

Sept. 15, 1959

M. C. TURNER

2,904,115

INTEGRAL CASING PACKING SEAT

Filed Oct. 21, 1954

FIG. 1.

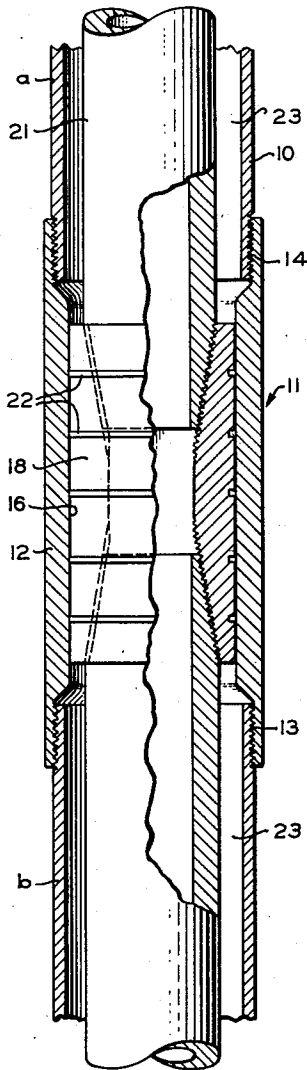


FIG. 2.

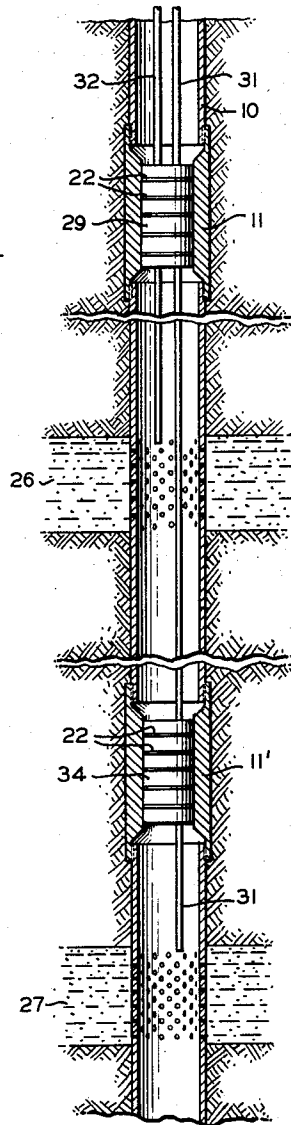


FIG. 3.

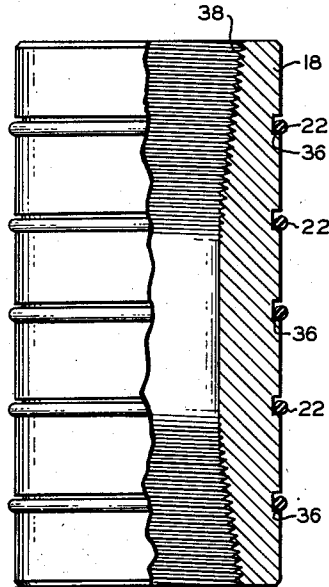


FIG. 4.

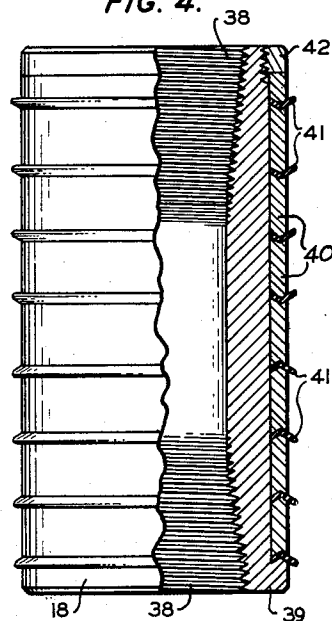


FIG. 5.

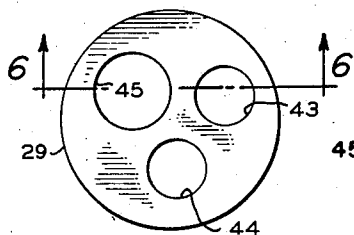
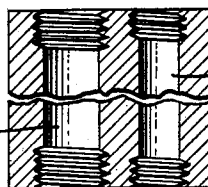


FIG. 6.



