

SWITCHING SYSTEM NO. 309
(AUTOVON)
GENERAL DESCRIPTION

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| D. Signaling | 2 | A. Introduction | |
| E. General Operation | 3 | 1.01 This section provides a general description of the No. 309, Switching System. This system is comprised of equipment required at a 4-wire subscriber station to enable the customer to establish both voice and data transmission with other stations on switched services such as the AUTOVON (AUTOMATIC VOICE NETWORK). | |
| 2. EQUIPMENT ELEMENTS | 4 | 1.02 This section is reissued to include information on the following: | |
| A. General | 4 | • 6-station conference bridging circuit | |
| B. Key Telephone Sets | 4 | • Line add-on conference circuit | |
| C. Line Circuit | 4 | • Association of No. 309 Switching System with 112A key equipment. | |
| D. Line Transfer Circuit | 6 | 1.03 The equipment units which make up the No. 309 Switching System consist basically of a series of coded key telephone sets and a 4-wire central office (CO) line circuit. For stations required to transmit and receive both voice and data, an auxiliary service transfer circuit is provided. ♦ This system can be associated with 112A key equipment (2.11) and 2- and 4-wire PBX lines.♦ | |
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B. Features

1.04 The more important features and operating functions of the No. 309 Switching System are:

- (a) To provide termination of the 4-wire subscriber line and carry the 4-wire transmission path to the station key telephone set.
- (b) To provide for telephone set terminations of precedence calls transferred from a PBX access line circuit when the call encounters either a busy station or a station which does not answer.
- (c) To provide an optional 6-station conference bridging circuit.
- (d) To provide an optional line add-on conference circuit.
- (e) To provide for multiple appearance of the 4-wire subscriber line at key telephone sets.
- (f) To provide for multiple 4-wire subscriber line termination with common audible arrangements.
- (g) To provide transfer of a 4-wire subscriber line from a key telephone termination to an auxiliary service (data) termination and optionally, to an alternate auxiliary service.
- (h) To provide for the use of any of several types of key telephone sets equipped with 16-button TOUCH-TONE® dials and a maximum of 5, 17, or 29 line buttons per telephone set.
- (i) To provide the station with multilevel precedence preemption capability which enables the station to originate calls of varying levels of precedence.
- (j) To provide visual and audible indications of the precedence alerting and preemption alarm signals from the line or lines.
- (k) To provide for optional use of speakerphones.
- (l) To provide for optional use of a rotary dial adjunct.

- (m) To provide a means of placing a line on hold.
- (n) To provide for exclusion of secondary key telephone sets.
- (o) To provide an optional means for the station to return a confirmed ringing audible signal to the calling station.
- (p) To provide an optional loop-back feature which loops the 4-wire transmission line toward the central office for making loop transmission tests.

C. System and Network Relationships

1.05 The No. 309 Switching System and its relationship with a network such as AUTOVON is illustrated in Fig. 1. As indicated in the figure, the No. 309 Switching System is directly connected via 4-wire subscriber lines to the switching center. The switching center is usually a 4-wire No. 5 crossbar office or a 4-wire No. 1 ESS office. Normally, a station will have access to only one switching center; however, important stations may have access to two switching centers. Since the 4-wire subscriber stations are generally located a considerable distance from the switching centers, carrier transmission facilities and SF signaling are used at some point between the station and the switching center. When the SF signaling units are not located at the station, DX signaling lead extension circuits are used.

