July 3, 1962 W. W. WORD, JR 3,042,427

MULTIPLE STRING TUBING HANGERS

Filed June 26, 1957 3 Sheets-Sheet 1

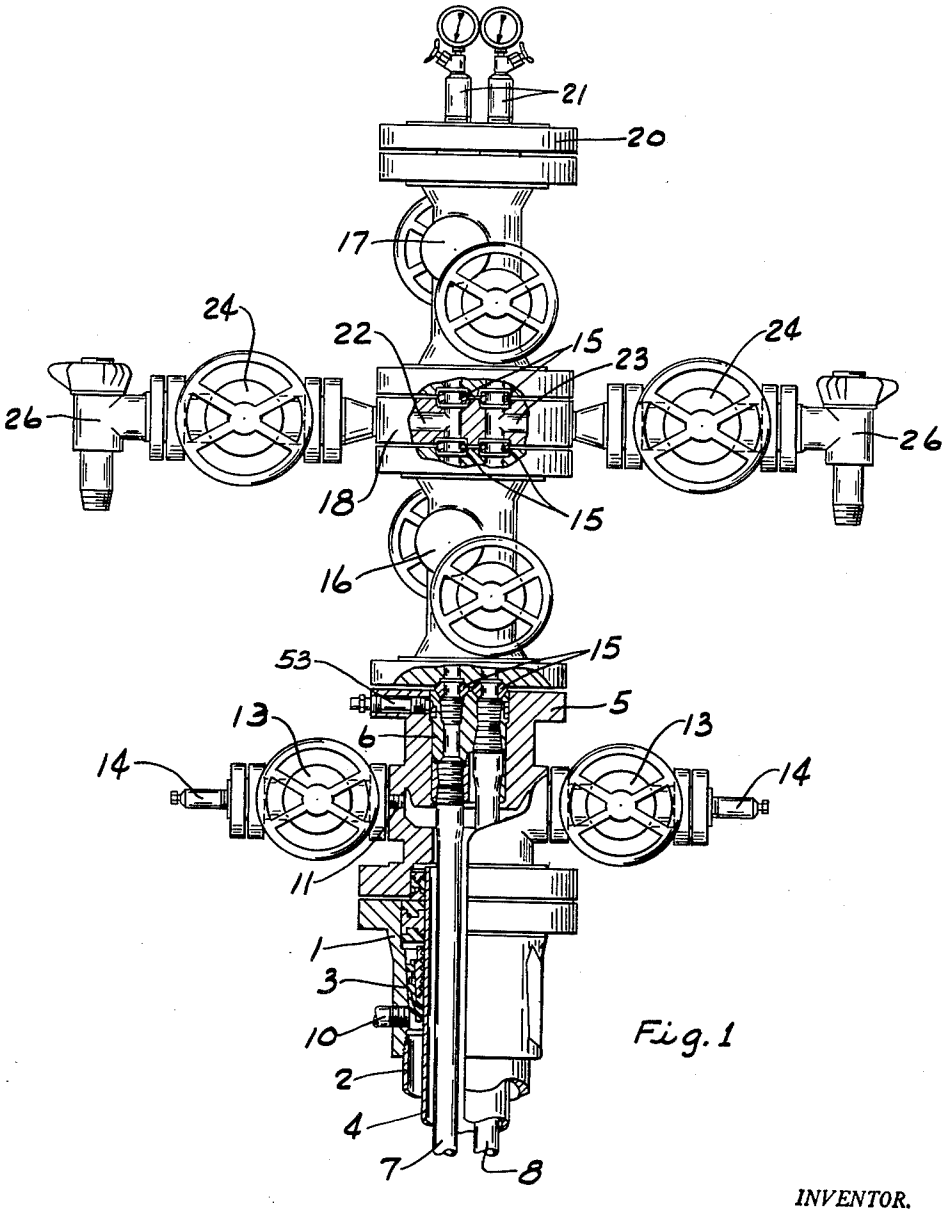


Fig. 1

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