# AUTOMATIC NUMBER IDENTIFICATION SYSTEM

## GENERAL DESCRIPTIVE INFORMATION

## LOCAL STEP-BY-STEP, PANEL AND NO. 1 CROSSBAR OFFICES

CONTENTS

## 1.00 INTRODUCTION

This section describes an ANI (automatic number identification) system which provides for automatic identification of the calling customer's directory number and for transmission of this number to the CAMA office.

CAMA (centralized automatic message accounting) operation, is a means of recording charge data at a centralized point, which permits customer dialing of certain charge calls which were formerly placed through operators. A description of this "operator-identified" CAMA method of operation, as it is called, is contained in BSP Section 960-120-100

This new ANI system is applicable to local step-by-step panel, and No. 1 crossbar offices and is capable of identifying the directory numbers assigned to individual, PBX, and two-party customers. When the party lines served have more than two main stations, a CAMA operator is brought in on the connection to obtain the customer's number verbally.

## 2.00 PRINCIPLES OF OPERATION

### 2.01 General

Although the basic identifying process is the same in each of the three local dial systems, certain operating differences exist and for this reason a separate method of operation is given in Section 3.00 for each of the three systems. Before proceeding with these descriptions, however, the general over-all ANI plan is described. The block diagram of Figure 1 illustrates the ANI switching arrangement.

### 2.02 Call Sequence

When a customer originates a call requiring automatic number identification, an ANI outgoing trunk is seized by the central office switching equipment and a connection to it is set up. The ANI outgoing trunk serves the dual purpose of providing a transmission path for the conversation, and furnishing access to the ANI identifying equipment. Some time, either before, after, or during dialing, a party test is made by the existing local office equipment or by the ANI equipment depending upon the type of originating office. The need for party information will become apparent later on in the description.

After dialing is completed and the called number digits have been transmitted to the CAMA point, the call is partially switched through the CAMA equipment but completion of the connection is delayed until the necessary calling number information

has been registered. To get this information the ANI trunk in the local office is alerted to seek connection to the identifying equipment which it does by bidding for an "outpulser". The outpulser is part of the identifying equipment and is the unit that transmits the calling number information to the CAMA office. Connection to the outpulser is established through an outpulser-connector. Upon seizure, the outpulser connects to an "identifier" to which it passes the party test information. The identifier then directs an oscillator serving the trunk in use to apply a 5800 cycle ac signal to the trunk sleeve, and proceeds with the identifying process.

To enable the identifier to determine the four digits of the directory number, a primary-secondary system of networks and buses is used. This network and bus array translates the identifying signal on the sleeve to signals appearing on several numerically designated output leads. Following is a detailed description of the most fundamental part of the ANI scheme, the primary-secondary system of networks and buses.

2.03 Primary System of Networks and Buses - (Figure 2)

The primary bus system consists of an array of 100 vertical and 100 horizontal "bus groups." Each of the 100 vertical and 100 horizontal bus groups is designated one of the numbers in the series 00 to 99 so that each of the resultant 10,000 intersections of these bus groups represent one of the four digit numbers in the directory number series 0000 to 9999. Each bus group consists of a number of electrical conductors called buses; vertical bus groups contain 3 buses, horizontal bus groups contain 2 buses. All buses are permanently attached to insulating panels. Vertical bus groups represent thousands and units digits of the directory number, horizontal bus groups represent hundreds and tens digits of the directory number.

In every vertical bus group there is a ring bus, a tip bus, and a multiparty bus. In every horizontal bus group there is a ring bus and a tip bus. Thus there are 100 vertical ring buses and 100 horizontal ring buses in the primary bus system and this configuration is known as the "ring field." Likewise, there are 100 vertical tip buses and 100 horizontal tip buses in the primary bus system and this configuration is known as the "tip field." The remaining 100 vertical multiparty buses make up the "multiparty field." This subdivision of the primary bus system yields three separate fields each having 10,000 similarly numbered intersections.

Included as part of the primary system are "capacitor-resistor networks", which are provided one per number and which are fastened to the insulating panels containing the buses. These networks are located one per intersection so that every network is associated with one of the distinct four-digit numbers. The networks are cabled permanently to the correspondingly numbered customer line sleeve punchings on the distributing frame, using one wire per network. In this manner, identifying tone connected to the sleeve of the outgoing trunk is transmitted back through the originating equipment to the line sleeve punching on the distributing frame, through the single wire conductor to a particular capacitor-resistor network.

The tone impressed across a capacitor-resistor network must be connected to one of the three fields for identification purposes. This is accomplished by means of network-to-bus cross-connections in the form of solderless wrapped wire straps as discussed under Number Network Cross-Connections. The field to which a network is connected depends upon the service class of the customer being served by the network. Except for networks associated with two-party message rate customers in step-by-step offices as discussed in 3.01, the ring field is reserved for networks serving individual, PBX and ring party customers while the tip field is reserved for networks serving tip-party customers. The multiparty field, as expected, is reserved for networks serving four-party and multiparty customers. With proper network-to-bus connections, the identifying tone impressed across a network is connected to either the ring field, the tip field, or the multiparty field.

Primary buses are not scanned directly, by the identifier because it would require a large number of identifier tone detectors to look at all the primary buses. Instead, secondary systems of networks and buses are used to convert the 1 in 100 signals obtained from the primary buses into separate decimal digits. A secondary network and bus system is provided for the horizontal primary buses; another secondary network and bus system is provided for the vertical primary buses. Both secondary systems constitute a secondary network and bus connector circuit one of which is required for each series of 10,000 directory numbers.

## 2.04 Secondary System of Networks and Buses - (Figure 2)

A secondary bus system consists of two arrays of 10 vertical buses each numbered 0 to 9 and 10 horizontal buses

numbered 0 to 9. In conjunction with the primary bus system, it indicates to the identifying equipment the directory number digits and the calling office code. This arrangement yields 100 bus intersections in each array with each intersection representing a two-digit number in the series 00 to 99. One array associated with the primary vertical buses represents the thousands and units digits and the other associated with the primary horizontal buses represents the hundreds and tens digits of the directory number. An inductor-resistor network is located at each of the 100 bus intersections and each network is permanently connected to the secondary vertical bus and the secondary horizontal bus at that point. The 100 vertical ring buses and the 100 vertical tip buses in the primary system are connected to the correspondingly numbered 100-inductor-resistor networks in the associated secondary bus system through contacts on party transfer relays. The 100 horizontal ring buses and the 100 horizontal tip buses in the primary system are connected in like manner through other party transfer relay contacts to the other secondary bus system. Consequently, the secondary network and bus connector circuit is connected to the primary ring field through back contacts when party transfer relays are normal or to the primary tip field through front contacts when party transfer relays are operated. The identifier uses the party test information to control the operation of these relays. This is necessary because on calls involving two-party lines, the identification signal usually appears in both tip and ring fields.

The 100 multiparty buses in the primary bus system are multipled to form ten groups of ten which are connected directly to a multiparty network in the secondary network and bus connector circuit. This multiparty network concentrates the resulting ten leads from the primary system into two leads which are used to indicate to the identifier when a multiparty customer is originating an ANI call.

## 2.05 Identification and Outpulsing

The output of the secondary bus and connector circuit consists of four groups of leads. Each group contains ten pairs of leads numbered 0 to 9 for thousands, hundreds, tens, and units digits. During bus scanning by the identifier, these four groups of output leads are connected to 10 digit detectors one group at a time in succession. The detectors amplify and detect the identification tone so that register relays representing the digits of the directory number can

be operated. In this manner, tone on a single sleeve lead is impressed across a capacitor-resistor network, connected to the primary bus system, transmitted to the secondary bus and connector circuit or the multiparty network where it emerges on output leads and where it is detected by amplifier-detectors in the identifier.

When the identifier has identified the four digits of the directory number, register relays representing this number are operated in the outpulser. Recognition of the particular secondary system in which the tone is found permits the outpulser to supply the corresponding three digits of the calling office code to complete registration of all the numerical digits required by the AMA recording equipment at the CAMA office. At this time, the identifier releases and the outpulser transmits all 7 digits along with other coded information to the CAMA office on a multifrequency (MF) basis.

If the calling number has been successfully identified, 10 digits are outpulsed to CAMA, a KP signal, an information digit, the 7-digits of the calling number, and an ST signal. The KP and ST signals indicate the beginning and end of pulsing to the CAMA MF receiver. If the calling line was recognized as a four-party or multiparty line or if trouble was encountered during identification and the number cannot be identified, then only 2-digits are outpulsed, namely; the KP pulse and the "information digit". The information digit outpulsed immediately after the KP signal on all calls, informs the CAMA equipment (1) that the calling number has been automatically identified, (2) that the calling number is to be operator identified, or (3) that trouble has been encountered in identifying the number. It also indicates whether or not the calling line is connected for service observing.

After transmitting to CAMA the calling cutomer's number and its associated information digit, or the information digit indicating a multiparty call or a trouble condition, the outpulser releases and restores to normal. The CAMA equipment simultaneous with these operations registers the calling number information or calls in an operator to make the identification. When the AMA recording functions have been completed, the talking path through the CAMA office is set up. The supervisory and timing functions for the call are thereafter handled by the CAMA equipment.

## 2.06 Information Digits

Tabulated below are the information digits used and their significance.

| | Information Digit | |
|---|---|---|
| | Nonobserved | Service Observed |
| Automatic Identification | 0 | 3 |
| Operator Identification (4-Pty. or Mpty. Line) | 1 | 4 |
| Operator Identification (Trouble in Identification) | 2 | 5 |

## 2.07 Operation in Case of Identification Failure

Certain features in local office switching may cause blockage of the identifying signal. This results in a failure to identify one or more digits of the calling number. To care for such situations, the identifier is arranged to make a retest or "second attempt" to fill in the missing digit or digits. If the retest is successful, the outpulser transmits the calling number information to CAMA.

Should the identifier be unable to make an identification in two attempts, a trouble is assumed and the outpulser is so notified. The outpulser functions to seize the ANI "trouble ticketer" which serves to record trouble information in printed form on paper tickets. The outpulser gives the trouble ticketer information for a trouble record, releases the identifier, and makes a second trial using the other identifier if one is provided. In the event that the second trial should fail in two attempts, the outpulser transmits the proper information digit to call in the CAMA operator for the identification.

## 2.08 Identification in Multioffice Buildings

The identifying equipment in multioffice buildings is arranged to serve a maximum of six originating offices. Such a combination of identifying equipment and originating offices is known as an "identifier group". More than one identifier group may be located in a single ANI installation.

The identifying equipment in an identifier group while making an identification must determine from which office the call is being originated and, subsequently, to scan the buses in that office for the directory number information. Under these conditions, the identifier

tests the thousands secondary buses for each office, in sequences, and, when the signal is found, tests successively the hundreds, tens and units buses in that office to complete the identification.

## 3.00 METHOD OF OPERATION

### 3.01 Call Progress in Step-by-Step Offices

Customers served by step-by-step equipment are required to dial a directing code for DDD calls. The block diagram of Figure 3 illustrates the step-by-step switching arrangement for handling this traffic.

After the directing code has been dialed, a connection is established to an ANI outgoing trunk through a line finder, first selector, and a service code selector. Digits of the called customer number subsequently dialed are received and registered in the CAMA office. After the first digit of the called number has been dialed following trunk seizure and before dialing of the next digit occurs, the ANI trunk makes party test. An indication as to whether the calling customer is a ring party or a tip party is registered in the trunk for later use by the identifier.

Two-party message rate line in step-by-step offices require a two-party message rate trunk between the line finder and first selector. This requires provision of a 4-wire service code switchtrain. On local calls, this trunk serves to identify the calling party by making a party test when it is seized and functions to score the proper party's message register on completed charge calls. On ANI calls, this trunk is not in a cut-through condition at the time party test is made by the ANI trunk. As a result, the ANI trunk always registers a ring-party indication on these lines. For this reason, number networks associated with both parties of message rate lines must be connected to the ring field of the primary bus system. The message rate trunk connects the identifying signal to the proper number network for the identification.

After dialing is completed, the CAMA equipment returns a start-identification signal to the step-by-step office which causes the ANI trunk to proceed with the identification process as outlined under Principles of Operation. In the case of calls from two-party message rate customers, the ANI trunk signals the message rate trunk at the end of outpulsing of the calling number causing it to cut-through.

