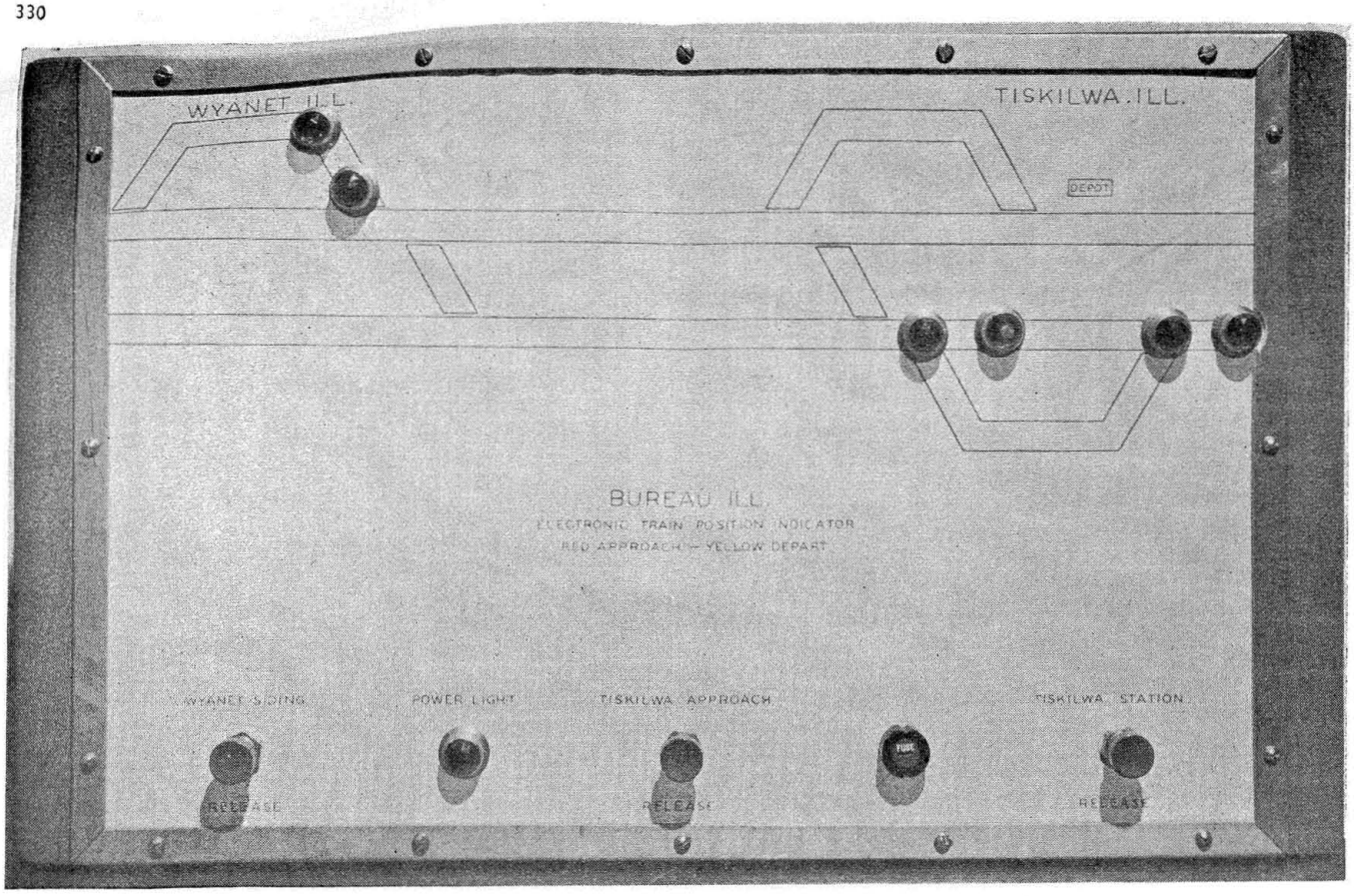


Panel at Kansas City, known as an electronic train position indicator, is similar to panel at Bureau, Ill., shown above

Rock Island Uses Carrier Equipment for Automatic OS Reports

System features visual train-approach and departure OS indications in dispatcher's office, holding indications until acknowledged, as well as automatic graphic record of trains and acknowledging time of indications

THE Chicago, Rock Island & Pacific has developed and installed a system including a panel board in the dispatcher's office with lamps to indicate when trains pass certain points or stations at outlying unattended places, the transmission of indications from the field to the office being accomplished by high-frequency carrier-current line signals superimposed on existing telephone, telegraph or signal line wires, so that the total expenditure for the equipment is small in proportion to the benefits derived. As applying to reports of passing trains, the letters OS stand for "out of station."

