R. S. OBERLY.

EXPLOSION POWER HAMMER.

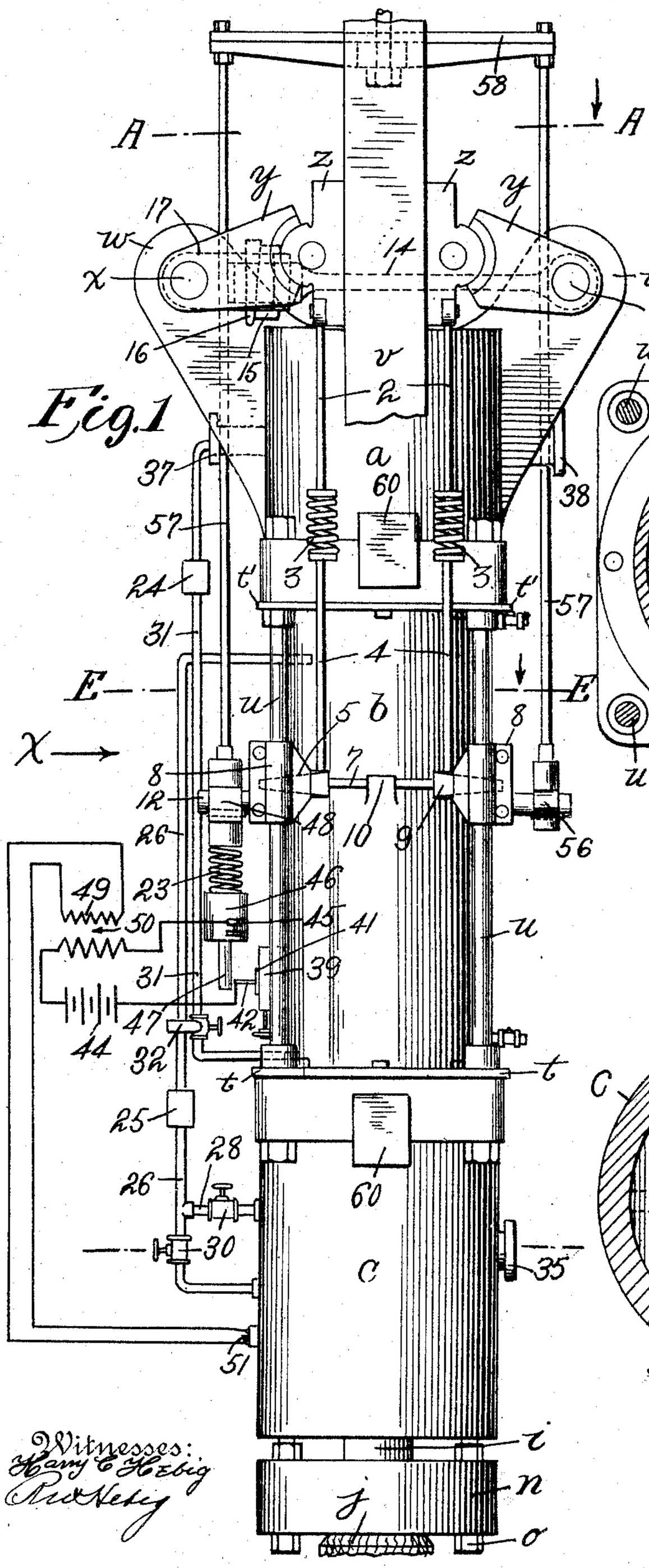
APPLICATION FILED AUG. 21, 1908.

929,696.

Patented Aug. 3, 1909.

4 SHEETS—SHEET 1.

Fig. 1



Witnesses:
Harry C. Hebig
Paul Hebig

Fig. 8.

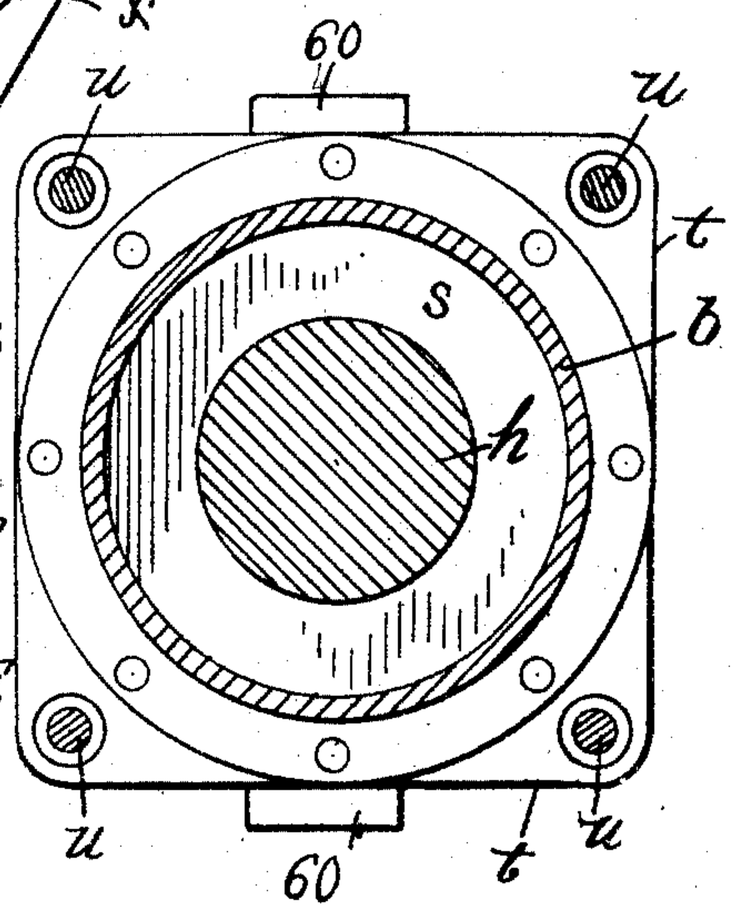
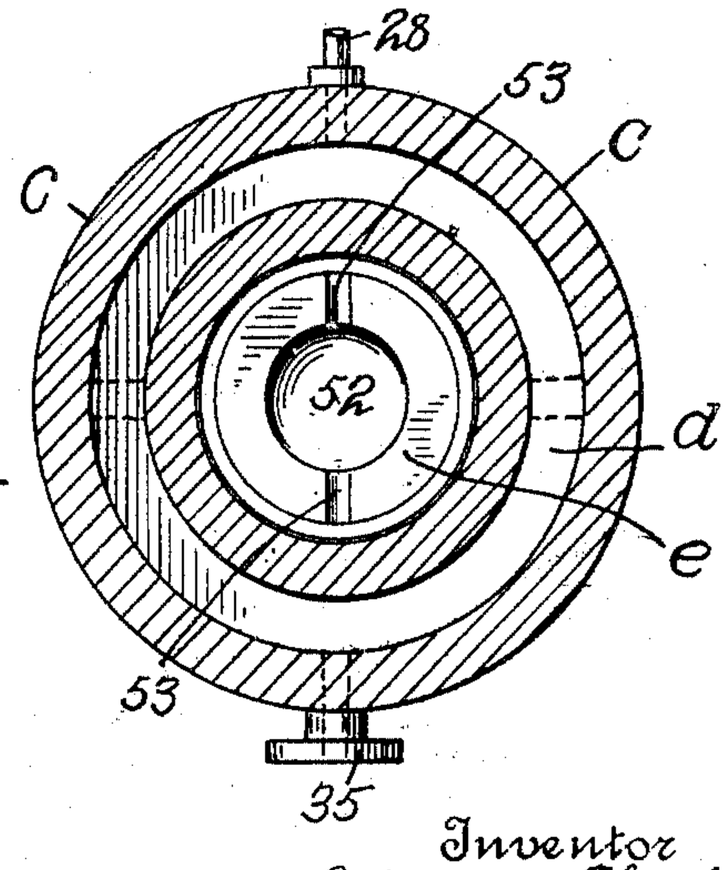


