

SWITCHING SYSTEMS MANAGEMENT
NO. 2 ELECTRONIC SWITCHING SYSTEM
TAPE OPERATED MEMORY UPDATE SYSTEM (TOMUS)
SYSTEM DESCRIPTION

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Figures		1.01 The purpose of this section is to provide the network administrator a general description of the Tape Operated Memory Update System (TOMUS). It is important for the network administrator to know the functions and capabilities of the TOMUS equipment because of its utilization as a local method of updating the permanent magnet twistor (PMT) memory cards on a module basis. (The TOMUS is capable of providing memory updates for several No. 2 ESS offices.) Additional information on memory updates using TOMUS is	
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NOTICE

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provided in Division H, Section 10d(5), Memory Updates. The TOMUS memory update process is not applicable for No. 2 ESS semiconductor memory systems such as the No. 2B ESS.

1.02 Whenever this section is reissued, the reason will be listed in this paragraph.

1.03 TOMUS is a computer controlled, stand-alone (not an integral part of a No. 2 ESS machine), high capacity facility for writing and verifying data on PMT memory cards (program and translation data storage medium of the No. 2 ESS). TOMUS operates from card-imaged, module-defined data stored on 9-track, 800 bits per inch magnetic tape. The facility is capable of data communication over a dial-up, voice grade telephone line, in a mode compatible with the No. 2 ESS Administrative Data Link. Using this feature, TOMUS can receive information via data link, and store the information on magnetic tape for use in subsequent card writing and verifying operations.

1.04 TOMUS was developed because of the need for a high capacity magnetizing device in the larger No. 2 ESS offices and some smaller No. 2 ESS offices for performing the following functions:

- Recent change (RC) update
- Office data assembler (ODA) run
- Generic program changes.

1.05 Since the TOMUS is not an integral part of a No. 2 ESS machine, it may be located in a No. 2 ESS office or in a central location such as a technical assistance center (TAC). A TAC location enables the TOMUS to service a group of nearby No. 2 ESS offices.

TOMUS FEATURE SUMMARY

1.06 The following is a list of the features provided by TOMUS:

- Can be added when and where needed.
- Can be centrally located and shared by a number of offices.
- Can write and verify memory cards independently of the No. 2 ESS.

- Can minimize ESS real time and responsibility for memory updating.

2. APPLICATIONS

2.01 The TOMUS features allow prompt local memory updates that can be monitored easily by a network administrator. TOMUS has the following applications for the No. 2 ESS:

- Recent change (RC) update
- Change in program store (CHIPS)

TOMUS may be used for these applications when the changes are considered too large for the No. 2 ESS single card writer (SCW). TOMUS is utilized most efficiently whenever more than 14 memory cards require changes. The improved memory update process offered by the TOMUS facility can aid in the administration of No. 2 ESS memory updates.

2.02 RC Update: During this procedure, the revised contents of the translation memory, (including RC) are data linked to the TOMUS facility. The translation data are recorded on magnetic tape for the subsequent card writing and verification. After the required card writing and verification are performed, the updated cards are delivered to the affected office. (Additional information is available in the Bell System Practices listed in Part 5.)

2.03 Change in Program Store: Generic corrections can be made by using the No. 2 ESS CHIPS procedure and the TOMUS in the single card writing mode. (Additional information is available in the Bell System Practices listed in Part 5.)

3. EQUIPMENT DESCRIPTION

3.01 The following paragraphs provide the network administrator a general description of the TOMUS facility. The fully equipped TOMUS (Fig. 1) consists of three frames:

- Controller frame
- Memory card writer frame
- Verifier frame.

The verifier frame is optional because an update verification can be performed by program store verification exercises at the No. 2 ESS office being updated.

3.02 The TOMUS equipment includes the following:

- Digital Equipment Corporation (DEC) Programmed Data Processor PDP-8/M-DC with teletypewriter
- Ampex TMX-1 tape transport
- Memory card writer frame (modified)
- No. 2 ESS 2B permanent magnet twistor memory module
- Bell System 201A3 (or list coded equivalent—201A-L1A/2A/3/6A/7A) data set and 804A7 data auxiliary set (supplied by the telephone company).
- Control interface (three printed circuit board assemblies housed inside PDP-8/M-DC)
- Three regulated dc power supplies.

3.03 A block diagram of TOMUS is illustrated by Fig. 2. The unit can be broken down into four functional subsystems which are controlled by the PDP-8/M-DC and the control interface. The functional subsystems are as follows:

- Tape unit subsystem
- Data link subsystem
- Card writer subsystem
- Verifier subsystem.

Although the PDP-8/M-DC is common to all subsystems, it warrants individual definition and will be treated separately, as well as referenced in subsystem discussions.

A. Programmed Data Processor PDP-8/M-DC

3.04 The heart of the TOMUS is the PDP-8/M-DC (referred to simply as the PDP-8/M for the remainder of this section) manufactured by the Digital Equipment Corporation. The PDP-8/M is a general purpose minicomputer designed with flexible,

high capacity input/output capabilities to allow it to control a large variety of peripheral equipment. Twelve-bit data words on 1.2/1.4 microsecond cycle time are provided by the PDP-8/M which has a capacity of 4096 words of read/write memory.

3.05 Five 12-bit registers are provided to control PDP-8/M operations, to read memory, to manipulate data, and to store data. The PDP-8/M has one programmable hardware register, the accumulator (AC).

3.06 The controls and indicator lamps on the PDP-8/M control panel (Fig. 3) provide manual control of the system and indicate the program conditions. The controls provide the user with the hardware to start, stop, examine, or continue a program.

3.07 The teletypewriter (TTY) used to communicate with the PDP-8/M is an automatic send-receive (ASR-33) type with a paper-tape reader/punch facility attached (Fig. 4). The paper-tape reader is used to input memory data punched on 8-channel perforated paper tape at a maximum rate of ten characters per second. The TOMUS MAG TAPE LOADER program is loaded by the paper-tape reader into the PDP-8/M memory core as part of the initialization procedure. The paper-tape punch is used to perforate 8-channel paper tape at a maximum rate of ten characters per second.

