

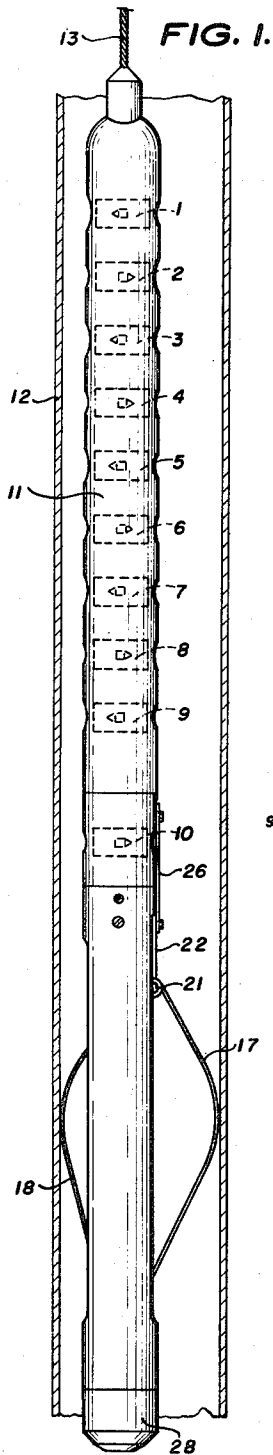
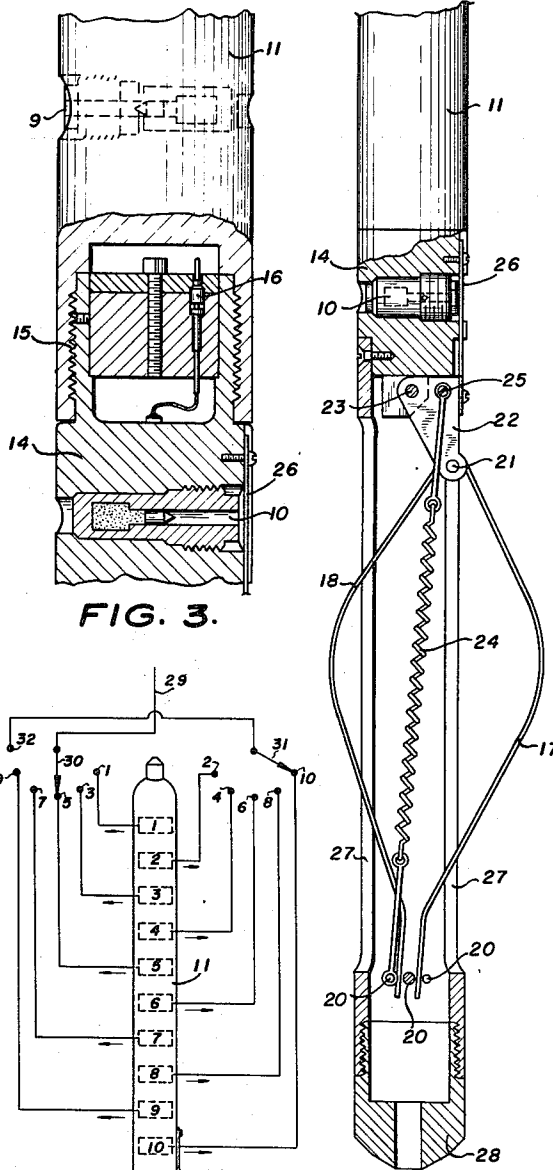
Sept. 14, 1954

F. A. BEYER, JR., ET AL

2,689,007

GUN PERFORATOR FOR WELLS

Filed April 25, 1952



INVENTORS.
Frank A. Beyer Jr.,
Bliss Adamson,
BY *Earl Babcock.*
ATTORNEY.

UNITED STATES PATENT OFFICE

2,689,007

GUN PERFORATOR FOR WELLS

Frank A. Beyer, Jr., and Bliss Adamson, Duncan,
Okla., assignors to Halliburton Oil Well Ce-
menting Company, Duncan, Okla.

Application April 25, 1952, Serial No. 284,418

3 Claims. (Cl. 164—0.5)

1

This invention relates to gun perforators for use in oil wells or the like and more particularly to an arrangement for properly locating guns in the casing of a well which is to be perforated so as to cause the guns to have efficient operation.

It is common practice to perforate casing in a bore hole, such as an oil well, by the use of bullet guns or shaped charges of explosive. An important factor in the efficiency of such guns is the amount of "stand-off" or distance from the gun to the casing.

In many gun designs this distance has not been accurately controlled. The carriage for the guns must be considerably smaller in diameter than the inside diameter of the casing to avoid the danger of hanging the tool in the well and this means that ordinarily, the assembly is laying along one side of the bore hole when the guns are being fired.

It has been proposed heretofore to mount all the guns in the carriage facing the same direction and place one or more drag-springs on the opposite side. Then all the guns have the proper stand-off.

However, it is best to stagger the direction of fire to some extent so that if the cement around the casing has channelled somewhat, or is thicker along one side of the casing than the other, effective perforation into a producing formation can still be accomplished.

In accordance with the present invention, a novel drag-spring arrangement is provided which causes the gun carriage to be held first in the proper stand-off position for one set of the guns and then in another position to bring about the proper stand-off position for another set of guns facing in a different direction. The arrangement is such that after the first set of guns are fired, the carriage automatically shifts to another position, the movement being controlled by the firing of the last gun of the first set.

Referring to the drawing, which shows a mechanism for bringing about this result:

Fig. 1 is a side view of a gun assembly constructed in accordance with the present invention located in a well bore, the casing of which is shown in cross-section.

Fig. 2 is a vertical cross-sectional view of the lower portion of the assembly of Fig. 1 and showing particularly the drag-springs and mechanism for actuating them.