Fig. 7.



Inventor
Robert S. Oberly

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4 SHEETS—SHEET 2.

Fig. 2.

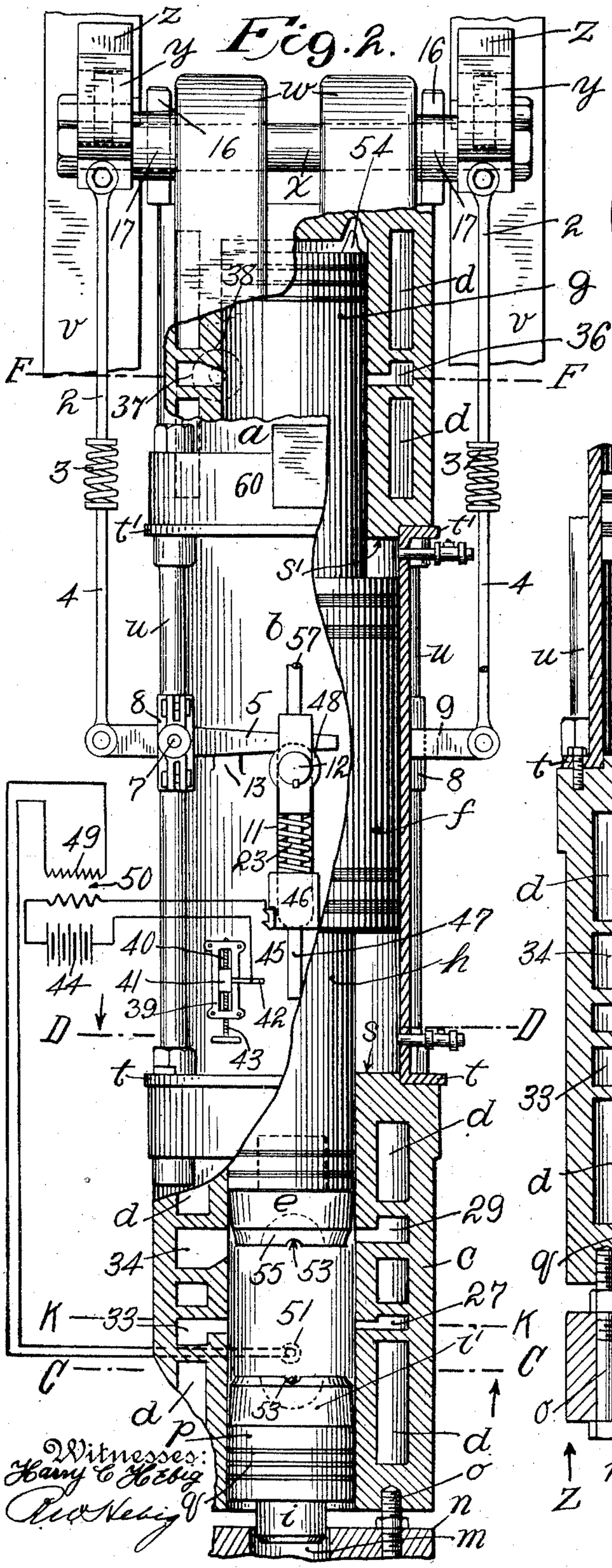


Fig. 11.

