"TOUCH-TONE®" CALLING FOR PBX SYSTEMS

GENERAL DESCRIPTIVE INFORMATION

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1. INTRODUCTION

1.01 This section describes the circuit and equipment arrangements required to provide TOUCH-TONE calling in PBX systems except 101 EPBX, No. 1 ESS Centrex, and No. 5 crossbar centrex.

1.02 This section replaces Section 981-602-100 which has been canceled.

1.03 TOUCH-TONE dial signals originate from eight tones in the voice frequency range in an array as shown in Fig. 1. Each TOUCH-TONE digit consists of two tones, one from a high frequency group and one from a low frequency group.

1.04 When a dial PBX is not arranged to operate from TOUCH-TONE signals, equipment must be provided at one end of the connection to convert the TOUCH-TONE signals to signals which can be

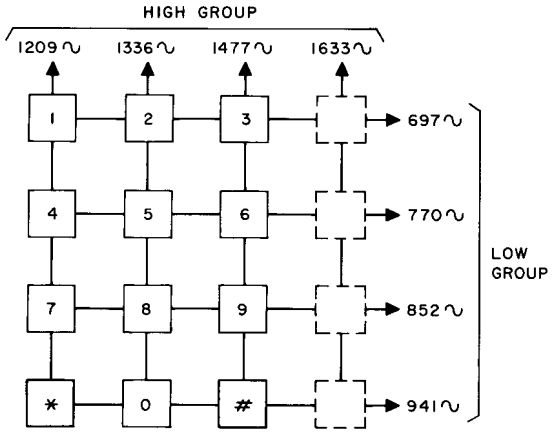


Fig. 1—TOUCH-TONE Dial Frequency Assignments

used to establish the connection. Several PBX equipment arrangements are available to accomplish this conversion. At step-by-step PBXs, common group TOUCH-TONE calling equipment consisting of TOUCH-TONE receiver-converters in association with required access circuits is provided. At 800A electronic PBXs and 756A, 757A crossbar electro-mechanical PBXs, TOUCH-TONE receivers are appliqued onto the dial pulse registers. When tie lines, foreign exchange (FX) lines, and foreign exchange (FX) trunks, etc, require conversion; either the local trunk or centralized TOUCH-TONE calling equipment, consisting of receiver-converters in association with access circuits, is provided. Each of these arrangements is described in this section.

1.05 In addition to the conversion equipment, PBX systems arranged for TOUCH-TONE calling must be equipped with precise (350 plus 440-Hz) dial tone since the nonprecise dial tone normally provided with PBXs can block registration of the initial TOUCH-TONE digit. This blockage results from the guard action (used to gain immunity to speech simulated signals) designed into the TOUCH-TONE receiver. Through the mechanism of this guard action, the use of nonprecise dial tone has the effect of reducing receiver sensitivity.

1.06 Precise dial tone is not required for the 761B PBX (Hotel-Motel PBX) when equipped with the type C receiver.

1.07 All PBXs except the 761B PBX are arranged so that some stations can be equipped for

TOUCH-TONE dialing while others use rotary dialing.

2. "TOUCH-TONE" CALLING CIRCUIT ELEMENTS

"TOUCH-TONE" RECEIVERS

A. General

2.01 Two general types of receivers designated type A and type C are used at PBXs arranged for TOUCH-TONE calling. The type A receiver is a common receiver originally designed for use at central offices equipped for TOUCH-TONE calling. The type A receiver is more sensitive and accurate than the type C receiver. The type C receiver is a low cost receiver designed primarily for use at PBXs where the cable loops between the station set and the PBX equipment are provided on a 2-wire nonrepeatered basis. Each of these receivers recognizes the multifrequency tones generated by the TOUCH-TONE dial and converts the tones to dc signals; the type A receiver on a 2-out-of-7 basis and the type C receiver on a 1-out-of-10 basis (type C1) or 1-out-of-12 basis (type C2). In general, PBXs require a translation circuit between the A type receiver and the PBX equipment. At crossbar and electronic common control PBXs, this translation circuit is provided as part of the dial pulse register. At step-by-step PBXs, which require TOUCH-TONE to dial pulse conversion, the translation circuit is provided as part of the electronic dial unit associated with the common group TOUCH-TONE calling equipment. At common control or manual PBXs, which require TOUCH-TONE to dial pulse conversion, the translation circuit is provided as part of either the electronic dial unit associated with the local trunk or centralized TOUCH-TONE calling equipment depending upon which is used. At common control PBXs the resulting dc signals are treated in the same manner as rotary dial calls by the dial pulse registers. At PBXs equipped with TOUCH-TONE to dial pulse conversion equipment, the dc signals are applied to the solid state converter where they are changed to dial pulses.

B. Signaling Ranges

2.02 The signaling range between the TOUCH-TONE station set and the TOUCH-TONE receiver is determined by the oscillator output of the station set (station set current), the loss of the cable loop between the station set and the receiver, the receiver sensitivity, and the range of variation between these parameters. The TOUCH-TONE signal output level of the set varies inversely with the amount of dc loop current passing through the TOUCH-TONE station set. At least 20 milliamperes of current should be maintained for proper signaling output. Since the receiver sensitivity of the type C receiver is less than that of the type A receiver, its operating range is also less. The basic range of the type C receiver is 3 dB of loss at 1000-Hz on a 2-wire nonrepeatered cable facility to the station set. The C receiver can be used on longer station loops if a distant termination is not bridged on the receiver during the interval that TOUCH-TONE signals may be received; therefore, longer ranges may apply at all common control PBXs and step-by-step PBXs arranged for intercom calls only. The type A receiver is required when the signaling range of the type C receiver is exceeded. In addition, the type A receiver is required to prevent double registration or mutilated digits when both ends of a connection are equipped for TOUCH-TONE calling.

C. Receiver Operation

2.03 The input circuit of each of the receivers is bridged across the tip and ring leads of the calling station or trunk cable pair. The input circuit is designed to reject all frequencies except the standard TOUCH-TONE frequencies. The TOUCH-TONE signals are separated into high and low component groups. In the A receiver the tones are converted to dc signals on a 2-out-of-7 basis (optionally 2-out-of-8 basis). When required, the output of the type A receiver is applied to a translation circuit which converts the 2-out-of-7 dc signals which represent the high and low components of the TOUCH-TONE signals to dc signals on a 1-out-of-10 basis which represent digits dialed. A translation circuit, in general, must be provided with each type A receiver. This translation circuit was designed as an integral part of the type C receiver. The 11th and 12th outputs from the receivers represent the * and # keys which are made available for special functions as required on the TOUCH-TONE dial. For more detailed information, refer to the general descriptive information in Sections 975-212-110 for the type A receiver and 975-212-130 for the type C receiver.

DIAL-TONE SUPPLY FOR "TOUCH-TONE" PBXs

2.04 PBX systems with TOUCH-TONE calling require a precise dial tone to prevent any

interference in the operation of the TOUCH-TONE receivers. The precise dial tone is a mixture of two pure sine wave frequencies of 350- and 440-Hz.

2.05 A series of dial-tone generators, designated 404 series, has been developed to provide precise dial tone for PBXs with TOUCH-TONE calling. The 404-type dial-tone generator consists of two frequency generators and a summing circuit. The sine wave outputs of these two frequency generators are combined in the summing circuit to produce the desired dial tone.

2.06 If duplicate dial-tone generators are required as in some large SXS PBXs, a tone monitor circuit is provided for each of the dial-tone generators. Both of these generators operate continuously, but only one generator feeds the load. The other generator is a spare. An automatic transfer circuit is associated with the tone monitor circuits which transfer the load to the spare generator if the regular generator fails. An audible and visual alarm is given if one or both generators fail. Switches are provided for manual transfer from the regular generator to the spare generator and for manual reset from the spare generator to the regular generator.

"TOUCH-TONE" CALLING FOR STEP-BY-STEP (SXS) PBXs

A. General

2.07 The common group TOUCH-TONE calling equipment is used to provide TOUCH-TONE calling at step-by-step PBXs. Two versions of the common group TOUCH-TONE calling equipment are in use. In the early version, trunk finder switches are used to gain access to the electronic dial units. This version has been manufactured discontinued and replaced by a later version which uses crossbar switches to gain access to the electronic dial units. Access to the common group TOUCH-TONE calling equipment may be obtained by either a station access circuit which is provided for each station equipped for TOUCH-TONE calling or ac converter trunk circuit which is provided on a per line finder basis for each customer group arranged for TOUCH-TONE calling. The station access circuit is connected between the station line circuit and the line finder (Fig. 2). The converter trunk is connected between the line finder and its associated local first selector (Fig. 3).

2.08 Block diagrams of the common group TOUCH-TONE calling equipment are shown in Figures 4 and 5.

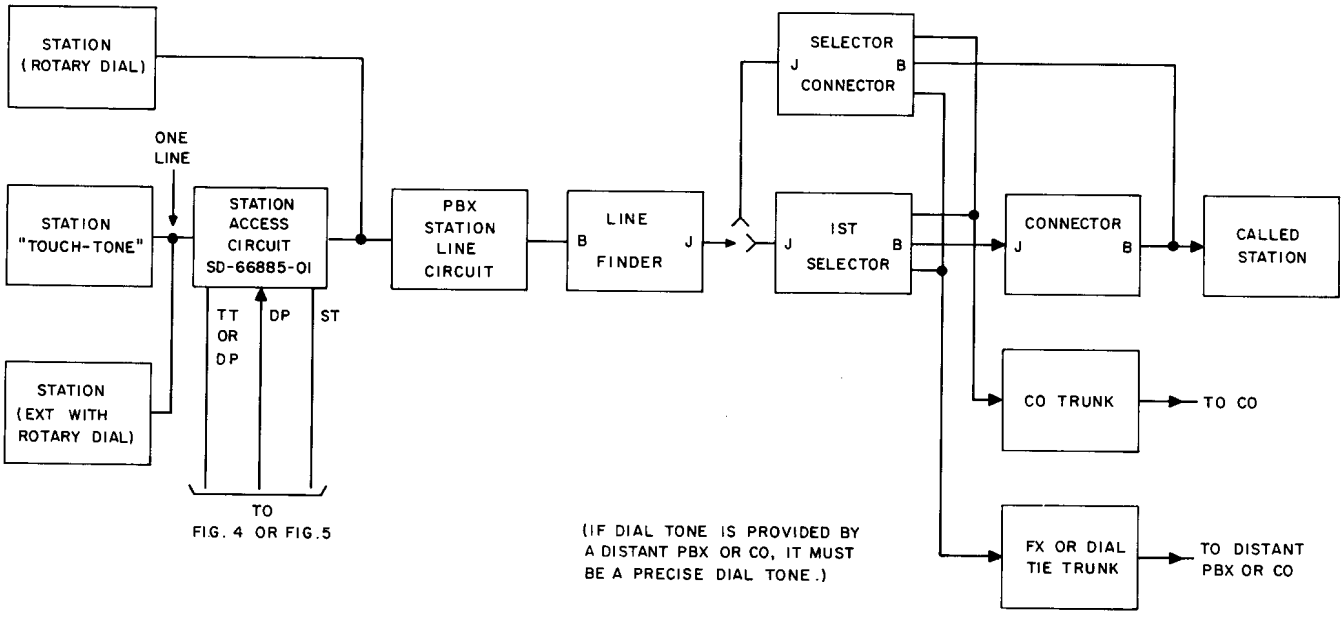


Fig. 2—Station Access to Common Group TOUCH-TONE Calling Equipment—Step-by-Step PBX—Block Diagram

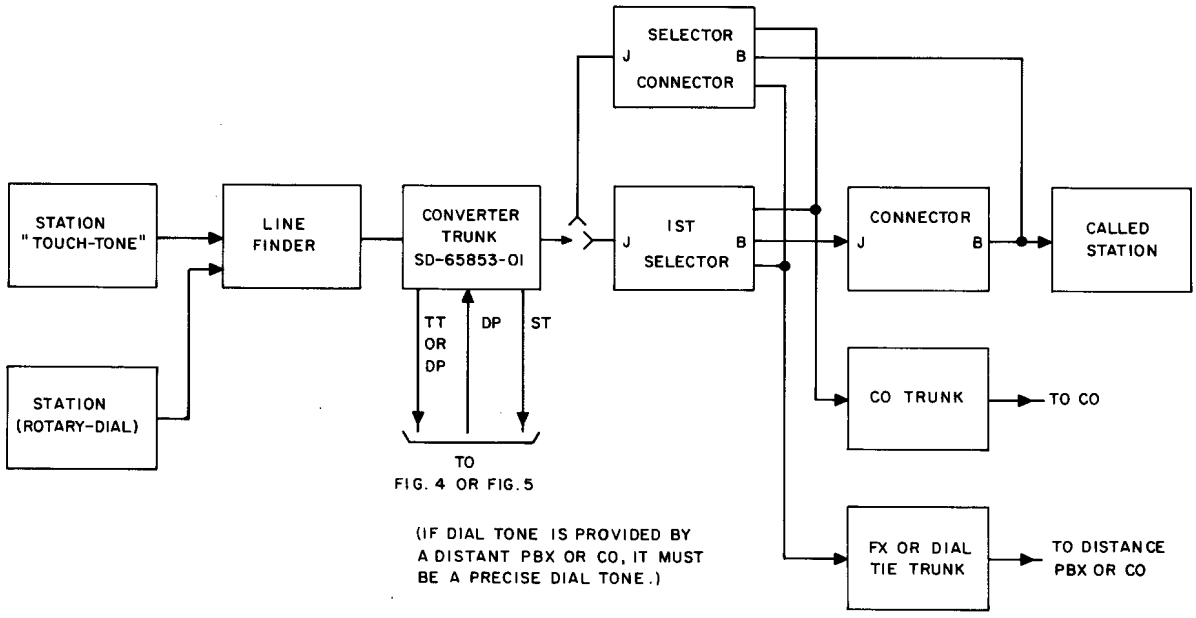


Fig. 3—Converter Trunk Access to Common Group TOUCH-TONE Calling Equipment—Step-by-Step PBX—Block Diagram

2.09 The circuit elements required to provide common group TOUCH-TONE calling at a SXS PBX with the trunk finder access arrangement are:

(1) Converter trunk or station access circuit

(2) Common group and subgroup circuit

(3) Trunk finder circuit

(4) Interface unit

(5) Solid state converter

(6) TOUCH-TONE receiver (type A or type C)

(7) TOUCH-TONE applique unit, required when type A TOUCH-TONE receiver is used.

Note: Items 4 through 7 are components of the electronic dial unit (EDU).

2.10 The circuit elements required to provide common group TOUCH-TONE calling with the crossbar-link arrangement are the same as the trunk finder arrangement with one exception—the trunk finder and common group circuits have been replaced by a crossbar, link, and controller circuit.

2.11 The modernized 701B PBX attendant position equipment (console or switchboard) is equipped with dc key pulsing dialing equipment in association with register-senders which are used to convert the dc signals to dial pulses. Since the attendant positions are not equipped for TOUCH-TONE calling, access to TOUCH-TONE to dial pulse conversion equipment is not required.

2.12 The nonmodernized 701A and 701B PBXs and the 740E PBX console attendant position may be equipped for TOUCH-TONE calling. The attendant outdial circuits at these installations terminate on line finders, and access to the TOUCH-TONE calling equipment is via converter trunks (Fig. 6). When one of these PBXs is arranged for TOUCH-TONE calling with switchboards as attendant positions, attendant access to TOUCH-TONE calling equipment is required on tie trunk and foreign exchange (FX) trunk calls only and is provided as shown in Fig. 7.

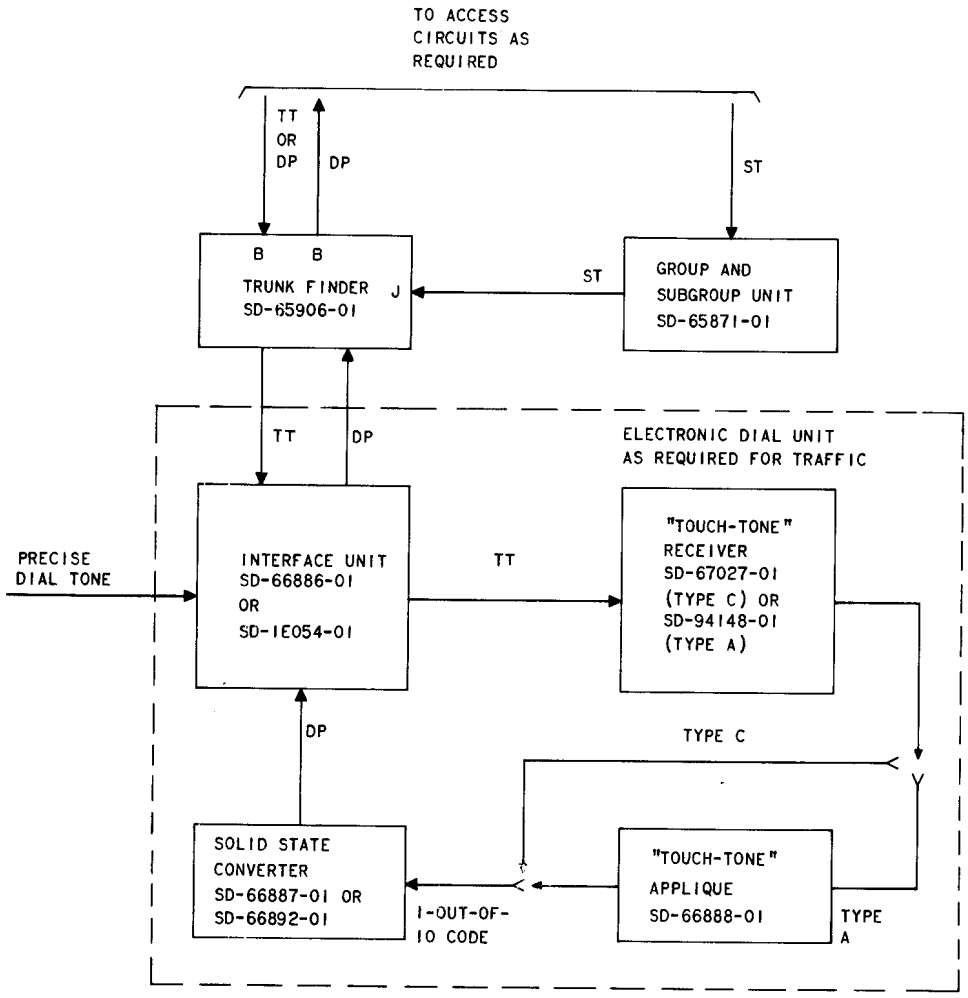


Fig. 4—Common Group TOUCH-TONE Calling Equipment—Trunk Finder Access—Block Diagram

B. Circuit Elements Peculiar to the Trunk Finder Access Common Group—TOUCH-TONE Calling Arrangement

2.13 The circuit elements peculiar to the trunk finder access common group TOUCH-TONE calling arrangement consist of the common group and subgroup circuit and the trunk finder switches.

Common Group and Subgroup Circuit

2.14 The common group and subgroup circuit is used to (1) start a trunk finder switch hunting for the access circuit requesting service, (2) detect operating difficulties within the trunk finder circuit, (3) signal the associated alarm circuit, and (4) provide visual indications of trouble in the trunk finder circuit.

Trunk Finder Switch

2.15 The trunk finder switch is a 100-point, 6-wire switch which can serve one test line and up to 99 TOUCH-TONE access circuits. The function of the trunk finder circuit is to connect the electronic dial unit to the access circuit requesting service.

C. Circuit Elements Peculiar to the Crossbar-Link Access Common Group—TOUCH-TONE Calling Arrangement

2.16 The circuit elements peculiar to the crossbar-link access common group TOUCH-TONE calling arrangement are the crossbar-link and controller circuits.

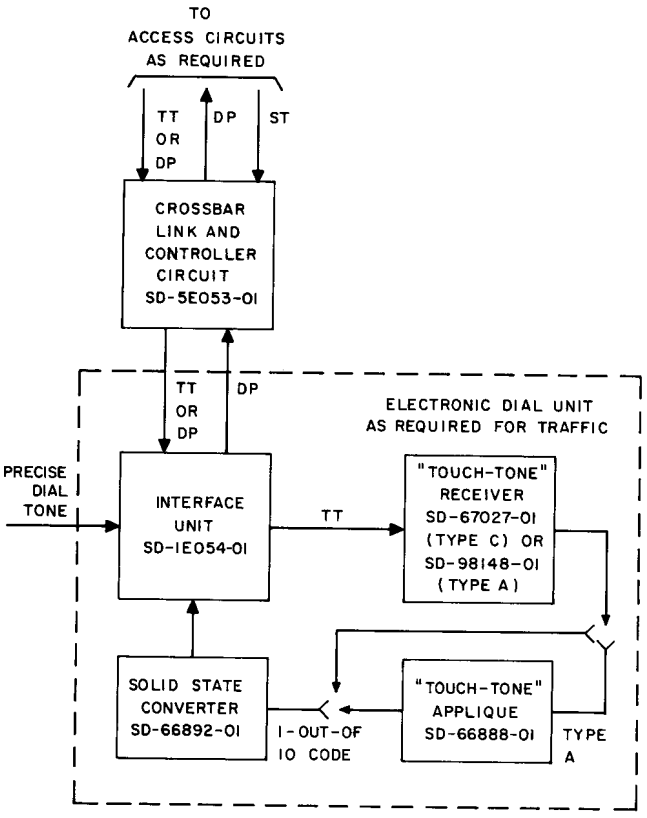


Fig. 5—Common Group TOUCH-TONE Calling Equipment—Crossbar-Link Access—Block Diagram

2.17 The crossbar-link and controller circuits identify the access circuit requesting service, select an idle EDU, and connect the access circuit to the EDU through the crosspoints of a crossbar switch.

2.18 Selection of the access circuit to be served is determined by a gate circuit. The gate circuit serves all the access circuits within a units group. Selection of the EDU to serve a particular request is determined by an allotter circuit which alternates the selection of an EDU in a manner that distributes usage over all the EDUs provided.

