

Sept. 11, 1956

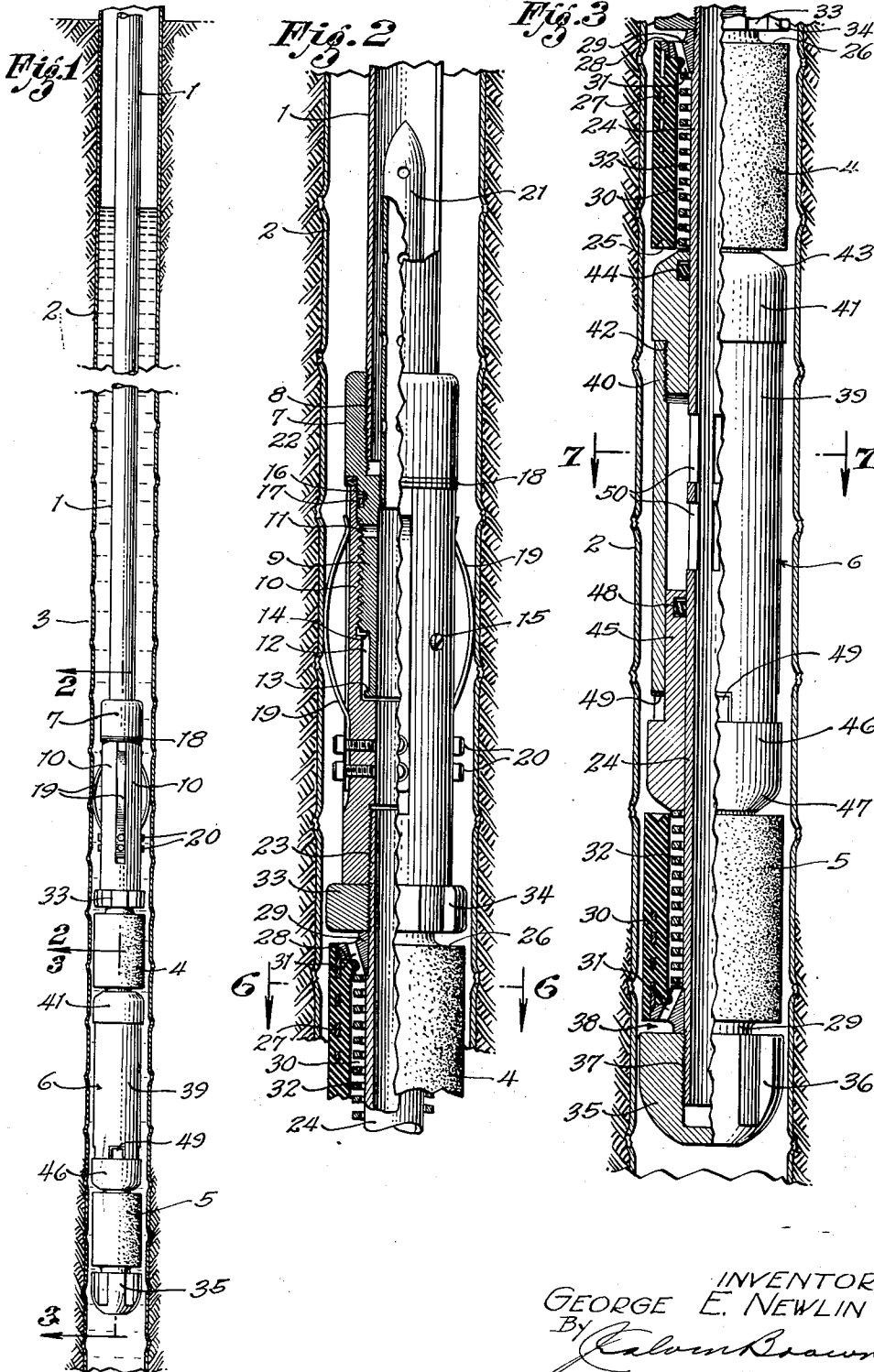
G. E. NEWLIN

2,762,441

OIL WELL WASHING DEVICE

Filed March 9, 1953

3 Sheets-Sheet 1



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