Centralized Automatic Message Accounting System

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A centralized automatic message accounting system (CAMA) has been developed so that the billing data can be recorded at a centralized crossbar tandum office for message unit and toll calls originated by telephone customers served by a large number of local dial central offices. It is an essential part of facilities for economical nationwide customer dialing through central offices with older types of switching equipment and through other central offices which could not otherwise economically give this service. The new system records the billing data on paper tapes in the same form now used by local automatic message accounting systems. Tapes for both local and centralized automatic message accounting systems are processed in the same accounting center.

INTRODUCTION

One broad objective of the Bell System is to extend the customer's dialing range so that ultimately he will be able to dial his own calls to any telephone in the country in much the same way as he now dials local calls. Several steps toward this goal have already been taken. A revised fundamental plan[1] for automatic toll switching[2] has been adopted which involves among other things the use of a nationwide numbering plan[3] covering the United States and Canada. In accordance with this plan each customer will be given a distinctive 10-digit designation which will consist of a 3-digit regional or area code, a 3-digit central office code, and a 4-digit customer's number. In many parts of the country automatic toll switching systems[4] are now in use by operators who complete more than 40 per cent of all toll calls by dialing directly to the called telephone in distant cities.

In order that customers may use these switching systems to dial their own toll calls, some automatic means for recording the necessary billing information on such calls must be provided.

PRESENT RECORDING AND CHARGING METHODS

Several types of automatic recording equipment are now in service in the Bell System.

Multi-unit registration (zone registration) has been in use for many years in a number of panel and No. 1 crossbar central offices whose rate structure permits bulk billing. This method can be used for calls which cost 6 or less message units for the initial period. Although zone registration is economical, it does not provide a detailed record of each call but merely scores the number of message units on a register associated with the customer's line.

Remote control zone registration has been serving customers in panel central offices since 1941. It is similar to multi-unit registration, but the timing and register control equipment is located in a tandem office instead of in each originating panel central office.

Automatic ticketing,[5] which was developed some years ago for use in step-by-step central offices, does make a record of the details of each customer dialed call. A simple ticket printer is permanently associated with each outgoing trunk to produce an individual typewritten ticket for each call. Common relay equipment is used to furnish the called number, calling number, etc. to the printer. The information printed on the ticket is in detailed form and is similar to that prepared by the operator in manual operation. It can be used for billing the customer manually either on a detailed or a message unit basis.

A greatly improved form of recording, the Automatic Message Accounting[6] (AMA) system, was introduced into the Bell System in 1948. In central offices having this equipment, all of the data required for billing of customer dialed calls are automatically perforated in code on paper tapes. These tapes are taken to an accounting center where they are processed by suitable machines to produce customers' bills. The recording machines are associated with the transmission circuits only when required to make a record, one recorder serving up to 100 such circuits. Recorders, together with their associated equipment, are installed in each central office arranged for local AMA recording. The information for each call is recorded on the tape in three stages, or entries. The initial entry is recorded after the customer has finished dialing. One time entry is recorded when conversation starts and another when conversation ends. For short-haul calls that are to be billed on a message unit basis, the initial entry contains only the calling office code and telephone number, and the charging rate. This information, together with the duration of the call, is sufficient for determining the charges. On toll calls which are to be billed in detail, the called office and telephone number are also

required. This system permits individual and two party customers in No. 1 and No. 5 crossbar offices to dial calls to telephones in their home area. In addition, customers in some No. 5 crossbar central offices may now dial directly to other areas. These facilities have been installed in No. 5 crossbar offices in Englewood, N. J., and in several other locations whose customers now may dial directly to about 13 million telephones in 13 metropolitan areas.

Relatively expensive recording equipment is required in each central office in the local AMA system. For new central offices this recording equipment is economical only if the toll and message unit calling rates are relatively high. The addition of local AMA recording equipment to existing offices is, in most cases, uneconomical.

CENTRALIZED AUTOMATIC MESSAGE ACCOUNTING

The Centralized Automatic Message Accounting system (CAMA) provides an economical means of recording billing data for customer dialed calls from many central offices that cannot justify local AMA. This system is economical because one group of recording equipment, located at a crossbar tandem office,[7] can serve as many as 200 local central offices without requiring major changes in, or additions to, those offices.

