

DATA LINE SWITCHING INTERCHANGE ARRANGEMENTS

DESCRIPTION

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 1. INTRODUCTION		
1.01 This section contains the description and operating principles of Data Line Switching Interchange Arrangements. Data line switching interchange arrangements were designed to move traffic from various private line teletypewriter systems into a data line switching system, and from a data line switching system into a variety of private line teletypewriter systems.		1.05 The over-all line switching service will use regular No. 5 crossbar switching offices directly interconnected by trunk groups, plus specially designed automatic DATA-PHONE sets and new teletypewriter equipment. All stations will be connected to these No. 5 offices (which may also be serving regular telephone subscribers) and selection of distant stations will be accomplished by automatically dialing the appropriate DDD code.

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1.06 The line switching system initially will be provided for a commercial air line. Ultimately, it is envisioned that the main body of private line telegraph service and TWX service will use line switching. With this in mind, certain switching offices that could handle such traffic, have been spotted throughout the country. Access to and from the No. 5 office will be either by local lines or by extended lines (foreign exchange type) where stations are remote from the No. 5 office. In all cases the sending and receiving stations will terminate on a frame of the designated No. 5 offices.

1.07 The No. 5 office was picked to switch data traffic for a number of reasons. First, No. 5 crossbar is the preferred equipment for all new central offices. It has features and flexibility that many other switching systems do not have. It provides "class of service" marks which can be used to separate various kinds of traffic. This capability is used to separate voice from data traffic. This separation is needed to properly route the data calls and to handle the different charging rates which will apply to this type of traffic. The No. 5 office does not introduce "hits" which cause errors in data transmission. The handling of priority and conference calls is being investigated.

1.08 Initially there will be two types of data stations (sending only and receiving only). Separate telephone numbers in the No. 5 office will be assigned to each line. At the No. 5 office, each line will be terminated on a line terminal arranged for ground start wiring option. This means simply, for example, that the "off-hook" condition of an originating DATA-PHONE set is indicated to the No. 5 office by the application of ground to the ring conductor of the line pair. A saving of several seconds per call results from the use of ground start operation instead of the conventional telephone dial tone and ringing. Ringing is indicated to the terminating data set by the appearance of ground on the tip conductor of the line pair from the No. 5 office. This explanation is for dc supervision. In the case of ac supervision, the same idea is carried out by use of a signaling converter and operation of the DATA-PHONE set on 43A1 carrier.

1.09 As stated above, separate originating and terminating station arrangements will be provided. Except for the preparation of the tape, the operation will be automatic at the sending end and unattended at the receiving end.

1.10 New automatic teletypewriter equipment and a new low speed, automatic DATA-PHONE set is used for the air lines system. The teletypewriter equipment will provide the controls for automatically setting up, using, and releasing the connection based upon information, logic arrangements, and coded instructions stored in the teletypewriter equipment. The DATA-PHONE sets will provide the means for executing that control.

1.11 The teletypewriter equipment will inform the originating automatic DATA-PHONE set that it has traffic to send, and the automatic DATA-PHONE set will present an "off-hook" condition to its No. 5 crossbar office. Upon receipt of the equivalent of dial tone (ground start operation), the data set will outpulse the DDD code of the distant receiving only station. The connection will be set up by the No. 5 crossbar machines. The distant machine will go "off-hook" automatically. By means of reverse battery supervision in the 2-way trunk circuit, the No. 5 office will inform the calling station that the called station has answered. The calling station will then send the called station's mnemonic code (see Part 2) to verify that the correct customer has answered. When confirmation is received, the calling station will proceed to send the message and hang up.

1.12 Multiple address messages are handled in a similar manner, utilizing a new automatic tape pull-back feature in the sending teletypewriter which permits the tape to be pulled back at high speed and run again, permitting each successive called point to receive the message. One way that this may be done is to route multiple address messages with six or more addresses and group code messages over the line switching system into a private line broadcast teletypewriter circuit with selective calling. Access to the broadcast circuit will be provided at the customer's communication center.

1.13 At the customer's communication center, arrangements are provided for handling intercept traffic. An originating station makes three automatic attempts to complete a call. If after three attempts the call is not completed, it is automatically sent to intercept. At intercept an additional automatic attempt is made. If still unsuccessful, it is routed to an ROTR for manual handling.

1.14 Also required at the communication center is a translator. This unit accepts messages from other airlines addressed with airline address (mnemonic) codes and translates these codes into corresponding DDD telephone numbers which are automatically inserted into a tape along with the mnemonic code and the rest of the incoming message for automatic retransmission on a DATA-PHONE basis.

2. MESSAGE FORMAT

2.01 The message format of the line switching system is based on the International Air Transport Association Interline Message Format and Procedure. The purpose of the standards adopted is to insure compatibility of messages that may be transmitted over more than one communication network. They may also be applied to those messages transmitted over a single network.

2.02 Standards are set up for construction of the format, the most significant of which are listed as follows.

(a) **Heading Line:** The purposes of the heading line are:

- (1) Condition receiving equipment for the correct receipt of an incoming message.
- (2) Insure continuity of traffic over a channel (to safeguard against loss of traffic).
- (3) Transmit online directing or switching codes in certain systems.

(b) For interline communications purposes, the heading line is not mandatory. Nevertheless, the inclusion of the heading line may be a requirement on some networks or circuits. Application of the heading line in interline communications should be determined by agreement.

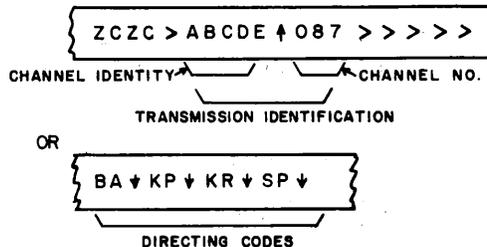
(c) Whenever a heading line is used, it shall include one or more of the following components.

(1) Start-of-message signal ZCZC followed by one SPACE and an identification of the particular transmission of the message. This shall consist of the channel identification provided by a combination of letters not exceeding five, followed by one FIGS and the channel sequence number, always indicated by three digits.

(2) Optional start-of-message signal, exclusive of Carriage Return (CR) Line Feed (LF) as online directing codes, switching codes, or other online tape beginnings.

(3) The spacing signal consisting of a sequence of five SPACES. The spacing signal is required for the removal of the heading that is present on a message as it arrives in a relay station, before the message is retransmitted with the new heading. In some types of automatic systems, the removal of the old heading and the insertion of the new heading may be accomplished automatically. In torn tape stations, however, the heading is removed by slipping the part of the tape which contains the old heading through the tape transmitter before starting its transmission and a sequence of five SPACES is required to provide room for maneuver to insure that the message following the heading is left intact.

(d) The heading line is constructed as in the following examples.



(e) The address section follows.

(1) Start-of-address signal is mandatory and is required to indicate the beginning of the address to automatic switching systems and to position the teletypewriter carriage. It consists of one CR and one LF followed

by one LTRS. The latter is included to insure that the equipment is always placed in the letters case at the beginning of the address section, with which many interline messages will commence, since the inclusion of the heading line is optional. If the heading line is used, the LTRS will return the equipment to the lower case after the transmission of the channel sequence number.

(f) **Priority of charges indicator:** Priority of charges indicator has an optional status and may be added when desired to include specific instructions relative to deferred handling of the message. It consists of two characters of which the first one shall always be Q; after this group will appear one SPACE. The following indicators may be used in interline communications.

QD — Deferred Message (off-peak period handling)

QR — Reverse Charges

QO — Deferred Message (inverse charges)

(g) **Address Indicators:** Address indicator(s) are of course a mandatory component of the address section, and consist of three character groups of which:

(1) The first three letters denote the city and/or airport.

(2) The fourth and fifth letters denote the office function (department) within the airlines, expressed in the two-letter code approved for interline communications.

(3) The sixth and seventh letters denote the airline or appropriate organization, for example.

AA — American Airlines

DL — Delta Airlines

XA — ARINC

AB — Federal Aviation Authority

A SPACE should follow each mnemonic code except CR and one LF shall be used between each lines of addressees and after the last addressee.

