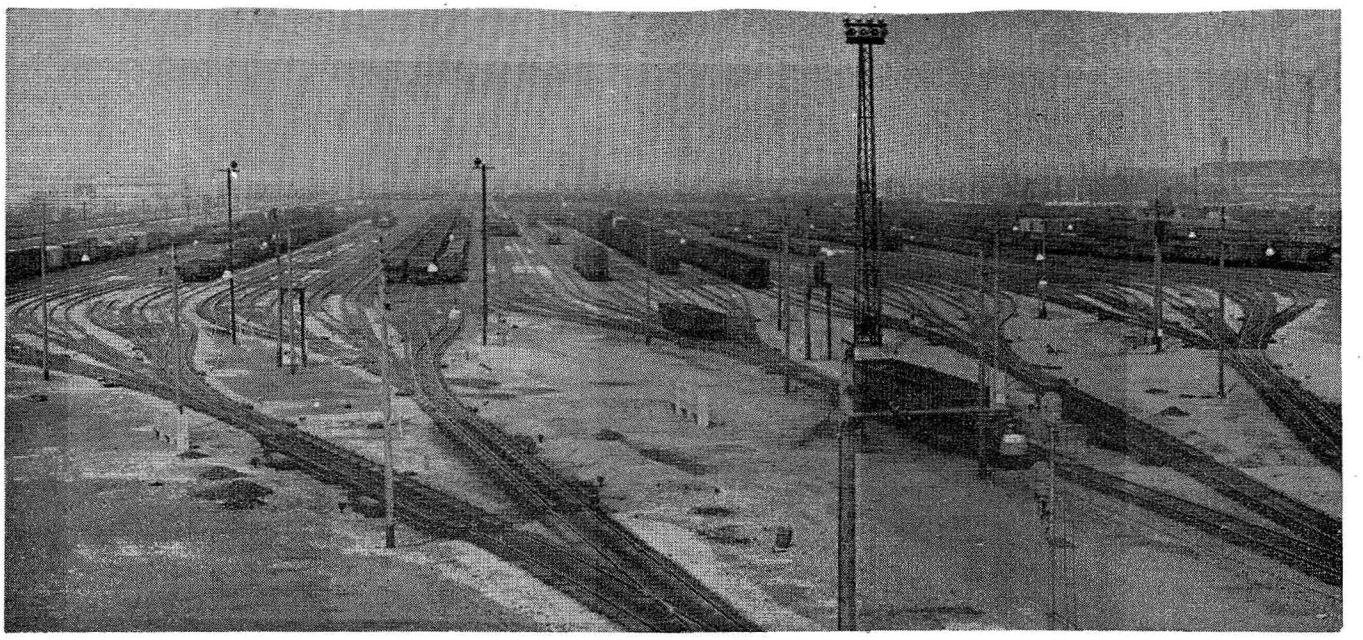
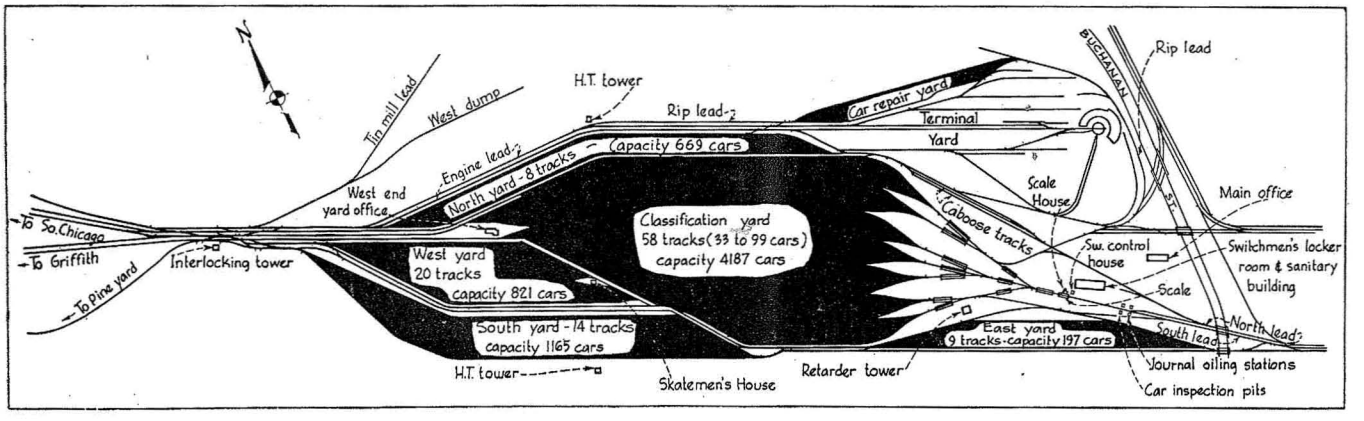