D. Circuit Elements Common to the Trunk Finder Access and Crossbar-Link Access Common Group—TOUCH-TONE Calling Arrangement

2.19 The electronic dial unit is common to the trunk finder access and crossbar-link access common group TOUCH-TONE calling arrangements. The electronic dial unit consists of the following circuit elements: solid state converter, TOUCH-TONE receiver, TOUCH-TONE receiver applique circuit when type A receiver is used, and interface circuit.

Interface Circuit

2.20 The interface circuit is interposed between the trunk finder and the receiver-converter circuits. Precise dial tone is inserted at the interface circuit. When TOUCH-TONE signals from a TOUCH-TONE station set are passed to the TOUCH-TONE receiver by the interface circuit, the interface circuit does not respond to the TOUCH-TONE signals; however, when the TOUCH-TONE calling equipment is serving a call originated from a rotary dial station set, the interface circuit recognizes the presence of dial pulses and repeats the first digit. During the interdigital time between the first and second digits, the interface circuit cuts through the calling station to the first selector and disconnects the trunk finder circuit and electronic dial unit from the access circuit. Before outpulsing of the first digit and between each succeeding digit, the interface circuit also provides a coupling between the TOUCH-TONE and dial pulse path for voice and dial tone. This coupling returns precise dial tone, when provided by the terminating PBX or central office. The interface circuit also signals the access circuit to cut through and release the trunk finder when the converter has determined by pretranslation or time-out that the last digit has been outpulsed. If answer supervision is received from a terminating PBX, the interface circuit will also signal a release.

2.21 The early cut and double registration control circuit is part of the interface circuit and serves to prevent the TOUCH-TONE digit from being detected at the distant end TOUCH-TONE receiver, if provided.

2.22 When the terminating office or PBX does not provide precise dial tone and tie trunk or foreign exchange service is provided, the interface circuit furnishes precise dial tone under control of the associated access circuit.

Solid State Converter Circuit

2.23 The solid state converter circuit completes the final phase of converting the TOUCH-TONE signals into dial pulses. Since the TOUCH-TONE signals are generated more rapidly than the

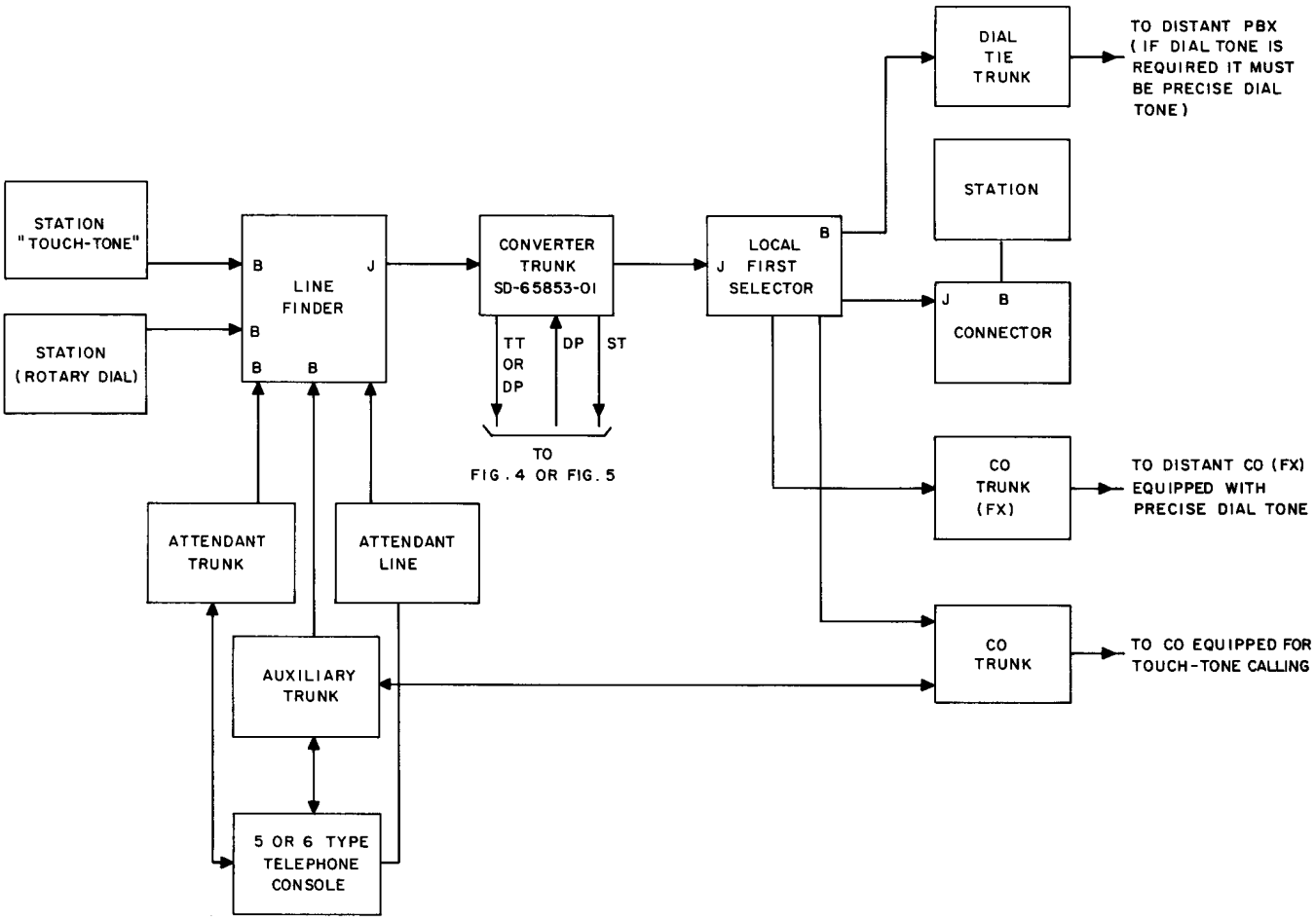


Fig. 6—5- or 6-Type Consoles Arranged for TOUCH-TONE Calling Using Common Group TOUCH-TONE Calling—Step-by-Step PBX—Block Diagram

equivalent dial pulse digits outpulsed by the converter, a buffer memory is provided as part of the solid state converter circuit. This memory uses coincident current storage and destructive readout and acts as a time buffer between the TOUCH-TONE receiver and the dial pulse generator circuitry in the converter. Memory ***write-in*** is controlled by the TOUCH-TONE receiver. ***Readout*** is controlled by the translation and dial pulse circuits. To obtain a more efficient use of the memory, the ***read*** and ***write*** circuits are recirculating. This allows the cleared word slots of the memory to be reused for the final digits of the dialed number, if necessary. Early models of the solid state converter have 10- digit storage slots. Later models have been increased to 14-digit storage slots. The actual maximum number of digits that can be stored in the memory depends upon the rate at which the digits are dialed.

2.24 The solid state converter circuit is arranged with a digit pretranslation circuit and a 10-second time-out to determine when to release. (This is changed to 3.5-second time-out when all converters are busy.) The pretranslation feature is based on the first digit dialed. The information for the pretranslation circuit is dependent upon a cross-connecting placement. Any or all of the first digits 0 through 9 can be cross-connected to provide release after one, two, three, or four digits (as required) are received. Absence of a cross-connection on any particular first digit will result in release, after the time-out interval or when answer supervision is returned.

TOUCH-TONE Receiver

2.25 The TOUCH-TONE receiver is described in 2.01 through 2.03. Either the type C or

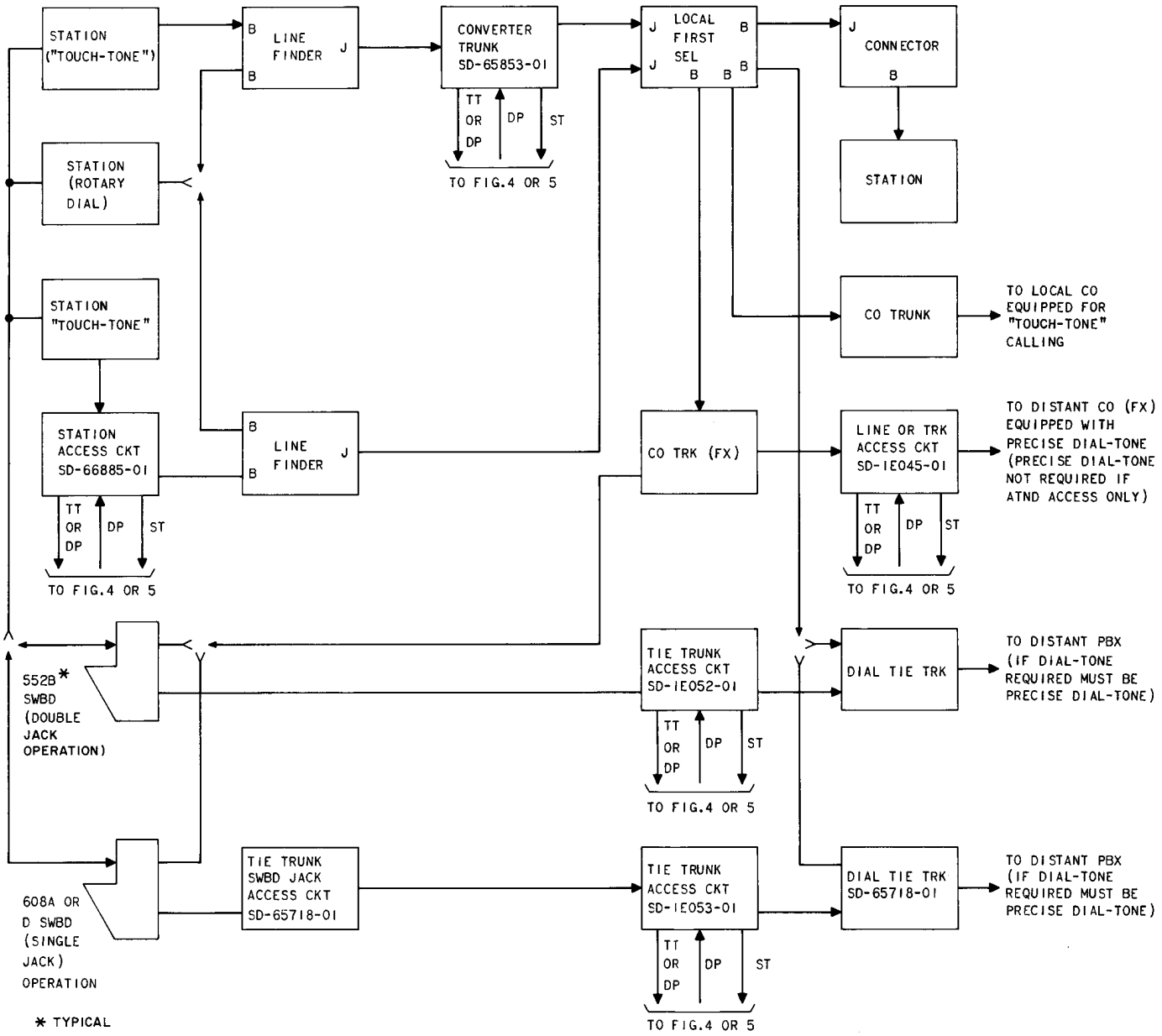


Fig. 7—Switchboard With Station Multiple Arranged for TOUCH-TONE Calling Using Common Group TOUCH-TONE Calling—Step-by-Step PBX—Block Diagram

type A receiver may be provided as part of the electronic dial unit. When the type A receiver is provided, a TOUCH-TONE receiver applique circuit is also provided.

TOUCH-TONE Receiver Applique Circuit

2.26 The TOUCH-TONE receiver applique circuit is interposed between the type A receiver circuit and the solid state converter circuit. This circuit translates the 2-out-of-7-dc signal code from the type A receiver to a 1-out-of-10-dc signal code. Since the circuitry equivalent to the TOUCH-TONE receiver applique circuit is internal to the type C receiver, the TOUCH-TONE receiver applique circuit is not necessary to make the type C receiver compatible to the solid state converter circuit.

"TOUCH-TONE" CALLING FOR CROSSBAR AND ELECTRONIC PBXs

A. General

2.27 All customer-located crossbar and electronic PBXs that are to be arranged for TOUCH-TONE calling require a TOUCH-TONE receiver for each originating or dial pulse register. The receiver input is bridged across the tip and ring input of the existing register, and the dc output of the TOUCH-TONE receiver is stored in the dial pulse register in the same manner as regular rotary dial pulses. This arrangement does not interfere with the operation of a register when serving rotary dial calls.

B. 756A PBX and 400 Switching System

2.28 The 756A PBX and 400 switching system can be arranged for TOUCH-TONE calling by providing a TOUCH-TONE receiver for each register (Fig. 8). Either the type A or type C TOUCH-TONE receiver may be used. When the type A receiver is used, an applique circuit is required between the receiver and register.

C. 757A and 800A PBXs

2.29 A TOUCH-TONE receiver and an interface circuit for each originating or dial pulse register are required when adding TOUCH-TONE calling to a 757A or 800A PBX. Either the type A or type C TOUCH-TONE receiver may be used. A block diagram of the 757A PBX with TOUCH-TONE calling is shown in Fig. 9. Figure 10 shows the arrangement for the 800A PBX.

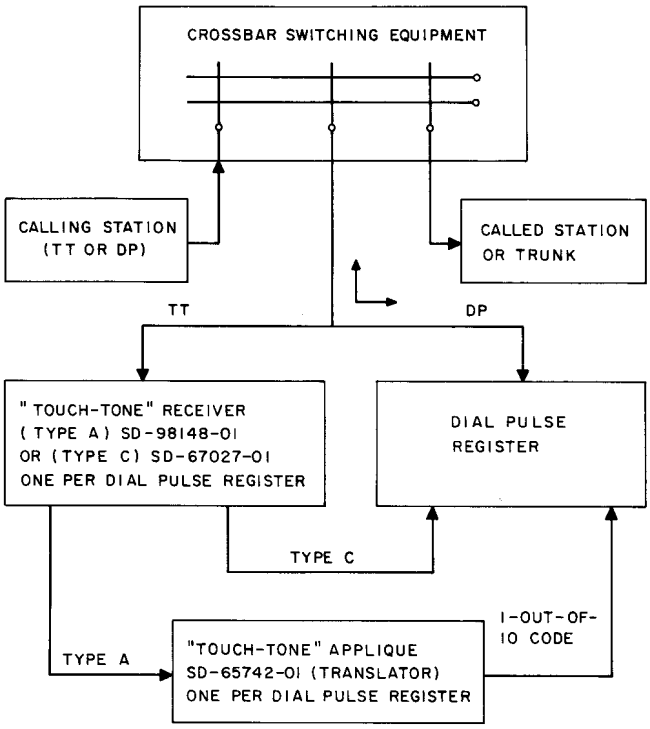


Fig. 8—756A PBX and 400 Switching System TOUCH-TONE Calling Arrangement—Block Diagram

D. 761B PBX

2.30 This system can function with either rotary dial or TOUCH-TONE telephone sets, but not with both. The circuit elements required to provide TOUCH-TONE calling with the 761B PBX are as follows:

(1) TOUCH-TONE access and remote answer circuits

(2) Type C TOUCH-TONE receiver (two receivers required when call controller provided)

(3) TOUCH-TONE call controller.

Figure 11 shows a block diagram of a 761B PBX arranged for TOUCH-TONE calling.

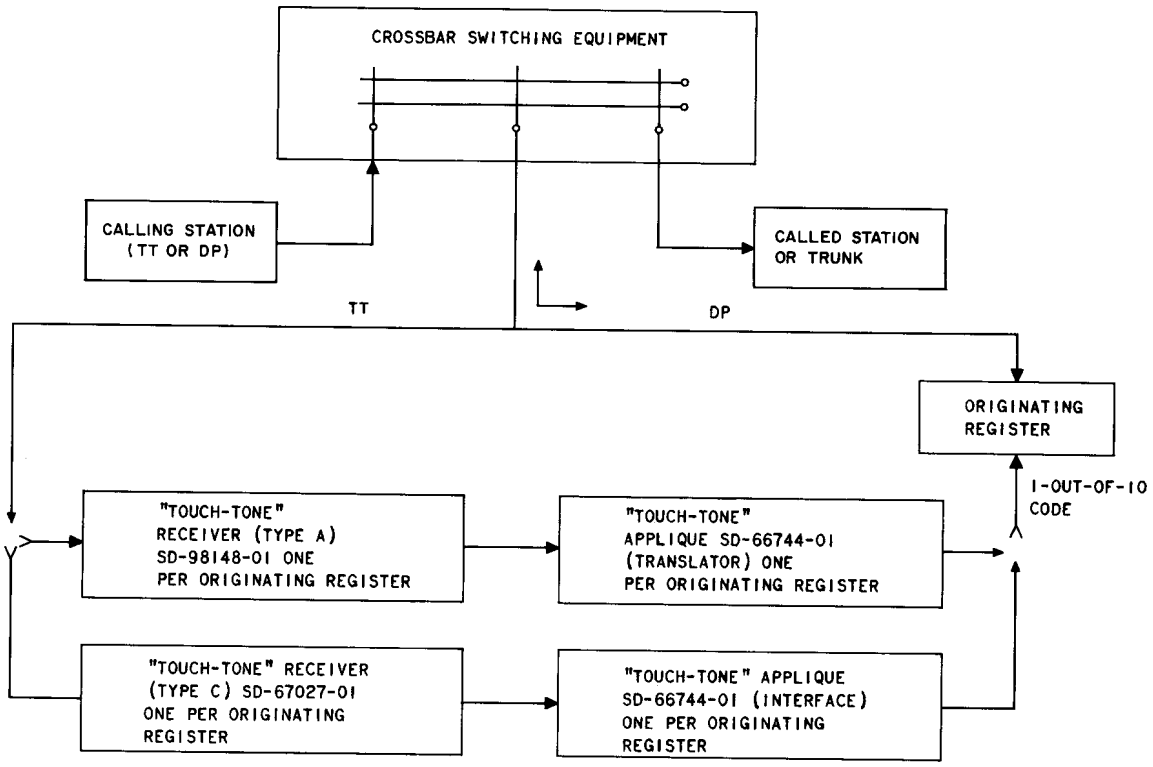


Fig. 9—757A PBX TOUCH-TONE Calling Arrangement—Block Diagram

"TOUCH-TONE" CALLING FOR MANUAL SWITCHBOARDS

2.31 To arrange a manual switchboard to operate with TOUCH-TONE calling, the switchboard must be equipped with a TOUCH-TONE dial and a dial auxiliary unit. The dial auxiliary unit is required to provide the battery for operation of the TOUCH-TONE oscillator which is part of the TOUCH-TONE dial.

"TOUCH-TONE" CALLING FOR CONSOLES

2.32 To arrange PBX console for TOUCH-TONE calling, the console must be equipped with a TOUCH-TONE dial.

"TOUCH-TONE" CALLING FOR TIE TRUNKS, FOREIGN EXCHANGE (FX) LINES, AND FOREIGN EXCHANGE (FX) TRUNKS

A. General

2.33 Tie trunks, foreign exchange (FX) trunks, and foreign exchange (FX) lines may be arranged for TOUCH-TONE calling by providing either the local trunk TOUCH-TONE calling equipment arrangement or the centralized TOUCH-TONE equipment arrangement. The local trunk TOUCH-TONE calling equipment when provided will be located at the PBX equipped for TOUCH-TONE calling while the centralized TOUCH-TONE calling equipment may be located at any conveniently centralized location.

2.34 When a number of lines and trunks requiring TOUCH-TONE conversion are routed from different PBXs or stations to an intervening centralized location, centralized TOUCH-TONE calling may be used. To provide access to this equipment, a line or trunk access circuit is associated at the centralized location requiring TOUCH-TONE to dial pulse conversion.

2.35 When the PBX is located in an area where the use of centralized TOUCH-TONE calling is not practical, the local trunk TOUCH-TONE calling equipment arrangement is used. At the local PBX, an access circuit to the local trunk TOUCH-TONE calling eequipment is provided for

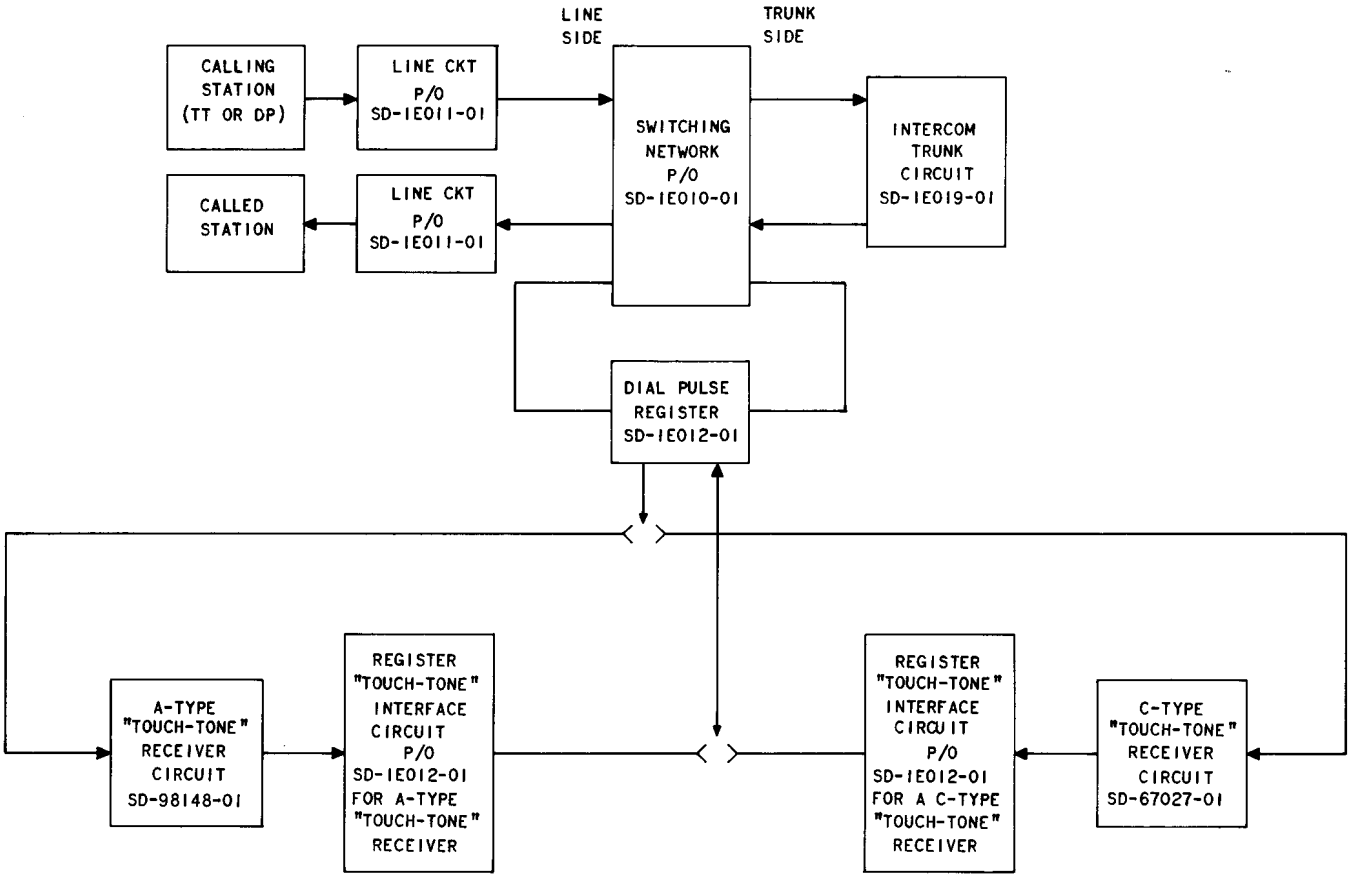


Fig. 10—800A PBX TOUCH-TONE Calling Arrangement—Block Diagram

each line or trunk requiring TOUCH-TONE to dial pulse conversion.