When the conversation is completed and disconnect occurs on calls from other than two-party message rate lines, the originating equipment proceeds to restore to normal unless the call was made by a tip-party. At the completion of a tip-party call, the ANI trunk holds up the connection until it makes a "ground removal" test. This test is made to insure against charging a customer falsely because of a trouble ground on the line. If the call was made by a two-party message rate customer, the ANI trunk makes a ground removal test irrespective of whether the ring-party or tip-party on the line made the call.

If a ground is detected on the line during the ground removal test, an outpulser is recalled by the trunk so that the trouble ticketer can be instructed to print a trouble ticket signifying a ground removal test failure. The trouble ticket also contains the indicated directory number involved.

No ground removal test is made if the trunk circuit releases as a result of time out in the CAMA office incoming trunk when the calling party fails to disconnect. Under this condition, the ANI trunk winks-off the originating switches.

## 3.02 Call Progress in Panel Offices

The block diagram of Figure 4 illustrates the panel switching arrangements for handling ANI traffic.

When a customer originates a call in a panel office, a line finder locates and connects his line to an idle district circuit which is an equipment unit that forms part of the part through the originating equipment and which performs supervisory and charging functions on local calls. At the same time a link circuit connects the district to an idle sender. The sender signals the customer to begin dialing by transmitting dial tone and subsequently registers the digits of the called number. When the first three digits have been received, the sender requests connection to a decoder to which it passes this information. The decoder translates the three digits, transmits to the sender the information necessary to control selection of an idle ANI outgoing trunk, and releases.

In office arranged for auxiliary sender operation, the subscriber sender determines that an auxiliary sender is required for all 10-digit calls to foreign numbering plan areas. For certain 7-digit calls, the decoder determines this and informs the subscriber sender that an auxiliary sender is required. The auxiliary sender increases the digit storing

capacity of the sender and is arranged to outpulse all digits of the called number on an MF pulsing basis. It is seized by the sender in time to register the last two digits on a 10-digit call.

When dialing is completed the sender or auxiliary sender transmits the called number to the CAMA office by either PCI of MF pulsing. On 7-digit calls, the called number can be outpulsed PCI by the subscriber sender or MF by the auxiliary sender. On 10-digit calls, the called number is always outpulsed MF by the auxiliary senders. PCI or MF trunks are required depending on the type of pulsing used. Once the called number has been forwarded to the CAMA office, the sender signals the district to advance to the "operator-talk" position and then releases. The district is set in this position on ANI calls to prevent any local charging equipment from being operating since charging for these calls is handled by the CAMA equipment, to provide a suitable sleeve path for the identifying tone, and to provide a clear tip and ring for party test.

After receiving the called number, the CAMA equipment returns a start-identification signal to the originating office. When the ANI trunk has received both the start identification signal from CAMA and the indication that the district has cut through, it bids for an outpulser. Once connected, the outpulser makes a party test when required and the outpulser then connects to an identifier after which the calling number is identified as outlined under Principles of Operation. When the identification process is completed, the party test information is registered in the ANI trunk.

When the calling customer disconnects at the end of the conversation, the ANI trunk releases the local office equipment immediately unless the calling customer is a tip-party. In this case, the ANI trunk calls in an outpulser to make a ground removal test before releasing the originating equipment. If the calling customer fails to hang up after the called customer disconnects, the ANI trunk awaits time out in the CAMA incoming trunk before releasing.

As discussed in Section 2.07, the identifier may fail to identify one or more digits of the directory number during the identification process. Failures of identification result in the call being routed to CAMA for operator identification. However, in panel offices serving two-party lines, complete failures of identification in the tip field are not handled in this manner. Instead, the outpulser signals the trunk to return reorder tone to the calling customer.

## 3.03 Call Progress in No. 1 Crossbar Offices

The block diagram of Figure 5 illustrates the No. 1 crossbar switching arrangement for handling ANI traffic.

When a customer originates a call in a No. 1 crossbar office, the controller associated with the line link frame on which his line appears, connects his line to an idle district junctor. The district junctor forms part of the path through the originating equipment and performs supervisory and charging functions on local calls. At the same time, the sender link frame connects the district junctor to an idle sender. The sender in the No. 1 crossbar office determines whether a party test should be made by the class of calling line information it receives. If a two-party line is originating the call, the sender makes party test after which it transmits dial tone to the calling customer. The sender then registers the digits of the called number as they are dialed.

When the first three digits have been received, the sender requests connection to an originating marker through the marker connector. The sender then passes to the marker the first three dialed digits, the results of the party test if one was made, and other information needed by the marker to set up the call. The marker translates the three digits, sets the district junctor in the "operator-talk" position, passes the party indication to the ANI trunk as it sets up the path through the originating equipment, transmits required information to the sender and releases.

In offices arranged for auxiliary sender operation, the subscriber sender determines that an auxiliary sender is required for all 10-digit calls to foreign numbering plan areas, for certain 7-digit calls, the worker determines this and informs the subscriber sender that an auxiliary sender is required. At the end of dialing, the sender makes a second party test if the call is from a two-party line. If the results of this test and the party test made before dialing are different, the call is routed to reorder. However, if the results of both party tests are identical the sender or auxiliary sender transmits the called number to the CAMA office by either PCI or MF pulsing. On 2-digit calls, the called number can be outpulsed PCI by the subscriber sender or MF by the auxiliary sender. On 10-digit calls, the called number is always outpulsed MF by the auxiliary sender. PCI or MF trunks are required depending on the type of pulsing used.

The CAMA equipment after receiving the called number returns a start-identification signal to the originating office. When the ANI outgoing trunk has received both the start-identification signal from CAMA and the indication that the district is cut through, it bids for an outpulser. The PCI trunk does not require receipt of the start identification to start its bid for an outpulser. Once connected, the outpulser registers tip or ring party information as furnished by the trunk. The outpulser then requests connection to an identifier after which the calling number is identified as outlined under Principles of Operation

When the calling customer disconnects, the ANI trunk releases the local office equipment. If the calling customer fails to hang up after the called customer disconnects, the ANI trunk awaits time out of the CAMA incoming trunk before releasing.

## 4.00 EQUIPMENT ELEMENTS

This part describes the additional central office equipment elements, except for maintenance facilities which are covered in Section 6.00, that are required when local step-by-step, panel, and No. 1 crossbar offices are arranged for ANI operation. All frames are bulb angle structures 11-feet 6-inches high, 2-feet 5/8-inches long, 10-inches deep and are arranged for 23-inch mounting plates.

The ANI equipment elements provided for the offices in a building are arranged in which is termed an "identifier group". Such a group of equipment has capacity for six originating offices. Depending on ANI traffic volumes and the number of originating offices within, a building may contain more than one identifier group of equipment.

The units of equipment provided as part of an identifier group are:

(a) outgoing trunks

(b) outpulser connectors

(c) outpulsers

(d) identifiers

(e) number network frames

(f) "X" number network frames (No. 1 crossbar)

(g) Miscellaneous Number Networks (Step-by-Step and Panel Offices and No. 1 Crossbar Offices Without X-Numbers)

In certain cases, an identifier group may be equipped with only one identifier and one outpulser. This arrangement is limited in application because traffic surges and occasional outages of identifying equipment may result in additional call volumes at the CAMA switchboard.

4.01 Outgoing Trunks

ANI outgoing trunks fundamentally are the same for all three local switching systems. They provide access to the identifying equipment and initiate the identification process after recognizing the request for calling number information from the CAMA office. They participate in the party test function required for identification and provide a path between outpulsing equipment and outgoing cable for transmission of the calling number after it has been identified. After release of the outpulsing equipment, trunks provide a transmission path with talking battery and supervision toward the calling customer and trunk supervision toward the CAMA end. Also, they furnish means for "holding" the originating switch train for the duration of the call.

Outgoing trunks are furnished in quantitites depending upon the volume of originating traffic. They are mounted on trunk frames and divided into subgroups for operation with the outpulser connector. The trunks assigned to an identifier group serve only those offices in the same identifier group and not any other offices in other identifier groups. Several of the more significant differences in these trunks are outlined below.

A. Step-by-Step Trunks

These trunks, of which there are two types, appear either on the banks of service code selectors or on the banks of rotary out-trunk switches when such switches are used from the banks of service code selectors. Loop signaling type trunks are used when the dialed digits are repeated to the CAMA office on a loop basis. When longer distances to CAMA are involved and when voice repeaters or carrier facilities are employed, E&M leads signaling type trunks are used. Both type trunks are arranged to make party test during dialing and to forward this information to the outpulser when it is seized. Also, these trunks make a ground removal test at the end of tip-party calls or calls from two-party message rate lines to insure against charging a customer falsely in the event of a trouble ground on the line.

Fourteen of these trunks form a connector subgroup and a frame has capacity for 14 trunks or a complete subgroup.

B. Panel Trunks

There are two types of panel trunks, namely PCI and MF, and both appear on either the district or office multiple. In identifier groups serving panel offices with two-party lines, the trunks are arranged to signal the outpulser at the beginning of the identification process to make party test. At the end of completed tip-party calls (the trunk receives the party test results from the outpulser and stores this information for the call duration), the trunk reseizes an outpulser and signals it to make ground removal test. If the panel offices in an identifier group serve no two-party lines, the trunks are arranged to signal the outpulser to omit party test. These trunks initiate the identification process only after receiving the start identification signal from CAMA and the indication of district selector "cut-through" in the local office. Cut-through of the district selector provides a continuous sleeve lead which is required for transmission of the ac identifying tone.

Thirteen of these trunks form a connector subgroup and a trunk frame has capacity for a maximum of 26 trunks or two fully equipped subgroups.

C. No. 1 Crossbar Trunks

There are two types of No. 1 crossbar trunks, namely PCI and MF, and both appear on the office link frame. These trunks receive from the originating marker party test information when initially selected and this information is passed to the outpulser when the outpulser is seized. Like panel trunks, they initiate the identification process only after receiving the start identification signal from CAMA and recognizing cut-through of the district junctor.

Thirteen of these trunks form a connector subgroup and a trunk frame has capacity for a maximum of 26 trunks or two fully equipped subgroups.

4.02 Outpulser Connector Equipment

All outgoing trunks in an identifier group have access to all outpulsers in that group. Connection of a trunk to an outpulser is established through an outpulser connector. This connector equipment is divided into three main parts as follows:

(a) trunk connector unit

(b) outpulser connector unit

(c) outpulser busy unit

Trunk connector units for panel and No. 1 crossbar trunks are arranged to serve two trunk subgroups and are mounted on the same trunk frame as are the trunks. The trunk connector unit for step-by-step trunks is arranged to serve one trunk subgroup and is mounted on the same frame as are the trunks.

The outpulser connector unit is arranged to connect any of five trunk subgroups to one of two outpulsers. Additional outpulser connector units are provided depending on the number of outpulsers and trunk subgroups in an identifier group. These units are mounted on a miscellaneous relay rack frame near the associated trunk frames.

The outpulser busy unit is arranged to serve the maximum number of seven outpulsers per identifier group and 12 trunk subgroups and is mounted on the miscellaneous relay rack provided for outpulser connector units. One is provided for each 12 subgroups.

4.03 Outpulser

The outpulser is the equipment unit that controls the identification process. It is arranged to receive party test information from outgoing trunks or to obtain this information itself, when required, by making party test. It makes a test to verify that the calling customer has not disconnected before proceeding further with the identification. When these functions have been completed, the outpulser seizes an identifier to which it passes the party test information.

As the digits of the directory number are identified by the identifier, they are registered in the outpulser. The outpulser translates the office identity it receives from the identifier into the three digits of the calling office code. When all seven digits of the calling customer's directory number have been obtained, they are outpulsed, along with the appropriate information digit to the CAMA office by means of MF signaling.

Usually, only one three digit office code is assigned to each series of 10,000 directory numbers but there are cases where additional codes, known as "theoretical codes", are assigned to some of the numbers within the number series. In such instances, the outpulser performs a translation of the office identity in relation to the directory number digits received from the identifier and furnishes the proper three digit office code.

Outpulsers are mounted on outpulser frames and a frame has capacity for two outpulsers plus some additional miscellaneous equipment. They are provided in accordance with the volume of ANI traffic starting with a minimum of one up to a maximum of seven per identifier group.

