FEATURE DOCUMENT

TRUNKING ARRANGEMENTS

NO. 3 ELECTRONIC SWITCHING SYSTEM

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FEATURE DEFINITION AND DESCRIPTION

1. DEFINITION

1.01 Trunking arrangements provide interconnections between one central office and another when a telephone subscriber places a call to a telephone not served from the originating central office.

1.02 In the No. 3 Electronic Switching System (ESS), provision of interoffice trunking requires that the office be capable of switching subscriber line circuits to various outgoing and incoming trunk circuits through the line and trunk switching network. "Trunk Circuits" are those control circuits that associate the switching network terminals with the transmission facility to distant offices. In addition to voice frequency transmission elements, they contain means for transmitting and receiving supervision from or to other offices and have one circuit on one circuit pack. The term "Trunk" is generally used to mean the entire channel from the switching network terminals of one office to the switching network terminals of another. This includes trunk circuits, signaling equipment, and transmission equipment as well as physical wires or carrier channels from one office to another.

1.03 The trunking arrangements for a particular No. 3 ESS office may be implemented using any current generic program. The specific hardware required to provide standard applications of the various central office trunking arrangements will be described here and is detailed in the HARDWARE ENGINEERING portion of this section.

1.04 The specific details for implementing the software associated with various trunking arrangements are found in the No. 3 ESS Translation Guide, TG-3.

2. DESCRIPTION

A. Customer (User) Perspective

2.01 When the customer desires to call a telephone served by another office, either a 7- or 10-digit number (with or without a prefix) must be dialed. The number will have the following format:

Prefix (If Required)	Area Code	Office Code	Station Number
0 or 1		NNX	XXXX
0 or 1	NXX*	NNX	XXXX
01 or 011	International		

* Current AT&T standard uses an 0 or 1 for the middle digit of the area code but the No. 3 ESS can handle any digit.

where: X = Any Number 0 through 9

N = Any Number 2 through 9

On calls outside the local calling area, a "1" prefix may be used to indicate no operator assistance is required. A "0" prefix indicates an operator is needed for such things as person-to-person calls, credit card, etc.

B. System Implementation

2.02 Several aspects of interoffice trunking are common to all types of trunks. These include the method of supervising the trunk, the types of address transmission (pulsing), and start dial signals. In addition to the above, the method of assigning trunk groups in the No. 3 ESS will be discussed.

Supervision

2.03 Supervision is the function of indicating and controlling the status of a call. In No. 3 ESS, two types of supervision may be used, loop and E&M. Loop with reverse battery (refer to paragraph 2.05) supervision is a method of signaling, utilizing the presence, absence, and direction of current in the tip and ring of the trunk conductors. E&M supervision is a method of signaling using the presence or absence of battery and ground on two leads (designated "E" and "M") between the trunk circuit and a signaling circuit associated with a transmission facility in the same building. Examples of loop and E&M signaling are shown in Figures 1, 2, 3, 4, and 5.

2.04 The terms ***on-hook*** and ***off-hook*** are generally used to refer to the idle or seized condition of the trunk. An idle trunk is said to be on-hook while a seized trunk is referred to as off-hook. Also, if a trunk is in a condition of

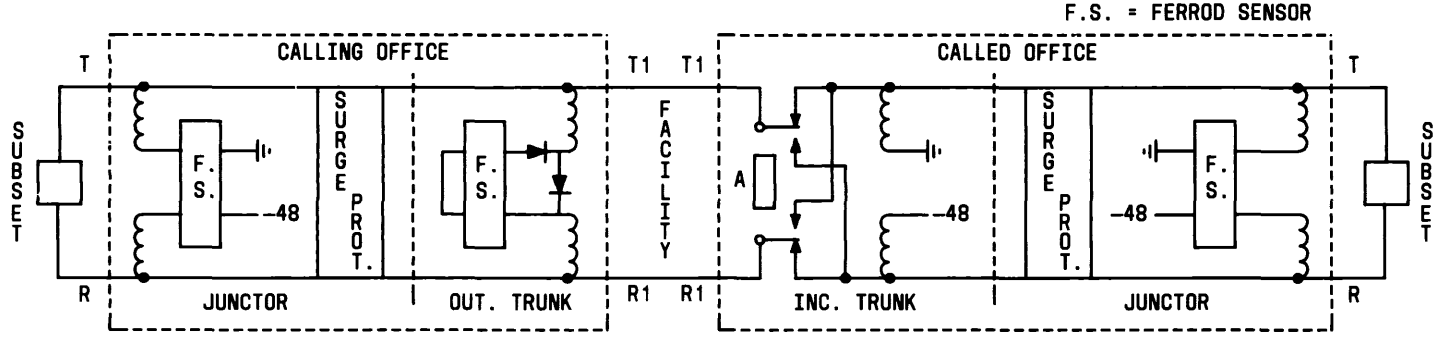

Fig. 1—Loop Reverse Battery Supervision

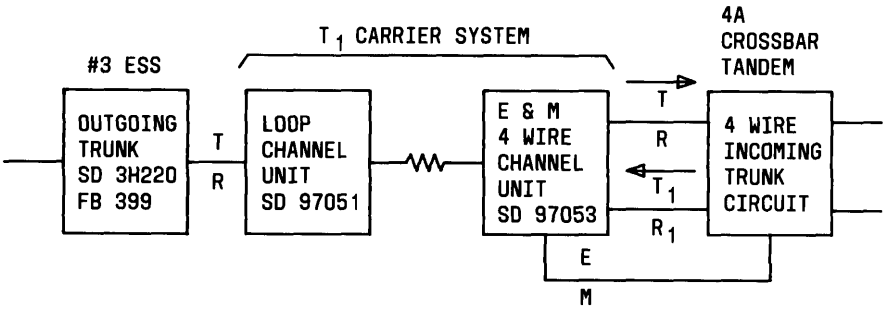

Fig. 2—Example of Combined Loop and E&M Operation

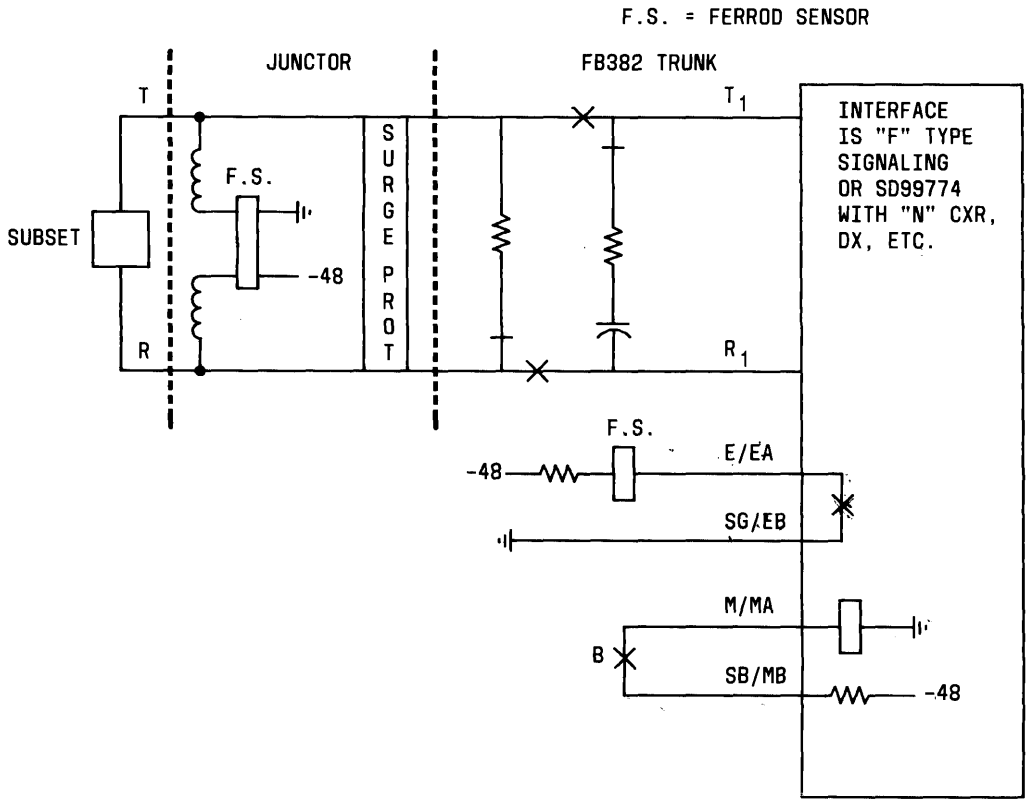

Fig. 3—Two-Way E&M Trunk Type II Interface

awaiting an answer from the called end, the called end is signaling on-hook toward the calling end. Answer of the call results in the sending of an off-hook signal back toward the calling end. Table A summarizes the physical conditions of both types of trunks in various states of supervision.

2.05 A loop type trunk with reverse battery supervision is used when it is convenient to signal over the transmission path. Refer to Figure 1 for an example of reverse battery supervision using SD-3H220/FB399 trunk circuit in an originating No. 3 ESS office connected by cable pair to another No. 3 ESS office using an SD-3H220/FB371 trunk circuit as an incoming trunk. Signaling in the forward direction is affected by a dc closure (off-hook) or an open (on-hook). In the reverse direction (supervision), an off-hook is recognized by ground

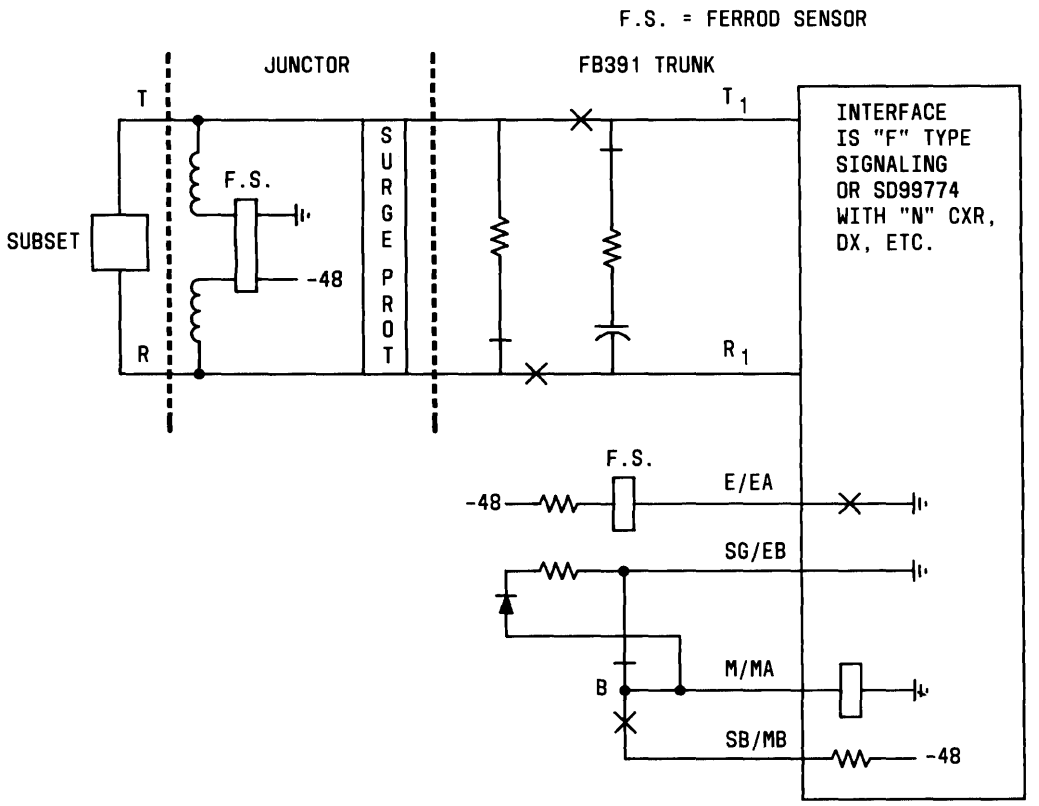

Fig. 4—Two-Way E&M Trunk Type III Interface

on the ring and battery (-48V) on the tip. The on-hook signal is the reverse of the above condition.

