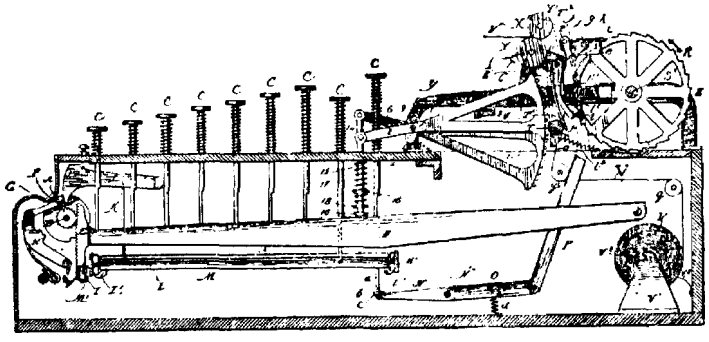

Figure 78

Comptograph (1889)

The Comptograph followed the Comptometer described earlier in this volume. It is essentially the same machine equipped with a printing device. It originated from Dorr E. Felt, who was the first to bring out a large printing adding machine. He could be described as the most successful and most versatile builder of adding machines, and both his method of setting up the type bars and his single type hammers were later adopted by Burroughs and others. His first model (patent applied for on 19 January 1888, granted 11 June 1889, partially illustrated in figure 78) was not, however, usable. For one thing. the spring that produced the printing motion had to be wound up. and the machine did not print zeros.

Even before the patent was granted. Felt brought out a new model. Felt and Tarrant built twenty-five of these new machines. These were sold to various hanks—the first in December 1889. This is the oldest printing adding machine known and was in use until 1889.[59] It can be found in the National Museum in Washington (figure 79).[60]

The paper was fed out by a hand lever attached to the right of the machine. This machine printed zeros automatically. Each row of keys not only had one typing sector but also a typing hammer that struck from behind the paper. The typing hammers were returned to their rest position by a lever, the use of which also caused the paper to be pushed up. The printing was always in full view.

59. Ernst Martin has obviously made an error in his dates. The error persisted in the 1928 edition. No attempt has been made to change either the dates or the sentence.
60. Now in the National Museum of American History, Smithsonian Institution.

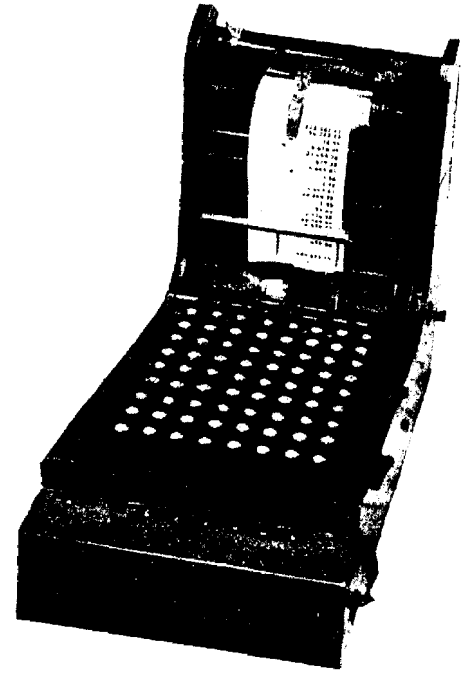

Figure 79

Felt's next improvement was the wide carriage. This enabled several columns to be printed next to one another. Other firms such as Burroughs, Wales. etc., were only allowed to make wide carriage machines after paying license fees to Felt. With this machine the digits had to be entered from right to left. In order to print the result, it had to be taken from the figures appearing in the result windows. The first hundred machines, which were produced in 1890, had a key on the left side of the keyboard that caused this printing to occur automatically. In entering numbers, keys could be pressed either from the left or right or in any order (figure 81). In all the models described here so far. addition and printing were carried out solely by pressing keys.[61]

The Comptograph described above was not introduced into Germany but rather a much-improved machine, briefly described here and shown in figures 82 and 83. This is a visible printing, full-keyboard adding machine with self-

61. On the 1890 machine. numbers entered were printed. The total accumulated on numeral dials. as on a comptometer. When this total was to be printed. one pushed a large key to the left of the keyboard.

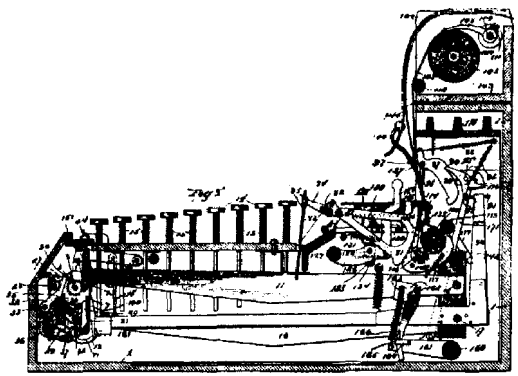

Figure 80
Cross section of the above machine.

