April 9, 1957 C. C. BROWN 2,788,074

WELL HEAD EQUIPMENT FOR WELLS WITH MULTIPLE PIPE STRINGS

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Fig. 1

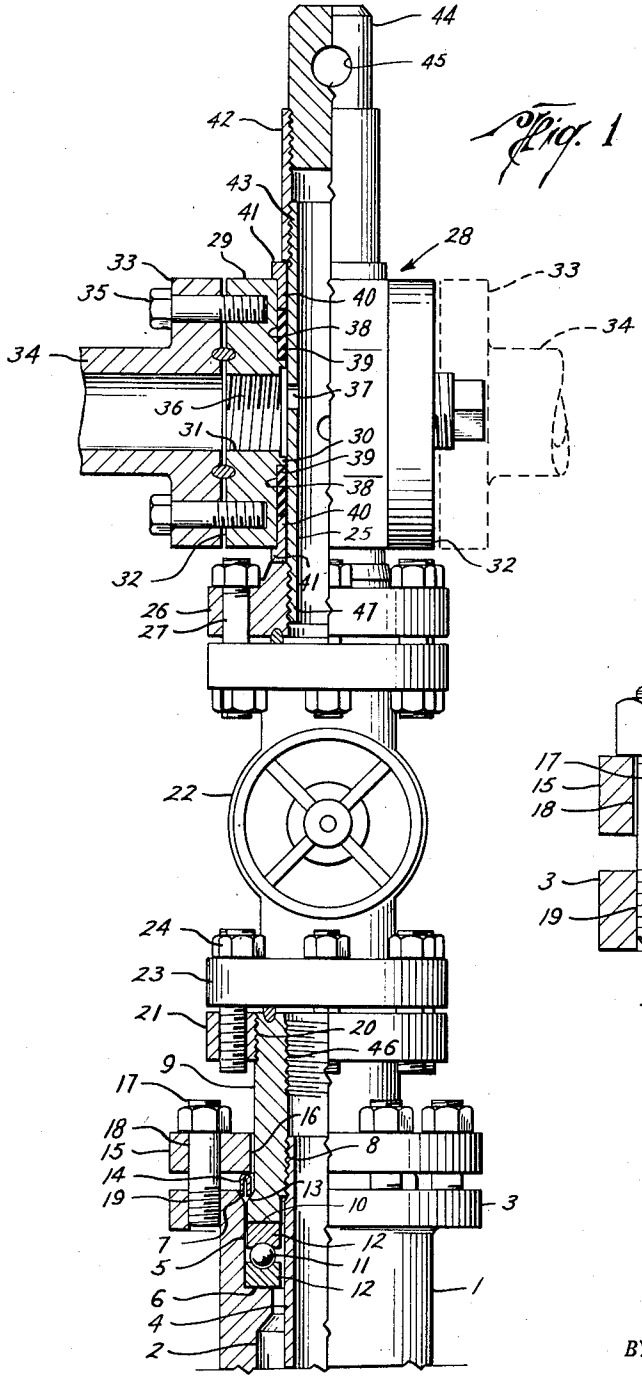
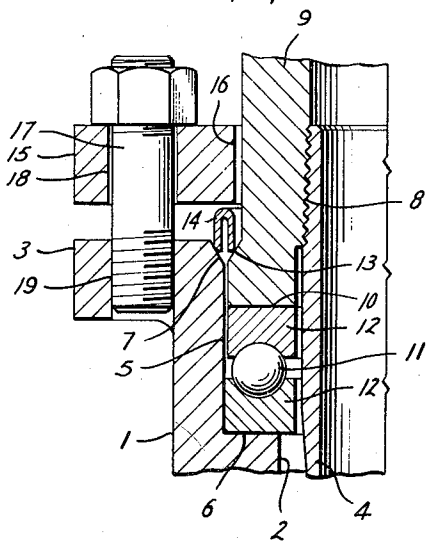


Fig. 2



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WELL HEAD EQUIPMENT FOR WELLS WITH MULTIPLE PIPE STRINGS

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6 Claims. (Cl. 166—78)

This invention relates to improvements in well head equipment as particularly employed on oil and gas wells.

In the operation of a well equipped with the conventional casing and tubing head construction, the tubing head supporting an inner pipe string within the well casing, it will often be necessary to rotate the inner pipe string, that is, the tubing string, in order to manipulate various pieces of equipment which are mounted on the tubing string and are located below the top of the well inside the casing. Such pieces of equipment which are thus manipulated may include packers, testing tools, anchors, and the like.

In conventional well head constructions, when it becomes necessary or desirable to rotate the inner pipe string, the connections to the lateral branch pipes must be broken, as well as the connections between the tubing head and the casing head, in order to permit the desired rotary movement of the inner string relative to the outer string. This not only requires considerable effort and expenditure of time but is hazardous to the well and to the personnel working about the well because breaking of the connections between the heads and the lateral connections exposes the well to loss of control of high pressure fluids in the well which might suddenly be released and cause dangerous blow-outs.

