

# The Marchant Computer System

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**T**HE Marchant MINIAc system is a completely new approach to the automatic accounting system, or as it has been frequently termed, the automatic office. With no intention of entering into the current debate as to whether the automatic office has arrived, report of the progress of its development is submitted.

When Marchant determined to undertake the development of an automatic office system, it troubled us somewhat that we had the whole distance to go, that we had no equipment now in use which might be adapted to this system. It has turned out, however, that this was a blessing in disguise since it permitted the engineering, from the ground up, of a completely modern system without the need of compromising specifications to encompass

nisms which are incorporated in each of the equipments comprising this system. It speaks the same language as all of the equipments in the system, even to and including a uniform cell density. It is a single-track recording device using a self-clocking recording method. While its conveyance is normally transportation by messenger or by U. S. Mails, it can be reproduced by long-distance telephone or leased wire at a speed compatible with the band width of the line. For example, the 2,500-cycle bandwidth of the telephone system will reliably transmit this information at about 200 characters per second. It is literally a piece of the memory of the data-processing system which is sent to data sources for primary records, then returned for processing.

Our own 6-bit code is used, providing 42 alpha-numeric characters, 6 typewriter commands, 6 director digits which are required by various portions of the data-processing system, and 10 prohibited combinations, which constitute ambiguity check against the 10 decimal digits.

The tape package contains the necessary tape-handling equipment, the recording head, end-of-tape sensing means, electric plug-in connections, and a unique package-identification device, whose use will be dealt with in more detail in the following.

In the language of the accountant, chronologically organized lists of transactions of a given type are called "journals"; groups of accounts falling within a given category, such as receivables, payables, etc., are termed "ledgers." It is a salient point with the Marchant MINIAc system that a given ledger or a given journal is a particular tape package. It is equally salient that a package contains all of the data of like kind for a given accounting period, without regard to the portion of its capacity used.

The alpha-numeric input device is based upon a standard electric typewriter, one of several available makes which may be specified by the customer. The Marchant servo unit which converts the typewriter into a magnetic-tape-reading-magnetic-tape-writing typewriter, occupies space below the typewriter, and contains two independent magnetic-tape

drives which will accept the tape package described (Fig. 3). The obvious advantage of this arrangement is that the most complex part of this equipment is mass-produced for a very large market and is therefore priced most reasonably. It also happens that the high-wear parts of the typewriter system are confined to the inexpensive section. The typewriter may be replaced by a new or factory-rebuilt one when its useful life has been exhausted. It does not have to be returned to our factory for overhaul.

The unit control is achieved through an accessory unit which is of the same physical size as the tape capsule described in the foregoing and plugs into a typewriter tape drive in the same manner. However, as Fig. 4 illustrates, it is a magnetic card-reading-card-writing device, which later will be available for a single-track card, or for a 10-track card, selection of the track to be accomplished by the keyboard shown along the top of the package. The unit-control card is one of two forms (Figs. 5 and 6). A typical arrangement of this equipment in a location like, for example, the sales office, is shown in Fig. 3 in which a standard tape capsule is plugged into one of the two tape drives and the card attachment plugged into the other. In this example, the sales office will have two tub-files. One is an alphabetical listing of all existing customers. If the 10-channel card is used in this instance, the first track will have all information normally found in the heading of billing; another contains terms; another, credit information. Other tracks hold bought-by and shipped-to combinations, etc. A second tub-file will be a numeric arrangement of stock control or catalogue numbers, each card therein containing ten stock-control numbers, descriptions, unit prices, and the like. Coded stop on the card permits manual adjustment, such as insertion of quantity ordered, or the selection of the size or color in the description. Ordinarily an order received by telephone, over the desk, by mail, or by a salesman's

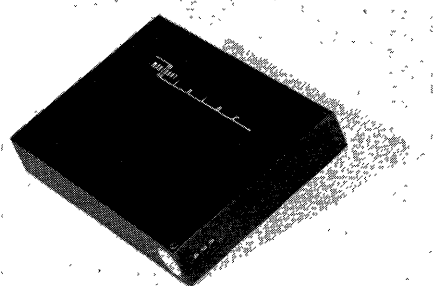


Fig. 1. Magnetic-tape work capsule

such equipments. Fullest use of modern techniques was therefore afforded.