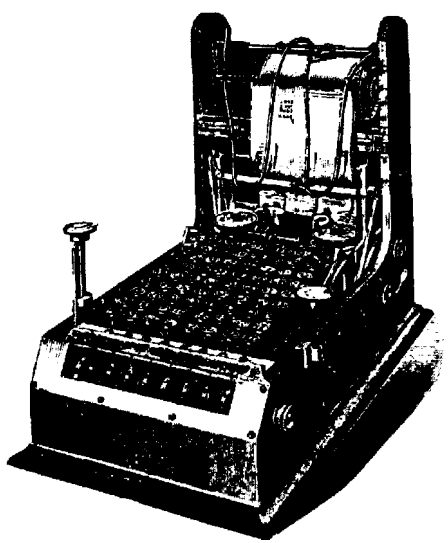

Figure 81
Later model.

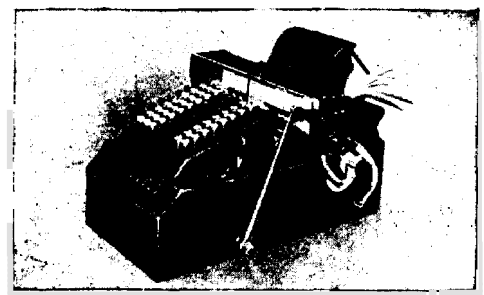

Figure 82
Improved machine

correcting keys and complementary figures for subtraction, wide carriage and, if desired, with paper rolls in whatever width is required. The Comptograph automatically indicates when the bottom margin of the paper has almost been reached. In this case it prevents the crank from being turned. It is thus impossible to print near the lower edge of the sheet, or to **have** the paper fall out. The paper lock operates in the same way with rolls of paper. This locking device allows one more number or sum to be printed, but only by pressing a lever. In order to bring the paper back to the beginning for the start of a new column, it is not necessary to **roll** the paper back **by** hand, as it **is** with typewriters. All that is needed is to press the paper return lever. This causes the paper to roll back automatically and at the same.time shifts the carriage one place over to the next column.

Devices for switching off the printing mechanism, for cutting out the last two columns, for dividing the machine into two or three separate printing and adding columns (for example. for dates and amounts, etc.) are all to be found, together with the repeat key, on the right side of the machine. The left hand is, therefore, always free **to** remain on the manuscript. Total addition **is** also carried out manually with one movement, so that the **left** hand **is** never needed for operating the machine. Row cancellation keys are found underneath the keyboard. The strike of a hammer can be made stronger in order to make a number of carbon copies. **It is** also possible to do cross addition with this machine. It is available with nine to sixteen places and with either manual or electric drive. The price is **$275** to $350 without electric drive, depending on the number of digits. Production has been established for a number of years and spare parts can be obtained through the Comptometer manufacturers.

Manufacturer: The Comptograph Co., Chicago.

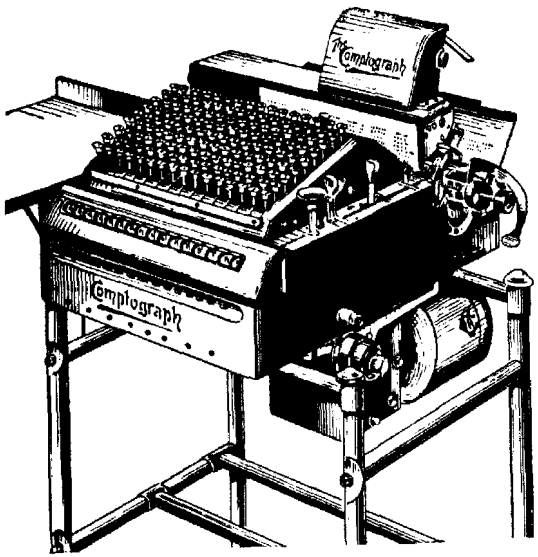

Figure 83

Cuhel (1890)

The designer was Dr. Franz Cuhel of Prague. The machine has eight places in the result mechanism and four places in the setting mechanism. It has thirty-six keys (nine keys repeated four times) in two long rows. It had no importance in the development of calculating machine technology.

Orlin (1892)

An automatic-screw adding and subtracting machine without keys. which never advanced beyond the experimental stage.

Esser (1892)

Setting occurs by using gears with a variable number of teeth. The designer was Heinrich Esser of Aachen. An example may be found in the Calculating Machine Museum of Grimme, Natalis and Company of Braunschweig."'

