June 18, 1940. L. A. BURROWS ET AL 2,205,081

COLLAPSIBLE TUBE METHOD OF DEPOSITING EXPLOSIVE CHARGES

Filed Oct. 7, 1939 2 Sheets-Sheet 1

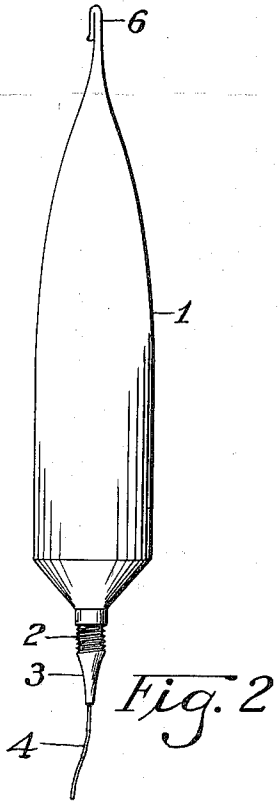


Fig. 2

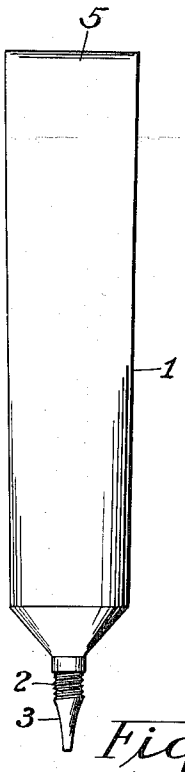


Fig. 1

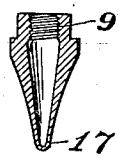


Fig. 2b

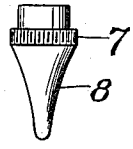


Fig. 2a

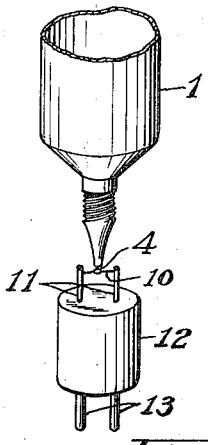


Fig. 3

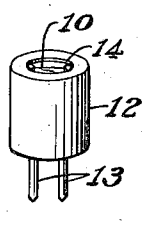


Fig. 3a

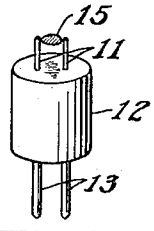


Fig. 3b

LAWTON A. BURROWS
CLIFFORD A. WOODBURY
INVENTORS.
BY Thos A. Wilson
ATTORNEY.

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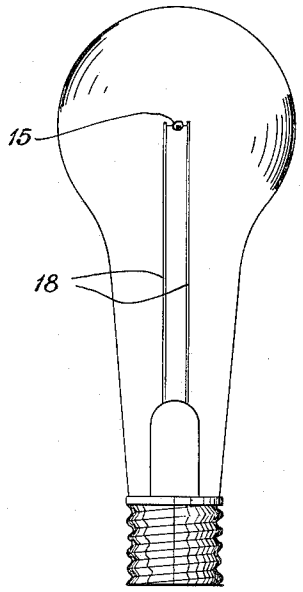


Fig. 4

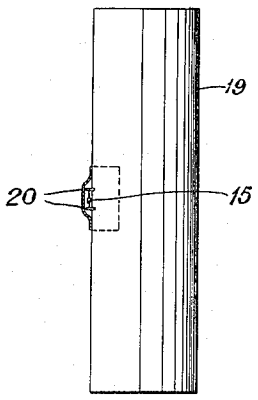


Fig. 5

Lawton A. Burrows
Clifford A. Woodbury INVENTORS

BY Thos. A. Wilson
ATTORNEY

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COLLAPSIBLE TUBE METHOD OF DEPOSITING EXPLOSIVE CHARGES

Lawton Arthur Burrows, Woodbury, N. J., and Clifford Akeley Woodbury, Media, Pa., assignors to E. I. du Pont de Nemours & Company, Wilmington, Del., a corporation of Delaware

Application October 7, 1939, Serial No. 298,420

4 Claims. (Cl. 86—10)

This invention relates to electric blasting initiators and similar devices wherein a combustible charge is employed in juxtaposition with an electric filament and to an improved method for the manufacture of said devices.

