

THE IBM WORLD WIDE ACCOUNTING MACHINE  
(WWAM)

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THE IBM WORLD WIDE ACCOUNTING MACHINE  
(WWAM)

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## INTRODUCTION

The World Wide Accounting Machine (WWAM) was born mainly from the competition the Bull Gamma is giving IBM in Europe. The Bull Gamma is a calculator hooked normally to an accounting machine. IBM France has tried many different approaches to meet this competition. The most important was the combination of an expanded 604 to the double feed 441 Accounting Machine. This, however, did no more than service a given number of installations. The basic problem still remained.

Then a year ago a selected group of men representing Engineering and Product Planning from Poughkeepsie, Endicott, and San Jose went to Germany to find the best way to develop an accounting machine capable of successfully solving this competition problem and also give IBM a lead in the field which would last for some years. After a few meetings, in which men from the German as well as from the French organization were cooperating, it was decided that a transistorized serial logic hooked up to a serial parallel printer provided the best approach. The transistorized serial logic with core storage was chosen because a more classical approach, an electromechanical parallel system, was not expandable and could not provide enough compute capacity. The serial parallel printer chosen was the stick printer because it has engraved printing, it is expandable, and is of lower cost than other similar printers.

If to make a decision on the printer was an easy job, we cannot say the same for pinpointing the specific type of serial logic which could best perform accounting machine functions. Three different types of logic were considered at that time. In Germany it was impossible to decide which was best suited for the job. A more thorough investigation was required which took place in Poughkeepsie from September to December, 1955. Two of the logics considered were of the fixed work length type while the third was a variable word length approach.

### LOGIC CONSIDERATIONS OF THE WWAM

Although it seemed that the competition was centered around fixed word length versus variable word length, I would like to consider it another way. In the case of the WWAM, the fixed word length logics represented the more or less classical approach of making an accounting machine by hooking a printer to a computer. The reasons for such an approach are quite obvious. A computer, if with enough capacity, is flexible enough to do any kind of computation and thus should be able to perform accounting jobs easily.

However, in the comparison below we can see that an accounting machine handles jobs in a quite different manner from a calculator.

