

L. H. BROADWATER.

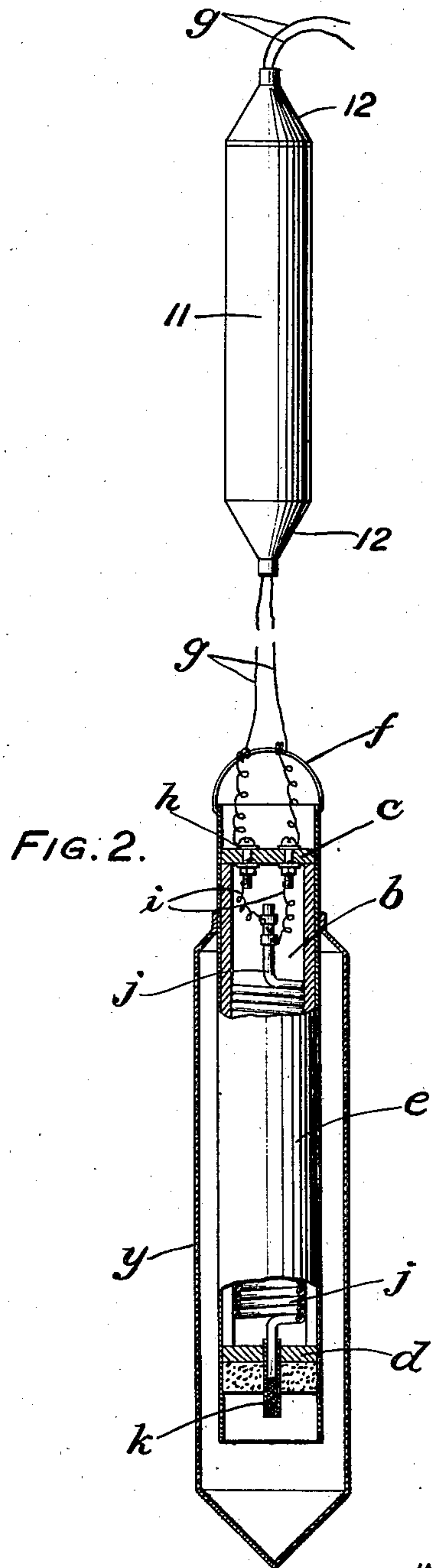
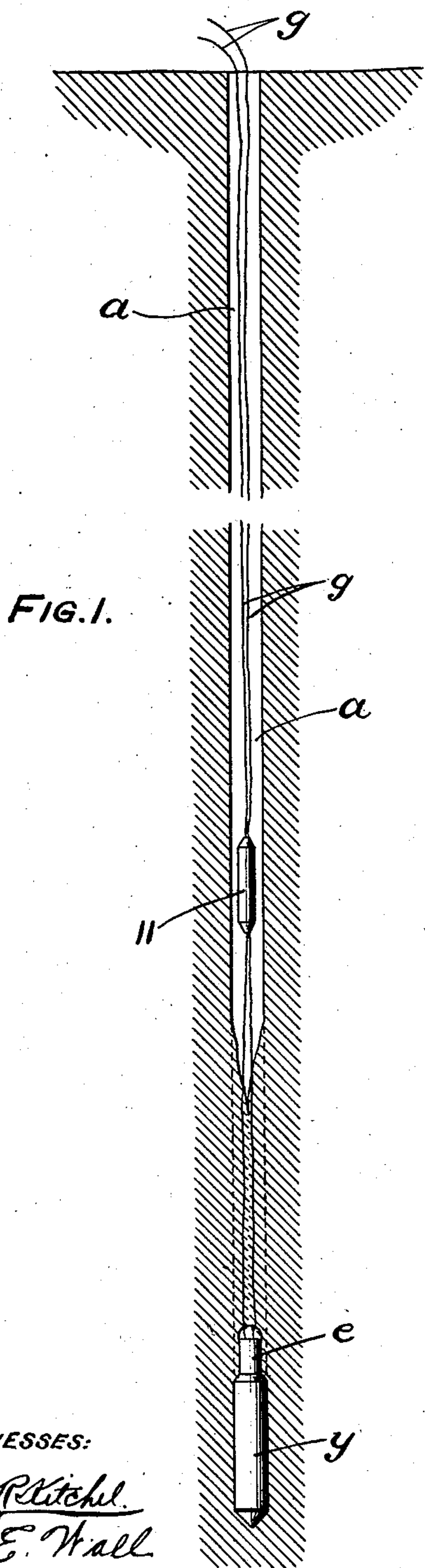
APPARATUS FOR FIRING EXPLOSIVES IN WELLS.

