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ELECTRIC LOCOMOTIVES FOR CLEVELAND

By GLENN L. R. BAUMHARDT, '38

PERHAPS the most outstanding development that has taken place in Greater Cleveland in the past few years is the railway electrification that developed with the construction of the Union Terminal. (With one exception, "The Mercury," the new streamlined train of the New York Central,) all trains entering or leaving the terminal are drawn by electric locomotives. On returning to Cleveland from Detroit, the Mercury stops at Linndale and has an electric locomotive substituted for the streamlined engine. However, in the morning, the original engine of the steam type, which has been taken to the terminal in the meanwhile, is used to take the train out of the terminal on to Detroit, inasmuch as the engine does not have to pass through the station when leaving with a full train as it would were it taking a train into the station. It is obvious that due to the smoke it is entirely impractical to take a steam locomotive into the terminal.

Each of these electric engines, 80 ft. long and weighing 207 tons, consists of three distinct parts, the body and two trucks. The weight is so distributed that there are 155½ tons on the 6 drivers of the body and 51½ tons on the two trucks. Driver is the term given to an axle and its pair of wheels. The wheels of the drivers are 4 ft. in diameter and are pressed on under a pressure of 120 tons. The gears are shrunk on the axles.

The engine operates across a line of 3,000 volts and is powered by six 1500-volt motors, that is, one motor for each driver. Each motor is geared directly to the driver in a 3 to 1 gear ratio. The motors are about five feet in height and use carbon brushes that are two inches wide, three-fourths inch thick, and two and one-fourth inches high. The speed of the motors is controlled by a rheostat operating in the shunt field circuit, and operation takes place over a range of three-motor combinations. The first combination has the six motors in series with 500 volts across each motor; the second is a series-parallel arrangement with three motors in series and 1000 volts across each motor; and the third is another series-parallel arrangement with 2 motors in series and 1500 volts across each motor. In starting, the motors draw as high as 400 amperes, but when running normally take only about 180. They are air-cooled by high and low speed blowers.

Power is transmitted into the engine from the trolley wire through devices known as pantographs. The pantograph is made up of a framework consisting of two sides, each side resembling a diamond-shaped frame. The two sides are connected to each other by braces terminating at corners. Across the tap of the pantograph, is the surface which runs along the trolley wire. This surface is about 6 inches wide and is built up with a very soft conductor in such a way that it will wear out from the friction much more rapidly than the trolley wire will. It can be readily understood that it would be an extremely expensive proposition to replace the entire power line of a system, whereas this pantograph surface may be conveniently replaced whenever occasion demands. Air pressure, at about 25 lb. is used to raise and lower the pantographs. Storage batteries supply power for this operation when the pantograph is not already in contact with the trolley wire.

The engines are equipped with 16 storage batteries, furnishing a supply of about 36 volts. Besides operating the pantographs, they also are used for lighting purposes when the pantographs are down, and for regulating the voltage when the engine is running and operating the generators. The batteries are located on the rear truck, and are "floated" in the circuit so that they will charge automatically when the engine is running.

To the passenger riding in a train drawn by an electric locomotive, the smoothness of operation is probably the most outstanding difference from the steam engine. The starts especially are generally so smooth as to be barely noticeable. The engines are capable of accelerating to a speed of 48 miles an hour in one minute, and can travel as fast as 90 miles an hour. However, in the city and on curves, there is a limit of 60 miles an hour. The engineers of these electric engines proudly boast that they can out-pull the steam type. Sand blasts are also provided to prevent slipping of the wheels.

Engineers of these modern engines have only four gages to worry about, a voltmeter, an ammeter, an air pressure gage, and a speedometer. The connection for the speedometer is made on the right hand side of the rear truck. The speed control arm and the two brake levers are located just in front of the left arm of the engineer as he occupies his place next to the window at the right of the cab. One of the brake levers operates the brakes of the engine alone, and the other operates the brakes of the entire train. The advantages in the latter system lie in quicker and smoother stops. It also helps to eliminate slack, the cause of jerks when trains start.

Automatic braking is one of the principal safety features of the electric locomotive. When a switch is set against the train, a device, known as an inductor and situated some distance in front of the switch, is automatically energized. The engine is equipped with a receiving device located in such a position that it will pass just over the inductor. Should the engineer and fireman both miss the signal, and the engine pass over the in-

ductor, the receiving device would be acted on by the energy of the inductor and consequently operate the brakes. There are two of these receiving devices, one on each side of the engine, in order to insure operation regardless of the direction in which the train is travelling.

A safety measure taken by the engineer and fireman is the practice of calling out the color of the signals. That is, the man that sees the signal first calls out its color, and the other man calls out the color as soon as it comes into his vision. Not only does this serve as a check on the color of the signal, but it also serves to prevent missing a signal.

In the cab there is also located a 155 lb. steam boiler for heating the cab and the cars. It is an oil-burner of the fire tube type, having 1250 tubes of three-fourths inch diameter. It is nearly entirely automatic in operation and takes only from 14 to 18 minutes to get up steam.

It is of interest to note here also that the engines are also equipped with lightning arresters. In fact, as far as equipment is concerned, the engine has at least two of everything. At each end of the body is a cab, having a complete set of controls, even to the boiler and pantograph.

In view of the fact that each locomotive not only represents a great financial investment, but also is directly responsible for the lives of a great many people, each engine receives a complete electrical inspection every twenty-four hours. This inspection ranges from raising and lowering the pantographs to testing every circuit breaker in the engine. There is also a federal requirement that the engines be completely inspected every thirty days.