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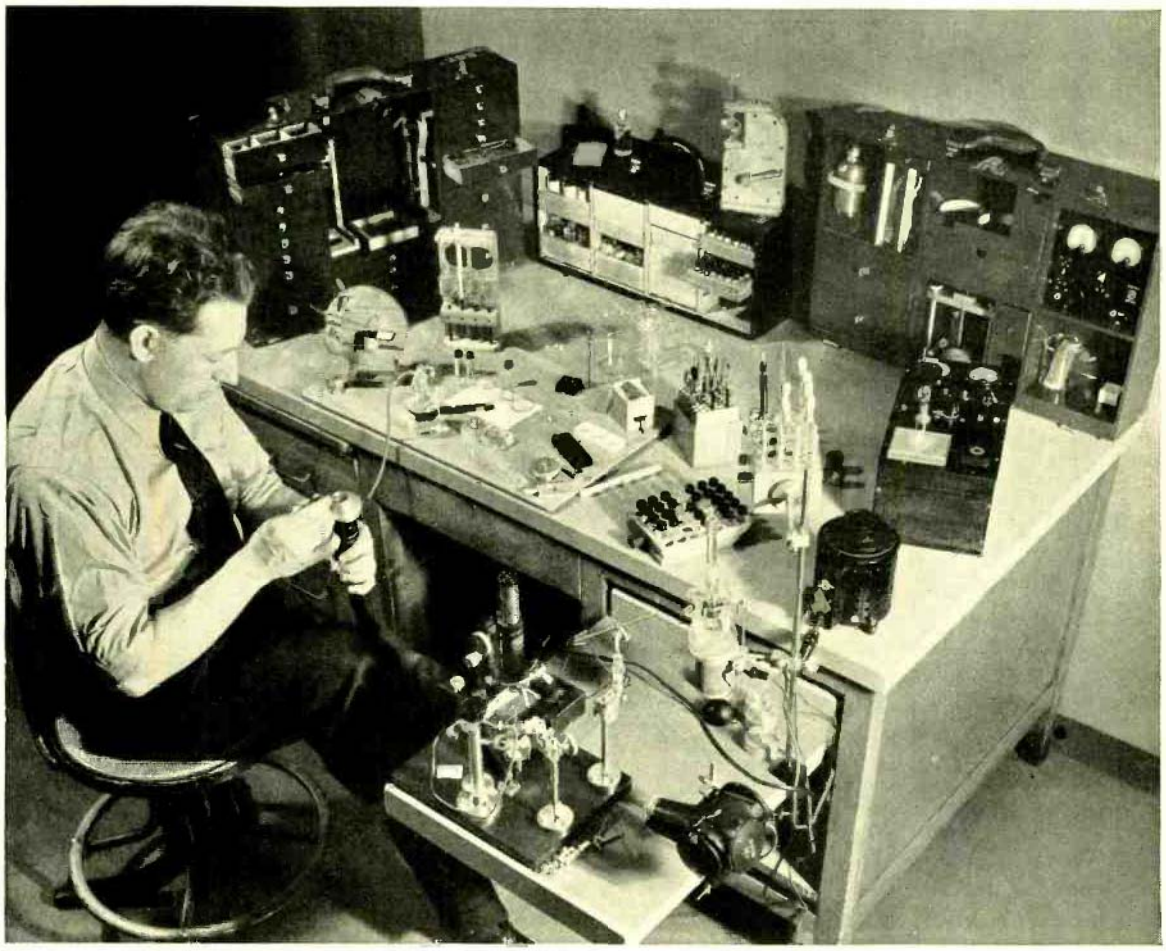

Portable microchemical equipment for investigations in the telephone plant

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Step-by-Step Intertoll Dialing

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THE operator at an "inward" toll switchboard may be required to complete calls either to local dial or manual offices or to outlying tributary offices. Some of these arrangements are indicated in Figure 1. For handling calls to dial offices she has either a dial or a key set with which she dials or "key pulses" the number wanted after plugging in to the proper trunk jack. When she extends a call to a manual office reached over a straightforward trunk, a lamp lights automatically at the distant office to attract the operator's attention. When she extends a call to a manual office that is reached over a ringdown trunk, however, she must ring over the trunk in order to attract the attention of the distant office.

