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TUBING HANGER

Filed Feb. 16, 1934

3 Sheets-Sheet 1

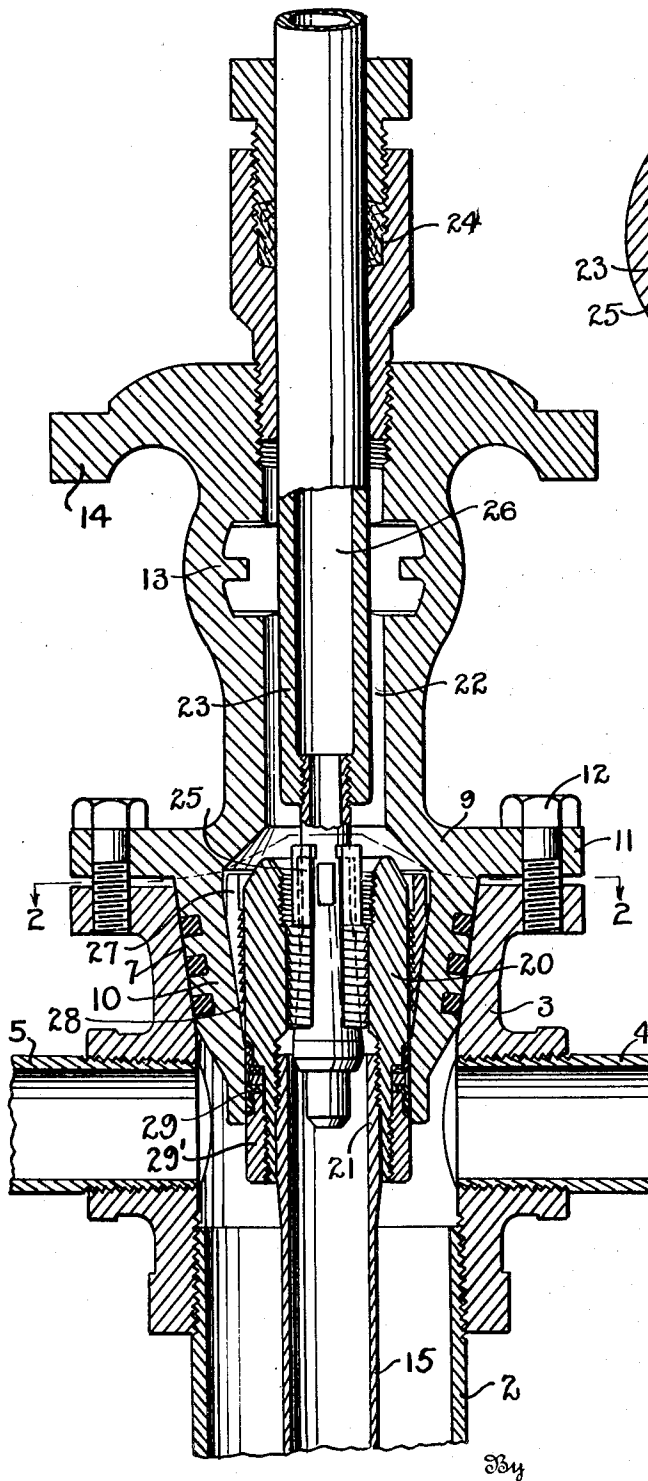


Fig. 2.

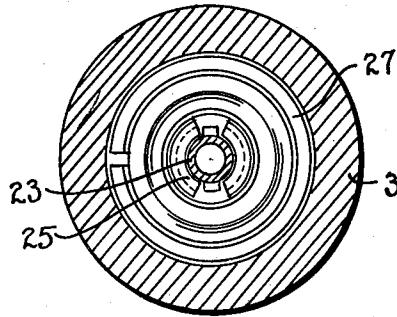


Fig. 1.

