

DATAMATIC 1000
THE GIANT STEP
FORWARD
IN BUSINESS
DATA PROCESSING

Honeywell



DATAmatic

ELECTRONIC DATA PROCESSING



1912
L.A. ...

HONEYWELL'S DATAMATIC 1000 ELECTRONIC DATA PROCESSING SYSTEM

The DATAMatic 1000 is a versatile system of high-speed processing equipment designed specifically to harness the vast capabilities of electronic computing for large-scale business record-keeping applications. The following typical applications represent basic speeds, flexibilities, and capacities of the system:

IN BANKING

Process a daily average of over 250,000 deposit accounting and stock transfer transactions including sorting and complete updating of master record files in less than two hours.

IN INDUSTRY

Process manufacturing and assembly schedules for a 100,000-unit weekly production rate consisting of 8000 device types and over 15,000 parts; maintain inventory files, bill-of-material files and work-in-progress records; and prepare a 14,000-man payroll and distribute labor charges in a total processing time of less than three hours.

IN INSURANCE

Process an average of 20,000 policy record changes and 10,000 premium billing notices against a file of 1,000,000 policies in less than two hours per day.

IN TRANSPORTATION

Process mileage and location statistics and freight revenue accounting for an average of 75,000 daily freight car

movements in less than two and one-half hours.

These abilities of the system have been achieved through studied departures from conventional data processing techniques. For example, an advanced method of magnetic recording produces faster and more reliable reading and writing, more efficient use of tape and a more effective means of filing, finding and revising business data. High-speed sorting, merging and file maintenance abilities are the result of powerful built-in machine instructions designed specifically for these purposes as well as the basic arithmetic and manipulative functions. Also, the speeds and flexibility of input and output equipment, including conversion from punch cards or paper tape to magnetic tape and from magnetic tape to paper tape, punch cards or printed forms, are consistent with the high speed processing abilities of the system.

A continuing high level of operating efficiency has been assured by strict adherence to conservative design techniques, plus a built-in marginal checking network to facilitate planned periodic maintenance. Completely integrated arithmetic checking verifies every detail of data manipulation.

The result is a combination of unique logical design, proved workmanship, successful performance and a heritage of service and customer satisfaction.

NEW MAGNETIC RECORDING TECHNIQUES

INCREASE SPEED AND CAPACITY

Master record files, work files, tabular data, programs and other permanent or semi-permanent types of information are maintained on magnetic tape where they are available to the Central Processor on demand. All new data is initially recorded on magnetic tape prior to processing and all processed data is returned to tape prior to an output operation.

The particular tape used, the method of recording, and the tape-handling equipment have all been designed to be mutually compatible and to provide high capacity, ease and speed of access to information, and maximum utilization of space on tape.

OVER 30-MILLION CHARACTERS PER REEL OF TAPE

A standard length of DATAmatic 1000 magnetic tape is three inches wide and 2700 feet long. Each tape is divided laterally into 36 channels and longitudinally into uniform segments called blocks. A standard reel of tape contains 50,000 such blocks. Of the 36 channels, 31 are available for recording information with five being used for control purposes.

Within each block, information is organized in discrete units called words. Two words are recorded serially along each of the 31 recording channels for a total of 62 words per block. The DATAmatic word consists of 52 code pulses (dots or dashes) called binary digits or bits. Four of these are used for checking purposes. The remaining 48 are used to represent numeric and alphabetic information. The decimal digits 0 through 9 are represented by combinations of four bits. Six bits are required to represent the various alphabetic characters. Thus, a DATAmatic word may contain up to 12 decimal digits, 8 alphabetic characters or any combination of up to 48 binary

digits. Each block, therefore, may contain up to 744 decimal digits and a reel of tape has a total capacity of 37,200,000 decimal digits (744 digits x 50,000 blocks).

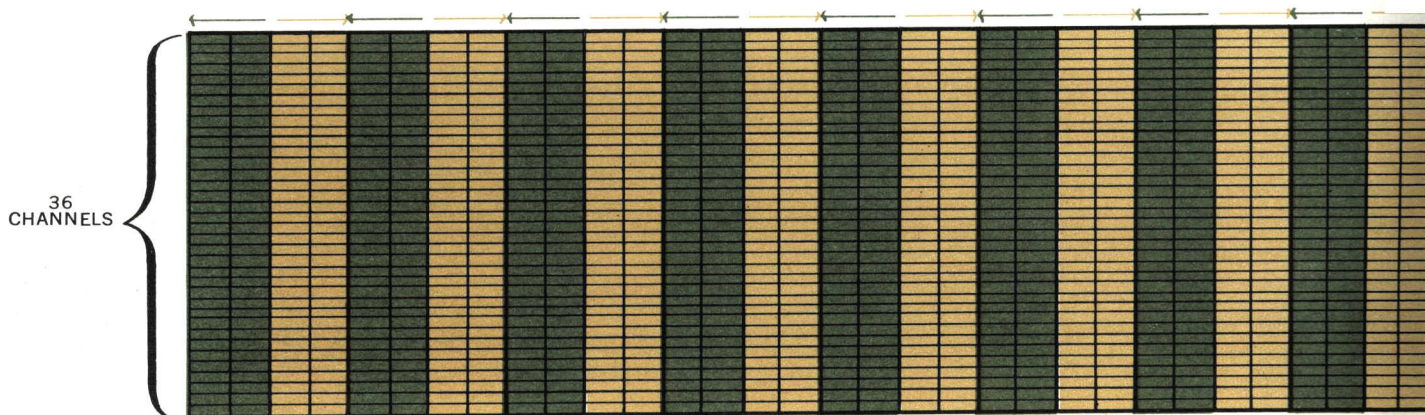
Record length is not restricted by the fixed length of blocks. Several records may be packed within each block or a single record may carry over into successive blocks. One of the uses of special codes, called sentinels, is to indicate the beginning and end of variable-length records.

