Sept. 28, 1965 J. K. BURNETT ETAL 3,208,349

WELL SOUNDER WITH ELECTRICALLY MOVEABLE SEAR PIN

Filed Feb. 12, 1962 2 Sheets-Sheet 1

Fig. 1

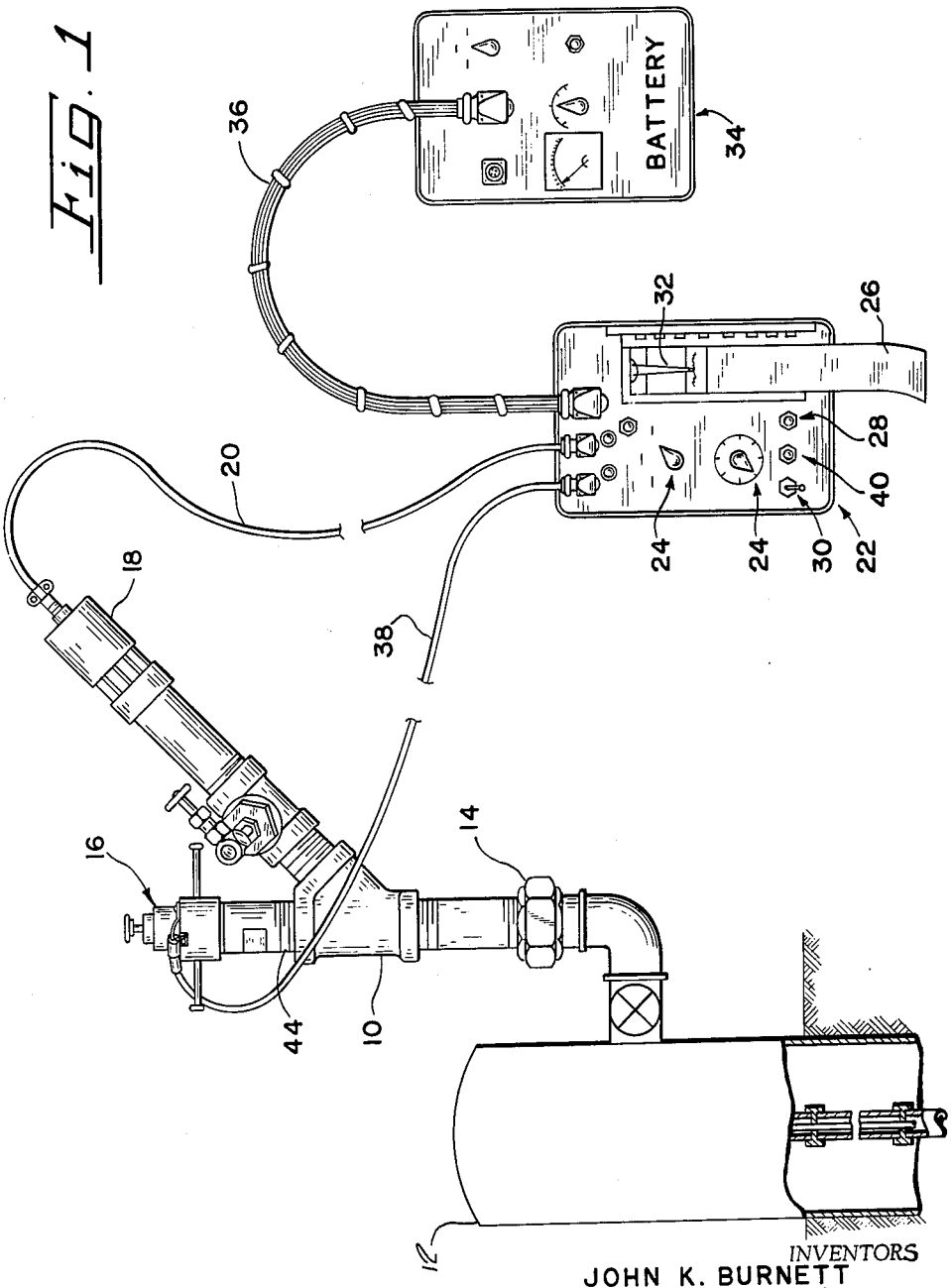

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Fig. 3

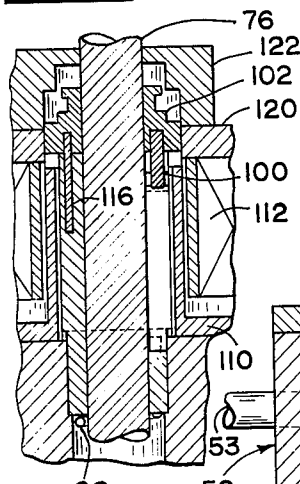


Fig. 2

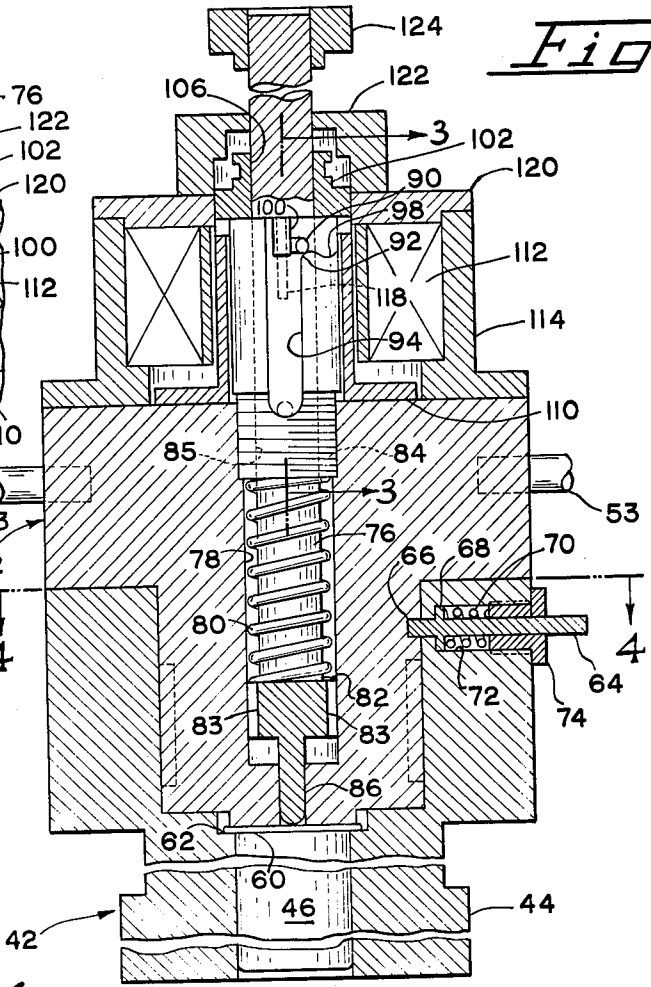


Fig. 4

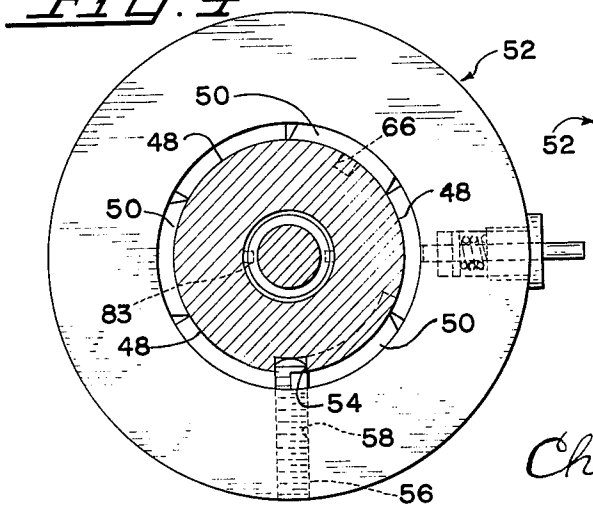
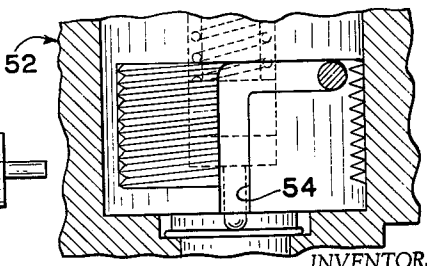


Fig. 2A



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3,208,349

WELL SOUNDER WITH ELECTRICALLY MOVEABLE SEAR PIN

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4 Claims. (Cl. 89—28)

This invention relates to well sounders for determining fluid levels in wells by the use of sound echoes.