Classification tracks are in groups, so each group retarder serves eight tracks

Electronics at Work



in E. J. & E. Yard

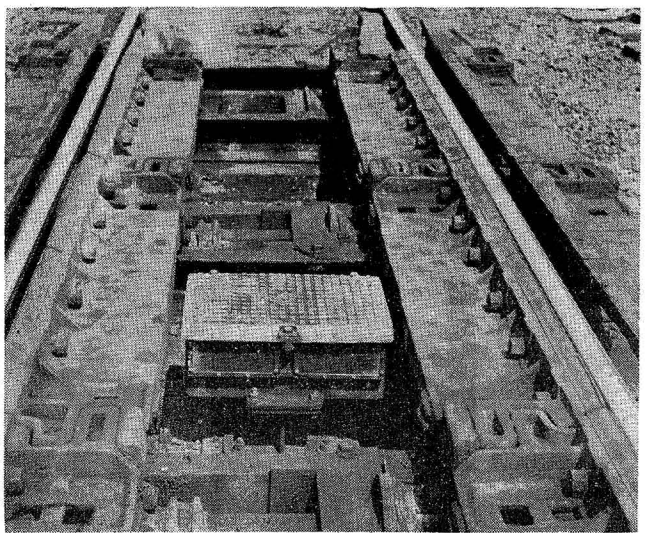
Extensive tests proceed on new automatic retarder control system which is based on weight and speed of cars, measured by electronic ultra-high frequency radiation using Doppler effect. Communications include loudspeaker system, intercoms and remote-control voice recorder.

THE NEW KIRK YARD of the Elgin, Joliet & Eastern at Gary, Ind., has many advanced design features, including a test installation of the new General Railway Signal Company automatic retarder control system, in which retarder controls are based not only on classifications of weights of cars, but also on speed as measured instantaneously and constantly by an electronic ultra-high frequency radiation device placed between the rails near the leaving end of each retarder.

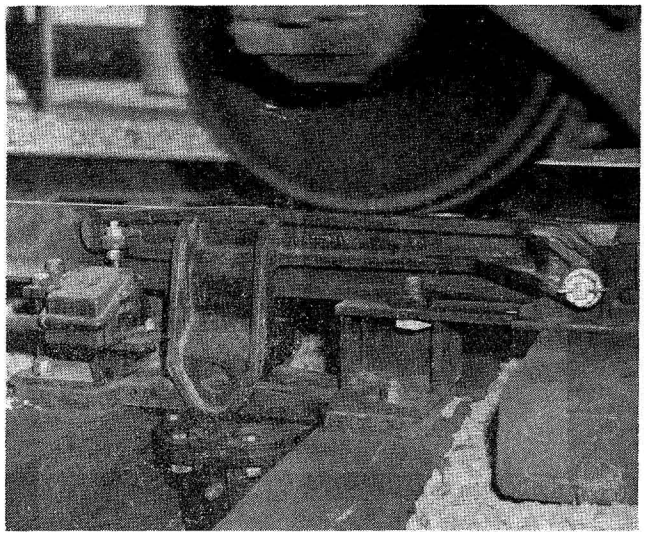
This system has been under development in this yard for the past eight months. For two months this system has been in full service, 24 hours daily, on four retarders, the 99-ft. master retarder on the hump, the 49.5-ft. retarder on the north secondary lead, and on the two 99-ft. retarders on the leads to the two north groups of tracks. Thus cars intended for any of the 16 tracks forming these groups are automatically controlled.

This new Kirk yard replaces eight small flat-switched yards which formerly occupied much of the area. With the new yard, cars are handled from 24 to 48 hours faster than in the old yards. Safety has been improved and operating expenses have been reduced.

