

UNITED STATES PATENT OFFICE.

WILLIAM LAWRENCE TURNER, OF ATHERSTONE, AND HAROLD ALEXANDRE
BLACKWELL, OF BISPHAM, BLACKPOOL, ENGLAND.

MANUFACTURE OF METAL ALLOYS.

1,321,684.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that we, WILLIAM LAWRENCE TURNER and HAROLD ALEXANDRE BLACKWELL, subjects of the King of England, and residing at Atherstone, in the county of Warwick, England, and Bispham, Blackpool, in the county of Lancaster, England, respectively, have invented Improvements in or Connected with the Manufacture of Metal Alloys, of which the following is a specification.

This invention relates to the manufacture of metals, metal alloys, and ferro-alloys, such as chromium, tungsten, manganese, and other metals, ferro-chromium, ferro-vanadium, ferro-titanium, ferro-tungsten, and ferro-manganese, and similar ferro alloys, by the process generally termed the "alumino-thermic" process, wherein aluminium, silicon, magnesium, calcium, and the like, are used as reducing metals, such metals being intimately mixed with the ores, oxids, sulfids, chlorids, or salts of the metals or alloys to be produced; and for convenience in stating this invention, it will be assumed that aluminium constitutes the reducing metal used, this metallic aluminium being the one which is the more commonly employed.

In the alumino thermic process, in order to secure the chemical reaction taking place in a satisfactory manner, the reducing metal is used in a finely, or more or less finely, divided state, in which form an intimate mixture may be made with the said ores, oxids, etc., which are generally more or less also in a finely divided state.

Aluminium in a granulated or powdered state, is customarily of a high degree of commercial purity, and is generally recognized in the trade as containing 98 to 99 per cent. of pure aluminium, and it is very expensive, and consequently the metals, metal alloys, or ferro-alloys, of the kind referred to, which are produced, are correspondingly expensive, and the object of this invention is to produce them at a substantially less cost; and in the case of such metals, metal alloys, or ferro-alloys being employed, in the production of other alloys, in which they will form constituents, the object is also to reduce the cost of manufacture of such alloys. One species of the alloys to be ultimately produced is steel alloys, as for instance high speed tool steels, and similar steels, the price

of which at present is very high, and which it is desired to produce at a lower cost.

According to this invention, instead of using the commercially pure metallic aluminium as the reducing metal, we employ alloys of aluminium containing zinc, copper, iron, etc.; the available supply of which is abundant, compared with the available supply of the more or less commercially pure metallic aluminium, and the price of which is much lower than the more or less commercially pure metallic aluminium.

It is well known that it has been proposed to use alloys of aluminium with magnesium, calcium, silicon, etc., but these latter elements are specifically introduced into the alloy for the definite purpose of taking part or assisting in the reduction of the oxids, chlorids, sulfids, etc.; this invention is not concerned with such alloys.

We have found by our experiments and tests that the other metals, which are the alloys with the aluminium, such as zinc, copper, iron, etc., do not in all cases, or necessarily take part in the reduction process or reaction, and may, in general, be regarded simply as impurities, and that the effect of their presence does not materially affect or interfere with the metal or alloy being produced.

The aluminium alloys to which this invention refers are those generally containing about from 65 to 97 per cent. of aluminium. Nevertheless the aluminium alloy used, besides containing zinc, copper, iron, or other metal alloys, may contain percentages or traces of magnesium, silicon, calcium, or the like.

As stated, we have found that the said aluminium alloys can be used in the alumino-thermic process for the production commercially of said metals, alloys, or ferro-alloys thereof, satisfactorily; especially in cases where it is desired to produce metals, alloys, or ferro-alloys, which do not require to be of a very high standard of purity, and in which small percentages or traces of such metals as zinc, copper, iron, etc., do not detrimentally affect or injure the quality of the metal or alloy in respect of the specific purpose to which it is ultimately desired to put it.

In the case of aluminium alloys containing an appreciable or substantial percentage of zinc, such as the aluminium and zinc:

alloy containing from 65 to 97 per cent. of aluminium content, we have found that the alumino-thermic reaction takes place, and may be carried out in the well known way; and that this reaction is successfully performed without any untoward effect or circumstances which prevent commercially the use of such aluminium alloys for the purposes in question, and that the heat generated, due to the alumino-thermic reaction is sufficiently great to volatilize the majority or all of the zinc which may be contained in the said aluminium-zinc alloy, and in this form will pass off into the atmosphere, and not remain in any appreciable quantity in the resultant metal or alloy produced by the process.

When using aluminium zinc alloy, the zinc may also enter into the reaction to some extent, reducing the oxid or compound of metal under treatment; in which case, such a material as zinc oxid would be driven off, or pass into the slag which is produced by the process.

