This invention relates generally to blasting caps, and particularly to electric blasting caps of the character wherein the lead wires extend through a closure plug of soft elastic material.

It has heretofore been proposed to utilize a plug of soft material, such as rubber, neoprene, or other rubberlike materials, as a closure about the lead wires at the open end of a blasting cap. In the process of crimping the open end of the blasting cap about such a soft plug, the latter is subject to considerable distortion and if, as is common, the lead wires extending therethrough are joined as their inner tips by a so-called bridge wire, the latter is liable to be broken, bent, or otherwise damaged during the crimping operation, and such damage, being concealed within the cap, cannot be visually ascertained. Moreover, the distortion of the soft plug may be so severe that the inwardly projecting tip of a lead wire may be moved into proximity with the internal wall of the case where friction might be created, which would accidentally discharge the cap. Moreover, if the end of a lead wire be distorted to a lesser degree, but nonetheless such as to reduce the air gap between the tip of a lead wire and the interior of the case, the cap is rendered more subject to discharge by static electricity that if the tips were properly positioned within the cap.

As heretofore proposed, the plug of rubberlike material has been either molded about the lead wires or the plug has been formed with a central bore through which the lead wires were threaded lengthwise. While the latter procedure makes possible the use of preformed tubing from which short lengths are cut to constitute the plug, it is a tedious matter to thread the lead wires through such a plug unless the bore therethrough provides a considerable amount of clearance in excess of the outside diameter of the wires to be threaded therethrough and, where such clearance is provided, the plug does not retain itself in proper position on the wires during handling.

The object of the present invention, generally stated, is to provide a soft plug closure which may be easily applied to lead wires and deformed within a case without disturbing the relative position of the several parts. Another object of the invention is to make use of short sections of preformed rubberlike tubing as the closure plug for a blasting cap, yet maintain the desired relationship of the parts during handling and assembly with other components.

Other objects will become apparent to those skilled in the art when the following description is read in connection with the accompanying drawings, in which:

Figure 1 is a perspective view of a closure plug and lead wire assembly constructed in accordance with the present invention;

Figure 2 is a sectional view taken along line 2—2 of Figure 1;

Figure 3 is a view in side elevation, part being shown in section, of a blasting cap constructed in accordance with the present invention, but before being crimped;

Figure 4 is a view in side elevation of the completed cap shown in Figure 3, part being broken away to reveal the relationship of the elements; and

Figure 5 is a perspective view of the closure plug of the present invention in the process of being applied to a lead wire.

The present invention makes use of a short length of elastic tubing as the closure plug for a blasting cap, and the case thereof is indented into, or deformed about, the plug so as to produce a seal in a manner generally comparable to that disclosed in British Patent No. 222,550, of 1924. The invention contemplates that such short lengths of elastic tubing be provided with a slit extending from the inner bore to the outer surface for the entire length of the plug. With such a slit tube, the lead wires may be laid in side wise through the slit, thereby eliminating the tedium of threading the lead wires through the bore endwise, and eliminating the necessity for the bore to be of greater diameter than the wires threaded therethrough. Due to the inherent resiliency of the material from which the elastic tube is made (which may be rubber, neoprene, or other rubberlike materials), the slit tends to close and grip the wires in the bore sufficiently to inhibit relative lengthwise movement (except when forces are deliberately applied for the purpose) during such handling as occurs prior to crimping the case about the plug.

In order to further assure that the slits be maintained in closed position, the inner end of the plug may be formed to interlock with a relatively stiff lead wire support, which may be of the character disclosed in the co-pending application of Charles M. Blackburn, Serial No. 227,828, filed May 23, 1951. When such a lead wire support is embedded or recessed in the end of the plug, the latter is stiffened in a direction which renders opening of the slits more difficult. Where a loose ignition charge is to be employed about a bridge wire adjacent a lead wire support of the character above mentioned, it is preferable that the interlocking arrangement between the support and the plug be such that the inner edge of the support is flush with the inner end of the plug, or nearly so.

