AUTOMATIC IDENTIFIED OUTWARD DIALING—TYPE A2

GENERAL DESCRIPTION

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1. INTRODUCTION

GENERAL

1.01 This section describes the PBX automatic identified outward dialing (AIOD) type A2 (PBX-AIOD-A2) equipment. A brief description of its operation and maintenance is contained in this section. Alarms and operational tests are contained in Section 201-831-501.

1.02 This section is reissued to include the integrated circuit shift register memory used as a replacement for the delay line unit and the addition of jacks to monitor frequency shift keying (FSK) over a data trunk. Numerous other changes are incorporated into this section. Since this reissue is a general revision, no revision arrows have been used to denote significant changes.

1.03 The PBX-AIOD-A2 equipment provides the PBX centrex system or common control switching arrangement (CCSA) with an automatic means for identification of a station or attendant making a direct dialed outward call requiring automatic message accounting (AMA). The PBX-AIOD-A2 receives from the PBX, stores in memory, and transmits, on request, station identification (SI) data. This data is later used by AMA for billing purposes.

1.04 A larger version of this system, known as PBX-AIOD-A1, is described in Section 951-331-100. Prior to the introduction of both systems, SI for any centrex PBX outward charge call required operator identification at a centralized automatic message accounting (CAMA) office.

1.05 The PBX automatic number identification (ANI) method used to determine the identity of a PBX station or attendant originating a call into a local central office is to identify, at the PBX, both the station making the call and the PBX trunk being used. This identification information is in the form of a 4-digit trunk number and a 4-digit station number. The station number and trunk number are forwarded to the central office where they are stored until required for charging. Identification and storage of the station number is performed for every central office call, whether or not it is a charge call. The station number remains in storage in the central office until requested by the AMA, ANI [local automatic message accounting (LAMA), or centralized automatic message accounting (CAMA)] facility. However, should the AMA or ANI facility not request the station number, it will remain in storage until it is updated by new information identifying another call on the same trunk.

1.06 A block diagram of the PBX-AIOD-A2 facility, with its connections to PBX and central office equipment, is shown in Fig. 1.

1.07 With PBX-AIOD-A2, a centrex PBX customer dialing a central office access code is identified by the last four digits of his/her in-dial directory number and the 4-digit number assigned to identify

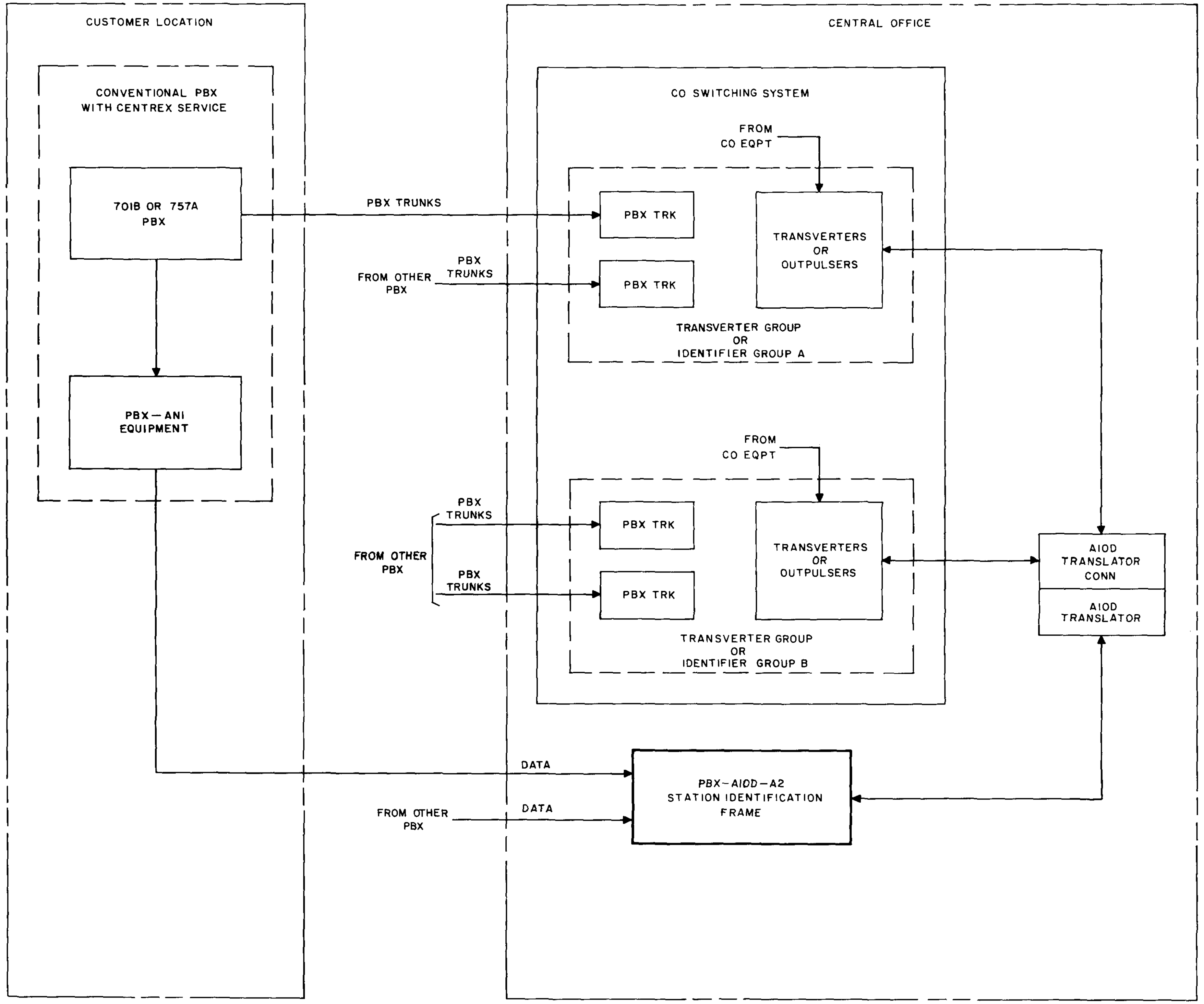

Fig. 1—PBX-AIOD-A2-Block Diagram

the PBX trunk seized for the call. The identification process for a conventional PBX is performed by PBX-ANI. Upon completion of the process, the two 4-digit numbers are temporarily stored in the PBX-ANI station and trunk number memories to await transmission over a data trunk through the data link connector to the PBX-AIOD-A2 SI store and control circuit. A description of PBX-ANI will be found in Section 981-601-100.

1.08 The SI store and control circuit is a receiving, processing, and storage circuit designed to handle a maximum of nine data trunks. It is capable of handling identification for a maximum of 223 PBX trunks distributed over a maximum of nine PBXs.

1.09 The data link connector circuit provides means for connecting one of a maximum of nine data trunks to the SI store and control circuit. Also, it provides means for access by the test circuit.

1.10 The test circuit provides means for operational testing, routine maintenance of the data link connector and SI store and control circuit. It is used as a PBX simulator to enter data into memory or for testing circuit functions. Also, it is used to simulate central office requests for office identification and station number. It monitors the progress of calls and displays progress and trouble lamps at a display and test control panel.

1.11 Upon completion of the identification process and temporary storage by a PBX-ANI installation, a bid signal is sent by the PBX-ANI equipment through its data trunk to the data link connector circuit which, in turn, bids for service from the SI store and control circuit. When the SI store and control circuit is ready, it signals the data link connector circuit which completes its connecting functions and signals the PBX-ANI equipment to start data transmission.

1.12 The PBX-ANI equipment then transmits its stored identification information over the data trunk. All data trunk transmission is in serial two-out-of-five code using FSK.

