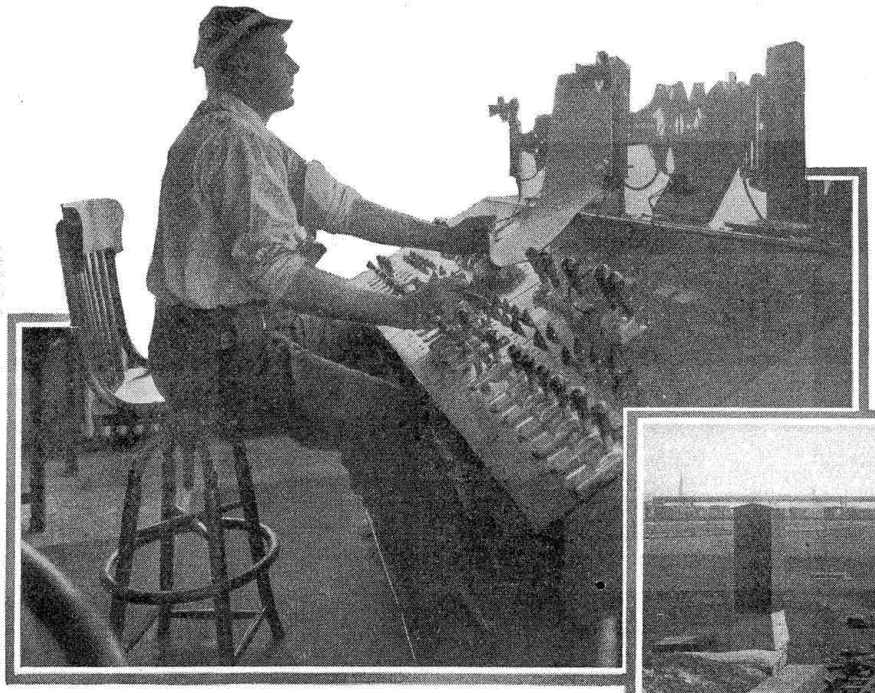
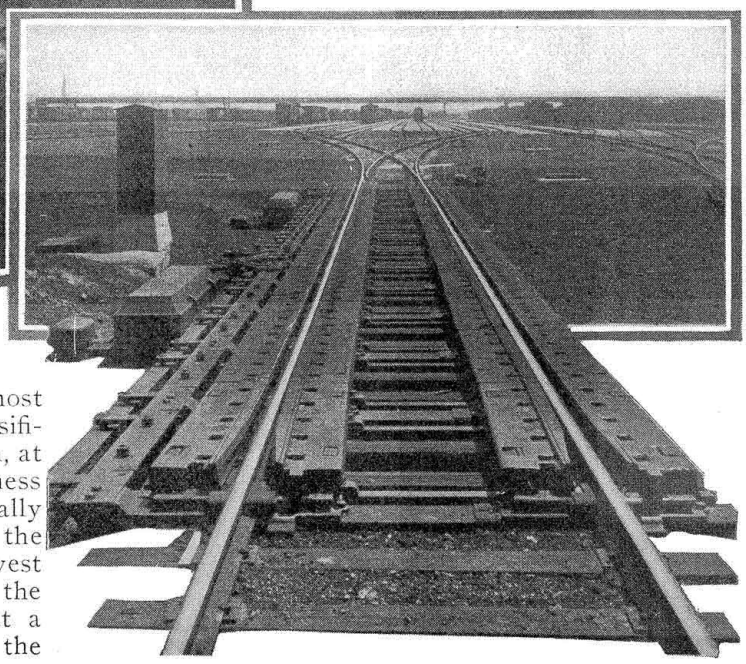
Railway Signaling

Car Retarders Installed by C. & N. W. at Proviso Yard, near Chicago



Power supply, including battery floating on generator, ensures constant service regardless of power failures



Top—Interior of tower showing control machine
Right—Retarder serving a group of seven tracks

THE car retarder system is one of the most important features of the new inbound classification yard of the Chicago & North Western, at Proviso, Ill., about 14 miles west of the business center of Chicago. Proviso is located strategically with reference to connecting lines, as well as to the four lines of the North Western radiating to the west and north of Chicago. The yard lies just north of the Galena division, or Chicago-Omaha mainline, at a point just west of the overhead crossing of the Indiana Harbor Belt line connecting with railroads to the East. Likewise, Proviso is the southern terminus of the so-called Des Plaines Valley line, which connects the Chicago-Omaha line with the Chicago-St. Paul line at Des Plaines and the Chicago-Milwaukee freight line. All inbound freight traffic, for connecting lines and for freight house and industries on North Western rails in the Chicago area is brought into Proviso.

