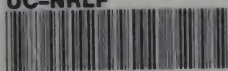


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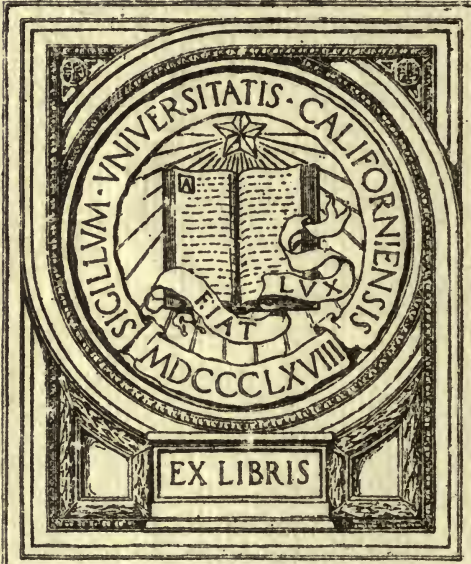
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# ACCOUNTING SESSION

AUTOMATIC, MECHANICAL  
PUNCHING, COUNTING, SORTING, TABULATING  
AND  
**PRINTING MACHINES**

ADAPTABLE TO VARIOUS LINES OF  
ACCOUNTING AND STATISTICAL WORK  
ESSENTIAL FOR  
PUBLIC SERVICE CORPORATIONS  
WITH PARTICULAR REFERENCE TO  
IMPROVEMENTS IN THE ART OF  
MECHANICAL ACCOUNTING

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BY  
**W. E. FREEMAN**

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READ BEFORE THE NATIONAL ELECTRIC LIGHT  
ASSOCIATION AT ITS THIRTY-EIGHTH  
CONVENTION, HELD AT  
SAN FRANCISCO, CALIFORNIA  
JUNE 7-11, 1915

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SYNOPSIS: In the opening pages of the paper the writer makes reference to the evolution of Babbage's calculating, difference and analytical engines and perforated cards; and to the improvements and advancements in the art of mechanical accounting.

Reference is made to several distinctive types of accounting and tabulating machines which have been developed since the days of Babbage.

Particular attention is directed to the improvements and advantages offered by the Powers Accounting and Tabulating Machines, consisting of punching, sorting and *tabulating-printing machines*.

The *Tabulating-printing Machines* are pointed out as one of the important features of the Powers machines. Through the medium of these machines, what was formerly considered impossible has been achieved, namely, the printing of tabulated totals in conjunction with the designations of code or group numbers directly upon the report or record, or, if desirable, the listing in detail of items represented by the perforations in each individual card.

Examples showing the practical and economical product of the Powers machines obtained by The New York Edison Company are included. A radical departure in mechanical accounting is described whereby the recording of all transactions is reduced to mechanical processes. For illustration, daily transactions are recorded by the *tabulating-printing machines* on loose-leaf sheets with printed captions; accumulated totals are carried forward on recapitulation sheets (if preferred, accumulated totals could be carried forward on individual daily sheets); proof postings are taken daily of the ledger cards on which entries have been recorded; trial balances in verification of the work are taken monthly of the ledger cards; loose-leaf sheets are filed in transfer binders during current periods,—on completion of the monthly or quarterly figures, they are bound in canvas books for protection, filing and reference.

The advantages in this connection are emphasized of introducing classified systems of accounts and substituting numerical and alphabetic designations for written descriptions of accounts and for indicating the various classes of direct and indirect labor, materials and supplies, apparatus, appliances, etc. Methods are explained for properly codifying accounts according to logical classes, divisions, sections and sub-sections.

Reference is likewise made to the importance of graphic methods for illustrating engineering and financial problems and conditions, and for affording continuous comparisons from month to month for periods of several years. The adoption of graphic

charts for presenting accounts in classified order, prepared on the numerical system, is advocated as the most efficient guide-device known for obtaining reliable records of business transactions.

Attention is directed to the periodical detail analyses of the important controlling accounts required by executive officials in order to ascertain the sources of income and profits, and of the expenses and losses incidental to a business, as well as to determine the characteristic elements of all classes of income and expenditures necessary to a comprehensive and intelligible statement of revenues.

Where several operating or manufacturing departments are maintained in the accounts, the accounting and tabulating machines referred to, it is asserted, will be found invaluable for the purpose of collating items of proceeds and expenditures of each department.

The accounting and tabulating machines, and particularly the printing machines, it is suggested, present opportunity for obtaining valuable data and information hitherto considered prohibitive on account of the excessive labor costs and expenses, as, for instance: (1) maintaining perpetual inventories of materials and supplies; (2) recording appraisals of buildings and equipment; (3) preparing perpetual inventories of underground and overhead transmission and distribution systems; (4) summarizing changes in consumers connected installations; (5) distribution of accounts payable charges, including operating and other expenses; (6) tabulating monthly consumption of current and bills rendered; (7) analysing operating earnings by geographical divisions, kinds of business and classified rates; (8) ascertaining in advance effect of various new rates suggested from time to time upon present operating revenues.

The paper is concluded with a summary of the various papers read at the Accounting Sessions of this Association dealing with the subject of punching, counting, sorting and tabulating machines.

## EVOLUTION OF BABBAGE'S CALCULATING, DIFFERENCE AND ANALYTICAL ENGINES AND PERFORATED CARDS, WITH PARTICULAR REFERENCE TO IMPROVEMENTS IN THE ART OF MECHANICAL ACCOUNTING.

Charles Babbage was probably the first individual to forecast the computation of arithmetical calculations by machinery. An interesting colloquy is contained in his book entitled "Passages from the Life of a Philosopher," published in 1864, as follows:

"The earliest idea that I can trace in my own mind of the calculating of arithmetical tables by machinery arose in this manner:

"One evening I was sitting in the room of the Analytical Society at Cambridge, my head leaning forward on the table in a kind of dreamy mood, with a table of logarithms lying open before me. Another member, coming into the room, and seeing me half asleep, called out, 'Well, Babbage, what are you dreaming about?' to which I replied, 'I am thinking that all these tables (pointing to the logarithms) might be calculated by machinery.'"

Of the numerous interesting and instructive passages recounted by the inventor and philosopher, appropriate selections in keeping with the subject of this paper are given herewith.

"The first difference engine with which I am acquainted comprised a few figures, and was made by myself, between 1820 and 1822. It consisted of from six to eight figures. A much larger and more perfect engine was subsequently commenced in 1823 for the Government.

"It was not until 1848, when I had mastered the subject of the analytical engine, that I resolved on making a complete set of drawings of the difference engine No. 2. In this I proposed to take advantage of all the improvements and the simplifications which years of unwearied study had produced for the analytical engine.

"To those who are acquainted with the principles of the Jacquard loom and who are also familiar with analytical formulæ, a general idea of the motion by which the analytical engine executes its operation may be obtained without much difficulty. In the exhibition of 1862 there were many explained examples of such looms.

"It is known as a fact that the Jacquard loom is capable of weaving any design which the imagination of man may conceive. It is also the constant practice for skilled artists to be employed by manufacturers in designing patterns. These patterns are then sent to a peculiar artist, who, by means of a certain machine,



punches holes in a set of pasteboard cards, in such manner that when those cards are placed in a Jacquard loom, it will then weave upon its produce, the exact pattern designed by the artist.

“The analogy of the analytical engine with this well-known process is nearly perfect.

“Every formula which the analytical engine can be required to compute consists of certain algebraical operations to be performed upon given letters, and of certain other modifications depending on the numerical value assigned to those letters.

“There are, therefore, two sets of cards, the first to direct the nature of the operations to be performed—these are called operation cards; the other to direct the particular variables on which these cards are required to operate—these latter are called variable cards. Now the symbol of each variable or constant, is placed at the top of a column capable of containing any number of digits.

“Besides the sets of cards which direct the nature of the operation to be performed, and the variables or constants which

<i>NUMBER</i>				<i>TABLE</i>						
2	3	0	3	3	6	2	2	9	3	9
●	●	○	●	●	●	●	●	●	●	●
●	●	○	●	●	●	●	●	●	●	●
○	●	○	●	●	●	○	○	●	●	●
○	○	○	○	○	●	○	○	●	○	●
○	○	○	○	○	●	○	○	●	○	●
○	○	○	○	○	●	○	○	●	○	●
○	○	○	○	○	○	○	○	●	○	●
○	○	○	○	○	○	○	○	●	○	●
○	○	○	○	○	○	○	○	●	○	●

Babbage's card from "Passages from the Life of a Philosopher," London, 1864. Two-thirds of actual size.

are to be operated upon, there is another class of cards called number cards. These are much less general in their use than the others, although they are necessarily of much larger size.

“Any number which the analytical engine is capable of using or of producing can, if required, be expressed by a card with certain holes in it; thus

“The above card contains eleven vertical rows for holes, each row having nine or any less number of holes. In this example the tabular number is 3,622,939, while its number in

the order of the table is 2,303. In fact, the former number is the logarithmic of the latter."

It was asserted that the British Parliament appropriated £25,000 to Babbage for the exploitation of his machine. This amount, however, was soon expended in experimental work and Babbage got no further than a crude hand-made and incomplete model. The Parliament became skeptical and refused to make any further advances in money, so that Babbage was obliged to discontinue work and the invention was lost to England.

The original model of one of the three Babbage calculating machines referred to was purchased from the inventor in 1858 by an American citizen for \$100,000 and donated to the Dudley Observatory, Albany, New York, where at the present time it may be inspected.

This model of the Babbage calculating machine is of considerable value scientifically, but it is very large, unwieldy and complicated compared with modern computing machines.

Several improved and distinctive types of automatic, mechanical, punching, counting, sorting, tabulating and printing machines have been developed by resourceful inventors since the days of Babbage, as follows:

Hollerith Tabulating Machines and Cards.

The Peirce Systems of Perforated Cards.

Powers Accounting and Tabulating Machines.

The practical application of the several systems operating with perforated cards outlined herein to the requirements of the electric-light industry is a matter demanding the attention of all accountants. The writer is firmly of the opinion that mechanical accounting must ultimately revolutionize the present methods of keeping accounts and recording statistics. There is positively no question but that substantial economies in operation will be effected by the substitution of such mechanical tools for the manual methods now extensively employed.



## HOLLERITH TABULATING MACHINES AND CARDS—A BUSINESS COMPASS—FACTS MADE IMMEDIATELY AVAILABLE FOR DETERMINING BUSINESS POLICIES.

The Hollerith Tabulating Machines and Cards have been fully described and discussed in several papers previously presented before the Accounting Session of this Association. In order, however, to make as complete a history as possible of the tabulating machines and cards, extracts are included from a pamphlet recently published, entitled "A Business Compass—Facts Made Immediately Available for Determining Business Policies."

"One day the president of a large steel company suddenly called upon his accounting department for a special analysis of the sales for the preceding five years. The next morning he had the complete analysis for the three years immediately preceding. But—as it would have taken a whole month, with a considerable increase in the accounting force, to give him the other two years, he accepted the three years' figures at hand instead of five years a month later. The reason for this was simple—Hollerith Tabulating Machines and Cards had been used for three years—prior to that the reports were all in loose-leaf form, and the work of compiling the special report would have involved going to original sources, and working over every piece of information from start to finish.

"In a large manufacturing plant the directors formerly met on the second Friday in each month, at which time full reports were available covering the operation of the second preceding month. For instance, the report made at meeting May 12th covered the month of March. After the Tabulating Machine equipment was in smooth operation, the directors' meeting was shifted to the third Friday of each month; and the report made May 16th, 1913, covered the month of April. It is evident that in this plant three weeks were gained by the system, and that this gain was permanent.

"Developed originally for the use of the United States Census Bureau, the Hollerith tabulating system has more recently been arranged for commercial use. It has been adopted by some of the largest concerns in the country, and is fast being extended to smaller concerns, as a most dependable and speedy means for interpreting facts developed in the every-day operation of a manufacturing or mercantile or other business. Some of the more-than-three-hundred concerns now using the system have had it in operation for over fifteen years.

"With one exception, the Pennsylvania Steel Company was the first company to realize the value of this equipment for covering the many items entering into the cost of manufacture and sale of its product. At the Steelton Works of this Company the

Hollerith equipment is installed in the Works Accounting Department, Billing Department and Storage Department of the Main Office; also in the Frog, Switch, Bridge and Construction Departments.”

The predecessor of The New York Edison Company—the Edison Electric Illuminating Company of New York—was probably the first electrical corporation to introduce tabulating machines and cards for verifying and analyzing operating revenues.

During the first quarter of the year 1903 the Auditor of The New York Edison Company and the writer visited the Steelton Works and inspected the tabulating equipment, with the results that the Hollerith machines were installed in the offices of the former company during the month of July, 1903, and subsequently adopted by other similar corporations in leading cities throughout the country, as, for instance, Chicago, Boston, Philadelphia, Brooklyn and Minneapolis.

## FUNDAMENTAL AND DISTINCTIVE PRINCIPLES CLAIMED FOR THE PEIRCE SYSTEMS OF PERFORATED CARDS.

Three fundamental and distinctive principles are claimed for the Peirce systems of perforated cards, as follows:

(1) The cards contain the original entry. In the Hollerith system and all other perforated card systems used heretofore, the sole functions, namely, automatic distribution and compilation form only one step in the accounting cycle. The cards are furthermore made from written reports or statistical sheets and are not originated where the entry comes into being. This the Peirce systems strive to obviate, for, if the cards are made from hand-written sheets, it is evident that an additional and unnecessary entry has been made, which only a great saving in subsequent automatic tabulation will warrant. Indeed, in a great many industrial accounting fields it is not justified. An effort has been made to develop a perforating machine suitable for each individual application. It is not too much to say that if the cost of making out the cards does not exceed the cost of making the same entry by hand, the perforated card system will ultimately displace the manual method.