1.13 The PBX trunk numbers are the numbers assigned by the central office to the PBX trunks used by the PBX for the outgoing call. The 4-digit numbers are determined by the trunk central office equipment location when the serving central office is a No. 1 crossbar LAMA, or No. 5 crossbar LAMA, or ANI (transverter) office. The PBX trunk number is an assigned number from a special AIOD number network when the serving central office is a step-by-step, panel, or No. 1 crossbar office equipped with ANI-B. Step-by-step offices equipped with ANI-C use the number assigned to the connector that is used for the PBX trunk.

1.14 The 4-digit trunk number is used by the SI store and control circuit to address a memory location in which the 4-digit station number is stored. The memory location also stores the number of the data trunk used in receiving the information from the PBX-ANI equipment. The 4-digit station number and data trunk number remain in storage until called for by the AMA or ANI equipment via the AIOD translator and translator connector. The data trunk number is converted by cross-connection into an office index number before it is forwarded to the AIOD translator. A request is initiated by the AMA or CAMA facilities only if the stored SI number is needed for billing.

CAPACITY

1.15 The memory of the SI store and control circuit provides storage for SI for 223 PBX trunks. Five additional memory slots are provided for number change and test entries.

1.16 One PBX-AIOD SI frame with an associated AIOD translator and translator connector can provide service to a maximum of two separate switching facilities as follows:

(a) A maximum of two ANI-B identifier groups with a maximum of ten ANI-B outpulsers per group

(b) A maximum of two AMA transverter groups with a maximum of ten transverters per group

(c) A maximum of two ANI transverter groups with a maximum of two transverters per group

(d) A combination of one AMA or ANI transverter group and one ANI outpulser group

(e) One ANI-C outpulser group.

1.17 The data link connector circuit can accept data from nine PBXs with each PBX identified by the same or different office indexes up to a maximum of 30 office indexes per No. 5 crossbar transverter group, nine office indexes per ANI-B outpulser group, or one office index per ANI-C outpulser group.

FEATURES

A. SI Frame Solid State and Magnetic Circuitry

1.18 The PBX-AIOD SI frame uses solid state devices, such as transistors, diodes, and electromechanical devices such as relays.

1.19 For the most part, solid state apparatus is mounted on circuit boards and electromechanical apparatus is mounted on conventional mounting plates.

B. SI Frame Program

1.20 The PBX-AIOD SI frame uses wired logic common control circuitry.

C. Alternate Treatment For New PBX Trunk Assignment

1.21 When a PBX trunk is reassigned in a No. 1 or a No. 5 crossbar LAMA or ANI central office and the number has not been changed at the PBX, the PBX-AIOD SI frame can be set to substitute the old number for the new and properly identify the station until the corresponding change is made at the PBX.

D. Alternate Billing Arrangement

1.22 Failure to provide a station number by the PBX AIOD equipment results in alternate billing. In a transverter type office, the listed number of the PBX is obtained from the regular AMA or ANI translator. In outpulser type offices, a CAMA operator is called to identify the calling PBX station.

E. Automatic Error Detecting

1.23 The PBX-AIOD SI frame has an automatic error detecting facility which continuously monitors its operation. An error will cause circuit status information to be collected and displayed at a display and test control panel. The information displayed is used to determine the trouble area. A separate section describes the methods of analyzing and clearing trouble indications.

F. PBX Trunk Number Assignment

1.24 The PBX trunk numbers are 4-digit numbers which are assigned to the PBX trunks at the central office. Numbers are assigned so that each call over a PBX and data trunk can be associated with the PBX-ANI information received from a PBX.

1.25 In central offices using the ANI-B system, the four digits assigned to a PBX trunk are derived from the special AIOD number network; in the ANI-C system the four digits are determined from the regular number network. In No. 1 and No. 5 crossbar LAMA or ANI offices, the line link frame location of the PBX trunk is translated in the AIOD translator to a 3-digit number; the thousands digit is assigned in the AIOD translator.

1.26 The PBX trunk number assignments at the central office may be any 4-digit number. Any unassigned number may be used for test purposes.

1.27 Where one transverter type office shares the SI store with an ANI-B or ANI-C system, trunk number assignment must be coordinated to prevent conflicts.

2. SYSTEM ELEMENTS

2.01 The three major elements of the PBX-AIOD-A2 system are: (1) data link connector circuit, (2) SI store and control circuit, and (3) SI test circuit. These three elements, the fuse alarm, and miscellaneous circuit are located on one factory wired 11-foot 6-inches high, 2-foot 5/8 inch long frame as shown in Fig. 2.

A. Data Link Connector Circuit, SD-1C233-01

2.02 The data link connector circuit provides means for connecting a data trunk to a data receiver which is part of the SI store and control circuit. It provides a metallic switched path for a maximum of nine data trunks, translates the data link number to two-out-of-five code, and sends this information to the SI store and control circuit. Also, it provides for access by the SI test circuit.

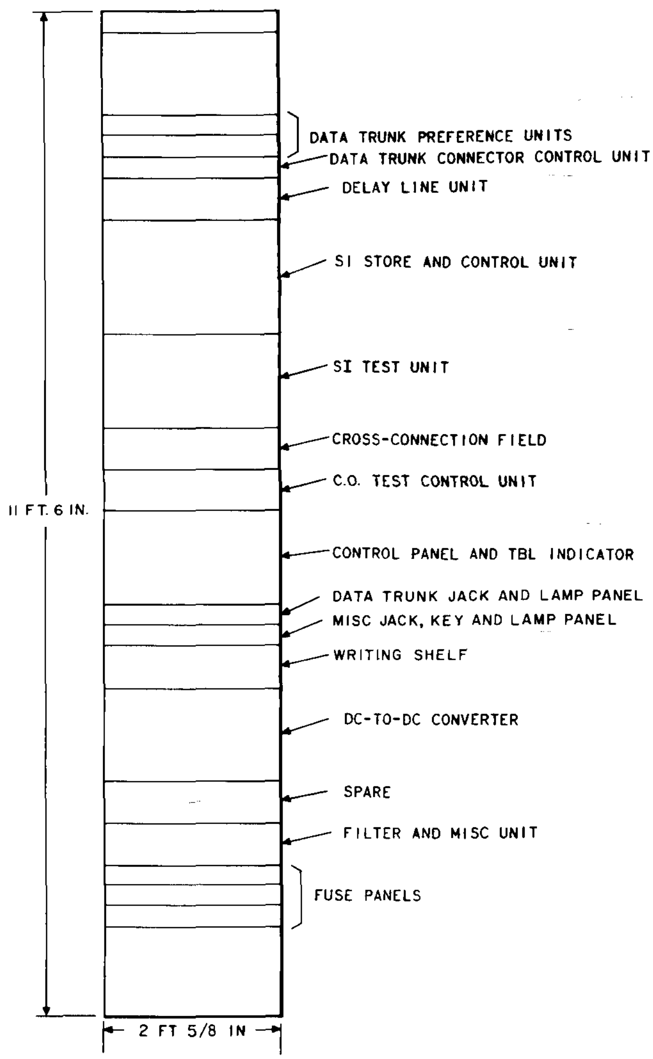

Fig. 2—PBX-AIOD-A2 Station Identification Frame Equipment Arrangement

B. Station Identification Store and Control Circuit, SD-1C234-01

2.03 The SI store and control circuit consists of 15 solid state subcircuits as shown in Fig. 3. This circuit controls the flow of data, registers data, and stores data in memory. Upon receipt of a request for SI from the central office, it searches the memory and transmits data to the AMA or ANI equipment.

2.04 This circuit generates receiver clock signals of 735.3 Hz to match the incoming bit rate. It synchronizes with the sending clock at the start of and during the transmission of data from the PBX. It makes validity checks of the digits received from the PBX and from the central office. It provides for a change to a new trunk number at the central office end while continuing to receive data from the PBX using the old trunk number.

2.05 This circuit uses a 10,125- or 10,260-bit memory, its contents continuously circulating at a 1-MHz rate in a closed loop. With option W, the memory device is a magnetostrictive delay line adjusted to contain 10,119 bits. The remaining six bits are contained in shift registers. This memory can store a maximum of 225 words of 45 bits each. With option V, the memory device used consists of integrated circuit static shift registers arranged to store 10,254 bits. With the six bits contained in other shift registers, this memory can store a maximum of two hundred twenty-eight 45-bit words. The rest of the circuit consists of gates, flip-flops, shift registers, monopulsers, and other special logic elements.