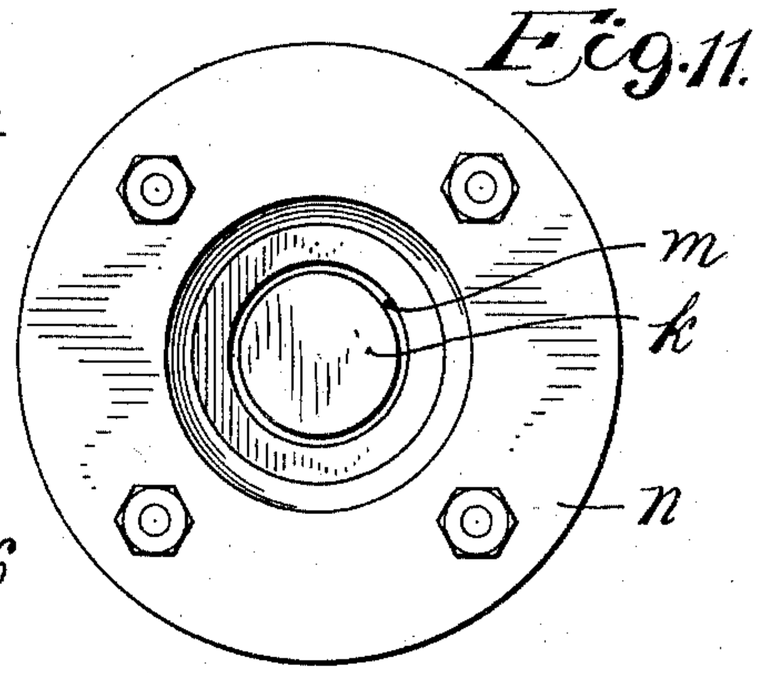
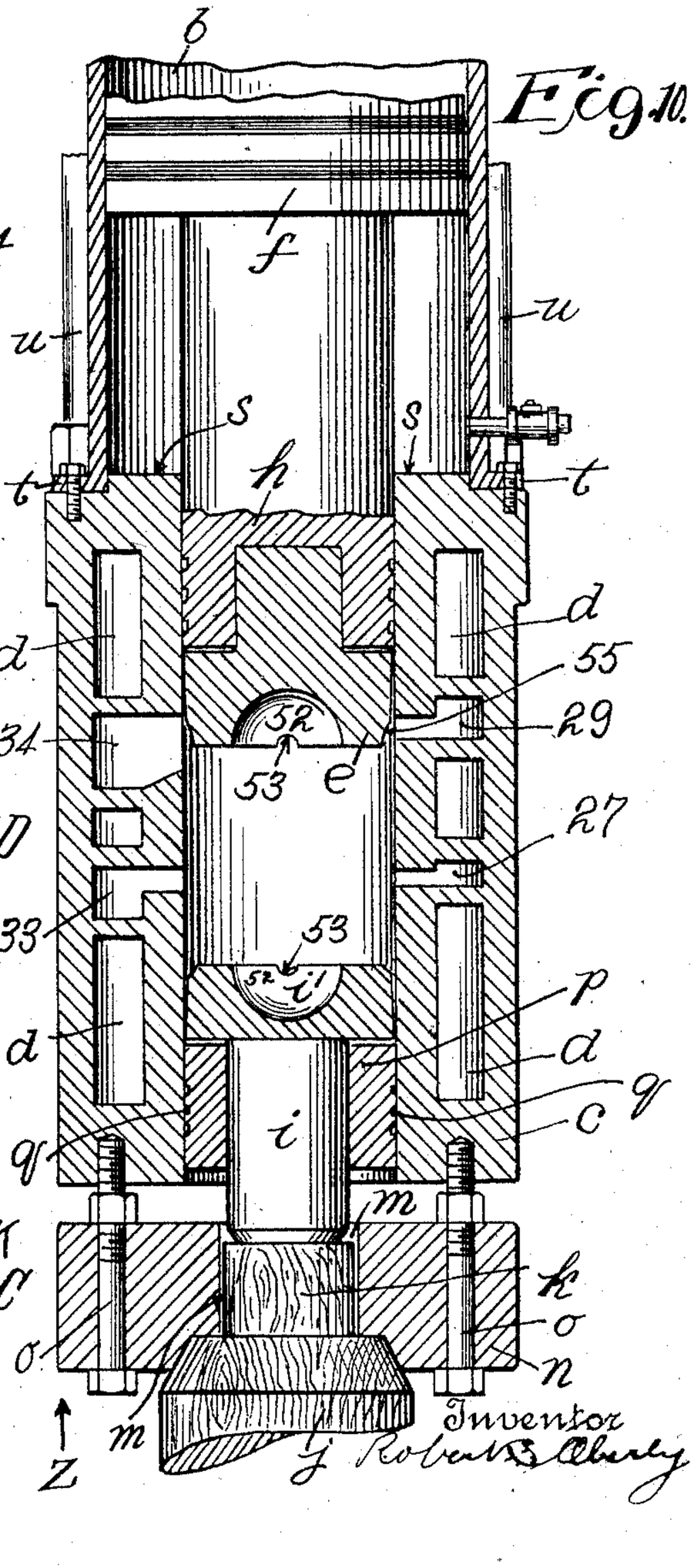


Fig. 10.



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4 SHEETS—SHEET 3.