This application is a continuation-in-part of our copending application, Ser. No. 149,150, filed June 19, 1937.

For many years industry has been confronted with the problem of forming a satisfactory unit charge of a combustible composition about an electric filament. This problem has arisen in the art of manufacturing electric blasting initiators, for example. It is also important to the art of manufacturing photo-electric bulbs. For instance the formation of such a unit charge is a necessary step in the manufacture of match-head initiators, and certain bridge plug ignition assemblies. In recent years the same problem has become acute in the manufacture of electric circuit fuses of the indicating type.

Several methods are known for the production of said charged filament, but none have proved to be satisfactory.

The conventional dipping method, for example, has many defects. In this method the combustible materials are suspended in solution. The filament is then dipped in the solution to form the unit charge thereon. One difficulty with this method lies in the fact that most of the desired ingredients are of such density that it is difficult to prevent them from segregating in the solution. This necessitates frequent stirring which is of course undesirable. Moreover, due to solvent evaporation, a highly sensitive film or crust forms on the surface of the solution, which is not only hazardous but also causes delay in the application of the material. In addition, the removal of this crust from the solution tends to cause variation in the composition of the material as it is applied to the various assemblies. If a high boiling point solvent is employed to decrease the evaporation of the solvent from the solution to minimize the effect of the aforementioned advantages, new difficulties arise. After application, the material does not "set up" quickly enough, but tends to flow over various parts of the firing circuit where it is undesirable. The formation of a mass of proper size, shape and strength at the desired locus is impossible under these conditions.

An alternative method, as employed in the formation of the concave plug assembly for initiators, involves forming a paste of the combustible ingredients, which paste is then wiped into position in the concave plug. This process is hazardous since the ingredients are sensitive to friction. It is also productive of defective assemblies for the reason that the necessary, completely uniform distribution of the composition in the concavity is not always achieved.

The object of the present invention is to provide an improved and safe method for the application of ignition compositions to electric blasting initiators and the like. Another object is an improved method of forming coherent unit charges of combustible compositions about an electric filament. A further object is a method which permits the application of ignition charges having uniform physical and chemical compositions. A still further object is a method for readily fixing an explosive composition in a locus of limited dimensions. Additional objects will be apparent from the following description of our invention.

We have found that the foregoing objects are achieved and the disadvantages overcome by combining the combustible ingredients with a fluid, and, if desired, a combining agent to form a plasticized or colloided mass, charging said plastic composition into a normally closed system adapted to extrusion, and extruding a coherent unit charge of said plastic composition about an electric filament, and causing said plastic unit to harden about said filament to produce a compact, desirable charged filament assembly.

Although any desirable extrusion system may be employed which is compatible with the solvent and ignition agents employed, we greatly prefer to charge the plastic or colloidal material into a thin-walled collapsible tube desirably made of tin or lead. The tube will preferably have a nozzle of convenient length for the application of the composition about the filament under conditions of close clearance. The size of the orifice or opening in the nozzle likewise depends on the requirements of the particular application. A threaded cap will serve as a suitable closure element for the opening in the nozzle. The closure means at the base of the tube need not be attached until after the tube is loaded. The tube may be charged by introducing the colloided or plasticized combustible composition into the base thereof by any suitable method. The base of the tube may be closed conveniently by doubling up the ends into a fold. A strip of metal can be annexed to each side of the fold by exerting pressure thereon. Extrusion through the opening in the nozzle may be effective readily by exertion of a slight pressure on the part of the operator. In this manner a limited quantity of the plastic com-

position is readily applied to any desired locus. As the quantity of the material in the tube decreases, the base of the tube may be rolled up or folded in order to prevent any flow in that direction.

