CHAPTER 10

INTRODUCTION TO DIGITAL COMPUTERS

The Navy's reliance on computer technology has greatly increased in recent years because of the ability of computing systems to provide fast and accurate analysis of logistical and tactical operations. Computing systems are highly reliable and can perform several operations simultaneously.

Computers are divided into two general types, analog computers and digital computers. The analog computer is one which solves problems by translating physical conditions; such as flow, temperature, pressure, angular position, and size of displacement into equivalent electrical quantities. These electrical measurements are continually being updated as the physical values change.

The gasoline gage on an automobile is one type of analog computer. The liquid in the gasoline tank operates a float which, in turn, physically controls the amount of battery current flowing through a rheostat mounted at the tank. The amount of current is proportional to the amount of gasoline in the tank and positions your gasoline gage to a position on the scale indicator which indicates the approximate amout of gasoline in the tank. Thus an analog computer gives an approximate solution in a continuous form, whereas a digital computer gives exact data solutions of discrete values.

The digital computer is one which solves problems by repeated high speed use of the fundamental arithmetic process of addition, subtaction, multiplication, or division in binary, decimal or any pre-determined notation. The digital computer uses increments (digits) to express distinct quantities.

An example of a digital computer is a cash register. Certain specific digits are entered at the console and stored, and upon request, a digital output representing the sum (or difference) is printed out. Other digital computers include the abacus, desk calculator, punchcard machine, and the modern electronic computer. The coverage in this text will be devoted to the digital computer.

Digital electronic computers are classified as special-purpose or general-purpose computers. The special-purpose computer is designed to handle a specific type of data processing task as exacting and as efficiently as possible. A general-purpose computer is designed to handle a variety of data processing tasks in which its adaptability, storage capacity and speed are adequate.

Some of the more common places where computers are used (mostly ashore but some afloat) are in command activities, operation centers, communications, finance, medical, weather, supply, maintenance, oceanography, weapon systems, and Naval Tactical Data Systems.

BASIC COMPUTER

The oldest and still most common data processor is man. In fact, man is still the most efficient data processor if size, mass, and power consumption are used as the criteria. The input to the human data processor is mostly through the eyes and ears. His memory (brain) stores data to be processed and the instructions for processing the data. His brain also functions as the arithmetic and logic element and as the control element. The output can be verbal, written, a physical action or a decision not to act.

Taken in perspective, the human being is the most versatile data processor. He has the ability to interpret his instructions in such a way that they will cover situations that were not explicit in the original form of the instructions. This, by the way, is not an ability inherent in the electronic data processor.

Although man is a versatile data processor, he has some rather serious shortcomings.

His memory capacity is rather limited (on a given subject). He is also unreliable. When called upon to remember large quantities of data, he has an annoying tendency to forget details. His calculating ability is quite limited. The average person, using only his mind, is unable to perform a series of simple calculations. Unaided, man is rather slow in performing the simplest data processing operation.

In addition, man is unreliable when performing repetitious operations. Most data processing operations are repetitious, i.e., the same basic operation is performed many times using different pieces of data. Man's ability to think tends to interfere with his performance of these boring operations. Thus, although man is a remarkable data processor, he needs some auxiliary equipment if he is to be part of an efficient data processing system.

The basic computer (fig. 10-1) is made up of a central processing unit and the input/output devices. Data processing equipments have five functions associated with them: input, storage, control, arithmetic, and output. The computer's input section introduces data into the system. Once interpreted, the information is sent to a control section where it is further directed according to programmed instructions. As specified, the data is sent to storage or memory, a high-speed device able to read in and read out data in a few millionths of a second. Data in storage can be used over and over, or can be used only once and replaced. If the computer is so instructed, the data can be directed to the processor or arithmetic section. It is here that the computer really computes; adding, subtracting, and comparing numbers. The organized results are transferable to an output section for the creation of records and reports, or to produce new media for further processing needs.

CENTRAL PROCESSING UNIT

The basic sections of a digital computer are shown in figure 10-1. The three center blocks (arithmetic logic, memory, and control units) comprise what is generally referred to as the Central Processing Unit or central data processor.

Control Unit

The control section is comparable to a telephone exchange. It directs the operations of the computer under the direct influence of a sequence of instructions called the "program". The instructions are comparable to the phone numbers dialed into a telephone exchange and cause certain switches and control lines to be energized.

The program may be stored in the internal circuits of the computer or it may be read instruction-by-instruction from external media. The internally stored program type of computer, generally referred to only as a "stored program" computer, is the most practical type to use when speed and fully automatic operation are desired.

In addition to the command which tells the computer what to do, the control unit also dictates how and when each specific operation is to be performed. It is also active in initiating circuits which locate any information stored in the computer and in moving this information to the point where the actual manipulation or modification is to be accomplished.

In the stored program computer, the control unit reads an instruction from the memory section (as instructed by the program). The information read into the control unit from memory is in the form of voltage levels that make up a "binary word," and represents a specific operation that is to be performed. The location of the data to be operated on is generally a part of the instruction, and energizes circuitry which causes the specified operation (add, subtract, compare, etc.) to be executed. Subsequently, the control unit reads the next instruction or jumps as directed, (explained later) to find the next instruction to execute.

The four major types of instructions are: (1) transfer; (2) arithmetic; (3) logic; (4) control. Transfer commands are those whose basic function is to transfer data from one location to another. One of the locations is an address in memory and the other is either a register or an input/output device. Arithmetic instructions are those which combine two pieces of data to form a single piece of data using one of the arithmetic operations. In some types of computers, one of the pieces of data is in a location specified by the address contained in an instruction, and the other is already in a register (usually the accumulator). The results are usually left in the accumulator.

Logic instructions make the digital computer into a system which is more than a high speed

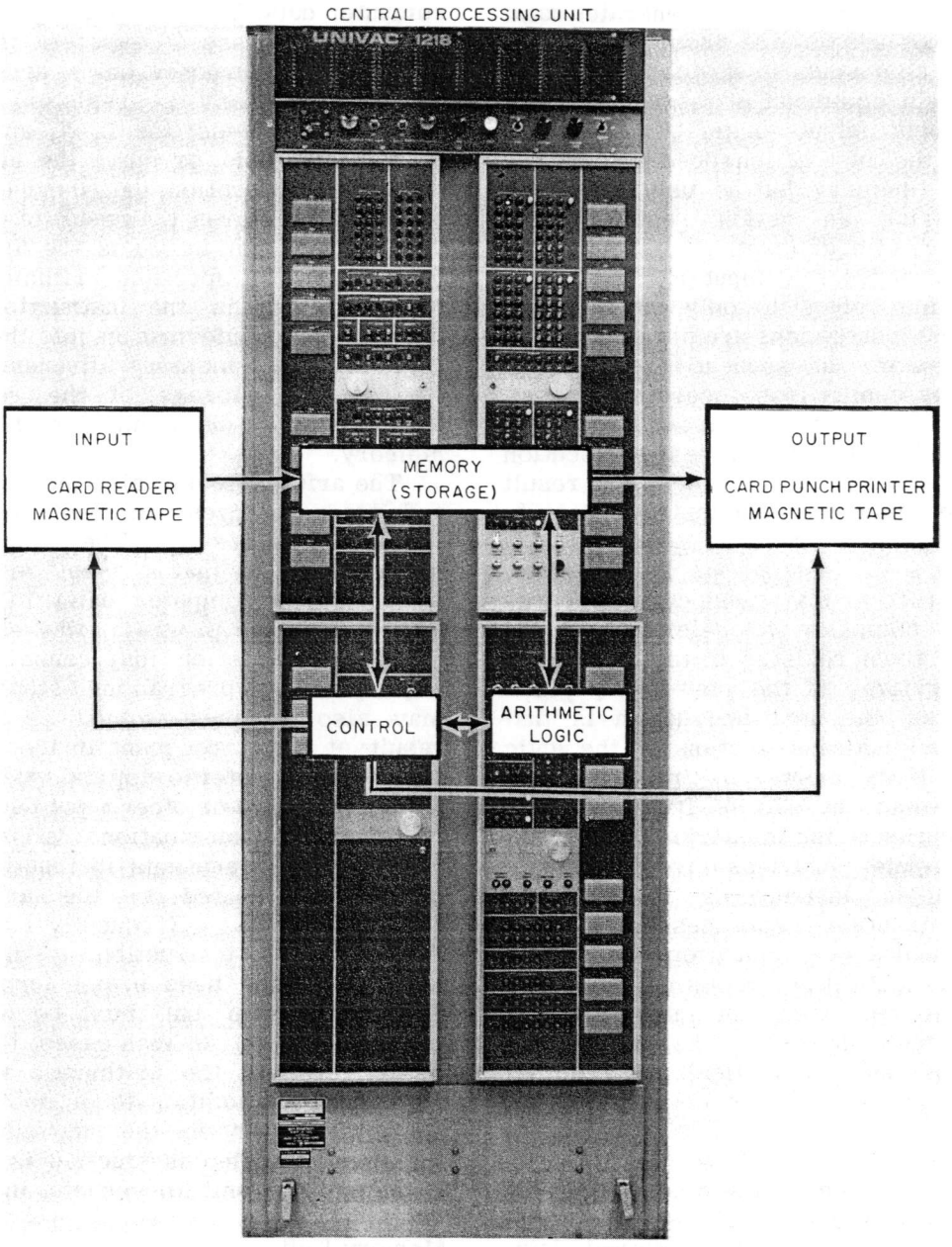

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Figure 10-1.—Representative digital computer.