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2,904,115

INTEGRAL CASING PACKING SEAT

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Application October 21, 1954, Serial No. 463,766

10 Claims. (Cl. 166—115)

This invention relates to improved apparatus for use in producing a well. A specific aspect of the invention pertains to combination collars and packers for well casing and tubing.

The cost of drilling and completing oil and gas wells can be reduced if the size of the borehole is reduced. For example, the cost of casing and cement and the cost of drilling obviously are less with small holes than with larger ones. However, to allow the installation of necessary equipment and to facilitate the downhole operation of equipment it is desirable to have the wells as large as possible. Thus, in most instances, the well size is a compromise between what is desirable and what is economical.

Obviously then, it is important to use the available space in a well bore efficiently. This becomes particularly true when the well is a dual completion in which it is necessary to separate the production from two zones. In the latter instance, and in a large number of single completions, it is necessary or desirable to use one or more packers. An ordinary packer takes up a great deal of the cross sectional area of a well. A packer generally combines means such as tapered slips, to hold it in place in the well, and means to seal between the packer body and the casing and between the packer body and the tubing. These parts take up so much of the available area in the well that, with one popular packer, the largest diameter tubing that can be run thru the packer in a 5½ in. casing is 1.900 in. O.D. plain tubing or 2.375 in. O.D. flush joint tubing. In 7 in. casing it is possible to run 2.375 in. O.D. plain tubing or 2.875 in. O.D. flush joint tubing.

Through the use of the invention, space in a well is utilized much more efficiently thus making it possible to run a much larger string of tubing in any given casing or to run a plurality of ordinary tubing strings therein.

An object of the invention is to provide improved well producing apparatus. Another object is to provide improved well producing apparatus which effects an economy of space in a well and permits use of smaller bore holes or the use of a larger number of pipes or larger pipes in a given bore hole. A further object of the invention is to provide a simple and efficient combination casing collar or pipe connector and packer which eliminates need for a special packer. A further object is to provide novel pipe collars for well casing and tubing which cooperate to function as packers. Another object of the invention is to provide apparatus which simplifies producing from multiple zones in a well. Other objects of the invention will become apparent from a consideration of the accompanying disclosure.

The invention utilizes a novel casing collar which provides a seat on its inner wall for a cooperating tubing collar having sealing means thereon, thereby eliminating the need for a special or separate packing device in order to seal off flow in the annulus surrounding the tubing where such is desired. The inner wall of the casing collar is of lesser diameter than the inner diameter of the casing

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which is attached to the collar and must necessarily be smaller in inner diameter than any casing joint in the string so as to permit passage thru the string of a tubing collar which fits the inner wall of the casing collar and forms a seal therewith. When running the casing in the well a special casing collar is inserted in the casing string at the desired point so as to provide packing off between the casing and tubing. Where more than one pack-off is desired or required, additional special casing collars are inserted at the required locations in the casing string as it is being run. The invention also provides tubing collars or connectors which form a seal with the special casing collars and which have a plurality of conduits running therethru to provide for a plurality of tubing strings to meet the requirements of multiple zone production in a well.

For a more complete understanding of the invention reference may be had to the drawing of which Figure 1 is an elevation, partly in section, of the casing collar and cooperating tubing collar or connector in combination with well casing and tubing; Figure 2 is an elevation, partly in section, of a casing string and a plurality of tubing strings connected by the novel collars or connectors of the invention; Figure 3 is a longitudinal view in partial section of a tubing collar; Figure 4 is a longitudinal view in partial section of another modification or embodiment of the tubing collar of the invention; Figure 5 is a plan view of a multiple tubing connector, and Figure 6 is a sectional view taken on the line 6—6 of Figure 5.

The various figures of the drawing are schematic and corresponding parts are correspondingly numbered.

