

Sept. 6, 1932.

G. FOX

1,875,583

METHOD OF AND APPARATUS FOR SHOOTING WELLS

Filed March 4, 1930 2 Sheets-Sheet 1

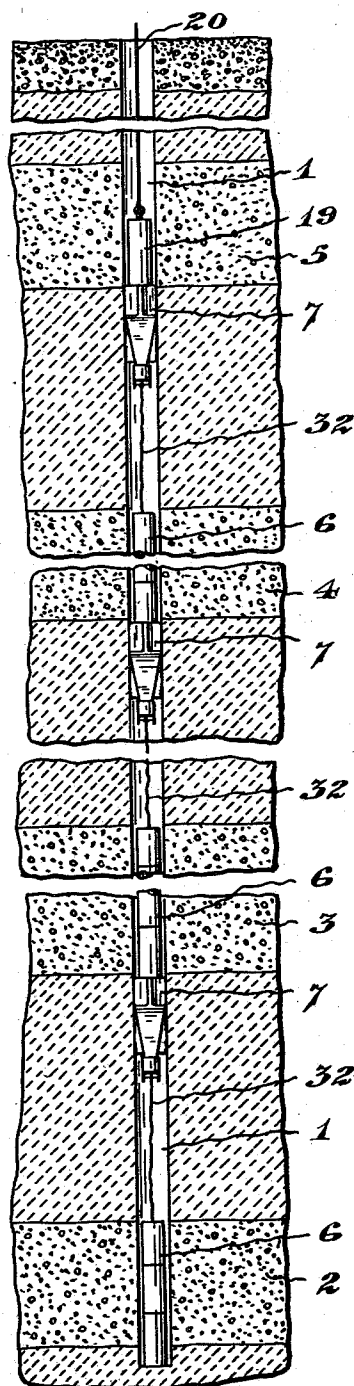


Fig. 1.

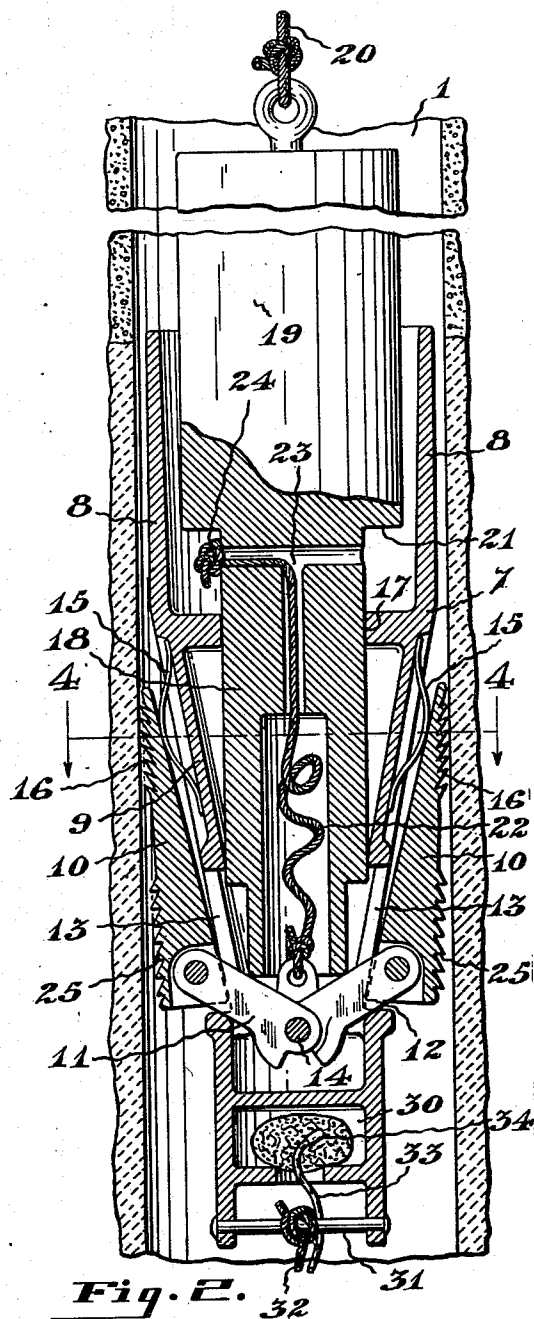


Fig. 2.

