Aug. 2, 1938. A. R. MacGREGOR 2,125,680

ALLOY

Filed June 10, 1936

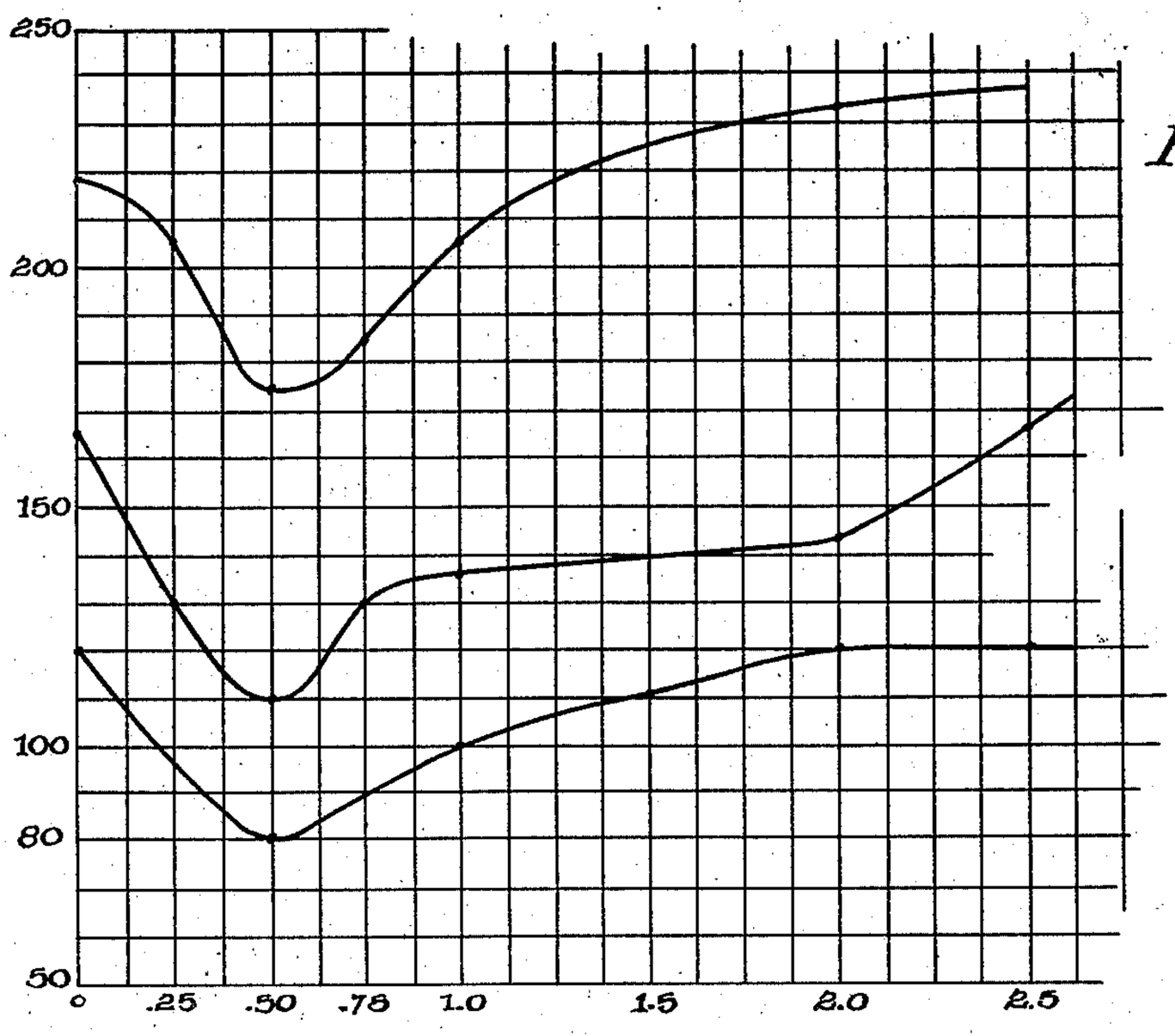

Fig. 1.

