Maintenance facilities for the No. 5 crossbar system

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In a No. 5 central office, new maintenance devices and techniques are employed, and the use of automatic trouble detecting facilities is increased. Also there is a greater degree of automatic coverage of the outside plant than in previous systems. Practically all the controls for maintenance equipment are concentrated in one location, called the maintenance center; the one at the Media office in Pennsylvania is shown in Figure 1. The equipment includes primarily a trouble recorder, an automatic monitor, a master test circuit, and a jack bay for outgoing trunks. Here also are means for extending the alarms* to a distant office during unattended periods.

The trouble recorder† functions automatically to keep a punched-card record of troubles that occur on service calls, both for the major part of the central office equipment and for the associated outside cable plant as well. The automatic monitor checks on a sampling basis the performances of the pulse-receiving equipment of all register circuits, and the pulse-sending equipment of all senders, and causes the trouble recorder to make records of irregularities disclosed. The master test circuit provides for simulating service calls under controlled conditions. This aids the maintenance personnel in the final diagnosis of an indicated trouble condition, and also permits insurance tests to be made of those parts of the central office equipment that do not have access to the trouble recorder. It also permits tests to be made of subscribers' line and outgoing trunk conductors, and associated incoming trunk circuits in distant offices. This includes a rapid test for continuity and polarity of outgoing trunks. The alarm extension facilities can keep an attendant at a remote central point informed of the occurrence of each trouble, and indicate to him its classification as to urgency of corrective action.

Automatic recording of trouble is aided by the nature of the No. 5 system wherein markers become associated with all major circuits in the process of establishing connections. Self-checking features, which are basic elements of markers, also check the associated circuits, and where faults are detected, they are recorded. Markers become associated with line circuits for originating and terminating calls, when checks for continuity and the absence of false ground are made, and through associated senders on outgoing calls they receive indications of open outgoing trunks. Such failures are recorded on the trouble recorder when encountered. Under key control, the trouble recorder may also record the identity of lines on which permanent signals occur.

The automatic monitor is provided to disclose irregularities in the pulsing features of registers and senders. This is one of the new devices in crossbar switching, and its performance is being followed with interest. Its circuit consists essentially of pulse-receiving equipment and two sets of digit recording relays. It associates itself automatically with registers on service calls and records on one set of recording relays the digits pulsed into the register by the subscriber, and on the other set, the digits passed from the register to the marker. It similarly associates itself with senders, and on one set of recording relays records the digits sent to the sender by the marker, and on the other set, the digits pulsed out by the sender. With both senders and registers, after pulsing is completed, the two sets of monitor recording relays are compared, and if mismatch occurs, the trouble recorder is caused to make a record of the details of the call. This record includes the identity of the as-

* See pages 126 and 131.
† See page 112.