(2) The contents of the cards are printed as well as perforated. This makes it possible for any one handling them to see at a glance the information they contain. Cards which have perforations only are awkward to handle, and, though by practice they may be read with fair facility, they cannot be compared with the simple, direct method of having the characters printed in clear, legible type. Furthermore, the Peirce cards are permanent records and are filed as such, thus making their field as broad as accounting itself.

(3) The characters are represented by combinations of holes. By using this method of representing the digits, it is possible to put a large amount of information on a single card and at the same time keep it in a convenient size. In the case of the Hollerith system, ten digits are provided in each column on the card and the standard cards contain thirty-eight columns. The recorded data is discovered by observing which numbers have been punched out. This makes it necessary to examine the entire body of the card in order to read its contents.

The machines adaptable for the consumers' accounts are: (1) The perforating machine; (2) the distributing machine, and (3) the automatic ledger machine. The entire cycle of operations, from taking the meter reading to making out and footing the bill, posting both debits and credits to the ledger, and rendering monthly statements, is performed automatically. All transactions are printed.

The meter under this system is equipped with a small, inexpensive perforating attachment about the size of a cyclometer.

The card is placed in the attachment and a key inserted in an aperture in the side and turned. The consumer's number and the reading of the meter, together with the statistical data, is perforated upon the card. The record is not printed in this instance, and hence the card is illegible to meter reader. It is believed this form of card will eliminate "curb readings."

These are briefly the characteristic features of the Peirce systems. If the expectations claimed for the Peirce systems are realized, they can be applied with equal advantage to all other accounting work, including payroll and cost accounting. They should offer likewise increased facility for auditing in all branches of accountancy.



**IMPROVEMENTS AND ADVANTAGES OFFERED BY THE  
POWERS ACCOUNTING AND TABULATING MA-  
CHINES, CONSISTING OF PUNCHING, SORTING,  
TABULATING AND *PRINTING MACHINES.***

The Powers Accounting and Statistical Systems consist of three machines, namely, (1) the Perforating Machine, by which the data and information is punched on the cards; (2) the Sorting Machine, which separates the cards into different classifications preparatory to tabulating; (3) the Tabulator-Printer, which compiles the data and information from the cards (Fig. 1) and prints the results. Three hundred of the above Perforating Machines were used in the compilation of the last Federal Census.

It should be noted that formerly machines for handling Tabulating Cards only perforated and totalized records; no printed record was obtainable. This was an inherent defect, which has been corrected by the development of the Powers Tabulator-Printer. The Tabulator selects and adds mechanically; prints designations and tabulated totals, with or without detail, on paper strips or record sheets; prints legibly five carbon copies; is equipped with one to seven designating or adding units which operate simultaneously. (Fig. 2). Takes totals without stopping the machine.

The advantages offered by the Powers improved accounting and tabulating machines are both exceptional and important, as for instance:

**ADVANTAGES OF THE PUNCHING MACHINES:**

(1) The automatic feeding and ejecting of cards; (2) the gang punching feature; (3) the automatic punching of ciphers; (4) the key selection by the use of the fingers of both hands; (5) the ability to review and correct the key selection; (6) the automatic line indicator and spacer, and (7) the correct registration of punched totals.

In connection with other lines of work where there is comparatively no gang punching, owing to the absence of repeated or consecutive facts, and where each fact must be separately selected on the keyboard, either a 12-key automatic punch or a hand punch is recommended.

**ADVANTAGES OF THE SORTING MACHINES:**

(1) The ease of operation and the removal of cards; (2) the ability of "split" sorting of any holes in a given column; (3) the machine automatically stops when the last card is sorted.



Yr		Mo		Day		Invoice No	State	Town	Customer No.	Salesman	Dept	Terms	Commodity	Quantity	Unit	Amount of Sale	Cost	
11	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9

FIG. 1

The above is a facsimile card used in connection with Power Automatic Machines. Cards are specially designed to meet local requirements of users.

DESIGNATIONS	X. Y. Z. RAILROAD ANALYSIS OF FREIGHT TRAFFIC FOR THE MONTH OF <u>MARCH 1915</u>							TOTALS WITH DETAIL	
	WAYBILL NUMBER	RECEIVING STATION	FORWARDING STATION	COMMODITY	WEIGHT	FREIGHT	ADVANCE		FREIGHT
	10000 4390	1765	3481		19 858	1459 12	538 12		921 00
25001 4390	1765	3451		29 190	1823 28	925 00	900 25		
25759 4390	1765	3451		31 015	1733 89	850 00	883 89		
25991 4390	1765	3481		23 115	1211 23	320 28	890 96		
28091 4390	1765	3451		31 015	1733 69	850 00	883 89		
31927 4390	1765	3401		55 139	1116 21	216 21	900 00		
				188 924	9079 59	3699 08	8360 01		
10043 4390	1765	3452		29 353	1310 00	530 00	780 00		
10072 4390	1765	3452		71 900	1234 15	780 00	254 15		
10111 4390	1765	3452		25 690	1327 78	701 31	626 44		
10223 4390	1765	3452		17 000	1122 00	320 80	801 50		
10760 4390	1765	3452		31 701	1428 55	128 00	900 55		
12763 4390	1765	3452		17 692	1518 88	605 00	710 00		
14609 4390	1765	3452		44 298	1411 10	710 00	701 10		
15384 4390	1765	3482		39 431	1321 05	720 50	600 55		
16107 4390	1765	3452		17 189	1510 25	805 00	705 25		
				343 020	12180 67	6900 31	8160 34		
10948 4390	1765	8617		17 563	1315 66	410 50	905 16		
10536 4390	1765	8617		26 347	1573 78	870 00	703 78		
10537 4390	1765	8617		12 731	1713 60	825 50	888 10		
10690 4390	1765	8617		51 980	1214 23	404 00	810 20		
11354 4390	1765	8617		83 600	1022 00	620 00	901 00		
11405 4390	1765	8617		43 732	1628 77	730 20	892 57		
				265 885	8661 04	3860 20	5100 81		
10749 4390	1765	8618		62 220	1431 47	730 00	701 47		
10749 4390	1765	8618		10 021	1156 87	723 70	433 17		
18974 4390	1765	8618		16 788	1221 82	825 00	601 30		
18974 4390	1765	8618		16 788	1221 82	820 50	601 32		
27674 4390	1765	8618		14 253	1725 46	820 00	905 46		
				182 272	8180 91	4244 70	3944 21		
10000 4390	2134	3451		31 016	1733 89	650 00	883 89		
12018 4390	2134	3451		44 125	1828 24	724 85	899 00		
13018 4390	2134	3451		01 348	152 02	425 00	695 52		
13799 4390	2134	3451		19 538	1489 12	530 12	921 00		
18091 4390	2134	3451		14 189	1499 09	320 20	845 14		
18091 4390	2134	3451		23 115	1211 23	320 20	890 98		
31927 4390	2134	3481		55 139	1111 21	724 20	899 00		
31927 4390	2134	3481		25 139	1628 77	715 20	899 00		
58109 4390	2134	3451		29 100	1022 00	925 00	900 00		
				332 648	12857 57	5333 83	8029 78		

X. Y. Z. RAILROAD ANALYSIS OF FREIGHT TRAFFIC FOR THE MONTH OF <u>MARCH 1915</u>							TOTALS ONLY
WAYBILL NUMBER	RECEIVING STATION	FORWARDING STATION	COMMODITY	WEIGHT	FREIGHT	ADVANCE	
4390		2134	3452	596 225	19964 15	9921 51	10041 74
4390		1765	3306	290 253	8254 47	3685 96	4568 42
4390		2134	3305	290 273	8254 47	3685 96	4568 42
4390		1765	3451	188 924	9079 59	3699 58	5380 01
4390		1765	3452	343 020	12180 67	6900 31	8160 34
4390		1765	8617	265 885	8961 04	3860 20	5100 81
4390		1765	8618	182 272	8180 91	4244 70	3944 21
4390		2134	3451	332 648	12857 57	5333 83	8029 78
4390		2134	3452	696 225	19964 15	9921 51	10041 74
4390		1765	3305	290 253	8254 47	3685 96	4568 42
4390		2134	3306	290 273	8254 47	3685 96	4568 42
4390		1765	3451	188 924	9079 59	3699 58	5380 01
4390		1765	3452	343 020	12180 67	6900 31	8160 34
4390		2134	3451	318 020	11405 18	4723 58	7157 84
4390		2134	3452	279 088	8421 95	4503 01	3918 94
4390		1765	3305	250 261	7058 14	3190 96	3877 18
4390		1765	3452	304 589	10859 62	5179 61	5559 79
4390		1765	8618	180 052	6757 44	3514 70	3242 74
4390		1765	3451	188 924	9079 59	3699 58	5380 01

FIG. 2—WORK OF TABULATOR-PRINTER

The counting sorter attachments are a distinctive feature of these machines.

A new sorting machine will be placed on the market shortly which possesses marked improvements over the present type of machine. This sorting machine will permit of the continuous feeding of cards without stopping the machine, thereby materi-



FIG. 3—CENSUS PUNCHING MACHINE

This model designed for the United States Government. Three hundred used in compilation of the 1910 Census. Automatically feeds and ejects cards. Gang punches repeated facts and makes one sort of cards without additional operation. Is equipped with 240 individual keys and is adapted for cards  $3\frac{1}{4} \times 6\frac{5}{8}$ ".

ally increasing the daily output. The box in the new sorter will hold three or four times as many cards as the present sorting machine, thereby greatly facilitating the ease and efficiency with which these machines can be operated.

## ADVANTAGES OF THE TABULATOR-PRINTER MACHINES:

(1) The rapidity with which totals can be taken on the Tabulator-Printer Machine and the machine automatically cleared to proceed with the next tabulation, and (2) the accomplishing of a printed sheet with carbon copies directly upon a finished report whereon are recorded the various designations in conjunction with the totals and the listing of individual items, thus obviating the possibility of errors in clerical transcription of totals.

It is claimed by the Powers Accounting Machine Company that the Tabulator-Printer Machine is not a competitor of the tabulators manufactured by other concerns, inasmuch as the former is a listing machine, whereas the latter are non-listing machines.

For the information of those interested, detailed descriptions of the several machines referred to are given herewith:

## POWERS PUNCHING MACHINES

Those who recall the illustrated article describing the use of the Powers Punching Machines in connection with the last Census, contained in the *American Machinist*, issue of July 30, 1914, will notice many points of difference between the Census Punching Machine (Fig. 3) and the Commercial Punching Machine (Fig. 4) now employed.

When it came to increasing the number of keys to 540, a radical change was desirable to have the keyboard compact enough to be easily manipulated, so that a new design, having but 45 key bars was selected. By giving each bar 12 notches, 540 punch locations are secured in compact form, and a number of advantages over the use of separate keys, as will be seen later.

These keys are in colors—white, black, red and blue, arranged on the keyboard to correspond with the vertical divisions or fields, printed on the cards to be punched. For example, the keys which are to show the value in money are in six columns and are red for the thousands of dollars, white for dollars and black for cents. These keys are, however, readily changed to correspond with any card arrangement which may be desired.

This type of keyboard is easily operated, as the palm of the hand rests on the plain plate at the bottom of the keyboard, while four fingers of each hand can readily be used in pulling down as many key bars as may be needed to the desired point. The tips of the fingers are merely placed over the number desired and pulled down to the edge of the plate. One great advantage of this method is that the complete setting of the machine can be read along the edge of the plate before the punch is tripped, enabling the operator to verify the setting and to correct it if necessary before punching the card. Touching the small lever at





FIG. 4—COMMERCIAL PUNCHING MACHINE

Automatically feeds and ejects cards and spaces line indicator. Permits verification by operator before card is punched. Each key can be set as a gang punch. All naughts are punched automatically. No spacing keys required. Punches holes in perfect registration.



the bottom releases any key and allows it to be reset at any desired point. This is particularly valuable when punching cards which have other data, and which would have to be made over again in case of erroneous punching.

Another valuable feature of this keyboard is the ability to set any individual key bar, or any number of key bars, so that they will not return to their normal position on the punching of the card. In the setting shown, the entire right-hand half of these keys have their stops pulled down so as to only return to zero. In this way any setting which is to be largely repeated in succeeding cards can be made by the operation of only a few keys, as shown. In the case of dollars, for example, \$1000.50 can be set by simply pulling down the 1 and the 5 in the proper columns, all the keys returning to zero as soon as the card is punched.

The unpunched cards are placed at the back of the machine and automatically fed after each punching by a raised edge about 0.005 inch high between the feeding rolls of the machine. With the data to be transferred to the card on the rack above, the operator simply sets the keys to the desired places, presses the foot pedal, which trips the clutch, raises the dies and card-holding mechanism against the punch and punches the entire number of holes desired at one stroke. After the die returns to the lower position the card is automatically fed into the front holder, and at the same time the line spacer or horizontal bar on the schedule holder above feeds down one notch, which facilitates the transfer of data and does away with all uncertainty on the part of the operator as to the line he is transcribing.

Each of the 45 key bars is mechanically connected with an independent lever, which in turn moves a slide into such positions as will select the punch which corresponds with the number on the key bar that is next to the upper edge of the plate.