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3 Sheets-Sheet 2

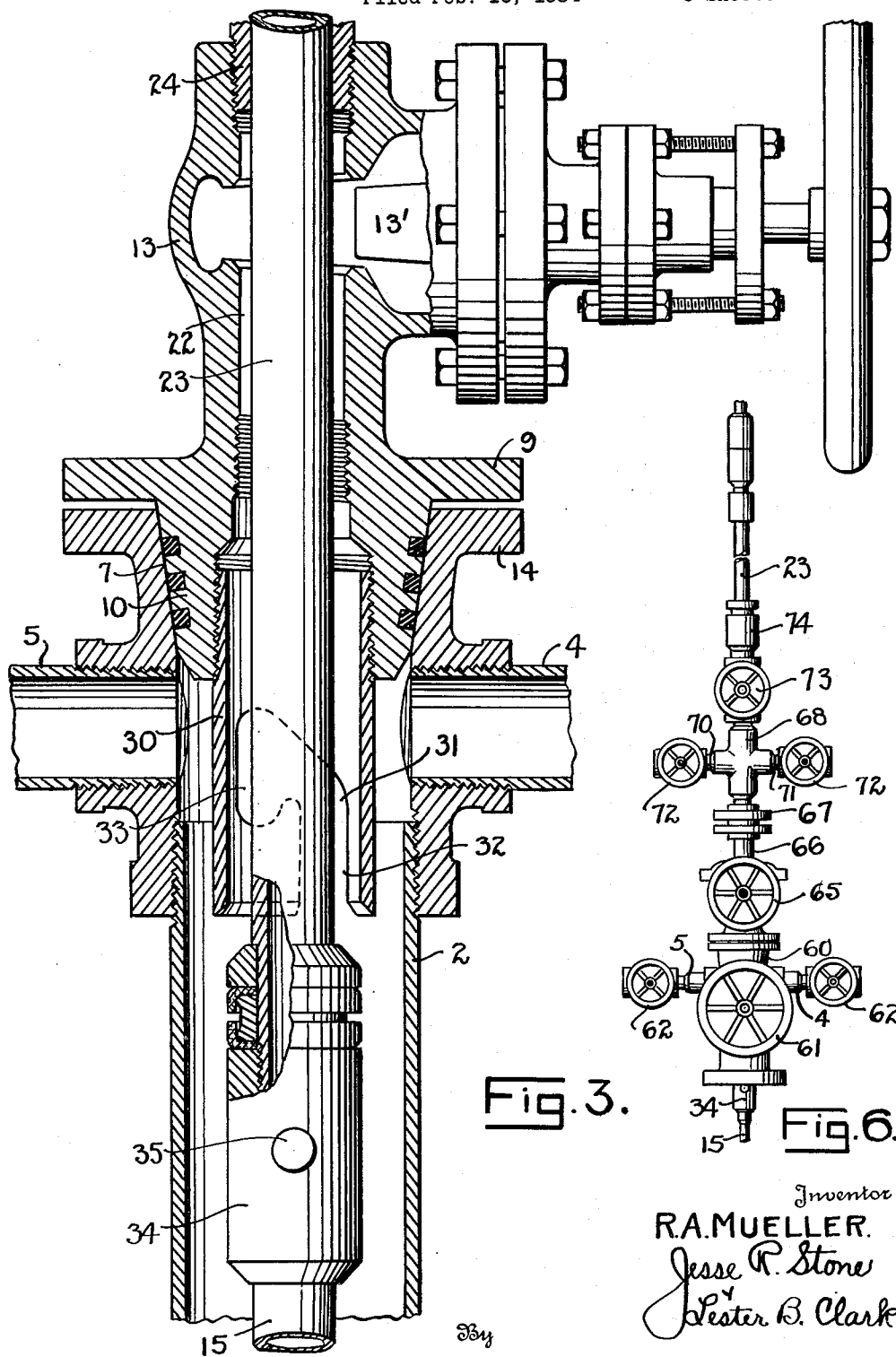


Fig. 3.

Fig. 6.

