May 2, 1933. H. R. STANDLEE 1,906,933

BOOSTER FOR WELL PUMPS

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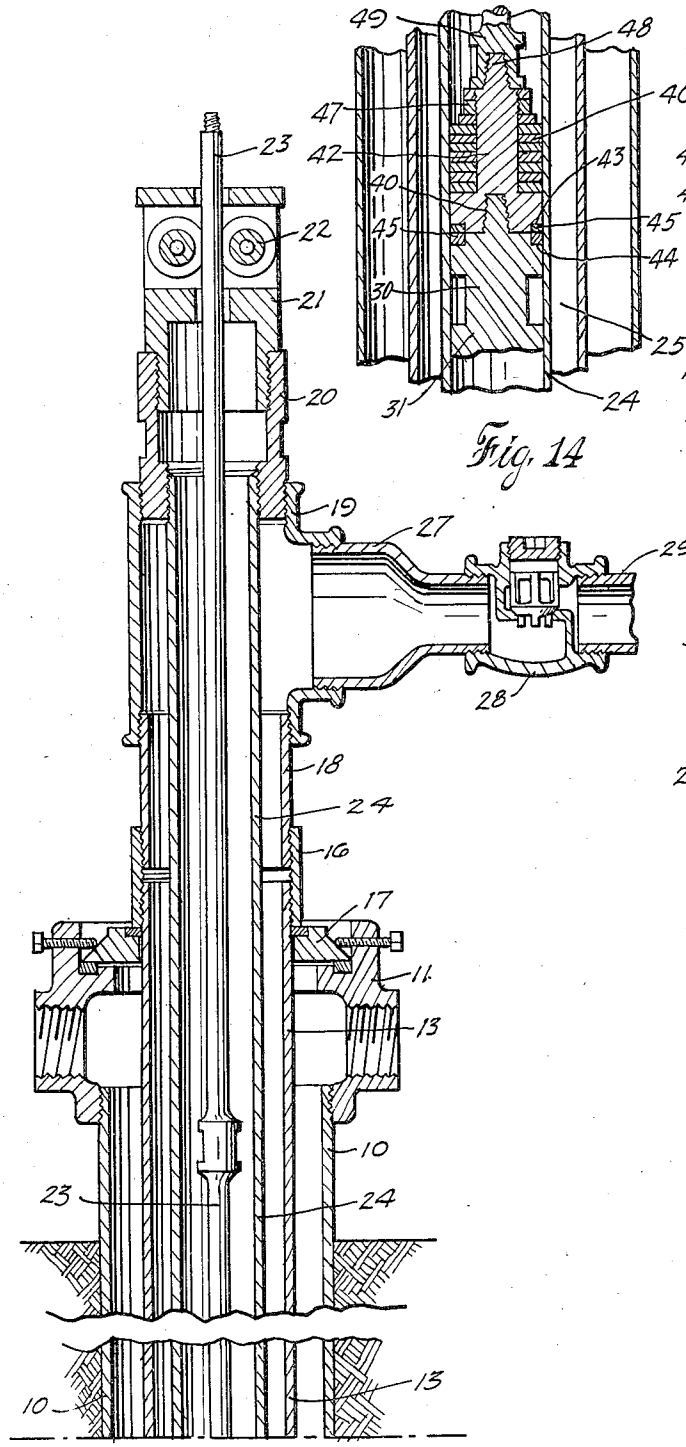


