UNITED STATES PATENT OFFICE.

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MANUFACTURING ALLOYS.

No. 912,246. Specification of Letters Patent. Patented Feb. 9, 1909.

Application filed March 26, 1907. Serial No. 364,731.

To all whom it may concern:

Be it known that I, HANS KUŽEL, a subject of the Emperor of Germany, and a resident of Baden, near Vienna, Empire of Austria-Hungary, have invented certain new and useful Improvements in Manufacturing Alloys, of which the following is a full, clear, and exact description, such as will enable others skilled in the art to which it appertains to make and use the same.

The manufacture of alloys, all or some of the constituent elements of which consist of refractory metals by the usual thermic methods offers by itself great difficulties owing to the high melting temperatures of such metals and to the great liability of their being attacked in the molten state by oxygen and also nitrogen. These difficulties become the greater the higher are the requirements as to the exactness of the composition of such alloys which have to contain only small quantities of one of the constituents and the more perfectly any contaminations have to be avoided that may be absorbed in melting, such as carbon, crucible material etc. These difficulties are avoided by the process disclosed in my prior application of January 4th 1904, Ser. No. 239637 by that the several constituents of the alloys are mixed in the form of colloids and then—after having been brought if desired to the shape required by mechanical working etc.—are reconverted into the ordinary metallic state by heating them to a white heat in the ordinary manner or by the electric current in an inert or preferably in a reducing atmosphere under increased or reduced pressure or *in vacuo*. As is seen in this case all the constituents of the alloy are used in the colloidal state. The present invention realizes an essential technical simplification and cheapening of the said method by the fact that according to the present invention not more than one constituent of the alloy to be made, need be made use of in the colloidal state while any desired number of other components may be used in the form of the essentially more readily obtainable crystalloids, viz.: in the form of any desired metal compounds for instance in the form of salts oxids, hydroxids, acid hydrates or halogen compounds and are combined with the colloid separately or in suitable combination prior to further treatment by suitable means whether by precipitation, for instance by salts, acids or bases etc. or by the simple contact effect between the solution of a metal compound and the colloid.

The process may be carried out for instance as follows:

(*a*) To a colloidal solution or suspension of metallic tungsten containing 50 grams of the metal per liter in any desired colloidal form, for instance as sol or gel. a dilute solution of platinum chlorid containing for instance 0.5 grams of platinum is added drop by drop under continuous stirring and then the whole is stirred or shaken for some time. Then so much of dilute alkali for instance a solution of caustic soda is added until a neutral or a just beginning alkaline reaction becomes perceptible and then the colloid is precipitated by an electrolyte for instance sodium chlorid. On then examining the separated clear liquid it will be found free from platinum. The colloid on the contrary contains all of the platinum in most uniform distribution and probably in the form of an absorption compound. The plastic mass obtained after filtering may be converted into the ordinary or crystalline state in the known manner above referred to for instance by heating to a white heat in hydrogen after having been, if desired, brought into the required shape, and then constitutes an alloy which containing 0.5 parts of platinum per 50 parts of tungsten and is at the same time perfectly homogeneous.

(*b*) If in the above example instead of platinum chlorid, a titanium salt, for instance a titanium chlorid soluble in water, or aluminium chlorid, is used correspondingly, exactly proportioned alloys of tungsten and titanium or tungsten and aluminium respectively are obtained. If both chlorids are used simultaneously the alloy contains besides tungsten also titanium and aluminium simultaneously.

(*c*) If the example (*a*) is modified in such a way that 1 gram of sodium silicate is added to the colloid and if at the same time 2 to 3 grams sal ammoniac are added then after continued stirring or shaking the entire hydrate of silicic acid has been absorbed by the colloid and the clear liquid separating after precipitation is free from silicic acid. Also the silicic acid can be first liberated by an equivalent quantity of hydrochloric acid and may then, after neutralization for in-

stance by ammonium bicarbonate, be precipitated by ammonium chlorid. In this way alloys with an exact proportion of silicon are obtained. Instead of colloidal tungsten and sodium silicate also for instance colloidal molybdenum and sodium tungstate may be subjected to the latter treatment.

(*d*) But if for instance to the colloidal solution of tungsten a compound is added which in dilute solution is not precipitated by alkalies, acids, nor electrolytes for instance boric acid or ammonium borate, the colloid nevertheless absorbs the boric acid, to wit, with constant conditions of concentration and the same nature of the colloid a given quantity of the colloid absorbs alway a definite quantity of the crystalloid, that is to say, the absorption proceeds until in the liquid the state of equilibrium has formed that corresponds to the systems existing. Therefore under the same conditions of experiment always the same proportion of the absorbed crystalloid will be obtained in the precipitated colloid. The absorption of dissolved substances by colloids is subject to certain laws which have been determined among others by the investigations of van Bemmelen. (*Landwirthschaftliche Versuchsstationen*, Vol. 35, 1888, pages 69-136, *Zeitschrift für Anorganische Chemie*, Vol. 23, pages 111-125 and 321-372 of 1900, see also Müller "*Allgemeine Chemie der Colloide*," page 129 and the following, further "*The Journal of the American Chemical Society*," Vol. XXVI, No. 10, page 1383, Whitney & Clarke, *Migration of colloids*).

It is obvious that in all the examples above given instead of one colloid only, a mixture of different colloids may be used and also precipitable crystalloids (for example, soluble titanium chlorid, aluminium chlorid, sodium silicate or sodium tungstate above mentioned) may be used simultaneously with non precipitable ones (such as boric acid or ammonium borate, for instance). In this simple way one may secure the desired exact proportions in an alloy avoiding any contamination whatever. These alloys may be used for the manufacture of filaments for electric glow lamps, of electric resistance wires, as also of articles of all kinds.

I do not claim in this application incandescent lamp filaments consisting of the metals or alloys herein described, as such filaments form the subject of applications filed by me. Nor do I claim in this case broadly, the colloidal process of making lamp filaments, as that forms a subject of my application Serial No. 239,637.

I claim as my invention:

Process for manufacturing alloys consisting in adding to a colloidal suspension of a metal a solution of a crystalloidal compound, mixing the two constituents intimately, adding to the whole a precipitant, permitting the precipitate to deposit whereby an absorption compound of the colloid and a crystalloid is formed, separating the deposit from the supernatent liquid, freeing such deposit from liquid and bringing the same into the desired shape and heating the mass whereby it is reconverted into the crystalloidal state, substantially as and for the purpose described.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses.

HANS KUŽEL.

Witnesses:
T. GEORGE HARDY,
ALVESTO S. HOGUE.