United States Patent [19]
Thomas et al.

[11] 3,763,783
[45] Oct. 9, 1973

[54] MANUFACTURE OF FUZE HEADS

[76] Inventors: Arwyn Theophilus Thomas, 66 Gillmans Rd., Orpington; Raymond James Williams, 48 Langdale Gardens, Hove, both of England

[22] Filed: July 9, 1971

[21] Appl. No.: 161,259

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 110,720, Jan. 28, 1971, abandoned.

[30] Foreign Application Priority Data

Feb. 4, 1970 Great Britain 5356/70

[52] U.S. Cl. ..... 102/28 M
[51] Int. Cl. C06c 1/00
[58] Field of Search ..... 102/28 M; 149/2

[56] References Cited

UNITED STATES PATENTS

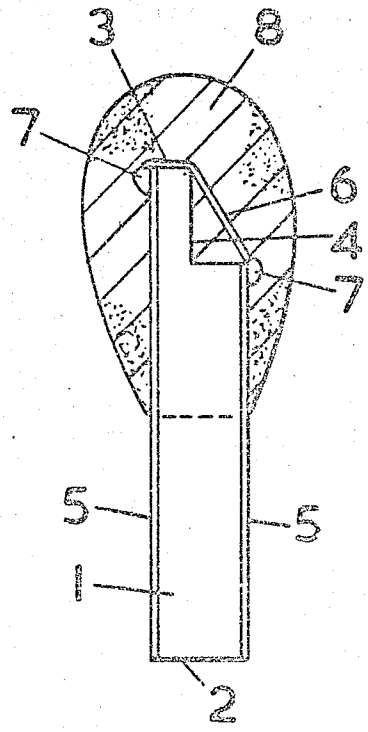
2,506,229 5/1950 Lowe et al. ..... 102/28 M
3,415,189 12/1968 Trevorrow ..... 102/28 M
3,586,551 6/1971 Nolan 149/2

Primary Examiner—Verlin R. Pendegrass
Attorney—Stevens, Davis, Miller & Mosher

[57] ABSTRACT

Novel fuse heads and a process for making them in which a suspension of a primary explosive composition is made in water to which a small amount of one or more organic hydrophilic polymers is added in the proportion one to 10 percent by weight of the dry primary explosive composition. Bridge wires are immersed in the suspension and removed with the adhering material and the fuse heads so produced are allowed to dry.

8 Claims, 2 Drawing Figures



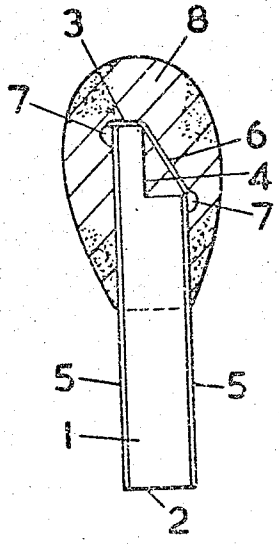


FIG. 1.

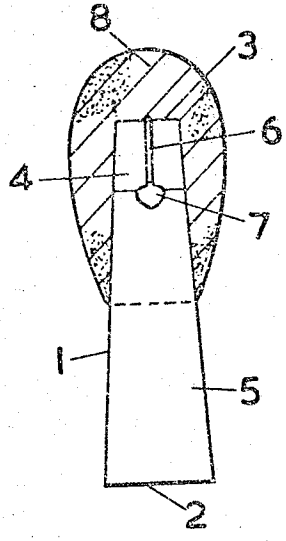


FIG. 2.

MANUFACTURE OF FUZE HEADS

This application is a continuation-in-part of our application Ser. No. 110730 filed 28th January, 1971, and now abandoned.

This invention relates to improved fuseheads and to methods of making them.