B. Control Interface

3.08 The TOMUS control interface circuit packs contain the registers, gating, and control logic necessary to enable the PDP-8/M to operate the hardware complement. The interface packs, manufactured by the Digital Equipment Corporation, are housed inside the PDP-8/M. Each interface section performs one or more of the following functions:

- Decoding (function selection)
- Data registration and gating
- Status gating
- Cable driving and terminating
- Control functions (clocking, timing, flagging, etc).

C. Tape Unit Subsystem

3.09 The tape unit subsystem consists of the following:

- Ampex TMX-1, 9-track magnetic tape transport
- Controller circuit pack which plugs into the PDP-8/M
- Software control package which handles transport control and data transfer functions.

3.10 The TMX-1 (Fig. 5), the heart of the tape unit subsystem, is a 9-track machine operating at 800 bits per inch to produce IBM-compatible tapes. The TMX-1 includes the following:

- Tape transport
- Basic transport control circuits
- Basic read-write data circuits
- Read-after-write, recording head
- Control panel.

D. Data Link Subsystem

3.11 The data link subsystem is made up of a Bell System 201A3 data set (Fig. 6), a Bell System 804A data auxiliary set (Fig. 7), and a data link controller (part of the MCW/data set interface circuit pack). The 201A3 data set is a binary serial transceiver operating at 2000 bits per second over a dial-up voice grade telephone line. Data will be transmitted using the American Standard Code of Information Interchange (ASCII) as described for the No. 2 ESS Administrative Data Link. Since this is an 8-bit code, the data link interface contains an 8-bit shift register and associated circuitry for the serial to parallel and parallel to serial conversion. All data transmission control, coding, and error checking is software controlled. The 804A data auxiliary set provides a telephone with provision for automatic answering. The automatic answering feature is activated by depressing the AUTO key on the set and typing in the required input message on the TTY. This feature allows data linking to the TOMUS facility once when unattended. The data link controller contains a decoder to generate control signals, a clocking arrangement, an 8-bit

shift register, and the controller data set signal level converters.

E. Memory Card Writer Subsystem

3.12 TOMUS utilizes the No. 1 ESS Memory Card Writer (MCW) as a card writing mechanism, with only minor modification to allow for differences in the No. 2 ESS memory arrangement.

3.13 The MCW is located in a single bay frame 7 feet high and 26 inches wide (Fig. 8). The components of the MCW include the following:

- 1A card writing unit
- Logic unit
- Control panel
- Power supplies and power control.

1A Card Writing Unit

3.14 The 1A card writing unit is the electromechanical equipment that automatically handles the memory cards during the writing process.

3.15 The card writing mechanism includes the following:

(a) **Loader Mounting:** The vertically moving loader mounting raises the card loader so that the appropriate memory card is level with the writing deck of the card writing mechanism (Figures 9 and 10).

(b) **Card Moving Fingers:** The fingers slide the memory card out of the card loader onto the writer deck and back into the card loader.

(c) **1B Card Writing Head:** The 1B card writing head (Fig. 11) is composed of 45-bit writing heads (00 to 44), 2 initialization writing heads (00 to 44), 2 initialization electromagnets (0 and 1), and 2 position sensing heads (0 and 1). The initialization electromagnets are mounted directly in front of the position sensing heads and are in line over the memory cards initialization magnet rows 0 and 1, respectively. The 00 to 44 bit writing heads track over the 45-bit magnets in each word row on the memory card. As the writing head travels from left to right (as viewed

from the front of the MCW), it magnetizes the memory card's initialization magnets. The writing head then generates signals in the position sensing heads which are used to sense the moment when the head is properly positioned to write each word.

- (d) **Mechanical Sequence Control Unit:**
The mechanical sequence control unit, consisting of a group of relays, controls the mechanical functions of the 1A card writing unit, polarity of writing, and the inhibit and enable signals for the logic sequence control.

Logic Unit

3.16 The logic unit receives the writing information from the central processor via the peripheral unit address bus. The logic unit is made up of several circuit packs which process the writing information as follows:

- (a) Register circuit packs temporarily store the words to be written.
- (b) Write control circuit packs provide writing currents to the 1B writing head.
- (c) Logic sequence control circuit packs generate the write gate, count, word request, word delivery checks, register reset, etc. The register and write control circuit packs are under the control of the logic sequence control circuit packs.

Control Panel

3.17 The control panel (Fig. 12) contains pushbutton keys, lamps, and some miscellaneous circuit apparatus. The pushbutton keys provide control for the mechanical operation of the 1A card writing unit, as well as control of power and alarm tests. The lamps are used to indicate power status, trouble conditions, and various operating conditions of the MCW.

Power Supplies and Power Control

3.18 The Lambda Model LME24 and Model LWEE48 power supplies or the system central office batteries supply +24 volts and -48 volts to the MCW circuit, +24 volt filter and -48 volt filter. These filters keep bus current changes to less than 0.1 amp per microsecond during changing load conditions. The power control circuits

provide power switching, fusing, monitoring, and alarm functions of the MCW. The regulated power supply circuit packs are mounted on the frame with the logic unit circuit packs.

1A Card Loader

3.19 The 1A card loader is used at the program store, the spare card storage units, and the TOMUS verifier module to remove or insert a whole module of 128 memory cards. It is used at the MCW to hold the module of memory cards being updated. The spare card storage units may be located either on a rack or in a portable cart. All 128 memory cards are simultaneously inserted or drawn from a program store module or spare card storage unit by a motor driven arrangement in the card loader. The card loader has a variable indicator that can be set to identify the particular program store module with which the 128 memory cards are associated. The card loader weighs about 40 pounds when full and about 22-1/2 pounds when empty. The card loader can be moved from one location to another, using the cart containing the spare card storage unit.

Note: The 1A card loader is not a part of the TOMUS; however, it is described here since it is used in conjunction with TOMUS operation.

