

**SWITCHING SYSTEMS MANAGEMENT**  
**STEP-BY-STEP SWITCHING SYSTEM**  
**AUTOMATIC MESSAGE ACCOUNTING—LOCAL AND CENTRALIZED**  
**SYSTEM DESCRIPTION**

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1. GENERAL

1.01 This section describes in general terms the application of Automatic Message Accounting (AMA) techniques to step-by-step (SXS) offices. The arrangements allow SXS customers on individual, 2-party flat-rate, and 2-party message-rate lines to dial calls to other offices which would otherwise be completed and recorded by an operator. AMA provides for recording charges of these calls mechanically in a form adaptable to mechanized accounting in an accounting center. This section also describes automatic identified (AI) and operator identified (OI) Centralized Automatic Message Accounting (CAMA) at SXS switching centers.

1.02 Whenever this section is reissued, the reason for reissue will be listed in this paragraph.

1.03 CAMA is a means of recording billing data at a centralized point. Local Automatic Message Accounting (LAMA) equipment is normally confined to one office.

1.04 The destinations reached through the AMA equipment are also available to operators and may be available to other classes of service on a non-AMA basis.

1.05 The arrangement of the AMA equipment in a No. 1 SXS office is shown in the block diagram of Fig. 1. The Automatic Number Forwarding (ANF) and Automatic Intercept System (AIS) equipment elements shown in Fig. 1 indicate an optional arrangement. The ANF equipment is required in AMA offices arranged to route person-to-person (0+) or operator assistance (0) traffic to the Traffic Service Position System (TSPS). The AIS equipment handles *three classes* of intercept calls that are routed to an Automatic Intercept Center (AIC).

- (a) Regular intercept (recently disconnected, changed, or unassigned numbers)
- (b) Trouble intercept (plugged-up lines)
- (c) Calls to unequipped numbers (vacant selector levels).

1.06 The equipment required for No. 1 SXS with AMA can be divided into *five* main categories: AMA information gathering, AMA billing, ANF, AIS, and maintenance.

1.07 Most of the AMA information gathering, AMA billing, ANF, and AIS equipment can be classified as common control equipment. Common control equipment is engaged when required during a call and then released to serve other calls.

1.08 The equipment required for the CAMA operation may be divided into *three* main categories; common control, AMA, and maintenance. With automatic number identification (ANI), the calling number is automatically identified by equipment located in the originating office. If ANI is not provided, an operator must obtain the calling number from the customer and key it into the CAMA equipment for billing purposes. Fig. 34 shows the relationship of the SXS-CAMA to other offices.

1.09 These are the primary AMA information-gathering circuits:

(a) **AMA Outgoing Trunk**—The AMA outgoing trunk serves as an interface between the SXS switching equipment and the AMA equipment. It provides a talking path with supervisory and charging features between the originating customer at the SXS office and the terminating (called) customer at the distant office.

(b) **Trunk Finder**—The trunk finder connects the AMA outgoing trunk to an idle sender circuit.

(c) **Sender**—The sender performs the following functions:

- (1) After seizure, it registers the remaining digits of the called number.
- (2) It performs a party test.
- (3) It connects to an idle identifier.
- (4) It passes called office code information to the identifier.
- (5) It passes calling party information (tip or ring) to the identifier.
- (6) It registers the called office and the calling office information from the identifier.
- (7) It connects to an idle transverter via a sender-transverter connector.
- (8) It passes the calling office and the calling office information to the transverter (for billing purposes).
- (9) It outpulses required digits of the called number to a distant office or a tandem office.
- (10) It performs a ground removal test after the tip party disconnect.

(d) **Identifier**—The identifier performs the following main functions:

- (1) It reconstructs the called office code (when necessary).

(2) It identifies the calling number.

(3) It connects to an idle translator on 1-plus calls for route relay operation.

(4) It connects to the dynamic overload control (DOC) circuit for codes that may receive DOC treatment.

(5) It passes the called number and the calling number information to the sender.

(6) It passes the calling number information to the outpulsor on AIS calls.

(e) **Identifier Trunk Connector**—This equipment cuts in approximately 20 additional information leads between the trunk and the identifier.

(f) **Code Connector**—The code connector is required on all calls, other than 1-plus calls, for operating a route relay in the identifier. It connects the code lead from the AMA outgoing trunk to the identifier circuit. For 1-plus calls, the translator is used to operate a route relay.

(g) **Translator**—The translator circuit is used on area code calls in offices arranged for 1-plus dialing. It determines which area route relay (controlled by the translator—maximum 30) to operate by decoding the first three digits that are dialed into the AMA equipment (excluding the one dialed for 1-plus).

(h) **Dynamic Overload Control**—The DOC circuit is controlled by network traffic control personnel at a toll tandem office. Control signals are transmitted by the distant toll tandem control identifier action. Of the calls to a particular area code, 25, 50, 75, or 100 percent can be blocked (depending on cross-connections) and routed to recorded announcement under control of the toll tandem.

(i) **Common Number and Class**—The common number and class circuit is used by the identifier for the calling number and class identification. It takes a maximum of five steps looking at a maximum of 20 thousand number frames per step (100 frames total times 1,000 numbers per frame gives a maximum of 100,000 lines per office). Each time it takes a step, it is attempting to locate the particular thousand

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number frame associated with the calling party. It also identifies the class of service of the calling number.

(j) **Thousand Number Frame**—The thousand number frame is used by the identifier to identify the hundreds, tens, and units digits of the calling number.

1.10 The AMA billing equipment records the billing data for a call. It translates the original data into a form suitable for recording on paper tape. These data consist of the following:

- (a) Answer and disconnect timing entries.
- (b) Identity of calling line.
- (c) Called number information.
- (d) Outgoing trunk number.

This equipment may also be considered as common control, inasmuch as it is only engaged for a portion of the call and is then released to serve other calls. However, the distinguishing features of AMA billing equipment are its recording functions.

1.11 The principal AMA billing units used in SXS-AMA offices are as follows:

- (a) **Transverter**—The transverter is used only on initial entries. It performs certain checking functions and converts the information necessary for billing to a form suitable for recording.
- (b) **Call Identity Indexer**—This equipment supplies a 2-digit number used to identify the outgoing trunk on initial, answer, and disconnect entries.
- (c) **Recorder**—The recorder provides access to the perforator for the transverter, CII, and master timers. The recorder also performs certain checking functions to ensure the accuracy of the AMA record, and exercises control over the perforator for the recording of the charging entries.
- (d) **Perforator**—The perforator performs the final recording function, the perforation of the paper tape. This tape is perforated with coded data which represent the detailed information pertinent to the call.

(e) **Master Timing Frame**—The master timers (even and odd) provide timing pulses to the record every 1 second or every 6 seconds (all offices will be converted to the standard 1-second timing). These pulses are used to determine the elapsed time for a call and the time of day (upon request) to the trouble recorder.

1.12 The ANF equipment is used on calls which are routed to an operator at a TSPS office. Its primary functions are to request an identifier for identification of the calling number and to output that number to the TSPS office. (See Fig. 1.)

1.13 The primary ANF units are as follows:

- (a) **ANF Outgoing Trunk**—This trunk is seized by customers who have dialed 0 (zero). It can be arranged to handle person-to-person or operator assistance calls either on a loop or an E and M lead basis. It serves as an interface between the calling party and the TSPS office.
- (b) **Outputer**—The outputer is seized by the ANF outgoing trunk. Its primary functions are to request an identifier for identification of the calling number and to output the calling number to the TSPS equipment at the distant office.

1.14 The AIS equipment is used on calls which are to be routed to an AIC. (See Fig. 1.)

1.15 The primary AIS units are as follows:

- (a) **Identifier**—The identifier passes called number information to the outputer.
- (b) **Outputer**—The outputer sends the calling number and class information to the AIC.
- (c) **Trunk Finder**—The trunk finder seizes an outgoing trunk to the AIC and originates class information.
- (d) **Auxiliary Intercept Trunk**—This circuit is used for connector intercept. Its primary function is to seize a trunk finder to access an outgoing trunk.
- (e) **Outgoing Trunk Circuit**—When receiving a seizure signal from the trunk finder, this circuit sends an off-hook to the AIC. When

the AIC acknowledges the off-hook, this trunk bids for an outpulser and forwards the class of intercept information from the trunk finder to the outpulser. After outpulsing is completed, the transmission path is cut through to the customer.

1.16 Maintenance equipment is provided to (a) detect failures of equipment, (b) perform routine and trouble testing, and (c) record both testing and service failures of the AMA equipment.

1.17 The primary units of maintenance equipment in a SXS-AMA office are as follows:

(a) **Sender-Identifier-Transverter (SITV)**

**Test Circuit**—The SITV is provided for routine testing of the sender, identifier, dynamic overload control, and transverter circuits. Indirectly it also tests the code connector, translator, common number and class, thousands number, and sender-transverter connector circuits.

(b) **Automatic Trunk Test (ATT)**

**Frame**—The ATT circuits test the AMA outgoing trunk circuits either on an automatic or a manual basis. The complete AMA system can be indirectly tested by the ATT frame (except ANF, AIS, and DOC equipment).

(c) **Trouble Recorder**—This equipment is arranged to take trouble records for some of the most common troubles of the identifier, outpulser, transverter, sender-transverter connector, recorder, and master timing circuits.

(d) **Trunk and Outpulser Test Frame**—This equipment is used to test the ANF and AIS outgoing trunks and outpulser circuits. It can be arranged to test on an automatic or a manual basis.

(e) **Master Timers**—The master timer circuits are used to perform routine tests of the recorders and perforators. They are also used for self-checks.

(f) **Plant Registers**—These registers provide a means for determining equipment failures.

1.18 A SXS-AMA office is arranged to serve a maximum of 100,000 calling subscribers. Calls are directed to the AMA equipment from the levels of first, second, or third selectors. Calls

processed by ANF equipment are directed to the ANF outgoing trunk circuit from the 0 (zero) level of first selectors. Area code calls in offices arranged for 1-plus dialing are directed to the AMA outgoing trunk circuit from the first level of first selectors.

1.19 The primary common control units used in SXS-CAMA offices are as follows:

(a) **Registers**—The register stores incoming dial pulses for all digits dialed and then transmits these digits to a sender by means of multifrequency (MF) signals.

(b) **Pretranslators**—This circuit is seized by an incoming register at the start of the fourth digit of the called number in the register. Its primary function is to return an area code, office code, or interchangeable code signal to the register which uses these signals to determine the number of digits to be received. Pretranslators are used *only* in offices equipped with interchangeable code dialing features. An interchangeable code is one which serves both as an office code and an area code. If an office is equipped with interchangeable codes, a register cannot identify the called number as an area code when the B digit of the called number is 0 or 1.

(c) **Senders**—Senders also store the called number and use this information to obtain further information from other common control equipment. Facilities are also provided in the sender to register the calling number. The sender also provides various circuits with information about the call; this information is used for selection, switching, and charging. As a result of various exchanges of information, the sender is advised of the type of outpulsing (MF or DP) required and proceeds to outpulse the called number.

(d) **Decoders**—From information received from the sender, the decoder determines the routing of the call, including the routing through the selector switches in the SXS-CAMA office. The primary function of the decoder may be classified as translation.

(e) **Trunk Class Translator**—This equipment supplies additional information about the call to the decoder in the form of trunk class marks.

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(f) **CAMA Positions**—On calls requiring number identification by the operator, the sender connects to a CAMA position, where the operator obtains the calling number from the customer and MF keypulses it into the sender.

1.20 The CAMA equipment records the billing data for a call and this information is in the same format as the AMA call data described in 1.10.

1.21 The primary AMA units used in CAMA-SXS offices are the same as those described in 1.11.

1.22 Maintenance equipment is provided to detect failures of equipment, to perform routine and trouble testing, and to record both testing and service failures of equipment. The primary items of maintenance equipment provided in a SXS-CAMA office are as follows:

(a) **Trouble Ticketer**—This equipment is arranged to take trouble recordings for a number of the most common troubles of the decoders, transverters, recorders, and master timers.

(b) **Manual Test Set and Circuit**—This equipment provides a means of testing all major equipment items.

(c) **Plant Registers**—The plant registers provide a means for determining the number of equipment failures.

1.23 A SXS-CAMA center, utilizing a maximum of 800 incoming trunk circuits, is arranged to serve a maximum of 150 originating offices. These offices may be located in the home numbering plan area and in either one or two of the foreign numbering plan areas. Calls may be routed directly from the CAMA center to terminating local offices in a maximum of four numbering plan areas. Calls not terminating in these areas are routed to other toll or tandem offices for additional routing.

1.24 Fig. 34 shows the relationship of a SXS-CAMA office to other offices. The SXS-CAMA office can receive either DP or MF pulses. It can outpulse either DP or a combination of DP and MF. Some of the outpulsed digits are always DP; these digits are called **exit** digits. They are used to route through SXS selectors in the CAMA office

or possibly through SXS selectors in an intermediate SXS office.

1.25 It is not anticipated that this system will serve panel or No. 1 crossbar offices, as these offices normally are served by crossbar tandem (XBT) or No. 4A CAMA systems (4A XBR).

1.26 Following the dialing of the directing or exit code, the customers in a SXS area are routed through the local office to an outgoing CAMA trunk. At the SXS-CAMA office the associated incoming CAMA trunk has access to a 10-digit DP register through a bylink arrangement.

1.27 With a bylink operation, the trunk is attached to a register over a temporary path in a short time (nominally 50 milliseconds). After the trunk has been attached to the register through the bylink, a connection is made between the trunk and register through a crossbar switch, and the bylink is released. The register is normally attached during the interdigital time between the dialing of the access code and the called number; therefore, a second dial tone or an attachment signal is unnecessary.

1.28 Service is also provided for No. 5 XBR offices, No. 1 ESS offices, TSPSSs, No. 1 SXS offices, and operator calls. The called number is first registered in the local office and then MF outpulsed to the SXS-CAMA office. On MF calls, the called number is registered directly into the sender.

## 2. AUTOMATIC MESSAGE ACCOUNTING (AMA) FEATURES

### LOCAL AUTOMATIC MESSAGE ACCOUNTING (LAMA)

#### A. General

2.01 The information which the AMA equipment must obtain for billing purposes is as follows: called number area, called number office code, called number thousands, hundreds, tens, and units, calling number, message billing and trunk number identity, and time. The AMA equipment obtains this required information as described in Part 4 of this section. The billing data for each call are recorded in the AMA office. The paper tapes are periodically taken to an accounting center where they are processed into a form from which customer bills are prepared.

**B. Tape Entries**

**2.02** *Three tape entries* are perforated for each call:

- (a) An initial entry (four or five lines) when the call is received at the SXS-AMA office and before the talking path is cut through.
- (b) An answer time entry (one line) when the called party answers.
- (c) A disconnect time entry (one line) when either party disconnects.

**2.03** The entries for a large number of calls, many of which may be going on at the same time, are perforated on the AMA tape. Usually entries for other calls are interspersed between the three entries for given calls. However, each entry for a call carries the number (CII) of the outgoing trunk used. The CII enables the entries for a particular call to be associated during the processing of the tape.

**2.04** In the accounting center the tapes are read in the reverse order of perforation; that is, the disconnect entry is read first (as the first entry encountered). This permits unanswered calls to be discarded immediately.

**2.05** The six digits making up a line of entry are designation A, B, C, D, E, and F from left to right. The three holes for the A digit are designated 0, 1, 2; those for the remaining digits are designated 0, 1, 2, 4, 7. The A2, B0, B1, B2, B4, B7, C0, C1, etc, are used to identify the respective perforator magnets and leads. The 2-out-of-5 (2/5) perforations are made under the additive system where the digit is the sum of the two numerals identifying the hole positions, except in the case of zero (0), which is represented by the 4, 7 combination. The ten combinations are shown in Table A. See Fig. 3 for AMA typical entries on tape.

**2.06** The perforator consists of 28 magnets, arranged in 2 tiers of 14 each, which actuate 28 perforating pins registering with lines of holes in a drum. The lines of holes are parallel to the axis of the drum, with 44 lines around its circumference. The drum is rotated a step or a line at a time by means of a magnet, pawl, and ratchet. Provision is made to feed the paper tape

around the drum. The perforating pins have conical points which, in conjunction with chamfered holes in the drum, produce holes in the paper with embossed edges. These edges, registering with the holes in the drum, insure alignment of the tape with reference to the perforating pins and provide the traction needed to carry the tape through the perforator. The perforator cabinet is shown in Fig. 2.

**Initial Entry**

**2.07** A maximum of 100 AMA outgoing trunks are associated with one recorder and with one call identity indexer (CII). When the last line of the initial entry is to be perforated, the trunk gets a signal from the transverter (which initiated the entry) to identify itself to the recorder through the CII. After the initial entry is completed, the trunk is set in the ready-to-change condition in preparation for initiating the answer and disconnect entries.

**2.08** The initial entry consists of two, four, or five lines. All calls are presently detail billed; ie, the AMA entry is either four or five lines, and the customer receives a detailed record in the form of a toll statement. The 4-line entry is used for the 7-digit and compressed area code calls, and the 5-line entry for 10-digit calls (not compressed).

**2.09** Initial entries of four or five lines contain the following information:

- (a) An entry index for each line which controls the accounting center equipment during the processing of the tape.
- (b) The called line numericals.
- (c) The area index consisting of digits between 0 and 9 arbitrarily assigned to differentiate between basic terminating plan areas (compressed codes—4-line entries only).
- (d) The called number index. A "1" indicates four digits with or without party letter, and a "2" indicates five digits.
- (e) The called office code.
- (f) The called area code (5-line entries only).

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- (g) The calling line numerals. These, together with the office index, establish the calling customer directory number.
- (h) Type of entry—The type of entry corresponds to the assigned digits as follows:
  - “3” indicates a 4-line entry nonobserved.
  - ”4” indicates a 4-line entry observed.
  - “5” indicates a 5-line entry nonobserved.
  - ”6” indicates a 5-line entry observed.
- (i) The message billing index. A zero indicates a test call, and a “9” indicates a service call.

**2.10** Fig. 3 shows a portion of a typical AMA paper tape and an example of the various entries it may contain.

### Answer And Disconnect Entries

**2.11** The answer and disconnect entries are identical single-line entries except for the time indicated. They contain the following information:

- (a) An entry index.
- (b) The time in minutes and tenths of a minute.
- (c) The same CII which appears on the associated initial entry. The accounting center equipment distinguishes between the answer and disconnect entries for a particular call by their relative positions on the tape.

### Answer Entry

**2.12** After the sender completes outpulsing to the called office, the control of the call is given to the AMA outgoing trunk. The called party answer supervision is timed by the trunk to distinguish between busyback or overflow signals and true called party answer. This interval (2 to 5 seconds) is termed the ***change delay interval***.

**2.13** When it has been determined that the call has been answered, the trunk calls in the AMA recorder through the CII and indicates that a timing entry should be perforated. If the recorder

is busy, the trunk waits its turn. Such delays are usually less than one second. The recorder sends a signal to the trunk when the perforation of the answer entry is completed. The trunk then releases the recorder.

### Disconnect Entry

**2.14** As soon as the calling party disconnects, the trunk partially restores to normal and releases the connection through the switches. Simultaneously, the trunk puts in a bid for the recorder to perforate the disconnect entry.

**2.15** If a trunk calls for disconnect entry and if the recorder is not immediately available, the trunk circuit will continue to bid for an interval equal to the charge delay interval. If a recorder is not available at the end of this interval, the trunk withdraws its request for the perforation of a disconnect entry and restores to normal. In this case the call has only one timing entry and the accounting center charges only for the initial period.

### Timed Release Entry

**2.16** The calling customer, normally in control of the call, is not permitted to maintain a connection through the AMA office indefinitely after the called customer has hung up. The trunk starts timing when the called customer disconnects; if the calling customer has not disconnected by the end of the timing period (12 to 30 seconds), the trunk initiates a timed disconnect entry.

**2.17** After the timed release disconnect timing period, the AMA outgoing trunk causes the selector switches in the distant office to release. Reorder tone is returned to the calling customer upon release of the selector switches.

**2.18** The timed disconnect entry causes the accounting center to deduct a time allowance from the elapsed time of the call so that the customer is charged only for the time he was actually connected to the called customer.

### Miscellaneous Entries

**2.19** In addition to the call entries, other entries are recorded on the tape by the central office equipment, either automatically or as a result of maintenance force operations. An example of these miscellaneous entries would be those which

identify the tape for processing or splice entries which indicate a section where the tape can be cut. Time is also perforated in the form of hour entries, starting at midnight as 00 and ending at 11 PM the next night as 23. These entries facilitate compiling and billing at the accounting center.

**C. Handling Of The Tapes**

**2.20** At 3 AM each day a series of identification entries are recorded automatically on the tape. Then a splice pattern, which provides a visually identifiable cutting area, and another set of identification entries are perforated. Thus, when the tape is cut in the splice pattern area, both the end of the old tape and the beginning of the new tape are left with identification entries. The tapes are cut, collected, and sent to the accounting center at regular intervals.

**CENTRALIZED AUTOMATIC MESSAGE ACCOUNTING (CAMA)**

**A. General**

**2.21** This description of AMA is limited to those operations which apply to CAMA. When an operator is called in on CAMA calls, the only function necessary is to obtain the calling number and key it into the equipment. The billing data for each call are recorded in the CAMA office. These data are perforated on paper tape. The paper tapes are periodically taken to an accounting center where they are processed into a form from which customer bills are prepared.

**B. Tape Entries**

**Call Entries**

**2.22** The paper tape entries are similar in format to the AMA or LAMA portion described in 2.02 through 2.20.

**3. EQUIPMENT ELEMENTS**

**LAMA**

**A. AMA Outgoing Trunk Frame**

**3.01** The AMA outgoing trunk frame (Fig. 4) is a bay 11 feet 6 inches high and 2 feet 0-5/8 inches wide. Ten AMA outgoing trunks are mounted on one frame. Two 5-circuit busy-tone appliers

can also be mounted on the frame on an optional basis. The AMA outgoing trunk frames employ a relay-rack mounted common release control unit which is supplied on a one-per-100-trunk basis (ten trunk frames). The step-by-step AMA system is limited to a total of 1000 outgoing trunk circuits.

**3.02** For equipment and traffic reasons the AMA outgoing trunks are divided into equipment groups referred to as sender groups. Five sender groups of 200 trunks and 20 senders each (maximum) are provided. The trunks within a sender group are further divided into finder groups A and B. A finder group consists of a maximum of 100 consecutively numbered trunks associated with the 20 senders within the particular sender group. A trunk finder connects the AMA outgoing trunks to the senders.

**3.03** Outgoing trunks for AMA (a) are cross-connected to selector levels or rotary out trunk switches, or both, and (b) are therefore reached by dialing the required digits. The principal functions of a trunk are (1) to record the first digit dialed after its seizure, (2) to provide supervision and calling party talking battery, (3) to provide a connecting means between the line sleeve and the identifier, and (4) to cause the disconnect time entry to be perforated on the tape. Upon seizure, the trunk circuit obtains an idle sender through the action of an 8-wire trunk finder traffic sensitive item. As mentioned, the first digit following seizure is registered in the trunk to allow time for connection to a sender and the succeeding digits are registered in the sender.

**3.04** Each trunk frame carries its own 48-volt signal fuses on a fuse panel at the top of the frame fed by power feeders per SD-80728-01. The 48-volt talking battery fuses (one required per trunk) are located on a central miscellaneous fuse bay cabled to the trunk frames.

**3.05** Outgoing trunks may be cross-connected (a) at the toll distributing frame or intermediate distributing frame to rotary out trunk switch banks and to selector levels, as required, and (b) at the main distributing frame to cable pairs to tandem or terminating offices.

**3.06** Each trunk is assigned a number from 00 through 99, depending upon its connection to call identity indexers and recorders. This

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number is arbitrary and is required to identify the entries for each trunk on the AMA tape.

### B. Trunk Finder

**3.07** The trunk finder is a 100-point 8-wire switch used primarily to establish a connection between an idle sender and a trunk (a) for transmitting dial pulses to the sender and (b) for transmitting dial pulses or multifrequency signals from the sender to the called office. A trunk finder unit has a capacity of ten trunk finders. The frame is capable of mounting six such units, although only two will be required normally.

**3.08** The trunk finder shelf uses universal shelf framework construction approximately 6 feet long. Each shelf is arranged to mount 10 trunk finders, a start circuit, an alarm circuit, miscellaneous equipment, and terminal strips. All miscellaneous equipment is arranged on horizontal mounting plates or panels, each 1 or 2 inches wide. Fuse panels are provided on each shelf. Fig. 5 shows two trunk finder units. When 10 or fewer senders are required to serve 100 to 198 trunks, 2 trunk units are required. When 11 to 20 senders are required to serve 100 to 198 trunks, 4 trunk finder units are required (2 units per each sender group half). Only the first unit in each sender group half will be equipped with G relays; the banks of the two units are multiplied to each other.

### C. Sender Trunk Connector

**3.09** A sender trunk connector consists essentially of a connector relay per trunk and a lockout and connector relay per sender. The sender trunk connector frame has a capacity of two 50-trunk sender trunk connector units. Each 50-trunk sender trunk connector unit will serve 50 trunks and 20 senders. Sender trunk connector frames in a sender group will serve senders and trunks as shown in Table B.

**3.10** The sender trunk connector frame, as shown in Fig. 6, is a bay approximately 2 feet wide and 11 feet 6 inches high. The bay accommodates two 50-trunk connector units. A 50-trunk sender trunk connector unit consists of plate-mounted apparatus with one mounting plate required for each trunk connector unit. One mounting plate which mounts group make-busy relays and battery supply resistances is also required.

**3.11** The 20 senders served by the 50-trunk sender trunk connector units on one frame are in all cases the same; but the 50-trunk sender trunk connector units on each frame serve a group of 50 trunks in each of finder groups A and B. Two sender trunk connector bays are required in each sender group when more than 50 trunks are placed in either finder group. The 50-trunk sender trunk connector units on the second frame in a sender group serve the same 20 senders as the units on the first frame.

**3.12** Each 50-trunk sender trunk connector unit contains equipment for five sender trunk connector circuits. Odd-numbered frames will mount connector circuits 1 through 5 and even-numbered frames will mount connector circuits 6 through 0. For purposes of sender trunk connector operation, the GRP bank terminals of the trunk finder are strapped in vertical columns; thus the 100 trunks are divided into 10 groups corresponding to the ten vertical columns of terminals on the trunk finder bank. One sender trunk connector is required for each vertical file of terminals on the trunk finder bank in which a trunk is terminated. This means that one connector can serve a maximum of ten trunks. Each connector can connect these ten trunks to any sender in the sender group. From the trunk assignment pattern illustrated in Fig. 7, (a) the first 50 trunks in a group of 100 are assigned to terminals in verticals 1 through 5 of the trunk finder bank, (b) the second group of 50 trunks are assigned to verticals 6 through 0, and (c) the trunks on any one frame are distributed over five verticals. Therefore, each 50-trunk sender trunk connector unit is equipped with its full complement of five connectors.

**3.13** In reference to the trunk assignment pattern of Fig. 7, which is used in the reverse order for coin zone trunks, CZ trunks 1 through 7 on frame 1 are assigned in the positions of trunk frame 10, trunks 9 through 3. CZ trunks 1 through 7 on frame 2 are assigned in the positions of trunk frame 10, trunks 2 and 1, and trunk frame 9, trunks 10 through 6, in that order. Succeeding CZ trunks are assigned similarly.

### D. Sender

**3.14** The sender frame, as shown in Fig. 8, is 11 feet 6 inches high by 7 feet 7-5/8 inches wide. Each frame provides the capacity for three sender circuits. The sender frame consists of two

bays per frame. The unit bay contains the major portion of the sender circuitry and the connector bay consists mainly of wire-spring multicontact relays used for connection to the identifier circuits. The maximum number of sender circuits in a step-by-step AMA office is 100 (20 per sender group).

**3.15** The principal functions of the sender are to register all digits dialed subsequently to those dialed in the trunk; to make party identification; to receive from the identifier the calling customer directory number, information for routing the call, and whether AMA registration is required; to transmit information to the transverter for recording the information on perforated tape; and to outpulse to the distant office.

**3.16** The sender is established in the connection through a trunk finder after the selection of a trunk. The sender in turn establishes a connection to an identifier after two digits are dialed into the sender. Information supplied to the identifier allows it to reconstruct the called office code and to pass to the sender information required for outpulsing as well as for recording. In completing the call, the sender generates and transmits dial pulses and/or multifrequency signals, as well as arbitrary digits where required, depending upon the setting of the relays and information received from the identifier.

**3.17** Some of the various classes of outpulsing available for pulsing to the distant offices are as follows:

(a) **Step-by-Step Class 1, SSC1:** Outpulsing is on a battery and ground basis at 10 pps. One or two arbitrary digits may precede the called number. No start signal or wink is required.

(b) **Step-by-Step Class 2, SSC2:** This is the same as for SSC1, except that outpulsing is on the loop basis at 10 pps.

(c) **Sender Class 1, SDC1:** Outpulsing is on a loop basis at 20 pps. It requires a start signal or wink from the distant office before any pulses are sent out. One or two arbitrary digits may precede the called number.

(d) **Sender Class 2, SDC2:** Outpulsing is on a battery and ground or loop basis at

10 pps, depending upon the option used. One or two arbitrary digits may precede the start signal or wink from the distant office.

(e) **Sender Class 3 SDC3:** This is the same as for SDC1, except that outpulsing is on a loop basis at 10 pps.

(f) **Multifrequency Class 1, MFC1:** Outpulsing is on a multifrequency basis at a speed of approximately seven digits per second. It requires a start signal or wink from the distant office before any pulses are sent out. One or two arbitrary digits may precede the called number.

(g) **Multifrequency Class 2, MFC2:** Outpulsing is on a battery and ground or loop basis at 10 pps for one or two arbitrary digits; the sender waits for a start dial signal or wink from the distant office. After the wink is received, the sender outpulses the called number on an MF basis.

**3.18** The sender circuit connects to identifiers and transverters through connector circuits. The connector used for the identifier is physically located at the sender frame and is included in the circuitry of the sender circuit. The connector used for the transverter (sender-transverter connector) is located in a remote frame from the sender frame and carries its own circuit drawing number. In the event of simultaneous demands for an identifier by two or more senders, the senders take their turns in a fixed order, depending on their relative positions in a chain circuit. Another chain circuit between connectors insures that only one connector at a time enters a particular identifier. A similar arrangement is provided in the selection of the transverter by the sender.

#### E. Identifier

**3.19** The basic identifier frame, as shown in Fig. 9, is 11 feet 6 inches high by 7-foot 9 inches wide. It consists of a 2-bay common equipment unit and a single route relay bay. Up to a maximum of five additional route relay bays may be provided. An office is equipped with a minimum of two and a maximum of ten identifier frames.

**3.20** The identifier is seized after one or two digits (depending on sender options) have

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been dialed and registered in the sender. If the office is equipped with ANF equipment, the identifier can also be seized by an outpulser. The functions of the identifier on ANF calls are to identify the calling number and to transmit the digits of the calling number to the outpulser. The functions of the identifier on AIS calls are to identify the intercepted number and to transmit these digits to the outpulser. When the identifier is seized by the senders, the functions of the identifier are to reconstruct the called office code; to process a call as denied service, AMA, DOC, or nonentry; to identify the calling line number and class of service; and to pass this and other information to the sender for completing its functions.

**3.21** Since the sender functions differently on certain calls, the identifier recognizes such calls and sends the sender only required information. In the reconstruction of the called office code, the identifier may or may not use the digits recorded in the trunk and sender in operating the route relay. In offices arranged for 1-plus dialing if the called office is located in a foreign area, the identifier connects to a translator for reconstruction of the called office code. The digit in the trunk and the first two digits registered in the sender determine which route relay will be operated. For all other calls the identifier uses a code connector for reconstructing the called office code. A code lead which corresponds to the point of seizure of the trunk represents either one, two, or three digits, depending upon whether the trunk was reached from a first, second, or third selector. Where the code point represents a complete office code or a group of partial office codes which may be treated alike, it is cross-connected to operate a route relay in the identifier directly. Otherwise, it is cross-connected through contacts of switching relays to place the selection of the route relay under the control of the digit received from the trunk or sender or both.

**3.22** The cross-connections of the operated route relay contacts complete the reconstruction of the called office code. The called office code and trunk digits are transmitted to the sender, where they are coupled with the digits dialed into the sender for complete registration of the called number. Other route relay cross-connections control sender operations such as type of outpulsing, number of digits to outpulse, message billing, type of entry, arbitrary digits to be outpulsed, etc.

**3.23** Calling office and number identification is made by the identifier by means of an ac signal sent out over the sleeve of the trunk through the originating equipment to a network associated with the customer connector terminal and also to class network coils connecting to line finders, trunks, or first selectors. Each identifier has its own frequency for the ac identifying signal. This signal, which passes through the networks and coils of the thousands number frame, is amplified and rectified, and is recognized by the number detectors on the identifier frame (see Fig. 31).

**3.24** The ac signal sent out by the identifier for calling office and number identification also passes through class networks connected to line finders, trunks, or first selectors to class coils and relays on the common number and class frame. It is recognized in class detectors in the identifier. In the case of lines connected for complaint service observing, tone is connected from the observing line circuit through the class coils to the class detectors in the identifiers.

**3.25** On each call, the identifier determines whether the call should be recorded, nonrecorded, or denied. This may involve a combination of the information received from the operated route, calling office register, and class register relays. In an office where the calling lines are of the same class, the route relay alone determines the class of charge. When all calls to certain routes are always nonrecorded, the identifier performs its functions without completing class or calling office code identification unless required for the segregation of route peg count registration with regard to calling class. Calls from coin and other normally denied lines, such as 4-party, may be completed to certain routes through the equipment on a nonrecorded basis. When AMA service is not provided on foreign exchange lines, these will be identified as a class and their calls will be handled as nonrecorded to certain routes and as denied to others. On nonrecorded calls, the identifier signals both the trunk and the sender that the call is nonrecorded. On denied calls, it signals the trunk only, which in turn releases the sender.

**3.26** If an office is arranged for 1-plus dialing and is equipped with DOC, the identifier performs additional functions. The DOC circuit is controlled by personnel at a distant toll tandem office. On foreign area code calls, the DOC circuit is connected to the identifier circuit through the

translator. If the call being translated is to receive DOC treatment, the DOC relay in the identifier will be operated instead of a route relay. The DOC relay causes recorded announcements or reorder tone to be connected to the AMA outgoing trunk.

#### F. Identifier Trunk Connector

**3.27** The identifier-trunk connector frame (Fig. 10) provides the circuitry required for connecting additional leads between the AMA outgoing trunks and the identifiers. Each identifier trunk connector frame provides connection from a maximum of 100 trunks (associated with a particular trunk finder-sender connector group) to a maximum of ten identifiers. The maximum number of identifier connector frames required in an office would be ten (two per sender group).