Fuse heads are electrical detonating means in which a section of a suitable bridge wire is coated with a primary explosive composition and a binder, and which on passage of an electric current thorugh the coated wire, ignite. They are normally made by immersing the bridge wire in a suspension of the primary explosive composition, a portion of which sticks on to and is retained by the wire as a bead. In order to obtain reproducible fuse heads, it is necessary to use a reasonably stable suspension of a sufficient quantity of the primary explosive to permit known quantities of the primary explosive composition to adhere to the wire. This has been achieved in the past by suspending the primary explosive composition in a suspension of nitrocellulose or ethyl cellulose in an organic solvent such as an amyl acetate/amyl alcohol mixture. Normally, this involves a two-stage dipping process. For example, a fusehead may consist of a first layer derived from a mixture of lead mono-nitro-resorcinate and potassium chlorate suspended in a mixture of nitro-cellulose or ethyl cellulose in an organic solvent and a second layer derived from a mixture of potassium chlorate and charcoal in a similar organic solvent suspension. This method has the disadvantages that the primary explosive must be handled dry, with the consequent risk of explosion, prior to the mixing with the nitrocellulose or ethyl cellulose suspension and the organic solvent being inflammable, greatly increases the hazards of the process.

Owing to the solubility of inorganic salts such as potassium chlorate in water, it has not been feasible to use binders suspended or dispersed in water to prepare fusehead dipping mixtures.

A further disadvantage of fuseheads incorporating nitrocellulose as a binder is that they should not be kept at temperatures above 100°C as the nitrocellulose then becomes unstable.

It has now been found that fuseheads may be prepared employing a one-stage dipping operation in a cheap and relatively safe way by immersing a bridge wire in an aqueous suspension of a primary explosive composition to which a small amount of an organic hydrophilic polymer has been added.

According to the invention, there is provided a process for the manufacture of a fusehead comprising forming a suspension of a primary explosive composition in water containing a small amount of one or more organic hydrophilic polymers (as hereinafter defined) in a proportion between about 1 to about 10 percent by weight of the dry primary explosive composition, immersing a bridge wire in said suspension, removing said bridge wire and adhering material and allowing the fusehead so produced to dry.

Preferably the organic hydrophilic polymer is at least one of the compounds methyl cellulose, sodium carboxy methyl cellulose and polyvinyl alcohol.

The term organic hydrophilic polymer as used in this specification refers to an organic polymer which when added to water gives a viscous colloidal dispersion or solution. It will be realised that the degree of substitution and the chain length of the polymer

in consequence, the viscosity of the aqueous solution may be affected not only by the concentration of the polymer but also by the degree of substitution or the chain length of the polymer. For instance, lower concentrations within the range 1 to 10 percent of a high molecular weight polymer can produce the same effect as higher concentrations within the range of 1 to 10 percent of lower molecular weight polymers.

The viscosity of the aqueous solution or dispersion of the organic hydrophilic polymer must be such that this solution will retain as a relatively homogeneous suspension the particles or granules of the primary explosive composition to be used for a period sufficiently long to prepare a worthwhile number of fuse heads without being re-mixed. The bridgewire need only be immersed for a few seconds and this can be a simple dipping action or a sweeping action. It may be immersed for one or more times depending on the concentration of the explosive in the suspension and the amount of explosive composition required on the fusehead. The colloidal dispersion must not be a rigid gel as this would adversely affect the adhesion of the dispersion on the bridge wire and the consistency of the bead size obtained.

The bulk density and the particle size of primary explosive compositions have various values and this factor must be taken into account. In accordance with well known principles in the art, the proportion of organic hydrophilic polymer in the aqueous suspension will need to be higher within the range 1 to 10 percent for compositions having higher bulk densities and/or larger particle sizes.

Fuseheads may be used for a variety of purposes including, for example, initiation of a detonator such as lead azide, ignition of a charge, for instance a delay charge or a propellant charge, or for the purpose of generating a gas pressure.

It will be realised that such applications require fuseheads giving different output energies. The variation in the required output energies may be obtained by a compensating variation in the initiating properties of the fusehead as is well known in the art. In the fuseheads according to the invention this variation in initiating properties may be obtained by a variation in the primary explosive composition and/or the proportion of the hydrophilic polymer incorporated in the fusehead composition. For concentrations greater than 5 percent, fuseheads would, in general, be less energetic but may be more suitable for particular applications such as the generation of a gas pressure. Too much polymer could render the resultant fusehead inert and a concentration of between 1 and 5 percent is generally preferable. A few simple tests would confirm the required concentration of any specific polymer within the range from about 1–10 percent against the particle size/density of the primary explosive, its specific function, and the mechanical properties of the fusehead produced.

