DATA SETS 101A AND 101B

3-ROW TELETYPEWRITER STATION ARRANGEMENT

FOR TWX AND DATA SET 101A FOR DATA-PHONE SERVICE DESCRIPTION AND OPERATION

1. GENERAL

1.01 Data Sets 101A and 101B and associated equipment are designed to provide TWX service. DATA-PHONE* service only uses Data Set 101A. This section contains general description and operating principles of this equipment.

* Service Mark of The American Telephone and Telegraph Company

1.02 This section is reissued to add information concerning DATA-PHONE service applications. An example of DATA-PHONE service applications is providing teleticketing service for the airlines. Due to extensive changes, arrows have been omitted.

A. Teletypewriter Exchange Service (TWX)

1.03 TWX provides transmission between two TTY stations over the switched telephone network (DDD). Signals used in the operation of TTY machines are dc voltages. These dc voltages must be converted to voice-frequency (ac) tones for transmission over the telephone network. This conversion from dc to ac and from ac to dc is performed by a Data Set 101A or 101B at each station.

1.04 The following abbreviations will be used in this section:

AMA—Automatic Message Accounting

DDD—Direct Distance Dialing

TWX—Teletypewriter Exchange Service

F1M—Mark Frequency 1270 Hz

F1S—Space Frequency 1070 Hz

F2M—Mark Frequency 2225 Hz

F2S—Space Frequency 2025 Hz

TTY—Teletypewriter

B. DATA-PHONE Service

1.05 DATA-PHONE service provides transmission between two TTY stations over the switched telephone network (DDD) with the added feature of alternate voice capabilities.

2. DESCRIPTION

A. TWX Service

2.01 The TWX station consists of three principal units of equipment (Fig. 1).

- Teletypewriter
- Data Set 101A or 101B
- Subscriber Set

2.02 The TWX TTYs are 60-speed, 5-level equipment. They can be arranged for the following service:

- 15 KSR attended or unattended
- 19 ASR attended or unattended
- 28 KSR attended or unattended
- 28 ASR attended or unattended
- 14-type equipment

Note: If the 14-type is used on TWX service, it must be engineered locally.

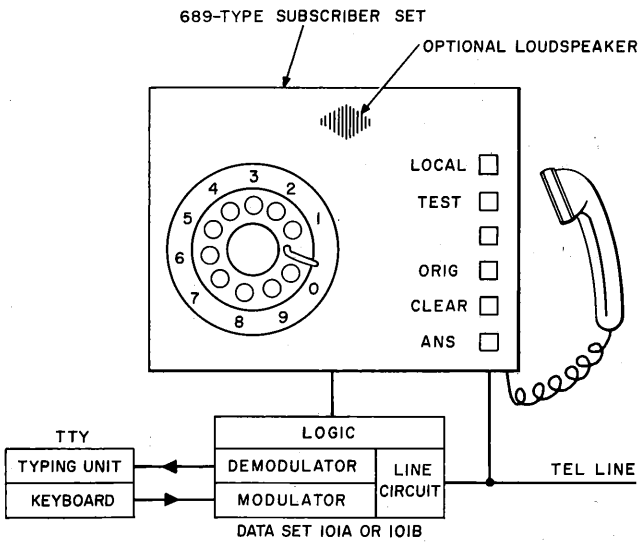

Fig. 1—Block Diagram of TWX Station

Subscriber Sets (Attendant Unit) SD-71023-01

2.03 A subscriber set is provided at each TWX station. It is used by the operator for originating, answering, and controlling the progress of calls. Two types of subscriber sets are used.

- The 689-type is used with the 28-type machine and is designed to fit the contour of the cabinet. It is mounted on the right side of the TTY table at keyboard level (Fig. 2).

- The 691-type is used with 14-, 15-, and 19-type machines. It is a key telephone set specifically designed for TWX and is mounted on the left side of the TTY table (Fig. 3).

2.04 A card dialer and/or loudspeaker with its associated amplifier, are available on an optional basis with the 689-type subscriber set.

2.05 The subscriber set basic components are:

- 689 Type—8C-58 Dial, D1B Ringer, 61A Filter, 548B Capacitor, 598D Key, and a 731A-51 Receiver.

- 691A-3—7L-3 Dial, C4A Ringer, 415F Network, 589S Key, D50H-3 Cord, and a 732A Receiver.

2.06 Table A summarizes the features of the subscriber sets by the type of service and subscriber set code.

Control Keys

2.07 The subscriber set contains a 6-button key unit. The keys are used as follows:

- No. 1—LOCAL—Practice typing, off-line preparation of perforated tape, and local copy test of TTY and data set circuits.

- No. 2—TEST—For loop-around test of line and data set.

- No. 3—This key is not used in TWX service and is left blank.

- No. 4—ORIG (originate)—Originate TWX calls.

- No. 5—CLEAR—Clears condition previously set up by operation of any other key. This will restore set to on-hook condition.

- No. 6—ANS (answer)—Answers incoming calls.

Data Sets 101A and 101B

2.08 The basic application of Data Sets 101A and 101B is for 3-row TWX service. Data Set 101B functions in exactly the same manner and provides the same terminals as Data Set 101A, but can be readily converted into a Data Set 101C for use with 4-row TWX service, when required. For this purpose, relay RB is furnished but not used. Terminal Strip D76 to D85 is provided, together with wires and cabling for its use after conversion. Detailed description of operation for Data Set 101A is contained in CD-71025-01 and for Data Set 101B, in CD-3D006-01.