In converting toll trunks so that the originating toll operator can dial directly a subscriber in a dial office at the distant end, the operator's core circuits at the inward toll board are replaced by selectors of the step-by-step type, giving an arrangement as shown in Figure 2. Each incoming toll trunk has an intertoll first selector associated with it, and by dialing any digit from 2 to 9 inclusive, the originating operator selects the office desired, either dial or manual, in the local area. Should there be more than eight offices, second selectors will be added. These selectors act as the first, or first and second selector in a local dial office, and give access to all numbers that are employed in that numbering area.

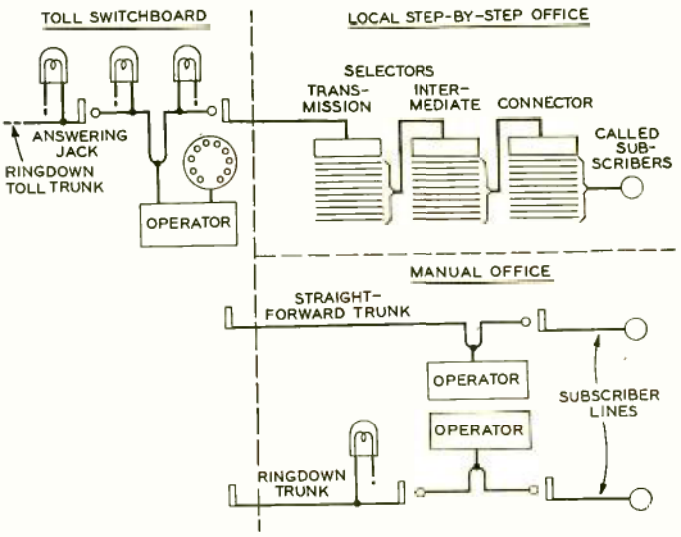

Fig. 1—Simplified schematic of arrangements for handling incoming toll calls at a manually operated board

For tributary manual or dial offices, an auxiliary first selector is used, which is reached from the first level of the intertoll first selector. Since such offices are not numbered in the series of local offices, they may be assigned a two-digit number between 11 and 19—the first digit indicating the first level of the intertoll selector, and the second, one of the levels of the auxiliary selector. Here, also, the

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second selectors may be added if necessary. Operators at the toll board are also reached through this auxiliary first selector. All of the operator trunks connected to this selector signal the distant operator automatically when they are seized.

When the office desired is reached over a ringdown trunk terminating in a jack at the remote switchboard, an auxiliary second selector is required to provide the two-second ringing needed. This selector is reached through equipment that provides two-second ringing, and trunks from it generally have a three-digit number. Although the trunks are shown arranged for one-way service, they may be arranged for two-way operation when conditions make it economical to do so.

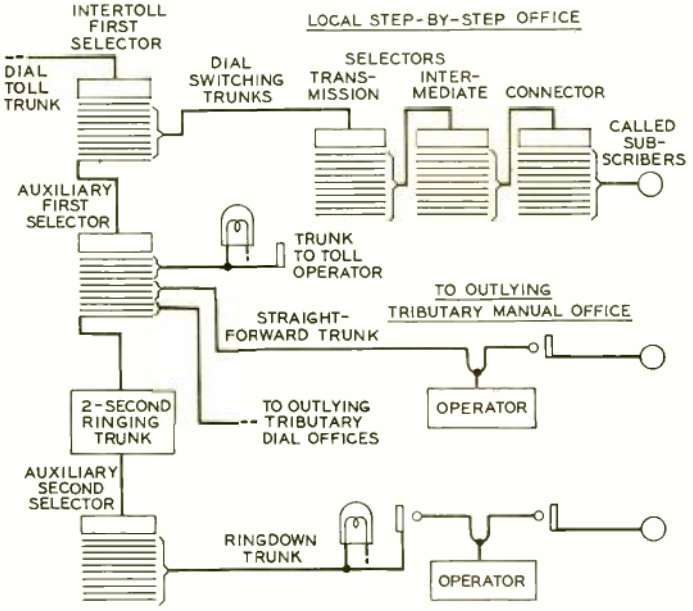

Fig. 2—In converting to dial operation, the operator's cord circuits are replaced by step-by-step selectors

The pulses sent over the toll trunk for operating the step-by-step selector and those that return the supervisory signals to the originating operator flow over a composited circuit as already described.* This composited circuit terminates in a CX relay at the toll office. This relay is used to send out the pulses that operate the intertoll selector, but the usual local type of dialing circuit cannot satisfactorily be used because line balance must be maintained to meet the requirements of repeatered toll circuits. To avoid disturbing this balance, a simplex pulsing circuit is provided for transmitting the pulses and signal through the central office.

