MANUFACTURE OF PLATE GLASS.

Among the numerous branches of manufacture which have made Pittsburg and the valleys of the Allegheny and the Monongahela the most famous industrial center in the world, the manufacture of glass in its various forms hold a prominent place. The subject of our front page engraving is the Charleroi plant of the Pittsburg Plate Glass Company—one of ten different establishments which are controlled by that great organization. The plant as here described is thoroughly up-to-date, and may be taken as illustrative of the latest processes in this industry.

The raw materials for the glass consist of sand, salt cake, soda ash, limestone, charcoal and arsenic. These are brought to the works on cars, which are run up on to a trestle that extends above a series of bins in the storage house. The various materials are dumped into their respective bins, from which they are shoveled, in the proper portions, into two-wheeled hand-carts, known as "batch wagons," and wheeled to the weighing machines, where the proper proportions of each constituent are determined by weight. The material is then thoroughly mixed, and wheeled to the casting-hall furnaces. Over 50 per cent of the mixture consists of sand, the grade of sand used in the manufacture of plate glass being an almost pure silica.

THE MELTING POTS.—The melting of the mixture is done in large clay pots which are 44 inches in diameter and 3 feet deep. As these pots have to be exposed to a fierce heat of nearly 3,000 degrees, the greatest care has to be taken in the selection and preparation of the clay from which they are molded. The "pot-clay," as it is called, is somewhat similar to firebrick clay; but it has to undergo a most careful and thorough kneading by foot in order to give it the proper consistency and the remarkable tenacity which is one of its chief characteristics. The kneading is done in a large square vat by specially trained workmen, who tramp sideways from end to end of the vat, stamping down the clay as they go. A poorer grade of the same clay is prepared for manufacturing the furnace doors. After kneading, the clay is taken to a room above, where the pots are carefully molded by hand, the molders building up the circular wall of the pot by working in a handful of the clay at a time, each lump being thoroughly kneaded into the piece as it grows into shape. The walls of the pot are 4½ inches thick. After the pot is completed it is left to dry by natural heat. The furnaces are arranged as shown in our engravings. The bottom of the furnace is level with the floor of the furnace room, and each furnace has ten vertically sliding doors, five on each side. The whole structure is built of first-class firebrick, the sliding doors consisting of large molded slabs of clay. In this particular works there are five of these furnaces, three of which are in continual operation, the others being held in reserve.

MELTING AND CASTING.—After the mixture of sand, salt cake, soda ash, etc., has been placed in the melting pot, it is picked up by a mammoth pair of tongs, brought by an overhead traveling crane to the furnace and placed on the floor of the same. After the doors are closed and sealed, the producer-gas is turned on, and in fifteen hours the mixture is melted ready for pouring. The door is then lifted and a large, wrought iron, balanced, pair of tongs is swung into the furnace by a traveling crane. The pot is withdrawn and brought to the casting table, a view of which is shown in our lower front-page engraving. The casting table is a carefully-trued surface of cast iron, and travels on a track laid between two lines of annealing furnaces. Upon one end of the table is a hollow cast iron roller 18 inches in diameter, which extends entirely across the table. Down each edge of the table is laid a strip of iron, half an inch in thickness, upon which the roller travels. Around each end of the roller is wound a chain, which is carried to the opposite end of the table, to the drum of a hand-winch. For convenience of operation the melting furnaces and the annealing furnaces are laid out at right angles to each other, intersecting at their common center. An overhead electrical crane carries the pot of molten glass up to the line of the annealing furnaces where it is set down and picked up by a small jib locomotive crane, which travels on a track that runs the full length of the annealing furnaces as shown. By this crane it is carried to the casting table, where the contents of the pot are poured out immediately in front of the roller already referred to. The roller is then drawn forward, and as it is raised above the table by just a half inch, or the thickness of the side strips upon which it travels, it follows that the molten glass is rolled out in a sheet of just that thickness. By the time it has been rolled out the glass has cooled sufficiently to be moved, and the door of the annealing furnace is raised and the sheet pushed forward into the furnace.