It is to be understood that in all cases the aluminium alloy reducing medium used, will be in a powdered, granulated, or an equivalent small form. It is also to be stated, that in carrying out the manufacture of metals or alloys according to this invention, at the part of the body or charge of the mixed materials, which are to undergo reaction, at the locality or localities of initiation of the reaction, the aluminium alloy may be in powdered or fine state of division, and mixed with the other powdered or granulated metallic substances to be operated upon; while through the rest of the charge, or mixture, the aluminium alloy reducing medium may be in larger form, viz., granular or in small pieces.

Although the aluminium alloys such as mentioned used in the carrying out of the manufacture of the metals, alloys, or ferro-alloys referred to, may be melted up, and cast into a convenient form as in ingots, and such ingots or castings powdered or granulated, so as to bring the aluminium alloy into a suitably divided or small form for carrying out the process, we have found that the same results may be generally obtained by taking quantities of alloy turnings, borings, or the like, (which materials are collectively known and classified in the trade under the general term of "swarf"), and grinding, crushing, or otherwise disintegrating the aluminium swarf by suitable machinery to a pulverulent or more or less small form of division; the material working well and satisfactorily under this treatment.

Where the swarf may be contaminated with impurities, such as oil, flooring sweepings, or other extraneous matter, which may have become mixed with it, by reason of the

fact that such material is often collected from the floors of machine shops and the like where such aluminium alloys have been worked, it—the swarf—may be pre-heated or calcined, which has the effect, not only of ridding it of these extraneous matters, but also in some cases of producing the same in a more or less brittle state, in which condition it can be more easily or readily crushed or broken down into the state of division required. Moreover, such alloys generally are more brittle than commercially pure aluminium, and thus their use is advantageous in that it is easier to bring them down to the required small state.

The use therefore of swarf treated as described, that is, broken down or crushed into the state of division required, is a factor in itself in the cheapening of the production or manufacture of metals, alloys, or ferro-alloys as referred to, by reason of the fact that it is not necessary, at least in all cases, to first re-melt the aluminium alloy, and subsequently granulate or powder it.

While the direct application and use of swarf has been specified as being a form of the aluminium alloy used under this invention, as the reducing metal or medium for the manufactures specified, other forms of aluminium alloy scrap may be also used in the like manner, such as sheet cuttings, wire or cable cuttings, and other similar forms of aluminium alloy scrap which may be used direct in the manner and for the purpose stated. Machine and motor car parts and other similar forms of aluminium alloy scrap may also be so used, but if so desired, they may be first completely melted, and then reground or granulated or disintegrated.

It is necessary that the aluminium swarf or scrap should be selected with regard to its analysis or constituents, having regard to the quality or description of the ultimate alloy or metal to be produced. For instance in the production of copper alloy, selection would be made as a reducing agent, of an aluminium alloy containing, preferably, a larger proportion of copper than of zinc, seeing that the copper or the majority of it, would be recovered and pass into the composition of the alloy being so produced. Similarly, where an appreciable quantity of copper would be regarded as an impurity or disadvantageous, aluminium scrap or swarf containing a preponderance of zinc as the metal alloy of the aluminium would be advantageous.

Such aluminium swarf or scrap may be used which has from about 65 to 97 per cent. or more of aluminium content, the balance being composed mainly of zinc, copper, iron, etc., in various proportions, with of course, traces or small percentages sometimes of manganese, magnesium, silicon, or

other elements, which may have been introduced into, or contained in the original alloy for purposes other than that which it is contemplated for the manufacture of metals or alloys to be produced by the application of this invention.

In cases where the oxid, ore, etc., of the metal or alloy to be produced is reduced with difficulty, it may be found that the chemical activity of the aluminium alloy is not sufficient to satisfactory carry out the reduction operation, in which case we substitute for a part of the aluminium alloy, pure metallic aluminium, magnesium, silicon, or the like.

Such alumino-thermic mixtures as are herein referred to may be preheated for the purpose of promoting the satisfactory reaction.

What is claimed is:—

1. The herein described process, which consists in mixing a finely divided alloy of a reducing metal and zinc with a finely divided metal compound to be reduced, heating the mass for effecting the reaction, and utilizing the heat from the reaction to vaporize off substantially all of the zinc whereby the resultant alloy or metal will be substantially free from traces of the zinc.

2. The herein described process, which consists in mixing a finely divided alloy of

a reducing metal and zinc with finely divided metal compound to be reduced and a reducing metal in the metallic form, heating the mass for effecting the reaction, and utilizing the heat from the reaction to vaporize off substantially all of the zinc whereby the resultant alloy or metal will be substantially free from traces of the zinc.

3. The herein described process, which consists in preheating a finely divided alloy containing a reducing metal to clean the same, further dividing the alloy, mixing the alloy thus treated with a metal compound to be produced, and heating the mass to effect the reaction.

4. The herein described process, which consists in introducing a mass of aluminium alloy in the presence of a metallic compound to be reduced, the aluminium alloy being divided and that portion thereof which is utilized for starting the reaction being of a finer sub-division, and heating the mass to effect the reaction.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

WILLIAM LAWRENCE TURNER.

HAROLD ALEXANDRE BLACKWELL.

Witnesses:

A. M. HANNAY,

SOMERVILLE GOODALL.