Our invention is best described in connection with its application to the fixation of coherent units of initating charges upon electric filaments of the types employed in the manufacture of electric blasting initiators, photo-electric bulbs, electric indicating fuses, and the like.

In order that our invention may be better understood, reference is made to the accompanying drawings. Fig. 1 is a view, in perspective, of the collapsible tube before it is closed at the base. This view shows the tube in the inverted position suitable for its charging. Fig. 2 is a view in perspective of the collapsible tube as it appears during application. Fig. 2*a* is a view in side elevation of the closure for the extrusion opening, while Fig. 2*b* is a vertical cross-sectional view of the same. Fig. 3 shows the collapsible tube in relationship with a bridge type plug, as employed in an electric blasting cap. Fig. 3*a* is a perspective view of a concave plug, while Fig. 3*b* shows a bridge plug after the application of the ignition composition in the form of a bead. Fig. 4 and Fig. 5 illustrate specific adaptations of our invention, Fig. 4 being a view of a photo-electric bulb, whereas Fig. 5 is a view of an indicating type electric fuse, having a bead of an ignitable composition fixed on the electric circuit of the fuse.

Similar numerals refer to similar parts throughout the several views.

Referring to Fig. 1, the body of the tube is designated by 1. The ignition composition is charged into the tube through the opening 5; the orifice 16 being closed at the time. The threads 2 serve as a means of attaching the closure element for the orifice. Fig. 2 shows the closure of the base 6 after the tube has been charged. After the cap, Fig. 2*b*, is removed, a slight pressure forces the composition through the nozzle 3. The shape and size of the material are, of course, influenced by the orifice. The cap, as shown in Fig. 2*a* and 2*b*, is made to fit the nozzle of the collapsible tube and is shaped accordingly (8). Surface 2 is provided for firmly gripping the cap and threads 9, which correspond to those, 2, of the tube. The tip of the cap contains a material, 17, which provides a tight seal when pressure is exerted thereon, rubber, for example.

Fig. 3 shows the application of the ignition composition 4 to the bridge plug 12. The bridge wire 10 is shown connecting the two bridge posts 11. The insulated wires 13 are shown leading to the plug 12. Fig. 3*a* shows a concave plug, wherein the bridge wire 10 is in the concavity 14, at a level below the surface of the plug. The ignition composition is introduced into the concavity so that it surrounds the bridge wire. Fig. 3*b* shows a bead 15, which has been attached to the bridge wire.

As stated hereinbefore, Fig. 4 shows a bead of an ignition composition fixed on the electric circuit of a photoelectric bulb. Upon passage of the electric current through the filament members 18, the bead of ignition composition, 15, is ignited, and in turn causes the ignition of the foil within the bulb (not shown) so that the desired degree of illumination is attained. Fig. 5 shows a bead of ignitable material 15 positioned on a current-conducting member of the indicating fuse 19. Said current-conducting member having the leads 20, is adapted to be heated upon passage of an electric current exceeding a predetermined value, the heating of said member causing ignition of the charge 15, which ruptures a paper label or equivalent material, which is usually placed over 15.

By way of further illustration of our invention the following examples set forth the details of preparing charged filament assemblies in the several types of devices with the use of particular solvents, designated ignition ingredients and combining agent and with all of the operating details described at length.

Example I

Two parts by weight of lead styphnate was mixed with approximately 1 part of a nitrocellulose solution, said solution consisting of 1 g. of No. 2 nitrocellulose and 7 g. 10-second nitrocellulose dissolved in 100 cc. of butyl acetate. This blend of nitrocellulose has been found very desirable where an extremely dense material like lead styphnate is employed, because it retains the lead styphnate in suspension as well as permitting a uniform distribution of the solid materials throughout the mass.

