

Oct. 23, 1962

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3,059,698

TUBING SUSPENSION

Filed Dec. 5, 1956

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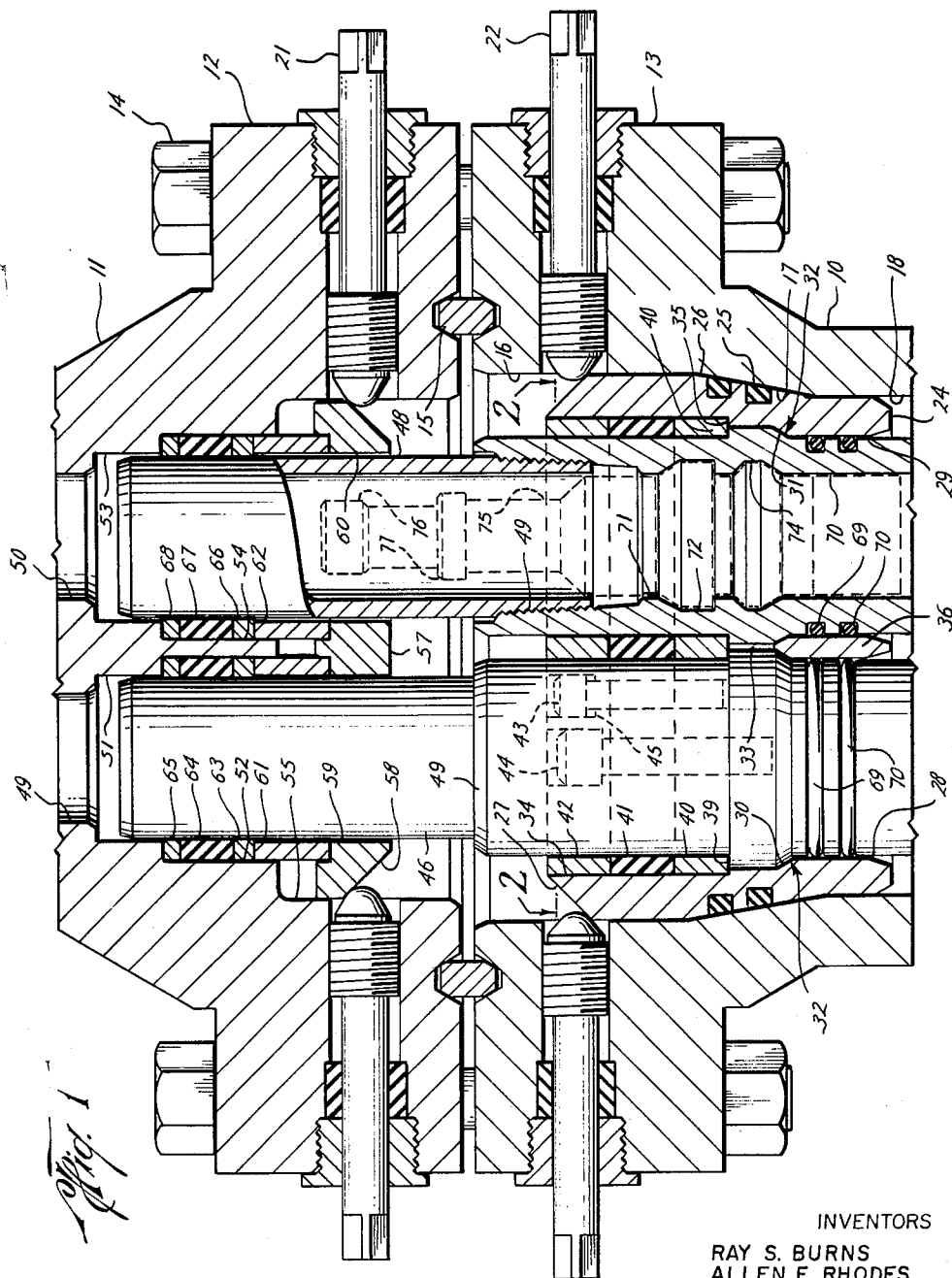


