

June 27, 1950

W. R. KINNEY ET AL
PERFORATION WASHER

2,512,801

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2 Sheets-Sheet 1

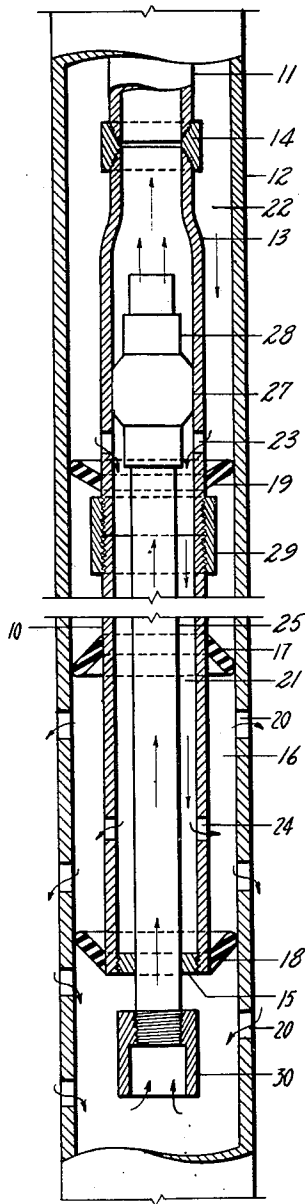


Fig. 1

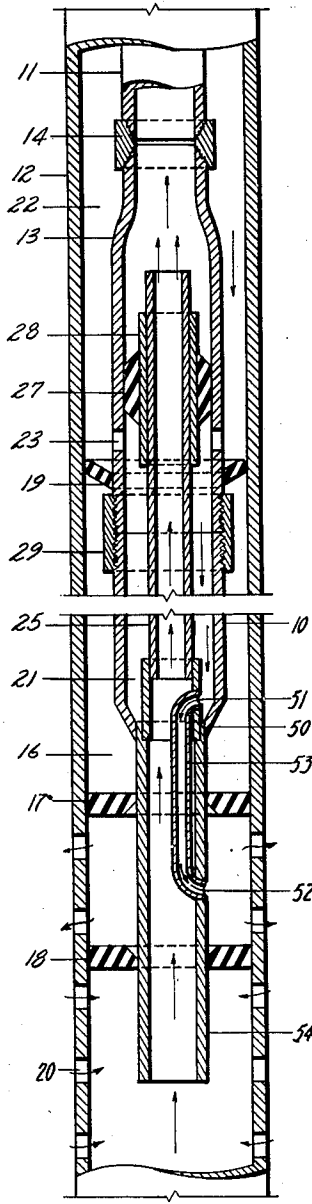


Fig. 3

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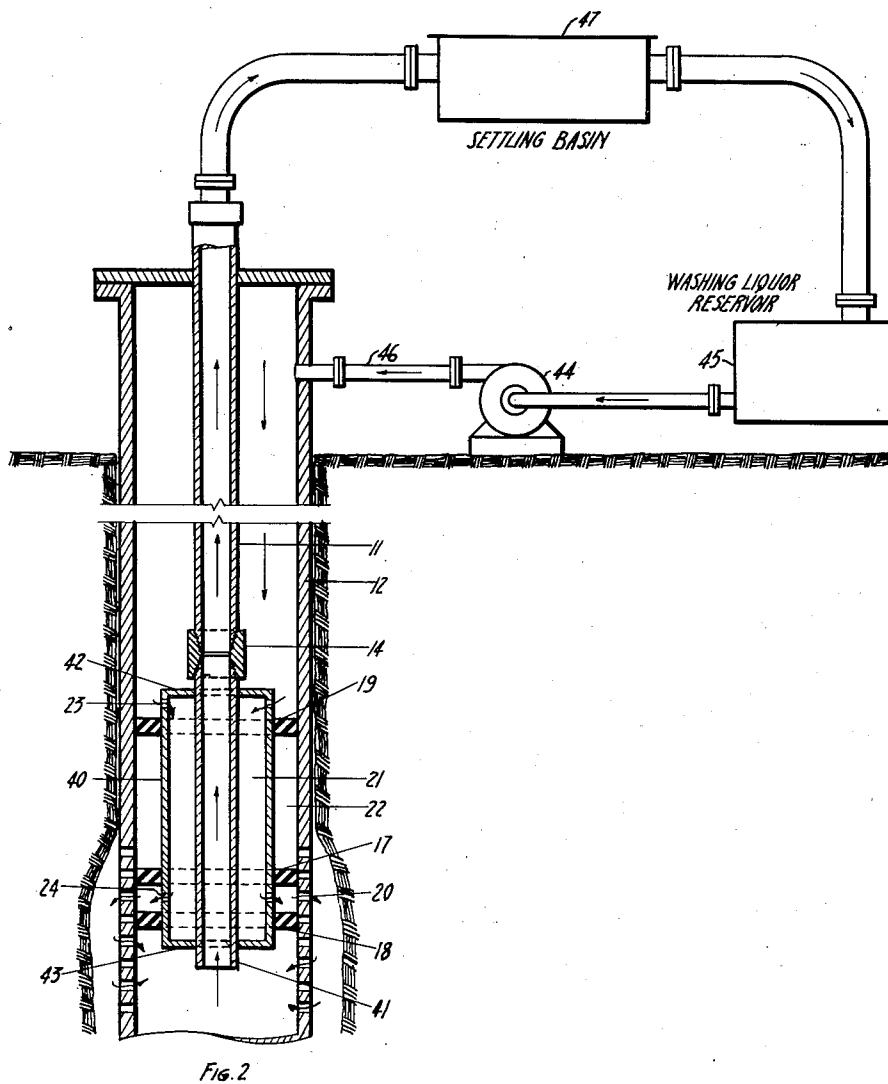
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PERFORATION WASHER