**3.28** The identifier-trunk connector associated with the trunk connected to the sender is seized by the identifier under control of the sender. An identifier-trunk connector has a capacity of 20 trunks and cuts through to the identifier a number of common control leads which are multiplied to all 20 or less trunks in the identifier-trunk connector group. These leads are used by the identifier to aid in the identification of the calling subscriber, the reconstruction of the called office code, and the control of the operation of the trunk. After an identifier has obtained access to these common leads through the identifier-trunk connector, they are individualized to a particular calling trunk by the operation of a connector relay within the trunk itself.

**3.29** The location of the trunks on the trunk finder banks determines the particular identifier-trunk connector to which they are assigned (see Fig. 7). The identifier-trunk connector frame (Fig. 10) has a capacity for mounting two units. Where the office is equipped with five or fewer identifiers, each frame accommodates up to 200 trunks. In an office having a maximum of ten identifiers, the first frame in each sender group accommodates the identifier-trunk connectors for the first 100 or less trunks. The second frame in a sender group accommodates the identifier-trunk connectors for the second group of 100 or less trunks.

#### G. Code Connector Frame

##### Bay Description

**3.30** The code connector frame (Fig. 11) consists of an originating bay which mounts the equipment for three code connectors through which five identifiers may secure access to code leads of all trunks or rotary out-trunk switches. This bay includes three cross-connection fields, one per code connector. The functions of these fields are to permit the code leads from the trunks and rotary out-trunk switches to be grouped according to the selector level through which the trunk or rotary out-trunk switch is seized and to be cross-connected to one of the code leads cut through by the code connector to the identifier. Where six or more identifiers are required, a supplementary bay is provided. The supplementary bay is arranged to mount the additional code connector relays for association with five additional identifiers. In addition, as many as five extension bays may be provided to take care of additional code lead requirements. The code connector frame and the associated rotary out-trunk switch bays are individual to a sender group.

**3.31** The code connector extension bay is required when the capacity of 117 code leads per identifier provided by the originating and supplementary bays is insufficient. The extension bay mounts equipment for three connectors and ten identifiers. Each bay provides 90 additional code leads per identifier.

**3.32** The code connector is used to aid the identifier in the reconstruction of the called office or foreign area code, except 1-plus calls (see 3.36). Three code connectors are provided for each sender group. The identifier receives an indication from the trunk as to which of the three code connectors is associated with the particular trunk. One, two, or three digits may have been dialed before the seizure of the trunk. The code connector aids the identifier in the reconstruction of these digits. A code lead from each trunk per selector level appearance is extended to the code connector (maximum of six code leads). Each code lead represents the digit or series of digits of the called office code which was dialed prior to trunk seizure. When the trunk is seized through a rotary out-trunk switch, a separate bank is provided on the switch for extending the code leads to the code connector. This bank is strapped so that it is divided into

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three equal segments, one for each of the three code connectors required. This permits the trunks of a switch group to be spread over all of the code connectors with the provision of only one lead per switch per code connector. The assignment of the trunks to code connectors is illustrated in Fig. 12.

**3.33** Several AMA trunks in the same traffic group, that is, trunks to the same designation, or several rotary out-trunk switches associated with the same traffic group of trunks may be reached by dialing the same code. Since each code lead cut through by a code connector to an identifier represents a particular called office code or portion thereof, all of the trunks or rotary out-trunk switches reached by dialing the same code may use a common code lead at the code connector. For this reason, each code connector has associated with it a cross-connection field where the individual code leads from the trunks and rotary out-trunk switches reached by dialing the same code may be concentrated and cross-connected to one of the code leads extended to the identifiers through the multicontact connector relays of the code connector.

### Cross-Connect Field Description

**3.34 *Originating Bay:*** The cross-connection field for each code connector consists of a group of four cross-connection terminal strips (XTS). The code leads from the armatures or common side of the connector relays of the associated code connector are terminated on the two center terminal strips (XTS "C" upper and XTS "C" lower). That is, the code leads at this point are individual to a particular code connector and accessible to all identifiers. Physically, each "C" point on these terminal strips is two adjacent punchings strapped together to permit a maximum of four cross-connections to each "C" point on each of the two terminal strips. Each of these terminal strips has a capacity of 120 such "C" points (numbered 00 to 119). However, "C" points 00, 01, and 60 are not wired and cannot be used because corresponding armatures on the associated multicontact connector relays are used for other purposes.

(a) The individual code leads from the trunk appear as "TS" punchings on the bottom terminal strip (XTS "TS"). This is a 6 by 80 terminal strip, each trunk having the exclusive use of one vertical row of punchings. A trunk may have from one to five selector level appearances in addition to a rotary out-trunk

switch appearance, each requiring a code lead to the associated code connector. The code leads from the trunk SL relays for selector level appearances 1 and 5 terminate on punchings "TS" 1 through 5, respectively.

(b) Code leads from rotary out-trunk switches appear as RS punchings on the top terminal strip (XTS "RS"). Each rotary out-trunk switch associated with the AMA equipment will have a code lead appearing on XTS "RS" of each code connector. In general, the capacity of a rotary out-trunk switch frame will be 60 switches arranged either in one group of 60, two groups of 30, one group of 40 and one group of 20, or one group of 50 and one group of 10. For this reason, the "RS" punchings on XTS "RS" are arranged in groups of 60 (numbered 1 through 60), each group of punchings serving the switches on one rotary out-trunk switch frame. This terminal strip has a capacity of eight such groups of RS punchings.

**3.35 *Extension Bay:*** The bottom terminal strips (XTS "TS" and XTS "RS") on the extension bays are identical with those of the originating bay. However, only one center terminal strip XTS "C" is provided and each "C" point consists of five horizontally adjacent punchings strapped together. This terminal strip has a capacity of 90 such "C" points, all of which can be used.

### H. Translator

**3.36** The translator unit (Fig. 13) consists primarily of wirespring relays and a cross-connect field. ***This unit only appears in offices arranged for 1-plus dialing.*** An office will be equipped with two translator units (designated ODD and EVEN).

**3.37** The translator is seized by an identifier on foreign area code calls for code reconstruction. It receives the identity of the trunk digit and first two sender digits from the identifier and translates them into one of 30 area routes for operation of a route relay in the identifier. All valid foreign area codes dialed will cause operation of a route relay. Invalid codes will cause the calling customer to be routed to recorded announcement. The cross-connect field is used for connecting all possible foreign area codes to either an area route or a vacant code route.

**3.38** If the office is equipped with a DOC circuit, the translator area route leads will pass through the DOC circuit for operating route relays. The DOC circuit has the ability to prevent operation of the route relays and reroute traffic to recorded announcement.

#### I. Dynamic Overload Control

**3.39** The DOC unit, with its associated code group counter, reroute unit, and signal control unit (Fig. 14) can only be equipped in offices arranged for 1-plus dialing. A maximum of four signal control units can be equipped. An office is equipped with one DOC unit.

**3.40** The DOC unit restricts the volume of originating toll traffic presented to the toll tandems under the control of a control circuit at the toll tandem office. Control signals are generated at the toll tandem office and received at the DOC unit which governs circuit action. Cross-connections at the DOC unit determine the action which a particular control signal has upon a particular dialed area code. The control signals are sent to the DOC circuit either directly from the toll tandem or relayed from another DOC circuit at another office. The DOC unit relays the signal to another DOC unit in another office or back to the toll tandem.

**3.41** The DOC unit receives the identity of the 3-digit area code from the translator. Under control of the toll tandem and predetermined cross-connections, calls are either permitted to be processed as usual or routed on a percentage basis (25, 50, 75, 100) to a recording which indicates a high volume of traffic.

#### J. Common Number And Class

**3.42** The common number and class frame (Fig. 15) provides means for identifiers to locate the thousands group in which an originating call appears. In this way, the identifier is directed to the proper thousands circuit. It also provides means whereby identifiers can obtain access to the networks connected to customer line finders, trunks, selectors, or service observing circuits to ascertain the class of service to which the calling subscriber is entitled and to determine whether service observing is required.

**3.43** An ac signal sent out by the identifier to the line networks associated by cross-connection with the tip, ring, and denied coils is extended to group relays on the common number and class frame. The identifier operates these relays in a predetermined order searching for the signal which identifies the coil associated with the originating call. As previously described, this permits the identifier to connect to the calling thousands group to obtain calling office and number identification or to recognize the call as one to which denied service treatment should be applied. The tone is later sent out by the identifier again and interrupted to make a check on the line.

**3.44** Class identification is obtained from a class network connected to the sleeve of each subscriber line finder or first selector for all except 2-party message-rate and prepay coin class subscribers. For 2-party message-rate and coin lines, the networks are connected to the sleeves of the associated trunks. The operator class is identified from class networks connected to the operator first selectors. Separate indications are required for 2-party message rate, foreign exchange 2-party message-rate, and all other foreign exchange, coin, and operator classes. Two-party class identification is required to provide the proper control of the associated 2-party trunks. The service observing class indicates that full details of the call will be required. Upon receiving this signal, the transverter changes a 2-line entry to a 4-line entry.

**3.45** The common number and class frame consists of class networks, repeating coils, and connector relays. Each group connector relay has a capacity of ten groups of 1000 or less numbers. A maximum of six connector relays are provided for 2-party flat-rate tip subscribers, and a maximum of ten connector relays are provided for other than 2-party tip subscribers. The class connector relays accommodate a maximum of ten class coils. When a maximum of four or more identifiers are required, the common thousands group and class connector relays for identifiers 4 through 10 are mounted on a supplementary bay. One common number and class frame is required per unit of AMA equipment.

**3.46** The ac signal sent out by the identifier for calling office and number identification also appears on the class networks and associated coils on the common number and class frame. The operator class coils are connected to contacts of

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the ring thousands group relays, as are the coin class coils, when spare contacts are available. Otherwise, all class coils are connected to contacts of class connector relays on the common number and class frame for extension to the identifier for testing. When connected to a thousands group relay, the identifier recognizes the coin class as denied, as in the case outlined above for denied service, and further identification is not required. Otherwise, class identification is separate from thousands group identification and in general is made simultaneously with it. The identifier recognizes the absence of an ac signal from the class connector as an indication that the call was originated by a subscriber of the largest class. This is done to reduce the quality of class networks and associated detecting equipment.

**3.47** Class identification with regard to foreign exchange and nonforeign exchange areas is used by the identifier to control initial period rate and peg count discrimination. Class identification with regard to 2-party message rate is used by the identifier to cut through the 2-party trunk without operating the line message register. As the register should operate on nonrecorded calls, 2-party message-rate foreign exchange lines of the nonrecorded type must employ the other foreign class coils. The coin class, whether identified through the thousands or class connection relays, is normally treated on the denied service basis. Operator class calls are recognized as such and served on a nonrecorded basis.

**3.48** The class networks are cabled to a distributing frame for cross-connection to line finders and first selector, except those for 2-party message-rate and coin lines cabled directly. The required points of connection in these circuits are not available at a distributing frame. Connections to the identifier and thousands number frames are made directly with switchboard cable.

### K. Thousand Number Frame

**3.49** The thousand number frame (Fig. 16) consists of an originating bay and a supplementary bay. The supplementary bay is required in offices having more than three identifiers. On the originating bay are mounted all of the networks and cross-connecting facilities (screw connections) for two groups of 1000 subscriber numbers each, the thousands amplifiers, the hundreds repeating coils, multicontact relays required to connect these

amplifiers and coils, and the subscriber connector terminals to the identifiers. The maximum number of thousand number frames in an office is 50.

**3.50** The thousands number frame provides means for making calling subscriber office code and number identifications by giving the identifiers access to the connector terminal appearances of all customer lines in a building. Identification is made by sending a signal from the identifier back over the sleeve of the AMA trunk, through the selectors and line finders to a network permanently wired to the customer connector terminal. The identifier then progressively tests all of the networks in the building in groups of 1000, 100, and 10 until it locates the signal. These tests are made through repeating coils and multicontact relays.

**3.51** For circuit operation reasons, AMA imposes the condition that tip and ring customers connected to the same flat rate line cannot be assigned in the same hundreds group.

**3.52** A capacitor-resistor network is provided for the connector terminal of each noncoin customer line. Within each connector hundred these networks are cross-connected to suitable common leads, segregating them by their association with tip or ring party or denied service customers. The networks of all 2-party, flat-rate, tip subscriber numbers are connected to the tip lead; all noncoin customers to whom AMA service is denied, to the denied service lead; and all other classes, to the ring lead. The ac signal sent out by the identifier through the trunk and originating equipment passes through the line network associated with the calling customer connector terminal over the proper one of these leads to its hundreds repeating coil and thousands amplifier on the thousands number frame, or to its denied service repeating coil on the common number and class frame. The thousands amplifiers for tip and ring numbers are connected to the common number and class frame. On a recorded or nonrecorded call, the identifier tests these repeating coils for the ac signal. After locating the coils in which the signal appears, the identifier either recognizes it as denied service or operates the associated thousands number connector relay. In the latter case, the calling office and thousand digits are registered in the identifier and tested to determine which hundreds group contains the signal. The identifier then operates the required hundreds connector relay on the thousands number

frame, extending 100 connector terminals to the identifier for tens and units identification.

**3.53** Networks are not provided for coin customers.

They will not be required for foreign exchange subscribers where these are segregated in a separate central office unit and are served on a non-AMA basis. These classes are identified and their calls disposed of as discussed in the description of the common number and class frame.

**3.54** The networks associated with the customer line connector terminals are cabled to their distributing frame terminations. Each network is associated with a tip, ring, or denied service lead on the thousands number frame by means of a screw connection. Other connections to the thousands number frame are made directly with switchboard cable.

#### L. Sender-Transverter Connector

**3.55** The sender-transverter connector frame (Fig. 17) accommodates a maximum of four sender-transverter connectors. Each connector connects a maximum of five senders to a maximum of six transverters. Only one call at a time can be served by a sender-transverter connector at a given time. In the event of simultaneous demands for a connector by two or more senders, the senders take their turn in a fixed order, depending on their relative positions in a chain circuit. Another chain circuit between connectors insures that only one connector at a time is attached to a particular transverter. A traffic control unit mounted on a miscellaneous relay rack provides for sender-transverter connector traffic control. It prevents a connector which has just released from a call from serving other calls until other sender-transverter connectors have been served.

**3.56** If a transverter fails to complete its functions and times out, it gives a trouble release signal to the connector. The connector releases the transverter and makes a second trial by seizing another transverter, or if all others are busy, the same transverter. If the second transverter encounters trouble, the call is handled free if it can be identified as being under a specified message billing index. If it is a toll statement call or has a message billing index above a specified number, it is routed to overflow.

#### M. Transverter

**3.57** The transverter frame (Fig. 18) accommodates two transverter units. An office may be equipped with as many as three transverter frames (six transverters). A transverter is accessible from a maximum of 20 sender-transverter connectors (serving 100 senders) and has access to all recorders (maximum of ten). It registers, translates, and converts information received from the sender to a form or pattern satisfactory to record and to transmit to the recorder in ordered sequence all pertinent information necessary for the initial forward to the recorder in a line-by-line formation being supplemented by entry identification as required. Information transferred to the transverter is as follows:

(a) **Recorder Number:** The recorder number (RN-) identifies the particular recorder (one of a maximum of 10) associated with the AMA trunk. Each recorder can be associated with a maximum of 100 trunks. The recorder number also identifies the particular call identity indexer associated with the AMA trunk and recorder. The recorder number is registered in the transverter.

(b) **Message Billing Index:** The charge category is determined in the identifier, passed to the sender, and in turn passed to the transverter. The charge category is in the form of a message billing index (MBI), with a maximum of 30 provided for, numbered 00 through 29. The 00 index is used to identify a trunk test call. The 09 index is used to identify a toll call. The other 28 indexes are used to indicate different charging rates for message unit charging. The message billing index is registered in the transverter and passed to the recorder for perforating in the tape at the proper time.

(c) **Service or Test Classes:** A transverter may be seized by a sender for handling three different classes of calls: (a) service call (SC), (b) sender or transverter test call (TVT), or (c) trunk test call (TTK). The class is registered in the transverter. The TTK class is required to insure that the accounting center is advised of the test call in order to reject the tape. The TTV class informs the transverter to cut through leads to the test circuit.

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(d) **Service Observing:** A separate signal is registered in the transverter for calls that are service observed (OBS) and those that are not service observed (NOB). To secure full details of the call, the transverter will change any entry normally made in two lines to a 4-line entry upon receipt of an OBS signal. A separate observing tape is perforated in the accounting center for all service observed calls. A distinctive number is perforated on the AMA tape to indicate to the accounting center that the call is observed or nonobserved.

(e) **Called Number Pattern:**

(1) The called telephone number is registered in the sender on various combinations of register relays, depending upon which digit is the first digit dialed into the sender, whether the called office code consists of two digits or three digits, and whether a foreign area code has been dialed. The information registered on these relays is transmitted to the transverter over sets of leads with designations related to the corresponding sets of sender relays.

(2) The called number pattern relays register an arbitrary number transmitted from the sender representing the different combinations of called number registrations. These relays in turn operate digit shift relays which shift the called number information on the leads incoming from the sender to the proper output leads to the recorder.

(3) The relationship of the called number pattern to the called number information registered in the sender is shown in Table C. This table shows the various conditions affecting the called number pattern: the selector level on which the AMA trunk is reached, the identity of the first digit dialed into the sender, and whether there is a C digit in the office code.

(4) The A, B, and C register relays in the sender register the called office code or foreign area code reconstructed by the identifier. The TK register relays record the digit dialed into the AMA trunk. The AR to IR registers record the digits dialed into the sender. These designations also identify the sets of leads which carry this information from the sender to the transverter.

(f) **Called Number Structure:** The called number structure information is derived in the identifier and passed through the sender to the transverter. The information is stored on register relays in the transverter. In the sender this information is called **no sender delay** or **sender delay** corresponding to 4DG and 5DG, respectively, in the transverter. On foreign area code calls, a 5DG signal is always received. The called number structure is required for accounting center use.

(g) **Called Number:**

(1) The called number is not registered in the transverter, with two exceptions: foreign area code and stations digit. However, the information is available to the recorder through the transverter, when required.

(2) A called number pattern (3, 4 or 8) (Table C) signal from the sender informs the transverter that a foreign area code has been dialed by the calling subscriber. The transverter then operates cut-in relays that permit register relays to operate corresponding to the foreign area code dialed.

(3) The called number leads carrying the stations digit information are always steered to the station digit register relays. If the stations digit is not dialed, these relays cause a zero to be perforated in the stations digit position on the recorder tape; they also cause the called number index information to the recorder to be modified from 2 to 1 if the called number structure was registered as 5DG. The accounting center therefore will be informed not to print a zero for the stations digit on the toll service statement, as none was dialed. This is based on the requirement that all positions on the recorder tape must be perforated in order to check the recorder operation. A check path is closed to permit the transverter to proceed with its functions. If a station digit is dialed, the stations register relays close a check path to permit the transverter to proceed with its functions. They also make the stations digit information available to the recorder when required.

(4) In the event that a detail billed call to a level hunting connector group is answered before the units digit is outputted, the sender

will immediately call for a transverter to record the initial entry. If the units digit has not been dialed by the subscriber, it will not be available for recording. To insure that a units digits will be recorded on the tape, the sender signals the transverter (UD1 relay) to open the leads carrying the units digits information and to improvise a digit one for recording at the proper time. A positive indication that the call has not been answered before the units digit is outpulsed is provided over the UDN lead.

(h) **Calling Number:** The calling number is identified in the identifier and stored in the sender. It is made available to the transverter upon seizure and is passed to the recorder at the proper time under the control of the transverter. The information is not registered in the transverter. The calling number consists of an arbitrary digit to represent the calling office code, plus four numerals.

(i) **Two-, Four-, and Five-Line Entries:**

(1) **Home Area Calls:** 2- and 4-Line Entries—Information supplied by the identifier route relay and passed to the transverter through the sender enables the transverter to determine whether the call should be entered on the central office tape in two separate lines or four. In general, all message unit calls are connected for 2-line entries (2L) and all toll calls to points within the same numbering plan area are connected for 4-line entries (4L). The choice of a 2- or 4-line entry is made a route relay function to permit making 4-line entries on calls to destinations with a message unit charge index if desired for accounting, commercial, or traffic department studies. When the accounting center recognizes a 4-line entry on a call with the message unit charge index, it arranges to print this call on a separate message unit detail (MUD) tape in addition to the usual tape for bulk-billed calls. If a call which normally would perforate a 2-line entry is service observed, the transverter steers the 2L signal to the 4L relay, thus causing a 4-line entry to be perforated on the central office tape. In addition, the transverter changes the entry index for the last line of the entry to inform the accounting center that the call is being observed. The accounting center

then prints this call on a separate observing tape in addition to the usual message unit tape.

(2) **Foreign Area Calls:** 4- and 5-Line Entries—On all foreign area calls code pattern 3, 4, or 8 is used along with the 4L signal from the sender. As mentioned previously, the foreign area code is registered in the transverter. By cross-connection, each foreign area code is either translated to a single-digit compressed code or steered to the third line of a 5-line entry to be perforated in full. When subscribers dial foreign area codes to reach foreign areas which receive large numbers of calls from the AMA office, a feature of the transverter called code compression may be used. This feature, as the name implies, compresses the 3-digit area code to a single digit arbitrarily chosen to represent the foreign area in which the call terminates. This digit is then perforated in the tape as the area index in a regular 4-line initial entry. Compressed codes must be in the N(0/1) X format, where N is a digit from 2 through 9 and X is a digit from 0 through 9. On calls to other foreign areas, a fifth line is perforated on the central office tape. This line contains the foreign area code and will appear on the central office tape as the third line perforated.

(j) **Information From Sender-Transverter Connector:** When the sender transverter connector cut-through relays operate, the sender transverter connector passes information to the transverter as to whether the seizure is a first trial (1 TR) or second trial (2 TR). Also, under certain conditions, a signal may be received indicating a transferred start lead (TRS).

#### N. Call Identity Indexer

**3.58** The call identity indexer (CII) frame (Fig. 19) accommodates a maximum of four CII units. An office may be equipped with as many as ten CII units (one for each equipped recorder).

**3.59** At the end of each entry on the AMA tape, a 2-digit number known as the call identity index is perforated. This number identifies the trunk being used for a call and permits the accounting center to associate the separate entries of each call.

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**3.60** The call identity index is supplied to the recorder by the call identity indexer. Each call identity indexer unit is associated with a recorder on the basis of one call identity indexer per recorder. Each call identity indexer can identify a maximum of 100 trunks.

**3.61** The call identity indexer is obtained by the transverter after recorder seizure; near the end of the initial entry, the transverter signals the call identity indexer to identify the trunk. Answer and disconnect entries are initiated by the trunk which gains access to the recorder through the call identity indexer.

**3.62** While a particular call is in progress, other calls which require the service of the same call identity indexer may originate or terminate. In case of simultaneous demand for the service of a call identity indexer by two or more trunks or transverters, the call identity indexer will serve these requests on a one-at-a-time basis. Each request is served on a preestablished order, depending on the location in a preference chain of the circuits requesting service.

### O. Recorder

**3.63** The recorder frame (Fig. 20) accommodates a maximum of four recorder units. An office may be equipped with as many as ten regular recorders and one emergency recorder or as few as one regular recorder and one emergency recorder. Each regular recorder is associated with a particular call identity indexer and 100 AMA outgoing trunks. The 100 trunks associated with a recorder are usually equally represented by all sender groups.

**3.64** In conjunction with an associated perforator, the recorder transfers the information needed for billing purposes to the paper tape. The recorder operates in response to a transverter in making initial entries and in response to the call identity indexer in making answer and disconnect entries. Other entries are made under the control of the master timing frame. When these circuits complete for the services of a recorder, first preference is given to the master timer; second to the transverter; and third to the call identity indexer.

**3.65** Upon being engaged by a transverter, the call identity indexer, or the master timer, the recorder operates perforator magnets as directed by the circuit in control, operates the perforator

stepping magnet as each line is perforated, and checks the operation of the perforator magnets.

**3.66** The recorder registers the time in minutes and tenths of minutes past the hour, under control of the master timer, and causes a record of the time in minutes and tenths to be placed on the tape at the beginning and at the end of the conversation period as directed by the trunk and call identity indexer.

**3.67** At the start of each hour, the recorder places an hour entry on the tape and at 3 AM, an end-of-tape pattern. These are made under the control of the master timer.

**3.68** The emergency recorder may be substituted for any of the regular recorders. The substitution is made by inserting a make-busy plug into the transfer jack of the regular recorder. Prior to the transfer, the master timer causes the end-of-tape pattern to be placed on the tapes of both the regular and the emergency recorders. This procedure is repeated when the regular recorder is returned to service. A record of the transfer thus appears on both tapes. The record on the emergency tape includes the number of the regular recorder for which it is substituted.

**3.69** For offices where the ultimate number of trunks will only require the services of one regular recorder, two alternative plans are available. The first of these provides for one recorder and an associated emergency recorder. A call identity indexer is normally associated with the regular recorder. A manual transfer from the regular to the emergency recorder is provided. In the event of a recorder trouble, no traffic will be completed until the transfer is made. The second plan for small offices provides two call identity indexers and two regular recorders. Each call identity indexer and its associated recorder serves half of the trunks. A manual transfer permits the trunks associated with either call identity indexer to be transferred to the other. In the event of trouble, either recorder can act as an emergency recorder for the other; in this case, half of the trunks are out of service until the transfer is made.

**3.70** When a transfer is made, a charge guard entry is perforated on the tape of the recorder that remains in service. When the trunks are transferred back to the original call identity

indexer, a charge guard entry is made on the tape of the original recorder.

#### **P. Perforator**

**3.71** The perforator cabinet (Fig. 2) is a single-sided, floor-supported steel enclosure. In the upper part, two perforators associated with two recorders are mounted. Paper supply bins and motor driven take-up reels for the paper tape are mounted below the two perforator units.

**3.72** The perforator is a electromechanical equipment element consisting of magnets and an associated pin arrangement, together with a cylindrical drum and a stepping mechanism. When a perforator magnet is energized, its associated perforating pin is forced through the paper tape located on the periphery of the drum. The hole produced, which has embossed edges, registers with a corresponding hole in the drum. The embossed edges ensure proper alignment of the tape with reference to the perforating pins. They also provide the traction needed to move the tape through the perforator. After the hole has been punched, the perforating pin is withdrawn and the stepping mechanism advances the tape and drum to the next position. In practice, a combination of these holes is punched simultaneously with the resultant pattern of holes forming a line. The perforator is under direct control of its associated recorder.

**3.73** Reels for taking up the perforated tape are motor driven and are under the control of a switch actuated by a movable arm in contact with the paper tape. When the output from the perforator reaches a certain amount, the motor is started and the reel rotated until the slack in the tape is taken up, whereupon the motor is stopped.

**3.74** The paper tape is supplied to the perforators in folded form from the supply bins. There are two such bins per perforator, each holding about 3000 feet of folded paper. The two bins are located one above the other so that the bottom of the paper tape in the top bin can be spliced to the top end of the paper in the lower bin. In this way, a total of 6000 feet of tape is available to each perforator without renewing the supply. In practice, a second carton of paper is introduced after the top one is exhausted. At that time, the lower bin is shifted to the upper position, a fresh carton is inserted in the second bin which is placed

in the lower position, and the two lengths of paper are spliced together.

#### **Q. Master Timer**

**3.75** The master timing frame (Fig. 21) is composed of an odd and even master timer, each controlled by a synchronous motor. Each office is equipped with one master timing frame.

**3.76** One of the functions of the timer is to supply a pulse every 1 second or every 6 seconds to all recorders (all offices are being converted to the standard 1-second timing). This operation can be performed by either timer, and the one selected for this function becomes the control timer. Transfer arrangements allow this and other functions to be assumed by the other timer in the event of trouble.

**3.77** The answer and disconnect time entries entered on the tapes by the recorders and associated perforators are determined by the setting of three selectors provided in each recorder. One of these selectors is advanced every 1 second or every 6 seconds by the pulse from the control master timer, and it in turn controls the others. At 1-minute intervals, the control timer makes a check of the other timer and of all recorders for synchronism. An alarm sounds if any timer is out of synchronism, and it is brought into synchronism by maintenance force operation.

**3.78** At the start of each hour, the master timing frame supplies the recorders with information for entry on the tapes. At 3 AM an end-of-tape pattern is placed by the master timer frame, with the odd-master timer controlling the odd recorders and the even master timer controlling the even recorders. The end-of-tape pattern includes the month, day, hour, recorder number, and the recorder group number. It also contains a splice pattern showing where the tape should be cut for removal to the accounting center for processing.

**3.79** In addition to the above functions, the master timing frame is arranged to test certain features of recorders and perforators. These are governed by the master timer not in control.

#### **R. Trouble Recorder**

**3.80** The trouble recorder equipment (Fig. 22) consists of two frames. The equipment is

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arranged in this manner, rather than as a 2-bay, shop-wired frame, so that a portion of it may be located remotely where a shortage of floor space will not permit accommodation of the complete equipment in the maintenance center. Accordingly, all of the control keys, jacks and lamps, the trouble recording perforator, and the plant registers are concentrated on frame 1. The second frame, frame 2, contains only multicontact relay equipment and need not be located adjacent to frame 1.

**3.81** As shown in Fig. 22, frame 1 mounts the perforator; a jack, key, and lamp panel; several mounting plates of plant registers; a sender-type casing enclosing the perforator control and test unit plus two mounting plates of relay equipment for the jack, key, and lamp circuit; a large group of connector control relays; and the fuse terminal strips. In addition, a fuse panel and a circuit breaker panel associated with the perforator motor are located at the top of this bay above the terminal strips.

**3.82** The second frame contains eight rows of multicontact relays together with a frame terminal strip for miscellaneous leads.

**3.83** The primary function of the trouble recorder is to automatically record troubles encountered during the establishment of service and test calls by means of punched cards. Fig. 23 shows the circuits which have access to the trouble recorder. Those circuits having direct access are shown in solid lines. In addition, the trouble recorder serves as a central location for plant registers, in-use lamps, make-busy jacks, battery test jacks, and alarm lamps. Refer to Bell System Practices Section 227-200-300 for information on trouble record card analysis.

### S. Sender-Identifier-Transverter Test Frame

**3.84** The sender-identifier-transverter frames (SITVs) (Fig. 24) are used to test the senders, identifiers, transverters, and DOC units of the AMA system. The SITV is also used for making line verification tests. A jack, key, and lamp panel is mounted on each bay. The first bay is associated with 20 senders and the second bay with 80 senders. Jacks are provided for holding and releasing the sender under test. Lamps are provided to indicate (a) the progress of the test at the time of a failure and (b) the sender under test, the group of senders under test, etc.

**3.85** Senders are selected for test by means of a 206-type selector per sender group with the senders of a group assigned to consecutive positions on a switch beginning with position 1 of the first switch for the first sender of the first sender group. A maximum of 20 senders may be connected to each switch. In testing all of the senders, the test frame may start with the first sender of the first sender group and will advance the switch one position after each sender has been tested in order to test the succeeding sender. When all of the senders of a group have been tested, the test frame advances the control to the switch for the succeeding sender group until the last sender of the last sender group has been tested. A test of the senders may also be started with any sender rather than the first, advancing the control to succeeding senders in the same manner.

**3.86** Senders are tested for busy and are then made busy over a directly connected sleeve lead. They are further connected to the test frame by a number of leads which terminate on multicontact relays in the sender. This replaces the trunk-finder and sender-trunk connectors used on service calls. The sender under test uses an identifier and a transverter as on a normal service call.

**3.87** The identifiers, transverters, and recorders of the AMA system may be selected for test on a random basis, or a particular one may be selected for a test or for a series of tests by means of keys on the test frame.

**3.88** The ability of an identifier to respond to normal or low-level identification frequencies may be tested by supplying the frequency directly from the test frame, thus eliminating the normal operation through the common number and class and the thousands number frames. When desired, however, the identification frequencies may be supplied to a particular customer line to test the identifier with all associated equipment in the transmission path. In either type of test, the test circuit matching register circuit determines whether identification is correct; and if the circuit fails to match, a trouble recorder is seized and a trouble card is made.

**3.89** The transverter is seized by the sender as on a normal service call and may be directed to a regular recorder or to a simulated recorder in the test circuit. When the simulated recorder is used, (a) the transverter extends information a

line at a time as it would to a regular recorder and (b) the output information is matched against the input information set up on the switches of the test circuit. If the circuit fails to match, a trouble recorder is seized and a trouble card is made.

**3.90** The transverter output is checked against the input information; if the information checks satisfactorily, the sender is released and the test circuit advances to the next sender. However, certain features such as the correct reception and sending of dial pulses by senders are tested automatically and lamp indications are given when a trouble condition is encountered.

**3.91** The DOC circuit is checked via a translator. One translator is made busy and is selected for testing. The test circuit checks the ability of the DOC circuit to return a code group and reroute seizure signal. It also verifies that the DOC circuit has the ability to restrict the volume of traffic presented to the toll tandem offices.

**3.92** The following miscellaneous facilities are provided as part of the sender-identifier-transverter test frame:

- (a) **A stuck sender lamp** is provided for each sender to indicate a trouble condition involving the particular sender.
- (b) **A hold jack** is provided for each sender to prevent the sender from restoring to normal after it has timed out due to trouble conditions.
- (c) **A release jack** is provided for each sender to restore the sender to normal after it has been held.
- (d) **A trunk-group-busy lamp** is provided for each sender trunk connector to indicate when a particular connector is held out of service due to trouble.
- (e) **A tube test circuit** is provided for testing a 313CA and 313CC electron tubes used in some of the circuits.
- (f) **A multifrequency receiver** is provided for testing the multifrequency pulses from the sender.

(g) **A test battery** is provided to furnish 100-volt positive battery to the meter for subscriber line test.

#### T. Automatic Trunk Test Frame

**3.93** The automatic trunk test (ATT) frame is used for testing a maximum of 1000 AMA trunk circuits on an automatic progression basis. It is a single-bay arrangement (Fig. 25) and is located at the test center. This frame is provided with many keys for making various types of tests. Lamps are provided to give trouble indications where the circuits fail to function properly. Make-busy and test jacks are provided for all trunks.

**3.94** The ATT frame can be used to make any preselected test of applicable trunks on an automatic progression basis or a series of tests of a particular trunk on a manual basis. The frame may also be arranged to perform some tests on distant central office equipment. In the performance of its function, the frame originates calls such as a customer would and employs appropriate service circuits such as senders and identifiers.

