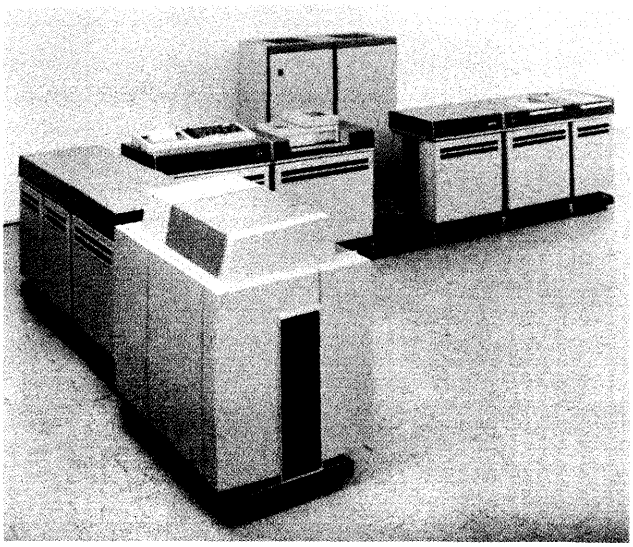
NCR Century Series



A family of two small-scale computer systems designed primarily for business data processing. Impressive performance at low prices is achieved through innovations such as rod memory, integrated circuits, dual-spindle disc units, and completely disc-oriented software.

MANAGEMENT SUMMARY

NCR made a belated but highly impressive entry into the third-generation computer sweepstakes in March 1968, when it announced the Century Series. The Century 100 and 200 Processors, supported by a well-defined complement of peripheral equipment and software, have made NCR a formidable contender in the hotly contested marketplace for small-scale business data processing systems.

Efforts by NCR designers to maximize performance while meeting pre-set cost targets have led to a number of significant technical innovations. A new type of thin-film, short-rod memory provides 800-nanosecond cycle times at comparatively low prices. Monolithic integrated circuits are used throughout the line, and more than 80 percent of the logic is made up of just six standard circuit boards. Every Century system includes at least one dual-spindle disc pack drive unit, with 12 read/write heads serving each disc surface to provide rapid access. Moreover, all software is disc-oriented, so that even the smallest Century 100 systems can use integrated operating systems and COBOL and FORTRAN compilers.

Initial deliveries of the Century 100 system were made in November 1968, and more than 300 have been delivered to date. Century 200 deliveries began in June 1969. NCR's announced marketing goal is to sell 5,000 Century computers within five years, and the company currently claims to be ahead of schedule in the pursuit of this goal.

CHARACTERISTICS

MANUFACTURER: The National Cash Register Company, Dayton, Ohio 45409.

MODELS: NCR Century 100 and Century 200 Computer Systems.

DATA FORMATS

BASIC UNIT: 8-bit byte. Each byte can represent 1 alphanumeric character, 1 or 2 BCD digits (in unpacked or packed format, respectively), or 8 binary bits.

FIXED-POINT OPERANDS: Can range from 1 to 256 bytes in length, in either decimal or binary mode.

FLOATING-POINT OPERANDS: Consist of a 7-bit hexadecimal exponent and a 24-bit or 56-bit fraction (in "short" or "long" format, respectively).

INSTRUCTIONS: 4 or 8 bytes in length, specifying 1 or 2 memory addresses, respectively.

INTERNAL CODE: USASCII.

MAIN STORAGE

STORAGE TYPE: Thin-film, short-rod. Each plated copper rod stores 1 bit and is 0.006 inches in diameter and 0.110 inch long.

CAPACITY: 16,384 or 32,768 bytes in Century 100; 32,768, 65,536, 131,072, 262,144, 393,516, or 524,288 bytes in Century 200.

CYCLE TIME: 800 nanoseconds per 1-byte access in Century 100; 800 nanoseconds per 2-byte access in Century 200.

CHECKING: Parity bit with each byte is generated during writing and checked during reading.

STORAGE PROTECTION: Provided by the optional Multiprogramming feature for the Century 200 only.

RESERVED STORAGE: Byte locations 0 through 1279 are reserved for registers, control words, and the resident executive.

