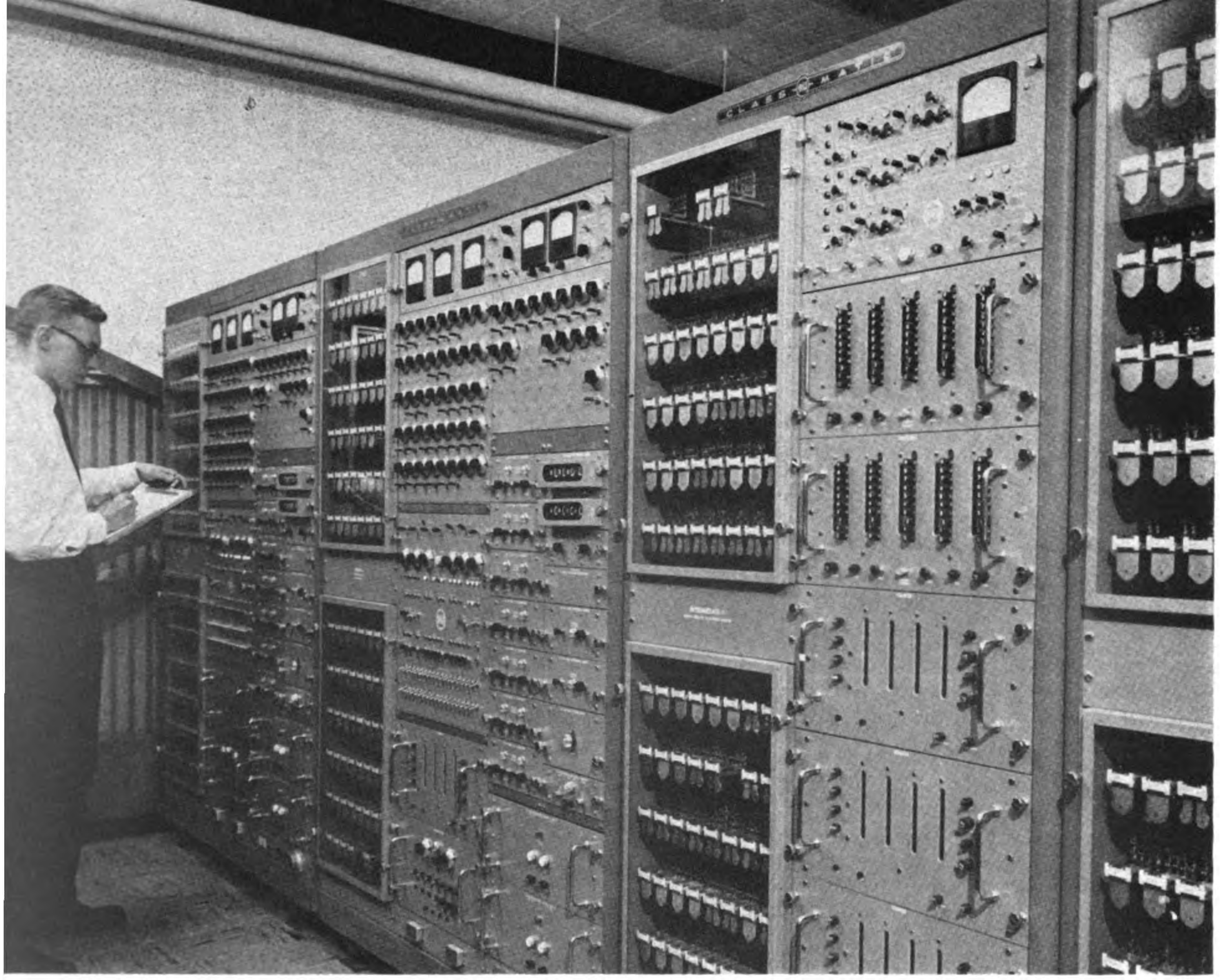


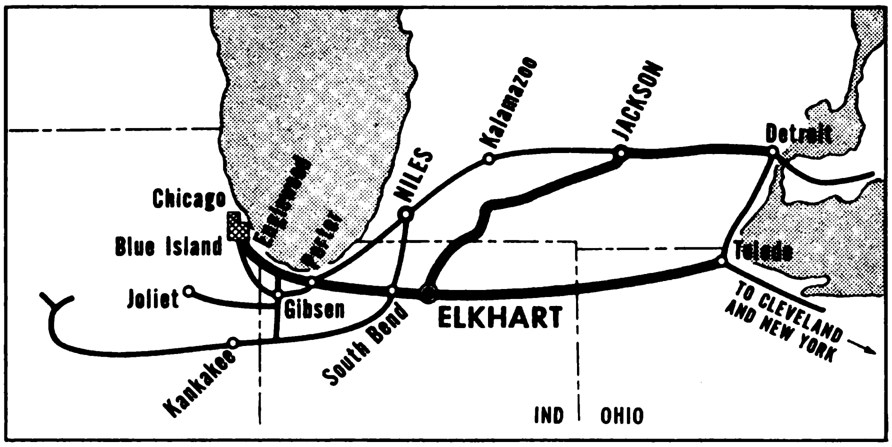
Electronic analog computers calculate the speed at which cars should be released from retarders. The master retarder and each group retarder has its own analog computer

Central Opens Young Yard

Named for Chairman Robert R. Young, the New York Central's newest retarder classification yards at Elkhart, Ind., will cost a little over $14 million. Replacing 12 other yards, it will cut freight car time through yards from 20 hr 29 min to 8 hr 49 min. Technical advances include the largest electronic analog computer devoted exclusively to control purposes, these being automatic control of retarders. Automatic programmed switching uses a magnetic core memory capable of storing classification information on 150-car trains. If cars stop short on classification tracks, a remotely controlled machine, known as a car accelerator can shove them to clearance. Television will be used to grab car numbers of inbound trains, and recorders used for number grabbing for outbound trains. Communications everywhere will include paging and talk-back speakers as well as radio. Car inspectors will use dual-channel walkie-talkies, and skatemen will use Dick Tracy radio transmitters operating in conjunction with paging loud-speakers.

IN ITS EFFORTS to improve service to shippers and reduce operating expenses, the new Robert R. Young yard at Elkhart, Ind., represents the application of the latest techniques of automation to the classification of freight cars, as well as being in a "natural" location. A look at the map shows Elkhart about 100 miles east of Chicago on the mainline to Toledo, Cleveland and New York. Other Central lines pertinent to the Elkhart story include Detroit-Niles-Porter with connections to the Indiana Harbor Belt at Gibson; a line to Joliet; a line west from South Bend to Kankakee (Kankakee belt line) with connections to western railroads; and a line from Elkhart, north and east to Jackson, Mich. Elkhart was a major classification point on the mainline for east-west traffic. Niles, Mich., was a classification point on the northern district for east-west traffic on the Detroit-Porter line.

