Western Avenue yardmaster giving instructions by radio to crew of radio-equipped switcher. Radio control unit is at right

Burlington Uses Radio on Switchers

Equipment in three yard offices and on 22 switch engines in the Chicago terminal area is an aid in providing better service to shippers and improved utilization of locomotives

As a means to improve service to shippers and to increase the utilization of switcher locomotives in the Chicago switching district, the Chicago, Burlington & Quincy has installed radiotelephone equipment for two-way telephone conversation between the offices of three yardmasters and 22 locomotives which are used for: (1) switching in three yards; (2) deliveries to connecting lines; and (3) serving industries. The area involved is located, in general, west of the Chicago Union Station, and extends roughly for about 15 mi. east and west, and 10 mi. north and south.

19 Diesel-electric and 3 Steam Locomotives Equipped

The project includes radio equipment on 19 Diesel-electric switchers and 3 steam locomotives, the latter being used primarily for long-distance transfers. In a normal 24-hr. period these locomotives are used by about 65 crews, each of which includes a foreman, two helpers, an engineer and a fireman. The three offices in this radio system are in yards at Fourteenth street, Western avenue and Morton Park, which are, respectively, 0.5 mi., 4 mi. and 8 mi. south and west from the Chicago Union Station.

The fixed radio station and aerial which transmits the calls from the offices to the locomotives, as well as receives the calls from the locomotives to the offices, is located on top the Burlington's 16-story general office building near the Union Station. This radio transmitter and receiver equipment is connected by a land-line wire circuit to the three yard offices. The fixed radio station and the radio on the locomotives operate on a frequency of 159.69 megacycles, under the call letters of WIAE, allocated by the Federal Communications Commission. The communication system operates like a party line, the radio being tuned to the 159.69-mc. frequency, so that the loud-speakers in the three offices and in all the locomotives ordinarily reproduce the calls and conversations between all parties.

How Yardmaster Uses Radio

Ordinarily if a yardmaster wants to call a locomotive he presses his push-to-talk switch and speaks into his microphone, as for example "Western avenue calling Burlington engine 9370." He then releases his push-to-talk switch and the reply comes in on his loud-speaker. Any member of the switching crew is authorized to answer the call on the locomotive. If the yardmaster wants to talk to some other member of the crew, as for example the foreman, that party is called to the phone. When the conversation is completed the parties sign off. As a general rule, each of the three yard-

View of the Western Avenue industrial yard, with one of the radio-equipped Diesel-electric switching locomotives in the foreground

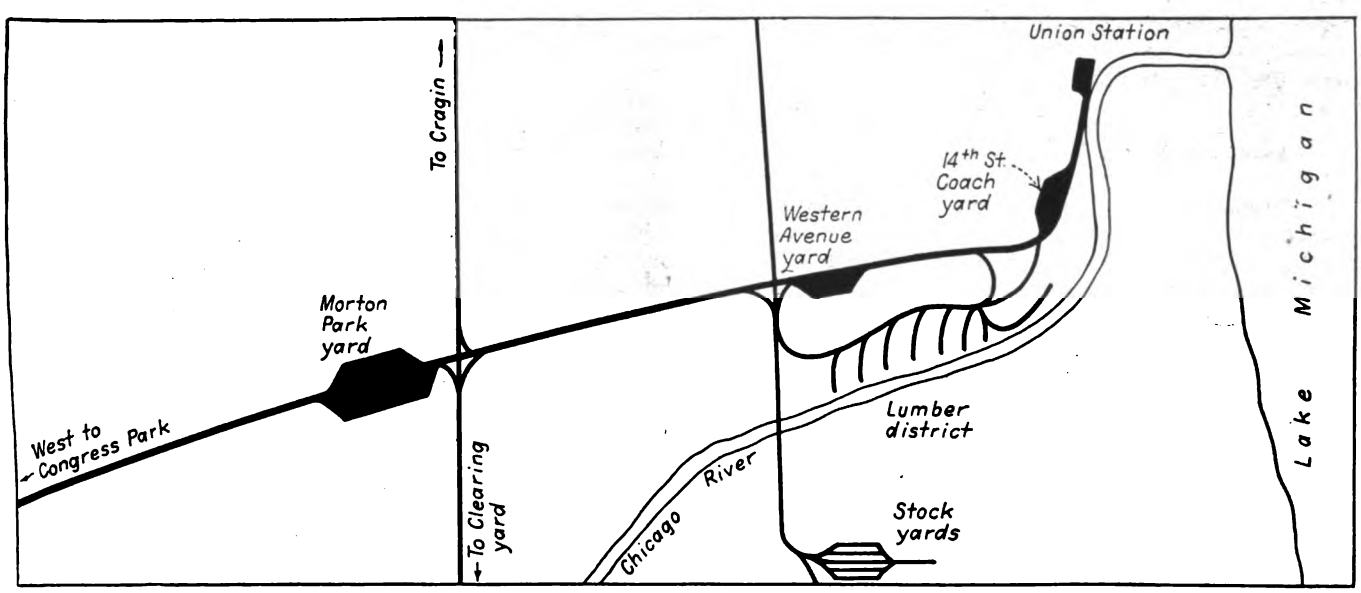
masters use the radio to communicate with the locomotives under his supervision, although a call can be initiated from any office to any locomotive in the entire area. If a yardmaster wants to talk to another yardmaster's office, he operates a small toggle switch on his set which cuts off the radio and then uses the wire circuit between the two offices as an intercommunication telephone circuit. In such instances the voice is not sent out on the air by radio.

