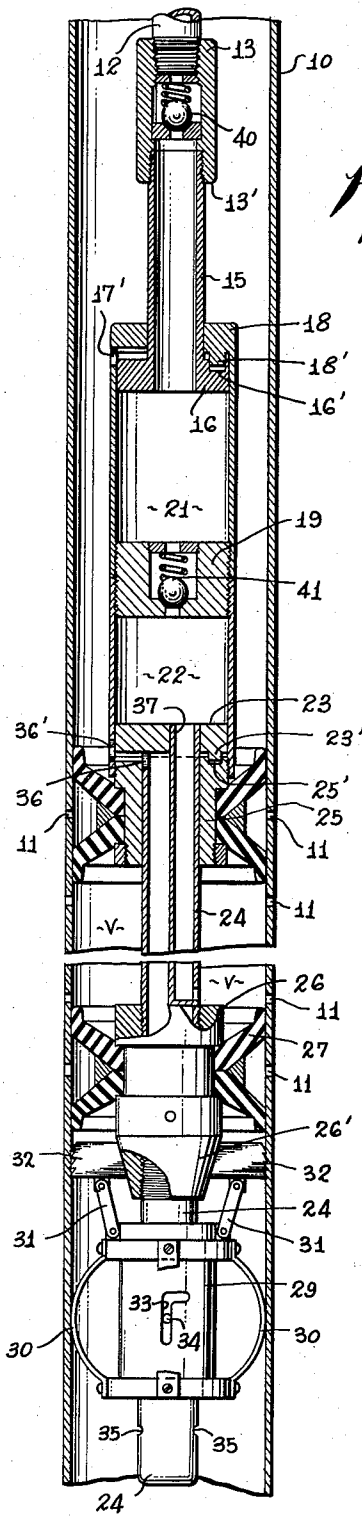
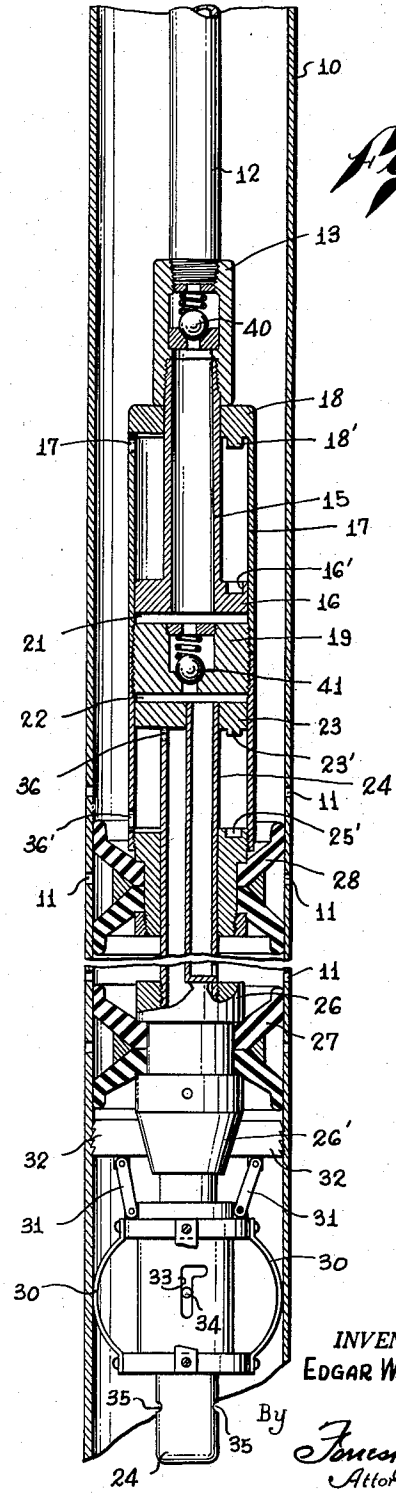



Fig. 4




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# OIL WELL TOOL

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6 Claims. (Cl. 166—101)

This invention relates to oil well tools and more particularly to an oil well cleaning device for washing perforations in oil well casings.

In the production of oil wells, the bore hole is generally lined with casing pipe extending downwardly in the well to oil sands at which point the pipe is perforated. The oil flows into the casing pipe through these perforations, whence it is lifted to the surface. During this producing operation the perforations oftentimes become clogged with mud, sand, tar, or debris of one sort or another, which tend to retard the flow of oil into the casing pipe.

In the past, various types of well cleaning devices have been proposed for removing such debris, one such form of device comprising spaced packing means adapted to be lowered into the well adjacent the perforations to be cleaned, and defining with the perforated casing pipe a confined space into which fluid may be pumped under pressure by suitable cylinder and piston arrangements in the tool, and forced through the perforations. Another cleaning device of the above type uses spaced packing means, whose positions with respect to one another may be varied, whereby the confined space between the packers is varied, and thus the pressure changed to force fluid into or out of the adjacent perforations.