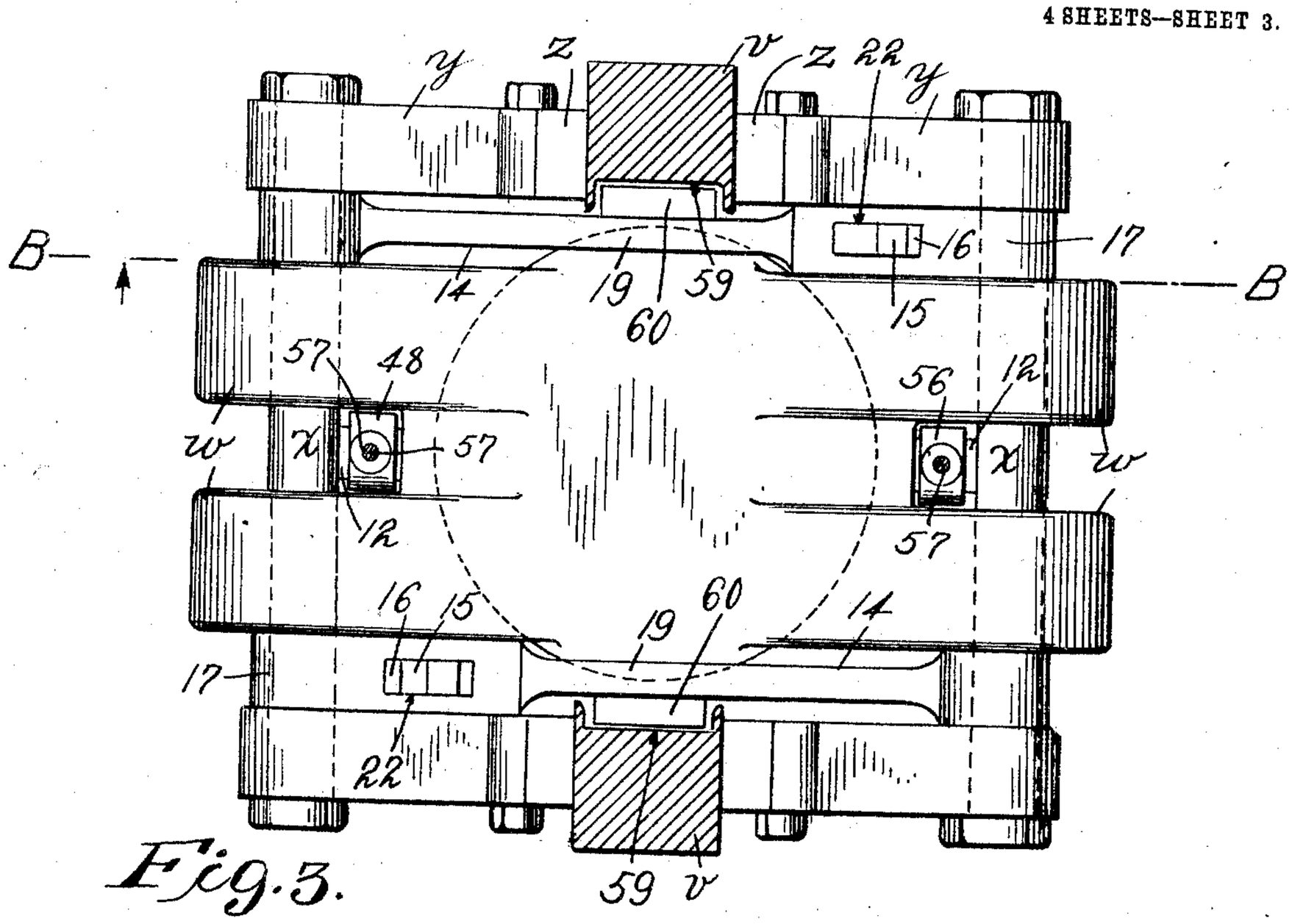
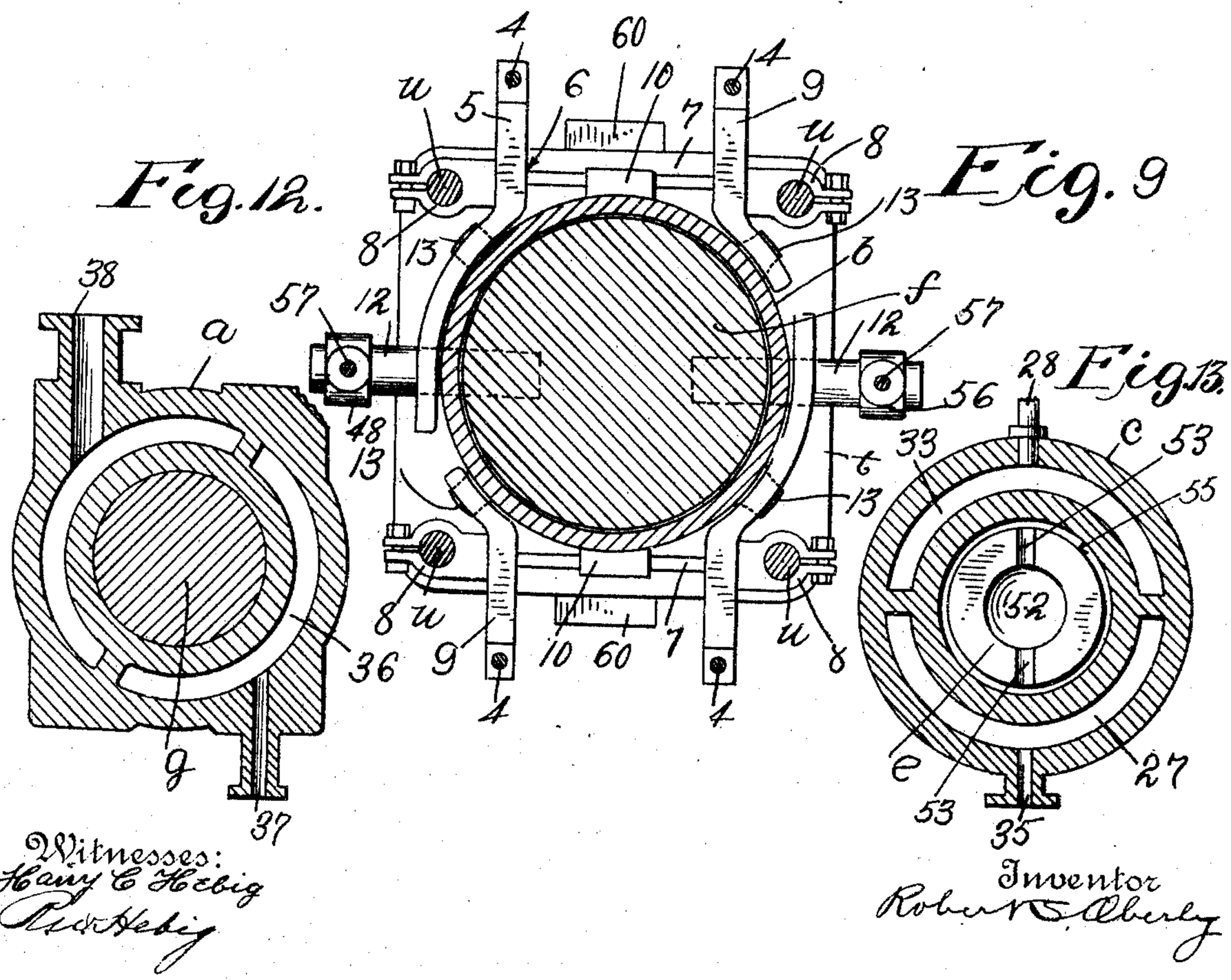


Fig. 3.



Witnesses:
Harry C Hebig
Rich Hebig

Inventor
Robert S. Oberly

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4 SHEETS—SHEET 4.

Fig. 4.

