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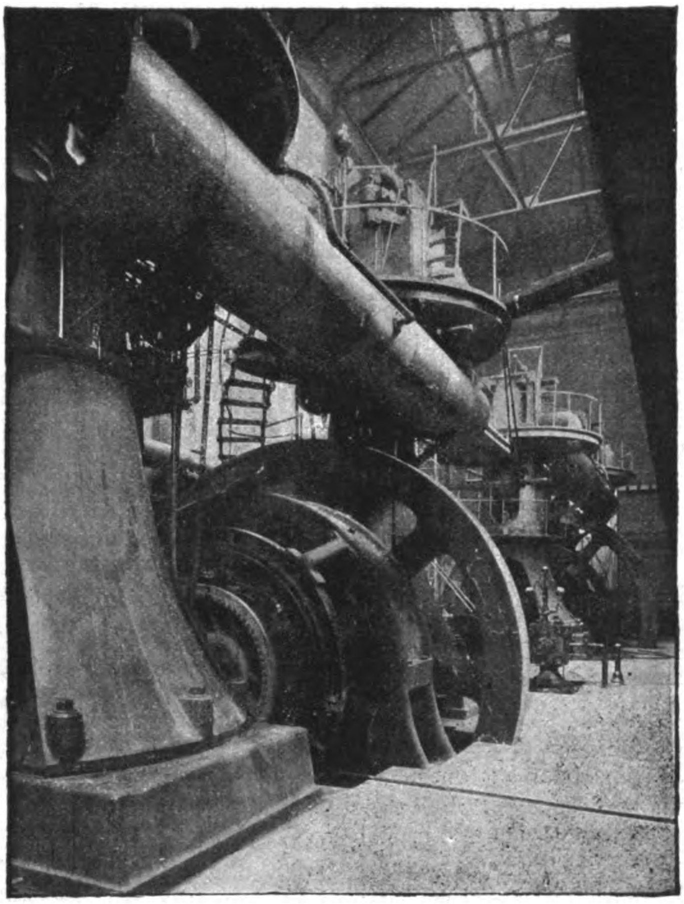
THE CHICAGO ELEVATED RAILWAY.

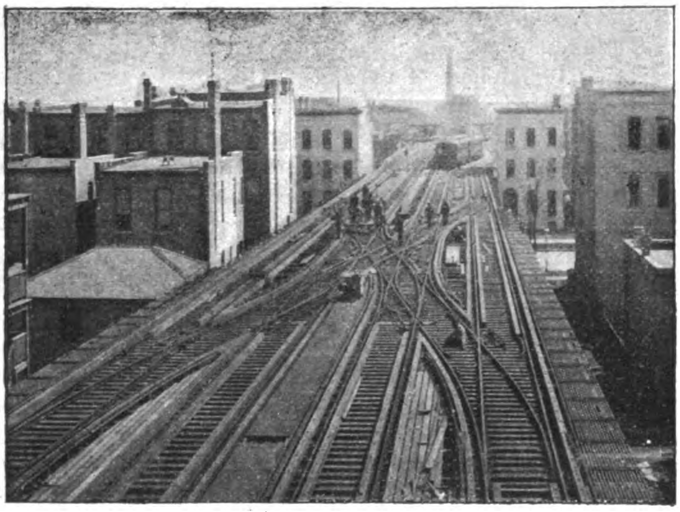
If we do not often beat Americans in being first with electrical projects, we can claim that the Liverpool Overhead Railway will have a marked influence on the elevated railroads of the United States. An elevated railway is quite an American institution; so foreign is it to English practice, that we believe the construction and the subsequent success of the Liverpool Overhead Railway had far more interest to American engineers than to English. At the same time although elevated railways may never be generally adopted in this country, some account of what our friends are doing across the water in this particular branch of railway engineering cannot fail to be of interest. The new elevated railroad of Chicago is said to be the finest elevated railway in the world, and constitutes, perhaps, the widest application of electricity yet made in railroad practice.

For much of the following information as well as illustrations, we are indebted to the columns of the *Street Railway Review* and the New York *Electrical Engineer*.

