NO. 1 ELECTRONIC SWITCHING SYSTEM ADF FULL-DUPLEX—100 WORD PER MINUTE DATA STATION USING 4-ROW TELETYPEWRITERS DESCRIPTION AND OPERATION

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1. GENERAL

1.01 This section describes the 4-row 100 word per minute (wpm) full-duplex (FDX) station employed in the No. 1 Electronic Switching System Arranged with Data Features (No. 1 ESS ADF) using the 33- and 35-type teletypewriters (TTY). The purpose of this section is to provide information concerning the theory of operation and functional description of the station equipment.

A. Purpose of System

1.02 The 4-row 100 wpm FDX station is part of the No. 1 ESS ADF (hereafter called ADF). The ADF system is a message store-and-forward data switching system which employs time-shared control. The operation is controlled by the ADF which uses stored program in lieu of wired logic.

1.03 The use of ESS devices allows the system to operate at speeds much higher than the rate at which events associated with a single message can occur. This permits the control equipment to be time-shared by all the messages which the system handles.

1.04 The ADF administers a number of half-duplex (HDX) and FDX lines. The HDX operation is described in the section entitled No. 1 Electronic Switching System ADF Half-Duplex—100 Word Per Minute Data Station Using 4-Row Teletypewriters—Description and Operation (580-301-100). Each FDX line can accommodate a number of FDX stations which may be either automatic send and receive (ASR), send only, or receive only (RO) type stations.

1.05 The block diagram in Fig. 1 shows the No. 1 ESS ADF system which consists of, in addition to the ADF, a control serving test center (CSTC), a number of serving test centers (STC), and a group of stations for each STC.

1.06 Messages can be automatically sent to and received from the ADF without attendant operation at the station. The ADF can provide data character code conversion, speed change, privacy, and error control. Messages can be routed by recognizing precedence, single address codes, multiple address codes, and group code addresses.

1.07 The CSTC provides connection between the ADF and multistation line groupings at the STC. The CSTC also provides a method of

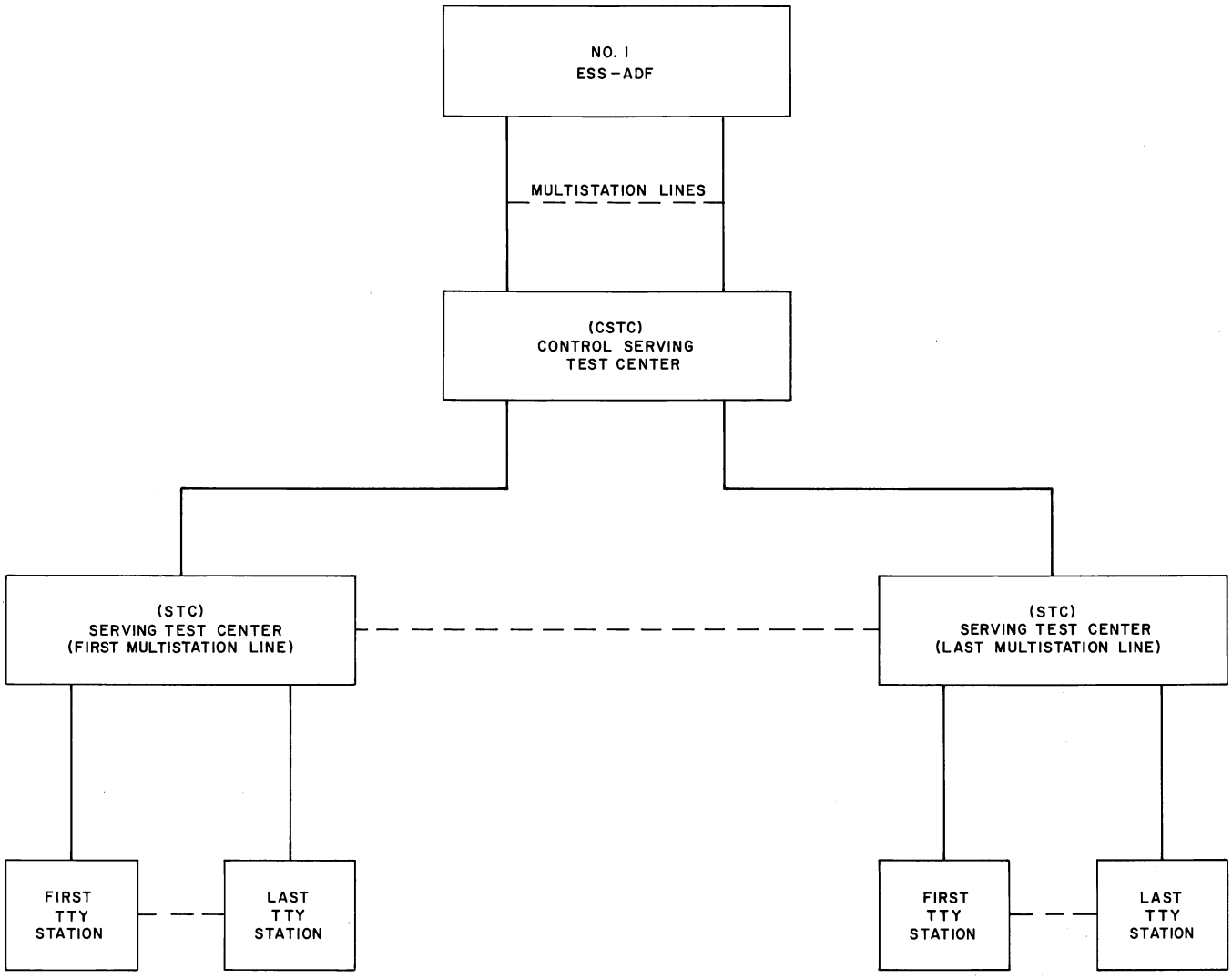

Fig. 1—No. 1 ESS ADF—Block Diagram

monitoring the service quality similar to that of the toll testboard in voice communications. The STC serves as a looping or grouping terminal for a multistation line.

B. System Operation

1.08 A number of stations can be accommodated by a single full-duplex multistation line. One station can send and receive simultaneously or one station can send while another is receiving. No more than one station may send at one time. Any number of stations may receive the same data.

1.09 In a full-duplex system, all messages are sent to the ADF for future delivery. All messages received are sent from the memory of the ADF. FDX stations do not communicate directly with each other.

C. Message Handling

Message Preparation

1.10 An interrogation scheme called polling is used by the ADF for recognition of station service requests. The ADF processor polls each station periodically for service requests.

1.11 The attendant at the sending station prepares a message on tape, loads it into the tape distributor, and conditions the sending station to indicate that it has traffic available when the station is polled by the ADF. A message normally includes the heading (routing information), the text (content of message), and characters required for automatic administration of the message.

1.12 A station with traffic may be selected by the ADF to send the traffic it has, and the message information is stored temporarily in the ADF. The sending station will be restored to the idle condition when the complete transmission has been picked up.

Message Delivery

1.13 At some later time, the ADF polls the designated receiving station. If the station is available for receiving (ready-to-receive), the ADF calls in the station as a receiver and delivers the message. After the complete message has been delivered, a roll-call sequence initiated by the ADF determines if the message reception was satisfactory. After the roll call, the station will be restored to the idle condition by the ADF.

D. Station Characteristics

1.14 The 4-row 100 wpm FDX station may be provided in three basic station arrangements: ***sending and receiving, sending only,*** and ***receiving only.*** The block diagram in Fig. 2 shows a complete (sending and receiving) FDX station. Table A lists the basic station arrangements which may be provided. These arrangements utilize the automatic sending and receiving (ASR) TTY units, receive only (RO) TTY units, and/or receive only typing reperforator (ROTR) units. Either the 33 or 35 ASR TTY units may be used for the sending portion of a station. Either the 33 RO TTY, 35 RO TTY, or 35 ROTR may be used for the receiving portion of a station. Data Auxiliary Set 804N1 is the attendant unit employed with the sending units. Data Auxiliary Set 804N2 is the attendant unit employed with the RO TTY receiving units. Data Auxiliary Set 804R3 is the attendant unit employed with the ROTR as the station receiving unit. An optional auxiliary receiving TTY unit may be provided with the 33 or 35 RO TTY master receiving units. An auxiliary receiving unit cannot be provided with the 35 ROTR master receiver unit. The 33 RO auxiliary receiving TTY unit is used with the 33 RO master receiving TTY unit. Either the 35 RO or 35 ROTR auxiliary receiving unit may be used with the 35 RO master receiving TTY unit.

Teletypewriter Units

1.15 A station may consist of only an ASR TTY or only an RO TTY. An RO TTY or an ROTR may be provided as an auxiliary receiving unit for use in conjunction with the main RO TTY unit of a station.

1.16 The ASR TTY is used to:

(a) Punch tape for message transmission.

(b) Send all messages from a transmitter distributor (TD).

(c) Print local copy, and if required, receive time, date, and message number (TDM) from the ADF for all transmitted messages, and print any service messages sent by the ADF concerning messages transmitted by the sending station.

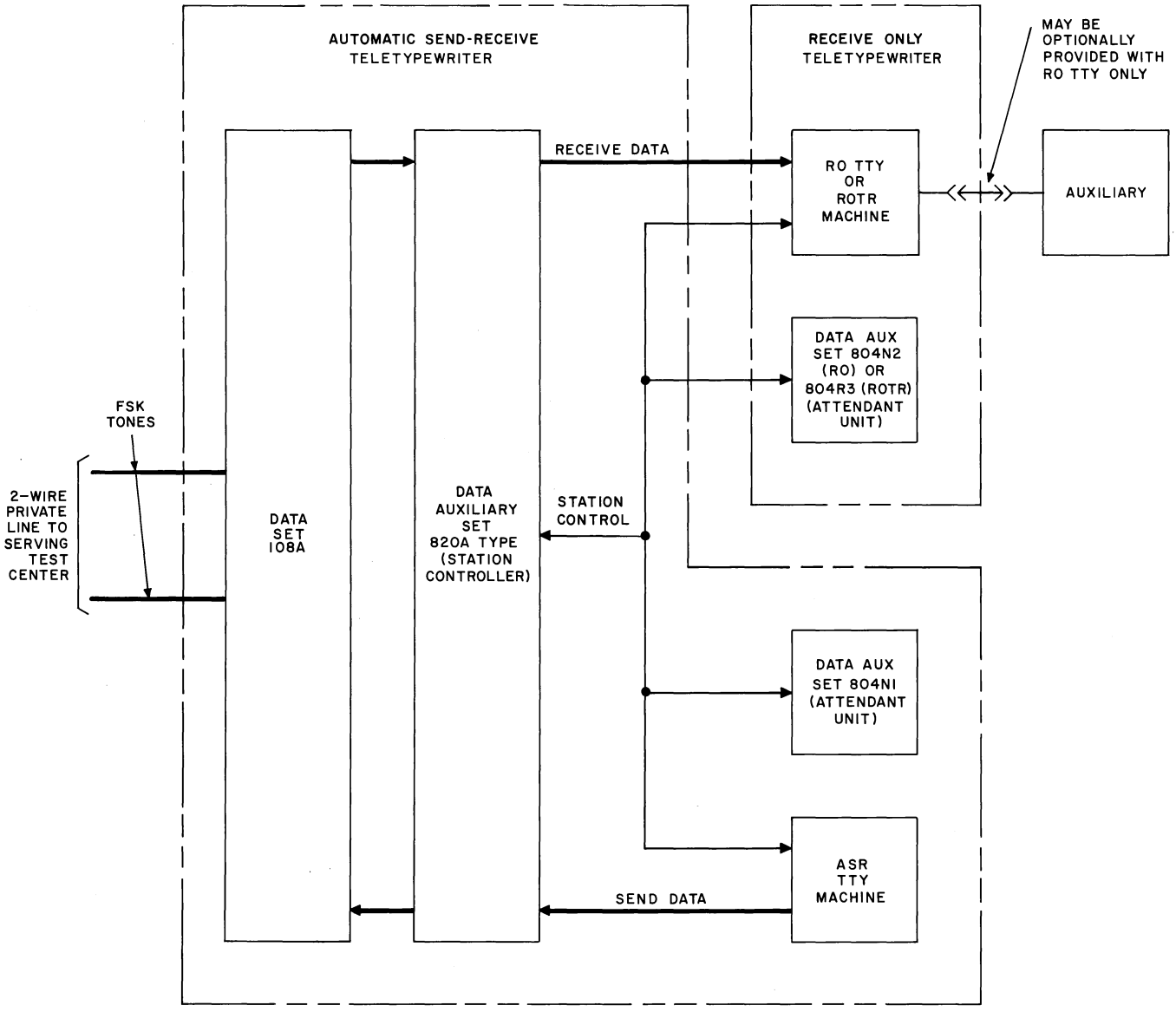

Fig. 2—4-Row 100 WPM FDX Station—Block Diagram

TABLE A

STATION ARRANGEMENTS

STATION TYPE	TELETYPEWRITER UNIT		ATTENDANT UNIT		AUXILIARY RECEIVER (OPTIONAL)
	SENDING	RECEIVING	SENDING	RECEIVING	
SEND AND RECEIVE	33 ASR	33 RO	804N1	804N2	Yes
	35 ASR	35 RO	804N1	804N2	Yes
		35 ROTR	804N1	804R3	No
SEND ONLY	33 ASR	None	804N1	None	No
	35 ASR	None	804N1	None	No
RECEIVE ONLY	None	33 RO	None	804N2	Yes
		35 RO	None	804N2	Yes
		35 ROTR	None	804R3	No

1.17 The master RO TTY is employed to:

(a) Print the time, date, message number, and a clean copy for all received messages

(b) Print service messages sent by the ADF concerning messages received by the called-in station.

1.18 The master ROTR is used to produce punched tape for the same functions described for the RO TTY (see 1.17).

Attendant Units

1.19 The attendant units associated with the ASR and RO TTY units are equipped with keys, lamps, and a loudspeaker. The keys are provided for the purpose of controlling the station. The lamps are employed to display the status of the station and to indicate alarm conditions. The loudspeaker provides audible alarms.

Station Controller

1.20 The Data Auxiliary Set 820A1 or 820A2 (hereafter called the station controller) enables the ASR and RO TTY units to automatically send and/or receive messages as directed by the ADF. The station controller provides circuits for detection and recognition of control characters from two sources:

(a) Characters read from tape by the sending TTY unit.

(b) Characters received from the ADF.

The station controller also provides circuits for generation of two types of characters:

(a) Response and service request characters to be sent to the ADF.

(b) An underline (_) character which is used to replace characters with incorrect parity in the received message.

Data Set

1.21 The Data Set 108A provides a means of converting the dc characters to audio frequency shift keying tones for transmission over voice frequency telephone facilities. The audio tones received from the ADF are converted to dc signals for application to the station controller.

E. Maintenance Features

1.22 Two types of loop-back tests are provided in the station controller: automatic and manual. An automatic loop-back test for a given station may be selected by sending a loop-back code sequence from the STC or CSTC. The automatic loop-back test facilitates the evaluation of line, data set, and control logic circuits.

1.23 A maintenance (manual loop-back) switch is provided at the station controller unit for data set loop-back testing. The manual loop-back test provides for performance testing of the data

set and transmission facilities. The dc received data output signal from the data set is looped back to the dc data input terminals of the data set.

F. Alarm Features

1.24 Separate alarm circuits are provided for the sending and receiving machines. The alarm circuits provide both lamp and audible alarm indications. The audible alarm may be silenced by a key on the attendant unit.

G. Station Power

1.25 The station equipment primarily operates from a 106 to 129 volts, 60 ±0.5 Hz power source fused for 6 amps. The station controller and data set are supplied dc power by a 24A power unit mounted on the controller.

2. PHYSICAL DESCRIPTION

2.01 This part describes the physical appearance of the components of a No. 1 ESS ADF 100-wpm FDX data station. There are three basic types of stations. Table B lists the types of FDX stations and the equipment groupings which may be employed for each type.

TABLE B

EQUIPMENT GROUPING FOR THE FDX STATIONS

STATION TYPE	TELETYPEWRITER UNIT		DATA AUX* SET	MOUNTING BRACKET	CORD †	ATTENDANT UNIT	
	SENDING	RECEIVING				SENDING	RECEIVING
SEND AND RECEIVE	33 ASR	33 RO	820A2	91A	M36E	804N1	804N2
	35 ASR With EOT Counter	35 RO	820A1	92A	M36E	804N1	804N2
		35 ROTR	820A1	92A	M36E	804N1	804R3
	35 ASR Without EOT Counter	33 RO	820A2	92A	M36E	804N1	804N2
		35 RO	820A2	92A	M36E	804N1	804N2
		35 ROTR	820A2	92A	M36E	804N1	804R3
SEND ONLY	33 ASR	None	820A2	91A	None	804N1	None
	35 ASR With EOT Counter	None	820A1	92A	None	804N1	None
	35 ASR Without EOT Counter	None	820A2	92A	None	804N1	None
RECEIVE ONLY	None	33 RO	820A2	91A	M36E	None	804N2
		35 RO	820A2	92A	M36E	None	804N2
		‡35 ROTR	820A2	95A	M36E	None	804R3

*Part of an assembly including the Data Auxiliary Set 820A-type and Data Set 108A. Data Set 108A is ordered separately. A 24A power unit is included in the assembly with the data auxiliary set.

†M36E cord is available in 3 lengths (4, 10, and 50 feet) to be ordered separately as required.

‡KS-20018 L1, L2, L3, or L4 cabinet also is required.

A. Stations

2.02 A typical sending and receiving FDX station using the 33-type TTY units is shown in Fig. 3. The left unit is the 33-type ASR TTY which is used for preparing tape and sending messages. The ASR TTY unit in this station is equipped with the following:

(a) Controller and data set assembly consisting of Data Auxiliary Set 820A-type and Data Set 108A, respectively.

(b) 91A bracket for mounting the controller and data set assembly in the ASR TTY pedestal.

(c) Data Auxiliary Set 804N1 (attendant unit).