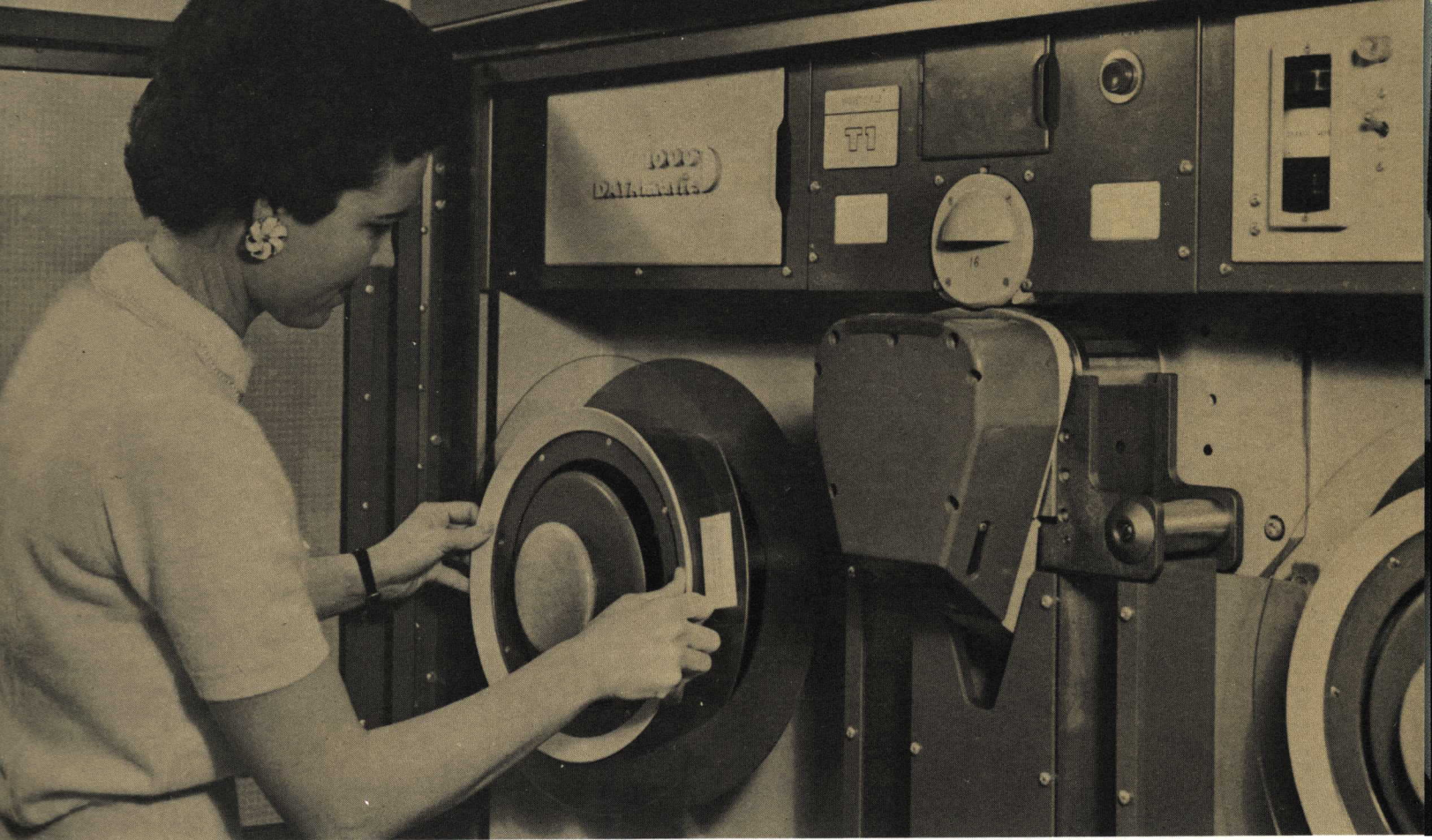
FULL UTILIZATION OF TAPE CAPACITY

Virtually all available recording surface is utilized on the tape due to a unique method of interlacing blocks. As in conventional systems, information is recorded in alternate blocks to allow areas for stopping and starting during processing. The DATAmatic 1000, however, upon reaching the physical end of the tape, automatically reverses tape motion and recording continues in the previously unused blocks. In addition to increased storage efficiency, the need to rewind tapes is eliminated since the last block is adjacent to the first block.

READS OR RECORDS AT A SUSTAINED RATE OF 60,000 DECIMAL DIGITS PER SECOND

Information is recorded on, or read from tape serially along all 31 channels simultaneously. With respect to a single tape, the instantaneous rate of information transfer is 120,000 decimal digits per second. When the need to traverse inter-block record gaps is considered, the sustained rate of transfer is 60,000 decimal digits per second. In normal operation, however, information is recorded on one tape and read from another, simultaneously. Thus the sustained rate of information transfer is





actually 120,000 decimal digits per second.

The recorded information can be read at top speed with the tape moving in either a forward or reverse direction. Also, data may be read and re-recorded selectively, i.e. a single block may be altered without disturbing the information recorded in any other block.

When scanning files for specific items of information, the system has the ability to search on 10 magnetic tapes simultaneously. This provides a scanning or searching rate of up to 600,000 decimal digits per second, a particularly significant ability in file updating applications where a relatively small portion of a large file is affected by a given batch of transactions.

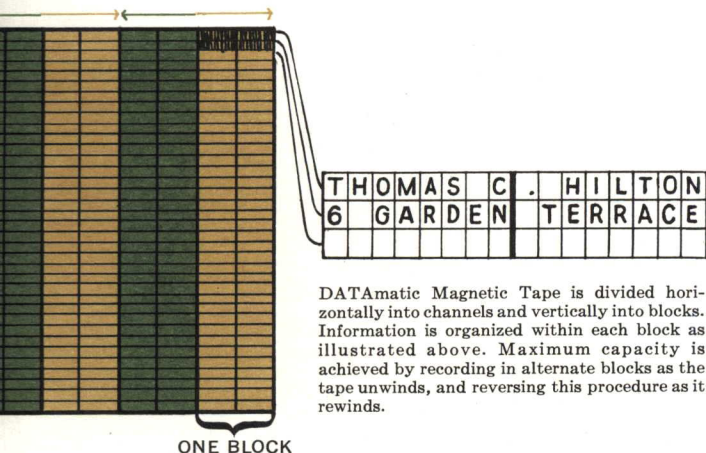
HEAVY-DUTY MAGNETIC TAPE PROVED IN USE

Type VTR-179 magnetic tape was selected for use with the DATAMatic 1000 because of its strength, durability and reliable recording properties. Developed initially for video recording techniques, its abilities were not only particularly well suited to DATAMatic requirements but it had been proved through extended use. It consists of a layer of iron oxide, the recording medium, bonded to a tough Mylar plastic base equipped with a self-lubricating agent. Extensive tests simulating years of day-to-day operation have thoroughly proved the durability of this heavy tape.

VIRTUALLY UNLIMITED FILE CAPACITY

A basic system will utilize four to eight Magnetic File Units although as many as 100 may be directly connected to the system. All Magnetic File Units are compatible with input, output and processing equipment and switching operations are under pushbutton control by the console operator. In addition, any number of Magnetic File Units may be included with off-line conversion systems.

The volume of transactions and the complexity of operations govern the number of directly connected Magnetic File Units needed in a given application. Should future requirements increase, units may be added to the basic system. All tapes are completely interchangeable among all basic input, output and processing operations.



