

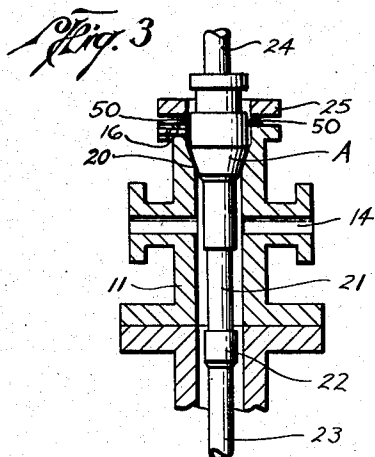
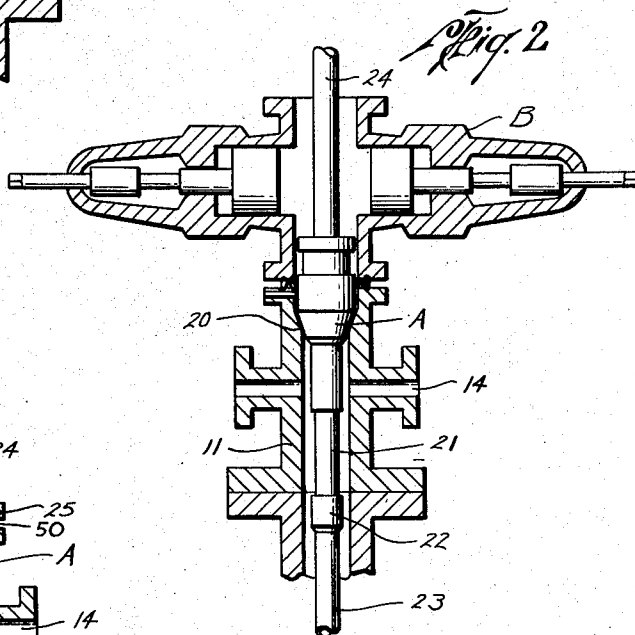
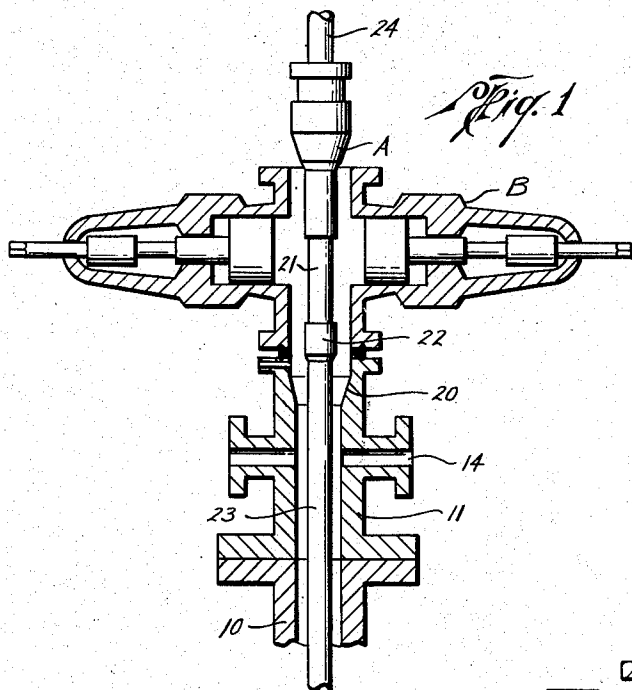
Nov. 24, 1953