2.06 The clock circuit generates pulses at a frequency of 1 MHz. This circuit provides timed command pulses which maintain the subsystems in synchronism. These command pulses are the trunk number pulse, the data number pulse, and the station number pulse.

C. Station Identification Test Circuit, SD-1C235-01

2.07 The SI test circuit provides means for simulating a PBX request for the purpose of: (1) making an operational test of the data link connector and the SI store and control circuit, and (2) entering a number change in the memory. Also, means are provided for simulating a central office request for the purpose of making an operational test of the SI store and control circuit.

2.08 The test circuit can be used to cause a system-down condition which prevents the seizure of the SI store and control circuit by either a PBX request or a central office request. In the system-down condition, the test circuit can be used to simulate PBX and central office requests to enter and withdraw information from memory. During this period, the data link connector circuit is arranged to send a transmit signal to the PBX on any PBX request although the information transmitted is not used. This feature prevents time-out and alarms at the PBX.

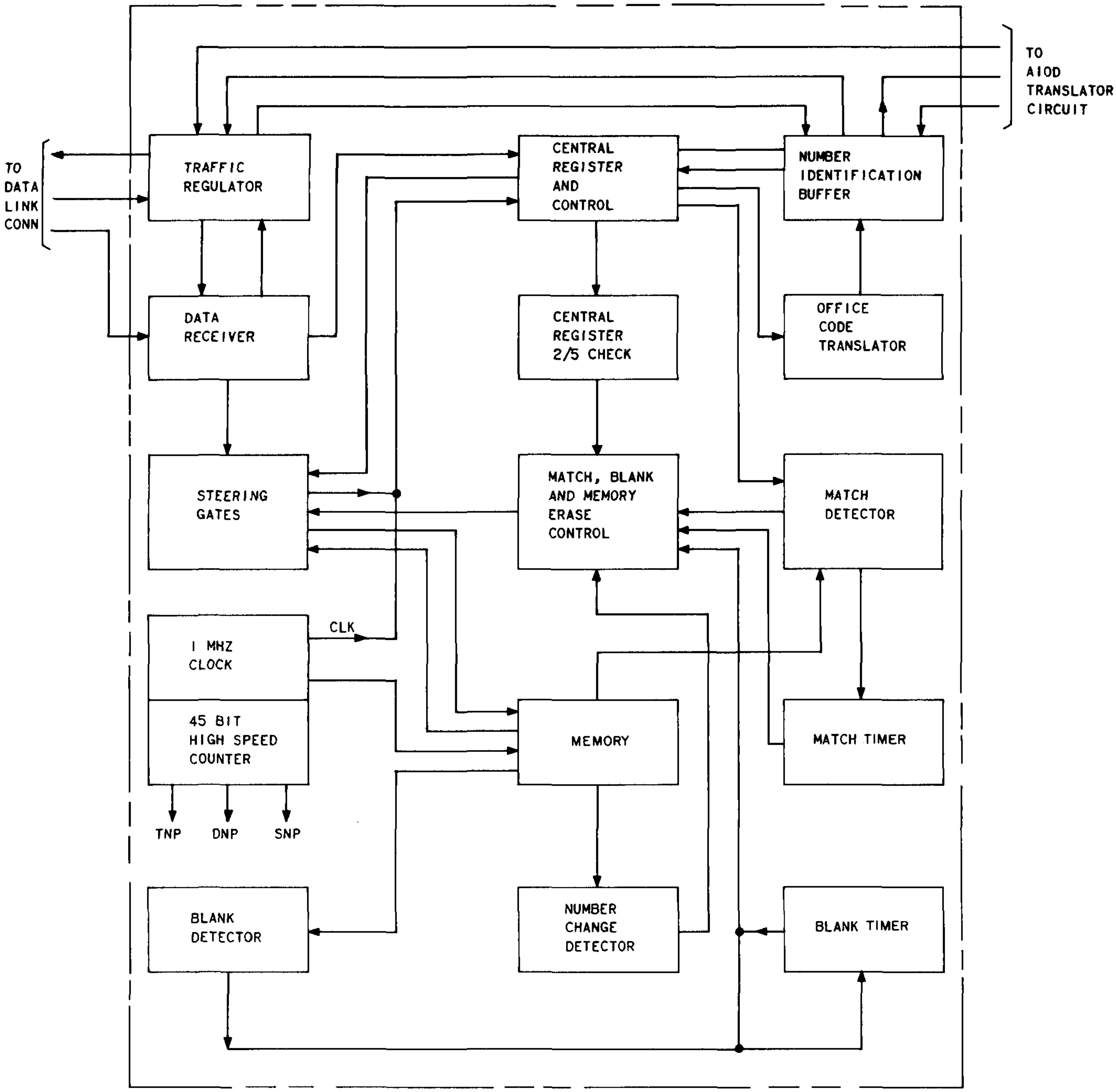

Fig. 3—SI Store and Control Circuit—Block Diagram

2.09 The test circuit continuously monitors the SI store and control circuit for various types of trouble conditions. When a trouble is encountered, this circuit records progress and trouble indications on a control panel and trouble indicator which is shown in Fig. 4. A condition which causes the entire memory to be cleared provides a trouble indication in order to alert maintenance personnel so that they may reenter a number change into memory if a number change is active at the time.

2.10 An option(s) is provided to monitor the FSK data transmitted by a PBX ANI trunk over a data link. A PBX ANI data link test set can

