

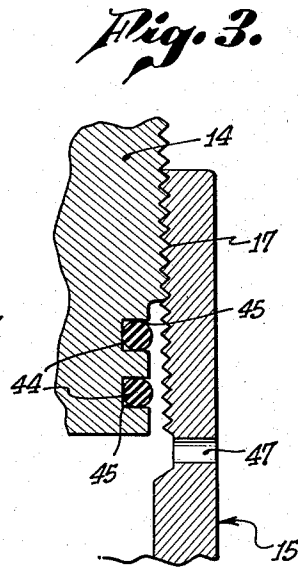
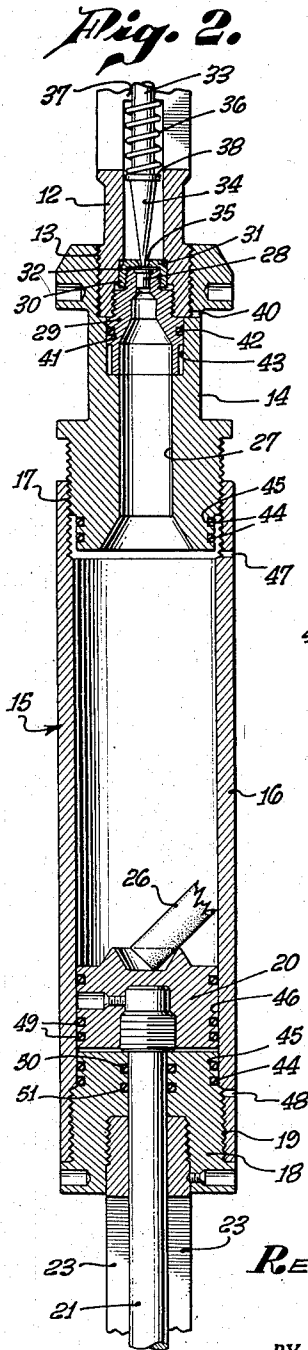
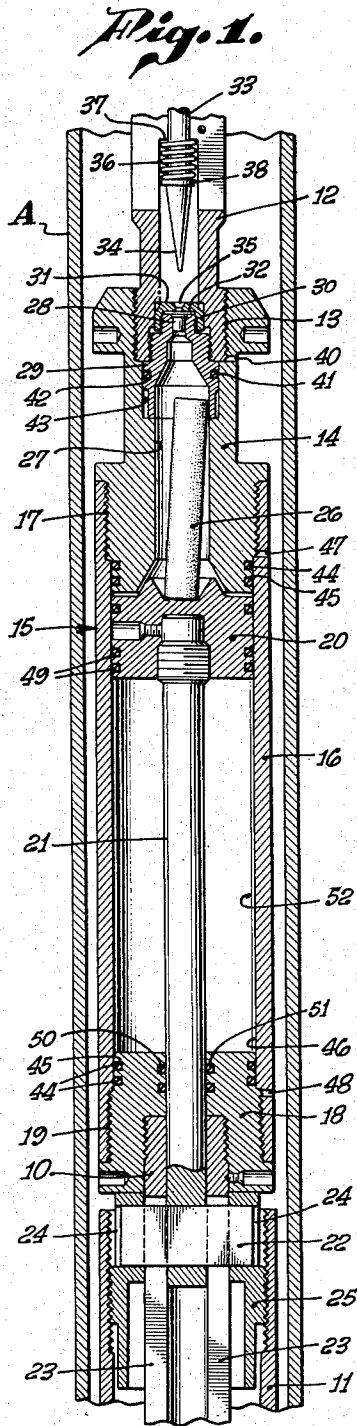
Aug. 31, 1954

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2,687,776

GAS OPERATED WELL APPARATUS

Original Filed Jan. 12, 1948



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UNITED STATES PATENT OFFICE

2,687,776

GAS OPERATED WELL APPARATUS

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Original application January 12, 1948, Serial No. 1,845, now Patent No. 2,640,547, dated June 2, 1953. Divided and this application March 24, 1952, Serial No. 278,181

7 Claims. (Cl. 166-63)

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The present invention relates to prime mover mechanisms, and more particularly to fluid power operated apparatus in which the motivating fluid medium is a confined gas under pressure.

This application is a division of the application of Reuben C. Baker, Thomas M. Ragan, John R. Baker and Martin B. Conrad, Serial No. 1,845, filed January 12, 1948, for "Gas Operated Well Apparatus," now Patent No. 2,640,547.

An object of the present invention is to provide an apparatus which is operated by gas under pressure, and in which assurance is had that such gas pressure is relieved prior to full dismantling of the apparatus, to guard against injury to persons or property.

