Jan. 6, 1953 T. M. RAGAN 2,624,412

HYDRAULIC BOOSTER OPERATED WELL PACKER

Filed Feb. 25, 1949 2 SHEETS—SHEET 1

Fig. 1.

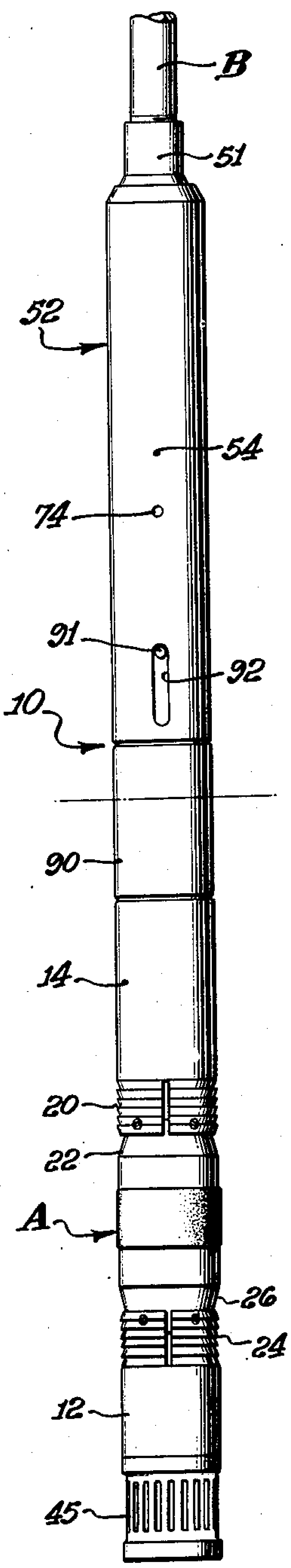

Fig. 2.

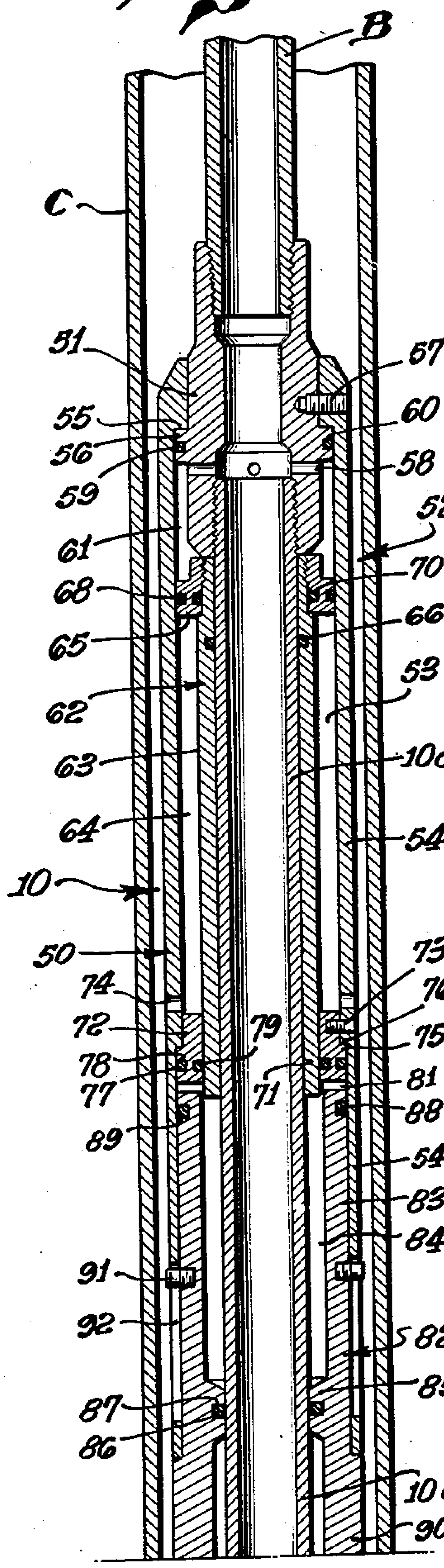

Fig. 2a.