Experimental installations of this carrier-current OS system were made at Bureau, Ill., and a few other locations, but the first project including a series of OS points on an extended mileage was on the Clay Center line which extends for 104 miles between McFarland, Kan. on the Golden State Route, and Belleville, Kan. on the Rocky Mountain Route. The panel board for this installation, which includes seven OS points, is located in the dispatcher's office at Kansas City, Mo., 101 miles east of McFarland on the Golden State Route. The Clay Center connecting line handles 2 passenger and from 2 to 12 freight trains daily, in addition to a local freight train each way daily except Sunday. This territory is single track, and train movements are authorized by timetable and train orders. On account of the light traffic and the comparatively small amount of local business, the open offices for handling train orders and for reporting the passing of trains are spaced several miles apart, especially during the night when agent-operators are off duty at many of the small towns on this line.

Reason for Installation

Under the foregoing conditions the dispatcher had difficulty in knowing the locations of and progress being made by trains. For example, a

freight train might take siding at some outlying location to wait for a meet with a superior train, but the dispatcher would not know where the first mentioned train was until it showed up later, at an open office.

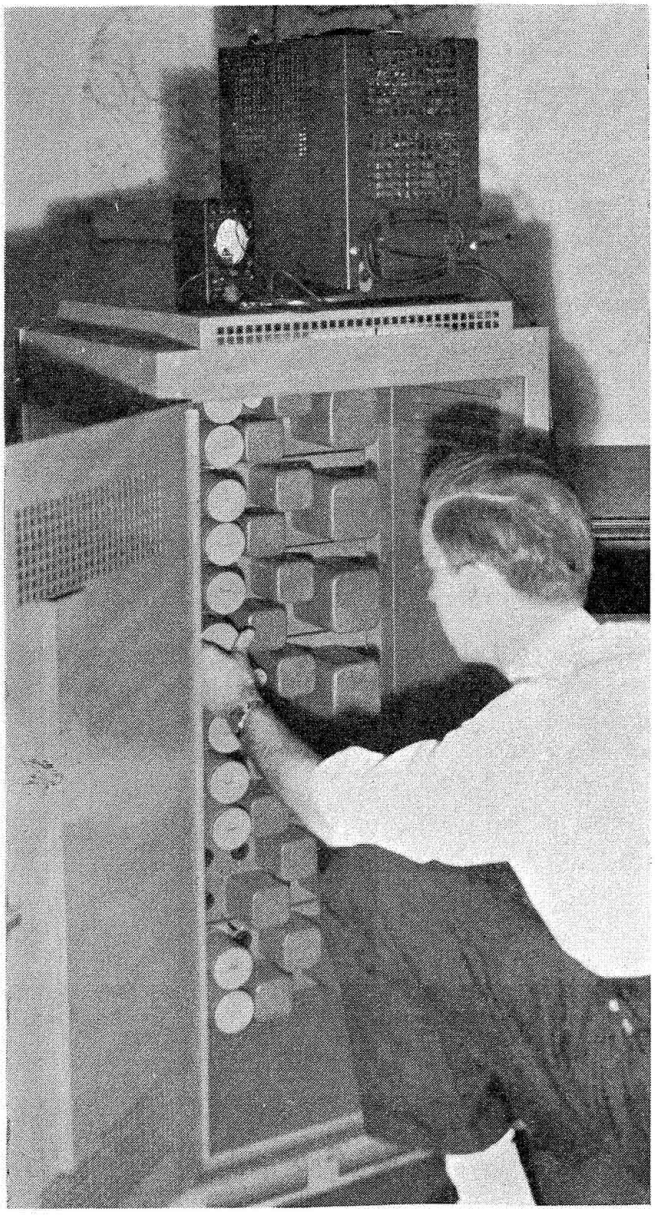
Development Program

Realizing the need for a system which would provide this information, a development program was set up in 1944 by C. O. Ellis, superintendent of communications, and E. A. Dahl, electronic engineer. Basic requirements were for a system which would (1) give an indication of train approach, (2) give an indication of train departure, (3) hold the indications until the dispatcher acknowledged them, and (4) give a written record of the arrival and departure times of trains, and the acknowledging time of the indications from the OS points in the field by the dispatcher.