C. C. BROWN
WELLHEAD APPARATUS

2,660,248

Filed Dec. 17, 1951

3 Sheets-Sheet 1



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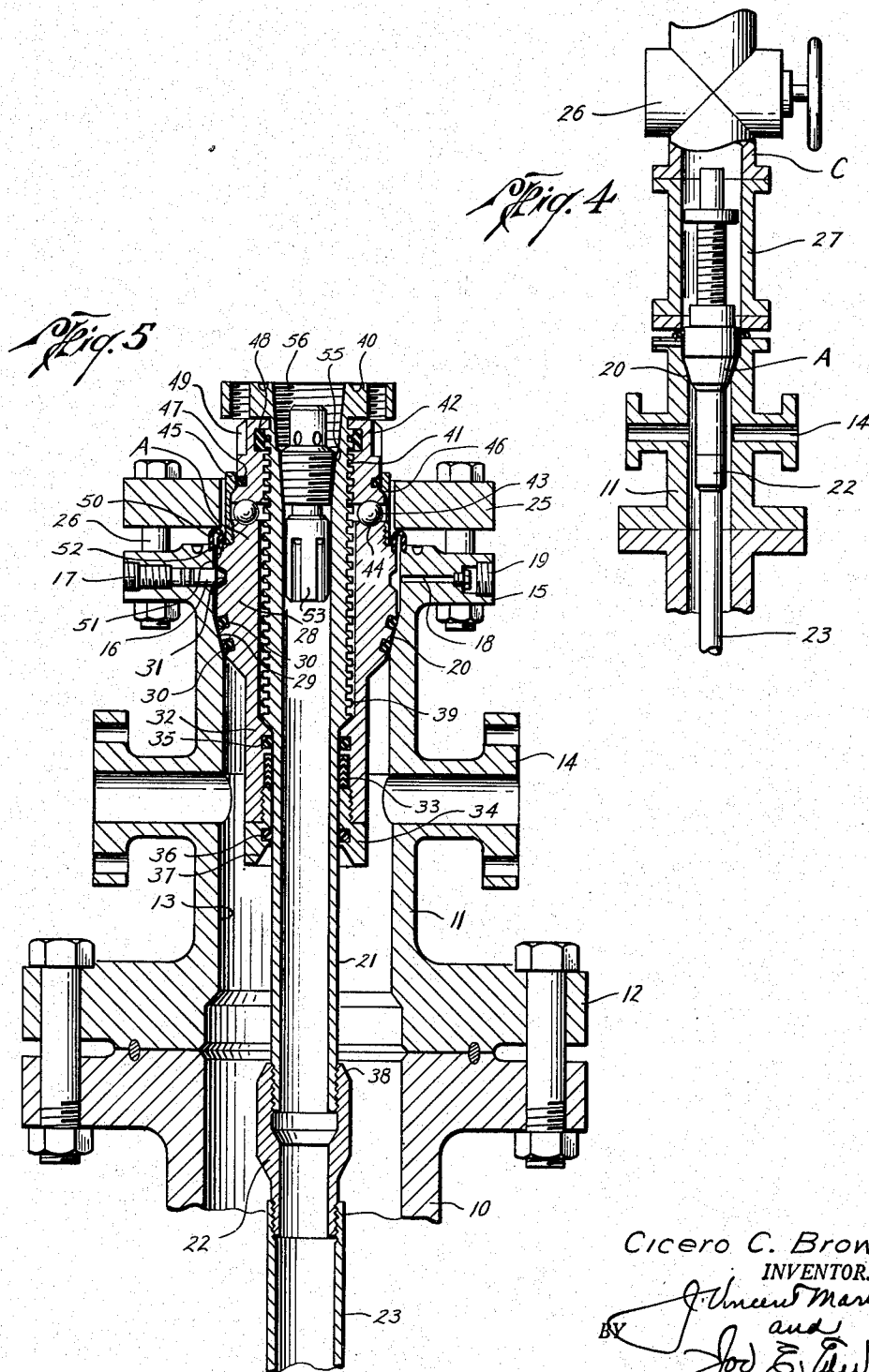
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3 Sheets-Sheet 2