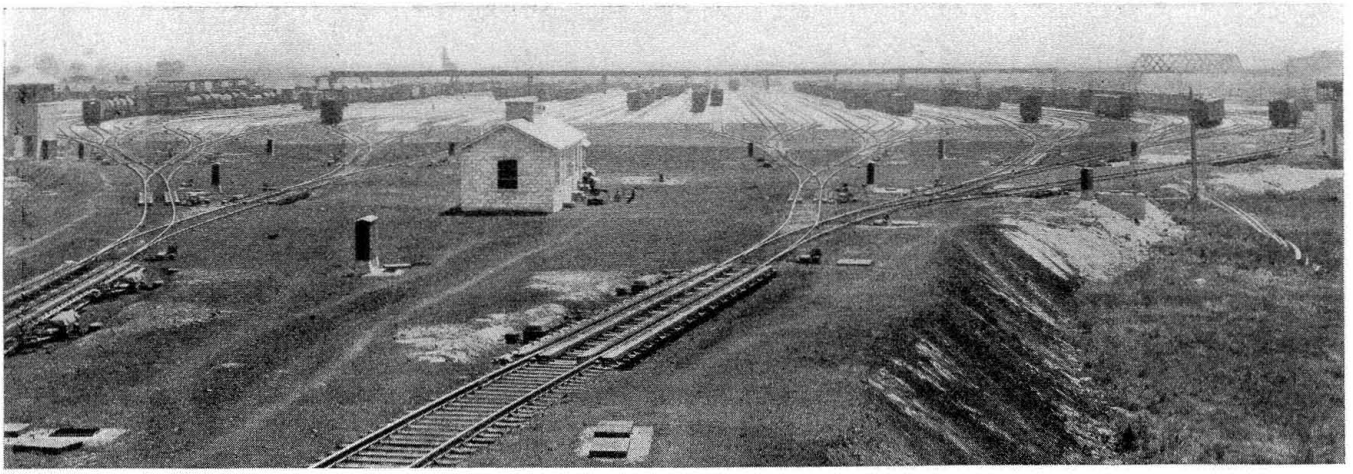
The Eastbound Yards

The receiving yard, consisting of 31 tracks, each holding from 90 to 100 cars, extends in a general north and south direction parallel with the Des Plaines Valley line and about a mile north of the Galena division main line, with a wye connection to the latter line. Trains from any of the incoming routes are pulled directly into the receiving yard, which lies on a practically level grade. A double-track line, built on a level grade, extends from the south end of this yard about one mile to the hump of the classification yard. The present traffic consists of from 2,500 to 3,400 cars daily. The number of classifications desired and the capacity of the yard determined that 59 tracks were required, varying in capacity from 44 to 96 cars. At the east end of the classification yard there is a forwarding yard of 21 tracks, each of 100 cars capacity, and also a repair yard that will hold about 120 cars.

Yard Layout and Retarders

Having made an investigation of various yards, it was decided that car retarders were to be installed for the new classification yard, therefore a special study was made of the various factors involved. Tests of the wind for a year and a half showed that, at various seasons, the wind blew at equal velocity and frequency from all points of the compass; therefore, this factor

was excluded. Approximately 90 per cent of the eastbound cars received are loads, the lading consisting of grain, coal, live stock, lumber, machinery, manufactured products and miscellaneous merchandise. Comparatively few cars have a gross tonnage of over 75 tons, and, therefore, this figure was adopted as the maximum to be handled by the retarder system. When a car with heavier gross tonnage, such as 100 tons, is received, it is lowered part way down the hump before being uncoupled.



