ON-LINE
INPUT/OUTPUT SYSTEM
FOR FAA

VOLUME I

SECTION 1 GENERAL DESCRIPTION
SECTION 2 OPERATION

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Remington Rand Univac®
DIVISION OF SPERRY RAND CORPORATION
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1. GENERAL

This instruction manual provides detailed information on the On-Line Input/Output System developed by Remington Rand Univac for the Federal Aviation Agency. This system, in conjunction with FAA Air Route Traffic Controller personnel, forms an air traffic control system designed to cope with the ever increasing volume of air traffic which has been further complicated by the airspeeds introduced by the now commonplace jet aircraft. To maintain a positive control over all aircraft in a given area and to remain current on the many items directly concerning each aircraft and its flight, it has been deemed necessary that a portion of the air traffic control responsibility be removed from the human operator and be delegated to an electronic control system termed the On-Line Input/Output System. This system, through the utilization of the very latest in electronic techniques, will allow the Federal Aviation Agency to realize a positive and complete control of all traffic.

2. SYSTEM APPLICATION

The On-Line Input/Output System is designed to provide a high speed communications link between the Univac File Computer and a number of telegraphic terminal equipments at locations that are remote to the computer. By means of this communications linkage, information may be inter-changed between the Univac File Computer and information source devices that may be physically positioned many miles from the computer installation.

The Univac File Computer is an electronic data processing system capable of high speed processing of binary digital information. In its application for air traffic control, the computer accepts information from FAA Air Route Traffic Controller personnel concerning:

Aircraft Identification
Type Aircraft
Speed
Coordinate Fix at a Specified Time
Proposed and Actual Departure Times
Destination
Estimated Time of Arrival
Any additional related information such as weather conditions, changes to previously filed flight plans, etc.

Information on the above categories is filed in the computer central storage section, accessible at any time. In addition, any of the flight plans in computer storage may be changed at any time to meet existing conditions. The changes to existing flight plans may originate locally, at the computer site, or remotely, some distance from the computer.

As a typical but simplified example of system operation, assume that a commercial airliner is leaving city D for city R. Prior to departure a complete flight plan will be received by the Univac File Computer. At the same time that the flight plan is placed in computer storage, a "flight strip" is produced for FAA operating personnel. This flight strip is a typed flight plan produced by a modified Inquiry Typewriter or by a modified High Speed Printer for use by FAA Air Route Traffic Controllers.

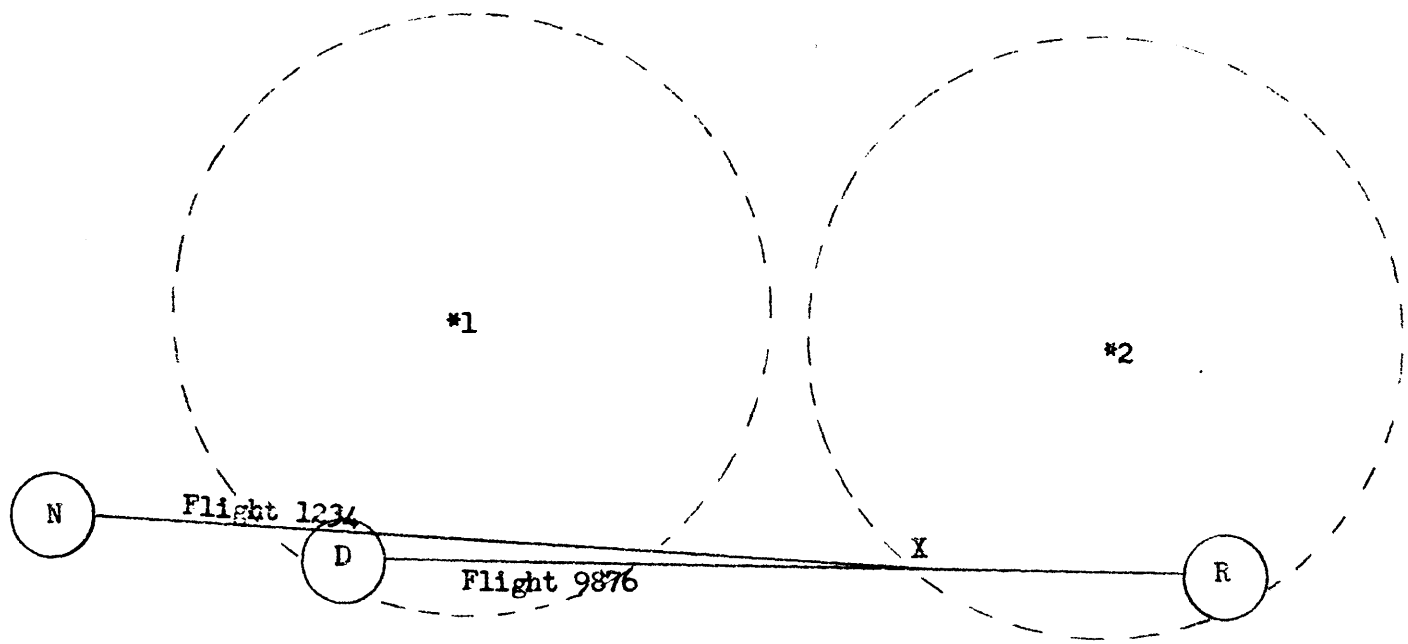
Each flight plan filed is cross-checked against all other flight plans for any possible conflict; if a conflict is noted by the computer or by operating personnel at the computer installation, adjustments must be made in one or more of the flight plans.

As the flight progresses from city D toward city R, it passes over various check points; the actual time over these check points is submitted to the computer and thence to operating personnel for comparison against the filed flight plan as it appears on the flight strip and in computer storage. If any discrepancy exists it may require changes to the previously filed flight plan.

If so, the changes are made and the adjusted flight plan is again checked against all other filed flight plans for conflict.

A possibility exists that weather conditions may arise that would necessitate changes to a number of flight plans. When this occurs, operating personnel enter appropriate weather information into computer storage; the computer and/or operating personnel will then check for all flight plans affected by the weather conditions. The affected flight plans may then be printed out on the Inquiry Typewriter or the High Speed Printer, allowing operator personnel to make the necessary changes to the flight plans, then return the plans to computer storage. Thus a complete and positive control is maintained over the literally thousands of aircraft within a specified control area for the On-Line Input/Output System.

The above example assumes that the flight from city D to city R remained within the control area of a single On-Line Input/Output System installation. Actually there are a number of identical On-Line Input/Output System installations, each assigned a specific air traffic control area. Therefore, in the above example, if city D and city R were physically located such that they were in different control areas, it is obvious that the mere filing of the flight plan at one installation would not be sufficient. It is also necessary that as this particular flight approaches the boundary of the control area, an up-to-date flight plan must be forwarded to the next control area. This information must be received before the flight actually enters the second control area in order that the flight plan may be checked for possible conflict. A need for the early forwarding of flight plans to the next control area is illustrated in Figure 1-1, an extremely simplified example of one air traffic control problem.



NOTE:

*1 = On-Line Input/Output System (Installation 1)
*2 = On-Line Input/Output System (Installation 2)
D = Departure City for Flight 9876
N = Departure City for Flight 1234
R = Destination City for Flight 9876 and for Flight 1234
X = Point of Potential Intersection

Figure 1-1. Simplified Example of a Typical Air Traffic Control Problem

Figure 1-1 illustrates the flight paths followed by Flight 9876 from city D to city R and flight 1234 from city N to city R. The dotted encircled areas on the illustration point out the areas of control for two air traffic control installations (On-Line Input/Output Systems), *1 and *2. Assume in this instance that Flights 1234 and 9876 have identical departure times and that the air speed of Flight 1234 exceeds that of Flight 9876 such that the Flight 1234 will overtake Flight 9876 at position X of the illustration. Under these assumptions there will be no conflict in these flights in the area supervised by *1. However, note that the point of potential intersection, designated by X on the illustration, is just within the boundary line marking the control area of *2. Thus if information concerning these flights is not received by *2 until the flights enter the area controlled by *2, there will be very little time for flight correction. However, if *2 receives information on these two flights before they enter the area controlled by *2, there will be sufficient time for the potentially dangerous situation to be recognized and for corrections to be made.

The above paragraphs comprise a brief presentation of the need for and the application of an air traffic control system, taking into consideration only the information source devices and the Univac File Computer. The actual On-Line Input/Output System is the stage between the computer and the information source devices, necessary to:

(1) couple a number of information source devices to the Univac File Computer and

(2) translate information between computer language (binary digital code) and source device language (Teletype code).

The above two items constitute the purpose and the function of the On-Line Input/Output System. A more detailed discussion of the means by which

information is processed and transmitted between the Univac File Computer and the information source devices is contained in paragraph 4, Basic Principles of Operation.

3. INSTRUCTION MATERIAL

The list below itemizes the manuals and drawings supplied with the equipment.

Volume 1	Section 1	General Description
	Section 2	Operation
Volume 2A	Section 3	Theory of Operation - Substation and Multiplex Unit
Volume 2B	Section 3	Theory of Operation - Translator and Format Control Unit
Volume 2C	Section 3	Theory of Operation - Input/Output Control Unit and Basic Circuits
Volume 3	Section 4	Installation
Volume 4	Section 5	Maintenance
Volume 5	Schematic Diagrams (Basic Circuits)	
Volume 6	Block and Circuit Diagrams (Multiplex Units - Input Scanner and Output Distributor)	
Volume 7	Block and Circuit Diagrams (Translator and Format Control Unit)	
Volume 8	Block and Circuit Diagrams (Input/Output Control Unit)	
Volume 9	Block and Circuit Diagrams (Substation and Synchro-Tape Substation)	

Instruction material on the Model 1 Univac File Computer is supplied in a separate set of manuals.

Each section of the instruction manual is written to serve a definite purpose and to satisfy a particular requirement. An understanding of the purpose of each section will assist the reader in making the best possible use of the information contained in each section.

General Description: This sections contains information on physical characteristics and principles of operation, and provides a general overall view of the equipment; its purpose and application. No attempt is made to detail equipment operation in this section.

Operation: The information contained in this section is intended primarily for persons who will be controlling the operation of the equipment. Turn-on procedures, turn-off procedures, general operating instructions, and a description of operating controls are included. The information furnished in this section should also be of interest to, and be understood by maintenance personnel.

Theory of Operation: The Theory of Operation section provides a detailed description of equipment operation, based primarily on the block and circuit diagrams contained in Volumes 6, 7, 8, and 9. This information is directed at persons interested in understanding equipment logic, and should be of particular interest to maintenance personnel if adequate and consistent maintenance is to be performed.

Installation: The Installation section contains recommendations for installing the equipment and furnishes information on necessary clearances, cabling requirements, and general installation techniques.

Maintenance: This section is aimed specifically at maintenance personnel. Included are: servicing procedures, descriptions of preventive and corrective maintenance techniques, maintenance routines, plus the information required for maintenance personnel to adequately perform their duties.

4. BASIC PRINCIPLES OF OPERATION

The On-Line Input/Output system serves two basic functions in its application for air traffic control:

(1) It serves as a means of data entry to and data exit from the Univac File Computer.

(2) It translates incoming information from communications code to Univac code; outgoing information is translated from Univac code to communications code.

Since at many times it is required that incoming and outgoing information be processed simultaneously, similar information channels are required for input and output. Figure 1-2 is a basic block diagram of the On-Line Input/Output System, showing the direction of flow for both input and output information. Each block in Figure 1-2 represents a cabinet or cabinet grouping in the system. The function of the individual cabinets in both the input and output modes of operation is explained in the following paragraphs.

4.1 Input Operational Mode

The major system sections involved in the input operational mode are illustrated in Figure 1-3. This figure illustrates the direction of information flow from the Univac Input substation to the Univac File Computer.

In the input operational mode, information is transferred from the information source devices to the Input Substation via telegraphic communication facilities. Information input to the Substation is in five-level communications code transmitted at a standard telegraphic rate of six, seven and one-half, or ten characters per second.

The Input Substation accepts the five-level code, adds a parity check level, and punches the message on paper tape. The message is then held in temporary storage in the substation until the Input Scanner is notified that a message is ready for transmission to the computer. It may be added at this point that the Univac Substation may be replaced with a Synchro-Tape Substation as an information source device. The Univac Substation will always be connected

