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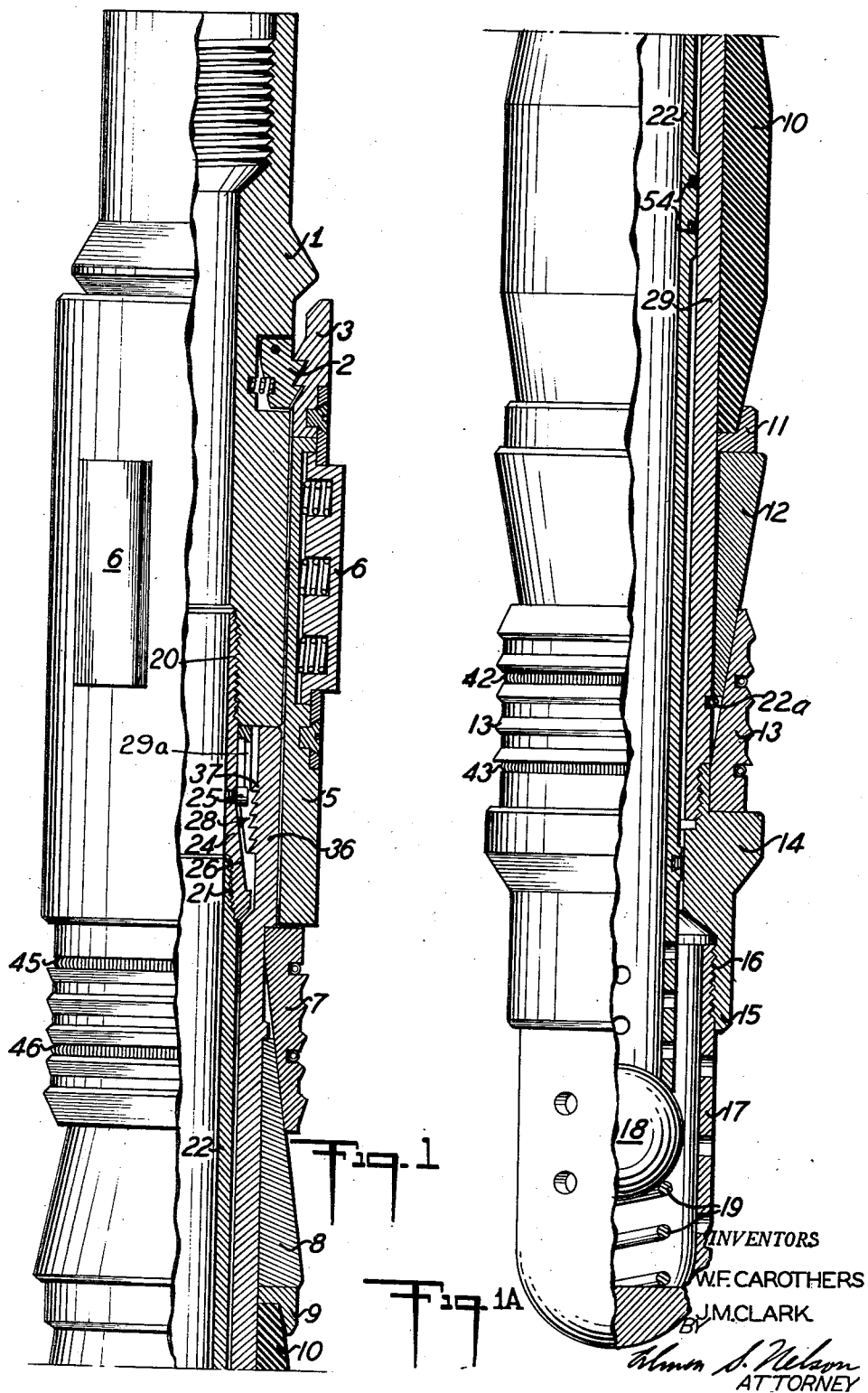
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PRODUCTION PACKER AND RETRIEVABLE CEMENTING TOOL

