Aug. 13, 1940. J. W. MacCLATCHIE 2,210,984

MEANS FOR PERFORATING WELL CASINGS

Original Filed April 13, 1937 3 Sheets-Sheet 1

Fig. 1

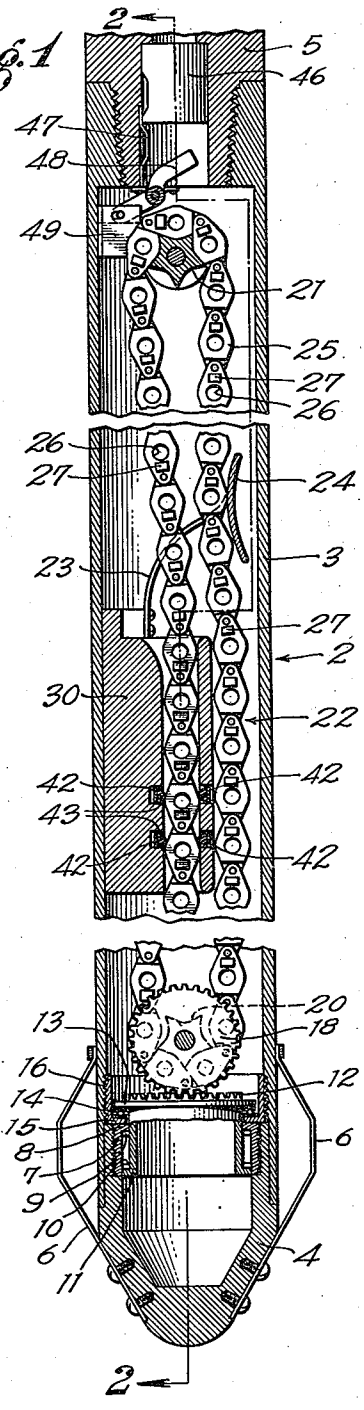
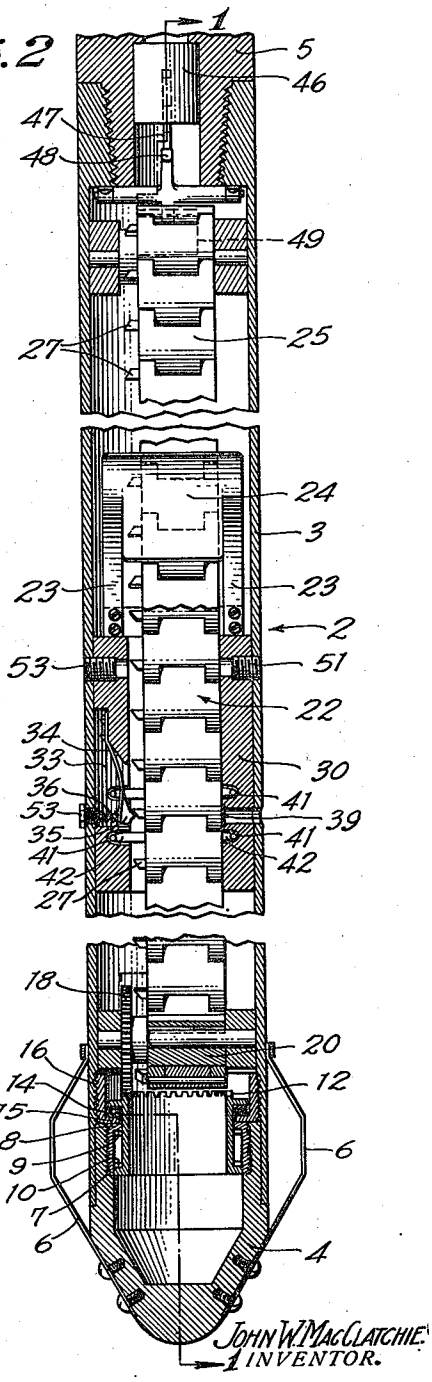


Fig. 2



JOHN W. MacCLATCHIE.
INVENTOR.

