

Dec. 16, 1958

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2,864,160

METHOD OF CONTINUOUSLY PROTECTING PYROPHORIC FLINT
MATERIAL MANUFACTURED BY EXTRUSION

Filed Oct. 11, 1954

FIG- 1

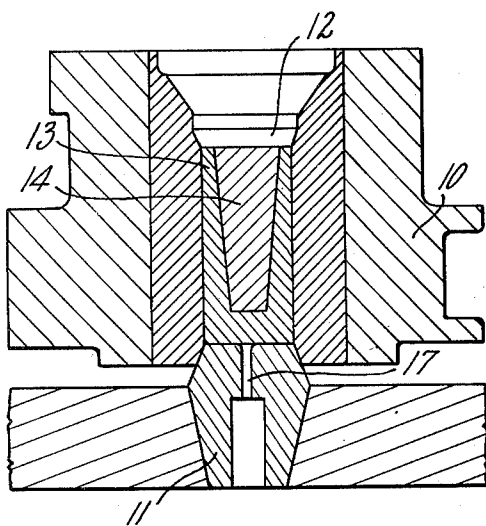


FIG- 2

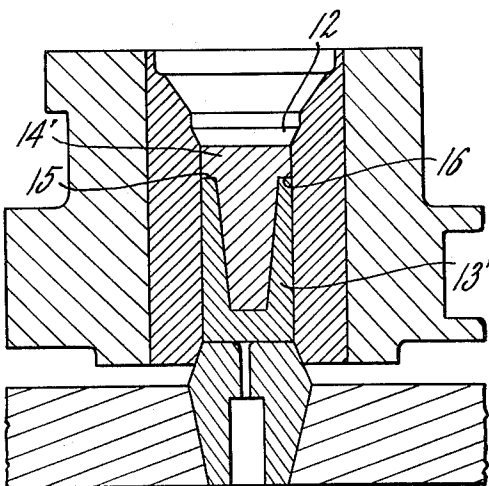
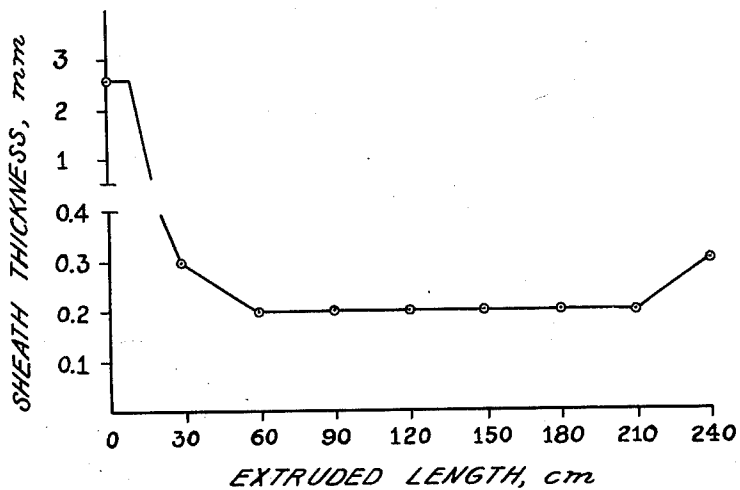


FIG- 3

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METHOD OF CONTINUOUSLY PROTECTING PYROPHORIC FLINT MATERIAL MANU- FACTURED BY EXTRUSION

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Application October 11, 1954, Serial No. 461,629

1 Claim. (Cl. 29—473.3)

This invention relates to the extrusion of pyrophoric materials having a protective coating thereon. More particularly, it relates to the extrusion of ingots of iron-cerium alloys having a protective aluminum-containing sheath or coating thereon and to novel protected flints resulting therefrom.

Heretofore, pyrophoric flints containing iron-cerium alloys have been produced by casting procedures, since extrusion of the alloys resulted in either a substantial reduction or a complete loss of the pyrophoric properties. The extruded alloy of the present invention, however, retains its pyrophoric properties without the necessity of first removing the unique protective coating thereon applied for protection during the metal-working process.

In an earlier filed application, Ser. No. 117,069, filed September 21, 1949, now U. S. Patent 2,660,301, a method was described according to which iron-cerium alloys having an iron content from about 15% to 40% by weight may be extruded to produce satisfactory flint materials. In co-pending application, Ser. No. 381,738, filed September 22, 1953, certain improvements in regard to the extrusion procedures were disclosed. In both of these disclosures I have stressed that the durability and stability of the extruded material may be enhanced by super-position of a protective metal coating on the flint core proper.

