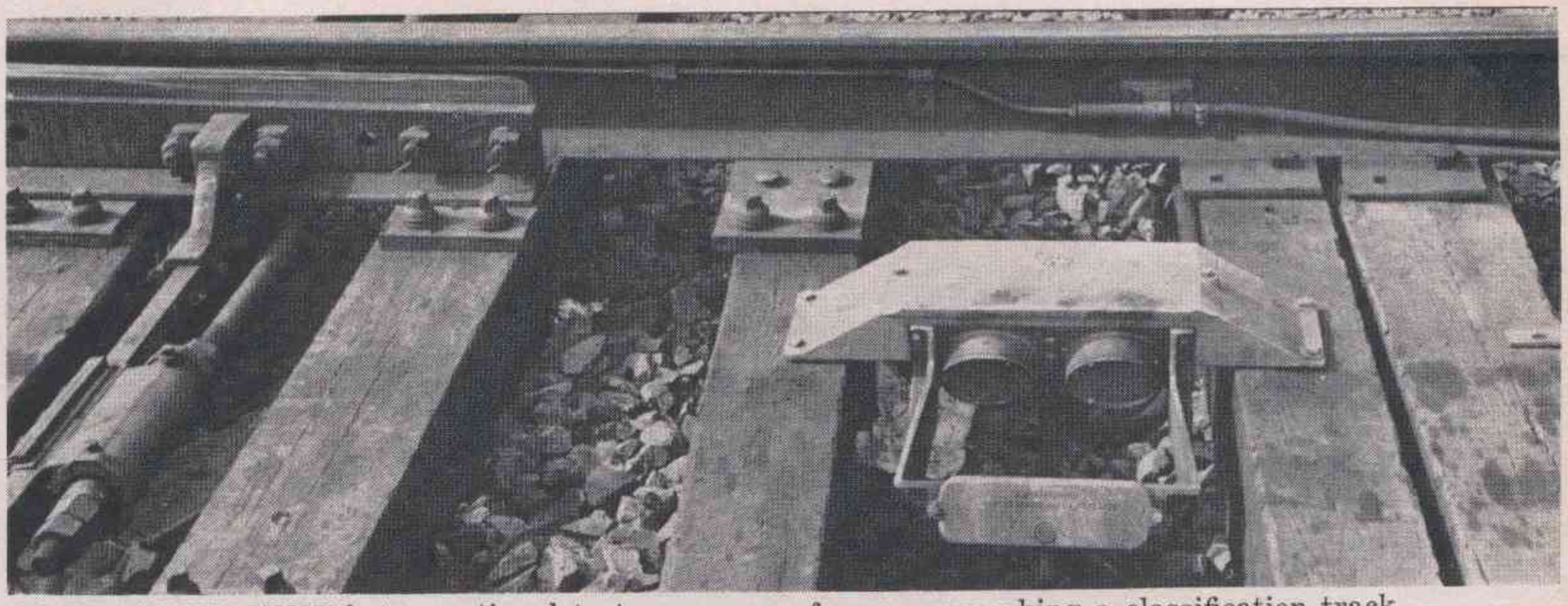
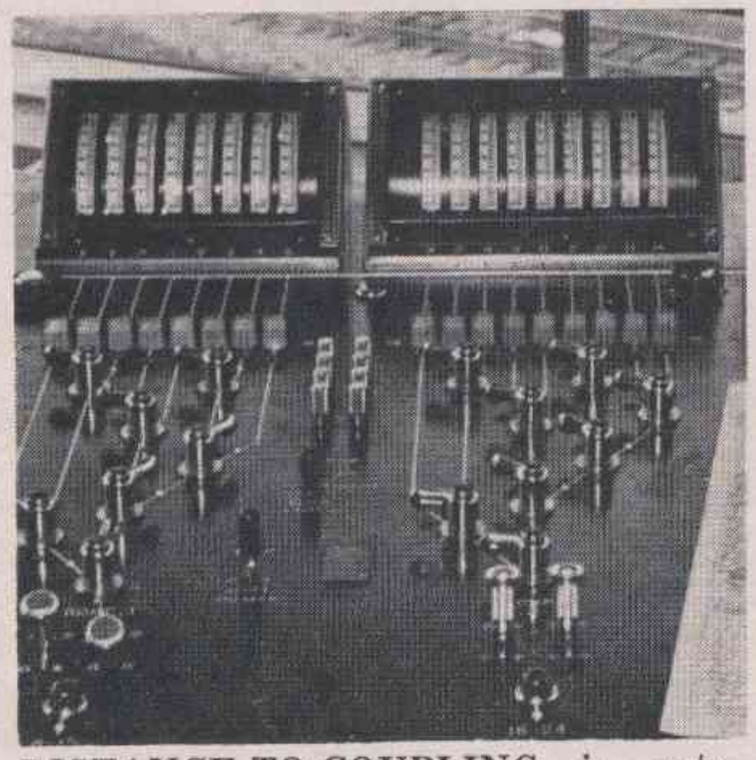
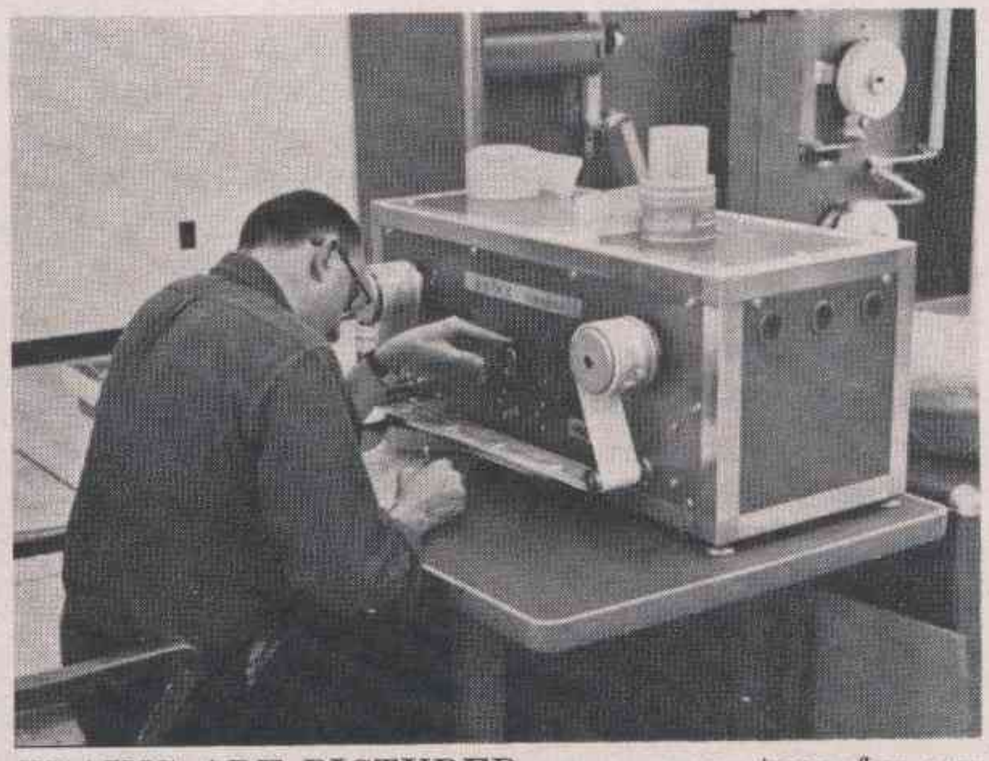


