A. H. CRANE.

HIGH LIQUID PRESSURE DETONATOR.

APPLICATION FILED MAY 11, 1921.

1,408,565.

Patented Mar. 7, 1922.

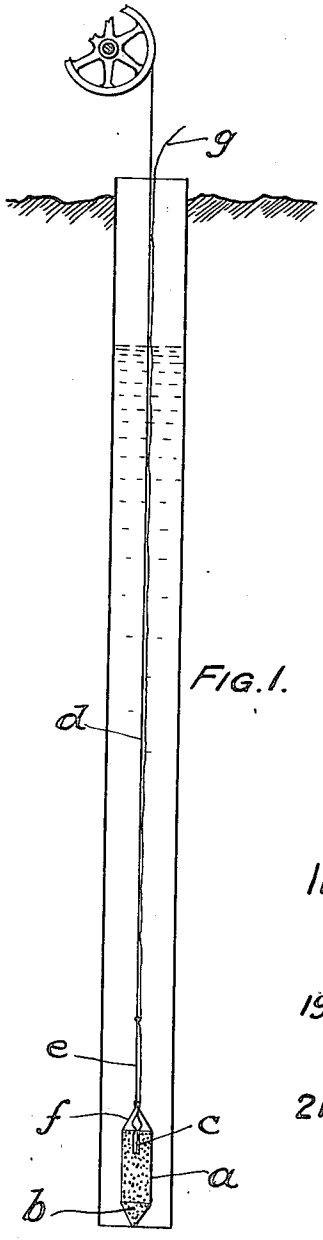


FIG. 1.

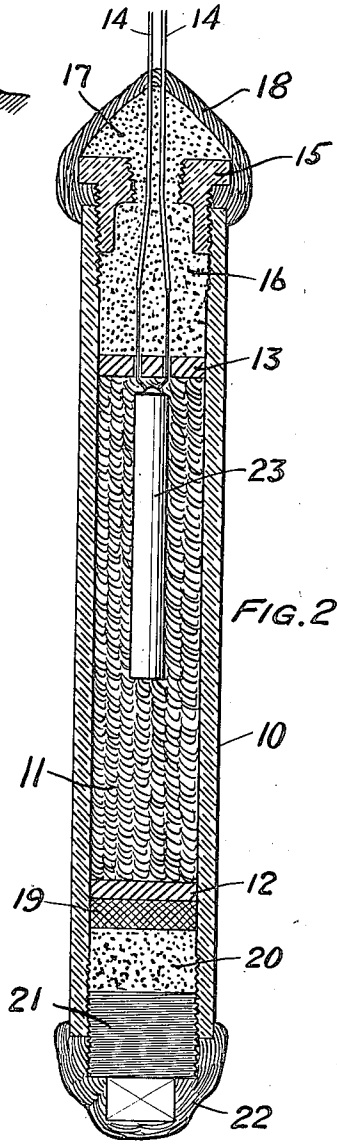


FIG. 2.

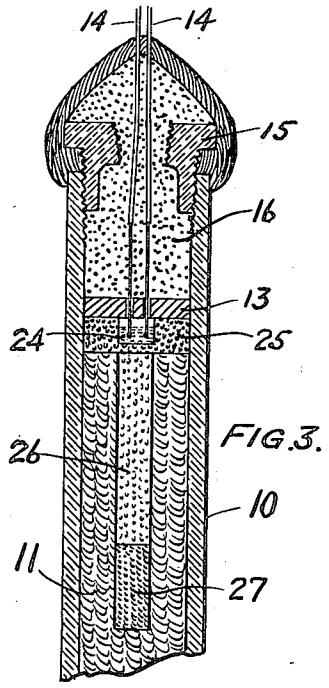


FIG. 3.