Note: The address indicator described above is the basis for the mnemonic code which will be frequently referred to in data line switching. The word mnemonic is defined as assisting or intended to assist memory. Based on the address indicator described, a mnemonic code may be constructed like this.

ATLOODL

ATL — Denotes the city and/or airport, ATL for Atlanta.

OO — Denotes the office or department function, OO for operations.

DL — Denotes the airline or appropriate organization, DL for Delta Airlines.

(h) **End-of-Address (EOM) Signal — Mandatory:** The end-of-address signal shall consist of FIGS M LTRS M.

(i) **Communication Reference Section—Mandatory:** Comprises two items, identification of the message and an indication of the office to which a servicing inquiry should be directed. It consists of two groups, located on the same line; first is message identity and second, message origin, separated by one space. The message identity may be any group of characters, excluding SPACE, ZCZC, NNNN, and all upper case characters other than numerals, period, and oblique. The message origin is a seven-character mnemonic code, for example, MSYRRDL (New Orleans Reservations—Delta).

(k) **Text Section:** This is the purpose of the message, and is constructed by the originator.

(l) **Ending Section—Mandatory:** Ending section requires a minimum of six LFs preceded or followed by CR. Next is EOM signal. It shall consist of four of the letter case N (NNNN). Where message separation is required for torn tape separation, the exact number of LTRS is determined by agreement. The ending section is as in the following example.

3.10 Should the tape contain a FIGS H LTRS ahead of, or in lieu of NNNN, the reperforator will be blinded but the stuntbox of the sequence selector will continue to read any characters that follow. If the assigned Call Directing Code (CDC) or LF is read, the control circuit unblinds the reperforator which resumes copying.

3.11 During the interval following FIGS H LTRS, if NNNN is read or if the central office disconnects, the control circuit will not generate FIGS H LTRS.

3.12 If an ROTR with noninterfering tape feedout is provided, the tape feed-out control is activated during the release interval of the control circuit, and LTRS feedout will start shortly after the FIGS H LTRS.

3.13 During the reception of signals, the sequence selector, through its universal contacts, generates for each received character, a short open-and-close pulse, which is transmitted through the sending side of the terminating DATA-PHONE set to the originating station. These signals are for circuit assurance. The control circuit shorts out these signals during an "open" condition or when a machine alarm is registered due to inability to respond mechanically to good teletypewriter signals. Such a condition might exist if the reperforator power switch were turned or left off, or due to mechanical failure of the reperforator.

3.14 The control circuit is not designed to recognize "alarm" conditions. A separate circuit, to provide alarms and other features, will be provided. The complete station may include the following alarms and features:

- (a) **MACHINE TROUBLE Alarm**
- (b) **TORN TAPE Alarm (Associated with a Reperforator)**
- (c) **LOW TAPE Alarm**
- (d) **TORN TAPE Alarm (Associated with the Transmitter)**
- (e) **BUSY OUT Key (Locking)** — Makes the station busy to subsequent calls. When operated while station is "off-hook", it shall make the station busy when the station next goes "on-hook".

(f) **Busy Indication to No. 5 Office** — In connection with station busy feature, provision is made for a busy indication to the No. 5 office when the power is turned off or goes off, and when the tape in the reperforator is low.

(g) **XMSN TEST Key (Locking)** — Operates a relay to connect the demodulator and modulator of the DATA-PHONE set back to back for transmission tests by the Telephone Company. This key is only to be used under the direction of the Telephone Company and shall be accessible but so located as to make inadvertent operation unlikely.

DIRECT PRIVATE LINE TO TRANSLATOR INPUT (ORIGINATING)

3.15 The preceding description dealt with the interchange of teletypewriter messages from a data line switching system to private line systems. The description that follows deals with the interchange of messages from private line switching systems into a data line switching system.

3.16 In the situation where the private line system is located in the same city or general area as the data line switching system communication center and translator, no separate control circuit is required.

3.17 Messages from the private line system arrive at the communication center via a private line, as perforated tape in a reperforator-transmitter set. It is addressed with a mnemonic code, e.g., MSYRRDL SPACE. (This code may be assigned to the particular airline reservations office at New Orleans.) The reperforator-transmitter set is under control of the communication center translator. The translator discards the private line system code, reads the address, inserts the DDD number of the designated station, and proceeds to deliver the message over the line switching system to its destination. The details of this message handling are described in other instructions pertaining to the communication center.

CONTINUOUS TAPE ORIGINATING VIA LINE SWITCHING SYSTEM TO TRANSLATOR INPUT

3.18 A private line system interchange outlet, located at a distance from the line switching communication center transmits its messages

over the line switching system network to a translator at the customer's communication center. Fig. 2 shows in block diagram form, the equipment required for this interchange, using a continuous tape. For illustration, it may be assumed that the private line interchange outlet is located in Ft. Worth, Texas, and the data line switching system communication center is located in Atlanta, Georgia.

3.19 Chart 1 shows the sequence of operations for a continuous tape originating station. As indicated in Fig. 2, the units that comprise the interchange arrangement are: (1) an RT set, with its associated alarm and reader circuit, (2) a control circuit, and (3) an automatic DATA-PHONE set, connected to a No. 5C office. Circuit elements necessary for complete message handling are a DDD number generator, a pseudomnemonic generator, a FIGS H LTRS and a 4N (NNNN) reader, anything other than LTRS (or BLANK) reader, and a SPACE/NNNN generator. Alarms are provided to inform the attendant of operating difficulties and to provide safeguards to prevent the equipment from unnecessarily tying up the No. 5 office equipment.

3.20 Message handling begins when tape becomes available in the RT set. The circuitry searches for a start-of-message, which is any character other than LTRS or BLANK. The message will be addressed with seven character mnemonic codes for the data line switching system. However, it is only necessary that we transmit the message to the translator at the communication center. The incoming equipment at the communication center is designed to discard 81 system codes, LTRS characters, and any other extraneous characters occurring before the Start-of-Address (SOA) Code. The control circuit is designed to generate the DDD number of the translator.

3.21 When the SOM character is read, the circuitry goes "off-hook". At this time, "off-hook" and dial mode is indicated to the DATA-PHONE set, and the first digit of the DDD number of the translator input is presented to the DATA-PHONE set.

3.22 The DATA-PHONE set assumes an "off-hook" condition and causes the No. 5 office to attach an originating register. The DATA-PHONE set, after an originating register has been attached, passes the first digit of the

DDD number to the No. 5 office and requests the next digit from the control circuit. This action is repeated until the number is completed. Thus the DDD number is dialed by the control circuit, together with the DATA-PHONE set and the register in the No. 5 office.

3.23 If the called station is not reached, the control circuit recycles in 11 seconds and will make up to seven attempts to complete the call. If the seventh attempt is unsuccessful, the NO CONN alarm is activated. The attendant may operate a key to deactivate the alarm, and reset the counter. The control circuit will then make up to seven more dialing attempts, after which it will again alarm.

3.24 When the called station is reached, it will go "off-hook", and return an answer-back signal to the originating control circuit. When the answer-back is received, the control circuit transmits a pseudomnemonic code for confirmation. The pseudomnemonic code consists of seven letters (similar to a mnemonic code) followed by a SPACE. The called station recognizes the code and returns a short open-and-closed pulse for confirmation. The control circuit recognizes the confirmation signal, transmits the SOM character and the remainder of the message over the connection now established to the translator. The transmitter control and the control circuit of the reperforator at the RT pool of the translator together maintain the line-switched connection as long as the transmitter has a message to send.

3.25 Circuit assurance is employed to insure that the called station is on the line. At the called station, a receiving element reads all incoming characters. By means of universal contacts that open and close one time for each character received, a spacing pulse nominally 50 milliseconds in length is transmitted over the send side of the terminating DATA-PHONE set and the line to the originating station. The loss of the circuit assurance pulses for one-half second will activate an alarm, and cause the control circuit to go "on-hook", terminating the connection.

3.26 The transmitter sends at 100 wpm while the incoming tape in the reperforator is arriving from a 75-wpm circuit. The transmitter is arranged to satisfactorily operate when the 100 speed of the transmitter catches up with the 75 speed of the reperforator.