The first crossbar tandem equipment arranged for CAMA was placed in service in Washington, D. C., in November, 1953. This equipment serves the customers in 85 central offices in Washington and in suburban Virginia and Maryland. They are able to dial each other directly and to dial their own calls to Baltimore and to other nearby toll points. Eventually, they will be able to dial their own calls to most points in the United States and Canada. Similar crossbar tandem CAMA equipments have been installed in Detroit, New York, San Francisco and Philadelphia.

The CAMA installation at Detroit enables the customers served by approximately 800,000 telephones in 99 Detroit panel and No. 1 crossbar local central offices to dial station-to-station multi-unit interzone and toll calls to 63 communities in Michigan and in nearby Canada. The map of Fig. 1 shows this dialing area.

THE CROSSBAR TANDEM SYSTEM

The crossbar tandem system into which CAMA has been introduced is used today in panel-crossbar and step-by-step areas. It receives calls from local dial central offices and completes them to other local central offices and to the toll network. It is also arranged to receive calls over

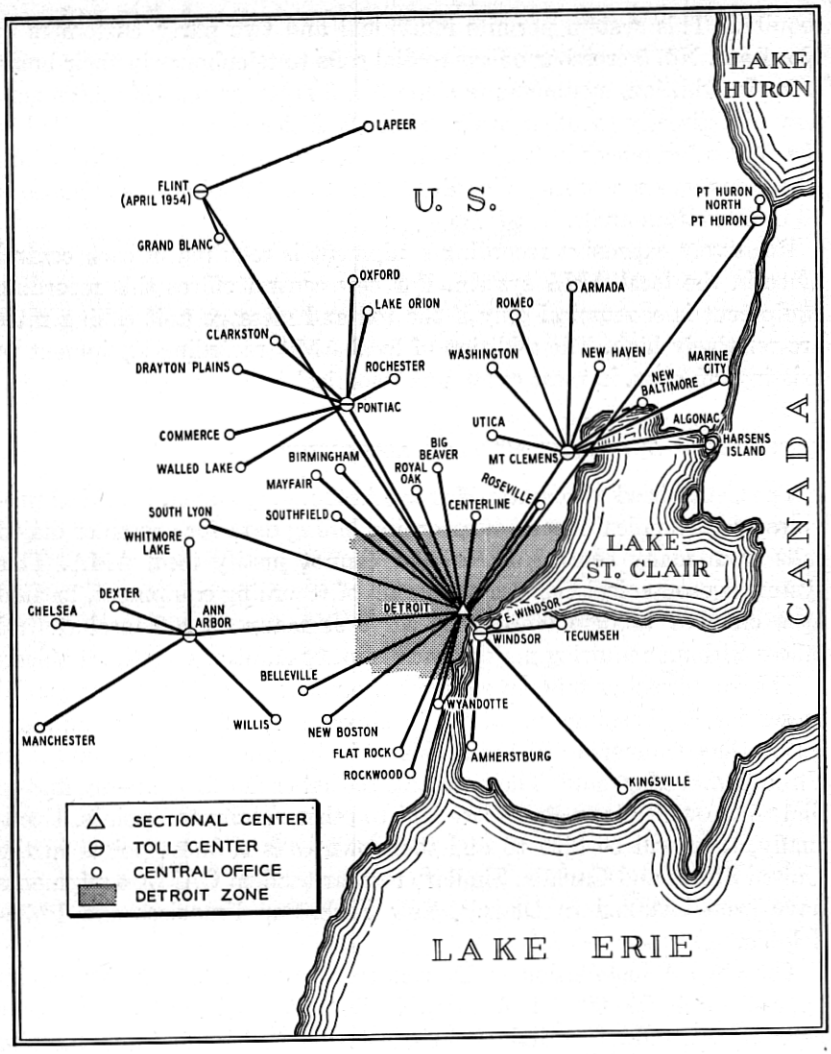

Fig. 1 — Points reached via Detroit CAMA at cutover in Dec., 1953.

intertoll trunks and complete them to other intertoll trunks or to local central offices. In many situations, it provides more efficient trunking facilities between central offices than do direct trunks and connects together offices with different signaling systems. Since the present crossbar tandem offices have in themselves no means for recording billing data, their use has been restricted to operator dialing, to customer dialing of

flat rate calls from all types of central offices, and to customer dialing of message unit and toll calls from central offices using one of the present methods of charging.

FIELD OF USE FOR THE CAMA SYSTEM

The CAMA system, as now developed, is suitable for use in panel-crossbar local areas. It is arranged to serve 7-digit calls only since facilities for 10-digit dialing are not available for panel and No. 1 crossbar central offices. Thus, in general, it can complete calls only to its own numbering area. However, provision is made for completing calls to one adjacent area, this area being selected by dialing "one-one" ahead of the listed 7-digit number.