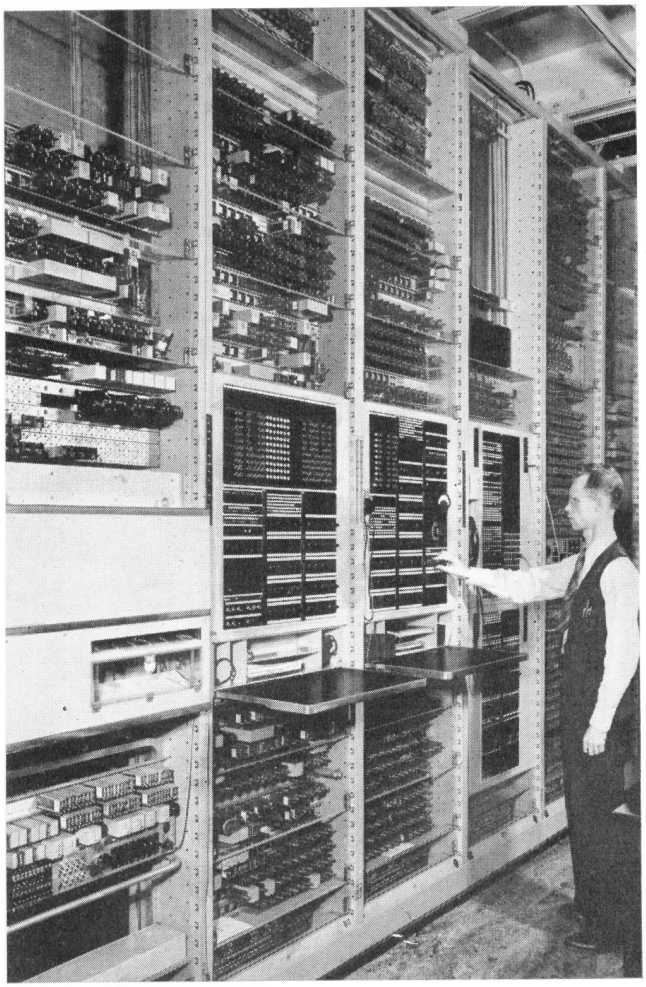

Fig. 1—Maintenance center of the Media No. 5 office.

sociated line or trunk, since some types of failure might be due to faulty line or trunk conditions. One monitor circuit cannot, of course, monitor all calls, but it works continuously, and over a period checks a substantial percentage of the calls each register or sender handles.

The No. 5 system is designed to permit a degree of unattended operation and therefore it is expected that there will be scheduled periods when an office is attended and others when it is not. Since the trouble recorder is automatic, it will record troubles which occur while the office is unattended as well as while it is attended. Also, during the unattended periods, alarms will be transferred to an attended office, and the seventy codes available permit the nature and seriousness of the trouble to be readily appraised. A repair man would at once be dispatched to the unattended office should any serious trouble arise, but normally the troubles will not be of a nature to require immediate attention.

When the maintenance force returns to the office at the next maintenance period, the punched cards stored in the trouble recorder give details on the troubles that have arisen, and thus they can readily be located and remedied. For this purpose the master test circuit is available. Its control panels carry keys and push buttons to permit the markers, registers, senders, and trunks to be selected as desired for a test call, and lamps on the control panel indicate the progress of the call. The automatic monitor can also function as a test circuit, and will be called in by the master test circuit in testing registers and senders. Troubles occurring in the major circuits while under test will be registered on the trouble recorder. The trouble recorder may also be controlled to give a record of the establishment of test calls which complete satisfactorily, to supplement lamp signals. Start and release control of this master test circuit can be extended to any point in the office where a maintenance man may wish to observe the performance of the equipment under these conditions.

While the office is attended, the master test frame is the observation and control point for the office. Here progress lamps display continuously the flow of traffic through the office, and an experienced man can often tell by the pattern of these lamp flashes in space and time whether or not all is well in the office. Audible and visual alarms will indicate the occurrence of irregular conditions in either the inside or outside plant under operating conditions. Individual circuit make-busy jacks are also concentrated here so that circuits with indicated troubles can be quickly isolated from service. Access by the master test circuit to circuits plugged busy is not prevented.

Both the trouble recorder and master test circuit are designed for use with automatic message accounting equipment where this is provided. It is necessary only to add a small relay unit to the master test circuit to adapt a master test frame for automatic message accounting maintenance. The trouble recorder was also designed in anticipation

of the future automatic testing of subscriber lines for low insulation resistance. When this is provided, subscribers' lines can be tested automatically when desired, and the trouble recorder will record the identity of lines found to have less than an established minimum insulation resistance.

The possibility of unattended operation for extended periods of time lies in no small measure in the many operating safeguards that have been built into this system. The extensive use of second-trial and alternative-choice features prevents localized troubles from interfering with the completion of calls through the office, and circuits have been designed to prevent the pyramiding of trouble that has sometimes occurred under overloads in previous offices. These designs include a more liberal provision of timing intervals in the markers. This permits timing the switching functions in smaller increments, thus providing less circuit delay when failure is encountered, and advance by timeout is required. Every precaution has been taken to localize trouble when it does occur. The more extensive use of double contacts, the elimination of relay types and contact combinations that have required abnormal maintenance in previous experience, as well as a more liberal use of contact protection, greatly contribute to the freedom from trouble in the No. 5 office.