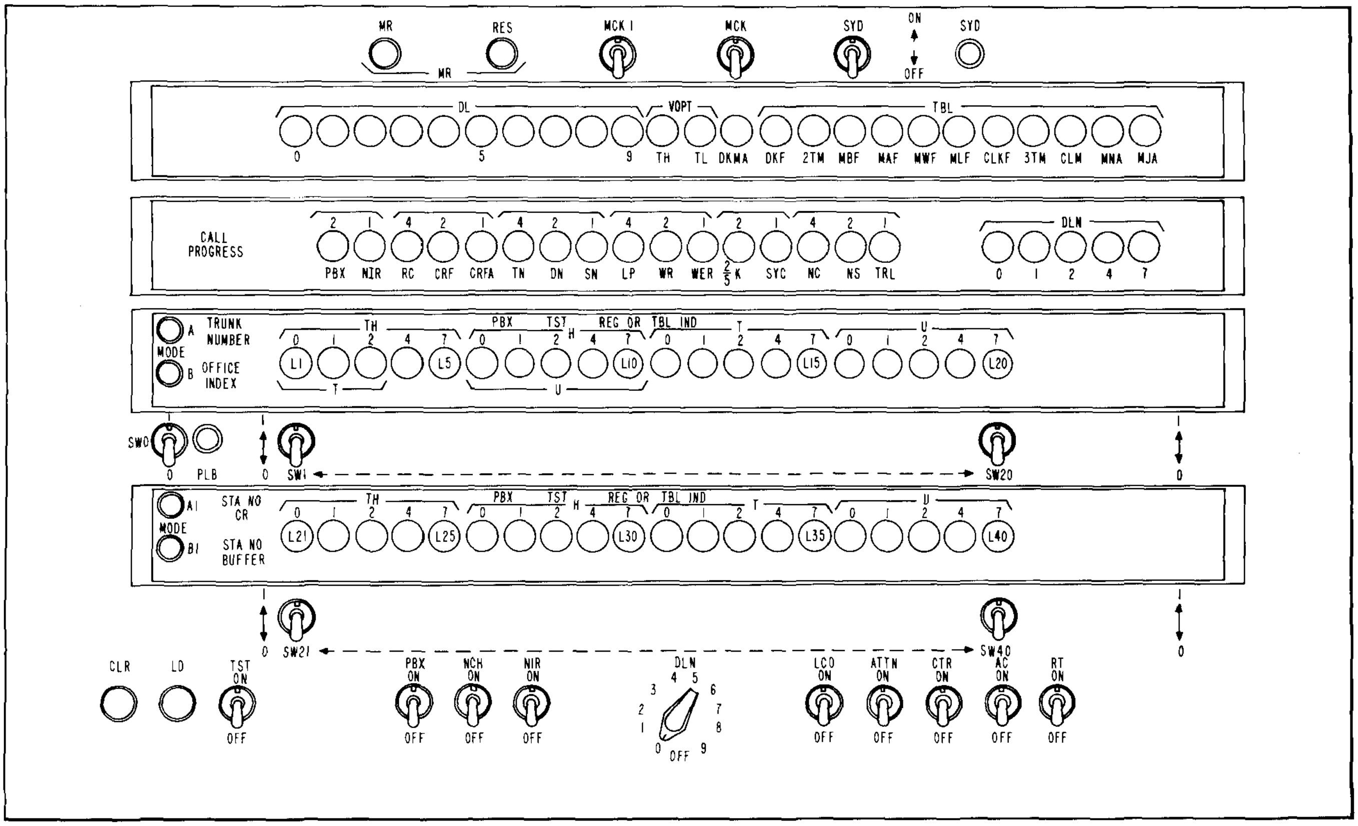

Fig. 4—Control Panel and Trouble Indicator

be connected at the data trunk jack and lamp panel (Fig. 9).

3. INTERFACE EQUIPMENT

3.01 The AIOD translator and translator connector, as shown in Fig. 5, form a preference and control circuit in the central office which furnishes the interface between existing central office equipment and the PBX AIOD SI frame. One translator and its associated translator connector is required with each SI frame. The central office connecting equipment can be AMA or ANI transverters in No. 5 crossbar offices, ANI outpulsers in panel, No. 1 crossbar, and step-by-step offices, or AMA transverters in No. 1 crossbar offices. The AIOD translator and translator connector functions vary depending upon the type of central office used.

3.02 It should be noted that all data transmission to and from the AIOD system is based on the two-out-of-five code. Also, the transverters in the transverter type office furnish to the AIOD translator, via the translator connector, an equipment location for the PBX trunk handling the call. The AIOD translator converts the equipment line location to a 4-digit PBX trunk number in two-out-of-five code for use by the SI frame. This 4-digit trunk number is used to address a memory location in the SI frame. Station number readout and the office index readout from the SI frame is in two-out-of-five code for station number and one-out-of-three and two-out-of-five code for office index. The AIOD translator converts the two-out-of-five portion of the message into one-out-of-ten code to properly interface with the central office transverters.

3.03 When interfacing between an outpulser type office and SI frame, a number code conversion on the two-out-of-five coded station number by the AIOD translator is not necessary because the outpulser uses the two-out-of-five code. The only conversion required is the office index from two-out-of-five to one-out-of-nine code.

3.04 The AIOD translator connector, acting as a preference and control circuit, functions to permit only one transverter or outpulser access to the SI frame at a time and in a predetermined order. Since one AIOD translator connector can serve a maximum of two separate central office number identification systems, each with a definite combination of identifiers and transverters, preference and control are required. The AIOD translator, in processing its input and output information, checks for word errors to assure proper word structure during its control, conversion, and transfer of information.

3.05 Upon receipt of the PBX station number from the AIOD translator via the translator connector, the transverter or outpulser follows the normal routine in forwarding the information to the AMA facility.

3.06 Should the AIOD translator detect a failure or error within its own circuit or within other equipment required in the identification process, the central office equipment is notified to perform an alternate billing routine. In AMA or ANI transverter type offices, alternate billing is made to the PBX listed number by using the regular AMA or ANI translator. In ANI outpulser type offices, CAMA operator identification is used as the alternate billing routine.

A. AIOD Translator Connector

3.07 The translator connector consists of a preference circuit and multicontact relay connectors. The preference circuit allows only one transverter or outpulser access to the PBX-AIOD translator at one time and in a predetermined order, thus guarding against a double connection. The multicontact relays provide connection paths for the many leads necessary between the central office switching system equipment and the PBX-AIOD translator.

B. AIOD Translator

3.08 The AIOD translator is composed of nine basic functional circuits. Figure 5 shows five of these circuits:

1. Trunk number thousands, tens, and units digit register circuit
2. Trunk number hundreds digit register circuit
3. Trunk number hundreds, tens digit translator circuit
4. Trunk number two-out-of-five check circuit
5. Trunk number sending circuit.

These five circuits perform the trunk number registration, translation, checking, and transmission of the PBX trunk number to the PBX-AIOD SI frame. The four remaining circuits as shown in Fig. 5 are:

1. Station number register circuit
2. Station number and office index 2/5 check circuit
3. Office index sending circuit
4. Station number sending circuit.

These four circuits perform the station number registration, translation, checking, and transmission to the central office switching system via the translator connector.

C. Operation With Transverter

3.09 In a transverter type office, the calling number request on PBX-AIOD calls is steered to the AIOD translator connector rather than the AMA or ANI translator by assigning a specific class of service to PBX trunks. The marker converts the ring party indication to tip party on lines with this class of service, and the transverter selects the AIOD translator connector as if it were a tip translator. When the transverter selects the AIOD translator connector, it receives service on a preference basis. When the transverter receives preference in the AIOD translator connector, it is connected through to the AIOD translator.

3.10 The thousands digit of the PBX trunk number is a direct indication of the transverter group to which the PBX trunk being identified is assigned. This digit is generated by the PBX-AIOD translator connector and the cross-connecting arrangement in the PBX-AIOD translator. Since each of the two transverter groups has a distinct thousands digit, there could be a maximum of 1000 PBX trunks assigned to each transverter group.

