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METHOD OF PREPARING UNREFINED COPPER ELECTRODES

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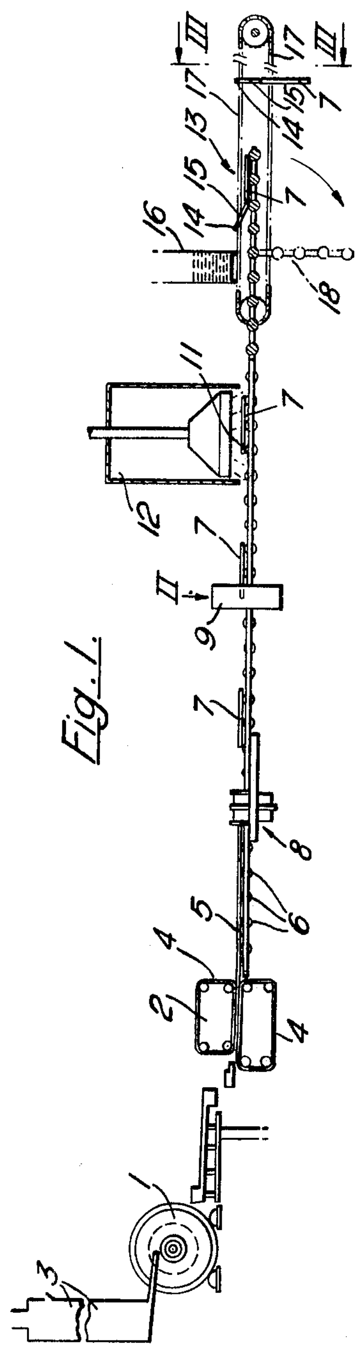

Fig. 1.

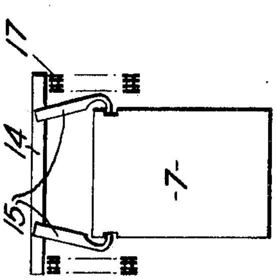

Fig. 3.

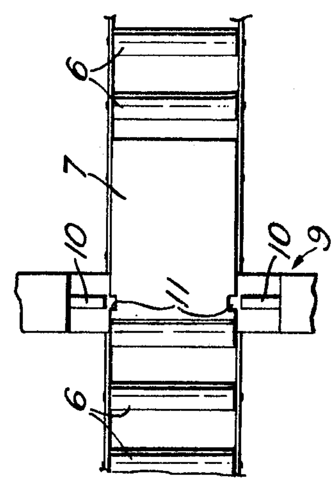

Fig. 2.

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METHOD OF PREPARING UNREFINED COPPER ELECTRODES

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ABSTRACT OF THE DISCLOSURE

Unrefined copper electrode for use in the process of electrolytically refining copper are prepared in quantity by forming an unrefined copper strip of indefinite length by a continuous casting process and cutting the strip into electrode lengths as it issues from the casting apparatus such that electrodes having a high superficial area are formed. Suspension means are attached to the electrodes thus formed and the electrodes are conveyed to storage while suspended from the suspension means.

This invention relates to the method of refining copper in which plates of the metal to be refined form electrodes in an electrolytic cell, usually containing an aqueous solution of copper sulphate acidified with sulphuric acid. The invention is concerned both with the parallel process and with the series process. In the parallel process the plates of copper to be refined form the anodes and are suspended in the electrolyte alternately with thin cathode plates, customarily of pure copper, and a direct current is passed from the anodes through the electrolyte to the cathodes. Copper is dissolved from the anodes and is carried to and deposited on the initially thin cathode plates. In the series process no thin sheets are used for cathodes but the direct current travels from each plate through the electrolyte to the next in line and so forth from one end of the bath to the other. In this way copper is dissolved from one side and deposited on the other side of each electrode.

Anodes for use in this parallel process and electrodes for use in the series process will hereinafter be referred to collectively as "unrefined electrodes."

If satisfactorily pure copper is to be deposited, the rate of deposition is limited to such an extent that it may take weeks for complete dissolution of the immersed electrodes. Consequently, for any substantial production of refined copper large numbers of large baths are required, involving heavy capital expenditure on plant and buildings. To keep this expenditure as low as possible, it is the practice to make the unrefined electrodes of as high a superficial area as is practicable and to pack them as close together as is possible without their coming into contact with one another or with the interleaved cathode plates and creating a short circuit. The term "superficial area" as used herein means the area of one face of the electrode, i.e., its length times its breadth.