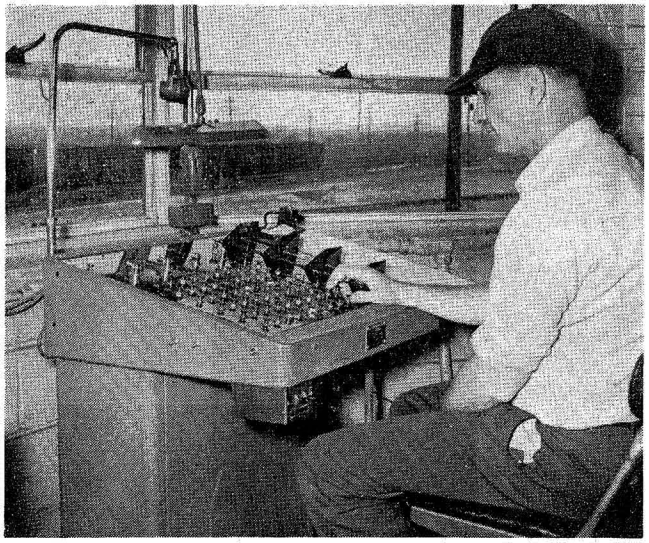
The new yard consists of 58 classification tracks, ranging from 33 to 99-capacity, with a total capacity of 4,187 cars. From the crest of the hump, the single main lead descends at 3 per cent for 300 ft. The tracks there fan out to three secondary leads, and then into



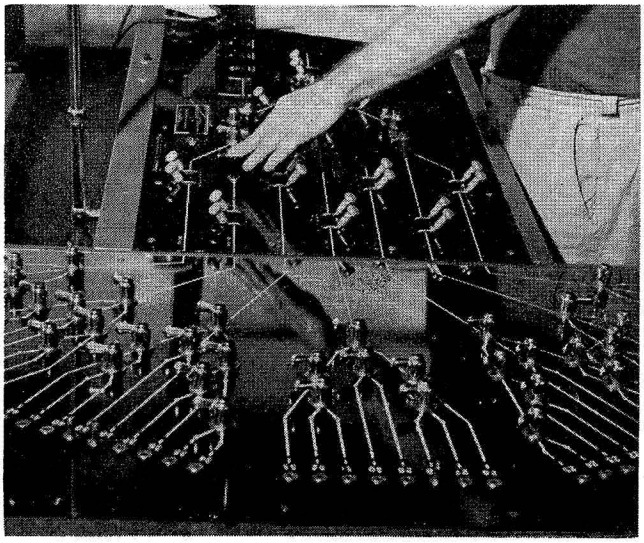
The UHF speed measuring unit is in a case between the rails near the leaving end of a car retarder



Automatic weight detecting unit is beside one rail in approach to first retarder going down the hump



Automatic switching controls are initiated by the switching crew foreman in the hump office



The operator may use a special lever to increase or decrease the release speed of the group retarder

seven track groupings, including the 58 classification tracks, while the grade gradually flattens out through a 1.5 per cent gradient for 400 ft. and 0.8 per cent for 190 ft., after which a descending grade of 0.2 per cent is maintained on all the classification tracks.

The primary retarder on the main lead down the hump is 99 ft. long. The retarder on each of the three secondary leads is 49.5 ft. long, and the final retarder of each of the leads to the seven groups is 99 ft. long. These retarders are the modern, fast operating electric type. The switches are operated by high-speed electric switch machines that throw a switch in 0.6 second.

What Automatic Switching Is

In automatic switching the switches in a route are automatically positioned ahead of a car or cut of cars as it passes from the hump through the various switches to its classification track. The automatic switching as installed at Kirk yard was developed by the General Railway Signal Company in 1950, and is the same as that in service or being installed at nine other yards in the western hemisphere.

In Kirk yard a switching crew uses a diesel-electric switch engine to push a string of cars up and over the hump. Each such crew includes an engineer, a fireman, a foreman, and two switchmen, one of whom acts as "pin-puller." The foreman is in charge of the operation, and when a string of cars is ready to be pushed, he goes to the small office at the crest of the hump. The Teletype list on his desk shows the initial and number of each car, whether it is empty, a light load, or heavy load, and the classification track to which it is to be routed .The list is also marked to indicate the number of cars in each cut.

On his desk is a sloping panel with a push-button for each of the 58 classification tracks. By pushing button "10," for example, he initiates controls so that the switches line up automatically ahead of the car or cut of cars as they pass down the hump and through the switches to classification track No. 10. By pushing buttons in sequence, he can "store" as many as four such route controls ahead of time. He uses his microphone, connected to an outdoor loudspeaker, to tell the pin puller the number of cars in the successive cuts. He can do this also by a button to operate an outdoor buzzer.

