

The Automatic Monitor

J. W. BRUBAKER
*Switching
Systems
Development*

In the panel and crossbar systems that preceded No. 5 crossbar, the senders, which perform the functions of both the register and sender in the No. 5 system, are maintained by circuits that originate test calls to each sender to check its various features—advancing automatically from sender to sender unless a trouble condition is disclosed. In the No. 5 system the objective has been to indicate troubles in senders and registers while they are handling service calls.

To meet this objective, the automatic monitor was designed to connect on a random basis to the registers and senders as they are selected for service calls. If connected to a register, the monitor independently records the called number pulsed into the register from the line, and checks it against the number that the register passes to the marker. If connected to a sender, the monitor records the number pulsed out over the trunk by the sender, and checks it against the number passed to the sender. If the numbers do not check, a trouble record is made.

This monitor forms part of a larger circuit known as the automatic monitor, register, and sender test circuit.* These latter facilities, which will be described in a subsequent article, are used to locate both the troubles reported by the monitor and those indicated by other methods. The monitoring and testing facilities are combined into a single circuit because a number of the circuit units are used for both. Actually the test facilities comprise the greater part of the circuit.

The monitor is arranged to check three general types of circuits: originating registers, incoming registers, and outgoing senders. It progresses from one type of circuit

to the next in the order named under control of a ten-step allotting circuit, which steps once for each monitored call. Cross-connections in the allotting circuit provide flexibility in apportioning the monitoring between the three types of circuits. This is usually done in proportion to the number of circuits of each type in the marker group. A typical division of the ten calls would be six on originating registers, two on incoming registers and two on outgoing senders. Since during light load periods there may be no interoffice traffic for long intervals, the allotting circuit is arranged to advance one step if no calls are received for one minute to prevent the monitor from waiting for sender or incoming-register calls during such periods. By key selection, monitoring can be confined exclusively to originating registers, incoming registers, or outgoing senders. Should a register or sender be suspected of trouble, the monitor can be caused to monitor every call that the suspected register or sender handles.

Each time a marker starts to establish a dial-tone or outgoing-sender connection, it requests the use of the monitor, and if the monitor is idle and if its allotter at that time is in the position to monitor on an originating register or outgoing sender, the marker will gain access to the monitor. If an originating register is called for, the marker—having gained control of the monitor—operates a relay in the register that establishes a direct connection between the register and the monitor. In addition to certain signaling leads, this connection includes the tip and ring leads incoming to the register from the subscriber's line. A dial pulse amplifier is bridged across these tip and ring leads in the monitor. The amplifier is a vacuum-tube circuit with a high-impedance input so that it will not disturb the pulsing capabilities of the register. As

* See page 105.

the subscriber dials, the pulses are amplified, counted, and registered by the monitor independently of the originating register.

When dialing is completed, the originating register selects a marker to set up the connection called for. The operation from this point on is illustrated by the block dia-

gram. When the monitor has recorded the information it receives from the marker, the connections to the monitor both direct and through the master test frame connector are released, and the monitor starts checking the called number. It has two sets of register relays; on one set is recorded the number

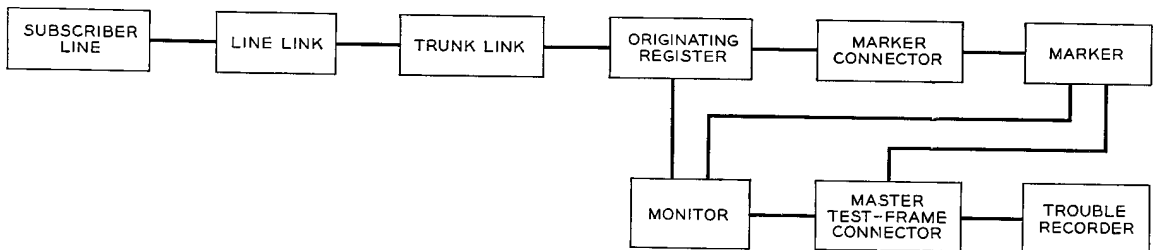


Fig. 1—Paths established for monitoring the action of an originating register.

