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THE SPOTLIGHT of publicity in the broad field of data processing has been primarily focused on the development, installation, and benefits obtained from the large electronic computer systems being used by many of our large corporations. Since major advances in this field have been made in less than a decade this attention is certainly justified. Equally important, however, to the smaller businessman has been the progress made in improving conventional office machines and systems techniques. Manufacturers of electronic computers and producers of peripheral equipment have applied the experience gained from installing large integrated systems to the growing paperwork problems of the smaller organizations.

Most of the equipment that will be discussed in this paper can be classified in the "common language" category. The term common language refers to a coding in a paper tape produced by the output media and read by the input media. The communication media that most closely fits this description is the conventional five channel teletype, punched paper tape. The combination of holes perforated in the tape represents numbers and letters which can be transmitted over wires or transferred between machines directly.

Since most small and medium-sized companies have no need to transmit their data long distances, the five channel restrictions of teletype lines can be overcome. Instead of five vertical holes with a maximum combination of 32 codes, six-, seven-, and eight-channel tapes have been developed for greater flexibility. For example, an eight-channel tape can offer 256 possible combinations. (See Chart 1 following this article.) This extra capacity allows for individual upper and lower case alphabetic codes and many operation codes for programming special features of the machines beyond the normal printing of numbers and letters. It also provides for the use of a parity checking device which adds an extra hole to make all combinations odd, regard-

354

less of the original coding. Therefore, if the machine reading the tape ever senses an even number of punches, it automatically knows an error is present. (See Chart 2.)

By creating a paper tape or punched card as an automatic by-product of the original writing, much repetitive information appearing on documents, such as sales orders, invoices, shipping papers, statements, etc., can be automatically carried through the entire accounting process. Substantial cost savings can be achieved by eliminating the clerical effort required in manually transcribing identical information many times for different purposes. Prepunched paper tape or punched cards containing fixed information, such as customer names and addresses, product description, etc., may also be used as input media to produce various basic documents.

The question is often raised—why create a by-product punched tape for conversion to tabulating cards, when in most instances the cards could be punched directly from the add punch, typewriter or accounting machine? This is a valid consideration in determining which type of output media is best for a particular system. Normally, if a company has a punched card installation on the same premises, conversion time, plus the cost of a tape-to-card converter, will be saved by direct punching of tab cards. Since the cards are individual unit records, they can be visually checked for errors much more readily than can a continuous reel of paper tape. This would be especially true if the cards are interpreted as they are punched.

On the other hand, the paper-tape approach has the following advantages over the direct punching of tab cards:

1. It can be the direct input media for teletype transmission or other tape equipment.
2. Sending tapes by mail is more economical and convenient than sending cards.
3. An individual transaction cannot be physically lost or misplaced in a continuous reel of tape.
4. Most tape-punching systems are manufactured and serviced by one manufacturer, whereas, the card punches are usually separate devices, sold and serviced by a tabulating machine manufacturer.
5. Tape perforating is often faster than card punching because of certain additional mechanical movements required of the card punch.
6. Depending on the volume of transactions, outside conversion

costs may be less than the costs associated with the purchase or monthly rental of a key punch.

As with any system evaluation, all of these factors must be thoroughly considered before a final decision is made.

Three basic types of machines will perform the functions we have previously discussed. They are adding machines, typewriters, and accounting machines equipped with various input and output devices.

ADDING MACHINES WITH OUTPUT DEVICES

The introduction of the adding machine was the first step in mechanized data processing. Its input, control, output and arithmetic features are merely a simplified version of present electronic computers. To utilize further the adding machine's capabilities, machine manufacturers have built attachments for use with either ten or full-bank machines to punch paper tapes or tabulating cards automatically as a by-product of the keyboard operation. To date, punched tape has been the more popular output media.