While one crew is pushing a string of cars over the

Console on the West End yardmaster's desk enables him to talk with his crews and with other offices

hump, a second crew with a diesel switcher has gone down to the yard to get another string of cars and pull them through either the north or south bypass track to the north or south hump leads, preparatory to humping the next string. Thus a minimum of time is lost and classification is practically continuous.

Apart from the new automatic control, the operation of the retarders is under manual control by a man at a machine on the top floor of a tower located on the south side of the throat and retarder area. The floor level of this operating room is 50 ft. above rail level. Large windows in the front and part of the sides of the room afford a clear view of cars as they pass down the hump through the retarders and well down along the classification tracks. The control machine is of the desk type, shaped like a capital "T." The right-hand panel, 20 in. by 42 in., is directly in front of the operator, and the cross panel, 24 in. by 54 in., is just to the left. On these panels, each track is represented by a white line ⅛ in. wide. On these lines, and at the place corresponding with each retarder, there are small toggle type levers. Each 49.5-ft. retarder is operated by one machine, controlled by one lever. One half of each 99-ft. retarder is operated by a separate machine, so that there are two levers for each of these longer retarders. When a lever is in the normal position the corresponding retarder is controlled to the open (non-retarding) position. Each lever can be thrown to any one of two other positions to secure light or heavy retardation.

Automatic Retarder Control

In the new automatic electronic car retarder control system, the cars are not actually weighed but are automatically classified as (1) light, (2) medium, and (3) heavy. The classifications in these ranges of weight are selected by a new device known as a weight detector unit which is mounted alongside the field edge of the south rail a few feet in approach to the first retarder going down the hump. A treadle on this device is normally in a position about ⅝ in. above the level of the top of the rail, being so held by a strong coil spring similar to those used in some freight car trucks. The amount which the treadle is depressed depends upon the weight of the car. A connection from the treadle actuates a circuit controller to close contacts in accordance with the weight.

At the same time, as the car moves into the retarder its speed is measured by the ultra-high frequency radiation device. This device is housed in a box 22 in. wide by 16 in. deep by 10 in. high, set between the rails, with the top of the unit about 2 in. below the level of the top of rail. The unit rests on a pedestal which is mounted on a footing independent of the retarder structure. Such a unit is approximately 8 ft. from the leaving end of each 49.5-ft. retarder. (Two such devices are used for each 99-ft. retarder.)

The electronic equipment in this device sends out ultra-high frequency waves, in the direction toward the oncoming car. Some of these waves are reflected back, to be received by the device. Because these reflected waves come from a moving object, there is a shift of frequency of the reflected wave (known as the Doppler effect). The difference in frequency between the original and the reflected waves is a measure of the speed of the approaching car. With continuous radiation and reflection while the car is in the retarder area, the measurement of speed is not only continuous but also practically instantaneous.

To change from manual to automatic control, the man in the tower throws the lever for that retarder from its normal manual control position to the "A" (automatic) position. The electronic measures of the weight and speed of cars are then effective in controlling relays in the tower which control the retarder automatically to adjust itself as required to have the car, or cut of cars, leave the retarder at the predetermined optimum speed for cars in that respective weight classification. The release speed can be adjusted according to local conditions and as required on account of low temperatures, snow and adverse winds. This adjustment is not made by the retarder operator, but by a signal department employee when conditions warrant.

On the line on the control panel representing the track lead to each of the two groups there is a special toggle-type lever, which can be thrown by the tower operator to modify the release speed of the corresponding group retarder. For example, for a "hard rolling" car he can modify the control to release the car at above normal speed. Or if a classification track is nearly filled so that the car has only a short distance to go, he can modify the control to release the car at less than normal speed. The automatic system includes allowances for reductions in speeds on curves in turnouts.

Manual Control of Switches

In addition to the automatic switching control described above, the control machine in the tower includes manual control of switches, which is primarily for use when making trimmer moves or when testing the operation at switches. This manual control includes rotary type levers which are placed on the tower control panel at locations corresponding to the respective switches. When automatic switching is in effect, these levers are set to the automatic position, which is with the lever handle off of the lines representing tracks. During manual control, the lever for a switch is moved to place it over the line representing the track to which the route is to apply. The position of the switch is repeated by a small opal indicator lamp in the diverging track line just beyond the lever. In the face of the barrel of each switch lever there is a red lamp which is lighted when the corresponding switch detector track circuit is occupied.