In well sounders of the present type, a sound pulse is created at the well head by firing a blank cartridge in the annular space between the casing and the tubing. The sound pulse travels down the well and is reflected back to the well head by tubing collar joints, the surface of the oil, and all other obstructions, including liner hangers, etc. These reflections are of widely differing characteristics, and are picked up by a sound detecting device (microphone pickup) attached to the well head. Each reflected pulse is amplified and recorded on a chart. By knowing the vertical distance between the various elements causing the reflections, it is a simple matter to compute the fluid level in a well. Such information is helpful in proper setting and operation of pumps used in wells.

The well sounders prior to this invention have required two operators to obtain good records. The reason for this is that the recording equipment is generally located a substantial distance from the well, and requires adjustments immediately after the cartridge is fired and during the subsequent recordings of echoes within the well to insure satisfactory recording of the different types of reflections. In the conventional systems, the gun or cartridge is fired manually by one man at the well head, and the recording equipment is operated by a second man some distance from the well.

This invention provides a completely portable well sounding apparatus which requires only one man for its operation.

In the well sounding apparatus of this invention, a cartride firing gun is mounted on the well, and includes remotely controlled solenoid-actuated firing means. A control switch for the firing means is located a substantial distance from the well adjacent the recording equipment, and preferably is in the same control panel as the other instrument knobs which must be adjusted during the recording operation.

In its preferred form, the invention provides a cartridge firing device of unique design which permits the use of a relatively small solenoid requiring low power to operate it. The firing device includes a hollow breech block which is open at opposite ends. A firing pin is mounted at one end of the breech block to be movable longitudinally between a cocked and a firing position. A guide is disposed adjacent the firing pin, and it includes a longitudinal slot with a surface inclined at an angle to the slot. A transverse projection on the firing pin rests on the inclined surface to hold the firing pin in a cocked position. Spring means urge the projection toward the slot and also urge the firing pin toward the firing position. A longitudinal movable sear pin is disposed adjacent the inclined surface to engage the projection and prevent it from moving into the slot. Solenoid-actuated means are provided for moving the sear pin away from the inclined surface to let the projection move into the slot, and allow the spring means to move the firing pin to the firing position.

Preferably, the sear pin is moved longitudinally with respect to the slot so that the projection is released with a minimum amount of force being required to move the sear pin.

These and other aspects of the invention will be more fully understood from the following detailed description and the accompanying drawings in which:

FIG. 1 is a schematic elevation of the presently preferred embodiment of the invention;

FIG. 2 is an elevation partly in section, of the presently preferred cartridge firing device of the invention;

FIG. 2A is a fragmentary elevation of part of the apparatus shown in FIG. 2;

FIG. 3 is a view taken on line 3—3 of FIG. 2; and

FIG. 4 is a view taken on line 4—4 of FIG. 2, with a breech lock cap rotated about 45° in the breech block from the position shown in FIG. 2.

Referring to FIG. 1, a conventional Y fitting **10** is secured to the upper end of a well casing **12** by a coupling **14**. A cartridge firing gun **16** is mounted in one end of the Y remote from the well, and a conventional transducer **18** is mounted in the other end of the Y remote from the well.

The transducer is connected by a cable **20** to a recorder **22** located a substantial distance from the well. The recorder includes the usual adjustable control knobs **24** which are used during a recording to obtain a record of the desired characteristics in a manner well known to those skilled in the art. The recorder also includes the usual chart **26**, which is driven by a motor (not shown) controlled through a motor switch **28** on the recorder. A switch **30** supplies power to a stylus **32**, which moves over the chart in accordance with electrical signals supplied from the transducer through cable **20**.

A battery (not shown) in a battery case **34** is adjacent the recorder and is connected by a cable **36** into the recorder to supply power through a cable **38** to the gun **16**, which is fired by the operation of a firing switch **40** on the control panel as described in detail below.

Referring to FIG. 2, the gun includes a breech block base **42** which has external threads **44** on its lower end to fit into internal threads (not shown) in the Y fitting **10**. The breech block base is hollow in that it includes a stepped bore **46**, which extends all the way through it. The upper end of the breech block includes three sets of internal interrupted threads **48**, which receive three sets of external interrupted threads **50** on the lower end of a breech lock cap **52** that seals the upper end of the breech block bore **46**.