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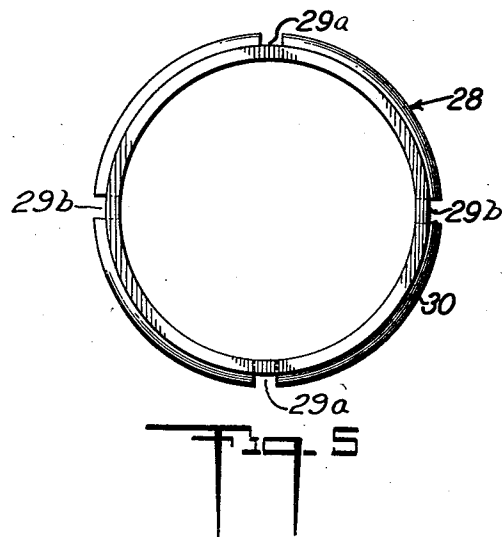
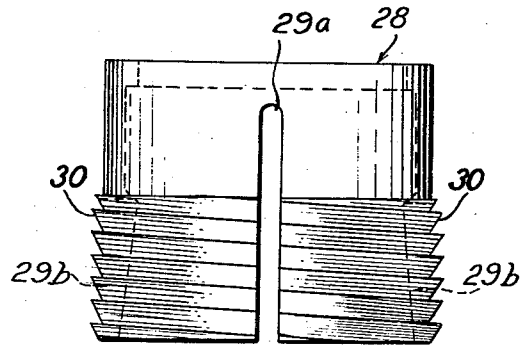
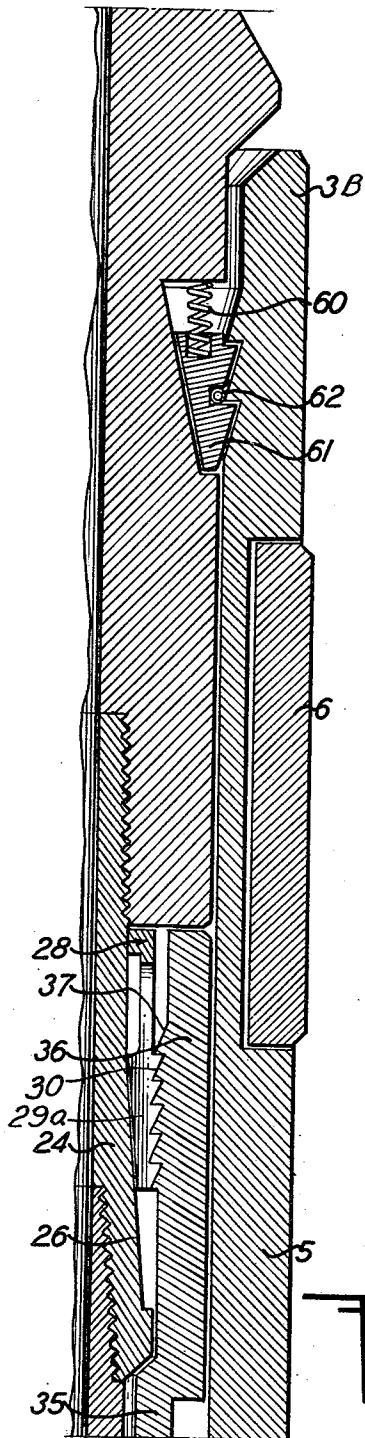
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PRODUCTION PACKER AND RETRIEVABLE CEMENTING TOOL

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3 Sheets-Sheet 3



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**PRODUCTION PACKER AND RETRIEVABLE
CEMENTING TOOL**

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5 Claims. (Cl. 166—126)

This invention is directed to a production packer and, as indicated, is more particularly directed to a tool adapted to be used in the bore of an oil well or the like and particularly at the end of a tubing string.

A main object of the invention is to avoid making costly strips with the tubing string into and out of the bore of the well and to further produce from different zones as well as to provide means for retrieving a portion of the packer setting mechanism that is not drillable.

One object of the invention is to provide a drillable packer assembly so that if the slip and/or packer become fouled in the well the same may be drilled up and flushed out of the bore.

A detailed object of the invention is to provide such a tool with a packer setting portion which can be released by a left-hand thread connection and recovered from the well along with the tubing string, thus leaving the packer in the hole where the same may be drilled up in order to clear the hole.

Another detailed object of the invention is to provide a mechanically set packer as distinguished from a pressure-operated packer, in which the packer is set by means of the tubing string, thus eliminating an extra trip in order to bring in upper sands.

A specific object of the invention is to provide a packer of resilient material such as rubber or synthetic rubber or substitutes having a high carbon content, the packer body being surrounded at its upper and lower edges with lead sealing rings which protect the packer body.