The present invention contemplates an improved oil well cleaning device incorporating the above principles and has as its primary object to provide greatly increased pressures in a confined packed-off space for forcing fluids through the perforations to be cleaned.

Another object is to provide such a device in which suction pressure greater than has heretofore been attainable may be applied to perforations.

Still another object of the invention is to provide a device in which a chemically treated fluid may be introduced into a confined space opposite the perforations, and forced through said perforations under great pressure.

These and further objects and advantages of the invention are attained by means of a cleaning tool provided with spaced packing means, one packing means being movable with respect to the other. The tool also includes a piston and cylinder arrangement for building up high pressures in the confined space defined by the packing means. After this fluid pressure is built up by the piston and cylinder arrangement, the movable packing means is moved towards the stationary packing means additionally increasing the pressure in the confined space opposite the perforations. In a second embodiment of the invention, the same tool may be used, after suitable valve adjustments thereon, as a pump or sucking tool for withdrawing fluids through the perforations. In this instance the piston and cylinder arrangement provide an initial suction and then one packing means is moved away from the other to increase the volume of confined space, thereby causing an additional suction.

A better understanding of the invention and its various features and advantages will be had by referring to the following detailed description in conjunction with the accompanying drawings, in which:



Figure 1 illustrates partly in section a preferred form of the well cleaning device in one extreme position;

Figure 2 illustrates the device of Fig. 1 in a second extreme position;

Figure 3 illustrates a modification of the device of Fig. 1 in one position; and

Figure 4 shows the device of Fig. 3 in a second position.

Referring to the drawing, there is shown in Figures 1 and 2 a casing pipe **10** including a plurality of perforations or openings **11** through which oil may be recovered from surrounding oil sands in the earth formations. The cleaning device of the present invention is supported on the end of the usual drill pipe **12** or any other type of suitable tubing providing a fluid passage. This connection is effected by means of a coupling **13** having a lower annular shoulder **13'** and including a one-way check valve **14**. Threadedly secured to the coupling **13** is an elongated hollow piston rod **15** terminating in a piston head **16**, the hollow tubular piston rod **15** being reciprocably operable in a main cylinder **17**. As shown, the upper end wall **18** of the cylinder **17** includes a clutch mechanism **18'** adapted to engage a cooperating clutch mechanism **16'** in the piston head **16** when the piston rod and piston head are at the upper end of their stroke. A breather port **17'** is provided in the upper end of cylinder **17**.

The cylinder **17** is preferably divided into two chambers **21** and **22** by a coupling **19** including a second check valve **20**, the two sections defining these chambers being conveniently threaded to the coupling **19**.

Within the lower chamber **22** of the cylinder **17** there is provided a plunger **23** mounted on a tubular member **24** reciprocably operable in the lower chamber **22** through bushing **25**. The tubular member **24** extends beyond the lower end of the cylinder **17** through a support **26** mounting stationary packing means **27**. Plunger **23** and bushing **25** include respectively clutch members **23'** and **25'** adapted to engage each other to prevent relative rotation of the tubular member **24** and cylinder **17** when the plunger and tubular member are in their lowermost position.

Mounted exteriorly of the lower end of the cylinder **17**, on bushing **25**, is a movable packing means **28**. This packing means **28** is rigidly secured to the cylinder and bushing and thus will move with the cylinder as will be described in connection with the operation of the tool.

The support **26** may take the form of a cylindrical sleeve surrounding and threadedly locked to the tubular member **24**. This support includes at its lower end conically inwardly sloping surfaces **26'** defining slip expanding means. A lower sleeve member **29** mounting belly springs **30** is rotatably mounted on the tubular member **24** as shown. The sleeve **29** also mounts links **31** connected to suitable slips **32** adapted to slide on the conical surface **26'** of the slip expander. A bayonet slot **33** is provided in the sleeve **29** and a cooperating pin **34** on the tubular member **24**.

The extreme lower end of the tube **24** includes ports **35** having fluid communication up through the tube **24** with a port **36** in the upper end of tube **24** and a port **36'** in the lower end of cylinder **17**. This communication serves to bypass well fluids about the packing means when the instrument is moved in the bore hole. The upper portion of tube **24** also includes an additional passage **37** providing fluid communication between the chamber **22** and the confined volume V between the packing means **27** and **28**.

