

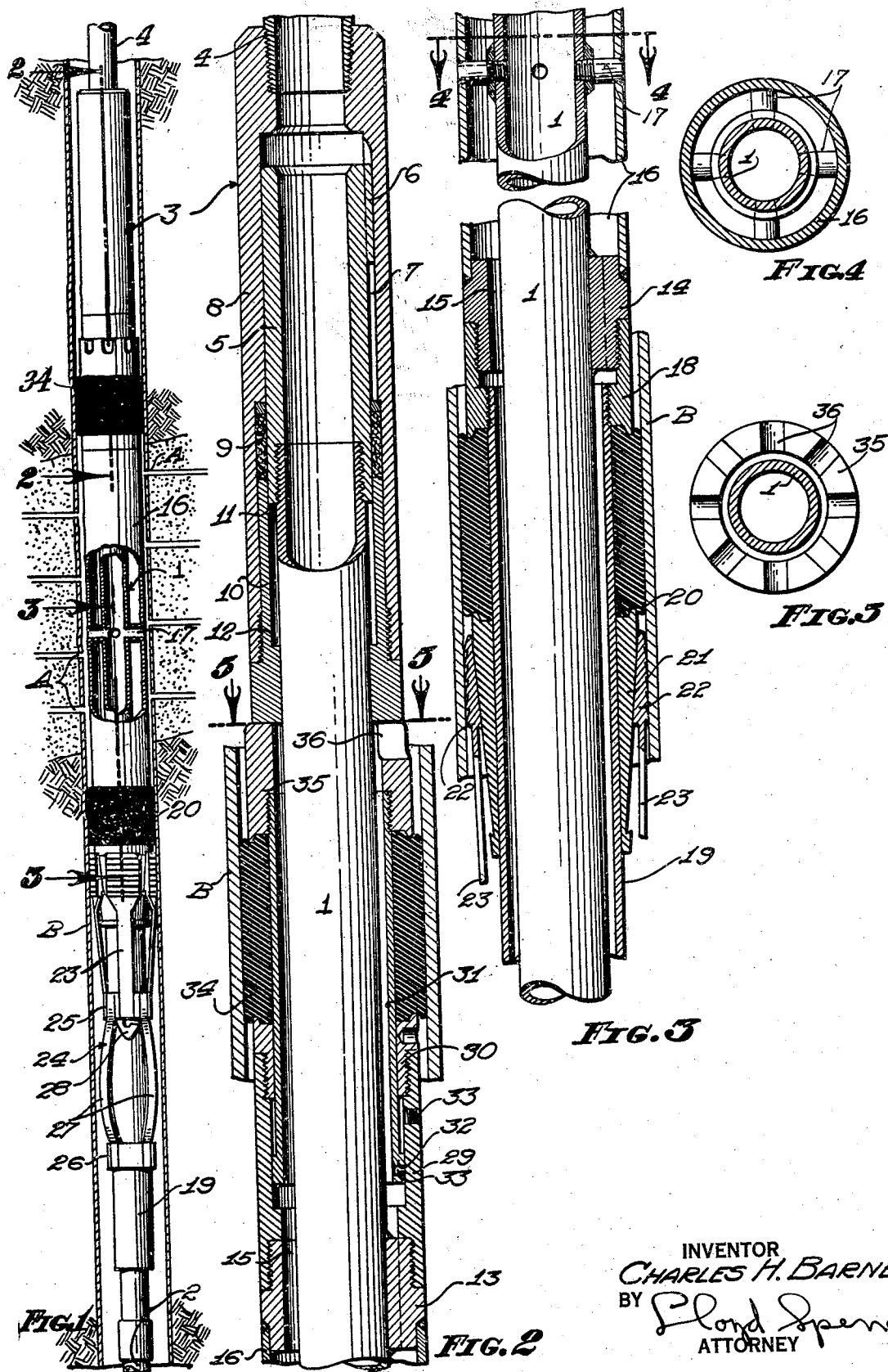
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DOUBLE SEAL PACKER

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## DOUBLE SEAL PACKER

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My invention relates to double seal packers for oil wells, and among the objects of my invention are:

First, to provide a packer whereby seals may be effected between a tubing string and surrounding casing at two points so that fluid may be permitted to enter the tubing string through perforations in the well casing between these two points;

Second, to provide a dual production packer of this type whereby communication may be maintained through the casing around the tubing from a point below the packer to a point above without interfering with the inflow of fluids to the tubing between the packing elements; and

Third, to provide a packer which is particularly adapted for gas-lifting fluids from a lower zone by introduction into the tubing string of gas from an upper zone while simultaneously controlling the back pressure against the lower producing zone.