2.09 The electronic circuitry of the data set is packaged on seven circuit packs. The circuit packs are plug-in type, easily removed for maintenance purposes. The circuit packs are contained in a metal cabinet that is mounted to the side of the associated TTY table (Fig. 2 and 3). The functions of each of the seven circuit packs are as follows:

TABLE A

SUBSCRIBER SET FEATURES

SERVICE		SUB SET	BASIC UNIT	AMP AND LSPK	CARD DIALER	HAND SET	28 TTY CONT CKTS
TWX		689A	X			*	
		689C	X	X		*	
		689D	X		X	*	
		689E	X	X	X	*	
		691A-3	X			†	
DATA PHONE	28 ASR	689A1	X			‡	X
		689C1	X	X		‡	X
		689D1	X		X	‡	X
		689E1	X	X	X	‡	X
	28 RO	689A2	X			‡	
		689C2	X	X		‡	
		689D2	X		X	‡	
		689E2	X	X	X	‡	

* 731A-51 Receive Only Hand Set
† 732A-3 Receive Only Hand Set
‡ 223B-52 Hand Telephone Set

- MODULATOR—Converts dc TTY pulses to frequency-shift tones for transmission over the telephone network.

- HYBRID—Provides proper terminating between data set and telephone line and adjustable attenuation in the send circuit (when strapped per service order or station layout card). Also provides additional transmit level attenuation when F1 band is transmitted.

- LIMITER, DEMODULATOR, and KEYER—Converts incoming frequency-shift tones into dc signals for the TTY selector magnet.

- TIMER—Supplies and monitors various timed intervals required for proper sequencing steps performed by data set and for recognition of various signals.

- ANSWER-BACK (two types)—One type is used to trigger operation of drum answer-back on 28-type TTY. The other type is used to produce letter V answer-back for 14-, 15-, and 19-type machines. These are both optional features.

2.10 Relays in the data set perform a number of important functions, for example:

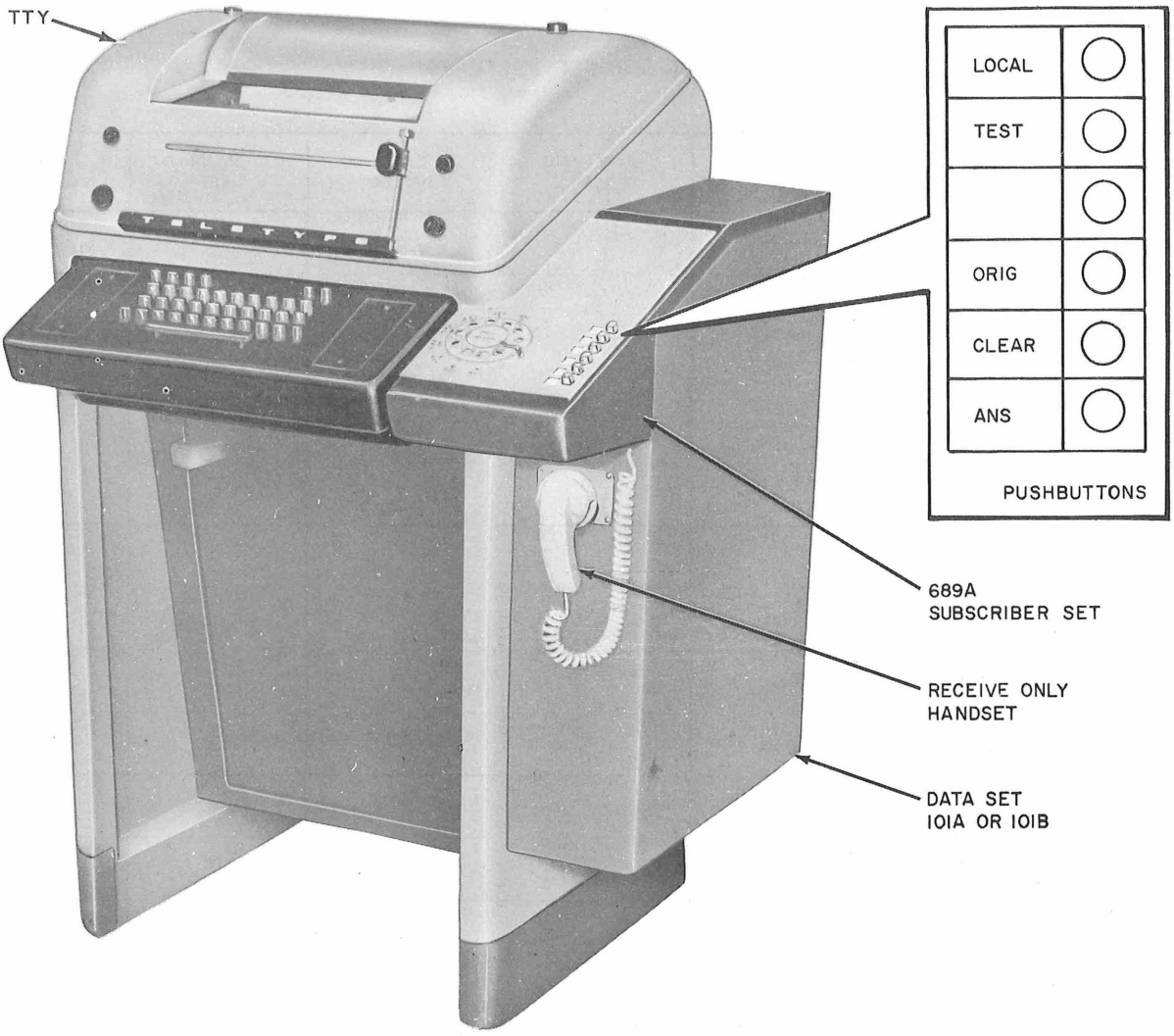

Fig. 2—Data Set 101A or 101B and Subscriber Set 689A Mounted on 28 KSR TTY

- Detect ringing for automatic answering when provided.
- Condition oscillator to produce proper sending frequency.
- Connect proper filters for transmitting or receiving frequencies.
- Control TTY motor and answer-back function.
- Condition timing circuit.
- Control lamps in subscriber set.
- Restore data set to on-hook after disconnect.

2.11 The power supply is a semiconductor ferro-resonant-regulated type rectifier delivering ±20 volts, 0.5 ampere dc. It is a single unit that mounts in the data set cabinet. Stations supplied with dc power require a KS-15982 inverter.