62. Now located in the Braunschweigisches Landesmuseum, Braunschweig

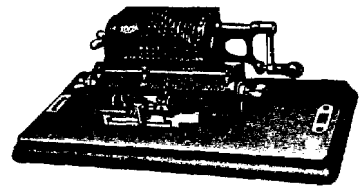

Figure 84
Model M.

Brunsviga (1892)

In 1892 the firm Grimme, Natalis and Company A.G. of Braunschweig acquired the current patents of the original Odhner pinwheel machine, which it manufactured in an improved form and sold under the name Brunsviga until about 1900. Since then the company has placed a number of new models on the market that embody basic improvements. The engineer S. Trinks is regarded as the originator of these improvements, and because of his calculating machine inventions he was appointed Doctor-Engineer Honoris Causa by the Technische Hochschule of Braunschweig. At the present time the following models of the Brunsviga (Trinks System) may be found on the market.

Model B: This machine is the oldest type and, in external appearance, approaches the original Odhner type closer than any of the other models. However, there are basic differences that make it superior to the Odhner machine. This model has nine places in the setting mechanism, thirteen places in the result mechanism, and eight places in the revolution counter. It is provided with white and red figures in the revolution counter mechanism and possesses all safeguards against misoperation.

Model M: This machine has all the features of model B, but it has the advantage of being extraordinarily small. Its leather case included, its dimensions are 26 × 15 × 12 cm and thus it may be taken along on trips. Like all models of the Brunsviga (Trinks System), it is furnished with an automatic carriage, which is an arrangement that makes it possible to shift the carriage to the left or right by pushing a bar. Apart from this device, the carriage may be shifted by any number of places without any special manipulations.

Model MD: This is similar to model M. It has twelve setting levers and twenty places in the result mechanism, with a tens-carry that goes right through to the last place. It has twelve places in the revolution counter.

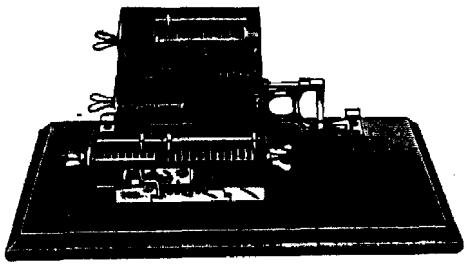

Figure 85
Model MH

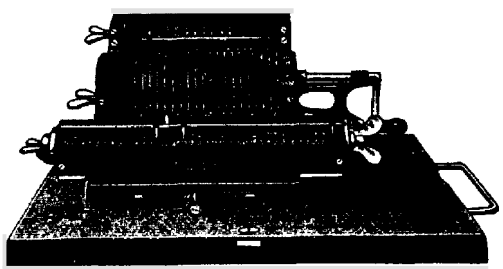

Figure 86
Model MJR

Model MH: The features of this machine resemble those of model M, but it has, in addition, a second revolution counter with a tens-carry mechanism to the last place. This machine allows one to very simply perform continuous multiplication calculations and simultaneous addition of the individual factors.

Model MJR: This machine has nine setting levers, fifteen places in the result mechanism, and ten places in the revolution counter. This model differs from the other types insofar as the entered value may. at any time during the whole calculating operation, be clearly and conveniently read from special windows. The revolution counter has tens-carry through to the last place. The addition and subtraction results appear in the revolution counter in white or red figures, respectively, without any reversing being necessary. The setting levers are longer than usual and remain stationary during calculation. This affords the operator an additional opportunity for continuous control.

Trinks Triplex R: This model has twenty setting levers, twenty places in the

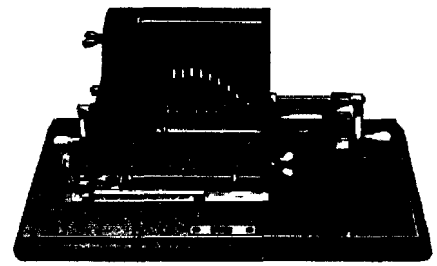

Figure 86a
Trinks—Triplex.

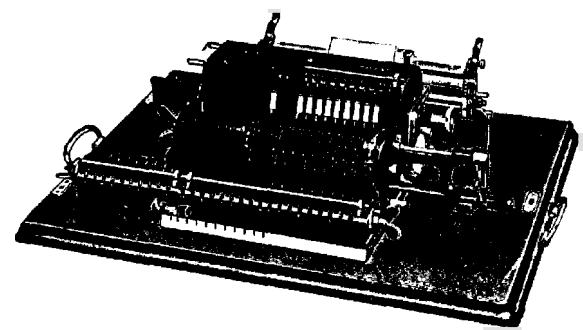

Figure 87
Trinks Arithmotype.

result mechanism, and twelve places in each of the two revolution counters. The Triplex R model has the efficiency of three calculating machines. Just as in model MH, the second revolution counter has a tens-carry that continues through to the last place; the other revolution counter acts in the usual manner. Red and white figures appear in the revolution counter without any reversing operation, just as in all R-type models, the reversing mechanisms being protected by patents. The advantages of this machine are enhanced by an arrangement that enables the result mechanism to be used as one unit or as two separate parts—each being capable of having a self-sufficient tens-carry and clearance. The Triplex R is popular wherever large numbers are involved in calculations; it is practically indispensable for scientific computations.