Another object of the invention is to obtain the automatic venting or ejection of a gas or gases under pressure, such as those constituted by products of combustion in a well bore setting or operating tool, upon partial dismantling of the portion of the tool containing the gas under pressure.

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.

Referring to the drawings:

Figure 1 is a longitudinal section through an apparatus embodying the invention;

Fig. 2 is a view similar to Fig. 1, with the parts in another relative position;

Fig. 3 is an enlarged sectional view of a portion of one of the gas venting portions of the apparatus.

The apparatus disclosed in the drawings has been particularly designed for setting a well tool, such as a well packer having slips (not shown), in a well casing A. The well apparatus includes a tubular mandrel 10 which is connectible to the body (not shown) of the well tool, and it also includes a setting sleeve 11 that is designed to exert a setting force upon the slips (not shown) of the well tool. The apparatus is lowered in the well casing A by means of a suitable running-in string, such as a wire line (not shown), which is connected either directly

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or indirectly to a gun body 12, secured by a threaded connection 13 into the upper end of an upper head 14 of a cylinder 15, in which a motivating gas under pressure is to be provided. This cylinder also includes a cylinder sleeve 16 secured to the upper head by means of a threaded connection 17, and also to a lower head 18 by means of a lower threaded connection 19, this lower head being threadedly attached to the upper end of the actuating mandrel 10 previously referred to.

The well tool (not shown) is actuated as a result of relative downward movement of a piston 20 within the cylinder 15 and the relative upward movement of the cylinder with respect to the piston. Such downward movement or force of the piston 20 is transmitted to the setting sleeve 11 through a piston rod 21 that is threadedly secured to the piston and extends through the lower cylinder head 18 and into the tubular actuating mandrel 10. An anvil or cross-piece 22 extends laterally through the lower portion of the piston rod and through a pair of opposed elongate slots 23 in the actuating mandrel 10, and on into holes or slots 24 in a setting ring 25 slidable on the actuating mandrel and threadedly secured to the setting sleeve 11.

It is apparent that downward movement of the piston 20 is transferred through the rod 21, anvil 22, setting ring 25 and setting sleeve 11 to the particular part or parts of the well tool, such as the slips (not shown), and that upward movement of the cylinder 15 is transferred through the tubular actuating mandrel 10 attached thereto to another part of the well tool, such as the body (not shown).

The motivating force for actuating the piston 20 in the cylinder 15 is supplied by developing a gas under pressure in the cylinder above the piston. As specifically disclosed, a railway flare or fusee 26 may rest on the piston 20 in the firing chamber portion 27 of the upper head 14, this railway flare containing its own source of oxygen. Upon its ignition, it will burn and develop a gas at a gradually increasing pressure, which will urge the piston 20 downwardly in the cylinder and move the cylinder 15 in a relative upward direction. Ignition of the railway flare or power charge 26 is instituted by igniting a blank cartridge 28, which is contained within a gun barrel 29 inserted within the upper end of the upper cylinder head 14 and threadedly secured in the lower portion of the gun body 12. This body also contains a breechblock or cap 30 threaded onto the upper end of the gun barrel

29 and having an inwardly directed flange 31 firmly engaging a thin, metallic disc 32 bearing against the cartridge 28. In effect, the breechblock 30 clamps the disc 32 and cartridge 28 to the gun barrel 29.

The cartridge 28 is fired by a pin 33 whose tapered end 34 can enter a tapered hole 35 in the breechblock 30, to strike and indent the disc 32 and thereby fire the cartridge 28. The flame emanating from the cartridge ignites the upper end of the fusee or railway flare 26 and initiates its combustion, which then becomes self-sustaining.

The firing pin 33 is initially maintained in an elevated position by a suitable latch device (not shown) against the action of a compressed helical spring 36 seating against a shoulder 37 in the gun body 12 and against a flange 38 on the firing pin. When the latch is released, the spring 36 will urge the pin 33 downwardly to strike and indent the disc 32, for the purpose of firing the cartridge.

Details of the mechanism associated with the apparatus illustrated are unnecessary to an understanding of the present invention and reference can be had to the above-identified parent application for all essential details.

The pressure generated in the cylinder 15, as a result of evolution of gas from the burning of the railway flare, can be comparatively high. As a matter of fact, final pressures in excess of 7500 p. s. i. are obtainable. Such gases may still possess considerable pressure when the setting tool is elevated from the well casing to the top of the hole. As a result, if any of the heads 14, 18, or the gun barrel 29, were to be dismantled with gas under high pressure in the cylinder 15, then injury or damage might occur. The present invention eliminates the possibility of such occurrences.