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3 Sheets-Sheet 3

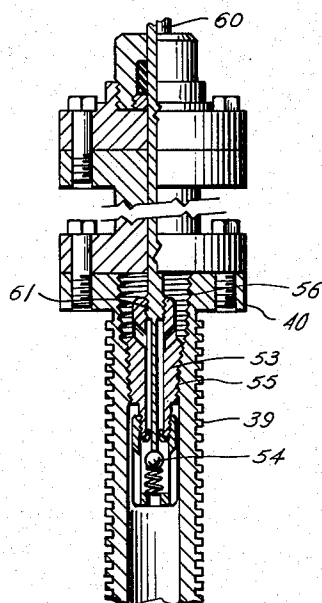
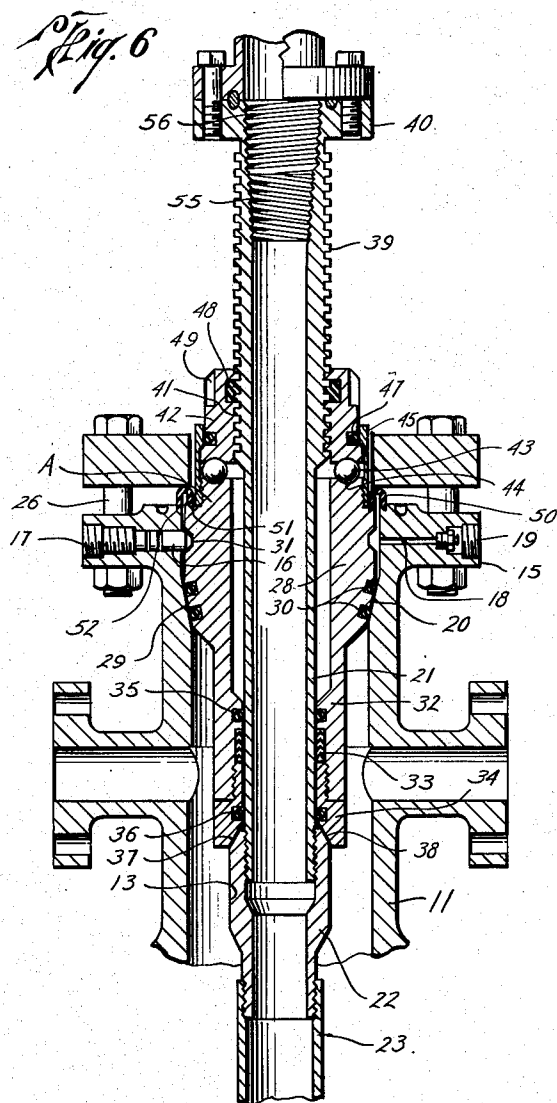


Fig. 7

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WELLHEAD APPARATUS

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Application December 17, 1951, Serial No. 262,014

14 Claims. (Cl. 166—15)

1

This invention relates to new and useful improvements in well head apparatus.

One object of the invention is to provide an improved well head apparatus which is so constructed that the well tubing which is suspended from the apparatus may be either rotated or moved longitudinally, as conditions require, whereby various well operations and the setting of well tools may be accomplished after the tubing has been landed.

An important object of the invention is to provide an improved well head assembly for landing and supporting a well tubing string and being arranged so that only metallic seals are exposed to the well pressures when the tubing is in its final position.

Another object is to provide an improved tubing head assembly which includes a swivel mounting for the tubing string whereby a rotative movement of the tubing which may be necessary to actuate or set well tools carried by the string can be carried out without in any manner interfering with the proper sealing off and suspension of the tubing.

Still another object is to provide an improved well head assembly having means which may be actuated after the tubing is in its finally landed position and the well packer set for pulling an upward tension on the tubing string to obviate leaks at the various couplings and joint connections of the tubing string.

Another object is to provide an improved well head apparatus which is particularly adapted for use in carrying out the well completion method disclosed in my co-pending application, Serial No. 202,174, which method discloses actuation of well tools by means of rotation of the tubing string.

A still further object is to provide an apparatus of the character described which will allow rotation or reciprocation, or both, of the tubing string, after the tubing has been landed and which is constructed so that the tubing may be lowered and landed through the usual blowout preventers and other pressure control equipment, whereby well completion may be carried out with the benefit of blowout protection devices in place, as is the usual practice.

The construction designed to carry out the invention will be hereinafter described together with other features thereof.