One curious feature about this scheme, though not unexampled, is, that much of the capital necessary for the undertaking has been raised in London. We are not going to draw comparisons between this fact and the one furnished by an electric railway in London, which was unable to proceed with its project because sufficient money was not forthcoming. We can, however, congratulate American railroad men upon convincing English financiers that there is something in electric traction; we may yet hope that these same financiers may look kindly upon electric traction even when proposed in this country.



Power House.

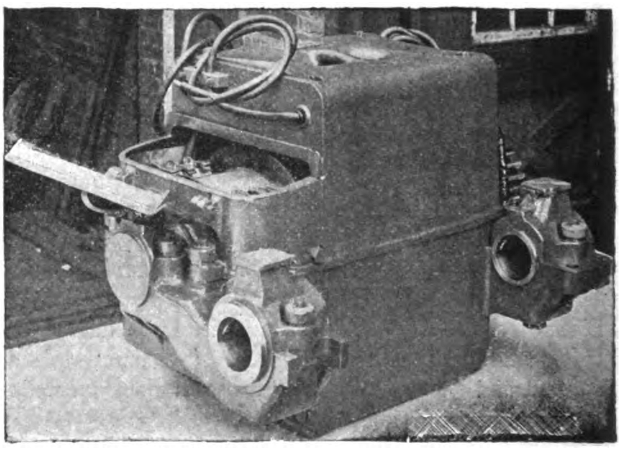


General View of Track.

The Chicago Elevated Railway, which will be shortly opened through its entire length to the public, will consist of 18 miles of road. Tracks are laid for express trains, which will pass from the centre of Chicago into the suburbs in 5 minutes. Originally, the railway was designed for steam, but a consideration of the figures shown by the intramural railway at the World's Fair resulted in the adoption of electricity.

The structure is one of the heaviest ever built. It was designed to carry safely 30-ton locomotives, followed by double-deck cars. The minimum height of the structure above the street is 14 feet, the usual height being 15 feet. The track is 4 feet 9 inches above the bottom of the supporting girders. The supporting pillars are 14½ to 18½ feet high. The standard foundation is 7 feet deep and 8 feet square. The girders are 4 feet deep. Distance between pillars is 39 to 50 feet. The lateral bracing is equivalent to 450 lbs. per lineal foot of track. At boulevard crossings a special ornamental form of structure is employed.

The most notable of the structures is the rolling lift or jack knife bridge across the Chicago river, which is shown in one of the illustrations. The bridge spans 174 feet from pier to pier. It is really two distinct bridges, each bridge having two tracks. The two parts are raised and lowered separately. The west halves are operated from an elevated tower between the tracks, and the east halves from the switch and signal tower south of the tracks. The motors, controllers, and air brakes for raising and lowering the bridges



G.E.C. Motor.

are practically identical with the motor car equipments described later. The longest of the viaducts spans a clear space of 254 feet.

The power station is 300 feet long, 90 feet wide, and 78 feet high. Its present capacity is 6,000 H.P., but should the service demand an increase, this capacity could be readily doubled, by extending it to take in the site of the municipal lighting plant which has become the property of the company.