Customarily, when an equipment system is being described, one speaks of the principal central equipment, such as a high-speed electronic computer, then the principal peripheral equipment, and finally, the data source equipment in its turn. However, this paper will reverse this procedure and, in fact, go beyond and first discuss a novel data conveyance. Fig. 1 shows what is literally the "little black box," and is one of a number of varieties of magnetic-tape encapsulations (Fig. 2). The storage capacity is in the order of 400,000 characters, or 8 hours of typewriter-out time, all in a volume measuring 5 inches wide by 7 $\frac{1}{4}$  inches long by 1 $\frac{1}{4}$  inches thick; or about the size of an ordinary book, facilitating labeling, handling, storage, and shipping.

It plugs into any of the drive mecha-

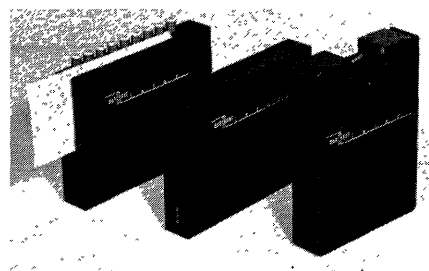


Fig. 2. Three varieties of Marchant MINIAc magnetic-tape encapsulations

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Fig. 3. Marchant servo unit with standard typewriter and two magnetic-tape capsules

notes will call for the selection of the customer card to be transcribed, along with manually inserted date, customer's purchase order number, and sales order number. Successively, items desired to be purchased by this customer are manually dropped into the card-reader slot and the track number chosen by the last digit of the stock control number. Coded stop permits manual quantity adjustment. The hard copy that results from this operation will be the customer's acknowledgment, the sales order, and a sales office copy. The work capsule that was plugged into the typewriter throughout this operation, is the sales journal and contains a record of all strokes of the typewriter, whether they are instituted by the card-reading attachment, or by manual keyboard. It will be seen that except for the insertion of date, customer's purchase order number, and specific quantities of items purchased, there has been no manual operation of the typewriter or any human file or catalogue reference for this transaction entry. In this use, the magnetic card contains format.

### Tape Information Processor

Equipment will be provided which will do the sorting, collating, and all other logical operations. It must be borne in mind that this equipment is not a physical sorter of documents, but rather does its sorting by reading from one tape, forms a decision as to which tape to transcribe to, and then carries out that transcription. It is a continuous-flow processing device operating above 1,000 characters per second, every second. It has a flexible register length up to 120 characters. Its speeds for sorting and collating correspond to about 800 80-column cards per minute. It is capable of alphabetic as well as numeric sorting and collating.

The tape information processor may

be installed and used as a sorter-collater without any computing facility, or it may be installed in conjunction with the MINIAC computer (Fig. 7). It is for this reason that one generally expects to find several tape information processors in a system to each MINIAC.

The unique identity-keying device incorporated in the tape capsule causes a tape drive associated with the MINIAC or tape information processor to react only to tape commands bearing the address of the tape capsule plugged into that drive. If a given accounting procedure calls for, say, four capsules of certain identities, it is sufficient to have these four capsules plugged into any four drives in the system without regard to which particular drive. Conversely, a tape command referring to a tape capsule which has not been plugged into some transport results in a malfunction and the calling of attention to the fact that a necessary tape capsule is not available to that machine. The operator may prepare for the next accounting procedure while the present procedure is being run, since he can plug the capsules pertaining to this next procedure into any transport with impunity. No time is lost in setting up for a procedure, since immediately upon completion of the last command of the given procedure, the operating plan is established for the next procedure; and when the plan is established, that procedure can commence immediately.

Again in the language of the accountant, at the close of an accounting period a process known as "posting" must be carried out; this requires every item in every journal to be entered as a debit in one ledger, a credit in another. This process is actually carried out by sorting the journal tape into a given order of account number corresponding to the order found in a given ledger, extending prices, then collating with the proper ledger tape. This tape is now re-sorted into another order to correspond with the opposite ledger, whereupon it is collated with that ledger.

It is important in this type of operation to have excellent controls in accordance with the accountant's use of the term. Running-column totals and cross-foot totals are carried out by MINIAC during the time of passage of one word from tape into the information processor and back onto tape again. In this regard, the information processor performs extractions from the long word representing the entire transaction. This extraction is assigned one or more 10-digit words in MINIAC as the running-total, or counter, depending upon the magnitude of the

expected column-total. All arithmetic functions are carried out by MINIAC. Malfunction resulting from the failure of cross-foot totals to check is detected by MINIAC's own logics, subject to MINIAC's numeric check for both transfer and arithmetic.