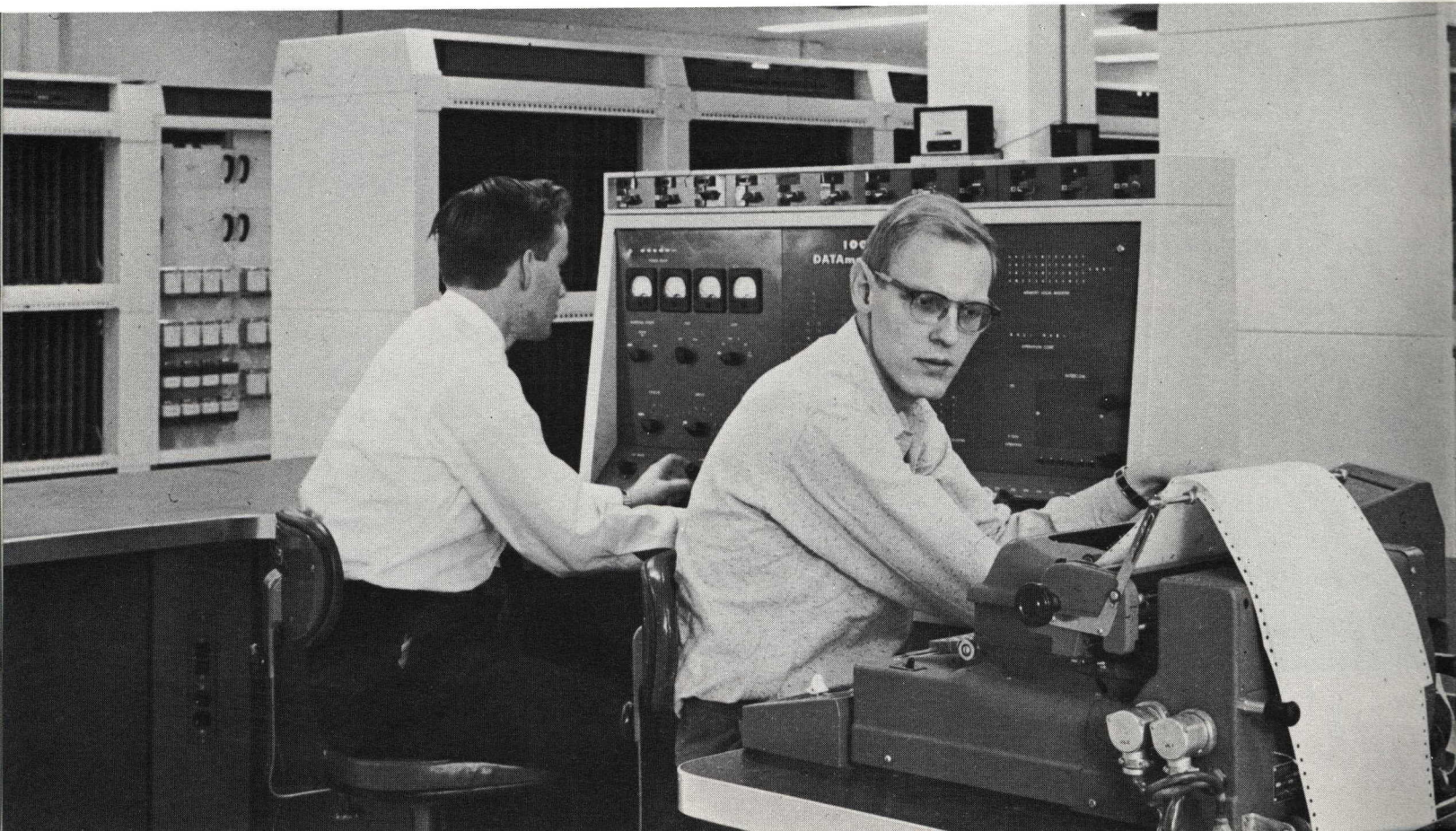
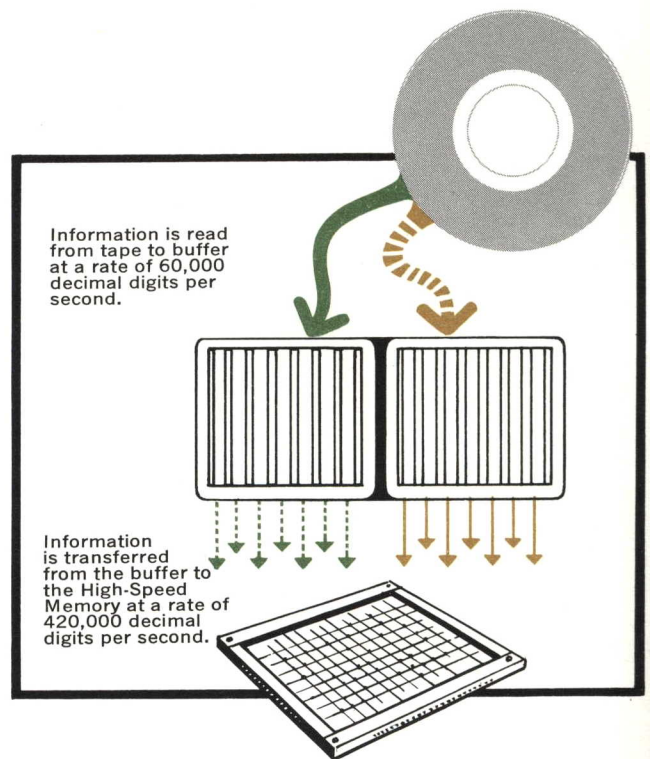
EFFICIENT HANDLING OF DATA INCREASES PROCESSING SPEEDS

The Central Processor includes a High-Speed Memory Unit, Input and Output Buffers, Arithmetic and Control Units, a Read-Write Switching Unit and a Central Console. Together, these units contain the circuitry and controls for automatic performance and monitoring of stored programs.

BUFFERS SPEED DATA FLOW FROM TAPE TO MEMORY TO TAPE

The High-Speed Memory Unit of the Central Processor utilizes over 100,000 magnetic cores to provide a capacity of 24,000 decimal digits. Access to memory is in parallel for rapid readout of stored information.

Auxiliary memory capacity is provided in the form of input and output buffer storage (2,976 decimal digits) which regulate the flow of data between magnetic tapes and the High Speed Memory. This buffer storage enables the Central Processor to process data, read new data from any one tape and record processed data on any other tape, simultaneously.



POWERFUL INSTRUCTIONS SPEED DATA MANIPULATION

The Arithmetic Unit of the Central Processor performs all computations including addition, subtraction, multiplication, division and comparison.

Typical operational speeds for the Arithmetic Unit are: 4300 additions or subtractions per second; 5500 comparison operations per second. Particularly significant is the fact that these speeds refer to complete operations as defined by the 3-address instructions used in the system. For example, an addition instruction provides for the extraction of both the addend and the augend from memory, the addition of these quantities, the transmission of their sum back to the memory, the complete verification of data transmission, the automatic checking of the addition operation, and finally, the transmission to the Control Unit of the next succeeding instruction to be processed.

The Control Unit is responsible for the orderly performance of all operations within the Central Processor, including the interpretation of the instructions and verification that the proper sequence of controls has been called into action.

TYPICAL ARITHMETIC INSTRUCTION

ADD 1054 1572 1976

FUNCTION: Addition

Add the number in memory location 1054 to the number in location 1572 and place the result in location 1976.

OPERATIONAL SPEEDS AND INSTRUCTIONS KEYED TO BUSINESS APPLICATIONS

The DATAmatic 1000 responds to 33 fundamental instructions including those used to perform memory and buffer transfers, word shifting, comparison, calculating, printing, and many other functions.

Many of these instructions were specifically designed for such fundamental business operations as sorting, merging and file maintenance and are in effect, small subroutines.

TYPICAL SORTING INSTRUCTION

DTS 0965 03 15 1300

FUNCTION: Double Transfer and Select

1. Transfer a record (15 words) from consecutive memory locations (starting at 0965) to the output buffer.
2. Transfer a new record (15 words) from the input buffer to the memory locations just vacated.
3. Select from the record, the word containing the sort key information (3rd word) and extract the pertinent sort digit or digits (governed by a stored constant).
4. Modify the third address (1300) based upon the selection made in step 3.
5. Branch to one of a number of alternative routines as determined by step 4.

Tables of representative digital and merge sorting speeds are listed below. In general, the efficiency of one method

versus the other depends on the ratio of the number of items in the file to the number of digits in the sort key. When sorting on large keys, it is frequently advantageous to use a combination of merge and digital techniques.

