

Dec. 8, 1942.

J. G. A. M. BIERMANN ET AL

2,304,394

OIL WELL TUBING COUPLING

Filed Nov. 7, 1939

3 Sheets-Sheet 1

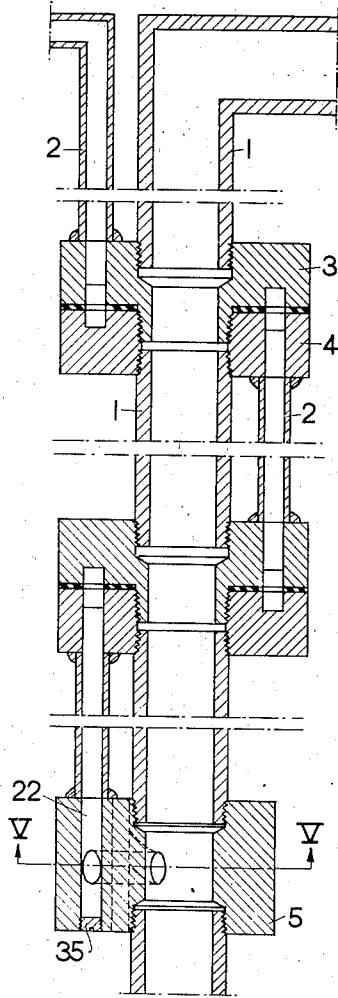


Fig. I

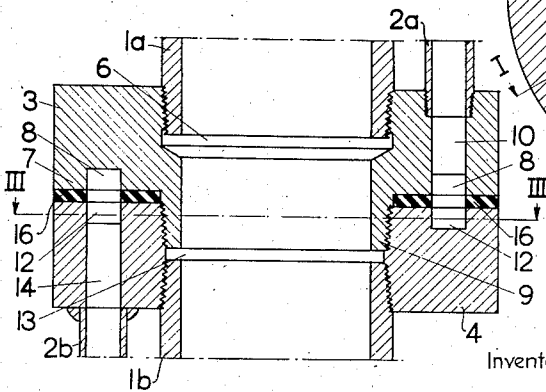


Fig. II

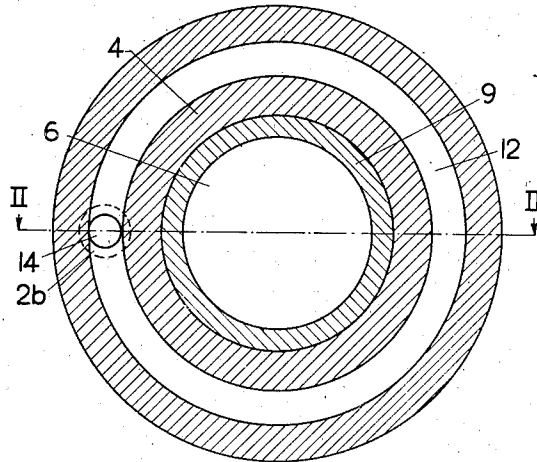


Fig. III

