

Feb. 24, 1942.

J. H. HOWARD ET AL

2,274,477

TUBING HANGER

Filed Aug. 24, 1939

2 Sheets-Sheet 1

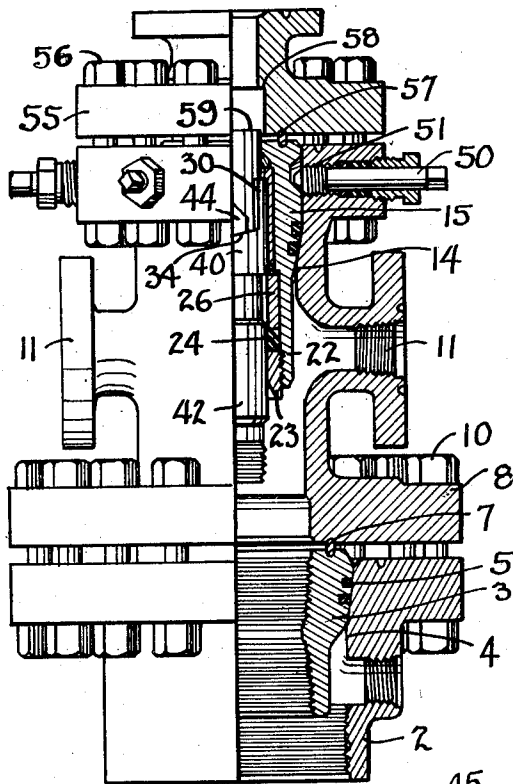


Fig. 1.

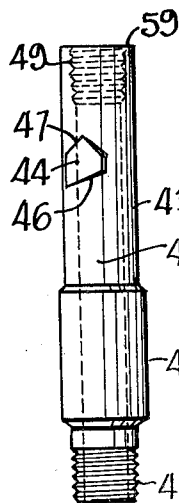


Fig. 6.

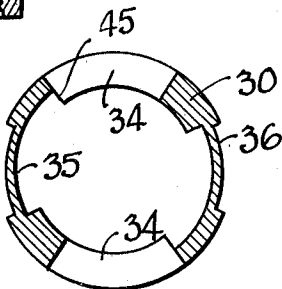


Fig. 4.



Fig. 5.

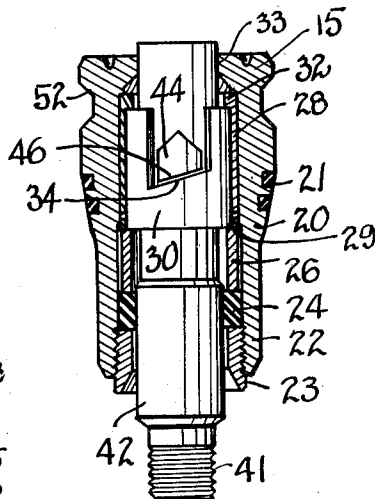


Fig. 2.

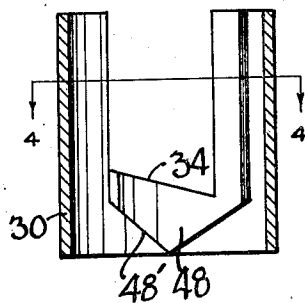


Fig. 3.

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2 Sheets-Sheet 2

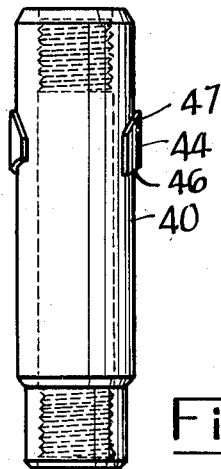


Fig. 8.

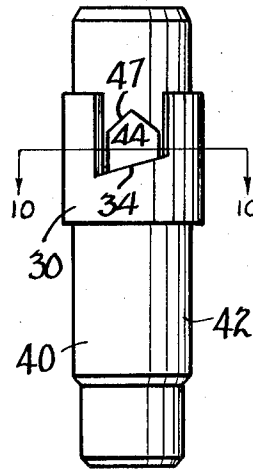


Fig. 9.