Fig. 1

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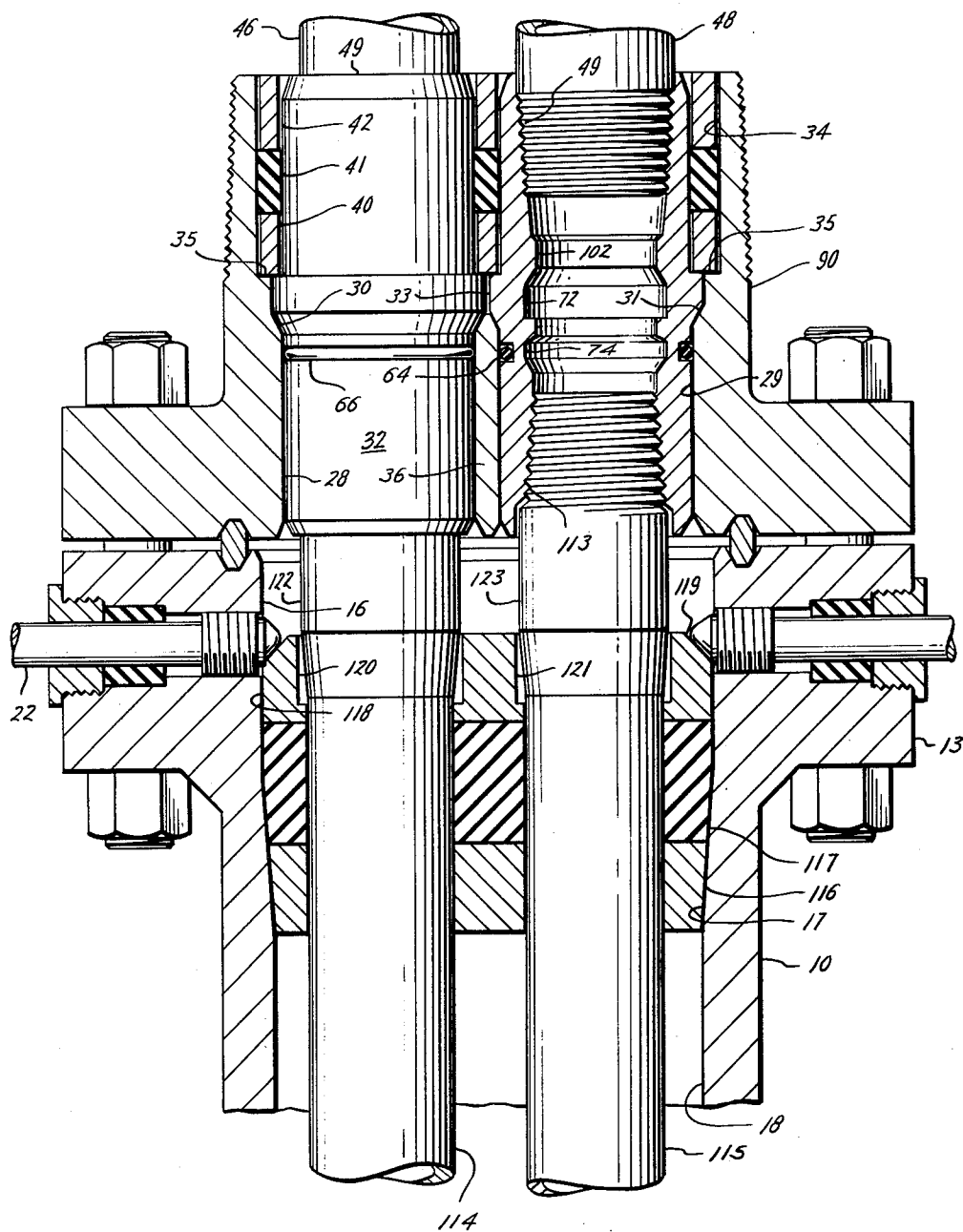