Fig. 1

Fig. 1A

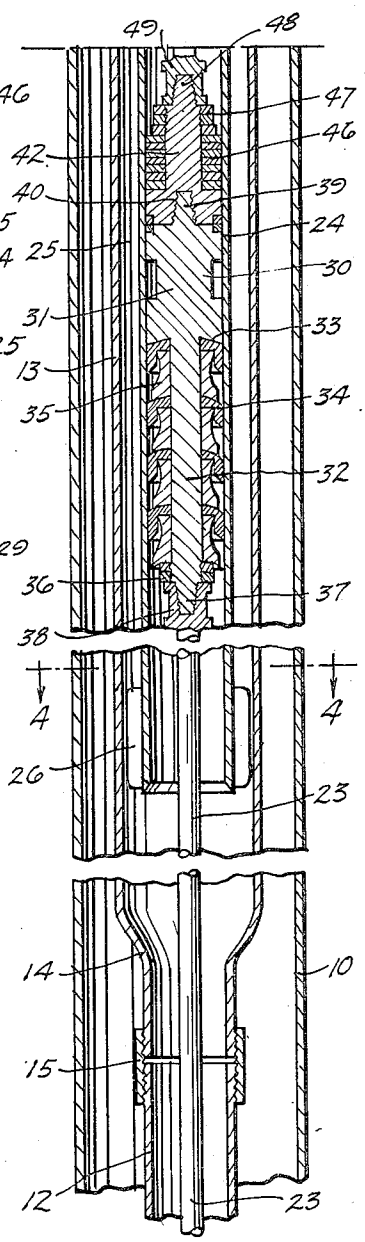


Fig. 2

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BOOSTER FOR WELL PUMPS

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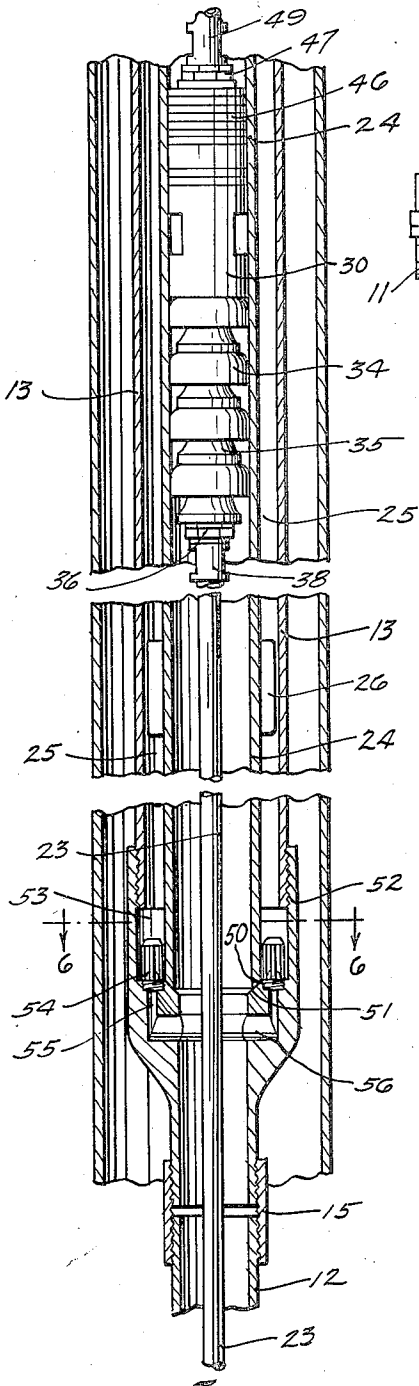


Fig. 5

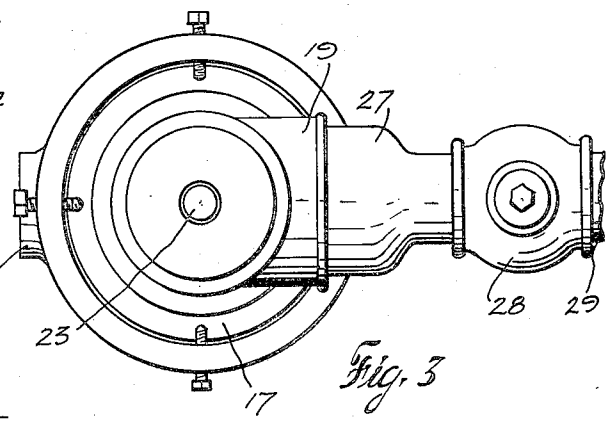


Fig. 3

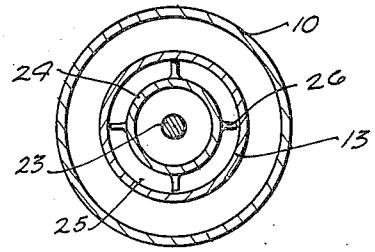


Fig. 4

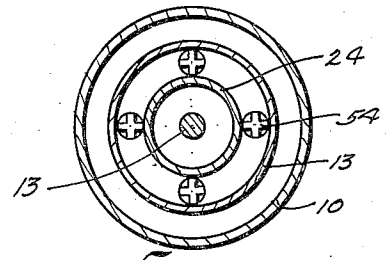


Fig. 6

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BOOSTER FOR WELL PUMPS

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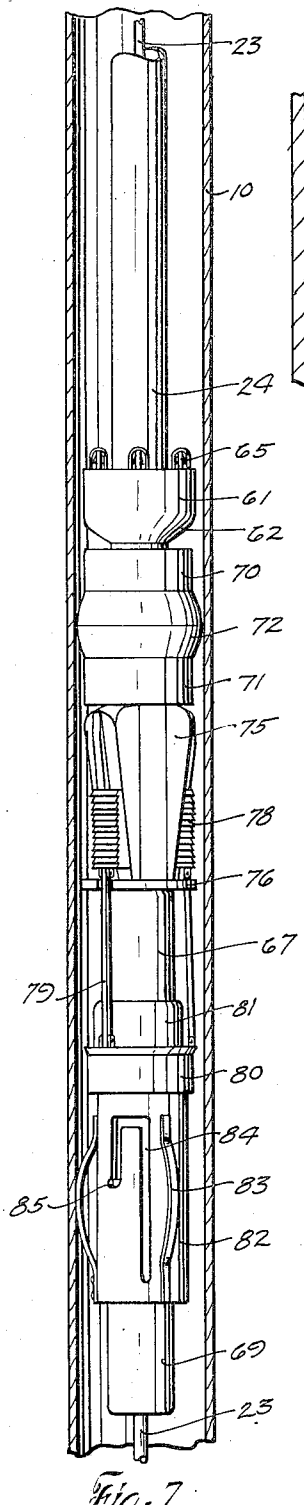