BY Robert M. McManigal
ATTORNEY

Aug. 13, 1940. J. W. MacCLATCHIE 2,210,984

MEANS FOR PERFORATING WELL CASINGS

Original Filed April 13, 1937 3 Sheets-Sheet 2

Fig. 3

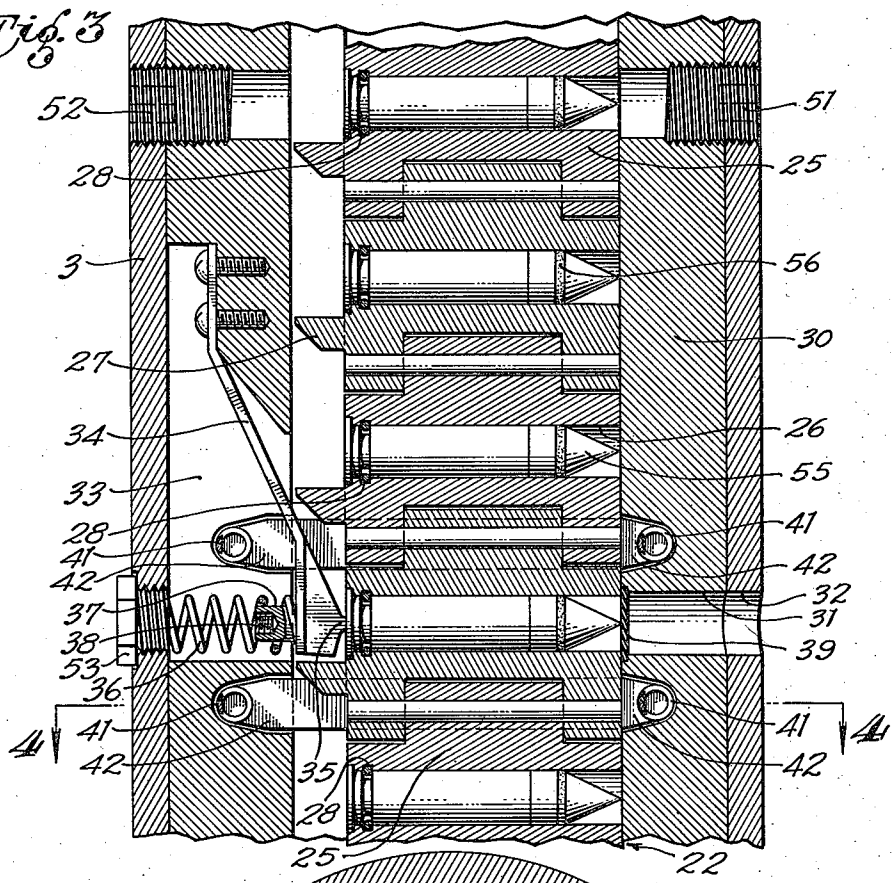
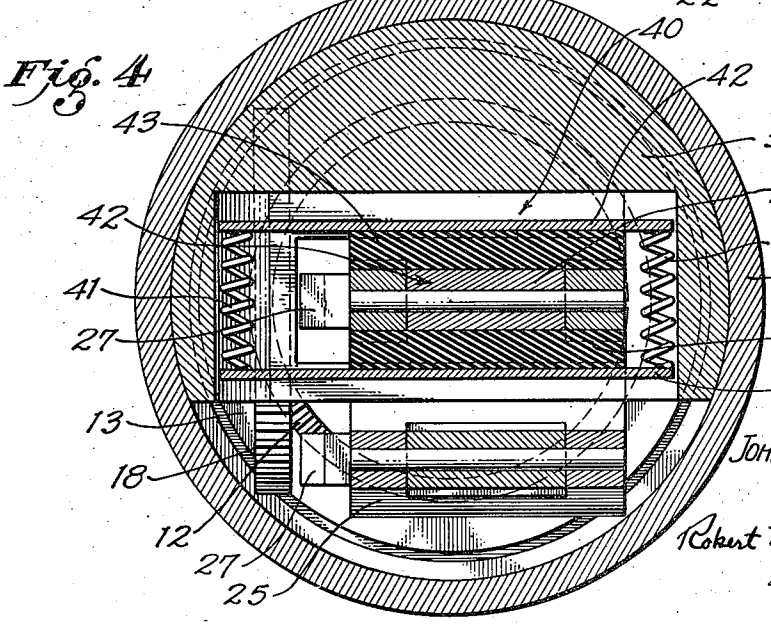


Fig. 4



JOHN W. MacCLATCHIE
INVENTOR.

