Feb. 3, 1959 H. L. BIGELOW 2,871,946

APPARATUS FOR EFFECTING OPERATION OF SUBSURFACE WELL BORE DEVICES

Filed April 20, 1956

FIG. 1.

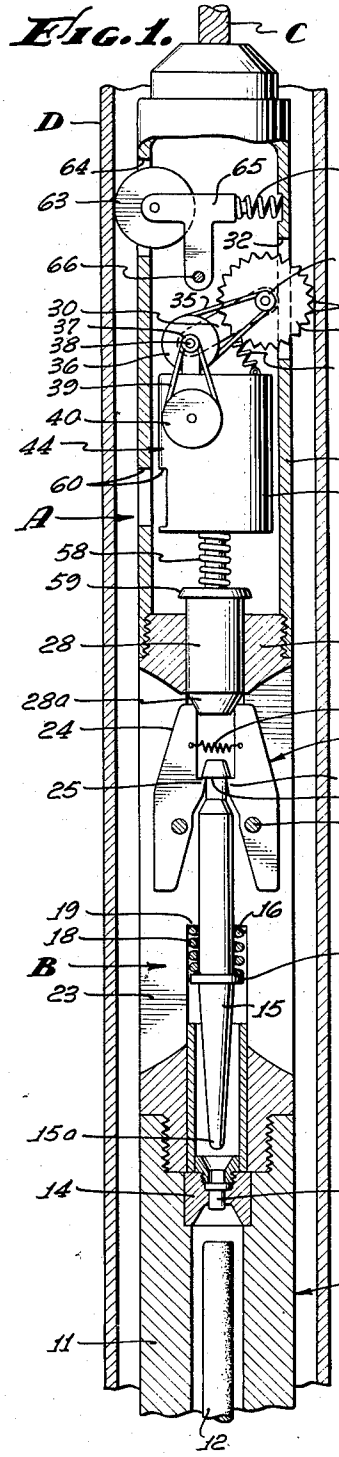


FIG. 3.

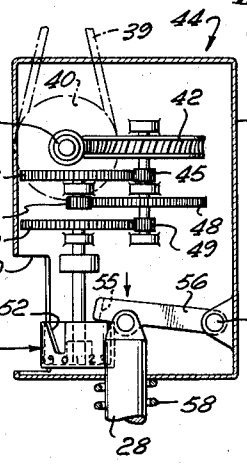


FIG. 4.

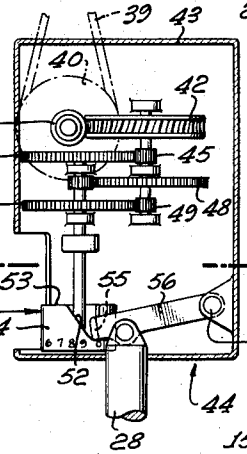


FIG. 5.

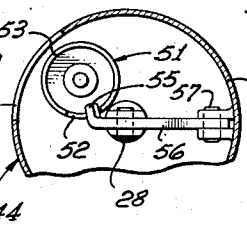
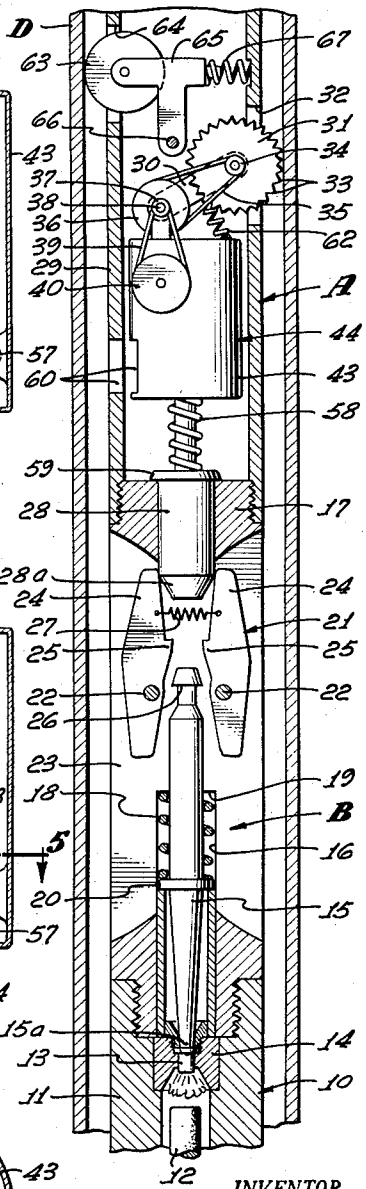


FIG. 2.



