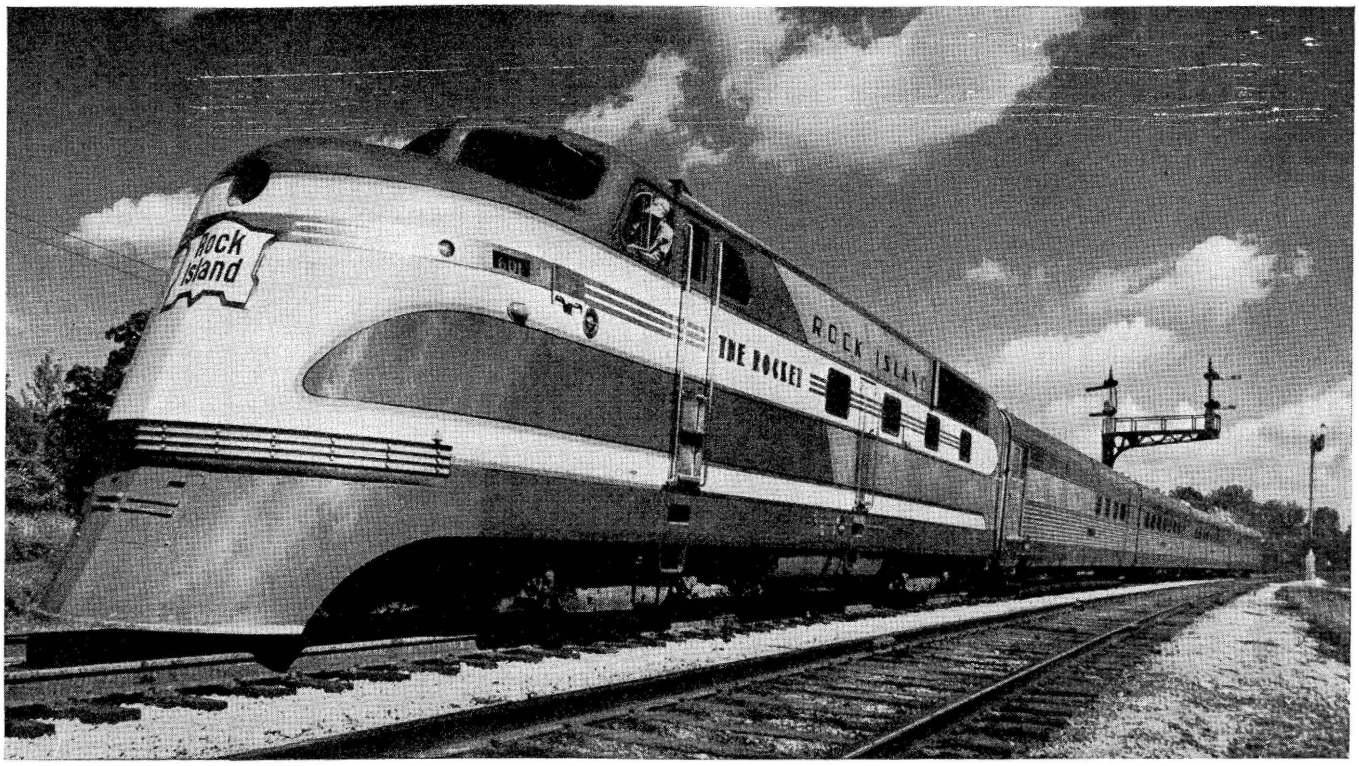

Rocket Train Telephones

Electro-magnetic system is provided for the convenience of passengers and crew—Head-end to rear-end facilities, with intermediate stations, aid train operation

ONE of the most interesting of the many features of the six new Rock Island Rocket trains is the provision of an electro-magetic train telephone system for the convenience of passengers, the use of the crew, and as an aid in train operation.

These trains, consisting of two four-car trains and four three-car trains, have been placed in service as follows: A four-car train between Chicago and Peoria, Ill.; a four-car train between Chicago and Des Moines, Iowa; a three-car train between Kansas City, Mo., and Denver, Colo.; a three-car train between Ft. Worth, Tex., and Houston; and two three-car trains between Minneapolis, Minn., and Kansas City.

Each telephone system consists of three line wires extending from one end of the train to the other. Telephone equipment is connected to this line circuit at the following four stations: Station No. 1 in the engine cab, station No. 2 in the diner, station No. 3 in the rear car, and station No. 4, consisting of an extension set in the rear car.