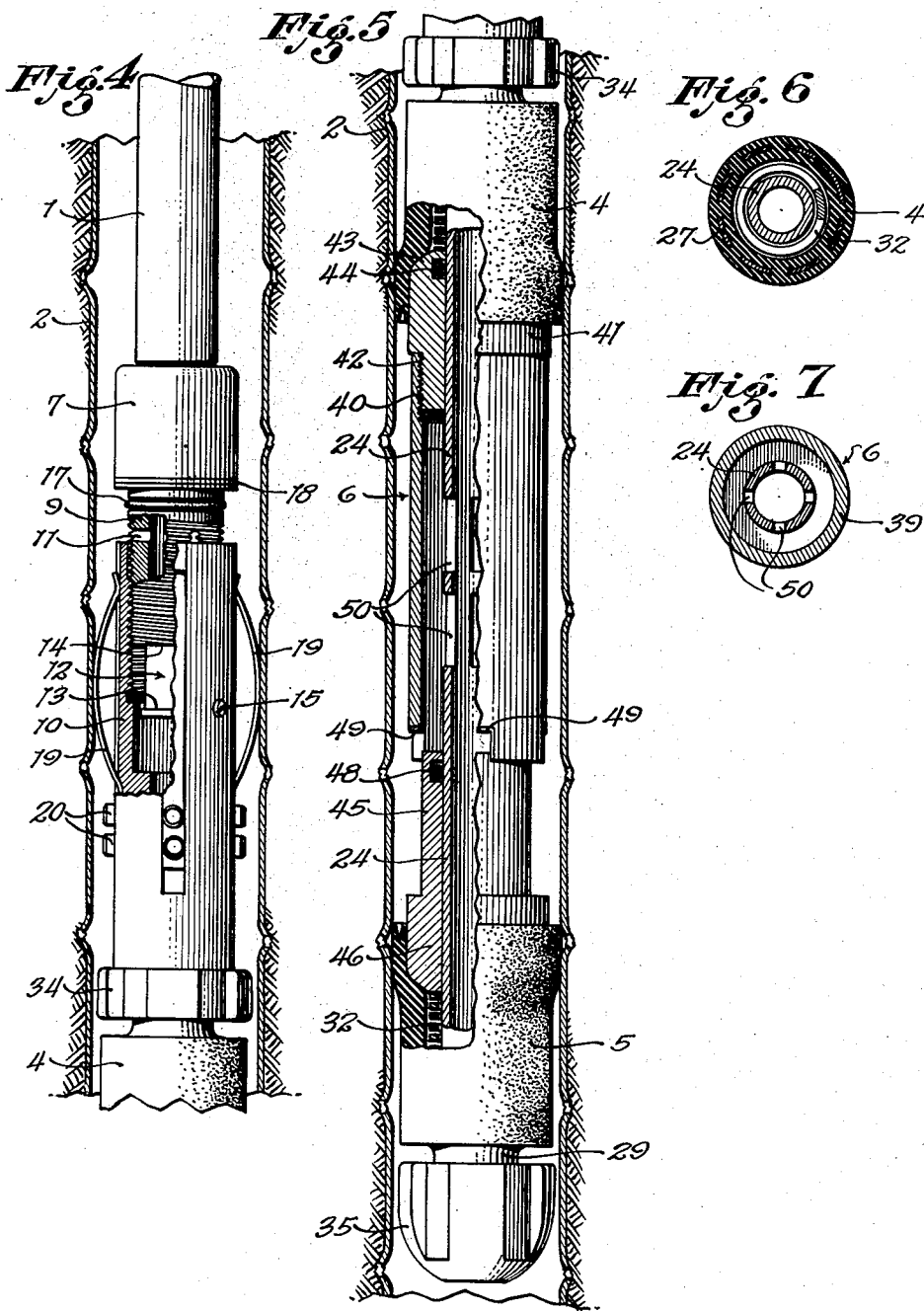
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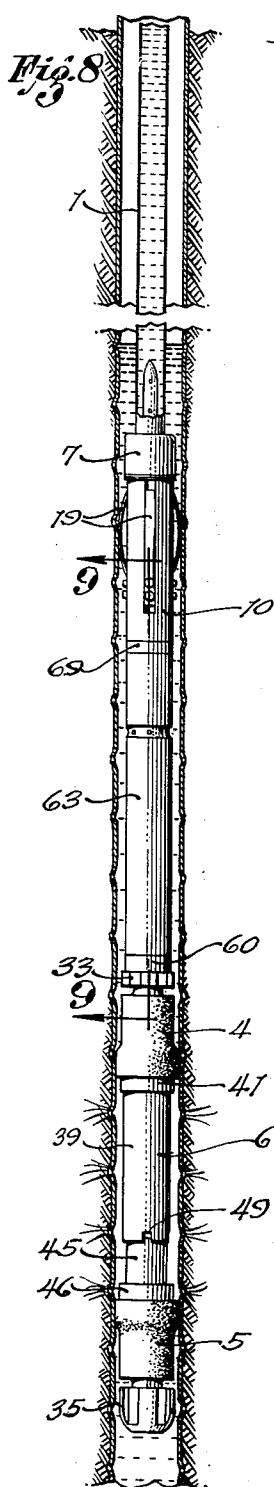
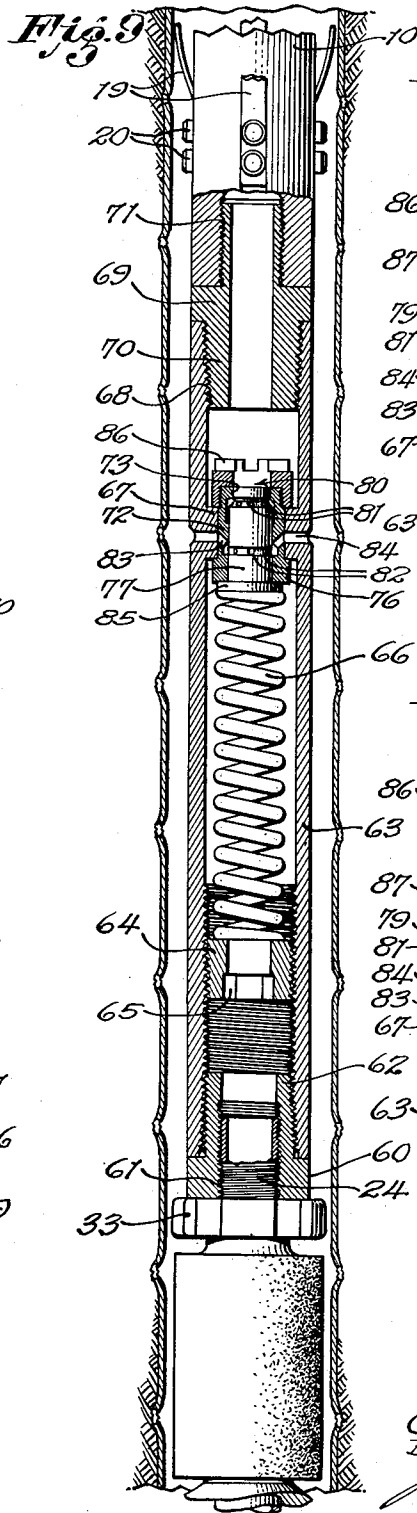
