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WELL HEAD CONSTRUCTION TO ACCOMMODATE PLURAL TUBE STRINGS

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2 Sheets-Sheet 1

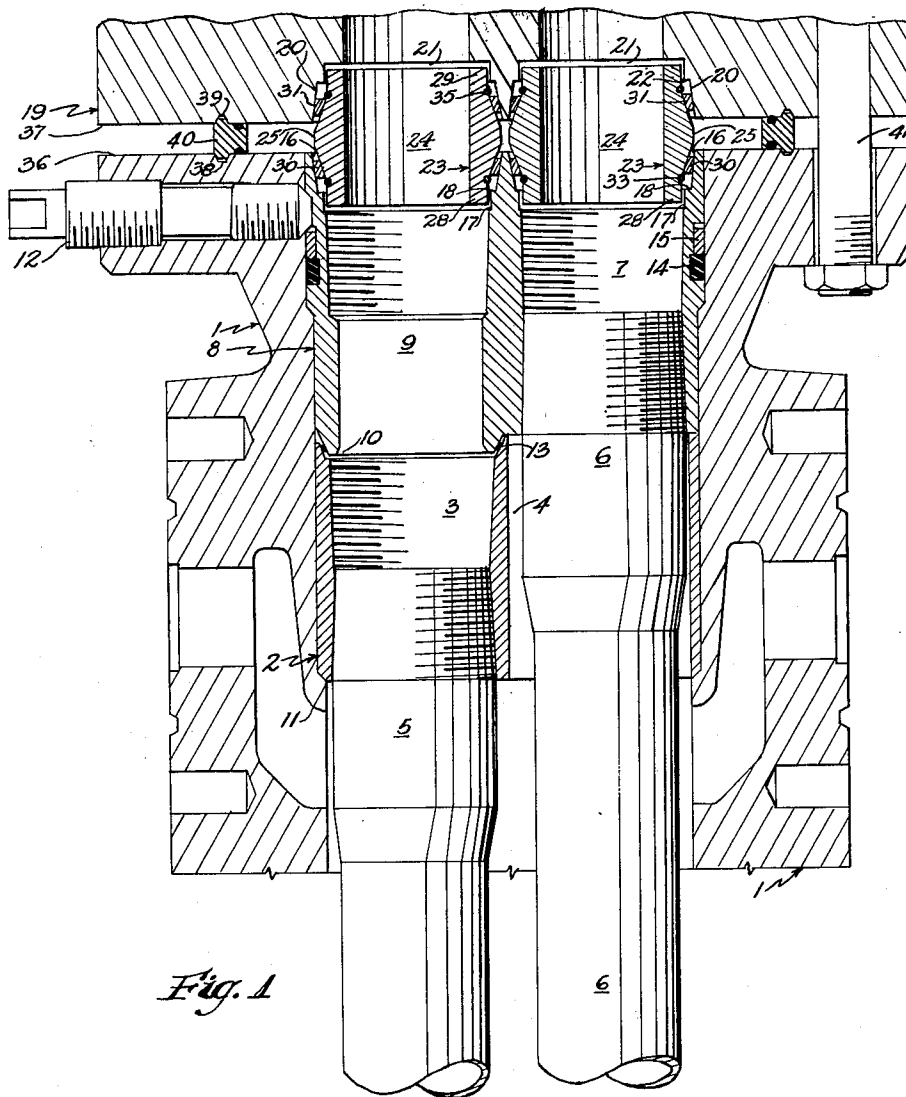


Fig. 1

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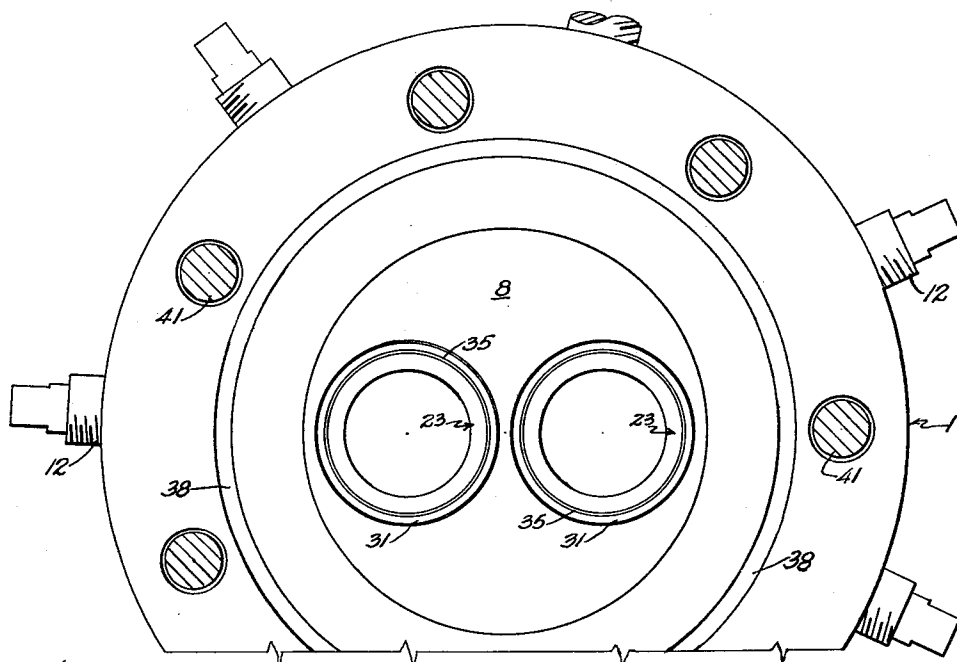


