MANUFACTURE OF STEEL RAILS.—II.

In our first article on the manufacture of steel rails, published in the SCIENTIFIC AMERICAN of April 26, we described the process of smelting the ore, decarbonizing the molten metal in the Bessemer converters, converting it into steel by the introduction of the proper percentage of carbon, and casting it into ingots. The ingots, which weigh 4,500 to 5,200 pounds, are cast in heavy vertical molds, carried on small narrow-gage ingot cars, there being two ingots to the car. After the steel has set the ingots are hauled successively beneath a hydraulic stripping machine, where the molds are drawn clear of the ingots. The latter are then hauled to the pit-heating furnaces, or "soaking pits," in which they are raised to the proper temperature for rolling down into blooms. The "soaking pits" are rectangular, gas-fired furnaces, ranged in a long row from the center of the furnace house. The ingots are charged and withdrawn through the roof of the furnace, the aperture being closed by a horizontally-sliding cast-iron door, lined with fire-brick, which is carried upon four wheels, and runs upon a pair of rails, one on each side of the furnace. The doors are operated by means of hydraulic cylinders. The ingots are lifted from the ingot cars and introduced and withdrawn from the pits by means of the electric traveling-crane, shown in our illustration, which is operated by three electric motors. For lifting the ingots there is a 30 horse power motor; for carrying the crane with its ingots along the runway there is a 20 horse power motor; while the derrick-like structure above the crane is traversed across the crane bridge by means of a 7½ horse power motor.

After the ingot has been heated to the proper point for rolling it is lifted from the pit and placed in a small electrically-operated car, in which it is run down to the rolls. As it reaches the table the car is upset by means of a hydraulic plunger, and the hot ingot is thrown over, end-on, upon the feed rollers, by which it is carried through the rolls. After passing through these seven times it is reduced to a section 9¼ by 9¼ inches, and is about 15 feet in length. It is then carried to the bloom shears where it is cut into two or three lengths, according to the length of rails which are to be rolled. For 60-foot rails it is cut into three lengths of 5 feet each; for 90-foot rails into two lengths of 7½ feet. These short lengths are now known technically as "blooms," and the subsequent process consists in rolling and rerolling the bloom until it is in the form of a finished rail of the exact section and weight desired.

The blooms are now conveyed to the Siemens heating furnace in the rail mill. This transfer is made by means of a bloom-carriage which operates between the bloom-shears and the bloom-reheating furnaces into which the blooms are thrust by the charging buggy, shown in our illustrations. These furnaces extend in a straight line through the building for 150 feet, and on each side and parallel to them there are two sets of tracks. On the track adjoining the furnace doors on the charging side is the bloom-carriage, and on the outer track is the bloom-charging buggy. The bloom-carriage consists of two separate trucks, one built up of T-rails on which the blooms are carried, the other being a motor car operated by a Westinghouse 15 horse power dust-proof motor. The bloom-charging buggy is operated by a 15 horse power motor, and it is provided with a long transverse cylinder which operates a pneumatic plunger. When the train of blooms has been brought opposite the furnaces the doors are lifted and the plunger of the charging-buggy moves forward, thrusting one bloom at a time into the furnace. One attendant operates the bloom-carriage and the electric buggy. He stands in the charging-buggy, and by moving one lever shifts the charging-buggy back and forth in front of the heating furnaces, and by means of another lever he operates the controller and moves the bloom-carriage from the shears to the reheating furnace.

On the opposite side of the furnace is another buggy and a pneumatic-electric withdrawing machine, the latter being entirely similar to the charging-buggy above described, except that instead of the plunger-head it carries a pair of tongs which are operated by compressed air. The withdrawing buggy operates along the back of the furnaces, and draws out the blooms upon an electrically-operated table, which carries them direct to the three-high mill, consisting of roughing rolls, intermediate rolls and finishing rolls. In the roughing rolls the bloom is passed backward and forward through five passes, during which it is brought down roughly to the desired section of rail. It is then run to the intermediate or "short" rolls, where it is again given five passes.

At this point the process known as finished rolling differs radically from the method which has invariably been followed of late years in rail rolling, the improvement being known as the Kennedy-Morrison rail-finishing process. Hitherto it has been customary to put the rail through the finishing rolls immediately after its leaving the intermediate rolls, and in early days when the rails were lighter, and there was a smaller mass of metal concentrated in the head, a very excellent quality of rail, with the proper density and toughness, resulted. For several years past, however, or ever since the weight and section of steel rails have been rapidly increasing, there has been a constant complaint from railroad engineers that the wearing qualities of the rails furnished by the mills a dozen or fifteen years ago were much superior to those of the rails which they are now receiving. After the railmakers had increased the quantity of carbon and other constituents to the highest extent consistent with the securing of other desirable qualities besides hardness in the rail, it was decided that further improvement was to be sought rather in mechanical than in chemical treatment. It was argued that the superior quality of the early rails was due to the fact that, being of smaller section, they cooled more rapidly, and the finishing rolling was done at lower temperature, resulting in a better quality of metal, particularly in the head. Hence, with a view to securing similar results in the large 80 to 100-pound rail now rolled, it was decided to introduce between the intermediate and finishing rolls a cooling table, on which the rails would be allowed to cool down to a certain predetermined temperature before being finished.