B. Centralized TOUCH-TONE Calling—Circuit Elements

Tie Trunk Access Circuit

2.36 The tie trunk access circuit is used in conjunction with existing dial repeating tie trunks to provide access to the centralized TOUCH-TONE calling equipment.

Line or Trunk Access Circuit—Ground Start

2.37 This access circuit provides access to the centralized TOUCH-TONE calling equipment for PBX off-premise extension lines, foreign exchange lines, or foreign exchange trunks where the terminating PBX or central office is not arranged to supply precise dial tone or where ground start operation is required.

2.38 Ground start is also used to control the return of local precise dial tone from the interface circuit to the originating station. In addition, ground start operation is used to inform the access circuit of the exact time to cut through the TOUCH-TONE calling equipment. This prevents the TOUCH-TONE calling equipment from being seized when an incoming call seizes the customer line during the silent interval of ringing.

Line or Trunk Access Circuit—Loop Start

2.39 This access circuit provides access to the TOUCH-TONE calling equipment for PBX off-premise extension lines, foreign exchange lines, or foreign exchange trunks from manual PBXs where the distant PBX or central office is arranged to provide precise dial tone. When this circuit is seized on an outgoing call, a path for dial tone from the distant end to the originating station is established. This operation enables the calling

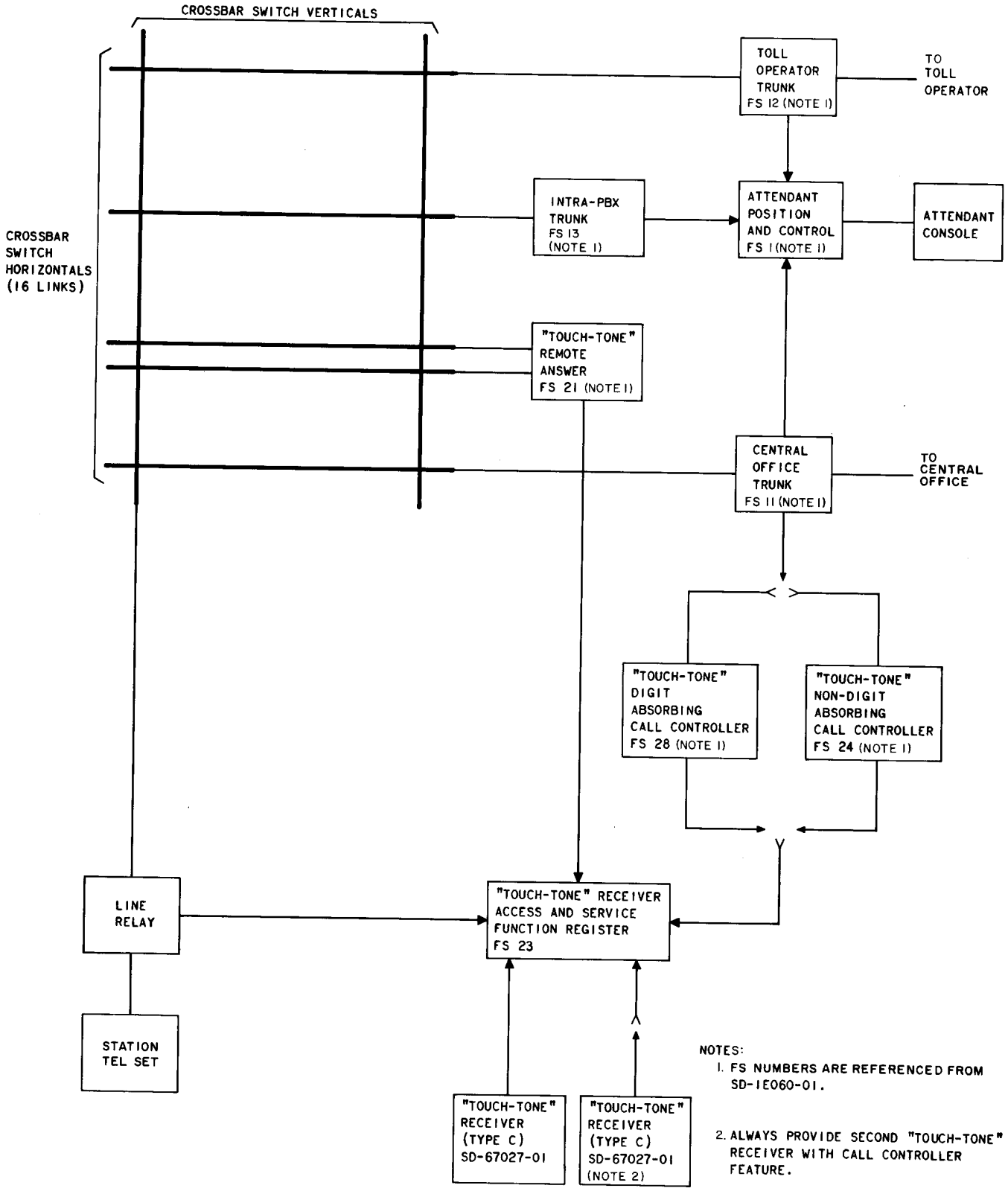


Fig. 11—761B PBX TOUCH-TONE Calling Arrangement—Block Diagram

party to receive precise dial tone from the distant end.

Centralized TOUCH-TONE Calling—Circuit Elements

2.40 The circuit elements required to provide centralized TOUCH-TONE calling are:

(1) Common group and subgroup circuit

(2) 100-Point trunk finder circuits

(3) Interface circuits

(4) Solid state converter circuits

(5) Type A TOUCH-TONE receivers

(6) TOUCH-TONE receiver applique circuits

(7) Digit class control and compensation network circuits

(8) Miscellaneous alarm circuit.

A block diagram of the circuit elements required to provide centralized TOUCH-TONE calling is shown in Fig. 12.

> ***Note:*** Items 3 through 8 above provide the electronic dial unit (EDU) for this arrangement.

Trunk Finder Circuit

2.41 The trunk finder circuit consists of an 8-wire trunk finder switch providing a means for connecting a TOUCH-TONE receiver, solid state converter, and associated circuits to the appropriate tie trunk or line access circuit. There is a capacity of up to 99 line or trunk access circuits and one test line. Six of the eight bank terminals provide in-and-out access to the TOUCH-TONE receiver and solid state converter. One of the remaining two terminals provides information for operation of the class relays in the digit class control circuit. The other terminal is a spare. The digit class control information is determined by cross-connecting the proper bank terminal to the proper relay in the digit class circuit.

2.42 The interface circuit in the centralized TOUCH-TONE calling arrangement is adapted with a hybrid coil to reduce the bridging loss (when the terminating end is bridged to the originating end) while the TOUCH-TONE digits are being received. This maintains the proper TOUCH-TONE level to the input of the receiver.

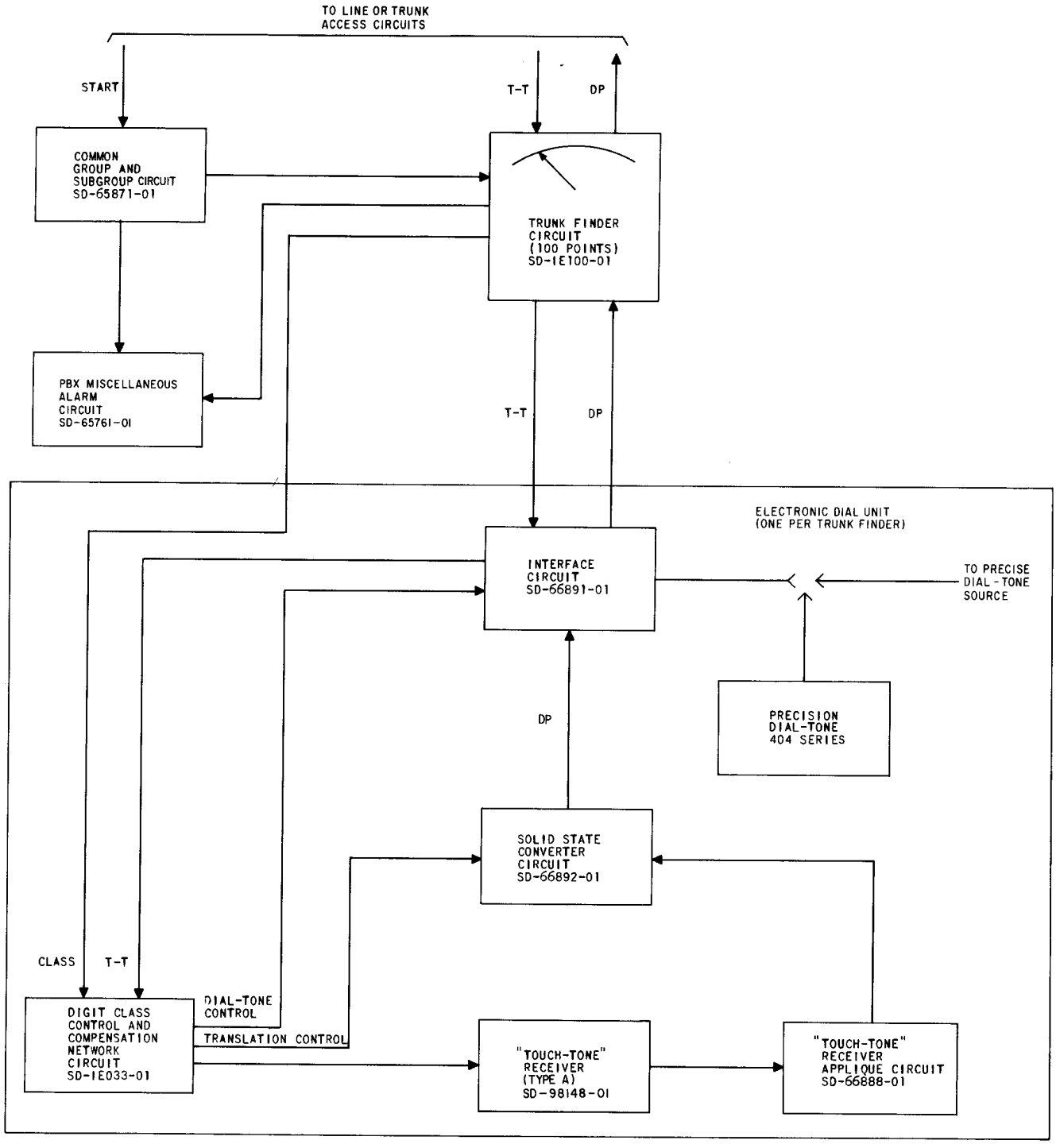
2.43 On rotary dial calls, the interface circuit repeats the first digit and signals the tie trunk or line access circuit to cut through and release the trunk finder. On TOUCH-TONE calls, the interface circuit passes the TOUCH-TONE signals to the digit class circuit and provides a path for dial pulses from the converter to the trunk finder. Coupling between digits, early cut feature, and the release feature are provided as described for the interface circuit which is part of the common group TOUCH-TONE calling equipment described in 2.20.

Digit Class Control

2.44 This circuit provides the appropriate pretranslation cross-connections on an individual or group basis for the solid state converter as determined by the operation of a class relay. This cross-connection is used by the converter circuit to determine when to release after the last digit has been outpulsed (after a total of 1, 2, 3, or 4 digits). This circuit provides a maximum of 50 class relays, permitting 50 different pretranslation cross-connections. It also provides a compromise network for compensation of the various transmission levels that will be encountered on the tie trunks and access lines requiring conversion. This network consists of an amplifier, an impedance matching transformer, and a dial-tone filter to reduce the level of dial tone to the input of the receiver. The compensation network is necssary to maintain the proper level of TOUCH-TONE signals into the TOUCH-TONE receiver. This circuit also informs the interface circuit when to insert local precise dial tone or repeat the dial tone from the distant end as determined by trunk finder strapping.

TOUCH-TONE Receiver Circuit

2.45 The TOUCH-TONE receiver circuit is the type A receiver described in 2.01 through 2.03. Later models of this circuit provide an output to the early cut and double registration control circuit which breaks the forward transmission path within 23 milliseconds after the beginning of a TOUCH-TONE digit. This is necessary to prevent actuating a far-end receiver when dial pulse conversion is provided for signaling between TOUCH-TONE-equipped PBXs.



NOTE:

TIE TRUNK FINDER CIRCUIT EQUIPMENT IS ARRANGED TO HANDLE A MINIMUM-OF-TWO TRUNK FINDER SWITCHES WITH ASSOCIATED ELECTRONIC DIAL UNITS.

Fig. 12—Centralized TOUCH-TONE Calling Equipment—Block Diagram

TOUCH-TONE Receiver Applique Circuit

2.46 This is the same applique circuit as used with the common group TOUCH-TONE calling equipment described in 2.26. The purpose of this circuit is to convert the 2-out-of-7 code from the output of the type A receiver to the 1-out-of-10 code required by the converter circuit.

Solid State Converter Circuit

2.47 This converter is the same as the solid state converter used in the common group TOUCH-TONE calling arrangement described in 2.23.

Common Group and Subgroup Circuit

2.48 This circuit is the same type as is used in the trunk finder common group TOUCH-TONE calling arrangement. The circuit starts the trunk finders hunting for the tie trunk, foreign exchange trunk, or foreign exchange line requiring conversion and operates associated alarms if abnormal conditions are detected in the trunk finders.

Miscellaneous Alarm Circuit

2.49 This circuit provides the visual and audible alarm signals in case of a malfunction in the TOUCH-TONE calling equipment.

C. Local Trunk TOUCH-TONE Calling—Circuit Elements

Tie Trunk Access Circuits

2.50 Tie trunk access circuit SD-1E052-01 provides access to the local trunk TOUCH-TONE calling equipment for tie trunks from manual PBX switchboards utilizing double-jack operation. This circuit also provides access for a cord switchboard associated with a dial PBX and can be used with the common group TOUCH-TONE calling arrangement.

2.51 Tie trunk access circuit SD-1E053-01 provides access to the common circuits of the local trunk TOUCH-TONE calling equipment for tie trunks from switchboards that utilize single-jack operation. The associated dial PBX must employ a separate tie trunk access circuit arranged for use with the tie trunk to obtain the TOUCH-TONE to dial pulse conversion. This circuit can also be used with the common group TOUCH-TONE calling equipment arrangement.

2.52 Tie trunk access circuit SD-1E034-01 used in the centralized TOUCH-TONE calling arrangement is also used in the local trunk TOUCH-TONE calling arrangement. The circuit is arranged to provide proper connections between the PBX switching equipment and tie trunk.

2.53 Line or trunk access circuit (loop start) provides access to the local trunk TOUCH-TONE calling equipment for loop start foreign exchange trunks from TOUCH-TONE manual switchboards to a foreign exchange central office (without TOUCH-TONE) equipped with precise dial tone. This particular access circuit is located between the foreign exchange trunk and the distant central office and is the same circuit that is used with the centralized TOUCH-TONE calling arrangement.

2.54 The line or trunk access circuit (ground start) provides access to the local trunk TOUCH-TONE calling equipment for foreign exchange central office trunks from dial PBXs, manual PBXs (where CO is not equipped with precise dial tone), and cord switchboards associated with a dial PBX. The access circuit is located between the foreign exchange trunk and the distant central office. This is the same circuit that is used with the centralized TOUCH-TONE calling arrangement. This circuit can also be used with the common group TOUCH-TONE calling arrangement.

Local TOUCH-TONE Calling—Circuit Elements

2.55 The circuit elements required to provide local trunk TOUCH-TONE calling consists of:

(1) Trunk finder circuit

(2) Interface circuit

(3) Solid state converter circuit

(4) Type A TOUCH-TONE receiver

(5) TOUCH-TONE calling receiver applique circuit.

A block diagram of the circuits required to provide local trunk TOUCH-TONE calling is shown in Fig. 13.

Note: Items 2 through 5 above provide the electronic dial unit in this arrangement.

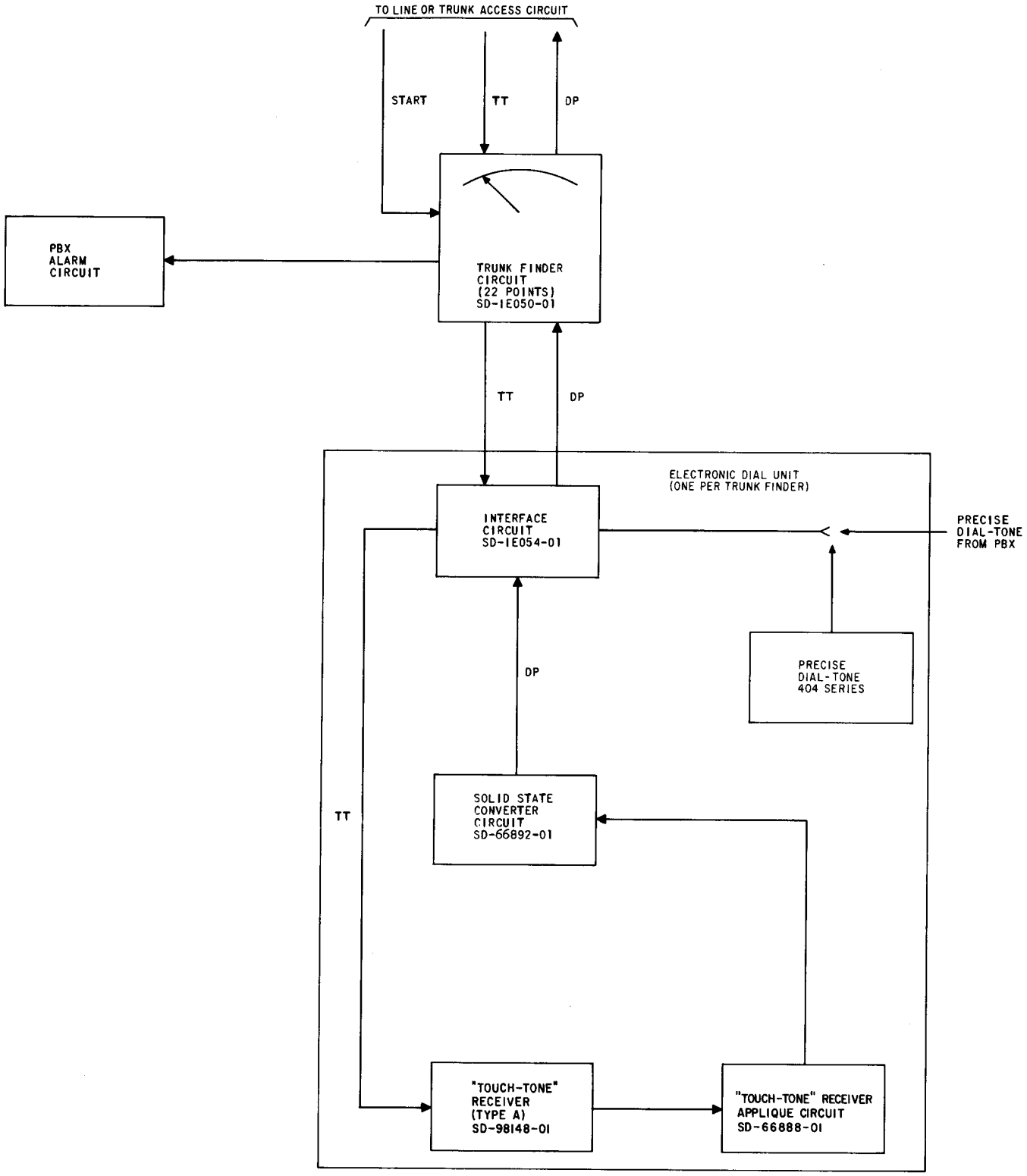


Fig. 13—Local Trunk TOUCH-TONE Calling Equipment—Block Diagram

2.56 The solid state converter TOUCH-TONE receiver, interface, and applique circuits are the same and perform the same functions as the circuits used in the common group TOUCH-TONE calling arrangement. The trunk finder circuit is described as follows:

Trunk Finder Circuit

2.57 This circuit is a 6-wire rotary selector switch used to connect the specific access circuit requiring TOUCH-TONE to dial pulse conversion to the electronic dial unit. The trunk finder has a capacity of up to 21 line or trunk access circuits and one test line.

2.58 When a start signal is received from an access circuit, the trunk finder finds the access circuit requesting service and connects it to an idle electronic dial unit. When a trunk finder is busy, the start signal is advanced to the next trunk finder in the trunk finder multiple.

