

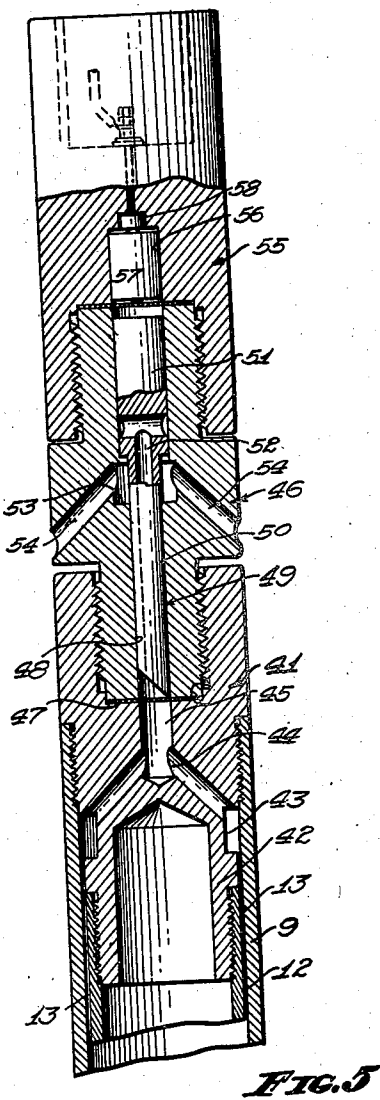
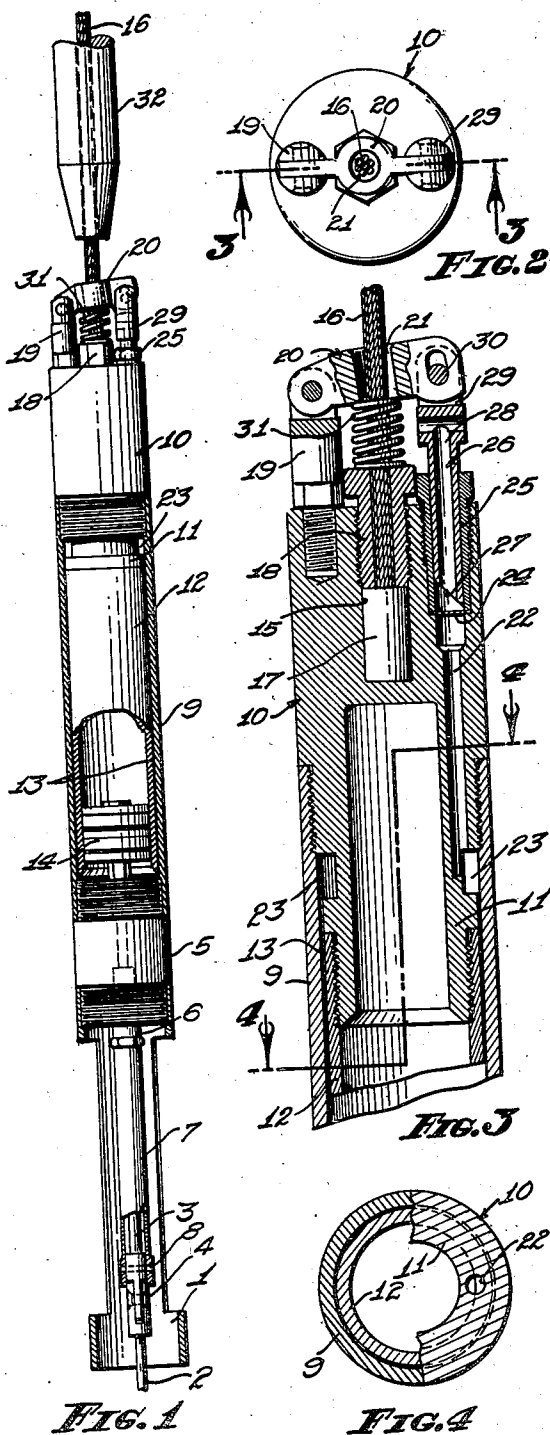
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HYDROSTATICALLY OPERATED SETTING TOOL

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HYDROSTATICALLY OPERATED SETTING
TOOL

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My invention relates to hydrostatically operated setting tools and among the objects of my invention are:

First, to provide a setting tool which utilizes the hydrostatic pressure of the fluid in which it is immersed to provide the motive power;

Second, to provide a setting tool which is particularly designed to secure bridging plugs in a well casing, but which may be employed to actuate any well tool responsive to longitudinal compression;

Third, to provide a setting tool of this character which is adapted to be suspended from a wire line and set into operation by dropping a tubular go-devil or may be suspended from a conductor core wire rope and caused to operate electrically; and

Fourth, to provide a hydrostatically operated setting tool which is particularly simple and economical of manufacture, easily serviced, and which is particularly easy to operate.