gram of Figure 1. When the register is connected to a marker, a direct connection for a limited number of signaling leads is established between that marker and the monitor, which has remained connected to the register. At this time the monitor selects the master test frame connector and causes the marker also to connect to this connector. This connection between the marker and monitor through the master test frame connector is used principally to permit the monitor to record the called number that the register is passing to the marker. The line location of the calling subscriber's line is also recorded in the monitor at this time so that pulsing failures caused by unfavorable subscriber line or dial conditions can

the monitor received from its dial pulse amplifier, and on the other set is recorded the number that the originating register passed to the marker. If the two numbers are identical, comparable relays in each set will both be operated or unoperated, and a check circuit through all relays will be completed. If this check is satisfactory, the monitor waits for the marker and originating register to restore to normal, and then releases and awaits a new call.

Should the number check fail, the monitor selects the master test frame connector for connection to the trouble recorder. The trouble record card will indicate the called number that the monitor registered, and the called number that the register passed

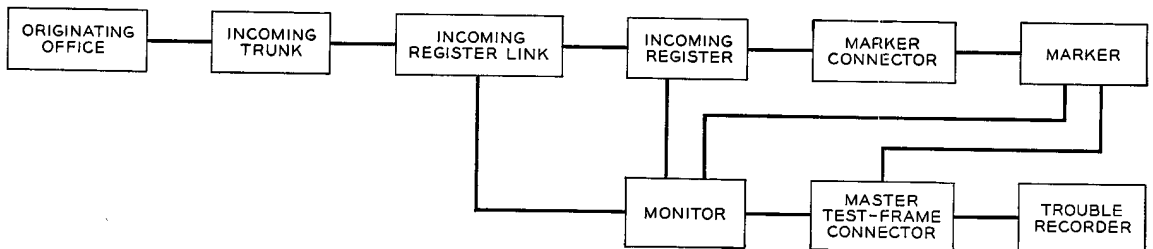


Fig. 2—Paths established for monitoring the action of an incoming register.

be associated with the line causing the trouble. The relays and leads which connect the marker to the master test frame connector are part of those used when the marker connects to the trouble recorder to make a trouble record. *

to the marker. In addition the card shows the location of the calling line, the originating register location, and the marker number. When the trouble record is complete,

* See page 112.

the monitor restores to normal and awaits a new call. Trouble records may be due either to register trouble or to improper line and pulsing conditions. Since both the register and the line are identified on the trouble record card, repeated trouble records should indicate which is at fault.

The connections which are established for incoming register monitoring are shown in the block diagram of Figure 2. When an incoming trunk is seized, it is connected to an incoming register by the incoming register link circuit. As the connection is being established, the use of the monitor is requested by the link, and if the monitor is available, it is associated with the register by operation of a relay in the

With revertive-pulse incoming registers, the monitor inserts a low resistance relay in series with the pulsing circuit. The output of this relay is counted and registered in the monitor. In revertive pulsing, the thousands and hundreds digits are translated at the originating office and transmitted to the No. 5 office as three numbers, or "selections," while the tens and units digits are transmitted without translation. In both the incoming register and the monitor the initial three selections are retranslated into the thousands and hundreds digits, since communication between circuits within a marker group of the No. 5 system is on the basis of the digits as dialed.

