

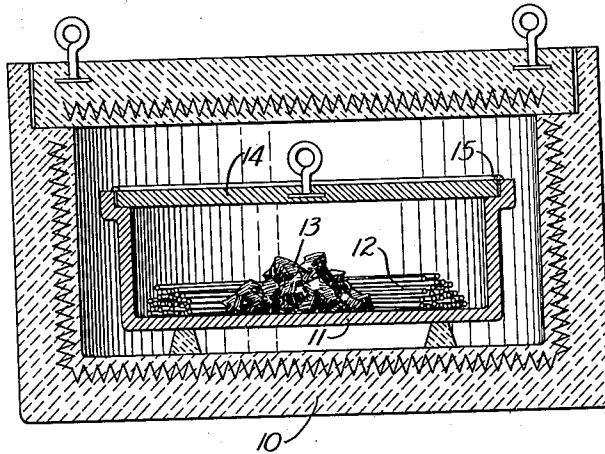
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REFINING OF COPPER

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REFINING OF COPPER

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The present invention relates to improvements in the refining of copper; it is of particular usefulness and finds ready application in the manufacture of copper signaling
5 conductors, particularly such conductors which are to be continuously loaded with magnetic material.

A feature of the invention relates to an improved method of producing conductors loaded
10 with high permeability magnetic material.

The loading material of loaded conductors requires a heat treatment subsequent to its application to the conductor, usually at temperatures ranging between 600 and 1100° C.
15 During processes of manufacture of copper wire and loading material, a certain amount of carbonaceous or other matter finds its way on to the conductor and loading material. During the heat treatment there is ordinarily
20 present in the heating chamber a certain amount of reducing agents, generated either by the incomplete combustion of the carbonaceous matter or by the incomplete combustion of the fuel heating the chamber, or due
25 to other causes. Copper usually contains a small proportion of oxygen, mostly in the form of oxides around the crystal boundaries. When copper is subjected to temperatures in the range above mentioned, the reducing agents diffuse into the copper and
30 combine with the oxygen to form water in the form of steam. This steam causes a dislocation of the crystals and thus the copper becomes embrittled.

35 An object of this invention is to provide a simple and convenient method of producing a deoxidized non-embrittling copper of good ductility.

It is known that if copper containing oxygen is heated in such gases as hydrogen, coal
40 gas, illuminating gas, and other gases containing reducing agents, at temperatures up to about 950° C., the copper becomes embrittled; it is also known that if such embrittled
45 copper is heated in a reducing atmosphere at temperatures of about 1000° C., the copper will have its original properties at least partly restored, while at the same time it is deoxidized. While the heating of copper in a
50 hydrogenous atmosphere at high tempera-

tures is possible on a laboratory scale, the exposure of a vessel containing such explosive gases as hydrogen, coal gas, illuminating gas, etc., to temperatures around 1000° C. on a commercial scale is fraught with considerable danger, inconvenience and expense. 55

In accordance with the present invention, the advantages of heating copper in a reducing atmosphere may be attained, while at the same time the dangers, inconvenience, and expense are avoided. 60

Application is made of the discovery that if copper containing oxygen is heated for sufficient length of time at a sufficiently elevated temperature in a closed vessel in the presence
65 of such substances as coal or charcoal the copper becomes deoxidized and at the same time the disrupted crystal structure of the copper is partially corrected, so that after proper mechanical working a ductile material is produced which may be subsequently
70 heated in a reducing atmosphere without having its desirable properties impaired. The deoxidizing of the copper is caused by the presence of gases produced by the heating of
75 the carbonaceous matter or by the distillation of the carbonaceous materials.

In producing loaded conductors difficulties have been encountered in the past due to the presence of carbonaceous materials such
80 as oils or greases upon conductors which were to be heat treated after loading in order to develop the desired magnetic properties in the magnetic material upon the conductor. In order to sweep out reducing gases and prevent them embrittling the copper conductor
85 inert gases such as nitrogen have been caused to flow through the heat treating vessel. Furthermore, efforts have been made to employ spacing materials such as paper and
90 other organic substances to space the magnetic material from the conductor. These spacing materials were subject to decomposition with resultant embrittling of the conductor. 95

By selecting copper, made in accordance with the present process or any other process, which is not subject to embrittling, no precautions relative to eliminating oils, greases, etc., or their effects need be used and 100

the difficulties involved in using organic spacing materials may be ameliorated.

One method of treating copper will be described in connection with the accompanying drawing.

5 In the drawing is shown a furnace 10 of the electric resistance type by means of which the temperature inside the furnace may be easily controlled. The furnace encloses a
10 vessel or pot 11 containing the copper to be treated in the form of a coil of wire or coiled bar 12, as well as the deoxidizing agent 13 having here the form of charcoal. A suitable proportion is about 1 lb. of charcoal for
15 every 10 lbs. of copper. The cover 14 of the pot is luted by means of fireclay 15. The pot and contents are heated for about 1 hour at a temperature of about 1000° C. The power is then cut off and the furnace and contents
20 allowed to cool to room temperature, which normally takes about four hours. The wire is then removed from the pot and cold worked by passing it through rolling mills or wire drawing benches, rolled in reels, reinserted
25 in the furnace and again heated in the presence of the same amount of fresh charcoal, at the same temperature for the same length of time. This treatment is productive of a tough annealed copper wire which may be
30 subsequently drawn or rolled to desired sizes, and which may be heated in any reducing atmosphere either before or after being loaded with magnetic loading material without becoming embrittled.

35 What is claimed is:

In manufacture of loaded cables in which a copper conductor is first surrounded by loading material and the loading material is thereafter annealed in situ thus subjecting
40 the copper to the action of vaporized oils or other reducing agents which tend to embrittle the copper, the method of inhibiting such embrittling which comprises first heat treating the copper conductor in a closed vessel in
45 which the distillation of carbonaceous materials is effected to deoxidize the copper, subjecting the copper conductor to mechanical working, and subsequently reheating said conductor in the presence of carbonaceous material at a temperature sufficient to produce
50 recrystallization of its structure and to render it highly ductile.

In witness whereof, I hereunto subscribe my name this 23rd day of November, 1928.

55 VICTOR E. LEGG.