B. DATA-PHONE Service

2.12 Fig. 4 shows typical station arrangement for DATA-PHONE service. The TTYs used for DATA-PHONE service are 100-speed, 5-level, Model 28-type equipment (see Figs. 5 and 6). They are arranged for the following service:

- 28 ASR attended (Fig. 5)
- 28 RO unattended (Fig. 6)

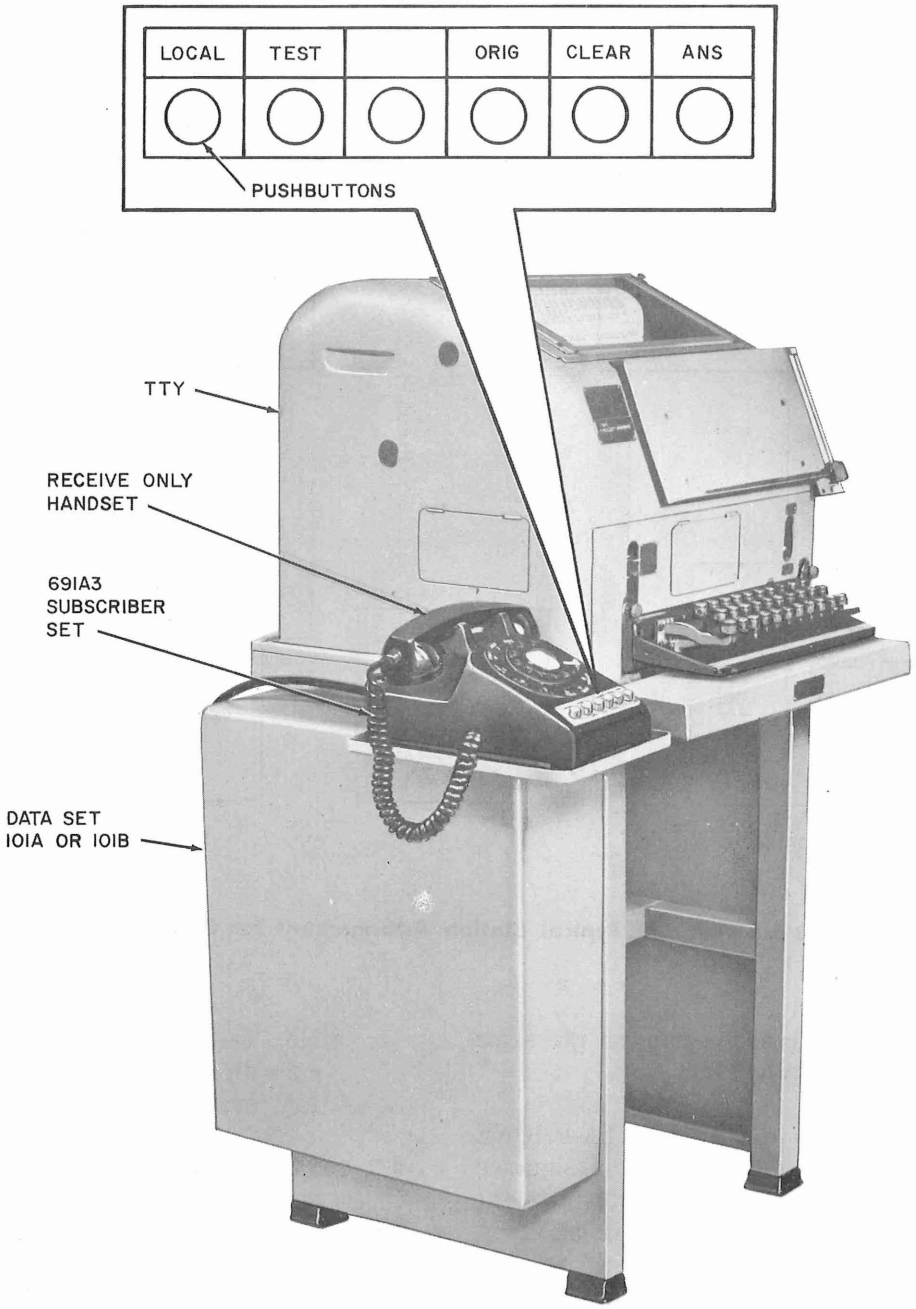

Fig. 3—Data Set 101A or 101B and Subscriber Set 691A3 Associated with 15-Type TTY

Note: At the present time, only the above equipment is available for 3-row DATA-PHONE service.

2.13 The 28ASR used for DATA-PHONE service is equipped with an additional switch (located on the top of the dome, under the rear cover, just to the left of the platen). The three switch positions are: NORMAL, REP ON LINE and TAPE COPY (NRT). Operation of this switch is covered in paragraph 5.08 of this section. In addition the K, KT, T knob is blocked in the K position.

2.14 When the 689-type subscriber set is used with the 28-type DATA-PHONE station, the 731A-51 receive only handset is replaced with a 223B-52 Hand Telephone Set to provide voice transmission.

2.15 The subscriber set keys for DATA-PHONE stations are used as follows:

- No. 1—LOCAL—This key performs the same function as the TWX LOCAL key.