## CALCULATOR

USUALLY DEALS WITH SINGLE INDEPENDENT CARDS

RESULTS ARE PUNCHED IN THE SAME CARDS

CARDS ARE USUALLY OF A SINGLE FORMAT

PUNCHING REQUIRES ALMOST NO EDITING

COMPLICATED COMPUTATIONS

BECAUSE OF THE ABOVE,  
EDITING IS A MINOR FUNCTION

## ACCOUNTING MACHINE

USUALLY DEALS WITH GROUPS OF CARDS

PRINTED REPORTS ARE THE RESULTS

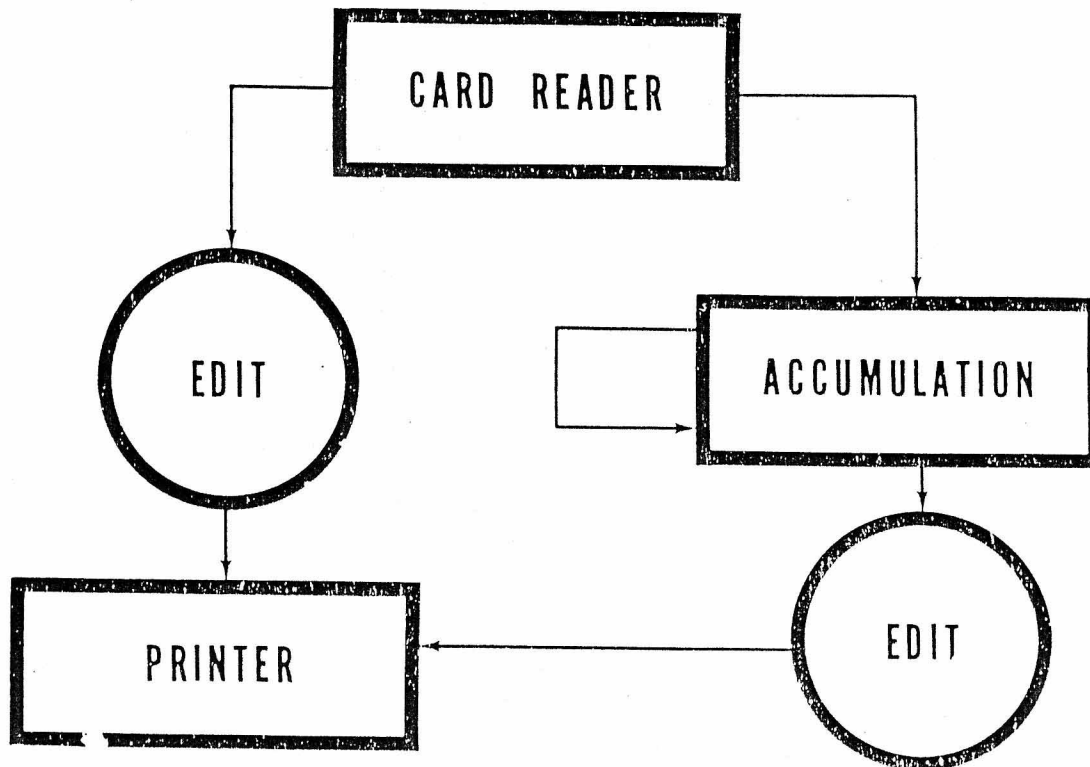
CARDS OF SEVERAL DESIGNS INVOLVED IN A  
SINGLE JOB

PRINTING IS ESSENTIALLY AN EDITING JOB

SMALL AND SIMPLE COMPUTATIONS  
(MOSTLY ACCUMULATION)

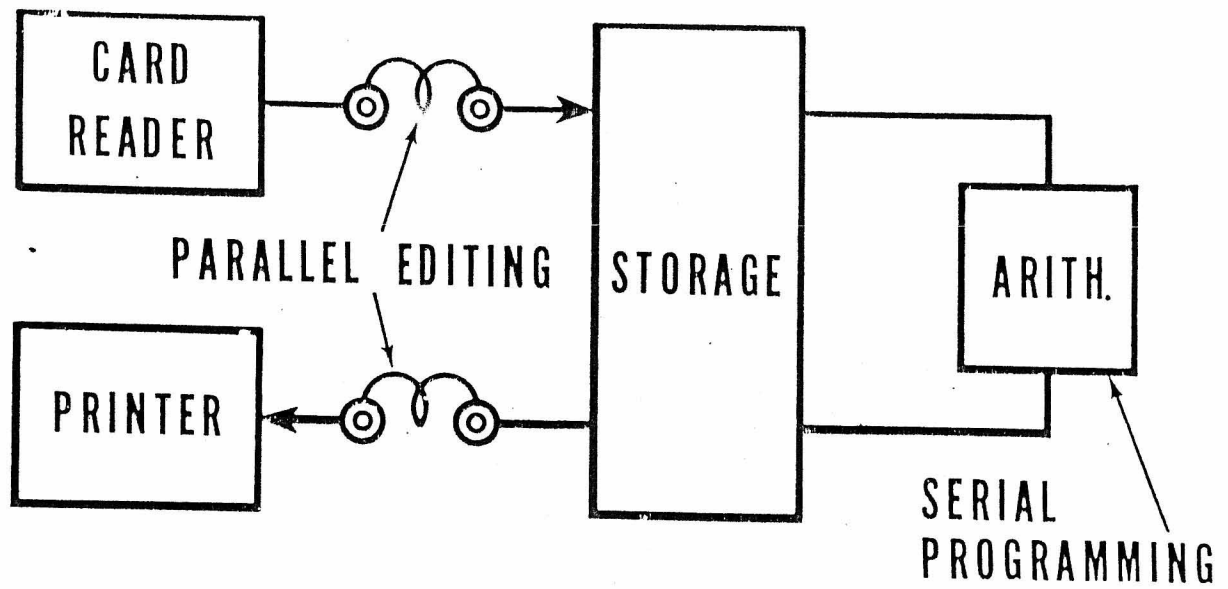
BECAUSE OF THE ABOVE  
EDITING IS THE MAJOR FUNCTION

From these considerations it thus looks that an accounting machine should first be able to edit properly. The diagram that follows indicates the information flow of an electromechanical accounting machine.