Trinks-Arithmotype: This machine possesses all the features and devices described further in connection with models J and N. In addition, the machine has a printing mechanism that allows it to perform all four kinds of calcula-

tions and simultaneously print the result of the operation. The printing mechanism may be connected or disconnected as desired, so it may be used without the printing mechanism just like a machine model J or N. The Trinks-Arithmotype is the first machine that prints for all types of calculation.

The following models are no longer in production:

Model A: The model A has all the features of model **B,** but it possesses eighteen places in the result mechanism. It is provided with either nine or twelve setting levers and has ten or twelve places in the revolution counter.

Model MA: The model MA has the same features as the model A but. like the model M, it is reduced to the smallest possible dimensions.

Model J: Instead of short setting levers, this machine is provided with long setting levers with convenient handles that may be grasped by two fingers and adjusted in an extremely convenient manner. The entered value appears in the special windows. All digit rows are arranged below one another, so that the operator may survey and check all functions of the machine at a glance. The setting levers are locked as long as the crank is released for. or in the process of, rotation; thus. the setting levers do not participate in the rotation.

Model MJ: This model has the same features as the model J, but it has been reduced to the minimum dimensions.

Model N: In its features this machine **is** almost identical with model J, but it has a particular feature that enables it to simultaneously and automatically transmit, by operation **of** the clearing device, the value from the result mechanism into the setting mechanism. **As** a byproduct of this arrangement, values also may be introduced directly into the result mechanism by the setting levers without operation of the crank. In this model the revolution counter is not located above the setting levers, as in model J, but on the left side of the carriage. The revolution counter has red and white digits, and the digits are smaller than those of the result mechanism, which avoids errors and confusion in reading. This model was provided with eighteen places in the result mechanism.

Model MDII: This is also called the Trinks-Triplex. This machine **is** no larger than model MD, yet it has twenty setting levers—that is, it has two groups of setting levers, one with twelve levers and the other with eight levers. Additionally the machine has twenty places in the result mechanism and twelve places in the revolution counter. The result mechanism has tens-carry to the twentieth place. The tens-carry mechanism is capable of interruption: thus,

the twenty setting levers and the twenty places in the result mechanism may be used jointly as an undivided unit or as **two** separate mechanisms. Two multiplications may be performed simultaneously on the machine or the machine may show individual products and, at the same time, the sum **of** the products. Moreover the machine may be used **for** multiplication and simultaneous division of large numbers. The numbers in the result mechanism may all be set to **zero** by a single turn of the winged clearing handle, or they may be set to zero separately if desired—that is, the whole row of numbers may be cleared all at once, or only either the left or right half of the numbers in the result mechanism may be cleared.

In France the Brunsviga was originally sold under the name Rapide, and the miniature models at one time bore the name Brunsvigula.

Burroughs (1892)

William Seward Burroughs was the designer of **this** machine, likely the most important of all the printing full-keyboard adding machines. He was born 28 January 1857, the son of a mechanic, in Rochester. He attended primary school in Auburn and was then employed in a branch of a bank there. In 1882 he moved to St. Louis where he found a position in a machine shop. There he became familiar with the Baldwin Calculating Machine and, from 1880 **on,** occupied himself with the idea of building an adding machine. Later he worked on his model of an adding machine in the workshop of Joseph Boyer in St. Louis. **He** completed the model in **1884,** and his first patent was granted on **21** August 1888. This was a machine that printed only the final sums, not the individual items. Nonetheless, in principle it otherwise already resembled the machines of the present day. On the same day, however, he was also granted a patent on a later application, according to which individual items could also be printed. The first fully functional Burroughs model is based on a patent granted on **5** May 1892, and it was during that year that the first large-scale production was undertaken. The inventor's health had suffered badly during the many long years of failure. His money often ran out, and he had to interrupt his work to earn money in other ways. He died prematurely on 14 September **1898** without ever having seen the great success **of** his invention.