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3 Sheets-Sheet 3

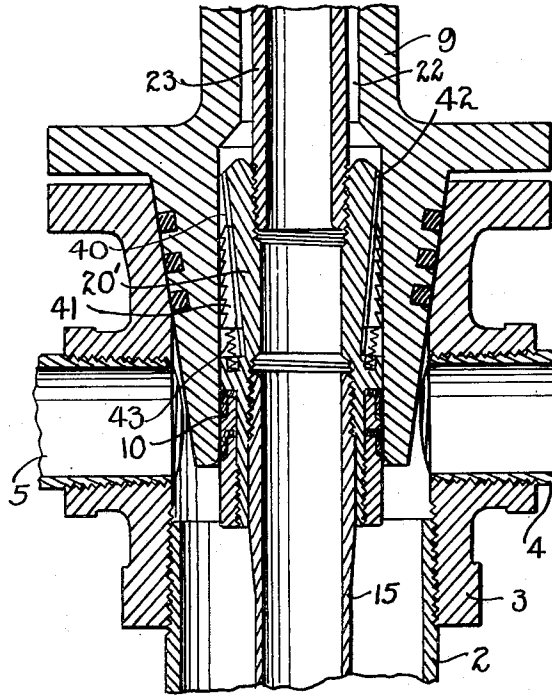


Fig. 4.

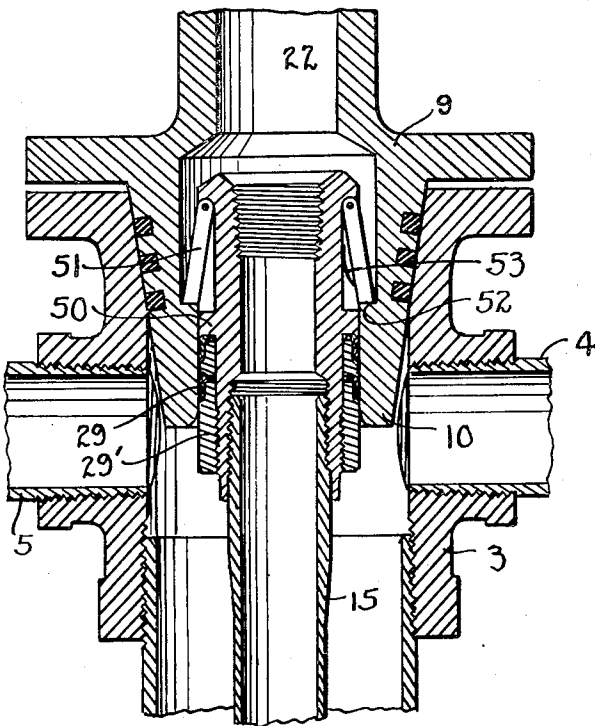


Fig. 5.

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UNITED STATES PATENT OFFICE

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TUBING HANGER

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8 Claims. (Cl. 166—15)

The invention relates to an improved type of tubing hanger and the method of positioning the same in order that complete control of the well may be had while the well is being washed and the tubing positioned.

It is one of the objects of the invention to provide a novel form of tubing hanger wherein the tubing may be subjected to reciprocation during the washing of the well, and then be suspended in position in such a manner that a seal may be maintained around the tubing during the entire operation.

Another object of the invention is to provide a tubing hanger wherein the tubing may be moved during the positioning thereof and finally anchored in such a position that it will be securely suspended in the well and to maintain a fluid seal at the well head during such operations.

Another object of the invention is to provide an apparatus wherein a string of tubing may be reciprocated in the well during the washing thereof and then latched in position for connection with the flow apparatus.

Another object of the invention is to provide a well head assembly wherein the valve is positioned on a boll weevil head and the Christmas tree hook-up positioned on the well before the well is washed.

Another object of the invention is to provide a method of washing the well and positioning the tubing wherein all of the operations may be performed while a seal is maintained at the well head.

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 central vertical section of a well head equipped with the invention and wherein the tubing is shown as latched in the well head after the washing operation has been completed.

Fig. 2 is a section taken on the line 2—2 of Fig. 1.

Fig. 3 is a central vertical sectional view of another form of the invention wherein the tubing is suspended by a J-latch after the washing operation.

Figs. 4 and 5 are sectional views of modified forms of the latching device which may be used to suspend the tubing in the well.