BRIEF DESCRIPTION OF THE CAMA SYSTEM

If a customer makes a call that requires CAMA treatment, the call will be routed by the local central office to a crossbar tandem office arranged for CAMA recording. Until automatic means for identifying the calling customer's number for billing purposes is developed, an operator will be bridged on the connection at the tandem office to obtain the calling number and register it in the CAMA equipment by keying. The

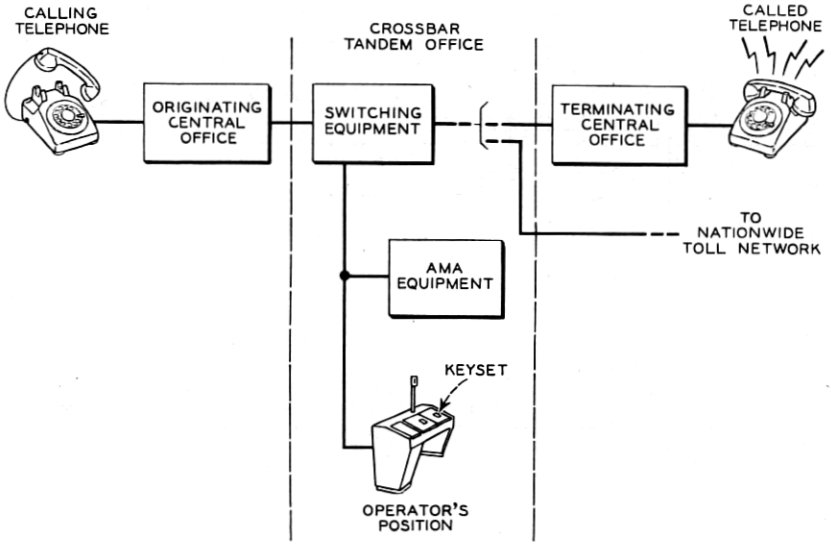

Fig. 2 – Simplified switching diagram.

information necessary for correctly charging for the call will then be recorded on paper tape by the automatic message accounting equipment located in the tandem office. This method of operation is shown in simplified form on Fig. 2.

A more detailed block diagram of the principal equipment units and their interconnections for a crossbar tandem CAMA office in a panel-crossbar area is shown in Fig. 3. Here the switching equipment consists of the conventional trunks, sender link frames, senders, markers and trunk link and office link frames for switching calls through the office. Such new units as the position link frames, positions, transverters, billing indexers, recorders, call identity indexers, and master timer constitute the major AMA equipments needed for recording the billing information for each call. Most of these have functions similar to corresponding local AMA equipments. AMA features have also been added to the trunks, sender links and senders.

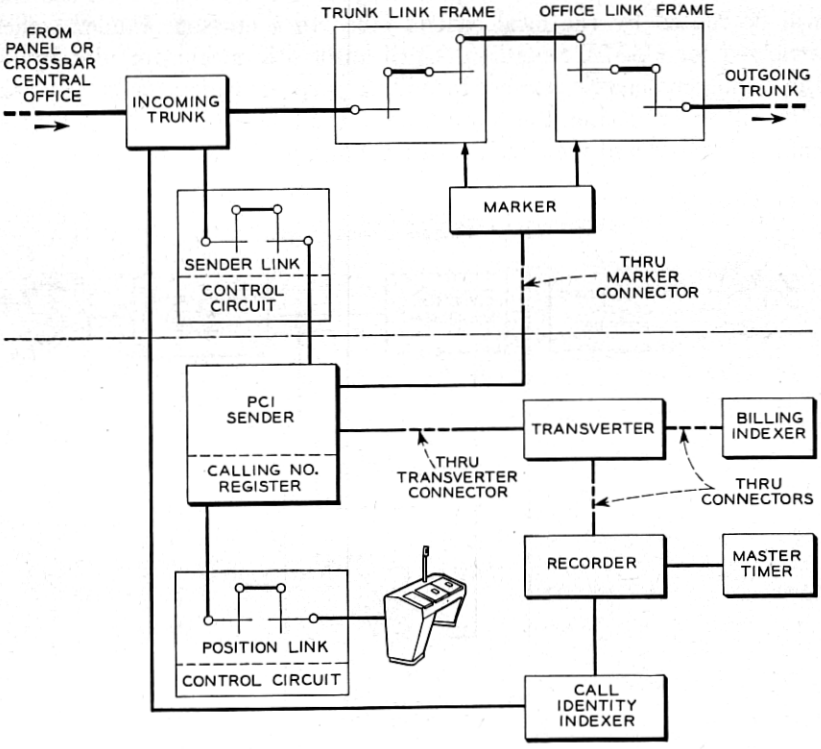

Fig. 3 — Block diagram of CAMA system in panel-crossbar areas.