D. Signaling

1.06 Switching centers such as AUTOVON are capable of handling calls of multilevel precedence preemption (MLP). The No. 309 Switching System enables the 4-wire subscriber stations to originate and receive all the signals associated with such calls. The five levels of precedence in ascending order are: ROUTINE, IMMEDIATE, PRIORITY, FLASH, and FLASH OVERRIDE. ROUTINE is the lowest level of precedence and has no preemption capability. Each progressively higher level can preempt calls of all levels below it. (Calls in AUTOVON are restricted within the bounds of precedence and routing treatment as defined by class-of-service assignment of the switching center.) The ROUTINE alerting signal to the station normally consists of a steady off-hook signal from the switching center; under certain circumstances,

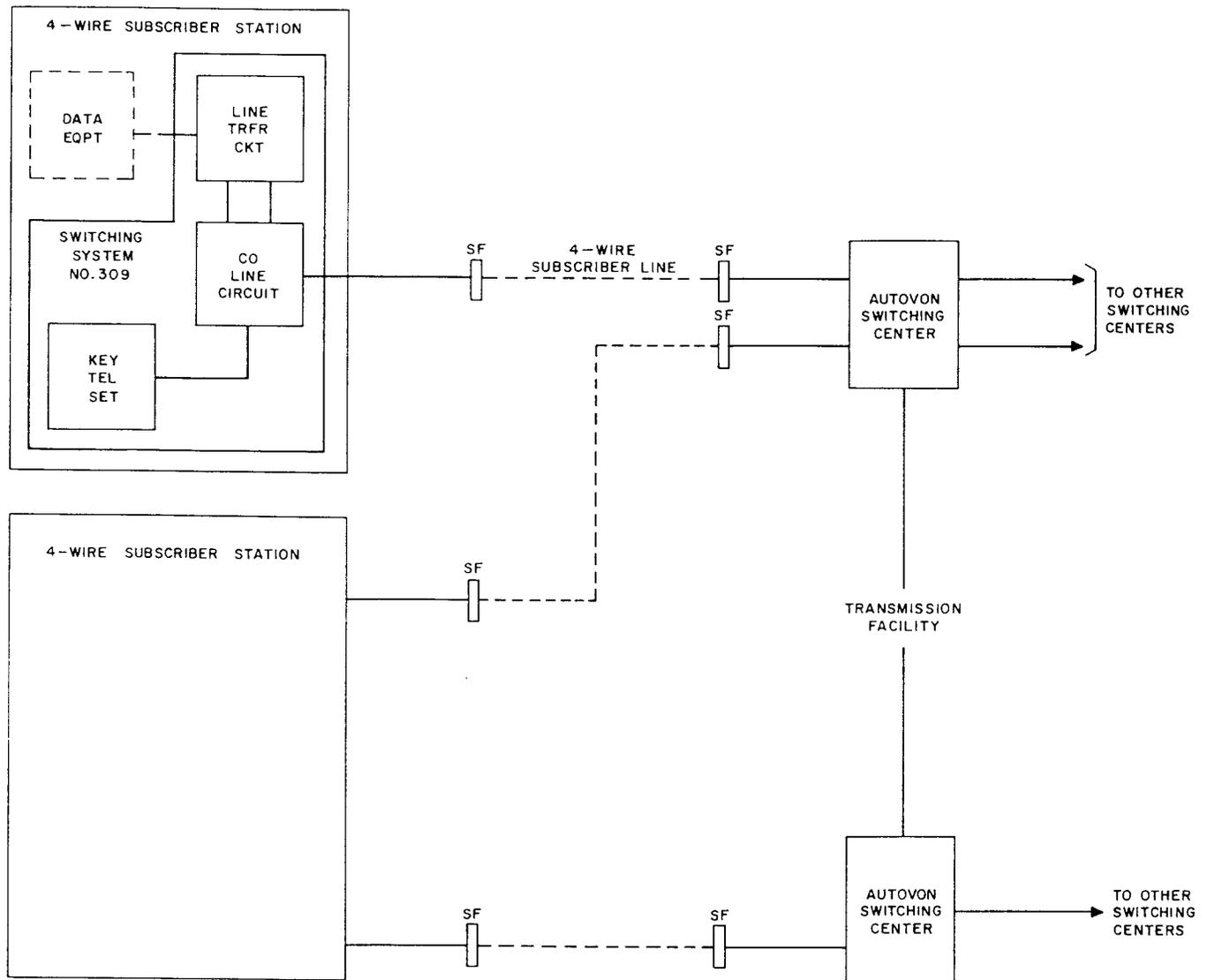


Fig. 1—No. 309 Switching System, Relationship Within Network such as AUTOVON

however, it may consist of a 2-second off-hook signal followed by a 4-second on-hook signal; this cycle continues for the duration of the call. For calls higher than ROUTINE, a Precedence-alerting signal to the station is used. It consists of an off-hook signal of about 1.6 seconds followed by an on-hook signal of 0.33 to 0.36 seconds continued repeatedly until the called party answers or the call is retired. When either a trunk or a line must be preempted to complete another connection of higher precedence, a preemption-notification wink signal is used. Basically, this signal is an on-hook wink signal of 0.33 to 0.36 seconds from the switching center. Whenever necessary, it will be preceded

or followed by an off-hook signal of 0.10 second. Outgoing precedence call signals to the switching center are initiated by operating an appropriate precedence button (one of four) included in the TOUCH-TONE dial of the station key telephone set.

E. General Operation

1.07 All station operations are controlled from the key telephone set. E and M lead trunk-type supervision is employed. Address dialing and originating precedence calling is accomplished via the TOUCH-TONE dial. TOUCH-TONE signals

are connected directly to the 4-wire subscriber line. The line circuit provides 4-wire subscriber line termination and control circuits for the key telephone set. The transfer circuit (if required) provides switching arrangements for transferring the 4-wire subscriber line from the key telephone set to an auxiliary service (data) termination.

2. EQUIPMENT ELEMENTS

A. General

