

BEST AVAILABLE COPY

UNITED STATES PATENT OFFICE.

HANS GOLDSCHMIDT, OF ESSEN-ON-THE-RUHR, GERMANY, ASSIGNOR TO THE FIRM OF TH. GOLDSCHMIDT, OF ESSEN-ON-THE-RUHR, GERMANY.

MANUFACTURE OF THERMIC MIXTURES.

No. 906,009.

Specification of Letters Patent.

Patented Dec. 8, 1908.

Application filed January 6, 1906. Serial No. 294,971.

To all whom it may concern:

Be it known that I, HANS GOLDSCHMIDT, a subject of the King of Prussia, German Emperor, and resident of Essen-on-the-Ruhr, German Empire, have invented certain new and useful Improvements in and Relating to the Manufacture of Thermic Mixtures, of which the following is an exact specification.

My invention has reference to improvements in the manufacture of thermic mixtures, as aluminum with a metal compound. It has been tried already to replace the aluminum employed in the well-known Goldschmidt-thermic-process by various other substances, quite especially by silicon, this element being very resistant to atmospheric influences and possessing a greater molecular oxygen-absorbing capacity than aluminum, so that its use would appear to be advantageous for reducing purposes. The experiments in this direction however have been disappointing. This surprising negative attitude of silicon has, in the course of further investigation, led to the following invention:

If calcium is admixed to the silicon, a smooth reaction takes place, which in its course is similar to the reaction between aluminum and metallic oxides. A few examples may serve to illustrate this: When operating with a mixture of about 20 per cent. calcium, 10 per cent. silicon, 70 per cent. iron oxid or iron-oxid-protoxid ($\text{Fe}(\text{Fe}_2)\text{O}_4$). In igniting this mixture a fluid iron and a slag which is very liquid, are obtained, the latter mainly consisting of silicate of calcium. The reaction takes place very quick, the mass is thoroughly fluid and the quantity of metal obtained is relatively large. Consequently this mixture is suitable for the purpose of producing metals, the reduction *e. g.* of chromium oxid is carried out in this fashion, or it may be used for welding or other heating purposes being a large amount of heat liberated, or the slag may be utilized, the operator being free to produce a "sintering reaction" (*i. e.* making the mixture coalesce or grow into a solid mass without passing through a state of complete fluidity), or to produce opaque or transparent glassy slags.

Naturally, after having investigated the properties of the calcium when employed in conjunction with silicon, the idea came to

the inventor, also to investigate what effect calcium alone would have on metallic oxides. The results of experiments in that direction however were negative, on account of the limited fusibility of the slag produced, wherefrom the conclusion is obvious, that the reaction of the calcium-silicon mixture upon metallic oxides, with or without addition of other metals, must be considered as a peculiarity. So for instance is chromium oxid reduced by metallic calcium, but no uniform extraction of the chromium in the form of a regulus takes place. Furthermore, the reactions carried out with pure calcium, are of extraordinary violence, *e. g.* if the reduction of iron oxid by means of calcium is effected, so that these reactions are not suitable for technical utilization. It must still be mentioned that the metals admixed may be metals that take an active part in the reaction, *e. g.* aluminum or magnesium, or metals only added to be molten down in order thus to increase the quantity of the metal gained or to alter the quality of the alloy. Furthermore, calcium and silicon cannot only be employed in the form of a mixture, but also particularly in the form of an alloy which presents the advantage of oxidizing not so easily as does calcium alone. This alloy may at the same time contain aluminum or magnesium. Of course, the metals or the alloy must be well granulated and intimately mixed with the metallic oxid. In regard to the latter the same conditions apply as those prevailing in the well known Goldschmidt aluminothermic-process. In these mixtures oxygen compounds, as iron-oxid or iron-oxid-protoxid, may be replaced by sulfids of metals or metallic halogen compounds, or mixtures of several of such compounds with oxids and salts respectively, such as sulfates or nitrates, which latter in this connection must also be regarded as oxygen compounds of the metals.

Having thus fully described the nature of my invention, what I desire to secure by Letters Patent of the United States is:—

1. A thermic mixture comprising metallic substances containing calcium and silicon, and a metal compound capable of being reduced to a metal, the substances being thoroughly mixed with each other and the proportions of the active reducing metals being such, that silicon forms the smaller part, by weight, of the active metals.

2. A thermic mixture comprising metallic substances containing calcium and silicon, and a metal compound containing only metal and oxygen; the substances being thoroughly mixed with each other and the proportions of the active reducing metals being such, that silicon forms the smaller part, by weight, of the active metal.
 3. A thermic mixture comprising metallic substances containing calcium and silicon, and an iron oxide compound, the substances being thoroughly mixed with each other.
 4. A thermic mixture comprising metallic substances containing calcium and silicon, iron-oxid (Fe_2O_3) and iron-oxid-protoxid (Fe_3O_4), the substances being thoroughly mixed with each other.
 5. A thermic mixture comprising metallic substances containing calcium and silicon, in form of an alloy, and an iron-oxid compound, the substances being thoroughly mixed with each other.
 6. A thermic mixture comprising metallic substances containing calcium and silicon in form of an alloy, an iron-oxid (Fe_2O_3) and iron-oxid-protoxid (Fe_3O_4) the substances being thoroughly mixed with each other.
 7. A thermic mixture comprising metallic substances containing calcium and silicon, iron-oxid (Fe_2O_3), and active oxidizable metals, the substances being thoroughly mixed with each other.
 8. A thermic mixture comprising metallic substances containing calcium and silicon, iron-oxid (Fe_2O_3), iron-oxid-protoxid (Fe_3O_4) and active oxidizable metals, the substances being thoroughly mixed with each other.
 9. A thermic mixture comprising metallic substances containing calcium and silicon in form of an alloy, an iron-oxid compound and active oxidizable metals the substances being thoroughly mixed with each other.
 10. A thermic mixture comprising metallic substances containing calcium and silicon in form of an alloy, iron-oxid (Fe_2O_3), iron-oxid-protoxid (Fe_3O_4) and active oxidizable metals, the substances being thoroughly mixed with each other.
 11. A thermic mixture comprising metallic substances containing calcium and silicon, an iron-oxid compound, the substances being thoroughly mixed with each other and the proportions of the active reducing metals being such, that silicon forms the smaller part, by weight, of the active metal.
 12. A thermic mixture comprising metallic substances containing calcium and silicon, iron-oxid (Fe_2O_3) and iron-oxid-protoxid (Fe_3O_4), the substances being thoroughly mixed with each other and the proportions of the active reducing metals being such, that silicon forms the smaller part, by weight, of the active metals.
 13. A thermic mixture comprising about 20 parts of calcium, 10 parts of silicon and 70 parts of an iron-oxid compound.
 14. A thermic mixture comprising about 20 parts of calcium, 10 parts of silicon, and 70 parts of iron-oxid (Fe_2O_3) and iron-oxid-protoxid (Fe_3O_4).
 15. A thermic mixture comprising in proportion about 20 parts of calcium, 10 parts of silicon and 70 parts of an iron-oxid compound with a partial substitution of other active oxidizable metals.
 16. A thermic mixture comprising in proportion about 20 parts of calcium, 10 parts of silicon and 70 parts of iron-oxid (Fe_2O_3) and iron-oxid-protoxid (Fe_3O_4) with the partial substitution of other active oxidizable metals.
- In witness whereof I have hereunto set my hand in the presence of two witnesses.
- HANS GOLDSCHMIDT.
- Witnesses:
WOLDEMAR HAUPT,
HENRY HASPER.