

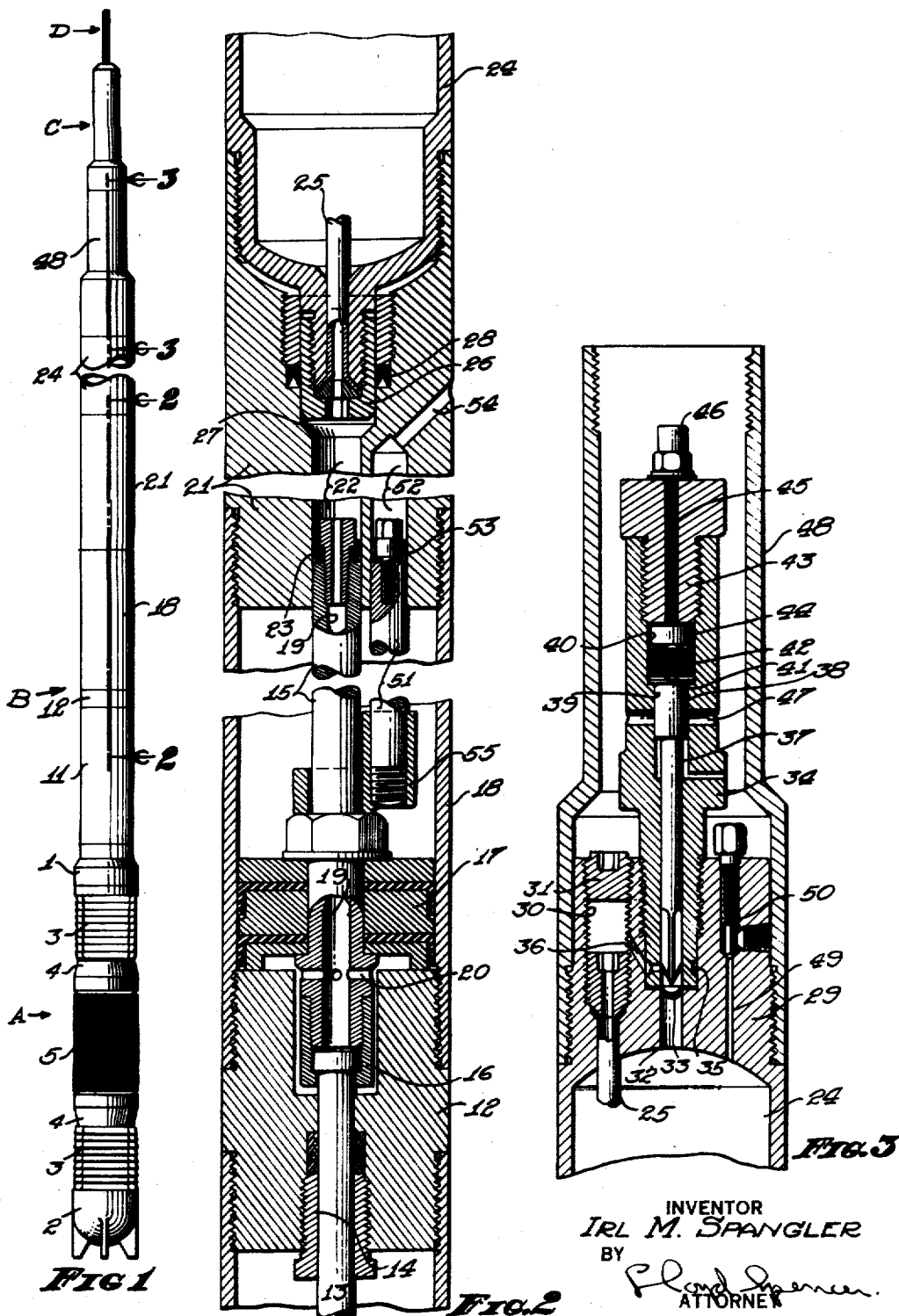
Aug. 10, 1943.

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2,326,404

SETTING TOOL FOR BRIDGING PLUGS

Filed March 15, 1941



UNITED STATES PATENT OFFICE

2,326,404

SETTING TOOL FOR BRIDGING PLUGS

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Application March 15, 1941, Serial No. 383,607

6 Claims. (Cl. 166—1)

My invention relates to setting tools for bridging plugs; more particularly to setting tools adapted to connect a bridging plug with a wire line or cable in such a manner that the bridging plug may be lowered into position and set or secured in the well by operation of the setting tool, whereupon the setting tool and the cable are freed from the plug for removal. Among the objects of my invention are:

First, to provide a setting tool which is adapted to be suspended from a conductor core cable and is so arranged that its operation is initiated by completion of an electric circuit through the cable;

Second, to provide a setting tool whereby the energy stored in a high pressure fluid container, forming a part of said setting tool, is utilized to operate a piston to cause setting of the bridging plug;

Third, to provide a setting tool which incorporates a novel arrangement for releasing the high pressure fluid;

Fourth, to provide a bridging plug setting tool which, although compact and of small diameter, is capable of exerting ample force to set the bridging plug even under adverse conditions;

Fifth, to provide a setting tool which operates equally well whether in a dry well or submerged to great depths in liquid;

Sixth, to provide a setting tool incorporating a high pressure storage cylinder which forms a section of the setting tool but may be readily separated therefrom and stored for use, such cylinder preferably being charged with an inert gas; and

Seventh, to provide a setting tool which, after being employed to set a bridging plug and removed from the well, may be readily and quickly relieved of any residual pressure and conditioned for use, all with a minimum amount of assembly and disassembly of the setting tool.