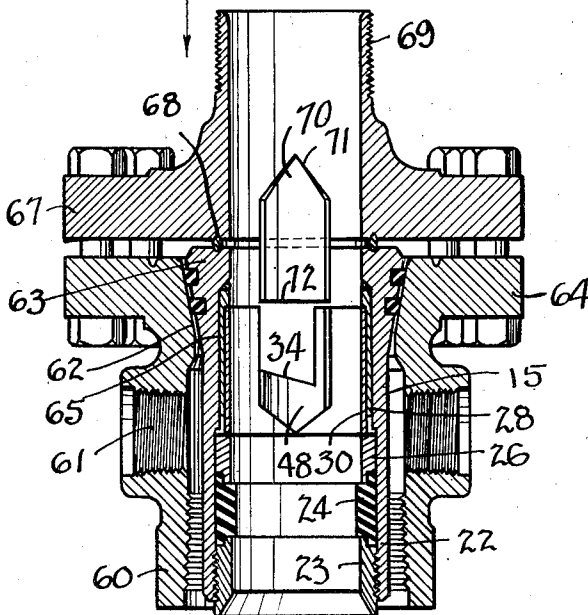


Fig. 7.

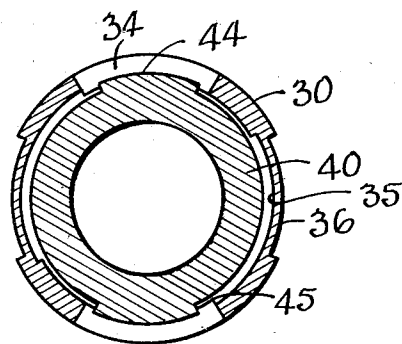


Fig. 10.

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2,274,477

TUBING HANGER

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Application August 24, 1939, Serial No. 291,660

8 Claims. (Cl. 166—14)

The invention relates to an improvement in tubing hangers and assemblies for completing wells which are drilled by the rotary method of drilling.

In the rotary method of drilling the well bore is filled with a drilling fluid composed of heavy mud to overcome formation pressures and to maintain the well wall. When the drilling operation has been completed and the tubing, strainer and liner have been lowered into position, it is desirable to remove the heavy drilling mud so as to reduce the pressure on the formation and to clean out the well by circulating water into the well to replace the mud. Upon removal of the mud the static pressure on the formation is reduced, and the most dangerous period in the drilling operation is when the well is washed. The present practice is to wash the well through the tubing and to then suspend the tubing and well bottom assembly in the desired position without removing the pipe or tubing used for the washing operation.

The present invention concerns itself with a structure at the well head whereby the washing operation may be accomplished, the tubing may be raised and lowered as necessity requires in order to land the well bottom assembly, wash the well and set the packer, and then finally be suspended at the desired elevation in the well head.

It is one of the objects of the present invention to provide a well head assembly wherein the tubing may be raised and lowered through the assembly and then eventually suspended at the desired elevation.

It is also an object to provide a well head assembly wherein the tubing may be run in thru the drilling head fittings, or the hanger for the tubing inserted, and the drilling fittings then removed before the well is completed.

Another object of the invention is to suspend a tubing string in a position in the well head so that the tubing may be either raised or lowered and so that a seal is maintained when the tubing is suspended.

Another object of the invention is to provide interfitting means on a tubing string and a tubing hanger so that the tubing string may be raised and lowered through the hanger at will and thereafter suspended in the hanger at a desired elevation.

Still another object of the invention is to provide alternate grooves and suspending seats in a tubing hanger so as to permit the tubing string to be raised and lowered through the hanger and thereafter suspended in the hanger.

Still another object of the invention is to provide a well head assembly having a full hole opening so that the tubing hanger may be inserted through the well head fittings and locked in position so that it cannot be displaced.

Still another object of the invention is to provide an inclined seat to cooperate with an inclined lug in a tubing and tubing hanger assembly so that the seat of the tubing will tend to position the tubing in the hanger upon its seat.

Other and further objects of the invention will be readily apparent when the following description is considered in connection with the accompanying drawings wherein:

Fig. 1 is a side elevation with certain parts shown in section and illustrating the assembly with the tubing suspended in the tubing hanger, which assembly has been run through the drilling equipment before the well is washed.