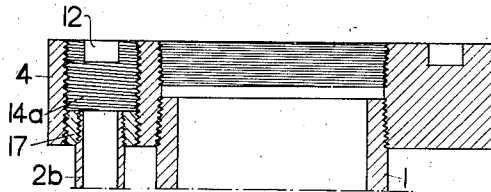


Fig. IV

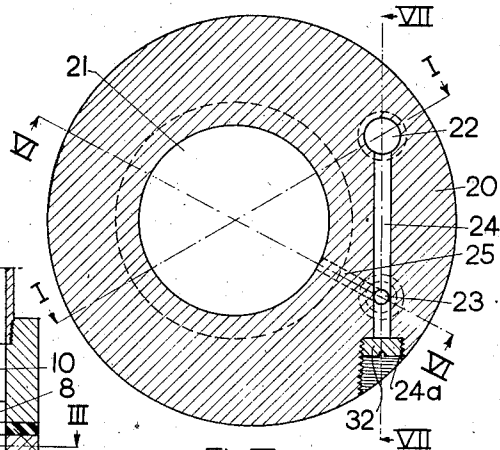


Fig. V

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3 Sheets-Sheet 2

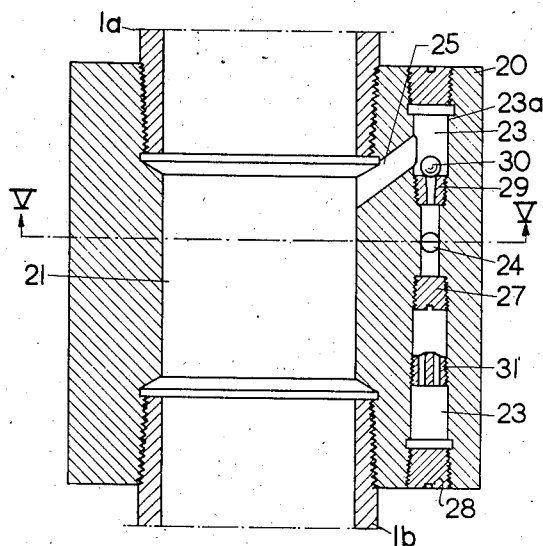


Fig. VI

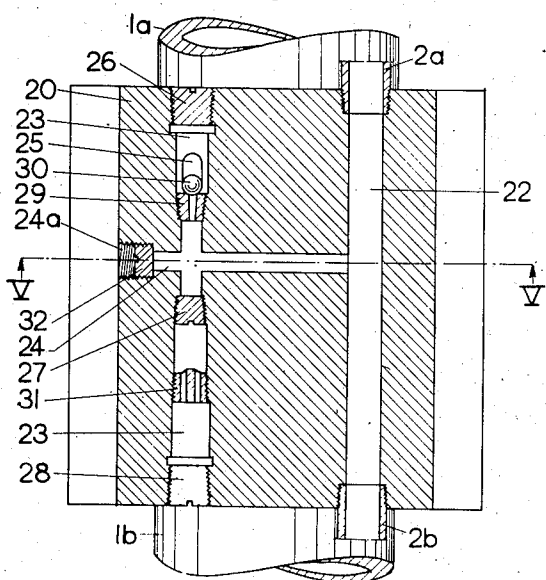
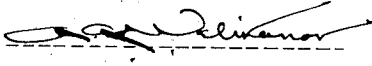