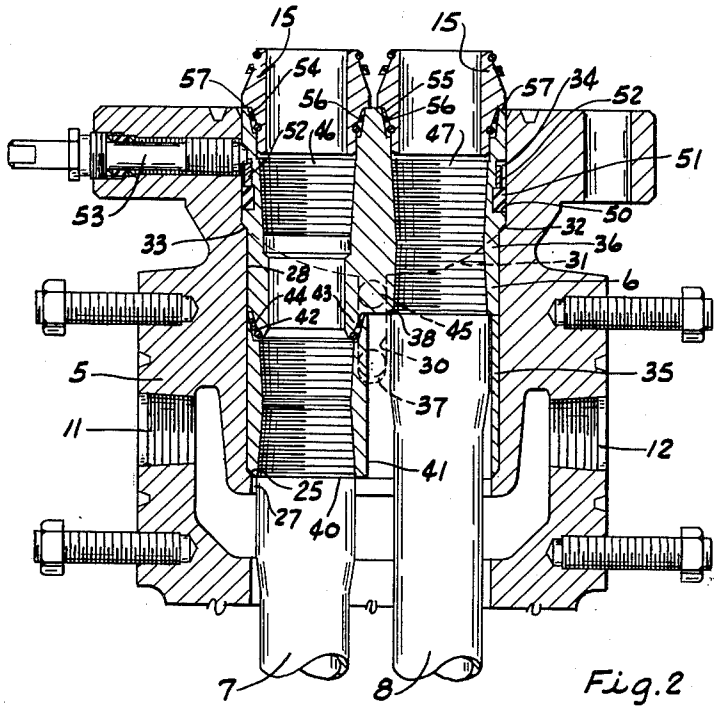


Fig. 2

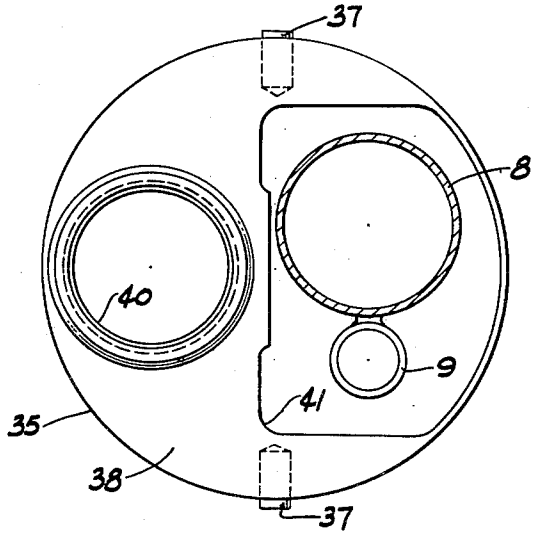


Fig. 3

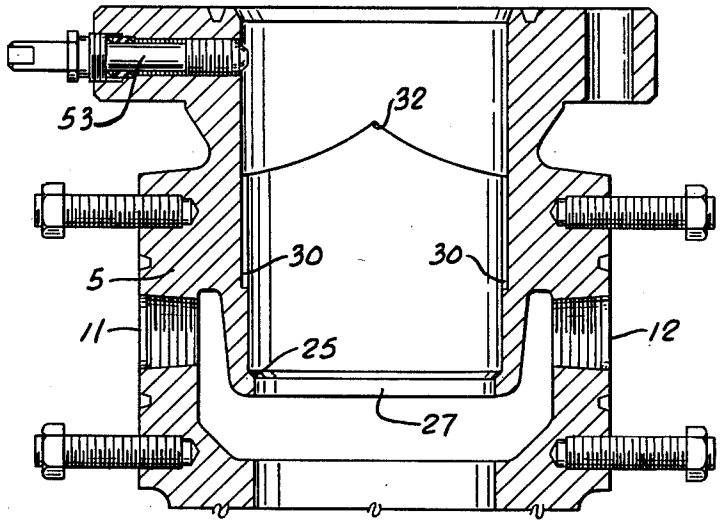
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Fig.4