Single Card-Writing Feature

3.20 Although TOMUS is designed for writing memory cards on a module basis, a single card-writing feature is provided for correcting possible magnetizing errors and performing single card updates. The 4A card-writing unit (overwrite tray) must be attached to the MCW (Fig. 13) to write a single card.

F. Verifier Subsystem

3.21 TOMUS utilizes a 2B permanent magnet twistor memory module as a verification device. The module is identical to the one used in the No. 2 ESS program and translation store, and it utilizes the memory control circuitry of the No. 2 ESS program store. The verification is similar to the program store margin tests performed by the No. 2 ESS during periodic control unit exercises. After the memory cards are updated by the MCW, the cards are loaded into the 2B memory module. The verifier compares the data

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written on the memory cards with the data recorded on the magnetic tape.

3.22 The verifier margin control panel (Fig. 14) provides seven margin settings:

- AUTO—for automatically extended margins under program control
- MAN—for manual margins
- OH—outer high
- IH—inner high
- NOM—nominal
- IL—inner low
- OL—outer low.

A MANUAL MARGIN ADJUST potentiometer is provided for adjusting the margin voltage when the MARGIN SELECT switch is set to MAN. Since the data comparison can be performed under voltage margin extremes, the verification not only certifies that the information is correctly located on the card, but it also gives an indication of the quality of magnetization of the magnets.

4. MODES OF OPERATION

4.01 TOMUS has three basic modes of operation:

- Data linking
- Card writing
- Verifying.

4.02 Data Linking: In the data linking mode TOMUS acts as a slave station and receives information from a data source (ie, a No. 2 ESS office) over a voice-grade, dial-up telephone line. The information is stored on 9-track magnetic tape for later use in card magnetizing and verifying.

4.03 Card Writing: In the card-writing mode, TOMUS magnetizes cards using a modified No. 1 ESS MCW. TOMUS is designed for magnetizing cards on a module basis; however, a

single card-writing feature is provided for correcting possible magnetizing errors and performing single-card updates (see 3.25). Information to be written on the cards is read from the magnetic tape, buffered, formatted, and presented to the MCW. Tape files may be generated by TOMUS in a previous data-link operation, or generated at a separate computation facility and transported to the TOMUS facility.

4.04 Verifying Mode: In the verifying mode, TOMUS compares the data written on the cards with the information stored on the magnetic tape. The verification is performed under program store margins and certifies that the information is correctly located on the cards and gives an indication of the quality of the magnets. If mismatches do occur, the card in question can be conveniently rewritten using the previously mentioned single card-writing feature.

5. REFERENCES

Bell System Practices

SECTION	TITLE
232-004-302	Updating Program Store Translation Information Procedures Using TOMUS
232-004-304	Change in Program Store Word Procedures Using TOMUS
232-007-301	TOMUS Operating Procedures
232-007-302	TOMUS General Maintenance and Trouble Shooting Procedures
232-124-302	Office Update Procedures Using TOMUS
231-004-101	Memory Card Writer Description
231-004-501	Memory Card Writer Tests
231-004-701	1A Card Writing Unit-Requirements and Adjusting Procedures
231-004-801	1A Card Writing Unit—Piece-Part Data and Replacement Procedures