ULTRASONIC UNIT between ties detects presence of cars approaching a classification track power switch. Tube on rail is an electric snow melter.



DISTANCE-TO-COUPLING is automatically fed to the retarder controls.



TRAINS ARE PICTURED on a paper tape for car checking purposes in the yard office.

Joint E-L, NKP Venture

Bison Yard in Service

Built at a cost of $13 million, the new electronic classification yard will speed cars through the Buffalo gateway at the rate of 3,000 a day. It was constructed under heavy traffic.

Bison Yard, first electronic class yard to be jointly owned and operated by two railroads, has started serving one owner and will start to work for the second in about a month.

The new retarder yard, at East Buffalo, N.Y., is owned 50-50 by Erie-Lackawanna and Nickel Plate. Already in service classifying E-L trains, it will take on NKP operations about June 1.

Bison represents a $13-million investment for its co-owners. Its purpose: classification of over 3,000 cars daily at one of the East's major rail centers, with significant savings in interchange time for the owning lines, connecting roads and shippers; better car utilization; and elimination of many duplicate operations.

● **Traffic is heavy.** Emphasis on time-saving is especially important, in view of the volume of traffic handled through the Buffalo gateway—E-L and NKP received 560,000 cars from nine connecting roads last year and delivered 580,000; interchange between the two approximated 95,000 cars each way.

The new yard, on the site of the former east and westbound Lackawanna yards, will feed traffic westbound to points on both E-L and NKP, and via connecting roads north and west to Niagara Falls and Canadian points. South and eastbound, traffic will flow over the E-L. Heaviest traffic periods at the yard will be Friday through Sunday, for all three tricks.

Bison Yard is notable for several firsts and other features that make it different from other electronic yards. Among the highlights:

● The yard was built under traffic (constructed in stages), with the E-L using sections of the new yard as soon as tracks were completed.

● The electrical distribution and lighting system has 19 floodlight towers, each 150 feet high and built to withstand 150-mph winds. Severe winters necessitated electric snow melters on 240 switches, hand-throw and power.

● The yard has the first use of

a Videograph car checking system, whereby inbound trains are scanned and their pictures printed on paper tape in the yard office.

- Blue flagging system provides protection for car inspectors working in the class yard.
- Ultrasonic presence detectors are used with 55-foot detector track circuits to detect presence of piggyback and other long cars.
- Distance-to-coupling data on class tracks is automatically fed into the computer of the automatic retardation control system.

Although Bison Yard was originally designed as a modern classification facility for Erie-Lackawanna only, an agreement was reached with Nickel Plate in the fall of 1961 for its participation. Each road has an undivided one-half interest and ownership to use the yard in common. Employees and supervisors of both railroads will jointly participate in the operation and maintenance of the yard.

At the time of the agreement, some grading, and removal of trees and brush had taken place and, of course, the basic design had been established. However, with NKP's interest in the yard, designs were revised for increasing its size to handle the additional traffic.

Contingent upon NKP participation, a joint operating committee was formed consisting of T. E. McGinnis, assistant general manager, E-L; V. E. Coe, general superintendent, NKP; J. I. Michel, assistant comptroller, E-L; and W. F. Bowman, assistant comptroller, NKP. This committee worked out details of the agreement for joint operation, as well as the myriad other details attendant upon two railroads owning and operating a large retarder classification yard. Administration and supervision of the yard will be distributed between both railroads, subject to the agreement.

