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ELECTRIC BLASTING DEVICE

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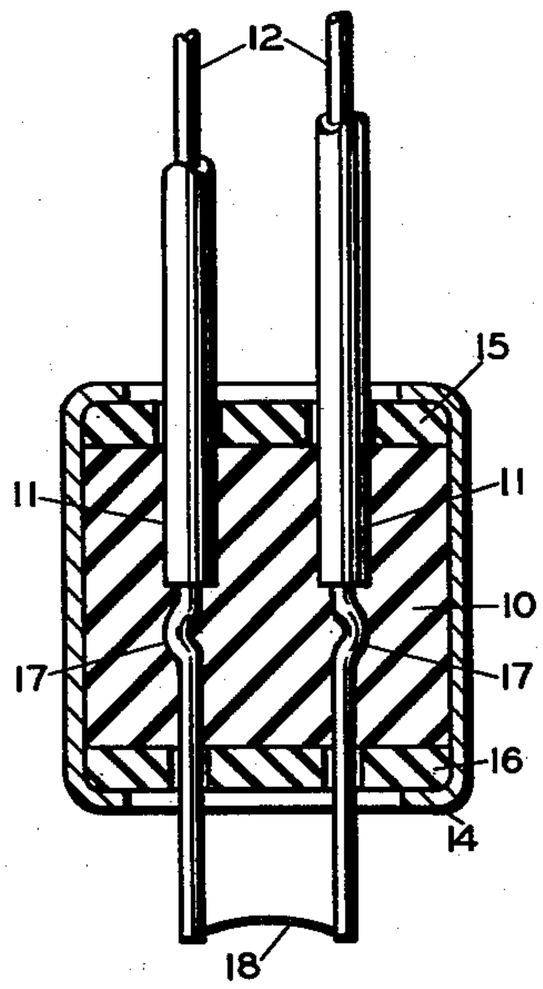