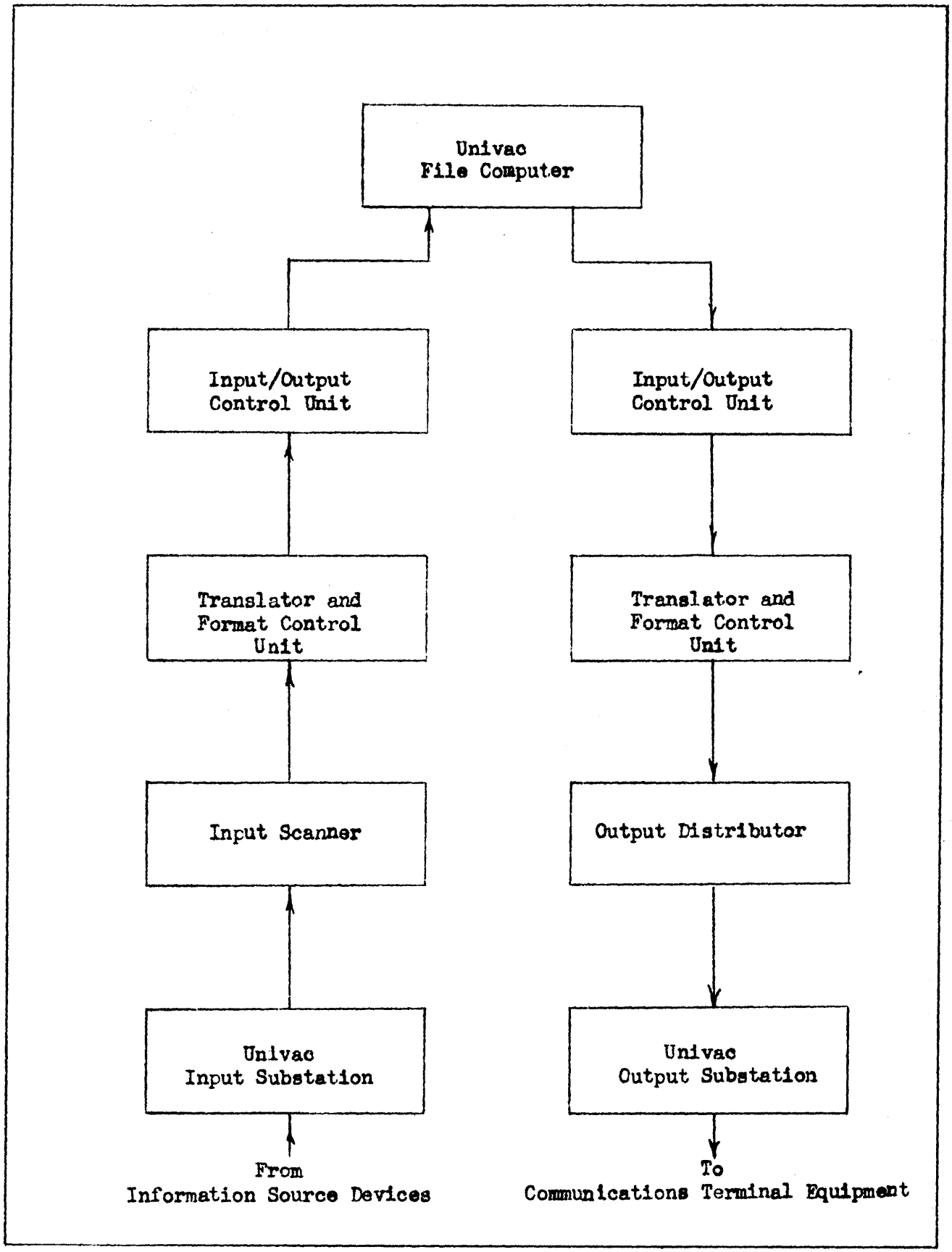


Figure 1-2. Information Flow Channels

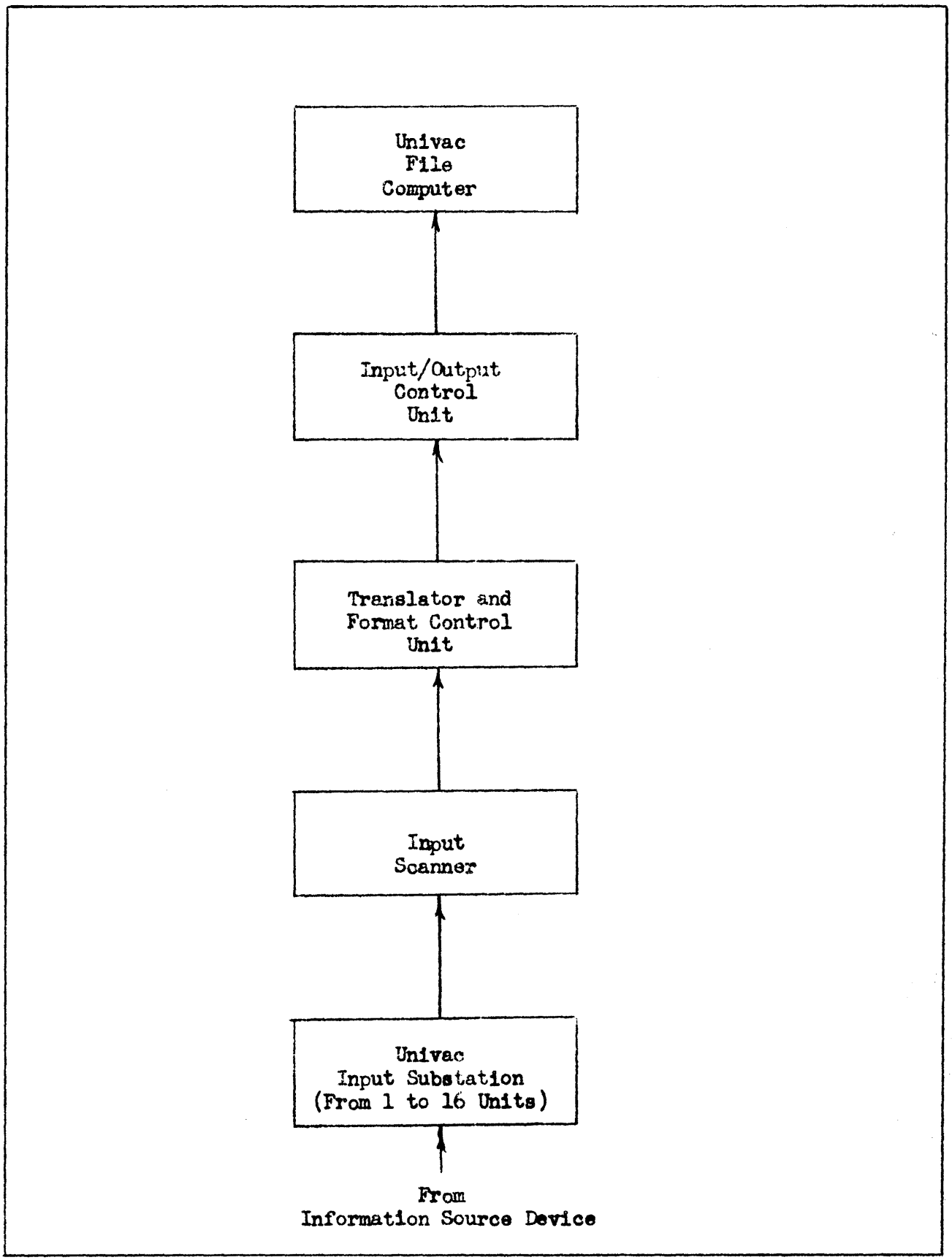


Figure 1-3. Information Flow During the Input Mode of Operation.

directly to a Teletype 28 Receive-Only Page Printer, to receive information from remote sources. However, the Synchro-Tape Substation is a local information source device, allowing an operator at the computer installation site to prepare messages for the computer.

The Input Scanner is a device that sequentially probes each Input Substation when signalled that a message is ready for transmission. The Input Scanner then connects the Substation to the Translator and Format Control Unit, whereupon the entire message is transferred from the Substation to the Translator and Format Control Unit.

The Translator and Format Control Unit accepts the input message, changes the message format where necessary, converts the characters in the message to seven-level Univac code, then advances the message via the Input/Output Control Unit, to the computer.

The Univac File Computer processes the message as directed by internal computer programming and by commands within the message; the information is then recorded in permanent magnetic drum storage.

The paragraphs immediately following detail the operation of the individual cabinets in the system during input operation.

4.1.1 Univac Input Substation

The Univac Input Substation receives information by means of telegraphic communication lines for transmission to a demand station of the Univac File Computer. Each of the substation units, a maximum of 16 units per input system, is tied directly to a Teletype 28 Receive-Only Page Printer (see Figure 1-4). Information input destined for computer processing is received by the 28 RO Set and then transmitted to the Univac Substation. By means of the Teletype connection to the On-Line Input/Output System, information may be

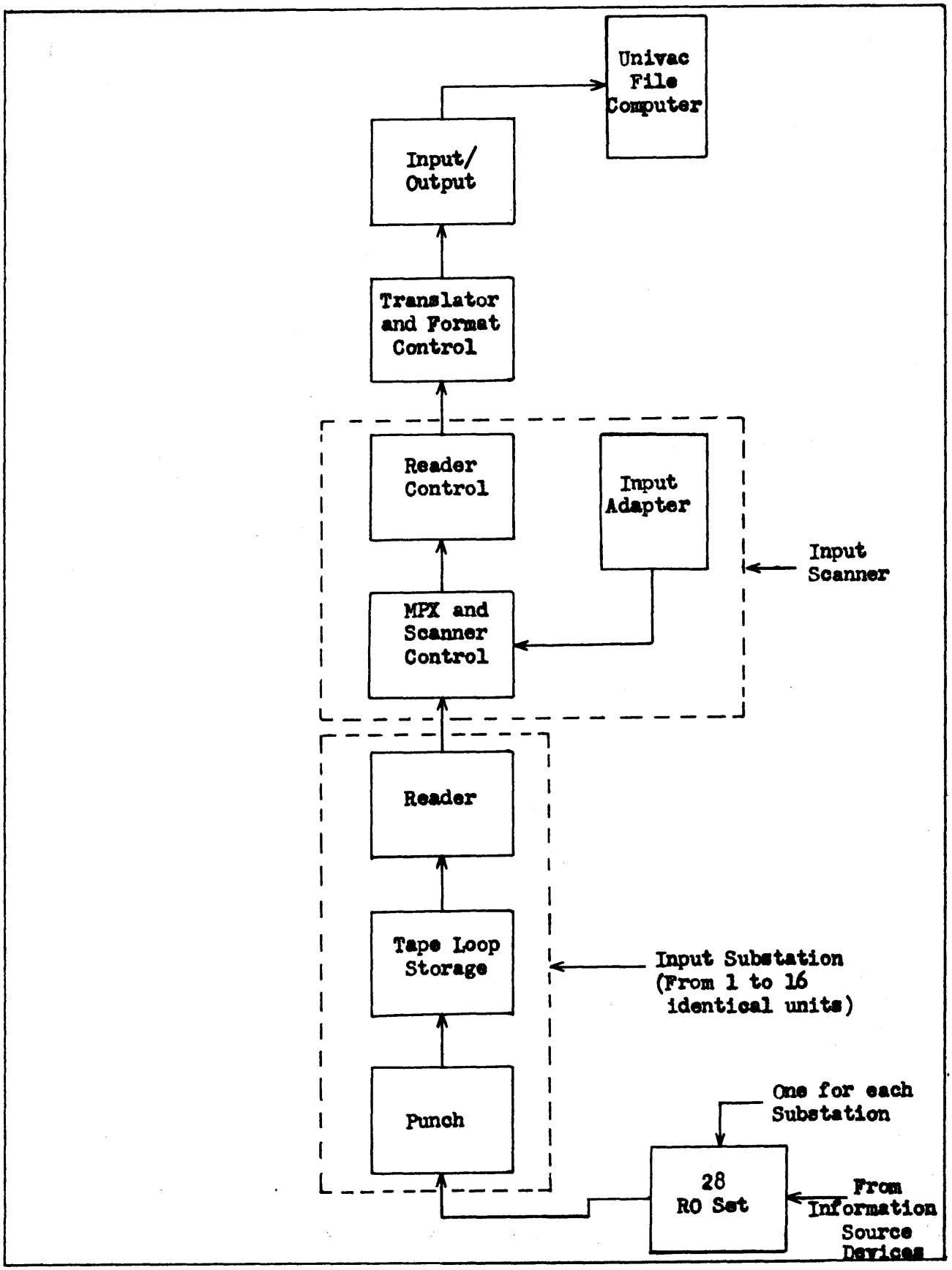


Figure 1-4. Input Operation

directed to the computer from any location that is telegraphically linked to the computer installation.

The incoming message is received by the Teletype 28 RO Set at one of the standard telegraphic transmission rates of 6, 7.5, or 10 characters per second. Each message is printed out by the 28 RO Set, thus forming a permanent record of all incoming messages. Message characters received by the 28 RO Set are also advanced to the Substation BRPE-2 Punch, in serial character form. A Substation cabinet is illustrated in Figure 1-5. A maximum of five Substation units may be contained in a single Substation cabinet. A single Substation Unit is illustrated in Figure 1-6. The basic units within each Substation are a Teletype Model BRPE-2 Punch, a Teletype Model BX-13 Reader, and a tape buffer storage device.

The Punch in the Substation records each incoming message character in chad type paper tape, the resulting communications coded paper tape is then placed in tape buffer storage. When punch control circuits reach the end of the message (as designated by a particular three character sequence) a series of inter-message fill characters are punched in the tape. The fill characters are punched at a 60 character per second rate until the punch is commanded to stop.

As the punch begins to record information input, paper tape is fed from the punch into tape buffer storage. The tape buffer storage device, illustrated in Figure 1-4, functions as a simple on-line storage device, necessary in the event that the computer is otherwise occupied at the time the message is received. As the punched paper tape enters the storage device, a "tape stored" switch detects this input and commands the Reader to begin operation. When the Punch has completed the message the first characters read by the Reader will be

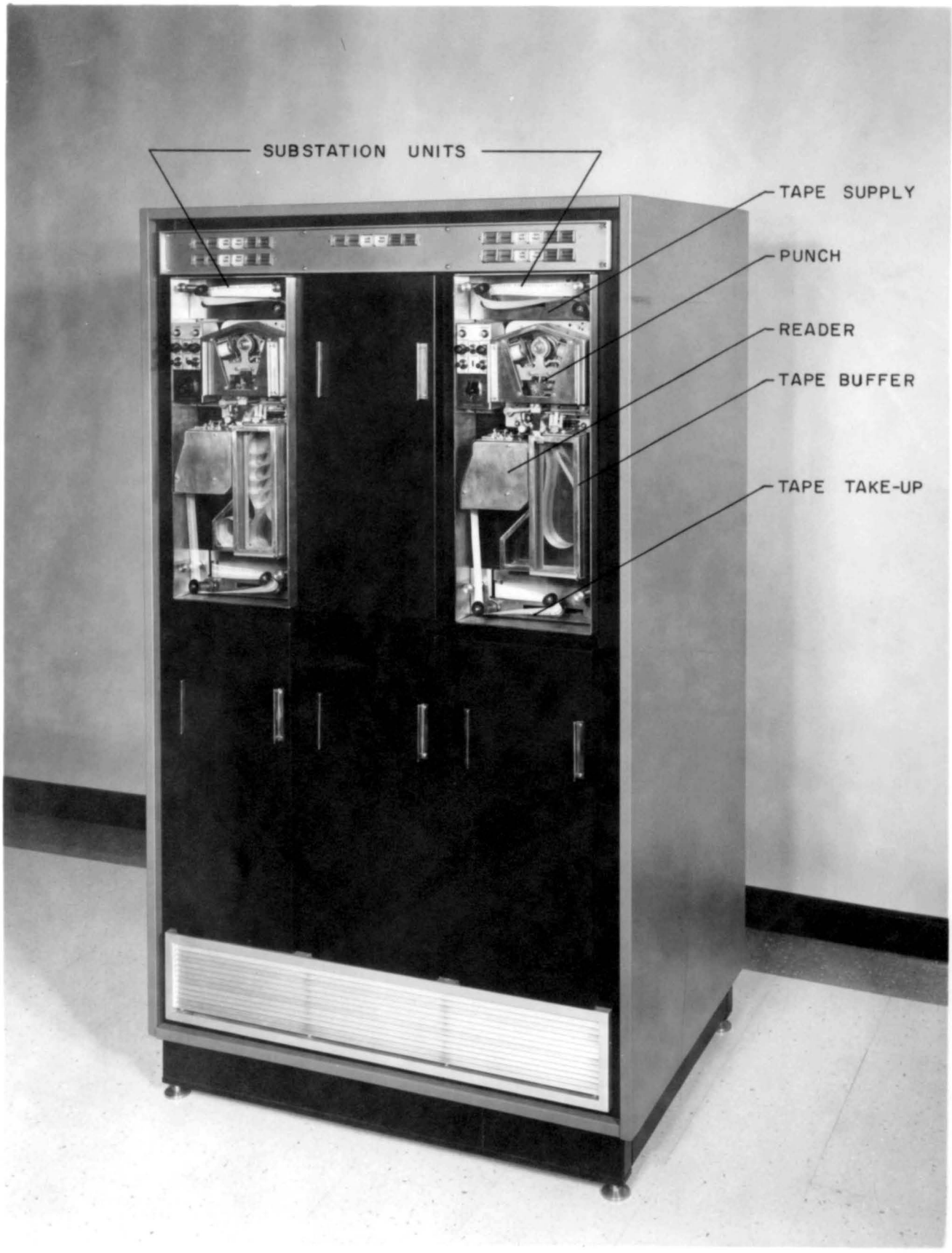


Figure 1-5. Substation Cabinet

Figure 1-6. Substation Cabinet With One Substation Assembly Extended

non-message or leader characters but since leader characters are of no information value, the Reader ignores or deletes these characters and continues reading until the first information character is detected. At this point the Reader stops and a signal is advanced to the Input Scanner signifying that a message is ready for transfer to the computer. The Reader will then remain inactive until the Input Scanner issues a command to process the message contained in tape buffer storage.

One, two, or more messages may be contained in tape buffer storage before the Reader supplies any message input to the Input Scanner. If a number of Substations contain messages, the Substations will be sequentially serviced - each providing a single message input. Thus, if Input Substation number 1 contains two messages in tape loop storage and Input Substation number 5 contains one message, inputs to the Input Scanner are in the following sequence:

(1) one message from substation number 1,

(2) one message from substation number 5,

(3) second message from substation number 1.

4.1.2 Input Scanner

The Input Scanner, see Figure 1-7, consists of three basic sections:

(1) MPX and Scanner Control,

(2) an Input Adapter, and

(3) a Reader Control.

The Input Scanner is a high-speed device that, upon receipt of a service request, signal sequentially scans the lines from the input Substations to locate the Substation requesting service, that is, a message ready. When the Substation requesting service is located, the MPX and Scanner control section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provides a direct line connection between the Substation Reader and the Reader Control section of the Input Scanner. This connection is maintained until one complete message is transferred to the computer, then the scanning cycle is resumed for the next Substation requesting service. Input Substations are scanned at a 25 KC rate.

The Input Adapter section conditions the basic MPX to unidirectional operation, allowing information to be transferred from the Reader in the Input Substation to the Reader Control circuits in the Input Scanner.

The Reader Control section of the Input Scanner serves to control the transfer of information between the Substation Reader and the Translator and Format Control Unit. When a completed message is contained in tape buffer storage and the Substation has been selected by the Input Scanner, Reader Control will read the message out of buffer storage, convert the Substation contact closures to pulses, and transfer the message to the Translator and Format Control Unit. When the Translator and Format Control Unit detects the end of message, it directs the Reader Control section to disconnect the Substation. This allows the Input Scanner to reinitiate its search for substations requesting service.