In **1888,** the American Arithmometer Company was founded in St. Louis. They were to take care of sales, while the manufacturing of the machines was

carried out by the Boyer Machine Company. Later, however, the first firm took over production as well. In 1904 the factory shifted to Detroit, and in 1905 the name was changed to the Burroughs Adding Machine Company. This company still manufactures the machine today and has branches in Windsor (Ontario) and Nottingham (England). It is the largest firm in the world for the production of printing adding machines.

Today, the Burroughs is manufactured in three designs:

Class I machines with one calculating mechanism (1892).

Class 2 machines with two calculating mechanisms (1910).

Class 6 machines with one calculating mechanism and direct subtraction.

Other classes carry the Burroughs name but were not designed by William Seward Burroughs:

Class 3 is the earlier Pike machine.

Class 4 is also a visible typing machine with special multiplication device.

Class 5 is the nontyping Burroughs Calculator (very similar to the Comptometer).

Class 7, the Moon-Hopkins, is a calculating typewriter manufactured previously by the Moon-Hopkins Company.

The last two machines will be described in detail later.

Class 1, 2, and 6 machines are known as the blind printing type because the operator cannot see the printed results without checking behind the machine. The interior mechanism has already been explained in the introduction. In these models, the carriage is attached behind the machine. It is designed to be folded back so that the printed work can be examined. Figure 10 shows this sort of machine with a hand crank. Class 2 machines have two calculating mechanisms. If the crank on the left of the keyboard is pushed up, then the items in the upper calculating mechanism are added and printed. On the other hand, if it is set on the lower calculating mechanism, then the items in the lower calculating mechanism are added and printed.

Class 3 machines are equipped with the following auxiliary keys:

Total key: all sums are indicated with a star, and at the same time the calculating mechanism is set on zero.

Subtotal key: all subtotals are indicated by an S.

Nonadd key: all amounts not added are specially marked

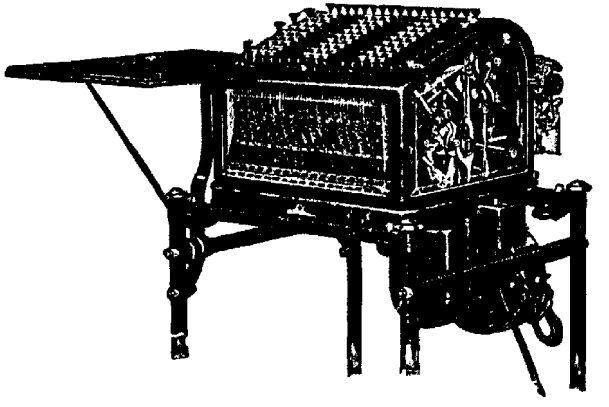

Figure 88

Keys for correcting single columns on the keyboard:

Correction key: when this is pressed, all the keys that have been pressed down return to their normal position,

Repeat key: this is particularly useful for multiplication and division.

The following devices can be attached on request; in certain models they are part of the machine:

Dividing devices: mechanisms that can divide the machine at any row of keys.

Movable paper carriage: this is for 31-cm or 45-cm wide paper.

Semiautomatic jump carriage: for 31-cm wide paper with adjustable tabulator stops.

Automatic jump carriage: for 31-cm wide paper.

Electrically driven carriage return: for setting up the carnage at the point of printing of the first item.

Platen dividing device: Enables the 31-cm wide carriage to be divided into two sections 9 and 22 cm wide so that it can then type two forms next to one another. The platen can also be used undivided.

Date printing and numbering device: The last two or three rows of keys can be separated and used as an item counter or for writing the date. There is a special lever on the keyboard for controlling this area. If this is put on the

mark labeled item counter, then the items are continuously numbered, the sum typed, and the number of items simultaneously printed. If the lever is shifted to date, then the machine prints the dates, which are not, however, added when the sums are printed.

Fractions: (eighths, twelfths, or sixteenths).

Form feeder and ejector.

Electric drive.

Carry-over key (only on Class *2* machines): when this key is pressed, it transfers an amount from the second to the first calculating mechanism and also sets the second calculating mechanism to zero.

Printing device: Special rows of keys with symbols for months, days of the month, as well as the designations debit, credit. and balance.

If you consider that the Burroughs is available today with nine, eleven, and seventeen places, then you can imagine how many different models can be created and how versatile the machine is. At one time the machine was also available with nine, eleven, thirteen, fifteen, and seventeen places.