adding machine. By using logic instructions the programmer may instruct the system on various alternate sequences through the program. For example through the use of logic instructions, a computer being used for maintenance inventory will have one sequence to follow if the number of a given item on hand is greater than the order amount and another sequence to follow if the number on hand is smaller than the order amount. The choice of which sequence to use will be made by the control unit under the influence of the

logic instruction. Logic instructions provide the computer with the ability to make decisions based on the result of previously generated data.

Control instructions are those which are used to send commands to devices which are not under direct command of the control unit, such as input/output units. The address contained in the instruction does not specify a location in memory but is usually a code group specifying an action required of a particular piece of equipment.

In a single address computer, i.e., where each instruction refers to only one address or operand, the instructions are normally taken from the memory in sequential order. If one instruction comes from a certain location, say X, the next instruction is usually taken from location X + 1. However, the execution of a logic instruction may produce a result which dictates that the next instruction is to be taken from an address as specified in a portion of the logic instruction. For example, the logic instruction may cause certain operations in the computer to determine if the content of a given register in the arithmetic section is negative. If the answer is "yes," the location of the next instruction is that specified in an address section of the logic instruction. If the answer is "no," the next instruction would be taken from the next sequential location in the memory.

Every computer provides circuitry for a variety of logic instructions for choosing alternate instruction sequences if certain desirable or undesirable conditions exist. The ability to "branch" at key points is the special feature of the computer that makes it able to perform such diverse tasks as missile control, accounting, or tactical air plotting.

Arithmetic Unit

The arithmetic unit of the computer is the section in which arithmetic and logic operations are performed on the input or stored data. The arithmetic operations performed in this unit include adding, subtracting, multiplying, dividing, counting, shifting, complementing, and comparing.

All arithmetic operations can be reduced to any one of four arithmetic processes; addition, subtraction, multiplication, or division. In most computers, multiplication involves a series of additions; and division, a series of subtractions.

The arithmetic unit contains several registers; units which can store one "word" of computer data. This group of registers generally include D, X, and Q registers (so named for identification purposes only), and a unit called an "accumulator" (A register). During an arithmetic process, the D, X, and Q registers temporarily hold or store the numbers being used in the operation, called "operands". The accumulator stores the result of the operation. The control unit instructs the arithmetic unit to perform the specified arithmetic operation (as requested in the instruction); transfers the necessary information into the D, X, and Q registers from memory (discussed later); and controls the storage of the results in the accumulator or in some specific location in memory.

The arithmetic unit also makes comparisons and produces "yes" or "no" or "go-no-go" outputs as a result. The computer may be programmed so that a "yes" or "go" result advances the computer units to perform the next step in the program, whereas a "no" or "no-go" instruction may cause the computer to jump several programmed steps. A computer may also be programmed so that a "no" result at a certain point in the program will cause the computer to stop and await instructions from a keyboard or other input device.

Generally information delivered to the control unit represents instructions, whereas information routed to the arithmetic unit represents data. Frequently it is necessary to modify an instruction. This instruction may have been used in one form in one step of the program but must be altered for a subsequent step. In such cases, the instruction is delivered to the arithmetic unit where it is altered by addition-to or subtraction-from another number in the accumulator. The resultant modified instruction is again stored in the memory unit for use later in the program.

Memory Unit

In most digital computers the storage or memory section is constructed of small magnetic cores, each capable of representing an "ON" ("1") or "OFF" ("0") condition. A system of these cores arranged in a matrix can store any computer word which is represented in binary form.

All computers must contain facilities to store computer words or instructions (which

are intelligible to the computer) until these instructions or words are needed in the performance of the computer calculations. Before the stored program type computer can begin to operate on its input data, it is first necessary to store, in memory, a sequence of instructions and all figures, numbers, and any other data which are to be used in the calculations. The process by which these instructions and data are read into the computer is called "loading."

Actually the first step in loading instructions and data into a computer is to manually place enough instructions into memory by using the console or keyboard so that these instructions can be used to bring in more instructions as desired. In this manner a few instructions are used to "bootstrap" more instructions. Some computers make use of an auxiliary (wired) memory which permanently stores the "bootstrap program," thereby making manual loading unnecessary.

The memory (or storage) section of a computer is essentially an electronically operated file cabinet. It is actually a large number (generally between 1 and 40 thousand) of storage locations; each referred to as a storage address or register. Every computer word which is read into the computer during the loading process is stored or filed in a specific storage address and is almost instantly accessible.

Input/Output Unit

Input and output devices are similar in operation but perform opposite functions. It is through the use of these devices that the computer is able to communicate with the outside world.

Input data may be in any one of three forms: it may be fed in manually from a keyboard or console; from instruments or sensors; or from a source on which data has previously been stored in a form intelligible to the computer.

Computers can process hundreds of thousands of computer words per second. Thus, a study of the first method (manual input) reflects the incompatibility of human-operated keyboards or keypunches to supply data at a speed which matches the electronic speed of digital computers. A high average speed for keyboard operation is 2 or 3 characters per second, which when coded to form computer words may have more than 15 to 20 binary digits. The computer is capable of reading several thousand times this amount of information per second. It is clear, therefore, that manual inputs should be minimized to make more efficient use of computer time.

Instruments are used as input sensors, and are capable of supplying several thousand samples regarding pressure, temperature, speed, etc., per second. This is equivalent to 10 or 20 thousand bits or binary digits per second. Digital computers which use these devices must be equipped with analog-digital converters to convert physical change to specific increments.

Input data which has previously been recorded on punched cards, perforated tapes, magnetic tapes or magnetic drums or disks in a form understood by the program may also be entered into the computer, this being a much faster method than entering data manually from a keyboard. The most commonly used input devices in this category are magnetic tape readers or paper tape (perforated tape) readers.

Output information is also made available in three types: human information, such as codes or symbols presented on a cathode-ray screen which are used by the operator to answer questions or make decisions; information which operates a control device such as a lever, aileron, or actuator; or information which is stored in a machine language or human language, on tapes, or printed media.

Devices which store or read-out output information include magnetic tape, punched cards, punched paper tapes, cathode-ray oscilloscopes, electric typewriters, line-at-a-time printers, and surface-at-a-time printers.

One of the main features of computers is their ability to process large amounts of data quickly. In most cases, the processing speed far exceeds the ability of input devices to supply information. One common limitation of most input devices is that each involves some mechanical operation, that is, the movement of a tape drive or card feeder. Because a mechanical movement of some part of these devices cannot take place fast enough to match electronic speeds within the computer, these input devices limit the speed of operation of the associated computer particularly in cases where successive operations are dependent upon the reception of new data from the input medium.

Several methods of speeding up mechanical operations have been devised, all of which are designed to move a smaller mass a shorter distance and with greater driving force. Many of these designs have been directed toward increasing the drive speed of magnetic tapes. Present day tape drives can pass up to 150 inches of tape per second over a tape reading head. Card readers can read between 100 and 2000 cards per minute, depending on the particular reader.

Another method of entering data into a computer which has not previously been mentioned is to link two (or more) computers together and program them to communicate with each other. This is the fastest method of entering or extracting data.

COMPUTER OPERATIONS

With an understanding of the function of the various computer sections, let us now consider a basic computer instruction and how this instruction is executed. Let the instruction be as follows:

> "Add the contents of the A register to the contents of memory address location 123 and store the results in address 456 in memory."