Such is the new innovation which has been developed and installed by the Rock Island. By use of carrier-current frequencies, the OS line signals are automatically repeated by carrier repeaters, enabling the system to work any length of distance without the addition of relays or repeaters. On wires where there are no existing carriers, satisfactory operation is obtained up to approximately 100 miles with no interference to telephone, telegraph or signal circuits existing on the lines.

General Scheme of Operations

When a train passes a given OS point in the field, the correct carrier frequency is transmitted to the dispatcher's office where it is detected and amplified to light a red lamp, indicating the train arrival at that point. When the train departs from the OS point, the line signal stops, lighting a yellow lamp, indicating that the train has departed from the OS point. In other words, one line signal provides two indications, one when the signal from the field starts, and the second when the signal stops. The lamps remain on until such time as the dispatcher acknowledges the receiving of the OS indications by pushing a button, extinguishing the lamps, and indicating that he has acknowledged the train passing the OS point. An electric recorder graphs the arrival and departure of trains at OS points, as well as the acknowledging time of OS indications by the dispatcher. With this arrangement, if a dispatcher is busy on other work or is away from his desk when the indication comes in, the lamps remain lighted so that all indications can be handled at his convenience, and a permanent automatic graphic record of train operation is formed.



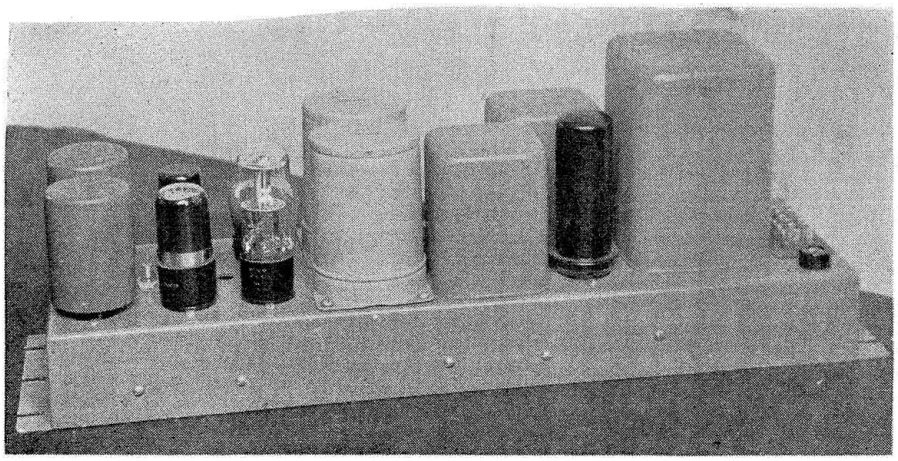
Dispatcher's office equipment for receiving OS line signals from the field at Kansas City is in a sheet-metal cabinet, the front of which is shown here with the door open. Rock Island electronic technician is shown assembling parts at the Chicago laboratories. Cathode-ray oscillograph and meter on top of the cabinet are not part of the equipment.

Panel Board

The panel board at Kansas City, known as an electronic train-position indicator, includes a track diagram of the territory between McFarland and Belleville, with seven sets of indication lamps. Approach lamps are red and departure lamps are yellow. Release buttons for each set of OS indication lamps are located at the bottom of the panel. In line with the row of release buttons there is also a green lamp which indicates that the power is on to feed the office equipment for receiving OS line signals from the field, and also that the equipment is in operation. While there is no audible signal provided in the dispatcher's office, such a signal could be applied in the form of a buzzer, bell or chime, operating in conjunction with the OS lamps. There is no indication as to direction of train movements. However, this feature could also be applied by installation of an additional red OS lamp.

The dispatcher's office equipment for receiving OS line signals from the field at Kansas City is in a sheet-metal cabinet. The receiving equipment for each of the seven OS points is mounted on individual light-metal chassis. These units in turn are mounted in the cabinet horizontally on their sides one above another, thus allowing access to both the front and rear of the units when the cabinet doors are open. Access to relays, transformers, filters, tubes and other equipment is gained through the front of the cabinet, while access to the wiring of the units is gained through the rear.

