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(54) **A DETONATION TUBE WITH IMPROVED SEPARABILITY FROM THE PROCESSED BROKEN STONE**

DETONATIONSROHR MIT VERBESSERTER TRENNBARKEIT AUS DEM BEARBEITETEN SCHOTTER

TUBE À DÉTONATION POSSÉDANT UNE SÉPARABILITÉ AMÉLIORÉE À PARTIR DE LA PIERRE CONCASSÉE TRAITÉE

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Description

Field of the Invention

[0001] The invention deals with double-layer, three-layer or multi-layer detonation tubes, also referred to as the Shock Tube type, used for industrial non-electric detonators, as described for instance in document US 5243913 A. In particular it deals with the design of their body to enable economically acceptable separation of remainders of such detonation tubes of non-electric detonators after the execution of blasting work from the other substances from the processed mined material.

Background of the Invention

[0002] Remainders of detonation tubes of non-electric detonators used during blasting work within mining of rock contaminate the resulting mined product, i.e. broken stone. In this case contamination is represented by the presence of remainders of tubes in the mined material, which subsequently causes problems during the treatment of the material in technological equipment as e.g. crushers where the broken stone or mining product is ground or sorters where the product is sorted into the required fraction. The above mentioned contamination and entering of insulation remainders to the above mentioned processing machines result in frequent shutdowns of the machines caused by the necessity to remove the remainders of detonation tubes from them. In extreme cases the machines may even break down. This is why it is necessary to remove the concerned remainders of tubes from the mined product, especially stone, which is carried out manually at present. This fact increases the costs of the series of blasting work and treatment of mined stone, which is a considerable disadvantage in technological procedures comprising the use of otherwise very safe non-electric detonators equipped with a low-energy detonation tube. At present, this disadvantage limits using non-electric detonators with a detonation tube. But on the other hand some utility and technical parameters of these non-electric detonators have not been exceeded yet. Significant advantages of these entire detonators are mainly the point of view of work safety and variability of creating timed detonating networks as well as high resistance to water and humidity. However, in the present detonators of this type these advantages are overshadowed by contamination of broken stone by remainders of detonation tubes.

Summary of the Invention

[0003] The above mentioned disadvantages are reduced to the decisive extent and a detonation tube with the possibility of easy machine separation from broken stone is achieved with the use of a detonation tube designed as double or multi-layer detonation tube of an industrial non-electric detonator containing the active com-

ponent of the detonator stored in an at least double-layered tubular body or package in accordance with the presented invention wherein at least one layer of the body or package of this detonation tubes is made of a magnetic material where this magnetic material is produced as a mixture of the magnetic and a non-magnetic main material component characterized in that the content of the magnetic main material component in individual layers of the body or package of the detonation tube is 10 to 30% of weight, related to the weight of the individual layers of the body or package of the detonation tube. The magnetic main material component may be beneficially produced on the basis of magnetite - Fe_3O_4 , or on the basis of ferrite with the general formula $\text{Me}^{\text{II}}\text{Fe}_2\text{O}_4$, where Me represents Co, Mn, Ni, Ca, Cu, Zn, Mg, or ferrite with the general formula $\text{Ln}^{\text{III}}\text{Fe}_2\text{O}_4$, where Ln represents noble earth elements, or on the basis of noble earth elements in the oxidation degree II, or on the basis of ferric oxide in the modification $\gamma\text{-Fe}_2\text{O}_3$, or on the basis of powder iron, or on the basis of a magnetic alloy of iron or on the basis of a mixture or alloy containing the above mentioned magnetic partial components, where advantageous magnetic alloys of iron are alloys containing at least noble earth elements, or especially advantageous magnetic alloys of iron are alloys containing at least one noble earth element and B and/or Co while advantageous metallic noble earth elements are Nd and Sm. Or alternatively the magnetic main material component is made on the basis of magnetically hard materials of the AlNiCo or FeCoCr type. The non-magnetic main material component is beneficially created on the basis of a plastic material from the group of polymers or copolymers while it is especially advantageous if the polymer or copolymer is represented by substances from the PE, PP, PTFE plastic material group or ethylene copolymer with derivatives of methacrylic acid.