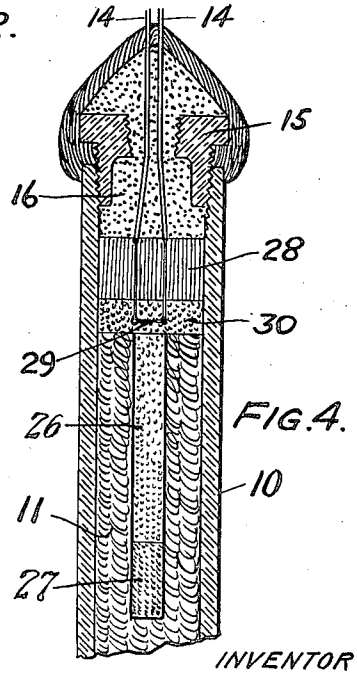


FIG. 4.

WITNESS:

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HIGH-LIQUID-PRESSURE DETONATOR.

1,408,565. Specification of Letters Patent. Patented Mar. 7, 1922.

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To all whom it may concern:

Be it known that I, ARTHUR H. CRANE, a citizen of the United States, residing at San Francisco, county of San Francisco, and State of California, have invented a new and useful Improvement in High-Liquid-Pressure Detonators, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, which form a part of this specification.

This invention relates to detonators and more particularly to detonators for shooting wells of great depth, in which the charge is subjected to a high liquid pressure.

Oil shooting and shooting under high pressures is very old, difficult, and very often unsatisfactory. This is particularly so when shooting a well of great depth, as the gelatin is very insensitive when under the high pressure to which it is subjected when used in shooting a well of great depth, under liquid pressure.

The object of my invention is to provide positive means for detonating gelatin when under high pressures, as well as a device of this character which is cheap of construction, easily assembled, and which can readily be assembled in the field.

The precise nature of my invention will be best understood by reference to the accompanying drawings, which will now be described, it being premised, however, that changes may be made in the construction and arrangement of parts without departing from the spirit and scope of my invention as defined in the appended claims.

Fig. 1 of the drawings is a sectional view through a well showing a torpedo in the well with one of my improved detonators in the torpedo.

Figs. 2, 3 and 4 are sectional views through three different forms of detonators made in accordance with my invention.

In the drawings, *a* designates the torpedo within the well containing the explosive charge *b*, and *c* is the detonator within the charge. *d* is the sand line leading from the usual sheave and from which the torpedo is supported by means of the usual shooting iron *e* and the bail or wires *f*. One end of the shooting iron *e* is connected to the end of the sand line *d*, while the other end thereof is connected to the torpedo by the bail or wires *f*. *g* are conducting wires leading to the wires of the detonator for firing the detonator which will in turn fire the charge in the torpedo. These wires *g* are tied to the sand line and shooting iron, and sufficient slack is provided between the detonator and the point at which said wires are tied to the shooting iron to prevent any strain being placed on the ends of the wires leading from the detonator by the weight of the torpedo.

The detonators *c* shown in Figs. 2 and 3 of the drawings comprise a tube 10 internally threaded at both ends. 11 is the charge within the tube 10 between the fibre gaskets 12 and 13. I preferably form the charge 11 of sixty per cent straight N. G. dynamite, and place a charge firing device in or at one end of the charge, which is provided with electrical conducting wires 14 extending from the firing device or element through spaced openings in gasket 13 to a point beyond the detonator. The wires 14 are preferably bared for a short distance above gasket 13 as shown so that the asphalt or other sealing compound will come in intimate contact with the bare wires and prevent the passage of water down through the insulation of the wires or in the space between the wires and the insulation. These wires are secured to the ends of wires *g* and properly taped to prevent short circuiting by contact or water. One end of the detonator is closed and sealed by means of bushing 15 which engages the threads in the end of the tube 10 and an asphalt sealing compound 16 which is flowed into the space within the tube 10 and bushing 15, above the gasket 13. The compound entirely fills said space, and I also preferably flow the compound over the outer face of the bushing to form a head 17 of compound on the end of the bushing. This compound not only fills the space in the detonator beyond the gasket 13, but also retains the wires 14 separated within the detonator. The entire end of the detonator is then wrapped with rubber tape, as indicated at 18 to further waterproof the end of the detonator.