Fig. 2

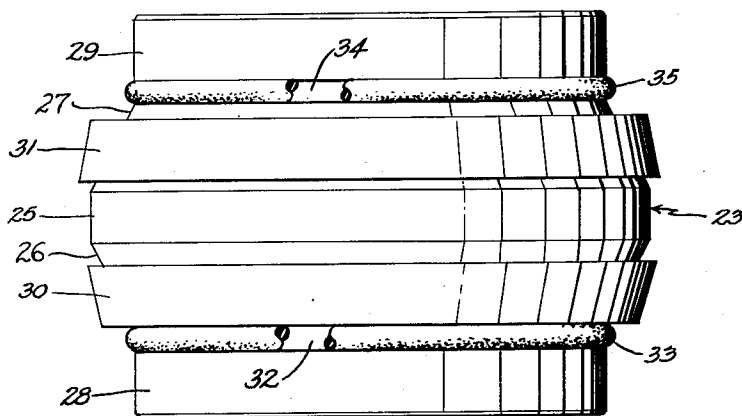


Fig. 3

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WELL HEAD CONSTRUCTION TO ACCOMMODATE PLURAL TUBE STRINGS

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This invention relates to improvements in well head equipment and coupling units especially adapted for use therewith, and more particularly to a novel well head construction incorporating a more effective sealing means between one component of the equipment, such as the tubing head, and a second component, such as a master valve.

Producing wells are conventionally equipped with one or more casing heads and a tubing head mounted on and disposed above the casing head or heads, the tubing head being equipped with a hanger or hangers, an additional well head component being mounted on the tubing head and having its interior portion in communication with the tubing hanger or hangers and thus in communication with the tubing supported thereby. The component parts of such a well head construction are very heavy and are handled, during assembly of the apparatus, by means of derricks. As is commonly recognized in the art, considerable difficulty arises because of the necessity of accurately aligning the various parts as they are brought into final position. This problem is particularly acute when separate tubular connector units are employed between the tubing hangers and the master valve, for example.

A general object of the invention is to devise a well head construction of the type referred to, including means providing an effective fluid-tight seal between the tubing hanger or hangers and the master valve, for example, while making it possible to mount the master valve or the like on the tubing head with a minimum of care being required to assure proper alignment of the various parts.

Another object is to provide, in such a construction, novel sealed connector units disposed between the tubing hanger or hangers and the next adjacent well head component, such as the master valve.

A further object is to provide an improved arrangement of tubing hanger, master valve and sealed connector units of such nature that, during assembly, the connector units are first seated in the hanger or hangers and the next adjacent component, such as the master valve, is then lowered into place without the necessity for manual positioning of the sealing element as the master valve or the like is lowered.

In order that the manner in which these and other objects are accomplished in accordance with the invention can be understood in detail, reference is had to the accompanying drawings, which form a part of this specification and wherein:

FIG. 1 is a vertical sectional view of a well head construction in accordance with one embodiment of the invention and embodying dual tubing hanger means;

FIG. 2 is a plan view of the apparatus of FIG. 1 with the master valve assembly removed therefrom, and

FIG. 3 is a side elevational view of one of the novel sealed connector units employed in accordance with the invention in the device of FIG. 1.

Referring now to the drawings in detail, it will be seen that the construction here illustrated includes a tubing head indicated generally at 1 and provided with a central bore of circular cross-section in which the tubing hanger means is disposed. The hanger means includes a lower hanger 2 of generally cylindrical form provided with a threaded bore 3 and a larger, semicircular bore 4, the axes of bores 3 and 4 being located on different sides of the axis of the lower hanger. A first tubing string 5 has its

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upper end threaded into the bore 3. A second tubing string 6 passes freely through the bore 4 and has its upper end threaded into the bore 7 of an upper tubing hanger 8.