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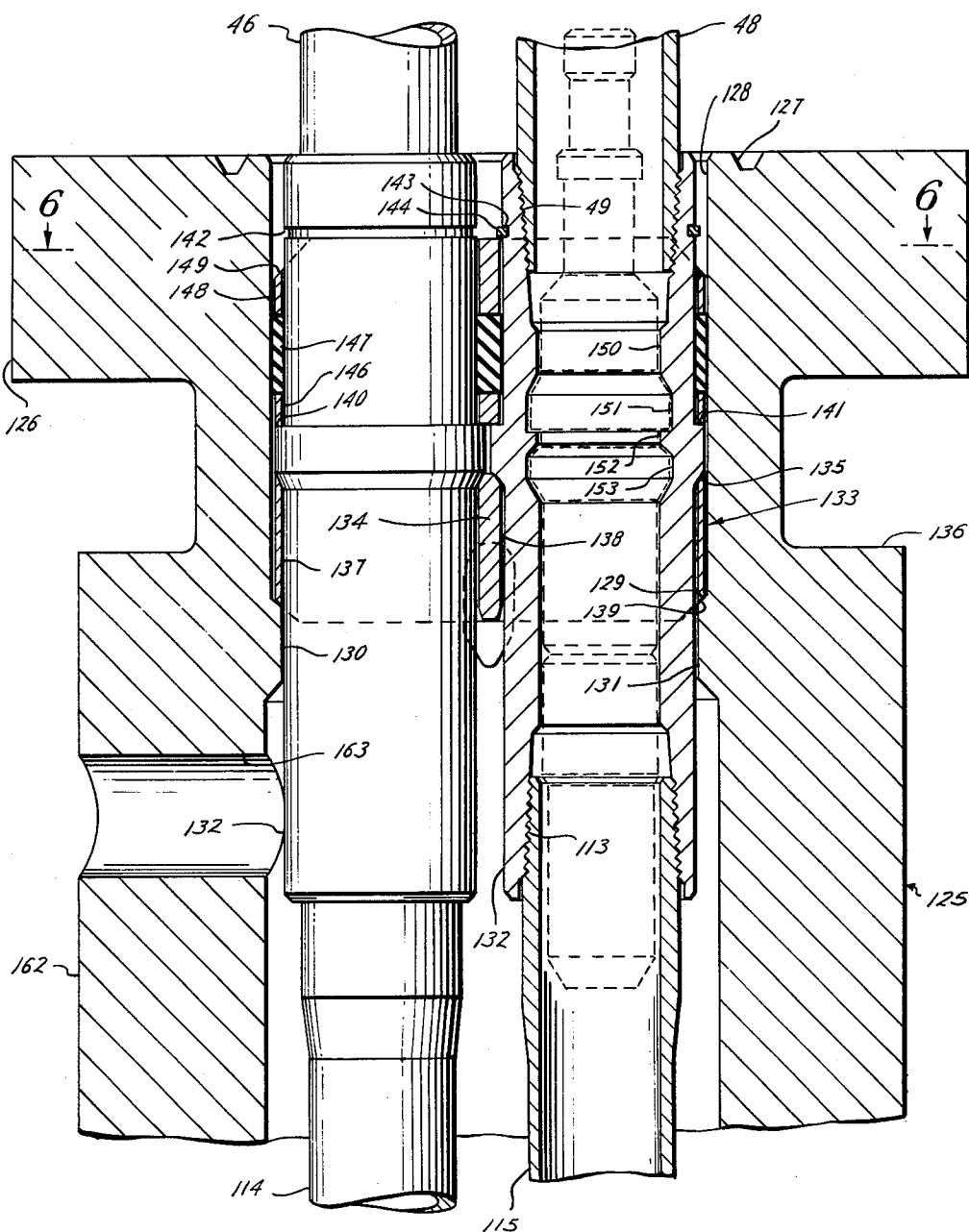