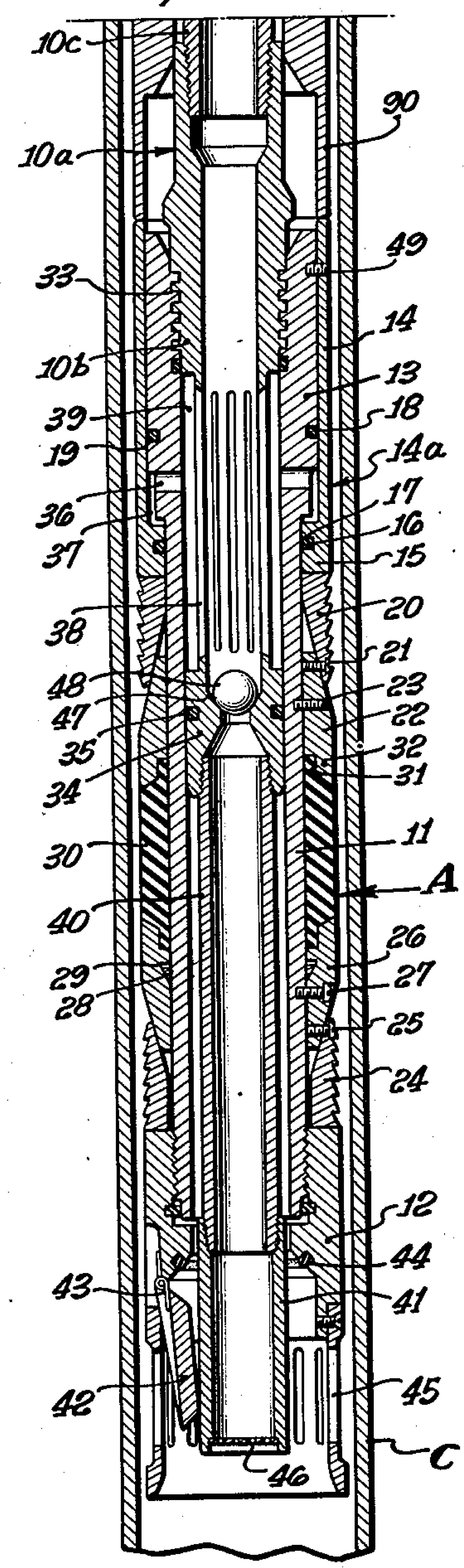

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Fig. 3.

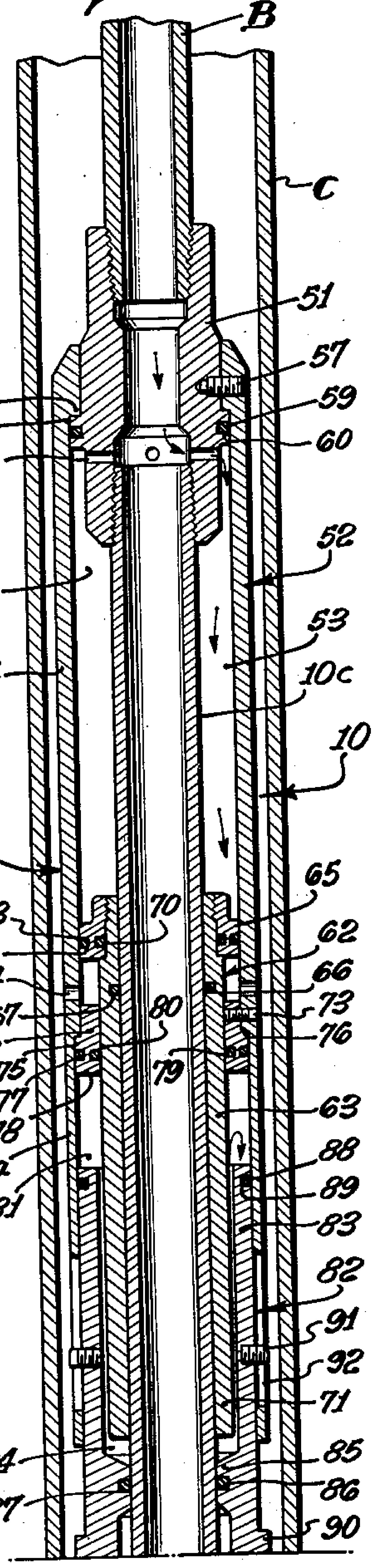


Fig. 3a.

