

THE MANUFACTURE OF MATCHES IN FRANCE.

BY JACQUES BOYER.

Since 1890 the manufacture of matches in France has been a government monopoly. There are seven national match factories, situated at Pantin, Aubervilliers, Saintines, Bègles, Trélaze, Aix, and Marseilles, each of which has a specialty of its own. The logs are sawed and cut into splints in the little village of Saintines on the edge of the forest of Compiègne; parlor matches come from Pantin and the wicks of wax matches are made exclusively at Marseilles. Two of the most interesting factories are described in this article — Pantin, with its old equipment which will soon be abandoned, and Aubervilliers, recently reconstructed and provided with machinery of the highest perfection. First we will visit the venerable factory at Pantin. The splints come in great boxes from Saintines. The best are made

of Russian willow, which is stronger than the French variety. Poplar and birch are also used. The splints are unpacked and laid in a row in a square form called a boat, and this is placed on an apparatus designed to arrange the splints in regular order, separate them from each other and bind them together in a "press" or iron frame. The operator, by pressing a lever with his foot, feeds into the press a row of 100 matches, which he covers with a thin strip of wood to separate it from the following row, formed by the next movement of the treadle. The "press" or frame, balanced by a counterpoise, gradually descends during this operation. When full it is locked by fastening on a headpiece, taken from the machine and carried to the sulphuring room.

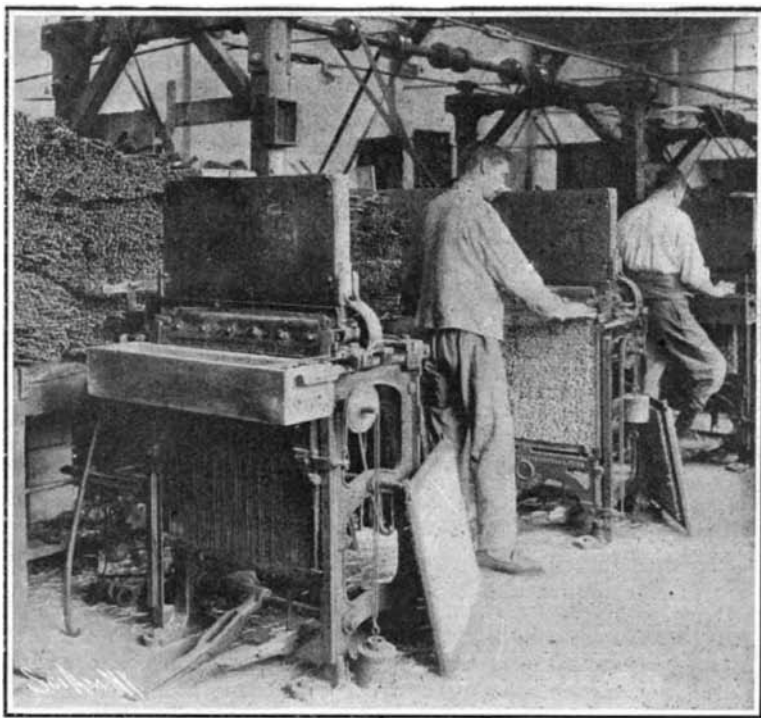
In framing safety matches the empty frame is laid horizontally under a battery of vertical tubes surmounted by a perforated plate on which the splints are stacked in a vertical position. Each movement

of the pedal causes a splint to descend through each tube to its place in the frame, which is thus filled at one effort. The upper part of the apparatus is then raised and the filled frame is locked and replaced by an empty one.

