Electrolytic Production of Copper Tubes

Manufacture of Copper Sheets, Tubes and Wire Direct from Impure Copper by Electrolysis. Various Early Methods. A Practical Method Devised by the Writer. Relative Cost of Different Processes. Abstract of Paper Given Before The Institute of Mechanical Engineers at Bristol, Eng., July, 1908.

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This article is limited to the description of the production of copper sheets, tubes and wire by electrolysis from impure copper.

The methods described are all based on the work of Davy and the law of electrolysis established by Faraday in 1833, namely, that when a current of electricity is passed through a solution containing metallic salts and two or more electrodes, one of which is soluble in the solution, a known quantity of metal is transferred from one electrode to the other for a given quantity of electric current; that is to say, if the soluble electrode (the anode) is connected to the positive pole, and assuming the metal and the electrolyte employed to be pure, a weight of metal will be deposited upon the cathode connected to the negative pole, corresponding to the amount dissolved from the anode. If the anode is of impure metal many difficulties are introduced, and if the current is increased to a sufficient density to enable the metal to be deposited at such a rate as will give commercial results, other serious difficulites arise. Electro-metallurgists have been working for thirty years or more devising methods to overcome the difficulties experienced in applying Faraday's law to the commercial production of copper tubes, sheet, and wire from comparatively impure copper having the physical properties of wrought copper, when deposited at a sufficiently rapid rate.

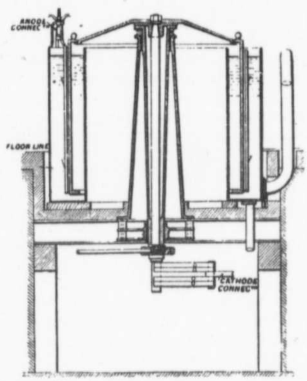

Fig. 1—Vat Used for Centrifugal Process.

The refining of copper by electrolysis has now assumed vast proportions, and the annual output of electrolytic copper in the year 1907 has been estimated at 400,000 tons, equal to 56 per cent. of the world's production, and the capital sunk in the industry at about £15,000,000. The whole of the copper thus produced is in the form of rough slabs or cathode plates which have to be smelted and worked to the desired forms.

Electro-metallurgists have been striving for many years to devise a process which does away with the smelting of copper after it has been electrolytically refined, and to electro-deposit copper after the refining operation in such a form that it can be placed direct on the market as finished sheets, tubes and wire.

Wilde's Process.

It was observed shortly after Elkington practically applied Faraday's law to the refining of copper in the year 1865, that the electric current density, or the rate at which the copper is deposited, could be considerably increased by circulating the electrolyte or moving the electrodes. It was soon found that circulating the electrolyte alone was unsatisfactory, and that the best results could be obtained with a vertical mandrel revolved in the electrolyte. Wilde was one of the first to use a cylindrical cathode, his object being to deposit copper on iron rollers suitable for textile printing purposes, for which he took out a patent in the year 1875. The anodes consisted of copper cylindrical tubes, and the iron cylinder to be coated with copper (the cathode) was placed in the centre of the cylindrical vat and caused to rotate on its axis. Such an arrangement, in conjunction with a circulating propeller placed in the electrolyte, ensured an even distribution of copper over the whole of the surface uniformly along the length of the roller by means of the motion imparted to the solution, and the equal density thus maintained. The current density was low, considerably under 20 amperes per square foot.

Elmore's Process.

The next development of importance was the Elmore process, which consists of using horizontal mandrels on which copper sheets or tubes are deposited, while agate burnishers travel continuously over the copper, so as to consolidate it, and at the same time prevent the growth of copper trees or nodules. Even with the use of a burnisher the current density could not be increased beyond 30 amperes per square foot, and the mechanical difficulties introduced by the burnisher are considerable. Large works were erected to operate this process near Leeds, England, and on the Continent, and are principally engaged in the production of large tubes and cylinders for special purposes.

Dumoulin's Process.

Dumoulin introduced, at a later date, a process for burnishing copper during deposition with sheepskin as a substitute for agate, and claimed that the process had also the advantage of insulating any projections that might be formed on the deposited metal, the sheepskin impregnator coating all projecting parts with a thin film of animal fat, thus preventing further deposition until the surrounding depressions are raised to

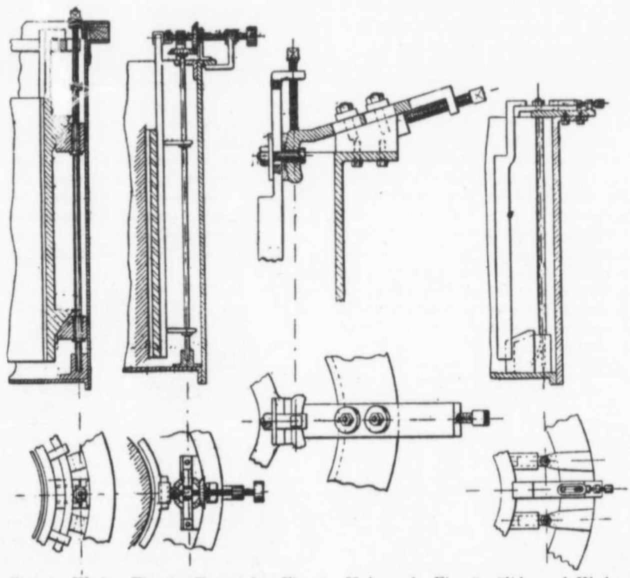

Fig. 2—Wedge Fig. 3—Eccentric and Screw Fig. 4—Universal Fig. 5—Slide and Wedge

Anode Adjustments.