The necessary changes were made in the mill, and the cooling table was located a few feet to the right of the main run. It is evident that on account of the greater amount of metal and heat contained in the head of the rail, it will cool more slowly than the base and web. To prevent this, each rail is laid on the cooling table on its side, with its head against the flange or base of the rail in front of it, the exchange of temperature between the adjacent metal being such as to cause the whole body of rails on the table, and every part of each rail, to cool off at approximately even temperature. Each rail remains on the cooling table for from three-quarters to one and a half minutes, at the end of which time it is passed through the finishing rolls and brought down to the exact section required by the specifications. The Kennedy-Morrison system, simple as it is, has worked a revolution in the manufacture of steel rails, the quality having been brought fully back to the high standard which prevailed fifteen or twenty years ago. After leaving the finishing rolls, the rails are carried to the hot saws, where they are cut to the exact length, the rails being cut slightly longer than their finished size in order to allow for contraction in cooling. After leaving the hot saws the rails are passed through the cambering rolls, where they receive sufficient camber, varying with the section, to allow the heat still remaining in the rail to deliver a practically straight rail from the hot-beds to the straighteners' beds.

The Current Supplement.

Chief in importance of the articles of the current SUPPLEMENT, No. 1376, is a fully illustrated description of the famous Carrara Marble Quarries. Other articles of interest are those on the mining and working of gold; lamps, burners and heating apparatus exhibited at the Paris alcohol exposition, and physical and chemical properties of alcohol and petroleum. The telpherage system of electric traction, which is just now attracting wide attention, is described in a well-illustrated account. To those of our readers who may not be sufficiently informed as to the distinctions to be drawn between war vessels of various types, an elementary article on the French Navy should be welcome. Charles L. Heisler describes a novel high-duty pumping engine of 10,000,000 gallons per twenty-four hours. The engine is one of his own design. The application of liquid fuel to battleships and the commercial marine is a subject of growing importance; for that reason an abstract of an admirable paper read before the British Institute of Naval Architects is not out of place. The usual Consular Notes are published. It may not be here amiss to call attention to the fact that a new SUPPLEMENT Catalogue, in which the papers published in the SCIENTIFIC AMERICAN SUPPLEMENT are indexed down to January 1, 1902, has been published, and is now ready for gratuitous distribution.

Severo's Airship Trials.

Severo's airship, an illustrated description of which recently appeared in the SCIENTIFIC AMERICAN, was given a trial in Paris on May 4 at the Vaugirard Aerostatic Park.

Severo ran no risks. He fastened his airship—which rejoices in the name "La Paix"—by means of a rope. Severo rose to a height of 130 feet, maneuvered about for a short time and then returned to his shed. The trials seem to have been satisfactory on the whole. The airship is said to have obeyed its propellers and steering gear, and to have maintained perfect equilibrium.

Severo is no inexperienced aeronaut. For over twenty years he has occupied himself with the problem of flying. In 1881 he carried out some dirigible kite experiments in Natal, capital of Rio Grande du Nord. Like Santos-Dumont, Severo is a Brazilian.

Science Notes.

Evidences of a buried village have recently been reported in Lassen County, California, on the line of what was known in 1848 as "Lassen's Cutoff." The discovery was made by a party of surveyors who camped one evening over the spot, and were led by certain indications to make a search for buried ruins. Digging down a short distance, they were rewarded by finding numerous skeletons and a number of peculiarly shaped dishes, cooking utensils, weapons, etc. It is said an expedition will shortly set out to determine the nature and extent of the discoveries.

The First International Congress for Electricity in Medicine and Radiography, which was held in Paris, was a complete success. More than 150 scientists from all countries were assembled. At that time it was voted to hold an international congress at intervals of three years; but in order to avoid clashing with other conventions, it was resolved that the second congress should be held in 1902 at Berne. The Congress will be opened September 1, 1902, at the Physiological Institute, Buehlplatz, Berne, Switzerland. Papers will be read on the present state of electro-diagnosis, surgical electrolysis, radiography and radioscopy of the internal organs, accidents caused by X-rays, and the danger of industrial electric currents. An international exhibition of all electrical instruments of physiological, electrotherapeutic and radiographical interest will be held.