Fig. 7

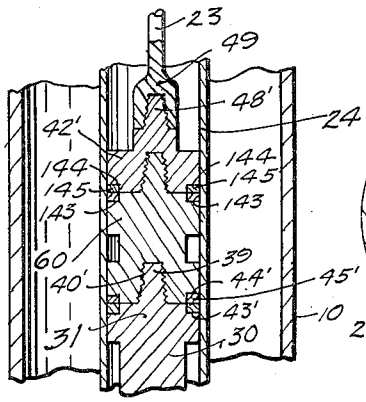


Fig. 15

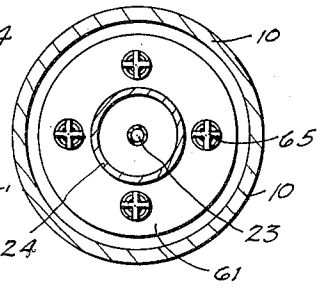


Fig. 10

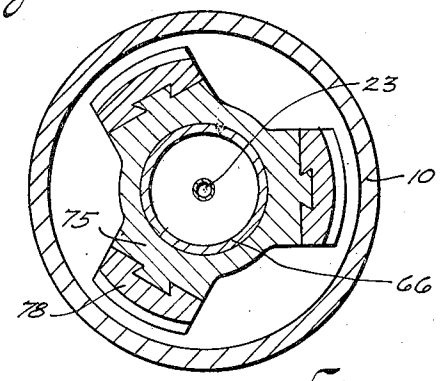


Fig. 12

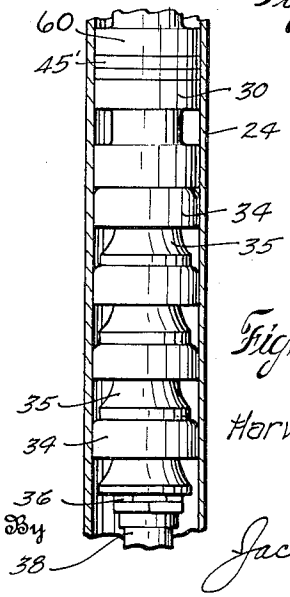


Fig. 13

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BOOSTER FOR WELL PUMPS

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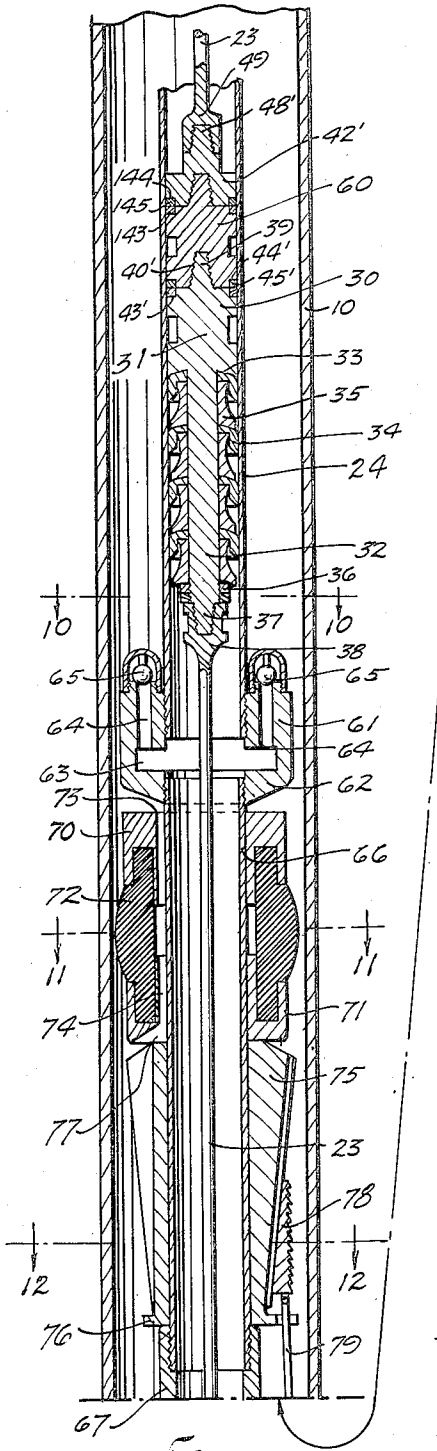