APPLICATION FILED DEC. 30, 1908. RENEWED NOV. 3, 1909.

943,383.

Patented Dec. 14, 1909.

2 SHEETS—SHEET 1.



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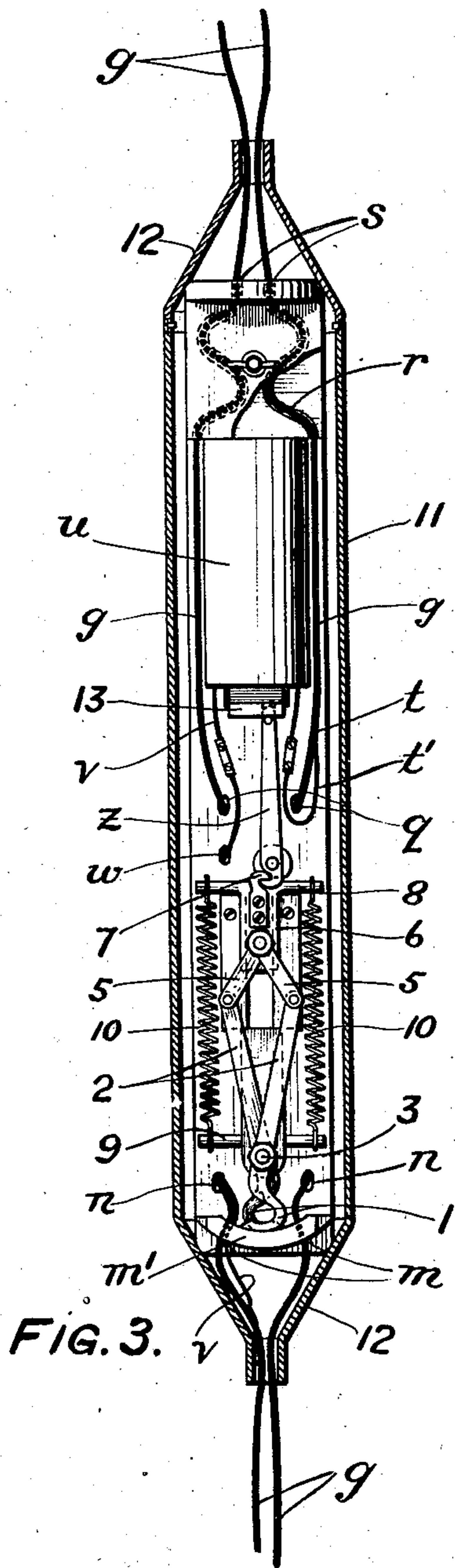


FIG. 3.