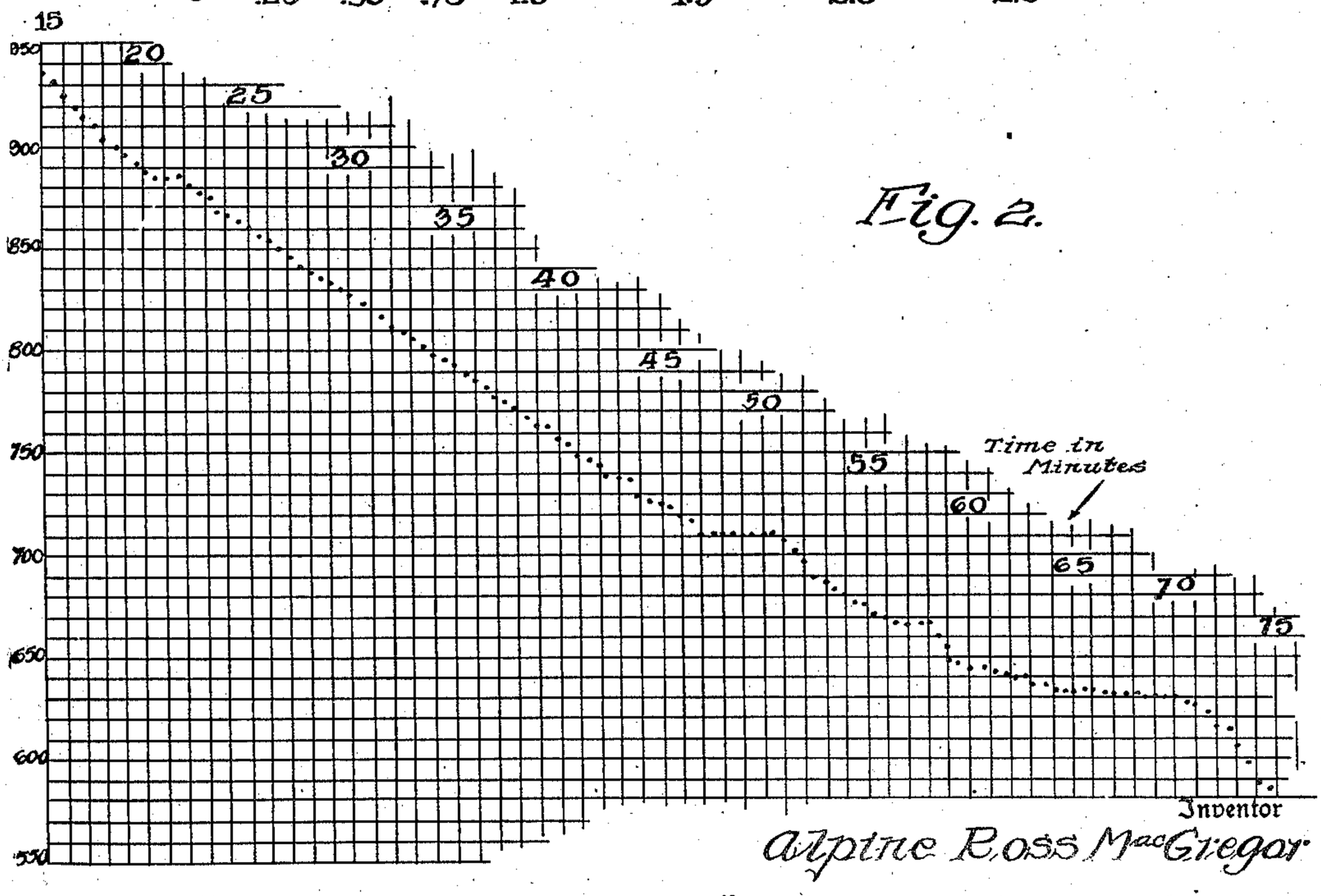

Fig. 2.

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2,125,630

ALLOY

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1 Claim. (Cl. 75—154)

My invention relates to copper base alloys suitable for use in welding, brazing, and soldering, and relates particularly to ternary alloys of copper, phosphorus, and tin adapted to be used for such purposes.

An object of my invention is to provide an improved alloy for the purposes set forth hereinabove.

A second object of my invention is to provide copper-phosphorus alloys having improved physical properties.

Another object of my invention is to provide an improved alloy containing copper and phosphorus, and adapted to use in welding, brazing, filling, and similar processes.

My invention has for other objects such other advantages as are found to obtain in the alloys described and claimed herewith.

It is well known that eutectic alloys generally have a relatively high degree of fluidity at temperatures above their melting points. Eutectic alloys of copper and phosphorus, for example, exhibit this characteristic to a marked degree, and such alloys have been used in the past for brazing, welding, and similar purposes. However, it has been found that the brittleness and low ductility of these alloys makes them unsatisfactory when ductile welds are desirable.

I have found that the addition of tin in the proper proportion to alloys of copper and phosphorus results in the formation of alloys having marked fluidity and at the same time possessing unusual ductility and softness. More specifically, I have found that alloys comprising copper, phosphorus, and tin, in which the percentage of phosphorus is less than or does not materially exceed that in the eutectic composition (about 8.3 per cent) and containing tin in amounts less than 1 per cent, are very satisfactory for use as welding or brazing media. These alloys result in a melt having high fluidity at the temperature of application, and form a weld or filling having unusually high ductility and softness, which allows them to be readily peened, machined, or otherwise dressed in the weld, or elsewhere. My alloys, furthermore, produce a strong, dense weld or braze capable of resisting high pressures, both gaseous and liquid.