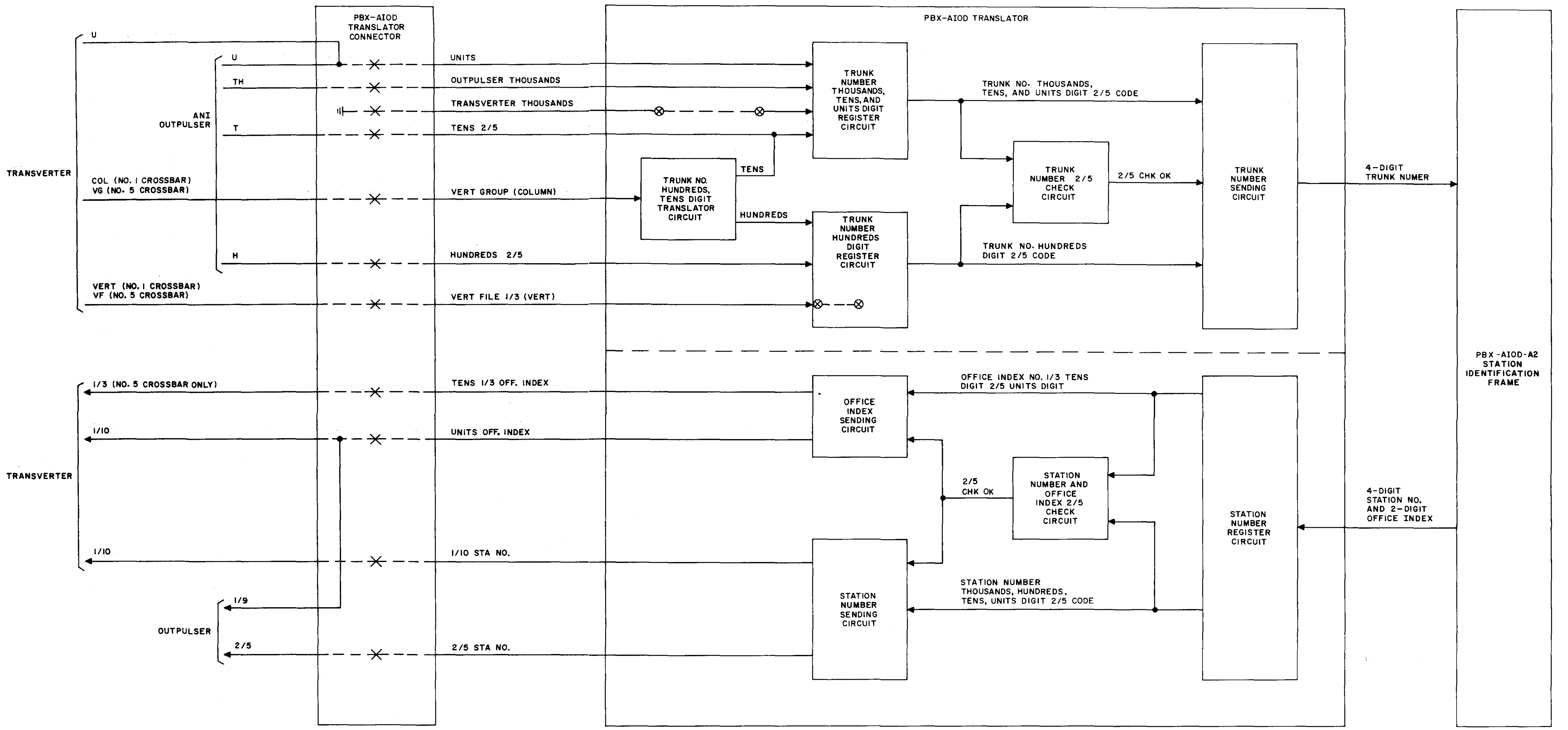

Fig. 5—PBX-AIOD Translator and Connector—Block Diagram

3.11 Although each translator and its connector can handle a maximum of 2000 PBX trunks (1000 trunks from each group), the memory in the PBX-AIOD-A2 SI frame is designed to handle a maximum of 223 trunks.

3.12 The hundreds digit of the PBX trunk to be identified is derived by the combination of vertical group (VG) location and vertical file (VF) location on the line link frame in a No. 5 crossbar office or the column VG and VF in No. 1 crossbar offices. The VG data is translated into a more usable form in the trunk number hundreds and tens digit translator circuit. They are combined in the trunk number hundreds digit register circuit with the VF data. The result of this combining is a trunk number hundreds digit in two-out-of-five code which is registered in the trunk number hundreds digit register circuit.

3.13 The tens digit is derived solely by the VG data. This data is translated directly into two-out-of-five code which is registered in the trunk number thousands, tens, and units digit register circuit.

3.14 The PBX trunk number units digit is actually the switch number of the horizontal group location of the PBX trunk requiring SI. This information is received from the transverter directly in two-out-of-five code and registered in the trunk number thousands, tens, and units digit register circuit.

3.15 The PBX trunk number thousands, tens, and units digits stored on the register relays in the trunk number thousands, tens, and units digit register circuit are checked by the trunk number check circuit to ensure that only two-out-of-five register relays are operated for each digit. Also, the PBX trunk number hundreds digit stored on the hundreds digit register relays, in the trunk number hundreds digit register circuit, is checked by the trunk number check circuit to ensure that only two-out-of-five register relays are operated. A valid two-out-of-five check results in the 4-digit PBX trunk number being transmitted to the PBX-AIOD SI frame in two-out-of-five multilead form via the trunk number sending circuit.

3.16 After the SI frame receives the 4-digit PBX trunk number from the PBX-AIOD translator and retrieves the 4-digit station number associated with the PBX trunk number from its memory, it transmits the 4-digit station number along with a 2-digit office index to the station number register circuit of the PBX-AIOD translator.

3.17 The office index number is received and registered in the station number register circuit in a one-out-of-three and two-out-of-five code. Since the maximum number of office indexes handled by the PBX-AIOD SI frame is 30, the office index tens digit is in one-out-of-three code, and the units digit is in two-out-of-five code. The station number thousands, hundreds, tens, and units digits are each received and registered in the station number register circuit in two-out-of-five code. The station number thousands, hundreds, tens, and units digits and the office index units digit registered on the register relays in the station number register circuit are checked by the station number and office index two-out-of-five check circuit to ensure that only two-out-of-five register relays are operated for each digit. The office index tens digit is checked to ensure that only one-out-of-three register relays are operated.

3.18 When the central office is a No. 5 crossbar office, a valid two-out-of-five and one-out-of-three check results in the 2-digit office index being transmitted in two parts to the transverter via the office index sending circuit and the PBX-AIOD translator connector. The tens digit is transmitted in one-out-of-three code and the units digit in one-out-of-ten code.

3.19 When the central office is a No. 1 crossbar transverter office, a valid two-out-of-five check results in a 1-digit office index being transmitted to the transverter in one-out-of-ten code via the PBX-AIOD translator connector. The one-out-of-three office index tens digit is not connected through the PBX-AIOD translator connector. In both No. 1 and No. 5 crossbar transverter offices, the station digits are transmitted in one-out-of-ten code to the transverter via the station number sending circuit and PBX-AIOD translator connector.

D. Operation With Outpulser

3.20 In an outpulser type office, the calling number request on PBX-AIOD calls is steered to the AIOD translator connector by assigning all PBX trunks to special number networks in the ANI-B system or by using one of the special treatment marks in the ANI-C number networks.

As is true with a transverter, when an outpulser receives preference in the translator connector, it is connected through to the translator.

3.21 The PBX trunk number thousands, tens, and units digits are received and registered directly in two-out-of-five code in the trunk number thousands, tens, and units digit register circuit. The PBX trunk number hundreds digit is received and registered directly in two-out-of-five code in the trunk number hundreds digit register circuit. No PBX trunk number word translation is required on PBX-AIOD translator inputs when associated with outpulser type offices since outpulsers use the two-out-of-five code.

3.22 Transfer and checking of data through the PBX-AIOD translator, for both the PBX trunk number and station number and office index, is identical to the process for a transverter type office.

3.23 Again, no number code conversion is required for PBX-AIOD translator station number outputs as the outpulser uses the two-out-of-five code.

3.24 Since the maximum office index handling capacity of any outpulser is nine office indexes, the office index is handled on a one-out-of-nine multilead basis to the outpulser.

4. EQUIPMENT

A. Devices

4.01 The PBX-AIOD-A2 SI frame (Fig. 2) is approximately 11 feet 6 inches high by 2 feet 5/8 inch long and is equipped primarily with solid state devices, such as transistors and diodes.

4.02 Low power solid state devices are utilized in logic packages which provide the gate circuits, flip-flop circuits, counter circuits, etc, needed to implement logical functions.

4.03 The SI frame uses both transistor resistor logic (TRL) and low level logic (LLL) to perform its switching and gating functions. All the transistors are of the NPN silicon type with the exception of those in the heater control circuit and the relay drivers which are of the PNP germanium type.

4.04 The frames memory consist of a magnetostrictive delay line and six associated flip-flops or IC static shift registers. The delay line package is a plug-in unit composed of a magnetostrictive delay line, together with the associated input and output electronics, thermostats, and a clock circuit. The delay line package is mounted in an enclosure equipped with heaters which maintain the delay line temperature between 110 and 126°F under the control of the thermostats and the heater control circuit. The heater control circuit and the six memory flip-flops are mounted on circuit packs as part of the SI store and control unit. The IC static shift register memory is contained in one standard size circuit pack and does not require the heaters needed with the delay line memory.

4.05 The SI frame is factory wired and composed largely of solid state components mounted on plug-in circuit packs. Connection and cross-connection facilities are provided as part of the SI frame.

B. Circuit Packs

4.06 The circuit packs are approximately 4 inches high by 7 inches deep and terminate in a 28-pin connector.

4.07 The circuit packs are divided into four categories. The first category includes the logic building blocks, such as LLL and TRL gates, flip-flops, and inverters; the second group includes monopulsers and timers; the third group is made up of circuit packs containing passive components, such as resistors and diodes; and the fourth group is made up of specialized circuits.