Referring to Figure 1, at any point where it is desired to provide a packer the regular casing collar connecting joints *a* and *b* of casing string 10 is replaced by special collar 11 which has a body portion 12 and threaded end sections 13 and 14. The inner wall 16 of body portion 12 of collar 11 is machined or otherwise provided with a true and regular surface so as to form a seat for tubing collar 18. The inner diameter of body member 12 is sufficiently smaller than the inner diameter of threaded end sections 13 and 14 to accommodate casing joints *a* and *b* of larger internal diameter than body member 12 so as to permit the free movement of tubing collar 18 thru the casing string until it reaches the special collar 11 and seat 16 thereof.

In operation, after the casing string containing collar 11 has been run and cemented in a well the tubing string 21 including collar 18 having seal rings 22 embedded in its outer wall is run and brought into position as shown in Figure 1. As collar 18 enters collar 11, seal rings 22 cooperate with the inner wall or seat 16 of collar 11 to provide a seal or pack-off preventing upward or downward migration of the fluids in the annular space 23 between the casing and tubing past collar 11.

Although not illustrated, it is possible and may be desirable in some instances to provide collar 11 with a shoulder which is engaged by a mating shoulder on the upper end of collar 18 to eliminate the necessity of making very accurate measurements to locate collar 18 relative to collar 11 and also to permit collar 11 to support a portion of the weight of the tubing string. In instances where it is desired to place the tubing string in tension, collars 11 and 18 are provided with a suitable latching mechanism, to permit these members to be detachably engaged. Baker Oil Tools, Inc., of Los Angeles, California, show in its 1954 catalog at pages 501 to 503 a tubing seal locator sub and a latching sub which may be utilized as the devices just referred to.

Figure 2 shows an arrangement wherein a pair of collars 11 and 11' are run in casing string 10 to permit separation of zones 26 and 27. A tubing collar or con-

necter 29 similar to collar 18 of Figure 1 but providing connections for two tubing strings 31 and 32 is seated in collar 11 and a similar collar or tubing connector 34 is seated in collar 11'. The arrangement shown in Figure 2 permits separate production from producing zones 26 and 27. Where it is necessary or desired, additional tubing strings may be run thru collars or connectors 11 and 11'. These may be run parallel to tubing strings 32 and 31 or concentric with either or both of these. Additional tubing strings are utilized in producing multiple zones in a well and in separately producing oil and gas in dual production zone wells.

Collars 11 and 11' are similar in construction and design to collar 11 of Figure 1. The internal diameter of collar 11' preferably is slightly smaller than that of collar 11 but it is also feasible to run the tubing strings of Figure 2 when the internal diameter of collars 11 and 11' are equal. Although collars 11 and 11' are illustrated with regular collar threads it may be desirable in some instances to provide pin and box threads to eliminate the necessity for removing a casing collar; and it is also feasible to weld these collars in the casing string. Obviously collars or tubing connectors 29 and 34 can be provided with connections for any desired number of tubing strings of the same or different diameters. These collars comprise a cylindrical body member having seal rings 22 embedded in the outer wall thereof similar to those of collar 18. A suitable number of conduits extend longitudinally thru the cylindrical body and have suitable means for attaching the tubing such as a threaded end section in each conduit into which the tubing is threaded. If desired, collars 29 and 34 may be identical in which case threaded plugs, not shown, are screwed into the openings in collar 34 which are not to be used.

Although the inside diameter of collars 11 and 11' can be varied from well to well to suit specific conditions, if desired, it is preferable to standardize these collars and to use such standardized collars when possible. In general it can be stated that the inside diameter of the collar should be somewhat smaller than the inside diameter of the heaviest pipe with which it is to be used in order to permit free passage of collars 18, 29, and 34 thru the casing, but not small enough to prevent passage of cementing plugs therethru.

Figure 3 shows an embodiment of the tubing collar 18 in which the outer wall of the cylinder is provided with grooves 36 in order to recess O-rings 22. Threads 38 at each end on the inner wall of the collar provide attaching means for the tubing joints at either end.

Figure 4 shows an embodiment of collar 18 in which a flange 39 is provided at one end of the collar as a shoulder for spacers 40 and packing or seal rings 41. A locking ring 42 screws onto the end of the collar to provide compression on the seal rings and spacers. Any suitable seal rings may be utilized in the collars of Figures 3 and 4.

