

A Small, Low-Cost Business Computer

ALEX B. CHURCHILL†

THE Monrobot IX is a desk-size electronic digital computer expressly designed for on-line business applications of those types which are basically repetitive. We include in this category such applications as invoicing, prepayroll computation, and production planning. In all of these applications, an operator must be able to receive problem solutions promptly after insertion of data into the machine. The Monrobot IX produces printed solutions to problems in a fraction of a second to a few seconds, depending upon the particular application.

Fig. 1 is an over-all picture of the computer in its desk. Input and output is by the electric typewriter, and the computer itself is entirely contained within the single pedestal of the desk. The power required is less than 750 watts at 115 volts ac.

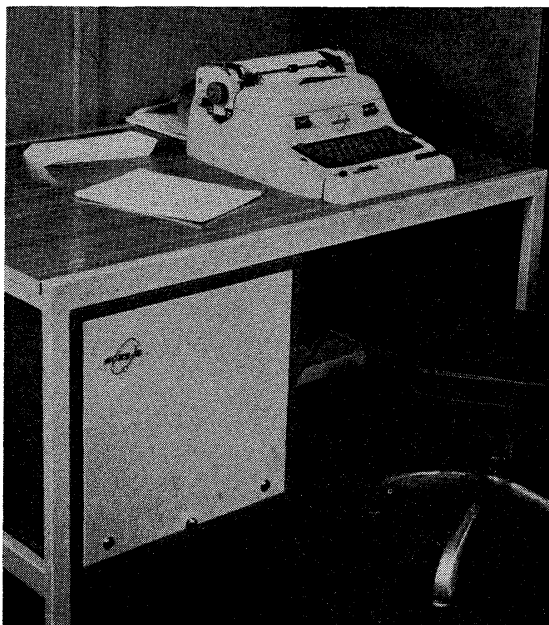


Fig. 1.

All operator controls are at the typewriter keyboard. Fig. 2 is a close-up of that keyboard and helps to illustrate operator requirements as to training and ability. The typewriter itself is a completely standard machine. The non-standard assembly located at the front of the typewriter is the program-selection keyboard. In this particular illustration the computer is programmed for invoicing. Each

program key is labeled to indicate the type of invoice line for which the machine has been programmed. For example, whenever the operator totals out an invoice, she depresses the proper key and the computer, causing the word "Total" and its dollar amount to be automatically printed out by the typewriter in the proper columns. Simultaneously, the accumulation to total accounts receivable is made internally, and the register being used for sub-totals is cleared in preparation for the next invoice.



Fig. 2.

calculating • adding • accounting • data processing

MONROE CALCULATING MACHINE COMPANY, INC.
General Office • Orange, New Jersey

DATE 12/02/1957 NO 19

SEND TO: KINGS FABRICS
12 EAST RIVER ROAD
ROANOKE, INDIANA

QUANTITY	DESCRIPTION	UNIT	PR	YD	DISC.	TOTAL
130	3/8	ITEMS	1.15	149.93	5	142.83
60	7/12	ITEMS	12.50	DZ 757.25	20	605.83
25		ITEMS	89.75	EA 2243.75	40	1346.25
	SUB TOTAL				10	2094.51
	DISCOUNT					209.45
	SUB TOTAL					1885.06
	F TAX ON			2094.51	6	125.67
	S TAX ON			1885.06		55.55
	POSTAGE AND INSURANCE				3	22.38
	TOTAL					2089.66

Fig. 3.

The capabilities of the machine can best be seen by looking at Fig. 3, which is a complete sample application. This figure illustrates a completed invoice in which multiplication by two different fractions are involved, and taxes are applied to two different subtotals. In this particular example, the date and invoice number, including the alphabetic characters, are automatically typed as the result of operator depression of the date and number-program key. Name and address are normally typed. The operator then selects the proper program to extend quantity times unit price less discount in which the fraction "eighths" occurs

† Monroe Calculating Machine Co., Orange, N.J.

in the quantity column. She enters the value 130, manually tabs, enters the numerator, 3, and the oblique dash, whereupon the computer causes the denominator "8" to be typed and the carriage to be tabbed into the description column. The start signal for the computer is obtained by operator depression of the manual tab or oblique dash key of the typewriter.