The punching of all holes simultaneously by means of a uniform punch and die insures perfect and uniform registration, which is particularly desirable in the sorting and tabulating of the data contained on the cards. Where desirable the punches can be equipped automatically to perforate two separate cards with each key selection, and to deposit these cards automatically in separate magazines if desired.

In one instance, a special punch has been designed for an insurance company which permits one-half of the card to remain visible in the machine. This was to allow the operator to see the data on the written portion of the card and to punch it correspondingly on the other half of the same card. (Fig. 5.)

Waste punchings are deposited in a receptacle under the machine, which prevents them being scattered over the floor.

Another type of punching machine, introduced by the Powers Accounting Machine Company since the article referred

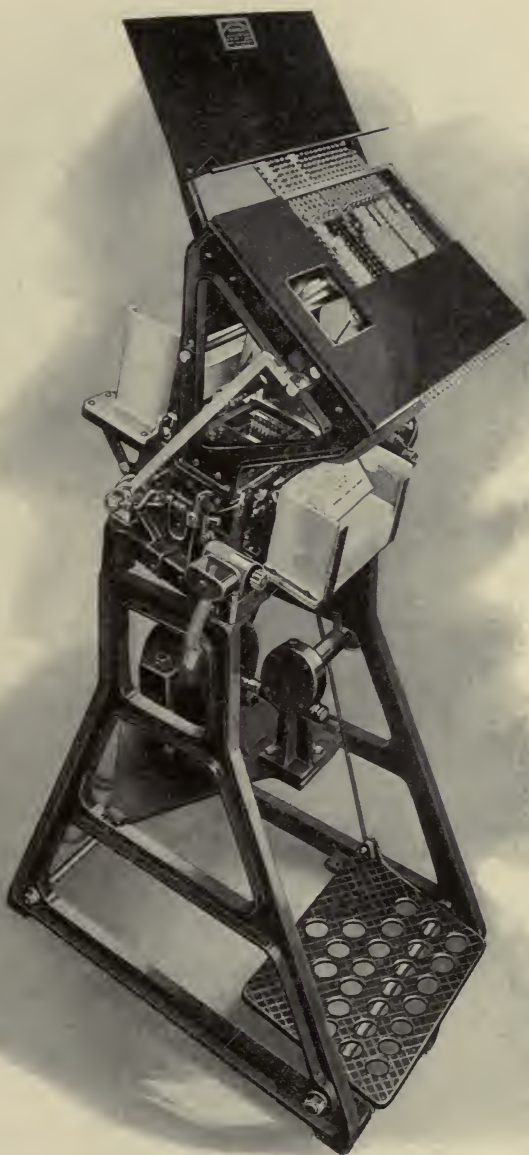


FIG. 5—VISIBLE PUNCHING MACHINE

Data to be punched is written upon half of the card. When in the machine the writing is visible to the operator, who punches the data upon the remainder of the card. Similar in all other respects to the Commercial Punching Machine.

to was published, should possibly be included in this connection, namely, the Verifying Machine (Fig. 6).

A 12-key automatic punch and, if desirable, a hand punch are provided for work where there is comparatively no gang punching, owing to the absence of repeated or consecutive facts and where each fact must be separately selected on the keyboard.

#### POWERS SORTING MACHINES

The next step in the tabulating of data by means of punch cards instead of by writing is the accurate sorting of the cards into their respective groups, so that the data contained on them may readily be examined and tabulated. This is all-important.

The Sorting Machine for use with the Powers Systems was illustrated in the *American Machinist*, issue of February 15, 1915. The mechanism is simple and capable of rapid operating, sorting and counting, when desired, at the rate of from 250 to 270 cards per minute.

It will be remembered that each card contains 12 horizontal rows, each comprising 45 points which may be punched to signify different facts. In sorting these cards the different values are picked out from each horizontal line by means of 12 plungers. Each of these plungers controls the operation of shutters, or switches, which divert the cards into their proper compartment according to the holes which have been punched in them.

The cards from the Punching Machines are placed in the magazine at the right (Fig. 7), being fed down by the pressure of the cards above. At each turn of the machine the upper card is picked from the pile and passed under the guide plate. Over this, carried on the cross-frame, are the 12 plungers, each having a small spring which tends to force it down. The plates controlled by the cams and springs at each end allow or prevent movement as desired.

When a card having a hole in any of the 12 horizontal lines in the row under the plungers passes under the guide plate, the corresponding plunger drops through the hole, setting the guide bar beneath, which diverts the card to the correct pocket. As a rule, there is but one hole in line, but in case of two or more there is a device for "split" sorting, as it is called, the pins for the holes not selected being locked so they will not open the shutter leading to the pocket. As soon as the tripping levers underneath have been set, the plungers rise out of the card, which is then moved forward in the position shown and carried under the rubber-covered wheels at the right to its proper compartment. At the same time another card is fed from the magazine and the process repeated; in fact, it is repeated so rapidly that the machine sorts from 250 to 270 cards per minute.





FIG. 6—VERIFYING MACHINE

Enables operator to verify cards previously punched. Insures accuracy and is more economical than double punching of cards for comparison or other methods of checking.

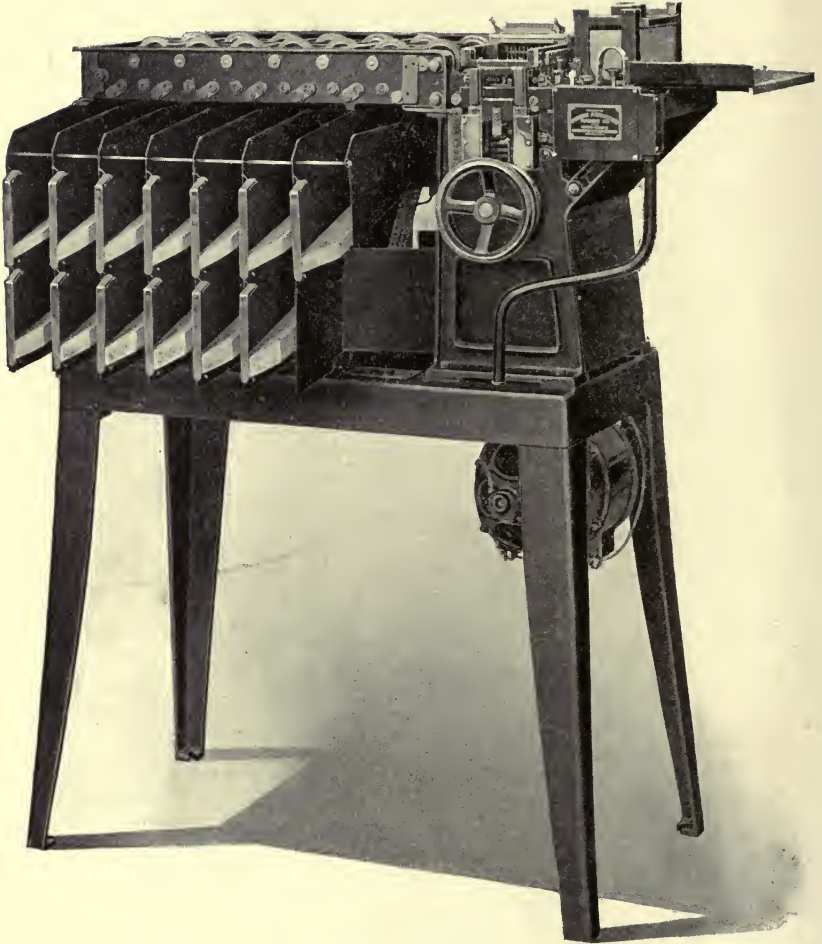


FIG. 7—COMMERCIAL SORTING MACHINE

Selects and operates mechanically. Equipped with 12 card boxes, all compactly and conveniently located. Machine automatically stops when last card is sorted.



One of the interesting features is the arrangement of pockets one over the other. The upper half of the division between the pockets is double, forming a chute through which the card for the lower pocket easily drops into its proper place without interfering in any way with the upper pocket. The number 12 box can, if desired, be used as a discard box into which all cards will go which are not punched in the column being sorted.

#### THE COUNTING SORTER

Another type of sorting machine, namely, the Counting Sorter, is shown (Fig. 8), this being a duplicate of that shown in Fig. 7, except for the counters on the upper part. This attachment consists of 12 individual counters, a sub-total counter and a grand-total counter, the last being at the extreme right. The first counts the cards going into each pocket, while the total number of cards in all the pockets is shown by the sub-total counter. These 13 counters only count cards which are properly punched and deposited in the various pockets. If any cards go through into the discard box they are shown on the grand total, but not on the sub-total. This forms a constant check, as the number of cards in the discard should equal the difference between the numbers on the two total counters.

All the counters except the grand total can be reset by a single feed movement controlling the individual box counter, the grand total being set separately. Should anything go wrong in the counting the machine is instantly stopped by means of a throw-out. The tallies on the counters can therefore be absolutely relied upon.

All these machines are driven by a  $\frac{1}{4}$  h. p. motor under the bed, the motor being connected to a main jackshaft and the power transmitted from this to all the other movements.

It will be noted that the operation is entirely mechanical in every detail, no electrical contact being used. This allows either direct or alternating current motors or any other power to be used for driving.

#### POWERS TABULATOR-PRINTER

A revolution in the methods generally accepted and followed by accountants and statisticians in the work of compiling statistical data and financial results during the last decade has been brought about by the invention of the Powers Automatic Mechanical Tabulator-Printer, whereby what was formerly considered impossible has been achieved, namely, the printing of tabulated totals in conjunction with the designations of code or group numbers directly upon the report or record or, if desirable, the listing

in detail of items represented by the holes punched in each individual card (Fig. 9).

This machine is also very simple and easily operated, the principle of mechanical selection being practically the same as that of the Sorting Machine, excepting that it is provided with as many rows of steel pins as there are vertical columns upon the card to be selected. The card is divided into fields, and the rows of selecting pins are accordingly arranged so that they will select

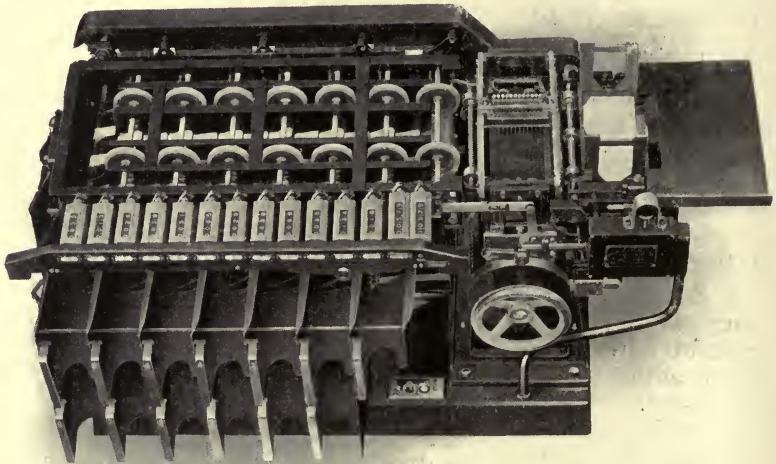


FIG. 8—COUNTING SORTING MACHINE

Equipped with sub-total and grand total master counters and twelve individual counters, one for each card box. Sub-total and all individual box counters are simultaneously cleared and set back to zero with one turn of the key. A thirteenth or separate reject box is provided for cards having no holes punched in column being sorted. Sorts and counts the cards, eliminating the tabulating operation, in the compilation of census, vital statistics and other data requiring the addition of units only.

and effect the listing and addition of the columns comprising each separate adding field in the corresponding Designating or Adding Unit of the Tabulator-Printer.

Perhaps as the business world of to-day is so thoroughly familiar with the various types of adding machines, it might be well to describe the Powers Tabulating Machine as an Automatic Adding Machine equipped with 63 "banks" operated by means

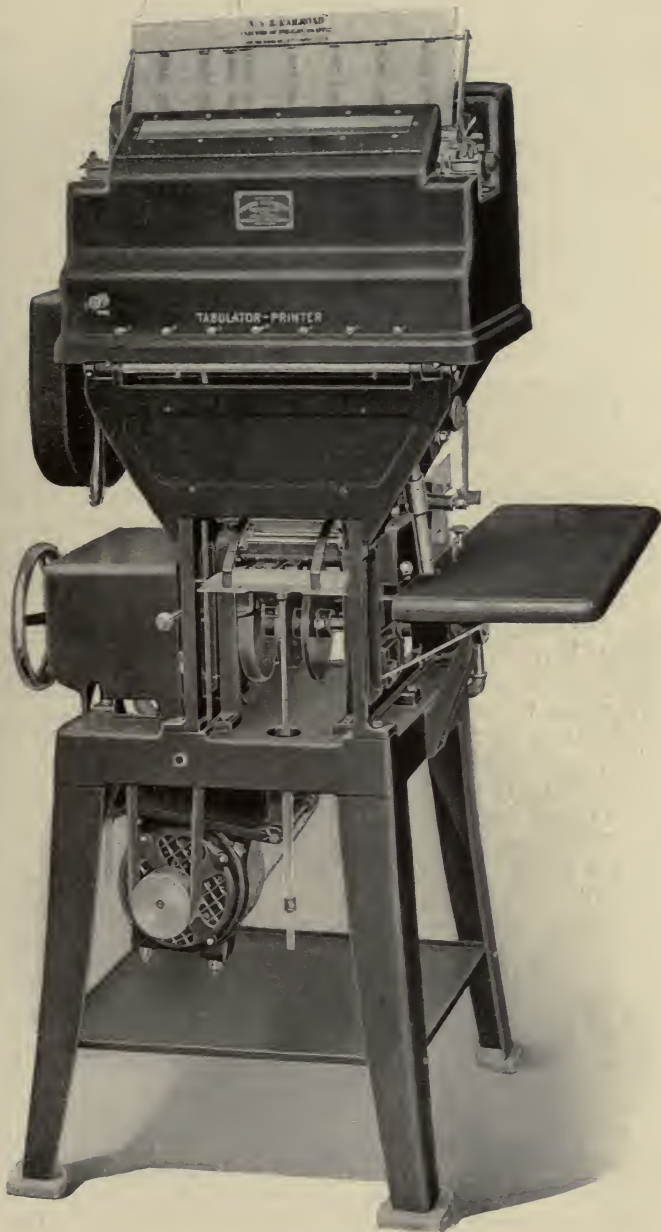


FIG. 9—TABULATOR-PRINTER

Selects mechanically; adds mechanically. Prints designations and tabulated totals, with or without detail, on paper strip or record sheet. Prints legibly five carbon copies. Is equipped with one to seven designating or adding units which operate simultaneously.



of punched cards. The selecting pins act as the human fingers and, according to the holes perforated in the various fields of each card, make simultaneously the corresponding selection of all the items to be listed or added internally within the Adding Head of the Tabulator-Printer. The machine automatically accomplishes the same result as when the handle of an ordinary adding machine is pulled and prints and accumulates the data perforated upon each individual card.