We will assume that the computer used is the stored program type and that all instructions, data, numbers, and symbols have been previously loaded or stored in memory at known addresses. The stored input may have been read from a magnetic tape (similar to that used with commercial tape recorders), from paper tape (similar to that used with teletype), or from punched cards.

If the instruction to be executed is the first programmed operation, energizing the start button will cause the control unit to issue an order "Read instruction." The instruction will be read into a register in the control unit where it will remain throughout the execution cycle.

Note that the mathematical operation requested in the instruction is ADD. The instruction word thus contains a code which is interpreted by the control unit as ADD.

After reading the instruction, the control unit automatically energizes circuits which will (1) read-out the contents of memory address 123, (2) transfer this information to a register (say the X register) in the arithmetic unit, and (3) perform an add X to A operation.

The ADD process is thus accomplished, being constantly monitored by the control unit to ensure that no further actions are initiated before the ADD operation is completed. The results of the ADD operation are stored in the accumulator from which, by control request, it is transferred to address 456 in memory. This ends the instruction. The control unit will read and execute the next instruction.

If the result is to be displayed at the output immediately or at a later time (as stipulated in the programmed instructions) the control unit upon receipt of the instruction will issue an order to read-out the contents of memory address 456. Because read-out (which sometimes involves printing by some electromechanical apparatus) is extremely slow as compared to computer speed, most computers use a secondary storage device called a buffer into which data is read directly from the primary (main) storage at computer speeds. When read-out is desired, the control unit enables the buffer storage to read-out all or any part of the buffer storage data. The buffer read-out is independent of the main computer operation, and in some computers only one instruction is required to start and stop the read-out process.

COMPONENTS USED IN COMPUTERS

Unlike the mechanical computer, such as adding machines and odometers which are based on the decimal (ten) digit system, modern electronic computers use components which will represent only 2 conditions. These conditions are sometimes referred to as the 1 (energized) or 0 (deenergized) states. Early computers used relays and electron tubes; now transistors and silicon or germanium diodes are used because of the higher speeds at which they can react, and too, because of their lower power consumption.

Electronic circuits used in computers are basically simple. To a large extent these circuits are of four types: the OR circuit which produces an output when one or more of its inputs are active, that is, in the one state: the AND circuit which yields an output only when all inputs are active; the flip-flop circuit which is a bistable multivibrator; and the inverter circuit which yields a high output with a low input or a low output with a high input.

COMPUTER TOOLS

Components or tools of a computer system are categorized as either hardware or software. Hardware includes all the mechanical, electrical, electronic, and magnetic devices within a computer system. Software consists of the automatic programming materials developed for the most efficient use of the hardware and is usually supplied by the manufacturer of particular systems.

Hardware.—Computer hardware falls into two categories, peripheral equipment and the central processor. PERIPHERAL EQUIPMENT includes all input and output devices associated with specific recording media such as, a card reader and punch with punched cards, or magnetic tape units with magnetic tape. This peripheral equipment can operate ON-LINE under direct control of the central processor or OFF-LINE, independently of the central processor.

As previously stated the CENTRAL PROCESSOR includes the Control, Arithmetic, and Memory units.

During ON-LINE operations, data can be transferred to and from peripheral devices and the central processor under the influence of CONTROL UNITS. These units may be free-standing, or built into either the central processor or the peripheral device, and receive their signals or instructions from the stored program.

In OFF-LINE or AUXILIARY operations, the input and output devices are used in conjunction with other peripheral devices not directly connected to the system. Since input output data conversion operations are relatively slow compared to the speed of the central processing unit, off-line operations free the computer of time-consuming procedures and provide more time for the computing and processing of data by the central processor. For example, a system's output data could be written on magnetic tape (because of its speed) and, in an off-line operation, converted to some other record form—by a slower device. This allows the computer to continue processing new data.

Software.—This consists primarily of general purpose programs that are common to many computer installations. Included among them would be assemblers and compilers which aid in producing machine language routines from a relative or nonmachine language source, plus sort, control, and other utility programs.

ELECTRONIC DATA PROCESSING EQUIPMENTS

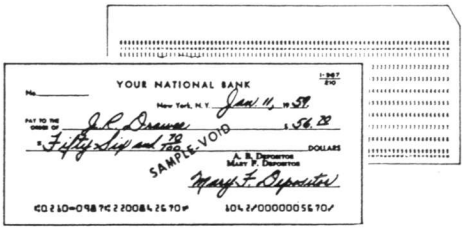
In certain respects, electronic data processing is similar to the unit record system in that punched cards may be used as input, and printed reports or punched cards may be produced as output. The unique difference lies in the manner of processing the data and the electronic equipment used in its processing applications. Whereas the unit record system required the physical movement of cards from one machine to another, the electronic system permits many processing functions to be performed in one operation. This is made possible through the use of several interconnected devices which, working together, can receive, process, and produce data in one operation without human intervention. These devices constitute an electronic data processing system.

The operations of preparing source documents, punching cards from source documents, and (for a punched card EDPS) sorting punched cards, are accomplished by the same methods used in the unit record system. However, systems using magnetic tape for input generally have punched card data transcribed onto the tape, and it in turn is sorted into a sequence acceptable for processing by the computer. Once information has been entered into the system, all classification, identification and arithmetic operations are performed automatically in one or several processing routines. This is accomplished by a set of written instructions called a PROGRAM which, when recorded onto punched cards or magnetic tape and fed into the system, controls operations automatically from start to finish.

Information used as input to an electronic data processing system may be recorded on punched cards, paper tape, magnetic tape, or magnetic ink or optically read documents, depending upon the system requirements. Similarly, output may be in the same forms with the addition of printed reports, again depending upon the system.

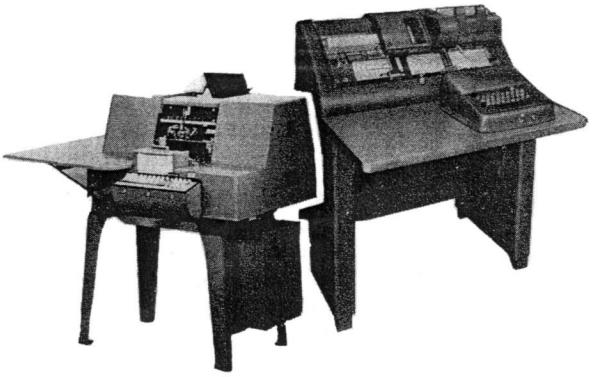
Figure 10-2 shows some of the major Electronic Data Processing (EDP) equipments presently in use.

UNIT RECORDS



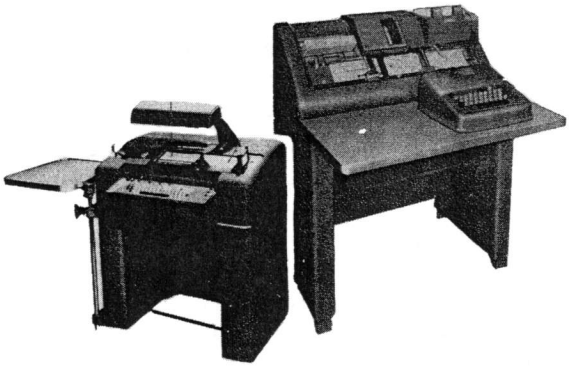
RELATED FACTS TREATED AS A UNIT, RECORDED ON INPUT MEDIA ACCEPTABLE TO A DATA PROCESSING SYSTEM.

CARD PUNCH



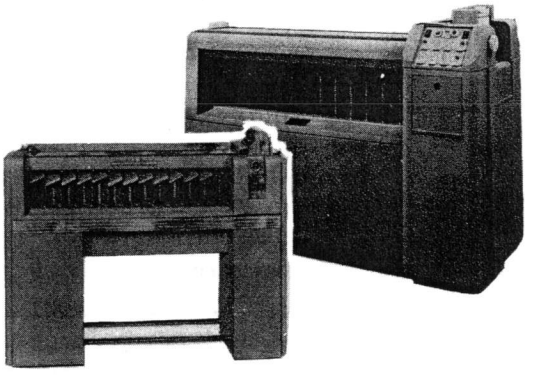
A MACHINE WHICH ALLOWS AN OPERATOR TO PUNCH DATA INTO CARDS FOR CONVEYANCE INTO OTHER MACHINES OR DEVICES. SYNONOMOUS WITH KEYPUNCH.

CARD VERIFIER



CHECKS ORIGINAL PUNCHING OF DATA IN CARDS FOR TRANSCRIPTION ERRORS.