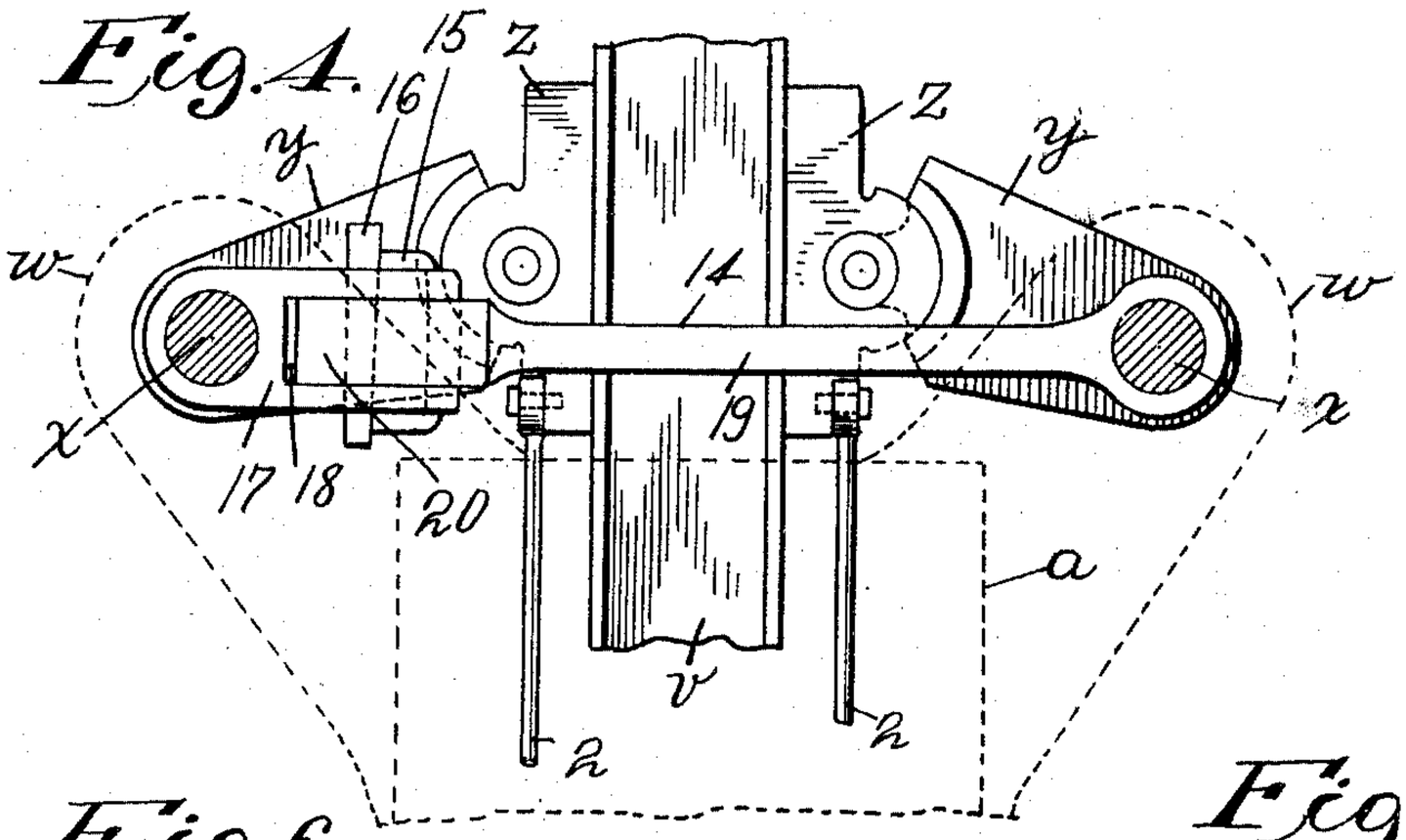
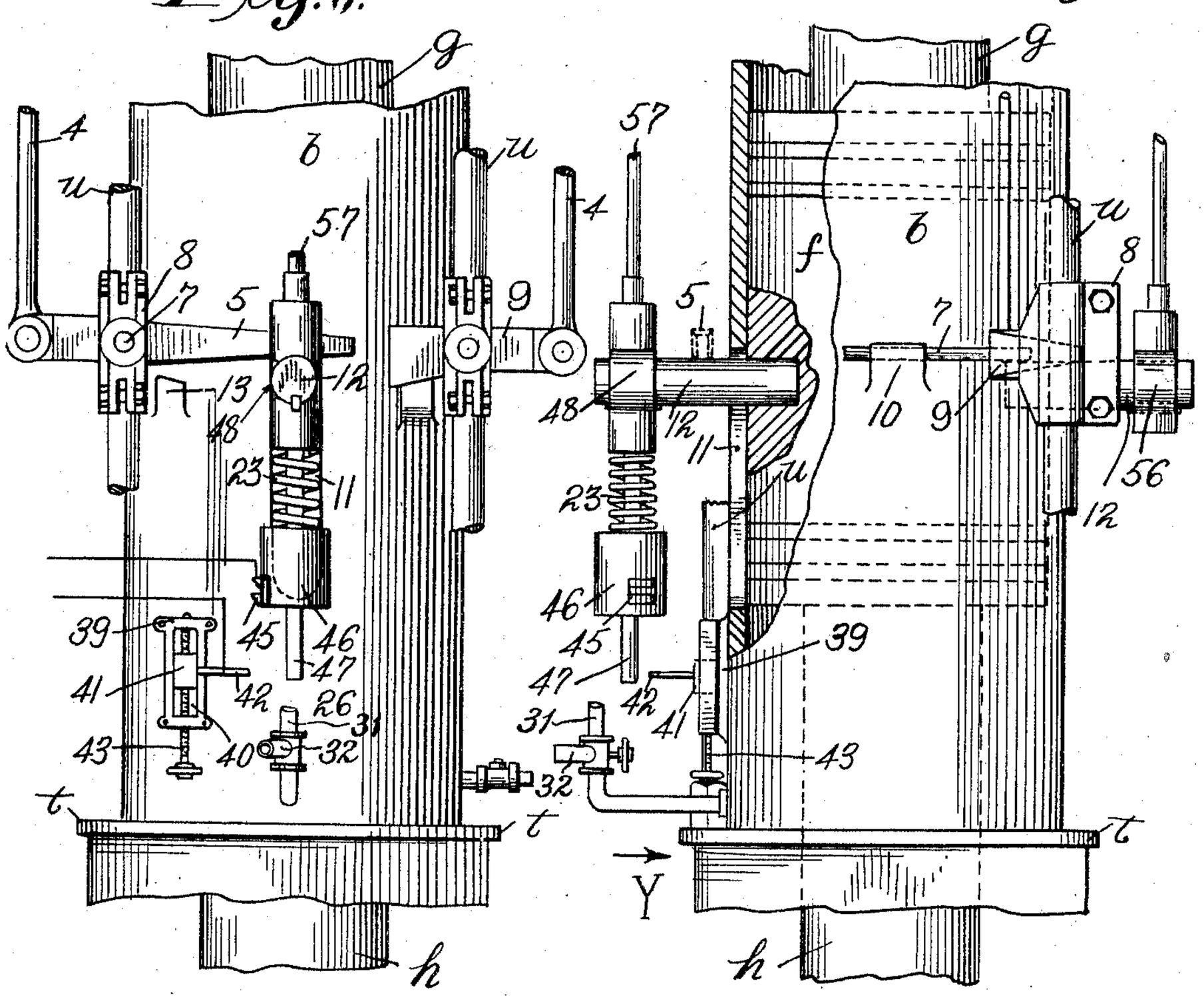


Fig. 6.

Fig. 5.



Witnesses:
Harry C. Hobig.
Rud. Hobig.

Inventor
Robert S. Oberly

UNITED STATES PATENT OFFICE.

ROBERT S. OBERLY, OF NEW YORK, N. Y.

EXPLOSION POWER-HAMMER.

No. 929,696. Specification of Letters Patent. Patented Aug. 3, 1909.

Application filed August 21, 1908. Serial No. 449,670.

To all whom it may concern:

Be it known that I, ROBERT S. OBERLY, a citizen of the United States, residing at New York, in the county and State of New York, have invented certain new and useful Improvements in Explosion Power-Hammers, of which the following is a specification, reference being had to the accompanying drawings.

My invention relates to improvements in power-operated hammers and particularly to improvements in explosion power hammers.

In the particular embodiment herein shown and described, I have explained my invention as applied to a pile-driver.

An object of my invention is to provide a hammer of the type referred to hereinbefore which will be simple in construction, comparatively cheap in manufacture and most efficient in operation.

Another object of my invention is to provide a hammer which will be compact and in which a large amount of energy may be transformed in a small space.