Fig. 2 is a vertical section of the hanger assembly with the tubing shown in elevation and suspended therein.

Fig. 3 is a vertical section of the nipple which carries the supporting seat for the tubing.

Fig. 4 is a section taken on the line 4—4 of Fig. 3.

Fig. 5 is a vertical section of the packing ring showing the configuration thereof when it is unconfined.

Fig. 6 is a side elevation of the coupling which is used in the string of tubing at the elevation where the tubing is to be suspended.

Fig. 7 is a vertical section of a modified form of the invention to be used where the blowout preventer and other drilling equipment is replaced by the Christmas tree and control equipment at the time the well is being completed so that the tubing is run therethru.

In Fig. 1 the casing head is indicated generally at 2 and may be threaded or flanged to the surface casing which is anchored in the well bore. A hanger 3 is disposed upon the seat 4 in this casing head and may suspend the production string of casing or the regular casing, which extends down to the producing formation, as the case may be. This hanger carries the packing rings 5 to provide a seal with the spool 8 which serves as a support for the well head fittings. This spool will be attached to the casing head by the bolts 10 so as to anchor it firmly in position and may be drawn downwardly to form a seal with the seal ring 7. This spool piece usually has the flow line openings 11 at each side and at its upper end is arranged with a bowl 14 which

is shaped to receive the tubing hanger 15 so as to suspend the hanger in the well bore.

The hanger assembly is best seen in Fig. 2 and comprises a body 20 which has an inclined seating area 21 to engage in the bowl 14. A skirt portion 22 extends downwardly and forms part of the body 20, and this skirt carries a stop ring 23. A packing ring 24 such as seen in Fig. 5 rests on this stop ring and is adapted to be compressed by a spacer ring 26 which is slidably mounted inside of the hanger body 20 and the skirt 22. Above the ring 26 are the keys 28 which are welded or fixed in the hanger body 20. The spacer ring 26 provides a shoulder 29 at an elevation below the keys. A bushing 30 and the spacer ring 26 may be welded together or made integral as desired. The keys 28 have an inwardly extending flange 32 at the upper end so as to confine the bushing 30 and retain it in position against upward movement out of the sleeve.

The bushing 30 is best seen in Figs. 3 and 4 and is of peculiar construction in that it has cut away portions spaced circumferentially there around in such a manner that a base of each portion forms an inclined seat 34. Arranged alternately between the seats 34 are the grooves or passages 35. The outer periphery of the sleeve is provided with grooves 36 which will receive the keys 28 on the inside of the hanger so as to prevent the nipple or bushing 30 from rotating relative to the hanger.

The purpose of seats 34 and the grooves 35 is to support the string of tubing which is to be lowered into the well while permitting its movement in and out of the hanger assembly.

To permit such manipulation of the tubing a coupling 40 has been shown in Fig. 6. This coupling will be attached to the upper end of the string of tubing and has a threaded lower end 41 to receive the upper tubing section. Above this threaded area is an enlarged portion 42 which merges with a reduced area 43. This reduced area carries a pair of oppositely spaced lugs 44 which serve to support the coupling and the string of tubing in the hanger bushing 30.

The lugs 44 are of such width and thickness that when the coupling 40 is turned to the proper position that these lugs can slide vertically through the grooves 34 in the bushing 30. These lugs cannot pass thru the top of the hanger which extends inwardly at 33 however and the coupling must be inserted thru the bottom of the hanger. When the lugs 44 are raised to the proper elevation and the coupling rotated the lugs will pass over the shoulder 45 so that the lower surface 46 of each lug will rest upon one of the inclined seats 34. These cooperating inclined faces 34 and 46 tend to seat the tubing. Thus if some pressure should occur in the well which causes movement of the packer or otherwise raises the tubing slightly the seats are so constructed that when the raising force is dissipated the tubing will settle back to its correct seated position. These inclined faces also assure a full seat to transmit the load because the weight would cause sliding of the inclined faces to obtain the proper seat. Of course any other desired shapes to accomplish this purpose may be used. The upper surface of the lug 44 has the tapered faces 47 so as to guide the lugs into the recesses 35 between the seats 34, each of the seats 34 being formed by the thickened portion 48 whose lower edges is beveled at 49 to cooperate with the bevels 47.

