

Sept. 17, 1940.

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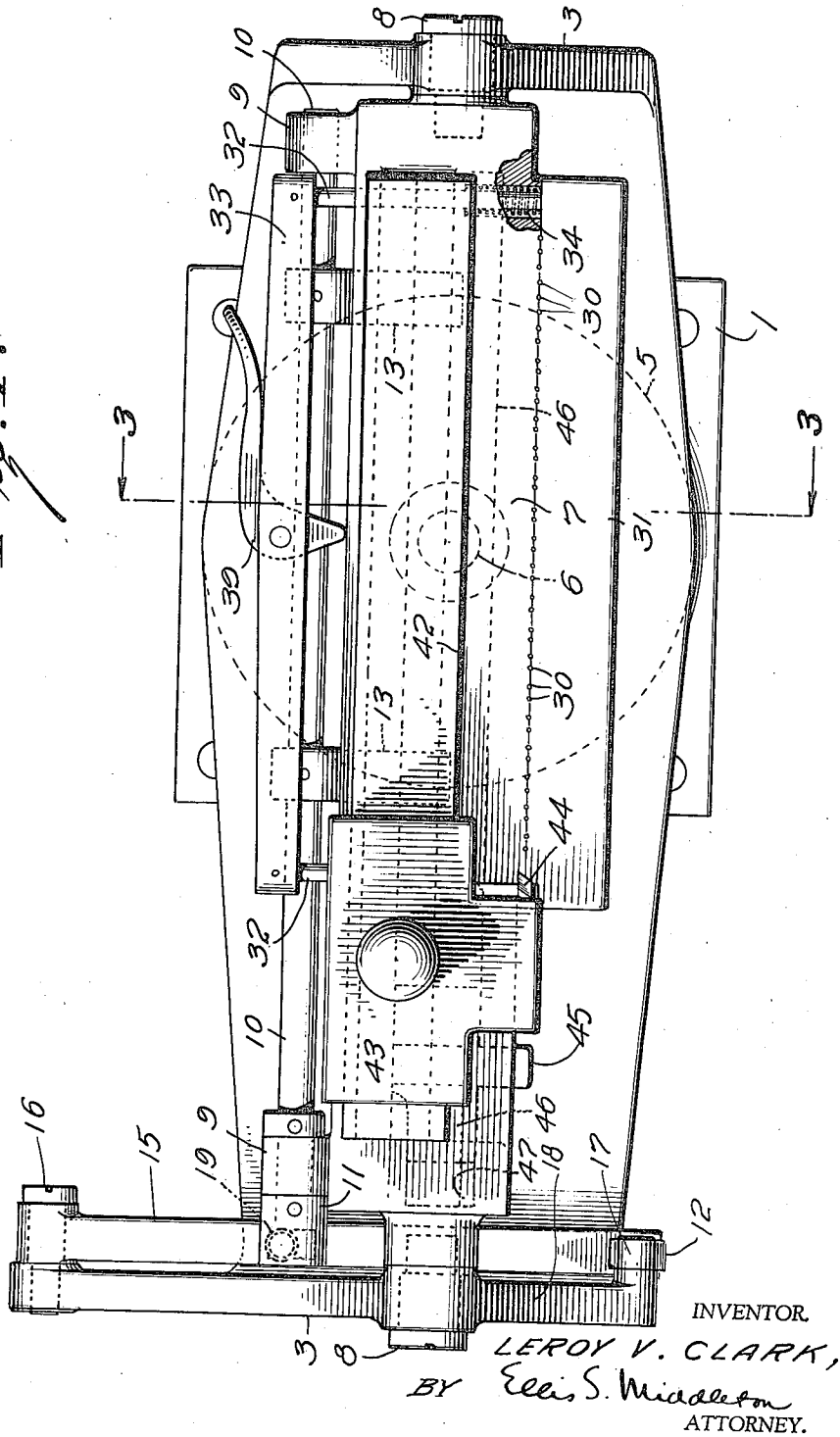
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METHOD FOR CASTING ELECTRIC BLASTING CAP PLUGS

Filed Dec. 22, 1938

13 Sheets-Sheet 1

Fig. 1.



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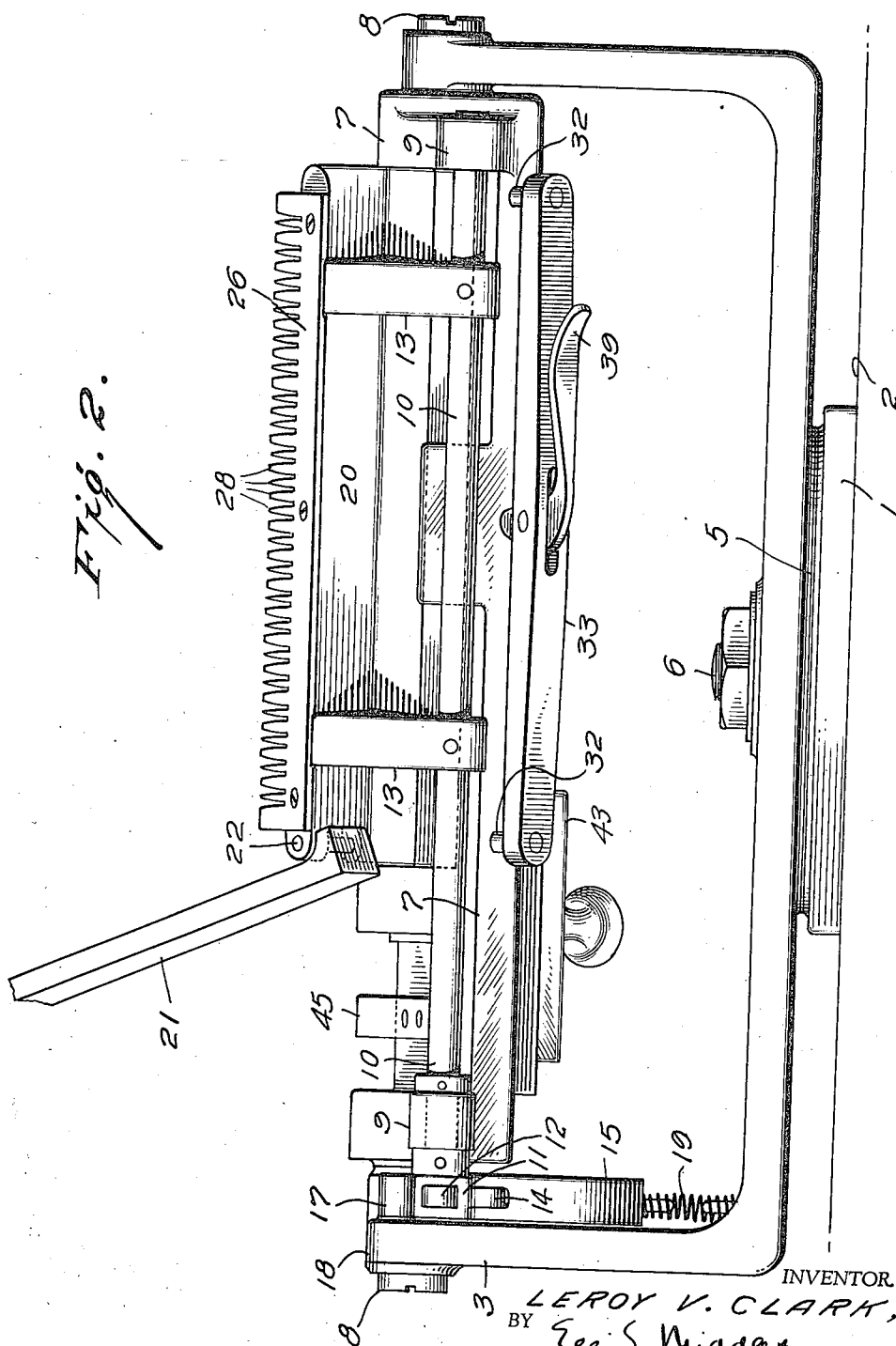
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13 Sheets-Sheet 2