**3.95** Specific digits must be pulsed by the ATT frame to reach the desired destination over a particular trunk. These digits are determined by cross-connections in the supplementary code relay unit, normally located at the bottom of trouble recorder bay 2. Each combination of digits employed uses a separate code relay, which is operated upon seizure of any trunk for which that combination is intended. The capacity of this unit is 100 code relays and 1000 trunks.

**3.96** Access to the trunks is obtained by way of a 200-point crossbar switch and control relays which cause the operation of the proper hold and select magnets to close crosspoints. The closure of the crosspoints provides access to five trunks, the particular one of the five being selected by an additional relay operation.

#### U. ANF Outgoing Trunk And Outpulser Connector Frame

**3.97** The ANF outgoing trunk and outpulser connector frame (Fig. 26) is arranged to accommodate two outpulser connectors and ten trunks. Due to traffic reasons, either ten or five trunks are assigned to a connector. When the ten trunks on the frame are associated with one

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connector, only one outpulser connector is equipped; when five trunks are associated with one connector, both outpulser connectors are equipped. The maximum number of ANF outgoing trunk and outpulser connector frames in an office is 30.

**3.98** The function of the ANF outgoing trunk is to complete special toll calls or dial assistance calls to TSPS offices. Normally, the trunk is reached by dialing a directing code through an auxiliary trunk and rotary outgoing trunk switch. It repeats the called number to the TSPS office on special toll calls or serves as a recording-completing trunk on dial assistance calls.

**3.99** The trunks are arranged for six different classes of service. The classes available and their respective functions are as follows:

CLASS	FUNCTION
CL3	Special Toll-Loop Pulsing
CL4	Operator Assistance-Loop Pulsing
CL5	Special Toll-E&M Lead Signaling
CL6	Operator Assistance-E&M Lead Signaling
CL13	Combination Special Toll and Operator Assistance-Loop Pulsing
CL14	Combination Special Toll and Operator Assistance-E&M Lead Signaling

Special toll calls are calls in which the calling customer had dialed zero plus the digits of a telephone number in a toll area (person-to-person toll calls). Operator assistance calls are calls in which the calling customer has dialed zero (0 operator) for assistance.

**3.100** A party test is made (a) on dial assistance calls immediately upon seizure [this information is passed to the outpulser] and (b) on special toll calls between the first and second digits.

**3.101** The outpulser connector is used to connect outgoing trunks to outpulsers. Depending on traffic, from 2 to a maximum of 60 connectors are provided per No. 1 step-by-step office with AMA, through which any one of a maximum of 300

outgoing trunks may secure access to any one of a maximum of 6 outpulsers when ANF is required. Each outgoing trunk has an appearance in only one connector. Depending on traffic, each connector serves a maximum of five or ten outgoing trunks and can handle one call at a time, being held until completion of forwarding of the calling number. In the event of simultaneous demands for a connector by two or more outgoing trunks, the trunks take their turn in a fixed order, depending on their relative positions in a trunk preference chain circuit. An outpulser preference chain circuit between connectors insures that only one connector at a time enters a particular outpulser.

**3.102** The trunk preference relays are designated TP0-9 whether all ten trunks on the frame are associated with one or two connectors. When two connectors are equipped on the frame, TP0 through TP4 are associated with connector 0 and TP5 through TP9 are associated with connector 1.

### V. Outpulser And Outpulser Identifier Connector

**3.103** The outpulser frame (Fig. 27) is arranged to accommodate a maximum of three outpulser units. An office can be equipped with two outpulser frames (maximum of six outpulser units).

**3.104** The outpulser unit is used on person-to-person or operator assistance calls routed to TSPS offices. Its functions are to connect to an identifier for identification of the calling number and to outpulse the calling number to the TSPS office. Check relays in the outpulser associated with the digit registers verify that each digit is registered on a 2-out-of-5 basis. If the calling subscriber is on a multiparty line, or if a trouble condition prevents identification, this information is registered in the outpulser. The outpulser then outpulses (on a multifrequency basis) the calling number to the TSPS office.

**3.105** Outpulsers are associated with the trouble recorder that serves identifiers, recorders, and transverters in the office. When one of the outpulsers encounters trouble, a trouble card is punched out by the card perforator which furnishes a record of the particular outpulser in trouble. A record of the progress of the call through the outpulser is also recorded. Outpulsers that find the trouble recorder busy will be released at once

and will light a display loss lamp to indicate the outpulser that attempted to record a trouble.

**3.106** The outpulser bids with existing LAMA senders, via an outpulser-identifier connector, for an identifier. One outpulser-identifier connector frame (Fig. 28) is required per office. The outpulser-identifier connectors circuitry is part of the outpulser circuit.

**W. Automatic Intercept System Trunk Finder And Auxiliary Intercept Trunk**

**3.107** The AIS trunk finder unit and auxiliary intercept trunks are used to concentrate the traffic to outgoing intercept trunks connected to the AIC. The class that reaches unassigned connector terminals will receive computer generated information; vacant selector levels are routed to a machine announcement; and plugged-up lines are answered by an operator.

**3.108** The unit has capacity of twenty 200-point step-by-step trunk finders and 160 auxiliary intercept trunks.

**X. AIS Outgoing Trunk And Outpulser Connector Frame**

**3.109** The AIS outgoing trunk and outpulser connector frame (Fig. 46) is arranged to accommodate five outpulser connectors and ten outgoing trunks. Each connector can be associated with a maximum of four outpulsers with a maximum of two trunks. There are a maximum of 10 connectors and 20 trunks in a fully equipped office.

**3.110** The function of the AIS outgoing intercept trunk is routing intercepted calls to the AIS at the distant office.

**3.111** The outpulser connector is used to connect outgoing intercept trunks to outpulsers. Depending on traffic, from one to a maximum of ten connectors are provided per No. 1 step-by-step office with AMA, through which any one of a maximum of 20 outgoing intercept trunks may secure access to any one of a maximum of four outpulsers. Each outgoing intercept trunk has an appearance in only one connector. Each connector serves a maximum of two outgoing intercept trunks and can handle one call at a time, being held until completion of forwarding the called number. In the event of simultaneous demands for a connector

by two outgoing intercept trunks, the trunks take their turn in a fixed order, depending on their relative positions in a trunk preference chain circuit. An outpulser preference chain circuit between connectors ensures that only one connector at a time enters a particular outpulser.

**3.112** The trunk preference relays are designated TP0 through 9. TP0 and 1 shall be associated with connector 0; TP2 and 3 shall be associated with connector 1; TP4 and 5 shall be associated with connector 2; TP6 and 7 shall be associated with connector 3; and TP8 and 9 shall be associated with connector 4.

**Y. AIS Outpulser And Outpulser Identifier Connector**

**3.113** The outpulser frame is arranged to accommodate two outpulsers and associated outpulser-identifier connector units.

**3.114** The function of the AIS outpulser is to transmit the number of the called line being intercepted to the AIC. The outpulsers bid with the existing SAMA senders for an identifier. Calling number identification is handled by SAMA equipment in the same manner as other calls in the office that require identification.

**3.115** The outpulser uses MF signaling for outpulsing. In general, ten digits are transmitted: keypulse signal, an information digit, the called office (three digits), a 4-digit station number, and a start-prime digit. The information digit will convey one of four possible items of information.

**3.116** These outpulsers are associated with the trouble recorder that serves an identifier, the recorders, and the transverters in the office. When one of the outpulsers encounters trouble, a trouble card is punched out by the card perforator which furnishes a record of the particular outpulser in trouble. A record of the progress of the call through the outpulser is also recorded. Outpulsers that find the trouble recorder busy will be released at once and will light a display lost lamp to indicate the outpulser that attempted to record a trouble.

**Z. Trunk And Outpulser Test Frame**

**3.117** The trunk and outpulser test frame (Fig. 29) is provided for automatic or manual testing of ANF and AIS outgoing trunks and outpulsers.

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The test frame is equipped with a test panel, surface wired units, a multifrequency receiver, a crossbar switch, and a writing shelf. A fuse panel and terminal strips are mounted on the top of the frame.

**3.118** The test panel is the central location for most of the operative and illuminative equipment needed to initiate and control the tests. Pushbutton keys program the test sequence before starting automatic progression from one trunk or outpulser to the next. Strip-mounted lamps indicate the progress or trouble condition of the test. Wafer-type switches are used to select a local order number to check the outpulsing of digits over the simulated loop.

**3.119** Trunk tests and outpulser tests using the trunk and outpulser test frame are covered in Bell System Practices Section 227-225-500 and 227-228-500, respectively.

### CAMA

#### A. Incoming Trunk

##### General

**3.120** A step-by-step CAMA office may be arranged to handle CAMA traffic from step-by-step offices, No. 5 crossbar offices without local AMA, No. 1 ESS offices, TSPS No. 1 offices, operator calls equipped with local AMA, and non-CAMA traffic from No. 5 crossbar offices equipped with local AMA. Two types of trunks, one DP and one MF, are available to handle this traffic. Both of the CAMA trunks may be arranged to handle either ANI- or operator-identified traffic.

**3.121** A DP trunk may be arranged for loop or E&M lead signaling or as a 3-wire trunk for traffic from a step-by-step office in the same building. When used as a 3-wire trunk, operator identification of the calling line must be made. When it is arranged for E&M lead signaling, it will receive traffic directly from the distant office outgoing trunk. When it is arranged for loop signaling, it may receive traffic as follows:

- (a) Directly from a distant office outgoing trunk, or

- (b) From a distant office E&M lead outgoing trunk through an E&M to loop converter. These arrangements are shown in Fig. 36.

**3.122** An MF trunk may be arranged for either loop or E&M lead signaling. It may be arranged for CAMA or non-CAMA operation.

**3.123** As in other common control systems, the incoming trunks have class marks. These marks may be used by the switching equipment to help determine the routing of the call or by the AMA equipment to help determine the charging of the call. In the step-by-step CAMA system, most of these marks are obtained from the trunk class translator described in Part 3B (CAMA). However, the service observing mark and the trunk test mark are sent directly from the trunk to the sender.

**3.124** The service observing mark tells the sender whether this trunk is under observation at the CAMA office. This mark is sent on to the CAMA equipment and perforated on the tape.

**3.125** The incoming CAMA trunk returns reorder to the customer under the following conditions:

- (a) If an incoming register is not selected and the customer dials.
- (b) If each dialed digit is not received within the interdigital time-out period of the register.
- (c) If a sender is not attached promptly.
- (d) If it is requested by the sender.

The sender will request reorder under several conditions, such as an all-trunks-busy condition on a final route, a trouble-release signal from the decoder, etc. The reasons for requesting reorder are described in more detail in the description of senders and decoders.

##### Charging Functions

**3.126** A CAMA trunk performs the following charging functions:

- (a) It identifies itself to an associated recorder through a call identity indexer.

- (b) It times to distinguish called party answer supervision from flashes or hits.
- (c) It controls the recording of the answer and disconnect time entries.

**Abandoned Call**

**3.127** If a customer abandons a call, no further AMA entries will take place, even though the trunk may not become idle. If the abandonment is recognized by the register (on DP calls), the trunk is immediately restored to normal. However, if the abandonment is recognized by the sender, it may first be necessary to complete certain functions before restoring the trunk to normal. If no answer or disconnect entry can be associated with the initial entry, no charge is made for the call at the accounting center.

**B. Trunk Class Translator**

**3.128** The trunk class translator is furnished on an optional basis and may be omitted in installations where all of the following conditions apply:

- (a) Only one regular recorder is installed, or two recorders, if the trunk transfer feature is provided.
- (b) All originating offices are in the home numbering plan area.
- (c) No non-CAMA traffic is served.
- (d) All originating offices are arranged to automatically identify the calling line, or all offices require calling line identification through an operator.
- (e) Each originating office has only one originating rate class for CAMA calls.
- (f) Traffic screening in the decoder is not required.

**3.129** As mentioned in 3.123, each incoming trunk has class marks used for routing and charging purposes. The trunk class translator

furnishes the decoder with the following class information:

- (a) Recorder number—designates one of eight possible recorders.
- (b) Area of origin—designates one of three possible originating areas.
- (c) Rate class—designates one of two possible rate classes.
- (d) Operator identification or automatic identification of the calling line or non-CAMA call.
- (e) Traffic screening class—designates one of ten possible traffic screening classes.

**3.130** The area of origin and the traffic screening class are used by the decoder for the routing of the call. The remaining marks are sent to the sender. The sender uses item (d) to determine the type of identification. If a non-CAMA class mark is received, the sender suspends its CAMA functions. The rate class and recorder number are passed on to the AMA equipment to be used for charging purposes.

**3.131** In cases of simultaneous demands on the translator by both decoders, the decoders take their turns, as determined by their relative positions in the decoder preference chain.

**3.132** The preference chain is provided in duplicate to protect against the loss of the entire trunk class translator in the event of trouble. Provision is made for both automatic and manual transfer. If a trouble is detected in either preference chain during operation, an automatic transfer will be made to the other chain. An automatic transfer will cause a minor alarm to be sounded.

**3.133** The trunk class translator consists of A and B subgroups. Each of these subgroups can serve either decoder. To distribute the traffic equally, the subgroup preference is alternated on each call.

**3.134** A particular trunk class subgroup may be tested or made busy. Test and make-busy jacks are provided for this purpose on the jack, key, and lamp panel.

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**3.135** As shown in Fig. 37, a decoder initiates a request for a trunk class translator by operating its associated decoder preference relay in the translator. This in turn applies battery to a lead which runs through the decoder connector to the trunk finder. On the trunk finder bank, the lead is associated with the incoming trunk. The bank terminal is cross-connected to one of 96 trunk class terminals to operate a class relay in the translator. This in turn cuts through the class information to the decoder.

**3.136** The trunk class translator unit is mounted on a miscellaneous frame. The basic unit provides the class relays and the connector relays in each subgroup for the first twelve classes of service. Class and connector relays may then be added for 12 classes at a time up to a maximum of 96 classes.

### C. Register Link

**3.137** The register link gives incoming DP CAMA trunks access to registers. Upon seizure by an incoming trunk, the link selects a register and returns a register attached signal to the trunk. It uses bylink operation over a temporary fast relay path to prevent loss of digits. A connection is then made between the trunk and the register through a crossbar switch, and the bylink is released.

### D. Incoming Register

**3.138** The incoming register records the incoming dial pulses, obtains a sender after a certain number of digits have been received, and outputs the stored digits to the sender on an MF basis. The CAMA register is shown in Fig. 38.

**3.139** Depending on how the office is equipped, the register can receive three, seven, or ten digits to complete a call. The register recognizes three digits (X11) as a service code call. A 7-digit call completes to an office within the same numbering plan area (NPA), and a 10-digit call completes to a foreign area code. The register distinguishes between a 7- or 10-digit call either by looking for a 0 or 1 at the second digit or by requesting a pretranslator, which returns an office code, area code, or interchangeable code signal to the register. An interchangeable code mark signals the register to time 3 to 5 seconds after the registration of the seventh digit in the register. If no more digits

are registered within this timing interval, the register classifies the code as an office code. Registration of the eighth digit within the 3- to 5-second timing period recycles the timer and classifies the call as a 10-digit call.

**3.140** The register requests a sender via the incoming trunk and the trunk finder. This request is made either after the sixth digit of a 7-digit call, the ninth digit of a 10-digit call, or upon completion of called number registration, depending upon how the CAMA office is equipped. When a sender has been attached, the register on an MF basis outputs the digits to the sender.

### E. Pretranslator

**3.141** The pretranslator circuit is used in offices equipped with interchangeable codes (see 1.19[b]). The pretranslator circuit is seized by the incoming register after the start of the fourth digit of the called number has been registered. It returns an AC, OC, or IC signal to the register. The register uses this signal to determine how many digits it can expect to receive so that a register will be connected a minimum amount of time.

**3.142** A cross-connect field at the pretranslator frame is used to convert the first three digits stored in the register to an AC, OC, or IC signal. If the pretranslator fails to translate the 3-digit code, the pretranslator times out and a trouble release consisting of AC, OC, and IC signals is sent back to register, which then assumes an IC indication.

### F. Trunk Finder

**3.143** The trunk gains access to the sender by means of a trunk finder. Each sender is associated with one or two trunk finders. The trunk finder banks may be wired to a maximum of 100 trunks. A sender group (maximum 20 senders) may serve 100 trunks or, by use of two trunk finders per sender, may serve 200 trunks. When a trunk desires connection to a sender, the trunk signals the trunk finder circuit. The trunk finder will step to the level of the trunk and then hunt over the level for the trunk requesting service; it cuts through leads between the trunk and sender for the exchange of information. Any trunk can obtain access to any sender in a group.

**G. Sender**

**General**

**3.144** The main functions of the sender are to register the calling and called numbers, to call in a decoder to translate the called code, to supply the transverter with information necessary for the initial entry, and to outpulse the called number as instructed by the decoder. A prototype of this sender is shown in Fig. 39.

**Receiving The Called Number**

**3.145** The sender receives the called number on a multifrequency basis. On calls from step-by-step offices, the called number is dial pulsed into an incoming register, which in turn MF pulses the number into the sender. On calls from No. 5 crossbar offices, No. 1 ESS offices, TSPS No. 1 offices, or calls from operators, the register is not used. The called number MF pulses directly into the sender. The sender must receive 3, 7, or 10 digits to complete its functions.

**Information To And From Decoder**

**3.146** As soon as the sender has registered the first three (X11 calls) or six digits, or when registration is complete, it calls for a decoder. These first three or six digits are passed on to the decoder, along with a first or second trial, a first or second seizure, and service or test call indications. The decoder uses the first three or all six of these digits, along with the area of origin and the traffic screening class received from the trunk class translator, to determine the routing of the call.

**3.147** The decoder sends the following information to the sender:

- (a) Automatic identification, operator identification, or non-CAMA as received from the trunk class translator.
- (b) 1 to 5 arbitrary digits to be outpulsed.
- (c) 0, 3, or 6 of the called number digits to be skipped.
- (d) Outpulsing class.
- (e) Alternate route available.

(f) Recorder number and rate class as received from the trunk class translator. (This information is not used by the sender. It is passed on to the AMA equipment.)

(g) A vacant code trap mark (on vacant or irregular codes) which causes a record of the call to be printed on a trouble ticket originated by a transverter.

**Receiving The Calling Number**

**3.148** If the sender receives an automatic number identification class mark, it sends a signal back to the local office after it has received the called number. The ANI equipment in the local office then proceeds to identify the calling customer number. The ANI equipment prefixes the directory number with a KP pulse, an information digit, and the calling code; and MF outpulses this information to the CAMA office. After outpulsing this information, the ANI equipment transmits an ST pulse and releases.

**3.149** The information digit is used in the CAMA office to determine the method of handling the call. As stated previously, the ANI equipment cannot identify multiparty line numbers and the CAMA office must bring in an operator to obtain the calling number on this type of call. An operator must also be obtained if the ANI equipment for some reason fails to identify the calling line. The specific information conveyed by the information digit is shown in Table A.

**3.150** When ANI equipment cannot outpulse the calling number, a KP pulse followed by the appropriate information digit is sent. In these cases the information digit directs the CAMA sender to obtain an operator.

**3.151** If the sender receives an operator-identified mark or if the information digit indicates that the call is to be operator identified, the sender puts in a bid for a position after the decoder has released. The operator obtains the calling number from the customer and keys it into the sender on an MF basis. The calling number is registered in the sender and is used for the subsequent billing of the call. The position is released when the transverter determines that the calling office code is an acceptable one.

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**3.152** If the call is a non-CAMA call, it is completed without registering the calling number in the sender.

### Outpulsing The Called Number

**3.153** The sender outpulses the called number as instructed by the decoder. Zero, three, or six digits may be deleted, and from one to five digits may be prefixed. One or two of the prefixed digits are used as exit digits. These digits are dial pulsed and are used for routing through selectors in the home office or possibly through selectors in an intermediate step-by-step toll office.

**3.154** The CAMA sender outpulses the dial pulse digits necessary to route the call through the CAMA office selectors to the desired outgoing trunk group. If all the trunks in the group are busy, the selector advances to the eleventh rotary position. If there is no alternate route, this causes the incoming CAMA trunk to return reorder tone to the customer.

**3.155** If there is an alternate route, the CAMA sender restores the selectors to normal, reseizes the decoder for alternate route information, and then outpulses the DP digits to route through the CAMA selectors to the alternate route.

**3.156** When an alternate route is provided, another method of operation may be used which utilizes the group busy feature. In this case, the decoder first determines if there is an idle trunk available in the high usage trunk group. If an idle trunk is not available, the sender is directed immediately to the final route trunk group.

**3.157** There are four outpulsing classes:

- (a) CL0—Dial pulsing to step-by-step.
- (b) CL1—Dial pulsing to common control.
- (c) CL2—MF pulsing to common control.
- (d) CL3—Dial pulsing to intercept trunk or announcement trunk.

**3.158** On DP to step-by-step areas, outpulsing starts immediately after instructions are received from the decoder if the call is operator identified. If the call is an ANI class call, outpulsing is started at the same point provided that the

sender has already registered the calling number. In either case, the last digit is held until the initial entry is perforated. With automatic identification, the initial entry will normally be perforated before the sender reaches the last digit. With operator identification, there may be a delay while the operator is talking to the customer.

**3.159** On DP calls to common control offices, outpulsing is started when the CAMA operator keys the first digit on OI calls. The outpulsing is held up until that time to prevent the common control equipment in the distant office from timing out while the operator is talking to the customer. If the call is an ANI class call, outpulsing is started when the sender receives the ST pulse from the local office. The last digit is outpulsed after the initial entry has been made. This type of operation may be used where it is desired to share existing facilities of step-by-step equipment in common control offices. Sender holding time is **increased** with this type of operation.

**3.160** On calls MF outpulsed to common control, the outpulsing is withheld until the CAMA operator keys the first digit; on ANI class calls, the outpulsing is withheld until the sender receives the ST pulse. In this case, because of the speed of MF pulsing, there is no penalty in sender holding time. The first one or two digits (the exit digits) are outpulsed DP. The sender then receives a **stop** signal. When it receives a **go** signal, it switches to MF pulsing for the remaining digits.

**3.161** On DP calls to an intercept trunk or announcement trunk, only one or two digits are pulsed.

**3.162** The sender recognizes **stop** signals. It will recognize a **stop** until start of pulsing of the last digit. If it receives a second **stop**, the call can be routed to reorder. An option is provided which permits recognition of two separate **stop** signals and sets up the reorder on receipt of a third **stop** signal.

### Operation With The Transverter

**3.163** After the calling number has been registered, the sender calls for a transverter. It then sends to the transverter the information necessary for the initial entry of the call. (This information, listed in 3.200, describes the transverter operation.)

**3.164** The transverter checks the calling office code against the first three digits of the called number to determine whether the customer gave the operator the called rather than the calling number. It also checks that the calling code is not a vacant code. After it has made both of these checks, it tells the sender to release the position. If either of the checks indicates that the customer has given wrong calling code, reorder flash is indicated to the operator.

**3.165** The sender releases the transverter when it receives an indication that the initial entry has been perforated.

**H. Decoder Connector**

**3.166** Decoder connectors are used to establish connections between CAMA senders and decoders. After the sender receives the first three digits (X11 calls) or six digits of the called number, or when the called number registration is complete, the sender connects to a decoder by means of a decoder connector and passes information to the decoder by grounding the appropriate leads. The sender will indicate to the decoder whatever information is contained in the A to F digits, whether this is a service or test call, and whether it is the first or second time the sender has seized a decoder on this call. The sender also indicates whether the call is an area code (AC) or a nonarea code (NAC) call if the office is equipped with the interchangeable codes feature. Coincident with the transmission of this information from the sender, the decoder connector tells the decoder whether this is the first or second trial to obtain decoder action on a single bid from the sender.

**I. Decoder**

**General**

**3.167** The principal function of the decoder is to supply the sender with routing information and with outputting instructions. In addition, the decoder may be used to supply alternate route information, trunk class marks, and to perform certain translations of the called number. The decoder common equipment frame is shown in Fig. 40.

**Information Received From The Sender**

**3.168** The following information is given to the decoder through the decoder connector:

- (a) The first three digits of the called number. (Actually, the sender presents the first six digits of the called number to the decoder; however, only three digits at a time are translated. This method of operation is explained in 3.146.) On X11 calls, just three digits are presented to the decoder.
- (b) Service or test call indication.
- (c) First or second seizure indication.
- (d) First or second trial indication.

**3.169** The above information is used by the decoder to determine the routing of the call. In some offices certain additional information about the incoming trunk is necessary. This information is obtained from the trunk class translator as described in 3.128. If all trunks have the same classification in each of these categories, no trunk class translator is provided. In this case, the decoder is arranged to skip this step of its operation.

**Translation Of The Called Code**

**3.170** The decoder, depending on office wiring, has two methods of determining whether an office code or area code has been registered in it. If the office is equipped with the interchangeable codes feature, the sender transmits an AC or NAC signal to the decoder when the decoder connector cuts through. If the office *does not* have the interchangeable codes feature, the decoder examines the second digit. The presence of a 0 or 1 in the second digit position indicates that an area code has been registered. The step-by-step CAMA office can serve a maximum of three originating areas and four terminating areas (including the home area) on a direct trunking basis. For each foreign area served, a foreign area translator circuit must be provided in the decoder. When the decoder recognizes the area code as one which represents a foreign area served on a direct route basis, it makes an additional translation of the office code. If an adjacent foreign area has one interchangeable code or more, and the home area of the CAMA center has none, the foreign area translator for this particular foreign area may be expanded to

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permit handling of the interchangeable code format (N0/1X + N0/1X + XXXX).

**3.171** To perform the second translation, the decoder maintains an indication of the area code and proceeds to register the office code. The decoder then selects the particular foreign area translator and uses the office code to operate a route relay.

**3.172** If the area code does not represent an area served through a foreign area translator, the decoder operates a route relay to correspond to the area code and presents the routing information to the sender.

**3.173** When the decoder receives an office code initially, it makes a translation of the code to operate a route relay. However, if more than one originating area is served, the decoder uses the area of origin mark, as received from the trunk class translator, to assist in the translation.

**3.174** Means are provided in the decoder for recognizing vacant or unauthorized codes. On such calls, an indication is returned to the sender which causes the calls to be routed to reorder, intercept, or announcement trunks. Under key control, a transverter trouble ticket can be produced on called vacant or irregular codes. The decoder also checks the fourth, fifth, and sixth digits on all 10-digit calls, regardless of whether 6-digit translation is performed, to insure that a legitimate office code has been dialed.

### Route Advance

**3.175** To speed the routing of a call, either the high usage trunk group or the alternate route trunk group, or in some cases both groups, may be provided with the optional trunk-group-busy feature. This permits the decoder to test for an idle trunk in the group equipped with the group-busy feature.

**3.176** If more than one route exists for a given dialed code, and if the trunk group corresponding to the operated route relay is equipped with the trunk-group-busy feature, the decoder will first determine whether an idle trunk is available in the preferred route before presenting the routing information to the sender. Should all trunks be busy, the decoder route advances and operates the route relay corresponding to the alternate route

for the dialed code. If this trunk group is not equipped with the group-busy feature, the decoder will present the alternate route information to the sender. However, if the alternate route trunk group is equipped with the group-busy feature, the decoder will also check this trunk group for an idle trunk. Should all trunks be busy in the alternate route trunk group, the decoder will return an indication to the sender to route the call to an announcement trunk.

**3.177** If the announcement trunks are not provided in the office, the trunk-group-busy feature is not provided for the alternate route trunk group. In this case, the decoder will always return the alternate route indication to the sender if the preferred trunk group is busy.

**3.178** A second type of route advance occurs when the sender finds all trunks are busy after being informed that a route is available. Under these conditions, the sender releases the intertoll selector (or selectors) and reconnects itself to the decoder. On this seizure, the decoder ignores the preferred route and then route advances to obtain the alternate route.

### Outpulsing Information

**3.179** The route relays in the decoder provide the sender with outpulsing information. The outpulsing information falls into four categories:

- (a) Arbitrary digits for routing to trunk or forwarding to tandem as an area code not required to be dialed by the customer.
- (b) Class of outpulsing required by the terminating or completing office.
- (c) Number of digits (0, 3, or 6) to be deleted in outpulsing the called number.
- (d) Alternate route available mark.

**3.180** After obtaining information from the route relay, the decoder transmits this information by connecting ground to a number of leads to the sender. Along with this routing information, the decoder also transmits to the sender any trunk class information that may be required by the sender or transverter.

**3.181** After checking that the sender has registered the information transmitted to it, the decoder transmits a release signal to the sender. The sender then releases the connection through the decoder connector, allowing the decoder to return to normal.

**J. Position Link**

**3.182** The position link provides a maximum of 40 senders with access to a maximum of 20 positions by means of crossbar switches. Traffic is distributed by means of two controllers. Each controller serves only one-half of the senders but has access to all of the positions. The two controllers can operate simultaneously, each setting up one call at a time.

**K. Position**

**General**

**3.183** The CAMA switchboard positions used in step-by-step CAMA offices and designed specifically for CAMA are of the cordless type. In small offices, toll or DSA positions modified to handle both CAMA and regular toll or DSA traffic may be used. The combination positions may also be used in offices where the cordless positions are closed down during light load periods.

**3.184** The No. 1, 3, 3C, and 3CL toll switchboards have been modified for CAMA operation. DSA switchboards will be modified on order.

**3.185** Each position, cordless or cordboard, requires a separate appearance on the position link. The maximum limit of 20 positions therefore includes both the day and the night positions.

**CAMA Switchboard**

**3.186** The cordless type of CAMA switchboard consists of a lineup of 2-position sections and a cable turning section. The framework is of sheet metal construction. Fig. 41 is a photograph of a switchboard section with a cable turning section in the foreground. A maximum of 20 positions may be provided. These positions may be located in the building with the CAMA equipment or in a remote location.

**3.187** Each position is equipped with the following:

- (a) A 10-button keyset
- (b) A CAMA supervisory lamp (red)
- (c) A register reset key
- (d) A position disconnect key
- (e) A call waiting lamp (white)
- (f) A supervisory call key and lamp
- (g) A position telephone circuit

**3.188** The CAMA supervisory lamp lights when the operator is connected to a sender and remains lighted until the sender releases the position. The lamp is flashed at reorder rate if the number keyed by the operator is not accepted as satisfactory by the sender or the transverter.

**3.189** The register reset key permits the operator to wipe out the number keyed into the sender and then to key again in case a reorder signal is received before the transverter is seized.

**3.190** The position disconnect key enables the operator to free the position if necessary. The operation of this key signals the sender to release the position link and position. Reorder is then returned to the customer by the incoming CAMA trunk.

**3.191** A lamp standard that contains a supervisory call lamp (amber) and three call waiting lamps (white, green, and red) is furnished for a maximum of ten positions. If more than ten positions are provided, two lamp standards should be provided. A multiple of the white call waiting lamp and the supervisory call lamp also appears at each position. A multiple of the supervisory call lamp may also appear at an adjacent switchboard lineup if a supervisor is in charge of both lineups. The call waiting lamps indicate the load on the lineup as follows:

- (a) Green—one or more senders waiting
- (b) White lamp—four or more senders waiting
- (c) Red lamp—six or more senders waiting.

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These signals are controlled by the call waiting signal circuit. To avoid flashing of the lamps due to fluctuations in traffic, the white and red lamps do not light until the call waiting load has persisted 3 to 5 seconds.

**3.192** In an emergency, the CAMA switchboard may have to be abandoned. An abandon switchboard key is provided to permit traffic normally handled by the lineup to be completed free of charge. This key may be located in the operating room at the maintenance center.

**3.193** Inasmuch as the operation of this key will result in a substantial loss of revenue, it is (a) threaded by a wire loop with a lead seal to disclose unauthorized operation and (b) covered by a guard to prevent inadvertent operation. A guard lamp is lighted and an alarm sounded in the operating room as long as the key is operated. An alarm is also sounded in the maintenance center, but this may be retired and replaced by a guard lamp.

### DSA And Toll Switchboards

**3.194** As mentioned previously, toll and DSA positions may be modified to handle both CAMA and DSA or toll traffic. Each position arranged for dual operation is equipped with a transfer key which, when operated, allows the selection of that position by the position link in the same manner as regular CAMA cordless positions. The DSA or toll operator then handles the CAMA traffic in the same manner as a CAMA operator at a cordless position. The cordboard is provided with similar keys and lamps for this purpose. A single appearance of the white and red call waiting lamp is centrally located above the multiple of one position arranged for CAMA service. A green call waiting lamp is located at each position handling CAMA traffic.

**3.195** The DSA or toll operator may also handle non-AMA traffic in the regular manner while handling AMA traffic. If a non-AMA call comes in while the transfer key is operated, the operation of a talk or monitor key makes the position busy to the position link.

### L. Transverter Connector

**3.196** A transverter connector connects senders to transverters so that information can be exchanged between these circuits. Within any

one connector, only one connection can be made at a time. However, as many simultaneous connections as there are transverters can be made through different connectors.

**3.197** In case of simultaneous demands on a connector by two or more senders, the senders take their turn, as determined by their relative positions in a sender preference circuit.

**3.198** The transverters are selected in a definite order by a chain circuit in each connector. If the first choice transverter is busy, then the first idle transverter in the order of preference is selected. If all transverters are busy, the connectors take their turn, depending upon the relative position which each connector has in the transverter preference chain.

**3.199** If a transverter fails to complete its functions and times out, it gives a trouble-release signal to the connector. The connector releases the transverter and makes a second trial by seizing another transverter, or the same transverter if all others are busy. If this second transverter encounters trouble, the call is routed to reorder.

### M. Transverter

#### General

**3.200** The major functions of a transverter are to register the information received from the sender, to convert this information to a form suitable for recording, and then to transmit to a recorder all of the information necessary for the initial entry of a call. This is the only entry for which the services of the transverter are required; the answer and disconnect entries are made under control of the trunk and the call identity indexer.

**3.201** The transverter circuit is primarily intended to handle 7- and 10-digit calls. However, initial entries can be processed by the transverter for 3-digit (X11 information) calls. The 3- and 7-digit calls are completed within the home area or to certain offices with nonconflicting codes in neighboring areas. When calls are completed to neighboring areas on a 7-digit basis, the same office codes *cannot* be used in other originating areas served by the CAMA office on a 7-digit basis. On 10-digit calls the transverter receives a 3-digit area code from the sender to indicate called foreign numbering areas.

**3.202** All calls (except non-CAMA calls) handled by step-by-step CAMA will be detail billed. The format for AMA recording of directory assistance calls is as follows:

- (a) Local area directory assistance 1+411
- (b) Home NPA directory assistance 1+555-1212
- (c) Foreign NPA directory assistance 1+NPA+555-1212.

No bulk billed traffic is handled. No provision has been made for code compression.