With the above and other objects in view, as may appear hereinafter, reference is directed to the accompanying drawing, in which:

Figure 1 is a elevational view of a bridging plug with my setting tool shown in association therewith;

Figure 2 is a fragmentary longitudinal sectional view of the setting tool through 2—2 of Figure 1; and

Figure 3 is another longitudinal sectional view through 3—3 of Figure 1 and continuing from Figure 2.

The bridging plug for which my setting tool is adapted comprises a head member 1 and a foot

member 2, between which are provided slips 3, cones 4 and a packing sleeve 5. The bridging plug is set by forcing the head and foot members toward each other to expand the slips on their respective cones and compress the packing sleeve between the cones. The setting tool acts upon the bridging plug by holding or forcing downwardly on the head member while pulling upwardly upon the foot member.

The setting tool includes a sleeve 11 which rests upon the head member 1 and is connected at its upper end to a cylinder base 12 in the form of a nipple externally threaded at each end. A pull rod 13 is suitably connected with the foot member 2 of the bridging plug, preferably by a shear pin (not shown). The pull rod 13 extends upwardly through a packing gland 14 provided in the cylinder base and is connected to a piston stem 15 through a coupling 16. A piston 17 is carried on the piston stem 15. A cylinder 18 for the piston is screw-threaded into the upper end of the cylinder base 12. The piston stem 15 projects upwardly above the piston 17 and is provided with a passage 19 therethrough from its upper end through the piston. Outlet ports 20 communicate between the passage and the underside of the piston.

The upper end of the cylinder 18 is screw-threaded into a cylinder head 21 which is provided with a bore 22 adapted to receive the upper end of the piston stem. A suitable sealing means 23 is provided between the piston stem and bore 22 so that the piston stem may operate as a plunger in the bore 22 and form a sealed connection therewith.

A high pressure reservoir 24 in the form of a tank closed at each end is screw-threaded into the upper end of the cylinder head 21. The high pressure reservoir is provided with a conductor tube 25 extending between its ends, the lower end of the conductor tube fitting within a neck portion 26 projecting from the reservoir and fitting into a counterbore 27 provided in the cylinder head and communicating with the bore 22. A sealing ring 28 provides a seal connection between the neck 26 and the counterbore 27 in which it fits, so that the conductor tube 25 is in communication with the underside of the piston through bore 22, passage 19 and outlets 20.

The upper end of the reservoir 24 is provided with a head 29 in which is provided an off-center socket 30 which receives the upper end of the conductor tube 25. The conductor tube is suitably sealed to the walls of the socket 30 so that the passage through the conductor tube is iso-

lated from the interior of the reservoir. The socket 30 is closed by a plug 31.

The reservoir 24 is provided with a discharge port 32, preferably located centrally in the head 28. The discharge port 32 is closed by a seal disk 33 which is clamped in place by a plunger barrel 34. The plunger barrel 34 is provided immediately above the seal disk 33 with lateral ports 35 which communicate with a passage 36 formed in the head extending from the ports 35 to the socket 30 below the plug 31, so that when the seal disk 33 is opened a passageway is formed from the reservoir through the discharge port 32, ports 35 and passage 36 into the interior of the conductor tube 25.

The plunger barrel 34 receives a plunger 37 having a pointed lower end adapted to pierce the seal disk 33. The upper end of the plunger 37 is provided with a plunger head 38 which fits in a counterbore 39 formed in the upper end of the plunger barrel 34. Above the counterbore 39 the bore of the plunger barrel 34 is further enlarged to form a cartridge chamber 40. The upper end of the plunger head 38 has welded, soldered or otherwise secured thereto a retainer disk 41 of easily ruptured material which initially holds the plunger 37 in an elevated position above the seal disk 33.

The cartridge chamber receives a cartridge 42 containing an explosive and preferably an electrically responsive fuse wire (not shown). The cartridge chamber is closed at its upper end by a breech plug 43, at the lower end of which is a terminal 44 connected to an insulated conductor 45 which extends upwardly through the breech plug and is joined to a suitable contact head 46.

The counterbore 39 is provided with bleeder ports 47 so positioned that after the plunger has moved downwardly a sufficient distance to rupture the sealing disk it permits the excess powder pressure to be vented laterally.

A sleeve 48 is screw-threaded to the reservoir head 29 and extends upwardly around the head and the breech plug 43 for connection to a cable head C which, in turn, is connected to a cable D.