3. EQUIPMENT ELEMENTS

GENERAL

3..01 The equipment required to arrange a PBX for TOUCH-TONE calling varies with each particular installation. However, all PBXs arranged for TOUCH-TONE calling require at least one TOUCH-TONE receiver unit. To determine the equipment arrangement required to arrange a particular PBX for TOUCH-TONE calling, refer to the general descriptive practice for the PBX located in the 981 Division of the Bell System Practices.

3.02 When a PBX other than step-by-step is arranged for TOUCH-TONE calling and tie trunk, (FX) trunk service, and the distant end are not arranged to accept TOUCH-TONE signals; either the PBX must be equipped with the local TOUCH-TONE converter equipment or arrangements must be made to route such calls through the centralized TOUCH-TONE converter equipment.

3.03 Special service features such as dial dictation, interface trunk, etc, require special equipment arrangements for TOUCH-TONE calling. To determine the arrangement required for a particular feature circuit, refer to the appropriate 981 Division general descriptive practice.

3.04 The TOUCH-TONE calling equipment is arranged in such a manner that some stations can be equipped with TOUCH-TONE dials while others can continue to use rotary dials.

"TOUCH-TONE" RECEIVERS

A. Type A TOUCH-TONE Receiver

3.05 The circuit components of the type A receiver are mounted on printed wiring boards in special housings. The housing occupies 6 inches of vertical mounting space on a standard 23-inch frame. Each housing will mount the circuit boards for two type A receivers. (See Fig. 14.)

B. Type C TOUCH-TONE Receiver

3.06 The circuit components of the type C TOUCH-TONE receiver are mounted on a standard mounting plate. The receiver is 6-3/4 inches in depth and occupies 2 inches of vertical mounting space of a standard 23-inch frame. (See Fig. 15.)

SOLID STATE CONVERTER

3.07 The solid state converter utilizes semiconductors, fluxor memory cores, and toroidial ferrite cores to convert the TOUCH-TONE signals to dial pulses. This unit provides 10- (MD) or 14-digit slots and occupies the space of one 2-inch panel in a standard 23-inch frame. The components of the 14-digit converter, other than relays, are mounted on plug-in printed wiring boards to facilitate maintenance.

PRECISE DIAL-TONE SUPPLY

3.08 A series of precise dial-tone generators designated the 404 series has been developed for use at PBXs. Crossbar PBXs use the 404C-type tone generator shown in Fig. 16. The 800A PBX uses the 404A-type tone generator. Small step-by-step PBXs use the 404B-type or 404D-type precise tone generator. Larger step-by-step PBXs use the 405A-type precise tone generator consisting of two 404B-type tone generators and a 10A tone monitor or a 405B-type tone generator consisting of two 404D-type tone generators and a 10B tone monitor. The 405B tone generator is shown in Fig. 17. All of the above tone generators are designed to mount on standard 23-inch frames except the 404A tone generator which is box-mounted.

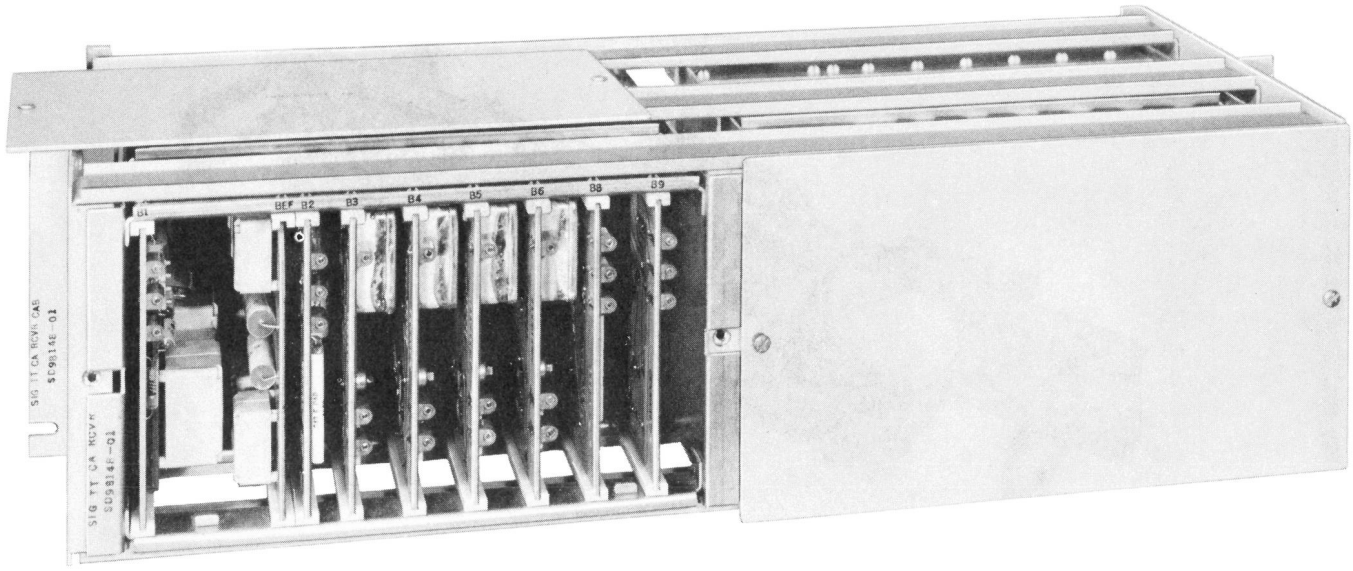


Fig. 14—Type A TOUCH-TONE Receiver

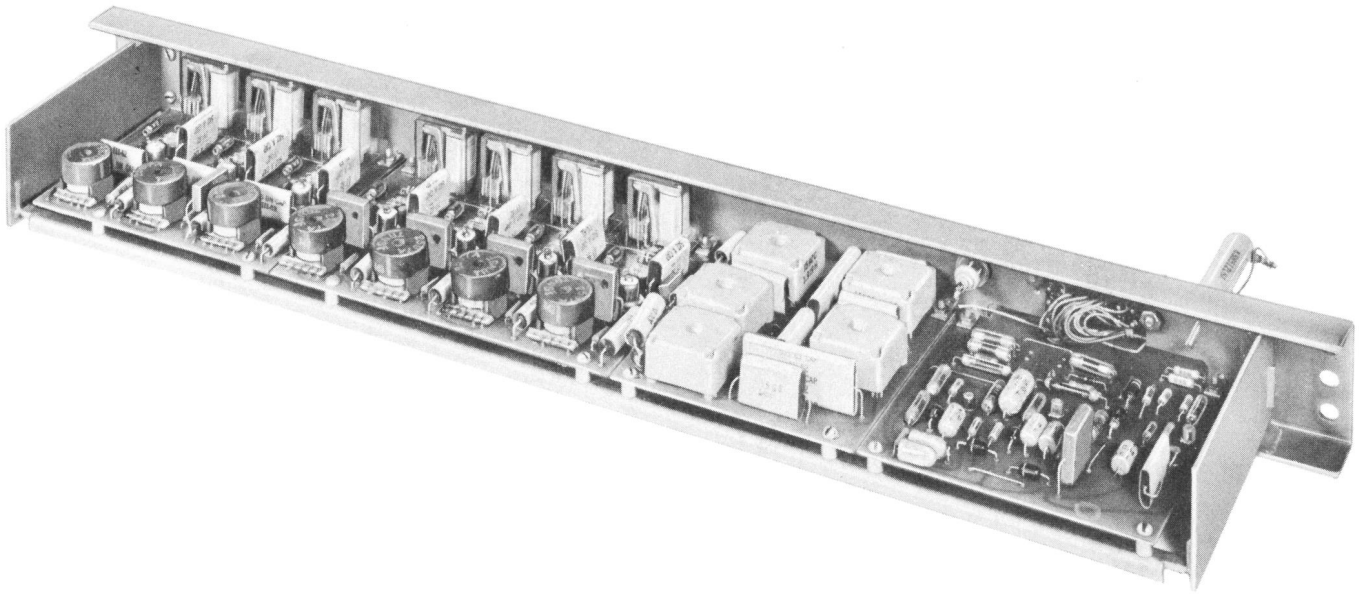


Fig. 15—Type C TOUCH-TONE Receiver

ELECTRONIC DIAL EQUIPMENT UNIT

3.09 The electronic dial equipment unit (Fig. 18) requires 24 inches of space on a 23-inch frame and consists of two complete electronic dial units. Each electronic dial unit consists of the following:

(1) Interface circuit

(2) TOUCH-TONE solid state converter circuit

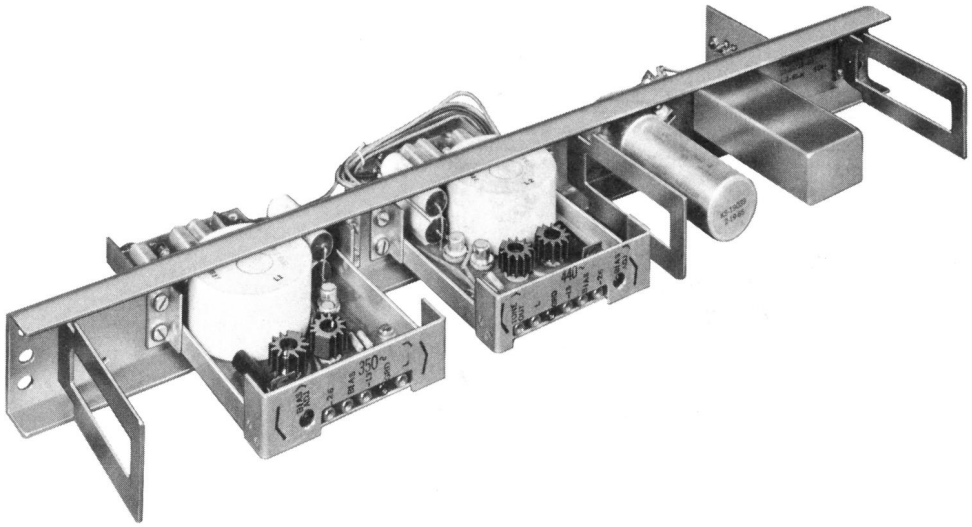


Fig. 16—404C Tone Generator—Precise Dial-Tone Supply for Crossbar-type PBX—Front View With Cover Removed

Fig. 17—405B Tone Generator—Precise Dial-Tone Supply for Step-by-Step PBX—Front View

(3) Receiver circuit (type A or type C)

(4) TOUCH-TONE receiver applique circuit (for type A receiver)

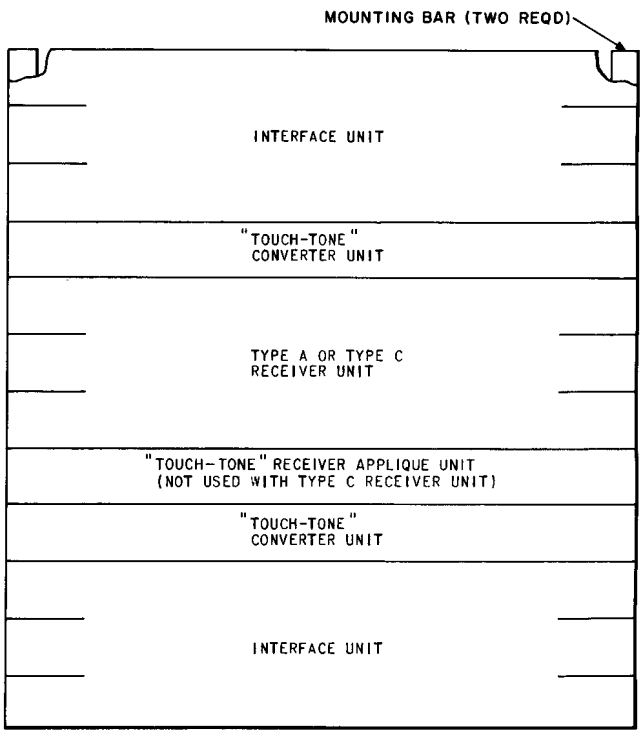


Fig. 18—Electronic Dial Unit—Equipment Arrangement—Step-by-Step PBX

"TOUCH-TONE" CALLING EQUIPMENT ARRANGEMENTS FOR STEP-BY-STEP PBXs

A. General

3.10 The common group TOUCH-TONE calling equipment is used to arrange step-by-step PBXs for TOUCH-TONE calling. In order to reduce engineering and installation effort, the common group TOUCH-TONE calling equipment is available on factory-wired and -equipped frames (Figures 19 and 20). The frames may be equipped with either station access or converter trunk access circuits SD-66885-01 or converter trunk circuit SD-65853-01 on a plug-in basis, as required. Line and trunk access circuits per SD-1E045-01, SD-1E052-01, and SD-1E053-01 may be arranged locally to mount on the frames by equipping the equipment units with a plug-ended cable and require only 2 inches vertically of standard 23-inch wide mounting space per unit.

3.11 The common group TOUCH-TONE calling equipment may be obtained without the relay racks and locally arranged in a manner to suit job requirements; however, the relay rack on which the equipment is mounted should be equipped with a fuse panel to supply the necessary power. The TOUCH-TONE receiver units and the solid state converter units are connected by means of a plug and jack arrangement to facilitate maintenance. The TOUCH-TONE receiver because of operating requirements should be mounted either directly above or below its associated solid state converter unit.

B. Common Group TOUCH-TONE Calling Equipment

Trunk Finder Access Arrangement (MD)

Equipment Elements

3.12 The equipment required to provide common group TOUCH-TONE calling with trunk finder access is installed on two standard 23-inch frames designated basic and supplementary (Fig. 19). The frames are equipped with the following equipment elements:

(1) 100-Point 6-wire trunk finder switches

(2) Common group and subgroup unit

(3) Electronic dial equipment units

The basic frame provides capacity for a maximum of eight station access or converter trunk units. The supplementary frame provides capacity for an additional 23 access units. Each of the access units provides two access circuits.

Capacity

3.13 The trunk finder access arrangement of the common group TOUCH-TONE calling equipment provides capacity for up to 99 access circuits and one test circuit. These figures are based on the total number of terminals available on the trunk finder banks used in conjunction with the common group and subgroup circuit. When required, the access circuit capacity may be increased by providing two or more common group and subgroup circuits with associated trunk finders and electronic dial

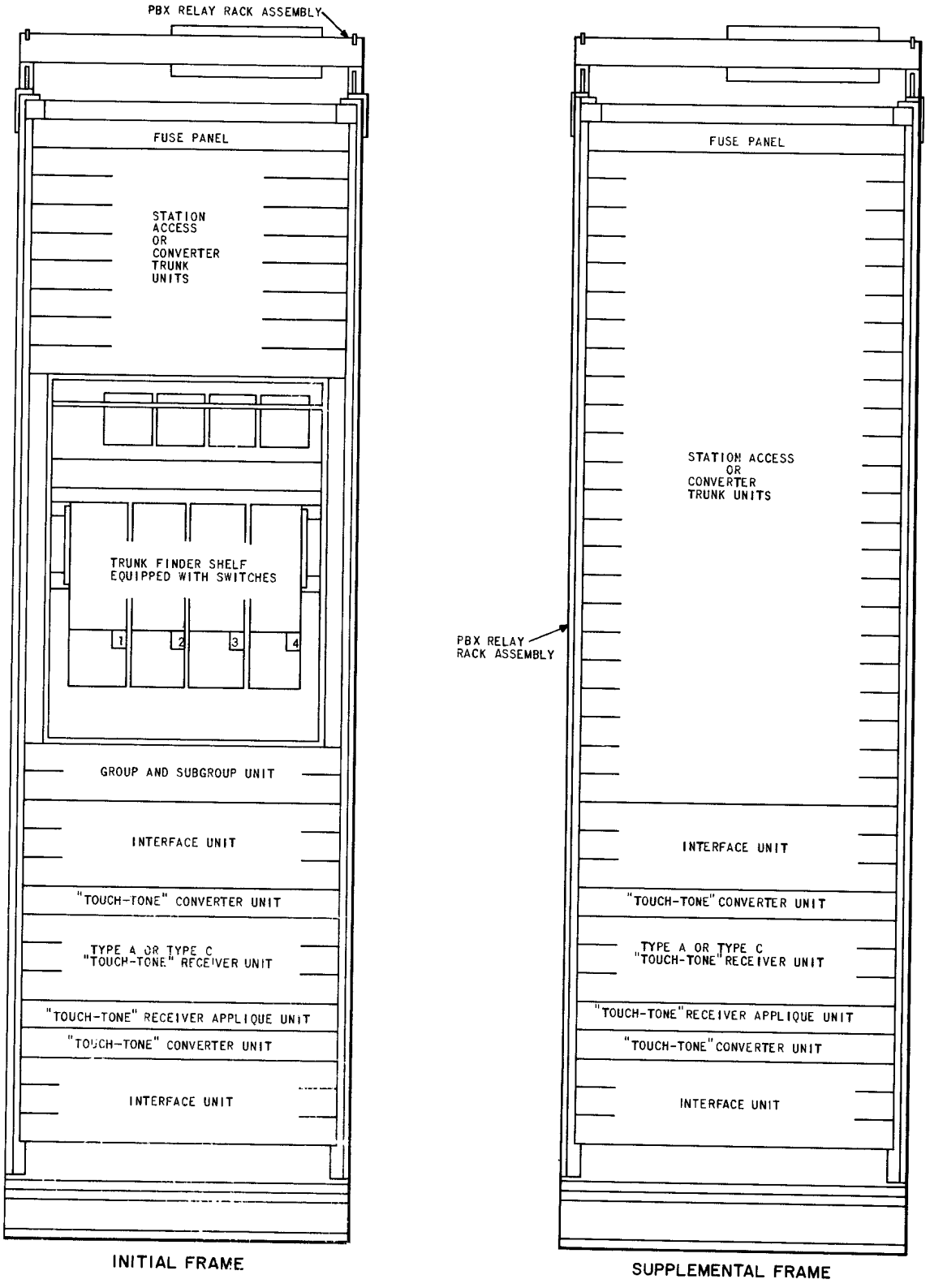


Fig. 19—Common Group TOUCH-TONE Calling—Trunk Finder Access—Equipment Arrangement

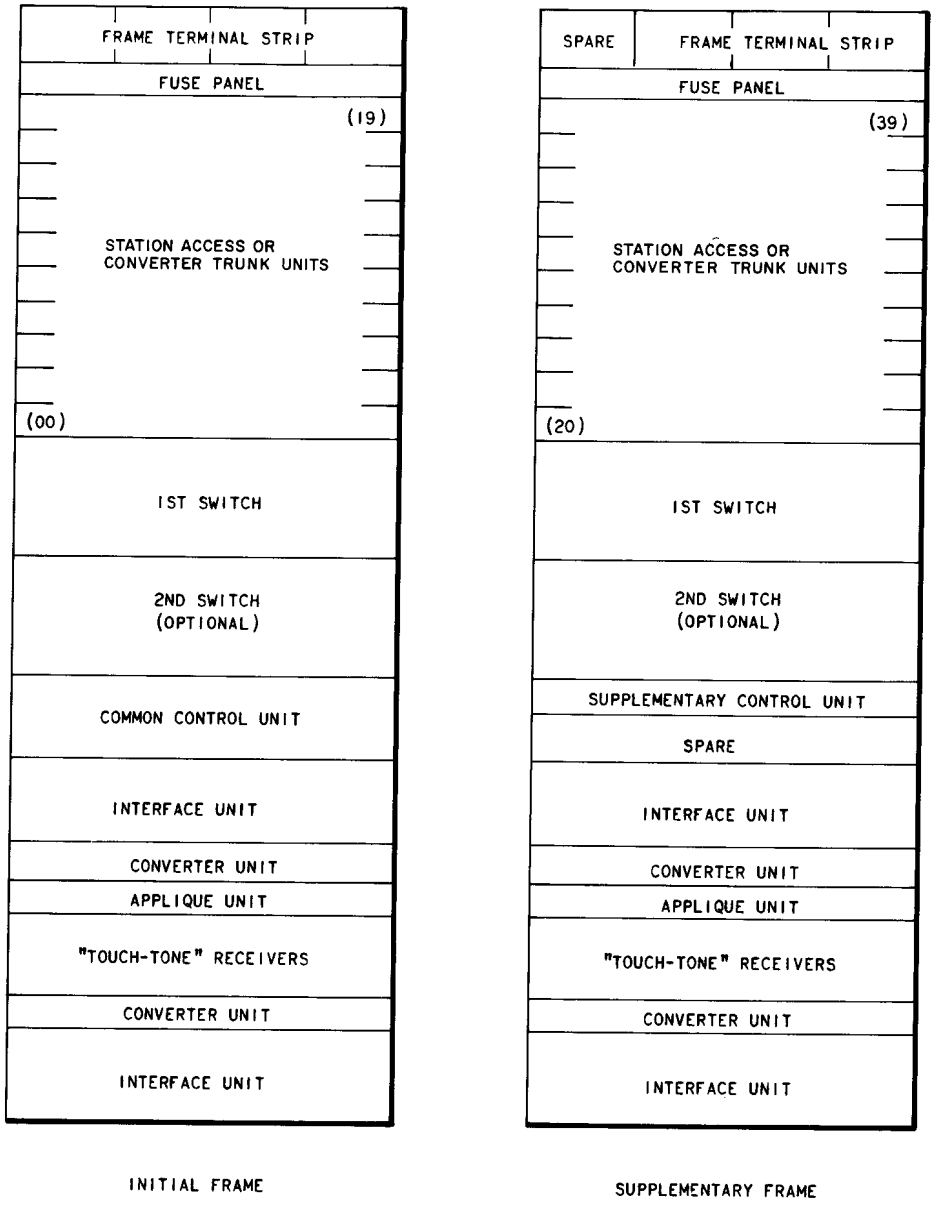


Fig. 20—Common Group TOUCH-TONE Calling—Crossbar-Link Access—Equipment Arrangement

units. The number of calls that may be dialed simultaneously depends upon the number of trunk finders and associated electronic dial units provided. A minimum of two trunk finders and two electronic dial units is provided at any common group TOUCH-TONE calling installation. Additional units may be provided depending upon the total number of circuits equipped and the calling rate of the associated PBX.