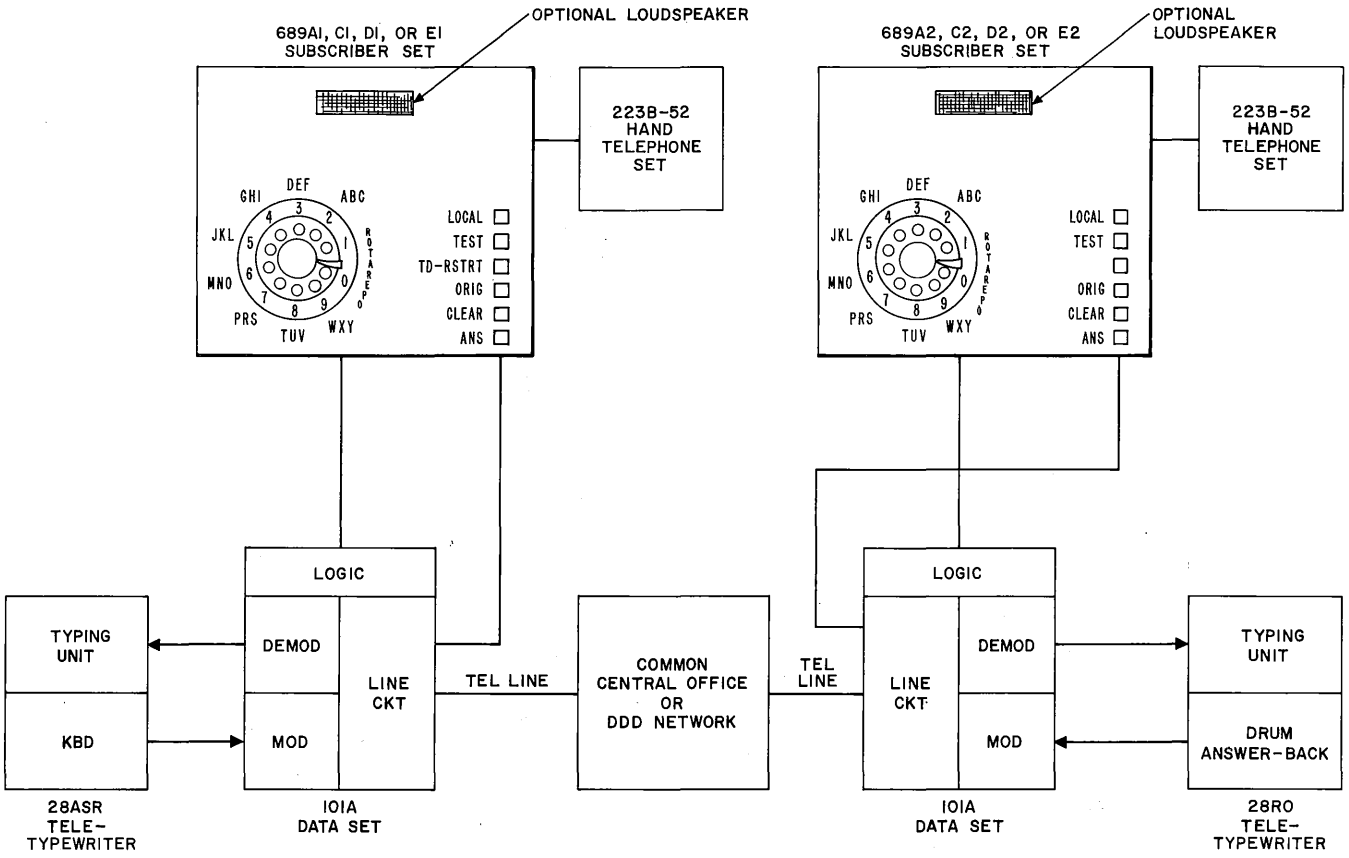

Fig. 4—Block Diagram Typical Station Arrangement for DATA-PHONE Service

- No. 2—TEST—This key performs the same function as the TWX TEST key.

- No. 3—TD RSTRT—Used for DATA-PHONE 28ASR stations only (key is not designated or activated on RO stations). Restarts the transmitter distributor when preparing tapes, using master tapes.

- No. 4—ORIG (originate)—On DATA-PHONE service, key is used at calling station to originate calls directly in data mode. Also used to transfer from talk mode to data mode.

- No. 5—CLEAR—Clears condition previously set up by operation of any other key. This will restore set to on-hook condition or transfers from data mode to talk mode ***after*** handset is removed from switchhook.

- No. 6—ANS (answer)—Answers incoming calls directly in data mode or transfers from talk mode to data mode at called stations.

3. OPERATING PROCEDURES—TWX

3.01 Calling Attended Terminating Station

Note: Numbers in brackets [] refer to numbered steps in flow chart, Fig. 7.

(1) Attendant at the originating station depresses ORIG key [1] located in the subscriber set. The light under this key turns on and remains on until call is completed.

- The data set presents an off-hook condition to central office [2]and connects its F1 sending and F2 receiving circuits through the hybrid coil. No F1 signal is sent at this time.