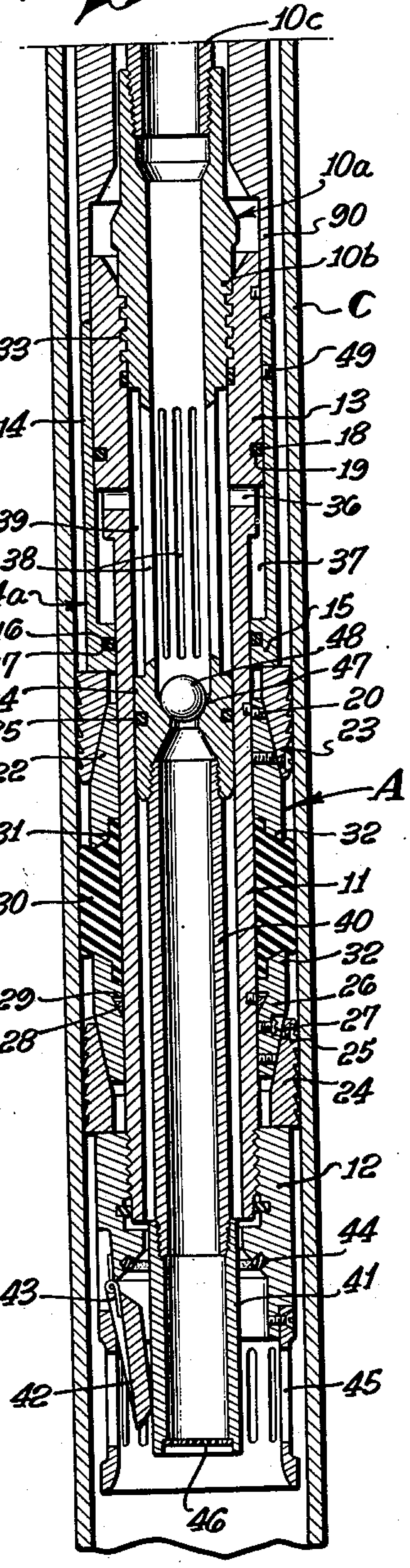
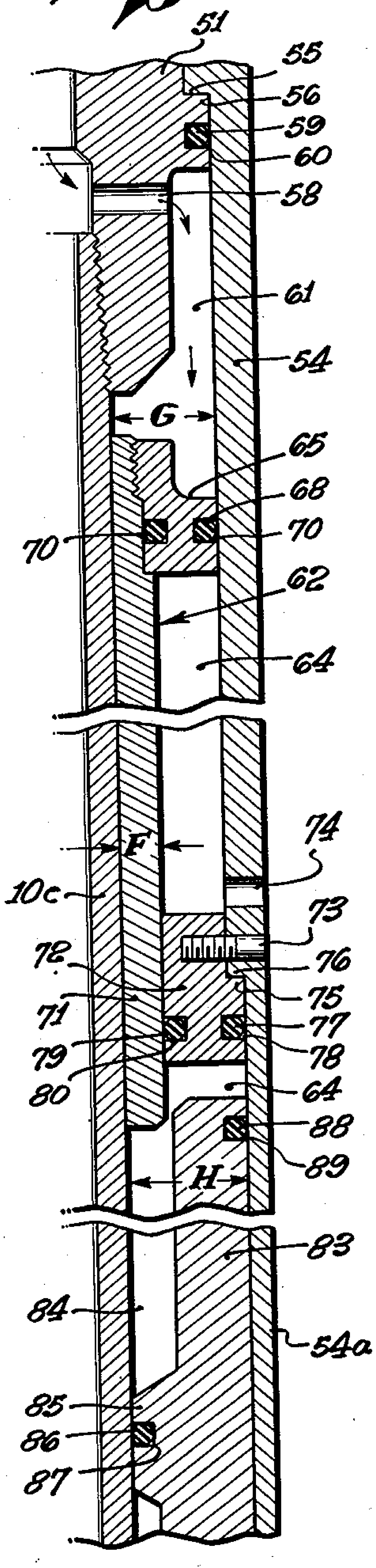


Fig. 4.



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2,624,412

HYDRAULIC BOOSTER OPERATED WELL PACKER

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Application February 25, 1949, Serial No. 78,353

16 Claims. (Cl. 166—12)

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The present invention relates to well packers adapted to be anchored in packed-off condition in casings, liners and similar conduits positioned in well bores.

Certain types of well packers employ slips and packing elements that are held initially in retracted position, and are then expanded outwardly into engagement with the wall of a well casing. Such outward expansion may be accomplished through the use of hydraulically operated instrumentalities, and also by longitudinally moving the tubing string to which the packer may be attached for running to the desired location in the well casing. The slips may be anchored in retracted position by one or more shear screws, that are designed to rupture at a predetermined pressure imposed on the hydraulically operated instrumentalities. To insure against premature and undesired disruption of the screws, they should be made of ample strength. However, any increase in diameter of the screws, or the use of screw materials having higher shear strengths, necessitates the imposition of a greater unit fluid pressure on the hydraulically operated instrumentalities. As a result, such unit pressures may be inordinately high.

It is sometimes not desired to set a well packer in the casing by a combination of applying hydraulic pressure to the setting instrumentalities and by moving the tubular string, to which the packer is attached, longitudinally in the well casing. At times, a comparatively large strain on the tubing string has been required to set the packer fully against the casing, which strain should be avoided.

Accordingly, an object of the present invention is generally to improve hydraulic mechanisms for setting well packers, or other well tools, in well casings.

Another object of the invention is to set or operate a well packer or other well tool in a well bore with a higher unit fluid pressure than the unit fluid pressure in the tubular string to which the packer or tool is attached.

A further object of the invention is to provide a hydraulic fluid pressure booster for setting a well packer in a casing or bore.

Still another object of the invention is to provide an improved hydraulic arrangement for setting a packer in a well bore, in which sufficient hydraulic force is available for setting the packer in packed-off condition in the well casing against both upward and downward movement therewithin.

This invention possesses many other advantages, and has other objects which may be made more clearly apparent from a consideration of a form in which it may be embodied. This form is shown in the drawings accompanying and forming part of the present specification. It will now be described in detail, for the purpose of illustrating the general principles of the invention; but it is to be understood that such detailed description is not to be taken in a limiting sense, since the scope of the invention is best defined by the appended claims.