Referring now to the drawings for an illustrative embodiment of the invention, the blasting cap consists of the usual metallic cup 1, in the closed end of which there is provided a suitable explosive train surmounted by an ignition charge 5. In accordance with the common practice, the charge 5 is ignited by electrical energization of a bridge wire 6, which is connected across the ends of a pair of lead wires 7 and 8. In the embodiment shown, the bridge wire 6 is embedded in the ignition charge 5, which is a loose granular mixture of any suitable well known composition.

The bridge wire 6 is soldered or otherwise electrically and mechanically connected to each of the lead wires 7 and 8. In order to facilitate the connection of the bridge wire 6 to the lead wires, to maintain the lead wires 7 and 8 in proper spaced relation adjacent the bridge wire, and thus prevent mechanical damage to the bridge wire pursuant to relative movement of the lead wires 7 and 8 thereto adjacent, it is preferable that said lead wires be sandwiched between two strips of thermoplastic material 9 and 10, which strips are autogenously connected together and beyond the respective lead wires, as shown in the aforesaid application of Charles M. Blackburn. In the alternative, the strips 9 and 10 may be formed of relatively stiff paperboard or other material, and cemented together and to the lead wires. Particularly good anchorage between the strips 9 and 10 and the lead wires is achieved when the insulation upon the lead wires 7 and 8 is a thermoplastic material, and the sheets 9 and 10 are likewise thermoplastic material, because thereby,
when heat and pressure are applied to the sheets 9 and 10, said sheets become interfused with the thermoplastic insulation on the lead wires.

The lead wires 7 and 8 extend through a closure plug 13 which, in accordance with the present invention, is a short length cut from a stock of tubing for rubber-like material. Preferably, the tubing is formed with two axially extending bores 14 and 15 of a size corresponding as near as may be, within practical limits, to the outside dimensions of the insulation on lead wires 7 and 8. The plug 13 is longitudinally slit on planes 16 and 17 so as to contact the bores 14 and 15, respectively, with the exterior of the plug 13. At the end of the plug 13 which is to constitute the inner end of the completed assembly, a recess 18 is formed of a size and shape such as to snugly receive the lead wire support above-described. The recess 18 extends at right angles to the direction of slits 16 and 17, in the embodiment shown, and in so doing intersects bores 14 and 15. With this arrangement of parts, when the lead wire support is interfitted with the recess 18, as shown in Figure 1, plug 13 is stiffened so that slits 16 and 17 are difficult to open.

Thed to the lead wires 7 and 8 either before or after the lead wire support 9—10 has been applied to the lead wires, and either before or after the bridge wire 6 has been applied thereto. In either event, slit 16 may be opened to permit the insertion of lead wire 7 into bore 14 sidewise and, similarly, slit 17 may be opened to permit the insertion of lead wire 8. When the lead wires are seated in the bores 14 and 15, the inherent resiliency of the plug tends to close the slits and, as aforesaid, when the plug is moved lengthwise on the lead wires to an extent sufficient to embed the lead wire support in the recess 18, the plug is reinforced in a direction which inhibits the opening of slits 16 and 17.

The assembly shown in Figure 1 is inserted into case 1 after the explosive charges are deposited therein and in such manner that the bridge wire 6 becomes embedded in the ignition mixture 5, while the lower end of plug 13 contacts the upper surface of the ignition charge 5. When the lead wire support is arranged so that its lower edge is flush with the lower end of plug 13, the quantity of ignition mixture required to assure that the bridge wire 6 will always be embedded is minimized.

After the assembly shown in Figure 1 is inserted into the case shown in Figure 3, the upper end of the case 1 is cramped, indented, or otherwise deformed about the plug 13 to an extent sufficient to form a seal between the plug 13 and the interior of the case 1, as well as to seal the plug about the wires 7 and 8, and seal the slits 16 and 17. If desired, a layer of molten sealing material, such as wax, may be applied to fill the space above plug 13 and within the upper extremity of case 1, but such sealing material is not necessary if the crimping of the case about plug 13 be sufficiently severe that the seal is effected as above-described.