The force of the explosion acts directly upon the top of the pile and also acts to force upwardly a ram which afterward falls and delivers a blow. By an additional feature of my new construction the ram may be forced downwardly by an explosion above it and may thereby be used after the manner of a projectile or as a vehicle of energy which acts by impact.

In power-operated hammers heretofore known to me, a piston or like member has been accelerated by the working fluid and, acting as a projectile, hits the pile or other object a blow In this case the working fluid does not act directly upon the pile but acts through a projectile in which the energy of the working fluid is stored to be afterward transformed by impact into work done by moving the pile. In my new hammer the ram is similarly used as a projectile; but in addition thereto the working fluid acts directly upon the pile to move it downwardly.

One feature of my invention resides in the novel means provided for entrapping and exploding the charge between the pile itself and the projectile (or ram) which afterward in its descent drives the pile down still farther by an additional blow.

Another feature of my invention lies in the novel means provided for igniting the charge after the ram has struck the pile.

A third feature of my invention is the arrangement of parts whereby the length of the travel and thereby the force of the blow struck by the ram may be varied.

A further feature of my invention consists in the provision of means for gripping the leads to prevent the casing from rising off the pile and in the arrangement of parts whereby such means are given an initial pressure against or grip upon the leads. By suitable mechanism this initial pressure is added to until the leads are gripped with such force as to prevent the casing from rising off the pile.

A fifth feature of my invention resides in the arrangement of parts whereby either one or two explosion cylinders may be used, depending upon the nature of the soil in which the pile is being driven.

A sixth feature of my invention consists in the provision of breakable and easily replaceable bolts or like retaining means for holding the pile cap to the lower end of the casing.

Still further features of my invention are the provision of novel heads for the ram and the hammer-block upon which the latter delivers its blow and in the arrangement of parts for maintaining the slidable nature of the fit of the hammer-block.

Other features of my invention will be pointed out in the description and claims which follow hereinafter.

In the drawings illustrating the principle of my invention and the best mode now known to me of applying that principle, Figure 1 is an elevation of my new pile-driver, Fig. 2 is an elevation partly in section looking in the direction of the arrow X in Fig. 1; Fig. 3 is a section on the line A—A of Fig. 1; Fig. 4 is a sectional detail on the line B—B of Fig. 3 and shows the arrangement of the tie-rods at the upper end of the pile-driver; Fig. 5 is a fragmentary elevation of the intermediate or charging cylinder; Fig. 6 is an elevation looking in the direction of the arrow Y in Fig. 5; Fig. 7 is a section on the line C—C of Fig. 2; Fig. 8 is a section on the line D—D of Fig. 2; Fig. 9 is a section on line E—E of Fig. 1; Fig. 10 is a central vertical section of the lower end of my new pile driver; Fig. 11 is an end view looking in the direction

of the arrow Z in Fig. 10 with the pile removed; Fig. 12 is a section on line F—F of Fig. 2; Fig. 13 is a section on line K—K of Fig. 2.

The main casing of my new pile-driver consists of three principal parts; to wit, the upper cylinder *a*, the lower cylinder *c* (in which is included the cap *n* thereto attached) and the intermediate or charging cylinder *b*. The upper and lower cylinders *a* and *c* are really explosion cylinders and their walls are formed with chambers *d* which are kept filled with water for preventing an excessive rise in temperature during the operation of the pile-driver; that is, the cylinders *a* and *c* are water-jacketed.

Slidably fitted in the main casing is the ram from each end of the body-portion *f* of which extends a plunger-head *g*, *h*. The lower plunger head *h* is provided with a hammer-head or ram-head *e* which actually delivers the blow upon the hammer-block *i*. Between the latter and the top of the pile *j* is placed a pile-block *k* of fiber or like material which fits in the central hole *m* of the cap *n*. The latter is fastened to the lower end of the lower cylinder *c* by the bolts *o* which are readily replaced if broken. Mounted with a snug fit upon the shank of the hammer-block *i* is a bushing *p* provided with packing rings *q* which fit closely the wall of the cylinder *c* at its lower end. The blows of the ram-head *e* fall directly upon the head *i'* of the hammer-block *i* and are transmitted directly through the shank of the latter to the pile-block *k*. The head *i'* of the hammer-block shields the bushing *p* and in case the head *i'* becomes burred or otherwise deformed by the force of the heavy blows upon it, the slidable nature of the fit of the hammer-block as a whole will nevertheless not be disturbed.

The shell or casing *b* of the intermediate cylinder is thin, and is bolted at both its ends over the reduced ends of the explosion cylinder *a*, *c*, concentrically therewith. The reduced ends of the explosion cylinders over which the shell *b* is bolted form ledges or shoulders *s*, *s'* within the shell. The opposed ends of the shell *b* are formed with flanges *t*, *t'* to which are bolted the ends of tie-rods *u* which are adapted and designed to hold in assembled relation the parts of the casing.

The leads or guide-standards *v* are shown only in part; but it will be understood by all skilled in this art that the leads form a part of the usual derrick in a way too well known to require either illustration or further description herein.

Cast integral with the upper end of the upper explosion cylinder *a* and projecting outwardly and upwardly therefrom are two pairs of shaft-supports *w* in each pair of which is mounted a bar or stationary shaft *x*. There is rotatably mounted a pair of toggle-links *y* on each shaft *x* and to each of the toggle-links *y* is pivotally fastened a shoe or presser-block *z*. These shoes or presser-blocks *z* lie in pairs on opposite sides of the leads *v* and as the shafts *x* are carried upwardly the shoes or presser-blocks *z* are forced with great pressure against the leads *v* on opposite sides thereof. The shoes or presser-blocks are held with an initial pressure against the sides of the leads by the following devices: To each of the shoes or presser-blocks *z* is pivotally fastened one end of a pull-rod 2 the other end of which is headed and is connected through the medium of a coil-spring 3 with the headed upper end of a pull-rod 4. To the lower end of each of one pair of these pull-rods 4 is fastened one end of a curved lever or rocker-arm 5 fulcrumed at 6 upon a bar 7. The lower ends of the other pair of pull-rods 4 are fastened pivotally each to an end of one of a pair of curved levers 9 which are shorter than the levers 5 and which are fulcrumed one on each of the bars 7. Upon each of the tie-rods *u* are bolted the clamp-plates 8 each of which carries an end of one of the bars 7. The latter are further supported by the lugs 10 which project from the shell *b* of the intermediate cylinder. The coil-springs 3 are placed under initial tension so that the shoes or presser-blocks *z* are held with an initial pressure against the leads *v*. In the shell *b* of the intermediate cylinder are formed a pair of longitudinal slots 11 through each of which projects the outer end of a post 12 the inner end of which is carried by the body *f* of the ram. Under the free end of each of the longer curved levers 5 lies one of these posts 12; and as the body *f* rises, the posts 12 rock upwardly the free ends of the levers or rocker-arms 5 upon the cross-bars or rock-shafts 7, whereby the outer ends of the rocker-arms 5 are depressed and, through the pull-rods 4 attached to these outer ends, stretch the coil-springs 3 and force the shoes or presser-blocks *z* with still greater pressure against the leads *v*. The steps 13 formed integral with the casing serve to hold the free ends of the curved levers 5, 9 up against the initial tension of the coil-springs 3.

