

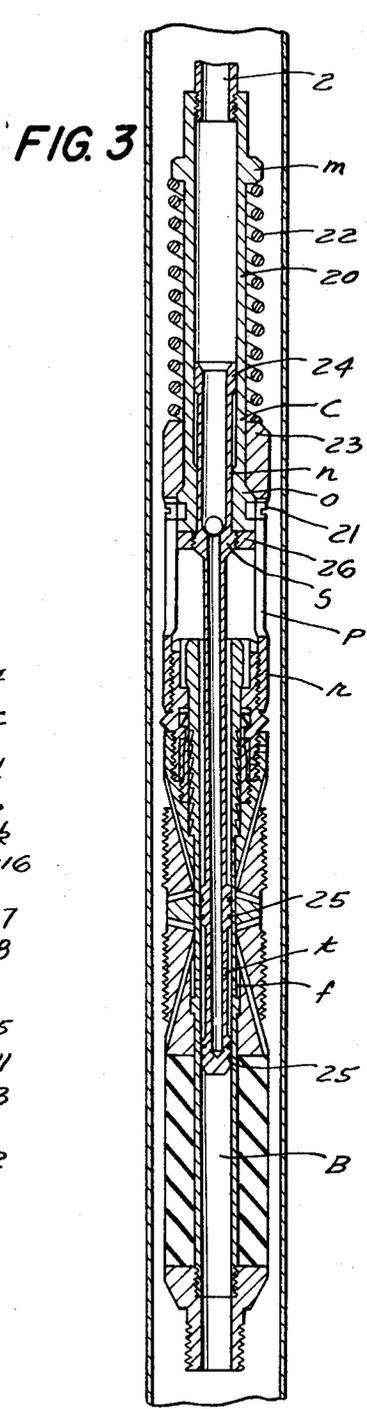
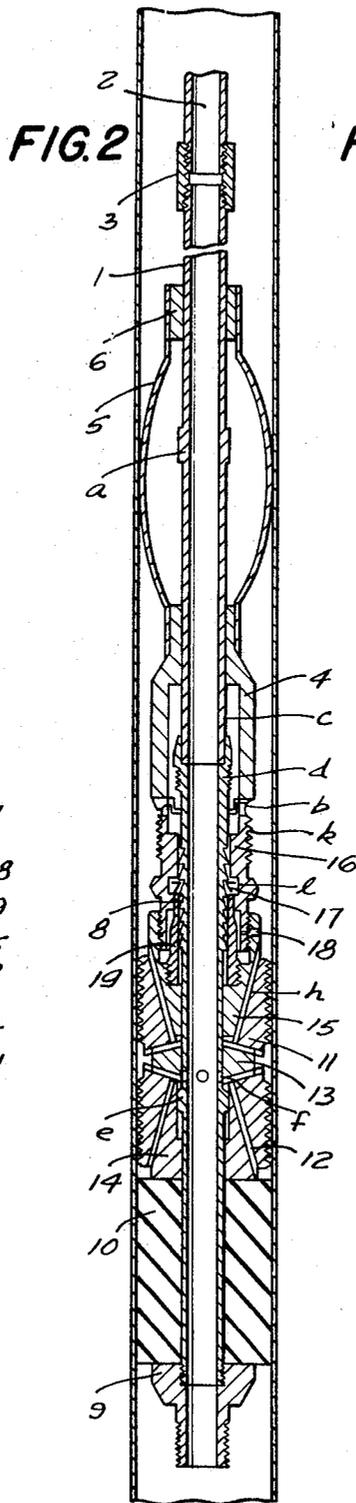
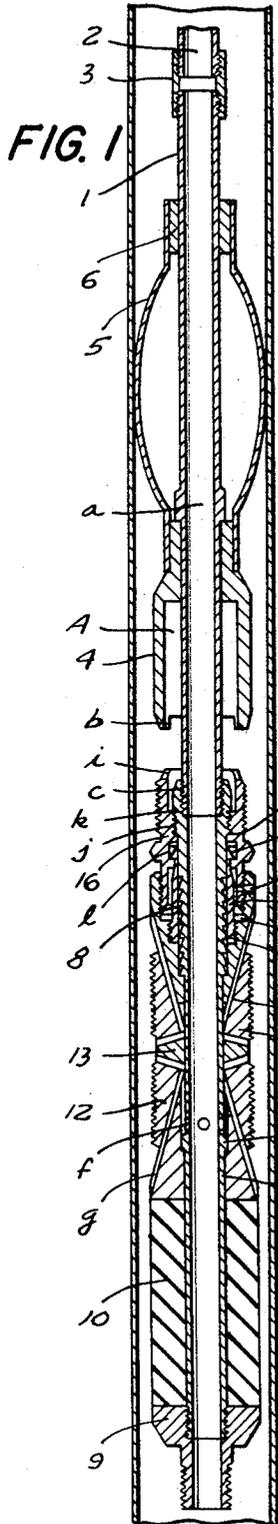
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RETRIEVABLE PACKER FOR WELLS