Robert M. McManigal
ATTORNEY

Aug. 13, 1940. J. W. MacCLATCHIE 2,210,984

MEANS FOR PERFORATING WELL CASINGS

Original Filed April 13, 1937 3 Sheets-Sheet 3

Fig. 5

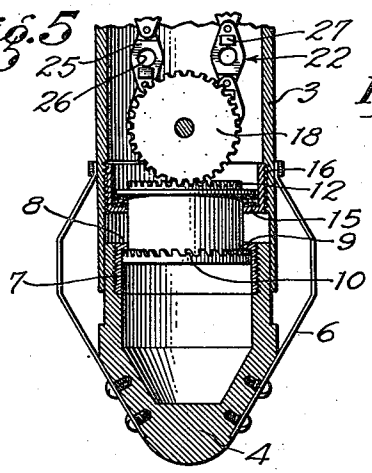


Fig. 6

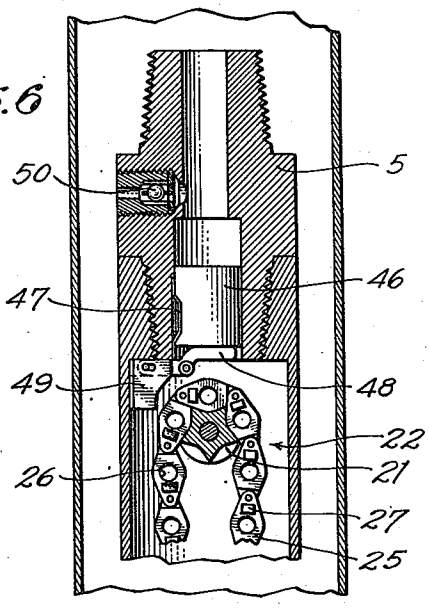


Fig. 8

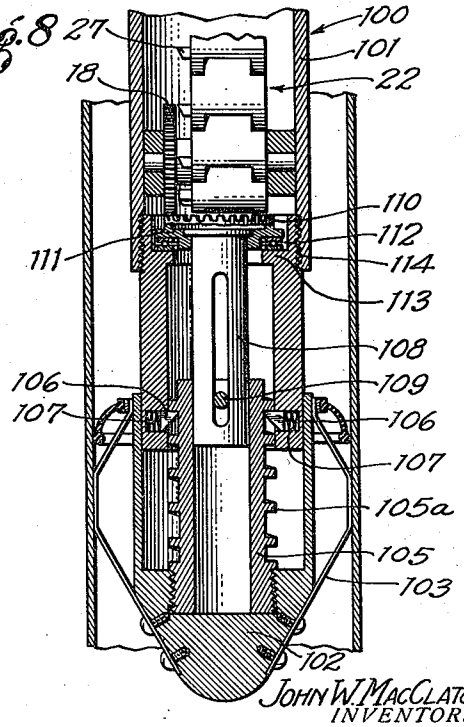
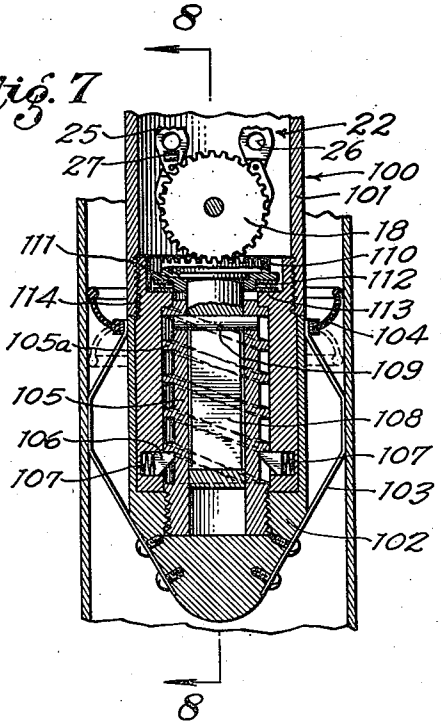


Fig. 7



JOHN W. MacCLATCHIE,
INVENTOR.