**Information From Sender**

**3.203** After connection to the sender, the transverter receives the following information:

- (a) Calling number
- (b) Called area code, if necessary
- (c) Called number
- (d) Recorder number, if required
- (e) Rate class, if required
- (f) Service call, test call using recorder, or test call not using recorder
- (g) No trouble condition, operator error, or ANI failure
- (h) Service observed or not service observed
- (i) Automatically identified or operator-identified
- (j) First or second transverter trial (from transverter connector)
- (k) AC or NAC mark, if equipped for interchangeable codes.

**3.204** The transverter checks the originating office code against the called office code to determine whether the customer gave the operator the called rather than the calling number. If the calling and called codes match, reorder is returned to the position.

**3.205** The transverter uses the calling office code to determine the office index which is used to identify the office within a recorder group. A maximum of 50 offices may be served. These office codes are cross-connected to a maximum of 30 office indices. Up to five offices may be assigned the same office index if each is served by a different recorder. Two rate classes may be provided for a maximum of 48 originating offices. Rate class permits the traffic in an office to be assigned to two office indices, thus enabling the accounting center to make a difference in the charges for two classes of customers.

**Operation With Recorder And Call Identity Indexer**

**3.206** The transverter calls in a recorder and the initial entry information is perforated on the tape one line at a time in the proper sequence. All calls are perforated in four or five lines. Four line entries are used for 3- or 7-digit calls and five line entries for 10-digit calls.

**3.207** Immediately after the recorder is seized, the transverter signals the call identity indexer to get ready to identify the incoming trunk. As the last line of the initial entry is being perforated, the call identity indexer furnishes the trunk number to the recorder. With the initial entry completed, the transverter signals the recorder that the initial entry is complete. The signal is relayed from the recorder to the trunk and tells the trunk that the call should be charged for if answered.

**3.208** If the transverter is unable to complete the initial entry, a second trial is made. In case of a second failure the call is routed to reorder.

**3.209** In rare instances, a recorder may be plugged busy and the emergency recorder may not be available. The transverter recognizes this condition when it attempts to seize a recorder. The call is routed to reorder without making a second trial.

**3.210** If a recorder is associated with the master timer for the 3 AM entry during the early stages of perforating this entry, or if the recorder is perforating a splice pattern, the transverter recognizes this condition and the call is routed to reorder. If the recorder is requested during the later stages of the 3 AM entry, a signal is given

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to the transverter, which then temporarily extends the timing to wait for the recorder.

### N. Call Identity Indexer

**3.211** At the end of each entry on the AMA tape, a 2-digit number known as the call identity index is perforated. This number identifies the trunk that is being used for a call and permits the accounting center to associate the separate entries of each call.

**3.212** The call identity index is supplied to the recorder by the call identity indexer. Each call identity indexer unit is associated with a recorder on the basis of one call identity indexer per recorder. Each call identity indexer can identify a maximum of 100 trunks.

**3.213** The call identity indexer is obtained by the transverter after recorder seizure; near the end of the initial entry, the transverter signals the call identity indexer to identify the trunk. Answer and disconnect entries are initiated by the trunk which gains access to the recorder through the call identity indexer.

**3.214** While a particular call is in progress, other calls which require the services of the same call identity indexer may originate or terminate. In case of simultaneous demand for the service of a call identity indexer by two or more trunks or transverters, the call identity indexer will serve these requests on a one-at-a-time basis. Each request is served on a preestablished order, depending on the location in a preference chain of the circuits requesting service.

### O. Recorder

**3.215** The recorder, in conjunction with an associated perforator, transfers the information needed for billing purposes to the paper tape. The recorder operates in response to a transverter in making initial entries and in response to the call identity indexer in making answer and disconnect entries. Other entries are made under the control of the master timing frame. When these circuits compete for the services of a recorder, first preference is given to the master timer; second, to the transverter; and third, to the call identity indexer.

**3.216** Upon being engaged by a transverter, the call identity indexer, or the master timer, the recorder operates perforator magnets as directed by the circuit in control, operates the perforator stepping magnet as each line is perforated, and checks the operation of the perforator magnets.

**3.217** The recorder registers the time in minutes and tenths of minutes past the hour, under control of the master timer, and causes a record of the time in minutes and tenths to be placed on the tape at the beginning and at the end of the conversation period as directed by the trunk and call identity indexer.

**3.218** At the start of each hour, the recorder places an hour entry on the tape, and at 3 AM, an end-of-tape pattern. These are made under the control of the master timer.

**3.219** Because of the diverse amounts of traffic that can be handled by different step-by-step CAMA offices, recorders are provided according to one of three possible arrangements. The first arrangement, for larger offices, provides for a maximum of eight and a minimum of two recorders. In addition, an emergency recorder is provided.

**3.220** The emergency recorder may be substituted for any of the regular recorders. The substitution is made by inserting a make-busy plug into the transfer jack of the regular recorder. Prior to the transfer, the master timer causes the end-of-tape pattern to be placed on the tapes of both the regular and emergency recorders. This procedure is repeated when the regular recorder is returned to service. A record of the transfer thus appears on both tapes. The record on the emergency tape includes the number of the regular recorder for which it is substituted.

**3.221** For offices where the ultimate number of trunks will only require the services of one regular recorder, two alternative plans are available. The first of these provides for one recorder and an associated emergency recorder. A call identity indexer is normally associated with the regular recorder. A manual transfer from the regular to the emergency recorder is provided. In the event of a recorder trouble, no traffic will be completed until the transfer is made.

**3.222** The second plan for small offices provides two call identity indexers and two regular

recorders. Each call identity indexer and its associated recorder serves half of the trunks. A manual transfer permits the trunks associated with either call identity indexer to be transferred to the other. In the event of trouble, either recorder can act as an emergency recorder for the other; in this case, half of the trunks are out of service until the transfer is made.

**3.223** When a transfer is made, a charge guard entry is perforated on the tape of the recorder that remains in service. When the trunks are transferred back to the original call identity indexer, a charge guard entry is made on the tape of the original recorder.

**3.224** No more than 30 office designations may be assigned to the same recorder. For accounting reasons, these 30 appear in a recorder group. One recorder may constitute a recorder group. However, the trunks may be divided over two recorders assigned to the same recorder group, if necessary.

**P. Perforator**

**3.225** The perforator for CAMA operates the same as the perforator for LAMA as described in 3.71 through 3.74.

**Q. Master Timer**

**3.226** The master timing frame for CAMA operates the same as the master timing frame does for LAMA as described in 3.75 through 3.79.

**4. METHOD OF OPERATION**

**LAMA**

**A. General**

**4.01** The equipment used in completing calls through a step-by-step office with AMA (Fig. 1) is shown in solid line blocks, whereas the step-by-step equipment is shown in dashed line blocks. The AMA equipment is seized after the calling customer has registered one, two or three digits on selector switches in the step-by-step office. (The third selector arrangement is not shown in Fig. 1.)

**4.02** When the calling customer initiates a call to a directory number outside of its designated

local calling area, the call is advanced through the step-by-step selectors to the AMA equipment. The trunk circuit is first to be seized. ANF outgoing trunk circuits are seized from the "0" level of first selectors; AMA outgoing trunks modified for 1-plus dialing are seized from the "1" level of first selectors. AMA outgoing trunks not arranged for 1-plus dialing can be seized from various levels of second or third selectors (depending upon the digits dialed).

**B. Call Through AMA—Second Or Third Selector Seizure**

**Seizure**

**4.03** Seizure of the AMA outgoing trunk causes a trunk finder to function and connect the trunk to a sender for the reception of dial pulses for controlling selections and for other control functions during the various stages of the connection. The sender is held under the control of the customer until such time as selections have been completed and the trunk has been cut through to the transmission condition.

**4.04** After the trunk seizure, the first digit dialed is registered in the trunk and transferred to the identifier when the identifier is connected. This is done to avoid the mutilation of a digit while the connection to the sender is being established. The next digit is registered in the sender. Should the trunk finder not be connected to the trunk in time to receive these pulses, a paths busy signal is given to the subscriber.

**4.05** After registration of the first digit in the sender, the sender performs a party test. It connects a party test relay to the tip and ring leads toward the calling customer's station. If ground is present on either the tip or ring leads, the sender detects the ground and registers a tip party indication in the sender. No ground present indicates a ring party. This information is transmitted to the identifier after it is connected. A check of the party test relays is made by the sender before releasing. A ground removal test is made on tip party stations after disconnect.

**4.06** Following the registration of the first digit in the sender (the second digit in the sender for offices arranged for 1-plus dialing), the sender is connected to an identifier through a lockout circuit. If the preferred identifier is busy, the

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next preferred identifier is selected. When this connection has been established, a large number of leads are cut through for the control and transmission of information back and forth between the sender and identifier. The identifier receives information from the trunk finder to be used by the identifier to identify a particular trunk out of a group of 20 and, in turn, associates itself with that trunk through an identifier-trunk connector.

**4.07** The identifier is informed by the sender of the type of party making the call (tip or ring) and the identity of the first digit (first and second digits for 1-plus calls) registered in the sender. In most cases, this information is necessary for reconstruction of the called office code and for identification of the calling number.

**4.08** By means of the connection established through the identifier-trunk connector, the identifier records the digit recorded in the trunk. At this time the identifier receives information from the trunk as to which one of the three code connectors serves this trunk. The identifier then seizes the code connector to extend the code leads from the trunk or rotary out-trunk switch to the identifier. The code leads correspond to the point of seizure of the trunk and represent either two or three digits, depending upon whether the trunk was reached from the banks of the second or third selectors.

**4.09** Where the code point represents a complete office code or group of partial office codes, all of which may be treated alike, it is cross-connected to operate a route relay directly. Otherwise, it is cross-connected through contacts of switching relays to place the selection of the route relay under control of the dialed digit registered in the trunk and, when required, the first digit registered in the sender. A schematic of the code connector operation is shown in Fig. 30.

**4.10** The operation of a route relay is utilized to register in the sender the three digits of the called office code. This may be accomplished by the route relay alone, or in conjunction with the trunk digit and sender digit translator relays. Cross-connectable contacts of the route relay pass to the sender the office code or foreign area code. Other contacts of this relay are used in connection with the registration in the sender of the message billing index to be applied, for the introduction of sender delay, the transmission by the sender of

prefixed digits to switch in a voice repeater or pulse a routing selector, and the transmission by the sender of the required number of called office code digits. Still other contacts of this relay are used to indicate to the sender the identity of the first digit registered in it, to operate a traffic register, and to control the disposition of the call as AMA, nonentry, or denied. In addition, the identifier prepares the trunks to eliminate the AMA feature if there is to be no AMA entry. For a blank or denied code, the identifier prepares the trunk to supply recorded announcement.

**4.11** After the identifier has been notified by the sender that the calling customer is a tip or ring party, the identifier seizes the common number and class circuit and operates the necessary relays for making a check in the tip or ring field. This frame is arranged to connect 10 to 20 groups of 1000 numbers to the 10 or 20 detectors of the identifier at one time. A tone generated by an oscillator in the identifier frame is connected through the identifier-trunk connector to the sleeve of the trunk. This tone is transmitted back through the originating equipment to the connector terminal assigned to the calling customer and to the thousands number circuits for presentation to the identifier for calling number identification. Rotation among the groups of 10 or 20 thousands is continued under the control of the identifier until a group containing the particular tone in some thousand is found. The identifier then operates the proper thousands number circuit, thus providing an operating circuit for register relays in the identifier and identifying the office and the thousands digit of the calling customer number.

**4.12** The operation of the thousands number circuit extends the ten coils representing the hundreds on that thousand to the identifier, where they are connected to the ten number detectors. For those thousands which represent operator or other classes on which number identification is not to be made, cross-connections enable the identifier to process without further identification. The hundreds digit register relay in the identifier corresponding to that hundred containing the tone operates and causes the operation of the corresponding hundreds connector relay in the thousands number circuit.

**4.13** The tone leads extended to the identifier by the hundreds connector relay are so wired through networks and repeating coils in the identifier

that the tone appears in one of ten coils, each of which is associated with a block of ten numbers. Tens identification and registration is accomplished in the same manner as hundreds, causing the operation of the proper tens connector relay in the identifier.

**4.14** The ten leads including that from the calling customer connector terminal are now connected through networks in the identifier to the ten number detectors. The units digit is identified and registered as in the foregoing.

**4.15** From contacts of the operated office (thousands, hundreds, tens, and units register relays), the calling customer number is transmitted to the sender and then to the recorder.

**4.16** The equipment is capable of identifying the numbers of customers on individual and 2-party flat- and message-rate lines only. Customers on other types of lines having access to the AMA equipment may be served on a non-AMA basis. Tone transmitted from the identifier toward 2-party flat-rate lines appears at the connector terminals of both parties. To permit positive identification, the tip parties of such lines are so cross-connected at the thousands number frames that they are presented to the identifier through thousands and hundreds repeating coils separate from those used for other lines. The sender is arranged to recognize the tip parties of 2-party flat-rate lines and, on calls for such parties, will direct the identifier to hunt for tone at these segregated coils. Similar treatment of the tip parties on 2-party message-rate lines is not required because switching features in the 2-party message-rate trunk direct the tone from the identifier to the connector terminal of the calling party.

**4.17** Class identification can be made at the same time that thousands identification is made. When class identification is made, the identifier associates its class detectors with the class coils on the common number and class frame by operating the class connector relay thereon. The particular detector to which tone is connected operates its associated class register relay. A schematic of the calling office, number, and class identification is shown in Fig. 31.

**4.18** The identifier next informs the sender of (a) the individual digits of the called office code, (b) the number of digits to transmit in completing

the call, (c) the arbitrary digits to manufacture for routing purposes or for dialing in voice-frequency repeaters, (d) the calling office and number, (e) the message billing index, and (f) other information necessary to complete selections and recordings; then it releases. In completing the call, the sender generates and transmits pulses governed by the setting of the register relays. According to information received from the identifier, the sender may transmit dial pulses at 10 or 20 pps or multifrequency pulses, or even combinations of both, as determined by the required class of pulsing. If the call is a nonentry call, the sender will cut the trunk through to the transmission condition, release itself, and cause the trunk finder to be released.

**4.19** When the identifier releases, the sender seizes the sender-trunk connector and cuts through leads if the call is an AMA call or if the sender wishes to indicate a paths-busy condition or a trunk group busy condition.

**4.20** After the sender has sufficient information pertinent to making an AMA record of the call, the sender requests to be connected to an idle transverter via a sender-transverter connector. The information stored in the sender is transmitted to the transverter for further processing of the call record. After the transverter has made a satisfactory pattern check, it calls for the particular recorder which is required (determined by sender-trunk connector cross-connected). Before connection can be made to the recorder, the transverter must await its turn in a chain circuit with other transverters, the call identity indexer, and the master timing circuit. The master timing circuit has first preference, followed by the transverter and the call identity indexer.

**4.21** After connection has been made to the recorder, the transverter then transmits the initial entry, one line at a time, to the recorder. Before transmitting the last line, the transverter requests the trunk over a path through the sender to identify itself to the recorder through the call identity indexer. As the last line is being perforated, the transverter signals the recorder to use the information supplied by the call identity indexer. As soon as the complete initial entry has been perforated, the transverter sets the trunk to establish the charge condition and releases the call identity indexer. The transverter then releases the recorder and a disconnect signal is sent to the sender. The

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sender then releases the sender-transverter connector and transverter.

**4.22** The sender completes the outpulsing of the called number upon transverter release. In some cases the outpulsing is completed before the transverter releases. At the completion of outpulsing, if the call is originated by a ring party, the sender releases together with the trunk finder and the sender-trunk connector. If the call is originated by a tip party, the sender-trunk connector is released after that information is registered in the trunk. The trunk is cut through to a transmission condition under subscriber control, and the sender releases itself and causes the trunk finder to release. The trunk maintains the connection through the switches.

**4.23** After outpulsing has been completed to the called office by the sender, the control of the call is restored to the trunk. The called party answer supervision is timed by the trunk to distinguish between busyback or overflow signals and a true called party answer. This is termed the charge delay interval. When it has been determined that the call was answered, the trunk calls in the AMA recorder through the call identity indexer and indicates that a timing entry should be perforated. If the recorder is busy, the trunk waits its turn. Upon completion of the perforation of the answer entry, the recorder signals the trunk, which then releases the recorder. If the call is a nonentry call, then the call may be charged through reversed battery supervision.

**4.24** As soon as the calling party disconnects, the trunk partially restores to normal and releases the connection through the selectors. Simultaneously, the trunk puts in a bid for the recorder to perforate the disconnect entry. When the disconnect entry has been perforated, if the calling subscriber was a ring party, the trunk circuit restores to normal. If the trunk is immediately seized for another call, the call will be accepted; but a sender will not be requested until the disconnect entry has been perforated for the preceding call. The second subscriber under these conditions will receive reorder tone. If the calling customer was a tip party, the trunk does not release to normal unless the sender has been called in, has made a test for false ground on the tip (ground removal test), and has released.

**4.25** Although the calling customer is normally in control of his call, he is not permitted to

maintain indefinitely a connection through the switches after the called customer has hung up. The trunk starts timing when the called customer disconnects and the calling customer does not. If the calling customer has not disconnected by the end of the timing period, the connection from the calling subscriber to the outgoing trunk is released and a timed release entry on the AMA tape is made. The timed release entry causes the AMA accounting center equipment to deduct a time allowance from the elapsed time of the call. In the case of a calling tip party, the false ground test and trunk restoration to normal will not take place until the calling customer disconnects.

### C. Call Through AMA—1-Plus Call

**4.26** The preliminary operation of the AMA equipment for 1-plus calls is the same as described in 4.03 through 4.07. After the identifier-trunk connector has been cut through, the identity of the trunk digit is transmitted to the identifier. A ground is extended from the trunk circuit through the identifier-trunk connector which operates the PO relay in the identifier. This relay signals the identifier that a translator circuit is required, rather than a code connector, for code reconstruction.

**4.27** The translator circuit is seized via a preference circuit and the identity of the trunk digit and first two sender digits are presented to it for translation. The translator steers the 3-digit code to a single code punching. This code punching (C\_) is cross-connected at the translator to one of 30 area route (AR) punchings. If the office is equipped with a DOC circuit, the AR punchings are wired to the DOC circuit which causes a route relay or DOC relay to be operated in the identifier. If the office is not equipped with DOC, the AR punchings are cross-connected to route relays. Fig. 32 shows the route relay operating path for 1-plus dialing calls.

**4.28** The operation of the AMA equipment elements are the same as those described in 4.10 through 4.25 for the remainder of 1-plus call processing.

### D. Automatic Number Forwarding Call

**4.29** The ANF equipment elements are arranged to process two types of calls to operators at a TSPS office: (a) person-to-person [0+ dialing]

calls, which shall be referred to as special toll calls and (b) operator assistance [0 operator] calls. For special toll calls, the calling customer who is served by the ANF equipment dials zero plus the directory number assigned to the person to whom the customer wishes to talk. For operator assistance calls, the calling customer requests operator assistance for completing calls. ANF outgoing trunk circuits can be arranged to handle either (or both) type of call.

**4.30** The ANF outgoing trunk circuit is seized by a calling customer from the "0" level of a first selector. A party test is performed either upon seizure (operator assist calls) or after the first digit has been dialed into the trunk circuit. The trunk circuit repeats the called number digits to the TSPS office as they are dialed into the trunk circuit (special toll calls only). Upon completion of the party test, the trunk circuit performs a test (self-check) of the party test relays to insure that they are properly adjusted.

**4.31** After the called number has been registered and the party test has been performed, the trunk circuit bids for an idle outpulser through a preference circuit in the outpulser connector to which it is associated. The party indication (tip or ring) is transmitted to the outpulser after it has been connected. The outpulser then makes an abandoned call check to insure that the calling customer is still connected. The outpulser bids for an idle identifier through the identifier-outpulser connector for identification of the calling number.

**4.32** Identification of the calling number is performed as described in 4.11 through 4.14. From contacts of the operated thousands, hundreds, tens and units relays in the identifier, information is transmitted to the outpulser as to the calling number. This is ultimately outpulsed to and recorded in the TSPS office.

**4.33** The outpulser stores the calling number digits as received from the identifier on its register relays. The outpulser checks the calling number through a relay contact network and tests the continuity of the outgoing tip and ring leads toward the TSPS office. Upon completion of a successful trunk test, the outpulser outpulses the calling number on a multifrequency basis to the TSPS office. If the calling number has been successfully identified, the number of digits outpulsed is ten (includes KP signal and information digit). The outpulser releases upon completion of outpulsing,

and control of the trunk is given to the TSPS office.

**4.34** After customer disconnect, the trunk circuit performs a ground removal test on all calls previously identified as being tip party originated. If the test is successful (ground not present), the trunk circuit restores to normal. If the ground removal test fails, an outpulser is again connected and a trouble record made.

#### **E. Dynamic Overload Control**

**4.35** The DOC circuit is activated under control of personnel at a remote toll tandem office. Control signals are transmitted either directly or relayed through a DOC circuit in another office from the toll tandem office to the DOC circuit. A maximum of eight control signals are generated to control the toll traffic in the AMA office. Predetermined cross-connects at the DOC circuit which are associated with each control signal restrict traffic on a 25, 50, 75, or 100 percent basis.

**4.36** If a call to a foreign area assigned to one of the control signal groups has been dialed, the AMA equipment initially functions the same as described for 1-plus calls (4.26 and 4.27). The DOC circuit then reroutes every call, every three out of four, every two out of four, or every one out of four calls (determined by cross-connects) to a DOC relay. If the DOC relay is operated, the AR\_ leads are opened between the translator and the identifier and route relay operation is blocked.

**4.37** The relay operated DOC signals the AMA outgoing trunk (via the identifier trunk connector) that the call is to be blocked. The AMA outgoing trunk causes the trunk finder, sender, identifier, identifier-trunk connector, and translator circuits to be released and connects the recorded announcement or reorder tone to the trunk circuit. The recorded announcement informs the calling customer of a high volume of toll traffic.

#### **F. Automatic Intercept System**

**4.38** Three classes of intercept calls are routed to an AIC:

- (a) Regular intercept (recently disconnected, changed, or unassigned numbers)
- (b) Trouble intercept (plugged up lines)

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- (c) Calls to unequipped numbers (vacant selector levels).

**4.39** On calls to unequipped numbers, the vacant code intercept trunk is seized from a selector multiple. The seizure starts a trunk finder and returns audible ringing to the calling customer. The customer receives an announcement telling him the number he reached is not in service and requesting him to check the number before dialing again.

**4.40** On trouble intercept calls, the trouble intercept trunk receives ringing current from the connector through a plugging up auxiliary line circuit. This causes the intercept trunk to bid for an outgoing trunk through a trunk finder. When the trunk finder cuts through, the ringing bridge is removed in the intercept trunk.

**4.41** On regular intercept calls, the auxiliary intercept trunk bids for an outgoing trunk through a trunk finder when a seizure signal is received on the sleeve lead from the connector. A connection is then established to provide the AIC with the called number. The connector is set to the ringing condition at the completion of called number identification and the outgoing trunk is set to trip ringing on the silent as well as the ringing intervals. This prevents ringing from being superimposed on the announcement received from the AIC.

**4.42** The trunk finder is arranged to pass class information through the outgoing trunk to the AIC. The outgoing trunk forwards this information to an outpulser arranged for intercept service. After the outpulsing is completed, the outgoing trunk cuts the customer through to the AIC. This circuit bids for an outpulser and forwards class information from the trunk finder to the outpulser. After outpulsing is completed, the transmission path is cut through to the customer.

### CAMA

#### A. General

**4.43** A general description of the progress of calls through a step-by-step CAMA office is given in the following paragraphs. Both ANI and operator identification of the calling line is discussed to illustrate the method of operation with the two types of identification. These descriptions will also

serve to illustrate the relationship of the various elements of equipment.

**4.44** Fig. 35 is a block diagram of a step-by-step CAMA office. A local step-by-step customer must first dial an access code to reach a CAMA office. A typical access code is 1. When the customer dials the code, he is connected in the local step-by-step office to an outgoing trunk to the CAMA office. When the incoming CAMA trunk at the step-by-step CAMA office is seized, it causes a link circuit to select an idle register (connections 1 and 1A). This connection is established during the interdigital time between the dialing of the directing code and the dialing of the area code or the office code. No indication is returned to the customer that a register has been attached. The customer continues to dial the called number without pause. If a register is not attached in time to receive the incoming digits, the trunk is arranged to return reorder tone to the customer.

**4.45** The incoming digits are registered in the register, which has a maximum capacity for 10 digits. The register circuit can process 3-, 7-, or 10-digit calls. If the office is equipped with a pretranslator, a request for the pretranslator circuit is made after the start of the fourth digit in the register (connections 2 and 2A). When the last digit to be received has been stored in the register, the register causes a signal to be sent through the trunk to connect to an idle sender (connections 3 and 3A).

**4.46** The trunk secures access to the sender through the trunk finder. When the sender is attached, it signals the register that it is ready; then the register outpulses on an MF basis the digits it has registered. After outpulsing the called number, the register is released.

**4.47** If the call originates on an MF basis from a No. 5 crossbar office, a No. 1 ESS office, a TSPS No. 1 office, or an operator, a sender is requested immediately after the incoming CAMA trunk is seized. When an available sender is attached, the called number is then registered directly in the sender.

**4.48** When the sender has registered the sixth digit, it proceeds to call in a decoder through the decoder connector (connections 4 and 4A). However, when the sender is equipped with the interchangeable code feature, it is necessary that

called number registration be completed before connection to a decoder is requested.

**4.49** When the decoder is attached, the sender presents to it the first three or six digits it receives. The decoder uses this information (and in some cases, other information) to determine the routing necessary for the call. It instructs the sender (a) which of the received digits must be outpulsed, (b) which arbitrary digits must be prefixed, (c) which type of outpulsing must be used, and (d) which trunk class information requested by the sender must make or bypass the AMA record. After transmitting this information, the decoder is released.

**4.50** Associated with the decoder are circuits and features which may be provided on an optional basis. One of these circuits, the foreign area translator, is actually a part of the decoder. The foreign area translator is used to provide additional routing information when required.

**4.51** Another optional circuit, the trunk class translator, is provided when the incoming trunks require different class marks. When this is necessary, the trunk class translator provides the class marks of the incoming CAMA trunks to the decoder.

**4.52** A group busy feature is also provided on an optional basis. This feature permits the decoder to determine if there is an idle trunk available in an outgoing trunk group.

#### **B. CAMA Call With Operator Identification**

**4.53** If necessary, the sender completes its registration of the called number while the decoder is engaged. When it has registered the last digit, the sender proceeds to make a bid for a CAMA position (connections 6 and 6A). If for some reason there is a delay in obtaining an operator, audible ringing tone is returned to the customer until the talking path is established.

**4.54** When a position is attached, the operator is given order tone and a talking path is established between the operator and the customer. The operator then obtains the calling number and MF keypulses it into the sender.

**4.55** On calls which route to or through common control offices, the sender begins outpulsing

with the start of the registration of the calling number. However, if the call does not go through a common control office, the sender will start outpulsing as soon as the decoder is released and registration of the called number is completed. In either case, the last digit is not outpulsed until the CAMA recording is completed. With this method of operation, level-hunting connectors in terminating offices must be modified to wait until the units digit is received before they start hunting for an idle line.

**4.56** A transverter is seized by the sender after the sender has received the units digit of the calling number (connections 7 and 7A). The transverter receives from the sender the details necessary to make a charge record of the call. It translates this information into a form satisfactory for recording and then secures access to a perforator through the recorder and recorder connector (connections 8 and 9).

**4.57** The recorder is essentially a preference circuit controlling the access of various circuits to the perforator. In addition, a number of check functions are incorporated in the recorder to ensure the accuracy and reliability of the AMA records.

**4.58** The perforator records the charge data on the AMA tape. Near the end of the initial entry, the trunk circuit identifies itself to the recorder through the call identity indexer (connections 10 and 11) and causes a call identity index to be perforated on the tape.

**4.59** After the initial entry has been perforated, the transverter is released and the sender outpulses the units digit and releases. The control of the call is then restored to the incoming trunk.

**4.60** The trunk now waits for called party answer supervision, which it times to distinguish between busyback or overflow signals and a called party answer. This feature is referred to as charge delay timing and requires a steady *off-hook* of 2 to 5 seconds before charging is begun.

**4.61** When it is determined that the call was answered, the trunk circuit calls in the AMA recorder through the call identity indexer and indicates that an answer entry should be perforated. Upon completion of the perforation of the answer entry, the recorder signals the trunk circuit to remove the entry request.

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**4.62** As soon as the calling party disconnects, the trunk partially restores to normal and releases the connection through the switches.

**4.63** Simultaneously, the trunk puts in a bid for the recorder to perforate a disconnect time entry. When the disconnect time entry has been perforated, the trunk is fully restored to normal.

### C. CAMA Call With Automatic Number Identification

**4.64** ANI is a method of automatically obtaining the calling customer directory number by means of equipment located in the originating office. This equipment will identify individual, 2-party, and PBX directory numbers, and is arranged to output this information to the CAMA office by means of MF pulses. The ANI system cannot identify multiparty (4 or more) directory numbers.

**4.65** On an ANI class call the sender, after receipt of the called number, signals the originating office to identify and output the calling number. The calling number is registered directly into the sender. The call then proceeds as previously described for operator identification, except that the sender starts outputting when it receives the (start) signal from the ANI equipment.

**4.66** If the ANI equipment cannot identify the calling number, a distinctive signal is sent to the CAMA office. Upon receipt of this signal, the sender will connect to an operator position. The operator receives a distinctive tone to identify the call as one that is normally ANI and proceeds to obtain the calling number and key it into the sender.

### D. Non-CAMA Call

**4.67** The CAMA equipment constitutes a separate train designed to handle CAMA calls. The only exception to this statement is for calls originated from and already recorded at a No. 5 crossbar LAMA office. These calls may be received on a non-CAMA MF basis. Use may be made of the CAMA senders and decoders to route through the CAMA selectors and to alternate route, if desirable. This is the only non-CAMA traffic which this system is designed to serve.

## 5. MAINTENANCE FEATURES

### LAMA

#### A. Trouble Recorder

**5.01** The trouble recorder records troubles encountered during service and test calls. Cards provided in the trouble recorder are perforated automatically, providing information regarding failures on service and test calls. The punched cards are gathered and analyzed for determining the source of trouble. Bell System Practices Section 227-200-300 describes trouble record card analysis.

**5.02** The identifier, translator, recorder, master timer, and outputter circuits have direct access to the trouble recorder (Fig. 23). Each of these circuits must wait until the perforator restores to normal before it can seize control of the trouble recorder. If a circuit does not gain access to the trouble recorder, a display loss indication at the trouble recorder frame is given.

#### B. Automatic Trunk Test Frame

**5.03** The automatic trunk test (ATT) frame as described in 3.93 is used for both automatic and manual testing of AMA outgoing trunks. Routine testing is normally performed on an automatic basis. The ATT frame can be arranged to either pass over all busy trunks or to wait until the trunk becomes idle before testing and progressing to the next trunk. Manual testing is usually applied as a result of trouble record card analysis. Bell System Practices Section 227-233-500 provides a method for performing trunk testing at the ATT frame.

**5.04** The ATT frame is arranged to provide audible and visual alarm indications for trunk test failures. The ATT circuit description (CD-32206-01) provides a list of the lamps that will be lighted if the ATT blocks and stops progressing. It also lists the trouble condition which caused the blockage.

**5.05** Trunk transmission and voltmeter tests can be performed on a manual basis at the ATT frame. The voltmeter tests are usually applied to AMA trunks (a) which are being connected for service and (b) which have indicated a trunk guard failure condition on the AMA trouble record card. Jacks and keys are provided at the ATT frame for connecting to portable transmission testing

equipment which facilitates transmission testing. Refer to CD-32206-01 for voltmeter and transmission testing methods.

**C. Sender-Identifier-Transverter Test Frame**

**5.06** The SITV test frame is arranged to provide automatic testing of senders and manual testing of senders, identifiers, transverters, translators, and DOC circuits. The SITV can be utilized for both routine and trouble testing. Trouble testing is usually initiated as a result of analyzing trouble record cards. The following Bell System Practices cover the use of the SITV:

SECTION	TITLE
227-221-500	Identifier
227-223-500	Translator
227-239-500	Sender
227-245-500	Transverter
227-252-500	Dynamic Overload Control

**D. Calling Line Verification**

**5.07** Calling line verification tests can be performed at the SITV test frame or at a calling line verification frame located remotely from the SITV frame. In making these tests, the lines to be checked are seized through a test distributor and the call is terminated on a trunk to the test equipment. The regular office equipment is utilized in the same manner as if a call were being originated from the line. When the calling number to be verified has been identified by the identifier, this information (as well as the class) is passed to the test circuit where it is matched against the calling number and class settings on switches or passed to a line verification unit where a lamp display is given.

**5.08** A block diagram of the equipment connections required for obtaining calling line verification is shown in Fig. 33. Access to the subscriber's line which is to be verified is obtained through a test distributor and test connector in the step-by-step office. The customer line circuit is seized and a dial tone connection is established via a line finder to a first selector. The calling line verification unit, under key control, pulses a 2- or 3-digit code

which completes a connection back to the verification unit. A sender is seized and one or two digits are pulsed into the sender which causes an identifier to be connected. The identifier sends out ac tone over the sleeve lead, through the selector switch train, connector bank terminals, thousand number frame, common number and class, and back to the identifier which identifies the number. The identified number is matched against the calling number switches on the line verification unit on the SITV or displayed on lamps at the line verification test frame. A matched condition, when testing at the SITV, causes the LVM lamp to be lighted, whereas an unmatched condition causes the LVF lamp to be lighted.

**E. Master Timing Circuit**

**5.09** In addition to controlling the timing of the AMA system, the master timing circuit provides means for checking the operation of the recorders. Any regular AMA recorder or emergency recorder can be tested by the use of this circuit. The recorder test is a manually controlled test in which all the perforator magnets in the recorder, as well as many operational features, are checked. If the recorder fails to perform any of its functions under these tests, the trouble recorder is called in and a minor alarm is sounded.

**5.10** A jack and lamp panel used in conjunction with the recorders is located at the master timing frame. The jacks are provided for routine testing of recorders and the emergency recorder, battery supply, remote control test operation, and frame-line telephone circuits. The lamp panel is used to indicate recorders under test, recorders waiting, recorders in trouble, and recorders out of synchronism.

**5.11** The following maintenance arrangements are also provided on this frame:

- (a) Means for exercising the various selector switches of the master timer which control the timing operations. After exercising such switches, it is necessary to synchronize them with the master timing circuit in control.
- (b) Transfer of control of time pulses for the recorders from one master timer to the other.