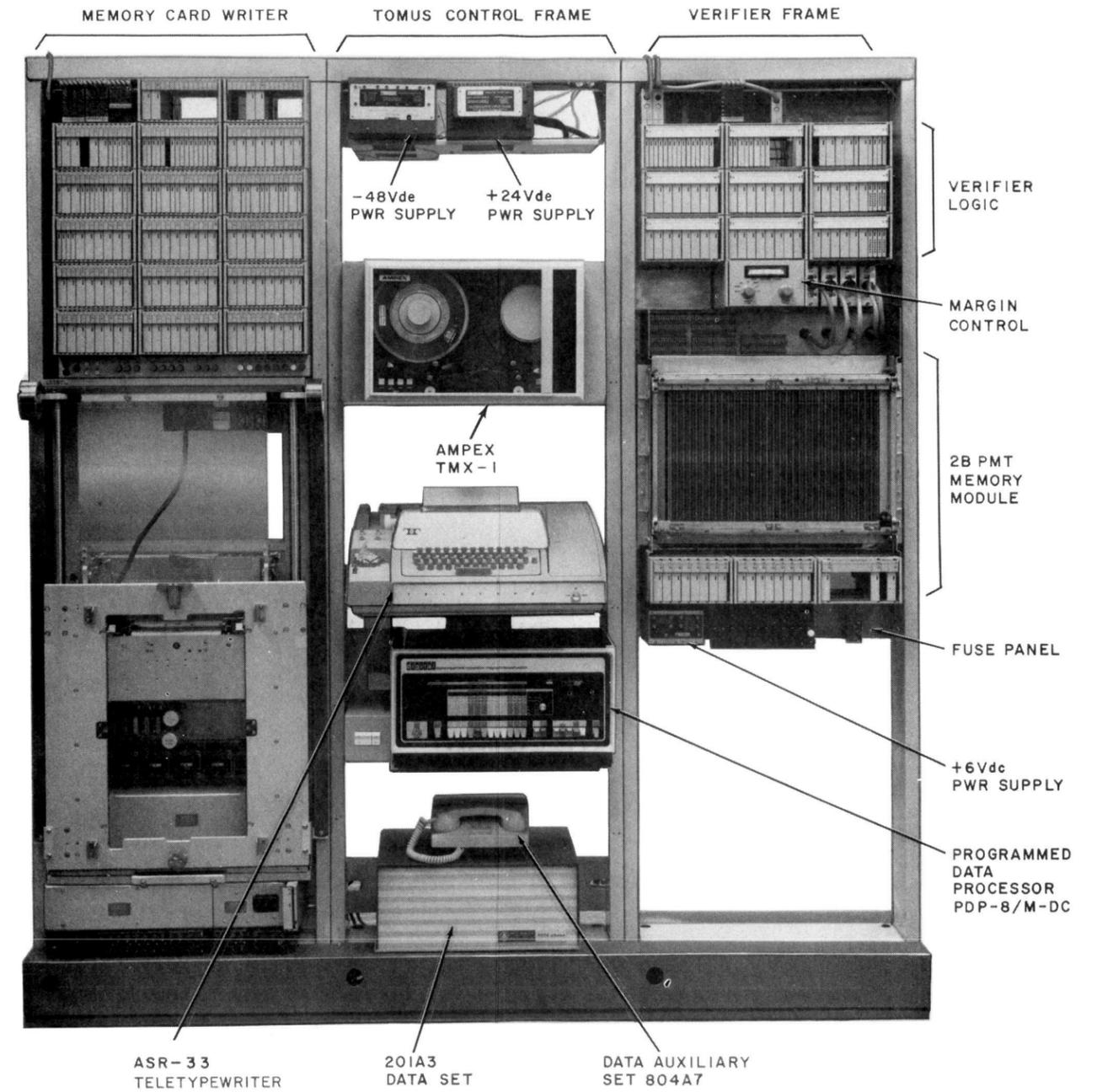


Fig. 1—Fully Equipped TOMUS

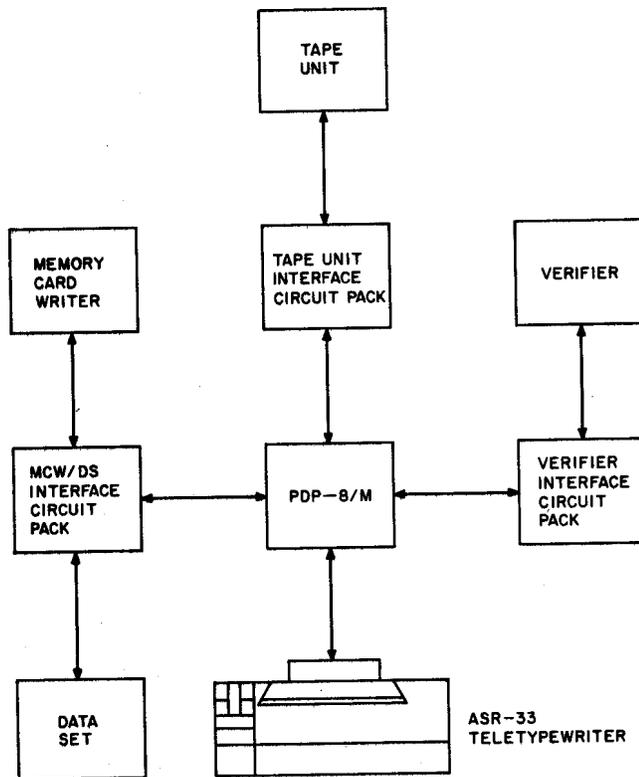


Fig. 2—Block Diagram Of Tape Operated Memory Update System

