UNITED STATES PATENT OFFICE.

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PYROPHORIC MASS.

976,760. Specification of Letters Patent. Patented Nov. 22, 1910.

No Drawing. Application filed January 19, 1910. Serial No. 538,926.

To all whom it may concern:

Be it known that I, Dr. CARL FREIHERR AUER VON WELSBACH, chemist, a subject of the Emperor of Austria-Hungary, residing at Wiedener Hauptstrasse 57, Vienna, IV, Austria-Hungary, have invented certain new and useful Improvements in Pyrophoric Masses, of which the following is a specification.

This invention relates to "improvements in pyrophoric masses" that is to say of masses which when rubbed with a file or with a knife-blade give off sparks of great intensity which may advantageously be used for igniting gases, liquids and solid bodies as well as for the purposes of illumination, signaling and photography and has for its object to manufacture these pyrophoric masses of such a composition that the same are possessing great durability, hardness and resistance to decomposition by the influence of atmospheric air.

My new pyrophoric substance contains a metal of the cerium group, which group consists, as the term, group, is herein used, of the rare earth metals, cerium and lanthanum; and I prefer to use, whenever practicable, cerium. But as is well known by all skilled in this art, it is nearly impossible commercially to manufacture pure cerium, and commercial cerium nearly always contains in actual practice small parts of such rare earth metals as neodime and praseodime. Hence, even where the principal rare earth metal used is cerium or a mixture consisting principally of cerium and lanthanum is used, other rare earth metals may and will generally be found in the resulting pyrophoric alloy. But these other rare earth metals (*e. g.* neodime and praseodime) are technically and economically of comparatively small importance.

Pure cerium when exposed to the air becomes coated with a thin layer of what appears to be suboxid but generally contains a small proportion of nitrid, and this layer in contradistinction to the unattacked metal has pyrophoric properties. Alloys of the metals of the rare earths which are rich in cerium behave like pure cerium. Now it is a noteworthy fact that this layer is formed more quickly on the most powerfully pyrophoric alloys consisting of rare earth metals and heavy metals, such as iron, nickel, cobalt or manganese, than upon those alloys which are less pyrophoric. It may be deduced from this fact that in all probability the pyrophoric behavior of all alloys of the rare earth metals is essentially dependent on the speed with which the suboxid layer is formed. It may be taken as generally true, therefore, that with the formation of suboxid layers the pyrophoric power of all rare earth metal alloys is increased. Since the substance constituting the said layer, which substance will in this specification be termed suboxid whatever its true nature may be, is tolerably stable in air, attempts to manufacture pyrophoric masses of rare earth alloys having suboxid admixtures in the mass, suggested themselves.

Now the invention has for its object a pyrophoric alloy containing a metal of the cerium group, above identified, this alloy being thoroughly impregnated with small quantities of suboxids or of suboxids and nitrids. The preferred procedure of making such pyrophoric masses is as follows: A rare earth metal or an alloy of only rare earth metals or of rare earth metals with other metals is first reduced to a fine powder or fine chips by abrasion or scraping, air being excluded if necessary. The powder or chips are then compressed by strong pressure varying between 1000 and 25000 kilos per square cm. in suitable molds. The compact mass thus obtained has a metallic appearance, but is not considerably more pyrophoric than the original substance. Pyrophority will considerably be increased by subsequently heating the compressed mass with a volume of air about equal to that of the compressed mass, in a metal casing having thin walls and adapted to be closed; the heating is at first gentle and gradual, but rapid at the conclusion, finally attaining a temperature corresponding with incipient red-heat. A lively reaction ensues, the mass glows and frits together.

The fritted mass exhibits a clear metallic luster on a freshly filed surface. The embedded suboxid is not visible to the naked eye. The mass is stable in air like the original alloy, but possesses a higher degree of pyrophoric power than the original alloy, that is to say, the particles separated by means of any tool are more easily

inflammable in the air and a smaller mechanical power suffices to produce sheaves of sparks, than with the original alloy. In case heating is proceeded with up to fusion, homogeneous alloys may be obtained the pyrophoric power of which is not appreciably greater than that possessed by the original material.

If the strongly pyrophoric alloy of cerium and iron is subjected to the foregoing treatment, a mass is obtained the pyrophoric power of which is so increased that by lightly drawing a knife blade across it, an actual sheet of flame is produced. The masses containing suboxid suffer less loss in their pyrophoric power when made from alloys containing indifferent metals than when made from the pure alloys. Thus for certain purposes, such as for varying the hardness or increasing the durability or illuminating effect, calcium, magnesium, aluminium, tin, zinc, lead or the like may be added up to 10 per cent. of the mass without particularly depreciating the pyrophoric power.

I desire in the following claims to be distinctly understood as including under the phrase, a metal of the cerium group, either cerium or lanthanum; and I have already explained hereinbefore that, in a commercial sense, it is practically impossible to obtain these two metals free from a mixture with other rare earth metals. Hence, the latter will inevitably, from a commercial standpoint, enter the pyrophoric alloy but are of slight importance. Cerium and lanthanum, which constitute the cerium group in the terminology which I have herein adopted, are the rare earth metals susceptible of use in producing alloys having the pyrophoric properties hereinbefore alluded to and are, therefore, the only important ones to be considered.

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

1. A pyrophoric alloy containing a metal of the cerium group; said metal being thoroughly impregnated with small quantities of its suboxid.

2. A pyrophoric alloy containing a metal of the cerium group; said metal being thoroughly impregnated with small quantities of its suboxid and its nitrid.

3. A pyrophoric alloy containing metals of the cerium group; said metals being thoroughly impregnated with small quantities of their suboxids.

4. A pyrophoric alloy containing metals of the cerium group; said metals being thoroughly impregnated with small quantities of their suboxids and their nitrids.

5. A pyrophoric alloy containing cerium thoroughly impregnated with small quantities of its suboxid.

6. A pyrophoric alloy containing cerium thoroughly impregnated with small quantities of its suboxid and its nitrid.

7. The process of manufacture of a pyrophoric substance which consists in compressing fragments containing a metal of the cerium group and then heating the compressed mass in the presence of an oxidizing agent until the fragments frit together.

8. The process of manufacture of a pyrophoric substance which consists in compressing fragments containing metals of the cerium group and then heating the compressed mass in the presence of an oxidizing agent until the fragments frit together.

In testimony whereof I affix my signature in presence of two witnesses.

CARL AUER VON WELSBACH.

Witnesses:

JOHANN LUX,

HANS LUX.