The invention will be more readily understood from a reading of the following specification and by reference to the accompanying drawings forming a part thereof, wherein an example of the invention is shown, and wherein:

2

Figure 1 is a schematic view illustrating the improved tubing head forming part of the present invention and showing the tubing string being lowered within the well through a blowout preventer,

Figure 2 is a similar view showing landing of the tubing hanger,

Figure 3 is a similar view with the blowout preventer and control equipment removed from the tubing head,

Figure 4 is a view similar to Figure 3 showing the lower valve of a Christmas tree assembly connected with the tubing head,

Figure 5 is an enlarged vertical sectional view of the improved well head apparatus illustrating the parts in position after landing of the tubing hanger,

Figure 6 is a view similar to Figure 5 showing the actuating stem moved upwardly with respect to the hanger with a tension pulled on the tubing string, and

Figure 7 is a sectional detail illustrating the manner of removal of the check valve which normally closes the bore of the tubing string during the lowering and landing of said string.

In the drawings the numeral 10 designates a casinghead which is mounted on the last string of casing extending downwardly into the well bore (not shown). A tubing head 11 provided with a base flange 12 (Figure 5) is bolted to the upper flange of the casinghead and is provided with an axial bore 13 from which the usual side outlets 14 extend. An upper flange 15 is formed on the tubing head body for connection with control equipment during lowering and running of tubing within the well bore. A plurality of radial lock screws 16, only one of which is illustrated, are provided in the flange and are arranged to project inwardly into the upper end of the bore of the tubing head body. A sealing plug 17 closes the outer end of the opening in which each locking screw is mounted. The flange also has a radial test port 18 normally closed by a plug 19. Within the upper portion of the bore 13 of the tubing head is an annular seat 20 which is adapted to receive a hanger assembly generally indicated by the letter A in Figure 5, as will be explained.

The tubing head 11 is assembled above the casing head 10 and as shown in Figure 1, a blowout preventer B is mounted above the tubing head. Above the blowout preventer is usually a second blowout preventer and a master gate valve, neither of which is shown because this is standard blowout prevention equipment. The hanger assembly A includes a tubular stem 21

which has its lower end threaded into a coupling 22 and said coupling is threaded onto the upper end of the tubing string 23. A lowering pipe 24 is adapted to thread into the upper end of the hanger assembly A, whereby the tubing and the hanger may be lowered downwardly through the blowout preventer equipment to engage the seat 20 within the tubing head 11. This lowering operation is clearly illustrated in Figures 1 and 2, the latter showing the hanger assembly seated within the tubing head.

After the assembly is seated the lock screws 16 are utilized to lock said hanger upon the seat, and as will be hereinafter explained, the tubing bore is closed at this time. When the hanger is locked down by the lock screws the blowout preventer equipment above the tubing head may be removed and a hold-down flange 25 may be substituted therefor, such hold-down flange being secured to the upper flange 15 of the tubing head by bolts 26. Thereafter the lowering pipe 24 is removed from the hanger assembly and the usual Christmas tree is then connected with the flange 25, as clearly shown in Figure 4. The entire Christmas tree is not shown since this is standard equipment and only the lower valve 26 of said Christmas tree is illustrated. The connection between the Christmas tree and the flange 25 may be made through the usual flanged riser 27.

The particular hanger assembly A is clearly shown in Figures 5 and 6 and includes a hanger body 28 having an inclined seating surface 29 which is adapted to engage the annular seat 20 within the tubing head. Suitable packing rings 30 which may be the usual O-ring type of packing are mounted in external grooves in the seating surface 29 and function to effect a pressure type seal at this point. An annular groove 31 is formed in the hanger body and when said hanger is in a seated position this groove is opposite the locking screws 16 whereby said screws may be moved inwardly into engagement with the groove to thereby lock the body against upward displacement. When the hanger body is seated the groove 31 is also opposite the test port 18 so that a testing of the seals may be effected in the usual manner.

The hanger body 28 is formed with an integral depending extension 32 and said extension has its bore recessed to receive chevron type packing 33 which is retained in place by a flanged packing gland 34. An O-ring type packing 35 is mounted within a suitable groove of the bore of the extension 32 above the packing 33 while a similar sealing ring 36 is mounted in the bore of the packing gland below the packing 33. The lower end of the bore of the gland 34 is formed with an inclined annular seating surface 37.