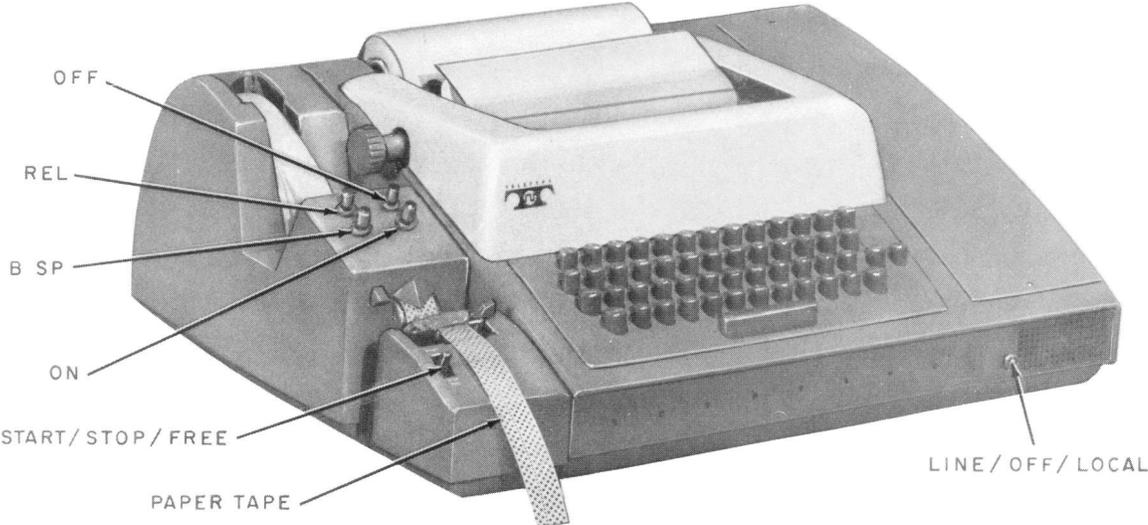


Fig. 4—ASR-33 Teletype Console

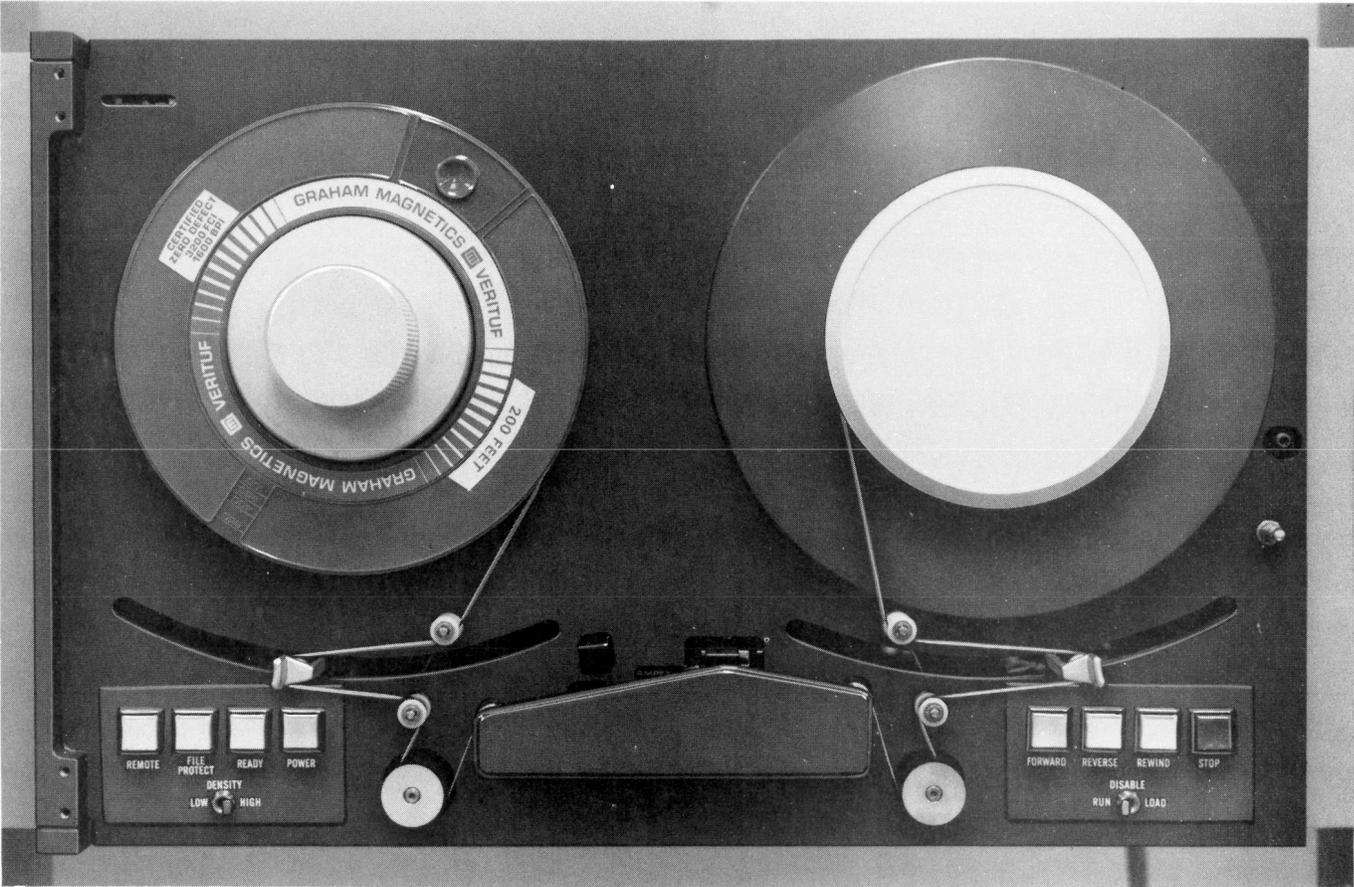


Fig. 5—Ampex TMX-1 Tape Transport



