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PROCESS AND FLUX FOR THE TREATMENT
OF LIGHT METALS

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This invention relates to fluxes for use in the treatment of light metals consisting of magnesium, magnesium base alloys, and aluminum base alloys containing magnesium, all hereinafter included in the term "metal."

Many such fluxes have heretofore been proposed and those generally used on a large commercial scale comprise two main kinds namely:

(a) An inspissated flux intended for refining the metal as well as for preventing oxidation, the main characteristics of which are described in British Patent No. 539,024; and

(b) A thinly fluid or non-inspissated flux of low melting point intended mainly for protecting the metal against oxidation during melting, examples of this type and its main characteristics are described in British Patent No. 539,023.

The present invention is concerned only with fluxes of the type referred to under paragraph (b) above.

Fluxes of both types contain chlorides and as is well known proper care must be exercised both in selecting suitable compositions for the fluxes and also in their use in order to minimise contamination of the finished metal with chlorides which give rise to corrosion of the metal.

This difficulty is experienced with normal commercial magnesium alloys containing minor percentages of manganese, aluminum and zinc. We have also met with chloride contamination difficulties of a special nature when dealing with the magnesium base alloys described in British Patent No. 511,137 namely alloys containing a small percentage of zirconium in the absence of elements such as aluminum and silicon which form high melting point compounds with zirconium.

It has been the constant experience hitherto that magnesium alloys containing zirconium are difficult to prepare in a flux-free state, and work on this problem had resulted in the inventions forming the subject of co-pending British patent applications Nos. 7227, 18,890 and 20,870, all of 1945, according to which it is proposed to effect alloying by means of zirconium fluoride dissolved in a molten bath of inert fluorides, or by potassium fluozirconates either with or without the presence of a chloride bath.

We have now found that even with the alloying methods described in these co-pending applications it is very difficult to remove undesirable traces of chlorides which may be introduced by chlorides present in the alloying mixtures or which may be introduced after alloying by the subsequent treatment with chloride-containing flux.

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We have also found that a given quantity of included flux produced on exposure to damp air a much more conspicuous corrosion mark on magnesium-zinc-zirconium than on standard alloys. This is not due to a difference in corrosion resistance of the alloys, but is caused by local surface discolouration developing on the magnesium-zinc-zirconium alloys. In order therefore to reduce the incidence of these traces of flux below that in the standard alloys, as judged visually by the exposure of carefully machined sections of the alloys in a humidity chamber, we have had to devise methods of producing in magnesium-zinc-zirconium alloys a degree of freedom from traces of flux not previously realised in standard alloys.

We have also ascertained that when magnesium alloy scrap containing zirconium is remelted with normal fluxes a considerable amount of new contamination is invariably introduced. Although light in nature, this secondary contamination is widespread and renders the remelted alloy quite unfit for most commercial purposes.

It is also well known that the preparation of cerium-containing alloys in a flux-free state is a matter of considerable difficulty and inconvenience.

We have succeeded in eliminating these residual traces of flux by the use both for melting and refining of a special type of inspissated flux containing barium and strontium salts whereby the flux has a high density and this forms the subject matter of the parent British patent application No. 25,993 of 1946.

It is however well known that although inspissated fluxes can be used for melting, better protection of the metal from oxidation and therefore better metal efficiencies are obtained if a thinly-fluid type of flux is used during melting, and this is particularly true in large scale operations. We find however that if the thinly-fluid fluxes of usual composition are used the resultant chloride contamination cannot be removed even by the use of the aforesaid special type of inspissated flux.

We have now found that thinly-fluid fluxes of special composition can be effectively used for melting, which when used in conjunction with the said special type of inspissated flux enables castings to be produced which are entirely free from chloride contamination.

These thinly fluid fluxes are characterised by a high content of barium chloride and/or strontium chloride whereby a high density of the flux

is achieved which enables any flux which penetrates the metallic meniscus to settle rapidly to the bottom of the crucible, whilst the surface tension properties of the flux enable it to form a satisfactory fluid layer on the surface of the molten metal.

According to the present invention therefore, a melting flux comprises at least two chlorides of the group consisting of the alkali and alkaline earth metals including magnesium, and contains not less than 25% of barium chloride, or 35% strontium chloride or a mixture of barium and strontium chlorides equivalent to not less than 25% barium chloride, reckoning 1% strontium chloride equivalent to 0.7% barium chloride, but not more than 5% of inspissating agents, and has a specific gravity of at least 2.05 and preferably at least 2.4 at 800° C., the liquidus temperature of the flux as a whole being not greater than 610° C.

For these melting fluxes, not more than 5% of ingredients capable of having an inspissating effect may be present. In particular, not more than 5% of oxides and fluorides in total can be tolerated.

When calcium chloride and magnesium chloride are both absent from the melting flux, no fluorides other than magnesium fluoride should be included if the difficulty of reduced wetting power is to be avoided, and the flux should be prefused.

The following ranges of compositions are particularly suitable, the figures all indicating percentages by weight:

	For all alloys not containing rare earth metals (A)	For alloys containing rare earth metals (B)	Non-deliquescent flux for all alloys (C)
	Per cent	Per cent	Per cent
BaCl ₂	25-65	25-70	35-60
CaCl ₂		15-40	
NaCl.....		10-25	15-27
KCl.....	5-25	7-15	24-38
MgCl ₂	20-55	0-7	
MgF ₂		0-5	0-5

The following specific compositions are further quoted by way of example, the small letter references corresponding to the similar above quoted capital letter references:

	(a)	(b) 1	(b) 2	(b) 3	(c) 1	(c) 2
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
BaCl ₂	50	60	55	58	48	46
CaCl ₂		18	18	18		
NaCl.....		13	10	10	21	20
KCl.....	12	9	13	10	31	30
MgCl ₂	38			4		
MgF ₂			4			4

The constituents of the fluxes (c) 1 and (c) 2 must be prefused together.

We claim:

1. In melting magnesium base alloys containing zirconium, melting the magnesium-zirconium in crucibles and effecting separation of chloride inclusion and protecting the alloy against oxidation by a flux consisting essentially of at least two chlorides of the class consisting of the chlorides of the alkali and alkaline earth metals, at least one of the aforesaid chlorides being magnesium chloride, and another being selected from the group consisting of barium chloride and strontium chloride in quantity at least equivalent to 25 per cent barium chloride reckoning 1 per cent of strontium chloride equivalent to 0.7 per cent of barium chloride, said flux including not more than 5 per cent of inspissating agents and having a specific gravity of at least 2.05 at 800° C., the liquidus temperature of the flux as a whole being not greater than 610° C.

2. A process as claimed in claim 1 wherein the flux includes also potassium chloride.

3. A flux for treating magnesium alloys containing zirconium which consists of magnesium chloride, at least one chloride from the class consisting of sodium chloride and potassium chloride, and at least one chloride of the class consisting of barium chloride and strontium chloride in quantity at least equivalent to 25 per cent barium chloride reckoning 1 per cent strontium chloride equivalent to 0.7 per cent of barium chloride, said flux having a specific gravity of at least 2.05 at 800° C., the liquidus temperature of the flux as a whole being not greater than 610° C.

4. A flux as claimed in claim 3 containing at least 20% magnesium chloride and in which there is also included up to 5 per cent of at least one of the fluorides of potassium, sodium, barium, strontium, calcium and magnesium.

5. A flux as claimed in claim 4 containing at least one metallic oxide, the fluorides together with the oxides not exceeding 5 per cent.

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