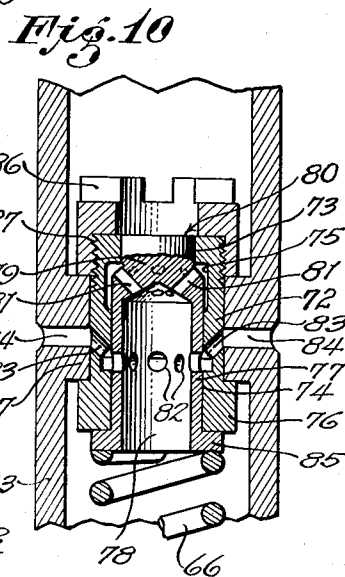
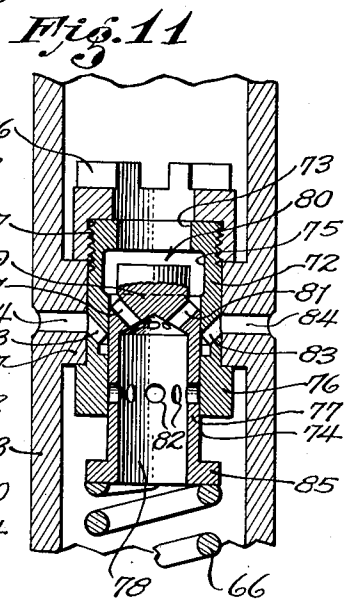
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OIL WELL WASHING DEVICE

