

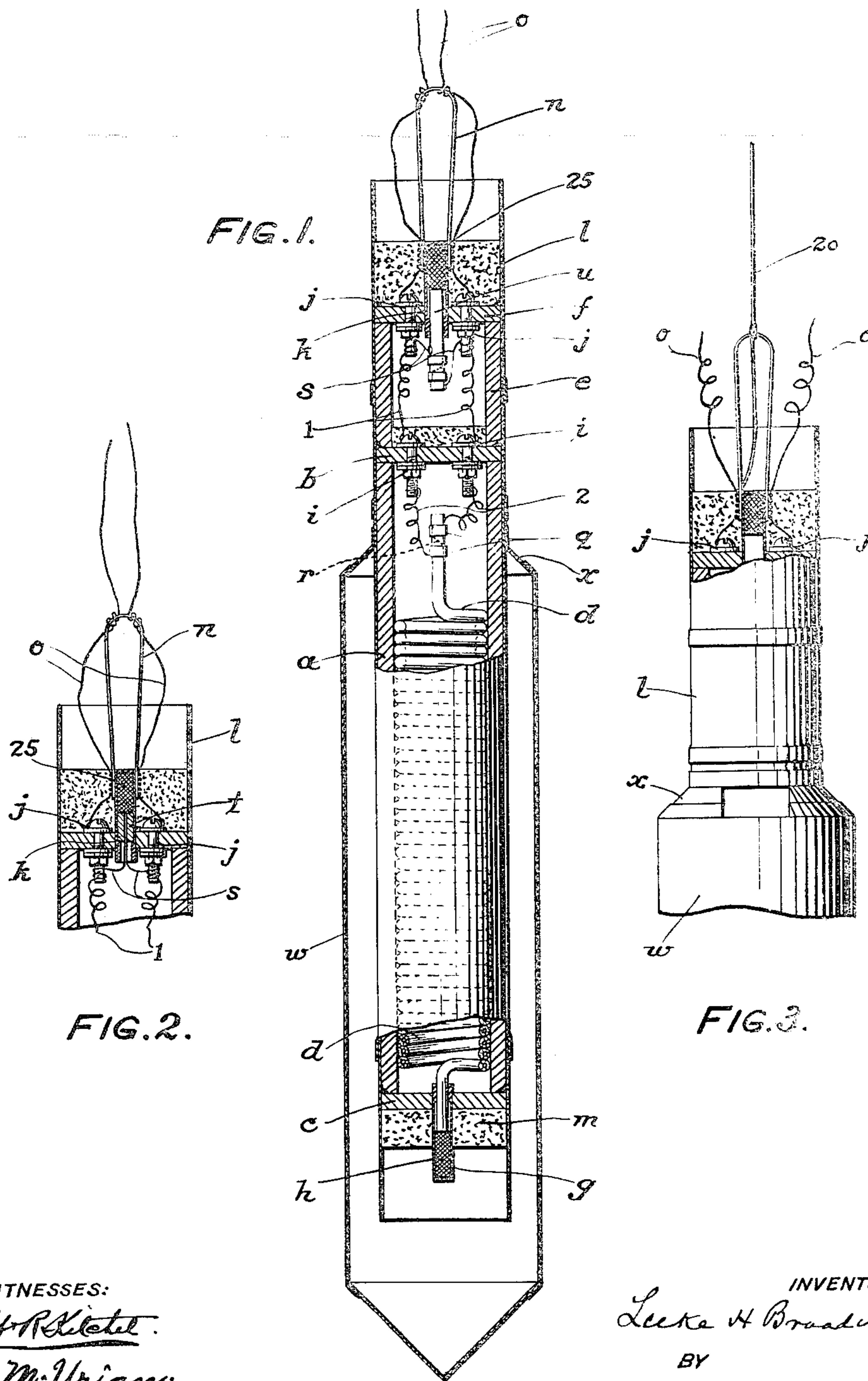
No. 855,224.

PATENTED MAY 28, 1907.

L. H. BROADWATER.
APPARATUS FOR FIRING EXPLOSIVES IN WELLS.

APPLICATION FILED FEB. 18, 1907.

2 SHEETS--SHEET 1.



WITNESSES:

Robert R. Ketchum.
A. M. Urian.

INVENTOR

Leake H. Broadwater

BY

Harding & Harding
ATTORNEYS.

No. 855,224.

PATENTED MAY 28, 1907.

