

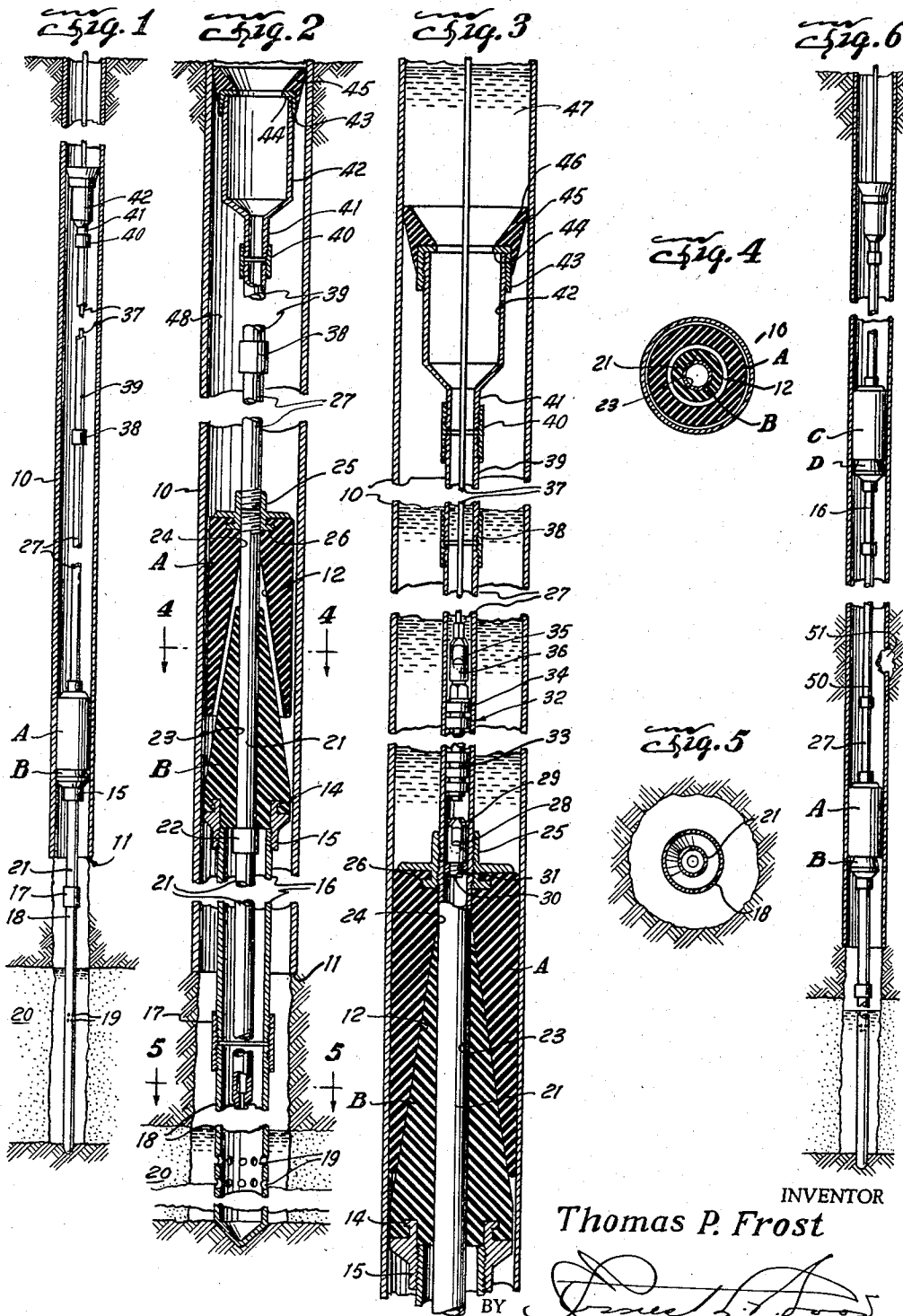
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COMBINATION WELL PACKER AND PUMPING ASSEMBLY

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COMBINATION WELL PACKER AND PUMPING ASSEMBLY

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14 Claims. (Cl. 103—181)

This invention relates to an apparatus for producing fluid from wells.