Fig. 5

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Fig. 6

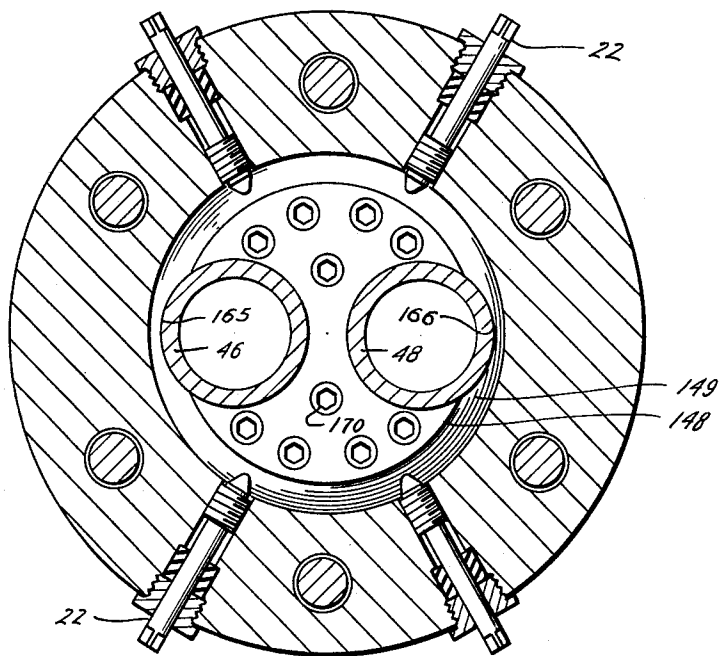
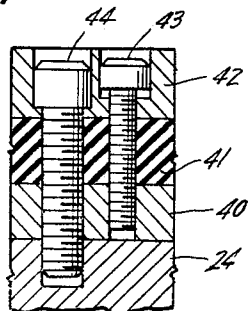


Fig. 7



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TUBING SUSPENSION

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Filed Dec. 5, 1956, Ser. No. 626,328

4 Claims. (Cl. 166—75)

This invention pertains to multiple completion well apparatus wherein means are provided for preventing blowing out through the pipe and tubing strings at the well head. More particularly, the invention provides multiple completion apparatus wherein removably disposed valve means are provided in the production strings at the well head, whereby each production string may be independently shut in, or plugged, at the well head.

This application is a continuation-in-part of our co-pending United States application for Letters Patent of the same title, S.N. 580,389, filed April 24, 1956, now abandoned.

It is a principal object of the invention to provide multiple completion well apparatus having means for shutting in, or plugging, the production strings at the well head.

Another object of the invention is to provide such apparatus wherein each of the multiple production strings may be shut in at the well head independently of the other production strings.

Another object of the invention is to provide such apparatus wherein the shut in means, or plugs, are removably disposed in the well strings at the well head.

Another object of the invention is to provide removable plug means insertable through upper well head equipment into any of multiple pipe strings in a well.

A further object of the invention is to provide such plug means which is seatable in the pipe strings at the well head.

A still further object of the invention is to provide such plug means removal of which enables full flow of fluid past its seat.

An additional object of the invention is to provide apparatus for completing multiple completion wells whereby the well production from a plurality of strata is safely brought in through a plurality of production strings with the well adequately protected against blowing out at all times.

It is often desirable in completing a well that flow through the production strings be stopped, particularly at times when work is being done upon the well head apparatus. The present invention provides apparatus by the use of which one or all of the production strings may be easily plugged at any time should the necessity for doing so arise. Means for seating and holding a valved plug means is provided for each or at least one production string of the equipment, each valved plug means being installable and removable through blowout preventers or upper well head equipment above the plug seat means. The valved plug means may be any standard type, and will usually include equalizing check valve means and open flow check valve means housed within a single mandrel. Engagement means at the upper end of the mandrel permits operation of the valves from above and also makes it possible to install and remove the plug means with a handling joint engaging the plug means from above. The invention is of broad scope and is adaptable to substan-

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tially all varieties of multiple completion well head equipment.

