Jan. 19, 1960 D. M. STONESTROM 2,921,520

DETONATOR PLUG

Filed June 18, 1953

FIG. 1

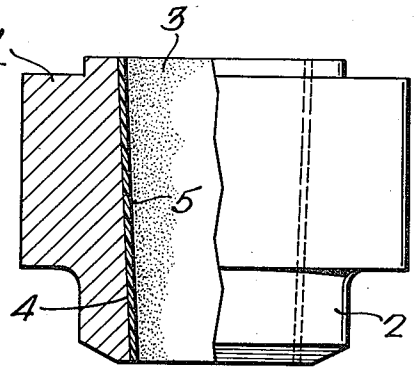


FIG. 2.

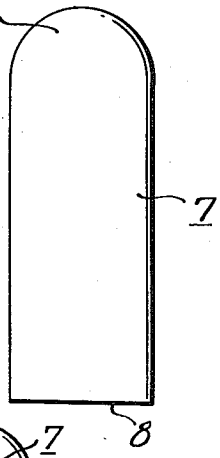


FIG. 3.

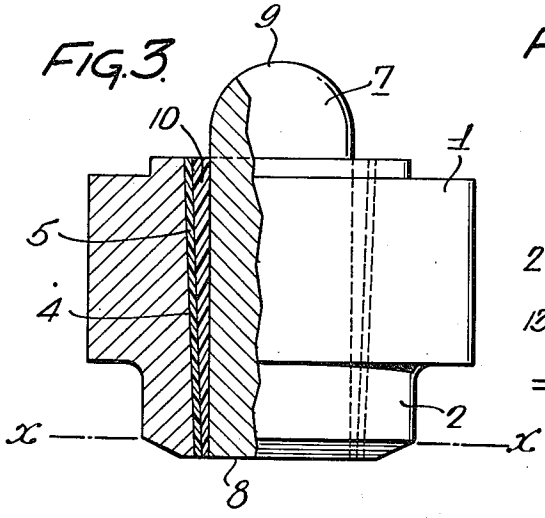


FIG. 4.

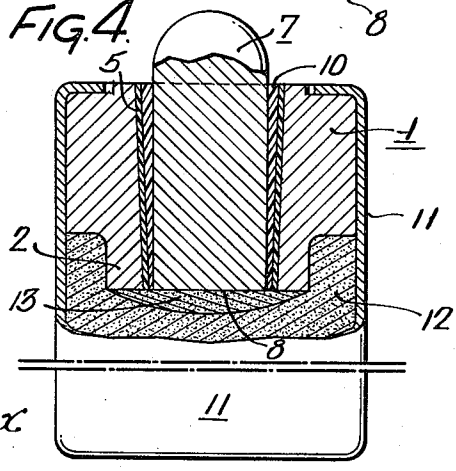


FIG. 5.

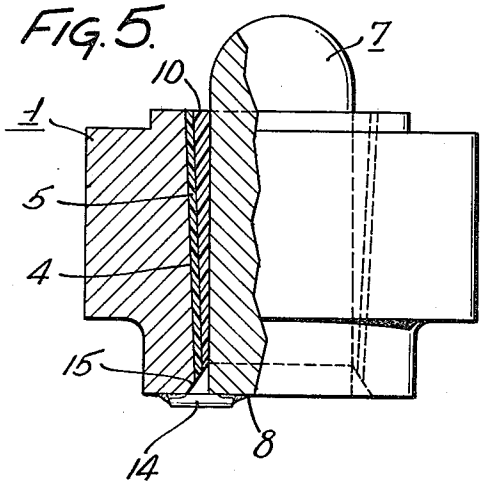
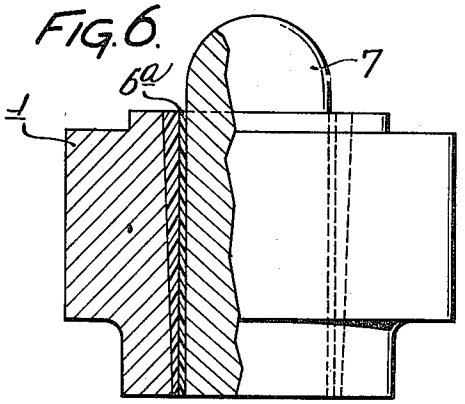


FIG. 6.



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DETONATOR PLUG

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1 Claim. (Cl. 102—28)

This invention relates to new and useful improvements in electric detonator plugs, and more particularly to plugs for detonators of the type employed to detonate military explosives.

Prior to the present invention the manufacture and assembly of detonator plugs has been complicated by the number of the parts required, molding requirements, and the difficulties encountered in soldering and assembling minute parts.

With this in mind, the principal object of the present invention is to provide a novel detonator plug construction which has a minimum number of parts and which may be manufactured and assembled without resorting to molding or soldering operations.