INVENTOR.

HERBERT L. BIGELOW

BY

Mellin and Hanscom

ATTORNEYS

United States Patent Office

2,871,946

Patented Feb. 3, 1959

2,871,946

APPARATUS FOR EFFECTING OPERATION OF SUBSURFACE WELL BORE DEVICES

Herbert L. Bigelow, Whittier, Calif., assignor to Baker Oil Tools, Inc., Los Angeles, Calif., a corporation of California

Application April 20, 1956, Serial No. 579,672

4 Claims. (Cl. 166—64)

The present invention relates to subsurface well apparatus, and more particularly to apparatus for effecting or initiating the operation of other devices disposed in a well bore.

An object of the invention is to provide an apparatus adapted to be secured to another device and to be lowered therewith in the well bore, the apparatus automatically effecting operation of the other device when a preselected depth in the well bore has been reached.

Another object of the invention is to provide an apparatus adapted to be lowered with another device in a well bore, the apparatus measuring the distance which it traverses while being lowered in the well bore and automatically effecting operation of the other device when the distance travelled reaches a predetermined value.

A further object of the invention is to provide an apparatus of the character indicated, which will not effect operation of the other device unless the preselected depth in the well bore is reached, which enables the apparatus and other device to be withdrawn from the well bore, if desired, without the other device being operated at any time before the preselected depth is reached.

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 apparatus disposed in a well casing, with the parts in a latched position;

Fig. 2 is a view similar to Fig. 1 disclosing parts of the apparatus in an unlatched position;

Fig. 3 is a diagrammatic view of the depth determining portion of the apparatus prior to its having been lowered in the well bore to the desired depth therein;

Fig. 4 is a view similar to Fig. 3, illustrating the relative position of the parts after the preselected depth has been reached;

Fig. 5 is a section taken along the line 5—5 on Fig. 4.

The apparatus A is shown somewhat diagrammatically in the drawings as being secured to a well device B, the operation of which is to be instituted or effected. The well device may be of any desired type. As specifically disclosed, the upper portion of a setting tool 10 is disclosed, which is more particularly shown and described in United States Patent No. 2,707,999. This tool includes a cylinder 11 containing a power charge 12 of relatively slow burning combustible material, the upper end of which is ignited when a cartridge 13 is fired, the latter being contained within a gun barrel 14 located in the upper end of the cylinder. The cartridge 13 is fired by

propelling a firing pin 15 in a downward direction against its upper end, this firing pin being slidable in a central bore 16 in a body 17 threadedly secured in the upper end of the cylinder 11. The pin 15 is propelled in a downward direction by a helical compression spring 18 surrounding it, the upper end of the spring bearing against a body shoulder 19 and the lower end against a flange 20 on the firing pin.

Initially, the pin 15 is held in an ineffective and upper position within the body by a pair of opposed latch levers 21 pivotally mounted on pins 22 extending across a longitudinal slot 23 in the body, the levers having upwardly extending arms 24 from which fingers 25 project inwardly to engage a downwardly facing shoulder 26 at the upper portion of the firing pin 15. The arms 24 are yieldably maintained in an inward direction, to hold the fingers 25 under the firing pin shoulder 26, by a tension spring 27 extending between the arms. The lever fingers 25 are releasable by a tapered latch actuator 28, which is movable in a downward direction to spread the arms apart sufficiently to disengage the fingers from the firing pin shoulder 26, which will then allow the spring 18 to expand and propel the firing pin in a downward direction, causing its lower point 15*a* to strike and fire the cartridge 13.

