July 12, 1938. W. L. CHURCH 2,123,500

PACKER AND SETTING TOOL

Filed Dec. 28, 1936

Fig. 1.

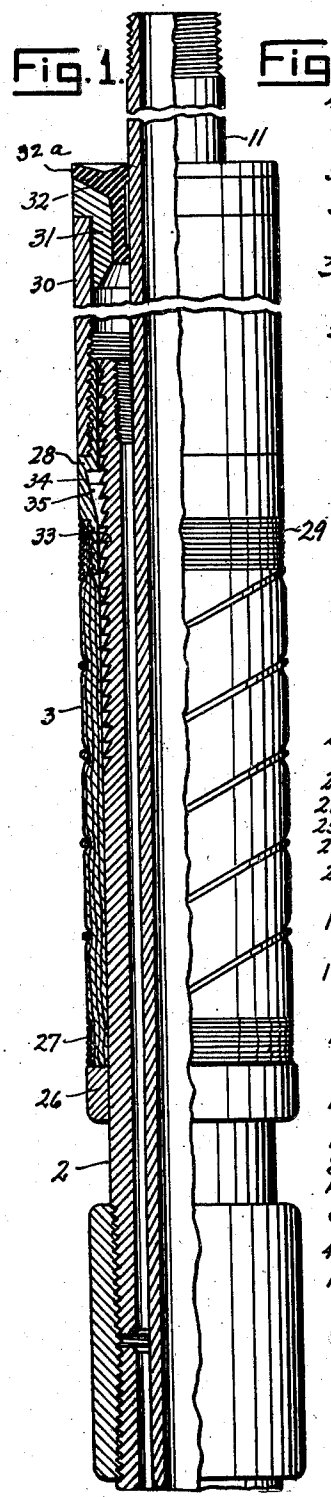
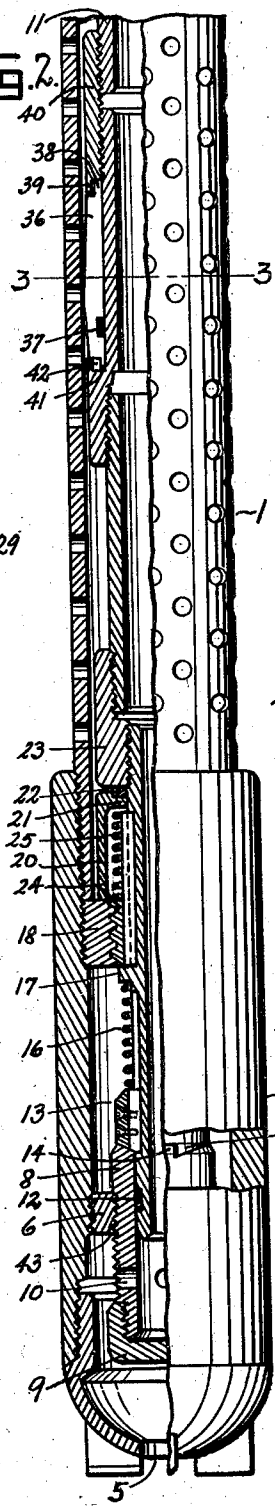


Fig. 2.



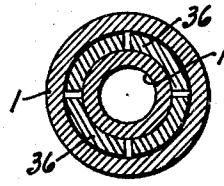


Fig. 3.

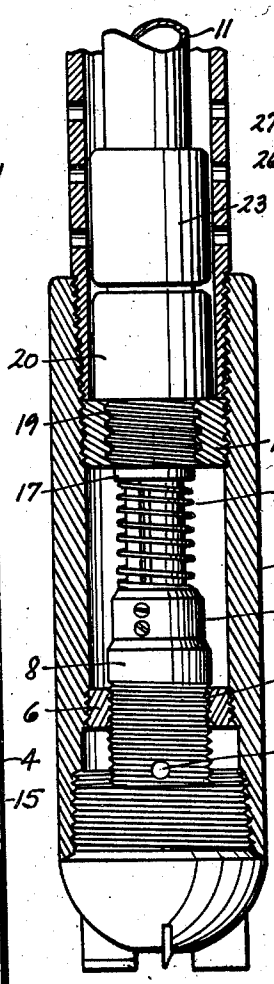


Fig. 4.