Another object of the invention is to provide a novel detonator of greatly simplified construction which is highly efficient and comparatively inexpensive to manufacture.

A further object of the invention is to provide a novel method for making a detonator plug having the construction and features set forth.

These and other objects of the invention and the various features and details of the construction and manufacture thereof are herein shown and described with reference to the accompanying drawing, in which:

Fig. 1 is an elevational view, partly in section, of the housing member of the detonator plug, showing the dielectric coating on the surface of the bore therein;

Fig. 2 is an elevational view of the pin member of the detonator plug;

Fig. 3 is an elevational view, partly in section, showing the pin and housing members in assembled relation;

Fig. 4 is an elevational view, partially in section, showing an electric detonator embodying a plug made according to the present invention;

Fig. 5 is an elevational view, partly in section, showing an alternate construction of the plug employing a bridge wire for firing the detonator; and

Fig. 6 is an elevational view, partly in section, of still another embodiment of the invention.

The detonator plug of the present invention consists essentially of an annular housing member in the bore of which a detonator pin is securely bonded and electrically insulated from the housing member.

Referring more particularly to the drawing, the annular housing member of the plug assembly is designated by the numeral 1. This annular housing member is composed of a metal which is both hard and electrically conductive such as, for example, stainless steel or the like. As shown in Fig. 1 of the drawing the housing member 1 has a reduced portion 2 at one end thereof and the central bore 3 which extends axially through the housing is tapered slightly in the direction of the reduced end portion 2 thereof, for example, as indicated at the surface 4.

In accordance with the present invention the surface 4 of the bore 3 of the housing member 1 is provided with a coating 5 of a material having high dielectric properties. It is important that the dielectric or insulating material be securely bonded to the bore surface 4 of the member 1 and that it exhibit a high degree of hardness. It is also particularly essential that the insulating coating 5 have a dielectric strength of at least 1 megohm with a potential of 325 volts D.C. applied across the pin member and housing in the case of a detonator plug of the spark gap type shown in Fig. 3. On the other hand, in the case of detonator plugs of the type in which a bridge is employed to connect the pin and housing as shown, for example, in Fig. 5, the dielectric strength of the insulating coating 5 may be very substantially reduced and may be as low as about 1000 ohms. In the present instance very good results providing these characteristics have been obtained by the use of one of the vinyl resins or a mixture or copolymer of such resins such as, for example, resins of the polyvinyl methylal type which are available commercially under the trade names "Formvar" and "Formex." These compounds are in liquid form at room temperature.

In the present instance the surface of the bore of the housing member 1 is coated with the selected coating compound so as to leave a coating 5 on the surface 4 of a thickness of from about 0.0009" to 0.0014". The housing member with its coated bore surface is then baked at a temperature within the range of about 400° F. to 550° F. for a predetermined period of about from 10 minutes to 30 minutes according to the temperature employed, and very good results have been obtained by baking the coated housing at a temperature of about 500° F. for approximately 20 minutes. When the baking operation has been completed the housing is allowed to cool.

The coating 5 provided on the surface 4 of the housing member 1 is continuous, is securely bonded to the surface of the member and is characterized by a high degree of hardness and a high dielectric strength. Other dielectric materials providing these physical properties may be employed as desired.

The central pin member is designated 7. As in the case of the housing member 1 the pin member is composed of metal which is both electrically conductive and characterized by a relative degree of hardness such as, for example, stainless steel or the like. The pin member 7 is of generally cylindrical configuration having a circular cross-sectional shape and, as shown in Fig. 2, the pin member is provided at one end with a plane transverse face, indicated at 8, and its other end is rounded on a true spherical radius, as indicated at 9. In accordance with the invention the cylindrical portion of the pin member 7 has a diameter slightly less than the diameter of the coated surface of the housing bore at its smaller end.

The pin member 7 is securely bonded in and to the coated bore of the housing member 1 by a bonding agent which will provide a strong and durable bond between the coated housing member and the pin member of the plug. Any suitable bonding agent which will insure a strong bond between the pin and housing members may be employed and very good results have been obtained by the use of polyvinyl methylal resins such as "Formvar," previously described, thermosetting silicone resins such as Dow Corning 2103, ethoxyline resins such as Araldite AN–115 and thermosetting phenol-formaldehyde resins.

The selected bonding agent may be applied initially to either the coated bore surface of the housing 1 or to the cylindrical surface of the pin member 7. When one of the members has been properly coated with the selected bonding material, the pin 7 is inserted coaxially in the tapered bore of the housing member and positioned, as shown in Fig. 3 of the drawing, with the flat end 8 of the pin 7 disposed substantially flush with the end face of the reduced portion 2 of the housing member and the rounded end 9 of said pin projecting endwise beyond the

opposite face of the housing member. Preferably the pin 7 is inserted inwardly of the larger end of the bore 3 in the housing 1, and it is important that the bonding material be applied to the selected member to a depth sufficient to entirely fill the space between the coated bore of the housing and the surface of the pin member 7 as indicated at 10 in the drawing. Any excess of the bonding material applied will be automatically displaced from the ends of the bore 3 as the pin 7 is inserted therein.