With the above and other objects in view, as may appear hereinafter, reference is directed to the accompanying drawing, in which:

Figure 1 is an elevational view of my double seal packer shown in position in a well casing, the casing and a portion of the packer being broken away and in section;

Figure 2 is an enlarged fragmentary, longitudinal sectional view of the upper portion of the double seal packer through 2—2 of Figure 1;

Figure 3 is a similar fragmentary, longitudinal sectional view of the lower portion of the double seal packer through 3—3 of Figure 1;

Figure 4 is a transverse sectional view through 4—4 of Figure 3; and

Figure 5 is a transverse sectional view through 5—5 of Figure 2.

My double seal packer includes an inner mandrel 1 connected at its lower end to a lower tubing string 2. Its upper end is connected through a slip joint 3 to the upper tubing string 4. The slip joint comprises an inner body 5 having a key 6 which slides in a keyway 7 provided on the inner wall of an outer body member 8 which fits over the inner body and is screw-threaded to the upper tubing string 4.

A packing ring 9 is interposed between the two body members and a packing nut 10 is screw-threaded into the lower end of the outer body member for engagement with the packing ring. The inner body 5 and packing nut 10 are provided with coacting shoulders 11 and 12, respectively, which coast to limit outward or downward movement of the inner body 8 when the

packer is suspended from the tubing. The slip joint is thus capable of limited longitudinal movement, as well as transmitting torque from the upper tubing string through the outer body to the inner body and to the inner mandrel 1.

The inner mandrel 1 has welded thereto an upper spacer 13 and a lower spacer 14 through which are provided by-pass slots 15. A surrounding shell 16 is welded to the two spacers and extends therebetween to form with the inner concentric mandrel 1 an annular intermediate flow passage. Lateral gas intake ports 17 in the form of short tubes or ducts are secured in the inner mandrel and extend laterally to the exterior of the shell 16. These enable fluid to enter the tubing from the space surrounding the outside of the shell without entering the annular space between the mandrel and shell.

A lower packer collar 18 is screw-threaded to the lower spacer 14. The lower packer collar supports a lower packer mandrel 19 in the form of a tube fitting over and spaced from the inner mandrel 1 to form an annular passage therewith which is a continuation of the beforementioned intermediate flow passage. The lower packer mandrel 19 receives a packing sleeve 20 or any other suitable expansible packing element. Below the packing sleeve 20 a wedge cone 21 is slidably mounted on the lower packer mandrel. The wedge cone 21 coacts with wedging slips 22 which are connected by reins 23 to a cage 24 comprising upper and lower collars 25 and 26 connected by cage springs 27. The cage also includes a latch means 28 in the form of a hook carried by one of the collars and a pin projecting from the lower packer mandrel, so that the slips may be latched in a lower or inoperative position with respect to the wedge cone while the packer is being run into a well.

The upper spacer 13 has secured thereto an upwardly extending upper packer collar 29, the upper end of which receives a ring nut 30. Slidably within the upper packer collar and ring nut is an upper packer mandrel 31 having a flange 32 which coacts with the ring nut to limit upward movement of the upper packer mandrel. While not essential to its operation, the upper packer mandrel is preferably initially held in an upper or extended position by means of a shear pin 33 which extends through the upper packer collar 29 into the flange 32. The upper packer mandrel receives an upper packer sleeve 34 and screw-threads into a top collar 35 which forms an abutment for the upper end of the packing sleeve, the ring nut forming the lower abutment

therefor. The top collar 35 is provided with a castellated upper end which forms by-pass ports 36 communicating with annular space between the sleeve 31 and mandrel 1. The upper packer collar 29, upper packer mandrel 31 and top collar 35 are spaced from the inner mandrel 1 as shown to form therewith an annular passage which communicates with and forms an upper extension of the beforementioned annular flow passage between the shell 16 and the inner mandrel 1.