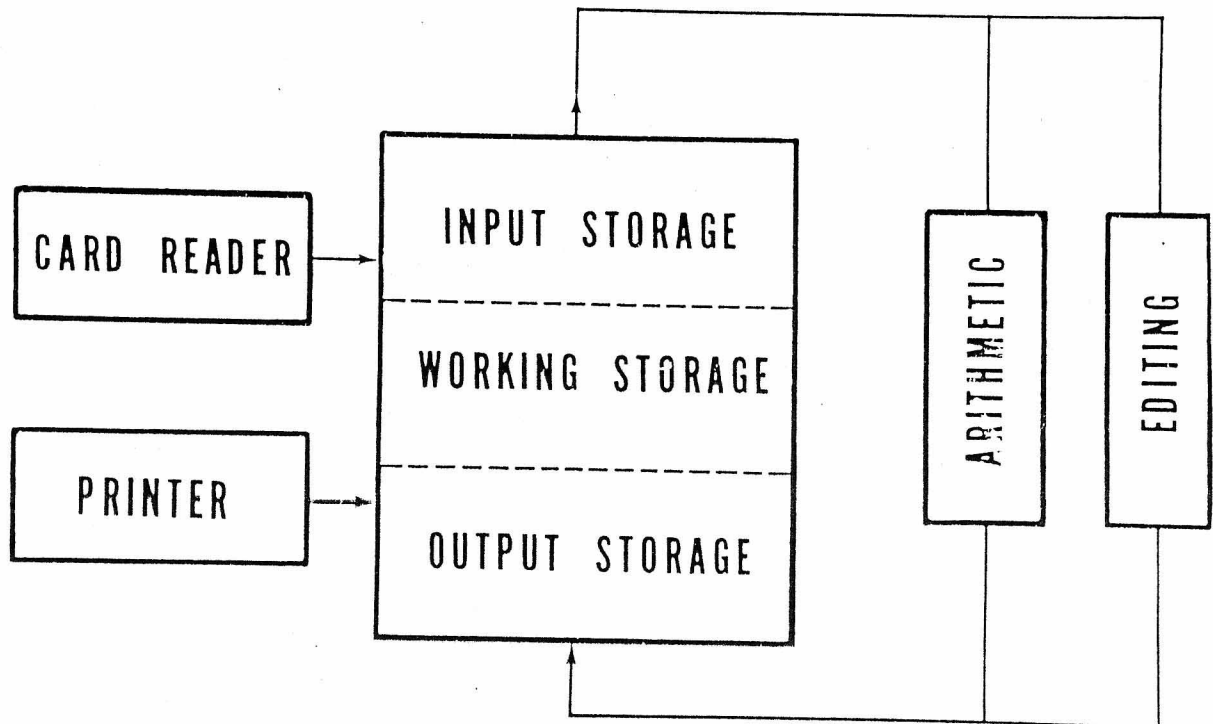
## INFORMATION FLOW IN A SIMPLE ACCOUNTING MACHINE

In this machine, editing is performed by the positioning wiring in the control panel. Editing is modified from line to line through the use of selectors. This results in complex wiring in these control panels. When a printer is hooked up to a calculator, the computing functions of the accounting machine are certainly improved by going to serial programming. However, the editing function, which is the most important function of the accounting machine, remains to be performed the old way, as we can see in the following diagram.



### CALCULATOR WITH PRINTER OUTPUT

Since it is recognized that what makes a computer so easy to program is precisely the serial type of programming, if the editing function of an accounting machine could be performed in a serial fashion a real improvement would have been obtained in the accounting machine field. We can see from the diagram below that we tried to move the editing out of the input and output system and bring it to a similar position as the arithmetic unit in order to have a serial editing. The moment we do this, we suppress the control panel between the input-output and the storage.



### SERIAL EDITING AND SERIAL ARITHMETIC

Thus, it happens that the card is dumped as is into storage and that the information in storage is printed as is without suffering any transformation.