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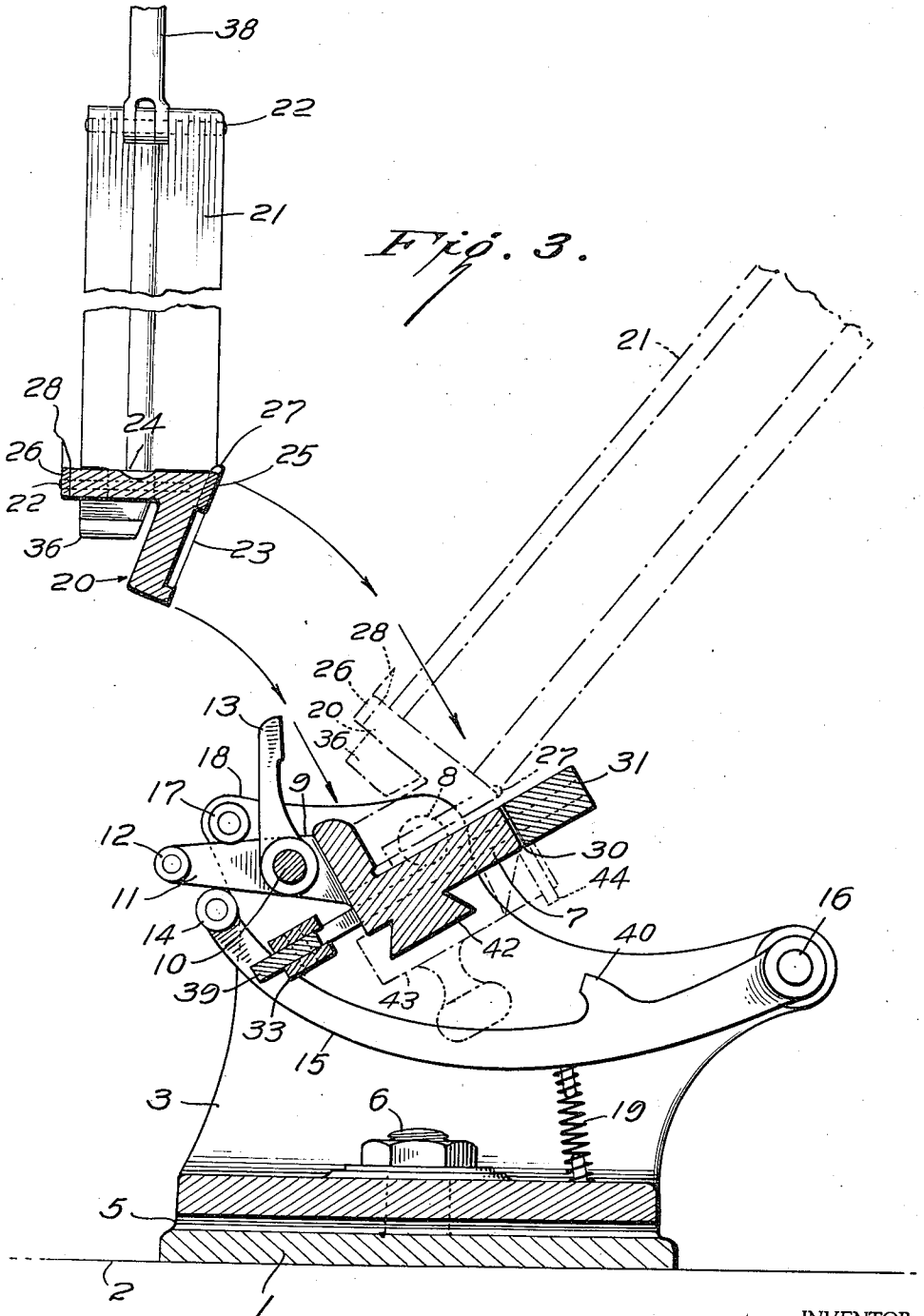
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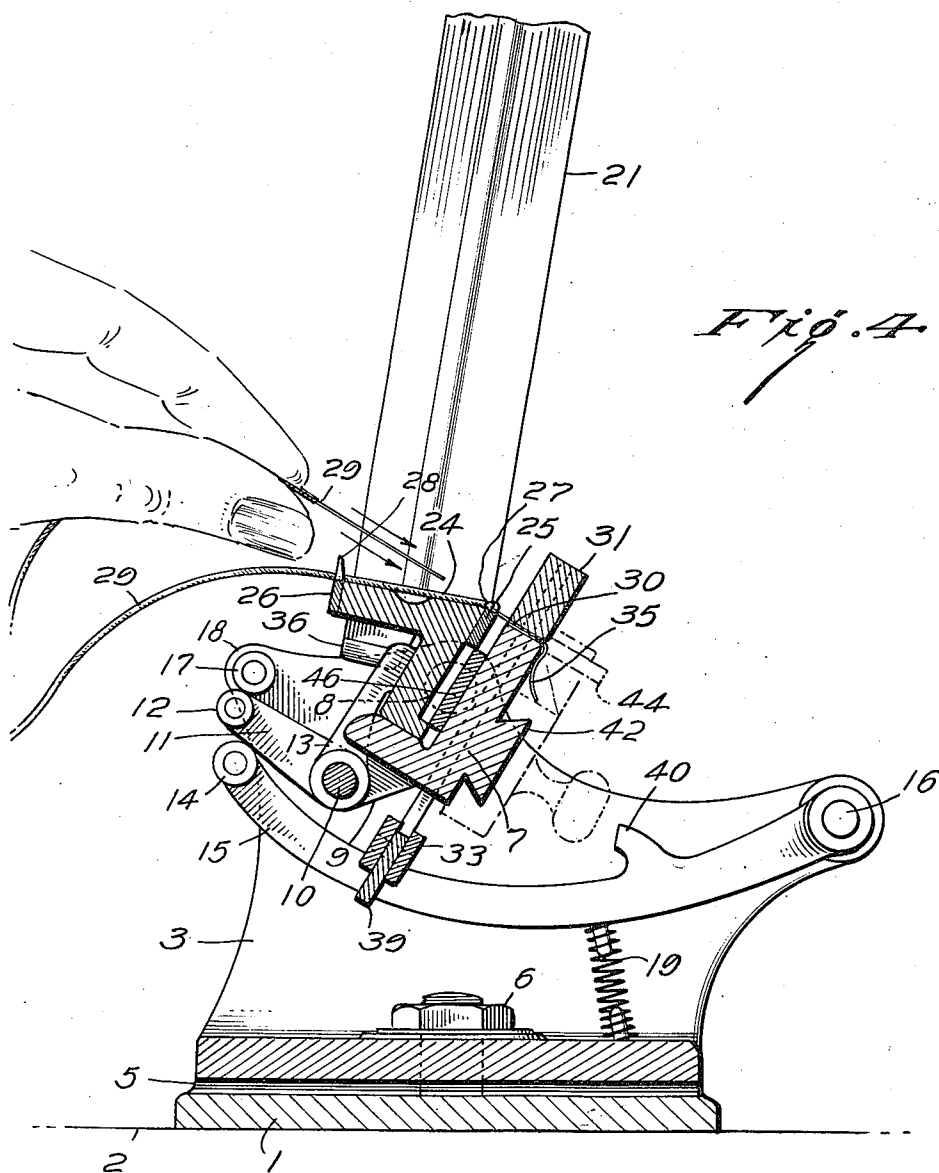
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13 Sheets-Sheet 4



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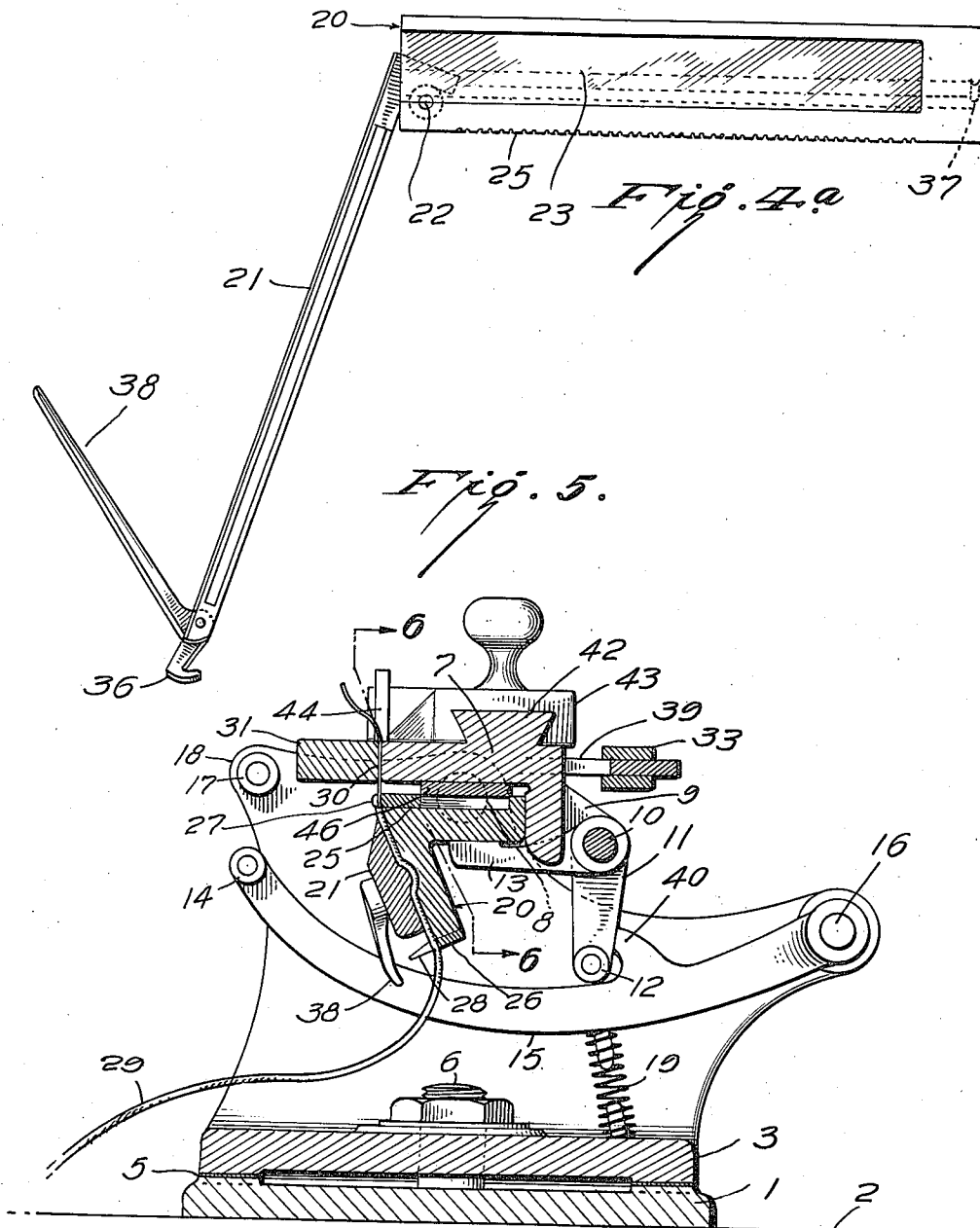
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METHOD FOR CASTING ELECTRIC BLASTING CAP PLUGS