4.04 Identifier

The identifier, as its name implies, is the unit that identifies the digits of the calling customer's directory number. It also determines when a call is originated by a four-party or multiparty customer and when a calling line is connected for service observing. Except for installations as discussed previously, identifiers are provided two per identifier group. A single identifier occupies the space of an entire frame and consists primarily of the following functional units.

(a) Secondary network and bus connector circuit. This circuit is part of the primary-secondary system of networks and buses and is provided one per originating office. Space for three of these units is reserved on the identifier frame. The two identifiers in the identifier group therefore, can serve a maximum of six originating offices.

(b) Amplifier detectors. These units scan the output of the secondary buses and detect the identifying tone. A maximum of 12 detectors may be furnished per identifier. Ten are always furnished for the identification of the thousands, hundreds, tens, and units digits 0-9. A multiparty detector and/or a service observing detector may also be provided per identifier if the identifier group serves any four-party or multiparty lines or if a distinctive record is desired on calls from lines connected for service observing.

(c) Service observing network unit. One of these units may be furnished per identifier group and is located on one of the two identifier frames if service observing is required. It provides a separate identification channel which supplies supplementary information to the effect that calls are service observed.

(d) Miscellaneous control and test equipment which is required per identifier for general control, steering, checking, and testing functions.

4.05 Number Network Frame

Number network frames contain the equipment that is required for the primary system of networks and buses. As discussed, this equipment consists of number networks, horizontal and vertical buses, and insulating panels to which these components are attached.

The capacitors and resistors for ten number networks (10 capacitors and 30 resistors) are fastened to a "card" as shown in Figure 6, and 20 such cards are attached to a two-section panel, 10 cards per section along with horizontal and vertical buses. Ten of these panels, each having capacity for 200 directory numbers, are furnished per number network frame giving the frame a total capacity of 2000 directory numbers. The ten cards on the left of each of the ten panels on a frame are in one thousand group, the ten cards on the right of the ten panels are in another thousand group. Five of these frames provide the required directory number capacity, in ten separate groups of a thousand consecutive numbers each for a complete office. Part of a panel is shown in Figure 7. A complete number network frame is shown in Figure 8.

4.06 X-Number Network Frame (No. 1 Crossbar - Only)

Extra numbers are used in some No. 1 crossbar offices in order to increase the directory number capacity of the originating office beyond the limits of the regular 10,000 number series. These numbers are called "X", "auxiliary," or "coded" numbers and are provided primarily for PBX use.

The X-number network frame shown in Figure 8, contains the number network equipment required in offices with X-numbers. A single X-number network frame can be equipped, as specified, with a maximum of 8 insulating panels of 200 networks each. When the 1600 number capacity of a single frame is exceeded, an additional X-number network frame is provided to care for the excess, to the 2500 maximum X-numbers in an originating office. All the number networks on a panel of 200 numbers are assigned to a single office.

The method of associating X-number networks with the number networks located on number network frames is described under the heading Number Network Cross-Connections.

4.07 Miscellaneous Number Networks (Step-by-Step and Panel, and No. 1 Crossbar Without the X-Number Feature

In step-by-step and panel offices, and in No. 1 crossbar offices not equipped with X-numbers, some PBX lines may be arranged for originating service only. Such lines are commonly referred to as "one-way" lines and are not usually assigned directory numbers. When an ANI call is originated from a one-way line, the identifying equipment must be able to obtain the listed directory number of the PBX to which the line is associated for billing purposes. For these lines, miscellaneous number networks are provided, with means for associating them with the number networks located on the number network frames.

Miscellaneous number networks are furnished in quantities of 200 per number network panel and the panels are mounted on a miscellaneous relay rack frame. The method of associating miscellaneous number networks with the number networks located on number network frames is described under the heading Number Network Cross-Connections.

5.00 NUMBER NETWORK CROSS-CONNECTIONS

Means for making network-to-bus field connections are provided on the number network, X-number network and miscellaneous number network panels. At each network location on the front of these panels appear seven terminals which protrude through holes in these panels. These terminals are extensions of the number network and the bus conductors as shown on Figure 9. Two terminals in the group are for the number network, two are for the vertical and horizontal ring buses of the ring field, two are for the vertical and horizontal tip buses of the tip field, and the remaining one is for the vertical multiparty bus of the multiparty field. Solderless wrapped wire straps from network terminals to bus terminals serve to connect number networks to bus fields.

Each number network located on the number network frames represents one four digit number in the directory number series 0000 to 9999. Identifier response to a directory number can be recorded only after the associated number network is connected to one of the bus fields. This response consists of the four digit number when the network is connected to either the ring field or tip field or a multiparty indication when the network is connected to the multiparty field.

With one exception (step-by-step, see 3.01), networks serving individual, PBX, and ring-party customers are connected to the ring field, networks serving tip-party customers are connected to the tip field, and networks serving four-party and multiparty customers are connected to the multiparty field. Examples of these connections are shown in Figure 9.

For PBX's, it is not practicable to connect each number network serving the PBX lines to the ring field at the location where mounted because this would result in the calls from the PBX being billed to several different directory numbers when calls from all lines of a PBX are ordinarily billed to the listed PBX directory number. Therefore, only the network representing the listed PBX number is connected to the ring field. The networks representing the other lines in the PBX are not connected to the ring field at the locations where they are mounted but are multipled to the terminals of the directory number network as shown in Figure 9. Effectively, therefore, they act as if they were all connected to the ring field at the same location as the directory number network. In this way, all ANI calls originating from the PBX are referred to the listed PBX directory number for billing purposes.

The directory numbers associated with the networks serving the lines of a PBX may not be in consecutive order but rather may be a group of nonconsecutive numbers representing networks that are located on one or more number network frames. In these cases, multipling of the networks for the lines of the PBX to the network for the listed PBX directory number involves multipling between frames. Terminal blocks on all number network frames and interframe tie cables which furnish connections between frames are provided to facilitate these connections.

X-number networks and miscellaneous number networks do not represent any of the numbers in the directory number series and as a result, cannot be used for billing purposes. Since these networks are assigned to PBX lines, they are multipled to the number network representing the listed PBX number in the same manner regular PBX number networks are multipled to a directory number network.

The following table summarises for the three systems and for various customer classes of service, the field to which a network is connected and the number of wire straps required for the connection.

| Class of Customer Served By Network | Field To Which Network Is Connected | Wire Straps Required | Remarks |
|---|---|---|---|
| Individual | Ring | 2 | - |
| All Ring Party Customers and Tip-Party Customers of Two-Party Message Rate Lines in Step-by-Step | Ring | 2 | - |
| All Other Tip-Party Customers | Tip | 2 | - |
| PBX | Ring | 2 | Network Associated With Listed Number Connected to Ring Field: All Other Networks of same PBX Multipled to the Directory Number Network. |
| Four-Party and Multiparty | Multiparty | 1 | Only One Terminal of One Network Associated With a Multiparty Line is Connected to the Multiparty Field. The Other Network Terminals Remain Unconnected. |

## 6.00 MAINTENANCE FACILITIES

### 6.01 General

The ANI circuit elements are designed so that they are self-checking to a large extent. Means are provided for checking and testing the various units of ANI equipment and to provide for recording trouble information. These maintenance units are discussed in the following paragraphs.

## 6.02 Trouble Ticketer Frame

In the event of an identification failure or certain other irregularities, a trouble record is made. Trouble recording in ANI offices is performed by a trouble ticketer which prints the trouble information in one line on a paper ticket. Space for forty printed characters is provided on a line and the ticketer is arranged to print any one of twelve characters in each space. The twelve characters available for use are the digits zero to nine (0-9), the dash (-) and the asterisk (*). With this arrangement, such information as type of call, trunk, outpulser, identifier, identifier group, calling directory number, outpulser and identifier progress, and time of day are recorded on the ticket.

One trouble ticketer frame is provided per ANI installation and serves all identifier groups therein. It has capacity for the following functional units:

(a) 1A message ticketer for printing trouble tickets and associated control, connector, and registration equipment for connecting the trouble ticketer to the various outpulsers being served.

(b) permanent signal identification circuit, associated 5800 cycle oscillator, and jacks for permanent signal holding trunks when required in panel and/or No. 1 crossbar offices. Jacks may be provided for a maximum of 600 permanent signal holding trunks in the ANI installation.

(c) outpulser and identifier usage lamps, jacks for making individual outpulsers and identifiers busy, registers for recording identification and outpulser failures, miscellaneous trouble and alarm lamps, and control jacks and keys.

This frame should preferably be located in the test or maintenance center adjacent to the ANI outpulser-identifier-trunk test frame.

## 6.03 Outpulser-Identifier-Trunk Test Frame

Testing equipment provided for outpulsers, identifiers, networks and outgoing trunks is located on the outpulser-identifier-trunk test frame. One such frame is required per

installation and is capable of serving all the outpulsers, identifiers, and trunks in a maximum of three identifier groups. The frame consists of two separate circuits: an outpulser-identifier test circuit and an automatic trunk test circuit. The latter circuit, in the case of panel and/or crossbar, has been arranged for a capacity of 1000 outgoing trunks, and in the case of step-by-step, for a capacity of 500 outgoing trunks.

The outpulser-identifier test circuit is arranged to:

(a) test outpulsers.

(b) test identifiers.

(c) provide a means for adjusting amplifier detectors in the identifiers.

(d) test the primary-secondary system of networks and buses.

(e) register the information outpulsed on a test call made by an ANI automatic trunk test circuit.

In testing an outpulser, an identifier, or a particular number network, a maintenance man originates a test call by means of this circuit. Keys are provided to permit the maintenance man to select any desired combination of outpulser and identifier for the test. A particular number network is selected by patching at the number network frame. The progress of the test call and the results of the identification and outpulsing are displayed on lamps provided as part of this unit.

The automatic trunk test circuit provides for automatic progression testing of outgoing trunks. One circuit is provided for panel and No. 1 crossbar trunks; another circuit is required for step-by-step trunks. It functions with the outpulser identifier test circuit to simulate the signals to the originating and terminating ends of the trunk circuit which would be encountered on a service call but functions independently of the originating and terminating circuits. This circuit checks certain operational features of the trunks and applies marginal tests to the calling and called end trunk supervisory relays.

Access to the outgoing trunks is obtained by means of a crossbar switch trunk test connector unit which has capacity for 500 trunks. These units are located on a relay rack near the trunks. When more than 500 trunks are provided, a second trunk test connector unit is furnished.

This frame should preferably be located in the test or maintenance center adjacent to the trouble ticketer frame.

## 6.04 Line Verification Facilities

When new customers are given service or when line numbers are changed, cross-connection work must be performed on the distributing frames and on the number network frames. It is essential that this service order work be checked to verify correct identification on calls from these lines. Line verification facilities are provided in ANI installations for making these identifications. In step-by-step and No. 1 crossbar offices, existing test train facilities are used to direct a test call to the line to be verified. In panel offices, this connection is established by patching at the intermediate distributing frame. The test connecting facilities, in any case, have access to the outpulsers through the outpulser connector. After the line to be verified is reached, the ANI equipment is actuated and the outpulser obtains an identification by the normal process. The identified calling number, however, is not transmitted to CAMA, but instead, is displayed on a numerical indicator lamp display convenient to the observer.

If the number verified is within a PBX group, the number identified and displayed will be the listed PBX direcory number.

If the number being verified is assigned to one of the customers on a four-party of multiparty line, it will be identified as such by the identifying equipment. A multiparty lamp will be lighted, instead of a directory number normally displayed on the numerical indicator tube display. This multiparty indication will be sufficient since on this type of call, the outpulser causes the CAMA office to connect an operator, who obtains the calling number verbally from the customer.

In the event of trouble during the identification, a trouble lamp will be lighted to indicate such a condition to the test man.