All components of the receiving equipment in the dispatcher's office are the commercial radio type, and include the necessary relays, transformers, filters and tubes. The relays



Receiving equipment for each of seven OS points is mounted on individual chassis

and filters are the plug-in type. All parts of the equipment are hermetically sealed. The tubes are the Type 5Y3, 6SN7, 6H6, 6C5 and 884 for standard radio broadcast receiving.

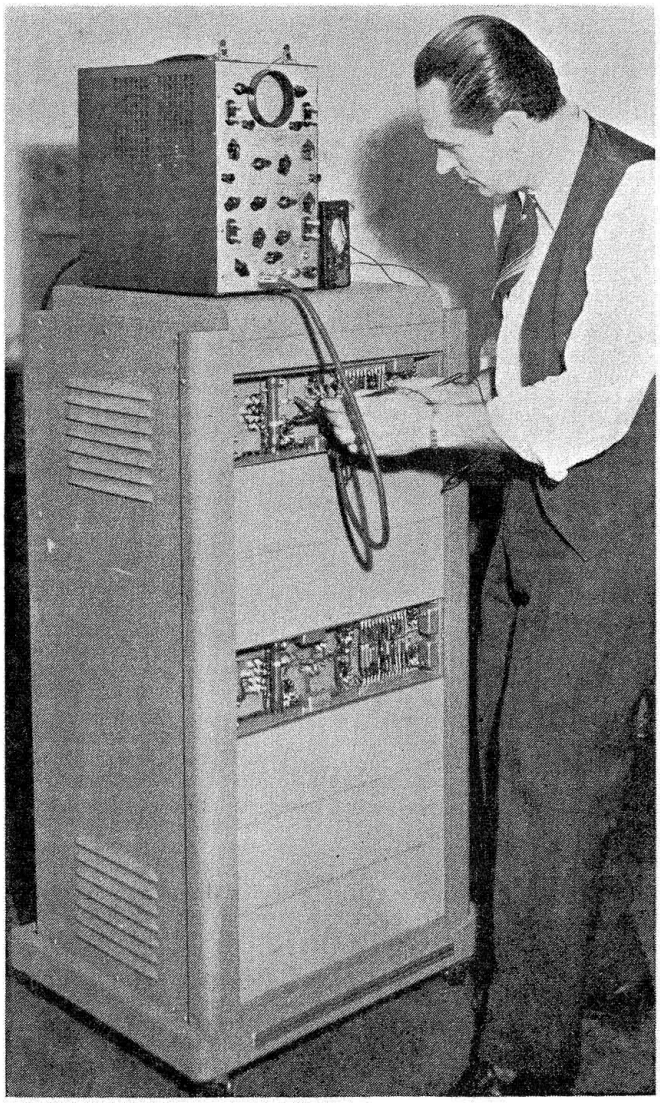
The purpose of the filters is to filter out instantly changing frequencies and interference from carrier currents. There are no mechanical-stick circuits in the equipment, such as in the control of OS indication lamps, this feature being accomplished electronicly by use of thryatrons where required. Positive d.c.-acting, amplifying circuits are used in conjunction with a thryatron electronic tube. The unit is fed by 110 volts, 60 cycles, a.c. from a commercial source in the office. The power circuit is protected by plug-type fuses. Indication lamps are rated at 6-8 volts.

As a protection against false indications from lightning, 200-volt ringing current on carrier circuits, and other foreign currents, the OS signals are broken through limiter tubes at the dispatcher's office. These are standard radio-broadcast receiving tubes which limit the intensity of all signals, ranging from 0.1 volt to 1,000 volts or higher, to 2 volts. The OS signals are then applied to time-delay and frequency-identification circuits. If the duration of time of the signals and the frequencies are satisfactory, the OS indication lamps corresponding to the field locations are lighted, indicating the location of the train.

Electric Recorder

A continuous, graphic, chronological record of the arrival, departure and acknowledging time of OS indications by the dispatcher is provided by an 18-pen Esterline-Angus recorder, located in the dispatcher's office. One OS location in the field is represented by two pens on the recorder. Each pen is operated by a 24-volt d.c. control magnet, and the chart-driving mechanism is operated by a 110-volt, 60-cycle a.c. synchronous motor. Strip charts are 90 ft. long, and are driven continuously at 3 in. per hour. One roll is sufficient for 15 days. Easy reading of the chart is facilitated by horizontal brown lines of graded width at 2, 10 and 60-minute intervals with marginal numbers at hourly intervals.