This manual control of switches is not normally in use, the switches being controlled by the automatic switching system. However, the man at the control

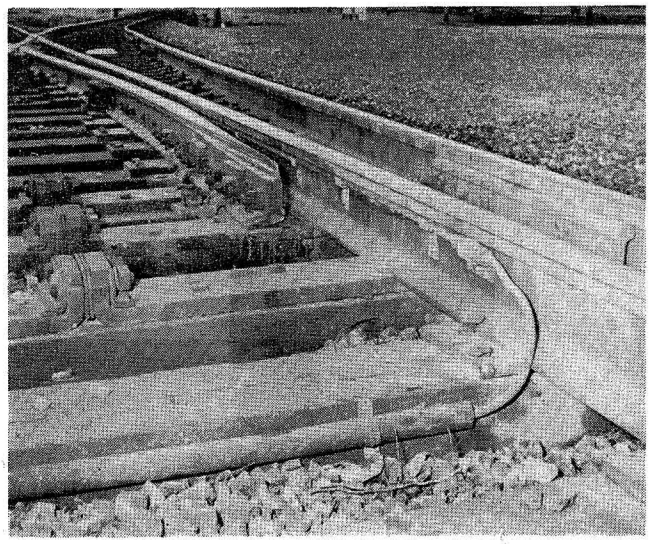
machine is responsible for watching the cars as they proceed to see that each cut is being routed to its proper classification track.

Power Switches

Each power switch is operated by a G. R. S. Model 6 high-speed electric switch machine, especially designed to operate a switch in 0.6 second. The machine is so constructed that if trailed through while trimming no damage will result to the machine, switch points or fittings. Each switch is equipped with General Electric electric switch heaters to melt snow. These heaters are the Calrod tube type operating on 440 volts a.c. and are rated at 200 watts per foot, with a total of about 5.8 kilowatts per switch.

The car retarders are operated by 265 volts d.c., and the switch machines by 132 volts d.c. A diverter-pole motor-generator, rated at 265 volts, 15 kw. output, is normally in operation to provide a floating charge across a set of 120 cells of 240-a.h. Exide lead storage battery. The 265-volt feed of the car retarders is across this battery. Feed for the switch machines at 132 volts is in groups; each group is across half of the battery.

If the commercial a.c. power fails, thus causing the



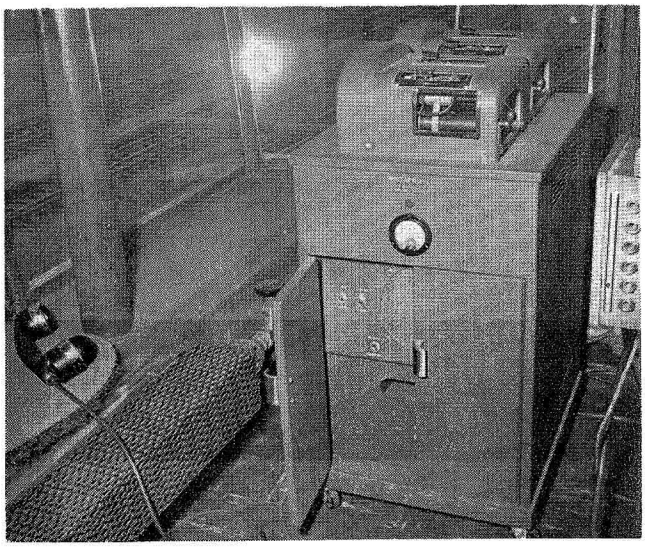
Electric heaters prevent snow from blocking switches

motor-generator to stop, the retarders and switches can be operated from the 240-a.h. battery. Also, in case of a failure of the commercial a.c. power, a 5-kva. d.c.-a.c. motor-generator automatically starts (running from the 120-cell storage battery) to produce 120-volt a.c. to feed the track circuits, indication lamps on the control panel, etc. The circuits for the power switch machines, retarders and signals, are in buried cable which was laid in trenches a minimum of 30 in. deep. This insulated wire and cable was made by the Okonite Company. Wire connections to terminals are made with Aircraft-Marine solderless terminals.

Operation of the Yard as a Whole

A former bottleneck in getting trains in and out of the west end of Kirk yard was eliminated by relocating the ends of two main tracks from South Chicago; and two main tracks from Joliet; the single track from Stockton and the single track from Pine yard, so that they all converge into four main tracks in a new interlocking known as Westgate, at the extreme west end of the yards as shown on the diagrammatic plan. Incoming as well as outgoing trains pass through this Westgate interlocking. The North yard is a receiving yard for traffic from the South Chicago Works of the U. S. Steel Corporation, as well as from industries along two EJ&E main lines from South Chicago southward to Kirk yard.