FIG. 1

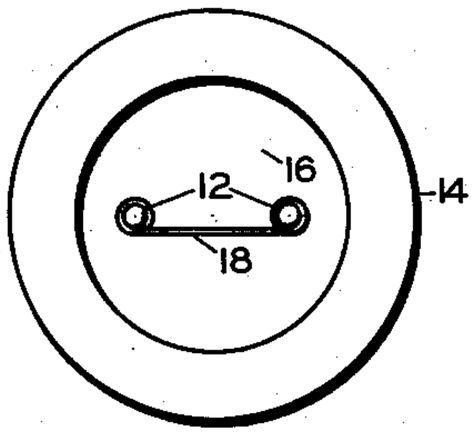

FIG. 2

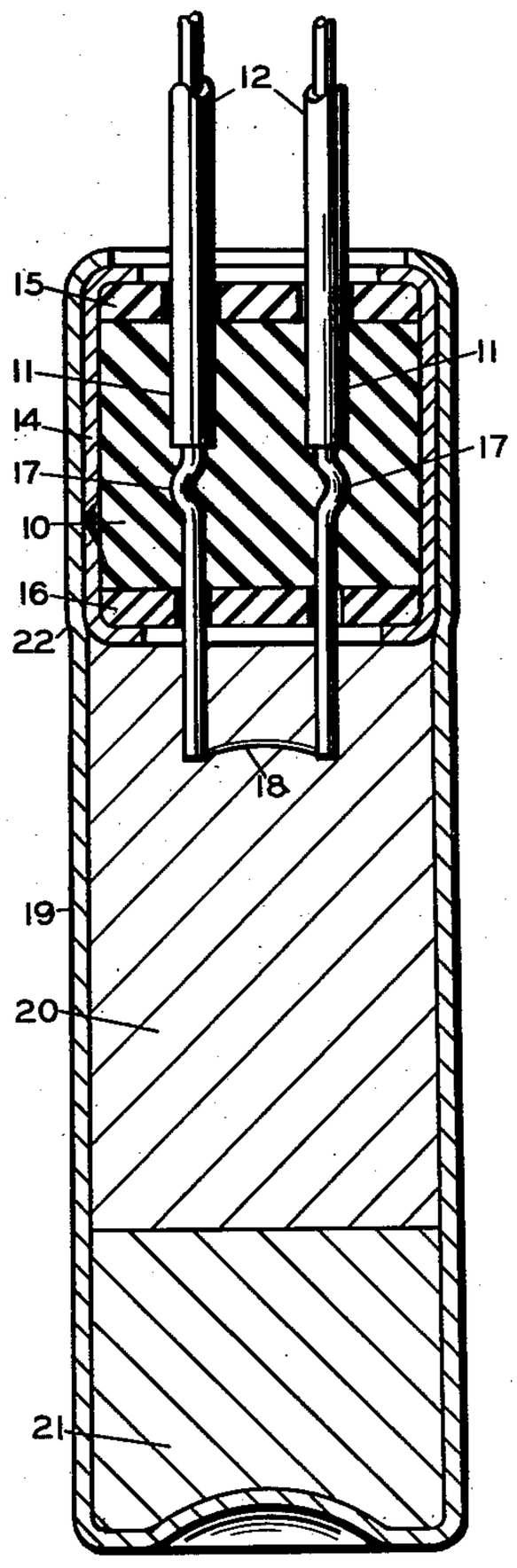

FIG. 3

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ELECTRIC BLASTING DEVICE

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8 Claims. (Cl. 102—28)

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This invention relates to improved electric blasting devices, and more particularly, to electric blasting caps containing a prefabricated composite plug.

The various prior art blasting devices such as electric blasting caps, electric delay caps, and the like, normally contain a plug which either slidably fits into the cap and is then sealed therein by means of asphalt, or the like, or contain a plug made of material adapted to be sealed therein by means of crimping the shell into the plug itself, or contain a plug made of material sufficiently rigid to cause expansion of the shell when inserted therein to form a seal. By these methods, caps can be made water-resistant, but often due to temperature changes and various external reasons, the caps do not maintain their water resistance. It has been found that a particular source of trouble resides in the difficulty of obtaining an adequate seal between the leg wires extending through the plug and the plug itself.

The above-described water-resistant caps have met with commercial success but it has often been found that the caps so produced do not perform entirely satisfactorily since some of these caps may lack complete waterproofness. The caps which do not maintain water resistance may cause trouble in firing various explosive shots and are therefore undesirable. The waterproofness of the caps may be seriously affected by hot storage conditions because waterproofing material such as asphalt tends to flow under hot storage conditions and either to exude out of the top of the cap or leak past the plug down into the explosive. Either type of flowage produces an unsatisfactory cap. In some instances, caps do not withstand cold storage because the waterproofing agent may harden and become brittle and pull away from the shell under low temperature conditions and thereby allow water to enter the shell. Prior art caps in which waterproofing is effected by the use of asphalt or other waterproofing material are undesirably long.

It is among the objects of the invention to provide an ignition assembly which will permit the manufacture of a relatively short-length cap.

A further object is to provide a plug and ignition assembly which will overcome the prior art shortcomings hereinabove mentioned particularly in respect to effecting an adequate and durable seal between the leg wires extending through the plug and the plug itself.

Other objects of this invention will appear

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hereinafter, the novel features and combinations being set forth in the appended claims.

Generally described, the present invention comprises an ignition plug assembly having a plug capsule retaining, with the aid of insulating washers at each end thereof, a resilient sealing member under compression. The compressed resilient sealing member firmly retains a pair of lead wires in spaced relationship with one another and a resistant wire electrically connects the terminal ends of these lead wires. The ignition plug assembly is preferably designed so that the outside diameter thereof is sufficiently larger than the inside diameter of the blasting cap shell to cause an expansion or bulging of the shell when the plug is inserted therein. In this manner, a friction seal between the plug assembly and the inside of the shell is formed which is completely waterproof up to extremely high pressures.

A preferred embodiment of the invention has been chosen for purpose of illustration and description and is shown in the accompanying drawings forming a part of the specification and wherein like reference symbols refer to like parts wherever they occur.

Figure 1 is an enlarged cross-sectional and elevational view of the ignition plug assembly showing the preferred embodiment of the invention prior to insertion into a blasting cap shell.

Fig. 2 is an enlarged end elevational view of the embodiment of the invention shown in Fig. 1.

Fig. 3 is an enlarged cross-sectional view of an electric blasting cap sealed by the ignition plug assembly shown in Fig. 1.

With reference to the drawings, a resilient sealing member 10 is preformed from a resilient material, such as natural or synthetic rubber, with a pair of spaced coaxial openings 11 therethrough. Said coaxial openings 11 should have a diameter of sufficient size to receive insulated leg wires 12 without undue preliminary expansion of said openings. The sealing member 10 with its above-mentioned openings 11 is preferably formed by extrusion to an outside diameter of such magnitude as to permit a sliding fit into a tubular capsule 14 prior to crimping said capsule. Upper insulating washer 15 and lower insulating washer 16 are formed of a rigid dielectric material with a pair of spaced openings therethrough to substantially correspond in size and spacing to those in the sealing member 10. The insulating washers 15 and 16 are preferably formed with an outside diameter permitting a sliding fit with the inside wall of the tubular

capsule 14. Before assembly of the component parts of the ignition plug assembly, the insulated leg wires 12 are stripped of their insulation for a short distance from their ends and a kink 17 is formed in the stripped portion to aid in anchoring the leg wires in the sealing member 10.