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5 Claims. (Cl. 166—186)

The present invention relates to an oil well washing device. The invention has for an object an oil well washing device adapted to clean perforations in standard perforated liners, and which device is readily controlled as to operation from the surface of the well hole.

Another object is the provision of an oil well cleaning device so constructed and arranged as to permit washing of both regular and gravel-packed liners.

A further object is the provision of an oil well washing device which washes mechanical punched and gunshot casings efficiently and rapidly.

A further object is the provision of an oil well washing device which is capable of washing rotary mud out of newly drilled wells before the well is put on production, and which is capable of washing liners loose after a production test, and which permits the use of chemicals in a washing operation where spotting is desired.

A further object is the provision of a device for washing liners which will not sand lock under normal use.

A further object is the provision of a device which may be readily released from the liner in the event that the device becomes frozen within the liner or frozen for any reason whatsoever.

A further object is the provision of a device which permits its release from carrying tools when in a well, to the end that the said carrying tools, such as tubing, may be withdrawn from the well.

A further object is the provision of a device for washing liners which is so designed and built that the same will operate with regular pump pressure and wherein there is no wastage of cleaning fluid.

A further object is the provision of a device which readily locates leaks in a casing.

A further object of the invention is the provision of an oil well washing device constructed and arranged to have a positive mechanical pack-off.

A further object is the provision of a device so constructed and arranged as to hold a column of fluid or chemical in tubing or drill pipe until pump pressure is applied, thereby enabling one to control the exact amount of fluid or acid applied to a selected area.

Other objects will readily suggest themselves to those skilled in the art.

With the above mentioned and other objects in view, the invention consists in the novel, and the useful provision, formation, construction, arrangement, and interrelation of parts, members and features, all as disclosed in certain embodiments in the accompanying drawings, described generally, and more particularly pointed out in the claims.

In the drawings:

Figure 1 is a sectional elevation of the improved oil well washing device shown within a well hole, the parts being in one position;

Figure 2 is an enlarged elevation partly in section of the tool shown in Figure 1 and taken on the line 2—2 of said figure;

Figure 3 is an enlarged elevation partly in section of

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further details of the tool, and taken on the line 3—3 of Figure 1;

Figure 4 is a fragmentary detail, partly in section, and similar to Figure 2, certain parts of the invention being in a moved relationship;

Figure 5 is a fragmentary elevation partly in section, and similar to Figure 3, parts of the invention being in moved relationship;

Figure 6 is a sectional view on the line 6—6 of Figure 2;

Figure 7 is a sectional view on the line 7—7 of Figure 3;

Figure 8 is an elevation, partly in section, showing a modified form of the device of the invention within a well hole;

Figure 9 is a fragmentary elevation, partly in section, taken on the line 9—9 of Figure 8;

Figure 10 is a fragmentary elevation, on an enlarged scale, and partly in section, of valve means shown in Figure 9; and

Figure 11 is a view similar to Figure 10, the parts being in changed relationship.

Referring now with particularity to the drawings, and specifically to Figures 1 to 7 inclusive, the device of the invention, as shown in Figure 1, has been lowered by means of a tubing 1 within well casing 2 to a position adjacent a perforated liner 3 with the intent of cleaning the perforations of detrital material. The device shown in its simplest embodiment includes: upper and lower packers 4 and 5 respectively, and an interposed hydraulic valve 6, which hydraulic valve is adapted to expand the packers 4 and 5 against the screen or perforated liner when pump pressure is applied to a column of oil within tubing 1 in the manner illustrated in Figure 5, and to thereafter allow the fluid to escape under pressure from the hydraulic valve while holding the packers expanded, and thus in this manner by jet action, force the fluid under pressure, outside said hydraulic valve and through the perforations of the liner or screen.

Other features of the invention include means for bleeding the device so as to release the packers from engagement with the screen or perforated liner, so that the packers may be released from said liner or screen for movement to a new location, together with means whereby the entire tool may be released from the tubing in the event the device becomes frozen within the well hole.

The tubing 1, at its lower end, is threaded within a coupling pin 7, as shown at 8. The pin 9 of said coupling is elongated and screw-threaded for engagement with the screw threads of a box 10. The pin 9 is provided with one or more transverse holes 11 and said pin inward from its lower end, is provided with an annular groove 12, of extended width, such construction providing shoulders at 13 and 14. The coupling box carries a stop-screw 15, which is received within the annular groove 12 and is adapted to limit movement between the coupling box and the coupling pin, when the pin is unthreaded relative to the box, the arrangement being such that when the tubing is turned in one direction to rotate the pin, the transverse bore or bores 11, will be exposed in the manner shown in Figure 4, the transverse screw 15 engaging the shoulder 13 to limit such unthreading movement. Exposing the hole or holes 11 acts to bleed the packer in a manner more fully set forth hereinafter. The pin 9 is annularly grooved at 16 for the reception of an O ring 17, interposed between a pair of back-up rings, which acts to fluid seal the pin and the box when the parts are in the position shown in Figure 2. In the drawing I have shown a pair of washers 18 between the pin and the box. The coupling box 10 externally carries a plu-

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ality of equidistantly spaced apart bowed leaf springs 19. These springs are held at one end by any appropriate means such as by the screws shown at 20. The upper ends of said springs are movable within longitudinal surface ways, as shown. Also included within the structure is a bull nose plug and strainer 21 of conventional form and which plug is screw-threaded within the coupling 7 at 22.