The latch actuator 28 is movable downwardly automatically when the apparatus has been lowered in the well casing by a preselected distance to a preselected location, at which the cartridge is to be fired and the well device B set in operation. The apparatus for automatically accomplishing this purpose may be contained within a depth measuring housing 29, the lower end of which is threadedly secured to the upper end of the firing pin body 17, and the upper end of which may be suitably secured to a wire line C, or other running-in string, extending to the top of the well casing D, and by means of which the apparatus and well device combination A, B is lowered in the well casing to the desired actuating point therewithin.

The housing 29 has a supporting arm 30 pivotally mounted thereto in any suitable manner, the outer portion of the arm rotatably carrying a measuring wheel 31 extending through an opening 32 in the housing and engageable with the surface of the well casing D. To minimize slipping of the measuring wheel 31 on the surface of the well casing, its periphery may be roughened or provided with teeth 33. The measuring wheel has a driving sprocket 34 secured thereto over which a chain 35 passes. This chain, in turn, passes over a driven sprocket 36 that has another driving sprocket 37 mounted for rotation therewith. The driven and driving sprockets 36, 37 rotate about the axis 38 of pivotal movement of the measuring wheel supporting arm 30. The sprocket 37 has another chain 39 passing thereover, which also meshes with a driven sprocket 40 mounted to rotate with a worm 41 meshing with a worm wheel 42 contained within a housing or enclosure 43 of a measuring and counting mechanism 44. A pinion 45 rotates with the worm wheel 42, this pinion meshing with a gear 46 that has another pinion 47 rotating with it, this latter pinion, in turn, meshing with a gear 48 that has a third pinion 49 rotating therewith that meshes with a final driven gear 50 to which a counter wheel 51 is secured.

It is evident that as the measuring wheel 31 rotates, its rotary motion is transmitted through the sprocket and chain transmissions, and through the gear transmission to the counter 51. In view of the fact that there is a very large transmission ratio between the measuring wheel 31 and the counter 51, many revolutions of the measuring wheel are required to effect one revolution of the counter. By way of example, assuming that the measuring wheel 31 has a circumference of one foot,

it may be required to partake of 10,000 revolutions to rotate the counter 51 one revolution. This can be accomplished in the present instance because of the large transmission ratio between the various sprockets 34, 36 and 37, 40, between the worm 41 and worm wheel 42, and between the various pinions and the gears 45 to 50. Of course, other transmission reducing arrangements can be used in place of the one specifically shown and described, in order to secure the proper transmission ratio between the measuring wheel 31 and the rotatable counter 51. In addition, the counter may have a different limit than the 10,000 foot limit given above by way of example.

The counter wheel has a notch 52 extending outwardly through the end face 53 of its rim 54, the end face being disposed at right angles to its axis of rotation. An inwardly extending finger 55 of a release lever 56 engages the end face, the lever being mounted on a fulcrum pin 57 suitably secured to the housing 43. The lever 56 is pin-connected to the actuating rod 28. Normally, a compression spring 58 seating against the housing 43 and a rod flange 59, tends to shift the actuating rod 28 in a downward direction, but such action is initially prevented by engagement of the lever finger 55 with the end face 53 of the counter 51. It is only when the counter has been turned to allow the finger 55 to move into the counter notch 52 that the release lever 56 can be shifted about its fulcrum 57 to move the actuating rod 28 and its tapered lower nose 28*a* in a downward direction, to cause the latter to spread the arms 24 apart and release the latch fingers 25 from the firing pin shoulder 26.