BY Robert M. McManigal

ATTORNEY

Patented Aug. 13, 1940 2,210,984

UNITED STATES PATENT OFFICE

2,210,984

MEANS FOR PERFORATING WELL CASINGS

John W. MacClatchie, Los Angeles, Calif.

Original application April 13, 1937, Serial No. 136,547. Divided and this application December 23, 1938, Serial No. 247,329

10 Claims. (Cl. 160—0.5)

This invention relates to a means for perforating well casing in place in a well hole, the present application being a division of my co-pending application, Serial No. 136,547, filed April 13, 1937.

The general object of the invention is to provide a means by which a casing perforator of the gun type can be operated by a drill string or a cable.

A further object of the invention is to provide an improved gun perforator which can be operated by means of a drill string or a cable, and by means of which a well casing can be perforated as desired without removing the gun from the well.

A further object of the invention is to provide a gun perforator which is simple in construction, which is capable of positive action by mechanical means, and which cannot be accidentally fired.

A further object of the invention is to provide a gun perforator by means of which the well casing can be perforated at any predetermined intervals as desired.

A further object of the invention is to provide a gun perforator which is provided with sealing means to prevent any fluid from entering the gun mechanism.

A further object of the invention is to provide a gun perforator in which the cartridges are carried by a traveling magazine.

A further object of the invention is to provide a novel means of rotating part of the gun perforator while the remainder of the gun remains stationary in the well casing which movement causes a magazine to travel and the gun mechanism to operate.

A further object of the invention is to provide a means of allowing fluid to flow from the well while the casing is being perforated, and means for controlling said flow.

My invention has many other objects, advantages, and features, some of which, with the foregoing, will be set forth at length in the following description where I shall outline certain forms of the invention, which I have selected for illustration in the drawings accompanying and forming a part of the present specification. In the said drawings, I have shown certain forms of my invention, but it is to be understood that I do not limit myself to such forms, since the invention, as expressed in the claims, may be embodied in a large plurality of forms.

Figure 1 is a central vertical section view through the improved device taken through the line 1—1 of Figure 2.

Figure 2 is a section taken on line 2—2 of Figure 1.

Figure 3 is an enlarged fragmentary section showing the firing mechanism and the sealing means.

Figure 4 is a section taken on line 4—4 of Figure 3.

Figure 5 is a central vertical view, partly in section, similar to the lower portion of Figure 1 showing the gun in firing condition.

Figure 6 is a central vertical view similar to the upper portion of Figure 1 showing the upper safety means in inoperative position.

Figure 7 is a vertical section of a modification of my invention, showing the gun in firing position.

Figure 8 is a section taken along the line 8—8 of Figure 7, showing the gun after one complete firing operation.

Referring to the drawings by reference characters the improved gum perforator is indicated generally at 2, and comprises a main body 3 and a head 4.

The upper part of the body 3 is provided with a drill pipe joint 5 and the head 4 is provided with friction springs 6 which are adapted to keep the head 4 from turning around when the gun is in firing operation. The lower ends of the springs 6 are secured to the head 4 by means of screws and the upper ends are supported by a ring through which the body is free to slide and rotate.

Threaded in the head 4 is a ring 7 which is provided with a flange 8 at its upper end. The under side of the flange 8 is provided with teeth 9 which are adapted to engage with teeth 10 of flange 11 which is formed on the bottom of a gear ring 12 as shown in Figure 5. The gear ring 12 is supported in the lower end of the body 3 by flange 13 which rests on anti-friction bearings 14. The anti-friction bearings 14 are supported by a flange ring 15 which is threaded within the body 3 as indicated at 16 in Figures 1 and 2.

The gear ring 12 is adapted to be locked to the head 4 when the teeth 9 and 10 are in mesh as shown in Figure 5.

Mounted in the body 3 above the gear ring 12, and adapted to be driven by the gear ring 12 by means of gear 18 is a sprocket 20. An idle sprocket 21 is mounted in the upper part of the body 3. A magazine belt 22 is mounted around the sprockets 20 and 21 and is adapted to be driven by the sprocket 20 and to be held taut

around said sprockets in any suitable manner such as by means of a spring 23 and a shoe 24.

