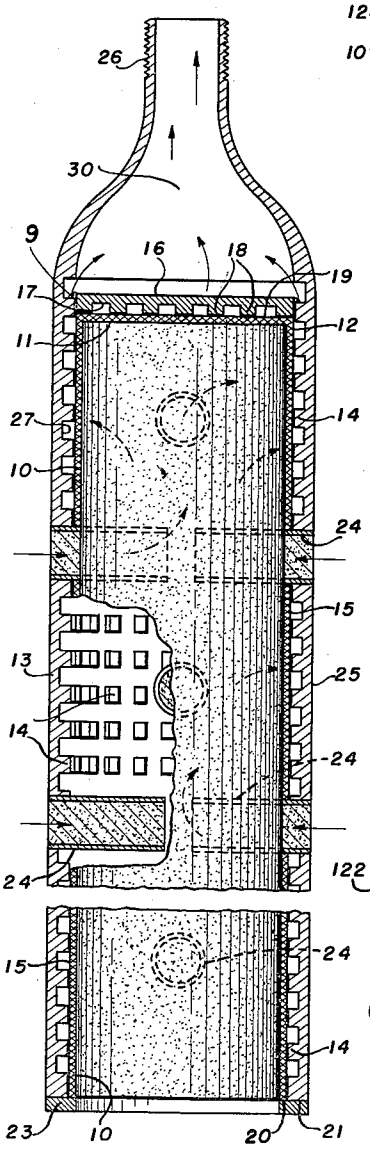
June 10, 1952 G. F. ABENDROTH 2,600,150

WELL SCREEN

Filed Nov. 9, 1950

FIG. 1.



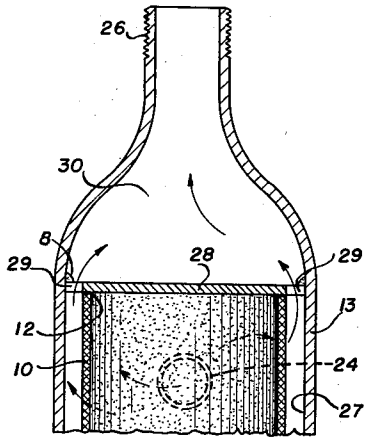


FIG. 3.

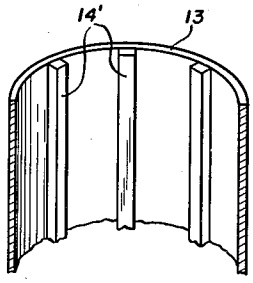


FIG. 2.

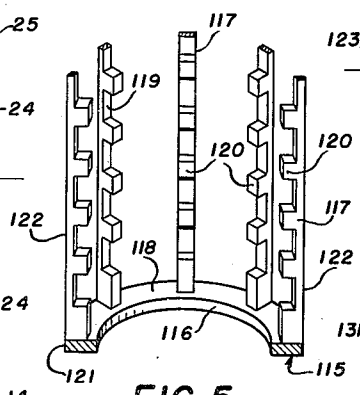
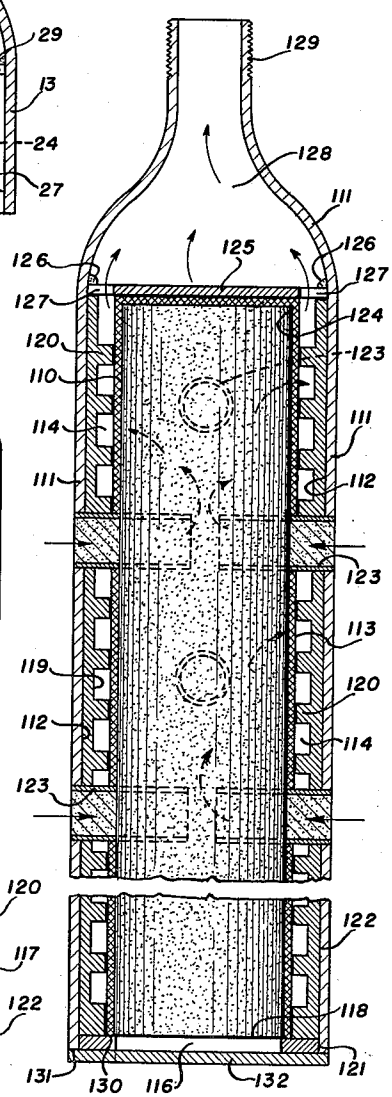


FIG. 5.

FIG. 4.



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WELL SCREEN

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Application November 9, 1950, Serial No. 194,743

4 Claims. (Cl. 166—5)

1

This invention relates to a well screen and, more particularly, relates to a screen used in conjunction with producing fluids from incompetent subsurface formations.