In a data-processing application utilizing this type of equipment, accuracy is controlled in two areas. First, the mechanism of the punching unit provides for a sensing device which will signal the operator when the punched coding does not agree with the key-entered data. Secondly, the conventional printed adding machine tape provides the means for a visual check on the original entry of information as well as control totals for subsequent balancing of the tabulated output data.

In add-punching applications, the ability of the machine to add is secondary in importance to the perforation of tapes or cards. The punched information, after processing by tabulating or computing equipment, can be printed out in any sequence or report format desired without the normal clerical costs and delays required under a manual system.

All accounts and classifications must be assigned an identification number and the source documents must be coded before the transactions can be processed. For example, if a sales-analysis report is required, adequate salesmen, customer and product codes must be assigned.

The actual processing in a sales-analysis application could be accomplished as follows:

1. Constant information, such as billing date, is entered in the

machine once for the duration of the run. Semi-constant data, such a salesman's number when all his billings are grouped together, would be keyed in once per batch.

2. Reference data for each line of an invoice is key entered and punched by depressing a non-add bar.
3. Quantity and·dollar amounts are entered by depressing the plus or minus bar. (Note: On certain machines, steps 3 and 4 are performed with one depression of the motor bar.)
4. After all the transactions have been entered, both the printed and punched tapes are sent to a tabulating department for preparation of reports. For many companies, an outside service bureau will perform the punched-card functions. (See Chart 3.)

In addition to sales analysis applications, the add-punch equipment is being used successfully in the distribution of operating costs. Many firms create a complete set of books of account and financial statements from their by-product tapes or cards.

DATA-PROCESSING TYPEWRITERS

The electric typewriter, as a self-contained unit with input and output devices, has gained wide acceptance in the last five years.

For purposes of this discussion, three basic types of automatic typewriters will be considered.

1. Noncalculating with input-output.
2. Calculating with output only.
3. Calculating with both input-output.

NONCALCULATING AUTOMATIC TYPEWRITER WITH
INPUT-OUTPUT

The primary function of the automatic typewriter is to produce a printed document while simultaneously capturing by-product data (such as sales-analysis information) in tape or cards. Input devices, again using punched tapes or cards, can feed repetitive information into the typewriter to actuate, automatically, the keyboard and movements of the carriage.

Consider, for a moment, the significance of this input feature. Under a manual operation a clerk must type entire invoices, requisitions, purchase orders, etc., even though much of the information is repetitive, or at least recurring. Most of the horizontal and vertical

spacing also follows a similar pattern for the same form. It is in this area that input devices have provided the means for obtaining substantial savings in clerical cost and preparation time—also in improved accuracy. Repetitive data, such as customer name and address, or product information, is initially punched into a set of tab cards, individual paper tapes or edge-punched cards. The cards or tapes are then filed beside the typing station. For each document, the operator selects the appropriate master punched record from the file and inserts it in the input reader. The repetitive data is automatically typed on the document and the operator manually enters only the variable data as it is called for on the form. Codes in the master input media can also activate skips, spaces and carriage returns. In many instances, up to 80 per cent of the required information can be recorded without any effort on the part of the operator. The by-product output tape or punched cards will contain information necessary for further processing through tabulating machines or other tape equipment.

In many applications, all the information appearing on a printed document will be recorded on paper tape which by making use of control codes can be used as input media to prepare other related documents. For example, a sales order may be typed using master customer and product cards as automatic input with order information keyed in manually. All of this information is punched into a tape which accompanies one copy of the order. When the shipment has been made to the customer, the completed order form and tape is returned to the typing station. The tape is fed into the machine to produce the customer invoice automatically except for the shipping data, quantity shipped, and extension, which are manually entered in the machine by the operator. A second by-product tape can now be produced for use in sales-analysis and accounts-receivable charges.

CALCULATING AUTOMATIC TYPEWRITERS WITH
OUTPUT ONLY

The basic calculating typewriter is essentially a sophisticated electric typewriter with the ability to add, subtract, multiply, and occasionally divide. Limited data-storage capacity provides for the automatic printing of certain constants such as date, unit of measure or tax description. Plugboards provide programming flexibility in the sequence of machine movements and type of computations.

