

[54] **WELLHEAD GUN FOR ECHO RANGING APPARATUS**

[76] Inventor: **James N. McCoy**, 1640 P.B. Lane, Wichita Falls, Tex.

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[51] Int. Cl.² **G01V 1/40; G01S 9/68**

[58] Field of Search **181/5 BE, .5 XC, 123, 181/124; 89/33 MC; 42/9; 166/250**

[56] **References Cited**

UNITED STATES PATENTS

14,077	1/1856	Merrill	42/9
113,194	3/1871	Nenninger	42/9

1,294,636	2/1919	Dovell	89/33 MC
3,316,997	5/1967	McCoy	181/5 BE

FOREIGN PATENTS OR APPLICATIONS

3,355	1860	France	42/9
10,944	8/1884	United Kingdom.....	42/9

Primary Examiner—Maynard R. Wilbur

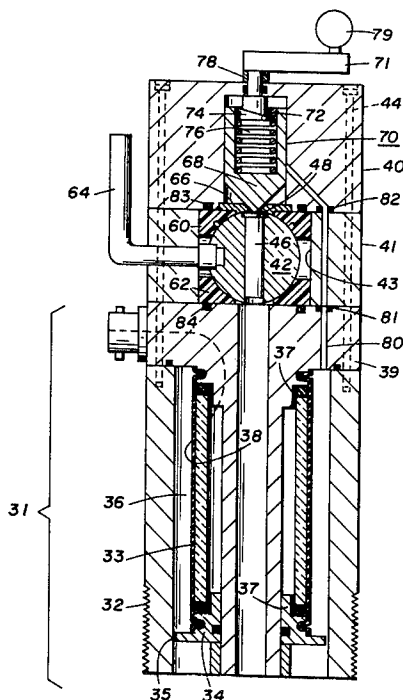
Assistant Examiner—H. A. Birmiel

Attorney, Agent, or Firm—Richards, Harris & Medlock

[57] **ABSTRACT**

In apparatus for determining fluid level depth in a well, a gun detonates an explosive cartridge to generate a pressure wave. As part of the gun, a rotatable element containing a firing chamber facilitates rapid loading and firing.