C. Circuit Pack Connectors

4.08 The mating connector for each circuit pack is mounted on a circuit pack tray assembly. The individual contact springs of these connectors are gold plated to ensure a low resistance electrical connection.

D. Tray Assembly

4.09 Each circuit pack tray assembly is 4 inches high by 23 inches wide and mounts a maximum of 32 circuit pack connectors. Designation strips are provided on the face of the tray for identification of the circuit packs that are housed in the tray assembly.

E. Delay Line Unit

4.10 As shown in Fig. 2, the delay line unit is mounted in the upper portion of the SI frame. The unit consists of a plug-in delay line package mounted in an enclosure equipped with heaters which maintain the temperature of the delay line between 110 and 126°F.

> ***Note:*** This unit is rated MD and replaced by an IC shift register memory circuit pack.

F. Station Identification Store and Control

4.11 The SI store and control unit consists of a 5-tray assembly for housing the SI store and control circuit packs.

G. Data Link Connector

4.12 The data link connector control unit and preference units are mounted on three 2-inch mounting plates near the top of the frame. The equipment consists of relays and component assemblies containing transistors, diodes, and resistances.

H. Station Identification Test Circuit

4.13 The components of the SI test circuit are located in the midportion of the frame, with the display and test control panel at convenient viewing and operating level. The central office test control unit is mounted above the control panel on two 2-inch mounting plates. Above this is a 4-tray assembly which house the circuit packs of the SI test unit. Just below the control panel is the data link jack and lamp mounting which permits patching of the data trunks for testing or substitution of a spare trunk.

I. Miscellaneous Jack, Key, and Lamp Panel

4.14 A miscellaneous jack mounting is located below the data link jack and lamp mounting, and mounts jacks, keys, and lamps associated with the fuse alarm and miscellaneous circuit.

J. Power Supplies

4.15 Power supply equipment occupies the lower portion of the frame. This equipment consists of +6, +12, +24, -12, and -48 volt fuse panels, a dc to dc converter unit, and a filter and miscellaneous unit.

5. CIRCUIT OPERATION

A. Typical Operation On PBX Request

5.01 A block diagram of the major circuits involved in processing and storing data from the PBX is shown in Fig. 6.

5.02 The data link connector, after receiving simplexed ground as a PBX service request over a data trunk, sends a start signal to the traffic regulator in the SI store and control circuit. When the SI store and control circuit is ready to handle the request, the traffic regulator sends a logic "O" start transmission signal to the data link connector. This causes the operation of a preferred cut-in relay.

5.03 At this time, momentary signals on two-out-of-five leads set two of the central register stages in the store and control circuit. This identifies the data trunk which originated the request. A -48 volt simplex signal is now sent over the data trunk. This causes the PBX to transmit, in serial form, 41 bits which include one premessage bit, followed by 20 bits representing the four digits of the trunk number, and 20 bits representing the four digits of the station number.

5.04 The 41 bits are transmitted from the PBX in the bivalued frequency-shift mode at the rate of 735.3 bits per second. A "one" bit is transmitted as 1850 Hz and a "zero" is transmitted as 1150 Hz. The data receiver converts the signals into dc logical "one" and "zero" signals which are steered to the central register and recorded.

5.05 The central register consists of 45 shift register stages numbered 01 through 45. The data link number, transmitted in parallel form by the data link connector circuit, is registered on register stages 21 through 25. The 40 bits representing the trunk number and the station number, transmitted in serial form by the data receiver, end up on register stages 26 through 45, and 01 through 20 respectively. The premessage bit is shifted through stages 01 to 45, bypassing 21 through 25, causing an indication that the central register is full when the last data bit from the PBX is registered in stage 01.

5.06 A two-out-of-five check is made of each of the nine digits comprising the trunk number, data number, and station number. If satisfactory, a search is made in the memory for a 45-bit slot containing a 20-bit trunk number that matches the trunk number recorded in the central register. Should no match be found, a search is made for a blank slot in the memory.

5.07 On a match, only the data trunk number and station number are transferred to the memory. The trunk number has already reentered the memory during the match operation. Since a blank is detected by checking the flip-flops at the end of the memory before the trunk number bits emerge from the memory, all 45 bits are exchanged in this case. The SI store and control circuit is now ready to process data on a new request for service. This request may be from another PBX or from the central office.

B. Typical Operation on Central Office Request

5.08 A block diagram of the major circuits involved in processing and transferring data to the central office is shown in Fig. 7.

5.09 A central office request for a station number associated with a PBX trunk appears as a signal at the traffic regulator. The traffic regulator accepts the request when the SI store and control circuit is ready to handle the request. Gates are enabled which admit the trunk number data in parallel form from the AIOD translator through the number identification buffer to the central register.

5.10 The central register records the trunk number and if the two-out-of-five check of the data is satisfactory, a search is made of the memory for a slot containing a 20-bit trunk number that matches the recorded trunk number. This search is made by the match, blank, and memory erase control circuit which compares each trunk number emerging from the memory with the trunk number in the central register.

5.11 When a match occurs, the central register and memory are now gated to effect an exchange of data between them. The memory sends the data trunk number and station number to the central register, which sends "zero" state bits to the memory. When the exchange of data is completed, a two-out-of-five check is made of each of the five digits of the data trunk number and station number.

5.12 The data is now gated to the number identification buffer. Here the two-out-of-five data number is translated to a one-out-of-three office index tens number and a two-out-of-five office index units number. The station number and the office index numbers are transmitted to the AIOD translator circuit in parallel form.

C. Central Office Request with Trunk Number Change

5.13 When a change in trunk number is required, the new trunk number is first assigned in the central office. During the interval before the trunk number is changed at the PBX, the old trunk number data is received by the SI store and control circuit which processes the data in the normal manner. When the central office requests number identification for the corresponding new trunk number, a search is made of the memory for a trunk number match. The match can be made by placing transition data into the memory by the SI test circuit when the new number is assigned.

5.14 The SI test circuit places 45 logic bits into a regular memory slot as shown in Fig. 8. The new trunk number is placed in the regular trunk number section. Five logic "ones" are placed into the data number section in order to indicate the special nature of the information in the slot. The corresponding old trunk number is placed in the station number section.

5.15 On receipt of a central office request using the new trunk number, a successful search can now be made of the memory for a trunk number match. At the same time, the presence of all ones in the data number section indicates that the old trunk number used by the PBX is stored in the station number section of the same slot.

5.16 In order to retain the information for future use, the data trunk number and station number information in this slot is simultaneously read out into the central register and reentered into memory. The information read out in the station number section is now shifted down 25 stages to the trunk number section of the central register. It is then used in a second search for