FUNCTIONS OF THE CAMA SYSTEM

The functions of the system in establishing a connection and in recording the billing data may be divided into seven major groups as follows:

1. Operation of the sender link and control circuit in selecting an idle sender and connecting the selected sender to the incoming trunk.
2. Receiving and registering the called office code and number in the sender. The sender does not pulse the entire number forward until the AMA functions are completed.
3. Operation of the marker in establishing the connection through the switches and furnishing the sender with directions for completing the call.
4. Operation of the position link and control circuit in selecting an idle occupied position and connecting it to the calling customer.
5. Obtaining the number of the calling telephone verbally from the customer and keying it into the sender.
6. Connection of the sender to a transverter and billing indexer and the derivation of the billing data from the called and calling office codes and the rate class of the calling customer, and recording the charging information on the AMA tape.
7. Operation of the sender in transmitting information of the proper type to the terminating office, or if a toll call, to the next toll office in the chain.

Calls from Panel and Crossbar Customers

The first three functions in a crossbar tandem CAMA-equipped office in a panel-crossbar area are the same as in a non-CAMA office. Since published information on these features[7] is available, they will not be described in detail.

The fourth major function is handled by the position link and control circuit which is shown in block diagram form in Fig. 4. This circuit consists of primary and secondary crossbar switch links and control circuits in duplicate. Each group functions independently to serve calls to the same 40 senders and can connect to two different groups of 50 positions. In case of failure of one link group, the other link group will continue to serve calls to the 40 senders. The control circuits are arranged in such a manner that all senders and all positions receive essentially equal treatment.

When the position link connects the sender to an idle CAMA position, the operator obtains the calling number verbally from the customer and

records that number in the sender by the operation of numerical keys located at her position. The CAMA switchboard shown in Fig. 5 is a cordless board of modern sheet metal design.

The sixth group of functions — that of converting the data into the desired form and perforating it on the paper tape — is performed jointly by the transverter, the billing indexer, the recorder and the call identity indexer. The transverter is very similar to that used in local AMA. It registers the calling and called number received from the sender, registers the billing data received from the billing indexer and controls the recorder in the perforation of the initial entry.

The billing indexer is strictly a translating circuit. It receives the calling and called office codes and the customer rate class from the transverter and converts this information into a form which the transverter and recorder can use. It provides a 1-digit billing index, which denotes the charging plan to be used, and provides a type of initial entry indica-

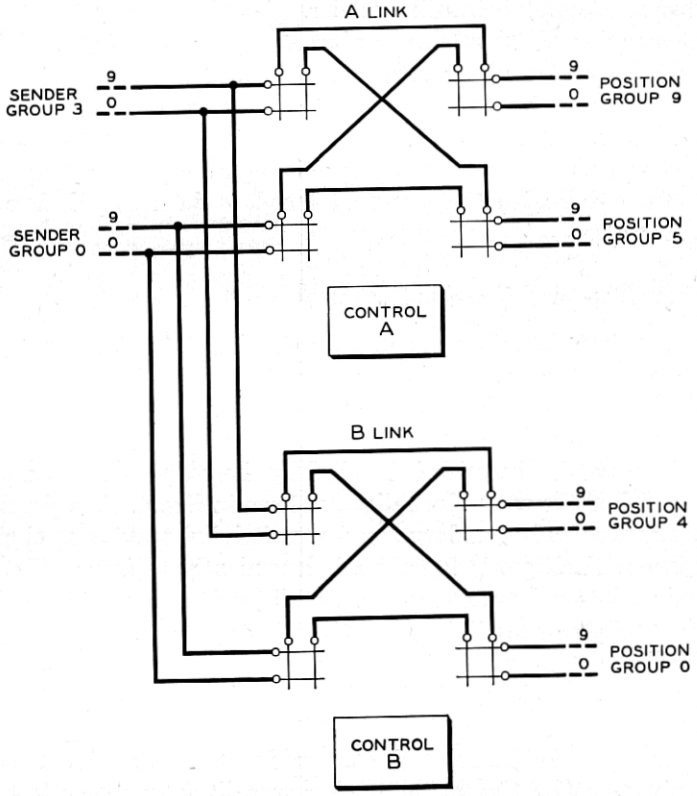

Fig. 4 — Position link and control circuit.