2.06 E&M signaling is used when it is necessary to interface with other trunk equipment in the same building that requires E&M lead signaling such as some types of N CARRIER channel units. Figures 3 and 4 (refer to paragraph 2.07) show the interconnection required between No. 3 ESS trunk circuits and E&M signaling units. It is not necessary to use E&M trunks when interfacing with T CARRIER facilities because there are loop signaling channel units available for use in the T CARRIER system. An ESS loop signaling trunk circuit may be directly connected to a T CARRIER loop signaling unit without regard to the type of signaling required at the distant end. See Figure 2 for a typical example of this type of trunk arrangement.

2.07 With FB382 Type II interface, the interface relay operates and places a closure on the E/EA and SG/EB leads which saturates the ferrod sensor to indicate an incoming signal to the trunk circuit from the distant end. The B relay in the trunk circuit places a closure on the M/MA and SB/MB leads, operating the interface relay. The interface relay being operated indicates an outgoing signal toward the distant end. (See Figure 3.) With FB391 Type III interface, the interface relay operates and places a ground on the E/EA lead which saturates the ferrod sensor to indicate an incoming signal to the trunk circuit from the distant end. The B relay in the trunk circuit, when operated, removes ground from the interface on the SG/EB lead. The B relay also places battery from the interface on the SB/MB lead onto the M/MA lead, operating the interface relay. Operating the interface relay indicates an outgoing signal toward the distant end. (See Figure 4.) A direct interface is a junctor unit SD-3H200 to "T" carrier D4 channel unit facility without the presence of a trunk circuit. In the junctor unit, the peripheral decoder (PD) points send signals and the ferrod scanner (FS) detects signals directly with the "T" carrier D4 channel unit. An incoming signal, from the distant end, places battery from the channel unit toward the junctor unit on the EA lead which saturates the ferrod scanner in the junctor unit.

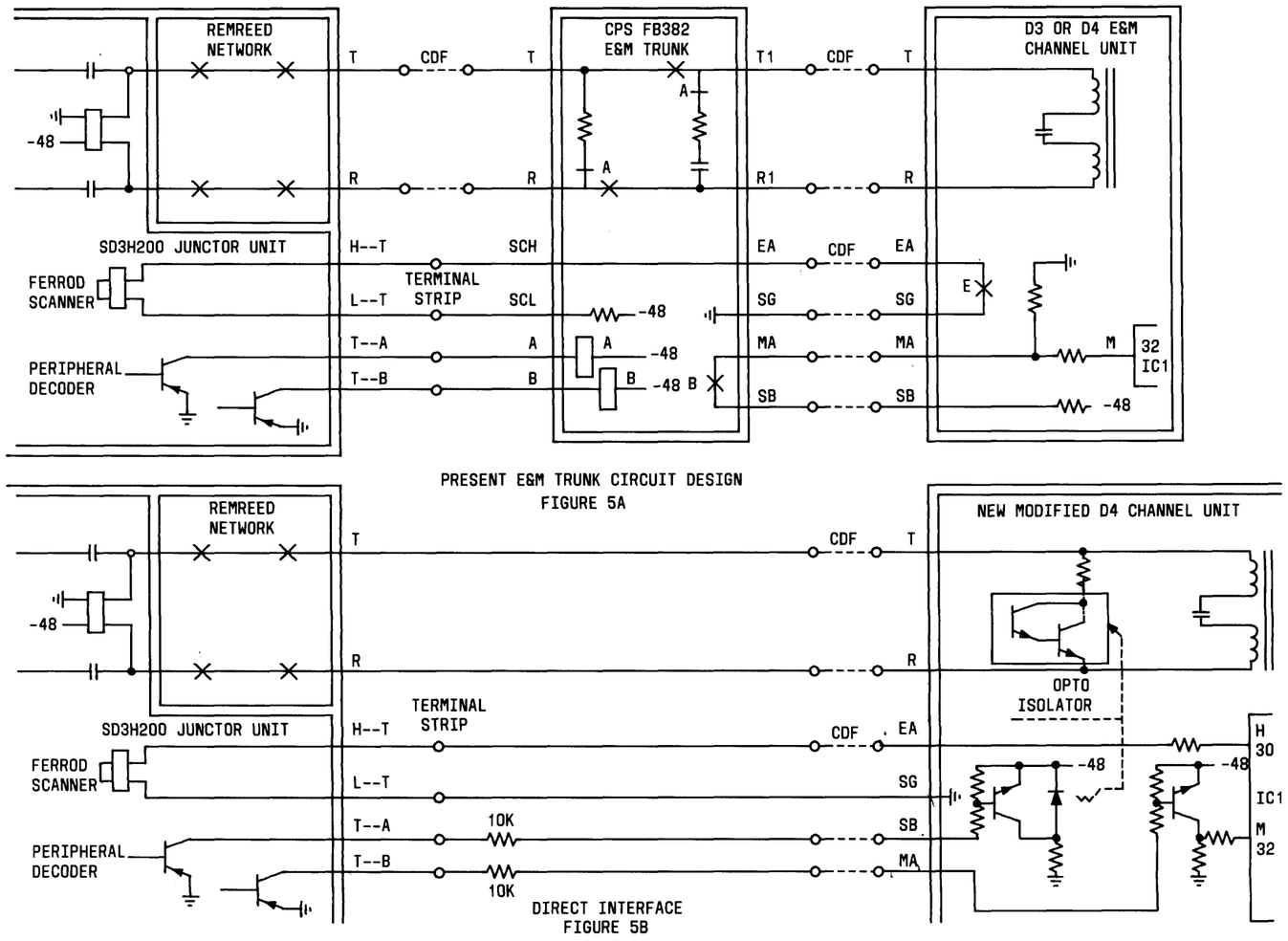

Fig. 5—Comparison of the Present E&M Trunk With Direct Interface

TABLE A

SUPERVISORY STATES

CONDITION	LOOP REVERSE BATTERY TRUNK	
	CALLING END	CALLED END
ON-HOOK	NO CURRENT FLOWING IN LOOP	BATTERY ON RING GROUND ON TIP
OFF-HOOK	CURRENT FLOWING IN LOOP	BATTERY ON TIP GROUND ON RING
	E & M TYPE II INTERFACE TRUNK	
ON-HOOK	OPEN ON "M" LEAD	OPEN ON "E/EA" LEAD
OFF-HOOK	BATTERY ON "M" LEAD	GROUND ON "E/EA" LEAD
	E & M TYPE III INTERFACE TRUNK	
ON-HOOK	GROUND ON "M" LEAD	OPEN ON "E/EA" LEAD
OFF-HOOK	BATTERY ON "M" LEAD	GROUND ON "E/EA" LEAD
	E & M TYPE DIRECT INTERFACE	
ON-HOOK	OPEN A & B NO CURRENT IN "M" LEAD	OPEN ON "E/EA" LEAD
OFF-HOOK	GROUND ON A & B AND CURRENT IN "M" LEAD	BATTERY ON "E/EA" LEAD

To indicate an outgoing signal, the peripheral decoder, under program control, places a ground on the B lead to the channel unit. This saturates the transistor in the channel unit which places battery on the M lead and sends a signal to the distant end. To remove the idle circuit termination from the T and R leads, the peripheral decoder places a ground on the A lead saturating the transistor in the channel unit. Saturating the transistor removes the current from the light

emitting diode (LED) causing the opto-isolator to remove the idle circuit termination from the T and R leads. (See Figure 5b.)

Pulsing Types

2.08 Two methods are used in No. 3 ESS for transmitting and receiving called telephone numbers to and from distant offices. These are dial pulsing (DP) and multifrequency pulsing (MF). Dial pulsing is generally used on trunks to step-by-step offices. It may be used to common control offices (crossbar and ESS) but considerable savings in equipment and setup time can be realized by utilizing MF on trunks to these types of offices.

2.09 Dial pulsing is a type of dc signaling utilizing either the trunk tip and ring conductors or E&M leads. It consists of an initial off-hook signal (seizure) and a series of on-hook pulses, the number of which correspond to a dialed digit. Between digits, there is a fixed interdigital time of 750 milliseconds. Pulsing speed is a nominal 10 pulses per second and the percent break (ratio of on-hook to the total pulse period) of the pulses is 60 percent. See Figure 6 for a graphical representation of a dialed digit.

2.10 Multifrequency pulsing is a system of transferring number information over trunks by various combinations of two and only two of six frequencies in the voiceband. Each combination of two frequencies represents a digit. Ten combinations are used for the digits 0 through 9 and one each for signals indicating the beginning (KP) and end (ST) of pulsing. The remaining three combinations are reserved for special signals. Table B shows the relation between the digits and frequency combinations. Multifrequency pulsing may be used with any of the No. 3 ESS interoffice trunks which require pulsing and should be employed where far office requirements make this possible. Since MF pulsing requires less setup time per call, a relatively small number of MF transmitters and receivers are required, compared to dial pulsing arrangements.

Start Dial Signals

2.11 Common control offices may require some amount of time (a few hundred milliseconds to several seconds depending on traffic load) to prepare for the reception of dialing signals on incoming trunks. A start dial signal is sent from the called office when it is ready to accept these signals. The No. 3 ESS office can accept and provide two types of start dial signals. These are delay dial and wink. No start dial signal is given or received from nonsenderized step-by-step offices as the switching elements in these offices are under direct control of the customer's dial.