TYPICAL DIGITAL SORTING SPEEDS

Number of Records	Length of Record (in words)	Sort Key (Decimal Digits)	Number of File Units	Time (in Minutes)
10,000	3	3	6	.75
50,000	15	5	7	28.65
100,000	10	5	4	55.56
200,000	6	4	11	29.17
250,000	5	6	20	30.38

TYPICAL MERGE SORTING SPEEDS

Number of Records	Length of Record (in words)	Type of Merge Sort	Number of File Units	Time (in Minutes)
20,000	30	2-way	4	23.35
50,000	15	2-way	4	30.04
100,000	10	3-way	6	30.5
500,000	5	3-way	6	126.12
1,000,000	15	4-way	8	495.28

For a representative file updating application, consider a main file containing 500,000 items, each of which averages 320 alphabetic characters and 240 decimal digits including a key of up to 24 digits. For a given updating run, assume that a batch of transactions affects 5000 items in this main file. On the DATAmatic 1000, this total file of 500,000 items can be updated *in less than 20 minutes*.

CENTRAL CONSOLE MONITORS SYSTEM OPERATION

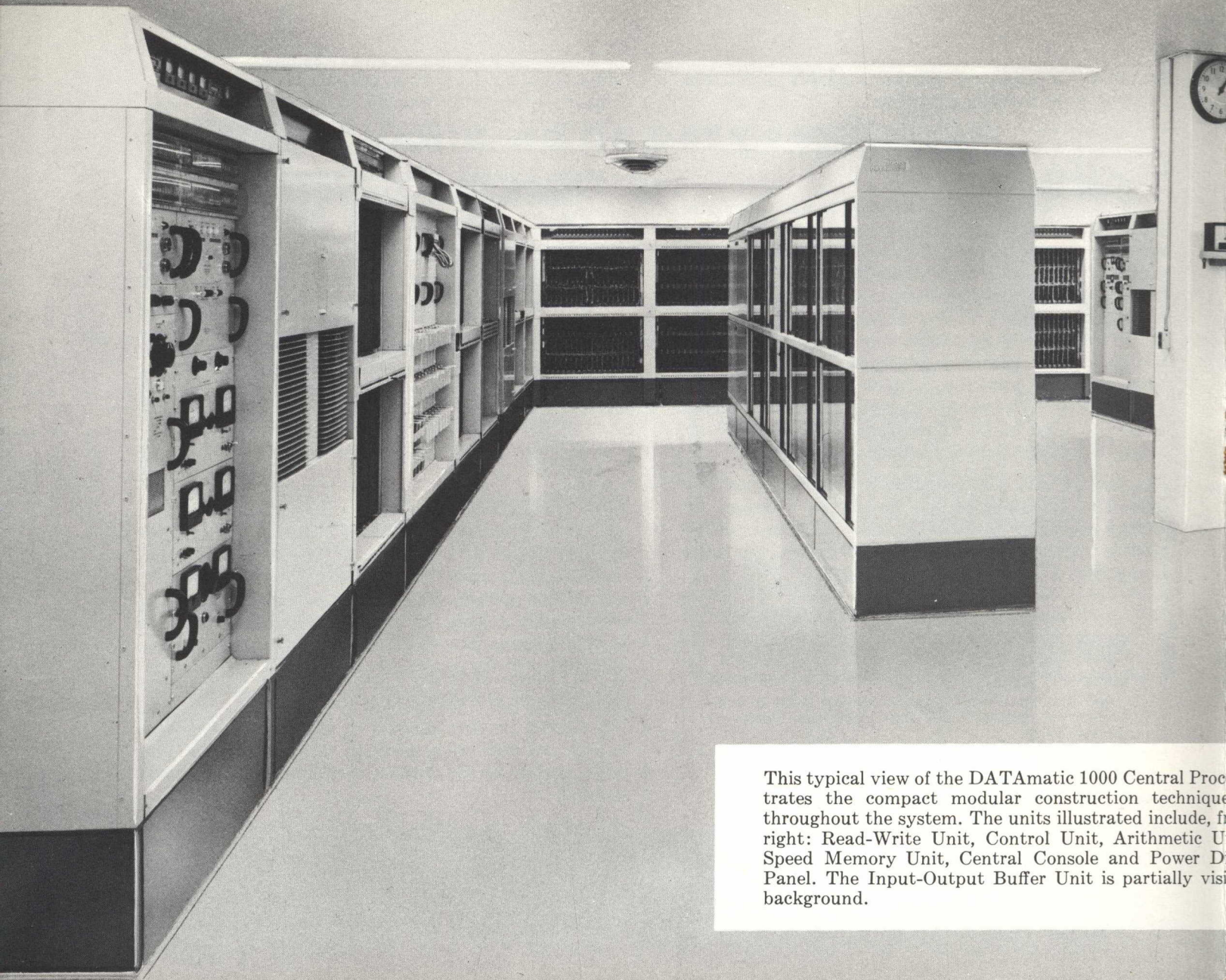
The Central Console provides an efficient means of controlling and monitoring operation of the system. An indicator panel shows the status of the system in all phases of operation.

The operator, via a console typewriter, may read into, or out of the High Speed Memory Unit and certain special registers in connection with the control of system operations.