A feature of the system is that all of the transmitters are of the magnetic, or self-powered, type. This type of transmitter gives clear commercial voice transmission without the aid of external current, sound being the only source of input energy. The diaphragm of the transmitter is connected, by means of a sturdy but very light connecting rod, to an armature balanced between the poles of a very powerful permanent magnet. When words are spoken into the transmitter, the diaphragm vibrates in accordance with the sound waves impinged upon it, and correspondingly vibrates the armature. The armature vibrations set up variations in the magnetic lines of force, both in number and direction; and currents of alternating voltage are, therefore, induced into the coil windings which form a part of the magnetic field. The currents thus generated are transmitted to the train line circuit, and vary in frequency and intensity with the sound waves of the speech input.

Telephone Equipment

The equipment units for the engine cab consist of a three-stage amplifier, a loudspeaker, a transmitter, and a key and lamp signal box. Diagram A shows the circuit arrangement of these units, while Diagram B shows the complete circuit of the amplifier and the loudspeaker. The function of the amplifier is to step up the voice currents from the other stations and reproduce them in

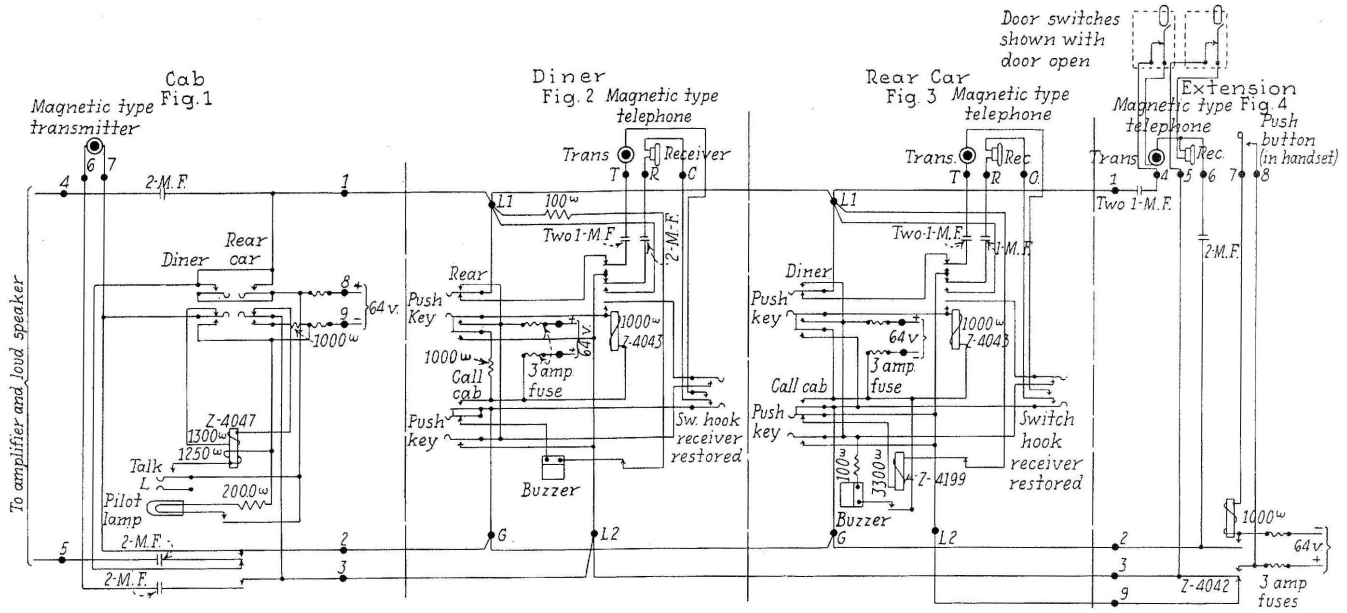

Diagram A.—Train telephone circuits

the loudspeaker. This arrangement eliminates the need of a telephone hand set in the engine cab. The transmitter permits the engineer to acknowledge calls received from the other stations, and to make calls to stations No. 2 and No. 3. The transmitter is mounted on a wall bracket fitted with a flexible arm, thus permitting the engineer to adjust the transmitter to a convenient position. The key and signal box consists of a standard telephone-type ringer box fitted with a hinged cover. On the front face of the cover are mounted the keys for signaling stations No. 2 and No. 3, and a key for connecting the engine cab transmitter to the train line circuit. A signal lamp box is located ahead of the engineer's position. Inside the key box are mounted the associated switching relay, resistance coils, condensers, signal buzzer, and fuses.