As soon as the operator completes the item description, she again manually tabs and the computer is ready to accept entry of the unit price. It is not necessary for the operator to align decimal points. As she makes her entry of unit price, the accumulation of the partial product within the computer occurs as each digit key is depressed. The computer may be programmed equally well to handle decimal or fractional parts of a cent in the price column. After completing the entry of unit price, the operator again tabs, the identifying letters *YD* are automatically typed, indicating that pricing was on a per yard basis, and the product of quantity times unit price is rounded off to the nearest whole cent, stored, and printed out in the gross column. The decimal point is automatically aligned. The typewriter tabs automatically and the machine is ready to accept entry of the discount percentage. The operator enters the discount value and tabs; the discount is applied, the answer is rounded off, accumulated to the subtotal and printed out. An experienced operator can complete that line, including manual typing of the word "Item," in nine seconds. The time required for computation of the net extension after the discount entry has been made and accumulate it to the subtotal is less than six-tenths of a second.

The next two lines of this invoice illustration use the same basic program with a few modifications. All that the operator has to do for the remainder of this invoice is to make the proper selections of programs in sequence, and at the appropriate times enter the number ten to effect a discount of 10 per cent on the subtotal, the 6 and 3 per cent tax rates, and the dollar amount for postage and insurance. All other information, both numeric and alphabetic, is automatically printed out by the computer. If the state or federal tax is a constant percentage, then it too could be automatically typed and computed.

Not indicated in the illustration is the fact that accumulations are being made of total sales, discounts, federal taxes, state taxes, postage and accounts receivable, all of which may be printed out whenever desired by selecting the appropriate program. Any other desired accumulation can be programmed.

A good operator can complete this entire invoice as shown, excluding the date and number line and typing of the name and address, in less than 78 seconds. In a competitive run between the Monrobot IX and an experienced desk-calculator operator, the computer cut almost 70 per cent off the time required by the desk-calculator-typewriter combination to perform the identical job.

It has been found that very little time is required to train an operator. Within one hour a Monrobot IX operator can outproduce a skilled typist and desk-calculator operator team. Her speed and accuracy will continue to rise and reach peak performance in less than a week.

This machine may readily be programmed for virtually any invoicing application, including step-rate utility billing and tax billing.

In the case of utility billing, the only operator entries required are the two meter readings. The quantity being billed and the dollar amount of the billing are both computed and printed within five seconds in the case of a rate structure having three steps.

We have said something about the field of application of the Monrobot IX. We would like to point out some of the features of the computer system design. Fig. 4 shows a block diagram of the computer and indicates the control and information paths. Program control is achieved by means of stepping switches in conjunction with a plug board. The computer is capable of the four common arithmetic operations, decimal shift right and decimal shift left. Other commands exist for automatic typewriter control and alphabetic printout.

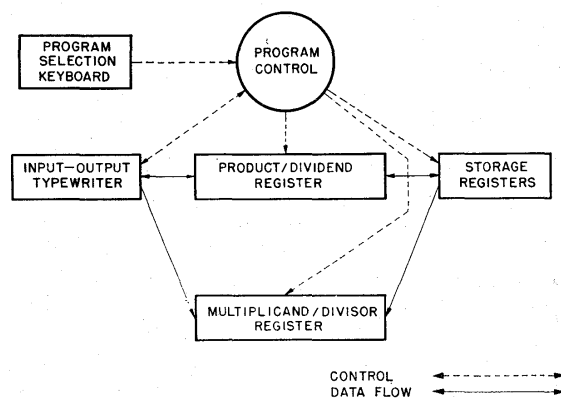


Fig. 4—Monrobot IX system.

Word size is equivalent to 18 decimal digits. Information is coded in straight binary form. Storage registers can be split in any desired manner by proper programming; thus, for example, for some applications the machine can be considered as having 42 six-digit registers, or 28 nine-digit registers.

Fig. 5 is an over-all view of the completed computer less typewriter and program-selection keyboard. The magnetic drum, which can be seen at the front of the assembly, rotates at a modest 2500 rpm. The one information track and the three clock tracks occupy less than one third of the drum surface. The extra width is unused.