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13 Sheets-Sheet 5



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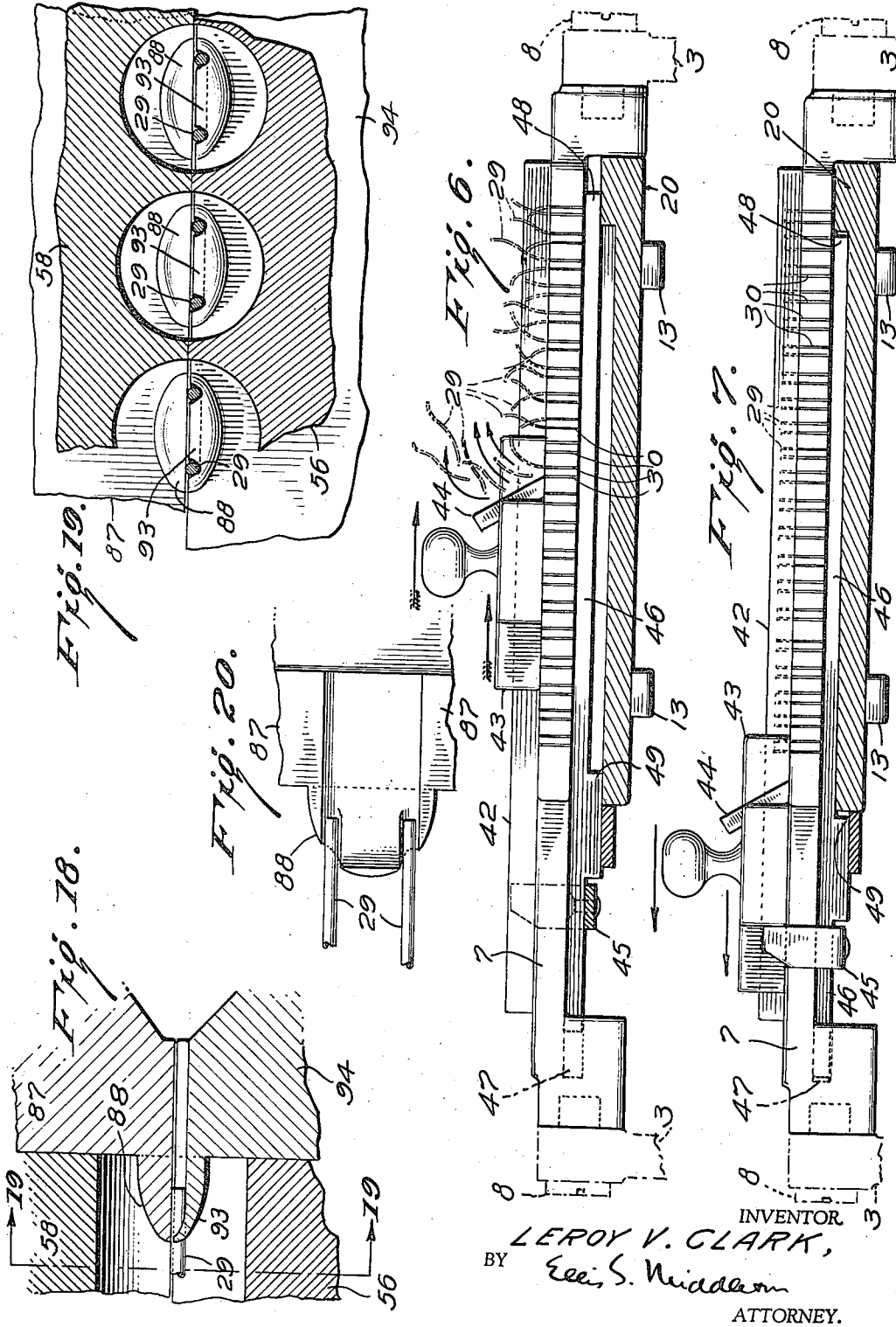
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13 Sheets-Sheet 6



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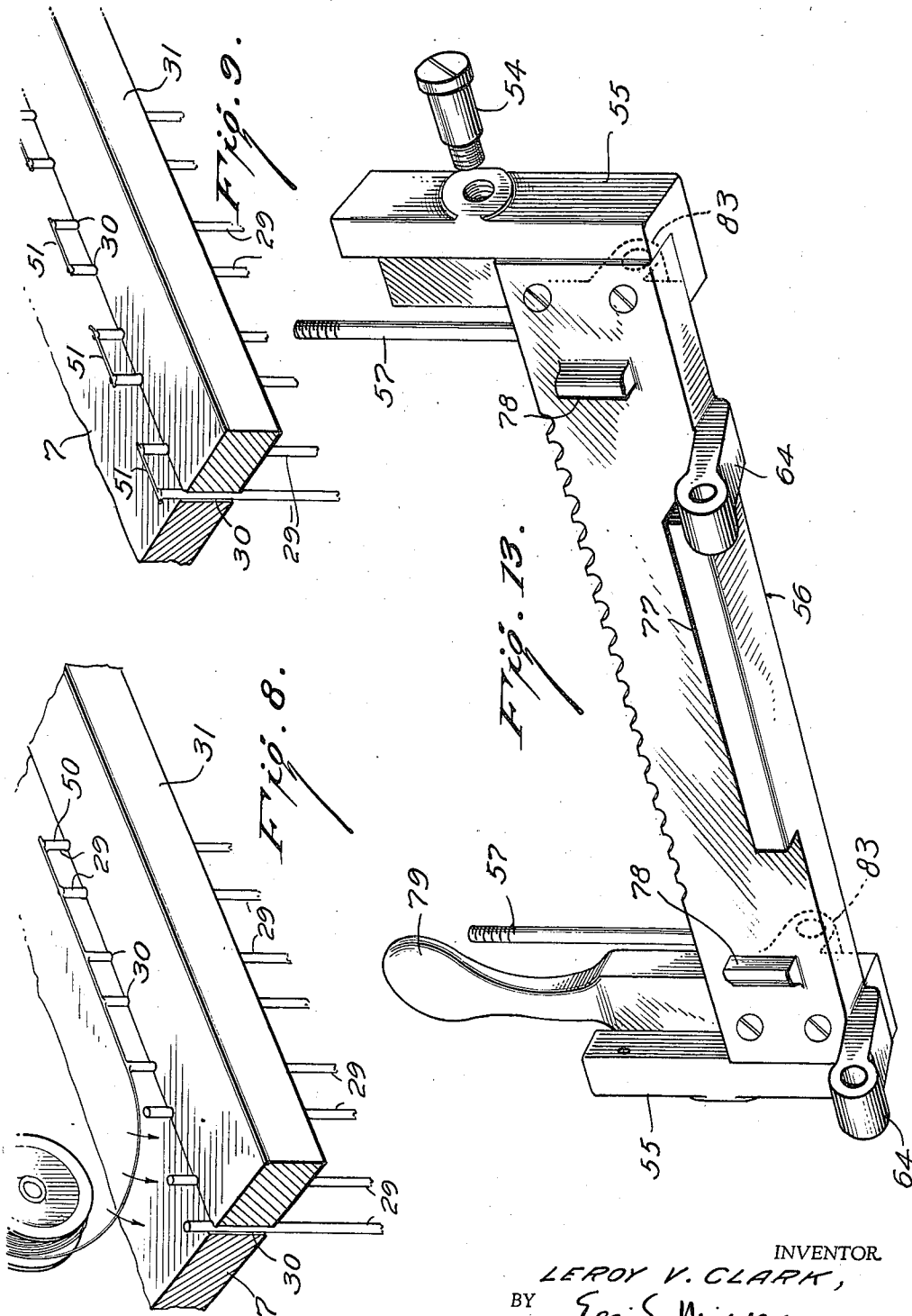
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13 Sheets-Sheet 7