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Referring to the drawings:

Figure 1 is a side elevation of a well packer and setting tool embodying the present invention;

Figs. 2 and 2*a* are enlarged longitudinal sections through the well tool disclosed in Fig. 1, shown with its parts in the relative positions they occupy for running the apparatus in a well casing, Fig. 2*a* forming a lower continuation of Fig. 2;

Figs. 3 and 3*a* are views similar to Figs. 2 and 2*a*, disclosing the apparatus actuated and the packer set fully in the well casing, Fig. 3*a* forming a lower continuation of Fig. 3;

Fig. 4 is an enlarged fragmentary longitudinal section through a portion of the hydraulic booster mechanism for setting the well packer.

As disclosed in the drawings, a well packer A is detachably secured to a setting tool **10** forming the lower end of a tubular string B running to the top of the well bore, and by means of which the packer is lowered to the desired setting or anchoring point within the well casing C.

The packer A includes a tubular body **11** having an abutment **12** threaded on its lower end and a head **13** at its upper end around which the skirt **14** of a cylinder **14a** is mounted. A cylinder head **15** extends inwardly from the lower end of the skirt and carries a suitable side seal ring **16** in a ring groove **17** slidably engaging the external surface of the body **11**. A suitable side seal ring **18** is also disposed in a body head groove **19** for slidable engagement with the interior of the skirt **14**.

A set of upper segmented slips **20** is disposed around the body immediately below the cylinder head **15**. These slips are held initially in retracted position by shear screws **21** attaching them to an upper conical expander **22**, initially secured to the body **11** by one or more shear screws **23**. The converging surfaces of the upper set of slips **20** and upper expander **22** are so disposed with respect to one another as to secure the packer against movement in an upward direction within the casing C, or similar well conduit, following outward expansion of the slips 20 into engagement with the casing.

A set of lower segmental slips 24 is provided adjacent the abutment 12. These slips are also secured by shear screws 25 to a lower tapered expander 26 attached initially to the body 11 by one or more shear screws 27. The direction of taper on the exterior of the lower expander 26 and the taper on the cooperable surfaces of the lower slips 24 are such as to hold the well packer against movement in a downward direction, following expansion of the slips 24 outwardly to casing engaging position.

A suitable lock is provided between the body 11 and lower expander 26 to permit upward movement of the body within this expander, but to preclude its downward movement. Such lock may be constituted by a split tapered wedge ring 28 received within the tapered groove 29 in the lower expander 26.

A suitable packing, such as a packing sleeve 30 of rubber or similar pliant material, is disposed around the body between the upper and lower expanders 21, 26. The ends of the packing sleeve 30 are received within annular pockets 31 formed between the expander skirts 32 and the exterior of the body 11.

The setting tool 10 includes a tubular member 10*a*, the lower portion 10*b* of which is threaded, as by a left-hand thread 33, into the head 13 of the packer body. This portion 10*b* has a lower head 34 carrying a suitable side seal 35 for sealing engagement with the inner wall of the body. The head 34 is disposed below body ports 36 positioned between the body and the cylinder head seals 18, 16 to establish communication between the interior of the body 11 and the annular clearance space 37 between the body head 13 and cylinder head 15. Elongated ports 38, in the form of slots, extend through the tubular portion 10*b* between its threaded portion 33 and head 34, establishing communication between the interior of the setting tool 10 and elongated annular space 39 between the exterior of the setting tool member 10*a* and the interior of the body 11.

The setting tool member 10*a* has a depending tubular section 40 secured to the lower head 34 and terminating in a lower portion 41 projecting from the body 11 and abutment 12, for the purpose of holding a back pressure valve in open position. This valve includes a valve head 42 pivoted on the abutment 12 and urged upwardly by a spring 43 into engagement with a valve seat 44 in the abutment. The lower tubing portion 41 can engage the valve head 42 and hold it in open position, as shown in Figs. 2*a* and 3*a*.

A slotted junk pusher and feeler 45 may be secured to the lower end of the lower abutment 12, to insure against premature setting of the well packer during its descent in the well casing. A screen 46 may also be provided across the mouth of the tubing section 41 to prevent undesired substances from entering the setting tool 10.

The setting tool member 10*a* is provided with a valve seat 47 in the lower head 34 on which a valve ball element 48 is adapted to come to rest, upon being dropped through the tubular string B, in order to prevent downward passage of fluid through the tubular string B and setting tool 10 below the setting tool head 34, and allow fluid pressure to be built up in the setting tool member 10*a*, the elongated ports 38, and the body ports 36, for the purpose of urging the cylinder 14*a* downwardly against the upper slips 20. The cylinder 14*a* is retained initially in an upward position by one or more shear screws 49 securing its skirt 14 to the body head 13.

The setting tool 10 also includes an upper hydraulic pressure booster portion 50 connected to the lower portion of the setting tool. Such connection may be effected by threadedly attaching the lower end of the upper tubular member portion 10*c* to the upper end of a lower tubular member 10*b*. The upper portion 10*c* is, in turn, threaded into a head or sub 51 secured to the lower end of the tubular running-in string B.