L. H. BROADWATER.
APPARATUS FOR FIRING EXPLOSIVES IN WELLS.

APPLICATION FILED FEB. 16, 1907.

2 SHEETS—SHEET 2

FIG. 4.

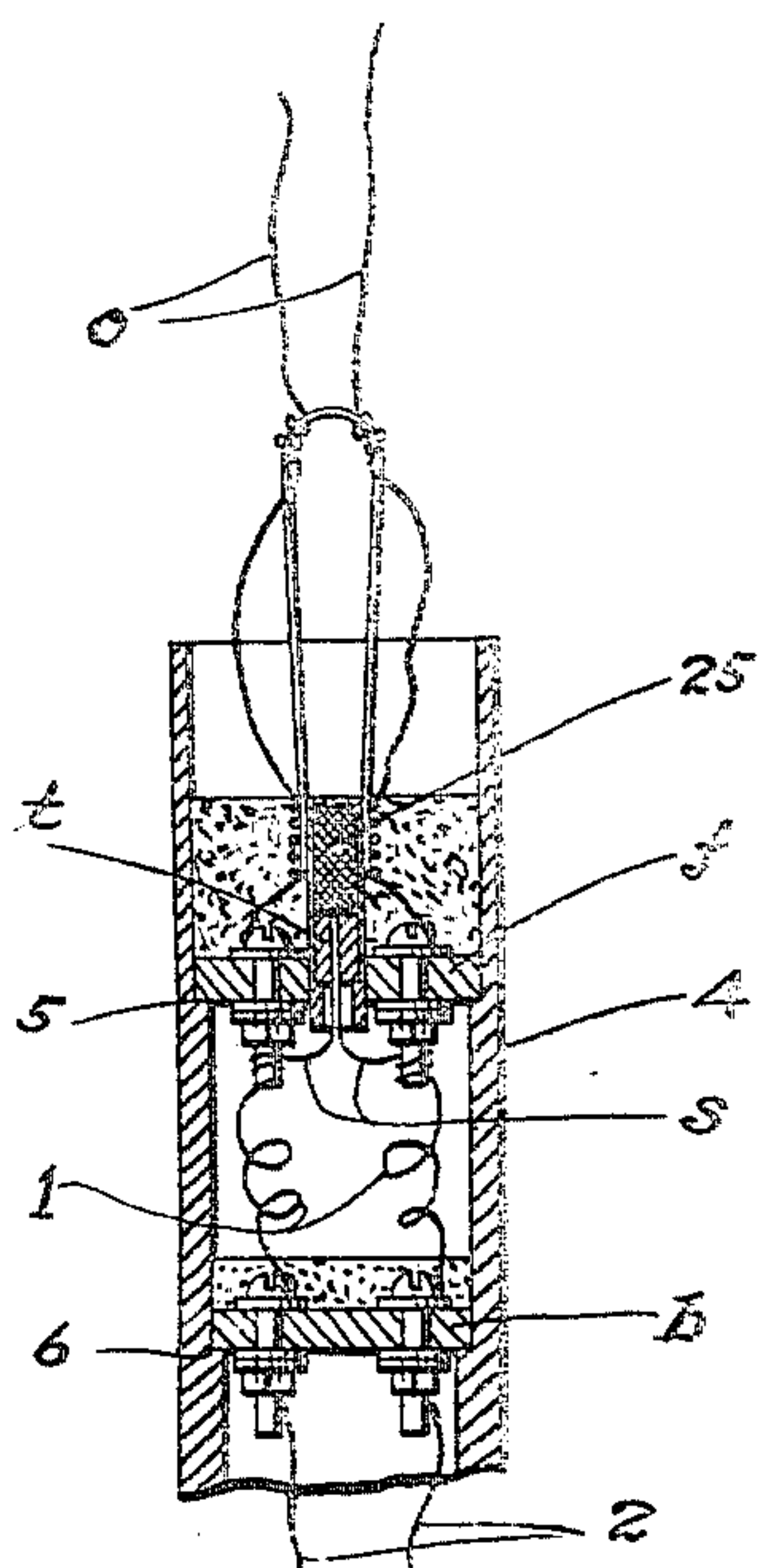
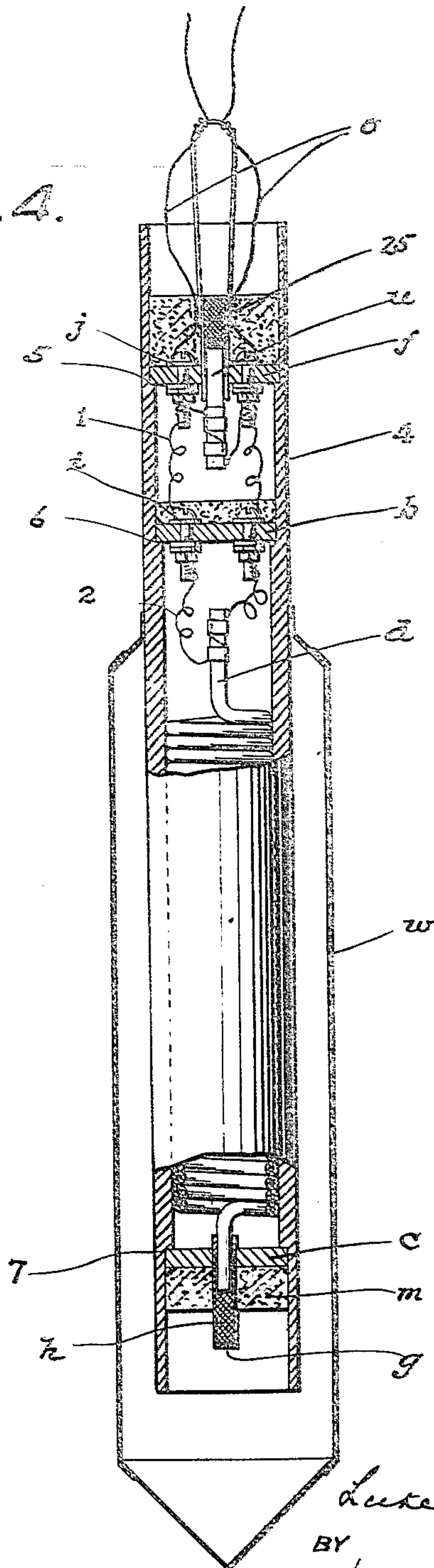