View of yard from Tower A

The question of rates and lengths of grades was determined by selecting a desired final speed of 5 m.p.h. leaving the last retarder, with no acceleration at the hump. The formula for figuring the grades is an elaboration of the familiar one for falling bodies, $V=\sqrt{2gh}$, in which "V" is miles per hour instead of feet per second. Substituting any value in miles per hour for "V," a table was worked out giving velocity heads in feet for any speed and from this the velocity a car obtains after traveling any distance on any grade was figured. The type of retarder selected has, when fully closed, a resistance on a maximum loaded car, 75 tons, equal to 2.34 velocity head feet.

In order to reduce the number of retarders, the tracks were grouped in sets of six or seven tracks each, with a set of retarders on the lead to serve all of the tracks on the group involved. There are 30 car retarders in all, located as shown in the plan, and so arranged that a car on any route passes through eight retarders. The retarders, as well as the power switch machines, are controlled by machines in three separate towers, the area controlled by each operator being indicated on the plan.

The track layout was designed to bring the switches as closely as possible to the hump, the average distance from the crest of the hump to the clearance points on the classification tracks being 975 ft. The frogs are No. 8, with the curvature split both ways. Experience showed that the resistance of curvature on curves under 12 deg. was negligible for free-rolling cars; therefore, no compensation was made for curvature.

Considering the fact that all kinds of loaded and empty cars are to be handled at Proviso, an average grade of 2.14 per cent was adopted for the section from the crest of the hump to the beginning of the non-accelerating grade below the last retarder in each route. However, the average grade is not the only consideration, for the length of the different rates of grade at certain locations has an important bearing in expediting the movement of cars. The North Western used a 4 per cent grade for 160 ft. down from the crest of the hump to secure a rapid acceleration of the cars, following which there is 230 ft. of 1.2 per cent grade; then 100 ft. of 3 per cent; then follows 286 ft. of 1.95 per cent grade, and finally 80 ft. of 0.8 per cent, including the last set of two retarders. The total fall from the crest of the hump to the foot of the last retarder is 18.38 ft. in a distance of 856 ft., giving an average grade of 2.14 per cent. From the lower end of the last retarder in each route a non-accelerating grade of 0.3 per cent extends through the several switches leading to the tracks in each group and throughout the classification tracks. At the lower end of the yard a rising grade starts about 200 ft. from each clearance point, the purpose being to slow the cars down where the head-end of a train is established.

