NCR

NCR ELECTRONIC DATA PROCESSING

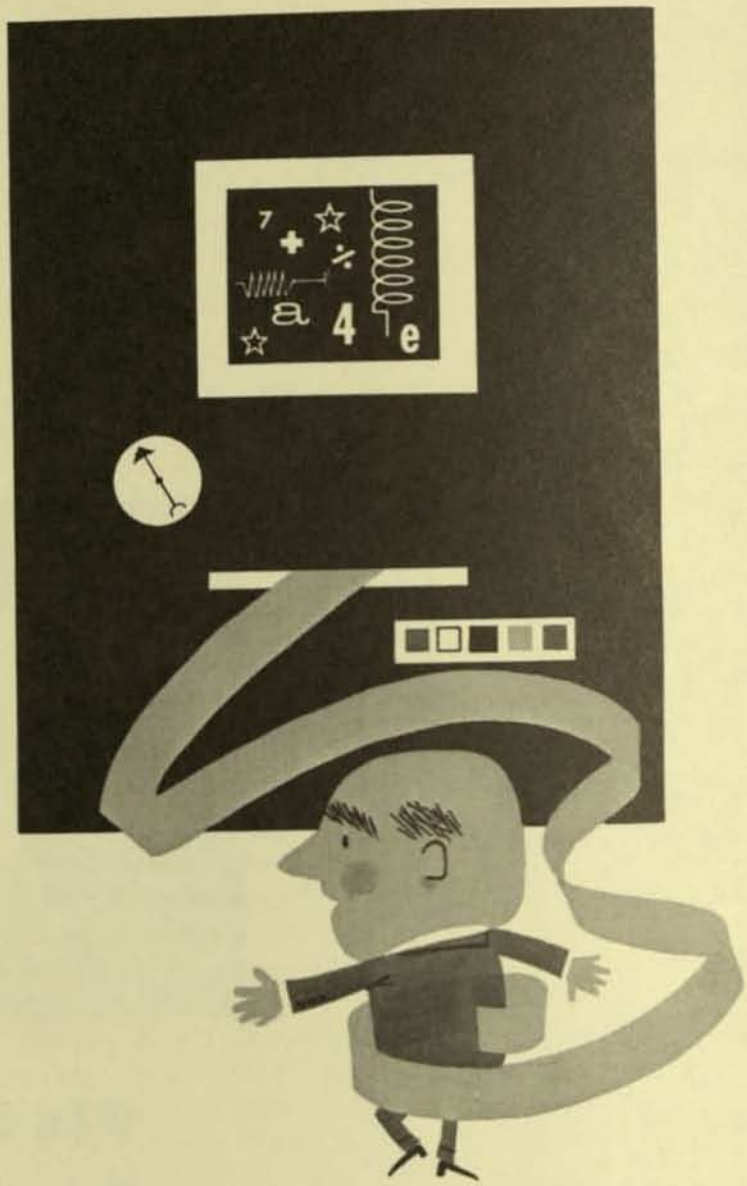
WRITTEN FOR THE LAYMAN

3. What is a Computer? #8438

3

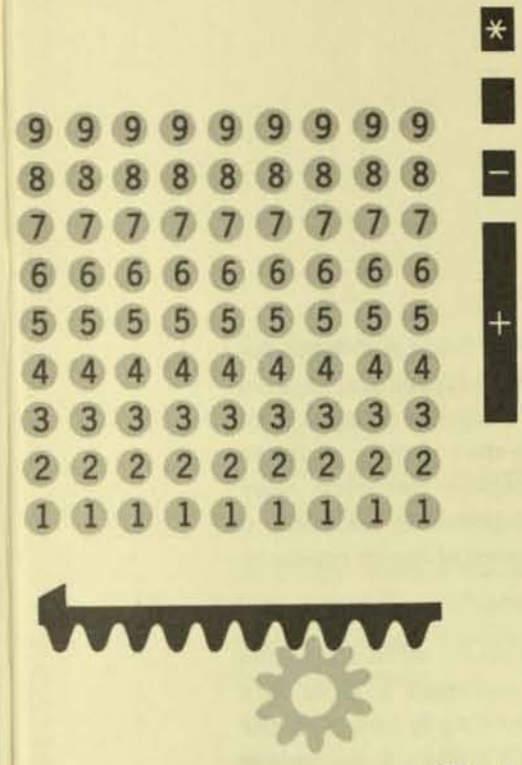
What is a Computer?

WHAT IS A COMPUTER?



To many people, a Computer is visualized as a giant electronic monster which has some sort of mysterious power and wisdom. In reality, nothing could be further from the truth.

Basically, most business machines . . . adding, accounting, or calculating . . . are miniature Computers. So, let's look at a machine with which people are familiar . . . a simple two-total adding machine.



What are the principle components of an adding machine?

INPUT UNIT The keyboard of the adding machine is used to "feed" data into the machine . . . so it could be called the Input Unit.

CONSOLE OR CONTROL PANEL Certain buttons on the keyboard (plus, minus, total, etc.) might be referred to as the Control Panel. This is because they are used by the operator to exercise control over the machine.

PROCESSOR Within the adding machine are gears, racks, wheels, etc., which process the data that has been "fed-in." For the purposes of this presentation, we might say that this section is made up of two units:

1. *The Arithmetic Unit* This would be one of the totals in the adding machine. Looking closely at the Total Mechanism, you would find a set of racks which are used to turn the counting wheels. These racks we could call the ADDER section . . . because they cause the arithmetic function to be performed.

   Next we have the Counting Wheels themselves. These we might call the ACCUMULATOR section of the Arithmetic unit . . . because the Counting Wheels store the result of the arithmetic operation until such time as it changes, or is "totaled" (printed-out) on the listing tape.

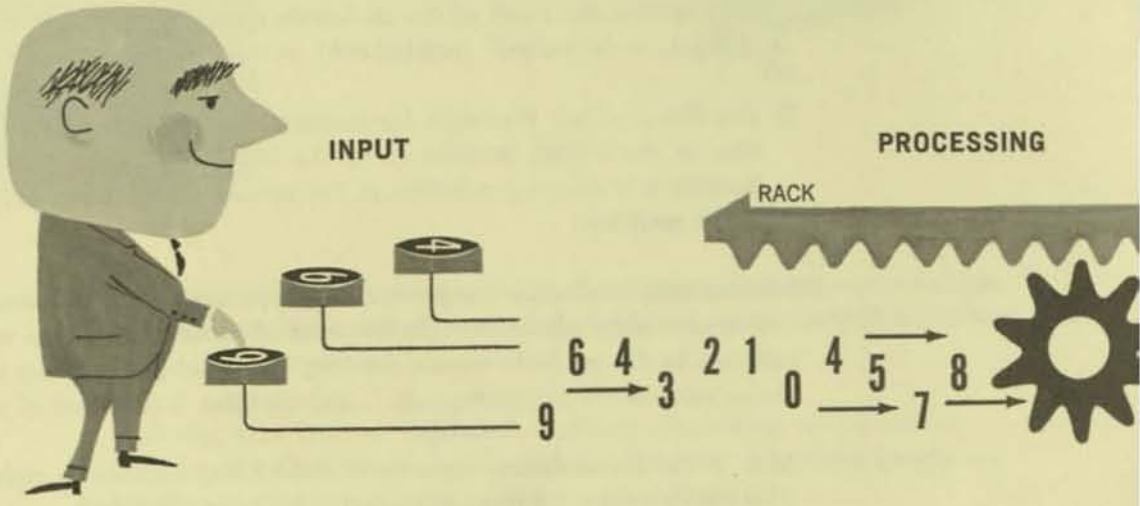
2. *The Memory Unit* We might, for discussion purposes, consider the second total in our adding machine to be the MEMORY of the computer . . . because it is always a reflection of the amount which is currently stored in the machine.

It is common to refer to a computer as having *so many words of memory*. Our two total adding machine might be referred to as having two words of memory. In the similarity we are drawing, we would prefer to say that one of the totals is the arithmetic unit . . . and the other is the word of memory.

Also, if the accumulating capacity of the adding machine is eight digits (999,999.99), the word-size can be said to be 8-digits in length.

We should point out, however, that there is one basic difference between the way a memory in an electronic computer is used and the way the memory in our miniature adding machine computer is used. In an Electronic Computer, memory can be used to store data . . . or it can be used to store instructions. Because a computer can have many thousands of words of memory in which instructions may be stored, it is capable of automatically controlling the sequence of events necessary to process complicated business problems.

OUTPUT UNIT The printing mechanism on an adding machine is used to record data on a listing tape . . . or sometimes to print data on an inserted document. So, since we said that data is "fed into" the processing section through the use of the INPUT keyboard, we can say that the data coming out of the processor is called OUTPUT, and is printed by the OUTPUT UNIT, the printer.