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2 Sheets-Sheet 2

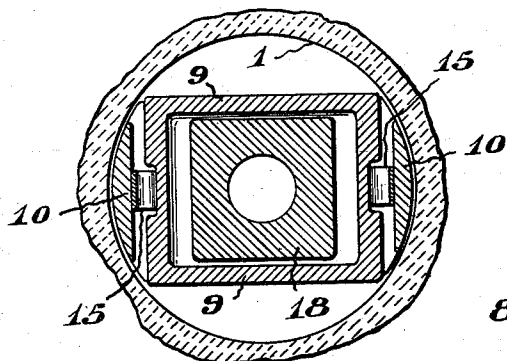


Fig. 4.

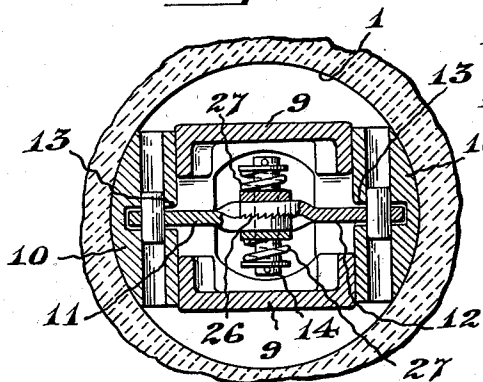


Fig. 5.

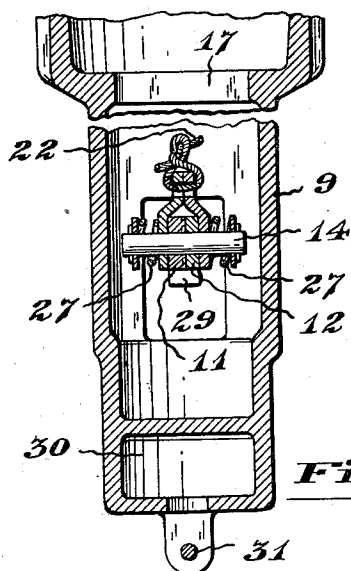


Fig. 6.

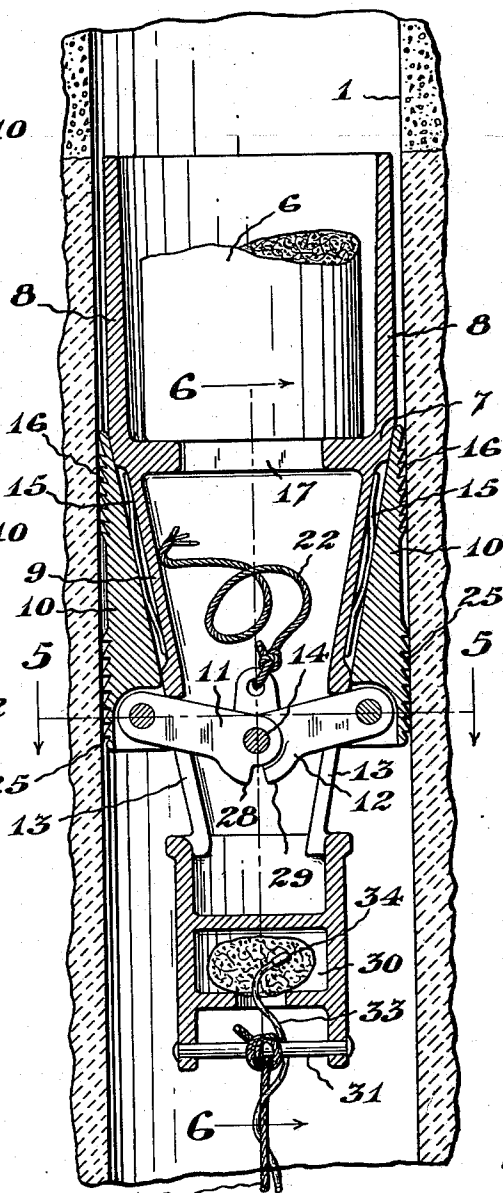


Fig. 3.