Thus, so far, in the description of the invention, I have provided a coupling for the tubing 1, which coupling in turn is threaded to a box 10, which box carries bowed leaf springs for engagement with the inner surface of the screen or perforated liner for holding the box against rotation when the tubing 1 is rotated, to in turn rotate the pin 9 and raise the pin 9 from the position of Figure 2 to that of Figure 4, to bleed the tubing. The bull nose plug and strainer functions to strain the liquid passing within the oil well washing device considered as an entirety.

The box 10 is internally threaded at 23 to receive the upper threaded end of a main barrel or mandrel 24. The packers 4 and 5 are carried on this mandrel, as is likewise the hydraulic valve 6. As the packers are of identical construction, but reversed as to position, the packer 4 will be described, the same numbers of reference applying to the packer 5.

The packer 4 includes an elongated member of annular form made of inherently resilient material such as neoprene, which is oil resistant, one end of which packer is provided with an annular V-shaped groove 25. Inward from the opposite end 26 and extending substantially one-half the length of the packer is a helical wire or leaf cage 27, the cage being molded within the packer material for the purpose of giving rigidity and non-expansibility to the packer at this zone. The packer is stepped inwardly from end 26 as shown at 28, and received on said step is a casting 29. The casting 29 is annular in form and adapted to fit on the mandrel 24. In particular, the said casting is T-shaped in section, which is to say, is enlarged at the portion which surrounds the mandrel and then reduced in thickness outwardly from said portion. As shown in the drawing, specifically Figure 3, the inner diameter of the packer is greater than the external diameter of the mandrel, so as to provide an annular space between said packer and mandrel at 30. The casting 29 is provided with a series of ports 31 which allows communication between the annular space 30 and the exterior of said casting. Within the confines of space 30 is a stiff coiled spring 32, one end of which spring bears against the lower end of the casting 29. As stated, the opposite packer 5, is of identical construction, except reversed as to position.

Referring to Figures 2 and 3, I have provided what I term a guide nut 33 which is in threaded engagement with the upper threaded end of the mandrel 24. This guide nut abuts the upper end of the casting 29 and is spaced from the outlets of ports 31 by the construction shown. Furthermore, the said guide nut is provided with a series of peripheral transverse flutes 34 which function as a sand bypass to eliminate sand locking. As shown in the drawings, the diameter of the guide nut is slightly greater than the diameter of the packer 4, thus aiding in preventing damage to the packer during movement of the packer within a well hole.

Referring to the lower packer 5, this packer is held in position upon the barrel or mandrel 24 by means of a guide plug 35. This guide plug is provided with a rounded end, as shown, with the periphery of said guide plug provided with transverse flutes 36, functioning as a sand bypass. The guide plug has the same diameter as the guide nut 33, and is formed with a threaded bore at 37 for engagement with the lower threaded end of the mandrel or barrel 24. The casting 29 for packer 5 engages the base portion of said guide plug, as shown, for the purpose of spacing the lower end of packer 5

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from said plug and likewise providing a space as indicated at 38, whereby fluid passage is provided from the space between the barrel or mandrel 24 and the packer, through the ports in said casting and outwardly therefrom.