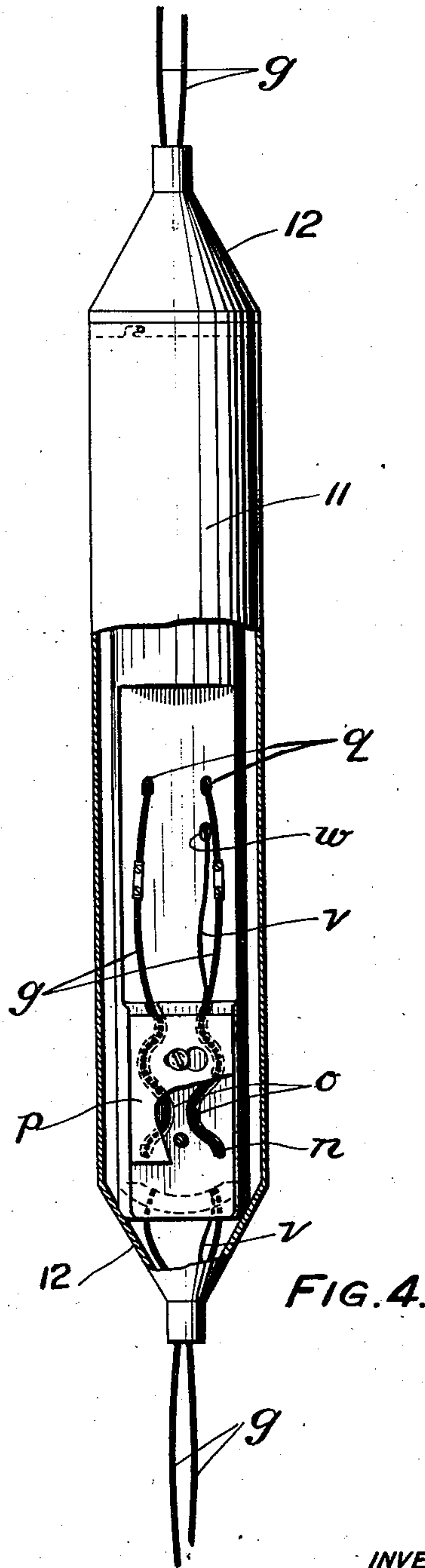


FIG. 4.

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# UNITED STATES PATENT OFFICE.

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## APPARATUS FOR FIRING EXPLOSIVES IN WELLS.

943,383.

Specification of Letters Patent.

Patented Dec. 14, 1909.

Application filed December 30, 1908, Serial No. 470,098. Renewed November 3, 1909. Serial No. 526,107.

*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 an apparatus for firing explosives in wells where the firing is produced by the electric current, in which the wires carrying the current to the priming charge in the well will be caused to be severed by the action of the current which causes said primer to act. In Letters Patent Nos. 855,224 and 866,838 I have shown, described and claimed certain apparatus for this purpose and which apparatus well performs its purpose. On the other hand, such apparatus has certain disadvantages. In the first place the rupture of the firing wires is caused by the action of an explosive. In the second place the apparatus used for rupturing the wire is itself destroyed.

My present invention relates to that portion of the apparatus which is used to sever the wires and with my improved construction the severing of the wires takes place by mechanical instrumentalities, the action of which is controlled by the current used to fire the primer in the well. Further, the electrical connection with the mechanical instrumentalities controlling the severing device and the line wires are simultaneously severed. The severance of the line wires takes place at the lower end of the severing device so that not only the line wires above the point of severance, but also the severing device itself, may be lifted from the well and used again. Finally, the electric connection between the line wires and the controlling device for the severing device are connected below the point of severance, which enables the severing of the line wires and the electric connection to the controlling device to be simultaneous and yet leave the arrangement otherwise ready for re-use.

I will now describe the embodiment of my invention as shown in the accompanying drawings.

In the drawings: Figure 1 is a view of my

apparatus in a well. Fig. 2 is a detail view of my apparatus, the firing portion being shown in section. Fig. 3 is a front sectional elevational view of the severing apparatus. Fig. 4 is a rear view of same.

*a* represents the well to be fired, in the bottom of which and close to the explosive charge is placed the fuse chamber *b*. This fuse chamber has the top and bottom caps *c* and *d* and the outer casing *e* extends above and below the caps *c* and *d*. To the casing *e* is connected the bail *f* around which the firing or line wires *g* are wound, and then pass to the binding posts *h* on cap *c*, from which wires *i* pass to the resistance in the main fuse *j*. This fuse *j* is in the fuse chamber *b* and its lower end is connected with the detonator *k* in the priming charge, which is contained in the vessel *y*. The wires *g* extend upward to the severing apparatus which is a distance far enough above the bottom of the well not to be affected by the caving in of the well by the explosion. The wires *g* extend through orifices *m* in the ledge or flange *m'* on the lower end of the severing apparatus, and pass through orifices *n* to the back thereof where they are guided in the sinuous grooves *o* covered by the plate *p*. They then pass along the back of the severing apparatus to the orifices *q* where they pass to the front thereof, and from thence along the front or top of this apparatus to the sinuous grooves *r* at the upper end, from which they pass through orifices *s*, and thence to the top of the well where they lead to the source of current supply including a switch, not shown, for closing the current, as in the ordinary manner. From one of these wires *g* at the point *t*, a wire *t'* leads to the electromagnet *u*. From the other side of said magnet a wire *v* extends, which wire passes from the face to the back through the orifices *w*, it also passes from the back to face through one of the orifices *n* and also through one of the orifices *m*, beyond which it is connected to the opposite wire *g* from that which the wire *t'* led and connect at a point which is below where the severing of the line wires takes place.