The circuit used is shown in simplified form in Figure 3. On an incoming call, the CX relay follows the pulses, opening and closing a ground connection to the simplex circuit, in which the current flows equally and in the same direction over both sides of the line. This circuit is connected to battery through the A relay, which follows each pulse and steps the selector up to the desired vertical level. Here the switch hunts horizontally until it finds an idle trunk, at which time the D relay operates and connects the two toll trunks together. The next set of pulses then flows through the selector contacts and the retard coil in the outgoing toll trunk to the pulsing relay, which by alternately connecting the mid-point of the CX1 relay to ground and battery sends the pulses over the composite circuit to the distant office. In the meantime a supervisory circuit

*RECORD, *July*, 1940, *p.* 337.

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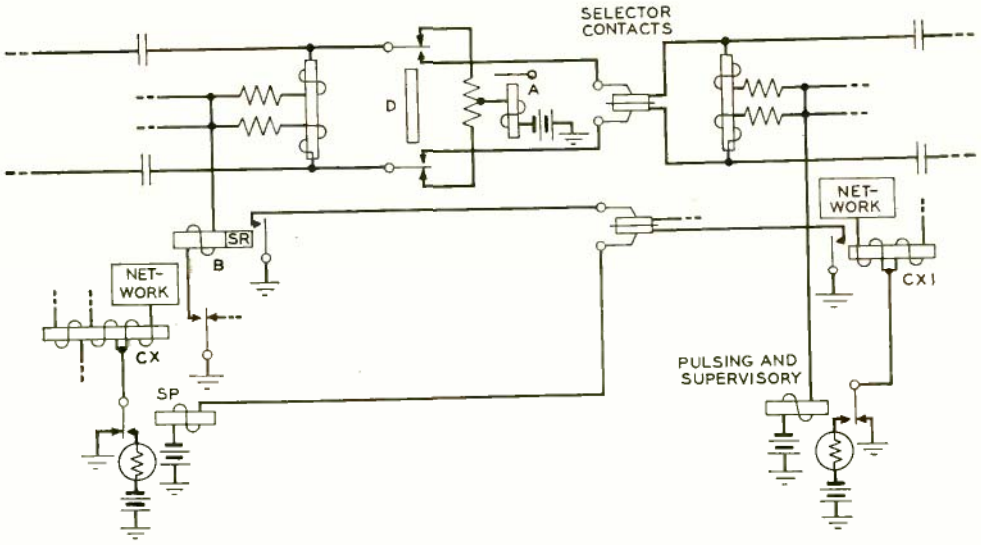

Fig. 3—Simplified schematic of simplex pulsing and signaling in the toll office

has been set up from relay CX1, through the selector contacts, and to the SP relay, over which signals may be returned to the originating operator.

An important feature of repeatered toll trunks is the control of gain by pads. When two toll trunks are connected together, these pads are cut out to increase the gain. When a toll trunk is connected to a subscriber, through a switching trunk, the pads must be left in the circuit to reduce the gain, because these local circuits are not balanced with sufficient accuracy by the balancing networks to permit the greater gain. Also the greater gain is not needed because of the comparatively short length of the circuit.

On manual toll trunks this pad control is secured by a circuit shown on Figure 4. When two toll trunks are connected together, the two P relays are in series to ground on each side, so that they release and operate their P1 relays, which short circuit the series resistances of the pad and open the shunt resistances. When the toll trunk is plugged into a switching trunk,