FIG. 5.

WITNESSES:

Robert Kitchel
A. M. Urian

INVENTOR

L. H. Broadwater
BY *Handy & Handy*
ATTORNEYS.

UNITED STATES PATENT OFFICE.

LUKE H. BROADWATER, OF FINDLAY, OHIO, ASSIGNOR TO THE E. I. DU PONT DE NEMOURS POWDER COMPANY, OF WILMINGTON, DELAWARE, A CORPORATION OF NEW JERSEY.

APPARATUS FOR FIRING EXPLOSIVES IN WELLS.

No. 855,224.

Specification of Letters Patent.

Patented May 28, 1907.

Application filed February 18, 1907. Serial No. 357,927.

To all whom it may concern:

Be it known that I, LUKE H. BROADWATER, a citizen of the United States, residing at Findlay, county of Hancock, and State of Ohio, have invented a new and useful Improvement in Apparatus for Firing Explosives in Wells, 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.

The object of my invention is to produce an apparatus for firing explosives in wells where the firing is produced by electricity. Its purpose primarily is to cause the firing of the fuse leading to the explosive for the primary charge simultaneously with the rupture of the connection of the firing wires and suspension wires and providing for a delay in the firing of the explosive for the primary charge, so that the firing and suspension wires may be lifted from the well before the main charge is exploded.

Further, it provides for certain details of construction which are general improvements in such apparatus.

Speaking generally, I accomplish this result by simultaneously firing the fuse, which controls the explosive for the primary charge, and an explosive which controls the connection of the firing wires and suspension wires with the apparatus. Further, in sealing the fuse chamber from the chamber containing the explosive which controls the connection of the firing wires and suspension wires with the apparatus.

I will first describe the embodiment of my invention shown in the accompanying drawings and then specifically point out the invention in the claims.

In the drawings: Figure 1 is a longitudinal section of my improved fuse. Fig. 2 is a partial section showing modified method of igniting. Fig. 3 is a partial elevation showing separate suspension wire. Fig. 4 is a longitudinal section of a modified form of my invention. Fig. 5 is a partial section showing modified method of igniting.

a is a metallic cylinder, having at the top the cap *b* and at the bottom the cap *c*. Within this cylinder is the fuse *d*. Above this cylinder *a* is the cylinder *e*, closed at the bottom by the cap *b* and at the top by the cap *f*.