CARD SORTERS



SELECTS OR ARRANGES PUNCHED CARD UNIT RECORDS IN A DESIRED SEQUENCE.

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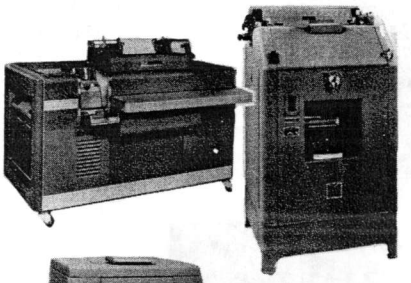
Figure 10-2.—Representative Electronic Data Processing Equipments.

ACCOUNTING MACHINE



PERFORMS END OF THE LINE PROCESSING OF PUNCHED CARDS THROUGH ITS ABILITY TO ADD, SUBTRACT, AND PRINT REPORTS. SYNONYMOUS WITH TAB AND TABULATOR.

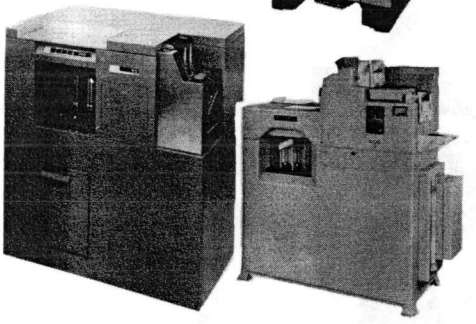
INTERPRETER

READS, INTERPRETS, AND PRINTS PUNCHED CARD DATA ON THE FACE OF A CARD.

REPRODUCER

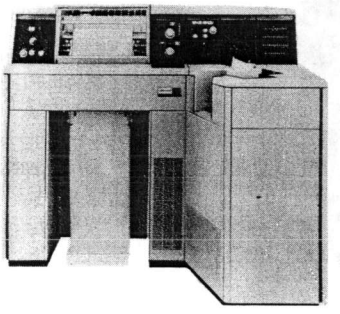
USED PRIMARILY TO CREATE NEW FILES BY REPRODUCING ALL OR PORTIONS OF DATA FROM ONE UNIT RECORD TO ANOTHER, OR ADDING NEW INFORMATION TO EXISTING FILES.

COLLATOR



A FILING MACHINE USED TO ARRANGE OR SELECT CARDS FOR SUBSEQUENT OPERATIONS.

1004 CARD PROCESSOR



A SOLID-STATE ELECTRONIC PROCESSING MACHINE WITH AN EXTERNAL CONTROL PANEL, INCORPORATING CARD READING, ARITHMETIC PROCESSING, AND PRINTING FUNCTIONS.

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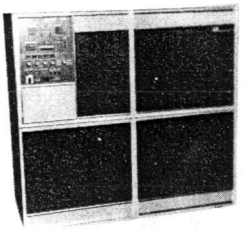
49.215.2

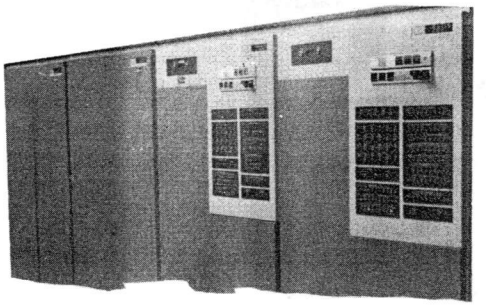
Figure 10-2.—Representative Electronic Data Processing Equipments—(Cont'd).

CENTRAL PROCESSING UNIT



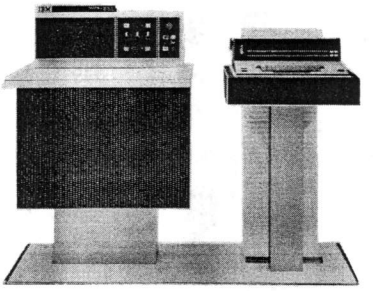
THAT PORTION OF A COMPUTER EXCLUSIVE OF PERIPHERAL EQUIPMENT THAT CONTAINS THE MAIN STORAGE, ARITHMETIC-LOGIC UNITS, AND CONTROL SECTION. SYNONOMOUS WITH CPU.

SYSTEM CONTROL UNITS



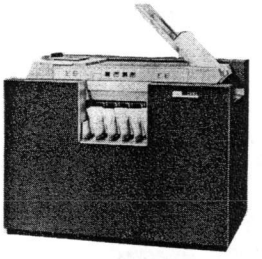
USED PRIMARILY TO CONTROL ALL OPERATIONS INCLUDING INPUT AND OUTPUT FUNCTIONS.

CONSOLE



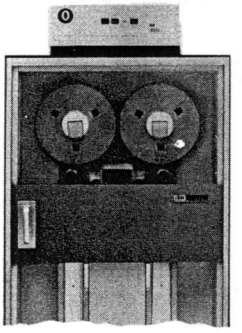
PROVIDES EXTERNAL CONTROL OF A DATA PROCESSING SYSTEM. USED MAINLY TO DETERMINE THE STATUS OF CIRCUITS, COUNTERS, PANEL REGISTERS, AND CONTENTS OF STORAGE.

CARD READ PUNCH



AN INPUT AND OUTPUT DEVICE THAT READS AND CONVERTS PUNCHED CARD DATA FOR TRANSFERENCE INTO STORAGE OR ONTO MAGNETIC TAPE; TRANSFERENCE FROM STORAGE OR MAGNETIC TAPE TO PUNCHED CARDS; CAN BE INDIVIDUAL UNITS.

MAGNETIC TAPE UNIT



INPUT AND OUTPUT DEVICE CAPABLE OF READING AND WRITING INFORMATION (REPRESENTED BY MAGNETIC SPOTS) ON AND FROM MAGNETIC TAPE.

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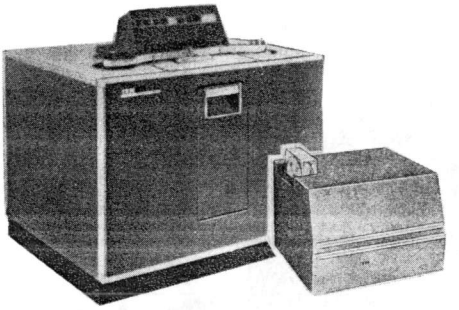
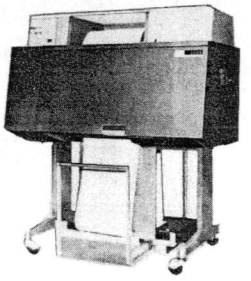
Figure 10-2.—Representative Electronic Data Processing Equipments—(Cont'd).

PAPER TAPE READER AND PUNCH



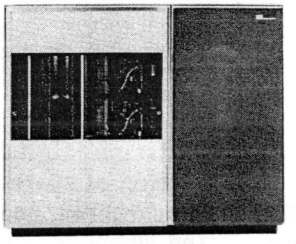
INPUT AND OUTPUT DEVICES WHICH CAN SENSE AND PUNCH THE HOLE PATTERNS OF PAPER TAPE, COULD BE A COMBINED UNIT.

HI-SPEED PRINTER



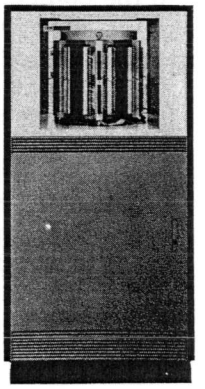
A PRINTER OUTPUT DEVICE WHICH OPERATES AT A SPEED COMPATIBLE WITH THE SPEED OF COMPUTER COMPUTATION AND PROCESSING, ENABLING IT TO OPERATE ON-LINE IF NECESSARY.

DISK STORAGE



A STORAGE DEVICE IN ADDITION TO MAIN STORAGE OF THE CPU WHEREIN DATA IS RECORDED BY MAGNETIC SPOTS ON THE SURFACE OF FLAT CIRCULAR MAGNETIC DISKS.

DRUM STORAGE



A STORAGE DEVICE IN ADDITION TO MAIN STORAGE OF THE CPU WHEREIN DATA IS RECORDED BY MAGNETIC SPOTS ON BANDS OR CHANNELS OF A ROTATING CYLINDER.

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Figure 10-2.—Representative Electronic Data Processing Equipments—(Cont'd).