Operation of my double seal packer is as follows: The packer is assembled as shown in Figure 1 and run into the well bore, the cage being locked to hold the slips 22 from coaction with the cone 21 and the shear pin or pins 33 holding the upper packer mandrel in an extended position so that neither the upper nor lower packing elements are under compression. When the desired location is reached as, for example, when the packing elements are located, respectively, above and below, a gun perforated section of casing (designated A in Figure 1), the slips are released into engagement with the wedge cone 21 against downward movement relative to the casing; thereupon weight is applied from the tubing string 4 through the outer slip joint body 8, top collar 35, sleeve 31, shear pin 33, upper packer collar 29, shell 16, lower packer collar 18, lower packing sleeve 20, and, thence, to the wedge cone 18 which causes the lower packing sleeve 20 to be compressed longitudinally and thereby to expand radially into sealing engagement between the packer mandrel 19 and the surrounding casing. Further weight shears the pin or pins 33, allowing the upper packer mandrel 31 and top collar 35 to move downwardly relative to the upper packer collar 29 and thereby, in turn, to expand the upper packer sleeve into sealing engagement between the packer mandrel 31 and the surrounding casing. The weight of the lower tubing string 2 and mandrel 1 tends to maintain the lowermost packing element in a pack-off position, while the weight of the upper tubing string 4, acting through the outer body 8 and upper packer collar 29, tends to maintain the upper packing sleeve in a pack-off position.

When the two packers have thus been seated, fluid such as gas which may enter through the perforations A into the annular space between the casing designated B, and the shell 16, will be confined by the packers and forced to pass into the intake ports and through the ducts 17 into the interior of the mandrel which communicates with the tubing strings 2 and 4. Gas entering these ports may thus be utilized to gas-lift liquid flowing upward from the lower tubing 2 to the upper tubing 4 from a lower production zone into which the lower tubing string extends. At the same time, pressure on the lower formation outside of the tubing 2 may be either increased or decreased and gas injected or withdrawn by way of the by-pass communication through the packer device from the lower end of the dual seal packer through the lower mandrel 19, lower spacer 14, shell 16, upper spacer 13, upper packer collar 29, upper packer mandrel 31, top collar 35 and by-pass ports 36.

While the shear pin 33 is preferably employed, it should be noted that the double seal packer is fully operative if this pin is omitted. Where the shear pin 33 is omitted, the force to compress the lower packing sleeve is transmitted through the upper packing sleeve. The upper and lower

packing sleeves, of course, then tend to expand simultaneously and, under such condition, the upper packing sleeve must slide slightly on the casing in its expanded or partially expanded condition in order to allow sufficient downward motion of the shell 16 to compress fully the lower packing sleeve. This slightly reduces the force available for expanding the lower packing sleeve, but the weight of the tubing string is usually more than adequate to insure complete setting of both packing sleeves under such condition.

For convenience of manufacture, the major structural assemblies which function as unitary parts of the device, in most cases, comprise several parts. For example, the shell or shell structure may comprise, not only the shell 16 per se, but also the mandrel 19, the collar 18, spacers 14 and 13, packer collar 29, and ring nut 30, all coupled coaxially together. The packing mandrel 31 and top collar 35 also may be considered as comprising a part of the shell or shell structure from which it slidably extends. The upper packing structure may constitute a sub-assembly portion of the shell structure, including not only the upper packing sleeve 34, but also those elements which directly affect its operation, namely, the ring nut 30, mandrel 31, and top collar 35. Similarly, the lower packing structure may form a sub-assembly portion of the shell structure, including the packing sleeve 20, collar 18, cone 21, slips 22, and slip cage 24.

The mandrel or mandrel structure may include the tubular portion and attached inner body 5. Also, the mandrel 1 and sleeve or shell structure, as defined hereinbefore, may be considered and described as constituting a unitary tubular assembly which taken as a whole, defines an inner, longitudinal flow passage, and an intermediate longitudinal flow passage or by-pass, and, together with the well casing within which the device is intended to operate, an outer flow passage; the inner passage being within the bore of the mandrel, the intermediate passage or by-pass being in the annular space between the mandrel and shell, and the outer passage being in the annular space between the shell and the surrounding casing.

Various changes and alternate arrangements may be made within the scope of the appended claims, in which it is my intention to claim all novelty inherent in the invention as broadly as the prior art permits.