[0004] This way a detonation tube is created where the magnetic substances contained in its body or package, at least in one layer enable magnetic separation of remainders of this tube from the mined material, which eliminates the hitherto considerable disadvantage of the necessity of manual separation of these remainders or in comparison with not performed separation reduces the risk of clogging or damaging processing equipment of broken stone contaminated by remainders of detonation tubes. At the same time detonation tubes made in accordance with the presented invention comply with requirements for cutting and rubbing resistance and the requirement for electric non-conductivity and also maintain their further benefits as high work safety and variability of creation of timed detonation networks as well as high resistance to water and humidity.

Description of the Preferred Embodiments

Example 1

[0005] A double-layer detonation tube was prepared.

The first layer was based on ethylene copolymer with methacrylic acid and the second layer was based on PE containing 80 weight parts of PE and 20 weight parts of magnetite - FeFe_2O_4 . The detonation tube prepared this way complied with the required rubbing and cutting resistance as well as the requirement of non-conductivity in accordance with relevant technical standards.

Example 2

[0006] A three-layer detonation tube was prepared. The first layer was based on the same composition as in example 1, the second layer was based on PE containing 85 weight parts of magnetite - FeFe_2O_4 and the third layer was based on PE containing 75 weight parts of PE and 25 weight parts of magnetite - FeFe_2O_4 . This detonation tube also complied with the required rubbing and cutting resistance as well as the requirement of non-conductivity in accordance with relevant technical standards.

Example 3

[0007] The detonation tubes prepared in accordance with examples 1 and 2 were used for sets of electric detonators. After the execution of blasting work with the use of these sets the removal efficiency of remainders of detonation tubes from the mined rock with a magnetic field was tested. In both the cases 100% efficiency of removal of remainders of detonation tubes was proved.

Industrial applicability

[0008] The equipment based on the presented invention can be used for blasting work where the resulting broken material is subsequently processed and the remainders of detonation tubes must be separated from the broken material.

Claims

1. A shock tube designed as a double layer or multi-layer shock tube of an industrial non-electric detonator containing the active component of the detonator at least one layer of its body or package is wherein made as a mixture of a magnetic main material component and a non-magnetic material component, **characterized in that** the content of magnetic main material component in individual layers of the body or package is 10 to 30% of weight, related to the weight of the individual layers.
2. A shock tube according to claim 1 **characterized in that** the magnetic main material component is produced on the basis of magnetite- Fe_2O_4 , or on the basis of ferrite with the general formula $\text{Me}^n\text{Fe}_2\text{O}_4$, where Me presents Co, Mn, Ni, Ca, Cu, Zn, Mg, or ferrite with general formula $\text{Ln}^n\text{Fe}_2\text{O}_4$, where Ln rep-

resents noble-earth elements, or on the basis of noble earth elements in the oxydation degree II, or on the basis of ferric oxide in the modification $\gamma\text{-Fe}_2\text{O}_3$, or on the basis on magnetic alloy of iron, or on the basis of a mixture or alloy, containing the above mentioned magnetic partial components.

3. A shock tube according to claims 1 and 2 **characterized in that** the magnetic alloys of iron are alloys containing Nd and Sm and B and/or Co.
4. A shock tube according to claim 1 **characterized in that** the magnetic main material component is produced on the basis of magnetically hard material of the AlNiCo or FeCoCr type.
5. A shock tube according to claims 1 to 4 **characterized in that** the non-magnetic material component is made on the basis of plastic, which is selected from PE, PP, TFE plastic group or ethylene copolymer with derivatives of methacrylic acid.