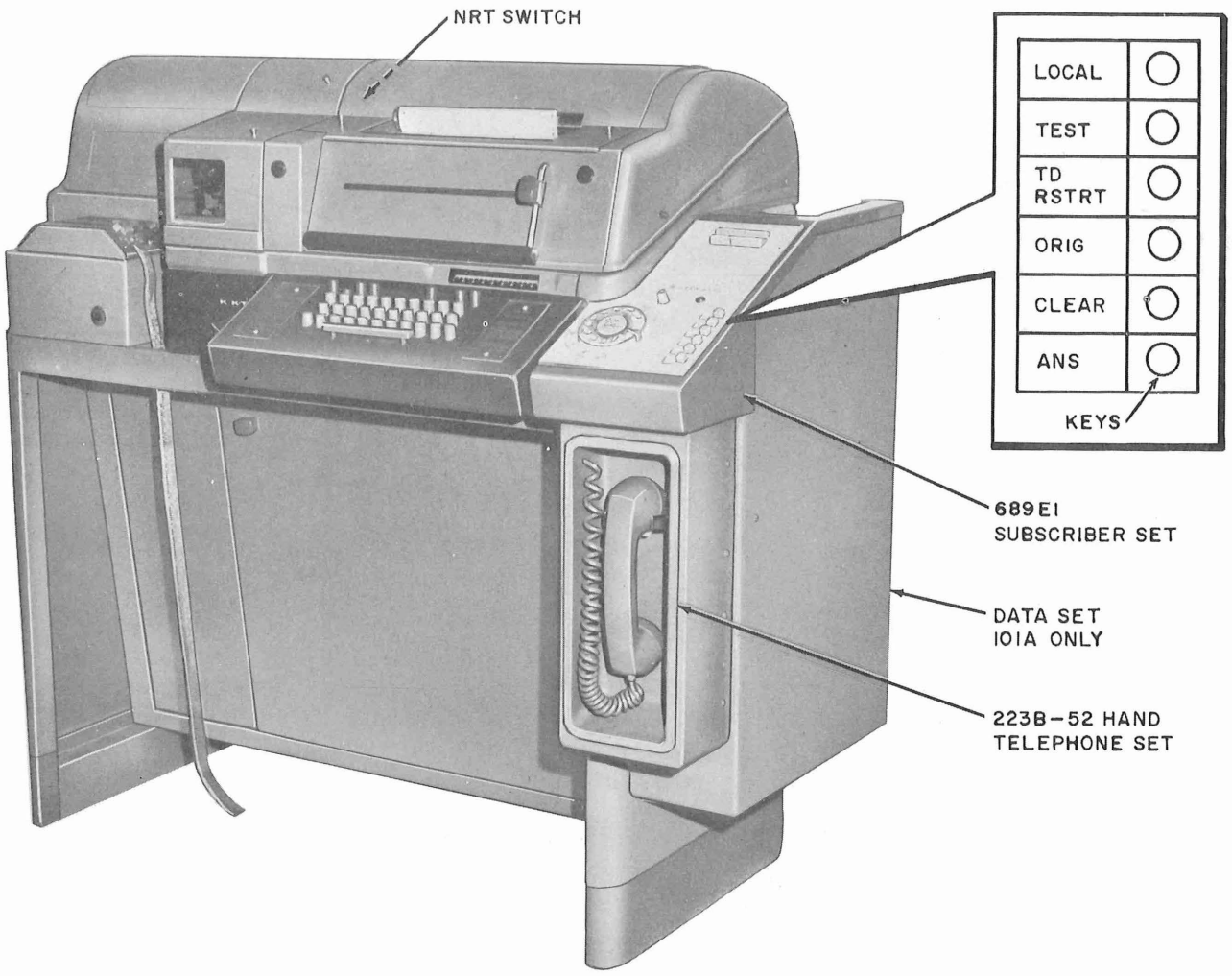

Fig. 5—Data Set 101A, Subscriber Set 689E1 and Hand Telephone Set 223B-52 Mounted on 28 ASR TTY

(2) Attendant listens for dial tone and, if present [3], dials number of terminating station [4].

(3) Connection over DDD switching network is now established. If busy tone or intercept report is received [5], originating station attendant will cancel call by depressing CLEAR key [6]. Data set will go on-hook [7]. If audible ringing is received [8] but called station does not answer, attendant will also cancel call by depressing CLEAR key.

(4) At terminating station the bell rings [9] and light under ANS key flashes on during ringing periods. Attendant depresses ANS key to answer incoming call [10].

- Data set sends off-hook signal to terminating office [11] and trips ringing. This off-hook signal is sent back to the originating office where an AMA initial timing entry is recorded. The data set also connects its F2 sending circuit and F1 receiving circuit to the loop through the hybrid coil.

(5) Terminating station data set introduces timing delay of approximately 1.0 second after going off-hook [12], then transmits F2M [13]. Delay in sending the F2M signal ensures that it will not interfere with transmission of the supervisory answer signal to the originating office over in-band frequency signaling systems. If any echo suppressors are involved in the circuit, they detect F2M and are disabled as long as F2 is present.