The magazine belt consists of a plurality of links 25, which are adapted to be connected by any suitable means, such as pins as shown in Figure 3. Each link consists of a body which is chambered to receive a cartridge, and formed on each body adjacent the cartridge opening 26 is a trigger projection 27. Each cartridge opening 26 is provided with a snap spring 28 which is adapted to snap into the groove of a shell and hold the cartridge in place when inserted in the cartridge opening 26.

A firing block 30 is mounted in the body 3 and is provided with a barrel opening 31 which is in alinement with a corresponding barrel opening 32 in the body 3. Formed in the firing block 30 on the opposite side of the barrel opening 31 is a firing pin opening 33. Mounted on this opening 33 is a hammer member shown as comprising a firing pin arm 34 which has a firing pin 35 normally situated in axial alinement with the barrel opening 31. The firing pin 35 is forced inward toward the cartridges in the belt by means of spring 36 which is supported around the pin 37 between the end of the hammer member and the inside wall of the body. The outer end of the pin 37 is provided with a recess which is threaded as indicated at 38 in Figure 3, which threads are adapted to be engaged by a suitable wrench (not shown) so that the firing pin arm can be drawn toward the wall of the body 3 and out of contact with the trigger projections 27 while the gun is being loaded.

As the magazine belt 22 travels, the trigger projection 27 is adapted to force the firing pin 35 out and snap back to explode the cartridge and force the bullet through the barrel openings 31 and 32 and perforate the casing. Mounted on the firing block 30, and surrounding the head of the barrel opening 31 is a sealing means 39, which may be in the form of a rubber washer or the like and is adapted to seal off fluid and thereby prevent fluid from entering the gun mechanism.

As shown in detail in Figure 4, wiping means 40 are provided above and below the barrel openings 31 and 32, to seal off around the magazine belt 22 and prevent any fluid from entering the gun mechanism. This means may consist of tension springs 41 which are mounted to plates 42 and thereby force the rubber wipers 43 against the magazine belt 22.

The drill pipe joint 5 is provided with a piston 46 which is held in inoperative position by means of springs 47 and which is adapted to trip a safety pin 48 when pressure is exerted on said piston by means of a go-devil, fluid pressure or other means. The safety pin 48 is connected to a wedge 49 which is adapted to engage the magazine belt 22 and prevent the belt from traveling, as shown in detail in Figure 1. As shown in Figure 6, the drill pipe joint may also be provided with a ball bearing valve 50.

The body 3 is also provided with removable plugs 51 and 52, and 53 in order to provide a means of loading and unloading the magazine belt 22.

In order to condition the gun for operation the plugs 51, 52 and 53 are removed. By means of a suitable wrench (not shown) which engages the threads 38, the pin 37, firing pin arm 34 and the firing pin 35 are drawn toward the wall of the body and out of engagement with the trigger projections 27 as they pass by, and held in said retracted position by any convenient means. Before being placed in a cartridge receiving opening 26, each cartridge 55 is provided with a sealing means 56, which may be in the form of a rubber washer, to seal off fluid and which may be mounted on the bullet as shown in Figure 3. The magazine belt 22 is loaded and the cartridges are held in place by means of the snap springs 28. After the loading operation is completed, the pin 37 is slowly moved to the position shown in Figure 3, and plugs 51, 52 and 53 are inserted in the body 3 for sealing purposes.

The gun is then lowered into the well casing by means of the drill pipe to the location where it is desired to perforate the casing. During this operation the gun is in the position shown in Figures 1 and 2, with the wedge 49 in locking engagement with the magazine belt 22, and the head 4 free to turn with the body 3 due to the fact that the teeth 9 and 10 are not in engagement. In this way it will be seen that the gun cannot be accidentally fired, thus providing an additional safety means to the wedge means 49.

When the gun has been lowered to the desired location, the drill pipe is raised a short distance forcing the teeth 9 and 10 into engagement and thereby locking the head 4 to the gear ring 12, as shown in Figure 5.

The upper safety means is then released by means of a go-devil or other pressure means exerted against the piston 46 which forces the piston 46 to trip the safety pin 48 and thereby release the wedge 49 from engagement with the magazine belt 22 as shown in Figure 6.