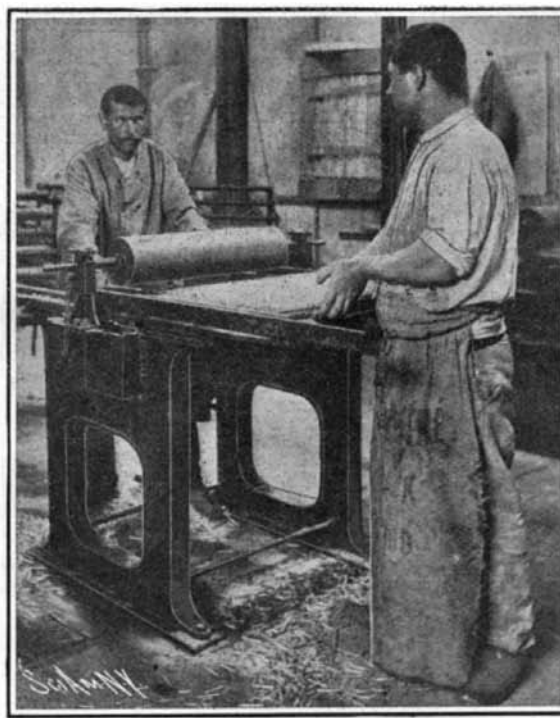
In the sulphuring room the frames containing the splints, regularly spaced, are first pressed upon hot iron plates which heat the ends of the splints in order to facilitate adhesion of the melted sulphur into

except that they are pressed on a metal plate covered with a uniform layer of the chlorate mixture instead of being dipped into a tank. The operation requires much care and skill, for the heads are large and all must be of the same size. In wax matches and all others in which the sulphur is replaced by stearine, paraffine, or some other combustible, a little potassium chlorate is added to the paste to increase the temperature of the flame. The heads of safety matches, which

contain neither uncombined sulphur nor phosphorus are made of a paste composed of 100 parts of potassium chlorate, 40 parts of antimony sulphide, 20 parts of gelatine and sufficient water to produce the desired consistency. These matches take fire only when rubbed on the box, which is coated with a mixture of 100 parts of red phosphorus, 80 parts of antimony sulphide, and 50 parts of gelatine. All these pastes, whether they contain phos-



Charging the Frames with Splints.



Applying Phosphorus Paste to the Sulphured Matches.

phorus or not, are prepared in a special laboratory where the ingredients are carefully weighed out and mixed by machines.

