Jan. 2, 1945. D. P. OAK 2,366,547

FITTING FOR USE WITH OIL WELL TUBING OR THE LIKE

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Fig. 1.

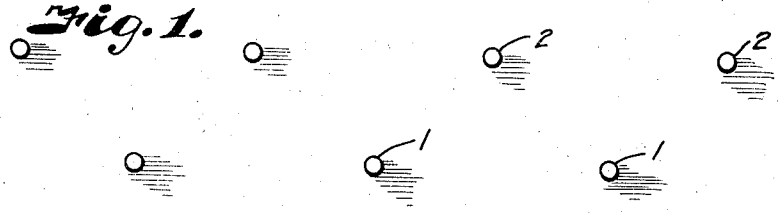

Fig. 2.

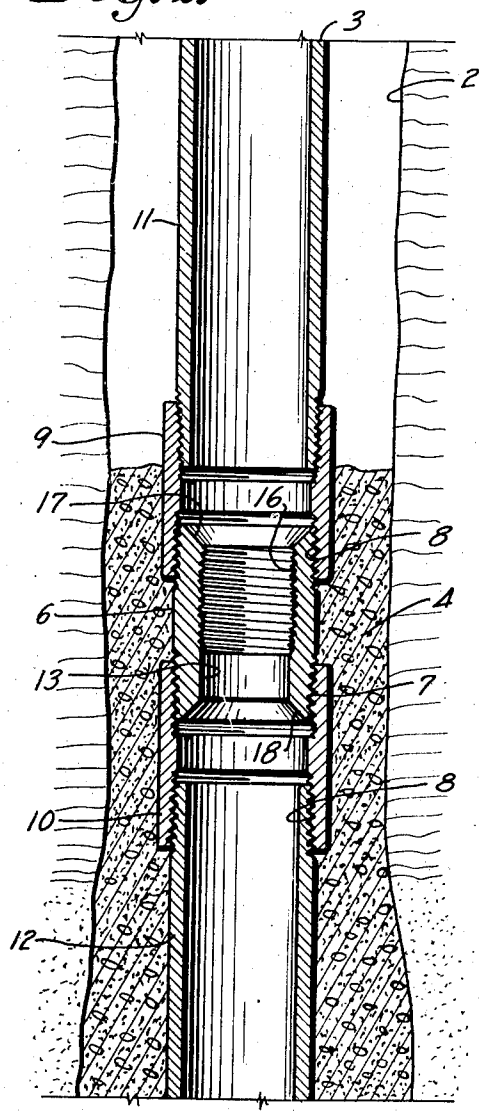

Fig. 3.

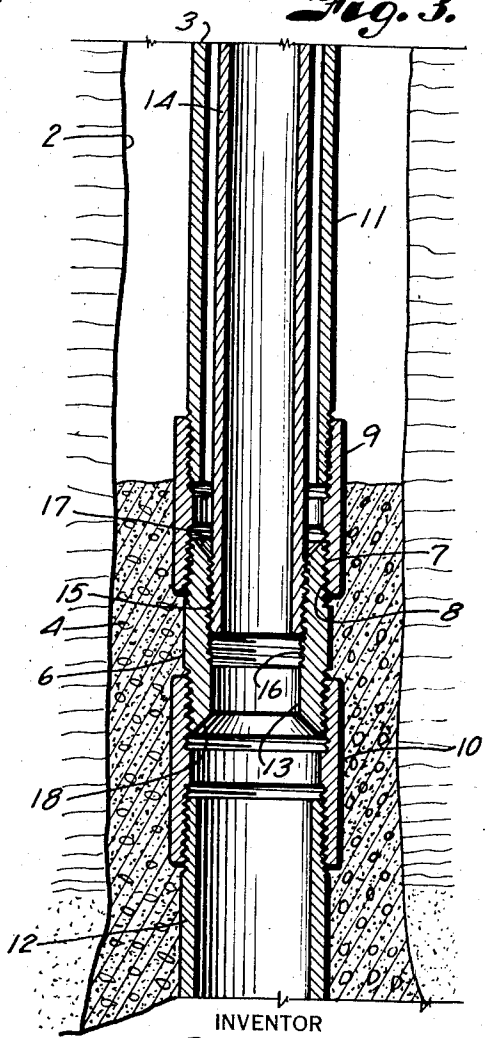

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Fig. 4.