In this patent specification, the words primary explosive composition are used to define a sparingly water soluble composition which may be readily ignited by a hot wire. This composition may include fuels and/or oxidants in addition to the conventional explosives. Compositions which may be used include metal styphnates such as the lead and barium salts, metal azides such as the lead and silver salts, the lead salts of dini-

and metal piorates such as the lead and potassium salts and include beta monobasic lead styphnate, normal lead styphnate, acid lead 4, 6-dinitroresorcinol, normal lead 4,6-dinitroresorcinol, basic lead 4, 6-dinitroresorcinol, lead azide, silver azide, monobasic lead azotetrazole, barium styphnate, potassium piorate and the lead salts of trinitrophloroglucinol.

A fusehead according to the invention is shown in side and front face elevation in the accompanying FIGS. 1 and 2.

The fusehead consist of an insulating body 1 made of pressboard which tapers slightly from the bottom 2 to the top 3. The top side 3 is partly cut away to leave a step 4. The sides of the body 1 are covered with brass-foil 5 attached to the body 1 by any known means. A platinum wire 5 is stretched across the step 4 and securely fastened to the brassfoil 5 by soldered joints 7. The upper end of the body 1 and the wire 6 is covered by a bead of a primary explosive composition 8.

The invention is illustrated by the following examples:

EXAMPLE 1

The water content of wet beta monobasic lead styphnate of particle size approximately 6–10 microns long and 1–2 microns wide was determined and sufficient material was weighed out to give 8.08g of the dry lead styphnate. The water content was adjusted to give a total water content of 2.0g. 5ml of an aqueous suspension containing 5 percent (wt/vol) of methyl cellulose (coagulation temperature 70°C, viscosity of 1 percent aqueous solution 10–20 cp) was added and the whole was mixed to give a smooth paste. Bridge wires were immersed in this paste, withdrawn and the formed fuseheads allowed to dry. The above paste was used without further re-mixing up to about 15 minutes with little variation in the composition and or bead size attained on the finished fuze-head.

EXAMPLE 2

The water content of wet beta monobasic lead styphnate was determined and sufficient material weighed out to give 9.5g of the dry lead styphnate. The water content was adjusted to give a total water content of 2.0g. 5.0ml of an aqueous suspension containing 10 percent (wt/vol) polyvinyl alcohol (99 percent hydrolysed, viscosity 4 percent aqueous solution 5–25cp) was added and the whole mixed to give a smooth paste. Fuseheads were made as in Example 1.

EXAMPLE 3

4.8g of finely divided lead azide (approximately 1–5 microns diameter) (prepared by precipitation) was taken and 2.5g of water added 2.0ml of 10 percent (wt/vol) polyvinyl alcohol (99 percent hydrolysed, viscosity of 4 percent aqueous solution 5–25cp) was added and the whole mixed to a smooth paste. By successive dipping operations, fuseheads containing up to 50mg of lead azide were made.

EXAMPLE 4

5.0g of beta monobasic lead styphnate was taken and mixed with 6.25ml of an 8 percent (wt/vol) aqueous polyvinyl alcohol (99 percent hydrolysed, viscosity of 4 percent aqueous solution 5–25cp) solution and the whole mixed to give a smooth paste. Fuseheads made from this suspension exploded satisfactorily but had a low energy output.

EXAMPLE 5

The water content of monobasic lead azotetrazole (particle size, length 10–20 microns, breadth 2–4 microns) was determined and sufficient material weighed out to give 5.0g of dry salt. The water content was adjusted to give a total water content of 1.3g. 4ml of an aqueous suspension containing 2.5 percent (wt/vol) sodium carboxy methyl cellulose (viscosity of a 1 percent solution 20–35cp determined in a U tube) was added and the whole mixed to a smooth paste. Bridge wires were immersed in this solution, withdrawn and the formed fuseheads allowed to dry.

EXAMPLE 6

5.0g of potassium picrate (average particle size 5–25 microns) was added to 3.0 ml of an aqueous suspension containing 5 percent (wt/vol) polyvinyl alcohol (as used in Example 2) and the whole mixed to a smooth paste. Fuse-heads prepared from this mix ignited readily and burnt quietly and completely.