In operation of the device shown in Figures 1 and 2,

the tool is initially in the position shown in Fig. 1 and is lowered into the well casing **10** by the drill pipe **12** to a position opposite perforations **11** to be cleaned. When the device is being lowered, the piston **16** and clutch **16'** are in engagement with the end wall **18** and clutch **18'**, and the plunger **23** and clutch **23'** are in engagement with the bushing **25** and mating clutch **25'** as shown. This first engagement of clutch **16'** and **18'** results from the weight of the cylinder **17**, which weight is supported by the piston **16**. The second engagement of clutch **23'** and **25'** results from the weight of the tube **24**, support **26**, and the slip apparatus, which weight is supported by the top of bushing **25** and lower portion of cylinder **17**.

As soon as the tool is properly positioned in the bore hole, the drill pipe **12** is turned which rotates the hollow piston rod **15**, cylinder **17**, plunger **23**, and hollow tubular member **24** thereby rotating the pin **34** to move it along the horizontal portion of the bayonet slot **33**. The sleeve **29**, links **31**, and slips **32** will not rotate because of the friction of the belly springs **30** against the bore hole casing. When the pin **34** has reached the end of the horizontal portion of the bayonet slot **33** the drill tubing **12** is then lowered and the pin enters the vertical leg of the bayonet slot. Further lowering of the drill pipe **12** causes the pin **34** and tube **24** to travel downwardly, and this action pushes the slips **32** along the sloping walls **26'** of the slip expander, the slip including teeth which engage the casing and throughly lock the lower portion of the tool in place. This action in turn insures that the packing means **27** is stationarily secured with respect to the casing in the position as shown in Figure 1.

Fluid is now pumped down through the drill pipe **12**, hollow piston rod **15** and into the upper chamber **21** of the cylinder **17**. This fluid will also pass through the check valve **20** down into the lower chamber **22** and through passage **37** in the tubular member **24** out into the confined volume V.

Reciprocation of the drill pipe **12** will initially operate the piston **16** to force fluid in chamber **21** through the check valve **20** into chamber **22** and down the passage **37** into the confined volume V as indicated by the arrows, increasing the pressure between the spaced packing means **27** and **28**. As soon as the piston **16** reaches its lowermost position the shoulder **13'** of the coupling **13** will engage the outer end of wall **18** of the cylinder **17**, thereby forcing the whole cylinder downwardly.

Referring to Fig. 2, this action has the effect of moving the packing means **28** closer to the packing means **27** thereby decreasing the volume V of the confined space. Furthermore, this action will decrease the volume of the chamber **22** by virtue of the plunger **23** being secured to the tubular member **24** which is in turn locked by the spear slips **32** to the casing. Thus the fluid in chamber **22** will be forced down the passage **37** into the confined volume V further increasing the pressure of fluid in this space. Fluid from chamber **22** cannot pass back up into chamber **21** because of the one-way action of the check valve **20**. With this greatly increased fluid pressure in the confined space V, the liquid therein will be forced out through the perforations **11** with great force and this fluid flow will serve to clean these perforations. Figure 2 illustrates the relative positions of the piston **16**, cylinder **17**, and packing means **27** and **28** at the end of the down stroke.

On the upstroke of the drill pipe **12**, the piston **16** and hollow piston rod **15** move upwardly in the chamber **21** and during this action any fluid above the piston **16** is passed out into the surrounding casing through the port **17'**. More liquid from a source disposed at the surface of the well passes down through the pipe **12** and hollow piston rod **15** into the chamber **21** as the piston is raised. When the piston **16** reaches the top of its stroke, it will engage the end wall **18** of the cylinder **17** and move the cylinder **17** upwardly. This action has the effect of expanding the confined volume V and the volume of the lower chamber **22** which expansion will cause fluid from chamber **21** to enter chamber **22** as the plunger **23** approaches the bottom of the cylinder due to the upward movement of the cylinder. On the next down stroke of the drill pipe **12** the process is repeated and pressure is again built up in the confined space V.

Figures 3 and 4 show a modification of the tool of Figures 1 and 2 useful for providing an extremely large suction to the perforations **11**. This cleaning tool, however, may also be used as a simple pump. In Figures 3 and 4 the same reference numerals used in Figure 1 are employed to designate corresponding elements and detailed description of these components is therefore not necessary. As shown, the structure is identical to the structure of Figures 1 and 2 except for the reversal of the two one-way valves **14** and **20** these valves being designated **40** and **41** in Figures 3 and 4 and shown operable in the opposite direction.

In the operation of the device of Figures 3 and 4, the tool is set opposite the perforations to be cleaned as in the case of the tool of Figure 1. During the sucking operation, however, no fluid is introduced down through the drill pipe **12**, but rather the drill pipe is simply reciprocated and serves as a conduit for conducting fluid sucked from the formations to the surface.