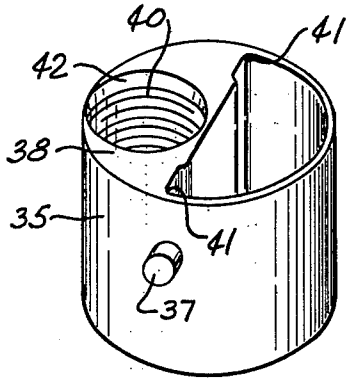


Fig.5

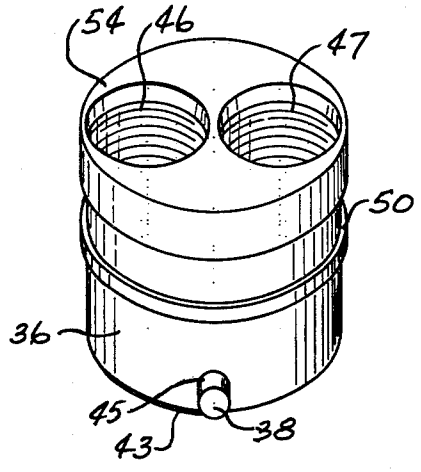


Fig.6

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MULTIPLE STRING TUBING HANGERS

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11 Claims. (Cl. 285—140)

This invention relates to tubing hangers for multiple parallel strings of tubing used to produce fluids simultaneously or alternately from strata at different levels of a well bore. It relates to a tubing hanger structure for multiple parallel tubing strings, the hanger sections of which can be passed through the control equipment such as blowout preventers, usually required to control well pressures when completing a well. It relates particularly to subjacent hanger sections providing a seal about the outside of the parallel tubing strings suspended therein prior to the removal of the control equipment.

The principal object of this invention is the provision of a plurality of tubing hangers or a tubing hanger made in at least two sections, the upper and lower sections each supporting a string of tubing within the tubing head body and in addition the upper section sealing the space between the tubing head bore and the outside of the tubing strings suspended in the said hanger sections.

Another object of this invention is the provision of a plurality of tubing hangers or a tubing hanger having upper and lower sections, the lower hanger section providing two passages, one having a supporting means for the suspension of a tubing string directly therefrom and forming or having another passage sufficiently large to pass a coupled tubing string equipped with enlarged valve body elements.

Another object of this invention is the provision of a plurality of tubing hangers or a tubing hanger made in two subjacent sections, the lower section supporting the upper section and each section supporting the tubing string.

Another object is the provision of a plurality of tubing hangers or a tubing hanger made in two independent sections, both of which are automatically guided into position within the tubing head body so as to properly align their corresponding passages and to further align these passages radially with respect to the tubing head body bore.

Another object is the provision of a plurality of tubing hangers or a tubing hanger having upper and lower hanger sections, with aligned vertical passages and sealing means located at the inter-face of the hanger sections, to confine produced well fluid pressures to at least one of the said vertical tubing passageways.

Another object of this invention is the provision of a lower cylindrical section of the tubing hanger that may be a complete cylinder with a large passage to admit the second string, or this tubing hanger may be open along one side to form the passage for admitting the string of tubing and valves that are subsequently suspended from an upper hanger section. In the latter case the cylinder may have an open span along one side thereof for approximately one hundred degrees or more around its perimeter, which allows about 260° support for the tubing head including those sections that carry the hanger guides that preposition these sections in the tubing head.

Other objects and advantages appear hereinafter in the following descritpion and claims.

The accompanying drawings show for the purpose of exemplification without limiting the invention or claims thereto, certain practical embodiments illustrating the principles of the invention wherein:

FIG. 1 is a view partly in section and partly in elevation of a tubing well head comprising this invention.

FIG. 2 is a sectional view of a tubing head having supported therein a tubing hanger with upper and lower independent tubing hanger sections, each section supporting a tubing string.

FIG. 3 is a top plan view of the lower tubing hanger section with one of the tubing strings shown in section.

FIG. 4 is a view in vertical section of the casing head shown in FIG. 2 but oriented through 190°.

FIG. 5 is a perspective view of the lower hanger member 35.

FIG. 6 is a perspective view of the upper hanger member.