When it is considered that the Powers Tabulator-Printer can be equipped with from one to seven Adding or Designating Units, each of such having a printing or accumulating capacity of nine figures, and that the selection, printing and adding upon all of these is performed simultaneously, it is seen what a decided advantage it offers to the business and statistical world, as compared with a *non-listing* machine having a capacity of five adding sections. The relation is practically the same as that of a 17-bank Burroughs or other standard *listing* adding machine as compared with a small Comptometer or *non-listing* machine. At present the largest standard listing adding machine, as above referred to, adds or lists 17 columns of figures, whereas the Standard Seven Unit Powers Tabulators have a capacity to list and add 63 columns of figures.

The Adding Section or Head of the Tabulator-Printer is directly above the selection pins. These pins are under the selective plates, between which the card rests, and when each card is in position to be tabulated a pin comes up through each hole in the columns of the fields being added or listed. The connection between these selective pins and internally with the adding head is absolutely mechanical and flexible as to its possibility of being changed according to the selections desired from different cards. This is accomplished by means of interchangeable selective boxes which can instantly be changed as a unit, which has a distinct advantage, compared with the necessity of changing separately each column to be selected.

The Standard Seven-Unit Tabulator Adding Head is of a size about 16 x 24 inches, and the whole machine does not occupy floor space exceeding 2 feet square. It can also be operated by any desired motive power or energy.'

In the tabulator the fact that the presence of carbon or metallic substances in the cards have absolutely no effect upon the selections, is very greatly appreciated by those who know of the difficulties encountered where erroneous results have been effected through electrical contacts, not intended, being made where the principle of selection was not mechanical.

Each tabulator is furnished with a roll paper holder and shifting carriage similar to that upon ordinary adding machines or typewriters. These can be of a size to suit the convenience and records of an individual user. The machine also has an



automatic ribbon feed and adjustable carriage-roll spacing device.

To operate the machine either to list the details of each card or to print the totals only requires the shifting of a small button from "Print" to "Non-Print."

The usual method of operating the Tabulator-Printer, in order to secure the greatest efficiency from it, is to make use of what are commonly termed "Total Cards." These are blank cards with a special hole perforated in them in such a location as to allow a plunger to go through, thereby causing the "Automatic Totaler" to take totals without stopping the machine. If desired, a "Stop Card" can also be used, thereby causing the "Automatic Totaler" to operate and stop the machine.

As an illustration of the application of these total cards, assume that the cards had been sorted by departments and a tabulated total of the sales for each department is desired. Between the cards for each department is placed a "Total Card." The cards are then placed in the rear magazine and the machine started by pressing the starting lever, which causes the cards to be fed one by one over the selecting pins, and when added to be ejected into the forward magazine, where they are easily removed. When all the cards for each department are selected, naturally the total card next comes between the selection plates and the machine automatically takes a total and proceeds with the tabulation of the cards for the next department.

As the various departments are placed in consecutive order into the magazine, after the totals for all departments are printed, the machine automatically stops and the operation is finished.

It is possible and is often the case where the group or designating code numbers, pertaining to a certain report, are known, that a total card is punched for each such code number in the field corresponding to the one on the regular cards being sorted. These punched "Total" cards naturally find their proper location during the sorting operation and automatically prepare the cards for the tabulator.

The Tabulating Machine is so arranged as to select and print the department or any desired designating code numbers or data directly from the total cards, provided they had been previously punched. Or the machine can be adjusted to select such designations from the cards tabulated and print the same when the total is recorded.

From this it will be seen that the securing of tabulated results from this machine can be made an entirely automatic operation, and a blank form or, if preferred, a printed sheet of paper can be placed in the tabulator carriage—the results being a report compiled automatically in accordance with the data indicated upon the cards.

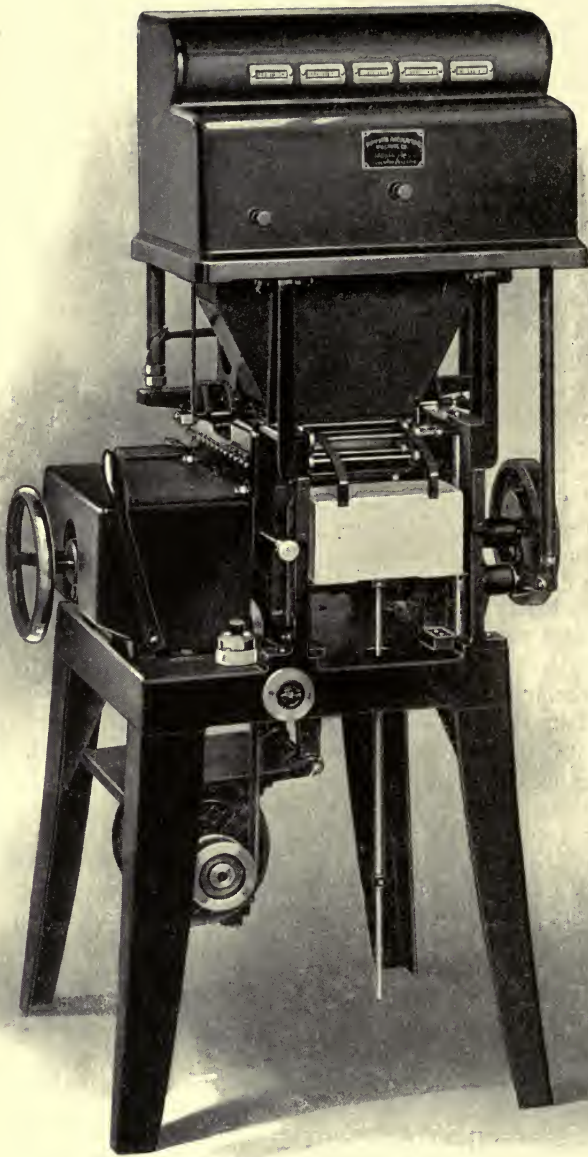


FIG. 10—NON-LISTING AND NON-PRINTING TABULATOR

Selects mechanically; adds mechanically. Accumulates totals for manual transcription. Is equipped with one to seven designating or adding units which operate simultaneously.

One advantage of the printing feature of the tabulator is found when it becomes necessary to check punched cards back with the original records from which perforated, either to verify the transcription or to locate an error either in punching or in the original record. Heretofore it has been customary to read the punched holes and compare with the original records. If a detail printed list showing the data, as perforated in the card, is made by the tabulator it is readily grasped that it is far easier to check the printed figures appearing on such list with the original data than to read the holes in the cards.

Several carbon copies can be made simultaneously by placing carbon paper between the records upon which the results or lists are recorded. The advantage of this is apparent. For instance, it is possible from the cards to prepare duplicate or triplicate copies of a report and retain a copy and send out what is an absolute transcription of their detailed records, if desired. In commercial or accounting work the usefulness of this feature alone is readily applied and appreciated.

A Non-Listing and Non-Printing Tabulator has recently been introduced by the Powers Accounting Machine Company (Fig. 10).



## EXAMPLES SHOWING THE PRACTICAL AND ECONOMICAL PRODUCTS OF THE POWERS ACCOUNTING AND TABULATING MACHINES OBTAINED BY THE NEW YORK EDISON COMPANY.

The New York Edison Company has purposely deferred, up to the present, introducing tabulating machines for accounting and statistical work with the exception of verifying monthly consumption of current and analysing operating earnings. The attitude of the Company has been that perforated cards and transcribed records of accumulated totals were not sufficient data and information for reference and other practical demands of the business. In other words, the Company has taken the position that wherever it is required to have ready reference as to the sources of charges, credits or individual items, a reliable means of identification must be obtained. For illustration, the distribution of accounts payable charges, including operating and other expenses. This deficiency has been admirably provided for by the invention of the Powers *printing machines* and there is offered thereby unlimited facilities for adapting mechanical accounting to the various lines of accounting and statistical work essential for public service corporations.

The Powers accounting and tabulating machines, and particularly the *printing machines*, have developed an opportunity for obtaining valuable data and information hitherto considered prohibitive on account of the excessive labor costs and expenses, as, for instance: (1) distribution of accounts payable charges including operating and other expenses; (2) maintaining perpetual inventories of materials and supplies; (3) recording appraisals of buildings and equipment; (4) preparing perpetual inventories of underground and overhead transmission and distribution systems; (5) summarizing changes in consumers connected installations; (6) tabulating monthly consumption of current and bills rendered; (7) analysing operating earnings by geographical divisions, kinds of business and classified rates; (8) ascertaining in advance effect of various new rates suggested from time to time upon present operating revenues.

The opportunity offered for securing increased efficiency and economy by the substitution of automatic, mechanical and printing methods for manually written books and records, has been taken advantage of by The New York Edison Company in connection with the consumers deposit accounts with satisfactory results. It is proposed to follow-up this introductory installation with automatic, mechanical and printing methods for the various lines of work indicated, as well as for all other kinds of work suggested by experience and a growing knowledge of possibilities in this direction.



On May 1, 1915, The New York Edison Company installed the Powers machines in connection with the consumers deposit accounts. The accounting and tabulating routine observed in the treatment of consumers deposits is outlined herewith.

Several series of perforating cards are employed in accordance with the logical divisions of the work, reduced facsimiles of which are given below:

For facility in handling the work, distinctive colored cards were introduced for the respective series, namely, manilla, salmon, blue and cherry.

P107	Name <u>John Smith &amp; Co.,</u>		Deposit Number	12 DATE		Year	Month	Amount
	Premises <u>781 Broadway</u>		0	0	0	0	0	0
	TRANSFERRED TO		0	0	0	0	0	0
	1	Date <u>3/26/14</u>	Premises <u>347 Broadway</u>	1	1	1	1	1
	2	"	"	2	2	2	2	2
	3	"	"	3	3	3	3	3
	4	Hold for transfer to premises <u>347 Broadway</u>		4	4	4	4	4
	5	Account out off - interest assess <u>5/10/15</u> sheet No. <u>225</u>		5	5	5	5	5
	6	Refund without cut off - Notice dated _____ Card No. _____		6	6	6	6	6
	7	Hold for account on ledger <u>115</u> Folio <u>1792</u>		7	7	7	7	7
8	Hold until amount in uncollectible bills is paid		8	8	8	8	8	
9	Remarks		9	9	9	9	9	
10	Card No. 2 issued <u>5/1/15</u> Card No. 8 issued <u>5/1/15</u>		10	10	10	10	10	

FIG. 1  
Deposits Received  
One-half of actual size.

P107	Deposit Number	12 DATE		Transfer	Ledger	Folio	ACCOUNTS RECEIVABLE APPLIED IN				UNCOLLECTIBLE BILLS APPLIED IN				Balance
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	
10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	

FIG. 2  
Deposits Adjusted  
One-half of actual size.



On schedule time daily these cards are tabulated and printed on Deposits Received Sheets, (Fig. 5).

When proof postings are obtained both Certificates of Deposits and Deposits Received Cards are delivered to typists for filling in the names and premises as provided for. Upon return of certificates and cards they are checked and the cards indexed. Certificates are then mailed and cards are filed in Deposits Received filing cabinets.

