March 2, 1943. E. J. ROACH ET AL 2,312,487

WELL CONTROL HEAD

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Fig. 1.

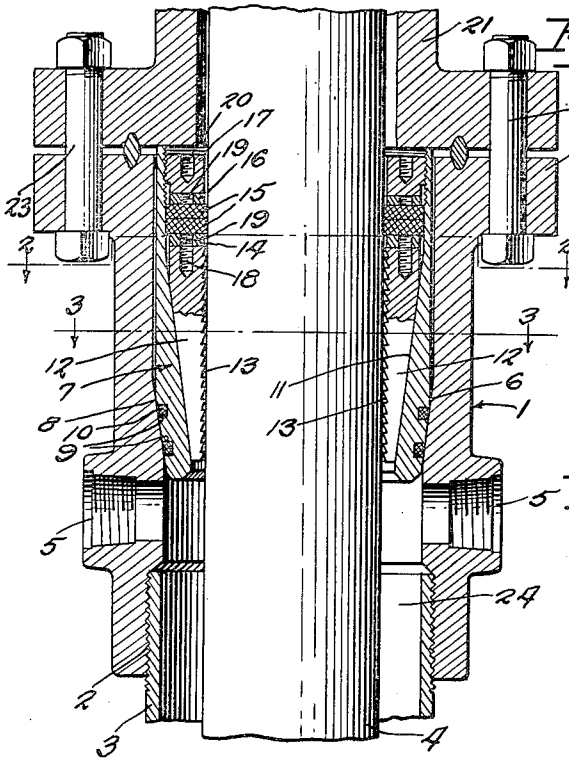

Fig. 2.

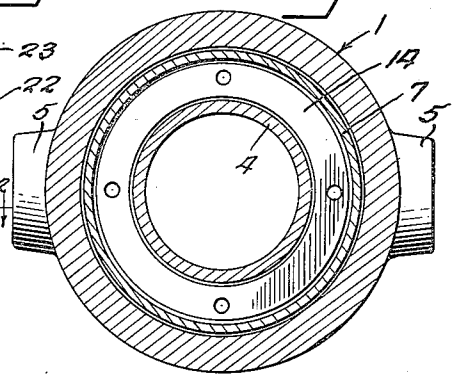

Fig. 3.

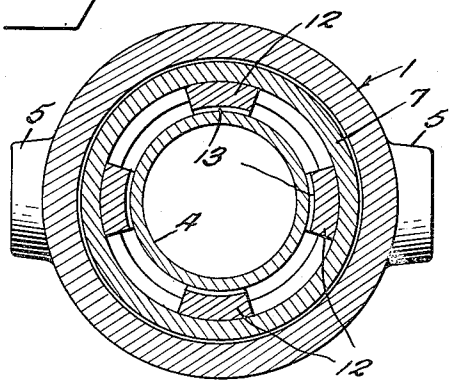

Fig. 4.

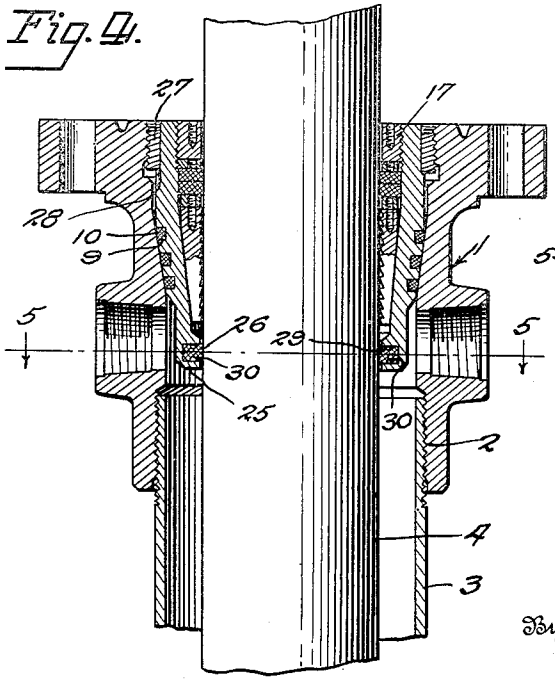

Fig. 5.