2.01 The No. 309 Switching System consists of a series of multiline key telephone sets and line circuits (and in some cases, transfer circuits). Station arrangements depend on the requirements of the location. Fig. 2 illustrates a basic station which terminates one 4-wire subscriber line at a single key telephone set.

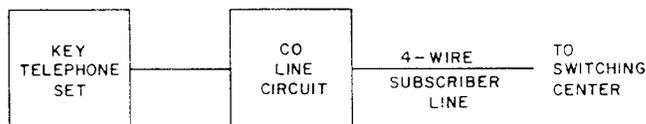


Fig. 2—No. 309 Switching System, Basic 4-Wire Subscriber Station, Block Diagram

2.02 A 4-wire central office line circuit is required for each 4-wire subscriber line terminated at the station. The basic line circuit terminates the 4-wire subscriber line in the primary key telephone set. For each additional appearance of the line at key telephone sets other than the primary set, a station line pickup circuit is required. When more than one 4-wire subscriber line or commercial key equipment 2-wire line is terminated at a station, a common audible circuit may be provided. The common audible circuit enables a common ringer or group of ringers to respond to incoming calls from up to four lines. When a station is required to transmit and receive data, an auxiliary service transfer circuit is provided. This circuit provides transfer of established voice calls from the key telephone set to an auxiliary service (data) termination. Fig. 3 illustrates a station equipped to terminate two 4-wire subscriber lines in two key telephone sets with common audible arrangements provided. A line transfer circuit is associated with one of the 4-wire subscriber line circuits to provide transfer of that line to either

of two auxiliary service (data) terminations. ♦ An optional 6-station conference bridging circuit provides a means of connecting from one to six telephone sets simultaneously to a 4-wire CO line circuit. An optional line add-on conference circuit provides for adding any combination of one to five 2-wire and/or 4-wire lines on a conference connection. ♦

B. Key Telephone Sets

2.03 Initially, four different key telephone sets are provided for use in the No. 309 Switching System. These are a 6-button key telephone set, an 18-button CALL DIRECTOR® type telephone set, a 30-button CALL DIRECTOR type telephone set, and a 6-button TOUCH-TONE card dialer telephone set. These sets are all equipped with a 16-button TOUCH-TONE dial. They are designed to work as alternate 2-wire, 4-wire sets with 1A1 or 1A2 key equipment and PBX and central office lines. The key telephone set used at a given station depends on the number of line pickup and signal key functions required.