Traffic studies showed Elkhart receiving 15 trains from the west and 13 from the east for classification, and Niles receiving 12 trains from the west and 8 from the east. Time for a car through Elkhart was 24 hr 24 min, and through Niles was 16 hr 23 min. Elkhart classified 1,328 cars daily (an average) and Niles handled 1,163 cars daily, this



work being handled in flat switching yards.

Why Not One Yard for Classification?

This question naturally came to mind as the Central management studied the situation. Certainly a modern retarder classification yard would reduce time spent by cars in the yards, give the shippers better service, and reduce operating expenses. If one new yard could handle the traffic where would it be located? Of the various sites possible, Elkhart appeared to be the best suited, not only traffic-wise, but the railroad had a 675-acre plot west of the passenger station which would "fill the bill nicely."

Redispatching studies were made, realizing that track and signal changes would be necessary to handle the traffic efficiently in and out of Elkhart. Westbound traffic from Detroit would be moved over a new or rebuilt Jackson-Elkhart line. Chicago-Detroit eastbound freights would move over the mainline, Chicago to Elkhart, and then after classification, would go via Jackson. These studies revealed that there would be considerably less traffic on the Jackson-Porter section of the Detroit-Chicago line. This led to the decision to take up one main track of this double-track line and install centralized traffic control. To handle traffic over the rehabilitated Jackson-Elkhart line, centralized traffic control was installed on this single-track with five controlled sidings. Another advantage of the new yard would be the finer classification of cars with the resulting reduction in switching and blocking of cars at other yards, such as Englewood (Chicago), Gibson, Ind., Blue Island, Ill., Kankakee, Detroit and Toledo.

What Does Young Yard Replace?

This new yard eliminates Niles as a classification point. Three yards here, totaling 59 tracks with 5,273 cars capacity, are to be replaced with a 16-track local yard of 720 cars capacity. Engine servicing, car cleaning and repair tracks and facilities are to be eliminated. At Elkhart, nine yards totaling 81 tracks with 5,112 cars are to be eliminated. Engine servicing facilities are to be re-established at the new yard site. Changing the Jackson-Porter double-track line to single-track with CTC will involve discontinuance of 10 interlocking stations, and 143 miles of second main track. The new Elkhart-Jackson route involves rehabilitating 97.5 miles of old line.

The following benefits are obtained by constructing a new modern retarder classification yard at Elkhart, Ind.:

- Two freight terminals are consolidated.
- Modern switching facilities reduce switching facilities at other yards.
- Concentration of operations produces peak utilization of yard engines and road power.
- New route reduces train-miles (Jackson-Elkhart connection).
- Operation of through tonnage trains is facilitated.
- Equipment and lading damage reduced by use of automatic switching and retarding controls.
- Valuable real estate becomes available for industrial development at Niles and Elkhart.
- Car detention is reduced and service to shippers is improved by 24-hr daily operation of car repair facilities.
- Service to shippers improved by more efficient classification of cars in the new yard.

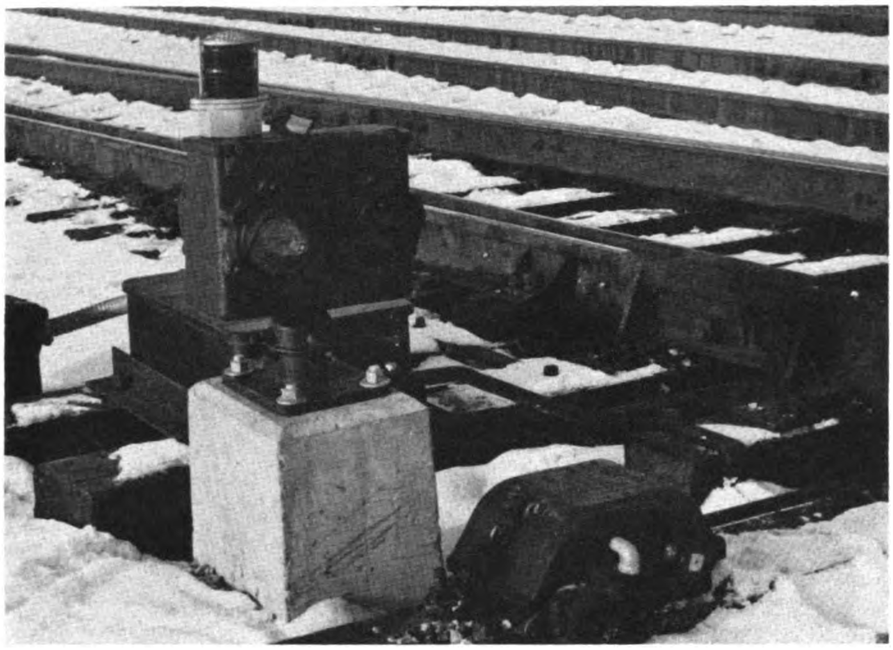
What's At the New Yard?

The new Young yard is about four miles long, parallel to and south of the mainline about a mile west of the Elkhart passenger station. This yard is the in-line type with the receiving yard (15 tracks, 1,954 cars) at the east, followed by the classification tracks (72 tracks, 3,540 cars). Parallel to these are the departure yards eastbound (5 tracks, 750 cars) to the north, and westbound (6 tracks, 900 cars) to the south. Eleven of the receiving tracks can handle 150 or more cars. A running track in the eastbound departure yard, as well as an "Early Bird" track (150 car capacity) can be used for trains with prior classification which only have blocks of cars added or taken off at Elkhart. An 11-track local yard has 434 cars capacity. The classification yard consists of eight groups, nine tracks each. Tracks 1-36 are for eastbound blocks; 37-42 for Elkhart, Western locals and repairs; and 43-72 for westbound blocks. Typical classifications include New York City, Weehawken, Kalamazoo, East DeWitt, etc. Typical westbound classifications include C&EI Chicago Heights, six separate blocks for IHB yard at Gibson, and five separate blocks for Englewood. Two class tracks are assigned for repairs (rip track), one track for holds (no bills) and one track to hold cars for cleaning.

Other facilities include a 200-car capacity repair area. The engine servicing facility will service road locomotives and also do the necessary inspection work for engines assigned to Elkhart. Two car-cleaning tracks of 95-car capacity are on the south side of the classification yard. Buildings include a hump general yard office with tower for the general yardmaster, terminal trainmaster, etc.; a hump conductor's office; retarder building with tower office for the retarder operator; west end yardmaster tower office and building; and the necessary buildings associated with the rip track and engine servicing facilities.