The gun is now set for firing operation which is accomplished by rotation of the drill string. As the drill string is rotated, the body 3 turns but the head 4 remains stationary due to the action of the friction springs 6 against the well casing. As the drill string is rotated, the stationary gear ring 12 in the head 4 drives the gear 18 as it travels around with the body and thereby causes the sprocket 20 to drive the magazine belt 22. As the belt 22 travels, the trigger projection 27 forces the firing pin 33 outward and as the upper edge of the trigger projection 27 clears the hammer, the spring 36 forces the firing pin 35 to snap back against the cap which explodes the cartridge sending the bullet through the barrels 31 and 32 and perforating the well casing. The gun mechanism can be made so that it will fire four or any other desired number of times during one complete revolution of the body. The body is rotated once, and then raised a distance equal to the desired distance between the holes and then given another complete revolution.

These operations may be repeated until the casing is perforated as desired.

The valve 50 allows the fluid in the well to flow out through the drill pipe while the gun is in the casing, but prevents the fluid from flowing back from the drill pipe when pressure is exerted on the pistons 46. A blowout preventer, such as described in Patent No. 1,708,316 granted April 9, 1929, may be mounted on the top of the drill pipe, which is adapted to control the flow of the fluid through the drill pipe, and thereby prevent blow-outs in the event that the bullets perforate high pressure areas.

In the modification of my invention shown in Figures 7 and 8, the gun 100 is adapted to be operated by means of a cable. The construction of the upper part 101 of the gun 100 is exactly the same as the upper part 3 of the gun 2. However,

the construction of the head 102 is different than that of the head 4.

The head 102 is provided with friction springs 103 and an annular cup 104, which may be made of rubber or any other resilient material, which are adapted to hold the head 102 against movement when the gun is in firing operation.

Mounted in the lower end of head 102 and rigidly secured thereto is a jack stem 105, the threads 105a of which are adapted to be engaged by jack stem teeth 106, which are forced into engagement with the jack stem threads 105a by means of springs 107, which are disposed between the jack stem threads 105a and the wall of the head 102. A gear ring pin 108 is mounted in the jack stem 105 and is adapted to slide therein, straddling a pin 109 which prevents the gear ring pin 108 from moving horizontally with respect to the jack stem 105.

The upper end of the gear ring pin 108 is secured to a gear ring 110 which is supported in the lower end of body 101 by means of a flange 111. The flange 111 is mounted on anti-friction bearings 112, which are supported by means of a supporting sleeve 113 which is threaded within the body 101 as indicated at 114 in Figure 7. The gear ring 110 is adapted to mesh with the gear 18.

The gun is also provided with a safety device which is adapted to be released by a go-devil or other pressure means, similar to the safety device described in connection with the gun 2.

The gun 100 is conditioned for firing operation as described in connection with the gun 2, and is then lowered in safety position to the location when the perforations are desired. While the gun is being lowered it is in the position shown in Figure 7.

The safety mechanism is then released and the cable is raised a sufficient distance to allow for the complete operation of the jack stem. During this operation, the head 102 of the gun remains stationary due to the action of the springs 103 which prevent the head from rotating and the cups 104 which prevent the head from raising in the well. As the body 101 is raised, it rotates in the well casing due to the body traveling up the jack stem thread, causing the gear 18 to travel on the gear ring 110, which is stationary, which in turn moves the magazine belt 22 and causes the bullets to fire and perforate the well casing as described in detail in connection with the operation of the gun 2. After the firing operation, the gun is in the position shown in Figure 8.

The gun can be constructed so that the complete operation of the jack stem will cause the body 101 to make one, two, or any other convenient number of complete revolutions as desired, and so that the gun will fire four or any other desired number of times during one complete revolution of the body.

After the firing operation, the head of the gun is raised the desired distance between the perforations. As the gun is raised the capacity of the cup is exceeded, due to the weight of the fluid in the well, which forces the cup into the reverse position indicated in dotted lines in Fig. 7.

In order to condition the gun for firing again, the cable is released until the head of the gun is again in the position shown in Figure 7. During the releasing operation, the jack thread teeth 106 snap over the threads of jack stem threads 105a due to the tapered surfaces of the jack thread teeth as shown in the drawings and the capacity of the cup is again exceeded, which forces the cup into its normal position shown in Figure 8.

The foregoing operations are continued until the casing has been perforated as desired without the necessity of removing the gun from the well casing.