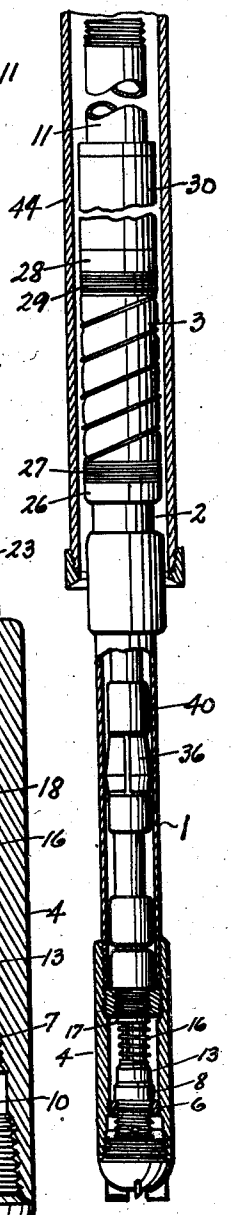


Fig. 5.

Inventor

Walter L. Church

By

Edward V. Hardeway.

Attorney

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PACKER AND SETTING TOOL

Walter L. Church, Houston, Tex.

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16 Claims. (Cl. 166—10)

This invention relates to a packer and setting tool.

It is an object of the invention to provide novel means for forming a fluid tight seal between an inner pipe and an outer pipe in a well.

It is a particular object of the invention to provide a packer and setting tool whereby a seal may be formed between the liner, to which the screen is attached, and the casing in the well, and the setting tool and setting string then detached and removed.

It is a further object of the invention to provide novel means for connecting the setting string and setting tool to the screen, carrying the packer, for lowering the screen and packer into the well.

It is a further object of the invention to provide in well equipment of the character described a novel type of control valve, operatively connected in a novel manner with the operating string whereby the valve may be operated to close the lower end of the screen prior to the packer setting operation.

The invention embodies certain improvements over that type of combination packer and setting tool disclosed in Patent No. 1,797,177 issued March 17, 1931, to applicant and another, as well as certain improvements over that type of packer and setting tool disclosed in Patent No. 2,017,434, issued to applicant on October 15, 1935.

With the above and other objects in view the invention has particular relation to certain novel features of construction, operation and arrangement of parts, an example of which is given in this specification and illustrated in the accompanying drawing, wherein:—

Figure 1 shows a side view, partly in section, showing the packer on the upper end of the liner.

Figure 2 shows a side view, partly in section, of screen and set shoe showing the setting tool, control valve and connecting parts.

Figure 3 shows a cross-sectional view taken on the line 3—3 of Figure 2.

Figure 4 shows a vertical, sectional view of the set shoe showing the valve therein, and

Figure 5 shows a side elevation, partly in section, of the complete equipment.

Referring now more particularly to the drawing wherein like numerals of reference designate the same parts in each of the figures, the numeral 1 designates the screen which may be of any conventional construction and whose upper end is connected to the blank liner 2 which forms a body, or support, for the expansible packer 3.

Attached to the lower end of the screen there is a tubular set shoe 4 of any selected form which has the lower end outlet opening 5. Threaded into the set shoe there is an inside annular anchor 6 which has internal left hand threads 7, and screwed through this anchor there is a tubular valve 8 whose lower end is closed by the cap 9, and this valve has side outlet openings 10.

The numeral 11 designates the operating tubular string of pipe which extends to the ground surface. The lower end of this string extends downwardly within the valve 8 and has a surrounding packing 12 forming a fluid tight joint between the valve and said lower end.