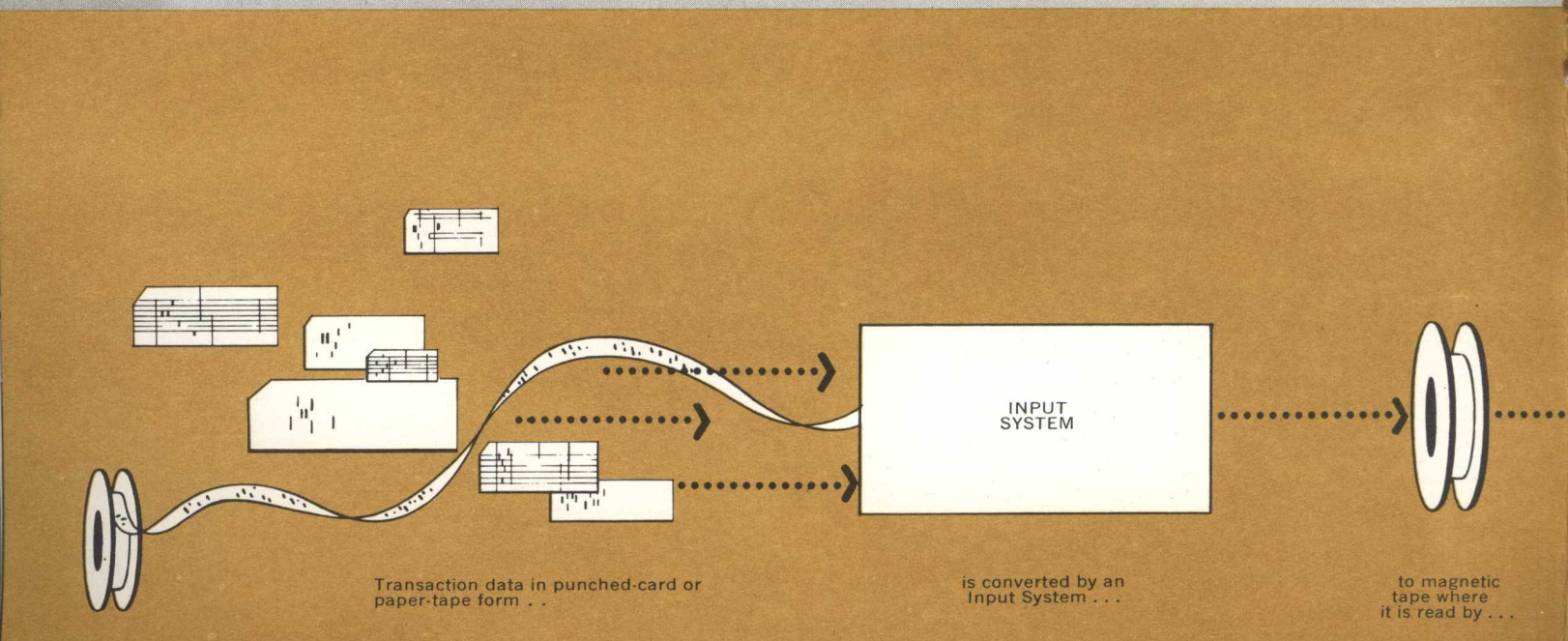
FULL COMPLEMENT OF AUTOMATIC PROGRAMMING AIDS

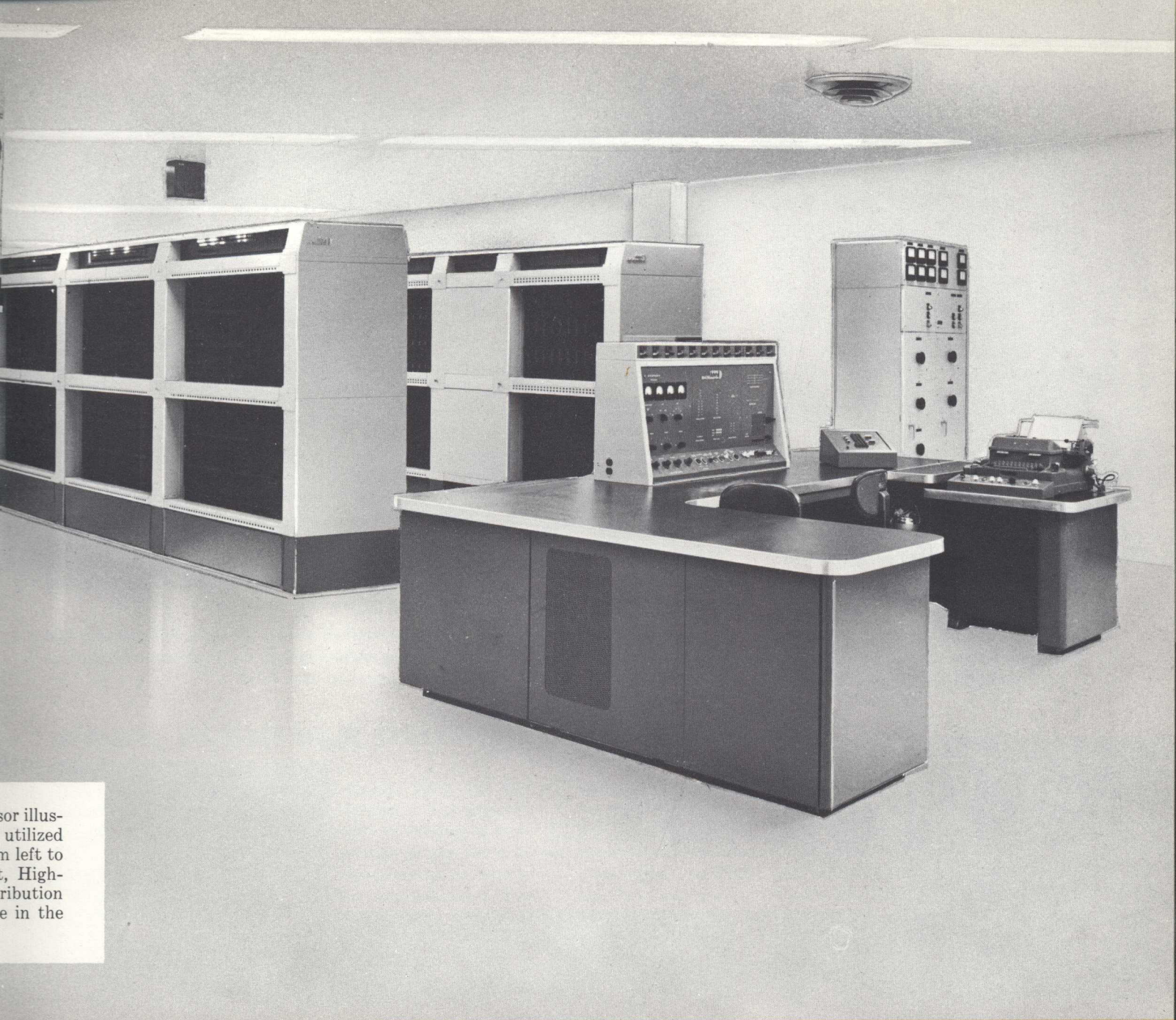
Each customer for a DATAmatic 1000 receives, in addition to the equipment, a growing system of special programs called the DATAmatic Automatic Business Compiler (ABC-1). These programs assist the user by utilizing the DATAmatic 1000 to perform many of the voluminous and routine details of programming. They include:

1. Special Coding systems which allow the programmer to draft his program in relatively simple, easy-to-learn language. Programs in this form can then be translated into machine language automatically by the DATAmatic 1000.
2. A magnetic-tape or punched-card library of standard program subroutines and generating routines, plus special provisions for compiling these routines into programs, adding new routines to the library or modifying existing routines.
3. A collection of utility or "housekeeping" routines which simplify program preparation, modification and checkout.