The principal object of the invention is to provide apparatus eliminating the need for production tubing in pumping wells which includes a packer from which depends a landing nipple supporting the packer at any desired elevation from the bottom of the hole and a packer expanding cone supporting the combined load of a working barrel and well pumping assembly and a centering tube in the well casing, thus to expand the packer into sealing engagement with the casing walls so that the well fluid may be displaced upwardly through the packer, working barrel, centering tube and into the well casing. The column of fluid rises in the well casing and is drawn off at the surface in substantially the same manner as it would be piped from the tubing if the latter were extended to the surface.

Another object of the invention is to provide an apparatus of the character set forth which is of exceptional value in by-passing breaks in the casing or leaky joints difficult to cement. In such cases, two packers are employed and supported by the landing nipple one on each side of the break or joint in order that the well fluid displaced upwardly by the pumping assembly between the packers will pass upwardly through both packers and into the well casing above the break or leaky joint.

Broadly, the invention aims to save the producer much of the cost necessary in pumping wells in the conventional manner, not only in obviating the need for a full tubing string but also the cost in time and labor incident to the running in and pulling of the tubing.

Other objects will appear as the description proceeds when considered with the annexed drawing, wherein:

Figure 1 is an elevational view of the invention shown installed in the casing of a well.

Figure 2 is a view in vertical section on a larger scale and longitudinally contracted.

Figure 3 is a vertical sectional view on a still larger scale showing the packer sealed and supporting a column of fluid in the well casing and further showing a swaged nipple on the tubing which serves as a tool guide and centering means for the tubing and further shows a means for running the tool into and withdrawing the same from a well.

Figure 4 is a transverse sectional view taken on line 4—4 of Figure 2.

Figure 5 is a transverse sectional view taken on line 5—5 of Figure 2, and

Figure 6 is an elevational view of the invention in a well showing the application of spaced apart packers opposing a leak in the casing of the well.

Continuing with a more detailed description of the drawing, reference numeral 10 denotes a conventional casing string in a well bore and is shown seated on the shoulder 11 formed in the bore.

This application is a continuation-in-part of application Serial No. 490,775, filed February 28, 1955 (now abandoned).

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The invention is comprised of a packer composed of two telescopically related sections A and B molded from rubber. The upper or sealing section A is formed with a hollow tapered core 12 which receives the correspondingly tapered expanding section or expander B. Embedded in the lower end of the expander B is the anchoring boss 14 of a flange coupling 15 which is of a diameter smaller than the expander B at its bottom. A length of pipe 16 has its upper end threaded into the coupling 15 and threaded onto the lower end of the pipe 16 is a collar 17 (Figure 2) and into the collar, in turn, is threaded the upper end of a landing nipple 18 which is provided with perforations 19 open to the production sand 20.

Extending axially through the packer sections A and B is a tubular mandrel or production tube 21 which is made in axially aligned sections for extension and which sections are joined together by a collar 22 (Figure 2). The mandrel or tube 21 extends through the axial bore 23 of the expander B and the axial bore 24 of the packer A and is threadedly received in a flange coupling 25 which has an integral boss 26 embedded in the upper end of the packer A.

Threaded into the upper end of the coupling 25 is the lower end of a working barrel 27 which communicates with the production tube 21 through a ball check valve 28 (Figure 3) whose cage 29 has a threaded nipple 30 which is received in an internally threaded reducer 31 in the coupling 25.

Reciprocable in the working barrel 27 is a traveling valve 32 (Figure 3) of conventional manufacture, made up of a bottom mandrel 33 on which is spaced a plurality of cups 34. A fluid lift valve 35 is arranged in a cage 36 whose lower end threadedly receives the upper end of the hollow mandrel 33 and is threadedly attached at its upper end to the lower end of a sucker rod string 37 which extends to the surface and is reciprocated in any conventional manner.

Attached by means of a collar 38 to the upper end of the working barrel 27 is a tubular extension 39 and connected to the upper end of the tubular extension 39, by means of a collar 40, is the reduced lower end 41 of a centering collar 42. The centering collar 42 is slightly less in diameter than the diameter of the well casing 10 and has a threaded upper end onto which is applied a half-collar 43 on which is formed an internal flange 44. Vulcanized to the half-collar 43 and its flange 44 is a tapered rubber seal 45. The wide upper end of the seal 45 is in sealing engagement with the inner wall surfaces of the casing 10 and has rounded edges as indicated at 46 which prevent fouling on the casing between joints as the equipment is pulled therefrom.