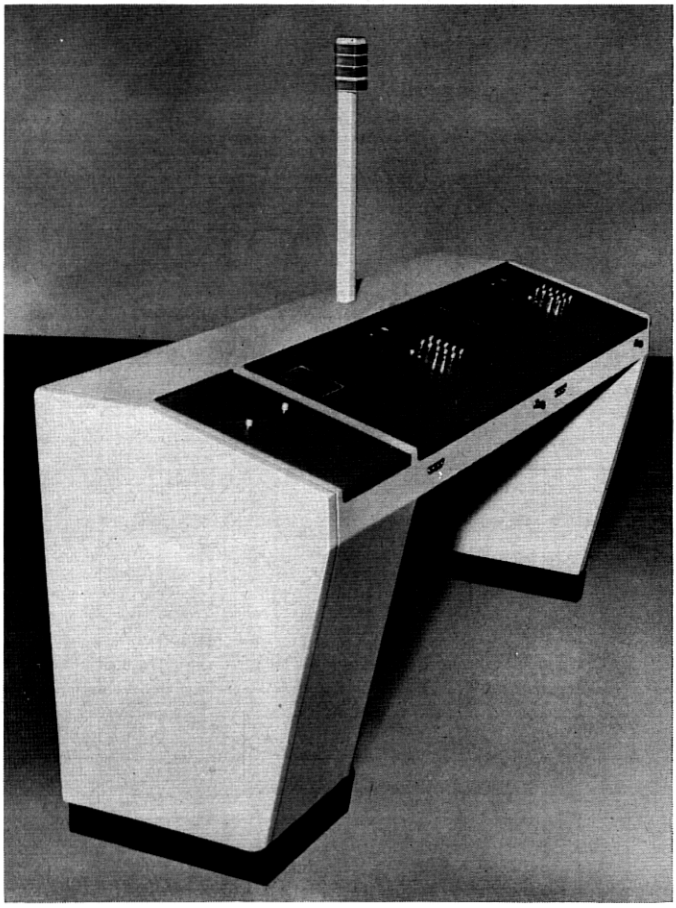

Fig. 5 — Switchboard.

tion which tells the transverter whether to perforate a two- or a four-line initial entry. The two-line initial entry used for calls billed on a message unit basis contains only the calling office code and telephone number, the billing index and the trunk identity whose function is discussed later. This information, together with the duration of the call, is sufficient for billing. Four-line entries contain, in addition, the called office code and telephone number. They are used for detail billed toll calls and for those bulk billed calls on which all details of the call are required for record purposes. Fig. 6 shows a simplified schematic of the billing indexer. The calling office code combined with the customer rate class, chooses a particular rate treatment relay. This rate treatment is common to all cus-