CENTRAL PROCESSORS

INDEX REGISTERS: 63, located in main storage.

INDIRECT ADDRESSING: None in Century 100; up to

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Early announcement of a third, more powerful processor was promised when the Century Series was introduced, but the promise has not been fulfilled to date. There are indications, however, that the announcement may occur early in 1970.

There have been scattered complaints from early Century Series users about hardware defects and software inefficiencies. Other users, however, are delighted with the performance of both the hardware and software, and the Century systems have been selected over competitive equipment in several situations where the choice was based upon price and performance on benchmark programs.

Compatibility between the Century computers and other currently popular systems is limited. IBM-compatible tape units and an 8-bit byte data format are used, but the internal code is USASCII rather than EBCDIC, and System/360 compatibility has been ignored in both the processor architecture and the removable disc packs. Optional compatibility features enable a Century 200 to execute machine-language programs written for the second-generation NCR 315 or IBM 1401, 1440, or 1460 computers.

NCR has maintained full upward compatibility between the Century 100 and 200 systems. The Century 100 Processor has a "stripped-down" repertoire of just 19 instructions. The Century 200, which is four to five times as fast internally as the 100, has 39 standard instructions, with up to 27 more instructions available through various optional features. NCR stresses that all hardware differences between the two processors are resolved by the standard software, so that it will be easy to move up from a Century 100 to a 200 without reprogramming.

The basic Century 100 system consists of a central processor with 16,384 bytes of rod memory, two I/O channels, one dual-spindle disc drive, a 450-lpm printer, and either a 300-cpm card reader or 1000-cps paper tape reader. The processor contains built-in controllers for the three standard peripheral units. The memory capacity can be increased to 32,768 bytes, and a wide range of peripheral equipment can be connected.

The basic Century 200 system consists of a processor with 32,768 bytes of rod memory, four I/O channels, a console typewriter, one dual-spindle disc drive, a 1500-lpm drum printer, and either a 300-cpm card reader or 1000-cps paper tape reader. A Century 200 can be expanded by adding up to 524,288 bytes of rod memory, four more I/O channels, numerous peripheral units, and several worthwhile optional features.

Probably the most significant Century Series peripheral unit is the dual-spindle disc drive. Every Century system

5 levels in Century 200.

INSTRUCTION REPERTOIRE: Century 100 has 19 instructions: decimal add and subtract, binary add and subtract, move, compare, pack, unpack, repeat, wait, input/output, and 8 differenct branch instructions. Arithmetic can be performed only in unpacked decimal and binary modes, upon unsigned fields up to 256 bytes in length.

Century 200 has 39 standard instructions, including all Century 100 instructions plus facilities for packed, signed decimal addition and subtraction, editing, code translation, scanning, and bit and character testing. Up to 27 more instructions can be added by the Optional Features listed below.

ADD TIME: for 2-address decimal addition of unsigned, unpacked 5-digit fields: 59 microseconds for Century 100; 18 microseconds for Century 200.

For 2-address decimal addition of signed, packed 5-digit fields: instruction not available for Century 100; 14 microseconds for Century 200.

MULTIPLY TIME: For 2-address decimal multiplication of signed, packed 5-digit fields: instruction not available for Century 100; 78 microseconds for Century 200 with optional Multiply feature.

DIVIDE TIME: Fixed-point divide instruction is not available; subroutine is always used.

OPTIONAL FEATURES (all for Century 200 only):

Multiply feature provides fixed-point multiplication of packed decimal fields.

Command feature provides logic and table compare instructions.

Floating Point feature provides 12 instuctions for floating-point arithmetic in "short" (4-byte) and "long" (8-byte) formats.

Multiprogramming feature provides base and limit address registers, interval timer, and other hardware facilities to make multiprogrammed operation practical.

Trace (Console Debug) feature provides 3 special instructions to facilitate program debugging.

NCR 315 Compatibility feature provides 3 additional instructions and a separate Emulation Unit, enabling a Century 200 to execute programs written for NCR 315 computers.

IBM 1401 Compatibility feature provides special instructions that facilitate software simulation of IBM 1401, 1440, or 1460 computers. Internal speed of Century 200 in Compatibility mode is about 1.5 times that of the original 1401.