With the input limited to a manual keyboard and stored constants, this model of calculating typewriter is generally restricted to the con-

ventional billing procedure. The operator types in practically all descriptive and variable data, while the computing unit calculates gross and net sales, taxes, freight, and other charges to arrive at the net invoice amount. All spacing is automatically controlled by the internal mechanism.

The increased speed and accuracy achieved can often justify the investment in such equipment. This would be especially true when a large volume of transactions to be processed include many mathematical calculations. Additional savings could be realized by using data from the punched tapes or cards to produce sales or inventory reports.

CALCULATING AUTOMATIC TYPEWRITER WITH BOTH
INPUT-OUTPUT

Combined reading and punching features of a calculating typewriter offer much broader applications than the equipment mentioned above. The reduction of manual key strokes by introducing prepunched data into the system can substantially step up paperwork production. Typing errors are minimized since most of the keys are actuated automatically.

One representative system might consist of a tab-card reader, calculating typewriter with both paper-tape and card-punching units. Its primary function would be customer billing with inventory control and sales analysis as automatic by-products. Before the actual invoicing begins, master customer name and address cards plus item description cards must be key punched. The latter will contain product number and description, unit cost and price, inventory balance, and other billing information. Both types of cards will carry control punches to activate the typewriter carriage, and will be housed in a revolving file for maximum accessibility to the operator.

The daily procedure would be as follows:

1. Constant information, such as date and beginning invoice number, is manually set into the machine once daily. The invoice number is automatically incremented by one as each new invoice is typed.

2. Referring to the sales order, the operator:

   a. Selects the appropriate customer name and address card and inserts it in the card reader. This step actuates the typewriter to print automatically all necessary heading

information except a limited amount of variable data that must be key entered. After the heading has been typed, the machine spaces vertically to the first line of the invoice.

  b. Selects the first item card and inserts it in the card reader. The quantity and discount, if any, are manually entered on the keyboard. Gross and net selling prices are automatically extended and printed by the machine. On the same line, item costs are computed and printed on a tear-off section of the invoice. Since previous inventory balances are in the item card, a new balance is calculated and simultaneously punched into an updated item card. The updated cards are then manually refiled in product number sequence.

 3. Each item card follows the same routine. After the final line is printed, tax, freight, and net invoice amounts are computed and typed on the invoice.

 4. A punched tape is simultaneously created with sales and cost data for ultimate conversion to tab cards. These cards will serve as the basis for producing various management reports as required. (See Chart 4.)

This, of course, is a very simplified description of the system, but certainly serves to point out many of its obvious benefits.

BOOKKEEPING MACHINES WITH TAPE AND CARD OUTPUT DEVICES

Bookkeeping machines have long been used for posting accounting records. Machine manufacturers, recognizing that important financial reporting data originates from these records, are now producing devices automatically to capture posted information on punched cards or paper tapes.

A wide variety of bookkeeping machines are available with output punching. One model offers an electronic computing unit for automatic extensions, internal storage of constants such as date and discounts and greater programming flexibility. All systems transmit the selected output data through a plugboard arrangement connected to the punch.

Most applications normally associated with conventional bookkeeping machine operations can be expanded to make use of simultaneous tape or card punching. For example, the preparation of labor

distribution and tax reports, as a by-product of payroll writing, has gained widespread acceptance in many offices. (See Chart 5.)

DATA PROCESSING BY OUTSIDE SERVICE BUREAUS

Once tapes or cards have been created, they must be translated to some printed form. Many smaller organizations contract with outside tabulating services to convert their punched media into reports or statements. These service bureaus usually maintain a complete range of punched-card equipment to meet any requirements of their customers.

Before the actual processing begins, the customer must send a chart of accounts or code assignments to the service bureau. The keypunch section will create a deck of master tabulating cards from these listings. These cards, when merged with detail transactions cards, will provide alphabetic descriptions on printed reports.