It is to be noted that the upper cylinder head 14 has a pressure relief hole or port 40 extending through it immediately at the lower end of the gun body 12. This hole is displaced a comparatively short longitudinal distance from a seal ring 41 disposed in a groove 42 in the gun barrel 29 and engaging the inner wall 43 of the upper head 14, in order to prevent leakage of gas between the barrel and the head. The threaded connection 13 between the gun body 12 and the upper head 14 extends over a much greater longitudinal length than the distance between the side seal ring 41 and the vent port 40, when the parts are fully assembled, as disclosed in Fig. 1. Accordingly, in the event that the gun body 12 is to be unscrewed from the upper head 14, the seal ring 41 would move out of sealing engagement with the side wall 43 of the upper head and be disposed above the port 40, in order to allow gas under pressure in the cylinder 15 to vent through the port 40, while a substantial threaded interconnection 13 still remains between the gun body 12 and the upper head 14. Accordingly, the gas under pressure will be ineffective to forcibly and rapidly separate the gun body 12 and the upper head 14, all of it being caused to discharge through the vent port 40.

Similarly, one or more side seal rings 44 are disposed in grooves 45 in the upper and lower heads 14, 18, engaging the inner wall 46 of the cylinder sleeve 16. The upper seal rings 44 engage the cylinder sleeve 16 immediately adjacent a vent hole or port 47 formed through the sleeve at the lower end of its threaded connection 17 with the upper head 14. Similarly, the seal rings 44 in the lower head 18 engage the cylinder sleeve adjacent

a vent hole or port 48 extending through the sleeve at the upper end of its threaded connection 19 with the lower head 18. Seal rings 49 are also provided on the periphery of the piston 20 engaging the inner wall of the cylinder sleeve 16. Rings 50 are also disposed in grooves 51 in the lower head 18, which slidably engage the periphery of the piston rod 21.

In view of the various seal rings, the cylinder space 52 between the piston 20 and the lower head 18 is a confined one, originally containing air at atmospheric pressure. As the piston 20 moves down, this air will be compressed to some extent. Even this air pressure might be sufficient to cause damage or injury to property or persons, and, for that reason, if the lower cylinder head 18 is first rotated to unscrew it from the cylinder sleeve 16, the lower seal rings 44 will move out of engagement with the cylinder sleeve and below the vent hole 48 prior to complete disengagement of the threaded connection 19 between the lower head 18 and the cylinder sleeve 16. Accordingly, any compressed air in the cylinder will be vented through the vent hole 48, since the longitudinal extent of the threaded connection 19 between the lower head and the cylinder is much greater than the distance that the uppermost seal ring 44 in the head 18 must move in order to allow bleeding or venting of the compressed air through the hole 48 in the cylinder sleeve 16.

In the event the upper head 14 is unthreaded from the cylinder sleeve 16 with gas under pressure in the cylinder 15, the side seals 44 in the upper head will be shifted upwardly to uncover the upper vent hole or port 47 long prior to disengagement of the threaded connection 17 (see Figs. 2 and 3). This is due to the fact that the lowermost side seal 44 in the upper head 14 is spaced longitudinally from the vent hole 47, when the parts are fully assembled, as shown in Fig. 1, a much lesser distance than the longitudinal extent of the threaded connection 17 between the upper head 14 and the cylinder sleeve 16. Accordingly, if the connection 17 between the upper head and the cylinder sleeve is first broken, prior to the disconnection between the gun body 12 and the upper head 14, then any gas under pressure will vent out through the hole 47 before the upper head 14 is completely disconnected from the cylinder sleeve 16.

After complete venting has occurred of the gases and air in the cylinder 15, then the dismantling of the cylinder and its associated part can continue to completion.

It is, accordingly, apparent that a safety feature has been incorporated in the gas operated well apparatus which insures that no gas under pressure remains in the cylinder 15 on either side of the piston 20 when the parts are to be completely disconnected from one another.

The inventor claims:

1. In well apparatus: a well device adapted to be operated in a well bore; fluid actuated means for operating said well device, comprising a cylinder and a piston slidable in said cylinder; means providing a gas under pressure in said cylinder; a port in said cylinder on the high pressure side of said piston for venting said gas; and means detachably connected to said cylinder and closing said port; said detachable means opening said port upon being disconnected from said cylinder, but prior to its complete disconnection from said cylinder.