3.27 The control circuit will recognize NNNN or FIGS H LTRS as the EOM code. If NNNN is read, the distributor is blinded, and the transmitter continues to read the tape as indicated in Sequence Chart 1, "Z" Option, continuous tape. If another SOM code is read, the control circuit causes the transmitter-distributor to restart, send the character, read and resume normal transmission. If no more tape is available, the station hangs up, that is, goes "on-hook". In the event of a torn tape, the station goes "on-hook" and alarms.

3.28 If FIGS H LTRS is read, the distributor is blinded but the transmitter continues to read tape. If a SOM code (a character other than LTRS or BLANK) is then read, the control circuit stops the transmitter, unblinds the distributor, and generates and sends NNNN, the EOM code for the line switching system. The distributor is then restarted, the SOM character is sent, and transmission is resumed.

3.29 If, after reading FIGS H LTRS above, availability of tape disappears before the start of a new message, the control circuit stops the transmitter, unblinds the distributor, and generates SPACE NNNN, the End-of-Transmission (EOT) Code.

3.30 Should "torn tape", a trouble condition requiring correction, be encountered rather than "taut tape", the control circuit stops the transmitter, unblinds the distributor and generates SPACE NNNN, sends 150-millisecond mark signal before hanging up. This condition activates the TORN TAPE alarm.

3.31 Conditions that could occur during transmission before FIGS H LTRS or NNNN are guarded by alarms. For example, if a "torn tape" condition should appear during text, the control circuit will stop the transmitter, hang up the station, and activate the TORN TAPE alarm. If "taut tape" occurs, or the transmitter stops for other than "taut" or "torn tape", a 30-second timer is activated. If the condition is maintained for less than 30 seconds, the timer resets and normal transmission resumes. If the condition is maintained for more than 30 seconds, the control circuit hangs up, terminating the transmission, and activates the MESSAGE INTERRUPTED alarm.

3.32 Four control keys are provided as follows.

(a) **TRANSMITTER SEND - STOP - HOLD Key (Locking)** — This key which when operated to the HOLD position will cause the transmitter to go "on-hook" and remain "on-hook" after the message in progress has been transmitted. When operated to the STOP position, it will cause the transmitter to stop immediately but will not break down the connection.

(b) **CALL TELCO Key (Nonlocking)** — For use by the customer on test calls to the serving test center. Operation of this key performs the following functions after the station has gone "off-hook" in the normal manner.

- (1) The transmitter will generate the DDD number of the serving test center.
- (2) All timers will be disabled upon receipt of answer-back indication that a connection is established.
- (3) The circuit assurance feature will be disabled.
- (4) The TORN TAPE alarm will be disabled. Conditions will restore to normal by the transmission of the EOM code. (The CALL TELCO key shall be accessible to the operator but so located as to make inadvertent operation unlikely.)

(c) **RESET Key (Nonlocking)** — This key is used to restore the circuit to normal, in the event the STC is not reached promptly after the operation of the CALL TELCO key.

(d) **XMSN TEST Key (Locking)** — This key is used to connect the demodulator and the modulator of the DATA-PHONE set back-to-back for transmission tests by the STC. This key is to be used only under direction of the STC and it shall be accessible to the operator but so located as to make inadvertent operation unlikely. The CALL TELCO, RESET, and the XMSN test keys are located inside the 28 RT cabinet.

3.33 The alarms provided are listed as follows.

(a) **REPERFORATOR TROUBLE** — Reperforator not operating in response to incoming signals.

(b) **TORN TAPE** — Tape torn between reperforator and transmitter.

- (c) **START FAILURE** — To guard against tape not feeding or an open line to the reperforator.
- (d) **DIAL FAILURE** — Indication that dialing ceased before completion.
- (e) **MESSAGE INTERRUPTED** — Tape unavailable for 30 seconds.
- (f) **CONNECTION LOST** — Station disconnected during message.
- (g) **NO CONNECTION** — Control circuit unsuccessful in reaching called station after seven attempts.
- (h) **LOW TAPE** — Reperforator tape supply low.

CONTINUOUS TAPE ORIGINATING VIA LINE SWITCHING SYSTEM TO A SINGLE TERMINATING STATION (Y OPTION)

3.34 The purpose of this interchange arrangement is to provide the necessary machine and control equipment to enable airline B to automatically transmit messages from a private line system via line switching to an airline C station which also employs a private line system. The connecting link is a line switching system DDD connection. The operation is shown on Sequence of Operations, Chart 1.

3.35 A reperforator-transmitter, with its associated control circuits, is fed signals from a private line system. The control circuitry is the same as that described in "Continuous Tape Originating via Line Switching System to Translator Input". The difference is in the handling of the EOM which is shown in "Y" Option of the drawing and the sequence of operation charts. The RT set control circuit is coupled to a No. 5 office by an automatic DATA-PHONE set and a line.

3.36 The single designated station of airline C with its controls is connected to a voice line of a No. 5 office via an automatic DATA-PHONE set, as described in "Data Line Switching-Terminating Interchange Circuit". It is assigned a DDD number, similar to other stations associated with the line switching systems. All messages are addressed with the required codes for the airline C private line system.

3.37 Message handling in this originating interchange arrangement begins with the availability of tape. The SOM character causes the control circuit to go "off-hook", relaying the "off-hook" condition to the No. 5 office, via the automatic DATA-PHONE set. The No. 5 office attaches an originating register, and the automatic DATA-PHONE set, together with the control circuit, dials the number of the designated airline C station. Answer-back is received, and the control circuit generates the mnemonic code and waits for confirmation. After the confirmation signal is received, the control circuit starts the transmitter-distributor of the RT set and sends the SOM character and the message.

3.38 In this operation, messages are handled one at a time, that is, at the end of each message, the connection is broken down, with a return of the control circuit to the "idle" circuit condition.

3.39 The EOM code may be either FIGS H LTRS or NNNN. Initially it is expected that it will be FIGS H LTRS. If FIGS H LTRS is read, the control circuit will stop the transmitter, generate and send NNNN, hold the line in a "marking" condition for 150 milliseconds, and hang up. If NNNN is read in the tape, the control circuit stops the transmitter, holds the line in a "marking" condition for 150 milliseconds, and hangs up.

3.40 During normal transmission, if a torn tape, or taut tape occurs, or the transmitter stops for other than "taut" or "torn tape", the action of the control circuit is the same as described in "Continuous Tape Originating via Line Switching System to Translator Input", and as indicated on the Sequence of Operations, Chart 1.

3.41 Alarm indications and control keys described under "Continuous Tape Originating via Line Switching System to Translator Input" are used with this arrangement.

TORN TAPE ORIGINATING VIA LINE SWITCHING SYSTEM TO TRANSLATOR INPUT (T OPTION)

3.42 The purpose of this arrangement is to provide the equipment to deliver teletypewriter messages on a torn tape basis from a

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private line switching system to a data line switching system station, via the line switching system. Fig. 3 is a block diagram of the equipment and circuitry required for this interchange. Chart 2 is sequence of operations for a torn tape originating station using a "T" option.

3.43 As indicated in Fig. 3, a 28 transmitter-distributor, with its associated control circuit, a DDD number generator, a pseudomnemonic generator, a 4N (NNNN) and a FIGS H LTRS reader, any character other than LTRS reader, a SPACE NNNN generator, and a 154A1 automatic DATA-PHONE set are the fundamental elements of this interchange arrangement. The DATA-PHONE set connects by a line to a No. 5 office.

3.44 The situation in which this arrangement is required is that in which airline C, using a private line teletypewriter system, has a message to transmit to a line switching station of airline A. Messages arrive at airline C interchange location in punched tape form.

3.45 A punched tape containing the message is inserted in the transmitter, and the STOP-RUN switch is operated to the RUN position. Tape handling begins immediately with a search for SOM LTRS and BLANKs are discarded; but the first character other than LTRS or BLANK is recognized as a SOM.

3.46 Messages are addressed with seven-character mnemonic codes, which will be recognized by the translator input at the communication center. The translator and associated equipment will supply the corresponding DDD number of the desired station and complete the delivery of the message.