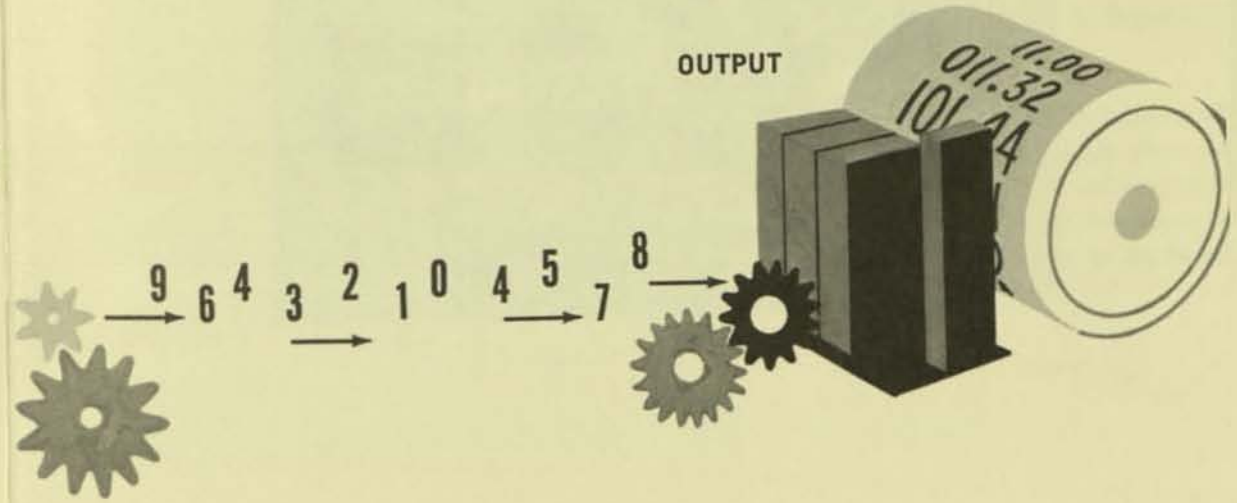


To summarize our adding machine type computer, we find that:

1. *INPUT* is controlled through a keyboard which must be indexed manually.
2. *PROCESSING* is performed by racks, gears, counting wheels, etc.
3. *OUTPUT* is accomplished by a printing mechanism.

While the adding machine is a valuable office tool . . . and while we have called it a miniature Computer . . . we must be honest and say that it has many limitations as compared with its big brother, the Electronic Computer.

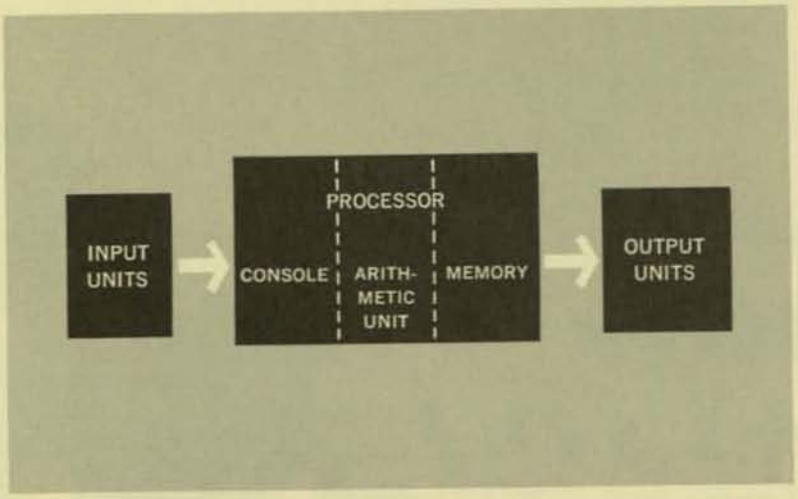
The following pages in this brochure are devoted to the "big brother" of the adding machine . . . the Electronic Computer. And, we will discuss the many computer components as they are related to the INPUT, PROCESSING, and OUTPUT functions of a Data Processing System.

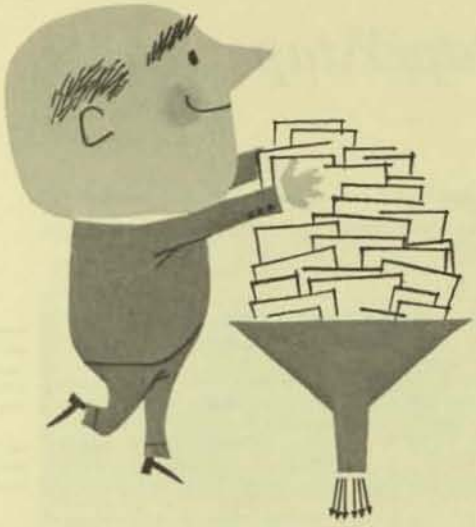


WHAT IS AN ELECTRONIC COMPUTER?

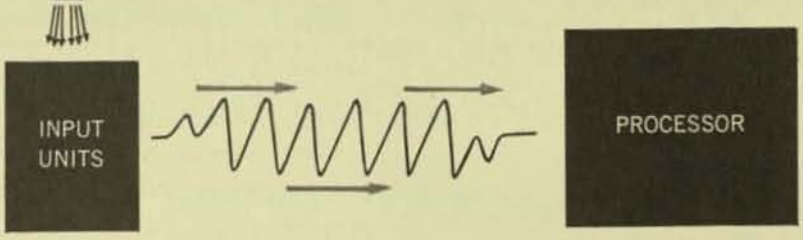
Essentially, a computer is made up of:

1. *INPUT UNITS* which feed . . . or introduce . . . data into the system.
2. *THE CENTRAL PROCESSOR* which controls the processing routines, performs the arithmetic functions, and maintains a quickly accessible memory. In effect, it is an electronic filing cabinet, completely indexed and capable of storing large amounts of data.
3. *OUTPUT UNITS* which serve two important functions:
   a. to create records and reports for people to use . . .
   b. to create new media which can be utilized to satisfy further automated processing needs.





INPUT



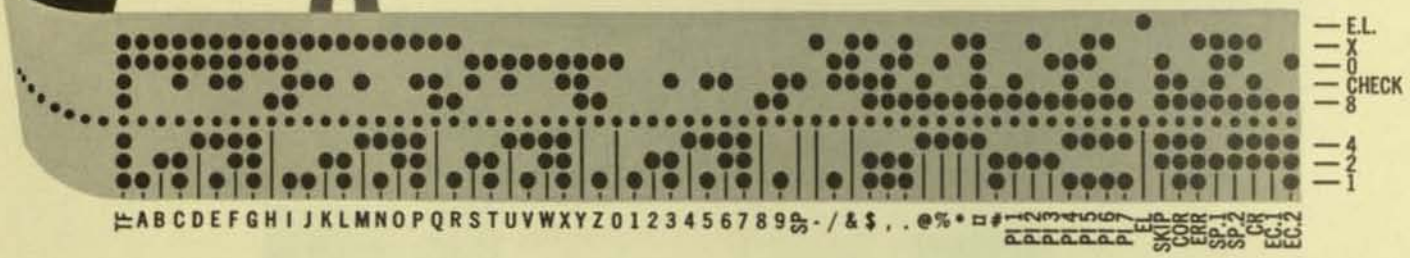
The term INPUT is used to describe the act of introducing data into a system. An invoice received from a vendor, for example, can be classified as INPUT MEDIA to an Accounts Payable System. In a bank, a deposit slip is INPUT MEDIA to the bookkeeping system.

In reality, INPUT DATA can be visualized as any data upon which one or more of the basic data processing functions are to be performed—Coding, Sorting, Computing, Summarizing & Reporting, Recording, Communicating.

Unlike conventional mechanical systems, wherein data is introduced into a machine through a keyboard, a Computer System must, in most cases, have the data regimented onto a type of medium that lends itself to automatic processing. Consequently, the data must go through a "get-ready" or "regimenting" process prior to its being "read-into" a Computer System.

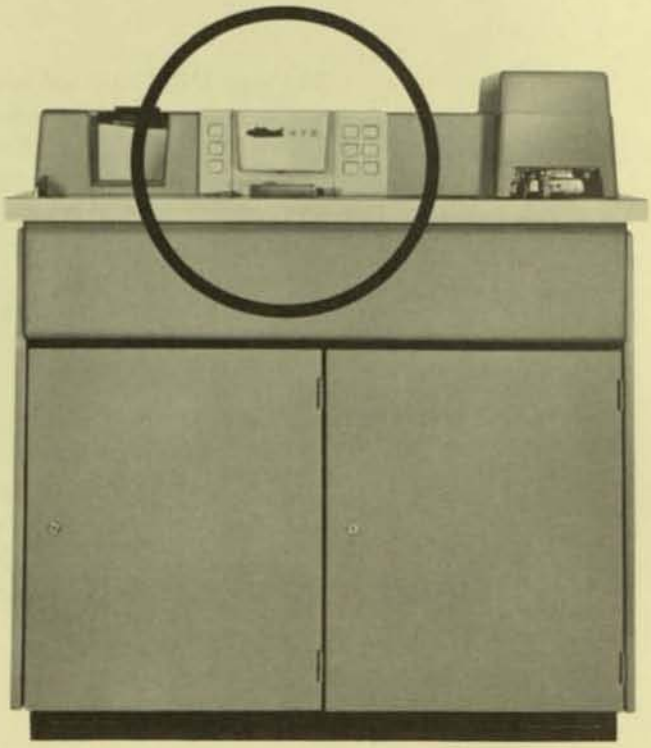
Paper tape reader

The two most common input-mediums onto which data is recorded for high-speed processing are punched paper tape and punched cards.