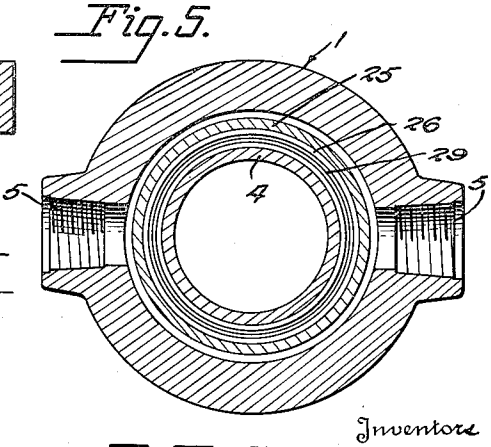

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Fig. 6.

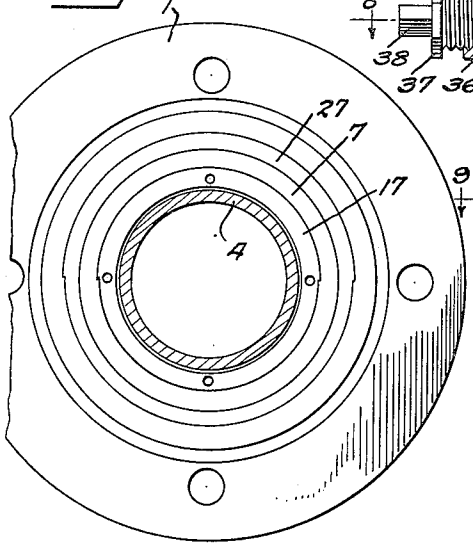


Fig. 7.

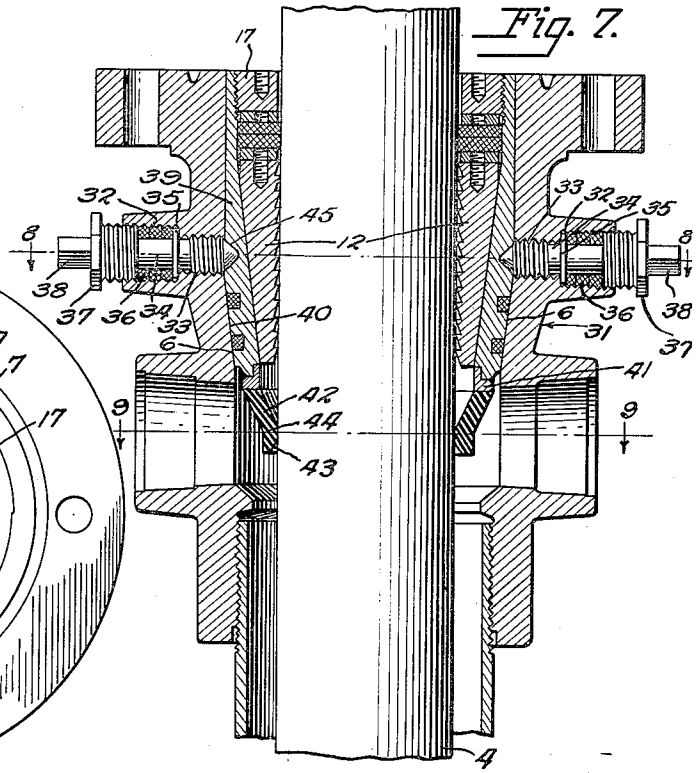


Fig. 8.

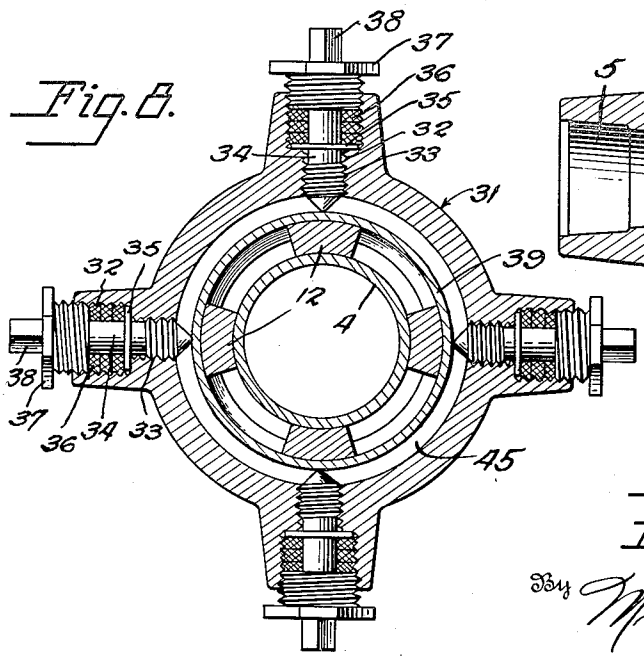
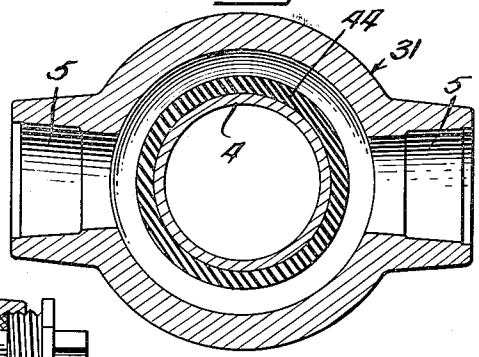