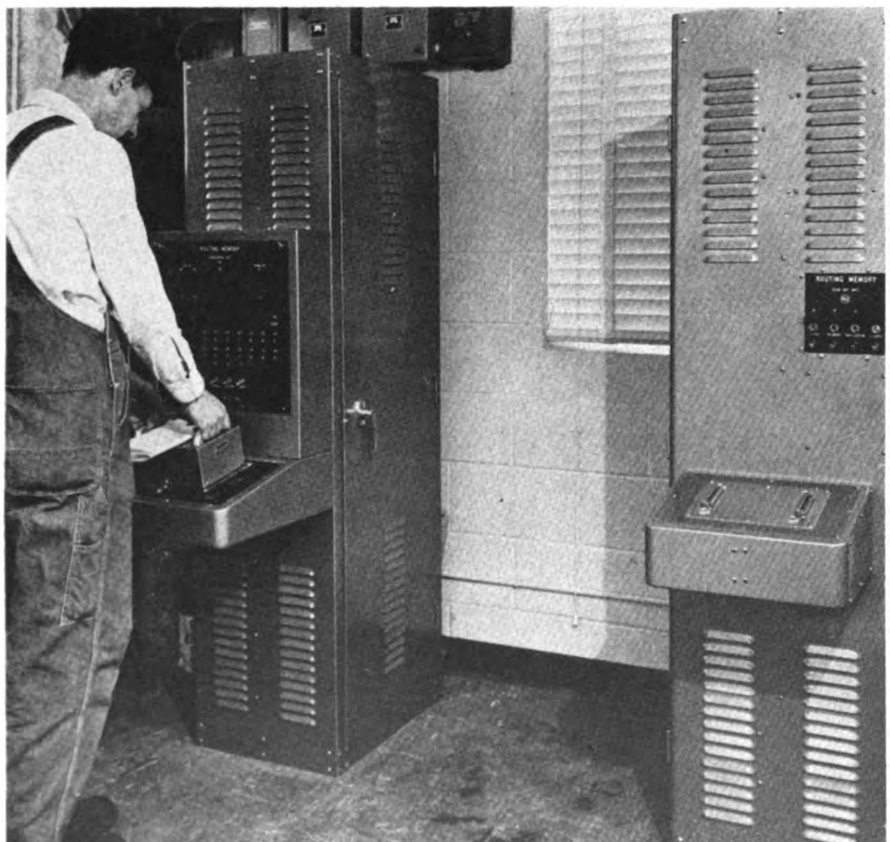
Trains Arrive and Depart With No Delay

Remote control interlockings at the yard entrances enable road trains to enter and leave the yard with no delay. These interlockings include the junction with the new route to Jackson, which leaves the mainline just east of Elkhart passenger station. As trains enter the receiving yard they move over GRS electric switchman machines, which are remotely controlled, by either of two switch tenders. A switch position signal shows lunar white for switch lined for the lead, and yellow for a diverging route. A red lamp atop the signal indicates stop.



Non-interlocked switches on receiving yard leads are remotely controlled

This light is illuminated when the switch points are in motion or if the switch does not complete movement. The control machine for these switches has a track model diagram with each switch represented by point indicator. When the switch tender controls a switch, he turns the indicator so that a solid white line 1/4 in. wide shows the route the train will take. A lucite button on each receiving yard track controls the yard track indicator. If the route is lined into a receiving track, pressing this button will control the yard track indicator to show the track number. Thus approaching enginemen know that the route is lined for them when they see the yard track indicator.



Ferrite core stores switch list, then is taken from memory unit to read-out unit

Automatic Switching Can Be Programmed

The automatic switching system in this yard is unique in that each train to be humped can be completely programmed in advance of humping operations. The heart of this ingenious GRS device is a ferrite core memory unit. A number of these memory units are employed to permit storing several trains ahead of time. When programmed, a given memory unit contains the class track assigned to each car in that train and will so hold this information until the cut is ready to be made.

The programming of the memory unit is entirely automatic. The switch list is prepared by a clerk in the yard office from a stack of IBM cards. These cards have been automatically made from a tape-to-card machine and initially contain information pertaining to railroad owner, car number, load or empty, type of car, and destination out of Elkhart. Local yard operations assign a class track number to the car represented by each card. This information is punched into the card by the clerk and the cards are then sorted into the order in which the cars will come over the hump. A Teletype tape is then prepared by running these cards through a card-to-tape machine. This tape is then inserted in a Teletype transmitter-distributor for transmission to various offices in the yard where it is received in page form. In addition, at the hump conductor's office the information is fed into the programming system which stores the switch list in the ferrite core memory unit.

The programming system further contains facilities whereby changes made in the switch list can be programmed manually into the memory unit before the train is humped without affecting other information already stored in the memory. When the humping is ready to begin, the memory unit is plugged into the read-out system which feeds information to the automatic switching system, and the hump conductor operates a key-switch from the "MANUAL" to the "AUTOMATIC" position. From that moment on, the class track number for each car in the train is fed automatically into the automatic switching system as the cars are cut off at the crest of the hump. The rate of advance of the cars over the hump governs the rate of advance of the read-out system, and thus, the application of the program to the automatic switching system.

Since each car in the train is programmed in the memory unit, it is necessary to consider the implications of a multiple-car cut. Only one or two-car cuts are being made in this yard. Since the switching system needs only the destination of the lead car of a two-car cut, the destination of the cut must be removed from the switching system to prevent the car following the two-car cut from taking this information. This is accomplished by holding in the initial storage of the switching system, the storage of the second car until the first car has passed through a test section. In this test section, it is determined whether the first car is alone or the second car is coupled to it. If the first car is alone, the storage for the second car is advanced into the automatic system. If the second car is coupled to the first car, the track destination for the second car is automatically canceled from the switching system.

It becomes necessary on occasion to change a class track number for a car from the class track programmed in the memory unit. For example, a bad-order car may be detected by the car inspectors. On such an occasion, the hump conductor moves the key switch from "AUTOMATIC" to "HOLD" when the car to be changed is read into the initial storage in the switching system. The original destination is canceled manually, and the new track number inserted by operation of the appropriate track push-button. The key-switch is then returned to "AUTOMATIC" and the humping proceeds without interruption.

A further advantage inherent in the ferrite memory unit lies in the ability to move to any point of storage in the device by simple push-button manipulation of the line number system. Read-out will take place at the chosen starting point. Thus if a group of cars has been removed from the train and appears at the end, for example, the memory can be operated to the point of discontinuity, reset at the new starting point, and finally returned to the "skipped" section when these cars appear at the end of the hump.

Automatic Retarder Control Uses Large Electronic Analog Computer

The distinguishing feature of the new automatic control system developed by GRS for Young Yard is the "fineness" of the degree of control obtainable in coupling speeds. After years of study and measurements GRS completed the design of the Class-Matic System now in service at Elkhart. The elaborate computations involved in the equations of motion used in the Class-Matic system are handled by precision analog computers. A separate analog computer is associated with the control system for each group retarder, and also, the master retarder.

Photocells "read" cut lengths (two cells one above other) and check car location

Factors such as grade, and other physical constants in the yard are "set-in" to each computer by numerous control knobs. Factors pertaining to a particular cut such as weight, route to be taken, distance-to-go, etc. are switched into the group computer as the cut nears the group retarder. The analog computer "thinks" in terms of resistance and reference voltages. All of the above factors are therefore converted to analog computer language before being fed to the computer. The computer requires approximately 0.1 sec. to arrive at the precise speed which the cut should leave the group retarder to enable the cut to make a damage free coupling. It is the job of the automatic retarder control system to deliver the cut at the end of the retarder at the computed leaving speed within very close tolerances.