The present invention is concerned with this improvement in the stability of the extruded flint materials, especially as realized by the extrusion of an outer cover or sheath simultaneously with that of the pyrophoric alloy.

In accordance with the present invention the pyrophoric material in the form of an ingot is encased in aluminum or an alloy thereof and the combined mass is extruded at elevated temperature and predetermined pressure.

As sheath-forming protective materials substantially pure aluminum may be employed or an aluminum alloy containing at least 95% by weight of aluminum and up to about 5% by weight of magnesium and/or silicon.

The pyrophoric alloy may be any of these capable of extrusion, as disclosed in my afore-mentioned earlier applications. The pyrophoric alloy may be inserted into a tube of the protecting material or the protecting material may be cast about an ingot of the pyrophoric iron-cerium alloy. The protective sheath may range from about 20 to 25% by weight of the entire mass, i. e., from about 1/3 to 1/4 the weight of the flint.

It is therefore one of the primary objects of the invention to provide means facilitating the transfer of a protective coating or sheath on a flint alloy during extrusion of the latter and in predetermined thickness and quantity, to thereby impart to said flint alloy improved and desirable properties.

It is another object of the present invention to provide means affording regulation of the thickness of the sheath during extrusion of the pyrophoric or flint alloy and proper coordination of the latter with respect to said sheath.

Still another object of the present invention is to pro-

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vide means conducive to an improved method of coating flint material to thereby increase its durability, appearance, saleability and to bring out easier handling of extruded flint material of considerable length.

These and other objects and advantages may be realized from the ensuing disclosure and attached drawings.

In preparing the combined mass for extrusion the aluminum body preferably encloses the pyrophoric ingot circumferentially as well as at the leading end, so that upon extrusion there is first obtained a length of pure protective material, then an integral length of protective material enclosing the pyrophoric alloy, and finally a length of unprotected pyrophoric alloy. Preferably the pyrophoric ingot is tapered to a reduced forward end and, in place of being wholly encased within the aluminum body initially, it may be provided with an abutting shoulder.

The invention may be more readily understood by reference to the accompanying drawing, wherein:

Fig. 1 is a longitudinal section of a pyrophoric, encased ingot disposed in an extrusion press preliminary to extrusion;

Fig. 2 is a view similar to Fig. 1 showing a modified form of the ingot; and

Fig. 3 is a graph showing the coating thickness of an extruded rod produced in accordance with the invention.

Referring now more particularly to the drawing in Fig. 1, there is shown a portion of an extrusion press 10 provided with an extrusion die 11. Within a recess 12 of the press there is disposed a composite ingot comprising a substantially cup-shaped body of protective aluminum-containing material 13 into which is telescoped a frusto-conical core of pyrophoric alloy 14.

In Fig. 2, the protective body 13' is of generally similar shape though slightly shorter. The pyrophoric alloy ingot 14' is provided with a shoulder 15 seating on annular portion 16 of the body 13', the annular portion and shoulder conforming in contour to each other. The composite ingots 13, 14, and 13', 14' are accordingly of approximately equal volume and space.

Upon heating and applying pressure against the composite ingot, the latter is forced through opening 17 of the die 10.

The thickness of the sheath may vary widely although it is preferred to obtain a uniform layer. Such uniformity will be realized when the thickness is about 5-7.5% of the diameter of the flint, i. e., a total thickness of twice the indicated amount, such as 10-15%.

The following examples are illustrative of the practice of the present invention:

Example 1

About a frusto-conical ingot of iron-cerium alloy containing about 20% by weight of iron and 80% of mischmetal and weighing about 71 grams there is cast a body of about 22 grams of an aluminum-magnesium alloy containing about 1% by weight of magnesium, the composite ingot having the geometric configuration shown in Fig. 1.

The composite ingot is pre-heated at 450° C. for about 15 minutes and then placed in recess 12 of the press, the walls defining the recess having also been pre-heated to about 450-460° C. Upon rapidly bringing the pressure to a maximum of about 22 tons, a rod of material is extruded at the rate of about 1 meter per minute. Over a period of 3 minutes the pressure falls uniformly to 0 and a smooth rod 3 meters long is obtained. The first 30 mm. of the rod comprise pure aluminum alloy, while the final 30 mm. comprise substantially pure unprotected iron-mischmetal alloy. The intermediate length ranges gradually therebetween, the thickness of the sheath being for the most part uniform.