4.1.3 Translator and Format Control Unit

The Translator and Format Control unit (T & F), see Figure 1-8, checks each character in the input message for proper parity, converts the characters in the input message from communications code to Univac code, performs any necessary message formating, and transfers the characters to the Input/Output Control Unit. Each character received by the T & F unit is subjected to three operational sequences:

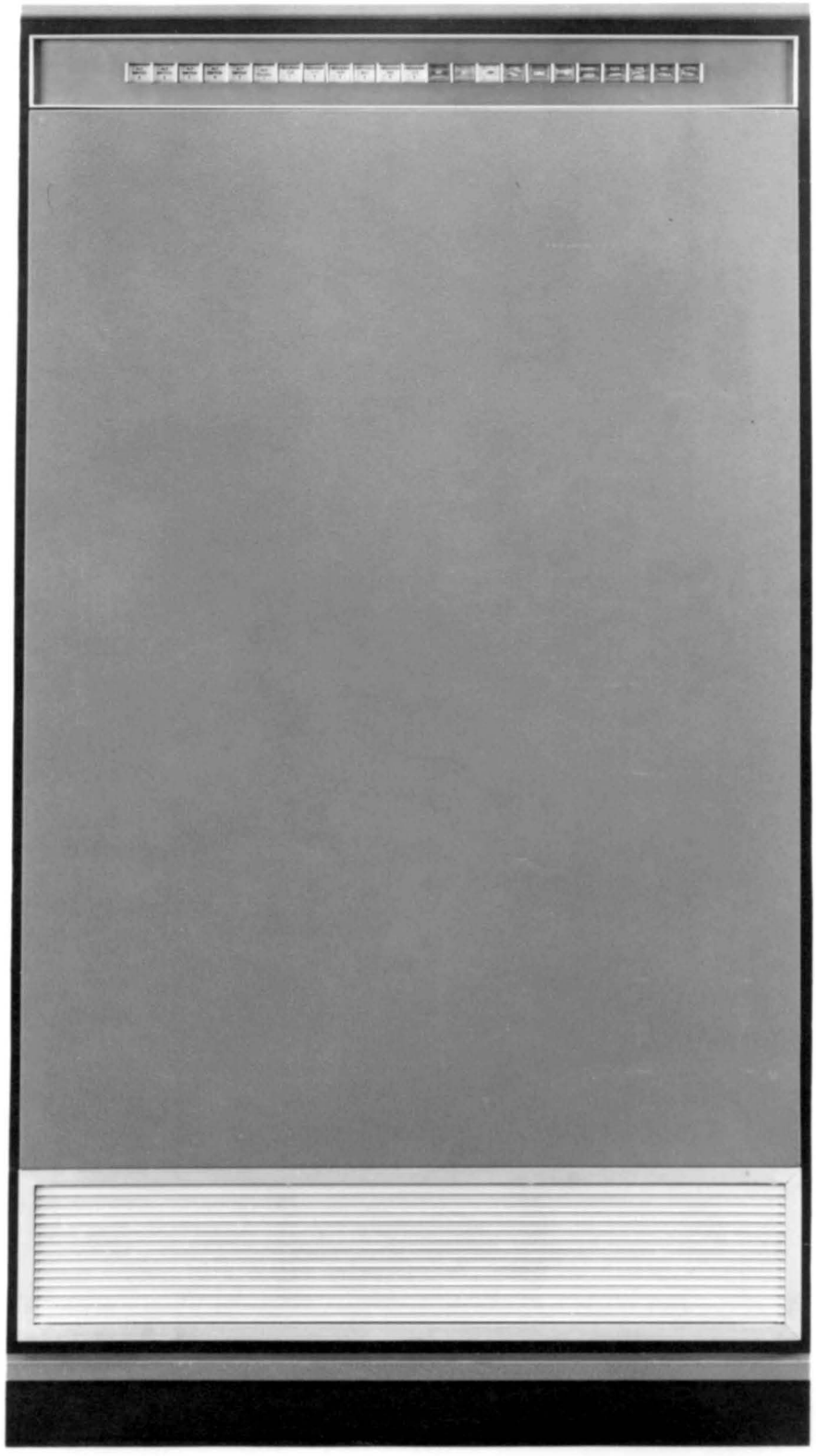

Figure 1-8. Translator and Format Control Cabinet

(1) Input sequence

(2) Output sequence

(3) Function sequence

During the input sequence, the T & F accepts the incoming character and stores it in a one character register. While in the register, the character is encoded (translated to seven-level code) to energize a specific hub on the T & F plugboard. Upon completion of the input sequence, a signal initiates the output sequence. The output sequence controls the transfer of characters to the Input/Output Control unit. The function sequence, interlaced in time with the output sequence, initiates and controls the message format functions. Interlacing the function sequence with the output sequence allows the addition of characters created by format control functions to the outgoing data.

The T & F has a "time out" feature that detects any discrepancy in the rate of character input to the T & F. Thus, in the case of an intra-message failure when transmitting information from Substation to T & F, the system will not be held inactive until the failure is corrected. Rather, a "time out" failure allows the system to discontinue processing of the interrupted message and releases the Input Scanner so that it may accept another service request.

4.1.4 Input/Output Control Unit

The Input/Output Control Unit, see Figure 1-9, is the data link between the T & F and the Univac File Computer. In the input mode the T & F directs the assembly of a number of message characters in a 120-character buffer core storage unit in the Input/Output Control Unit (I/O). Each character is transferred in parallel from the T & F Unit to a one-character buffer register in the I/O Unit. From the buffer register, each character is transferred to a definite address in buffer core storage. After a complete

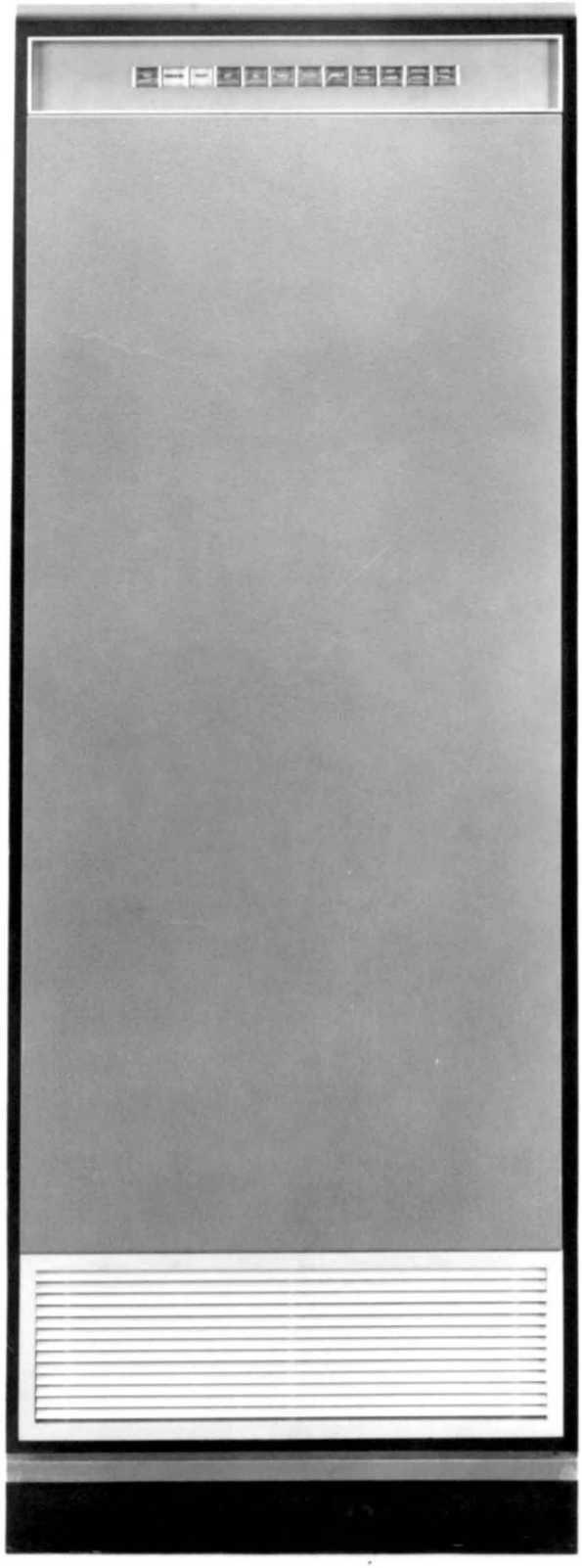

Figure 1-9. Input/Output Control Unit Cabinet

message is assembled in the 120 character buffer, the I/O Unit directs the transfer of buffer content to the storage facilities of the Univac File Computer.

4.1.5 Univac File Computer

The Univac File Computer (UFC) is an electronic computing system capable of high speed processing of binary digital information. The On-Line Input/Output System utilizes separate computer demand stations to accept message input and provide message output, thereby taking full advantage of the versatility of the UFC. For a complete explanation of the computer, refer to the instruction manuals for that unit.

4.2 Output Operational Mode

Figure 1-10 is a basic block diagram of the On-Line Input/Output System for the output operating mode. The output mode refers to an operational condition wherein information is transferred from the Univac File Computer to the telegraphic communication terminal equipment. The File Computer furnishes the information output to the I/O Control Unit and the T & F Unit. In the T & F Unit the message is translated from seven-level Univac code to a five-level communications code plus a parity check level, a check is made for any necessary format changes, and then the message is forwarded to the Output Distributor.

The Output Distributor is a high-speed scanning device that accepts the information output from the T & F and directs this information to the appropriate Output Substation. The correct Output Substation is selected through information contained in the outgoing message.

The Output Substations serve as signal linking devices between the Output Distributor and the outlying telegraphic communication facilities. Error

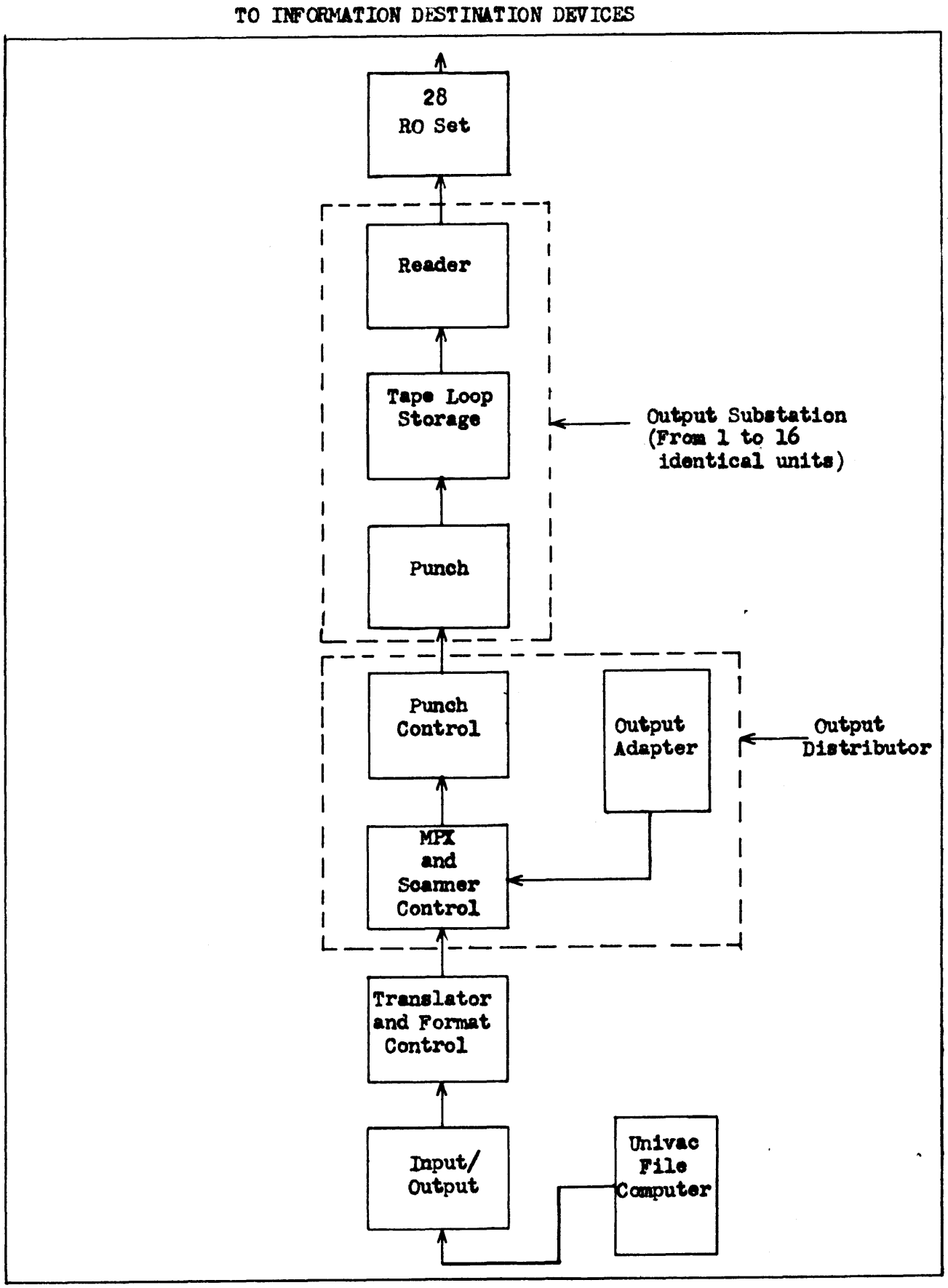

Figure 1-10. Output Operation

checking circuits in the Output Substation verify message accuracy during message transfer.

4.2.1 Univac File Computer

Messages to the outlying stations in the communications network are composed of or based on information contained in computer storage. These messages are transmitted, via a computer demand station, to the Input/Output Control Unit. Complete information on the Univac File Computer is contained in a separate set of manuals.

4.2.2 Input/Output Control Unit

In the output mode and under direction of the computer, the content of the central computer I/O track currently communicating with the computer is transferred to the 120-character buffer core storage unit in the I/O. When the buffer is filled, or the end of message is reached, the characters in the buffer are sequentially or selectively made available to the T & F Unit. This I/O Unit is identical to the one used in the input operational mode.

4.2.3 Translator and Format Control Unit

This T & F Unit is identical to the one used in the input operational mode, with one exception. The plugboards used to control the operation is different for the two T & F Units.

The T & F checks each character in the output message for proper parity, converts the characters in the output message from seven-level Univac code to five-level communications code, performs any necessary message formatting, and transfers the characters to the Output Distributor.