An M36E cord, which may be ordered in three lengths (4, 10, and 50 feet), provides a connection between the station controller and the RO TTY unit. The RO TTY unit is equipped with a Data Auxiliary Set 804N2 (attendant unit).

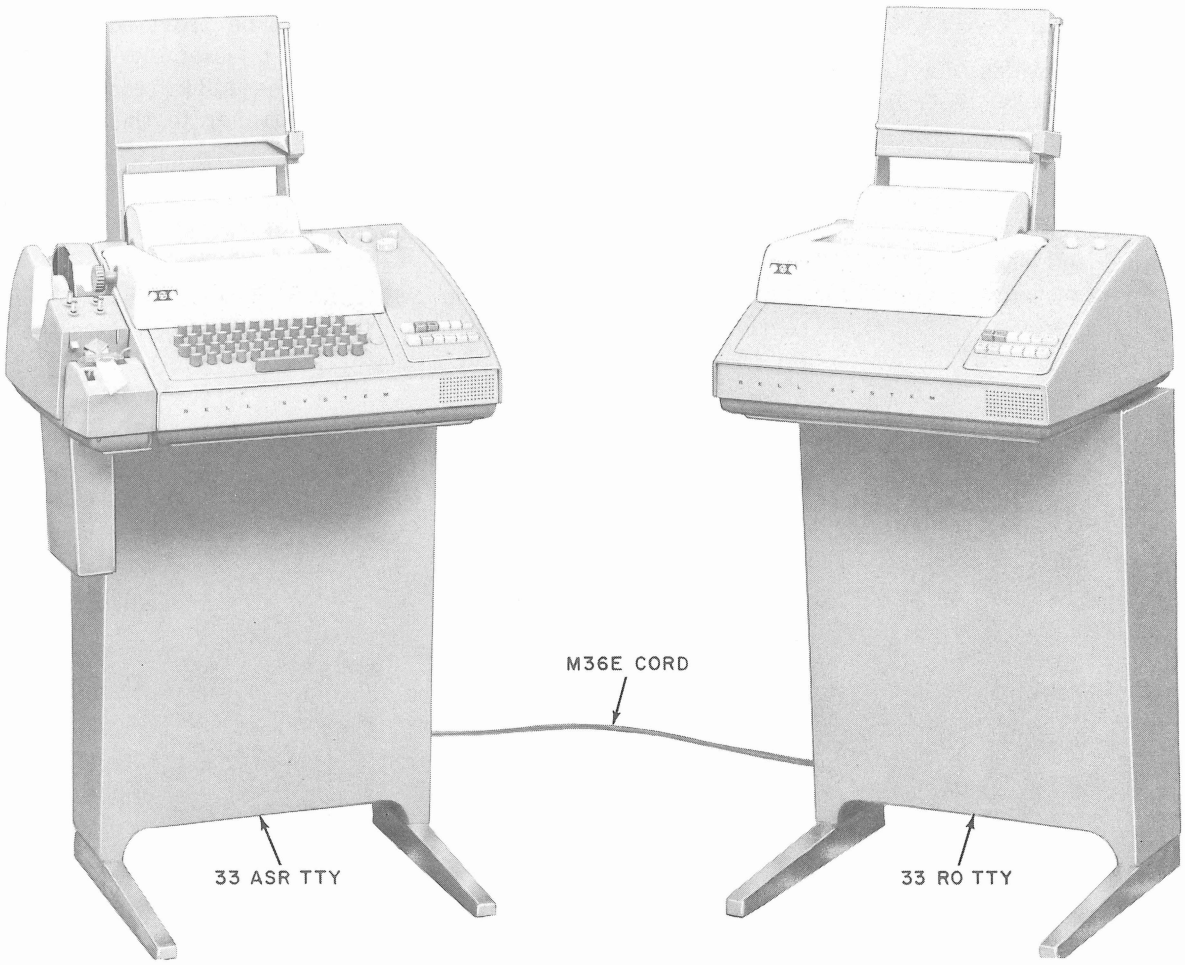

Fig. 3—33-Type FDX Station

2.03 A typical sending and receiving FDX station using the 35-type TTY units is shown in Fig. 4. The left unit is the 35-type ASR TTY which is used for preparing tape and sending messages. The ASR TTY unit in this station is equipped with the following:

(a) Controller and data set assembly consisting of Data Auxiliary Set 820A-type and Data Set 108A, respectively.

(b) 92A bracket for mounting the controller and data set assembly in the ASR TTY pedestal.

(c) Data Auxiliary Set 804N1 (attendant unit).

An M36E cord, which may be ordered in three lengths (4, 10, and 50 feet), provides a connection between the station controller and the RO TTY unit. The RO TTY unit is equipped with Data Auxiliary Set 804N2 (attendant unit).

2.04 Fig. 3 and 4 are typical TTY stations and show the same model TTY units for the ASR and RO; however, any of three receiving units may be employed in an FDX station with either of the sending type units. The receiving units are the 33 RO TTY, the 35 RO TTY, and the 35 ROTR.

2.05 A send only-type station may be provided using the 33 or 35 ASR TTY unit as described in 2.02 or 2.03, respectively. In the send only station, the RO TTY unit and M36E cord are omitted.

2.06 A receive only-type station may be provided using the 33 or 35 RO TTY, or the 35 ROTR unit. The controller and data set assembly, mounting bracket, and M36E cord are installed in the RO TTY pedestal. When an ROTR is used, a separate cabinet (KS-20018) must be provided to house the controller and data set assembly and the 95A mounting bracket. The M36E cord is used to connect the station controller to the ROTR unit.

B. Teletypewriter Units

The Station Sending Unit

2.07 The 33 ASR TTY (Fig. 5) is an 8-level, 4-row, 100-wpm TTY which uses the ASCII

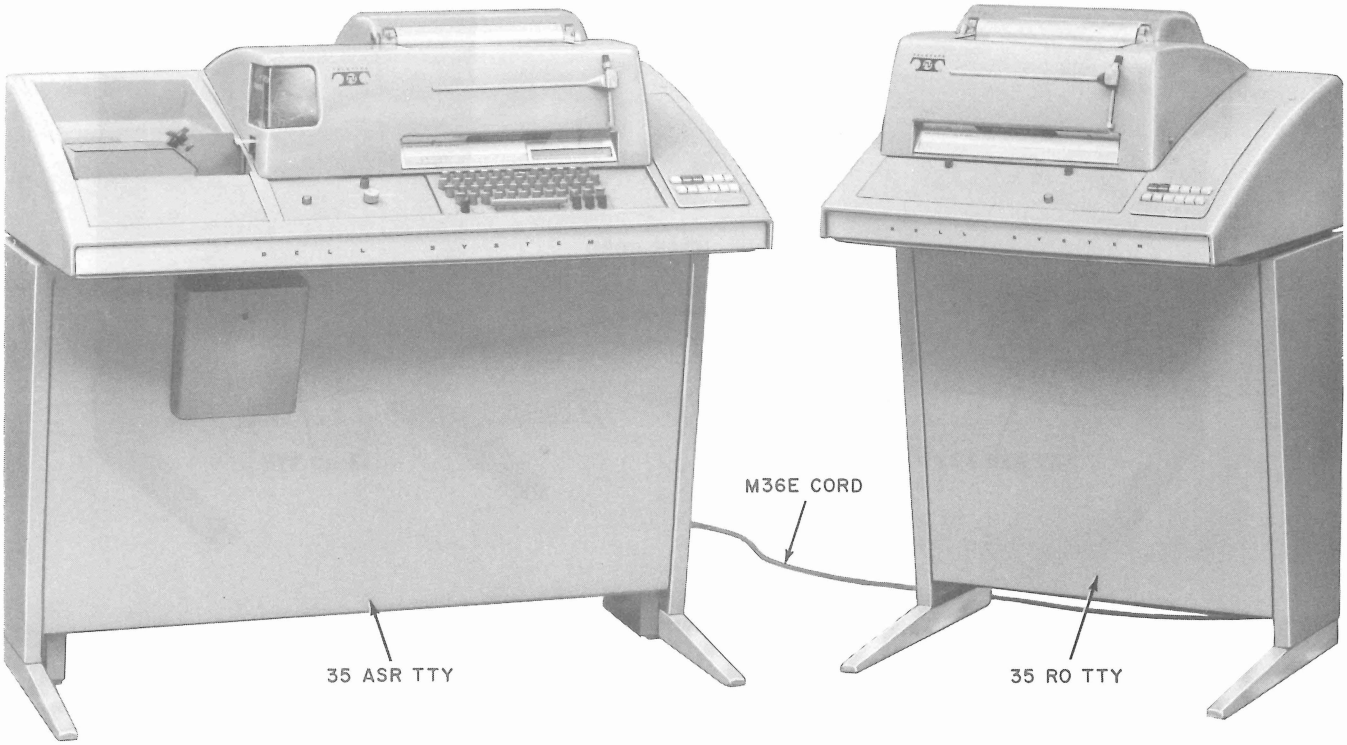

Fig. 4—35-Type FDX Station

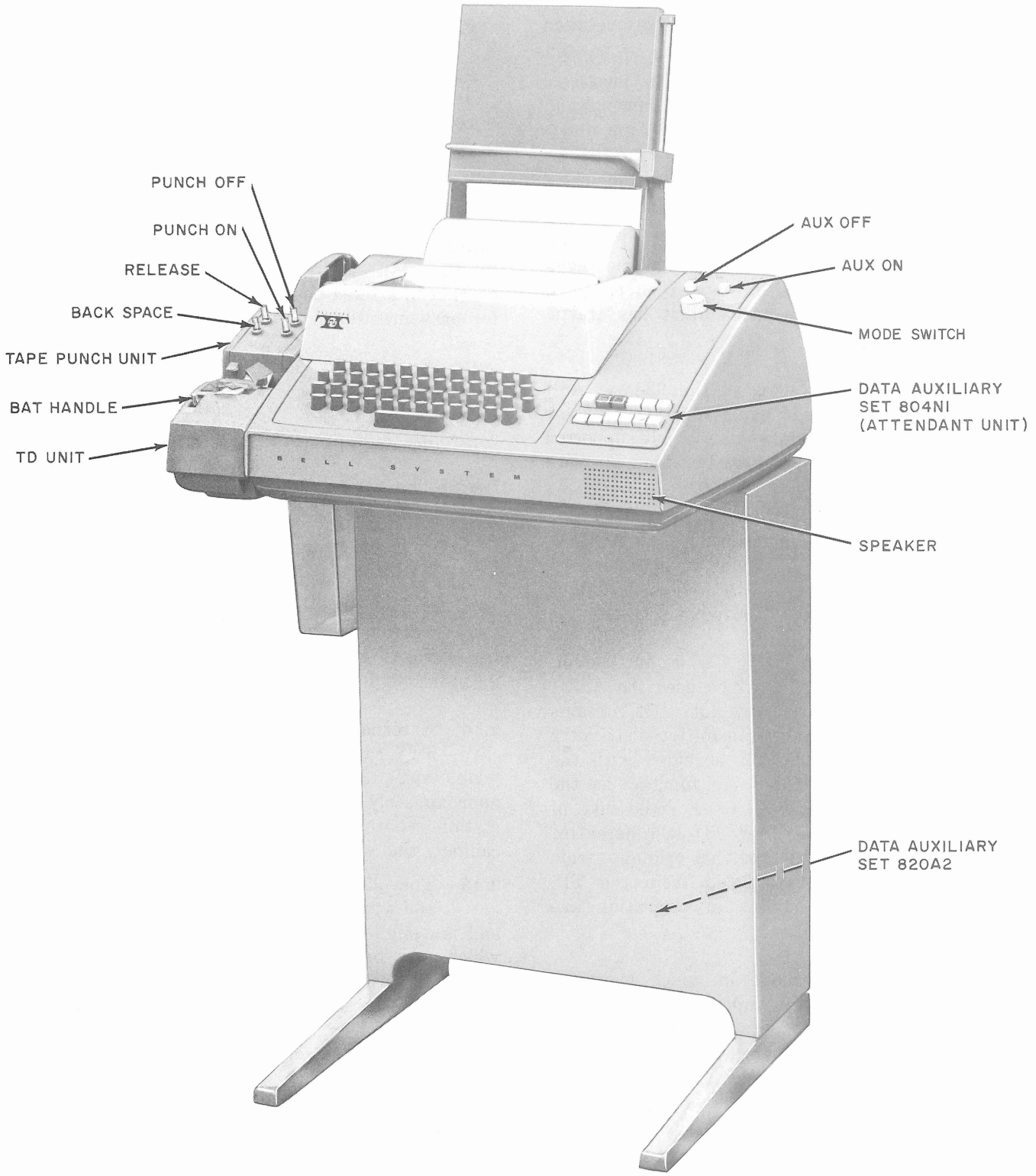

Fig. 5—33-Type ASR TTY Unit

code. It consists of a page printer, tape punch, tape reader, and keyboard. All messages originated by the 33 ASR stations are transmitted from the tape reader. Two switch-selected modes of operation are possible. They are:

(a) The OFF LINE mode in which messages may be prepared, on tape, for transmission. In this mode, the page printer and tape punch operate from either the keyboard or tape reader, messages cannot be transmitted, and the motor runs continuously.

(b) The ON LINE mode in which the page printer and tape punch will copy all messages transmitted by the station tape reader. The motor runs only when the station has traffic available.

2.08 Fig. 6 is a rear view of the 33-type ASR TTY with the rear panel removed to show the station controller and data set assembly supported by the 91A bracket which may be tilted outward to facilitate maintenance.

2.09 External overall dimensions of the 33 ASR TTY cabinet are 33 inches high, 22 inches wide, and 18.5 inches deep. The weight, including controller, is approximately 105 pounds.

2.10 The 35 ASR TTY (Fig. 7) is an 8-level, 4-row, 100-wpm TTY which uses the ASCII code and is designed for heavy duty. It contains a page printer, tape punch, transmitter distributor (TD), and keyboard. The TD provided with the 35 ASR TTY performs the same function as the tape reader of the 33 ASR TTY. For the sake of simplicity, the tape reader or TD will hereafter be called the TD. All messages that originate from 35 ASR stations are transmitted from the TD. Three switch-selected modes of operation are possible. They are:

(a) The OFF LINE mode in which messages may be prepared on tape for transmission. In this mode, the typing unit and tape punch operate from either the keyboard or TD. Messages cannot be transmitted and the motor runs continuously. The tape punch is controlled by the PUNCH OFF-ON switch.

(b) The ON LINE mode in which messages may be prepared, on tape, in the blind while transmitting messages from the TD. A record copy of messages being transmitted by the TD is reproduced by the typing unit.

(c) The UNATTENDED mode in which messages may only be sent if the station became a selected sender prior to selection of this mode. Thus message transmission in progress will continue as long as the station is a selected sender with traffic available.

2.11 The station controller and data set assembly are mounted in the 35 ASR TTY cabinet behind the front panel in the lower right side of the pedestal. The assembly is supported by a 92A bracket in a fixed position (facing outward) suitable for easy maintenance.

2.12 External overall dimensions of the 35 ASR TTY cabinet are 38.5 inches high, 40 inches wide, and 24 inches deep. The weight, including controller, is approximately 370 pounds.

The Station Receiving Unit

2.13 The 33 RO TTY (Fig. 8) is an 8-level, 100-wpm TTY which uses the ASCII code. The 33 RO TTY, which may be used as the station receiving unit, contains a page printer. The printer motor runs only when the station is a called-in receiver. An auxiliary receiver unit may be used with the 33 RO TTY station receiver unit.

2.14 External overall dimensions of the 33 RO TTY cabinet are 33 inches high, 18.6 inches wide, and 18.5 inches deep. The weight is approximately 81 pounds. In a receive-only type station where the controller is included in this cabinet, the weight is approximately 100 pounds.

2.15 The 35 RO TTY (Fig. 9) is an 8-level, 100-wpm TTY which uses the ASCII code and is designed for heavy duty. The 35 RO TTY, which may be used as the station receiving unit, contains a page printer. The printer motor runs only when the station is a called-in receiver. An auxiliary receiver unit may be used with the 35 RO TTY station receiver unit.

2.16 External overall dimensions of the 35 RO TTY cabinet are 38.5 inches high, 24 inches wide, and 24 inches deep. The weight is approximately 170 pounds. In the receive only-type station where the controller is included in this cabinet, the weight is approximately 190 pounds.