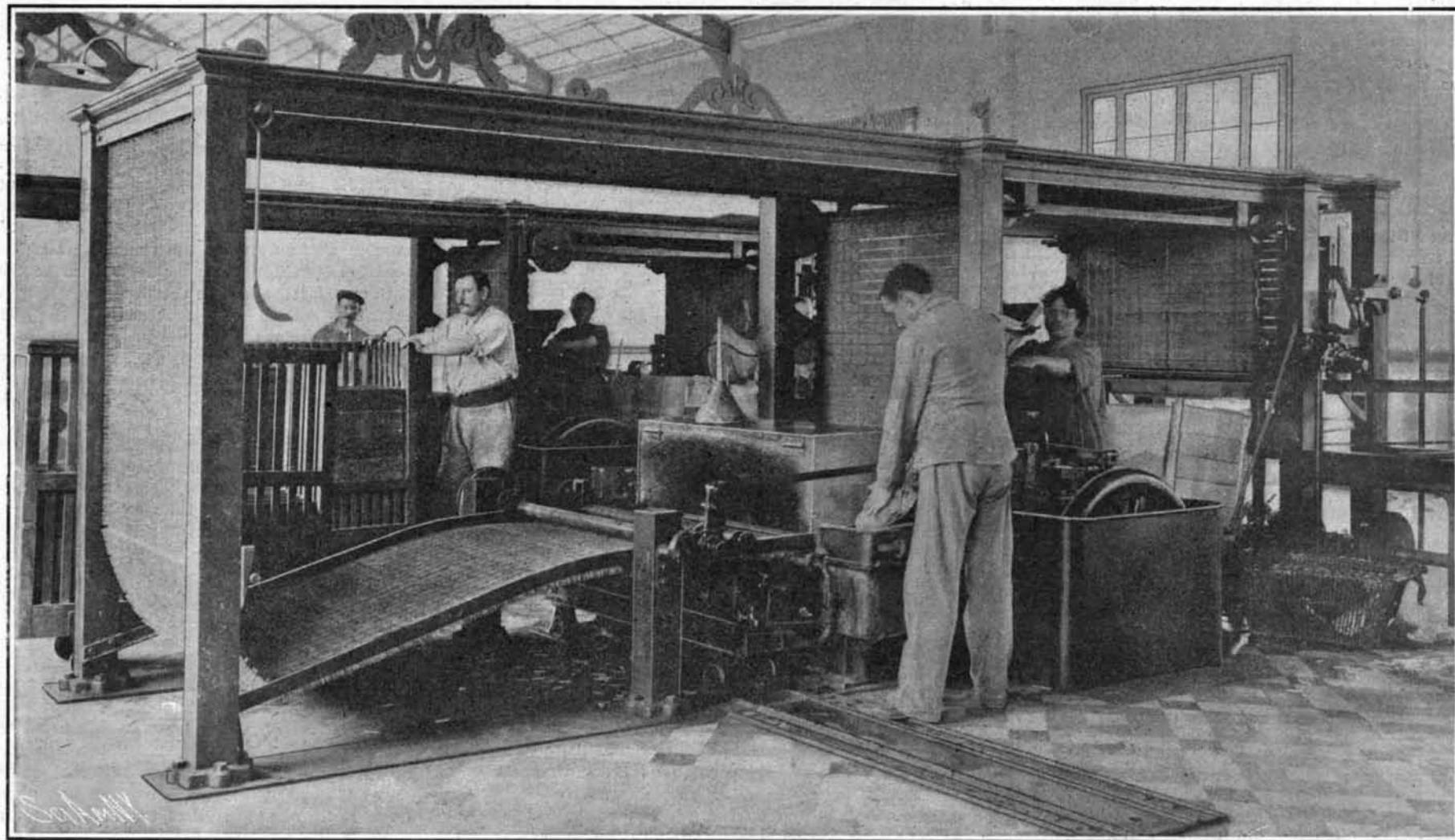
The common sulphur matches after receiving their two coatings, of sulphur and phosphorus, are conveyed, still clamped in the frames, on iron cars to the drying rooms. These tunnel-shaped rooms have airtight doors at each end, and the drying is effected by the combined agencies of steam pipes and energetic ventilation. If fire breaks out it simply consumes the contents of the fireproof room, producing volumes of offensive smoke but doing little damage.

From the drying rooms the cars laden with matches are rolled to the discharging rooms where women open the frames and put the matches into open boxes called "boats," which are divided into small compartments. This operation is performed almost mechanically. The operator places the frame on the apparatus, unloads the frame and removes, one by one, the strips of wood

which they are next dipped. The depth of the immersion is limited by the contact of the iron frame with the rim of the steam-heated vessel, in which the level of the melted sulphur is maintained constant. Expert workmen are needed for this operation, as too brief or too prolonged immersion may seriously injure or even destroy the value of the product.

The heads of common matches next receive a coating of phosphorus. The apparatus employed for this purpose consists essentially of a horizontal cylinder which dips into the phosphorus paste to a depth equal to one-third of its diameter and carries a layer of the paste with it as it revolves. The frames filled with sulphured matches are passed between this cylinder and another, at such a distance above it that the sulphured ends are pressed firmly against the paste-covered lower cylinder.

Parlor matches are headed by a single operation which resembles the sulphuring of common matches,



A Machine Which Automatically Converts Splints Into Finished and Boxed Matches.

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between the rows of matches, at the same time pressing a pedal which causes the row of matches just released to fall into the boat below. Another woman turns, with pincers, all matches that have become inverted. The loaded boats are then taken to the boxing room. The boxes for common sulphur matches are made by machine in a neighboring apartment and are brought, piled pell-mell in great crates, to the women in the boxing room, who fill them very rapidly. Boxing is also done by machine.