In using the apparatus, the counter 51 is turned or adjusted to the point at which the lever finger 55 engages its end face 53 opposite the depth indication at which the firing pin 15 is to be released and actuation of the well device B initiated. Access to the counter 51 can be had through suitable openings or windows 60 in the housings 29, 43. The actuator wheel 31 is rotated until the setting depth indicated on the counter 51 is at the finger 55. The main indications disclosed by way of example in the drawings show that the counter can operate at depths up to 10,000 feet. If, for example, the apparatus were to be actuated when a depth of 3,000 feet is reached, the counter would be turned until the 3,000 foot indication was at the finger 55, the zero indication being opposite the beginning of the longitudinal notch 52 in the counter. Accordingly, the counter 51 would have to be turned back toward the zero position a fraction of a revolution before the finger 55 could move into the notch 52, allowing the spring 58 to move the actuating rod 28 in a downward direction. Before the preselected depth has been reached, the finger 55 continues to engage the end face 53 of the counter 51, which will prevent downward movement of the actuating rod 28 under the influence of the spring 58.

The measuring wheel 31 is maintained firmly in engagement with the wall of the well casing D by a spring 62. As specifically disclosed, such spring 62 may be of the tension type having one end suitably secured to the housing 43 and the other end to the measuring wheel supporting arm 30. In addition, the entire housing 29 may be maintained in a substantially central position within the well casing D, and may be urged toward the side of the well casing engaged by the measuring wheel 31, by a spring actuated pressure or idler roller 63 extending through an opening 64 in the housing 29 on the side opposite the location of the measuring wheel. This idler roller is rotatably mounted on an arm 65 pivotally mounted on a pin or fulcrum 66 secured to the housing 29. A helical compression spring 67 engages the arm 65 and the housing 29, urging the arm and the roller 63 in a direction outwardly of the housing and maintaining the roller 63 firmly against the well casing. The combination of the idler roller 63, which is spring pressed against the wall of the casing D, and of the measuring wheel 31, which is also spring pressed against the wall of the casing D, insures proper slip-free contact of the measuring wheel 31 against the casing wall, and also tends to maintain the housing 29 and the apparatus in a substantially coaxial position within the well casing.

In the operation of the mechanism, the counter is set at the preselected depth by turning the counter wheel 51 until the preselected depth is at the release lever finger 55. The latch lever fingers 25 are disposed under the firing pin shoulder 26, and the apparatus and device B attached thereto are lowered in the well casing D on the running-in string C. During such lowering action, the measuring wheel 31 will roll along the wall of the well casing D, its rotation being transmitted through the several transmissions to the counter wheel 51, to turn the latter. The idler roller 63 and measuring wheel 31 are maintained in proper engagement with the well casing by their respective springs 67, 62. When the preselected depth in the well casing has been reached, the counter wheel 51 will have been turned along the finger 55 to the point at which the finger can move downwardly into the wheel notch 52, which then allows the spring 58 to shift the outer end 28*a* of actuating rod 28 in a downward direction between the latch lever arms 24, forcing them apart and releasing the fingers 25 from the firing pin shoulder 26. When so released, the compression spring 18 propels the firing pin 15 downwardly, to strike its point 15*a* against the cartridge 13 and fire the latter. The flame issuing from the cartridge ignites the upper end of the power charge 12, initiating its combustion and producing a proper gas pressure in the cylinder or chamber 11 for the purpose of accomplishing a desired operation in the well casing D, such as, for example, to set a well packer or bridge plug (not shown) therewithin, as explained in the above-identified Patent 2,707,999. Of course, in lieu of setting a bridge plug, the gas pressure developed in the cylinder 11 can be used for operating other mechanisms and for accomplishing other desired purposes.

It is to be noted that until the preselected depth has been reached, the finger 55 rides along the end face 53 of the counter and will not permit the spring 58 to shift the actuating rod 28 in the downward direction. If, for any reason, the apparatus is to be withdrawn from the well casing before the preselected depth is reached, release of the firing pin 15 and firing of the cartridge 13 cannot occur, inasmuch as elevation of the apparatus in the well casing will rotate the measuring wheel 31 in the opposite direction, which will oppositely rotate the counter wheel 51 and insure that the release lever finger 55 will remain in its holding position against the end face 53 of the counter wheel. Accordingly, the apparatus can be elevated in the well casing and removed completely therefrom, prior to its being lowered to the preselected firing depth, without effecting or initiating operation of the well device B attached to the apparatus.