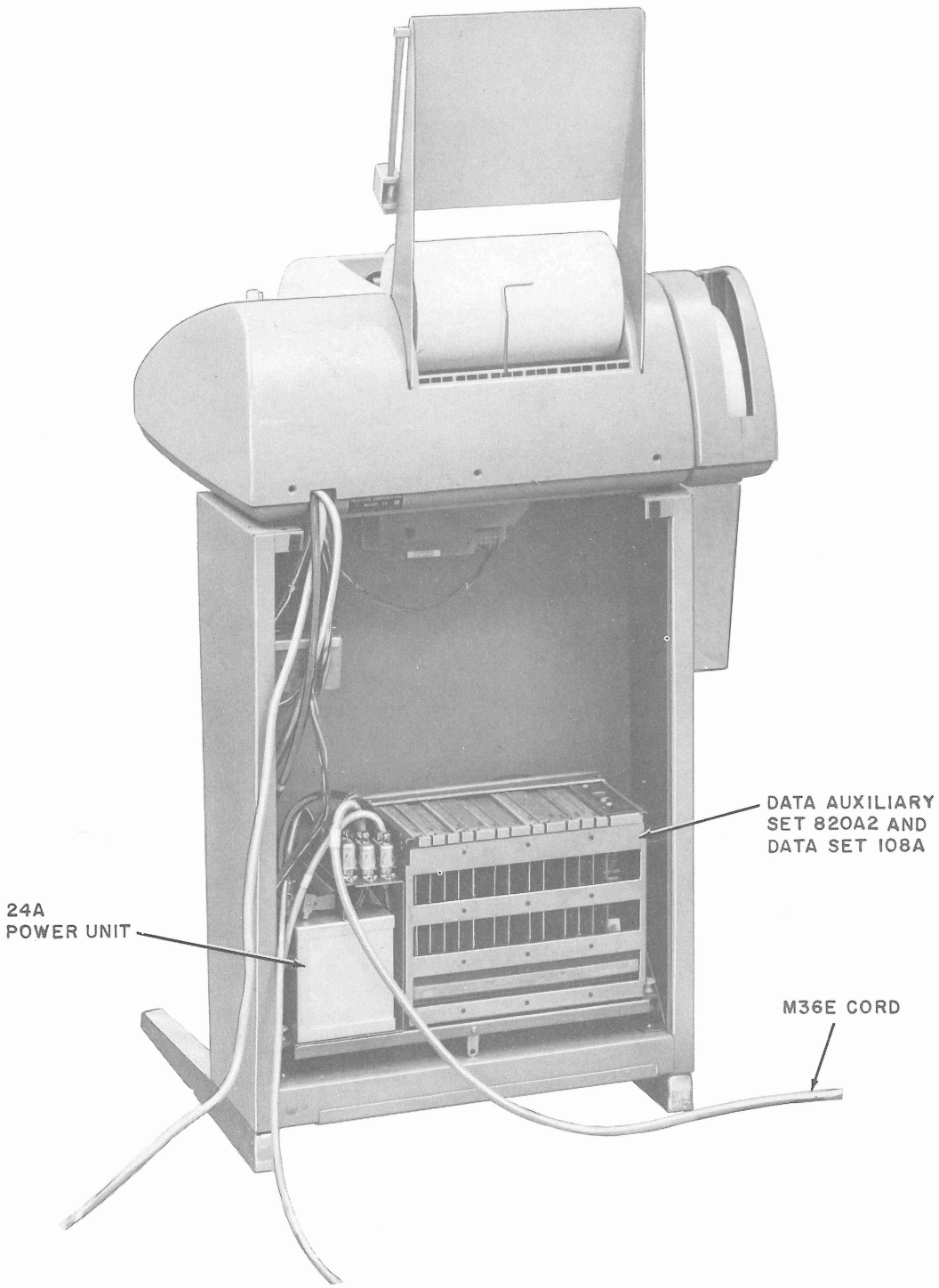

Fig. 6— 33-Type ASR TTY—Rear View

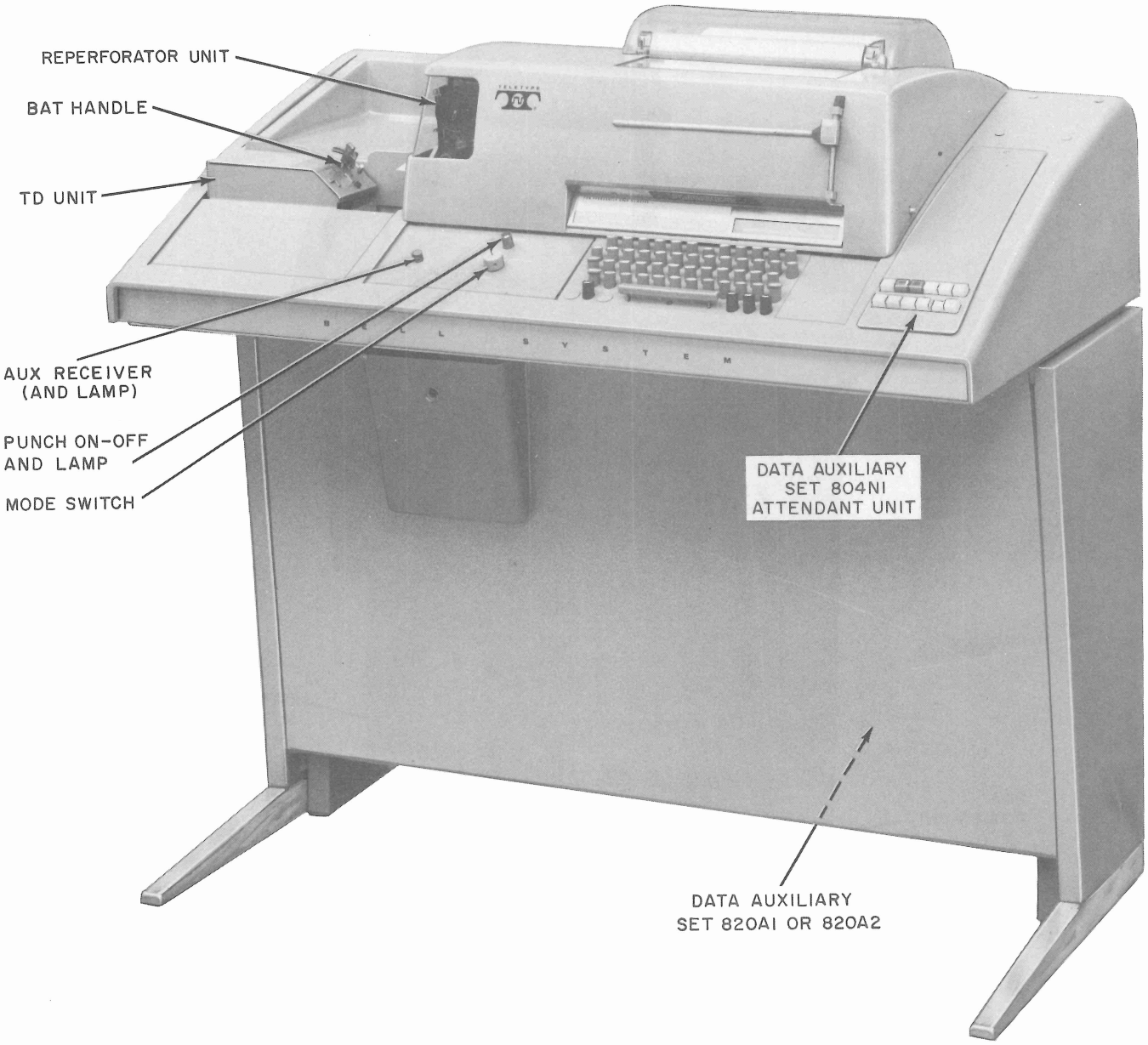

Fig. 7—35-Type ASR TTY Unit

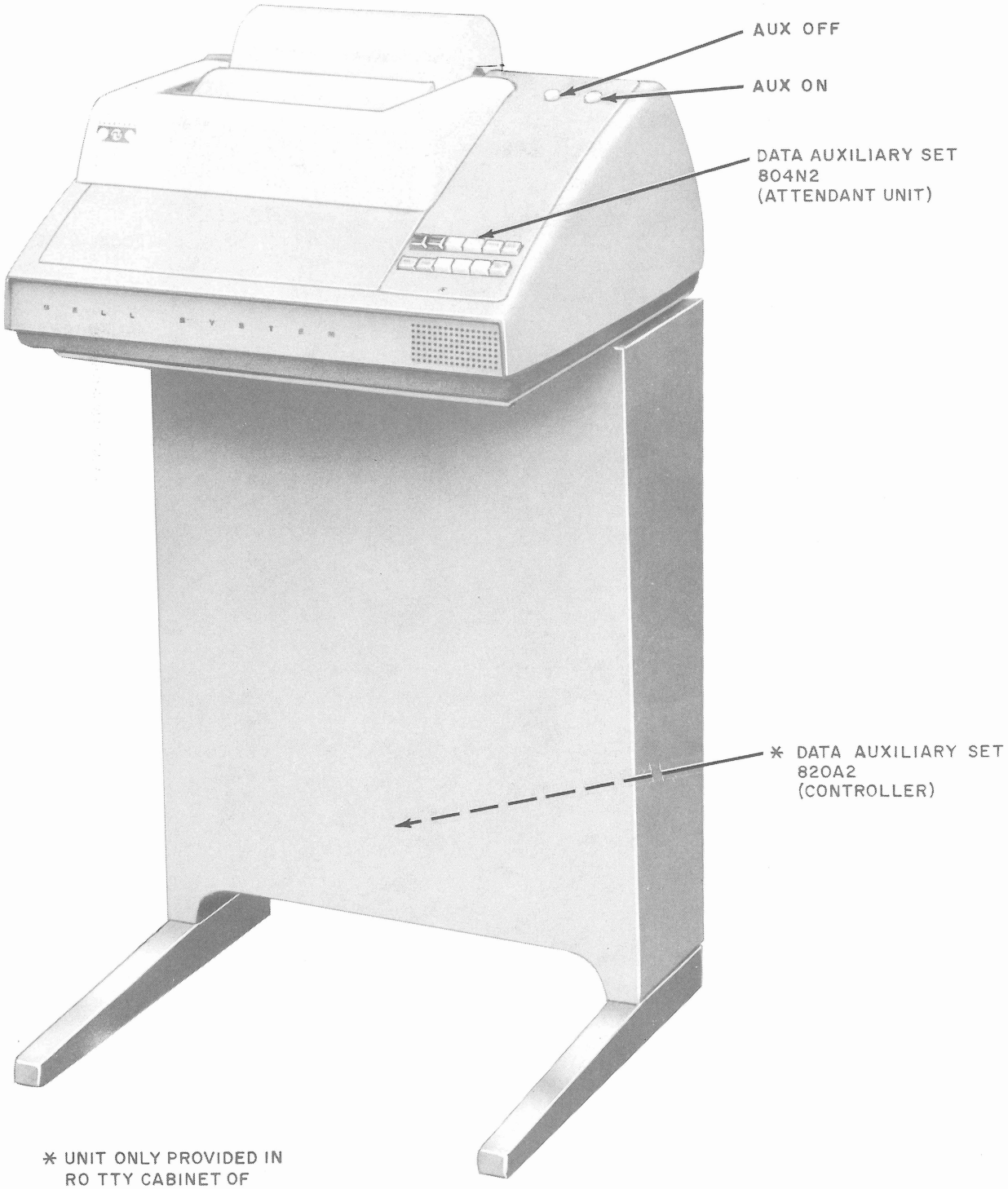

Fig. 8—33-Type RO TTY Unit

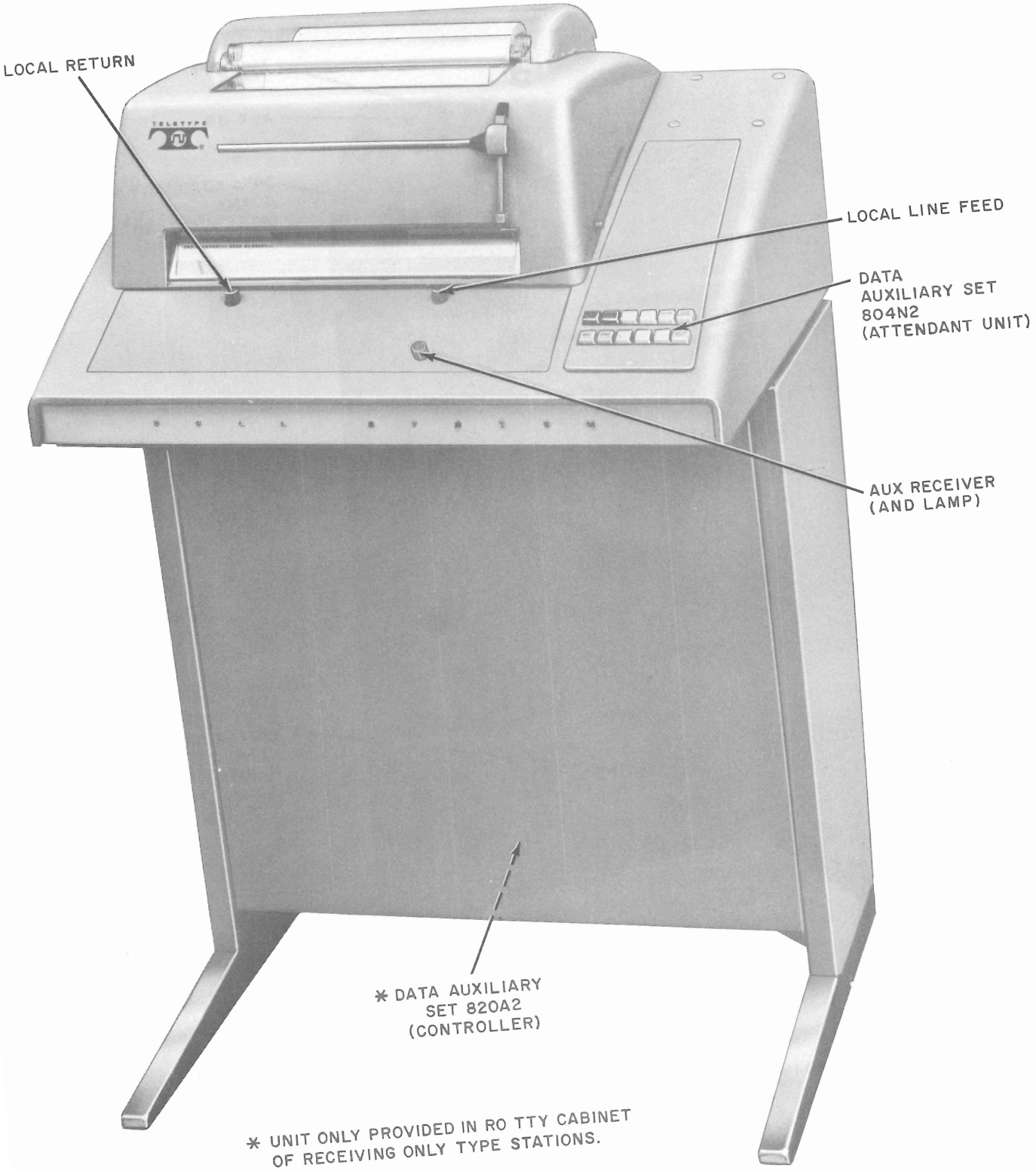

Fig. 9—35-Type RO TTY Unit

2.17 The 35 ROTR (Fig. 10) is an 8-level, 100-wpm machine which is a tape punch. The ROTR may print characters on the punched tape. An auxiliary receiver unit is never provided for use with the 35 ROTR station receiver unit.

2.18 External overall dimensions of the 35 ROTR unit with stand-alone cabinet are 34 inches high, 13-5/16 inches wide, and 14 inches deep. The weight is approximately 75 pounds.

The Auxiliary Receiving Unit

2.19 Each FDX receive-type station equipped with a 33 or 35 RO TTY unit may be optionally equipped with an auxiliary receiving unit. The auxiliary receiving unit may be a 33 or 35 RO TTY or a 35 ROTR. The ROTR as a master receiving unit is not arranged for operation with an auxiliary unit. The 35 ROTR as an auxiliary receiver may be used only with the 35 RO TTY master receiving unit.

C. Station Controller

2.20 The station controller and data set unit (Fig. 11) are always mounted in the ASR cabinet pedestal of send only or send and receive stations. In receive only stations, the controller is mounted in the RO cabinet (or KS-20018 cabinet for ROTR). The station controller (Data Auxiliary Set 820A1 or A2) consists of 12 circuit packages beginning immediately to the right of the 24A power unit and connector panel.

2.21 The plunger, a nylon device captive in the controller, facilitates installation of the controller to the mounting bracket in the TTY pedestal. The 748A tool is used for extracting the circuit packages from the controller for maintenance purposes. Connectors and terminal strips are provided for connection of power, the station line (tip and ring), the sending TTY (M), the sending attendant unit (N), and the RO or ROTR receiver unit (P). Switches are provided for control of modulator squelch and maintenance tests (manual loop-back).

D. Data Set

2.22 The Data Set 108A (Fig. 11) is the single circuit package located at the right end of the station controller and data set assembly. The data set is not supplied with the controller and must be ordered separately for installation with the controller.

E. Attendant Units

2.23 Either of three types of attendant units is used in the FDX stations. The 33 and 35 ASR TTY are equipped with the sending attendant unit, Data Auxiliary Set 804N1 (Fig. 12 and 13). The 33 and 35 RO TTY are equipped with the receiving attendant unit, Data Auxiliary Set 804N2 (Fig. 14 and 15). The 35 ROTR, as a master receiving unit, is equipped with the receiving attendant unit, Data Auxiliary Set 804R3 (Fig. 16). The attendant unit is mounted on the right-hand side of the TTY pedestal top for the ASR and RO TTY. The attendant unit for the ROTR is located in the front door of the ROTR stand.

2.24 The sending attendant units contain the keys and lamps (Table C) associated with the sending functions of the station. The receiving attendant units contain the keys and lamps (Table D and E) associated with the receiving functions of the station.

3. FUNCTIONAL DESCRIPTION

3.01 This part describes the various components which make up the basic types of 100-wpm FDX stations and their various arrangements.

A. Station Arrangements

3.02 In the descriptions which follow, it will be assumed that the station under consideration is a complete sending and receiving station. Message transmission will be covered separately from message reception so that the method of operation may be applied to terminate only situations.

3.03 Reference will be made to the ASCII code. Table F shows the ASCII code for bits one through seven. Seven bits provide message character information and an eighth bit is employed for parity checking purposes. Parity in this system is even. Table G provides the definitions for the various station control code characters.