As stated hereinabove, my preferred alloys of copper, phosphorus, and tin contain not more than about 8.3 per cent phosphorus, and I have found that a phosphorous content of about 6.5 to 7.5 per cent is especially desirable for general use for the purposes indicated. The use of tin in suitable proportions in accordance with my invention is also advantageous with copper alloys containing higher and lower percentages of phosphorus, however, and I have found that especially ductile welds are obtained by the use of an alloy containing about 4 or 4.5 per cent phosphorus. With alloys of this type having a phosphorous content ranging up to about 8.3 per cent, I have found that the most effective tin addition is about 0.5 per cent, and that in substantially all cases the maximum ductility is obtained by the addition of this amount of tin. Good results are also obtained by the addition of tin in amounts from about 0.25 per cent to about 0.75 per cent, but additions of tin in amounts less than about 0.2 per cent or more than about 0.85 per cent have relatively little effect on the ductility of the alloys as compared with additions within my preferred range. In fact, larger additions of tin may result in alloys having greater hardness and lower ductility than alloys of similar phosphorous content to which no tin is added, as shown hereinbelow.

The effect of tin on phosphorus-copper alloys is illustrated in the following tables, which give the Brinell hardness values of alloys, containing constant phosphorous proportions, as stated, varying amounts of tin, as stated, and the remainder substantially copper.

Table I

Per cent phosphorus	Per cent tin	Brinell hardness
4.0	0	120
4.0	0.5	80
4.0	1.0	100
4.0	1.5	110
4.0	2.0	120
4.0	2.5	120

Table II

Per cent phosphorus	Per cent tin	Brinell hardness
7.0	0	166
7.0	0.25	130
7.0	0.50	110
7.0	0.75	130
7.0	1.00	136
7.0	2.00	143
7.0	2.50	166

Table III

Per cent phosphorus	Per cent tin	Brinell hardness
8.3	0	219
8.3	0.25	206
8.3	0.50	175
8.3	0.75	184
8.3	1.00	206
8.3	2.00	232

The above values are plotted in Fig. 1 of the accompanying drawing. Entirely similar results

are obtained when other percentages of phosphorus within the preferred range (from about 2 per cent to about 8.3 per cent) are used.

In addition to their improved ductility, I have also found that alloys of my preferred compositions have melting points considerably lower than that of the eutectic copper-phosphorus alloy, and are therefore more readily employable for welding, brazing, soldering, filling, and the like. For example, I have found that the ternary alloy containing 7 per cent phosphorus and 0.5 per cent tin with the remainder substantially copper begins to melt at approximately 631° centigrade, with pronounced periods of arrest in the cooling curve at approximately 634°, 663°, and 709°, being entirely liquid at about 885° centigrade, as shown in Fig. 2.

I have successfully used alloys described hereinabove for welding and brazing ferrous and non-ferrous parts by both the electric arc and the gas flame methods, for joining brass, bronze, and copper tubes and sheets, and for the repair and filling of cast objects, both copper base and iron base. However, due to the unique properties of these alloys they are adapted to many uses, and it is not my intention to limit their application to any particular form or to any particular purpose.

The alloys constituting my present invention may be prepared by processes analogous to those known to the art for the manufacture of other alloys. For example, I may melt phosphor-copper or a mixture of phosphor-copper and copper having the desired phosphorus content with the correct amount of tin, or I may melt the tin and copper together and then add the phosphorus. The resulting alloy in either case is then cast, drawn, rolled, or otherwise fabricated, into welding rods, electrodes, or other desired forms. It is generally more convenient to employ the alloy in such forms, but in any case a remarkably strong, dense, ductile weld is formed by the use of my alloys because of their fluidity, ductility, searching power, and strong adhesion to other metals.

I am aware that alloys of copper and phosphorus are known to the prior art as welding and brazing media, as disclosed, for example, in U. S. Patents 1,652,107 to Eschholz and 1,651,709 to Jones. I am also aware that ternary alloys of copper, phosphorus, and tin have been developed in the past, and such alloys, which are generally of the type known as phosphor-bronzes, have many uses. They have been used for welding, but do not produce the results obtained with alloys of my preferred composition because of their generally higher tin content and lower phosphorus content. Similarly, my alloys are distinguished from those disclosed in U. S. Patent 1,988,422 to Miller by their characteristically lower tin contents, which produce materially different results as shown hereinabove.

When welding with alloys of my preferred composition, some of the phosphorus is driven out and serves as an efficient deoxidizer, but enough remains to make the weld strong. The tin in the amounts specified overcomes the brittleness which would otherwise result from the presence of phosphorus, and makes it possible to peen or machine the weld, and the presence of tin in combination with the phosphorus makes tinning of the welded joint readily possible.

My new alloys may be employed in welding or brazing copper, iron, and the like without the use of a flux, but when brazing brass or other metals or alloys containing appreciable amounts of zinc I prefer to use a flux of borax or the like, in the manner known to the prior art.

I claim as my invention:

An alloy containing from 2 per cent to 8.3 per cent phosphorus and from 0.25 per cent to 0.75 per cent tin, the balance being substantially all copper.

ALPINE ROSS MacGREGOR.