Dec. 1, 1959 M. C. HENGEL 2,915,012

METHOD FOR ASSEMBLING CERAMIC PLUG TO LEAD WIRES FOR ELECTRIC BLASTING CAPS

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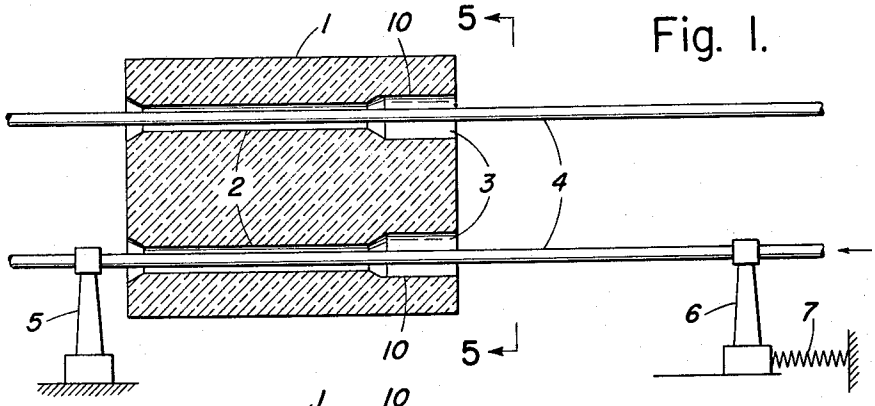


Fig. 1.

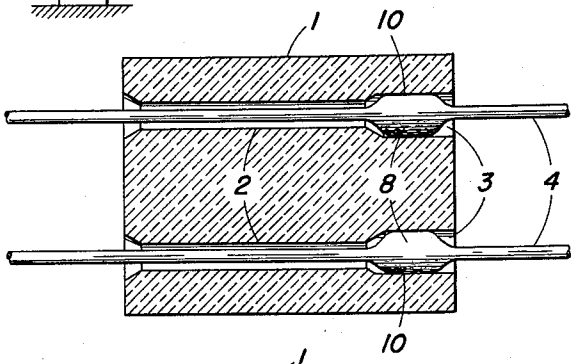


Fig. 2.

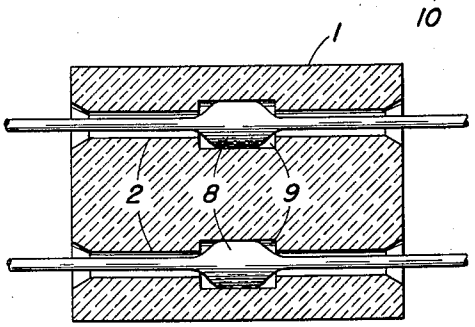


Fig. 3.

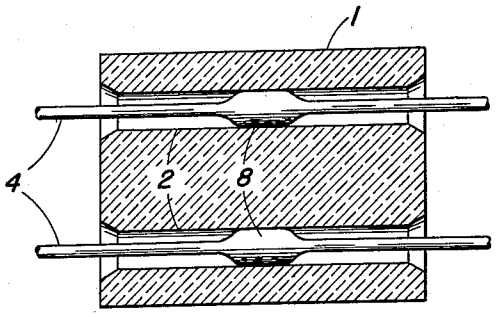


Fig. 4.

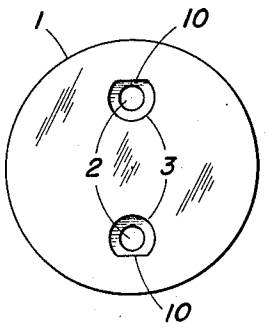


Fig. 5.

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METHOD FOR ASSEMBLING CERAMIC PLUG TO LEAD WIRES FOR ELECTRIC BLASTING CAPS

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2 Claims. (Cl. 102—28)

This invention relates to the production of an electric blasting initiator and more particularly to a method of sealing the lead wires into the ignition plug in an electric blasting cap and to a new article comprising an ignition plug with lead wires affixed therein by expansion against the walls of the wire holes in the plug.

