

March 23, 1954

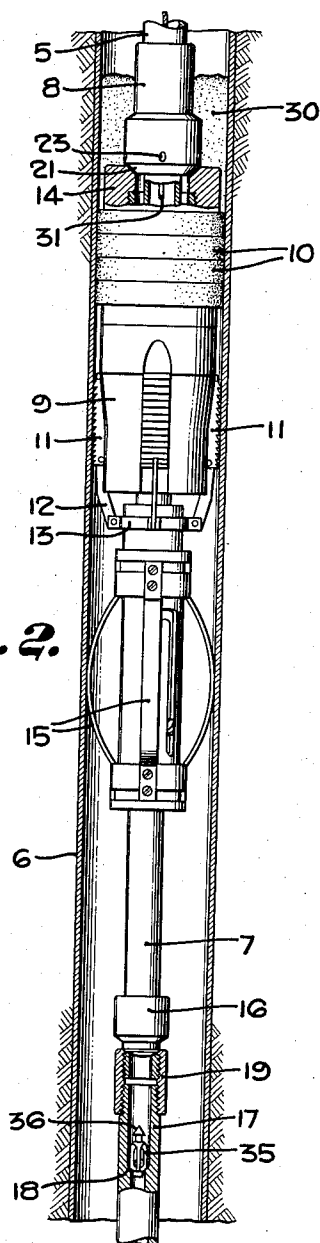
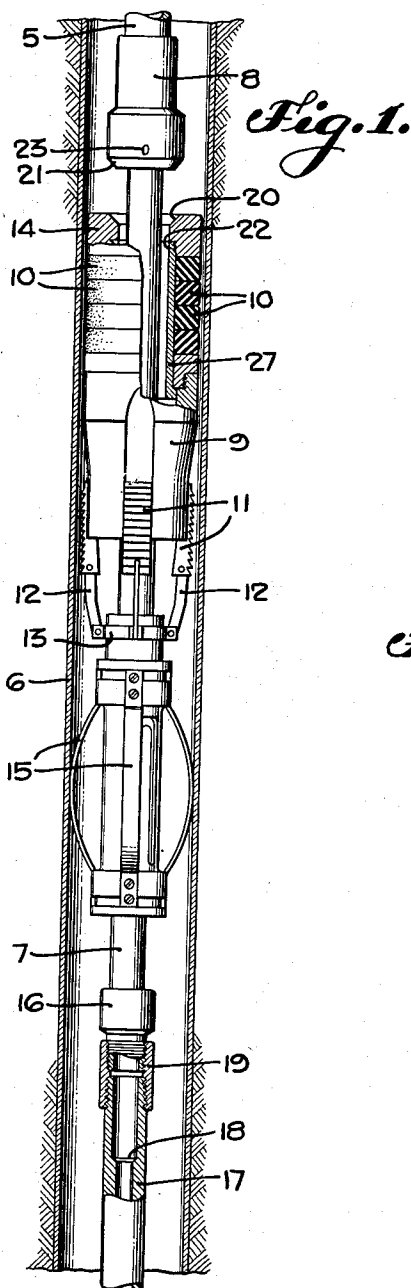
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2,672,934

METHOD AND APPARATUS FOR RELEASING PACKERS

Filed Oct. 7, 1949

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

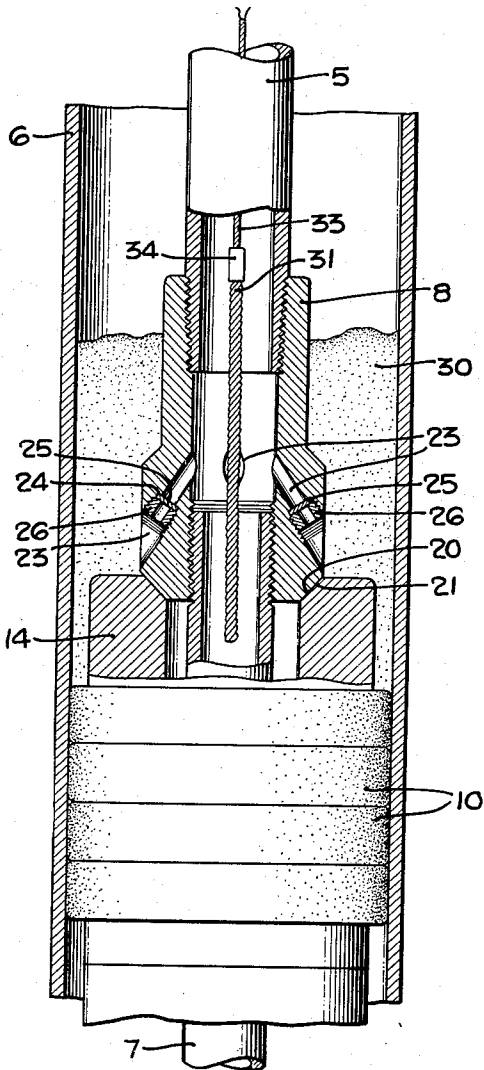


Fig. 3.