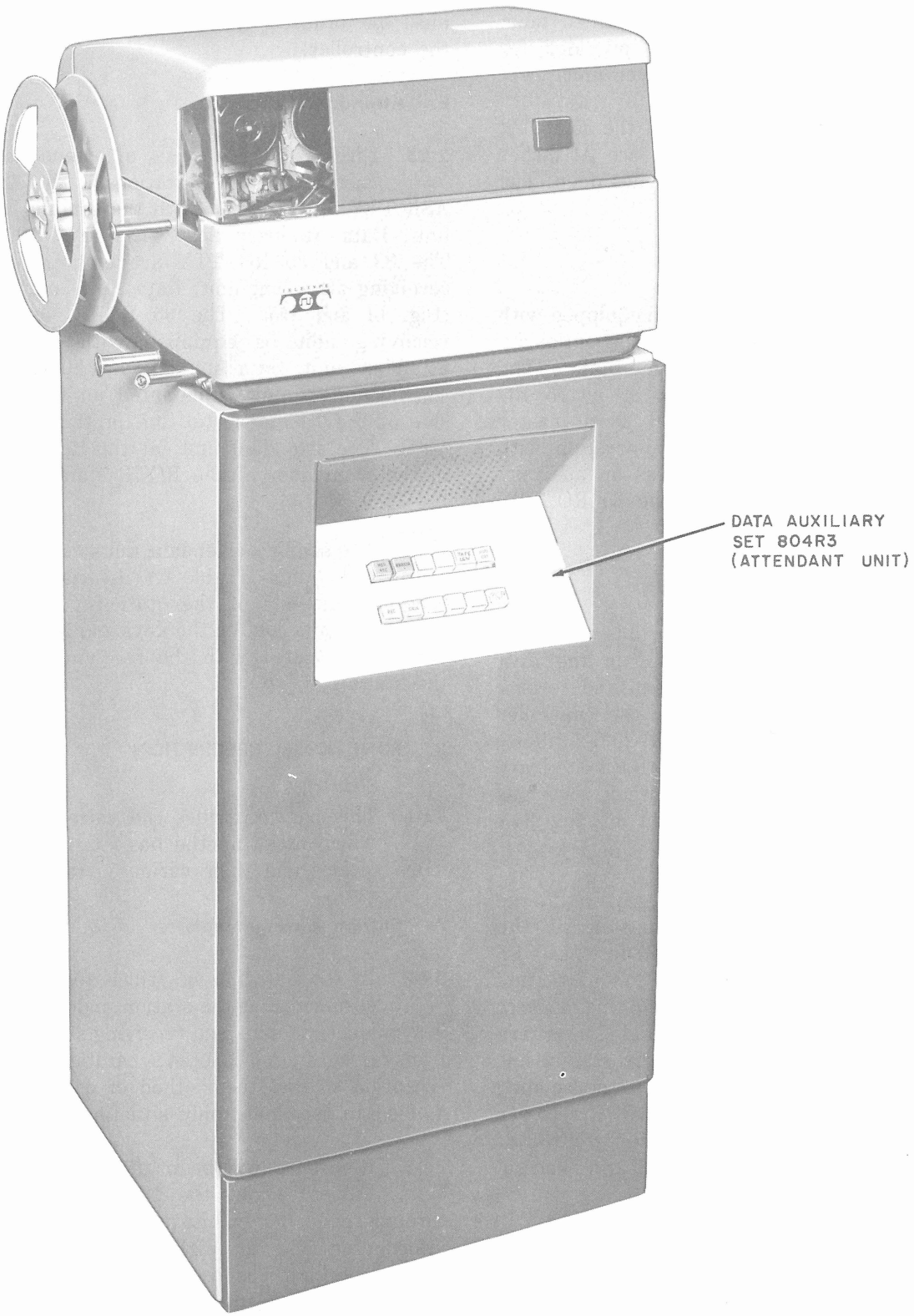

Fig. 10—35-Type ROTR Unit

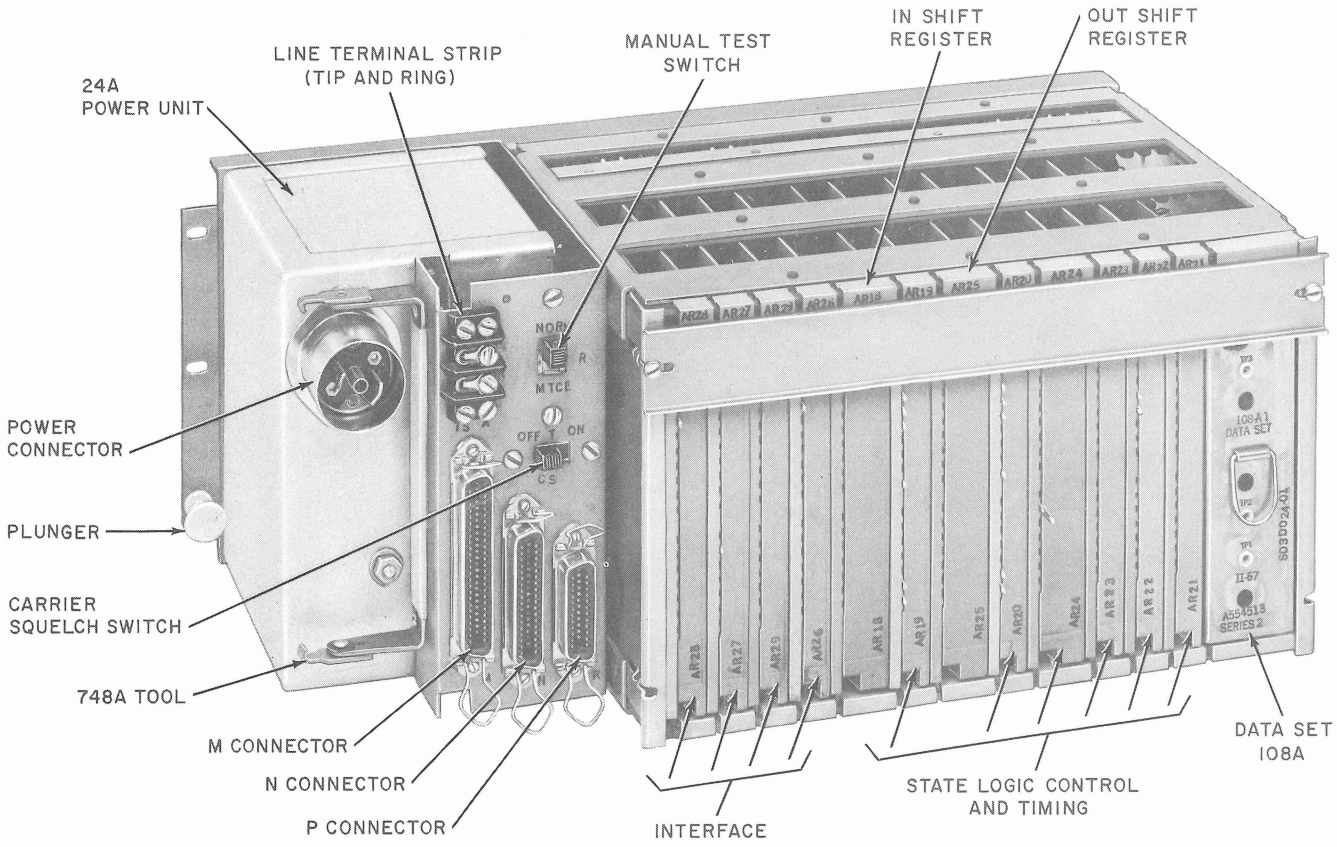

Fig. 11—Data Auxiliary Set 820A and Data Set 108A

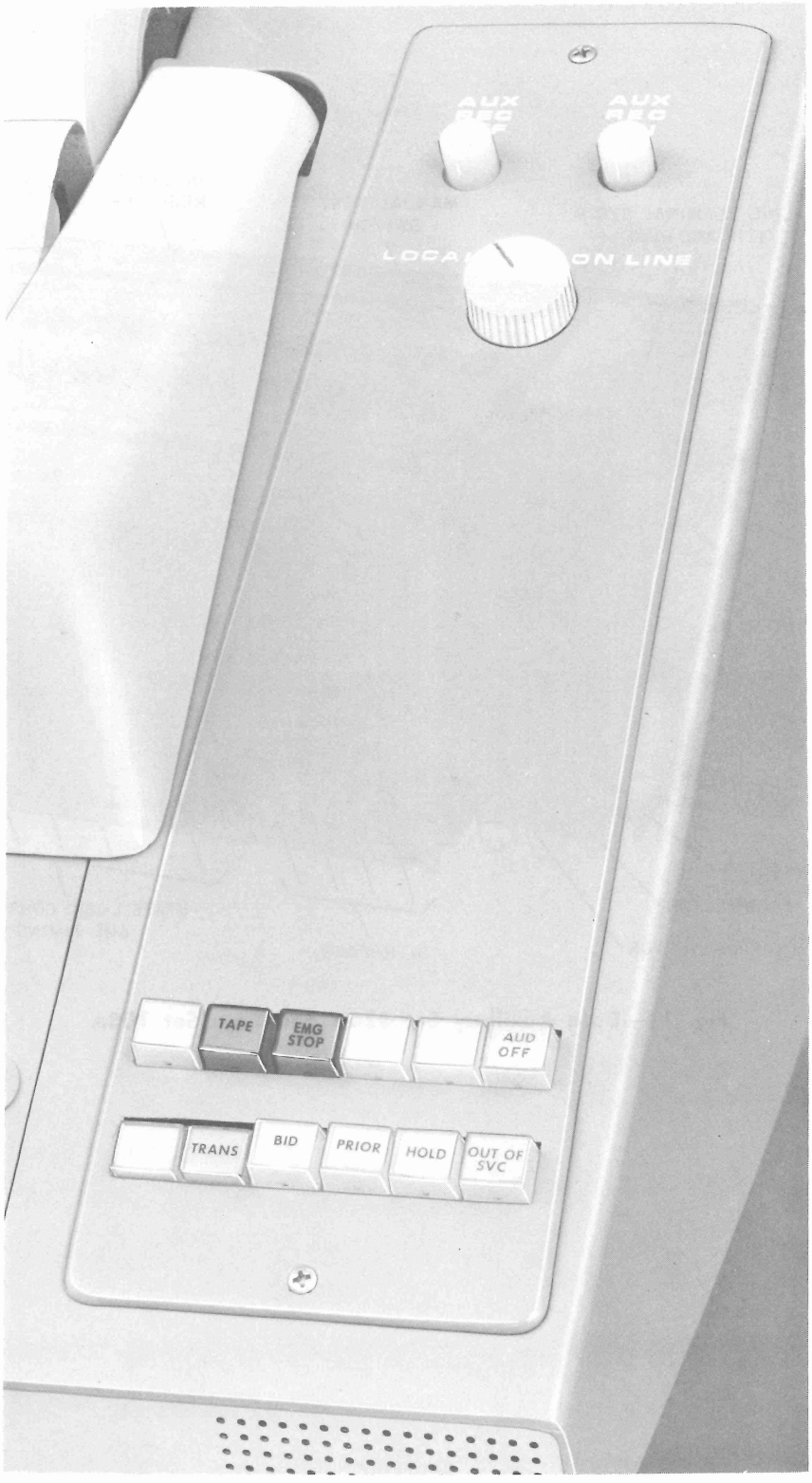

Fig. 12—Data Auxiliary Set 804N1 in 33 ASR TTY

Fig. 13—Data Auxiliary Set 804N1 in 35 ASR TTY

Fig. 14—Data Auxiliary Set 804N2 in 33 RO TTY

Fig. 15—Data Auxiliary Set 804N2 in 35 RO TTY

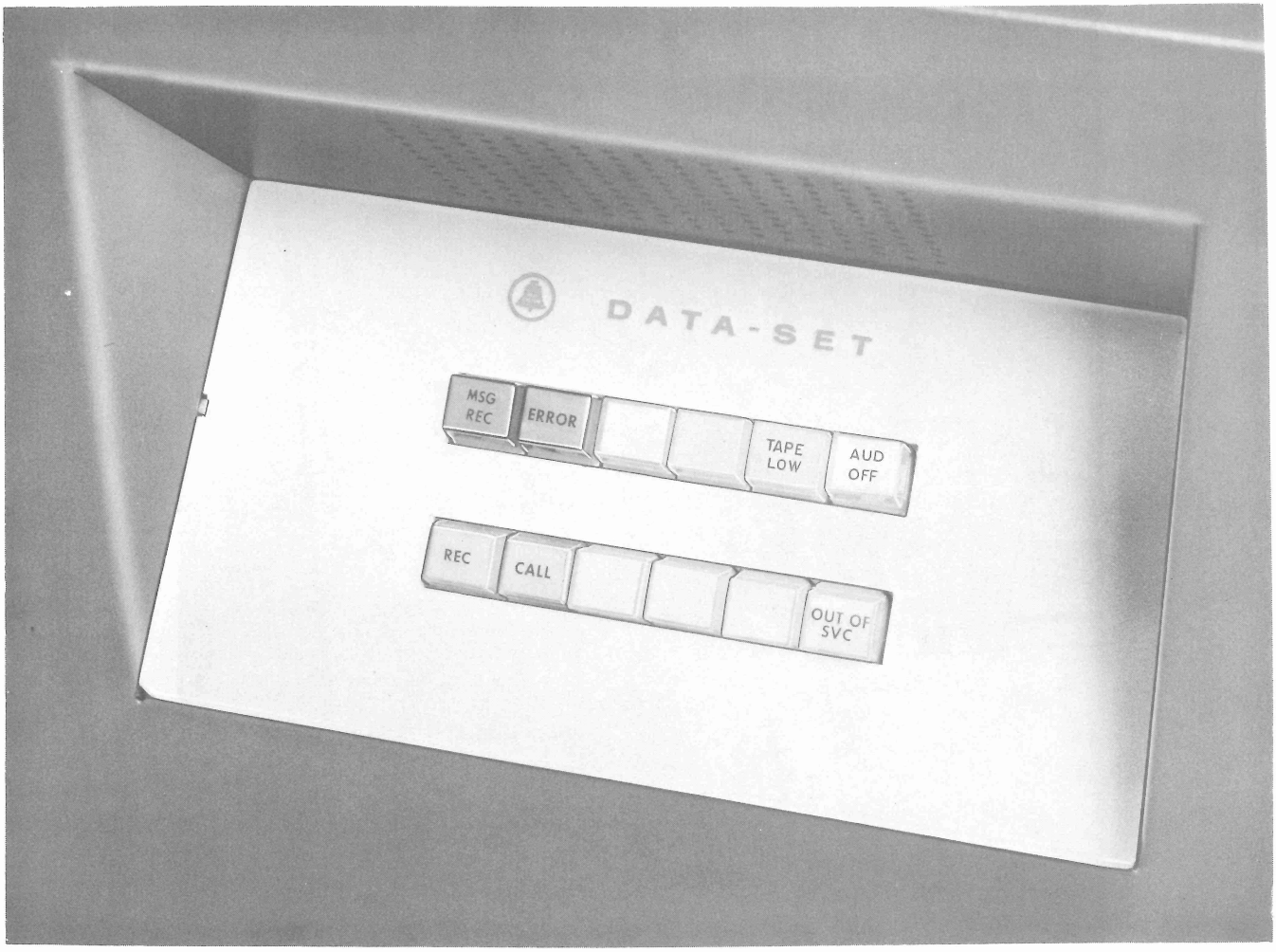

Fig. 16—Data Auxiliary Set 804R3 in 35 ROTR

TABLE C

KEYS AND LAMPS ON THE 804N1

DESIGNATION	KEY TYPE	LAMP COLOR
OUT OF SVC	PP	CLEAR
BID	NL	CLEAR
TRANS	LAMP ONLY	AMBER
PRIOR	NL	CLEAR
HOLD	PP	CLEAR
EMG STOP	NL	RED
TAPE	NL	RED
AUD OFF	PP	CLEAR

TABLE D

KEYS AND LAMPS ON THE 804N2

DESIGNATION	KEY TYPE	LAMP COLOR
OUT OF SVC	PP	CLEAR
REC	LAMP ONLY	AMBER
CALL	LAMP ONLY	AMBER
MSG REC	NL	RED
ERROR	NL	RED
PAPER LOW	NL	CLEAR
AUD OFF	PP	CLEAR

TABLE E

KEYS AND LAMPS ON THE 804R3

DESIGNATION	KEY TYPE	LAMP COLOR
OUT OF SVC	PP	CLEAR
REC	LAMP ONLY	AMBER
CALL	LAMP ONLY	AMBER
MSG REC	NL	RED
ERROR	NL	RED
TAPE LOW	NL	CLEAR
AUD OFF	PP	CLEAR

PP denotes a push-push key
NL denotes a non-locking key

TABLE F

USA STANDARD CODE FOR INFORMATION INTERCHANGE

USAS X3.4 — 1967

B_7 B_6 B_5 → / BITS					0 0 0	0 0 1	0 1 0	0 1 1	1 0 0	1 0 1	1 1 0	1 1 1
B_4	B_3	B_2	B_1	COLUMN → / ROW ↓	0	1	2	3	4	5	6	7
0	0	0	0	0	NUL	DLE	SP	0	@	P	`	p
0	0	0	1	1	SOH	DC1	!	1	A	Q	a	q
0	0	1	0	2	STX	DC2	"	2	B	R	b	r
0	0	1	1	3	ETX	DC3	#	3	C	S	c	s
0	1	0	0	4	EOT	DC4	$	4	D	T	d	t
0	1	0	1	5	ENQ	NAK	%	5	E	U	e	u
0	1	1	0	6	ACK	SYN	&	6	F	V	f	v
0	1	1	1	7	BEL	ETB	'	7	G	W	g	w
1	0	0	0	8	BS	CAN	(	8	H	X	h	x
1	0	0	1	9	HT	EM	)	9	I	Y	i	y
1	0	1	0	10	LF	SUB	*	:	J	Z	j	z
1	0	1	1	11	VT	ESC	+	;	K	[	k	{
1	1	0	0	12	FF	FS	,	<	L	\	l	|
1	1	0	1	13	CR	GS	−	=	M	]	m	}
1	1	1	0	14	SO	RS	.	>	N	^	n	~
1	1	1	1	15	SI	US	/	?	O	_	o	DEL

3.04 There are basically three types of FDX stations available. They are the send and receive station, the send only station, and the receive only station. Each of the three types of stations may be equipped with one or a combination of TTY units. There are five types of TTY units: 33 ASR, 35 ASR, 33 RO, 35 RO, and 35 ROTR. The equipment groupings were listed in Table B and described in Part 2 of this section.

3.05 When power is first applied to the station, an initializer circuit in the controller applies a momentary positive voltage to all critical state logic memory elements and places the controller in the idle mode.