In this case the boat is placed behind a glass screen, through which the attendant watches the operation, and is subjected to constant shaking in consequence of which the matches glide, by their own weight, into a tube which holds the number of matches required to fill a box. The attendant empties the filled tube into a box by pressing a pedal and two assistants cover the filled boxes. One machine with its crew of three women can put up, on an average, 20,000 boxes in a day. The packing and labeling of the boxes offer nothing of particular interest except the dexterity of the women who do the work. The boxing of parlor matches is performed in a different manner, as shown in one of the illustrations. Women sit at a table on which the frames of matches are placed vertically. After unlocking the frame the operator takes out with her forefinger and thumb the matches of one row, arranges them on the table and puts them into a box, then proceeds to the next row, and so on. The great inflammability of the matches makes the operation rather dangerous and also makes boxing by machine impossible. Occasionally a match ignites and sets fire to others. The woman must then promptly spring back from the table and sweep to the floor the burning boxes and

frame. These little fires are usually extinguished without difficulty, as are those which are caused, now and then, by the parlor matches or other matches which always litter the floor, for dropped matches are of too little value to be picked up as they fall, so they are simply swept up once a day and burned in a furnace provided for the purpose.

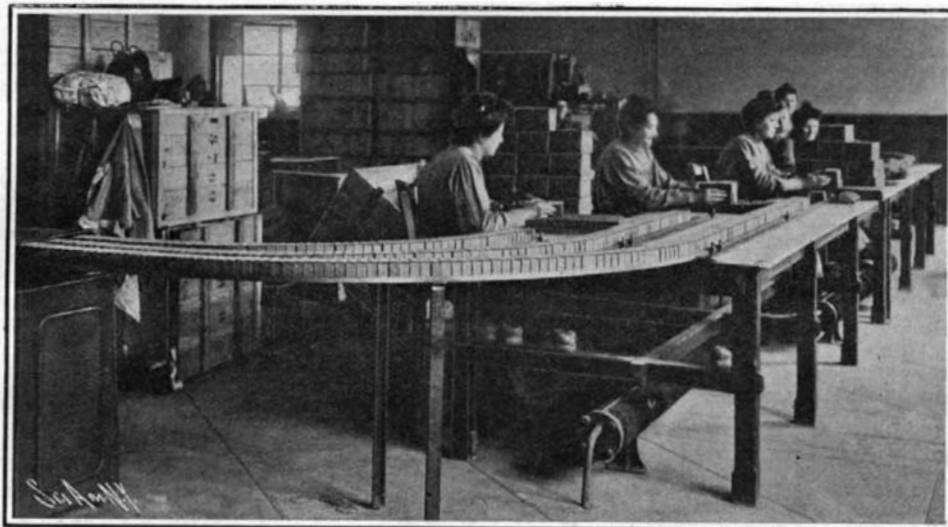
The boxes for parlor matches and safety matches are coated on their sides with frictional or chemical

ber, to the packing tables where girls put them up in packages.

Now, having reviewed the successive operations which are required in the manufacture of matches by the old methods, let us examine the remarkable machine invented by MM. Cahen and Sevène which takes the place of many hands, automatically transforming the bare wooden splints into perfect matches and even putting them into boxes. Twenty of these mas-

terpieces of mechanism are employed in the new factory at Aubervilliers, near Paris. A woman feeds the machine with splints while a man sees to the replenishment of the tanks of sulphur and phosphorus composition. At one end of the machine is a funnel into which a girl feeds empty boxes which are quickly filled and dropped before another girl who puts them in a large open crate for transportation to the crating room. The essential part of the match-making machine is the carrier, which in the French industry bears the same name, "presse," that is given to the small frame used in the hand manufacture. This carrier consists of a long endless band composed of a great number of steel plates connected by chains and driven forward by toothed wheels and pawls. Each plate is

2½ inches long (in the direction of motion) and 48 inches broad and is pierced with 550 round holes, the diameter of which (1/12 inch) is sensibly equal to the width of a match splint. Hence when the ends of the square splints are forced into the round holes they become fastened very securely to the plates. The holes are arranged in five rows, each containing 110 holes and holding the matches required to fill one box of 100 or two boxes of 50—the excess of 10 per cent having been found necessary to allow for broken