To hold the shafts *x* in place against the force tending to separate them, a pair of tension-rods 14 is provided. Each of these tension-rods consists of two parts held together by two taper or wedge-shaped keys 15, 16 which pass through slots in the two parts. One of these parts is a block 17 of metal formed with a recess 18 and mounted rotatably upon one of the shafts *x;* while the other or coöperating part is a bar 19 of metal formed with a head 20 at one end and at its other end mounted free to rotate upon the opposite shaft *x*. The head 20 fits in the re-

cess 18 in the block 17 and is formed with a channel or slot which registers with the slots 22 formed in the walls of the recess 18. When the slots are in line with each other, the keys 15, 16 are driven in. The bar 19 is then expanded by heating it and the keys 15, 16 are again driven in to fill up the openings due to the expansion of the metal bar 19. This operation places the tension-rods 14 under an initial tension.

The upper end of the charging cylinder *b* is connected with the lower explosion cylinder *c* by a pipe 26 the lower end of which communicates with the lower explosion cylinder *c* through the inlet port 27. In the pipe 26 is mounted a generator-valve, which is shown conventionally at 25 and which serves to impregnate with the fuel the air flowing through the pipe 26 toward the lower explosion cylinder *c*. A branch pipe 28 leads off from the pipe 26 and communicates with the explosion cylinder *c* through the inlet port 29 which lies above the inlet port 27. In each of the pipes 26, 28, there is mounted a valve 30; and by properly manipulating the valves 30, the flow of the explosive mixture may be directed through either of the inlet ports, as may be desired. The lower end of the charging cylinder *b* is connected with the upper explosion cylinder *a* by the pipe 31 in which are mounted a second generator valve 24 and a three-way valve 32. The latter allows the lower end of the charging cylinder *b* to be brought into communication with the atmosphere at will.

In the explosion cylinder *c* are formed two exhaust ports 33, 34 both of which lead into the exhaust pipe 35. The exhaust port 33 extends slightly below the inlet port 27 and the exhaust port 34 is similarly placed with respect to the inlet port 29. Hence, the exhaust port 33 will open slightly in advance of the inlet port 27 and the same is true of the exhaust port 34 with respect to the inlet port 29. This insures that the pressure in the lower explosion cylinder will be reduced to atmospheric pressure at the time the inlet ports open. The upper explosion cylinder *a* is formed with an inlet port 36 and an exhaust port 37 and the latter opens into the upper exhaust pipe 38.

The ignition apparatus for the lower explosion cylinder may be described as follows: Upon the shell *b* of the intermediate cylinder is mounted a bracket or frame 39 having a central slot or channel 40 in which is slidably fitted a block 41 which carries a contact-finger 42. By means of the screw 43 the position of the block and its contact-finger may be varied at will. The latter is electrically connected with one pole of the battery 44 the other pole of which is electrically connected with a serrated contact-plate 45 mounted upon but insulated from the inertia block 46 mounted free to slide upon the rod 47 but held thereon by a coil-spring 23 one end of which is fastened to the block 46 and the other end of which and the rod 47 are fastened to the collar 48 mounted upon the outer end of one of the posts 12. When the body *f* of the ram reaches the end of its downward travel or stroke, the inertia block 46 continues its downward travel against the tension of the coil-spring 23 and carries the toothed contact-plate 45 against the contact-finger 42, whereby the circuit from the battery 44 is momentarily made or completed. A current is induced in the secondary 49 of the induction coil 50; and when the current is interrupted, a spark is generated at the spark-plug 51 in the explosion cylinder *c*.

The ram-head *e* and the head *i'* of the hammer-block *i* are each formed with a recess 52 and with grooves 53 leading radially from the recess 52. When the ram-head and the head of the hammer-block are in contact, the recesses 52 combine to form a chamber in which is held under compression the explosive charge. The latter is fired through the medium of the ignition apparatus just described and the pile is driven downwardly and the ram is forced upwardly.

In the upper explosion cylinder *a* the plunger-head *g* is formed at its upper end with a deflector 54 by which the inflowing gaseous mixture is deflected and drives before it the exploded charge out through the exhaust port. In this cylinder the explosion may be caused by the heat of compression of the gases or by any other suitable means. In the lower explosion cylinder the annular beveled part 55 of the end of the ram-head *e* acts as a deflector.

Upon the posts 12 are mounted the collars 48, 56, which are connected by pull-rods 57 with the crossbeam 58. By raising and lowering the latter, the body *f* of the ram may be moved up and down in the casing at starting or at any other time desired.

The leads *v* are formed with guideways 59 and the casing with guide-blocks 60 which travel in the guideways 59.

The operation of my new explosion powder hammer may be described as follows: Assuming the ram to be in the position shown in Fig. 2, the ram has been forced upwardly by the previous explosion and the body *f* has forced from the lower end of the charging cylinder a charge of air, which in passing through the generator-valve 24 becomes impregnated with the fuel, whereby there is formed an explosive mixture. The latter has been delivered into the upper end of the upper explosion cylinder *a* through the inlet port 36 and past the deflector 54 and has been compressed by the upward movement of the plunger-head *g*. The same upward movement of the ram drives air from the upper end of the charging cylinder

b through the pipe 26 and the generator valve 25 therein to the lower explosion cylinder *c*. The explosive mixture flowing in through one of the inlet ports 27 or 29 (depending on which valve 30 is closed) strikes the reflector-surface 55 on the ram-head *e* and drives the burned gases out into the exhaust pipe 35 through one of the exhaust ports 33 or 34. The upward movement of the plunger-head *g* generates heat in compressing the explosive charge and this heat is relied upon to fire the charge; but any suitable means may be used to ignite the mixture, as will be readily understood by those skilled in this art. An explosion in the upper cylinder *a* results and the ram is driven downwardly. As the ram-head *e* meets the hammer-block head *i'*, the explosive mixture is entrapped in the chamber formed by the recesses 52 and in the slight space between the wall of the lower cylinder *c* and the heads *e* and *i'*. When the ram is brought to rest by its impact with the pile *j*, the inertia block 46 continues its downward travel against the tension of the coil-spring 23. In its continued downward travel the inertia block 46 brings the serrated contact-plate 45 into electrical connection with the contact-finger 42 and thereby completes the battery circuit, which is almost immediately broken by the upward pull of the coil-spring 23, whereby a spark is generated at the spark-plug 51 and the explosive charge in the lower cylinder between the heads *e* and *i'* is fired. The ram is now driven upwardly and the cycle of operations is repeated. The casing follows the pile *j* in the latter's descent so that the cap *n* always rests upon the top of the pile.