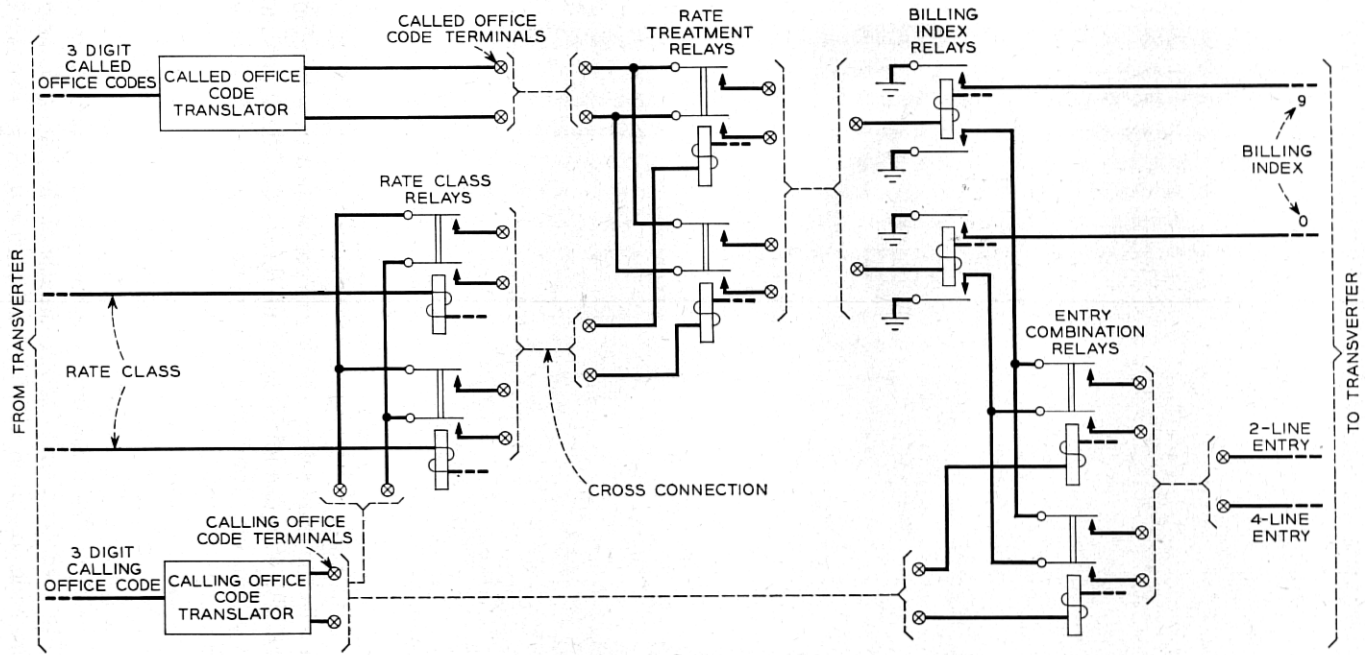

Fig. 6 — Simplified schematic of billing indexer.

tomers in the area who are charged alike for their calls through the tandem office. To actually determine the billing index or charge treatment for each call, the rate treatment is modified by the called office code by means of the rate treatment relays. Since calls with the same billing index may require a 2-line entry if originated in some offices and 4-line entry if originated in other offices, the billing index and calling office code information are translated jointly by means of the entry combination relays to produce either the 2-line or 4-line indication.

The recorder,[8] call identity indexer and master timer circuits are of the same type as used in local AMA and perform the same functions. The recorder perforates initial entries as directed by the transverter. It also perforates a timing entry at the beginning of conversation and another at the end of conversation. The call identity indexer, one of which is associated with each recorder, identifies the trunk used on a call as a particular one of the maximum 100 served by a recorder. This enables the recorder to perforate that identity on initial and timing entries. The identity is used by the accounting center to gather together the three entries involved on each call.

The master timer[9] keeps the recorders continually informed as to the correct time.

When the initial entry is completely recorded on the AMA tape, the sender completes its task of pulsing the called number forward and then releases. The transmission path is now completed through the tandem office and the only CAMA functions remaining are the perforations of the timing entries mentioned above.

ACCOUNTING CENTER PROCESS

The accounting center process for CAMA is the same as for local AMA. It automatically assembles the three bits of information pertaining to each call, computes the conversation time on all calls, sorts by the type of call, prices each call either in terms of message units for bulk-billed calls or in terms of dollars for detail billed toll calls and brings together the records of all calls made by each customer.

MAINTENANCE FEATURES

To properly maintain the AMA recording facilities, test circuits are provided for testing the major features of the CAMA equipment. An automatic incoming trunk test circuit tests the CAMA trunks. An automatic sender test circuit tests the CAMA senders in much the same way that the present sender test circuit tests non-AMA senders. Facilities are also provided for making operating tests of the position links, posi-

tions, transverters and billing indexers. As in the local AMA system, testing of the recorder features is done by the test unit on the master timer frame.

The AMA circuits are provided with many self-checking features which detect trouble while a call is being handled. When a trouble is detected, the AMA circuits connect momentarily to a recording circuit called a "trouble indicator" which lights lamps to indicate how far the call has progressed and which of the common control circuits were used on the call. This information aids the maintenance force in locating the trouble.

FUTURE DEVELOPMENTS

As stated earlier, use of Centralized Automatic Message Accounting by panel and crossbar customers will be restricted initially to calls to the home area and one foreign area. The centralized recording will be done initially at crossbar tandem offices with operators identifying the calling telephones. Ultimately, customers served by all types of dial local central offices will be able to dial their own calls — local or nationwide. Operator identification of individual and two-party lines will be replaced in many cases by automatic identification. The centralized recording equipment will be located in various types of tandem and toll offices as determined by the economics of each case.

CONCLUSION

The development of Centralized Automatic Message Accounting arrangements is another major step toward nationwide customer dialing from central offices which cannot be economically equipped with local AMA recording equipment.

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