EXAMPLE 7

The water content of wet acid lead salt of 4, 6-dinitro resorcinol (20–50 microns long, 1–2 microns wide) was determined and sufficient material weighed out to give 5.0 g of the dry salt. The water content was adjusted to give a total water content of 1.25g. 6.26 ml of an aqueous suspension containing 3 percent (wt/vol) sodium carboxy methyl cellulose was added and the whole mixed to a smooth paste. Fuseheads prepared from this mix ignited readily and burnt quietly and completely.

EXAMPLE 8

The water content of a wet lead salt of trinitrophloroglucinol (50–90 microns long, 2–4 microns wide) was determined and sufficient material weighed out to give 5.0g of the dry salt. The water content was adjusted to give a total water content of 1.5g. 5.0 ml of an aqueous suspension containing 5 percent (wt/vol) methyl cellulose (as used in Example 1) was added and the whose mixed to a smooth paste. Fuseheads were made from this mixture by the method given in Example 1.

Fuseheads prepared according to the invention are mechanically stable and suffer a negligible increase in weight due to absorbing water even when stored for three months at ambient temperatures and 98 percent relative humidity. There is no visible deterioration after heating at 160°C for two hours and no deterioration when cooled at −10°C.

Although fuseheads made according to the invention show no tendency to absorb moisture, they may finally be covered by a lacquer of a hydrophobic colloid.

The invention also provides novel fuseheads comprising a mixture of a primary explosive composition and an organic hydrophilic polymer in which the proportion of the polymer is about one to about 10 percent by weight of the primary explosive composition.

What we claimed is:

1. A fusehead having ignitable material comprising a primary explosive composition comprising β monobasic lead styphnate and an organic hydrophilic polymer wherein the proportion of the hydrophilic polymer is within the range from about 1 to about 10 percent the dry primary explosive composition.

2. A fusehead having ignitable material comprising a primary explosive composition comprising β monobasic lead styphnate and an organic hydrophilic polymer wherein the proportion of the hydrophilic polymer is within the range from about 1 to about 5 percent of the dry primary explosive composition.

3. A fusehead according to claim 1 wherein the organic hydrophilic polymer is at least one of the group consisting of methyl cellulose, sodium carboxy methyl cellulose and polyvinyl alcohol.

4. A fusehead according to claim 1 wherein the fusehead additionally comprises cover a hydrophobic colloid.

5. A fusehead according to claim 1 wherein the primary explosive substance contains at least one compound selected from the group consisting of fuels and oxidants.

6. A fusehead according to claim 2 wherein the organic hydrophilic polymer is at least one of the group consisting of methyl cellulose, sodium carboxy methyl cellulose and polyvinyl alcohol.

7. A fusehead additionally comprises according to claim 2 wherein the fusehead a hydrophobic colloid cover.

8. A fusehead according to claim 2 wherein the primary explosive substance contains at least one compound selected from the group consisting of fuels and oxidants.

* * * * *

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,763,783 Dated October 9, 1973

Inventor(s) THOMAS et al

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Col. 1, line 11, change "thorugh" to --through--.
Col. 3, line 17, change "wire 5" to --wire 6--.
Col. 4, line 43, change "whose" to --whole--.
Col. 5, line 12, Claim 4, after "comprises" delete "cover".
line 13, after "coloid" insert --cover--.

In claim 7, col. 6, line 7, delete "additionally comprises".
line 8, after "fusehead" insert --additionally comprises--.

Signed and sealed this 2nd day of July 1974.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

USCOMM-DC 60376-P69
U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,763,783 Dated October 9, 1973

Inventor(s) THOMAS et al

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Col. 1, line 11, change "thorugh" to --through--.
Col. 3, line 17, change "wire 5" to --wire 6--.
Col. 4, line 43, change "whose" to --whole--.
Col. 5, line 12, Claim 4, after "comprises" delete "cover".
line 13, after "coloid" insert --cover--.

In claim 7, col. 6, line 7, delete "additionally comprises".
line 8, after "fusehead" insert --additionally comprises--.

Signed and sealed this 2nd day of July 1974.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

FORM PO-1050 (10-69)

USCOMM-DC 60376-P69
U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334