Fig. 8

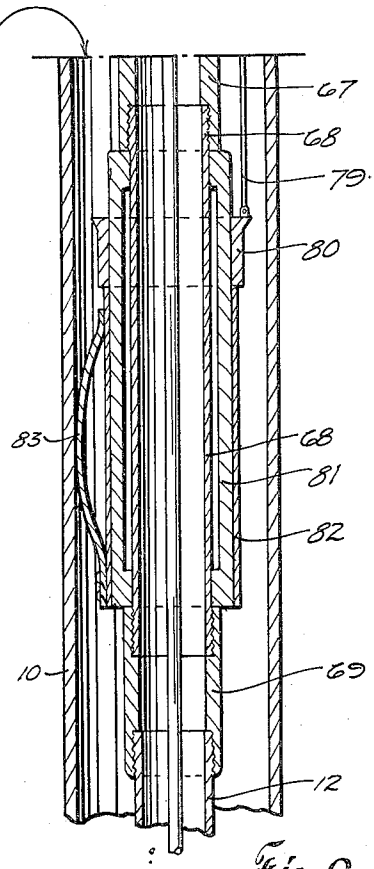


Fig. 9

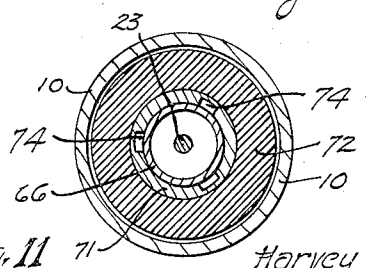


Fig. 11

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BOOSTER FOR WELL PUMPS

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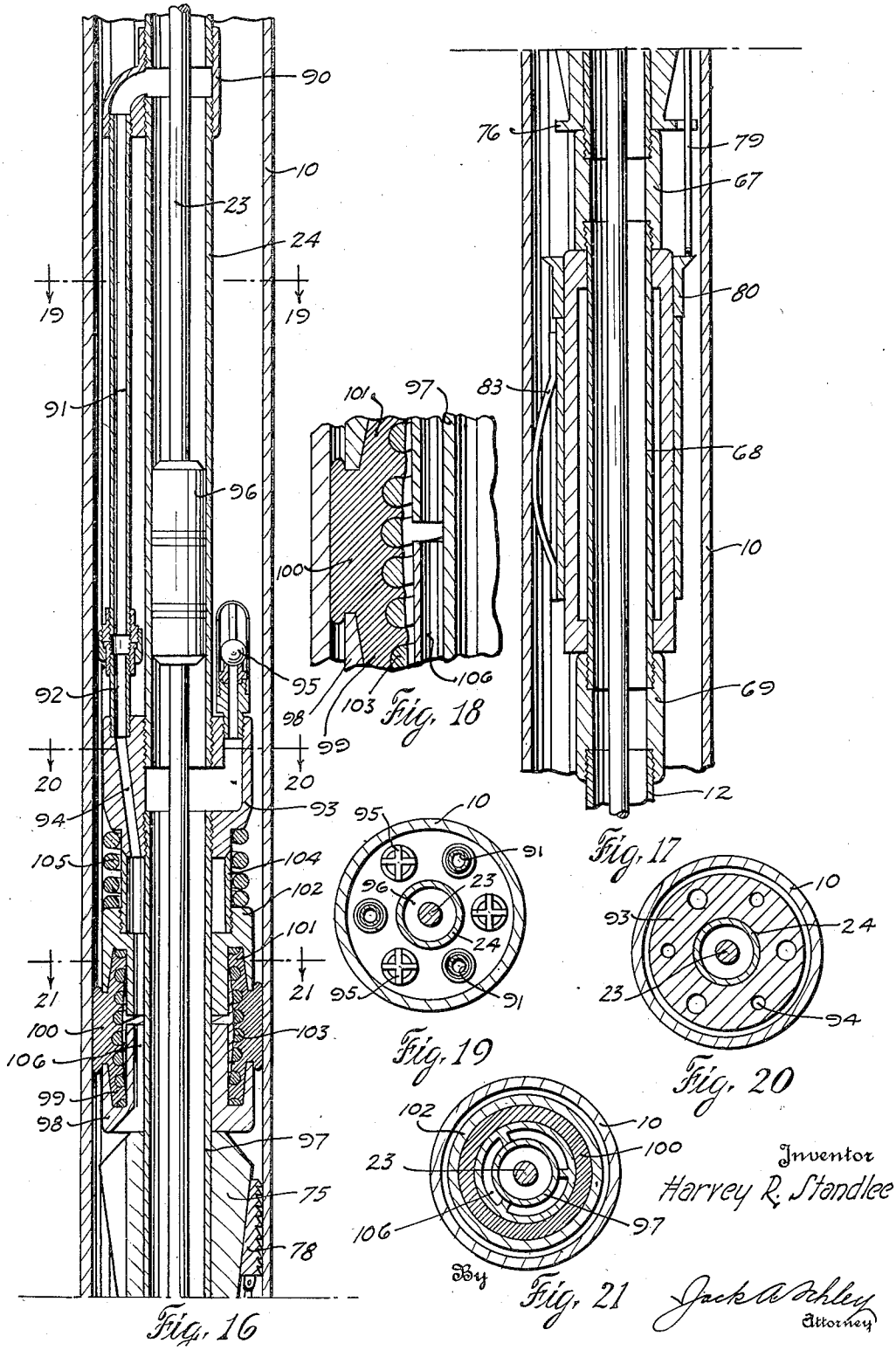