INPUT/OUTPUT CONTROL

I/O CHANNELS: 2 in Century 100; 4 or 8 in Century 200. A maximum of 2 Century 200 channels can be special "High-Speed Trunks."

CONFIGURATION RULES: 8 I/O unit positions per

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includes at least one of these units, and all software is disc-resident. Each disc unit has two vertical spindles, and each of the spindles drives a removable disc pack. The NCR disc pack consists of three discs, weighs less than 10 pounds, and holds 4,194,304 bytes or 8,388,608 packed BCD digits.

NCR also offers an upgraded version of its CRAM (Card Random Access Memory) for the Century Series. CRAM was the first successful magnetic-card storage device and the most novel feature of the second-generation NCR 315 system. The new Model 653-101 CRAM unit stores up to 145 million bytes in an interchangeable 384-card cartridge. It provides large on-line data storage capacities at comparatively low cost, though card wear considerations and relatively slow access times make it unsuitable for storing data that must be accessed very frequently.

A broad range of other peripheral equipment is offered for the Century Series, as described in the CHARACTERISTICS Columns of this report. All of the Century equipment is manufactured by NCR except for the magnetic tape units (Control Data), data recorders (Mohawk), and display units (Sanders).

NCR currently offers only one communication controller for the Century computers, a simple controller for up to 15 lines that can handle transmission speeds ranging from 45 to 40,800 bits per second. A family of adapters provides the appropriate interfaces between the controller and various types of communication lines and terminal equipment.

All software for the Century computers is disc-oriented and highly integrated. The principal software facilities include four levels of operating systems, compilers for COBOL and FORTRAN, an assembler for NCR's own NEAT/3 language, and an impressive assortment of utility routines and application programs. COBOL and FORTRAN compilers are each offered at three different levels, tailored for operation on different equipment configurations.

NEAT/3 is essentially a symbolic assembly language, but it places an unusually strong emphasis upon the use of macro-instruction facilities. NCR is encouraging most Century users to program exclusively in the "Level 1" version of NEAT/3. At this level, all coding consists of macro-instructions and pre-coded "Major Functions." Thus, the programmer does not need to concern himself with machine instructions or other hardware details. For more advanced programmers, higher-level versions of NEAT/3 permit full utilization of all the Century hardware facilities.

Customer support for the Century Series computers is focused on several Regional Systems Centers. These facilities are staffed by specialists in the major fields

channel. Integrated peripheral units occupy 6 positions in Century 100 and 2 full channels in Century 200. All remaining positions can be used to service other I/O units and/or controllers.

SIMULTANEOUS I/O OPERATIONS: Maximum of 2 in Century 100 and 4 or 8 in Century 200 (i.e., 1 operation per I/O channel).

I/O DATA RATE: Maximum of 40,000 and 120,000 characters per second, respectively, for the two Century 100 I/O channels. Maximum of 130,000 and 450,000 characters per second, respectively, for the Century 200 standard and High-Speed channels.

I/O INTERFERENCE: Century 100 Processor is delayed 4.8 microseconds per I/O character transferred to or from main storage. Century 200 is delayed 3.2 or 0.8 microseconds per character for the standard or High-Speed channels, respectively.

MASS STORAGE

DUAL-SPINDLE DISC UNITS: Each unit has two independent spindles, each capable of driving a removable disc pack. Each 3-disc pack stores up to 4,194,304 bytes in 512-byte sectors. Twelve read/write heads serve each of the 6 recording surfaces. Up to 262,144 bytes per pack can be read without head movement. Average head movement time is 44 milliseconds. The following models are available:

655-101 & 655-102: First and second "integrated" disc units for Century 100. Average rotational delay is 20.8 milliseconds. Data transfer rate is 108,000 bytes/sec.

655-201: Usable with Century 100 or 200. Up to 4 units can be connected to a 625-101 Disc Controller. Average rotational delay is 20.8 milliseconds. Data transfer rate is 108,000 bytes/sec.

655-202: Usable with Century 200 only. Up to 4 units per 625-101 Disc Controller. Average rotational delay is 12.5 milliseconds. Data transfer rate is 180,000 bytes/sec.