The upper tubing hanger 8 has an additional bore 9 and, at such bore, is provided with a dependent, circular lip 10 extending into the correspondingly shaped upper end of bore 3 in lower hanger 2. The bores 7 and 9 of the upper hanger are vertically aligned with the bores 3 and 4 respectively, of the lower hanger. The bottom of the lower hanger 2 is seated against an inwardly directed flange 11 formed in the body of the tubing head. The bottom of the upper hanger is seated directly on the top of the lower hanger, the upper hanger being supported by such engagement. The dependent lip 10 of the upper hanger is sealed to the adjacent surface of the lower hanger in any suitable fashion, as by a packing ring 13. Intermediate its end, the upper hanger is provided with a packing ring 14 which may be compressed, to obtain increased sealing action, by a ring 15 which is cammed downwardly by the tapered ends of a plurality of radially extending anchor screws 12 threaded in tubing head 1. The anchor screws 12 also serve to prevent the hanger from being blown out of the well.

Upper portions of the bores 7 and 9 are threaded, as shown in FIG. 1, in order that tubing may be temporarily screwed thereto to handle the preliminary assembly. Above such threaded portions, the bores 7 and 9 terminate in upwardly directed recesses each comprising an upper, generally frusto-conical portion 16 and a lower cylindrical portion 17, the portions 16 and 17 joining each other in an annular transverse shoulder 18.

The master valve or like component 19 includes two bores disposed to align with the bores 7 and 9 of the upper tubing hanger. At their lower ends, each such bore of the valve or the like terminates in a downwardly directed recess having a lower, generally frusto-conical portion 20 and an upper, cylindrical portion 21 joining each other in an annular transverse shoulder 22. Except that they face in opposite directions, recess portions 20, 21 are identical to recess portions 16, 17, respectively.

The recesses in the upper hanger and the valve or the like are each constructed to cooperate with a connecting element 23 having a plain cylindrical bore 24, an enlarged central portion 25, opposed, generally frusto-conical portions 26 and 27 and cylindrical tips 28 and 29. Each element 23 is so dimensioned that the cylindrical tips 28 and 29 thereof are of slightly smaller diameter than the corresponding cylindrical recess portions 17 and 21. The opposed, generally frusto-conical portions 26 and 27 are so arranged as to taper inwardly at a somewhat sharper angle than the walls of the corresponding recess portions 16 and 20.

Disposed between the wall of recess portion 16 and the cooperating generally frusto-conical portion 26 of connecting element 23 is a sealing ring 30. Similarly, a sealing ring 31 is disposed between the wall of recess portion 20 and the generally frusto-conical portion 27 of the element 23. Sealing rings 30, 31 have an inner diameter smaller than intermediate portion 25 of element 23. Advantageously, the sealing rings 30 and 31 are constructed from a material which is softer than the materials from which hanger 8, master valve 19 and elements 23 are made, and are constructed in accordance with U.S. Patent 2,687,229, issued August 24, 1954, to Laurent.

As best seen in FIG. 3, there is provided in each connecting element 23, at the junction between portions 26 and 28, a circumferential groove 32 of rectangular cross-section in which is seated a retainer element 33. Similarly, a groove 34 is provided at the junction between portions 27 and 29 of the connecting element 23 and there is retained in that groove a second retainer element 35. The retainer elements 33 and 35 are of such cross-section

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tional dimension that, when they are disposed in their respective grooves, they will extend outwardly from their respective grooves to act as stops to prevent the sealing rings 30 and 31 from becoming disengaged from surfaces 26 and 27, respectively. Retainer elements 33, 35 can be in the form of metal snap rings or, as illustrated, O-rings advantageously fabricated of rubber or other suitable resilient material.

The tubing head 1 is provided with an upper transverse flange 36 and the master valve or the like 19 is provided with a matching flange 37. The upper face of flange 36 has an annular, upwardly directed groove 38 surrounding the connecting elements 23 and co-axial with the tubing hanger means. On its lower face, the flange 37 is provided with a matching, downwardly directed groove 39. An annular gasket 40 of any suitable conventional construction is seated in the grooves 38 and 39 and the flanges 36 and 37 are clamped together in the usual fashion, as by a plurality of bolts 41. Thus, gasket 40 seals the space between flanges 36, 37 through which connectors 23 extend.