Because Bison Yard was started by the E-L (it let the original contracts), construction has been under jurisdiction of E-L's assistant chief engineer, maintenance of way, R. F. Bush. Since its inception, the joint operating committee has been interested in the construction of the yard and has worked with Mr. Bush, even though the committee's major interest has been working out agreements for the joint operation.

At present, Bison Yard is classifying E-L trains. Nickel Plate is expected to begin using the yard June 1, when it is anticipated that diesel servicing and car repair (spot repair system) facilities will be completed. Chesapeake & Ohio and Wabash trains which were handled in other E-L yards are temporarily running into the new yard, pending agreements between those roads and Bison Yard's co-owners.

- **Classifies 3,000 cars.** The new yard, with its 49-track classification yard, is designed to classify 3,000 cars daily. Space limitations did not permit an in-line yard, so receiving and departure yards are on either side of the six-group class yard. North yard has nine such tracks, while south yard has five corresponding tracks. Dwarf-type signals mounted two high and facing in opposite directions serve as shove signals for departure yard tracks. Illumination of the lunar-white shove signal alerts the crews to stop shoving to avoid fouling leads on the opposite end of these departure tracks.

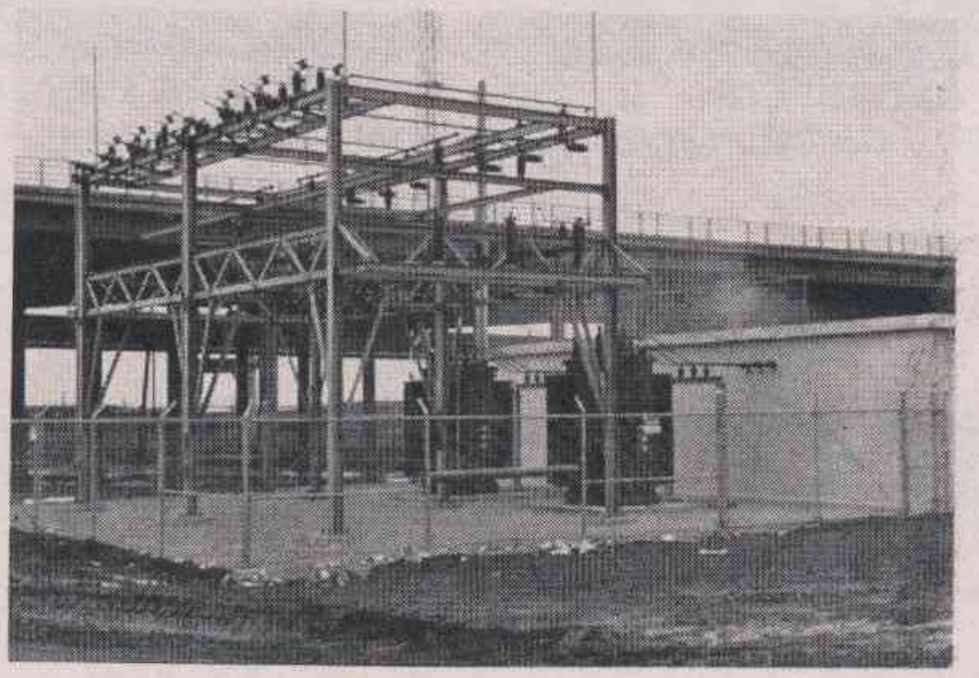
Classifying is from east to west (to take advantage of the lay of the land). Trains are pulled back and shoved over one of the two hump leads towards the crest by road-switcher locomotives equipped with radio and inductive-type cab signals. Wayside hump and trimmer signals are also provided. Trimming is performed by a separate locomotive that is radio-equipped. Although not installed, there is room to extend the second hump lead over the crest to provide simultaneous humping of two trains if future traffic warrants. There is also room for an additional class-track group north of the present six groups.

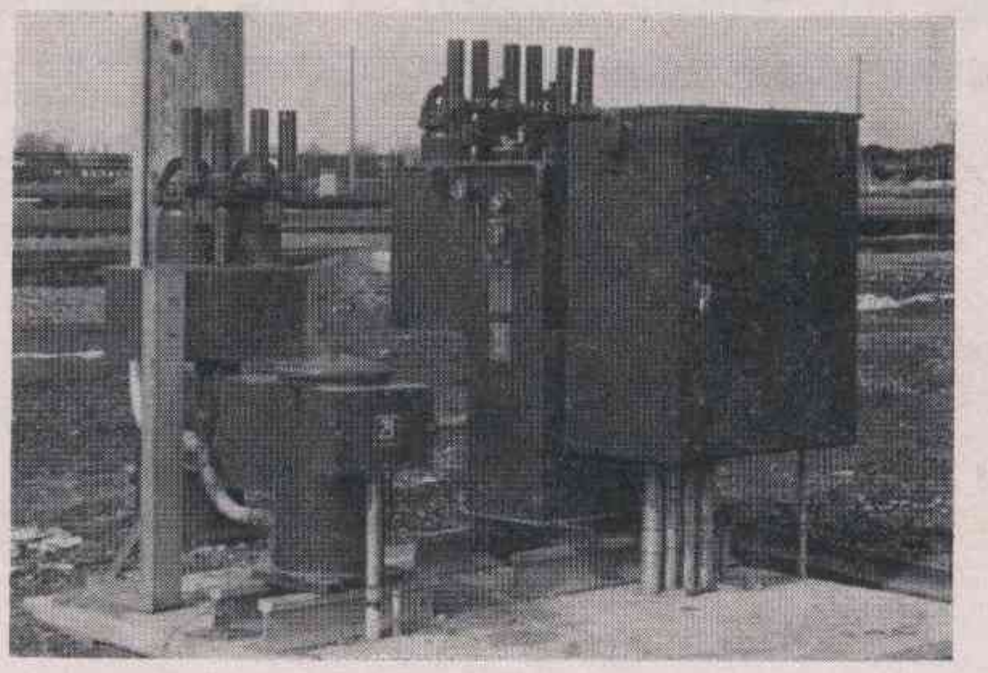
Automatic switching (hump conductor presses numbered buttons corresponding to class tracks) and automatic retarder control is provided by General Railway Signal Co.'s Class-Matic II system. Piggyback cars are to be humped as single-car cuts.