At present unrefined electrodes for this process are made by casting them individually in open moulds and the unrefined electrodes of the highest superficial area that have been used satisfactorily are about 42" x 45" (107 cm. x 114 cm.) as larger sizes of plate cannot be cast without risk of warping and warping is undesirable because warped plates must be spaced apart further than flat plates. Consequently hitherto, any economies obtainable by increasing the superficial area of unrefined electrodes have been off-set by the greater length or number of the refining tanks and the buildings to accommodate them.

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Objects of the present invention are to provide an improved process of electrolytically refining copper in which the copper to be refined is formed into large electrodes that is to say electrodes having a high superficial area, preferably of at least 8 square feet or 0.75 square metre, and in which the electrodes can be formed by a continuous process from copper which is less refined than is the copper at present used for casting electrodes in open moulds, for example blister and/or scrap copper.

The method in accordance with the invention comprises forming a copper strip of indefinite length by a continuous casting process, cutting this strip into lengths such that plates having a high superficial area, preferably of at least 8 square feet or 0.75 square metre, are formed, immersing the cut lengths as electrodes in an electrolyte solution and passing a direct current through the electrolyte to cause copper to be dissolved from the unrefined electrodes and deposited as pure copper.

The shearing of the continuously cast plate is preferably done whilst the copper is hot and no further shaping is normally needed other than that entailed in the provision of supporting means for the unrefined electrodes. Should, however the shearing operation cause a slight distortion of the plate this can readily be removed by rolling.

Owing to their method of manufacture, the unrefined electrode plates so formed have flatter and smoother surfaces and are more accurate in all their dimensions than electrodes cast in conventional open moulds and can therefore be satisfactorily used in larger sizes than is economically possible with electrodes cast individually in open moulds and/or they can be packed closer together than such electrodes, thus reducing the superficial area of the bath and/or the consumption of power for a given output of refined copper.

Since the continuous casting process enables sufficiently smooth plates to be formed from copper that has not been fully fire refined, e.g., scrap or unrefined blister copper, the method in accordance with the invention has the important advantage that some refining step or steps can be reduced in or omitted from the usual method of preparing copper for casting such electrodes. In our preferred process, the continuous casting apparatus is continuously fed with molten copper obtained simply by continuously melting blister or scrap copper or a mixture of blister copper and scrap copper.

The conventional method of suspending heavy unrefined electrodes is by means of integrally cast lugs which project transversely from two adjacent corners of the electrode. In the method in accordance with the present invention the unrefined electrodes can be supported by any convenient means, for example lugs may be attached to the plates as by rivetting, but we prefer to suspend the electrodes from a bar by means of rivetted straps or hooks passing through holes or into notches formed in the upper part of the plate. Suitable holes or notches can conveniently be punched in the plates while they are being sheared or before or immediately after they have been sheared from the continuously cast strip and while they are still hot. An advantage of the bar and hook assembly is that it is reusable.

The invention will be further illustrated by a description by way of example with reference to the accompanying diagrammatic drawing of our preferred method of making electrodes for electrolytic refining. In the drawing,

FIGURE 1 shows in diagrammatic form the apparatus used for casting the plate, cutting it into anode lengths, shaping the lengths for suspension and suspending them for transfer to store prior to loading the electrolytic bath,

FIGURE 2 is a plan in the direction of the arrow II in FIGURE 1 of part of the apparatus and

FIGURE 3 is a sectional elevation on the line III—III in FIGURE 1 of another part of the apparatus.

Referring to the drawing, molten copper is fed from a rotary holding furnace **1** into a continuous casting machine **2**. The holding furnace **1** is supplied continuously with molten copper by a continuous, gas fired, shaft type melting furnace **3**, for example that made by the American Smelting and Refining Company in accordance with their U.S. Patent No. 3,199,977. The molten copper flows continuously through the holding furnace **1**, the function of which is to provide an even flow of copper to the casting machine **2** independent of variations in the output of the furnace **3**.

The furnace **3** is fed with blister copper and/or scrap copper, thus avoiding the normal refining steps which precede the casting of copper as anodes, i.e., blowing with air and poling with green timber.