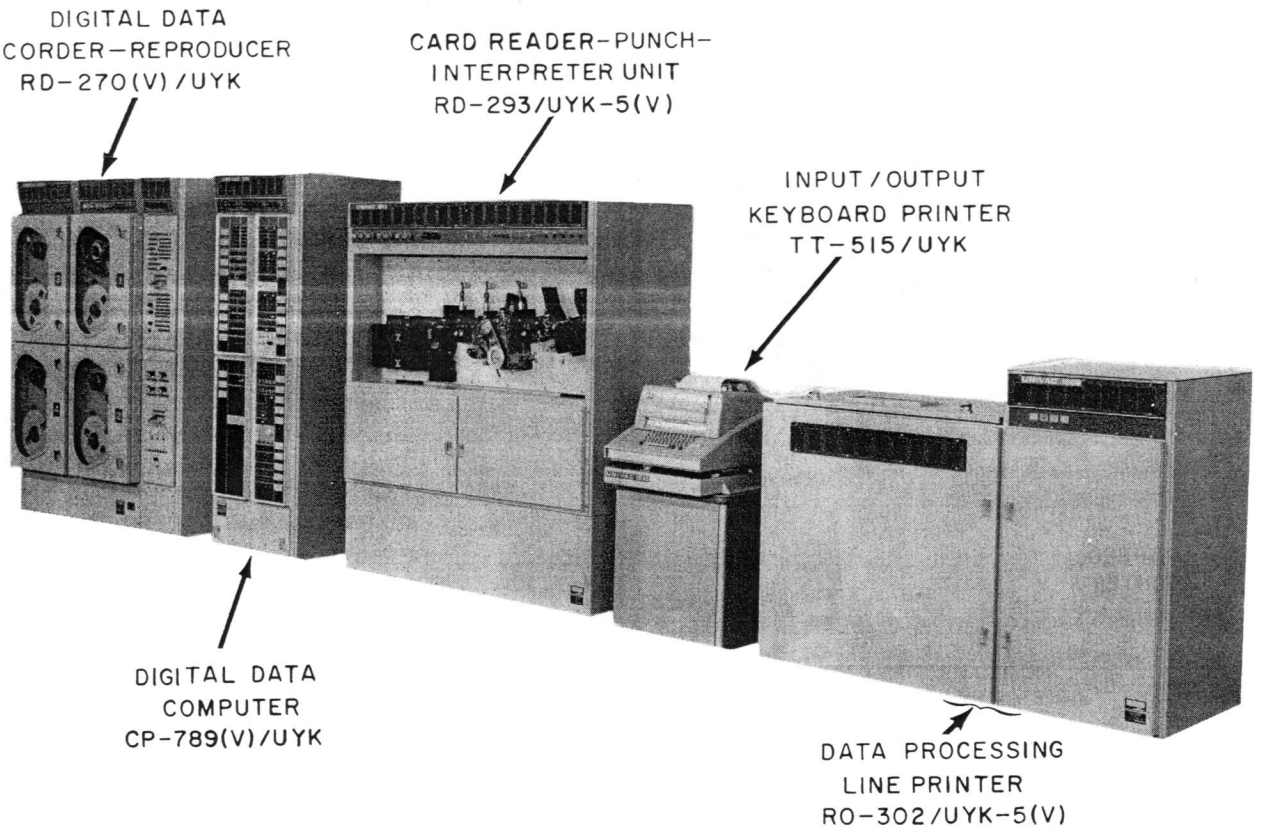

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Figure 10-3.—Data Processing Set AN/UYK-5(V).

DATA PROCESSING SET AN/UYK-5(V)

The Data Processing Set AN/UYK-5(V) (fig. 10-3) is a general purpose processing system developed for shipboard installations of the Standard Navy Maintenance and Material Management (3M) system. It includes:

- Digital Data Computer CP-789(V)/UYK
- Digital Data Recorder-Reproducer RD-270(V)/UYK
- Card Reader-Punch-Interpreter Unit RD-293/UYK-5(V)
- Input/Output Keyboard Printer TT-515/UYK
- Data Processing Line Printer RO-302/UYK-5(V)
- Motor-Generator PU-655/U (not shown)

The handling of supplies and accounts is accomplished by a stored program type real-time digital data computer. During the execution of stored instructions from memory, the input/output section is continuously monitored and whenever any peripheral equipment connected to the computer has a request to send data to the computer or wants data from the computer, the computer program interrupts and honors the input/output request. After input or output, the computer resumes executing programmed instructions as stored in memory.

The input/output sections have four channels available. All input/output transfers are buffered under buffer control so that they do not require program attention, and will operate at the rate required by the external device.

DIGITAL DATA COMPUTER CP-789(V)/UYK

The computer (fig. 10-4) consists of a power control panel, with either four or six pull-out bays and a power supply. The upper

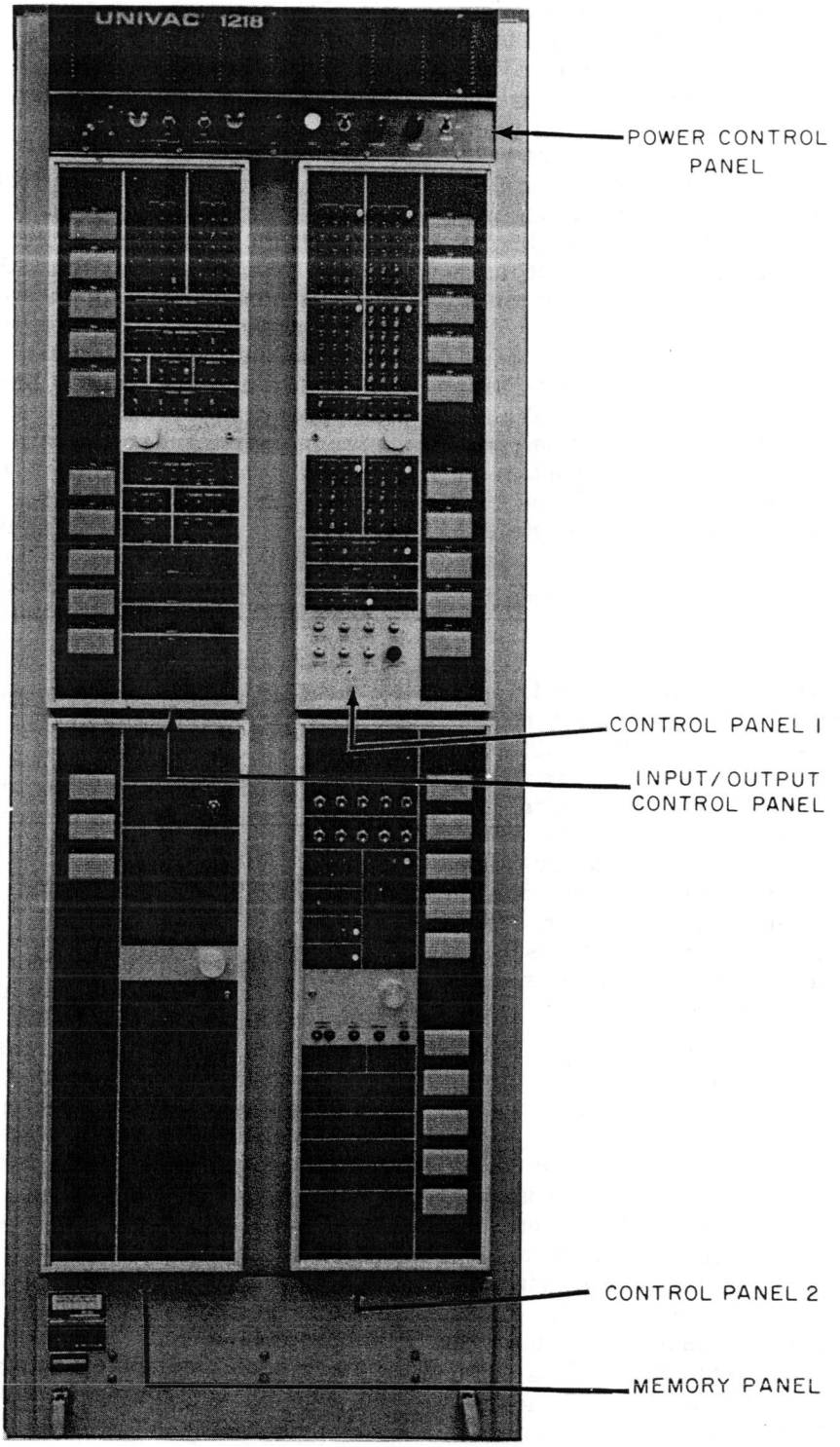

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Figure 10-4.—Digital Data Computer CP-789(V)UYK.

left bay contains the input/output section logic and switches. The upper right bay (control panel 1) contains the arithmetic section logic and some of the control section logic and switches. The lower left bay contains the computer memory. The lower right bay (control panel 2) contains control section logic and switches. If six pull-out bays are present (not shown), the upper bay is empty and the lower bay contains a larger core memory. The pull-out bays extend forward to facilitate access to the printed-circuit cards, switches, and memory modules. Internal blowers cool the computer.