Patentansprüche

1. Ein Stoßrohr, das als zweischichtiges oder mehrschichtiges Stoßrohr eines nichtelektrischen Zünders für die Industrie konzipiert ist, bei dem die aktive Komponente des Zünders enthalten ist, wobei mindestens eine Schichte dessen Körpers bzw. deren Einheit aus der Mischung einer magnetischen Hauptmaterialkomponente sowie einer nichtmagnetischen Materialkomponente verwendet wird, **gekennzeichnet dadurch**, dass der Inhalt der magnetischen Hauptmaterialkomponente in den einzelnen Schichten des Körpers bzw. der Einheit im Vergleich zum Gewicht der einzelnen Schichten 10 bis 30% des Gewichtes ausmacht.
2. Ein Stoßrohr nach Anspruch 1 **gekennzeichnet dadurch**, dass die magnetische Hauptmaterialkomponente auf Magnetit-Basis $\text{-Fe}_2\text{O}_4$ bzw. auf Ferritbasis mit der allgemeinen Formel $\text{Me}^n\text{Fe}_2\text{O}_4$ hergestellt wird, wobei Me für Co, Mn, Ni, Ca, Cu, Zn, Mg oder Ferrit mit der allgemeinen Formel $\text{Ln}^n\text{Fe}_2\text{O}_4$ steht, wobei Ln für Seltenerdelemente steht bzw. auf der Basis von Seltenerdelementen, die in der Oxidationsstufe II sind oder auf Eisenoxidbasis in der Modifikation $\gamma\text{-Fe}_2\text{O}_3$, oder auf der Basis von magnetischer Eisenlegierung bzw. auf der Basis einer Mischung bzw. Legierung, welche die oben genannten magnetischen Einzelteile enthalten.
3. Ein Stoßrohr nach Ansprüchen 1 und 2 **gekennzeichnet dadurch**, dass es sich bei den magnetischen Eisenlegierungen um Legierungen handelt, die Nd und Sm sowie B und/ oder Co enthalten.

4. Ein Stoßrohr nach Anspruch 1 **gekennzeichnet** t **dadurch**, dass die magnetische Hauptmaterialkomponente auf der Basis von hartmagnetischem Material des Typs AlNiCo oder FeCoCr hergestellt wird. 5
5. Ein Stoßrohr nach Ansprüchen 1 bis 4 **gekennzeichnet** t **dadurch**, dass die nicht magnetische Materialkomponente auf der Basis von Kunststoff hergestellt wird, welches aus einem Kunststoff der Gruppe PE, PP, TFE oder Ethylencopolymer mit Derivaten aus Methacrylsäure besteht. 10

Revendications

1. Un tube de détonation construit comme le tube de détonation double couche ou multicouche d'un détonateur industriel non électrique, contenant le composant actif du détonateur dans lequel au moins une couche de son corps ou de l'emballage consiste en un mélange d'un composant magnétique du matériau principal et d'un composant non magnétique du matériau, **caractérisé en ce que** le contenu du composant magnétique du matériau principal, en couches individuelles, du corps ou de l'emballage, représente 10 à 30 % du poids par rapport au poids des couches individuelles. 15 20 25
2. Un tube de détonation selon la revendication 1, **caractérisé en ce que** le composant magnétique du matériau principal est produit sur la base de magnétite - Fe_2O_4 , ou sur la base de ferrite avec la formule générale $\text{Me}^n\text{Fe}_2\text{O}_4$, où Me présente Co, Mn, Ni, Ca, Cu, Zn, Mg, ou ferrite avec la formule générale $\text{Ln}^n\text{Fe}_2\text{O}_4$, où Ln représente des éléments terrestres rares, ou sur la base d'éléments terrestres rares dans le degré d'oxydation II, ou sur la base d'oxyde ferrique dans la modification $\gamma\text{-Fe}_2\text{O}_3$, ou sur la base d'un alliage de fer, ou sur la base d'un mélange ou d'un alliage contenant les composants magnétiques partiels ci-dessus mentionnés. 30 35 40
3. Un tube de détonation selon les revendications 1 et 2, **caractérisé en ce que** les alliages magnétiques de fer sont des alliages contenant Nd et Sm et B et/ou Co. 45
4. Un tube de détonation selon la revendication 1, **caractérisé en ce que** le composant magnétique du matériau principal est produit sur la base d'un matériau magnétique dure du type AlNiCo ou FeCoCr. 50
5. Un tube de détonation selon les revendications 1 à 4, **caractérisé en ce que** le composant non magnétique du matériau est produit sur la base de matière plastique choisi du groupe groupe plastique PE, PP, TFE ou de copolymère éthylique avec des dérivés d'acide méthacrylique. 55

REFERENCES CITED IN THE DESCRIPTION

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