In producing fluids, particularly oil and gas, from subsurface formations, much difficulty has been encountered in those instances in which subsurface strata penetrated by the borehole are incompetent. When fluid is produced from such a formation, very fine sand becomes entrained in the formation fluids and is produced along with the fluids. In some fields the quantity of entrained formation materials is so large that the fluid cannot be economically produced, a fact which may result in abandonment of the well.

In combatting the difficulties arising from the presence of unconsolidated materials, various practices have been adopted. For example, it is common practice to employ crude screens such as a section of slotted pipe, perforated pipe and wire-wrapped screen. Screens prepacked with gravel have also been used. In particularly troublesome cases, sections of the borehole surrounded by incompetent formations have been packed with gravel. Unfortunately all of the devices heretofore used are subject to erosion by the entrained formation materials and are subject to being clogged by such materials, thereby seriously reducing the amount of fluid which can flow therethrough. Furthermore, some of these devices are fragile and, consequently, are easily broken at the time they are installed or later when in use.

An object of the present invention is to provide an oil well screen which is rugged and simple. A further object is to provide an oil well screen of such a design as to materially reduce erosion due to entrained formation materials. A further object is to provide a screen which can be maintained in service for long periods of time without clogging.

The present invention may be described briefly as a borehole screen for wells producing fluids, particularly oil and gas, which includes an inner cylindrical permeable filter sleeve composed of sintered metal. Surrounding this sleeve concentrically is a tubular member equipped on its inner surface with inwardly extending projections which contact the sleeve, giving the sleeve support. These projections also space the sleeve away from the inner surface of the tubular member and are so arranged as to permit the fluid to flow longitudinally within the space between the outer surface of the sleeve and the interior surface of the tubular member. The upper end of

2

the cylindrical sleeve may be closed by means of a solid plate or by means of a cover made of permeable sintered metal in which case it is backed up by a metallic plate extending transversely across the tubular member, this plate being provided with downwardly extending projections to support the sintered metal screen and to permit fluid to flow laterally between the screen and the plate. The lower end of the screen may be closed off by means of a plate or it may be allowed to remain open, but the annular space between the outer surface of the sleeve and the inner surface of the surrounding tubular member is closed off at the lower end of the sleeve. Transversely extending conduits may be provided which extend from the tubular member into the interior of the sleeve. The interior of the sleeve is filled with a finely divided aggregate material, such as sand, the aggregate material being consolidated with a suitable binding material, such as plastic, to form a solid, permeable mass through which fluids can flow.

When such a device is lowered into a borehole and positioned opposite a producing formation, the well fluids flow from the well bore through the open lower end of the filter sleeve or through the transversely extending conduits into the interior of the screen and then through the permeable sleeve into the space between the outer surface of the sleeve and the inner surface of the tubular member. It will be apparent that the fluid entering the well screen must pass through the sand disposed in the interior of the well screen before it reaches the screen. Furthermore, the sand tends to spread the fluid over a large surface of the filter sleeve. This arrangement prevents the formation materials from clogging the filter sleeve and, accordingly, the screen has a long, useful life. Inasmuch as the sintered metal filter screen is supported on the inside by the consolidated sand and on the outside by the aforementioned inwardly extending projections, it can withstand both burst and collapsed pressures and, accordingly, is not subject to breakage when in use in a producing string.

The present invention will be more fully understood from the following detailed description of typical preferred forms of my invention throughout which description reference is made to the accompanying drawings, in which:

Fig. 1 is a longitudinal cross-sectional view of one embodiment of the well screen of my invention;

Fig. 2 is a cross-sectional view of a modification of a portion of the device shown in Fig. 1;

Fig. 3 is a modification of a portion of the device shown in Fig. 1.

Fig. 4 is a longitudinal cross-sectional view of another embodiment of the well screen of my invention; and

Fig. 5 is a detailed showing of the spacing means between the screen and the outer tubular member of Fig. 4.

Referring to Fig. 1, 10 designates a cylindrical permeable filtering sleeve composed of sintered metal. In constructing this screen any metal may be used which is capable of resisting corrosion of well fluids, and stainless steel is particularly suitable for this purpose. An end wall 11 also composed of sintered metal is affixed to the upper end 12 of sleeve 10. Surrounding sleeve 10 is tubular member 13 having grids 14 machined on the inner surface thereof. In Fig. 1 grids 14 are shown as circumferentially arranged in longitudinally extending rows. Projections 14 contact the outer surface 15 of sleeve 10, thereby physically supporting said sleeve. A transversely extending plate 16 is disposed above end wall 11 of sleeve 10 and is affixed to tubular member 13 as by means of welding the outer periphery of plate 16 to projections 14 as indicated at 9. Plate 16 carries on its under side 17 a plurality of downwardly extending projections 18, these projections abutting against the outer surface 19 of end wall 11, giving it support. The lower end 20 of sleeve 10 and the lower end 21 of tubular member 13 are closed by means of closure plate 23 although it is obvious that plate 23 need not close the lower end 20 of sleeve 10.