Morton Park Yard

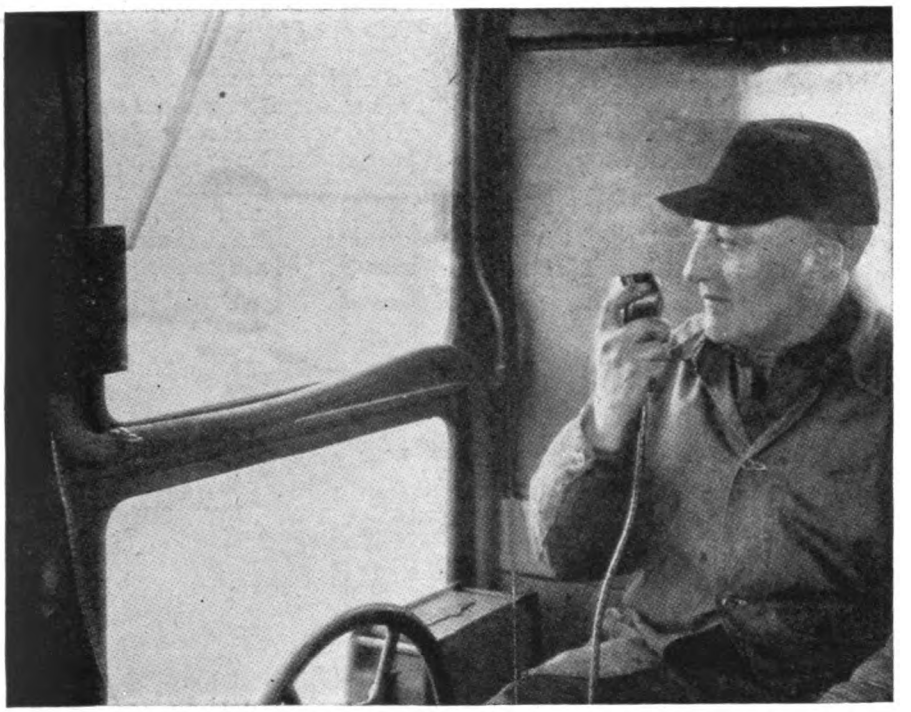
The Morton Park yard is an extensive layout about 2 mi. long including receiving tracks, a hump, classification tracks and other facilities used for yarding road freight trains. Seven switch engine crews are on duty each trick in this yard. During each 24-hr. period an average of 22 outgoing westbound trains, including about 1,300 cars, are made up in this yard, and about 22 incoming eastbound road trains, including about 1,100 cars, are received and classified for delivery in cuts to Western avenue yard and to connections with other roads at Clearing yard and other places.