Fig. 6—201 A3 Data Set



Fig. 7—804A7 Data Auxiliary Set

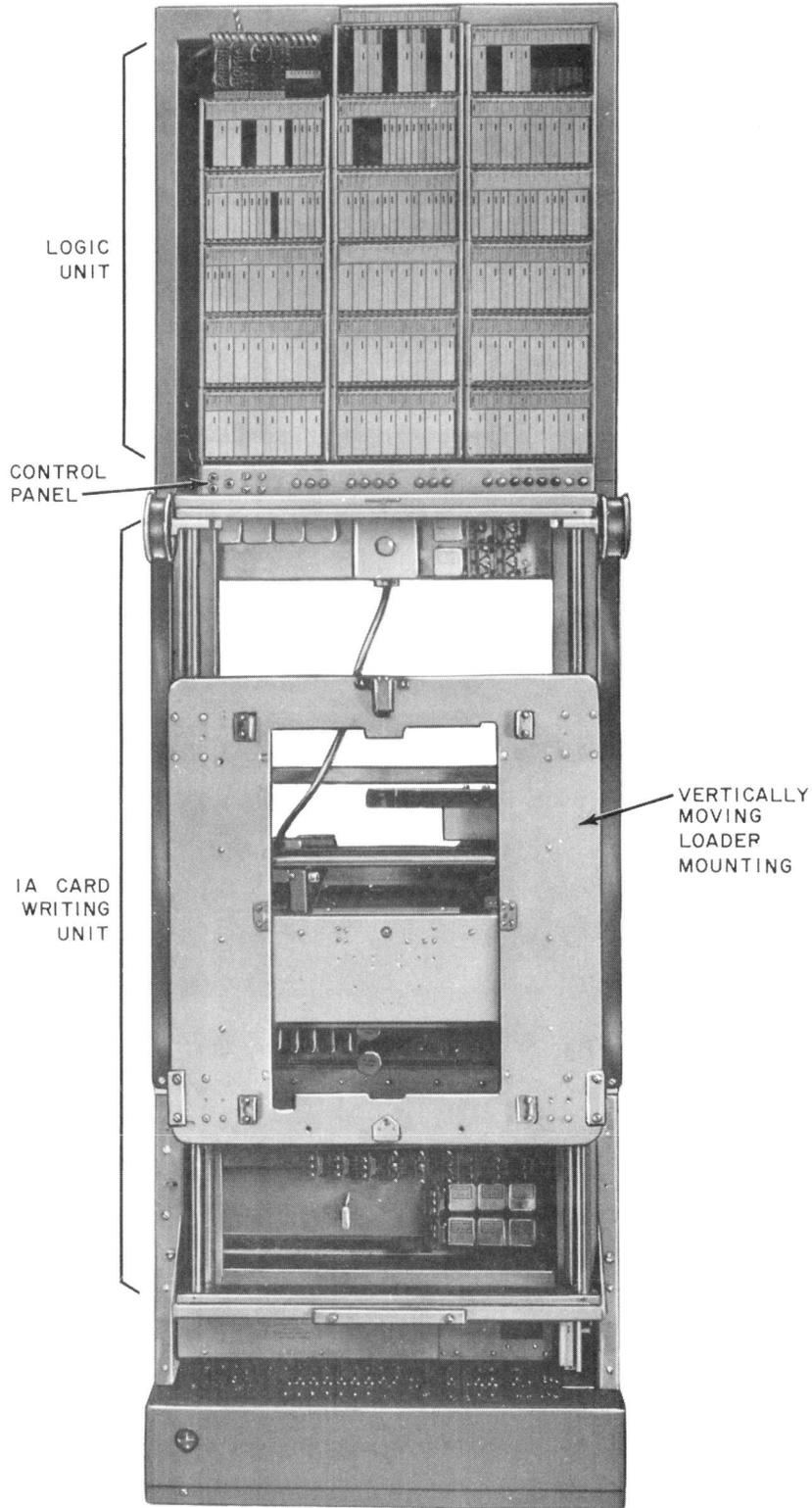


Fig. 8—Memory Card Writer Frame

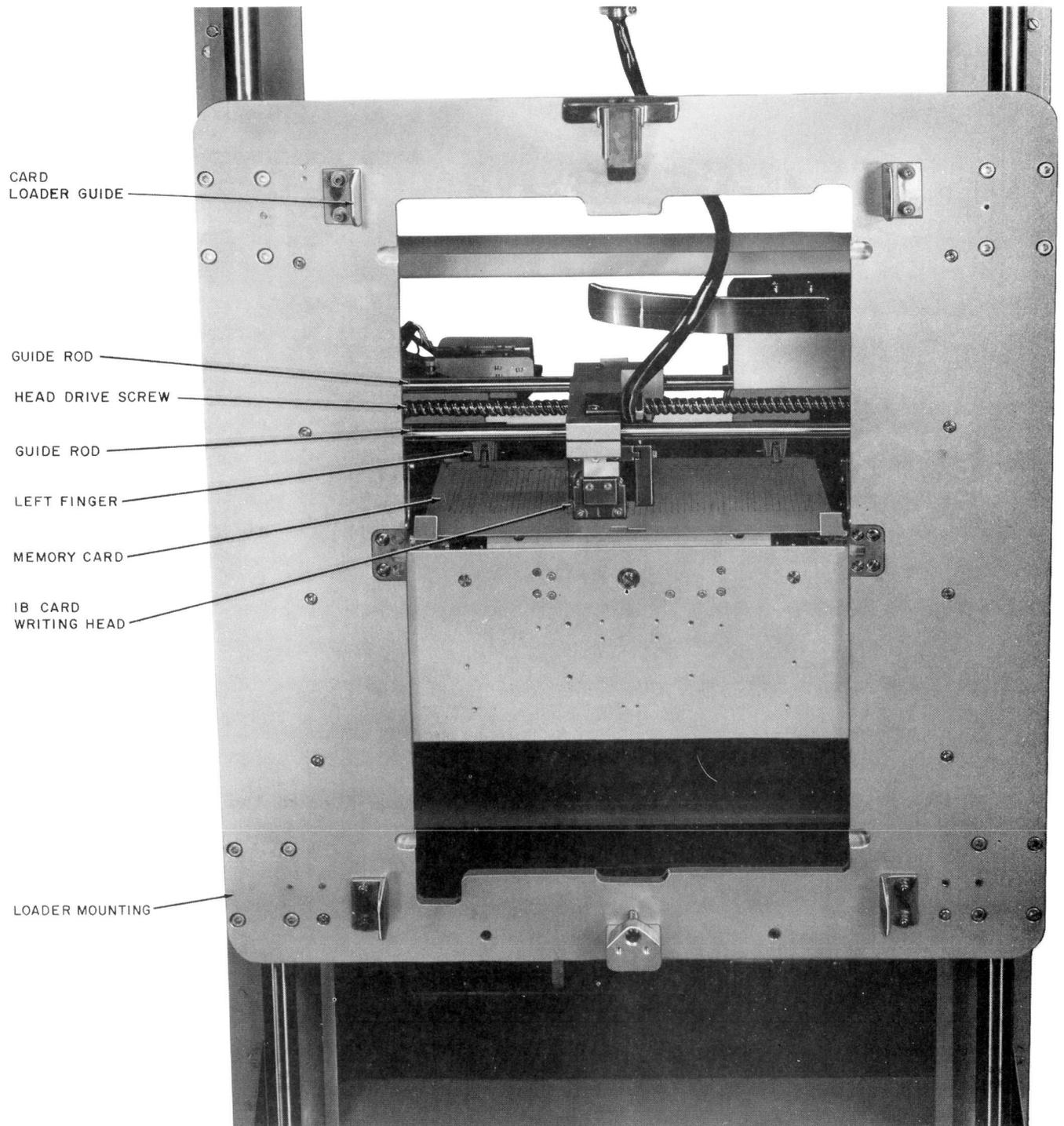


