ELECTROLYTIC REFINING OF COPPER.

On the banks of the Raritan River and on the outskirts of the thriving town of Perth Amboy, N. J., there is located the largest copper-refining works in the world. Here, in the course of every month, some 10,000,000 to 12,000,000 pounds of refined copper are deposited in the Tank House; while the monthly output from the refining furnaces varies from 15,000,000 to 18,000,000 pounds. The Raritan Copper Works are devoted exclusively to the electrolytic refining of the product of the great smelters of the West.

THE FURNACE HOUSE.—The raw product comes to the works in the shape of copper pigs, which measure about 5 inches by 8 inches by 16 inches in length, and whose quality ranges from 95 to 99 per cent pure copper. It receives its first treatment in the Furnace House, which consists of three buildings, the first of which measures 80 x 600 feet and contains four 50-ton anode furnaces and five refining furnaces of the same capacity. The second building measures 80 x 200 feet and contains four 25-ton furnaces; and there is also a blast-furnace building. The anode furnaces, as the name implies, are used for melting down pig copper in order that it may be cast into the large flat plates which form the anodes in the depositing tanks. The copper pigs are charged into large reverberatory furnaces, each charge weighing about 100,000 pounds. After about six or seven hours in the furnace the charge is melted, and then for thirteen or fourteen hours more it is thoroughly worked by methods similar to those used by the puddlers in some systems of iron-making. The effect of the furnace treatment is to work off some of the impurities, the copper being advanced from 98½ per cent of purity to about 99½ per cent. The slags formed in the furnace treatment by the oxidation of the copper and the impurities combined with the silicious materials forming the sides and bottoms of the furnaces float as scum on the surface of the molten metal. It is skimmed off and sent to the blast furnace to recover the 55 per cent of copper which it contains. After eighteen hours' treatment in the anode furnace, the copper is drawn off into a casting machine, which consists of an endless chain of molds, each mold being pivotally carried in and forming part of a conveyer. The taphole of the furnace discharges into a ladle, from which the metal is poured into the mold. This ladle has a transverse tipping motion and is of large enough capacity to hold a charge for one mold, and as much more metal as may run into the ladle while that charge is being poured. The anodes are one inch in thickness, 24 inches in width and 36 inches in depth. Each is provided on its upper edge with two projecting lugs, which extend over the edge of the depositing tank and serve to support the plate in the electrolyte. We present an illustration showing a similar casting machine in operation before a refining furnace, from which wire bars are being cast for the wire mills. The anodes are now loaded upon cars and drawn into the Tank Building. Here they are loaded into frames, each of which holds twenty-two anodes, which is the total number necessary for each tank.

THE TANK HOUSE.—The Tank House contains the whole of the electrolytic plant. It consists of one large building measuring 200 feet in width by 600 feet in length. The main floor space is given up to 1,600 depositing tanks, which are arranged in four groups of 400 each; while in small additions at the end of the main building there are 32 liberating tanks. Four powerful electric cranes for handling the electrodes run the length of the building, each crane serving 400 tanks. The tanks are operated on the regulation multiple system, the tanks arranged electrically in series and the electrodes in each tank are parallel. The latter are about 2 feet wide by 8 feet long, and 3 feet deep, and each contains 22 anode and 23 cathode plates arranged in multiple. They are filled with dilute sulphuric acid and sulphate of copper electrolyte, and with a view to securing a constant circulation of the electrolyte the tanks are arranged in sets, with a solution well and a pump to each set. The liquor is drawn from the bottom of one tank and flows over to the next tank below it, the electrolyte being thus brought in thorough contact with the whole surface of the plates in the series of tanks.

