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APPARATUS AND METHOD OF COMPLETING A WELL

Filed July 6, 1931

2 Sheets-Sheet 1

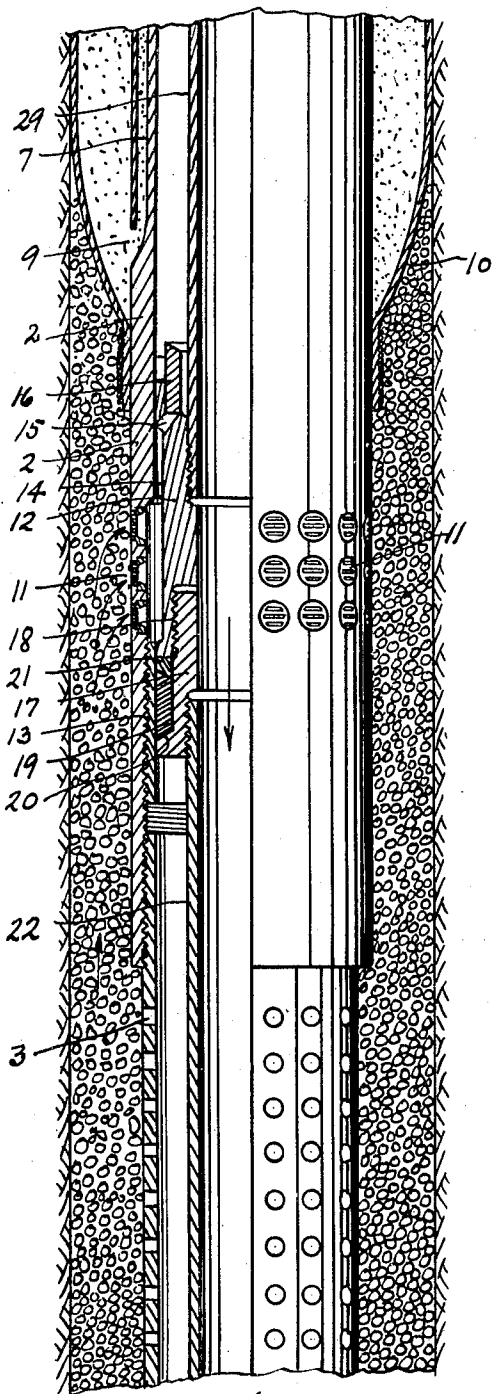


Fig. 4.

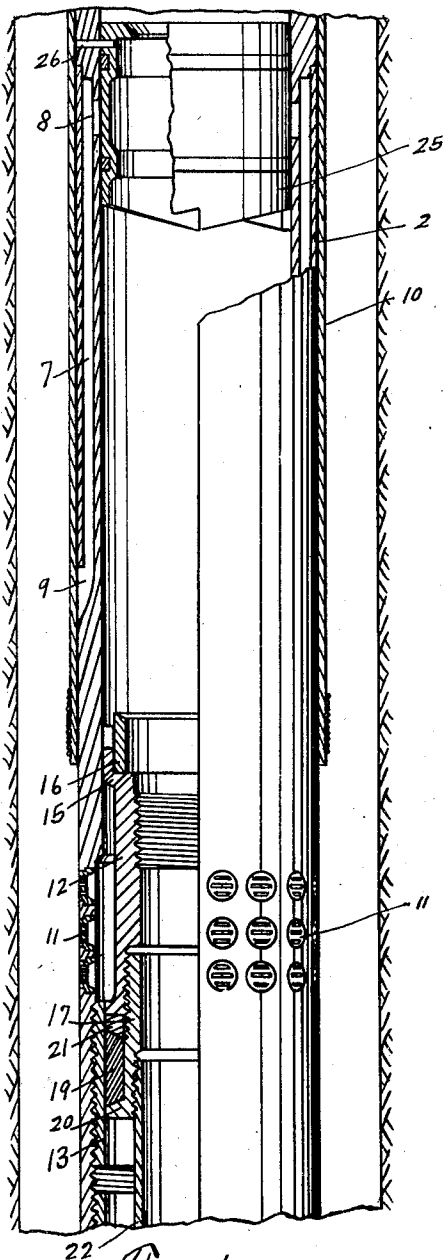


Fig. 1.