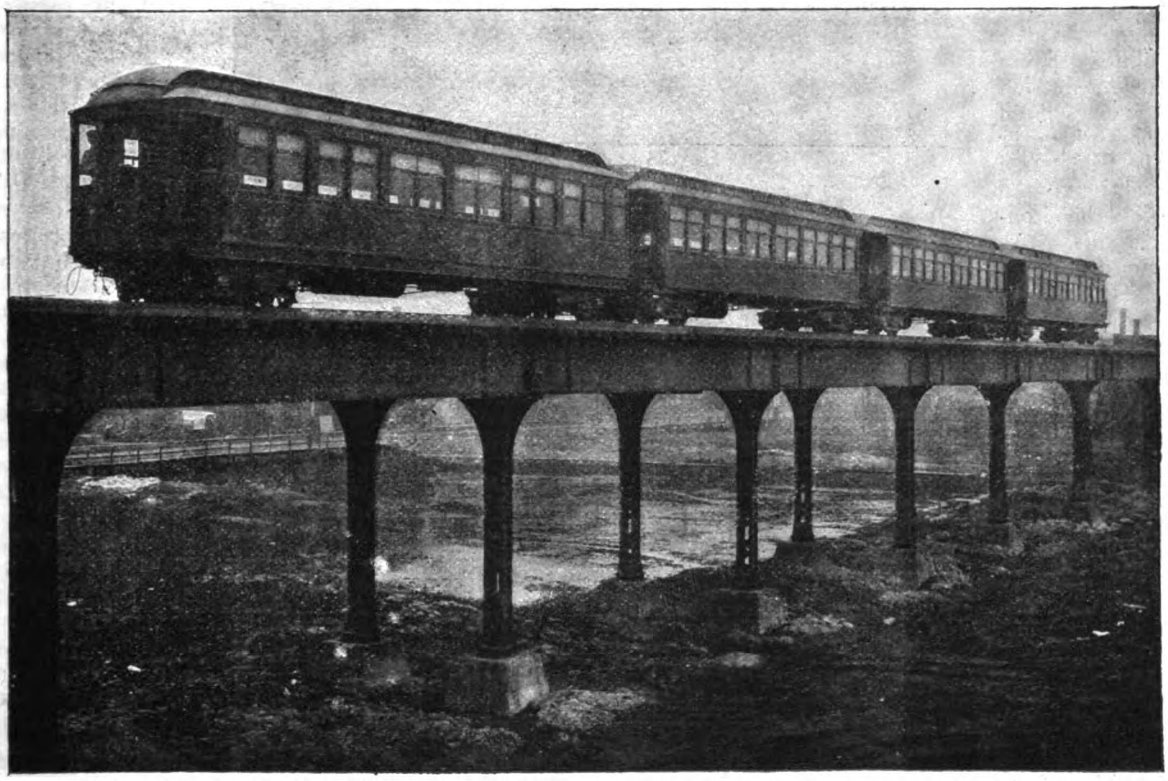
The engines are of the compound inverted vertical direct acting Corliss type, constructed by the Allis Company, of Milwaukee. Four of these are already set up in place on solid brick and concrete foundations. Two are of 2,000 H.P. each and two of 1,000 H.P. each. The cylinders of the larger engines measure 36 and 72 × 48 inches stroke, those of the smaller 23 and 48 × 48 inches stroke. The diameter of the shaft in the larger engine is 24 inches; it carries a 70-ton fly-wheel, 24 feet in diameter, with a rim 21 × 20 inches, making 75 revolutions per minute. The fly-wheel in the smaller engines weighs 35 tons, is 17 × 17 inches at the rim, 18 feet in diameter, and makes 100 revolutions per minute. Easy access is gained by the galleries to all parts of the engines. Each pair of engines is fitted with two distinct governors, one controlling the point of cut-off, the other connected with a safety valve in the main steam pipe. This is closed the instant the speed exceeds a certain number of revolutions.

The boilers are 12 in number, and come from the works of the Babcock & Wilcox Company. Each boiler has a capacity of 300 H.P., and is provided with a Babcock and Wilcox mechanical stoker. They are divided into six batteries of two boilers each, and are designed for a working pressure of 165 lbs. The furnaces are provided with smoke consuming devices, which work, so far, satisfactorily.

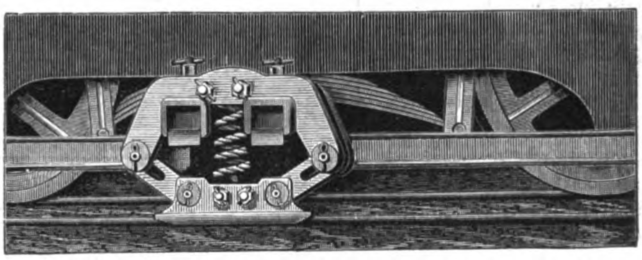
The entire electrical equipment, generators, motors, and accessories, was furnished by the General Electric Company. The generating plant consists at present of two 1,500 kilowatt generators similar to those now operating the Brooklyn City Railroad, of Brooklyn, and the People's Traction Railroad, of Philadelphia; and two 800 kilowatt generators similar to those in the railway power station at Buffalo and at St. Louis.