2.12 A delay dial signal is defined as an initial off-hook signal, which may start as an on-hook and change to off-hook when the seizure is detected, transitioning to an on-hook signal when

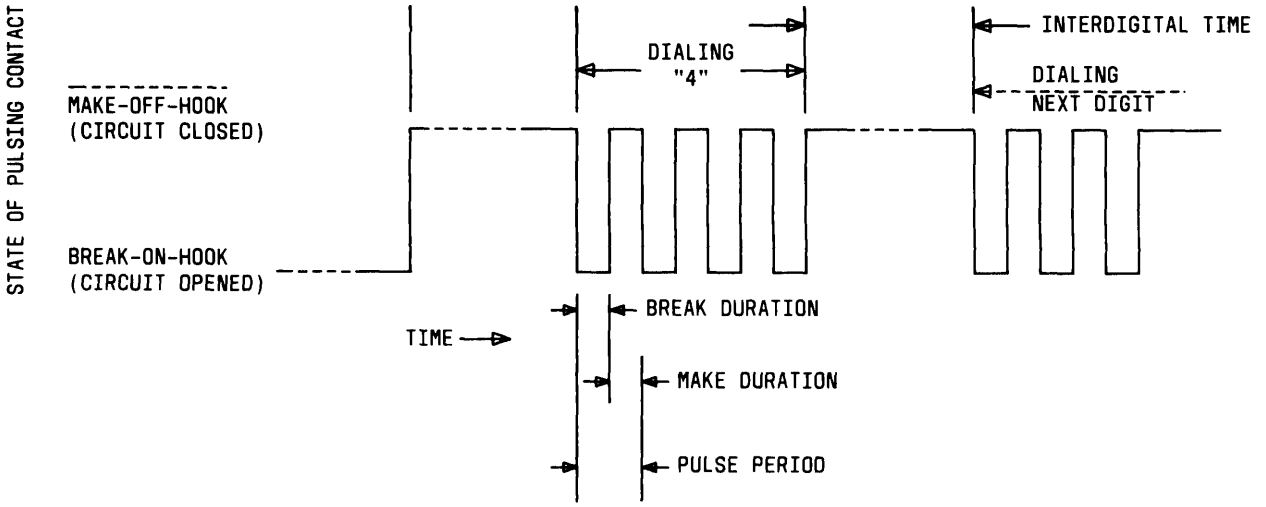

Fig. 6—Dial Pulsing

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OFF-HOOK	BATTERY ON "M" LEAD	GROUND ON "E/EA" LEAD
	E & M TYPE III INTERFACE TRUNK	
ON-HOOK	GROUND ON "M" LEAD	OPEN ON "E/EA" LEAD
OFF-HOOK	BATTERY ON "M" LEAD	GROUND ON "E/EA" LEAD
	E & M TYPE DIRECT INTERFACE	
ON-HOOK	OPEN A & B NO CURRENT IN "M" LEAD	OPEN ON "E/EA" LEAD
OFF-HOOK	GROUND ON A & B AND CURRENT IN "M" LEAD	BATTERY ON "E/EA" LEAD

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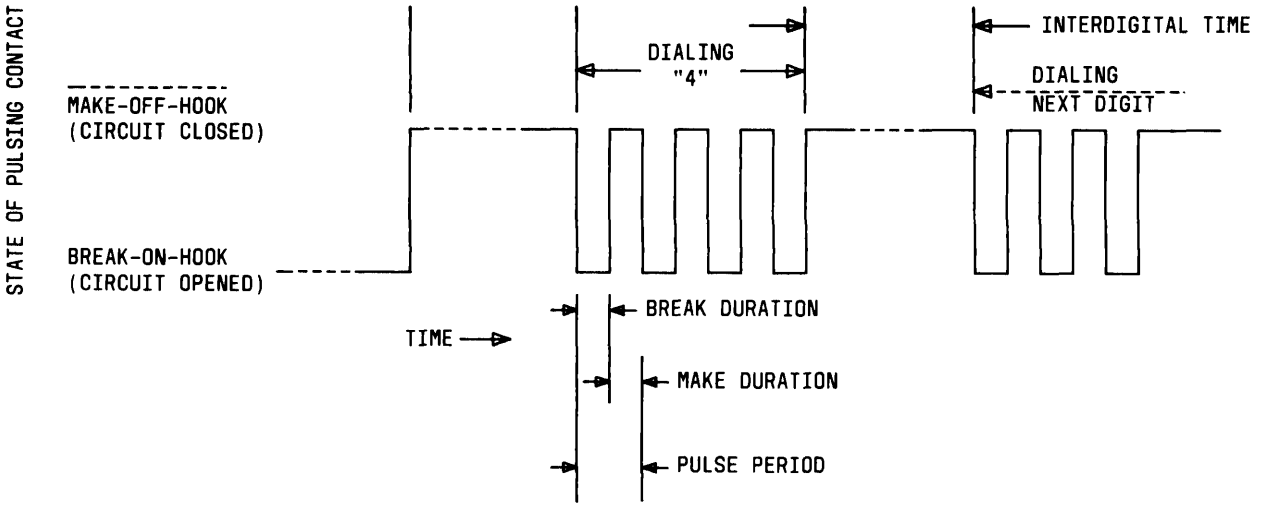

Fig. 6—Dial Pulsing

TABLE B

FREQUENCIES FOR MF PULSING

900	1				
1100	2 or CC	3	DIGITS		
1300	4	5	6		
1500	7	8	9	0	
1700	ST3P or Rering	STP	KP or CR	ST2P	ST
Frequency	700	700	1100	1300	1500

CC — Coin Collect

CR — Coin Return

KP — Keypulse (beginning of pulsing)

ST
STP
ST2P
ST3P — START (end of pulsing, indicating different classes of calls in different systems)

(Note: STP is sometimes called ST1P)

ST only is used to a 3CL switchboard. With TSPS, the various START signals have the following meanings:

ST — Coin, 1+ or no prefix

STP — Coin, 0+ prefix, or 0—

ST2P — Non Coin, 1+ or no prefix

ST3P — Non Coin, 0+ prefix, or 0—

pulse receiving equipment is ready to accept pulses. This type of start signal is in general use in the switching network by toll tandem machines such as 4A crossbar, etc. (Note) If there is a choice, wink should be used due to the possibility of false charging. See Figure 7A. E&M signaling, Type II, III, and Direct Interface references shall be made to SD-99421-01 and Section 179-100-301.

2.13 A wink signal is defined as a momentary on-hook/off-hook/on-hook signal (140- to 290-millisecond off-hook interval) when pulse receiving equipment is ready to accept pulsing. This system is in general use in the local switching network between common control offices. See Figure 7B.

TRUNK NUMBERING SCHEME

2.14 Trunk and service circuit groups are assigned group numbers in a definite pattern according to their function. A 3-digit trunk group number is assigned to each group. Group numbers 000 to 063 are reserved for multiline hunt groups. Group numbers 064-127 are reserved for service circuits.

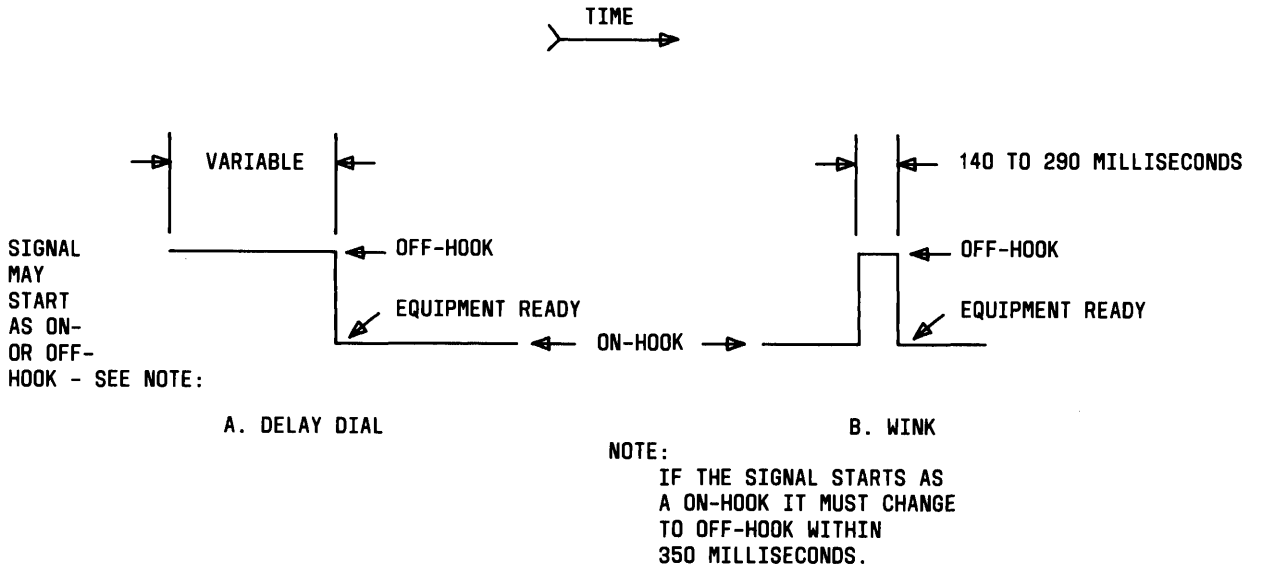

Fig. 7—Delay Dial and Wink Start

Group 128 is reserved for a spare and testing group of SD-3H220 type trunks, but other groups may be used. Each CPS-FB-XXX must be in its own dummy group for spare and testing. FBs of different numbers cannot be mixed in the same trunk group. Groups 129 to 255 are available for assignment of trunk groups as determined by the telephone company.

2.15 Member numbers of individual trunks can range from 000 to 127.

ALTERNATE ROUTING

2.16 Alternate routing is the feature of the No. 3 ESS by which a call, after encountering an "all trunks busy" condition in the first choice route, is offered another route to, or toward its destination. An example of the use of this feature is where a small outgoing high-usage trunk group exists between the No. 3 ESS and another local office. Calls can be made to overflow into a tandem trunk group when all the trunks in the small group become busy.

2.17 The means of implementing this feature is contained in The Route Index Expansion Translations (ESS Form 3303). On this form, an "Alternate Route Index" may be specified as an alternate route. Three route indexes may be linked together in any one alternate route arrangement. If no alternate route exists for the route or if the route is the final route, the Alternate Route Index Column is left blank. See TG-3, Division 5, Section 3d for details.

OUTGOING TRUNK FUNCTIONS—BASIC CONSIDERATIONS

2.18 The outgoing trunk function is that function which provides the interconnection between a customer that originates a call in a No. 3 ESS office directed to another office. This function may be classified into two general types, automatic (dial) operation and manual operation. Automatic operation involves interfacing the No. 3 ESS with another automatic type office (ESS, crossbar, etc.) in which a directing address (telephone number) must be forwarded over the trunk facility to the terminating office. Manual operation implies no address information is needed by the terminating office to route the call. For example, simply seizing a trunk to a repair service desk is enough information to establish a connection to the repair attendant.

2.19 In addition to the general trunk operating methods outlined in paragraphs 2.02 through 2.13, there are several operating features unique to outgoing trunks. These are:

- Digit prefixing and deleting

- Overlap outpulsing
- Access codes
- Trunk diagnostics.

Digit Prefixing and Deleting

2.20 To facilitate routing flexibility, one to six or all leading digits of the dialed telephone number may be deleted from the digits outpulsed to the terminating office. In addition, up to three arbitrary digits may be prefixed to the string of outpulsed digits. Each trunk group's Route Index Expansion table has provision for specifying the digits to be prefixed and/or the number of digits to delete. See the TG-3, Form 3303 for details on using this feature.