The tubular stem 21 which forms part of the hanger assembly extends downwardly through the hanger body and the extension, as well as through the packing gland 34, and has the coupling 22 secured to its lower end. The upper end of the coupling 22 is formed with an inclined surface 38 which is adapted to engage and seat within the lower end of the gland 34, the surface 38 contacting and maintaining sealing engagement with the seat 37 of said gland.

For imparting a rotative movement or a longitudinal movement or both to the sealing stem 21 to impart similar movement to the tubing 23, the upper portion of said stem is enlarged and provided with coarse threads 39 which may be

either left or right hand threads. Above the threads the stem is formed with a flange 40 whereby, if desired, the Christmas tree may be attached directly to the stem instead of to the retaining flange 25. The threads 39 are adapted to interengage with threads 41 formed within the bore of a rotatable actuating nut 42. The threads 41 will of course be in the same direction as the threads 39, and likewise may be either left or right hand threads. As is clearly shown in Figure 5, the nut 42 is mounted upon ball bearings 43 which are disposed within a raceway 44 formed in the upper surface of the hanger body 28. Upward displacement of the rotatable actuating nut 42 is prevented by a retaining collar 45 which has its upper end overhanging an external shoulder 46 formed on the nut; the retaining collar is threaded onto the upper end of the hanger body and thereby retains the actuating nut as part of the assembly. A suitable O-ring packing 47 seals off between the retaining collar and actuating nut, while sealing material 48 is interposed between the bore of the nut and the threads of the actuating stem to seal off the thread connection. Two or more recesses 49 may be formed in the exterior of the actuating nut for receiving a spanner wrench to impart rotation to the nut.

When the hanger assembly A is seated within the tubing head, as illustrated in Figure 5, and the blowout preventer equipment has been removed, an additional seal between the hanger body 28 and the tubing head body is effected by a sealing ring 50. This sealing ring is of an inverted U-shape in cross-section and engages within a groove 51 provided in an external shoulder on the hanger body as well as within a groove 52 formed in the upper surface of the tubing body. The flange 25 rests upon the upper surface of the sealing ring 50 and functions to hold the same in sealing position.

In the operation of the apparatus, the hanger assembly A has its tubular stem 21 connected through the coupling 22 with the tubing 23. A back check valve 53 (Figures 5 and 7) having an upwardly closing ball check 54 is connected in left hand threads 55 formed within the upper end of the tubular stem 21 of the hanger assembly. This ball check functions to close the bore of the tubing during lowering and landing of the tubing. Right hand threads 56 provided above the threads 55 receive the lower end of the lowering pipe 24.

The tubing head 11 is mounted on the casing head, as shown in Figure 1, with the blowout preventer equipment mounted thereabove. By means of the lowering pipe 24 the last portion of the tubing 23 and the hanger assembly A are lowered through the blowout preventer until the inclined seating surface 29 of the hanger body 28 engages the seat 20 of the tubing head. Upon reaching this position the lock screws 16 are operated to engage the annular groove 31 in the hanger, and thus the hanger is locked down within the tubing head. The hanger functions to seal the annular space between the tubing and the casing while the back check valve 53 closes the bore of the tubing against upward flow. It is thus possible to remove the blowout preventer equipment from above the tubing head and when this is done the sealing ring 50 is placed in position between the hanger body 28 and the tubing head body; the flange 25 is then bolted in position to the upper flange of the tubing head and

5

functions to maintain the sealing ring 50 in position.