The machines are set up in place between the high and low pressure sides of the engine, and are thus enclosed by the engine frames.

From the generators the current is led over insulated copper cables to the switchboards, which are built up of General Electric standard generator and feeder panels. Each of the former is equipped with the necessary field rheostat, lightning arrester, voltmeter plug switch, and positive and negative main switches, both single pole. In addition, it carries a Weston illuminated dial ammeter, and an automatic circuit breaker, which breaks the generator circuit instantly should a dangerous overload be thrown upon the machine by accident. The equalising switch is mounted on a pedestal near the generator, and the length of the equaliser is thus reduced. The field rheostat and lightning arrester are set at the back of the board, the former being operated from the face by a hand wheel. A discharge resistance is attached to the field rheostat to cushion the discharge when the field switch is opened. It is connected in series with a pilot lamp in front of the panel. The lightning arrester consists of an iron clad electro-magnet, in the field of which are two carbon points separated by a $\frac{1}{32}$nd inch air gap. The points are connected between the generator lead and ground; the magnet, between the generator and line, the induction of its windings affording additional protection to the generators against lightning. The lighting switch is single pole and quick break, and is connected to the negative terminal main switch. The positive side of the lighting circuit is connected through a magnetic cut-out to the equalising bus. Current can therefore be supplied for lighting purposes from any generator, whether its circuit breaker or main switch is open or closed. The voltmeter is a Weston illuminated dial instrument, which is connected by the insertion of a plug in the four point receptacle in front of the board, two of the points of which are connected to the generator between it and the main switch, the other two to the voltmeter bus bars.



TRAIN ON LINE.



COLLECTOR UNCOVERED.

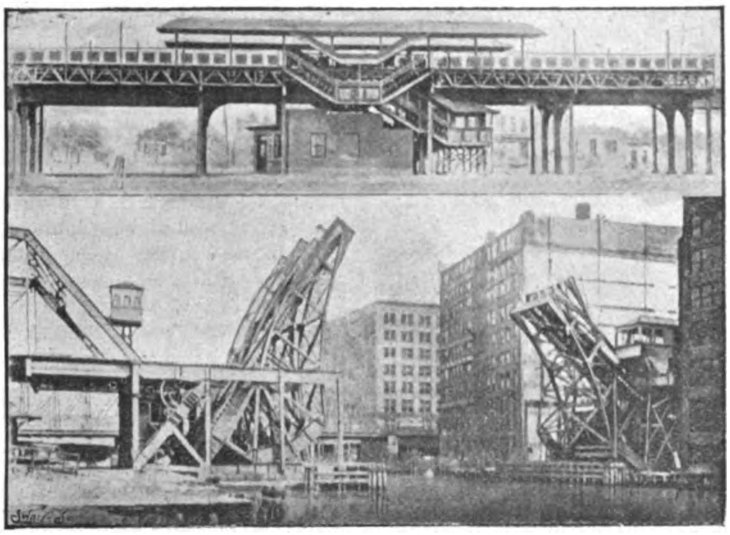
The feeder switchboard is divided into a separate panel for each feeder.

From the station the current is conducted by heavy feeder cables to the lateral third rail used as a working conductor which is shown in the view of the track. This rail is fastened to heavy timber beams set outside the guard timbers of the regular track. The top of the rail is elevated somewhat above that of the service rails, which are used for the return, and are carefully bonded by two copper strips, one on each side, of extra large cross section riveted cold through the holes in the web. Fifty-five motor cars and 100 trailers will make up the rolling stock of the road at its opening.