Mr. E. G. Clayton, of London, has been engaged for some time past examining and analyzing the incrustation upon the exterior masonry of the stone gallery of St. Paul's Cathedral. This stone during the two centuries it has been standing has become very weather-worn, and the gray incrustation with which it is covered is as much as ¾ inch in thickness at places. The composition of this substance analysis reveals to be as follows: Water loss at 100 deg., 2.06; water loss at 150 deg., 22.48; carbon (soot), 1.10; calcium sulphate, 59.38; calcium phosphate, 2.22; calcium silicate, 1.63; magnesium silicate, 0.67; iron silicate, 2.40; sand and uncombined silica, 8.06. The substance is stalagmite in character, chiefly composed of calcium sulphate, hydrated together with some silicious matter. It is probable that the rain and the sulphurous and sulphuric fumes exhaled by the surrounding chimneys combined with the rain are responsible for the calcium sulphate deposit.

In a recent number of Science a method of utilizing fluorine from fertilizing plants is described. When natural phosphates are decomposed by sulphuric acid in the manufacture of superphosphate fertilizers, there is much hydrofluoric acid set free as such or as fluoride of silicon. This is especially the case when apatite is used; indeed, this fact detracts very materially from the value of the immense apatite deposits of Canada. In Germany manufacturers are compelled by law to prevent the escape of these deleterious gases into the atmosphere, and efforts are being made to utilize the waste product. By leading the gases through water, fluosilicic acid is formed, and from this solution sodium fluosilicate or magnesium and aluminium fluosilicates may be readily prepared. The last two have some use in hardening calcareous stone. More recently it has been discovered that fluosilicic acid has strong antiseptic properties, and that as a preservative of manure it surpasses plaster, kainite, or superphosphate of lime. The denitrifying action of bacteria is checked, preventing the loss of nitrogen. The greatest difficulty in the way of its adoption for this purpose is its preparation in suitable form. The aqueous acid in bottles would hardly be acceptable to the farmer, and no satisfactory absorbent of the acid has been found. A patent for a new manure preservative has recently been taken out, in which the fluosilicic acid is incorporated with clay, with the bases of which it for the most part combines. With this powder goes another consisting of a porous substance saturated with sulphuric acid. A small quantity of each powder is scattered over the manure pile, and by the action of the sulphuric acid on the fluosilicates fluosilicic acid is generated, which acts as an antiseptic.

Martinique's Disaster.

Terrible news comes from Martinique. The town of St. Pierre has been completely destroyed by fire, with a loss of life that is appalling. Not only is the town wiped out, but thousands of its inhabitants have perished. The cause of the disaster was the eruption of the volcano Mont Pélée. On the morning of May 9, the crater began to belch forth molten rocks and ashes. Within a radius of four miles, in which district the town of St. Pierre is included, terrible destruction was wrought. The Commander of the French cruiser "Suchet" in a telegram to the French Minister of Marine states that the entire population of about 25,000 persons is thought to have perished. The "Suchet" brought back about thirty survivors. All the shipping in the harbor was destroyed by fire. Further news will be awaited with anxiety.

Engineering Notes.

A petrol motor has been fitted to one of the large boats at Lowestoft, England, employed in the North Sea herring fishing industry. The engine is of 24 nominal horse power, having three cylinders of 6½ inch bore and stroke, and a speed of 300 revolutions per minute. Economy of storage space is a marked feature of this type of motor, which is stowed in the cabin under the crew's table. Propelling the boat is not intended to be the sole use of the motor. It is also employed as a donkey-engine, to heave anchor, to hoist sails, and to work the pumps. The extremely small weight, both of the motor and the fuel to be carried, and the necessity for so few alterations in construction, make the adaptation of petrol motors to existing boats of this class a comparatively simple matter.

Sir William Arrol & Co., the famous bridge building firm of the Dalmarnock Iron Works, Glasgow, have secured the contract for the construction of the huge railway viaduct to be erected over the River Barrow, in the south of Ireland, in the face of strong American and European competition. The erection of this viaduct is a part of the scheme being undertaken by the Fishguard & Rosslare Railway & Harbors Company, for developing the inter-communication between these ports and Milford Haven in the south of Wales. The viaduct is to be 1,980 feet in length, consisting of thirteen fixed spans each of 140 feet, and two opening spans each of 80 feet, through which vessels will be able to pass at high tide. Owing to the peculiar nature of the soil of the bed of the river huge cast iron caissons will be sunk to a considerable depth —to 100 feet from the under side of the superstructure of the bridge to the bottom in some instances. The bridge is to be built of steel throughout. This company also recently secured the contract for the large bridge carrying the Caledonian Railway of Scotland across the Clyde from the central station at Glasgow.