Method of Operation

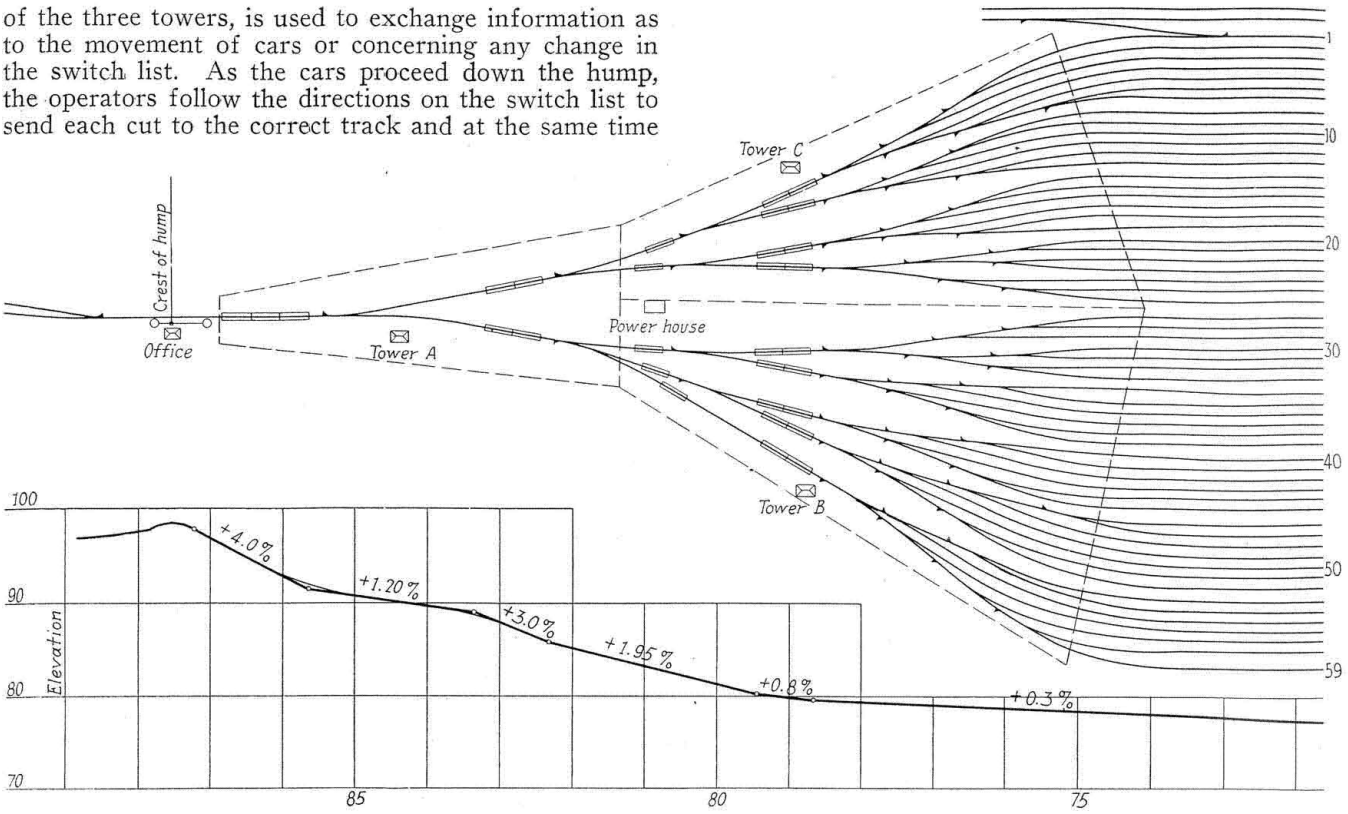
As trains pull into the receiving yard, the waybills are handed from the locomotive to a messenger near the yard office, and are at once sent by a pneumatic tube system to the main yard office, about 1.5 mi. away, requiring only 2.5 min. in transit. After the train is in the yard, about 20 min. is required for a crew of four car inspectors to look over the train and uncouple the air hose. During this time the waybills are checked for classification and the switch list is prepared on a Teletype machine, being duplicated automatically by a Teletype receiving machine in the humpmaster's office and in each of the three towers. An interesting feature is the enclosing of the Teletype receiving machines in cases lined with celotex sound-absorbing material, the result being that the operation of the machines does not distract the attention of the towerman or those in the humpmaster's office.

As soon as the car inspectors complete their work a hump engine pushes the train to the hump, an interesting feature being that the approach from the receiving yard to the hump is on a level grade, so that an ordinary road locomotive can readily handle 100 cars in this service.

The movement over the hump is under the direction of the humpmaster, who operates the control lever for the humping signals. If necessary, the operator in the first tower can put the signals to red. A conductor, assisting the humpmaster, checks the cars against the switch list and directs the cutter, who "cuts" the cars as they pass over the crest of the hump. One brakeman is on hand to ride cabooses and cars loaded with such lading as milk, explosives, etc.

A loud-speaker telephone system, with sending and receiving equipment, located at the hump and in each

of the three towers, is used to exchange information as to the movement of cars or concerning any change in the switch list. As the cars proceed down the hump, the operators follow the directions on the switch list to send each cut to the correct track and at the same time



Track layout showing track grouping

use the retarders to control the speed properly. While the classification is being made, the waybills are sent by pneumatic tube from the main yard office to the departure yard office.

Speed of Operation

The classification yard is producing the desired results in eliminating yard delays, for no car lingers long at Proviso. An average of 30 inbound scheduled time-freight trains, each handling from 70 to 100 or more cars, arrive at Proviso daily, and second sections of some of these trains are run when the traffic requires. As high as 3,400 cars have been classified in 24 hr. and on one occasion 100 cars were classified in 20 min.