A further object of the invention is to provide a latch-back mechanism mounted on a stinger connected to the lower end of the tubing string, the latch-back mechanism comprising a left-hand threaded sleeve movable upon a conical surface on the stinger. This renders it possible to release the tubing string and tubing from the packer due to the provision of complementary left-hand threads on a mandrel upon which the packer body is mounted.

A still further object of the invention is to provide means permitting rapid, easy removal of a stinger seal which facilitates the replacing of mud on the upper producing zone if the well is to be a dual completion job.

Another object of the invention is to provide a packer which can be set between different zones in a well after which the upper zone may be washed in by removing the stinger from the packer and then by replacing the stinger in the packer, the lower zone can be swabbed in without removal of the tubing production string from the well bore, thus eliminating expensive trips with the tubing producing string.

Still another object of the invention is to provide means operable upon decision of the operator to abandon the lower zone in the form of a packer which may be used as a bottom hole plug or, if desired, which can be squeezed through, thus cementing off the lower zone without the necessity of setting another tool.

A further object of the invention is to provide a combination of a tubing string, packer setting mechanism and stinger wherein, if desired, the tubing string may be removed along with the packer setting mechanism and stinger and may subsequently be used on the other packer settings.

A broad object of the invention is to provide a tool very simple in design and arrangement of parts and wherein the setting mechanism provides a tool which

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is impossible to prematurely set while going into the hole.

A construction designed to carry out the invention will be hereinafter described, together with other features of the invention.

The invention will be more readily understood from a reading of the following specification and by reference to the accompanying drawings, in which an example of the invention is shown and wherein:

Fig. 1 and Fig. 1-A are elevation views with one-half of the tool shown in vertical section;

Fig. 2 and Fig. 2-A are elevations of a modification with one-half thereof in section;

Fig. 3 is a partial vertical section of a modification of the latch mechanism which connects the tubing string and the packer setting mechanism;

Fig. 4 is an elevation of that part of the latch-back mechanism which is mounted on the stinger.

Fig. 5 is a plan view taken from above Fig. 4.

Referring now to the drawings and more particularly to Fig. 1, it will be seen that the tubing string 1 is connected to the upper end 3 of the upper packer setting mechanism by means of a latch 2 which is spring loaded and is pivoted to the tubing string.

The upper packer setting means includes a friction block which comprises a cylindrical member having an upper part 3, a lower part 5, spaced wiper pads 6 lying between such parts, and slips and an expander cone therefor.

Immediately below the lower end 5 of the friction block, slips 7 are mounted upon cone 8 so that upon downward movement of the slips the same are forced outwardly into engagement with the casing wall. An annulus 9 is mounted below the cone 8 and has a depending flange so as to encircle the upper edge of packer 10, this annulus being formed of lead. In the same manner, a lead ring 11 is mounted at the lower edge of the packer 10, these lead seals performing the dual function of retaining the free edges of the packer and also protecting the packer which is preferably formed of rubber or rubber-like material having a high carbon content.

The lower packer setting means comprises a specially disposed cone 12 supported below the lower lead seal 11, this cone being held in place on mandrel 29 by the shear ring 22a and a lower set of slips 13 which are retained about the cone 12 by means of springs 42 and 43. The upper slips 7 are retained in the same manner by means of coil springs 45 and 46.

Threadedly connected to the lowermost end of the mandrel 29 is a cylindrical member 14 enlarged at its upper edge to normally support the slips 13. The interior surface of the lower portion 15 of said member is threaded in order to support the tailpipe 17 which can be perforated, as shown in Fig. 1-A, thus permitting the flow of production up through the stinger, the tubing string, and to the surface. This tailpipe 17 is closed at its lower end, thus providing a seat for the compression spring 19 which urges the ball valve 18 upwardly into tight engagement with the lower end of the stinger 22.

Referring now to Fig. 2, the same general combination of parts is shown, this combination comprising the tubing string 1, packer and packing mechanism described as above, stinger 22b, mandrel 35, and latch-back mechanism which will be described hereinafter.

At the upper end 3A of the friction block, left-hand setting threads 4 are provided which mate with complementary threads upon the tubing string 1 so that upon rotation to the right the tubing string 1 and stinger 22b may be removed.

At the upper end of the stinger 22b a cylindrical member 24 is threadedly connected to the stinger by means of threads 21 and this member is in turn connected to the tubing string 1 by means of threads 20.