Quartz bowlders and pebbles found in placer gravels are frequently reported to carry no quartz gold, according to The Mining and Scientific Press. The condition is not universal, for placers are known in which the quartz bowlders and pebbles do contain gold. The barren character of such float quartz is far the more common, however, and has been the foundation of many theories of formation of the gold found in the placers which excluded the idea of its coming originally from the quartz. The explanation of the seeming contradiction is simple. The gold in quartz is originally associated with pyrite and other sulphides. Surface percolating waters oxidize these sulphides and largely remove them, before the quartz, still containing the gold, by erosion of its overburden is itself in turn eroded and becomes placer. The quartz breaks up on its lines of least resistance, which are the lines where sulphides have been removed. The larger part of its original gold content is thus freed and the separated quartz fragments are barren. In addition to the structural weakness of the quartz containing gold, its higher specific gravity constantly increasing as the fragment becomes smaller by abrasion, by retarding its downstream movement relative to quartz containing no gold, keeps it for a longer period of time under abrading influences. There are as well many quartz ledges that are barren of gold, and those ledges that do contain gold have barren portions. Such barren quartz, called "bull quartz" by the miners, is more resistant to disintegration than the gold-bearing quartz. It may thus happen that the quartz found in the gravels with the gold is not the quartz from which the gold was derived.

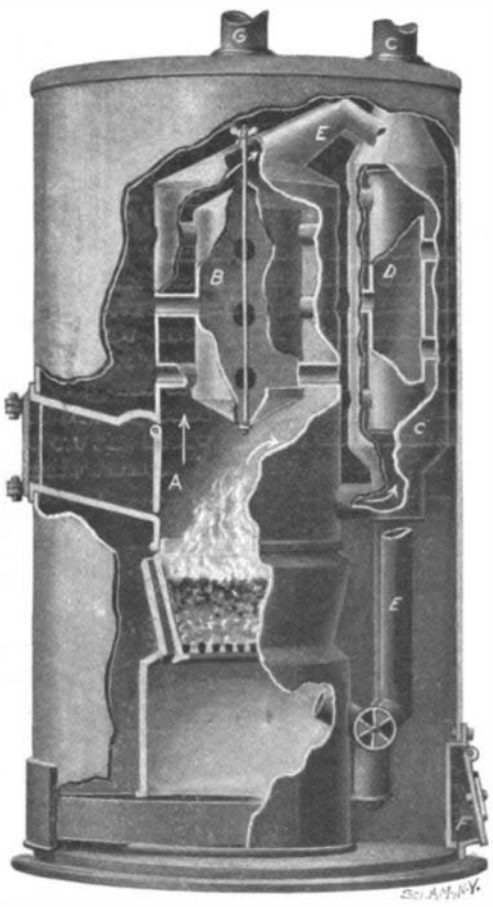
Death of President Morton.

President Henry Morton of Stevens Institute of Technology died on the evening of May 9, at the age of sixty-six. A scientist of world-wide reputation, Professor Morton began his scientific career as an instructor of chemistry and physics at the Protestant Episcopal Academy in Philadelphia. He became a founder of the Philadelphia Dental College in 1863, and was first to hold its chair of chemistry. As an archæologist, Professor Morton also distinguished himself. In 1859, he published a translation of the text of the Rosetta stone. While Resident Secretary of Franklin Institute and editor of the Institute's "Journal," he organized an expedition to photograph the total eclipse of the sun in Iowa. When Stevens Institute was founded in accordance with the will of Edwin A. Stevens, Professor Morton was made President. He held that position down to the time of his death. To Professor Morton's earnest efforts the success of Stevens Institute and the very high place which it has assumed in the technological schools of this country is largely, if not entirely due. The interest which he took in the Institute is sufficiently manifested by his liberal endowments. He gave the Institute a mechanical laboratory fitted with steam engines and tools. Out of his own purse he furnished apparatus for the study of applied electricity and guaranteed the salary of a professor of electricity. When a chair of engineering practice was established in 1888, Professor Morton endowed it with $10,000, following this gift four years later with another of $20,000. In 1897 Dr. Morton received the degree of Doctor of Laws from Princeton.

A NEW HEATER.

A heater of peculiar construction has recently been patented by two Nebraskan inventors. It belongs to the class in which hot air is used as a heating medium, and aims to receive a large amount of air and to provide a large area of radiating surface, thus supplying great heat with an economical use of fuel.