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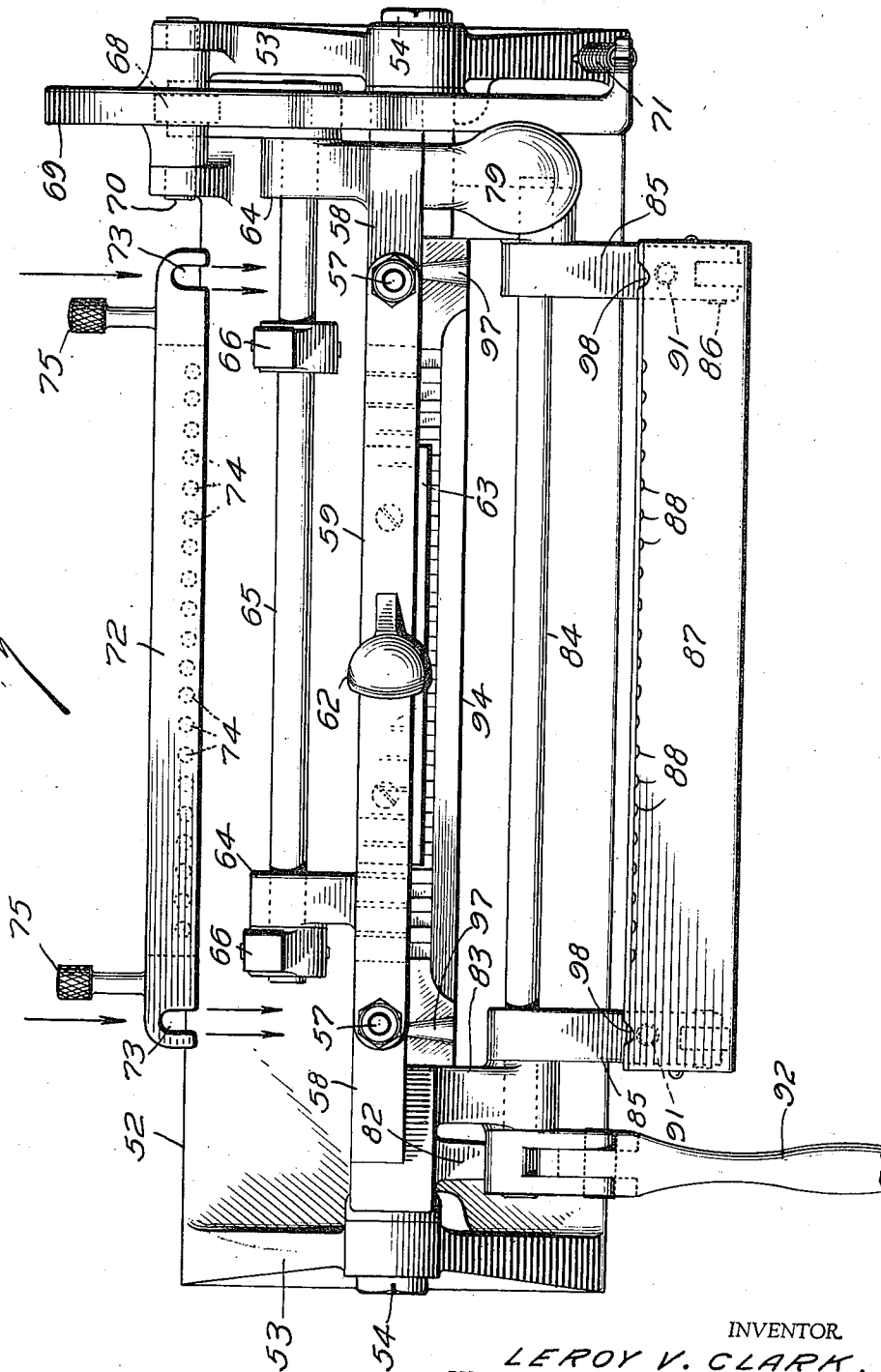
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Fig. 10.



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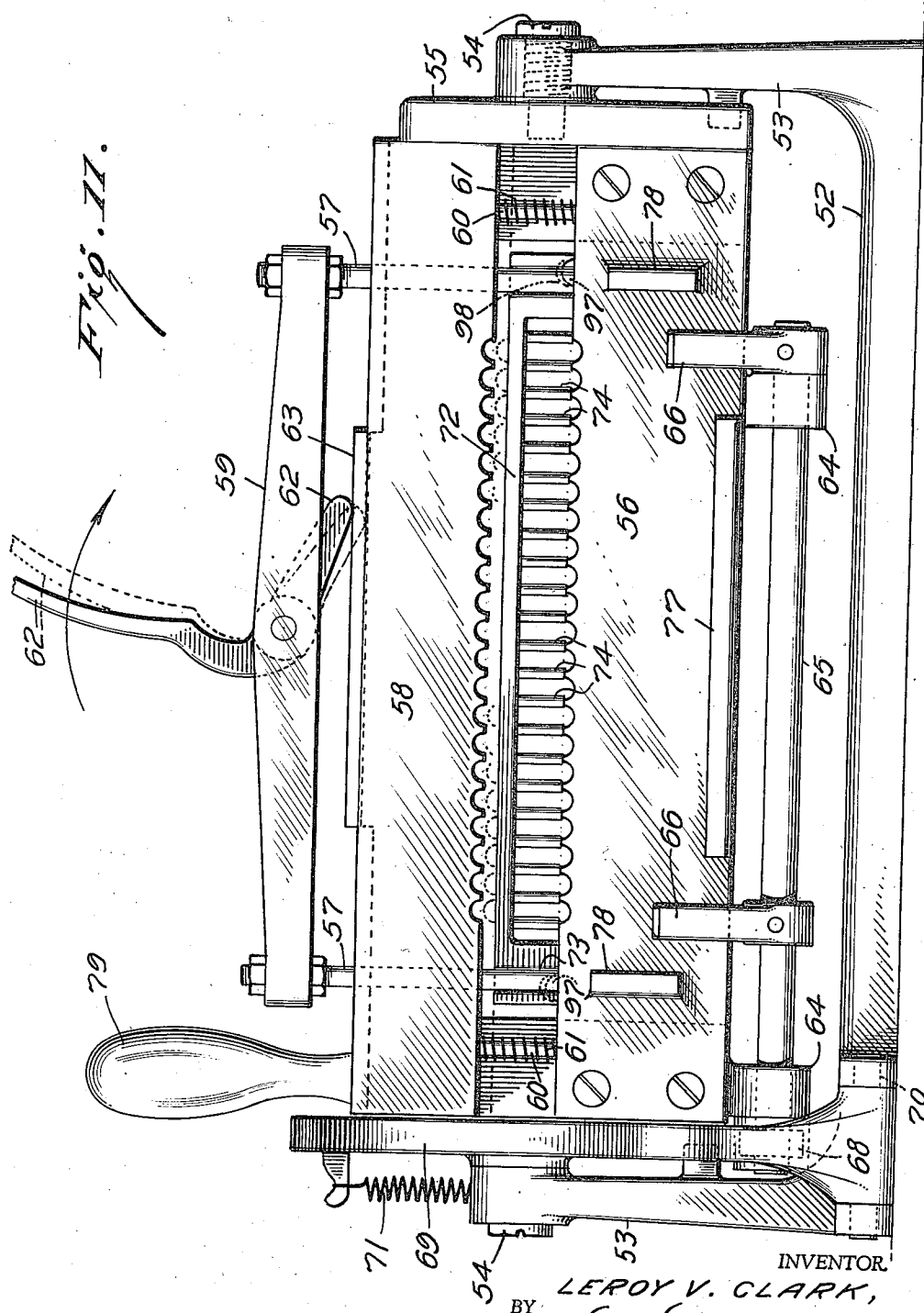
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METHOD FOR CASTING ELECTRIC BLASTING CAP PLUGS

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13 Sheets-Sheet 9



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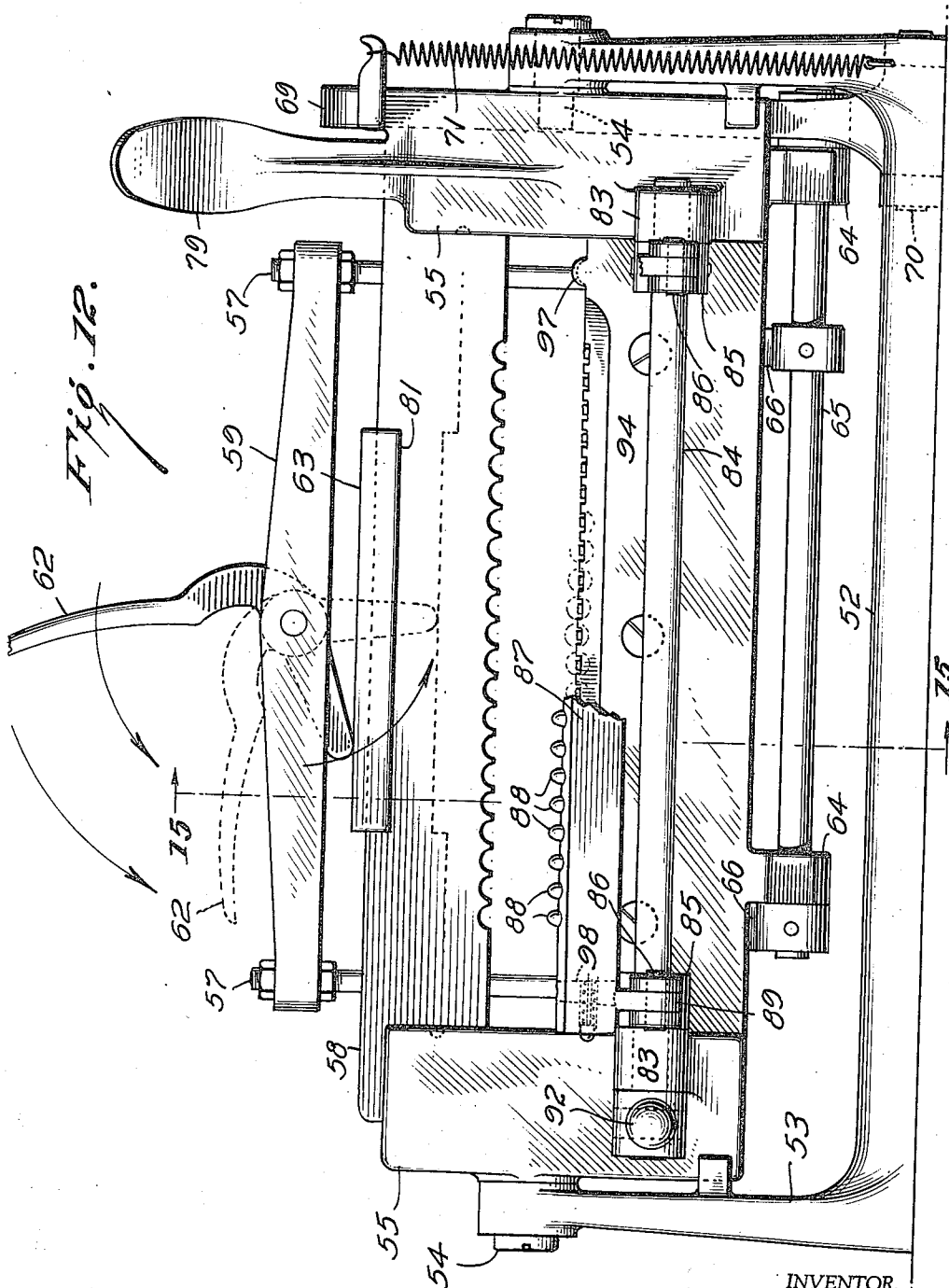
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13 Sheets-Sheet 10