The centering collar 42 has more than one function. First, it provides a coupling or connector for a running and retrieving tool such, for example, as described in my co-pending application Serial No. 517,559, filed June 23, 1955. The internal flange 44 is engaged by the jaws of the running and retrieving tool and it is by means of this flange that the invention is suspended in the well casing. Second: The seal 45 of the collar 42 prevents settlements from the column of oil above the assembly from dropping onto the packer A and possibly interfering with proper seating thereof. Third: The flange or seal 45 keeps the working barrel 27 straight and insures against whipping or wobbling of the traveling valve as it reciprocates in the working barrel, thereby prolonging the efficiency of the cups 34, and finally, the tapered portion of the seal or flange 45 guides the pumping equipment into the working barrel after the tool is set down for operation in a well.

The sole purpose of the tubing extension 39 is to provide the necessary weight to initially expand the packer A against the casing walls with a force sufficient to in-

sure adequate seal against by-passage of well fluid from either below or above the packer. The tubing extension does provide a means, cooperating with the flange 45 of the collar 42 for guiding the pumping assembly into the working barrel and has the effect to insure rectilinear travel of the pump assembly therein. It is seldom necessary, particularly in shallow wells, to install more than one section of pipe for the tubular extension because the packer A is fluid controlled or fluid seated, once pumping operations begin and a column of fluid is accumulated above the packer in the casing, the weight of which keeps the packer in positive sealing engagement with the casing walls. Of course, in deep wells, all of the elements of the described combination must be proportionately larger since the casing is larger.

To install the invention in a cased well, the assembly consisting of the packer sections A and B, landing nipple 18, working barrel 27 and tubular extension 39 are lowered by the running and retrieving tool above mentioned or by any conventional running tool into the casing until the landing nipple 18 rests on the bottom of the hole. During lowering of the assembly, the weight of the packer expander B and the landing nipple is sustained by the collar 22 and are separated from the packer A, hence the packer will contract to a diameter small enough that it will pass freely through the casing 10. When the landing nipple 18 is brought to rest on the well bottom, the weight of the relatively movable assembly thereabove causes the packer A to be expanded by its engagement with the tapered body of the expander B and will engage the walls of the casing 10. When this occurs, the production tube 21 is slid downwardly through the packer 12 to a point spaced above the bottom of the landing nipple.

When the packer has been set in the manner described, the stationary valve 28 is lowered into position followed by the pump assembly 30. These elements are installed in any conventional manner and by tools well known to the trade.

The sucker rod string 37 is reciprocated in the usual manner to actuate the pump assembly in the working barrel 27, thus to draw fluid upwardly from the producing sand 20 through the production tube 21 and into the working barrel 27 on the up-stroke of the pump which displaces the ball valve 28 from its seat. Upon the down-stroke of the pump, valve 28 is closed and valve 35 opens to pass the fluid from the working barrel upwardly into the tubular extension 39. Continued operation of the pump builds up a column of well fluid 47 in the casing 10, some of which enters the annular space 48 between the extension 39 and the casing 10. Well fluid is added to the column of fluid in the casing until the fluid emerges from the top of the casing from whence it is piped to storage in the usual manner. The weight of the column of fluid remaining in the casing serves to impose a downward force against the packer A at all times, keeping the same in tight sealing engagement with the casing walls.

In Figure 6 is shown another adaptation of the invention. A split may occur in the wall of the casing during well shooting operations or the casing may be perforated at a level thought to be a producing sand by-passed in drilling but instead water enters the casing. These casing leaks caused by whatever means are difficult to cement and often the cementing job is ineffective.

In cases described in the foregoing the invention, in actual practice, has been found highly effective in by-passing casing leaks without any change in construction or operation. It is necessary only to incorporate a second packer C in the assembly, separated from the packer A by a section of tubing 50 which latter is of a length sufficient to space the packers A and C on opposite sides of the casing leak 51.

The packer A, pump assembly, production pipe 21 and landing nipple 18 in the adaptation shown in Figure 6 remain in the same position and relationship described

in the foregoing. Of course, the pipe 16 below the packer A, the production tube 21 and the landing nipple 18 may be elongated to dispose the packer A in closer relationship with the casing leak 51, wherever it may be and the lower end of a section 50 of tubing is connected to the top of the working barrel 27 and at its opposite end to the pipe 16 of the added packer C, resulting in an assembly such as shown in Figure 2 except that the landing nipple 18 and the working barrel 27 are omitted from the upper assembly.

