April 3, 1956 B. P. ARTERBURY ET AL 2,740,481

CLEANING TOOL

Filed March 25, 1953

Fig. 1

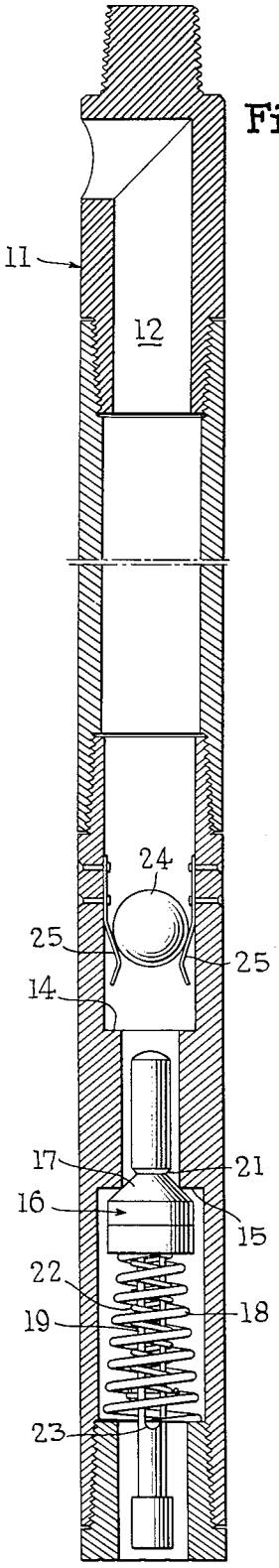



Fig. 2

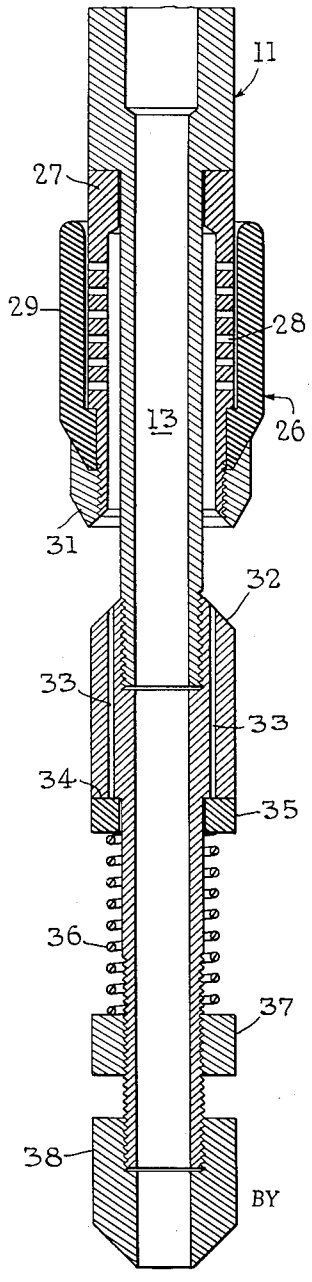
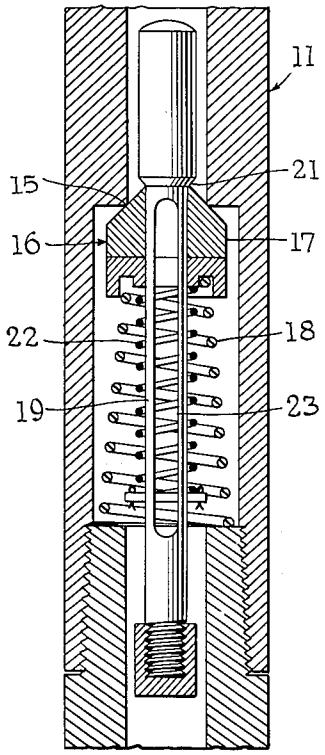



Fig. 3




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2,740,481

Patented Apr. 3, 1956



2,740,481

# CLEANING TOOL

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Application March 25, 1953, Serial No. 344,592

7 Claims. (Cl. 166—177)

This invention relates to oil well service tools. Specifically, it relates to a tool which may be used to clean the screen or perforated section of tubing which is interposed in the well casing in the region of the oil producing formation.