Fig. 16

Fig. 18

Fig. 17

Fig. 19

Fig. 20

Fig. 21

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Patented May 2, 1933

1,906,933

UNITED STATES PATENT OFFICE

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BOOSTER FOR WELL PUMPS

Application filed March 9, 1931. Serial No. 521,261.

This invention relates to new and useful improvements in boosters for well pumps.

One object of the invention is to provide means for cushioning or compensating the down stroke of the pump rods, whereby the shock at the end of the down stroke is absorbed.

A further object of the invention is to provide means for boosting the flow of liquid from a well, whereby the breaking or rods is reduced to a minimum, the usual stuffing box and polish rod eliminated and the weight of the rods utilized on the down stroke to lift liquid.

Another object of the invention is to provide means auxiliary to the pump for assisting in lifting the liquid.

A further object of the invention is to provide means for packing off the casing at a predetermined depth adjacent the booster and utilizing the casing above the packer to conduct the liquid to the surface.

A construction designed to carry out the invention will be hereinafter described together with other features of the invention.

The invention will be more readily understood from a reading of the following specification and by reference to the accompanying drawings in which an example of the invention is shown, and wherein:

Figure 1 is a vertical sectional view of the upper portion of a booster constructed in accordance with the invention,

Figure 2 is a vertical sectional view of the lower portion of said booster,

Figure 3 is a plan view of the same,

Figure 4 is a horizontal cross-sectional view taken on the line 4—4 of Figure 2,

Figure 5 is a fragmentary vertical sectional view showing a modified form of construction made in accordance with the invention,

Figure 6 is a horizontal cross-sectional view taken on the line 6—6 of Figure 5,

Figure 7 is an elevation showing another form of structure made in accordance with the invention,

Figures 8 and 9 are enlarged vertical sectional views of the same,

Figure 10 is an enlarged cross-sectional view taken on the line 10—10 of Figure 9,

Figure 11 is a cross-sectional view taken on the line 11—11 of Figure 8,

Figure 12 is an enlarged horizontal cross-sectional view taken on the line 12—12 of Figure 8,

Figure 13 is an enlarged elevation of the piston,

Figure 14 is an enlarged sectional view of the upper portion of the piston shown in Figure 2,

Figure 15 is an enlarged vertical sectional view of the upper portion of the piston shown in Figure 8,

Figure 16 is a partial vertical sectional view showing a modified form of the invention,

Figure 17 is a vertical sectional view of the portion immediately below Figure 16,

Figure 18 is a detail of the spring pressed packer elements, and

Figure 19 is a horizontal cross-sectional view taken on the line 21—21 of Figure 16,

Figure 20 is a horizontal cross-sectional view taken on the line 20—20 of Figure 16, and

Figure 21 is a horizontal cross-sectional view taken on the line 21—21 of Figure 16.

In the drawings the numeral 10 designates the casing on which the usual casing head 11 is fastened. Within the casing I provide a lower string of tubing 12 and an upper string of tubing 13. The upper string of tubing 13 is of larger diameter than the lower string and is connected to said lower string of tubing by a swaged nipple 14 secured to the said tubing by a collar 15.

The upper tubing 13 extends through the casing head 11 and has a collar 16 screwed onto its upper end. This collar is supported by a hanger 17 fastened in the head and suitably packed to prevent leakage. A nipple 18 (Figure 1) is screwed into the bottom of a T 19, which has a nipple 20 screwed into its top and this in turn supports a guide cap 21. Guide rollers 22 are mounted on opposite sides of the cap for guiding the pump rod 23. The pump rod is connected to the usual plunger in the working

barrel (not shown) at the bottom of the well.

Within the upper tubing section 13 a cylindrical barrel 24 is concentrically disposed and has its upper end screwed into the nipple 20, whereby said barrel is suspended. The barrel is somewhat less in diameter so as to provide an annular space or conduit 25 between its outer wall and the inner wall of the upper tubing section. Spacer lugs 26 (Figures 2 and 4) are provided on the lower end of the barrel 24 for centering it within the tubing. The liquid which is elevated is carried up through the conduit 25 and discharged into the T 19. A swaged nipple 27 has its larger end screwed into the T while its reduced end is screwed into a check valve 28. A discharge pipe 29 leads from the valve. This valve acts to prevent a backward flow of the liquid into the well.