Projecting through an orifice in the cap *c* is the copper casing *g*, closed at its lower end and having its upper end, within the cylinder *a*, open. The lower end of the fuse *d* projects into this casing and in contact with an explosive *h* in the casing. This explosive is preferably a fulminate cap. Projecting through the cap *b* are the electric conductive binding posts *i*. Projecting through orifices in the cap *f* are the electric conductive binding posts *j*. Projecting through an orifice in the cap *f* is the casing *k*, having one end closed and an open end within the chamber *e*. These cylinders *a* and *e* are sealed with respect to themselves and to each other by means of a cylindrical shell *l*, made in sections, which sections are, when in position, soldered to each other and to the caps. This cylindrical shell *l* is preferably made of tin. Below the cap *c* is placed sealing material *m*, which will attach itself to the cap and tin casing. Above the cap *b* is placed similar material and in like manner above the cap *f*. Within the casing *k* is an explosive 25. Attached to the casing *k* is the bail *n*. *o* are the firing wires which lead from the source of current supply. These wires pass around the bail *n*, so that, by these wires, the apparatus may be suspended and lowered into the well. The wires *o* are wound around the casing *k* and are attached to the binding posts *j*. From the other end of the binding posts *j* one set of wires 1, passes to the binding post *i*, and thence by wires 2 respectively to clips *q*, which are attached to the upper end of the fuse *d*, and make contact with a resistance wire *r* projecting through said fuse. The other set of wires *s* from the binding post *j* connect with the wires of a resistance connected with a fuse *u* leading to the explosive 25 in the chamber *k*. These wires *s* could be attached to the wires of a resistance in a detonator *t* in the tube *k*, as shown in detail in Fig. 2. The apparatus so far described is inserted in the vessel *w* containing the priming charge. This vessel *w* has the neck *x*, a portion of the circumference of which is attached to the shell *l*. A portion of this neck is unattached, so as to admit the insertion of the priming charge at the point of use, and also to enable fluid in the well, if any, to enter to equalize the pressure upon the vessel *w*.

The apparatus is assembled as follows: Sections of the shell *l* are first soldered to each of the caps *b*, *c* and *f*. The casings *g* and *k* are placed in position and soldered to their respective caps, their contents are then inserted therein, the bail *n* having been soldered to the casing *k* before the contents are inserted. The wires *o* are then wound around the casing *k* and connected respectively to the binding posts *j*, which have previously been placed in position. In like manner, the wires 1 and 2 are properly connected up with their respective binding posts, and the wires *s* with either the fuse or the wires leading to the resistance. The wires 2 are connected to clips and binding posts, the clips being connected to one end of the fuse, which fuse is then dropped down so that the other end enters the tube *g*. The cylinder *a* is then placed in position and a section of the shell *l* placed around it, which is soldered to the shell sections connected to the caps *b* and *c*. The cylinder *e* is then placed in position. The cap *b* is covered with retaining material.

The cap *f* is then placed on top of the cylinder *e* and the shell section bearing the cap *f* is soldered to the shell section bearing cap *b*. Retaining material is also placed within the shell *l* above the cap *f* and below the cap *c*.

The vessel *w* is then connected to the shell *l*. Instead of using the shell *l* I can use the construction shown in Fig. 4, in which the cylinders *a* and *e* are formed as a unitary cylinder, provided with offsets 5, 6, and 7, upon which respectively rest the caps *f*, *b*, and *c*. In this case there is formed a brazed connection between the vessel *w* and the walls of the cylinder 4. The caps *f*, *b* and *c*, being cemented in any well known manner upon the offsets 5, 6 and 7 respectively.

Instead of using the firing wires to suspend the firing apparatus, I can use a separate wire or cable. In that case both the supplemental suspension wire or cable 20, and the firing wires *o*, are wound around the tube *k* as shown in Fig. 3.

In practice, when the electric current is completed through the firing wires, the fuse *d* and either the fuse *u* or detonator *t* are ignited, thus exploding the explosive 25, and rupturing the connection of the firing wires, or firing wires and suspension wires with the apparatus. The fuse *d* should be made long enough or of such slow burning quality that the firing and suspension wires may be removed before the priming charge is exploded.

The use of the fuse *u* is preferable to the detonator *t*, as it insures time for the certain ignition of fuse *d*.