ANNEALING.—The object of annealing is exactly the same as that of annealing in the manufacture of steel; namely, to take out any cooling strains which may have been set up in casting, and to allow the molecules to rearrange themselves and take up a position which will leave the plate absolutely free from initial strains. The annealing furnace is heated to the proper temperature, about a cherry red, and as soon as the plate has been introduced the gas is shut off and the plate is left in the furnace for from four to five days.

GRINDING.—The glass plate as taken from the annealing furnace is half an inch in thickness, and it now has to undergo the grinding and polishing processes, during which it will be reduced to the finished thickness of a quarter of an inch, an eighth of an inch being lost on each side of the plate. The rough grinding is done between series of grinding tables arranged in groups of three, each group consisting of a lower and two upper tables. The lower table is a large cast iron rotating disk which has been faced and carefully trued up. The plate is laid upon this and secured to it with plaster of Paris. Bearing upon the glass plate are two circular runners, one of which is 12 feet and the other 14 feet in diameter. The two runners are journaled in a trussed frame which extends across the top of the machine, and they are driven by means of miter gears and shafting. The bottom face of the runners is shod with a number of parallel, cast iron, serrated bars, which are spaced about 3 inches apart. The grinding is started at a slow speed, the runners moving at the rate of about two revolutions to the minute. As it proceeds, the speed is increased until it reaches a speed of 30 revolutions to the minute. Sharp river sand and water are fed to the plate, and as not merely the runners, but the table below, are constantly rotating, the grinding is perfectly even over the whole surface of the glass, and a remarkably true surface is secured. When about an eighth of an inch has been taken off, the plate is turned over and the rough grinding is repeated on the opposite side. As the sand and water flows from the grinders it is carried to a series of pits and boxes where it is graded into four grades.

POLISHING.—The plate as it comes from the rough grinders is somewhat opaque and its surface has a milky appearance. It is now necessary to give it a finish polishing, which is done in a separate room upon a large number of low tables of the kind shown in our engraving. Down the full length of each table extends a stout cast iron girder, to which is attached at intervals of about 20 inches a series of transverse wrought iron bars. Through the end of each of these bars extend the vertical shafts of a series of felt-covered polishing disks. The pressure upon these disks is regulated by means of cup-shaped weights which are placed upon their vertical spindles. The polishers are fed with a rouge which is somewhat similar to the polishing rouge of jewelers, but is of coarser consistency. The longitudinal girders before referred to are connected to the crank-arm of a series of spur wheels driven, in each case, by a 75 horse power engine, and by this means an oscillatory movement is given to the whole series of polishers. It takes about 12 hours, 6 hours to each side, to give the proper finish polish to a plate of glass. When the polishing is completed, the plates are stamped and taken to the salesroom, where they are carefully examined by experts both for finish and quality. Any faults, such as small bubbles, unmelted portions of the original mixture that may have come through the process, scratches, etc., are cut out, or, if it is necessary, the whole plate condemned. The capacity of the Charleroi works is about 3,000,000 feet of finished glass per annum. The total capacity of plate glass by the whole ten establishments of the Pittsburg Plate Glass Company is 22,000,000 feet per annum.

The Marconi Patents.

Marconi's patents have been declared valid in the suits brought against the Anglo-Italian inventor by the owner of the Dolbear patents for a mode of electrical transmission without wires. The suit was brought in the United States Circuit Court, Judge Alfred C. Coxe presiding; damages of $100,000 were asked for. Marconi's answer was that his apparatus was an original invention and did not infringe on the Dolbear patent rights. He had two expert witnesses—Dr. J. A. Fleming, of London, and Prof. C. R. Cross, of the Massachusetts Institute of Technology. Dr. Fleming in his testimony, which was made in the form of a deposition, said that he had tried the Dolbear patent instruction, and he had failed to obtain any such signals or effects as described therein. No evidence was heard on the side of the plaintiff. The suit was dismissed, and the assignee did not wish to offer any testimony, it being claimed that the plaintiff had decided that wireless telegraphy without selective arrangements had no commercial value.