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**RETRIEVABLE PACKER FOR WELLS**

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**ABSTRACT OF THE DISCLOSURE**

A retrievable packer for wells, such as oil and gas wells. The packer includes a packer assembly and a setting-tool assembly for setting the packer assembly at a selected location in the well. The packer assembly has a central mandrel surrounded concentrically by an expandable elastic sleeve, which can be radially expanded into pressing engagement with the casing wall, this central mandrel also being surrounded by an expandable and contractable slip means for gripping the casing wall when expanded and for releasing the packer assembly from the casing wall when contracted, this slip means responding to longitudinal compression and radial expansion of the elastic sleeve to be expanded outwardly against the casing wall and to elongation and radial contraction of the elastic sleeve to be retracted inwardly from the casing wall. At the upper end of the packer assembly is a control sleeve which surrounds and is releasably connected with the mandrel, and when the mandrel is disconnected or displaced upwardly with respect to the control sleeve, the elastic sleeve is compressed and radially expanded while the slip means is also expanded into gripping engagement with the casing wall. In response to this upward movement of the mandrel with respect to the control sleeve, a releasable lock means is actuated to lock the mandrel against downward movement, in opposition to the force with which the elastic sleeve tends to displace the mandrel downwardly with respect to the control sleeve. A release means is provided for releasing the releasable lock means, and when it is desired to release the packer assembly for removal from the well, a release tool assembly is coupled to the control sleeve to actuate the latter for causing the releasable lock means to be released by the release means, thus freeing the elastic sleeve for longitudinal expansion with resulting contraction of the slip means inwardly away from the casing wall so that the packer assembly can then be removed from the well.

This invention is related to a retrievable packer for oil and gas wells, which is set in the well casing by means of anchoring slips holding both against upward and downward motion, and which is provided with a safety device against any accidental setting in the casing.

There are already known retrievable packers for wells provided with slips for anchoring both ways inside the casing, which are set by rotating the pipe string and by pulling or lowering on the packer a part of the string weight, thereby causing the anchoring slips to grip.

There are also known retrievable packers which are set only by rotating the pipe string, but the string remains at all times tied to the packer.

These types of packers present the disadvantage that they have a complicated design and are liable to cause accidents by tripping the packer before it is lowered into the casing to the desired depth, or by getting stuck while being pulled out.

The packer according to this invention eliminates the above mentioned disadvantages by the fact that it has a central mandrel having saw-type teeth circularly cut on its external surface, and a cylindrical body screwed on the mandrel together with a lock ring, the packer setting

operation in the casing being realized by unscrewing the threaded cylindrical body and by vertical movement of the mandrel in relation with this cylindrical body, having as a result the slips expand and the packer set in the casing, obtaining also the sealing of an elastic sleeve, the setting being realized by successive engagements of the locking ring in the mandrel teeth, and for the central mandrel rotation and travel, in order to set the packer, a setting device placed at the tubing string end is used, while a recovery device is used for releasing and pulling the packer out of the casing.