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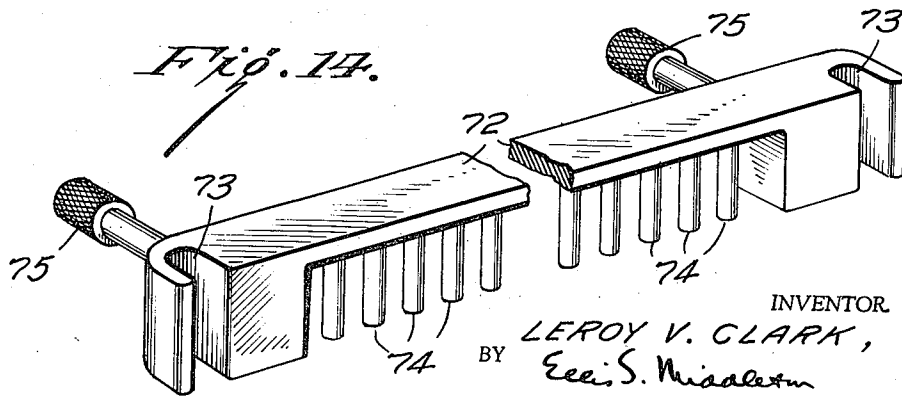
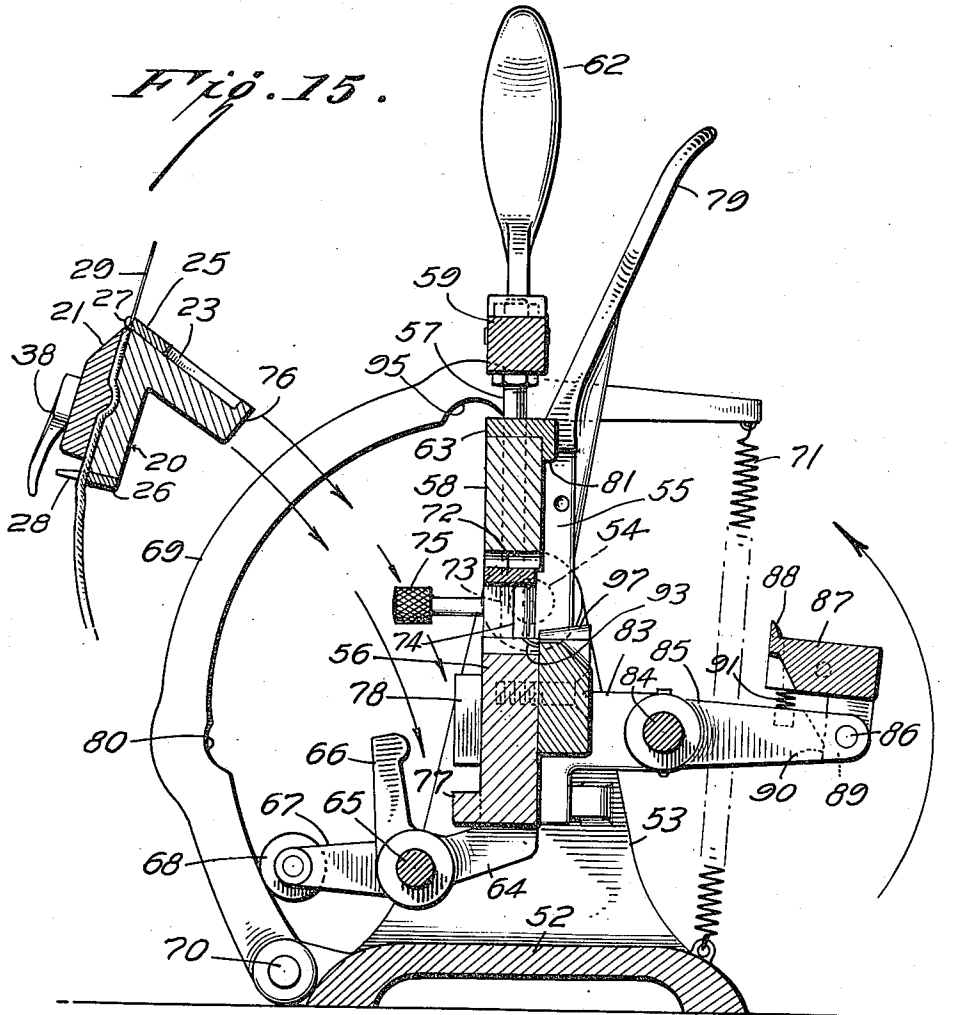
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METHOD FOR CASTING ELECTRIC BLASTING CAP PLUGS

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13 Sheets-Sheet 11



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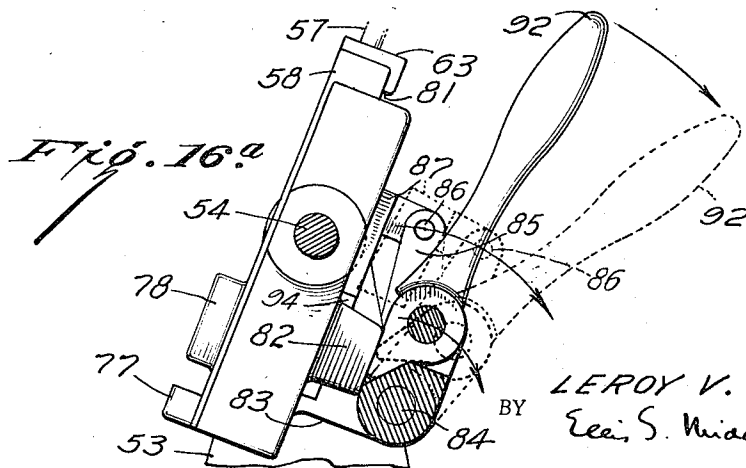
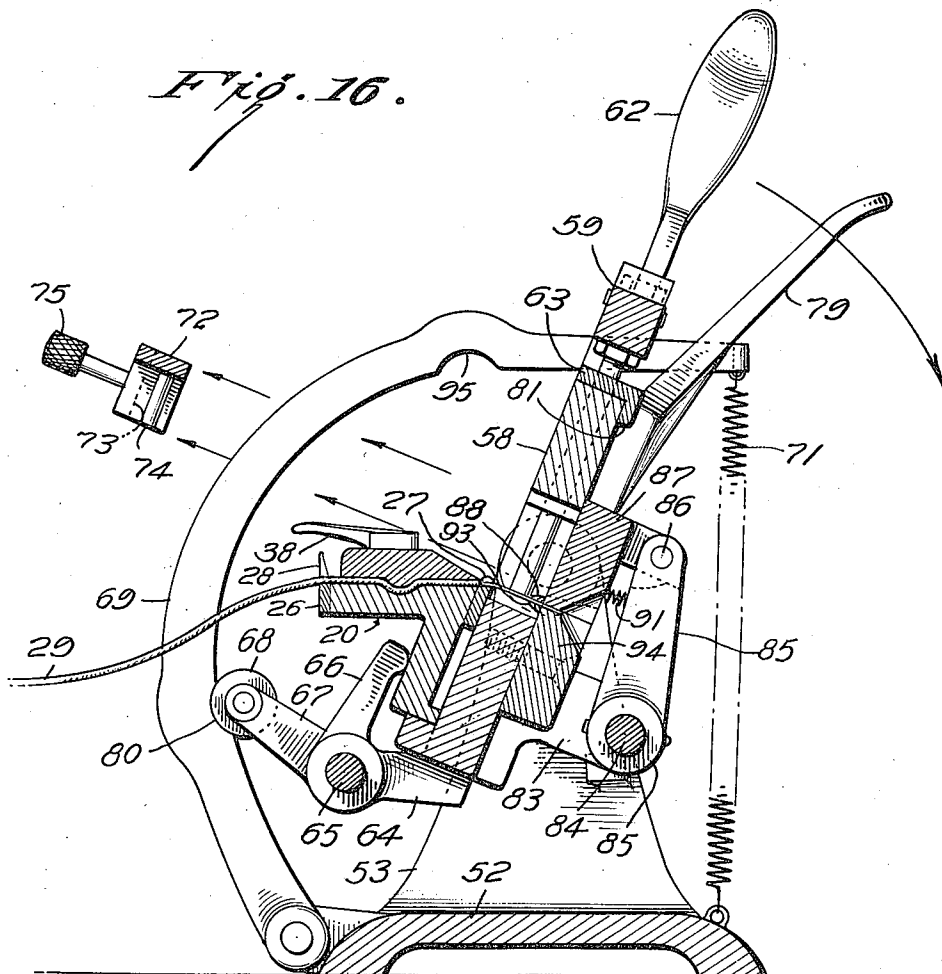
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13 Sheets-Sheet 12