We regret to note the death of John Charter, Sr., the inventor of the Charter gas engine, who died at his home, at Sterling, Ill., on April 30. He was born in Freiberg, Germany, in 1838, and came to America in 1844, settling in Pennsylvania. In 1882 he invented the Charter gas engine, which was the first engine of its kind in the world to use gasoline direct.

Electrical Notes.

There are 150 miles of electric railways in Spain, of which Madrid has 16 miles.

Minister Smith reports from Monrovia, February 26, 1901, that Mr. T. J. R. Faulkner, a civil engineer from the United States, has placed that city in telephonic communication with White Plains, a settlement 25 miles up the St. Paul's River. This is the longest line in the country.

There seems to be an opening for electric fire pumps in many of our large towns. They could be transported to the scene of the conflagration and power can readily be obtained from the trolley wires. The engines might either run on the rails or be drawn by horses, or they might be provided with storage batteries and run as automobiles.

The Lexington Avenue Line of the Metropolitan Street Railway Company of New York is now operated by electricity as far as Twenty-third Street and Broadway, the road having been converted on May 6; and May 11 the cable service on the Columbus Avenue Line will be replaced by electricty, and a similar change will be made on the Broadway system on May 18. There will then be no cable lines in operation in Manhattan.

At the Buffalo Exhibition visitors will have the opportunity of seeing a small building made of aluminium. Niagara Falls is the principal aluminium manufacturing place in the world, and the white metal is a product of two principal factories located there, current being taken from both of the great power companies. This structure will be octagonal, and it will be as large as can be built in a space 15 feet square. The height will be about 22 feet, and it will be made of No. 24 sheet.

The Navy Department has been giving careful attention for some time to the subject of wireless telegraphy with a view of ascertaining how far it can be practically applied to the naval service. The subject has now advanced to a point where Secretary Long has appointed a special board of officers to make a thorough inquiry concerning it. The meeting of these officers will take place at Newport, and it is expected that their conclusions will determine to what extent the wireless system can be utilized for the navy.

Consul-General Guenther, of Frankfort, says that the captain of a channel mail steamer, which is equipped with an apparatus for wireless telegraphy, reports that on his last trip a message was received from the French light-ship, which is anchored about 25 sea miles from Dunkirk, stating that the latter would be unable to light up the next night unless help arrived from shore. The captain at once sent a second wireless message to La Panne, on the Belgian coast, from which point it was forwarded to Dunkirk by the regular telegraph line. From this place a boat was dispatched to the light-ship and the necessary repairs were made.

Consul-General Bittinger, of Montreal, under date of April 11, 1901, says that there are 102½ miles of electric road in that city; as motor power, there are available six engines of 600 horse power each, one engine of 3,000 horse power, twelve 200-kilowatt generators, six 300-kilowatt generators, and one 1,500-kilowatt generator. The rolling stock consists of 372 closed and 370 open cars. The company's capital at present is $5,500,000 paid up. In 1900, the company carried 43,362,262 passengers. Last year's business showed a net profit of $647,246.64, as compared with $630,870.61 for the year 1899. The above does not include the suburban roads.

Consul Jones, of Funchal, March 2, 1901, says that the Eastern Telegraph Company has just finished laying a cable from Falmouth to St. Vincent, Cape Verde Islands. It passes through the office of the Western Telegraph Company, Limited, at Funchal, and is worked in connection with the Cape-St. Helena route. The latter company has landed four cables at Funchal —two to Lisbon and two to St. Vincent. One of the Lisbon cables is continued to Brazil and connects that country with Europe. The direct cable route from Funchal to the United States, adds the consul, is via Lisbon and the Azores. The tariff to New York is about 50 cents per word.

The illumination of a clock face is undoubtedly an important business, and it is a matter for surprise, now that the electric light is obtainable in so many quarters, that progress in this direction has not been more rapid. As pointed out by Mr. A. A. Johnston in a paper on this subject before the Society of Arts, gas is the worst form of illuminant for the illumination of clocks. It corrodes the works, smokes and discolors the glass, dries up the oil, and is altogether most unsuitable. Lamps are preferable to gaslight, but the advantages of the electric light over all others for this purpose must be generally admitted. One advantage not specifically mentioned by Mr. Johnston, says the English Electrical World, is the ease with which the illumination of the dial can be made automatic when electricity is the lighting agent.