653-101 CRAM (Card Random Access Memory): Each unit stores 145 million bytes in a removable cartridge containing 384 oxide-coated mylar cards. Card drop time is 90 to 125 milliseconds. Average rotational delay is 24 milliseconds. Data transfer rate is 83,000 bytes/sec. Up to 8 units per 623-201 CRAM Controller.

INPUT/OUTPUT UNITS

MAGNETIC TAPE HANDLERS: Seven models of CDC-built tape units are offered. Data transfer rates range from 10,000 to 240,000 bytes/sec. All use standard 1/2-inch tape and have vacuum-capstan drives. Up to 8 tape handlers can be connected to a control unit. The following models are available:

633-111: 9 tracks; 1600 bytes/inch; 80,000 bytes/sec.

633-121: Dual-drive unit with same characteristics as 633-111.

633-211: 9 tracks; 1600 bytes/inch; 144,000 bytes/sec.

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served by NCR. The centers also provide training courses for customer personnel and computers on which customers can compile and test their programs before their own systems are delivered.

On September 29, 1969, NCR announced a new U.S. pricing structure that can best be described as "partial unbundling." The company will supply certain essential and predetermined systems support, educational assistance, and software without extra charge, but additional services required above that basic level will be separately priced.

With respect to systems support, each customer will be entitled, as part of the regular system rental or purchase price, to approximately 30 man-days of support for each $1,000 of monthly rental. Systems support beyond this basic allowance will be billed at rates commensurate with the level of professional skills required. As of January 1, 1970, the same pricing concepts will apply to educational support and software as well.

NCR's new pricing policy represents a reasonable "middle road" between the overall package pricing that has been traditional for the computer industry and the complete separation of hardware and software prices. The NCR approach recognizes each computer manufacturer's fundamental obligation to provide its customers with the basic tools necessary to implement their systems. At the same time, it makes additional software, support, and education conveniently available to users who need this further assistance and are willing to pay for it, without penalizing those who do not. □

633-221: Dual-drive unit with same characteristics as 633-211.

633-311: 9 tracks; 1600 bytes/inch; 240,000 bytes/sec. Not usable with Century 100.

633-117: 7 tracks; 200, 556, or 800 char/inch; 10,000, 27,800, or 40,000 char/sec.

633-119: 9 tracks; 800 bytes/inch; 40,000 char/sec.

682-100 INTEGRATED CARD READER: integral part of the Century 100 or 200 console. Reads standard 80-column cards at 300 cpm.

686-101 CARD READ/PUNCH: Single card feed path. Reads up to 750 cpm and punches 82 to 240 cpm, depending on number of columns punched.

686-201 CARD READER: Reads up to 750 cpm.

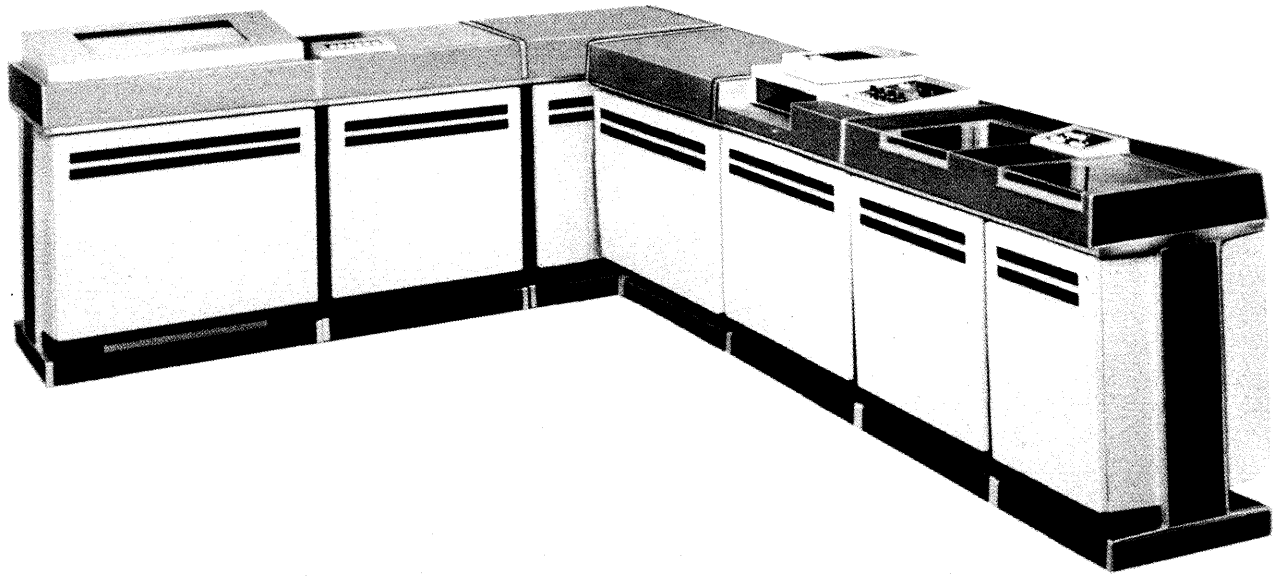
686-301 CARD PUNCH: Punches 82 to 240 cpm, depending on number of columns punched.