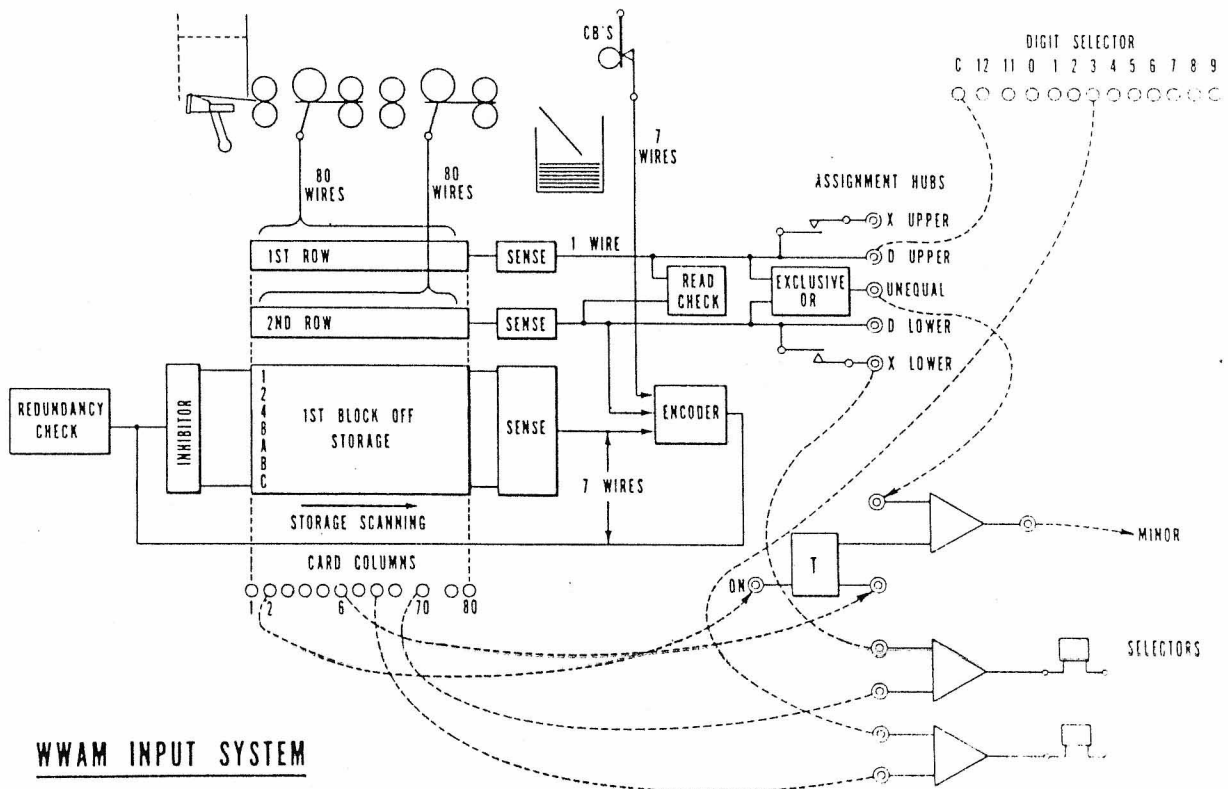
Since the information read from cards as well as the information to be printed is of variable word length, here comes the variable word length concept of the WWAM.

However, in order to simplify storage addressing, this concept has not been carried to the extent of having a single storage block for the whole machine divided in characters as the 702 has. The storage has rather been divided in blocks of 80 characters each since this figure represents the length of the most common record, the card. For printing, either one, one and a half, or two block are used, depending on the number of print positions: 80, 120 or 160. Thus the card is read into one of these storage groups and is done in this machine in a unique fashion.

### WWAM INPUT MECHANISM

The code used throughout this machine is the well-known 1248 ABC seven-bit code. Conversion from the Hollerith code to this code is required. This conversion is done in the input mechanism.

The input storage, not like the other storage groups, has two extra rows of cores. Each of the 2x80 cores in these rows has an additional winding which can be impulsed from a given brush of the card feed mechanism as can be seen in the following diagram.