The lower end of the breech lock cap includes an inverted L-shaped slot **54** which receives and guides the inner end of a screw **56** threaded into a transverse bore **58** in the upper portion of the breech block base. The breech lock cap **52** is sealed in the upper end of the breech block base bore by sliding the vertical portion of slot **54** down over the inner end of screw **56** so that the external interrupted threads on the cap pass down between adjacent interrupted internal threads in the breech block base. When the breech lock cap is lowered to the point where the horizontal portion of slot **54** is at the same level as the inner end of screw **56**, the breech lock cap is rotated to engage the interrupted threads and press the lower end of the breech lock cap down against the upper end of a cartridge **60** disposed on a shoulder **62** in the breech block base bore **46**. A horizontal safety lock pin **64** fits in a horizontal bore **66** in the breech block base to prevent inadvertent disengagement of the breech lock cap from the breech block base. The safety lock pin includes a flange **68** adjacent its inner end to receive a compression spring **70** which is held in a bore **72** by a safety lock nut **74** so that the safety lock pin is urged inwardly.

An elongated firing pin **76** is disposed in a longitudinal stepped bore **78** extending entirely through the breech

lock cap. The lower end of a compression spring **80** is disposed around the intermediate portion of the firing pin and bears against an annular shoulder **82** formed at the enlarged lower end of the firing pin, which makes a sliding fit against the inside of bore **78**. The enlarged portion at the lower end of the firing pin includes vertical slots **83** to facilitate the movement of the firing pin into the firing position. The upper end of the compression spring **80** bears against a firing pin guide sleeve **84** threaded at its lower end into the upper end of the longitudinal bore **78** in the breech lock cap. The firing pin extends through a bore **85** in the guide sleeve, and includes a striking element **86** in its lower end adapted to fire the cartridge when the gun is actuated.

A transverse horizontal projection **90** on the firing pin rests on an inclined or upwardly curved convex shoulder **92** at the upper end of a longitudinal slot **94** in the firing pin guide sleeve. The inclined portion **92** of the slot merges with a detent portion **98** which is curved concave upwardly for holding the firing pin projection in a safe position. With the projection **90** in the position shown in FIG. 2, the firing pin is held in a cocked position, but is prevented from being forced downwardly by the compression spring into a firing position by the vertical sear pin **100** which extends downwardly from an annular trigger **102** into the longitudinal slot **94**. The trigger ordinarily rests on the upper end of the guide sleeve, and includes a central bore **106** which makes a close sliding fit around the upper portion of the firing pin. The trigger has an external diameter which is slightly greater than that of the firing pin guide sleeve so that it can be lifted by a trigger lift **110** disposed around the firing pin guide sleeve and lying within a solenoid winding **112** enclosed in a solenoid case **114** mounted on the upper end of the breech lock cap. An annular flange integral with the bottom of the trigger lift rests on top of the breech lock cap.

A trigger guide pin **116** (FIG. 3) extends downwardly from the trigger and into a vertical bore **118** in the upper end of the firing pin guide sleeve to keep the sear pin axially aligned as the trigger moves up and down. An annular solenoid cover **120** is mounted on top of the solenoid case, and a trigger stop cover **122** is mounted on top of the solenoid cover to limit the upward travel of the trigger. A cocking handle **124** is screwed onto the upper end of the firing pin projecting from the upper end of the gun.

With the apparatus assembled as shown in FIG. 1, a record is obtained by lifting the firing pin up to the dotted line position shown in FIG. 2 and rotating the firing pin until the firing pin projection comes to rest in the detent **98** at the upper end of the firing pin guide sleeve. The breech lock cap is removed by pulling the safety lock pin **64** outwardly until it clears bore **66**, and rotating the breech lock cap until the inner end of horizontal screw **56** is aligned with the vertical portion of slot **54**. The breech lock cap is then lifted from the breech block base, and a cartridge is placed in position as shown in FIG. 2. The immediate foregoing procedure is reversed to reseal the breech lock cap in the breech block base. Thereafter, the firing pin is lifted slightly against the action of compression spring **80** to clear projection **90** from detent **98**. The firing pin is then rotated until projection **90** rests on inclined surface **92** and is urged by the compression spring against the sear pin **100** and toward the slot **94** in the firing pin guide sleeve.

The record selector switch is set to the appropriate position to obtain either a "collar" or a main obstruction record. The gain control knob is adjusted to obtain a readable record. The stylus switch is moved to on, and so is the motor switch so that the strip recording paper **26** moves under the stylus. The gun firing switch **40** is momentarily depressed to supply electrical power to the solenoid. This causes the trigger lift to fly upwardly against the lower edge of the trigger and lift the sear pin from the vertical slot **94** so that the projection **90** is free to move into the slot **94** by producing a slight rotation to the firing pin, which is forced downwardly by the compression spring so that the striker **86** hits and fires the cartridge. The recorded return pulses are observed by the operator, who adjusts the gain to obtain a readable record throughout the operation.