Accordingly, it is a primary object of the present invention to provide an improved well head construction which will obviate the disadvantages of the more conventional well head constructions as described.

An important object is to provide an improved well head construction which will readily permit rotation of an inner pipe string relative to an outer pipe string without requiring the breaking or releasing of any of the several connections between the respective heads and between the heads and the several lateral branches.

A more specific object is to provide a swivel connection between a casing head and a tubing head whereby the string of tubing connected to the tubing head may be rotated in the tubing head relative to the casing head without disturbing the lateral branch connections to the tubing head.

A further object is to provide a tubular spool connected to the upper end of the tubing string and mounted to swivel in the casing head and being arranged to swivel in the tubing head above the casing head.

Other and more specific objects and advantages will become apparent from the following detailed description when read in conjunction with the accompanying drawing which illustrates one useful embodiment in accordance with the present invention by which the various objects and advantages of this invention may be successfully accomplished.

In the drawing:

Fig. 1 is an elevational view, partly in section, showing the improved device in accordance with this invention incorporated in a well Christmas tree; and

Fig. 2 is an enlarged longitudinal sectional view of a detail of the construction illustrated in Fig. 1.

In the drawing, there is shown the upper portion of a conventional tubular casing head 1 having an axial bore 2 and also having the usual annular laterally extending bolt flange 3. It will be understood that the lower end of casing head 1 (not shown) will be mounted in the usual manner on the upper end of a conventional well casing (not shown) of relatively large diameter which extends into a well bore from the ground surface. Extending coaxially through bore 2 is a string of smaller diameter pipe, such as the tubing string 4, the upper end of which projects slightly above the upper end of casing head 1. The upper end of bore 2 is counterbored at 5 to form an upwardly facing annular seat 6. The upper end of counterbore 5 runs out into the upper end of flange 3 in a bevelled surface 7.

The upper end of tubing string 4 is provided with external threads 8 adapted to threadedly receive the lower end of a tubular nipple 9 which extends into counterbore 5 between the exterior of tubing 4 and the wall of the counterbore to a point vertically spaced from seat 6. The lower end of nipple 9 terminates in a downwardly facing annular seating surface 10. The space between seat 6 and seating surface 10 is adapted to receive ball bearings 11 mounted between races 12—12 by means of which a swivel connection is provided between tubing 4 and casing head 1. The outer surface of nipple 9 is suitably machined or formed to provide a bevelled seat 13 opposite bevelled surface 7 and tapering oppositely to the latter to form therewith a V-shaped notch between the wall of counterbore 5 and the exterior of nipple 9, this notch being adapted to receive an inverted U-shaped packing ring 14 to seal the space between the wall of counterbore 5 and nipple 9. An annular bolt flange 15 is mounted about the exterior of nipple 9 and has an axial bore 16 in which nipple 9 is freely rotatable. A plurality of studs 17 extend through holes 18 in flange 15 and screw into registering threaded holes 19 in flanges 3 whereby flange 15 may be tightly secured to casing head 1, the tightening of studs 17 serving to compress packing ring 14 and to hold nipple 9 down in the bore of casing head 1. With the arrangement thus far described, it will be seen that nipple 9 and tubing 4 may freely swivel in casing head 1, seat 6 serving to support the weight of the tubing string and other elements mounted thereon as will subsequently be described.

The upper end of nipple 9 is externally threaded at 20 to receive a bolt flange 21. A master valve 22, of any suitable and generally conventional construction, having end flanges 23—23 is mounted on top of flange 21, one of the end flanges 23 being secured to flange 21 by means of the bolts 24. Master valve 22 is positioned on flange 21 so that the flow passage of the valve (not shown) will extend vertically and will be co-axial with the bore of tubing string 4.

Secured to the upper end of flange 23 of master valve 22 is a tubular sleeve 25, provided about its lower end with a bolt flange 26 by which sleeve 25 is secured to flange 23 by means of bolts 27, sleeve 25 being thus vertically positioned and co-axially aligned with the tubing string. Surrounding sleeve 25 is a tubing head structure, designated generally by the numeral 28, and comprising a generally tubular body 29 having an axial bore 30 in which sleeve 25 will be readily rotatable. Body 29 is provided intermediate its opposite ends with a plurality of radial passages 31 providing communication between bore 30 and the exterior of the body, the surfaces of the latter about the outer ends of passages 31 being annularly flattened to provide seating surfaces 32—32 for attachment of the flanged ends 33 of lateral branch conduits 34