The continuous casting machine **2** is of the kind, for example that known under the trademark Hazelett as the Hazelett No. 14 Strip-casting machine, in which the major surfaces of the mold are formed by a pair of power driven water cooled endless metal belts **4**. The machine produces continuously a strip **5** of copper 42–45 inches (107–114 cm.) wide. The thickness of the strip may vary from 2 inches to ½ inch or less (5 cm. to 1.3 cm.), thinner strip generally being preferred for the series process and thicker for the parallel process.

The continuous strip **5** of copper leaving the machine **2** passes over rollers **6** and is cut into 4–6 ft. (112 cm.–183 cm.) lengths **7** by a flying shear **8** which itself moves at the same speed as the strip **5** during the time it is actually making the cut. The cut length of copper **7** is accelerated away from the shear by the rollers **6** to a fixed position where it is stopped within an hydraulic press **9** and tools **10** are pressed into each edge near one end to form notches **11**. After shearing and punching the plates are cooled in a cooling chamber **12** in which cooling is effected by water sprays. The water sprays will generally remove any surface scale from the plates but, if necessary to remove residual surface scale, the plates can be brushed after cooling, for example by a mechanical rotary brush (not shown).

Alternatively, the press **9** may be associated with and moved with the shear **8** so that the tools **10** are pressed into the strip during the shearing operation.

The plates then move in succession to the end **13** of the roller conveyor where copper bars **14**, longer than the width of the plate and each provided with two rigid hooks **15**, are lowered over them from a bar feeder **16** in such a way that the hooks engage the notches **11** and the ends of the bar rest on a power driven chain conveyor **17**. Each time a plate **7** reaches the end **13** of the roller conveyor and its notches **11** have been engaged by a pair of the hooks **15** the end **13** of the conveyor pivots downwards to the position **18** (shown dotted), leaving the plate **7** suspended from the hooks of the bar and each end of the bar resting on the chain conveyor **17**. The unrefined electrodes are conveyed to storage by the conveyor **17** prior to being transferred to an electrolytic bath (not shown), in which they are refined either by the series or by the parallel process.

What I claim as my invention is:

1. In the process of electrolytically refining copper which comprises immersing unrefined copper electrodes in an electrolyte solution and passing a direct current through the electrolyte to cause copper to be dissolved from the unrefined electrodes and deposited as pure copper, the improvement which comprises the steps of:

(a) forming an unrefined copper strip of indefinite length by a continuous casting process;

(b) cutting the strip into electrode lengths as it issues from the casting apparatus such that electrodes having a high superficial area are formed, and

(c) attaching suspension means on the unrefined electrodes thus formed so that the electrodes may be conveyed while suspended from said suspension means.

2. In the process of electrolytically refining copper which comprises immersing unrefined copper electrodes in an electrolyte solution and passing a direct current through the electrolyte to cause copper to be dissolved from the unrefined electrodes and deposited as pure copper, the improvement which comprises the steps of:

(a) forming an unrefined copper strip of indefinite length by a continuous casting process;

(b) cutting the strip into electrode lengths as it issues from the casting apparatus such that electrodes having a high superficial area are formed;

(c) moving the cut lengths successively through apparatus which forms suspension apertures in the lengths; and

(d) ataching suspension means to the unrefined electrodes thus formed so that the electrodes may be conveyed while suspended from said suspension means.

3. A method as claimed in claim **2**, in which the suspension apertures are punched in the hot strip while it is being sheared.

4. A method as claimed in claims **2** or **3**, in which the suspension apertures are notches formed by punching opposed edges of the strip.

5. A method as claimed in claims **1** or **2**, in which the copper strip is cut into lengths such that unrefined electrodes having a superficial area of at least 8 square feet are formed.

6. A method as claimed in claims **1** or **2**, in which the copper strip is formed by feeding a continuous casting apparatus with copper selected from blister copper, scrap copper and mixtures thereof to produce the copper strip.

7. A method as claimed in claims **1** or **2**, in which the copper strip is sheared into lengths while still hot such that the electrodes are formed without further shaping other than that entailed in the provision of the suspension means.

8. A method as claimed in claims **1** or **2**, in which the electrode lengths are cooled before attaching the suspension means.

9. A method as claimed in claim **8**, in which the electrode lengths are brushed after cooling and before attaching the suspension means.

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