down the wall of the building and terminates in a buried ground plate set in pulverized coke. After passing through the choke coils, the high-tension wires drop along the wall to the General Electric hand-operated oil switches.

By reference to the plan it will be observed that all the high-tension apparatus has been so placed as to require the minimum length of high-tension cable. The bus line is immediately over the oil switches and is carried on an iron frame supported partly by the switch structures. This frame is of wrought iron pipe, the insulators being supported by pins clamped around the pipe. From the bus-bars leads to the oil switches for the machines drop directly down. The emerging wires from the switches are carried up over the frame again and into the air blast transformers. The secondaries of the transformers are taken out through the base into the air chamber in the basement and then along the underside of the floor to the machines. The direct current leads from the machines drop down through porcelain insulators and are carried to the switchboard on the side of the room opposite the entering high-tension wires. At present two blowers for the transformers and the reactance coils are installed. The blowers are of the Buffalo Forge Company type and are driven by 1-hp induction motors. Plans, however, provide for four separate blowers, one for each of the three sets of transformers and an extra one for emergency.

The converters are started from the alternating-current side by means of the reactance coil previously mentioned. A starting panel for each machine is located near the reactance coil and adjacent to the alternating-current machine panel upon which is the control for the high-tension oil switches. The equalizer stands for the separate machines are located at the direct-current end and nearest the switchboard. The switchboard consists of four direct-current feeder panels and three direct-current rotary panels. The feeder panels are provided with General Electric form K circuit breakers and Thomson recording wattmeters. The outgoing feeders drop down below the floor immediately behind the switchboard and are then carried up along the wall to a point near the roof trusswork, where they pass through the wall to a pole line. The sub-station was built and designed under the supervision of John A. Kreis, Jr., master mechanic and superintendent of power stations of the road.

One express aim in the design was the accessibility of apparatus and cables, and reference to the plans will show that the idea has been well carried out. It may be noticed that the wiring of the cables is all open work. No tubes or ducts are employed except where the wires pass through floors or partitions.

THE OPERATION OF CARS IN TRAINS AT COLUMBUS

A novel method of train operation has been inaugurated by the Columbus Railway & Light Company, of Columbus, Ohio. Practically all of the city cars are operated over High Street, in the downtown district, and the tracks in this street have about reached the limit of their carrying capacity. To lessen the congestion on this street, as well as to increase the carrying capacity during rush hours, some of the city cars are operated in two-car trains, with two motors on each car. Only

FIG. 2.—A TWO-CAR TRAIN IN COLUMBUS, OHIO

FIG. 3.—CABLE RECEPTACLE ON THE DASH

FIG. 4.—JUMPER TERMINAL WITH WIRE EXPOSED

FIG. 5.—COUPLING BETWEEN TWO CARS

one of the cars of each train is provided with a multiple-unit control system. The rear one has a controller of the K-10 drum type, and the motor circuits of the two cars are connected by means of jumpers between the cars. The accompanying drawing, Fig. 1, shows the wiring of the two controllers and the manner in which the connections are made. Fig. 2 shows a train of two motor cars, as operated at Columbus.

Each of the cars is equipped with two motors, but the forward car of the train is provided with a type-M General Electric multiple-unit equipment for four motors. The wiring of the multiple-unit controller is identical with that of an ordinary four-motor equipment, with the exception that the leads for motors No. 3 and 4, instead of going to motors, are tapped into a bus line, extending the full length of the car, and terminating in receptacles on each dash. On the rear car wires leading from the receptacle on each dash are tapped in on the motor leads, and other than this addition no changes from the usual K-10 controller wiring is made.

Fig. 3 shows the receptacle on the dash, while Fig. 4 is a view of the jumper terminal inserted in the receptacle, with the outer insulation pulled down to show the wires. As all the current for the rear car is carried by the jumper, the wires in it are necessarily larger and the sockets and terminals are much heavier than are the jumpers for the control circuits of multiple-unit equipment. Fig. 5 shows the electric and air couplings.

The cars are equipped with controllers at each end. The terminals of the wires of the bus lines in the receptacles are so arranged that the proper connections are made, no matter what end of the cars is connected. A lug on the jumper terminal, which fits into a slot in the receptacle, prevents the terminal being inserted in any other than the proper position.

The chief advantage of the employment of the two different kinds of controllers is that the extra expense of installing a multiple-unit controller on the rear car is avoided. The plan was first suggested by M. S. Hopkins, general superintendent of the railway system, and was afterward worked out by Charles E. Hott, master mechanic, and his assistants. Up to the present time ten cars have been fitted for operation in trains in this manner, and ten more are now being equipped.

FIG. 1.—WIRING DIAGRAM OF TWO-CAR TRAIN, ONE CARRYING COMPLETE MULTIPLE-UNIT SYSTEM AND THE OTHER THE STANDARD K-10 TYPE CONTROL

The Supreme Court of Ohio has handed down an interesting decision on transfers in the case of the Cleveland City Railway Company vs. John Connor. Mr. Connor was a passenger on the Franklin Avenue line and asked for a transfer on St. Clair Street. The transfer was punched so as to make it good on the Woodland line, and on refusing to pay another fare Connor was ejected, and he then sued for damages. In the trial the attorneys for Mr. Connor asked the court to order the jury to return a verdict for damages, if they found that an error had been made by the conductor who issued the transfer, and that it could not have been obviously correct to Connor, but the court refused to do so. On that as an error, the case was carried up and the Circuit reversed the Common Pleas, and now the Supreme Court affirms the Circuit, so the case will now go down for new trial, and in that trial the court will be required to instruct the jury as Connor contended it should be instructed.