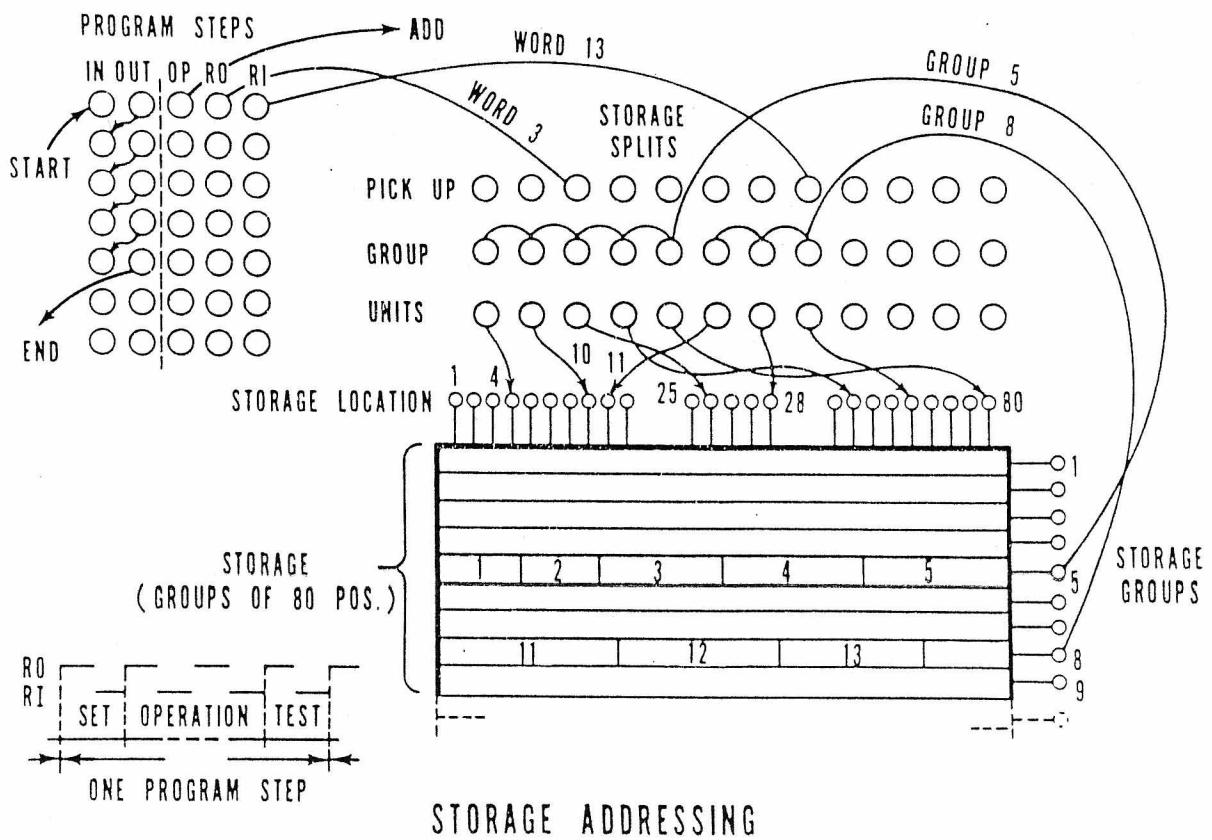
Cards are read in parallel. Thus when nines are read, the cores in the two rows are turned on if a hole is detected by their corresponding brush. In other words, between cycle point 9 and cycle point 8, the two rows of cores hold all the



The address from where the information is read out is called the RO field, and the address where the information is read into is called the RI field. In an add operation, for instance, the RO word is added to the contents of the RI field, and the result is found at the end in an RI field. This type of operation, we notice, enables us to perform accumulation, the most common operation encountered in an accounting machine, in a single program step. Accumulation, in an ordinary calculator, takes three program steps.

Since the storage has only one set of sense amplifiers and one set of inhibition drivers, only one character can be processed at a time. Thus the RO and RI addresses are given alternatively while scanning proceeds so that character, the information can be moved around. A single character register holds the information from RO time to RI time. In order to perform this, the storage is arranged so that it can be scanned by two different rings, namely the RO ring and the RI ring. These rings are alternatively tied to the storage while they are progressing. This way each ring will scan its corresponding word from low order to high order.

A program step has three different parts as can be seen below; a set time, an operation time, and a test time. During set time the two rings are set to the units position of the addresses desired. Each program step has 5 hubs, an In hub, an Out hub, an Operation hub, an RO hub and an RI hub. The In and Out hubs are used to establish the proper program sequence. The Operation hub is wired to the operation add, subtract, etc. required. While a program step is on, the RO and RI hubs alternatively emit pulses.