The thin cathode sheets which are used in the depositing tanks are formed in what are known as "stripping" tanks, of which there are one hundred and eighty. The cathodes in the stripping tanks consist of rolled plates of pure copper, smeared with grease or plumbago, with their edges protected against the formation of copper by grooved wooden strips. After the cathodes have been in the stripping tanks for thirty-six hours, they are removed, and the thin sheet of coppper is peeled from the plates, the grease serving to prevent any close adhesion of the surfaces. The thin cathode sheets are then flattened out by beating with wooden paddles, and are hung by means of two thin copper loops, riveted to the plates, from copper rods, the ends of which rest upon the edges of the depositing tank. The anodes as they are brought to the Tank House from the casting furnace, are hung on special iron frames, on which they are so positioned that they will have the proper spacing in the depositing tanks. The traveling crane picks up the frame with its complete set of anodes (twenty-two) and places them in position in the tanks, the total weight of the complete set being between four and five tons, while the twenty-three cathodes together weigh 160 pounds. The action of the current is to transfer pure or practically pure copper from the heavy anode plates and deposit it upon the thin cathode sheets. The latter increase in weight from 6 to 8 pounds to 75 to 80 pounds during the seven days that they are in the tank. At the end of seven days they are withdrawn, loaded onto cars, and taken to the refining furnaces. Fresh cathodes are supplied, until the anodes, at the end of forty-two or forty-three days, have been so reduced as to have to be themselves replaced with fresh anodes.

REFINING FURNACES.—The product of the tanks, in the shape of heavy deposited cathodes, is taken to the 50-ton refining furnaces, where it is melted down and brought to "pitch," that is, to a purity of 99.88 per cent. In the process of melting the copper takes up a certain amount of oxygen, and this is removed by introducing into the bath of molten metal a pole of green wood, the carbon of which combines with the oxygen, and passes off as carbon dioxide. From the refining furnaces the copper is cast into the various forms required by the mills to which the copper is to be shipped. One of our illustrations shows the mechanical conveyor of one of the "wire-bar" furnaces, that is to say, a furnace which is occupied in casting bars of copper for shipment to the wire works. The molten metal flows from the taphole into a ladle and from the ladle is poured directly into the molds, as they are brought successfully beneath it. The molds are pivoted at their ends to the links of a conveyor. After each mold is filled with metal, it is drawn through a bath of water, and then tipped over to discharge its contents. The conveyer is operated by a ten horse power electric motor, and the ladle is operated by a hydraulic plunger which is under the control of the ladler.

TREATMENT OF THE SLIMES.—The first process in the treatment of the slimes is to extract the copper, and this is done by boiling the slimes in concentrated sulphuric acid and blowing air through the liquid during the process. The slimes are then washed, dried and smelted on the hearth of a cupel furnace, and a bullion of gold and silver is recovered. The silver and gold bullion is boiled in large kettles filled with sulphuric acid, where the silver is dissolved and forms sulphate of silver, while the insoluble gold collects on the bottom of the kettle. The sulphate of silver solution is siphoned off into tanks, the bottom and sides of which are lined with copper plates. Here the sulphate is reduced, the silver being precipitated on the copper plates as "sponge silver," which is collected, washed, dried, melted in crucibles, refined, and cast. The gold is collected from the bottom of the kettles and is also washed and refined and cast, the pure silver and gold, thus obtained, being shipped to the Mint.

The power house for the supply of the large amount of current necessary for the depositing of 12,000,000 pounds of copper a month is, as may well be imagined, a large one. The boiler room contains eight 400 horse power and two 200 horse power Babcock & Wilcox water-tube boilers, equipped with the Murphy automatic stoker. The fuel is brought to the boilers and the refuse, ashes, etc., removed by mechanical conveyers. The engine room contains five vertical cross-compound condensing engines, each direct-connected to a General Electric generator, the largest of which delivers 4,500 amperes at an efficiency of 93.5 per cent.

The Current Supplement.

The current SUPPLEMENT, No. 1367, opens with an illustrated description of the "Kronprinz Wilhelm," one of the latest fast ocean steamers. Mr. R. Spoerr describes in an illustrated article "Nurseries for Grapevine Grafts." "Silk and Its Producers" is the title of an instructive article by Mr. R. Lydekker. Prof. David Starr Jordan, president of the Leland Stanford University, who is one of the foremost American zoologists, has an able article upon the "Fish-Fauna of Japan." How armor plate is made is told in a brief article accompanied by engravings. Major P. Cardew continues his popular description of the three-phase electric railway. Diagrams accompany his explanation. The study of the phenomena occurring in the four-cycle gas engine, by means of the manograph, is made the subject of another article. A biography of Mathias Baldwin, the founder of the locomotive industry of the United States, will prove of special interest at a time when the Baldwin Works are celebrating their seventieth anniversary. The usual Consular and Trade Notes will be found in their customary places.