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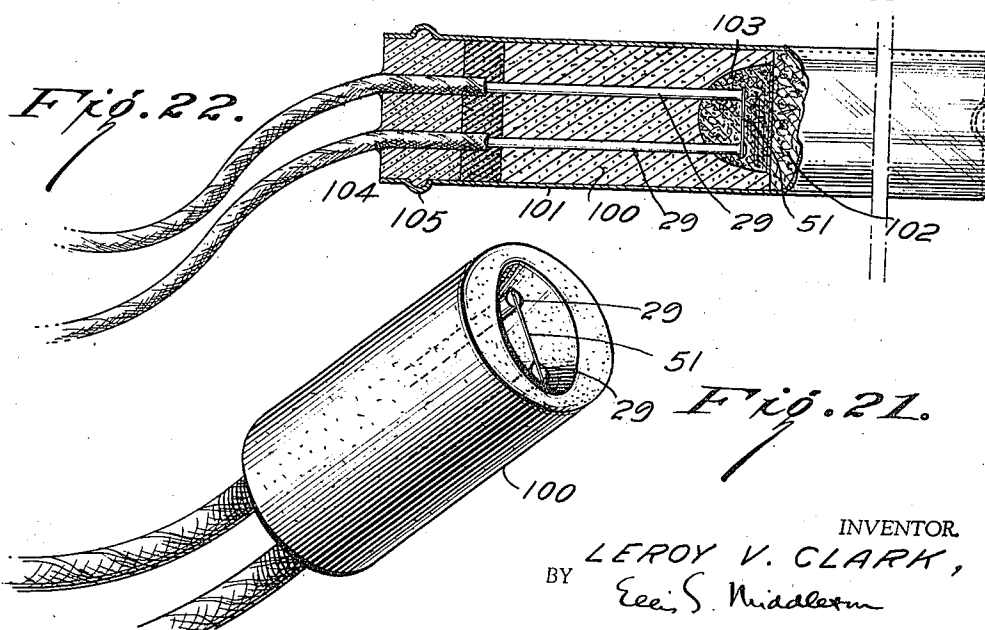
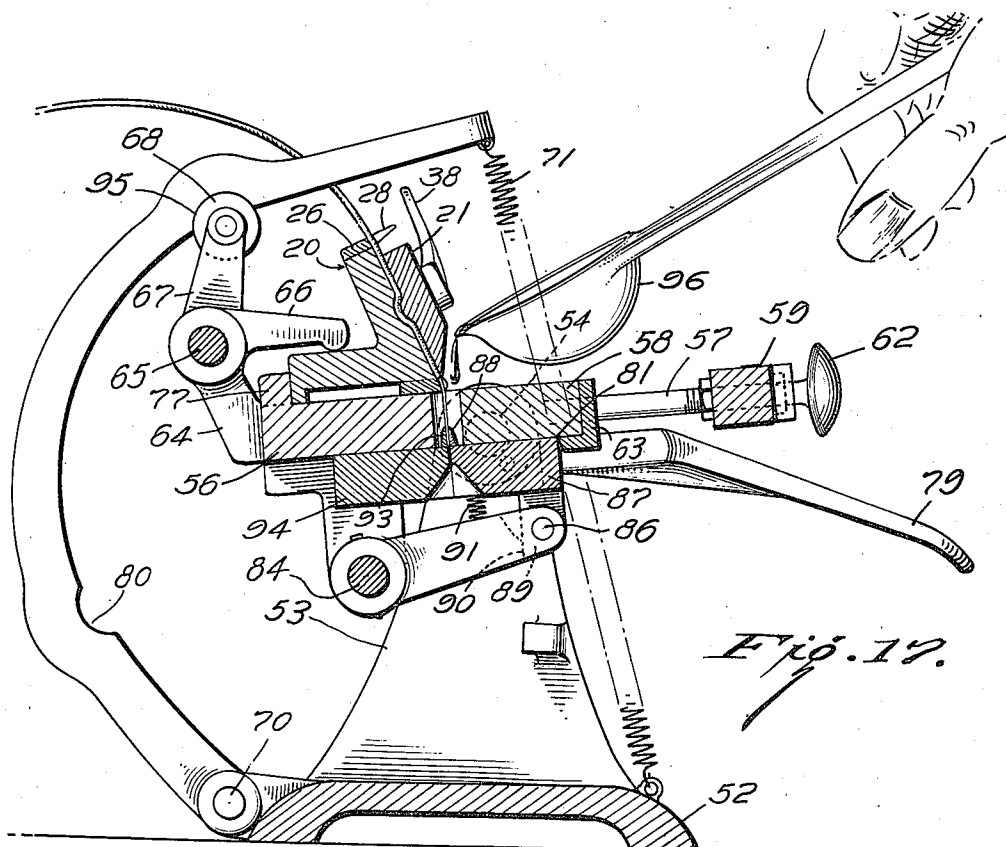
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METHOD FOR CASTING ELECTRIC BLASTING CAP PLUGS

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13 Sheets-Sheet 13



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UNITED STATES PATENT OFFICE

2,215,066

METHOD FOR CASTING ELECTRIC
BLASTING CAP PLUGS

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Application December 22, 1938, Serial No. 247,144

6 Claims. (Cl. 18—59)

The present invention relates to a method for casting plugs about lead wires, such plugs being useful in the manufacture of electric blasting initiators.

5 In this art, an electric blasting initiator usually includes a thin metal open-ended shell into which is filled detonating or explosive charge of varied compositions. This first, or base, charge is usually set off under the influence of a small quantity of explosive of the primary initiating type such as lead azide, mercury fulminate or the like in the manner well known to those skilled in the art. The primary initiating explosive may be set off by the influence of a small gauge electrically heated bridge wire embedded therein, and extending between the ends of a pair of lead wires, the latter being held in a plug of asphaltic or other composition inserted in the upper end of the shell. The plug is usually topped with thermoplastic materials such as pitch and sulfur to hold the parts together in a waterproof seal. When the two lead or leg wires are attached to a suitable source of E. M. F., the bridge wire is heated to incandescence, exploding the primary ignition composition in which it is embedded, which latter initiates detonation in the base charge. It is clear from the above description that the bridge wire extending between the ends of the leg wires must be positioned below the base of the plug and in an exposed position to facilitate embedding it into the primary initiating explosive. Because of the exposed or "open" position of the bridge wire, this type of plug is commonly referred to as the "open bridge wire" type.

For reasons well known to those skilled in the art, it is often desirable from technical or other reasons, to employ an ignition head capable of delivering a small spit of hot flame to impinge across a short space against an explosive composition, or, for example, to impinge against and ignite the delay powder train in delay electric blasting caps. For this purpose, it is undesirable and impracticable to have an exposed bridge wire embedded in loose powder as described above. The desired result has been accomplished for years past by use of an ignition plug of the general design of that shown in Fig. 21, in which the bridge wire between the ends of the leg wires is recessed into a small cavity in the base of the plug. The cavity is then filled with the desired powder composition, in the form of a thick paste with a solution of any suitable type of binder in volatile solvent. This type of plug

(Fig. 21) therefore is commonly spoken of as the "pasted type."

Manufacture of pasted type plugs has always presented great technical difficulties. For instance, years of effort in this direction have failed to produce any practicable way of affixing the bridge wire to the leg wires after formation of the cavity in the base of the plug. Heretofore the only known method for the manufacture of these plugs involved the following operations:

10 It has been the practice to place a small plug of thermoplastic material around, and a short distance back of the ends of the leg wires to firmly hold them in position. The assembly was then taken to the soldering operation and the bridge wire attached. Following this step, the assembly was sent to a second casting operation for completion of the plug and formation of the cavity around the bridge wire. This latter step was accomplished in a special type of mold in which the thermoplastic plug composition was poured around the small original plug to form a completed plug in outward appearance resembling that shown in Fig. 21. A plug prepared as just described is referred to as a "double-cast, pasted type."