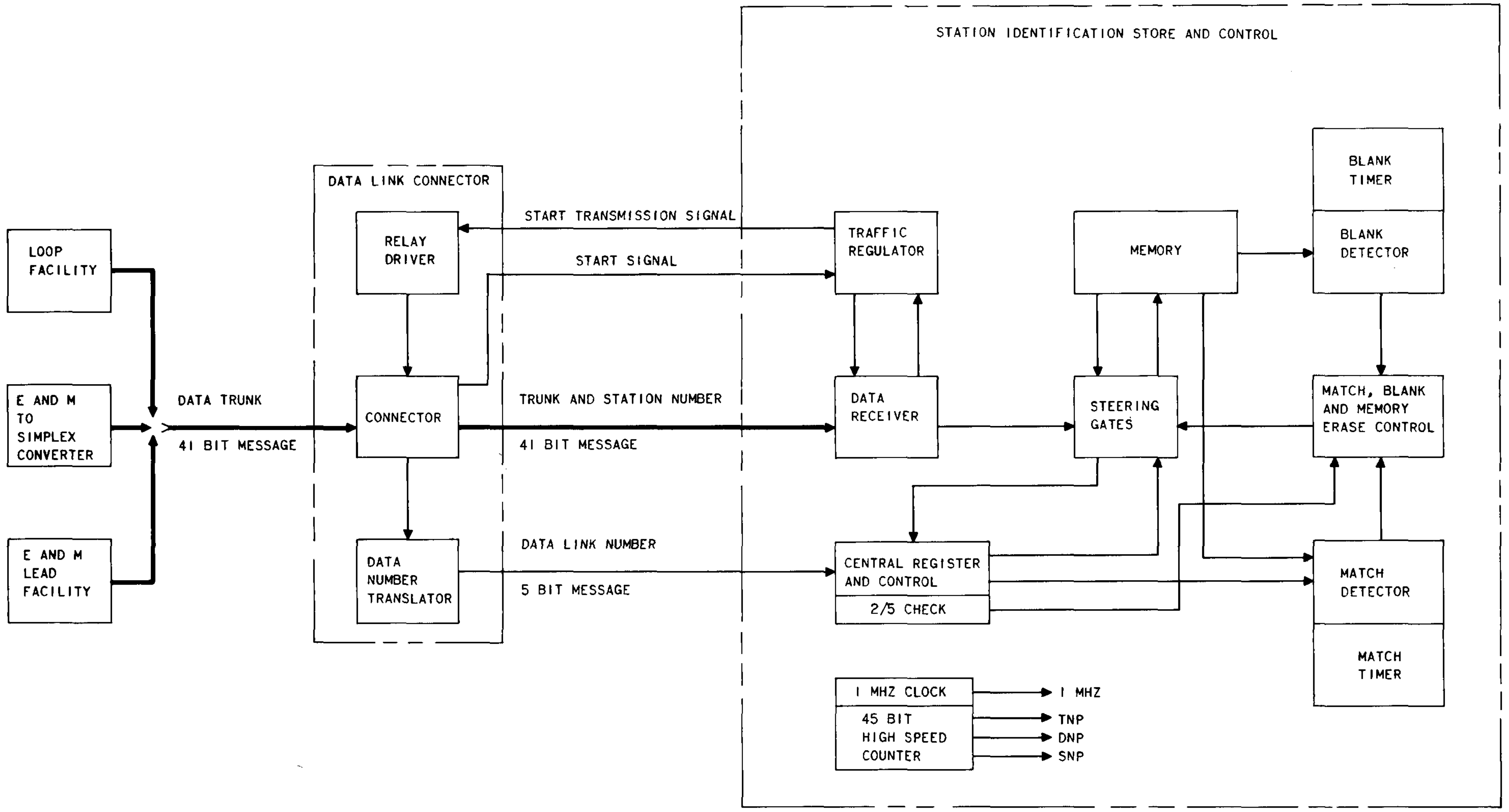

Fig. 6—Typical Operation on PBX Request—Block Diagram

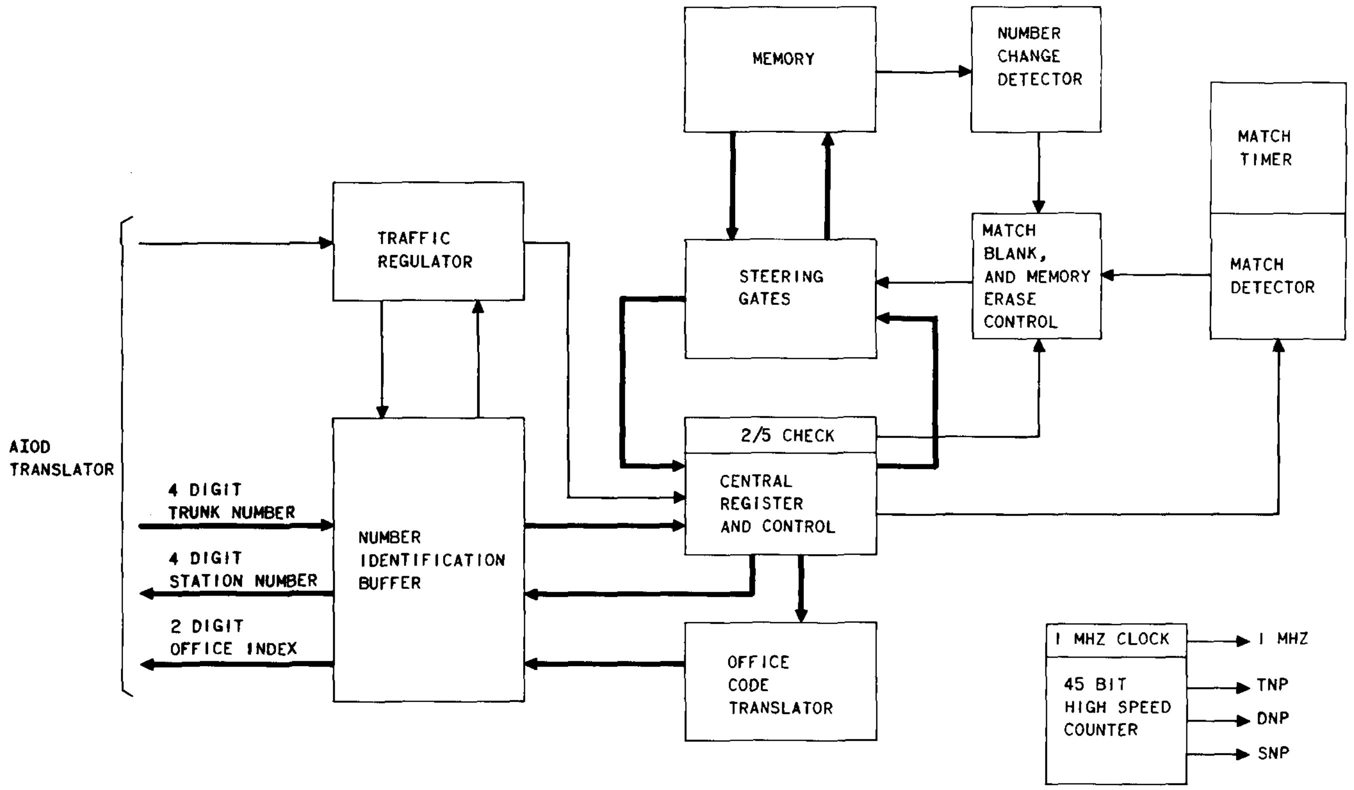

Fig. 7—Typical Operation on Central Office Request—Block Diagram

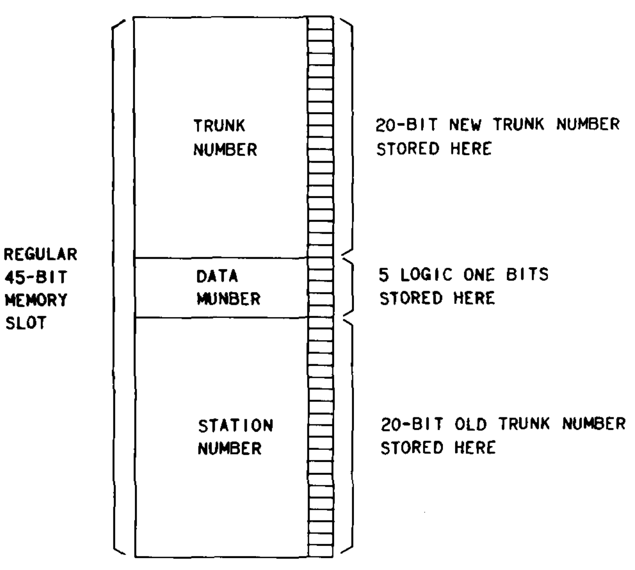

Fig. 8—Method of Storing Number Change Data in Memory

trunk number match which proceeds in the normal manner.

D. Operation of Station Identification Test Circuit

5.17 The SI test circuit is functionally divided into three major areas: (1) it monitors the operation of the SI store and control circuit, (2) it provides means for making various operational tests of the data link connector and SI store and control circuit, and (3) it is used to enter trunk number change information into memory.