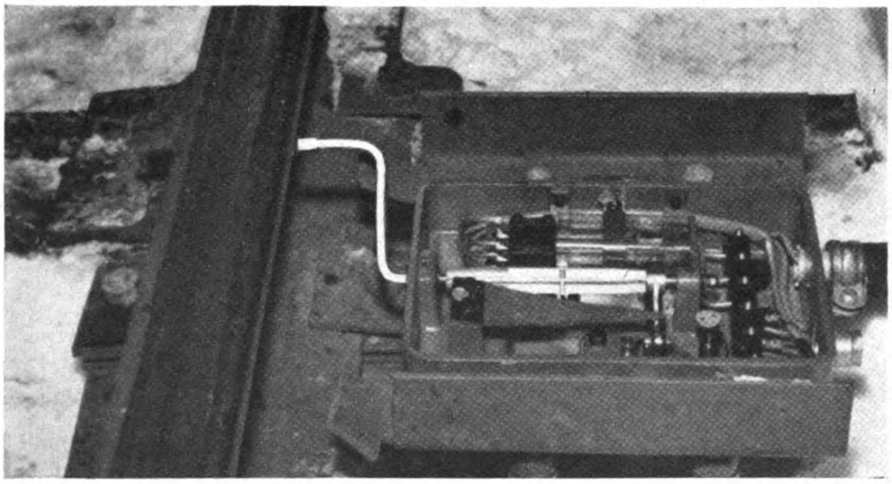
Test sections equipped with rail treadles are located at intervals ahead of the master and each group retarder for the purpose of accurately measuring the speed of a cut as it rolls free. From these speed measurements, the computers calculate the ratio of friction to weight for each cut ahead of the master retarder, and again, ahead of each group retarder. This ratio is used to determine the computed release speed of each cut from the master retarder, and is one of many factors used to determine the computed release speed from the group retarders.

Before Young Yard was placed in service on Jan. 10, the Central worked closely with GRS for approximately one month making test car runs into 45 of the 72 tracks in the yard. A special test train of ten cars was used and each of the ten cars were humped individually three times into each track which was tested. Treadles spaced along each body track were connected to special computing equipment in the tower for these test runs. The analysis of this test data enabled the GRS to set the yard factors into the control computer for each group.

Let's Follow A Car

Now let's follow a car down the hump through to its final class track. From the crest of the hump the car rolls down about 250 ft. of 3 per cent grade (over a 105 ft. electronic track scale) and onto the master retarder (4.15 per cent grade for 198 ft.), then onto 515-560 ft. of 0.93 per cent, 1.11 or 1.18 per cent grade on the various leads and through the group retarders. The tangent class tracks have a 0.15 per cent descending grade to the skating point. Then there is 400 ft. of ascending grade ranging between .25 per cent and .35 per cent. Hand skates are placed and removed by skatemen.

As the car leaves the crest of the hump it passes the long-cut photo-



Track treadle (with cover removed) depressed by car wheel starts or stops counter

cell located midway of the track scale. Information as to the length of the cut (in this case one car) is fed to the master retarder computer. Next the car's time is measured as it travels 34 ft. down the hump lead. A front wheel of the car depresses a treadle, which starts a five-digit counter. When the same front wheel depresses the second treadle 34 ft. further, the counter is stopped. The counter has registered a certain number of cycles from a 6.6 kc oscillator frequency. As this is a measure of the time the car traveled the 34 ft., the average velocity of the car over the 34 ft. distance is easily computed. Just beyond this first set of treadles, the car passes through the photocell beam of the counter clearout photocell. When this beam is interrupted (car has passed) the counter information is dumped into relay storage and into the computer. When this beam is restored, the counter is reset for the next car or cut. This velocity VI of the car is calculated. Then after rolling a short distance, the front wheel of the car depresses another treadle, travels 34 ft. and depresses a second treadle. The time of passage of the car is timed by a second 5-digit counter. This count is transferred to the computer which calculates velocity V2. This, again, is average velocity over the 34 ft. distance.

Next, the car passes over a weight detector, which is a slot-in-the-rail device. Three micro-switches detect the weight as light, medium or heavy. This information is fed into this master retarder computer. The computer then calculates the speed at which the master retarder should release the car. The computer calculates the release speed for the car in about 1/10 of one second just before the car enters the master retarder. As the car enters the master retarder it interrupts the entrance photocell of the master retarder. Restoration of this photocell beam releases the computer for the next car.

The master retarder consists of four 49-1/2 ft. sections which are individually controlled. Each section can be controlled to five different positions from open to closed.

Radar Enters Here

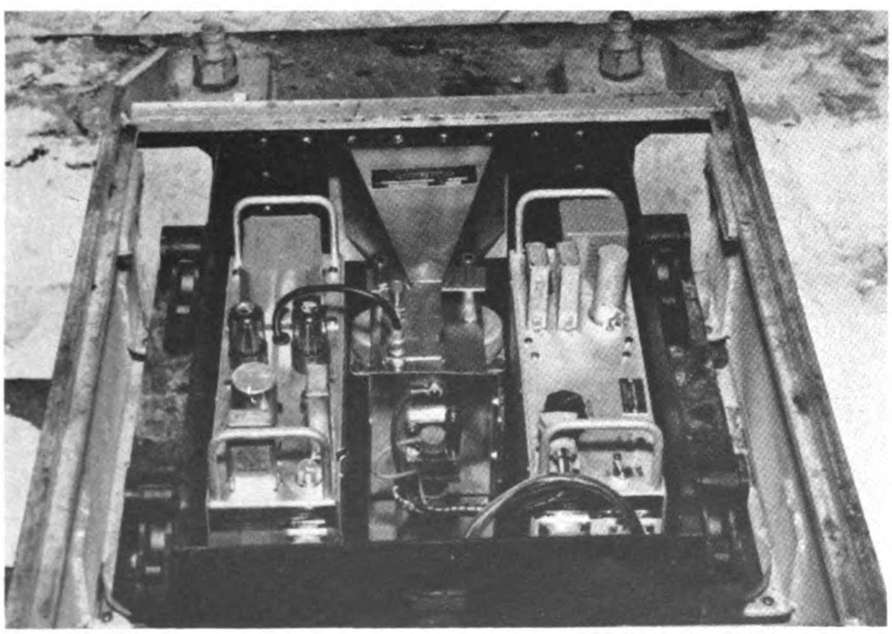
As our car entered the master retarder, it passed over a radar transmitter-receiver mounted between the rails. The radar is beamed down the hump toward the receding car. Operated on a frequency of 10,525 mc, the radar beam is reflected from the car. The difference between the outgoing and the reflected beam is used to determine the speed of the car. This is compared with the computer calculated release speed. The retarders are adjusted to the position such that the car will be released at the computer calculated speed.