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METHOD OF AND APPARATUS FOR SHOOTING WELLS

Application filed March 4, 1930. Serial No. 433,054.

This invention relates to a method of and apparatus for shooting oil or gas wells to increase the flow of gas or oil or both from productive strata through which the well passes.

After the flow of oil or gas from a well has become so slow that the operation of the well is no longer profitable, or, when the flow in a new well is below commercial requirements, it is common practice to increase the flow of oil or gas by exploding a charge of nitroglycerine, gun cotton or other suitable explosive, lowered into the well.

In many instances, the well passes through a number of oil or gas bearing strata and the strata may be several hundred feet apart. In blowing wells such as above referred to, it has heretofore been the practice to charge the well with explosive from the bottom thereof to a point above the uppermost productive stratum.

It will be apparent that a very large volume of explosive is required for such a well and that a great proportion of the explosive force is wasted by reason of the fact that it is exerted on the walls of the well between the oil or gas bearing strata.

The present invention has for its object to provide a method of and apparatus for shooting wells having a number of oil or gas bearing strata by means of a separate explosive charge within each productive stratum, thereby effecting a very great saving in explosive and also reducing the volume of debris resulting from the explosion which must subsequently be removed from the well.

The present invention has for a further object to provide suitable bridges or supports for explosive charges which are adapted to be successively lowered into the well and to be anchored adjacent the bottom of each stratum to be shot.

A further object is to provide means for simultaneously anchoring a bridge or support in the well and freeing the same from the hoisting means by which it has been lowered into the well so that the portion of the well above the bridge or support will be

open for the lowering of a suitable explosive charge onto the bridge or support.

A further object is to provide a connection between successive spaced charges of explosive by which the charges are fired one from another in succession.

With the above and other objects in view, the invention may be said to comprise the method of and apparatus as illustrated in the accompanying drawings hereinafter described and particularly set forth in the appended claims, together with such variations and modifications thereof as will be apparent to one skilled in the art to which this invention appertains.

Reference should be had to the accompanying drawings forming a part of this specification in which:

Figure 1 is a diagrammatic view showing a well passing through a number of productive strata in which an explosive charge is positioned in the well within each stratum.

Fig. 2 is a vertical section through a supporting member or bridge adapted to be anchored in a well and provide a support for a charge of explosive.

Fig. 3 is a vertical section through a supporting member or bridge showing the same anchored in the well.

Fig. 4 is a section taken on the line indicated at 4—4 in Fig. 2.

Fig. 5 is a section taken on the line indicated at 5—5 in Fig. 3.

Fig. 6 is a section taken on the line indicated at 6—6 in Fig. 3.

Fig. 1 of the drawings shows a well bore 1 which extends through a series of oil or gas bearing strata 2, 3, 4 and 5 and having the charge 6 of explosive positioned within each of said strata preparatory to shooting the well.

In order to locate the explosive charges at spaced points within the well bore, it is necessary to successively anchor suitable supporting members or bridges 7 in the well adjacent the bottom of each productive stratum above the lowermost. An explosive charge is lowered onto each bridge after it is anchored and a bridge is then lowered to the bottom of the stratum next higher. After the charges are

placed, they may be fired by any suitable means, but it is preferred to fire the top charge first and provide suitable quick burning fuse connections between the charges so that the charges are fired in succession from the uppermost charge down to the lowermost.