As transaction tapes are received, the service bureau will convert them to tabulating cards. The cards will be balanced to control totals accompanying the tapes, then processed on other punched-card equipment. The end result is a printed report or series of reports, ranging from sales analysis to complete financial statements. Naturally, no conversion is necessary when punched cards are submitted by the customer. (See Chart 6.)

Charges for performing such services are usually based on the volume of transactions and the frequency of reporting. Since no manual keypunching is called for, only a few working days are required between the receipt of raw data and the delivery of the finished reports.

MAGNETIC LEDGER POSTING

In addition to the more conventional office equipment previously discussed, the management of small and medium-sized businesses might also consider machines of a more specialized nature. One device that fits this category is the bookkeeping machine which utilizes a magnetic ledger card for bank checking-account posting. Magnetic strips on the back of individual ledger cards contain account number, old balance and other data pertinent to the account. The electronic circuitry within the posting machine automatically compares the account number to the key-entered number, picks up the old balance, prints charges and credits on the card, tests for stop payments, and

finally records the new balance in both magnetic and printed form.

This method of combining the advantages of electronic data processing with the retention of individual ledger cards has interested many companies outside of the banking industry. Any firm with a sizeable volume of postings where balance-forward amounts are required, could do well to investigate this equipment as a major cost saving tool.

POINT OF ORIGIN DATA CAPTURING EQUIPMENT

This type of equipment is used to collect information at its original source for transmission to a central processing department. Several manufacturers produce point-of-sale cash registers which automatically record pertinent sales data on paper tape. Daily, these tapes are forwarded to a tabulating department for conversion to punched cards. The cards are then processed to prepare reports relating to sales activity, inventory control, buying and other information required by retail store management. Data-collection systems have also been installed in the factory to transmit production information to a central receiving location. Input stations, strategically located throughout a plant, read repetitive data from tabulating or plastic cards, plus variable information through keyboards, dials or time clocks. Multiple units on the network relay the messages over communication lines to a central collection device which punches paper tapes or tab cards. This punched information is used to produce cost and production reports. (See Chart 7.)

Like other specialized equipment, these collection systems can serve less complex and less voluminous operations. Hospitals, hotels and multi-branch businesses all have the dual problem of transmitting data to a central location fast enough to make the compiled information timely, yet keeping the costs to a minimum. The devices mentioned above may be the solution to these data-collection problems.

CONCLUSION

Office equipment manufacturers are meeting the needs of small and medium-sized business by producing a wide variety of low cost data-processing equipment. A properly designed and operated system, utilizing this equipment, can provide both current operating facts and cost reductions to meet the increasing profit squeeze in our present economy.

Appendix

DATA PROCESSING MACHINES
FOR SMALL AND MEDIUM-SIZED BUSINESSES

Approximate Price Range (Including 6% Federal Excise
and 4% Sales Taxes) September 1960

Type of Machine	With Output Devices Only		With Both Input-Output Devices	
ADDING MACHINES:				
Monroe	$1,500–1,900	(A)		
Friden	2,500	(B)		
NCR	1,400–2,500	(A)		
Burroughs	2,200	(B)		
Clary	1,600–2,400	(B)		
Victor	1,400–2,200	(B)		
Comptometer	2,000–4,000	(A)		
AUTOMATIC TYPEWRITERS:				
Friden Flexowriter			$ 2,600– 3,500	
Remington Syncrotape			2,400– 3,800	(C)
COMPUTING TYPEWRITERS:				
Friden Computyper B	5,200	(D)		
Monroe Monrobot 9	11,000	(D)		
IBM 632	8,700	(D)	10,000	(D)
Friden Computyper CTS			9,900–14,000	
Monroe Monrobot 11			27,000	
Burroughs 101			25,000	