Within the barrel 24 I mount a piston 30 which is coupled in the pump rod 23. The piston includes a cylindrical head 31 and is shown in Figures 2, 5, 8 and 13. An axial stem 32 depends from the head and is surmounted by an undercut shoulder 33. A plurality of flexible cups 34 are mounted on the stem and held apart by spacers 35. These cups are inverted and the uppermost cup fits against the shoulder 33. A pair of lock nuts 36 screwed on the lower end of the stem engage the lowermost spacer and thus secure the cups and spacers in place on said stem. A threaded pin 37 is formed on the lower end of the stem and engages in the socket 38 of the pump rod 23 which is located below the piston.

The head 31 of the piston has an upstanding threaded pin 39 and in Figures 2 and 5 this pin engages in a socket 40 in the bottom of a cap 42, which is fastened down upon the head. As is shown in Figure 14, the head has an annular groove 43, while the cap has a complementary groove 44 for receiving resilient metallic piston rings 45 which contact with the inner wall of the barrel 24 for forming a fluid-tight joint. The upper portion of the cap is reduced and a plurality of superimposed packing collars 46 are held thereon by nuts 47. These packing collars may be of rubber, rubber compound, rubber fabric, or other material capable of producing a soft packing. The cap has a threaded pin 48 engaging in the socket 49 of the upper section of the pump rod 23.

It is obvious that upon reciprocation of the piston, fluid will not be able to pass the rings 45 or the collars 46. It is preferable to make the barrel 24 of a larger diameter than the working barrel (not shown) of the pump and consequently on the up stroke of the rod 23 and the piston 30 an increased suction will be produced which will augment the lifting action of the pump. The liquid will be elevated in the lower string of tubing 12 and from thence into the conduit 25. Upon the up stroke of the rod and piston some liquid will be drawn into the lower end of the barrel 24, but upon the down stroke the cups 34 will be expanded and this liquid will be expelled from the barrel and elevated in the conduit 25. In case the cups should not expand, the collars 46 will prevent leakage. It is obvious that upon the down stroke of the rod 23 the oil below the cups will cushion the down stroke and absorb the shock at the lower end of the stroke.

The piston 30 may be located at any desired depth and its position will depend upon conditions. It is pointed out that by use of the piston the weight of the rod may be utilized during the down stroke to elevate the liquid. Where it is desired to place the piston in deep wells, ranging from four thousand (4000) feet to deeper depths, I desire to use the structure shown in Figures 5 and 6, wherein the barrel 24 has its lower edge 50 bevelled and ground so as to fit on a seat 51 in a bell nipple 52. The upper string of tubing 13 is screwed into the top of this nipple and the reduced end of the nipple is screwed into the collar 15, as in Figure 2.

The nipple has an enlarged annular chamber 53 surrounding the barrel 24 below the tubing 13 and communicating with the conduit 25. The check valve 28 is eliminated and ball check valves 54 are screwed into the bottom of the chamber 53 at the upper ends of ports 55 connected with the bore of the nipple by laterals 56. The nipple 52 may be placed a goodly distance down the well, say for instance in a six thousand (6000) foot well at a depth of two thousand (2000) feet. The check valves will act to take the weight of the liquid in the conduit 25 off of the pump rod and thus only the weight of the liquid below the piston 30 would be imposed upon the pump rod. It is obvious that in either of the forms which have been illustrated considerable more liquid will be elevated by use of the booster and rod breakage will be reduced to a minimum.

In Figures 7 to 12 inclusive, I have illustrated a preferable structure for carrying out the invention. In this instance the enlarged upper tubing section 13 is eliminated and the casing 10 is utilized as a conduit. The barrel 24 is supported, as in Figure 1, and the piston 30 is the same except that instead of the cap 42 the pin 39 is screwed into the socket 40′ of an upper head section 60, as is shown in detail in Figure 15. The head 30 has an annular groove 43′ and the section 60 has a complementary annular groove 44′ for receiving rings 45′ similar to the rings 45. The head section 60 has a groove 143 at its upper end and a cap 42′

is fastened on the section 60. This cap has an annular groove 144 and piston rings 145 fit in these grooves. The rings 45′ and 145 are resilient metal rings and the soft collars 46 are eliminated in this form. The cap has a threaded pin 48′ fitting in the socket 49 of the upper section of pump rod 23.

The lower end of the barrel is screwed into an enlarged collar 61 having a conical bottom 62. The collar is provided with laterals 63 and upright ports 64 having check valves 65 at their upper ends similar to the valves 54. A tubing section 66 is screwed into the bottom of the collar 61 and this section has its lower end screwed into a collar 67, as is shown in Figure 8. The collar 67 is screwed onto the top of the tubing section 68 and has its lower end screwed into the upper end of a collar 69, which in turn is screwed onto the lower string of tubing 12, as is shown in Figure 9.