About 60 per cent of the cars are destined for connecting lines and the remainder for delivery to freight houses or industries on North Western rails in the Chicago area. Several important through trains bringing grain, live stock and fruit from the west, machinery and automobiles from Milwaukee and Kenosha, etc., are scheduled to arrive at Proviso between midnight and 7 a. m. All of these cars are classified and those for delivery on North Western rails are set at freight houses or industries in time for the opening of business, while the cars for connecting lines are pulled out by the connecting roads in time to make connections at Blue Island, Gibson and Colhour for 10 a. m. and noon departures to the East. The Mohawk, a fast "main-tracker" freight train from St. Paul-Minneapolis, arrives at Proviso at 12:30 p. m. and all cars are classified and ready for departure by 2:15 p. m. in order to make deliveries and eastern connections.

An unusual feature is that some outbound traffic is classified in this yard. For example, cars from the Wisconsin lines that are destined for movement over the Galena division are sent over the hump and classified, several tracks being assigned for this business.

The retarder system, including the power switch machines and signals, was furnished complete by the General Railway Signal Company. The control machines in the three towers are the latest panel-construction type. The levers for controlling the switches are at the bottom of the panels, indicating lights being located immediately above each switch lever. The next row of levers, each of which controls a retarder, are marked to show the four degrees of retardation that can be secured. A special button switch in each tower is provided to operate a Klaxon horn located on the power house for calling the maintainer in case of trouble.

The retarders are the latest, all-electric enclosed type, operated by 220-volt d-c. motors. They stand normally clear and are moved to four other positions closer to the rail, giving the four respective degrees of retardation, at the last position the retarder shoes being at 4 in. opening. The switch machines are the Model-6, high-speed type, operated by 110-volt motors and are so designed that the switch can be trailed through without damage to the machine. For the benefit of enginemen on trimmer engines, a two-indication color-light type switch target is located at each switch to indicate yellow when the switch is normal and lunar white when it is reverse. These targets can also be of some benefit to the towerman, although the same information is shown by lights above each switch lever.

Hump and Trimmer Signals

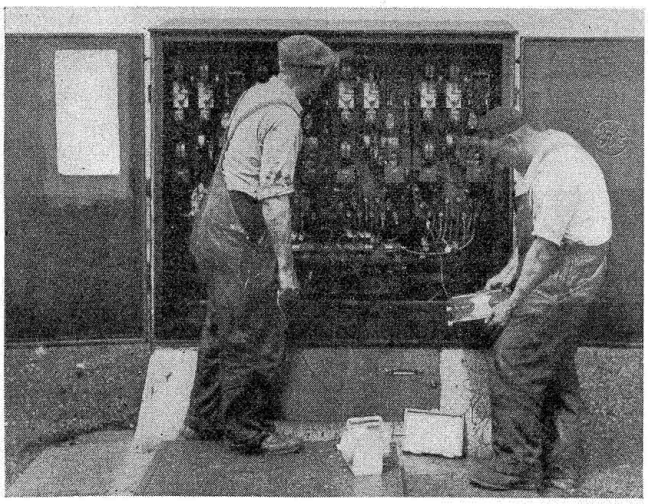
The hump signals are the horizontal-type color-light units. The four indications are as follows:

Green—Hump fast.
Green and yellow—Medium speed.
Yellow—Hump slow.
Red—Stop.
Yellow and red—Back up.

On account of the approach to the hump being on a curve, it was necessary to provide nine hump repeater signals, seven of which were placed on wood poles on account of difficulty in securing proper footing for concrete foundations on the fill. The trimmer signal is of the same type as the hump signal and located back to back on the same pole as the hump signal.

Both the hump and trimmer signals, as well as all of the repeating signals, are controlled from a special hump signal control stand just outside the hump conductor's office. A four-position lever controls the hump signal and a two-position lever, the trimmer signal. Red, yellow and green repeater lights are provided on this control stand, so that the conductor can tell instantly what signal aspect is displayed. Also, the hump signal control is so arranged that the retarder operator in Tower "A" can put the hump signal at red at any time by pushing a toggle switch on his machine.