In assembling the construction just described, the two tubing hangers are connected to their respective tubing strings and mounted in the tubing head as seen in FIG. 1. The connecting elements 23, with sealing rings 30 and 31 retained thereon by retainer elements 33 and 35, respectively, are then dropped into the two recesses in the upper tubing hanger. Positioning of the connecting elements 23 requires no special attention, since the lower sealing rings 30 automatically adjust to the cooperating generally frusto-conical surfaces 16 and 26. The lower cylindrical tips 28 of the connecting elements 23 come to rest in a position centered within lower recess portions 17. At this point, it will be noted that the cylindrical tips 28 of elements 23 are only slightly smaller than the corresponding cylindrical recess portions 17, so that the elements 23 are allowed only a very slight tilting or rotational movement before the master valve or the like is lowered into place. Thus, without special attention from the workers, assurance is had that the elements 23 will be properly aligned.

The master valve or like well head component 19 is now lowered into place, the upper cylindrical tips 29 of elements 23 entering into the corresponding cylindrical recess portions 21. Sealing rings 31, heretofore held in place by the retainer elements 35, adjust automatically to their cooperating sealing surfaces 20 and 29. The workers need only make certain that the master valve or the like 19 is lowered fully into place, so that the gasket 40 is properly engaged in the opposed grooves 38 and 39, the assembly being completed by the bolts 41.

I claim:

1. In a well head construction, the combination of a tubing head having an upright passage therethrough; hanger means mounted in said passage and having at least one upright bore connected at its lower end to a tubing string in the well, said bore terminating at its upper end in an upwardly facing recess, said recess comprising a generally frusto-conical, downwardly and inwardly tapering top portion and a cylindrical lower portion extending downwardly from the lower end of said top portion; an upright connector unit comprising a body member including a lower cylindrical tip, a downwardly and inwardly tapering first frusto-conical portion above said tip, and a second frusto-conical portion located above said first frusto-conical portion and tapering upwardly and inwardly, said body member having an upright through bore and the surfaces of said tip and said first and second frusto-conical portions being concentric with said through bore, said body member being provided with a transversely extending, outwardly opening, annular

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groove at the lower end portion of said first frusto-conical portion,

a first sealing ring embracing said first frusto-conical portion of said body member and disposed above said recess,

a circularly extending retaining element seated in said annular groove and projecting outwardly therefrom, and

a second sealing ring embracing said second frusto-conical portion,

said connector unit being dimensioned for downward insertion into said upwardly facing recess of said hanger means to bring the outer surface of said first frusto-conical portion of said body member into such proximity to said frusto-conical portion of said recess that said first sealing ring is engaged between said frusto-conical portions of said recess and body member,

said lower cylindrical tip of said body member being closely embraced by said cylindrical lower portion of said recess, when said connector unit has been lowered into said recess to establish such engagement of said first sealing ring; and

an upper well head member adapted to be lowered onto said tubing head and having passage means terminating at the bottom of said upper well head member in a downwardly facing recess,

said downwardly facing recess comprising a downwardly and outwardly tapering frusto-conical portion adapted to receive said second frusto-conical portion of said body member and engage said second sealing ring,

disposition of said lower cylindrical tip of said body member in said cylindrical lower portion of said recess in said hanger means being effective to maintain said connector unit substantially in vertical alignment, whereby said upper head member can be lowered onto said tubing head and said second frusto-conical portion of said body member will be properly received in said downwardly facing recess without manual adjustment of said connector unit during lowering of said upper head member,

said first sealing ring loosely embracing said first frusto-conical portion of said body member, before said connector unit is inserted into said upwardly facing recess, but having an inner diameter smaller than the maximum outer diameter of said body member between said first and second frusto-conical portions thereof, and said retaining element being effective to retain said first sealing ring on said body member.

2. A well head construction in accordance with claim 1 and wherein

said hanger means includes at least another upright bore terminating at its upper end in an upwardly facing recess,

said upper well head member includes at least another downwardly facing recess, and

the well head construction further comprising at least another upright connector unit,

said downwardly facing recesses being disposed for vertical alignment with respective ones of said upwardly facing recesses, and said upwardly facing recesses, said downwardly facing recesses and said connector units all being respectively alike.

3. A well head construction in accordance with claim 1 and wherein

said body member of said connector unit further comprises an upper cylindrical tip and is provided with a second transversely extending, outwardly opening, annular groove at the upper end portion of said second frusto-conical portion,

said connector unit further comprising a second circularly extending retaining element seated in said second groove and projecting outwardly therefrom, said cylindrical tips, frusto-conical portions and seal-

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ing rings all being respectively alike, whereby either end of said connector unit can be operatively associated with said upwardly facing recess of said hanger means.

4. A well head construction in accordance with claim 5 and wherein said retaining ring is a continuous O-ring of resilient material.

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