SPECIAL REPORT

P&LE

Signaling and Communications

A visitor to the Pittsburgh & Lake Erie with an interest in signaling and communications will come away with the distinct impression that the men in the department are doing a good, professional job. Equally important, these men have a real sense of accomplishment and are enjoying their work.

This special report, by your RSC editor, includes not only technical data on specific projects, but will try to capture the spirit and philosophy of the road's signal and communications department.

"We're always looking for better ways to do things," says Dale W. Shackley, the road's superintendent of signals and communications. He would like to have each man in the department come up with a new idea or better way of doing something every week. Although he doesn't receive 50 ideas each week, Mr. Shackley is a strong believer in the saying: "The origin of an idea doesn't affect its value." Also, he and John D. Rock, signal and communications engineer, sincerely listen to others with a willingness to accept and encourage new ideas. This attitude also makes it easy for anyone in the P&LE's signal and communications department to present his ideas to the boss.

This two-way communications for ideas—up and down—in the S&C department has paid off handsomely—for the men, for the department and for the railroad. Many of these better ways to do things make work easier for the men, take less time, are more efficient and produce a real money saving for the railroad. For example, a time saving method to check for grounds at cases, housings, etc. with a Megger was devised by J. E. Walther, chief signal and communications inspector. New, simplified circuit drawings and wiring charts which require less time to prepare and which save time for men making wiring changes in interlockings or CTC were developed by field signal and communications engineer Charles E. England and circuit engineer H. J. Davis. (Details on these and other new ideas or practices are presented on other pages of this special report.)

Another facet of the P&LE signal and communications department is its aid to safety and morale. It is always reminding S&C men: "Safety Always First". A recent safety slogan says: "We need your help to protect YOUR Mrs.' Mr." These and other safety slogans are printed on small business cards and passed out to the men. Handy to carry and glance at as a safety reminder is one reason for their card like appearance. When P&LE had its first no-accident month in June 1962, management presented a watch chain and charm with the road's initials to each employee on the railroad. Wording on the charm read: "First no accident month in '62. How about this month?" Along with the chain and its attached charm, each employee of the S&C department received A Safety Always First card, which read: "We appreciate your individual contribution to this overall perfect record."

In addition to the safety cards, S&C bulletins are periodically distributed and posted with pertinent information for men in the department. A monthly bulletin of WORDS TO REMEMBER contains a saying that, while it may have humorous overtones, is of serious import. A recent bulletin read: "Industry cannot flourish if labor languish."

How does P&LE's top management view the S&C department? "While to those outside of railway life, signals and communications may appear to be less spectacular and essential than rolling stock, track and trains, the former are equally vital and interesting," states P&LE president John W. Barriger. "Improvements in communications and signals have constantly extended the length of the arms and the range of vision of railroad management as greater lengths of track and more extensive terminal operations can be effectively controlled from some one point as though the entire operation was being conducted within the immediate gaze of the supervisor.

"While in the past, signals and communications have ranked below the civil and mechanical engineering sections of the railways in prestige and importance, the former will advance to a status of full equality with the latter two branches, which will have to look to their laurels as the most advanced and highly developed technical branches of railroading may be found in the signal and communications department as it paves the way to a highly perfected state of railway operation which will enable everyone concerned with train movement or yard services to be continuously in touch, visually and audibly with every condition and circumstances affecting the work," P&LE's president said. One reason for the growing importance of the S&C department says Mr. Barriger is "the rapidly intensifying technical, professional and scientific complexities produced by the amazing rapidity of the development of electronics. Its limitless possibilities will someday be completely capitalized in railway operations to dissolve the limitations of distance and other impediments to the continuous transmission of information and instructions needed to run trains and operate yards and terminals more effectively and safely."

When it comes to doing things better, Mr. Barriger is a staunch supporter of the S&C department and its black boxes. He has always been an ardent advocate of technological progress. When Mr. Shackley proposed using a solid state system for transmitting controls and indications in an interlocking (a departure from the conventional relay coding systems) he received the approval and backing of Mr. Barriger and E. G. Brisbin, chief engineer.

"Our policy has been to encourage the S&C department to come up with new ideas and give them a reasonable freedom to work out these ideas. Also, we have gone along with spending a reasonable amount of money to develop and implement these new ideas. Of course, train operation must be in accordance with safety regulations at all times," states Mr. Brisbin.

As would be expected there have been differences of opinion between management and the signal and communications superintendent, but the friendly relationship has fostered correct solutions and mutual understanding. The S&C philosophy behind their part in this relationship is stated by John Rock: "You have to sell signals and communications a little at a time. And, more importantly, you have to prove yourself and your ideas to management. You just can't go to management, ask for a big chunk of money and expect them to give it to you." P&LE has a complete dial telephone system, Mr. Rock said, but it did not come all at once. It was a case of putting in an automatic dial exchange at Youngstown when the new retarder yard was constructed. Then party line phones on the Pittsburgh automatic exchange were converted to dial operation. By doing it a little at a time, he said, the cost was not great at any one stage. As the program advanced, management could see the benefits; with additional modest expenditures, the program was completed. But, as Mr. Rock says, "it takes time for management to assimilate your progress and gain confidence in you and the work you can accomplish."

That Mr. Shackley had won the confidence of Mr. Brisbin and others in P&LE management was shown clearly in December, 1959, when after six years as superintendent of communications, he was promoted to superintendent of signals and communications. The transition was "rough" as Mr. Shackley says, "but we pitched right in and with the help of the signal boys, particularly Chuck England, Jim Walther and other supervision we made it." Charles E. England, field signal and communications engineer was office engineer, signals, when Mr. Shackley was made head of the combined signal and communications department. "When it comes to signaling, we rely implicitly on Chuck England," says Shackley. As it has worked out, the solid communications background of Shackley and Rock (they have been in NYC and P&LE communications, respectively since 1942 and 1936) and the solid signal experience of England and the other signal men have blended very well. "There's plenty of room for new ideas and a good chance of getting your ideas over to the boss," is how one signalman stated it. "Also," he said, "it's a good place to work."

S&C exploits new ideas

Radio shop uses one wall for a two-way cabinet.

Sometimes it's the simple things that make the big difference. Take for example, the method of handling radio units to and from diesel locomotives at the McKees Rocks radio shop. The radio shop is inside the diesel shop, and in one wall of the radio shop is a cabinet with doors on both sides. When an electrician replaces a radio unit in a locomotive, he unlocks the doors on his side of the shop cabinet and pulls out a radio set. The handle is toward him. When he puts a set in need of repair into the cabinet, he puts it in with the handle facing toward the radio shop.

When the radio man comes to work, he unlocks his cabinet doors and takes out those radios with handles facing him, because these need repairs or frequency checks. When he puts a repaired set in the cabinet, he puts it on the shelf with the handle facing out toward the locomotive shop. The cabinet is normally locked, with the radio men and electricians having keys.

Thus, the radio man or the electrician can easily tell, at a glance, which radio units are available for his use.

On the radio shop side of the wall cabinet, the radio unit with the handle showing indicates it is in for repair.

Cherry picker is a versatile S&C work tool.

Making work easier can produce dividends not only for the men doing the work, but in time savings for the railroad. For example, P&LE signal and communications construction crews have a utility truck equipped with a Truco Equipment Co. (Denver, Colo.) cherry picker. In addition to providing a high reach for pole line and signal work, the arm can be used as a crane. Using a chain and hooks, the unit has been used to place switch machines, sectional concrete foundations, crossing gate mechanisms and masts.

In addition to a full compliment of tools, this truck (as are all maintainer's and linemen's trucks) has railroad radio. An outside speaker, mounted on the cab roof, is wired into the radio receiver so that when the men are out of the truck, they can hear incoming radio calls.

An example of the excellent coordination and time savings that can be accomplished because S&C trucks are radio equipped was demonstrated recently when a signal crew with the cherry picker had to change out a switch machine near Youngstown. A radio-equipped truck was bringing a new switch machine from the signal shop at McKees Rocks. The crew at the switch location radioed the driver and found that he expected to arrive in about 30 min. Having gotten the track from the dispatcher, the crew loosened the bolts on the old machine. When the new machine arrived, the crew used the cherry picker to lift out the old unit, and set the new switch machine in place, and promptly bolted it down. If the crew had had to wait until the truck had arrived with the new machine, they would not have had enough time to make the change. They would have had to wait about an hour for traffic to clear before making the change. So in this instance, radio coordination saved at least an hour, and maybe more.

Another time and work saver on the cherry picker is 1½ kw gas engine generator used to power electric tools, such as saws, drills and a grinder.

An earth auger attachment on the cherry picker is used to bore pole holes, and the P&LE has used it for digging signal foundation holes. To dig a square hole 5 or 6 ft on a side for example, the earth auger is used to dig holes at three or four of the corners of the square. Each of these holes is dug to about a depth of 5 ft. The earth is then caved in toward the center of the square, and a man using a powered tamper packs the dirt. Again, the auger is used to dig three or four holes, same locations, down another 5 ft or so, and the earth caved in toward the center and tamped. Usually only two diggings are required to make a foundation hole about 8 ft deep with packed or tamped earth on the bottom. Then, using the cherry picker as a crane, the sectional foundation is lowered into place and earth tamped around it. Thus a hole is dug without piling a lot of dirt out on top of the ground.