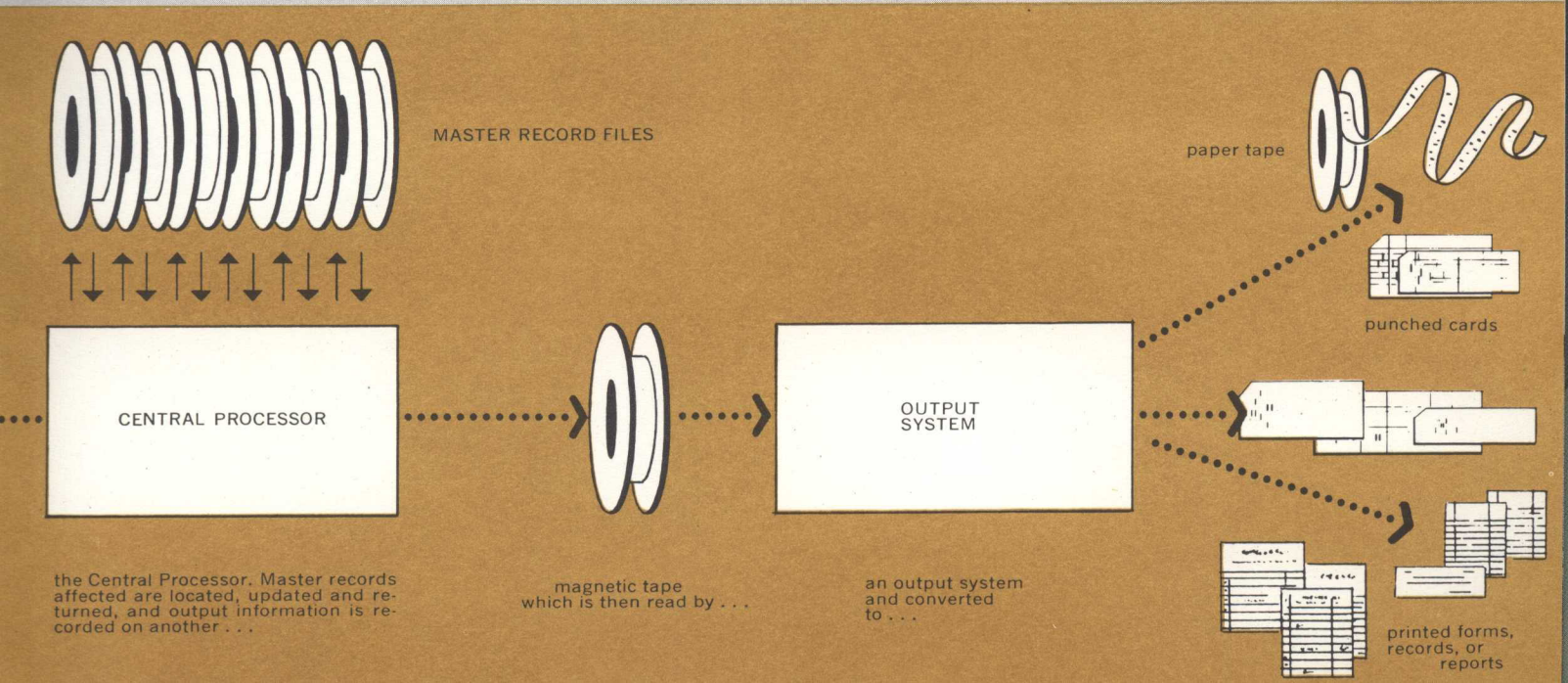


This typical view of the DATAmatic 1000 Central Processor illustrates the compact modular construction technique throughout the system. The units illustrated include, from left to right: Read-Write Unit, Control Unit, Arithmetic Unit, Speed Memory Unit, Central Console and Power Distribution Panel. The Input-Output Buffer Unit is partially visible in the background.





or illus-
 utilized
 n left to
 e, High-
 ribution
 e in the



INDEPENDENT PUNCHED CARD TO MAGNETIC TAPE CONVERSION

The basic input conversion section of the DATAmatic 1000 System consists of a high-speed punched card analyzer and converter feeding a standard Magnetic File Unit. A paper-tape reading input system is also available. All configurations of input equipment may be operated independently of, and thus concurrently with, processing and output operations.

Input information in the form of standard 80-column punched cards is processed at the rate of 900 cards per minute. Each card is read twice and the two readings are compared. The data is converted into machine language, edited, arranged in desired format and recorded on magnetic tape. In this form it is immediately available to the Central Processor.

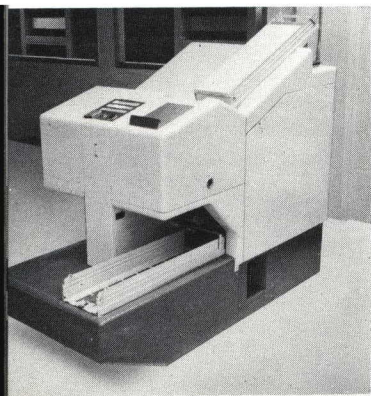
For cross-reference purposes, a control number may be assigned to each batch of punched cards processed. The converter console panel includes provision for entering this number and any constants desired, such as the date

on tape with the corresponding data.

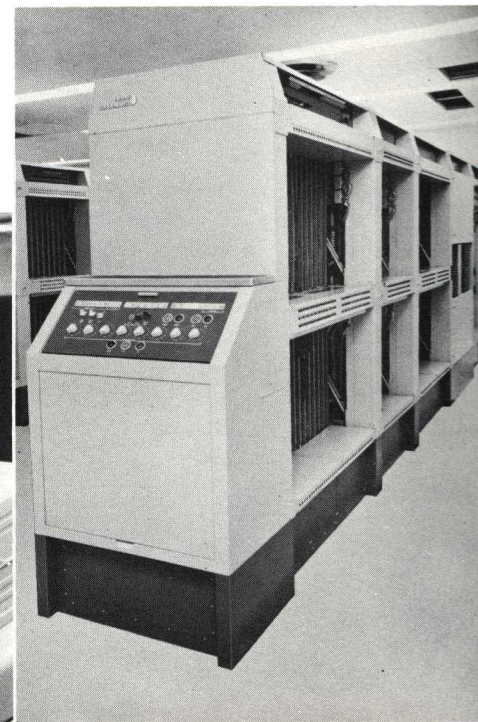
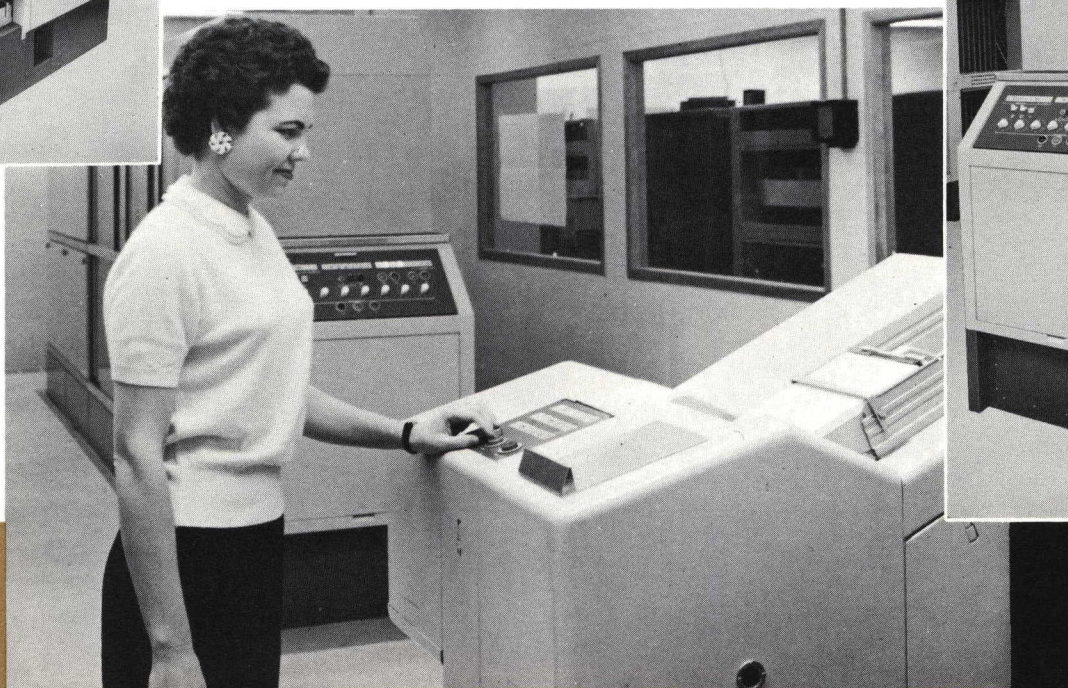
VERSATILE EDITING AND FORMAT CONTROL