4.2.4 Output Distributor

The Output Distributor, see Figure 1-11, consists of three basic units: an MPX and Scanner Control, an Output Adapter, and a Punch Control section. The first character in the outgoing message is a station selecting

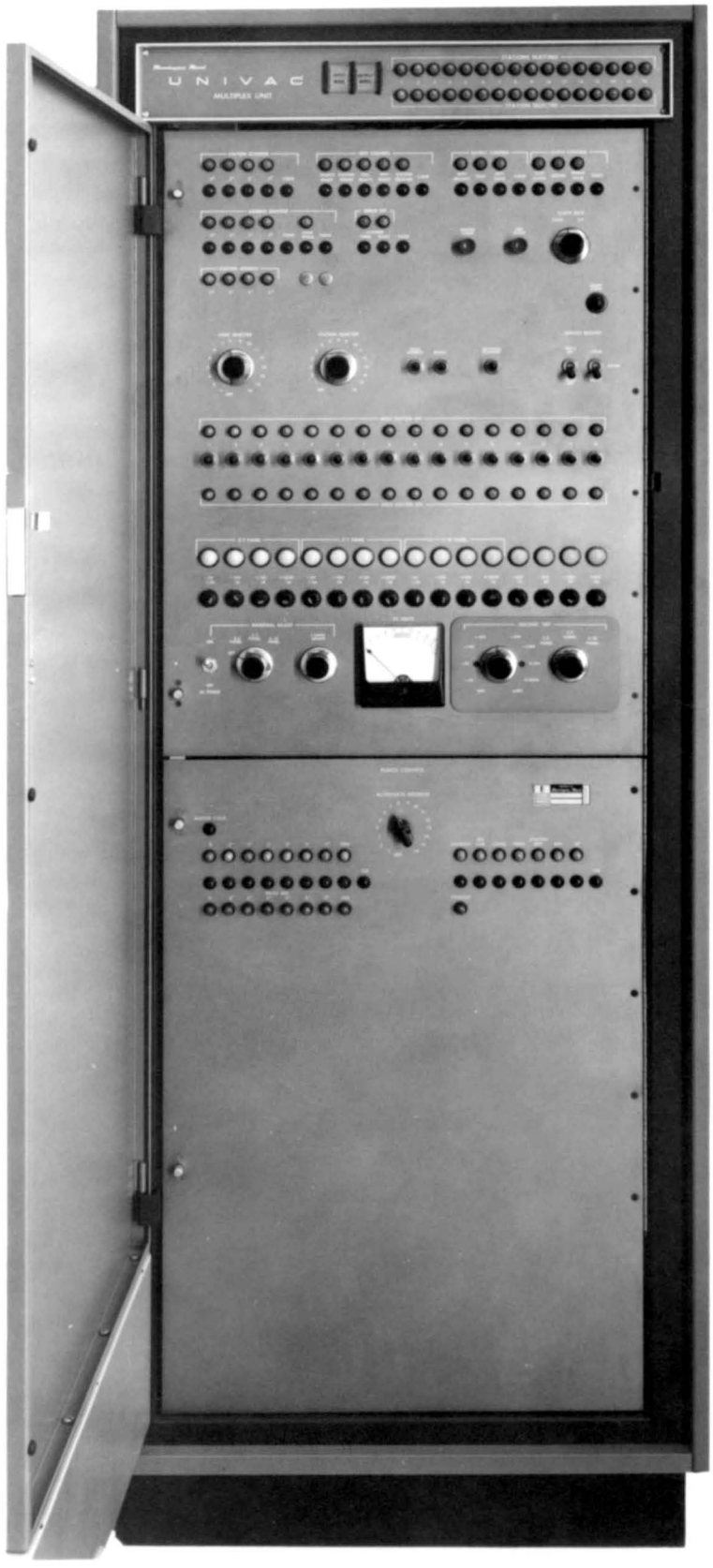

Figure 1-11. Output Distributor

character that allows the Output Distributor to select the proper output Substation. The MPX and Scanner Control provides a direct line connection between the designated Substation Punch and the Punch Control Unit. The connection is maintained until the message is completed.

The Output Adapter section conditions the MPX and Scanner Control section for uni-directional operation, allowing information to be transferred only from the Punch Control circuitry in the Output Distributor to a specific Output Substation punch.

The Punch Control section serves to control the transfer of information between the Translator and Format Control unit and the Punch in the Output Substation. Each individual character in the message must follow the sequence:

(1) character requested by Punch Control,

(2) character transferred by Translator and Format Control unit,

(3) signal to T & F acknowledges receipt of transferred character, and

(4) character is punched on paper tape.

This sequence is repeated until the complete message has been transferred and is recorded on paper tape. When the End of Message code is detected, Punch Control is directed to disconnect the substation. At this time the Output Distributor is prepared to scan for and select the next Output Substation designated to receive a message from the computer.

4.2.5 Output Substation

The basic units within each Output Substation are a Punch, a Reader, and a tape buffer storage device; identical to the components in the input substation. The function of the substation is to match the high speed output of the computer to the relatively low speed of the telegraphic communications

equipment and to provide a means of storing completed messages that are awaiting transfer to the outlying stations.

Information input to the Punch is in five-level communications code plus parity, received character by character. The Punch records each character in chad type paper tape at a maximum rate of 60 characters per second. As the paper tape is punched, it enters the tape buffer storage unit. After the last character of the message is received, leader characters are added to provide inter-message spacing.

As the message enters tape buffer storage, the Reader begins processing tape, searching for the first non-leader character. When the first message character is detected, the 28 RO Set is notified that a message is ready for transfer to communications equipment. The 28 RO Set then controls the transfer of the entire message to associated communications equipment.

The various tape detection devices associated with the tape buffer storage section, as described in the input mode of operation, are also present in the tape buffer storage section of the Output Substation.

5. PHYSICAL DESCRIPTION

The On-Line Input/Output System consists of the following cabinets or cabinet groupings identified as:

(1) Substations (Input and Output)

(2) Multiplex Units (Input Scanner and Output Distributor)

(3) Translator and Format Control Unit

(4) Input/Output Control Unit

(5) Univac File Computer

The paragraphs that follow give a brief physical description of each of the above.

5.1 Substation

The Substation cabinet illustrated in Figure 1-12 has the following dimensions:

Height 60 inches

Width 34 inches

Depth 24 inches

The front section of the cabinet contains five individual Substation assemblies and a power supply. Each Substation assembly consists of:

(1) a High Speed Paper Tape Punch (Teletype Model BRPE-2, modified),

(2) a Tape Reader (Teletype Model BX-13, modified),

(3) a tape buffer storage unit, and

(4) paper tape take-up and supply reels.

Figure 1-13 illustrates a single Substation assembly as it appears when extended from the front of the cabinet. Each assembly is mounted on slides, allowing the unit to be extended from the cabinet for operational and maintenance procedures.

The rear portion of each Substation assembly contains the relay and transistor logic necessary for operational control of that substation. This unit is mounted on slides so that it may be extended from the cabinet for maintenance.

Although the substation cabinets and assemblies may be individually designated as "input" or "output", the physical appearance of these cabinets and assemblies are nearly identical.

5.2 Multiplex (Input Scanner and Output Distributor)

Two basic multiplex units are employed in the On-Line Input/Output System. These units are designated as Input Scanner and Output Distributor, illustrated

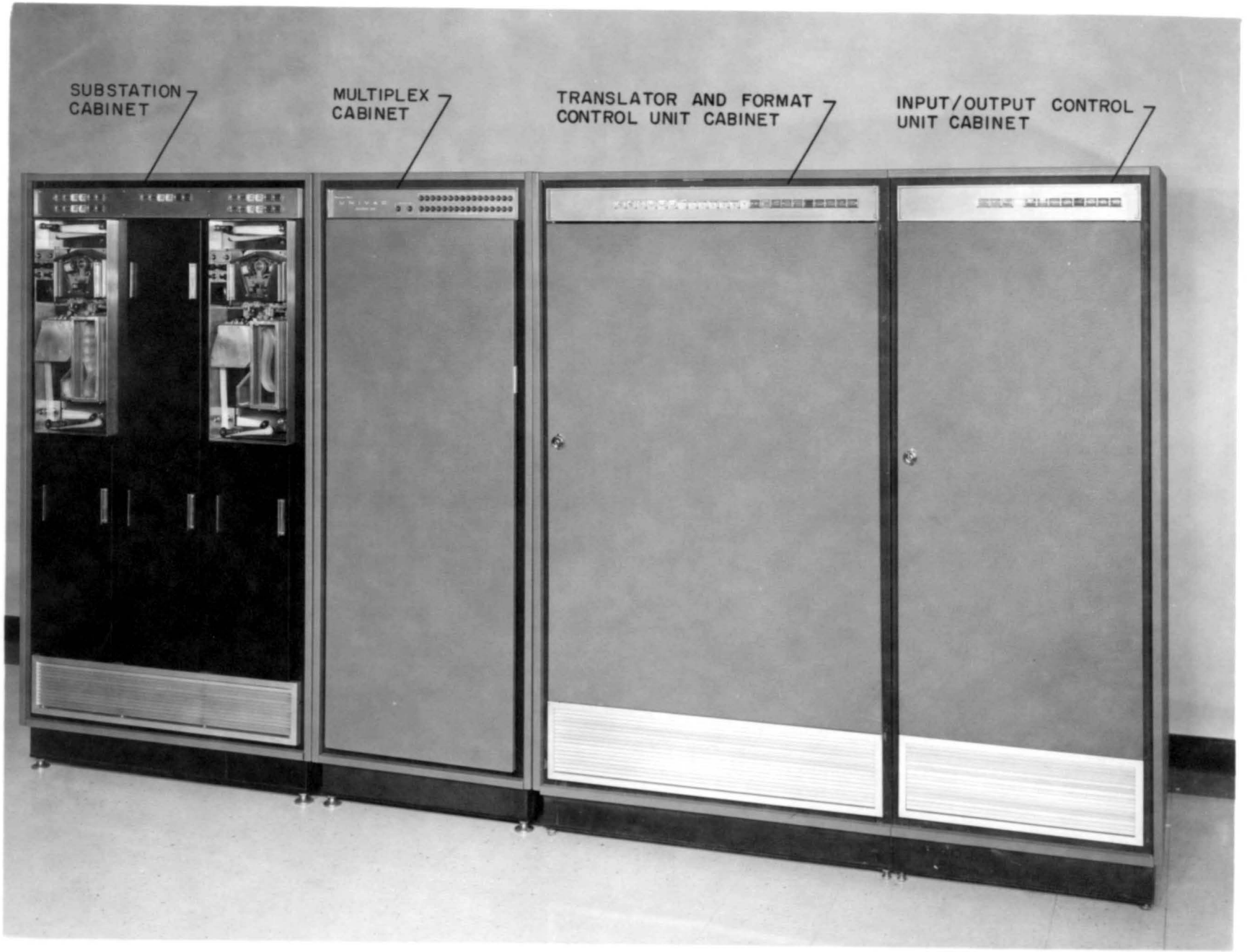

Figure 1-12. Cabinet Grouping for a Single Operational Mode, Input or Output

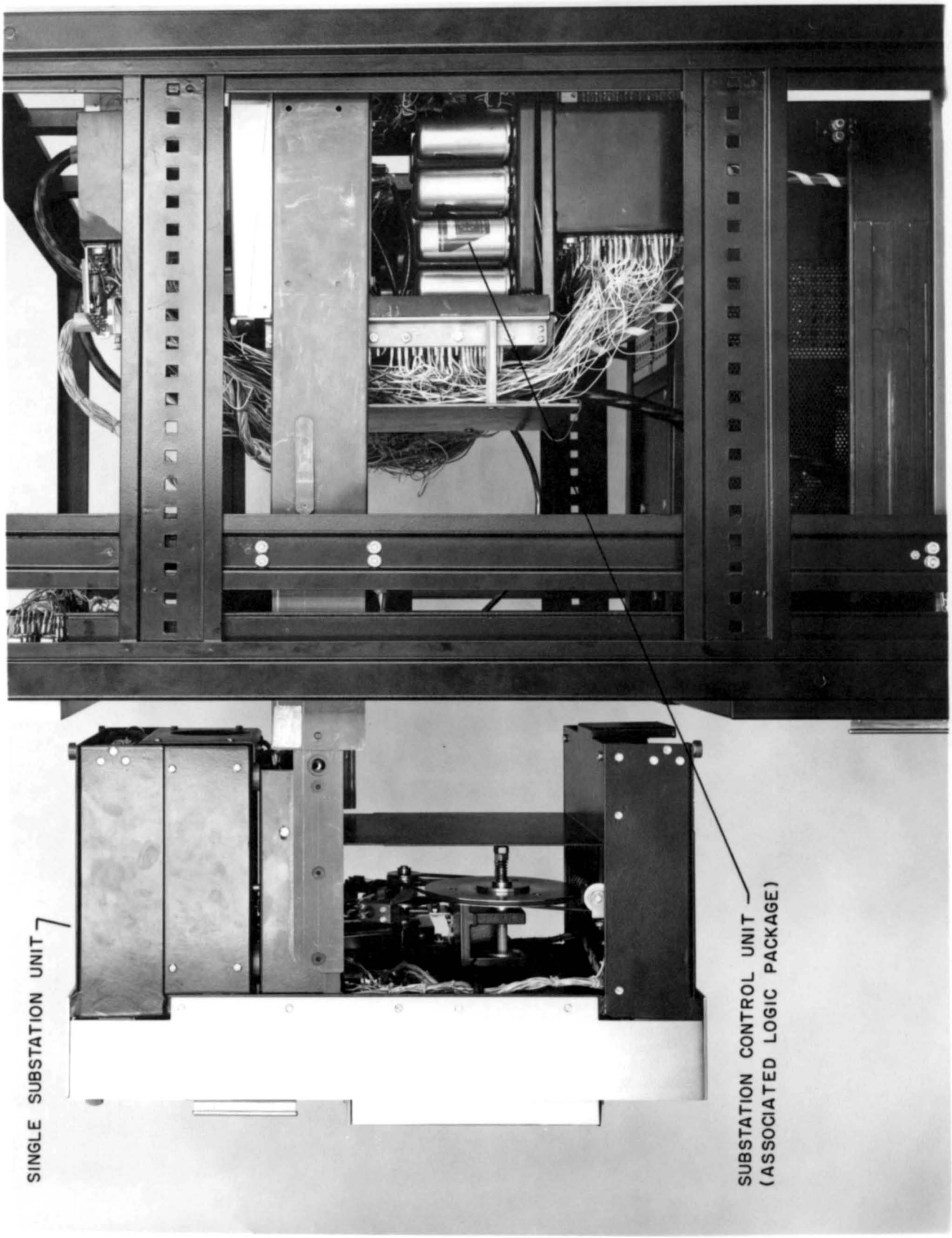

Figure 1-13. Extended Substation Assembly

in Figures 1-14 and 1-15. In outward appearance the two units are very nearly identical. The physical characteristics listed below are identical for both units. Cabinet dimensions are:

Height 60 inches

Width 22 inches

Depth 24 inches

An indicator panel is positioned along the upper front edge of the cabinet. Opening the front cabinet door exposes the maintenance panel, power distribution panel, and a 12-1/2 inch circuit card mounting panel.

The upper-rear interior of the cabinet contains two relay racks, each slide-mounted so the relays may be extended from the cabinet interior for maintenance purposes. Directly beneath the relay racks are two circuit card mounting panels. The circuit card mounting panels are attached to a retractable frame assembly that may be extended from the cabinet interior and swung open. Blowers mounted at the base of the cabinet force air up through the interior for cooling purposes.

5.3 Translator and Format Control Unit

Inside the front of the Translator and Format Control Unit (T & F) cabinet are mounted two circuit card mounting panels, a group of eight B-blocks, and a removable plugboard. The rear of the cabinet contains the maintenance panel and power distribution panels; both panels are hinged to provide access to a fixed panel rack in the cabinet interior. The fixed panel rack contains four rows of circuit cards, additional B-blocks, and a relay mounting panel.