Cherry picker can be used to dig line pole holes, foundation holes or carry an insulated bucket for high-level work.

D. W. Shackley demonstrates how the cherry picker boom may be used as a crane for placing switch machines.

Signal maintainers' trucks have outside loudspeaker that broadcasts radio calls when maintainer is out of truck.

One meter serves many uses for signal maintainers.

With a revised Triplett 630 volt-ohm-milliammeter, P&LE signal maintainers can now use this one meter to check coded track circuits, audio frequency overlay circuits, conventional DC track circuits, high and low-voltage switch machines, etc.

The revisions, were devised by C. E. England, field signal and communications engineer. Range changes to the model 630 meter included providing a 0 to 12 ma full scale, 0 to 1.2 amp full scale and a 0 to 6,000 volts DC as well as 0 to 6,000 volts AC. The revisions included a 30 amp shunt and fusing. The meter has a 600 microamp range at 600 ohms, 1 milliwatt for db readings for AFO circuit checks.

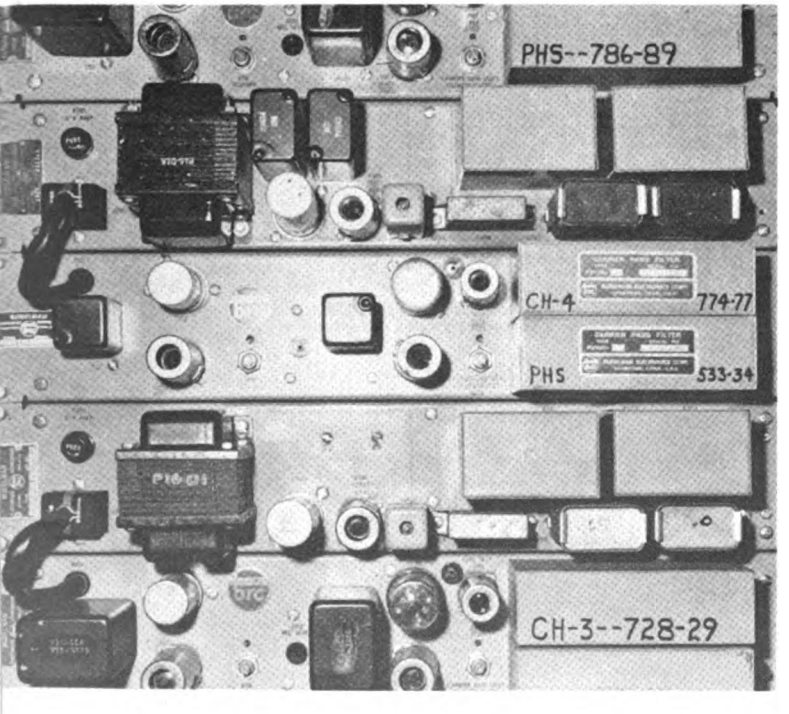
A red stop hand was added for ease in checking coded track circuits. A reading is taken on the track, the red stop hand holds the needle from following the coded impulses, allowing peak coding voltages to be read quite easily.

P&LE has direct distance dial telephone service.

D. B. Fleming, P&LE general manager, makes a direct distance dial phone call as E. G. Brisbin, chief engineer watches.

Right: Dial telephone is mounted on centralized traffic control machine so it is within easy reach. Code-start buttons are above the telephone.

Below: Part of the carrier filter section at Pittsburgh telegraph office. P&LE uses subscriber carrier to handle party line dial phones.



All the offices of the Pittsburgh & Lake Erie are no served by direct distance dialing. From Pittsburgh, P&L has 10 wire pairs going west which drop out at vario locations. On these physical pairs are superimposed 13 ca rier circuits. Three carrier circuits extend to NYC Clev land offices. Eight 2-way dial trunks extend from Pittsburg to Youngstown with tandem dialing through to Ashtab la, O., and Erie, Pa. From Pittsburgh to McKees Rock Pa., there are nine outgoing dial trunks and six incomin dial trunks. From Pittsburgh east there are six wire pai with seven carrier circuits. These seven carrier circu have 2- and 4-party dial phones. Also, there are sever short runs of physical circuits between various locatio All offices have ninth level call out where needed.

Even the wreck train has dial service. A box with t necessary equipment for emergency service is kept wi the wreck crew. At the work site, the phone is connect to the line, and the number of a little used station is a signed. The normal recipient is instructed not to answ during the emergency period. DC transistorized talk-ba amplifiers are also on hand to be used on the dispatch line.

The benefits obtained by replacing the ring down a selector message circuits were two fold:

Faster telephone service conserves man hours, and e ables the railroad to give its shippers better service.

Automatic dial telephones have allowed the railro to reduce the number of operators from 17 to 3, with n savings of at least $5,000 per operator in annual operati costs.

The dial phones provide more than double the efficie cy of manually placed calls. Less circuit time is requir for each call. Since users know they won't have to wa for the operator, then wait for a line, they are less pro to hang on to a call while searching files for data.

The railroad installed and maintains the outside plan including bringing the wires into the office. The telepho company is responsible for all the inside plant includi the protectors.

The Pittsburgh automatic exchange has a capacity 400 lines. A satellite automatic exchange at Youngstow has 100 lines capacity. A third satellite exchange at M Kees Rocks (major shops) has a capacity of 200 line Four night offices at McKees Rocks (4 miles west Pittsburgh) have extensions off of the Pittsburgh exchan for purposes of setting up night connections. At Aliquip (19 miles west of Pittsburgh, a major yard) there a lines from both the Pittsburgh and Youngstown exchange

The P&LE dial switchboard at Pittsburgh is interco nected with the Baltimore & Ohio switchboard with tw 2-way dial tie lines.

A complete dial system was installed on the Monong hela (jointly owned by P&LE, B&O, and PRR). Thre Budelman rural subscriber carriers type 16B, were installe to create four 10-party dial circuits over the old messa circuit. Three code line circuits were converted to 10-par dial, thus providing a complete intercity dial system. Tw way dial tie lines were created between the automat satellite at Brownsville, Pa., and the P&LE switchboar Pittsburgh, and the Pennsylvania switchboard at Elram Pa. Individual dial extensions were used throughout th offices in the Brownsville station.

As an example of the savings available, the estimate installation costs of the dial satellite exchange on th Monongahela were $6830. The higher phone rental more than offset by the labor cost saving, yielding a n saving of $2495 each year. This amortizes the cost i about 2½ years, a 40% return on investment.

P&LE FACT SHEET

Radio Units:
Automobiles 11
Trucks 34
Locomotives 112
Portable transmitters 19
Walkie-talkies 37
Wayside stations 16

Automatic Telephone Exchanges:
Pittsburgh, Pa. 400 lines
McKees Rocks, Pa. 200 lines
Youngstown, O. 100 lines

Maintenance:
2 radio maintainers
2 telephone linemen
2 telephone maintainers
4-man telephone construction crew
3 wire chiefs, 1 manager of wire chiefs
1 chief telephone operator, 2 PBX operators

Hotbox Detectors:
1 bidirectional
2 unidirectional

CTC: 103.4 track miles

Interlockings:
direct control—7 plants
remote control—26 plants
controlled signals—3 locations

ABS: 257.1 track miles
ATS: 156.6 track miles, 40 locomotives

Highway Crossing Protection:
52 rail-highway crossings

Signal Repair Shop:
McKees Rocks, Pa. (1 relay man, 1 mechanic)

Signal Construction Gang:
1 foreman, 5 men

Signal Maintenance:
17 maintainers, 13,682 AAR units

Radio Shops:
McKees Rocks, Pa.
Youngstown, Ohio

Teletypewriter Network:
Pittsburgh-Cleveland
Party lines: 4 stations on each line
Pittsburgh east to Newell and Dickerson Run
Pittsburgh west to Youngstown

Printers:
To B&O station
P&LE at Pittsburgh—
freight transportation office
freight sales office
Printer and reperforator at "DE" general telegraph office

How S&C men paint more efficiently and easily.

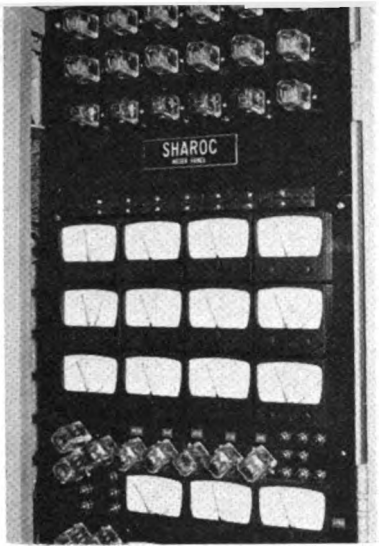
P&LE signalmen, like others, painted with brushes, but now only rarely. For touch up jobs, such as when moving switches or signals, Rust Oleum black or aluminum is used in aerosol cans. Simply point the can, and press the button. For larger jobs, the men use a 5 gal garden weed spray unit that has a strap for carrying over the shoulder and a pushbutton on the long nozzle. For aluminum painting the proportions are ½ pint thinner to 1 gal of Rust Oleum No. 740.

The time required to paint the compressed air tanks at Gateway yard has been cut by more than 50% with the use of the weed spray gun.