Referring to FIGS. 1, 4, 5 and 6, the casing head 1 is threadably mounted on the top of the outer casing 2 that extends into the ground, the casing head also carries a casing hanger 3 that supports the inner casing 4. The flanged top of the casing head is bolted and sealed with the flanged bottom of the tubing head 5. The bolts for clamping the adjacent flanges of the several casing and tubing heads have been omitted in the drawings. This tubing head is somewhat longer than the ordinary tubing head in that it is required to carry the dual tubing hanger or two part tubing hanger 6. The lower tubing hanger section suspends the tubing string 7 and the upper tubing hanger section suspends the tubing string 8.

The casing head 1 is vented at 10 for controlling any pressure or flow in the outer casing 2.

The tubing head body 5 is vented at 11 and 12 to receive the manifold valves 13 that are connected by flanges to the flow lines 14. The passages 11 and 12 of the tubing head body communicate with the interior of the inner casing 4.

As shown in FIGS. 1 and 2 the tubing strings 7 and 8 communicate through the seal members 15 to the lower dual bore gate valve member 16 which in turn communicates with the boxes of the upper valve member 17 which valve members are mounted one above the other, between which is positioned in sealed relation the T member 18 having four seals 15, two at the bottom and two at the top of said T. A bonnet 20 closes the top of the dual valve 17 by the use of similar seals 15. The flanges on each of these members are bolted together to hold them in position. The interior of each independent passageway through the dual valve members 16 and 17, the T 18 and the bonnet 20 is closed by the plugs 21 at the top of the Christmas tree, which plugs are provided with escape valves and gauges.

The T 18 provides an independent take off flow passage for each tubing string. The fluid flow from the tubing strings 7 and 8 is taken off by the independent and separate passages 22 and 23 of the T through the manifold gate valves 24 and the flow T's 26.

Referring to FIGS. 2 to 6, the tubing head 5 is provided with a sloping shoulder or annular seat 25 formed between the bore 27 and the enlarged concentric counterbored section 28. The long counterbored section 28 is provided with opposed slots 30 which extend upwardly terminating at the upwardly facing arcuate guideways or shoulders 31 that extend around the bore and join in the opposed points 32 and 33. The arcuate guideways 31 together with their points 32 and 33 define the end of the counterbore 28 and the enlarged bore 34 extends from these guide surfaces to the top of the tubing head 5.

The dual tubing hanger 6 is made up of a lower section or the lower tubing hanger 35 and an upper section or the upper tubing hanger 36. Both of these sections or hangers are cylindrical and having a sliding fit in the counterbore 28, as well as aligned passages comparable to the tubing bore.

The lower tubing hanger or section 35 has a beveled

edge which seats on and is supported by the sloping shoulder 25.

Diametrically opposite dowels 37 are mounted on the outside of the hanger or section 35 for the purpose of engaging the arcuate guide sections 31 and dropping into the slots 30 to position this hanger or section in one of two 180° positions, either of which assures proper alignment between the tubing string passages in the hanger section with the dual bores of the gate valves 16 and 17. The dowels form an abutment or a shoulder means on the hanger to prevent the hanger from movement about its axis. The slot 30 provides the cooperating abutment or shoulder means in the tubing head. The top of the lower hanger or section 35 is flat, as indicated at 38, and it is provided with two passages 40 and 41. The passage 40 is threaded at both ends to receive the tubing string 7 at one end and a handling pipe, not shown, at its upper end. A conical bore 42 extends upwardly beyond the threaded end of the passage 40 to receive a corresponding nose member 43 on the under side of the upper hanger or section 36. The rest of the top face 38 of the lower hanger or section is flat and supports the upper hanger or section 36. A seal means 44 is mounted between the nose 43 and the conical bore 42 to seal the passageway 40 relative to the two parts 35 and 36 of hanger 6, providing an aligned pressure-tight conduit through the hanger for the flow of fluid from the tubing string 7.