The tubing string may have a packer mounted thereon which is to be set down the hole to pack off between the tubing and the casing in the usual manner, and such packer may be of a construction which will set the same upon a rotation of the tubing string. In order to effect the seating of the packer it is only necessary to impart a simultaneous rotation to the sealing stem 21 and actuating nut 42, this rotation being possible when the actuating nut is abutting the flange 40 of the sealing stem and the nut or stem is turned in a direction such that the nut and stem tend to thread toward each other. For example, if threads 39 and 41 are right hand threads, the stem 21 is turned to the right or clockwise, or the nut 42 is turned to the left or counter-clockwise to effect the simultaneous rotation of the nut and stem. The simultaneous rotation of the nut 42 and the stem 21 is substantially frictionless since the nut 42 is mounted upon the ball bearings 43. The rotation of the sealing stem 21 with a simultaneous rotation of the actuating nut 42 will impart a rotative movement to the tubing to effect a setting of the packer or to effect the operation of any well tool mounted on the tubing which will be actuated through rotation. At this time there is a metal to metal seal between the hanger body 28 and the seat 20 of the tubing head. Sealing off around the stem 21 is effected by the O-rings 35 and 36, as well as by the chevron packing 33. After the packer or other well tool has been operated through a rotation of the tubing, it is then desirable to pull an upward tension upon the tubing. It has been found that particularly in the case of older tubing such upward tension is necessary to prevent a leakage at the connecting collars of the tubing string. To accomplish the upward movement of the tubing to pull a tension thereon, it is only necessary to rotate the actuating nut 42 with respect to the tubular stem 21. Such independent rotation of the nut 42 relative to the stem results in the interengaging threads 39 and 41 effecting an upward movement of the stem. The actuating nut 42 is of course held against upward displacement by the retaining collar 45 and when the threads 39 and 41 are right hand threads, upon a rotation of the nut 42 to the right or clockwise, the coaction between the threads produces an upward travel of the stem. The lower portion of the tubing will, of course, be held stationary by the setting of the packer and the upward movement of the upper end of the tubing will pull a tension on the entire tubing string. Upward movement of the tubular actuating stem 21 continues until the parts assume the position shown in Figure 6, at which time the beveled upper end 38 of the coupling collar 22 engages the inclined seat 37 at the lower end of the gland 34. The engagement of these parts produces a metal to metal seal which seals off between the bore of the tubing and the hanger. It is thus apparent that in final position only metal to metal seals are exposed to the well pressures and the difficulties which are encountered due to the ordinary flexible packing being exposed to well pressures are obviated.

After the apparatus has been actuated, the Christmas tree C is connected either to the flange 25, as illustrated in Figure 4, or is connected to the upper flange 40 of the stem 21 of the assem-

6

bly. As is the usual practice the Christmas tree has a lubricator at its upper end so that a retrieving tool generally indicated at 50 in Figure 7 may be employed for removing the closure 53 from the tubing. The retrieving tool 50 is threaded into the upper end of the valve or closure 53 with a connection being made by right hand threads 61. Since the threads 51 which mount the valve within the stem 21 are left hand threads the tool may be employed to remove the valve or closure, after which the well may be placed on production with control being through the usual Christmas tree and other valved connections.

From the foregoing it will be evident that a simple and effective type of well head apparatus is provided. The unit is so arranged that it may be lowered and landed through the usual control equipment in accordance with general practice; after the hanger assembly is in place the apparatus may be manipulated to impart a rotation to the tubing or to impart longitudinal movement to the tubing so that any of the well known type of well tools may be set within the well casing. After setting, an upward longitudinal movement of the tubing may be carried out to pull and maintain a tension on the tubing string. The sealing arrangement of the assembly is such that only metal to metal seals are exposed to the well pressure so that the difficulties encountered with exposure of flexible packing to such pressures are eliminated.

The foregoing disclosure and description of the invention is illustrative and explanatory thereof and various changes in the size, shape and materials, as well as in the details of the illustrated construction may be made, within the scope of the appended claims, without departing from the spirit of the invention.

Having described the invention, I claim:

1. A well head apparatus including, a tubing head, a hanger assembly supported within said tubing head and including a hanger body seated in said tubing head, means forming part of said hanger assembly depending from said hanger body and connected with a well tubing for suspending said tubing, and means for mounting said last named means for rotation and longitudinal movement of said well tubing with respect to the hanger body.

2. A well head apparatus including, a tubing head, having a supporting seat, a hanger engageable with and supported upon said seat, a tubular stem element mounted within the hanger and having its lower end depending therefrom and connected with a well tubing, and means for mounting the tubular element for rotation and longitudinal movement of said well tubing with respect to the hanger.

