

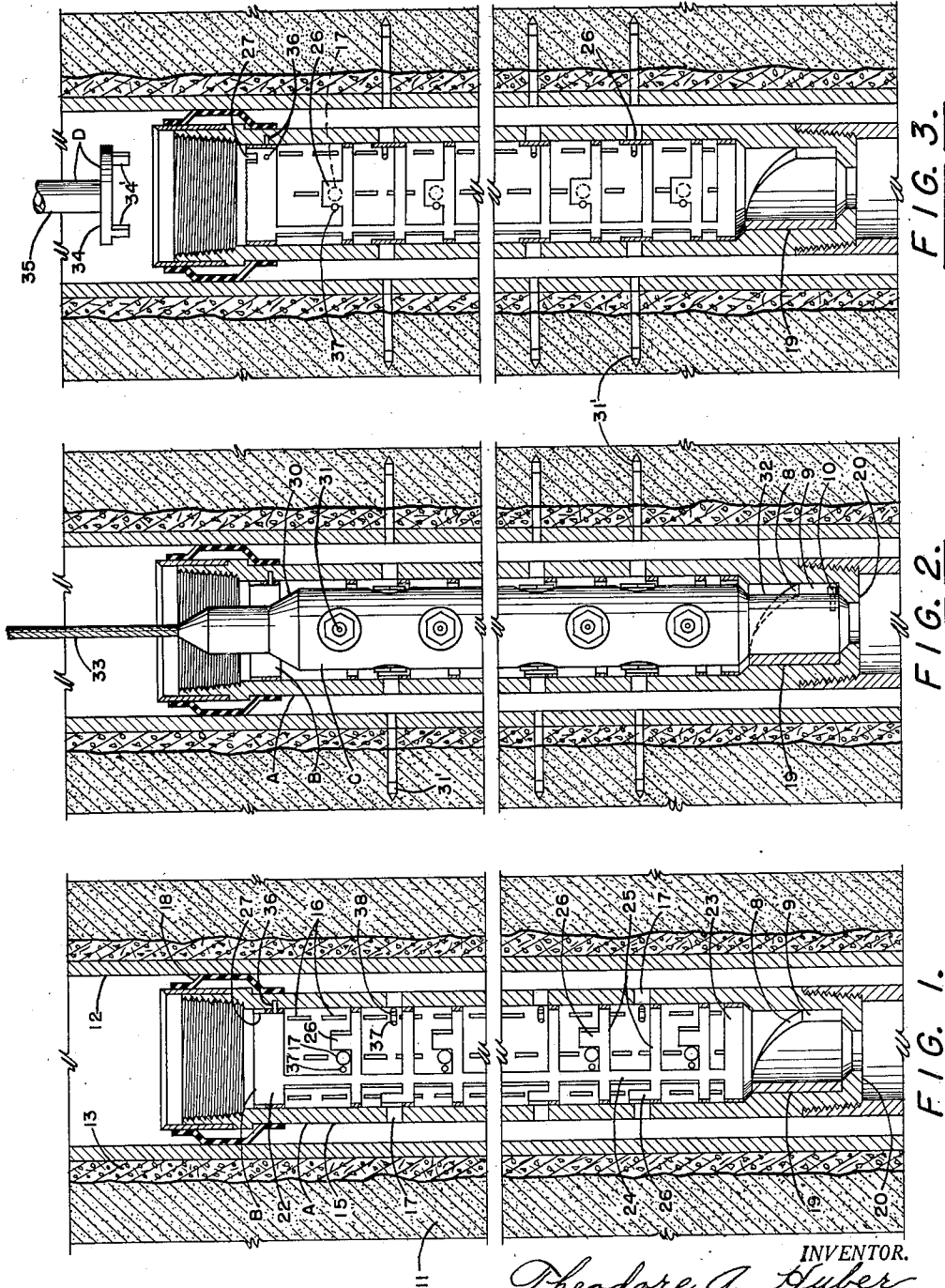
March 14, 1950

T. A. HUBER
SCREEN ASSEMBLY FOR WELLS

2,500,754

Filed July 23, 1945

2 Sheets-Sheet 1



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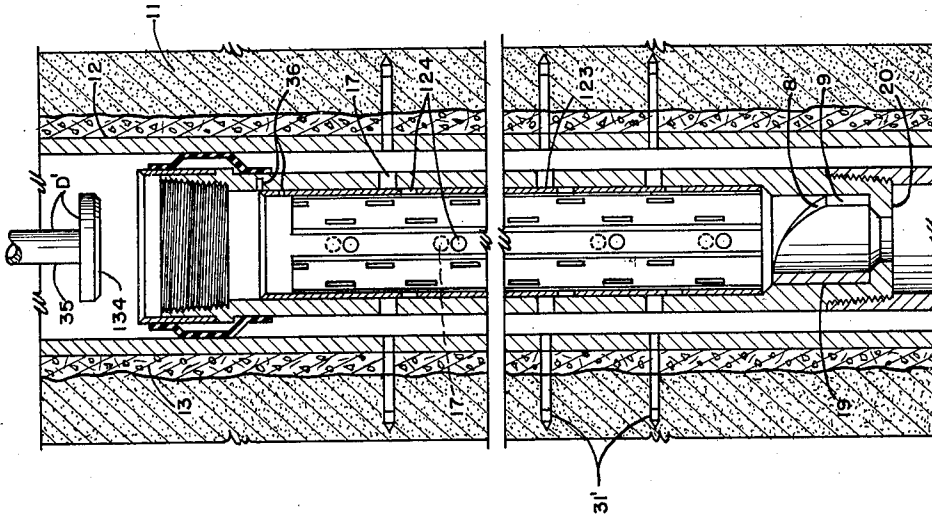
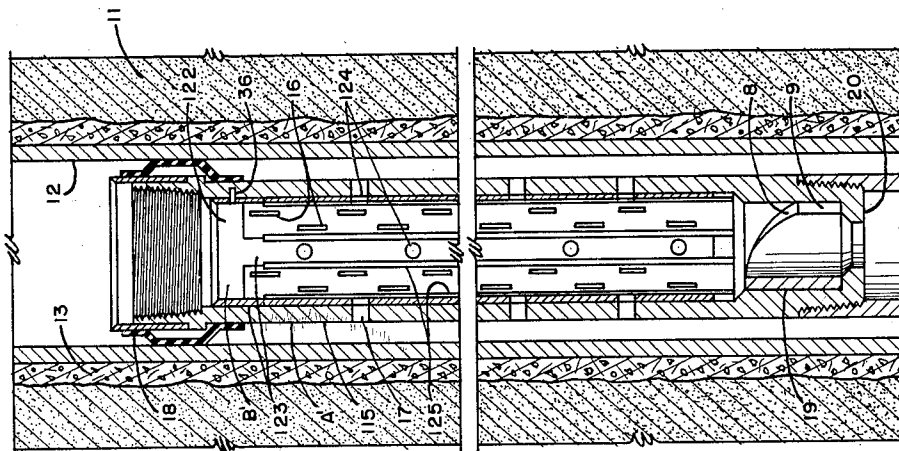
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UNITED STATES PATENT OFFICE

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SCREEN ASSEMBLY FOR WELLS

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5 Claims. (Cl. 166—5)

1

The present invention is directed to a screen or perforated pipe member adapted for use in cased wells which allows perforation of the casing after the screen has been placed in position within the casing.

An object of the present invention is the provision of a screen or slotted pipe adapted to be placed within a cased borehole so that the casing may be perforated by a mechanism lowered within the screen without harm to the screen.

Another object of the present invention is the provision of a screen or slotted liner adapted to be placed within a cased borehole and provided with a series of spaced openings, means adapted to close said openings at the option of an operator and a guide means adapted to cooperate with a gun perforator to position the gun perforator so that bullets shot therefrom pass through the openings into the casing without harm to the body of the screen member.