## DEPOSITS ADJUSTED

Where Certificates of Deposits are under Twenty-five (\$25.00) Dollars, and consumers' cut-off accounts exceed the amounts of certificates and accrued interest, consumers are requested to endorse and deliver over the certificates and pay any remaining balances either in cash or by checks. In cases where Certificates of Deposits are over Twenty-five (\$25.00) Dollars, and con-

THE NEW YORK EDISON COMPANY			
District <u>1</u>		DEPOSITS RECEIVED, Date MAY - 1916	
DEPOSIT NO.	KIND OF BUSINESS SOURCE	DEPOSITS RECEIVED	REMARKS
1 159	12 89	5 00	
1 160	25 83	5 00	
1 161	24 83	15 00	
1 162	24 87	5 00	
1 163	26 91	5 00	
1 164	55 87	3 00	
1 165	33 88	25 00	
1 166	24 86	10 00	
1 167	22 82	5 00	
1 168	25 90	5 00	
1 169	11 85	5 00	
1 170	33 87	10 00	
1 171	77 89	10 00	
1 172	24 82	10 00	
1 213	22 92	2 00	
1 214	32 92	10 00	
1 215	26 84	10 00	
1 216	37 87	5 00	
1 217	65 92	5 00	
1 218	28 89	15 00	
1 219	32 87	15 00	
1 220	28 90	5 00	
1 221	35 83	5 00	
1 222	24 82	15 00	
1 223	24 87	5 00	
1 224	26 91	5 00	
1 225	59 87	5 00	
1 226	33 88	30 00	
1 227	54 88	10 00	
1 228	32 92	5 00	
		710 00	

FIG. 5

Deposits Received Sheet  
Size—14 by 17 inches.

sumers' cut-off accounts are more than the certificates plus interest, book transfers are made by bookkeepers of the amounts of certificates and interest and applied in part settlement of consumers' accounts. Statements of accounts are prepared by bookkeepers showing any remaining balances and the same referred to the Collection Bureau for attention. All book transfers are listed on Daily Checking Sheets by the Bookkeeping Bureau and the same received for by the Consumers' Deposits Bureau.

The Deposits Adjusted Cards are punched out directly from the original source of the information, or the book transfers. The same routine which obtains in connection with the Accounts Receivable Account is likewise followed for the Uncollectible Bills Account. Particulars on the Deposits Adjusted Cards follows: District, deposit number, date, transfer number, ledger-folio, accounts receivable—applied in part or full, uncollected bills—applied in part or full and balance, (Fig. 2).

Separate sheets are utilized for tabulating and printing Deposits Adjusted transactions, namely, Deposits Adjusted—Accounts Receivable (Fig. 6) and Deposits Adjusted—Uncollectible Bills (Fig. 7).

THE NEW YORK EDISON COMPANY						
District <u>1</u>		DEPOSITS ADJUSTED, Date <u>MAY - 1916</u>			Accounts Receivable	
DEPOSIT No.	TRANS. No.	LEDGER	FOLIO	PART	ACCOUNTS RECEIVABLE APPLIED IN	BALANCE
					FULL	
1103	001	123	0 232	5 49		9 31
1101	002	111	1 110			
1127	003	123	0 253		6 00	
1114	004	122	0 221	8 71	15 00	1 29
1112	005	198	1 110	9 10		04
1117	006	124	0 444			
1118	007	125	0 380	1 44	5 00	3 56
1124	008	104	2 310	61		4 29
1123	009	102	0 220	4 00		8 89
1139	010	122	0 222	4 50		5 00
1144	011	124	1 770	1 00		6 32
1145	012	105	0 053	4 61		8 63
1154	013	124	0 352	4 11		8 00
1149	014	112	2 240	5 00		6 01
1152	015	124	0 331	99		
1207	042	134	0 068	1 25		8 78
1186	043	119	1 122		30 00	
1168	044	135	2 600		5 00	
1164	045	118	2 299	5 25		3 98
1142	048	143	2 155		10 00	
1159	047	111	1 199	1 28		2 91
1106	048	112	0 988	5 00		1 00
1107	049	112	1 245	16 47		13 53
1131	050	147	1 220			
1117	051	134	1 220	63	16 00	9 37
1134	052	333	0 232	35		4 65
1137	053	135	1 110	4 00		1 60
1129	054	130	2 600		25 00	
1125	055	140	1 133	10 30		14 90
				256 85	190 00	233 15

FIG. 6  
Deposits Adjusted—Accounts Receivable  
Size—14 by 17 inches.

#### DEPOSITS REFUNDED

Upon presentation of Certificates of Deposits at Branch Offices, endorsed by consumers, for amounts not exceeding Twenty-five (\$25.00) Dollars, with payment coupons or statements of accounts stamped "Cutoff," local cashiers are authorized to make payments in cash to consumers or bearers, including accrued interest. Where certificates are presented by persons other than consumers, they are required to endorse thereon the names of consumers per their signatures (bearers' addresses are required).



THE NEW YORK EDISON COMPANY							
District 1		DEPOSITS ADJUSTED, Date MAY - 1 1916				Uncollectible Bills	
DEPOSIT TRANS. No.	LEDGER	FOLD	PART	UNCOLLECTIBLE BILLS APPLIED IN	FULL	BALANCE	
1005 001	133	0 232		5 68			
1075 002	111	1 110			5 00	9 31	
1044 003	112	0 900		16 46		58 54	
1019 004	122	0 220		41 67		83 33	
1099 005	123	0 233			15 00		
1041 006	122	0 221		0 71		11 28	
1054 007	198	1 110		7 16		04	
1037 008	123	0 224			5 00		
1021 009	120	0 330		1 44		3 58	
1046 010	104	2 310		81		4 39	
1103 011	102	0 229		9 10		5 98	
1116 012	122	0 222		4 80		5 50	
1110 013	124	1 770		1 00		4 00	
1010 014	105	0 033		4 61		5 39	
1012 015	124	0 252		9 11		88	
<hr/>							
1019 033	115	1 092			15 00	19 00	
1035 040	124	1 234		6 00		8 75	
1056 041	134	0 088		1 25	30 00		
1047 042	119	1 122			25 00		
1001 043	133	2 500				23 75	
1097 044	118	2 192		24 85			
1109 045	143	2 355			10 00		
1123 046	112	0 988		9 00		1 00	
1127 047	112	1 245		16 47		3 32	
1137 048	147	1 220			25 00		
1139 049	124	1 220				29 37	
1056 050	133	0 222		63		6 88	
1042 051	130	1 110		4 00		6 00	
1065 052	190	2 200		10 43		39 57	
				333 58	195 00	455 42	

FIG. 7  
Deposits Adjusted—Uncollectible Bills  
Size—14 by 17 inches.

THE NEW YORK EDISON COMPANY							
District 1		DEPOSITS REFUNDED, Date MAY - 1 1916				Interest Payments	
DEPOSIT No.	VOUCHER No.	SHEET No.	DEPOSITS REFUNDED	INTEREST PAYMENTS			
1 191	555	715	5 00				
1 179	566	718	10 00	10			
1 046	560	715	30 00	2 00			
1 057	505	715	25 00	1 00			
1 055	564	715	15 00	1 00			
1 052	565	715	10 00	1 00			
1 046	566	716	5 00	80			
1 046	566	716	25 00	1 90			
1 037	565	715	5 00	1 29			
1 005	564	715	25 00	81			
1 177	566	718	5 00	31			
1 044	566	715	8 00	61			
1 042	566	715	10 00	31			
1 042	566	715	5 00	13			
<hr/>							
1 041	569	717	5 00	81			
1 003	569	717	15 00	1 01			
1 084	569	716	5 00	6			
1 017	569	717	5 00	67			
1 014	569	717	5 00	79			
1 006	569	717	5 00	81			
1 141	569	716	10 00	8			
1 033	570	0 000	10 00	14			
1 093	570	0 000	25 00	8			
1 092	570	0 000	25 00	8			
1 088	570	0 000	5 00	10			
1 030	570	C 00	5 00	14			
1 013	570	0 000	10 00	17			
1 025	570	0 000	5 00	8			
				756 00	43 58		

FIG. 8  
Deposits Refunded—Interest Payments  
Size—14 by 17 inches.

Cancelled certificates are delivered by the Branch Offices to the General Office with daily reports. Reimbursement vouchers are prepared containing the cancelled certificates from which Deposits Refunded Cards are punched out.

In cases where Certificates of Deposits are over Twenty-five (\$25.00) Dollars and the amounts of deposits and interest are more than consumers' accounts, adjustments are made only by voucher checks issued by the General Office, drawn on a special Consumers' Deposits Fund. This fund is likewise reimbursed daily for the total amount of certificates refunded.

The Deposits Refunded Card, for convenience in operation, was devised to take care of both kinds of transactions and, therefore, provides for district, deposit number, date, deposits refunded—source and amount, interest payment—voucher number and amount, and interest applied—card number and amount (Fig. 3). Separate sheets are introduced for recording, namely, (1) Deposits Refunded—Interest Payments (Fig. 8) and (2) Deposits Refunded—Interest Applied (Fig. 9).

Where it is claimed by consumers that they have mislaid or lost Certificates of Deposits, release and discharge forms are furnished. No refunds in such cases are permissible at the branch offices. Signatures to such forms are compared with those on the applications for service before accounts are adjusted.

Consumers' deposits are transferred to new premises only upon delivery of Certificates of Deposits through the General

THE NEW YORK EDISON COMPANY			
District <u>1</u>	DEPOSITS REFUNDED, Date <u>MAY - 1916</u>		Interest Applied
DEPOSIT No.	CARD No.	INTEREST APPLIED	REMARKS
1103	1	1 59	
1101	2	0 6	
1127	3	1 00	
1114	4	1 00	
1112	5	0 9	
1119	6	4 9	
1110	7	4 9	
1124	8	4 6	
1123	9	0 9	
1139	10	9 4	
1144	11	4 7	
1148	12	0 0	
1154	13	8 9	
1149	14	8 7	
1122	15	4 5	
1107	16	1 00	
1186	43	3 00	
1189	44	0 0	
1186	45	1 11	
1148	46	1 25	
1149	47	0 6	
1106	48	1 19	
1107	49	3 37	
1131	50	0 6	
1117	51	1 07	
1134	52	0 3	
1137	53	0 3	
1139	54	0 0	
1125	56	2 14	

88 46

FIG. 9  
Deposits Refunded—Interest Applied  
Size—14 by 17 inches.

Office. Consumers returning Certificates of Deposits for transfer are given receipts stating that they are turned in for the purpose of recording transfers. Book transfers as distinguished from voucher-check transfers are confined to district boundaries. No book transfers are made between districts.

Consumers are given the option of having the transfers endorsed on Certificates of Deposits or receiving new certificates in exchange for same and checks for accrued interest to date. Unless upon special request by consumers, certificates for former premises are cancelled and new ones delivered with checks for amount of accrued interest to dates of transfers.

In making settlements with consumers, statements of accounts are obtained from the respective bookkeepers only for the last premises endorsed on the Certificates of Deposits or recorded on the Consumers' Deposits Records; in other words, the Collection Bureau is held responsible for the collection of accounts at former premises.

#### INTEREST APPLIED

Interest on consumers' deposits ceases thirty (30) days after the termination of the electric service or thirty (30) days after the issuance of written notices to consumers that the Company is prepared to refund deposits. If certificates are surrendered within the period of thirty (30) days interest is computed to dates of settlement.

Upon applying deposits in liquidation of consumers' accounts interest is computed to dates of settlement.

In cases where deposits plus interest exceed consumers' accounts interest is applied in part settlement thereof. Fig. 3—Deposits Refunded—Interest Applied—and the balances of the accounts are satisfied out of the consumers' deposits. Fig. 2—Deposits Adjusted—Accounts Receivable.

Interest on any remaining portions of deposits is computed from the dates of adjustment to the dates specified in written notices.

The cards employed for these purposes are filed in steel cabinets according to the divisions of the work as outlined:

- (1) Deposits Received.
- (2) Deposits Adjusted.
- (3) Deposits Refunded.

The cards are filed in the sequence of Certificates of Deposits numbers by geographical or district divisions. Before filing in transfer cabinets cards are checked with the respective daily printed sheets in order to obviate the possibility of errors in filing them.

THE NEW YORK EDISON COMPANY					
District <u>1</u>		ACCUMULATIVE TOTALS, Date <u>MAY 31 1918.</u>			Deposits Received
MO. DAY	A. No.	BALANCE	DEPOSITS RECEIVED	DEPOSITS ABYANCE	TOTAL
5 01	11	3528 00	888 00	55 00	3225 00
5 02	11	2053 19	788 00	70 00	4070 19
			1410 00	125 00	
5 03	11	1691 57	710 00	60 00	2441 57
			2120 00	165 00	
5 04	11	1092 87	610 00	48 00	1749 87
			2750 00	210 00	
5 05	11	520 25	910 00	15 00	1445 25
			3540 00	225 00	

FIG. 10  
Accumulated Totals—Deposits Received  
Size—14 by 17 inches.

THE NEW YORK EDISON COMPANY					
District <u>1</u>		ACCUMULATIVE TOTALS, Date <u>MAY 31 1918.</u>			Deposits Adjusted
MO. DAY	A. No.	DEPOSITS ADJUSTED APPLIED BY		DEPOSITS REFUNDED	BALANCE
		PART	FULL		
5 01	31	236 85	190 00	166 00	2055 16
5 02	31	201 58	176 00	610 00	3691 57
		436 43	363 00	1665 00	
6 03	31	294 70	200 00	654 00	1092 87
		786 13	565 00	2419 00	
5 04	31	251 62	185 00	791 00	620 25
		904 75	750 00	3210 00	
5 05	31	157 16	85 00	524 10	679 01
		1141 87	835 00	6734 10	

FIG. 11  
Accumulated Totals—Deposits Adjusted  
Size—14 by 17 inches.



THE NEW YORK EDISON COMPANY							
District <u>1</u>		ACCUMULATIVE TOTALS, Date <u>MAY 31 1915</u>				Deposit Statistics	
MO. DAY	AA No.	No. RECEIVED	No. IN ABEYANCE	No. IN PART	No. IN FULL	No. REFUNDED	REMARKS
5 01	51	39	00 10	20	00 15	35	
5 02	51	46	00 11	18	00 10	41	
		125	00 21	38	00 25	76	
5 03	51	61	00 08	23	00 14	43	
		186	00 29	61	00 38	117	
5 04	51	57	00 05	11	00 10	39	
		243	00 34	72	00 49	138	
5 04	51	70	00 01	7	00 04	51	
		313	00 35	79	00 53	209	

FIG. 12

Accumulated Totals—Deposits Statistics  
Size—14 by 17 inches.