2. In well apparatus: a well device adapted to be operated in a well bore; fluid actuated means

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for operating said well device, comprising a cylinder and a piston slidable in said cylinder; means providing a gas under pressure in said cylinder; said cylinder including a skirt and a head threaded into said skirt at the high pressure end of said cylinder; a port in said skirt adjacent said head for venting said gas; and seal means between said head and skirt for preventing communication between said port and the cylinder space between said head and piston, said seal means being disposed in such position as to provide a broken seal between said head and skirt upon unthreading of said head from said skirt, but prior to its complete unthreading from said skirt.

3. In well apparatus: a well device adapted to be operated in a well bore; fluid actuated means for operating said well device, comprising a cylinder and a piston slidable in said cylinder; means providing a gas under pressure in said cylinder; said cylinder including a skirt and a head threaded into said skirt at the high pressure end of said cylinder; a port in said skirt adjacent said head for venting said gas; and a seal ring on said head sealingly engaging the side wall of said skirt between said port and piston when said head is threaded fully into said skirt, said seal ring being moved out of sealing engagement with said side wall upon unthreading of said head from said skirt, but prior to its complete unthreading from said skirt.

4. In well apparatus: a well device adapted to be operated in a well bore; fluid actuated means for operating said well device, comprising a cylinder and piston means slidable in said cylinder; means providing a gas under pressure in said cylinder on the high pressure side of said piston means; said cylinder and piston means providing a closed fluid tight space on the low pressure side of said piston means into which well fluid externally of the cylinder cannot enter during lowering of the apparatus in a well bore; said cylinder having a first port on the high pressure side of said piston means for venting said gas; said cylinder having a second port on the low pressure side of said piston means establishing fluid communication between said closed fluid tight space and the exterior of the cylinder; means detachably connected to said cylinder and closing said first port; means detachably connected to said cylinder and closing said second port; both of said detachable means opening their respective ports upon being disconnected from said cylinder, but prior to complete disconnection from said cylinder.

5. In well apparatus: a well device adapted to be operated in a well bore; fluid actuated means for operating said well device, comprising a cylinder and piston means slidable in said cylinder; means providing a gas under pressure in said cylinder on the high pressure side of said piston means; said cylinder and piston means providing a closed fluid tight space on the low pressure side of said piston means into which well fluid externally of the cylinder cannot enter during lowering of the apparatus in a well bore; said cylinder including a skirt, a first head threaded into said skirt at the high pressure end of said cylinder and a second head threaded into said skirt at the low pressure end of said cylinder; a first port in said skirt adjacent said first head for venting

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said gas; a second port in said skirt adjacent said second head; first seal means between said first head and skirt preventing communication between said first port and the cylinder space between said first head and piston means; and second seal means between said second head and skirt preventing communication between said second port and said closed fluid tight space; both of said seal means being disposed in such position as to provide broken seals between said heads and skirt upon unthreading of said heads from said skirt, but prior to complete unthreading of each head from said skirt.

6. In well apparatus: a well device adapted to be operated in a well bore; fluid actuated means for operating said well device, comprising a cylinder and piston means slidable in said cylinder; means providing a gas under pressure in said cylinder on the high pressure side of said piston means; said cylinder and piston means providing a closed fluid tight space on the low pressure side of said piston means into which well fluid externally of the cylinder cannot enter during lowering of the apparatus in a well bore; said cylinder including a skirt, a first head threaded into said skirt at the high pressure end of said cylinder and a second head threaded into said skirt at the low pressure end of said cylinder; a first port in said skirt adjacent said first head for venting said gas; a second port in said skirt adjacent said second head; a first seal ring on said first head sealingly engaging the side wall of said skirt between said first port and piston means when said first head is threaded fully into said skirt; a second seal ring on said second head sealingly engaging the side wall of said skirt between said second port and said piston means when said second head is threaded fully into said skirt; said seal rings being moved out of sealing engagement with said side wall upon unthreading of said heads from said skirt, but prior to their complete unthreading from said skirt.

7. In well apparatus: a well device adapted to be operated in a well bore; fluid actuated means for operating said well device, comprising a cylinder and a piston slidable in said cylinder; means providing a gas under pressure in said cylinder; said cylinder including a skirt and a head threaded into said skirt at the high pressure end of said cylinder; a gun barrel in said head; a cartridge in said barrel for initiating generation of said gas in said cylinder; means detachably secured to said head for retaining said barrel in said head; said head having a vent port adapted to communicate with said cylinder on the high pressure side of said piston; and seal means between said barrel and head closing said port, said seal means being shiftable to a position opening said port upon disconnection of said securing means from said head, but prior to full disconnection of said securing means from said head.

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