Realizing that the second half of the retarder is separately controlled, the computer calculated release speed was put into storage for transfer to the control system for the second half of the retarder. This transfer is made by our car's breaking and restoration of an intermediate photocell light beam at the midpoint of the master retarder. Restoration of this beam readies the first half of the master retarder control system for the following cut, and also, cuts in the radar unit covering the second half of the retarder. Thus this section of the retarder can be properly positioned to release the car at the computed speed.

As the car leaves the master retarder, its weight and cut length pass into the transfer system feeding the group retarder analog computers. Restoration of the exit photocell beam readies the second half of the master retarder for the following cut.

Free Rolling for 130 Ft.

Our car now rolls at least 130 ft. before it encounters another set of rail treadles (54 ft. apart) for calculating velocity. Further on in approach to the group retarder, it passes over two more treadles 54 ft. apart. The group retarders are 115.5 ft. long with the exception of the two center groups which are on the shortest and straightest route from the master retarder. These



Radar unit (cover removed) measures speed of receding car (antenna in center)

Track fullness is shown by line of lights (by operator's elbow) on retarder control panel

center group retarders are 99 ft. long. As our car enters the group retarder, it passes over a radar unit which measures its speed through the retarder. Here again, breaking and restoration of an entering photocell light beam releases the computer for the following cut.

In addition to these measured speeds, the group computer receives the routing information from the automatic switching system, and the cut length and weight from the information transfer system. Impulse switch detector track circuits are used in the yard.

The computers operate continuously. When no car is in the system, a test problem is fed to each computer to check its answer against a calibrated standard. The constant temperature and humidity in the room aid in keeping all resistors, tubes and other components within their adjusted operating tolerances. Blower fans are used to cool the computers.

All adjustments and the testing of the equipment can be done from the front of the computers. Switches, pushbuttons, potentiometers and meters are all "out in the open." A special test board and patch panel enables any circuit functions to be checked without "getting inside" of the equipment.

The retarder control machine panel is similar to previous panels with conventional controls for the retarders and switches. Several new features have been added as part of the GRS Class-Matic yard controls. A lucite pushbutton with an indication lamp is located on each class track. When the operator presses one of these lucite track buttons, a distance-to-go indicator consisting of a row of lucite pushbuttons is lighted to show the distance-to-go on that particular track. These latter buttons show distance-to-go in car lengths from 2, 4, 6, 8, 10, 12, 16 . . . and up to jumps of four to 72. By pressing one of the pushbuttons on the distance-to-go indicator, the operator can instantly reset or change the distance-to-go fed to the computer for that track. Distance-to-go is measured from two car lengths beyond the end of the group retarder. This measurement is kept up to date by a rail treadle which counts car wheels, four indicating a car. As car count information is fed into the computer, the distance-to-go is automatically decreased. The operator can "see" this action by observing his distance-to-go indicator from time to time.

When the track is pulled, he presses his track button followed by pressing the reset button, which puts the proper empty track distance-to-go back into the computer. The length of the various tracks is one of the factors originally "set in" in the computer. The retarder operator may have occasion to adjust distance-to-go as a result of a car stopping short on a class track as may occur when a hand brake is set. When this occurs, he presses the track button, which lights the row of distance-to-go buttons. He then presses the button that represents the corrected distance-to-go. This is registered in the computer, which functions as though the track was filled with cars up to the "short" car. Thus the retarder operator can prevent damage to lading by, in effect, telling the computer "don't send cars down fast on this track to drive the 'short' car."

Track fullness for each class track is registered in the hump yardmaster's office. Car count is indicated by mechanical counters which must be reset manually when a track is pulled. Thus, at a glance, the yardmaster knows how many cars he has in a class track. Above each counter is a plate with the car capacity of the track.

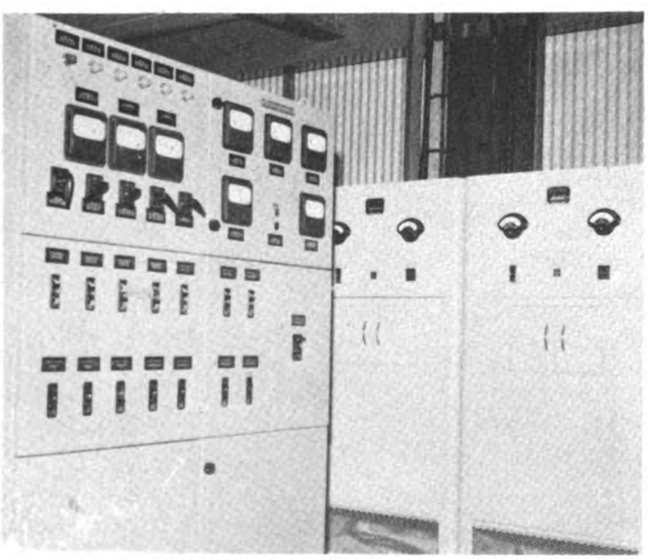
Yard accelerator is unattended unit to push cars to clearance on class tracks

As a guide to the operator, two meters are on the panel, which can be switched to register for the master retarder or each of the eight group retarders. One meter shows the computed (release) speed in mph, and the other registers rolling resistance of the cut.

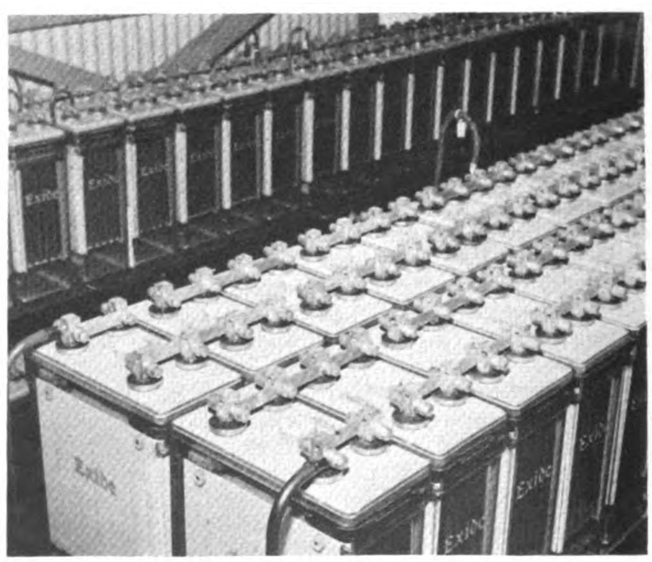
Meters registering wind direction and velocity are also provided, as is a thermometer outside the tower window. If the computer or some part of the automatic retarder control system is in doubt, a white indication lamp on the retarder control machine panel in approach to the master retarder or one of the group retarders flashes, and an audible alarm sounds notifying the operator, so he must apply manual control to the retarder involved.