Western Avenue Yard

The Western avenue layout is a smaller flat yard used primarily as a distributing and assembly yard by crews which deliver cars to and pick up cars from industries, lumber yards, stock yards, coal docks, fruit terminals, team tracks and freight houses, as well as for interchange with numerous roads. Approximately 225 industries are served from this yard. About 15 of these are lumber industries in the lumber district located along the south branch of the Chicago river in an area of two square miles, a mile south of Western avenue yard. Eight switching crews are on duty each trick at this yard. About six round trips are made daily to the stock yards. About ten round trips are made daily to team tracks and produce terminals. In the lumber district the switching during the day is hampered by heavy automobile and truck traffic on the streets and at loading platforms. Therefore, one switching crew performs service in this area during the day, and after 5 p.m. additional crews are assigned to complete the switching during the early part of the night. At least twice each day a crew makes a run from Morton Park to Congress Park, about 13 mi. west of Chicago, to interchange cars with other roads. Similar trips are made daily to various other points of interchange in the Chicago switching district. The radio communication is highly satisfactory throughout all this area and anywhere within a range of up to 20 mi. from the radio station



Simplified map showing the locations of the yard offices



Member of train crew in the cab of a radio-equipped Diesel-electric switcher talking to a yardmaster by radio. Radio control unit is shown at the left

on the Burlington building. Cars which are assembled in Western avenue yard are hauled in cuts to the Morton Park yard to be made up in outbound trains.

The Coach Yard

The Fourteenth street layout is a typical coach yard for serving the passenger train equipment of the Burlington trains which terminate at or depart from the Chicago Union Station, this including about 66 suburban trains and 30 through trains, involving more than 700 cars daily. An average of 500 switching moves are made between this yard and the Union Station every 24 hours. Additional moves are required to turn trains on the wye and to move trains through the car washers which are about 1 mi. west of the yard. Seven switching crews are assigned on the first and second tricks, and five crews on the third trick.

How the Radio Helps

This use of radio is an advantage because a call is direct and instantaneous, and the reply is equally prompt, whereas no matter how many telephones were previously in service in booths and offices throughout the area, there was no practical means of calling the switching crew foremen to such fixed telephones. With the radio, important information can be passed between the crew and the yardmaster or vice versa, and, as a consequence, the work can be done as required by changing circumstances. As a result the shippers are given more prompt service.

In one instance a shipper made a rush request by telephone for two empty gondolas. Using the radio, the Western avenue yardmaster called a switching crew which was working in that area and instructed them to place the cars at the shipper's plant. This saved several hours in spotting the cars which was important to the shipper because he was paying $150 per day for a steam crane to load cars.

Radio Helpful in the Case of a Locomotive Failure

In another instance the engineer of engine 9373 used the radio to inform the yardmaster at Western avenue that the fuel pump on the locomotive had failed, and, therefore, could not move under its own power. The yardmaster replied that he would have him pulled into Western avenue yard. Within 30 sec. the yardmaster instructed engine 9370, which was nearby, to bring engine 9373 to Western avenue. Also he notified the roundhouse by telephone to send a machinist to the pit. A machinist was working on engine 9148 at the roundhouse when notified of the trouble. He used the radio on this locomotive to secure, directly from the yardmaster and the engineer of the disabled locomotive, further details of the trouble and of the whereabouts of the locomotive. In a few more minutes the yardmaster called engine 9370 again and asked if he had gotten 9373 yet, to which 9370 answered that he was cutting off 9373 at the engine pit. Thus the radio served in this emergency to convey information quickly between the two enginemen, the yardmaster and the machinist, to the end that, within a brief period of only 7 min., the disabled locomotive had been towed to the pit and the machinist was there with advance information of the defect. As a result, the repairs were made and the locomotive returned to service an hour or more sooner than would have been possible without the radio.

Another Example of How the Radio Helps

A suburban passenger train broke down one day on the main line near Western avenue. As soon as the yardmaster heard of the incident, he used the radio to call a switcher, working in the yard near where the suburban train had broken down, and asked the crew to find out the trouble. This was done, and the switcher notified the yardmaster that the suburban locomotive had a broken side rod. The yardmaster then instructed another switcher to go to the scene and pull the train into the yard. In the meantime, following trains were rerouted over another track. When the suburban train was pulled into the yard, the passengers were transferred to another train. This action, which took place in a matter of a few minutes, saved a delay of about 1½ hours, and permitted clearing the main line in a minimum of time, which also eliminated delay of following trains.