Slidably mounted on the string 11 and having a splined connection therewith there is the annular ratchet ring 13. The upper end of the valve and the lower end of the ratchet ring have interengaging teeth 14 and 15, respectively, which are pitched to operate idly when the operating string is turned to the left but to inter-engage so as to turn the valve when the operating string is turned to the right. These teeth are urged into interengaging position by the light coiled spring 16 which surrounds the operating string and whose lower end is seated against the ring 13. The upper end of the spring 16 is seated against the external annular rib 17 on the operating string.

Screwed into the upper end of the set shoe 4 there is an annular coupling 18 having internal coarse, left hand threads 19. This coupling 18 forms a support on which the lower end of the hood 20 may rest when the parts are assembled and coupled together as shown in Figure 2.

The upper end of this hood has an inwardly extending annular flange 21 which closely surrounds the setting string 11 and whose upper face carries the wear-ring 22 on which the coupling 23 may rest to support the string 11.

Splined on said string, and surrounding the same there is a nut 24 having external, course, left hand threads arranged to intermesh with the threads of the coupling 18. A coiled spring 25 is housed within the hood, or housing 20 with its upper end resting against the flange 21 and its lower end resting against the nut 24. The hood 20 relieves the threads of the nut 24 of the load of string 11.

The upper end of the liner 2 forms a packer support on which the expansible packer 3 is mounted. This packer may be formed of fabric or rubberized fabric. Its lower end abuts the annular shoulder 26 carried by the packer support, and is fastened to said support in any suitable manner as by wrapping the same with wire 27.

Surrounding the upper end of the packer support and slidably mounted thereon there is a set collar 28 to the lower end of which the upper end of the packer is secured as by wire wrapping 29. Attached to and upstanding from the set collar 28 there is a setting nipple 30 which has the annular gland 31 secured in the upper end thereof and provided with an upwardly flared face 32. Fitted within the gland 32 and closely surround-

ing and gripping the string 11 is the resilient packing 32a.

The upper end of the packer support 2 has external, downwardly pitched, buttress threads 33 and the set collar 28 has an inside downwardly converging seat 34 on which the wedge shaped slips 35 are seated, said slips having inside teeth reversely pitched with respect to the threads 33 and adapted to engage therewith to hold the packer expanded as will be hereinafter explained.

Mounted on the setting string there are the expansible dogs 36 whose lower inside ends are seated against the internal coiled springs 37. The upper ends of these dogs are inwardly shouldered forming upward extensions 38 which extend upwardly within an internal, annular recess in the lower end 39 of a coupling 40 of the setting string.

The lower ends of the dogs 36 are inwardly shouldered forming downward extensions 41 which work in a wide upwardly facing groove 42 in the enlarged lower end of section 11a of the setting string 11. The fingers 38 and 41 retain the dogs against detachment and the groove 42 is of sufficient width to allow outward movement of the lower ends of the dogs.

In assembling the apparatus the valve 8 is screwed to its lower position so that its outlet openings 10 will be beneath the anchor 6 so that the valve will be open.