In our illustration the heater is partly broken away to show the peculiar arrangement of outer and inner drums which are designed to superheat the air. Supported on the fire-pot is a drum, *A*, closed at the top, excepting that it has two flues or pipes, *E*, leading downward and admitting the air again below the grate. Fresh air enters the outer casing through the damper, *F*, and a valve on the pipes, *E*, controls the supply of fresh air to the fire. The projection seen below this valve is provided with a removable bottom, so that soot may be readily cleaned from the pipe. Supported within the drum, *A*, is a smaller, interior drum, *B*, which is entirely closed to communication with the gases from the fire, but communicates with the space between the drum, *A*, and the outer casing through a series of tubes. Similarly, a cylinder, *B*, is arranged within the



A PECULIARLY-CONSTRUCTED HEATER.

enlarged portion of the take-up or smokepipe, *C*, which communicates at its lower end with the drum, *A*. If desired, a pipe, *G*, may lead from the heater to an upper room for the purpose of heating the same.

The following operation is claimed for the heater: Cold air entering the damper, *F*, at the bottom of the outer casing will pass through the air valve and discharge into the firebox. This air will circulate through the drum, *A*, with a portion of the smoke, while a portion of the air with a certain amount of smoke will pass through the smokepipe, *C*. Warm air surrounding the drum, *A*, will pass through the tubes into the cylinder, *B*, and warm air will also pass through the tubes into the cylinder, *D*. The air and smoke passing through the drum, *A*, will move downward through the pipe, *E*, and again discharge into the lower portion of the firepot, and during this discharge it will have mixed with it a new supply of pure air or oxygen, thus causing a part of otherwise wasted combustibles to be used. By this great circulation of air the lower portion of the heater will become thoroughly heated, and thus heat the lower stratum of air in a room which is usually cool. The inventors of this heater are W. M. Thomas and L. Van Scoyoc, of Louisville, Neb.

Yale Honors Lord Kelvin.

On May 5 Lord Kelvin received at Yale University the honorary degree of LL.D. at a notable ceremony in which the entire university took part. For the first time in over one hundred years a special assembly has been held at Yale for the conferring of an honorary degree. Lord Kelvin was ushered in the Battell Chapel to the strains of a large symphony orchestra.

In conferring the degree, President Hadley spoke thus:

"William Thomson, Baron Kelvin—To some of the men of science it is given to render practical service by their discoveries; to others it is given to use those discoveries as a means to the profounder understanding of the laws of the universe. Yours has been the rare honor of combining both these results in the work of a single life. You have joined the remotest regions of human activity by your investigations of the submarine telegraph; you have joined the different realms of human thought by your contributions to physical theory. In recognition of this long and glorious service, wherein each achievement which seemed to the world a culmination of your labors was to you only an incentive to labors more arduous, and the stepping stone toward achievements yet higher, we confer upon you the degree of doctor of laws, and admit you to all its rights and privileges."

Electrical Notes.

Madison, Wis., is a university town, and like most university towns it has a campus upon which grow huge trees. In these trees squirrels have made their habitation, to the great delight of the students and townspeople. For a long time the telephone service of the town has been bad. No one knew why. Finally a curious official discovered that the squirrels had nibbled off the insulation of the telephone cables, cut into the wires, and wrought havoc in many other ways. Rather than exterminate the squirrels, the telephone company determined to keep the force of linemen busy repairing the ravages. But the squirrels have eaten away the insulation faster than the linemen could supply it. A crusade against the squirrels will probably be instituted, despite the protest of the university faculty.

A long critical article on the position of wireless telegraphy appeared recently in the Kölnische Zeitung, which, as is well known, is one of the most influential papers in Germany. The agreement between the Marconi Company and Lloyd's is strongly criticised, and our contemporary asks if the Marconi Company and Lloyd's are really so naïve as to think that the States in whose territory the signaling stations would exist would not oppose this "monopoly-greed." Our contemporary further asserts that the communication from the German government on an international agreement on the subject of wireless telegraphy was not due to the refusal of the Nantucket lightship to communicate with the "Deutschland," but that the subject had been mooted some time previously. The article also compares the Marconi, the Slaby-Arco and the Braun systems from a technical point of view, and claims that the two former have both adopted, in their system of transmitting, a method of which Braun is the original inventor and patentee. It suggests a combination of interests between the owners of the Braun and Slaby patents, who should fight the Marconi Company on the patent question. It will be remembered that the Slaby-Arco patents are owned by the Allgemeine Elektricitäts Gesellschaft, and that the Braun patents are the property of Messrs. Siemens & Halske.