Yard Accelerator Shoves Cars

If cars should stop short on a class track because of set brakes, the retarder operator can remotely control an unattended storage battery powered GRS Class-Matic accelerator to come down and push the cars to clearance or up to 10-car lengths beyond. Under these circumstances, the operator would notify the hump conductor and hump yardmaster, and receiving the "OK" would put the hump signal to stop. By manual control, he would open the retarders and line his class track switches. He would then reverse the power switch at the accelerator spur track, just behind the hump crest. (Assuming, of course, that the hump engine had backed off with the train.) A dial on the retarder control machine panel controls the accelerator: stop; creep, 2 mph; slow, 4 mph; fast, 8 mph; back slow, 4 mph and 8 mph. Fast speeds can only be accomplished by having the operator keep a button constantly depressed. The accelerator is inductively controlled. An insulated wire is fastened just under the rail head. When the retarder operator takes control of the accelerator, a blue light supported 16 ft. above rail level by a mast, is lighted and a bell rings as a warning to persons of its movement. Headlights on each end are also lighted. The front of the device has a large resilient plate for pushing against the car coupler. If the accelerator stalls while pushing a car or cut, the blue light flashes and driving power is cut-off from the driving motors. The operator must place the controls in the "OFF" position before further movement is possible. In emergency, the accelerator can be stopped, from the ground, by pulling an emergency cord on the side of the device. The accelerator can be moved beyond its control area



Power switchboard and rectifiers to charge battery for . . .



Retarders and switch machine operation in the class yard

by means of a manual control cable which is plugged into a receptacle on it.

Cab Signal System

The cab signal system, as used on the hump locomotives, is of the inductive carrier type. The carrier is frequency modulated by the signal tones. Each locomotive equipment is made responsive to three tones, two of which provide for the four cab signal indications and the third provides for a frequency shift of the locomotive radio to a channel different from the general yard radio frequency. The locomotive cab signal equipment provides plug-in electronic units relays. The electronic units are transistorized.

The signaling equipment for this Young Yard, including the Class-Matic yard automation controls and the yard accelerator, were furnished by the General Railway Signal Co. All power switches are equipped with General Electric Cal-rod electric snow melters.

Hump yardmaster's console has voice circuits for talk-backs, pagers and radio

Communications Facilities Are Everywhere

This yard is well equipped with modern communications systems. They include: (1) talk-back and paging speaker systems; (2) mobile and walkie-talkie radio systems including Dick Tracy radio and paging speakers for skatemen; (3) television for viewing car initials and numbers of inbound trains; (4) sound recording system for car checkers with various control points throughout the yards; (5) a local intrayard Teletype system and connections to the Central's IBM-Teletype car reporting system; and (6) a local PBX and conventional railroad telephone circuits.

The seven separate talk-back speaker systems give practically blanket coverage of the yard for the particular activity being carried on. Any loudspeaker can be identified as being associated with a particular system by colored bands on the pipe mast. Most speakers are mounted in back-to-back pairs on the pipe masts.

The 38 talk-back speaker pairs in the "orange" system are controlled from a console in the hump switchtender's office. He can also page over these speakers in the following groups: east of the hump; north and west of the hump; south and west of the hump and east end of the eastbound departure yard. The hump conductor's "black" system has speakers in the hump area to provide communication between the hump yardmaster, hump conductor, retarder operator, pin-puller and car inspector at the inspection pit on the hump lead. The hump conductor can page over these speakers as well as use them for talk-back purposes.

The "blue" system consists of 52 talk-back speaker pairs, which are along various ladder tracks and at switches at the west end of the classification yard. The control console is in the west-end yardmaster's tower office. These speakers are divided into three groups for paging: west of the yard office; east and south of the car repair facilities; and east and north of the car repair facilities. The "brown" system has 12 talk-back locations (divided into two paging groups), which are controlled by the east-end switchtender in the car inspector's building west of Oakland Avenue. This switchtender remotely controls the switches at the east end of the receiving yard.

The diesel shop foreman has a control console for his "green" talk-back system which includes 13 outside talk-back pairs and 6 speakers located inside the shop. The car foreman has a similar system ("yellow") which consists of 14 talk-back pairs outside and 6 inside the car shop. Both of these systems are divided for group paging.

A separate talk-back system was installed for signal maintenance in the retarder area (red systems). Inside speakers, often in the ceiling, are in the basement signal shop, the relay and power rooms (retarder battery), the analog computer room, and the retarder operator's control machine. Outside, jacks are installed in 2-ft pipe masts located between each of the group retarders. The maintainer takes a portable reel-type speaker with a 50-ft cord and plugs the cord into the jack. Thus he can unreel the cord, taking the speaker to the particular retarder, switch machine or instrument case where he is working. When the maintainer talks, he is heard on all the speakers in the retarder building, as well as the hump switchtender's office.

Paging System in Class Yard

A general paging system, using 30-watt speakers mounted on 40-ft wood poles and floodlight towers, covers the classification yard. Direct access to this system is provided by consoles of the terminal trainmaster, hump conductor, hump yardmaster, hump switchtender, west end yardmaster and car repair foreman. Several telephones (Automatic Electric type 43 monophones) on talk-back speaker poles can be used to page over this system. They can also be used to answer calls over the paging system originating in the hump yardmaster's office. The skatemen's Dick Tracy radios can also page over this system (details later).

Several direct intercom circuits are between communications consoles of men such as the hump yardmaster and retarder operator. The general yardmaster has eight such direct connections, the hump yardmaster has nine, etc.

The equipment for these paging and talk-back speaker systems was furnished by the Electronic Communication Equipment Co. The cable for these systems was made by Ansonia Wire & Cable Co. The design is a shielded, all-purpose star quadded polyethylene cable worked out by the communications people of the railroad.