### A. Step-by-Step Line Verification

The block diagram of Figure 10, shows the equipment involved on a line verification call in a step-by-step ANI installation. Verification involves dialing directory number digits of the line to be verified by a test man at a dial control position. This causes a connection to be established

from the line verification circuit through a test distributor and test connector to the line connector terminal. With "test train" verification arrangements, this is all that is required. When the connector terminal has been reached and found to be idle, the line verification circuit seizes the identifying equipment through the outpulser connector. The identifying tone placed on the sleeve is transmitted through the test train to the connector terminal and then to the ANI number network equipment. The identifier identifies the directory number of the particular line under test and this number is subsequently displayed on numerical indicator tubes convenient to the test man. With the "test train and service train" verification arrangements, dialing of additional digits after the connector terminal is reached through the test train is required to direct the call from the connector terminal through the service train to the line verification circuit. Once this has been accomplished, the line verification circuit seizes the identifying equipment and the identification is performed as discussed above. The identifying tone in this case, however, is directed through the service train to the number network equipment and not through the test train.

One line verification circuit is provided per identifier group and can serve a maximum of five separate dial control positions and associated numerical tube display panels. The basic line verification circuit is arranged for "test train" verification. Additional equipment is required to arrange the basic circuit for "test train and service train" verification. This latter equipment is required for performing line verification tests on two-party message rate lines.

B. Panel Line Verification

The block diagram of Figure 11, shows the equipment involved on a line verification call in a panel ANI installation. This arrangement requires that a patch cord connection be made to the customers line at the intermediate distributing frame. A new line verification trunk circuit is provided, one per message register rack location, which connects to the line verification connector and display circuit which serves all line verification trunks in the identifier group. This latter circuit has access to the identifying equipment through the outpulser connector. When the verification is initiated by the test man at a message register rack location, the line verification connector and display circuit seizes the identifying equipment and the directory number associated with the line being tested is

identified. The outpulser passes this information to the line verification connector and display circuit which causes the number to be displayed on the numerical indicator tube display panel located at the originating point.

An optional arrangement provides for supplementing these facilities with access and indicator tubes at one or more number network frame locations.

C. No. 1 Crossbar Line Verification

The block diagram of Figure 12, shows the equipment involved on a line verification call in a No. 1 crossbar ANI installation. The ANI line verification facility is superimposed upon the existing line verification arrangements which provide features for checking message register operation and line distributing and block relay frame cross-connections. For present tests, it is necessary to make a patch cord connection to the customer's line vertical on the line link frame but this is not required if only an ANI line verification test is to be made. In either case, with or without the patch cord connection, the maintenance man, by dialing a special code and the directory number digits, completes a connection to the line being verified through the terminating equipment. When this connection has been established and after any other tests have been made if required, the ANI feature is activated by the maintenance man which causes the line verification connector and display circuit to seize the identifying equipment. The identified number is subsequently passed from the outpulser to the line verification connector and display circuit and displayed on the numerical indicator tube display panel located at the originating point.

An optional arrangement provides for supplementing these facilities with access equipment and indicator tubes.

6.05 Permanent Signal Test Calls

If a line develops a trouble which simulates a request for service or if customer dialing does not start in the time allowed on Panel and No. 1 crossbar offices, the common control switching equipment routes the call to a permanent signal holding trunk. Such lines are connected to these trunks so that plant personnel may take the proper steps to clear the trouble condition. It usually becomes necessary to obtain the identity of the line involved before further procedures can be applied. Ordinarily, this involves manual tracing through the office switches but with ANI, a means is available for automatically obtaining the identity of the calling line. This arrangement is diagrammed in block form in Figure 13.

When a permanent line is to be identified, the cord of the ANI permanent signal identification circuit is connected to the jack of the permanent signal holding trunk to which the line in trouble is connected. This causes the permanent signal identification circuit to seize an outpulser after which the directory number of the faulty line is identified as on a regular service call. However, the calling number information is passed to the trouble ticketer along with a permanent signal indication instead of being outpulsed. The trouble ticketer subsequently prints a permanent signal record containing the directory number information. These permanent signal records are shorter in length than trouble tickets and may be readily separated from the tickets in the trouble ticketer bin. A successful permanent signal identification is accompanied by a lamp indication at the trouble ticketer frame. Should a trouble be encountered a trouble ticket "marked" as permanent signal will be printed; for this trouble condition there is not lamp indication. Also, the lamp is not lighted if for any reason the trouble ticketer is not available to print a permanent signal record.

The permanent signal identification circuit transmits a ring party indication to the outpulser on every permanent signal call. Should the identifier fail in the ring field, it is subsequently switched to the tip field to search for the directory number information.

If a multiparty line is in a permanent signal condition and the identifier identifies it as a multiparty line, a ticket is printed minus the directory number information but indicating a multiparty line. In cases of a permanent PBX line, the identifier obtains the listed PBX directory number and this information is subsequently printed on a ticket. This number may or may not be the number associated with the permanent PBX line.

This facility may be used to obtain the identity of permanent coin lines as well, providing that the associated number networks are strapped to the bus field.

One permanent signal identification circuit is required per ANI installation and will serve all the identifier groups therein. It is located on the trouble ticketer frame along with the permanent signal jacks which are provided one per permanent signal holding trunk. Provision has been made for a maximum of 600 jacks per installation.

This facility is not available for the step-by-step system because this system is not arranged to connect permanent lines to holding trunks.

## 7.00 OBSERVING FACILITIES

Observing facilities provide a separate identification channel, distinct from the one provided for directory number identification, so that supplementary information may be obtained when a line originating a call is being observed. This information is detected by the service observing detector in the identifier during the identification process and passed to the outpulser. This causes the information digit (see 2.06) transmitted to the CAMA office to be modified, i.e., it indicates to the AMA equipment that a service observed record is to be perforated on the AMA tape.

Observing facilities are divided into two general categories; namely, traffic observing and complaint observing. For traffic observing purposes, the service observing detector in the identifier will be operated when a call is originated by a customer connected for observing and when the associated equipment has been able to complete a connection to the service observing equipment. The observed information digit is transmitted to CAMA on calls originated by any party on the observed line. For complaint observing purposes, the service observing detector in the identifier will be operated each time a call is originated by a customer connected for observing. To eliminate excessive observed entries on the AMA tape for calls from two-party lines, features are available which provide for detector operation only when the particular party being observed originates the call.

No distinction is made in the information digits between traffic and complaint observations.

## 8.00 TRAFFIC MEASURING FACILITIES

Connections to the following traffic measuring facilities have been provided:

(a) A register per outpulser to count the total number of calls, plant calls as well as traffic calls handled by the outpulser.

(b) A register per identifier group to record the number of calls requiring the services of a CAMA operator including calls not only from four-party and multiparty customers but also when the identification equipment fails to make an identification because of trouble.

(c) A register per identifier group to record the number of plant test calls.

(d) Outpulsers and identifiers are arranged to connect, by means of two separate leads, to the traffic usage recorder circuit. One lead indicates all traffic, test, and maintenance usage except the plugged busy condition; the other lead indicates the plugged busy condition only.

(e) Outgoing ANI trunks are arranged to connect to the traffic usage recorder circuit.

(f) Panel ANI outgoing trunks are arranged to connect to registers for recording the number of calls offered to these trunks.

(g) Step-by-step trunks are arranged to score a register whenever one of these trunks fails to seize an outpulser during its timeing interval. For graded and nongraded groups, an (LTB) last trunk busy register is connected to the register lead of the last choice trunk unit in each group. Where rotary out-trunk switches are used, each ROTS subgroup is arranged to provide means for (ATB) all trunk busy registrations.

## 9.00 LIST OF RELATED DRAWINGS AND FIGURES

| Figure Number | Title |
|---|---|
| 1 | Block diagram of ANI Switching Arrangement |
| 2 | Simplified schematic of the Primary-Secondary System of Networks and Buses |
| 3 | Block diagram, showing ANI equipment in a Step-by-Step Office |
| 4 | Block diagram showing ANI equipment in a Panel Office |
| 5 | Block diagram showing ANI equipment in a No. 1 Crossbar Office |
| 6 | Opposing sides of card on which number networks are mounted in groups of ten |
| 7 | Part of number network panel |
| 8 | (Number Network Frame<br>("X" Number Network Frame |