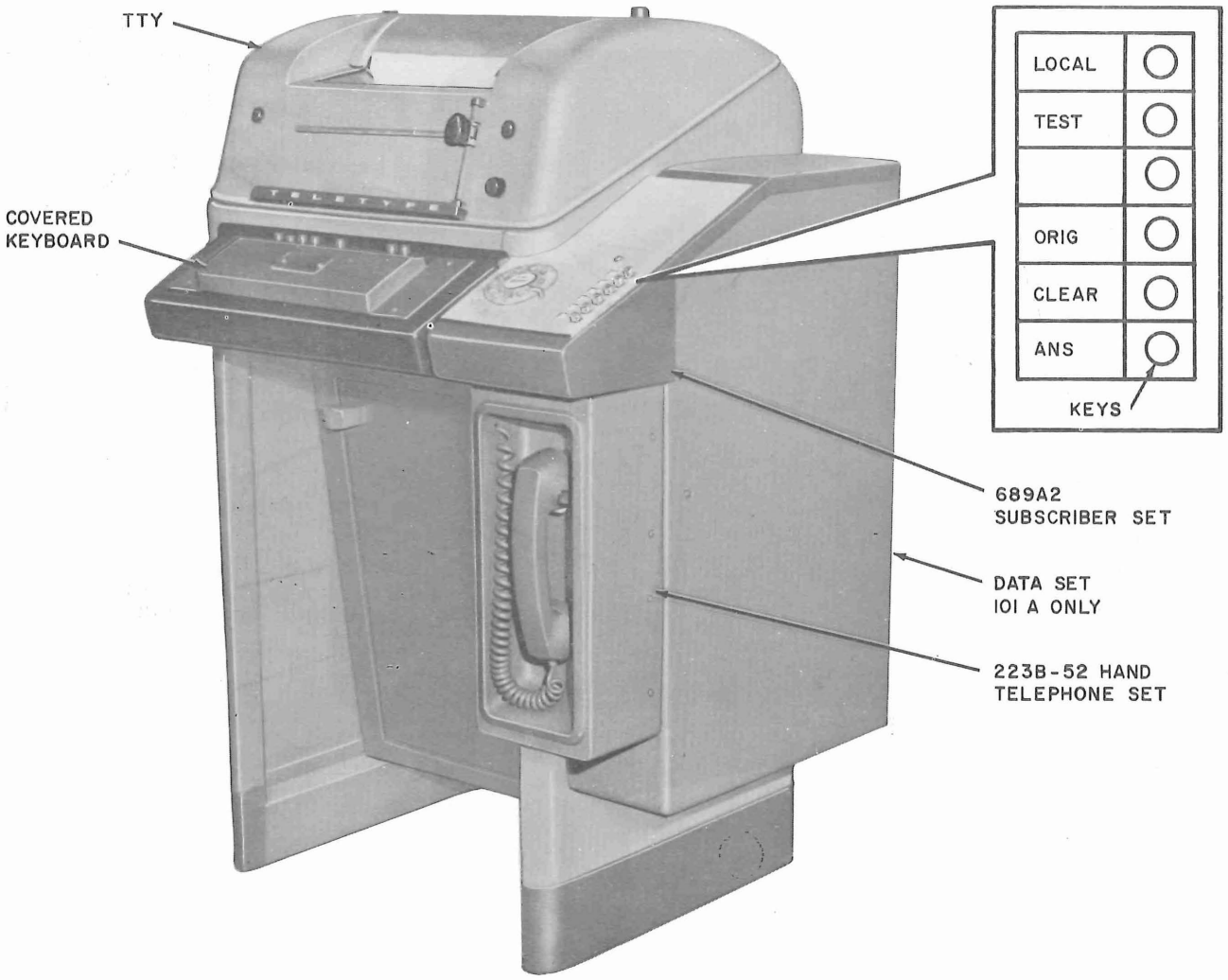

Fig. 6—Data Set 101A, Subscriber Set 689A2 and Hand Telephone Set 223B-52 Mounted on 28 RO TTY

(6) Upon receipt of F2M[14], originating station monitors for approximately 1.0 second [15]. This ensures that echo suppressors have been disabled and the receipt of steady F2M (rather than an imitation created by circuit noise). The data set at originating station now sends F1M[16] and starts its TTY motor [17].

(7) The terminating station data set receives F1M[18] and starts a monitor timing of approximately 1.0 second [19]. Terminating TTY motor starts [20].

(8) Starting of terminating station TTY motor is signal to attendant to send station identification [21]. Terminating station is now ready to receive message.

(9) Originating station attendant recognizes terminating station identification [22]. Transmission of message begins [23]. Receiving station can interrupt transmission at any time by using the BREAK key on TTY. The sending station can call in the receiving station by transmitting bell signal.

(10) At conclusion of transmission, either originating or terminating attendant may depress CLEAR key [24]to disconnect both stations.

- Operation of CLEAR key causes data set at station involved to disconnect TTY from data set, generate a 1.0 second F1S or F2S signal and go on-hook [25]. The 1.0 second F1S or F2S signal ensures disconnection of distant station [26].

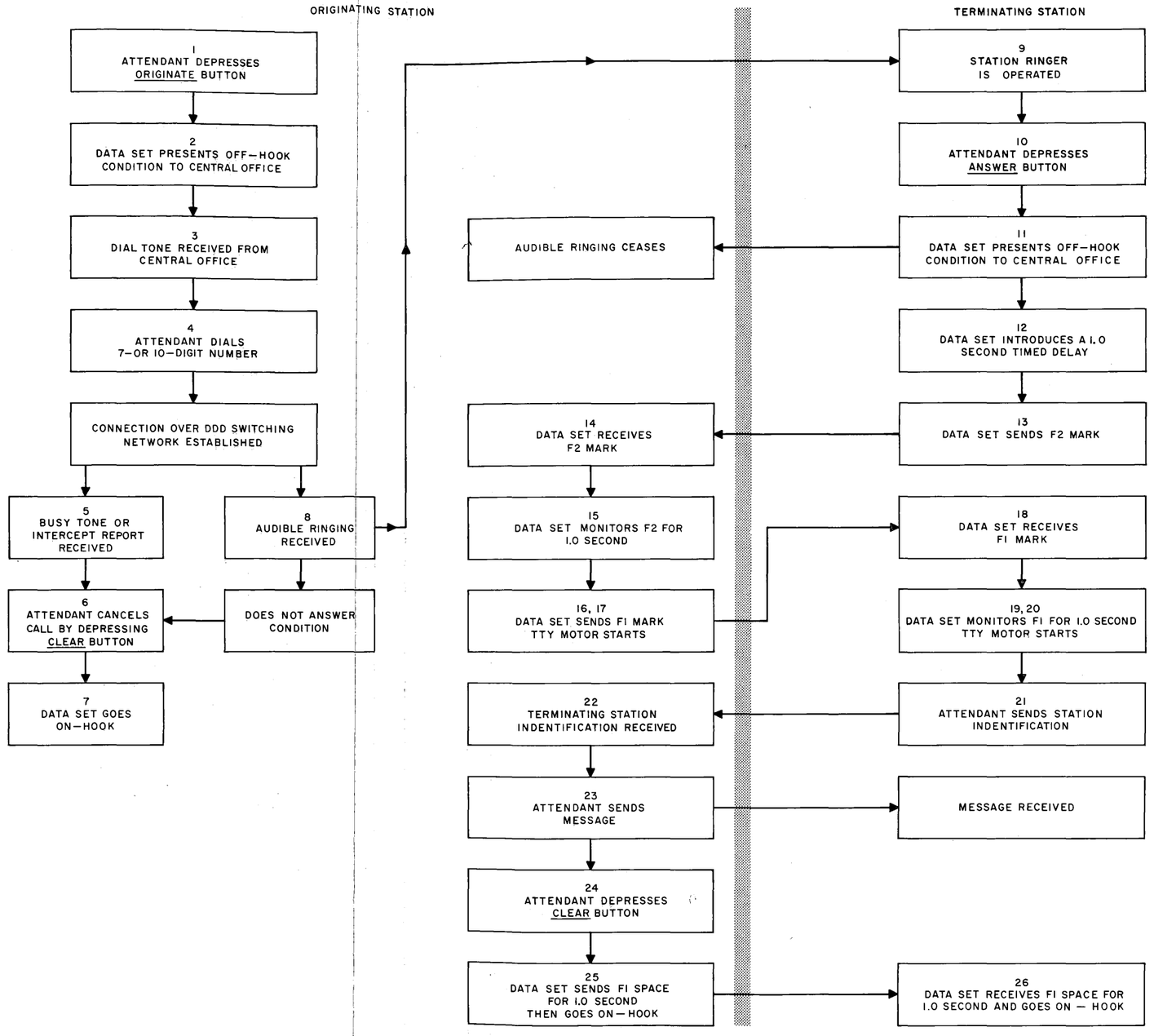

Fig. 7—Flow Chart of TWX Connection Between Attended Stations

3.02 When calling terminating station arranged for unattended operation, answering of call and sending of station identification are performed automatically as follows:

(1) When ringing is applied to the station, a relay in the data set is operated. This automatically causes the sequence of operations which follows depression of ANS key in an attended station. If terminating TTY is 28-type equipped with drum answer-back mechanism, motor will start when terminating station begins to send F2M instead of after incoming F1M has been received.