9 Claims, 4 Drawing Figures



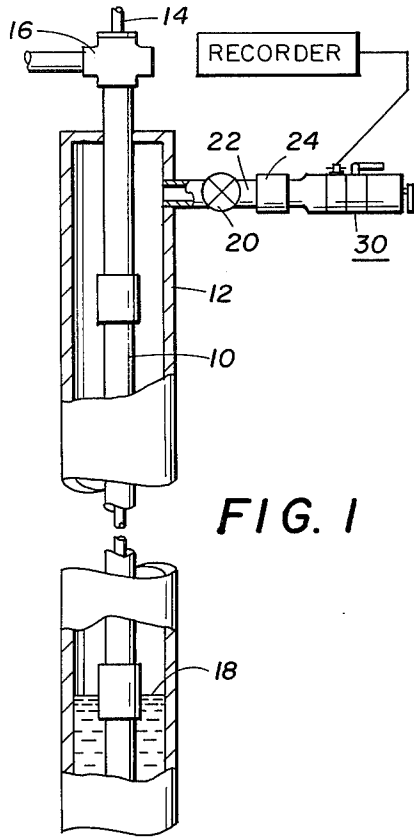


FIG. 1

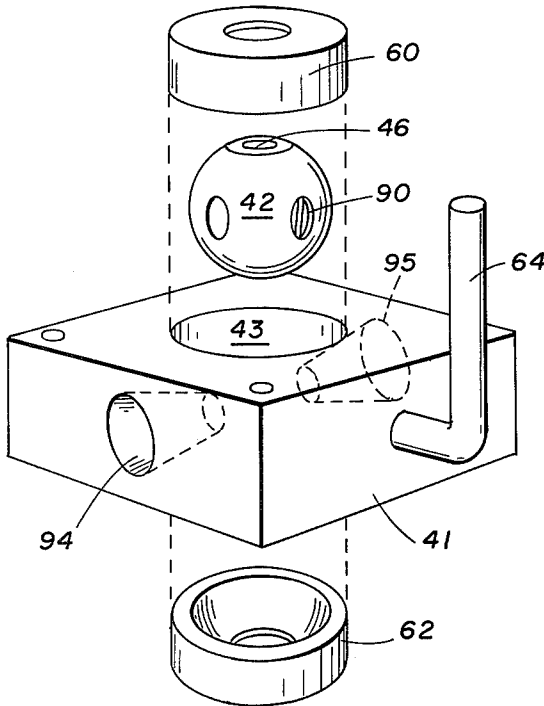


FIG. 3

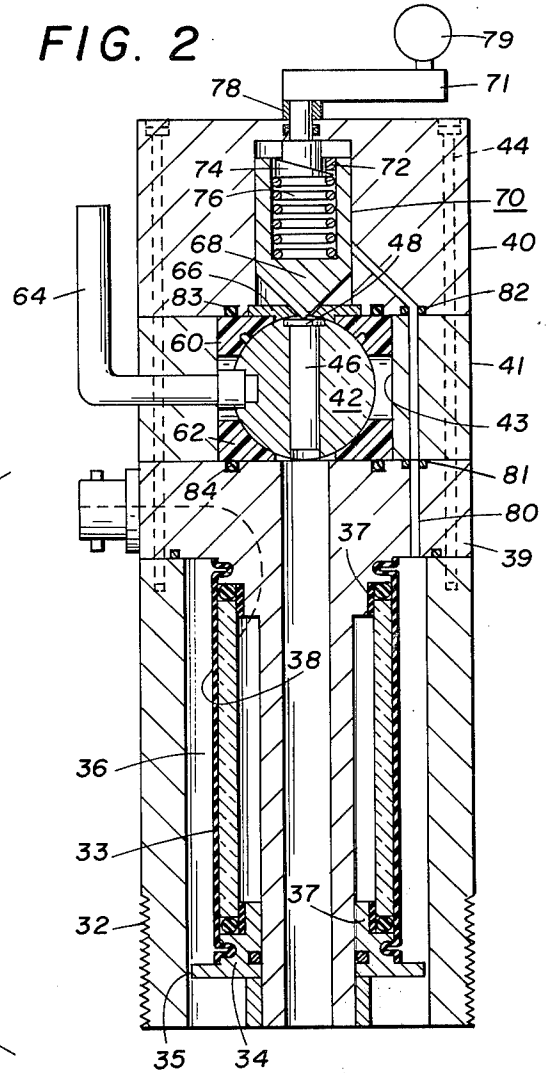


FIG. 2

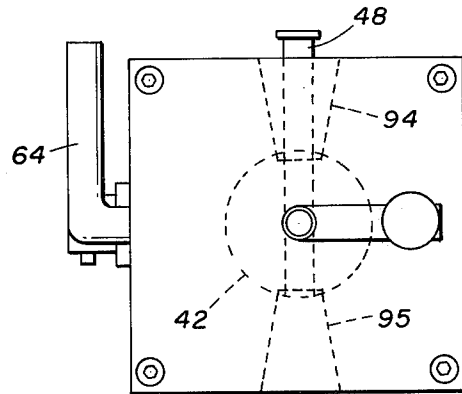


FIG. 4

INVENTOR :

JAMES N. McCOY

Richards, Harris & Hubbard

WELLHEAD GUN FOR ECHO RANGING APPARATUS

BACKGROUND OF THE INVENTION

This invention relates to an apparatus for inducing an acoustical pressure wave in the casing of an oil well and for detecting the reflected pressure waves so that the depth of fluid standing in the well may be determined. More particularly, the invention relates to a wellhead device for generating pressure waves in a well, having a rotatable element with a firing chamber for loading and detonating an explosive cartridge.

In the petroleum industry various methods have been used to determine the level of fluid standing in the casing of a wellbore. One method for ascertaining the fluid level is described in U.S. Pat. No. 3,316,997 wherein a pressure wave is induced in the wellhead by detonating an explosive cartridge. The returning pressure waves from each tubing joint and from the fluid are sensed, and proportionate signals are generated.

In the above-referenced patent, considerable time and effort were required to load a cartridge in the firing chamber. The housing had to be unscrewed and separated each time a charge was loaded. If the casing annulus contained high pressure gas, a valve between the wellhead gun and the casing annulus had to be closed to permit loading of the charge. Then, before the charge was exploded, the valve was reopened to allow the generated pressure pulse to travel in the casing annulus gas. To facilitate use of the system, provision has been made in the present invention for loading, firing and reloading with a minimum of operations.

SUMMARY OF THE INVENTION

The present invention provides an improvement in a wellhead assembly for generating acoustical waves in a well and includes a housing for attachment to a wellhead containing a pressure responsive transducer for generating signals proportional to pressure variations in the wellhead. Housing members define an axial channel communicating with the well. An element in the housing has a passage for receiving a cartridge. A firing mechanism detonates the cartridge when it is aligned with the axial channel.

In accordance with a more specific aspect of the invention a rotatable element is provided with a firing chamber therein to receive an explosive cartridge, and a firing mechanism is provided for detonating the cartridge positioned in the chamber. A housing supports the firing mechanism and the rotatable element and has an axial channel communicating to the well. A lateral passage is provided for loading the firing chamber. A crank is provided for rotating the element to align the firing chamber therein either with the loading passage or with the axial channel into which the cartridge is fired.