662-100 INTEGRATED PUNCHED TAPE READER: Integral part of the Century 100 or 200 console, as alternative to the 682-100 Card Reader. Reads 5-, 7-, or 8-channel tape at 1000 char/sec.

660-101 PUNCHED TAPE READER: Reads 5-, 7-, or 8-channel tape at 1500 char/sec.

665-101 TAPE PUNCH: Punches 5-, 7-, or 8-channel tape at 200 char/sec.

640-102 INTEGRATED PRINTER: Integral part of basic Century 100 system. Can also be connected to a Century 200. Has 132 print positions and 64 printable characters. Peak speed is 450 lpm. Optional 51-character set enables all-numeric printing at 900 lpm.



The basic NCR Century 100 System.

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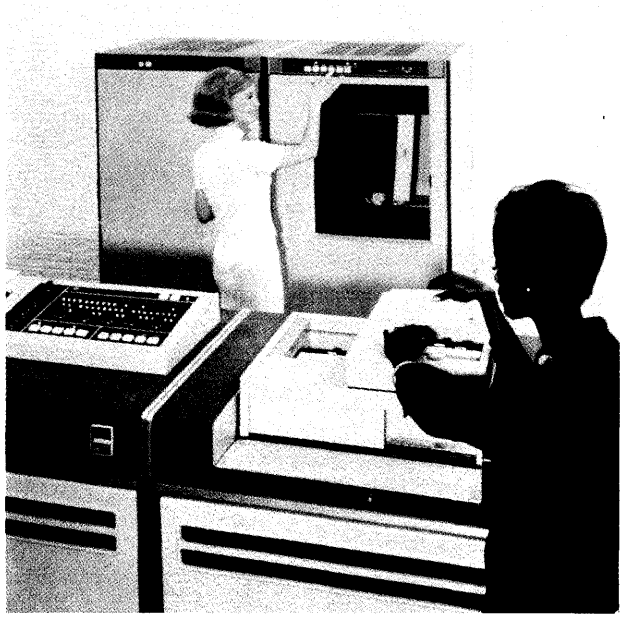

The Century 200 control panel (left), card reader (right), and CRAM unit (background).

640-200 PRINTER: Usable as integrated printer in basic Century 200 system. Can also be connected to any Century 100 or 200 I/O unit position via 626-101 Control. Has 132 print positions and 64 printable characters. Peak speed is 1500 lpm. Optional 52-character set enables all-numeric printing at 3000 lpm.

620-210 PRINTER: Same as 640-200, except has 160 print positions.

640-300 PRINTER: Usable in same manner as 640-200. Has 132 print positions and up to 128 printable characters. Peak speed is 600 lpm for 64- and 96-character sets.

I/O WRITER: Standard in Century 200 Processor; optional in Century 100. Provides keyboard input and serial printed output. Rated output speed is 66 words/min.

420-1 OPTICAL CHARACTER READER: Reads journal tapes imprinted with NCR Optical Font (NOF) characters at 52 lines per second. Reads up to 32 characters per line. Recognizes 10 stylized numeric digits and 6 special symbols.

670-101 MICR SORTER: Reads MICR-encoded documents at up to 600 per minute. Has 11 pockets. Also usable for off-line sorting.