In the past, electric blasting initiators have been assembled with insulated lead wires positioned and secured by a plug or bushing of sulfur, rubber or plastic composition. The wires that pass through the plug are attached thereto by physical or chemical adhesion since the plug had been formed or molded about a section near one end of the wires. Frequently, the wire encompassed by the plug is formed into a symmetrically tortuous pattern, to improve the tensile strength of the bond between the wires and the plug. The plug is positioned in and retained within the open end of the metal capsule or shell by a seal which is formed in place by alternate layers of molten sulfur and asphaft by thermoplastic compositions or in the case of rubber plugs, by crimping the walls of the capsule into the body of the plug. These prior methods of assembly in construction result in a product with a limited resistance to deformation, temperature variations, and ingress of water.

It has been proposed to replace such a molded plug with a preformed ceramic plug. In the co-pending application of G. Bayard Young, Serial No. 449,175, filed August 11, 1954, now Patent Number 2,882,820, the preparation of such a ceramic plug is described. Ceramic plugs have the advantage of unusual resistance to extremes of pressure, temperature, and physical abuse as well as unusual resistance to water penetration. However, the sealing of the lead wires into a ceramic plug presents a very difficult problem. In the past, the lead wires have been fixed in ceramic pieces by one of two methods. In one, the ceramic is metallized around the holes through which the lead wires are inserted and the lead wires are then soldered to the metallized coating. Alternatively, the ceramic is silvered and then fired to produce a metal coating to which the lead wires may be soldered. In soldering small joints, it is difficult to avoid the formation of a brittle union because of cold soldering and the danger of this presents a still further disadvantage of the previous method.

According to the present invention, I have found a greatly simplified method of sealing the lead wires in a plug so that they will not shift when stress or strain is placed upon them. My method comprises swaging the wire into a recess in the spaced holes for the insertion of the wire while passing an electric current through the wire in such a manner as to soften the wire at the proper point.

It is an advantage of my invention that there are eliminated the difficult steps involved in obtaining a seal between the wire and the plug. There is no need to silver or otherwise metallize the interior of the bore through the plug and the elimination of such a step is an obvious economy measure. It is a further advantage of

the process of my invention that the need for use of solder on the plug is eliminated. Both the steps of metallizing or silvering and the step of soldering are tedious and to be done properly must be done by hand. In my invention these steps are eliminated and the sealing of the wire into the plug can be carried out simply and automatically.

In carrying out the process of my invention, there is used a plug which has been cast with a recess in the holes for the insertion of the wires. The plug may be composed of any suitable rigid material such as porcelain, glass or a thermo-setting resin such as the phenol formaldehyde type. However, because of their rigidity, high dielectric properties, and low cost, ceramic plugs are preferred. The holes for the lead wires are formed in such a plug during the casting and firing of the plug, but in those of a resinous material, they can be drilled out after the plug has been formed or can be formed by the extension die. They are spaced exactly the right distance apart for the lead wires. In each hole there is preferably a recess into which the wire is to be swaged. This recess may be anywhere in the hole, but preferably, because of ease of manufacture, it is in the form of a counterbored hole of somewhat larger diameter at one end of the lead holes. The holes must be spaced exactly in the plug in order to keep the bridge wire length always the same, since such length governs the amount of current needed to explode the initiating charge in the cap.

The process of my invention will be more clearly understood with reference to the accompanying drawing.

Figure 1 is a sectional side view of an electric blasting cap plug through which the wires have been inserted and to which one pair of electrodes has been fastened, in preparation for the swaging operation;

Figure 2 is a sectional side view of the same electric blasting cap plug after the wires have been swaged into place;

Figure 3 is a sectional side view of an electric blasting cap plug of a different modification in which the recess is in the middle of the bore and the wires have been swaged into the said recess;

Figure 4 is a sectional side view of an electric blasting cap having no recess for the expansion of the wire, and

Figure 5 is an end view of the plug of Figure 1 on the end 5—5, without the wire in place.