For additional aspects, objects and advantages of the invention reference may be had to the following description taken in conjunction with the accompanying drawings, wherein:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic diagram of an oil well illustrating the manner in which the apparatus constructed in accordance with the present invention may be used;

FIG. 2 is a longitudinal sectional view of an apparatus constructed in accordance with the present invention;

FIG. 3 is a perspective view of a rotatable element, along with supporting structure and handle, constructed in accordance with the present invention; and

FIG. 4 is a top view of the same apparatus showing the rotatable element in position for loading a cartridge.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, and in particular to FIG. 1, a string of tubing 10 is shown disposed in a string of casing 12. A string of sucker rods 14 extends through a pumping T 16 to a pump (not illustrated) located at the bottom of the well to force the liquid standing at a level 18 upwardly through the tubing 10. Access to the casing 12 may be obtained through the casing valve 20 and a short nipple 22. The casing valve 20 is customarily installed on all wellheads. An apparatus constructed in accordance with the present invention is indicated generally by the reference numeral 30 and is connected to the nipple 22 by a sleeve 24.

The wellhead gun 30 in a preferred embodiment is shown in longitudinal cross-section in FIG. 2. The detector portion of the apparatus 31 (indicated by bracket) is substantially the same as the device in U.S. Pat. No. 3,316,997, and reference is made to that patent for a more specific description. In this embodiment the housing has a male threaded lower end of the sleeve 32 for connection of the wellhead assembly 30 to a well. Sleeve 32 is open at the bottom to insure uniform exposure of the detector 33 to pressure variations. The lower landing of a support ring 34 restricts an annular passageway 35 to the detector cavity 36 to about 0.05 inches clearance. Ring 34 thus acts as both a support to detector 33 and a restrictor to the flow path leading to detector 33. Nonconductive sleeves 37 electrically insulate the detector 33 from the support ring 34 and mandrel 39. A sleeve 38 covers detector 33.

The present invention is particularly directed to a system for loading and detonating explosives which produce the acoustic waves detected by the element 33. Housing members 40 and 41 are secured by bolts 44, extending through a top flange on mandrel 39 to the top of sleeve 32. Member 40 supports a firing mechanism 70. Member 41 houses a rotatable ball 42.

A steel ball 42 provides a firing chamber 46 sized to receive a blank cartridge 48 of conventional construction. Two plastic ring seats 60 and 62 support and seal the ball 42 in a cylindrical passage 43 in the housing 41. O-rings 83 and 84 on the outer surfaces of seats 60 and 62 provide additional pressure seals. A handle 64 is seated in ball 42 and extends outside housing 41 for rotating ball 42 from a loading position to the firing position shown.

A cartridge 48 is held in the end of the firing chamber 46 by a breech cap 66. A firing pin 68 is positioned axially in housing 40 directly above firing chamber 46. A passage is formed in the breech cap 66 through which firing pin 68 protrudes to contact the primer of cartridge 48.

A spring 76 is positioned axially inside pin 68. A shoulder 72 is connected to the inside of pin 68 above spring 76. A screw 74 is placed on top of spring 76 and in contact with the under side of shoulder 72. A crank 71 is connected to screw 74 and extends outside housing 40. A sleeve 78 between housing 40 and crank 71 prevents the screw 74 which actuates the spring 76

from moving in an axial direction. A handle 79 is connected to crank 71 to facilitate turning.

In placing the unit in operation, the unit 30 is secured to a wellhead, and a valve such as valve 20 is opened. When this is done, the onset of pressure from the well will force the ball 42 rearward and result in unequal forces on ball 42 and seats 60 and 62. In order to "float" ball 42 by applying equal pressure on ball 42 and seats 60 and 62, a channel 80 runs from mandrel 39 through housing members 40 and 41 to the cavity containing the firing mechanism 70. A flow channel 80 is thereby provided to communicate pressure in the region of the detector 31 to the cavity containing firing mechanism 70. Thus pressures on the ball 42 and the seats 60 and 62 are equalized. O-rings 81 and 82 provide a fluid seal along the channel 80 to maintain pressure.

The firing pin 68 is retracted by turning crank 71. As crank 71 is rotated, shoulder 72 forming part of pin 68 rides up the inclined plane of screw 74. The firing pin 68 is thus retracted until shoulder 72 falls off the top of the inclined plane of screw 74. Spring 76, placed under compression by retraction of the firing pin 68, drives pin 68 downward onto the primer of cartridge 48, firing the cartridge.

In firing position chamber 46 is aligned with channel 47 in detector 31. During loading of chamber 46, ball 42 is partially rotated as shown in FIG. 4. Ball 42 thereby seals off channel 47 while loading takes place. Valve 20, shown in FIG. 1, need not be closed during the loading operation.