Other objects, uses, advantages, and improvements of the invention will appear from the following description of preferred embodiments thereof, reference being made to the accompanying drawings, of which:

FIGURE 1 is a vertical section through a preferred embodiment of the invention taken at the axes of the two bores thereof;

FIGURE 2 is a horizontal section of the embodiment of FIGURE 1, taken at line 2—2 of FIGURE 1;

FIGURE 3 is a vertical section similar to FIGURE 1 of a modified embodiment;

FIGURE 4 is a plan view of the embodiment of FIGURE 3, the couplings and pipes connected thereto being removed and the surrounding flange and bolts being omitted;

FIGURE 5 is a vertical section of another modified embodiment;

FIGURE 6 is a horizontal section taken at line 6—6 of FIGURE 5; and

FIGURE 7 is a partial vertical section taken at line 7—7 of FIGURE 2.

Referring now in detail to the drawings, there is shown well head apparatus having means for seating and holding a valved plug means in a pipe hanger means within a tubing head (FIGURES 1—2), in a tubing head adapter (FIGURES 3—4), and in a modified tubing head (FIGURES 5—6). The embodiments shown are exemplary only, and well head apparatus wherein the seating and holding means is in other locations is within the scope of the invention.

Referring more particularly now to FIGURES 1—2, in one embodiment the invention includes a tubing head 10 having upper connecting flange 13 which is surmounted by an upper well head element 11 having lower flange 12. A plurality of bolts 14 pass through flanges 12, 13, and a standard ring joint gasket 15 is disposed in suitable circular grooves in the flange faces to seal the joint. Tubing head 10 has upper bowl opening 16 which has a lower conically tapered seat portion 17 to support the pipe suspension means disposed therein. Bowl opening 16 forms the upper part of the axial tubing head opening 18 through which a pair of well pipes, or tubing strings (not shown), run into the well. A plurality of lock-screws 21 are disposed radially through flange 12 of element 11, and a plurality of lock screws 22 are disposed radially through flange 13 of tubing head 10.

A circular hanger body 24 is disposed within bowl opening 16 and seated at conical seat 26 thereof, the taper of seat 26 being the same as the taper of seat 17 upon which it rests. A beveled upper edge 27 is provided on hanger body 24 for engagement of the inner ends of the lock screws 22. Hanger body 24 has a circular upper opening 34 which merges into two nonconcentric lower bores 28, 29, having conical shoulders 30, 31, respectively, near their upper ends. Opening 34 has a bottom shoulder 35 below which extend the bores 28, 29. The axes of bores 28, 29, are located non-concentrically on a diameter of opening 34, and the bores are close together so that the conical shoulders 30, 31, thereof, intersect leaving an opening 33 between the bores above shoulders 30, 31. The web 36 separating bores 28, 29, below opening 33 has a thickness no greater than the sum of the radial com-

ponents of the shoulders 30, 31, about bores 28, 29. The intersection of shoulders 30, 31, which results in the opening 33 between the bore portions above the shoulders is best shown in FIGURE 2 of the drawings.

Two identical couplings 32 are disposed within opening 34, one extending into and above bore 28, and the other extending into and above bore 29. Couplings 32, 32 each have outwardly projecting annular shoulders 39 having lower conical surfaces of the same taper as shoulders 30, 31, upon which they seat to support the couplings. The upper sides of shoulders 39 coincide with lower shoulder 35 of opening 34 when the couplings are thus seated within the hanger body. Above the flat surface formed by shoulders 39 of the couplings and shoulder 35 of opening 34, is an annulus-like space within opening 34 which serves as a pack off receiving recess for sealing off about the couplings. Support for the pack off means is had except above opening 33 between the couplings, and the shoulders 39 occupy a part of opening 33 so that the unsupported area is very small. Within this pack off space are disposed a lower support element 40, a pack off element 41 of elastomeric material, and an upper packing compression element 42. These pack off elements 40-42 are shaped as flat circular discs having alignable circular openings for the upper ends of the couplings 32 and completely fill the pack off space above the supporting shoulders. Lower element 40 bridges over the space above opening 33 so that the elastomeric pack off element 41 is completely supported, even in the space between the couplings.