Much trouble has been experienced with such construction in that it is difficult to obtain an integral joint between the plug material initially and finally cast, and in the assembly operation involving handling of these plugs they are frequently broken at the joint between castings, or the plug is found to be useless by virtue of the bridge wire having been covered during the second casting operation, or broken during the several operations.

It is the principal object of the present invention therefore to design a method and apparatus whereby the bridge wires may be affixed to the leg wires prior to any casting operation, and for casting said plugs as an integral whole in one operation, thus avoiding the objections heretofore existing.

Inasmuch as a blasting initiator and its parts are of small size, they are difficultly handleable. Moreover, due to the fact that failures must be eliminated to a maximum extent, it is necessary that these devices be manufactured with extreme precision. Consequently, it is another important object of this invention to design a machine for handling these small parts with precision in large quantities and to, as far as possible, eliminate inaccuracies due to individual handling.

To this end, the invention includes the novel arrangement, combination and construction of

parts more fully described hereinafter and shown in the accompanying drawings, in which—

Fig. 1 is a top plan view of a device embodying the present invention;

5 Fig. 2 is a side elevation thereof;

Fig. 3 is a transverse sectional view taken along the line 3—3 of Fig. 1, showing the attachment of the lead wire clamping device;

10 Fig. 4 is a similar view with the parts in an advanced position and showing the threading of the lead wires;

Fig. 4a is a plan view of the wire clamp in open position;

15 Fig. 5 is a similar view of the parts farther advanced, showing the wires at the beginning of the cutting operation;

Fig. 6 is a sectional view along the line 6—6 of Fig. 5 showing the wire cutter, the wires being shown in dotted lines;

20 Fig. 7 is a similar view with the cutter in full return position showing the wires in advanced position in dotted lines;

Fig. 8 is an enlarged detail view showing the manner of attaching the bridge wire to the lead wires;

Fig. 9 is a similar view showing completed pairs of lead wires with bridges attached;

Fig. 10 is a top plan view of the casting mechanism;

30 Fig. 11 is a front elevation thereof;

Fig. 12 is a rear view of the same device;

Fig. 13 is a perspective view of the lower jaw member;

Fig. 14 is a perspective of the positioning comb;

Fig. 15 is a transverse sectional view along the line 15—15 of Fig. 12;

Fig. 16 is a view similar to Fig. 15 with the parts in an advanced position and showing the manner of detachment of the positioning comb;

40 Fig. 16a is a detail view showing the manner of removal of the moving parts from the cast plug after solidification;

Fig. 17 is a similar view with the parts farther advanced to the casting position;

Fig. 18 is an enlarged detail of a part of Fig. 17 showing the manner of gripping the lead wires during the casting operation;

Fig. 19 is a sectional view along the line 19—19 of Fig. 18;

Fig. 20 is a plan view of the bar 87 showing the relationship of the lead wires and a lip 88;

Fig. 21 is a perspective of the completed single cast plug; and

Fig. 22 is a sectional view of a typical electric blasting initiator showing the single cast plug in place.

Wire threading, cutting, and advancing operation

60 The mechanism for performing these operations is shown in Figs. 1 to 5 and may consist of a base plate 1 suitably secured to a table 2, the former carrying bifurcated arms 3 extending upwardly and carrying between their terminal portions the assembly about to be described. The arms 3 are preferably provided with a turn-table section 5, mounted upon a corresponding part of the base plate 1 and secured thereto as by bolt 6. Thus the mechanism is mounted for rotation about the central point 6 for convenience.

75 A bed plate 7, L-shaped in cross section, is carried at its ends between the upper portions of the arms 3 by cap screws 8, so that the plate and the mechanism carried thereby may be oscillated about the screws as a center. The ends of the bed plate 7 are provided with lugs 9 between which is carried shaft 10. On this shaft is fixedly mounted cam arm 11 having a roller 12 at the end thereof, and also a pair of pressure fingers 13. The sides of the cam arm 11 are held between a roller 14 mounted on the end of spring pressed arcuate arm 15 pivoted as at 16 to one of the arms 3. The other side of the cam arm 11 engages roller 17 carried by an extension 18 of the arm 3. Spring 19 causes the arcuate arm 15 to exert pressure against the cam arm 11 in certain positions. Reference is here made to Fig. 3 in which the parts just described are generally shown.

5 In order to clamp the wires in a position so that they may be cut and advanced a sufficient amount to permit attachment of the bridge wire in any suitable manner, such as by soldering, swaging or welding, a body member substantially V-shaped in cross section and indicated generally at 20 is provided, having a clamp 21 pivoted as at 22. The surface 23 is adapted to rest upon the bed plate 7, whereas the other surface 24 is arranged to support the wires. The body member 20 is provided with plates 25 and 26 at each longitudinal edge thereof, the upper edges of which terminate in a series of teeth 27 and 28 respectively.

15 When the wire clamping mechanism is moved in the direction of the arrows from the position shown in Fig. 3 to the position shown in Fig. 4, the surface 23 rests in proximity to the bed plate 7. The bed plate and its mechanism and the clamping device and its mechanism is then oscillated in a counterclockwise direction about the common pivot 8 until the roller 14 on the arcuate arm 15 has pushed the cam arm 11 and through this part pressure fingers 13 against the inside of the V of the body member 20 and the parts are thus held in this position. The wires are now ready to be threaded and clamped.

30 Each individual wire 29 is now threaded through a hole 30 formed between the edge of the bed plate 7 and an extension bar 31. This bar is secured to the bed plate 7 by means of rods 32 (Fig. 1) passing through the bed plate 7 and terminating in a connecting member 33 with springs 34 between the connecting member 33 and the extension bar 31. The extension bar 31 is thus normally held away from the bed plate 7 by the springs. Under the action of cam 39, however, the extension bar 31 may be drawn tightly up against bed plate 7, thus making holes 30 available for threading the wires. The ends of the wires 29, after passing through these holes 30, are turned down as at 35 (Fig. 4) to temporarily hold them in this position and the main part of each wire is then positioned between the teeth 27 and 28 and against the surface 24. When all of the series of wires are thus located, the clamp 21 is then brought down against the wires to hold them in that position, hook 36 at the end of the clamping arm (Fig. 4a) engaging in notch 37 on the underside of the body member 20 and cammed tight by means of lever 38. The wires are thus held in spaced relationship ready for the next operation, which is the cutting step.

45 Each individual wire 29 is now threaded through a hole 30 formed between the edge of the bed plate 7 and an extension bar 31. This bar is secured to the bed plate 7 by means of rods 32 (Fig. 1) passing through the bed plate 7 and terminating in a connecting member 33 with springs 34 between the connecting member 33 and the extension bar 31. The extension bar 31 is thus normally held away from the bed plate 7 by the springs. Under the action of cam 39, however, the extension bar 31 may be drawn tightly up against bed plate 7, thus making holes 30 available for threading the wires. The ends of the wires 29, after passing through these holes 30, are turned down as at 35 (Fig. 4) to temporarily hold them in this position and the main part of each wire is then positioned between the teeth 27 and 28 and against the surface 24. When all of the series of wires are thus located, the clamp 21 is then brought down against the wires to hold them in that position, hook 36 at the end of the clamping arm (Fig. 4a) engaging in notch 37 on the underside of the body member 20 and cammed tight by means of lever 38. The wires are thus held in spaced relationship ready for the next operation, which is the cutting step.

70 The parts are then further oscillated in a counterclockwise direction to occupy the position shown in Fig. 5. At this point, it is to be noted that cam arm 11 rests against stop 40 on the arcuate arm 15, thereby positioning the bed 75

plate in a horizontal location and facilitating the next operation.

It will be noted that the bed plate 7 is provided with a dovetail 42 engaging a cutter carriage 43 which slides longitudinally on the bed plate. The cutter blade 44 is suitably mounted on the carriage 43 in line with the projecting ends of the wires 29 (Fig. 1). Movement of the carriage 43 in a direction toward the observer in Fig. 5 or in the direction of the full line arrow in Fig. 6, causes the ends of the projecting wires to be snapped off flush with the surface of the bed plate 7 and extension bar 31.

After the wires are all cut off, the carriage 43 is then returned in the opposite direction and to its initial position. Fig. 1 shows the carriage near the end of its extreme left hand or initial position. Further movement to the left causes the carriage to engage trip 45 (Fig. 6), which is carried by a slide 46, which is, in turn, mounted on the bed plate 7. Reference to Fig. 6 will show that as the slide 46 under impulse of the carriage 43, is moved to the left within the depression in the underface of body member 20, the end of the slide moves into a guiding recess 47 until the body member 20 of the wire clamping assembly clears the corners 48 and 49 of the slide. At this point, under the action of the pressure fingers 13, the body member is moved toward the bed plate 7, the thickness of the slide 46 and consequently, the wires held by the clamping assembly are advanced through the holes 30 between the bed plate and extension bar by that amount. They are now ready to have the bridge wires soldered in position.

Soldering the bridge wires

Referring now to Figs. 7 and 8, which show the wires advanced an equal distance beyond the bed plate and the extension bar, bridge wires are now soldered in place between adjacent pairs of lead wires in the following manner:

One end of a spool of small gauge wire, usually of platinum or a platinum alloy, is placed adjacent the top of the extreme right hand wire indicated at 50 and a drop of solder applied thereto to thus anchor the wire of small gauge. It is then extended out to the left while at the same time the operator touches the end of each projecting lead wire to solder the platinum bridge wire thereto. This is continued in like manner until the projecting ends of the lead wires are all connected.

