

UNITED STATES PATENT OFFICE.

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IGNITIBLE METALLIC MIXTURE AND PROCESS FOR PREPARING THE SAME.

1,318,769.

Specification of Letters Patent.

Patented Oct. 14, 1919.

No Drawing.

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To all whom it may concern:

Be it known that I, CLAUDE THEODORE JAMES VAUTIN, a subject of the King of England, residing in London, England, have invented a certain new and useful Improved Ignitable Metallic Mixture and Process for Preparing the Same, of which the following is a specification.

This invention relates to ignitable metallic mixtures, such for example as that commonly known wherein powdered aluminium and powdered iron oxid are intimately mixed together with the result that, if a sufficiently high temperature be created locally in the powder, combustion will proceed of itself under the oxidation of the aluminium and the reduction of the iron.

Such materials as heretofore prepared and used have given rise to difficulty under certain conditions of employment, by reason of the two constituents becoming more or less separated by segregation. One method of overcoming this difficulty has been tried by which a combining material was added to the powder, which combining material was inert and was added in the least possible proportions so as to interfere as little as possible with the normal chemical and heat reactions. Nevertheless the addition of such a binding material slightly delayed the reaction, and when the mixture was highly compressed to form a solid substance, the latter was not so easy to ignite as the loose powder without the binding material.

It is the main object of the present invention to provide a process for preparing an ignitable metallic mixture in the form of a solid body which shall be superior to that just above described.

Various pulverized mixtures of one or more heavy or light metallic powders with sulfur alone or a sulfur compound alone, have heretofore been proposed for various purposes. These mixtures, however, were loose and did not constitute a solid body such as that provided by the process according to my invention; also the generation of heat by these loose powders is apparently so slow that they could not be used for incendiary bombs or like purposes, and I make no claim to any such loose mixtures.

It has also been proposed to employ in the form of a solid body a mixture of aluminium with a sulfur-containing compound for the manufacture of metal castings or

alloys. Such a mixture contained no free sulfur, and I make no claim for any mixture which does not contain free sulfur.

One form of the process according to the present invention for preparing an ignitable metallic mixture consists in heating sulfur to a temperature not exceeding 200° C. until it becomes plastic, and adding thereto with constant stirring a finely divided metallic substance, for example a finely divided metal such as aluminium.

Conveniently, a plastic mass obtained as just described or prepared by heating a mixture of sulfur and finely divided metal to the said temperature with constant stirring is cast into the desired shape while still plastic and allowed to set hard. If desired, oxid of iron may be mixed with the finely divided metal before the mixture is heated.

Further, according to the invention, an ignitable body in solid form may be made by a process consisting in mixing a metallic sulfid, for example iron pyrites, in the form of a fine powder, with finely divided sulfur in the proportion of from 15% to 50% by weight of the said sulfid, heating the mixture of sulfur and sulfid to a temperature below the burning point of sulfur (for example not exceeding 200° C.) with constant stirring until the mixture becomes a plastic mass, subsequently allowing the mass to become cool and hard, reducing the mass to powder and employing the powder thus obtained in substitution for or for part of the sulfur in the process described above in the two preceding paragraphs.

The free sulfur employed according to the present invention has the advantage of being itself combustible and, further, of readily forming metallic sulfids with an exothermic reaction, and in the product resulting from the process according to the invention it is present in such form as to constitute both a binding material and a chemically-reacting material. In one form of the product the sulfur is present in combining proportion with a metal or in more than such proportion. The combining material in the product may comprise a metallic sulfid and sulfur intimately mixed together, the sulfid being preferably a natural sulfid; for example, when iron is used as the metal, iron pyrites is the preferred sulfid.

The proportion of sulfur employed will depend partly upon the particular metallic

sulfid selected and partly upon the degree of viscosity required. In general the higher the sulfur content the less plastic and the more fluid is the result when hot.

5 By way of example to illustrate the nature of the present invention, the following mixtures may be cited:—

Mixture (A)—A mixture of aluminium powder and sulfur.—For the aluminium powder ordinary aluminium scrap contain-
10 ing about 87% of aluminium and 7%–8% of zinc may be employed, the powder being reduced to pass a 20-mesh screen or finer. For the sulfur ordinary commercial finely-
15 divided sulfur of 97% purity at least is employed.

These materials are so mixed and proportioned that the materials combine to give Al_2S_3 and ZnS with substantially no excess
20 of sulfur.