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2 Sheets-Sheet 2

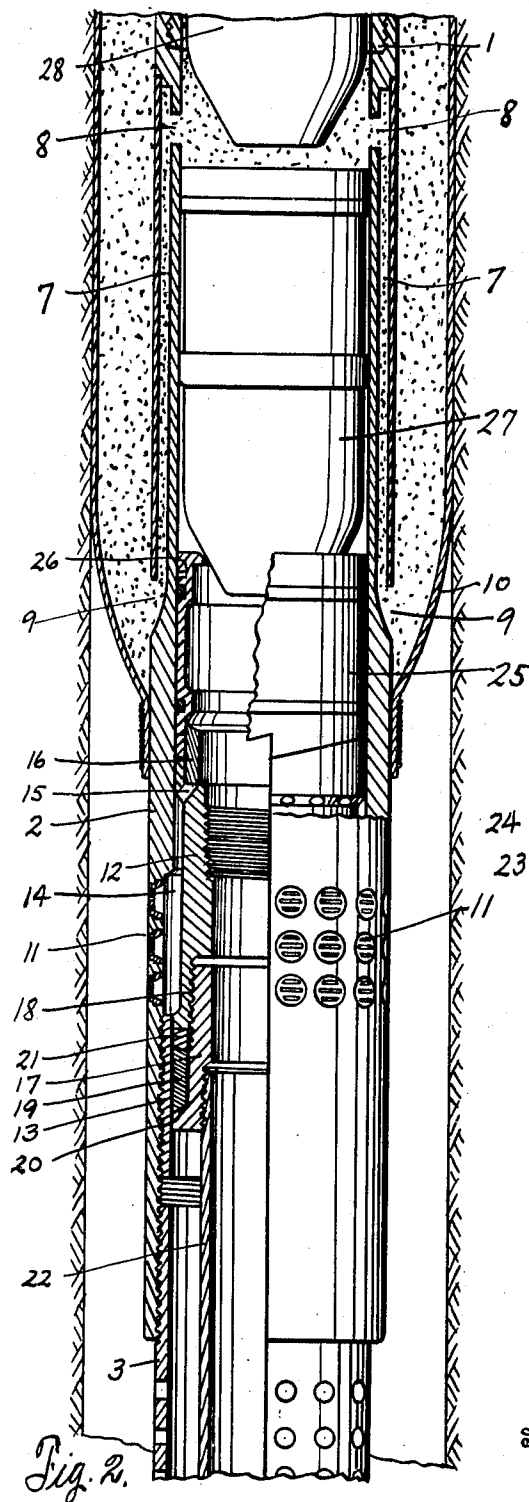


Fig. 2.