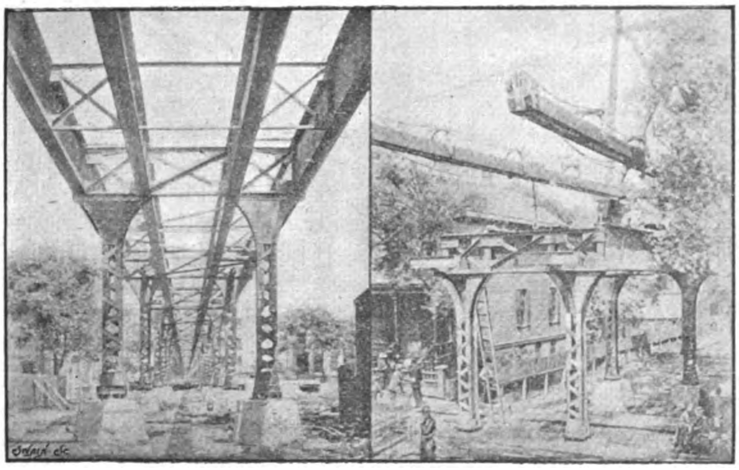
The motors are known as G.E. 2,000, a title explained by the power of the motor, which is rated at 2,000 lbs. horizontal drawbar pull through a 33-inch wheel at 20 miles an hour. The rated capacity in horse-power is 100 H.P. under normal conditions, and 150 H.P. for short intervals. The maximum speed is rated at between 35 and 40 miles an hour on straight and level track.

These motors, one of which is illustrated, are of the single reduction type, 33 inches high and 50 inches wide over gears. The field frame is of steel, and the armature of the iron-clad type, with series drum single turn barrel winding, these windings being set in slots in the outer surface of the core. The motor is thus rendered mechanically staunch and easy of repair. The insulation both in the armature and field is of asbestos and mica, thus making the deterioration of the insulation from heating impossible. It is entirely enclosed, and is dust and water-proof. Two doors at the commutator end allow of access to the interior, and the motor can be readily inspected either from above or below. Two of these motors are mounted upon one of the two trucks of the motor cars, one to each axle.

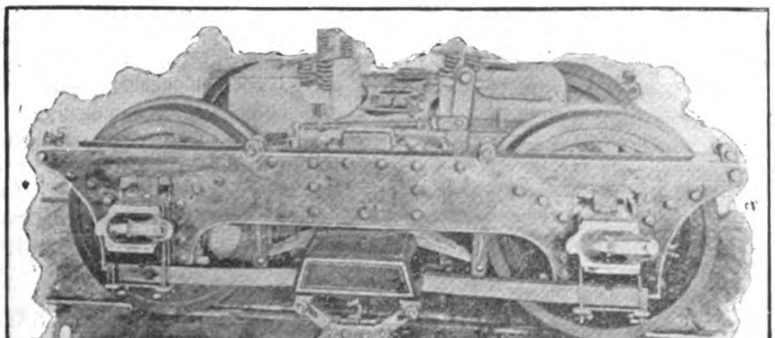
In addition to the motors each car is equipped with two series-parallel controllers especially designed for this work, and two electric air compressors for the air brakes. The motors are protected by an automatic main switch which is in this case a "K" automatic circuit-breaker. In the operation of the controller, when a quick start is desired, the handle is brought round one half a turn to the right, thus bringing the motors into multiple at full speed. If the start is to be the ordinary gradual acceleration, the handle is moved half a turn to the left, and the motors brought up to half speed; another turn in the same direction throws them in multiple, and they move forward at full speed. The arrangement is such that each motor takes an equal portion of the load; and this is, perhaps, one of the most important factors in traction work.



Views of Station and Rolling Lift Bridge.



The Railway in Course of Construction.



Motor Truck Showing Collector Covered.

The reversing switch which is arranged at the side of the controller, and is capable of movement from and toward the motor-man, is equipped with a safety interlocking device. This operates to render the reversal of the motors impossible, should the controller handle not be in the right position. As in the "K" controller, this one is equipped throughout with the G. E. magnetic blow-out.