The next operation is shown in Fig. 9 in which parts of the bridge wires are clipped off or otherwise removed so as to leave pairs of lead wires, each connected by a section 51 of a bridge wire.

The bed plate and the wire clamping mechanism along with the lead wires held thereby is then oscillated in a clockwise direction back to the initial position shown in Fig. 3, which causes the pressure fingers 13 to release the body member 20 from the bed plate. Movement of cam 39 in a clockwise direction (Fig. 2) now releases the extension bar 31 (Fig. 3) permitting it to move upwards from bed plate 7, so releasing the wires and permitting their removal without damage to the delicate bridge wires. Thus the clamping device, still carrying all of the wires with bridge wires attached, is ready for the casting operation.

The casting operation

Reference is here made particularly to Figs. 11, 12 and 13, in which the casting mechanism is

generally illustrated. This assembly consists of a supporting element 52 having upwardly projecting arms 53 carrying, by means of pivot screws 54, end plates 55 to which is attached the lower section of a jaw member 56. Anchored in the lower jaw member 56 are vertical rods 57 which pass loosely through and hold thereon in parallelism an upper jaw member 58. The tops of the vertical rods 57 are attached to cross bar 59.

Auxiliary rods 60 extending between the upper and lower jaw members carry springs 61 normally exerting pressure against the jaw members and tending to separate them. A cam lever 62 is pivotally mounted on cross bar 59 and serves to exert pressure upon the bearing plate 63 mounted upon the upper jaw member 58 and move it downwardly towards the lower jaw member 56 against the action of springs 61.

The lower jaw member 56 is provided with a pair of integral extensions 64 carrying between them rock shaft 65 which carries a pair of retaining devices 66 and a projection 67 which terminates in a roller 68. This roller is adapted to ride against the curved arm 69 pivoted as at 70 to the base 52. A spring 71 extends between the other or free end of the curved arm 69 and the base 52.

Referring to Figs. 11 and 14, there is shown a positioning comb comprising a frame 72 having end channels 73, downwardly extending teeth 74 and handles 75.

Referring back to Fig. 11 and with the upper and lower jaw members 58 and 56 in the position there shown in full lines, the comb of Fig. 14 is inserted between upper and lower jaws 58 and 56 so that the channels 73 straddle rods 57. The lever 62 is then moved slightly (dotted lines Fig. 11) to cam the jaw 58 against the top of the comb sufficiently to temporarily hold the parts in this position.

The body member 20 with the lead wires clamped therein is then attached to the casting mechanism as shown in Fig. 15 by movement in the direction of the arrows until the edge 76 of the body rests upon the top of horizontal ledge 77 (Figs. 13 and 16), the ends of the body being positioned between vertical lugs 78. During this movement, each pair of lead wires with its attached bridge wire falls between the teeth 74 on the comb. When thus positioned, the handle 79 is grasped and moved in a clockwise direction (Fig. 15) which causes the assembly to oscillate in that direction until the roller 68 rides into the depression 80 in the curved arm 69 (Fig. 16). During this movement, pressure finger 66 is caused to move about its shaft 65 until the fingers bear upon the inside V of the body 20 of the wire clamping device and thus hold it in the position shown in Fig. 16.

Referring now to Figs. 10, 12, 15 and 16, lugs 83, which are cast integral with end plates 55, carry between them shaft 84 on the ends of which are mounted crank arm 85. To the end of this arm is pivoted as at 86 a bar 87 having a series of lips 88 projecting therefrom. As shown in Fig. 15, the bar 87 cannot move in a clockwise direction by reason of the fact that its extension 89 bears against shoulder 90 on the arm 85. It can, however, move slightly in a counter-clockwise direction and against the spring 91.

The above parts are now moved in the direction of the arrow in Fig. 15 by the handle 92 and into the position shown in Fig. 16. At this point, the lips 88 together with lips 93 on the

member 94 hold firmly between them the ends of the lead wires with the bridge wires attached as shown in Figs. 18, 19 and 20. This relationship is important in the actual casting operation which will be described more fully hereinafter. The cam lever 62 is then backed off which permits the upper jaw 58 to move upwardly a slight distance and thus remove the comb 72.

The lever handle 62 is now moved in a counterclockwise direction (Fig. 12) until it occupies the position shown in the dotted lines. At this point, the lower edge 81 of the bearing plate 63 bears upon the upper edge of the bar 87 and locks the latter securely in position. At this time, the upper jaw 58 has been brought into approximation with the lower jaw 56 as shown in Fig. 17. Reference to Figs. 18 and 19 will show that the upper and lower jaws are provided with substantially semi-cylindrical grooves therein which, when the two jaws are brought together, form a cylindrical cavity in each of which is substantially centrally located a pair of lead wires with the bridge wires attached. The walls of this cylindrical cavity define a mold within which the material for the eventual plug is cast, the ends of the lead wires with its bridge wire being protected by the lips 88 and 93.

The parts are now further oscillated in a clockwise direction as shown in Fig. 17 until the roller 68 engages the groove 95. At this point, the mold cavity is substantially vertical. A suitable insulating composition such as an asphaltic composition, either with or without diluents and fillers, such as mica, in a more or less fluid condition is then poured from the ladle 96 into each of the mold cavities. Any other thermoplastic insulating material may be used in place of the above. As a matter of fact, it is preferred that such a composition be chosen from those which are non-inflammable and incombustible, which, however, have the characteristics of good adhesion, insulating qualities and being substantially unshrinkable at low temperatures. The halogenated hydrocarbons are eminently satisfactory for this purpose. Upon solidification, this fluid insulating material forms a one piece plug within which the lead wires are securely embedded.

Upon solidification of the plug material, the parts are then oscillated counterclockwise to the position shown in Fig. 16. At this point, the lever 62 and the lever 92 are grasped and simultaneously released. Release of the lever 62 serves to relieve the pressure between the edge 81 of the bearing plate and the upper surface of the bar 87 while release of the lever 92, by camming the lower end thereof against lug 82, moves bar 87 away from upper jaw 58. To facilitate movement of the bar 87 away from the cast plug, a pair of upstanding tapered projections 97 (Figs. 10 and 15) are formed on the upper edge of the member 94, which are adapted to engage with similarly formed recesses 98 in the bar 87. Consequently, as the handle 92 is moved to a releasing position, the bar 87 rides upon the tapered projections 97 and thus moves away from the cast plug in a slightly upward as well as outward direction. The fact that all moving parts are backed away in an upward direction prevents mutilation or breaking of the bridge wire and the fragile material of which the plug is made.

At this point, the wire clamping assembly is still in position. Further oscillation in a counterclockwise direction releases the pressure fingers 66 from the clamping assembly and the latter is then removed. Release of the lever 38 and

clamping arm 21 now frees the pairs of lead wires with the plugs cast around the ends thereof for further disposal as desired.

A completed single cast plug is shown at 100 in Fig. 21.

A typical electric blasting initiator assembly is shown in Fig. 22 to include a thin shell of metal 101 containing any suitable explosive or detonator composition 102 with a single cast plug 100 having a pasted ignition composition 103 within which bridge wire 51 is embedded. A fill 104 of any suitable thermoplastic material, either similar or dissimilar to the plug material, overlies the top of the plug 100 and not only surrounds the ends of the insulation on the lead wires and prevents the same from back ravelling, but also securely fixes the plug within the shell. Where desired, an assisting crimp 105 may be used.

While the invention has been shown and described with specific reference to particular embodiments, it is to be understood that it is not to be limited thereto but is to be construed broadly and restricted only by the scope of the appended claims.

I claim:

1. A method of manufacturing cast plugs for electric blasting initiators which includes the steps of securing a series of lead wires in a holding device with their ends projecting through apertures, cutting off the ends of the wires flush with one terminus of the apertures, advancing all of the wires a uniform distance through the apertures and securing bridge wires between the projecting ends of the lead wires, covering the bridge and adjacent portions of the lead wires and casting a plug around and forming a cavity in the end of the plug, the walls of the cavity protecting the ends of the lead wires and the bridge wire.

2. The method of claim 1 in which the advance of the severed ends of all lead wires is made simultaneously.

3. The method of claim 1 in which the lead wires are severed successively and advanced simultaneously.

4. A method of manufacturing cast plugs for electric blasting initiators which includes the steps of securing a bridge wire between two lead wires, covering the bridge and adjacent portions of the lead wires, and casting a plug around the covering means and the lead wires to thereby form a plug securely gripping the lead wires, with a depression in the end of the plug, the ends of the lead wires and the bridge wire being within the depression and removing the covering means.

5. A method of manufacturing cast plugs for electric blasting initiators which includes the steps of securing a series of lead wires in a holding device, securing a bridge wire between the ends of the lead wires, inserting the thus held wires in between a two-part mold, covering the bridge and adjacent portions of the lead wires, approximating the edges of the two-part mold to form a mold cavity around the wire ends and casting a plug around the lead wires and the bridge covering means and removing the covering means.

6. The method of claim 5 in which after the cast material has solidified, the bridge wire covering device is moved simultaneously away from the bridge wire and away from the mold parts.