The T & F cabinet has the following dimensions:

Height 60 inches

Width 34 inches

Depth 24 inches

Figure 1-14. Input Scanner

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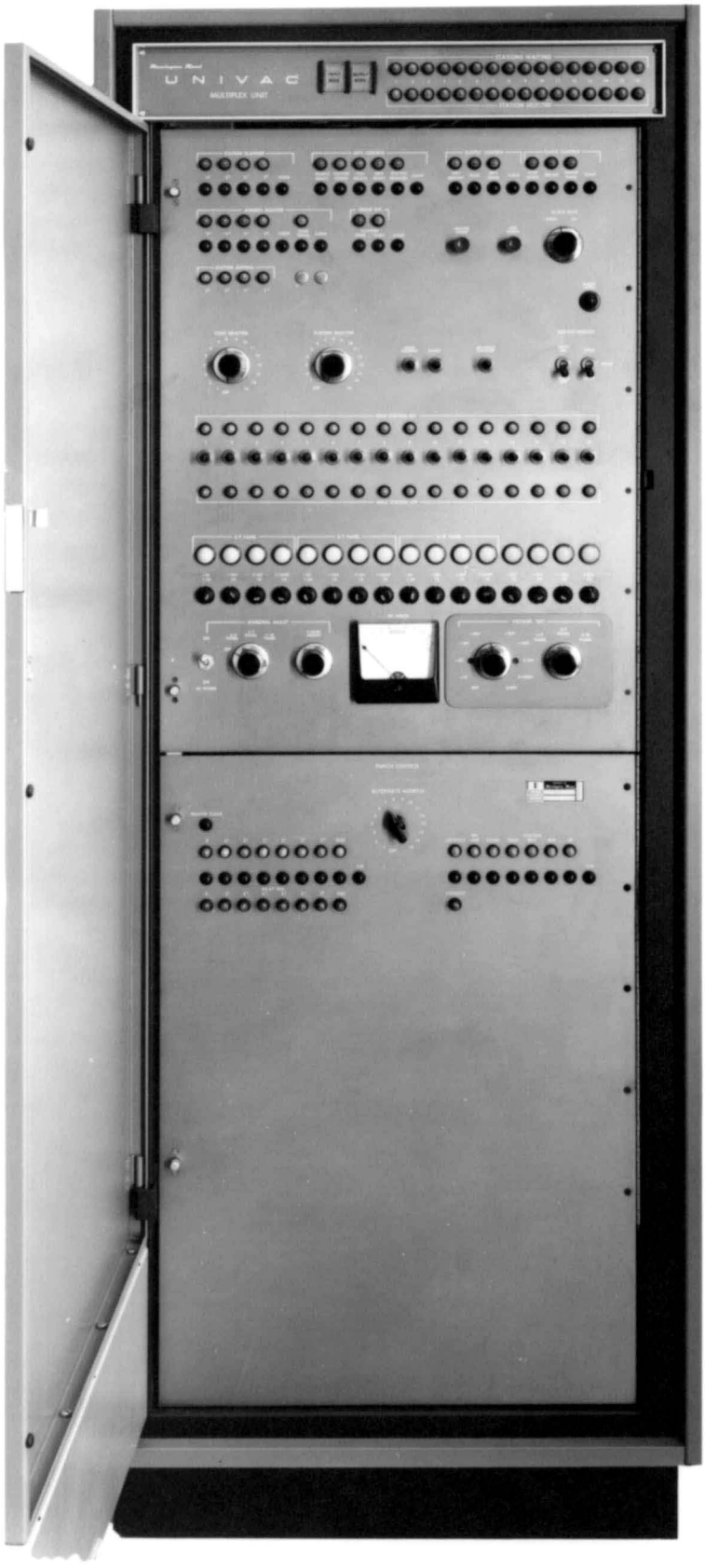

Figure 1-15. Output Distributor

Figure 1-16 illustrates the hinged doors that allow access to the cabinet interior. For maintenance purposes, the cabinet top panel may be removed to expose interior components. A blower mounted at the bottom of the cabinet forces air up through the cabinet interior; warm air is exhausted through a grille at the top of the rear door.

5.4 Input/Output Control Unit

The Input/Output Control Unit cabinet illustrated in Figure 1-17 has the following dimensions:

Height	60 inches
Width	22 inches
Depth	24 inches

An operator panel is located along the upper front edge of the cabinet. The front interior of the cabinet contains five horizontal rows of circuit cards.

A maintenance panel is mounted across the upper rear interior of the cabinet, visible when the rear door is opened. A power supply and power distribution panel are mounted directly below the maintenance panel. Two blowers at the base of the cabinet direct a stream of cooling air up through the cabinet interior.

5.5 Univac File Computer

A complete outline of the physical characteristics of the Univac File Computer (UFC) is contained in the instruction manual for that unit.

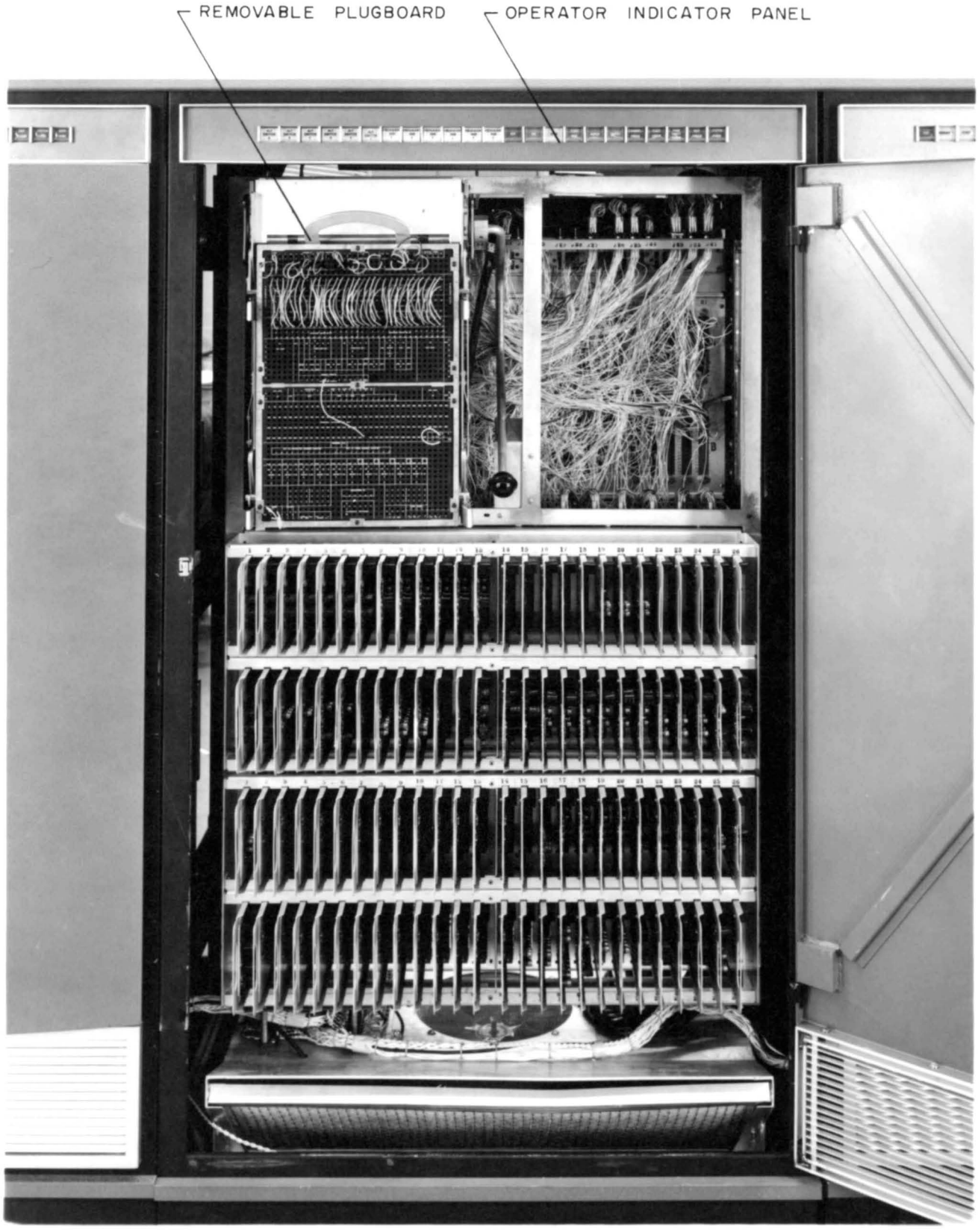

Figure 1-16. Cabinet Interior, Translator and Format Control Unit

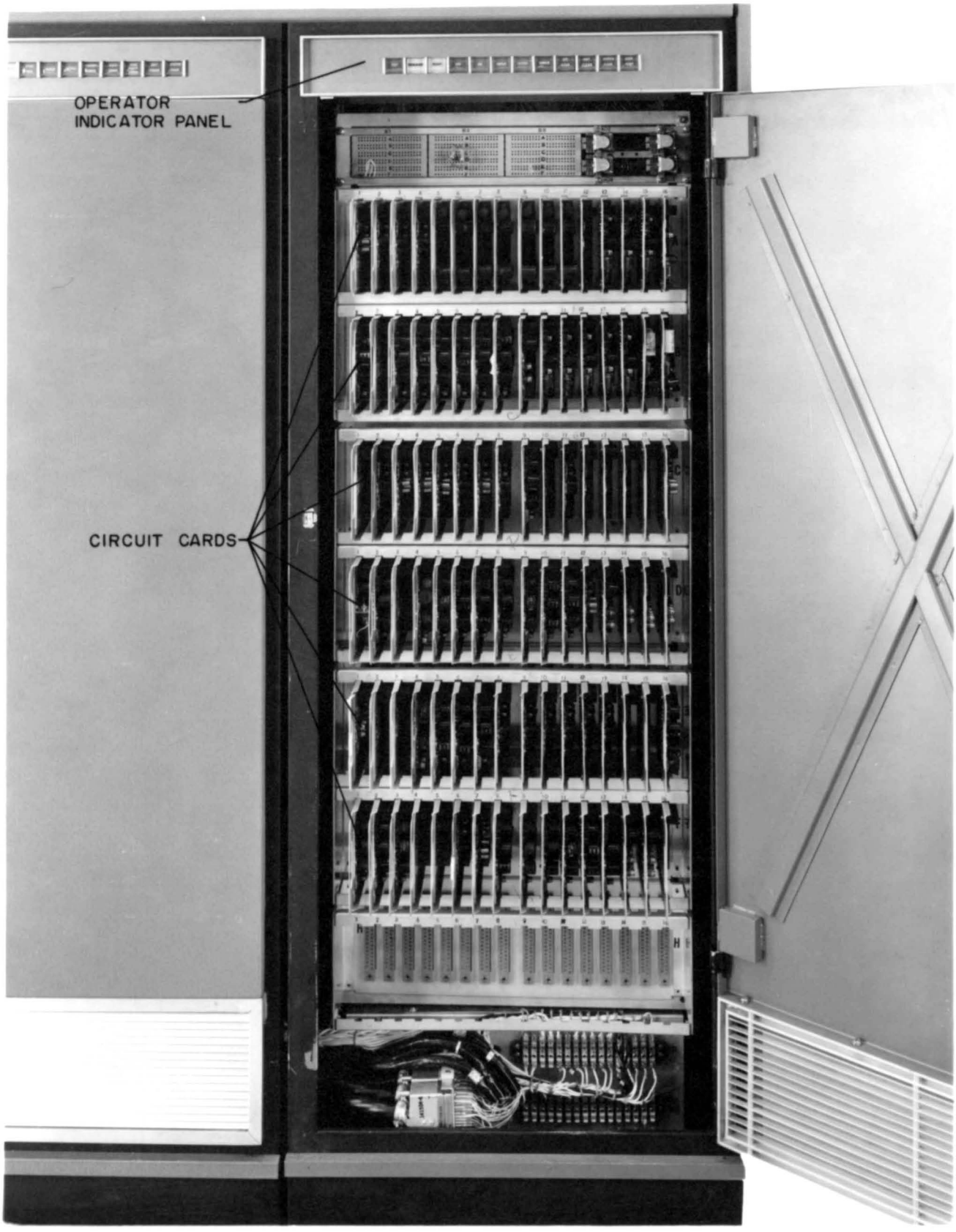

Figure 1-17. Cabinet Interior, Input/Output Control Unit

Section 2

OPERATION

1. GENERAL

This section of the instruction manual contains information on operator controls, and equipment turn-on and turn-off procedures. Also included are special operating instructions concerning substation switching, fault conditions requiring operator intervention, and procedures for replacing tape in the substations.

2. OPERATOR CONTROLS

A number of controls are provided on each equipment for use by operating personnel. The following paragraphs give a detailed description of the logical function of each operator control on the following cabinets:

Substation

Multiplex Unit

Translator and Format Control Unit

Input/Output Control Unit

An explanation of operating controls on the Univac File Computer is contained in the instruction manual for that unit.

2.1 Substation

Each substation mechanical assembly within the cabinet has its own operator control panel. The panel measures approximately 2-1/2 inches wide by 5-1/2 inches long and is located in the upper left corner of the front panel assembly. On it are mounted four push-button indicating switches, three telephone switches, and a 17-position rotary switch as shown in Figure 2-1. The function of each switch and indicator is listed below.

SWITCH/INDICATOR	FUNCTION
INPUT INDICATOR	The INPUT indicator is lighted when the associated substation is prepared to operate in the input mode. The input mode refers to a condition wherein information is received from the telegraphic equipment and transmitted to the Univac File Computer.
OUTPUT INDICATOR	The OUTPUT indicator is lighted when the associated substation is prepared to operate in the output mode. The output mode refers to a condition wherein information is received from the Univac File Computer and transmitted to the telegraphic equipment.
PUNCH LOCKOUT SWITCH	Depressing the PUNCH LOCKOUT push button inactivates the associated punch unit and lights the PUNCH LOCKOUT indicator. During normal operation, a PUNCH LOCKOUT indication denotes that a fault has occurred, causing a particular substation to be inactivated. A punch lockout may be caused by either a tight tape condition in the substation or by a command from the T & F Unit.

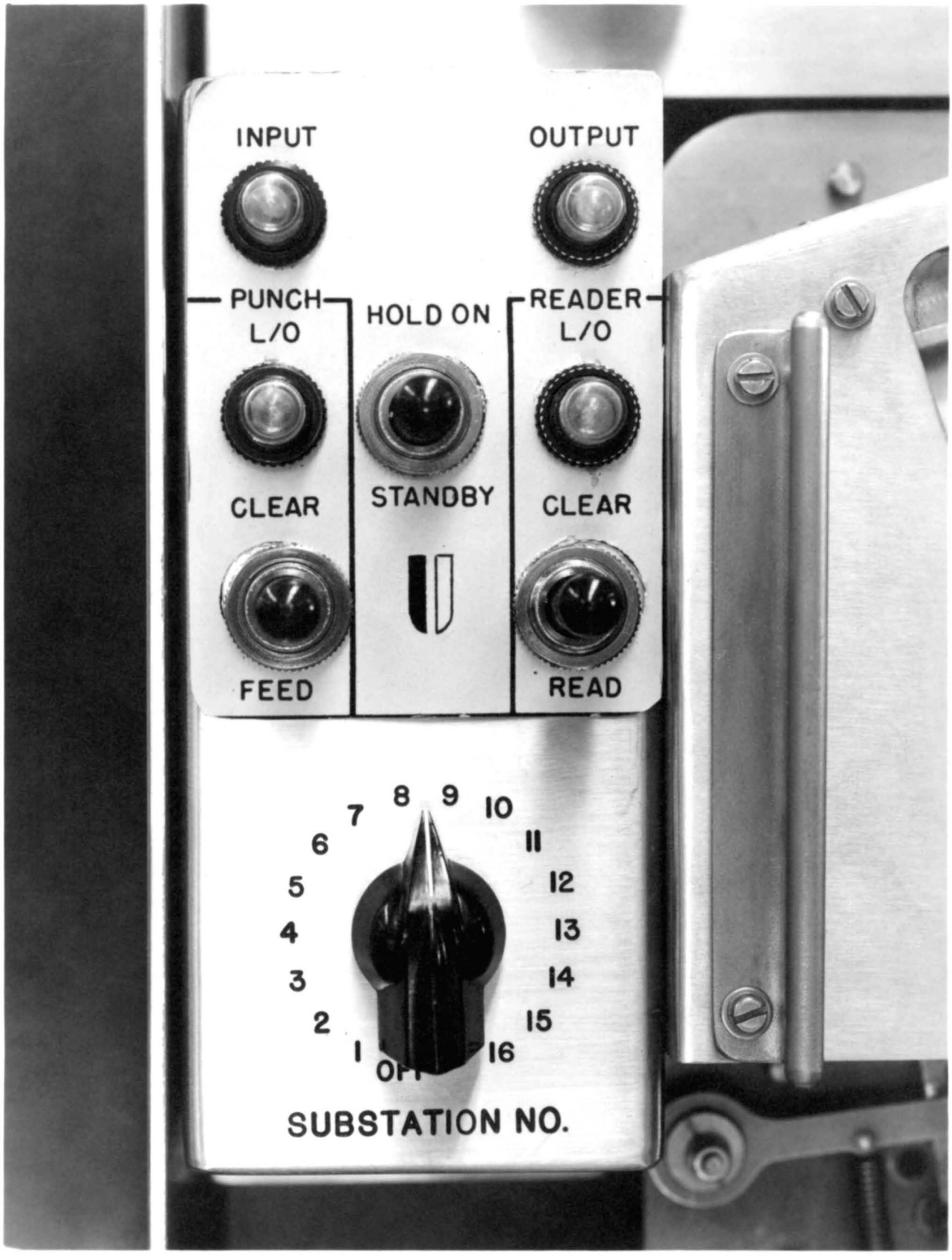

Figure 2-1. Substation Operator Control Panel

READER LOCKOUT SWITCH

Depressing the READER LOCKOUT push button inactivates the associated reader unit and lights the READER LOCKOUT indicator. During normal operation, a READER LOCKOUT indication denotes that a fault has occurred, causing a particular substation to be inactivated. A reader lockout may be caused by a tight tape condition in the tape storage box or by command of the T & F Unit.