|	No. of Registers	With Both Input-Output Devices	
ACCOUNTING MACHINES, ETC.:			
NCR #158	2	$ 2,800– 3,300	(A)
NCR Class 32	2–3	3,900– 5,500	(A)
Burroughs Sensimatic	2	5,500– 7,200	(A)
Monroe	2–3	2,600– 3,200	(A)
NCR Class 32	5–10	6,200– 9,300	(A)
Burroughs Sensimatic	5–11	7,500–11,200	(A)
Monroe	4–8	4,100– 5,700	(A)
NCR Class 31	10	9,800–11,700	(A)
NCR Class 33	21	10,000–12,000	(A)
Burroughs Sensimatic	19	11,000–12,400	(A)
COMPUTING ACCOUNTING MACHINES:			
NCR Compu-Tronic	31	22,000–23,000	
Burroughs Series F 2000	19	11,400–12,600	(F)

NOTES:

(A) With punched card coupler, rental or purchase price of key punch not included.
(B) Paper tape output only.
(C) Paper tape input and output only.
(D) Card output only.
(E) Card input only.
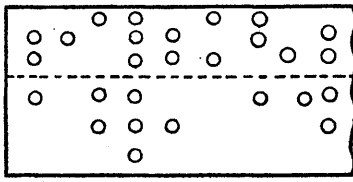(F) No output punching device available at present.

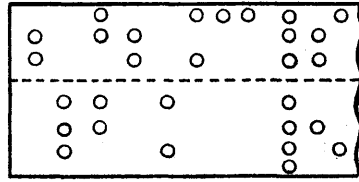# Chart 1

Punched Tape Coding
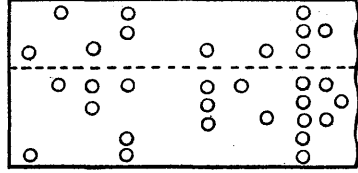
5 channel - 32 combinations
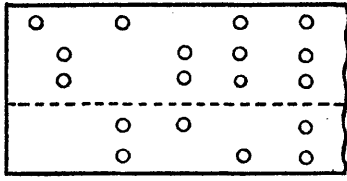
6 channel - 64 combinations