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- (c) Synchronization of the timers and the recorder. Alarms are provided to indicate when one of the master timers is out of synchronism with the other or when the master timer and recorders are out of synchronism.

### F. Recorder Transfer

**5.12** To allow for the maintenance on regular AMA recorders, means are provided to permit the traffic handled by any one recorder to be transferred to the one emergency recorder provided. When a transfer is made for a regular recorder to the emergency recorder, the call identity indexer circuit associated with a particular recorder is transferred to the emergency recorder.

**5.13** The master timer is called in and controls the perforation of the end-of-tape pattern. This pattern is perforated first on the regular AMA recorder tape and then on the emergency recorder tape. The emergency recorder substitutes for the regular AMA recorder and performs all the normal recording functions. When service is restored to the regular AMA recorder, an end-of-tape pattern is perforated first on the emergency recorder tape and then on the regular AMA tape. The emergency recorder is then released and the AMA recorder placed in service.

### G. Trunk And Outpulser Test Frame

**5.14** The trunk and outpulser test frame described in Part 3 is provided for automatic and manual testing of the ANF and AIS outgoing trunks and outpulsers. Individual trunks or outpulsers can be selected for testing on a manual basis only. Automatic testing has three modes of operation:

- (a) **Outpulser Tests**—A series of tests are applied to each of the outpulsers in turn, until all outpulsers have been tested.
- (b) **Trunk Tests**—A series of tests are applied to each ANF and AIS trunk in turn, until all ANF and AIS trunks have been tested or a trouble has been encountered.
- (c) **Trunk and Outpulser Tests**—A series of tests are applied to the outpulsers in turn, and then advanced to the trunk testing mode; a series of tests are applied to each ANF and AIS trunk until all trunks have been tested or a trouble has been encountered.

**5.15** Trunk and outpulser tests using the trunk and outpulser test frame are covered in Bell System Practices Sections 227-225-500 and 227-228-500, respectively.

## CAMA

### A. General

**5.16** The basic provisions for maintenance of step-by-step CAMA offices consist of the following:

- (a) Arrangements for providing notice of and information about failures occurring on service and test calls.
- (b) Testing equipment for various circuits and associated apparatus.
- (c) Means for removing equipment from service.

**5.17** The maintenance equipment is mounted on a single bay frame called the trouble ticketer and test frame (Fig. 42). The manual test circuit and other relay equipment are located on the lower part of this frame. Above this, about 3 feet from the floor are a writing shelf and pigeon holes. Next are the trouble ticketer, the plant registers, and the jack, key, and lamp panels. The remaining space is used for additional relay equipment.

**5.18** The manual test circuit is used with a portable test set to test various circuits in the office. The tests may be made from the test frame or at the frame of the equipment under test.

**5.19** Arrangements have been included for audible and visual alarms to indicate failures occurring on service and test calls. If the office is unattended, arrangements have been made to modify the alarm checking terminal to indicate major and minor CAMA troubles.

### B. Trouble Ticketer

**5.20** The primary function of the trouble ticketer is to facilitate the location of troubles in the office. The trouble ticketer may be called in by a decoder, transverter, recorder, or master timer. If, during a service call, the circuit fails to complete its function in the allowed time or detects a fault by other means, a trouble ticket

will be made. In addition, a trouble ticket (Fig. 43) can be forced on test calls.

**5.21** The trouble ticket contains 42 printed characters. The first two and last two are always asterisks and are used as a margin to ensure that none of the digits are lost when the ticket is cut. The first digit after the asterisk indicates the originating circuit as follows:

0,1—Even or odd master timer

2-5—Transverter 03

6,7—Decoder 0 or 1

8,9—Regular or emergency recorders.

Depending upon the type of circuit initiating the request for the trouble ticket, the remaining digits provide such information as the progress of the call, time-out conditions, the identification of connecting circuits, crosses, grounds, or other trouble conditions, and the time at which the failure occurred.

**5.22** When the trouble ticketer is seized an alarm is sounded. This may be a major or minor alarm, depending upon which circuit requested the ticket and whether the trouble occurred on a first or second trial. The alarm can be retired by the operation of a key.

**5.23** A preference chain is provided in the trouble ticketer to permit connection to only one circuit in case of simultaneous seizures by more than one circuit. In case of simultaneous seizures, the highest circuit in the chain will be served, the others will be released, and a display lost lamp will be lighted.

**5.24** The master timer makes recorder test and special entries (such as 3 AM, splice, etc). While these tests and entries are being made, a trouble ticket cannot be printed for a recorder or transverter; and the trouble ticketer is made busy to these circuits. The decoder, however, can cause a ticket to be printed while the tests are being made.

**5.25** If a circuit tries to seize the trouble ticketer when it is busy, it will withdraw the request, light a display lost lamp, sound an alarm, and then return to normal and be free to serve other calls.

**5.26** During regular operation, when a trouble ticket is printed, the previous ticket is cut off and dropped into a bin. To permit a ticket to be examined immediately after it is printed, a ticket eject feature is provided. After a ticket has been printed, the operation of a key will cause another ticket to be printed (all dashes) and the desired ticket to be cut off.

**5.27** Jacks are provided on the jack, key, and lamp panel to permit the trouble ticketer to be made busy to all connecting circuits or to any selected connecting circuit.

### C. Manual Test Set And Circuit

**5.28** The manual testing equipment for step-by-step CAMA consists of a test circuit and a jack, key, and lamp panel on the trouble ticketer and test frame and a portable test box which may be patched to the test circuit at the trouble ticketer and test frame or at any one of a number of the belt line appearances at the CAMA equipment frames. The portable test set is shown in Fig. 44.

**5.29** The circuits that may be tested are trunks, links, senders, incoming registers, transverters, decoders, and trunk finders. The trunk finder tests are made at the trunk finder frame and do not require the use of the portable test set.

**5.30** The portable test set is equipped with the following:

- (a) A start key (START) to put the circuit in operation.
- (b) A 10-button keyset for keying the calling and/or the called number.
- (c) A register reset key (RS) to permit rekeying the calling number if an error is discovered before completion of keying.
- (d) A single frequency key (SF) to permit the maintenance man to test the action of the sender if it receives one frequency rather than two.
- (e) A KP key to condition the MF receiver to receive pulses.
- (f) A start key (ST) to indicate that all digits have been keyed.

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- (g) A dial to place a dial pulse test call.
- (h) A CI key which permits the maintenance man to key in the calling number rather than call an operator.
- (i) An answer key (ANS) which permits the test set to simulate called party answer.
- (j) A busy key (BSY) which makes the outgoing trunk test busy and permits testing of the alternate route feature.
- (k) A stop dial key (SD) to permit a stop dial signal to be sent to the sender after one or two digits have been outpulsed. Release of the key provides an on-hook signal.
- (l) A position disconnect key (PD) to test this feature in the sender.
- (m) A numerical indicating lamp which displays the pulsed digits to check the output of the various circuits.
- (n) A nonlocking digit control key (DC) which permits the digits to be displayed one at a time rather than at the rate that they are pulsed. If the DC key is operated momentarily when the test call is started, the display of the first digit will remain until the key is again operated. Each operation of the key will advance the circuit to the next digit.
- (o) An initial entry lamp which lights when the initial entry is made. This lamp is retired when the answer entry is made.
- (p) An answer entry lamp which lights when the answer entry is made and goes out when the disconnect entry is made.
- (q) A busy lamp which lights to indicate that the connecting circuit is busy and which flashes as a reorder signal.
- (r) An RV lamp which lights to indicate that the sender is ready to receive the calling number and when retired indicates that the connecting circuit has disconnected.
- (s) A position lamp which, when flashing, indicates that the test circuit simulating a position is being reordered.

## 6. MISCELLANEOUS FEATURES

### GENERAL

**6.01** Service observing facilities are provided in step-by-step CAMA offices for observing the speed and accuracy with which traffic through the CAMA office is provided. Information from such observations is used to increase the efficiency of the CAMA office. Observations may be made at a No. 7 or No. 12 service observing desk.

**6.02** Complaint observing has not been provided in step-by-step CAMA, since all calls are detail recorded.

**6.03** The service observing facilities are described briefly below. A more detailed description is given in Bell System Practices Section 984-525-100, which is a general description of the No. 12 service observing desk.

**6.04** Incoming CAMA trunks on which service observing is desired are wired to jack appearances at a patching panel where they may be patched to a maximum of 30 loop conductors associated with a trunk to the service observing desk. This trunk handles only one call at a time; and at the desk end of the trunk, the call is assigned by a call distribution circuit to a position arranged for CAMA service observing. Generally, a 20 percent maximum of the incoming CAMA trunks are arranged for service observing.

**6.05** When connection to the observing position is established, the incoming CAMA trunk gives an observing mark to the sender, which passes it on to the CAMA equipment. The observing mark is put on the AMA tape and compared at the accounting center with the observing records.

### KEY MONITORING FACILITIES

#### A. General

**6.06** Two arrangements of key monitoring facilities for use in monitoring operations and in observing the keying performance of an operator in a CAMA office are discussed below.

- (a) Key monitoring facilities at a CAMA cordless position may be used to monitor CAMA cordless positions only.

(b) Key monitoring facilities at a DSA or toll switchboard may be used to monitor on CAMA cordless positions, on combined CAMA and DSA (or toll) switchboards, and on regular DSA or toll positions.

**B. Combined CAMA And Key Monitoring Position**

**6.07** To use a CAMA position for key monitoring, the CAMA position must be modified by the addition of a key and display panel. This panel displays the keyed number and the number of the connected operating position. The operation of a key prepares a combination CAMA monitoring position for monitoring operations and makes the position appear busy to incoming CAMA traffic. When the key is normal, the position operates like a regular position.

**6.08** Means are provided whereby a monitor is connected to any desired CAMA position by keying the number of the position with the regular position keyset. When an operating position is connected to a monitoring position, the number of the operating position is displayed before the monitor. The operating position is released by the operation of the position disconnect key in the monitoring position.

**6.09** When a call is received in the CAMA position, the monitor receives an order tone. The monitor is able to hear all conversations between the calling customer and the CAMA operator. A display of the number keyed by the CAMA operator appears before the monitor unless deleted by the monitor operating register reset key.

**6.10** If the CAMA operator wishes to delete a registration and key again for any reason, the operation of the register reset key extinguishes the display before the monitoring operator and lights a reset lamp in the indicator display panel at the monitoring position. This lamp is locked in until the CAMA operator begins to key again and is extinguished by the subsequent keying of the first digit.

**6.11** If a CAMA operator receives a reorder signal from a sender, the monitoring operator receives a flashing lamp at the time of reorder. If the CAMA operator operates the position disconnect key, two lamps are lighted in the indicator display panel at the monitoring position.

**6.12** There is no partial registration of a call at the monitoring position, because the monitoring operator cannot be connected when a CAMA operator is in the process of handling a call. This also applies if a CAMA operator begins keying before the monitor is ready to begin monitoring; for example, a CAMA operator may key a call before the monitor has recorded the number and wiped out the display of a preceding call. If this happens, the keying of the succeeding number does not disturb the record of the previous number.

**C. Key Monitoring At A Toll Or DSA Switchboard**

**6.13** The DSA or toll positions used for key monitoring must be modified to monitor on CAMA calls. A jack is furnished at the monitoring position for each position to be observed. When a monitoring cord is inserted into this jack, a connection is established with the position to be monitored. The operation of a key at the combined DSA-CAMA or toll CAMA position to take up a CAMA call automatically arranges the monitoring circuit for monitoring on the CAMA call, and no action is required by the monitoring operator.

**7. TRAFFIC AND PLANT MEASURING FACILITIES**

**CAMA**

**A. Traffic Registers**

**7.01** The following traffic registers are available for the CAMA facilities:

- (a) All registers busy—one per register group
- (b) All senders busy—one per sender group
- (c) Permanent signal and partial dial—one per office
- (d) Pretranslator peg count—one per pretranslator, which scores on pretranslator seizure
- (e) Decoder peg count—one per decoder for 3- or 7-digit calls and one per decoder for 10-digit calls (first attempts only)
- (f) Position seizure peg count—one per position
- (g) Position disconnect peg count—one per office

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- (h) Transverter peg count—one per transverter, which scores for service calls only
- (i) Match check peg count—one per transverter group
- (j) Vacant calling office code peg count—one per transverter group
- (k) Irregular called code—one per office
- (l) Answering time recorder—one per office
- (m) No position attached—one per office

**7.02** The irregular called code register operates under any of the following conditions:

- (a) The first three digits are a vacant office code.
- (b) An area code is followed by a vacant office code.
- (c) An area code is followed by a code with a 0 or 1 in either or both of the next two digits in offices not arranged for interchangeable codes.

**7.03** The answering time recorder controls the scoring of two registers.

- (a) For each call, a register is scored when the sender starts for a position.
- (b) If a position is not attached within a predetermined time, a second register is scored.

**B. Plant Registers**

**7.04** The following plant registers are located on the trouble ticketer and test frame:

- (a) Stuck register—one per group of registers
- (b) Pretranslator time-out register—one per pretranslator circuit
- (c) Stuck sender—one per group of senders
- (d) Decoder peg count—one per decoder
- (e) Decoder first trial failure—one per decoder

- (f) Decoder second trial failure—one per office
- (g) Transverter first trial failure—one per transverter
- (h) Transverter second trial failure—one per transverter group
- (i) Trouble ticketer peg count—one per office
- (j) Recorder and recorder connector trouble—one per recorder
- (k) Master timer trouble—two per office—one for the even master timer and one for the odd master timer.

**C. Traffic Usage Recorder**

**7.05** The traffic usage recorder (TUR) is a measuring facility used in obtaining traffic load information on various circuits. The following CAMA circuits are arranged for connection to the TUR:

- (a) Incoming CAMA trunks
- (b) Registers—both maintenance and service busy, and maintenance busy only
- (c) Senders—service busy only
- (d) Transverters—both maintenance and service busy, and maintenance busy only
- (e) CAMA positions.

**7.06** The traffic load is measured by making repeated scannings of the busy test terminals for the circuits under study. The number busy is scored cumulatively. At the end of any period of time, the average traffic load carried can be determined by taking account of the number of scans and of the total number of busy conditions.

**7.07** A more detailed description of the traffic usage recorder is given in Bell System Practices Section 951-510-100.

**D. Call Count Process Control**

**7.08** Call count process control is a means of keeping an account of the calls or messages at various stages, beginning at the CAMA office

and extending through the AMA center. For this purpose, four 4-digit registers per recorder are provided at the CAMA office. These registers are automatically cut into operation on successive days during a 4-day cycle. The register is scored for each completed entry and test call perforated on the recorder tapes.

**8. SUPPLEMENTARY INFORMATION**

**Bell System Practices**

SECTION	TITLE
814-000-000	Step-by-Step Systems Index
814-005-150	General Outline—No. 1 and No. 350A Offices—Equipment Design Requirements—Step-by-Step Systems
814-005-152	General Outline—Common Control Facilities—No. 1, 350A, and 355A Offices—Equipment Design Requirements—Step-by-Step Systems
814-100-150	General Outline—Automatic Message Accounting—No. 1 Office—

SECTION	TITLE
	Equipment Design Requirements—Step-by-Step Systems
814-100-151	General Outline—(CAMA) Automatic Message Accounting Intertoll Dialing Office Equipment Design Requirements—Step-by-Step Systems
955-210-100	No. 1 Step-by-Step Offices—Automatic Message Accounting—General Description
955-310-100	Centralized Automatic Message Accounting—General Description Information—Step-by-Step Intertoll Offices
<b>Drawings</b>	
SD-31359-01	No. 1 SXS Office Keysheet
SD-90250-01	Master Keysheet
<b>Other</b>	
E-1392	Questionnaire for No. 1 SXS Offices

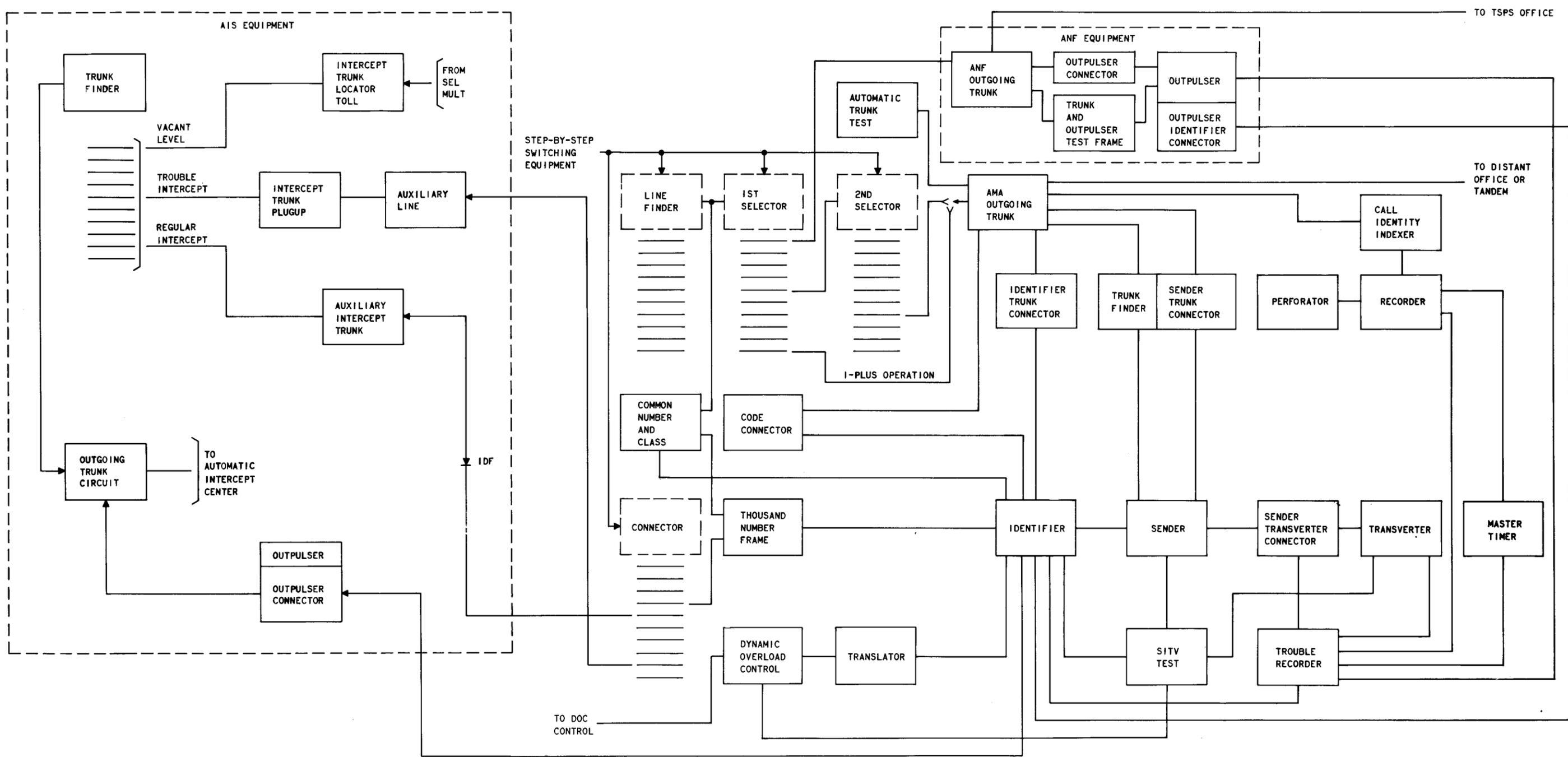


Fig. 1—Block Diagram Of Automatic Message Accounting Equipment

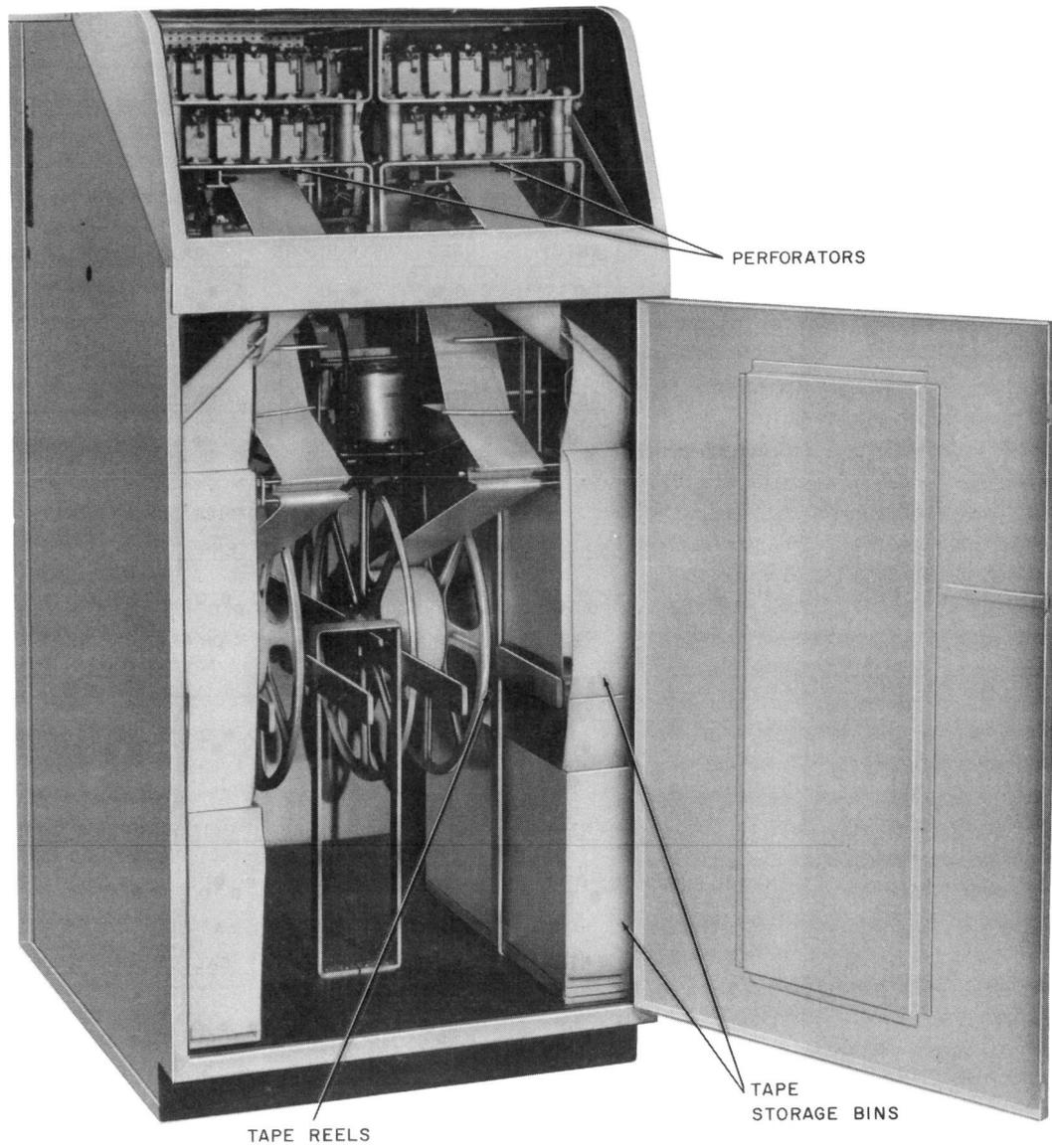
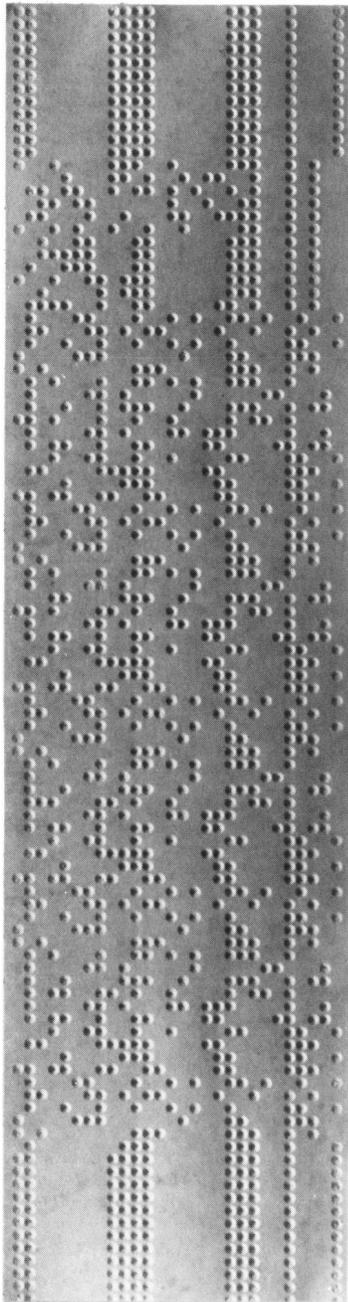


Fig. 2—Perforator Cabinet

TAPE FROM CENTRAL OFFICE RECORDER



TYPE OF ENTRY	INFORMATION RECORDED DIGITS					
	A	B	C	D	E	F
INITIAL ENTRY 7-DIGIT CALL 4 LINES	ENTRY	CALLED LINE NUMERICALS				NOT USED
	●●	●●●●	●●●●	●●●●	●●●●	●●●●
	0	TH	H	T	U	
	ENTRY	NOT USED	CALLED NO. STRUCTURE	CALLED OFFICE CODE		
●●	●●●●	●●●●	●●●●	●●●●	●●●●	
0		1 OR 4	A	B	C	
INITIAL ENTRY 10-DIGIT CALL 5 LINES	ENTRY	OFFICE INDEX UNITS	CALLING NO.			
	●●	●●●●	●●●●	●●●●	●●●●	●●●●
	0		TH	H	T	U
	ENTRY		MESSAGE BILLING INDEX	OFFICE INDEX TENS	CALL IDENTITY INDEX	
●●	●●●●	●●●●	●●●●	●●●●	●●●●	
2	3 OR 4	0 OR 9	0,3 OR 6	T	U	
ANSWER OR DISCONNECT ENTRY 1 LINE	ENTRY	CALLED NO.				NOT USED
	●●	●●●●	●●●●	●●●●	●●●●	●●●●
	0	TH	H	T	U	
	ENTRY	NOT USED	CALLED NO. STRUCTURE	CALLED OFFICE CODE		
●●	●●●●	●●●●	●●●●	●●●●	●●●●	
0		1 OR 4	A	B	C	
ANSWER OR DISCONNECT ENTRY 1 LINE	ENTRY	CALLED AREA CODE				
	●●	●●●●	●●●●	●●●●	●●●●	●●●●
	0			2-9	0,1	0-9
	ENTRY	OFFICE INDEX UNITS	CALLING NO.			
●●	●●●●	●●●●	●●●●	●●●●	●●●●	
0		TH	H	T	U	
ANSWER OR DISCONNECT ENTRY 1 LINE	ENTRY		MESSAGE BILLING INDEX	OFFICE INDEX TENS	CALL IDENTITY INDEX	
	●●	●●●●	●●●●	●●●●	●●●●	●●●●
	2	5 OR 6	0 OR 9	0,3 OR 6	T	U
	ENTRY	TIME IN MINUTES				CALL IDENTITY INDEX
●●	●●●●	●●●●	●●●●	●●●●	●●●●	
1	TENS	UNITS	TENTHS	T	U	

Fig. 3—AMA Paper Tape And Typical Entries

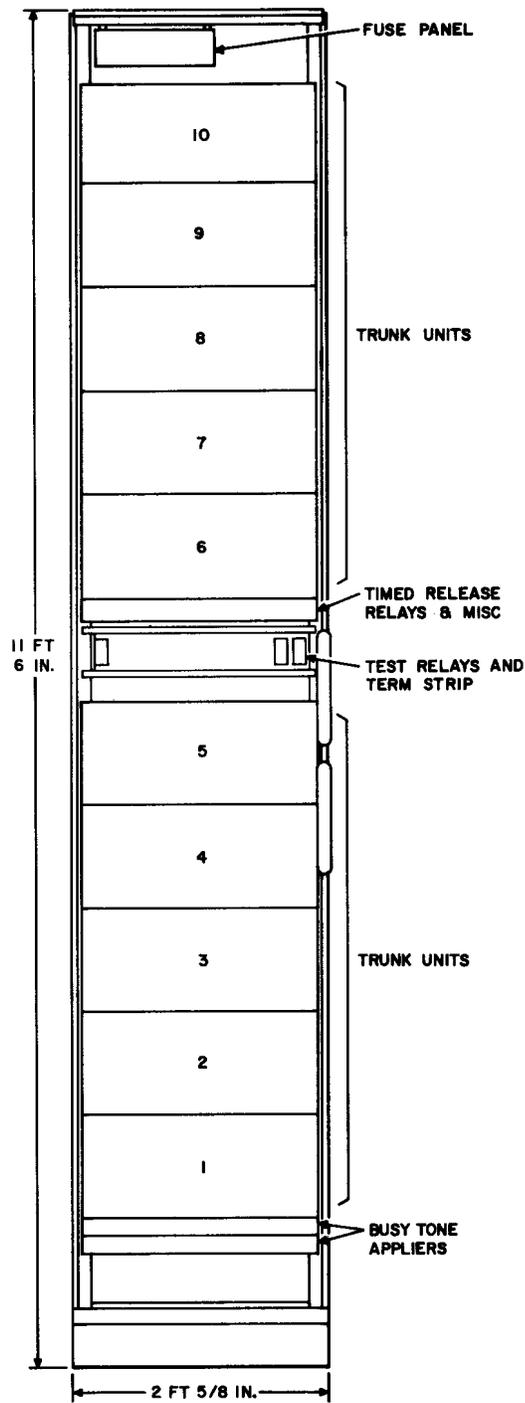


Fig. 4—Outgoing Trunk Frame

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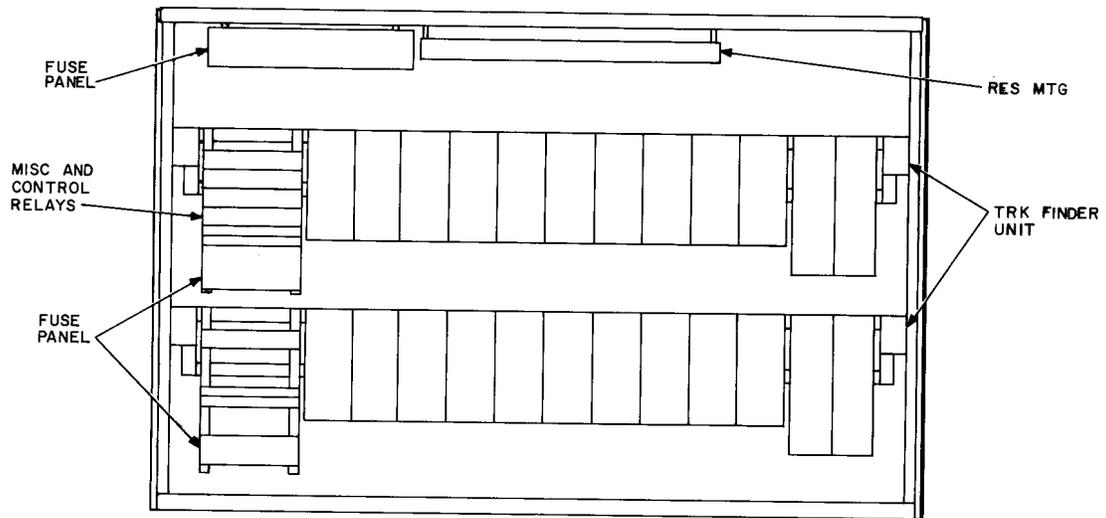


Fig. 5—Two Trunk Finder Units

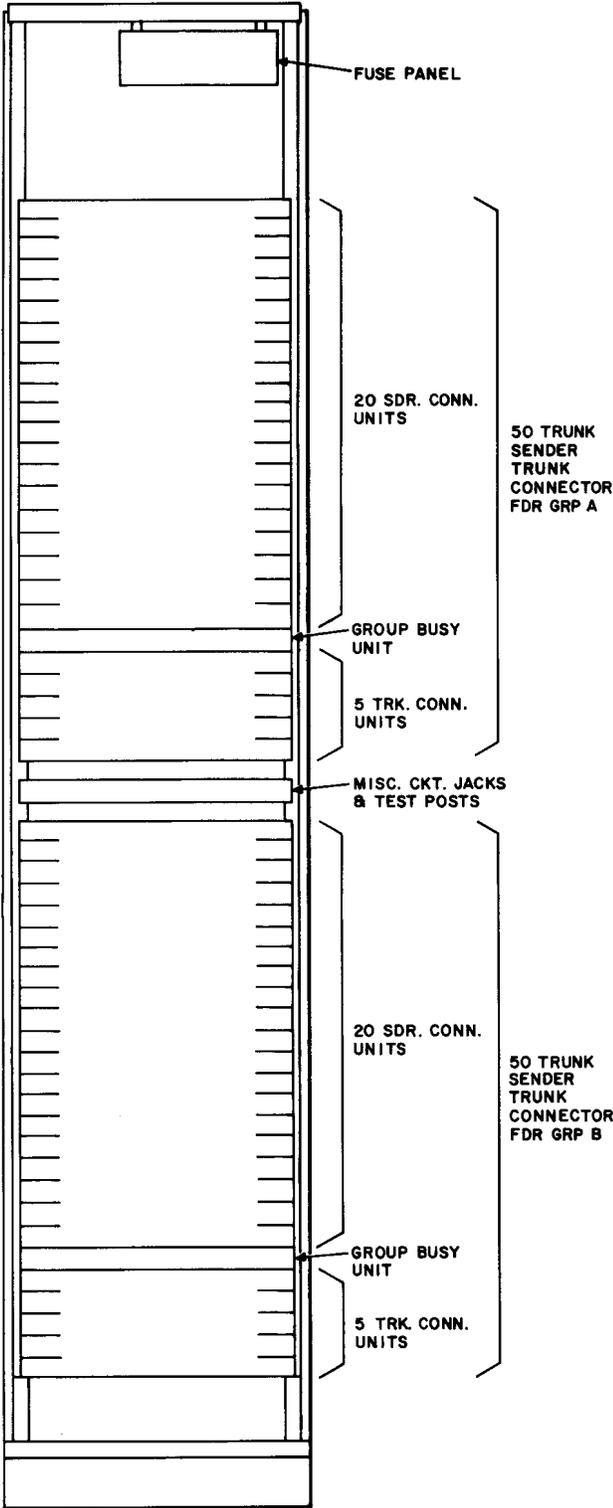


Fig. 6—Sender-Trunk Connector Frame

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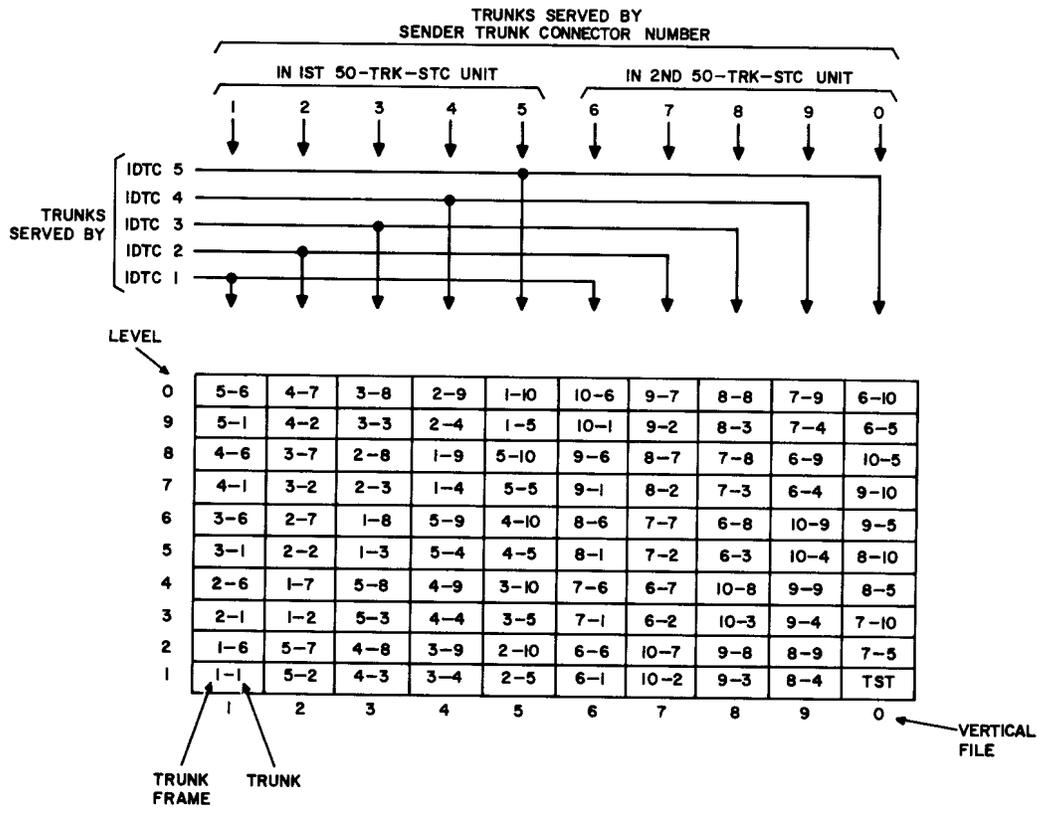