BLOCK DIAGRAM OF AUTOMATIC NUMBER IDENTIFICATION SYSTEM

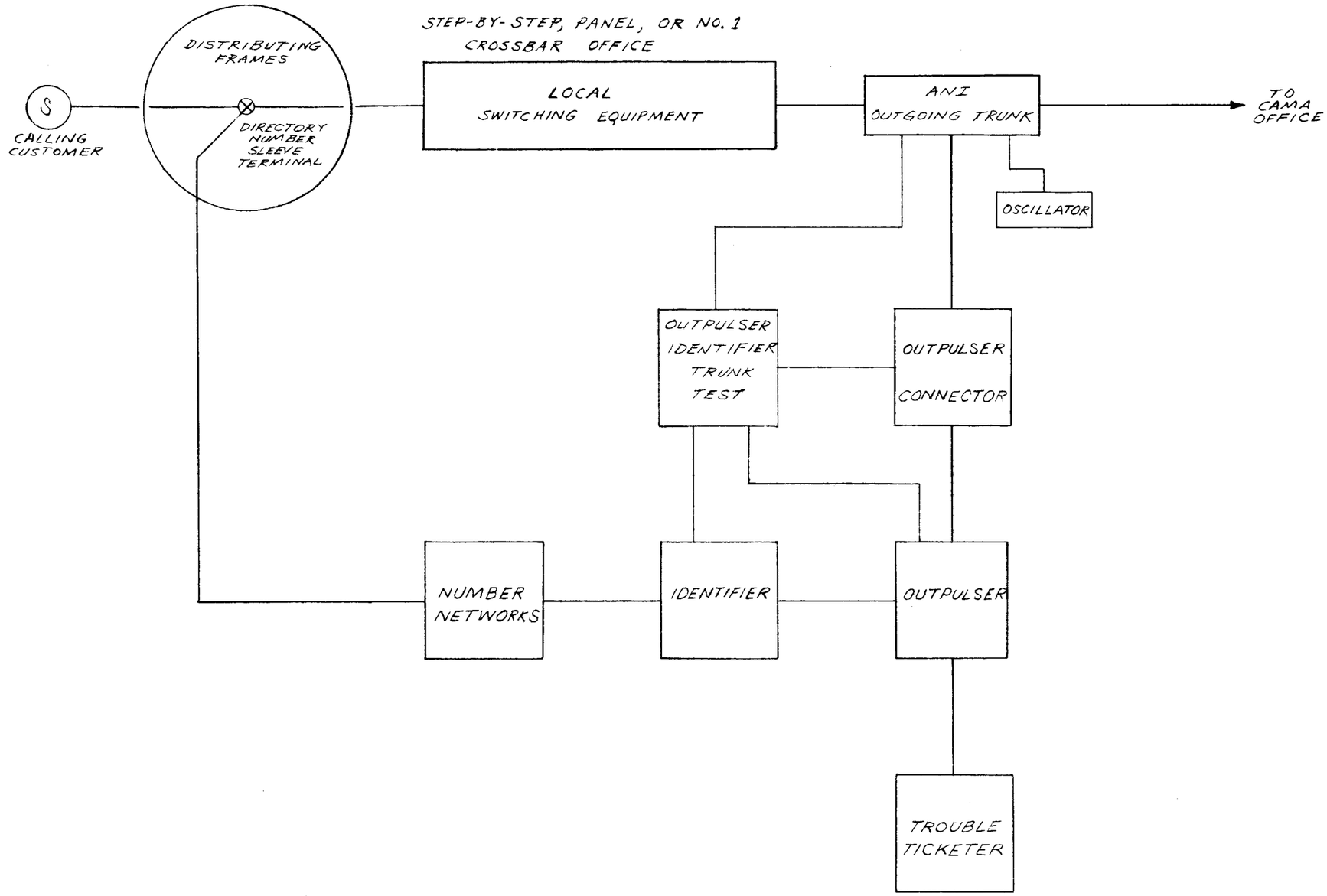



Fig. 1

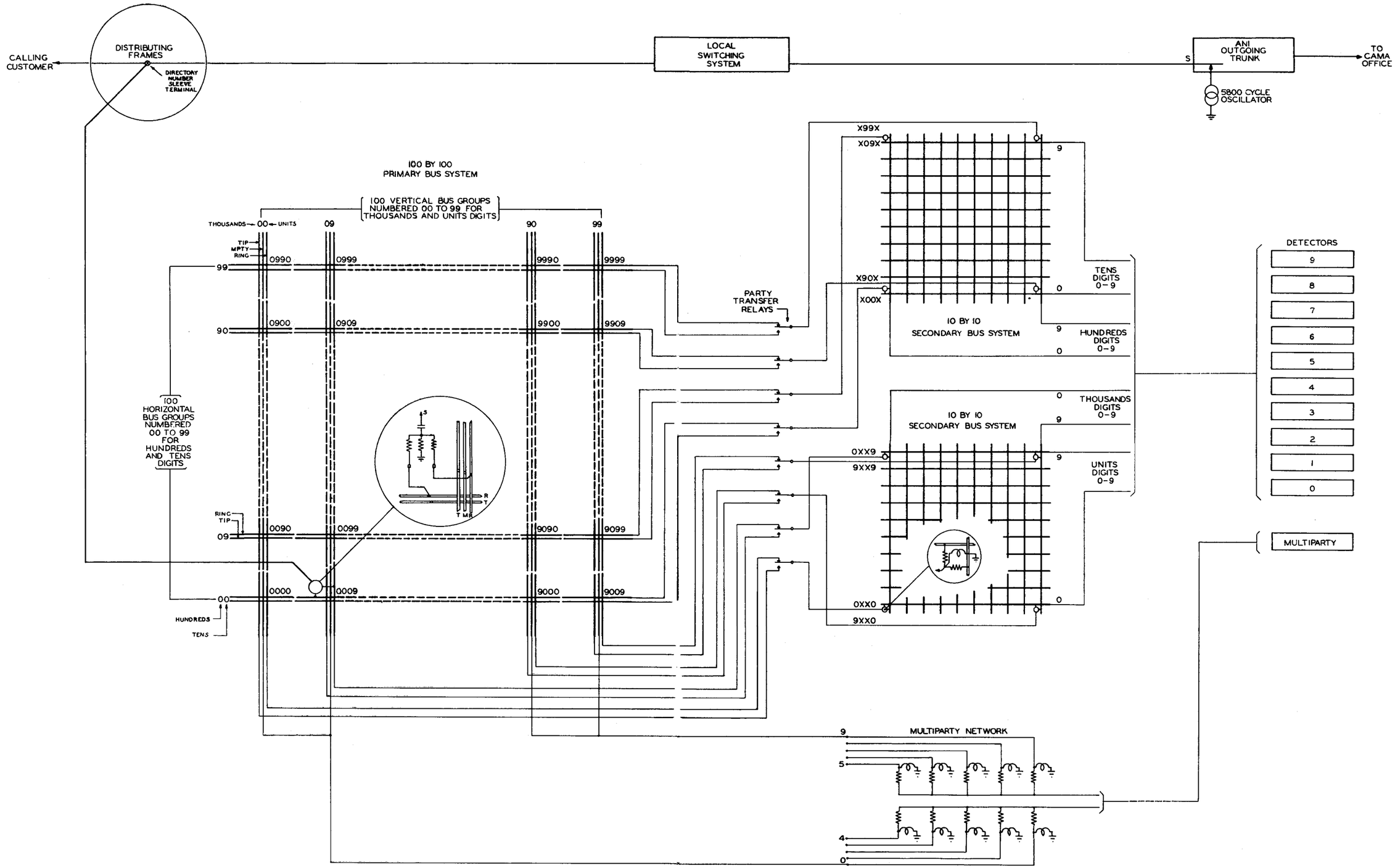
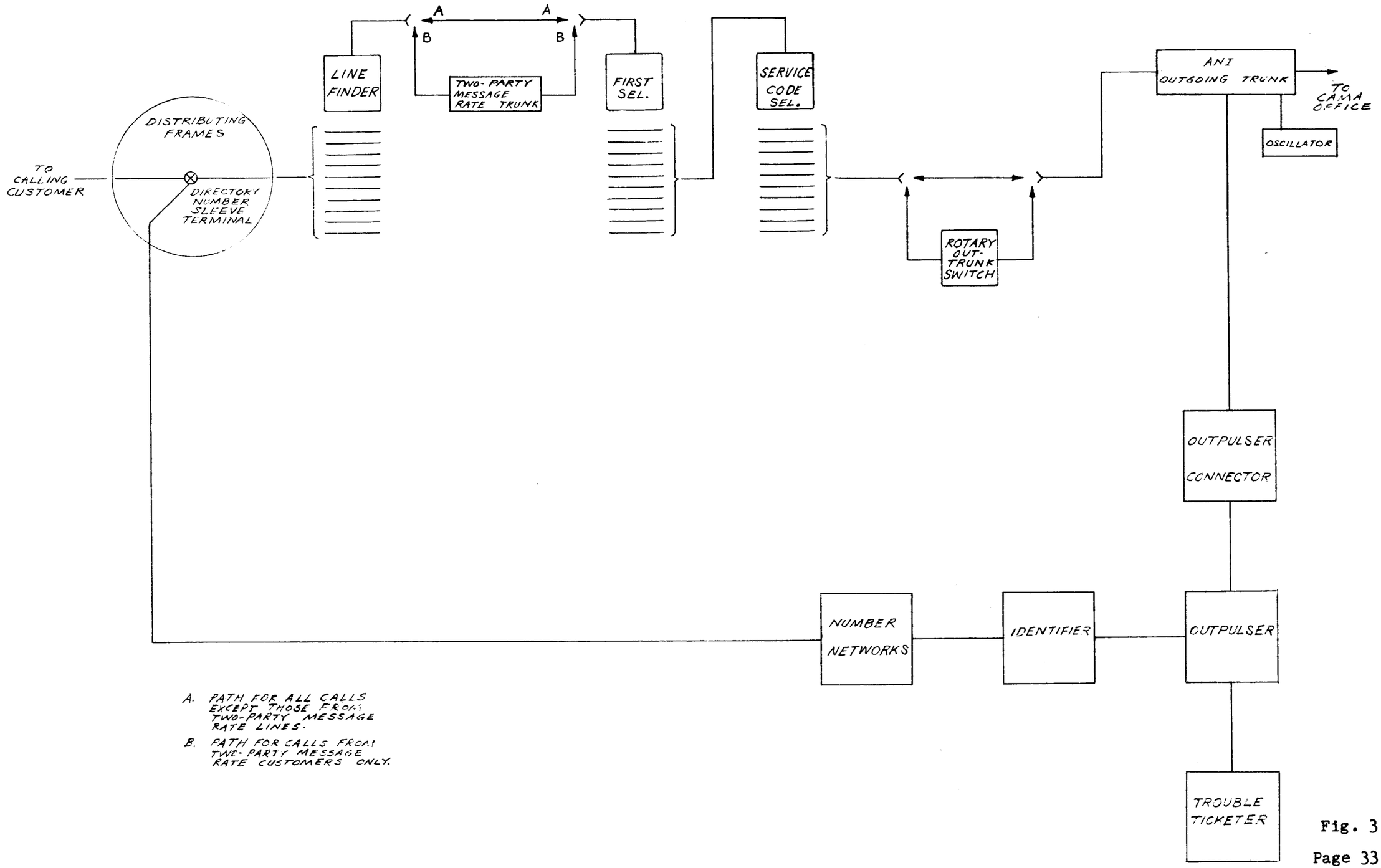

CALLING CUSTOMER
DISTRIBUTING FRAMES
DIRECTORY NUMBER SLEEVE TERMINAL
LOCAL SWITCHING SYSTEM
ANI OUTGOING TRUNK
S
TO CAMA OFFICE
5800 CYCLE OSCILLATOR
100 BY 100 PRIMARY BUS SYSTEM
100 VERTICAL BUS GROUPS NUMBERED 00 TO 99 FOR THOUSANDS AND UNITS DIGITS
THOUSANDS
UNITS
00
09
90
99
TIP
MPTY
RING
0990
0999
9990
9999
0900
0909
9900
9909
100 HORIZONTAL BUS GROUPS NUMBERED 00 TO 99 FOR HUNDREDS AND TENS DIGITS
RING
TIP
0090
0099
9090
9099
0000
0009
9000
9009
HUNDREDS
TENS
S
R
T
M
PARTY TRANSFER RELAYS
X99X
X09X
X90X
X00X
10 BY 10 SECONDARY BUS SYSTEM
TENS DIGITS 0-9
HUNDREDS DIGITS 0-9
THOUSANDS DIGITS 0-9
UNITS DIGITS 0-9
0XX9
9XX9
0XX0
9XX0
DETECTORS
9
8
7
6
5
4
3
2
1
0
MULTIPARTY
MULTIPARTY NETWORK
5
4
0