The supporting member or bridge is illustrated in Figs. 2 to 5 and is preferably in the form of a metal casting having a bowl 8 at its upper end and having a tapering lower end 9 below the bowl. Wedge shaped anchoring members 10 are carried by the bridge at its lower end, these anchoring members being pivoted adjacent their lower ends to toggle links 11 and 12, which extend through diametrically opposite slots 13 in the bridge member and which are pivotally connected at their inner ends by means of a pivot pin 14. The upper ends of the anchoring members 9 are pressed outwardly against the wall of the well by means of arched springs 15 interposed between the anchoring members and the body of the bridge members. The tips of the anchoring members 10 are provided with ratchet shaped teeth or projections 16 which are so disposed that they will slip over the surface of the well wall, while the bridge member is being lowered into the well, but which will dig into the well wall and effectively resist movement of the anchoring members in an upward direction. The bridge member is provided at the bottom of the bowl 8 with a central socket 17 which is preferably rectangular in cross section and which is adapted to receive the reduced rectangular extension 18 of a weight 19 which is supported by a suitable hoisting element 20 by means of which the weight may be lowered into or withdrawn from the well. The weight 19 has a cylindrical body portion of a size to readily enter the bowl 8 and the rectangular extension 18 is of such length that the lower end thereof is adapted to rest on the links 11 and 12 to hold the toggle in retracted position with the pivot 14 below the connections between the outer ends of the links 11 and 12 and the anchoring wedges 10. The bridge 7 is connected to the weight 19 before it is lowered into the well by means of a short length of cable 22 which is attached at its lower end to a toggle pin 14 and at its upper end to the weight 19, the cable extending through a passage 23 formed in the weight and being anchored to the weight by means of a knot 24 tied in the cable. The cable 22 serves to prevent separation of the bridge from the weight during the lowering operation. The anchoring members 10, however, retard the downward movement of the bridge so that the weight rests on the bridge with its lower end bearing against the toggle lengths 11 and 12 and holding the same in a position in which the anchoring members are retracted at their lower ends.

To insert a bridge in the well, the bridge

is attached to the weight 19 and lowered into the casing at the top of the well. The anchoring members 10 bear against the wall of the well while the bridge member is being lowered, but the weight 19 is sufficiently heavy to overcome the frictional resistance of the anchoring members and insure the lowering of the bridge member to the desired depth in the well. When the supporting member or bridge has been lowered to the desired depth in the well, the hoisting mechanism is reversed, causing the weight 19 to move upwardly and exert a pull on the cable 22. The upward movement of the supporting member or bridge is resisted by the teeth 16 of the anchoring members and the pull on the cable 22 moves the pivot 14 of the toggle upwardly toward dead center position, straightens the links 10 and 11 and forces the lower ends of the anchoring members which have downwardly directed ratchet shaped teeth 25 against the well wall. The engaging faces of the inner ends of the links 10 and 11 may be provided with ratchet teeth 26 which permit relative rotation of the links in a direction to permit the toggle to straighten, but which interlock to prevent relative rotation in a direction to break the toggle, the links being pressed into engagement with each other by means of springs 27 on the pin 14. The upward pull on the cable 22 thus acts to straighten the toggle and set the same in anchored position in the bore of the well, the pull being continued until the cable 22 breaks, whereupon the weight is separated from the bridge member. The links 11 and 12 are preferably provided with shoulders 28 and 29 which engage to prevent movement of the toggle links past dead center position. In order to obtain a more positive anchoring of the bridge member in the well, the weight 17 is preferably raised a short distance above the bottom of the bowl 8 and then dropped back upon the bottom of the bowl 8 to drive the bridge down into wedging engagement with the anchoring members 10, and to more firmly set the members 10 into the bore of the well. The socket 17 of the bridge member being of uniform rectangular cross section, the weight when dropped back in the bowl will not enter the socket 17 but will strike the bottom of the bowl to drive the bridge member down upon the wedges.