This material in itself constitutes an excellent ignitable mixture provided the local temperature to ignite it be high enough. On the other hand, the temperature of the mix-
25 ture can be raised to the ignition temperature of sulfur in air without combination of the aluminium and sulfur taking place throughout the mass.

Conveniently the sulfur is heated separately to a temperature of $200^\circ C.$ or less, and the aluminium powder is then stirred in until the whole forms a plastic mass. Alternatively the mixed powders may be
35 heated with constant stirring to provide the said plastic mass.

If preferred, pure aluminium powder may be used and in such case no sulfur has to be provided to form zinc sulfid.

In another preparation according to this
40 invention there is first provided what is ordinarily known as aluminothermic mixture consisting of a mixture of powdered aluminium with the usual zinc adulteration when scrap aluminium is used and ferros-
45 ferric oxid in proportions such that the final result of the reaction is a mixture of Al_2O_3 and ZnO and iron.

Here again alternatively, pure aluminium powder free from zinc may be used, giving
50 the commonly known mixture. Either the above specified aluminothermic mixture or the said known mixture is hereinafter described as Mixture (B).

Mixture (C).—This mixture consists of
55 one part of Mixture (A) and two parts of Mixture (B). The calculated proportions of the ingredients for this double mixture are intimately mixed and then heated to a temperature not exceeding $200^\circ C.$ with constant stirring until the contents become
60 plastic.

The plastic mass obtained with the hot sulfur in any of the above mixtures may be cast or rammed direct into bomb-cases or
65 molds as desired. In a short time, for ex-

ample about 30 minutes or slightly over, the mass sets into a solid condition, which is also tough, and in which the mass can be bored or turned.

The resulting slag from Mixture (C) is 70 more fluid at the temperature of reaction than is the resultant product from Mixture (B) alone. This extra fluidity is frequently of considerable value.

Whereas the Mixture (C) is cited as being 75 excellent for such purposes as incendiary bombs, for other purposes the proportions of (A) and (B) may be varied from say equal quantities of each down to one of (A) and nine of (B). 80

Another mode of carrying out the present invention is now described by way of ex-
ample. Iron pyrites is ground to an impalpable powder and mixed with 40% of its own weight of sulfur. The mixture is then
85 heated with constant stirring to about $190^\circ C.$ until the whole becomes a homogeneous plastic mass. This is then poured out and allowed to become cool and set hard. The hard mass is then crushed and ground to a
90 powder, and is then employed exactly as is the sulfur in the mixtures above described. Alternatively it may be used to replace part only, instead of the whole, of the sulfur in those mixtures. 95

The mixture of sulfur and metallic sulfid is somewhat safer to handle during the process of manufacture than is the mixture wherein sulfur alone is employed as the binding material without admixture there-
100 to of a metallic sulfid. The mixture thus provided has other qualities which constitute it a desirable alternative to, or addition to, the sulfur employed in the manner de-
105 scribed above.

This invention is not limited to the employment of sulfur or sulfur and metallic sulfid in mixtures of only the precise character quoted above, but extends to the use of these materials as a binding and combin-
110 ing material in any solid ignitable metallic mixture.

What I claim as my invention and desire to secure by Letters Patent is:—

1. A process for preparing an ignitable
115 solid body consisting in mixing a finely divided metal and free sulfur in combining proportions with one another together with a finely divided metal and an oxid, which second said metal and oxid together constitute an ignitable mixture, in heating the mixture to a temperature not exceeding $200^\circ C.$ with constant stirring until the mixture becomes a plastic mass, and in leaving the mass to set into a solid condition. 120
125

2. A process for preparing an ignitable solid body consisting in mixing a finely divided metal and free sulfur in combining proportions with one another together with an oxygen compound of another metal in 130

powdered form, in heating the mixture to a temperature not exceeding 200° C. with constant stirring until the mixture becomes a plastic mass and in leaving the mass to set into a solid condition.

3. A process for preparing an ignitable solid body consisting in mixing finely divided aluminium, an oxid of iron, and free sulfur in combining proportions with one another, in heating the mixture to a temperature not exceeding 200° C. with constant stirring until the mixture becomes a plastic mass, and in leaving the mass to set into a solid condition.

4. A process for preparing an ignitable solid body consisting in mixing a metallic sulfid in the form of a fine powder with finely divided sulfur in the proportion of from 15% to 50% by weight of the said sulfid, heating the mixture to a temperature not exceeding 200° C. with constant stirring until it becomes a plastic mass, and adding thereto with constant stirring a finely divided metallic substance.