Interposed between the packers 4 and 5 is the hydraulic valve 6. The hydraulic valve includes a cylinder 39 of elongated form and which is internally threaded at 40 for connection with an expander 41, so called because it is adapted to expand the packer 4, as hereinafter set forth. The said expander has a reduced diameter and threaded portion at 42, for connection with the threads 40, the enlarged portion of said expander having a diameter slightly greater than the diameter of the cylinder 39 with the end portion 43, termed the head, slightly domed or curved, so as to readily enter the packer 4. Said expander head is provided with an internal annular groove 44, within which is confined an O ring which engages the periphery of the barrel or mandrel 24, to provide a fluid tight fit at this portion. The opposite end of the cylinder receives a plunger sleeve 45 which forms a part of the expander 46. The plunger sleeve is confined between the periphery of the barrel or mandrel 24 and the inner surface of the cylinder 39, and has a greater length than the portion 42 of the expander 41. As before, the expander 46 has a head portion which is rounded, or curved at 47, so formed as to enter the packer 5 to expand the same, and the diameter of said head portion is slightly greater than the diameter of the cylinder 39. The plunger sleeve of the expander is provided with an internal annular groove 48 within which is positioned an O ring, which has engagement with the periphery of the barrel or mandrel 24. The lower end of the cylinder 39 is provided with segmental slots 49, of which there may be a plurality. These slots provide ports for the escape of oil when the plunger sleeve, and the cylinder have moved to a certain position, as for instance, illustrated in Figure 5. Thus, this portion provides one form of valve.

The main barrel or mandrel 24, at that portion thereof which is normally confined within the cylinder 39, is provided with a longitudinal series of elongated slots 50. These slots act as ports for the escape of oil from the mandrel into the space included between the inner wall of said cylinder and said mandrel for the purpose of causing relative movement between the cylinder and the plunger sleeve 45 to in turn move the head portions 43 and 47 within the packers 4 and 5 to expand said packers against the wall of the casing or the liner in the manner shown in Figure 5, and after said expansion to permit the said oil under pressure to escape through the segmental slots 49.

The form of the invention just described is utilized when a return circulation of oil is possible. The space included between the tubing 1 and the tool is filled with oil to the top of the well, and the tubing 1 is filled with oil so that there will be substantially equal hydrostatic pressure both within and without the tool. This is essential, otherwise the valves in the tool will not work properly and may remain open.

The form of the invention shown in Figures 8 to 11 inclusive is utilized in conjunction with the tool just described, for holding oil within the tubing 1 prior to applying pump pressure. The invention includes means which may be preset at the surface of the well so as to hold the weight of oil in the tubing 1 for a given depth, and is adapted to be inserted between the safety coupling box and the nut 33.

Referring to Figure 9, a pin 60 is internally threaded to the upper threaded end of the mandrel 24, as shown at 61, and the external threads of said pin are in threaded engagement with internal threads 62 of a fluid release barrel 63. The fluid release barrel confines an adjustable annular nut 64 provided with a hexagonal socket 65 whereby by suitable tool it may be threaded inwardly or

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outwardly of the said fluid release barrel 63, and which nut is adapted to bear against the lower end of a coil spring 66 confined within said barrel 63. The barrel is provided with an internal annular flange 67 and the barrel beyond the flange is internally taper screw threaded at 68 for connection with a coupling 69. This coupling has two pins, one pin 70 is in threaded engagement with the threads 68 of the barrel, while pin 71 is threaded to the internal threads of the safety coupling box 10.

A valve of the type best depicted in Figures 10 and 11, is carried by the annular flange 67. The valve includes a housing or cage 72 having a cylindrical outer surface and provided with a through bore, the upper portion 73 of the bore being of lesser diameter than the remaining portion 74 of said bore. The housing is likewise provided with an enlarged counterbore 75. The housing is flanged at 76, with the flange adapted to abut the under surface of the flange 67. The housing or cage fits within the confines of the flange 67, with the upper end of the spring 66 abutting against the lower end of a valve piston 77 adapted for sliding movement within the housing or cage 72. The piston is provided with a central bore 78 which, however, does not extend through the head 79 thereof. The head of the piston is provided with a cylindrical plug 80 which fits within the reduced diameter bore 73 of the housing or cage. The head of the piston is provided with a series of inclined ports 81 which communicate between the outer surface of the head of the piston and the central bore 78. The wall of the piston, substantially intermediate in length, is provided with an annular series of radial bores 82 and in one position, the position shown in Figure 10, said bores 82 communicate with inclined bores 83 in the housing or cage, the bores 83 in turn registering with radial bores 84 in the flange 67 of the barrel 63. The barrel is provided with an annular groove in the plane of the bores 83. The piston is provided with a base flange 85 adapted to abut the flange 76 of the housing or cage to limit upward movement of the piston within said housing or cage. The upper end of the coil spring 66 abuts against the base flange 85 of the piston for urging the piston inwardly of its casing or cage. An annular nut 86 has threaded engagement with threads 87 on the housing or cage 72 and in this manner, the entire valve assembly is held in engagement with the flange 67, it being observed that the flange 76 of the housing or cage engages the under surface of the flange 67 and that the nut 86 engages the opposite surface of said flange 67. It is further to be observed that the plug 80 fits with close tolerance within the reduced bore 73, so as to close entrance within the housing or cage 72 of any fluid.