Thus, with the apparatus of this invention, a complete record is obtained by only one operator because of the remotely actuable cartridge firing gun, and the location of the firing switch adjacent the recorder and control knobs on the recorder. Moreover, the system provides maximum safety for personnel because the firing of the blank cartridge is controlled remotely, eliminating the need for an operator to be near the well head when the gun is fired.

We claim:

1. A cartridge firing device for use with acoustic well sounding equipment comprising:

(a) a hollow breech block open at opposite ends,

(b) a firing pin mounted at one end of the breech block to be movable longitudinally between a cocked and a firing position,

(c) a guide disposed adjacent the firing pin, the guide having a longitudinal slot with a surface inclined at an angle to the slot,

(d) a transverse projection on the firing pin and adapted to rest on the inclined surface to hold the firing pin in the cocked position,

(e) spring means urging the projection toward the slot and the firing pin toward the firing position,

(f) a longitudinally movable sear pin disposed in the slot adjacent the inclined surface to engage the projection and prevent it from moving into the slot, and

(g) solenoid-actuated means for moving the sear pin away from the inclined surface to let the projection move into the slot and allow the spring means to move the firing pin to the firing position.

2. A cartridge firing device for use with acoustic well sounding equipment comprising:

(a) a hollow breech block open at opposite ends,

(b) a firing pin mounted at one end of the breech block to be movable longitudinally between a cocked and a firing position,

(c) a guide disposed adjacent the firing pin, the guide having a longitudinal slot with a surface inclined at an angle to the slot,

(d) a transverse projection on the firing pin and adapted to rest on the inclined surface to hold the firing pin in the cocked position,

(e) spring means urging the projection toward the slot and the firing pin toward the firing position,

(f) a longitudinally movable trigger disposed adjacent the slot in the guide,

(g) a sear pin on the trigger and disposed adjacent the inclined surface to engage the firing pin projection and prevent it from moving into the slot,

(h) a trigger lift disposed adjacent the slot to be movable toward and away from the trigger, and

(i) solenoid-actuated means for driving the trigger lift against the trigger and moving the sear pin away from the inclined surface to let the projection move into the slot and allow the spring means to move the firing pin to the firing position.

3. A cartridge firing device for use with acoustic well sounding equipment comprising:

(a) a hollow breech block open at opposite ends,

(b) a firing pin mounted at one end of the breech block to be movable longitudinally between a cocked and a firing position,

(c) a guide disposed adjacent the firing pin, the guide having a longitudinal slot with a first surface inclined at an angle to the slot and merging with a second surface having a detent portion,

(d) a transverse projection on the firing pin and adapted to rest in the detent portion and be movable to rest on the inclined surface to hold the firing pin in the cocked position,

(e) spring means urging the projection toward the slot and the firing pin toward the firing position,

(f) a longitudinally movable sear pin disposed adjacent the inclined surface to engage the projection and prevent it from moving into the slot, and

(g) solenoid-actuated means for moving the sear pin away from the inclined surface to let the projection move into the slot and allow the spring means to move the firing pin to the firing position.

4. A cartridge firing device for use with acoustic well sounding equipment comprising:

(a) a hollow breech block open at opposite ends,

(b) a firing pin mounted at one end of the breech block to be movable longitudinally between a cocked and a firing position,

(c) a guide sleeve disposed around the firing pin, the guide sleeve having a longitudinal slot with a surface inclined at an angle to the slot,

(d) a transverse projection on the firing pin and adapted to rest on the inclined surface to hold the firing pin in the cocked position,

(e) spring means urging the projection toward the slot and the firing pin toward the firing position,

(f) a longitudinally slidable trigger disposed around the firing pin,

(g) a longitudinal sear pin on the trigger and disposed adjacent the inclined surface to engage the firing pin projection and prevent it from moving into the slot,

(h) means for maintaining axial alignment of the sear pin with the inclined surface as the trigger is moved longitudinally,

(i) a trigger lift disposed around the firing pin to be movable longitudinally toward and away from the trigger lift, and

(j) solenoid-actuated means for driving the trigger lift against the trigger and moving the sear pin away from the inclined surface to let the projection move into the slot and allow the spring means to move the firing pin to the firing position.

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