B. Sending a Message

Message Format

3.06 Messages are prepared on punched tape by the attendant using the ASR TTY keyboard. All messages follow the same format. Each message is preceded by several inches of DEL characters

TABLE G

CONTROL CHARACTER CODE DEFINITIONS

DESIGNATION	DEFINITION	DESIGNATION	DEFINITION
NUL	All spaces	DLE	Data Link Escape
SOH	Start of Heading	DC1	Device Control 1
STX	Start of Text	DC2	Device Control 2
ETX	End of Text	DC3	Device Control 3
EOT	End of Transmission	DC4	Device Control 4 (Preferred for STOP)
ENQ	Enquiry	NAK	Negative Acknowledge
ACK	Acknowledge	SYN	Synchronous Idle
BEL	Bell or other signal	ETB	End Transmission Block
BS	Backspace	CAN	Cancel
HT	Horizontal Tabulate	EM	End of Medium
LF	Line Feed	SUB	Substitute
VT	Vertical Tabulate	ESC	Escape
FF	Form Feed	FS	File Separator
CR	Carriage Return	GS	Group Separator
SO	Shift Out	RS	Record Separator
SI	Shift In	US	Unit Separator
DEL	Delete All Marks	SP	Space

on the tape. The DEL characters allow introduction of the tape into the gate of the TD and are also used as transmission separators. The message format consists of an SOH character, the message heading, an STX, the text of the message, and an ETX. One or more additional messages also may be prepared in sequence on the same continuous length of tape immediately following the ETX of the first message, but each message must follow the same format. The last message of a sequence (transmission) should include the ETX character followed by an EOT character (end of transmission).

3.07 When the attendant completes the preparation of a punched tape for torn-tape operation, the tape may be inserted into the gate of the TD, the bat handle set to RUN, and the BID key operated to initiate a "traffic available" procedure. If the status of the message is to be priority, the PRIOR key should be operated in conjunction with the BID key. When the BID key is initiated, the BID lamp is lighted and the TD starts moving tape and searching for the SOH character.

3.08 The TD runs until an SOH character is detected. When the SOH is detected by the controller, the TD stops. The "traffic available" state is activated and the station controller will respond "priority traffic available" or "regular traffic available" dependent upon whether or not the PRIOR key is operated when polled by the ADF.

3.09 When continuous-tape operation is employed, the punched tape usually remains in the TD and therefore will not need to be inserted in the

gate. The BID key is operated to initiate a "traffic available" procedure. Operation of the PRIOR key in conjunction with the BID key indicates a priority message. When the "traffic available" is initiated, the BID lamp is lighted and the TD starts running to search for the SOH character on the continuous tape. The TD runs as described in 3.07 and 3.08.

3.10 If the EOT counter option is included in the station controller (35 ASR only), the "traffic available" procedure is initiated when the attendant operates the EOT character key from the keyboard. When the "traffic available" is thus initiated, the BID lamp is lighted and the TD starts running to search for the SOH character on the tape. The TD runs as described in 3.08.

EOT Counter

3.11 If the EOT counter option is included in the station controller, the continuous tape continues to run until the EOT count is reduced to zero. The EOT character is inserted by the attendant at the end of each additional transmission prepared on the continuous tape. Each EOT punched on tape from the keyboard also causes the EOT count to increase by one count (maximum EOT count is 15). Each EOT character, detected while the tape is being transmitted, reduces the EOT count by one count. Thus, when all the messages on the continuous tape have been sent, the last EOT character on the tape reduces the EOT count to zero causing the station controller to cancel the traffic available condition. During a HOLD key operation sequence, the EOT counter will be reset to the zero when the gate is opened to insert a torn-tape message.

Polling (Fig. 17)

3.12 All stations on the multistation line are periodically polled by the ADF. Fig. 17 is a sequence chart of the polling routine. The ADF sends a DLE character followed by the unique Station Polling Code (SPC) identification for the station. The response generated by the station controller of the FDX station depends upon the sending and receiving status at the station being polled. The station polling responses are listed in Table H.

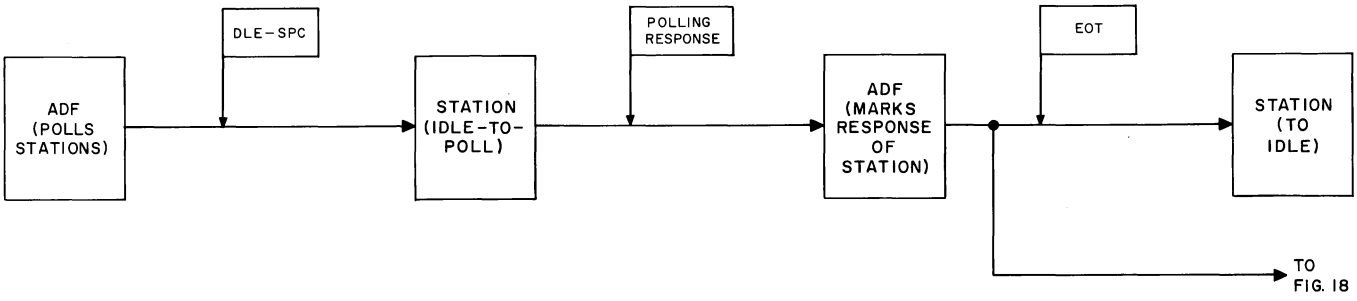

Fig. 17—Station Polling—Sequence Chart

TABLE H

STATION POLLING RESPONSES

RESPONSE	STATE OF SENDING TERMINAL	STATE OF RECEIVING TERMINAL
CAN	No Traffic To Send	Ready to Receive
R-ACK	Regular Traffic to Send	Ready to Receive
P-ACK	Priority Traffic to Send	Ready to Receive
R-NAK	Regular Traffic to Send	Not Ready to Receive
P-NAK	Priority Traffic to Send	Not Ready to Receive
NAK	No Traffic to Send	Not Ready to Receive

Note: A station is ***READY*** to receive if it is not out of service, has an adequate paper supply, and is not in form-feed or tape feed-out process. If any one or more of these three conditions are not met, the station is ***NOT READY*** to receive.

Selecting a Station to Send (Fig. 18)

3.13 Fig. 18 is a sequence chart for selecting a station to send. To select a station as a sender (after polling), the ADF transmits ENQ followed by the unique call enquirey code (CEC) of the station. If traffic is still available, the station controller responds by generating and transmitting an SOH character which causes the station to become a selected sender (TRANS lamp is lighted). The ADF sends a DLE followed by a DC1 character. The detection of a DC1 causes a transfer of the ASR TTY page printer to the receive data lead for reception of the time, date, and message (TDM) number (if required) followed by a DC2. The detection of a DC2 starts the TD and restores the ASR TTY printer to the normal condition for copying the TD output. After the heading and text are transmitted, the end of text (ETX) character appears on the tape. The station controller logic ignores the ETX unless the HOLD key has been operated by the attendant. If the HOLD key is not operated, the TD continues to run and one of the following may occur:

(a) If the station has additional messages to transmit, the TD will continue to run until an SOH is detected from the tape. The TD stops and the SOH is transmitted to the ADF thereby indicating that traffic is still available. Since the station is a selected sender, the ADF may restart the station TD by transmitting DLE—DC1, TDM, followed by DC2, and the pickup process may be repeated.

(b) If no additional messages are to be transmitted, the ETX on the tape is followed by EOT. Assuming that the EOT counter option is not provided and when the EOT is detected, the station is unselected as a transmitter (TRANS lamp is extinguished). The TD continues to run until the end of the tape is reached (if torn-tape operation) or until the tape becomes taut (if continuous-tape operation). When either occurs, the BID state is cancelled, the BID lamp is extinguished, and the TD is stopped. A TAPE alarm is not initiated by the end-of-tape or taut-tape condition since the station is unselected.

(c) If the EOT counter option is provided, the tape continues to run until an EOT is detected. When the EOT character is transmitted to ADF, the count is reduced by one, and the station becomes unselected as a transmitter (TRANS lamp is extinguished). If the count is reduced to zero, the TD is stopped and the EOT count BID state is cancelled. However, if the count is still greater than zero, indicating at least one additional complete transmission is available, the TD will continue to run until the next SOH is detected. SOH stops the TD and the traffic available state is presented. To pick up the next message, the ADF will repeat the polling and selecting sequence.

Hold Operation (Fig. 19)

3.14 The HOLD key permits introduction of a message contained on a separate piece of tape during an in-progress transmission following the completion of any message in progress. A hold feature is provided which causes the TD to stop when an ETX character is detected from the tape. When the TD stops, the attendant may insert the torn-tape message. The torn-tape message should conform to the standard message format.

3.15 The HOLD key may be operated at any time during a transmission prior to the final ETX character. Fig. 19 is a sequence chart for HOLD key operation at the sending station. Operation of the push-push HOLD key enables detection of ETX from tape. Detection of the ETX character causes the TD to stop, the HOLD lamp to turn on, and the audible alarm to sound. In addition, the tape alarm is disabled when the TD is stopped in this manner.

3.16 With the TD stopped, the attendant may remove the original tape and insert the torn-tape message. Opening the gate on the TD clears the EOT count and cancels the traffic available indication (BID lamp is extinguished). To restart the tape, the HOLD key must be released, and the BID key must be operated.

3.17 While the tape is being changed, the line is kept marking and the ADF allows an adequate time-out interval, after which the station is disconnected by an emergency stop procedure if the transmission has not resumed. To resume transmitting the original tape, the hold sequence is repeated and when the TD stops, the original tape again can be inserted. The audible alarm can be silenced by operating and releasing the AUD OFF key.

Interrupting a Selected Sender (Fig. 20)

3.18 If the station is a selected sender and is to become a selected receiver, the station must stop sending while being selected as a receiver so that call-in responses may be sent to the ADF. When the station receives an ENQ character from the ADF, the TD is stopped. After the station is selected as a receiver, reception of a DC2 character restarts the TD and message transmission is resumed.

Emergency Stop (Fig. 21)

3.19 If it becomes necessary for the ADF to interrupt the selected sender, an emergency stop sequence will be initiated. The emergency stop sequence consists of the character sequence DLE, X, and DC1. When the DLE is detected, the TD stops and the RO TTY unit of any selected receive station on the line is blinded. The X causes the EMG STOP lamp to be lighted. The DC1 conditions the ASR TTY page printer to receive the emergency stop service message from the ADF. After the service message has been sent, the ADF transmits a 2-character sequence consisting of DC3 and DC2. The DC3 unselects the selected sending station. The DC2 unblinds any called-in receive stations on the line and restores them to the condition which existed before the emergency stop service message sequence started. The EMG STOP lamp is manually extinguished by the attendant and the sending station is restored to idle.

Cocking (Fig. 22)

3.20 An idle station may be in the cocked or uncocked state depending upon the traffic status of other sending stations on the line. To cock a station(s), the ADF transmits a DLE, an EOT, and a DC2. In the cocked state after a message is inserted in the TD and the TD is started, SOH is detected from the tape which stops the TD and the station sends its station identity code (SIC) to the ADF. The ADF will poll when thus alerted that the station has a message. At the beginning of polling, DLE from the ADF uncocks the stations. To avoid interference, a station is cocked only if all the sending stations on the same line are idle (no traffic available).

C. Receiving a Message

Normal Message Reception (Call In)

3.21 If the ADF has a station marked "ready to receive," it can call in that station for message reception and proceed to call it in as a receiver. Fig. 23 shows the sequence of calling in a station. To call in the station, the ADF transmits ENQ followed by the unique CEC of the station. The station responds with its unique SIC followed by either ACK if it is ready to receive, or NAK if not ready. If the station response is NAK, the CALL lamp is lighted to indicate that the station has been called. If the response is ACK, the CALL lamp flashes and the RCV lamp is turned on to indicate that the station is a called-in receiver. The ADF sends per-station information to the called-in station.