The computer is basically an automatic machine, however there are certain switches and controls that affect computer operation. These switches and controls provide means of selecting computer operating speed, selecting optional program jumps or stops, selecting input/output modes, and setting and clearing the registers.

DIGITAL DATA RECORDER-REPRODUCER RD-270(V)/UYK

The RD-270(V)/UYK magnetic tape unit (fig. 10-5) is a large capacity, medium speed, magnetic tape storage system. It is capable of receiving data from the computer and recording it on magnetic tape or retrieving information previously recorded on tape and transferring it to the computer. It is usually used on-line, but it may be used in an off-line mode of operation with the high speed printer. Information recorded on magnetic tape is retrieved and transferred to the high speed printer for reproduction in printed form.

Card Reader-Punch-Interpreter Set RD-293/UYK-5( )

The RD-293/UYK-5( ) (fig. 10-6) unit is a computer input/output device that provides interim storage for, and intermediate control over information transmitted between the computer and keyboard-printer, high-speed printer, and reader-punch interpreter system. The reader-punch-interpreter assembly is an on-line panel-mounted card reading, punching, and printing system. It consists of a card punch head assembly, a printer head assembly, two photoelectric reading stations, an input card hopper, two output card stackers, and the electrical mechanical and pneumatic devices necessary to select, transport, process and stack standard size 80-column cards.

Input/Output Keyboard Printer TT/515/UYK

The teletypewriter set (fig. 10-7) provides a means by which an operator can conveniently transmit information to and receive direct replies from the computer. As an input device the unit can be used for manually loading programs and other input data, for example, constants and program parameters, into the computer; for altering existing programs, portions of a program, or constants stored in the computer memory, and for initiating and terminating various computer operations. As an output device the unit can be used for printing out errors, conditions requiring decisions or operator intervention, and various types of computer output data. The control logic for the keyboard printer is incorporated in the card reader-punch-interpreter cabinet.

DATA PROCESSING LINE PRINTER RO-302/UYK-5(V)

The RO-302/UYK-5(V) is a high speed line/printer system consisting of two major sections (fig. 10-8) referred to as a printing compartment (mechanical section on left side) and electronics compartment (on right side).

The printing compartment houses a high speed line/printer mechanism which consists of a drum gate assembly, interlock, drum motor, position pickup, paper feed assembly, paper interlocks, paper feed stepping motor, and paper feed magnetic pickup.

The electronics compartment consists of two power supplies, printed logic chassis, two printed-circuit card chassis and cards, two capacitor banks, fuse panel and a control circuit for the paper feed stepping motor.

The high speed line/printer can be used as an on-line computer output device which produces printed copy in alphanumeric form from binary-coded computer output data. The unit is capable of printing 64 different characters including the upper case alphabet, numerals 0 through 9, punctuation symbols, and special characters.

The high-speed printer control panel contains all the controls and indicators necessary

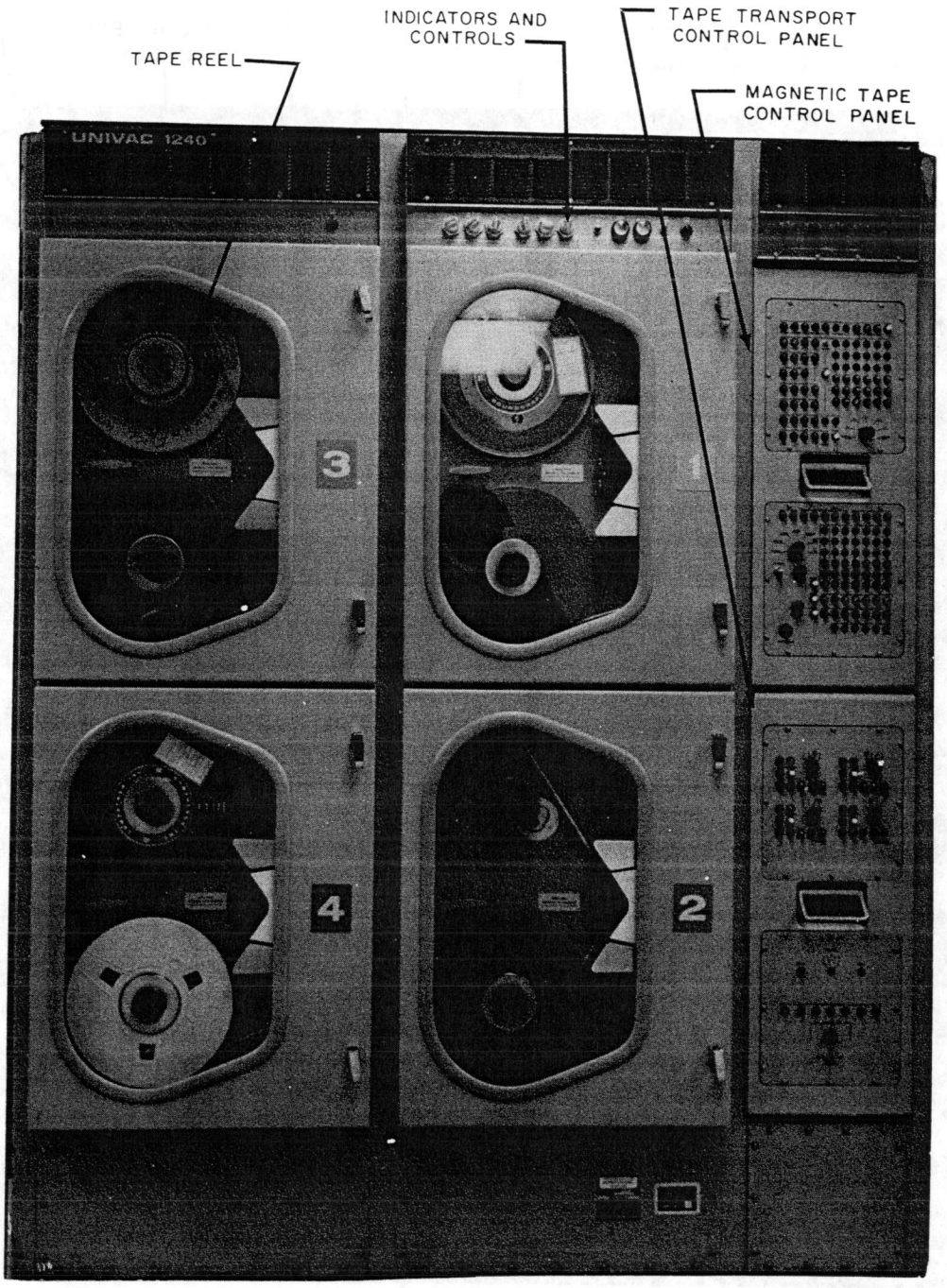

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Figure 10-5.—Digital Data Recorder-Reproducer RD-270(V)/UYK.