The trial balance, in the language of the accountant, is carried out entirely within MINIAC. It will be seen that all of the recapitulation figures resulting from the posting of all of the ledgers in the accounting system are contained within the drum storage of the MINIAC computer, due to its dual function as computing element adjunct to the magnetic-tape processor during posting. The financial statement, balance sheet, profit and loss statements, etc., are, therefore, only a systematic read-out of the addresses in the internal memory of the MINIAC computer known to correspond with the entities contained in that statement. Format is supplied by a format-tape capsule by collation.

Billing results from a collation of the sorted sales journal, with the sorted shipping clerk's report to determine which of the items ordered by the customer have been shipped, back-ordered, and cancelled. This leads to a corrected sales tape, which contains the customer account number along with all lines of billing. Prices are now extended and summarized. Finally, collation with

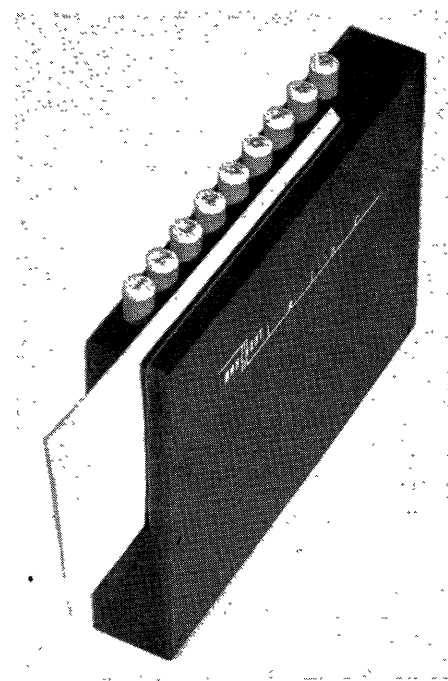
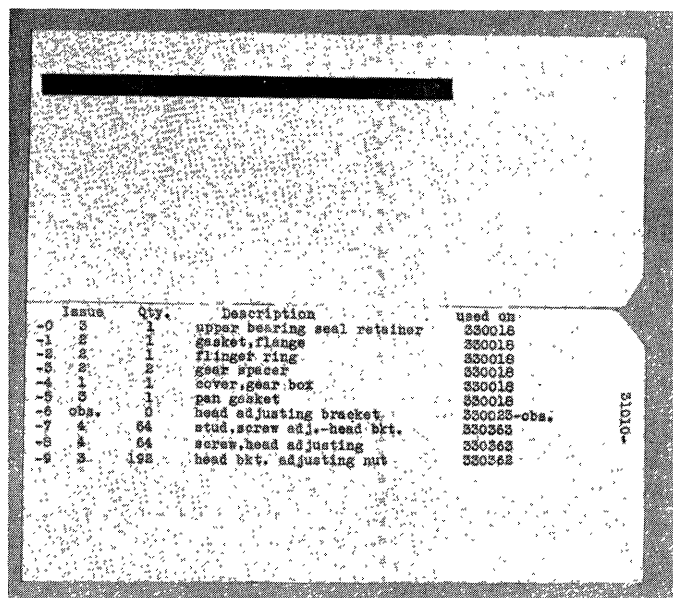


Fig. 4. Magnetic card-reading-card-writing capsule. Reads from or writes on any one of ten selected tracks on magnetic strip associated with card



Issue	Qty.	Description	used on
-0	3	1 upper bearing seal retainer	230018
-1	2	1 gasket, flange	230018
-2	1	1 flange ring	230018
-3	2	2 gear spacer	230018
-4	1	1 cover, gear box	230018
-5	3	1 pan gasket	230018
-6	obs.	0 head adjusting bracket	230023-obs.
-7	4	64 stud, screw adj.-head bkt.	230363
-8	4	64 screw, head adjusting	230363
-9	3	192 head bkt. adjusting nut	230362

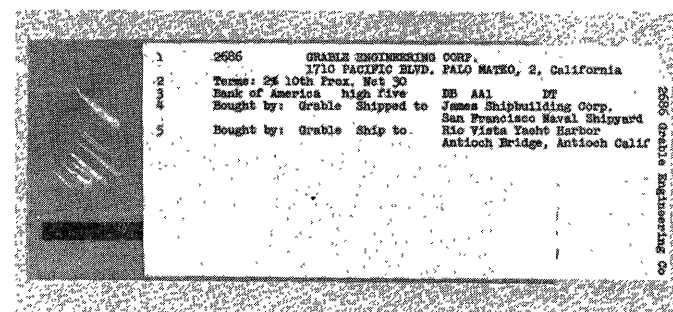


Fig. 6 (above). Card in transparent envelope with magnetic strip affixed to one side

Fig. 5 (left). Card with magnetic strip sealed to back surface

customer's register tape for name and address results in the billing tape, ready to be inserted into the magnetic-tape-reading typewriter so as to produce the hard copy of billing.