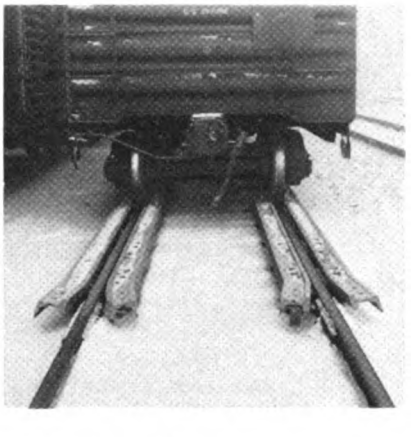
Maintainers also use a garden weed spray gun for applying graphite switch plate lubricant. They formerly used a paint brush, but no more. This idea was suggested by leading signal maintainer Wayne Davis. To get the proper consistency of the graphite lubricant (about like water) and to save time, the signal shop in the retarder tower at Gateway yard has an electric paint shaker with a timer. A maintainer clamps a 1 gal can of Grafett in the shaker and sets the timer for 5 min, which starts the shaker. It shuts off automatically at the end of the preset time so that the maintainer can go out and spray graphite lubricant while a new can is being mixed. "It not only saves time," says signal supervisor E. J. Taylor, "but we get a good mix that the spray gun can squirt under the rails onto the switch plates." At Gateway yard, P&LE uses about 15 gal of switch plate lubricant per month.

Wayne Davis, leading signal maintainer, uses garden weed spray for spreading graphite switch plate lubricant.

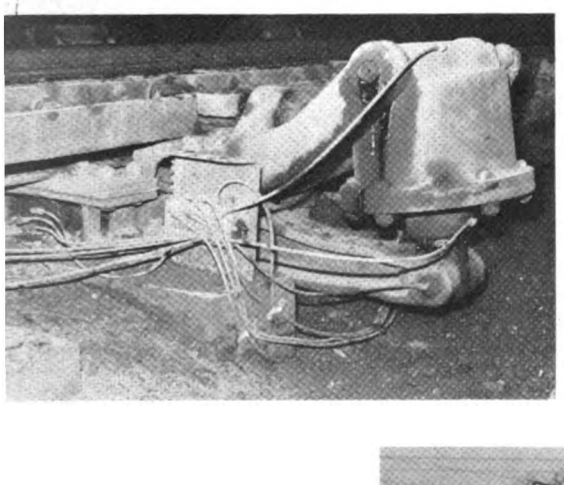
Refinements are always being ma



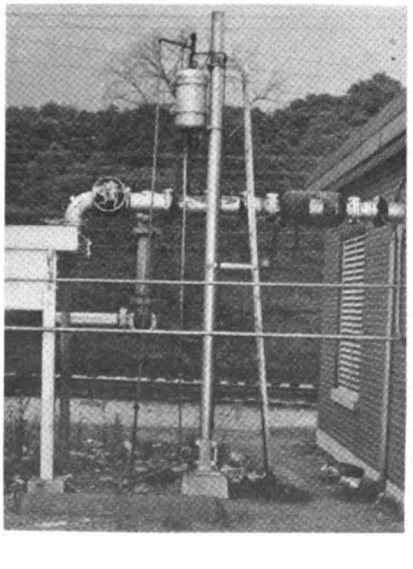
Meter panel checks yard radar units. A normal radar unit will produce about 10 volts AC. When the output of the radar unit is less than 3.5 volts AC while a car is occupying the track circuit, the contact meter will lock up and set off an alarm notifying the retarder operator that a failure has occurred.



P&LE has installed inert retarders at the bowl end of the classification yard tracks to prevent cars from fouling the ladder tracks. The installation of inert retarders has eliminated the use of track skates.



In a test installation, a grease dispensing valve was installed on one cylinder of the master retarder with nylon tubing going to 14 zerk fittings. Only one operation is required to grease the 14 fittings.



Alcohol tank, buried in the ground (bottom of picture), holds 100 gal. Signal maintainer only has to open valve to blow alcohol into air lines to prevent moisture condensation in the winter.

An automatic retarder yard is never really finished; there are always refinements that can be made to improve its operation, especially after it has been in service for a time. One of the major problems of such a yard is to have a radar unit fail during humping operations. To solve this problem at P&LE's Gateway Yard, a meter panel was developed to alert maintenance personnel when a radar unit was operating below its proper voltage so it could be changed out before failure *(RSC July 1962 p 21)*. Gateway Yard is at Struthers, Ohio.

To inform the yardmaster and terminal trainmaster that the master retarder and five group retarders are in automatic operation, a green indication lamp on their desks is lighted. The light is extinguished if the system goes into manual operation.

As a further check on master retarder operation for the maintenance men, a paper tape recording is made of a yes-no function. "No" is recorded if the master retarder releases a car or cut ±¼ mph from the proper release speed to which the retarder should be controlled. Red and green lights on the retarder operators control panel indicate proper release (green if yes, red if no).

Gateway yard has the Union Switch & Signal Vela system of automatic switching and automatic retarder control. Although there is a fixed output of the master retarder, this can be modified with a Fast, Normal or Slow control to take into account changes in car rollability due to weather conditions, temperature, etc. Conventionally, the retarder operator sets a selector switch to F, N or S depending upon conditions. To provide more precise automatic control, S&C engineers of the P&LE and retarder technician George D. Shanabarger along with signal supervisor E. J. Taylor developed a temperature compensation for the F, N or S controls. A Minneapolis-Honeywell outdoor thermometer was mounted outside the relay room in the retarder tower. Contacts on the thermometer close at specific temperature settings. When the outdoor temperature is below 32 deg F, contacts close to complete a circuit to operate the master retarder modification controls to the Fast position. Above 32 deg F, the modification control is set to Normal. To avoid incorrect retardation settings during automatic retarder operation, these temperature controls do not take effect until the master retarder is put into manual control (for trimming, for example) following the period of automatic operation during which the temperature change was sufficient for a modification.

To eliminate loss of control of the first cut through the master retarder following trimming (when the master is in the off position), heavy air is pumped into the 3-section master retarder for 10 sec before automation retarder control is put into effect. When the retarder operator puts the master retarder levers into automation position from the off position, an amber lamp is lighted on his control console. After 10 sec, the amber lamp goes out and a green lamp is lighted to indicate that the master retarder has full air and humping may proceed.

To assure that humping will not proceed when the master retarder is in the off position, S&C engineers developed and installed an alarm system to alert the retarder operator, hump conductor, pin puller and hump engineman. With the master retarder in the off position, if the hump conductor punches up a class track number on his automatic switching panel, two red lights flash alternately on the retarder operator's console, and a door chime sounds as well. The hump engine cab signals go to red, and the hump conductor is alerted by a red cab signal indication

P&LE's Gateway retarder yard.

lamp being lighted on his automatic switching panel. A horn at the pin puller's location is also sounded to alert him that he is not to pull pins. When the retarder operator places the master retarder levers in the automation position, lights are extinguished and the horn and chime cease operation so that humping may proceed.

Because wet track will enable cars to roll faster, the S&C department is planning to install a rain detector for modifying controls of the group retarders. In this case, the detector would operate to overide Normal control and put the Slow control into operation for the group retarders.

Another aid to the retarder operator is a speedometer that indicates the leaving speed of cars or cuts from the group retarders. This is considered to be psychologically good because it helps the operator become a better judge of car speeds.

Although only a "black box idea", Mr. Shackley would like to have a device to read the speed of impact of car coupling on class tracks. The New York Central laboratories at Collinwood, O., is working with the P&LE S&C department to develop a meter which would be connected to the distance-to-go panel on the retarder operator's console. If accomplished, this would pinpoint the impact coupling speed which is so closely watched and vitally important in reducing damage to lading.

An interesting sidelight on lading damage is that if the Gateway Yard rip track begins to fill up, the S&C men make a particular point to check the automatic retarder controls to be sure the retardation is proper for low speed couplings. "An empty rip track means a proper retarder operation," says Mr. Shackley.

Inert retarders, made by American Brake Shoe Co., have been installed at the bowl end of the class tracks.

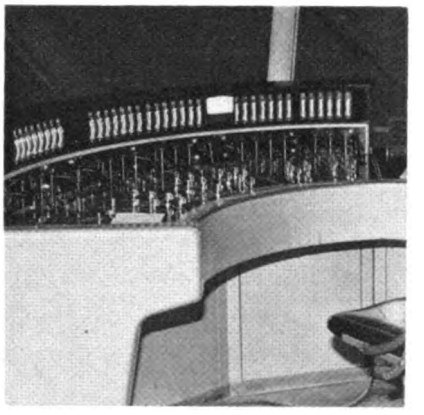
To reduce the time required for greasing the zerk fittings of the electro-pneumatic retarders a grease dispensing valve with a fitting was installed for test at one retarder cylinder. From this valve, nylon tubing is run to each of the 14 zerk fittings of the cylinder. To grease a cylinder the technician only has to put his grease gun on the top zerk fitting and pump grease, compared to 14 such operations required formerly. Farval Lubrication Co., Cleveland, is working with the P&LE on this test.