(2) When F1M has been received by terminating station for 1.0 second, terminating data set triggers drum answer-back of 28-type machine. If terminating station is a 14-, 15-, or 19-type, which is not equipped with drum answer-back, data set shifts its F2 output to space for a timed interval. Character V is then sent as an answer-back code. TTY motor is started.

(3) The automatic answer feature of unattended stations is disabled by operation of LOCAL key. If station is called while in local condition, bell will ring and ANS lamp will flash during each ringing cycle. If at this point ANS key is depressed, data set will proceed automatically with remaining sequences of call answering operation.

Tape Sending Station

3.03 Calls from TWX machines equipped for transmitting messages from perforated tape (19 and 28 ASR) will be handled as described above except that after identification has been received from terminating station, the originating station attendant will start message transmission by operating transmitter start switch. When all of the taped message has been transmitted, the TD will stop and data set will transmit F1M. The terminating station will then transmit its message or the disconnect sequence will be initiated when the CLEAR key is depressed at either station.

Local Mode

3.04 A LOCAL (locking-type) key is provided in the subscriber set. This key places the TTY in an off-line condition for preparation of perforated tape and for practice purposes. When the LOCAL key is depressed, data set turns on TTY machine. Its transmitting contacts and selector are connected together and supplied with local dc power. Operation of the CLEAR key is the normal way of placing TTY back in normal on-hook condition. If an incoming call is received while station is in local mode, the ANS key should be depressed. This will cancel the local condition and cause station to assume a normal off-hook condition.

Test Mode

3.05 When TEST key in subscriber set is depressed it permits the test center to make a loop-back test. The test center can transmit a signal to a station and receive the signal back. TTY being tested will print the incoming signals. This is accomplished by connecting together the modulator and demodulator units of the data set. When requested by a test center, the station can be "flipped," ie, changed from originate to answer mode. This can be accomplished in the following manner. While in the originate mode, depress the CLEAR key momentarily. The CLEAR lamp will light for about 1 second. During this interval depress the ANS key and hold down until CLEAR lamp extinguishes and the ANS lamp lights. The station can now accept data in the answer mode. Depressing either the ORIG or ANS key will release the locking TEST key. The station is restored to on-hook condition by operation of CLEAR key.

4. OPERATING PROCEDURES—DATA-PHONE

4.01 Voice Call Origination

Note: To place a voice call to a telephone or to a non-automatic answer DATA-PHONE station, proceed in the normal telephone call manner. To place a voice call to an automatic answering station, originate a data call and then proceed as in 5.06.

(1) Attendant at the originating station removes handset from its cradle.

- Removal of the handset from its cradle presents an off-hook signal to the central office.

(2) Attendant listens for dial tone and, if present, dials number of terminating station. If card dialer is provided, attendant would insert appropriate card and depress START bar when dial tone is heard.

(3) Connection over DDD switching network is now established. If busy tone or intercept report is received, originating station attendant will cancel call by replacing handset in its cradle. If audible ringing is received but called station does not answer, attendant will also cancel call by replacing handset in its cradle.

(4) At terminating station the bell rings. Attendant answers by removing hand-set from its cradle. A normal voice link has now been established.

- Removal of the handset from its cradle will cause the answering station to send an off-hook signal to the serving central office and trip ringing as in a regular telephone call.

5. ATTENDANT'S INSTRUCTIONS—ASR STATION USING MASTER TAPE

5.01 The data facilities of an ASR DATA-PHONE station are similar to an attended 3-row TWX station equipped with a 28-type ASR sprocket-feed TTY with typing reperforator, except that the machine is arranged for 100 WPM and a 223B-52 hand telephone set is provided for voice communications.

Tape Preparation

5.02 The following procedure should be used for tape preparation:

(1) Place TD "bat" handle in RUN position.

(2) Depress REC key and insert appropriate master tape into the TD.

Note: If vertical tabulation is provided, it will be initiated by the sequence FIGS, CAR RET, H. This should not be confused with FIGS H which is a disconnect sequence. However, initiating the disconnect sequence will cause vertical tabulation.

(3) Depress SEND key. Transmission of the tape will begin. Each time the tape stops, the lamp under the TD RSTRT (TD restart) key lights. Type the variable information on the keyboard and restart the TD by momentarily depressing the TD RSTRT key. The information for one or more tickets can be put on the tape in this manner.

(4) Type FIGS H, and a sufficient number of LTRS to feed out the tape after the last ticket to any one receiving station.

Tape Transmission

5.03 The following procedure should be used to transmit tapes:

(1) Insert prepared tape in the TD and the appropriate card into the card dialer (if provided).

(2) Depress REC key and momentarily depress ORIG key. ORIG lamp will light.

(3) When dial tone is heard in the loudspeaker, depress the START bar. (If no card is available, or card dialer is not provided, the number can be dialed on the telephone dial.)

(4) Observe call progress tones in the normal telephone manner.

- When the call is answered by the receiving station, the motor will start and the copy lights will light. Station identification will be sent automatically from the RO station.

(5) At the completion of station identification, depress SEND key. All the tickets on the tape up to the first FIGS H will be transmitted. When FIGS H is transmitted both stations will vertical tabulate and go back to their "idle" (on-hook) condition.