PUNCH CLEAR/FEED SWITCH

This is a three-position telephone switch mounted below the PUNCH LOCKOUT push button indicator. The center position is the normal or operating position. Momentarily setting the switch to CLEAR extinguishes the PUNCH LOCKOUT light, clears the punch, and allows the substation to resume normal operation if the fault causing the lockout is no longer present. Momentarily setting the switch to FEED automatically feeds tape to the punch for a predetermined time-out period. The time-out period is such that the punch punches between 6 and 7 inches of leader before stopping automatically.

READER CLEAR/READ SWITCH

This is a three-position telephone switch mounted below the READER LOCKOUT

push button/indicator. The center position is the normal or operating position. Setting the switch to CLEAR extinguishes the READER LOCKOUT light, clears the reader, and allows the substation to resume normal operation if the fault causing the lockout is no longer present. The reader will automatically stop when it detects the first "non-leader" character, or if only leader is stored in the tape storage box, when all tape has been read. Setting the switch to READ activates the reader, allowing it to read tape from the storage box for as long as the switch is held in the READ position or until a tight tape condition causes a reader lockout.

HOLD ON/STANDBY SWITCH

In the HOLD ON position, this switch enables the operator to manually hold the associated substation "on-line" to the Input Scanner. This feature is used to provide continuous service to a substation that has accumulated a large backlog of messages. In the STANDBY position, this switch prevents the substation from being serviced until the switch is returned to the operate position. In the

	standby mode, all conditions for operation have been met, except the substation is prevented from entering a service request.
SUBSTATION SELECTOR	The SUBSTATION SELECTOR is a 17-position rotary swith. It is used to assign a specific station address to the associated substation. This switch allows the operator to readily change substation addresses when replacing an "on-line" unit with a standby, or new unit.

In addition to the control panel on each Reader/Punch module, there is an indicator panel positioned horizontally across the upper front edge of the cabinet as illustrated in Figure 2-2. This panel is divided into five identical indicator groupings; each group is associated with one of the substation assemblies within the cabinet. The function of each indicator is as follows:

INDICATOR	FUNCTION
STANDBY	The STANDBY light is lit when all conditions necessary for substation operation have been met, with two exceptions - the substation is not connected to the Multiplex Unit, and the HOLD ON/STANDBY switch is in the STANDBY position.
OPERATE	The OPERATE light is lit when the substation is connected to the Multiplex Unit and is prepared to operate in the

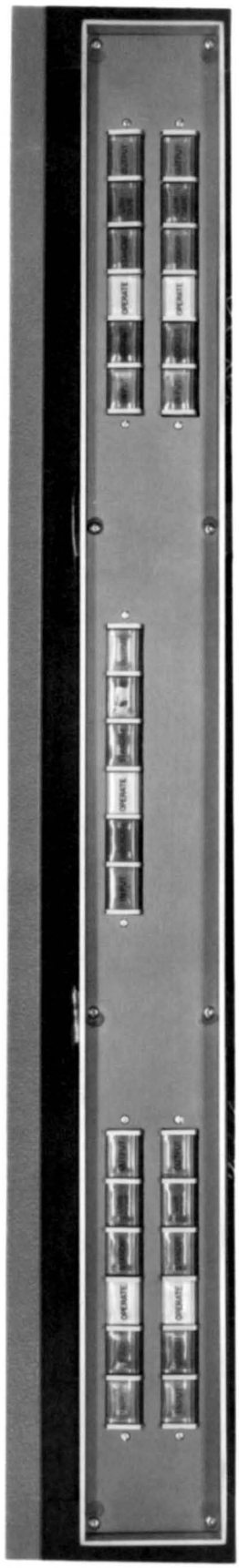

Figure 2-2. Indicator Panel, Substation Cabinet

normal mode. All conditions necessary for operation have been met and the HOLD ON/STANDBY switch is in the normal position.

LOW TAPE — The LOW TAPE light, when illuminated, informs the operator that the tape supply in the associated substation needs replenishing. Normally, the tape remaining on the supply reel is adequate to allow the operator sufficient time to place a standby substation "on-line" before the tape supply is exhausted.

TAPE FAULT — The TAPE FAULT light, when illuminated, informs the operator that one of the following conditions have occurred.

1. Broken tape-Punch
2. Broken tape-Reader
3. Buffer Full
4. Full take-up reel

PUNCH LOCKOUT — This light is in parallel with the PUNCH LOCKOUT indicator on the associated operator control panel. Both lights, therefore, should be lighted or extinguished simultaneously. The PUNCH LOCKOUT light is lit when the punch in the associated substation is locked-out by a tight tape condition in the tape supply drawer.

READER LOCKOUT	This light is in parallel with the READER LOCKOUT indicator on the associated operator control panel. Both lights, therefore, should be lighted or extinguished simultaneously. The READER LOCKOUT light is lit by a tight tape condition in the tape storage box or by command of the T & F Unit.

2.2 Multiplex Unit

There are two types of Multiplex Units used in the FAA On-Line Input/Output System - an Input Scanner and an Output Distributor. These two units are identical insofar as the operator panel is concerned. The operator panel is mounted horizontally across the upper front edge of the cabinet as shown in Figure 2-3. Indicators on this panel and their function are described below.

INDICATOR	FUNCTION
INPUT and OUTPUT	These two indicators are located in the lower central portion of the operator panel and provide a visual indication of the Multiplex Unit's operating mode. The INPUT indicator will be lit on the Input Scanner to denote input mode operation whereas the OUTPUT indicator will be lit on the Output Distributor to denote output mode operation.
STATIONS WAITING	These are a group of 16 numbered indicators positioned in a row along the upper edge

	of the panel. The number associated with each indicator identifies the substation represented by the indicator. When lit, these indicators identify substations that have requested and are waiting for service. Any number of these indicators may be on simultaneously. After the substation has received service, the indicator is extinguished if the substation is not "held on."
STATION SELECTED	These are a group of 16 numbered indicators positioned in a row along the lower edge of the operator panel. The number associated with each indicator identifies the substation represented by the indicator. When a particular indicator is on, its associated substation is connected to the Multiplex Unit to furnish or accept a message being processed.

The following switches, although located on the maintenance panel, are referred to as operating controls since their manipulation by operating personnel is necessary to place the equipment in operation. The maintenance panel is shown in Figure 2-4.

SWITCH	FUNCTION
AC POWER	The AC POWER switch is a toggle switch located at the extreme left edge of the

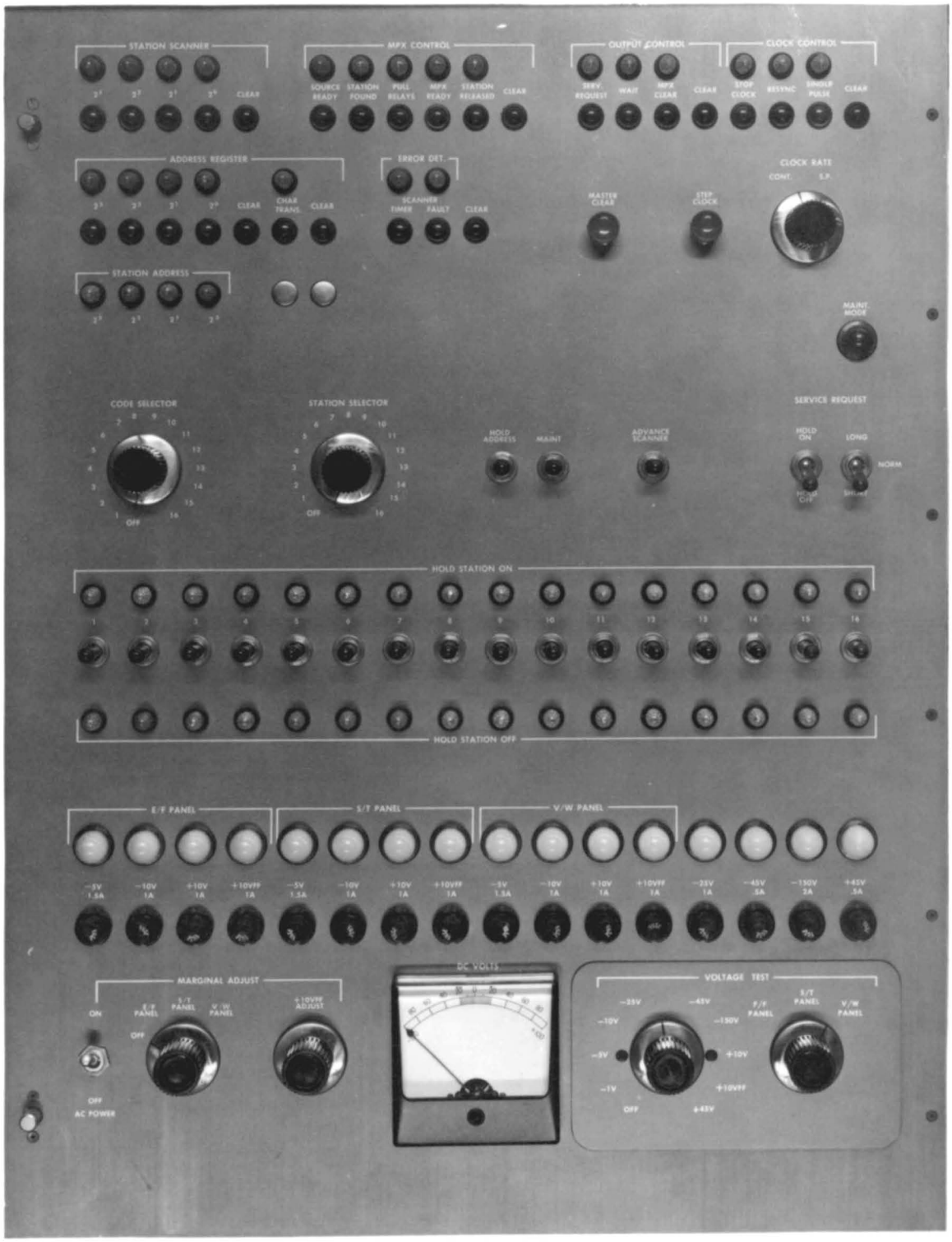

Figure 2-4. Maintenance Panel, MPX Unit

	panel. Placing the switch in the ON position applies ac power to the Multiplex Unit.
CLOCK RATE	This is a two-position rotary switch used to select the operating mode of the equipment. Its positions are labeled CONT (continuous) and S.P. (single pulse). For normal operation, the switch is set to CONT. The S.P. position is used during maintenance for operating in the single pulse mode.
MASTER CLEAR	Depressing this push button returns all circuits in the Multiplex Unit to their initial operating position.
STATION HOLD	These are a group of 16 three-position telephone switches mounted across the central portion of the panel. The switches are numbered to correspond to the substations with which they are associated. Placing a switch in the HOLD OFF position prevents the associated substation from being serviced until the switch is returned to the center position. Holding a switch in the HOLD ON position prevents the station from being disconnected until the switch is released.

The "hold on" feature is used primarily to provide continuous service to a substation that has a large backlog of messages accumulated in the tape storage box.

HOLD ON/HOLD OFF

This switch is a three-position telephone switch located below and to the left of the MAINT INTERLOCK light. With the switch set to, and held in the HOLD ON position, the Multiplex Unit is held "on-line" until the switch is reset to the normal position. The "hold on" feature is used primarily when two or more Multiplex Units are connected in series between the substations and the T & F Unit. With the switch set to HOLD OFF, the Multiplex Unit is inactivated until the switch is returned to the normal operating position. This position of the switch is used when removing a Multiplex Unit from "on-line" operation for maintenance or replacement.

SERVICE REQUEST

The SERVICE REQUEST switch is a three-position telephone switch mounted directly to the right of the HOLD switch. It is functional only when two or more

Multiplex Units are connected in series between the substations and T & F Unit. This switch should be operated only by personnel thoroughly familiar with the system configuration and with the switch functions as outlined in paragraph 4.1.2.3 of Volume 2A, Theory of Operation.

2.3 Translator and Format Control Unit

The T & F Unit operator panel is located on the upper-front edge of the T & F cabinet. See Figure 2-5. This panel contains 23 switches and/or indicators whose function and operation are described below.

The first six switches and associated indicators, reading from left to right across the panel, are labeled ALT SWITCH A through ALT SWITCH F. These switches are connected to 18 hubs on the plugboard in a manner such that depressing any one of the six switches will initiate a definite equipment function, as determined by plugboard wiring. As an example of the possible exploitation of the Alternate Switch grouping, plugboard hubs associated with Alternate Switch 1 might be wired to condition the equipment to operate in the input (substation to computer) mode. Thus, a means of selecting the input mode of operation is afforded the operator.

Since selecting an Alternate Switch is ordinarily a continuing situation (that is, the switch will ordinarily remain depressed for some time), the physical characteristics of the switch are such that by pushing the switch straight in and then down, the switch will remain closed. To open the switch, depress and apply a slight upward pressure.

The indicators labeled PROGRAM IND 1 through PROGRAM IND 6 are connected to six plugboard hubs to provide a means of visually observing the present

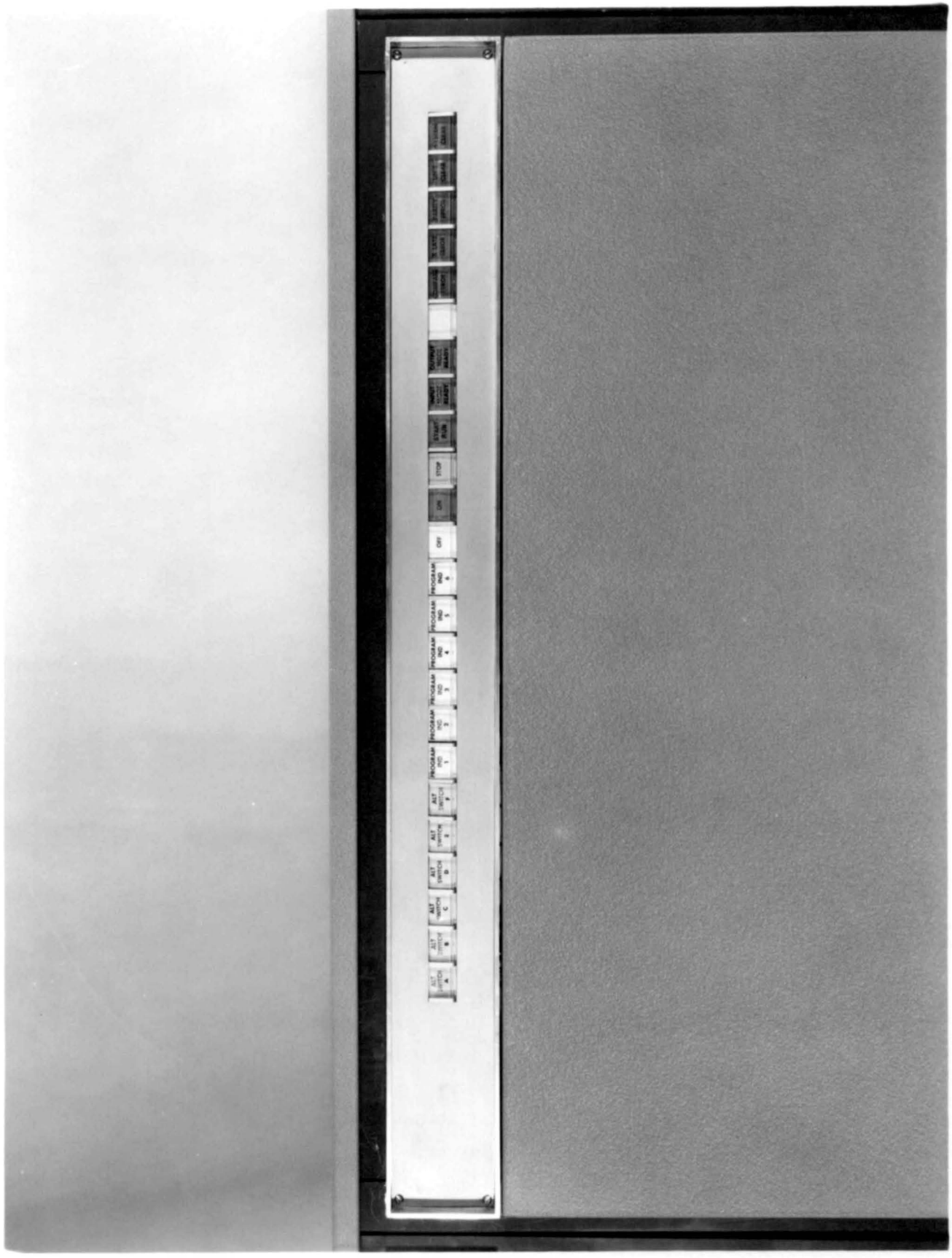

Figure 2-5. Operator Panel, Translator and Format Control Unit

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operating point of the equipment. The signals used to energize these six plugboard hubs are up to the discretion of the programmer. As an example, PROGRAM IND 1 could be energized when the T & F and I/O Control Units are in the input (substation to computer) mode. As a second example, PROGRAM IND 1 could be energized to indicate a Fill function.