It is evident from the foregoing that the packers A and C seal off the casing on opposite sides of the leak 51 and that the well fluid drawn upwardly by the pump assembly will by-pass the leak 51 through the added section of tubing 50, the packers A and C sealing the casing both above and below the leak, the tubular extension 39 serving to initially provide the weight necessary to thrust the packer C down onto the expander D, which latter is identical to the wedge or expander B, thus causing the packer to expand against the casing walls.

When it is desired to remove the packer and its associated elements from the well, the pumping assembly is first pulled and the running and retrieving tool is lowered into engagement with the connector collar 42 by which the packer A, the tubing extension 39, working barrel 27, production tube 21 and the landing nipple 18 are lifted. First, the packer A, which is fixed to the working barrel, is moved upward away from the wedge or expander B, as shown in Figure 2. When the collar 22 is moved upwardly against the bottom of the expander B, the latter is lifted, along with the landing nipple 18. When the packer A is displaced from the expander B, it contracts away from the casing walls, enabling it to move freely through the casing.

Manifestly, the construction as shown and described is capable of some modification and such modification as may be construed to fall within the scope and meaning of the appended claims is also considered to be within the spirit and intent of the invention.

What is claimed is:

1. In a cased well, a combination packing and pumping assembly comprising a perforated landing nipple seated on the well bottom, an elongated cylindrical packer of resilient material having an axial bore communicating with an axially aligned and tapered cavity therein, a tapered expander carried by the upper end of said landing nipple received in the cavity of said packer to expand the same and having an axial bore, a working barrel affixed to and extending upwardly from said packer, a piston reciprocable in said working barrel, a pump rod string connected to and actuating said piston from the surface, a tubular rod guide connected to and extending upwardly from said working barrel, a collar carried by the upper end of said rod guide having a tapered flange in sealing engagement with the walls of the casing of said well, a production tube connected to said working barrel and extending downwardly through the bores of said packer and said expander, said expander being slidable thereon, said working barrel, rod guide and collar imposing weight on said packer to urge the same onto said expander in seated position of said landing nipple to expand said packer into sealing engagement with said casing walls.

2. In a cased well, a combination well packer and pumping assembly comprising a perforated landing nipple seated on the well bottom, a working barrel, a piston reciprocable in said working barrel, a rod line connected to and operating said piston from the surface, a production tube depending from said working barrel into said landing nipple, a packer of resilient material secured to said working barrel and embracing said production tube, an expander secured to the upper end of said landing nipple and slidably embracing said production tube and adapted to be engaged by said packer upon downward movement thereof to expand the latter into sealing en-

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gement with the walls of the casing of said well, and means carried by the upper end of said working barrel for centering the latter in said casing and for sealing said casing against precipitation of extrinsic substances onto said packer from a column of well fluid elevated into said casing above said packer through said production tube.

3. In a cased well, a combination well packer and pumping assembly, comprising a perforated landing nipple seated on the well bottom, a production tube extending downwardly into said landing nipple, a working barrel connected to and extending upwardly from said production tube, a packer of resilient material carried by the lower end of said working barrel and embracing the upper portion of the production tube, an expander for said packer carried by the upper end of said landing nipple and slidably embracing said production tube, a surface actuated rod line, a pump piston connected to and reciprocable by said rod line in said working barrel, a tubular rod line guide connected to and extending upwardly from said working barrel, said working barrel and rod guide imposing weight on said packer in seated position of said landing nipple, said packer being movable into engagement with said expander to seal the casing of said well preliminary to loading said packer with well fluid elevated by said pump piston and means carried by said rod guide for centering the same and said working barrel in said well casing.

4. In a cased well, a combination well packer and pumping assembly, comprising a perforated landing nipple adapted to be seated on the well bottom, a tapered packer expander carried by the upper end of said landing nipple, a production tube slidable through said expander and entering said landing nipple, a working barrel connected to said production tube and extending upwardly in the casing of said well, a packer of resilient material connected to said working barrel and having a tapered cavity receiving said expander when said packer is set down onto said expander under the weight of said working barrel and production tube to expand said packer into sealing arrangement with the walls of said casing.

5. The structure of claim 4, a pump piston reciprocable in said working barrel, a surface operated rod string connected to said pump piston for actuating the same, a tubular guide secured to and extending upwardly from said working barrel, means carried by the upper end of said rod guide for centering the same and said working barrel in said casing.