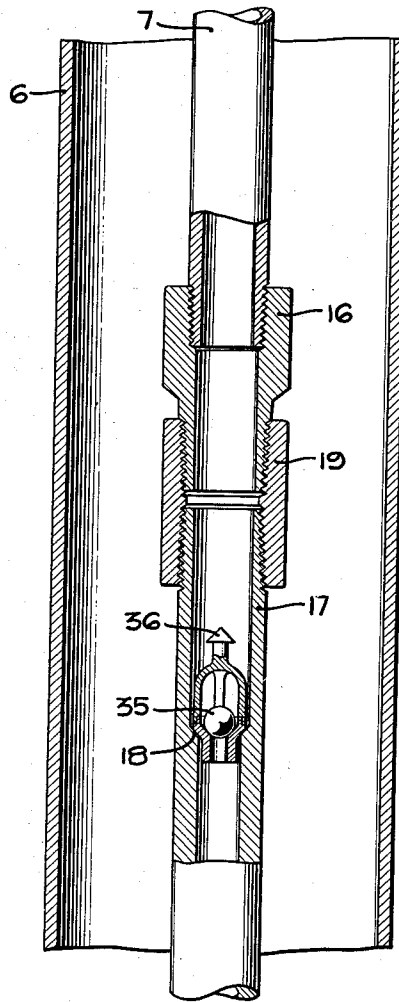


Fig. 4.

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METHOD AND APPARATUS FOR RELEASING
PACKERS

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mesne assignments, to Lane-Wells Company,
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11 Claims. (Cl. 166—12)

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This invention relates to the use of packers in wells, especially oil and gas wells. More particularly it has to do with the freeing of packers which have become wedged or stuck in place in well boreholes or casings by the accumulation of sand or hardened mixtures of sand and drilling mud above the packer, a condition which is generally referred to as being "stuck" or "sanded-in." This condition is frequently encountered when packers have been in place in wells for a long time or are set in wells to isolate two or more producing zones for dual or multiple completion and sand has entered from the upper producing zones and settled on top of the packers.

One object of the invention is, therefore, to devise a simple method and apparatus for dislodging and displacing sand and other material which settles and accumulates upon a packer and prevents it from being released.

Another object is to provide an improvement in well packers which will facilitate their removal from well boreholes and casings under sanded-in conditions.

This invention, broadly stated, involves the provision of ports or passageways which are normally sealed by frangible closures or disks and located for discharging a flushing fluid beneath any sand and debris which may have accumulated on top of the packer sufficient to prevent its release. When the packer becomes sanded-in by such settlements, the frangible closures may be ruptured by suitable means to permit flushing fluid to be forced out of the ports under pressure to dislodge the settled sand or other binding debris. For convenience and efficiency the force of an explosive is preferably utilized to rupture the frangible closures. Besides rupturing the closures, the shock or vibration and fluid jetting action induced by the explosive also usually contributes materially to the loosening of the sand so that it is more readily displaced when flushing medium is subsequently forced through the ports. By preference the explosive force is applied from within the packer mandrel and thus it also tends to loosen the packer from its gripping engagement with the casing of the well. In practice, the explosive is lowered within the pipe string, to which the packer is attached, and into the vicinity of or adjacent to the frangible closures in the packer head and in order to confine the force of the explosive to that area within the packer head, it is advantageous to block off the passage leading downward, from the packer head through the packer mandrel to the pipe string therebelow.

In the drawings which illustrate a preferred

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embodiment of the invention and manner of its use and in which like reference characters designate the same or similar parts throughout the several views:

5 Figure 1 is a vertical sectional view through the casing of a well showing a well packer, modified in accordance with the present invention, as it appears upon being lowered into the well prior to being set, the packer being shown mostly in elevation but partly in section;

10 Figure 2 is a vertical sectional view similar to Figure 1 but showing the packer as it appears when set in the well and stuck in place by an accumulation of sand in the annulus above the packer, this figure being illustrative of steps of the method of releasing the packer;

15 Figure 3 is an enlarged vertical sectional view of a fragmentary portion of the upper end of the packer in the condition shown in Figure 2; and

20 Figure 4 is a similar, enlarged, vertical sectional view of a fragmentary portion of the lower end of the packer mandrel of Figure 2.