On the tubing sections 66 and 68 is mounted a packer and anchoring device, whereby the casing may be packed off at this point and the upper portion utilized as a conduit. No particular claim is made to the structure of the packer because this latter is substantially the same as that illustrated in my Letters Patent No. 1,777,021. The packer includes an upper grooved ring 70 and a lower grooved ring 71. An elastic packing body 72 has its reduced ends seated in the rings, as is shown in Figure 8. The ring 70 has an annular conical seat 73 for receiving the collar 61 to form a fluid-tight joint. Vertical grooves 74 are provided in the walls of the bores of the rings as is shown in Figures 8 and 11 to by-pass the fluid around the packing body 72 in case it cannot pass the outside of said body.

The lower ring 71 rests upon a conical head 75, which in turn is supported by a flange 76 on the head above the collar 67. The ring 71 has passages 77 at its lower end connected with the grooves 74 for by-passing the fluid. Gripper slips 78 are slidably mounted on the head 75 and are supported by links 79 extending through the collar 76. As is shown in Figures 7 and 9, the lower ends of the links 79 are pivoted to a collar 80 slidable on a tubular filler 81 fastened on the tubing section 68 between the collars 67 and 69. The collar 80 rests upon the upper edge of a sleeve or cage 82 having a snug sliding fit on the filler and forming part of a hook-wall operator.

As is shown in Figures 7 and 9, the sleeve 82 has bow-shaped friction springs 83 fastened at their lower ends to the lower end of the sleeve and extending vertically so as to engage the inner wall of the casing 10. The sleeve 82 is provided with an inverted L-shaped slot 84 receiving a pin 85 carried by the filler 81. Normally this pin is at the bottom of the short leg of the slot.

It will be seen that when the device is lowered in the casing 10 the springs 83 will drag on the inner wall of the casing and the pin 85 being in the bottom of the short leg of the slot will propel the sleeve downwardly. This will hold the gripper slips 78 in a retracted position and the packer may thus be easily lowered into the well. When the anchoring point is reached, the barrel 24 will be lifted, whereby the pin 85 will be moved upwardly in the slot 84. The springs 83 being in engagement with the casing will hold the sleeve stationary. By rotating the barrel 24 and the tubing, the pin 85 will be brought over the long leg of the slot 84 and may then be lowered therein. The sleeve 82 still remaining stationary and supporting the collar 80, which in turn supports the slips 78, it is obvious that the head 75 will be lowered and the slips caused to expand and grip the casing.

With the parts thus anchored, the barrel and tubing may be released, which will cause the conical bottom 62 of the collar 61 to engage the seat 73 of the ring 70. The weight of the super-imposed parts will force the ring downwardly, whereby the elastic packing body 72 will be expanded into contact with the wall of the casing 10. This will seal the casing at this point so that the liquid thereabove will be supported and the upper portion of the casing will form a conduit.

The operation of the piston 30 is, of course, the same and in this form of the device it may be readily placed at any desired point. It has the advantage of being vertically adjustable in the casing and eliminates the upper enlarged tubing string.

In Figures 16 to 21 inclusive, I have shown another form of the invention, in which the barrel 24 is made in sections and has connected therein an elbow 90 from which a gas pipe 91 extends downwardly between the barrel and the casing 10. This gas pipe is connected with a nipple 92 which is screwed into a collar 93 similar to the collar 61 of Figure 8. A port 94 leads down through the collar from the nipple 92. The collar is hollow and has a check valve 95 similar to the valve 65. The pump rod 23 has a suitable piston 96 working in the barrel 24. A tubing section 97 of substantially the same diameter as the barrel is connected with the lower tubing section 68 by the collar 67 and the associated elements are the same as is shown in Figures 8 and 9, except as is hereinafter described.

Above the head 75 a ring 98 quite similar to the ring 71 is mounted on the tubing section 97. This ring is channeled to receive the lower annular flange 99 of an elastic packing body 100. The upper annular flange 101 of the body fits in the channel

of an upper ring 102. A coiled spring 103 is embedded in the bore of the packing body, as is shown in Figures 16 and 18. When the ring 102 is forced downward to compress the body the spring 103 will tend to force the body outwardly into contact with the wall of the casing and when pressure is released, said spring will tend to withdraw the packing member.

The upper ring 102 carries a cylindrical guide 104 which is surrounded by a coiled spring 105. The spring 105 rests upon the top ring 102 and engages under the collar 93. This spring tends to force the parts away from each other when the device is lifted.

It will be seen that gas rising in the casing will pass up through the groove 106 through the sleeve 104 to the port 94. This gas will then be conducted by the nipple 92, pipe 91 and elbow 90 to the tubing. This is of advantage where there is very much gas in the well and makes it unnecessary to force the gas through the standing valve. This also forms a bypass for draining the oil from the barrel 24 back into the well.

Various changes in the size and shape of the different parts as well as modifications and alterations may be made within the scope of the appended claims.