Fig. 2

## PATH OF ANI CALL IN STEP-BY-STEP OFFICE




A. PATH FOR ALL CALLS EXCEPT THOSE FROM TWO-PARTY MESSAGE RATE LINES.

B. PATH FOR CALLS FROM TWO-PARTY MESSAGE RATE CUSTOMERS ONLY.

Fig. 3

# PATH OF ANI CALL IN PANEL OFFICE

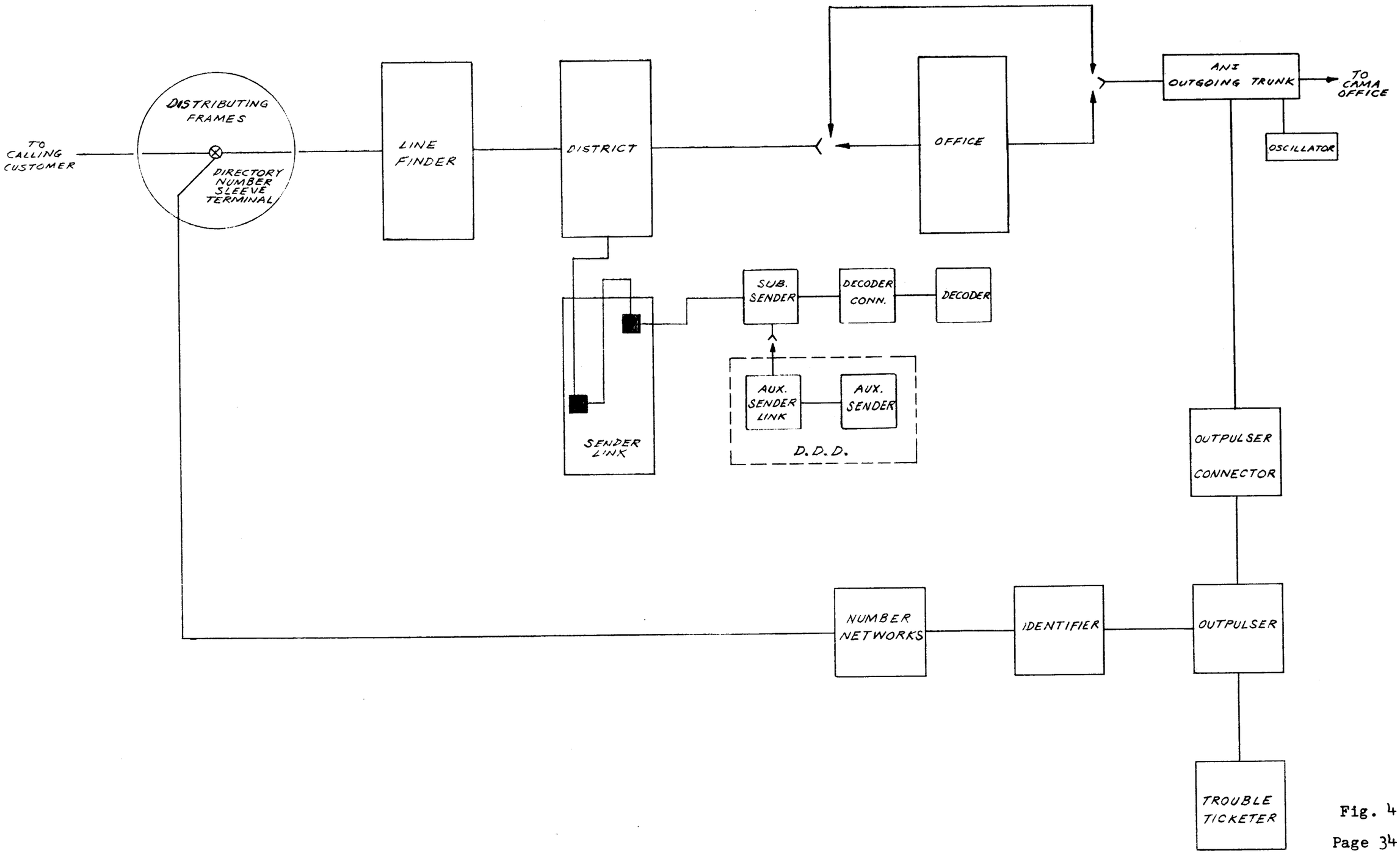
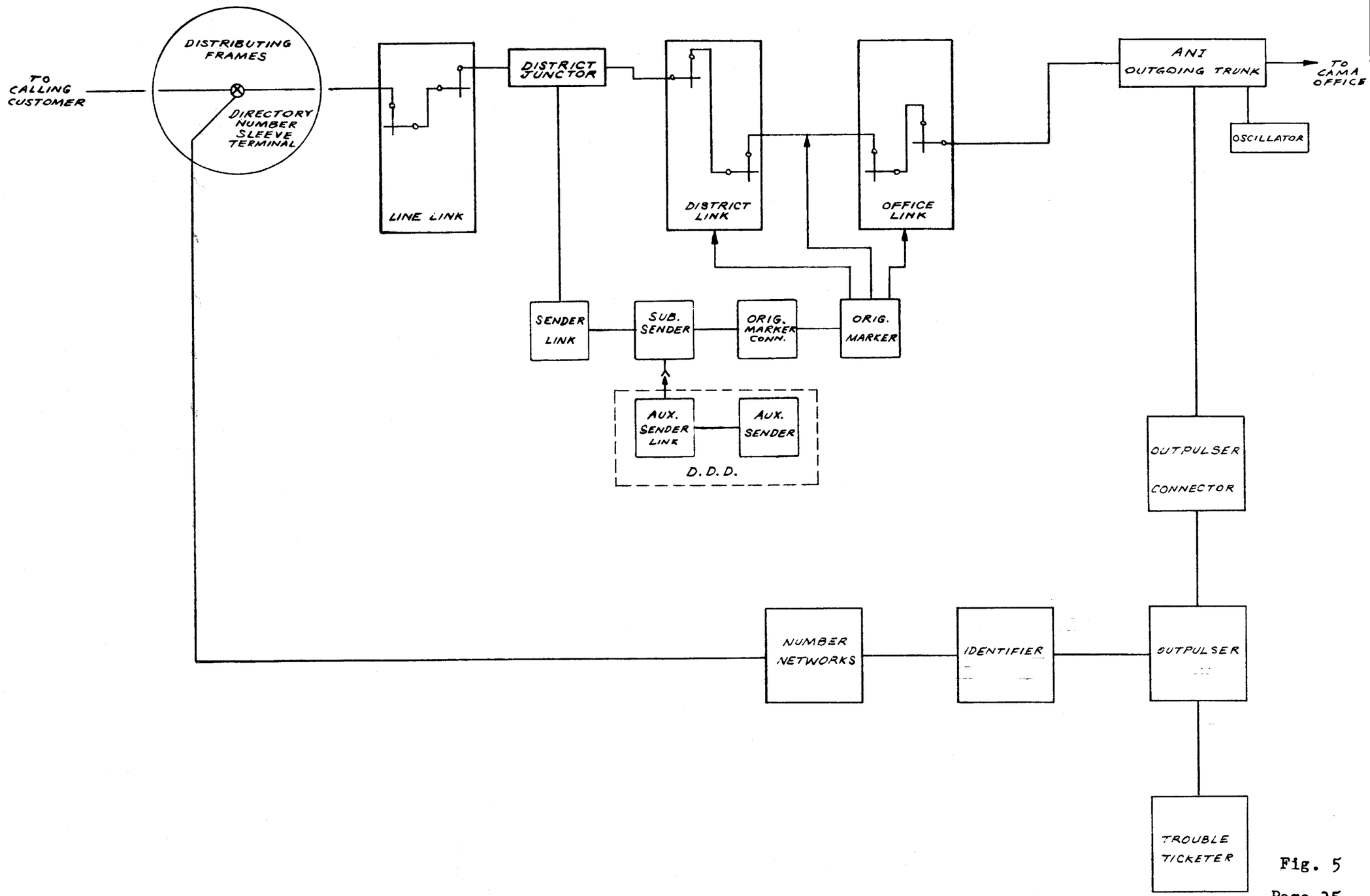