Payroll has been avoided as an example in this paper, not because it is a less practicable procedure, but because of the greater complexity of its description. It should be pointed out however, that the automatic payroll procedure requires the following tapes:

1. The timekeeper's authorized pay report.
2. Employees' schedule, listing hourly rate, overtime and premium pay rules, income tax deduction data, etc.
3. Federal Old Age Benefits records.
4. Payroll register, listing payroll account number versus name.
5. Dollar table, listing numerical dollar versus alphabetically expressed dollar, etc.

There results, not one, but a number of tapes, namely:

1. Check printing tape.
2. Federal Old Age Benefits report.
3. State Unemployment Insurance report.
4. Federal Income Tax deduction report.
5. Cashier's report (of other deductions).
6. Possibly company pension plan report.

The column totals may be found in MINIAIC drum memory.

We have discussed the use of magnetic-tape capsules as journals, and as ledgers. Other important uses are

1. Intermediate storage devices, such as pockets for sorting.
2. Registers, such as a customer's register, equating account number to customer's name.
3. Purchase-order registers listing all open purchase orders or dues.
4. Work tapes in hybrid systems employ-

ing card-to-tape, tape-to-card, or perforated-to-magnetic-tape transformation.

5. Archive storage for data storage required by law for very long periods.

It is easily shown that the real savings a low-labor-cost accounting system can bring about are not fully realized when a hybrid system is used. For example, a system involving a combination of cards and magnetic tape, perforated tape and magnetic tape, or manual and magnetic tape does not afford the ultimate

system. A card-to-tape and a tape-to-card translator operating at 150 cards per minute serves as the control unit for a standard punched-card reader and punch. A perforated-to-magnetic-tape translating device is also offered. This equipment operates at a maximum of 15 characters per second and brings about a full code translation during transfer. A second piece of equipment, a high-speed perforated tape-to-magnetic-tape transcriber is available for use where no translation is required, its speed being 1,000 characters per second. There is no magnetic-to-perforated transcriber for high-speed operation.

Data processing as applied to office procedures involves three phases:

1. *Communications.* Collecting, trans-

Fig. 7. Standard Marchant MINIAIC computer with Flexowriter input-output. The magnetic tape system supplants the Flexowriter



in savings principally because the over-all system is at best only semiautomatic and still contains many labor costs. However, it is a mistake not to recognize that some business firms have excellent reasons for using hybrid systems. This requirement brings about a discussion of a class of equipment contained in the Marchant

porting, disseminating, filing.

2. *Organization.* Arranging, classifying, merging.

3. *Computation.* All arithmetic operations.

The view of many in this industry is that progress in the data-handling field

has been retarded by the "giant-brain" school of thought. It emphasizes computation out of all proportion to its importance; it justifies extremely inefficient

use of a general-purpose machine for data organization; it accepts the communication bottleneck as a burden to be borne. Indeed, the very inefficiency of data

organization forces internal speeds which discourage avoidance of hybrid combination of data media, and imposes unnecessarily grievous programming problems.

## Discussion

**Salvatore Intagliata** (Underwood Corporation): How do you arrange to have the units associated with the operation of the electric typewriter compatible with five different makes of machine?

**G. B. Greene:** If I understand this question correctly, the way we arrange this is by building a little unit which sets a typewriter, and by customer's specification we can assemble our mechanical matrix unit to provide a given identity to a given order along the typewriter. They all are key devices and all of them are basically able to be operated a key at a time by something pulling one key down as though it were a finger-tripped operating unit. By the same token, keyboard operation will depress this same element, so that it can be, and is, a 2-way street.

**R. E. Schoenberg** (New York Telephone Company): Did you say your tapes could be reproduced over ordinary talking telephone circuits of 2,500 cycles?

**G. B. Greene:** Yes.

**D. N. Lee** (RCA Service Company): What type of checking does the MINIAc employ?

**G. B. Greene:** The MINIAc has a numeric check system. We have our own code. It is a 6-point, or 6-hole, as some people call it, information system. Roughly it is 42 alpha-numeric characters, six punctuation and the like, and then some control and director digits that are required in other parts of the system, finally bringing us up to a total of 54. Then we have ten other entities that are the ambiguous, or prohibited combinations, of the ten decimal digits. Our people feel that ambiguity checking for alphabets is not economically justified in most applications.