The South yard is a receiving yard used primarily by incoming road trains from Griffith and beyond. The West yard is used principally as an outbound yard, but it is used also for traffic from and to nearby connec-



Westgate tower operator uses telephone controlled Dictaphone machine to make a record of car numbers

tions, such as the Wabash, the B&O, the Pennsylvania, and NYC. The East yard also is used for cars to and from nearby industries, particularly those east of Kirk yard. It is used also as a "hold" yard.

Cars to be classified are pulled eastward to a point east of the hump, where there are two long tracks. From one or the other of these tracks, cars are pushed west to a single lead which extends westward up a 3 per cent grade to the crest of the hump. On this ascending grade, there are two car inspection pits (one on each side of the track), and a dragging equipment detector, which sounds an alarm if defective equipment is hanging from a car.

The pushing of cars up to the hump is directed by a color-light signal at the crest of the hump, the aspects of which are repeated by four signals along the track in approach, so that the engineman always has a signal in view.

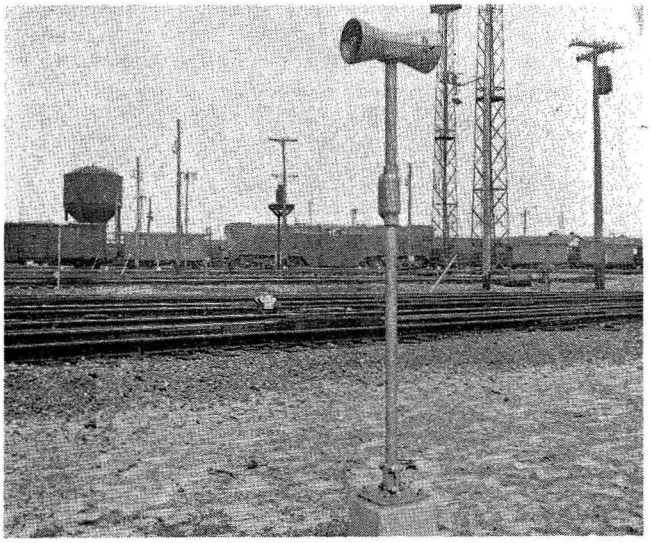
Buildings and Offices

The assistant general superintendent, superintendent, and agent have offices in a previously existing building, known as the general office, at the east end of the yard about 300 ft. east of the hump. The general yardmaster, assistant general yardmaster, and some of the yard clerks are in the yard office on the second floor of a new brick building 40 ft. by 150 ft., just north of the hump. The assistant general yardmaster's office, in the southwest corner of this building, has a large glass-enclosed projection, so that he can see all operations at the east end of the yard. The 10 ft. by 10 ft. one-story building, known as the hump office, north of the track at the hump, includes the control panel for the automatic switching system, this panel being operated by the hump conductor. The retarder tower, located south of the yard opposite the

main area of retarders, is several stories high, the floor of the operating room being 50 ft. above rail level.

At the departure end (west) of the classification yard, there is a new brick building, the upper floor of which is the office for the West End yardmaster. This man has charge of switching operations to remove cars from the classification tracks and make up departing trains, and also he is in charge of directing the work in North yard, South yard and West yard.

As incoming eastward trains pass the Westgate interlocking tower at the west approach to Kirk yard, a yard clerk, standing at the window talks into a Dictaphone machine, stating the initials and number of each car in sequence. This is recorded on a Memobelt. Cars originating at Buffington (a point on the EJ&E main line from South Chicago) are carded on the north side. To read these, the yard clerk leaves the Westgate tower, and stands at a point north of the arriving train. On such occasions, the clerk detaches the microphone



Talk-back loudspeakers are on short pipe masts at numerous strategic locations throughout the yard

and extension cord from the Dictaphone in the tower; adjusts that machine for reception from a telephone line; goes downstairs to his position across the tracks; and plugs his extension cord into the telephone jack in the nearest switch machine. He can then recite the information which he reads from the cars which is recorded on the Memobelt in the tower. Floodlights, on the tower and on two talk-back speakers in front of the tower, permit car numbers to be read easily at night.