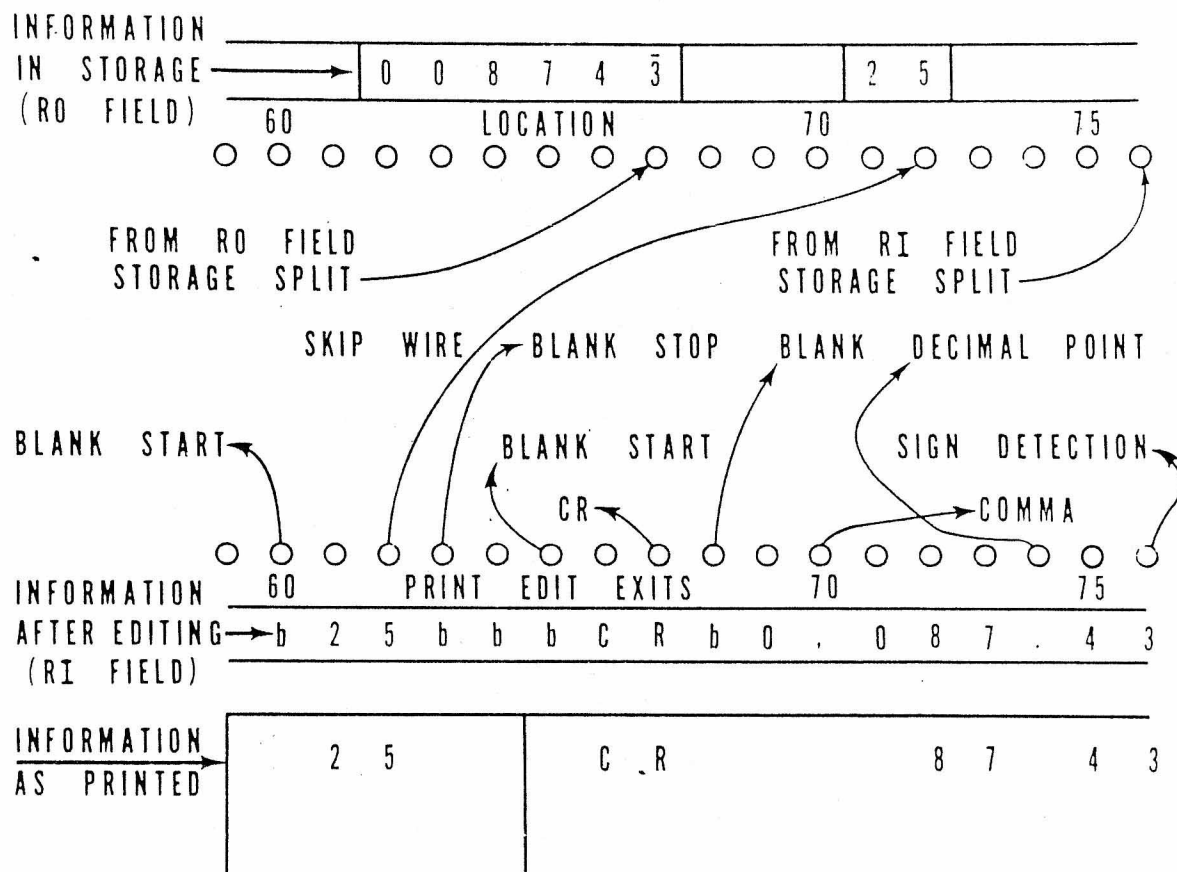


Prior to wiring the program steps, the storage unit has to be split into words of the proper size. Storage #1, the input storage, obviously is split to suit the proper card format. Storage splits are used for this purpose. These have a pickup hub which is normally wired from the program steps RO or RI hubs, and two exit hubs, one being the Group hub and the other the Units hub. These two hubs are wired to the storage so that each storage split will define the units position of a given field in a given group of storage. High order positions of the words will be fixed by the units position of the word at the left. Thus contiguous fields have to be defined by contiguous storage splits. During set time, the two storage splits impulsed by the RO and RI hubs of the program step will set the two starting addresses in storage. During operation time of the program step, the storage splits at the left of the ones impulsed will indicate the ending positions of the scans and thus the end of the program step. Impulsing a storage split from either the RO or the RI hub of a program step is, therefore, the same as calling for a word in storage in another machine.

This system of defining the words by wiring the units position is a big saving in the control panel wiring since it suppresses completely the positioning wiring required in other machines. Changing of card format or storage distribution can be done by simply selecting the units plug-wires, as seen on the preceding figure. Only one selector position per field is required instead of as many digits as the field has. This is a big saving in selectors. As an example, a job that today cannot be performed in the 407 because of lack of selectors has been programmed in the WWAM using only 29 selector positions. An additional advantage of this type of variable word length over the 705 system is that the same storage portion can be simultaneously split into several arrangements for detail and block transfer. This is done by using different storage splits, splitting the same storage group.

#### THE PRINT EDIT FUNCTION

This system of storage handling has greatly facilitated the print edit function. Print edit is essentially transferring information from card storage and working storage into print storage and simultaneously arranging it in order to build up a line with all details so that it can be dumped as is into the printer. Editing even a full 160 character line usually takes only one single program step. If the line is over 80 characters, two groups of storage are used. These two groups can be coupled and considered as a single group so that editing can still be performed in a single program step. This program step calls as operation, Print Edit, and as RI field, the width of the line. The RO hub impulses through a storage split the units of the first field to be transferred to print storage. The print edit instruction renders operative a row of up to 160 print edit exit hubs, one per print storage position. While each position of the RI field is scanned, the corresponding print edit exit hub emits an impulse. This impulse can be used to modify the otherwise standard transfer of information from a position of the RC field to this particular position of print storage. As we can see, in the following diagram in position 76 the transfer is modified by giving an instruction "Sign Detect."