To prevent cars from fouling leads at the bowl end of the class yard, Racor inert retarders (made by American Brake Shoe Co.) were installed on each of the 49 class tracks.

To expedite movement of trains into and out of receiving and departure yard tracks, non-interlocked model 6A power switches were installed. These switches, controlled by an operator in the west-end yard office, have only an operating rod and are equipped with a switch-circuit controller.

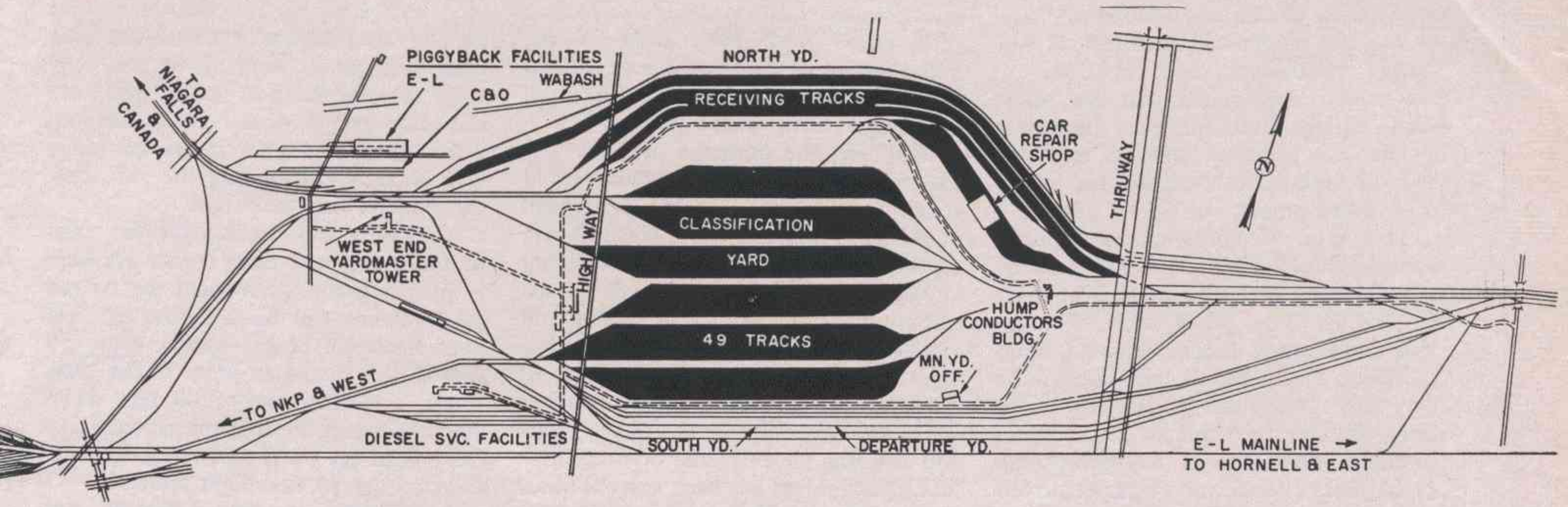
- **Extensive communications.** Several communications systems were provided to insure efficient operation. Western Railroad Supply Co. was the contractor for installing the communications facilities. Seven talk-back speaker systems, three two-way radio systems, three pneumatic tubes, printing telegraph equipment and PBX dial telephones off existing exchanges were installed. Made by Electronic Communi-





Lighting and Power Distribution

Floodlight towers 150 feet high concentrate the light where needed. Primary power has dual feeds to 37.5 kva transformers (top). Distribution is to self-contained transformer banks (below).



BISON YARD is adjacent to the E-L mainline (bottom of map). Yard was built under traffic.

cation Equipment, Inc., the loudspeaker systems have a total of 178 talk-back speakers, each controlled by the following personnel from office consoles: general yardmaster, west-end yardmaster, retarder operator, west-end operator (controls non-interlocked power switches), train-yard foreman, car-repair foreman, and hump conductor. Intercom circuits connect these consoles to provide instant two-way communications. Facilities have been provided whereby the general yardmaster can, when required, take over individually or collectively the west-end yardmaster system, the car-repair foreman system and the train-yard foreman system.

The three VHF radio systems (Motorola transistorized equipment) are designed to operate as independent entities. One of the systems is under the control of the hump conductor and is used by him for communication with the hump engines. Only the hump conductor has access to the transmitter in this system. However, a monitoring facility is provided whereby the general yardmaster and west-end yardmaster can monitor the transmission.