Fig. 9.



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UNITED STATES PATENT OFFICE

2,312,487

WELL CONTROL HEAD

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Application November 18, 1941, Serial No. 419,646

7 Claims. (Cl. 285—22)

This invention relates to oil well construction and has for its general object the provision of novel structure for suspending and sealing an inner casing with respect to a casing head.

One of the specific objects of the invention is to provide a casing head and a slip bowl unit cooperating therewith, said slip bowl unit comprising a bowl and slips which can be secured to the inner casing at any desired position to seat in the casing head in a fluid-tight manner when the inner casing is set so as to prevent leakage of gas under pressure which may develop between the inner and outer casing and to prevent the slip bowl unit from being displaced or blown out by excess gas pressure from the well.

Another object of the invention is to provide a slip bowl unit which may be drawn from the casing head as a unit on the inner casing when the latter is drawn up so that the position of the slip bowl unit can be changed relative to the inner casing if it is desired to alter the depth to which the inner casing is to be set.

Another object of the invention is to provide a packing unit securable within the slip bowl and above the slips expansible radially into sealing contact both with the inner casing and with the surrounding wall of the slip bowl by longitudinal pressure positively applied by the means which secures the slips and packing within the slip bowl.

Other objects of the invention will appear as the following description of a preferred and practical embodiment thereof proceeds.

In the drawings throughout the several figures of which the same characters of reference have been employed to denote identical parts:

Figure 1 is a longitudinal axial section through the upper part of the well structure illustrating an embodiment of one form of the inventive concept;

Figure 2 is a cross section taken along the line 2—2 of Figure 1;

Figure 3 is a cross section taken along the line 3—3 of Figure 1;

Figure 4 is a longitudinal axial section taken through a slightly modified form of the invention;

Figure 5 is a cross section taken along the line 5—5 of Figure 4;

Figure 6 is a plan view of Figure 4, the inner casing being shown in section;

Figure 7 is a longitudinal axial view through still another modified form of the invention;

Figure 8 is a cross section taken along the line 8—8 of Figure 7; and

Figure 9 is a cross section taken along the line 9—9 of Figure 7.

Referring now in detail to the several figures and first adverting to that form of the invention shown in the group of Figures 1 to 3, inclusive, the numeral 1 represents in general a casing head which is suitably secured as by the threaded connection 2 to the upper end of an outer casing 3, it being assumed that the bottom of the outer casing has been firmly cemented in the well and that drilling has proceeded to the point of completion at which the inner casing 4 is to be set. The casing head is provided in the zone immediately above the end of the outer casing 3 with suitable ports 5 which may be either closed by bull plugs not shown, or connected to a suitable conduit for flowing in mud or withdrawing gas, etc. Above the zone of the ports 5, the bore of the casing head is provided with a long downwardly tapered seat 6 and above this seat it is preferably cylindrical to the top of the casing head.

A slip bowl unit 7 is received within the casing head having a lower tapering end portion 8 seating upon the tapered portion 6 of the casing head and provided with ring grooves 9 receiving compressible packing rings 10 which normally project above the surface of the tapered end portion 8, but are compressed flush with said surface and against the seat 6 of the casing head either through the weight of the suspended inner casing or by the upper well equipment which may be bolted or therwise secured to the top of the casing head.

The bore of the slip bowl 7 has a long taper 11 in its lower portion between which and the inner casing 4 the slips 12 wedgingly seat. There are a plurality of the slips 12 arranged at spaced intervals around the inner casing 4, the outer surfaces of said slips conforming to the taper of the lower portion of the bore of the slip bowl and the inner surfaces conforming to the curvature of the inner casing 4 and being preferably provided with teeth 13 to give them gripping contact with the inner casing 4.