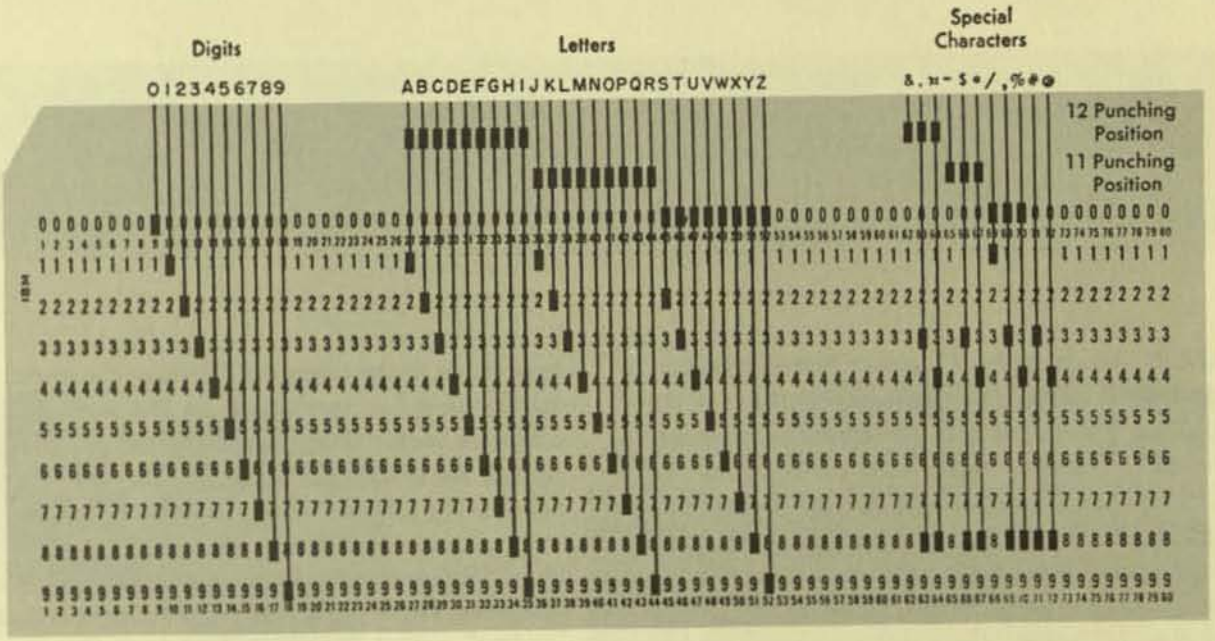


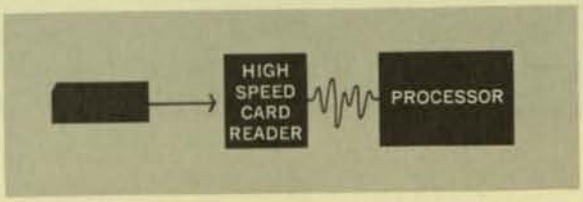
As the name implies, the Paper Tape Reader "reads" holes which have been punched into paper tape. Thus, paper tape eliminates the necessity for the computer operator to manually index data on a keyboard in order to introduce information into a computer. Instead, the data can be recorded into tape prior to its coming to the computer. Then, when placed in the Paper Tape Reader, it can be read by the computer, as needed, completely independent of human attention.

The NCR Paper Tape Reader shown in this illustration is capable of reading data at speeds up to 1,000 characters . . . 200 five-digit amounts . . . per second. Obviously, this is many times faster than people are capable of operating a machine. As a result, the Paper Tape type of Input is more in keeping with the speeds at which Computers are capable of working.



High-speed card reader





Like the Paper Tape Reader, the Card Reader converts holes punched in paper into electrical impulses, and transmits the data to the memory of the computer for processing.

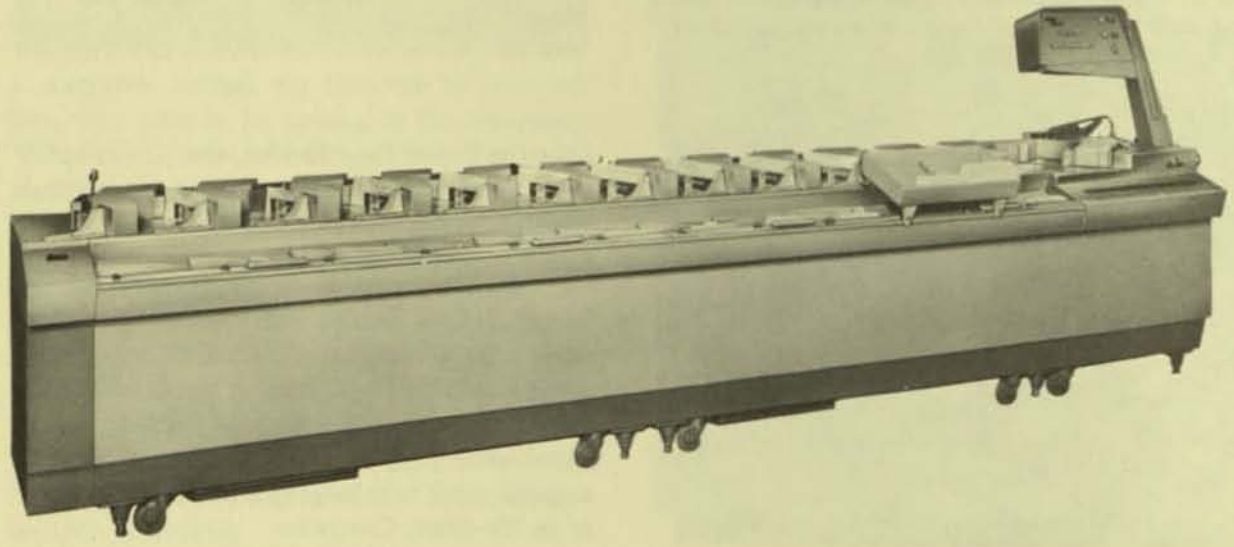
The NCR Card Reader shown in this illustration reads up to 400 cards . . . 32,000 characters . . . per minute. Like the Tape Reader, the Card Reader provides a means of automatic INPUT . . . at a speed which people are unable to match, and at a speed which is in keeping with the capabilities of an Electronic Computer.

Magnetic document sorter-reader

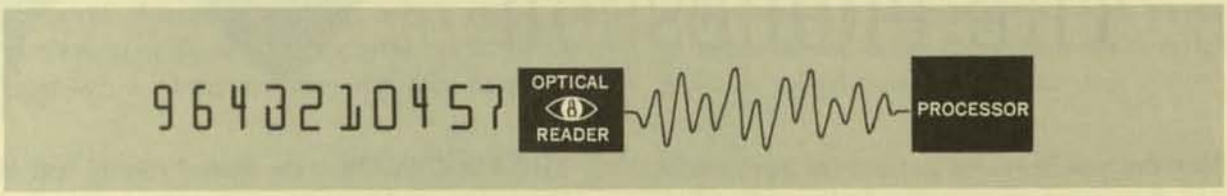
MICR (Magnetic Ink Character Recognition) . . . developed through the cooperative efforts of the banking profession and the machine manufacturers . . . is known as the "common-language" for banks. This system is based on the principle that the special properties of the ink used to print the data on the documents can be given small charges of electricity. As a by-product of reading these electrical impulses, the sorter transmits the data to the memory of the computer for processing.

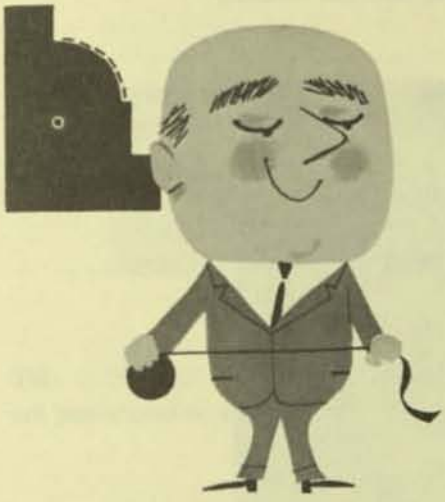
When used "on-line" . . . that is, linked to a computer . . . the sorter is under direct control and supervision of the computer. Thus, as the electrical impulses are received from the sorter, the computer has the ability to immediately send back another set of impulses which tell the sorter into which of its 12 pockets to place the document.