Two types of screen cleaning tools are in general use today. In one type of tool a cleaning liquid is introduced from the well surface under pressure and is caused to flow outward through the screen or perforated section of tubing which is to be cleaned. This type of tool is expensive because it necessitates that a delivery pipe extend from the producing formation to the surface of the well. Its use is time consuming because removal of the tool after the screen has been cleaned is complicated by the fact that the delivery pipe must be removed. The other type of cleaning tool which is in common use makes use of a packer member which may be reciprocated to induce circulation of liquid from within the well casing outward through the screen. This type of tool is relatively cheap, but in general its cleaning action is inferior to the cleaning action of a forced circulation type of tool.

There are two reasons why inferior cleaning results. One is the fact that the induced circulation is not as active as the forced circulation, but a second and more important reason is the fact that it is difficult to introduce an undiluted cleaning agent for use during the cleaning operation.

The present invention relates to a cleaning tool of the induced circulation type which includes means whereby a cleaning agent, for example an acid such as hydrochloric acid, may be introduced into the well casing adjacent to the screen to be cleaned without having been diluted by the liquid within the well casing, and without using a separate tool for this purpose.

The tool comprises an elongated tubular body which encloses a reservoir and a delivery portion which are separated from one another by two reversely set valve seats. A pressure operated supply valve is normally maintained against the lower valve seat and is effective when so seated to prevent flow from the reservoir. The upper valve seat is arranged to receive a ball check valve which is seated thereon only during the cleaning operation but not during the time when cleaning liquid is being introduced into the well casing past the supply valve.

The body is encircled by a reciprocable packer assembly which is arranged in such a way that when the tool is raised the pressure differential to open the supply valve is created. This packer assembly also creates the pressure differential which is required to cause induced circulation of cleaning liquid during the cleaning operation.

A relief valve is provided and serves to limit the pressure differential created by the packer assembly when the tool is being raised. The relief valve is arranged on the exterior of the tool and its setting may therefore be simply changed. The relief valve is so arranged that it assists in cleaning the well screen when it is opened.

A preferred embodiment of the tool will be described having reference to the accompanying drawing in which:



Figures 1 and 2, when arranged one above the other in the order stated comprise an axial section, partly broken away of the tool.

Figure 3 is a fragmentary axial section on a somewhat larger scale.

The tool comprises an elongated tubular body 11, having at its upper end a suitable connection whereby it may be attached to a wire line. The body 11 includes a reservoir 12 and a delivery portion 13. Reservoir 12 and portion 13 are separated from one another by means of upward presented valve seat 14 and a downward presented valve seat 15. A supply valve assembly 16 is arranged to seat against the valve seat 15. The assembly 16, as shown in Figure 3, includes an annular valve member 17 which is biased against the seat 15 by a compression spring 18. Reciprocable in and guided by the member 17 is a valve stem 19 which carries at its upper end a drain valve 21. The drain valve 21 is biased to seat against the member 17 by means of a compression spring 22 which reacts between the member 17 and the stem 19. The stem 19 is provided with an elongated opening 23 which serves as an outlet opening when the drain valve 21 is unseated from the valve 17 as hereinafter described.

A buoyant ball valve member 24 is captive in the reservoir 12. The ball valve 24 is normally maintained in spaced relationship to the valve seat 14 by means of spring clips 25. A packer assembly 26 is reciprocable on and encircles the body 11. The asembly 26 comprises a sleeve-like mandrel 27 having radial ports 28 therethrough. A cup-like packer 29 and a retaining nut 31 are mounted on the mandrel 27. In the lowermost position of the assembly 26, the nut 31 seats against an inclined shoulder 32 provided on the body 11. A circumferential series of longitudinal ports 33 formed in the body 11 extend to the face of shoulder 34 from the annular space defined between the sleeve 27 and the body 11, when the sleeve 27 is seated on the inclined shoulder 32. An annular relief valve member 35 is biased by a compression spring 36 to close the ports 33. The spring 36 reacts between the annular member 35 and a nut 37 which is threaded onto the body 11. The lower end of the body 11 is provided with a shoe 38 which guides the tool and protects the threads on which the nut 37 is carried.