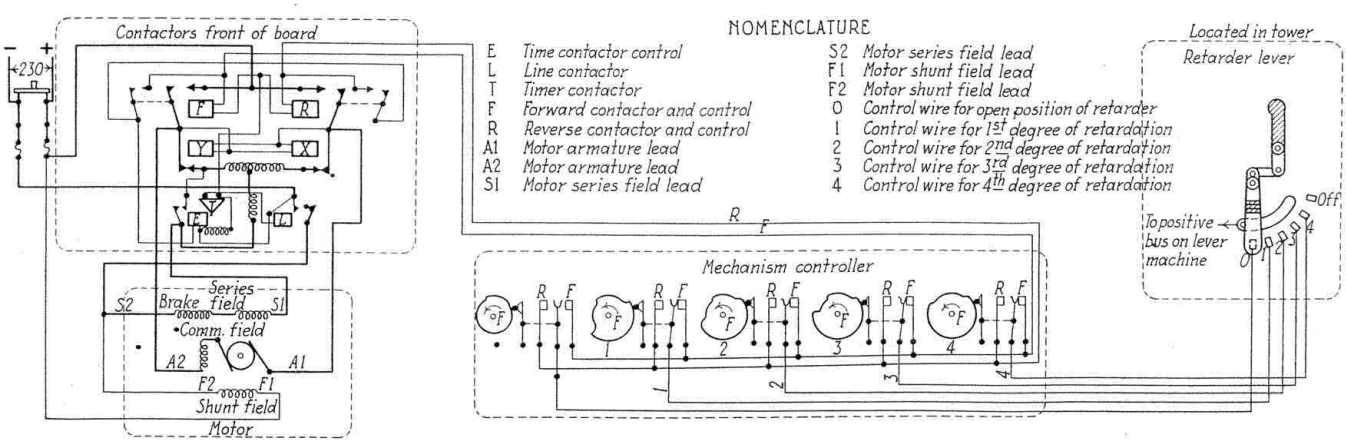
Power is received in the power house at 440-volts, 3-phase. The two motor-generator sets are identical, each being in service during alternate eight-hour periods. The motor on each set is rated at 40 h.p., 440-volt, 3-phase, and the generator is rated at 265 volts at 56.75 amp. normal full load. However, on account of the special diverted pole construction of each generator, it can take a momentary load of 150 amp. without appreciably reducing the voltage regulation; in other words, the momentary capacity is about 40 kw.



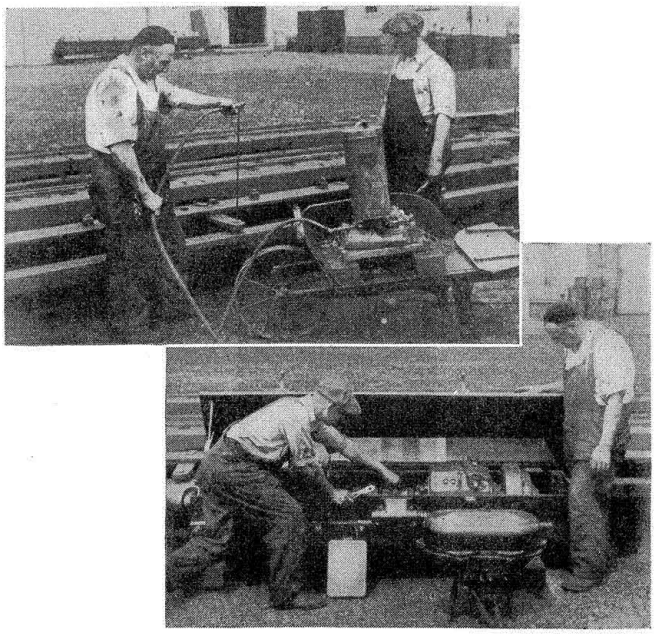
E. A. Mennecke, leading maintainer, at left, and Erving Geer, maintainer, testing controller equipment

The storage battery consists of 120 Exide Type-DMGO-9, 160 a.h. cells. Normally this battery floats across the 265-volt terminals of the generator and is thus fully charged at all times. The main battery is split and 115-volt taps are extended to the three towers to feed the switch-operating circuits which originate at the respective levers.

