Patented June 9, 1936 2,043,387

UNITED STATES PATENT OFFICE

2,043,387

METALS AND METHOD OF FORMING SAME

Samuel R. McBride, Long Beach, Calif., assignor to Harry L. Fuog, Los Angeles, Calif.

No Drawing. Application November 5, 1934, Serial No. 751,585

14 Claims. (Cl. 75—17)

This invention relates to a method of forming improved metals and the metals themselves, and refers particularly to a method in which improved metals are produced by treating the metals with radioactive irradiation.

This application is a continuation, in part, of my copending application, Serial No. 696,023, filed October 31, 1933.

I have discovered that metals may be improved by subjecting them to irradiation of the character of radioactive action. A radioactive source or agent of relatively pure form may be employed, or an extracted or artificially produced agent, or concentrates, or ores of sufficient radioactivity.

In one aspect of the invention, radioactive ores, elements and chemical substances may be added to various metals in the molten state or to various alloys or mixtures of metals in the molten state and effect an improvement in the properties of such metals.

I have further discovered that various metals or various alloys or mixtures of metals may be subjected to radioactive emanations, as given off by radioactive ores, elements or chemical substances, when said metals, alloys or mixtures of metals are cold or at elevated temperatures less than the melting point of the metals, such as in the heat treatment of metals, and will effect an improvement in the properties of such metals. The metal, alloys or mixtures of metals can be treated by the radioactive ore, element or chemical substance and may either be a ferrous or non-ferrous metal, and the particular properties of the metal which are improved by this treatment will vary considerably with the particular metal treated. In general, however, the treatment produces an improvement in the strength and ductility of the metal, which may be supplemented by improvements in other properties, and will be more thoroughly explained hereinafter in connection with typical treatments of different specific metals or materials.

A radioactive ore or element is one that is constantly undergoing disintegration, and during the process of disintegration gives off alpha, beta and gamma emanations. The alpha particles or emanations are positively charged. They have low penetrating power and are the main cause of phosphorescence. They have a mass of four, and are known to be helium atoms, each carrying two positive charges of electricity. Beta particles or emanations are negatively charged and are considered streams of negatively charged electrons. They correspond to the cathode rays, which are produced by a vacuum tube discharge. Gamma rays or emanations are emitted whenever matter is bombarded by beta rays; in other words, the sudden stoppage of swiftly moving beta rays, or electrons, by the atoms of matter is accompanied by the generation of gamma rays. In addition, it is also known that under certain conditions primary gamma rays will themselves generate secondary gamma rays upon being absorbed in matter. The gamma rays are not material substance at all, but pulsations similar to Röntgen rays. They are vibrations of very short wave length. The rate of disintegration of radio active atoms is independent of all physical conditions and is independent of the chemical combination in which they are placed, and proceeds at the same rate whether the atoms are in a metallic state or in combination as a halide, carbonate, sulphate, etc. At the present time, there are recognized about thirty-five distinctly different elements which emit radiation. The elements comprise the uranium, thorium, and actinium series of radio active elements.

It is understood that the words "chemical substance" are to cover such substances as radium barium sulphate and other similar compounds obtained in the treatment of radio active ores.

I have found that the following radio active ores produce identical results, in the treatment of metals, in proportion to their radio active contents—pitchblende, carnotite, tobernite, autunite, monazite sand, and a black carbonaceous unclassified mineral found in Utah, containing approximately 16% of uranium oxide, U_3O_8, with the remainder principally carbon and silica.

The present invention, together with various objects and advantages thereof, will best be understood from a description of a number of examples of a method embodying the present invention, both as it is applied to the treatment of ferrous metals and alloys and non-ferrous metals and alloys. For this purpose, there is hereinafter given a number of examples embodying the invention. It is to be understood that the radio active ore mentioned in the following examples contains approximately the same radio activity as is present in carnotite ore, as found in Utah, and containing 5% U_3O_8.

In the first example, to molten, commercially pure aluminum in a crucible there was added 1% of radio active ore and the contents of the crucible held at the molten condition for about one-half hour at a temperature of, for example, slightly above 1750° F., after which the metal was cast in green sand molds. By this treatment, it was found that the commercially pure aluminum which normally possessed a tensile strength of about 15,000 pounds per square inch now exhibited an average tensile strength of about 19,000 pounds. The specific gravity increased from 2.68 to 2.71. The grain size was reduced, porosity was reduced and improved machinability was found in the treated aluminum.