Fig. 7—Bank Of Trunk Finder 1 Showing Association Of Trunks, Trunk Finder Bank Terminals, Sender Trunk Connectors, and Identifier Trunk Connectors

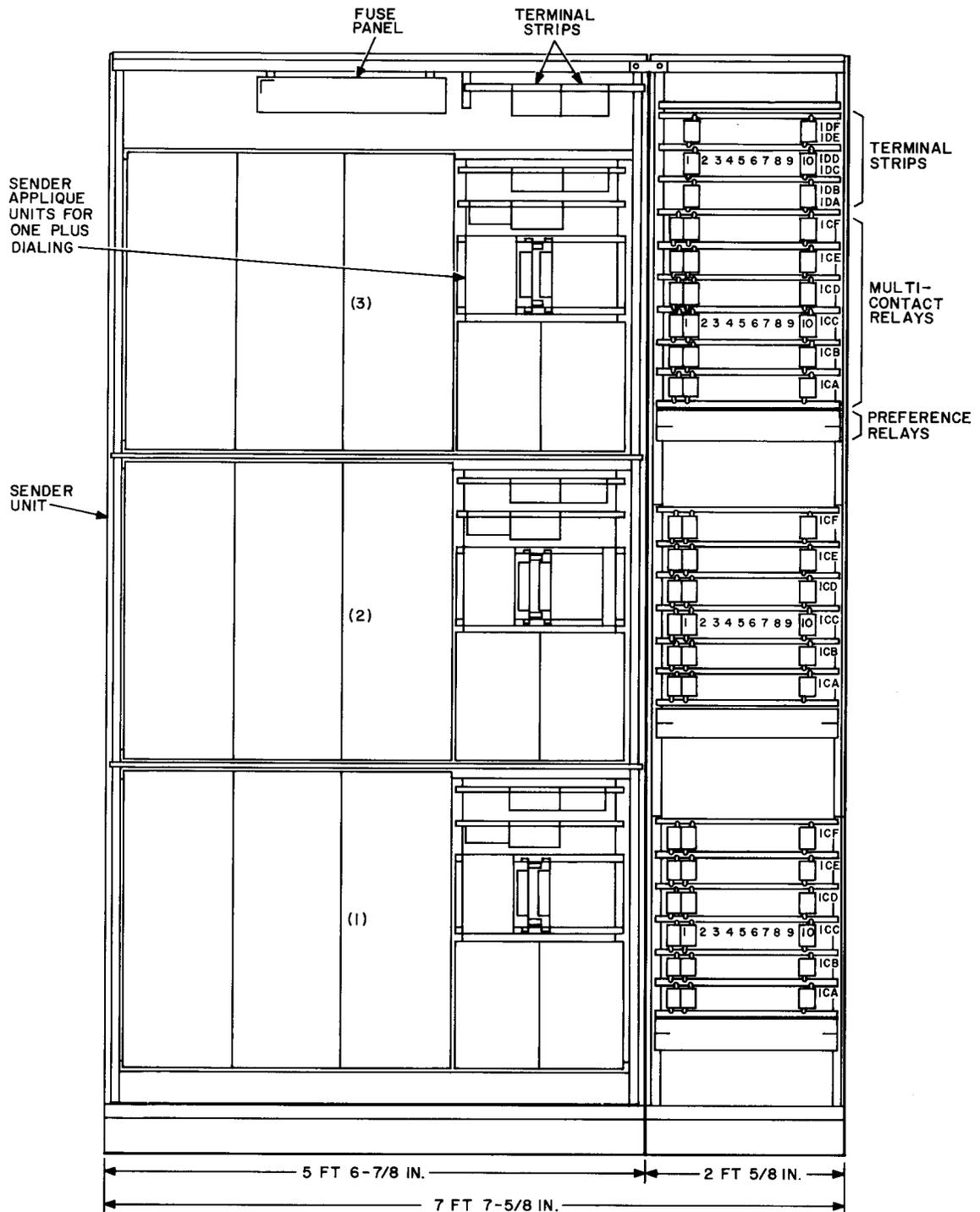


Fig. 8—Sender Frame



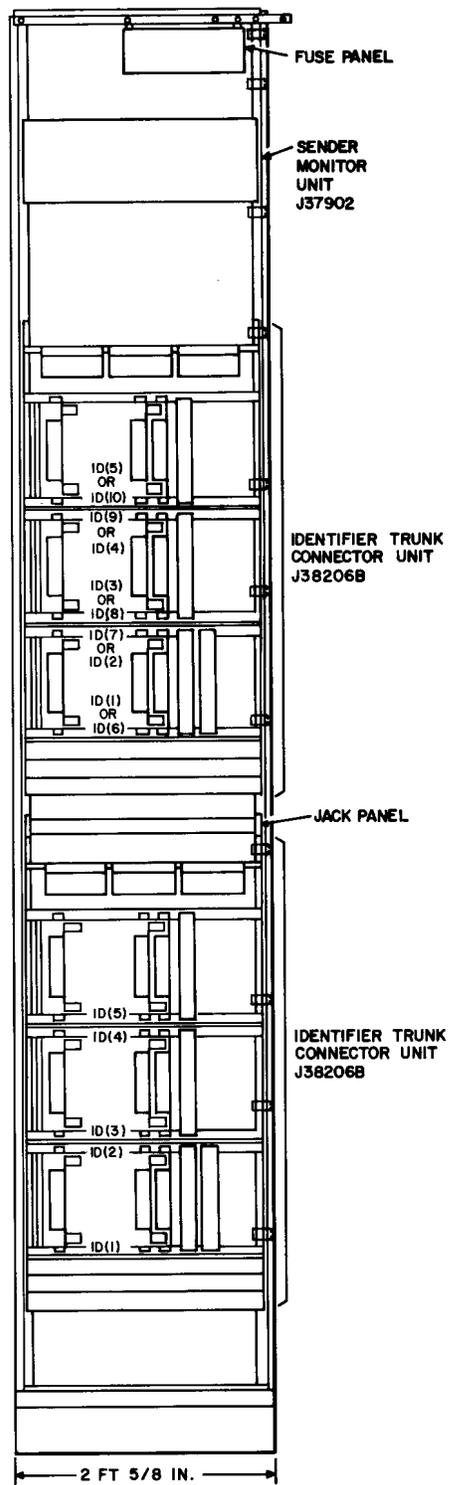
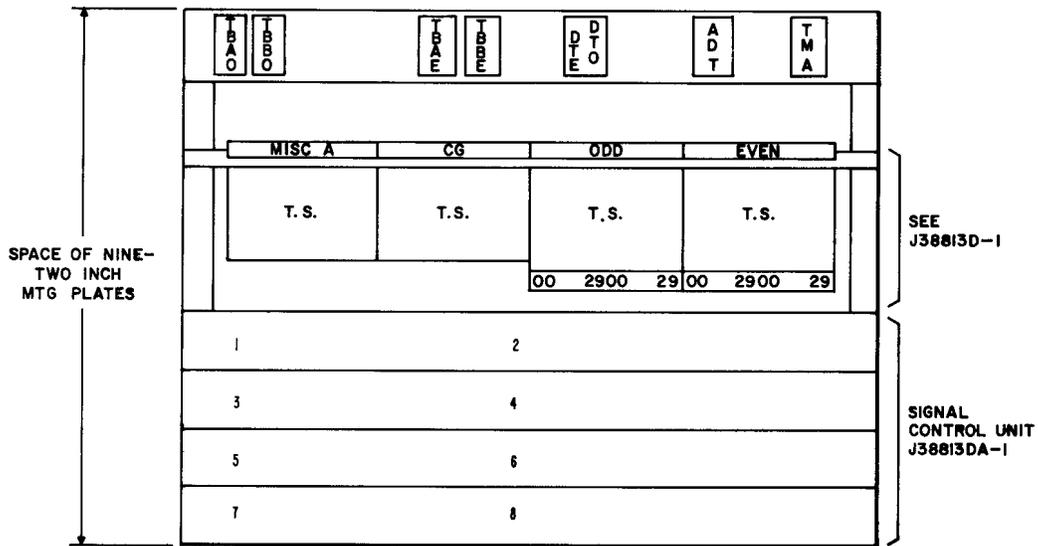


Fig. 10—Identifier-Trunk Connector Frame





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FRONT VIEW

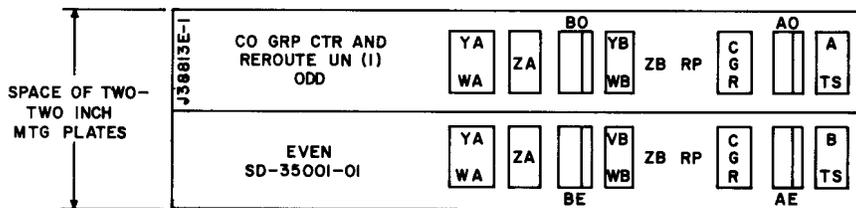


Fig. 14—Dynamic Overload Control Unit

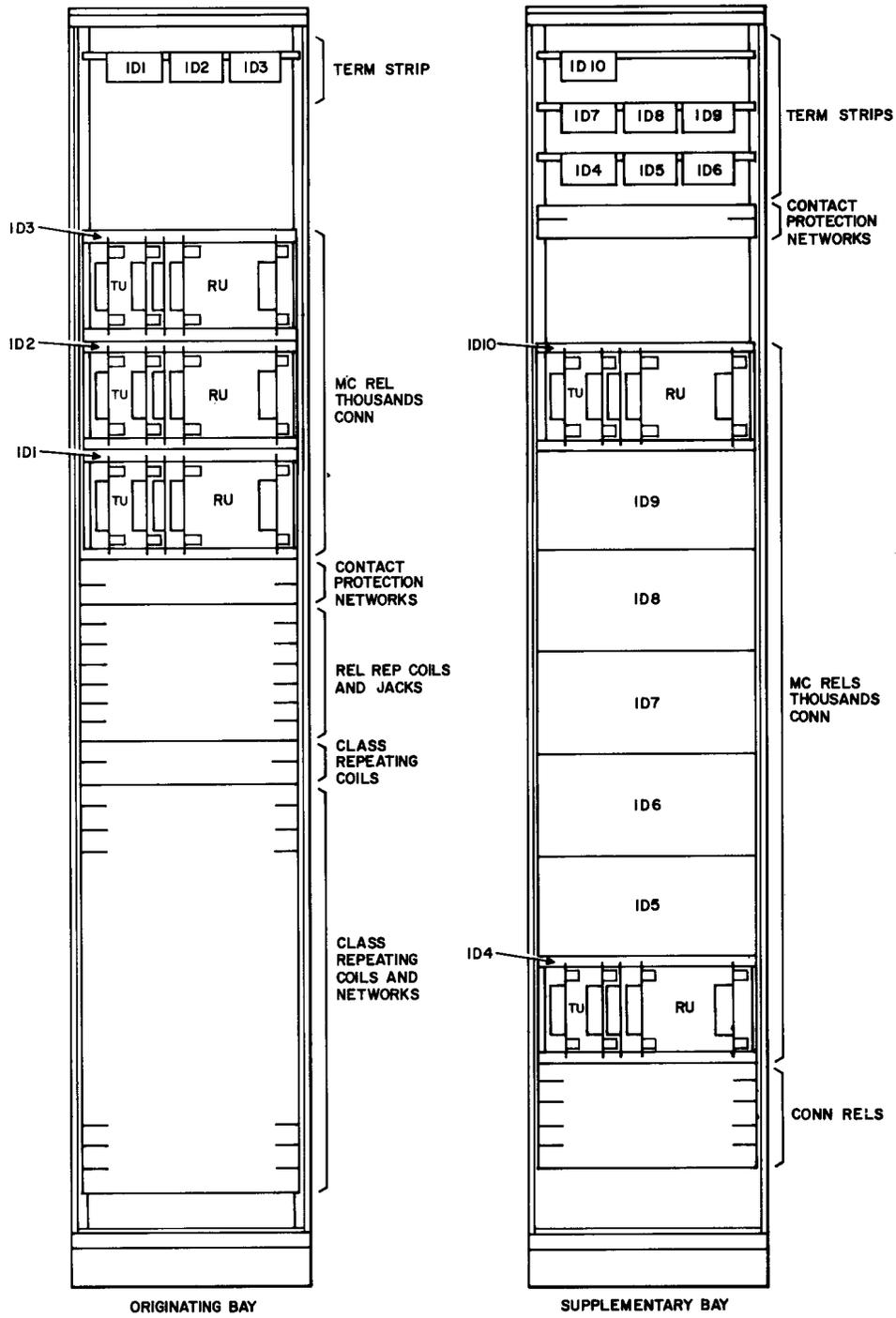


Fig. 15—Common Number And Class Frame

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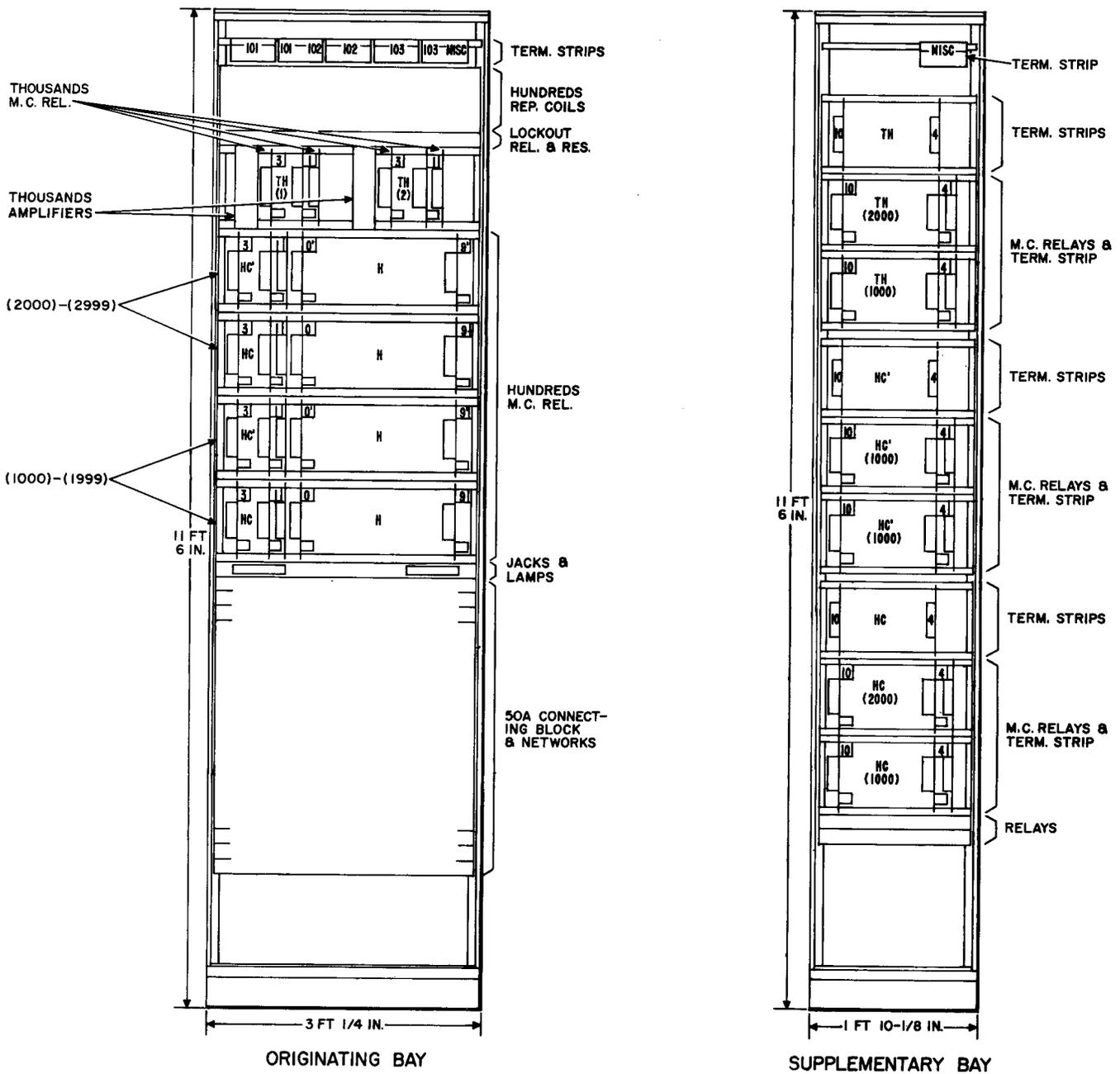


Fig. 16—Thousand Number Frame

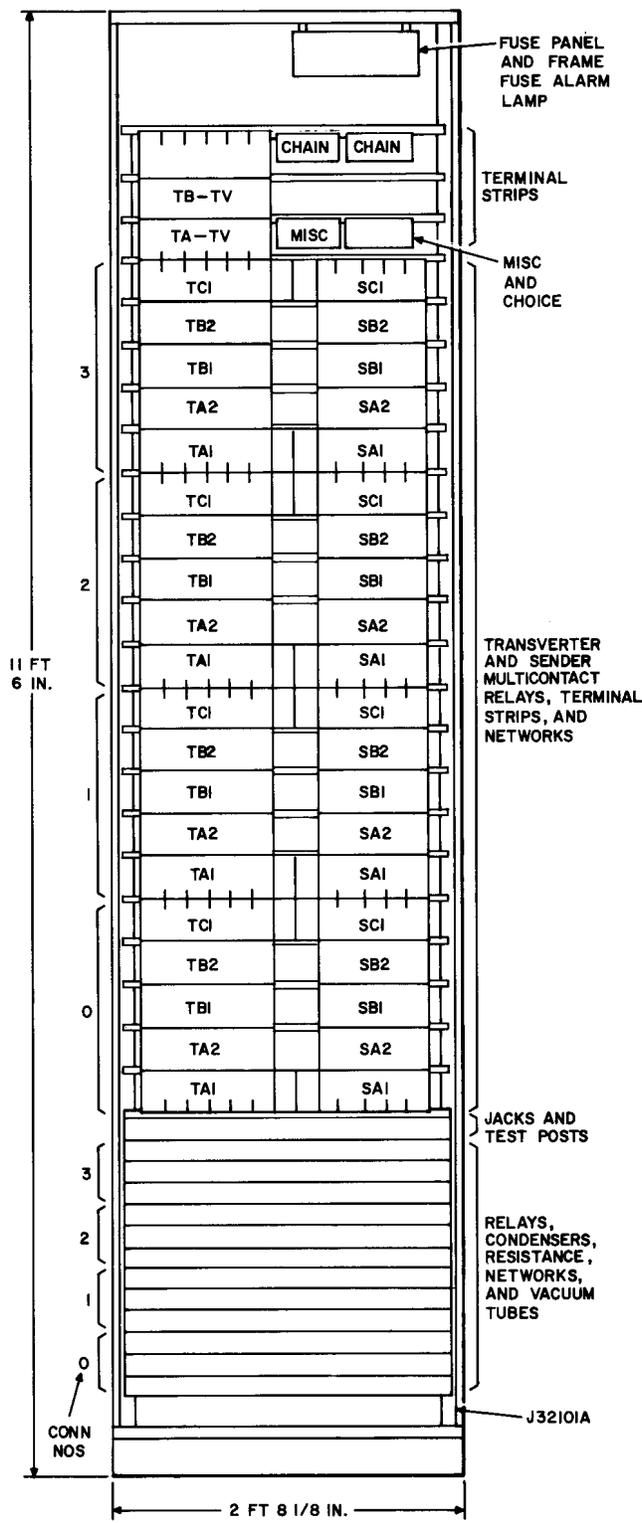


Fig. 17—Sender-Transverter Connector Frame

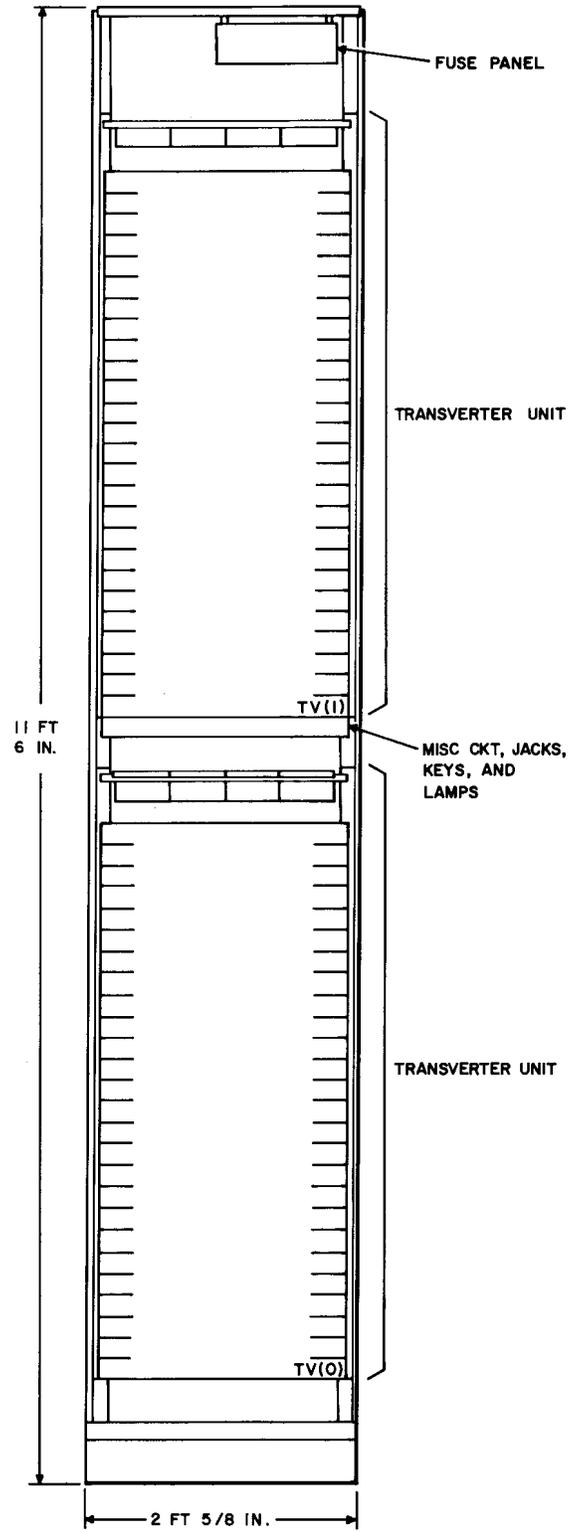


Fig. 18—Transverter Frame

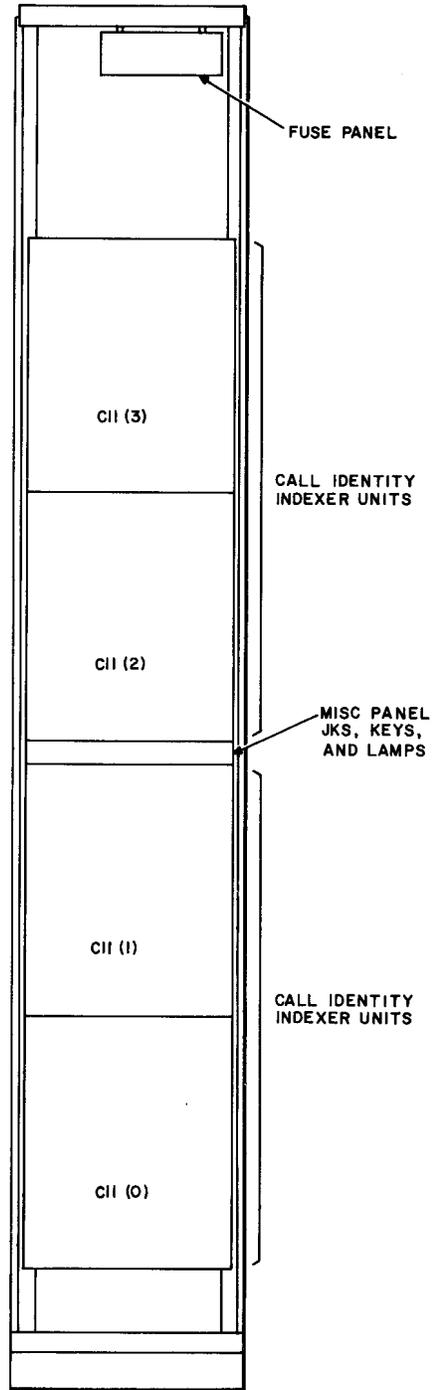


Fig. 19—Call Identity Indexer Frame

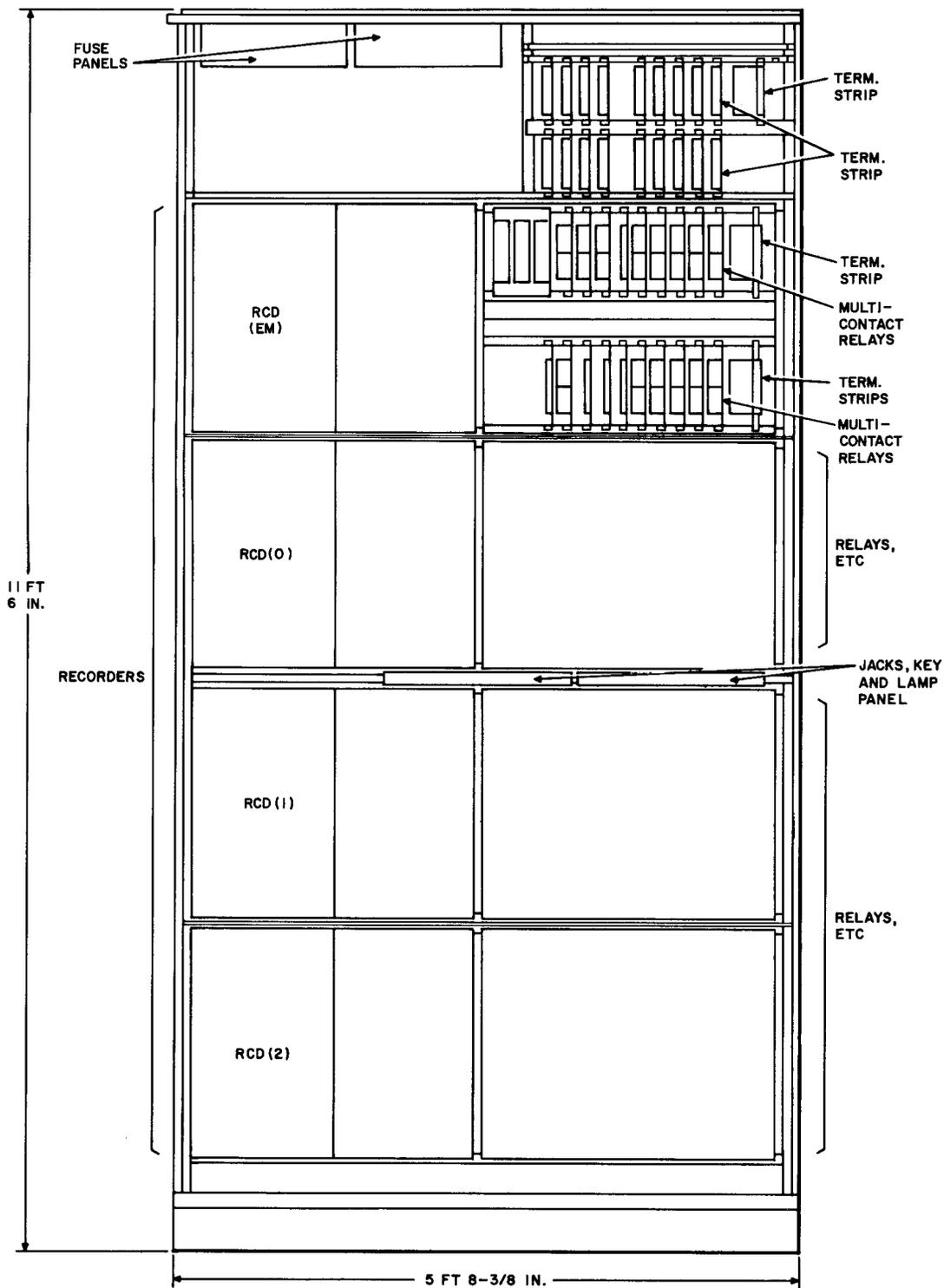


Fig. 20—Recorder Frame

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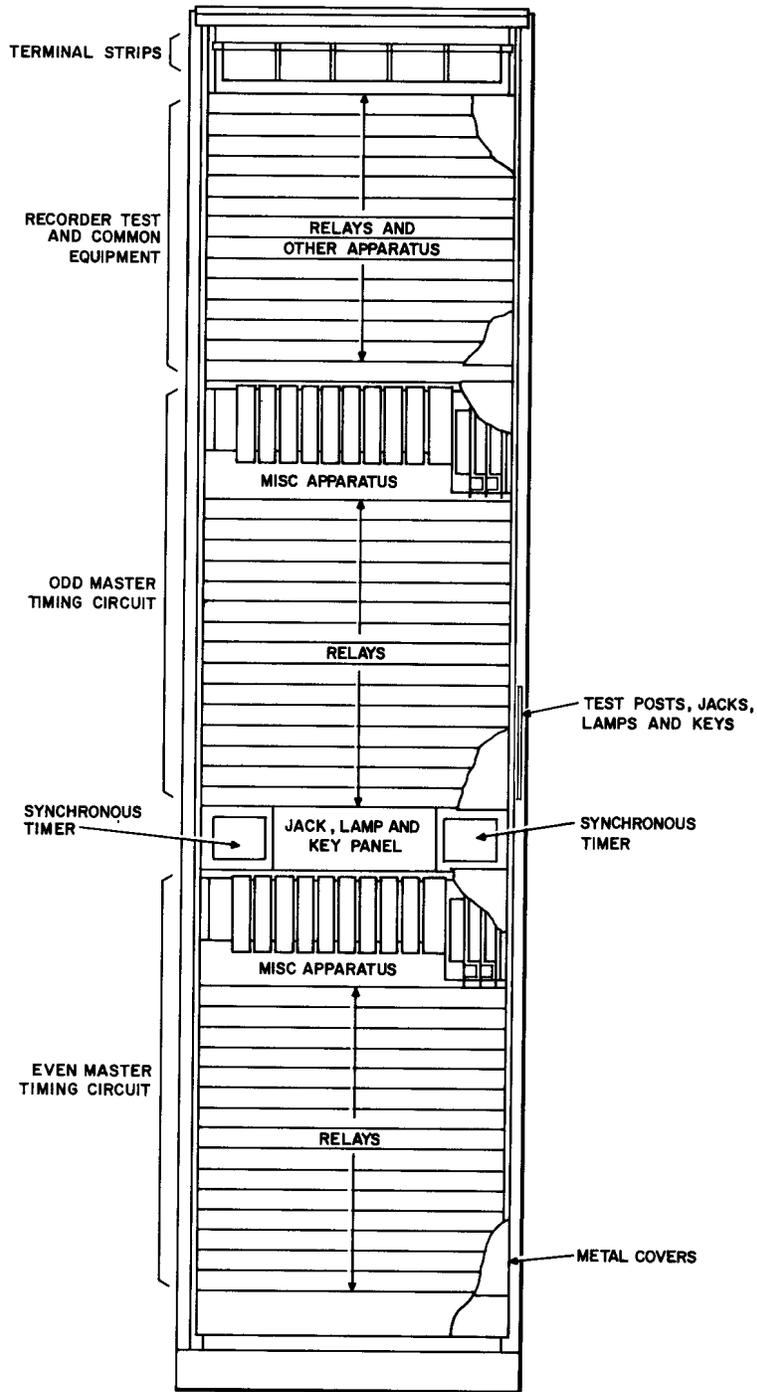