The upper portion 50 of the setting tool 10 constitutes a hydraulic pressure booster designed to multiply the unit fluid pressure in the tubing string B, and impose such increased unit pressure upon the well packer A, in effecting its complete anchoring in packed-off condition hydraulically. The hydraulic booster includes an upper fluid motor portion 52. This motor portion consists of an elongate annular cylinder 53 formed by the upper tubular member 10*c* and a cylinder sleeve 54 spaced outwardly from this member. The upper end of the sleeve 54 has a shoulder 55 resting upon a flange 56 projecting from the upper head 51. The engagement between the shoulder 55 and flange 56 prevents downward movement of the cylinder sleeve 54, whereas upward movement of the sleeve is prevented by one or more lock screws 57 threaded through the upper end of the sleeve and into the head 51.

The head 51, in effect, forms the upper or head end of the annular cylinder 53. Fluid may enter the cylinder from within the tubing string B and setting tool member 10*c* through lateral ports 58 in the head 51 below its flange 56. Such fluid is precluded from passing upwardly between the head 51 and cylinder sleeve 54 by a rubber side seal 59 contained within a ring groove 60 in the flange 56 and engaging the inner wall of the cylinder sleeve.

The fluid under pressure enters the cylinder space 61 between the cylinder head 51 and a composite annular piston or plunger 62. This annular piston includes an inner elongate skirt portion 63 slidable along the exterior of the upper tubular member 10*c* and spaced inwardly from the cylinder sleeve 54 to provide an annular space 64 therebetween. A piston annulus 65 is threaded, or otherwise secured, to the upper end of the piston skirt 63, the periphery of the piston annulus being slidable along the inner wall of the cylinder sleeve 54. Leakage in both directions between the skirt 63 and upper tubular member 10*c* is prevented by a seal ring 66 disposed in a groove 67 in the skirt and sealingly engaging the exterior of the tubular member 10*c*. Leakage around the exterior of the composite piston 62 is prevented by a rubber piston ring 68 disposed in a suitable ring groove 69 in the annulus 65 and sealingly engaging the inner wall of the cylinder sleeve 54.

It is apparent that the fluid pressure in the cylinder space 61 between the composite piston 62 and the cylinder head 51 is prevented from leaking downwardly by the inner and outer piston rings 66, 68. Leakage through the threaded connection between the annulus 65 and skirt 63 may also be prevented by a suitable seal ring 70.

The skirt 63 of the composite piston or plunger 62 also constitutes an annular piston of substantially smaller cross-sectional area F than the area G of the large fluid motor piston (Fig. 4). The lower piston portion 71 of the skirt 63 extends through an intermediate head 72 secured to the cylinder sleeve 54 by one or more lock pins 73 immediately below bleeder ports 74 extending through the cylinder sleeve. The intermediate head 72 has an enlarged portion or flange 75 engaging a shoulder 76 formed in the sleeve 54, such engagement preventing upward movement of the intermediate head 72 with respect to the cylinder sleeve 54. Leakage between the intermediate head 72 and cylinder sleeve is prevented by a suitable side seal 77 disposed in a peripheral groove 78 in the head and engaging the inner wall of the lower portion 54*a* of the cylinder sleeve. Leakage between the intermediate head 72 and small annular piston or skirt 71 is prevented by a side seal 79 disposed within an internal head groove 80 and slidably engaging the periphery of the skirt 71.

The skirt portion is movable downwardly through the head 72 and within a lower annular cylinder space or chamber 81 formed between the tubular member 10*c* and the cylinder sleeve portion 54*a*. Another piston 82 is movable within this elongate chamber 81, the piston comprising an upwardly extending sleeve 83 slidable along the inner wall of the lower portion 54*a* of the cylinder sleeve, but spaced from the tubular member 10*c* to provide an elongate annular space 84 between the piston sleeve 83 and member 10*c* into which the upper piston skirt portion 71 is receivable. At the lower end of the upwardly directed piston sleeve 83, the lower piston 82 has an inwardly directed head 85 slidable along the tubular member 10*c*. Leakage between the head 85 and member 10*c* is prevented by a seal ring 86 disposed within an internal piston head groove 87 and slidable along the exterior of the tubular member 10*c*. Similarly, leakage between the sleeve 83 and cylinder 54*a* is prevented by a seal ring 88 in a sleeve groove 89 slidable along the cylinder portion 54*a*.

The lower piston 82 has a depending skirt portion 90 projecting from the lower end of the cylinder sleeve 54*a* and engageable with the upper end of the lower cylinder sleeve 14 disposed around the packer body 11. The lower piston 82 is prevented from rotating with respect to the cylinder sleeve 54 by one or more pins 91 secured to the piston and slidable in longitudinally extending slots 92 in the cylinder sleeve.