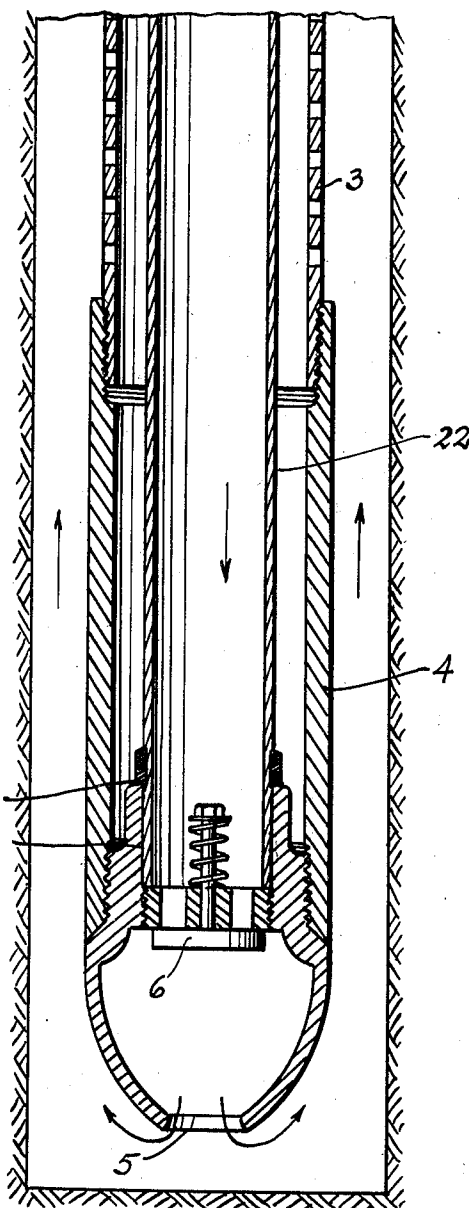


Fig. 3.

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UNITED STATES PATENT OFFICE

1,944,443

APPARATUS AND METHOD OF COMPLETING
A WELLSanford E. Manning, deceased, late of Houston,
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Houston, Tex.

Application July 6, 1931. Serial No. 548,818

13 Claims. (Cl. 166—21)

This invention relates to an apparatus and method of completing a well.

An object of the invention is to provide screen setting apparatus whereby a well screen may be set in a well bore and washed and embodies also means for forming a cement barrier above the upper end of the screen and between the screen pipe and the walls of the bore to shut off the water strata above from the oil bearing strata. The invention also comprehends means whereby coarse aggregate such as gravel may be deposited in the bore around the screen therein.

A further object of the invention resides in the provision of apparatus of the character described whereby the cement barrier above referred to may be formed and whereby the gravel or coarse aggregate may be deposited around the screen in the bore, beneath the barrier.

A further feature of the invention resides in a novel method of washing and cementing the screen and depositing the coarse aggregate in the bore and about the screen.

With the above and other objects in view, the invention has particular relation to certain novel features of construction, operation and arrangement of parts, and to a novel method, an example of which is given in this specification and illustrated in the accompanying drawings wherein:

Figure 1 shows a fragmentary side elevation partly in section of the upper portion of the apparatus, showing the screen set in the well ready to be washed.

Figure 2 shows a fragmentary side elevation partly in section of the screen in the well bore showing the cement being applied to form a barrier about the upper end of the screen pipe.

Figure 3 shows a vertical sectional view of the lower end of the screen showing a set shoe thereon and showing the wash pipe therein, and

Figure 4 shows a fragmentary view of the apparatus partly in section with the cement set and in position for introducing the gravel or other aggregate into the bore around the screen.

Referring now more particularly to the drawings wherein like numerals of reference designate similar parts in each of the figures the numeral 1 designates the setting string to the lower end of which an elongated special type of coupling 2 is connected. A screen 3 of any selected design is attached to the lower end of said coupling and to the lower end of said screen a conventional type of set shoe 4 is connected, the lower end of said set shoe having the discharge opening 5 which is controlled by the suitable downwardly opening back pressure valve 6.

The coupling 2 has the channels 7 whose upper ends have the ports 8 leading into the interior of the coupling and whose lower ends have outlet ports 9.

There is a sack like basket or container 10 formed of flexible material and whose lower end is secured around the coupling 2 beneath the outlet ports 9, said container surrounding the coupling and its upper end being free. Beneath the lower end of the container 10 the coupling 2 has a series of inlet openings as 11 preferably provided with suitable screens usually in the form of slitted buttons as shown in Figures 2 and 4 and within the coupling 2 opposite the openings 11 there is a collar 12 whose upper end fits closely within the coupling 2 and whose lower end fits closely within the upper end of the sleeve 13 which is screwed into said coupling beneath the openings 11 by left hand threads. The collar 12 has the external vertical channels 14 arranged opposite the openings 11 and which lead upwardly and inwardly through the ports 15 into the interior of the coupling 2, said ports being controlled by the upwardly opening sleeve valve 16.