A general card index, arranged alphabetically, irrespective of district divisions is maintained for convenient reference to Consumers' Deposits Accounts. All transfers to Deposits Adjusted and Deposits Refunded sections of the filing cabinets are recorded on these cards.

The advisability of filing the cards in separate sections of the steel cabinets during the calendar month until the completion of the trial balances has been considered, when they would be placed in the regular compartments.

As previously explained, proof postings are secured daily with the original sources of Deposit Receipts, Deposits Adjusted and Deposits Refunded. Accumulated totals of the above transactions are carried forward daily by means of the accumulated totals card. (Fig. 4)—Accumulated Totals. This card answers for three distinctive purposes, by which the following information is obtained:

(1) Accumulated Totals—Deposits Received, including Balance, Deposits Received, Deposits in Abeyance and Totals Received.

**THE NEW YORK EDISON COMPANY**

District 1 TRIAL BALANCE, Date MAY 31 1916 Deposits Received

DEPOSIT No.	KIND OF BUSINESS SOURCE	DEPOSITS RECEIVED	REMARKS
1 002	41 85	15 00	
1 004	43 85	15 00	
1 005	43 85	15 00	
1 010	44 85	10 00	
1 015	45 86	15 00	
1 016	45 86	3 00	
1 018	19 87	15 00	
1 020	19 87	10 00	
1 022	1 45	5 00	
1 024	1 45	5 00	
1 026	1 46	8 00	
1 027	1 46	5 00	
1 213	24 82	10 00	
1 214	24 82	8 00	
1 215	27 87	8 00	
1 217	65 82	5 00	
1 219	26 80	5 00	
1 220	26 80	5 00	
1 221	23 83	10 00	
1 222	24 87	5 00	
1 223	66 81	8 00	
1 224	55 87	5 00	
1 225	24 88	2 00	
1 226	24 88	10 00	
1 227	32 82	5 00	

1080 00

**FIG. 13**  
Trial Balance—Deposits Received  
Size—14 by 17 inches.

**THE NEW YORK EDISON COMPANY**

District 1 TRIAL BALANCE, Date MAY 31 1916 Deposits Adjusted

DEPOSIT No.	TRANS. No.	LEDGER FOLIO	ACCOUNTS RECEIVABLE APPLIED BY	FULL	BALANCE
1103 001		123 0 232			9 51
1103 017		124 0 208			1 38
1107 049		112 1 245			13 32
1108 046		112 0 982			1 84
1112 005		198 1 110			1 00
1114 004		122 8 221			1 89
1117 021		134 1 220			9 37
1118 007		125 0 338			3 54
1123 009		102 0 180			6 38
1124 008		106 1 310			6 00
1125 055		140 1 133			16 70
1134 055		133 0 225			4 38
1137 052		133 1 110			1 00
1139 010		122 0 222			4 45
1144 011		124 1 770			8 58
1148 047		116 1 129			3 71
1148 012		102 0 033			4 20
1148 014		112 2 240			5 09
1152 015		116 8 136			5 20
1152 018		124 0 331			5 89
1154 013		124 0 332			8 91
1157 018		112 0 203			8 09
1158 018		112 0 110			3 40
1158 025		112 2 330			6 00
1158 026		113 2 822			6 00
1158 028		113 2 498			5 00
1159 025		112 1 100			2 78
1175 040		124 1 240			4 00
1182 024		112 2 300			4 39
1182 028		111 0 211			13 84
1187 027		112 2 500			4 21
1187 028		112 0 232			5 00
1193 029		112 0 059			3 69
1194 021		112 1 250			3 52
1195 037		110 2 466			3 85
1201 030		113 0 222			4 37
1204 033		113 0 833			5 00
1207 042		114 0 082			8 75
1208 033		112 0 122			1 00
1210 031		112 8 655			8 00
1211 032		112 8 655			16 00
1212 034		112 0 533			6 00

230 15

**FIG. 14**  
Trial Balance—Deposits Adjusted  
Size—14 by 17 inches.

(2) Accumulated Totals—Deposits Adjusted, including Deposits Applied in part and full, Deposits Refunded and Balance.

(3) Accumulated Totals—Deposits Statistics, including Number Received, Number in Abeyance, Number Applied in part and full, Number Refunded and Remarks.

Corresponding accumulated total sheets to the above are tabulated and printed as illustrated, (Figs. 10, 11 and 12).

Trial balances in verification of the daily proof postings are prepared for the calendar months of both Deposits Received (Fig. 13) and Deposits Adjusted (Fig. 14).

The loose-leaf sheets are placed in transfer binders during current periods, and at the expiration of the month or quarter they are bound in inexpensive canvas books for protection, filing and reference.

#### GENERAL REMARKS

A radical departure in mechanical accounting has been achieved in this connection, whereby the recording of all transactions is reduced to mechanical processes. Daily transactions are recorded by the tabulating-printing machines on loose-leaf sheets with printed captions. Accumulated totals are carried forward on recapitulation sheets (if preferred, accumulated totals could be carried forward on daily sheets). Proof postings are taken daily of the ledger cards on which entries have been recorded. Trial balances in verification of the work are taken monthly of the ledger cards; the loose-leaf sheets are filed in transfer binders during current periods. On completion of the monthly or quarterly periods they are bound in canvas books for protection, filing and reference.

Previous to the installation of the Powers accounting and tabulating machines there was a congestion of work throughout the month. Trial balances for the current month usually were not obtained until the 15th of the succeeding month or thereafter. Five ledgers with provisions for 25,000 accounts each, were maintained, and three or four days, including overtime work, were required for bookkeepers to take off the trial balances.

Under the new conditions the work is constantly up-to-date. Proof postings are taken daily, and trial balances, it is reasonably assured, will be tabulated and printed on the first day of the calendar month. The last day of the month, therefore, for all practical purposes, is the same as any other day of the month and all overtime is eliminated. In addition to the improved methods and practices a substantial reduction has been obtained of approximately fifty per cent. in clerical labor and expense.

## SCIENTIFIC AND CLASSIFIED SYSTEMS OF ACCOUNTS FOR PUBLIC SERVICE CORPORATIONS—IMPORTANT FAC- TORS IN THE MATTER OF MECHANICAL ACCOUNT- ING.

Suggested schedules of classified accounts for public service corporations are given below:

If logically arranged, the indicant or general ledger accounts should be grouped under several principal schedules, as follows: (1) Actual Resources, (2) Actual Liabilities, (3) Income Accounts—Debits, (4) Income Accounts—Credits, (5) Appropriation Accounts—Debits, (6) Appropriation Accounts—Credits, (7) Intangible Capital, and (8) Capital Liabilities.

These schedules should be divided into divisional accounts, as follows:

- |                             |                              |
|-----------------------------|------------------------------|
| (1) Actual Resources:       | (2) Actual Liabilities:      |
| Tangible Capital            | Funded Debt                  |
| Materials and Supplies      | Current Liabilities          |
| Current Assets              | Accrued Liabilities          |
| Treasury Securities         | Suspense Accounts—Credits    |
| Investment Accounts         | Associated Companies—        |
| Special Deposits            | Credits                      |
| Prepaid Accounts            |                              |
| Suspense Accounts—Debits    |                              |
| Reacquired Securities       |                              |
| Associated Companies—       |                              |
| Debits:                     |                              |
| (3) Income Accounts—Debits: | (4) Income Accounts—Credits: |
| Operating Expenses          | Operating Revenues           |
| Non-Operating Revenue       | Non-Operating Revenues       |
| Deductions                  |                              |
| Income Deductions           |                              |
| (5) Appropriation Accounts— | (6) Appropriation Accounts—  |
| Debits                      | Credits:                     |
| Dividends on Outstanding    | Bad Debts Collected          |
| Stocks                      | Other Additions to Surplus   |
| Amortization Elsewhere Un-  |                              |
| provided for                |                              |
| Appropriations to Reserves  |                              |
| Other Deductions from Sur-  |                              |
| plus                        |                              |
| (7) Intangible Capital:     | (8) Capital Liabilities:     |
| Organization Expenses       | Stock Accounts               |
| Franchise or Rights         | Reserve Accounts             |
| Patent Rights               | Corporate Surplus            |

The aggressive and successful executive official or general manager requires periodical detail analyses of the important controlling accounts in order to ascertain the sources of income and profits and of the expenses and losses incidental to the business, as well as to determine the characteristic elements of all classes of income and expenditures necessary to a comprehensive and intelligible statement of revenue.

Where several operating or manufacturing departments are maintained in the accounts, the automatic, mechanical, punching,



sorting and tabulating machines referred to in this paper will be found invaluable for the purpose of collating items of proceeds and expenditures of each department.

Examples of the several classes of income and expenditures and the important controlling accounts applicable to public service corporations are given below:

**OPERATING REVENUES:**

Commercial revenues; municipal revenues; other electrical corporations; rent of electrical appliances; electric merchandise and jobbing revenue; sales of by-products; miscellaneous electric revenue.

**OPERATING EXPENSES:**

General and miscellaneous expenses; commercial expenses; production expenses; transmission expenses; electric storage expenses; distribution expenses; utilization expenses.

**WORK IN PROCESS:**

Capital additions; capital betterments; capital replacements; capital withdrawals; operating orders; contract orders (to be billed); standing orders (to be pro-rated).

**MATERIALS AND SUPPLIES:**

Tube and cable material; wiring supplies and appliances; arc and incandescent supplies; hardware, piping, structural iron, etc.; general station supplies; automobile supplies; second-hand material.

Accounting and tabulating machines are especially serviceable in the preparation of accounting and statistical figures, including all production factors, the various trading accounts, the profit and loss accounts and the revenue accounts. To illustrate, either daily, weekly or monthly comparative statements can be compiled containing both dollars and cents and quantities, and showing variations between current, preceding and corresponding periods, such as: (1) Current months and preceding months, with corresponding months of former years; (2) Current months and elapsed months, with corresponding periods of former years, and (3) Extended differences in dollars and cents and quantities, with the percentage of increase or decrease.

Mechanical accounting is susceptible to innumerable applications along the lines of accounting and statistics. The punching, sorting, tabulating, and particularly the printing machines, present opportunity for obtaining valuable data and information hitherto considered prohibitive on account of the excessive labor costs and expenses, as, for instance, maintaining perpetual inventories of materials and supplies; recording appraisals of buildings and equipment; preparing perpetual inventories of underground and overhead transmission and distribution systems; summarizing changes in consumers' connected installations; distribution of accounts payable charges, including operating and other expenses; tabulating monthly consumption and bills rendered; analysing operating earnings by geographical divisions, kinds of business and classified rates; ascertaining in advance effect of various new rates suggested from time to time upon present operating revenues.

**SUBSTITUTION OF NUMERICAL AND ALPHABETIC DESIGNATIONS FOR WRITTEN DESCRIPTIONS OF ACCOUNTS AND FOR INDICATING THE VARIOUS CLASSES OF DIRECT AND INDIRECT LABOR, MATERIALS AND SUPPLIES, APPARATUS, APPLIANCES AND MISCELLANEOUS EXPENSES.**

There is a growing tendency at the present time to substitute numerical and alphabetic designations for written descriptions of accounts in accounting work. This modern method has been demonstrated to be efficient and reliable.

The systems of accounts prescribed for electrical corporations by the various Public Service Commissions and those adopted by the accounting session of this association at its thirty-seventh convention, and subsequently approved by the executive committee, for illustration, might be divided to advantage into ten main classes, numbered from 00—09 to 90—99. Each of these ten classes should be sub-divided into ten divisions, and each of these ten divisions should be again divided into ten sections. Each account should be numbered according to the section in which it appears, and all the accounts should be arranged in simple numerical order. While the classes, divisions and sections of accounts should be indicated by numerals, the various stations, departments and bureaus should be designated by letters. Sub-account numbers also could be used for a more complete analysis of materials and supplies, work in progress accounts and standing and specific orders.

As an illustration, the main classes might be designated as follows:

- 00 to 09 General and Miscellaneous Expenses
- 10 to 19 Commercial Expenses
- 20 to 29 Production Expenses
- 30 to 39 Production Expenses—Repairs
- 40 to 49 Transmission Expenses
  - Electric Storage Expenses
  - Distribution Expenses
- 50 to 59 Utilization Expenses
- 60 to 69 Fixed Capital—Land, Buildings and Equipment
- 70 to 79 Fixed Capital—Transmission, Distribution Systems
  - Work in Progress
- 80 to 89 Other Indicant or Ledger Accounts—Debits
- 90 to 99 Other Indicant or Ledger Accounts—Credits

Provision should be made for all the accounts prescribed by the Public Service Commissions and those required by the company, but only such accounts as are actually needed should be opened on the books and records of the company.

In this connection it might be suggested that possibly the ten classes and the ten divisions only would answer all demands of the small corporations, while the large corporations would undoubtedly require to sub-divide the ten divisions into ten sec-

tions, and in some instances it might be necessary for them to again sub-divide the ten sections in order to take care of any extended analysis needed. Assuming that the ten classes and ten divisions would furnish all information exacted by the public authorities for annual reports, all corporations, regardless of size, would be in a position to conform to standard schedules and distribution of accounts.