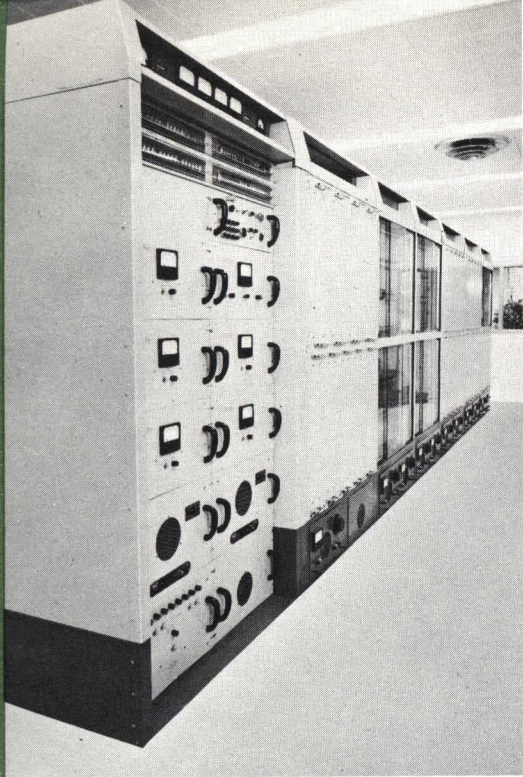
A substantial amount of input data editing can be accomplished in the Input System. For example, a card column may be converted into alphanumeric, numeric or hexadecimal code. In addition, all code configurations based upon common card-punching practices can be translated in special ways. For example, overpunching of particular columns to indicate sign information is readily handled, as well as dual information punching in any column. The converter is equipped to detect erroneous blank columns as well as illegal or impossible punch configurations and to take any of several alternative actions when an illegal punch is sensed.

The Converter control panels also provide considerable flexibility in the transposition, duplication or deletion of input data in punched card form.



This high-speed Input System reads punched cards at the rate of 900 cards per minute, including checking, editing, converting and recording the information onto magnetic tape.





The DATAmatic high-speed Output Printing System converts, edits and prints information at the rate of 900 120-character lines per minute.

FAST, FLEXIBLE OUTPUT CONVERSION

The Output Section of the DATAmatic 1000, like the Input Section, is independent of the rest of the system. Its function is to convert information on magnetic tape to paper tape, punched cards or printed forms. Several output systems are available and the selection or combination will depend upon the output requirements of the application.

HIGH SPEED OUTPUT SYSTEM PRINTS 900 LINES PER MINUTE

DATAmatic's high-speed Output Printing System operates at a rate of 900 lines per minute, printing up to 120 characters over a range of 160 possible print positions per line. In many instances, two or more forms can be printed side by side, effectively multiplying the basic printing speed.

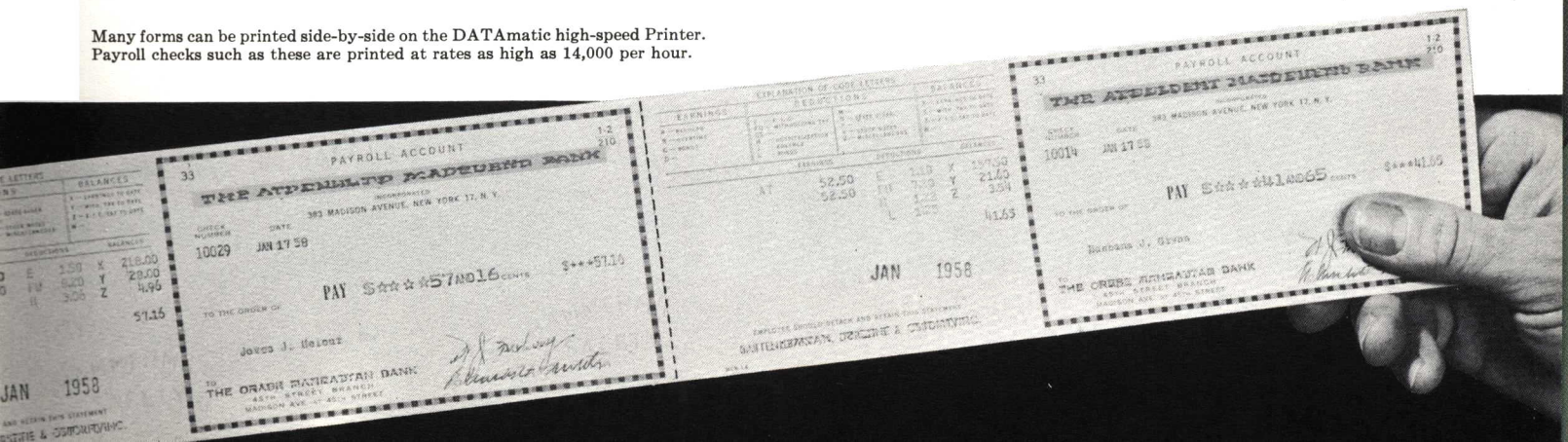
Input and output storage plus a series of control panels give the system exceptional flexibility in converting data

on magnetic tape to final printed form. Information may be selected, rejected, transposed or repeated on almost any basis desired. Characters may be added to, or substituted for, characters of the original data. Certain parts of information, normally printed, may be suppressed dependent upon the content of other data within the particular record. Complete printing format flexibility is thus available without any need for using Central Processor time to edit output tapes.

STANDARD PUNCH CARD, PAPER TAPE OR PRINTED OUTPUT AVAILABLE

Other DATAmatic output equipment includes a conversion system for driving a standard 150-line-per-minute printer or 100-card-per-minute card punch, and a magnetic-tape-to-paper-tape system which includes a standard 3600-character-per-minute paper tape punch.

Many forms can be printed side-by-side on the DATAmatic high-speed Printer. Payroll checks such as these are printed at rates as high as 14,000 per hour.



DATAMATIC 1000 RELIABILITY IS A COMBINATION OF ESTABLISHED ACCURACY, POSITIVE CHECKING AND CONSERVATIVE ENGINEERING

The DATAmatic definition of reliability includes the business requirement of continued optimum performance from electronic and mechanical equipment backed up by positive arithmetic accuracy.

High electronic and mechanical reliability is achieved through the use of conservative, thoroughly proved design practices. Accuracy is assured by a combination of arithmetic and engineering techniques including a completely integrated checking system.



Unit package techniques, used throughout the system, insure high reliability and facilitate maintenance.

WEIGHT COUNT CHECKING PROVES ALL TRANSFERS AND COMPUTATIONS

An arithmetic checking system is utilized in the DATAmatic 1000 to verify all generated results, plus all transfers of data within the system. A weight count digit (based on the "casting out of nines" principle) is generated for each basic unit of data during the conversion process and is recorded with the data. Following each transfer, a new weight count digit is generated and compared with the original. Furthermore, checking circuit performance is in turn checked for positive assurance of accuracy.

SPECIAL CHECKING CIRCUITS VERIFY PERFORMANCE OF INSTRUCTIONS

An extension of the weight count checking system is utilized in connection with instructions. The operation code and memory locations are checked individually and several other logical checks are included to assure proper execution of each instruction.

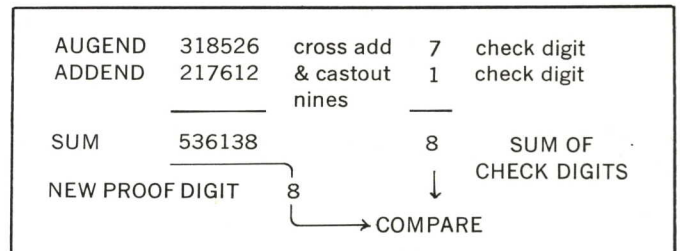
As an added safeguard, the code structure has been designed so that the signals representing one operation cannot be transposed to represent any other legitimate operation. Furthermore a continuous check is made on the operation code to assure that it remains constant while it is in storage. Thus, it is impossible for the system to perform any operation other than that called for by the program.