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6 Claims. (Cl. 166—20)

1

This invention relates to well tools and pertains more particularly to a perforation washer tool adapted to deliver fluid to a predetermined zone within a well screen to wash, open and clean the perforations or mesh of said well screen.

Oil wells are commonly lined with a casing having a wire-wound or perforated screen attached thereto, which is located in the producing zone of the well. Unless cleaned from time to time the openings in the well screen become clogged with mud, sand, debris, etc., which slows down the rate of liquid inflow to the casing or pump reservoir. It is therefore a primary object of this invention to provide a perforation washer adapted to be lowered and positioned in a well casing for efficiently cleaning conventional well screens.

The washing of a screen is normally accomplished by the forcing of fluid under pressure outwardly through various sections of the screen. Material washed out of the perforations may be forced by the fluid pressure into the producing formation thus tending to clog it, or it may enter the casing through the perforations not under outward pressure and accumulate in the casing. It is, therefore, a further object of this invention to provide a perforation washer having associated therewith means for removing and raising to the surface the sand and debris that collect in the bottom of the well casing, thus eliminating the need for stopping operations to bail out the sand and also providing for a close inspection, at the surface, of all materials washed out from behind the perforations.

Another object of this invention is to provide a reverse-flow circulation system utilizing a perforation washer adapted to convey debris-carrying washing fluid from the washed screen to the tubing string and thence up to the surface.

It is a further object of this invention to provide a perforation washer of simple and sturdy construction having a main body and packing elements carried thereon, said washer being so designed as to permit the packing elements to be set closely together, whereby relatively small areas of the well screen can be subjected to the pressure of the washing fluid being discharged between the packing elements.

Another object of the present invention is to provide a washer that can be run into and out of a well easily and that can be operated during both the raising and the lowering of the tubing string.

A still further object is to provide a perforation washer that can be positioned without the use of slips in a well screen attached to any casing or oil string.

2

These and other objects of this invention will be understood from the following detailed description of the preferred embodiment of the invention and from the accompanying drawings, wherein:

Fig. 1 is a diagrammatic view, partly in longitudinal cross section, of the perforation washer of the present invention.

Fig. 2 is a sectional elevation through a well illustrating a modified form of this invention in connection therewith.

Fig. 3 is a cross sectional view of a modified form of the perforation washer.

Briefly, the present perforation washer is to be adapted to be attached to the lower end of the tubing string and to be positioned within the perforated well screen. The washer structure comprises a central tubular body member closed at its lower end and having three packers attached thereto, two of said packers being located near the lower end of said body member and the third being located near the upper end thereof so as to be positioned outside the well screen at all times, fluid inlets through said body member above this third packer, fluid outlets through said body member between the two lower packers, a diametrically smaller inner tubular member disposed within the central body coaxially therewith and extending through the closed end thereof, and a packer attached near the upper end of said inner tubular member so as to seal the annular space between said member and said body member at some point above the fluid inlets of the central body member.

For clarity, the present perforation washer will be described hereinbelow with regard to the illustrated embodiment thereof, it being understood that the present invention is in no way restricted to said illustrated embodiments, but has a scope defined only in the claims attached to the present specification.

Referring more in detail to the drawing:

The reference numeral 10 designates the perforation washer of the present invention, which is removably attached, for example, by means of a collar 14 to the lower end of the tubing string 11, said tubing string depending within the oil string, casing or liner 12, which has perforations 20 in one or more sections, usually at the lower end thereof, forming a well screen. In order to utilize a washer of as large a diameter as possible, the washer is usually swaged as shown at 13.