7 channel - 128 combinations

8 channel - 256 combinations
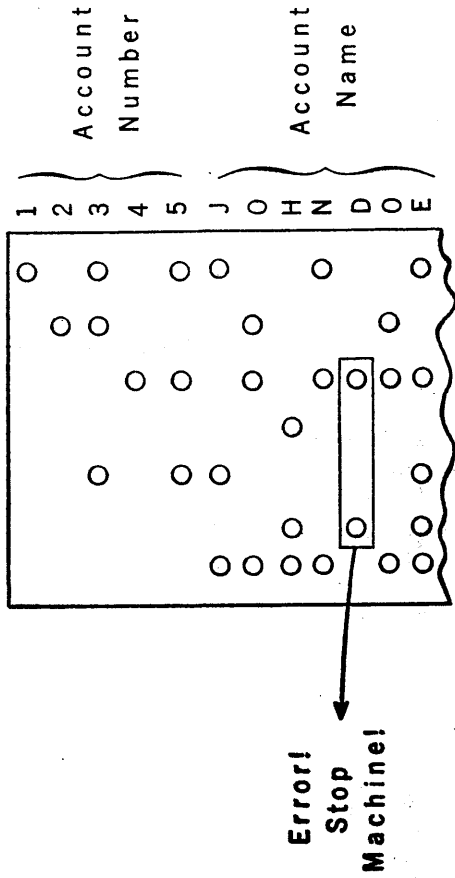
Chart 2

Parity Error Check
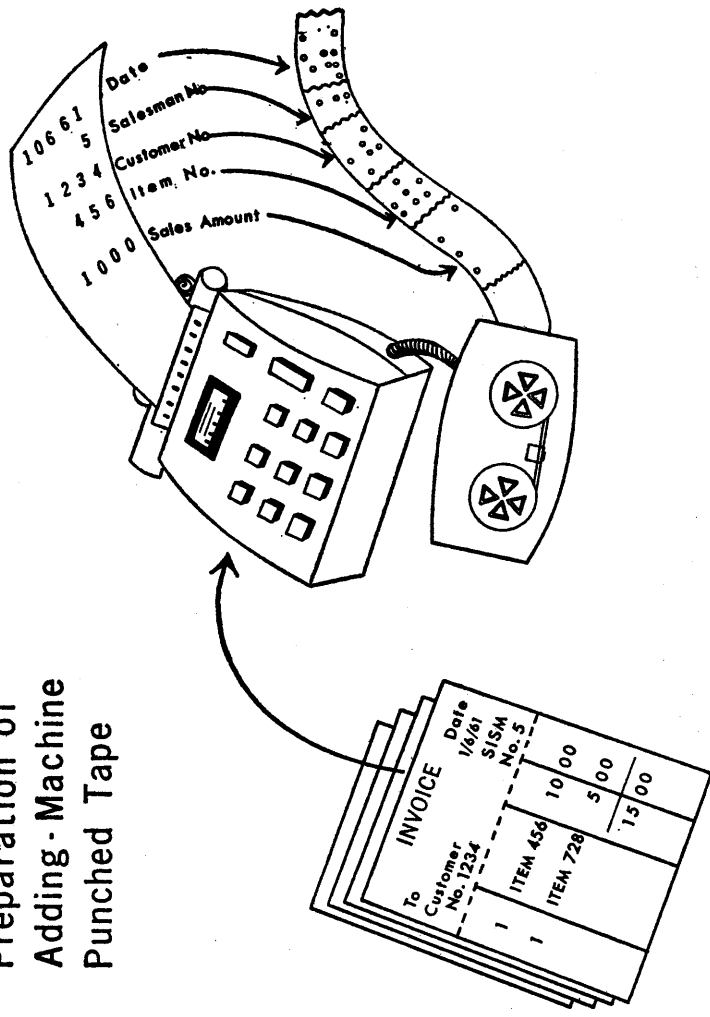
All coding must have odd number of punches

Account Number

Account Name

1 2 3 4 5 J O H N D O E

Error!
Stop
Machine!

Chart 3

Preparation of
Adding - Machine
Punched Tape

10 6 6 1 Date
5 Salesman No.
1 2 3 4 Customer No.
4 5 6 Item. No.
1 0 0 0 Sales Amount

