Patented Oct. 11, 1927. 1,644,741

UNITED STATES PATENT OFFICE.

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UNITING DISSIMILAR METALS.

No Drawing. Application filed January 2, 1923. Serial No. 610,373.

This invention relates to the bonding of dissimilar metals such as copper and iron, and especially to the bonding of cooling fins to an engine cylinder.

The present invention is susceptible of a variety of uses and is particularly useful in connection with the cylinder finning process described and claimed in the copending application of Charles F. Kettering, Serial No. 514,014, filed November 9, 1921. This application describes the bonding to an iron or steel engine cylinder of a continuous strip of copper fin material including a plurality of fin loops by means of an intermediate bonding element of sheet brass which unites with the cylinder wall and with the copper fin material in such a manner as to produce a bond having mechanical permanence and providing true thermal contact between the cylinder and the fins. The process described in the application referred to includes wrapping flexible fin material about the exterior cylindrical surface of the cylinder with a thin sheet of flexible brass between the cylinder and the portions of the fin material to be united with the cylinder, the surfaces to be united having been coated with a suitable flux. These parts are temporarily held in assembled relation by means of binding wires, the assembly is dipped in a bath to provide a protecting coating for the fins, and is then heated to a temperature sufficient to melt the brass to cause it to unite with the iron and copper.

Especially where a flexible copper body is to be united with a cylindrical ferrous surface it is advantageous to use a brass which can be obtained in thin flexible sheets, and one which has a relatively low melting point. It has been found that increasing the percentage of zinc and decreasing the percentage of copper in the brass will cause the melting point to be reduced, and, if the percentage of zinc is not too great, the bond when formed will be sufficiently tough to withstand the differential expansion of the copper and iron and also mechanical shocks. However, before the zinc content of sheet brass is increased to the point where a brittle bond would result, brass itself becomes brittle, and it is impossible to roll it into the thin flexible sheets which can be wrapped around the cylinder.

It has been found that brass analyzing fifty percent zinc and fifty percent copper will provide a tough bond, but it is impossible to roll such a brass into thin sheets. Brass analyzing about sixty five percent copper and thirty five percent zinc appears to have the maximum zinc content consistent with working it into thin flexible sheets. Obviously the last specified brass has a higher melting point than the brass analyzing fifty percent copper, fifty percent zinc.

One object of the present invention is to treat a bonding material having the necessary thinness and flexibility in such a way that certain metallic bodies having reverse interfitting nonplaniform surfaces can be joined upon heating these metals with the treated bonding material between them to a temperature substantially less than possible when using the untreated bonding material, while yet forming a mechanically permanent joint. This invention contemplates starting with a metallic substance which can be obtained readily in thin flexible sheets, and in using this flexible material as a base to which can be attached or against which may be placed another metallic substance capable of alloying with the substance of the flexible sheet at a temperature lower than the melting point of the flexible sheet when used alone as a bonding agent between metallic bodies having nonplaniform surfaces to be joined. The alloying temperature of the flexible sheet with the additional substance is also sufficient to cause the resulting alloy to become active with respect to the metals to be joined and to produce a strong tough bond when the alloy is solid.

In applying this process to brass to be used for brazing, one may start with a brass having the highest zinc content which will permit it to be worked into thin flexible sheets. It has been found that such a brass analyzes about sixty five percent copper and thirty five percent zinc as stated before. A sheet of this brass is coated with zinc, by plating, for example in a cyanide zinc bath until the treated bonding material analyzes a relatively much higher percentage of zinc, such as fifty percent zinc and fifty percent copper, or whatever is desirable depending on the nature of the joint. The fifty-fifty analysis has been found suitable for bonding fins to an iron engine cylinder. The surfaces to be joined, such as the surfaces of the fin material and engine cylinder are

fluxed; the fin material and bonding material are assembled around cylinder and secured thereto by binding wires; this assembly is coated with a protecting flux and is heated to melt the bonding material to cause it to unite with the fin material and cylinder as described in detail in the Kettering application referred to. The zinc coating or plating appears to alloy with the original brass sheet and to form a bonding material having the desired strength at the temperatures to which the cylinder may be subjected in use. The temperature at which zinc coating and the brass sheet will alloy is lower than the melting temperature of a similar brass sheet uncoated. This alloying temperature is sufficient to cause the bonding material thus formed to be active with respect to the metals to be joined, that is, there is such an intermingling of this new alloy with the metals to be joined that a mechanically permanent joint is obtained. Therefore the desired result is obtained with the use of less heat than necessary where the uncoated flexible sheet is used.

It has been found that the alloying temperature for zinc coating and the flexible brass is higher than that of the melting point of zinc, the alloying temperature for the zinc coated brass sheet in the example given being about 1600° Fahr.

Where it is desired to bond a copper equalizer upon the head of a cylinder, the flexible brass sheet can be coated with zinc to analyze sixty five per cent zinc and thirty five per cent copper, since the strength of the joint need not be as great between the copper located upon the flat cylinder head as between the copper fins and cylindrical surface of the cylinder.

Instead of using zinc coated flexible brass, the flexible brass can be sandwiched between layers of sheet zinc and simply held in place by the binding wires which temporarily hold together the metals to be joined.

It is preferable to use the zinc in two layers or coatings, one on each side of the flexible brass sheet rather than to have a thick layer of zinc between two layers of flexible brass.

Instead of a flexible impervious sheet, the brass may be in the form of a sheet of fine flexible wire gauze which can serve as a base for a filling of zinc in the spaces between the wires.

In bonding with brass which includes a flexible core of brass and a coating of zinc, it is desirable to have some of the total zinc content of the bonding material originally combined with the copper in order that the zinc will not run away before the temperature of the alloying of the brass with the zinc coating is reached. Therefore it is best to start with a brass having as high a zinc content as possible consistent with working it into flexible sheets.

While the forms of embodiment of the invention as herein disclosed, constitute preferred forms, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What I claim is as follows:

1. A process of bonding two or more metallic bodies having reverse interfitting non-planiform surfaces, which comprises bending, into conformity with the surfaces to be united, a thin flexible metallic sheet comprising at least one ingredient of a desired bonding alloy associated superficially throughout with another ingredient of said desired alloy; heating the assembled bodies with the separate bonding metals interposed sufficiently to effect alloyage between said sheet and associated ingredient and thereby the union of the bodies; the two ingredients of the desired bonding alloy being of such character and in such proportions that if alloyed in a single sheet, said sheet would be too inflexible to be forced into conformity with said surfaces.

2. The process of uniting copper and ferrous bodies having reverse non-planiform surfaces, which includes placing between said surfaces a sheet of brass with zinc uniformly distributed with respect to the sheet of brass, heating the assembly to a temperature sufficient to cause the zinc and brass to alloy and thus bond the bodies together.

3. The process of uniting a flexible copper body to the curved surface of a ferrous body, which comprises placing between the two bodies a flexible brass sheet coated with zinc and heating the brass and zinc sufficiently to cause them to alloy and thus bond the two bodies together.

4. The process of uniting a flexible copper body to the curved surface of a ferrous body, which comprises placing between the two bodies a flexible brass sheet associated with a layer of zinc in flexible form and heating the brass and zinc sufficiently to cause them to alloy thereby bonding the two bodies together.

In testimony whereof I hereto affix my signature.

HARRY C. MOUGEY.