It is well known that high-voltage currents have been in use for years in the United States for long distance transmission of energy. Some of the plants, where the climate is very favorable, have adopted voltages up to 40,000 and even 50,000 volts. On the Continent, where water power in the immediate vicinity of industrial centers is becoming more and more scarce, long distance power transmission with high voltage is being frequently resorted to, as the following will show: A 23-mile transmission at 20,000 volts has been constructed to supply Como with energy. In the vicinity of Zaragoza, in Spain, two plants, of 4,000 horse power and 6,000 horse power respectively, are being installed. The power obtained will be transmitted at 30,000 volts over distances of 28 and 50 miles. The Feurs and Morge installation near Grenoble, in France, is a 7,000 horse power plant, supplying current at 26,000 volts to a number of towns and villages, such as Voiron, Moirans, etc., the distance covered being 32 miles. This plant has been completed and is now working. The Reznau plant near Waldshut provides 10,000 horse power, and the current is sent over distances up to 37.5 miles at a voltage of 25,000. Lastly, an order has recently been placed for the machinery of a 13,000 horse power plant to be erected on the Cellina River in Northern Italy, the energy being supplied, at a tension of 36,000 volts, to the towns of Venice, Udine, Pordenone, etc. Current in this installation is transmitted over distances up to 56 miles. In all the above plants the current is three-phase, and is generated at a comparatively low tension of a few thousand volts, and raised to the transmission voltage by means of stationary transformers.

A company is to be formed in England for the purpose of utilizing Mr. Edison's patent for extracting iron ore and profitably working the deposits on the west coast of Norway. The company is said to be capitalized at $10,000,000.

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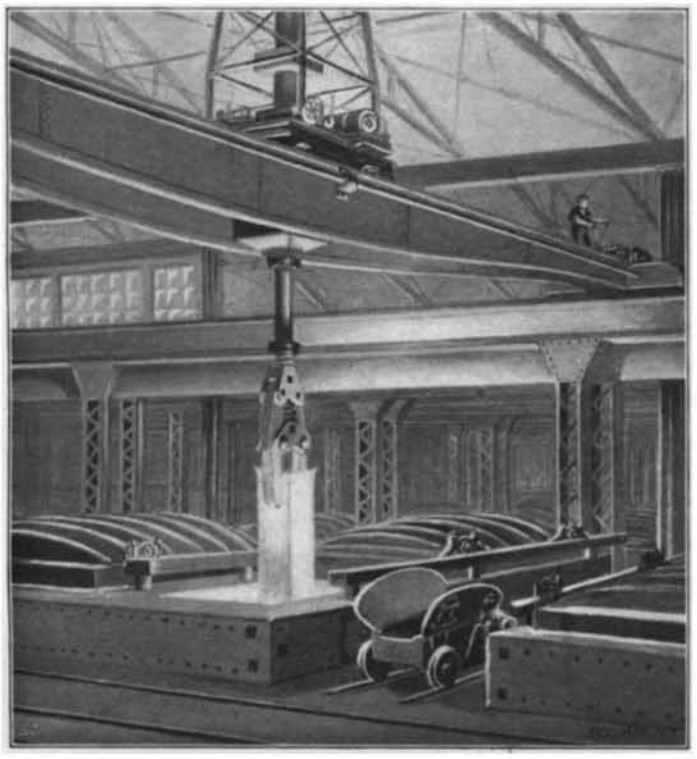
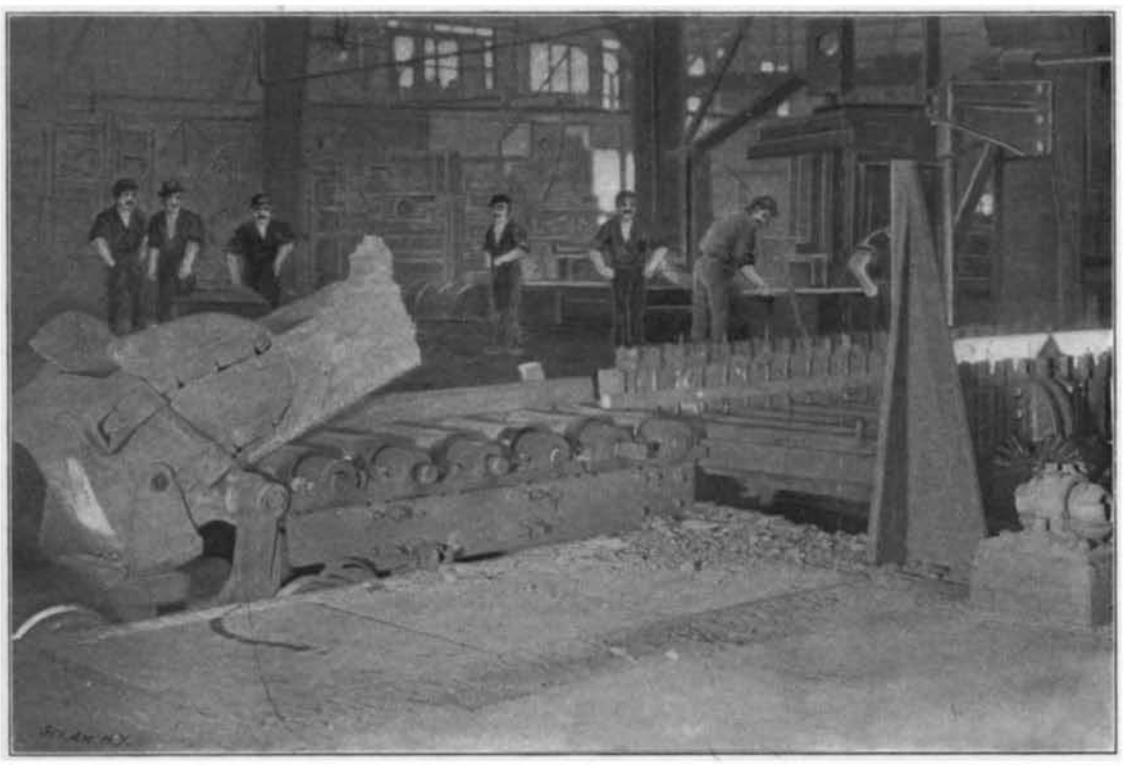
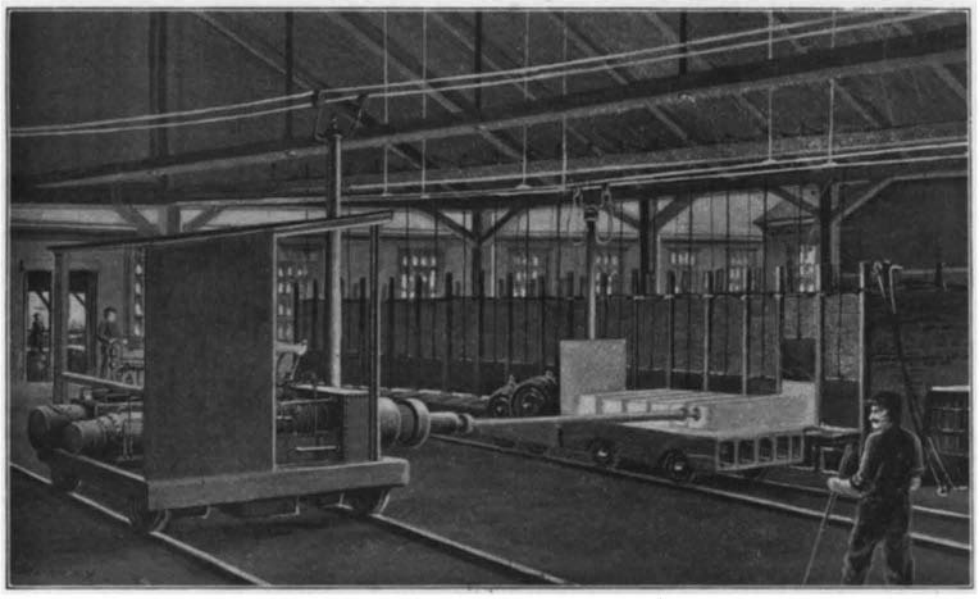