The passage 41 of the lower hanger or section 35 is more clearly shown in FIG. 3 and is larger in size than the passage 40 or substantially as large as half the volume of the tubing hanger to permit the tubing string 8 together with the valve members 9 attached thereto and any tubing coupling member to pass therethrough. Since the tubing coupling or a valve such as shown at 9 in FIG. 3 is materially larger than the tubing to which it is attached the passage 41 in the lower hanger section 35 must be sufficiently large to accommodate the same. The function of the valve 9 or any other large body or appendage attached to the tubing string 8 is not per se a part of this disclosure. It is sufficient to say that the passage 41 is sufficiently large to admit bodies materially larger than tubing couplings.

The upper hanger or section 36 seats on the flat face 38 of the lower hanger or section 35 and is thus supported by the tubing head 5 through the shoulder 25. The upper hanger or section 36 is also provided with the diametrically opposed dowel members 45 which guide along the guiding surface 31 and into the slot 30 to properly position and align its tubing passageways 46 and 47 with the passageways 40 and 41 of the lower hanger or section 35. The dowels form an abutment or a shoulder means on the hanger to prevent the hanger from movement about its axis. The slot 30 provides the cooperating abutment or shoulder means in the tubing head.

As shown in FIG. 2 the passageway 47 of the upper hanger 36 is threaded at both ends to receive the tubing string 8 at one end and a handling pipe not shown at its upper end. The passage 46 of the upper hanger 36 is threaded at its upper end to permit the use of a handling pipe, or upon the subsequent removal of the dual port valve 16 the installation of a threaded flow control element, neither of which are shown.

The upper hanger or section 36 is provided with an exterior annular seat 50. A clearance is provided between the under side of the seat and the points 32 and 33 so that there can be no independent support of the upper hanger or section 36 on these guide points 32 and 33.

The annular seat 50 receives the resilient packing member 51 on which is mounted the steel ring 52 and the top of the steel ring 52 may be engaged by a series of hold-down screws 53. The hold-down screws 53 engage the ring 52 and compress the packing ring 51 so that it seals on the seat 50 and between the peripheral surface of the upper hanger section 36 and the bore 34 of the tubing head 5, thus providing a means to control pressures in the annular space between the tubing head bore and the suspended parallel tubing strings.

The upper passages 46 and 47 of the upper hanger or section 36 are provided with the flared bores 54 and 55 which receive the sealing rings 56 which are mounted on the seal members 15. Each of the seal members 15 has a shoulder 57 that comes to rest on the top surface of the upper hanger or section 36, thus controlling the flange bolt load which can be applied to the seal members 56. The upper ends of the seal members are equipped with seal rings similar to 56 which fit into the dual gate valve 16 as indicated in FIG. 1 for the purpose of completing the seal of the passages for the tubing strings 7 and 8.

The flanges on the casing head 1 and the tubing head 5 together with the dual gate valve members 16 and 17 are all bolted together so as to hold the assembled Christmas tree against pressures within the same.

When completing a well using the described multiple string tubing hanger in conjunction with blowout preventer control equipment attached to the top flange of the tubing head 5 (FIGS. 1 and 2), one of the tubing strings would be run into the well through the preventers and having attached the lower hanger section to the top of this string it would be lowered into the head body through the preventers by means of a "handling joint." The second tubing string would also be run into the well through the preventers and having attached the upper hanger section to the top joint of this string it would also be lowered into the head body through the preventers by means of a "handling joint." Obviously, as each hanger comes to rest in the tubing head body the guide mechanism which has been provided aligns the tubing passageways of the hanger sections with each other and with the bolt holes in the upper flange of the tubing head body. Thus having "landed" and automatically aligned the tubing strings, the packing mechanism provided in the upper hanger section would be urged into sealing engagement by the anchor screws 53 preparatory to the safe removal of the preventer equipment and the expeditious installation of the integral dual port valve 16. The efficient, quick, and pressure controlled completion technique made possible by the disclosures herein are very important during the critical "nippling up" period of a well's completion.