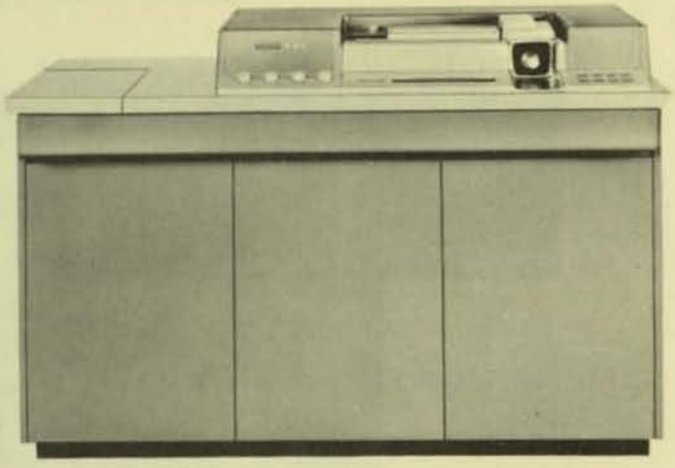
In addition to operating as an input device to the computer, the sorter is capable of being operated "off-line" . . . that is, independent from the computer . . . to sort the media into "fine-sort" order. In a bank, for example, fine-sorting could be the function of arranging checks and deposits into customer account number order.



Optical reader







This system is based on the principle that the special shape of each character printed on the Input Media is capable of being identified by a reading device. For example, the audit-journal from a Cash Register . . . if printed in a distinctive optical font . . . could be used as the Input Media to a computer.

As the Optical Reader reads each character from the Input Media, it translates the data into electrical impulses which in turn are transmitted to the computer for processing.

Since the NCR Optical Reader shown on this page can read up to 31,200 characters per minute, it provides high speed input to a computer. Then, too, since the media itself is capable of being used as a conventional human-language record as well as an electronic-language input medium, no further regimentation of the data for input is necessary.

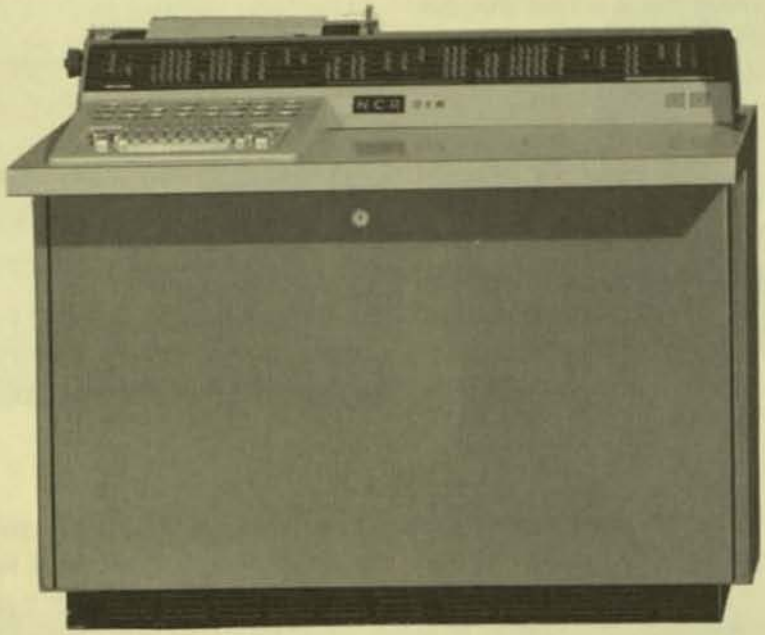
This is not to say that Optical Input makes all other types of Input obsolete. It does not. However, it does provide the ability to utilize the journal records and other type documents created on Adding Machines, Cash Registers, and Accounting Machines as Input Media to the computer.

THE PROCESSOR

Now that you have seen the types of input media, and their respective reading devices, let's take a look at the heart of the system—the Central Processor.

THE PROCESSOR is the central control unit of the system, and is made up of:

1. A Console
2. An Arithmetic Unit
3. An Internal Memory



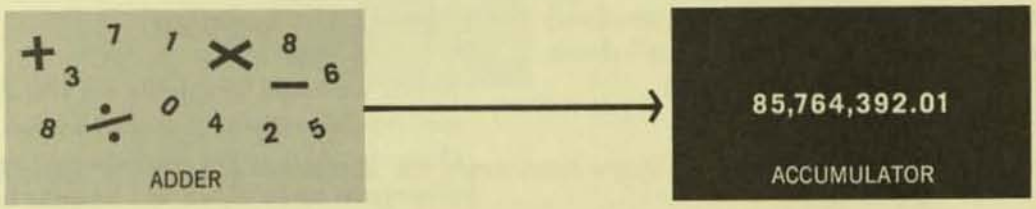
Console

The Console is, in effect, the external control center of a computer and is used primarily to monitor the system. The panel is made up of a series of lights which serve as visible signals to the operator, and a series of buttons which enable the operator to give certain commands, such as the starting and stopping of processing functions.

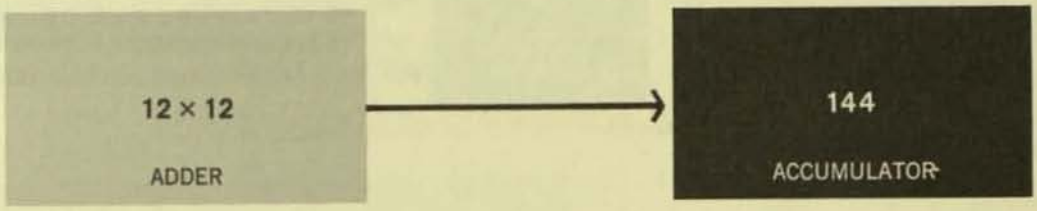
Also built into the console is an electric typewriter which serves as a means of communicating with

the processor, and for the processor to communicate with the operator. Unlike conventional mechanical devices, however, who's speed of processing is dependent upon the speed of the operator, a computer does not rely upon the human-operator to feed it data and to initiate its every command. As a result, the control panel is used primarily to supervise, or to permit humans to communicate with, the various units which make up a total computer system.

Arithmetic unit



This is the unit where the arithmetic functions are performed in a computer system. Basically, it is made up of two sections, the ADDER and the ACCUMULATOR.

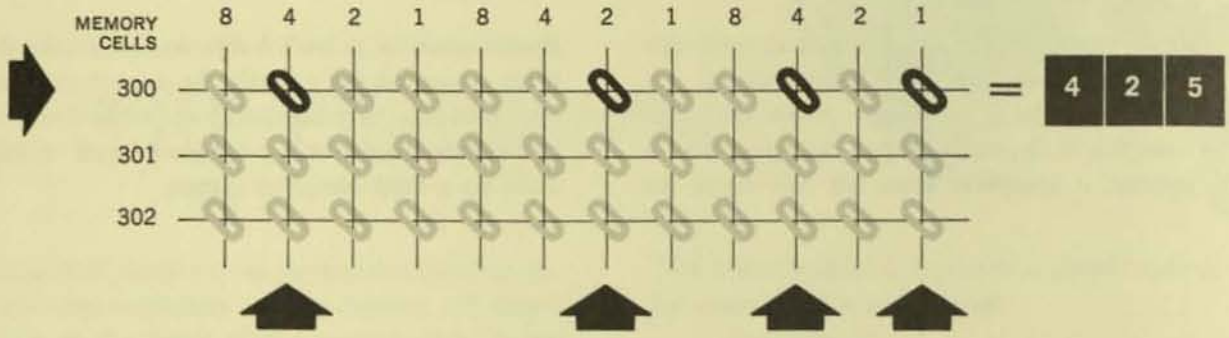


The Adder is that portion of the arithmetic unit where the arithmetic (add, subtract, multiply, divide) is actually performed.

The Accumulator is that portion of the arithmetic unit where the result (answer) of an arithmetic operation is stored.

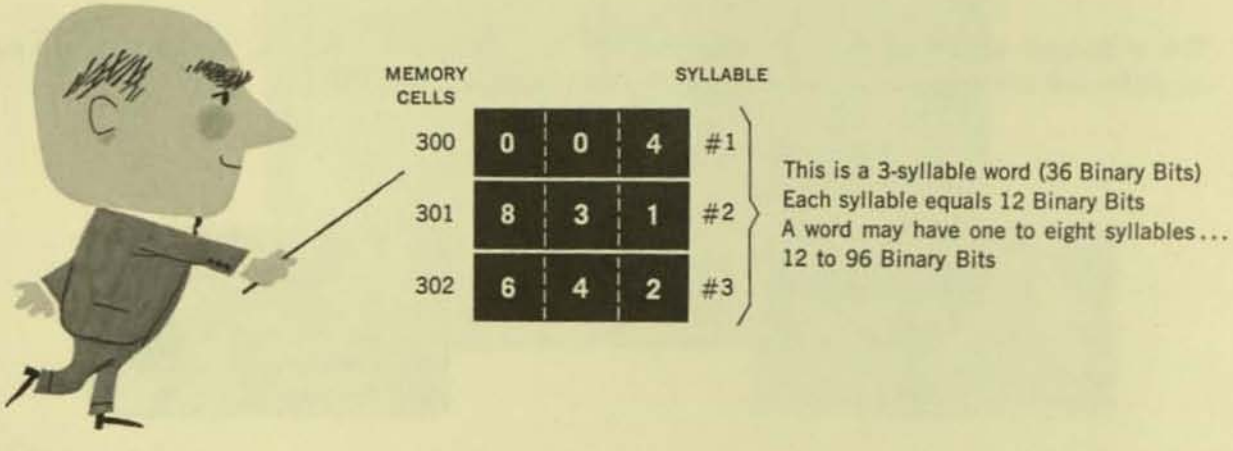
In other words, when a command is given, the addition, subtraction, multiplication, or division will be performed in the ADDER, and then the answer will be stored in the ACCUMULATOR.