Fig. VII

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3 Sheets-Sheet 3

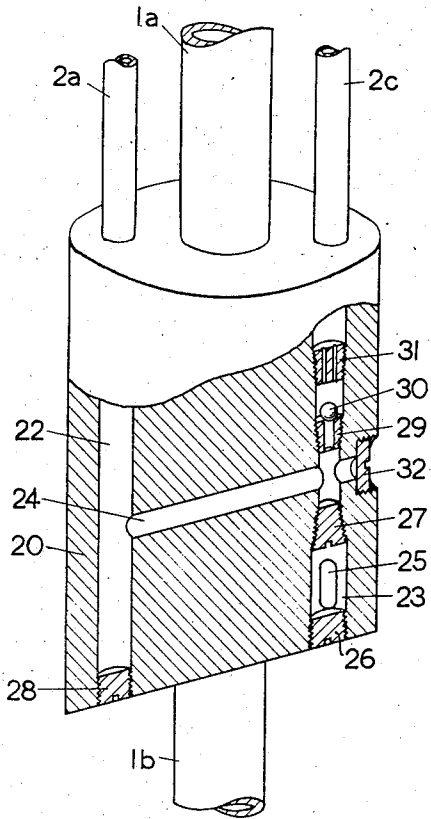


Fig. VIII

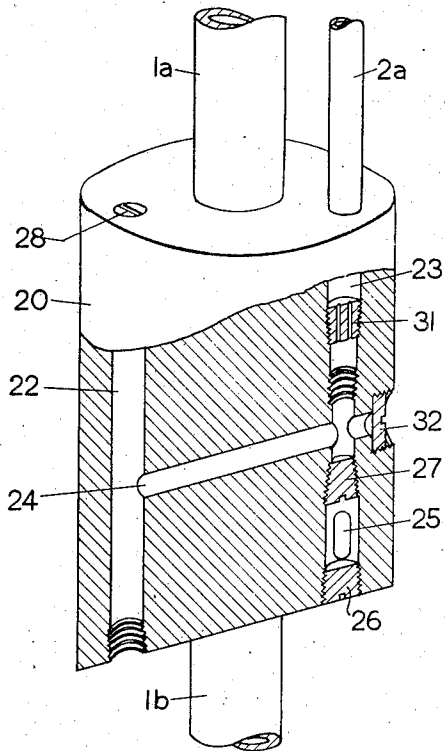


Fig. IX

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UNITED STATES PATENT OFFICE

2,304,394

OIL WELL TUBING COUPLING

Josephus Georgius Antonius Maria Biermann and
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Application November 7, 1939, Serial No. 303,284
In Rumania November 19, 1938

4 Claims. (Cl. 103—232)

The present invention relates to couplings for oil well tubing and pertains more particularly to couplings or tool pins for use in oil wells which contain an auxiliary string of tubing extending into the well along with the producing or main string, but not enclosed within the latter.

The purpose of an auxiliary tubing string is usually to provide a conduit for passing fluids to the bottom of the borehole. For example, steam may be conducted down such a tubing string, which is clamped to the usual producing string, to prevent paraffin deposition within the producing string with resultant plugging thereof. In another instance, liquids, air, or other gases may be forced down under pressure to aid in bringing oil to the surface through the producing string, as, for example, in fluid pressure pumps, in gas-lift pumping operations, etc. However, independent or separate joining of the single lengths of the auxiliary tubing and the single lengths of the producing string leads to cumbersome structures and causes a considerable loss of time during withdrawal or insertion of the tubing strings.

It is, therefore, the object of the present invention to provide a device for simultaneously joining both the single lengths of the producing string of tubing and the single lengths of the auxiliary string of tubing.

A further object is to provide an arrangement comprising a special bottom coupling containing three longitudinal channels connected with each other by cross channels, which serve to connect the bores of the auxiliary tubing and oil-producing tubing, or to open the auxiliary tubing to the space within the casing or to a return string, the desired arrangement involving the use of only relatively simple devices, such as plugs, check valves, and nozzles, which are inserted into the channels.

Other objects and advantages will be readily apparent from the following description taken in reference to the drawings, wherein:

Figure 1 is a vertical section through adjacent tubing strings joined together by the present coupling device and showing schematically a special bottom coupling.

Figure 2 is a detailed vertical section of the coupling device.

Figure 3 is a transverse sectional view taken along the line III—III of Figure 2.

Figure 4 is a vertical sectional view of a modified portion of the coupling device.

Figure 5 is a transverse sectional view of the bottom coupling taken along the line V—V of Figure 1, and shown to an enlarged scale.

Figure 6 is a vertical sectional view taken along the line VI—VI of Figure 5.

Figure 7 is a vertical sectional view taken along the line VII—VII of Figure 5.

Figure 8 is a perspective elevation of a modified arrangement of the bottom coupling shown in partial cross-section along the line VII—VII of Figure 5, and Fig. 9 is a perspective view of another modified arrangement.

Referring to Figure 1 of the drawings, the single lengths of a producing string of tubing 1 and an auxiliary string of tubing 2 are respectively joined together by means of the present coupling device which comprises upper and lower cylindrical members 3 and 4. A special bottom coupling or tubing joint 5 is attached between two lengths of the producing string 1 and to the lower end, preferably, of the auxiliary string.

