

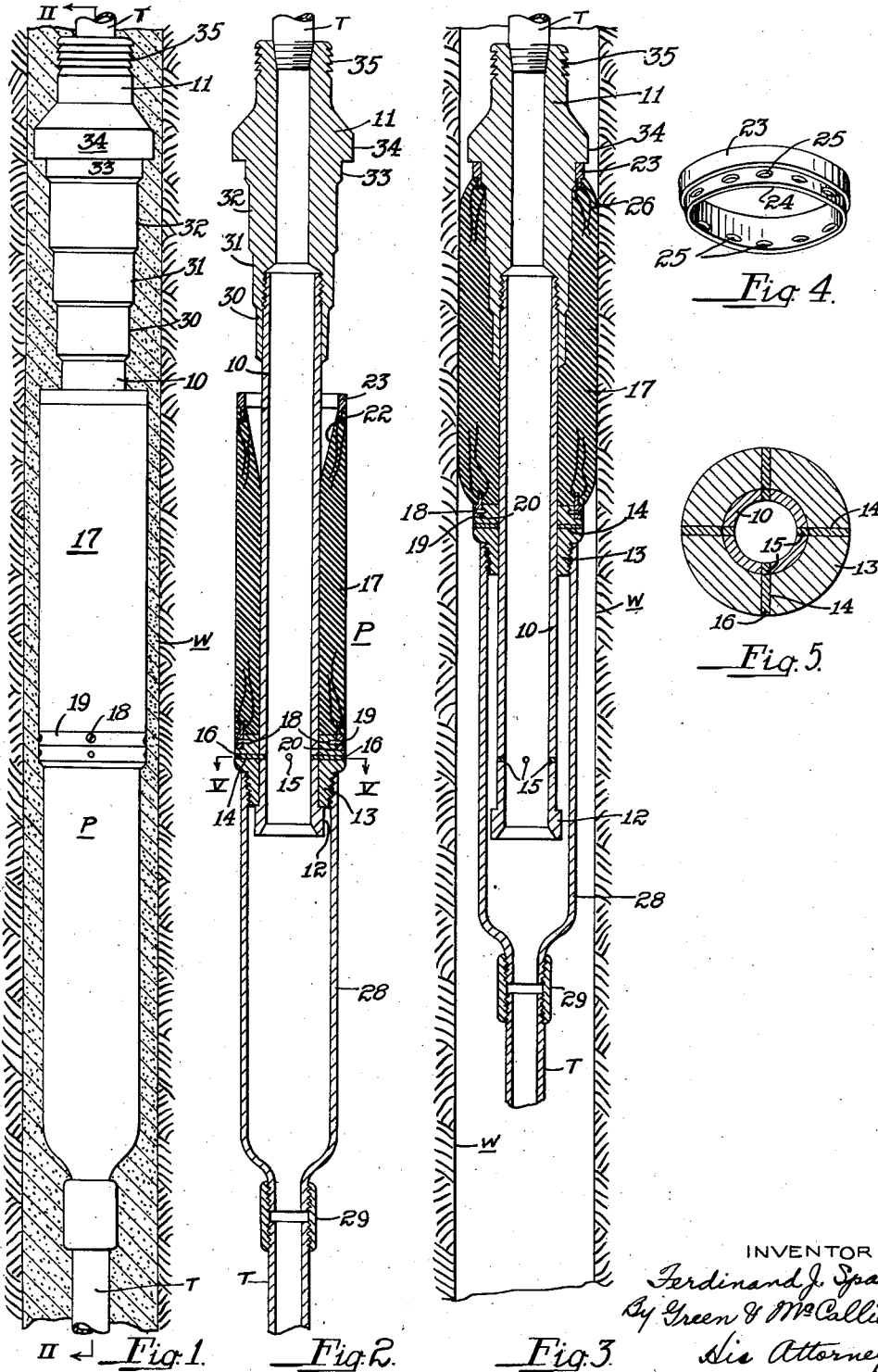
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PACKER

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UNITED STATES PATENT OFFICE

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PACKER

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14 Claims. (Cl. 166—10)

This invention relates to well packers, and more particularly to improvements in packers of the type adapted to be used in packing extremely deep wells producing a large volume of natural gas and having a relatively high rock pressure.

In the production of natural gas after the well has been drilled through the gas producing formation a string of tubing, having a packer located therein, is run into the well and the packer is set to confine the flow of gas from the well to the string of tubing.

Two types of packers are generally employed, both of which are provided with rubber packing elements. In the conventional type of packer, the rubber packing element is confined between two shoulders which limit its travel, while in all other types of packers the upper end of the packing element is left free and unsupported.