How Waybills Are Handled

When the rear of the incoming train passes the Westgate interlocking tower, the conductor throws off the waybills, which, with the Memobelt, are sent by pneumatic tube 2 miles to the yard office just north of the hump. While the cars of that train are in the receiving yard, and are being moved to the track to be pushed over the hump, the paper work is done in the yard office. There the Memobelt is run through a Dictaphone transcribing machine, and a listening stenographer types a train list.

Clerks check the waybills with this list, and then designate the classification track for each car or cut of cars. Then a switch list is typed on a Teletype sending machine which simultaneously operates Teletype receiving machines to type the same list in other offices: (1) in the hump office which includes the automatic switching control panel; (2) in the assistant general yardmaster's office which overlooks the hump area; (3) in the track scale house; (4) in the retarder control tower operating room and (5) in the West end yardmaster's office.

While cars are being classified, the waybills are being sorted in the office. When cars on a classification track are being made ready for a departing train, a yard clerk makes a walking inspection and lists the car numbers in the order found. Returning to the yard office, the clerk dictates a Memobelt record of his information, and sends it to the agent's office, where the consist list is made and the waybills arranged accordingly.

Another check is made as the departing train pulls past the Westgate interlocking, where the yard clerk makes a Memobelt record of the car numbers in sequence. This Memobelt is sent by pneumatic tube to the agent's office, where the information is checked against the office copy of the train list. Hence, corrective measures can be taken if any car gets into the wrong train, or fails to be in the train for which it was intended.

Loudspeaker Systems

Throughout the entire yard, wherever the need presented itself, customized loudspeaker systems were installed. For greatest efficiency, it was felt that all those directly involved in the hump operation should be kept informed on the operation as it developed. For this purpose, "Line 1" was installed. Obviously such a system using only a single line demanded constant monitoring, which could be more of a hindrance than a help to some of the stations. As a result "Line 2" was provided. Both lines were brought to the assistant gen-

A clerk in the yard office Teletypes a switch list which is simultaneously reproduced on Teletype printers in yard and hump offices and elsewhere

eral yardmaster, hump conductor, retarder operator, scale house, signal shop and relay room in the retarder tower, and yard clerk in the general yard office. Only Line 1 was brought into the car inspection pits.

The assistant general yardmaster normally monitors Line 2. If his attention is required on the hump, he is paged on that line and switches over to Line 1 to investigate. This station is capable of two-way operation on both lines.

The signal shop and relay room in the retarder tower

are equipped with units which are capable of two-way operation on Line 1 or monitoring only on Line 2. The signalmen use Line 1 as an intercom and periodically monitor it to ascertain equipment difficulties through humping peculiarities. Since they are not concerned with usual hump operations, their speakers are kept on Line 2 where they are called should trouble arise.

The hump conductor, scale operator, retarder operator and yard clerk in the general yard office normally converse on Line 1. Their units incorporate a switching arrangement allowing transmission only on Line 2 when it becomes necessary to contact the signalmen or assistant general yardmaster. In addition, the general yardmaster can converse on Line 1 if he desires. He also has a private intercom with the assistant general yardmaster, can converse with the West End yardmaster and monitor the West Gate interlocker-assistant general yardmaster intercom. The hump conductor has a paging speaker which he uses in directing the pin puller. Supplementing Lines 1 and 2, the retarder operator monitors the assistant general yardmaster's transmissions over the group of three paging speakers mounted on the retarder tower, and four two-way speakers in the throat of the hump.