2.04 The 16-button TOUCH-TONE dial permits sending four precedence signals on a TOUCH-TONE basis in addition to the regular dialing signals. Fig. 4 shows the TOUCH-TONE dial including the location and function of the precedence keys and the operating frequencies of the various tones.

2.05 Each telephone set includes a HOLD button arranged for illumination. On both the 6-button set and the 6-button TOUCH-TONE card dialer set, leads are provided for connecting an external speakerphone. Speakerphone transmitters may be provided as an integral part of the 18-button and 30-button CALL DIRECTOR type telephone sets. All the sets are equipped with an exclusion switch and control leads. The TOUCH-TONE dial on specially coded sets may be optionally illuminated.

2.06 In those cases where some lines terminating at the No. 309 Switching System key telephone set are arranged for rotary dialing, a rotary dial adjunct may be associated with the key telephone set to provide rotary dial pulsing.

C. Line Circuit

2.07 The 4-wire central office line circuit provides means for talking, holding, and signaling on

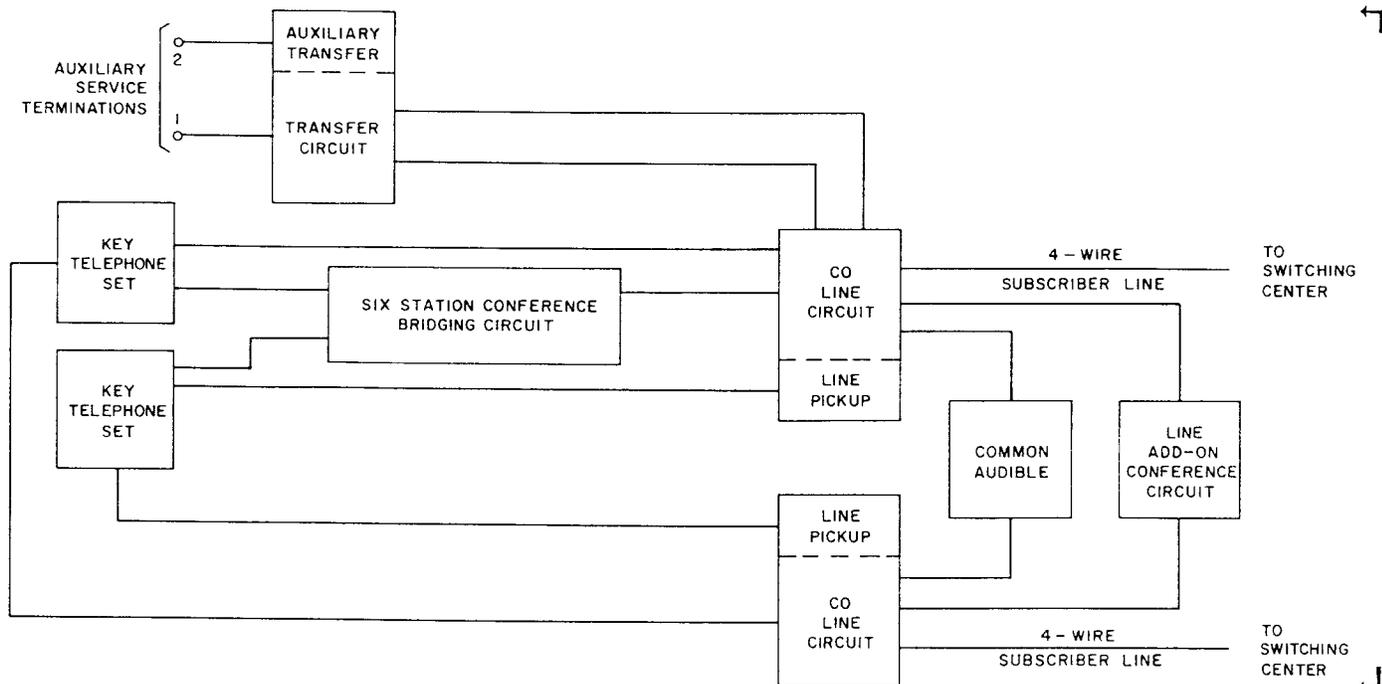


Fig. 3—No. 309 Switching System, 4-Wire Subscriber Station Arranged for Voice and Data Transmission, and for Station and Line Conferencing

a 4-wire subscriber line between a 4-wire central office and key telephone station.