A second radio system is provided for communication with the trimmer engine and also with road trains of E-L and NKP. This system is controlled by both the general yardmaster and the west-end yardmaster. In addition to the E-L base station (yard and road frequencies), an NKP base station was provided. To obtain good coverage to road trains, the antennas for the E-L and NKP base stations are atop 150-foot floodlight towers, as are the other radio-system base-station antennas.

The car inspectors' radio system is controlled by the train-yard car foreman and provides not only for communication between him and the car inspectors, but also for instant two-way communication between car inspectors. This system consists of separate transistorized transmitters (160.95 mc) and receivers (161.55 mc) carried by the inspectors in a belt around the waist. The units work with three receiving base stations and one transmitting station. A voting circuit selects the strongest received signal, which is sent via wire line to the transmitter and the train-yard car foreman's console.

Three tube systems

Three Kelly pneumatic tube systems are provided to transmit such things as waybills and switch lists to proper personnel with minimum delay. One 6-inch tube system connects the east-end entrance to the yard with the general yard office. To enable conductors of inbound trains to put their waybills into the tube system without stopping the trains, an ingenious conveyor-belt-and-hopper unit was installed. The conductor is provided with a conventional pneumatic tube carrier in which to place waybills. As the train approaches the hopper, occupancy by the train of a track circuit actuates a 40-foot conveyor belt. As the caboose passes, the conductor lobs the carrier into the hopper and the conveyor moves the carrier into the tube system. The second 6-inch pneumatic-tube system connects the west-end yardmaster with the general yard office. An access point to this system is provided approximately midway between the two terminations. This access point enables inbound train crews to use the facilities of the system.

A third 3-inch tube connects the general yard office with the hump conductor, general yardmaster and retarder operator. This system permits quick distribution of train switch lists.

IBM-Teletype equipment is used at the general yard office for preparation of switch lists and train consists. The teleprinter system connects the general yard office with the nearest advance train-consist relay points (major yards). Westbound consists are sent simultaneously to Conneaut, Cleveland and Bellevue, Ohio, on the NKP and to "BX" office at Buffalo and then to Meadville, Pa., on the E-L. Eastbound consists are sent to "BX" office at Buffalo and then to the E-L yard at Hornell, N.Y.

At the spot-repair car facility, a car-reporting recording system will be installed enabling the general car foreman to record the necessary information required for accounting of car repairs. An electronic tape-recording device in the car-repair office will be actuated by the foreman pressing a pushbutton on a telephone handset plugged into any of several outlets along the repair tracks.

● **Built under traffic.** Because Bison Yard occupies the site of the former DL&W east and westbound yards, the new yard was built under traffic. Design had to take into account highway and railroad overpasses at the east and west ends, the Lehigh Valley mainline on the south, and industries on the north. These factors and the contour of the land determined where the class yard and hump would be located.

As E-L was using the former DL&W yards, the new yard had to be built in stages. One of the first steps was construction of what is now the south yard. Land was cleared and graded. New tracks, using 130-pound rail obtained from other areas of the E-L railroad (portions of double main track removed when mainline was single-tracked and equipped with CTC) were laid using the panel method. After several tracks were connected to other sections of the yard, these tracks were released to the operating department for its use. In turn, the eastbound yard was taken out of service, and new tracks were laid after grading and the

installation of drainage facilities. One of the last stages was removal of the former westbound yard. Portions of the former Erie yards and the NKP yards will be used for local purposes. Tracks not required will be removed and the land made available for industrial development.

This type of construction required considerable flexibility on the part of the operating departments to keep traffic moving. Other yards, such as Meadville and Hornell, helped reduce Buffalo switching requirements by pre-blocking cars for connections at Buffalo. Similarly, Buffalo was able to send blocks to these yards without any presorting, so that finer classification was performed at Meadville and Hornell for cars destined to these points and beyond. Nickel Plate, and also Wabash and C&O, performed blocking or presorting of cars for E-L to help reduce its switching load during construction of the yard.

NKP trains will enter and leave Bison yard over double-tracked access routes acquired by Nickel Plate.

During construction of the yard, some problems were encountered because of working under traffic. For example, some earth under the former yard could have been used in the initial phases of yard construction. Two borrow pits east of the yard were used to provide earth where needed.

Similarly, the drainage problem was magnified by constructing the yard in stages with sections of the yards still in service. Drainage was a big problem, reports Bernard Dexter, E-L resident engineer, and was not helped by the soil conditions—foundry sand, slag and cinders on top of the ground and a layer of clay beneath with water in between. By spreading these materials in the swampy areas alongside the yards and building an extensive drainage system, the problem has been solved. Main drains, 30 and 24 inches in diameter, are parallel to yard tracks. Lateral drains are 18 and 24 inches. Drainage pipe is perforated, with an asphalt-coated asbestos bonded to corrugated galvanized steel. This drain pipe was chosen because the perforations handle the drainage better than tile and lower the water table.

Only 130-pound rail is used in the new yard. New 130-pound rail was purchased for use over the hump, the crest and down to the clearance point on the classification tracks. After the relay rail panels (one rail-length long) were laid in the new yard, ties were inspected and those not up to standard were replaced. Stagger in the rail joints was obtained by pulling the rail after the panels had been laid.