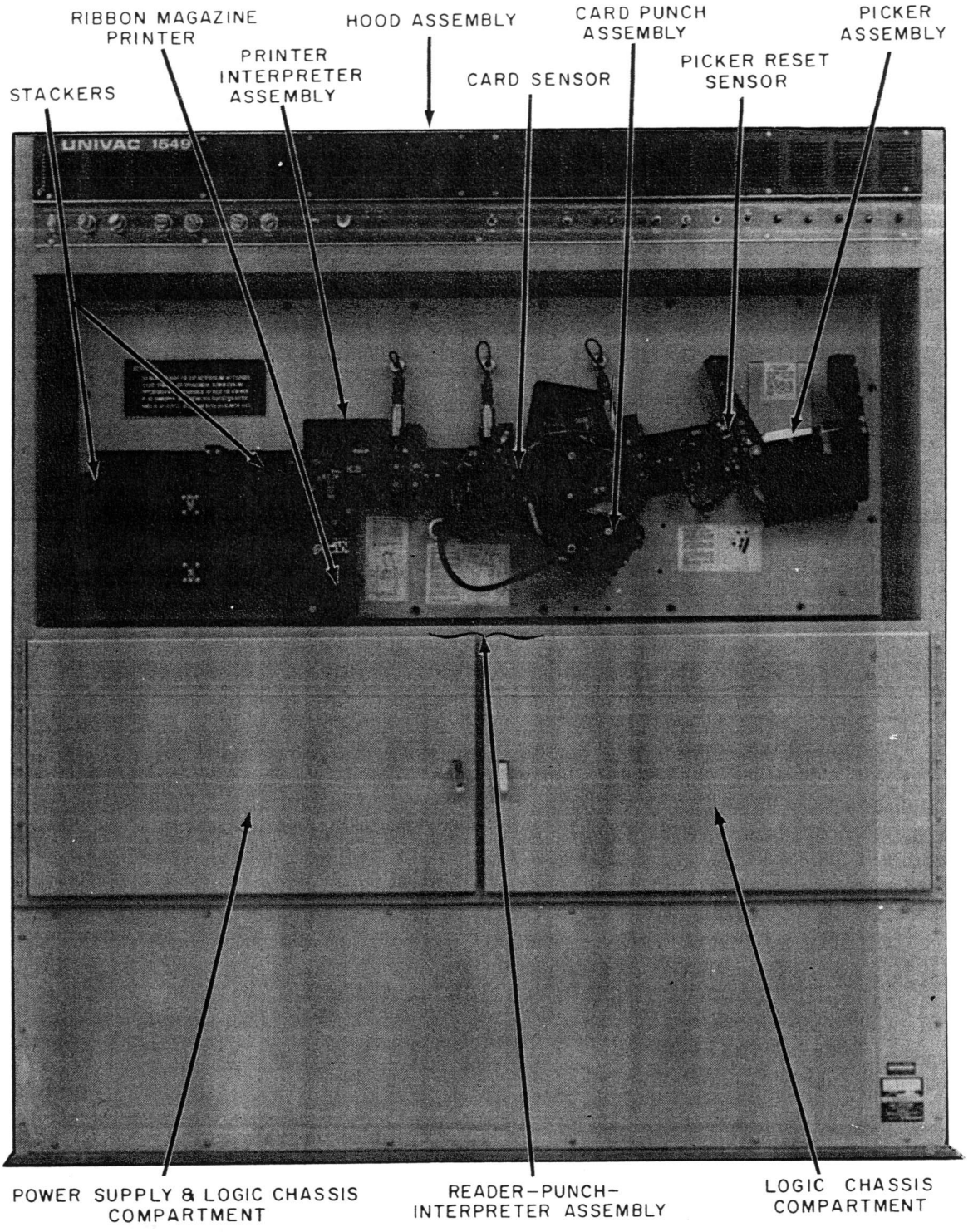

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Figure 10-6.—Card Reader-Punch-Interpreter Unit RD-293/UYK-5(V).

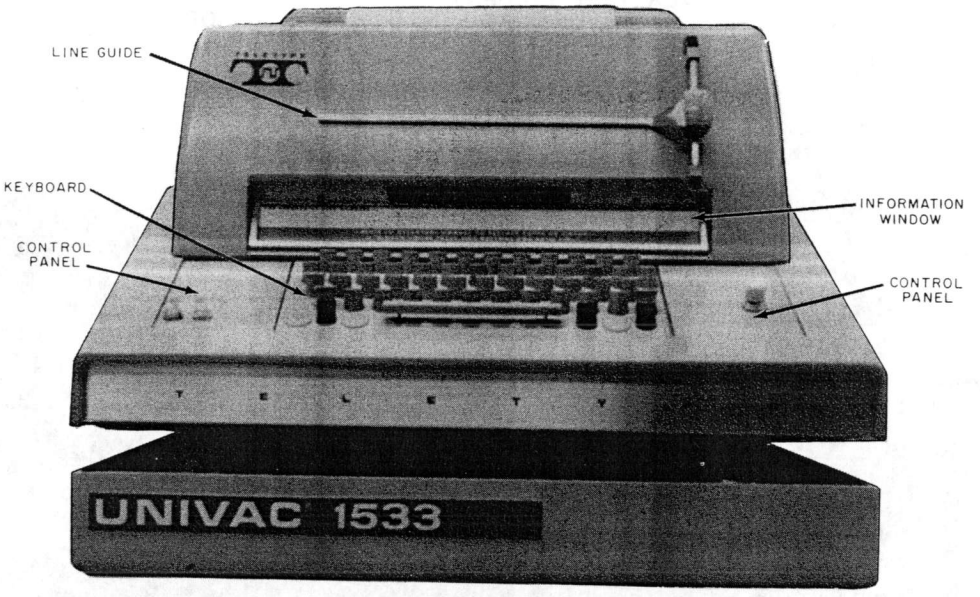

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Figure 10-7.—Input/Output Keyboard Printer TT-515/UYK.

to operate and monitor the printer once paper and ribbon have been properly installed in the printer mechanism.

UNIFORM AUTOMATIC DATA PROCESSING SYSTEM

The Uniform Automatic Data Processing System (UADPS) is a program designed to apply electronic data processing equipment and techniques to the supply function at Navy Stock Points. The Navy Stock Point provides a large variety of items for bulk and ready issue supply support to the operating forces of the fleet and to shore based activities.

The UADPS system consists of Inventory Control Points, the Naval Supply Depot in Rhode Island, and several supply centers. The basic control points are for navy ships parts, aviation supplies, and electronic supplies.

The UADPS centers use real time random access computer operations to process incoming requisitions, receipt notices, and requests for information. Many incoming requests enter the system from dockside input/output stations.

Upon receipt of a request, inventories are are automatically checked and warehouses are notified of articles to be shipped, or where needed articles can be obtained. The system also keeps accounting and inventory records, assembles and prints management reports, and points out trouble spots for immediate attention.

DATA PROCESSING SET AN/UYK-1

The AN/UYK-1 (not shown) is a general purpose, stored program computer set designed for shipboard environment. The computer can be used with, but is not a part of, the Navy Tactical Data Systems, and with the oceangraphic and navigation systems. It computes and manipulates digital data at electronic speeds, and stores data in its magnetic core memory. The computer controls, or can be controlled by a variety of peripheral devices such as teletype machines, paper tape punches, and readers, magnetic tape transports, punched card readers, high speed printers, magnetic drums, and all components of NTDS. The computer uses 30-bit words. Magnetic core memory may contain as many as 32,768 words.

Digital Data Computer CP-642( )/USQ-20(V)

The Naval Tactical Data System (NTDS) is an automatic data system for gathering and processing data received from the ship's