The couplings 32 each have lower threaded sockets (not shown) and upper threaded sockets 49, the well pipes being screwed at their upper ends into the lower sockets to be supported in the well, and a pair of short pipe nipples 46, 48, being screwed into the upper sockets to provide flow path means to the surmounting equipment above tubing head 10. Well head element 11 has two non-concentric vertical bores 49, 50, which are spaced apart to be alignable with the couplings 32 in tubing head 10. Around the lower ends of each of the bores 49, 50, there are provided, respectively, upper recesses 51, 53, to receive the upper ends of nipples 46, 48, lower packing recesses 52, 54, to receive packing means for sealing off around the nipples, and a single lower opening 55, which is circular and surrounds both packing recesses with which it merges. A circular support disk 57 fitted within opening 55 surrounds the nipples closely, and has lower beveled edge 58 which is engaged by lockscrews 21, vertical openings 59, 60, through which the nipples 46, 48, are received, and recesses around the tops of openings 59, 60, within which are seated collars 61, 62. Above the collars 61, 62, are rings 63, 66, rings 64, 67, of elastomeric material, and rings 65, 68, rings 64, 67, being compressed, respectively, between lower rings 63, 66, and upper rings 65, 68, to form seals around the nipples when lockscrews 21 are screwed in against beveled edge 58 of disk 57 to urge the collars 61, 62, simultaneously upward against the sets of packing elements.

The packing means within opening 34 of hanger body 24 is compressed by a plurality of screws 44 which pass through aligned holes in elements 40-42 and are screwed into tapped holes in shoulder 35, there being recesses in the upper surface of element 42 to receive the heads of the screws flushly. A second plurality of screws 43 pass through aligned holes in elements 40-42, the holes in lower element 40 being threaded, and upper element 42 having recesses for the screw heads. Screws 43 hold the three packing elements 40-42 together as a unit for assembly, and screws 44 are provided for compressing of the packing elements. As best shown in FIGURE 1, the heads of screws 43 are raised from the bottoms of the recesses when the packing element 41 is compressed by screwing in screws 44.

O-ring seals 69, 70 around each coupling 32, provide temporary seals between the couplings and hanger body

during assembly of the apparatus. Seals 69, 70 are referred to as "temporary" although they remain permanently in place and effective because they become unnecessary after pack off elements 40-42 are once in place.

In the bore 71 of each coupling 32, there is provided a pair of recesses 72, 74, upper recesses 72 having a conical upper side and lower recesses 74 having both the upper and lower sides conical. These recesses serve as seats for engaging and holding a back pressure valve 75 within each of the couplings (only one shown), and may be modified for other forms of back pressure valves or tubing plug means. The valves 75 shown are McEvoy-Otis back pressure valves having upper collars 76, 77, for engaging handling joints (not shown) and the like, and equipped with an equalizing check valve means (not shown) and open flow check valves (not shown). The valves 75 have V-ring packing seals therearound (not shown) to prevent flow around the valves in the collars. As stated, the form of the back pressure valves is immaterial to the invention, and any type of back pressure valve, plug, or mandrel may be substituted.

In FIGURES 3-4 there is shown a modified form of the invention. In this embodiment, a tubing head adapter 90 is formed, inwardly, like the interior of hanger body 24. Two of the couplings 32 are disposed upon conical seats 30, 31, of bores 28, 29, respectively. The web 36 between the bores and the opening 33 above the web are the same as in the first embodiment. The lower threaded sockets of the couplings 32, sockets 113, support the pipe strings 114, 115, as shown. The pipe nipples 46, 48, are screwed into the upper coupling sockets 49 as before and are usually sealed at their upper ends into upper equipment in the manner previously described.