The upper zone of the bore of the slip bowl is cylindrical and threaded at its upper end.

A packing assembly rests upon the tops of the slips, said packing assembly including a metallic junk ring 14 which may be in one or more parts and above this one or more radially compressible packing rings 15. A metallic follower ring 16 rests upon the top of the compressible packing rings and engaged by a ring nut 17 which has a threaded connection with the

threaded upper end of the bore of the slip bowl whereby it may be screwed down upon the packing assembly to slide the compressible packing rings radially into sealing engagement, on the one hand with the inner casing and on the other with the surrounding wall of the slip bowl.

The slips are provided with threaded sockets 18 permitting the insertion of a threaded tool by means of which the slips can be withdrawn from the slip bowl and the junk rings and follower rings are similarly provided with threaded apertures 19 permitting their withdrawal by means of a suitable inserted threaded tool. The ring nut is provided with suitable holes 20 in its upper end so that a turning tool may be inserted for screwing or unscrewing the ring nut

The upper end of the slip bowl preferably extends a slight distance above the planiform upper end of the casing head 1 to be engaged by the flanged lower end of any suitable piece of upper well equipment 21 which may be bolted to the flange 22 of the casing head by the bolts 23 so as to hold the slip bowl from being displaced upwardly through the development of excess gas pressure in the space 24 between the inner and outer casings.

In operation, the inner casing 4 is lowered through blowout preventers into the bored hole until the approximate amount of inner casing is in place. The slip bowl unit 7 may then be assembled on the inner casing 4 on the outside of the blowout preventers. Said unit may be made up tightly on the inner casing by inserting the slips, the packing assembly and the ring nut and screwing the latter into tight relation so as to cause the slips to grip the inner casing and to cause the compressible packing members to sealingly engage the inner casing and the adjacent wall of the slip bowl. The inner casing with the slip bowl unit thus firmly attached can then be lowered into the bore until the slip bowl unit seats firmly upon the tapered seat 6 within the casing head. The weight of the inner casing compresses the packing rings 10 into sealing engagement with the casing head. Alternatively, the inner casing may be lowered to the proper point and the slip bowl unit loosely assembled about the inner casing and then released allowing the slip bowl unit to drop freely into the casing head until it engages the tapered seat 6 of the casing head. Then the slip bowl assembly may be tightened firmly about the inner casing, in situ. In either case the slip bowl unit would pass freely through the blowout preventers.

The outside means which have been used to support the inner casing 4 can then be released and suspension of the inner casing is dependent upon the engagement of the teeth 13 of the slips 12. While the weight of the suspended inner casing 4 may generally be relied upon as sufficient to prevent the lifting or blowing out of the slip bowl unit, an extra means of safety is provided by the clamping engagement of the upper well equipment 21 with the projecting upper end of the slip bowl.

In some instances the inner casing will be cemented firmly in the well after it is set, in which case its weight will be taken more or less off of the slips so that the engagement of the upper well equipment 21 with the upper end of the slip bowl becomes essential in pressing the slip bowl sealingly upon its seat in the casing head against any pressure which may develop between the inner and outer casings.

Figures 4, 5 and 6 show a modified form of the invention in which the lower end of the slip bowl is provided with a ring groove 25 opening in the surface of the bore of the slip bowl and containing a yielding packing ring 26 which normally projects inwardly from the ring groove and is sealingly compressed by the inner casing 4. In this construction the packing ring 26 acts as a blowout preventer so that the accessory blowout preventers which are ordinarily provided on top of the casing head may be removed, permitting the slip bowl unit to be tightened while in situ in the casing head without the escape of gas from the well.

In this form of the invention the slip bowl unit is positively retained within the casing head independently of any upper well equipment by means of a ring nut 27 which surrounds the slip bowl making threaded connection with the wall of the bore at the upper end of the casing head and seating upon an external shoulder formed on the slip bowl. In this form of the invention the slip bowl and casing head are provided with cooperating tapering seats, the tapered seat of the slip bowl having the ring grooves 9 in which are seated the packing rings 10, the latter being pressed into sealing contact with the casing head both by the weight of the inner casing 4 and the pressure imposed by the ring nut 27 against the external shoulder 28.

The packing ring 26 may be formed with annular upper and lower grooves 29 and 30 which facilitate its deformation into sealing contact both with the inner casing 4 and with the walls of the ring groove 25.