Prior to lowering, the tool is inserted into the upper end of the well casing and a cleaning liquid is poured into the reservoir 12. The ball 24 floats on the surface of the cleaning liquid admitted to the reservoir 12 and rises to the upper end of the reservoir when it is filled. The tool is then lowered into the well casing to a position adjacent the screen which is to be cleaned. During the lowering of the tool the ball 24 acts to inhibit co-mingling between the cleaning liquid and the liquid in the well casing whereby the cleaning liquid is maintained substantially undiluted.

When the tool is raised the packer 29 seals against the well casing creating a difference between the pressure in the liquid above the packer 29, and the pressure in the liquid below the packer 29. This pressure differential is effective to overcome the bias of the spring 18, whereby the supply valve 17 moves away from the seat 15. The pressure differential created by the packer assembly is effective to cause liquid from the well casing to enter the reservoir above the ball valve 24 and to cause the liquid in the reservoir to flow downward past the supply valve 17 through delivery portion 13 into the well casing below the tool. The flow rate past the valve 17 is of a magnitude such that the ball 24 is carried downward thereby past the spring clips 25 and into seating relationship with the valve seat 14. When the ball 24 is seated further flow of liquid downward through the tool is prevented.

After the cleaning liquid has been introduced the tool is lowered through this liquid and then is raised at a brisk rate. During this phase of the operation the pressure differential created is effective to cause liquid in the casing above the packer **29** to flow outward through the screen and inward through the screen below the packer assembly. This induced flow is effective to clean the screen by the induced circulation of the cleaning liquid introduced. The pressure differential created during upward movement of the tool is determined by the relief valve **35** and the compression of the spring **36**. It will be noted that the adjusting nut **37** and the valve **35** encircle the body **11** of the tool. Hence it is easy to adjust the setting of the spring **36** and the condition of the valve **35** may be easily determined by inspection. When the valve **35** is opened the fluid which flows through the ports **33** from above the packer assembly **26** is caused to flow radially outward and impinge against the screen being cleaned.

The cleaning operation may be continued by repeated reciprocation of the tool through the screen portion. After the cleaning operation has been completed, the tool may be raised to the surface and removed from the well casing.

To condition the tool for re-use, it is necessary to raise the ball **24** to a position above the spring clips **25**. This is accomplished by inserting a rod through the delivery portion **13** into contact with the stem **19** raising the drain valve **21** from its seat into contact with the ball valve **24**, whereby the latter may be raised to a position above the spring clips **25**.

When the drain valve **21** is unseated the liquid from the well casing which has accumulated in the reservoir **12** is allowed to drain out through the portion **13**. The rod is then removed and the tool may again be charged with cleaning liquid.

The invention has two main advantages as compared to induced circulation tools of the type which have been used in the past. First it is possible to introduce the acid into the well casing at any desired depth with considerable accuracy; and second, the cleaning liquid at the time that it is introduced is undiluted by the liquids in the well.

Another important advantage is the fact that the cleaning liquid may be introduced and its circulation through the screen induced without having to change tools. This eliminates the loss of time which results from having to change tools and means that the cleaning liquid is used for its intended purpose before it has an opportunity to become diffused through the producing formation and before it is diluted by the liquids in the well casing.

The tool may be used as a simple induced circulation screen washer without the provision of the means to introduce a special cleaning liquid. When so used the bore through the tool and the valves therein may be omitted. The tool when used as a simple induced circulation screen washer possesses certain advantages over similar tools which are now in use. Particularly the setting of the relief valve may be adjusted without the necessity of disassembling the tool and secondly, the relief valve is so arranged that its opening permits a flow of liquid which assists in the performance of the cleaning operation.