The set shoe with the coupling 18 therein is then attached to the screen and the screen and liner, with the packer thereon, are then assembled and held suspended in the top of the well by the usual equipment for that purpose. The lower end of the setting string 11 with the appendants 13, 16, 20, 24, 25 and 36 are then lowered through the screen. The lower end of the nut 24 will engage the upper end of the coupling 18 and compress the spring 25 as the string moves on down to land the hood 20 on the coupling 18 and the packing 32a will move down into the gland 32. Said nut 24 will then be up in the hood 20 with its threads in readiness to engage the threads of the coupling 18. The string 11 is then turned to the left and the pressure of the spring 25 will cause the threads of said coupling and nut to intermesh causing the nut to move downwardly into the position shown in Figure 2. While the string is being turned to the left the teeth 15 will ride over the teeth 14 without turning the valve 8 so that the lower end of the setting string will be open. While the string is being lowered through the screen the dogs 36 will be held retracted by the screen as shown in Figure 2. The setting string is now made up and the apparatus is lowered until the set shoe 4 lands on the bottom with the packer up in the lower end of the casing 44 as shown in Figure 5. Clean washing fluid may now be forced down through the string 11 and will pass out through the openings 10 and 5 and back up around the screen until the screen is washed clean. The packing 32a will prevent sand and the like from settling down into the liner and screen about the string and setting tool, during the washing process, and causing the string and setting tool to stick in the screen. The setting string is now turned to the right and thereupon the teeth 14 and 15 will interengage causing the valve 8 to be screwed upwardly to carry the openings 10 up into the anchor 6 with the upper end of the cap 9 seated against the beveled seat 43 at the lower end of the anchor to close the lower end of the screen as illustrated in Figure 2. While the string is being turned to the right to move the valve 8 upwardly it will also operate to move the nut 24 upwardly into the hood 20 and release it from the threads of the coupling 18. The string 11 may now be elevated, carrying the packing 32a with it, until the lower ends of the dogs 36 clear the upper end of the setting nipple 30 whereupon the springs 37 will expand the lower ends of said dogs. The string may now be lowered and said expanded lower ends of the dogs will engage the face 32 and move the setting nipple 30 and the set collar 28 downwardly expanding the packer 3 against the surrounding walls of the casing and forming a fluid tight seal therewith.

The slips 35 will move downwardly over the threads 33 but will thereupon engage said threads and maintain the packer expanded. The string 11 may be secured in said elevated position and used as a flow tube while the well is flowing. After the well stops flowing the string and setting tool carried thereby may be removed from the well.

The drawing and description disclose what is now considered to be a preferred form of the invention by way of illustration only while the broad principle of the invention will be defined by the appended claims.

What I claim is:—

1. The combination with a tubular screen, of a valve movable into one position to open the lower end of the screen and into another position to close said lower end, a tubular operating string and means arranged to be actuated idly upon rotation of the string in one direction and to actuate the valve to closed position upon rotation of the string in the other direction.

2. The combination with a pipe adapted to be set in a well, of a valve arranged to open and close the lower end of the pipe, an operating string extended from the valve to the ground surface and means operable by the string and effective to actuate the valve upon rotation of the string in one direction and to operate idly upon rotation of the string in the other direction.

3. The combination with a pipe adapted to be set in a well, of a valve arranged to open and close said pipe, a tubular operating string operable in the well from the ground surface and operative in one direction idly and in another direction to operate the valve.

4. The combination with a screen pipe for a well, of a rotatable valve to open and close the passageway through the pipe, a tubular operating string operable in the well from the ground surface and means operable by the string and effective, upon rotation in one direction, to actuate the valve and to operate idly when rotated in the other direction.

5. The combination with a screen pipe adapted to be set in a well, of a valve mounted in said pipe and having a threaded connection whereby the valve, upon rotation, will be moved to open or close the passageway through the pipe, a tubular operating string operable in the well from the ground surface and means operable by the string in one direction idly and in another direction to rotate the valve.

6. The combination with a screen pipe adapted to be set in a well, of a valve mounted in said pipe and having a threaded connection whereby the valve upon rotation will be moved to open and close the passageway through the pipe, a tubular operating string operable in the well from the ground surface and means arranged to be operated by the string and operable in one direction

idly and effective when operated in the other direction to rotate the valve to closed position.

7. The combination with a screen pipe for a well, of a tubular operating string operatable in the well and extended into the screen pipe, means in the screen pipe for rotatably supporting said string, a rotatable valve having a threaded connection and arranged to open and close the passageway through the screen pipe, means arranged to be actuated by the operating string, upon rotation of said string in one direction, to connect said string with the screen pipe, valve actuating means arranged to be operated idly by the string, upon rotation of said string in said direction and being effective to actuate the valve when the string is rotated in the other direction, said connecting means being releasable upon the rotation of the string in said last named direction.