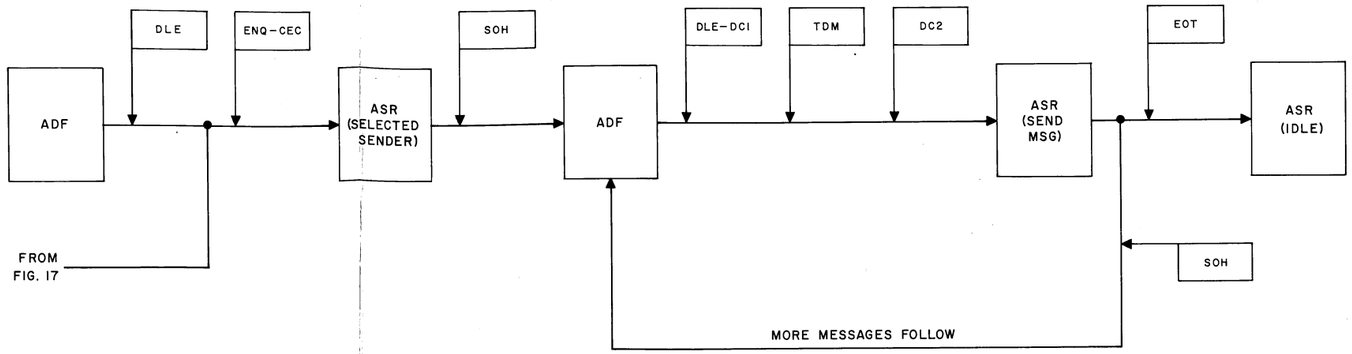

Fig. 18— Sender Selection —Sequence Chart

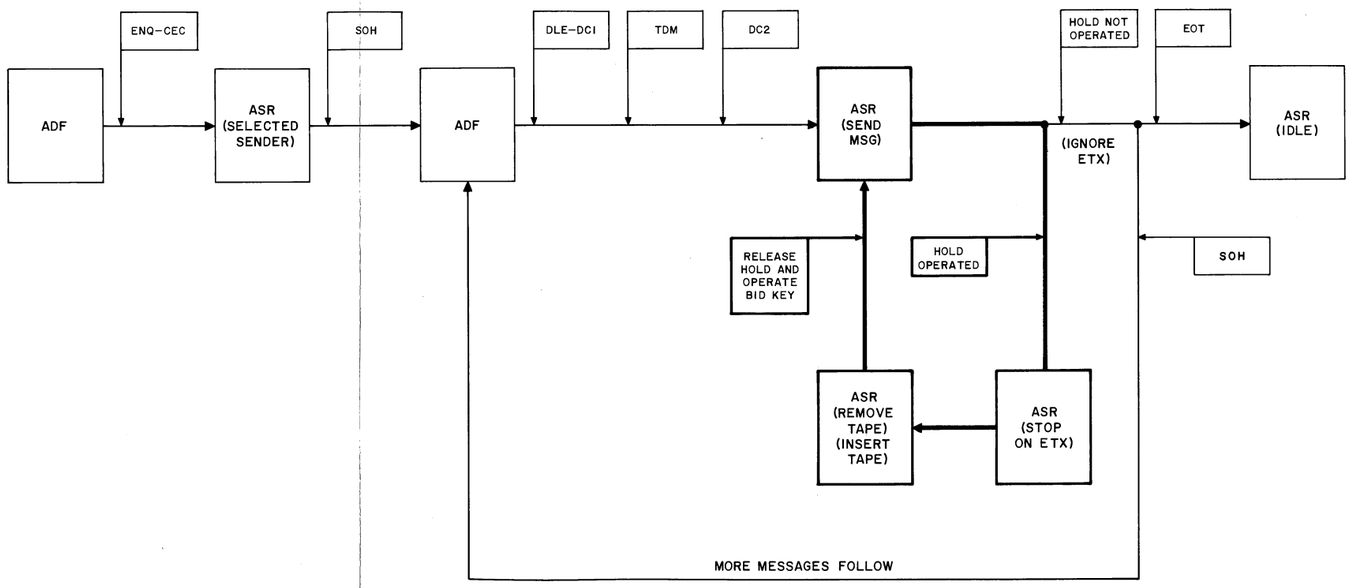

Fig. 19—Hold Key Operation—Sequence Chart

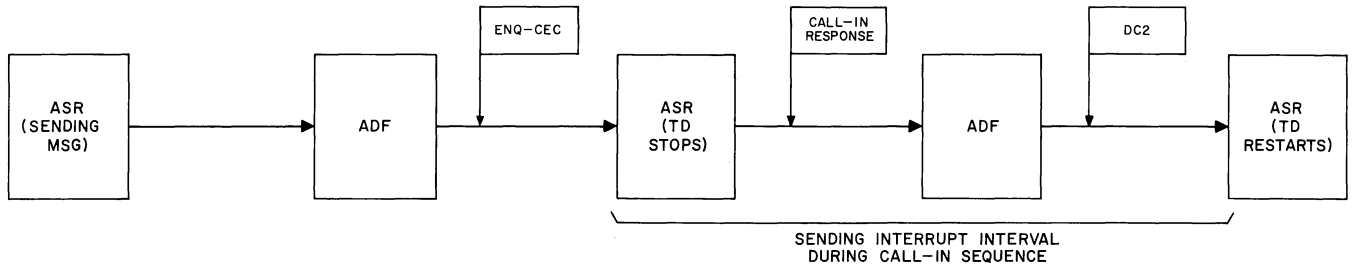

Fig. 20—Interrupting a Selected Sender (Call In)—Sequence Chart

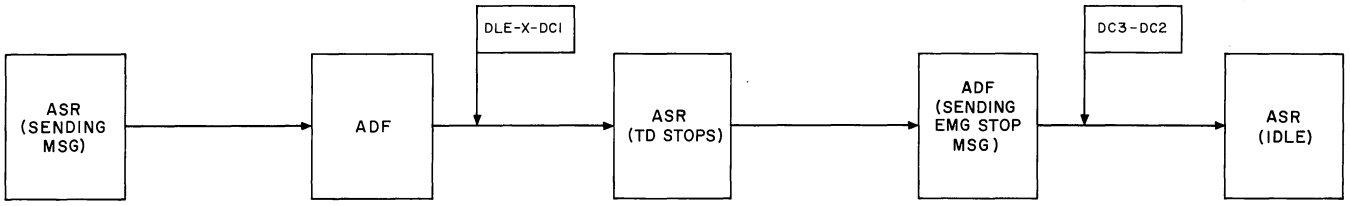

Fig. 21—Emergency Stop—Sequence Chart

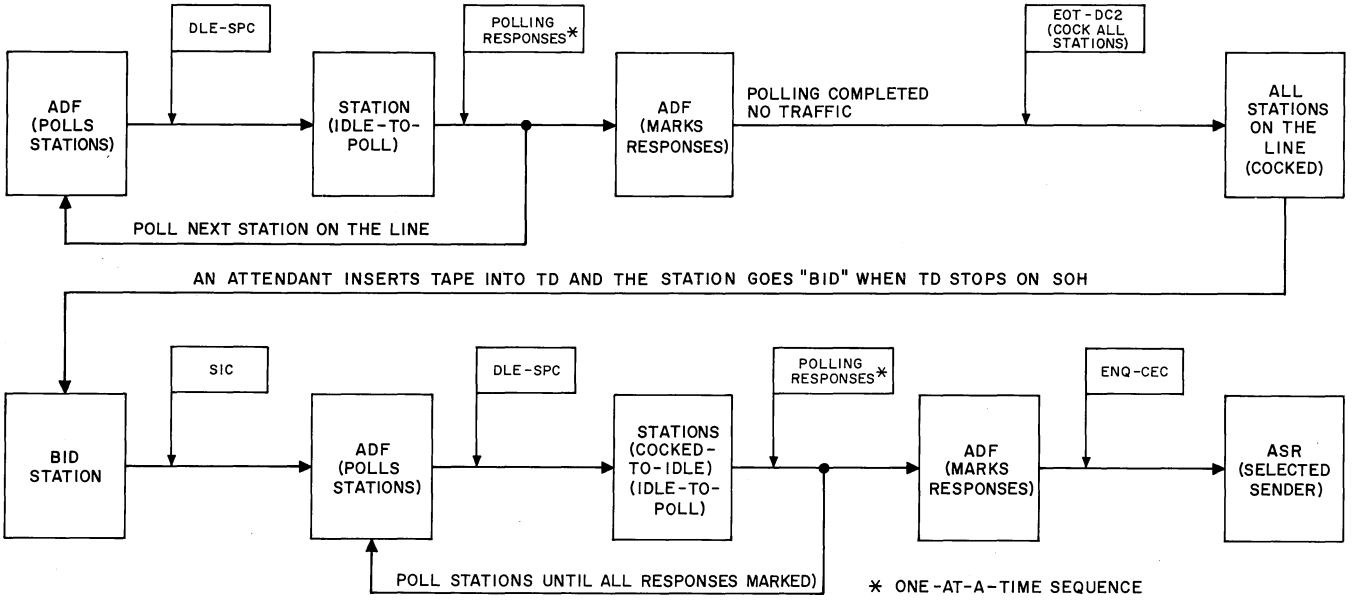

Fig. 22—Cocked Stations—Sequence Chart

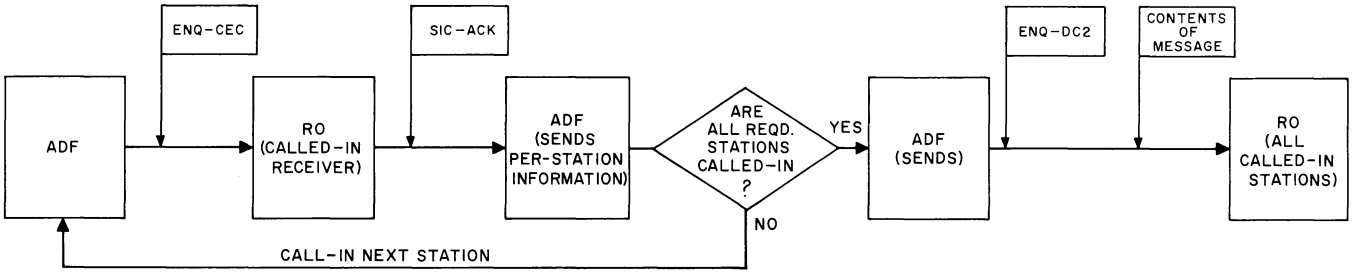

Fig. 23—Calling In a Station—Sequence Chart

3.22 A station is not ready to receive if any of the following conditions exist:

(a) The station is out of service.

Note: The station receiving TTY unit or sending TTY unit cannot be placed out of service if it is called in as a receiver or selected as a sender, respectively.

(b) Paper is low or form is out and the station is not selected to receive.

(c) Form is being fed and the station is not selected to receive.

(d) The controller is in the process of initialization or is in the manual test mode.

(e) Tape is low in station using the 35 ROTR as a master receiving unit.

3.23 If another station is to be selected as a receiver, the ADF transmits ENQ followed by the CEC of the second station. ENQ blinds the first station so that the RO TTY units will not print the data received from the ADF during second (etc) station call-in. If additional stations are to be called in, the process just described is repeated. The ADF transmits the SOH character, personal address information (PAI), and delivery number. After all the stations have been called in, the ADF transmits ENQ and DC2 to unblind all the receiving stations. The ADF then transmits the delivery time/date (if required), originating number (if required), and complete message heading (if required).

3.24 If a station is to be selected as a receiver while another station on the same line is sending, the TD of the sending station is stopped, when ENQ is detected, to prevent interference to the message transmission while the SIC is being generated by the called-in station. After all stations on the line have been called in, the ADF sends a DC2 which causes the TD to restart at the sending station.

Roll Call (Fig. 24 and 25)

3.25 After the message text (including ETX) has been delivered, the ADF initiates a roll-call sequence by sending ENQ followed by the CEC of the station. ENQ interrupts a sending station and, if a station is cocked, it is inhibited from generating a polling request code (PRC). The roll-call characters ENQ and CEC are the same characters used for the call-in. However, since the station controller has previously received an ETX, the ENQ and CEC sequence is recognized as a roll call. The station controller responds with SIC and CAN characters if the message was received satisfactorily or with SIC and NAK if the message was not received satisfactorily. The NAK response is generated if any of the following conditions occur during the interval between the time the station was selected to receive and the initiation (ENQ) of the roll-call sequence.

(a) ETX was not received and/or detected by the controller.

(b) A character was "lost" and did not reach the typing unit.

(c) The station received a form feed (FF) order followed by DEL, form ran out while feeding, and the next character was not ETX (applicable to sprocket-feed page printers only). If the station answers NAK to roll call, the MSG REC lamp is lighted and the audible alarm is sounded. The lamp can be extinguished and the alarm silenced by operating the MSG REC key. After all called-in stations have been roll called, the ADF transmits an EOT and a DC2. The EOT restores receive stations to the idle mode. The DC2 restarts the TD of the interrupted sender and removes the PRC inhibition of a cocked station.

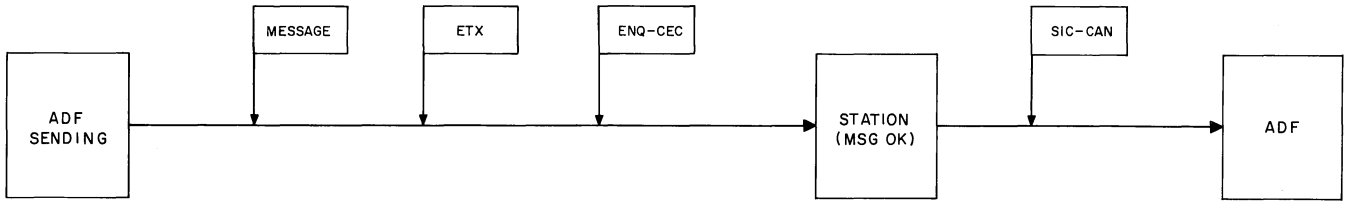

Fig. 24—Roll Call (Message Received Satisfactorily)—Sequence Chart

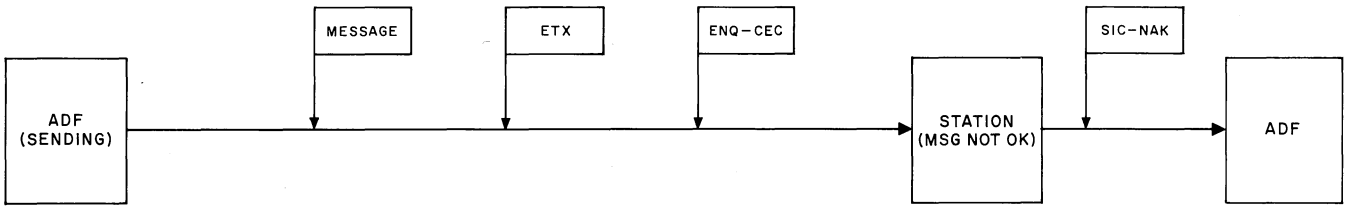

Fig. 25—Roll Call (Message Not Received Satisfactorily) Sequence Chart

Message Reception Alarm

3.26 If the ADF detects that there are irregularities in the message being sent to a receive station, it will notify the station by means of the message reception alarm sequence. The sequence starts with a DLE which stops the TD of any send station and blinds all called-in receive stations. Cocked sending stations are also uncocked. Next, a W character lights the MSG REC alarm lamp and sounds an audible alarm at the receive stations. A DC2 then unblinds all selected receivers and restarts the TD of the selected sender. After the service message is completed, the ADF transmits an EOT and restores selected receivers to idle. The audible alarm is silenced and the MSG REC alarm lamp is extinguished manually by the attendant.

Auxiliary TTY Connect and Disconnect
33 RO-Type Station

3.27 A 33 RO TTY may be used as an auxiliary receiver. It may be connected and disconnected manually and, if the appropriate wiring option is provided in the master machine, automatically.

3.28 The auxiliary receiver is connected manually by operation of the AUX ON key located on the master machine. This unblinds the selector magnet driver (SMD) of the auxiliary receiver (connected in parallel with the SMD of the master machine), thereby allowing the auxiliary receiver to copy information copied by the master machine. A lamp under the AUX ON key is lighted whenever the auxiliary receiver is connected. Operation of the AUX OFF key, which is adjacent to the AUX ON key, will disconnect the auxiliary receiver by blinding its SMD.

3.29 The auxiliary receiver is automatically connected on reception of DC2 and disconnected on reception of ETX and/or (optionally) DC4 provided the typing unit of the master machine is not blinded.

35 RO-Type Station

3.30 A 35 RO TTY or 35 ROTR may be used as an auxiliary receiver. They may be connected and disconnected manually and automatically if the appropriate wiring option is provided in the master machine.

3.31 The auxiliary receiver is manually connected by operation of the AUX RECEIVER key located on the master machine. This unblinds the SMD of the auxiliary receiver (connected in parallel with the SMD of the master machine), thereby allowing the auxiliary receiver to copy information being copied by the master machine. A lamp located adjacent to the AUX RECEIVER key on the master machine is lighted whenever the auxiliary receiver is connected. Restoration of the AUX

RECEIVER key disconnects the auxiliary receiver by blinding its SMD.

3.32 When the wiring option, that allows automatic auxiliary receiver connect and disconnect, is provided on the master machine, reception of DC2 will connect the auxiliary receiver and reception of ETX and/or DC4 (option) will disconnect the auxiliary receiver if the master machine typing unit is not blinded. A manually connected auxiliary receiver can only be disconnected manually. An automatically connected auxiliary receiver can only be disconnected automatically.

3.33 A further option, called print suppression, also may be provided. This option causes the typing unit of the master machine to be inhibited while the auxiliary receiver is connected. Disconnecting the auxiliary machine will restore the typing unit of the master machine to service.

3.34 When the auxiliary receiver is a 35 ROTR, automatic tape feed out (TFO) will occur whenever the auxiliary ROTR is disconnected manually or, if a wiring option is provided in the master machine when the ROTR is disconnected, automatically. In either case, between 3 and 10 inches of tape will be fed out punched with rub-outs (DEL). If the auxiliary ROTR is connected manually, and the automatic disconnect TFO option is provided, reception of an automatic disconnect character will cause TFO to occur, but the auxiliary ROTR will remain connected.

35 ROTR-Type Station

3.35 When a 35 ROTR is used as a master machine, there are no provisions for connecting an auxiliary receiver.

D. Teletypewriter

Sending TTY Unit (Fig. 26)

3.36 The keyboard, typing unit, and tape punch are used in the OFF-LINE mode for preparing tapes and printed copy (with PUNCH ON). The keyboard and typing unit may also be used in the OFF-LINE mode for typing practice (with PUNCH OFF).

3.37 In the ON-LINE mode, the typing unit is used to print the message being sent from the TD via the controller. The TD converts the punches on the tape to electrical signals and presents them to the controller during the sending sequence. When the TD stops at an SOH character on tape and the station has been selected as a sender, the controller may receive a DC1 character from the ADF. Detection of a DC1 character will transfer the ASR TTY typing unit to the receive data lead for copying TDM information. Detection of a DC2 character by the controller will restore the typing unit to copying the TD output and start the TD. During a transmission, a DC1 character will cause the TD to stop and connect the ASR typing unit to the receive data lead for reception of an emergency stop message. A DC3—DC2 character is initiated at the conclusion of the emergency stop message sequence. The DC3 restores the selected sender to idle and the DC2 restores other receiving stations on the line for message reception (if selected).

Receiving TTY Unit (Fig. 27).

3.38 The voltage signals from the controller are applied via the receive data lead to the SMD which operates the RO TTY typing unit or ROTR tape punch. The typing unit (RO) or punch (ROTR) is blinded by the controller during reception of the TDM or emergency service message by the ASR typing unit. Detection of a DC1 character blinds the receiving unit and a DC2 unblinds the unit.

E. Station Functional Description (Fig. 28)

3.39 During the transmit sequence, the ASR TTY unit of a sending station converts the characters from tape into voltage signals which conform to Electronic Industries Association (EIA) specification RS-232-3 and presents them to the controller. In the Data Auxiliary Set 820A (station controller), the EIA voltage signals are monitored, controlled, regenerated, and sent to the data set. The Data Set 108A converts the data signals into voice-frequency tones suitable for transmission by private line to the ADF. The Data Auxiliary Set 804N1 (attendant unit) used with the ASR TTY unit performs the following functions:

(a) Provides visual and audible alarms with silencing.

(b) Conditions the station controller to respond to polling indicating that the station has routine traffic to send.