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 partial elevational, partial sectional view of my setting tool with the parts shown in their initial position and with the go-devil, shown fragmentarily, about to engage the setting tool and cause its operation;

Figure 2 is an enlarged top plan view of my setting tool with the cable from which it is suspended shown in section;

Figure 3 is an enlarged fragmentary longitudinal sectional view thereof in the same plane as Figure 1 and taken substantially through 3—3 of Figure 2;

Figure 4 is a transverse sectional view through 4—4 of Figure 3; and

Figure 5 is a fragmentary longitudinal sectional view similar to Figure 3, but illustrating a modified form of my setting tool.

The bridging plug with which my setting tool is used is for the purposes of this application assumed to be conventional and therefore is not shown. A conventional bridging plug consists essentially of two relatively axial movable members between which are positioned a slip and cone means and a packing element. The slip and cone means is adapted to engage a surrounding casing to lock the bridging plug against movement therein and the packing element is adapted to form a fluid-tight seal. Engagement of the slips and packing element with the casing is accomplished by the axial compression of tele-

scoping of the two end members of the bridging plug.

My setting tool includes a tubular adapter shell 1, which is adapted to engage the upper end of a bridging plug, and a setting rod 2 which is attached to the lower end of the bridging plug, preferably by a shear pin not shown. Within the adapter shell 1 the setting rod 2 is connected to a piston rod 3 through a suitable separable coupling 4. The piston rod 3 extends through a partition block 5 in which is provided a packing gland 6. The outer end of the piston rod is covered by a sleeve 7 which is connected at its lower extremity to the piston rod by a shear pin 8, which initially holds the piston rod in its lower or extended position.

An outer shell 9 is screw-threaded to the upper end of the partition block and is in turn joined at its upper end to a cylinder head 10. The cylinder head 10 is provided with a hollow extension 11 which projects downwardly inside the outer shell 9 and is of slightly smaller diameter. Secured to the hollow extension 11 is a cylinder 12 which lines the inner wall of the outer shell 9 and terminates just short of the partition block 5. The hollow extension and cylinder head form with the inner wall of the outer shell 9 an annular passage 13 communicating with the cylinder 12 at its lower end. A piston 14 is mounted within the cylinder 12 and is connected to the piston rod 3.

The upper end of the cylinder head 10 is provided with a cable anchor socket 15 which receives a cable 16, at the lower end of which is provided an enlargement 17 which may be molded or cast about the end of the cable. The cable is provided with an anchor plug 18 which screws into the outer end of the anchor socket to secure the cable to the cylinder head.

At one side of the cable anchor plug 18 there is secured a fulcrum post 19 which extends axially upward and journals one end of a lever 20. The lever 20 extends diametrically across the end of the cylinder head 10 and is provided with an opening 21 therein to accommodate the cable 16.

Diametrically opposite the post 19 the cylinder head 10 is provided with a passage 22 which extends downwardly and intersects an annular channel 23 provided around the hollow extension 11, so that the passage 22 communicates with the annular passage 13. The passage 22 is enlarged at its upper portion to form a shoulder upon which rests a shear disc 24. The shear disc is held in place by a tubular retainer plug 25. A tubular punch 26 having a beveled lower end 27

is slidable within the retainer plug 25. A passage 28 is formed through the punch and communicates with the exterior of the setting tool. The upper end of the punch is provided with a head 29 which is connected by a pin 30 to the lever 20. A spring 31 tends to hold the lever in an upper position.

A tubular go-devil 32 is adapted to slide down the cable 16 to engage the lever 20 and thereby cause the punch 26 to perforate the shear disc 24.

Operation of my setting tool is as follows: The setting tool is lowered into the well on the cable with the parts in the positions shown in the drawing; that is, with the piston in its lower position and its piston rod extended. When the setting tool and bridging plug have been lowered to the desired depth the go-devil 32 is dropped. The go-devil engages the lever 20 so that the punch 26 perforates the shear disc 24 and the well fluids may flow through passages 28 and 22, annular passage 23 and passage 13 to the underside of the piston.

It is customary to set bridging plugs in wells which are filled with water or other liquid, usually a depth of several thousand feet. Consequently, the hydrostatic head of liquid in which the setting tool is immersed may exceed 1,000 pounds per square inch. The interior of the cylinder, however, is at atmospheric pressure so that when the passage is opened ample force is thereby exerted against the piston to move it upward and thereby draw upward on the setting rod 2.

The force required to set the bridging plug is, of course, known and the shear pin (not shown) which connects the setting rod 2 with the bridging plug is adapted to shear when the required setting force is exceeded. Under the normal conditions of operation in which the liquid level is several hundred feet above the tool, the available force against the piston is materially in excess of the force required to set the bridging plug, so that there is ample excess force to shear the pin which attaches the setting tool to the plug. This pin should not be confused with the shear pin 8 shown in the drawing. The shear pin 8 is intended merely to prevent the hydrostatic pressure against the piston rod 3 from forcing the piston upward before the shear disc 24 is broken. The rod 3 may be relatively small in diameter so that only a nominal amount of upward force is exerted and, consequently, a comparatively small shear pin 8 suffices.