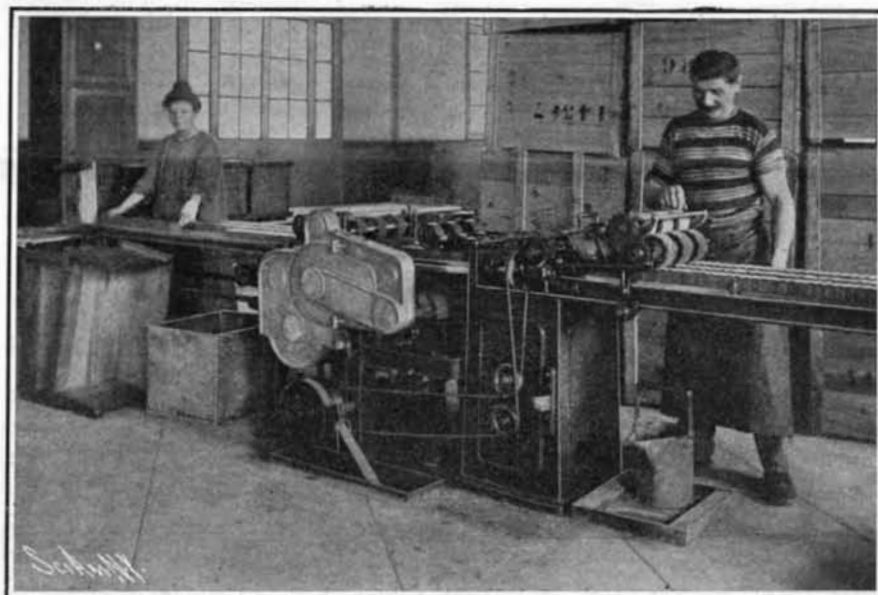


Making Packages of Filled and Coated Boxes of Safety Matches.

compositions on which the matches are to be scratched. These coatings are applied either by hand or by machine. In the former case the box is simply dipped lightly in the phosphorus or other composition; in the latter, the curious machine shown in one of the illustrations is employed. The filled boxes, arranged in rows on three long rails, are pushed by a woman under rollers which drive them forward to rotating brushes which apply the coatings. The boxes then travel onward, automatically, through a drying cham-



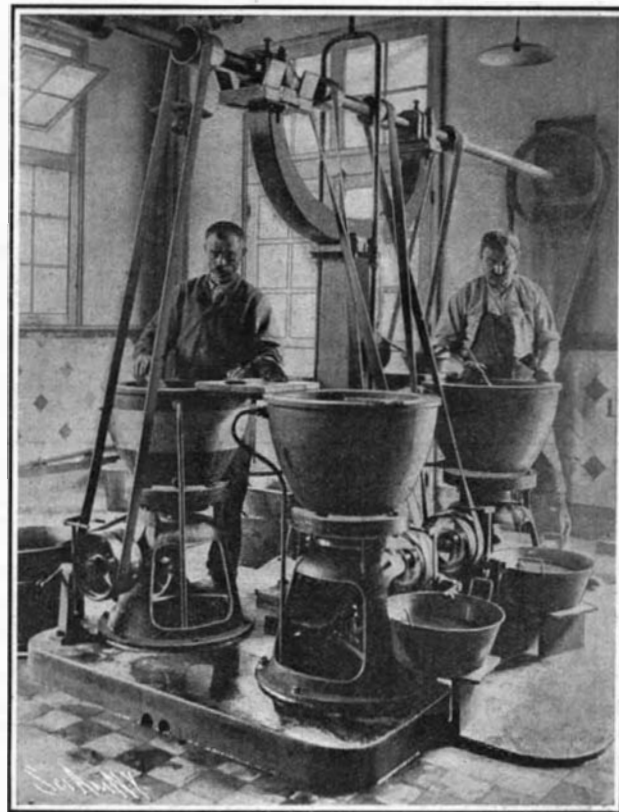
Filling Small Boxes with Safety Matches.