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

1. The combination with an apparatus for firing explosives, comprising a firing fuse, of

firing wires, a connection between said firing wires and said apparatus adapted to be ruptured by an explosive, an explosive carried by said apparatus, adapted to rupture said connection, and electrical connection between said firing wires and the firing fuse and explosive.

2. The combination with an apparatus for firing explosives, comprising a firing fuse, of firing wires, a connection between said firing wires and said apparatus adapted to be ruptured by an explosive, an explosive carried by said apparatus, adapted to rupture said connection, and electrical connection between said firing wires and the firing fuse and explosive, the explosive and the firing fuse being sealed from each other.

3. The combination with an apparatus for firing explosives, comprising a firing fuse, of firing wires, a connection between said firing wires and said apparatus adapted to be ruptured by an explosive, an explosive carried by said apparatus, adapted to rupture said connection, and electrical connection, in multiple, between said firing wires and the firing fuse and explosive.

4. The combination with an apparatus for firing explosives, comprising a firing fuse, of firing wires, a connection between said firing wires and said apparatus adapted to be ruptured by an explosive, an explosive carried by said apparatus, adapted to rupture said connection, an electrical connection, in multiple, between said firing wires and the firing fuse and explosive, the explosive and the firing fuse being sealed from each other.

5. In an apparatus for firing explosives in wells, the combination with a chamber containing the firing fuse, and a chamber containing an explosive, of firing wires, a connection between said firing wires and said apparatus, adapted to be ruptured by said explosive, and electrical connection between said firing wires and the fuse and explosive.

6. In an apparatus for firing explosives in wells, the combination with a sealed chamber containing the firing fuse, and a sealed chamber containing an explosive, of firing wires, a connection between said firing wires and said apparatus, adapted to be ruptured by said explosive, and electrical connection between said firing wires and the fuse and explosive.

7. In an apparatus for firing explosives in wells, the combination with a chamber containing the firing fuse, and a chamber containing an explosive, of firing wires, a connection between said firing wires and said apparatus, adapted to be ruptured by said explosive and electrical connection, in multiple, between said firing wires and the fuse and explosive.

8. In an apparatus for firing explosives in wells, the combination with a sealed chamber containing the firing fuse, and a sealed

chamber containing an explosive, of firing wires, a connection between said firing wires and said apparatus, adapted to be ruptured by said explosive, and electrical connection, in multiple, between said firing wires and the fuse and explosive.

9. The combination with an apparatus for firing explosives, comprising a firing fuse, of suspension wires, a connection between said suspension wires and said apparatus, adapted to be ruptured by an explosive, an explosive carried by said apparatus adapted to rupture said connection and electrical connection to the firing fuse and explosive.

10. The combination with an apparatus for firing explosives, comprising a firing fuse, of suspension wires, a connection between said suspension wires and said apparatus adapted to be ruptured by an explosive, an explosive carried by said apparatus, adapted to rupture said connection, and electrical connection to the firing fuse and explosive, the explosive and the firing fuse being sealed from each other.

11. The combination with an apparatus for firing explosives, comprising a firing fuse, of suspension wires, a connection between said suspension wires and said apparatus, adapted to be ruptured by an explosive, an explosive carried by said apparatus, adapted to rupture said connection, and electrical connection, in multiple, to the firing fuse and explosive.

12. The combination with an apparatus for firing explosives, comprising a firing fuse, of suspension wires, a connection between said suspension wires, and said apparatus adapted to be ruptured by an explosive, an explosive carried by said apparatus, adapted to rupture said connection, and electrical connection, in multiple, to the firing fuse and explosive, the explosive and firing fuse being sealed from each other.

13. In an apparatus for firing explosives in wells, the combination with a chamber containing the firing fuse and a chamber containing an explosive, of suspension wires, a connection between said suspension wires and said apparatus adapted to be ruptured by said explosive and electrical connection to said fuse and explosive.

14. In an apparatus for firing explosives in wells, the combination with a sealed chamber containing the firing fuse, and the sealed chamber containing an explosive, of suspension wires, a connection between said suspension wires and said apparatus, adapted to be ruptured by said explosive, and electrical connection to said fuse and explosive.

15. In an apparatus for firing explosives in wells, the combination with a sealed chamber containing the firing fuse, and a sealed chamber containing an explosive, of suspension wires, a connection between said suspension

wires and said apparatus, adapted to be ruptured by said explosive, and electrical connection, in multiple, to said fuse and explosive.