Fig. 6 is a diagrammatic assembly of the well head hook-up.

In completing wells drilled by the rotary method it is necessary to as completely as possible remove the mud and drilling fluid from the well. It is

understood that when a well is drilled by the rotary method, the well bore is filled with mud which is circulated to remove the cuttings and maintain the walls of the well bore. When the well is to be completed, however, the casing and screen are set in the well while the well is filled with mud, the mud being retained in the well in order to overcome the pressure of the oil and gas formations which have been encountered.

Where high pressures are encountered, the well can only be completed when it is stifled or smothered by the enormous pressure caused by a column of heavy mud in the well. Behind this protection the operations of completing the well are carried out, the casing and screen are set, and the tubing placed in position.

With this set of facts in mind, it is apparent that practically all of this mud in the well must be replaced by liquid of lesser density so that the walls of the formations will be cleaned of mud and the strainer will be washed clean to permit an inflow of oil.

The present invention relates to a novel method of positioning the tubing so that the well may be completely washed and the tubing hung in position while the well is sealed to prevent blowing out.

In Fig. 1 the usual form of well casing is shown at 2. Said casing has mounted thereon the usual casing or tubing head 3 which is provided with the outlets 4 and 5. The head 3 is constructed with a bowl 7 which is arranged to receive the hanger head 9, from which the tubing is suspended and upon which the well head fittings, or Christmas tree structure is supported. In Fig. 1 the hanger head 9 is made up of a tapered shank 10 which is arranged to seat in the bowl 7, the flanges 11 through which the bolts 12 project in order to fasten the hanger head to the casing head, as well as the gate valve portion 13 and the ears 14 by which the head is suspended from the elevators or other suitable device.

The string of tubing being positioned is indicated at 15 and is shown as being suspended in the well bore from the shank 10 of the hanger head 9. It is understood that the casing 2 is full of heavy mud when the string of tubing 15 is being run into the well, so that the mouth of the casing may be opened without material danger of a blowout because of the enormous pressure which the mud has exerted on the oil formation. The tubing 15 is lowered into the well until the lower end thereof arrives at a position adjacent the bottom of the well, or the screen, through which the fluid is to enter the casing. When

the upper end of the tubing is at the elevation of the well head it is then desirable to connect the hanger head to the well casing so that the well may be sealed during the washing operation.

8 The tubing must be reciprocated as the screen is washed so that water issuing from the lower end of the tubing may clean all portions of the screen. The lift nipple 23 is engaged with the upper end of the tubing for this purpose. The connection between the lift nipple and the tubing is a detachable one. A coupling 20 at the upper end of the tubing has a threaded socket into which the nipple may screw as in Fig. 3, or a releasable spear 25 on the nipple may engage within the coupling as shown in Fig. 1. The lift nipple 23 has a seal with the hanger by means of the stuffing box 24 at the upper end of the valve housing 13. Through this seal the tubing may be raised or lowered without affecting this seal. The lift nipple is to be understood as connected with the fluid pumps through the usual swivel, not shown. Thus circulation may be maintained through the tubing during the washing and hanging operations.

25 In attaching the hanger head 9 to the casing head 3 it is probable that the lift nipple 23 will be positioned in the hanger head substantially as shown in Fig. 1, with the spear 25 gripping the inside surface of the coupling 20. These three parts, that is, the nipple, spear and coupling will be at a slightly lower elevation than shown in the drawing, so that the coupling 20 will be positioned below the shank 10 of the hanger head. The coupling 20 will then be connected to the upper end 21 of the string of tubing 15 and with the coupling 20 still below the shank 10 the hanger 9 will be attached to the casing head 3 by the bolts 12. It is understood that the weight of the string of tubing 15 is then supported by the spear 25 and the lift nipple 23 which is suitably suspended in the derrick.