Attention is directed to the fact that any slight movement of the tubing as pointed out above does not destroy or release the seal of the packing 24 with either the hanger or the tubing nor permit pressure from the tubing to leak back into the casing.

In the assembly of Figs. 1 and 2 the hanger, bushing, packing and coupling 40 are all assembled as seen in Fig. 2 and connected to the tubing which has been run into the well bore which is still full of drilling mud. A handling tool is connected to the upper end of the coupling 40 and the assembly of Fig. 2 landed on the seat 14. The lock screw 50 is turned in and the hanger thus locked. The weight of the tubing expands the packing 24 to provide a seal and in as much as there is a back pressure valve on the lower end of the well bottom assembly a blowout cannot occur and the well is positively closed. The blowout preventer, master valve and other drilling fittings can now be removed from the top of the spool 8.

The Christmas tree and production fittings can now be attached to the spool 8 and are illustrated by the flange 55 held in place by the bolts 56 on the seal ring 57. These usually include a stuffing box on the top outlet so that the handling tool may now be reinserted thru the tree and connected to the coupling 40. The coupling is thus raised slightly, turned to move the lugs 44 into the grooves 35 and the tubing can then be lowered and the well washed. The tubing is next lowered to bottom, released, any additional washing accomplished, the packer set and the tubing raised to again seat the lugs in the bushing 30.

The handling tool is then unscrewed and raised enough to close the master of the Christmas tree. This closes the well completely and the handling tool is then removed. The stuffing box on top of the tree is next removed and the bull plug or a flow line connected to the top of the tree. The master valve is then opened and the well will produce thru the tubing. Swabbing or pumping operations may be carried on thru the stuffing box if desired.

In order to additionally limit displacement of the tubing string and the coupling 40 an internal shoulder 58 is provided in the top 55 so that the upper end 59 of the coupling 40 will abut against this shoulder and prevent its displacement. Any suitable flow line connection may be arranged upon the Christmas tree of which the flange 55 is the base.

When the load of the tubing is suspended in the hanger the lugs 44 engaging upon the seats 34 transmit the load of the tubing thereto. This tends to move the nipple 30, the sleeve 28, and the spacer ring 26 against the packing 24. This load causes lateral expansion of the packing 24 so that it assumes the position shown in Figs. 1 and 2 where it has been caused to form a seal with the inside of the skirt 22 and with the enlarged portion 42 on the coupling 40. In this manner a complete seal is formed around the string of tubing merely by suspending the tubing in the hanger.

Figs. 7 to 10, inclusive, show a slightly modified form of the device where it is intended that the tubing hanger shall be landed without the coupling 40 and the blowout preventer and the other drilling equipment removed from the well before the tubing is run. In this construction the casing head is shown generally at 60 and has the outlets 61 at the side thereof. It should be

noted that the opening thru this form is larger than in Fig. 1 so that the coupling 40 may be raised and lowered thru the hanger. The lip 33 is not formed on the hanger. A bowl 62 is arranged to receive the hanger 63, and it should be particularly noted that the spool 8 has not been positioned in this form of the invention. The flange 64 on the casinghead will ordinarily receive a blowout preventer or master valve and other drilling equipment may surmount such head. When the drilling has been completed the drill stem can be removed through these fittings. The hanger assembly 65 as seen in Fig. 7 without the coupling 40 will be lowered through the fittings and suspended in the bowl 62 as seen in Fig. 7. This assembly is of the same general construction as that shown in Fig. 2 including the packing, spacer ring, a sleeve, and bushing 30. In Fig. 7, however, the nipple is shown in section, whereas, in Fig. 2 it is shown in elevation.

The blowout preventer and other drilling equipment is then removed from the well and a base 67 affixed to the casing head and the seal ring 68 arranged to seal with the tubing hanger so as to insure its proper position.