When the pin has been inserted in the coated bore of the housing member 1 as described, the resulting plug assembly is baked for a predetermined time at an elevated temperature depending upon the particular bonding material employed. For example, when a polyvinyl methylal resin such as "Formvar" is used as the bonding material the plug assembly is baked at a temperature of 500° F. for a period of approximately one hour. This same baking temperature and period also may be employed successfully when a thermosetting silicone resin such as "Dow Corning 2103" is used as the bonding agent. On the other hand, in the case of a thermosetting phenol-formaldehyde resin the plug assembly is baked at a temperature of about 360° F. for a period of approximately 90 seconds, and in the case of an ethoxyline resin such as Araldite AN–115 the plug assembly is baked at a temperature of about 450° F. to 500° F. for approximately from about one and one-half to two hours.

When the plug assembly has been baked as described, it is allowed to cool after which the lower end faces of the assembly are ground or machined, for example, to the broken line *x*—*x* (Fig. 3), to remove the excess bonding material 10 and to level off the bottom faces of the pin and housing members. It is to be noted that the minimum diameter of the tapered bore 3 through the housing 1 is sufficiently larger than the diameter of the pin 7 so that the coating 5 either alone or in combination with the bonding material 10 provides an efficient dielectric insulator between the pin member 7 and housing 1.

Referring to Fig. 4, a plug assembly made in accordance with the present invention is shown in conjunction with a typical detonator. In the detonator construction illustrated, the plug assembly is mounted inwardly of the open end of an elongated cup-shaped casing member 11 containing base and priming charges (not shown) a flash charge 12 and an ignition button 13. The ignition button 13 is in underlying contact with the flat end face of the metal pin 7 of the plug assembly and the adjacent end face of the reduced portion 2 of the housing member 1, and the flash charge 12 in turn underlies the ignition button 13, and extends upwardly thereabout so that it is in surrounding contact with the lateral surface of the reduced portion 2 of the housing 1. Of course, the plug assembly may be used in conjunction with detonators of other type and construction.

The plug assembly illustrated in the drawing is of the spark gap type and is fired by applying a high potential between the pin member 7 and housing 1 causing a spark to jump between the end surface 8 of the pin member and the adjacent end surface of the housing 1. The detonator plug of the present invention may also be used effectively with a bridge which connects the end surface 8 of the pin and the end surface of the housing 1 such as shown, for example, at 14 in Fig. 5 of the drawing. Such bridges may be of the conventional wire, graphite, conductive mix or spark gap bridges well-known in the art.

In the event a bridge wire 14 is employed, the coated bore of the housing member 1 preferably is chamfered or beveled at its bottom or smaller end as indicated at 15 in Fig. 5 of the drawing, in order to remove the dielectric coating and provide a gap or space between the housing 1 and pin 7 above the bridge wire. The bridge wire 14 is secured to the parts by welding or the like prior to assembling the detonator plug into the detonator casing 11.

It will be obvious, of course, that in lieu of forming the dielectric coating 5 on the surface 4 of the housing bore 3 as previously described, the dielectric coating may be formed on the cylindrical surface of the central pin member 7, as indicated at 6*a* in Fig. 6, and the coated pin 7 bonded in and to the bore of the housing 1 in the manner described to provide a detonator of the construction shown in Fig. 6 of the drawing.

While a particular embodiment of the present invention has been shown and described herein it is not intended to limit the invention to such disclosure and changes and modifications may be made within the scope of the following claim.

I claim:

A detonator plug comprising, an annular electrically conductive metallic housing having a reduced portion thereon and flat end faces, said housing having a bore extending axially therethrough and tapering in a direction towards said reduced portion, said housing being chamfered between said bore and one of said flat end faces at said reduced end of said housing, a cylindrical electrically conductive metallic pin defining a flat surface at one of its ends and a rounded surface at its other end, said pin being adapted to extend through said tapered bore of said housing with said flat end being disposed substantially flush with the end face of said reduced portion of said housing and said rounded end of said pin projecting outwardly beyond the opposite end face of said housing, a hard coat of vinyl resin having high dielectric properties bonded over the entire surface of said tapered bore, a bonding compound securely bonding the confronting surface of said pin to said vinyl resin on said bore surface, and a wire bridging across the flat end of said pin, said chamfer in said tapered bore and the end face of said reduced portion of said housing, said chamfer forming an annular gap between said housing and said pin and said wire forming an electrical connection between said housing and said pin.

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