Several examples of the divisions and sections of accounts, which are self-explanatory, follow :

- 00 to 09—*General and Miscellaneous Expenses*
- 01—Salaries and Expenses of General Office Clerks
  - 011 Fiscal Department
    - 0111 Cashiers
    - 0112 Paymasters
    - 0113 Bookkeepers and Clerks
    - 0114 Payroll Clerks
  - 012 Accounting Department
    - 0121 Abstract Clerks
    - 0122 Work Order Clerks
    - 0123 Auditing Clerks
- 03—General Stationery and Printing
  - 032 General office stationery
    - 0321 Fiscal Department
    - 0322 Accounting Department
    - 0323 Purchasing Department
    - 0324 General Service
    - 0325 General Offices
  - 034 Commercial Department
    - 0341 Indexing
    - 0342 Collecting
    - 0343 Contracts
    - 0344 Accounting
- 10 to 19—*Commercial Expenses*
- 16—Commercial Administrative
  - 161 Commercial Department Indexing
    - 1611 Meter Clerks
    - 1612 Meter Reading
  - 162 Commercial Department Collecting
  - 163 Commercial Department Contracts
  - 164 Commercial Department Accounting
    - 1641 Bill Clerks
    - 1642 Ledger Clerks
    - 1643 Statistical Clerks
  - 165 Commercial Department Miscellaneous
    - 30 to 39—*Production Expenses—Repairs*
- 34—Repairs of Boiler Apparatus
  - 341 Feed Pump Repairs
  - 342 Boilers and Boiler Engine
  - 343 Heaters for Feed Water
  - 344 Coal Conveying System
  - 345 Ash Conveying System
  - 346 Filters
  - 347 Miscellaneous

Specific and standing work orders could be divided into four classes: (1) Sales orders, or those covering accepted proposals by customers; (2) Stock orders, or those representing standard



contracts to be manufactured for stock during slack periods; (3) Plant orders, or those issued for the construction of machinery for the plant and extensive repairs to apparatus of plant buildings, and (4) Standing orders, or those giving authority for supervision and general service work, and in addition thereto minor repair work at all times as needed.

Examples of work in process serial numbers :

70 to 79— <i>Fixed Capital—Work in Process</i>			
75—Work in Process			
Construction Department			
SO	1000—	1999	Standing Orders (to be pro-rated)
CA	5000—	9999	Additions
CB	20000—	24999	Betterments
CR	30000—	34999	Replacements
CW	40000—	49999	Withdrawals
OE	50000—	99999	Operating
AR	110000—	114999	Contracts (to be billed)

Examples of the various classes into which materials and supplies could be separated, arranged and designated :

80 to 89— <i>Other Indicant or Ledger Accounts—Debits</i>	
80—Materials and Supplies	
00	Tube and Cable Material
01	Tube Feeders
02	Tube Mains
03	Junction Boxes
04	Junction Box Parts and Supplies
05	Tube System Material
06	Cable Material and Jointing Supplies
07	Reels and Carboys
30	Hardware, Piping and Structural Iron, etc.
31	Light Hardware and Sundries
32	Iron
33	Steel and Heavy Hardware
34	Pipe and Fittings
35	Copper, Brass, etc.
36	Structural Iron
37	Lumber
38	Building Material
60—Second-hand Material	
61	Scrap Brass and Copper
62	Brass and Iron Filings
63	Iron Pipe Ends
64	Meters, Transformers and Arc Lamps
65	Electric Signs
66	Electrical Apparatus
67	General Machinery
68	Spare Parts
69	Building Material

As an indication of the efficiency of the numerical system for designating accounts, suppose it is required to make a charge for labor or expense against the following :

Main Class Account 00 to 09—  
General and Miscellaneous Expenses



Divisional Account 01—  
 Salaries and Expenses of General Office Clerks  
 Sectional Account 011—  
 Fiscal Department  
 Sub-Sectional Account 0114—  
 Payroll Clerk

instead of writing the full description, as indicated, all that is necessary is to designate the figures  
 "0114."

Again, should it be desirable to make a charge for pipe and fittings against a supply-room located, for instance, at 41st Street and First Avenue, in place of writing

Account Letter L—  
 Storeroom, 41st Street and First Avenue  
 Main Account 80 to 89—  
 Other Indiant or Ledger Accounts—Debits  
 Divisional Account 80—  
 Materials and Supplies  
 Sectional Account 30—  
 Hardware, Piping, Structural Iron, etc.  
 Sub-Sectional Account 34—  
 Pipe and Fittings

all that is essential is to indicate  
 "L80—34."

IMPORTANCE TO EXECUTIVE OFFICIALS AND GENERAL MANAGERS OF GRAPHIC METHODS FOR (1) ILLUSTRATING ENGINEERING AND FINANCIAL PROBLEMS AND CONDITIONS; AND (2) AFFORDING CONTINUOUS COMPARISONS FROM MONTH TO MONTH FOR PERIODS OF SEVERAL YEARS.

Graphic methods have been utilized for many years by engineers in all classes of engineering work for illustrating various problems and conditions. It is only recently, however, that such methods have been turned to practical service for illustrating statistics and numerous kinds of accounting problems.

An important advantage secured by adopting the graphic methods is the opportunity afforded for continuous comparisons from month to month for periods of several years.

The consolidation and condensation of a series of statements, covering monthly and annual periods, presented in graphic form, enables executive officials and general managers to pass judgment on important problems without devoting valuable and unnecessary time and labor to comparing and dissecting numerous individual statements.

Before any statistical and graphical charts can be prepared it is essential that all the necessary data and information should be collated and compiled in advance. In preparing the various kinds of accounting and statistical work essential for public service corporations the mechanical machines outlined herein will be found invaluable.

In discussing the necessity of graphic methods for presenting facts Willard C. Brenton, an authority on this subject, has suggested that the method of presentation is as important as the data. In his treatise entitled "Graphic Methods for Presenting Facts," he considers among other important matters the possibility of standard methods of presenting tabulated figures versus graphic methods; various methods, including simple comparisons involving time; examples of good practice in curve plotting; component parts shown by curves; curves for income and expense on accumulative basis; vertical bars to represent frequency; methods for combining curves, with figures recording the data; corporation financial reports; records of previous years not usually given; recent examples showing bad practice, etc.



grouped according to classes, sections and sub-sections, and designated by numbers, is the most effective guide device known for obtaining reliable records of business transactions. The sections should be numbered from 00 to 99 and the accounts logically arranged in numerical sequence, as previously suggested. Where several operating or manufacturing departments are maintained in the accounts, as, for instance, gas, electrical and street railroad, provision should be made therefor. An illustration of a proposed classified and numerical system of accounts for electric corporations is given herewith.



SUMMARY OF THE VARIOUS PAPERS READ AT THE  
ACCOUNTING SESSIONS OF THE NATIONAL ELECTRIC  
LIGHT ASSOCIATION, DEALING WITH THE SUBJECT  
OF PUNCHING, COUNTING, SORTING AND TABU-  
LATING MACHINES.

Numerous illustrations consisting of charts, tables, figures, etc., are contained in the papers, showing the application of such machines to various lines of accounting and statistical work. The authors' descriptions are given herewith in abridged form. For complete explanatory remarks and comments reference should be made to the papers.

*Paper entitled "Payroll Problems of the Electric Light Industry," by W. E. Freeman, read before the Association at its Thirty-second Convention, held at Atlantic City, New Jersey, June 1, 2, 3 and 4, 1909.*

"A list of the mechanical appliances on the market for recording time, cost-accounting, etc., would contain slip, sheet and card time-recorders, electric master clocks, elapsed time machines, electrical adding and listing machines, combined adding machines and typewriters, statistical calculating machines and numerous miscellaneous payroll appliances.

"This list embraces only recording and computing machines that are in actual commercial use.

"In this connection, however, it may be interesting to note that the trend of invention in the payroll and cost-keeping field seems to be along the line of computing machines automatically controlled by the electric contact principle—that is, making electric contact through the perforations in a card representing the factors of the computation.

"There has recently come to the attention of the writer a very interesting device of this sort which bids fair to pass the laboratory stage before long.

"If the apparatus is brought to a point of commercial efficiency it would eliminate a heavy percentage of clerical labor and cost-keeping and would permit a far closer analysis of labor costs than is now practicable, to say nothing of greater speed and efficiency."

*Paper entitled "Significance of Statistics," by George A. McKana and D. F. McGuire, read before the Association at the Thirty-third Convention, held at St. Louis, Missouri, May 23, 1910.*

"In the preparation of this paper it has been thought best to present several typical examples of statistical charts and tables, prepared from actual data covering the experience of the Commonwealth Edison Company of Chicago, giving some significant statistics rather than dwelling on the significance of statistics.

“Chart No. 1—One method of presenting statistics and also a concrete example of their value, and a justification of the expense and time necessary for proper preparation and study of same.

“This chart shows some actual statistics on the cost in cents per dollar of income for four of our important distribution expense accounts. Cents per dollar of income is used as a basis in the preliminary and general study of expense accounts for the reason that it not only takes into consideration the relative increase and decrease in both expense and output, but it also takes into consideration any change made in the rate of charge for output. This feature is considered valuable for the reason that any company, to be in a thoroughly healthy financial condition, should be reducing its cost per unit at least as rapidly as it is reducing its rate of charge per unit.

“Chart No. 2 shows the net increase in lighting customers, and actual advertising and soliciting expense, and the lighting rates in effect during the period for each of the last fourteen calendar years. The rate curve is the regular Wright demand rates based on three hours' use per day of the maximum.

“This chart is a complete vindication of a liberal policy regarding soliciting and advertising, although it is quite probable that the “Number of Customers” curves would not show up as favorably as it does were it not for the frequent reduction in rates. On the other hand, a reduction in rates, unaccompanied by intelligent advertising, probably oftentimes does not result in the desired increase in business and is probably one of the principal reasons why a great many companies fear reductions in rate and improvements in lamp efficiency.

“Table No. 3 was prepared from the building data of all residence and small store customers in the territory surrounding the business center, a total of 50,000 in October, 1909.

“An interesting feature regarding flats and houses is that, notwithstanding a rate reduction of 5 per cent. during the period compared, both the kilowatt hours and the income show a greater increase than the number of customers; in other words, the average bill per customer is increasing, due probably to freer use of light and the use of heating and cooking devices.

“Table No. 4 was prepared to establish the total diversity between the sum of the customers' maxima and the combined total of output for power house maximum, less allowance for transmission, conversion and other losses, and has been carefully worked up for the month of October, 1909.

“Chart No. 3 gives a comparison of the coal consumed per kilowatt hour with the total amount of energy generated and shows graphically what an important factor the large central station company has become in helping to solve the nation's problem, “Conservation of Natural Resources.” This improvement

has been brought about by installing the largest and most efficient types of prime movers and by improving the load-factor through supplying from one source energy for practically every purpose.

“The coal burned per unit of output by the stations of the Chicago Company is only one-half the amount burned in 1904. If the energy generated at the present time by this company was supplied by numerous small plants, such as the average isolated plant, the amount of coal burned would be at least twice as great, or an absolute waste of nearly 1,000,000 tons per year.

“Table No. 6 is a classification of all the small and medium-sized light customers on whom we have demand meters installed. The significance of this table lies probably in the actual use that can be made of it by solicitors throughout the country. One of the first things that a prospective customer wishes to know is about what his bill would be, and the solicitor, in order to answer such a question intelligently, must keep posted. This table is probably the most comprehensive that has been published and is right up to date. The figures are for the month of January, 1910.

“Table No. 7, on power, is for the business section of the city only, this section being supplied by direct current. The outlying territory, supplied by alternating current, is not included because demand meters are not installed on the alternating current power customers. About the same remarks apply to the power tables that have been made concerning the light table just preceding, excepting that the average kilowatt hours used in the different classes is a great deal larger for power customers than for light customers, which is one of the reasons why the power rate should be lower than the light rate.

“Table No. 8, classified according to rate schedules, shows the number of customers on each of the various rate schedules, the average kilowatt hours used, the maximum kilowatts per customer and the hours’ use per day.

“With customers’ data classified in this way the rate of growth of all schedules can be kept track of, and if a reduction in rates is contemplated its effect on the company’s income can be readily determined.

“In the preparation of the statistical data given in this paper the most efficient mechanical computing devices have been used, such as adding machines, listing machines, multiplying machines and dividing machines, slide rules and electrically operating sorting and tabulating machines and, in fact, the expense of working up such statistics as given in this paper without the use of the machines would be prohibitive.”

*“The Extent to Which a Tabulating Machine Can Be Used in Accounting Work,” by William Schmidt, Jr., read before the Association at Its Thirty-fourth Convention, held at New York, May 29 to June 2, 1911.*



“In our company we use the machine for tabulating the monthly electric sales. The card that we are using for this purpose is somewhat similar to the card used in other companies.

“The information taken from these cards is used for statistical information, for the monthly credit to operating income, for balancing the number of meters in service, for the monthly balance of the consumers’ ledgers, and for checking the monthly bills.

“The tabulating system is also used in making a daily analysis of incandescent lamps, tungsten lamps, shades, etc., issued from the lamp renewal room. This analysis shows the class of issue, such as free renewals, charge renewals, cash renewals, etc. The total issues of the various classes ascertained in the analysis of lamp renewals are used in making journal entry of the credit to storeroom stock. If this analysis had to be made up on tabulating sheets, the expense would be almost prohibitive, the chances for errors creeping in would be greater and it would be very difficult to check totals. By the tabulating system, if you once arrive at the grand total of a lot of cards, any distribution of those cards, no matter how diversified, will always equal the original figures, notwithstanding how many times it is re-added.