The inventor claims:

1. In subsurface well apparatus: a well device; a measuring member movable with said well device in a well casing and contactable with and movable along the wall of the well casing; a counter mechanism operatively connected to said measuring member and movable thereby in accordance with the distance traversed by said measuring member along the casing wall; a longitudinally movable operating member operatively connected to said well device for effecting operation of said well device; latch means releasably engaging said operating member to hold it initially in an ineffective position; a latch releasing member engageable with said latch means to shift it from said operating member to release said operating member; means for moving said latch releasing member longitudinally into engagement with said latch means to positively shift and release said latch means from said operating member; and a holding member connected to said latch releasing member and engaging a holding por-

tion of said counter mechanism to be held by said holding portion in a position preventing said latch releasing member from moving longitudinally; the holding portion of said counter mechanism moving from engagement with said holding member to permit longitudinal movement of said latch releasing member in response to movement of said counter mechanism a predetermined amount by said measuring member.

2. In subsurface well apparatus: a well device embodying a combustible product; a measuring member movable with said well device in a well casing and contactable with and movable along the wall of the well casing; a counter mechanism operatively connected to said measuring member and movable thereby in accordance with the distance traversed by said measuring member along the casing wall; means including a longitudinally movable operating member for firing said combustible product; latch means releasably engaging said operating member to hold it initially in an ineffective position; a latch releasing member engageable with said latch means to shift it from said operating member to release said operating member; means for moving said latch releasing member longitudinally into engagement with said latch means to positively shift and release said latch means from said operating member; and a holding member connected to said latch releasing member and engaging a holding portion of said counter mechanism to be held by said holding portion in a position preventing said latch releasing member from moving longitudinally; the holding portion of said counter mechanism moving from engagement with said holding member to permit longitudinal movement of said latch releasing member in response to movement of said counter mechanism a predetermined amount by said measuring member.

3. In subsurface well apparatus: a well device embodying an explosive; a measuring member movable with said well device in a well casing and contactable with and movable along the wall of the well casing; a counter mechanism operatively connected to said measuring member and movable in accordance with the distance traversed by said measuring member along the casing wall; means including a longitudinally movable operating member for firing said explosive; latch means releasably engaging said operating member to hold it initially in an ineffective position; a latch releasing member engageable with said latch means to shift it from said operating member to release said operating member; means for moving said latch releasing member longitudinally into engagement

with said latch means to positively shift and release said latch means from said operating member; and a holding member connected to said latch releasing member and engaging a holding portion of said counter mechanism to be held by said holding portion in a position preventing said latch releasing member from moving longitudinally, the holding portion of said counter mechanism moving from engagement with said holding member to permit longitudinal movement of said latch releasing member in response to movement of said counter mechanism a predetermined amount by said measuring member.

4. In subsurface well apparatus: a well device; a measuring member movable with said well device in a well casing and contactable with and movable along the wall of the well casing; a counter mechanism operatively connected to said measuring member and movable thereby in accordance with the distance traversed by said measuring member along the casing wall; a longitudinally movable operating member connected to and coaxial of said well device for effecting operation of said well device; latch means releasably engaging said operating member to hold it initially in an ineffective position; a latch releasing member having a portion coaxial of said well device, said portion being engageable with said latch means to shift said latch means from said operating member to thereby release said latch means from said operating member; means for moving said latch releasing member longitudinally to engage said portion with said latch means and cause said portion to positively shift and release said latch means from said operating member; and a holding member connected to said latch releasing member and engaging a holding portion of said counter mechanism to be held by said holding portion in a position preventing said latch releasing member from moving longitudinally, the holding portion of said counter mechanism moving from engagement with said holding member to permit longitudinal movement of said latch releasing member in response to movement of said counter mechanism a predetermined amount by said measuring member.

References Cited in the file of this patent

UNITED STATES PATENTS

2,200,505	Kerr	May 14, 1940
2,292,938	Hennessy	Aug. 11, 1942
2,629,445	Dill	Feb. 24, 1953
2,707,999	Ragan	May 10, 1955