However, with either type of packing element it is difficult to lower the packer into the well without inflicting considerable damage thereto, especially when large volumes of gas under high pressure are flowing through the casing, since the gas exerts a considerable wiping action on the packing element. The wiping action of the gas on the packing element of the conventional type packer tends to thin the rubber at the lower end and to elongate it to such an extent that it "bunches" at the top where its movement is limited by the upper shoulder with the result that the packing element is not only subjected to excessive frictional wear but the packing element may lock and cause the packer to be set prematurely before it has been lowered to the desired location in the well. With packers having the upper end left free, this wiping action of the gas causes the top of the packing element to flutter and to tear into shreds, which is augmented by the abrasive action of the sand or shale carried in the gas, thereby destroying the packing element.

One object of the present invention is to provide a packer which may be readily lowered into a gas producing well without damage to the packing element by the flow of a large volume of gas under high pressure past the packer.

Another object of this invention is to provide a packer having a packer element so constructed that it will permit the gas to flow past it readily and will not elongate or "bunch" and will not flutter as a result of the gas flow.

A further object is to provide a packer which is constructed to restrict the flow of gas past the top thereof to such an extent that the highest

velocity of the gas is obtained above the top of the packer element whereby the packing element is maintained in a zone of reduced velocities having a lower rate of flow and is protected from excessive whipping action.

These and other objects which will be hereinafter made apparent to those skilled in this particular art are accomplished by means of this invention, one embodiment of which is described in the following specification and illustrated in the accompanying drawing, wherein:

Figure 1 is a view in vertical section through a well bore having a packer made in accordance with my invention lowered thereto and illustrates the relation of the packer elements to the wall of the well bore.

Fig. 2 is a sectional view of the packer taken on line II—II of Fig. 1.

Fig. 3 is a sectional view of the well bore and packer showing the packer in its expanded or set position.

Fig. 4 is an enlarged perspective view of the metallic ring used to protect the upper end of the packing element.

Fig. 5 is an enlarged sectional view taken on line V—V of Fig. 2.

Referring to the drawing in detail, W represents a well drilled through a gas producing formation having my improved packer P, which is inserted between adjacent sections of pipe, making up a string of tubing T, lowered thereto. The packer P comprises a cylindrical body 10 having its upper end threaded into a coupling member 11 which is threaded onto the lower end of one section of the tubing T. The lower end of the body 10 is provided with an outwardly projecting flange 12 which forms a limit and a support for an annular member 13 that is slidably mounted on the body 10. The member 13 has a series of circumferentially spaced openings 14 which, when the member is in its lower position and supported on the flange 12, cooperate or register with openings 15 formed in the body 10, and the member 13 is normally held against sliding movement on the body 10 by frangible pins 16 which extend through the registering openings 14 and 15.

A packing element 17 of general cylindrical shape, which may be made of rubber or any other suitable material, is slidably mounted on the body 10 and has its lower end supported on the member 13 and to which it is secured by screws 18 which extend through a metallic ring 19 secured to the element 17 and mounted in a recess 20 on the surface of the member 13.

The upper end of the packing element 17 is free and unsupported and the inner surface thereof is flared outwardly as at 22, to space it from the outer surface of the packer body 10. This free upper end of the packing element 17 is protected by a metallic ring 23 (Fig. 4) which is provided with a downwardly depending flange 24 having apertures 25 therein through which suitable strips 26, such as canvas duck, are threaded and molded into the packing element prior to the vulcanization thereof. The ring 19 is similar in construction and is attached to the lower end of the packing element 17 in the same manner that the ring 23 is attached to the upper end thereof.

To actuate or set the packer, a sleeve 28 of substantially cylindrical form is threaded exteriorly to the member 13 and extends downwardly a substantial distance below the bottom of the body 10. The lower end of the sleeve 28 is reduced in diameter and is connected to the upper end of a section of tubing T by means of a collar or coupling 29.

When the lower end of the string of tubing 25 reaches the bottom of the well and comes to rest thereon, the weight of the tubing T above the packer P shears the frangible pins 16 and permits the body 10 to telescope through the member 13 and move into the sleeve 28. This downward movement of the body relative to the packing element 17, which is held stationary, causes the coupling 11 to approach and enter the flared upper end of the packing element 17. Coupling member 11 is provided with three cylindrical steps 30, 31, and 32, of successively increased diameter from the bottom to the top thereof, and as the coupling moves into the packing element 17, the free upper end of the packing element is successively engaged by each of the three steps 30, 31, and 32, and the packing element is consequently expanded. The coupling 11 is also provided with a seat 33 for receiving the ring 23 and with an enlarged head or collar 34 which forms an upper abutment for the ring 23.