A conical surface 26 is provided on the exterior of the member 24 along which the latch back slip 28 (see Fig. 4) is designed to slide a definite distance, depending upon the length of the slots 29a. This latch back slip or sleeve has exterior left-hand threads 30 which mesh with interior left-hand threads 37 on the upper end 36

of the mandrel 35. The latch back slip is retained by means of headed bolts 25 which permit a small amount of radial movement, this depending upon the taper of the surface 26 and also permit longitudinal movement depending upon the length of the slots 29a. The shorter slots 29b impart resilience to the lower portion of the latch back slip 28.

Sealing rings 23 and 31 are provided adjacent the lower end of the stinger to separate upper and lower production zones if dual completion is desired, and to prevent the lower zone from producing into casing-tubing annulus above the packer. This embodiment of the invention differs from that depicted in Figs. 1 and 1-A in that the lower end instead of being provided with a tail pipe has pivoted thereto a spring loaded flapper valve 52. The spring has not been shown since it would merely complicate the drawings and the flapper valve 52 is provided with a sealing ring 53 adapted to contact the lowermost horizontal surface of the collar 40 which is threadedly connected to the mandrel 35 by means of the threads 39.

The lower slips 13 are retained by means of headed bolts 41 of somewhat the same character as described with respect to the bolts 25 of the latch-back mechanism.

The lower slip cone 12 is normally retained in position by means of a shear ring 38. When it is desired to set the packer a predetermined amount of upward force will shear the ring 38, thus permitting the slip cone 12 to rise and compress the packer while the slips 13 are forced into engagement with the casing.

Referring now to Fig. 3, a modification of the connecting means between the tubing string 1 and upper end 3B of the friction block is shown. In this form the latch 61 is provided with a left-hand thread which engages complementary threads on the upper end 3B of the friction block 5 and the latch is surrounded by a garter spring 62 which secures it to the tubing string. Coil spring 60 normally presses the latch radially outwardly so that the threads are in engagement. Disconnection may be made by rotating the tubing string to the right and the parts may again be reconnected by a straight downward movement.

This figure also shows the latch-back mechanism with the parts thereof connected and somewhat enlarged.

In operation mechanical setting of the packer is achieved by turning the tubing string 1 two or three turns to the right thereby releasing the upper left-hand threads 4 of Fig. 2 or the left-hand threaded latches 2 of Fig. 1 and 61 of Fig. 3. When this has been done the latch back slip 28 and the mandrel are free to move upwardly with respect to the friction block and upper slips 7 are set first by upward movement of the tubing string after the packer is positioned. Continuous upward movement will then set the lower slips. This upward movement relative to the friction block forces the upper slips 7 out on the cone 8 due to the holding action of the friction block. Inasmuch as the mandrel 35 Fig. 2-A is threadedly connected at its lower end with the collar 40, and in Fig. 1-A the mandrel 29 is similarly connected to cylindrical member 14. The lower slips 13 are forced upwardly on the lower cone 12 which in turn forces the resilient packer radially outward into tight engagement with the interior casing wall, thus setting the packer.

The "stinger," which is a term used herein to describe a hollow cylindrical sleeve-like member, this being the innermost member of the assembly, is then free to be unlatched by the latch-back slip 28. If it is desired to wash in the upper zone the stinger is disengaged entirely from the packer body by turning the tubing string to the right and pulling upwardly to a desired distance above the friction block whereupon the weighting material or mud in the tubing string may be displaced, inasmuch as the mud lies in the annulus formed by the interior surface of the casing and the exterior surface of the tubing string. After this washing operation the stinger can be again inserted into the packer body and latched into a locked position either by a straight downward movement of the tubing string where latches 2 of Fig. 1 or 61 of Fig. 3 are employed or by rotation to the left where the setting threads of Fig. 2 are employed.

If, upon exhausting the lower zone, the operator desires to squeeze off the lower zone since it is no longer productive, it is only necessary to unlatch the tubing

string and stinger from the set packer body after killing the lower zone. The stinger is then lifted from the packer body, the upper zone is sealed off with mud and the two zones are automatically separated mechanically with the flapper valve 52 of Fig. 2-A which closes by the pressure of a spring (not shown) when the stinger is removed. The mud in the tubing string may be displaced with cement slurry when the stinger has been replaced into the packer and it is then possible to proceed to squeeze the lower zone with cement by pushing the flapper valve open with the stinger. After this the stinger may be again removed whereupon the flapper valve closes and the lower zone is sealed off without making a trip out of the bore and into the bore with the tubing string and the stinger.