Each bridge member is preferably provided adjacent its lower end with a chamber 30 which is adapted to receive a small charge of explosive and below this member, there is provided a cross bar 31 to which may be attached a cable 32 which may have a suitable weight attached to its lower end and which is of sufficient length to reach down to a previously positioned explosive charge. The cable 32 serves as a support for a quick burning fuse 33 which may be wrapped

around the cable extending the full length thereof and up into the explosive chamber 30. The successive charges of explosive are thus connected by quick burning fuses which will cause the charges to be successively exploded. The small explosive charges in the chambers 30 are exploded by the concussion of the main charge or by means of a detonator cap 34 attached to the fuse. The bridge and anchoring members being composed of cast metal will be completely broken up by the explosions so that the fragments thereof may be easily removed with the other debris resulting from the explosions.

It will be apparent that the present invention effects a very great saving in explosions and at the same time greatly reduces the labor and expense incident to the clearing of the well of debris after shooting, making it possible to shoot wells at a small fraction of the expense heretofore required and making it feasible to shoot wells which have heretofore not been considered sufficiently productive to warrant the expense of shooting.

Furthermore, it is to be understood that the particular form of apparatus shown and described, and the particular procedure set forth, are presented for purposes of explanation and illustration and that various modifications of said apparatus and procedure can be made without departing from my invention as defined in the appended claims.

What I claim is:

1. The herein described method of shooting oil or gas wells which extend through a plurality of productive strata which consists in independently anchoring a separate charge of explosive in the well adjacent each stratum, and exploding said charges.

2. The herein described method of shooting oil or gas wells which extend through a plurality of productive strata which consists in independently anchoring a separate charge of explosive in the well adjacent each stratum, and successively exploding said charges.

3. The herein described method of shooting oil or gas wells which extend through a plurality of productive strata which consists in independently anchoring a separate charge of explosive in the well adjacent each stratum, and exploding said charges, firing the uppermost charge first and the lower charges in succession.

4. The herein described method of shooting oil or gas wells which extend through a plurality of productive strata, which consists in placing a charge of explosive in the well adjacent the lowermost stratum successively anchoring supporting members adjacent the bottom of strata above the lowermost and placing explosive charges thereon, and exploding said charges.

5. The herein described method of shoot-

ing oil or gas wells which extend through a plurality of productive strata, which consists in placing a charge of explosive in the well adjacent the lowermost stratum successively anchoring supporting members adjacent the bottom of strata above the lowermost and placing explosive charges thereon, and exploding said charges firing the uppermost charge first and the remaining charges in succession.

6. Apparatus for shooting oil or gas wells, comprising a plurality of supports for explosive charges means carried by each support for anchoring the same at the desired depth in the well, and means connecting successive explosive charges for firing one from the other.

7. Apparatus for shooting oil or gas wells, comprising a plurality of supports for explosive charges means carried by each support for anchoring the same at the desired depth in the well, and fuses connecting successive explosive charges.

8. Apparatus for shooting oil or gas wells comprising a supporting member adapted to be lowered into the well bore, movable anchoring members carried by said supporting member having portions engaging the wall of the well during downward movement of the supporting member and resisting upward movement thereof, means connected to the anchoring members for pressing the same outwardly against the well wall, a hoisting element, and means connecting the hoisting element to said means to set the anchoring members by an upward pull on the hoisting element.

9. Apparatus for shooting oil or gas wells comprising a supporting member adapted to be lowered into a well bore, vertically disposed anchoring members mounted to swing about their lower ends on said supporting member, springs for holding the upper ends of said anchoring members in engagement with the well wall, a toggle connecting the lower ends of said anchoring members, means for normally holding the lower ends of the anchoring members in retracted position, and means for applying outward pressure to said anchoring members to anchor the supporting member.