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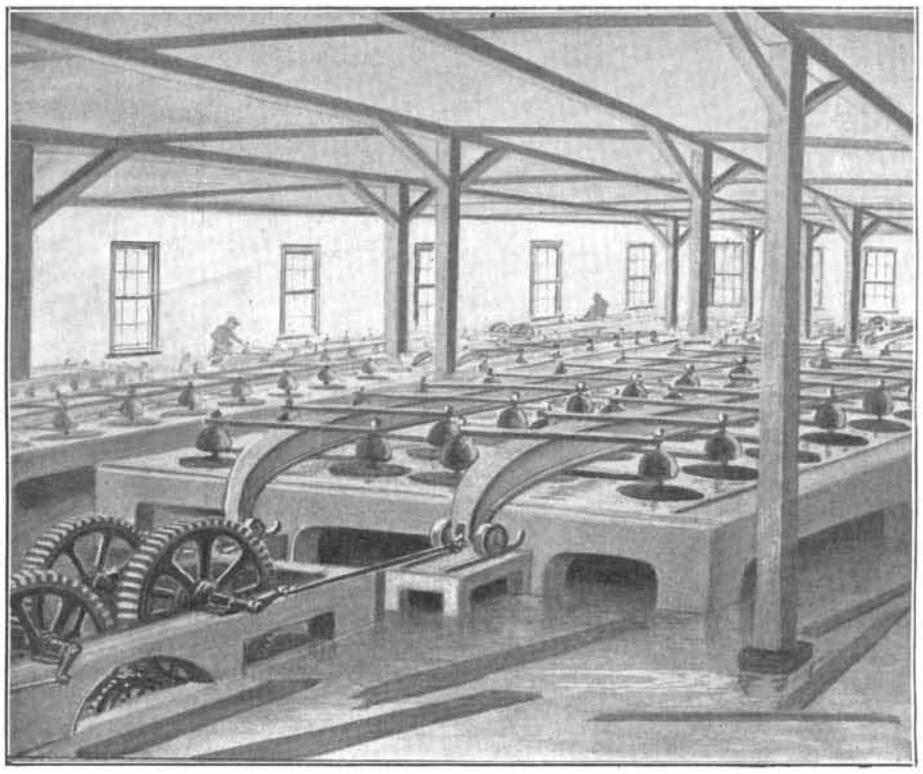
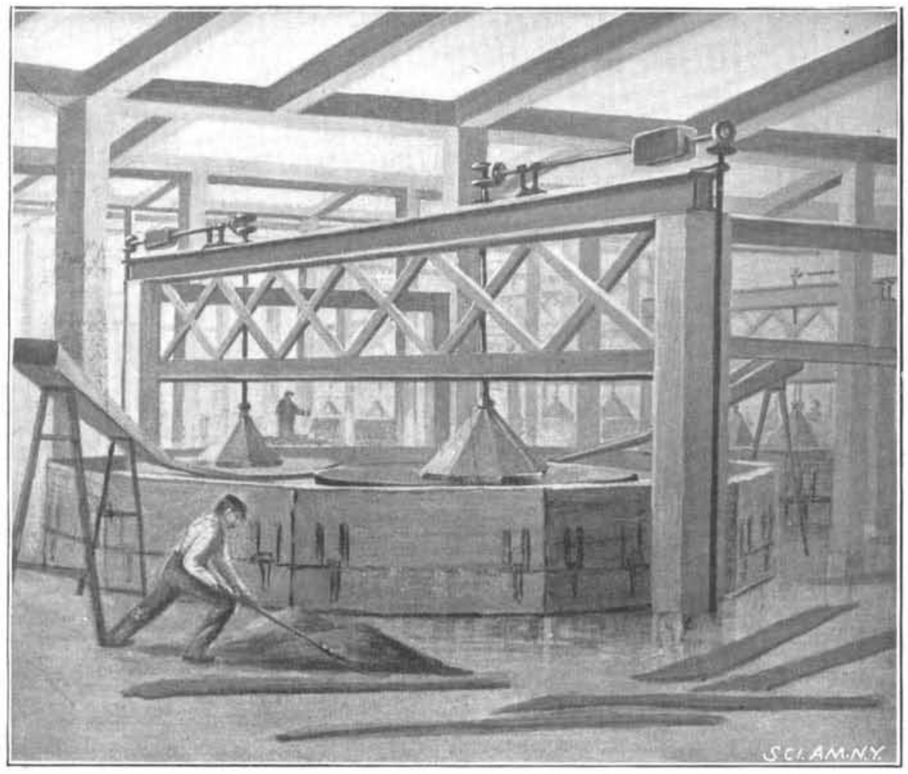
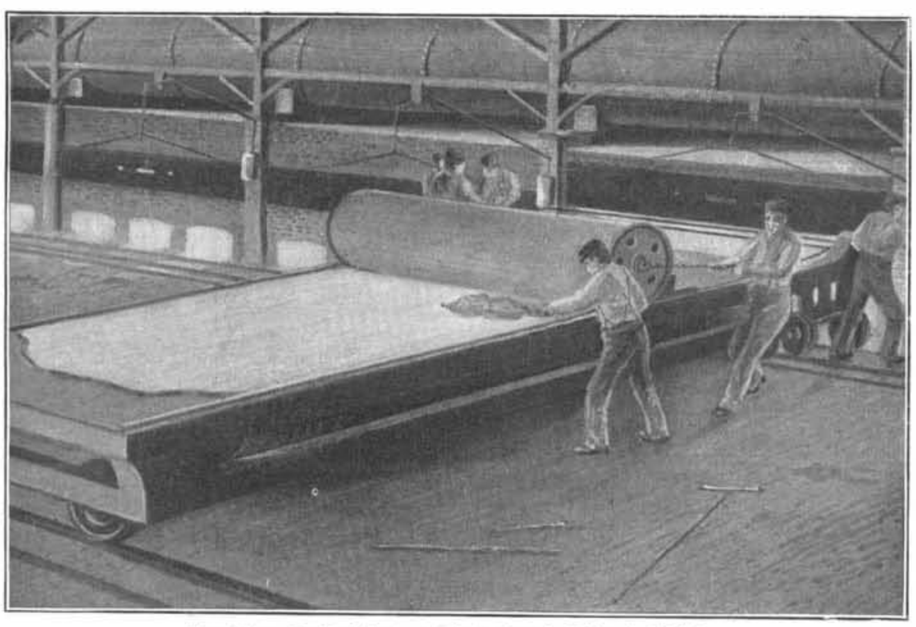