Current is taken from the third rail by a contact shoe (illustrated), which hangs from an open beam projecting from the side of the truck. The shoe is suspended by means of links, which allow of its accommodating itself to any unevenness of the rail or track. Each motor truck is equipped with two of these, one on either side. Going north the right shoe is in contact, going south the left shoe. The road has no loops at the terminals.

Each motor car is provided with two motor-man's compartments built out upon the platforms, set diagonally at the opposite ends. Each compartment contains its own controller and pump.

The trains will consist, at first, of one motor car, fitted up as a smoking car, and three trailers. Each motor car, fully loaded and equipped, will weigh 63,500 lbs., each trailer car loaded 46,000 lbs. With the two motor cars and three trailers the average speed will be 13 miles an hour, measured on the tangents of the Garfield Park line, including stops of 15 seconds each at stations approximately 2,000 feet apart. The present plans contemplate the eventual adoption of six car trains made up of one motor car, equipped with four G. E. 2,000 motors, and five trailers. The average speed of these trains, on some tangents, will be 15 miles an hour, including stops.

The four-track structure has necessitated rather an elaborate system of switches. The interlocking switches are similar to those employed on American steam railways, but have the added complication of the third contact rail, which in some places has to be shifted along with the switches.

There are, of course, numerous details in the construction and equipment of this line which it is impossible to note in this article, but from the principal features that we have put forward, it is evident that our American friends have brought a great undertaking to a successful issue.

THE CENTRAL STATION AT NANCY.

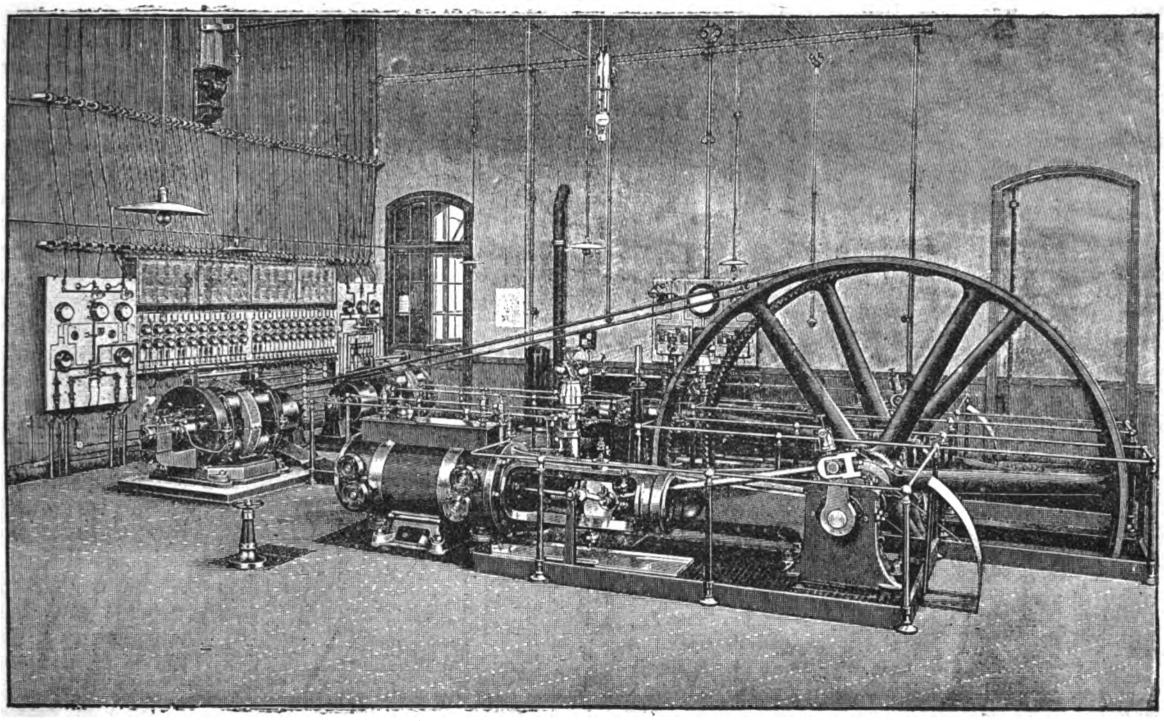
WE had occasion, a short time ago (writes M. Laffargue in *L'Industrie Electrique*) to visit and examine in detail the central station at Nancy. This station was fitted up by the firm of Fabius Henrion under good conditions; its working is conducted on an economical system, which we think it will be interesting to describe in detail.