From the foregoing description taken in connetcion with the accompanying drawings, the uses, advantages, and operation of the gun of my invention will be readily understood by those skilled in the art to which the invention appertains. While I have described the principle of operation together with the forms of my invention which I now consider to be the best embodiment thereof, I desire to have it understood that the articles shown are merely illustrative and that the invention is not to be limited to the details disclosed herein, but is to be accorded the full scope of the appended claims.

I claim:

1. A gun for perforating a well casing in place within a well hole which comprises a body which is adapted to be rotated in the well casing and which is provided with a head, means for preventing the rotation of said head in said casing, a magazine belt in said body provided with a plurality of cartridges and a plurality of trigger means, means for moving said magazine belt when said body is rotated with respect to said head, firing means for firing said cartridges, and means for rotating said body with respect to said head.

2. A gun for perforating a well casing in place within a well hole which comprises a body which is adapted to be rotated in the well casing and which is provided with a head, means for preventing the rotation of said head in said casing, a magazine belt in said body provided with a plurality of cartridges and a plurality of trigger means, means for sealing said cartridges and magazine belt, means for moving said magazine belt when said body is rotated with respect to said head, firing means for engaging said trigger means and firing said cartridges, and means for rotating said body with respect to said head.

3. A device for perforating a well casing in place within a well hole which comprises a body provided with a head and which is adapted to be rotated in the well casing with respect to said head, a magazine belt in said body provided with a plurality of cartridges, means for sealing said magazine belt and cartridges, means for securing said head against movement in said well casing, and means for rotating said body with respect to said head and firing said cartridges.

4. A gun for perforating a well casing in place within a well hole which comprises a body adapted to house a magazine belt containing a plurality of cartridges, said body being lowerable within the well casing, safety means for preventing the discharge of said cartridges, means for sealing said cartridges and magazine belt, means for releasing said safety means, means for moving the magazine belt, and means for firing the cartridges.

5. A gun for perforating a well casing in place within a well hole which comprises a body adapted to house a magazine belt containing a plurality of cartridges, said body being lowerable within the well casing, safety means for preventing the discharge of said cartridges, means for sealing said cartridges and magazine belt, means for releasing said safety means, a head connected to said body, means for maintaining the head in fixed position in the well casing, means

for rotating the body in the well casing with respect to said head, and means for firing the cartridges by rotating the body with respect to the head.

6. A gun for perforating a well casing in place within a well hole which comprises a body which is adapted to be rotated in the well casing and which is provided with a head, means for preventing the rotation of said head in said casing, a magazine in said body provided with a plurality of cartridges and a plurality of trigger means, means for moving said cartridges and trigger means with respect to said body when said body is rotated with respect to said head, firing means for firing said cartridges, and means for rotating said body with respect to said head.

7. A device for perforating a well casing in place within a well hole which comprises a body provided with a head and which is adapted to be rotated in the well casing with respect to said head, a magazine in said body provided with a plurality of cartridges, means for sealing said magazine and cartridges, means for securing said head against movement in said well casing, and means for rotating said body with respect to said head for advancing and firing said cartridges.

8. A gun for perforating a well casing in place within a well hole which comprises a body having a barrel opening and adapted to house a magazine containing a plurality of cartridges, said body being lowerable within the well casing, safety means for preventing the discharge of said cartridges, means for releasing said safety means while the device is in place to fire, and means for advancing said cartridges with respect to said barrel opening and firing said cartridges through said barrel opening.

9. A gun for perforating a well casing in place within a well hole which comprises a body adapted to house a magazine containing a plurality of cartridges, said body being lowerable within the well casing, safety means for preventing the discharge of said cartridges, means for sealing said cartridges and magazine, means for releasing said safety means, a head connected to said body, means for maintaining the head in fixed position in the well casing, means for rotating the body in the well casing with respect to said head, and means for firing the cartridges by rotating the body with respect to the head.

10. A gun for perforating a well casing in place within a well hole which comprises a body having a barrel opening and adapted to house a magazine containing a plurality of cartridges, said body being lowerable within the well casing, safety means for preventing the discharge of said cartridges, means for releasing said safety means from the surface of the ground while the device is below the surface, and means for advancing said cartridges with respect to said barrel opening and firing said cartridges through said barrel opening.

JOHN W. MacCLATCHIE.