Liquid is now circulated through the lift nipple and tubing for a considerable period of time until the returns coming up the casing 2 and discharged from the outlets 4 and 5 show that the mud has been practically removed from the well. In order to completely remove the mud and wash the screen in a satisfactory manner, it is necessary that the liquid be discharged from the lower end of the tubing at different elevations at the bottom of the well. With this in mind, while the liquid is being circulated through the lift nipple and tubing the lift nipple will be raised and lowered by the device from which it is suspended in the derrick, the seal being maintained about the lift nipple by the packing gland 24. During this washing operation the coupling 20 will be at an elevation below the shank 10 of the hanger head, but when the washing has been completed then the lift nipple is raised to such an elevation that the coupling 20 will be drawn into the shank 10. Positioned in the shank 10 is a set of slips 27 which are arranged on a tapered seat 28 in such a manner that the inner toothed faces of the slip will grip the coupling 20 and prevent it from downward movement after the coupling has once been drawn up into the shank. When the washing operation is completed, the coupling 20 will be drawn into the shank and gripped by the slips so that it is securely held by these slips and the tubing suspended from the hanger head in this manner.

During all of this time the seal is maintained and fluid pressure maintained by the pumps is applied to the interior of the lift nipple so that

the well cannot blowout. The lift nipple is now rotated so as to release the spear 25 and is withdrawn upwardly through the hanger head. As soon as the spear has passed the gate valve 13 the valve can be closed to completely cut off the well. The lift nipple is then completely removed from the hanger head, and if desired the stuffing-box 24 will be removed and a suitable Christmas tree connection made thereto, or if desired the Christmas tree connections can be made directly to the upper end of the lift nipple and the lift nipple remain in position in the stuffing-box and hanger head, but with the lower end thereof slightly above the elevation of the gate of valve 13.

Suitable packing 29 is provided on the coupling 20 which is held in position by the ring 29' so that a seal will be maintained with the shank 10 of the hanger head.

Fig. 3 shows a modified form of the invention which will be manipulated in exactly the same manner as the construction of Fig. 1. The modification consists of providing a sleeve 30 in the shank 10. This sleeve 30 is arranged with an inverted J-latch 31 which consists of the slots 32 and the offset recesses 33. The string of tubing 15 is the same in this form of the invention as Fig. 1, except that instead of the coupling 20 a latching head 34 is provided. This head is in the form of a coupling and is provided with the outstanding lug 35 which is arranged to enter the slot 32 and be positioned in the recess 33 to suspend the tubing.

During the washing operation the tubing will be reciprocated by the lift nipple 23, the same as in the Fig. 1 form of the invention. The lift nipple, however, may be connected directly to the latching head 34 instead of being connected thereto by a spear. When the washing operation has been completed, the latching head 34 will be raised so that the lug 35 will enter the J-latch 31. A partial rotation positions the lug in the recess 33 so that the tubing will be securely latched in position and suspended from the sleeve 30. A seal between the head and the sleeve 30 is provided so that the passage of fluid around the tubing is closed, as in the Fig. 1, embodiment. As soon as the head is latched, the lift nipple 23 will be backed off or unscrewed from the latching head and raised upward to permit the gate 13' of the gate valve 13 to move across the opening 22 to completely close the well, the same as in the Fig. 1 form of the invention.

Fig. 4 shows a form of the invention somewhat similar to Fig. 1, except that the coupling 20' is provided with beveled faces 40 which serve to support the slips 41 so that the coupling may be latched in the shank 10. The slips 41 are mounted on the beveled face 40 by means of a dovetailed construction 42. The springs 43 tend to move the slips upwardly to their outermost position. When the washing operation is complete, the coupling 20' will be raised into the shank and slips 41 forced downwardly until they pass into the shank. A slight lowering action thereafter causes the slips to seat on the inside face of the shank 10 and in this manner securely anchor the coupling and tubing in position. The lift nipple 23 will be then unscrewed as described in connection with Fig. 3.

Fig. 5 shows still another form of the invention wherein the coupling 50 is provided with the pivoted latches 51 which are arranged to seat on a shoulder 52 in the shank 10 of the hanger head 9. Small springs 53 may be positioned behind the latches 51 in order to normally urge

them outwardly to engage the seat or shoulder 52. The washing operation will be carried out as previously described, and the coupling then raised into the shank 10. As soon as the latches 51 have 5 passed the shoulder 52 the springs will thrust the latches outwardly so that they will engage on the shoulder 52.