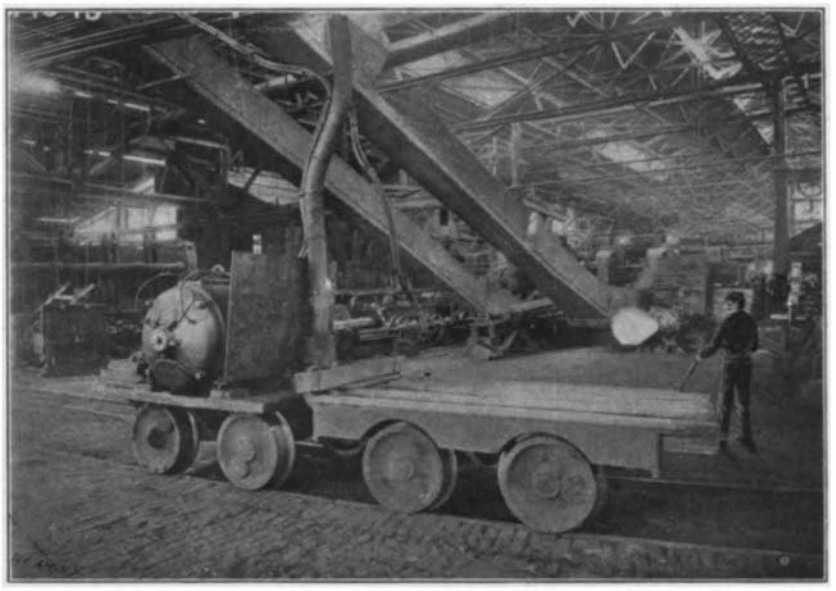
Withdrawing Heated Ingot from "Soaking Pit."