3. A well head apparatus including, a tubing head, having an annular seat within its bore, a tubular hanger having an external seating surface engageable with said seat, whereby the hanger is supported within the head, means extending laterally through the head and adapted to engage the hanger for locking said hanger in seated position within the head, a tubular stem extending axially through the hanger and having its lower end connected with a well tubing, and means mounting the tubular stem for rotation and axial movement of said well tubing with respect to the hanger and tubing head.

4. A well head apparatus including, a tubing head, having an annular seat within its bore,

a tubular hanger having an external seating surface engageable with said seat, whereby the hanger is supported within the head, means extending laterally through the head and adapted to engage the hanger for locking said hanger in seated position within the head, a tubular stem extending axially through the hanger and having its lower end connected with a well tubing, an annular actuating member surrounding the stem and rotatably mounted on the upper end of the hanger, and interengaging means on the actuating member and stem for imparting longitudinal movement to said stem upon a rotation of said member.

5. A well head apparatus including, a tubing head, having an annular seat within its bore, a tubular hanger having an external seating surface engageable with said seat, whereby the hanger is supported within the head, means extending laterally through the head and adapted to engage the hanger for locking said hanger in seated position within the head, a tubular stem extending axially through the hanger and having its lower end connected with a well tubing, an annular actuating member rotatably mounted on the upper end of the hanger and surrounding the stem, and interengaging threads on the stem and member whereby rotation of the member independently of the stem imparts a movement to the stem axially of said member and said hanger.

6. A well head apparatus as set forth in claim 5, together with an enlargement on the stem below the hanger and movable into sealing contact with the lower end of the hanger when the stem is moved to its limit of upward movement with respect to the hanger.

7. A well head apparatus including, a tubing head having an internal seat, a tubular hanger supported upon said seat, an annular actuating member rotatably mounted on the upper end of the hanger, a tubular stem extending through the actuating member and hanger and having its lower end projecting below the hanger and connected with a well pipe, a coarse thread connection between the stem and actuating member, whereby rotation of the actuating member moves the stem axially with respect to the hanger and tubing head, and stop means on the upper end of the stem engageable with the upper end of the actuating member when the stem is at its limit of downward movement, whereby a subsequent rotation of the actuating member in a direction tending to thread the stop means toward the actuating member effects a simultaneous rotation of the member and stem.

8. A well head assembly as set forth in claim 7, together with an enlargement on the stem below the hanger and movable into sealing contact with the lower end of the hanger to seal between the stem and hanger and also to limit the upward movement of the stem.

9. A well head apparatus as set forth in claim 7, wherein the tubular hanger is formed with an external seating surface having sealing contact with the seat within the tubing head.

10. A well head apparatus as set forth in claim 7, wherein the tubular hanger is formed with an external seating surface having sealing contact with the seat within the tubing head, and also wherein said stem has an enlargement thereon below the hanger which enlargement is movable into sealing contact with the lower end of the hanger to seal between stem and hanger and also to limit the upward movement of the stem.

11. A well head apparatus as set forth in claim 7, together with radially extending locking means mounted within the tubing head and engageable with the hanger for locking said hanger on the seat within the head.

12. A well head apparatus including, a tubing head having an internal seat, a tubular hanger having an external seating surface adapted to engage the seat with sealing contact, an annular actuating member rotatably mounted on the upper end of the hanger, a sealing ring between the upper end of the hanger and the tubing head sealing the joint therebetween, a retaining flange secured to the upper end of the tubing head engaging the sealing ring to retain it in position, a tubular stem extending axially through the actuating member and hanger and having its lower end connected to a well pipe, and coarse interengaging threads between the member and stem whereby rotation of the member imparts longitudinal movement to the stem relative to the hanger and tubing head.

13. A well head apparatus as set forth in claim 12, together with a flange on the upper end of the stem adapted to engage the upper end of the actuating member to limit downward movement of the stem with respect to the hanger, and an enlargement on the stem below the hanger and movable into sealing contact with the lower end of the hanger when the stem is moved to the limit of its upward movement with respect to the hanger.

14. A well head apparatus as set forth in claim 12, together with a closure removably mounted within the stem to close the bore of the well pipe to which the stem is connected.

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