Overlap Outpulsing

2.21 When an outgoing trunk uses dial pulsing as its method of signaling, overlap outpulsing may be specified. This allows outpulsing to start after reception of the first three digits from the customer, as opposed to waiting for the entire telephone number to be stored in the originating register before the start of outpulsing. Digit deletion beyond three digits is not possible because only three digits have been received at this point. Any prefixed digits specified will be outpulsed immediately, then succeeding digits are outpulsed as they are received from the customer. Holding time of transmitters is increased to realize savings in call setup. This is trading off to realize a greater saving. See the Trunk Feature Table (ESS Form 3204) section in the TG-3 for implementation of this feature.

Access Codes

2.22 As described in the Customer (User) Perspective Part of this section, the subscriber may be optionally required to dial a 0 or 1 prefix before dialing the telephone number. Options exist to either require or prohibit dialing a "1" prefix for any particular 3-digit code (first three digits of a 7- or 10-digit telephone number). Also a "1" prefix may be ignored or allowed on any 3-digit code. The "0" prefix may be specified for any 3-digit code. When so specified the "0" may or may not be dialed depending on whether operator assistance is needed. These options are implemented by the proper completion of the Code Index Table (ESS Form 3304) see the TG-3 for details.

Trunk Diagnostics

2.23 A request for a test of a trunk can be initiated from these test request sources:

- Maintenance TTY
- Trunk and Line Test Panel

A trunk may be taken out of service by the error analysis subroutine when the error rate exceeds the required amount. Certain outgoing, nonoperator trunks can be tested through to the distant office according to a schedule in the traffic work table. Tests to a permanent busy number (in the distant office) can be made on all trunks that are tested in this manner. Operational tests, ie, tests that check the supervisory features of the trunk may also be made when the distant office is equipped with a synchronous or nonsynchronous test line. SD numbers of trunks that may be diagnosed in this manner are as follows:

SD-3H220/FB382

SD-3H220/FB391

SD-3H220/FB399

Direct Interface.

See the Automatic Trunk Test Table (TG-3 Form 3505) for implementation of this feature when it becomes available.

UNIVERSAL TRUNK CIRCUIT (SD-3H220)

2.24 All trunk circuits in No. 3 ESS consist of individual circuit packs and are mounted in a Universal Trunk Unit except incoming local test desk trunk. This in turn is mounted either in the network frame, or additional growth units may be mounted on the control or miscellaneous frames. Each Universal Trunk Unit can accommodate 24 FB-type trunk circuit packs. At present, these are the codes of trunk circuit packs available:

- FB391—Two-way E&M Type III Interface
- FB382—Two-way E&M Type II Interface

- FB370—Incoming Reverse Battery Delay Dial
- FB371—Incoming Reverse Battery Wink or Immediate Start
- FB399—Outgoing Reverse Battery High-Low
- There is also a direct interface.

In addition, the FB519 Incoming Local Test Desk Trunk is mounted in the Peripheral Test Circuit (SD-3H520). Throughout the remainder of this section, the trunk circuits will be referred to by their circuit pack codes, and it will be understood that they are mounted in their respective universal trunk circuits or peripheral test circuit.

AUTOMATIC (DIAL) OPERATION

Interoffice Trunks

2.25 Outgoing trunks from a No. 3 ESS to a local or tandem dial central office will use FB399 as the trunk equipment. Proper selection of dial pulse or multifrequency pulsing, type of start dial signal, overlap outpulsing, etc, will depend on the type of terminating office as covered in the general trunk operating methods of this description.

2.26 If E&M lead signaling is required at the originating end because of transmission facility arrangements, FB382 with Type II interface should be used because of noise considerations, but FB391 with Type III interface can be used or a direct interface may be used. This trunk circuit is intended to be used as a two-way trunk but one-way operation is possible. It may also be used as a substitute for FB399 providing E&M transmission facilities are available at the originating end.

Centralized Automatic Message Accounting (AMA) Trunks

2.27 For offices without AMA or when it is otherwise desirable to record billing information at another location, (eg, for directory assistance charging), a CAMA trunk group may be set up. This trunk group usually connects to a crossbar tandem office equipped with AMA, although several other tandem-type offices may be available. Appropriate routing and trunk group information must be entered in translations, such as 1+ or 0+ prefixing if required, the proper trunk type marked in the Trunk Feature Table (CAMA) and all other usual information pertaining to outgoing trunks, (type of pulsing, supervision, etc).

2.28 The hardware required for this type trunk group is as follows:

- Direct interface
- FB399 (Hi-low and reverse battery supervision)
- FB382 (E&M supervision)
- FB391 (E&M supervision).

When possible, loop supervision methods should be used at the originating end of a carrier facility and converted to E&M signaling at the terminating end.

Traffic Service Position System (TSPS) Trunks

2.29 When operator services (ie, local assistance, person-to-person collect calls, credit card, etc) are provided by a TSPS, a trunk group from the No. 3 ESS to a toll office with TSPS trunk circuits interposed is established. This trunk group may be considered as one connecting the No. 3 ESS and TSPS even though the ultimate connection is onward through the TSPS to the toll office. The TSPS only provides the switching and control to the operator position through a bridged connection. When the operator functions are completed, the TSPS disconnects the operator and sets up the through connection to the toll office.

2.30 Special translation treatment for this type of trunk group consists of 0 or 1 prefix treatment in the Code Index Table and the proper trunk type (TSP, TSPS) marked in the trunk feature table. Multifrequency pulsing should also be specified in this table.

2.31 The trunk circuit type used for TSPS trunk is the FB399 when loop supervision is appropriate. Use the FB382 and FB391 two-way trunk circuit and direct interface as an outgoing trunk when E&M lead signaling is necessary.

Automatic Intercept System (AIS) Trunks

2.32 AIS is a system to route a call placed to a nonworking number to equipment that provides recorded announcements specifically tailored

to each intercept case. When a call to a nonworking number is processed by the No. 3 ESS, the called number is outpulsed over the AIS trunk before the calling number is connected. The AIS will then provide an automatically assembled recorded announcement or route the call to an intercept operator as appropriate.

2.33 Translation treatment for AIS will involve the entry type in the route index expansion table, in addition to specifying MF pulsing on the trunk feature table. Delay dial or wink start signal is specified according to the requirements of the AIS. Loop or E&M signaling may be used depending on the transmission facilities available.

2.34 If loop supervision is possible at the No. 3 ESS use an FB399 trunk circuit. If E&M signaling is required because of transmission facility arrangements at the originating end use an FB382 and FB391 two-way trunk circuit and direct interface as a one-way trunk.

MANUAL OPERATION

Recording Completing Trunks (3CL)

2.35 When operator services are provided by a 3CL switchboard any one of several types of trunk groups may be created depending on individual office needs. The following are examples of different types of trunk groups that may be required:

- "0-" Assistance (Noncoin)
- "0-" Assistance (Coin)
- "0-" Assistance (Coin Dial-Tone-First)
- Manual Operator
- Emergency Services.

2.36 When assistance services (0-) are provided to customers from a 3CL switchboard, it is sometimes desirable to segregate customers by class of services such as coin or noncoin, flat rate, or message rate, etc, in order that the proper charge treatment may be made or for other traffic operating reasons. There are zip line class of service tones that the operator may hear on the same trunk group for identification of the incoming caller.

2.37 No special provisions are required to provide +48 volt supervisory battery for dial-tone-first coin lines. This function is provided by the Dial-Tone-First Coin Line Circuit (SD-3H205/FB428) associated with each coin line.

2.38 When manual telephone service is to be provided (eg, for handicapped customers) a special trunk group may be set up for this purpose. Also 911 emergency service may be provided by a special group of 3CL trunks in lieu of a public assistance bureau (external to the telephone company organization). Nine-one-one (911) service can also be provided by using an FB371 as an outgoing line circuit where tip and ring reversals are required. In this case, the line is supervised by the trunk detector circuit. The 911 line can be rung with the trunks in the bypass state.

2.39 Translation treatment for 3CL trunk groups requires setting loop and joint hold for supervision in the Trunk Feature Table. Also, proper service code routing (0, 911) and class of service screening must be provided. In the case of the manual class of service, the use of a special line class code (major class 10) will cause call processing to route an originating call attempt directly to the manual operator trunk group. No dial tone is sent to the customer. See TG-3 forms 3300, 3301 and 3306 for details.

2.40 The hardware required for 3CL application is the FB382 or FB391, ie, E&M or FB399 if loop or a direct interface.

Intercept and Directory Assistance

2.41 When manual intercept service is required (as opposed to an AIS), disconnected or unused directory numbers are routed to a trunk group connected to a manual intercept bureau.

2.42 Three types of intercept service can be provided over the same trunk group. These are:

- Machine intercept—used for unassigned or vacant number treatment
- Regular intercept—used to provide operator handling of disconnected numbers requiring number change information

- Trouble intercept—used when called number is in the "plugged up" state (trouble in outside plant).

2.43 These types of intercept services are implemented by assigning directory numbers requiring intercept to one of three route indexes that point to the intercept trunk group. Each route index will have a different call type to specify the intercept treatment required. See TG-3, Division 5, Section 3d for details on constructing route index expansion tables to meet these requirements. Loop supervision, regular hold and DP outpulsing must be specified in the Trunk Feature Table for the trunk group. All digits must be deleted and a prefix of 1, 2, or 3 inserted to distinguish between the three types.

2.44 Hardware required to implement this type of trunk is the FB382 or FB391 if E&M or FB399 if loop or direct interface.

2.45 Directory assistance is provided in a similar manner except multiple route indexes are not required and either FB382 or FB391 if E&M or FB399 if loop or direct interface may be used depending upon requirements of the directory assistance office.

Repair Service Trunks

2.46 A special trunk group should be established from a No. 3 ESS to a No. 2 repair service desk. These trunks enable the repair attendant to busy out the trunk circuit from the repair position or alternately to route calls to another group of trunks, possibly to a different repair bureau. Either a 3-digit service code (611) or a regular 7-digit telephone number may be used to access the repair desk trunk group. This type of call should be free of charge. A route index is assigned to the telephone number or service code. The route index then points to the repair service trunk group. Trunk circuits FB382 or FB391 if E&M or FB399 if loop or a direct interface provide the necessary hardware to implement the Remote Make Busy feature.

Local Test Desk

2.47 No provision is made for LTD test trunks outgoing from the No. 3 ESS to the test position. Testing is accomplished by the outside repair person calling the test desk over regular telephone facilities and the test person then originates a call incoming to the ESS via the no-test trunk. This type trunk will be covered in the incoming trunk portion of this document.

INCOMING TRUNK FUNCTION

Basic Considerations

2.48 The incoming trunk function is that function which provides the interconnection between a call originated in another central office and a customer in the No. 3 ESS. In noncentrex trunking, only automatic (dial) type trunks exist; there are no incoming manual type trunks.

2.49 In addition to the general trunk operating methods outlined in paragraphs 2.02 through 2.13, there is a unique method of operation for all DP reception, that is, all receptions are done on the ferrod of the trunk (there are no DP receivers).