Now referring to the more detailed Figures 2 and 3, the upper cylindrical member 3 of the coupling has an axial bore 6, enlarged and internally threaded at the upper end to receive the externally threaded end of a length 1a of the producing string 1. The lower transverse face 7 of this member 3 has a ring-shaped groove 8 cut therein and an externally threaded shank 9 projecting therefrom about the bore 6. A vertical channel 10 penetrates from the ring-shaped groove 8 to the upper face of the member 3.

The lower cylindrical member 4 of the coupling assembly has a ring-shaped groove 12 in the upper transverse face to match the groove 8 in the upper member 3. An axial bore 13 in said member 4 is internally threaded at its upper end to receive the threaded shank 9 and at its lower end to receive the externally threaded end of a length 1b of the producing string 1. Member 4 likewise has a vertical channel 14 from the ring-shaped groove 12 to the lower transverse face.

Thus, an axial passage is provided by means of bores 6 and 13 between the lengths 1a and 1b of the producing string to allow unrestricted flow therethrough. Further, on attaching a length 2a of the auxiliary string 2 to the channel 10 in the upper face of the upper member 3 and a similar length 2b to the channel 14 in the lower face of the lower member 4, a passage is obtained between the lengths 2a and 2b by means of channel 10, which enters ring-shaped groove 8, which forms a ring-shaped channel in conjunction with the ring-shaped groove 12, which in turn has the vertical channel 14 extending therefrom to the auxiliary tubing length 2b, attached at the lower face of the lower member 4. A gasket 16 is inserted between the lower face of the upper member 3

and the upper face of the lower member 4 in order to prevent leakage from the ring-shaped channel to the axial bore or vice versa.

Preparatory to lowering into the well, a section of combined producing string and auxiliary string is assembled by attaching a coupling member 3 to one end and a coupling member 4 to the other end of a length of the producing string. The vertical channels 10 and 14 of the coupling members are co-axially aligned and a length of auxiliary tubing inserted therebetween.

The lengths of auxiliary tubing may be butt welded between the coupling members on each end of a length of the producing string (as shown in Figure 1) or they may be threadably connected to the coupling member at one end and butt welded to the coupling at the other end of the length of the producing string (as illustrated in Figure 2). The auxiliary tubing may likewise be attached between the coupling members by enlarging one (as shown in Figure 4) or both of vertical channels 10 and 14 in the coupling assembly, then slipping the tubing segment 2b through one such enlarged channel 14a, after the coupling members are attached to each end of the producing tube, and fastening the tube 2b to the coupling member 4 by means of an internally and externally threaded ring or nipple 17 adapted to be threaded into the enlarged channel 14a and around the tubing length 2b.

Sections made up in this manner can be quickly joined together in one operation by threading the externally threaded shank 9 of a coupling member 3 into the upper internal thread of bore 13 in a lower coupling member 4. Hence, simultaneously or jointly connected but separate producing and auxiliary tubing strings can be placed in the hole quickly and easily to form a conduit for bringing up oil and another conduit for passing fluid down into the well.

However, it is to be understood that the term "ring-shaped groove" includes also grooves in the form of partial rings as it is evident that grooves forming an arc slightly greater than half a circle will, when placed together as described, communicate with each other at some point and permit flow therethrough. This being sufficient for the purpose of the present invention, it is intended that said term be so construed throughout this specification and the appended claims.

It is likewise intended that the coupling members may be modified so as to have more than one independent groove with vertical channels extending from each, while retaining at least some of the advantages of the present invention.

It is often desirable to inject the downwardly flowing fluid from the auxiliary tubing string into the producing string or into the space within the borehole casing. These desirable features may be obtained from an arrangement of the present invention comprising a special bottom coupling in conjunction with a producing string, an auxiliary string and couplings as described above. Serving to couple together lengths of the producing string, the bottom coupling may be attached to the lower end of the auxiliary tubing string as shown in Figure 1, or may be connected between lengths of the auxiliary string in the lower portion thereof as illustrated in Figure 7, or both.