Paper Alarms

5.04 If the sending station is connected to the line, the motor will stop whenever the forms run out or when the paper jams. Both sending and receiving stations will go to the "idle" condition. If a call is subsequently attempted, the CLEAR lamp will light momentarily each time the ORIG KEY is depressed. To correct this situation, the paper supply should be checked and replenished if necessary. Also, the paper may require straightening and the PAPER JAM switch may need resetting.

Interrupting Sending Station

5.05 When the receiving station wishes to interrupt, it will send a "break" which stops the TD at the ASR station and disables the keyboard. This usually indicates trouble at the receiving station such as a broken type ribbon or reception of garbled copy.

Transfer from Data Mode to Telephone Mode

5.06 To transfer from the data mode to the telephone mode, lift telephone handset and send FIGS, S, S....(Bell). When the attendant at the receiving station hears this signal and proceeds according to his instruction, the motor will stop, the lights will extinguish, and the telephone will be activated. After the telephone conversation, either terminate the call by replacing the handset of after agreeing with the attendant at the receiving station to resume data mode, momentarily depress ORIG key and hang up the handset. If the attendant at the receiving station wants to transfer from the data mode to the telephone mode, he will send repeated breaks. On noticing this signal, pick up the handset, and either send FIGS H or depress CLEAR key. The motor will stop, the copy lights will go out and the telephone will be activated.

Master Tape Preparation

5.07 To prepare master tapes, depress LOCAL key and type information for the master tape on the keyboard.

> ***Note:*** In the LOCAL mode the reperforator is enabled by the released D relay.

NORMAL—REP ON LINE—TAPE COPY (NRT) Switch

5.08 To gain access to the NRT switch, open front lid by releasing the two knurled knobs and pulling the lid to the front. Lift the rear lid. The NRT switch is located on the channel, left of the platen. The three position switch is used as follows:

- NORMAL—This position blinds the electronic selector magnet driver (ESMD) preventing line signals from reaching the reperforator.
- REP ON LINE—Enables reperforator to punch tape from incoming line signals.
- TAPE COPY—Enables reperforator to punch tape from signals originated by the station TD.

Master Tape Copying

5.09 To copy a master tape, operate NRT switch to the TAPE COPY position. Insert tape to be copied into the TD, and depress LOCAL key. Local copy will not be received on the typing unit. Restore NRT switch to NORMAL position after use.

Reperforator on Line

5.10 To perforate a tape from line signals (such as when receiving a master tape from another sending station or for reperforator tests) operate the NRT switch to the REP ON LINE position. Restore NRT switch to NORMAL after use.

6. ATTENDANT'S INSTRUCTIONS—REMOTE RECEIVING TELETICKETING STATION

6.01 The data facilities of a RO DATA-PHONE station are similar to a 3-row TWX station equipped with a 28-type sprocket-feed KSR TTY and an automatic drum answer-back feature, except that the keyboard is covered and the machine is arranged for 100 WPM operation. A 223B-52 Hand Telephone Set is provided for voice communications.

Message Reception

6.02 The RO station is arranged for automatic answer using a drum answer-back. When the station is called, one or two short rings may be heard. The TTY motor will start, the ANS lamp and copy lights will light, and the answer-back drum will send the station identification. If a call is received in error from a telephone, the motor will start and after a few seconds stop automatically due to the timer circuit not receiving F1M. After station identification has been sent, the sending station will start transmission. At the end of transmission (which may contain one or more tickets), the ANS lamp and copy lights will extinguish and the motor will stop. No action is required at the receiving station to receive tickets.

Paper Alarms

6.03 Whenever the paper runs out or jams during reception of a message both sending and receiving stations will go to their idle condition. If a call is subsequently received, the telephone bell will ring repeatedly indicating the paper supply should be checked and replenished if necessary. Also, the paper may require straightening and the PAPER JAM switch may need resetting.

Interrupting The Sending Station

6.04 To interrupt the sending station for any reason, such as a broken ribbon or garbled copy, lift the telephone handset and depress BREAK key momentarily. If the sending station attendant follows his instructions the station will clear and the telephone will be activated. If the station does not clear, or if copy is not received for a substantial period of time while the ANS lamp is on and the motor is running, depress CLEAR key momentarily.

Sending of Station Identification

6.05 To manually send station identification, depress HERE IS key momentarily.

Transfer From Data Mode to Telephone Mode

6.06 To transfer from the data mode to the telephone mode, lift the telephone handset and depress the BREAK key repeatedly to attract the attendant at the sending station. When the attendant at the sending station notices the break signal and proceeds in accordance with his instructions, the TTY motor will stop, the copy lights will extinguish, and the telephone will be activated. If the sending station wants to transfer from the data mode to the telephone mode, it will activate the TTY bell. Upon hearing the bell, pick up the handset and depress the CLEAR key. The TTY motor will stop, the copy lights will extinguish, and the telephone will be activated. After the telephone conversation, either terminate the call by hanging up the handset or continue data operations by first agreeing to continue then depressing the ANS key and replacing the handset.

7. REFERENCES

7.01 The following Bell System Practices, Plant Series, pertain to the apparatus required for Data Sets 101A and 101B 3-row TTY station arrangements for TWX and DATA-PHONE service.

SECTION	TITLE
	Data Sets 101A and 101B 3-Row Teletypewriter Station Arrangement For TWX and DATA-PHONE Service
591-012-100	Description and Operation
591-012-200	Installation and Connections
591-012-300	Maintenance
	Subscriber Set 689 Type
502-200-101	Identification
502-200-410	Connections
	Hand Telephone Set 223B
502-320-103	All Series
573 Layer	28 ASR and RO TTY

7.02 The following circuit description (CD) and schematic diagrams (SD) pertain to the apparatus listed above.

SD & CD 71025-01 Data Set 101A

SD & CD 3D006-01 Data Set 101B

SD & CD 71023-01 689 Type Subscriber Set

SD & CD 3D045-01 223B Hand Telephone Set