

UNITED STATES PATENT OFFICE

1,923,955

ALLOY

Walter C. Smith, Maplewood, N. J., assignor to
Allied Process Corporation, New York, N. Y., a
Corporation of New York

No Drawing. Application November 16, 1931
Serial No. 575,468

3 Claims. (Cl. 75—1)

In my United States Letters Patent No. 1,812,992 I have disclosed a process of refining copper by the addition thereto of small amounts, e. g. from about 0.00018% to about 0.04% of metallic lithium based on the weight of the copper treated. It is indicated in said patent that any unconsumed excess of lithium left in the copper is detrimental to its electrical conductivity. My United States Letters Patent No. 1,812,993 relates to another method of refining copper in which for the purpose of saving lithium and perhaps, in some instances, also improving the refining of the copper, it is subjected to a preliminary refining with an agent such as phosphorus and then treated with lithium. In this patent it is noted that a sufficiently small amount of lithium left in the copper does not appreciably reduce its electrical conductivity. These statements regarding the effect of lithium in the refined copper are inconsistent, but it will be appreciated that the statement in Patent No. 1,812,993 is an erroneous conclusion based upon the observation of the effects of quantities of lithium which were as a matter of fact detrimental, while the statement in Patent No. 1,812,992 is a conclusion based upon a closer observation of the effects of smaller and harmless quantities of lithium. Now I have found that within certain limits the presence of lithium in the copper actually increases its electrical conductivity and the present invention embraces such additions and the lithium-containing copper product so obtained. The invention embraces or is independent of any particular method of adding the lithium to or incorporating it in the copper, whether in the refining of copper by the use of lithium alone, as disclosed in my Patent No. 1,812,992, using the necessary excess over that consumed as refining agent, or in the refining of copper with lithium in conjunction with the use of another refining agent, such as phosphorus, as disclosed in my Patent No. 1,812,993, here also adding the required excess of lithium, or in any other suitable refining process capable of operation, so that a predetermined amount of lithium is left in the copper, or simply by the direct addition of lithium, not as refining agent but as alloying agent to the copper. Since the amount of the lithium addition is relatively very small and the lithium content of the copper must be regulated within rather narrow limits, the addition of the lithium, not as refining agent and in excess, but as alloying metal to copper which is free of lithium, and of impurities capable of consuming the lithium, has the advantage that

it permits accurate predetermination of the lithium content of the finished metal. Otherwise it frequently becomes desirable in practice to approach the desired lithium content by small successive additions and measurement of the lithium content of samples of the metal until the desired lithium content is arrived at. It is, of course, also possible to determine fairly accurately the necessary lithium addition when part of it is to be consumed as refining agent by tests upon a small sample of the batch of metal. Also one may add an excess of lithium to a batch of copper and then bring the lithium content down to the desired figure by dilution with pure copper. Or the copper may be refined with lithium in accordance with either of my patents above referred to and thereafter the desired quantity of lithium added for the purpose of increasing conductivity in accordance with the present invention. It will be appreciated that refining copper with lithium ordinarily increases its electrical conductivity and the addition of alloying lithium to the copper in proper quantity also increases its electrical conductivity. These two effects of the addition of lithium to copper are not to be confused with each other.

Ordinary commercial copper has an electrical conductivity of about 58 to 58½. The conductivity may be increased to 59 or 60 by a suitable content of lithium: The lithium content of the copper is best determined by spectrum analysis. Starting with mechanically worked, i. e. rolled or drawn copper having a conductivity of 58, and adding lithium in small increments so that it appears in the finished metal and is not consumed as refining agent, the conductivity gradually increases to a maximum of 60, when the lithium content reaches 0.01% and then gradually decreases to 58 again, when the lithium content reaches a point slightly greater than 0.02%. At 0.03% the conductivity is reduced to 56. With cast copper having a conductivity of only 46 the conductivity rises sharply with lithium content up to a conductivity of 60 at a lithium content of 0.01% and then falls with further increase in lithium content at the same rate as in the case of worked copper. A lithium content as low as .002% is effective, producing a definite measurable increase in conductivity while a lithium content of .02% is permissible in the case of worked or drawn copper which in the pure refined state has a conductivity of 58 or even 58½. In the case of cast copper a lithium content as high as .07 is effective in improving its initial conductivity of 46.

The increase in conductivity of copper produced

by the small additions of lithium described is surprising in view of the reduction of conductivity produced by the presence in the copper of other metal additions or alloying agents.

- 5 The lithium is best incorporated in the copper in the form of an alloy thereof, such as a copper-lithium alloy containing 2% of lithium. Such alloy is stable against oxidation and formation of lithium nitride which is detrimental to the copper. Both lithium and high lithium alloys have
- 10

the fault that they react rather strongly with the oxygen and nitrogen of the air.

I claim:

1. An alloy of copper and lithium having a lithium content of from .002% to .03%.
2. An alloy of copper and lithium having a lithium content of from .002% to .02%.
3. An alloy of copper and lithium having a lithium content of about .01%.

WALTER C. SMITH.

80

85

15

90

20

95

25

100

30

105

35

110

40

115

45

120

50

125

55

130

60

135

65

140

70

145

75

150