As pointed out above, the upper piston 65, 63 has an area G subject to the fluid pressure within the tubing string B that is much greater than the area F of the small annular piston 71 extending through the intermediate head 72. As a result, the unit fluid pressure in the upper cylinder 52 acting over the large annular area G of the upper piston 65, 63 is multiplied several times by the small piston 71 acting on liquid filling the chamber 81 below the intermediate head 72. Thus, as an example, if 1000 p. s. i. is imposed upon the large annular piston 65, 63, and if this piston has three times the area of the smaller annular piston 71, the latter will impose a pressure on the liquid in the lower cylinder space or chamber 81 of 3000 p. s. i.

The liquid within the lower chamber 81 is thereby subjected to a much greater unit pressure than the pressure on the fluid in the tubing string B, and this greater unit fluid pressure is being imposed on a comparatively large annular piston area H provided by the lower piston 82. This fluid is acting over the cross-sectional area of the upwardly extending piston sleeve 83 and also over the cross-sectional area of the inwardly directed piston head 85. This combined annular area H, as disclosed in the drawings (see particularly Fig. 4), is actually greater than the area G of the large fluid motor piston 65, 63 at the upper end of the booster mechanism. Accordingly, the greatly increased unit pressure in the lower chamber 81 is being imposed over a large area H on the lower piston 82, resulting in a much larger total hydraulic force being directed downwardly on the lower piston 82 than is being imposed on the upper composite piston 65, 63. Extending the above example, if the lower cross-sectional annular piston area H is one-third greater than the area G of the upper piston, and assuming that the unit fluid pressure in the lower cylinder space 81 is three times the unit fluid pressure in the upper cylinder space 61, the total force imposed downwardly on the lower piston 82 will be four times to total hydraulic force imposed downwardly on the upper piston 65, 63. This greatly increased force is, of course, being imparted to the lower cylinder sleeve 14 disposed around the packer body 11. Reactively, the force is acting upwardly over the annular area of the upper cylinder head 51 within the cylinder 53, and over the annular area of the intermediate head 72, tending to exert an upward pull on the upper and lower tubular members 10*c*, 10*b* of the setting tool, and on the packer body 11 to which the lower setting tool member 10*b* is threadedly attached.

The composite piston 65, 63 forms part of a fluid motor, whereas the lower annular piston portion 71 forms part of a fluid pump, which develops a hydraulic pressure within the cylinder or chamber 81. This pressure acts upon the piston 82, which actually constitutes a portion of a second fluid motor.

The tool is made up in the manner disclosed in Figs. 1, 2 and 2*a*, except that the ball valve element 48 is omitted. The tool is run downwardly through the well casing C on the tubing string B to the desired point at which the packer A is to be set, and the ball valve element 48 then dropped into the tubing string B from the top of the well bore, gravitating through the fluid in the tubing string until it engages the seat 47 in the setting tool head 34. Fluid pressure may then be imposed on the fluid in the tubing string B and setting tool 10, the ball valve element 48 preventing downward passage of the fluid through the setting tool 10 and packer 11, and allowing its pressure to be increased. This fluid under pressure in the tubing string and setting tool is being imposed on the fluid in the cylinder space 37 in the packer A, since it can be transmitted thereto through the body ports 36. It is also being imposed on the fluid in the upper cylinder space 61 of the hydraulic booster 50, acting through the head ports 58.

The fluid under pressure acts downwardly over the area of the cylinder head 15 of the lower cylinder 14*a* and also reactively in an upward direction over the annular area of the body head 13. At the same time it is acting downwardly over the upper booster piston 65, 63, this force being transmitted through the smaller piston 71 to the fluid in the lower cylinder space 81, the pressure of the fluid in this space being increased several times over the pressure in the upper cylinder space 61 and being imposed downwardly over the lower piston area H. The lower piston 82 exerts a downward force on the cylinder sleeve 14.

When the downward force is sufficient to shear the screws 49 holding the cylinder sleeve 14 to the packer body head 13, and to disrupt the upper slip screws 21, the upper slips 20 are shifted downwardly along the upper conical expander 22 and radially outward into engagement with the casing wall. An increase in the fluid pressure then tends to elevate the booster cylinder 54, setting tool members 10b, 10c, and the packer body 11, inasmuch as the lower piston 82 and lower cylinder sleeve 14 are prevented from moving downwardly to any further extent by the wedging engagement of the upper slips 20 with the casing C. When the pressure in the tubing string B has been increased to a sufficient extent, the shear value of the upper expander screws 23 is exceeded, and these screws are broken, the lower slips 24 and lower expander 26 then being moved upwardly toward the upper expander 22, in order to foreshorten the packing sleeve 30 and expand it outwardly against the wall of the casing.

The fluid pressure in the tubing string B and setting tool 10 may then be increased to a further extent, eventually exerting an upward force on the hydraulic members and body 11 sufficient to disrupt the lower expander screws 27 and lower slip screws 25, enabling the packer body 11 to move upwardly to still a further extent, and causing its abutment 12 to shift the lower slips 24 upwardly along the lower expander 26 and radially outward against the casing wall C.