After all three of the steps 30, 31, and 32 have exerted an expanding influence on the packing element 17 the ring 23 on the free upper end thereof seats on the ring seat 33 confining the packing element 17 between the member 13 and the collar 34, and the continual pressure of the coupling 11 and the weight of the tubing T above the packer exerts an expanding force on the packing element 17 which causes it to further expand and press firmly against the well bore W, thus sealing the space between the well bore and the tubing and preventing the flow of gas around the packer element.

So that the packer may be readily withdrawn from the well bore if the tubing breaks or comes loose from the packer P, the outer surface of the coupling 11 is provided with externally formed serrations 35 which are adapted to receive and cooperate with a suitable grappling or fishing tool by means of which the apparatus may be fished from the well bore.

The collar 34 on the coupling 11 is considerably larger than the external diameters of the annular member 13 and of the packing element 17, and consequently forms a flow restricting member and because of the law governing the behaviour of gases under various pressures the space between this flow resisting collar 34 and the well bore W becomes the orifice through which the gas passes at the greatest velocity as the packer is lowered into the well bore. As a

result of this construction, a zone of highest gas velocity is maintained above the top or free end of the packing element 17, which materially reduces fluttering and objectionable elongation of the packing element.

As a further result of the flow restricting collar 34, the point of destruction or disintegration of the well bore W, because of the velocity of the gas passing the packer, is localized above the rubber packing element 17, and such destruction or disintegration does not occur until after the packing element has passed below such point. Consequently, the blow of gravel, shale, etc., from the wall of the well W does not come into contact with the rubber packing element 17 and the abrasive action of such particles of gravel and shale on the rubber packing element is eliminated. From the foregoing it will be noted that enlarged flow restricting collar 34 on the coupling 11 causes the retention of a higher gas pressure below it than above it due to the fact that the gas having once passed the collar expands rapidly and this maintenance of the higher gas pressure on the lower side of the area restricting collar not only reduces the volume of the gas below the collar but also decreases its rate of flow, and therefore the gas has less tendency to whip the packing element, and, consequently, the danger of shredding or otherwise injuring of the packing element is materially reduced.

It is apparent that when a packer construction in accordance with my invention, with the lower end of the rubber packing element 17 firmly attached to the annular member 13 and the upper end free, is lowered into the well W, the movement of the gas past the element has a tendency to elongate it, but there is no expanding or bunching thereof since the upper end is free to move upwardly and the metallic ring 23 on the top of the packing element reduces fluttering and prevents it from being whipped or frayed by the movement of the gas past the packing element.

Further, it will be noted that when the packer is set (Fig. 3), the ring 23 engages the ring seat 33 on the top coupling 11 and the fabric 26 carried by the ring spreads out within the rubber packing element 17 in such a way as to form a basket and protect the rubber from being blown off the packer.

While it is old in the art to use metallic rings with perforated slots and fabric to connect the ring to the rubber packing element, I believe that I am the first to use such a ring on a rubber packing element having its upper end free and spaced from the ring seat on which it is adapted to come into engagement in the process of setting.

From the foregoing description of my invention it is apparent that I have produced a device for packing extremely deep gas wells having a large volume of flow therethrough and having high rock pressure in which the packing element is protected against damage, during the time it is being lowered into the well bore, from the wiping and shredding action of the gas and the abrasive materials carried thereby, and since the velocity of the gas is highest at a point above the free end of the packing element the flow and pressure of gas adjacent the packing element is reduced and the whipping action of said gas on said packing element is substantially minimized or eliminated.

While I have described the collar 34 as having

3 successively enlarged steps thereon which enter the free end of the packer element 17, it is to be understood that I am not limited to this particular member, but that any number of multiple steps may be formed on the collar 34 and that other modifications, additions, subtractions, and omissions may be made in the packer illustrated in the drawing without departing from the spirit of my invention and the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent is:

1. A well packer comprising a body, a cylindrical expansible element carried by said body, a member secured to said element and slidable over said body, an area restricting member of larger diameter than said expansible element secured to said body, and means on said area restricting member for expanding said element.
2. A well packer comprising a body, a packing element surrounding said body, a member secured to said element and movable relative to said body, a stepped expander carried by said body, and means associated with said expander for maintaining a higher velocity of gases above said packing element than adjacent thereto.
3. A well packer comprising a body, a cylindrical resilient packing element carried by said body, a member secured to said element and movable relative to said body, means secured to said body for expanding said element on movement of said member relative to said body, frangible means for connecting said member to said body, and an area restricting member of greater diameter than said packing element mounted on said body above said expansible element.
4. A well packer comprising a body, a cylindrical element surrounding said body and having the upper end thereof free and unsupported, the inner surface of said element at the free end thereof flaring away from said body, a metallic ring attached to the flared upper end of said element, and means for expanding said element.
5. A well packer comprising a body, a cylindrical expansible element surrounding said body and having its upper end free and unsupported, the inner surface of said element at the free end thereof flaring away from said body, a solid metallic ring secured to the flared end of said element for protecting the unsupported portion thereof from the whipping and shredding action of gases passing therearound, and means adapted to pass through said ring for expanding said element.
6. A packer for use in gas wells having a high rock pressure comprising a body, an expansible element of cylindrical form surrounding said body and having its upper end free and unsupported, the inner surface at the free end thereof flaring away from said body, means for reducing the velocity of the gas adjacent the flared end of said expansible element, and means for expanding said element.
7. A packer for use in gas wells having a high rock pressure comprising a body, an expansible element of generally cylindrical shape surrounding said body and having its upper end free and provided with a tapered inner surface, an area restricting member on said body of greater diameter than said element and spaced thereabove, means for protecting the tapered end of said element, and means for expanding said element.
8. A well packer comprising a tubular body, a member slidably mounted on said body, a packing element surrounding said body and having

its lower end secured to said member and its upper end free and unattached the inner surface of the free end thereof being tapered, a solid metallic ring secured to the upper end of said packer element, an expander secured to said body and having a ring seat thereon normally spaced above said ring, and means for causing movement of said body relative to said member to move said element over said expander and position said ring on said seat.

9. A well packer comprising a tubular body, a member slidably mounted on said body, a packing element surrounding said body and having its lower end secured to said member and its upper end free and unattached and flared away from said body to receive an expander, a metallic ring secured to the upper end of said packer element, a coupling carried by said body and normally spaced above said packing element, said coupling having a series of successively enlarged cylindrical steps adapted to successively pass through said ring and expand said packing element on movement of said body relative to said element, and means for causing movement of said body relative to said member.

10. A well packer comprising a tubular body, a member slidably mounted on said body, a packing element surrounding said body and having its lower end secured to said member and its upper end free and unattached, the upper end of said element having a flared inner surface, a ring secured to the flared upper end of said element, a coupling mounted on said body and normally spaced above the upper end of said packing element, a series of successively enlarged steps on said coupling, a ring seat on said coupling above said steps, and means for moving said body and coupling relative to said member to move said steps into the flared end of said packing element and position said ring on said seat.

11. A well packed comprising a tubular body, a member slidably mounted on said body, a packing element surrounding said body and having its lower end secured to said member and its upper end free and unattached, the upper end of said element having a flared inner surface, a ring secured to the flared upper end of said element, a coupling mounted on said body and normally spaced above the upper end of said packing element, a series of successively enlarged steps on said coupling, a ring seat on said coupling above said steps, a collar on said coupling above said ring seat and having a diameter greater than the diameter of said member and said packing element, and means for moving said body and coupling relative to said member to move said steps into the flared end of said packing element and position said ring on said seat.

12. A well packer comprising a tubular body, a member slidably mounted on said body, a packing element surrounding said body and having its lower end secured to said member and its upper end free and unattached, the upper end of said element having a flared inner surface, a ring secured to the flared upper end of said element, a coupling mounted on said body and normally spaced above the upper end of said packing element, a series of successively enlarged steps on said coupling, a ring seat on said coupling above said steps, a collar on said coupling above said ring seat and having a diameter greater than the diameter of said member and said packing element, frangible means for holding said member stationary relative to said body, and means

for shearing said frangible means and cause said body to move relative to said member to move said steps into the flared end of said packing element and position said ring on said seat.

- 6 13. Apparatus for use in packing a gas producing well having a high rock pressure, comprising a body adapted to be lowered into a gas well, a packing element surrounding said body and movable relative thereto and having its upper end free and unsupported, means coaxing with the unsupported end of said packing element for expanding the same, means on said body for increasing the velocity of the gas flow at a point above the free and unsupported end of said packing element and for reducing the velocity adjacent said element, and means for moving said packing element relative to said body.

14. Apparatus for use in packing a gas producing well having a high rock pressure, comprising a body adapted to be lowered into a well, a packing element surrounding said body and movable relative thereto, said packing element flaring away from said body at the upper end thereof and being free and unsupported, means carried by said body adapted to enter the flared end of said packing element for expanding the same, means associated with said expanding means for increasing the velocity of the gas flow at a point above said packing element while said apparatus is being lowered into the well, and means for moving said packing element relative to said body to move the flared end thereof over said expanding means.

FERDINAND J. SPANG.

CERTIFICATE OF CORRECTION.

Patent No. 2,136,597.

FERDINAND J. SPANG.

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It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 3, first column, line 38, claim 4, before the word "element" insert packing; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 10th day of January, A. D. 1939.

Henry Van Arsedale

(Seal)

Acting Commissioner of Patents.