Fig. 21—Master Timing Frame

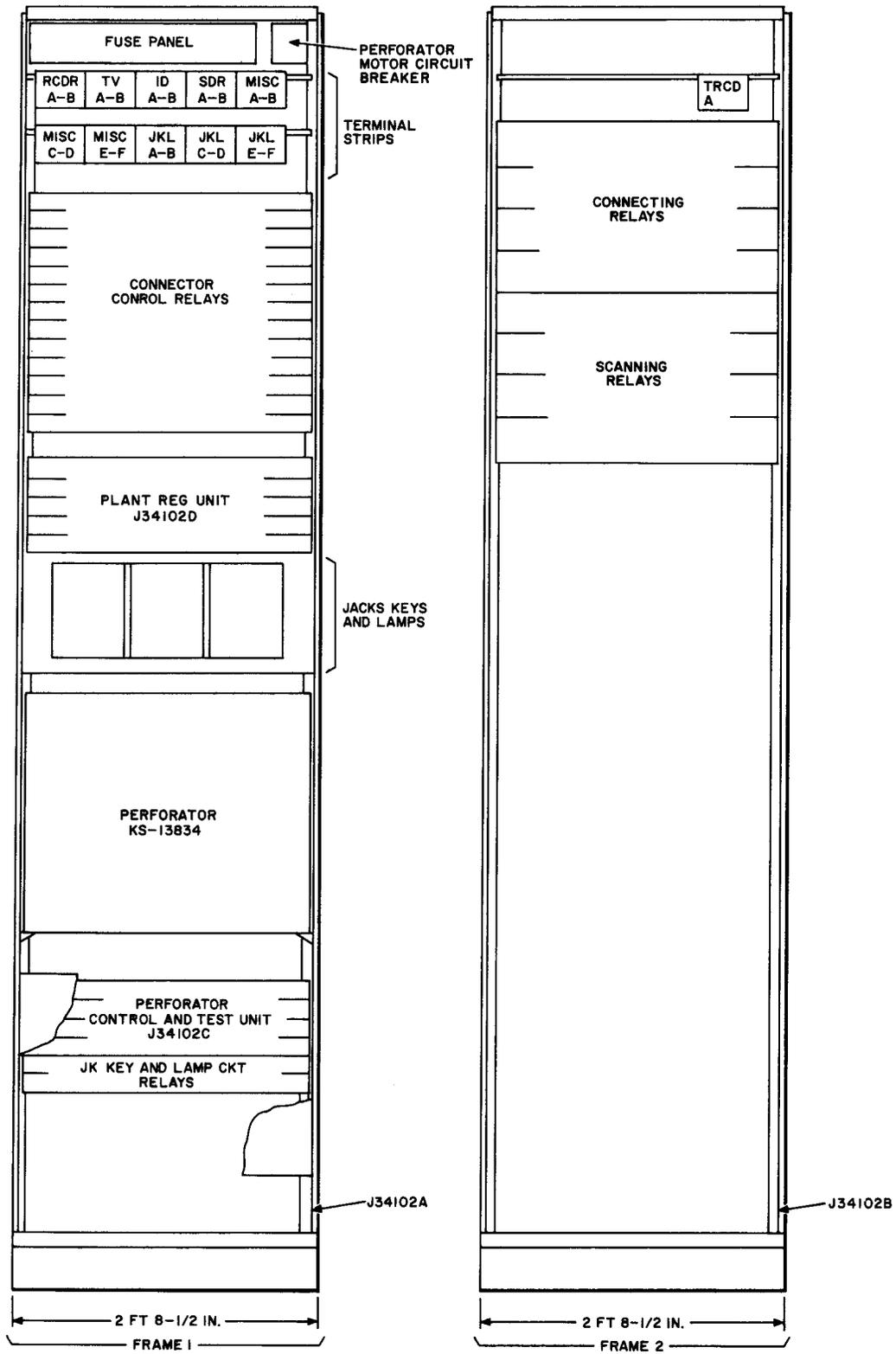


Fig. 22—Trouble Recorder Frames

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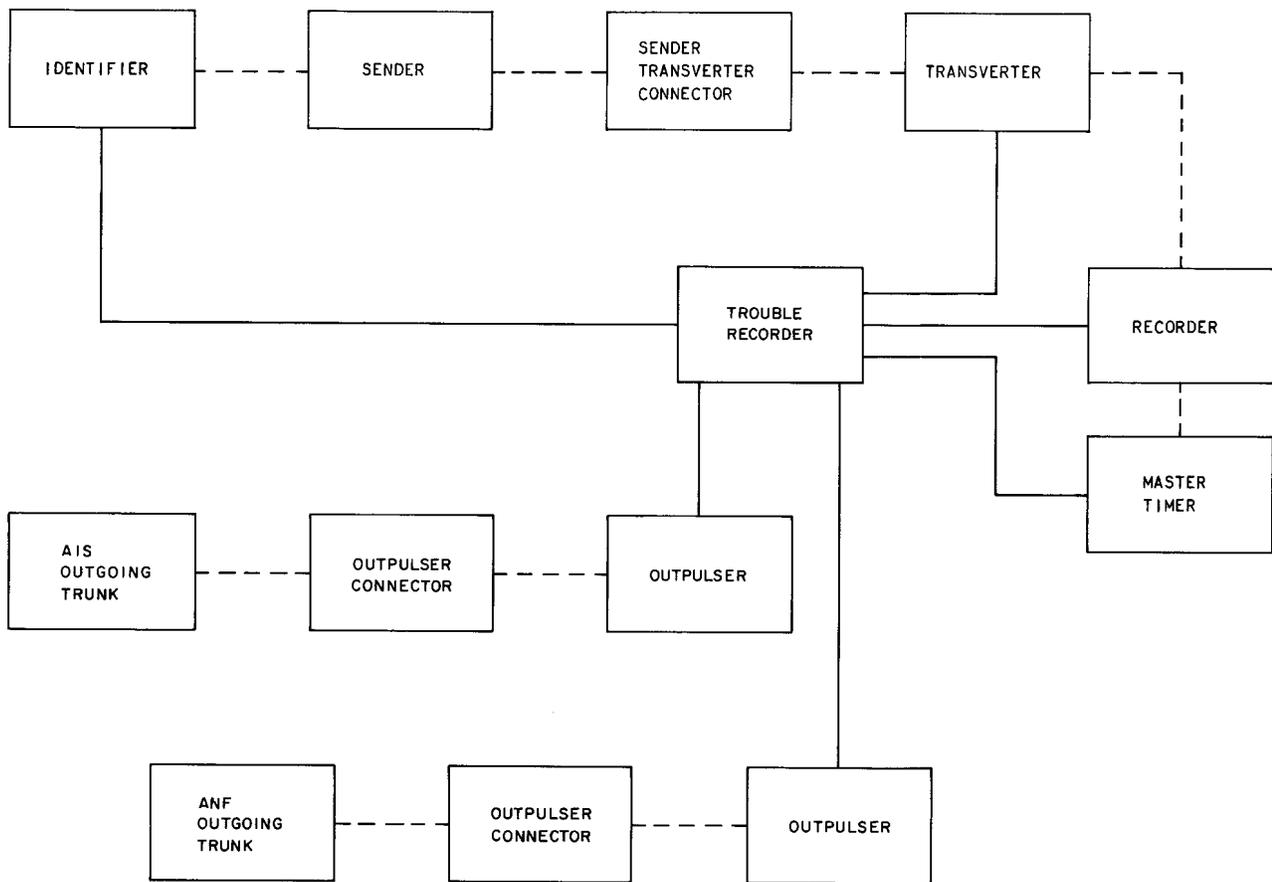


Fig. 23—Block Diagram—Trouble Recorder And Associated Circuits

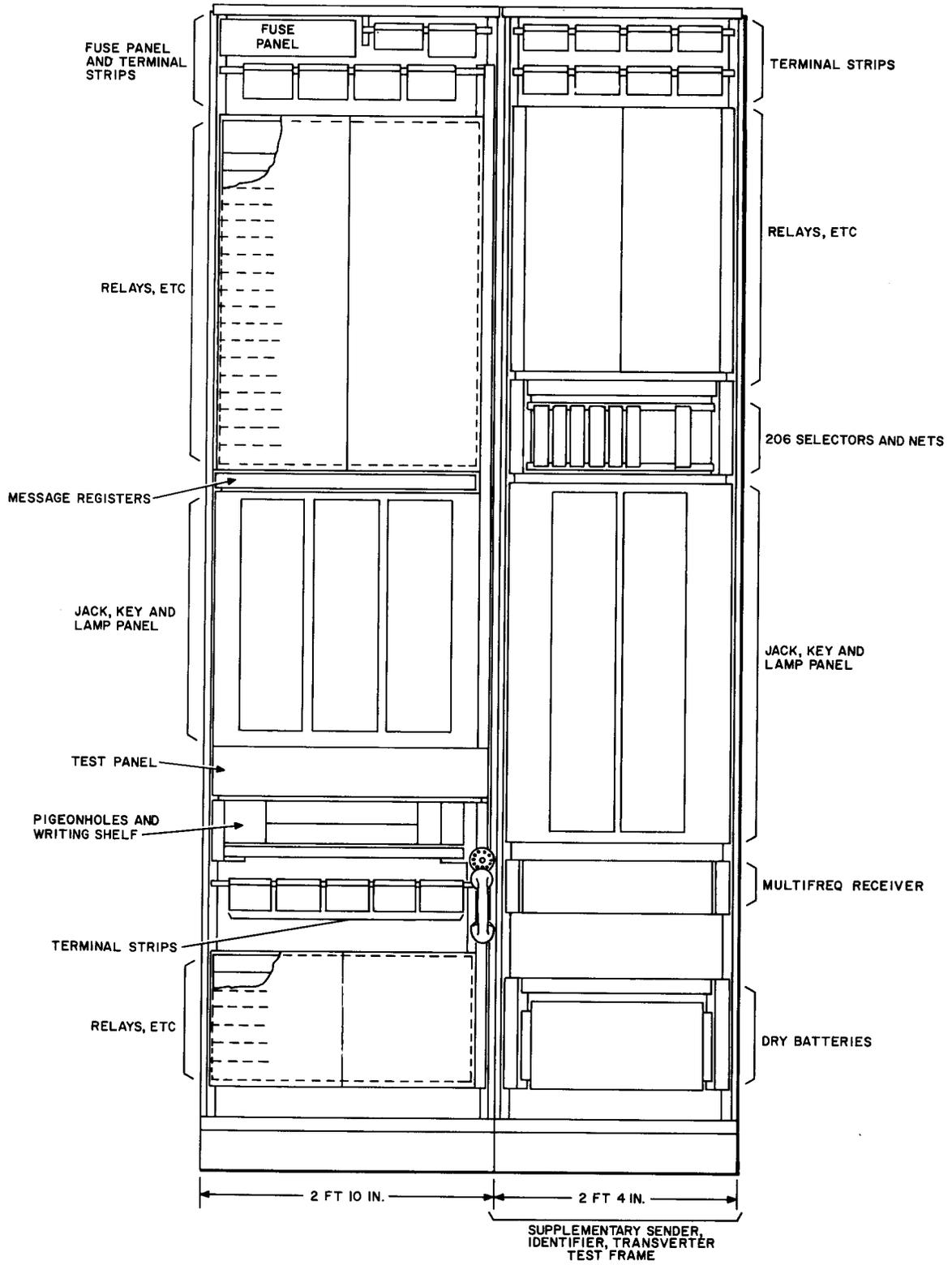


Fig. 24—Sender-Identifier-Transverter Test Frame

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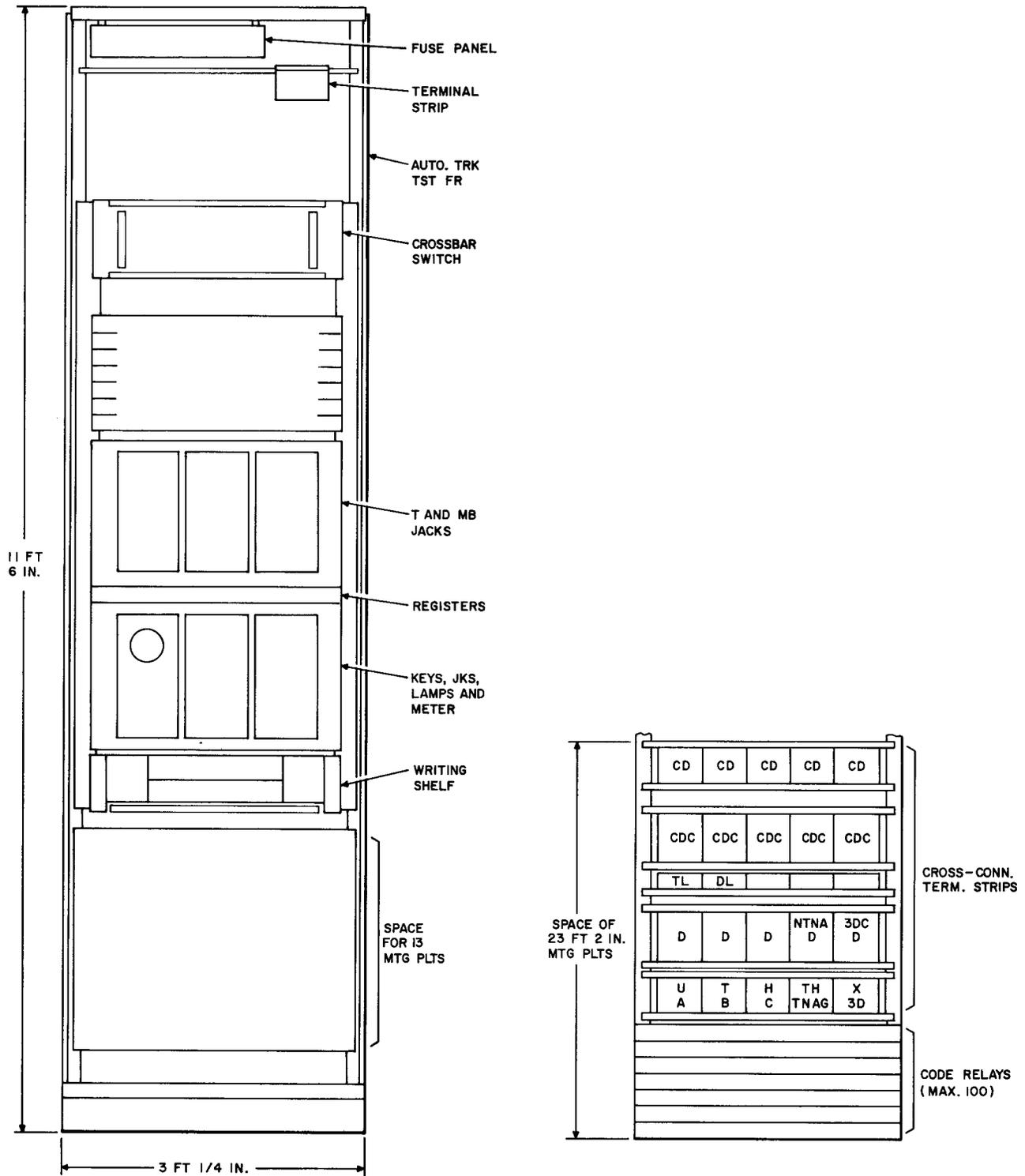


Fig. 25—Automatic Trunk Test Frame And Code Relay Unit

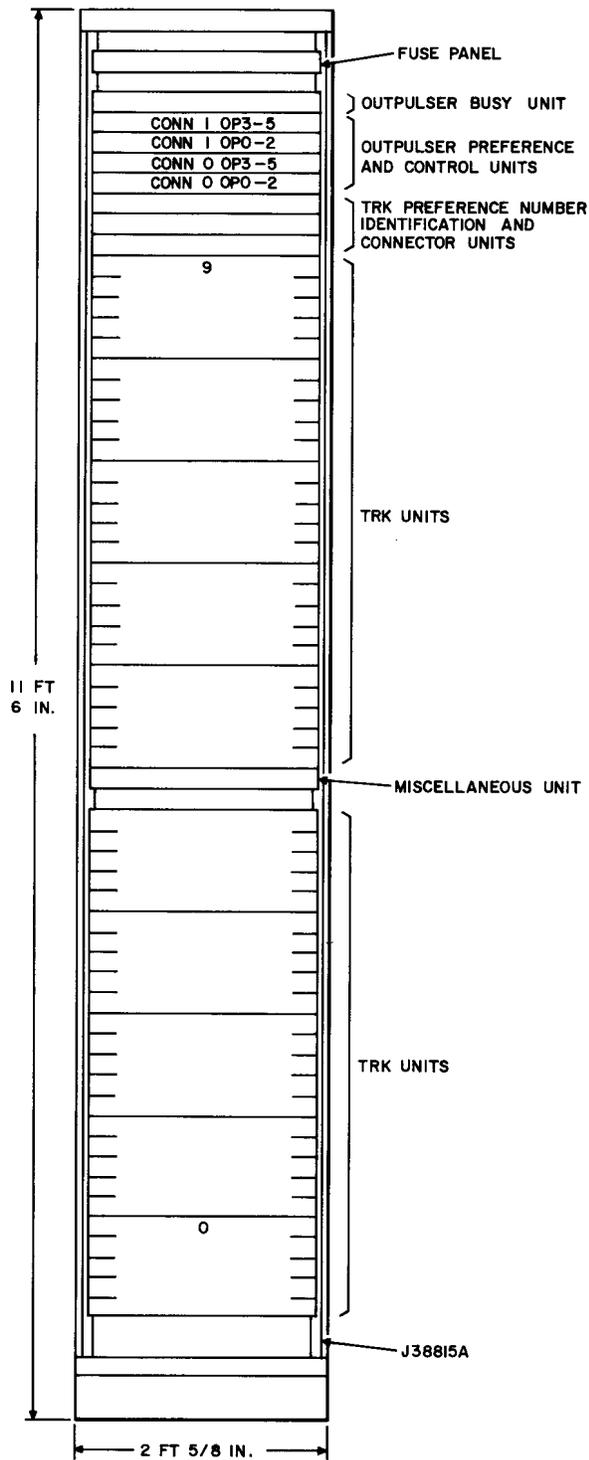


Fig. 26—ANF Outgoing Trunk And Outpulser Connector Frame

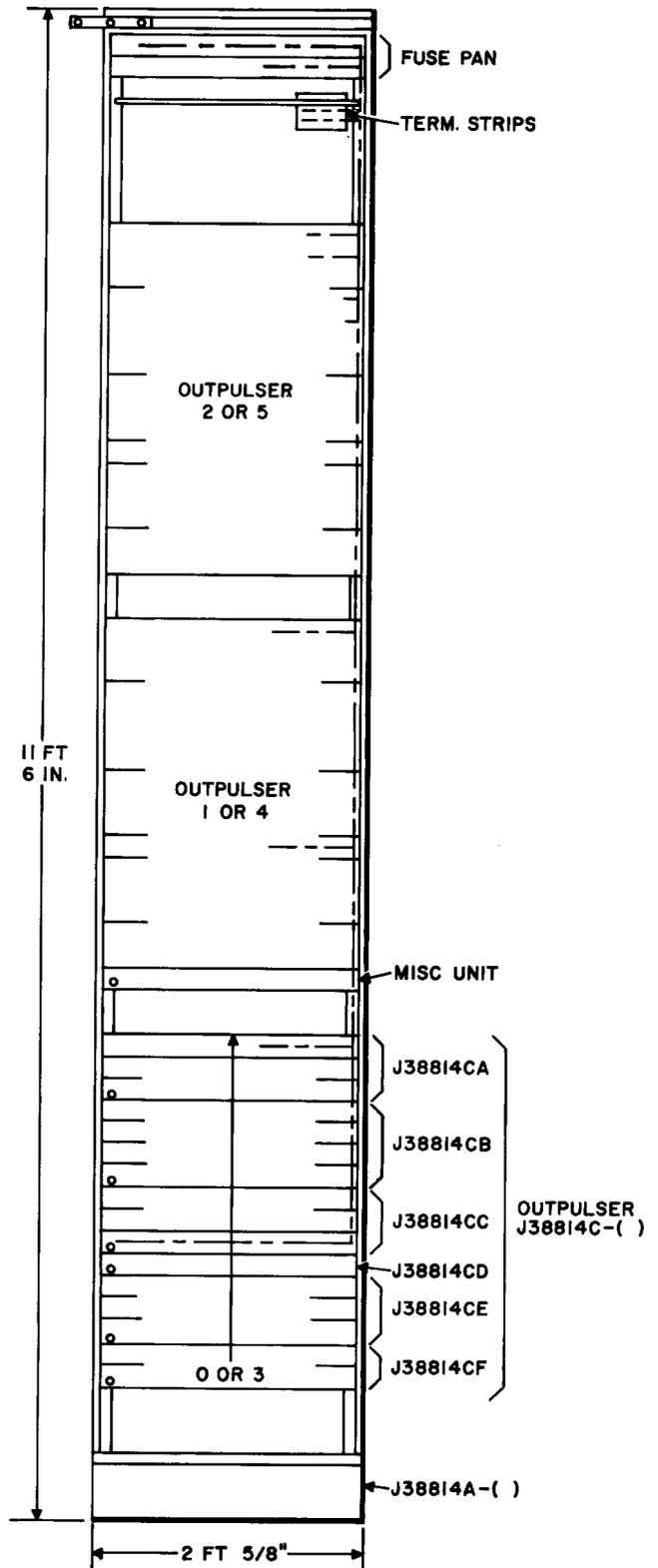


Fig. 27—Outpulser Frame

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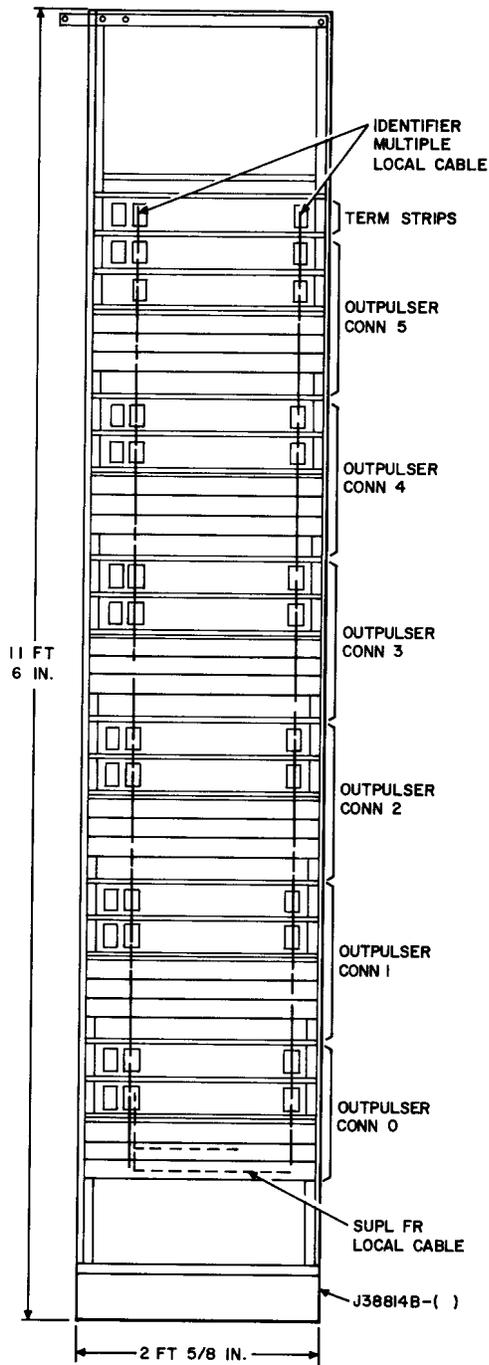