In this manner, the packer A can be anchored in packed-off condition against movement in the well casing C in both longitudinal directions. The upper slips 20 prevent upward movement of the packer within the well casing, whereas the lower slips 24 prevent downward movement of the packer body 11 within the well casing. Any force tending to move the body downwardly is transferred through the tapered lock ring 28 and lower expander 26 to the slips 24, which are anchored firmly against the well casing.

Following complete setting of the well packer A, the tubing string B may be rotated to the left to disconnect the setting tool 10 from the packer A at the left-hand threaded connection 33. The tubing string B and setting tool 10 may then be removed to the top of the well bore. As the depending portion 41 of the setting tool is elevated, it moves from engagement with the back pressure valve head 42, and allows the spring 43 to shift the head upwardly against the valve seat 43 in the abutment 12.

As the upper piston 65, 63 is moved downwardly within the cylinder 53, the fluid below the piston head 65 is forced outwardly of the cylinder through the bleeder ports 74; so as to avoid entrapping any fluid below the piston head which might tend to forestall its movement.

It is evident that the hydraulic booster arrangement enables the well packer A to be set hydraulically with a much greater total force than would be available if the fluid under pressure in the tubing string B were caused to act directly up the well packer A, in effecting its setting. This is due to the multiplication of the unit pressure that the hydraulic booster provides. As a matter of fact, the well packer A could be set by the hydraulic booster setting tool portion 50 in the absence of the body ports 36, or without causing fluid to pass through the body ports 36 at all. Of course, the cylinder sleeve 14, or its equivalent, would still be present in transmitting the downward force of the lower piston 82 and its depending sleeve portion 90 to the upper slips 20.

The greatly increased hydraulic force provided in setting the well packer allows the shear screws in the tool to be of increased shear value. Disruption of these screws is still effected with a comparatively low unit pressure in the tubing string B.

Moreover, it is evident that the well packer A can be set to its fullest extent hydraulically. However, if desired, after the upper slips 20 have been tripped and wedged against the well casing C, an upward strain can be taken on the tubing string B, to shear the expander screws 23, 27 and lower slip screws 25, and effect a full packing off and anchoring of the well packer in the well casing. If it is not desired to subject the tubing string to a mechanical strain, then the hydraulic force alone can be utilized in completely setting the well packer.

The inventor claims:

1. In well apparatus: a body adapted to be lowered in a well conduit on a tubular string; normally retracted means on said body; means for expanding said normally retracted means against the well conduit, comprising hydraulically operable means engageable with said normally retracted means, a fluid motor responsive to the pressure of fluid in said tubular string, a fluid pump operable by said fluid motor for developing a fluid pressure adapted to act on said hydraulically operable means, the fluid pressure area in said motor over which said fluid pressure in said tubular string is capable of acting being substantially greater than the fluid pressure creating area of the pump.

2. In well apparatus: a body adapted to be lowered in a well conduit on a running-in string; normally retracted means on said body; and means connected to said body for expanding said normally retracted means against the well conduit, comprising a fluid motor, a fluid pump operable by said motor, and hydraulically operable means responsive to the fluid pressure of said pump and engageable with said normally retracted means, the fluid pressure effective area of said motor being substantially greater than the fluid pressure effective area in said pump, in order that the unit fluid pressure developed by said pump is greater than the unit fluid pressure imposed upon said motor.

3. In well apparatus: a body adapted to be lowered in a well conduit on a running-in string; normally retracted means on said body; and means connected to said body for expanding said normally retracted means against the well conduit, comprising a fluid motor, a fluid pump operable by said motor to impart pressure to fluid in said pump, and hydraulically operable means responsive to the pressure of the fluid of said pump and engageable with said normally retracted means to urge said normally retracted means against the well conduit.

4. In well apparatus: a body adapted to be lowered in a well conduit on a running-in string; normally retracted means on said body; a tubular member connected to said body and having a port; hydraulically operable means slidable along said body in response to the pressure of fluid in said member and port; a fluid chamber on said body; means movable in said fluid chamber by said hydraulically operable means to develop a unit fluid pressure in said chamber that is greater than the unit fluid pressure imposed upon said hydraulically operable means; and means responsive to the pressure of fluid in said

chamber for expanding said normally retracted means against said well conduit.

5. In well apparatus: tubular means adapted to be lowered in a well conduit on a running-in string; normally retracted means on said tubular means; said tubular means having a port; hydraulically operable means slidable along said tubular means in response to the pressure of fluid in said tubular means and port; a fluid chamber on said tubular means; means movable in said fluid chamber by said hydraulically operable means to develop a unit fluid pressure therein that is greater than the unit fluid pressure imposed upon said hydraulically operable means; and means responsive to the pressure of fluid in said chamber for expanding said normally retracted means against said well conduit.