The tubular capsule 14 is preferably blanked and drawn from commercial sheets of bronze, zinc, aluminum or other suitable materials. The crimp inwardly formed at the lower end of said capsule is made preferably during the drawing operation to form an abutment for the lower washer 16 before receiving a lower washer 16, sealing member 10, upper washer 15, and leg wires 12 threaded therethrough all loosely preassembled in the order named. Pressure exerted upon the upper washer 15 to force said washer with the sealing member 10 before it into said capsule compresses the sealing member 10 and in so doing said member expands outwardly to exert pressure on the inner wall of said capsule. With the sealing member 10 held in a state of compression in the confined area in the capsule between the upper and lower washers, the upper end of the capsule is inwardly crimped over the upper washer to retain said sealing member in compression. Compression of the sealing member also creates a gripping force applied to the leg wires which are thereby rigidly held in spaced relationship and effectively sealed against the entrance of moisture. A resistance wire 18 connecting the terminal ends of the lead wires 12 in a manner and for a purpose well known in the art completes the construction of a composite ignition assembly as shown in Figures 1 and 2.

As shown in Fig. 3 the ignition assembly of the present invention is pressed into a shell 19 having a primer charge 20 superimposed on a base charge 21 formed in the closed end of said shell. The resistance or bridge wire 18 is imbedded into the primer charge 20. It can be readily understood that the present ignition assembly is applicable for use with a large number of igniting and explosive charge constructions well known in the blasting cap art. Preferably the ignition assembly should be slightly larger in diameter than the inside diameter of the shell 19 so that said assembly must be forced into the shell, causing sufficient expansion of the shell to produce a slight bulge 22 when completely inserted in the shell. By this procedure there is formed a completely waterproof seal between the shell and ignition assembly and the shell grips said assembly sufficiently tightly to maintain it in position.

In Fig. 3 it is noted that the ignition assembly when inserted into the cap, is inserted below the top of the shell and then the top of the shell is crimped or folded over the assembly. This type of crimping increases the resistance of the ignition assembly to accidental removal by tension placed on the wires and also improves the appearance of the finished product. However, if desirable, the ignition assembly may be inserted into the shell only sufficiently far to be flush with the top of the shell.

The pressing force required for insertion of the ignition assembly into the shell may be provided by a hydraulic press or the like. Insertion may be facilitated by slightly flaring the open end of the shell. A coating of a wax-like substance on the inside of the shell or on the outside of the ignition plug assembly has also been found to be beneficial.

The capsule is preferably made by a blanking and drawing operation in which a disc is blanked from a sheet of bronze, gilding metal, aluminum, zinc or the like and drawn to form a capsule of a desired dimension with an end wall which is partially punched out to leave an inwardly turned lower end portion. The outside diameter of the capsule is preferably .002 inch to .006 inch greater in diameter than the inside diameter of the shell into which it is to be inserted. A force fit of the ignition assembly into the shell will thus produce a waterproof seal having a high frictional resistance to removal.

The insulating washers may be molded or blanked out from sheets of dielectric material. Suitable dielectric materials for the washers include bakelite, vulcanized fiber, and phenolic laminates. The resilient sealing member is perfectly cut to length from extruded rods of synthetic or natural rubber having the apertures longitudinally therethrough. The sealing member should, to facilitate assembly into the capsule, be slightly smaller in diameter than the inside diameter of the capsule.

The leg wires which are used in the ignition assembly of the present invention are the normal leg wires as used in the art. Thus, they may be Number 20 or Number 22 copper wire either plain, tinned, or enameled, or they may be Number 22 iron wire either plain or tinned. Further, the leg wires may be insulated in a desirable manner such as, for example, by cotton servings or by plastic materials well known in the art. Either the cotton or plastic insulated wires are readily retained in a waterproof manner by the ignition plug assembly of the present invention.

The bridge wire which is used in the ignition plug assembly of this invention may either be noble metal or base metal resistant wire. Thus, for example, platinum alloys or iron alloys may be used and such resistant wires are well known. The resistant wires are joined to the leg wires either by swaging, soldering, or welding.

The invention has been described in connection with blasting caps of the instantaneous type; however, these ignition assemblies are adaptable for use in electric blasting caps of the delay type or may be used in the production of electric squibs or the like. In each instance the use of the ignition plug assembly of the present invention provides a completely waterproof device which is shorter than normal devices and presents a much neater appearance. This device is readily produced by mass production methods to effectuate a great saving in production costs over other devices previously known in the art.