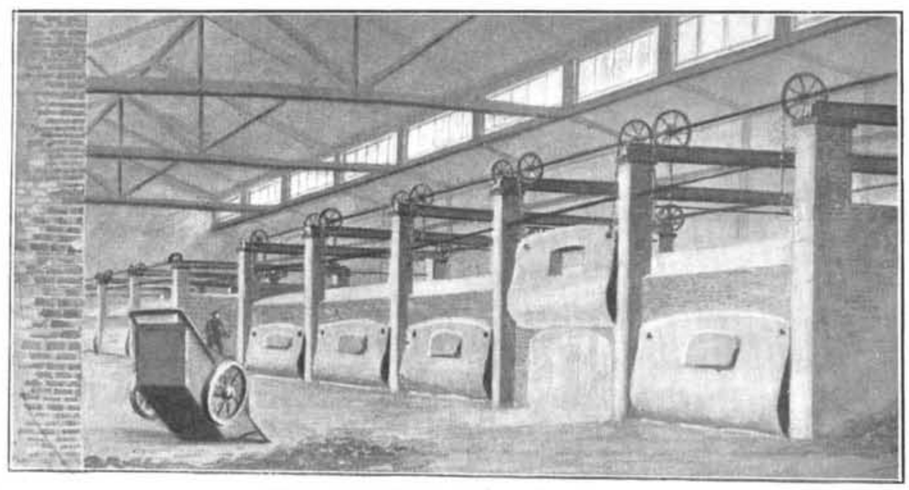
Polishing.