“Recently we had a request for the number of meters in service, as to size, kind and type, meters having different constants and wire and the average light of all the meters in use, and the class of service on which these meters were installed. By the use of the tabulating system we were not long in getting this data. Similar information was compiled also for indicators, transformers and arc lamps in service.

“Another request made was in regard to the number of poles and apparatus attached to the poles. The information desired was as follows: The size of the various poles, whether painted or unpainted, lamp or line poles, taxable or non-taxable, and located on private or public rights-of-way; the kind of pavement surrounding the pole, the number of cross-arms attached to the pole, whether used by ourselves or other companies; the name of the company occupying same, whether any transformers or additional apparatus were attached to the pole, the number of poles of other companies occupied by our company, and the name of the company owning them.

“This information was gathered on cards prepared for the purpose and which were then turned over to the tabulating department for assortment and summarizing.

“In the gas division of the company we have been using this machine in tabulating sales made by the various solicitors, showing kind and amount of business brought in by each man—which results are used as a basis for the commission payroll—a daily statement showing kind of appliances sold, the number of applications taken for new business, complaints reported, etc. This



machine has also been used in gathering certain details from gas consumers' ledgers, somewhat similar to the electrical statistical information.

"We are now arranging to take care of our voucher distribution by the use of this machine instead of the present tabulated sheets. Our classification of accounts provides for approximately 400 accounts, each having its own columns in the voucher distribution journal, and a number of errors have occurred, due to the clerk entering the distributing amount in the wrong column. These errors will be obviated by the use of this machine because the clerk, in making perforation of the cards, has to bear in mind only the account number and the amount charged to the account on which he is working at that instant, thus avoiding the great number of columns that he would otherwise have to bear in mind and eliminating the possibility of errors."

*Papers entitled "Progress Made in the Uses of the Tabulating Machine," by William Schmidt, Jr., read before the National Electric Light Association at the Thirty-fifth Convention, held at Seattle, Washington, June 10 to 13, 1912.*

"The system of mechanical tabulation of statistics and accounting in connection with the commercial work applies to the reporting of current sales, summarizing and reporting changes in connected installations, incandescent lamp transactions, contracts taken and cancelled, miscellaneous appliances sold as to kind, and meter rentals. The tabulating method secures for us a distribution of our revenue in almost any way in which it may be wanted. We can prepare easily a distribution of our business as between different classes of customers, different classes of rates and different classes of current. We can readily determine the aggregate amount of consumption on bills at the base rate and at each of the secondary rates, and estimate the effect of any change in rates by applying a rate different from that now established to the different amounts of consumption at the existing rate. We can determine the number of customers that have more than one meter and, if it becomes necessary, the amount of sales for each feeder, for the purpose of comparing it with the amount of current furnished to the feeder. We can readily determine the movement of business by comparing the number of residences or any other class of customers at one time with the number in service at another time, and determine which part of the business is meeting with the greatest extension in use and which part needs stimulation.

"The tabulating system provides something that no previous system we have ever used has provided—that is, a check as to the accuracy of individual bills; in other words, a checking of the extension and footing. When a bill is extended incorrectly the fact that there has been an error made is indicated in that the aggregate amount of the bills at the rate in question differs from

the aggregate amount of the consumption multiplied by that rate. This is accomplished by applying the base rate and the different secondary rates to their respective consumptions and comparing the aggregate of the billing with the aggregate of the amount of the bills as reported by the bookkeeping department.

“The work of reporting connected installations is much facilitated by the use of the tabulating system, as we can conveniently get an analysis of all connections and disconnections, as to class of business on connections, reasons for disconnections and the amount of business lost for each reason. This enables us to classify the disconnections as to removals, changes of name, etc.

“The tabulating system having worked out so well in all classes of work to which it has been applied, we next designed a card to take care of the weekly payroll charges to the various operating accounts, the various job order numbers and the classification of the expense of teams and automobiles.”

*Paper entitled “Mechanical Office Appliances—Their Uses and Economics,” by H. D. Lohmeyer, read before the National Electric Light Association at the Thirty-sixth Convention, held at Chicago, Illinois, June 2 to 6, 1913.*

“HOLLERITH TABULATING MACHINE.—As to the economies effected by the use of these machines I may say that a large amount of valuable information is compiled now which before the advent of a tabulating machine would have been almost a practical impossibility or, if not impossible, would have been compiled at great cost and delay and then only in cases of extreme necessity. For our electric division alone there are now being compiled about seventy different reports, and a number of others are under consideration. This entire work is being handled by a force of five men and ten girls, equipped with two sets of sorting and tabulating machines and nine punching machines.

“In connection with the distribution of vouchers for the accounting department there is compiled for the treasurer his monthly report and cash disbursements. After the operator has completed one set of cards for a section of the month’s vouchers he immediately punches a second set direct from the same vouchers. The two sets of cards are compared, thus eliminating the verbal check with the voucher clerk. It has been found that the extra set can be punched and checked with the first set just as quickly as the verification could be made by the former method and save the entire time formerly used by the voucher clerk in verifying cards with the operator. Each day the vouchers which have been paid are so punched on the second set of cards, and at the end of the month both sets are sorted into account order, the one set covering vouchers issued during the month and comprising the basis of the report of the distribution of vouchers for the accounting department, and the second set comprising the vouchers paid during the month and forming the basis of the

treasurer's report of cash disbursements. Both sets are then filed away in account order, thus leaving the voucher record always accessible for any analysis of accounts or special statements which may be requested.

"I may add that some accountants fear the Hollerith System because the record it produces is not displayed in the form of nice statements or reports. This fear or dislike is, however, unfounded, as the record made by the tabulating system is just as accessible, convenient and permanent as any other method."

*Paper entitled "An Accounts Payable Method, Including the Mechanical Tabulation and Distribution of Operating and Other Expenses," by F. A. Birch, read before the National Electric Light Association at its Thirty-seventh Convention, held at Philadelphia, June 1 to June 5, 1914.*

"We all know that the rapid development of our industry is a phenomenon in the business world to-day. As a result of this marvelous growth greatly increased demands have been made upon every department of our industrial activities, and yet we have but crossed the threshold into a still further development, the ultimate magnitude of which no man can accurately forecast. The accounting department comes in for its share of this increased burden. A great many more accounts must be carried upon the books, and the mathematical results of operations must be shown in minute detail for every department. The very fact that our business is experiencing this remarkable growth creates in the executive officers of the company a desire to obtain more promptly each month the statistics relating to revenue and expense, and we therefore have the double burden of added work and the demand for still earlier reports. In formulating a method for expeditiously handling the accounting problem which thus confronts us, thought is naturally directed back to the point where the materials are purchased, and things begin to be factors in the expense accounts and the accounting which prevails at that point. We shall briefly review the method now employed by the Philadelphia Electric Company for handling this very important item.

"While the old-style voucher register was employed the monthly reports were not completed until about the twentieth day and sometimes later than that. By using the tabulating machines it was found possible to complete the monthly figures around the 10th or 12th of each month, a saving of a week or ten days in determining the expenses and other operating data of the preceding month.

"Details of all operating expenses, construction charges and other accounts that are affected by accounts payable are obtained from the tabulating cards; none of this information is kept in the voucher register. It is found that the time required to run through the tabulating machines the accounts payable cards for any month is very much less by several days than the time that



was formerly required to add the 140 written-out columns on each written-out 20 pages of the voucher register. The voucher register sheet employed in conjunction with the tabulating machines has only six columns. No distribution whatever of the vouchers is made upon this sheet. To further facilitate the prompt tabulation of operating expense, special journal entry sheets for receiving the recapitulation of the tabulating division's figures at the end of the month have been provided, on which have been printed the names of every account in the company's classification of charges. Thirty different sheets are required to accommodate all of the company's classifications. By having these sheets printed and coded in advance of the closing date much congestion and consequent delay are avoided. Sheets in the ledger, which is of the loose-leaf type, are run in the same sequence as the accounts on the special journal entry sheet. As a result it is only necessary for a clerk to take the tabulating cards for a given month, after they have been properly sorted, sit down to the tabulating machine with the printed journal entry sheets at his right hand and swiftly set down beside each charge that is affected the amounts that are obtained from the tabulating machine. When questions are raised later on regarding the composition of any particular item of expense the tabulating cards are available for the most minute detail, and instant reference to the voucher containing the bills charged against such expense accounts is afforded. It is a matter of but a few moments to assemble and tabulate the vouchers and so obtain complete analysis of any account.

“The one small disadvantage in the use of the tabulating machine in connection with work of this character is the fact that when an analysis of any particular account is desired it may take a few minutes longer to get it than it formerly took when each separate item, with explanation attached, was entered in a book. Only totals for the month are obtained from the tabulating division, and consequently but one item a month is posted in all of the books. It is believed, however, that the small disadvantage of a few extra minutes in analyzing a single account is very much more than counter-balanced by the saving in time that is effected through eliminating the work that was required to itemize all of the accounts in books, when particulars regarding only a few are needed and very probably none of them may be asked for. It is contrary to the principles of scientific and efficient management to prepare and maintain a maximum of data for hundreds of items when particulars will be requested on only a very few.

“It will be seen, therefore, that none of the details which were maintained and preserved under the old and laborious voucher-register method have been sacrificed or curtailed. In addition to the fact that all of the information which was formerly kept is still available when using the tabulating machine,



the speed with which a month's accuracy of business can be tabulated and the saving of time in getting out figures, and the consequent promptness in the rendering of reports to the board of directors, will be appreciated by every one who has to do with the accounts of large corporations, where vast amounts involving many items over many classifications must be handled.

"Machinery has invaded many lines of industrial activity which formerly were closed to it, and this Hollerith tabulating method has probably done more in the way of making accounting mechanical than anything else. The introduction of machinery into accounting methods does not, however, eliminate the accountant or bookkeeper nor decrease the value of his services. It relieves him from the multitude of details and permits him to devote his time to the contemplation and solution of problems of greater magnitude and import. Every man in the accounting division of the electric lighting industry will do well to investigate mechanical tabulation, for his investigation will not only be very interesting to himself but will open up vistas of inquiry and solution which will increase his value to himself and his company."

*Paper entitled "Application of Sorting and Tabulating Machines to the Inventory of Transmission and Distribution System," by C. V. Woolsey, read before the National Electric Light Association at the Thirty-seventh Convention, held at Philadelphia, June 1 to 5, 1914.*

"A record of the transmission and distribution systems is usually maintained by all operating companies, either in the form of scale maps or, where necessary, of an elaborate card or loose-leaf book record. It is not the object of this paper to advance any schemes for maintaining a special kind of record, but rather to offer a solution of the problem of taking from these records or in the field an inventory of all the material installed, to be used in making reports on the physical property and its valuation.

"Familiarity with the tabulating machine soon discloses the need of a set of code numbers for the computation of material. Even without considering the machine, such a code simplifies the taking of an inventory, shortens the time consumed and reduces the chance for errors in transfer. In designing the code which is shown herewith a number of things were considered and an effort made:

"(1) To have the code indicate only certain characteristics of the material as are required to estimate its unit value in the reports of physical property;

"(2) To have the code as simple as possible by using a code number consistent with the material represented.

"This is illustrated in the code used for the underground system under the heading "Ducts." For example, the code number for a twelve-duct subway consisting of fiber conduits,

laid two ducts wide and six ducts high, in the trench would be 1,212. The first two figures (12) indicate the number of ducts in the trench; the third figure (1) represents the kind of conduit (fiber), and the last figure (2) shows how many ducts wide there are laid in the trench. The third figure is then the only one assigned arbitrarily. These four figures give everything that need be known in order to estimate the average cost per foot to install this conduit at an average depth. The average depth chosen for estimate would be the one most used for general construction, to which there would be a few exceptions, due to the abnormal conditions in the path of the work;

“(3) To design the code to fit the size and spacing of the tabulating cards already in use by the company for other statistics.

“In order to file the original inventory systematically with its subsequent monthly maintenance a form was designed as in Fig. 1. This form is intended to transfer the records of material from the record maps or cards in code form to the statistical department, where it is set up on tabulating cards for sorting and summarizing.

“What may seem at first glance to be a complicated and cumbersome scheme for handling this work proves to be very simple. Our experience has been that one man devoting his whole time to preparing the original inventory sheets is able to handle both the underground and overhead systems. He gets his information from reports turned in by inspectors of the work in progress, which reports are used principally for the regular map records. These inventory sheets are turned over periodically to the accounting department, where the work on the cards and the transferal to the summary sheets is done during spare time in the regular accounting work.

“In 1910, when a detailed inventory was required for the purpose of making a report to the State Tax Commissioner, with the prospect of reports of changes to follow annually, it looked like a job that would require an immense amount of time and labor, with no practical way of checking the final results or maintaining them with accuracy. When the tabulating machine suggested itself, due to its use for other statistics by the company, we proceeded to design forms to fit its use and found that we had a system by which we could with ease check any item in our final summary.

“For example, referring to the form on page 272, if we desire to prove that we had 900,000 duct feet of two-duct fiber subway on January 1, 1914, as shown on the line marked with an asterisk, we would refer to the file of subway cards, a sample of which is shown on page 265, Fig. 2. By passing these cards through the sorting machine all cards of that assembly number

could be separated. The street and sheet numbers in the first two columns of these cards would identify the sheet shown on page 264, from which they were punched and then, if necessary, these could be further traced by actual inspection in the field."

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