Injecting alcohol into the reservoir tanks at Gateway Yard in Youngstown has been a means for keeping the air lines open to the electro-pneumatic retarders during the cold winters. Here again, a little ingenuity paid off. Instead of the time consuming job of climbing a ladder to remove a plug so he can pour alcohol into a reservoir tank, the signal maintainer simply opens a small valve and compressed air pumps alcohol into the reservoir tanks. Buried in the ground is a 100-gal tank which is filled with alcohol each fall.

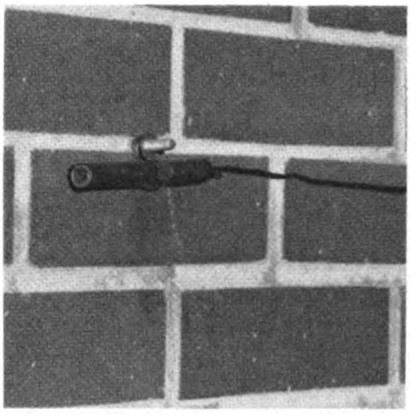
To prevent freeze-up of the air lines to the receiving yard NA-15 electro-pneumatic switches, P&LE has installed an air dryer which uses desiccant beads instead of alcohol as the drying agent. Made by General Welding & Fabricating Co., Erie, Pa., the unit has a capacity of 25 cu ft per min. It is installed between the compressor and the storage tank.

P&LE has two Servo Corp. hotbox detectors, one at each end of Gateway yard located near the yard track indicator. When the yard track indicator number is dialed, the hotbox detector is set into the operation and the recorder chart starts running in the car foreman's office. Tapes are checked by the foreman and those cars indicating overheated journals are checked by the inspectors.

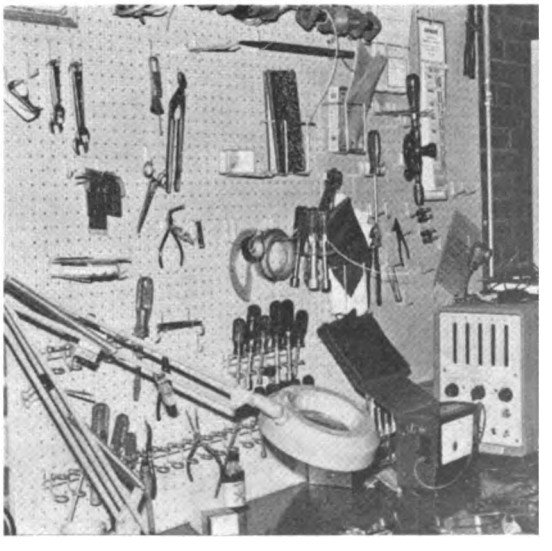
Signal supervisor E. J. Taylor demonstrates use of new Motorola lightweight portable radio transmitter-receiver. New unit is for use by Gateway yard car inspectors. Portable radio works with base station repeater to provide extended coverage.



Distance-to-go panel on the retarder operator's console is at the back of the class track diagram. Meter indicates speed of cuts as they leave the group retarders.

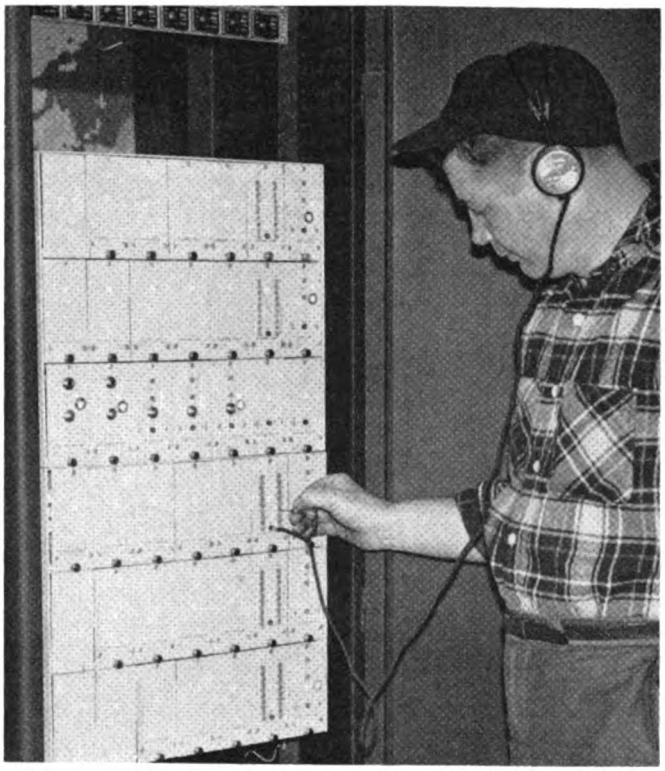


Sensing unit of a thermometer is mounted on the outside wall of the retarder building just above the second floor. Critical temperature is 32 deg. F for retarder control settings.

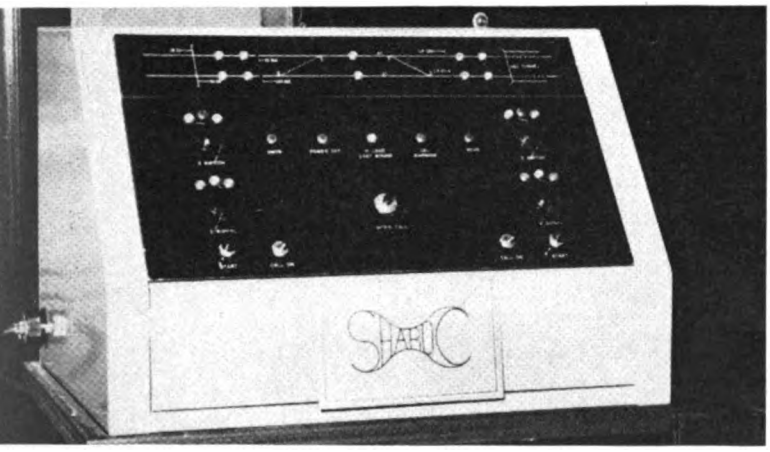


Work bench for the retarder technician has a peg board for hanging tools within easy reach. Bench is in the retarder tower Velac control room. Radar meter panel is also here.

Solid state devices handle interlocking controls.



D. E. Bissell, signal mechanic, checks out solid state units by listening to audio tones with a headphone.



Crossover and signals at J&L tunnel are controlled from this machine using solid state control system elements.

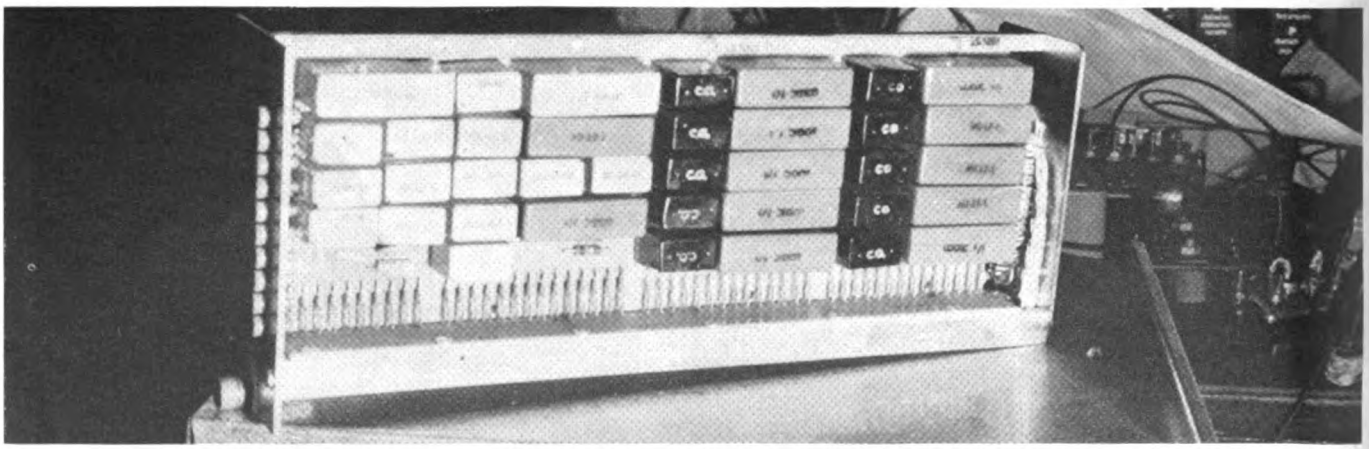
Two miles east of P&LE's Pittsburgh station is a 2,200 ft tunnel known as the J&L (Jones & Laughlin) tunnel. Although the railroad is double track, the eastbound track was lowered in the tunnel last year to provide a 17.5 ft clearance for piggyback cars and other high loads. Westward trains which have actuated the high load detector at the Monongahela river bridge are routed over a crossover at BK interlocking to the eastbound track, about 1.5 miles east of the tunnel. To return these westward trains to the westbound mainline, a crossover was installed just west of the J&L tunnel entrance. This crossover and associated signals are controlled from BK interlocking.

Factors entering into the decision to use a solid state (transistorized) system for transmission of controls and indications were: (1) lower initial cost; (2) faster operation than conventional relay coding techniques; and (3) less maintenance. "The patience and understanding of Mr. Brisbin, Mr. Barriger and Mr. Fleming, the general manager, played an important part in our decision to go to solid state devices," reports Mr. Shackley. "They knew we'd have bugs in the system, but had confidence that we could eliminate the bugs, and in the final analysis, the solid state system would be best."