The function of the remaining switches on the operator panel, reading from left to right, is as follows:

SWITCH	FUNCTION
OFF	Depressing this switch removes power from the T & F Unit and the I/O Unit.
ON	Depressing this switch applies power to the T & F Unit and the I/O Unit.
STOP	Depressing this switch causes the T & F Unit to stop cycling.
START RUN	Depressing this switch energizes the START RUN indicator and initiates the T & F Unit and I/O Control Unit cycle providing the three following conditions are met: 1. The SYSTEM CLEAR indicator is extinguished. 2. Either the INPUT MODE READY or OUTPUT MODE READY indicator is energized. 3. No Fault indicators are energized.
UNIT CLEAR	Depressing this switch returns all circuits in the T & F Unit to their initial operating condition.

SYSTEM CLEAR	Depressing this switch returns all circuits in the T & F Unit and the I/O Control Unit to their initial operating condition.

The function of the remaining indicators on the operator panel is as follows:

INDICATOR	FUNCTION
INPUT MODE READY	This indicator is illuminated when: 1. The input mode (information transfer from substation to computer) has been selected by plugboard wiring. 2. The T & F Unit, I/O Control Unit, and File Computer are energized. 3. All necessary time delays have been accomplished.
OUTPUT MODE READY	This indicator is energized when: 1. The output mode (information transfer from computer to substation) has been selected by plugboard wiring. 2. The T & F Unit, I/O Control Unit, and File Computer are energized. 3. All necessary time delays have been accomplished.
COMPARE ERROR	A special function that may be utilized as an additional check feature on the

accuracy of input information. If this feature is used, the COMPARE ERROR indicator is wired to the Comparison Register Output Error hub on the plugboard. An energized indicator will then denote an error in input information.

XLATE ERROR — The XLATE ERROR light indicates that an input character has been received but that the Output Control cycle of the T & F Unit has detected none of the following:

1. A Decoder Output.
2. A Delete character.
3. A Precedence character.

This indicates either the receipt of an unauthorized input code or the loss of signal between the decoder and encoder.

PARITY ERROR — This indicator is energized when the T & F Unit detects a parity error in the character received in the Translator Incoming Buffer.

2.4 Input/Output Control Unit

The I/O Control Unit operator panel is located across the upper-front edge of the cabinet. See Figure 2-6. This panel contains 11 switches and/or indicators whose function and operation is described below.

INDICATOR OR SWITCH	FUNCTION
TEST INDICATOR	The TEST light denotes that the Univac File Computer is in the test mode. The

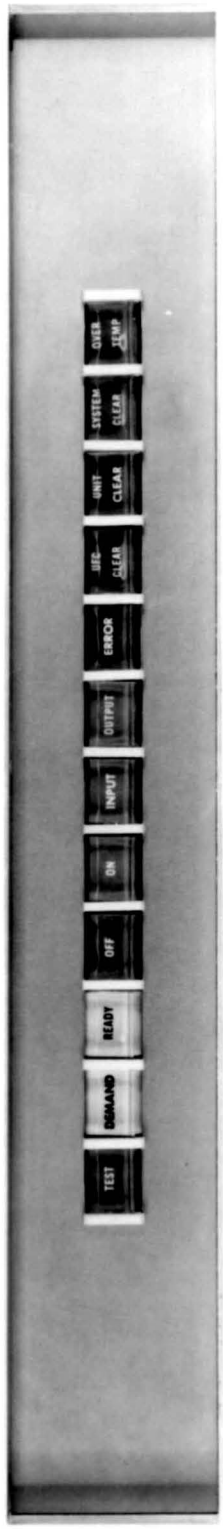


Figure 2-6. Operator Panel, Input/Output Control Unit

	control for this indicator is a TEST switch positioned just below the main plugboard on the File Computer.
DEMAND INDICATOR	The DEMAND light is on when the computer has demanded this particular I/O Unit.
READY INDICATOR	When illuminated, the READY light denotes that the I/O Unit is ready for operation and is subject to demand by the computer. The READY and DEMAND indicators should not be illuminated simultaneously; normally when one is lit the other is extinguished.
ON SWITCH	Depressing this push button applies power to the I/O Unit and the T & F Units. After a suitable time delay the unit is ready to operate.
OFF SWITCH	Depressing this push buttom removes power from the I/O and T & F Units.
INPUT MODE READY INDICATOR	When the INPUT MODE READY light is on, it denotes that the I/O Control Unit has been conditioned to operate in the input mode (message transfer from substation to computer). The I/O operating mode is determined by the three-position operating mode switch on the maintenance panel. If the INPUT MODE switch is turned to INPUT MODE,

	the I/O Unit is locked into the input operating mode. If the switch is turned to OUTPUT MODE, the I/O Unit is locked in the output operating mode. The third position, NORMAL, allows the plugboard in the T & F Unit to select between operating modes.
OUTPUT MODE READY INDICATOR	When illuminated, the OUTPUT MODE READY indicator denotes that the I/O Control Unit has been conditioned to operate in the output mode (message transfer from computer to substation).
ERROR INDICATOR	The ERROR indicator is illuminated when the I/O detects an error during message processing.
UFC CLEAR INDICATOR	The UFC CLEAR indicator is illuminated whenever the MASTER CLEAR switch is depressed on the Univac File Computer console. Circuits in the I/O Control Unit are cleared to their initial operating condition when this indicator is energized.
UNIT CLEAR SWITCH	The UNIT CLEAR push button provides for clearing all I/O circuits to their initial operating condition.
SYSTEM CLEAR SWITCH	The SYSTEM CLEAR push button provides for clearing the T & F and I/O circuits to their initial operating condition.

OVERTEMP INDICATOR	The OVERTEMP indicator is illuminated when the temperature of the cabinet interior exceeds 125 degrees Fahrenheit. If the cabinet temperature rises beyond 140 degrees Fahrenheit, power is automatically removed from the equipment.

3. EQUIPMENT TURN-ON PROCEDURE

The following paragraphs provide a separate turn-on procedure for each of the four equipments comprising the basic On-Line Input/Output System. A detailed turn-on procedure for the File Computer is described in the instruction manual for that unit.

3.1 Substation

A circuit breaker on the power supply panel controls ac power to the substation cabinet. Throwing the circuit breaker ON supplies ac power to the cabinet power supply, blowers, and individual substation assemblies. Once power is applied, certain preliminary checks should be made to ensure proper operation during on-line operation.

These checks include the following:

1. Check the blown fuse indicators to ensure the presence of all dc voltages in the cabinet.
2. Make certain that the motor switch on each substation control unit is turned on.
3. Check the power supply by means of the meter and voltage selector on the power distribution panel. All voltages should be within the specified tolerance. Variaces are provided for adjusting critical voltages; less critical voltages are fixed and cannot be adjusted.

4. Check each tape supply drawer to make certain that sufficient tape is available to allow normal operation for a reasonable amount of time. If necessary replenish the tape supply. A tape loading procedure is outlined in paragraph 4.2 of this section.

5. Check each take-up drawer to make certain that no take-up reel is near its full capacity.

6. If necessary, empty the chad boxes.

3.2 Multiplex Unit

Step 1. Set all STATION HOLD switches to the center position and the two SERVICE REQUEST switches to NORMAL.

Step 2. Turn the CLOCK RATE switch to S.P. to prevent any spurious pulses from being transmitted when power is turned on.

Step 3. Set AC POWER switch to ON and check all blown fuse indicators to ensure that all voltages are present in the cabinet.

Step 4. Depress MASTER CLEAR push button.

Step 5. Rotate the VOLTAGE SELECTOR through its entire range while viewing the meter. Then rotate the panel switch to each of its two remaining positions and repeat the above procedure with the VOLTAGE SELECTOR. The meter should read center scale with the selector in the -5v, -10v, and +10v positions and within $\pm$10 per cent of center scale for the

remaining positions. A variation of more than ±5 per cent of center scale for the -5, -10, and +10 voltages; and a variation of more than ±10 per cent of center scale for the other voltages should be reported to maintenance personnel before completing the turn-on procedure.

Step 6. Turn CLOCK RATE switch to CONT and depress the MASTER CLEAR push button. The Multiplex Unit is now in the normal standby condition and will, upon receipt of a Service Request from one of its associated substations, automatically begin its cycles of operation. In the standby condition, only the INPUT or the OUTPUT indicator, and one STATION SELECTED indicator should be lighted on the indicator panel. On the maintenance panel, all indicators except the dc voltage indicators and possibly the scanner indicators should be extinguished.

3.3 T & F Unit

This turn-on procedure applies only when operating the T & F Unit from its associated operator panel. If the T & F Unit is to be operated from the File Computer console, a turn-on procedure designated by the programmer should be followed rather than the turn-on procedure outlined below.

Step 1. Place the plugboard in position in the T & F Unit. The plugboard is to be wired for the appropriate mode as designated by the programmer.

Step 2. Depress and hold in the ON switch for two to five seconds to allow the thermal relays to operate.

Step 3. Depress ALTERNATE switches as designated by the programmer.

Step 4. Depress UNIT CLEAR switch.

Step 5. Depress START RUN switch. The T & F Unit is now in the normal standby condition. In this condition, only the following indicators should be lighted on the operator panel.

ON

INPUT MODE READY or OUTPUT MODE READY

START RUN

ALTERNATE (see Step 3, above)

PROGRAM INDICATORS (as designated by the programmer)

3.4 I/O Control Unit

Like the T & F Unit, the I/O Control Unit can be operated either from its associated operator panel or from the File Computer console. If the I/O Unit is to be operated from the UFC console, a turn-on procedure designated by the programmer should be followed rather than the turn-on procedure outlined below.

Step 1. Depress and hold in the ON switch for two to five seconds. After a suitable delay, the unit is prepared to operate.

Step 2. Depress the UNIT CLEAR switch. The I/O Unit is now in the normal standby condition, and ready to accept operational commands from the computer.

The following lights on the operator panel should be illuminated.

ON

INPUT MODE READY or OUTPUT MODE READY

TEST, DEMAND or TRACK READY

4. CONDITIONS REQUIRING OPERATOR INTERVENTION

4.1 Fault Conditions

Operator intervention is required when any one of the following fault conditions are displayed on the substation indicator panel:

(1) Reader Lockout

(2) Punch Lockout

(3) Tape Fault

(4) Low Tape

READER LOCKOUT

A reader lockout may result from either a malfunction in the substation reader/punch module or on command of the Translator and Format Control Unit. Generally, this fault is caused by a tight tape condition in the tape buffer storage box; that is, tape tension between the storage box and reader head exceeds a specified safe limit. This condition may be corrected by momentarily setting the CLEAR/FEED switch on the substation operator panel to FEED to provide additional tape leader to the buffer box, and then setting the

CLEAR/READ switch to CLEAR. If the fault persists notify maintenance personnel immediately.

PUNCH LOCKOUT

A punch lockout generally results from a tight tape condition in the tape supply drawer. This condition may be caused by a binding tape reel or may occur if the tape end is attached to the reel hub and cannot be completely unwound. A punch lockout fault may be corrected by toggling the FEED/CLEAR switch between its two positions. If the fault persists after attempting the above operation, notify maintenance personnel immediately.

TAPE FAULT

A tape fault indication will result from any one of the following fault conditions:

(1) FULL TAPE which indicates that the diameter of tape on the take-up reel has exceeded the specified limit. This condition may be determined by visually inspecting the tape take-up drawer of the substation causing the fault. Replacing the full reel with an empty one and properly threading the bottom drawer and reel should correct the fault condition.

(2) BUFFER FULL which indicates that an excessive amount of tape has accumulated

in the buffer storage box. This condition may be determined by visually inspecting the buffer storage box of the substation causing the fault. To correct the fault condition, set the HOLD ON/STANDBY switch to HOLD ON until all or most of the accumulated tape has been read out of storage. If the fault persists or a reader lockout occurs due to a "tight tape" condition, notify maintenance personnel immediately. (3) and (4) BROKEN TAPE which indicates that the tape has broken between either the tape supply drawer and punch or between the reader and tape take-up drawer. Visual examination of the substation will locate the break. Refer to the tape splicing procedure in paragraph 4.2.3 for the proper splicing technique.

LOW TAPE

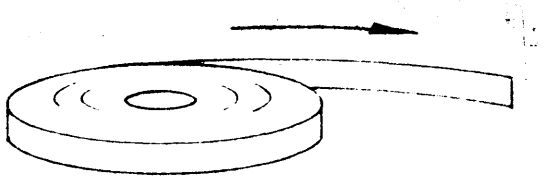
A low tape condition results when the amount of tape remaining on the supply reel reaches a predetermined diameter. To correct a low tape condition, replenish the tape supply. Refer to the tape loading procedure outlined in paragraph 4.2.

fault conditions warrant rethreading the punch and reader mechanisms and/or the top tape drawer sensing arms. Since it requires a complete threading (or re-threading) of the reader and punch assemblies as well as the tape supply and take-up reels, this procedure must be performed only by the chief operator or other qualified personnel. It is recommended that this procedure be used only for initial tape loading and that wherever possible, subsequent tape loading be done in accordance with the procedure given in paragraph 4.2.3.

Basically, this procedure consists of placing a full roll of tape on the supply reel, threading the tape in the reader and punch mechanisms, and securing the loose tape end to the take-up reel. The step-by-step procedure for performing these operations is given below, with illustrations included where necessary to supplement the text. The mechanical parts and assemblies involved in this procedure are shown in Figure 2-7.

Step 1 Release top tape drawer by turning the two drawer fasteners their extreme counterclockwise position. Pull drawer forward.

Step 2 Pick up a full roll of tape, holding the roll so that tape unwinds in a clockwise direction off the back of the roll. See illustration.