which communicate with passages 31, flanged ends 33 being secured to surfaces 32 by means of studs 35. Passages 31 may be internally threaded at 36 to receive screw connections to branch conduits 34 instead of the flanged connections shown. The wall of sleeve 25 is pierced by a plurality of angularly spaced ports 37 adapted to register with passages 31 at various angular positions of sleeve 25 whereby to provide communication between the bore of sleeve 25 and passages 31. Bore 30 of body 29 is counterbored from its opposite ends to form annular stuffing boxes 38—38 terminating at their inner ends above and below passages 31. Compressible packings 39 are seated in the stuffing boxes whereby to provide fluid-tight seals between body 29 and sleeve 25 while permitting rotation of the latter relative to body 29. Annular packing glands 40—40 are inserted in stuffing boxes 38—38 in axial compressive relation to the respective packings and are provided at their outer ends with outwardly projecting annular lips 41—41. The lip 41 on the lower gland projects between the end of the hub of flange 26 and the adjacent lower end of body 29. The lip 41 on the upper gland projects over the upper end of body 29 and is urged downwardly by the lower end of a collar 42 which is screwed down over the upper end of sleeve 25 which is externally threaded at 43 to receive collar 42. It will be seen that as collar 42 is screwed down on sleeve 25 it will bear against the outer end of upper gland 40 and the compressive force thus applied will be transmitted to upper packing 39 and through body 29 to lower gland 40, the reaction of which, through its abutting engagement with the hub of flange 26, will compress lower packing 39. The upper end of collar 42 is closed by means of a metal plug 44 having a transverse hole 45 therethrough for the reception of a wrench bar or other turning tool (not shown).

When it is desired to rotate tubing string 4, with the above-described arrangement, it is only necessary to insert a suitable wrench bar or turning tool into opening 45 to serve as a handle by which sleeve 25 may be rotated relative to body 29. Rotation of sleeve 25 will act through its connection to valve 22 and nipple 9 to rotate tubing string 4 in casing head 1. It will be seen that this rotational movement may be effected without in any way disturbing the external connections to casing head 1 and tubing head 28. The ports 37 will maintain communication between the interior of tubing string 4 and lateral branches 34 and fluid flowing through tubing string 4 will remain fully under the control of master valve 22.

It will be obvious that master valve 22 may be eliminated from the connection between sleeve 25 and nipple 9, if desired, without altering the rotary function of the device. In such modification, nipple 9 is provided at its upper end with internal threads 46 into which the lower externally threaded end 47 of sleeve 25 may be screwed. Flanges 21 and 26 would thus also be eliminated and lip 41 of the lower gland 40 would rest on the upper end face of nipple 9.

It will be understood that numerous alterations and modifications may be made in the details of the illustrative embodiment within the scope of the appended claims but without departing from the spirit of this invention.

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

1. In a well equipped with concentric inner and outer pipe strings, the outer pipe string having mounted on the upper end thereof a generally tubular casing head and said inner pipe string having a portion projecting upwardly through said casing head, a tubing head structure for the inner pipe string in which the inner pipe string is rotatable, comprising, a generally tubular body mounted on said portion above said casing head in vertically spaced relation to the upper end thereof and having a through bore co-axial with the inner pipe string to rotatably receive the upwardly projecting portion of said inner pipe string, radial passages through the wall of said body communicating with said bore, swivel means in said casing head arranged to rotatably support said inner pipe string therein, means closing the upper end of said portion, port means positioned in said portion to maintain communication between said radial passages and the interior of the inner pipe string during rotation of the latter relative to said body, and sealing means disposed in said body to seal about said portion above and below said passages.

2. In a structure according to claim 1, a block valve interposed in said upwardly-projecting portion between said body and said casing head.

3. A structure according to claim 1, wherein said upwardly-projecting portion comprises a tubular sleeve member separably connected to the upper end of said inner pipe string.

4. A structure according to claim 1, wherein said swivel connection comprises a downwardly facing external annular shoulder on said inner pipe string, a cooperating upwardly facing internal annular shoulder in the bore of the casing head and anti-friction bearing means disposed between said shoulders.

5. In a structure according to claim 1, annular sealing means positioned to seal the annular space between said well head fitting and the exterior of said pipe string above said swivel means.

6. In a well equipped with concentric inner and outer pipe strings, the outer pipe string having mounted on the upper end thereof a generally tubular casing head and said inner pipe string having a portion projecting upwardly through said casing head, a tubing head structure for the inner string in which the inner pipe string is rotatable, comprising, a generally tubular body mounted on said portion above said casing head in vertically spaced relation to the upper end thereof and having a bore coaxial with the inner pipe string to rotatably receive said upwardly projecting portion, said upwardly projecting portion comprising a tubular sleeve member separably connected to the upper end of the inner pipe string and extending entirely through the bore of said tubular body, swivel means in said casing head arranged to rotatably support the inner pipe string therein, a block valve interposed in said upwardly projecting portion at a point between said body and said casing head, radial passages through the wall of said body communicating with said bore, means closing the upper end of said sleeve member, port means positioned in the sleeve member to maintain communication between said radial passages and the interior of the inner pipe string during rotation of the latter relative to said body, and sealing means disposed in said body to seal about said sleeve member above and below said passages.

References Cited in the file of this patent

UNITED STATES PATENTS

1,662,984	Scott et al.	Mar. 20, 1928
2,261,440	Layne	Nov. 4, 1941
2,294,061	Williamson	Aug. 25, 1942
2,575,938	Brenneke	Nov. 20, 1951
2,599,039	Baker	June 3, 1952