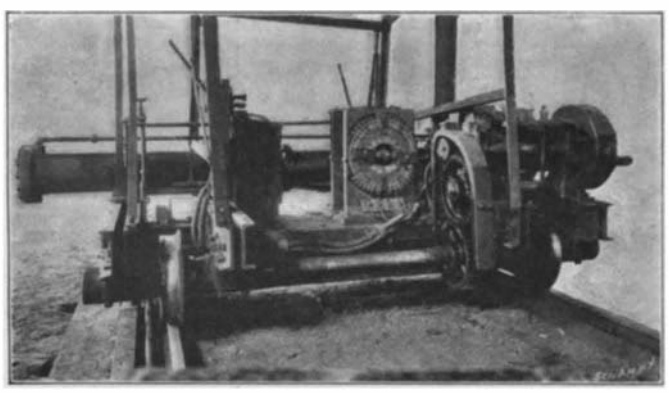
Discharging Ingot from Car to Feed Rollers of Mill.



Bloom-Charger Thrusting Blooms Into Re-Heating Furnace.

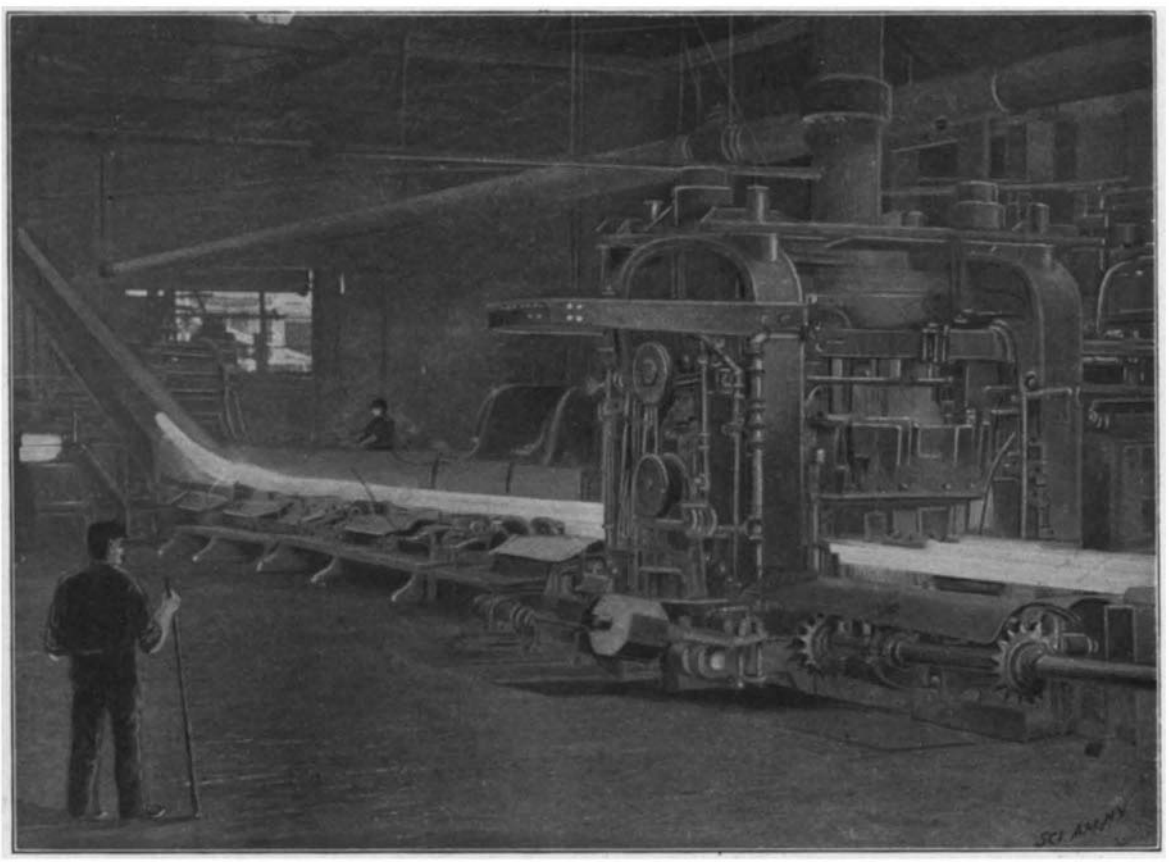


Bloom-Carriage and Motor for Transfer of Blooms.



Charging Machine No. 2 Rail Mill.

Charging Machine No. 1 Rail Mill.



Rolling One Hundred Pound Rails.

MANUFACTURE OF STEEL RAILS—II.—[See page 346.]