In the second example, 1% of radio active ore was added to gunmetal bronze in the crucible

and the mass maintained in a molten condition for about 45 minutes. The composition of the gunmetal bronze was about 88% copper, 10% tin and 2% zinc. This gunmetal bronze normally has an average elastic limit of about 11,000 pounds to 13,000 pounds, and an average tensile strength of 28,000 to 29,000 pounds. The portion of gunmetal bronze treated with radio active ore, after it had been poured into sand molds exhibited an elastic limit of 14,500 to 15,000 pounds, and an average tensile strength of 33,700 pounds. The treated bronze also exhibited a finer grain structure, absence of porosity and improved machinability.

As a further example, 0.5% radio active ore was cooked with virgin copper for about 45 minutes, and cast in molds at a temperature of about 2300° F. This product had a Brinell test of 49–51, tensile strength 30,000 to 31,000 pounds, and a conductivity of 98–99 whereas the same copper untreated had conductivity of 91–92, and an average tensile strength of 25,400 pounds. The treated copper exhibited a very fine grain structure, increased density and reduction of piping tendency.

The following is an example of the process of the present invention applied to the treatment of ferrous metals, iron or steel. A metal of the type used in poppet type valve heads and containing about—

	Per cent
Silicon	2.3
Manganese	.54
Phosphorus	0.19
Sulphur	0.05
T. C	2.75
C. C	0.75
G. C	2.00
Chromium	0.34
Nickel	0.75
Molybdenum	0.50

was treated with 1% radio active ore in the electric furnace for about 30 minutes and cast in molds. This metal had, before treatment, a Brinell test of 269, a transverse test of 4,630 pounds, a tensile test of 53,260 pounds, and a deflection of 0.150. After treatment with the aforesaid active ore, it exhibited a Brinell test of 276–284, a transverse test of 4910, a tensile test 56,400 pounds, and a deflection of 0.164. The treated metal also exhibited improved grain structure, increased density, improved corrosion resistance, better dispersion of the alloying elements and improved machinabiilty.

As a further example, nickel, chromium cast iron commonly employed in cylinder and cylinder-heads having an analysis of—

	Per cent
Silicon	2.44
Sulphur	0.135
Phosphorus	0.098
Manganese	0.45
G. C	2.66
C. C	0.62
Chromium	0.71
Nickel	1.57

was treated with 1% radio active ore in the spout of the cupola. The radio active ore is preferably added to the stream of molten iron passing from the spout of the cupola as the molten iron is poured into the ladle. This iron exhibited a Brinell test of 207–217, as compared with a value of 187–205 before treatment, a tensile strength of 37,500 pounds to 40,200 pounds, as compared with an average of 35,000 pounds before treatment, and in addition thereto the treated iron exhibited an improved grain structure, increased density, improved dispersion of the alloying elements, reduction of porosity, elimination of hard spots and improved machinability.

As a further example of the effects of radioactivity upon metallic structures, I have found, for example, that if a sheet of commercial duralumin be contacted with about 5% of radioactive ore, for example, an ore containing 16% or more uranium, distributed evenly over the top surface of the sheet and the temperature increased to the normal heat treatment temperature of this metal and the exposure to the radioactivity be for several hours, depending upon the thickness of the sheet, that the passivity to corrosion is increased materially. In some cases, I have found this increased passivity to amount to as much as 400%. The normal heat treatment of duralumin is about 520° C.

The above treatment can be applied to other metals and alloys during or preceding heat treatment.

I have also found that with alloys where there is normally a limit to the amount of a component that can be absorbed, radioactive irradiation raises such limit and increases the alloying coefficient or the amount of the component that can otherwise be carried without separation.

As an example, I have added from 0.10% to 1% of radioactive ore to mixtures of copper and lead—for example, 60% copper and 40% lead. At these percentages the lead is in excess normally soluble in the copper in the solid state, but the addition of radio activity to this mixture of metals in the molten condition produces, upon cooling the metals, a structure in which the lead is uniformly dispersed throughout the copper, producing a material of superior quality for bearing purposes.