Coating Safety-Match Boxes With Red Phosphorus Composition.



Discharging the Frames.



Mixing the Inflammable Coating.

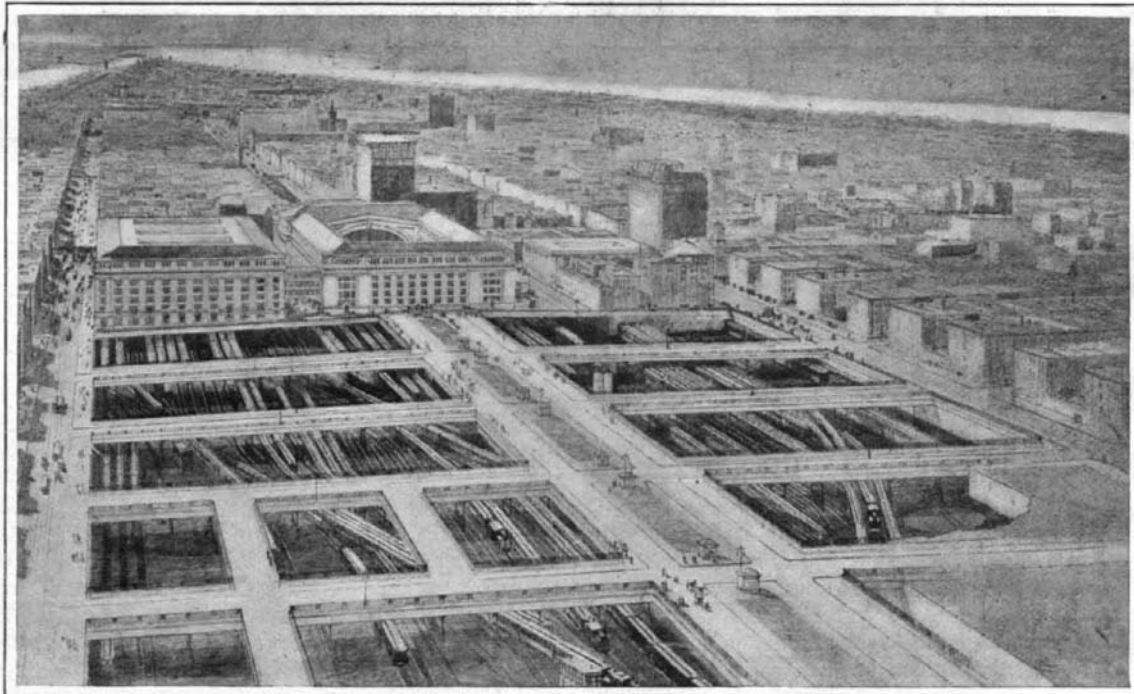
or otherwise spoiled matches. The carrier being set in motion is charged with splints in the following manner: The splints fall from an oscillating hopper upon a horizontal iron table bearing 110 parallel grooves. The splints lodge in these grooves from which they are driven by plungers, at each stroke of the machine, into the 110 grooves of a traveling table or charger, which moves to and fro between the fixed table and a vertical portion of the endless carrier. As the charger approaches the carrier a blade rises behind it and prevents the splints from being driven backward. The splints, being a little longer than the charger, project in front of it and are forced into the 110 holes of one row of the carrier plate, where they remain firmly attached when the charger retreats. The force required for this operation is so great that an iron plate is pressed automatically on the splints from above to prevent bending and breaking.

As the carrier travels onward the free ends of the splints with which each plate bristles are dipped successively into a paraffine and a sulphur bath after which they receive their coat of phosphorus from a rotating cylinder which dips in a vessel of the composition. Then they travel a long distance, for the purpose of drying, and finally reach the discharging and boxing station. Here they are expelled from the holes in the carrier plate by minute plungers so controlled by springs that they follow the plate in its motion as nicely as a human hand could do and perform their functions without shock or jar. The matches fall, in groups of five, into little receptacles whence they are pushed by pistons into the boxes, which are mechanically opened to receive them and similarly closed when full. The machine, therefore, does everything, even boxing, human hands merely feeding it with the raw material and removing the finished product. One such machine attended by three girls, turns out about 50,000 boxes, each containing 50 matches, in ten hours—an output which would require the labor of twenty persons in the old method of manufacture.