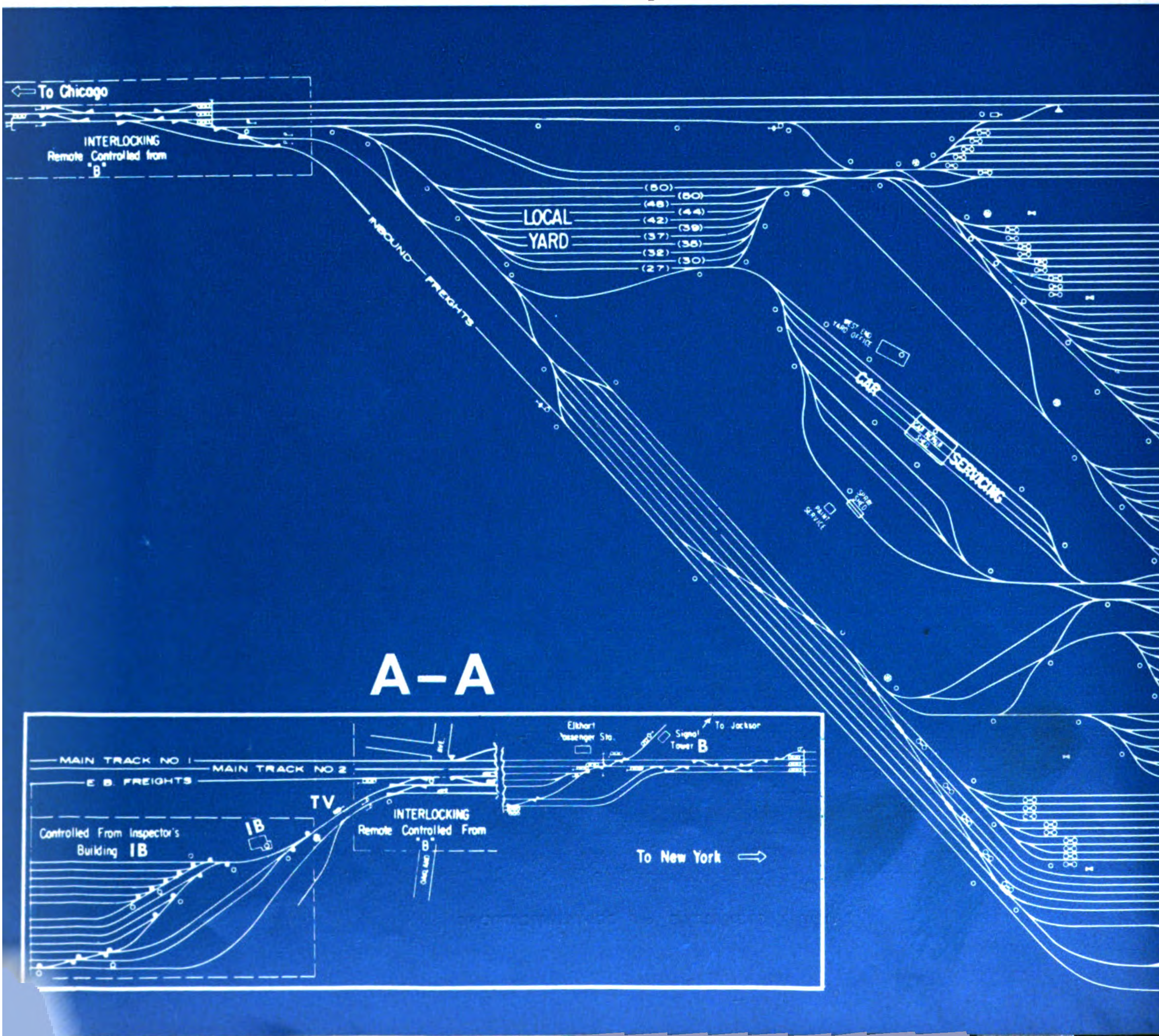
The three hump engines (each consisting of one 2,000-hp switch engine and one 1,000-hp hump trailer coupled) are equipped with dual-channel Motorola single-package radio with the transistor power supply for direct operation off the 64-volt d.c. engine-starting battery. The hump frequency is 159.99 mc and the yard frequency that these engines may use is 161.73 mc. The base station equipment is in the hump yard office with the yagi antenna (hump frequency) mounted on an adjacent light tower. A lance-type antenna is used for the yard frequency. Antenna leads are RG-17/U coax cable. Remote controls of the base station are extended to the hump conductor, hump yardmaster, hump switchtender and retarder operator.

A feature of this radio is that the locomotive radio operation on hump frequency is dependent upon the conductor having selected to transmit cab signals to the locomotive. When he selects the yard locomotive for cab signal transmission, the receipt of this inductive signal on the locomotive actuates a relay to switch the locomotive radio over to hump frequency. Thus the hump conductor talks to only one hump engine at a time, which insures privacy of the hump radio system to the engine working the hump.

The five yard engines also have this transistorized radio operating on two channels: 161.73 mc and 159.75 mc. The latter frequency is for use with walkie-talkies carried by the switch crew foremen when working the west end pulling cars from the class tracks to build trains in the departure yards. The base station for this 159.75 mc frequency is at the west-end yardmaster's office, the lance antenna being atop a 110-ft floodlight tower. The west-end yardmaster, hump conductor, retarder operator, hump switchtender, and hump yardmaster can get in on this yard radio system. The hump and yard engines have footboard speakers which receive all calls to the engines, and can be used to initiate engine radio calls. They do not have the intercom feature between the footboard and the locomotive cab.

The two engines working industrial areas around Elkhart and west of here on the mainline to Osceola

Communications covers this yard with loudspeakers,



and Mishawaka (11 miles) have dual-channel radio equipment operating on 160.17 mc for this industrial use, and the 161.73 mc Robert R. Young yard frequency. The terminal trainmaster has a remote control line off the base station at Osceola (5 miles), which is at the midpoint of the area worked by the engines.

Car Inspectors Have Packsets

The car inspectors carry dual-channel walkie-talkies: 159.57 mc for transmitting and 160.47 mc for receiving. The transmitting base station is 800 ft from the receiving base station, so as not to desensitize the receiver. These inspectors work the trains in the receiving yard, as well as the outbound trains in the departure yards. The hump yardmaster and the car foreman can get in on this system.

Dick Tracy Aid Skatemen

Skatemen working at the west end of the class tracks carry portable Handie-Micro-Talkies which transmit on 161.13 mc. The base station receiver is at the west-end yardmaster's office, the yagi antenna mounted on a floodlight tower. This receiving base station feeds an incoming radio call into the classification yard paging system, as well as into communications consoles on the desks of the west end yardmaster, hump yardmaster and hump conductor.