The equipment units for the diner consist of a magnetic-type hand set (transmitter and receiver) and a wall-type cradle telephone equipped with two push buttons for signaling the engine cab and the rear car. Inside the telephone are mounted a buzzer for indicating incoming calls to the diner, a switching relay, resistance coils, condensers, and fuses. As shown in the wiring details, a 2-M.F. capacitance is connected in the transmitter circuit and a 2-M.F. capacitance in the receiver circuit. Due to the limited mounting space in the interior of the telephone, one 2-M.F. condenser was furnished for one of the 2-M.F. capacitances, and two 1-M.F. condensers (wired in multiple) for the other 2-M.F. capacitance. The cradle of the telephone is fitted with two spring (wire) clips for holding the hand set firmly in place on the telephone when not in use. The hand set is connected to the telephone by means of a 4-conductor cord. Three conductors of the cord terminate on a 3-point terminal block located inside the telephone, and the fourth conductor is run directly to the associated contact spring of the cradle plunger switch.

Rear Car Equipment

The equipment units for the rear car consist of a magnetic-type hand set (transmitter and receiver) and a wall-type cradle telephone equipped with two push buttons for signaling the engine cab and the diner. The rear car is provided with an extension set consisting of a magnetic-type hand set (transmitter and receiver) and a box (telephone ringer type) equipped with a switching relay, condensers, and fuses. The box is not designed to mount the hand set, as the intention is to store the hand set in an adjacent drawer or

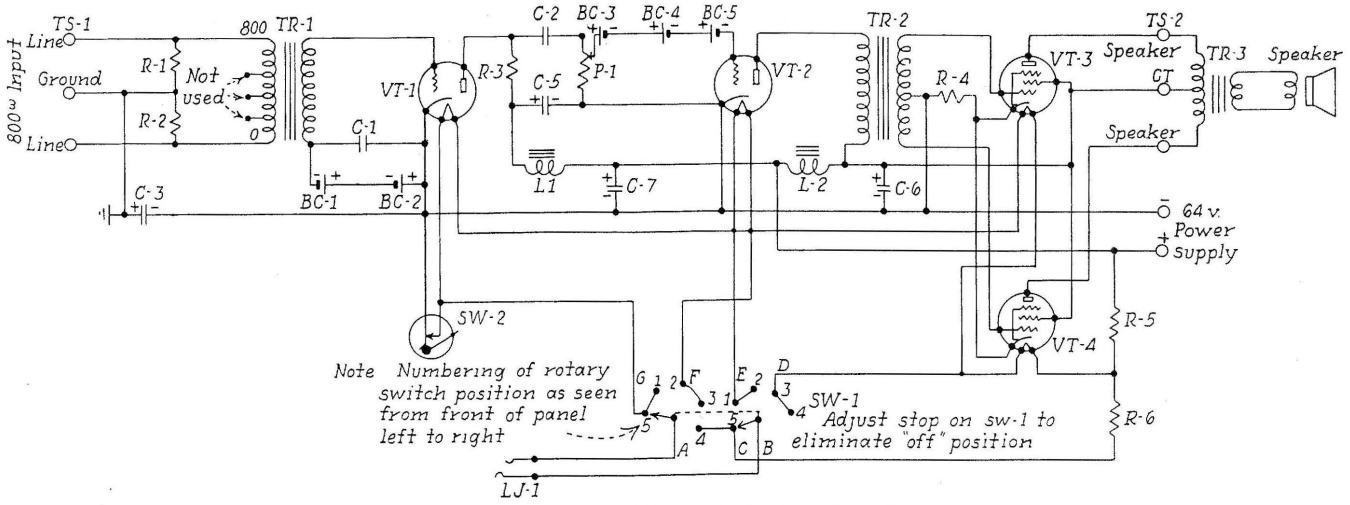

Diagram B.—The amplifier and loudspeaker circuit

cabinet when not in use. The hand set is connected through cut-off springs to the terminal block of the box by means of a 12-ft., 5-conductor cord. The hand set is fitted with a push button in the handle for enabling the user to signal the engine cab. The diner telephone cannot be signaled from the extension set.