At each field OS location there is a single-frequency basic audio oscillator which produces the carrier frequency assigned to the respective OS station. This equipment is in operation only while a train passes. The oscillator, mounted on a single light-metallic chassis, consists of a plug-in type interchangeable frequency coil, two Type 1117N7GT standard broadcast receiving tubes, and an isolating transformer to prevent line overloads. The frequency of the carrier current transmitted by this unit does not depend upon the tubes, but upon the coil used. The unit is provided with vernier frequency adjustment and volume control to control the volume of the signal on the line. All adjustments are normally made in the shops prior to the installation of the units. The normal signal volume is usually about —10 decibels, or in other words, 0.3 volt. The oscillator is fed 110 volts, 60 cycles a.c. from a commercial source. The power circuit is protected by plug-type fuses. A 6-8 volt green pilot lamp is illuminated when the power is on and the oscillator in operation. All parts of the unit are hermetically sealed. The oscillator is 9½ in. by 5



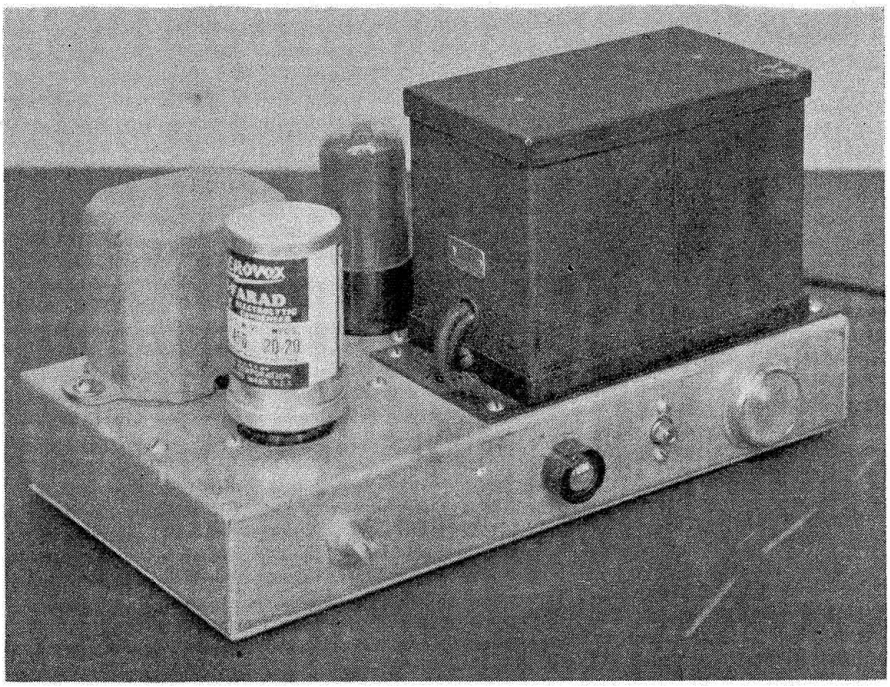
Rock Island electronic technician shown testing Kansas City dispatcher's office equipment in the electronic laboratories at Chicago. View shows rear of cabinet with seven individual receiving unit chassis mounted in place. Covers of two chassis are removed. The cathode-ray oscillograph and meter on top of the cabinet are not part of the equipment, and are only being used for testing equipment.