The setting tool includes a central pipe which, at the surface, is screwed with one end to the packer mandrel, and with the other end is screwed to the tubing string, the central pipe being provided, at a certain distance from the central mandrel, with a lower collar provided with front engagement teeth and a second upper collar tied to the lower collar by means of leaf springs; when the packer is run into the bore hole, the device slips on the casing wall together with the springs, being pushed down by a central pipe collar. The packer setting operation at the desired place consists of a slight upward motion of the central pipe, until the cylindrical body is coupled with the lower collar and the central mandrel rotation, until it is unscrewed and comes out of its cylindrical body, pulling up the central mandrel until the packer is completely set on the well casing, and then a further rotation of the central pipe is carried out until it is unscrewed from the central mandrel, after which the setting tool is pulled out of the well together with the tubing string.

The recovery device includes a concentric collar provided inside with a thread that can be screwed on the packer cylindrical body, a cylinder attached at the tubing string lower end, over which can slide, under the action of a spring placed on the cylinder, the concentric collar guided by a guide peg, and a piston provided with a central port and a valve seat placed inside the cylinder, the packer releasing operation being done by screwing the catching concentric collar on the packer cylindrical body, the concentric collar being farther rotated until shearing of a fastening peg with the packer cylindrical body and this body then moves downward besides an un-locking piece, which with a sharp edge enters under the locking spring, opening it, and allowing the packer to be elongated and to be pulled out together with the pipe string.

In case the packer slips get stuck due to sand settling, the sand can be washed due the fact that the piston rod is provided with a series of windows corresponding to other windows placed in the packer central mandrel body.

In order to obtain the release of the slips and of the elastic rubber sleeve from the casing wall, hydraulic pressure may be used, by dropping inside the tubing a ball which sets on the valve seat, causing the pressure to rise by pumping fluid, a pressure nut placed on the piston rod pushing the central mandrel by means of the cylindrical body and of the lock ring, pushing downward the packer lower tapered ring, freeing the lower slips, and the upper slips being subsequently released by pulling.

An example of the invention is illustrated in FIGURES 1-3, which represent:

FIG. 1.—Longitudinal cross-section through the packer body while being introduced into the well.

FIG. 2.—Longitudinal cross-section through the packer body, after the packer was set and before pulling out the tubing with the setting tool.

FIG. 3.—Longitudinal cross-section through the packer body during the recovery operation with the recovery device.

According to FIG. 1, the packer is composed of a setting tool A and a sealing packer B.

The setting tool is constituted of a central pipe 1, connected at its upper end with the tubing 2 by means of a sub 3.

At its lower end, the central pipe 1 is threadably attached to the packer B itself, and at its middle is provided with a shoulder *a* which during the running in of the packer bears upon a lower collar 4 slidable over the central pipe 1 and provided at its lower end with a toothed crown coupling *b*.

Four leaf-springs 5 which slide along the casing wall, are attached at one end to the lower collar 4 and at the other end to a second slidable upper collar 6, the whole assembly consisting of the collars 4 and 6 and of the springs 5, having the possibility of longitudinally sliding a limited distance along the central pipe 1.

The packer is constituted of a central mandrel 7, provided at its upper end with an inner thread *c*, into which the central pipe 1 is screwed, and an outer thread *d*. Also on the outer side and on its upper half, on the central mandrel 7, a number of sawtooth gripping rings 8 directed downwardly are provided, and toward its lower half a fixing shoulder *e* and a number of washing ports *f* are provided.

The mandrel lower end 7 is connected by a thread to a piece 9 on which a rubber sleeve 10 bears.

Two sets of gripping slips, an upper slip set 11 with the teeth directed downward, and a set of lower slips 12, having the teeth directed upward, are placed on the mandrel body 7, being centered by means of a ring with slanting edges 13, which ensures simultaneous and uniform slips expansion.

Under the slips 12, a tapered lower ring 14 provided with guiding ribs is placed, and behind the slips 11, a second tapered upper ring 15 provided with guiding ribs *h* is placed, serving to provide the slips expansion.

A cylindrical body 16, having an upper edge provided with a toothed coupling crown *i*, is fastened to the central mandrel 7 by means of an inner thread *j*, threaded onto the thread *d*. The cylindrical body 16 upper part outer surface is provided with a thread *k*. The inner recess *l* of the cylindrical body or control sleeve 16 contains a V-shaped springy lock ring 17 which can snap over the gripping teeth 8, locking the packer in place. A shear pin 18 is used for locking the cylindrical body 16 inside the upper tapered ring 15.