Method of Operation

To establish communication with the engine cab (station No. 1), the calling trainman at either the diner telephone (station No. 2) or the rear car telephone (station No. 3) first removes the hand set from the cradle. The "call cab" push button in the face of the telephone is then depressed one or more times to signal the engineer. The buzzer is sounded and the pilot lamp at the engine cab station glows during each period that the call cab push button is depressed. The attention of the engineer may, therefore, be readily attracted by the buzzer sounding and the pilot lamp flashing at periodic intervals. It is unnecessary to hold the push button depressed during the conversation period. The call is answered by the engineer operating the talk key of his key and signal box and speaking into his transmitter. The operation of the talk key connects the amplifier and the engineer's transmitter to the train line circuit. The key remains in the operated position during the conversation period, and the pilot lamp glows continuously as a reminder to restore the key to normal when the conversation is finished. When the conversation is completed, the calling party returns his hand set to the cradle, and the engineer restores the talk key to the normal position. In case the engineer fails to restore the talk key to normal after a conversation is completed, the pilot lamp cannot be flashed or the buzzer sounded on a subsequent call. The amplifier and the engineer's transmitter, however, remain connected to the train line circuit, and the caller may challenge the engineer over the telephone after attempting to signal him.

The engineer may be signaled from the extension set in the rear car by operating the push button located in the handle of the hand set. It is unnecessary to hold the push button depressed during the conversation period. When the conversation is completed, the calling party returns the hand set to the drawer or cabinet, and the engineer restores the talk key to the normal position.

The engineer may call either the diner (station No. 2) or the rear car (station No. 3) by operating the diner key or the rear car key, respectively, on his key and signal box one or more times, and then operating the talk key. The buzzer at the diner telephone responds each time the diner key in the engine cab is operated; and the buzzer at the rear car telephone responds each time the rear car key is operated. The call is answered at the signaled telephone by removing the hand set from the cradle. It is unnecessary to operate keys to answer the call. The talk key in the engine cab remains in the operated position during the conversation period, and the pilot lamp glows continuously as a reminder to restore the key to normal when the conversation is finished. The engineer restores the talk key to the normal position when the conversation is completed, and the called party returns his hand set to the cradle.

A call may be made from the diner (station No. 2) to the rear car (station No. 3) by removing the hand set from the cradle and then depressing the rear car push button one or more times. The buzzer at the rear car telephone responds each time the rear car push button is depressed, and the call is answered by removing the hand set from the cradle. When the conversation is completed, both hand sets are returned to the respective cradles. A call may be made from the rear car (station No. 3) to the diner (station No. 2) in a similar manner.

Calls cannot be made directly from the engine cab or diner to the extension set in the rear car. Incoming calls to the rear car from the engine cab or diner, however, may be answered at the extension set, provided that the buzzer signal of the telephone at station No. 3 can be heard from the location of the extension set.

Direct-current energy is not required for the operation of the four transmitters associated with the four stations, as these units are of the magnetic, or self-powered, type. However, direct current of 64-volt potential (standard train current) is required for the operation of the switching relays and the amplifier unit.

The Amplifier

The amplifier is completely mounted, including power supply filters, in a single chassis equipped with a "slip-on" cover. The chassis unit is attached to a mounting plate with intervening shock-proof type mountings to cushion the tubes and other amplifier components from the extreme vibration normally obtained in train service. All controls and the terminal strips are located on top of the chassis base in such a position that they cannot be reached except by removing the cover. The chassis cover is held in place by means of screws to prevent possible tampering. A pilot lamp is mounted at one end of the chassis base to serve as an "on-off" indicator. This pilot lamp is visible with the cover in place. Another function of the pilot lamp is to locate an "open" tube heater. The controls consist of a power switch and a volume control.

The amplifier employs two stages of voltage amplification and one

Conductor using the rear car extension set

"push-pull" power output stage, using heater-type tubes. The heater and plate power is obtained directly from the 64-volt direct-current train supply circuit. Illustration "B" shows the complete circuit of the amplifier and the loudspeaker. The two voltage amplifier stages both use type 76 tubes. The transmitters of the diner telephone, rear car telephone and rear car extension set are connected to the first stage voltage amplifier by means of an input transformer. The first stage is resistance-coupled to the second stage, and the second stage is transformer-coupled to the push-pull power output stage. A potentiometer connected between the first and second stages, provides means for controlling the output volume of the amplifier assembly.

