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EXPLOSIVE COMPOSITION FOR
DETONATING RIVETS

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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-nitrosamino-guanyltetrazene, briefly referred to as tetrazene, are particularly efficient and readily prepared preparations in accordance with this proposal.

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 electro-corrosion, detonating charges which are poor in lead azide and the lead azide content of which amounts only to about 18–20%, have already been prepared. The lead azide portion which is omitted is in this case replaced by a mixture of highly shattering nitro-bodies or esters and inert diluents.

Still more suitable, however, were compositions of metal-free initial explosives or of explosives which contain the same metal as that of which the material to be riveted consists. Unfortunately, the known purely organic initial explosives are quite out of the question for this large-scale use, since they are far too sensitive and partly also are not stable to storage, for example, nitrodiazobenzene perchlorate and cyanuric triazide.

It has now been 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 re-

markable 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 not 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 aluminium powder, be raised up to about 85% of the mixture, without the detonation sen-

sitivity 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.

In the case of rivetings of metal pieces which are sensitive to corrosion, the diluent must 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, for the most part always 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, aluminium powder will exclusively be used.

Example of a mixture for light metal rivets

	Percent
Tetrazene	10
Mannite hexanitrate	25
Aluminium powder	65

The mannite hexanitrate may also be replaced by 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 comprising a nitrate of a solid polyvalent alcohol

containing between 4 and 6 hydroxy groups, and guanyl-nitrosamino guanyl-tetrazene.

2. In an explosion rivet an explosive charge comprising a nitrate of a tetravalent alcohol, and guanyl-nitrosamino guanyl-tetrazene.

3. In an explosion rivet an explosive charge comprising the nitrate of a pentavalent alcohol, and guanyl-nitrosamino guanyl-tetrazene.

4. In an explosion rivet an explosive charge comprising the nitrate of a hexavalent alcohol, and guanyl-nitrosamino guanyl-tetrazene.

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

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

7. In an explosion rivet an explosive charge comprising mannite hexanitrate, guanyl-nitrosamino guanyl-tetrazene, and a powder substance of good thermal conductivity selected from the class consisting of metals, metal carbides, metal sulfides, metal sulfites, and metal oxides.

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

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

10. 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 carbides, metal sulfides, metal sulfites, and metal oxides, and tetrazene.

11. 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.

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

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

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

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