There is a collar 17 whose upper end is screwed into the lower end of the collar 12 by means of left hand threads 18 and the external surface of the collar 17 is counter sunk to receive an annular packing ring 19 which surrounds the same and which is clamped in place between the lower annular shoulder 20 of said collar 17 and the upper ring 21 which abuts the lower end of the collar 12.

The collar 17 is screwed onto the upper end of the wash pipe 22 which is located within the screen and whose lower end is seated in a smooth seat 23 and carries a surrounding lead seal 24 which forms a fluid tight joint with said set shoe.

There is a sleeve valve 25 which is located in the coupling 2 in position to close the ports 8 and is retained in said position by a frangible pin 26, shown in Figure 1.

The apparatus, as hereinabove specifically described, is assembled as shown in Figures 1 and 3 and let down into the well bore with the screen 3 opposite the oil bearing stratum and clean washing fluid is then forced down through the setting string and through the coupling 2 and on down through the wash pipe 22 and out through the back pressure valve 6 and the opening 5 and on up around the screen to thoroughly wash and clean the same and clean out the bore, the return washing fluid passing upwardly past the flexible container 10 and up around the setting string. During this washing operation the

valve 16 will close the ports 15 to prevent the escape through said ports of the washing fluid. When the screen is thoroughly cleansed a plunger like plug 27 is lowered into the string above and a load of cementitious material is emptied into said string and the top plug 28 is then inserted and fluid pressure is applied by means of a suitable pump against said top plug to force said plugs and the load of cement between them downwardly through the string. When the lower plug lands on the valve 25 the pressure will shear the pin 26 and force the valve 25 downwardly until the valve lands on the upper end of the collar 12. When the upper end of the lower plug 27 clears the ports 8, the continued pressure of the upper plug 28 against the load of plastic cement will force said cement out through the ports 8 the channels 7 and the ports 9 into the sack 10 and the sack will be expanded closely against the surrounding walls of the well bore and this cement is then allowed to set.

The plugs 28, 27 and the valve 25 are then drilled out.

An upper wash pipe 29 is then lowered through the valve 16 and its lower end is screwed into the upper end of the collar 12. A fluid laden with the aggregate to be deposited around the screen is then forced down through the pipes 29 and 22 past the back pressure valve 26 and the aggregate will collect in the lower end of the bore, but the fluid will pass on upwardly and will be forced inwardly through the openings 11 and will pass through the channels 14 and will lift the valve 16 and will pass on up between the valve 16, and the upper wash pipe 29 into the coupling 2 and thence on up through the setting string 1 and out, said water washing all fine sand and clay and other foreign matter from the coarse aggregate and this operation may be continued until the cavity in the bore around the screen is entirely filled with said coarse aggregate.

When this operation is completed the upper wash pipe 29 may be turned to the right, backing off the left hand threads 18 and permitting the packer 19 to relax and an upward pull on the wash pipe 29 will then result in the withdrawal of both wash pipes and the appendants thereon from the well leaving the screen free and the well ready for production.

It may be desirable to now close the openings 11 as these openings may not be suitable for screening the inflowing oil and in such cases a suitable tool may be lowered into the string and engaged with the sleeve 13 and turned to the right thus running said sleeve upwardly to cover and close said ports 11.

Should the screen 3 and/or the coarse aggregate surrounding the same become clogged up with paraffin, or other clogging material, the sleeve 13 may be run down to uncover the ports 11 and the pipe 22 may be again let down into the well, and the couplings 17, 12 and packing 19 assembled therewith and the pipe 29 connected thereto and all lowered to the bottom and the lower end seated in the seat 23 with the packing below the ports 11, and a suitable washing fluid may then be forced down through said connected pipes and out through the port 5 past the back pressure valve 6 and up through the aggregate and about the screen 3, in through the ports 11 and on up through the setting string to the ground surface. In this case the valve 16 may be omitted from the assembly if desired. The washing fluid used for this purpose may contain a suitable chemical, suitable for the purpose, and

usually one that will generate sufficient heat to melt the congealed paraffin or other clogging material.

