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SALT BATH

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This invention relates to salt bath furnaces and is directed particularly to an improvement in salt baths for salt bath furnaces and the annealing of metals therein.

Salt bath furnaces are used primarily for the annealing of metals at elevated temperatures. Salt baths as heretofore known usually comprise mixtures embodying one or more of such ingredients as sodium chloride, potassium chloride, soda ash, potash, sodium nitrates, potassium nitrates, cyanides, etc. One well known salt bath comprises, for instance, a mixture of 50% potassium chloride and 50% sodium carbonate. Such salt baths produce, however, an alkaline reaction and tend to corrode metals to be annealed and to produce surface conditions on such metals which are detrimental to subsequent soldering or welding operations. Salt baths embodying cyanides produce highly poisonous fumes and salt baths embodying nitrates and nitrites are highly oxidizing and have only restricted use.

It is one object of my invention to provide a salt bath for salt bath furnaces which shall not corrode metals treated therein, which shall not develop poisonous fumes in use and which shall not be of oxidizing nature. It is another object of my invention to anneal metals in such salt bath.

I have found that an excellent salt bath for salt bath furnaces is produced by an aqueous mixture of boric acid and sodium fluoride in the proportions of 55% to 71% boric acid and 45% to 29% sodium fluoride. A reaction occurs in the mixture which is exothermic, evolving considerable heat, and produces a hydrated polyboric acid compound, probably tetraboric acid and pentaboric acid, containing water as a constituent thereof. The compound also seems to contain sodium fluoride as a constituent thereof. When heated the reacted mixture quickly loses any excess of water, but the water which is contained in the boric acid compound as a constituent thereof is released only slowly and gradually and only in part. The reaction takes place spontaneously at room temperature if the mixture is subjected to a thorough grinding procedure. The reaction also takes place without the necessity of thorough grinding when the mixture is heated to a temperature of about 110° C. to 120° C. and more, whereafter the reacted mixture is cooled.

The salt bath mixture has a definite melting point ranging, in accordance with its composition, from about 843° C. to 715° C. The molten mass has a high liquidity and fluidity, a factor of great importance in producing a successful operative salt bath for salt bath furnaces. Likewise, such mass has a low surface tension. The liquidity and fluidity gradually decrease with an increase in the boric acid content.

Salt baths produced from mixtures of 55% to 71% boric acid and 45% to 29% sodium fluoride solidify to a salt cake with a definite crystal structure, whereas masses produced from other mixtures of boric acid and sodium fluoride solidify as a transparent glassy mass and do not have a definite melting point.

In the salt bath according to my invention there is produced a weak acid reaction, rather than an alkaline reaction as heretofore, and no corrosion of metals takes place during the annealing. The liquid salt bath according to my invention also has an excellent cleaning effect upon the material annealed therein. Harmful alkaline films are entirely eliminated and no poisonous fumes are developed. In view of the high liquidity and fluidity of my salt bath mechanical losses in using such bath are kept at a minimum. Oxidation or other contamination of the object being annealed is prevented due to the nature of my salt bath composition.

My salt baths can be utilized in the annealing of ferrous as well as non-ferrous metals and metal compositions and is suitable for the annealing of brass, copper, aluminum, steel, stainless steel, and other metals of base metal nature as well as in the annealing of precious metals such as silver, gold, platinum, etc. The object to be annealed in my salt baths may be in the form of sheet, wire or any other suitable shape. The salt bath furnace, containing the molten salt bath according to this invention, may be operated electrically or may be fuel fired.

The term "metal" as herein used shall include not only metals as such but also alloys and other metal compositions or combinations, and the term "annealing" shall also include any other form of heat treatment.

The hydrated complex polyboric acid compound salt bath is best produced by first mixing together, preferably in a mortar or grinding machine, the sodium fluoride and boric acid in the specified proportions and then adding the proper amount of water. Thus about 35 to 45 cc. water may be added to 100 grams mixture according to my invention of sodium fluoride and boric acid to result in the desired hydration. Since boric acid does not readily wet water, there may be added to the water a trace of wetting agent. The

liquid crystallizes while evolving heat to result in a hard mass which is then ground into a thin paste. The mass may also be produced by dissolving sodium fluoride in hot water and then adding boric acid, the hydrated complex polyboric acid compound crystallizing after cooling. For instance, a mixture of commercial boric acid, dehydrated commercial sodium fluoride, and 750 cc. water containing a trace of Lamepon A as wetting agent, is finely ground until the mass is transformed into a thick gray liquid which on standing turns itself by crystallization into a white mass which is then thoroughly ground and thereby transformed into a smooth paste.

The salt bath for salt bath furnaces, according to my invention, may also be produced by fusing a mechanical mixture of boric acid and sodium fluoride, in the specified proportions, without the addition of water, as technical boric acid and sodium fluoride contain a sufficient quantity of water for the formation of the hereinbefore described reaction product.

What I claim is:

1. A salt bath for salt bath furnaces, comprising a reaction product of a mixture of 55% to 71% boric acid and 29% to 45% sodium fluoride.

2. The method of annealing metal at a temperature in excess of 700° C. comprising heat treating said metal in a molten salt bath consisting of the reaction product of a mixture of 55% to 71% boric acid and 29% to 45% sodium fluoride.

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