13 is the armature of the magnet *u*. A pivoted hook *z* is normally held in an orifice in the armature 13.

1—1 are two knives connected to the arms



2—2 pivoted at 3 so that said arms move in the arc of a circle along the face of the ledge or flange  $m'$  through which the orifices  $m$  extend. The ends of these arms 2—2 are pivotally connected by links 5 with a slide 6 carrying the hook 7. Upon this slide is the fixed rod or bar 8.

9 is a fixed bar or rod. The rods or bars 8 and 9 are connected by springs 10. By pulling the bar 8 forward, the hook 7 may be brought into engagement with the hook  $\varepsilon$ , and the knives 1 brought to their central position, and the springs 10 thrown into tension (as shown Fig. 3).

When the circuit is closed through the wires  $g$  a shunt circuit passes to the magnet  $u$  energizing the same and causing its armature to move upward, releasing the hook  $\varepsilon$  which in turn releases the hook 7, and, the action of the springs 10, causes the knives to move outward passing over the orifices  $m$  and thus severing the live wires  $g$  and the shunt wire  $w$ , to the electromagnet. By means of the sinuous grooved passages for the wires  $g$ , and the passage of the wires from front to back, the severing apparatus and the wires between the top of the well and the lower end of the severing device may be lifted out of the well and used again. Moreover, this severing of the wires is positively accomplished and accomplished with certainty. Moreover, the apparatus may be readily equipped for use again by connecting up the proper amount of wire  $g$  to the severed ends and adding sufficient wire  $w$  to make the connection from the electromagnet to the wire  $g$  in the same manner as it was initially.

The severing mechanism is placed within the casing 11. This casing is made of some light metal as, for instance, aluminum. It has the cylindrical body and the conical ends 12—12. This enables this device to be readily lowered into the well and lifted therefrom after firing.

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

1. A wire severing device for an apparatus for firing wells, comprising the combination with the firing electric wires, of severing cutters adapted to sever said firing wires, an electric device for controlling the action of said severing device, said electric device being in circuit with the firing wires.

2. A wire severing device for an apparatus for firing wells comprising the combination with the firing electric wires, of severing cutters adapted to sever said firing wires, an electric device for controlling the action of said severing device, electric wires in shunt with the firing wires, said shunt circuit including said electric device and extending in the path of said severing cutters.

3. A wire severing device for an apparatus for firing wells comprising the combination with the firing electric wires, of severing cutters adapted to sever said firing wires, an electric device for controlling the action of said severing device, electric wires in shunt with the firing wires, said shunt circuit including said electric device and extending in the path of said severing cutters, said shunt being included in the firing wire circuit beyond said cutters.

4. A wire severing device for an apparatus for firing wells, comprising the combination with the firing electric wires, of severing cutters adapted to sever said firing wires, an electric device for controlling the action of said severing device, said electric device being in circuit with the firing wires, said firing wires being connected to said severing device so that said severing device may be lifted by said wires.

5. A wire severing device for an apparatus for firing wells comprising the combination with the firing electric wires, of severing cutters adapted to sever said firing wires, an electric device for controlling the action of said severing device, electric wires in shunt with the firing wires, said shunt circuit including said electric device and extending in the path of said severing cutters, said firing wires being connected to said severing device so that said severing device may be lifted by said wires.

6. A wire severing device for an apparatus for firing wells comprising the combination with the firing electric wires, of severing cutters adapted to sever said firing wires, an electric device for controlling the action of said severing device, electric wires in shunt with the firing wires, said shunt circuit including said electric device and extending in the path of said severing cutters, said shunt being included in the firing wire circuit beyond said cutters, said firing wires being connected to said severing device so that said severing device may be lifted by said wires.