Between the upper tapered ring 15 and the central mandrel 7, opposite the part provided with gripping teeth 8, a tapered unlocking or release piece 19 is placed, which bears with its larger base on the upper tapered ring 15, its smaller tapered tip being used for acting upon the locking ring 17.

For releasing and pulling out, the packer is provided with a recovery device C constituted by a cylindrical body 20 attached by a thread to the pipe string 2 and provided outside, toward its upper end, with a collar *m* and with an external collar *o* toward the lower end.

The external collar *o* is provided with a number of guiding pegs 21. A helical spring 22 is mounted on the outside of the cylindrical body 20 pressing with one end on the collar *m* and with the other end on a concentric sleeve 23. The concentric sleeve 23 is extended downward with some longitudinal windows *p* in which are gliding the guiding pegs 21, and the lower part is provided with an end having the internal thread *r*.

A cylindrical piston 24 is mounted inside the cylindrical body 20, its rod having a valve seat with ball *s* inside piston 24 extending into the packer B towards its lower end. A number of ports *t* are provided at the same level with the ports *f*, to allow washing the slips 11 and 12 in case they are blocked by impurities. The seal between the piston rod 24 and the packer interior is realized by means of some sealing elastic rings 25.

A lock nut 26 is placed on the piston rod 24, opposite the valve seat with ball *s*.

The packer is run into the well with the string of pipes

2. Due to the leaf-springs 5 which slide along the casing wall, the lower collar 4 provided with the toothed coupling crown 6 is maintained at a certain distance of the packer B, being pushed downward into the casing by the shoulder *a* provided on the central pipe 1.

When the packer reaches the region where it is to be set, the pipe string 2 is pulled up until the cylindrical body 16 coupling teeth *i* are coupled with the collar 4 teeth *b*, which, due to the leaf-springs 5 frictionally engaging the casing remains stationary.

Afterwards, the pipe string is rotated 5 turns to the right continuing to pull up, which fact allows in the first instance the uncoupling of the cylindrical body 16 off the mandrel 7, by disengaging the threads *j* and *d* which have been, at the surface, screwed together with a small tightening moment and subsequently, by the upward motion of the central mandrel 7, the slips 11 and 12 are compelled to expand and grip the casing, according to FIG. 2.

By continuing to pull up the pipe string, the rubber sleeve 10 is compressed, providing the seal on the casing.

Downward forces on the packer body with the sleeve 10, are transmitted by means of the lock ring 17 to the upper tapered ring 15 which pushes the slips 11 farther towards the casing and if the body is pulled up, the sleeve 10 pushes the lower tapered ring 14 under the slips 12 gripping the casing, so that greater forces are applied on the packer, and a better setting both ways is achieved for the packer.

Together with the central mandrel 7 upward motion, the locking ring 17 engages the lock teeth 8 which ride up over the ring 17, preventing downward travel of the mandrel and maintaining the packer set.

By continuing the right hand rotation with 7 turns, the thread *c* is unscrewed, separating the setting tool A central pipe 1 from the packer B central mandrel 7, thus allowing the pipe string 2 and the setting tool to be pulled out.

For recovering the packer, the recovery device C is introduced with the pipe string 2 into the well, inasmuch the piston rod 24 penetrates inside the packer B, and the sleeve 23 lower part is superposed over the cylindrical body 16 upper end, being pushed due to the spring 22 action. By rotating the pipe string 2 to the right the rotation motion is transmitted by means of pin 21 to the sleeve 23, allowing the sleeve 23 thread *r* to be threaded onto the cylindrical body 16 thread *k*.

By continuing the right hand rotation, the shear pin 18 is sheared off, and the cylindrical head 16 is completely screwed into the tapered ring 15. Due to this movement, the tapered unlocking piece 19 penetrates under the lock ring 17 causing it to expand, which fact realizes the freeing of the central mandrel 7.

Due to the sealing sleeve 10 elasticity, the tapered piece 14 is pushed downward, the force being transmitted by means of the central mandrel 7 fixing shoulder *e*, causing in this way the packer elongation and thus making possible to pull it out.