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Example II

The procedure of Example I is repeated employing a tubular body of about 16 grams of the aluminum alloy into which there is inserted an ingot comprising about 64 grams of the pyrophoric alloy, the composite material having the configuration shown in Fig. 2.

A rod about 240 cm. long is obtained wherein the thickness of the aluminum-alloy lengthwise of the rod is shown in the graph of Fig. 3.

As can be seen, about the first 10 cm. of the rod is composed of solid protective material. Over the next 20 cm. the thickness of the sheath drops rapidly to about .3 mm. and over the next 30 cm. of length the thickness drops to about .2 mm. at which value it remains substantially uniform for the next 150 cm., i. e., through the 210th cm. of its length. The thickness of the sheath increases gradually over the final 30 cm. to a value of 60 mm. In other words, the thickness of the sheath is relatively uniform over the major length of the rod and is of increased thickness over the first $\frac{1}{4}$ and the last $\frac{1}{4}$ of the length of said rod.

Example III

(a) By repeating the procedure of Example I employing instead an alloy containing 2% by weight of silicon, 1% by weight of magnesium and the remainder aluminum, a rod of similar appearance and properties is obtained.

(b) An aluminum-silicon alloy containing 3.5% by weight of silicon produces substantially similar results when employed in the process of Example II.

It is preferable that the thickness of the sheath be as uniform as possible. It is not possible, however, to attain such uniformity merely by extruding a tubular sheath of the same length as the cylindrical core contained therein. In practice it has been found that by modification of the shapes of the sheath and the core a flint rod can be obtained wherein the leading portion is substantially pure sheath material, followed by a considerable length of flint material having a sheath of uniform thickness surrounding a core of uniform thickness, finally followed by a length of substantially unprotected core. By using the shapes of core and sheath shown in the drawing, a maximum length of flint material having a sheath of uniform thickness may be obtained. Variations in the shapes of the core and sheath may be made, however, with corresponding variations in the length of that portion of the flint which is of uniform sheath- and core-thickness.

The high extrusion pressures and temperatures employed effect a fusion and probably a chemical interaction along the interface between the core and sheath so that these parts are integrally bonded and cannot be removed or separated from each other.

This application is a continuation-in-part of application Ser. No. 381,738, filed September 22, 1953, now Patent No. 2,762,707 which in turn is a continuation-in-part of application Ser. No. 117,069, filed September 21, 1949, now Patent No. 2,660,301.

It is to be noted that the extrusion properties of the core material and of the sheath material should be sub-

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stantially coordinated or equal and the formation of both parts (core material and sheath material) should be carried out within predetermined limits so as to obtain a substantially uniform thickness of the sheath material over a predetermined length of the core material.

The pressures for extrusion will vary in known manner in dependence upon the specific compositions of the core and sheath compositions employed. Generally, however, pressure variations of about 10 tons of the value shown in the examples, will be possible. Further, additions of magnesium into the pyrophoric alloy or increase of its iron content will usually necessitate relatively higher pressures.

Similarly, the temperature of extrusion may be varied although in most cases a temperature ranging from about 400° C. to about 500° C. will be suitable.

Various changes and modifications may be made without departing from the spirit and scope of the present invention and it is intended that such obvious changes and modifications be embraced by the annexed claim.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent, is:

The method of extruding a pyrophoric flint rod structure with a protective covering; comprising the steps of first forming a cup-shaped ingot body comprising an aluminum alloy consisting of at least 95% by weight of aluminum and up to about 5% by weight of a metal selected from the group consisting of magnesium and silicon, telescoping into the hollow of said cup-shaped ingot an ingot body of an extrudable pyrophoric alloy of iron and cerium with iron content ranging between 15% and 40% by weight which conforms in shape to said hollow of said cup-shaped ingot, heating the telescoped ingot bodies thus obtained to extrusion temperature, and extruding in a single operation said bodies simultaneously through die means, to thereby produce a finished flint rod having fusion bonded thereto a protective outer aluminum alloy covering of substantially uniform thickness throughout, amounting to about 5% to 7.5% of the diameter of said flint rod, whereby the pyrophoric properties of said flint rod are maintained at an optimum.

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