RECONSTRUCTING A GREAT CITY RAILROAD TERMINAL.

In a comparison of the problem presented by the construction of the two great railroad terminals which

any delay or confusion of its schedule, right upon the very ground where the new station and the complicated yard is being built. The problem would be perplexing enough, in all conscience, did it consist merely in the pulling down of the old and the erection of the new buildings in the presence of the traffic; but as a matter of fact, the difficulties are enormously increased by the fact that the whole surface, both of the station yard and train shed, has to be excavated to a least depth of 15 feet to accommodate the express traffic of the road, and that 25 feet below this level as thus depressed, yet another yard and station



The new station and yard as they will appear from Fiftieth Street. The broad central roadway is Park Avenue, which will extend to the office and station building. To the left is the new Post Office. The open spaces will eventually be covered by buildings.

THE NEW GRAND CENTRAL TERMINAL, NEW YORK.

must be excavated for the accommodation of the local service. At the present writing the westerly third of this excavation is completed, and the suburban service of the New York Central Railroad is being operated from a temporary terminal station built in this completed portion.

Nor are the difficulties of reconstruction at all assisted by the fact that simultaneously with all this excavation and tearing down and building up, a radical change is being carried out in the methods of traction employed, the steam trains being abolished and an elaborate and costly system of electric traction installed. Moreover, as though this were not sufficient, the company have put upon their engineers the burden also of instituting an entirely new system of signaling suitable to the electrified road.

Apart from the fact that there may be in the long run some slight financial gain from the change of motive power, and that there will be an immediate

the intersection of Fiftieth Street and Park Avenue. One of them portrays a scene which may be witnessed at any time in the present yard when the condition of the atmosphere is favorable to a slow dissipation of the steam and smoke. The other view represents the conditions as they will appear in the year 1909, when the new yard and station shall have been built, and Park Avenue with the intersecting streets from Fiftieth to Forty-fifth Street have been built above the yard and restored to the use of the city. When this work has been completed there will be a complete absence of steam and smoke, and the loud exhaust of the

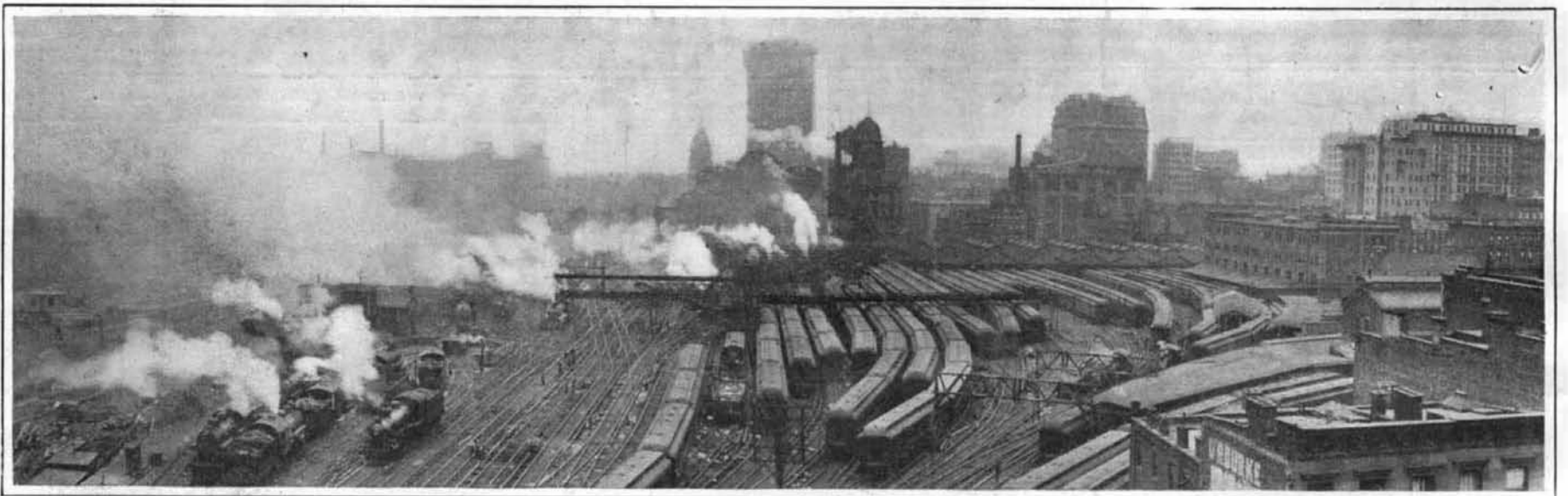
steam locomotives will give place to the quiet hum of the big electric motors and the multiple-unit trains.

