UNITED STATES PATENT OFFICE.

HUGH RAMAGE, OF DUBLIN, IRELAND.

PROCESS OF SOLDERING ALUMINIUM SURFACES AND PREPARING SAME FOR SOLDERING.

SPECIFICATION forming part of Letters Patent No. 549,610, dated November 12, 1895.

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To all whom it may concern:

Be it known that I, HUGH RAMAGE, a subject of the Queen of Great Britain, residing at Rathmines, Dublin, Ireland, have invented new and useful Improvements in Processes of Soldering Aluminium Surfaces and Preparing the Same for Soldering; and I do hereby declare that the following is a full, clear, and exact description of the invention, which will enable others skilled in the art towhich it appertains to make and use the same.

My invention relates to the preparation or coating of aluminium with metals, alloys, or metallic mixtures, whereby surfaces are produced which, as they do not oxidize readily, retain their brightness in air, and with which melted metals unite or alloy directly with great ease. Other metals may also be deposited electrically upon such surfaces after an ordinary pickling process. The materials used to form the said surfaces may also be used as solders for the metal, and the surfaces may be formed and the pieces soldered together in one operation, or solders of various composition may be used on these surfaces with or without the use of a flux. The substances I use to unite with the aluminium to form the said surfaces are alloys or mixtures of metals which, when heated to a sufficiently high temperature, become perfectly liquid, but which, as they cool, deposit metallic crystals and become quite pasty before the point of complete solidification is reached. I have found that zinc is the best metal for the purpose of giving the said metallic crystals, and that it may be combined either with tin or cadmium, or with both of these metals.

The following table gives the composition of various alloys or mixtures of metals:

ALLOY OR MIXTURE OF METALS.

Zinc.	Tin.	Cadmium.	Temperature at which alloy begins to deposit crystals.	Solidifies completely.
Parts.	*Parts.*	*Parts.*	*About.*	*About.*
50	50	.....	328° C.	192° C.
25	75	.....	260° C.	192° C.
10	.....	25	277° C.	255° C.
15	.....	25	292° C.	255° C.
20	20	20	240° C.	156° C.
24	52	24	200° C.	156° C.

An alloy containing twelve and one-half parts of zinc and eighty-seven and one-half parts of tin appears to fuse completely at about 192° centigrade. I have found that while these alloys or mixtures are in the intermediate stage—that is, while the crystals and liquid are present together—they are exceedingly effective in attacking the resisting surface on the aluminium, and that a very gentle rubbing suffices to cause the metal, alloy, or mixture of metals and the aluminium to combine at once. The mixture containing equal parts of zinc and tin is one of the best, as it has the greatest range of temperature during which it is in this especially active condition. These alloys are best made by first melting the zinc which has the highest melting-point in a clay crucible and adding the other metal or metals to it. If complete fusion does not take place at once, the mass must be heated until it does. The alloy or mixture of metals may be kept in a melted condition, or it may, when solid, be divided into small pieces.

According to my invention I coat the aluminium as follows: Pieces of the alloy or mixture of metals are placed upon the aluminium to be treated and the whole heated by any convenient means such as by the non-luminous gas-flame, or over a clear fire, or by placing it on any hot surface until the alloy or metallic mixture becomes quite liquid. If it be rubbed with a suitable rubber in its present condition, little or no action will result; but as the metals cool the crystals above referred to form, and while they are forming gentle rubbing causes the aluminium to alloy with the other metals and the surface remains roughened by the crystals. On reheating the aluminium these crystals melt and the surface becomes smooth and bright.

The alloy or mixture of metals may, if preferred, be kept liquid and the rubber may be dipped in or kept floating in the liquid. The rubber on being removed will have sufficient of the alloy or metallic mixture adhering to it to coat a considerable surface of the aluminium.

In cases where large surfaces have to be dealt with it would be advantageous to have a special means of heating the aluminium so that the temperature at which the action is best could be maintained. This would, however, leave the surface roughened by the crystals and it would be necessary to raise the tem-

perature of the aluminium by some other apparatus in order to melt the crystals and cause them to alloy with the aluminium. This would present no advantage, however, in the case of small articles.

A rubber which is advantageously used to give the gentle rubbing required according to my invention is made of a material which is not decomposed at the temperature employed. I have succeeded best with asbestos fibers bound together with wire or inserted tightly in a metal or glass tube, the latter being preferable, as only a short length of asbestos need protrude, and as this wears away more may be pushed down by pressing on the ends of the fibers in the tube.

If only a limited area of the aluminium is to be prepared, the rest may be protected by a shield of thin metal, mica, asbestos, or a like material which retains its shape at the working temperature and which does not decompose. Only that part of the aluminium touched by the rubber is attacked and the soft fibers of the asbestos reach up to the edges of the shield, thereby enabling any sharply-defined area to be prepared. Surfaces of aluminium thus coated or prepared may be soldered as follows: The aluminium is heated to a temperature exceeding the melting-point of the solder and is brought into contact with the solder. The solder melts and unites with the aluminium surface. Any ordinary solder may therefore be used, and among others I have found pure tin and pure cadmium to answer well, as also alloys or mixtures of these with each other or with zinc.

A solder composed of equal parts of tin and cadmium is especially useful, as it possesses a low melting-point and gives a joint of considerable strength.

Two pieces of aluminium may be soldered together by first preparing the edges which are to be united and the surfaces immediately adjacent to these edges in the manner hereinbefore described, then bringing them together, then heating them above the melting-point of the solder, and then drawing a strip of solder down the surfaces, whereby a portion of the solder melts and unites the two pieces of aluminium; or onlythe edges need be prepared, and when each is charged with melted solder they may be brought together, whereupon the solder unites and when cold forms a sound joint. A hollow closed body may thus be made from two or more pieces previously shaped to suit requirements.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is—

1. The herein described process of soldering aluminium surfaces which consists in preparing said surfaces by heating the aluminium surfaces, treating said surfaces with a metal or a mixture of metals in a liquid condition allowing the liquid metal or metals to partially cool until the formation of crystals, then rubbing the metals upon the aluminium surfaces with a suitable rubber, then reheating the said surfaces; heating the prepared surfaces to a temperature above the melting point of solder, applying the solder, and bringing the surfaces together to form a joint, substantially as described.

2. The process of preparing aluminium surfaces which consists in heating the aluminium surface, treating the same with a metal or mixture of metals in a liquid state, allowing the said metal or metals to partially cool until the formation of crystals, then rubbing the said metal or metals upon the said surface with a suitable rubber, then reheating the aluminium surface, substantially as described.

In witness whereof I, the said HUGH RAMAGE, have hereunto set my hand.

HUGH RAMAGE.

Witnesses:
A. DONN PIATT,
NEWTON B. ASHBY,
JAMES SCOTT MACKENZIE.