It is an ordinary ambiguity check system, but there is one small point which might be considered. We use an adder principle which gives us not only the sum digit but the proper ambiguity bit along with it, so the actual error detection is a matter of a transfer check. Each time any digit gets out onto transfer busses it is determined there for once and for all whether it was ambiguous or not.

**W. L. Martin** (Telecomputing Corporation): What kind of checking and marginal testing are used in MINIAc?

**G. B. Greene:** We have a very complete marginal checking, marginal manipulation system built into MINIAc, intended, however, to be done on a manual basis in concert with a diagnostic routine.

**R. A. Rahenkamp** (International Business Machines Corporation): Would you

describe the type of card you mentioned? How is MINIAc controlled—by plugboard, tape, or stored program?

**G. B. Greene:** I overlooked mentioning the card because it can be anything from a calling card to an 8½ by 11-inch card. You can think of this as anything that will fit your own system: a piece of paper, a piece of card. Its weight is not important. It has a magnetic track placed on the back of it.

You usually think of the face side of this card as containing the hard copy contained in the magnetic track of the card, and the actual length of this track is something like 4 inches and the capacity of one of these cards with the size of the card that we have always used runs about 120 alpha-numeric characters per track and ten tracks. Obviously there is not room enough for the hard copy of 1,200 characters on a card the size we are all accustomed to using, so this does mean that the card might need to be larger on occasion. We register only to one edge of the card and one end of the card, so its dimensions are not important.

In regard to how MINIAc is controlled, it is a stored program machine. Its program is loaded at 1,000 digits a second through any one of the tape drive devices provided.

**L. A. McCabe** (Campbell Soup Company); **O. D. Seeley** (Metropolitan Life Insurance Company); **J. W. Pontius** (General Electric Company); **John Mekota** (Raytheon Manufacturing Company); **E. F. Cooley** (Prudential Insurance Company): Please give information as to price and availability and whether or not the Marchant Sales organization has the equipment yet.

**G. B. Greene:** I don't know where to begin on this question. In the first place, the Marchant Sales organization does not have it yet.

The question of price is quite a problem. As you who are acquainted with systems realize, it is difficult to name a figure, that makes much sense unless speed or volume parameters are employed. In big systems you expect to find multiples of these equipments; it makes no sense to talk about one piece of equipment being worth this much or that it can be rented for that much. It may be of some help, though, to point out that the typewriter without tape capsules is around the \$4,000 mark, the tape drive units are around \$2,000, etc. It is not expensive equipment. It is intended for large production and is largely electro-mechanical.

Somebody wanted to know when it will be available. That is one of the most

difficult questions yet, since he would mean available in quantity, and big system-wise, no doubt. There will be a few of these equipments built before the end of 1955, but not enough to be particularly significant to the industry. Our real production won't start until the first of 1956.

**E. H. Friend** (New York Life Insurance Company): In the system described, would you consider the tape information processor, rather than the computer, the real heart of the system?

**G. B. Greene:** I definitely believe that the tape processor is the real heart. I myself am one of a number of men in this industry who hold that the computer field, the data-processing field, has actually been harmed far more than it has been aided by the so-called "giant brain" school of thought. That school of thought of course glorifies the computation aspects of office procedures out of all proportion to its importance, and I believe that surely in this case the heart of the equipment, that without which you could not operate along this philosophy at all, is a much more rudimentary piece of equipment than a general-purpose computer.

**N. C. Jochlin** (University of Michigan): Do you have any magnetic-tape to paper-tape conversion units?

**G. B. Greene:** Yes, we can supply a tape-drive unit and capsules to co-operate with Flexowriter equipment for the conversion.

**B. B. Jordan** (Western Electric Company): Are your elements to be available separately for automatic production machine control?

**G. B. Greene:** That would be a policy matter that I would not be able to answer. I am quite certain in my own mind that the answer would be "yes," but I don't believe I am authorized to say so.

**V. M. Wolontis** (Bell Telephone Laboratories): When a tape capsule is attached to the machine, is the tape brought under the reading head without human intervention? If so, how is this accomplished?

**G. B. Greene:** Bear in mind you soon lose sight of the fact it is magnetic tape you are working with when all you see is a little black box. The actual tape transport, the machinery for moving tape off one reel around past the head and a capstan for driving it back on to another reel, are all contained in the package rather than in the machine it plugs into, and it is an instantaneous process. You can almost throw these things at their drive and they land in place. No tape can be seen or handled.

The assembly of these capsules requires a fixture; it isn't even recommended that a man try to repair his own.