3.47 The SOM code is recognized by the control circuit, which stops the transmitter and goes "off-hook", causing the DATA-PHONE set and the No. 5 office to go "off-hook". The No. 5 office connects an originating register and relays this condition to the control circuit via the DATA-PHONE set. The control circuit generates and transmits the DDD number of the translator input RT pool at the communication center, into the DATA-PHONE set, which output pulses it to the No. 5 office originating register. The No. 5 office

sets up the connection to the called station, the RT pool at the translator. When the connection is completed, the called station is rung and it goes "off-hook". This condition is relayed back to the originating station where it is recognized as an answer-back signal.

3.48 The control circuit starts the distributor, generates and transmits the mnemonic code for the translator. At the receiving station, which is the RT pool at the translator, the system designators and SPACE are recognized and a confirmation signal is returned to the calling station. The confirmation signal is a short open-and-close signal, recognized by the control circuit, which then switches the transmitter to the message tape. The transmitter-distributor sends the SOM character which was stored, the mnemonic address code, and the remainder of the message. Message transmission continues with the control circuit searching for the EOM code, NNNN or FIGS H LTRS.

3.49 If NNNN is read, the control circuit blinds the distributor but continues to read the tape. If the tape contains characters other than LTRS or BLANKs, (the start of another message), the control circuit stops the transmitter and unblinds the distributor. The SOM that was described above, is sent, and the transmitter-distributor resumes normal transmission.

3.50 If, after reading NNNN, a taut tape is found, the control circuit will go "on-hook" and activate the TAPE TROUBLE alarm. The going "on-hook" by the control circuit activates the chain of events whereby the automatic DATA-PHONE set goes "on-hook", releases the No. 5 office, which releases the receiving No. 5 office, the DATA-PHONE set and control circuit, returning the control circuit to the "idle" circuit condition. If a torn tape had been encountered, rather than a taut tape, the control circuit would go "on-hook" but not activate the TAPE TROUBLE alarm.

3.51 FIGS H LTRS is the most likely EOM code because the message was originated on a private line circuit which normally uses FIGS H LTRS for EOM. If FIGS H LTRS is read, the control circuit will blind the distributor

and continue to read the tape. The action will then be:

(a) If a character other than LTRS or BLANK is read (start of another message), the control circuit will stop the transmitter, unblind the distributor, generate and send NNNN, trip the distributor to send the SOM character just read, and resume normal transmission.

(b) If taut tape is encountered, the control circuit will stop the transmitter, unblind the distributor, and generate and send SPACE NNNN. It will then hold the line "marking" for 150 milliseconds, hang up and activate a TAPE TROUBLE alarm.

(c) If torn tape (or end of tape) occurs, the control circuit will stop the transmitter, unblind the distributor, generate and send SPACE NNNN. It will then hold the line in a "marking" condition for 150 milliseconds and then hang up.

3.52 If during normal transmission, the following action takes place:

(a) Torn tape is found, the control circuit stops the transmitter and hangs up. Since no EOM code has been transmitted, two alarms are activated, TAPE TROUBLE and NO EOM lamp.

(b) If a taut tape occurs, the control circuit stops the transmitter, or if the transmitter stops for other than "taut" or "torn tape", a 30-second timer is activated. If the condition is maintained less than 30 seconds, the timer is reset and the transmitter-distributor resumes normal transmission. If the condition is maintained more than 30 seconds, the timer times out, the control circuit goes "on-hook" and activates a MESSAGE INTERRUPTED alarm.

3.53 Circuit assurance is employed in this torn tape operation, in the same manner as that described for continuous tape operation. Also, as in the continuous tape arrangement, if the attempt to dial the RT pool at the translator is unsuccessful, the control circuit hangs up, recycles, and tries again. Each dial attempt is registered in a counting circuit. If the seventh attempt is unsuccessful, the NO CONN alarm is activated. The attendant may depress a key to deactivate the

alarm and reset the counting circuit. Should this be done, the control circuit may try up to seven more times, and if still unsuccessful, the alarm will again be activated.

3.54 Control keys are provided as described in 3.32. A number of conditions are guarded by alarms and these are listed as follows.

(a) *Connection Lost* — Activated by loss of circuit assurance pulses.

(b) *Dial Failure* — Dialing ceased before complete DDD number was dialed.

(c) *Message Interrupted* — Transmission stopped for 30 seconds, and control circuit went "on-hook", with no EOM code.

(d) *No Connection* — Seven unsuccessful attempts have been made to reach terminating station.

(e) *Tape Trouble* — An indication of taut tape or end of tape (or torn tape) before an EOM signal. Alarm also activated by taut tape, after FIGS H LTRS or NNNN.

Note: On a 28 transmitter, taut tape is evidenced by a tangled tape or the tape is manually lifted to raise the taut tape lever that normally rides the tape. Raising this lever opens the stop-run contacts. Torn tapes or end of tape allows the sixth pin to rise and break the sixth pin contact.

TORN TAPE ORIGINATING VIA LINE SWITCHING SYSTEM TO A SINGLE TERMINATING STATION (W OPTION)

3.55 The purpose of this arrangement is to deliver messages on a torn tape basis to a single terminating station via a line switching system connection. The control circuitry and equipment used in this interchange arrangement, except for optional wiring and equipment, is the same as that covered in 3.42 through 3.54. The same control keys and alarms are used. Sequence of Operations, Chart 2, "W" Option, shows the operation of the circuit. In general, the operation from idle circuit to normal transmission is the same as that described in "Torn Tape Originating Via Line Switching System to Translator Input (T Option)".

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3.56 The same equipment and circuitry, referred to in 3.44, is used for this operation. Optional wiring in the circuit provides the difference in operation.

3.57 This interchange arrangement is used in the situation where the messages for interchange arrive at the office of airline C in punched tape, over a private line teletypewriter switching system. Such messages are to be delivered to airline B interchange location, located at a distance from airline C interchange location. It was decided to bridge this distance by using a line switching system link.

3.58 All interchange messages between airline C and airline B are routed to a single station as described in 3.06. That station consists of a receiving only typing reperforator, with its associated control circuitry, alarms, and a 154A1 automatic DATA-PHONE set, connected to a No. 5 office.

3.59 Interchange messages that arrive at the airline C interchange location are in punched tape form and addressed with the private line service system codes of airline B. The tape is torn from the reperforator and inserted in the transmitter-distributor. Tape handling begins as soon as the STOP-RUN switch is operated to the RUN position.

3.60 The tape is fed into the transmitter and the control circuit searches for SOM, which again is any character other than LTRS or BLANKS. When a SOM is read by the control circuit, it goes "off-hook" and indicates "off-hook" and dial mode to the 154A1 DATA-PHONE set and the first digit of the DDD number is presented to the DATA-PHONE set. The DATA-PHONE set assumes an "off-hook" condition and causes the No. 5 office to attach an originating register.

3.61 The control circuit recognizes the signal from the No. 5 office, via the DATA-PHONE set, that the register is attached. The control circuit teams with the DATA-PHONE set, to output the DDD number assigned to the single station of airline B. The No. 5 office makes the connection to the called station. If the station is reached, it is rung and goes "off-hook", and an

answer-back signal is sent back over the line to the originating station to indicate a completed connection. This signal is recognized by the originating station, which generates and transmits the pseudomnemonic code for the called station for confirmation.

3.62 When the mnemonic code is received by the called station, the stuntbox of the sequence selector recognizes the last two characters followed by a SPACE as system designators. The called station sends back over the line a short open-and-close signal, recognized by the originating station as a confirmation that a station associated with the desired line switching system has been reached.

3.63 If the called station had not been reached when the DDD number was dialed, the originating control circuit would register the attempt in a counting circuit, hang up, and try again. It will make seven attempts, and alarm on the eighth. The attendant may operate a key to release the alarm and reset the counter.

3.64 When confirmation is received, the control circuit transmits the SOM character and starts the transmitter to send the message to the single station at the interchange location of airline B. The control circuit then looks for the EOM code. The EOM code may be either FIGS H LTRS or NNNN. The message originated on a private line teletypewriter switching system, and initially, FIGS H LTRS will be the EOM code. Sequence of Operations, "W" Option, shows the operation of the circuit, when the EOM code is read or the tape is torn, taut, or if the transmitter-distributor stops for any reason. The action is described in the following paragraphs.