INVOICE   Date
1/6/61
SISM
No. 5

To
Customer
No. 1234

ITEM 456   10 00
ITEM 728   5 00
            15 00

Chart 4

Automatic Typewriter Systems

INVOICE

Cost Data

Tape Punch

Tab Card Punch

Up-dated Masters

Tape Reader

Tab Card Reader

Master Cards

File

367
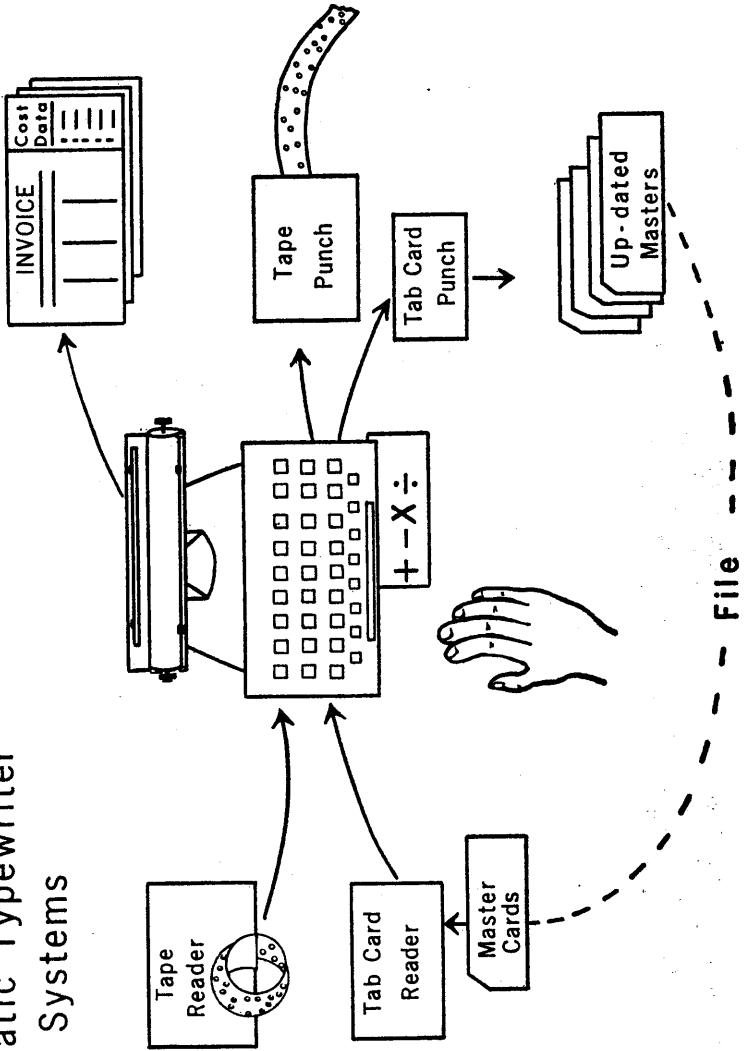
Chart 5

By Products From
Machine Posting

Earnings
Record

Pay : Check

Payroll Journal

Converter

Statistics
Tax Reports

Labor
Distribution

Tape

Tab Cards

Bookkeeping
Machine
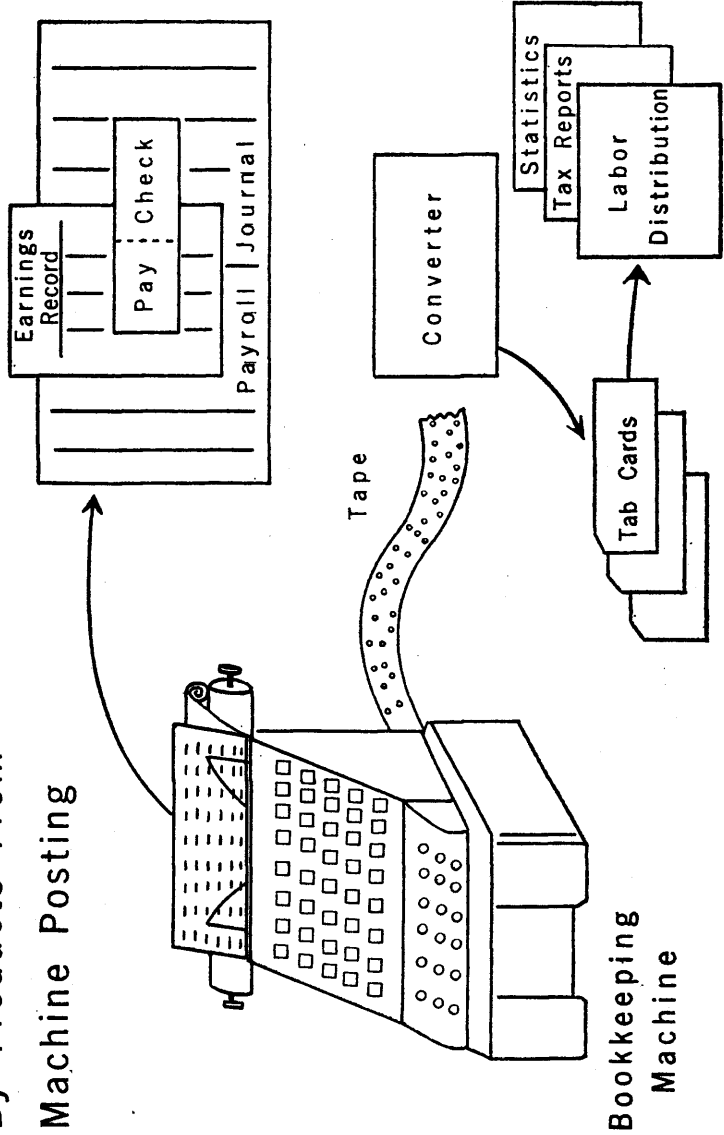
Chart 6

Cycle of Raw Data to Final Documents