7. In an apparatus of the character described, in combination, a frame, an electromagnet carried by said frame, cutters pivoted on said frame, spring normally holding said cutters in their active position, a locking device controlled by said magnet for holding said cutters in their inactive position against the action of said spring, firing wires extending in line of movement of said cutters, and shunt wires from said firing wire circuit including said electromagnet.

8. In an apparatus of the character described, in combination, a frame, an electromagnet carried by said frame, cutters pivoted on said frame, spring normally holding said cutters in their active position, a locking device controlled by said magnet for



holding said cutters in their inactive position against the action of said spring, firing wires extending in line of movement of said cutters, said electromagnet being included  
5 in the firing wire circuit.

9. In an apparatus of the character described, in combination, a frame, an electromagnet carried by said frame, cutters pivoted on said frame, spring normally holding  
10 said cutters in their active position, a locking device controlled by said magnet for holding said cutters in their inactive position against the action of said spring, firing  
15 cutters, and shunt wires from said firing wire circuit including said electromagnet, said shunt wire circuit extending in line of movement of said cutters.

10. In an apparatus of the character described, in combination, a frame, an electromagnet carried by said frame, cutters pivoted on said frame, spring normally holding  
20 said cutters in their active position, a locking device controlled by said magnet for holding said cutters in their inactive position against the action of said spring, firing  
25 wires extending in line of movement of said cutters, shunt wires from said firing wire circuit including said electromagnet, said shunt wire circuit extending in line of movement  
30 of said cutters, said firing wires passing from front to back and vice versa in the length of said frame.

11. In an apparatus of the character described, in combination, a frame, an electromagnet carried by said frame, cutters pivoted on said frame, spring normally holding  
35 said cutters in their active position, a locking device controlled by said magnet for holding said cutters in their inactive position against the action of said spring, firing  
40 wires extending in line of movement of said cutters, said electromagnet being included in the firing wire circuit, said firing wires passing from front to back, and vice versa, in  
45 the length of said frame.

12. In an apparatus of the character described, in combination, a frame, an electromagnet carried by said frame, cutters pivoted on said frame, spring normally holding  
50 said cutters in their active position, a locking device controlled by said magnet for holding said cutters in their inactive position, against the action of said spring, firing  
55 wires extending in line of movement of said cutters, shunt wires from said firing wire circuit including said electromagnet, said shunt wire circuit extending in line of movement  
60 of said cutters, said firing wires passing from front to back and vice versa in the length of said frame, there being sinuous grooves at each end of said frame in which  
said wires rest.

13. In an apparatus of the character described, in combination, a frame, an electromagnet carried by said frame, cutters piv-

oted on said frame, spring normally holding said cutters in their active position, a locking device controlled by said magnet for holding said cutters in their inactive position, against the action of said spring, firing  
70 wires extending in line of movement of said cutters, said electromagnet being included in the firing wire circuit, said firing wires passing from front to back and vice versa in the  
75 length of the frame, there being sinuous grooves at each end of said frame in which said wires rest.

14. In an apparatus of the character described, in combination, a frame, an orificed flange upon the lower end of said frame, cutters, means to move said cutters along the  
80 face of said flange and over said orifices, an electromagnet, means controlled by said electromagnet for restraining the movement of said cutters, and firing electric wires passing  
85 through said orifices in said flange.

15. In an apparatus of the character described, in combination, a frame, an orificed flange upon the lower end of said frame, cutters, means to move said cutters along the  
90 face of said flange and over said orifices, an electromagnet, means controlled by said electromagnet for restraining the movement of said cutters, firing electric wires  
95 passing through said orifices in said flange, said electromagnet being in circuit with the firing wires.

16. In an apparatus of the character described, in combination, a frame, an orificed flange upon the lower end of said frame, cutters, means to move said cutters along  
100 the face of said flange and over said orifices, an electromagnet, means controlled by said electromagnet for restraining the movement of said cutters, firing electric wires passing  
105 through said orifices in said flange, said electromagnet being in circuit with the firing wires, said firing wires being secured to said frame.