Reference is now directed to Figure 5: The structure here shown differs principally in the arrangement of the cylinder head so that an explosive charge may be utilized to open the cylinder to the hydrostatic head of fluid. A cylinder head 41 is illustrated, the lower end of which is similar to the cylinder head 10. It is provided with a hollow extension 42 to which the cylinder 12 is attached. An annular channel 43 is provided around the hollow extension above the cylinder 12 and communicates by passages 44 with a socket 45 centered in the cylinder head. The outer end of the socket is enlarged or counterbored and internally threaded to receive a gun block 46. Between the gun block 46 and the shoulder formed by the enlarged portion of the socket is clamped a shear disc 47.

The gun block 46 is provided with a bore 48 therethrough which receives a punch member 49. The punch member 49 comprises a stem 50 which extends into the lower portion of the bore 48 and a head 51 fitting the upper portion of the bore, said upper portion being slightly enlarged. A

longitudinal passage 52 is provided in the stem which is connected to a cross passage in the head 51. The enlarged or counterbored portion of the bore 48 which accommodates the head 51 forms, with the normal portion of the bore 48, a shoulder 53 for limiting downward movement of the punch. Immediately above the shoulder 53 the bore is further enlarged and provided with laterally directed ports 54 communicating with the exterior of the gun block.

The gun block 46 is adapted to be secured to a gun body 55 which is provided with a cartridge chamber 56 in alignment with the bore 48. The cartridge chamber contains a cartridge 57, preferably of the type adapted to be fired electrically and engages a terminal 58 which is suitably connected in a conventional manner with the conductor of an electric cable (not shown) from which the setting tool may be supported.

Operation of the modified form of setting tool shown in Figure 5 is as follows: When the cartridge 57 is fired the punch 49 moves downwardly, shearing the disc 47 and thereby providing an avenue of communication through ports 54, passages 52 and 44, channel 43, and annular passage 13 to the underside of the piston 14.

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 setting tool for well devices, comprising: a cylinder; a piston dividing the cylinder into an atmospheric pressure chamber and a well fluid chamber, said piston and cylinder being operatively connected with a well device; means defining a passage from said well fluid chamber to the exterior of said setting tool; means initially closing said passage; and means for opening said closing means whereby the hydrostatic head of fluid may be exerted against said piston.

2. A setting tool for well devices, comprising: a cylinder; a piston dividing the cylinder into an atmospheric pressure chamber and a well fluid chamber, said piston and cylinder being operatively connected with a well device; a shear disc initially closing said passage; a punch for perforating said disc; a cable supporting said cylinder; a lever engageable with said punch and positioned contiguously to said cable; and a go-devil adapted to ride said cable and engage said lever to actuate said punch.

3. A setting tool for well devices, comprising: a cylinder; a piston dividing the cylinder into an atmospheric pressure chamber and a well fluid chamber, said piston and cylinder being operatively connected with a well device; a shear disc initially closing said passage; a punch for perforating said disc; a cable supporting said cylinder; and a go-devil adapted to travel down said cable and actuate said punch.

4. A setting tool for well devices, comprising: a cylinder; a piston dividing the cylinder into an atmospheric pressure chamber and a well fluid chamber, said piston and cylinder being operatively connected with a well device; a shear disc initially closing said passage; a punch for perforating said disc; and an explosive cartridge adapted to actuate said punch.

5. A setting tool for well devices, comprising: a piston and cylinder means defining an atmospheric pressure chamber and a well liquid pressure chamber; a piston rod extending from said piston through said well liquid pressure chamber

to the exterior of said piston and cylinder, whereby hydrostatic pressure on the exposed end of said piston rod tends to expand said well liquid pressure chamber; means defining a passage from said well liquid pressure chamber to the exterior of said piston and cylinder means; means initially closing said passage; and means for opening said closing means, whereby the hydrostatic pressure of the well liquid in which said setting tool is immersed is directed against said piston.

6. A setting tool for well devices, comprising: a piston and cylinder means defining an atmospheric pressure chamber and a well liquid pressure chamber; a piston rod extending from said piston through said well liquid pressure chamber to the exterior of said piston and cylinder, whereby hydrostatic pressure on the exposed end of said piston rod tends to expand said well liquid pressure chamber; means defining a pas-

sage from said well liquid pressure chamber to the exterior of said piston and cylinder means; a shear disc initially closing said passage; a punch for perforating said disc; and means for actuating said punch.

7. A setting tool for well devices, comprising: a piston and cylinder means defining an atmospheric pressure chamber and a well liquid pressure chamber; a piston rod extending from said piston through said well liquid pressure chamber to the exterior of said piston and cylinder, whereby hydrostatic pressure on the exposed end of said piston rod tends to expand said well liquid pressure chamber; means defining a passage from said well liquid pressure chamber to the exterior of said piston and cylinder means; a shear disc initially closing said passage; a punch for perforating said disc; and an explosive cartridge adapted to actuate said punch.

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