For outgoing sender monitoring, the

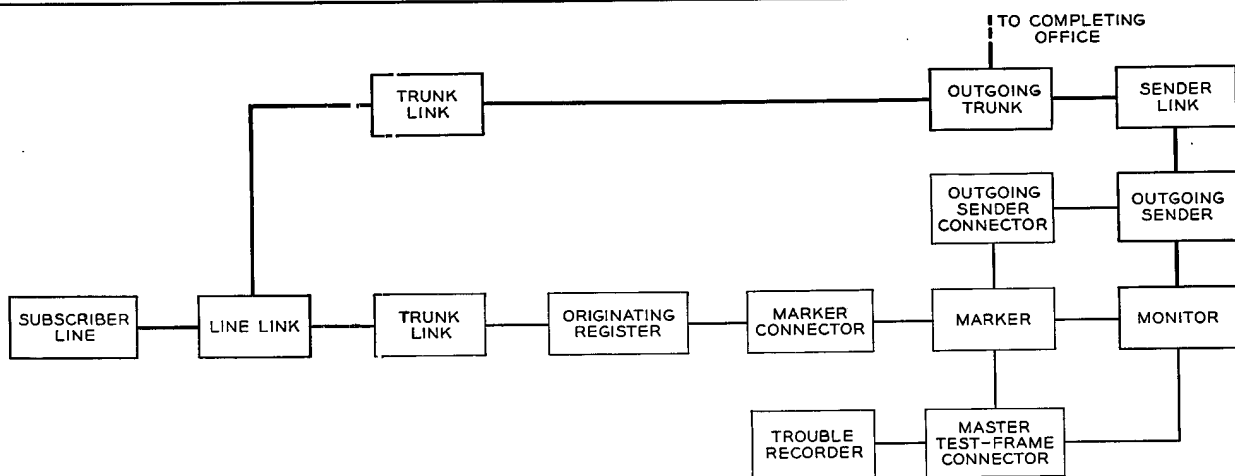


Fig. 3—Paths established for outgoing sender monitoring.

register. If the incoming register is of the dial-pulse type, the operation from this point on is as described for an originating register except that the location of the incoming trunk instead of the subscriber's line will be shown on the trouble card.

In addition to dial-pulse incoming registers, a No. 5 office may also have revertive and multifrequency incoming registers. For receiving multifrequency pulses, a high impedance amplifier is bridged across the tip and ring to the incoming register. The output of this amplifier is connected to a standard multifrequency receiver associated with the monitor, which detects the incoming frequencies, and operates corresponding register relays.

marker requests the use of the monitor as soon as it recognizes that the call will require an outgoing sender. The block diagram of Figure 3 illustrates the connections involved. At the time the marker selects the monitor, a direct connection for a limited number of signaling leads is immediately established between the marker and the monitor. The monitor also connects to the marker through the master test frame connector. Through this latter connection the monitor receives the called number, which is being passed to the marker from the originating register, and also the signals passed from the marker to the sender, which may require the sender to modify the number sent it. On

a direct call to another office, for instance, the office code will not be pulsed out, and the marker will indicate this to the sender. The marker may also direct the sender to prefix a one-one, an additional digit, or both ahead of the number passed to the sender. Such signals from marker to sender are recorded by the monitor, since it must readjust its checking circuit to take into account any difference between the number which is passed to the sender and the number which is pulsed out. In addition to the called number, the monitor records the location of the outgoing trunk used on the connection. When all necessary information has been recorded, the paths between the marker and monitor both direct and through the master test frame connector are released.

When the marker connects to the outgoing sender, a relay is operated in the sender that establishes a direct connection between the sender and the monitor. After the marker has completed its functions, it releases, and for the remainder of the time, while the sender is pulsing out, the connections are as shown by the heavy lines in the diagram.

Through the direct path to the sender,

the monitor connects to the tip and ring over which the sender outpulses. The pulses sent out by the sender are picked up, counted, and recorded in essentially the same manner as described for registers. There are four types of outgoing senders, multifrequency, dial pulse, revertive, and panel call indicator. Monitoring on the latter sender requires a special amplifier to repeat the PCI (panel call indicator) type of pulsing. After the sender has completed pulsing, the monitor checks the pulsed out number against the number passed from the register to the marker. A trouble record is made if the numbers do not check.

In the initial No. 5 crossbar installation at Media, records indicate that there are approximately 35,000 daily usages of outgoing senders, originating registers, and incoming registers. There are approximately 2,000 monitor usages per day. Thus about one call in every seventeen handled by a register or sender is monitored. Larger offices will, of course, have more senders and registers, but one monitor is still considered adequate to sample sender and register operation and to bring any faulty operation to the attention of the maintenance forces.