Bylink Operation

2.50 Normal incoming trunk processing may require that a digit receiver be associated with the incoming trunk. When this is accomplished, a wink is sent to the originating office to indicate readiness to receive pulsing. This may take from 250 milliseconds up to several seconds depending on office load. In nonsenderized step-by-step offices, pulsing is under direct control of the customer's dial. Therefore, the immediate need exists to detect and store pulses that may arrive at the No. 3 ESS. This is done by scanning the trunk side ferrod of the incoming trunk for dial pulses. A TCR, selected on interrupt level, is then used to accumulate the dialed digits. Thus, time is saved since the call processing programs need not find and connect receivers and network paths before collecting digits.

2.51 Incoming E&M trunks that use dial pulse signaling receive the pulses over the E lead. To prevent call processing from interpreting pulses as a series of on-hook hits, the bylink method of digit collection is used. All phases of processing E&M trunks are identical to the way bylink trunks are handled with the exception that E&M trunks are allowed to return a start dial over the M lead if a start dial signal is required. Therefore, E&M trunks may be used for other applications.

TANDEM OPERATION

2.52 The No. 3 ESS switching network presents no problems for tandem operation, in that, any terminal (trunk) can be connected to any other terminal (trunk). Surge protection and dc blocking are provided in the junctor which is switched in between the incoming and outgoing trunks in the "trunk-to-line" or "line-to-trunk" state with the "line" side towards the incoming trunk and the "trunk" side towards the outgoing trunk (see Figure 8). The junctor ferrods must both indicate "on-hook" during tandem operation. Supervision will be monitored at the trunks. The following restrictions apply:

(1) When using inband signaling from an operator, no operator functions are available.

(2) Toll tandem operation will not function properly with No. 3 ESS.

AUTOMATIC (DIAL) OPERATION

Interoffice Trunks

2.53 Incoming trunks from local or tandem dial offices may utilize the following trunk circuit types:

- FB371 Reverse Battery Supervision
- FB382 Two-way E&M Signaling
- FB391 Two-way E&M Signaling
- FB370 Reverse Battery-Delay Dial
- Direct Interface.

2.54 The two-way trunk circuits may be used as one-way incoming.

2.55 Translation data required to implement the incoming trunk function is covered in Part 11 of this section and in the TG-3.

Toll Switching Trunks

2.56 When operator services are provided by a 3CL toll switchboard and toll switching trunks are required from the switchboard to the No. 3 ESS, they can be provided by using the FB382, FB391, FB370, FB371, and direct interface trunk circuit. These circuits are used as incoming trunks and can provide the controlled ring function and coin signaling as required. If a verification trunk is required, these circuits may be used as no-test trunks to verify a busy number or provide emergency communication to a busy number through the use of the no-test vertical in the No. 3 ESS.

Local Test Desk (LTD) Trunks

2.57 The purpose of these trunks is to provide a means of establishing a metallic test connection from a No. 14 test desk or a No. 3 test cabinet to a customer line through the No. 3 ESS. The connection is made through the regular switching network path if the line is idle or through the no-test vertical if the line is busy. Provision is made to send various supervisory signals back to the test position (flashes, interrupted tone, etc) when various conditions are encountered. The trunk circuit used for this application is FB519. Construction of this type trunk group is similar to

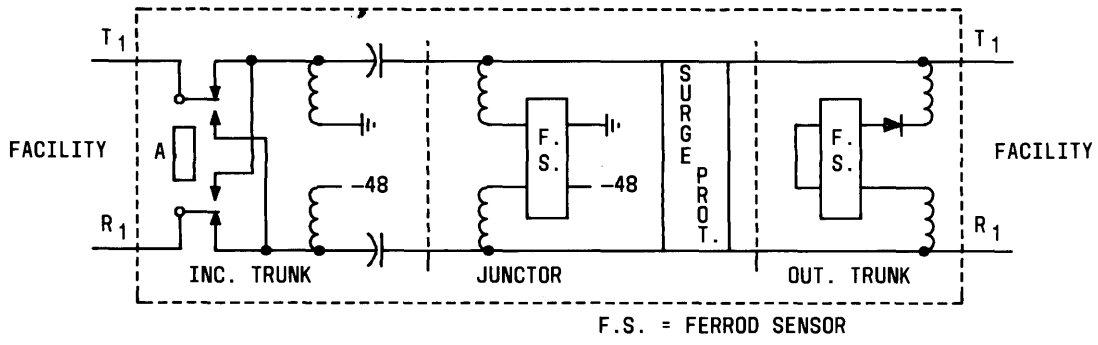

Fig. 8—Tandem Connection

other incoming trunk groups with the exception of the REMOTE TEST EQUIPMENT and NO-TEST mark in the trunk feature table (ESS Form 3204).

TWO-WAY TRUNK FUNCTION

Basic Considerations

2.58 It is sometimes desirable for traffic engineering reasons to provide a trunk group with combined incoming and outgoing functions. This may be done in No. 3 ESS by using FB382, FB391, and direct interface trunk circuits and constructing translation data as if the trunk group was both an incoming and outgoing group. In particular, the trunk direction portion of the Trunk Feature Table, ***both*** incoming and outgoing columns, should be marked. In other translations, the trunk group should be considered as a one-way group.

2.59 Two-way trunks are subject to occasional simultaneous seizures at both ends because of the unguarded interval between the seizure of the trunk at one end and the consequent making busy of the trunk at the other end. This is called "glare." In No. 3 ESS, provision is made for resolving this conflict by providing a special mark (Glare) in the trunk feature table. A check mark in this column indicates that the No. 3 ESS relinquishes control of the trunk when a glare situation occurs. The absence of a check mark indicates that the distant office must relinquish control. If the outgoing portion of the trunk in the No. 3 ESS is utilizing delay dial, the terminating office must back off under glare conditions, since the No. 3 ESS cannot check for glare in this case. A check mark in the "no start" column of the trunk feature table will cause the No. 3 ESS to back off in a GLARE condition on an immediate start type of trunk.

Automatic (Dial) Operation

2.60 Two-way trunks between a No. 3 ESS and a local or tandem dial central office use three types of trunk circuits.

- FB382 and FB391—used when E&M leads are necessary to interface with the near-end transmission facilities. Either dial or multifrequency pulsing may be used.

- Direct Interface.

EXAMPLES OF TYPICAL CALLS

2.61 The following paragraphs describe the sequence of actions that occurs when a typical outgoing call to a dial office is placed (refer to Figure 9). After the customer dials the desired number, the No. 3 ESS will:

(a) Determine from the dialed digits the trunk group required to route the call.

(b) Select an idle trunk from this group for use on this call.

(c) Select and connect through the network the proper type of transmitter (dial pulse or multifrequency)* and wait for start dial signal if required.**

(d) Transmit the required portion of the called telephone number to the distant office over the selected trunk.

(e) Remove the transmitter network connection.**

(f) Establish talking connection and supervise for answer if charging is required.

(g) Supervise call for disconnect.

(h) When disconnect occurs, idle network connection and trunk, restore line ferrod, and resume line scanning.

2.62 In the case of an incoming call the sequence is as follows (see Figure 10):

(a) Recognize the arrival of a call on an incoming trunk and connect an MF receiver, if required*** to the trunk through the network and send start dial signal, if required.

(b) Collect incoming dialed digits and translate them to the called customers appearance on the network.

(c) Apply ringing current to called customer's line.

(d) Return audible ringing tone to calling customer from junctor circuit.

(e) When called customer answers, establish a talking connection through the network

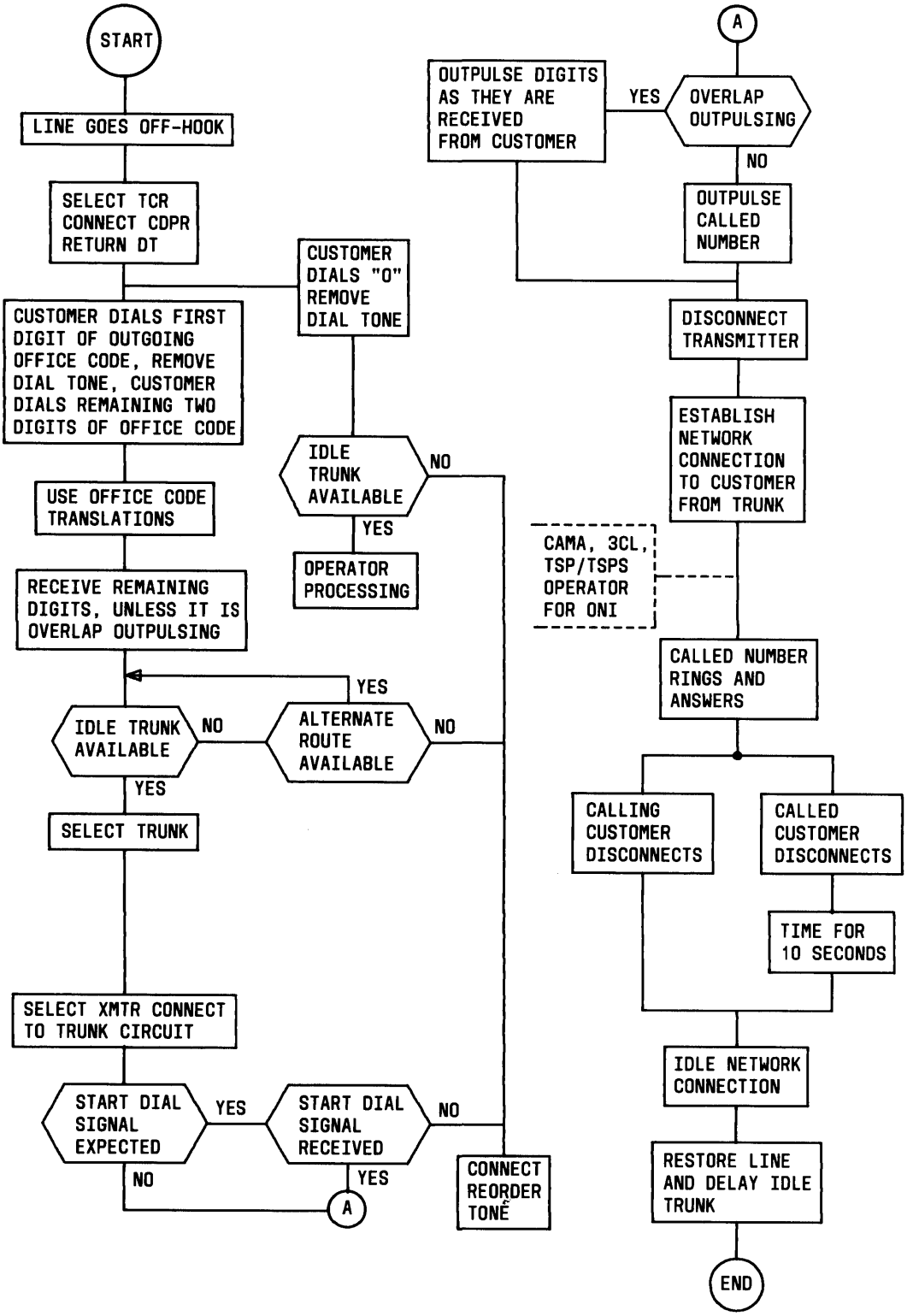

Fig. 9—Outgoing Call

between the incoming trunk and the called customer's network appearance. Check for free number and return supervision, if required.