Fig. 4

# PATH OF ANI CALL IN NO. 1 CROSSBAR OFFICE



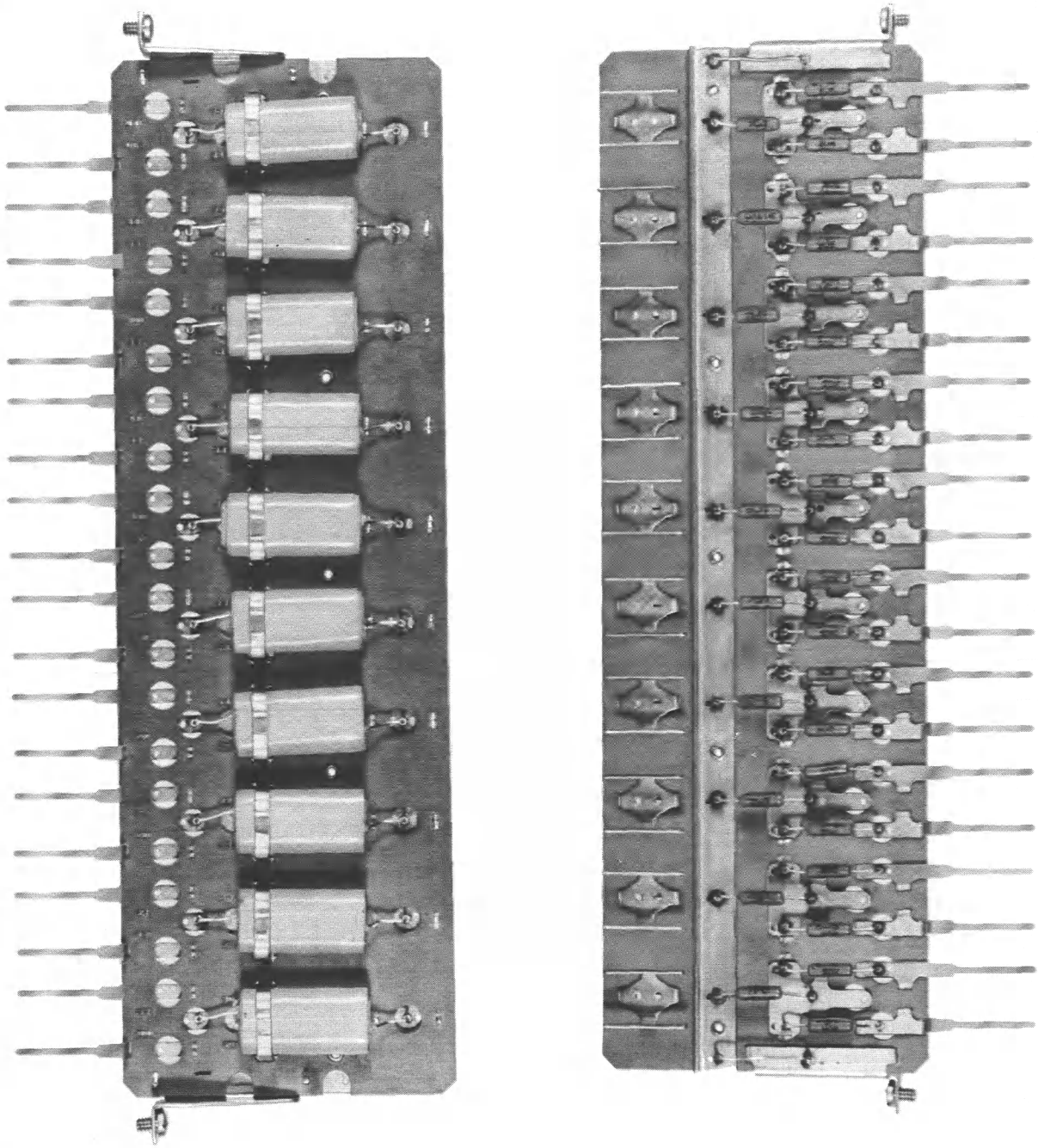


Fig. 6

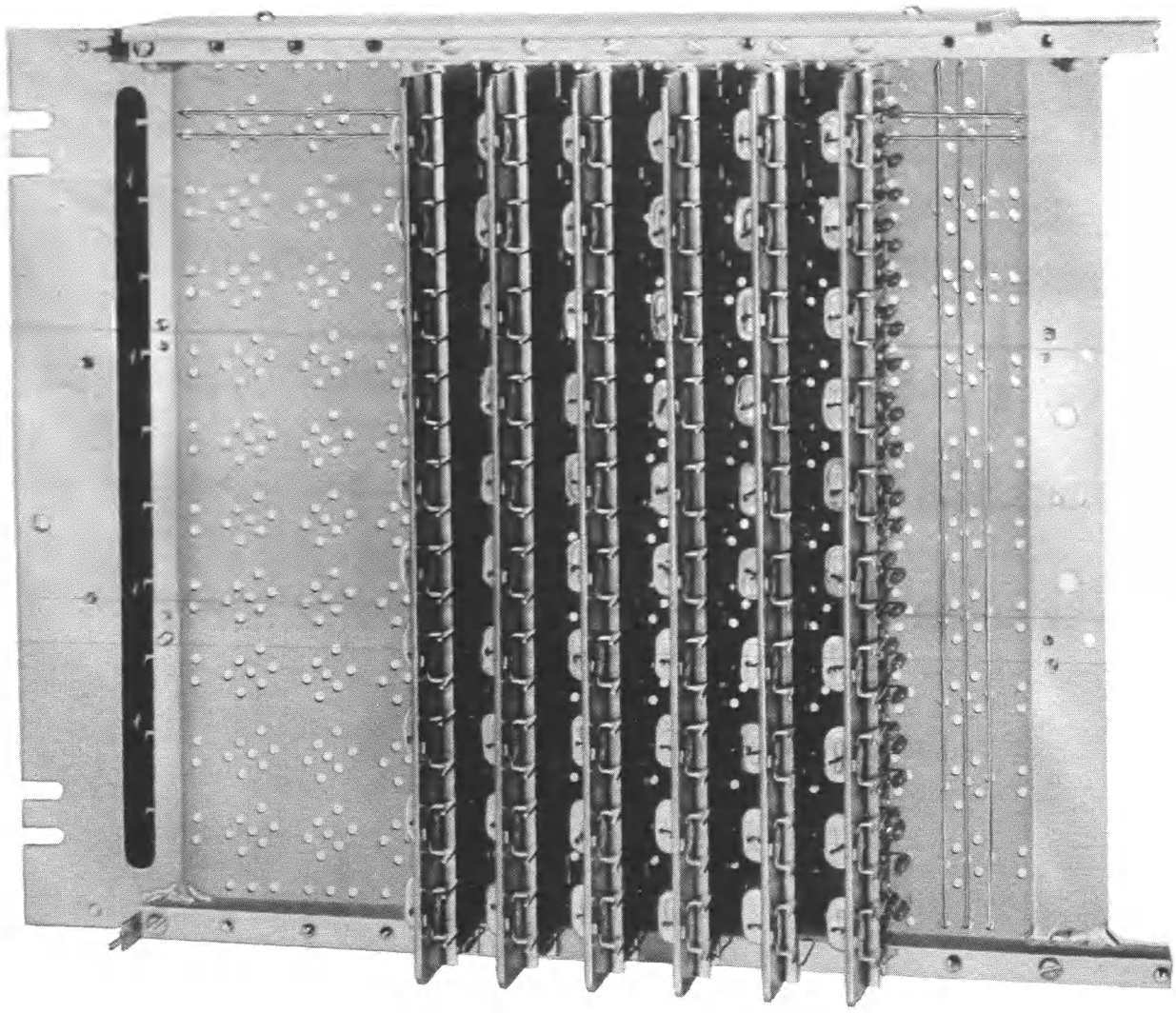


Fig. 7

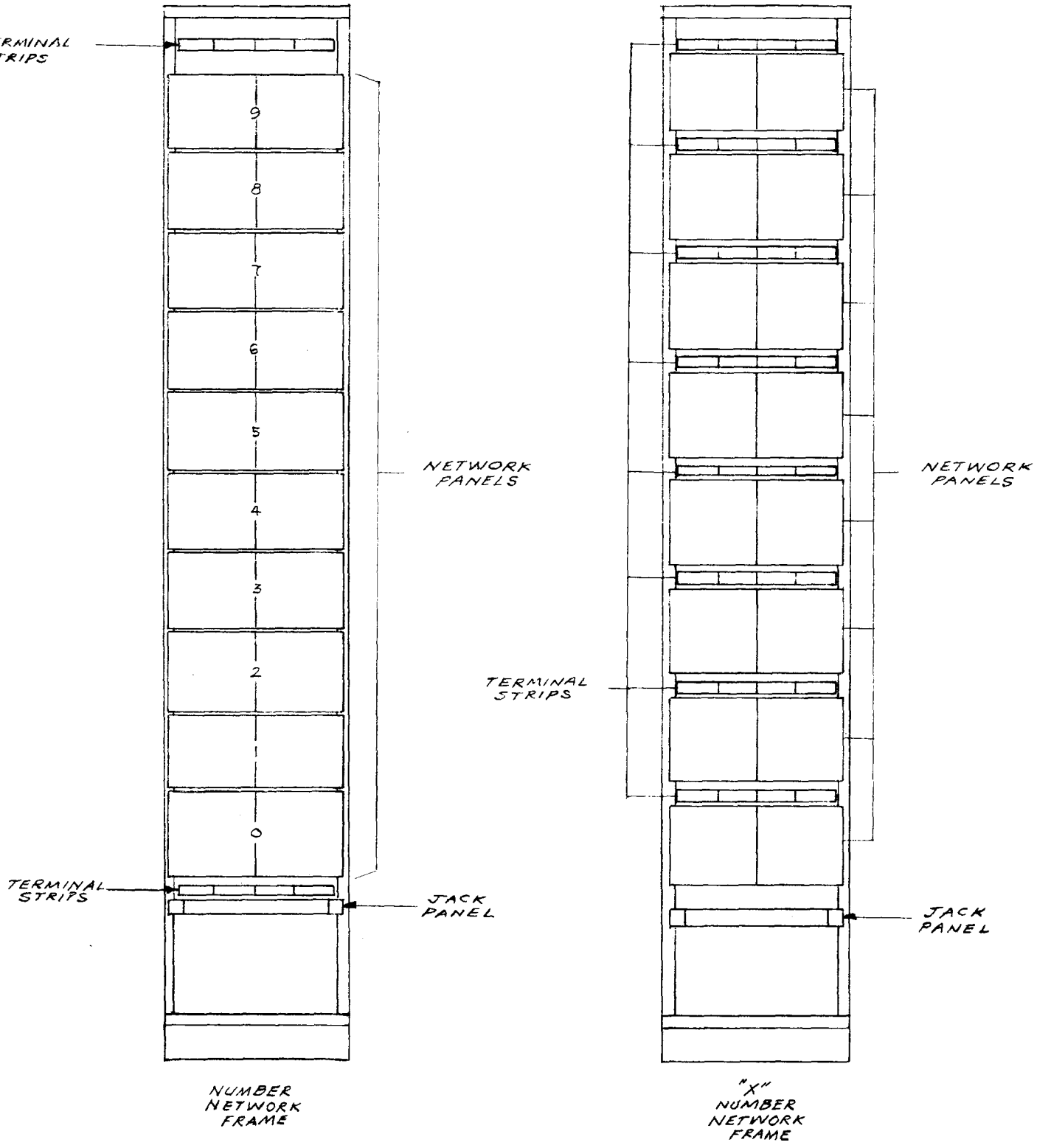
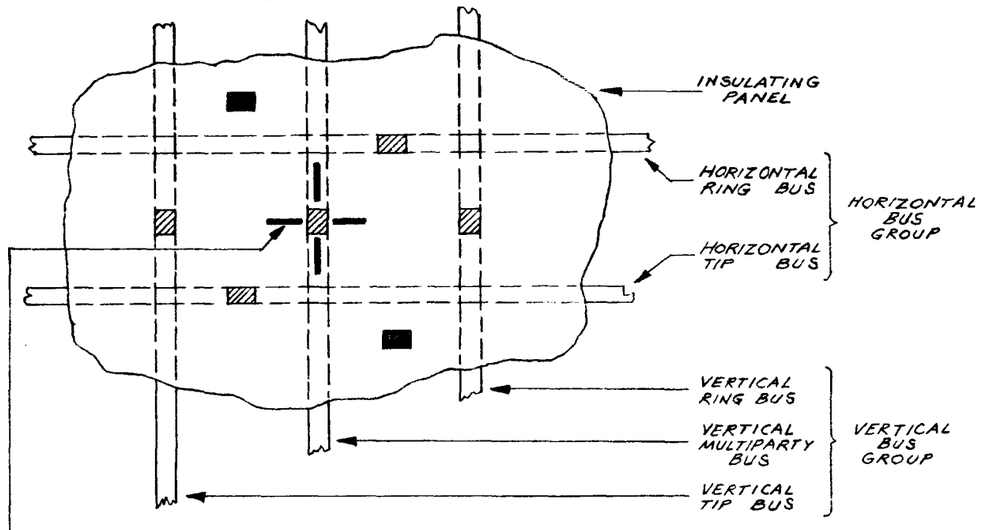

TERMINAL STRIPS
9
8
7
6
5
4
3
2
1
0
NETWORK PANELS
TERMINAL STRIPS
JACK PANEL
NUMBER NETWORK FRAME
NETWORK PANELS
TERMINAL STRIPS
JACK PANEL
"X" NUMBER NETWORK FRAME

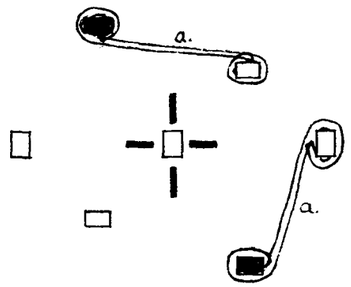
Fig. 8

# NUMBER NETWORK CROSS CONNECTIONS

SCHEMATIC REPRESENTATION OF DIRECTORY NUMBER LOCATION AS VIEWED FROM FRONT OF INSULATING PANEL



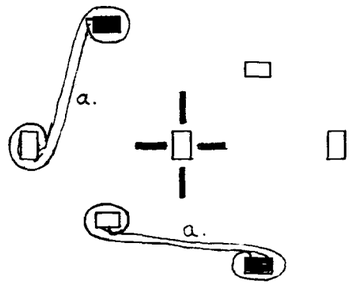

RING-PARTY FIELD CONNECTION

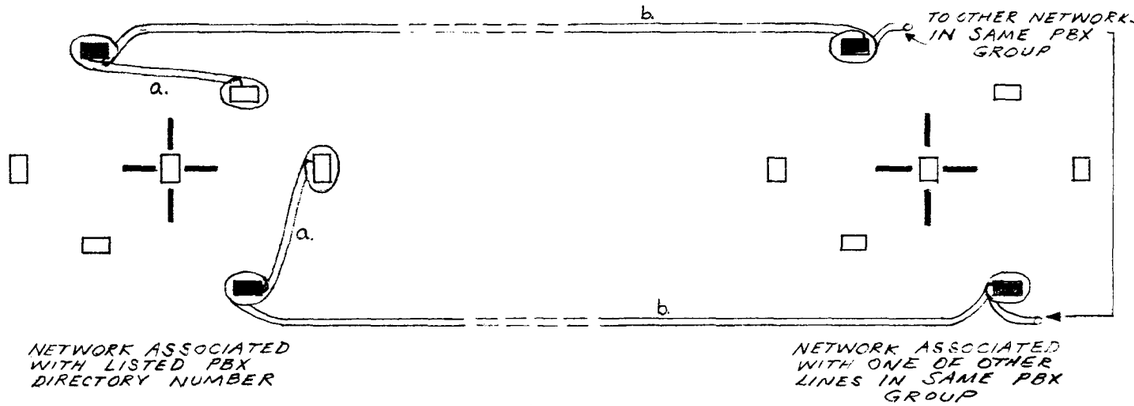



a. BARE WIRE STRAPS

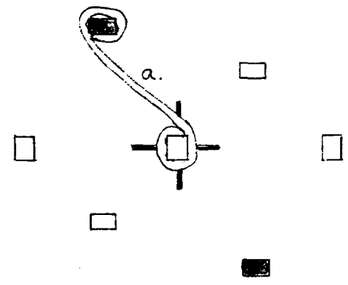
b. INSULATED STRAPS FOR PBX NETWORK MULTIPLING.