In Figure 1, a packer, attached to the lower stand 5 of a pipe string, is illustrated as it appears while being lowered within well casing 6 preparatory to being set. The packer which is of the hook wall, by-pass circulation type, is conventional for the most part and may be constructed, although not necessarily so, in accordance with the patent to Renouf 2,005,955. As herein illustrated, the packer comprises a central mandrel 7 attached to the lower end of a suspending pipe string 5 by means of a top collar or packer head member 8. Carried slidably on mandrel 7 is a slip cone member 9, supporting a plurality of packing rings 10 on its upper part and containing conventional slips 11 dovetailed in downwardly convergent grooves on the lower part of member 9. Slips 11 are provided with slip reins 12 connecting them with a slip rein ring 13 carried on the cage sleeve of a conventional cage spring assembly of the dowel and J-slot type and which is provided with outwardly bowed friction springs 15 adapted to make frictional engagement with the surrounding casing to assist in setting the packer. At the lower end of mandrel 7 is lower collar or connection 16 for attaching a length of tail pipe or tubing 17. By preference and as shown, tail pipe 17 is provided with a section of reduced internal diameter forming an upwardly facing internal shoulder 18 for the purpose to be described hereinafter. Tail pipe 17 is secured to the lower end of mandrel 7 by means of a bottom sub 16 and coupling 19.

Telescopically slidably supported at the top

of the slip cone member 9 is a packer sleeve 27 around which the annular packing elements 10 are supported. Threaded to the top end of the packer sleeve 27 is an annular valve seat member 14 having a valve seat 20 which is adapted to be engaged by valve head 21 which is in turn carried at the lower end of the packer head 8, when the pipe string 5 and mandrel 7 are lowered relative to the slip cone member 9 in setting the packer. The annular, fluid by-pass passage 22 formed between the outside of the mandrel 7 and the inside surface of the packer sleeve 27 and the slip cone member 9 may thus be closed off.

The packer head 8, is provided with a plurality of ducts or ports 23 extending from the interior to the exterior thereof at a level slightly above the valve head member 21 and directed divergently downward toward the top area of the valve seat member 14. For convenience of illustration, four such ports are shown in the drawings, although any other suitable number of ports may be employed. Each of the ports 23 is counter-bored from the exterior to provide an annular shoulder 24, as best shown in Figure 3, against which is seated a closure element 25 which may take the form of a frangible disk of material which will shatter under a predetermined pressure impact or shock, as for example that caused by an explosive. The frangible closures or disks 25 may be of brittle metal such as cast iron, or glass or plastic material. A suitable retainer such as an externally threaded annular member or ring 26 threaded into each counterbore, serves to hold each frangible disk 25 securely in fluid tight engagement with its seat.

The setting of packers of the type shown in Figures 1 and 2 is well known and therefore only a brief description will be given herein. When the packer is at the desired depth in the well, where it appears as shown in Figure 1, pipe string 5 is turned rotationally in a lefthand direction, through an angle sufficiently to release the dowel on mandrel 7 from the horizontal to the longitudinal portion of the J-slot in the cage sleeve, whereupon mandrel 7, top collar 8 and pipe string 5 are then free to be lowered while cage 14 remains stationary within the casing by reason of the frictional engagement of springs 15 upon the inside surface of well casing 6. As cone member 9 descends by gravity with the lowering of pipe 5 and mandrel 7, slips 11 move up in their slots relative to the slip cone and are forced outwardly thereby into gripping engagement with the surrounding well casing 6. Valve 21 on top collar 8 next moves down into engagement with valve seat 20 and the weight of the pipe string applied through the packing elements 10 to the slip cone and slips telescopes the packer sleeve 27 into the slip cone member 9 compressing packing rings 10 longitudinally until they expand laterally into engagement with the casing 6. The packer is then set, as shown in Figure 2. An accumulation of sand or other hardened or dense settlements is shown at 30, in the annulus upon the packer head 8 and valve seat member 22 sufficient to wedge the packer in place by preventing the said packer head 8 and mandrel 7 from being raised to open valve 20, 21 and to prevent valve seat member 22 to raise relative to the slip cone 9 sufficiently to release the packing elements 10 and slips 11 from gripping engagement with the inside of casing 6.