(f) Supervise for disconnect.

(g) Disconnect network connection.

*Steps c, d, and e are omitted on a manual outgoing trunk call.

**Steps c and e are omitted on E&M and direct interface trunks.

***If the bylink feature is being used, a receiver is not connected. Dial pulses are detected by scanning the trunk ferrod.

3. FEATURE FLOW DIAGRAM

3.01 Feature flow diagrams giving the functional operations of incoming and outgoing calls are shown in Figures 9 and 10.

4. INTERACTIONS

4.01 Interactions with other features within the No. 3 ESS and with other offices are of a general nature and are covered in other paragraphs of this section.

ATTRIBUTES

5. STATION/SYSTEM

5.01 The various trunking arrangements are provided on a per-office basis.

5.02 Trunk circuits are provided on two types of frames, network frames and miscellaneous frames. The network frame can accommodate one universal trunk circuit which in turn can contain 24 trunk circuits. There can be a maximum of 15 network frames per office. Additional universal trunk circuits may be mounted on the miscellaneous or control frames.

6. LIMITATIONS

6.01 The No. 3 ESS has a maximum capacity of 128 separate trunk groups with a maximum of 128 trunk members in any given group. Trunk group numbers must be assigned starting with trunk group number 129 to 255.

7. RESTRICTION CAPABILITY

7.01 Restriction of certain lines or groups of lines by class of service to the various trunk groups can be accomplished by using special line class codes and line screening codes. The method used involves translators set up by use of ESS Form 3301 Rate and Route Table and Form 3306 Line Class Code Table. The description and procedure is given in the TG-3, Division 5, Section 3b and 3f.

8. COST DATA

8.01 Each trunk in the No. 3 ESS requires one mounting position in a universal trunk circuit except the incoming local test desk trunk (FB519) which requires one mounting position on the test frame. In addition, each trunk requires one office equipment number appearance on a network frame.

8.02 Translation store word requirements consist of:

- Trunk Group Data Table: Eight words per trunk group
- Member List: For each trunk group one word plus two words per member.

8.03 Temporary (writable) store requirements consist of:

- Selection Status Blocks—One per trunk group consisting of five words plus one word for each sixteen trunk members.

8.04 Other related memory requirements are the remainder of translation tables related to routing and charging. This is dependent on the particular office routing plan rather than the total number of trunks and/or trunk groups.

INCORPORATION INTO SYSTEM

9. PLANNING

9.01 In planning the initial trunking job, completion of translation input forms listed in OFFICE DATA will be required. An ODA run will usually be required when the volume of input data is such that it is impractical to submit the data by normal recent change procedures. Normal lead time should

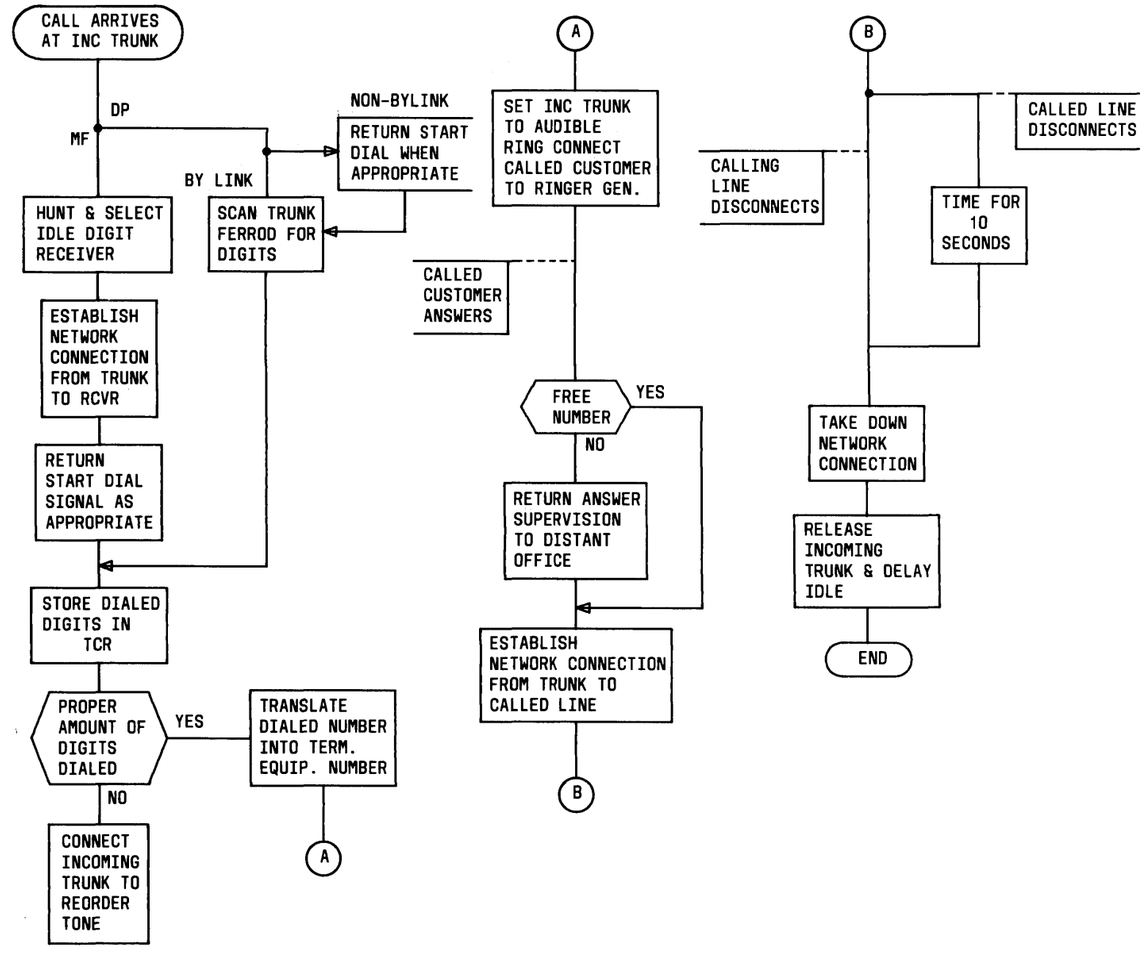

Fig. 10—Incoming Call

be observed when ordering required hardware and making ODA changes.

10. HARDWARE ENGINEERING

10.01 Trunking hardware requirements for No. 3 ESS are satisfied by selecting and installing proper plug-in circuit packs at the universal trunk circuit (SD-3H220). Each universal trunk circuit can accommodate 24 trunk circuits. Enough universal trunk circuits must be provided on either the network frames or miscellaneous and control frames to accommodate the total number of trunks required in the office.

10.02 Table C lists the five FB-type circuit packs and direct interface presently available for use in the universal trunk circuit. Specific types used to interface with other switching systems are also shown.

10.03 One nonuniversal type trunk circuit is available at this time. This is the Incoming No. 3 ESS Test Cabinet or the Local Test Desk No. 14 or No. 16 Trunk Circuit (CPS FB519). The FB519 is mounted in the test frame and is used for test access to the lines in the No. 3 ESS by the test desk.

10.04 For trunk net loss requirements, refer to Trunk Transmission Design Loss Objectives, Section 853-101-100.

10.05 Figure 11A depicts a network frame using a universal trunk unit. Figure 11B depicts a combined E&M, T1 carrier channel unit described in other sections.

11. SOFTWARE ENGINEERING

11.01 The software engineering required to implement all or a part of the trunking requirements for a No. 3 ESS consists of completing the various ESS translation forms contained and described in the TG-3 Translation Guide. These forms when processed will build the required translators in the ESS memory.

TABLE C

SD-3H220 UNIVERSAL TRUNK CIRCUIT PACKS

CIRCUIT	FOR USE WITH:
CPS-FB-382 Type II and FB-391 Type III Interface 2-Way E&M Signaling Direct Interface	1, 2, and 3 ESS, 4A and 5 Crossbar, Crossbar Tandem, Step-by-Step 3CL Toll, 6A Announcement, AIS, Repair Service, Intercept Desk, TSPS, RTA
CPS-FB-370 Incoming Reverse Battery-Delay Dial	4A Crossbar, etc.
CPS-FB-371 Incoming Reverse Battery Wink or Immediate Start	1, 2, and 3 ESS, 1 and 5 Crossbar Panel, Step-by-Step, Crossbar Tandem 3CL Toll
CPS-FB-399 Outgoing Reverse Battery High-Low	4A and 5 Crossbar, AIS, Crossbar Tandem CAMA, Crossbar Tandem TSPS/TSP, 1, 2, and 3 ESS, 1 and 5 Crossbar, Crossbar Tandem, Step-by-Step, Directory Assistance Desks