A plurality of conduits 24 extend from tubular member 13 into the interior of sleeve 10. The particular number of conduits employed and their spacing with respect to each other is not critical, the only requirement being that means be provided for permitting formation fluids to have easy access to the interior of sleeve 10. In the drawing, conduits 24 are shown as circumferentially and longitudinally spaced along tubular member 13. The space confined within sleeve 10 between end 11 and closure plate 23 will hereinafter be referred to as the inner chamber. This inner chamber is filled with a highly permeable, finely divided aggregate, such as a highly permeable sand, which is consolidated with a suitable material, such as a plastic, to form a solid, permeable mass within said chamber. Since the sand is placed inside and consolidated in the inner chamber subsequent to the time that conduits 24 are installed, it is convenient to permit the consolidated sand to also fill conduits 24 flush with the outer surface 25 of casing 13.

Although the distance which conduits 24 extend into the inner chamber is not critical, it is desirable that these conduits extend a considerable distance into the chamber and preferably should be allowed to extend approximately to the axial center thereof. By so doing, the path which the incoming oil must take through the sand before reaching sleeve 10 is increased to the maximum.

As is shown in Fig. 1, the upper end of tubular member 13 may be swaged down and provided with a threaded end 26 so as to be easily attachable to a section of pipe.

Instead of inwardly extending projections 14 being in the form of grids shown in Fig. 1, projections 14 may be in any other form which will permit fluid to flow longitudinally in the space between the outer surface 15 of sleeve 10 and the inner surface 27 of tubular member 13.

In the embodiment shown in Fig. 2, tubular member 13 is shown as having a plurality of circircumferentially spaced longitudinally extending projections 14'. The inner surface of these projections abut against the outer surface 15 of sleeve 10 while permitting fluid to move longitudinally in the spaces therebetween.

Rather than having an end wall 11 of sintered metal affixed to the upper end 12 of sleeve 10, upper end 12 may be closed by a metal plate 28 affixed to tubular member 13 by suitable means such as welds 8 as is shown in Fig. 3. It will be appreciated, of course, that spaces 29 must be allowed to remain around the edge of plate 28 so that fluid can pass from the space between the outer surface 15 of sleeve 10 and the inner surface 27 of tubular member 13 into the space 30 above sleeve 10.

When the hereinbefore described screen shown in Figs. 1 to 3, inclusive, is in position in the borehole of a producing well, formation fluid enters the screen through conduits 24 as indicated by the arrows and passes through the permeable, consolidated sand located in the inner chamber through sleeve 10 and end plate 11. That portion which passes through sleeve 10 enters the space between the outer surface 15 of sleeve 10 and the inner surface 27 of tubular member 13 and moves upwardly in said space into the space 30 above transverse plate 16. That portion which passes through end 11 flows into the space between the outer surface 19 of end 11 and the inner surface 17 of plate 16, moving laterally within said space and around the edge of plate 16 into the space 30 above said plate. Of course, the fluid in space 30 has been freed of suspended formation materials in its movement through the screen.

Figs. 4 and 5 illustrate another embodiment of the present invention which employs a somewhat different spacing means for spacing the filter sleeve from the inner surface of the tubular member than is shown in Figs. 1 to 3. Referring to Figs. 4 and 5, 110 designates a cylindrical, permeable filtering sleeve composed of sintered metal. Surrounding sleeve 110 is a tubular member 111, the inner surface 112 of tubular member 111 being spaced from the outer surface 113 of filter sleeve 110 to define annular space 114 between said members. Disposed in annular space 114 is a spacing and supporting member 115 which may consist of a circular ring 116 having a plurality of bars 117 affixed thereto. These bars are circumferentially spaced along the upper edge 118 of ring 116 and are substantially perpendicular to the plane of the ring. Each of bars 117 carries on its inner surface 119 a plurality of inwardly extending, longitudinally spaced projections 120. Spacing member 115 is disposed in annular space 114 so that the outermost surface 121 of ring 116 and the outer surface 122 of bars 117 abut against the inner surface 112 of tubular member 111 while projections 120 contact the outer surface 113 of sleeve 110. Thus, spacing member 115 provides support for sleeve 110 while permitting fluid to flow longitudinally in space 114. A plurality of conduits 123 extends from tubular member 111 into the interior of sleeve 110. The upper end 124 of sleeve 110 is closed by means of transversely extending plate 125 affixed, as at 126 by welding, to tubular member 111, openings 127 being provided at the outer periphery of plate 125 to permit fluid to flow from annular space 114 into space 128 in tubular member 111 above

plate 125. The upper end of tubular member 111 may be swaged inwardly and provided with screw threads 129 for convenient engagement with pipe. The lower end 130 of sleeve 110 and the lower end 131 of tubular member 111 is closed by means of closure plate 132. It will be understood, of course, that an opening may be provided in plate 132 so that borehole fluids can flow through said opening into the interior of sleeve 110. The interior of sleeve 110, that is the space within said sleeve between transversely extending plate 125 and closure plate 132, is filled with a highly permeable, finely divided aggregate, such as a highly permeable sand which is consolidated with a suitable material, such as plastic, to form a solid, permeable mass within said sleeve. Conduits 123 may also be filled with this permeable mass as shown.