The drawings and description disclose what is now considered to be preferred forms of the invention by way of illustration only, while the broad principle of the invention will be defined by the appended claims.

What is claimed is:

1. In completing a well, the process which consists in lowering a tubular string with screen attached to the bottom of the hole, closing the space above the screen outside of said string, then forcing fluid laden with coarse aggregate through the string and filling the space around the screen with said aggregate and returning the fluid back up through the string.

2. The process of completing a well comprising forcing fluid laden with an aggregate down through an inner tube into a closed space at the bottom of the hole and returning said fluid around a screen in the bore and up through an outer string, allowing the aggregate to settle in said space around the screen.

3. The combination with a tubular string having a perforated section incorporated therein and having an inlet opening above the perforated section, of means for forming a barrier to close the space above said opening outside of said string, a wash pipe extending down through the string and perforated section, means closing the space between the wash pipe and string below said opening.

4. The combination with a tubular string having a screen and having an inlet above the screen, of a barrier closing the space above said opening outside of the string, an inside tube extending down through the string and screen, means closing the space between the string and tube beneath said inlet.

5. The combination with a tubular string having a screen and having an inlet above the screen, of a barrier closing the space above said opening outside of the string, an inside tube extending down through the string and screen, means closing the space between the string and tube beneath said inlet, and a valve controlling said inlet and permitting the passage of fluid inwardly therethrough but closing the inlet against the flow of fluid outwardly therethrough.

6. The combination with a string of pipe including a screen incorporated therein, said string having an inlet opening above the screen, a wash pipe through the screen, means for closing the space between the wash pipe and string beneath said opening.

7. The combination with a string of pipe including a screen incorporated therein, said string having an inlet opening above the screen, a wash pipe through the screen, means for closing the space between the wash pipe and string beneath said opening, and means for closing the space between the lower end of the wash pipe and the screen.

8. The combination with a string of pipe including a screen incorporated therein, said string having an inlet opening above the screen, a wash pipe through the screen, means for closing the space between the wash pipe and string beneath said opening, and a valve arranged to permit the flow of fluid inwardly, only, through said inlet.

9. The combination with a string of pipe including a screen incorporated therein and having an inlet above the screen, of a container

around the string above said inlet, said string having an outlet opening into said container, a displaceable valve normally closing said outlet opening, a wash pipe through the screen, means
5 beneath said inlet closing the space between the wash pipe and string.

10. The combination with a string of pipe including a screen incorporated therein and having an inlet above the screen, of a container around
10 the string above said inlet, said string having an outlet opening into said container, a displaceable valve normally closing said outlet opening, a wash pipe through the screen, means beneath
15 said inlet closing the space between the wash pipe and string, and a valve permitting the passage of fluid inwardly, only, through the said inlet.

11. The combination with a string of pipe including a screen incorporated therein and having an inlet above the screen, of a container around
20 the string above said inlet, said string having an outlet opening into said container, a displaceable valve normally closing said outlet opening, a wash pipe through the screen, means beneath said inlet closing the space between the wash pipe and
25 string, and a valve permitting the passage of

fluid inwardly, only, through the said inlet, and means in the string adjustable into one position to close said inlet and into another position to open the inlet.

12. The combination with a string of pipe having a screen incorporated therein and an inlet opening above the screen, a barrier closing the space around the outside of the string above said opening, a wash pipe through the screen, means
80 beneath said opening closing the space between the wash pipe and string, and means adjustable into one position to close said opening and into another position to open said opening.

13. The combination with a tubular string having a screen and having an inlet adjacent the upper end of the screen, of a barrier around the string above said opening adapted to close the space between the string and the walls of a well bore, an inside tube extending from above the screen down through the screen and means closing
90 the space between the string and tube beneath said inlet.

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