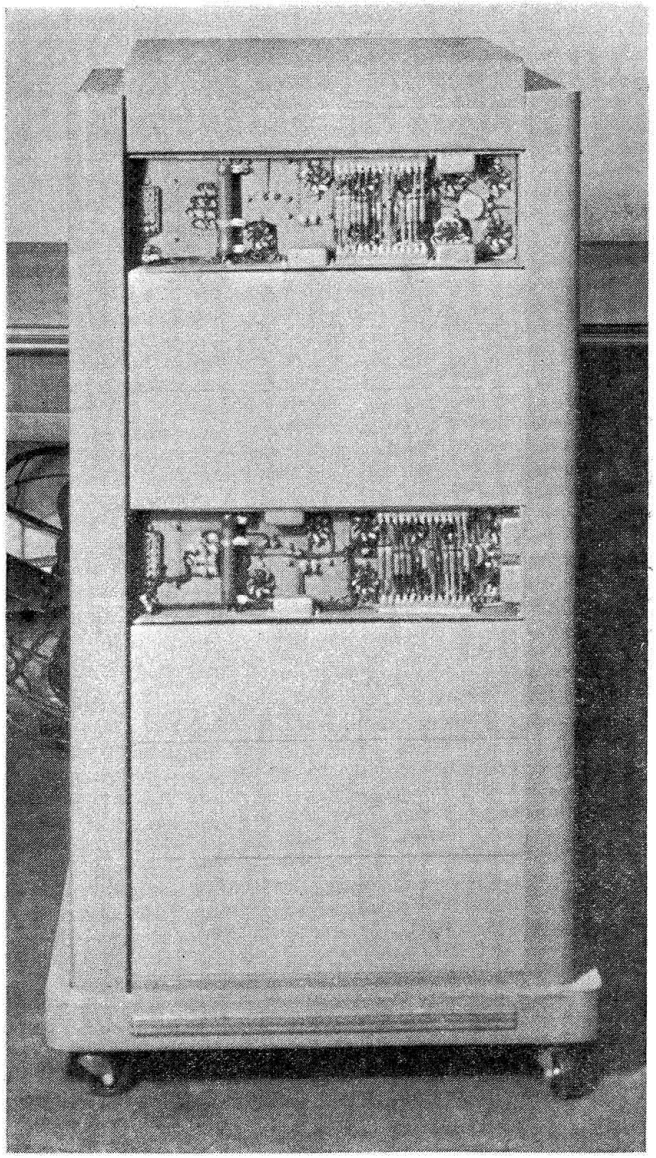
in. by 5½ in., which is small, thus enabling it to be placed in any appropriate existing shelter in the field.

The frequency of the OS signals from the seven OS points between McFarland and Belleville range from 16,200 to 8,000 cycles per second. The seven frequencies used are 16,200, 14,400, 12,800, 11,400, 10,100, 9,000 and 8,000, the respective differences between these frequencies being 1,800, 1,600, 1,400, 1,300, 1,100 and 1,000 cycles, or an average of 1,366.6 cycles. The differences between the frequencies of the OS points were so planned as to provide for additional frequencies of intermediate OS points in the future if required.

Control of Oscillators

The oscillator is controlled by a track relay or by coils buried in the ballast. One coil is located on each side of the track, to set up a field around the track. Passage of a train between the coils distorts the field, resulting in the function of a keying circuit of the oscillator, which, in turn transmits the high-frequency carrier-current signal to the dispatcher's office.





Above — Single-frequency basic audio oscillator used at the OS points in the field to produce the carrier frequency. Pilot lamp is shown on the front of the chassis at the right, while the vernier frequency adjustment, volume control and fuse are to the left of the pilot lamp. Left — Close-up rear view of dispatcher's office equipment cabinet at Kansas City, showing seven individual chassis mounted in place, covers of two of which are removed, showing parts and wiring. Note cabinet is mounted on castors.

These coils are wound on a fiber base about 4 in. by 8 in., using No. 14 or No. 16 wire. This assembly is dipped in General Electric Glyptil, a rosin compound used in motor armature and transformer construction, and which is impervious to dampness and other weather conditions. The number of turns of wire used in these coils depends upon the frequency used on the oscillator keying circuit, and which varies under local conditions, such as the location and distance between coils.

This system was designed, developed and built in the Rock Island electronic laboratories at Chicago under the jurisdiction of C. O. Ellis superintendent of communications, and E. A. Dahl, electronic engineer, of the Chicago, Rock Island & Pacific. The panel board, sheet-metal cabinet and individual equipment chassis in the dispatcher's office, as well as the oscillator chassis in the field for this installation were manufactured by the Tempo Manufacturing Company, of Chicago. Transformers were furnished by the Sola Electric Company and the Chicago Transformer Corporation, both of Chicago. Coils were supplied by the United Transformer Corporation of New York, and the relays were furnished by C. P. Clare & Company, of Chicago. Radio tubes were supplied by the Radio Corporation of America and the General Electric Company. The remainder of the radio equipment was furnished by the Allied Radio Corporation and the Newark Electric Company.