E. Monitoring Operation of Station Identification Store and Control Circuit

5.18 On a trouble condition prior to the start of memory search functions, the test circuit records the contents of the SI control circuit central register and the state of the two-out-of-five check circuits. This record is displayed on lamps at the control and test panel.

5.19 On a central office request which encounters trouble, the test circuit displays the contents of the SI control circuit central register and the state of the two-out-of-five check circuits, either before or after information has been retrieved from memory depending upon the nature of the trouble detected.

5.20 Functional call progress information is recorded and displayed on any call which encounters trouble.

5.21 A trouble display is made if a call encounters trouble due to errors of the interface gates controlling memory to memory or central register to memory transfer of data.

5.22 A trouble display is made on a failure to match on a central office request. A failure to match or to find a blank position in memory on a PBX request will cause a trouble display.

5.23 Certain troubles at the PBX-ANI equipment cause all "ones" to be transmitted to the PBX- AIOD-A2 equipment. This causes a two-out-of-five check failure which results in a trouble display.

5.24 Should the entire memory be cleared for any reason, a trouble display is made and a major alarm given. This alerts maintenance forces to reenter a number change into memory if a number change is active at the time.

F. Operational Tests

5.25 Operational tests of the PBX-AIOD-A2 equipment may be made by means of jacks, keys, lamps, and switches located at the display and test control panel. In general, these tests simulate either a PBX request or a central office request for the services of the SI store and control circuit.

5.26 On a PBX simulated test, the central register of the test circuit is loaded with a test word consisting of 41 data bits according to the setting of 41 switches. The accuracy of the settings is verified by the operation of a load switch which lights lamps associated with test register flip-flops. The test word is then shifted out in serial form through the data transmitter in either single or continuous transmission.

5.27 The operation of the test (TST) switch causes the seizure of the data link connector which proceeds to connect the test circuit to the SI store and control circuit in the normal manner. The SI store and control circuit signals the test circuit which starts transmission of the test word under control of the transmitter clock. The transmitter clock is a crystal controlled transistor circuit producing an output of 735.3 pulses per second.

5.28 The data transmitter passes the output of the test register through a modulator into the multivibrator section which produces a frequency shift between 1150 and 1850 Hz. These outputs simulate the data of a PBX.

5.29 When all of the test word has been transmitted to the SI store and control circuit, the transmitter clock counter is stopped. The SI store and control circuit makes a two-out-of-five check of the trunk number, data link number, and station number in preparation for the start of the looping function to search the memory for a matching trunk number or to find a blank position in memory. The test circuit is signaled that this function is started. At this time, the test circuit releases the data link connector but continues to monitor the SI store and control circuit and record its progress.

5.30 When the SI store and control circuit releases, an indication is received at the test circuit which constitutes a system release only and not a successful completion of a test. Call progress lamps and, if trouble is encountered, trouble lamps remain lighted until the clear (CLR) switch is operated.

5.31 On a simulated central office request, a 4-digit trunk number is loaded into the central register of the test circuit according to the setting of the 20 trunk number switches. This trunk number must be one which is part of a word which has previously been placed in memory. The operation of number identification request (NIR) and TST switches initiates the seizure of the AIOD translator connector.

5.32 When the test circuit gains access through the preference chain, the translator connector closes 20 leads between the SI store and control circuit and the 20 trunk number switches of the test circuit. Grounded leads on a two-out-of-five basis set corresponding shift register stages in the central register of the SI and control circuit. When the two-out-of-five check has been completed, a search of memory is made for the trunk number recorded in the central register. When a trunk number match has been made, the information in memory is transferred to the central register. During all these operations, flip-flops are set in the SI store and control circuit to set flip-flops in the test circuit to record call progress.

5.33 The SI store and control circuit now makes a two-out-of-five check of the data link number and station number recorded in the central register. On a successful check, the data link number is gated into the number identification buffer as office tens and office units. The station number is gated into the number identification buffer as recorded in the central register. Office tens, office units, and station number is recorded in the test circuit test register.

5.34 When the SI store and control circuit functions to clear the system, the translator connector is returned to normal. The display and test control panel will display office index, station number, call progress, and trouble lamp indications, if trouble is encountered.

G. Entering Number Change Information Into Memory

5.35 An additional use of the test circuit is to place a trunk number change into memory. When it becomes necessary to change the central office trunk number associated with a particular PBX trunk, the test circuit is prepared as on a regular simulated PBX seizure except that the NCH switch is operated and the PBX switch is left in the normal position. The new trunk number is set up on the trunk number switches 1 through 20 and the old trunk number is set up on the station number switches 21 through 40.

5.36 The data are transmitted to the SI store and control circuit as in a simulated PBX seizure except that all "ones" are recorded in the data trunk number position of the central register. Now when the information is transferred from the central register to memory, all "ones" will be stored in the data trunk number position of the memory slot as a flag to indicate the special nature of the information.

5.37 It is important to note that when a number change has been entered into memory, no simulated PBX test call should use the new trunk number. Such a call would change the status of the data link number. Furthermore, any time the memory is cleared, as indicated by a lighted CLM lamp, the number change must be reentered into memory.

6. MAINTENANCE

6.01 The PBX-AIOD-A2 SI test circuit records malfunctions within the SI store and control circuit, on the data trunk, and trouble conditions from PBX-ANI. These trouble conditions are indicated by display lamps at the display and test control panel. The displays are recorded on a form and cross referenced in a trouble locating manual where corrective measures are outlined. (See reference TLM 1C235.)

A. Display and Test Control Panel

6.02 The display and test control panel, part of the SI test circuit, is shown in Fig. 4. From this panel, PBX and central office simulated test calls can be initiated and results observed on display lamps. Display lamps also indicate trouble conditions detected by the continual monitoring of the SI store and control circuit by the test circuit.

B. Test and Data Trunk Jacks

6.03 The test and patch jacks, part of the SI test circuit, are shown in Fig. 9. There are three separate groups of jacks provided: (1) DR jacks provide jack appearances for the data link connector inputs, (2) DT jacks provide jack appearances for the data trunks, and (3) S jacks and associated S lamps provide jack appearances for PBX trunks which are used, if required, to substitute for a faulty data trunk. The M1, M2, and DL jacks provide connections to a portable PBX ANI data test set to monitor the FSK data being transmitted.

6.04 The DT jacks allow any data trunk to be temporarily patched to the DRO jack and the DR jacks allow the data link connector input representing the data link number of the patched data trunk to be temporarily patched to the TST jack. This arrangement permits testing a faulty data link channel and at the same time restoring service on the associated data trunk. The TST jack is also used to test the two-out-of-five check circuits in the SI store and control circuit on a system-down basis by a temporary patch to the DRT jack.

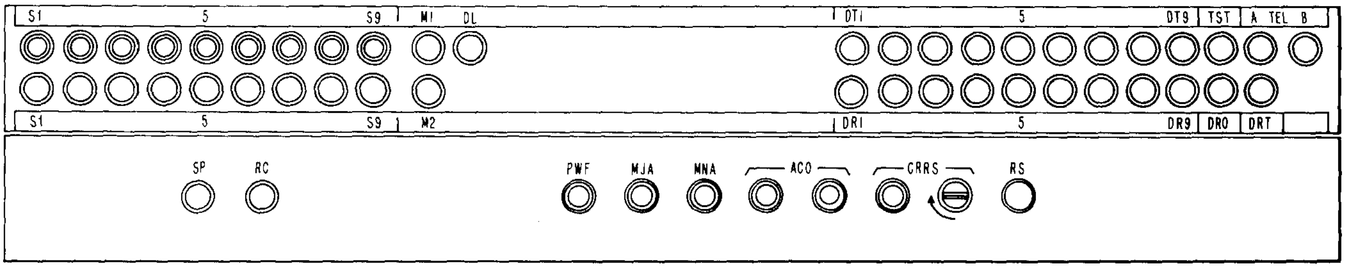

Fig. 9—Data Trunk Jack and Lamp, Miscellaneous Jack, Key, and Lamp Panel