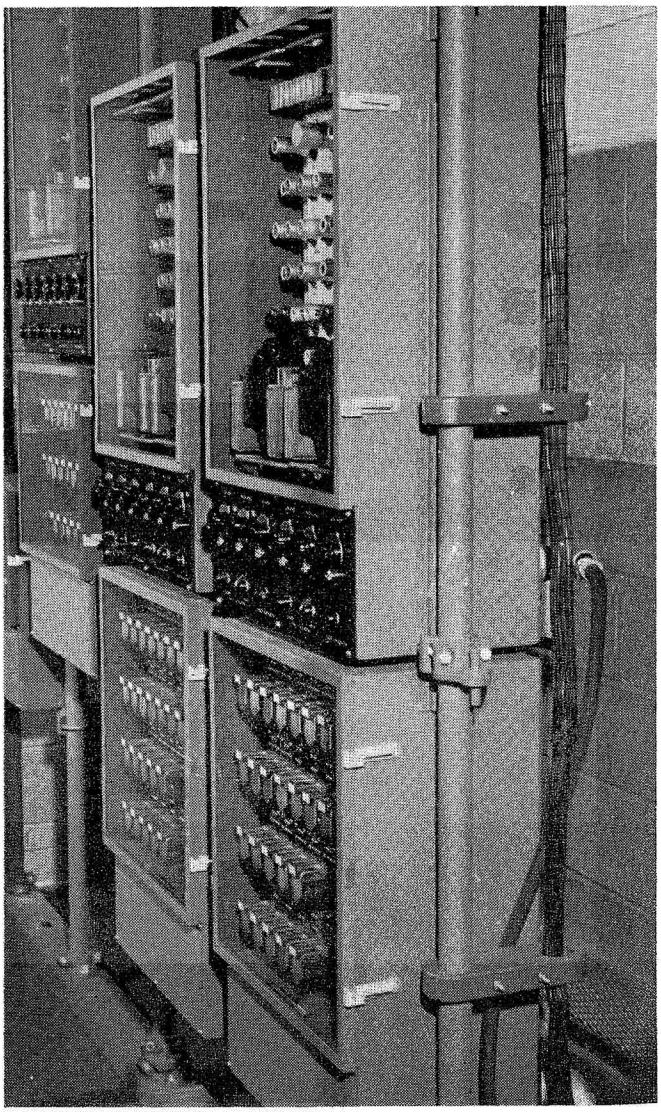
A console on the assistant general yardmaster's desk gives him control of a more comprehensive system. One group of two paging speakers is located at the east lead to the North yard, with a second group of three being mounted on the retarder tower; 13 two-way speakers, one being at the west end of the caboose track, two along the east lead to the North yard, one north of the switchman's building, one at the switch to the north hump lead, one at the switch to the south hump lead, one at the east end of the crossover East yard to the south hump lead, one at the east end of the crossover south to north hump leads, one west of the Broadway bridge, and four in the throat of the hump, cover the area. The latter four can be tied together through a special circuit for group paging. To complete his fingertip control of the yard, the console contains intercoms with the West End yard office yardmaster and West Gate interlocker operator, as well as the facilities mentioned previously. To accomplish better coordination, a station on the West End yard office intercom was provided in the general yard office.

The West End yardmaster has the largest loudspeaker system in the yard. His console controls six paging groups: three groups of three speakers each, and three groups of two each. They are located near the west end of the terminal yard, at the west end of the rip track, midway of the west lead to the classification yard, on the tower, at the west end of North yard, and midway of the west lead to South yard. Twenty-six two-way speakers, four along the north side of the engine lead, 13 along west leads to the classification yard, three near the west lead to North yard, three along the west lead to the West yard, one midway of the west lead to South yard and one near the car inspector's office in the tower are under his control. The 13 placed along the west lead to the classification yard can be grouped together for paging purposes. This feature was provided to instruct skate men, who fall under the yardmaster's jurisdiction. Intercom lines were installed to the West Gate interlocker and assistant general yardmaster.

The operator's console, at West Gate interlocker, controls one paging group, nine two-way speakers and two intercom lines as already explained. The paging group consists of a total of six speakers, three mounted on the interlocker tower, two at the east end of the interlocking plant, and one at the west end of the engine lead. Three two-way speakers are installed between tracks directly in front of the tower, and three speakers span the east end of the interlocking plant. Three speakers also cover the west end of the plant; one on the main line from Griffith, one on the main line from South Chicago, and one at the west end of South yard.

The communications equipment on this project, furnished in complete packaged form by the R. W. Neil Company, included relays made by the C. P. Clare Company, and talk-back and paging speakers made by Jensen Radio Manufacturing Company. The bulk of the underground intercommunication and loud-speaker circuits are in Whitney-Blake, Teleseal, No. 14, twisted pair. The d.c. energy for operating the Teletype circuits is furnished from Fansteel rectifiers.

The signals, retarders, power switch facilities, and controls, as well as the communications systems in this yard, were planned and installed by EJ&E forces, under the general jurisdiction of the late F. G. Campbell, chief engineer, S. H. Shepley, chief engineer, in immediate charge of field construction, and W. K. Waltz, signal engineer. The construction of the signaling facilities was supervised by Arthur Jensen, signal supervisor, and the communications equipment including the pneumatic tube system, by W. E. Storey, chief lineman. The power switch machines, car retarders and special control systems were furnished by the General Railway Signal Company.



Automatic retarder control equipment and relays