Crossbar-Link Access Arrangement

Equipment Elements

3.14 The equipment required to provide common group TOUCH-TONE calling with crossbar-link access is installed on standard 23-inch frames designated initial and supplementary (Fig. 20). The

frames are equipped with the following equipment elements:

(1) 100-Point crossbar switches

(2) Common control units

(3) Electronic dial equipment units.

The initial frame provides capacity for a maximum of ten station access or converter trunk units. Each supplementary frame provides capacity for an additional ten access units. Each of the access units provides two access circuits. An installation will consist of the initial frame and up to five supplementary frames.

Capacity

3.15 The crossbar-link access arrangement of the common group TOUCH-TONE calling equipment provides capacity for up to 120 access circuits and 20 electronic dial units. Each supplementary frame may be equipped with one to 20 access circuits and, with the exception of the fifth supplementary frame, two electronic dial units. The supplementary frames may be equipped with access circuits without electronic dial units or electronic dial units without access circuits. If five or less electronic dial units are required, only one crossbar switch per 20 access circuits is provided. If six or more electronic dial units are required, two switches per 20 access circuits are provided.

"TOUCH-TONE" CALLING EQUIPMENT FOR TIE TRUNKS, FOREIGN EXCHANGE (FX) LINES, AND FOREIGN EXCHANGE (FX) TRUNKS

A. General

3.16 When a manual, crossbar, or electronic PBX (other than 101 EPBX) is equipped for foreign exchange line, foreign exchange trunk, or tie trunk service and TOUCH-TONE to dial pulse conversion is required, either the local trunk TOUCH-TONE calling equipment (Fig. 21) or the centralized TOUCH-TONE calling equipment (Fig. 22) may be provided. The local trunk TOUCH-TONE calling equipment is also used to provide TOUCH-TONE to dial pulse conversion on calls originated from manual attendant switchboards. The local trunk TOUCH-TONE calling equipment is provided on a factory-wired and -equipped frame. The centralized TOUCH-TONE calling equipment is provided by locally mounting the TOUCH-TONE calling equipment elements on standard 23-inch frames. The arrangement shown in Fig. 22 is a typical arrangement of the equipment required to provide the centralized TOUCH-TONE calling arrangement.

B. Local Trunk TOUCH-TONE Calling Equipment

Equipment Elements

3.17 The equipment required to provide local trunk TOUCH-TONE calling is installed on one standard 7-foot relay rack (Fig. 21) and includes the following equipment elements:

(1) 22-Point rotary selector switches used as trunk finders

(2) Electronic dial equipment units.

Capacity

3.18 The equipment arrangement of the local trunk TOUCH-TONE calling equipment provides capacity for up to 21 access circuits and one test circuit. These figures are based on the total number of terminals available on the rotary selector switch used as a trunk finder in this arrangement. A minimum of two trunk finders and associated electronic dial units is always provided. Up to four trunk finders with associated electronic dial units may be provided. The local trunk TOUCH-TONE calling equipment arrangement always includes the electronic dial unit equipped with the type A TOUCH-TONE receiver and the receiver applique unit.

C. Centralized TOUCH-TONE Calling Equipment

Equipment Elements

3.19 The equipment elements required to provide the centralized TOUCH-TONE calling arrangement is intended to be mounted on relay racks in the central office or some other centralized location. The equipment elements are ordered separately and must be installed and wired locally. Fuse panels as required may be installed on the relay rack with the conversion equipment as shown in Fig. 22 or any other convenient location. Cross-connecting terminal strips are provided on the trunk finder units for the option of either coupling precise dial tone from the distant end or furnishing precise dial tone from the local conversion

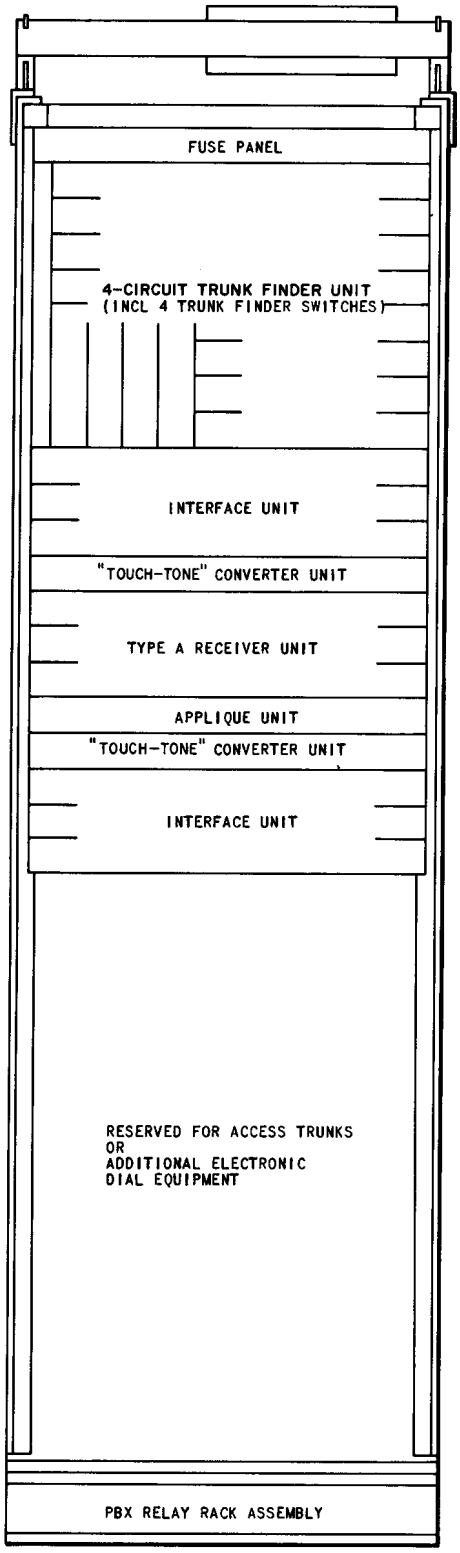


Fig. 21—Local Trunk TOUCH-TONE Calling—Equipment Arrangement

equipment. The same terminal strips on the trunk finder plus additional terminal strips on the digit class control netork unit provide for cross-connecting a maximum of 50 classes of service. For either or both options, cross-connections on a per access circuit basis must be provided for each trunk finder switch that is furnished. The following equipment elements are required to provide the centralized TOUCH-TONE calling arrangement:

(1) 100-Point, 8-wire trunk finder switches

(2) Common group and subgroup unit

(3) Digit class control unit

(4) Electronic dial unit

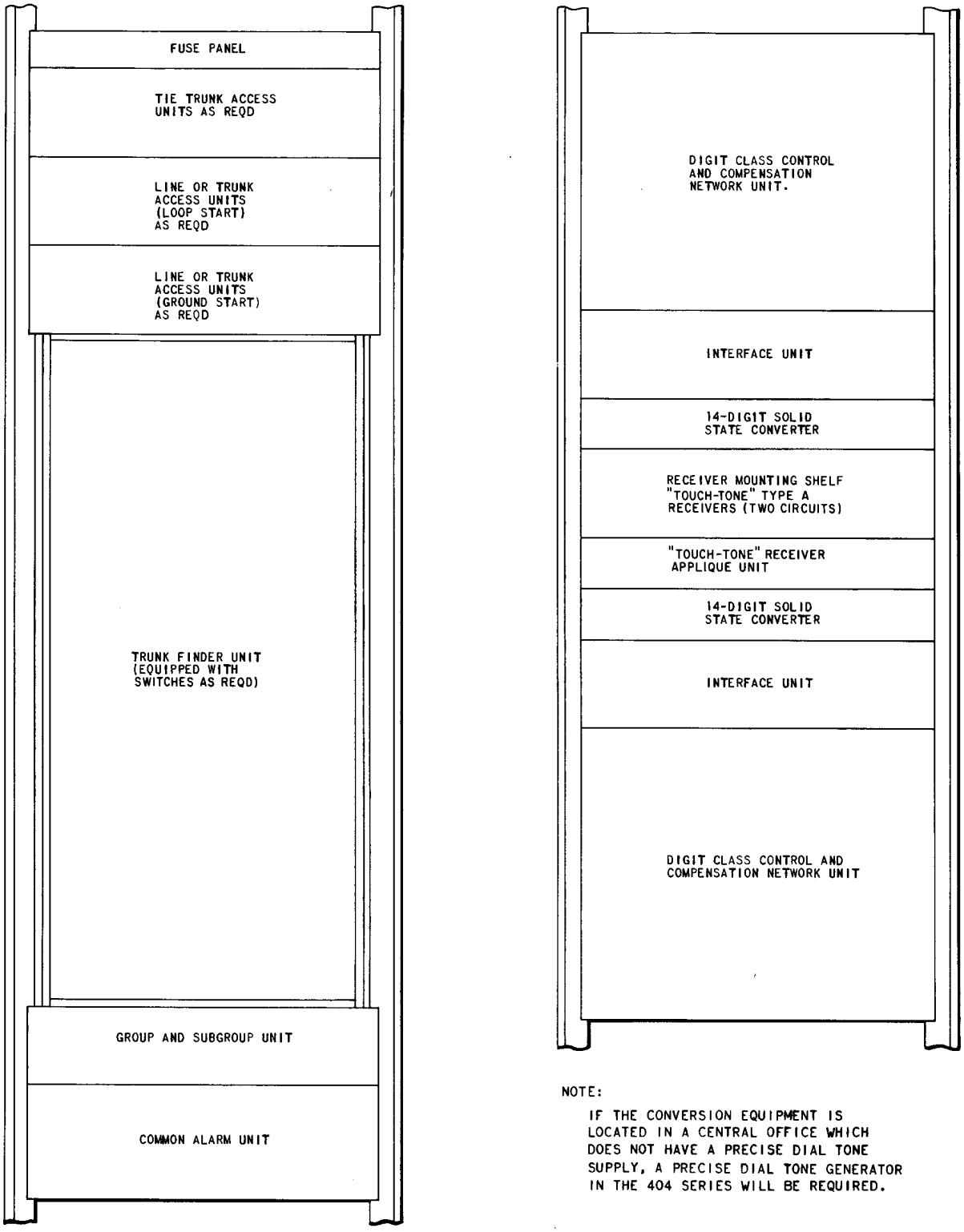
(5) Common alarm unit.

Capacity

3.20 The maximum capacity of the centralized TOUCH-TONE calling equipment is 99 line or trunk access circuits in any combination as indicated by PBX service plus one test line. These figures are based on the total number of terminals available on the trunk finder banks used in conjunction with the group and subgroup circuit. When required, the access circuit capacity may be increased by providing two or more common group and subgroup circuits with associated trunk finders and electronic dial units. The number of calls that may be handled simultaneously depends upon the number of trunk finders and associated electronic dial units provided. A minimum of two trunk finders and two electronic units is provided on any centralized TOUCH-TONE calling installation. Additional units may be provided depending upon the total number of circuits equipped and the calling rate of the associate PBXs.

"TOUCH-TONE" CALLING EQUIPMENT FOR MANUAL PBXs AND ATTENDANT POSITIONS

3.21 TOUCH-TONE calling may be provided for manual PBXs and dial auxiliary attendant switchboard by replacing the rotary dial units with TOUCH-TONE dial units and associated dial auxiliary units. The TOUCH-TONE dial unit consists of a 12- or 16-button TOUCH-TONE dial and associated dial mounting and is installed on the surface of the switchboard keyshelf in the space normally occupied by the rotary dial and dial mounting. The dial auxiliary unit consists of several capacitors,



NOTE:

IF THE CONVERSION EQUIPMENT IS LOCATED IN A CENTRAL OFFICE WHICH DOES NOT HAVE A PRECISE DIAL TONE SUPPLY, A PRECISE DIAL TONE GENERATOR IN THE 404 SERIES WILL BE REQUIRED.

Fig. 22—Centralized TOUCH-TONE Calling—Typical Arrangement

coils, resistors, and a transformer and is either mounted on the underside of the keyshelf or directly on the switchboard telephone unit. The dial auxiliary unit is required to provide the 7 to 9 volts required by the TOUCH-TONE dial. The following switchboards can be arranged for TOUCH-TONE calling: 550A, B; 551A, B, D; 552A, B, D, E; 554B, C; 555; 556A; 557A, B; 605A; 606A, B; 607A, B; 608A, D. Only the 608A and 608D are available from the factory equipped for TOUCH-TONE calling. All other switchboards must be converted for TOUCH-TONE calling in the field.

3.22 To arrange consoles for TOUCH-TONE calling requires replacing the rotary dial with a TOUCH-TONE dial. The following consoles are available equipped with a TOUCH-TONE dial: 1-, 2-, 3-, 4-, 5-, 6-, 14-, and 15-type. In addition, the consoles used with the 761B PBX and the 2A and 3A automatic call distributing systems are available equipped with a TOUCH-TONE dial.

3.23 At locations equipped with the 507-type (cordless) switchboard, a telephone set coded 1500M is required to provide attendant TOUCH-TONE calling.

4. "TOUCH-TONE" CALLING TRAFFIC OPERATION

STEP-BY-STEP PBXs

A. Station Access TOUCH-TONE Calling

4.01 With station access TOUCH-TONE calling when a station party goes off-hook, the station access circuit associated with the calling station signals for the TOUCH-TONE calling equipment and a line finder. (See Fig. 2.) After the line finder locates the calling station and connects to the first selector, the crossbar-link or trunk finder equipment connects the station access circuit to an electronic dial unit; and precise dial tone from the TOUCH-TONE calling equipment is returned to the calling station. Upon receiving dial tone, the calling station party, using a TOUCH-TONE dial, dials the desired number. The TOUCH-TONE calling equipment receives the TOUCH-TONE signals, converts them to dial pulses, and sends the dial pulses to the first selector. The call is completed in the same manner as a regular rotary dial call.

B. Converter Trunk Access TOUCH-TONE Calling

4.02 A block diagram of the converter trunk access TOUCH-TONE calling arrangement is shown in Fig. 3. The basic TOUCH-TONE to dial pulse conversion functions are the same as described in 4.01. The difference in the traffic pattern in the two arrangements is in the location of the access circuit for the conversion equipment. The converter trunk circuit is located between the line finder and the first selector. This allows the converter trunk circuit to be common to all the station lines served by the associated line finder.

C. Call Transfer—Individual

4.03 The TOUCH-TONE call transfer—individual arrangement for the 701B PBX is shown in Fig. 23. When a PBX is equipped with the call transfer—individual feature, an incoming call from a central office trunk party station A completed to station B in the PBX may be dial-transferred to station C within the PBX. To initiate dial transfer, station B flashes the switchhook of the station set. Flashing the station set switchhook places station A on hold and sets up a secondary connection between station B, the dial transfer circuit, and the TOUCH-TONE calling equipment. When the connection is completed, the TOUCH-TONE calling equipment transmits precise dial tone through the TOUCH-TONE transfer circuit to station B. Using the station set TOUCH-TONE dial, station B dials the code for station C. The TOUCH-TONE signals from station B are transmitted through either the dial transfer circuit associated with a DID trunk or the non-DID incoming trunk arranged for dial transfer to the TOUCH-TONE transfer circuit. From this circuit the TOUCH-TONE signals are applied to the TOUCH-TONE conversion equipment where they are converted to dial pulses. The dial pulses are outpulsed to the dial transfer circuit associated with a DID trunk or non-DID incoming trunk arranged for dial transfer and then used to complete the connection to station C. When station C answers, stations B and C may converse privately as in a rotary dial call.

D. Conference Calling—701B PBX

4.04 The TOUCH-TONE conference calling arrangement for the 701B PBX is shown in Fig. 24. The conference circuit is seized from the originating station by going off-hook and then dialing the conference calling code. The conference call

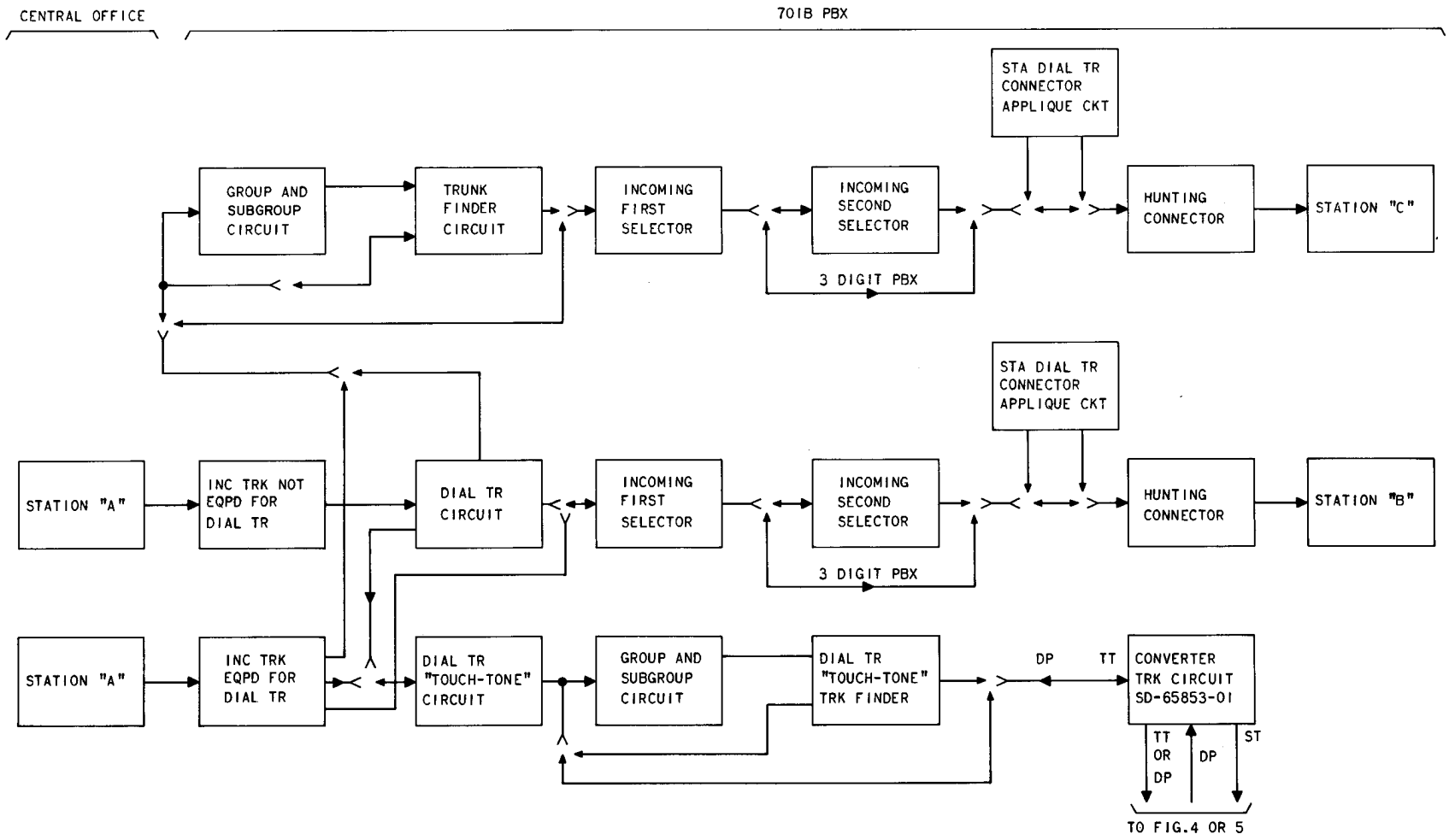


Fig. 23—Call Transfer—Individual TOUCH-TONE Calling Arrangement—Step-by-Step PBX—Block Diagram

is completed to the first selector as described in 4.01 and 4.02. From the conference access level of the first selector, the conference call is directed to the conference circuit which in turn seizes the converter trunk. The conference originator then receives a second precise dial tone from the TOUCH-TONE calling equipment associated with the converter trunk connected to the conference circuit. Upon receiving second dial tone, the conference originator dials the number of the first conferee. The TOUCH-TONE calling equipment translates the TOUCH-TONE signals to dial pulses and outpulses them to the conference selector associated with port 1 of the conference circuit. From here the call is directed through the required circuits to the first conferee. The converter trunk associated with the conference circuit then releases, and the originator and conferee can converse. To connect the conferee to the conference buss, the originator flashes the switchhook. This also advances the originator to the next conference port and again seizes the TOUCH-TONE calling equipment via the converter trunk associated with the conference circuit. After receiving dial tone, the originator may dial the number of the second conferee and connect the conferee to the conference buss in the same manner as the first conferee. However, when the second conferee is connected to the conference buss, the originator is also connected. To add additional conferees to the conference buss, the originator flashes the switchhook a second time, receives dial tone from the TOUCH-TONE calling equipment, and repeats the operations described for adding the second conferee.

CROSSBAR AND ELECTRONIC PBXs

A. TOUCH-TONE Station Call—756A, 757A, 800A PBX Systems and 400 Switching System

4.05 The traffic operation of these systems is basically the same with or without TOUCH-TONE calling. Block diagrams of the 756A, 757A, and 800A PBX TOUCH-TONE calling arrangements are shown in Figures 8, 9, and 10, respectively. Figure 8 also applies to the 400 switching system. After a TOUCH-TONE station is connected to the register and digits are dialed, the TOUCH-TONE signals from the station are applied to the input of the register. The register, however, does not respond to these signals. The TOUCH-TONE receiver bridged across the input of the register receives the TOUCH-TONE signals, converts them into dc signals, and transmits them, as required, either directly or through an applique circuit to the register. The dc signals are used to complete the call the same as a rotary dial call. The call will not be completed to the station or trunk until TOUCH-TONE signals are no longer present at the input to the register.

B. TOUCH-TONE Station Call—761B PBX System

4.06 A block diagram of a 761B PBX system arranged for TOUCH-TONE calling is shown in Fig. 11. A call may be originated from a TOUCH-TONE station by going off-hook, receiving dial tone, and dialing the code of the desired destination. The TOUCH-TONE signals from the station are transmitted through the line relay, switch circuit, and the TOUCH-TONE access circuit to the TOUCH-TONE receiver. In the receiver, the TOUCH-TONE signals are converted to a dc-coded output which is sent to the TOUCH-TONE access circuit. Here the dc code is used to direct the connection of the station through the line relay and switch circuit to the proper destination.