In Figure 1 an electric blasting cap plug **1** has been provided with two carefully spaced holes **2**. At one end of each bore is a larger counterbored recess in the bored hole **3**. The lead wires **4** have been inserted in the holes through the plug. To one of the wires has been clamped a pair of electrodes **5** and **6**. Electrode **5** is stationary and electrode **6** is movable, but by being clamped to the wire it remains stationary, holding spring **7** compressed. The spacing of the electrodes is such that the midway point between them occurs in the middle of the recess in the bore **3**. Normally two pairs of electrodes are used so that both wires are swaged simultaneously. Alternatively, each wire can be swaged individually and for simplicity Figure 1 shows this modification.

In Figure 2 the same electric blasting cap plug and lead wires are shown after the wires have been swaged into place. The wire has expanded, forming an enlarged portion **8**, into the recesses **3** in such a way as to lock the wire in place. The locking is done not only by the fact that the expansion prevents the wire from sliding through the narrower diameter bore, but also because the bulged portion **8** has been pushed tightly against the contour of the recess **3**.

In Figure 3 an electric blasting cap plug is shown with wires in place, completely swaged. This, however, is a modification in which the recess **9** is not at one end of the wire holes but in the middle, making a more perfect

locking against any movement of the wire. This is to illustrate that the recess can be at any place in the lead wire hole. It is most important to lock the wires against a movement out of the dynamite cap, as for example when the lead wires are pulled, and the recess is preferably placed at the end of the plug which is nearest the bridge wire. However, it can be placed anywhere in the hole depending on the ease with which such a recess can be constructed. Such a recess can be constructed by drilling with expandible drill or other tool known to the art or by casting with a collapsible mandrel. This modification is more expensive to manufacture and that of Figure 1 and Figure 2 is for this reason preferable since adequate locking can be obtained there.

In practice, it is not necessary to have a recess, although such is the preferred modification of my invention. In its broadest sense my invention includes the process of swaging or expanding the lead wires against the walls of the wire holes in a plug in which the said holes have no recess. This is illustrated in Figure 4. An effective locking can be obtained by this modification because the inside of the wire hole **2** will not be completely smooth and the wire will be pushed at the expanded point **8** into the irregularities in the wall. The wire, being expanded tightly against the walls, cannot slide in either direction. However, a recess is greatly to be preferred, since it does not depend on uncontrollable irregularities for the efficiency of the locking.

In practice, it has been found advantageous, although not necessary, to have the recess **3** made with a flattened surface. This permits the swaging to prevent the rotation of the wire in the holes **2** as well as sliding out of the holes. In Figure 5, such a modification is shown. The flat surface **10** locks the wires more firmly after being swaged into the recess **3** and prevents rotation within the hole **2**.

The electrodes which furnish the electric current for the swaging can be of standard type clamping rigidly on the lead wire. The clamping must be rigid because the electrodes are also used, preferably, to furnish the compression necessary to expand the softened metal of the wires. At least one of the electrodes is movable and is fastened to the wire while compressed against a spring. When the metal softens under the influence of the current, the compression automatically expands the softened metal. Alternatively, separate rigid clamps can be provided to supply the pressure necessary to expand the softened wire, in which case the electrodes can be simple electrical connection of any temporary type which clamps one wire on another.

The positioning of the electrodes on the wire is important since the softening will occur halfway between them. The positioning must therefore be calculated to put the halfway point at the spot where the expansion is desired.

When a 22 gauge copper wire is used as the lead wire, a potential of 110 volts and a current of 10 amperes is supplied to the system. Wires of greater thickness or other metals take greater current. In general, a low current is supplied and is gradually increased until the wire is softened and swaging occurs. Normally, this occurs quite rapidly and only a brief passage of the electrode current is needed to effect swaging.

I claim:

1. An electric blasting cap plug assembly which comprises a ceramic electric blasting cap plug, two apertures for lead wires extending longitudinally through said plug, each of said apertures having an enlarged portion substantially midway of its length, lead wires in each of said apertures, said lead wires having an expanded diameter within said enlarged portion of the apertures completely filling said enlarged portion, said lead wires being rigidly affixed in said plug by said expanded diameters.

2. The assembly of claim 1 in which the said enlarged portion has a flattened surface.

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