In case the load on the generator should exceed 150 amp., as required by the retarders, the voltage will drop so that the battery will deliver current to meet requirements, thus preventing further voltage drop on the power-feed circuit. Likewise, in case of an outage of the 440-volt alternating current incoming power supply, the motor-generator stops and the operation of the retarders as well as the switches is carried by the main battery. The switch repeater lever lights, the hump signals, and the loud speakers are normally operated on alternating current. Therefore, in order to continue operation of these functions during a power outage, a separate emergency motor-generator unit was provided.



Typical retarder control circuits



Top—Using an electrically operated power gun to Alemite the retarder bearings
Bottom—Inspecting a retarder mechanism

This machine has a 1.5 h.p., 110-volt, d-c. motor taking power from the main battery, and the alternator is rated at 750 watts at 110 volts.

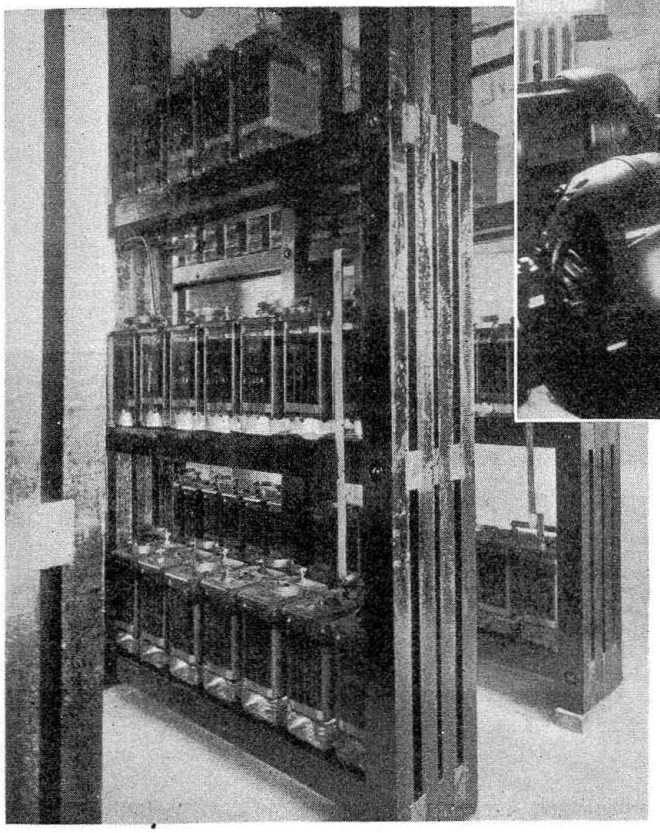
The control and operating circuits between the towers, retarders, switches and power house are all run in underground wires and cables. The main runs are single-conductor insulated wires placed in Bermico fibre duct set in concrete. A concrete manhole is located in front of each tower, under each control panel case at each retarder layout, and near each switch, as well as at other points in the duct runs where required, there being a total of 51 manholes. The circuits from the control panels to the retarder

mechanism, as well as from the manholes to the switch machines, are run in steel-taped parkway cable to pothead boxes near the machines, and single conductors extend through flexible metal conduits to the mechanisms themselves.

The conductors for the 220-volt d-c. circuit for the operation of the retarders are No. 000. The 110-volt power circuit from the switchboard to each tower for the switch machines varies according to the distance and load involved. The control circuits between the towers and the retarder panels are No. 14 conductors. All insulated wires and cable are Okonite.