On the initial downstroke of the piston **16** in Figure 3, the fluid in the chamber **21** will be forced up through the hollow piston rod **15** since the check valve **41** closes off the chamber **22** from the chamber **21**. When piston **16** reaches the end of its downward stroke, as shown in Fig. 4, the shoulder **13'** on the coupling **13** will engage the end of wall **18** of the cylinder **17** forcing the cylinder downwardly and causing the confined volume V to be decreased due to the movement of the movable packing means **28** towards the stationary packing means **27**. This action forces fluid in the confined space V up through the passage **37** in the tubular member **24** into the chamber **22**, past the check valve **41**, into the chamber **21**, and thence through hollow piston rod **15** and drill pipe **12** to the surface.

On the upstroke of the piston **16** and piston rod **15**, a partial vacuum will be created in the chamber **21** thereby sucking fluid from chamber **22** up past the check valve **41** and also sucking fluid from the confined space V up through passage **37** in the tubular member **24**. When the piston **16** engages the upper end of wall **18** of cylinder **17**, the cylinder will then be moved upward thereby increasing the volume of the confined space V and thus creating a further suction therein. Oil or other fluids which lie behind the perforations in the formations will thus be sucked through the perforations **11**, passed up through the passage **37**, and subsequently through the drill pipe **12** to the surface.

It is to be noted that in each of the described embodiments a two-fold action takes place. First, a pressure or suction is built up by means of the piston **16** operating in the upper chamber of the cylinder **17**. Secondly, a further pressure or suction is created by movement of the movable packing means **28** with respect to the stationary packing means **27**. A further pressure or suction associated with these two is built up in the chamber **22** by the action of plunger **24**. It is because of this compound effect of building up pressure or suction that a greatly improved cleaning operation is realizable with this tool.

It is to be noted that by virtue of the fact that the cylinder **17** in Fig. 1 is made in two sections connected by the coupling **19**, check valve **20** may be easily reversed. Similarly the coupling **13** may be removed, and the check valve **14** reversed. Thus the same tool may be used for a sucking or pumping operation.

Various modifications within the spirit of the present invention will occur to those skilled in the art.

I claim:

1. In an apparatus for cleaning perforations in oil

wells, means for creating a fluid pressure across said perforations between a confined space and the exterior of the casing, comprising in combination: a stationary packing means adapted to be secured within and held stationary with respect to said casing; a movable packing means spaced from said stationary packing means to define, with said perforated casing and said stationary packing means, said confined space; a cylinder secured to and movable with said movable packing means; a plunger means slidably receiving said cylinder and including a tubular member secured to said stationary packing means; a one-way check valve dividing said cylinder into two chambers, said plunger means being operable in one of said chambers; a piston means reciprocably receivable in the other of said chambers and including means engaging said cylinder at the extremes of the stroke of said piston means whereby further movement of said piston means moves said cylinder; a one-way check valve in said piston means; fluid communicating means between said confined space and said one chamber; means for reciprocating said piston means; and means providing a source of fluid communicating with the said other chamber through said piston means.

2. The subject matter of claim 1 wherein said first-mentioned check valve comprises a valve member which is seated by fluid pressure in said one chamber and the other check valve comprises a valve member which is seated by fluid pressure in the other chamber.

3. The subject matter of claim 1 wherein said first-mentioned check valve comprises a valve member which is unseated by fluid pressure in said one chamber and the other check valve comprises a valve member which is unseated by fluid pressure in the other chamber.

4. Apparatus for cleaning perforations in well casings, comprising in combination: movable and stationary packing means positionable within and in sealing contact with a perforated well casing at opposite sides of perforations therein, a cylinder extending axially of and secured to the movable packing means, means for securing the stationary packing means in fixed position within the casing, means movably connecting said stationary packing means and cylinder for movement of the latter and said movable



packing means toward and limited movement away from said stationary packing means, plunger means axially movable in said cylinder, means for limiting movement of the plunger means in the cylinder, said plunger means including a tubular member having means for attaching the member to a tubing string for reciprocating the plunger means from the surface, movement of the tubular member in an axial direction with said stationary packing means held stationary initially moving said plunger means to one limit of its movement in the cylinder and thereafter moving the movable packing means toward the stationary packing means, movement of said tubular member in the opposite direction initially moving the plunger means to the other limit of its movement in the cylinder and thereafter moving the movable packing means away from the stationary packing means, said cylinder having a transverse wall defining with said plunger means a chamber which is decreased in volume by movement of the plunger means toward said one limit and increased in volume by movement of the plunger means toward said other limit, said tubular member having first fluid passage means communicating at one end to said chamber and open at the other end for communication to the interior of a tubing string secured thereto, there being second fluid passage means communicating said chamber to the space between said packing means, and one way check valve means in said first passage means.

5. The subject matter of claim 2 wherein said check valve means comprises a valve member which is seated by fluid pressure in said chamber.

6. The subject matter of claim 2 wherein said check valve means comprises a valve member which is unseated by fluid pressure in said chamber.

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