671-101 MICR SORTER: Reads MICR-encoded documents at up to 1200 per minute. Has 18 pockets. Also usable for off-line sorting. Not usable with Century 100.

735 & 736 DATA RECORDERS: These keyboard-to-tape recorders, manufactured by Mohawk Data Sciences, can be connected on-line to provide low-speed magnetic tape input (at up to 1500 char/sec) and output (at up to 700 char/sec).

795 DATA DISPLAY SYSTEM: Displays alphanumeric data in 7.5 by 9.5 inch viewing area on a CRT. Displays a maximum of 256, 512, or 1024 characters, in 32 lines with 64 character positions each. Optional keyboard permits manual data entry. Control unit handles up to 12 display units.

COMMUNICATION CONTROL

621-101 COMMUNICATIONS CONTROLLER: Controls up to 15 lines, at transmission speeds of 45 to 40,800 bits/sec. Has a 16-position scanner and single-character buffer. Most I/O control functions must be performed by the Century 100 or 200 Processor.

SOFTWARE

OPERATING SYSTEMS: NCR provides 4 different levels of integrated, disc-resident operating systems for the Century Series computers. Each consists of a Monitor, an Executive, and several other routines. The Monitor controls the sequencing, loading, and linking of programs. The Executive is a run-time supervisor that handles all I/O operations, error conditions, and program overlays. The 4 levels can be summarized as follows:

BASIC EXECUTIVE (B1): Usable on all Century systems. Handles batch processing of one program at a time. Resident portion occupies about 4000 bytes of main storage. Delivered in November 1968 with the first Century 100 systems.

DUAL OPERATING EXECUTIVE (B2): Usable on Century 100 or 200 systems with at least 32K bytes of main storage. Divides memory into two distinct areas. One is dedicated to a single real-time or batch program. The other area is used for sequential processing of batch programs. Delivered late in 1969.

MULTIPROGRAMMING EXECUTIVE (B3): Usable on Century 200 systems with at least 64K bytes and the Multiprogramming feature. Divides memory into two or more partitions of at least 16K bytes each. Each partition has its own set of 63 index registers, its own disc unit, and its own job stream, so its operations are largely independent of those in other partitions. Delivered late in 1969.

MULTIPROGRAMMING EXECUTIVE (B4): Requires at least 128K bytes and the Multiprogramming option. Divides memory into fixed partitions, each with a separate job stream. Provides multitask control for up to 240 active tasks. No firm delivery date has been specified.

COBOL: Three different COBOL compilers are available. All use source language based on the USA Standard.

STAGE I COBOL: Usable on a basic 16K Century 100. Language is a restricted but useful subset of USASI COBOL. Compilation speed, according to NCR, is about 50 or 100 statements per minute on a 16K or 32K Century 100, respectively.

STAGE II COBOL: Usable on a 32K Century 200. Language consists of the following USASI modules: high level Nucleus, Random Access, and Sequential Access; medium level Table Handling; and low level Segmentation and Library. Compilation speed,

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according to NCR is about 100, 200, or 500 statements per minute on a Century 200 with 32K, 65K, or 262K, respectively.

STAGE III COBOL: Usable on a Century 200 with at least 65K. Language is stated to be a complete, high-level implementation of USASI COBOL, including the Sort and Report Writer modules. Compilation speed, according to NCR, will be about the same as for Stage II. Delivery is scheduled for April 1970.

FORTRAN: Three different FORTRAN compilers are offered:

CENTURY BASIC FORTRAN: Usable on a basic 16K Century 100. Language is USASI Basic FORTRAN plus 12 useful extensions.

CENTURY INTERMEDIATE FORTRAN: Usable on a 32K Century 100. Language is the same as Century Basic FORTRAN, plus 6 more extensions.

CENTURY FORTRAN: Usable on a Century 200 with at least 32K bytes. Language is full USASI FORTRAN plus 6 extensions (e.g., number of array dimensions is unlimited, mixed-mode expressions are allowed).