Release of the packer which has become stuck or sanded-in in the beforedescribed manner is

effected in accordance with the present invention by rupturing the frangible closures 25 in ports 23 so that flushing fluid is thereby jetted through, and can be discharged, through ports 23 upon the top of cone member 14 to displace the sand and debris 30 from around top collar 8. Rupturing the closures or disks 25 is accomplished by the force of an explosive and preferably from within top collar 8. To this end an elongated body of explosive 31 preferably a length of detonating cord such as that commercially obtainable under the name of Primacord, is lowered through pipe string 5 to the immediate vicinity of ports 23 within the packer head 8 as shown in Figures 2 and 3. The explosive 31 is then detonated in known manner, blowing out frangible disks 25 and forcing thereby a high velocity fluid jet into the surrounding annulus containing the settlements. Fluid is then pumped under pressure through pipe string 5 to be discharged through ports 25 to jet out the settled sand and debris 30 which will have been already loosened to some extent by the shock of the explosive and by the jet blasts therefrom issuing through ports 23.

By way of illustration the explosive may be lowered on a suitable conductor cable 33 having a detonating cap 34 connected to the lower end thereof and detonate electrically within the lower end of the pipe string 5 adjacent the packer head 8 in the manner and by means of apparatus disclosed in the patent to Alexander No. 2,414,349.

In order to confine the explosive to the area adjacent the frangible closures 25 and to limit the outlet of the flushing fluid to ports 23 it is, as hereinbefore mentioned, usually desirable to block off the passage from the pipe string 5 at some suitable point below the ports 23. This may be done at any place in the packer mandrel but a convenient place is in the upper end of the tail pipe. Hence by providing a tail pipe 17 with a stop shoulder as at 18, blocking of the passage is readily accomplished by lowering or dropping into the pipe string a suitable plugging device such as, for example, a check valve as shown at 35. The check valve shown is of the ball cage type which seats on shoulder 18 and is provided with an upwardly extending conical point 36 by which it can, if desired, be fished out by well known means after the packer has been released. While blocking of the passage below the packer is not always necessary, it is under some conditions a desirable step in the hereindescribed method of freeing a sanded-in packer.

Figure 2 illustrates the method up to the point of firing the explosive since the check valve 35 is already in place in tail pipe 17 and a length of detonating cord 31 has been lowered within top collar 8. The remaining steps are to detonate the explosive and then pump flushing fluid, such as drilling fluid, oil or the like suitable liquid, out through ports 23 which have been opened by rupture of frangible disks 25 by the explosive. Since the explosion to a large extent takes place within the packer itself, it vibrates and tends to loosen all parts which are interlocked with each other or with the well casing 6, thus further facilitating the freeing of the stuck or wedged packer. Once the packer head 8 is relieved of the grip of packed and hardened sand and drilling mud, permitting upward movement of the valve member 20 and the packing sleeve 27 relative to the slip cone member 9, pipe string 5 can

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be raised to loosen the slips and then to elevate the packer in the casing or to bring it to the surface in the usual manner.

For convenience of illustration, the invention has hereinbefore been described in connection with a by-pass circulation type of hook-wall packer, but obviously the invention is equally applicable to non by-pass and other types of packers in which the sanding-up or sticking of the upper elements thereof prevents the upward release of the packings and the wall gripping elements.

It is, therefore, to be understood that the foregoing is illustrative only and that the invention is not limited thereby but may include various modifications and changes made by those skilled in the art without departing from the spirit and scope of the invention as defined in the appended claims.

What is claimed is:

1. In a well packer having an annular packing body, casing gripping means to support the lower end of said packing body, and a hollow packer head member to apply longitudinal compressive force through said packing body to said casing gripping means to expand said packing body radially into sealing contact with a surrounding casing, the combination comprising: a lateral duct extending through the wall of said packer head member from the interior to the exterior thereof and directed toward a point adjacent the top surface of said annular packing body; a frangible member in said duct and initially closing said duct against flow of fluid therethrough and adapted to be ruptured upon application of a predetermined pressure differential thereacross.

2. In a well packer having a tubular mandrel, an annular packing body surrounding said mandrel, casing gripping means to support the lower end of said packing body, and a hollow packer head member, connected to said mandrel, to apply longitudinal compressive force through said packing body to said casing gripping means to expand said packing body radially into sealing contact with a surrounding casing, the combination comprising: a lateral duct extending through the wall of said packer head member from the interior to the exterior thereof and directed toward a point adjacent the top surface of said annular packing body; a frangible member in said duct and initially closing said duct against flow of fluid therethrough and adapted to be ruptured upon application of a predetermined pressure differential thereacross; and closure means lowerable through said packer head member to close the passage leading through said head member and mandrel at a point below said head member.

3. Apparatus according to claim 1 and explosive means locatable within said packer head member to apply a rupturing differential pressure to said frangible member.

4. Apparatus according to claim 2 and explosive means locatable within said packer head member to apply a rupturing differential pressure to said frangible member.