Fig. 9—1A Card Writing Unit—Partial Front View

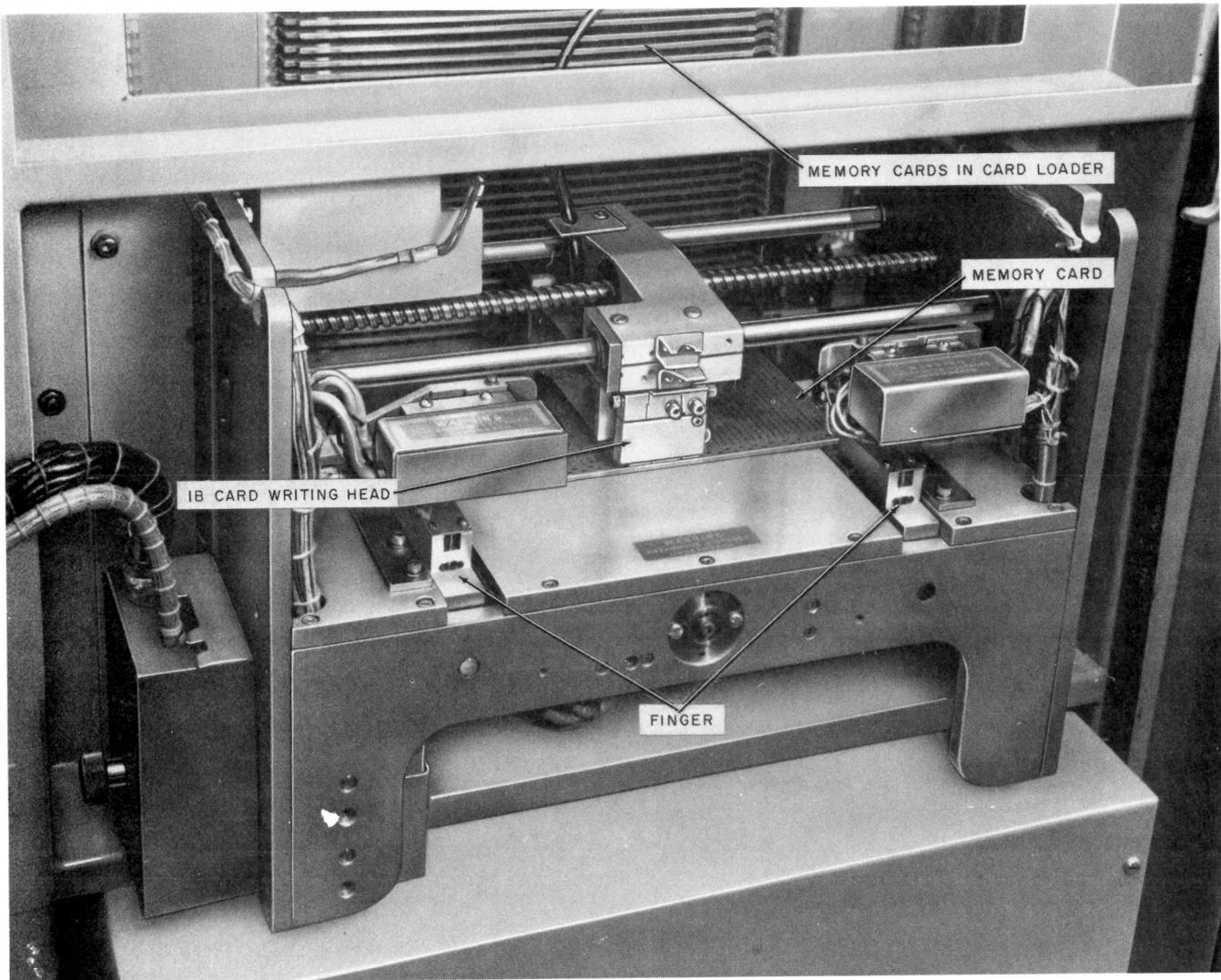


Fig. 10—1A Card Writing Unit—Partial Rear View With Loader Attached And Bar Removed