I preferably thread the opening in the bushing as clearly indicated in the drawings and which threads together with the head 17 will prevent external pressure being transmitted to the contents of the detonator through the sealing compound, as the

tendency to flow of the small cross-sectional area of the compound within the small opening of the bushing is resisted by the head and the internal threads of the bushing.

The other end of the detonator is closed and sealed by means of a layer of saw dust 19 or other suitable material, a layer of sealing compound 20, and a threaded plug 21. This end of the detonator is also wrapped with rubber tape as indicated at 22 to further waterproof this end of the detonator.

In the structure shown in Fig. 2, the firing device 23 consists of what is known as a No. 8 waterproof electric blasting cap.

The detonator shown in Fig. 3 is identical with that shown in Fig. 2 with the exception of the firing device. The firing device shown in Fig. 3 comprises an electric squib having a bridge within an ignition charge 24 embedded in a layer of fuse powder 25, and an ordinary No. 8 blasting cap 26 containing a blasting cap explosive charge 27. If desired, the blasting cap 26 may be eliminated, as the squib and fuse powder are sufficient to fire the charge, but I preferably use the cap in connection with the squib when using a squib for firing.

The detonator shown in Fig. 4 is identical with those shown in Figs. 2 and 3 with the exception of the firing device. The wires 14 of the firing device in this form are bared a short distance and wrapped with rubber tape to form a plug or gasket 28. The ends of the wires 14 are connected to each other by means of a bridge element 29 of the desired resistance which is embedded in a layer of fuse powder 30 above the charge 11. If desired, I may also place a blasting cap 26, such as above described, with the charge 11. By the use of a bridge element of the proper resistance, I am enabled to provide a detonator which will not be fired by static electricity or some stray currents not intended to fire the detonator.

The various elements with the exception of plug 21 are assembled, and melted sealing compound is poured into the ends of the tube and bushing, and as the threads extend into the space filled with the compound, the compound will hermetically seal the ends against water. The plug 21 is then screwed into the end and preferably before the compound has set so that the compound can be spread by the plug, while the compound is still plastic, so as to completely fill the space within the tube. The ends are then taped as above described, which will further protect the ends against moisture as well as form a protection for the head 17 of the compound.

The torpedo is then made up with the detonator in position and the torpedo is secured to the end of the sand line. The ends of the wires 14 are electrically connected to the ends of the wires *g*, which are then taped to prevent short circuiting. The torpedo is then lowered into the well to be shot, by paying out the line from the calf-wheel, and when the torpedo is lowered to the proper depth, an electric circuit is closed through the wires *g* and 14 to explode the detonator, which will in turn explode the torpedo or main charge.

As the shell or tube 10 of the detonator is formed of tubing of heavy gage, there is no danger of subjecting the charge in the detonator to pressure by the head of water or other liquid in the well, as tube 10 will resist lateral pressure, while the plug 21 will resist the longitudinal pressure in the one direction and the bushing 15 together with the compound will resist longitudinal pressure in the other direction. I preferably construct the detonator of standard members, so that the man in the field can readily purchase the parts already threaded, in a plumbers' supply house, or which can be cut and threaded with an ordinary set of pipe fitters' tools.

For example, the detonators shown are built up of a standard brass tube six inches long, one inch outside diameter and three-quarter inch inside diameter, and which can readily be cut from a length of tubing. The ends are then threaded internally with a standard tapered tap. One end is closed with a standard brass plug, while the other end is closed with a standard brass reducer or bushing.

The advantages of my invention result from the provision of a detonator which will withstand the high pressure of a deep well without placing the contents within the detonator under pressure, so that I am enabled to shoot very deep wells as effectively as shallow wells. Also from the provision of a detonator which is built up of standard pipe fittings, and in such a manner that the device can readily be constructed and assembled in the field. Also from the provision of a detonator which is proof against firing by static electricity, or some other stray currents not intended to fire the detonator. Also from the provision of the detonator of sufficient strength to satisfactorily detonate explosive charges which have been rendered relatively insensitive by high pressure.