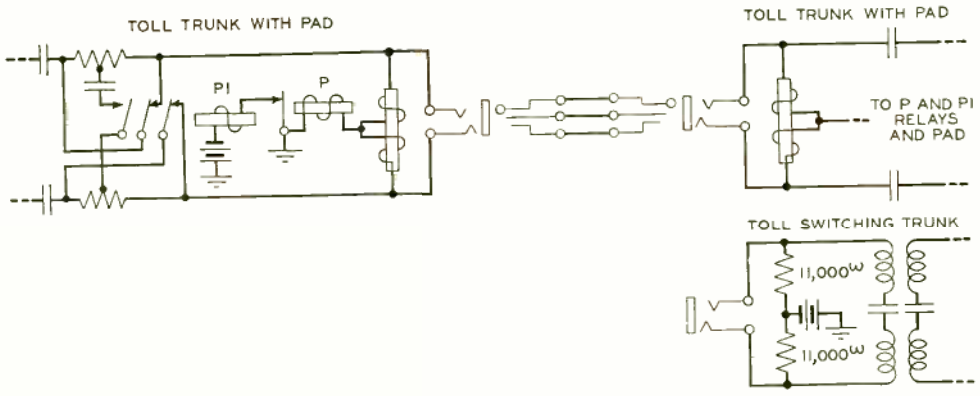

Fig. 4—Arrangements for pad control in manual toll offices

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however, a high-resistance battery connected to the simplex circuit in the switching trunk operates the P relay which in turn releases the PI relay and connects the pad.

In adapting these circuits for intertoll dialing this arrangement cannot be used because the ground associated with the P relays would operate the pulsing relay. By a modification shown in Figure 5, however, this difficulty is avoided, while still securing the proper action of the P and PI relays. Instead of connecting the winding of the P relay in the simplex circuit to ground, it is connected across the line through the retard coil and thus will not operate on simplex current. The ground is obtained from the CX relay through two balanced resistances. In the outgoing toll trunk, the battery operating through the pulsing relay is similarly connected through balanced resistances. When these two trunks are connected together, no current will flow through the winding of P because it is connected across equipotential points of the circuit from battery on the pulsing relay to ground on the CX relay.

The resistances through which the pulsing relay is connected to the retard coils on switching trunks, however, are not balanced, one being larger than the other. When the toll trunk is connected to such a trunk, therefore, the points across which the P relay is connected are not at the same potential because of the unbalanced resistances ahead of it. As a result, a current will flow through P and operate it. This will open the circuit to PI, and the pad will be connected into the circuit.

The above intertoll dialing circuits, which provide all the features necessary for toll operation, can be installed in any step-by-step area, and can be used in conjunction with existing toll plant and switchboards.

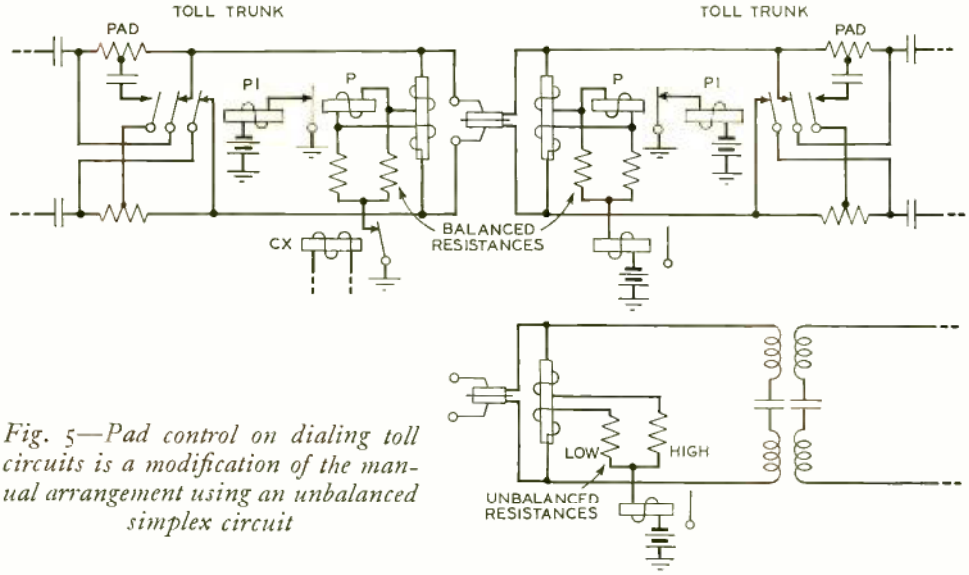

Fig. 5—Pad control on dialing toll circuits is a modification of the manual arrangement using an unbalanced simplex circuit

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