Maintenance Organization

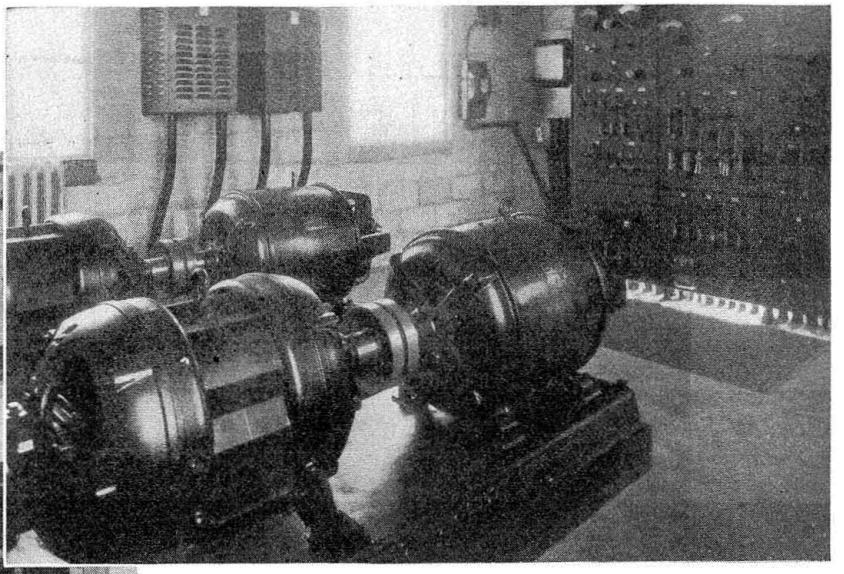
The maintenance of the car retarder system, including the power switches, retarders, Teletype system and loud-speaker telephones, is handled under the direction of one leading signal maintainer, with one maintainer, one assistant maintainer and a helper on the first trick from 6 a. m. to 2 p. m.; a maintainer and an assistant maintainer on the second trick from 2 p. m. to 10 p. m., and a maintainer and an assistant maintainer on the third trick from 10 p. m. to 6 a. m.



The main operating battery

At the beginning of each trick the maintainer makes a general inspection of all equipment to locate any unusual operation or defects, which are corrected as soon as possible. Having cleared up any minor defects, the maintenance men follow a regular program of work as laid out by the leading maintainer, who is on duty during the first trick. The first-trick force concentrate on the retarders, making adjustments to compensate for shoe wear, keeping all pins, bolts and nuts tight, etc. The proper opening of the shoes is 4 in. when closed, and this opening is corrected to compensate for shoe wear by adjustment nuts on one of the main connections, which are moved about ¾ in. to take up ¼ in. on the shoe opening. On the retarders subject to heaviest duty, the outside shoes wear out in about six months, while the inside ones wear 18 months or longer. The replacement of shoes, the renewing of plates and pins, etc., are considered heavy repairs and this class of work is scheduled for Monday of each week, which is the day of lightest traffic.

The first-trick crew also handles the lubrication of the retarders, each retarder being lubricated every two weeks. An electrically-operated power gun is used to force the lubricant into the fittings, about two hours being required for one man to lubricate the 228 Alemite fittings on each retarder. Saturday is clean-up day, at which time the entire first-trick force is busy cleaning the retarders. A mixture of 50 gal. of black oil and 200 gal. of kerosene is made. Taking a pail full and a heavy broom, this mixture is spread all over the retarders and connections to clean off the dirt, to permit the oil to run down into the retarder mechanism as a lubricant, and to prevent rust.



The motor-generator sets and switchboard

The second-trick maintainer and his assistant take care of all the switch machines and the operating mechanisms of the retarders, including the motors. The switch machines are standard equipment, the maintenance being the same as on any interlocking. The retarder mechanisms are inspected to keep the commutators clean and adjusted for wear on the electric brake. Inspection is also made as to correct oil level in the gear case. The controller panels in the cases also require some attention to keep the contacts on the 220-volt circuit breakers clean, a fine file being used for this purpose.

The third-trick maintainer and his assistant take care of all inside equipment, including the switchboard, motor-generators, battery, etc., in the power house and also the control machines in the three towers. Battery readings are made and recorded, and the battery is maintained and kept clean. The motor-generators are inspected daily and kept clean and oiled.

The retarder system described in this article was planned and installed under the jurisdiction of J. A. Peabody, signal engineer, and under the immediate direction of S. E. Noble, assistant signal engineer.