The electronic unit is shown expanded as though for servicing. The main circuit section, which is visible at the center of the illustration, and the programming section,

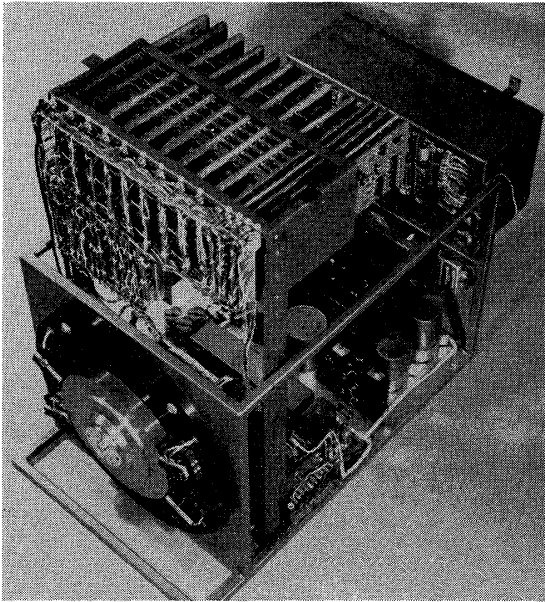


Fig. 5.

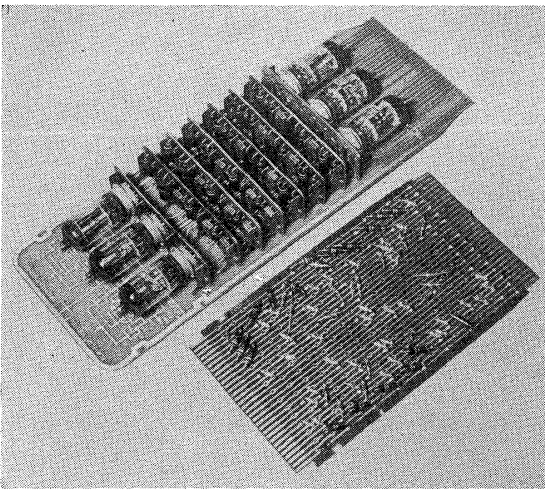


Fig. 6.

visible at the rear, folds into the frame to make a compact unit. The machine is divided into four basic subassemblies to simplify construction and repair.

Our application of printed-wiring techniques is shown in Fig. 6. Each tube board contains three flip-flops, three inverters, and their associated circuits, although other combinations are possible without modification of the basic printed wiring. Each diode card can readily accommodate 60 diodes. There are 9 printed tube circuit boards and 15 diode boards in this machine.

Monrobot IX uses approximately 1000 diodes and 71 tubes, of which 23 are flip-flops and 24 are inverters. Minimization was of tubes rather than diodes since we are able to use a type of diode costing 23 cents each. Logical levels are plus and minus 3 volts.

A four-stage counter, not shown in the block diagram,

serves as buffer storage between typewriter and computer and as storage location-selection control. Multiplication and division are by repetitive addition or subtraction. Conversion of a number from pure binary to decimal form for read-out is achieved by dividing that number by the appropriate power of ten. A count of the successful subtractions before the remainder goes negative yields the desired decimal digit. The next lower order decimal digit is obtained by decimally shifting the remainder and repeating the iterative subtraction.

The computer is fast enough to be able to read a number out to the typewriter at the rate of twelve characters per second, which corresponds to the maximum rated speed of the typewriter.

We mentioned that there was only one information track on the magnetic drum. The two fast access loops, the product/dividend register and the multiplicand/divisor register, are interlaced together with the storage registers in such a manner that only one record circuit and one playback circuit are required for the handling of all information. Fast access loops are regenerated continually, whereas storage registers remain untouched except on the occurrence of a store command. Pulse density on the information track is approximately 75 bits per inch, and pulse-repetition rate is about 80 kc.

Negative numbers are not encountered in this machine because the subtract operation has been modified to what has been called the diminish operation. The result of this operation is zero whenever the subtrahend is greater than the minuend. Under any other conditions the operation is a normal subtraction. This feature is particularly useful in handling such problems as step-rate billing and payroll computation in that it eliminates the need for branch programs. The diminish operation and its field of application has recently appeared in the literature.¹

To summarize, the Monrobot IX is an on-line business machine that is well suited to several basic business functions in which format and computation are repetitive; for example, invoicing. The machine is sufficiently versatile to be able to compute answers involving fractions such as are encountered in lumber billing. The machine can be applied to any currency in the world, including that of the British Sterling. Problem solutions are printed within a fraction of a second to a few seconds after entry of input data, depending upon the particular application.

Training time for an operator is virtually negligible provided the operator commences training with the ability to type.

One of the chief advantages of this machine is to be found in the form of a by-product, that is, accumulations of group totals, such as total accounts receivable, total federal taxes, total quantities, and so forth, which are readily available simply by the push of a button.

¹R. W. Murphy, "A positive integer arithmetic for data processing." *IBM J. Res. and Dev.*; April, 1957.