Internal memory



The internal memory of a computer can take many forms. However, we shall confine this presentation to magnetic core memories as discussed previously (see Installment II). As you recall, small donut-shaped pieces of "ferrous-oxide" material are strung in a special way on wires to form the internal memory of a computer.

So that we might be specific, we will discuss the core-type memory as it is used in the NCR 315 Computer. And, so you can better understand the subsequent material, we will be quite basic.



Computers are normally referred to as having *so many* words of memory. In most computers, a word is a basic unit of information. With the NCR 315, however, a word can be considered as a unit of information, and that unit can have from one to eight syllables.

Since a word may have as many as eight syllables ... we call them SLABS ... this means that up to 24 digits, or 16 alpha-characters can be stored in a

315 word. (Alpha-characters require six binary bits, as opposed to four binary bits for digital information.)

Specifically, a SLAB (three digits or two alpha-characters) is stored in a single cell of memory. These cells (12 ferrous oxide cores) are numbered and are capable of being addressed singly, or addressed in groups.

For example, let's say that the program called for a word of memory to be added to the accumulator ... and, let's assume that the accumulator contains nothing but zeros:

MEMORY CELLS				SLAB
400	0	0	8	#1
401	2	1	6	#2
402	4	9	5	#3
403	2	0	0	#4

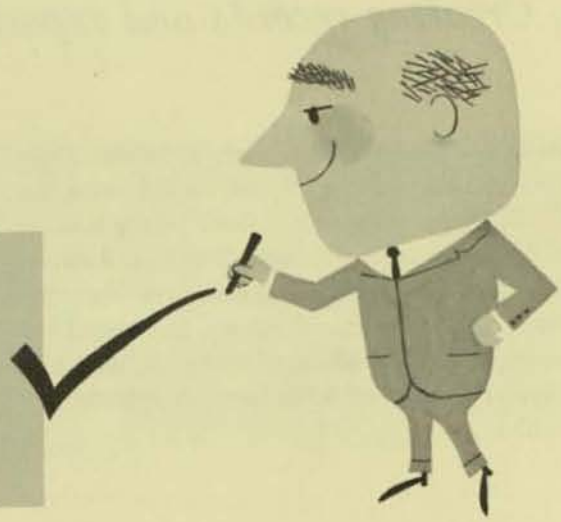
This would be considered as one 4-SLAB word. It could be the balance of an account... 82,164,952.00.

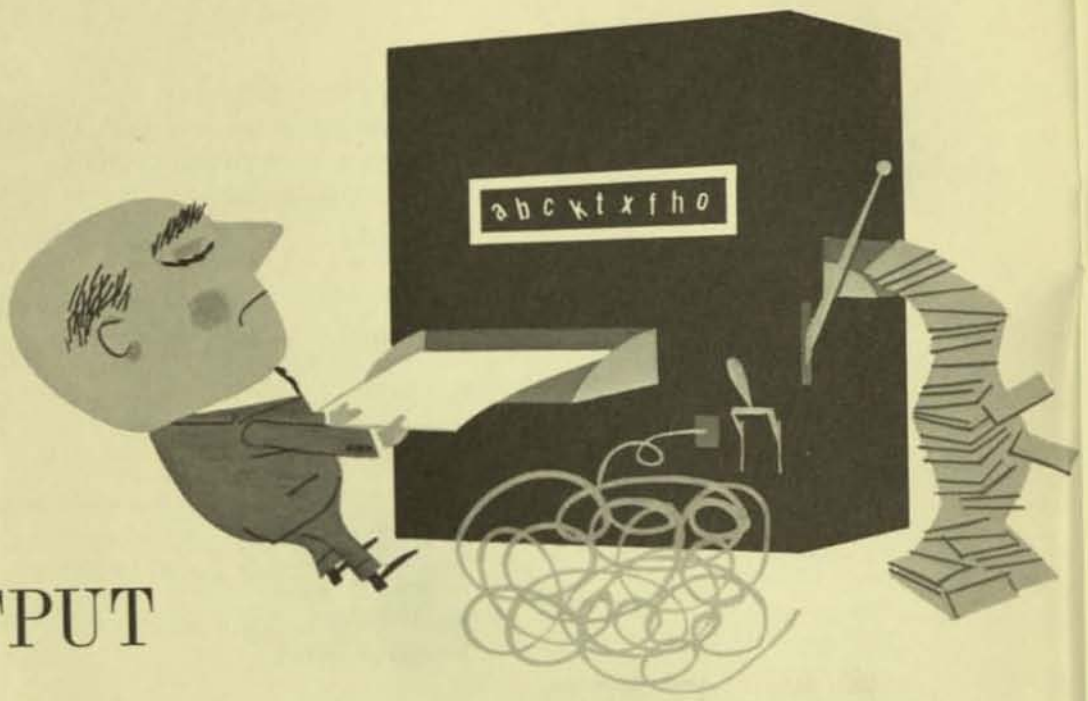
After execution of the ADD instruction, the above word would appear in the accumulator as follows:

0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	2	1	6	4	9	5	2	0	0

As stated previously, the accumulator is that part of the arithmetic unit which contains the result of an arithmetic operation. It is made up of 96 Binary Bits, and can store 24 digits of information.

A NOTE IN PASSING: The internal memory of the NCR 315 Computer can have as many as 40,000 addressable cells (SLABS) ... thus, it can store up to 120,000 digits of information, or 80,000 alphabetic characters.



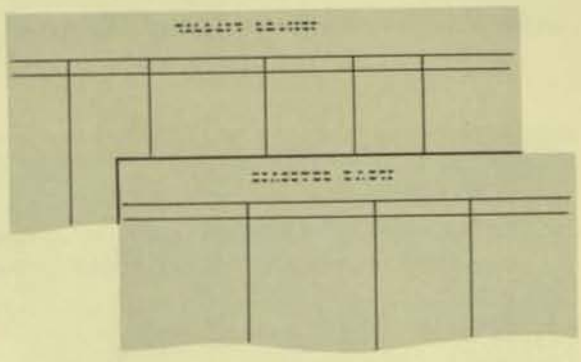


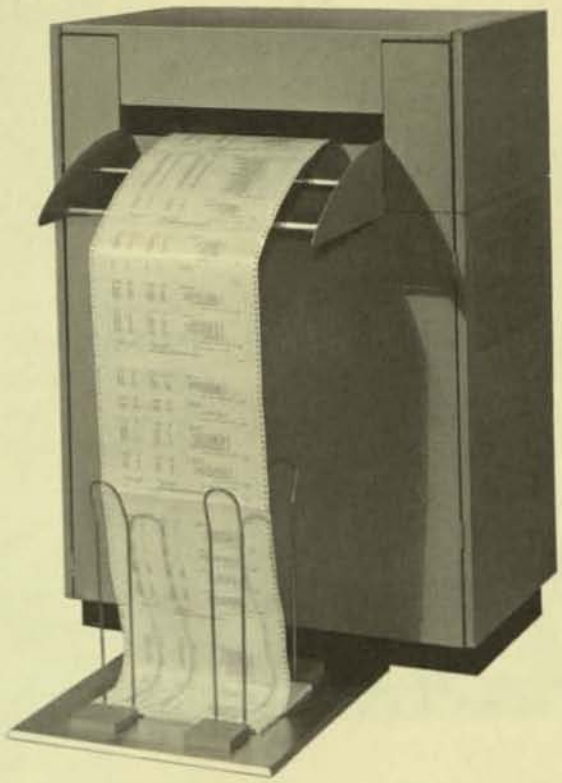
OUTPUT

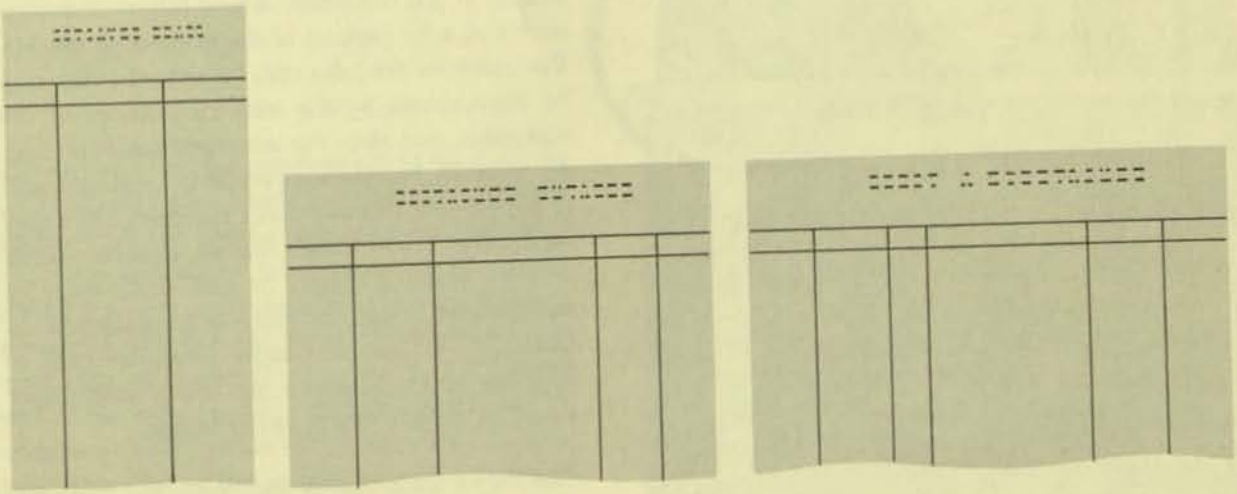
The term OUTPUT is used to describe the act of extracting data from the central processor. As stated earlier in this installment, OUTPUT serves two important functions: 1—to create records and reports for people to use... 2—to create new media which can be utilized to satisfy further automated processing needs.