5. A process for preparing an ignitable solid body consisting in grinding a metallic sulfid to a fine powder, mixing finely divided sulfur therewith in the proportion of from 15% to 50% by weight of the said sulfid, subsequently heating the mixture to a temperature not exceeding 200° C. with constant stirring until it becomes a plastic mass, leaving the mass to become cool and hard, reducing the mass to powder, mixing the powder thus obtained with powdered sulfur, heating the mixed powders to a temperature not exceeding 200° C. until it becomes a plastic mass, and adding thereto with constant stirring a finely divided metallic substance.

6. A process for preparing an ignitable solid body consisting in mixing a metallic sulfid in the form of a fine powder with finely divided sulfur in the proportion of from 15% to 50% by weight of the said sulfid, heating the mixture to a temperature not exceeding 200° C. with constant stirring until it becomes a plastic mass, leaving the mass to become cool and hard, reducing the mass to powder, mixing the powder thus obtained with a finely divided metal and heating the mixed powders to a temperature not exceeding 200° C. with constant stirring until the mixture becomes a plastic mass, and casting the said mass into the desired shape while still plastic and permitting it to set.

7. A process for preparing an ignitable solid body consisting in grinding a metallic sulfid to a fine powder, mixing finely divided sulfur therewith in the proportion of from 15% to 50% by weight of the said sulfid, subsequently heating the mixture to a temperature not exceeding 200° C. with constant stirring until it becomes a plastic mass, leaving the mass to become cool and

hard, reducing the mass to powder, mixing the powder thus obtained with powdered sulfur and finely divided aluminium, heating the mixed powders to a temperature not exceeding 200° C. with constant stirring until the mixture becomes a plastic mass, and casting the mass thus obtained into the desired shape while still plastic and permitting it to set.

8. A process for preparing an ignitable solid body consisting in mixing a metallic sulfid in the form of a fine powder with finely divided sulfur in the proportion of from 15% to 50% by weight of the said sulfid, heating the mixture to a temperature not exceeding 200° C. with constant stirring until it becomes a plastic mass, leaving the mass to become cool and hard, reducing the mass to powder, mixing the powder thus obtained with a finely divided metal in combining proportions with one another together with a finely divided metal and an oxid, which second said metal and oxid together constitute an ignitable mixture, heating the mixture thus obtained to a temperature not exceeding 200° C. with constant stirring until the mixture becomes a plastic mass, and leaving the mass thus obtained to set into a solid condition.

9. A process for preparing an ignitable solid body consisting in mixing a metallic sulfid in the form of a fine powder with finely divided sulfur in the proportion of from 15% to 50% by weight of the said sulfid, heating the mixture to a temperature not exceeding 200° C. with constant stirring until it becomes a plastic mass, leaving the mass to become cool and hard, reducing the mass to powder, mixing the powder thus obtained together with finely divided aluminium, an oxid of iron and powdered sulfur in combining proportions with one another, heating the mixture to a temperature not exceeding 200° C. with constant stirring until it becomes a plastic mass, and leaving the mass to set into a solid condition.

10. An ignitable metallic mixture in the form of a compact solid body, consisting of a mixture of a finely divided metal, free sulfur and a metallic sulfid.

11. An ignitable metallic mixture in the form of a compact solid body consisting of free sulfur, finely divided aluminium, and powdered iron pyrites.

12. An ignitable metallic mixture in the form of a compact solid body consisting of a mixture of finely divided aluminium, free sulfur and an oxygen compound of iron in powdered form.

13. An ignitable metallic mixture in the form of a compact solid body consisting of finely divided aluminium, free sulfur, a free metallic sulfid, and an oxid of iron in powdered form.

14. A process for preparing an ignitable

metallic mixture in solid form, consisting in heating a finely ground metallic sulfid, sulfur and a metallic substance to a temperature not exceeding 200° C., with constant stirring until the mixture becomes a plastic mass, and then permitting the mixture to set.

15. A process for preparing an ignitable metallic mixture in solid form, consisting

in heating finely ground iron pyrites, sulfur and a finely divided substance to a temperature not exceeding 200° C., with constant stirring until the mixture becomes a plastic mass, and then permitting said mixture to set.

In testimony whereof I affix my signature.

CLAUDE THEODORE JAMES VAUTIN.