5. In a well packer, the combination comprising: a mandrel; an annular packing body surrounding said mandrel; casing gripping means on said mandrel and adapted to support the lower end of said packing body when in gripping engagement with a surrounding casing; a hollow packer head member on said mandrel above said packing body, movable longitudinally with respect to said casing gripping means and posi-

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tioned to apply downward longitudinal compressive force through said packing body to said casing gripping means whereby said packing body may be expanded radially into sealing contact with a surrounding casing; at least one laterally directed duct extending through the wall of said packer head member from the interior to the exterior thereof adjacent the top of said packing body; and closure means in said duct normally closing said duct to passage therethrough of fluid but adapted to open upon application of sufficient differential pressure between the inside and outside of said packer head.

6. In a well packer, the combination comprising: a mandrel; an annular packing body surrounding said mandrel; casing gripping means on said mandrel and adapted to support the lower end of said packing body when in gripping engagement with a surrounding casing; a hollow packer head member on said mandrel above said packing body, movable longitudinally with respect to said casing gripping means and positioned to apply longitudinal compressive force through said packing body to said casing gripping means whereby said packing body may be expanded radially into sealing contact with a surrounding casing; at least one laterally directed duct extending through the wall of said packer head member from the interior to the exterior thereof adjacent the top of said packer body; and frangible closure means in said duct normally closing said duct to passage therethrough of fluid but adapted to rupture upon application of sufficient differential pressure between the inside and outside of said packer head.

7. In a well packer, the combination comprising: a mandrel; an annular packing body surrounding said mandrel; casing gripping means on said mandrel and adapted to support the lower end of said packing body when in gripping engagement with a surrounding casing; a hollow packer head member on said mandrel above said packing body, movable longitudinally with respect to said casing gripping means and positioned to apply longitudinal compressive force through said packing body to said casing gripping means whereby said packing body may be expanded radially into sealing contact with a surrounding casing; at least one laterally directed duct extending through the wall of said packer head member from the interior to the exterior thereof adjacent the top of said packing body; and frangible closure means in said duct normally closing said duct to passage therethrough of fluid but adapted to rupture upon application of explosive force applied from within the packer head.

8. In a well packer, the combination comprising: a mandrel; an annular packing body surrounding said mandrel; casing gripping means on said mandrel and adapted to support the lower end of said packing body when in gripping engagement with a surrounding casing; a hollow packer head member on said mandrel above said packing body, movable longitudinally with respect to said casing gripping means and positioned to apply longitudinal compressive force through said packer body to said casing gripping means whereby said packing body may be expanded radially into sealing contact with a surrounding casing; at least one duct extending through the walls of said packer head member from the interior to the exterior thereof in a downwardly diverging direction toward the top of said packer body; and frangible closure means

in said duct normally closing said duct to passage therethrough of fluid but adapted to rupture upon application of explosive force applied from within the packer head.

9. In a well packer, the combination comprising: a tubular mandrel; an annular packing body surrounding said mandrel; casing gripping means on said mandrel and adapted to support the lower end of said packing body when in gripping engagement with a surrounding casing; a hollow packer head member on said mandrel above said packer body, movable longitudinally with respect to said casing gripping means and positioned to apply longitudinal compressive force through said packer body to said casing gripping means whereby said packing body may be expanded radially into sealing contact with a surrounding casing; at least one duct extending through the walls of said packer head member from the interior to the exterior thereof in a downwardly diverging direction toward the top of said packer body; frangible closure means in said duct normally closing said duct to passage therethrough of fluid but adapted to rupture upon application of explosive force applied from within the packer head; and means lowerable through said packer head member to close the passage leading through said packer head member and said mandrel.

10. A method for freeing a sanded-in packer having at least one duct extending through the wall of a hollow head member thereof and directed toward a point adjacent the top of said packer, said duct being initially closed by frangible closure means, comprising: lowering a body of explosive into said head member to a position adjacent the inner end of said duct; and deto-

nating said explosive whereby said frangible closure means is ruptured and a fluid jet propelled by said explosive is projected from said duct into the space surrounding said head member adjacent the top of said packer.

11. A method for freeing a sanded-in packer having at least one duct extending through the wall of a hollow head member thereof and directed toward a point adjacent the top of said packer said duct being initially closed by frangible closure means, comprising: lowering a body of explosive into said head member to a position adjacent the inner end of said duct; detonating said explosive to rupture said frangible closure means and to propel a fluid jet from said duct into the space surrounding said head member adjacent the top of said packer; and subsequently forcing a quantity of a flushing fluid through said duct.

KEITH H. MINER.

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