CHECK CIRCUITS INSURE FOOLPROOF READ-RECORD OPERATIONS

Several check circuits in the Magnetic File Units verify that the operation called for is initiated, that the designated unit has been selected, that only one operation is being performed, that the tape is properly positioned and moving in the correct direction, and that the proper read or write selection has been made. Following an operation, checks are made to assure that the tape has stopped unless a new operation has begun on the same unit. A final check is made to verify that the operation performed was that called for by the order.

CHECK SIGNAL VERIFIES PRINTED INFORMATION

One of the last of a long series of individual checking steps



The "casting out nines" principle of arithmetic checking is utilized throughout the DATAmatic 1000.

compares the characters activated in the High-Speed Printer with the characters stored in the converter output register. This verifies, first of all, that a character has been driven, and secondly, that it is the correct character.

UNITIZED COMPONENTS PLUS MARGINAL CHECKING SPEED MAINTENANCE

The design technique of unitized plug-in components has been incorporated throughout the DATAmatic 1000 system to facilitate replacement and maintenance. Furthermore, a built-in marginal checking network, operated from the Central Console, permits convenient systematic checking of component performance levels.

TIME MODULATED PULSES INCREASE RECORDING RELIABILITY

A specially developed method of magnetic recording varies the length rather than the strength of the magnetic pulses which form the code used in storing data on tape. The resulting dot-and-dash code affords a much wider range of positive signal identification than conventional on-off codes.

EFFICIENT AIR CONDITIONING BUILT-IN

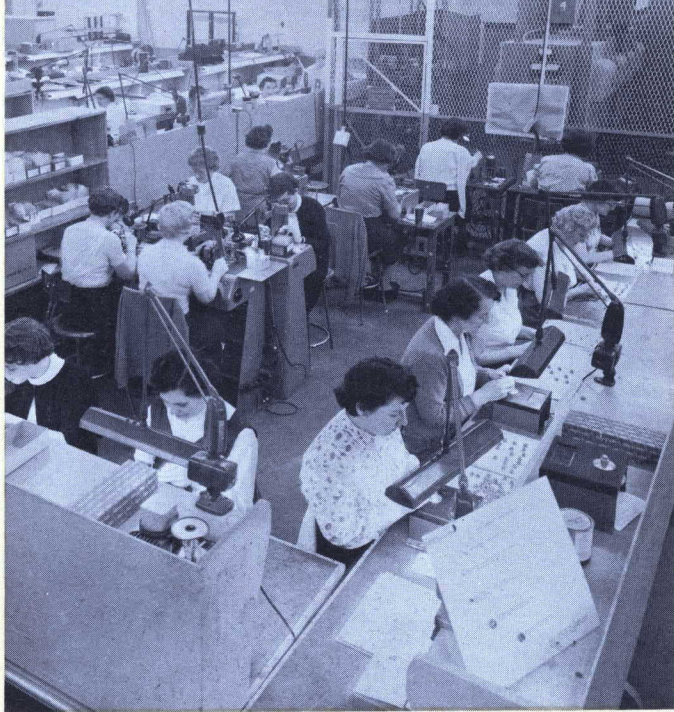
Incorporated within the system are 35 to 40 tons of cooling. Cooled air is distributed efficiently through the equipment and exhausted into the room at temperatures normally sufficient to provide comfortable year-round working temperatures in a typical room enclosure.

BEFORE, DURING AND FOLLOWING INSTALLATION

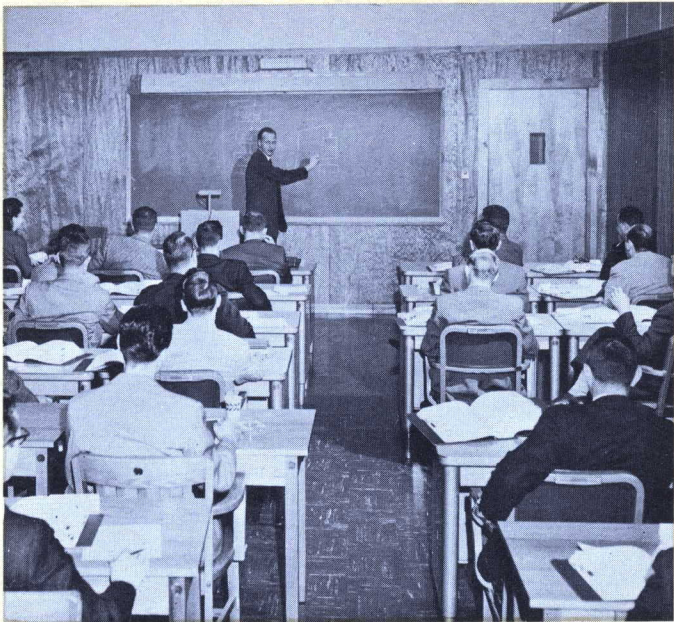
DATAmatic places a full staff of expert personnel at the disposal of every customer. Specific DATAmatic customer services include full indoctrination, training and initial supervision of customer application, programming and operating personnel. Counsel and assistance in site preparation and installation are followed by continuing instruction and guidance in advanced programming techniques and applications.

New developments in programming and application techniques as well as equipments are communicated on a continuing basis.

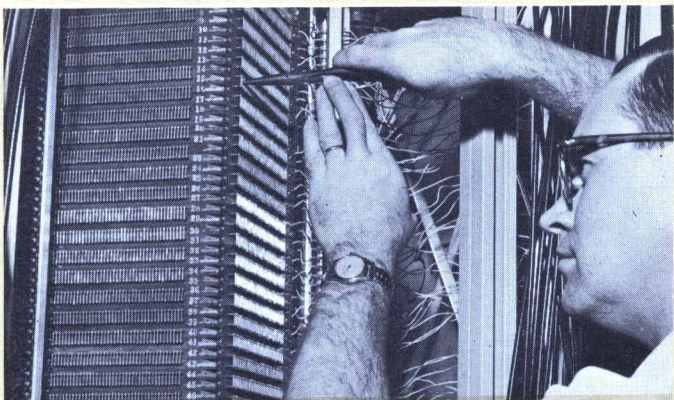
A well-trained maintenance staff is stationed at each installation and is equipped with a full complement of spare parts and test equipment.



Highly conservative design and construction techniques plus exhaustive quality control insure reliable system performance.



DATAmatic service includes thorough training of customer personnel in operation and application of the system.




The High-Speed Memory of the DATAmatic 1000 contains over 100,000 tiny magnetic cores.

**A HERITAGE
OF ELECTRONIC
PIONEERING**



The DATAmatic 1000 has evolved from more than ten years of extensive digital computer design and development experience. Key DATAmatic personnel were instrumental in developing and utilizing the first military and scientific computers conceived during World War II. Following delivery of the large-scale scientific computer, RAYDAC, to the United States Navy, research and development leading to an advanced system specifically designed for business data processing applications was initiated at Raytheon Manufacturing Company. This system became the DATAmatic 1000 when, in 1955, Minneapolis-Honeywell Regulator Company and Raytheon formed the jointly owned DATAmatic Corporation. . Approximately two years later, Honeywell acquired full ownership, and DATAmatic was subsequently established as a division of the Minneapolis-Honeywell Regulator Company.



For additional information on DATAmatic
1000 applications, availability and perform-
ance write: DATAmatic

A Division of Minneapolis-Honeywell
Regulator Company

151 Needham Street
Newton Highlands 61, Massachusetts

Honeywell



DATAmatic

ELECTRONIC DATA PROCESSING