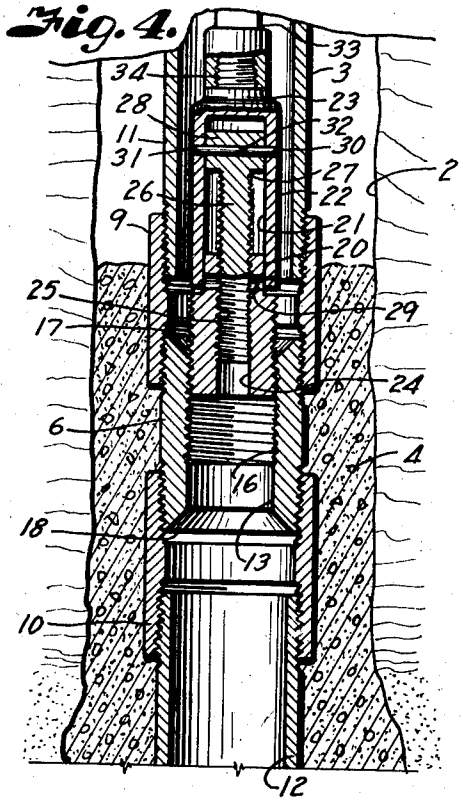


Fig. 5.

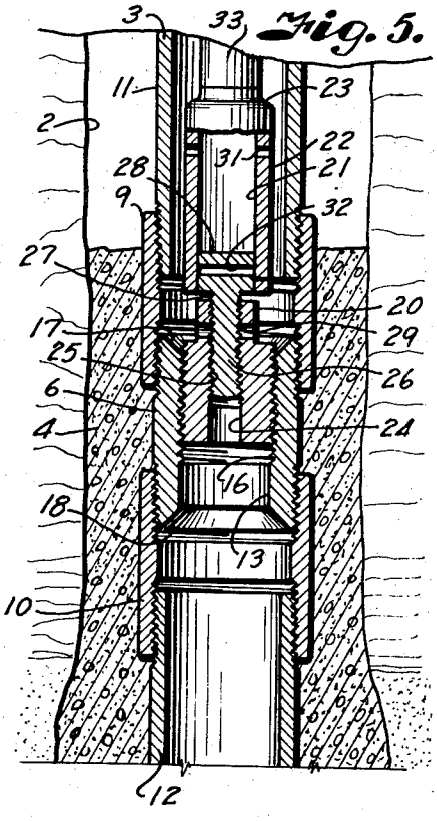


Fig. 6.

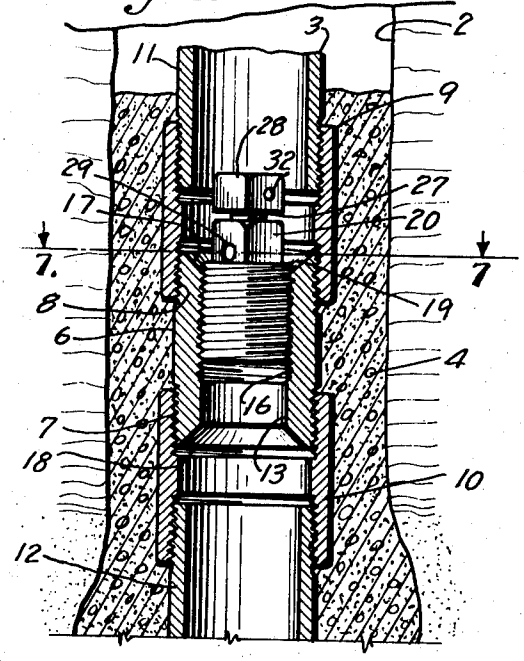
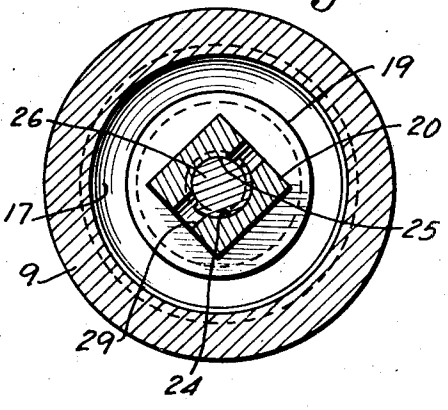


Fig. 7.



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UNITED STATES PATENT OFFICE

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FITTING FOR USE WITH OIL WELL TUBING OR THE LIKE

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Application January 10, 1942, Serial No. 426,274

2 Claims. (Cl. 166—2)

This invention relates to a fitting for use in connection with well tubing, and has for its principal objects to provide a fitting which facilitates connection of a secondary string of tubing in case a leak develops in the original tubing; to provide a fitting which facilitates permanent or temporary plugging off wells or repair and reestablishment of abandoned wells; and to provide a fitting adapted for facilitating certain well operations which must be carried on under high pressure or flow conditions.

