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PROCESS FOR THE MANUFACTURE OF COMPACT JUNCTIONS OF LIGHT METALS AND LIGHT METAL ALLOYS WITH HEAVY METALS AND HEAVY METAL ALLOYS

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Our invention relates to the manufacture of compact junctions of light metals or their alloys and objects made therefrom with heavy metals or their alloys and objects made therefrom whereby these compact junctions are made without any welding or soldering process.

According to our invention beryllium, aluminium, magnesium and their alloys may be used as light metals, whereas copper, lead, tin, gold, silver, zinc, iron, nickel, chrom tungsten, molybdenum, titanium, thorium and their alloys may be used as heavy metals.

Our invention may be employed over a very wide range, so for instance, for the junction of tubes, pieces of tubes, cylinders, sheets, rods, wires and so on, made from light metals, with the same or otherwise formed objects, which are made from heavy metals, or vice versa. According to our invention, for instance, tubes made from heavy metals may be manufactured with intermediate pieces from light metals, or tubes may be formed which consist out of alternate nearly equal parts of heavy metals and light metals. Furthermore, it is possible to join sheets of heavy metals with those made from light metals. Objects, such as for instance, sheets of light metal, may be coated with heavy metals or may be bordered with them. A further object of our invention consists in manufacturing, for instance, a cylinder from soft metal which is enclosed in a cylinder of heavy metal in such a manner that the outer wall of the internal cylinder and the inside wall of the external cylinder are in contact with each other. Sheets of light metals which are bordered with ledges of heavy metals or the like may be used, for instance, for the manufacture of cases or the like.

According to our invention the junction of light metals and their alloys with heavy metals and their alloys will be carried out as follows: The junction points are brought into contact with each other and then heated to temperatures lying below the melting point of the lowest melting constituent. During the heat treatment the objects to be joined are subjected to sintering by means of pressure. These very simple proceedings result in excellent junctions between light metals and heavy metals according to the fact that a diffusion process takes place at the junction points of the metals. We have found that the penetration of one metal into the other or the alternate diffusion between the metals develops quicker with higher temperatures. Therefore it has been proved advantageous to use temperatures which are near the melting point of the lowest melting constituent. Nevertheless, lower temperatures will yield also to satisfactory junctions. In cases which require an absolute stability of form and constancy of volume we have found it advantageous to use temperatures considerably below the melting temperature of the lowest melting constituent. It is necessary to extend the duration of treatment in such cases.

An important feature of our invention is the effect of pressure during the heat treatment. The use of pressure involves a better, more uniform and remarkably quicker diffusion. Of course the rate of diffusion depends also on the constants of material.

The duration of heat treatment depends on the consistency of the metals to be joined with each other and on the other conditions of work, such as height of temperature, height of pressure and so on. Usually a heat treatment of about one to five hours is sufficient. In some cases 10 minutes or about half an hour will suffice.

According to our invention higher pressures, for instance, 50 to 100 kgrs/qcm or more may also be used. In many cases lower, even considerably lower pressure will be sufficient. A low pressure is, for instance, well suited of soft metals, such as copper or lead, are to be treated.

The pressure may be produced after well known methods, for instance, by compression. Sometimes the use of compression will be superfluous, for instance, if one of the metal components, such as the border part or the outer casing will be able to exert a pressure on the included metal part during the heat treatment on account of its thermal properties. For instance, a light metal sheet, made from beryllium, which is to be joined tightly with a border of a heavy metal, such as copper, may be worked in such a manner that the copper border is shrinked on. Furthermore, the metals may be joined with each other in such a manner that the desired pressure at the junction area originates from the irregular dilatation of the metals. According to our invention double cylinders, junctions between tube connecting pieces and so on may be manufactured in this manner.

If necessary the metal areas which are to be joined with each other may be subjected to a precleaning. Very good junctions may be obtained, however, if the special cleaning processes such as descaling, treatment with chemicals and so on are not employed.

Our invention may be illustrated with the following example of a junction between copper and beryllium: A temperature of 850° C. and a

pressure of, for instance, 70 to 100 kgrs/qcm during a time of about one hour will result in a diffusion layer of about 1 mm thickness which proves to be an intimate and solid junction between the objects to be joined with each other.

Our invention is of special advantage insofar as a junction of light metal parts with heavy metal parts or objects therefrom may be carried out with absolute consistency of volume and stability of form. Furthermore, our invention is especially sulted for metals or metal alloys which may be soldered or welded only with difficulty, such as, for instance, beryllium and certain beryllium alloys.

An important field for the employment of the process according to our invention is, for instance, the manufacture of windows for X-ray emanation, tubes or other emanation tubes which serve for the formation of electromagnetic or corpuscular rays (electron microscope, radio active, i. e. atomic conversion phenomena). Our invention is especially suited for these purposes giving the possibility to border windows from beryllium which is not weldable or solderable per se with a ring of a sultable heavy metal, for instance, copper. Those windows may then be inserted vacuum tight after a known method into vacuum apparatus of all kinds, for instance, by welding or soldering.

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