Proceeding now to that form of the invention shown in the group of Figures 6 to 9, inclusive, the casing head 31 is similar to that shown in Figure 1, excepting that in a zone above the seat 6 it is provided with a plurality of transverse bores 32 having their axes preferably in the same transverse plane and being threaded as at 33 to receive threaded bolts 34 which may be adjustably screwed inwardly so as to extend into the longitudinal bore of the casing head. Said transverse bores are counterbored at their outer ends and threaded, to receive a stuffing gland comprising a washer 35, packing 36 and a ring nut 37 surrounding the bolt and threadedly engaging the wall of said counterbore. The bolts have external polygonal portions 38 or other equivalent means by which they may be adjustably manipulated from without the casing head.

The slip bore 39 is externally provided with a tapered portion 40 complementary to the surface of the casing head seat 6 and seated thereupon. It has ring grooves 9 and packing rings 10 similar to those shown in Figure 1 and described in connection with that figure. The inside furnishings of the slip bowl are the same as those illustrated in Figure 1. The lower end of the slip bowl has a ferrule 41 suitably secured thereto as by welding, said ferrule carrying in permanent adherence therewith a skirt 42 of flexible material such as rubber or duoprene. The skirt 42 has a lower flared end 43 adapting it to be readily slipped over the inner casing, and an intermediate cylindrical portion 44 of normally smaller internal diameter than the external diameter of the inner casing 4. The said cylindrical portion of said skirt is expanded by the insertion of the inner casing therethrough so that it presses sealingly against the inner casing and prevents leakage of gas under well pressure between the wall of said inner casing and

said skirt. This is useful in permitting the slip bowl to be dropped loosely along the inner casing after the latter has been set, and the removal of the usual blow-out preventers so that the packing above the slips can be tightened in situ after the slip bowl is in place in the casing head without the leakage of gas past the slips during the tightening operation.

The slip bowl 39 is provided with an annular groove 45 above its tapered seating surface 40, the middle of which groove is in the axial plane of the transverse bores when the slip bowl is in seated position in the casing head. The ends of the bolts 34 have the same shape in axial planes as the cross-section of the annular groove 45, so that when said bolts are moved inwardly they fit the annular groove 45 and positively hold the slip bowl upon its seat in the casing head. This prevents blowing out of the slip bowl unit by any excess gas pressure which might develop in the well between the inner and outer casings. For removing the inner casing it is necessary merely to retrack the bolts 45, to apply the accessory blow-out preventers to the top of the casing head and to lift the inner casing, together with the attached slip bowl, through the blow-out preventers by the usual hoisting means. The ring nut 17 may then be removed so as to release the packing; the slips may be loosened by driving downwardly upon the slip bowl and the loosened parts may then be readily removed.

While I have in the above description disclosed what I believe to be a preferred and practical embodiment of the invention, it will be understood to those skilled in the art that the details of construction and the arrangement of parts as shown and described are by way of example, and not to be construed as limiting the scope of the invention as defined in the appended claims.

What we claim as our invention is:

1. Casing control head for oil wells comprising a casing head having a planiform upper end and a longitudinal bore with an internal tapered seating shoulder for supporting a slip bowl unit adapted to surround an inner casing, said slip bowl unit including a slip bowl with a complementary tapered external seat, said external seat being formed with ring grooves and expansible packing in said grooves normally extending therefrom adapted to be pressed sealingly against said casing head seat under the pressure of said slip bowl unit, said slip bowl projecting a slight distance above the upper end of said casing head, a member engaging the projecting end of said slip bowl and bolted to the upper end of said casing head for positively holding said slip bowl unit to its seat and means within said slip bowl cooperating therewith to maintain said slip bowl unit wedgingly fixed to said inner casing.

2. Casing control head for oil wells comprising a casing head having a bore with an internal downwardly tapered seating shoulder for supporting a slip bowl unit, the latter including a slip bowl with a complementary tapered external seat, said external seat being formed with ring grooves and compressible packing in said grooves extending therefrom adapted to be compressed sealingly against said casing head seat under pressure of said slip bowl unit, said slip bowl having an interior bore with a cylindrical upper portion and a downwardly tapered lower portion the latter portion forming a seat for slips, a plurality of tapered slips arranged circumferentially within said slip bowl having outer seating surfaces complementary to the tapered portion of the slip bowl bore and having inner cylindrical faces complementary to the surface of an inner casing which the slip bowl is adapted to surround, for wedgingly gripping said inner casing, a packing unit in the cylindrical portion of the bore of said slip bowl comprising a junk ring resting upon said slips, radially expansible packing above said junk ring and a ring nut screwing into said bowl against said packing for expanding it against said bowl and said inner casing and for wedgingly forcing said slips into engagement with said inner casing.