I do not at this time fully understand the action of the irradiation upon the atomic structures of the metals and alloys. If the action is caused by the alpha ray emanations, then it is apparently one wherein the positive particles of the alpha emanations are absorbed by the atoms in the structure of the metal. If this occurs, then those atoms which have absorbed the positive particles have changed in character and belong to the group next higher in the periodic table. This change would cause a disturbance in the molecular structure and in turn would cause an unstable condition in the metallic structure, thus probably affecting the polarity, to some extent, of the elements in the metallic structure. This disturbance of the atomic polarity would in turn probably set up a secondary electrical action through the metal, and this action would account for at least some of the apparent electrical activity. It is my belief at this time that the beta emanations create little, if any, activity in the metallic structure, unless the action be somewhat similar to the alpha action, except that in this case negative particles must be considered, but it is well known that the beta emanations are the source of the gamma pulsations or gamma rays. The gamma rays are electrical waves possessing great penetrating powers. There are two or more actions created in metals by the passage of gamma rays into the metallic structure. For example, when gamma rays pass through or cut the magnetic fields surrounding the atoms in the metallic structure, an induced electrical activity is generated, the amount and strength of the in-

duced activity depending upon the number and the velocity of the gamma rays and the strength of the magnetic field of the atoms. Due to the great penetrating power of the gamma rays, it is entirely possible for a single gamma ray to pass through a large number of atomic fields, thus generating induced activity for a considerable distance in the metallic structure.

It is well known that under certain conditions primary gamma rays will themselves generate secondary gamma rays upon being absorbed in matter, thus magnifying the electrical activity created by the initial gamma ray penetration. It is also well known that gamma rays are able to ionize gases to influence the electrical properties of liquids and solids, able to liberate photoelectrons, of activating catalysts in some cases, of flocculating colloids, and are able to stimulate or to kill living matter.

Another possible action of the gamma rays is that the rays in passing through the atomic structure disturb or knock out of position one or more electrons present in the outer ring of the atoms, thus creating an unstable condition in the atom. This action would probably affect, to a certain extent, the polarity and magnetic strength of the atomic structure.

Any or all of these actions may cause a more or less dormant atomic structure to become electrically active, creating a condition, in most cases, whereby the atoms in the structure possess a more mutual attraction for each other, and a better distribution of the elements through the metallic structure. Thus, the better distribution and improved mutual attraction could account for the reduction in hard spots, the reduction of porosity, increased density, improved machinability, improved grain size, the reduction of internal strains, and the increased resistance to corrosion. Since corrosion is electrolytic in character, it is possible that the increased resistance to corrosion in metals treated with radioactive elements is helped by the increased electrical activity tending to reduce the formation of Galvanic couples in the metallic structure, and also a possible reduction in potential that is set up between the harder and softer metallic parts.

While the particular process herein described is well adapted to carry out the objects of the present invention, the present invention is not limited to the particular examples given, but includes all such modifications and changes as come within the scope of the appended claims.

I claim:

1. A method of improving metals, which comprises contacting the same in a molten state with carnotite ore.

2. A method of improving metals, which comprises contacting the same in the molten state with carnotite ore and then casting the metal in molds.

3. A method of improving ferrous metals, which comprises adding to the molten metal carnotite ore.

4. A method of treating non-ferrous metals, which comprises adding to the molten metals carnotite ore.

5. A method of improving bearing metals, which comprises bringing a mixture of copper and lead to a molten condition and introducing therein carnotite ore.

6. A method of improving metals, which comprises contacting the same in a molten state with ore substantially free of carbonaceous shale containing a radio active metal.

7. A method of improving metals, which comprises contacting the same in a molten state with ore substantially free of carbonaceous shale containing a radio active metal, and then casting the metal in molds.

8. A method of improving ferrous metals, which comprises adding to the molten metal an ore substantially free of carbonaceuos shale containing radio active substances.

9. A method of treating non-ferrous metals, which comprises adding to the molten metals an ore substantially free of carbonaceous shale containing radio active substances.

10. A method of improving bearing metals, which comprises bringing a mixture of copper and lead to a molten condition and introducing therein an ore substantially free of carbonaceous shale containing a radio active substance.

11. A method of improving metals, which comprises bringing the metals to a molten condition, subjecting the metals to the action of a radio active substance substantially free of carbonaceous shale.

12. A method of improving metals, which comprises contacting the same while in the molten state with a concentrated ore substantially free of carbonaceous shale containing a radio active substance.

13. A method of improving metals, which comprises contacting the metal in a molten state with a radioactive ore containing uranium substantially free of carbonaceous shale.

14. A method of improving metals, which comprises contacting the metals while in a molten state with a member of the group of ores including a pitchblende, carnotite, tobernite, autunite, and monazite sand.

SAMUEL R. McBRIDE.