If the packer B gets sanded up during its stay in the well, the slips can be washed and cleaned by pumping fluid through the tubing string 2, piston rod 24 and the ports *t* and *f*, then the pipe string is moved up and down few times, acting directly upon the tapered rings 14 and 15, which fact has the result that the slips 11 and 12 become loose from the casing.

The packer recovery can also be realized by dropping a ball through the pipe 2, which ball seats on the cylindrical piston 24 valve seat *s*; by pumping liquid under pressure through the pipe string 2, the pushing force applied upon the central mandrel 7 is increased. By this pressure, the lower tapered ring 14 is pushed downward, freeing the lower slips 12 and the upper slips 11 being deformed and freed by traction.

The packer according to this invention, presents the following advantages:

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The safe running in of the packer into the well is realized without the danger of getting stuck during the trip.

The packer setting is realized by simple manoeuvres and the setting tool is disengaged easily.

The recovery of the packer is done by means of a recovery device and even in case the packer is sanded up, there is the possibility of washing out the sand.

The packer releasing can be realized by hydraulic means also.

It will thus be seen that with the structure of the invention, the packer assembly includes the central mandrel 7, which is surrounded by the elastic sleeve 10, which upon being longitudinally compressed spreads radially against the casing wall, and which resiliently tends to assume its elongated condition shown in FIGS. 1 and 3. The parts 11-15 form an expandable and retractable slip means for gripping the casing wall when expanded, and for releasing the packer assembly from the casing wall when contracted, and this slip means responds to axial compression of the elastic sleeve 10 to be radially expanded into engagement with the casing wall and to elastic elongation of the sleeve 10 to be retracted inwardly away from the casing wall. Situated over the slip means 11-15 is the control sleeve 16, which is releasably connected to the mandrel 7 by the threads *j*, *d*. The setting-tool assembly A includes the pipe 1, which is releasably connected to the mandrel by the threads *c*, and the sleeve 4 together with the leaf springs 5 and the collar 6 form, in coaction with the collar *a*, an arresting means for selectively arresting the packing assembly at a desired location along the casing. By way of this arresting means upward movement of the control sleeve 16 is terminated so that the rotation of the pipe 1 of the setting-tool assembly will cause the mandrel 7 to be separated from the control sleeve 16, thus permitting the entire packer assembly to be subjected to an upward pull transmitted to the mandrel by the setting tool and string 2, with the resultant longitudinal compression and radial expansion of the sleeve 10 and the resultant expansion of the slip means 11-15 into engagement with the casing wall.

The teeth 8, together with the lock spring 17, form a releasable lock means, which releasably locks the mandrel, in opposition to the force of the sleeve 10, against downward movement, and thus the packer is retained in its set position. The tapered sleeve 19 forms a release means for releasing the releasable lock means 8, 17, and the shear pin 18 provides a releasable connection of the control sleeve 16 to the slip means so that when this releasable connection 18 is broken, the sleeve 16 can be moved downwardly by the recovery-tool assembly C, thus lowering the lock spring 17 onto the tapered upper tip of the release means 19, which thus spreads the lock ring 17 outwardly away from the teeth 8 to release the packer assembly to the force of the sleeve 10, which now expands longitudinally to automatically retract itself inwardly away from the casing wall while at the same time providing retraction of the slip means inwardly away from the casing wall, so that the parts now assume the position shown in FIG. 3, enabling the entire assembly to be removed.

Although the present invention has been described in conjunction with a preferred embodiment, it is to be understood that modifications and variations may be resorted to without departing from the spirit and scope of the invention, as those skilled in the art will readily understand. Such modifications and variations are considered to be within the purview and scope of the invention and appended claims.