The embodiment shown in Figs. 4 and 5 operates in exactly the same manner as the embodiment shown in Figs. 1 to 3, inclusive. That is to say, formation fluid enters the screen through conduits 123, as indicated by the arrows, and passes through the permeable, consolidated sand located in the interior of sleeve 110, thence through sleeve 110 into annular space 114. The fluid entering annular space 114 through sleeve 110 passes upwardly in said space through openings 127 at the outer periphery 125 into space 128. Of course, the fluid in space 128 has been freed of suspended formation materials in movement through the consolidated sand and sleeve 110, this cleaned-up borehole fluid passing from space 128 through threaded end 129 in the manner indicated by the arrows.

Having fully described the invention, what is claimed as new and useful is:

1. A borehole screen for wells producing fluids comprising a cylindrical, permeable filter sleeve composed of sintered metal forming an inner chamber; a finely divided, permeable consolidated aggregate filling said chamber; a tubular member surrounding said sleeve, the interior surface of said tubular member and the outer surface of said sleeve forming an annular space therebetween; spacing means disposed in said annular space for supporting said screen, said spacing means being arranged to permit fluid to flow longitudinally within said annular space; a transverse plate in said tubular member affixed thereto arranged to permit fluid to flow from the space between said sleeve and said tubular member to the space in said tubular member above said plate; and means adapted to permit the passage of borehole fluids into said inner chamber, whereby fluids pass from the borehole through said means into the inner chamber, thence through said sleeve into the space between said sleeve and said tubular member.

2. A borehole screen for wells producing fluids comprising a cylindrical, permeable filter sleeve composed of sintered metal forming an inner chamber; a finely divided, consolidated, permeable aggregate filling said chamber; a tubular member surrounding said sleeve, an interior surface of said tubular member and the outer surface of said sleeve forming an annular space therebetween; spacing means disposed in said annular space for supporting said sleeve and spacing it away from said tubular member, said spacing means being arranged to permit fluid to flow longitudinally within said annular space; a transverse plate in said tubular member affixed thereto arranged to permit fluid to flow from said annular space to the space in said tubular member above said plate; and a plurality of conduits extending laterally through said tubular member and said sleeve into said chamber, whereby well fluids pass from the borehole through said conduits into the inner chamber, thence through said sleeve into the space between said sleeve and said tubular member.

3. A borehole screen for wells producing fluids comprising a cylindrical permeable filtering sleeve composed of sintered metal forming an inner chamber; a finely divided consolidated permeable aggregate filling said chamber; a tubular member surrounding said sleeve, said member defining inwardly extending projections for supporting said sleeve and for spacing said sleeve from the inner surface of said tubular member, said projections being arranged to permit fluid to flow longitudinally within the space between the outer surface of said sleeve and the interior surface of said tubular member; a transverse plate in said tubular member affixed thereto arranged to permit fluid to flow from the space between said sleeve and said tubular member to the space in said tubular member above said plate; and a plurality of conduits extending laterally through said tubular member and said sleeve into said chamber, said conduits being longitudinally and circumferentially spaced with respect to said tubular member and said sleeve, whereby well fluids pass from the borehole through said conduits into the inner chamber, thence through said sleeve into the space between said sleeve and said tubular member.

4. A borehole screen for wells producing fluids comprising a cylindrical filter element having a permeable cylindrical wall composed of sintered metal and an upper end wall composed of sintered metal; a tubular member surrounding said cylindrical wall, said member defining inwardly extending projections for supporting said cylindrical wall and for spacing said cylindrical wall from the inner surface of said tubular member, said projections being arranged to permit fluid to flow longitudinally within the space between the outer surface of said cylindrical wall and the interior surface of said tubular member; a transverse plate in said tubular member affixed thereto defining downwardly extending projections arranged to abut on the end wall of said filter element for spacing said plate from said end wall, said plate being arranged in said tubular member to permit fluid to flow from the space between said filter element and said tubular member and from the space between said transverse plate and said filter element to the space in said tubular member above said plate; a consolidated finely divided permeable aggregate filling said cylindrical filter element; and means for admitting borehole fluids into the interior of said filter element, whereby fluids pass from the borehole through said means into the interior of said filter element, thence through said filter element into said tubular member.

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