Fig. 3 is an enlarged cross-sectional view of the lower guns of the assembly of Fig. 1, showing how the drag-spring switching gun may be mounted.

2

Fig. 4 is a diagrammatic view of the gun assembly showing one way of making the electrical connections to the guns to cause them to fire in the desired sequence with relation to the position of the drag-springs.

Referring to the drawing in detail, it will be seen from Fig. 1, that a gun carriage 11 is lowered into the casing 12 of a well on an electrical cable 13. The gun carriage is provided with a number of guns. For convenience, ten guns, numbered 1 to 10 have been shown, and these have been illustrated as employing bullets to do the perforating, although it will be readily understood that the invention is of application to jet perforation or any other perforators where stand-off is a factor in their operation.

As illustrated in the drawing, the guns are alternately arranged to face in the opposite directions. Thus guns numbered 1, 3, 5, 7 and 9 are shown facing the left and guns 2, 4, 6, 8 and 10 are shown facing the right.

The lower gun 10 of the assembly is constructed the same as the others except that it is preferably mounted in a detachable section 14 of the assembly and is adapted to control the position of the drag-springs.

As shown in Fig. 3, there is a screw-threaded joint 15 between the section 14 and the main portion 11 of the assembly. This joint 15 has an electrical coupling 16 therein for making connection for the gun 10. This coupling 16 may be of the type ordinarily used for making connections between sections of the gun assembly, which, as commonly employed may consist of the number of sections required to make as many shots as desired, with one trip in the hole.

As illustrated, two drag-springs designated 17 and 18 are employed. Both of these are mounted in the section 14 of the assembly beneath the gun 10. As the assembly is lowered into the hole, the drag-springs occupy the position shown, with the spring 17 exerting a greater influence on the carriage than the drag-spring 18 so that the carriage rides along, but spaced from, the left-hand side of the casing, as shown in Fig. 1. When the gun 10 fires, the drag-springs snap to a different position so that the drag-spring 18 exerts the greater influence and the carriage moves to the right.

The snap action mechanism for controlling the drag-springs is shown in detail in Fig. 2. The lower ends of the drag-springs 17 and 18 are freely slidable in guide pins 20 while the upper ends are connected to a pin 21 on an offset link 22 pivoted to the section 14 at 23. A coil tension

spring 24 is connected between one of the guide pins 20 and a connection 25 on the link 22, which tends to swing the link 22 downwardly and move the pin 21 to the left at all times.

Movement of the link 22 from the position shown in Fig. 2 is prevented until the gun 10 fires. The link 22 is connected by a shear strap 26 to the section 14, the strap extending across the muzzle of the gun 10 as illustrated. When the gun 10 fires, the strap 26 breaks and the drag-springs move with respect to the carriage.

The section 14 is hollow and provided with slots 27 to accommodate the drag-springs 17 and 18 and it may be provided with a suitable nose 28.

With the arrangement illustrated the gun 10 will not be as effective as the others in perforating the casing. In the first place it will expend some energy in bursting the strap 26. Secondly it will not have the correct stand-off.

The arrangement could be so arranged that the gun 10 faced in the same direction as the gun 9 and hence have the proper stand-off, but this would complicate the structure of the strap 26 and the structure shown is preferred because of its simplicity.

Any desired electrical system may be used for firing the guns in the desired sequence. The details of the electrical system are not shown or described herein since they are well known. The U. S. patent to Robidoux No. 2,338,872 granted January 11, 1944, shows a suitable system.

It is to be noted, however, that the gun 10 should fire in between the two sets of guns which face in opposite directions. One way of accomplishing this is to provide two step-by-step switches similar to those shown in the Robidoux patent cited. This is illustrated in Fig. 4.

A suitable firing order for the guns is 1, 3, 5, 7, 9, 10, 8, 6, 4, 2. The odd-numbered guns are then fired when the drag-spring 17 is exerting the greatest influence and the even-numbered guns except gun 10, are fired when the drag-spring 18 is exerting the greatest influence on the position of the carriage.

The switching arrangement illustrated in Fig. 4 is such as to bring about the above firing order. The conductor 29 of the cable 13 is connected to a step-by-step switch 30, the buttons of which are connected to guns 1, 3, 5, 7 and 9. In addition this switch 30 has a button 32 connected to the

moving arm of a second step-by-step switch 31 the buttons of which are connected respectively to the guns 10, 8, 6, 4 and 2. The switch 30 is actuated first. When its arm is moved to contact button 32 it stops and the signals from the conductor then travel to the switch 31. Of course, any other switching mechanism may be provided, one way being merely to rearrange the connections in a system like that of the Robidoux patent mentioned to cause the proper firing sequence. Of course, the firing sequence in any given set need not be as given. It is important only that the guns facing one direction all be fired before those facing in the other direction are fired.

While only one embodiment is shown and described herein, it is obvious that various changes may be made without departing from the spirit of the invention or the scope of the annexed claims.

We claim:

1. A gun perforator for use in a well bore, comprising, in combination, a carriage, a plurality of guns mounted in the carriage, one set of which is facing in one direction and another set of which is facing in another direction, means for holding said carriage alternately in proximity to one wall or another of the well bore corresponding to the directions of said sets of guns, said means including a pair of drag-springs mounted on the carriage for controlling the stand-off position of said sets of guns, linkage mechanism associated with said drag-springs for causing them to snap from one position to the other and means for automatically controlling said linkage mechanism to cause the carriage to move after one set of guns has fired.

2. The combination of claim 1 in which a shear strap is mounted across the muzzle of one of said guns and which holds the linkage mechanism in one position until that gun is fired.

3. The combination of claim 1 in which the automatic means includes a strap and an explosive charge capable of bursting the strap.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
2,313,369	Spencer	Mar. 9, 1943