The reservoir 24 is adapted to be filled with an inert gas such as nitrogen, preferably of a high pressure, for instance, 1500 to 2000 pounds per square inch. This may be done through a filling port 49 provided in the head 29, which port may be closed by a needle valve 50.

A counterbalancing plunger 51 may be provided. The counterbalancing plunger is mounted within the cylinder 18 above the piston 17 and extends upwardly along the side of the stem 15 and into a bore 52 and is provided with a suitable sealing means 53. The bore 52 communicates with the exterior through an inlet port 54. The counterbalancing plunger 51 may be connected to or rest upon the upper side of the piston 17 by means of a yoke 55. The counterbalancing plunger 51 is equal to the effective diameter of the pull rod 13 so that, regardless of the head of fluid in which the setting tool may be immersed, the hydrostatic pressure of such fluid has no effect on the piston 17. It should be borne in mind that the setting tool may be operated under several thousand feet of liquid and that the pressure exerted on the pull rod by reason of the hydrostatic head may be equal to several hundred pounds.

Although the bridging plug may easily be arranged so that it will not set unless the force exerted is greater than that applied by reason of the unbalanced area of the piston 17 due to

the pull rod, it is preferred to control accurately the amount of force applied to the bridging plug and such control is greatly facilitated by eliminating the variable due to the hydrostatic head.

Operation of my setting tool is as follows: The setting tool is attached to a bridging plug and suspended from a cable, as shown in Figure 1. The parts are in the positions shown in Figures 2 and 3. When the setting tool and bridging plug have been lowered to the desired position the cartridge 42 is fired by electrical current supplied through the cable causing the plunger 37 to pierce the sealing disk 33. The high pressure gas within the reservoir 34 is thereby permitted to pass upwardly through discharge port 32, then through ports 35, passage 36, conductor tube 25, bore 22, passage 19 and ports 20 to the underside of the piston 17. The size of the reservoir and the pressure of the gas contained therein is such that the force exerted on the pull rod exceeds that required to properly set the bridging plug. The shear pin or other means connecting the pull rod to the bridging plug is designed to give way at a predetermined load, which, of course, is below the force capable of being applied to the pull rod. Thus, once the cartridge is set off the setting tool automatically sets the bridging plug, then shears the connecting pin and is freed therefrom.

Various changes and alternate arrangements may be made within the scope of the appended claims, in which it is my intention to claim all novelty inherent in the invention as broadly as the prior art permits.

I claim:

1. A bridging plug setting tool comprising: a piston and cylinder operatively connected with a bridging plug; a closed container of fluid under high pressure; means defining an initially closed passageway between said container and said piston and cylinder; remotely controlled means for opening said passageway; and means for hydrostatically balancing said piston against fluid in which the setting tool may be immersed.

2. A bridging plug setting tool comprising: a piston and cylinder operatively associated with said bridging plug; a closed container of inert gas; means defining an initially closed passageway between said container and said piston and cylinder; the pressure and volume of gas in said container being such that after expansion into said cylinder to move said piston the residual pressure remains above that required to cause setting of the bridging plug; means for opening said passageway; and means for hydrostatically balancing said piston against fluid in which the setting tool may be immersed.

3. A bridging plug setting tool comprising: a piston and cylinder operatively connected with a bridging plug; a reservoir for gas under high pressure, said reservoir being in the form of a cylindrical container connected with said cylinder and suspended from a cable; means defining a passageway from the upper end of said reservoir to said piston and cylinder; a closure for said passageway at the upper end of said reservoir; means for opening said closure; and means for balancing said piston against the hydrostatic pressure of fluid in which the setting tool may be immersed.

4. The combination with a well device adapted to be operated by relative longitudinal movement of its parts and a cable for suspending said devices in a well bore, of a setting tool interposed between said device and cable and comprising: a

cylinder connected with one part of said device; a piston for said cylinder; a stem connecting said piston with another part of said device; a container of high pressure fluid; means defining a passageway from said container to said piston and cylinder; a rupturable seal initially closing said passageway; and an explosively operated means for rupturing said seal.

5 5. The combination with a well device adapted to be operated by relative longitudinal movement of its parts and an electric cable for suspending said device in a well bore, of a setting tool interposed between said device and cable and comprising: a piston and cylinder connected with the relatively longitudinal parts of said tool; 10 a container of high pressure fluid connected to and extending coaxially upwardly from said cylinder; means defining a passageway from the upper end of said container through said container but isolated therefrom, to said cylinder; 15 a seal between the upper end of said container

and said means; an electrically responsive device electrically connected with said cable for opening said seal; and a cable head for said cable, said container forming a connecting link between said cable head and said cylinder.

6. The combination with a well device adapted to be operated by relative longitudinal movement of its parts and an electric cable for suspending said device in a well bore, of a setting tool interposed between said device and cable and comprising: a piston and cylinder connected with the relatively longitudinal parts of said tool; a container of high pressure fluid connected to and extending coaxially upwardly from said cylinder; means defining a passageway from the upper end of said container to said cylinder; a shear disk between the upper end of said container and said means; a punch for said shear disk; and an electro-explosive means for operating said punch.

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