Type 43 tubes are employed for the third (push-pull power output) stage. The power-output stage feeds the loudspeaker through a transformer attached to the speaker frame. The filaments of all tubes are in service across the 64-volt power supply, with an additional resistor in the circuit to hold the applied tube-heater voltages slightly below their rated potentials. This arrangement insures good tube life under the condition of continuous operation. The plate supply circuits include two noise filters (one for the first stage and the other for the second and third stages together), thus securing adequate suppression of supply circuit noises. Since the plate-supply voltage is only 64 volts, the grid bias for the first and second stages is provided by Mallory Bias cells instead of the more usual method of self-bias. The third stage, however, because of its comparatively large bias voltage requirement, receives its control grid bias in the form of a drop across a resistor placed in the common cathode return circuit.

The correct volume control setting is that for which the loudness of the voice from the loudspeaker is adequate for proper understanding by the engineer when in his normal driving position. To adjust the amplifier volume control, it is so set that satisfactory loudspeaker volume is obtained (with the train running) when a trainman is talking in the ordinary manner from one of the cars to the engine cab.

In view of the difficulty normally experienced in locating an open heater in a series circuit, the amplifier is provided with means for directly indicating which tube has failed in such a manner. A 5-point, 2-pole switch, designated as SW-1 on Diagram B, is so wired in combination with the tube filaments and the pilot lamp that the pilot lamp may be used to indicate the open heater.

The switch is turned from the normal position (position No. 5) to position No. 1. This connects the pilot lamp in multiple with the filament of the tube in the first stage; and the pilot lamp will glow brilliantly if the filament of tube No. 1 is open. If the filament of tube No. 1 is complete, the pilot lamp will not receive sufficient current to glow. If tube No. 1 tests O.K., the switch is next turned to position No. 2. If the filament of the tube in the second stage is open, the pilot lamp will glow brilliantly; otherwise the pilot lamp will remain dark. In this manner, the condition of the individual tube heaters may be determined by observing the pilot lamp for the various switch positions.

The telephone equipment on the Rocket trains was supplied by the Automatic Electric Company.

Illinois Central Petitions to Remove Train Control

THE Illinois Central has applied to the Interstate Commerce Commission for authority to substitute "the protection of modern three-indication color-light automatic block signals of the searchlight type on the wayside" for the automatic train-stop and two-indication cab signal devices now in operation on its 122-mile line between Champaign, Ill., and Branch Junction. The application, which takes the form of a petition for a modification of the commission's order of June 13, 1922, sets forth, among other contentions, that traffic conditions in the territory involved have changed substantially since the present system was installed, and desired maximum train speeds can be achieved only after an expenditure of $68,411 for rearranging the present roadside apparatus to provide the full braking distances required.

Rather than make this expenditure the road would prefer to spend $123,045 on the proposed new automatic block system, because the latter would bring only $18,967 a year in operating costs as compared with the $44,421 spent annually to operate the present system. Thus, the petition points out, the extra $54,633 investment will result in an annual saving of $25,454.

The system which the road desires to discontinue was completed in January, 1926, at a total installation cost of $394,307. It is the Union Switch & Signal Company continuous induction type automatic train stop with forestalling feature and two indication cab signal without permissive wayside signals; 94 locomotives are at present equipped. Present conditions, and those to be expected in the future, the petition says, are such that they "will not hereafter reasonably require the continued maintenance and operation of the present expensive system to afford adequate protection and safety." The density of traffic and number of trains moved have both diminished, chiefly because of the "development of improved highways in the territory and the increased use of trucks, buses and private automobiles."

As to train speeds it is pointed out that at the time of the installation in 1926 the maximum operating speed in the territory involved was 60 m.p.h. This has been gradually raised and it is now desired to put in an 85 m.p.h. maximum for passenger trains and a 60 m.p.h. limit for freight trains. These plans, if carried out with the present system in operation, would require the $68,411 rearrangement expenditure mentioned above.

On the other hand, the petition insists, the proposed signal installation will provide adequate protection, adding that signals of the same type are now in service on the Illinois Central on 1,533.7 miles of road and 2,293 miles of track. Citing statistics of accidents in the automatic train stop territory the petition regards it as "noteworthy" that these have occurred in spite of the system. Also, there are "no known instances" wherein the system has prevented collisions or accidents on this line which would have occurred in its absence. Meanwhile the system "has caused numerous undesired brake applications resulting in stopping and delaying trains and damage to equipment and lading." Elimination of the latter and the discontinuance of the locomotive devices are cited as economies, in addition to the above-mentioned saving in operating costs.