It will be noted that the packer assembly **26** shown in preferred embodiment of the tool is reciprocable. This is desirable because jarring of the assembly when it reaches either limit of its motion aids in clearing sand or other material which might otherwise accumulate behind the packer **29**. The invention is not limited to the inclusion of this feature.

The preferred form of the invention has been described in detail, but no limitation to the precise construction is implied except as may be expressed in the appended claims.

What is claimed is:

1. A tool for cleaning well screens and the like comprising in combination a body; a packer assembly encircling said body and arranged to seal against said screen during upward movement of said tool; means affording a by-pass flow path through the side walls of said body from a point above said packer to a point beneath said packer; a valve seat in the form of a generally transverse annular face on the exterior surface of said body at the lower end of said flow path; an annular valve encircling said body beneath and cooperating with said valve seat, said annular valve biased in an opening direction by pressure in said flow path; and means biasing said valve closed.

2. The combination defined in claim 1 in which said biasing means comprises a nut threaded onto the exterior of said body and a spring reacting between said nut and said annular valve.

3. A tool for use to clean well screens or the like comprising in combination an elongated tubular body having therein a reservoir for cleaning liquid and a delivery connection extending from the bottom of said reservoir, a buoyant valve member captive in said reservoir and having a cross-section similar to but smaller than the transverse section of the reservoir, resilient means in said reservoir spaced above the bottom thereof and effective to sustain the weight of said valve member, a valve seat at the bottom of said reservoir and arranged to receive said valve member when flow through the reservoir carries it downward with an inertia large enough to overcome the force exerted by said resilient means, a pressure operated supply valve biased upwardly to close said delivery connection, a packer assembly encircling said body and arranged to seal against the well screen to be cleaned and thereby create a pressure differential to bias said supply valve open when said body is raised upward through the well casing.

4. The combination defined in claim 3 in which said packer assembly comprises a ported sleeve slidable on said body and a cup-like packer carried by said sleeve, and in which said tool provides a by-pass flow path including said ports and extending through the tool from a point above to a point below said packer assembly, and a relief valve biased to close flow through said path and opened by pressure differential created by said packer assembly when it exceeds a chosen maximum.

5. The combination defined in claim 3 in which said packer assembly comprises a ported sleeve guided by and reciprocable on said body; and a cup-like packer carried by said sleeve and having its lower edge attached to said sleeve beneath the ports therein; and a relief valve controlling flow through said ports and opened by the pressure differential created by said packer assembly when it exceeds a predetermined maximum amount.

6. The combination defined in claim 3 in which said supply valve comprises a seat and an annular valve member biased upward against said seat; a reversely set drain valve guided in and seating against said annular valve member; means biasing said drain valve closed; said drain valve including an upward extending projection effective to raise said buoyant valve member to a position above said resilient means when the drain valve is opened.

7. A well tool to clean perforated elements defining a well bore and including a body and a packer assembly including a sleeve encircling and slidable upon said body and an upwardly facing cup-like packer encircling said sleeve and carried thereby to frictionally engage the well bore wall, a fluid passage provided in said sleeve extending from its exterior above the connection of said packer thereto through its interior to discharge therefrom below said packer connection, a valve seat on the exterior of the lower end of said sleeve outwardly of said fluid passage, a valve element engageable with said valve seat and encircling said body beneath said packer assembly and having a flow passage therethrough establishing fluid communication with said fluid passage when said packer assembly valve seat seats thereon, means biased to normally close the lower end of said valve element flow passage, said body being adapted to be lifted with relation to said packer assembly to seat said

valve seat on said valve element to place said fluid passage and said flow passage in communication and said packer then being expandable into firm engagement with the well bore wall by pressure of fluid from thereabove and said valve element then being openable by excessive fluid pressure.



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