The pipe strings or tubing strings 114, 115, being supported in the tubing head adapter 90 instead of in the tubing head 10, a second pack off means may be installed within the tubing head opening 16. A lower support element 116 having its outer side conical to seat against the lower portion of conical bowl shoulder 17, is disposed in the lower portion of the tubing head bowl. Packing element 117 of elastomeric material and upper element 118 having upper beveled edge 119 are fitted within opening 16 above support element 116. Elements 116-118 have aligned holes to snugly receive the pipe strings, and these elements fill the space around the pipe strings in the bowl opening 16. Lockscrews 22 engage beveled surface 119 to hold down and compress the packing. Upper element 118 has recesses 120, 121 to provide clearance for upset portions 122, 123, of the pipe strings. The pack off elements 116-118 provide a second pipe suspension means, the upset portions 122, 123, of pipes 114 and 115 being capable of being supported in recesses 120, 121, of element 118, the weight of the pipes then acting on element 118 to compress the packing element 117. Thus, when well pipes 114, 115 are supported in adapter 90 instead of in tubing head 10 as shown in FIGURES 1 and 2, dual well pipe support may be provided if desired. The lower hanger means may be used temporarily before the upper hanger means is installed. In the embodiment of FIGURES 3-4, the lower pack off and hanger means 116-118 may be omitted, and in that case the embodiment of FIGURES 3-4 is identical with the embodiment of FIGURES 1-2, except as to its location in the equipment and the substitution of adapter 90 for hanger body 24.

Another embodiment of the invention is shown in FIGURES 5-6. This embodiment is similar in arrangement to the embodiment of FIGURES 1-2, the well pipes each being suspended from a coupling held in a hanger body disposed in a tubing head. The couplings, 132 except for minor modifications, are like couplings 32 of the other embodiments. The hanger body 133 is similar in form to hanger body 24, but is novelly modified to be received within a tubing head 125 of smaller diameter than tubing head 10. This embodiment represents an important deviation from standard practice, and enables

the use of smaller well head apparatus for a given size of well pipes or tubing strings, thereby reducing the cost of the apparatus and making it easier to handle. Tubing head 125 has a circular bowl opening 128 which has a diameter only sufficient to receive a pair of couplings centered at non-concentric points on a diameter of opening 128. The couplings 132 have outer shoulders 135 which are identical with shoulders 39 of couplings 32, and when the couplings 132 are set in place within bowl opening 128, with shoulders 135 of the two couplings closely spaced, the shoulders 135 are also closely spaced from the walls of opening 128 at the ends of the diameter through the coupling axes. At the lower end of bowl opening 128, there is a shoulder 130 having upper and lower conical faces upon the upper face 129 of which the hanger body 133 is supported. At the exterior of tubing head 125, a recess 136 is formed below flange 126 to provide access space for bolting flange 126 to the lower flange of a surmounting well head element. Below recess 136, the tubing head body is thickened as at 162, and a manifold port 163 is provided therethrough from the axial bore of the tubing head. The hanger body 133 has a circular conical seat 139 at its lower edge which rests upon upper surface 129 of shoulder 130. Two non-concentric vertical openings 137 and 138 of circular shape are provided through the hanger body, being separated by a web 134 having a thickness about equal to the combined radial thicknesses of the two coupling shoulders 135 of the adjacent couplings and having an outer wall thickness at opposite sides on the diameter through this axis only about half as great as the thickness of web 134, or about equal to the radial thickness of one coupling shoulder 135. Shoulder 129 being of a greater radial width than the radial thickness of one shoulder 135, the hanger body openings 137 and 138 overlap shoulder 129, and arcuate recesses 165 and 166 are provided at opposite sides of shoulder 129 to permit the insertion of the couplings past the shoulder. Therefore, the alignment of tubing head 125 determines the alignment of the well pipes, since the couplings 132 can be disposed upon only one diameter of the tubing head corresponding to the recesses 165 and 166.

The couplings 132 are formed similarly to couplings 32 of the other embodiments, being outwardly cylindrical and having outer shoulders 135. A groove 142 around each coupling near its upper end receives a steel snap-ring 144 which serves to hold down the packing means during assembly of the apparatus. The pack off means comprises a lower support element 146, a sealing element 147 of elastomeric material, and an upper compression element 148. The compression element 148 has an upper beveled surface 149 for engagement by a plurality of lockscrews 22 radially disposed through the tubing head flange 126. Surface 149 is intersected at opposite sides by the aligned coupling openings of the pack off means. A plurality of screws 170 pass vertically through aligned screw holes in the elements 146-148 and are screwed into tapped holes in the upper surface of hanger body 133, whereby the packing is compressed by screwing down the screws 170. In this embodiment, the snap rings 144 on the couplings replace the screws of the other embodiments to hold the packing elements together during assembly.