The base 67 has an upstanding portion 69 to receive the Christmas tree and other fittings. The usual practice is to assemble the Christmas tree and test it, after which it is connected to the well head as a unit. In this event the base 67 is the bottom of the tree. All of the Christmas tree fittings will be of larger diameter in this form of the invention so as to permit the passage of the tubing and coupling. Inside of the passage through the base 67 is a guide member 70 which has inclined upper faces 71 to guide the lugs 44 around the seat 34 as the tubing string is being lowered therethrough. This insures that the tubing may be lowered to the desired elevation and the washing and seating operations carried on. The tubing is then raised slightly so that the lugs 44 may pass upwardly through the grooves 35 and upon slight rotation pass under the lower end 72 of the guide member 70. A slight lowering then permits these lugs to engage a seat 34 whereby the tubing is suspended.

The packing 24 of Fig. 7 is slightly larger than in Fig. 1 because it must pass the tubing and coupling but still form a seal with the coupling when the load of the tubing is carried.

Figs. 8, 9 and 10 show details of the construction above described and illustrate the manner of the arrangement and assembly thereof.

Broadly, the invention contemplates a well head arrangement whereby the pressure of the well may be controlled while the well is being completed and the tubing suspended at the desired elevation without danger of losing the well.

What is claimed is:

1. A well head assembly for washing and completing wells, including a casing head, a tubing hanger assembly therein including a hanger sleeve, a packing therein, a support coupling resting thereon, a string of tubing, including a support nipple thereon, and interfitting means on said coupling and nipple including inclined lugs and seats therefor, a guide member for said lugs projecting above said hanger to turn the tubing so that the tubing may be raised and lowered through the coupling in washing and completing the well, and then said means interengaged to hang such tubing.

2. A well head assembly for washing and completing wells, including a casing head, a tubing hanger assembly therein including a hanger sleeve, a packing therein, a support coupling resting thereon, a string of tubing, including a support nipple thereon, and interfitting means on said coupling and nipple so that the tubing may be raised and lowered through the coupling in washing and completing the well, and then said means interengaged to hang such tubing, said means including an outstanding lug and seat structure wherein the seat is inclined so that the weight of the tubing tends to resist unscrewing of the tubing.

3. In a well head a hanger, a sleeve therein having a circumferentially inclined seat, a tubing string, a lug thereon having an inclined complementary lower face to engage said seat, and channels spaced circumferentially in said sleeve to allow passage of said lugs while raising and lowering the tubing.

4. A tubing hanger assembly for wells including a body, a stop ring therein, a packing on said ring, a spacer on said packing, a bushing resting on said spacer, alternate seats and recesses in said bushing, a tubing coupling for said bushing including outstanding lugs to engage said seats but arranged to pass thru said recesses so that the tubing may be seated or unseated for movement in completing the well.

5. A tubing hanger assembly for wells including a body, a stop ring therein, a packing on said ring, a spacer on said packing, a bushing resting on said spacer, alternate seats and recesses in said bushing, a tubing coupling for said bushing including outstanding lugs to engage said seats but arranged to pass thru said recesses so that the tubing may be seated or unseated for movement in completing the well, said seats extending inwardly adjacent the recesses so as to receive said lugs upon rotation.

6. A tubing hanger assembly for wells including a body, a stop ring therein, a packing on said ring, a spacer on said packing, a bushing resting on said spacer, alternate seats and recesses in said bushing, a tubing coupling for said bushing including outstanding lugs to engage said seats but arranged to pass thru said recesses so that the tubing may be seated or unseated for movement in completing the well, said seats and the base of the lugs being inclined so that the load of the tubing will tend to cause sliding of the lugs to a complete seat.

7. A well head including a casing head, a tubing hanger therein, seats in said hanger to receive the tubing, a tubing, lugs outstanding thereon to be engaged upon said seats by rotating the tubing, and guide means on the head above said seats to direct said lugs around the seats when the tubing is being lowered into the hanger.

8. A tubing head construction including a casing head, tubing hanger and Christmas tree base, a tubing coupling to be engaged in said hanger to support the string of tubing, lugs on said coupling to engage said hanger, and guide means in said hanger and base to guide said lugs across the joint between said base and hanger.

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