TIP-PARTY FIELD CONNECTION



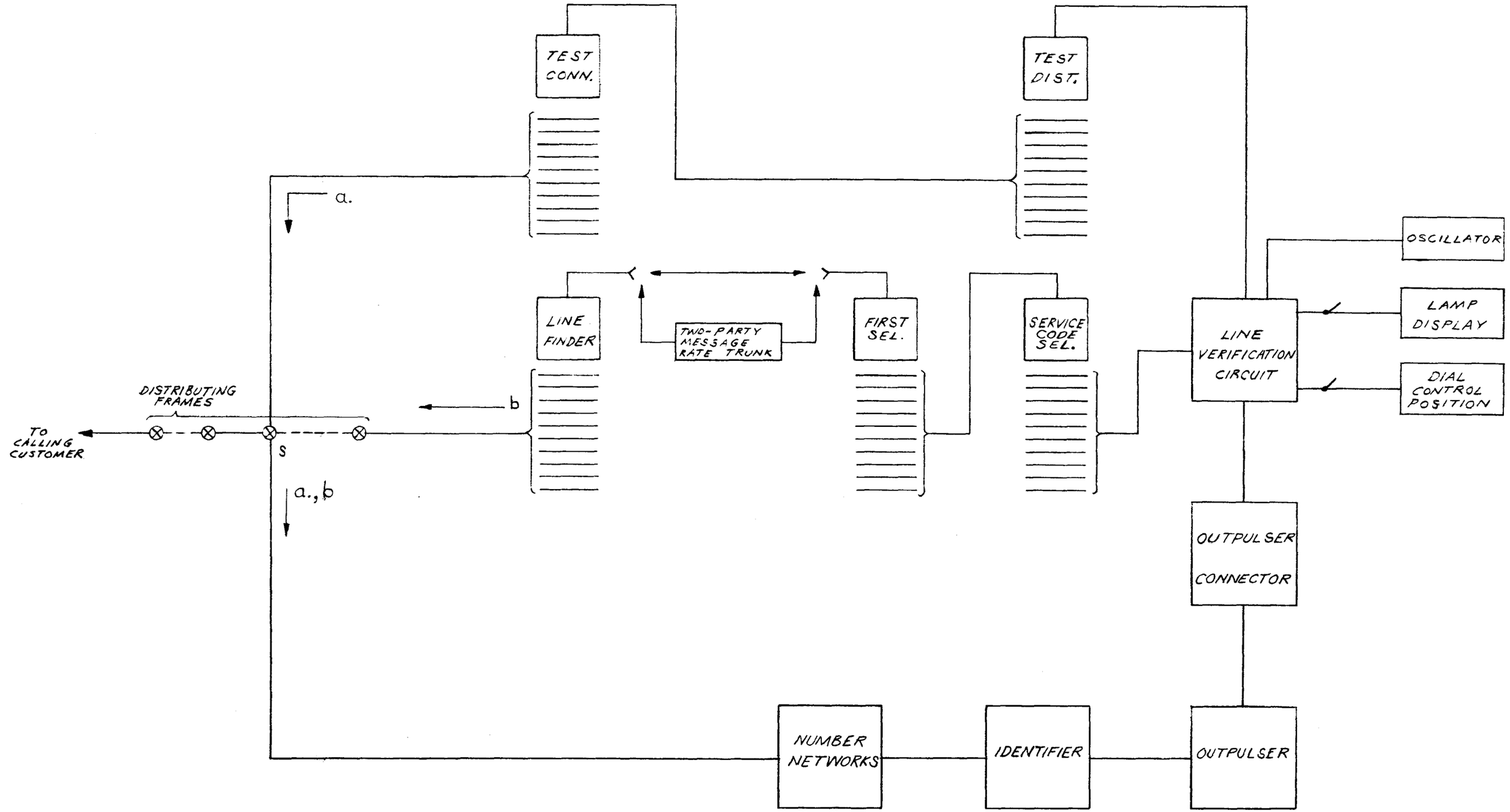




PBX CONNECTIONS




MULTIPARTY FIELD CONNECTION

ANI LINE VERIFICATION ARRANGEMENT FOR STEP-BY-STEP OFFICES




a. TONE PATH FOR "TEST-TRAIN" VERIFICATION

b. TONE PATH FOR "TEST TRAIN AND SERVICE TRAIN" VERIFICATION

# ANI LINE VERIFICATION ARRANGEMENT FOR PANEL OFFICES

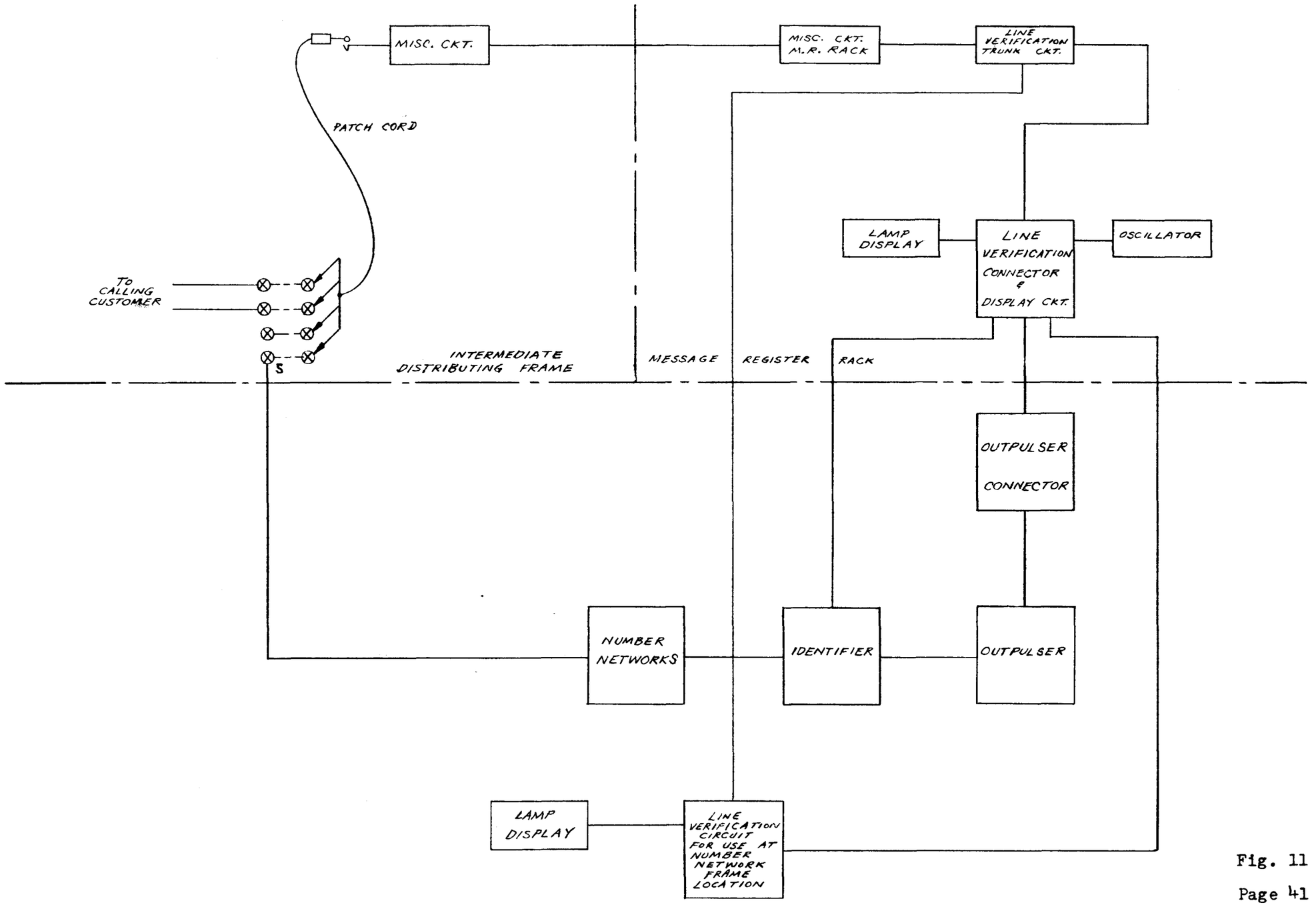



Fig. 11

# ANI LINE VERIFICATION ARRANGEMENT FOR NO.1 CROSSBAR OFFICES

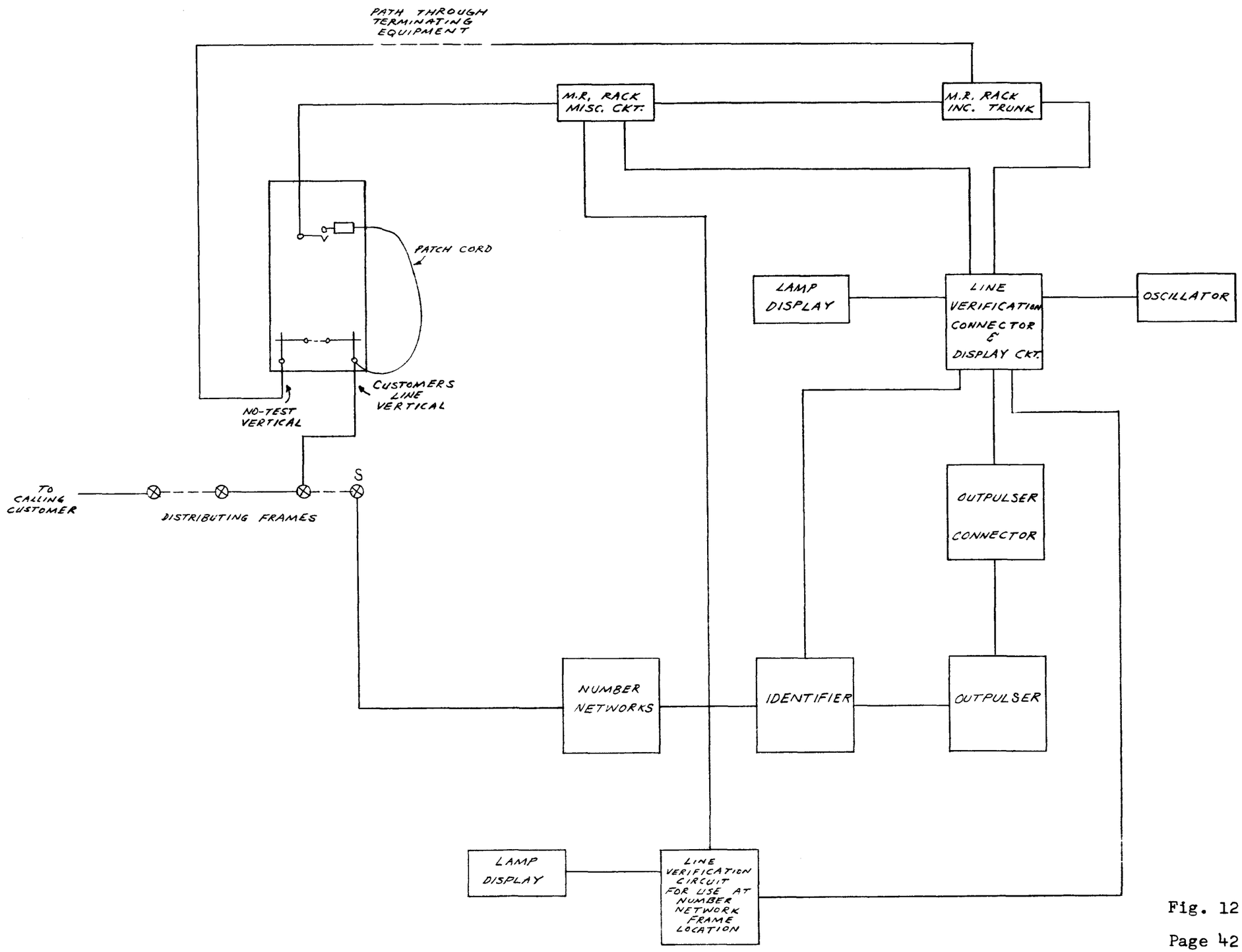



Fig. 12

PERMANENT SIGNAL IDENTIFICATION ARRANGEMENT FOR
PANEL AND NO. 1 CROSSBAR OFFICES

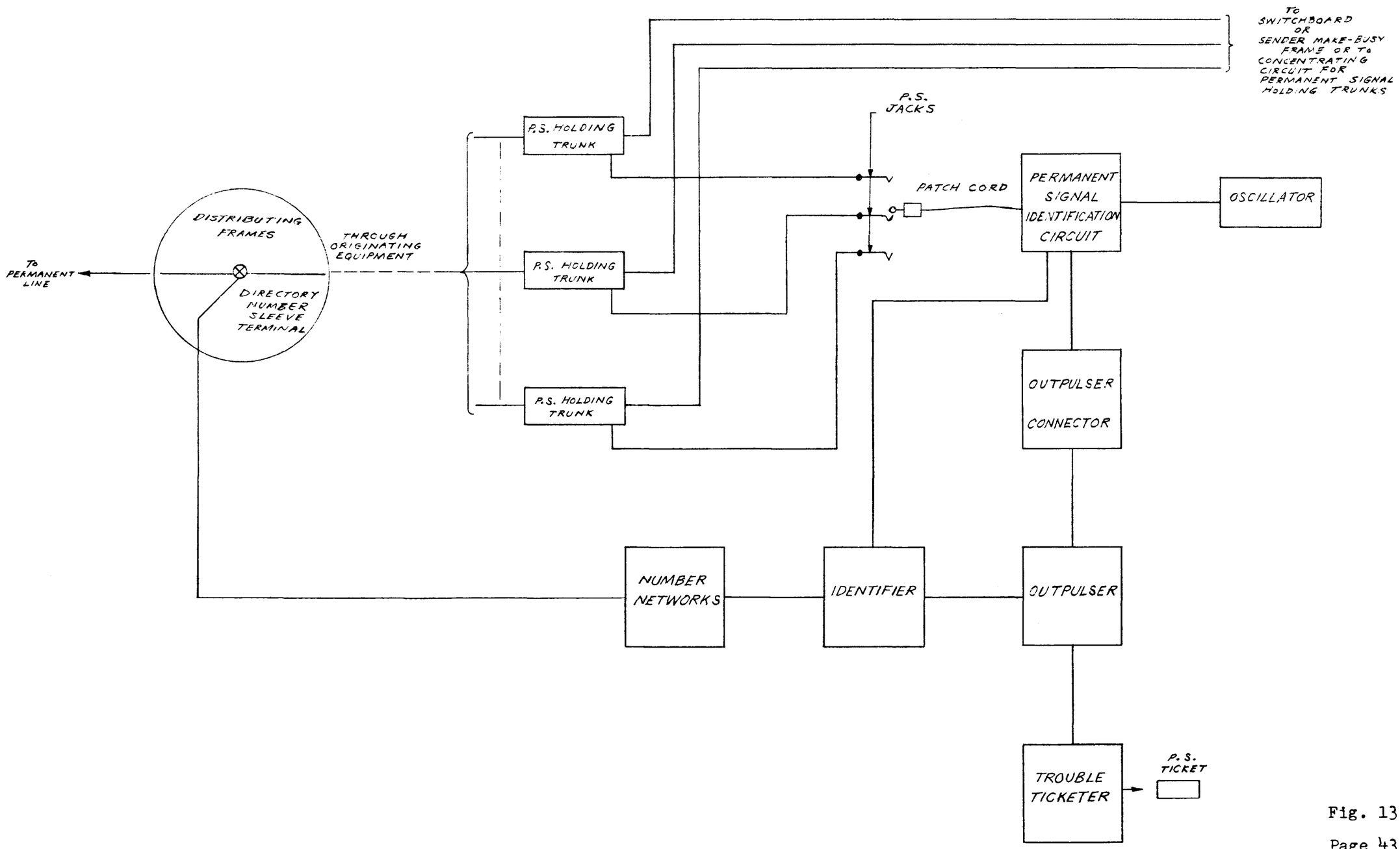



Fig. 13