Operator Position

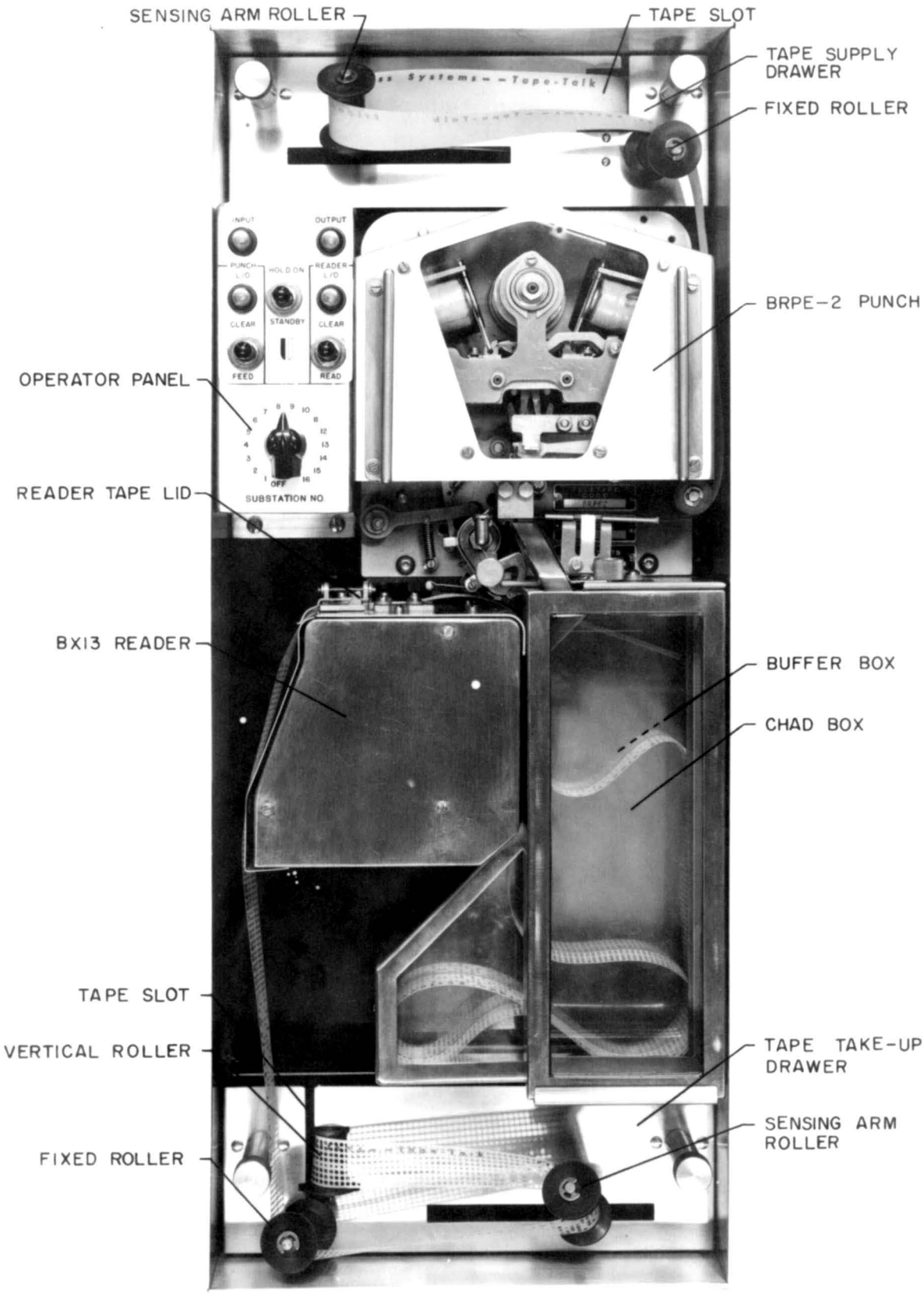


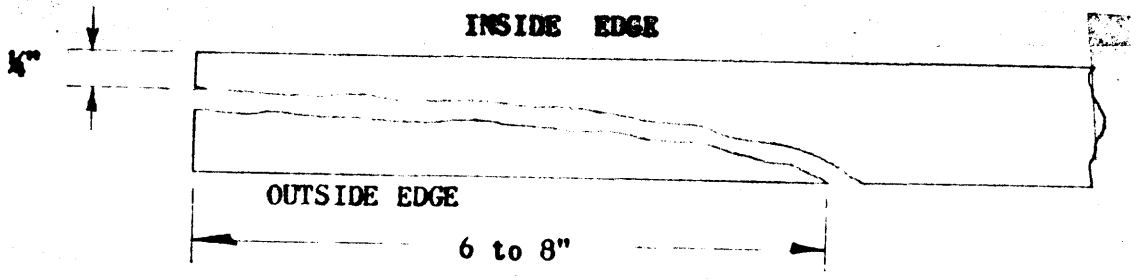
Figure 2-7. Substation Mechanical Assembly

Step 3 Place the tape roll on the turntable, making sure that the Low Tape Sensing Lever is being retracted as the roll is inserted.

Step 4 Thread the loose tape end through the tape slot and pull approximately 3 feet of tape through the slot. Close the drawer and lock in posiition by tightening the two drawer fasteners until finger tight.

Step 5 Without inversion, place the tape behind the Sencing Arm Roller. Thread the tape under the Sensing Arm Roller and then over the Fixed Roller on the right side of the drawer. Drop the loose end of tape between the chad box and tape guard on the right side of the substation assembly. Figure 2-7 illustrates the tape-threading technique.

Step 6 At this point determine the inside and outside edges of the tape. Holding the loose end of the tape approximately 1/4 inch from the inside edge, carefully tear a 6 to 8 inch strip, gradually tapering the tear toward the outside edge of the tape as shown in the illustration.



Step 7 Set the punch CLEAR/FEED switch to FEED and hold in that position while threading the punch guide bracket. To thread the punch guide bracket, push the tape through the bracket until it freely enters the punch. (Tape emerging from the punch will be in two strips due to the tearing action of the Feed Hole Punch). Then while depressing the outer tape guide to the left, pull the tape through the punch, allowing the Feed Hole Punch to space out the feed holes.

CAUTION

If the punch mechanism jams while threading the tape, turn off the punch and carefully remove tape from the punch dies and associated mechanism and attempt to re-thread the tape. If the second attempt results in a jammed punch mechanism, notify maintenance personnel immediately.

Step 8 Return the CLEAR/FEED switch to the normal position. Approximately 1 inch from the left of the sprocket wheel, carefully tear the tape and tuck the loose end between the sprocket wheel and outer tape guide. (These parts are identified on Figure 2-8). Release outer tape guide and do not re-open during the remaining portion of this procedure.

Step 9 Momentarily set the CLEAR/FEED switch to FEED and return to normal several times to punch feed holes in short bursts. Continue to do this until approximately 1 to 2 feet of tape are in the storage box. (It may be necessary to manually push the tape through the punch guide bracket until the sprocket wheel engages the tape and begins feeding automatically.)

Step 10 Release the reader tape lid, When released, the lid should swing up approximately 45 degrees, allowing ample space for threading the reader.

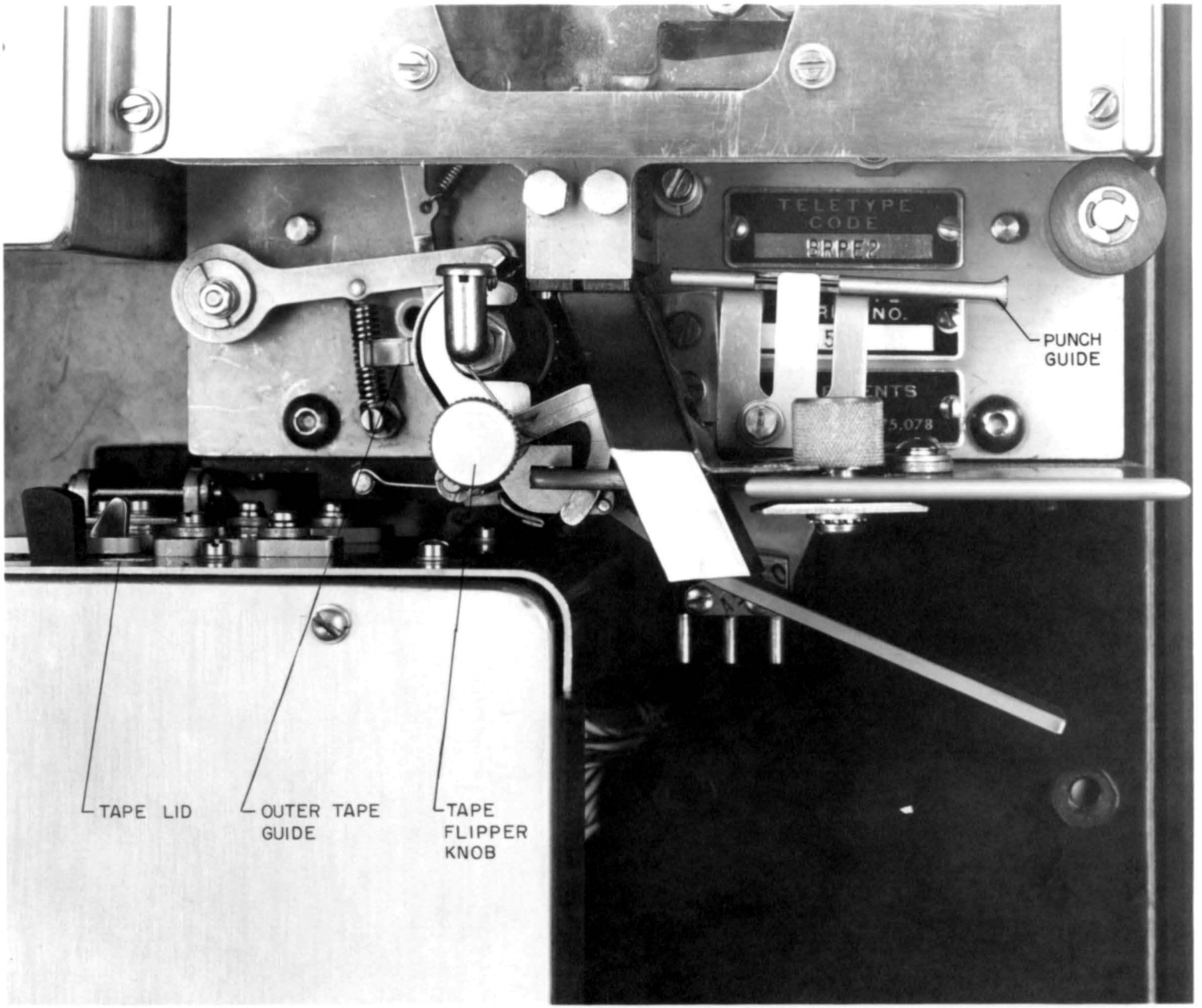


Figure 2-8. Parts Identification, Tape Transport

Step 11 Rotate the Tape Flipper Knob clockwise until it stops; a small tape loop should emerge from the storage box. Carefully pull the loop until all tape is removed from the storage box, and then thread the tape on the reader sprocket wheel. Close and secure the reader tape lid.

Step 12 Using the CLEAR/FEED switch, feed approximately 2 feet of tape into the storage box in short bursts, and then read it out by means of the CLEAR/READ switch.

Step 13 Release the bottom tape drawer by turning the two drawer fasteners to their extreme counterclockwise position, and pull out the drawer. Being careful to avoid twisting, tearing, or inverting the tape, thread the tape under the Fixed Roller, over the Movable Roller, and through the tape slot into the drawer as shown in Figure 2-8.

Step 14 Fold the tape over double approximately 1/4 inch from the end. Insert the folded portion in the tape slot provided in the turntable core. Manually rotate the turntable 5 or 6 turns to allow sufficient tape to accumulate on the take-up to prevent the tape from slipping.

Step 15 With the left hand, grasp the Sensing Arm Roller on the bottom drawer and pull to the left to cam power off the internal take-up reel. With power cammed off, close and secure the bottom drawer by tightening the two drawer fasteners finger tight.

Step 16 Holding the tape in proper position, carefully cam power on until tape is taunt. With the CLEAR/FEED and CLEAR/READ switches alternately punch and read tape in short bursts to ensure

correct tape threading and proper operation of the punch and render mechanisms. Complete the procedure by reading tape from the storage box until the reader stops automatically.

4.2.3 Substation Loading During Normal Operation

The following is a procedure recommended for tape loading during normal, or "on-line" operation. It requires a minimum amount of "down time" and may easily be performed by any qualified operator.

Basically, this procedure consists of replacing the tape supply reel and splicing the supply reel tape end and the tape strip remaining from the spent reel. The step-by-step procedure for performing these operations is given below, with illustrations included where necessary to supplement the text.

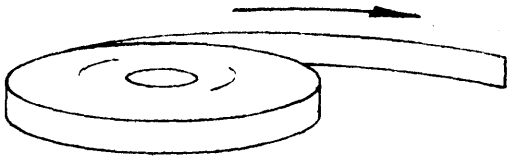
A scissors and a roll (or strip at least 1-1/2 inches long) of 3M Scotch brand colored cellophane tape (3/4") should be available before starting this procedure. If the substation is equipped with a tape splicing device a scissors will not be required and steps 7, 8, and 9 will not apply as such.

Step 1 Set HOLD ON/STANDBY switch to STANDBY. Remove chad box, empty completely, and replace in the substation assembly.

Step 2 Pull approximately 2 feet of tape through the slot in the top drawer and tear off the tape.

Step 3 Release the top drawer by loosening the two drawer fasteners and pull drawer forward. Remove spent tape roll and discard remaining tape.

Step 4 Place a full roll of tape on the turntable, making sure that the Low Tape Sensing Lever is being retracted as the tape is inserted. The roll should be positioned so that tape unwinds in a clockwise direction off the back of the roll as shown in the illustration.



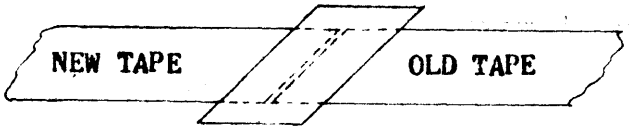
Operator Position

Step 5 Pull approximately 2 feet of tape through the tape slot and close the drawer. Lock in position by tightening the two drawer fasteners finger tight.

Step 6 Place the tape strip from the drawer behind the Sensing Arm Roller, and the tape strip from the punch over the Fixed Roller. Refer to Figure 2-7.

Step 7 Determine the inside and outside edges of both tapes. Without inverting or twisting either tape, place one tape directly on top of the other, making sure that the inside and outside edges are aligned exactly. Cut both tapes simultaneously at a 45 degree angle and discard loose ends.

Step 8 Cut a 1-1/2 inch strip of splicing tape and attach it to the right forefinger lightly. Butt the two cut portions of paper tape together and WITHOUT OVERLAPPING, splice as shown in the illustration.



SPLICING TAPE

Step 9 Trim both edges of the tape and then burnish the splice to assure good adhesion of the splicing tape to the paper tape.

Step 10 Thread the tape on the top tape drawer rollers according to instructions given in Step 6.

Step 11 Using the CLEAR/FEED switch, punch tape in bursts until the spliced portion of the tape clears the punch and enters the storage box by several feet. To prevent the loss of information through a splicing failure, the splice MUST clear the punch before resuming normal operation. If the splice should fail prior to clearing the punch, it is possible that all information stored in the punched portion of the tape would be lost.

Step 12 Provided no messages are stored in the tape storage box, read the accumulated tape out of the storage box, using the READ position of the CLEAR/READ switch. Make certain the spliced portion of tape clears the reader.

CAUTION

In no case should the spliced portion of tape be left in the storage box longer than 1/2 hour. The desirability of clearing the storage box of the spliced portion of tape is to prevent plasticizing of the splicing tape by oils impregnated in the paper tape.

Step 13 After the splice has cleared the reader, tear the tape at the splice, and carefully feed the old tape end into the bottom drawer.

Step 14 Release the bottom drawer by turning the two drawer fasteners to their extreme counterclockwise position, and pull out the drawer. Remove the tape roll and dispose of it as directed by the chief operator.

Step 15 Using the CLEAR/FEED and CLEAR/READ switches, alternately punch and read tape until approximately 3 feet of punched

tape is available. Fold the tape over double approximately 1/4" from the end and insert the folded portion in the slot provided in the turntable core. Manually rotate the turntable 3 or 4 turns to allow sufficient tape to accumulate on the take-up reel to prevent slipping.

Step 16 With the left hand, grasp the Sensing Arm Roller on the bottom drawer and pull to the left to cam power off the internal take-up reel. With power cammed off, close and secure the bottom drawer by tightening the two drawer fasteners finger tight.

Step 17 Holding the tape in proper position, carefully cam power on until tape is taunt. With the CLEAR/FEED and CLEAR/READ switches, alternately punch and read tape in short bursts to assure correct tape threading and proper operation of the punch and reader mechanisms.

Step 18 Return the HOLD ON/STANDBY switch to the normal position.