Having illustrated and described preferred forms of the invention, what I claim, is:

1. In a well pumping booster, the combination with a casing and the string of tubing in the casing, a pump adjacent the lower portion of the well and a pump rod located in said tubing, of a piston within the tubing, closing the tube and connected to the rod and arranged to augment the lifting of fluid by the pump and to cushion the down stroke of the rod, means for packing off the casing below the piston, and a check valve adjacent the piston and above the packing means, whereby fluid elevated into the casing is prevented from back flowing.

2. In a well pumping booster, the combination with a casing and the string of tubing in the casing and the pump rod in said tubing of a barrel within the casing above the lower string of tubing, a liquid conduit exterior of the barrel and connected with the upper end of the tubing, a piston working in the barrel and connected to the pump rod for boosting the elevation of liquid and for cushioning the rod on the down stroke thereof, means for packing off the casing below the piston, means for discharging elevated liquid above the packing means and below the piston, and a check valve at the discharge means for preventing back flowing of the elevated liquid.

3. In a well pumping booster, the combination with a well casing and the pump rod therein, of a tubular barrel suspended in the upper portion of the casing, a packer below the barrel, means connecting the barrel and the packer and having an outlet to the casing for discharging elevated liquid into the casing above the packer, a lower string of tubing connected to the packer, and a piston working in the barrel and connected to the pump rod.

4. A well pumping booster as set forth in claim 3, and a check valve at the outlet of the connecting means for preventing back flowing of elevated liquid.

5. In a well pumping booster, the combination with a well casing and the pump rod therein, of a tubular barrel suspended in the upper portion of the casing, a packer below the barrel, a collar mounted on the lower end of the barrel and having outlet passages, check valves connected with said passages, a string of tubing depending from the packer, and a piston connected to the pump rod and working in the barrel.

6. In a well pump booster, the combination with a casing and the string of tubing in the casing, a pump adjacent the lower portion of the well and a pump rod located in said tubing, a piston within the tubing connected to the rod and arranged to augment the lifting of fluid by the pump and to cushion the down stroke of the rod, means for packing off the casing below the piston, a check valve adjacent the piston and above the packing means, whereby fluid elevated into the casing is prevented from back flowing, and a by-pass connected with the tubing above the piston and also connected with the casing below the packing.

7. In a well pump booster, the combination with the well casing, the string of tubing therein and the working barrel, of means connected to the tubing above the working barrel for packing off the casing around the tubing, an outlet from the tubing to the casing above the packing means, a check valve at said outlet preventing a back-flow from the casing above said means to the tubing, and a piston working in the tubing above said outlet.

8. A well pump booster as set forth in claim 7, in which the packing means has a by-pass, and a conductor from the by-pass connected with the tubing above the piston.

9. In a well pump booster, the combination with the casing, the tubing mounted in the casing and the pump rod mounted in the tubing, of a packer connected with the tubing at a point intermediate the ends thereof, a collar connected in the tubing and having an outlet to the casing just above the packer, the collar having a seat on the packer, a spring for forcing the collar and packer apart, a duct extending through the packer and the collar, a piston connected in the rod and working in the tubing above the collar, a conductor connecting the duct with

the tubing above the piston, and a check valve mounted at the outlet of the collar.

10. In a well booster, the combination with a well casing, the string of tubing therein and the working barrel, of means connected to the tubing above the working barrel for packing off the casing around the tubing, an outlet from the tubing to the casing above the packing means for discharging the elevated oil into the casing, a check valve at said outlet, and a by-pass for conducting gas from the casing below the packing means and discharging it into the tubing above the packing means, whereby oil may be carried off from the casing and gas carried off from the tubing.

11. In a well pumping booster, the combination with a casing, the string of tubing in the casing, the pump at the bottom of the tubing and the pump rod in said tubing, of a piston within the tubing connected to the rod and arranged to augment the lifting of the fluid by the pump and to cushion the down stroke of the rod, and means for packing off the casing below the piston, whereby the casing above said means may be utilized as a conduit for the boosted liquid.

12. In a well pumping booster, the combination with a casing and the string of tubing in the casing, a pump adjacent the lower portion of the well and a pump rod in said tubing, of a barrel within the casing, a liquid conduit exterior of the barrel and operatively connected with the upper end of the tubing, a piston working in the barrel and connected to the pump rod for boosting the elevation of liquid and for cushioning the rod on the down stroke thereof, means for packing off the casing below the piston, and means for discharging elevated liquid above the packing means and below the piston.

13. In a well pump booster having a piston therein, said piston including a head having a screw threaded pin, an upper head section mounted on the head and having a socket receiving the pin, a screw threaded pin on the upper head, a cap mounted on the upper head having a socket receiving the pin of the upper head, resilient piston rings seated in and confined between the head and the upper head, and additional piston rings seated in and confined between the cap and the upper head.

In testimony whereof I affix my signature.

HARVEY R. STANDLEE.