4.07 When a call is made to the central office and the PBX is arranged for call controller operations (code restriction), the digits dialed to the central office are also monitored by the TOUCH-TONE call controller equipment. The TOUCH-TONE signals, when received by the TOUCH-TONE call controller circuit, are transmitted to the central office and also to the TOUCH-TONE receiver. The TOUCH-TONE receiver converts the TOUCH-TONE signals to dc signals, and the call controller monitors the required number of dialed digits and determnes that the central office call either be allowed or diverted to busy tone.

MISCELLANEOUS SERVICES FOR PBXs

A. Code Call

4.08 Code call provides a way for any station or attendant to actuate an audible signal in specificly coded signal patterns. Code call also provides a means for a call to be made from any station associated with the PBX to the code calling equipment to obtain a talking connection to the calling party. A block diagram of the code call TOUCH-TONE calling arrangement is shown in Fig. 25. Any PBX station or attendant may obtain access to this equipment by dialing the proper code. After the connection is completed, the special code corresponding to the called party may be dialed.

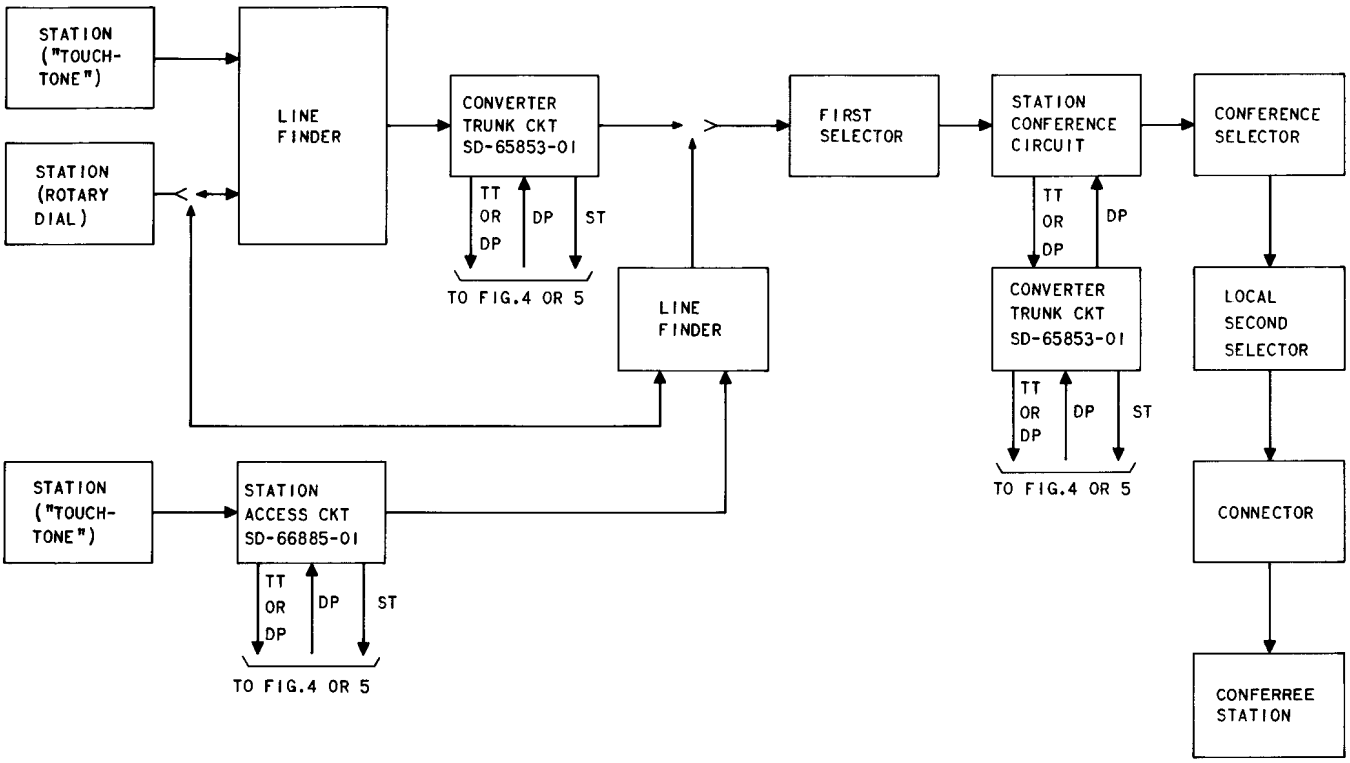


Fig. 24—Conference Calling TOUCH-TONE Calling Arrangement—Step-by-Step PBX—Block Diagram

If the call is from a TOUCH-TONE station, the TOUCH-TONE signals are received by the code calling unit and are applied through the terminal circuit to the TOUCH-TONE receiver where the TOUCH-TONE signals are converted to dc signals. When the TOUCH-TONE receiver is type A, a TOUCH-TONE translator circuit is required to adapt the dc signals to the TOUCH-TONE relay circuit. The TOUCH-TONE relay circuit receives the dc signals from either the type C receiver or translator circuit, as required, and converts the dc signals to dial pulses for application to the code sending circuit. The call is then completed the same as a rotary dial call.

B. Interface Trunk Call

4.09 A block diagram of the interface trunk TOUCH-TONE calling arrangement is shown in Fig. 26. The interface trunk provides the means for connecting Bell System equipment to customer-owned and -maintained (COAM) radio code sending or paging equipment.

4.10 By dialing an assigned code from a calling station, the caller will be connected to the interface trunk. Second dial tone is then returned to the caller. After receiving the second dial tone, the caller dials the appropriate code to the interface trunk. If the call is from a TOUCH-TONE station, the TOUCH-TONE signals are converted to either dial pulses or 2-out-of-7 dc signals (depending upon the option provided) and transmitted to the COAM equipment. In step-by-step PBXs, second dial tone may be eliminated, and the initial connection to the TOUCH-TONE calling equipment can be used to provide TOUCH-TONE to dial pulse conversion on a time-out basis if warm-up time is not required by the COAM equipment. If warm-up time is required, then the TOUCH-TONE to dial pulse option must be provided in the interface circuit and connected as an access circuit to the TOUCH-TONE calling equipment. The initial connection to the TOUCH-TONE calling equipment must be released by pretranslation on a single access code basis with second dial tone by the second TOUCH-TONE calling equipment connection. In common control PBXs, the local trunk TOUCH-TONE calling equipment arrangement must be used to provide dial pulses

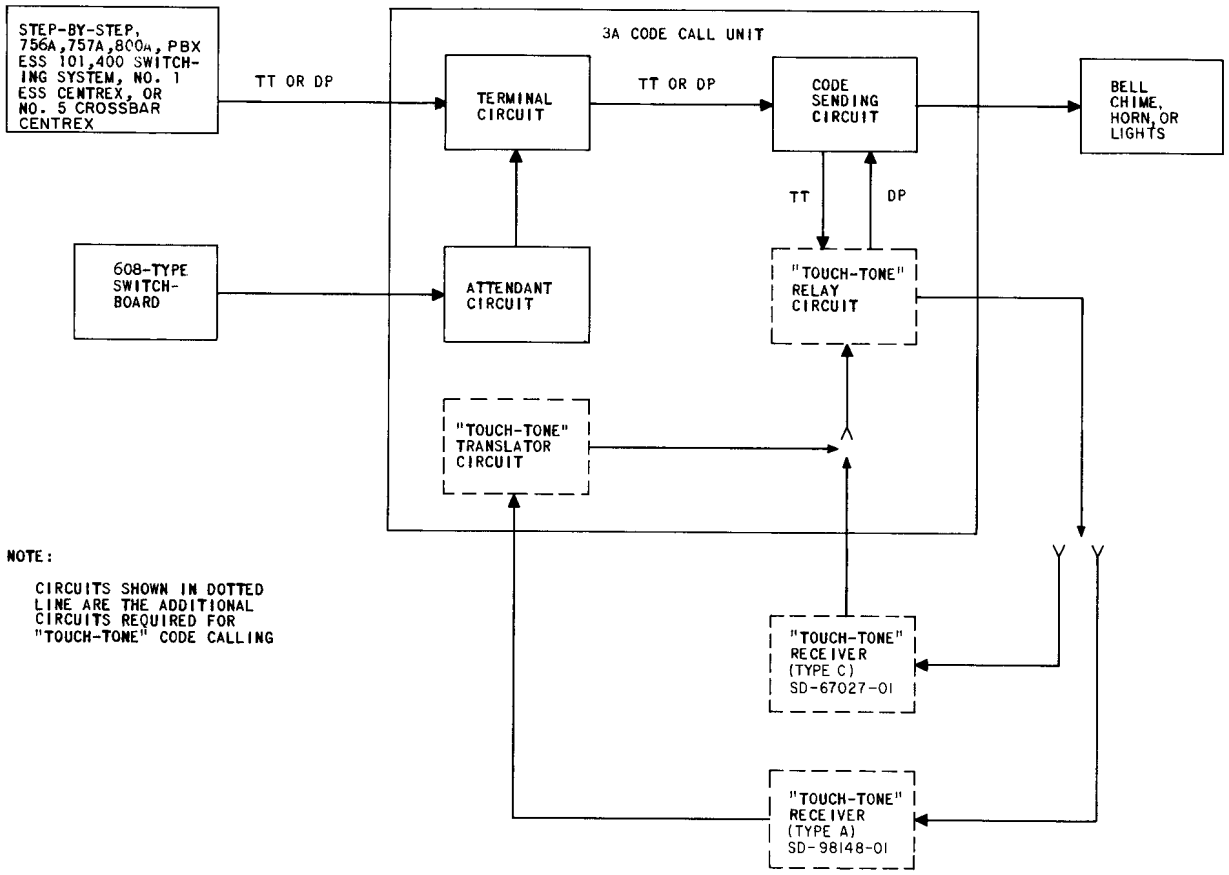


Fig. 25—Code Call TOUCH-TONE Calling Arrangement—Block Diagram

to the COAM equipment. The COAM equipment, after receiving the required digits from the interface trunk, causes ringing tone to be returned to the calling party. Ringing tone ceases when the COAM equipment signals that it is ready to receive.

C. Recorded Telephone Dictation Trunk Call

4.11 The recorded telephone dictation trunk provides a means of connecting a rotary dial PBX station, a centrex station, or a TOUCH-TONE PBX station to customer-recorded dictation facilities. The trunk may be seized from any PBX station by dialing the dictation trunk access code. To indicate that the dictation machine has been seized, a continuous audible ringing tone or steady dial tone is returned if the dictation machine is dial-controlled; or a spurt of tone is returned if the dictation machine is voice-controlled. The start function of the dictation machine is either dial-controlled or voice-controlled depending upon the type dictation machine provided. All other functions for either machine are dial-controlled.

4.12 A block diagram of the recorded telephone dictation trunk arranged for TOUCH-TONE calling is shown in Fig. 27. The 1-digit dictation function codes, when dialed from a TOUCH-TONE station, must be converted to dc signals in the telephone dictation trunk. The TOUCH-TONE signals, when received by the trunk, are applied through the TOUCH-TONE control circuit to the dedicated type A TOUCH-TONE receiver. Here the TOUCH-TONE signals are converted to dc signals (2-out-of-7 code) which are transmitted to the TOUCH-TONE control circuit. This circuit then converts the dc signals from a 2-out-of-7 code to a 1-out-of-10-code for application to the dictation machine.

AUXILIARY SERVICES—TIE TRUNKS, FOREIGN EXCHANGE (FX) LINES, AND FOREIGN EXCHANGE (FX) TRUNKS

A. Tie Trunks

4.13 The tie trunk is used to connect the local PBX to a distant PBX. When the local

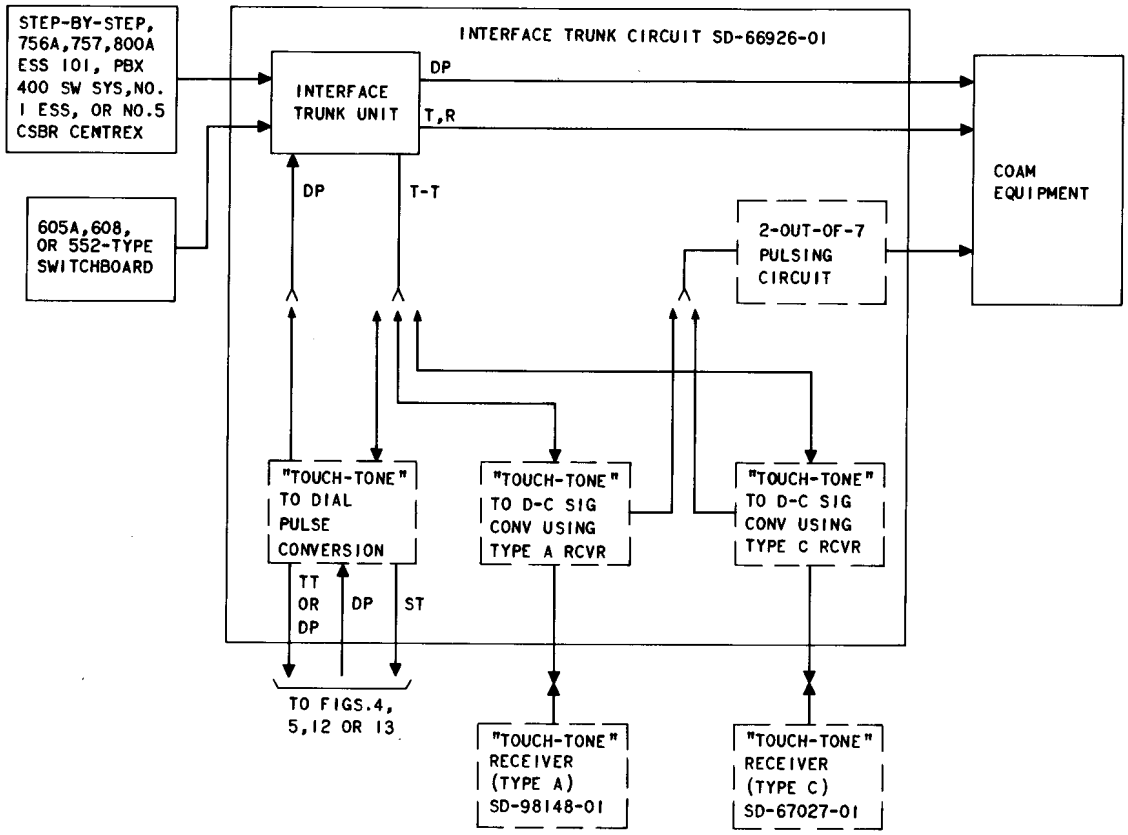


Fig. 26—Interface Trunk TOUCH-TONE Calling Arrangement—Block Diagram

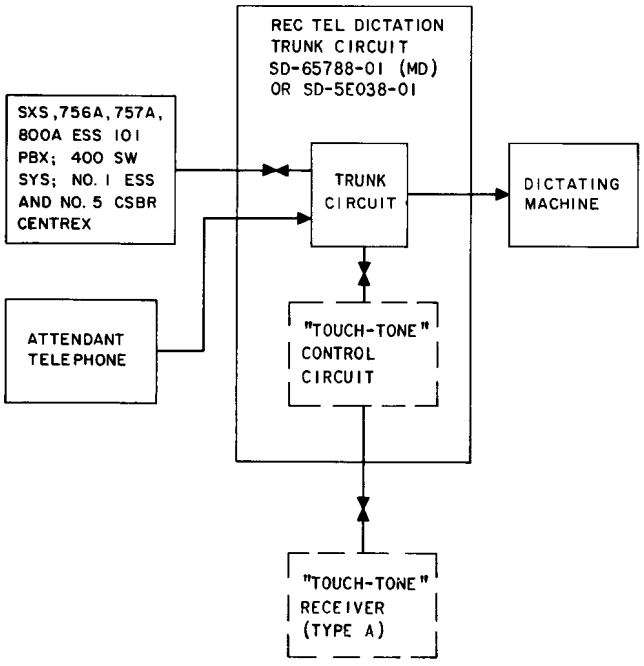


Fig. 27—Recorded Telephone Dictation With TOUCH-TONE Calling Arrangement—Block Diagram

PBX is arranged for TOUCH-TONE calling, the TOUCH-TONE signals must be converted to dial pulses on tie trunk calls, if the call is to a SXS system or a system without TOUCH-TONE calling. Block diagrams of the tie trunk traffic arrangements for the SXS, crossbar, and 800A PBX systems are shown in Figures 2, 3, 6, 7, and 28 through 32.

4.14 The step-by-step traffic arrangements (Figures 2, 3, 6, and 7) allow a call to be made from either a console, switchboard, or station to the distant PBX. When a call is originated from a TOUCH-TONE switchboard, the TOUCH-TONE signals are applied through the tie trunk access circuit SD-1E052-01 (for double jack switchboards) or SD-1E053-01 (for single jack switchboards) to the TOUCH-TONE calling equipment where they are converted to dial pulses. The dial pulses are outpulsed through the tie trunk access circuit and tie trunk to the distant PBX. The talking connection between the switchboard and the distant PBX is through the tie trunk access circuit and tie trunk. When a call is originated from a TOUCH-TONE station to the distant PBX, a tie trunk access circuit is not required. The TOUCH-TONE signals are

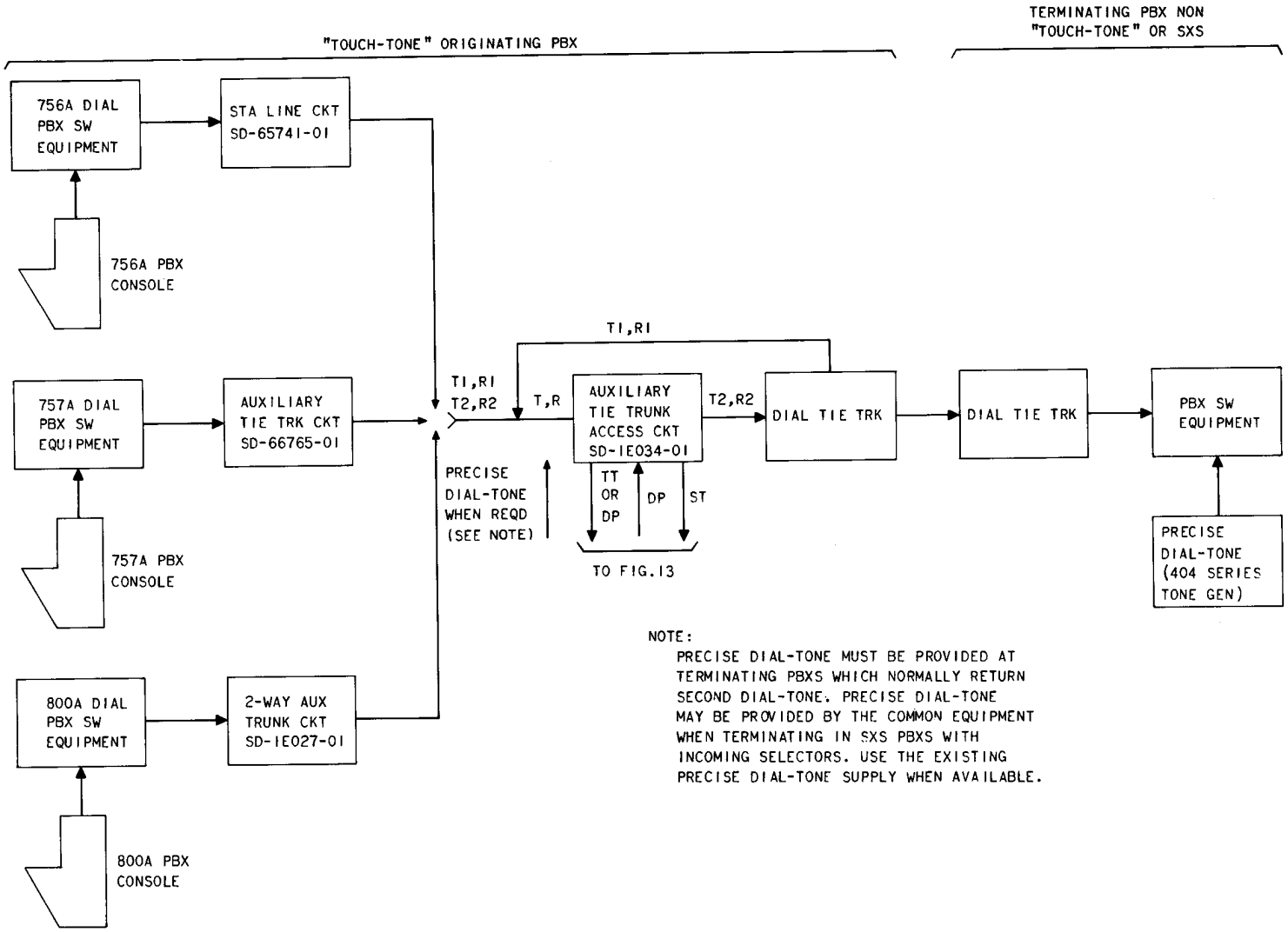


Fig. 28—756A, 757A, and 800A PBX Tie Trunk TOUCH-TONE Calling Arrangement Using Local Trunk TOUCH-TONE Calling With Console Attendant Position Equipment—Block Diagram