Other objects and advantages of the present invention may be seen from a reading of the following description taken with the drawing in which

Fig. 1 is an elevation, partly in section, of a screen constructed in accordance with the present invention arranged within a cased borehole with the figure showing a section of the casing cemented in position adjacent a formation;

Fig. 2 is a view of that section of the borehole shown in Fig. 1 with a borehole gun within the screen and illustrating the appearance of the borehole immediately after the casing has been perforated by use of the borehole gun;

Fig. 3 is a view of the embodiment of the preceding figures with the borehole gun removed, the openings in the screen, through which the casing was perforated, closed and the closing tool in the position it occupies immediately after the closing mechanism has been activated;

Fig. 4 is an elevation, partly in section, of another embodiment of the present invention shown in position in a section of casing cemented in a well; and

Fig. 5 is a view of the embodiment of Fig. 4 after the casing has been perforated and showing the ports in the screen, through which the perforations were made, closed and the closing tool in the position it occupies immediately after the closing means has been activated.

Turning now specifically to the drawing and first to the embodiment illustrated in Figs. 1, 2 and 3, a borehole is shown penetrating formation 11. A casing 12 is arranged within the borehole and is cemented into position by a layer of cement

2

13. It will be understood that casing 12 extends above and below that portion of the borehole shown in the drawing and communicates at its upper end with the surface of the earth and has its lower end provided with conventional arrangements, not shown, employed for the setting of casing.

Arranged within casing 12 is a tool or assembly A. Body 15 of assembly A is in the form of a tube with a plurality of small slot or screen openings 16 and spaced relatively large side ports or openings 17. Assembly A is constructed with such external dimensions as to allow it to be lowered into position within the casing. After assembly A has been lowered into position, it is desirable to prevent fluid flow between the interior of the casing and the upper end of the assembly and, accordingly, a packer 18 is mounted on the upper end of member 15. It will be understood that packer 18 allows assembly A to be moved freely down through the casing to its position adjacent the formation to be penetrated and when this depth has been reached, the packer may be set; packers suitable for this purpose are well known to the art and for the purpose of simplifying the drawing packer 18 has not been shown in detail but only schematically.

Assembly A is provided with a suitable guide means for cooperating with a borehole gun to guide the gun into a predetermined position with each of the bullets of the gun adjacent a port 17, whereby upon the firing of the gun the bullets pass through ports 17 and perforate casing 12 and cement 13. In the drawing, the guide means is indicated as a cylindrically shaped insert 19 having its upper end cut at a slant and the slanting surface designated by numeral 8. A longitudinal groove 9 extends vertically downward from the lower edge of surface 8. Insert 19 is commonly known to the art as a sleeve cam or mule shoe throw guide.

The lower end of body 15 is shaped to form ledge 20 which serves to support sleeve 19 and the borehole gun when the borehole gun is lowered into assembly A.

Arranged within tubular member 15 is a closure member B of such construction as to expose ports 17 when in a first position and to cover them when in a second position. The closure member is also of such construction as to interfere as little as possible with the slots or screen openings 16. Closure member B may be described as formed with an upper annulus 22, a lower annulus 23, longitudinally extending members 24 joining the two annuli together and a plurality

3

of spaced annuli 25 arranged between the two end members 22 and 23 and secured to longitudinally extending members 24. Annuli 25 are shown in the drawing as spaced slightly below ports 17 and serve as mounting means carrying cover members 26. Cover members 26 are clear of ports 17 when the closure member B is in a first position, as shown in Figs. 1 and 2, and cover the ports when closure member B is in a second position, as shown in Fig. 3. Annulus 22 is provided with notches 27 which are adapted to engage with a tool for rotating closure B from its first to its second position.