In accomplishing these and other objects of the invention hereinafter pointed out, I have provided improved details of structure, the preferred form of which is illustrated in the accompanying drawings, wherein:

Fig. 1 is a schematic view of well arrangement in a field where flow is effected through repressuring with a fluid such as water and in which wells the present invention is particularly adapted.

Fig. 2 is a sectional view through a portion of a well equipped with a tubing provided with a fitting in accordance with the present invention, the fitting and tubing being shown in section.

Fig. 3 is a similar view illustrating an inner string of tubing which is inserted through the original string and connected thereto by the fitting.

Fig. 4 is a section similar to Fig. 2 but illustrating insertion of a closure plug into the fitting preparatory to shutting off the well against bottom hole pressure.

Fig. 5 is a section similar to Fig. 4 illustrating closure of the pressure relief openings through the plug.

Fig. 6 is a similar section after the plugging operation is completed.

Fig. 7 is a cross-section on the line 7—7 of Fig. 6.

Referring more in detail to the drawings:

As above mentioned, the present invention is particularly useful in oil fields where flow is effected through pressuring or repressuring the production formation with hydrostatic heads of fluid sufficient to effect flow from the formation through selected wells. For example, natural formation pressure in many production areas is depleted to such an extent that the wells are not self-flowing and it is necessary to resort to pumping operations. As the pressure is further reduced the production formation usually floods with water so that it is not economical to pump the fluid mixture.

It is the practice to reestablish flow from the producing wells indicated at 1, Fig. 1 of the drawings, by drilling holes 2 spaced from the producing wells and to run tubings 3 into the bore-holes which are cemented in at the lower ends adjacent the cap rock, as indicated at 4, so that the full effect of a hydrostatic head of liquid pumped into the tubing acts upon the fluid in the formation to effect flow of the oil and water mixture from the producing wells.

The tubing of such wells is subject to deterioration, failure caused by electrolysis, erosion, and chemical reactions so that leaks develop and they become useless for their intended purpose. For the same reason, leaks develop in the tubing of the producing wells. It then becomes necessary to equip the wells with new tubing, but this is a difficult operation since the tubing of the pressuring wells must be inserted against high hydrostatic pressures and that of the producing wells under flow conditions.

In carrying out the present invention, the original string of tubing 3 is, therefore, provided with a fluid-tight pressure resistant fitting 6 of sleeve-like form inset between selected points of tubing and made a part of the tubing system by welded or threaded connections at the time the tubing is installed. In the illustrated instance, the fitting has external threads 7 at the respective ends thereof conforming to the internal threads 8 of tubing couplings 9 and 10, which are attached to the threaded ends of adjacent tubing sections 11 and 12. The interior of the fitting is provided with an internally threaded axial bore 13 to pass the fluid and so that in case a leak develops in the tubing 3, a smaller string of tubing 14 having threads 15 on the lower end may be threadedly engaged with threads 16 of the bore 13.

In order to facilitate insertion of the tubing 14, the upper end of the fitting is provided with a bevelled counterbore 17 which tapers downwardly and inwardly toward the axis of the bore to guide the threaded end of the tubing into engagement with the threads. The opposite end of the fitting is also provided with a tapered counterbore 18 to facilitate flow of fluid therethrough.

To install the fitting it is applied between selected sections of tubing and run into the bore-hole 2 after which the space between the tubing 3 and wall of the bore-hole is packed off at a point above the production formation so as to seal off upward flow around the tubing and maintain full effect of the pressuring liquid in the tubing 3 whereby the oil and water mixture is caused to move toward a producing well and flow upwardly

through the tubing thereof under hydrostatic heads carried within the tubing of the water wells. The tubing may be packed off in any suitable manner, however, it is desirable to effect a permanent seal of cement around the tubing in sufficient quantity and depth that the cement is retained in place and maintains the desired seal. The fitting 6 is also preferably located so that it is contained within the cement packing as shown in Fig. 2.

After the tubing has been in use for some time leaks may develop therein so that the head of liquid leaks therefrom and it becomes necessary to insert another string of tubing 14. This is readily effected by making up the string of smaller sized tubing and inserting it through the original tubing, the thread of the first section of tubing being of the same diameter, direction, pitch, and type of thread as the thread within the bore of the fitting 6. The new tubing is lowered through the original tubing until the end encounters the tapered counterbore or bevel surface at the upper end of the fitting which guides and centers the inner tubing relatively to the bore, then by turning the inner tubing in proper direction, the threads thereon screw into the threads of the bore making up the joint and providing a leak-proof connection therewith. If desired, another fitting 6 may be installed between selected joints of the inserted tubing so that an additional string may be run thereinto when the second string becomes unserviceable for its intended purpose. However, I find that in most installations, the second string may be readily removed from the fitting 6 and withdrawn from the outer string of tubing and a new string of tubing inserted in its place.