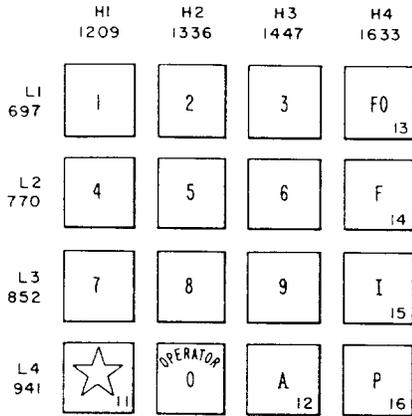
2.08 The components which make up the line circuit unit are mounted on a 4- by 23-inch mounting plate. The mounting plate provides space for a second line pickup unit when a secondary key telephone set is used. Since transmission pad sockets are mounted on the back of the 4- by 23-inch plate, care should be taken in selecting mounting arrangements. An additional 2- by 23-inch mounting plate which mounts two line pickup units is required when more than one secondary key telephone set is used. The line circuit equipment is designed for miscellaneous mounting in 23-inch relay rack-type bays.

2.09 The line circuit terminates the 4-wire subscriber line from the switching center and extends the 4-wire transmission path to the key telephone set or, when the station is equipped for data transmission, to the termination of the line transfer circuit. The line circuit operates with E and M supervisory signaling. It is arranged to detect ROUTINE, Precedence, and preemption incoming signals from the central office and to

provide distinct visual and audible alerting signals to the station key telephone set.

2.10 The line circuit connects local ringing, lamp, and talking battery supplies to the key telephone set and incorporates an interrupter to provide proper interruptions of the visual and audible signals. It may also connect a tone generator through the interrupter to the line to provide confirmed ringing audible tone (ringback) to a calling station. The line circuit incorporates a sidetone network to provide sidetone to the key telephone set. It provides a hold circuit for placing the line on hold, an exclusion circuit for exclusion of secondary telephone sets, and a loop-back circuit for looping the transmit and receive pairs for transmission testing.

2.11 When the line circuit is associated with 112A key equipment, the key equipment attendant set and the No. 309 Switching System telephone set have access through their respective line circuits to the same 4-wire line facility. Supervisory signals are sent to both line circuits whenever either line circuit is used. ♦



SPECIAL DIAL BUTTONS

| BUTTON NO. | DESIGNATION AND FUNCTION | PRECEDENCE LEVEL |
|------------|--------------------------|------------------|
| 11 | ☆ (SPARE) | _____ |
| 12 | A (PUNCTUATION) | _____ |
| 13 | FO (FLASH OVERRIDE) | P0 |
| 14 | F (FLASH) | P1 |
| 15 | I (IMMEDIATE) | P2 |
| 16 | P (PRIORITY) | P3 |

BUTTONS 11 THROUGH 16 EQUIPPED WITH CHANGEABLE DESIGNATION CAPS.

Fig. 4—TOUCH-TONE Dial, No. 309 Switching System, Key Telephone Sets

D. Line Transfer Circuit

2.12 The auxiliary service transfer circuit operates in conjunction with the station line circuit and key telephone set to transfer the 4-wire line from a telephone termination to an auxiliary service (data) termination. The components which make up the line transfer circuit are mounted on a 2-by 23-inch mounting plate. This unit is designed for miscellaneous mounting on 23-inch relay rack-type bays.