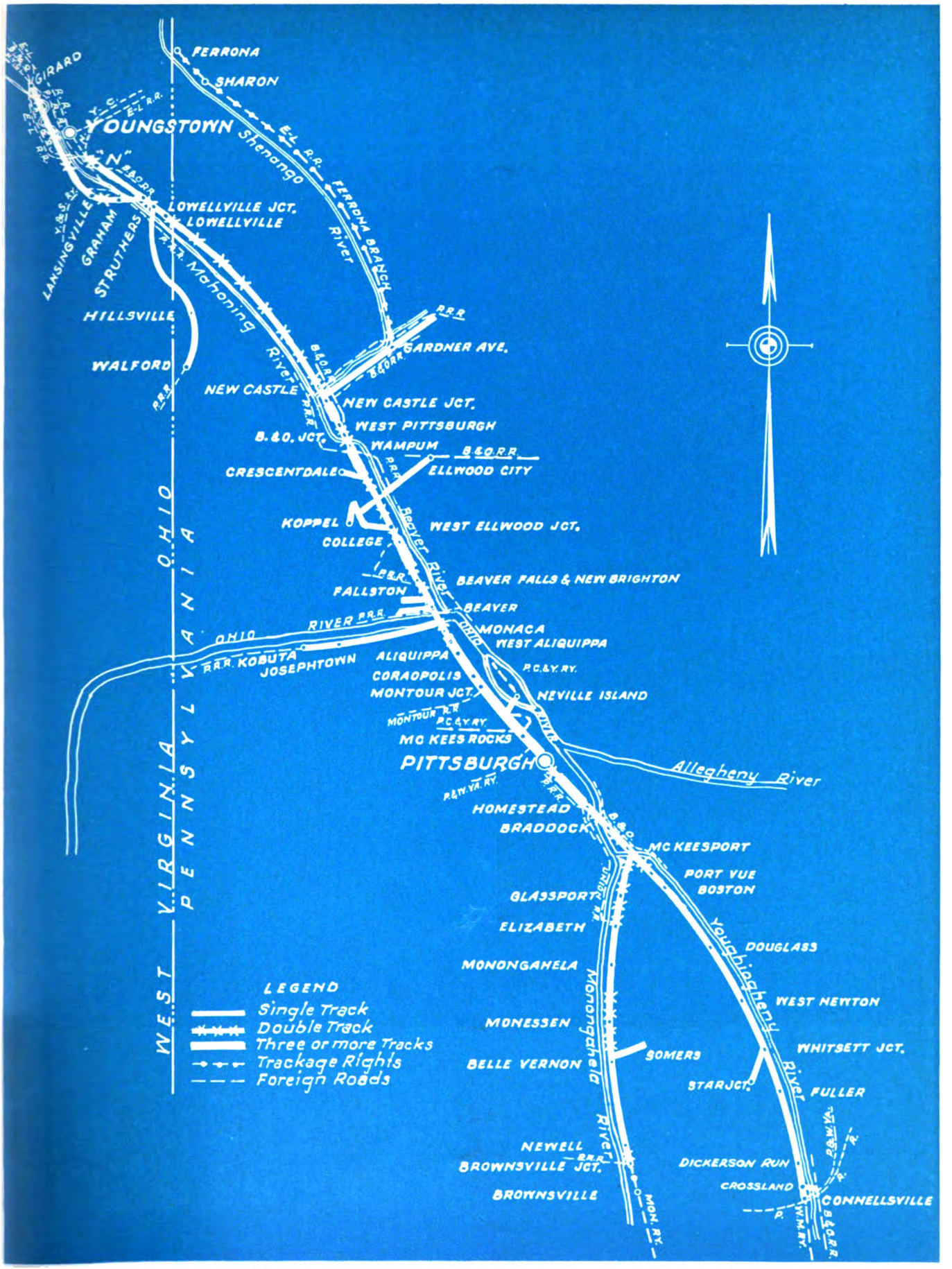
The pushbutton control machine is mounted on a portion of an existing model 14 electric interlocking machine at BK tower. Two wire operation is used to transmit the 17 indications (23.0 kc) and 11 controls (28.1 kc) between BK tower and the west end of J&L tunnel. A wire pair goes from the control machine to the pole line where the circuits are run on 1 mile of open wire then into a 16 gauge, 25 pair communications cable for one mile to the instrument bungalow at the field location. The open wire line is transposed for 3 kc. The solid state control equipment which works off 24 volts DC, was made by Noller Control Systems, Inc., Richmond, Cal.

"We have several locations where we would like to use solid state control and indication systems," Mr. Shackley states. "For example, we are now in the process of installing this same type of equipment where the controls of four major interlockings will be consolidated. There are approximately 600 functions (indications and controls) involved in this project for which Noller Control Systems have furnished the equipment."

This system makes use of a highly redundant coding principle to obtain reliability. (*Railway Signaling and Communications* will publish a detailed article on this interlocking consolidation project involving the use of solid state equipment for handling indications and controls in an early issue.)

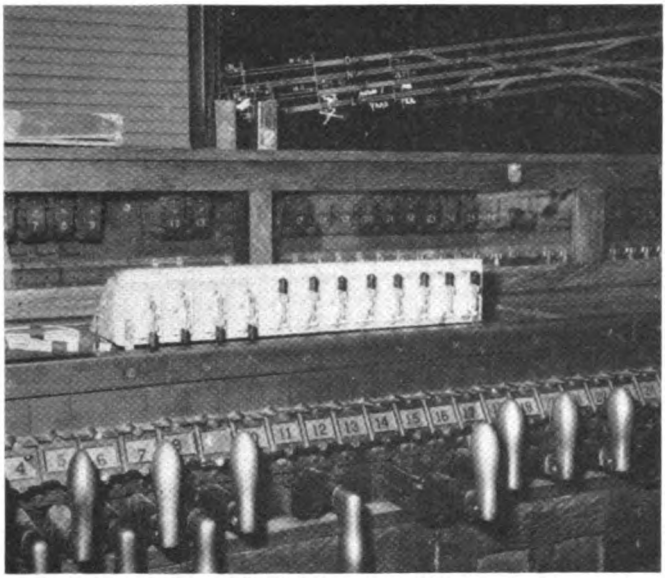


One drawer of the solid state equipment (top photo) contains modular units for ease of maintenance and replacement.

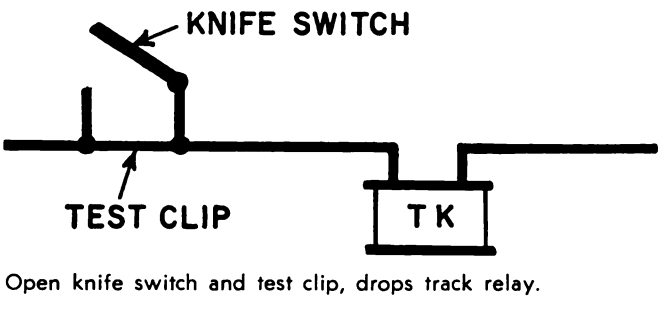


Pittsburgh & Lake Erie is not as straight a railroad as it would appear to be on the map. Maximum length of tangent track on the entire system is only 1.4 miles long, between Pittsburgh and New Castle, Pa. Also, the entire railroad is within yard limits except for a 4.79 mile section between Boston and Douglass, Pa., along the Youghiogheny river.

How interlocking operations are checked on the P&LE.



Knife switches on this board are wired to test clips that are wired in series with the track relays.



Open knife switch and test clip, drops track relay.

WESTWARD ROUTE LOCKING - CH INTERLOCKING

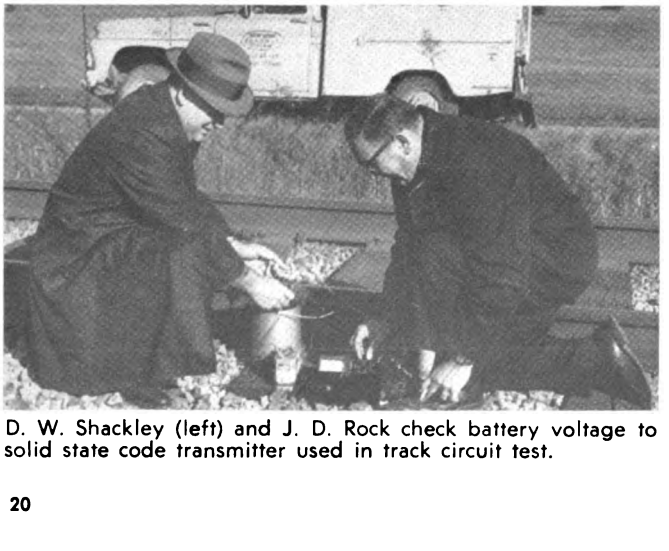
From Signal	Detector Track Circuit	Route	To Signal
LD108	107	(107) - 103 - 89 - 61 - 45 - (41)	R42

To check route locking in an interlocking plant can be a tedious and time-consuming job. At one time on the P&LE it took two men about a two days to check out one plant. Now it takes one man about a half day. Key to simplification and time saving is a knife-switch arrangement by which one man at the control machine can drop the detector track relays or their repeaters that are downstairs in the relay room.