Fig. 5 shows that the lift nipple has already been removed and merely illustrates the tubing 10 in its suspended position.

Fig. 6 shows a diagrammatic arrangement of one form of well head assembly to which the present invention is particularly adapted. In this arrangement a combination gate valve and boll 15 weevil head 60 has been illustrated. This head is of a type somewhat similar to the head 3 but a blow-out preventer member 61 has been incorporated in the head below the outlets 4 and 5 so that a closure may be had around the tubing 15, 20 or any other pipe which is suspended in the well. The outlets 4 and 5 are each provided with a gate valve 62 in order to control the flow of liquid from around the outside of the tubing. The boll weevil head 60 has a top bowl 7 as described in con- 25 nection with the head 3 which is of particular advantage in connection with the well head assembly because it enables the operator to position a gate valve such as 65 on the boll weevil head by inserting the shank 10 of the valve in the bowl 30 7. This valve 65 is a combination valve and tubing hanger, the same as the valve 13 illustrated in the other figures.

This construction is simple and economical and of advantage because if a valve is positioned on the head 3 during the drilling operation, the valve 35 must be of the same design as the casing 2 in order to allow the drilling operation, but if the head is so constructed that the blow-out preventer 61 is positioned below the outlets 4 and 5, 40 then the valve member need not be positioned above the head as illustrated, and when the drill has been finished the smaller gate valve 65 can be placed on the well, and a small 6-inch valve may be used instead of a 9 $\frac{5}{8}$ inch valve. This 45 serves as a material reduction in the cost of the well head equipment, and enables the operator to more accurately and safely control the operations of his well.

In lieu of the stuffing-box 24 which is shown 50 in Fig. 1, the nipple 66 has been fastened in the top of the valve 65. A suitable flange and swivel arrangement 67 is positioned above the nipple 66 in order to support the Christmas tree assembly 68 which is made up of a cross 69 the outlets 70 55 and 71, and the gate valves 72 thereon. The Christmas tree assembly extends above the cross 68 and carries a closure valve 73 and is topped with a stuffing-box 74 which is similar to the stuffing-box 24 previously described.

60 In Fig. 6 the lift nipple 23 is shown as extending above the assembly in order that the tubing 15 and the coupling 34 thereon may be raised into position and latched in the hanger which is carried by the lower end of the valve 65 inside 65 of the head 60.

One of the particular advantages of this arrangement is that all of the parts are made up so that one will fit the other, and when the operator has transported all of these parts to the well 70 location and attempts to assemble them, he is assured that all the threads, fittings, and other connections are proper and he is assured of success in assembling the entire well head. The practice now in general use includes purchasing 75 of the fittings and valves indiscriminately, and

when they are gathered at the well for assembly, it is not uncommon at all that the threads are of different sizes and such that as much as two or three days is required in refitting the parts in order to assemble them. The general arrange- 5 ment of the assembly shown in Fig. 6 has been devised after a great deal of effort and study with a view of simplifying the assembly and obtaining parts which the operator will be assured are going to fit with the other parts so that no difficulty 10 will be encountered in assembling the head.

In some types of construction, a packer or lead seal is carried by the tubing 15 which must be set after the well has been washed in order to form a seal between the tubing 15 and the casing 15 2 near the bottom of the well. These packers are well known in the art and are usually expanded by setting down on the tubing 15 after a removable connection has been operated in the tubing. If this type of arrangement is to be used in con- 20 nection with the tubing hanger 9, it may be necessary to suspend the valve 13 and the Christmas tree in the derrick during the washing operation, but in a position where it can be quickly lowered into the bowl 7. 25

After the washing has been completed, then the couplings 34 will be drawn up and latched in the tubing hanger in a manner such as shown in either Figs. 1, 3, 4, or 5. After the coupling has been latched in position then the entire Christ- 30 mas tree including the hanger 9 will be set down on the well bottom so as to expand the packer and the hanger 9 is then securely fastened to the casing head.