2.13 The line transfer circuit is controlled by a key on the station key telephone set. Upon receipt of a transfer signal from the off-hook station key telephone set, the line transfer circuit transfers the 4-wire transmission path from the telephone termination to the auxiliary service (data) termination. It provides an off-hook signal to the line circuit when the line is transferred and provides and maintains steady visual signals to the line key and transfer key of the key telephone set.

2.14 An optional auxiliary transfer feature is available. When provided, the circuitry is included in the line transfer circuit mounting plate. It is controlled from a second transfer key on the key telephone set. This feature provides for transfer of the 4-wire transmission path to a second, different service termination. Transformers are included in the line transfer circuit to provide dc isolation between the 4-wire line and auxiliary service equipment. Individual pads are provided in the transmitting and receiving circuits of the auxiliary service terminations for attenuation adjustment.

3. METHOD OF OPERATION

A. General

3.01 All operations for handling incoming and outgoing calls are performed at the key telephone set. Regular key set operations are used for normal calls. Special procedures are used for making precedence calls and transferring from an established voice call to data equipment.

B. ROUTINE Call

3.02 The station is alerted to a ROUTINE incoming call by the ringing of the telephone bell and the flashing of the line key lamp. (The ringing interval is 1 second on and 3 seconds off; also, the line key lamp flashes at 60 ipm.) The call is answered by first depressing the flashing line key and then taking the handset off-hook. When the call is answered, the line key lamp lights steadily and the bell is silenced. When the established call is terminated and the handset is placed on-hook or another line is selected, the line key lamp will extinguish.

3.03 To make a ROUTINE outgoing call, the line is selected by depressing the proper line key on the telephone set and taking the handset off-hook. The line key lamp of the line selected lights steadily. An off-hook indication is sent to the central office. The central office returns dial tone to the station. After dial tone is heard, the desired number is dialed. When the call is completed and the handset is placed on-hook, the line key lamp extinguishes and all circuits return to normal idle condition.

C. Precedence Call

3.04 An incoming call which has a Precedence level exceeding ROUTINE is indicated by the sounding of the audible bell in the telephone set at the Precedence ring rate (approximately 1.65 seconds on, 0.35 seconds off). The line key lamp for the line associated with the incoming call flashes at the same rate. The Precedence call is answered in the same manner as a ROUTINE call. Upon depressing the flashing line key and taking the handset off-hook, the bell is silenced and the line key lamp lights steadily. When the call is completed and the handset is placed on-hook or another line is selected, the line key lamp will extinguish.

3.05 To originate an outgoing Precedence call, the subscriber proceeds as for a ROUTINE call but precedes the dialing of the address by momentary operation of one of the four TOUCH-TONE Precedence keys. If a route change is required, a 1X code is dialed before the address but after the Precedence code. The subscriber then proceeds as for a ROUTINE call.

D. Holding—ROUTINE or Precedence Call

3.06 Either a ROUTINE or Precedence call may be placed on hold by momentarily depressing the nonlocking HOLD key. The release of the HOLD key also releases the operated line key. The line key lamp of the line placed on hold will begin winking at a 120-ipm rate to indicate a hold condition. The telephone set is released to be used elsewhere. When the line is reselected at any station appearance, the hold condition will be released. If a held call is abandoned by the party at the other end, the disconnect signal from the switching center will release the hold condition.

E. Data Call

3.07 An incoming data call appears as any other ROUTINE or Precedence call. After the voice call has been established and agreement is reached as to the details of the data transmission, the line is transferred to the data equipment by momentarily depressing a nonlocking TRANSFER key on the key telephone set. The line key lamp continues to light steadily and the TRANSFER key lamp lights steadily. The transmission path to the handset is cut off. The handset may be placed on-hook, if desired. After data transmission has been completed, the line key is again depressed (if

not already operated), the handset is taken off-hook, and the TRANSFER key is momentarily depressed. The reoperation of the TRANSFER key returns the transmission path to the handset. The TRANSFER key lamp is extinguished. After the data transmission has been verified, the line is released by placing the handset on-hook or by selecting another line. The lamp under the original line key is extinguished.