Raco test clips were installed on the terminal board downstairs in the relay room, and wired in series with the detector track relay coil. There is a test clip for each detector track relay. A wire pair from the test leads of each test clip is run upstairs to a knife switch. Several switches are mounted on a board, which with slack cabling can be stored underneath the control machine or other out of the way place. In normal operation the test clip is tightened. When the route locking is to be checked, the knife switches are closed and then the test clips are loosened. Thus the current to the detector track relay coils go through the knife switches. The board of knife switches is placed conveniently near the interlocking machine. After the inspector lines a route, he simply opens knife switches to simulate the movement of a train. The fact that he can quickly drop out and pick up the detector track relays saves time and enables him to make his checks without interfering with traffic.

Formerly it took about a month to check a large interlocking to see if lever manipulation was correct. A maintainer or inspector would copy down the manipulation chart and then he would go about setting up the routes. The various track relays in the route would be dropped to simulate a train move. Now the P&LE signalmen have come up with a set of sheets that list all possible manipulations and it is a simple matter to drop track relays and place check marks on the list for correct operations or positions of switches and signals. For example, a route from signal LD108 to signal R42 at "CH" interlocking would show that the route is over detector track circuit 107, switch 107 reversed, switches 103, 89, 61 and 45 normal and switch 41 reversed. Once the sheets are made up for an interlocking, copies can be easily made by reproduction techniques such as a white print or ozalid machine. A track and signal plan of the interlocking is part of the set of check list sheets. These sheets are made up for each large or multiple interlocking.

Solid state coder can work up to a 20,000 ft track circuit.



D. W. Shackley (left) and J. D. Rock check battery voltage to solid state code transmitter used in track circuit test.

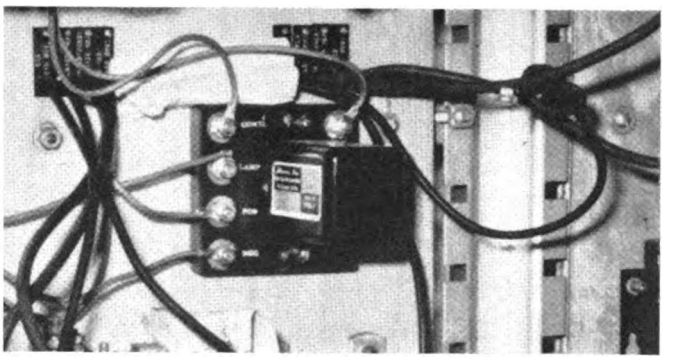
From McKeesport to Dickerson Run, the P&LE's PMcK&Y operates by train order under manual block protection. It has been proposed to install controlled signals at each end of this 36 miles of single track with one automatic signal location in the middle. P&LE S&C engineers are exploring the idea of sending a code in at one end, repeating it at cut sections throughout the 36 miles and if all is clear, the code will pick up a relay at the other end which will feed code back to the point of origin. Following this receipt of the return code, a signal could be cleared allowing a train to proceed.

It is the desire to have as few cut sections as possible. Working with Communications & Control Co., Pittsburgh, a solid state coding transmitter has been developed. In a test in non-signaled territory which was bonded, the solid state coding transmitter put out a sufficient signal to pick up a code following relay at distances equivalent to con-

ventional relay coding techniques. Further tests have indicated that distances up to 20,000 ft can be practical for this type of coded track circuit equipment.

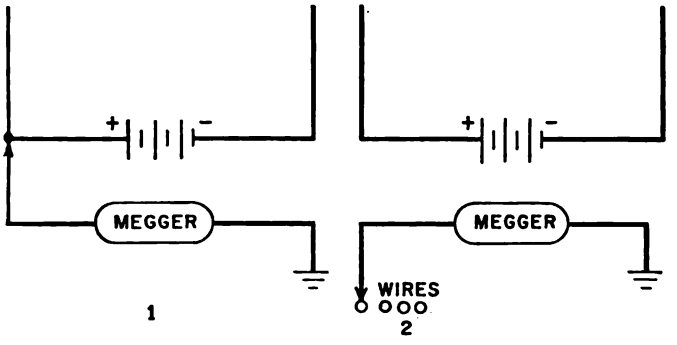
The solid state coder which uses flip-flops and a multivibrator puts out a square wave at a pre-requested rate. At the end of a particular circuit, a decoding transformer and another transmitter would be installed. In other words, the plan is to recognize the code and regenerate a good wave form.

This working with a supplier and using the railroad as a testing laboratory is much in line with the road's S&C department philosophy about the railroad-supplier relationship: "Railroads must assist suppliers in testing products and working with the railroads in developing new products."



Solid state flashing relay has been on test for several months. Might be used to provide flashing signal apsects.

A simple, effective way to test for grounds.



Drawing at left shows connection for Megger when clearing grounds from battery. At right, connections are shown for clearing or checking wires after battery is cleared.

J. E. Walther, chief signal and communications inspector developed a faster way to test for grounds in wiring. Instead of the former method of disconnecting a cable at both ends at the terminal boards, Mr. Walther suggested that first the battery in the case should be meggered, and if below 1 megohm, grounds should be cleared sufficiently to be above 1 megohm. With one Megger lead connected to ground, the other is momentarily touched to the cable and wire terminals. Only those wires that are grounded are taken off their terminals and later checked individually.

In one case there was a ground on an EN signal lighting circuit. Rather than disconnecting wires at the relay case, base of signal mast, etc., the inspector simply removed the light bulb, breaking the circuit at that point. Then he Meggered each side and found his trouble.

P&LE management encourages departments to find new and better ways of doing things.

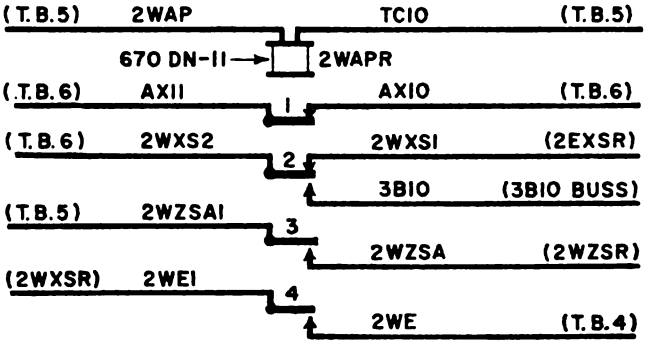
All operating departments on the Pittsburgh & Lake Erie are continually urged to find new and better ways to conduct the affairs of their department. This article points out some of the things that have been accomplished in the signals and communications department.

In the transportation department, a modern classification yard has been built at Struthers, Ohio, as well as revamping the yard at McKees Rocks, to permit a more efficient operation. The mechanical department has developed a mechanical cushion underframe to reduce damage to shipments in transit. Modernized facilities such as spot repair of bad order cars, improved lighting and modern machinery and tools have been installed at McKees Rocks shop so that a more efficient job can be accomplished. The engineering department is fully mechanized and is able to maintain the railroad efficiently and economically. The stores department reports and records are prepared on IBM machines. Inventory has been drastically reduced by close control of purchases as related to use. All cruiser cars of the property protection department, as well as the office, are equipped with radio which aids in providing an efficient coverage of the railroad.

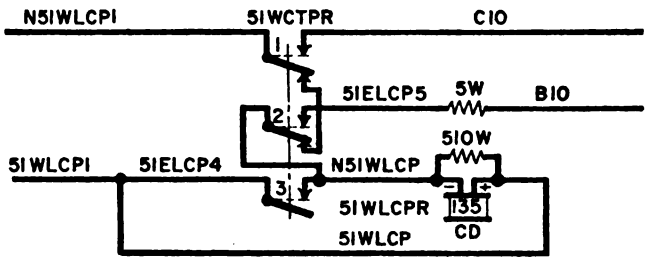
We have continually encouraged our people to be ingenious and each suggestion or recommendation is given careful attention, which makes for an excellent esprit de corps among the employees of the Pittsburgh & Lake Erie.

D. B. Fleming,
General Manager

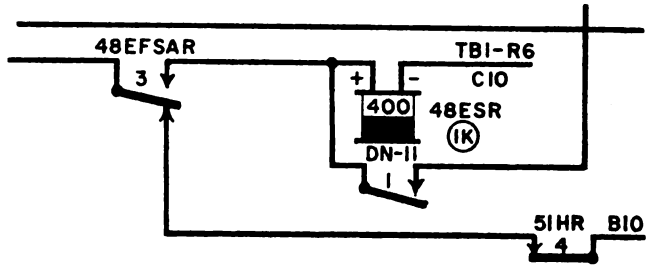
Revisions made to simplify circuit and wire plans.