8. The combination with a screen pipe for a well, of a tubular operating string operatable in the well and extended into the screen pipe, means in the screen pipe for rotatably supporting said string, a rotatable valve having a threaded connection and arranged to open and close the passageway through the screen pipe, means arranged to be actuated by the operating string, upon rotation of said string in one direction, to connect said string with the screen pipe, valve actuating means arranged to be operated idly by the string, upon rotation of said string in said direction and being effective to actuate the valve when the string is rotated in the other direction, said connecting means being releasable upon the rotation of the string in said last named direction, an expansible packer supported above the screen pipe and means on the string arranged to be rendered active upon elevation of the string and effective to engage and expand the packer upon subsequent downward movement of the string.

9. The combination with a screen pipe adapted to be set in a well, an expansible packer thereon, a valve for controlling the flow of liquid through the screen pipe, a tubular operating string operable in the well from the ground surface and extended into the screen pipe, means for operatably connecting the string with the screen pipe upon rotation of the string in one direction, valve actuating means operable idly by the string upon such rotation in said direction, said connecting means being releasable upon rotation of the string in the other direction and said actuating means being effective to operate the valve upon such rotation in said other direction.

10. The combination with a screen pipe adapted to be set in a well, an expansible packer thereon, a valve for controlling the flow of liquid through the screen pipe, a tubular operating string operable in the well from the ground surface and extended into the screen pipe, means for operatably connecting the string with the screen pipe upon rotation of the string in one direction, valve actuating means operable idly by the string upon such rotation in said direction, said connecting means being releasable upon rotation of the string in the other direction and said actuating means being effective to operate the valve upon such rotation in said other direction, means normally held retracted and movable into active position upon elevation of the string and effective to expand the packer upon subsequent downward movement of the string.

11. The combination with a screen pipe adapted to be set in a well, an expansible packer thereon, a valve for controlling the flow of liquid through the screen pipe, a tubular operating string operable in the well from the ground surface and extended into the screen pipe, means for operatably connecting the string with the screen pipe upon rotation of the string in one direction, valve actuating means operable idly by the string upon such rotation in said direction, said connecting means being releasable upon rotation of the string in the other direction and said actuating means being effective to operate the valve upon such rotation in said other direction, means normally held retracted and movable into active position upon elevation of the string and effective to expand the packer upon subsequent downward movement of the string, and means for maintaining the packer expanded.

12. The combination with a well screen, of a rotatable valve at the lower end thereof movable into open and closed position, an operating string operable in the well and extended into the screen, means effective, upon rotation of the string in one direction, to connect the screen to the string, valve actuating means operable idly by the string when the latter is so rotated, said connecting means being releasable upon rotation of the string in the other direction and said actuating means being effective to operate the valve upon said last mentioned rotation.

13. The combination with a pipe adapted to be set in a well, of a valve to open and close the passageway through the pipe, a tubular operating string extended into said pipe, means, releasable by rotation, having a splined connection with the string and a threaded connection with the pipe whereby said pipe may be supported and lowered into the well by said string, valve actuating means arranged to be operated by the string, and to actuate the valve to closed position upon rotation of the string to release said supporting means.

14. The combination with a pipe adapted to be set in a well, of a valve to open and close the passageway through the pipe, a tubular operating string extended into said pipe, means, releasable by rotation, connecting the pipe to the string whereby said pipe may be supported and lowered into the well by said string, said pipe and string, one being clutched with said connecting means and the other having a threaded connection therewith, valve actuating means arranged to be operated by the string, and to actuate the valve to closed position upon rotation of the string to release said supporting means, an expansible packer on the pipe and means on the string movable into active position, upon elevation of the string relative to the pipe and effective to expand the packer upon the subsequent downward movement of the string.

15. The combination with a screen pipe having a packer support and adapted to be set in a well, of a valve arranged to open and close said pipe, a tubular operating string operable in the well from the ground surface, a housing supported by the screen pipe and supporting the string, said operating string being operative in one direction idly and in another direction to operate the valve.

16. The combination with a pipe adapted to be set in a well, of a valve arranged to open and close said pipe, a tubular operating string operable in the well from the ground surface, a ratchet operative in one direction idly with the string and operative in another direction with the string, to operate the valve.

WALTER L. CHURCH.