10. Apparatus for shooting oil or gas wells comprising a supporting member adapted to be lowered into a well bore, anchoring means carried by said member and engageable with the well wall to resist upward movement of the member, a hoisting element for lowering the supporting member into the well, means for setting said anchoring means to anchor the supporting member, and means for operating said setting means comprising a frangible connection between said setting means and hoisting element.

11. Apparatus for shooting oil or gas wells comprising a supporting member adapted to

be lowered into a well bore, anchoring members carried by the supporting member having portions engaging the well wall to resist upward movement of the member in the well bore, a toggle for setting the anchoring members, a hoisting element for lowering the member into the well, and a frangible connection between the toggle and hoisting element.

12. Apparatus for shooting oil or gas wells comprising a supporting member adapted to be lowered into a well bore, anchoring members carried by the supporting member having portions engaging the well wall to resist upward movement of the member in the well bore, a toggle for setting the anchoring members, a hoisting element having a weight attached thereto, and a frangible cable connecting said weight to said toggle.

13. Apparatus for shooting oil or gas wells comprising a supporting member adapted to be lowered into a well bore, said member having an upper bowl shaped portion and a tapering lower end portion having a transverse slot, wedge shaped anchoring members mounted on said tapering portion for longitudinal movement thereon, a toggle extending through the slot and connecting said anchoring members, a hoisting member having a weight adapted to rest on said toggles and hold the same in wedge retracting position, and a connection between the weight and the toggle pivot adapted to be broken by an upward pull on the hoisting element.

14. Apparatus for shooting oil or gas wells comprising a supporting member adapted to be lowered into a well bore, said member having an upper bowl shaped portion and a tapering lower end portion having a transverse slot, wedge shaped anchoring members mounted on said tapering portion for longitudinal movement thereon, a toggle extending through the slot and connecting said anchoring members, a hoisting member having a weight adapted to rest on said toggles and hold the same in wedge retracting position, a connection between the weight and the toggle pivot adapted to be broken by an upward pull on the hoisting element, and a ratchet associated with the toggle for holding the same against collapsing movement.

15. Apparatus for shooting oil or gas wells comprising a supporting member adapted to be lowered into a well bore, said member having an upper bowl shaped portion and a tapering lower end portion having a transverse slot, wedge shaped anchoring members mounted on said tapering portion for longitudinal movement thereon, a toggle extending through the slot and connecting said anchoring members, a hoisting member having a weight adapted to rest on said toggles and hold the same in wedge retracting position, a connection between the weight and the toggle

pivot adapted to be broken by an upward pull on the hoisting element, a ratchet associated with the toggle for holding the same against collapsing movement, and stops in the toggle links to limit upward movement of the toggle pivot.

16. Apparatus for shooting oil or gas wells comprising a supporting member adapted to be lowered into a well bore, said member having a bowl shaped top portion and a tapering lower end portion having a transverse vertically extending slot, said member having a rectangular socket leading from the bottom of the bowl portion into the tapering portion thereof, floating anchoring members mounted for vertical movement along said tapering end portion of the supporting member, a toggle extending through said slot and connecting said anchoring members, a hoisting element having a weight attached thereto which has a lower end portion formed to fit in said socket, and a connection between the weight and the pivot of the toggle adapted to be broken by an upward pull on the hoisting element.

17. Apparatus for shooting oil or gas wells comprising a supporting member adapted to be lowered into a well bore, said member having a bowl shaped top portion and a tapering lower end portion having a transverse vertically extending slot, said member having a rectangular socket leading from the bottom of the bowl portion into the tapering portion thereof, floating anchoring members mounted for vertical movement along said tapering end portion of the supporting member, a toggle extending through said slot and connecting said anchoring members, a hoisting element having a weight attached thereto which has a lower end portion formed to fit in said socket, a connection between the weight and the pivot of the toggle adapted to be broken by an upward pull on the hoisting element, and means associated with the toggle for automatically retaining the same in extended position after said connection has been broken.

In testimony whereof I affix my signature.
GLENN FOX.