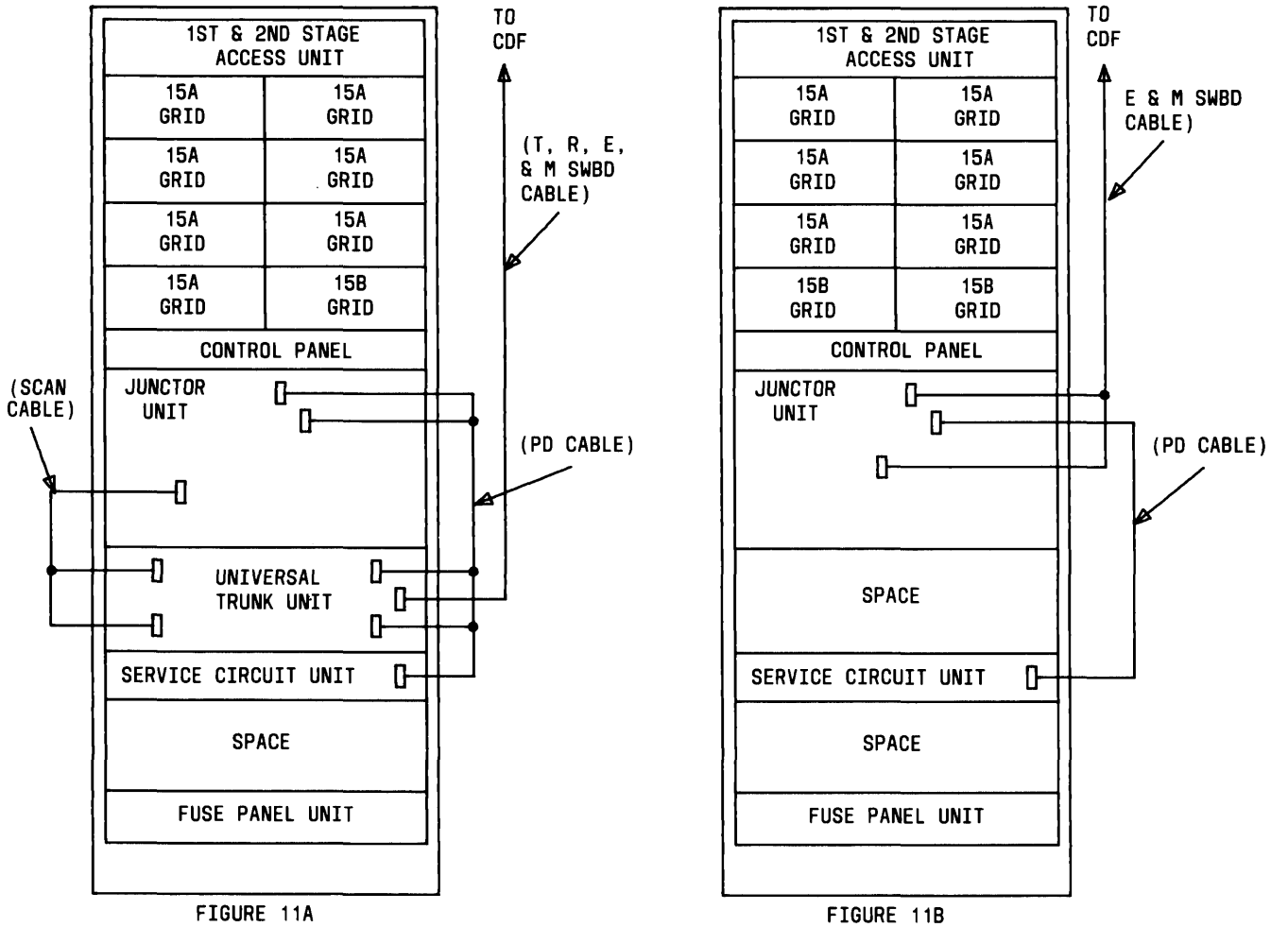

FIGURE 11A

NO. 3 ESS NETWORK FRAME USING A UNIVERSAL TRUNK UNIT

FIGURE 11B

NO. 3 ESS NETWORK FRAME USING A COMBINED E&M TRUNK AND T1 CHANNEL UNIT

Fig. 11—Comparison of the Present Network Frame With the Combined E&M Trunk and T1 Channel Unit Frame

11.02 On initial jobs, a complete set of these forms is submitted to the Western Electric Regional Engineering Center which is processed by the ODA. This is a computer process that generates a magnetic tape cartridge whose contents are installed in the main store translation area. In addition, computer printed office records are produced and sent to the office. See Section 3 of the TG-3 for a complete description of the ODA process.

12. COMPATIBILITY

12.01 Various aspects of compatibility of trunks with other types of central offices can be divided into several categories. These include type of supervision, type of pulsing, start signal required, bylink operation and special purpose type trunks such as trunks to TSPS or AIS offices. To ensure proper operation, the specific hardware (ie, trunk circuits) should be selected using SD-3H912-01.

Most software compatibility requirements are met with the proper completion of ESS Form 3204 (TG-3). This form contains the data that constructs the Trunk Feature Table. It specifies for each trunk group the various operating parameters to make the trunk group compatible with other offices and/or transmission systems. Figure 12 tabulates the items contained in the Trunk Feature Table and associates specific attributes with types of trunks and their various operating features. The E&M trunk and D4, T1 carrier channel can be combined into a single unit and still have flexibility with the cross connections on the CDF. See Figure 5A and 5B. Compatibility is very easily achieved by changing the far-end channel unit to LP, E&M, etc, as desired. Service observing No. 7B set and No. 12 desk are compatible.

13. OFFICE DATA

A. Translations

13.01 The relationship of the various translation tables in No. 3 ESS is illustrated in Figures 13 and 14. Figure 13 shows the call processing flow through translations on an outgoing call. Figure 14 shows the processing flow on an incoming call. As an aid to understanding the translation process, the flow is presented from the point of view of the translation forms rather than the actual structure of translations in program store. The ESS form number appears in the lower right-hand corner of the data blocks of the figures.

13.02 Translation forms related specifically to trunks and their purposes are as follows:

(a) Form ESS 3201—Trunk Assignment Table—Used to associate the scan points and distributor points with particular circuits. This form must be completed with the following information:

(1) Terminal Equipment Number Assignment

(2) Equipment Location

(3) Circuit Code

(4) Supervisory Scan Point

(5) Directed Scan Point

(6) Distributor Triplet

(7) Trunk Group Number

(8) Member number.

(b) Form ESS-3202—Trunk Group Table—Used to establish a trunk group number for each trunk group entering or leaving the office.

(c) Form ESS 3204—Trunk Feature Table—Provides information associated with trunk group specified on Form 3202 as follows:

(1) Trunk Type

(2) Supervision Type

(3) Outpulsing

(4) Inpulsing

(5) Miscellaneous Attributes.

13.03 Generally, each trunk group must have an item in each of the above categories specified. Figure 12 outlines the various options available for each category. Certain items selected for each category require or restrict other items from being selected. See the TG-3, Division 5, Section 2c for Trunk Feature Table Requirements and Restrictions.

(a) ESS Form 3505—In No. 3 ESS, provision is made for automatic testing for certain outgoing trunks. This form specifies the type of test the automatic diagnostic will perform and the directory number of the test line used for testing at the distant office. Outgoing trunk groups using the following trunk circuit SD numbers may be entered on this form.

- Direct Interface
- SD-3H220 CPS FB382
- SD-3H220 CPS FB391
- SD-3H220 CPS FB399

B. Recent Change (RC) Messages

13.04 The following RC messages are used to add or change translations required for various trunking arrangements including all rate and route type translations. Refer to the Input