3.65 When the transmitter starts sending the message, the called station sends back a 50-millisecond spacing signal for each character received. This spacing signal is recognized by the control circuit as circuit assurance. The control circuit recognizes the circuit assurance pulses by means of a solid state pulse detector circuit which checks each spacing pulse for length. If the pulse is between 35 and 65 milliseconds in length, it is accepted and the detector recycled. If the circuit assurance pulses fail or do not meet the timing re-

quirements above, for a period of about 500 milliseconds, the control circuit will go "on-hook", light the CONNECTION LOST lamp, and operate the audible alarm (buzzer). A key is provided to silence the audible alarm and another key to release the alarm and restore the circuit to normal. The connection has been lost, and it will be necessary to resend, or otherwise dispose of the message.

3.66 If FIGS H LTRS is read, the control circuit blinds the distributor and continues reading tape. Provision is made for either of the following situations.

(a) If the tape is torn, the control circuit stops the transmitter, unblinds the distributor, generates and transmits NNNN. Then the line is held "marking" for 150 milliseconds, and the control circuit hangs up.

(b) If a taut tape occurs, the control circuit stops the transmitter, unblinds the distributor, generates and sends NNNN. The control circuit then holds the line in a "marking" condition for 150 milliseconds and then hangs up. In addition, a visual and audible TAPE TROUBLE alarm is brought in, to alert the attendant of the difficulty.

(c) If a character other than LTRS or BLANK (SOM code) is read, the control circuit unblinds the distributor, starts the distributor to send the character just read, and then resumes normal transmission.

3.67 If NNNN is read, the control circuit converts the fourth N to LTRS and continues reading tape. Provision is made for either of the following situations.

(a) If the tape is torn, the control circuit stops the transmitter, unblinds the distributor. It then generates and transmits NNNN. The control circuit then holds the line in a "marking" condition for 150 milliseconds and then hangs up.

(b) If taut tape occurs, the control circuit stops the transmitter, unblinds the distributor, generates and sends NNNN. The control circuit then sends a 150-millisecond mark (holds the line marking), hangs up, and initiates a TAPE TROUBLE alarm.

(c) If a character other than LTRS or BLANKS (SOM code) is read, the control circuit stops the transmitter and unblinds the distributor. It then starts the distributor to send the character just read, and resumes normal transmission.

3.68 If, while a message is being transmitted, a torn tape is found, the control circuit stops the transmitter and hangs up. The NO EOM lamp lights and a visual and audible TAPE TROUBLE alarm is operated.

3.69 During transmission, if a taut tape is found, the transmitter is stopped or if the transmitter stops for other than taut or torn tape, a timer is activated. If the condition is maintained for less than 30 seconds, the control circuit resets the timer and permits the transmitter-distributor to resume normal transmission. If the condition is maintained more than 30 seconds, the control circuit will hang up, and operate the MESSAGE INTERRUPTED alarm.

SEMIAUTOMATIC 8-LEVEL TAPE PREPARATION FOR INTERCHANGE ENTRY AND THE MANUAL RE-ENTRY OF INTERCEPTED MESSAGES

3.70 The purpose of this arrangement is to operate with the 28 ASR and Codomat unit of an originating station to permit the preparation of an 8-level tape from a 5-level tape, suitably edited and coded for introduction into the data-line switching system.

3.71 The equipment is used at an interchange location to permit the introduction of messages from a foreign system into the data-line switching system. This type of operation is referred to in this description as "manual entry."

3.72 The equipment is also used at the INTERCEPT SERVICING position at the communication center to permit an intercepted message from the data line switching system to be manually reintroduced into the system. This type of operation is referred to herein as "manual re-entry".

3.73 The equipment required for this operation consists of a 5-level auxiliary 28 transmitter-distributor, control circuit, a key and lamp

cabinet, and a 48-volt rectifier. It functions with the tape preparation circuit of the 28 ASR, which must be suitably modified, and its associated Codomat unit. The modification of the 28 ASR does not interfere with its normal originating station use. Fig. 4 shows in block schematic form the general arrangement of the equipment used in this arrangement.

3.74 In both types of operation, the messages are received on a typing reperforator, and therefore appear in the form of a 5-level tape. These tapes need to be edited and coded so as to make them suitable for introduction into the data line switching system. These changes are made by the control equipment reading the tape as it passes through the auxiliary transmitter, with the assistance of an attendant. The edited and coded message appears as an 8-level tape at the output of the reperforator associated with the 28 ASR of the originating station.

3.75 Addressing information is inserted in the 8-level tape by the Codomat unit. Certain codes, such as the SOM and EOM may be inserted manually as required by the operation of keys on the 28 ASR. The equipment is controlled from a key and lamp cabinet. The function of the keys and lamps is as follows.

- (a) **CT (CONTINUOUS TAPE) Key (L) and Lamp** — Operation arranges equipment for continuous tape i.e., sequence or batch message operation. Lamp remains lighted while key is operated.
- (b) **ADS (ADDRESSES) Key (NL) and Lamp** — Operation and insertion of Codomat card causes the control code accompanying the mnemonic code in the card to be changed to that of a pseudomnemonic code when it is perforated. Lamp lights when key is operated and stays lighted until Codomat card is ejected.
- (c) **TFR (TRANSFER) Key (NL) and Lamp** — Operation transfers reperforator from the Codomat to control circuit and auxiliary transmitter. Lamp is lighted while this transfer is effective.
- (d) **NO EOM (NO END-OF-MESSAGE) Lamp and Audible Alarm** — Indicates no end-of-message code in 5-level tape.
- (e) **AS (ALARM SILENCE) Key (NL)** — Silences audible alarm.

3.76 Manual Entry (Interchange Location):

The message tape, taken from the typing reperforator, is inserted in the auxiliary 5-level transmitter-distributor. The tape is positioned with the CR character, preceding the mnemonic code of the called station, over the pins. The transmitter-distributor is not started at this time.

3.77 The attendant then operates the SOM key on the 28 ASR machine, which causes the SOM code to be inserted in the 8-level tape. The ADS key is then operated, and the Codomat card is inserted in its reader position. This causes the DDD number, and the mnemonic code, accompanied by the No. 7 control hole, to simulate a pseudomnemonic code, to be perforated in the 8-level tape. This operation of the ADS key must be repeated for each additional address to be codomated.

3.78 Operation of the TFR key of the control circuit transfers the 8-level reperforator from the 28 ASR and Codomat unit to the auxiliary transmitter and starts the tape. All characters are deleted until the first CR or LF is read. This character, (whichever appears first) is deleted and the subsequent characters changed to LTRS until a LTRS character is read in the tape. This LTRS character along with the 6 and 7 control holes is perforated in the 8-level tape to form the EOA code. From this point, the reperforator reproduces the tape as it is transmitted.

3.79 The EOM code on the 5-level tape may be FIGS H LTRS or NNNN. In the control circuit, X wiring is provided to activate the FIGS H LTRS reader. On receipt of FIGS H LTRS the control equipment will automatically generate the EOM Code NNNN with the 0 and 6 control holes by the third N.

3.80 As the auxiliary transmitter continues to send to the reperforator, the control equipment looks for the EOM Code NNNN or FIGS H LTRS. If NNNN is read, these characters will be perforated along with the 0 and 6 control holes by the third N, the auxiliary transmitter will stop, and the reperforator will be switched back to the 28 ASR and Codomat unit ready for reprocessing of the next message. If FIGS H LTRS is read, the tape will stop, and the control circuit will cause the NNNN with the

acter, (whichever appears first) is deleted, and the subsequent characters are changed to LTRS, until a LTRS character is read. The LTRS character is perforated in the 8-level tape, accompanied by the 6 and 7 control holes to form the EOA code. From this point, the reperforator reproduces the 5-level tape.