The perforation washer 10 forms a central tubular body member whose lower end is closed by a fluid tight plug 15. Three resilient packing elements are carried on the outer wall of said

central body member to seal the annular space 16 between said body member 10 and the oil string or liner 12. These packing elements, made of some resilient material such as rubber, rubberized canvas, etc., may be of several forms but are shown in this embodiment as rubber swab cups. Two of the packers, 17 and 18, are located near the lower end of the body member 10. These packers may be adjustable so that the space between said packers may be adjusted to any desired length depending upon the desired area of the well screen to be washed at any one time. A third packer 19, near the upper end of the body member 10, and removed relatively far from the packers 17 and 18, is located on said body member so that it is positioned above the well screen perforations 20 at all times.

The inner bore 21 of the body member 10 is in communication with the bore 22 of the casing 12 above the upper packer 19 through the fluid inlets 23 in the wall of said body member. The above-mentioned bores, 21 and 22, communicate similarly through the fluid outlets 24 which are located in the wall of said body member 10 between the lower packers 17 and 18. A diametrically smaller inner tubular member or return pipe 25 is supported coaxially within the body member 10 and extends through the plug 15 in fluid-tight fashion. This inner tubular member 25 may be removably positioned within the perforation washer 10, so as to facilitate the cleaning and repairing of the latter, or may be formed integrally therewith. The annular space within the bore 21 around the inner tubular member 25 is closed at the upper end by a resilient fluid tight packer 27 of a rubber-like material which may have an adjustment collar 28 for axially compressing and radially expanding said packer 27. For ease of maintenance the body member 10 may be made in two sections connected to each other by a collar 29. If desired, a cup or collar 30 may be attached to the end of the inner tubular member 25.

In operation, the above-described perforation washer 10 is attached to the lower end of the tubing string 11 and run into the well. It is positioned, as indicated in Fig. 1, with the lower packers 17 and 18 in contact with the bore 22 of a perforated section of the casing 12 so as to confine or pack off that section of the perforated casing to be washed. The washing fluid is pumped down the casing 12 until it reaches the upper packer 19. It is then channeled through the fluid inlets 23 and down the annular space within the bore 21 around the return pipe 25. The washing fluid is then discharged through the outlet ports 24 and is forced through the perforations 20 located between the packers 17 and 18. The force of the fluid pressure removes sand and debris from any of the clogged perforations 20 in the casing and washes it back into the casing through other perforations outside the packed off area. This return fluid and sand enters the lower end of the inner return pipe 25 and flows upward through the tubing string 11 to the surface where the sand may be separated from the washing fluid and inspected.

Due to the improved and unique construction of this perforation washer the screen washing process may be carried on continuously while lowering or raising the washer. Since the packers at the lower end of the perforation washer are adjustable the jetting force of the cleaning fluid may be intensified against difficult-to-wash perforations by positioning the packers close to each

other thus permitting the complete washing of the screen. The use of widely-spaced packers on a perforation washer often results in an incompletely washed screen as the jetting force of the washing fluid is dissipated through the open perforations while other perforations remain plugged.

A modified form of the present invention is shown in Fig. 2. The perforation washer comprises a return tube 41 attached by means of a collar 14 to the tubing string 11, an outer tubular member 40 surrounding said inner return tube 41, transverse flange means 42 and 43 at the end of said outer tubular member closing the space between the inner and outer tubes, perforations 23 and 24 in said outer tube and packers 17, 18 and 19 carried thereon.

When the perforation washer is in operation a pump 44, drawing washing fluid from a reservoir 45, is connected by means of a conduit 46 to the screen string 12. Washing fluid, pumped down the screen string, enters the washer through the perforations 23 and is discharged through perforations 24 between the lower packers 17 and 18. The discharged fluid is then forced through the perforations 20 of the screen string 12 circulating downward and re-entering the screen string through perforations in the string below the packer 18 thereby tending to clean these perforations also. Thus, the washing fluid exhibits a dual cleaning effect by this downward circulation which is necessarily downward as the open end of the return tube 41 is below the discharge ports 24 of the washer. The debris-laden washing fluid is then forced upward through the return tube 41 and tubing string 11 to the surface where it may be discharged into a settling basin 47. The effective raising of the debris-carrying washing fluid is accomplished by the use of reverse circulation in the system. Since the fluid is returned to the surface through the smaller tubing string the flow of fluid is accelerated greatly upon entering this restricted conduit thus enabling the fluid to carry the debris with it to the surface.