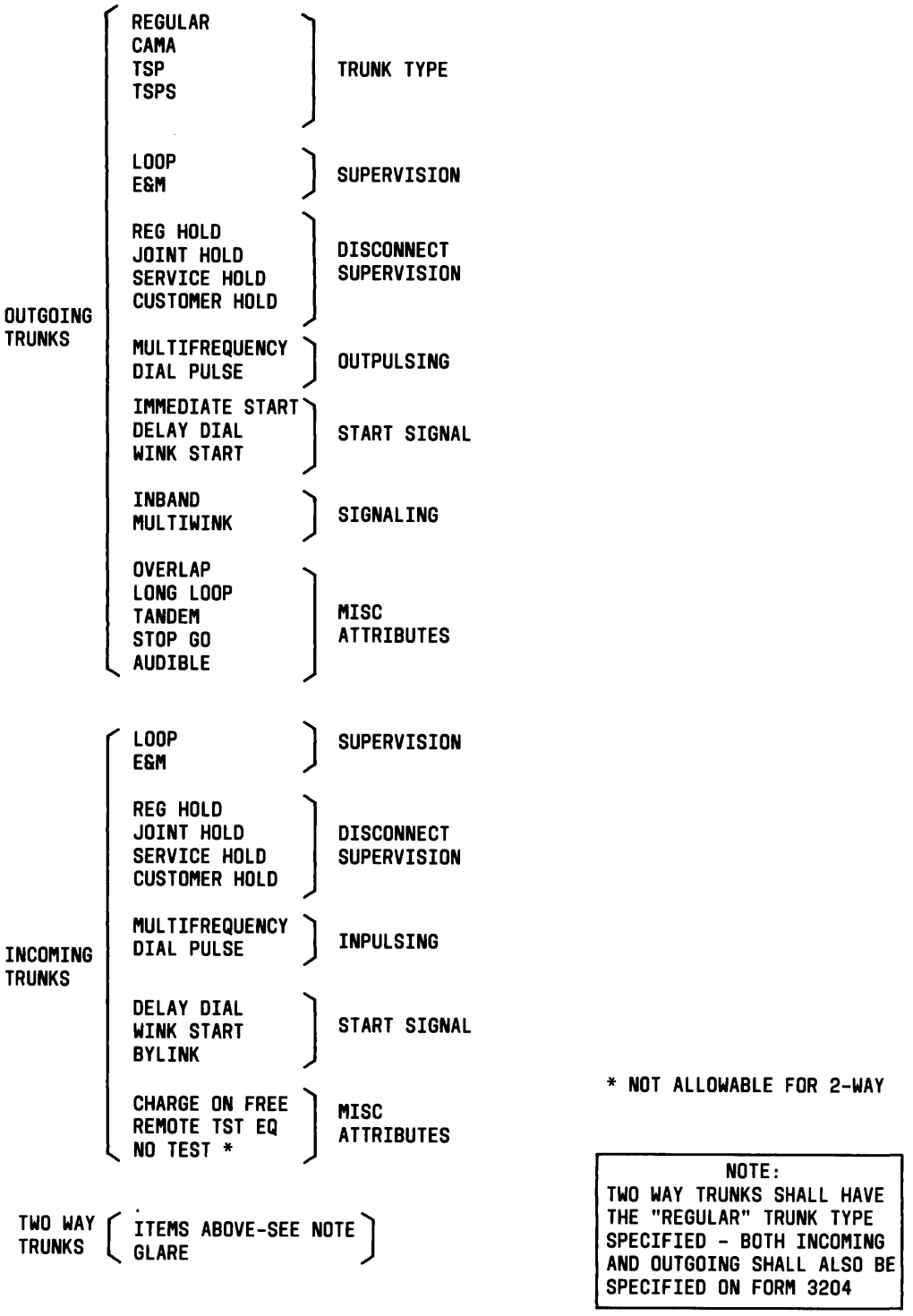

Fig. 12—Trunk Feature Table Options

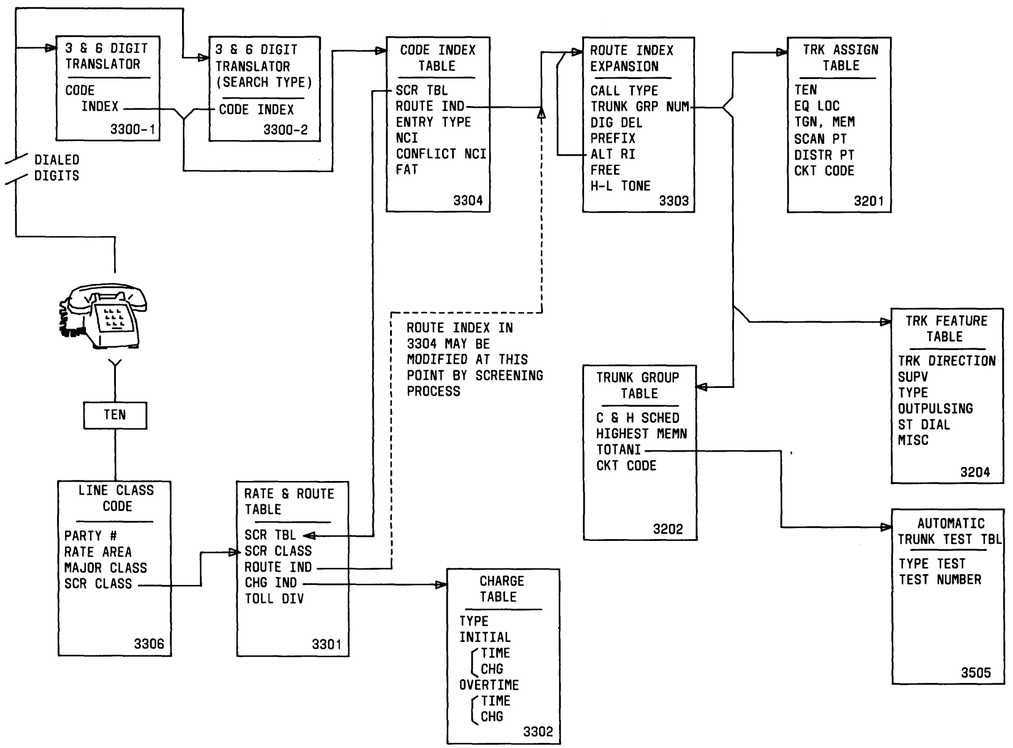

Fig. 13—No. 3 ESS Translation Interaction Outgoing Call

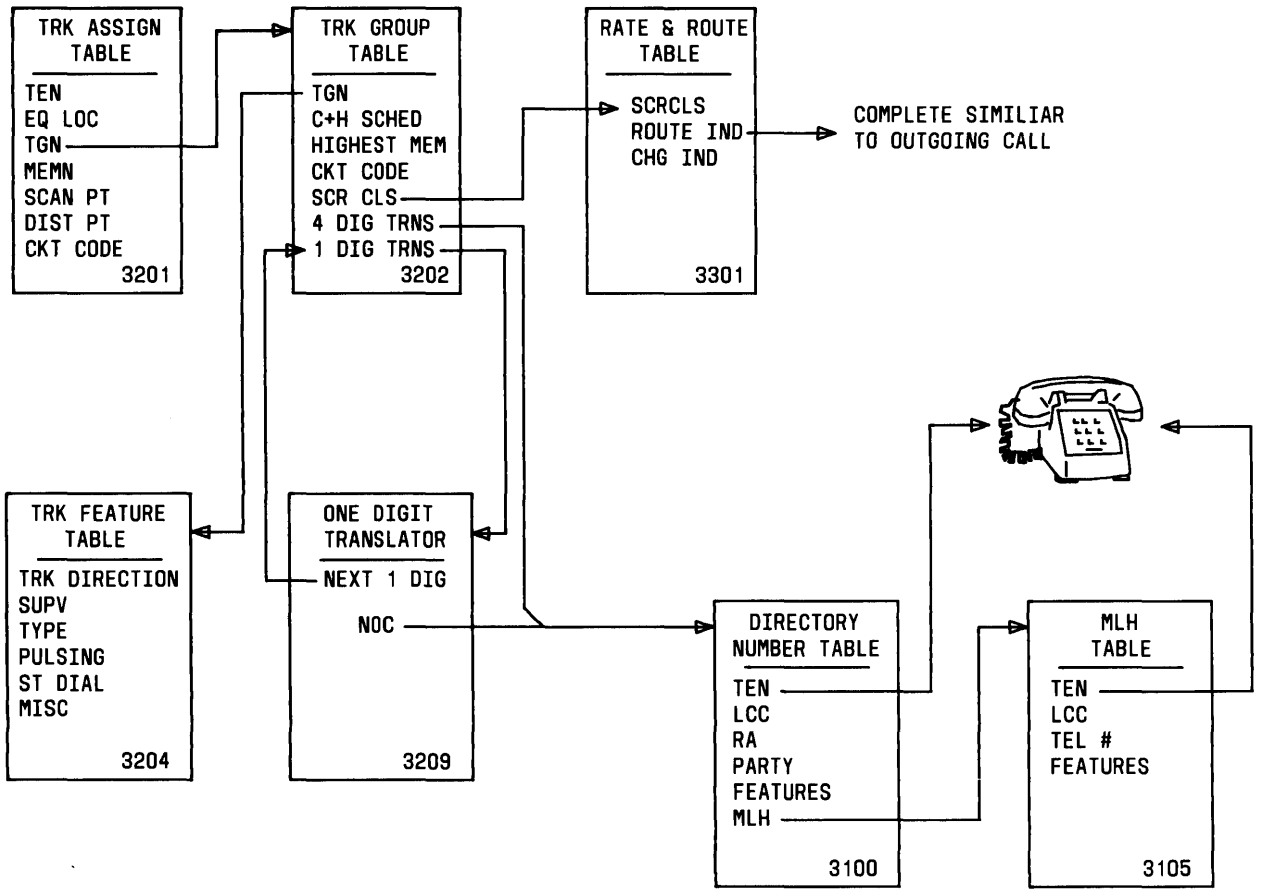

Fig. 14—No. 3 ESS Translation Interaction Incoming Call

Recent Change Manual for details on the use of these messages and their associated keywords.

RC MESSAGE	AFFECTS FORM	EXPLANATION OF MESSAGE
RC:CDI	3304	Used to define code index expansion entries
RC:CHI	3302	Used to define a new charge index, to change an existing charge index, or to delete an existing charge index. Used to define charge status for calls which require no initial deposit.
RC:CKT	3201	Used to associate SPNs, TENs and member numbers with particular circuits of a trunk group.
RC:DIG	3300	Defines the code index for a 3- or 6-digit translation or a default code index for an area translator.
RC:GRP	3202 & 3204	Defines the trunk features for the group.
RC:LCC	3306	Used to associate an originating or terminating major class and a screening class with a line class code and rate area.
RC:LINE	3100	Used to add, change, or remove individual LINE information.
RC:MLHG	3105	Used to change multiline hunt group tables.
RC:ODIG	3209	Defines or changes a one-digit translation entry.
RC:RTI	3303	Adds, changes, or deletes a route index expansion entry and its alternate route index expansion entry.
RC:SCR	3301	Defines or changes a screening class expansion entry.
RC:TOTANI	3505	Used to specify test access numbers for automatic or manual testing.

14. GROWTH/RETROFIT PROCEDURES

14.01 The general method for adding a trunk group to an office is as follows:

(1) Install necessary cross-connects for each trunk in the group on the combination distributing frame.

(2) Refer to Part 13 of this section and input all required recent change messages to complete the trunk group sufficiently for testing. This will generally require the RC:GRP and RC:CKT messages to be completed.

(3) Test the individual trunk circuits for operation using procedures outlined in Section 233-135-105 Trunk and Line Test Panel Operating Procedures or in Part 15 of this section.

(4) Complete all routing and charging recent changes necessary to link the trunk group into the overall system.

(5) Update all office records.

14.02 To add individual trunks to existing trunk groups, the procedure is the same as above with the omission of Step 4.

15. TESTING

15.01 All trunk testing can be performed at the No. 3 ESS Maintenance Center using the Trunk and Line Test Panel. Tests available are operational and transmission tests. Voltmeter tests of trunk conductors may also be made in addition to applying various types of terminations for balance testing, etc. See Section 233-135-105 for Trunk and Line Test Panel Operating Procedures.

ADMINISTRATION

16. MEASUREMENTS

16.01 Each trunk group defined in the office has assigned to it a set of four traffic registers. These are peg count, usage, overflow, and maintenance busy counts. These counts are collected continuously for all trunk groups in the office. The registers can be read when a TTY printout is requested or when traffic data is automatically printed out in accordance with an assigned schedule in the Traffic Work Table (TWT). See Dial Facilities Management Practices, Division H, Section 11h for details on the various measurements currently available and Section 11i for data scheduling and collection procedures.

17. RECORD KEEPING

17.01 The operating company may request a new partial or complete set of office translation records for a No. 3 ESS office. The operating company may request new copies of the records from time to time to replace worn sets or to verify the actual machine translations. Form ESS 3002 in conjunction with the administrative data link is used to inform Western Electric Regional Engineering Center of the records required. Refer to Division 2, Section 7 of the TG-3 for details of the procedure.

17.02 Local records must be maintained of the layout, transmission facilities, and distant office trunk circuits for each trunk in the No. 3 ESS office.

18. CHARGING

18.01 The Automatic Message Accounting Recording System (AMARS) feature is provided at a local central office and is used to generate and compile certain telephone call information associated with calls being originated through that office. The data is then temporarily stored for subsequent transmission to the Automatic Message Accounting Recording Center (AMARC) where all data for each telephone call is assembled into a data block and stored on magnetic tape. The data is then used to compute charges for customer-dialed billable calls and to perform special traffic studies. The AMARS feature performs the same functions as the Local Automatic Message Accounting (LAMA) feature, used in many central offices, except that the data is recorded at the remote AMARC instead of by a local Automatic Message Accounting (AMA) tape recording machine. This feature is available in generic program SO-2, Issue 4, and later programs.

18.02 Centralized Automatic Message Accounting (CAMA) or Message Registers may be used for recording chargeable calls. Also, a TSP/TSPS office may be used. For coin telephones, Local Untimed Charging and/or Local Overtime Options exist. See TG-3, Division 5, Section 3c for details on implementing these features.

AVAILABILITY

19. NEW INSTALLATIONS

19.01 The trunking features described in this document are available with any issue of No. 3 ESS generic program. Availability of specific types of trunk circuits can be determined by referencing the HARDWARE ENGINEERING and COMPATIBILITY Parts of this section.

20. GROWTH/RETROFIT

20.01 See Parts 9, 10, 11, and 13, of this section.

SUPPLEMENTARY INFORMATION

21. GLOSSARY

21.01 The following list identifies terms that may be unfamiliar to the reader.

E&M Signaling—A local signaling system between trunk equipments and transmission facilities in which the near-end supervisory state is reflected by the M lead and the far-end state by the E lead. Trunks may have Type II, Type III interface, or direct interface.

Loop Signaling—A signaling method which uses the metallic loop formed by the trunk conductors and terminating bridges and operates by opening, closing, and reversing the polarity of the direct current path through the loop.

Multifrequency Pulsing—A method of transferring data over trunks by various combinations of two-out-of-six voice band frequency combinations.

Supervision—The function of indicating and controlling the status of a call.

Wink—A short off-hook signal sent from the receiving end of a trunk to indicate the receiving end is in a condition to receive pulses.

Delay Dial—A signal consisting of an initial off-hook signal going to on-hook when the receiving end is ready to receive pulses.

Two-Way Trunk—A trunk that has both outgoing and incoming attributes at each central office and can be used in either direction of calling.

Zip Line Class of Service Tones—A short burst of tone used to indicate audibly to the operator the type of incoming call so that it may be answered properly.

22. REASONS FOR REISSUE

22.01 This is the initial issue of this section.

23. REFERENCES

23.01 The following documents may be referenced for supplementary information:

- Translation Guide TG-3
- L-370394 No. 3 ESS Layout Specification
- No. 3 ESS Preliminary Recent Change Input Manual
- Section 233-190-010 No. 3 ESS System Description
- SD/CD 3H220-01 Universal Trunk Circuit
- Dial Facilities Management Practices, Division H
- Section 233-100-015 Recent Changes
- Section 233-135-105 Trunk and Line Test Panel Operating Procedures
- SD-99421-01 Signaling Compatibility
- Section 179-100-301 Signaling Compatibility
- SD-3H912-01 Hardware Compatibility
- Section 853-101-100 Trunk Transmission Design Loss Objectives