1. Creating records and reports for people to use

Based on the needs of the user, up to four high-speed printers can be placed on-line with the NCR 315 Central Processor. Each printer is capable of printing up to 900 lines of numeric data per minute, or 680 lines of alpha-numeric data per minute. Up to 120 characters can be printed per line. Paper spacing, often referred to as "slewing," occurs at the rate of 5,040 lines per minute.

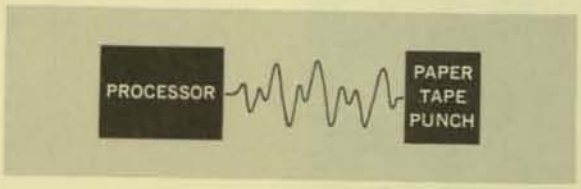




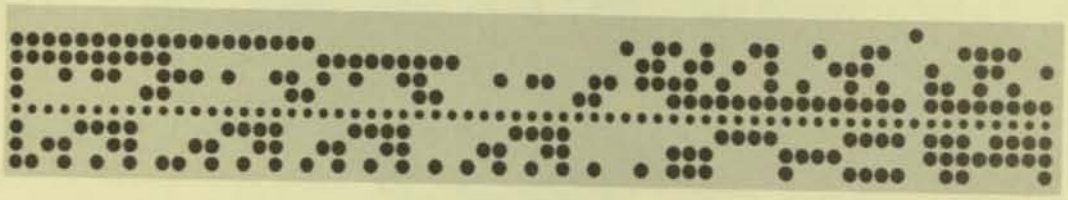


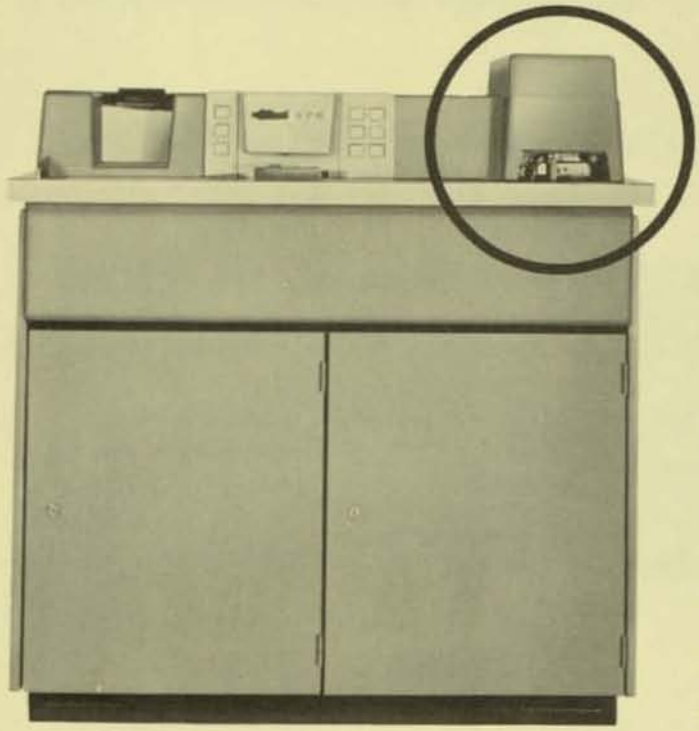
2. Creating new media to satisfy further automated processing needs

High-speed paper tape punch



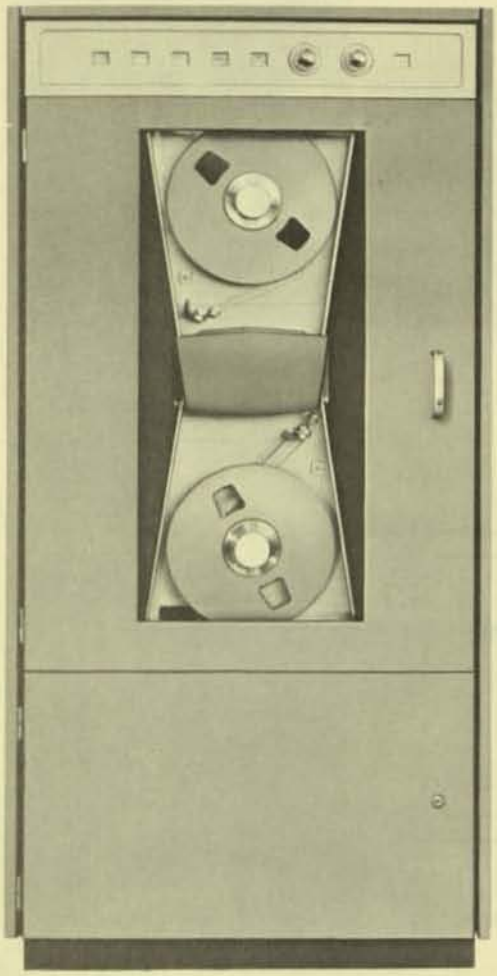
The Paper Tape Punch is one of the facilities employed by the NCR 315 to store data outside the memory of the central processor. With this unit, the computer causes data to be stored for future use in the form of holes punched into paper tape.



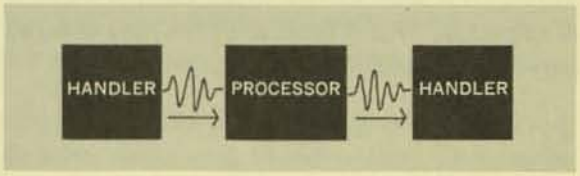


In most cases, this punched data, created under control of the computer, is new information generated as a by-product of the processing routine. For example, the sales data processed today may be summarized by the internal memory of the computer, and then the summary totals of sales by product, by salesman could be recorded into paper tape. In this way, daily summary tapes may be created. Then, when spliced together at the end of a week or month, the daily totals could be summarized to create weekly or monthly reports. Similarly, the monthly tapes could be used to generate quarterly reports, and the quarterly tapes could be used to create yearly reports.

The Paper Tape Punch used with the NCR 315 Computer System records data into paper tape at the rate of 110 Characters per second. This is equivalent to punching twenty-two 5-digit amounts per second.

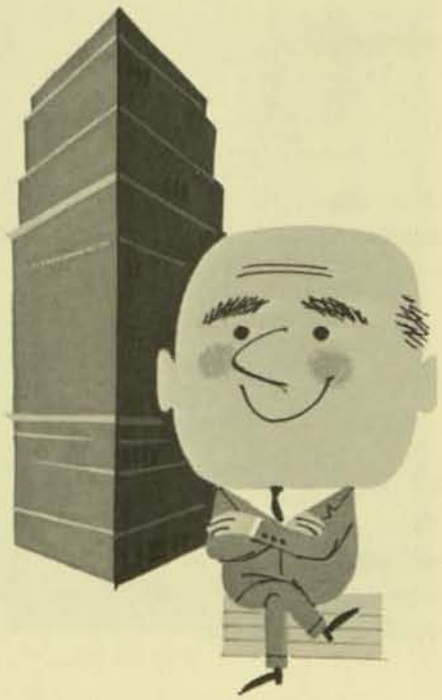


Magnetic tape handler

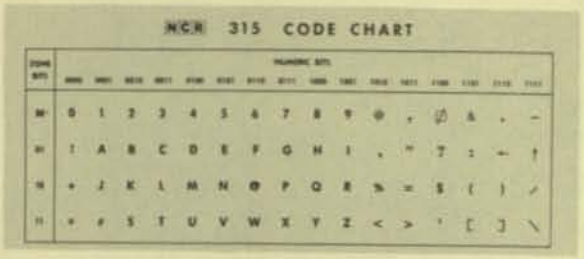


The Magnetic Tape Handler is, in reality, a dual purpose unit. In a computer system, it may be used to 1—write data onto magnetic tape, or 2—read data from magnetic tape into the computer.

Depending upon the requirements of the user, the NCR 315 may have as many as eight of these units on-line with the central processor. Because magnetic tape permits a great amount of data to be stored in a very small space (as many as 750 digits per inch), and because it can be written onto or read from at tremendous speeds, it has become one of the most popular mediums employed by computers as a means of storing data. To give you some idea of the amount of data capable of being stored on magnetic tape, a department store in New York City has its entire file of 1,000,000 accounts receivable recorded on just 20 reels of magnetic tape.