3.91 *Alternate Mode:* All of the initial characters sent by the auxiliary transmitter are discarded until a SPACE is read. This SPACE is discarded. The following characters (which are the CDCs) are perforated along with the sixth control hole until a CR or LF character is read. This character (whichever appears first) is discarded, and the subsequent characters changed to LTRS until LTRS is read. The LTRS is perforated along with the 6 and 7 control holes to form the EOA code. From this point the reperforator reproduces the 5-level tape.

3.92 *Normal and Alternate Mode:* The auxiliary transmitter continues to send to the reperforator until the EOM Code NNNN is read or until the "end-of-tape" occurs. When NNN is read, the control circuit allows three Ns (NNN) to be perforated and causes control holes 0 and 6 to be inserted by the third N. The next character, which should be the fourth N, is perforated as read in the tape. The auxiliary transmitter then stops, and the reperforator is switched back to the 28 ASR and Codomat.

3.93 If the "end-of-tape" occurs before the receipt of the EOM Code NNNN, the NO EOM lamp lights, an audible alarm sounds, and the reperforator switches back to the 28 ASR and Codomat. The audible silence key (AS) may be operated to silence the alarm, and the NO EOM lamp will remain lighted. The EOM key on the 28 ASR may then be operated, which will cause the EOM code to be perforated in the 8-level tape, extinguish the NO EOM lamp, and silence the audible alarm if it has not already been silenced by operation of the AS key.

3.94 *Reprocessing a Sequence of Messages (Continuous Tape Operation):* Message tapes for the same terminating station may be spliced together, if necessary, to form a spliced tape sequence of messages. Each such message will be preceded by the CR, LF, LTRS sequence, and will have NNNN as the EOM code. This

method of operation is referred to herein as sequence message or continuous tape operation. It is under the control of the CT key in the control cabinet. This key must be operated, and this operation may take place at any time prior to the operation of the TFR key.

3.95 The sequence of operation is the same as that previously described for a single message until the EOM code at the end of the first message is read.

3.96 *Normal Mode:* The operation of the CT key causes the character following the third N (which should be the fourth N) in the EOM code to be changed to LTRS and also causes the deletion of the 0 and 6 control holes normally present with the third N. Subsequent characters are deleted until the CR or LF preceding the start of the next message is read. This character (whichever occurs first) is deleted and the subsequent characters are changed to LTRS until a LTRS is read. The reperforator then reproduces the 5-level tape until the EOM Code NNNN is again read in the tape.

3.97 This process continues until after having read NNNN the "end-of-tape" occurs. The end-of-tape stops the auxiliary transmitter, the NO EOM lamp lights, and the reperforator is automatically switched back to the 28 ASR and Codomat. The audible alarm does not sound. The attendant may then operate the EOM key on the 28 ASR, which inserts the EOM code in the 8-level tape, and extinguishes the NO EOM lamp. The CT key is a locking-type key, and it is then restored manually.

3.98 *Alternate Mode:* The operation of the CT key causes the fourth N of the EOM code to be changed to LTRS and the deletion of the control holes by the third N. This operation is the same as for the normal mode. The subsequent characters are discarded until a SPACE is read. This character is discarded. The control circuit then generates the EOM code FIGS H LTRS, which is perforated in the 8-level tape. The reperforator then reproduces the tape until the NNNN sequence is again read, at which time the cycle is repeated.

3.99 This process continues for each message until the "end-of-tape" occurs. When this does occur, the auxiliary transmitter stops, the NO EOM lamp lights, and the reperforator switches back to the 28 ASR and Codomat. If the "end-of-tape" condition occurs after the reading of NNNN but before the SPACE of the next message, the audible alarm is suppressed; otherwise it sounds. Operation of the EOM key on the 28 ASR inserts the EOM code and extinguishes the audible alarm if it has not already been silenced by operation of the AS key. This EOM code may be inserted automatically by the control circuit by restoring the CT key to its (unoperated) NORMAL position at anytime during the text of the last message. If it was not restored during the text of the last message, it should be restored upon completion of the message, so as to return the control circuit to its normal "idle" circuit condition.

3.100 In this manner, a series of messages has been perforated in the 8-level tape, having only one inserted codomated address for the entire series, and having EOM Codes NNN LTRS, FIGS H LTRS with no control holes for each individual message. The last message is ended with NNN LTRS followed by the normal EOM code with control holes by the third N.

3.101 Message handling by the 28 ASR and the associated automatic DATA-PHONE set is covered in other instructions.

4. REFERENCES

4.01 The following sections and drawings give complete and detailed information on the interchange arrangements related to this section.

591-010-901 LL — Data Line Switching Interchange Arrangements—Operating Tests

CA-15021 — Data Line Switching — Terminating Interchange Station

CA-15022 — Data Line Switching — Originating Interchange for Continuous Tape Operation — Alarm and Reorder Circuit

CA-15023 — Data Line Switching — Originating Interchange for Continuous Tape Operation — Transmitter Control Circuit

CA-15024 — Data Line Switching — Originating Interchange for Torn Tape Operation

CA-15025 — Data Line Switching — Semiautomatic Tape Preparation Interchange Entry and Manual Reentry — Auxiliary Transmitter-Distributor and Control Unit

