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EXPLOSION RIVET

Edmund von Herz, Cologne-Dellbruck, Heinz Gawlick, Furth/Bay, and Hans Rathsburg, Stadeln, uber Nuremberg, Germany, assignors to E. I. du Pont de Nemours & Company, Wilmington, Del., a corporation of Delaware

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This invention relates to the art of explosion rivets and to explosive compositions for charging the same.

The present application is a continuation in part of our copending application Serial No. 277,322, filed June 3, 1939 now Patent Number 2,261,195.

As a charge for detonating rivets, the ignition of which is brought about by indirect or direct heating of the rivet to the explosion temperature of the charged explosive, it has been proposed to use heavy metal azides the high explosion point of which is reduced to about 150° by addition of explosives which explode at low temperature.

Mixtures of lead azide and guanyl-nitrosaminoguanyltetrazene, briefly referred to as tetrazene, are particularly efficient and readily prepared preparations in accordance with this proposal.

A problem is presented in view of the fact that the deposit of metallic lead arising in the detonation of lead azide leads in the case of light metal rivetings to high electrocorrosion. Accordingly, the art would welcome some means of overcoming this difficulty.

The object of the present invention is a new and improved explosion rivet. A further object is an explosion rivet characterized by an improved explosive charge. Other objects will be appreciated from the following detailed description of our invention.

We have found that the foregoing objects may be accomplished and disadvantages overcome by employing as a charge in an explosion rivet an explosive composition comprising an ingredient which is an explosive per se, and a substance of good thermal conductivity preferably selected from the group consisting of metal powders and other powdered substances of good thermal conductivity such as the metal alloys, metal carbides, silicides, sulphites, oxides and the like. As the explosive ingredient we may employ, for example, any detonating composition, for instance, a primary detonating explosive. A particularly effective explosive for this purpose comprises a nitrate of a solid polyvalent alcohol, for instance, a nitrate of a polyhydroxy alcohol containing between 4 and 6 hydroxy groups. Thus, a charge comprising mannite hexanitrate and a metal powder is suitable.

In special cases wherein it is undesirable to employ a high ignition temperature for firing the rivet, we prefer to include in the explosive composition an ingredient such as guanyl nitrosaminoguanyl tetrazene or its equivalent. As disclosed in our copending application Serial No. 266,706, filed April 7, 1939, suitable equivalents for tetrazene for this purpose are diazobenzene nitrate, chlornitrodiazophenol, dibromdiazophenol, nitrodiazophenol, diazobenzene sulphonic acid, silver acetylide, and copper acetylide. All of these tend to off-set the difficulty mentioned.

Our preferred compositions therefore comprise a detonating explosive, tetrazene, or its equivalent, and a powdered substance of high thermal conductivity.

For instance, we have found that mixtures of mannite hexanitrate and tetrazene on rapid heating detonate with a high "starting" velocity (i. e. a high velocity of the chemical action leading to detonation) and high shattering power corresponding to initial explosives owing to a peculiar interchange action between the two explosive substances. This property in itself does not belong to either of the two explosive substances since a charge consisting merely of tetrazene blows out without any effect on igniting the rivet by heating, and a pure mannite hexanitrate charge even burns out only without any detonation.

If, on the other hand, the mannite hexanitrate is mixed with about 30% tetrazene, then on heating in the rivet this mixture detonates with the high "starting" velocity peculiar to initial explosives and with high shattering power. Peculiarly enough, this action occurs only on uniformly heating the whole quantity of explosive in the rivet and not with flame and spark ignition, which at best leads only to a burning away of this explosive mixture. This property is very remarkable and is fundamentally important from a technical point of view, since this composition affords a great degree of safety from accidental explosions, both in the case of the loose composition as well as in the case of the finally charged rivets.

The mixture in question, at high charging densities, i. e. when pressed under high pressure, possesses such a brisance that it may be used only for very strong-walled rivets. In the rivets ordinarily used, having relatively thin wall strength of the explosive chamber, the charging density should not exceed about 1, on account of the danger of complete destruction of the rivet. Low charging densities, moreover, mean a charge pressed only slightly, which, as the result of its lack of compactness, tends to become detached and to crumble out; therefore the safety in transportation and use of such explosive rivets is greatly impaired. Such a lightly pressed charge of low charging density, therefore, makes a special covering of the rivet opening by a strong layer of lacquer, or the like, necessary. Since such measures make the manufacture expensive, it is more expedient to dilute the explosive charge so greatly by the addition of inert materials and to diminish its energy to such an extent thereby that even high charging densities cannot lead to an excessive, destructive brisance. In such explosive rivets, with charges of high loading density, the explosive charge is so strongly pressed that loosening and falling out, even without a protective covering, is entirely out of the question. This dilution, however, cannot be effected as when using pronounced initial explosives, with any desired pulverulent substances, e. g., kieselguhr, since such substances, even in the smallest quantity, prevent the development of detonation.

On the other hand, it has been found surprisingly enough that this necessary dilution is to be carried out more particularly with metal powders and with powdered substances of good thermal conductivity, such as, for example, metal carbides, silicides, sulphites, oxides, etc. The detonation sensitivity of the mannite hexanitrate-tetrazene mixture is no only in no way hindered by this addition but, quite on the contrary, is enhanced to a considerable extent, apparent from the great uniformity of the expansion or splaying results. It is certainly remarkable that the proportion of diluent can, in the case of satisfactorily conducting metal powders, e. g., silver, copper and aluminum powder, be raised up to about 85% of the mixture, without the detonation sensitivity and the high "starting" velocity being impaired.