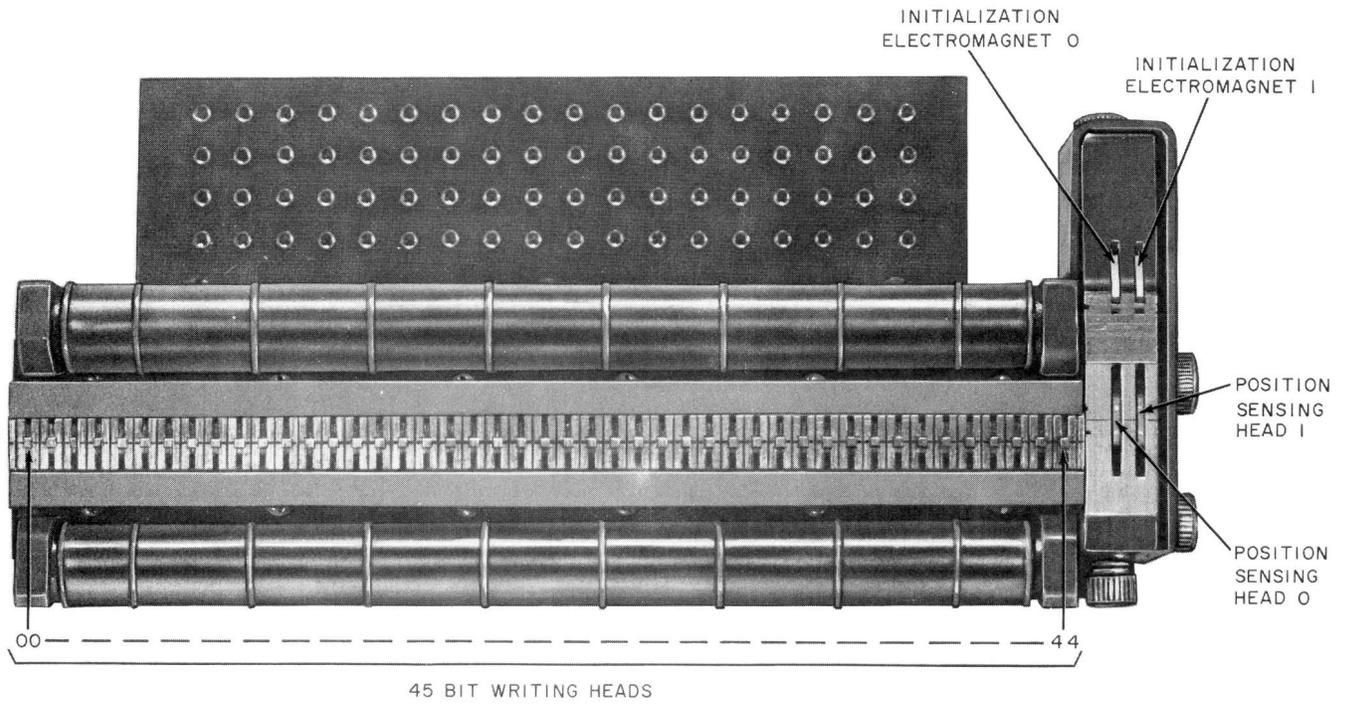


Fig. 11—1B Card Writing Head—Bottom View

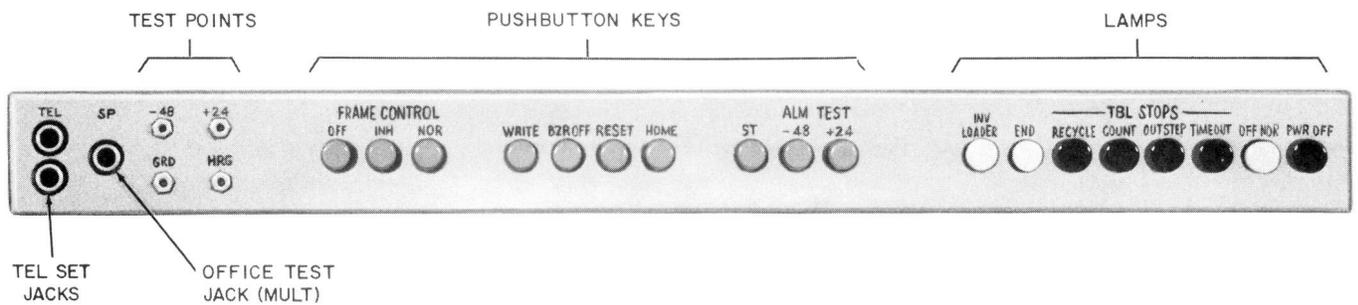


Fig. 12—MCW Control Panel

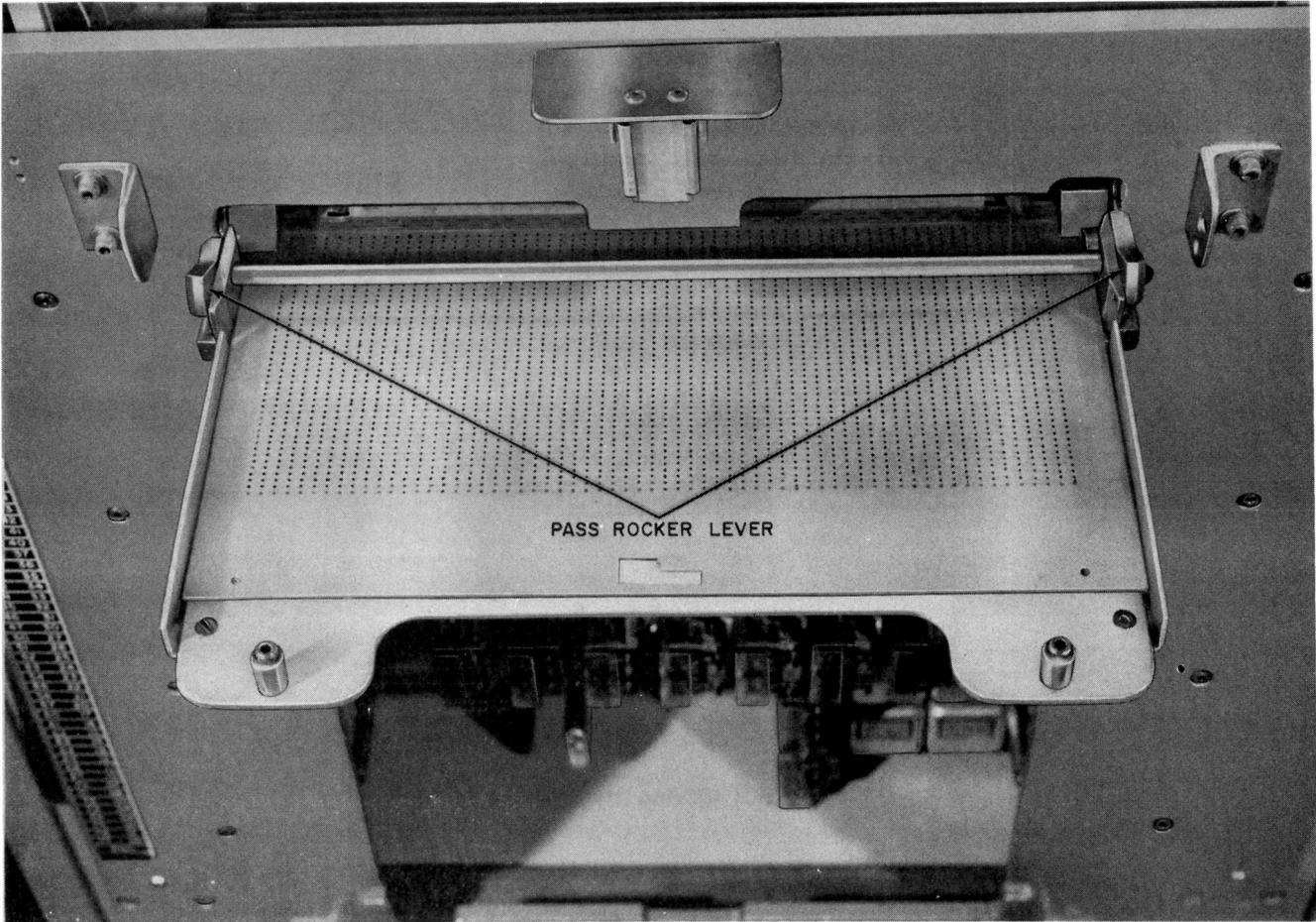


Fig. 13—Overwrite Tray In Position

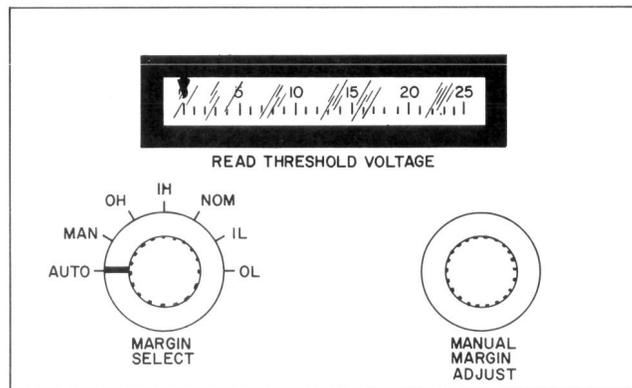


Fig. 14—Verifier Margin Control Panel