An Example of the Use of the Machine in a Business Office

The account sheet is fed into the automatic jump carriage, and a special device quickly brings it up to the required height for typing. The old balance is typed. When the electric key is pressed, the carriage, together with the account sheet, jumps into the column for the date and receipt number. The date is automatically typed and can be repeated as often as is necessary. The entry symbol (corresponding to that used in the account or journal) is typed in abbreviated form. When the receipt number has been typed, the carriage moves into the debit column, where the debit is automatically subtracted. The machine is automatically set on addition when the carriage moves into the credit column. There the credit is automatically added, and the machine then moves on to the new balance column. Here the new balance is automatically calculated and typed without any effort on the part of the bookkeeper. The account sheet is ejected just as quickly as it was fed in. At the end of the workday, the machine supplies a check of the entries that have been made by demonstrating that the difference between the old and new balances is the same as the difference between the net total of debits and credits. Except for the fact that the amounts that are to be entered must be typed, and the electric key must be pressed. the machine operates automatically throughout.

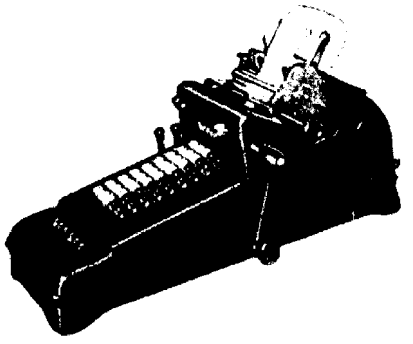

Figure 89

Such a mechanical entry of accounts offers a number of advantages over the old handwritten method. The main ones are:

1. A quick check of all entries made during the day. This assures that the old balance was brought forward correctly, that not only were all the items entered but they were entered correctly, and, finally, that the credits and debits of the individual items have been done on the right account.

2. Automatic daily raw balance.

3. Automatic calculation and typing of the new balance on each account.

4. Automatic warning signal that shows when an account has been overdrawn; the overdrawn account is automatically calculated, typed, and specially marked—all simultaneously.

5. All balanced accounts are specially marked.

6. The date of each entry is automatically typed and repeated.

7. The statements of accounts are typed and checked daily, which means that the counter account books do not have to be brought into line each month.

Some class 1 and *2* machines are supplied with hand or electric drive and some only with electric drive and either eight, eleven, or seventeen decimal places. Prices for these range between $325 and $910.

Class *3* machines were manufactured to meet the demand for cheaper, visible typing, full-keyboard machines (see figure **89).** The total, subtotal, and nonaddition keys print the same symbols as do the class 1, **2,** and *6* machines. These machines also have repeat and nonadd keys, while the total key serves at the same time as a correction key. Some of the models of this class are

supplied with a two-colored ribbon and can be divided so that it is possible to add and print two columns at once. They are also available with a date printing device. Those machines that use only roll paper have a fixed carriage. On the other hand, they can also have a movable carriage for monthly statements as well as a wide carriage that is also movable. The movable carriages are equipped with tabulator stops, although they must be manually raised each time; that is, the machines have no automatic or only semiautomatic carriages, and it is not possible to attach an electrically driven carriage return as it is in the machines of the major classes. The amount stored each time in the calculating mechanism can be read from the viewing windows underneath the keyboard. Most machines of this class have self-correcting keys. Certain models can be supplied with electric drive, others with forms feeder and ejector. There are machines available with fractions (eighths and twelfths) and they are made with five, seven, nine, or ten columns of keys. Prices range from $125 to $375. Electric drive, like any other special extra, results in an additional charge.

Class 4 machines resemble those of class 3. They also print visibly and have result viewing windows under the keyboard, the same auxiliary keys. and a two-colored ribbon. They are available with both electric and manual drive and also have a device with which it is possible to move the multiplicand from right to left or from left to right, which certainly makes the multiplication easier. This machine is only made with ten digit places and costs $425 (at one time it was also available with nine places).

Shohe Tanaka (1893)

A single-column adding machine with only five keys. Values above five were set by depressing three and three, three and four, four and four, or four and five. Shortly afterward the same designer made a similar single-column adding machine with nine keys. It seems that none of them was ever put into production. The designer was Dr. Shohe Tanaka from Awadji, Japan, who was staying in Berlin at the time.

Rapid Computer Adding Machine (1893)

The manufacturers were the Rapid Computer Adding Machine Company in Benton Harbor, Michigan, which was a branch of the Baker-Vawter Company. This machine will be described in detail under the name Comptator.

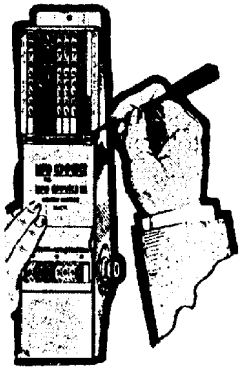

Figure *90*
Rapid Computer.

Millionaire (1893)

This machine is intended for the performance of all simple and composite problems of calculation that can be solved by the application of the four operations: addition, subtraction, multiplication, and division. The main advantage of the Millionaire calculating machine, as against all other types of calculating machines, is the astounding speed with which it operates, especially while doing multiplication and division.