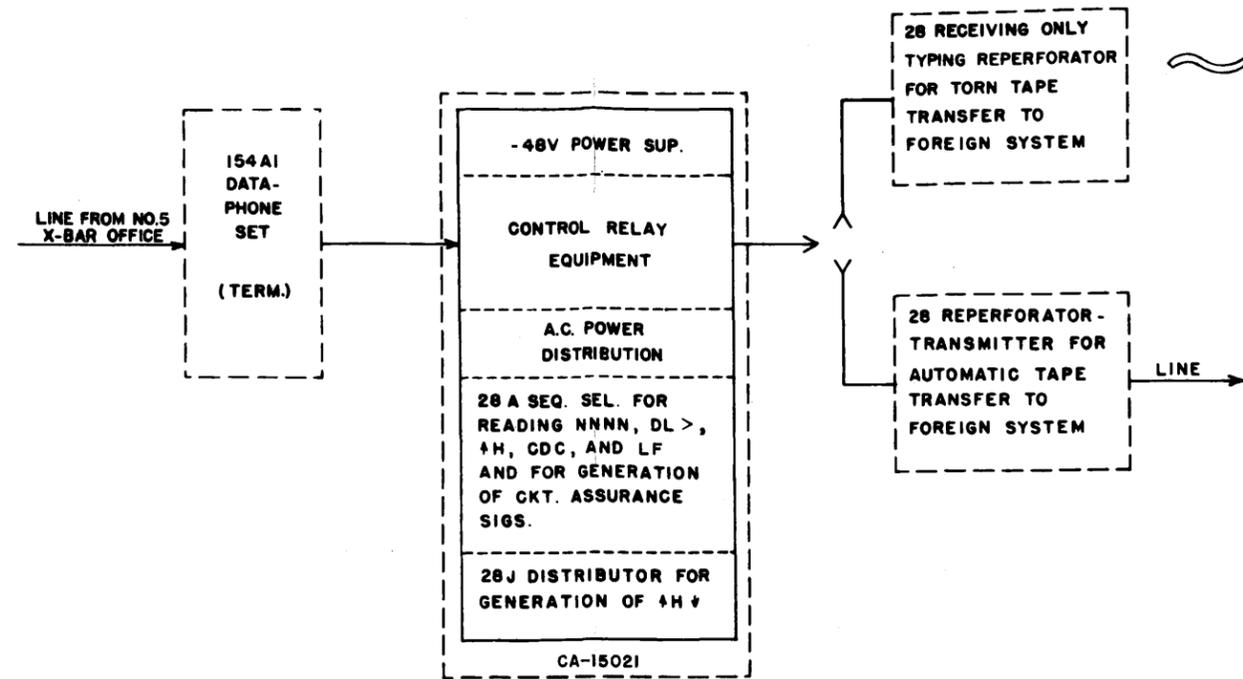


Fig. 1 - Typical Terminating Interchange Arrangement

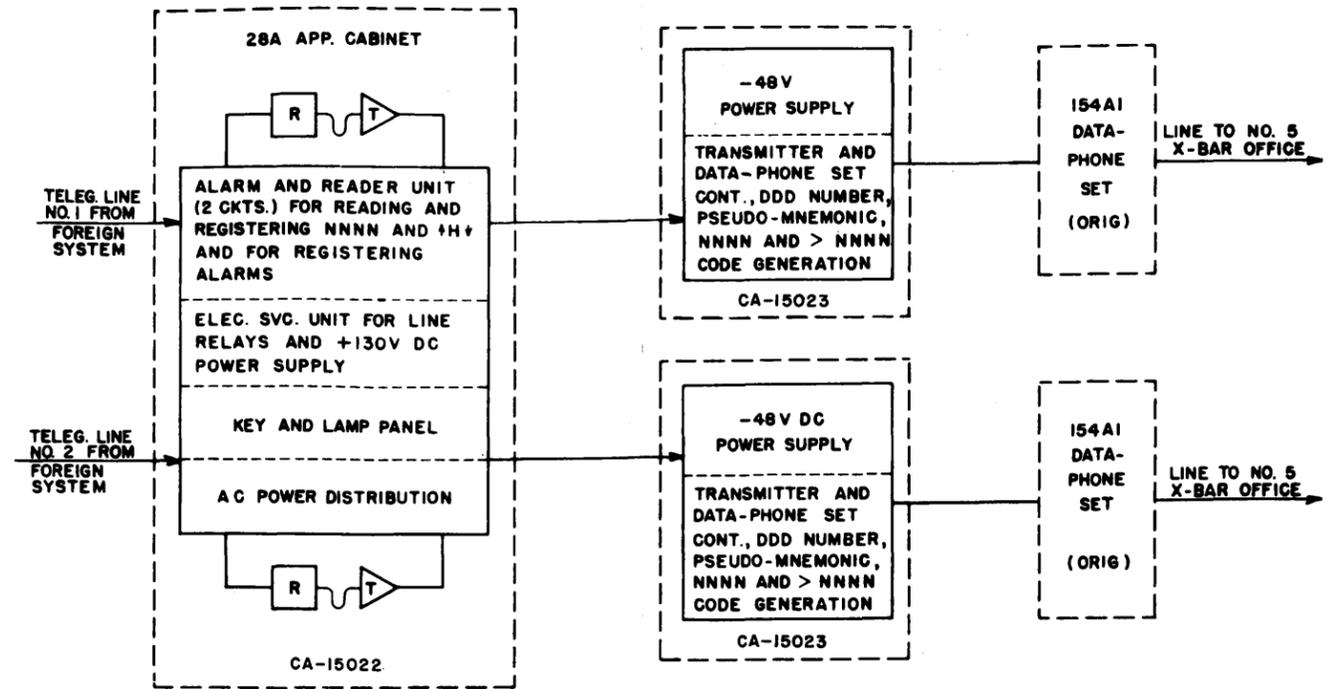


Fig. 2 - Typical Originating Interchange Arrangement - Continuous Tape Operation

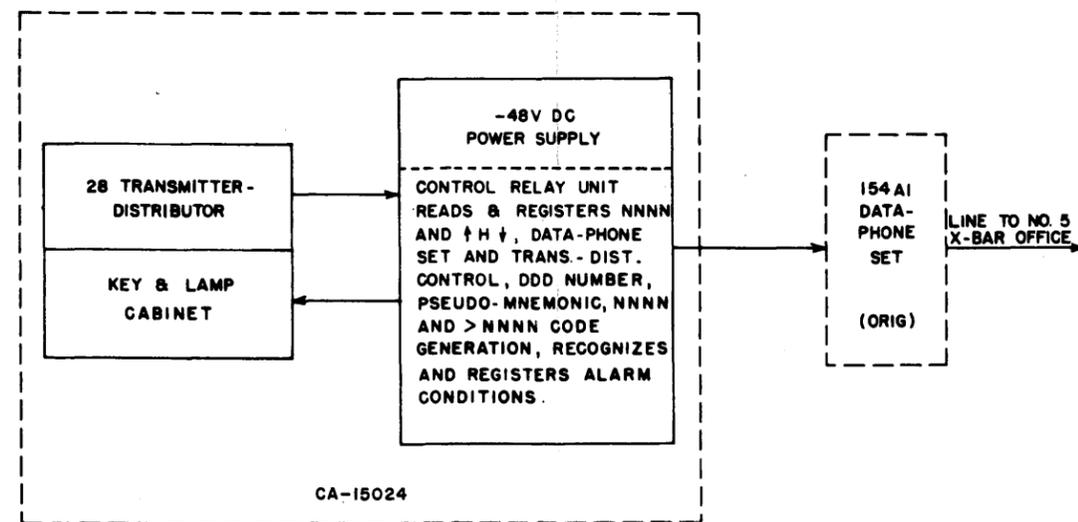


Fig. 3 - Typical Originating Interchange Arrangement - Torn Tape Operation