This peculiar effect of these heat-conducting diluents is probably to be attributed to the fact that, owing to the satisfactory heat transference to the interior of the explosive charge, the explosive particles simultaneously ignite more rapidly and in much greater number. Owing to the fact that the detonation is not, as otherwise general, initiated at one end and does not travel layerwise through the explosive charge but takes place practically at the same moment at all points of the charge, there is an increase in the "starting" velocity and a shortening in the time of detonation. The braking effect of large quantities of inert substance is completely compensated for by this new effect and the action of the detonation is made still more uniform by the increased decomposition velocity.

It is to be understood that the beneficial effect of the powdered thermal conductors is not limited to three component compositions containing tetrazene or the like, but is achieved likewise in compositions comprising a detonating explosive and said thermal conductor, for instance, a composition comprising mannite hexanitrate and powdered aluminum.

Likewise, as disclosed and claimed in our Patent Number 2,261,195, special advantages are observed in the two component compositions comprising the nitrate of the solid polyvalent alcohol and tetrazene or one of its equivalents, already mentioned, for instance, a composition comprising mannite hexanitrate and tetrazene.

In the case of rivetings of metal pieces which are sensitive to corrosion, the diluent should be so chosen that the explosion residues can in no circumstances lead to an electrical difference in voltage with the metal coated therewith, since the current flow set up under the action of moisture may lead to severe corrosion. As diluting agent, therefore, preferably the metal powder or the metal compound which corresponds to the rivet metal, or to the metal being riveted, will be employed. In the case of rivetings of light metals, e. g., in aircraft construction, aluminum powder will preferably be used.

Example of a mixture for light metal rivets

	Per cent
Tetrazene	10
Mannite hexanitrate	25
Aluminum powder	65

The mannite hexanitrate may also be replaced by any solid nitrate of a polyhydroxy alcohol or other detonating explosive, for instance, the nitrates of tetrabasic and pentabasic alcohols, e. g., by erythrite tetranitrate.

A particular advantage of these explosive compositions is the insensitivity towards mechanical influences brought about by the large quantity of metal powder, which makes the charging and pressing of the rivets filled therewith practically free from danger.

These mixtures containing metal powder also are ignited by flame only with very great difficulty and then they burn away harmlessly.

The present invention therefore represents a noteworthy advance over the pure initial compositions sensitive to flame, impact and friction heretofore proposed and used.

We claim:

1. In an explosion rivet, an explosive charge which comprises a detonating, solid, nitrated explosive compound and a powdered thermal conductor selected from the group consisting of metal powders, metal alloy powders, metal carbides, silicides, sulphites, and oxides.

2. In an explosion rivet, an explosive charge comprising a detonating solid nitrated explosive compound, an additional explosive compound of low ignition temperature, and a non-explosive ingredient comprising a powdered thermal conductor selected from the class consisting of metals, metal alloys, metal carbides, silicides, sulphites, and oxides.

3. In an explosion rivet, an explosive charge comprising a nitrate of a solid polyvalent alcohol and a powdered thermal conductor selected from the class consisting of metals, metal alloys, metal carbides, silicides, sulphites, and oxides.

4. In an explosion rivet, an explosive charge comprising mannite hexanitrate and aluminum powder.

5. In an explosion rivet, an explosive charge comprising the nitrate of a solid polyvalent alcohol, guanyl-nitrosamino guanyl-tetrazene, and a substance of good thermal conductivity selected from the class consisting of metals, metal alloys, metal carbides, silicides, sulphites, and oxides.

6. In an explosion rivet, an explosive charge comprising mannite hexanitrate, guanyl-nitrosamino guanyl-tetrazene, and a substance of good thermal conductivity selected from the class consisting of metals, metal alloys, metal carbides, silicides, sulphites, and oxides.

7. In an explosion rivet, an explosive charge comprising mannite hexanitrate, guanyl-nitrosamino guanyl-tetrazene, and a metal powder.

8. In an explosion rivet, an explosive charge comprising mannite hexanitrate, guanyl-nitrosamino guanyl-tetrazene, and aluminum powder.

9. In an explosion rivet, an explosive charge comprising a detonating, solid, nitrated explosive compound, and a finely divided diluent of high thermal conductivity selected from the class

consisting of metals, metal alloys, metal carbides, silicides, sulphites, and oxides.

10. In an explosion rivet, an explosive charge comprising a nitrate of polyhydroxy alcohol containing between 4 and 6 hydroxy groups and a finely divided diluent of high thermal conductivity selected from the class consisting of metals, metal alloys, metal carbides, silicides, sulphites, and oxides.

11. In an explosion rivet, an explosive charge comprising a nitrate of a polyhydroxy alcohol containing between 4 and 6 hydroxy groups, a finely divided diluent of high thermal conductivity selected from the class consisting of metals, metal alloys, metal carbides, silicides, sulphites, and oxides, and tetrazene.

12. In an explosion rivet, an explosive charge comprising a nitrate of a polyhydroxy alcohol containing between 4 and 6 hydroxy groups, tetrazene, and a finely divided metal.

13. In an explosion rivet, an explosive charge comprising a nitrate of a polyhydroxy alcohol containing between 4 and 6 hydroxy groups, tetrazene, and a finely divided metal comprising silver.

14. In an explosion rivet, an explosive charge comprising a nitrate of a polyhydroxy alcohol containing between 4 and 6 hydroxy groups, tetrazene, and a finely divided metal comprising copper.

15. In an explosion rivet, an explosive charge comprising a nitrate of a polyhydroxy alcohol containing between 4 and 6 hydroxy groups, tetrazene, and a finely divided metal comprising aluminum.

EDMUND von HERZ.
HEINZ GAWLICK.
HANS RATHSBURG.