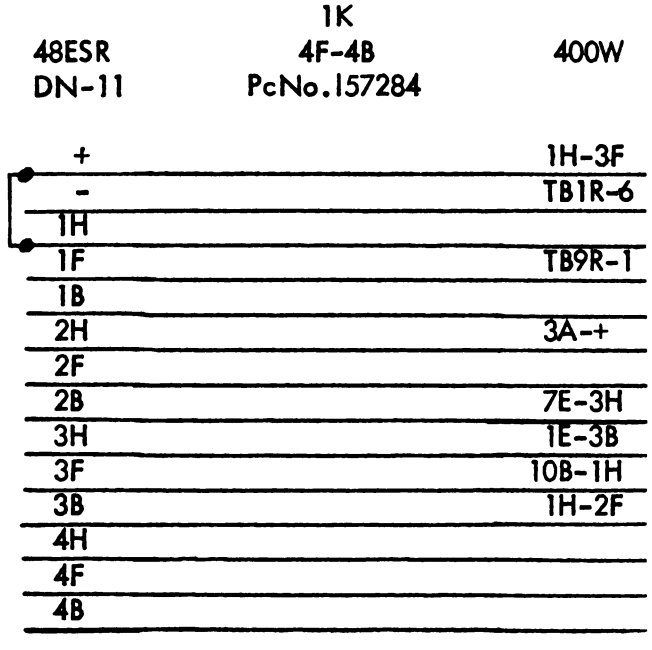
Wiring drawing before revisions were made.



Circuit drawing before revisions were made.

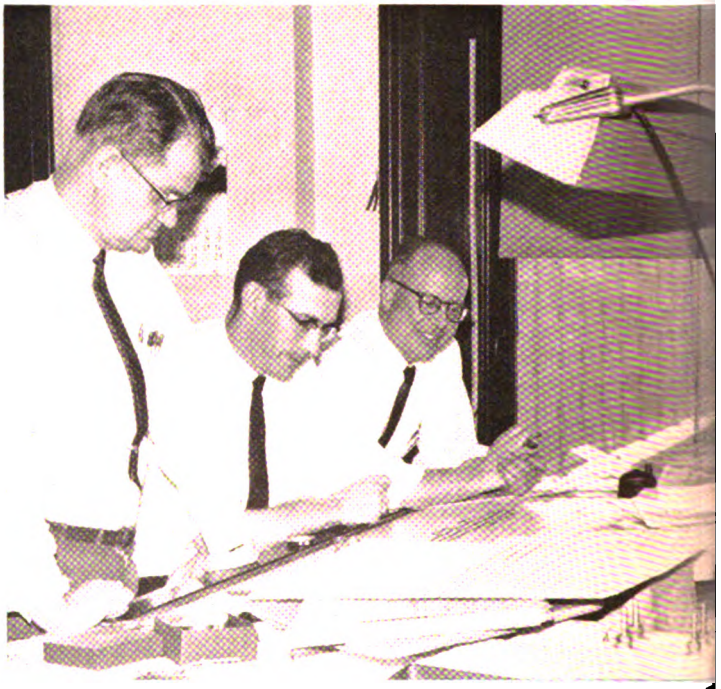


Simplified circuit drawing after revisions were made.

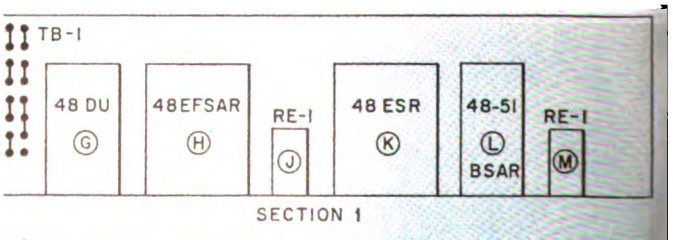


A revision of drawing signal circuit plans has eliminated separate wiring diagrams in the P&LE's signal drafting practices. Revisions were devised by Charles E. England, field signal and communications engineer and H. J. Davis, circuit engineer. Wiring nomenclature is left off the circuit plans, and by using location designations for relays, a simplified wiring sheet is prepared and given to signalmen who do the wiring in the field. They are also given a location sheet indicating where the relays are placed on shelves in cases or in bungalows and interlocking towers. The wiring sheets can be easily drawn up using blank forms. Wiring nomenclature, however, is used for all wires that leave a case and is also used to identify the relays.

To simplify tagging relays and indicating contacts in the field, a 2¼" by 6" white vinyl label with an adhesive backing (made by Avery Label Co.) has designations for various relay contacts such as 1F, 1B, 1H and + and −. A small + sign under these designations serves as a target for a paper punch to make holes under these designations. The label is separated from its backing and stuck to the backboard behind the relay. The signalman simply drills holes through the backboard at places indicated by a hole on the label, and brings the wires to the relay through these holes.



C. E. England, field S&C engineer (left); H. J. Davis, circuit engineer; J. E. Walther, chief S&C inspector (right).



Above: location plan shows relay position in housing or tower. **Left:** wiring sheet shows connections to be made.

CTC code line carries radio station controls.

The operator at BV tower at McKeesport has remote control of base radio stations at Monnessen (23.5 miles distant) and Newell (33.7 miles distant). Budelman carrier, type 391B1 handles the radio controls on the CTC code line. Tones are used to control the radio stations. When the operator at BV steps on his footswitch, after selecting the radio station, a tone is sent out over the carrier line to key the radio transmitter. The audio and tone controls are bidirectional so that the operator can talk out over both radio stations, and also receive calls from both stations. This gives him good radio coverage to trains along the Monongahela subdivision.

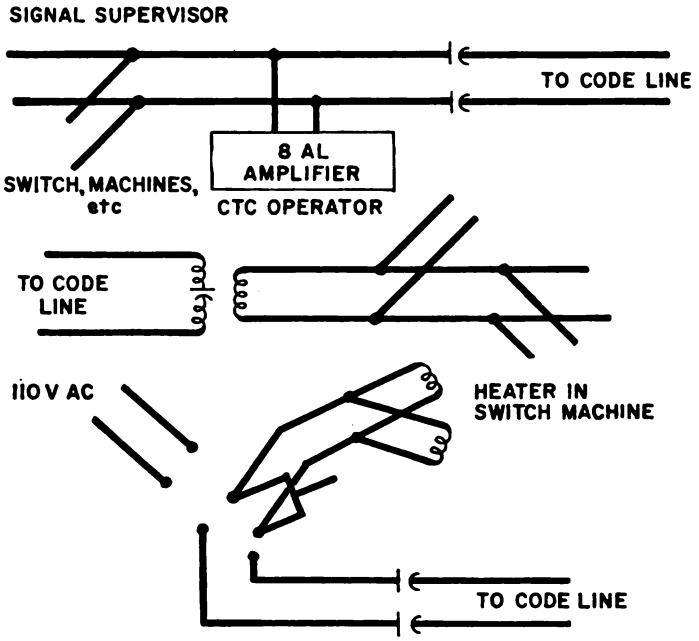
Electric switch lamps reduce maintenance costs.

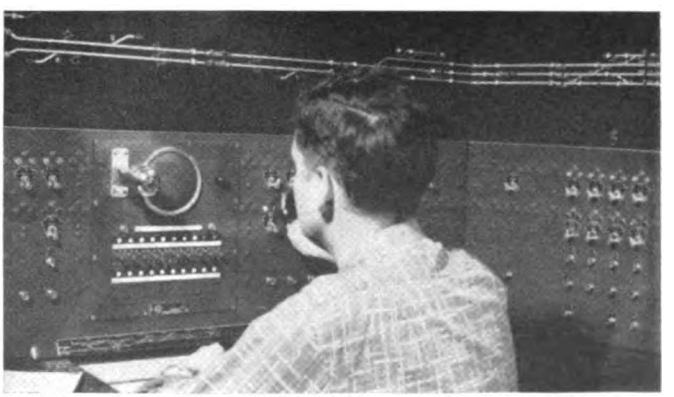
Replacing kerosene switch lamps with new electric lamps is reducing maintenance costs as well as providing yardmen with a consistently good light aspect at the switches. The new Western Railroad Supply stainless steel lamps operate off 10 volts AC. A Superior Cable two-conductor No. 9 solid copper wire with 1/64" polyethylene insulation is used for the 110 volt AC charging line. Transformers step the 110 volts down to 10 volts, and up to 10 lamps are wired in parallel off one transformer secondary line. P&LE has installed 94 of these electric switch lamps at McKees Rocks yard, and 42 along ladder tracks at the bowl end of the Gateway classification yard.

Signal maintenance forces uses CTC code line for talking.

P&LE utilizes spare cable conductors for talking purposes in CTC territory. For example, spare conductors to each switch machine are tied together on common terminals and "piped" to or connected to a line tapped off the code line. With proper isolation using condensers or a transformer and condenser, on this tapped-off line, a maintainer at a switch machine can plug in his transistorized intercom unit and talk directly to the CTC operator. On some switch machines a double-pole, double-throw switch was installed that is wired to the heaters in the switch machine and to a tap off the code line. When the maintainer comes to work on the switch, he throws the DPDT switch from 110-volts AC to the code line. Then he connects the alligator clips of his intercom unit to the heater coils in the switch machine. Note: the code line itself is never run directly to switch machines.

Signal maintainer (below) makes use of the code line for talking to the CTC operator (below right). The maintainer may ask the operator for time to work on the switch, and also he may request that the operator change the position of the switch so the maintainer may observe its operation. Code line circuit provides instant two-way communication between the two men.