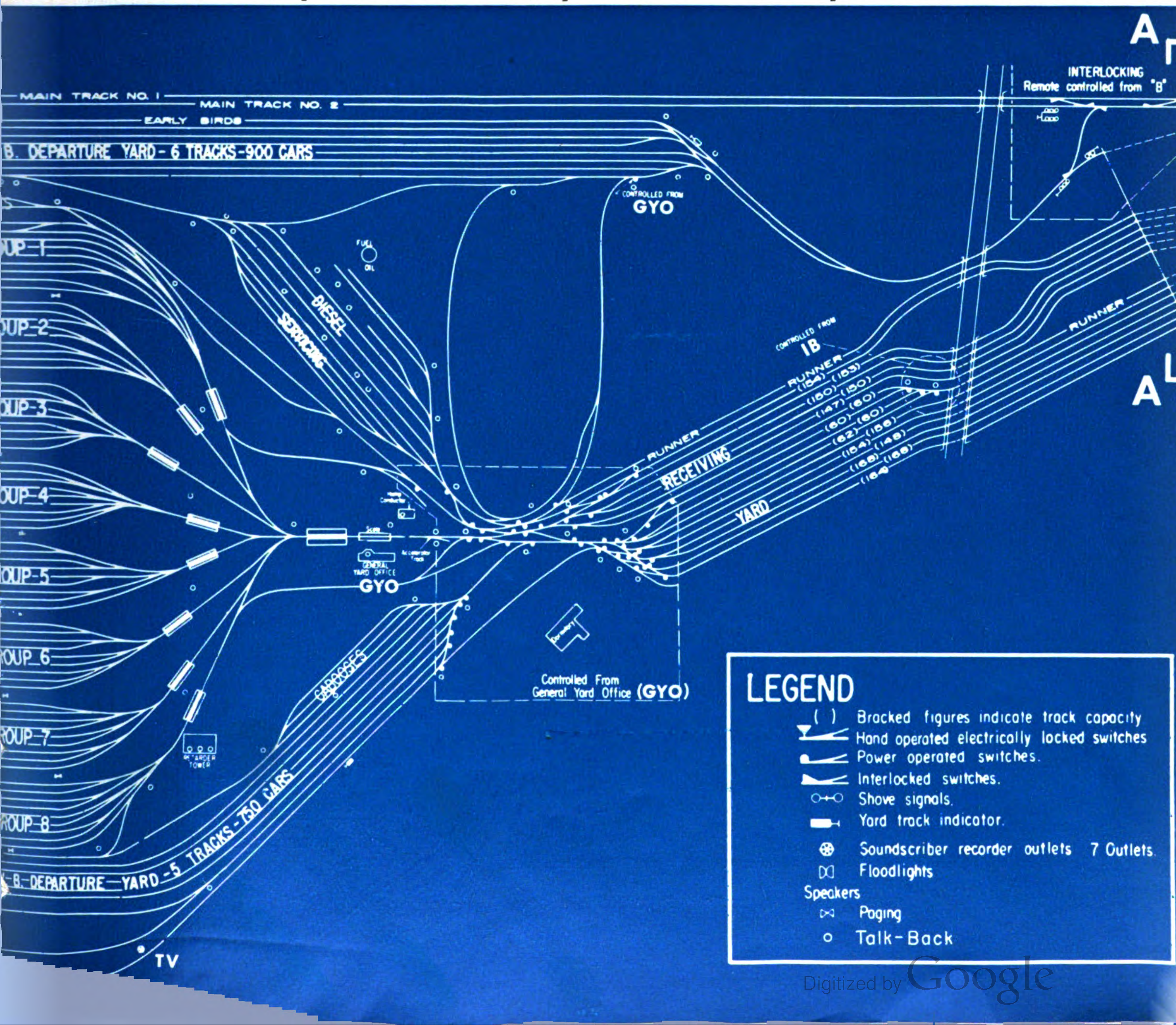
A skateman can selectively call over his micro transmitter. Pressing the push-to-talk button once puts him on the paging system; three times selects the west-end yardmaster; four times selects the hump yardmaster; and five times selects the hump conductor. Two was purposely omitted, because a man might inadvertently press the button twice.

The radio equipment, including the walkie-talkies and the base stations, was furnished by Motorola, Inc.

Television Checks Inbound Trains Arriving From East or West

TV cameras are in metal housings at each yard entrance: view

ice recorders, phones, TV, printers and pneumatic tubes



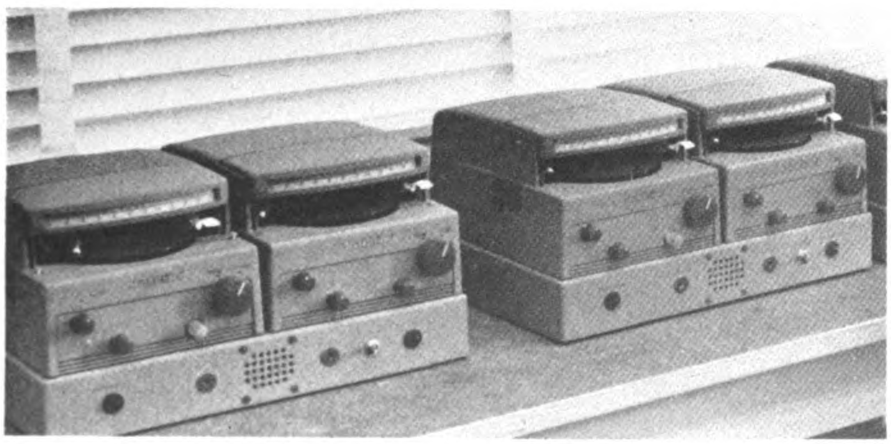
Car inspectors carry dual-channel walkie-talkies to help them in their work

trains from the east near Oakland Avenue and view trains from the west from a point south of the local yard. The monitors and remote controls are in a car checking office on the ground floor of the hump yard office. When a train is due to arrive, the clerk will turn on the camera, which is focused to view the side of the train as it enters the receiving yard lead. The trains slow to 10 mph when passing the TV camera. The clerk watching the monitor speaks the car initials and number into a SoundScriber recorder. This recording is later transcribed for preparation of the hump switch list.

The cameras, amplifiers and monitors are made by Radio Corporation of America. Night lighting has been installed for operation at night and on very cloudy days if necessary. The coax cable is run on messenger strand attached to wood poles. Two amplifiers are used for the 9,000-ft run to the cameras at the east yard entrance, and no amplifier is used for the 1,000-ft run to the west end yard entrance cameras.

Recorders for Car Checking

An 8-station sound recording system has been installed, primarily for use in checking cars as they are pulled from the class tracks to build trains in the departure yards. The transmitting stations are in booths or telephone boxes, six of which are in the general vicinity of the west end yard office, the west end of the classification yard and the westbound departure yard. Two stations are also located near the east and west yard entrance TV camera sites for possible use in checking arriving trains. The handsets in these recording boxes are connected into SoundScriber recorders in the car checker's office room in the hump yard office (where the TV monitors are located).



Recorders are paired for car checking so no cars are "missed" in a long train

The man at the box lifts the handset from the hookswitch, and listens to hear if the line is clear. If it is, he presses the push-to-talk button on the handset and calls the car numbers and initials. If he is interrupted or suspects that he has made an error, he can have the last few numbers played back to find his place, by pressing a play-back button on the instrument. Then he resumes recording. When he completes the checking, he hangs up the handset, closes and locks the phone box.

Meanwhile, the clerk in the office is alerted by a bell and indication lamp that someone is recording from one of these outside stations. He also knows that the inbound train is due to arrive. Simultaneous with the recording, the clerk may select to use a headset or speaker to take down the car initials and numbers directly. To avoid any possible errors, the recording is always made and later transcribed. Six recorders, working in pairs, are connected to the phone boxes, so that three 150-car trains can be checked without changing records. These recorders use vinylite discs, which hold 22 min. of recording. When the first recorder is within 30 sec. of the end of the disc, the second recorder is automatically cut in. Thus, no car information is lost as there is a 30-sec. overlap when both SoundScribers are recording.

Yard Printer Circuit

Hump switch lists are sent via printer from the hump yard office to the hump conductor, hump yardmaster, west-end yardmaster and retarder operator, each such office having a receiving page printer. This printer circuit is also fed into the magnetic core memory unit for programmed automatic switching (explained earlier).

Pneumatic tubes connect the general yard office at the hump with the west-end yard office and the switchtender's location at the east end of the receiving yard. These are Grover Co. double-direction, single 6-in. tubes, which are used for transmission of waybills, orders and other papers.

The telegraph office at the 21st Street general yard office is to be moved into the new general yard office at the hump, which is, in effect, the communications headquarters of this new yard. The IBM-Teletype equipment used for car reporting is in this building, as is a communications maintainer's shop.