In another instance an engine had completed its work at an interchange point with another railroad and was ready to return to its yard. Reconsigned cars turned up at the interchange point, and the yardmaster instructed the crew to pick up the cars and bring them to Western avenue, to be placed on the team tracks for sale of the contents. This avoided considerable delay in the handling of these important cars.

A fire broke out one day in the lumber district, and the yardmaster knew several cars of lumber were nearby that would be destroyed unless moved. He notified the nearest switch engine to pull the cars to safety and thus saved the cars and lumber that were endangered.

Heretofore when a switching crew was coming out of the lumber district or elsewhere, the train had to stop at the yard entrance and call the yardmaster by telephone before entering

the yard. He now asks this information by radio while moving, thus saving a stop.

Aid at Morton Park

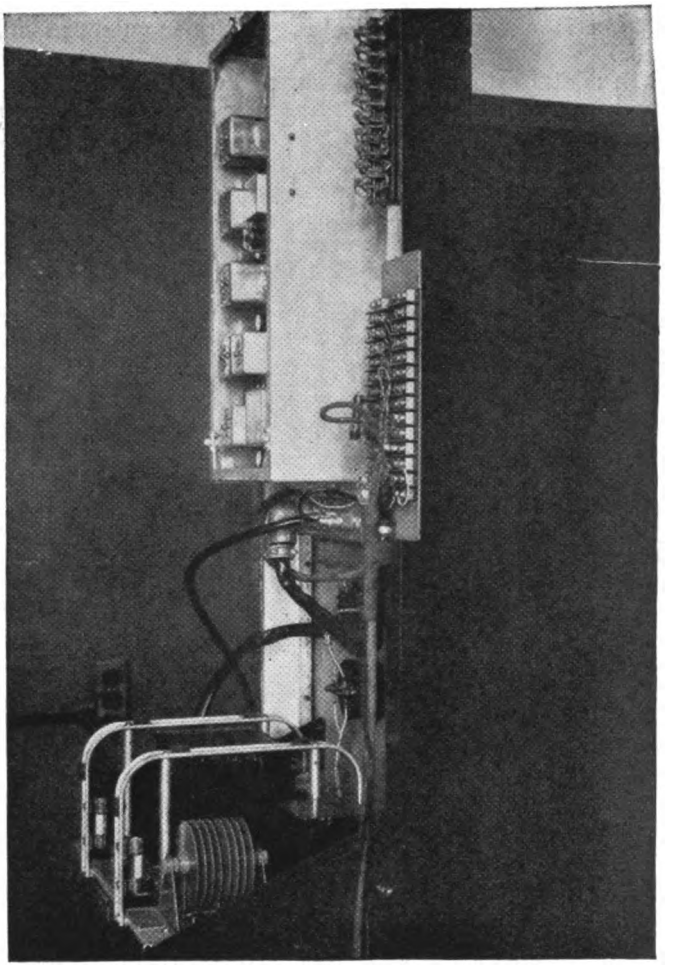
The radio has been very helpful in certain instances at Morton Park. For example, a car will be in a westbound train ready to depart when it is reconsigned from its original destination after cut-off time. By immediately contacting a switching locomotive, the yardmaster is able to instruct the crew to pick up the car, thus saving it from going to Galesburg, Savanna, or elsewhere and having to be returned. If there was no radio this would not be possible, as the yardmaster would have to walk, and chances are he would have insufficient time to contact the crew of the train in time.

The radio has been very beneficial in handling eastbound trains coming into Morton Park late, with cars for the stock yards. Switching engines are immediately sent to pick up such cars for delivery without any further delay.

In the Coach Yard

Numerous examples of the benefits of radio are also evident in the coach yard at 14th street. For example, a switching engine was handling bad-order coaches. Nearby on another track there were two cars of coal. A truck arrived to unload the coal which required respotting the cars. The yardmaster immediately notified the switcher handling the bad-order cars to spot the two coal cars first. This took only 3 min. from the time it was initiated until finished.

When passenger cars are going through the washers, about one mile west of the coach yard office, the radio is the only way in which the yardmaster can keep in contact with the crews and know what cars are going through the washers.