To assure that track over the crest of the hump and class tracks are kept at proper grade, permanent top of rail grade stakes will be set every 25 feet over the crest of the hump, every 50 feet to the clearance point in the class tracks and then every 200 feet down the class tracks. Permanent bench marks have been set on the concrete foundations of the 19 floodlight towers.

● **Lighting system.** Although not quite turning night into day, Bison Yard's floodlighting provides a minimum light level of one-half foot-candles, rising to 10 foot-candles at the retarders and reaching a maximum of 20 foot-candles at the crest of the hump (conservative ratings). Mounted atop each of the 150-foot floodlight towers are incandescent, 1,500-watt bulbs with spun aluminum reflectors. A tower at the crest of the hump and two in the retarder area have a second set of lamps mounted at the 85-foot level. Control of the lighting for each tower is by a photocell mounted at the 38-foot level. Lights are automatically turned on when the ambient light level falls to 3 foot-candles. The photocells face north, and the narrow-beam floodlights are focused in an east-west direction so that the photocells will not receive enough illumination from the floodlights to turn them off.

Each of the light towers is 150 feet high and built to withstand 150 mph wind loading. The use of towers was preferred because of high winds and blowing snow in the winter. The high winds prevalent in the area, it was felt, would probably damage a catenary lighting system (where strings of lights are hung low on catenaries over the tracks). The tower system was considered most desirable and allowed the use of narrow-beam floodlights to concentrate the light where needed.

Primary power for the yard is supplied by dual 34.5-kv three-phase aerial feeders from Niagara-Mohawk Power Co. through two 3,750 kva transformers to provide a yard distribution voltage of 4.8 kv. Both incoming feeders are energized, but either can supply the entire power requirements of the yard if and when necessary. To supply power for the floodlighting and other facilities in the yard, electrical distribution is provided by seven 4.8-kv radial feeder circuits supplying 17 three-phase transformer substations at

(Continued on page 21)

Retardation at Both Ends

Master (above) and group retarders are electric, while the inert retarders at the bowl end of the class tracks (below) are spring loaded to stop rolling cars. Retarder operator has a tower office (left).

Buffalo's New Bison Yard

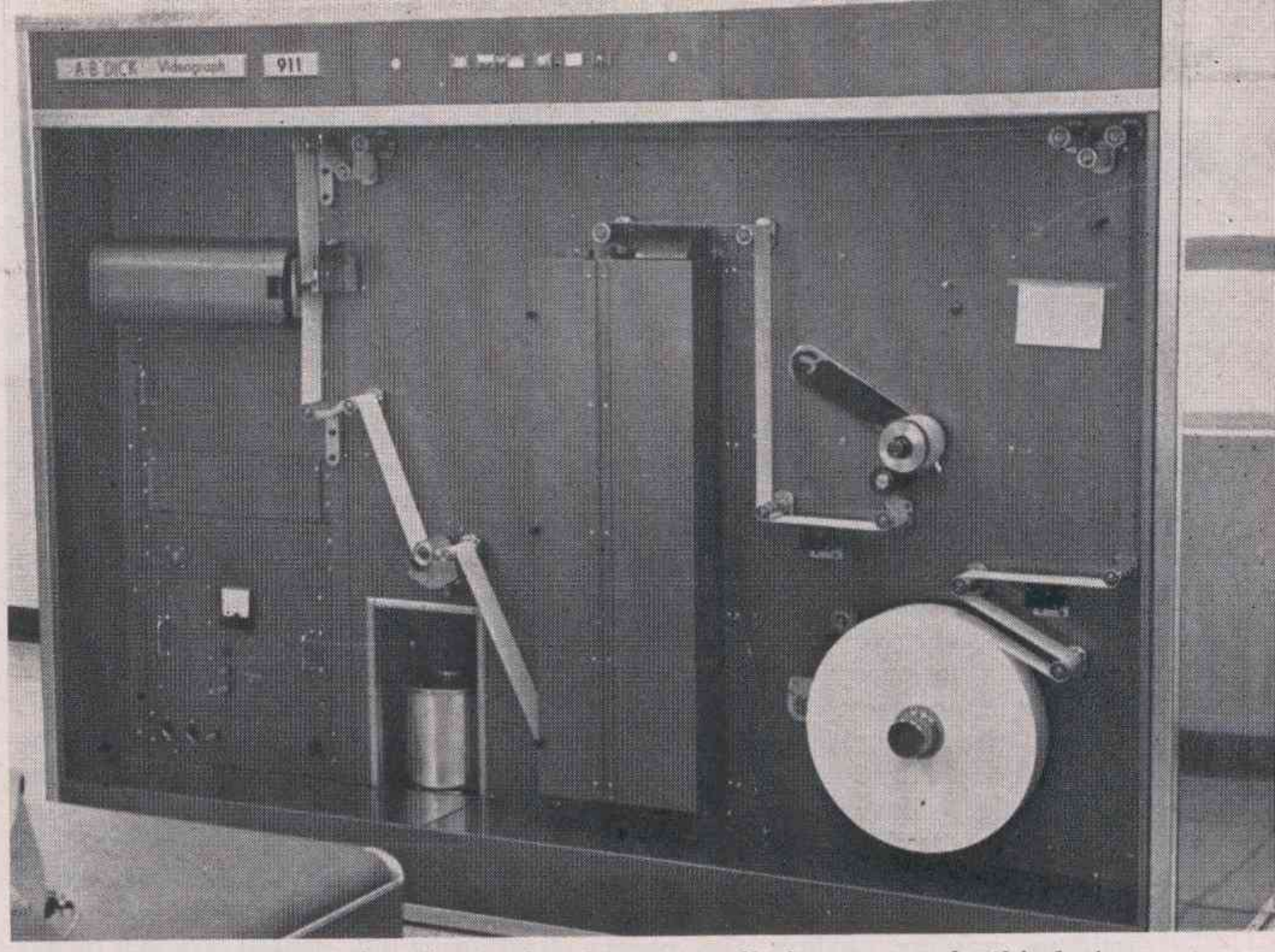
(Continued from page 16)