The NCR 315 Language Code Chart shown here can be used to determine the pattern of magnetic bits required to represent data on magnetic tape.

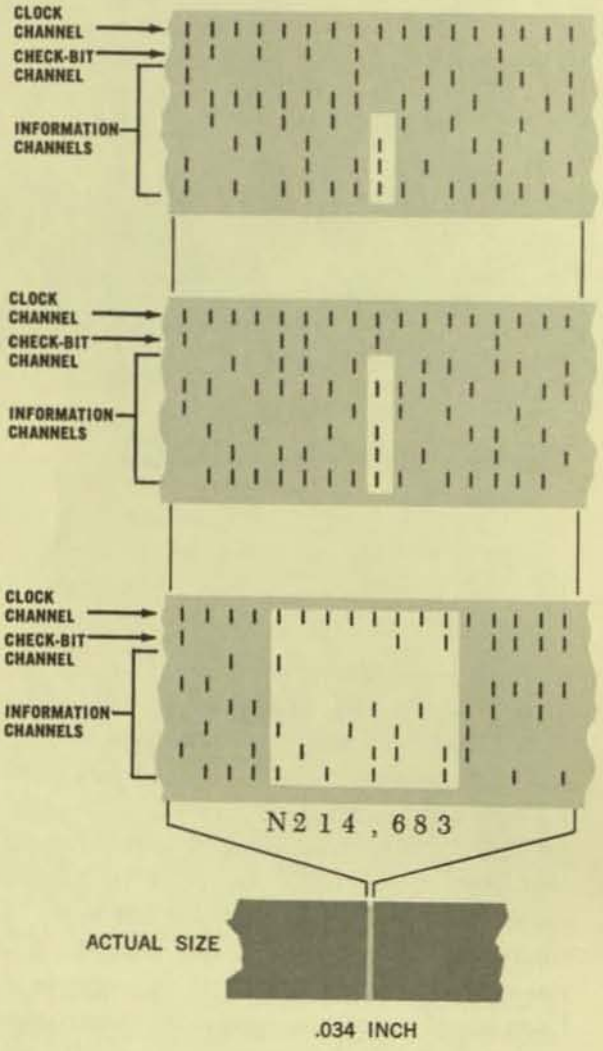


As stated earlier, it takes only four bits (magnetized spots) to represent a numeric quantity. However, it takes six bits to represent alphabetic information. This difference of two bits is taken care of automatically by the computer.

For example, the digit "7" is represented as "0 1 1 1" on magnetic tape.

The letter "G" is represented as "0 1 0 1 1 1." The two extra bits are called zone bits.

This illustration shows the bit configuration to represent a part number, N214,683



In passing, your attention is called to the fact that this same pattern of magnetized spots is used to represent data on CRAM cards, and is used to represent data in the internal core memory of the NCR 315 Computer.

Card Random Access Memory (CRAM)

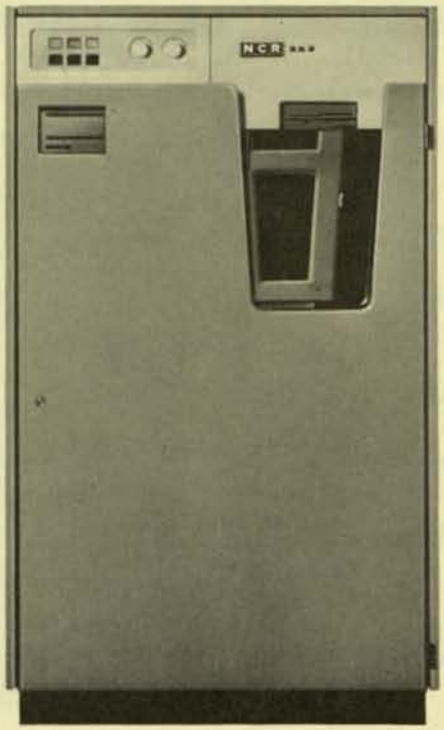
This computer facility is unique to the NCR 315 System. Specifically, it is the newest concept in the area of RANDOM ACCESS—and has many advantages over conventional filing systems which utilize Drums, Discs, Magnetic Tape, Etc.

In effect, you may visualize a reel of magnetic tape having been cut into 1,792 strips, each 14 inches long. These strips of magnetic tape can then be visualized as being placed side by side, in groups of seven, on plastic cards.

Each card is notched at the top in such a way that as they hang on a series of eight rods, any card in a deck (256 cards) can be caused to drop into a read-write station for processing.

With this unique random access facility, individual groups of data are isolated into small . . . quickly accessible . . . strips of tape. Since up to 16 CRAM units can be operated on-line with the central processor, 4,096 cards . . . each containing

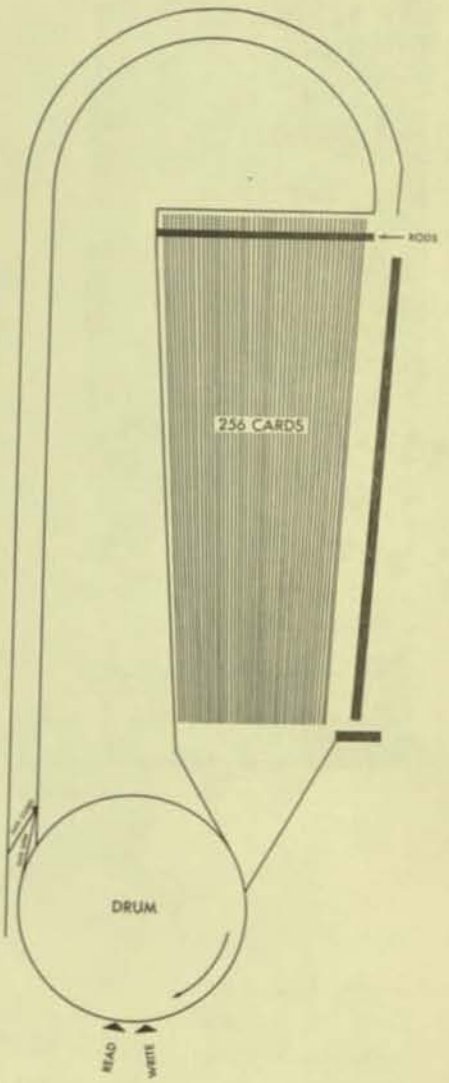
256 cards are housed in a special cartridge which can be removed and a new cartridge mounted in approximately 30 seconds.



21,700 alpha-numeric characters . . . can be selected at random by the processor. Since each card contains seven addressable tracks, there are 28,672 groups of data—anyone of which can be quickly selected by the processor.

Our previous discussion of magnetic tape highlights the advantage it provides to a computer system. However, a reel of magnetic tape has one basic weakness . . . to find a given account number, or other bit of information, often requires that many feet of tape be passed through the magnetic tape handler. Then, too, magnetic tape systems usually require that all transactions be put into strict sequential order prior to the actual updating of the master files.

A similarity might be drawn by comparing the NCR 315 CRAM System with the manner in which you and I find a given account in a file. We select the proper tray, then behind the proper index we select the desired account. In other words, we humans use the random-method of filing . . . we pass over all non-active records, and go directly to the active area of the selected file.



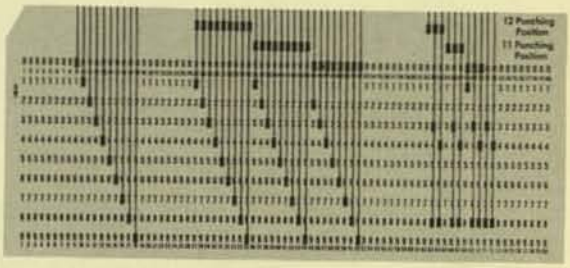
Basically, CRAM permits the computer to do the same thing. However, it performs its duties at speeds measured in fractions of a second. For example, a card can be selected at speeds measured in milli-seconds (a milli-second is 1/1,000 of a second) . . . and data can be read from or written onto these versatile cards at the rate of 100,000 characters per second.

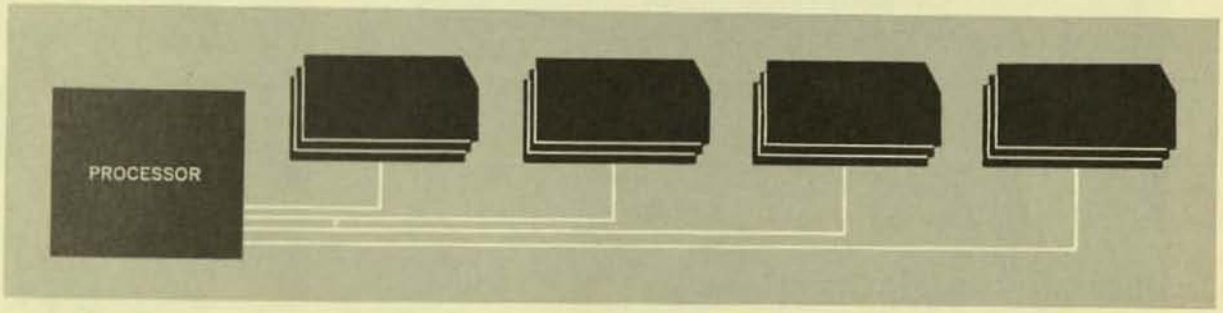
Here are some additional facts about CRAM . . .