From the foregoing description it will be seen that we have provided a squeeze tool and production packer wherein the packer is drillable and the setting tool 1 and "stinger" are retrievable. It will also be noted that the packer setting tool can be released and recovered leaving the packer in the well which can be subsequently drilled up to clear the hole. In addition to the foregoing it will be noted that a mechanically set packer is employed and that it is operated by the tubing string thereby eliminating extra trips to bring in the upper sands. Protective lead seals have been provided above and below the packer.

A wide departure from prior art mechanism resides in the latch-back mechanism which permits release of the major portion of the tool from the packer once it has been set but where if desired, the major portion of the tool may be again connected to the packer.

Finally, it will be noted that a means has been provided to avoid making costly trips with a tubing string into the well. After the lower zone of the well has been exhausted operations may still be performed with respect to the upper zone or zones of the well and the lower zone may be sealed off without pulling the tubing string from the well.

It will be obvious that modifications may be made by those skilled in the art without departing from the spirit of the invention, and it is our desire to cover all such modifications as come within the scope of the invention as defined in the following claims.

We claim:

1. In apparatus of the character described the combination of a tubing string, a stinger connected to the lower end of said string, a mandrel surrounding said stinger, a packer mounted on said mandrel, packer setting means releasably connected to said string and means connecting said stinger and said mandrel, said means comprising a threaded sleeve mounted on a conical surface on said stinger, being movable with respect thereto and complementary threads located upon the interior surface of said mandrel, said threads being left-handed and said threaded sleeve having slots therein with head bolts secured to said stinger and lying in said slots to permit a limited amount of radial and longitudinal movement.

2. In apparatus of the character described the combination of a tubing string, a stinger connected to the lower end of said string, a mandrel surrounding said stinger, a packer mounted on said mandrel, packer setting means slidable on said mandrel and releasably connected to said string and disconnectable from said string to expand said packer upon upward movement of said string and mandrel relative to the packer setting means and means releasably connecting said stinger and said mandrel, said means comprising a threaded sleeve, mounted upon a conical surface on said stinger, means non-rotatably mounting said threaded sleeve on said conical surface, for longitudinal movement with respect thereto and complementary threads located upon the interior surface of said mandrel engageable and disengageable with said threaded sleeve and whereby the string, stinger, and mandrel are movable together when connected and the string and stinger are removable from the packer setting means, packer, and mandrel which may be left in the well bore.

3. In apparatus of the character described the combination of a tubing string, a stinger connected to the lower end of said string, a mandrel surrounding said stinger, a packer mounted on said mandrel, packer setting means slidable on said mandrel, and including friction means adapted to engage the interior surface of a casing, said packer setting means being initially releasably connected to said string by a spring-loaded latch pivoted to said tub-

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ing string and cooperating left-hand threads on said latch and said packer setting means to maintain said packer setting means in non-packer setting position and releasable from said string to set said packer, and means releasably connecting said stinger and said mandrel whereby the string, stinger, and mandrel are movable together when connected and the string and stinger are removable from the packer setting means, packer, and mandrel which may be left in the well bore.

4. In apparatus of the character described the combination of a tubing string, a stinger connected to the lower end of said string, a mandrel surrounding said stinger, a packer mounted on said mandrel, upper packer setting means slidable on said mandrel, and including friction means adapted to engage the interior surface of a casing, said packer setting means being initially releasably connected to said string by cooperating left-hand threads on said friction means and said tubing string, lower packer setting means mounted on said mandrel and movable therewith whereby, upon disconnection of said string from said upper packer setting means and upward movement of said string and mandrel relative to said packer setting means, said packer is set, and means releasably connecting said stinger and said mandrel whereby said string and stinger may move as a unit when connected and said string and stinger may be removed from said mandrel and packer upon disconnection.

5. In apparatus of the character described the combination of a tubing string, a stinger connected to the lower end of said string, a mandrel surrounding said stinger, a packer mounted on said mandrel, upper packer

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setting means slidable on said mandrel, and including friction means adapted to engage the interior surface of a casing, said packer setting means being initially releasably connected to said string, lower packer setting means mounted on said mandrel and movable therewith whereby, upon disconnection of said string from said upper packer setting means and upward movement of said string and mandrel relative to said packer setting means, said packer is set, and means releasably connecting said stinger and said mandrel, whereby the string, stinger, and mandrel are movable together when connected and the string and stinger are removable from the packer setting means, packer, and mandrel which may be left in the well bore, said packer being composed of rubber having a high carbon content and having its upper and lower ends surrounded by flanged annular lead members.

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