In case it is not desired to use the upper explosion cylinder *a*, the generator-valve 24 is closed and the three-way valve 32 is opened to the atmosphere. The other parts then operate as before, the blow of the ram upon the pile being that due to only the weight of the ram instead of that due to the same weight plus the energy of the explosion in the upper cylinder.

In case the ram is to have only a short travel or flight, the valve 30 in the branch pipe 28 is closed and the explosive mixture flows through the pipe 26 and the inlet port 27 into the lower cylinder *c*. However, when the soil is hard to penetrate and the energy of the working fluid transformed into work done in throwing upwardly the ram is relatively great as compared with the work done in forcing the pile downwardly, the valve 30 in the lower end of the pipe 26 is closed and the explosive mixture flows through the branch pipe 28 and enters the lower explosion cylinder *c* through the inlet port 29. Thus, provision is made for a variation of the throw or travel of the ram.

As the body *f* of the ram travels upwardly, it carries with it the posts 12 which move in the slots 11 in the shell *b* of the intermediate cylinder. Two of the posts 12 engage and force upwardly the free inner ends of the levers or rocker-arms 5 and depress correspondingly the outer ends of the same rocker-arms, thereby exerting a downward pull on the rods 2 and 4 and increasing the tension of the coil-springs 3 by stretching the same. The downward pull on the rods 2 tends to press the shoes or presser-blocks *z* against the leads *v* and to increase the frictional resistance between these members. Thus, an additional resistance is offered to the movement of the casing relatively to the leads. This resistance is still further increased by the arrangement of parts shown in Fig. 4, in the event of the casing moving upwardly relatively to the leads *v*. In this case the shaft supports *w* rise with the casing and carry upwardly the shaft *x* and thereby the outer ends of the toggle-links. It will be obvious from an inspection of Fig. 4 that an upward movement of the outer ends of the toggle-links *y* will tend to force the pressure-blocks *z* against the leads with great pressure and the more the casing moves upwardly, the greater is this pressure increased, according to the well-known principles governing the action of toggle-joint mechanisms.

In starting the hammer, the crossbeam 58 is raised and allowed to fall, thereby giving to the ram a corresponding reciprocating motion. This raising and lowering of the crossbeam and ram is kept up, until an explosion of the mixture under the ram-head *e* takes place and the operation of the hammer becomes automatic.

It will be observed that the casing and all parts of my new hammer carried within and by the casing follows the pile in the descent of the latter.

It will be obvious to all skilled in this art that many variations may be made in the construction of my new hammer without departing from the principle of my invention; and I desire to be understood as claiming my invention in the broadest manner legally permissible. The upper explosion cylinder *a* may be omitted altogether, together with the upper plunger-head *g;* and so may be the mechanism for gripping the leads. Other changes in the particular embodiment of my invention hereinbefore described will suggest themselves to persons skilled in this art and may be made without departing from the spirit of my invention; but I desire to be distinctly understood as claiming all such changes as being within the scope of the following claims.

I claim:

1. In an apparatus of the character described, the combination with the casing of an explosion chamber one end of which

casing is recessed to fit over and hold the end of a pile; of a closure for said end of said casing; a ram mounted in said chamber; and means for introducing an explosive charge into said chamber.

2. In an apparatus of the character described, the combination with the casing of an explosion chamber one end of which casing is recessed to fit over and hold the end of a pile; of a closure for said end of said casing; a ram mounted in said chamber; means for introducing an explosive charge into said chamber; and means for firing said charge.

3. In an apparatus of the character described, the combination with the casing of an explosion chamber one end of which casing is recessed to fit over and hold the end of a pile; a gas-tight closure for said end of said casing; a ram mounted in said chamber; and means for introducing an explosive charge into said chamber.

4. In an apparatus of the character described, the combination with the casing of an explosion chamber, said casing being provided with means for holding the end of a pile; of a closure for one end of said casing; a ram mounted in said chamber; and means for introducing an explosive charge into said chamber.

5. In an apparatus of the character described, the combination with the casing of an explosion chamber; of a ram mounted in said chamber; a hammer-block mounted in said chamber; and a slidable bushing interposed between said hammer-block and casing and having a gas-tight fit against the opposed wall thereof.

6. In an apparatus of the character described, the combination with the casing of an explosion chamber; of means for holding the end of a pile; and bolts for fastening said means to said casing, said bolts being readily replaceable in case of breakage.

7. In an apparatus of the character described, the combination with leads and a casing guided thereby, of shoes adapted to bear against said leads; and links one end of each of which is pivotally connected to one of said shoes and the other end of each of which is pivotally connected with said casing; the last-named end of the link being normally lower than its end connected with the shoe.

8. In an apparatus of the character described, the combination with leads and a casing guided thereby, of shoes adapted to bear against said leads; links pivotally connected with said shoes and with said casing; and means for holding said shoes against upward movement along said leads.

9. In an apparatus of the character described, the combination with a casing; of a ram mounted in said casing; supports in which said casing is mounted; gripping devices for connecting said casing and supports; and mechanism actuated by said ram for increasing the gripping action of said devices.

10. In an apparatus of the character described, the combination with leads and a casing guided thereby, of shoes adapted to bear against said leads; means carried by said casing for forcing said shoes against said leads, when said casing moves upwardly; and yielding devices under initial tension for holding said shoes against upward movement along said leads.

11. In an apparatus of the character described, the combination with leads and a casing guided thereby, of shoes adapted to bear against said leads; means carried by said casing for forcing said shoes against said leads, when said casing moves upwardly; a ram mounted in said casing; and means actuated by said ram for increasing the gripping action of said shoes.

12. In an apparatus of the character described, the combination with a casing; of supports in which said casing is mounted; a ram mounted in said casing; and gripping devices actuated by said ram for holding said casing against movement in said supports.

In testimony whereof I have hereunto set my hand this eighteenth day of August, 1908, at said New York, in the presence of the two undersigned witnesses.

ROBERT S. OBERLY.

Witnesses:

ROBERT A. FLUM,

JOHN L. OBERLY.