Example II

This composition consisted of an 80–10–10 mixture of lead nitrato bis basic lead dinitro-orthocresylate, zirconium, and potassium chlorate dissolved in a nitrocellulose solution, the ratio of solid mixture to the nitrocellulose solution being 10 to 6. In this case, the nitrocellulose solution was made up of ½ g. No. 2 nitrocellulose and 10 g. ½-second nitrocellulose per 100 cc. of solvent.

The foregoing specific embodiments are given only by way of illustration of our invention, and we do not intend to be restricted thereto.

For instance, both the amount and type of solvent employed depend on the ignition ingredients that are used, and on conditions existing during the application. Such variations may be readily made to meet the particular requirements. For example, it has been found advantageous to employ a relatively large proportion of a solvent of high boiling point in the manufacture of the concave plug types, whereas a lower proportion of a solvent of low boiling point may be more suited for the application of the ignition composition to plugs of the so-called bead type.

It should be noted that we greatly prefer the collapsible tube to the other embodiments of our invention, especially to the type of closed system which is operated with a piston. An unexpected advantage of the collapsible tube over such a piston system is that dried colloidal explosive material may perhapse be squeezed between the piston and the side of an extrusion cylinder. By contrast, there is no opportunity for this hazardous result in the collapsible tube. The tube is simply folded upon itself as used, without any frictional rubbing of the material remaining therein.

Comprehensive tests have shown that the method described herein possesses many advantages over those heretofore described.

An outstanding advantage of the method of our invention is the fact that it is much faster than any method known heretofore. It has been determined by actual experiment that an operator equipped with the collapsible tube containing the plasticized material according to the present

invention is able to complete many times more charged filament assemblies in a given time than the same operator could produce with any method known to the art. For example, a given operator manufacturing bridge plug bead assemblies for electric blasting caps was able to form only 300 per hour by the conventional dipping method as described in the foregoing. However, the same operator was able to prepare over 1,000 of the same assemblies by means of the collapsible tube extrusion process of our invention.

Investigation has revealed that ignition compositions of the desired plasticity may be made wherein there is no settling out of any of the commonly employed ignition agents, over reasonable periods of time. Also, since there is no evaporation of solvent during confinement in the closed system, the physical structure of the composition does not vary. This permits the use of solvents which evaporate very readily, without the danger of the formation of highly sensitive crust or film. Ignition compositions mixed with this type of solvent, tend to "set up" quickly, upon application to the firing circuit of the initiator, and thus eliminate the undesirable flowing of the material.

The use of separate closed containers reduces the explosive hazard that is ordinarily present, since the quantity of material present at any one time is greatly reduced. In addition, tubes containing extremely sensitive ingredients, such as lead styphnate, for example, are found to be relatively safe.

Not only is the hazard greatly reduced by this method of fixing an explosive charge at a desired locus, but, in addition, this is accomplished in a manner so simplified as to render possible the attainment with safety of a much higher speed of operation than ever achieved by methods heretofore employed. Moreover, there is no segregation of the ignition ingredients before the composition is applied to the various devices, hence there is no variation in composition and performance of said devices.

Numerous variations from the method herein described may be made without departing from the scope of this invention. For example, the ignition ingredients and solvent may be mixed in the same container from which the material is later extruded. We intend, therefore, to be bound only by the following claims.

We claim:

1. The method of introducing an ignition charge onto the filament of an electric blasting initiator, which method comprises extruding said charge in plastic form from a closed system into suitable position on the filament of said initiator.

2. The method of introducing an ignition agent onto the filament of an electric blasting initiator, which method comprises concurrently extruding and depositing a charge of said ignition agent in plastic form from a collapsible tube in position on the filament of said initiator.

3. The method of beading an electric blasting initiator, which comprises simultaneously extruding and suspending a bead of an ignition agent in plastic form from a collapsible tube on the bridge wire of said initiator.

4. The method of introducing a plastic combustible composition onto the filament of an electric utility of the types disclosed, which method comprises extruding said plastic combustible composition from a collapsible tube onto said filament.

LAWTON ARTHUR BURROWS.
CLIFFORD AKELEY WOODBURY.