load centers. These feeder circuits consist of three single aluminum conductors, mounted in a triangular ceramic spacer suspended from an Alumoweld messenger that is grounded. Ground rods are driven at every fourth or fifth pole, and resistance to grounding is one-half ohm or lower. The substations are at ground level and have self-contained transformer banks. At each substation 4,800 volts from the aerial distribution line is dropped down the pole to an oil fuse disconnect to the transformer primary. The transformer secondary is Y-connected providing 277/480 volts on the secondary for distribution directly to loads. This 277/480 volts was chosen because it is an economical voltage for distribution and provides a safe voltage ground, reports the Harry F. Ortlip Co., electrical engineers and constructors for the yard. Distribution from the transformer substations is by underground cable.

Because of possible heavy snow and ice conditions at Bison Yard during the winter months, all 240 power (GRS) and hand-throw switches (Ramapo-Ajax model 22, trailable) are equipped with Rails Co. electric snow melters. For the power switches, the snow melters are rated at 8 kw, using a rod rated at 500 watts per foot; and on the hand-throw switches, the snow melters are rated at 4.6 kw (300 watts per foot).

Snow melters in the class yard are controlled from the retarder operator's location; melters at the east end of the yard are controlled from the general yardmaster's office and those at the west end of the yard are controlled from the west-end yardmaster's office. When the snow melters are to be operated, the control circuitry is through a ratchet timer so that the melters are turned on in groups of about 200 kw, thus preventing overloading by connecting the entire load on the line at one time.

An Onan 85-kw standby power plant is in the basement of the general yard office to provide emergency 480 volts, 3-phase AC for retarder and signal operation. The unit cuts in automatically if commercial power fails. The retarder operator and the general yardmaster are in the tower of this building. Automatic retarder and switching control equipment, as well as the radio station equipment and talk-back speaker system amplifiers are in this building—the signal and communications nerve center of the yard, hence the need for emergency standby power.



TRAIN PICTURE is developed and printed out on a roll of paper tape by this device.

● **Train picture.** A new feature of Bison Yard is the use of the A. B. Dick Videograph system for car-checking of inbound trains. The system scans a train or cut of cars moving at speeds ranging from 4 to 35 mph and immediately provides a black-and-white printed picture of each car, showing all identification features of the car on a 2¾-inch paper tape at the general yard office. A clerk checks the advanced Teletype train consist against the picture of the arriving train.

Scanners at yard entrances

The system consists of three scanners and three printers interconnected by means of underground video-pair cable. Scanners are located at entrances to the yard, and printers are located in the yard office. Normally a printer is associated with each scanner. However, if needed, any one of the three scanners may be used with any of the three printers. One scanner is approximately 9,300 feet east of the yard office and has a wide-band amplifier approximately midway between the scanner and the printer. The other two scanners are about 4,000 feet west of the yard office and do not have intermediate amplifiers. Each scanner is located in a T-shaped building which spans the track and forms a tunnel for a distance of 40 feet. The scanner is mounted on a heavy concrete base in a compartment in the end of the T of the building.

Cars are scanned through a narrow vertical slot, 3 inches wide. The side of the car is lighted by a bank of nine 500-watt floodlamps mounted vertically on a frame attached to the wall and close to the vertical slot. On the wall opposite, the slot is a fluorescent light tube to provide a distinctive white separation between cars for the scanners' viewing field.

The individual scanner, flood lighting and associated printer are placed in operation by a train or cut of cars occupying a track circuit in approach to the scanner. The scanner and light source were enclosed in the T-shaped building to minimize the effects of weather and differences in lighting between daytime and night on the operation of the system.

Operation of the Videograph car-recording system is automatic, requiring only that the operator load a fresh supply of paper and liquid toner as necessary and remove the printed output roll.

The scanner is a mechanical-optical device designed to scan a narrow, vertical area of a moving freight car. While it is scanning a vertical distance of about 10 feet, the movement of the car itself provides the horizontal component of the picture. The scanner consists of a lens arrangement, a high-speed rotating prism, a photo-multiplier tube and electronic circuiting for converting light images into television-type signals. Use of a mechanical-optical scanner rather than a television camera permits obtaining maximum reliability at no sacrifice in picture quality.

The scanner transmits a wide-band television-type signal, which can be transmitted over coaxial cable, video pair or microwave. Coaxial cable or video pair are usable over distances of a few miles when wide-band amplifiers are used at one-mile intervals.

The printer utilizes a special cathode-

ray tube for electrostatic printing at a speed of 3 feet of paper tape per second. This development uses a matrix of fine wires permanently fused in the face of the cathode-ray tube at a density of approximately 250 wires per linear inch in one or more rows across the tube face. A series of tiny electrostatic charges are placed on the paper as it moves past the face of the tube. The pattern of these charges is in the form of the image being scanned. Charges are then developed into the image by application of a black-dyed liquid toner which adheres to the paper only in the charged areas. After development, the paper is airdried and fixed for permanency.