6. In well apparatus: a body adapted to be lowered in a well conduit on a running-in string; normally retracted means on said body; tubular means connected to said body and having a port; a cylinder secured to said tubular means and spaced outwardly therefrom to provide an annular cylinder space therebetween communicating with said port; a first piston in said cylinder space which is subject to fluid under pressure in said tubular means and port; means providing a second annular cylinder space around said tubular means; a second piston in said second cylinder space which is shiftable by said first piston, said second piston having a lesser cross-sectional area than said first piston; and hydraulically operable means shiftable by the fluid in said second cylinder space to expand said normally retracted means outwardly against the said well conduit.

7. In well apparatus: tubular means having a port and adapted to be lowered in a conduit on a running-in string; normally retracted means on said tubular means; a cylinder secured to said tubular means and spaced outwardly therefrom to provide an annular cylinder space therebetween communicating with said port; a first piston in said cylinder space which is subject to fluid under pressure in said tubular means and port; means providing a second annular cylinder space around said tubular means; a second piston in said second cylinder space which is shiftable by said first piston, said second piston having a lesser cross-sectional area than the first piston; and hydraulically operable means shiftable by the fluid in said second cylinder space to expand said normally retracted means outwardly against said well conduit.

8. In well apparatus: a body adapted to be lowered in a well conduit on a running-in string; normally retracted means on said body; tubular means connected to said body, and having a port; an elongate cylinder secured to said tubular means and spaced outwardly therefrom; a head partially bridging the distance between said cylinder and said tubular means; a first piston movable in said cylinder on one side of said head and subject to the fluid pressure in said tubular means and port; a second piston shiftable by said first piston and slidable along said head; and hydraulically operable means on the other side of said head responsive to the pressure of fluid developed by said second piston for shifting said normally retracted means against the well conduit.

9. In well apparatus: a body adapted to be lowered in a well conduit on a running-in string; normally retracted means on said body; tubular means connected to said body and having a port; an elongate cylinder secured to said tubular means and spaced outwardly therefrom; a head partially bridging the distance between said cylinder and said tubular means; a first piston movable in said cylinder on one side of said head and subject to the fluid pressure in said tubular means and port; a second piston shiftable by said first piston and slidable along said head; and hydraulically operable means on the other side of said head responsive to the pressure of fluid developed by said second piston for shifting said normally retracted means against the well conduit; the cross-sectional area of said first piston being greater than the cross-sectional area of said second piston.

10. In well apparatus: an inner member having a port; an elongate cylinder secured to said inner member and spaced outwardly therefrom; a head partially bridging the distance between said cylinder and inner member; a first piston movable in said cylinder to one side of said head and subject of fluid pressure passing through said port; a second piston shiftable by said first piston and slidable along said head; and hydraulically operable means on the other side of said head responsive to the pressure of fluid developed by said second piston.

11. In well apparatus: an inner tubular member adapted to be lowered in a well conduit on a running-in string and having a port; a cylinder secured to said tubular member and spaced outwardly therefrom to provide an annular cylinder spaced therebetween communicating with said port; a first piston in said cylinder space and subject to fluid under pressure in said tubular member and port; means providing a second annular cylinder space around said tubular member; a second piston in said second cylinder space and shiftable by said first piston, said second piston having a lesser cross-sectional area than said first piston; and hydraulically operable means shiftable by the fluid in said second cylinder space.

12. In well apparatus: a tubular member having a port and adapted to be lowered in a well conduit on a running-in string; hydraulically operable means slidable along said member in response to the pressure of fluid in said member and port; a fluid chamber on said member; means movable in said fluid chamber by said hydraulically operable means to develop a unit fluid pressure therein that is greater than the unit fluid pressure imposed upon said hydraulically operable means; and means in said chamber responsive to the pressure of fluid developed therewithin.

13. In well apparatus: a body adapted to be lowered in a well conduit on a running-in string; normally retracted means on said body; tubular instrumentalities connected to said body and having a port; first cylinder means around said tubular instrumentalities providing an annular cylinder space communicating with said port; first piston means in said cylinder space; one of said first means being subject to fluid under pressure in said tubular instrumentalities and port and shiftable along said tubular instrumentalities; second cylinder means around said tubular instrumentalities providing a second annular cylinder space; second piston means in said second cylinder space; one of said second means being shiftable by said one of said first means; and hydraulically operable means shiftable by the fluid in said second cylinder space to expand the normally retracted means outwardly against the well conduit.

14. Well apparatus as defined in claim 13, wherein said one of said second means has a lesser cross-sectional area than said one of said first means.

15. In well apparatus: tubular instrumentalities having a port; first cylinder means around said tubular instrumentalities providing an annular cylinder space communicating with said port; first piston means in said cylinder space; one of said first means being subject to fluid under pressure in said tubular instrumentalities and port and shiftable along said tubular instrumentalities; second cylinder means around said tubular instrumentalities providing a second annular cylinder space; a second piston means in said second cylinder space; one of said second means being shiftable by said one of said first means; and hydraulically operable means shiftable by the fluid in said second cylinder space.

16. Well apparatus as defined in claim 15, wherein said one of said second means has a lesser cross-sectional area than said one of said first means.

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