The southerly end of the depressed yard will be covered by the new Grand Central Station proper, whose southerly façade will stretch for 300 feet on 42d Street, and its westerly façade for 680 feet on Vanderbilt Avenue on the west. The building will also extend 625 feet on Forty-fifth Street, 400 feet on Lexington Avenue, 275 feet on Forty-fourth Street, and 260 feet on Depew Place. Of this great block of buildings, the southerly portion will include the station proper, and the northerly and larger half will be taken up by the offices of the company. In the view herewith given, the northerly façade of the office buildings lies to the right.

The large building, of similar architectural treatment, to the left, is the new Post Office building, beneath which will extend a portion of the tracks of the upper express level.

The station building proper will include a ticket lobby 90 feet wide by 300 feet long, from which access will be had to a grand concourse 160 feet in width by 470 feet in length, the latter being covered by a vast domed roof, rising at its crown to a height of 150 feet above the floor. Beyond the concourse will be thirty-four stub tracks for passenger trains, with broad platforms, of an average width of 16 feet, between them. On the lower deck will be a separate station for suburban travel, which will be served by fifteen parallel tracks and a two-track loop.

Referring again to the view illustrating the completed station, it will be observed that between Fiftieth and Forty-fifth Streets, the squares which would normally be occupied by blocks of buildings are, for the



The yard here shown will be lowered fifteen feet; below this will be the suburban tracks. The steam and smoke will disappear with the introduction of electric traction.

VIEW OF THE PRESENT GRAND CENTRAL STATION FROM THE NORTH.

are now being built in this city, one for the Pennsylvania Company and the other for the New York Central, it must be admitted that the New York Central terminal presents the greater difficulties, for whereas the Pennsylvania Railroad station is being built *de novo*, and on a stretch of ground bought for the purpose, and free from any complications save those directly incidental to the construction of the station itself, the New York Central terminal problem is greatly complicated by the fact that the whole of the traffic of two large trunk railroads has to be provided for, and kept in movement, as far as possible without

gain in convenience of operation, the immediate motive for this costly work was the desire to render safe and comfortable the operation of trains through the Park Avenue tunnel, and to abolish the smoke and steam, the noise and odors, incidental to the use of steam locomotives in the terminal yard. There is no doubt whatever that all of these objects will be secured; and by way of illustrating how completely the smoke and steam nuisance will be abated, we present two illustrations which show in a very dramatic way how great will be the improvement. Both illustrations are taken from a point of view near

present, being left vacant. There is no doubt, however, but that ultimately these enormously valuable areas will be covered by office or apartment structures; indeed, the railroad company, in laying out the tracks in the yard below, have been careful to make provision for suitable footings for the bases of the columns of the buildings which will ultimately be put in place when the increased value of this property warrants their erection. When that is done, the entire yard with its hundreds of entering and leaving trains, will be entirely shut out from view, and the noise of the traffic will be entirely eliminated.