Paper used in the printer is coated with a non-sensitized plastic base coating. One side is coated for proper conductivity and the other side for required insulating properties. This results in an inexpensive paper stock which permits optimum printing quality. The paper tape is 2¾ inches wide and comes in 6,000-foot rolls.

The printer features smooth, silent operation. The speed is adjustable according to speed limits previously established for car or train movements. Should a car move slower or faster than the established speed, it merely results in either an elongated picture for slower speed movements or a shortened picture for higher speed movements. Normally a picture of an average freight car occupies about 12 inches of paper tape.

To handle the printed tape records quickly and efficiently, a small desk-top viewing device is used to handle the printed output rolls of the printer. A foot pedal facilitates starting and stopping the viewer, thus leaving the operator's hands free to handle waybills, check consists, and to prepare switch lists. A narrow band along the edge of the paper tape is left blank for any special notations (arrival time and train number, for example).

It is expected that the Videograph car-recording system will eliminate need for manual car recording at the entrances to the yard. Identification will be speeded up and errors and delays associated with manual recording will be reduced.

A standby car-recording system uses a magnetic disc recorder remotely actuated by pressing a pushbutton on a telephone handset at scanner locations.

● **Blue flagging.** A special system of protection has been set up to protect car inspectors working on transfer-cut cars in the classification yard. Two blue-flagging switch-key controller panels are at the west end of the classification tracks. These controllers provide means for supplementing blue-flagging requirements under operating rules. The device electrically locks a switch leading to the selected class track, ensuring that the retarder operator (or the automatic switching system) cannot route a car into the track under blue-flag protection. Tracks selected for the blue-flagging system can be used to classify transfer and/or local cars. By eliminating the need for setting these cars over into the departure yards, the cars are inspected and depart directly from the classification yard.

Operation of the blue-flagging device works as follows: When it is necessary to blue-flag a class track, a car repairman calls the retarder operator on the talk-back speaker system and requests permission to use a certain track. The operator positions the switch at the entering (east) end of the class-yard track in a manner preventing entrance of the car into such track, and places a pin in a hole corresponding to the track being blue-flagged. The pin breaks a switch control circuit so the automatic switching system cannot route a car to the track that is to be blue-flagged and displays a flashing light on the field key controller. Next, the retarder operator notifies the car repairman that the track may be blue-flagged. The carman then inserts a switch key in the key controller marked Cut-Out under the track number of the track to be blue-flagged. Turning the key activates a circuit electrically locking the entering switch to that track. When the route is properly locked, the light indicator in the key controller panel changes from flashing to steady.

Removal of blue flag

When work is completed and the blue flag is to be removed, the carman again contacts the retarder operator to advise him regarding removal of the blue flag. The operator must first restore the switch involved to the automatic position, and then remove the pin from the proper hole. This extinguishes the light on the carman's key controller panel. The carman then inserts the key, turns it clockwise and back, then removes it. The operator then checks the switch manually for proper control and correspondence.

● **Presence detector.** Ultrasonic presence detectors are used at Bison Yard in conjunction with 55-foot impulse-type track circuits in the class yard. Detectors are equipped with a heater under the reflector plate to melt ice and snow. Here, as explained by GRS engineers, is a description of the operation of the ultrasonic detector:

"It operates in parallel with the existing detector track circuit in such a way that the length of the detection zone is, in effect, adjusted in proportion to the length of the car. As a result, extra-long cars are handled automatically, the same as normal-length cars. The ultrasonic, track-mounted sensing unit is located within the circuit, approximately at the switch points. Thus, although an extra-long car can span the track circuits, it is still protected by the presence detector, thereby preventing switch movement until the trailing trucks of the car are off the track circuit."

● **Distance to coupling.** One of the other new features of the Class-Matic II automatic yard-control system at Bison Yard is the automatic correction for car count distance-to-coupling. As stated by GRS engineers, the automatic DTC feature works this way:

"The development of an automatic correction for car-count distance-to-coupling provides a means of measuring the actual distance to the coupling point. This corrects for errors resulting from the variations in car length and changes in the coupling distance caused by stalls or the pulling down of cars. The problem of the car-count system was not knowing where a car stopped. Now a track circuit is used to measure the distance to coupling. It is a constant-current track circuit; the voltage changes as the track fills up. A motion detector has been provided to sample the voltage to determine whether cars are in motion on a track. If not, the impressed voltage is used as a correction factor.

"The Class-Matic ARC distance-to-coupling system provides the following for each classification track:

"(a) A storage of the count of cars whether positioned by actual count, automatic correction when called for, or manual correction.

"(b) Lights to indicate occupancy of each clearance-point track circuit; and a numerical display, to indicate distance-to-coupling (DTC). This information is based on car-count storage for any track manually interrogated, with a maximum capacity of 60 cars.

"(c) Automatic correction of an empty track to the correct DTC in accordance with track capacity.

"(d) Automatic correction of any track to the correct DTC in accordance with the position of the last car.

"(e) Provision for manual correction (increase or decrease of DTC) for any track in case of automatic failure.

"(f) Provision for manual correction (decrease of DTC only), in case of stalling outs when system is in automatic.

"(g) Automatic positioning of computer relays to form a code representing DTC for a car or cars about to enter a group retarder."