Each place of the multiplier or quotient requires only a single turn of the crank, during which the necessary displacement of the result occurs automatically. From the outside the machine possesses the following parts (figure 91): the reversing lever *U*, by means of which the machine may be set for the different types of calculation; the hand crank ***K;*** the multiplication lever ***H;*** the setting board with the setting slides e-e; and the corresponding row e'-e'; for checking. The register mechanism has the following parts: the row of numeral dials *g-g* for the results; the row of numeral dials *f-f* for checking the positions of lever H; the mechanisms ***R*** and *C* for returning these numeral dials to their zero positions; and the knob *W*, by means of which the register mechanism may be shifted.

The Millionaire machine is to be regarded as a proper multiplication machine in that it solves problems of multiplication directly on the basis of the multiplication table, whereas other types of calculating machines are only adding machines and, as such, carry out multiplication by a continued series of additions (exceptions are the machine by Bollée, of which only a very few

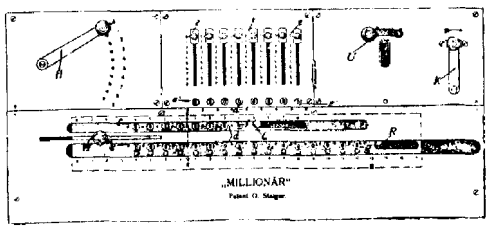

Figure 91

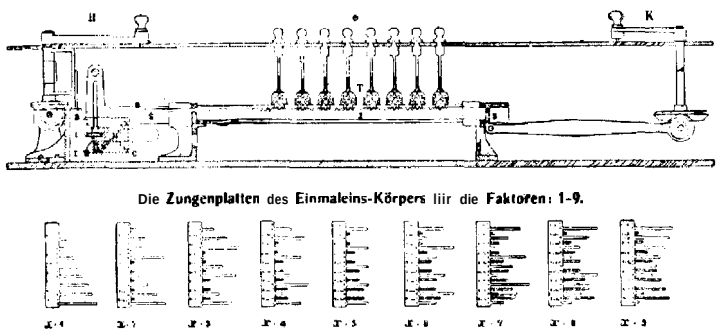

Figure 92/93

were ever produced, the Moon-Hopkins machine, and the Kuhrt U.S. machine). (Subtractions and divisions may be regarded as additions and multiplications in a negative sense; therefore, we shall not make any special mention of them from this point on.)

It is obvious that a multiplication machine that only employs the multiplier digit 1 corresponds to a pure adding machine.

Three main mechanisms may be distinguished in the Millionaire (figures 92, 93, and 94): (1) the multiplication mechanism, (2) the transmission mechanism. and *(3)* the register mechanism, which in turn is divided into two sections, one of which (*g*-*g*) is essential and registers the product, whereas the second one (*f*-*f*) is in fact only a matter of convenience in that it registers the multiplier and is not absolutely necessary in the actual multiplication machine.

The multiplication mechanism consists of the so-called multiplication table body[63] and its setting device that permits it to move **(1)** in vertical direction,

63. There does not appear to hc any generally accepted English phrase lor this device. Martin originally used *Einmaleinskörper* so wc have simply accepted a close translation.

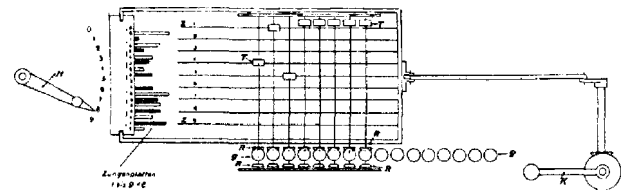

Figure 94

(2) in horizontal-longitudinal direction, and (3) in horizontal-transverse direction. The multiplication body, which is the essence **of** the multiplication machine, consists of nine toothed plates (figure 93), the first of which contains thc product of 1–9 times the digit 1, the second contains the product of 1–9 times the digit 2, and so on; the ninth plate contains the product 1–9 times the digit 9 so that the entire multiplication table **is** represented. Every one of these products is expressed by two elements (teeth) each, one of which represents the tens value (cross-hatched) and the other represents the units value of the product in question. The length of the tooth corresponds to the value it represents. All the tens values of a toothed plate form a group and **so** do all units values, and these groups act successively upon the transmission and register mechanisms. **A** review of figure 93 shows every individual product; thus, for the factor **6** we have on plate 7 four tens and two units, which is the product $7 \times 6 = 42$.