Having now fully described my invention, what I claim and desire to protect by Letters Patent is:

1. A detonator comprising a tube, a detonating charge therein, means closing one end of the tube, a bushing partially closing the other end of the tube, a charge firing element having electric wires connected thereto and extending through the bushing, and a sealing material within which said wires are embedded, said sealing mate-

rial filling the bushing and the space in the tube adjacent the end of the bushing and extending outside the bushing to form a head.

2. A detonator comprising a tube, a detonating charge and a firing element therein, a plug closing one end of the tube, a bushing threaded in the other end of the tube, sealing material filling the end of the tube adjacent said plug, sealing material filling the end of the tube adjacent the bushing and extending through and outside the bushing to form a head, the firing device having wires extending through the last named sealing material and the bushing.

3. A detonator comprising a tube, a detonating charge and a firing element therein, plugs inserted in the opposite ends of the tube, gaskets in the tube between which the detonating charge and the main portion of the firing element are positioned, sealing material filling the tube between the gaskets and the plugs, the firing element having wires extending through the body of sealing material and plug at one end of the tube, and flexible waterproof closures at the opposite ends of the tube.

4. A detonator comprising a metallic tube internally threaded at both ends, a threaded plug closing one end of the tube, a detonating charge in the tube, an externally threaded bushing partially closing the other end of the tube, a charge firing element having electric wires connected thereto and extending through the bushing, and an insulating compound poured into the space within the tube through the bushing to maintain the wires out of contact with each other and for filling the space within the bushing and the space within the tube above the charge and below the bushing.

5. A detonator comprising a metallic tube internally threaded at both ends, a threaded plug closing one end of the tube, a detonating charge in the tube, an internally and externally threaded bushing partially closing the other end of the tube, a charge firing element having electric wires connected thereto and extending through the bushing, and an insulating compound poured into the space within the tube through the bushing to maintain the wires out of contact with each other and for filling the space within the bushing and the space within the tube above the charge and below the bushing.

6. A detonator comprising a metallic tube internally threaded at both ends, a threaded plug closing one end of the tube, a detonating charge in the tube, an externally threaded bushing partially closing the other end of the tube, a charge firing element having electric wires connected thereto and extending through the bushing, a gasket on each end of the charge, a filler of sealing material between one of the gaskets and the plug, sealing material filling the bushing and the space in the tube between the end of the bushing and the other gasket and surrounding the wires leading to the firing element, and a head of sealing material on the end of the bushing.

7. A detonator comprising a metallic tube internally threaded at both ends, a threaded plug closing one end of the tube, a detonating charge in the tube, an externally threaded bushing partially closing the other end of the tube, a charge firing element having electric wires connected thereto and extending through the bushing, a gasket on each end of the charge, a filler of sealing material between one of the gaskets and the plug, sealing material filling the bushing and the space in the tube between the end of the bushing and the other gasket and surrounding the wires leading to the firing element, a head of sealing material on the end of the bushing, and rubberized tape wrapped around the ends of the detonator.

8. A detonator comprising a metallic tube internally threaded at both ends, a threaded plug closing one end of the tube, a detonating charge in the tube, an internally and externally threaded bushing partially closing the other end of the tube, a charge firing element having electric wires connected thereto and extending through the bushing, a fiber gasket on each end of the charge, a layer of saw dust in contact with the gasket at the opposite end from the firing element, a filler of asphalt between the saw dust and the plug, a filler of asphalt surrounding the wires and within the space in the tube and bushing beyond the other gasket, a head of asphalt on the bushing on the exterior of the detonator, and a covering of tape on the ends of the detonator.

In testimony of which invention, I have hereunto set my hand, at San Francisco on this 26th day of April, 1921.

ARTHUR H. CRANE.