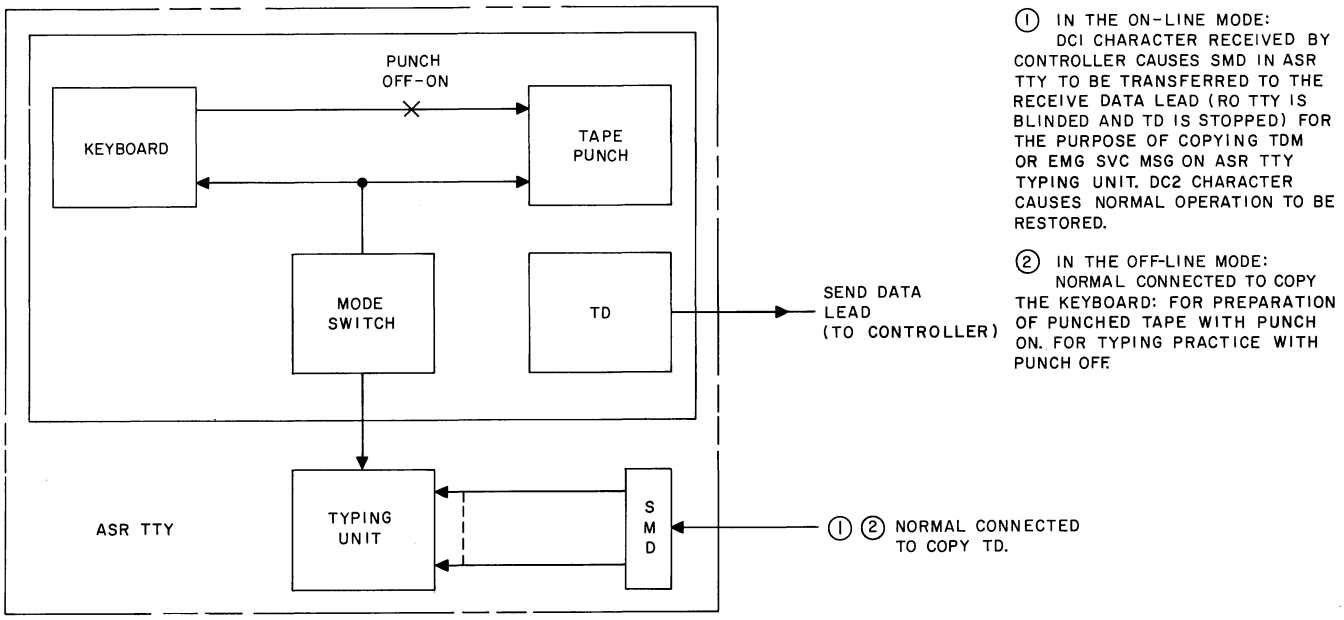

Fig. 26—Sending TTY Unit—Block Diagram

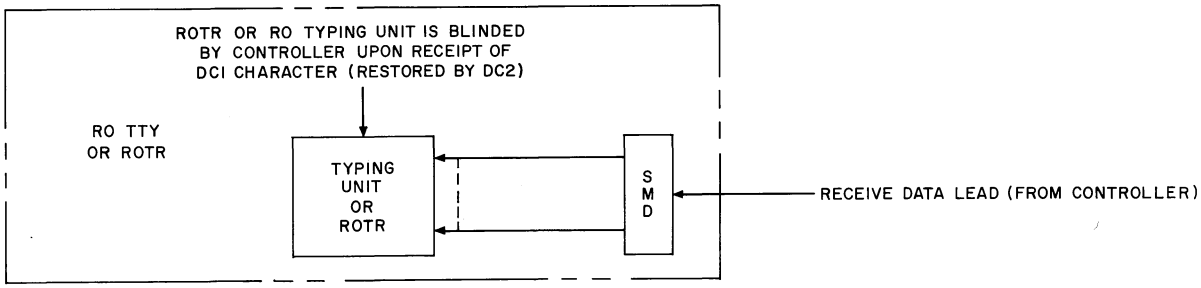

Fig. 27—Receiving TTY Unit—Block Diagram

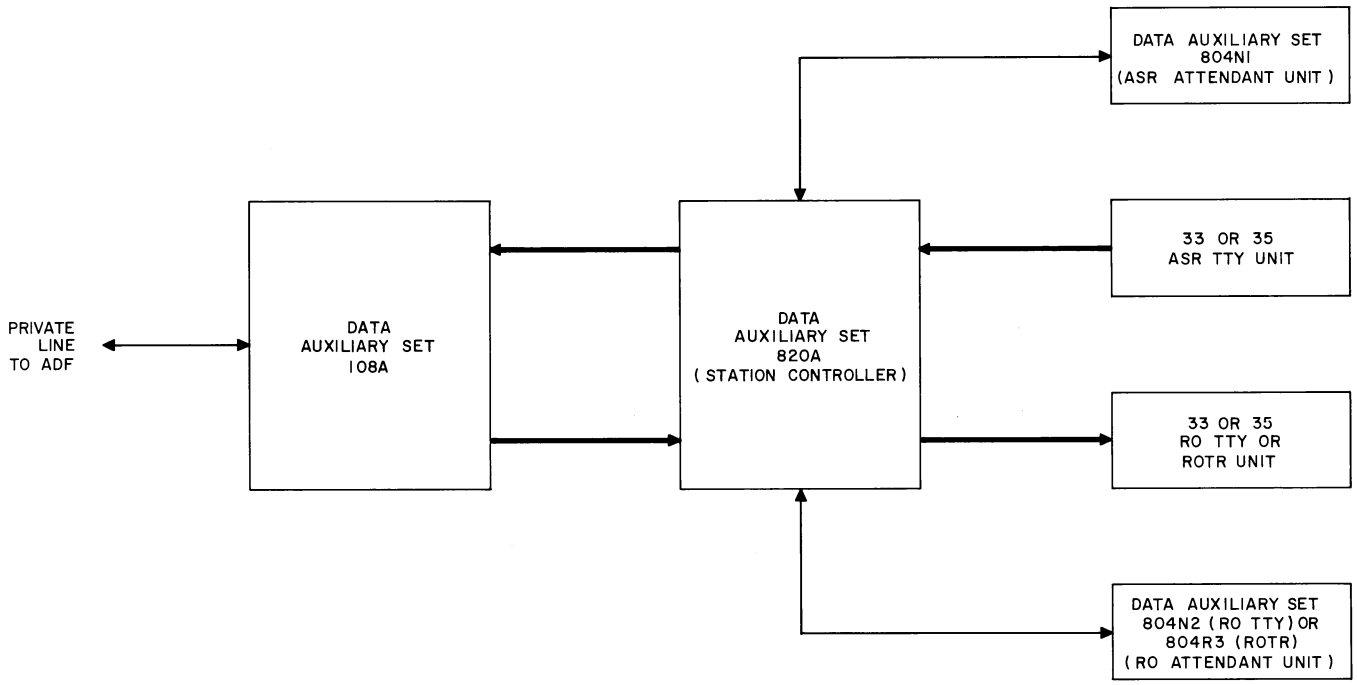

Fig. 28—100 WPM FDX Station—Block Diagram

(c) Conditions the station controller to respond to polling indicating that the station has priority traffic to send.

3.40 The receiver sequence for the RO TTY unit of a receiving station is essentially the reverse of the transmit sequence. The Data Set 108A converts the incoming line voice-frequency tones to EIA voltage signals which are applied to the station controller and receiving TTY.

Out-Of-Service

3.41 An OUT OF SVC key and lamp are provided in each attendant unit. The key is a push-push type switch. The lamp is illuminated when the station is out of service. When the ASR TTY or the RO TTY is out of service, the station responds "no traffic" to polling or "not ready" to call in by the ADF, respectively. If the OUT OF SVC key on the sending (AS) attendant unit is operated while the station is a selected sender, the ASR TTY unit does not go out of service until it becomes unselected. Similarly, operation of the OUT OF SVC key on the receiving (AR) attendant unit has no effect as long as the station is a selected receiver.

Automatic Loop-Back Test (Fig. 29)

3.42 The FDX station controller may be placed in a loop-back mode by automatic means. The automatic loop-back allows performance tests to be made with most of the controller circuits included in the signal path. The data that would normally be delivered to a page printer or punch (ROTR) at the receiver is transmitted back to the sender via the controller. The automatic loop-back sequence consists of the characters ENQ—CEC followed by DLE, +, and DC2. Reception of the DLE and + characters causes the OUT OF SVC lamp to light and the station cannot originate traffic at this time. Station alarms are disabled during loop-back tests. Reception of an EOT character restores the station controller to the normal mode and extinguishes the OUT OF SVC lamp.

Manual Loop-Back Test

3.43 The R switch, located on the station controller, disconnects the data set from the remainder of the station and connects the transmitted data lead to the received data lead of the data set. The manual loop-back isolates the station controller from

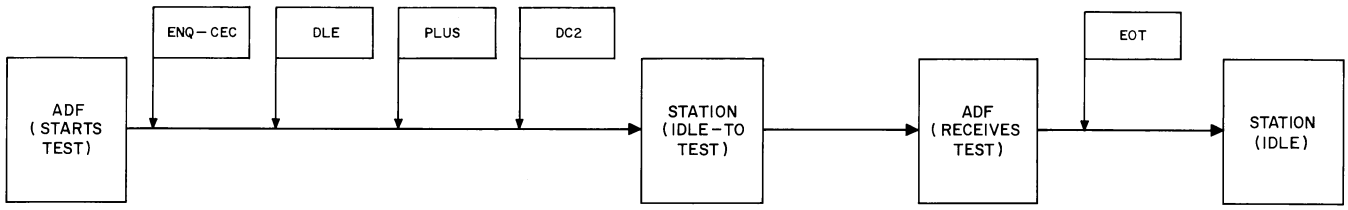

Fig. 29—Automatic Loop-Back Test—Sequence Chart

the data set and allows tests of the transmission facility and data set to be performed. In the manual loop-back condition, the OUT OF SVC lamp is lighted.

3.44 The TAPE and EMG STOP alarms and the associated audible alarm are disabled when the station is in the manual or automatic loop-back mode or when the ASR mode switch is in the OFF-LINE (local) position.

3.45 The MSG REC, ERROR, PAPER LOW alarms, and the receiver audible alarm circuit are disabled when the station is in the manual or automatic loop-back modes.

Station Alarms

3.46 An FDX station may consist of two machines (send and receive) which can be physically separated by a maximum distance of 50 feet. For this reason, the alarm circuit is split into two parts, associated with the AS and the AR attendant units in the respective TTY machines.

3.47 The alarms at the AS unit are TAPE and EMG STOP. The TAPE alarm can be activated only when the station is selected to send. The TAPE alarm is initiated when tape runs out, when the tape becomes taut, or if the bat handle is moved from the RUN position.

3.48 The alarms at the AR unit are ERROR, PAPER LOW, and MSG REC. The PAPER LOW alarm cannot be cancelled unless the paper supply is replenished.

3.49 The alarms can be reset by operating the corresponding nonlocking key (illuminated by the alarm lamp). If only cancelling of the audible alarm is desired, the AUD OFF push-push key can be operated and released. The audible alarm will be held off if the AUD OFF key is operated once. The AUD OFF key does not affect the visual alarms.

Parity Error

3.50 The eighth bit of the ASCII code is used to provide even-bit parity. That is, the eighth bit of each ASCII code character is chosen (mark or space) so that the character contains an even number of marking and spacing information bits. The controller monitors the number of spacing information bits of each received character. If the count is odd indicating a parity error, the ERROR lamp is lighted, the audible alarm is sounded, and the character with incorrect parity is replaced with an underline character (_) by the controller. The ERROR lamp is extinguished and the alarm is silenced by operation of the ERROR key.

Out-of-Synchronism Error

3.51 In TTY systems, a synchronous character timing is employed. Specifically, a mode of operation known as start-stop is used. A fixed time pattern is used for the group of bits representing a character, but each group is preceded by a signal transition that serves to denote when the fixed pattern is to start. In this system, the beginning of a character is identified by a mark-to-space transition. The start interval is spacing and is one bit interval long. The stop interval is marking and is two bit intervals long for 100-wpm operation.

3.52 Normally the local clock, used for sampling and timing the information bits, is started on the mark-to-space transition of the start interval. The clock is arranged to run for a fixed number of cycles and stop during the stop interval of the incoming character. If the local clock is falsely started, or if the character is mutilated, there may

be no marking interval on which to stop at the end of the normal sampling cycle. In this case, the timing circuit is arranged to stop after the normal timing interval and to wait for the next mark-to-space transition before recycling. The receiver usually regains synchronization quickly unless some repeated combination is transmitted that causes the selector to synchronize on a mark-to-space transition other than the normal start.

3.53 In order to reduce the number of incorrect characters that are printed when the receiver is recovering synchronization, the controller samples the received character at the end of the timing interval. The controller is looking for the marking stop interval. If this sample is found to be a space, the character is incorrect and is replaced with an underline (_) character, the ERROR lamp is lighted, and the audible alarm is activated. The ERROR alarm may be deactivated by depressing the ERROR key.

F. Data Auxiliary Set 820A

3.54 The Data Auxiliary Set 820A (called the station controller) provides the control circuitry that allows automatic sending and receiving at the FDX station. The station controller also provides circuits for initializing the station when power is applied (or restored in case of failure).

3.55 When the power is first turned on, all the required control and state logic memory devices are initialized. This is accomplished by applying a pulse to the appropriate circuits when the power is turned on (or restored).

3.56 A block diagram of the Data Auxiliary Set 820A is shown in Fig. 30. The data transmission path is shown with heavy lines. The control signal paths are shown with thin lines.

3.57 Two shift registers are provided in the FDX station. The in-line shift register is employed in the receiving transmission path, and the out-line shift register is employed in the sending transmission path. Both registers perform the functions of character delay and detection in their respective transmission circuits.

Receiving

3.58 Characters are received serially from the data set under control of the sampling gates. The start of each character triggers the local clock in the timing circuit and the clock runs for the duration of the character. The local clock is used to sample each bit of the received character and serially shift it into the shift register. While in the shift register, each character is monitored by the character detection circuit to detect specific receive control characters. Characters that may be detected are listed in Table I. The in-line shift register is wired at installation to detect the unique SPC and CEC assigned to the station.

3.59 The detected characters control the receive modes (such as blinding the TTY, etc) of the station, and, together with the state logic, initiate appropriate responses.

3.60 Each succeeding incoming character initiates a new timing cycle and the previous character is shifted out of the shift register. If it is a control character, it will not be printed because the page printer is blinded. However, if the character is a message character, the TTY will not be blinded and the character will be regenerated, gated to the SMD of the RO TTY or ROTR, via the interface circuit, and printed by the typing unit. There is a one-character delay between the receiving and printing of a character.

3.61 An underline (_) character generator is provided for typing a printed underline in place of erroneous received message characters which may be the result of parity failure or out-or-synchronism errors. A generated underline character applied to the in-line shift register wipes out and replaces the erroneous character.

Sending

3.62 Characters from the ASR TTY TD are applied serially, via the interface circuit, to the gate and sample circuit under the direction of the control and state logic circuit. Timing for the send characters is developed in a manner similar to that for the receive characters. After sampling, the send characters are regenerated and gated to the data set.

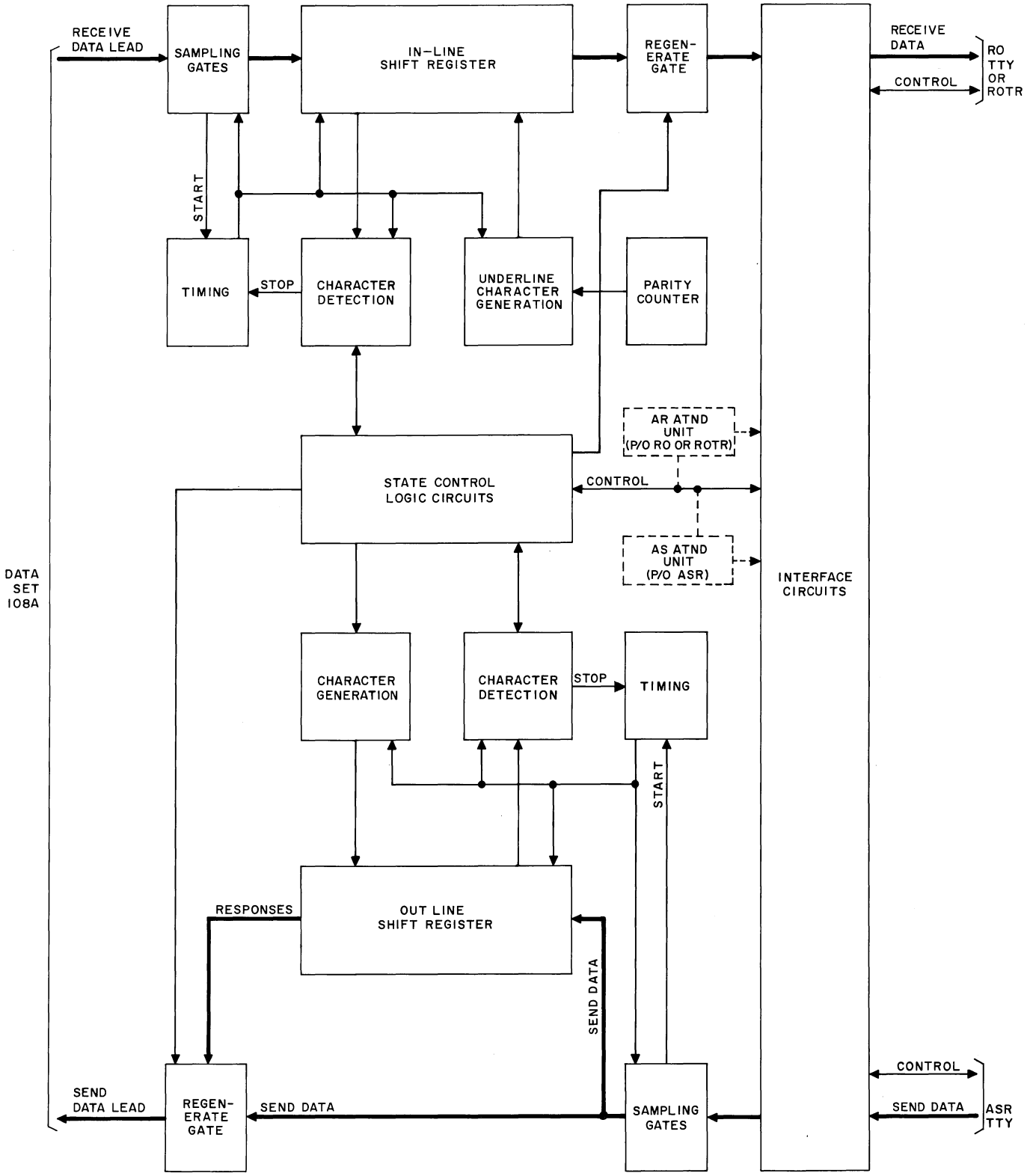

Fig. 30—Data Auxiliary Set 820A—Block Diagram

TABLE I

CHARACTER DETECTION

DETECTED CHARACTER	SHIFT REGISTER	
	IN-LINE	OUT-LINE
CEC	X	
DC1	X	
DC2	X	
DC3	X	
DLE	X	
ENQ	X	
EOT	X	X
ETX	X	X
PLUS	X	
SPC	X	
W	X	
X	X	
SOH		X

3.63 At the same time, the send characters are also serially inserted into the out-line shift register. Each character is monitored while in the out-line shift register by the character detection circuit to detect specific transmit control characters. These characters are SOH, ETX, and EOT. When a transmit control character is detected, the character detection circuit signals the control and state logic circuit to initiate the appropriate procedure.

3.64 The seven responses that may be generated by the controller are ACK, NAK, CAN, SIC, SOH, P, and R. Which of these characters are generated as a response is governed by the control and state logic circuit which monitors the status of the station. The character is written into the out-line shift register from the character generation circuit in a parallel fashion. The local clock in the timing circuit then serially shifts the character out of the register. The character is regenerated and gated to the data set.

3.65 The out-line shift register in the FDX controller is required for detecting and generating responses only.

G. Attendant Units

Data Auxiliary Set 804N1

3.66 The sending attendant unit in the ASR TTY controls and indicates the state of the sending portion of the Data Auxiliary Set 820A. The attendant unit provides the BID, PRIOR, HOLD, OUT OF SVC, TAPE, EMG STOP, and AUD OFF keys. Also provided are the lamps associated with these keys, the TRANS lamp, and a loudspeaker. The loudspeaker is used to produce an audible alarm. The sending attendant unit connects directly to the station controller and is located under the hood of the ASR TTY unit.

Data Auxiliary Set 804N2

3.67 The attendant unit in the RO TTY controls and indicates the state of the receiving portion of the Data Auxiliary Set 820A. The keys and lamps provided in the receiving attendant unit are OUT OF SVC, MSG REC, ERROR, PAPER LOW, and AUD OFF. Additional status indicating lamps are designated REC and CALL. The attendant unit is equipped with a loudspeaker and a junction box.

H. Data Set 108A

3.68 The Data Set 108A-type provides low-speed, full-duplex, serial data communications over 2-wire voiceband transmission facilities. The Data Set 108A communicates only with a Data Set 108B.

3.69 The data sets employ frequency-shift-keyed modulation and the transmit and receive frequencies are fixed. Therefore, two data sets of the same type cannot communicate with each other. Table J lists the line frequencies for the data set.