What I claim and desire to protect by Letters Patent is:

1. In an electric ignition device the combination of an upper nonmetallic insulating member; a lower nonmetallic insulating member; a separate, metallic, tubular capsule retaining said insulating members; a resilient sealing member retained under compression between said upper and lower insulating members; a pair of lead wires extending through said insulating members and through said resilient sealing member and firmly retained by the compressed resilient sealing member; and a resistance wire connecting the terminal ends of said lead wires.

2. In an electric ignition device the combination of an upper nonmetallic insulating member; a lower nonmetallic insulating member; a separate, metallic, tubular capsule retaining said insulating members in spaced relationship;

a resilient sealing member being retained under compression between said upper and lower insulating members; a pair of lead wires extending through said insulating members and through said resilient sealing member firmly retained in spaced relationship by the compressed resilient sealing member; and a resistance wire connecting the terminal ends of said lead wires.

3. In an electric ignition device the combination of an upper nonmetallic insulating member; a lower nonmetallic insulating member; a separate, metallic, tubular capsule retaining said insulating members in spaced relationship; a resilient sealing member having a pair of spaced apertures longitudinally therethrough, said sealing member being retained under compression between said upper and lower insulating members; a pair of lead wires extending through said insulating members and through said resilient sealing member and firmly retained in said spaced apertures by the compressed resilient sealing member; and a resistance wire connecting the terminal ends of said lead wires, said terminal ends extending below said lower insulating member.

4. In an electric ignition device the combination of an upper nonmetallic insulating member having spaced apertures therethrough; a lower nonmetallic insulating member having spaced apertures therethrough; a separate, metallic, tubular capsule retaining said insulating members in spaced relationship; a resilient sealing member having a pair of preformed spaced apertures longitudinally therethrough, said sealing member being retained under compression between said upper and lower insulating members; a pair of lead wires extending through said spaced apertures of said insulating members and through said resilient sealing member and firmly retained by the compressed resilient sealing member; and a resistance wire connecting the terminal ends of said lead wires.

5. In an electric blasting device the combination of a charged shell; an ignition device inserted in said shell comprising an upper nonmetallic insulating member; a lower nonmetallic insulating member; a separate, metallic, tubular capsule retaining said insulating members; a resilient sealing member retained under compression between said upper and lower insulating members; a pair of lead wires extending through said insulating members and through said resilient sealing member and firmly retained by the compressed resilient sealing member; a resistance wire connecting the terminal ends of said lead wires; and a bulge in that portion of the shell in contact with said ignition device, said bulge being formed by the insertion of the ignition device into the shell.

6. In an electric blasting device the combination of a charged shell; an ignition device inserted in said shell comprising an upper nonmetallic insulating member; a lower nonmetallic insulating member; a separate, metallic, tubular capsule retaining said insulating members in spaced relationship; a resilient sealing member being retained under compression between said upper and lower insulating members; a pair of lead wires extending through said insulating members and through said resilient sealing member firmly retained in spaced relationship by the compressed resilient sealing member; a resistance wire connecting the terminal ends of said lead wires; and a bulge in that portion of the shell in contact with said ignition device, said bulge being formed by insertion of the ignition device into the shell.

7. In an electric blasting device the combination of a charged shell; an ignition device inserted in said shell comprising an upper nonmetallic insulating member; a lower nonmetallic insulating member; a separate, metallic, tubular capsule retaining said insulating members in spaced relationship; a resilient sealing member having a pair of spaced apertures longitudinally therethrough, said sealing member being retained under compression between said upper and lower insulating members; a pair of lead wires extending through said insulating members and through said resilient sealing member and firmly retained in said spaced apertures by the compressed resilient sealing member; a resistance wire connecting the terminal ends of said lead wires, said terminal ends extending below said lower insulating member; and a bulge in that portion of the shell in contact with said ignition device, said bulge being formed by insertion of the ignition device into the shell.

8. In an electric blasting device the combination of a charged shell; an ignition device inserted in said shell comprising an upper nonmetallic insulating member having spaced apertures therethrough; a lower nonmetallic insulating member having spaced apertures therethrough; a separate, metallic, tubular capsule retaining said insulating members in spaced relationship; a resilient sealing member having a pair of preformed spaced apertures longitudinally therethrough, said sealing member being retained under compression between said upper and lower insulating members; a pair of lead wires extending through said spaced apertures of said insulating members and through said resilient sealing member and firmly retained by the compressed resilient sealing member; a resistance wire connecting the terminal ends of said lead wires; and a bulge in that portion of the shell in contact with said ignition device, said bulge being formed by insertion of the ignition device into the shell.

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