3. In a casing control head, means for suspending an inner casing in a casing head comprising a slip bowl unit including a slip bowl with an external downwardly tapered seat for seating upon a complementary seating shoulder in a casing head, said slip bowl having an interior bore with a cylindrical upper portion and a downwardly tapered lower portion the latter portion forming a seat for slips, a plurality of tapered slips arranged circumferentially within said bore having outer seating surfaces complementary to the tapered portion of the slip bowl bore and having inner cylindrical faces complementary to the surface of an inner casing which the slip bowl is adapted to surround, for wedgingly gripping said inner casing, and a packing unit in the cylindrical portion of the bore of said slip bowl comprising a junk ring resting upon said slips, radially expansible packing above said junk ring, and a ring nut screwing into said bowl against said packing for expanding it against said bore and the inner casing and for forcing said slips into engagement with said inner casing.

4. Casing control head for oil wells comprising a casing head having a bore with an internal downwardly tapered seating shoulder in its lower portion for supporting a slip bowl unit, a cylindrical intermediate portion and an upper threaded cylindrical portion of larger diameter than said intermediate portion, in combination with a slip bowl unit including a slip bowl having an external downwardly tapered seat complementary to the said seating shoulder of said casing head, said seat having ring grooves with compressible packing therein and extending beyond the surface of said seat, said slip bowl having an upwardly facing external shoulder in the zone of the upper cylindrical portion of the bore of said casing head, and a ring nut surrounding the upper part of said slip bowl engaging said upwardly facing shoulder and screwing into said casing head for positively holding said slip bowl unit upon its seat in the casing head.

5. In a casing control head for oil wells, means for suspending an inner casing in a casing head comprising a slip bowl unit including a slip bowl with an external downwardly tapered seat in an intermediate zone for seating upon a complementary seating shoulder in a casing head, and having a longitudinal bore with a downwardly tapered seat in the same zone as said external seat, a plurality of tapered slips arranged circumferentially within said slip bowl having outer seating surfaces complementary to the surfaces of said internal seat and having inner cylindrical faces complementary to the surface of an inner casing which the slip bowl is adapted to surround, upper packing above said slips, means for expanding said packing in sealing relation to said inner casing, said slip bowl having a lower portion below said internal seat

and an annular flexible packing element carried by said lower portion surrounding said inner casing of normally smaller internal diameter than the external diameter of said inner casing, sealingly pressing said inner casing for preventing leakage between said inner casing and slip bowl unit until the said upper packing has been expanded.

6. In a casing control head for oil wells, means for suspending an inner casing in a casing head comprising a slip bowl unit including a slip bowl with an external downwardly tapered seat in an intermediate zone for seating upon a complementary seating shoulder in a casing head, and having a longitudinal bore with a downwardly tapered seat in the same zone as said external seat, a plurality of tapered slips arranged circumferentially within said slip bowl having outer seating surfaces complementary to the surfaces of said internal seat and having inner cylindrical faces complementary to the surface of an inner casing which the slip bowl is adapted to surround, upper packing above said slips, means for expanding said packing in sealing relation to said inner casing, said slip bowl having a lower portion below said internal seat, said lower portion having an internal ring groove opening toward said inner casing and a flexible packing in said ring groove normally of smaller internal diameter than the external diameter of said inner casing sealingly pressing said inner casing for preventing leakage between said inner casing and said slip bowl unit until the upper packing has been expanded.

7. Casing control head for oil wells comprising a casing head having a longitudinal bore with an internal downwardly tapered seating shoulder for supporting a slip bowl unit and having threaded transverse bores in a zone above said seating shoulder communicating with said longitudinal bore, said slip bowl unit including a slip bowl with an external downwardly tapered seat complementary to the surface of said seating shoulder, provided with ring grooves and compressible packing in said ring grooves normally extending therefrom and adapted to be compressed sealingly against said seating shoulder under pressure of said slip bowl unit, said slip bowl having an external annular groove above said external tapered seat and in the transverse plane of the transverse bores of said casing head when said slip bowl unit is seated in said casing head, bolts screwing into said transverse bores engaging said slip bowl unit within said groove for positively holding said slip bowl unit upon its seat in the casing head, and stuffing glands in said transverse bores sealingly engaging said bolts.

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