In normal operation, the assembly A of Figs. 1, 2 and 3 has the closure means B in its first position when at the surface of the earth and after it is lowered along the axis of the casing to the point at which the casing is to be perforated the packer 18 is set to prevent the flow of fluid at the surface between the upper end of the member 15 and casing 12. A borehole gun C is then lowered into position and the casing perforated through ports 17. The borehole gun is then raised to the surface and a tool D lowered into the borehole and employed to move closure B from its first position to its second position. In order to retain closure B in its first position while assembly A is being lowered through the casing and while the casing is being perforated, a shear pin 36 is provided; this shear pin may be readily sheared by tool D and closure B moved from its first to its second position.

The assembly A in position for the perforation of a casing adjacent a desired formation and with the ports exposed to allow the projection of bullets therethrough is shown in Fig. 1. In Fig. 2 a gun perforator C is shown in position in assembly A and adapted for projecting bullets through ports 17 of assembly A for perforating the casing. The gun perforator comprises a body 30 and a lower end 32. The lower end 32 is of such configuration as to cooperate with sleeve 19 of the assembly A and is provided with a laterally extending pin 10. As the gun perforator C is lowered within the assembly A, the pin 10 comes in contact with surface 8 and causes assembly C to move angularly until pin 10 enters longitudinal slot 9 and orients perforator C with respect to assembly A. The gun perforator C is provided with a plurality of barrels 31, with each barrel arranged for projecting a bullet through a port 17 when end 32 is engaged with sleeve 19 with the pin 10 lying within slot 9. A cable 33 is arranged for suspending the gun and for transmitting signals from the surface to the gun in the known manner for firing the gun. When the gun is lowered to the position shown in Fig. 2, it will be supported by ledge 20 and the barrels 31 will each be exactly opposite a port 17 so that when the gun is fired the bullet may be projected through the ports without harm to screen body 15.

A number of cable suspended gun perforators adapted to be controlled by the operator at the surface of the earth are known to the art and for this reason the operating mechanism of the gun perforator is not shown in detail. A suitable firing mechanism which may be employed is that disclosed in U. S. Patent 2,296,318, issued September 22, 1942.

After gun C has been lowered into position with end member 32 engaging with guide base 19, it may be fired in the usual manner. When the gun is fired the bullets are projected through ports 17 and penetrate through casing 12, ce-

4

ment 13 and into formation 11 to open communication between the formation and the interior of screen member 15. Fig. 2 illustrates the gun perforator in position after the bullets 31' have been fired and shows the openings through the casing and cement made by the bullets and the bullets lodged in formation 11.

Following the firing of the gun perforator, it is withdrawn to the surface in the usual manner and fluid produced from formation 11, if the formation is capable of producing fluid. It will usually be desirable to clean the well by allowing it to flow through the casing perforations and ports 17 into the central passage defined by screen body 15 and thence upwardly through the bore of the hole. The amount of fluid which must be produced from the well in order to clean it will vary with the condition of the borehole and other factors, but usually the well should be allowed to flow through ports 17 for a period ranging from 12 to 48 hours in order to insure a thorough cleaning of the formation. Flow of fluid through ports 17 is terminated by moving closure B from its first position to its second position. It will be understood that it is not necessary to flow the well through ports 17 but the entire production of the well may be caused to pass through screen openings 16.

In Fig. 3 is shown a suitable tool D for engaging with closure member B and for rotating it from its first to its second position. It will be seen that the tool is constructed with an annulus 34 having its upper surface secured to the lower end of a string of tubing 35 and provided with downwardly extending rods 34' adapted to engage with notches 27 of closure B. Upon the lowering of setting tool D into position to engage members 34' with notches 27 and rotating, the pin 36 is sheared and closure B rotated from its first to its second position. Movement of closure B beyond its second position may be prevented by a suitable stop means. In the drawing, the stops are shown as consisting of laterally projecting rods 37 each arranged adjacent a port 17 and having a notch 38 which engages with a corresponding cover member 26. This arrangement aids in sealing ports 17 in a fluid-tight manner. After member B has been moved from its first to its second position the setting tool may be withdrawn to the surface of the earth and the well allowed to produce through screen openings 16 in the conventional manner.