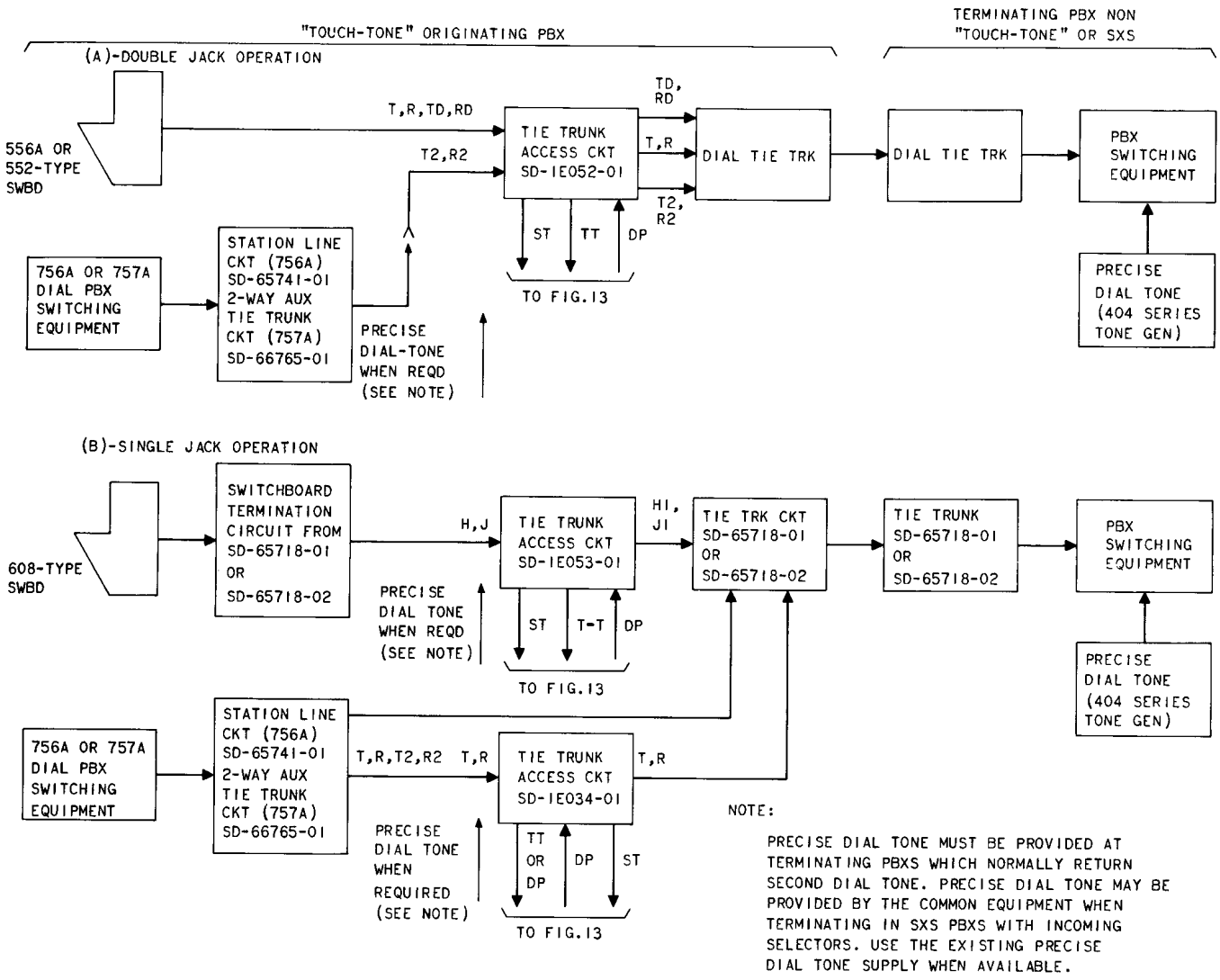


Fig. 29—756A, 757A PBX Tie Trunk TOUCH-TONE Calling Arrangement Using Local Trunk TOUCH-TONE Calling With Switchboard Attendant Position Equipment—Block Diagram

converted to dial pulses by the TOUCH-TONE calling equipment which is located between the line finder and first selector or between the station and the line finder. The talking connection between the TOUCH-TONE station and distant PBX is through the line finder, converter trunk (or station access circuit), and the tie trunk. When a call is made from a console arranged for TOUCH-TONE calling, the attendant outdial circuits terminate on a line finder, and converter trunk access to the TOUCH-TONE calling equipment is used.

4.15 The traffic arrangement shown in Fig. 28 is a tie trunk arrangement (the local trunk TOUCH-TONE calling equipment for the 756A, 757A, and 800A PBXs with associated consoles). A call from either a PBX station or the console to the distant PBX is routed through tie trunk access circuit SD-1E034-01 to the TOUCH-TONE calling equipment. From the TOUCH-TONE calling equipment, the call is connected through the access circuit and tie trunk to the distant PBX. Precise dial tone is then returned to the calling party either from the distant PBX locally or via the TOUCH-TONE calling equipment. When the call is a TOUCH-TONE call, the TOUCH-TONE signals are converted to dial pulses by the TOUCH-TONE calling equipment; then outpulsed to the distant PBX. After outpulsing,

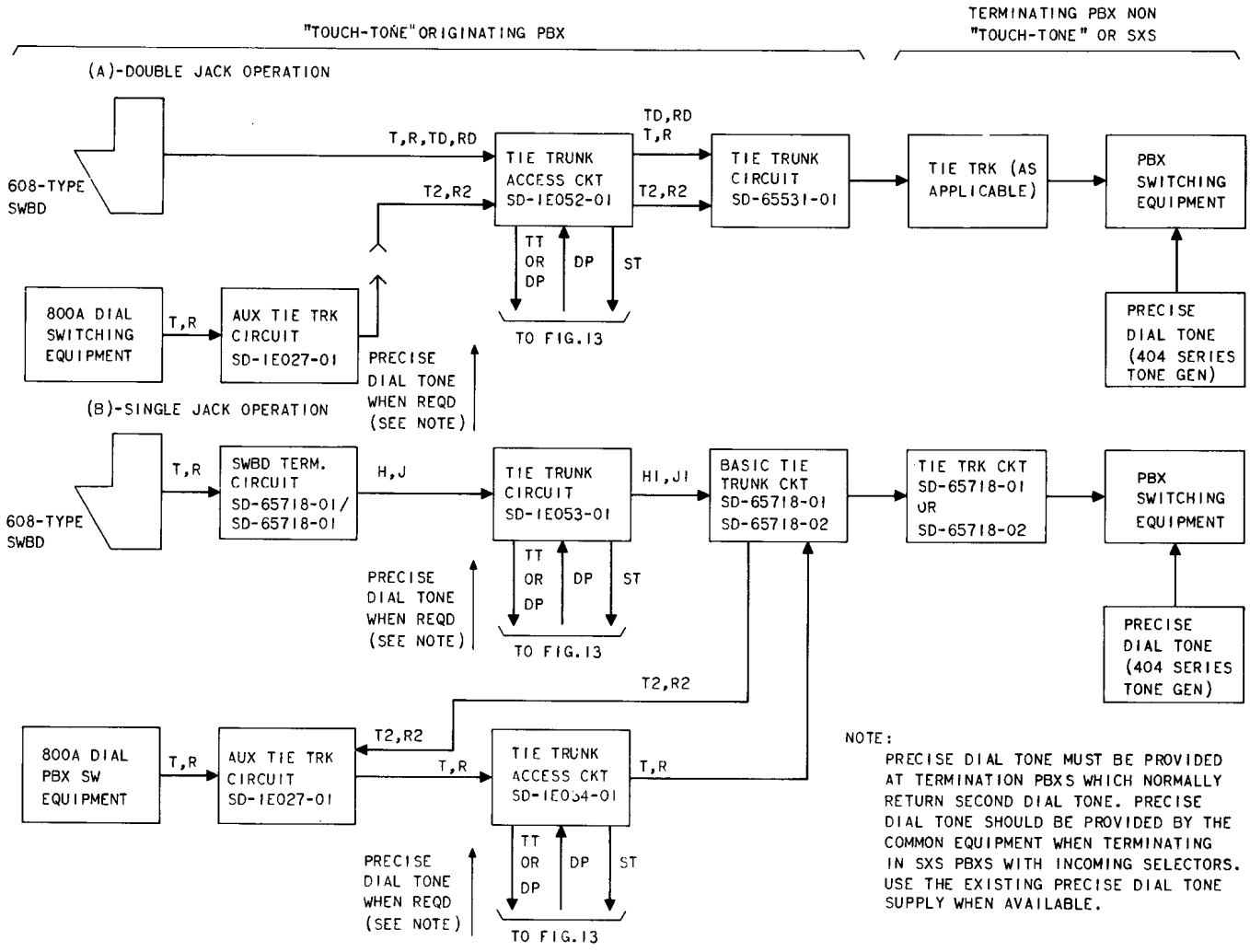
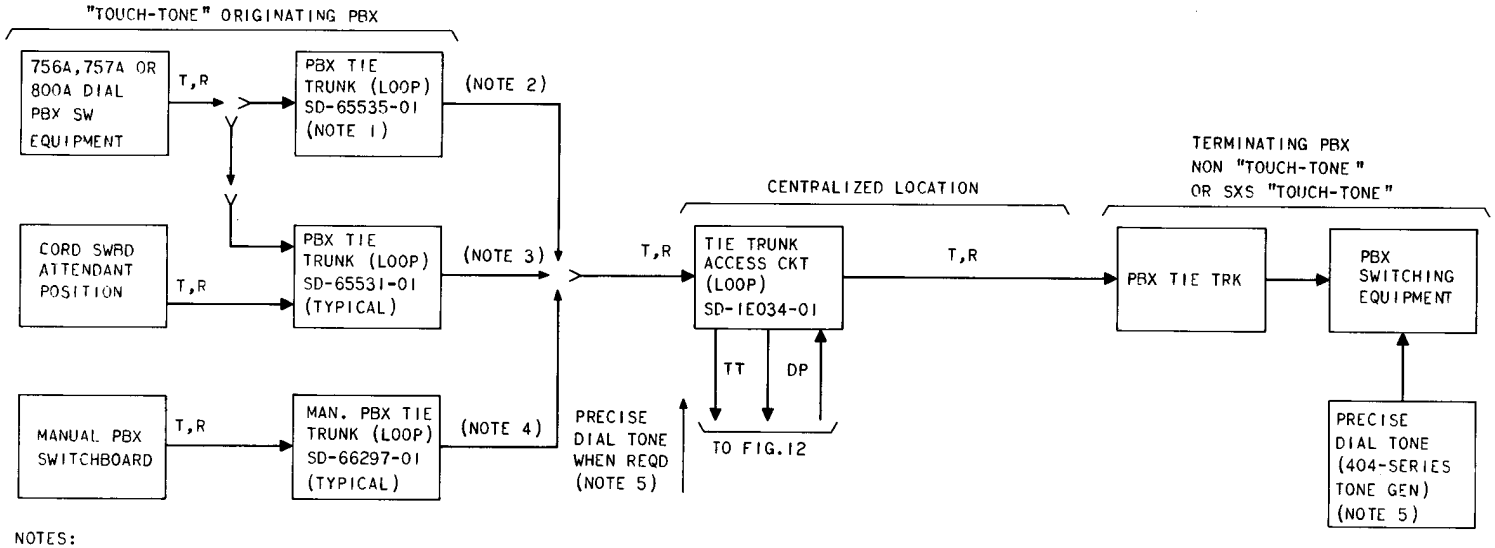


Fig. 30—800A PBX Tie Trunk TOUCH-TONE Calling Arrangement Using Local Trunk TOUCH-TONE Calling With Switchboard Attendant Position Equipment—Block Diagram

the call is cut through the access circuit to the distant PBX, and the TOUCH-TONE calling equipment releases. When the call is a rotary dial call, the first digit is repeated by the TOUCH-TONE calling equipment to the distant PBX. Between the first and second digits, the TOUCH-TONE calling equipment connects the call through the access circuit and releases. The remaining digits of the call are pulsed directly through the access circuit to the distant PBX.

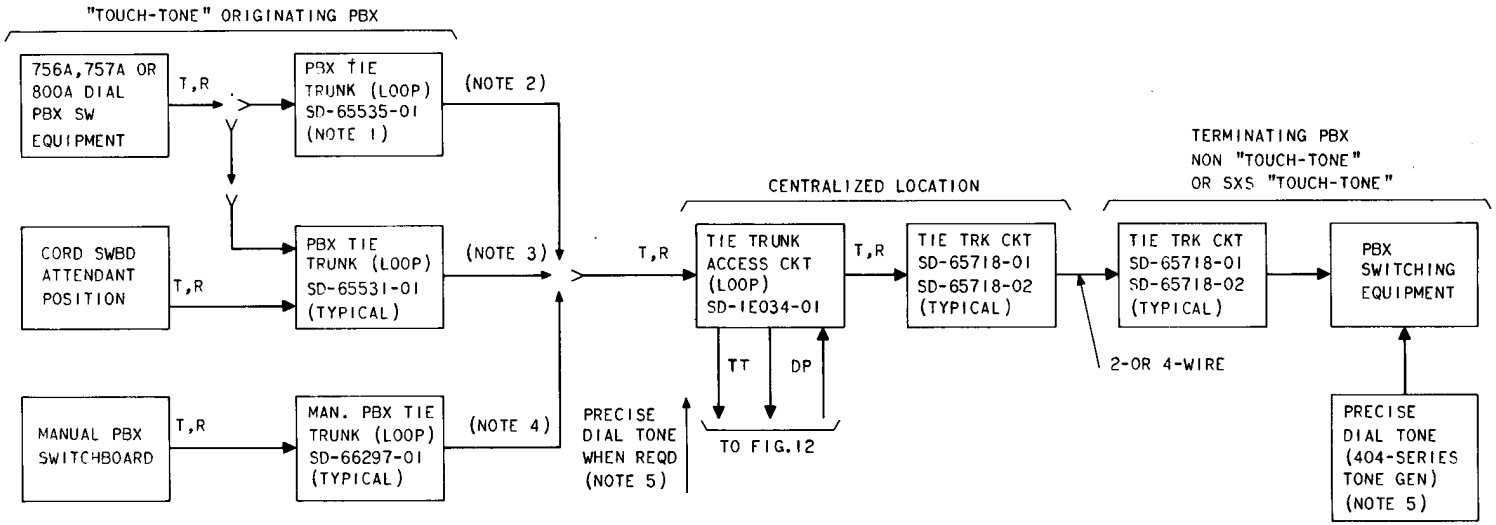
4.16 All incoming calls to the local PBX from the distant PBX bypass tie trunk access circuit SD-1E034-01.

4.17 The traffic arrangements shown in Figures 29 and 30 using local trunk TOUCH-TONE calling are tie trunk arrangements from manual PBXs and from switchboards associated with 756A, 757A, and 800A dial PBXs. Section (A) of Figures 29 and 30 shows a switchboard arrangement with double jack operation using tie trunk access circuit SD-1E052-01 for TOUCH-TONE calling. Section (B) of Figures 29 and 30 shows a tie trunk arrangement for a switchboard with single jack operation using tie trunk access circuit SD-1E053-01. The tie trunk arrangement for the associated PBX uses the tie trunk access circuit SD-1E034-01. With these tie trunk arrangements, a call to the distant



NOTES:
1. IN SOME CASES, THE EXISTING CIRCUIT MUST BE CHANGED TO CONFORM WITH THIS PLAN.
2. THIS ARRANGEMENT USED WHEN CORD SWITCHBOARD NOT ASSOCIATED WITH DIAL PBX.
3. THIS ARRANGEMENT IS USED WHEN A CORD SWITCHBOARD IS ASSOCIATED WITH THE DIAL PBX.
4. THIS ARRANGEMENT USED WITH MANUAL PBX.
5. PRECISE DIAL TONE MUST BE PROVIDED AT TERMINATING PBXS WHICH RETURN SECOND DIAL TONE. PRECISE DIAL TONE CAN BE PROVIDED BY THE COMMON EQUIPMENT WHEN THE TIE TRUNK TERMINATES IN SXS PBXS INCOMING SELECTORS. USE THE EXISTING PRECISE DIAL TONE SUPPLY WHEN AVAILABLE.

Fig. 31—756A, 757A, 800A and Manual PBX Tie Trunk TOUCH-TONE Calling Arrangement Using Centralized TOUCH-TONE Calling—Distance Between Centralized Location and Terminating PBX Within Loop Signaling Range—Block Diagram



NOTES:

1. IN SOME CASES, THE EXISTING CIRCUIT MUST BE CHANGED TO CONFORM WITH THIS PLAN.
2. THIS ARRANGEMENT USED WHEN CORD SWITCHBOARD NOT ASSOCIATED WITH DIAL PBX.
3. THIS ARRANGEMENT IS USED WHEN A CORD SWITCHBOARD IS ASSOCIATED WITH THE DIAL PBX.
4. THIS ARRANGEMENT USED WITH MANUAL PBX.
5. PRECISE DIAL TONE MUST BE PROVIDED AT TERMINATING PBXS WHICH RETURN SECOND DIAL TONE. PRECISE DIAL TONE CAN BE PROVIDED BY THE COMMON EQUIPMENT WHEN THE TIE TRUNK TERMINATES IN SXS PBXS WITH INCOMING SELECTORS. USE THE EXISTING PRECISE DIAL TONE SUPPLY WHEN AVAILABLE.

Fig. 32—756A, 757A, 800A, and Manual PBX Tie Trunk TOUCH-TONE Calling Arrangement Using Centralized TOUCH-TONE Calling—Distance Between Centralized Location and Terminating PBX Exceeds Loop Signaling Range—Block Diagram

PBX is completed fundamentally the same as the call described in 4.14. All incoming calls on the tie trunk arrangement bypass the access circuit.

4.18 The traffic arrangements using centralized TOUCH-TONE calling for tie trunk TOUCH-TONE from dial and manual PBXs are shown in Figures 31 and 32. These arrangements use the tie trunk access circuit SD-1E034-01 located at a centralized location. When the originating dial PBX is arranged without cord switchboards, the PBX tie trunk circuit SD-65535-01, or equivalent, is used for tie trunk calls. When the originating PBX is arranged with cord switchboard, however, the PBX tie trunk circuit SD-65531-01 or equivalent circuit is used instead of the SD-65535-01 circuit for tie trunk calls from either the switchboard or a PBX station. The trunk arrangements between the central office and the terminating PBX may be provided in various arrangements, as required. Precise dial tone will be provided from either the terminating PBX or the TOUCH-TONE calling equipment at a centralized location. On a TOUCH-TONE call from the originating PBX, the TOUCH-TONE signals are passed to the centralized TOUCH-TONE calling equipment where they are converted to dial pulses. The dial pulses are then sent to the terminating PBX, and the call is completed to the called party (station or attendant).

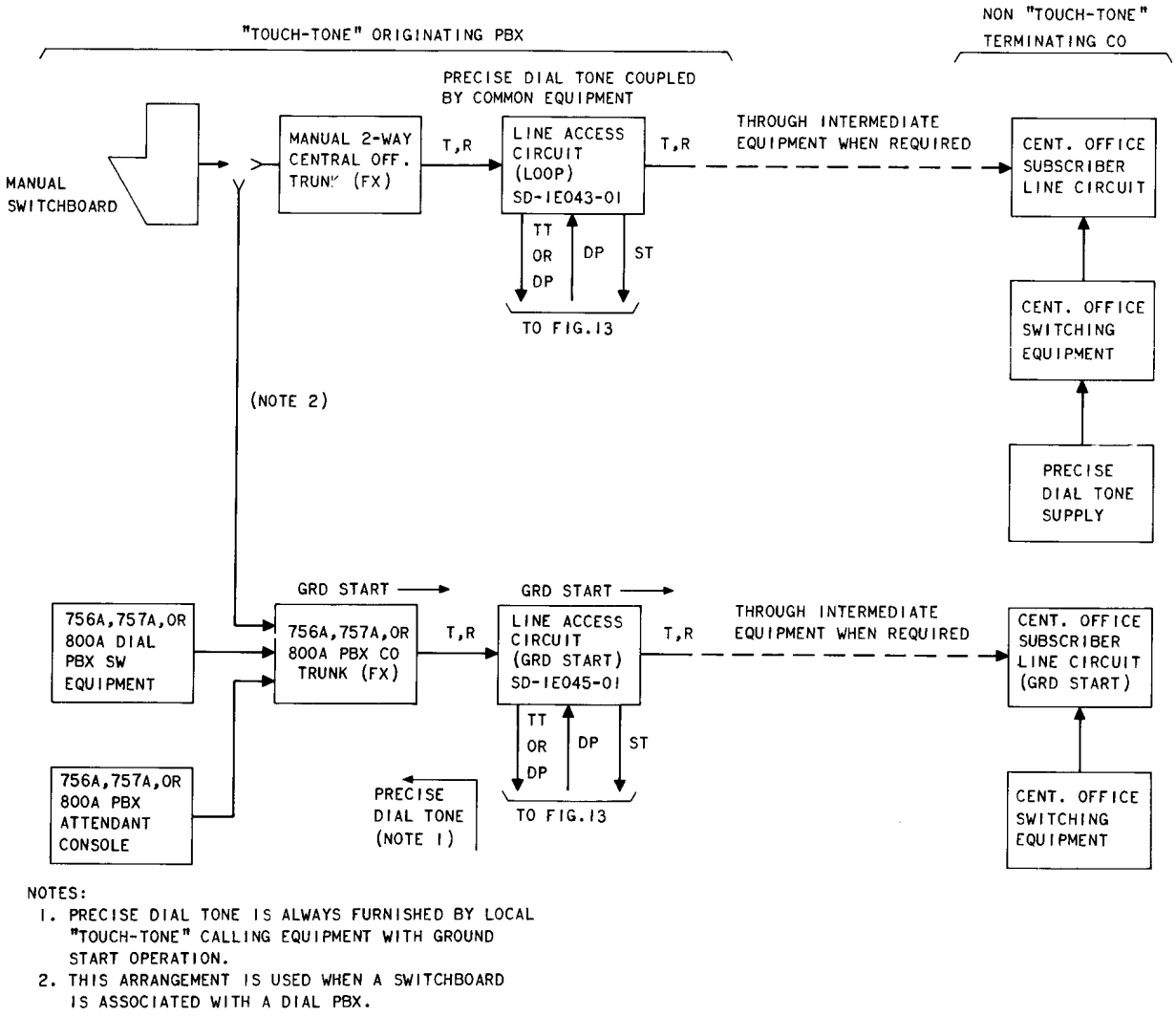
B. Foreign Exchange (FX) Lines, Foreign Exchange (FX) Trunks, and Off-Premise Extensions (OPX)

4.19 Foreign exchange trunk TOUCH-TONE calling arrangements for step-by-step PBX systems are shown in Figures 2, 3, 6, and 7. With the arrangement in Fig. 7, a line or trunk access circuit SD-1E045-01 is inserted between the central office trunk circuit and the distant central office. Foreign exchange trunk calls from the switchboard are directed through the central office trunk circuit and access circuit to the distant central office. Foreign exchange trunk calls from PBX stations are directed through the line finder, converter trunk, station access circuit, first selector, central office trunk, and access circuit to the distant central office which supplies the second dial tone. Second dial tone (precise dial tone) will be provided from the common group TOUCH-TONE calling equipment servicing the central office trunk on switchboard calls. TOUCH-TONE signals from the switchboard are converted to dial pulses by the common group TOUCH-TONE calling equipment associated with the SD-1E045-01 access circuit and outpulsed to the distant central office. TOUCH-TONE signals from a PBX station originating a foreign exchange trunk call are converted by the TOUCH-TONE calling equipment associated with the converter trunk SD-65853-01 instead of the line or trunk access circuit SD-1E045-01. The central office trunk, recognizing that the call is from a station, signals the access circuit to cut the call directly through without calling in the TOUCH-TONE calling equipment. With Fig. 6, foreign exchange calls from PBX stations or the 5- or 6-type attendant console are directed through the line finder, converter trunk, station access circuit, local first selector, and central office trunk to the distant central office which provides the second dial tone which must be precise dial tone.