In the operation of the wells, it sometimes becomes desirable to plug off one of the wells and this may be readily accomplished by screwing a plug or properly closed pipe section into the bore of the fitting. This may be effected while maintaining hydrostatic pressure in the other wells with a special plug designed to be set against fluid pressure in the tubing 3. The plug 19 comprises a cylindrical body having external threads conforming in diameter, direction and pitch with the threads 16 in the bore of the fitting. The plug 19 has a polygonal-shaped head 20 conforming in shape to a socket 21 formed within a wrench-like head 22 of a lowering-in tool 23 wherewith the plug may be lowered through the tubing and inserted in the fitting as later described.

The body of the plug including the head 19 has a central axial bore 24 provided with internal threads 25 in which is threaded the shank 26 of a cap-screw 27 having a head 28 conforming in shape to the head 20 and which is also adapted to be received in the socket 26 of the lowering-in tool. The head 20 of the plug has lateral openings 29 that are spaced from the upper end thereof so that the shank of the cap-screw may be started into the threaded bore without covering the lateral openings 29, as shown in Fig. 4.

When applying the plug, the shank of the cap-screw is threaded into the upper end of the bore of the plug so that the end thereof is just above the openings 28 as shown in Fig. 4. The flat sides of the cap-screw are aligned with the corresponding sides of the head 20 and the assembly inserted into the socket 21 where the cap-screw is secured by a shear pin 30 that is extended through openings 31 in the wall of the socket and through a transverse opening 32 in the head of the screw. Any form of shear pin may be used such as an ordinary cotter pin, wire, or the like.

The assembly is then lowered through the tubing with the aid of a string of sucker rods or the like 33, the lowering-in tool being threaded upon the lowermost rod as indicated at 34, Fig. 4. When the plug reaches the fitting it is guided by the tapered counterbore thereof into registering alignment with the threaded bore and upon turning the rods in the proper direction the plug is threaded into the bore of the fitting, during which time pressure therebelow is being relieved through the plug openings 24 and 29. Therefore, the plug is readily lowered against pressure carried in the producing formation. When the plug is in proper position the pin 30 is sheared off by exerting an upward pull on the lowering-in rods and the socket is raised sufficiently so that it clears the head 20 of the plug. The cap-screw is then rotated into the bore 24 of the plug so that the threaded shank thereof closes the lateral openings 29 and stops flow through the tubing.

When old fields are to be revived by repressuring the formation with hydrostatic heads of fluid, selected wells in the field may be used for the repressuring wells and in conditioning thereof my improved fitting forms an important part as it enables cementing in of the tubing under pressure carried in the producing formation. The bore-hole to be used is cleared of tubing, debris and the like and a tubing equipped with my improved fitting is lowered into the bore-hole to provide relief of pressure while the cement is being placed around the tubing to seal the upper formations from the producing formation and so that the full static head created in the tubing acts directly upon the fluid contained in the producing formation.

Since the flow through the tubing relieves the pressure while the cement sets, the cement forms a positive seal and is retained in its desired sealing position. If it is desired to close off flow from the production formation completely, a closure plug may be readily screwed into the bore of the fitting in the manner just described, after which the tubing 11 may be unscrewed from the coupling should it be desired to seal the well permanently. If the closure is only temporary, the tubing may be left in position and the plug later removed with aid of the lowering-in tool.

My improved fitting is also desirable where it is necessary to reduce the cross-sectional area of the flow tubing. The smaller tubing is readily inserted through the flow tubing and threaded into the bore of the fitting so that flow from a well is diverted through the smaller tubing.

From the foregoing it is obvious that I have provided a fitting which is particularly adapted for use in connection with wells producing fluid as well as the wells which establish the hydrostatic heads so as to maintain desired control of such wells while maintaining hydrostatic pressure on the producing formation.

What I claim and desire to secure by Letters Patent is:

1. In an apparatus of the character described in combination with a well tubing, a fitting having fluid-tight connection with the tubing near the lower end thereof and provided with a flow opening therethrough and provided with internal threads, a plug member having external threads for engaging the threads of said opening and having an axial port provided with internal threads, a head on said plug member having lateral ports connected with said axial port, a

screw member having a shank adapted to be threaded into the axial port to close said lateral ports, a head on the screw member, said heads having socket engaging portions, and a socket member having portions to engage said portions of the heads to rotate said members.

2. In an apparatus of the character described, a plug having an axial bore and lateral ports connected with said bore, a polygonal head on said plug, a shank threaded into said bore, a polygonal head on said shank, a polygonal socket member engaging said heads, and shear means connecting one of said heads with the socket member.

DONALD P. OAK.