Referring to Figures 5, 6, and 7, the special bottom coupling consists of a cylindrical member 20 having three longitudinal channels 21, 22, and 23 connected to each other by cross channels 24 and 25. Longitudinal channel 21 is threaded

internally at both ends to receive the threaded ends of lengths 1a and 1b of the producing string and has a bore substantially equal to the size of the bore of the tubing in the producing string. Longitudinal channel 22 has a bore about the size of that of the auxiliary string tubing and has internal threads at each end of said bore, adapted to receive the threaded ends of lengths 2a and 2b of the auxiliary string, or when the bottom coupling is attached to the lower end of the auxiliary tubing string, a plug 35 may be threadably inserted in the lower end of channel 22, as shown in Figure 1, to prevent passage of fluid from within the auxiliary string to the well casing. The longitudinal channel 23 communicates with channel 21 by means of cross channel 25 and with channel 22 by means of cross channel 24. The bore of channel 23 narrows in a step-wise manner from both ends toward the cross channel 24 and by means of internal threads is thereby adapted to receive various threaded plugs, nozzles, and check valves, such as are shown, for example, plugs 26, 27, and 28, check valve seat 29 and ball 30, and nozzle 31. Cross channel 25 slants downward from the upper enlarged portion 23a of longitudinal channel 23 and above the check valve seat 29 and ball 30 therein and toward the longitudinal channel 21. The cross channel 24 extends from the longitudinal channel 22 to the longitudinal channel 23 and on to the exterior of the coupling body terminating in an enlarged and threaded bore 24a normally closed by plug 32 therein.

With a tubing coupling or joint of this type any desired connection or shutting off may be obtained. Thus, for example, when it is desired to prevent paraffin precipitation in the tubing by introducing steam, or the like, as a heating medium, into the auxiliary string, the check valve 29 in the arrangement shown in Figures 6 and 7 prevents the well fluid in the producing string 1a from flowing into the auxiliary string 2a but allows the condensed steam to accumulate and build up a column of liquid in the auxiliary string 2a. When the condensation water column has created a back pressure sufficient to overcome the pressure within the producing string, the ball 30 of the check valve rises and the condensate discharges into the producing string and is carried to the surface along with the well fluid. Further, in another advantageous arrangement shown in Figure 8; obtained by reversing the positions of the check valve 29 and the plug 27 and replacing the plug 28 with a string of tubing 2c which forms a return line, steam as a heating fluid may be circulated down the auxiliary string 2a, through the tubing joint 20 by way of vertical channel 22, cross-channel 24, and vertical channel 23 through the therein contained check valve 29 and nozzle 31 which serve, respectively, to prevent reversal of flow and to impart a back pressure to the descending fluid in the flow line 2a and thence up the return string 2c. Thus, the walls of the producing string may be heated and the deposition thereon of paraffin prevented, but without discharging the steam or condensate into the oil stream which may cause the formation of undesirable emulsions. Also, in still another arrangement, as shown in Figure 9 which differs from that shown in Figure 8 in that the auxiliary tubing string 2a is attached to channel 23 instead of channel 22, plug 28 closes the upper end of channel 22, the lower end of which is now open, and the check valve 29 removed from channel 22,

a heating fluid such as steam may be passed down the auxiliary string 2a into vertical channel 23, where a back pressure is built up by means of the nozzle 31, and passes on through cross-channel 24 and vertical channel 22 and discharges therefrom to inside the well casing.

It may be readily seen that the bottom coupling 5 is advantageously flexible in its uses. Thus, for example, the rearrangeable coupling is particularly effective throughout the life of a well having paraffin trouble by facilitating several phases of treatment to maintain efficient production. In the early life of the well, little paraffin generally accumulates and small amounts of steam may be passed down the auxiliary or heating string and discharged into the oil stream, as shown in Figs. 6 and 7, the amount of steam being so small as not to form emulsions with the oil. In the later life of the well, greater amounts of steam are necessary to maintain efficient production by preventing increased paraffin deposition in the oil flow string. Since the greater amounts of steam increase the emulsion problem often to such an extent that steam and condensate can no longer be discharged in the oil stream, the coupling 5 is rearranged to allow discharging into some other return passage, such as, a return line string, as shown in Fig. 8, or into the space between the tubing strings and the borehole, as shown in Fig. 9.