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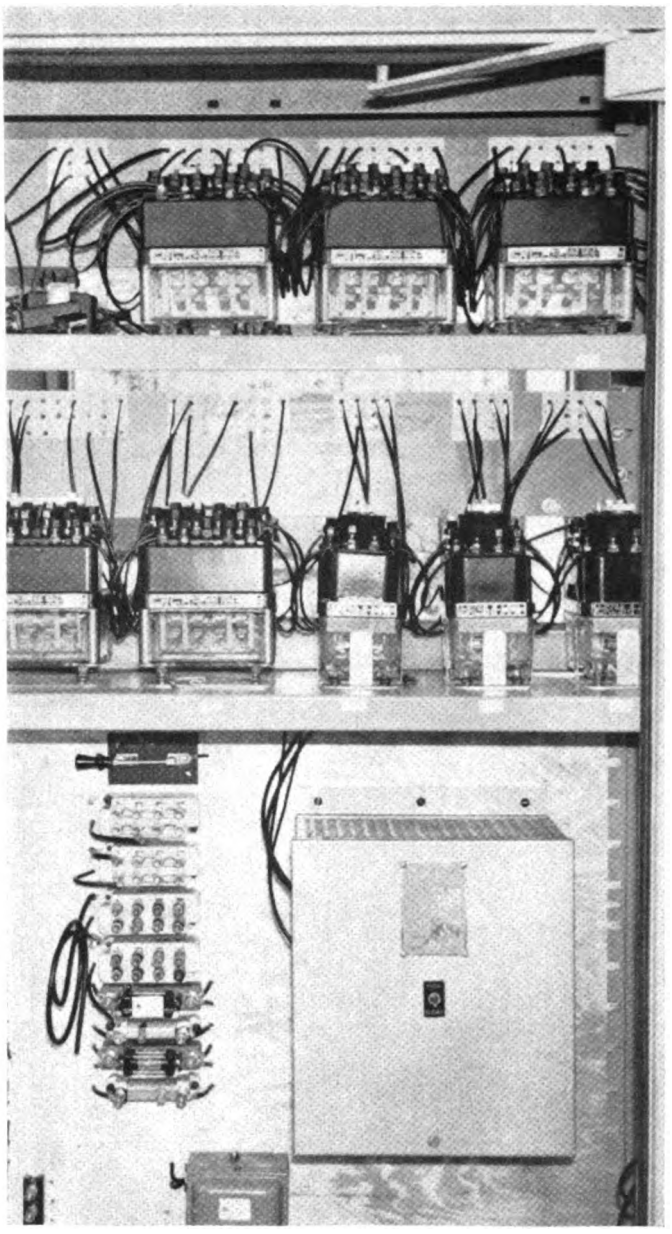
Rectifier saves at rail-highway grade crossing.

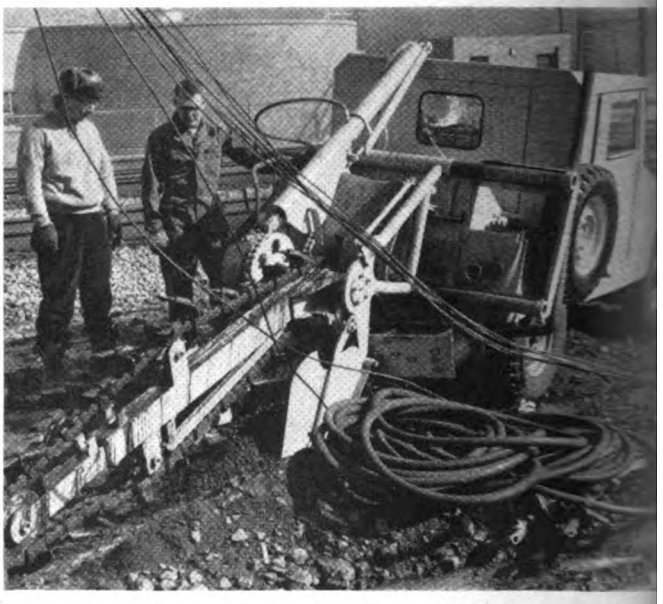


Rectifier (lower right) and battery feed lights and gates.

In a test installation at a highway crossing, P&LE has installed a LaMarche 10-amp constant voltage rectifier to supply, with the battery, all power for the gates and flashers. When the crossing protection equipment is operating, the rectifier and battery deliver full current (14 amp per gate motor; and 10 amp for lights for 5 min for the average train). After the gates and flashers cease operation, the rectifier continues to deliver 10 amp output until the battery is fully charged. Then the rectifier output drops off to deliver just enough current to keep the battery fully charged.

Formerly the flashers were operated off AC with a power-off relay to switch over to DC if the AC failed. Savings accrue from less maintenance with all DC operation and the initial cost is estimated to be less because of the elimination of a power-off relay, two-rate charge control relay and a 110/10 volt transformer for the flashing lights.

In another test, a constant voltage rectifier has been used to charge one cell of Edison nickel-iron alkaline track battery. Since the rectifier was first installed over 15 months ago, the battery has not required the addition of water.



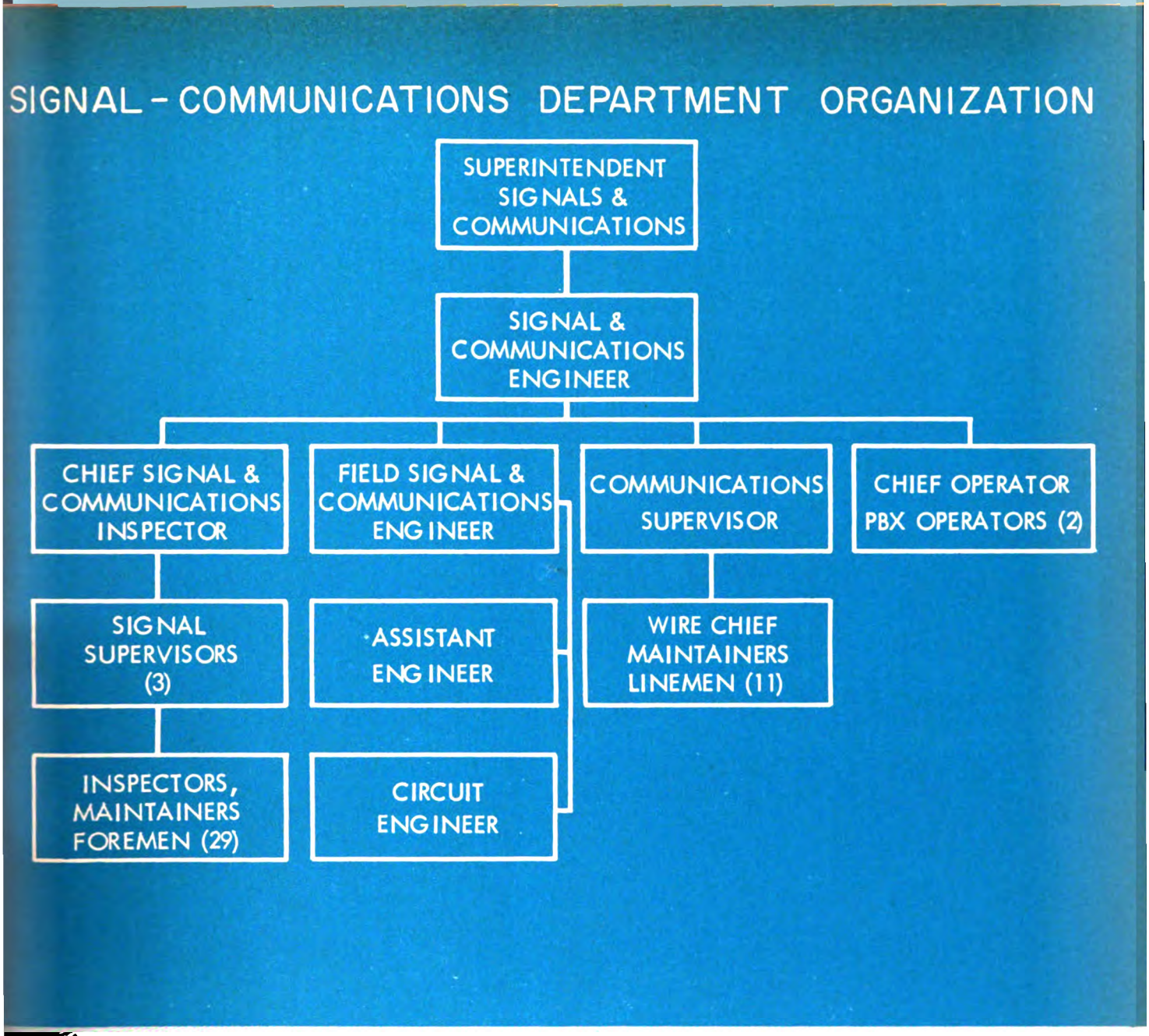
Jeep with digger attachment trenches at highway crossing.

Detector at Monongahela river bridge checks high loads.

To be sure that loads do not catch in the J&L tunnel (17.5 ft clearance), the road's S&C forces installed a high load detector on the Monongahela river bridge 7.5 miles east of the tunnel to check westbound trains. The bridge was a natural location affording solid support at the proper height for the detector's light sources and photocells. Also the bridge is a sufficient distance from BK tower where a train can be stopped short of the tunnel. Two light sources were installed. If the normal light goes out and stays out for 4 sec, the standby light source is turned on.

If a high load breaks the light beam, an indication lamp is lighted and a bell rings at BK tower. The operator sets the home signal to the stop aspect.

Direct wire control is from the detector to Homestead, 2.9 miles, where the controls are put on the US&S 510 code system for transmission 3.2 miles to BK tower.



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