6. The structure of claim 5, wherein said centering means is comprised of a rubber covered flange in sealing engagement with the casing walls to prevent precipitation of extraneous substances out of a column of well fluid transferred by said pump piston into said casing above said flange.

7. In a cased well, a combination well packer assembly, comprising a perforated landing nipple seated on the well bottom, a tapered expander carried by the upper end of said landing nipple and stationary therewith, a production tube slidable longitudinally through said expander into said landing nipple, a working barrel extending upwardly into the casing of said well, a packer of resilient material having a portion extending downwardly over said tapered expander to be expanded upon relative axial movement of the expander and packer, said packer joining said production tube and said working barrel and stationarily embracing the upper portion of said production tube for movement into engagement with said expander under the weight of said production tube and working barrel in seated position of said landing nipple to expand said packer into sealing engagement with the walls of said casing.

8. The structure of claim 7, and reciprocable means in said working barrel operated from the surface for continuously transferring well fluid upwardly through said landing nipple, said production tube and said working barrel into said casing above said packer.

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9. The structure of claim 8, a tubular guide for said reciprocable means above and connected to said working barrel and means carried by said tubular guide for centering and stabilizing said tubular guide and said working barrel in said casing.

10. A packer assembly for use in pumping a well without tubing and through a well casing which comprises, in combination, an elongate resilient packer having a conical cavity extending thereinto from the lower end thereof, a conical expander having its apex extending upwardly into said conical cavity and movable thereinto to expand said packer, a first tubular nipple connected to said expander and extending downwardly therefrom and away from the packer, a second tubular nipple connected to the packer and extending upwardly and away from the expander, means providing a supporting connection between the expander and packer and providing relative axial movement therebetween whereby said packer can be lowered contracted into a well with the expander supported therebelow and upon said first tubular nipple coming to rest at a fixed position in the well, continued downward movement of the packer will cause the expander to expand the packer, said supporting means also providing a fluid passageway through the packer and expander between said first and second nipples, a pump barrel forming a part of one of said first and second nipples, and means connected to said second tubular nipple and having a part engageable by a landing or pulling tool for landing or pulling the packer assembly.

11. As a subcombination, a centering collar for a casing pump comprising an annular body having a lower end and an upper end, means on the lower end of the body for connection with a tubular element, an annular shoulder extending inwardly in said body proximately said upper end and facing said lower end, and a resilient annular seal at the upper end of said body having a conical internal bore sloping downwardly to said upper end, said seal having an upper portion for forming a seal with a casing in which the collar is inserted.

12. A packer assembly for use in pumping a well without tubing and through a well casing which comprises, in combination, an elongate resilient packer having a conical cavity extending thereinto from the lower end thereof forming an annular lip at the packer's lower periphery which extends downwardly so that the packer can be pulled from the well without exerting a swabbing action, a conical expander having its apex extending upwardly into said conical cavity and movable thereinto to expand said packer, pump barrel and conduit means having one portion connected to the expander and extending in a direction away from the packer and said expander apex and another portion connected to the packer and extending in a direction away from the expander, means connecting the packer and expander for limited relative axial movement and providing a fluid passageway between said portions of the pump barrel and conduit means, and means connected to said another portion for engagement with a landing or pulling tool so that the packer assembly can be lowered through a casing to be landed therein and can be pulled therefrom.

13. The assembly of claim 12 in combination with an annular seal connected to the upper end of said another portion and extending outwardly therefrom for forming a seal with said casing, said seal having a conically shaped inner surface sloping downwardly from proximately the outer periphery of the seal to the upper end of said another portion to form a guide for inserting a pump plunger into said assembly after it has been landed in a well.

14. A packer assembly for use in pumping a well without tubing and through a well casing, comprising an elongate resilient packer having a conical cavity extending thereinto from the lower end thereof, a conical expander having its apex extending upwardly into said conical cavity and movable thereinto to expand said

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packer, a tubular nipple including a pump barrel connected to the packer and extending upwardly and away from the expander, a tubular connector supporting the expander from the packer for relative axial movement therebetween, whereby said packer may be lowered into the well in a contracted state and then expanded by said expander into engagement with the well casing upon said expander coming to rest at a fixed position in the well and continued downward movement of the packer, said tubular connector also providing a fluid passageway between the tubular nipple and the well casing beneath

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the expanded packer, and means connected to the tubular nipple and having a part engageable by a landing or pulling tool for landing or pulling the packer assembly.

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