We claim as our invention:

1. In a system for conveying fluids to and from a borehole by means of a main tubing string and an auxiliary tubing string exterior and substantially parallel to the main string, the combination of said strings of tubing with coupling means for said tubing strings comprising a substantially cylindrical coupling body, a central longitudinal bore therethrough, connecting means on the upper and the lower portion of said bore adapted to hold in engagement the ends of the first tubing string adjacent said coupling, longitudinal bores extending into the coupling body respectively from the upper and lower faces thereof to a distance less than one-half of the axial length of the coupling body, said bores being offset with regard to the central bore and to each other, connecting means on the upper and lower portions of said bores respectively to hold in engagement the ends of the second tubing string adjacent said coupling, and transverse channel means within the coupling body in communication between said bores, a passage for returning to the surface fluid flowing down through the auxiliary string and means associated with the lowest length of the second tubing string adapted to direct fluid flow therefrom into said return passage.

2. In a system for conveying fluids to and from a borehole by means of a main tubing string and an auxiliary tubing string exterior and substantially parallel to the main string, the combination of said strings of tubing with coupling means for said tubing strings comprising two substantially cylindrical members, screw-threaded pin and box means on said members for engagement with each other, a central longitudinal bore through the coupling body formed by the engagement of said members, connecting means on the upper and the lower portion of said bore adapted to hold in engagement the ends of the first tubing string adjacent said coupling, longitudinal bores extending into the coupling body respectively from the upper and lower faces thereof to a dis-

tance less than one-half of the axial length of the coupling body, said bores being offset with regard to the central bore and to each other, connecting means on the upper and lower portions of said bores respectively to hold in engagement the ends of the second tubing string adjacent said coupling, and transverse channel means within the coupling body in communication between said bores, a passage for returning to the surface fluid flowing down through the auxiliary string and means associated with the lowest length of the second tubing string adapted to direct fluid flow therefrom into said return passage.

3. In a system for conveying fluids to and from a borehole by means of a main tubing string and an auxiliary tubing string exterior and substantially parallel to the main string, the combination of said strings of tubing with coupling means for said tubing formed of two substantially cylindrical members having screw-threaded pin and box means for engagement with each other, each of said members having a transverse face adapted to abut a corresponding face of the other member when said members are engaged, arcuate grooves on said faces at least partially in register when said members are engaged, a central bore passing longitudinally through the coupling formed by the engagement of said members, connecting means on the upper and lower portion of said bore adapted to hold in engagement the ends of the first tubing string adjacent said coupling, longitudinal bores extending into the coupling members from the non-abutting transverse faces of said members and opening into the grooves of their abutting faces, said bores being offset with regard to the central bore and to each other when the members are engaged, and means on the upper portion of the offset bore through the upper member and on the lower portion of the lower member to hold in engagement the ends of the second string adjacent said coupling means, a passage for returning to the surface fluid flowing down through the auxiliary string, and means associated with the lowest length of the second tubing string adapted to direct fluid flow therefrom into said return passage.

4. In combination, at least two tubing strings exterior and substantially parallel to each other, and coupling means for simultaneously joining sections of said tubing strings, said means being formed of two substantially cylindrical members having screw means for engagement with each other, each of said members having a transverse face adapted to abut a corresponding face of the other member when said members are engaged, arcuate grooves on said faces at least partially in register when said members are engaged, an axial bore through each of said members, means at the end of said bores adjacent the non-abutting faces of said members for connecting sections of one of said tubing strings thereto, longitudinal bores offset with regard to said axial bores and extending into the coupling members from the non-abutting transverse faces of said members and opening into the grooves of their abutting faces, and means at the ends of said offset bores adjacent the non-abutting faces of said members for connecting sections of the other tubing strings thereto.

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