1. Convert Tapes

Service Bureau

xxxxT
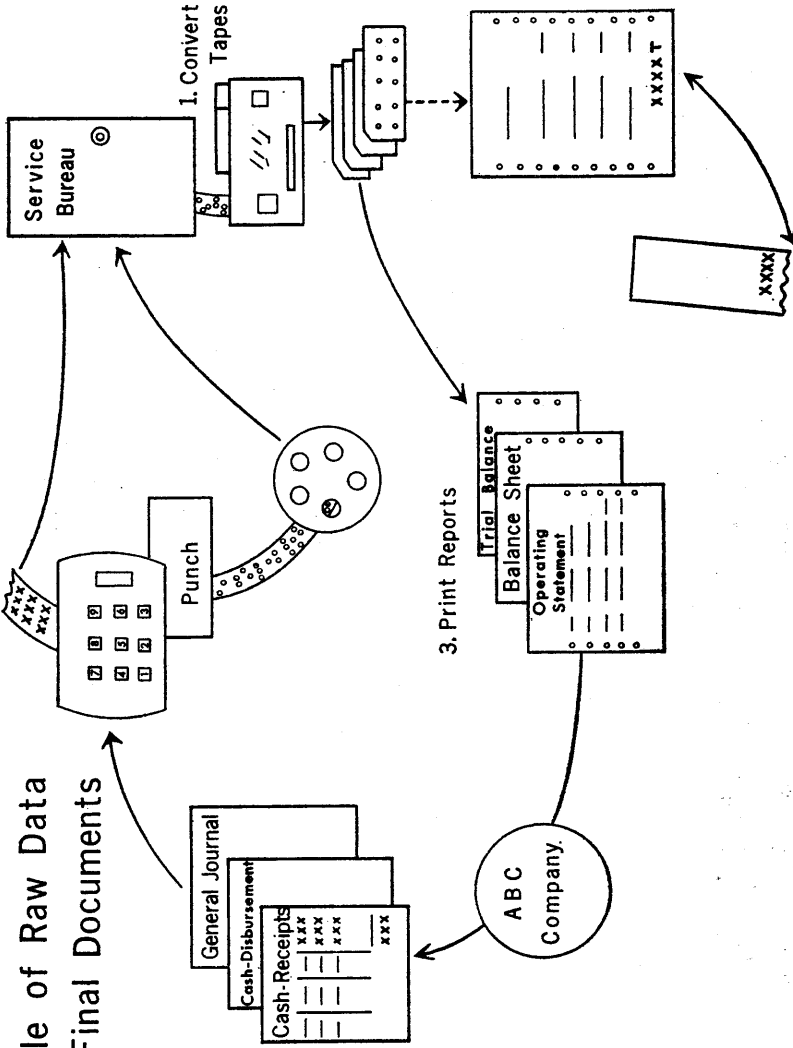
2. Balance Cards to Adding Machine Tape

xxxx

Punch

3. Print Reports

Trial Balance

Balance Sheet

Operating Statement

General Journal

Cash-Disbursement

Cash-Receipts

ABC Company

Chart 7

Data Collection System - Job Costing
Production Control
Inventory Control

Tape-to-Card Converter

Composite Cards

Perpetual Inventory

Job Costs

Machine Loading

In Process Summary

Central Compiler

and

Tape Punch

Job Transaction Card

Time Clock

Employee I.D. Card

Dial in Variable Data