Figure 5 shows a plan view of a tubing collar or connector, such as 29, providing three different connections for as many tubing strings. As illustrated in this figure, conduits 43 and 44 are of similar diameter and conduit 45 is of larger diameter.

Figure 6 is a cross section of the tubing collar of Figure 5 taken on the line 6-6 and shows threaded sections on the ends of conduits 43 and 45 for attaching to well tubing or other conduits.

The apparatus of the invention eliminates much of the complicated mechanism utilized in conventional equipment for sealing off between the tubing and casing of a well and provides an efficient sealing means which occupies considerably less lateral annular space than does equipment heretofore available.

Certain modifications of the invention will become apparent to those skilled in the art and the illustrative details disclosed are not to be construed as imposing unnecessary limitations on the invention.

I claim:

1. A pipe connector-sealing member comprising a cylindrical body the outer surface of which is a substantially continuous cylinder having sealing rings spaced apart thereon said body including a plurality of conduits running therethrough parallel with the axis thereof; and means in said body at each end of each of said conduits for forming a joint with a pipe.

2. The device of claim 1 wherein said means comprises a threaded section on each end of each conduit.

3. In combination in a well bore, a string of pipe connected by at least one pipe collar having internally threaded end sections threaded to said pipe and an intermediate body section of smooth cylindrical bore of lesser diameter than the internal diameter of said pipe providing a sealing surface; a plurality of pipe strings within said string of pipe connected at said pipe collar by means of a pipe connector-sealing member comprising a cylindrical body the outer surface of which is a substantially uniform cylinder slidable completely thru said pipe collar; sealing rings on said pipe connector-sealing member forming a seal with said sealing surface; and in said body a plurality of conduits running therethrough parallel with its axis, each conduit being axially aligned with one of said strings of pipe.

4. The apparatus of claim 3 including a second pipe collar of the character described positioned in first said pipe string below aforesaid pipe collar; a second pipe connector-sealing member of the character described positioned inside of said second pipe collar to form a seal therewith; and at least one pipe string connected to both said pipe connector-sealing members to provide a passageway for fluids from a zone below said second pipe collar upwardly thru last said pipe string to a zone above first said pipe collar.

5. The apparatus of claim 4 wherein said second pipe collar is of lesser inside diameter than first said pipe collar.

6. The apparatus of claim 4 including a pipe string extending from a position between said connector-sealing members upwardly thru the upper of said members to a zone above same.

7. In combination a first pipe string connected by pipe collars having internally threaded ends, each of said collars having a smooth internal bore of uniform diameter substantially smaller than the internal diameter of said pipe string; a second pipe string connected by pipe collars internally threaded at each end and of uniform external diameter slightly less than said bore; sealing rings on said second pipe collars which form a seal between same and the outer pipe collars when the inner collars are positioned within said first pipe collars, said second pipe collars with seal rings thereon being slidable completely thru said first pipe collars to permit lowering said second string of pipe within said first string thru successive such first pipe collars in said first string and positioning said second pipe collars in sealed relation with said first pipe collars.

8. The combination of claim 7 wherein a pair of said collars form a seal between said strings of pipe above an upper producing formation and a second pair of said collars form a seal between said strings above a lower producing formation; said outer string is perforate adjacent each of the formations; and said inner string terminates at substantially the level of said lower formation.

9. The combination of claim 8 including a third string of pipe extending thru the inner collar of the upper pair and terminating intermediate the upper and lower pairs of collars.

10. In combination a pipe collar adapted to couple a pipe string, comprising an elongated annular member having internally threaded end sections adapted to thread over the end of matching pipe and a body section intermediate said end sections of smooth uniform internal bore extending completely thru said body section, said bore

being of substantially lesser diameter than the internal diameter of said end sections to provide a cylindrical sealing surface; a pipe connector-sealing member comprising a cylindrical body having a uniform cylindrical outer surface provided with seal rings forming a seal with said cylindrical sealing surface, said member being slidable completely thru said collar; and at least one conduit extending longitudinally thru said cylindrical body.

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