The couplings 132 have upper and lower sockets, 49 and 113, respectively, as in the other embodiments, the pipe nipples 46 and 48 being screwed into the upper sockets 49 and the well pipes 114 and 115 being screwed into and supported at the lower sockets 113. The axial bores 150 of the couplings have therearound a pair of recesses 151 and 153 which are identical with recesses 72 and 74 of couplings 32 for engaging the back pressure valves 75, there being bore wall portions 73 between the recesses.

The back pressure valves 75 may be inserted through the tops of the couplings 32, 132, in any of the embodi-

ments shown. When the valves are removed, the couplings provide full flow from or to the well, the circular grooves 72 or 151 and 74 or 153 within the coupling bores offering no resistance to the flow. In some cases it may not be desired to provide seats in a coupling for a back pressure valve, in which case the grooves 72, 74, or 151, 153 may be omitted. But generally, it will be desirable to provide the back pressure valve seat grooves in all of the couplings, even through back pressure valves may never be inserted into some of the couplings. It should be noted that the back pressure valves are passable to the couplings through blowout preventers and through any equipment openings as large as the well pipe bores.

While preferred embodiments of the invention have been shown and described herein, many modifications thereof may be made by a person skilled in the art without departing from the spirit of the invention, and it is intended to protect by Letters Patent all forms of the invention falling within the scope of the following claims.

We claim:

1. Well head apparatus comprising a tubing head having a vertical opening having circular horizontal cross sections therethrough, an upwardly facing seat about said tubing head opening for supporting a hanger body and forming a bowl thereabove within said tubing head opening, a hanger body laterally outwardly conforming with said tubing head opening and seat seated upon said seat within said tubing head opening, plural non-concentric vertical openings through said hanger body each having circular horizontal cross sections, vertically spaced upper and lower upwardly facing seats around each said hanger body opening, a tubular coupling means laterally outwardly conforming with a portion of said hanger body opening and with said lower seat seated upon said lower seat of each hanger body opening and each extending above and below the lower seat to above and below the upper and lower ends of said hanger body, each said coupling means having an upwardly facing seat therearound at substantially the same vertical level as said upper seat of the hanger body opening within which it is disposed, said hanger body openings each having portions of their side walls relieved to be open one to another above said lower seats thereof, common seal means across said relieved wall portions and about all of said hanger body openings and said coupling means therein for sealing between said coupling means and said hanger body, said common seal means being supported over its entire lower end by said upper seats and said coupling means seats acting together, at least one of said coupling means including means around the tubular opening thereof for supporting valve means and valve means insertable into the tubular opening supported thereby.

2. The combination of claim 1, said common seal means having an exterior circular horizontal cross sectional form.

3. The combination of claim 1 wherein each said valve supporting means comprises a spaced pair of valve engaging circular grooves annularly disposed along the said coupling means tubular opening.

4. Multiple parallel tubing support apparatus, comprising a tubing head having a vertical opening therethrough and an upwardly facing seat around said opening, a hanger body having an encircling surface seated upon said seat, sealing means between said seat and said surface, plural vertical passages through said hanger body each having a lower upwardly facing seat therearound and an upper upwardly facing seat spaced thereabove partially therearound, said upper seats of adjacent ones of the plural passages being spaced around said hanger body adjacent the sides thereof whereby adjacent seat openings in said upper seats result between adjacent passages, a tubular coupling means having an outward projection therearound disposed in each of said passages, each said projection including a lower surface seated on

said lower seat of the passage and an upper surface adjacent said upper seat of the passage, sealing means supported upon all of said upper seats and upon all of said upper surfaces and sealing between said coupling means and said hanger body, each said tubular coupling means having a vertical flow port therethrough, at least one of said flow ports having seat recess means therearound and valve means controlling fluid flow through the flow port disposed therein by said seat recess means.

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