TABLE J

LINE FREQUENCIES FOR THE DATA SETS

DATA SET	FREQ BAND	MARK FREQ	SPACE FREQ
108A	Transmit	2225 Hz	2025 Hz
	Receive	1270 Hz	1070 Hz
108B	Transmit	1270 Hz	1070 Hz
	Receive	2225 Hz	2025 Hz

3.70 The block diagram in Fig. 31 shows Data Set 108A which consists of a sender, or transmitter, a receiver, and a carrier fail circuit. A hybrid provides a 2-wire to 4-wire connection tor the send and receive circuits.

Send Circuit

3.71 The transmitter consists of an oscillator, a keyer, a filter, and a buffer amplifier. In the idle or marking condition, the keyer is conditioned to cause the oscillator to generate a steady mark signal tone (2225 Hz). The output of the oscillator is filtered and applied to the send buffer amplifier.

3.72 The send buffer amplifier, in addition to isolating the send filter impedance from the hybrid, is an adjustable gain amplifier with an output level range of 0 dBm down to 14 dBm. The output of the send buffer amplifier is applied to the hybrid and then to the line.

Receive Circuit

3.73 The receive circuit consists of a buffer amplifier, bandpass filter, limiter, discriminator, low-pass filter, and dc amplifiers. The received signal from the hybrid is applied to the receive buffer amplifier. The receive buffer amplifier isolates the hybrid from the bandpass filter. The gain of the amplifier is adjusted in two 4-dB steps by means of screw-switches.

3.74 The output of the receive buffer amplifier passes through the bandpass filter to the limiter. The limiter amplifies and limits to provide an output with a constant amplitude, which is applied to the discriminator and the carrier detector. The discriminator detects, rectifies, and produces a voltage signal that is proportional to frequency. The output of the discriminator passes through the low-pass filter. The low-pass filter removes any ripple in the rectified signal from the discriminator.

3.75 The dc voltage output from the low-pass filter passes through the dc amplifiers and then to the controller.

Carrier Fail Circuit

3.76 The data sets incorporate loss-of-carrier detection (carrier fail circuit) which permits recognition of transmission interruptions caused by signal fading, line opens, etc. The carrier fail circuit consists of a carrier detector, a time-out gating circuit, an amplifier, and a preconnect gate. The carrier detector monitors the output of the limiter for the presence of an acceptable level of the carrier. The carrier detector circuit is activated when the received carried power level falls below –40, –36, or –32 dBm (dependent on the setting of the D switch) for approximately 110 to 250 milliseconds. The carrier fail signal also clamps the receive data to a mark (ie, mark hold condition). After carrier fails, the data set will assume a preconnect mode. In this mode, the data set is not restored to normal until a marking carrier at normal power persists for approximately one-half second.

> ***Note:*** Some service applications using Data Set 108-type with Data Auxiliary Set 820A-type will use carrier squelch on data carrier failure option. When this option is provided, the amplifier will also condition the squelch amplifier to connect a ground to the oscillator, thereby turning off transmitted carrier to the distant data station.

3.77 When the two conditions have been met for 200 to 400 milliseconds, the carrier detector circuit removes the signal to the amplifier. The amplifier removes the clamp on the received path signals lead, turns on the data carrier detector lead to notify the terminal equipment that carrier has been restored, and, if the squelch option is provided, removes the ground to the oscillator.

4. OPERATION

A. Sending TTY Unit

4.01 The Data Auxiliary Set 804N1 (sending station attendant unit) provides seven keys with lamps plus one additional lamp. Table K lists the designation, type, and function for each key. Table L lists the designation, color, and function for each lamp.

B. Receiving TTY Unit

4.02 The Data Auxiliary Set 804N2 (receiving station attendant unit) provides five keys with lamps plus two additional lamps. Table M lists the designation, type, and function for each key. Table N lists the designation, color, and function for each lamp.

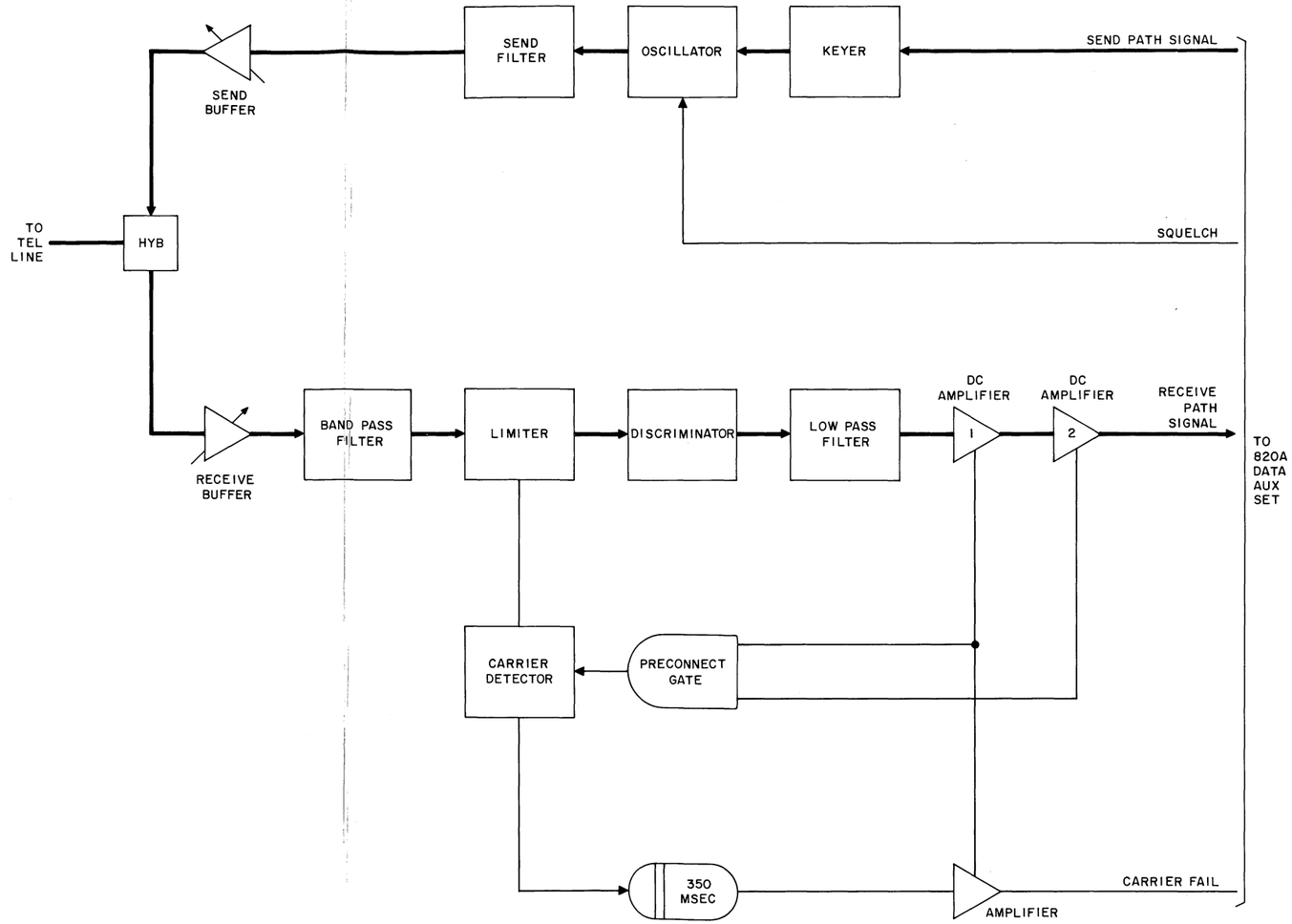

Fig. 31—Data Set 108A—Block Diagram

TABLE K

SENDING ATTENDANT KEYS — DATA AUXILIARY SET 804N1

KEY		FUNCTION
DESIGNATION	TYPE	
OUT OF SVC	PP	When the key is depressed the first time: (1) If station is unselected as a sender when key is operated, generation of a TRAFFIC AVAILABLE indication is inhibited. (2) If station is a selected sender, operation of the key enables the out-of-service mode when the station (sending portion) becomes unselected as a sender. When the key is depressed the second time, the sending unit is restored to service and can be selected as a sender.
BID	NL	If tape is inserted in TD, signifies to station controller that a message is ready to be sent.
PRIOR	NL	If tape is inserted in TD, simultaneous operation of PRIOR and BID keys signifies to the station controller that a priority message is to be sent.
AUD OFF	PP	When the key is depressed the first time, silences and disables audible alarm without any effect on visual alarms. When the key is depressed the second time, the audible alarm circuit is restored to normal operation.
HOLD	PP	When the key is depressed the first time, if the station is a selected sender, operation of the HOLD key causes the TD to stop on ETX, the HOLD lamp to light, and the audible alarm to sound. The attendant may then change tape and restart the TD during a 40-second time-out interval. To restart the TD, close the gate, depress the HOLD key (extinguishing the HOLD lamp), and depress the BID key.
TAPE	NL	Resets TAPE lamp indication.
EMG STOP	NL	Resets EMG STOP lamp indication.

TABLE L

SENDING ATTENDANT LAMPS — DATA AUXILIARY SET 804N1

LAMP		FUNCTION
DESIGNATION	COLOR	
OUT OF SVC	Clear	Lights when the ASR TTY is in the out-of-service mode.
BID	Clear	Lights when BID key is operated after insertion of tape into the TD.
TRANS	Amber	Lights when the station becomes a selected sender.
PRIOR	Clear	Lights when BID lamp is lighted and PRIOR key is operated.
HOLD	Clear	Lights and audible alarm sounds when TD stops on ETX because the HOLD key is operated. The attendant may change tape when lamp is lighted.
EMG STOP	Red	Lights when ADF interrupts sending (TD stops) for reception of emergency stop service message on the ASR TTY printer. Lamp is extinguished manually by attendant.
TAPE	Red	Lights if BAT handle of TD is moved out of RUN position or if tape becomes taut or runs out while station is a selected sender (provided HOLD lamp is not lighted).
AUD OFF	Clear	Lights when AUD OFF key is operated.

C. Auxiliary TTY Unit

4.03 To manually connect the optional auxiliary receiving unit, operate the AUX ON key on the 33 RO TTY unit (or the AUX RECEIVER key on the 35 RO TTY unit). Operation of the AUX ON (or AUX RECEIVER) key causes the AUX ON (or AUX RECEIVER) lamp to light and, if the auxiliary receiver is an ROTR, causes automatic TFO to occur.

4.04 To manually disconnect the auxiliary receiver, operate the AUX OFF key on the 33 RO TTY unit (or the AUX RECEIVER key on the 35 RO TTY unit). This will extinguish the AUX ON (or AUX RECEIVER) lamp and, if the auxiliary receiver is an ROTR, cause automatic TFO to occur.

4.05 When the RO station is a 35 ROTR-type station, to manually cause TFO, momentarily operate the TFO key located on top of the ROTR cover.

D. Sending Station

Mode Switch

4.06 The 33 ASR TTY unit is equipped with a 2-position mode switch. The 35 ASR TTY unit is equipped with a 3-position mode switch. Table O lists the designation and function for each mode switch position on the respective sending machines.

35 ASR TTY Unit

4.07 Tapes can be prepared with the MODE switch in either the OFF LINE or ON LINE position.

4.08 When preparing tapes in the OFF LINE position, the OUT OF SVC lamp in the sending attendant unit will be lighted, the station will answer CAN (no traffic to send—ready to receive) or NAK (no traffic to send—not ready to receive) to station polling depending upon the condition of the station receiver unit. The typing unit will make copy of the message being prepared on the tape.

TABLE M

RECEIVING ATTENDANT KEYS — DATA AUXILIARY SET 804N2 OR 804R3

KEY DESIGNATION	TYPE	FUNCTION
OUT OF SVC	PP	When the key is depressed the first time: (1) If station is unselected as a receiver when key is operated, the receiver is placed in the out-of-service mode. (2) If station is a selected receiver, operation of the key enables the out-of-service mode when the station (receiving portion) becomes unselected as a receiver. When the key is depressed the second time, the receiving unit is restored to service and can be selected as a receiver.
MSG REC	NL	Resets MSG REC alarm.
ERROR	NL	Resets ERROR alarm.
PAPER LOW*	NL	Resets PAPER LOW alarm provided paper supply has been replenished.
AUD OFF	PP	When the key is depressed the first time, silences and disables audible alarm without any effect on visual alarms. When key is depressed the second time, the audible alarm circuit is restored to normal operation.

* Key is designated TAPE LOW on 804R3 and PAPER LOW on 804N2.

TABLE N

RECEIVING ATTENDANT LAMPS — DATA AUXILIARY SET 804N2 OR 804R3

LAMP DESIGNATION	COLOR	FUNCTION
OUT OF SVC	Clear	Lights when the receiver unit is in the out-of-service mode.
REC	Amber	Lights when station is selected receiver.
CALL	Amber	Lights if the station responds SIC NAK to a call-in receiver.
MSG REC	Red	Lights when station controller receives emergency reception service message while a selected receiver or responds SIC NAK to a roll call.
ERROR	Red	Lights when station controller detects a parity or out-of-synchronization error.
PAPER LOW*	Clear	Lights when the paper supply is low. Will not extinguish unless paper supply is replenished.
AUD OFF	Clear	Lights when AUD OFF key is operated.

* Lamp is designated TAPE LOW on 804R3 and PAPER LOW on 804N2.

TABLE O

MODE SWITCH

MODE SWITCH POSITION	FUNCTION	
	33 MACHINE	35 MACHINE
OFF LINE (or LOCAL)	TTY is disconnected from the controller allowing tape preparation or practice (OUT OF SVC lamp in the sending attendant unit is lighted).	Same as for the 33 machine.
ON LINE	Normal function of the TTY is provided, but the motor runs only when the station has a BID in.	
ATTENDED		Normal function of the TTY is provided with the motor running continuously.
UNATTENDED		Provides for a previously selected sender to complete the transmission in progress, but new traffic cannot be originated. The motor runs only while the station is a selected sender.

4.09 When preparing tapes in the ON LINE position, the typing unit will not make copy of the message being prepared; however, the message will still be printed on the tape.

4.10 To prepare a tape, select the mode of operation most desirable for the station at the time with the MODE switch, load the blank tape into the tape punch, assure that the PUNCH OFF key is not operated (OFF LINE mode only), and type the message on the keyboard.

4.11 To send a transmission when the EOT counter option is not to be used, select ON-LINE mode, insert the prepared tape into the TD, close the TD gate, set the TD bat handle to RUN, and operate the BID key on the attendant unit. This lights the BID lamp, makes the TD run until the controller detects SOH from the tape, and causes the station to respond "regular traffic available" when polled by the ADF. Operation of the PRIOR key on the attendant unit, in conjunction with the BID key, lights the PRIOR lamp in addition to the BID lamp and causes the station to respond 'priority traffic available" when polled by the ADF.

4.12 To send a transmission when the EOT counter is to be used, the station must be in the ON LINE mode. Load the blank, unprepared tape into the punch and advance it to the TD by means of DEL characters. Close the TD gate and set the bat handle to RUN. Typing the message (including EOT) on the keyboard will cause the punch to perforate the tape. The EOT will raise the count in the EOT counter by one, light the BID lamp, cause the TD to run until the controller detects SOH from the tape, and cause the station to respond "traffic available" when polled by the ADF.

33 ASR TTY Unit

4.13 Tapes can be prepared only with the MODE switch in the OFF LINE position. In this mode, the OUT OF SVC lamp in the sending attendant unit will be lighted, the station responds CAN (no traffic to send—ready to receive) or NAK (no traffic to send—not ready to receive) to station polling depending upon the condition of the station receiver unit.

4.14 To prepare a tape, set the MODE switch to the OFF LINE position, load the blank tape

into the punch, operate the PUNCH ON key, advance the tape with DEL characters to the tape reader, and type the message on the keyboard. The typing unit will make copy of the message being punched on the tape.

4.15 To send a transmission, load the prepared tape into the tape reader, close the gate, set the bat handle to RUN, and operate the BID key on the attendant unit. This will light the BID lamp, make the tape reader run until the controller detects SOH from the tape, and cause the station to respond "regular traffic available" when polled by the ADF. Operation of the PRIOR key on the attendant unit, in conjunction with the BID key, lights the PRIOR lamp in addition to the BID lamp and causes the station to respond "priority traffic available" when polled by the ADF.

33 or 35 ASR TTY Unit

4.16 To send a message on a tape other than the one the station is transmitting, depress the HOLD key once (first operation) on the attendant unit before the ETX on the tape being transmitted is reached by the TD. This causes the HOLD lamp to light and the TD to stop when ETX is detected from the tape. The new tape, which must conform to standard format, can now replace the old tape in the TD. Opening the TD gate extinguishes the BID lamp. When the new tape is in the TD, depress the HOLD key again (second operation—this extinguishes HOLD lamp) and operate the BID key.

4.17 To resume transmission of the original tape, the hold operation described in 4.16 must be repeated and the original tape reinserted in the TD at the exact point where the original transmission was stopped.

4.18 If the ADF transmits an emergency stop procedure on the station during the transmission of a message, the following will happen.

(a) EMG STOP lamp lights.

(b) Audible alarm sounds.

(c) Station is unselected.

(d) Traffic available state is cancelled.

(e) Message reception is interrupted and the RO TTY is blinded.

(f) ASR TTY typing unit is connected to the receive data lead. The ADF then sends the appropriate service message, which is copied by the ASR typing unit. Upon completion of the service message, the ASR TTY printer is restored to normal, the RO TTY printer is unblinded, and normal message reception is restored. The sending station is idle and it is necessary to operate the EMG STOP key to extinguish the EMG STOP lamp and silence the alarm.

4.19 When a taut-tape condition occurs at the TD while the station is a selected sender (and not in HOLD), the TAPE lamp will light and the audible alarm will sound. After the condition is cleared, operate the TAPE key. This will extinguish the TAPE lamp and silence the audible alarm.

E. Emergency ASR TTY Motor Stop

4.20 To stop the TTY motor in an emergency, operate the OUT OF SVC key on the sending attendant unit and set the MODE switch to the OFF LINE position.