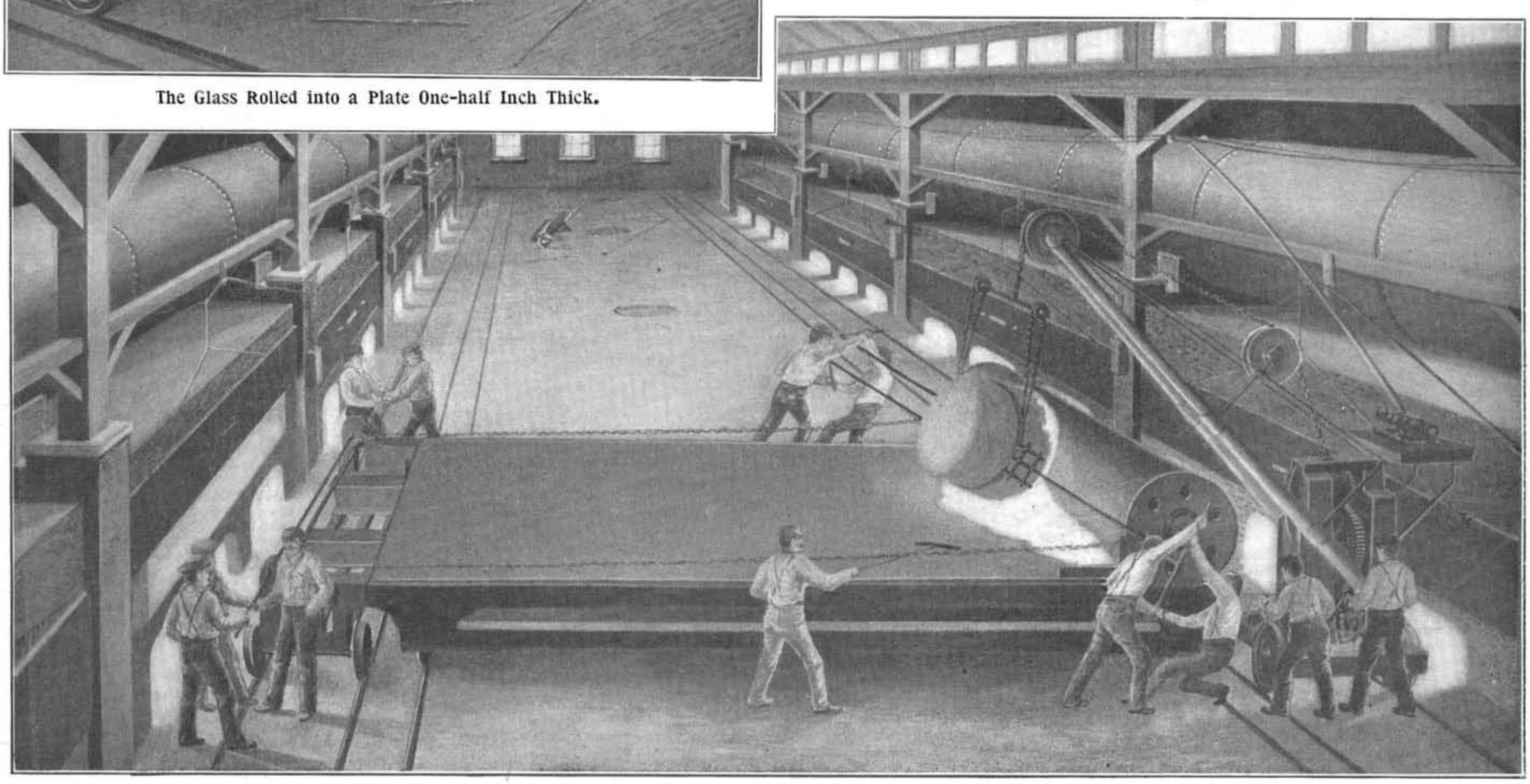
Rough Grinding.



The Glass Rolled into a Plate One-half Inch Thick.



The Front of the Melting Furnaces.



Pouring the Molten Glass on to the Casting Table.

MANUFACTURE OF PLATE GLASS.—[See page 311.]