Fig. 28—Outpulser-Identification Connector Frame

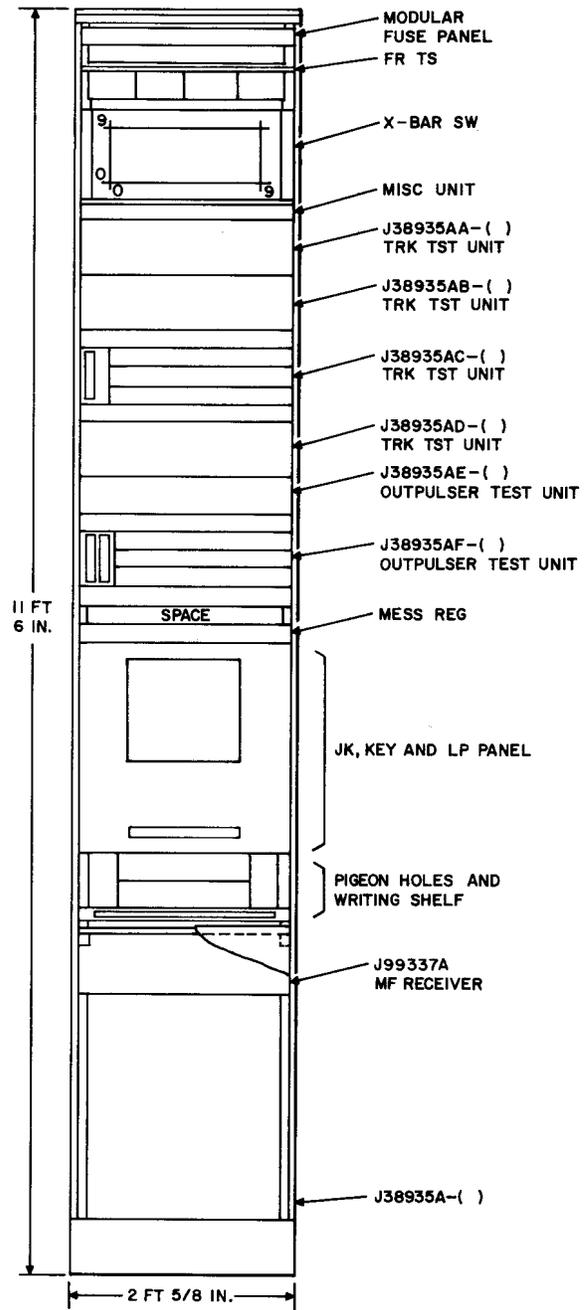


Fig. 29—Trunk And Outpulser Test Frame

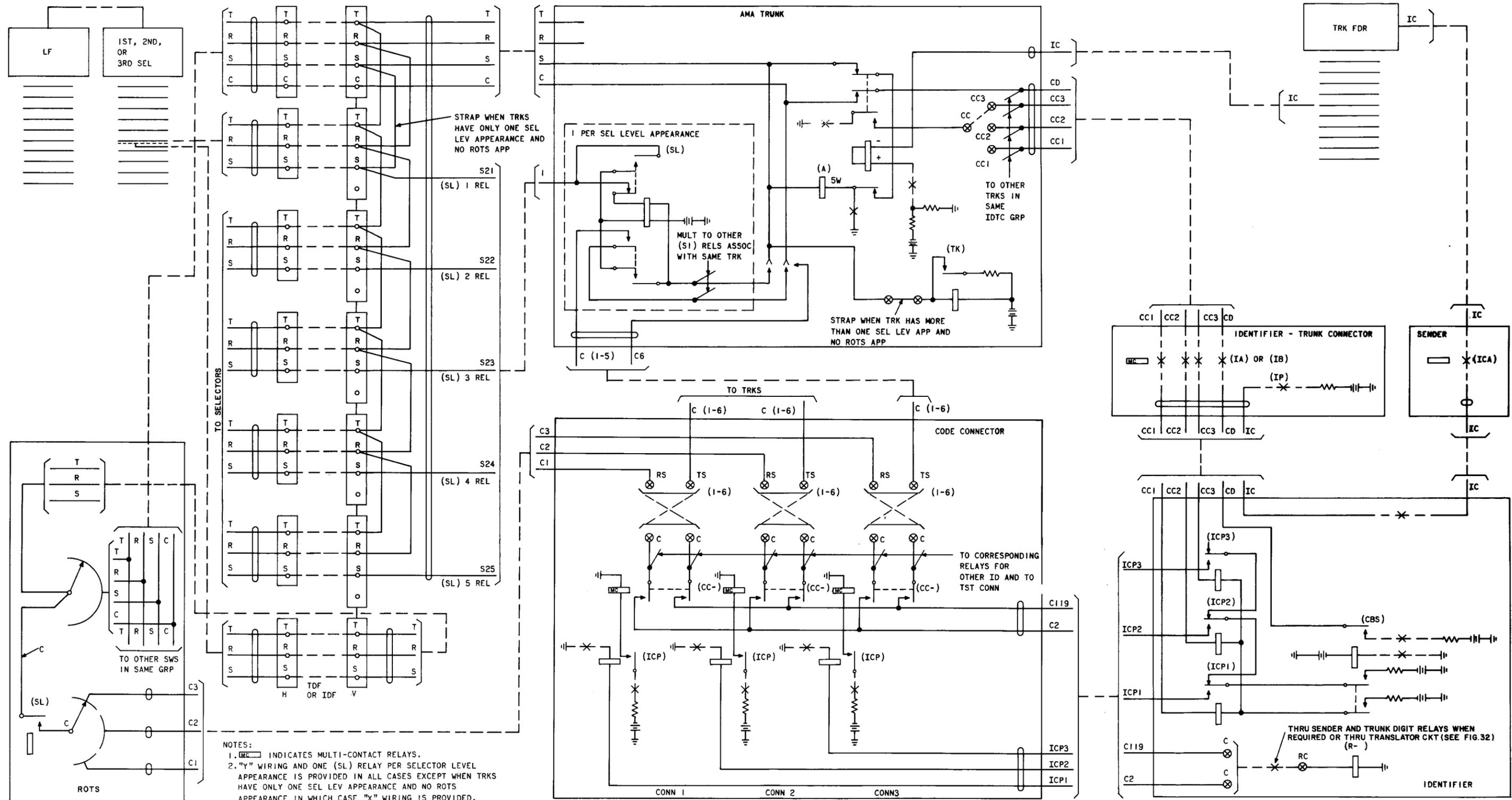


Fig. 30—Code Connector Operation And Code Lead Cross-Connections

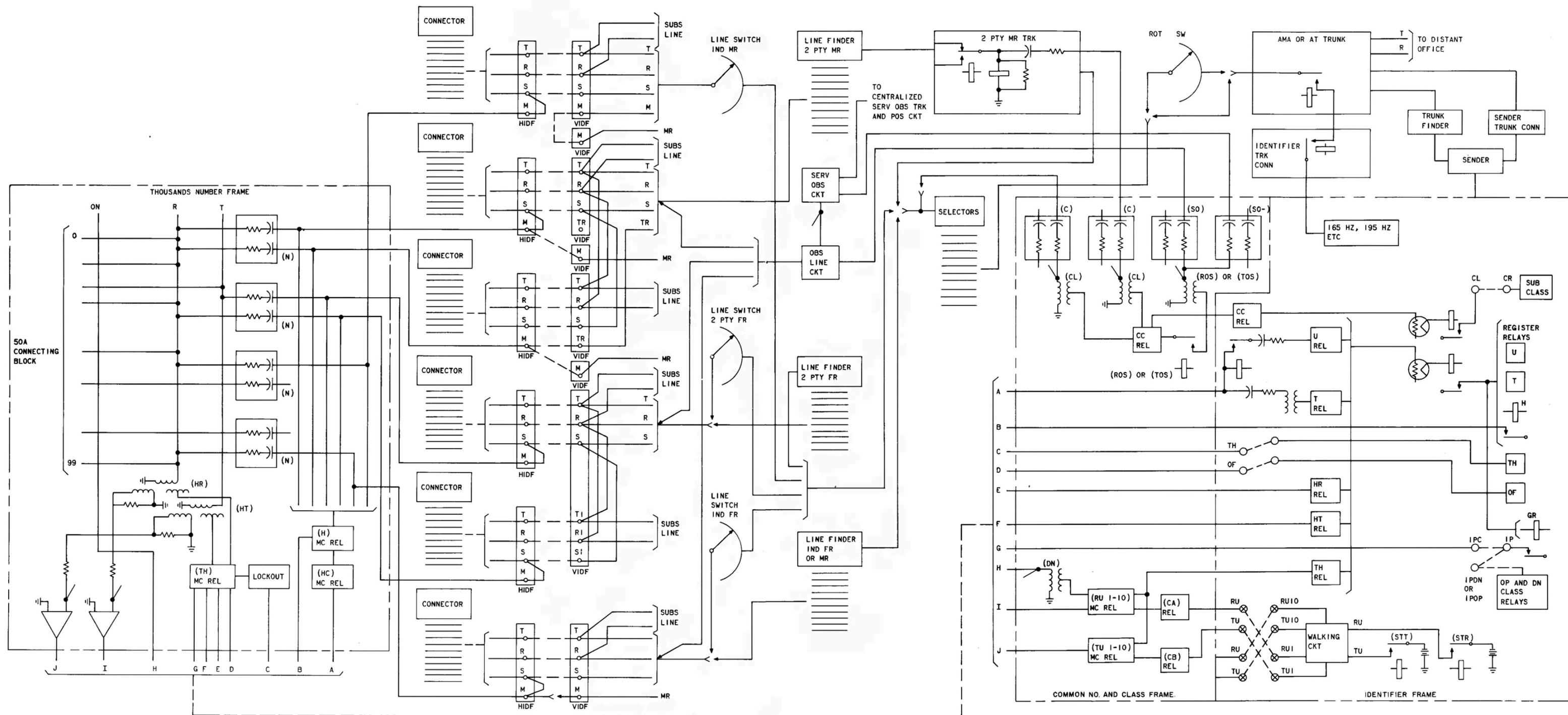


Fig. 31—Calling Office, Number, And Class Identification

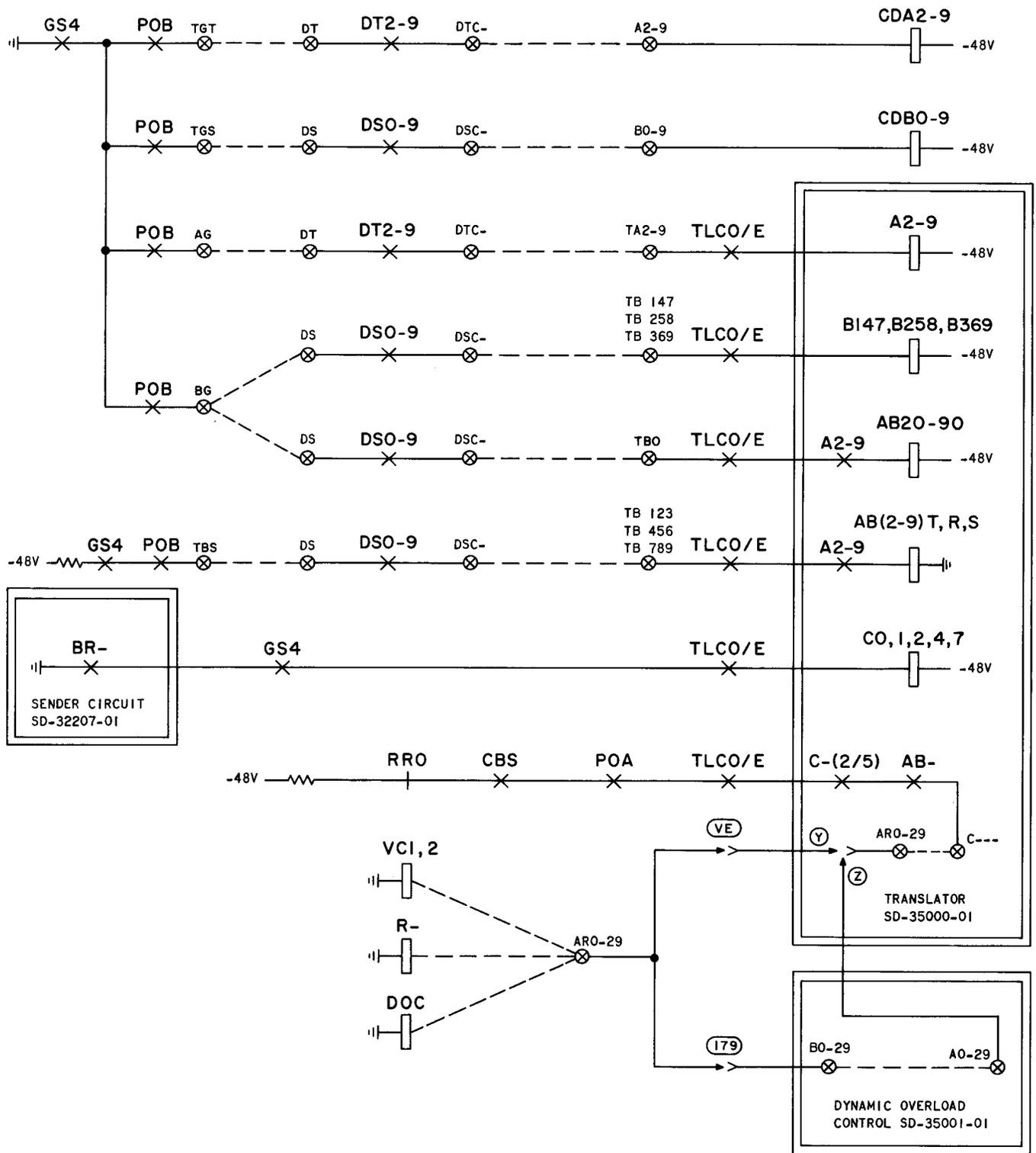


Fig. 32—Route Relay Operation For 1-Plus Dialing

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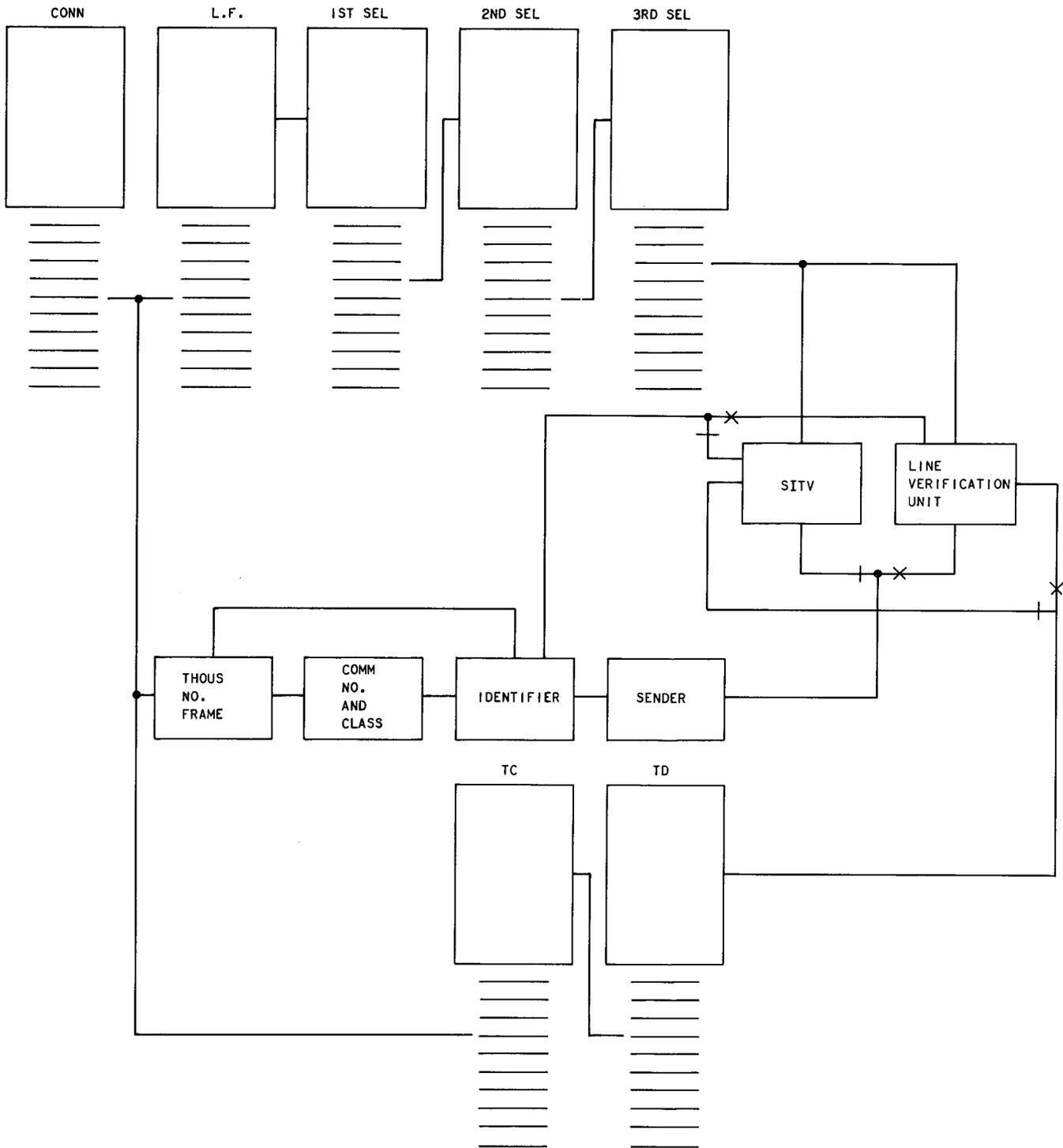


Fig. 33—Calling Line Verification



Fig. 34—Relationship Of Step-By-Step CAMA To Other Offices

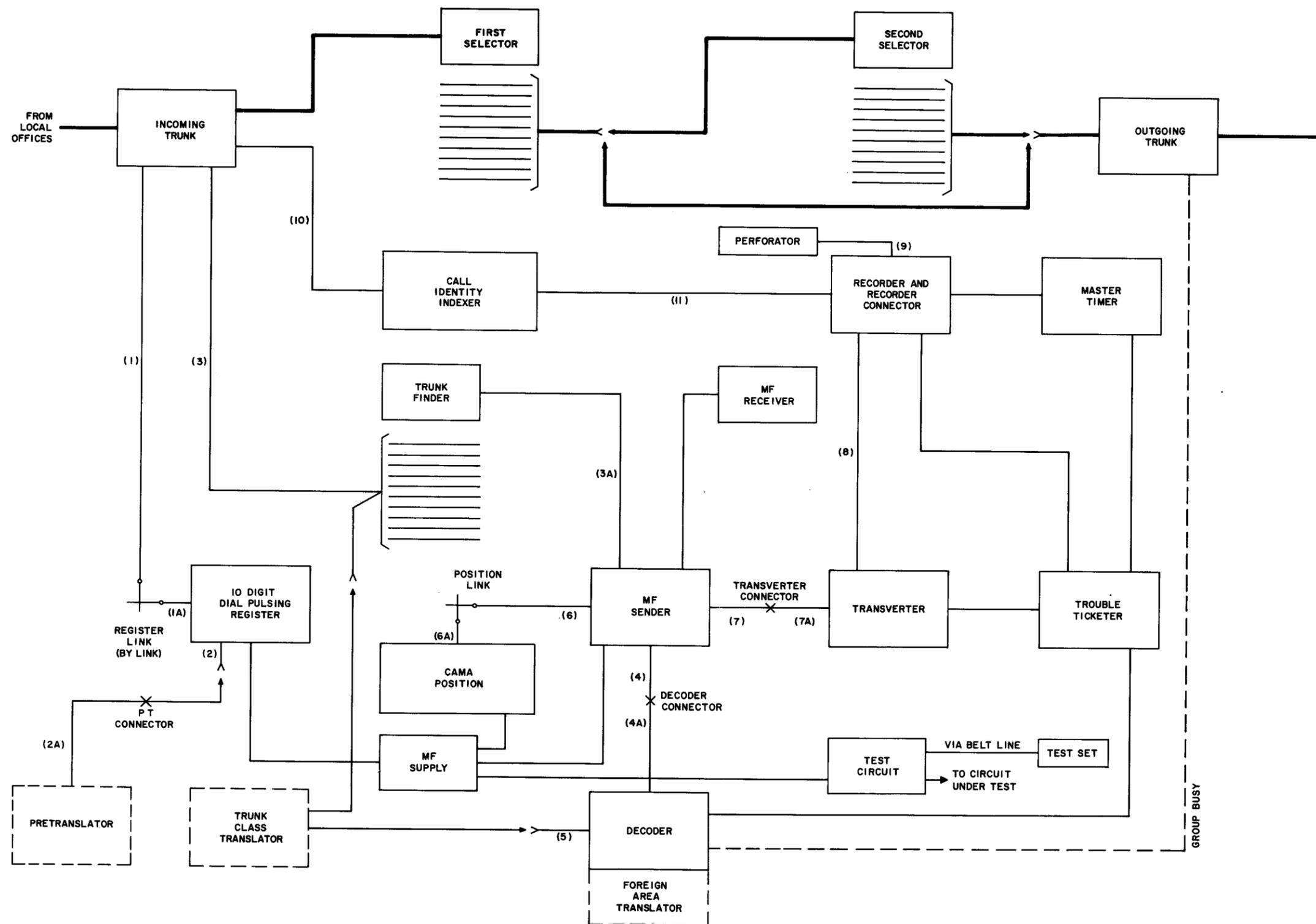


Fig. 35—Block Diagram Of A Step-By-Step CAMA Office

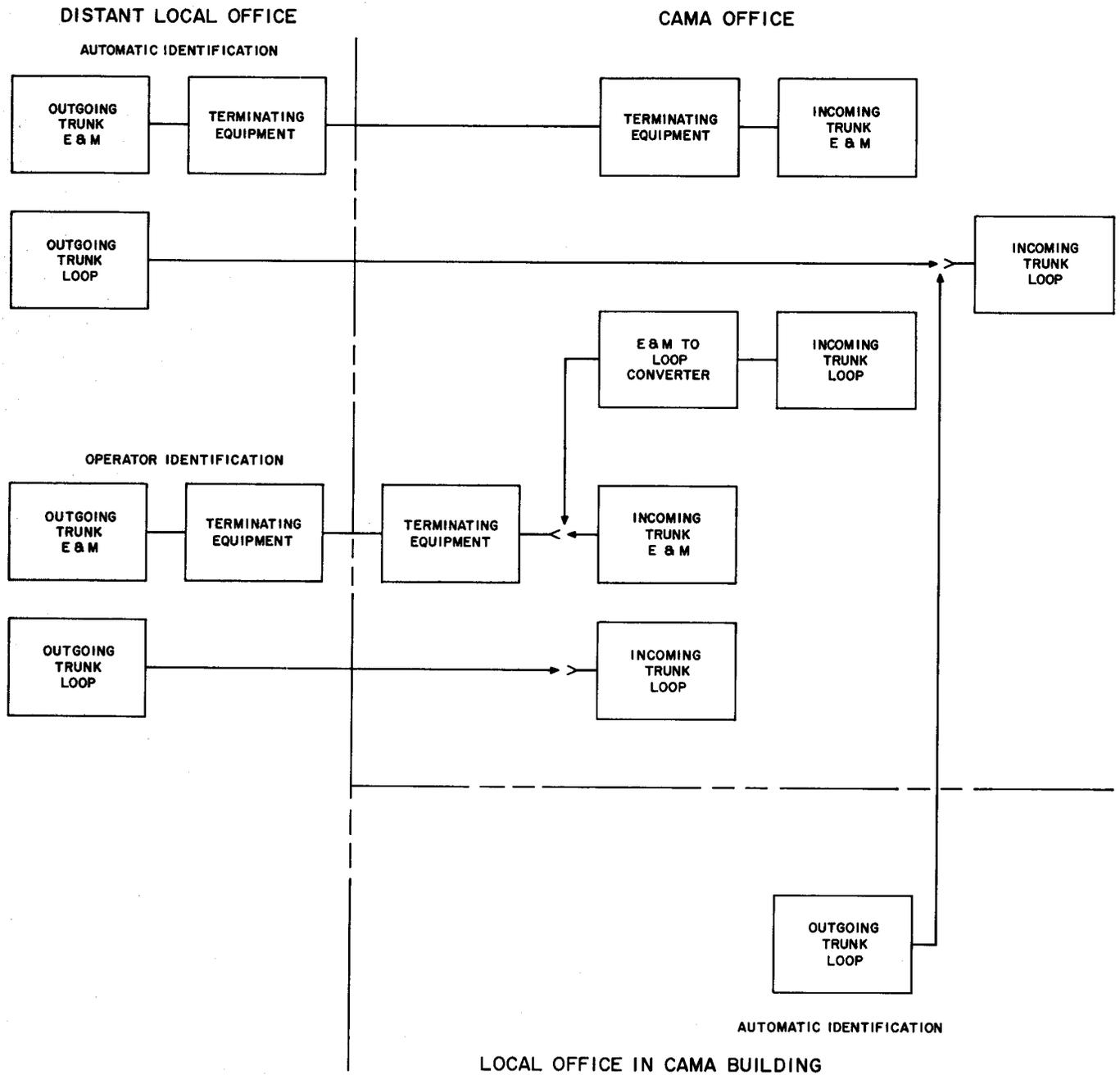


Fig. 36—Trunking Arrangements

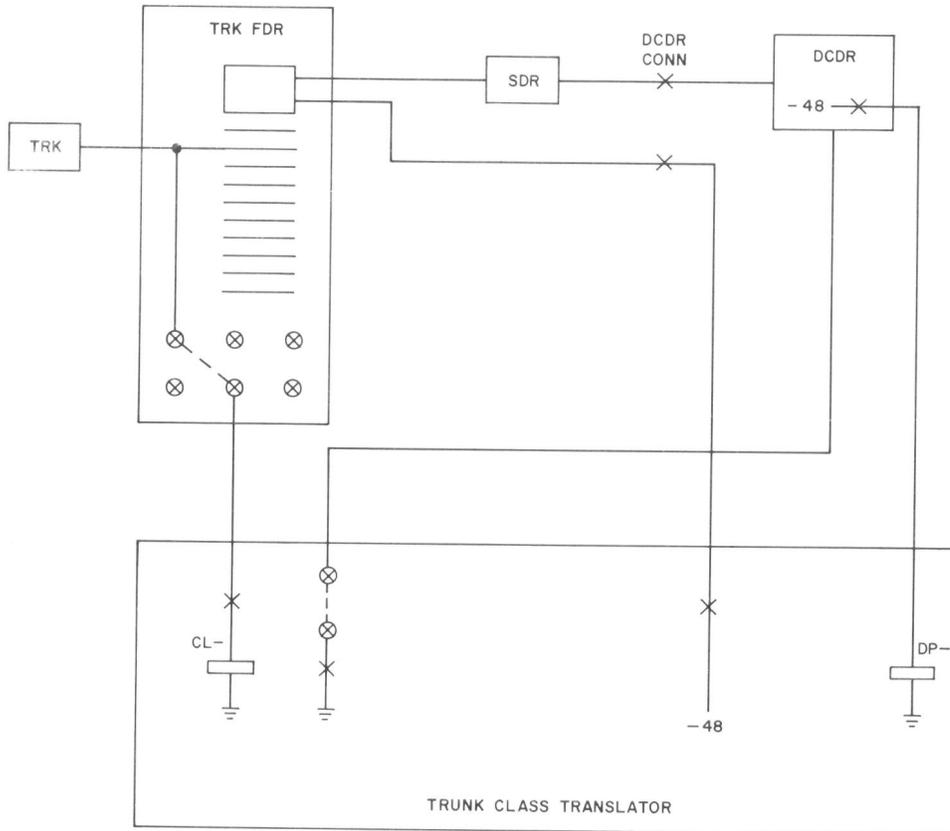


Fig. 37—Simplified Schematic Of The Trunk Class Translator

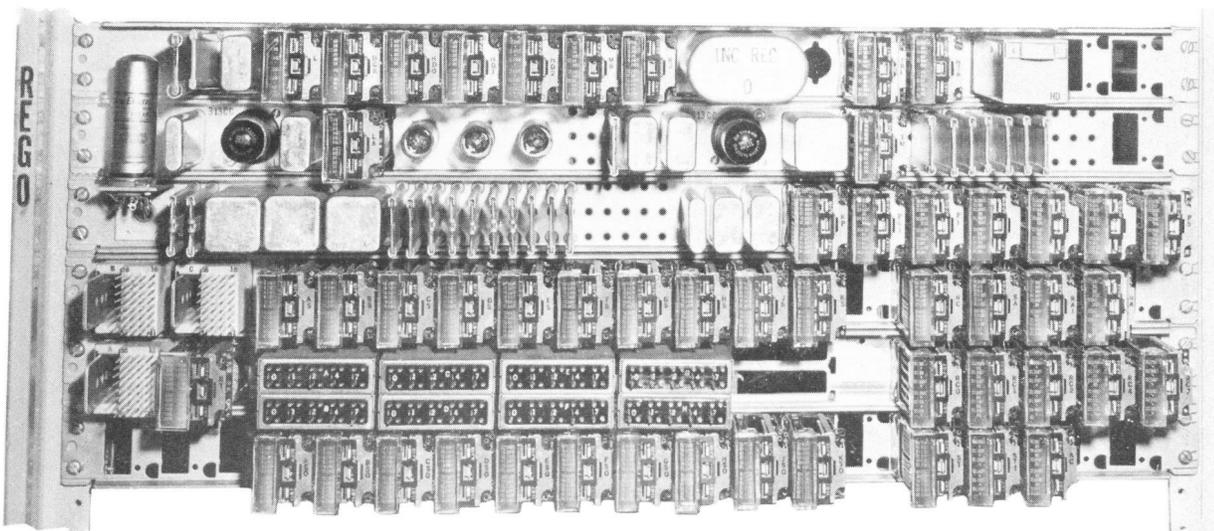


Fig. 38—CAMA Dial Pulse Register

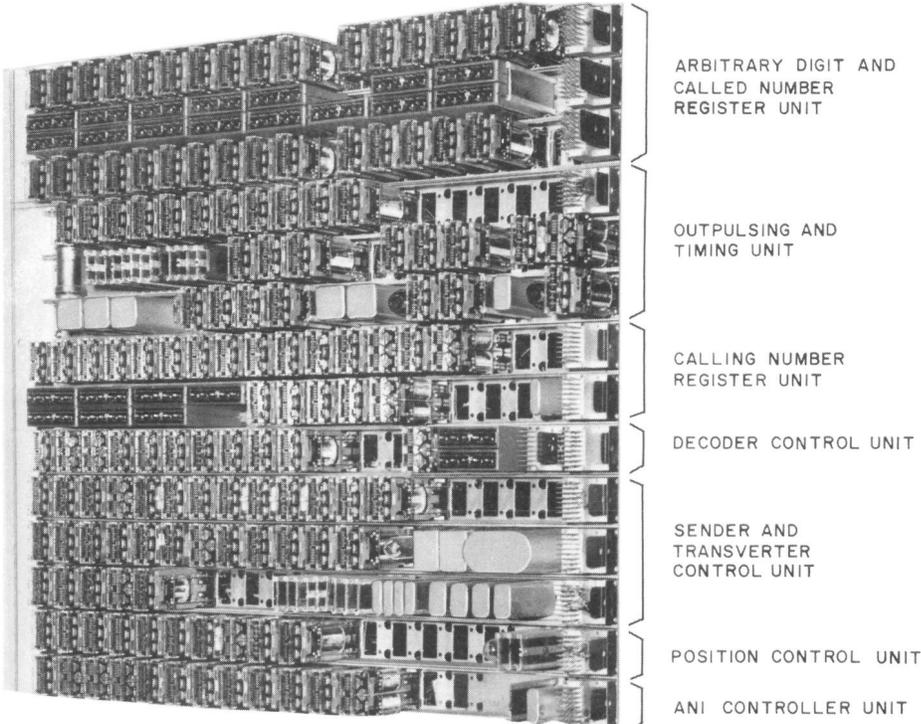


Fig. 39—CAMA Sender

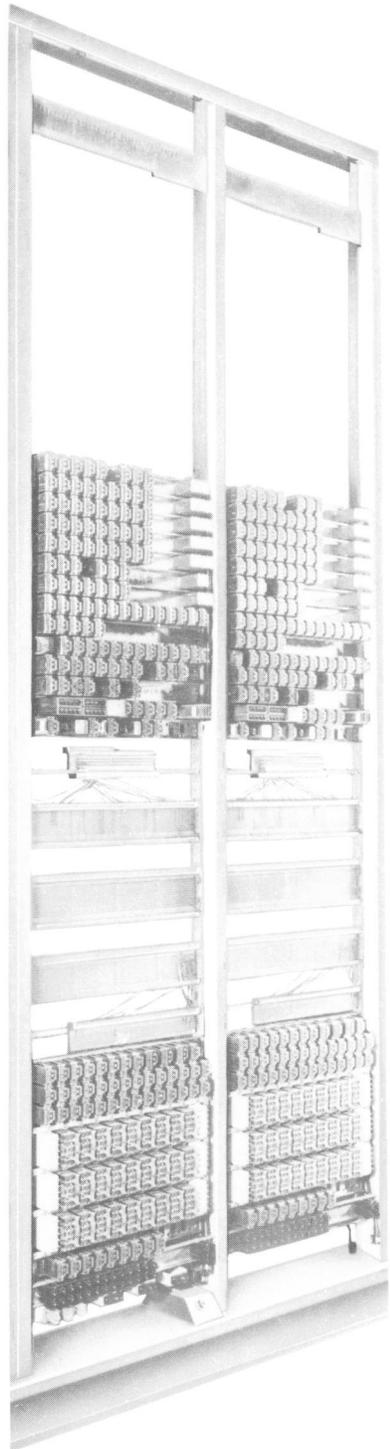


Fig. 40—Decoder Common Equipment Frame

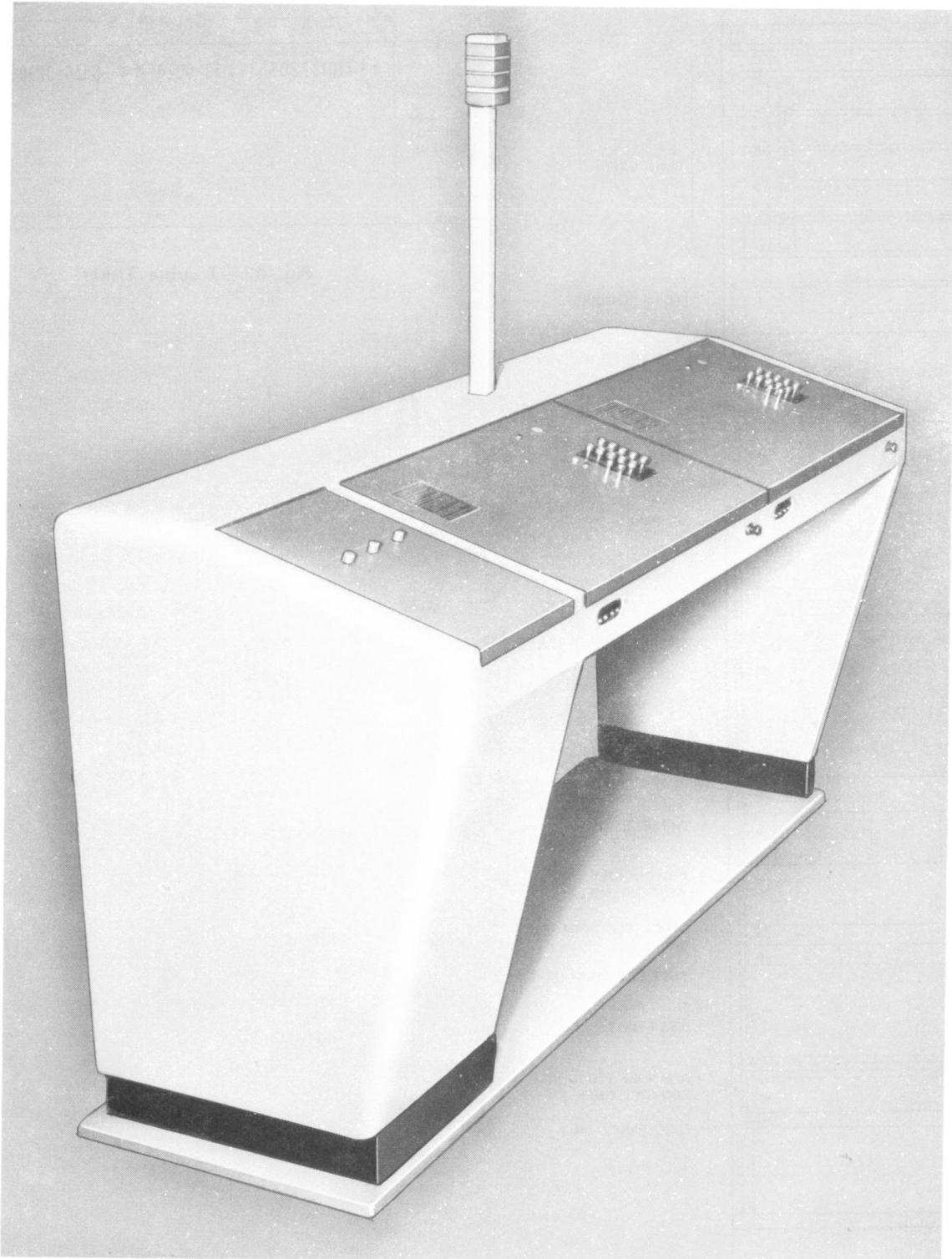


Fig. 41—CAMA Switched And Cable Turning Section

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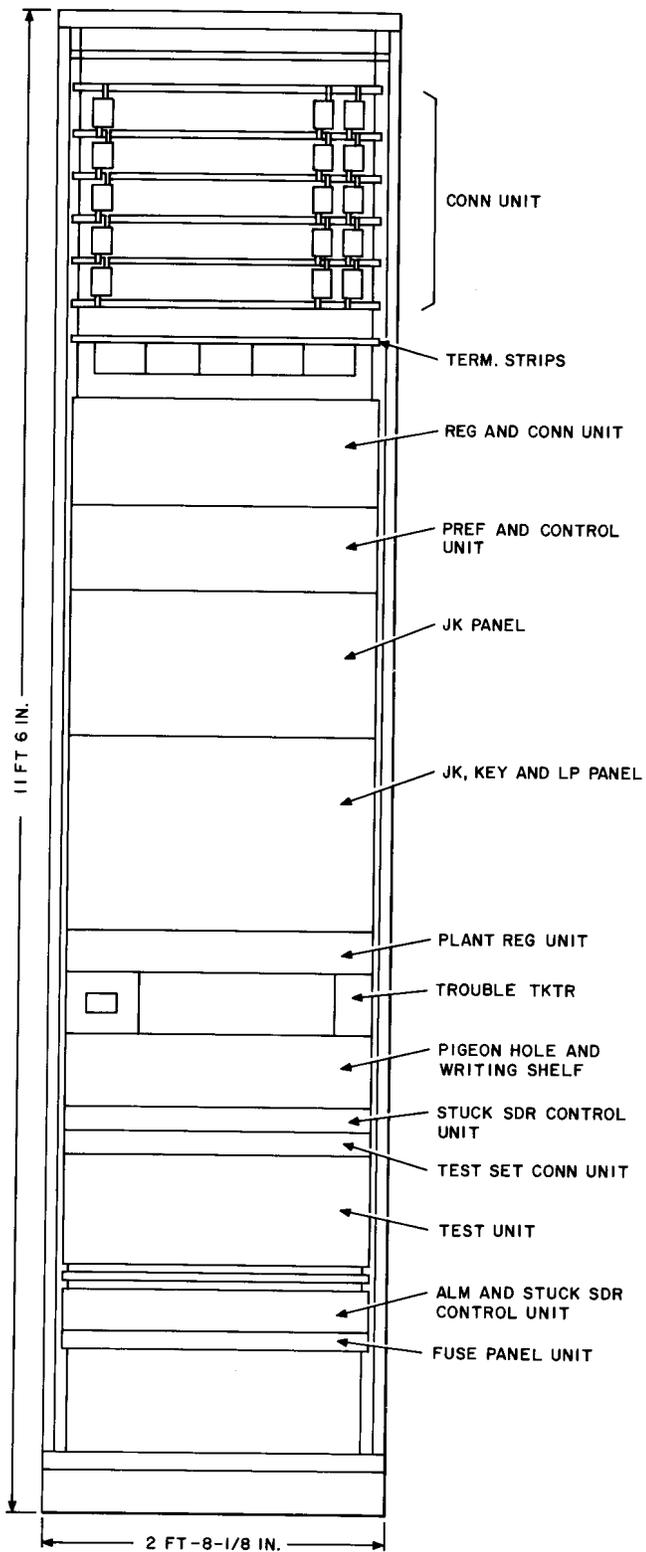


Fig. 42—Trouble Ticketer And Test Frame

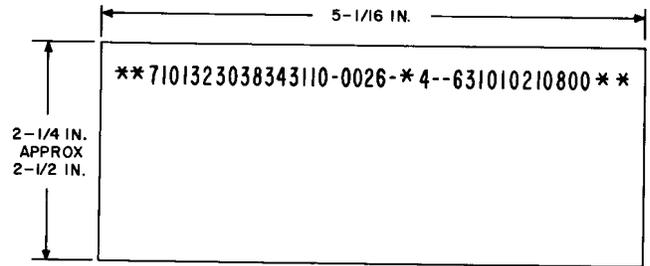


Fig. 43—Trouble Ticket



Fig. 44—Step-By-Step CAMA Test Set

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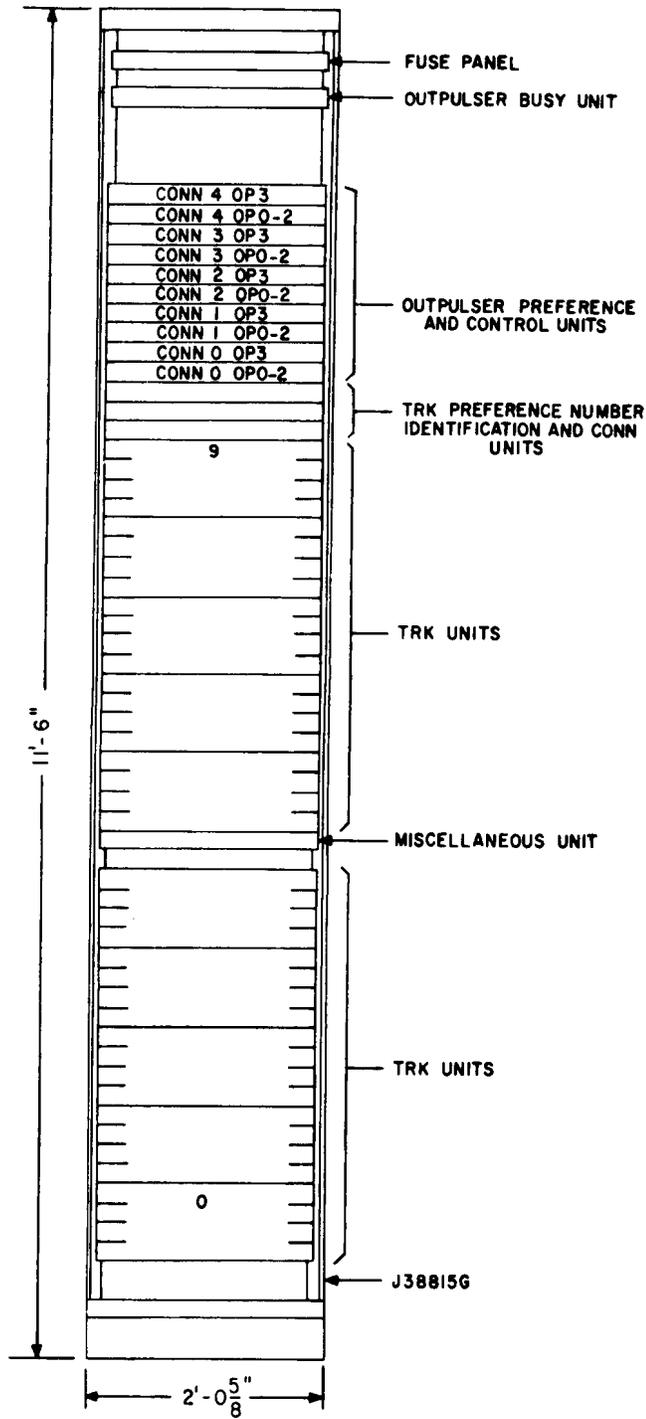


TABLE A

DIGIT	HOLE POSITIONS PERFORATED
0	4, 7
1	0, 1
2	0, 2
3	1, 2
4	0, 4
5	1, 4
6	2, 4
7	0, 7
8	1, 7
9	2, 7

TABLE B

SENDER TRUNK CONNECTOR ARRANGEMENTS

	TRUNKS		SENDERS
	FDR GRPA	FDR GRPB	
ONE-SENDER TRK CONN FR	50	50	20
TWO-SENDER TRK CONN FRs	100	100	20

Fig. 45—Outpulser And Outpulser-Identification Connector Frame (AIS)

TABLE C

	CALLED NUMBER PATTERN NUMBER							
	1	2	3	4	5	6	7	8
Selector Level	3rd	2nd	3rd	2nd	2nd	1st	1st	1st
First Digit in Sender	H	TH	B	A	H	TH	C	FB
C Digit in Office Code	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Sender Register Relays and Leads to Transverter	DIGIT OF CALLED NUMBER							
A	A	A	N	N	A	A	A	N
B	B	B	X	X	B	B	B	X
C	C	C	X	X	—	—	C	X
TK	TH	(C)	A	(X)	TH	(B)	(B)	(N)
AR	H	TH	B	A	H	TH	(C)	(X)
BR	T	H	C	B	T	H	TH	(X)
CR	U	T	TH	C	U	T	H	A
DR	STA	U	H	TH	STA	U	T	B
ER		STA	T	H		STA	U	C
FR			U	T			STA	TH
GR			STA	U				H
HR				STA				T
IR								U

Note: The digits in parentheses indicate information which is recorded in the sender but not used in the transverter because of duplication of this information on another set of leads.