4.20 The foreign exchange trunk arrangements for manual, 756A, 757A, and 800A PBX systems using the local trunk TOUCH-TONE calling equipment arrangement are shown in Fig. 33. Two foreign exchange trunk arrangements are shown, an arrangement using loop start and an arrangement using ground start. The loop start arrangement is used with manual PBXs. With this arrangement, the line access circuit SD-1E043-01 is used to provide access to the TOUCH-TONE calling equipment. Precise dial tone in this case is provided by the central office. The ground start arrangement may be used with both dial and manual PBXs when the distant central office is not equipped with precise dial tone. This arrangement uses the line access circuit SD-1E045-01 to provide access to the TOUCH-TONE calling equipment. Precise dial tone is always furnished by the TOUCH-TONE calling equipment with ground start operation.

4.21 The centralized TOUCH-TONE calling arrangements for foreign exchange lines and trunks and off-premise lines are shown in Fig. 34. Two arrangements are shown, an arrangement using line or trunk access circuit SD-1E043-01 and an arrangement using line or trunk access circuit SD-1E045-01.

4.22 The SD-1E045-01 access circuit provides access to the TOUCH-TONE calling for PBX foreign exchange trunks arranged with ground start. In addition, this access circuit will operate with loop start PBX off-premise lines, central office foreign exchange lines, and manual PBX foreign exchange trunks (when the distant central office does not provide precise dial tone).



NOTES:
1. PRECISE DIAL TONE IS ALWAYS FURNISHED BY LOCAL "TOUCH-TONE" CALLING EQUIPMENT WITH GROUND START OPERATION.
2. THIS ARRANGEMENT IS USED WHEN A SWITCHBOARD IS ASSOCIATED WITH A DIAL PBX.

Fig. 33—756A, 757A, 800A, and Manual PBX Foreign Exchange Trunk TOUCH-TONE Calling Arrangement Using Local Trunk TOUCH-TONE Calling—Block Diagram

4.23 Ground start operation is used to control return of precise dial tone from the interface circuit to the originating station. Also, ground start operation is used to inform the access circuit when to cut through to the common equipment. In this way, the conversion equipment cannot be seized when an incoming call seizes the subscriber line during the silent interval of ringing.

4.24 When the access circuit is seized on an outgoing call, the centralized TOUCH-TONE calling equipment is attached, and a ground start signal is sent forward to the distant PBX or central office. When the distant end is ready to receive dial pulses, battery and ground are returned by the subscriber line circuit. Upon receipt of this signal, the line or trunk access circuit causes the TOUCH-TONE calling equipment to return precise dial tone to the calling station. The nonprecise dial tone from the distant end does not reach the TOUCH-TONE receiver input in the TOUCH-TONE calling equipment.

4.25 The SD-1E043-01 access circuit provides access to the common equipment for PBX off-premise extension lines, foreign exchange lines, or foreign exchange trunks from manual PBXs arranged for loop start and in instances where the

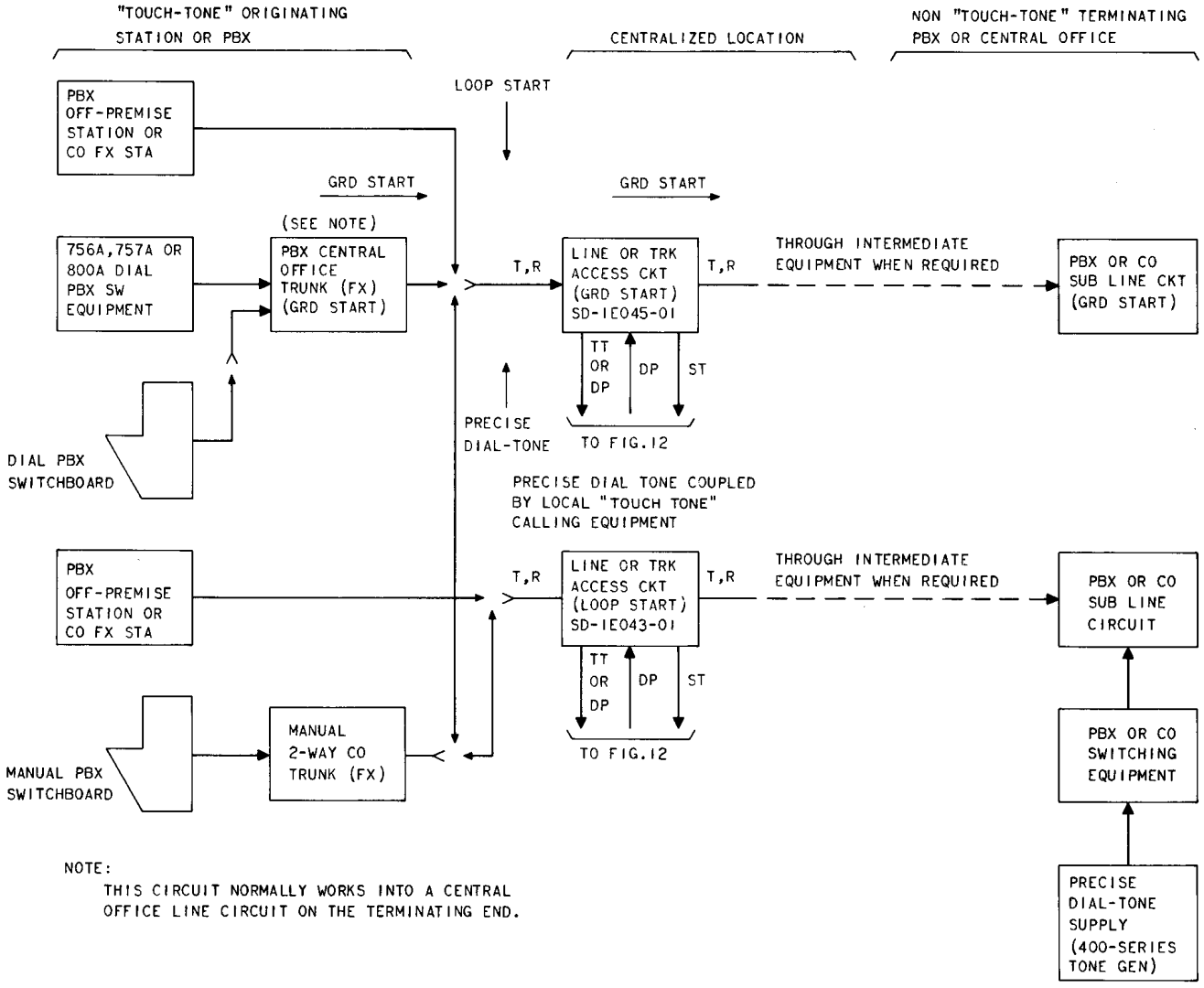


Fig. 34—756A, 757A, 800A, and Manual PBX Off-Premise and Foreign Exchange Stations—Using Centralized TOUCH-TONE Calling—Block Diagram

distant PBX or central office is arranged to provide precise dial tone. When this circuit is associated with centralized TOUCH-TONE calling equipment on an outgoing call, a path for dial tone from the distant end to the originating station is established, enabling the calling party to receive precise dial tone from the distant end.

5. CIRCUIT OPERATION

GENERAL

5.01 The circuit operation of the common group, local trunk, and centralized TOUCH-TONE calling equipment arrangements is described in the following paragraphs. The basic function of this equipment is to convert TOUCH-TONE signals to dial pulses.

COMMON GROUP "TOUCH-TONE" CALLING

5.02 For this description refer to Figures 2 through 7. Assume that the rotary dial or TOUCH-TONE call from the calling party has progressed to the access circuit (station access, converter trunk access, tie trunk access, or line or trunk access circuit). When the access circuit receives an off-hook signal from the calling party,

a start signal is sent either via the common group and subgroup circuit to the trunk finder circuit or to the crossbar-link and controller circuit. The function of the common group and subgroup circuit is to relay the start signal to an idle trunk finder and to check for abnormal operating conditions in the trunk finder. After the trunk finder or crossbar-link and controller circuit receives the start signal and locates the access circuit, a path is provided from the associated interface circuit to the access circuit.

5.03 If precise dial tone is to be provided at the distant end, a ground signal from the access circuit is applied on the S1 lead to the interface circuit. The precise dial tone is applied through the interface circuit on the T and R leads to the calling party. When ***no*** ground signal is present on the S1 lead, the interface circuit provides the precise dial tone. Both dial-tone arrangements can be used in the same PBX to meet the requirements for various type calls.

TOUCH-TONE Dialing

5.04 After receiving dial tone, the calling party dials the desired number. The TOUCH-TONE signals are sent over the T and R leads via the interface circuit to the TOUCH-TONE receiver. Here the TOUCH-TONE signals are separated into their high and low frequency components. The high and low frequency components corresponding to each digit dialed are then applied in a 2-out-of-7 code to the translation circuit where they are translated to a 1-out-of-10 code. If the type C receiver is used, the translation circuit is part of the receiver. However, when the TOUCH-TONE calling equipment is arranged with the type A receiver, the translation (TOUCH-TONE receiver applique) circuit is a separate circuit and not part of the receiver. The dc signal (1-out-of-10 code) output from the translation or applique circuit is sent to the solid state converter along with digit steering signals. In the solid state converter, the digital information is fed to the coincident fluxor memory. The digital information is not registered in the memory at this time. The steering signal is used to trigger the ***write*** control and advance the ***write*** stepping switch which sends a ***write*** current to the coincident fluxor memory. The ***write*** current along with the digital information is necessary to set the cores in the memory. The ***read*** control is free running and continually scans the coincident fluxor memory. When a stored digit is detected in the memory, a signal is sent through the output amplifier setting this digit in the translation shift register. Each digit is stored in the memory in the sequence received. The digit in the translation shift register is translated, and the number of pulses corresponding to the digit is generated and sent to the dial pulse generator. Here, each pulse triggers the dial pulse generator which generates dial pulses having the required 60 percent break and 40 percent make. The solid state converter outpulses the digits in the same sequence that they are stored, inserting after each digit a 600 ms interdigital time to give sufficient time for the switching equipment to hunt for an idle circuit. These digits are outpulsed through the common group TOUCH-TONE calling equipment and access circuit on the FT and FR leads to the destination. On pretranslated dial codes, after the last digit is outpulsed, the converter sends a signal to the interface circuit which initiates the release of the TOUCH-TONE calling equipment. When the TOUCH-TONE calling equipment releases, the call is cut through the access circuit to the destination. On a call that has no pretranslation, after the last digit is outpulsed, the converter remains connected to the call until a time-out occurs. During this time the coupling arrangement in the interface circuit permits conversation between the calling and called parties. The TOUCH-TONE calling equipment then releases, and the call is cut through. On certain calls polarity reversal (answer supervision) is encountered on the FT and FR leads which cut the call through the access circuit and release the TOUCH-TONE calling equipment.

Rotary Dialing

5.05 After receiving dial tone, the calling party dials the desired number. The dial pulses are sent over the T and R leads to the interface circuit and TOUCH-TONE receiver. The dial pulses have no effect on the TOUCH-TONE receiver. Upon receiving the first digit, the interface circuit repeats the pulses on the FT and FR leads. During the interdigital time between the first and second digit, the interface circuit starts release of the TOUCH-TONE calling equipment and signals the access circuit to cut the call through. The access circuit cuts the call through in time for the remaining digits to be pulsed through this circuit to the required destination.

LOCAL TRUNK "TOUCH-TONE" CALLING

5.06 The access circuits for local trunk TOUCH-TONE calling are shown in block diagram arrangements

in Figures 28, 29, 30, and 33. These access circuits are served by the local trunk TOUCH-TONE calling equipment (Fig. 13). Since the operation of the local trunk TOUCH-TONE calling equipment is similar in operation to the common group TOUCH-TONE calling equipment, only the differences will be discussed.

5.07 After the access circuit receives an off-hook signal from the calling party, a start signal is sent directly to the trunk finder. One of the 22-point trunk finder switches finds the access circuit and provides a path to the associated interface circuit. Precise dial tone may at this time be returned to the calling party from either the distant end or the local trunk TOUCH-TONE calling equipment. (See 5.03.) The dialed number and the connection of the call is handled as described in 5.04 and 5.05.

CENTRALIZED "TOUCH-TONE" CALLING

General

5.08 The access circuits for centralized TOUCH-TONE calling are shown in block diagram arrangements in Figures 31, 32, and 34. These access circuits are served by the centralized TOUCH-TONE calling equipment shown in Fig. 12. Upon receiving an off-hook signal from the originating PBX, the access circuit sends a start signal to the common group and subgroup circuit. The common group and subgroup circuit summons an idle trunk finder and checks the trunk finder for any abnormal conditions, and an alarm is operated when an abnormal condition is detected. After the selected trunk finder circuit finds the access circuit and connects it through to the interface circuit, a signal is sent to the digit class control circuit. The signal provides a digit class mark which provides the solid state converter with pretranslation of the first TOUCH-TONE digit. The signal also on the DT lead initiates the return of dial tone to the calling party, when dial tone is to be provided by the interface circuit. When dial tone is to be provided by the distant end, a signal is not provided.

TOUCH-TONE Dialing

5.09 After receiving dial tone, the originating PBX calling party dials the desired number. The TOUCH-TONE signals from the originating PBX are sent over the T and R leads to the conversion equipment in the central office. In the conversion equipment, the TOUCH-TONE signals are applied through the trunk finder and interface circuit to the digit class control circuit where the signals are amplified and then sent to the TOUCH-TONE receiver. Refer to 5.04 for discussion of the TOUCH-TONE to dial pulse conversion through the TOUCH-TONE receiver, translation (applique), and solid state converter circuit to the final completion of the call. On pretranslated codes, the pretranslation is done by the solid state converter in conjunction with the class mark from the digit class control circuit.

Rotary Dialing

5.10 The rotary dial call is processed through the conversion equiment and connected as described in 5.05.

6. MAINTENANCE FACILITIES

ALARMS

General

6.01 The alarms vary with the different types of TOUCH-TONE calling equipment arrangements. In addition to the normal fuse alarms, the common group TOUCH-TONE calling equipment (when using trunk finder access) and the centralized TOUCH-TONE calling equipment provide alarms for the following conditions:

(1) Permanent ground on start lead

(2) Foreign potential on chain circuit

(3) All finders busy

(4) Call blocked.

6.02 The common group TOUCH-TONE calling equipment, (when using crossbar-link access), in addition to normal fuse alarms, provides alarms on a second trial connection to electronic dial unit and for a shorted output transistor in the recycle timer.

6.03 The local trunk TOUCH-TONE calling equipment provides the normal fuse alarms and the call-blocked alarm.

6.04 Each of the alarms provided with PBX TOUCH-TONE calling arrangements is described as follows.

Permanent Ground on Start Lead Alarm

6.05 When a permanent ground is detected on the start lead to the common group and subgroup circuit, the start (S) lamp on this unit lights. The alarm, a major or class A alarm, is extended to an associated alarm circuit and, when required, to the local switchboard and the central office. The alarm remains locked in until released by operation of the alarm release (AR) key on the common group and subgroup circuit.

Foreign Potential on Chain Circuit

6.06 The chain (C) lamp on the common group and subgroup circuit lights when foreign battery or ground is detected on the A and B lead from the trunk finder. This alarm is also a major or class A alarm and is extended to the same locations mentioned in 6.02. Also the alarm remains locked-in until released by operation of the AR relay.

All Finders Busy

6.07 The all finders busy (AFB) alarm is a minor or class B alarm. When the common group and subgroup circuit detects an all finders busy condition, it lights the AFB lamp and starts a timer. After the timer times out, the alarm operates and is extended to the required locations. If a trunk finder becomes idle before time-out occurs, the alarm condition is canceled. The alarm, if operated, is also released when a trunk finder becomes idle.

Call Blocked

6.08 When a call blockage condition is detected in the SXS or centralized TOUCH-TONE conversion equipment, the call-blocked (CB) lamp on the common group and subgroup circuit lights. A timer starts, and upon time-out, an alarm is sent to the required locations. The alarm is released when the call blockage condition is removed. When a call blockage condition is detected in the local trunk TOUCH-TONE conversion equipment, a timer (10-sec) is started. After approximately 10 seconds, if the call blockage condition is not removed, the timer times out and causes an alarm to operate in the associated alarm circuit. The alarm remains locked in until released, by momentarily inserting a dummy plug into the make-busy alarm release (MB-ALM RLS) jack on the trunk finder (22-point) circuit.

Second Trial Alarm

6.09 An alarm is provided with the crossbar-link arrangement of the common group TOUCH-TONE calling equipment to indicate a failure of the controller to make a connection to an electronic dial unit after two consecutive attempts. This causes the local ALM lamp to light steadily and grounds lead ALM to the PBX alarm circuit. The PBX treats this alarm condition as a call-blocked alarm. The alarm may be released by operation of key AR. Key AR operated releases the alarm condition, extinguishes the local ALM lamp, and removes the ground from the ALM lead. With the release of the alarm, the operate sequence continues the same as a first trial failure, and a third trial is made for an EDU.

Recycle Timer Protective Circuit Alarm

6.10 The crossbar-link and controller circuit of the common group TOUCH-TONE calling crossbar-link arrangement is equipped with the recycle timer protective circuit which operates the R fuse if the output transistor of the recycle timer circuit becomes shorted. The R fuse supplies battery only to the RCY timer and relay. If the R fuse operates, the controller continues to process calls less the recycle/alarm function. The normal frame fuse alarm indicates this trouble condition.

KEYS AND LAMPS

6.11 Various keys and jacks are provided as part of the TOUCH-TONE calling equipment for maintenance purposes. These are listed in Table A along with a description of their primary purpose.

TEST LINE

6.12 A test line consisting of the A, B, and C jacks (shown in Table A) is provided with the trunk finder common group, centralized, and local trunk TOUCH-TONE calling equipment arrangements. The jacks are provided as part of the common group and subgroup circuit of the common group and centralized arrangements and connect to bank terminal 99 in multiple of each trunk finder switch in a group. The jacks connect to bank terminal 22 in multiple of each trunk finder

TABLE A

TOUCH-TONE CALLING EQUIPMENT MAINTENANCE KEYS AND JACKS

EQUIPMENT	KEYS	JACKS	FUNCTION
Common Group TOUCH-TONE Calling With Trunk Finder Access and Centralized TOUCH-TONE Calling	TST	—	To check stepping actions of trunk finder switch.
	MB	—	To remove associated trunk finder switch from service.
	—	TEST & MON	Access to trunk finder switch and associated conversion equipment for testing or monitoring the equipment.
	—	A,B,C	Access jacks to conversion equipment for solid state converter and receiver test set.
Local TOUCH-TONE Calling	—	MB-ALM RLS	To remove associated trunk finder switch from service or to release locked-in alarm.
	—	Start	Access to trunk finder switch and associated conversion equipment for seizing the equipment for testing.
	—	A,B,C	Access jack to conversion equipment for solid state converter and receiver test set.
Common Group TOUCH-TONE With Crossbar-Link Access	AR		To release second trial alarm condition.
	B (1-10)		To manually make busy an EDU position.

switch in a group when provided with the local trunk TOUCH-TONE calling equipment.

SOLID STATE CONVERTER-RECEIVER TEST SET (Fig. 35)

6.13 The solid state converter-receiver test set is used in testing the functions of the converter-receiver combination at each of the TOUCH-TONE calling equipment configurations. The test set consists of a rotary dial, TOUCH-TONE dial, numerical display unit, patching jacks, and control keys. Also required patching cords are shipped as part of the test set. The following functions of the TOUCH-TONE calling equipment are tested by the test set:

(1) Processing of both rotary and TOUCH-TONE test calls

(2) Pretranslation

(3) Converter time-out

(4) Dial pulse generator percent break

(5) TOUCH-TONE receiver functions.

7. REFERENCES—SCHEMATIC DRAWINGS AND FIGURES

7.01 The Schematic Drawings (SDs) relating to TOUCH-TONE equipment in this section are listed below. The figures on which they appear follow the SD- number:

SCHEMATIC DRAWINGS	FIGURES
SD-65853-01	3, 6, 7, 23, 24
SD-65871-01	4, 12
SD-65906-01	4

Fig. 35—Solid State Converter and Receiver Test Set

SCHEMATIC DRAWINGS	FIGURES
SD-66885-01	2, 7, 24
SD-66886-01	4
SD-66887-01	4
SD-66888-01	4, 5, 12, 13
SD-66891-01	12
SD-66892-01	4, 5, 12, 13
SD-67027-01	4, 5, 8, 9, 10, 11, 25, 26
SD-1E052-01	7, 29, 30
SD-1E053-01	7, 29, 30
SD-1E054-01	4, 5, 13

SCHEMATIC DRAWINGS	FIGURES
SD-98148-01	4, 5, 8, 9, 10, 12, 13, 25, 26
SD-1E033-01	12
SD-1E034-01	28, 29, 30, 31, 32
SD-1E043-01	33, 34
SD-1E045-01	7, 33, 34
SD-1E050-01	13
SD-5E038-01	27
SD-1E100-01	12
SD-5E053-01	5