ASSEMBLER: NEAT/3 is the symbolic assembly language for the Century Series. Strong emphasis is placed upon the use of macro-instructions and "Major Functions" to facilitate coding. Major Functions are pre-coded routines to perform common data processing functions such as Accumulate, Collate, and Master File Update; the programmer fills out a questionnaire to tailor these routines to his needs. The disc-oriented NEAT/3 Compiler is usable on all Century systems.

UTILITY ROUTINES: Both disc and tape sort generators are available. There is also an adequate complement of utility routines to handle file creation, data transcription, overlay control, disc file management, tracing, memory dumps, etc.

APPLICATION PROGRAMS: NCR is providing "packaged" programs to handle key applications in retailing, banking, insurance, industry, hospitals, utilities, education, and government. Virtually all of the packages are designed to operate on a basic 16K Century 100 system, with full upward compatibility.

PRICING

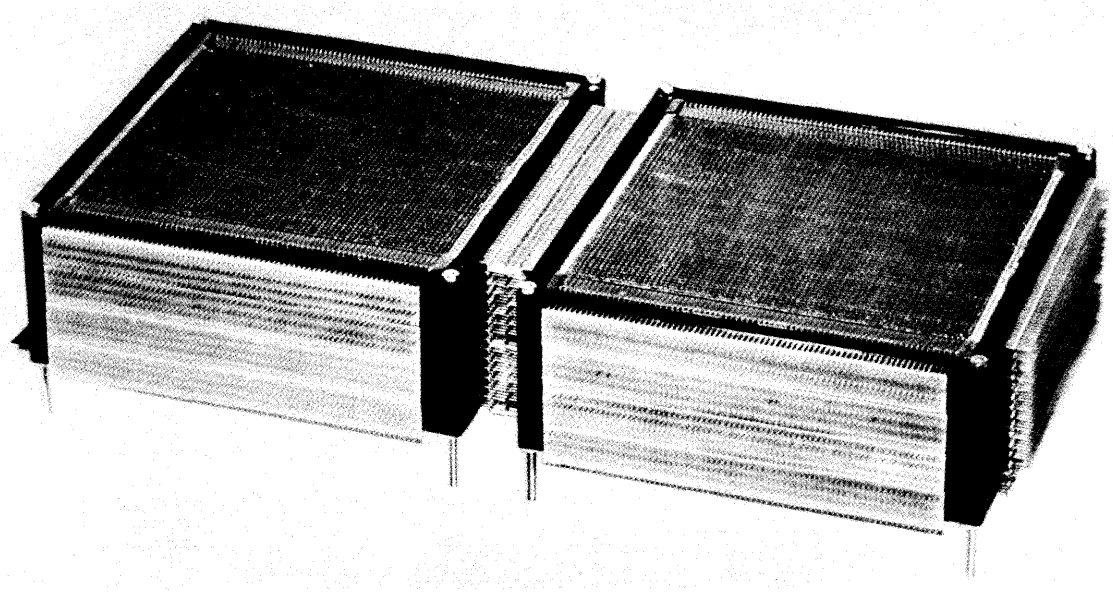
CENTURY 100: Basic system consists of 16K processor, dual-spindle disc unit, 450-lpm printer, and either 300-cpm card reader or 1000-cps paper tape reader. Monthly rental, $2250 or $1910, under 1-year or 5-year lease, respectively. Purchase price, $112,000.

Most Century 100 systems will also include an I/O Writer (console typewriter), which rents for $100 per month or sells for $4,800. An additional 16K bytes of main storage rents for $375 per month or sells for $18,750.

CENTURY 200: Basic system consists of 32K processor, I/O Writer, dual-spindle disc unit, 1500-lpm printer, and either 300-cpm card reader or 1000-cps paper tape reader. Monthly rental, $3,950 or $3355 under 1-year or 5-year lease, respectively. Purchase price, $188,500.

An expanded Century 200 system with 128K processor, I/O Writer, two dual-spindle disc units, 1500-lpm printer, 300-cpm card reader, 750-cpm card read/punch, and six 144KB magnetic tape units would rent for about $11,900 per month (1-year lease) or sell for about $550,000.

CONTRACT TERMS: The standard NCR rental contract permits 200 hours of use per month. An unlimited-use contract is available at an additional charge of 10% over the basic rental. ■



Rod memory unit as used in the NCR Century computers

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