From the foregoing description it should be evident that the invention accomplishes its objects and provides a structure which is inherently sealable by crimping the case without subjecting the bridge wire to possible injury in the process of manufacture. Furthermore, the arrangement is such that the manufacturing procedure is simplified and flexible to permit the application of the elastic plug either before or after the bridge wire is applied to the lead wires. An important advantage of the arrangement is the ease and facility with which the elastic plug may be applied to the rubber-like material and so to remain itself in proper position, yet be moved relative to the other components when it is desired to do so during the process of assembly.

While one complete embodiment of the invention has been disclosed in detail and various alternatives suggested, it is to be distinctly understood that the invention is not limited to the details of the foregoing disclosures, but various modifications and variations may be made within the spirit of the invention without departing from the scope of the appended claims.

Having thus described the invention, what is claimed and desired to be secured by Letters Patent is:

1. An electric blasting cap having an elastic closure plug and a lead wire extending through a bore in said plug, the improvement which comprises, said plug having a slit extending lengthwise between the bore and the exterior thereof, the parts on opposite sides of said slit being integrally connected together, and said plug being interconnected with a more rigid member disposed in angular relationship with said slit.

2. The cap of claim 1 wherein the inner end of said plug is recessed to accommodate said member, and said member is secured to the lead wire.

3. In the manufacture of blasting caps, the process comprising, providing a length of substantially cylindrical elastic plug having an internal bore, slitting said plug lengthwise between the bore and the exterior thereof while maintaining an integral connection between the parts on opposite sides of said slit, inserting said slitted plug through said slit and into said bore, inserting the assembly into a case, and crimping the case about said plug to deform the latter and seal the slit.

4. In the manufacture of blasting caps, the process comprising, providing a length of elastic plug having a pair of internal bores, forming a recess in the end of said plug in communication with both bores, slitting said plug between said bores and the exterior thereof, connecting a relatively rigid support to a pair of lead wires, inserting the lead wires sidewise through said slits and into said bores respectively, and drawing said lead wires lengthwise of the plug until said support is seated in said recess.

5. The process of claim 4 wherein said support fits snugly within said recess and rigidifies said plug in a direction which restrains opening of said slits.

6. An article of manufacture comprising a pair of lead wires, a bridge wire interconnecting the tips at one end of said lead wires, and an elastic plug, said plug having a pair of bores each accommodating one lead wire, and said plug being slitt lengthwise between said bores respectively and the exterior of the plug and each slit terminating inwardly at a bore.

7. The article of claim 6 wherein said lead wires are interconnected adjacent said bridge wire by a relatively rigid support, and said support is interfitted with a recess in the end of said bridge wire.

8. In an electric blasting cap comprising a case, a preformed soft closure plug of rubber-like material in resilient sealing relationship with the interior of the case, lead wires extending through said plug and interconnected at their ends within said case by a bridge wire, a relatively stiff support secured to said lead wires adjacent said bridge wire, said plug having a recess proportioned to accommodate said support, said support being located in said recess substantially flush with the inner end of said plug and substantially surrounded thereby to interlock the same, and a lead wire extending through said bridge wire and contacting the end of said plug.

9. In a closure for an electric blasting cap, a substantially cylindrical plug of rubber-like material, said plug having a slit extending lengthwise thereof and substantially halfway therethrough, the parts of the plug on opposite sides of said slit being integrally connected beyond the inner end of said sill, a lead wire seated in said sill adjacent the inner terminus thereof, said plug having a recess extending substantially at right angles to said sill, and a relatively stiff supporting member snugly seated in said recess to stiffen the plug in the direction which restrains opening of said sill.

(References on following page)
<table>
<thead>
<tr>
<th>References Cited in the file of this patent</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNITED STATES PATENTS</td>
</tr>
<tr>
<td>1,751,827 Marshall</td>
</tr>
<tr>
<td>2,108,031 Acuff</td>
</tr>
<tr>
<td>2,137,887 Abbott</td>
</tr>
</tbody>
</table>

2,158,496 George May 16, 1939
2,477,458 Johnson July 26, 1949
2,527,858 Stuart Oct. 31, 1950

FOREIGN PATENTS
Great Britain Feb. 27, 1942