F. Preemption

3.08 When a station is in a busy condition, either with a normal voice call or a data call, or is in a hold condition and some link in the connection is preempted, the audible bell of the key telephone set will ring steadily and the line lamp will flash at a 120-ipm rate (0.25 seconds on, 0.25 seconds off). Also, on voice calls a 440/620-cycle tone is heard. These signals continue until the station goes on-hook.

G. Loop-Back

3.09 An optional loop-back feature may be provided which loops the transmit and receive pairs of the 4-wire subscriber line toward a switching center for the purpose of making loop transmission tests. To place the 4-wire subscriber line in a loop-back condition, a call is first established with a test center and the loop-back key on the key telephone set is momentarily operated. The line key lamp and the loop-back key lamp light steadily, indicating the line is in the loop-back condition. The handset is released and may be placed on-hook. The line will remain in the loop-back condition until either the handset is picked up and the loop-back key is reoperated or the central office disconnects.

H. Conferencing

3.10 The optional 6-station conference bridging circuit provides a loss-free connection between six telephone sets and a 4-wire CO line circuit. This is accomplished by providing each telephone set with a separate battery feed circuit, and terminating each transmission path to the telephone sets with equivalent resistors when the set is not connected. A transmit amplifier and a receive amplifier make up the loss of the six parallel transmission paths and their build-out resistors. In this manner a loss-free connection between the

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telephone sets and the 4-wire line circuit is established.

3.11 Conversation between telephone sets is provided through the sidetone network in the 4-wire CO line circuit.

3.12 Stations in the No. 309 Switching System provided with the line add-on conference feature originate and receive calls on 2-wire and 4-wire lines in the normal manner. Any of these lines may be associated with an add-on circuit. When a station has the ability to add lines on a conference circuit, one locking pickup key is required for access to the conference bridge. One nonlocking conference add-on key associated with each line to be added on is also required. To establish a conference connection, the originating station makes or receives a call on a line, informs the party of a conference and holds the connection, establishes a call on another line and holds that connection. The originator connects to the conference bridge by momentarily operating the locking add-on line pickup key. The add-on line key will light steadily. The originator momentarily operates the nonlocking conferencing key associated with each line on hold, transferring the line termination to the conference bridge. As the held lines are transferred to the bridge, the nonlocking conference key will light steadily and the line lamps associated with the lines on the bridge change from wink-hold to steady, indicating a busy condition at all stations.

3.13 The originating station can leave the conference to establish, answer, add on another line, etc, by placing the add-on line on hold. The bridge add-on pickup key will change from steady to

wink-hold. Under this condition lines that are connected to the bridge are in a conference condition. Originating stations can disconnect any line individually when connected to the bridge by reoperating the nonlocking conference key associated with each line. All lines can be disconnected simultaneously by operating the switch hook or by releasing the add-on pickup key. Bridge add-on line pickup and conference add-on circuits may multiple to any station in the system. Lines that will disconnect from an on-hook condition must have the hold feature to appear on the conferencing circuit. Lines that will not disconnect from an on-hook condition or are signal key lines, operator originating, etc, may not require the hold feature.♦

4. MAINTENANCE FEATURES

4.01 Test and maintenance features are included in the station equipment units to enable system maintenance personnel to make various maintenance tests.

4.02 Test jacks provided in the 4-wire subscriber line circuits permit testing toward the switching center or toward the voice and data equipment. The test jacks are located so that when a test is being conducted toward the switching center, the line (1C) pads are included in the circuit; when a test is being conducted toward the data equipment, the (1C) pads in the data paths are included.

4.03 A station may be equipped with a loop-back feature which, when operated, will loop the transmit and receive pairs at the station. This permits the connected test center to make loop transmission tests of the 4-wire subscriber line. The method of placing the 4-wire line in loop-back condition is described in 3.09.