While several modifications of the invention 35 have been shown and described, it is to be understood that the invention broadly contemplates a novel manner of washing the well by reciprocating the tubing while a seal is maintained about the tubing and while circulation is being 40 carried on, and to thereafter suspend the tubing in a permanent position without breaking the seal on the well head.

There is the further advantage that the pump pressure may be maintained through the lift nip- 45 ple and the tubing while the lift nipple is detached from the tubing and raised above the valve 13, so that the whole upper end of the well may be closed by shutting the valve. This enables the operator to equip the upper end of the well for 50 flowing so that the valve 13 may then be opened and fluid may flow as desired.

What is claimed as new is:

1. The combination with a casing head of a tubing hanger, a shank on said hanger to seat 55 in said head, a stuffing box on said hanger adapted to seal about a pipe passing there- through, a lift nipple extending through said head, a string of tubing releasably supported by said nipple whereby the tubing may be recip- 60 roated during the washing of the well, and means on the tubing to be raised into said shank after the washing to anchor said tubing in said shank.

2. The combination with a casing head of a tubing hanger, a shank on said hanger to seat in 65 said head, a Christmas tree above said hanger, a stuffing box on said tree adapted to seal about a pipe passing therethrough a lift nipple extending through said head, a string of tubing releasably supported by said nipple whereby the tubing may 70 be reciprocated during the washing of the well, and means on the tubing to be reciprocated through said shank during the washing and to thereafter anchor said tubing in said shank.

3. A well head assembly made up to completely 75

control the well while washing and setting tubing comprising a combination blowout preventer and boll weevil head having outlets above said preventer, valves on said outlets, a combination tubing hanger and gate valve disposed in said boll weevil head, said hanger having a shank to seat in said head, a tubing string adapted to be suspended from said hanger, means in the hanger to suspend the tubing, a flow line cross and valves disposed above said combination valve and hanger, a stuffing box above said cross, and a setting tool adapted to pass through said stuffing box, cross and gate and hanger to manipulate and carry flushing liquid to said string of tubing during the washing operation and also adapted to move said tubing to suspended position from said means.

4. The combination with a casing head of a tubing hanger and string of tubing, a downwardly opening recess in said hanger, a slip element disposed within said recess, a tubular hanger member on said tubing which is upwardly insertable into said recess to be engaged by said slip element for support of said tubing, packing on said member adapted to form a sliding seal between said member and said hanger, said tubing being hung from said member, and a releasable lift nipple adapted to engage and actuate said member whereby the tubing may be reciprocated in the well and then raised and hung by said member.

5. The combination with a casing head of a tubing hanger, a shank on said hanger to seat in said head, a slip element within said shank, a well tubing, a coupling member thereon adapted to be engaged by said slip element for support,

and packing carried by said coupling and positioned to engage within said shank and form a seal therewith when said coupling member is supported by said slip element.

6. The combination with a casing head of a tubing hanger, a shank on said hanger to seat in said head, a downwardly opening recess therein, a well tubing, a coupling member thereon upwardly insertable into said recess, slip segments carried by said member and adapted to engage within said recess to support said coupling and tubing, packing on said coupling and insertable within said recess to form a seal.

7. The combination with a casing head of a tubing hanger, a hollow shank on said hanger to seat in said head, a downwardly opening socket in said shank, a well tubing, a coupling member on said tubing adapted to be upwardly inserted into said socket, interengaging means on said coupling and socket to support the tubing, a packing element on said coupling member to form a seal between said coupling and said hanger, and means to secure said coupling in supported engagement within said socket.

8. The combination with a casing head of a tubing hanger, a shank on said hanger to seat in said head an enlarged downwardly opening socket in said shank, an upwardly facing shoulder therein, a well tubing, a coupling member thereon insertable within said opening, a sealing element to form a seal about a tubing with said hanger, and dogs on said coupling adapted to pass upwardly into said opening and be expanded to engage said shoulder to support said coupling and tubing.

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