In the embodiment of Figs. 4 and 5, an assembly A' having a body 115 and ports 17 is provided with a closure B' consisting of an annulus 122 positioned at the upper end of the tubular body 115 and downwardly extending members 123, the upper ends of members 123 being secured to annulus 122. The closure B' is of such dimensions as to be slidable longitudinally with respect to body 115 so that it may be moved from a first position to a second position. Openings 124 are provided in members 123 so that when the assembly is in its first position, openings 124 and ports 17 coincide to allow flow of fluid through the ports and when it is in the second position, wall portions of members 123 are adjacent ports 17 and prevent the flow of fluid through them. Body 115 is provided with longitudinally extending guide members 125 to retain the outer surfaces of members 123 adjacent portions of the inner surface of body 115 while allowing relative movement between closure B' and body 125. A shear pin

5

36 is provided so that closure B' may be placed in its first position with respect to body 115 when assembly A' is at the surface of the earth and after the casing is perforated the pin may be sheared to allow closure B' to be moved from its first to its second position.

In Fig. 4 assembly A' is shown with closure B' in its first position and in Fig. 5 is shown assembly A' as it appears after the casing has been perforated, the borehole gun removed from the hole and setting tool D' has been used to move closure B' from its first to its second position. In Fig. 5 setting tool D' is shown in the borehole. In Fig. 5 setting tool D' is shown as constructed with an annulus 134 having its upper surface secured to the lower end of a string of tubing 35. It will be seen that annulus 134 is of such dimensions as to engage with annulus 122 of assembly A' and when these annuli 122 and 134 are so engaged, tubing 35 may be moved downwardly to shear pin 36 and move closure B' from its first to its second position to close ports 17. The several parts of the apparatus shown in Fig. 5 are in the position which they occupy immediately after annulus 134 has sheared pin 36 and forced closure B' downwardly from its first to its second position. It will be understood that instead of closing means D', shown in Figs. 4 and 5, other suitable means may be employed for moving closure B' from its first to its second position.

While I have shown and described specific embodiments of the present invention, it will be understood by workmen skilled in the art that the present invention is not to be restricted to the specific embodiments shown; for example, instead of employing a slotted tubular body as a screen member, a wire wrapped screen member or other types of well screens may be employed. Similarly, various changes in the dimensions and proportions of the closure means used for preventing the flow of fluid through the ports after the casing has been perforated may be made by workmen skilled in the art without invention and will be seen to be within the scope of the present invention.

Having fully described and illustrated preferred embodiments of the present invention, what I desire to claim is:

6

1. A wall screen assembly, comprising, in combination, a tubular member defining small screen openings and at least one port larger than the screen openings, a closure member slidably mounted on the tubular member and adapted to assume a first position exposing all of the ports larger than the screen openings defined by the tubular member and a second position closing all of said ports while exposing at least a major portion of said screen openings, and a guide means mounted on said tubular member for positioning a perforating gun having bullets arranged to be projected radially with the bullets in alignment with and adjacent to said ports.

2. An assembly in accordance with claim 1 in which said tubular member defines a plurality of spaced ports larger than the screen openings and said closure member is circumferentially movable from its first position to its second position.

3. An assembly in accordance with claim 2 in which a packer is mounted on the exterior of the upper end of the tubular member and in which said closure member is slidably mounted on the interior of the tubular member.

4. An assembly in accordance with claim 1 in which said tubular member defines a plurality of spaced ports larger than the screen openings and said closure member is longitudinally movable from its first position to its second position.

5. An assembly in accordance with claim 4 in which a packer is mounted on the exterior of the upper end of the tubular member and in which said closure member is slidably mounted on the interior of the tubular member.

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