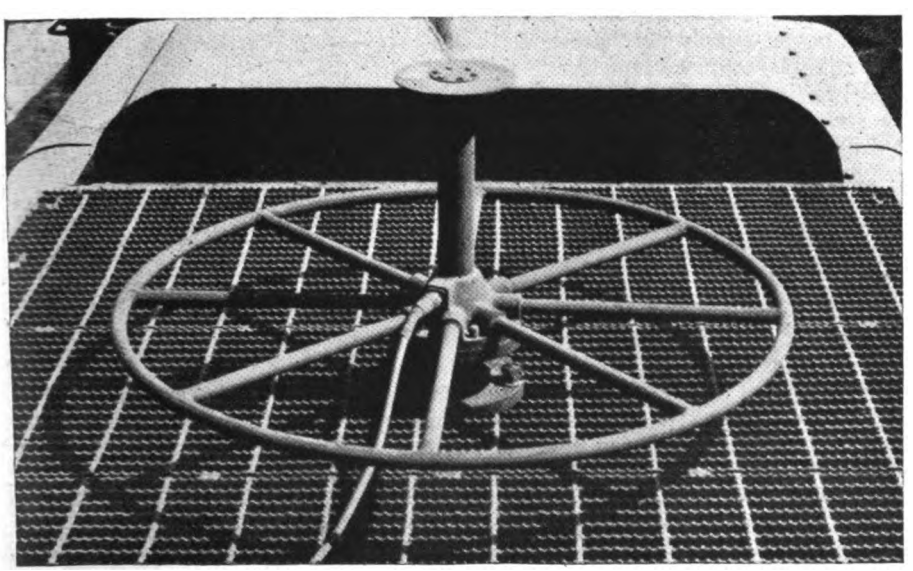
The transmitting and receiving equipment in the fixed station at the general office building is mounted in an open type of rack

Other Advantages

Before the radio was installed and when a switching crew left a yard to perform its work at various industries, they would only have a chance to telephone in two or three times in eight hours. Communication is now almost instantaneous, and allows on-time delivery and pick up of cars to shippers, saving in some instances from 12 to 24 hours. As applying to switching operation in all the areas, the radio has also proved very helpful during snowstorms when it is difficult for crews and yardmasters to walk on the ground.

Transmitters and Receivers

The radio transmitters and receivers in the fixed station and on the locomotives are the Bendix Type MRT-1B, crystal controlled and frequency modulated (FM), operating on the 36th harmonic of the crystal frequency. The power output of the transmitters is from 10 to 12 watts. A differential type of microphone is used to avoid interference from ambient noise. All mobile equipment is interchangeable and shock mounted in aluminum cases. The transmitting and receiving equipment in the fixed



Typical antenna on one of the locomotives is the ¼-wave top-loaded vertical type, mounted about 12 ft. above the top of the rails

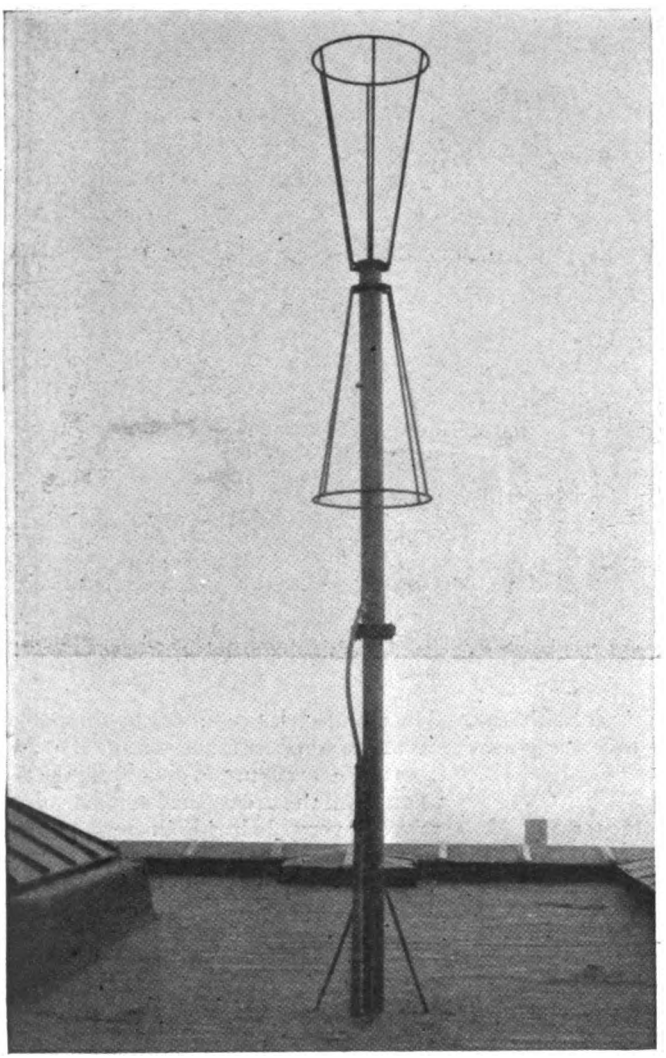
station is mounted in an open-type rack.