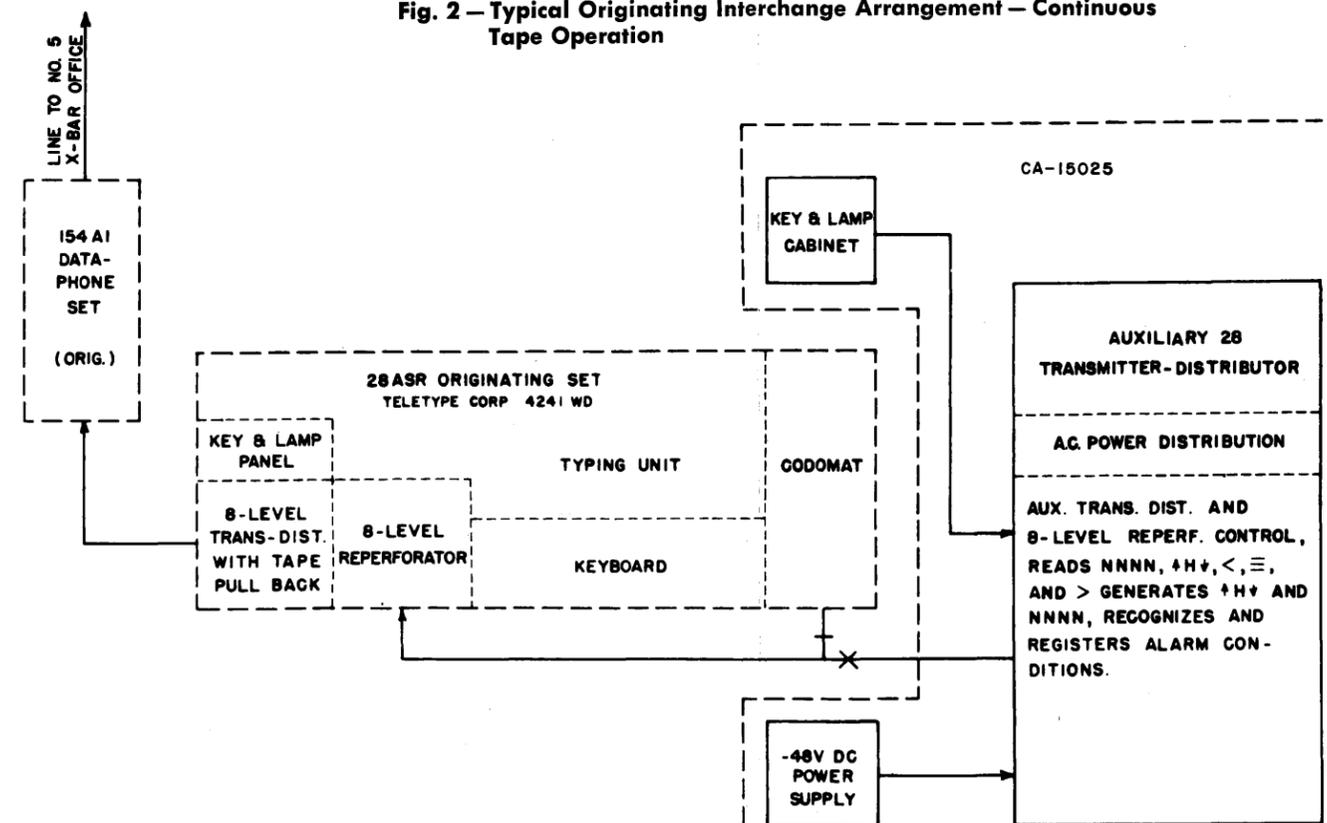
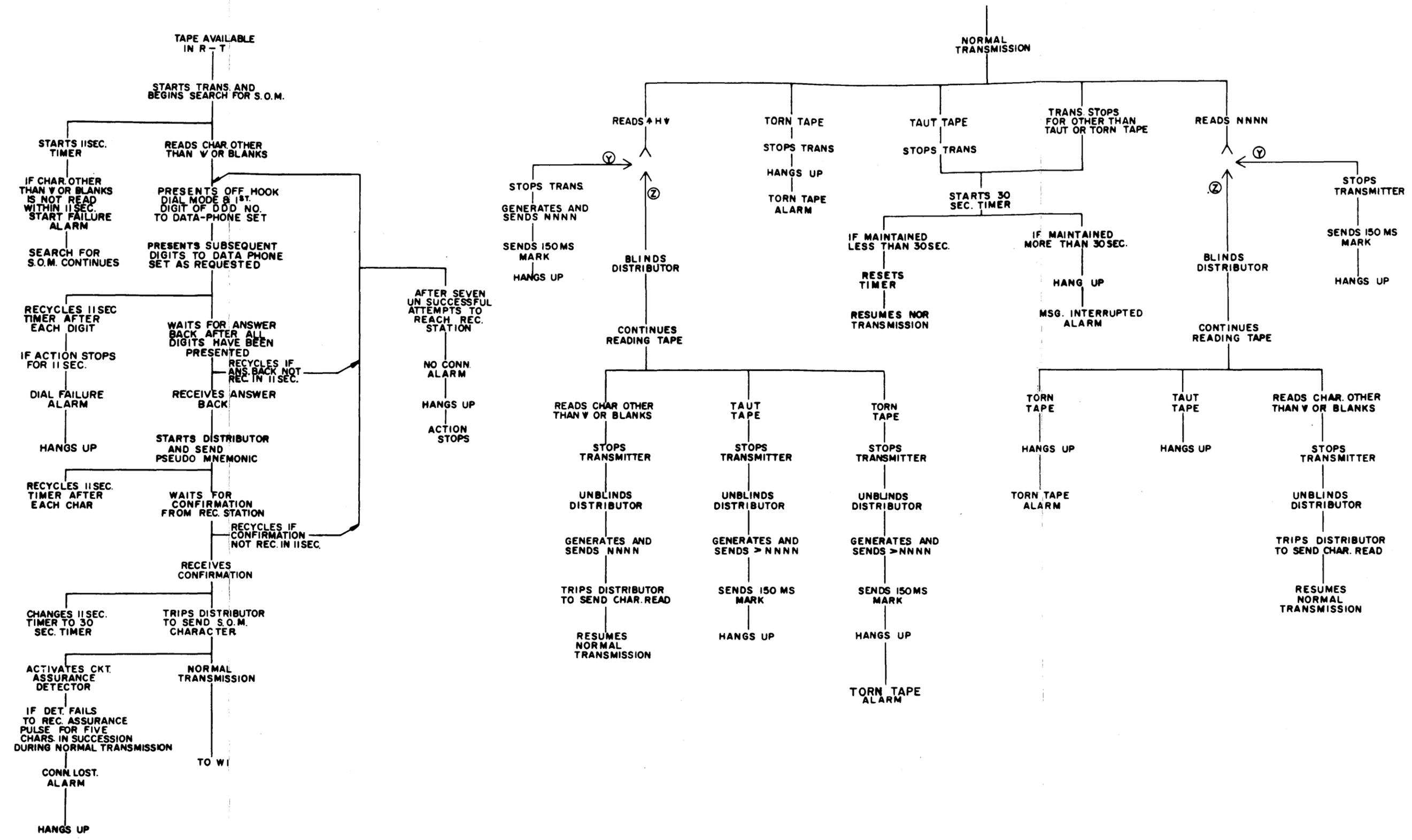


Fig. 4 - Typical Originating Arrangement for Interchange Entry or for Re-entry of Intercepted Messages

Fig. 1, 2, 3, and 4



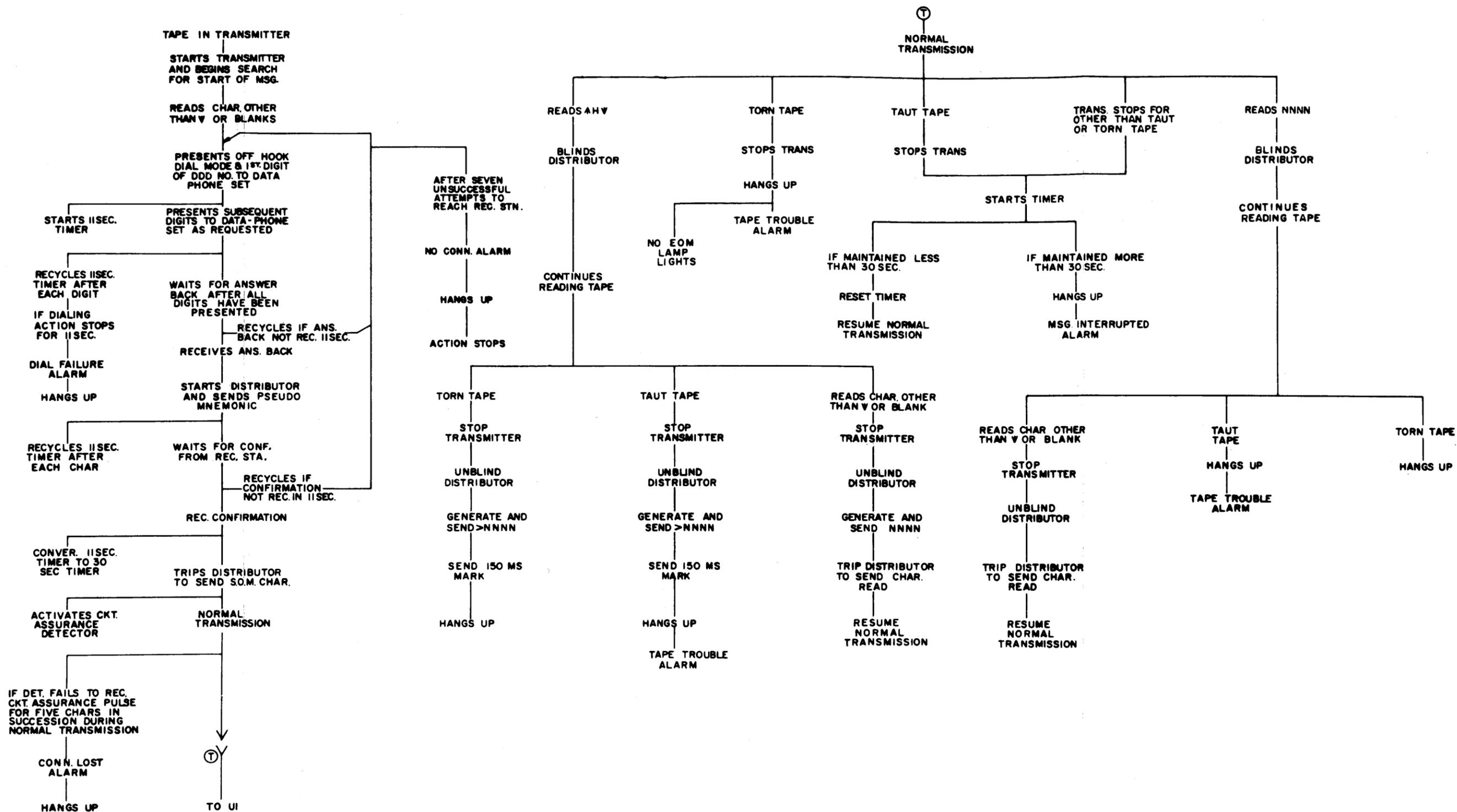


Chart 2 — Sequence of Operations — Torn Tape Originating Station