I claim:

1. In a well device adapted to be suspended from a tubing string and set within a well casing: an inner tubular mandrel forming an inner longitudinal flow passage from end to end through said device; an external shell structure surrounding a portion of the tubular mandrel and rigidly attached in spaced relation thereto to form a separate, intermediate, longitudinal flow passage therethrough; a lateral duct extending between and interconnecting the interior of said inner mandrel and the exterior of said shell structure; a slip joint for coupling said mandrel to said tubing string with freedom for limited longitudinal sliding motion of said tubing relative to said mandrel; a pair of packing sleeves, positioned on said shell structure adjacent the opposite extremities thereof and in longitudinally spaced relation on either side of said lateral duct; gripping means associated with said shell structure and adapted to effect gripping engagement with a surrounding casing; and means actuated by relative longitudinal sliding motion between

said tubing and said gripping means to axially compress said packing sleeves and thereby radially expand them into sealing engagement between said sleeve structure and a surrounding casing.

2. In a well device adapted to be suspended from a tubing string and set within a well casing: an inner tubular mandrel forming an inner longitudinal flow passage from end to end through said device; an external shell structure surrounding a portion of said tubular mandrel and rigidly attached in spaced relation thereto to form a separate, intermediate, longitudinal flow passage therethrough; a lateral duct extending between and interconnecting the interior of said inner mandrel and the exterior of said shell structure; gripping means longitudinally slidable on said shell structure and adapted to effect gripping engagement with a surrounding casing; a pair of packing sleeves positioned on said shell structure adjacent opposite extremities thereof and longitudinally spaced on either side of said lateral duct, said packing sleeves being adapted, under axial compression, to radially expand into sealing engagement between said shell structure and a surrounding casing; and means including a slip joint coupling for said tubing string and said tubular mandrel for axially compressing both of said packing sleeves upon movement of said tubing string in a direction toward said gripping means.

3. In a well device adapted to be suspended from a tubing string and set within a well: an inner tubular mandrel forming an inner longitudinal flow passage from end to end through said device; an external shell structure surrounding a portion of said tubular mandrel and rigidly attached in spaced relation thereto to form a separate, intermediate, longitudinal flow passage therethrough; a lateral duct extending between and interconnecting the interior of said inner mandrel and the exterior of said shell structure; a wedge cone longitudinally slidable on said shell structure; slips adapted to be forced into gripping engagement between said wedge cone and a surrounding casing; means normally retaining said slips in retracted position relative to said wedge cone and operative to release said slips into wedging engagement between said wedge cone and a surrounding casing; a pair of packing sleeves positioned on said shell structure adjacent opposite extremities thereof and longitudinally spaced on either side of said lateral duct, said packing sleeves being adapted, under axial compression, to radially expand into sealing engagement between said shell structure and a surrounding casing; and means including a slip

joint coupling for said tubing string and said tubular mandrel for axially compressing both of said packing sleeves upon movement of said tubing string in a direction toward said wedge cone.

4. In a well device adapted to be suspended from a tubing string and set within a well casing: a tubing string; an inner tubular mandrel forming an inner longitudinal flow passage from end to end through said device; an external shell structure surrounding a portion of said tubular mandrel and rigidly attached in spaced relation thereto to form a separate, intermediate, longitudinal flow passage therethrough between said mandrel and said shell structure and, when set in a surrounding casing, an outer flow passage between said shell structure and said casing; a lateral duct extending between and interconnecting the inner flow passage in the interior of said inner mandrel and the outer flow passage on the exterior of said shell structure; a slip joint for coupling said mandrel to said tubing string with freedom for limited longitudinal sliding motion of said tubing relative to said mandrel, said slip joint including a tubular member adapted to be secured to said tubing string; a collar surrounding said tubular mandrel and adapted to be engaged by said tubular member upon downward movement thereof; a wedge cone longitudinally slidable on said shell structure adjacent the end thereof opposite to said slip joint; slips adapted to be forced into gripping engagement between said wedge cone and a surrounding casing; latch means normally retaining said slip in retracted position relative to said wedge cone and operative to release said slip into wedging engagement between said wedge cone and a surrounding casing; a pair of packing sleeves positioned on said shell structure and longitudinally spaced on opposite sides of said lateral duct, said packing sleeves being adapted, under axial compression, to radially expand into sealing engagement between said shell structure and a surrounding casing, one of said packing sleeves being disposed longitudinally between said wedge cone and a portion of said shell structure, and the other of said packing sleeves being disposed longitudinally between said collar and a portion of said shell structure, all in such manner that both said packing sleeves are axially compressed when said tubing string moves in the direction toward said wedge cone.

5. In a well device apparatus according to claim 3 and means for coupling a second length of tubing to the end of said mandrel opposite to the said slip joint.

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