Referring now to FIG. 3, this exploded view shows the rotatable ball 42 with an empty firing chamber 46 in the vertical firing position. A recess 90 permits attachment of crank 64 in ball 42. Ring seats 60 and 62 position ball 42 within a cavity 43 of housing 41 and provide a pressure seal. A conical-shaped lateral passage 94 in housing member 41 communicates between the cavity 43 and the atmosphere and is provided for loading chamber 46.

Unloading is facilitated by another conical passage 95 on the side of housing 41 opposite passage 94. Insertion of a rod through passage 95 will drive the shell of a spent cartridge from ball 42.

In FIG. 4, crank 64 has been turned 90°, rotating ball 42 from the position shown in FIG. 3. In such position the firing chamber 46 is aligned with the passage 94 to allow insertion of a cartridge 48. After cartridge 48 is loaded, ball 42 is rotated by crank 64 so that firing chamber 46 is returned to the vertical position shown in FIG. 2. In this manner cartridges may be readily loaded and fired to facilitate multiple tests with echo ranging apparatus.

From the above detailed description of a preferred embodiment of the invention, it can be seen that repeated loadings and firings can be made simply and quickly upon rotating the ball 42 with crank 64. Housing members 40 and 41 need not be disassembled for loading chamber 46. Valve 20 need not be closed during reloading because ball 42 seals off channel 47. Further, O-rings provide fluid seals to withstand high pressures and to protect the housing cavities from debris and other contaminants.

The use of a spherical element 42 for containing the cartridge 48 is used in the preferred embodiment of the invention. Nonspherical elements, having symmetry about an axis normal to the firing chamber contained

within it, may be used. For example, a cylinder mounted in a lateral passage in housing 41 with its axis normal to the axis of passage 94 and firing chamber 46 may be employed.

Thus, while a preferred embodiment of the invention has been described in detail, it is to be understood that various changes, substitutions and alterations can be made therein without departing from the spirit and scope of the invention as defined by the appended claims.

What is claimed is:

1. In a wellhead device for generating acoustical waves in a well by detonating a cartridge, the combination which comprises:

- a. housing structure forming an axial channel communicating with said well with a lateral passage intersecting said axial channel,
- b. an element in said housing structure disposed in sealing relation between said axial channel and said lateral passage and having a chamber for receiving an explosive cartridge inserted through said lateral passage when said chamber is aligned with said lateral passage, and
- c. means for aligning said chamber with said axial channel without destructing said sealing relation to position said cartridge in alignment with said axial passage for detonation.

2. In a wellhead device for generating and sensing acoustical waves in a well, the combination which comprises:

- a. a rotatable element provided with a firing chamber therein for receiving an explosive cartridge,
- b. firing means for detonating said cartridge positioned in said chamber,
- c. housing structure supporting said rotatable element in pressure sealed relation and said firing means and forming an axial channel communicating between said well and said firing chamber and a lateral passage adjoining said channel providing access to said firing chamber, and
- d. crank means for rotating said element from alignment with said axial channel to alignment with said lateral passage for loading said firing chamber.

3. The combination defined in claim 2 wherein said structure includes:

- a. a first housing for containing said rotatable element having said lateral passage therein for loading said firing chamber,
- b. rings on opposite sides of said rotatable element oriented coaxially with said axial channel for retaining said rotatable element in said first housing,
- c. a second housing for supporting said firing means, and
- d. connecting means for fastening said first housing to said second housing for retaining said rings in said second housing.

4. The combination defined in claim 2 wherein said housing structure is provided with a pressure equalizing channel for communicating pressure variations from said well to said firing means.

5. The combination defined in claim 2 wherein said crank means comprises a crank handle connected to said rotatable element and extending outside said housing structure.

6. The combination defined in claim 2 wherein said firing means is comprised of

- a. a firing pin for striking the primer of said cartridge,

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- b. a breech cap connected between said firing means and said chamber,
 - c. a compression spring urging said pin toward said breech cap, and
 - d. screw means for retracting said firing pin from said breech cap and for releasing said pin.
7. The combination defined in claim 2 wherein said rotatable element is a sphere having said firing chamber therein.
8. In a wellhead device for generating and sensing acoustical waves in a well, the combination which comprises:
- a. a rotatable sphere provided with a firing chamber therein for receiving an explosive cartridge,
 - b. a firing mechanism for detonating said cartridge positioned in said chamber,

- c. a first housing containing said sphere having a lateral passage therein for loading said firing chamber and an axial channel therethrough communicating with said well,
 - d. a second housing for supporting said firing mechanism having a channel therein to communicate pressure variations from said well to said firing mechanism, and
 - e. a crank handle connected to said sphere and extending outside said first housing for rotating said sphere.
9. The combination set forth in claim 8 wherein means engage said sphere to seal said first housing against pressure in said well.

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