16. In an apparatus for firing explosives in wells, the combination with a sealed chamber containing the firing fuse, and a sealed chamber containing an explosive, of suspension wires, a connection between said suspension wires and said apparatus, adapted to be ruptured by said explosive, and electrical connection, in multiple, to the firing fuse and explosive.

17. In an apparatus for firing explosives in wells, in combination with a sealed chamber, an inverted casing in said chamber containing an explosive, electric conductors leading to said explosive, a second sealed chamber, a firing fuse in said chamber, a casing, adapted to contain an explosive, opening into said chamber, said fuse entering said casing, and electric conductors leading to said fuse.

18. In an apparatus for firing explosives in wells, in combination with a sealed chamber, an inverted casing in said chamber containing an explosive, electric conductors leading to said explosive, a second sealed chamber, a firing fuse in said chamber, a casing, adapted to contain an explosive, projecting into said chamber, said fuse entering said casing, electric conductors leading to said fuse, the electric conductors leading to the first mentioned explosive and the electric conductors leading to the firing fuse being in multiple.

19. In an apparatus for firing explosives in wells, in combination with a sealed chamber, an inverted casing in said chamber, containing an explosive, a bail connected to said casing, electric conductors leading to said explosive, a second sealed chamber, a firing fuse in said chamber, a casing, adapted to contain an explosive, opening into said chamber, said fuse entering said casing, and electric conductors leading to said fuse.

20. In an apparatus for firing explosives in wells, in combination, a cylinder, caps closing the bottom and top of said cylinder, said caps being sealed, a fuse in said chamber, electric conductors leading to said fuse, a casing, adapted to contain an explosive, opening into said cylinder into which said fuse extends, a second cylinder above the first cylinder, a cap closing the top of said cylinder, an inverted casing, adapted to contain an explosive, opening into said cylinder, electric conductors in last mentioned cylinder leading to the casing projecting therein, and to the firing fuse in the first mentioned cylinder.

21. In an apparatus for firing explosives in wells, in combination, a cylinder, caps closing the bottom and top of said cylinder, said caps being sealed, a fuse in said chamber, electric conductors, leading to said fuse

a casing, adapted to contain an explosive, opening into said cylinder into which said fuse extends, a second cylinder above the first cylinder, a cap closing the top of said cylinder, an inverted casing, adapted to contain an explosive, opening into said cylinder, electric conductors, in multiple in last mentioned cylinder leading to the casing projecting therein and to the firing fuse in the first mentioned cylinder.

22. In an apparatus of the character described, in combination, a sealed chamber containing a fuse, a surrounding vessel adapted to contain a primary charge, a portion of said vessel being secured to the exterior of said chamber, whereby liquids may pass or be pressed to the interior of said vessel when said vessel is secured to said chamber.

23. In an apparatus of the character described, the combination with a primary charge, suspension wires, a connection of the suspension wires and apparatus, the explosive for firing the primary charge and the explosive for rupturing the suspension wires connection, of a fuse connected to each explosive, the fuse to the rupturing charge being adapted to explode the rupturing charge before the explosive for firing the primary charge is exploded by its fuse.

24. The combination with an apparatus for firing explosives in wells and its fuse, of suspension wires for said apparatus said suspension wires being connected to said apparatus, an explosive, adapted to rupture the connection of said suspension wires and said

apparatus, and electrical connection to said firing fuse and said rupturing explosive.

25. The combination with an apparatus for firing explosives in wells and its fuse, of suspension wires for said apparatus said suspension wires being connected to said apparatus, an explosive, adapted to rupture the connection of said suspension wires and said apparatus, and electrical connection, in multiple, to said firing fuse and said rupturing explosive.

26. The combination with an apparatus for firing explosives in wells and its fuse, of firing wires for said apparatus said firing wires being connected to said apparatus, an explosive, adapted to rupture the connection of said firing wires and said apparatus, and electrical connection from said firing wires to said firing fuse and said rupturing explosive.

27. The combination with an apparatus for firing explosives in wells and its fuse, of firing wires for said apparatus said firing wires being connected to said apparatus, an explosive, adapted to rupture the connection of said firing wires and said apparatus, and electrical connection, in multiple, from said firing wires to said firing fuse and said rupturing explosive.

In testimony of which invention, I have hereunto set my hand, at Woodbury, on this 14th day of February, 1907.

LUKE H. BROADWATER.

Witnesses:

BESSIE D. SHARP,
FRANCIS B. DAVIS.