17. In an apparatus of the character described, in combination, a frame, an orificed flange upon the lower end of said frame, cutters, means to move said cutters along the  
110 face of said flange and over said orifices, an electromagnet, means controlled by said  
115 electromagnet for restraining the movement of said cutters, firing electric wires passing through said orifices in said flange, shunt wires connecting said electromagnet and  
120 the firing wires, the wires of said shunt circuit passing through said orificed flange.

18. In an apparatus of the character described, in combination, a frame, an orificed flange upon the lower end of said frame, cutters, means to move said cutters along the  
125 face of said flange and over said orifices, an electromagnet, means controlled by said electromagnet for restraining the movement of said cutters, firing electric wires passing  
130 through said orifices in said flange, shunt



wires connecting said electromagnet and the firing wires, the wire of said shunt circuit passing through said orificed flange, and connected to the firing wire circuit beyond said flange.

19. In an apparatus of the character described, in combination, a frame, an orificed flange upon the lower end of said frame, cutters, means to move said cutters along the face of said flange and over said orifices, an electromagnet, means controlled by said electromagnet for restraining the movement of said cutters, firing electric wires passing through said orifices in said flange, shunt wires connecting said electromagnet and the firing wires, the wires of said shunt circuit passing through said orificed flange, said firing wires being secured to said frame.

20. In an apparatus of the character described, in combination, a frame, an orificed flange upon the lower end of said frame, cutters, means to move said cutters along the face of said flange and over said orifices, an electromagnet, means controlled by said electromagnet for restraining the movement of said cutters, firing electric wires passing through said orifices in said flange, shunt wires connecting said electromagnet and the firing wires, the wire of said shunt circuit passing through said orificed flange and connected to the firing wire circuit beyond said frame, said firing wires being secured to said frame.

21. In an apparatus of the character described, in combination, a frame, an orificed flange upon the lower end of said frame, cutters, means to move said cutters along the face of said flange and over said orifices, an electromagnet, means controlled by said electromagnet for restraining the movement of said cutters, firing electric wires passing through said orifices in said flange, said firing wires passing from front to back and vice versa, in the length of said frame, said electromagnet being in circuit with the firing wires.

22. In an apparatus of the character described, in combination, a frame, an orificed flange upon the lower end of said frame, cutters, means to move said cutters along the face of said flange and over said orifices, an electromagnet, means controlled by said electromagnet for restraining the movement of said cutters, firing electric wires passing through said orifices in said flange, said fir-

ing wires passing from front to back and vice versa in the length of said frame, there being sinuous grooves at the upper and lower portions of said frame, in which said wires rest, said electromagnet being in circuit with the firing wires.

23. In an apparatus of the character described, in combination, a frame having an orificed flange, firing wires passing through said orificed flange, pivoted knives adapted to move along the face of said flange and over said orifices, springs acting to move said knives apart, arms connected to said knives, a slide, links connecting said arms and slide, a hook connected to said slide, an electromagnet, a pivoted locking device controlled by the armature of said electromagnet adapted to secure said slide hook, said electromagnet being in circuit with the firing wires.

24. In an apparatus of the character described, in combination, a frame having an orificed flange, firing wires passing through said orificed frame, pivoted knives adapted to move along the face of said flange and over said orifices, springs acting to move said knives apart, arms connected to said knives, a slide, links connecting said arms and slide, a hook connected to said slide, an electromagnet, a pivoted locking device controlled by the armature of said electromagnet adapted to secure said slide hook, said electromagnet being in circuit with the firing wires, said springs being connected to said slide.

25. In an apparatus of the character described, in combination, a frame having an orificed flange, firing wires passing through said orificed flange, pivoted knives adapted to move along the face of said flange and over said orifices, springs acting to move said knives apart, arms connected to said knives, a slide, links connecting said arms and slide, a hook connected to said slide, an electromagnet, a locking device controlled by said electromagnet for securing said slide hook, said electromagnet being in circuit with the firing wires.

In testimony of which invention, I have hereunto set my hand, at Findlay, Ohio, on this 26th day of December, 1908.

LUKE H. BROADWATER.

Witnesses:

J. FRANK AXLINE,  
JOHN E. BETTS.