Description of the Station.—The station comprises a boiler room, an engine room, and various offices and warehouses. The fig. gives a general view of the machinery.

Boilers.—The boiler room contains two semi-tubular steam generators, with a heating surface of 60 square metres, registered at a pressure of 6 kg. per square centimetre, and capable of producing about 750 kg. of steam per hour. The water is conveyed from the Moselle, and is supplied by means of an injector, or, if the injector should be stopped, by feed pumps. A special automatic sluice lessens the draught when the stoker opens the door to make up the fire. The chimney, which is altogether 30 metres high, is placed in the courtyard at a distance of 40 metres. The water obtained from the purifiers and by condensation is sent back to the boilers.

Steam Engines.—The engine room at present contains only two Corliss condensing steam engines, placed at the left; the space on the right is reserved for two other engines. The steam engines have a normal power of 50 H.P., their angular speed is 78 revolutions per minute without load, and 75 when fully loaded. By varying the admission, the power can be brought up to 90 H.P. under good mechanical conditions, but with a greater consumption of steam. The two axles are in continuation of one another, and a special coupling switch enables the two engines to be coupled for working. Under these conditions, if an accident happens to one steam engine or to any dynamo, the remaining engine can drive one of the dynamos, or both at once. Underground rooms have been arranged for the inspection of the engines.

Each steam engine drives, by a belt, an over compounded Henrion dynamo, giving 110 volts and 400 ampères, or 115 volts and 350 ampères, or 40 kilowatts at a speed of 500 revolutions per minute. These dynamos have the advantage of keeping the difference of potential constant, notwithstanding the sudden variations of load.



NANCY STATION.

On leaving the dynamos the current is sent into a special distribution board mounted on marble. This board contains two voltmeters, two ampèremeters, and also a megohmmeter for measuring directly the insulation resistance of the canalisation by a single reading.

Next to this board we find a second one with which are connected the various lighting circuits. The Pilsen arc lamps used for lighting the railway station are 100 in number, and of various intensities (4, 8 and 12 ampères); there are also about 300 incandescence lamps for lighting the offices. The cables consist entirely of insulated wires supported on porcelain insulators. Each circuit of two arc lamps is connected with this board, and is provided with circuit breakers, a rapid interrupter and an ampèremeter enabling the rate of working and the regulation of the lamps to be followed at each moment, thus serving both as an indicator and a measuring instrument. This installation has necessitated a somewhat considerable expenditure at the outset; but it ensures perfect safety and good working to an important and extensive railway station. We may add that the lines, the extent of which amounts to 1,100 metres, serve as resistance, partly taking the place of the usual rheostat, at least for the lines of sufficient resistance.

A second table is intended for the manipulation of two batteries of accumulators of a capacity of 300 ampère-hours. These are available in case of accident, and in the daytime, before the engines have started, and during the night after they have stopped. The accumulators, constructed by the firm of Fabius Henrion, are formed of plates with fine grooves separated by grooved supports and glass tubes. Special precautions have been taken for the installation of these accumulators, and to ensure their insulation with regard to the earth. All the contacts and connections are established by autogenous solderings. An automatic switch serves for the charge and discharge; it couples the accumulators automatically on the general circuit of distribution as soon as the difference of potential falls below a certain value. We will also mention the regulating board; it bears a large voltmeter of 50 centimetres diameter, with large divisions, and two automatic rheostats introduced into the shunt circuits of the dynamos. A registering voltmeter enables the continuous working of the station to be followed exactly.

At 4·8 km. from the Nancy station is the sorting station of Jarville, which also has to be supplied with light. In order to feed the lamps at this distance, a continuous cur-