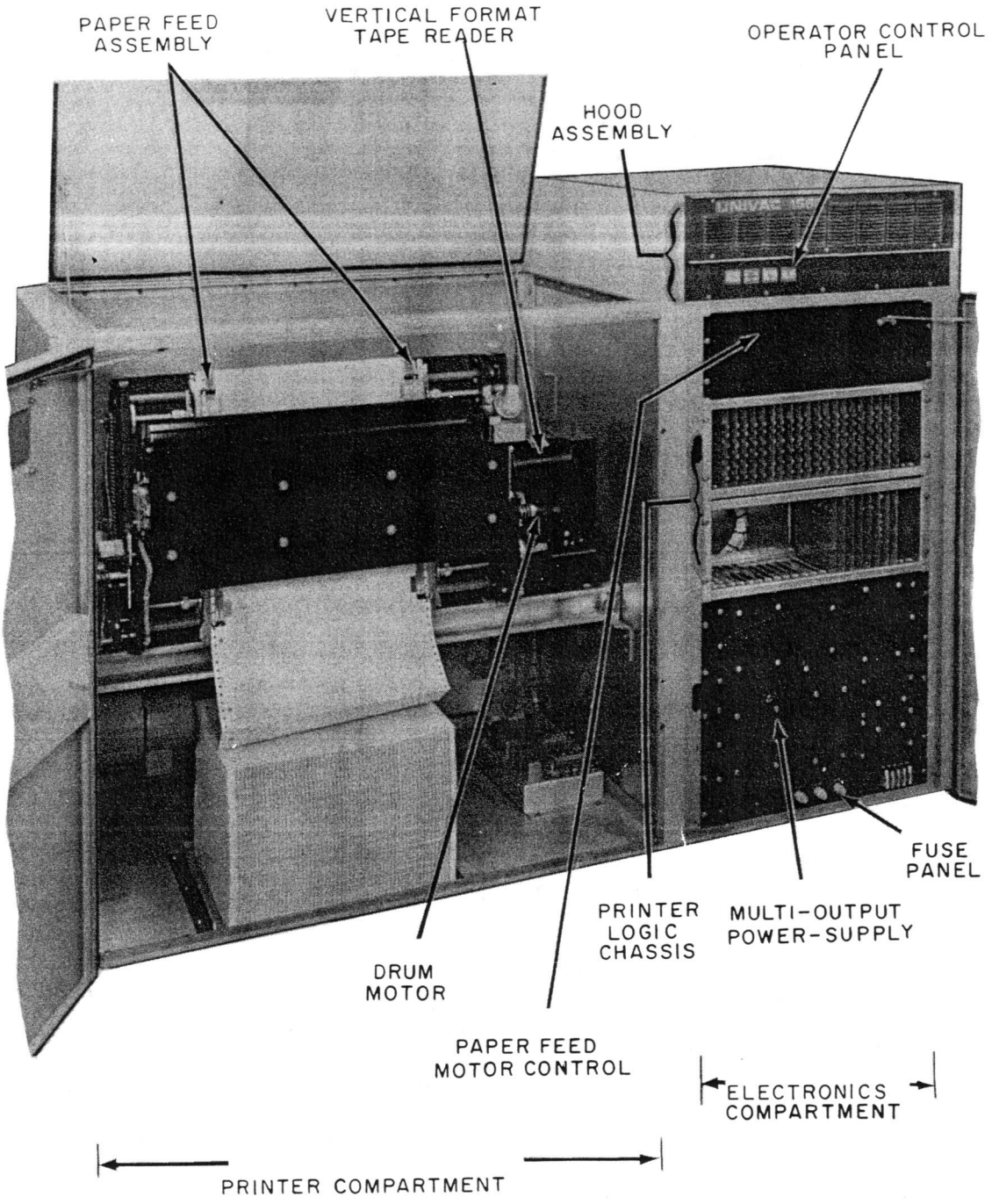

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Figure 10-8.—Data Processing Line Printer RO-302/UYK-5(V).

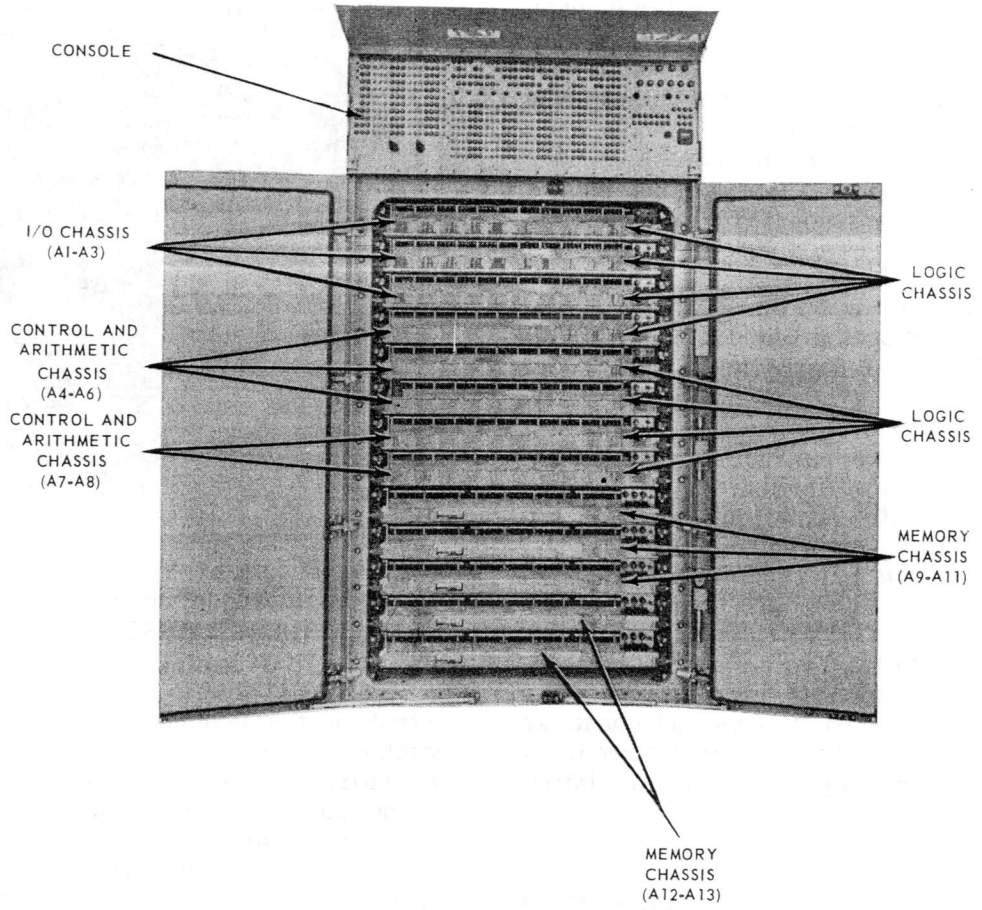

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Figure 10-9.—Digital Data Computer CP-642( )/USQ-20(V) showing major subassemblies.

sensors. It utilizes digital computers which operate in a real-time environment.

The NTDS computer CP-642( )/USQ-20 (fig. 10-9) is a general purpose, stored program computer. A list of instructions (program) is entered into the computer storage area prior to executing the problem. The program directs the computer in the execution of logical steps which ultimately produce a solution to a given problem. In addition to performing routine tasks in connection with calculating and processing the information received in the Combat Information Center, such as tracking and presenting intercept solutions, the computer can store a program to check out the NTDS equipments, or, when not needed for CIC use, it can be used to solve logistic problems.

The CP-642( )/USQ-20(V) is capable of rapid processing of large quantities of complex data. The computer performs arithmetic and logical functions by manipulating binary numbers in automatic or manual modes of operation.

The major subassemblies of the computer are of modular design, having 13 roll-out type chassis; eight of which are logic chassis used for input/output, control, and arithmetic, and five used for memory. Memory chassis are interchangeable.

Connections between the chassis are made by movable plug-racks (not shown) located on the sides of the computer and jacks mounted on the sides of the chassis. Connections between the computer and external equipment is via jacks (not shown) located on the top of the computer.

OPERATIONAL FEATURES

The major features of the computer include:

1. An internal, high-speed magnetic storage with a cycle time of eight microseconds and a capacity of 32,768 30-bit words.
2. A repertoire of 62 instructions, most of which provide for conditional program branches.
3. Average instruction execution time of 13 microseconds.
4. A word length of 30 bits.
5. Optional operation with 15-bit half words.
6. Internally stored programs.
7. Parallel, one's complement, subtractive arithmetic.
8. Single address instructions with provisions for address modification.
9. Internal 7-day real-time clock for initiating operations at desired times.
10. Twelve input and twelve output channels for rapid data exchanges with external equipment.
11. Two input and two output channels for intercomputer data transfer.
12. A 16-word auxiliary wired memory for storage of critical instructions and constants that provide the facility for automatic recovery in the event of program failure and for initial loading of programs.

Computer Console Set C-3413/USQ-20(V) is the remote console associated with the computer (fig. 10-10). Although the computer itself is basically an automatic machine, the console provides facilities for manual intervention and control of the computer. The operator has switches on the console that are used to affect the entire computer operation by injecting several modes of operation as, providing certain jump or stop conditions, controlling computer operations, and governing speed of operation. There are also controls by which a single stage can be set or an entire register can be cleared.

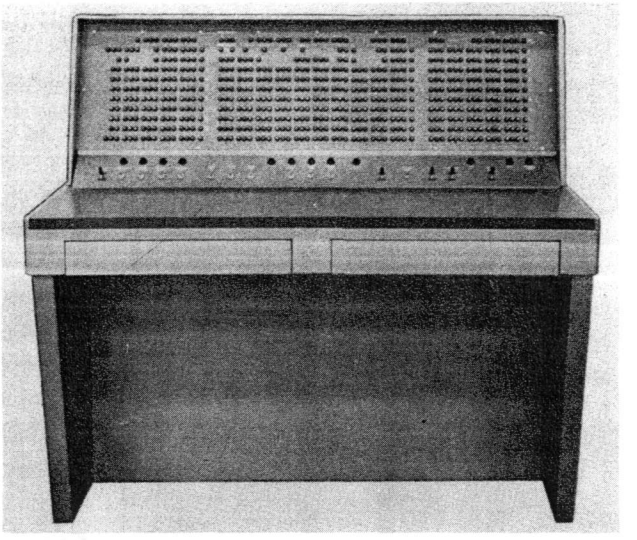

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Figure 10-10.—Computer Console Set C-3413/USQ-20(V).