In Figure 11, I have shown a moved position of the piston wherein the plug 80 has moved within the counterbore 75, which allows any fluid to pass through the bore 73 into the counterbore, thence through the ports 81 into the bore 78 of the piston. The ports 82 have moved downwardly from the position shown in Figure 10, thereby closing communication through ports 82, 83 and 84. In the position shown in Figure 11, the spring 66 has been compressed.

The operation, uses and advantages of the invention just described are as follows:

Taking the form of the invention shown in Figures 1 to 7 inclusive, the tool may be lowered within a well casing 2 by means of tubing or drill pipe 1 to any desired location within the well hole. In Figure 1, I have shown oil at a certain level within the casing of the well hole and the oil well washing device has been positioned adjacent certain perforations in the casing which are to be cleaned of detrital material. All parts of the tool will be in the position shown in Figures 1, 2 and 3, which is to say, the packers are free of the inner surface of the perforated casing and the nuts 33 and 35 have guided the tool within the casing without damaging the packers. The bowed leaf springs 19 are in engagement with the inner

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surface of the casing as shown. Assuming that the casing perforations included between the packers 4 and 5 in Figure 1 are to be cleaned, fluid under pressure is pumped through the tubing 1. This fluid, which is usually hot oil passes through the bull nose strainer 21 and through the bore in the safety coupling pin 7 and the bore of the safety coupling box 10 into the mandrel or barrel 24. This oil, which is under pump pressure, will pass through the transverse slots 50 in the barrel and impinge against the inner wall of the cylinder and the end of the pin 42 and the inner end of the plunger sleeve 45. The oil under pressure will cause relative separation between the cylinder and the plunger sleeve with the result that the expander heads 41 and 46 will telescope the packers 4 and 5 compressing the springs 32 and forcing the packers into engagement with the inner surface of the casing in the manner shown in Figure 5. The expansion of the packers is approximately half the thickness thereof to cause a perfect seal with the casing in two separated zones. This expansion of the packers against the casing wall will continue until the lower end of the cylinder has raised the ports 49 to a certain distance above the plunger sleeve 45, as shown in Figure 5. An outlet is therefore provided for the oil under pressure, which oil impinges the casing, and specifically, the perforations for the purpose of cleaning the same. During said cleaning, the packers are at all times held in engagement with the casing.

Assuming that the perforations in a given zone have been cleaned, and it is desired to move the tool to a new location within the casing for a further cleaning operation pump pressure on the oil within the tubing 1 is released, and there is a hydrostatic balance, both exterior the tubing and within the tubing, release of oil pressure within the tubing to the tool allows the springs 32 to move the expander heads 41 and 46 outwardly of the packers and the plunger sleeve to move within the cylinder to the position shown in Figure 3. Any tendency to sand up is effectively prevented, as oil may flow through the ports 31 from space 30 and outwardly around the expanders and packers. As a consequence the tool is easily released from casing engagement.

If we assume, however, that the tool should become frozen within the casing and could not be freed in the manner aforesaid, then the safety coupling release may be utilized by making a certain number of turns on the tubing 1 at the surface of the well. In actual practice, six turns of the tubing 1 to the right will move the safety coupling pin to the position shown in Figure 4, to expose the transverse ports 11 above the end of the safety coupling box 10. There is no danger in turning the tool as stated, as the safety stop screw 15 will indicate, at the surface of the well, when said screw has moved within the annular groove 12 from the position shown in Figure 2 to that shown in Figure 4. In this manner, it is quite impossible to drop the tool within the casing or well hole, and this method provides a liquid release to bleed the tubing after a given job has been completed or to apply fluid to wash away sand which might form above the top packer 4.

A second condition might be considered, to wit: if the tool is stuck in a broken casing. By turning the tubing 1 to the right on the derrick floor the safety coupling is forced open, and the safety stop screw 15 cuts a thread through the portion 13 of the safety coupling pin, thus releasing the safety coupling pin upon further turning of the tubing, from the safety coupling box. This allows complete withdrawal from the well hole of all tubing together with the bull nose plug carried by the safety coupling pin. Thereafter, a fishing tool may be dropped within the casing to recover the balance of the tool.

The device of Figures 8 to 11 inclusive is used to balance the weight of oil within the tubing 1, prior to applying pump pressure thereto.