I claim:

1. An improved tubing hanger contoured for abutment with the complete bore of a tubing head and for supporting a multiple string of tubing comprising a lower hanger body, a tubing head having a guide and a seat to receive and guide said hanger body onto said seat, a pair of independent tubing passages through said lower hanger body, a means on said lower hanger body to suspend and seal one string of tubing in one of said tubing passages, an upper hanger body having tubing passages corresponding with those of said lower tubing hanger, a seat on said lower hanger body to receive and support said upper hanger body, guide means on said upper and lower hanger bodies to cooperate with said tubing head guide to align their passages independent of the string of tubing, a second means on said upper hanger body to suspend and seal another string of tubing through said other tubing passage in said lower tubing hanger, and seal means to seal the upper tubing hanger with said tubing head.

2. The tubing hanger of claim 1 characterized in that said other tubing passage in said lower hanger body is defined by a polygonal side connected by an arcuate side and is substantially greater in volume than one half of said lower hanger body to admit tubing string appendages of greater cross section than a tubing coupling.

3. A multitubing string tubing hanger comprising a body having a plurality of openings therethrough, means on the body within selected of said openings for suspending a tubing string from one end thereof, said body having a curved outer surface to fit the bore of a tubing head, first shoulder means on said curved surface for supporting the

body against movement longitudinally of the openings therethrough independent of the tubing string, and second shoulder means extending laterally of said body for preventing movement of said body about the axis of said opening, characterized in that one of said plurality of openings through said body is defined by a polygonal side connected by an arcuate side and is materially larger to provide ample room for the passage of appendages larger than tubing couplings.

4. The tubing hanger of claim 3 which also includes annular seal seat means on the top of said body, said body being a lower unit, an upper tubing hanger having a body with a plurality of openings therethrough selected of which have an annular seal seat means in the bottom of the body to cooperate with the annular seal seat means on the top of the lower unit.

5. The tubing hanger of claim 4 characterized in that both the upper and lower tubing hangers are externally cylindrical.

6. Wellhead equipment comprising a tubing head having a bore therethrough, a plurality of tubing hangers each having a plurality of longitudinal openings therethrough and being disposable in subjacent relation within the bore through the tubing head for suspending tubing within the well from each tubing hanger, seat means in said tubing head for supporting said hangers against movement longitudinally downwardly within the bore, and means for independently guiding said hangers into predetermined alignment and for holding each of said hangers against movement rotationally out of the position it occupies when so disposed, each hanger having a peripheral complementary surface contoured for mating with the bore through the tubing head when supported therein and being of such size as to at least substantially close said bore and provide a space therein as large as said bore when all are removed.

7. The tubing head and hanger structure of claim 6 characterized in that said means for independently holding at least one of said hangers against movement rotationally includes an upwardly open slot means in the bore of the tubing head and the hanger surface contoured for abutment with the bore through the tubing head when supported therein including an abutment means entering into said upwardly open slot.

8. The tubing head and hanger structure of claim 7 characterized in that said last mentioned abutment means entering into said upwardly open slot is a pin on each tubing hanger.

9. The tubing head and hanger structure of claim 7 characterized by sloping guide surfaces in said bore of said tubing head to guide said abutment means into said upwardly open slot.

10. Wellhead equipment comprising a tubing head having a bore therethrough, a plurality of tubing hangers each having a plurality of longitudinal openings therethrough and being disposable in subjacent relation within the bore through the tubing head for suspending tubing within the well from each tubing hanger, seat means for supporting said hangers against movement longitudinally downwardly within the bore, and means for guiding said hangers into predetermined alignment and for holding said hangers aligned and against movement rotationally out of the position they occupy when so disposed, seal means between subjacent tubing hangers to seal their longitudinal openings that cooperate with each other and to seal said hangers above the openings arranged to suspend tubing, an annular shoulder on the outer surface of the uppermost tubing hanger, an annular seal on said shoulder, and means operating from the exterior of said tubing head to expand said annular seal and seal between the bore of the tubing head and said uppermost tubing hanger.

11. The wellhead equipment of claim 10 characterized by an annular metal ring above said annular seal and said means operating from the exterior of said tubing head engaging said ring to expand the annular seal and maintain said tubing hangers seated against pressure in the bore of said tubing head.

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