A slightly modified form of the perforation washer is shown in Fig. 3. In this embodiment the body member 10 is swaged as shown at 50 thus forming a closure means between the body member 10 and an extension 54 of the inner tubular member 25. A fluid inlet 51 in the inner tubular member 25 above said closure means 50 is connected by means of a conduit 53 to a fluid outlet 52 in the body member 10 between the packers 17 and 18 carried thereon. In operation the washing fluid is pumped down the casing 12 until it reaches the upper packer 19. It is then channeled through the fluid inlets 23 and down the annular space within the bore 21 around the return pipe 25. When said liquid reaches the swaged section 50 it enters fluid inlet 51, passing through conduit 53 to be discharged at fluid outlet 52 and is forced through the perforations 20 located between the packers 17 and 18. The washing fluid returns through other lower perforations 20 outside the packed-off area and returns to the surface through the return pipe extension 54 and the return pipe 25.

We claim as our invention:

1. An apparatus adapted to be attached to the end of a tubing string and to be lowered within a tubular screen in a well to wash said screen, said apparatus comprising an elongated tubular outer member, an elongated inner tubular member arranged within said outer member, the upper

5

end of the inner tubular member being open to the space within said outer member, and the lower end of said inner tubular member being open to the space below said outer member, upper and lower sealing means radially spacing said tubular members from each other and defining an elongated annular chamber therebetween, a plurality of packer means axially spaced from each other carried on the exterior of the outer tubular member, flow means comprising first port means in said outer tubular member providing communication between said annular chamber and the space outside said outer tubular member above the uppermost packer means, and flow means comprising second port means in said outer tubular member providing communication between said annular chamber and the space outside said outer tubular member between two of the lowermost packer means.

2. An apparatus adapted to be attached to the end of a tubing string for lowering into a tubular screen forming part of a string in a well to wash said screen, said apparatus comprising an elongated tubular body having inner and outer tubular members, said inner member being open to the space within said outer member at its upper end and open to the space below said outer member at its lower end, an annular chamber formed between said tubular members near the lower end of the inner member and at a distance thereabove, upper and lower transverse closure means sealing said annular chamber, first port means through the walls of the outer tubular member below said upper closure means, second port means through the walls of the inner member above said lower sealing means, third port means through the walls of the inner member below said lower sealing means, a conduit within said inner member in communication between said second and third port means, first packer means carried on the exterior of said outer tubular member below said first port means, and second and third packer means carried on the exterior of said outer member respectively above and below said third port means.

3. An apparatus adapted to be positioned at the end of a tubing string within a tubular screen in a well to wash said screen, said apparatus comprising an elongated tubular outer member, means for attaching the upper end of said outer member to said tubing string, an inner tubular member arranged concentrically within said outer member, upper and lower sealing means radially spacing said tubular members from each other and defining an elongated annular chamber therebetween, said inner tubular member having a lower end opening to the space below said lower sealing means and an upper end opening to the space above said upper sealing means, a plurality of packers axially spaced from each other carried on the exterior of said outer tubular member, first port means through the walls of said outer tubular member below said upper sealing means and above the uppermost packer, and second port means through the walls of said outer tubular member between two of the lowermost packers.

4. An apparatus adapted to be positioned at the end of a tubing string within a tubular screen in a well to wash said screen, said apparatus comprising an elongated tubular inner member,

6

means for attaching the upper end of said inner member to said tubing string, an outer tubular member arranged concentrically outside said inner member, upper and lower sealing means radially spacing said tubular members from each other and defining an elongated annular chamber therebetween, said inner tubular member having a lower end opening to the space below said lower sealing means and an open upper end, at least three packers axially spaced from each other carried on the exterior of said outer tubular member, fluid inlet ports through the walls of said outer tubular member below said upper sealing means and above the uppermost packer, and fluid outlet ports through the walls of said outer tubular member between the two lower packers.

5. A perforation washer adapted to be attached to the end of a tubing string and to be lowered within a tubular screen in a well to wash said screen, said washer comprising an elongated tubular outer member, an elongated inner tubular member open at both ends arranged within said outer member coaxially therewith, upper and lower sealing means radially spacing said tubular members from each other and defining an annular chamber therebetween, a plurality of packer means axially spaced from each other carried on the exterior of the outer tubular member, said outer tubular member having first port means therethrough in communication between said annular chamber and the space outside said outer tubular member above the uppermost packer means, and second port means therethrough in communication between said annular chamber and the space outside said outer tubular member between two of the lowermost packer means.

6. A perforation washer adapted to be attached to the end of a tubing string and to be lowered within a tubular screen in a well to wash said screen, said washer comprising an elongated tubular outer member, a plurality of longitudinally spaced packer means carried on the exterior of the outer tubular member, an elongated inner tubular member open at both ends arranged within said outer tubular member coaxially therewith, upper and lower sealing means radially spacing said tubular members from each other and defining an annular chamber therebetween, said upper and lower open ends of said inner tubular member extending through said upper and lower sealing means respectively, said outer tubular member having therethrough first port means in communication between said annular chamber and the space outside said outer tubular member above the uppermost packer means, and second port means in communication between said annular chamber and the space outside said outer tubular member between two of the lowermost packer means.

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