This will detect any sign in top of the character transferred and suppress it so that a numeric character is printed instead of an alphabetic combination. Also, the sign is stored in a trigger. At position 74 the instruction given is "decimal point." This holds the RO field and inserts a decimal point, then it proceeds. At position 70 a comma is inserted. At position 68 a blank is inserted. Then at position 67 the instruction given is "insert CR." Of course, this symbol will only be inserted if previously a minus sign has been detected. In case of a positive sign, blanks are inserted instead. Then the print edit starts inserting blanks and further along stops the insertion of blanks. In the meantime, the RO field has been held at a standstill.

At position 62 the instruction given is "skip to position 72." This will reset the RO ring which was standing on position 61 and set it at position 72. Thus the 25 standing in position 72 and 71 will be transferred to print storage. This type of print edit instruction enables the machine to get information from anywhere in storage and permits any kind of information arrangement. A similar operation goes on until the RI field is finished.

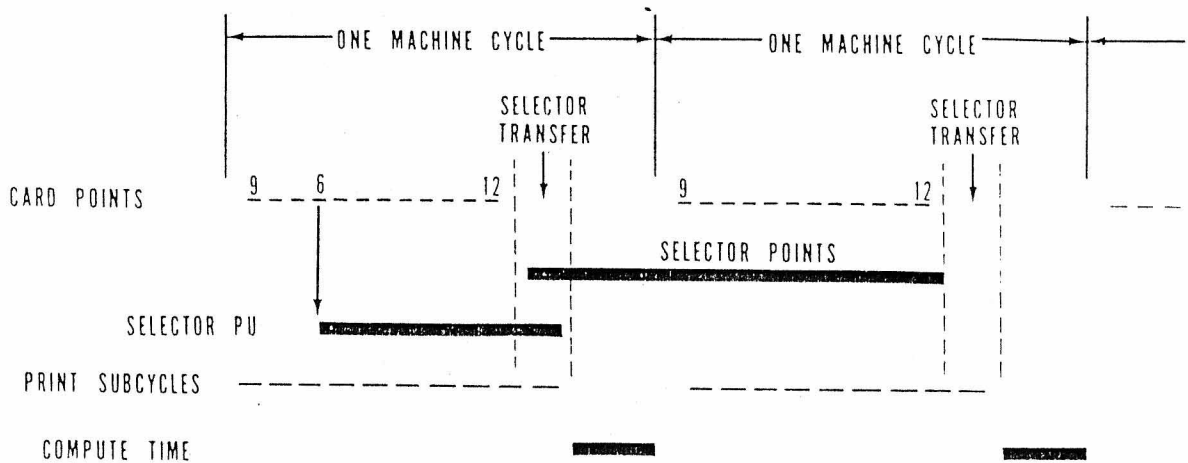
A complete set of print edit instructions are available so that any detail of a line can be prepared. Any character can be inserted and thus fixed words can be built. It can be seen that zero suppression takes place automatically at the right of any blank. This is performed through an automatic left to right scan at the print storage which takes place before printing. No wiring is required for normal zero suppression. Special zero suppression instructions, however, are available for treating exceptions. Another interesting print edit instruction provides the floating dollar sign to protect checks. One single wire gives this instruction.

As can be seen, the print edit function is a serial operation since only one operation is made at one time. Only the exceptions require wiring. Normal word transfer is automatic.

As in the storage splitting, all print edit wiring can be selected to change the editing from line to line. Here also the savings in selection are enormous. For summary punching, a similar edit function is provided so that, usually, no control panel is required in that machine. The same is true for the reader punch.

### SELECTOR OPERATION

We can see in the next diagram a timing chart where we show the relationship between card cycles, print cycles, and compute time for an unbuffered machine. We can observe there that a selector picked up through a punching in a card is up while this card is computed and remains up until the next card has been read. Thus, points of the same selector can be used for selecting anything in the machine and therefore only one type of selector is required.