Automobile News.

Bucolic opponents of the automobile have some very queer ideas concerning the operation of motor carriages. An Ohio genius proposes that, in order to prevent the frightening of horses the life-size figure of an equine be attached to the front of every motor vehicle.

Dr. Schatzel, an official connected with the Bavarian Post Office, has recently made an extensive report of the subject of automobiles in the postal service. He is very much in favor of the self-propelled wagons, and predicts a far-reaching revolution to take place upon the general introduction of the motor car in the government postal service.

A Westfield, Mass., firm has recently shipped a gasoline carriage to Cape Town. The names of the persons ordering the machine were not announced, and it is hinted that it was designed for use for scouting purposes by English officers. The order was given, however, after a test in which a number of vehicles of different types were entered.

The Fairbanks Company have within the last few months equipped, throughout, a number of automobile companies, selling them their entire equipment of power, plant, machinery and tools, and taking charge of the erection, the transmission and the complete installation of the same. Their success in this line has led them to form a distinct department for the consideration of this work.

An automobile tire of the single-tube pneumatic type recently placed on the market has a core inserted. This core is molded and vulcanized in halves, each half being a complete ring semicircular in cross section; it is constructed on the truss principle. Even the largest puncture cannot put this tire out of commission, the resiliency of the core keeping the tire in shape after the air has been entirely exhausted. All the wear comes on the outer surface of the tire, which can be made light or heavy, according to the demands made upon it.

A peculiar speed-measuring device for automobiles has recently been patented. The instrument is inclosed in a metal case with a glass front, the whole being as nearly dust and air proof as possible. In the inner case are two fans, the larger one receiving its impulse from the vehicle tire and the smaller one deflected by the air currents set up by the larger fan. The arbor on which the small fan is mounted carries a pointer and is encircled by a hair-spring providing the counter-force. When the speed of the vehicle is to be measured, the roller at the end of the shaft is brought into direct contact with the tire of one of the road wheels.

The minimum of lightness is claimed to have been attained in the 3 horse power runabout now being built by R. H. Metcalfe, of Patchogue, L. I. Its weight will closely approximate 250 pounds, and it will possess a maximum speed of eight miles an hour. A new feature will be the cooling of the motor by means of a funnel underneath the body designed to catch the wind and direct it to the engine. In this connection it may be stated that French designers and builders have become convinced that lightness in a motor vehicle is attained only at the expense of strength, and that all the latest patterns of light pleasure machines are being constructed on heavier lines than heretofore.

The question of the storage of his fuel is one of the most serious questions which confronts the owner of a gasoline automobile. The fuel must be stored around in more or less generous quantities, and when kept within a building there is always risk as well as increased insurance charges. In order to meet these emergencies a cabinet has been devised and manufactured by S. F. Bowser & Company, of Fort Wayne, Ind. It consists of a construction of galvanized metal standing about seven feet high. The lower half contains the gasoline, while the upper part contains the pump, access to the latter being secured through a drop door. The pump is supplied with a measuring device, by which it is possible accurately to gage the amount of gasoline, thus preventing overflow and waste.

The new electric stages running on Fifth Avenue present a very striking contrast to the ancient horse-drawn vehicles which have been such a familiar sight along the avenue for so many years. The new vehicles are of the Riker build, and are known as the Wilkesbarre type. They carry 48 cells of a capacity of 250 ampere hours or a little more. The weight of the batteries is 3,800, and that of the complete carriage 10,350 pounds. They have a traveling radius of about 50 miles and a speed of about fifteen miles an hour, and the Fifth Avenue trip is made with a saving of one-third the time as compared with the horses. Each vehicle has two 5 horse power motors. It is the intention of the company to place in service two larger omnibuses carrying thirty-two passengers. Those now in use carry eighteen.