In addition to the transmitter and receiver on the locomotives there is a power supply unit, which will be discussed later, a Type MI-34A loud-speaker, Type MS-104A control unit and Type 600D microphone. The loud-speaker is designed to accentuate speech frequencies for highest intelligibility, and is housed in a weather-proof metal cabinet with a conduit connection.

The control unit on the locomotives contains only a simple on-off switch and channel selector (not used on this installation) together with a green indicator light and a loud-speaker volume-control knob. The microphone is the hand-held differential type including a push-button to control the transmitter.

The fixed station antenna is the bi-conical two ⅝-wave type, with two cones mounted end to end in a vertical position. This is a non-directional antenna with a 3 to 4-decibel gain over the standard dipole-type antenna. The antenna lead-in is about 75 ft. long and consists of a heavy-duty RG-17U, 52-ohm, coaxial cable. The fixed station antenna is mounted 300 ft. above street level atop the general office building near Union Station.

The antennas on the locomotives are ¼-wave top loaded verticals. These antennas are connected to the radio equipment by a short RG-58U, 52-ohm, coaxial cable. The antenna is mounted about 12 ft. above the top of the rails on the fore part of the locomotives. The transmitter, receiver and power-supply units are housed in a suitable compartment inside the Diesel engine cabs. The equipment on the steam locomotives is located in a cast aluminum, weatherproof housing mounted on the engine pilot to the rear of the hand grab rail.



The fixed-station antenna on the roof of the general office building is the bi-conical two ⅝-wave type, with two cones mounted end to end vertically

Yard Office Control Units

The radio control unit in each yard office is known as a Type MS-102A remote control unit. Each unit includes an amplifier, loud-speaker, switch for selection between the intercommunication feature or radio. The loud-speaker on the remote control unit can be used as a microphone, but in this installation separate desk-stand microphones are used because of background noise, such as talking and people walking around the offices. A green light on the unit indicates when it is in service. A red light indicates when transmitting by radio and a blue light when intercommunication is in service.

Monitoring Station

A monitoring station is located at the site of the fixed transmitter and receiver at the general office building. This consists of an MS-102B control unit, which is the same as the MS-102A units at the yard offices, but has no amplifier. The unit enables listening in on conversations, making tests of issuing instructions if necessary.

Power Supply on the Locomotives and at Monitoring Station

Power for operation of the radio on the Diesel-electric and steam locomotives is supplied by a 1,200-1,500-r.p.m. dynamotor, which operates from the storage battery on the Diesel-electric locomotives, and from a separate steam turbine provided on the steam locomotives. This dynamotor supplies 12 volts for filament voltage, as well as 300 volts for plate circuits. Relays, regulators and the line filter, consisting of capacitors, are located in a box atop the dynamotor. The dynamotors are designed for 24-hour daily operation, with bi-annual inspection.

The power at the monitoring station is supplied by a Type MP43A vacuum-tube rectifier with transformer. This power-supply unit operates from the commercial 110-volt a.c. power source. A standby motor-generator is available at the fixed station to supply power for the radio transmitter and receiver. In the event of failure of city power, this motor-generator operates from the standby power system in the building. Power for the three yard offices is secured from a commercial 110-volt a.c. source suitably rectified in the control unit. No standby power is provided at the remote control points in the three yard offices.

Installation

This installation was made under the direction of H. H. Hasselbacher, superintendent of telegraph, and under the supervision of T. W. Wigton, supervisor of electronics, in co-operation with J. P. Falk, superintendent of the Chicago Terminal, representing the operating department. The major items of radio equipment for the installation were furnished by the Bendix Radio Division of the Bendix Aviation Corporation.