POINTS OF THE SAME SELECTOR CAN BE USED FOR

CARD FORMAT SELECTION  
 PROGRAM SELECTION  
 PRINT EDIT SELECTION  
 PUNCH EDIT SELECTION  
 AND SELECTION OF NEXT CARD CONTROLS

### SELECTOR TIMING

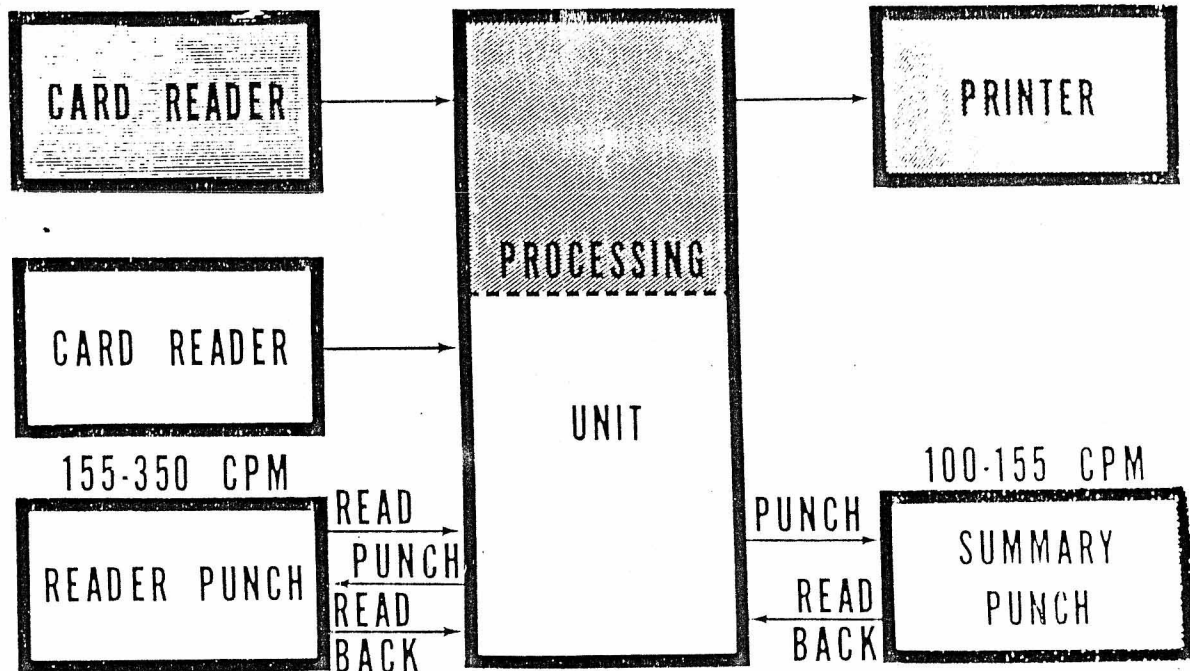
In a buffered machine the same timing remains and a control panel wired for an unbuffered machine can be used without modification in a buffered machine.

### THE WWAM SYSTEM

We can see in the block diagram following that the WWAM system is a modular system. The card readers usually go at the same speed as the printer but a tabulation speed of 300 CPM is also provided.

150-230-300-428 CPM

150-230-428 LPM



## THE WWAM SYSTEM

Reader punches of two different speeds may be hooked to the system. There is provision for reading a card, punching results into this card, and then reading back the whole card for recomputation. Two different types of summary punches also may be attached, the ones now in the field at 100 CPM, or a more modern one at 155. Higher speeds for the Summary Punch do not seem to be too interesting. The Summary Punch can also read back. Summary punching, as well as all other inputs and outputs, may overlap or non-overlap computation. Only the shaded portion of the figure constitutes the basic machine.

Input clutch control in multiple feed operation is done by crossfeed comparing through an internal automatic sequence. Comparing fields are defined by using standard storage splits. A basic set up circuitry like the one in the collators is provided for simplifying the use of the results of comparison. Card feeds may have multiple stackers. The processing unit may contain multiplication and division, up to 1900 position, of working storage, 160 program steps and also sterling computation. All instructions to this multi-unit system are given through a single 407 control panel in the main frame. The fact that this is possible shows how the wiring can be reduced using this system. Wiring of this control panel can be done through the intermediate use of planning charts as in a stored program machine.

## CONCLUSIONS

The mechanical units of this machine are now being engineered in Germany using as basis the work previously done in Poughkeepsie for the stick printer and in Endicott for the card feeds and paper carriages. Responsibility for the logic falls on the French Laboratory. Packaging and transistor circuitry now in development in the United States will be used in the main frame. Thus this machine is not only a World Wide Accounting Machine in the sense of being usable by customers all over the world, and in being a universal machine, but also in the sense of the world wide team that is building it.