The first operation consists in determining the depth to which the tool is to be lowered and held within the

casing. Knowing the capacity of the tubing 1 at that depth, the weight of a column of oil is easily determined. The operator, by suitable tool inserted within the hexagonal portion 65 of the nut 64, compresses the spring 66 to the end that the valve shown in Figures 10 and 11 will not open, nor move from the position in Figure 10 to that of Figure 11, while supporting the static weight column of oil aforesaid. The moment, however, that pump pressure is applied to the column of oil, the valve opens, and allows the oil to pass through the opening 73 into the space 75 and through the ports 81 in the crown of the piston. This oil continues its path of movement through the barrel 63, into the hydraulic valve, which has heretofore been described. After movement of the hydraulic valve part to expand the packers, both top and bottom, the oil is forced under pressure through the milled openings at 49 and into the space included between the packers for the purpose of pressure cleaning the perforations. The moment that pump pressure is relieved at the surface of the well, from the column in the tubing 1, the piston 77 will close, the plug 80 entering the bore 73 and the ports 82 will be in communication with the ports at 83 and 84, so that oil under pressure within the tool and particularly within the hydraulic valve will be relieved to the end that the hydraulic valve will close, being assisted in this regard by the springs 32 included between the mandrel or working barrel, and the said packers. Quite obviously, the fluid is retained within the tubing 1 after pump pressure is discontinued and it is now an easy matter to relocate the tool within the liner for further operation.

I claim:

1. The combination with an oil well cleaner of the type having spaced packers which are expanded against a liner by pressure exerted through the hollow stem to which the cleaner is secured, of anti-sand-lock means, said means including a perforated closure member in each packer, a wedging expander at the opposite end of each packer, and a spring loosely mounted between the stem and the inside surface of each packer, urging the closure member and the expander apart, whereby any sand collecting above an expanded packer and blocked by the proximate expander will move freely downward past the packer when the expander is urged out of the packer by its spring upon release of pressure urging the packers into engagement with the liner.

2. In an oil well cleaner of the type having spaced packers which are expanded against a liner by pressure exerted through the hollow stem to which the cleaner is secured, a coupling box attached to the cleaner, a coupling pin attached to the stem and having threaded engagement with the box, said pin having an external annular groove near its bottom end and said box having a set screw normally limiting relative rotation of the box and the pin by extending into the groove and striking the lower shoulder of the groove, but cutting a releasing thread below said shoulder by greater rotative movement exerted upon the stem, whereby the stem may be removed should the cleaner become frozen to the casing.

3. A valve structure for cleaning devices for perforated oil well casings and adapted to hold a column of fluid in the stem or tubing prior to applying pump pressure, comprising a tubular member having transverse parts, a cage secured thereto having ports constantly in communication with the transverse ports and a port coaxial with the tubular member to provide a chamber proximate the coaxial port, a thimble valve slidable in the cage, said valve having a head snugly engaging the coaxial port and having transverse ports registering with the cage transverse ports when the valve is moved to position its head in the coaxial port to close that port and to engage the cylindrical side wall of the cage in coaxial part open position, said thimble valve having additional ports constantly placing the interior of the valve in communication with the chamber in the cage below the coaxial port, and resilient means for urging the valve into position to close the coaxial port by moving said head therein.

4. A valve structure for cleaning devices for perforated oil well casings and adapted to hold a column of fluid in the stem or tubing prior to applying pump pressure, comprising a tubular member having a restricted portion with a main bore coaxial with the tubular member and a smaller coaxial bore spaced from said main bore to provide a chamber between the two bores, said restricted portion and the tubular member having common transverse ports connecting the main bore with the outside of the tubular member, a thimble valve slidable in the main bore and having an elongated plug head above the thimble portion to fit snugly within the smaller bore when the valve is closed and having lower ports to register with the said transverse ports and lead to the interior of the valve when the plug head closes the smaller bore and having upper ports below the head constantly establishing communication between the interior of the thimble valve and the chamber, and adjustable means for spring loading the valve before introducing the assembly into the well thereby to hold the expected hydrostatic fluid weight at the tool so that the valve can only be opened by added pump pressure at the surface.

5. The valve structure of claim 4 in which the adjustable means includes a coil spring many times the axial length of the valve structure and a nut movable axially a greater distance than said axial length, and the restricted portion includes an annular flange extending inwardly from the tubular member, a cage having a shoulder engagement with the flange, and a hollow locking member engaging the flange and secured to the cage.

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