I claim:

1. In a retrievable packing structure for a well having a casing wall, a packer assembly and a setting-tool assembly, said packer assembly including a central mandrel, an upper control sleeve surrounding and releasably connected to said mandrel, expandable and contractable slip means

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situated beneath said sleeve and also surrounding said mandrel, and an elongated elastic sleeve also surrounding said mandrel to be longitudinally compressed and radially expanded into engagement with a casing wall in response to upwardly movement of said mandrel with respect to said control sleeve, said slip means responding to upward movement of said mandrel with respect to said sleeve for automatically expanding radially into engagement with the casing wall, and said elastic sleeve, when axially compressed, urging said mandrel downwardly with respect to said control sleeve for radially contracting said elastic sleeve inwardly away from the casing wall, said slip means automatically responding to longitudinal elongation of said elastic sleeve for retracting itself inwardly away from the casing wall, said setting-tool assembly including an elongated pipe removably connected with said mandrel at an upper end thereof and an arresting means carried by said pipe for arresting upward movement of said control sleeve and the entire packer assembly therewith at a selected location along the casing wall, said arresting means when preventing upward movement of said control sleeve retaining the latter stationary while turning of said pipe with said mandrel disconnects said mandrel from said control sleeve so that said mandrel and said pipe can then be pulled upwardly with respect to said control sleeve to longitudinally contract said elastic sleeve, expanding the latter radially into engagement with the casing wall while said slip means automatically expands into engagement with the casing wall, and releasable lock means carried in part by said mandrel and in part by said control sleeve for releasably locking said mandrel against downward movement with respect to said control sleeve by said elastic sleeve, release means for releasing said releasable lock means, and a release tool assembly operatively connectable to said control sleeve for actuating the latter to displace said releasable lock means into engagement with said release means to be released thereby for freeing said elastic sleeve for longitudinal expansion and radial contraction to provide for automatic retraction of said slip means inwardly away from the casing wall to release the entire packer assembly from the casing wall.

2. The combination of claim 1 and wherein said releasable lock means includes a series of downwardly directed rings of sawtooth configuration distributed axially along said mandrel and an annular locking spring carried by said control sleeve and over which said rings ride to be engaged by said locking spring to prevent downward movement of said mandrel with respect to said control sleeve.

3. The combination of claim 2 and wherein said release means includes an elongated release sleeve surrounding said mandrel at the portion thereof where said lock rings are located and having an upper tip on which said locking spring slides during downward movement of said control sleeve with respect to said mandrel so that said release sleeve spreads said locking spring away from said teeth to release said mandrel to said elastic sleeve.

4. The combination of claim 3 and wherein a shear pin releasably fixes said control sleeve to said slip means for responding to the action of said release tool assembly to break the connection between said control sleeve and slip means during downward movement of said control sleeve by said release tool assembly for displacing said locking spring into engagement with said release means.

5. The combination of claim 1 and wherein a hollow piston forms part of said release tool assembly and extends slidably into said mandrel, said piston being formed with washing ports and said mandrel also being formed with washing ports communicating with said piston washing ports at the elevation of said slip means so that liquid may be washed against said slip means to contribute to releasing of the latter from the casing wall.

6. The combination of claim 1 and wherein a hydraulic means coacts with said release tool assembly for dis-

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placing said control sleeve downwardly with respect to said mandrel.

7. The combination of claim 1 and wherein said slip means includes an upper tapered slip expander having a hollow interior in which said release means is supported, a shear pin connecting said control sleeve to said upper slip expander, and said release tool assembly including an outer sleeve threaded onto said control sleeve for turning the latter with respect to said expander to break said shear pin and displace said control sleeve downwardly with respect to said mandrel to place said releasable lock means in engagement with said release means to be released thereby.

8. The combination of claim 1 and wherein said control sleeve has an upper toothed edge, said arresting means including a sleeve slidable on said pipe of said setting tool assembly and having a lower toothed edge to en-

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gage said upper toothed edge of said control sleeve, said pipe having a shoulder engaging the top end of said sleeve which is slidable on said pipe to displace the latter downwardly with said pipe, and leaf spring means with said sleeve on said pipe for releasably retaining the latter at a selected elevation along the casing wall.

#### References Cited

##### UNITED STATES PATENTS

10	2,221,204	11/1940	Santiago	-----	166—124
	2,737,244	3/1956	Baker et al.	-----	166—124
	3,108,638	10/1963	Burns	-----	166—124
	3,171,491	3/1965	States	-----	166—124
	3,241,616	3/1966	Cox	-----	166—134
15	3,260,309	7/1966	Brown	-----	166—124

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