- The CRAM Handler has seven sets of read-write heads . . . a set for each of the seven tracks on a card.
- 3,100 alpha-numeric characters can be stored on each track.
- 21,700 alpha-numeric characters can be stored on each card.
- Over 5.5 million alpha-numeric characters can be stored in a single cartridge (256 cards) . . . this is equivalent to over 69,000 punched cards.
- Over 88 million alpha-numeric characters can be stored on-line with 16 CRAM handlers.

High-speed card punch

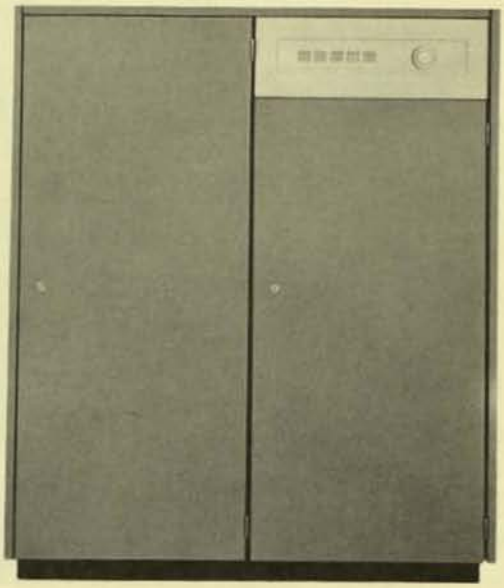
Basically, Card Punches, like all peripheral units, are specialized components in a computer system. As their name implies, Card Punches are used to create new unit media (namely, punched cards) according to the demands of the central processor.





For those cases where a re-usable unit-type media is required, up to four high-speed card punches may be placed on-line with the central processor in the NCR 315 Computer System.

Two models of card punches are available. One punches cards at the speed of 100 per minute . . . this is equivalent to 8,000 card columns per minute. The other model punches cards at the rate of 250 per minute . . . this is equivalent to 20,000 card columns per minute.



CARD PUNCH BUFFER

In conclusion

we ought to now take a look . . . a bird's-eye-view, if you will . . . at a total computer system. To do this, we will discuss the NCR 315 and its ability to efficiently supervise the various input and output units which make up the total system.

In reality, the NCR 315 Computer System can be visualized as a self-contained office, made up of machines which have individual skills and specialized talents—much like the people in your office.

The Central Processor . . . the *office supervisor* . . . assigns work to the various units, and being extremely efficient *employees*, they go about their duties, DEMANDING attention of the Central Processor only when it is absolutely necessary that *he* be INTERRUPTED.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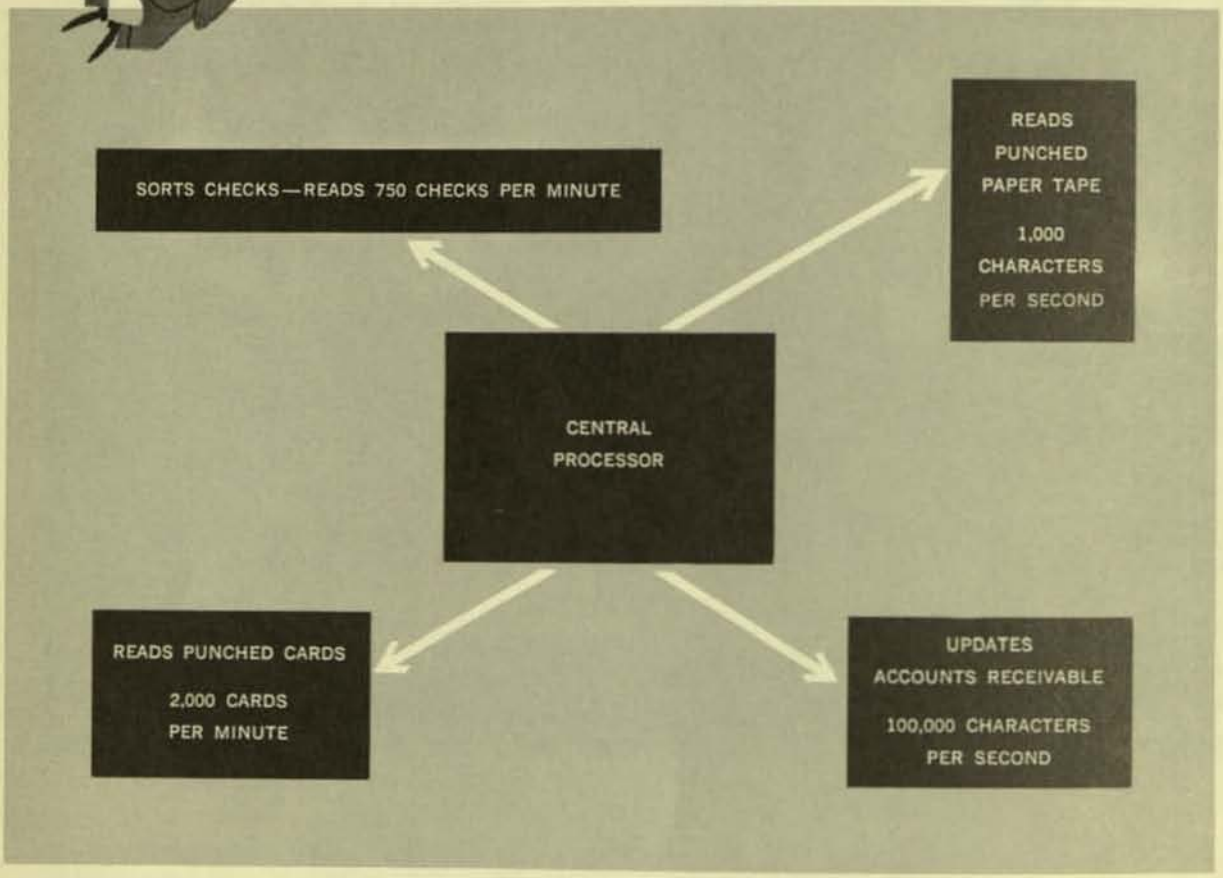
In other words, a computer . . . specifically, the NCR 315 . . . can be defined as a TEAM of automatic EMPLOYEES, working together to process business data efficiently, economically, and at a rate of speed which humans cannot match.

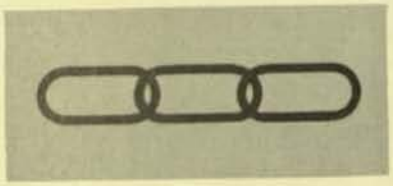


Since the Central Processor is given the duty of serving as the *Electronic Office Supervisor, he* has the ability to assign work to *his employees,* knowing:

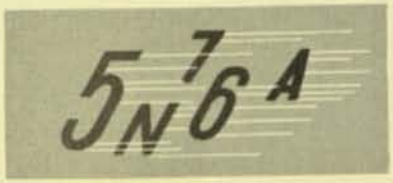
- that *his* instructions will be followed in the most efficient manner.
- that all of *his* employees are working simultaneously . . . one is not being delayed by another.
- and, that *he* will only be interrupted from his own work when new work needs to be assigned . . . or when important decisions need to be made.

Also, since many of the components are capable of performing their separate functions off-line . . . that is, while the Central Processor is doing something else . . . this means:

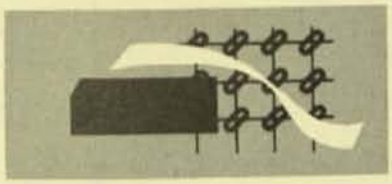
Many components can be operated simultaneously . . . thus the greatest amount of "time-sharing" is obtained.



No component is permitted to operate as a weak-link in the system . . . maximum efficiency is obtained.



Each component operates at an *effective* speed which is closely associated with its rated speed.



The Central Processor is not limited by the speeds of its peripheral units. Being the unit that does the internal processing, the Central Processor is permitted to do most of its sorting, processing, arithmetical, and updating functions while the other units in the system are performing their assigned duties.

Effective application of these exciting tools is past the stage of theory . . .

Today, hundreds of business firms and governmental agencies are processing data more effectively, more economically than ever before possible. Obviously, an awareness of the things computers are capable of contributing to the business world will contribute much to your successful utilization of these new tools.

Fully aware of our responsibilities as a Computer Manufacturer, we at NCR are dedicated to the task of providing Computer Systems which meet the challenges of modern day data processing. Designed with the future in mind, the NCR 315 is evidence of our desire to broaden the horizon of the "World of Computers," and to provide electronic systems which best serve the needs of people in business.

NCR PROVIDES TOTAL SYSTEMS – FROM ORIGINAL ENTRY TO FINAL REPORT–
THROUGH ACCOUNTING MACHINES, CASH REGISTERS OR ADDING MACHINES, AND DATA PROCESSING
The National Cash Register Co. • 1,133 offices in 151 countries • 79 years of helping business save money

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