The transfer mechanism consists of (a) nine parallel racks **Z,** and (b) the shafts positioned transversely across these racks. Along these shafts the setting wheels *T*, may be shifted in the customary manner by means of the knobs on the setting board and may thus be brought into mesh with any one of the nine racks, depending upon the vatue of the respective place of the multiplicand.

On each of these shafts is also mounted a pair of bevel gears *R*, which are shiftable in their axial direction. The bevel gears transmit the rotation **of** the drive gears *T*, which corresponds to the longitudinal movement of the racks onto the register mechanism in a positive sense in case of multiplication and in a negative sense in case of division. Appropriate shifting mechanisms move these bevel gears periodically into and out of mesh with the register mechanism so that only the forward movement of the racks is transmitted while the return movement of the racks has no effect upon the register mechanism. The ends of thc racks are either opposite the tens **group** or the units group of the teeth of a multiplication plate. The alternation **of** the groups is effected by a small, horizontal, transverse shift of the multiplication body, whereas the set-

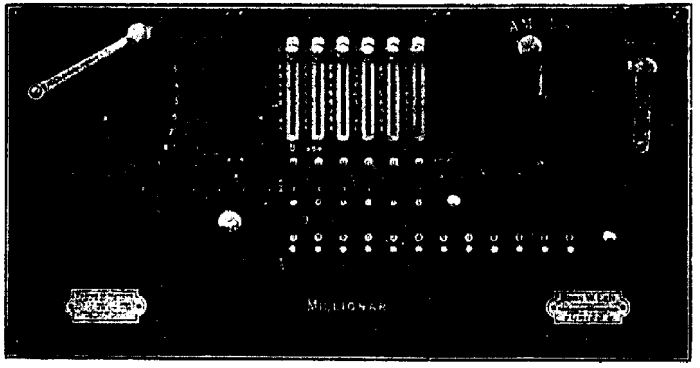

Figure 95
Millionaire with slide setting

ting of the various plates occurs by shifting the lever H along a scale. For each rotation of the hand crank ***K,*** that is, when multiplying with any single-digit factor, the racks are first advanced according to the tens values and are advanced a second time according to the units values. Since the tens and units values in the multiplication body are made up of the same length units, it is necessary that, after transmission of the tens value, the register mechanism be shifted one place to the left, which occurs automatically so that the units values are registered one place to the right next to their respective tens.

This explains the essence of the calculating machine. To facilitate understanding, the method of operation will be explained with the aid of an example. Let us, for instance, multiply 516 by 8. For this purpose the first setting slide *e* (counted from the left) is shifted on the cover plate to position drive gear *T* above rack ***5,*** the second setting slide *e* is shifted to position drive gear *T* above rack 1, and the third setting slide *e* is shifted to position drive gear T above rack 6. The multiplier is entered by shifting the lever *H* to the respective digit of the scale, with the result that the multiplication plate ***X*** x 8 is placed opposite the ends of the racks. During a revolution of the hand crank K, the multiplication body is pushed twice against the racks Z, and these racks are pushed forward an amount corresponding to the tens and units values of the products of 1–9 × 8. Transmission to the register mechanism occurs, of course, only from those racks above which drive gears T have been set. In the present case, therefore, the racks 5, 1, and 6 transmit the products ***5*** × 8 = 40, 1 × 8 = 08, ***6*** x 8 = 48 in such a manner that

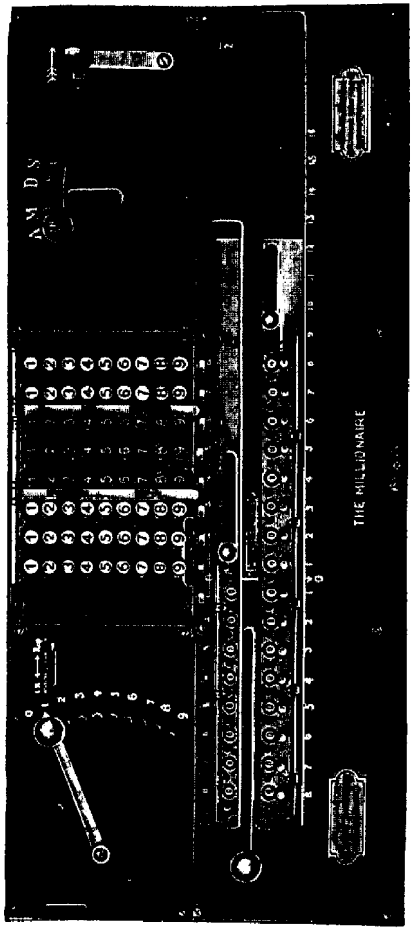

Figure 96
Key-set Millionaire.

the apparatus registers first the tens 4, **0,** and 4; after displacement of the tens by one place to the left, the units 0, **8,** and 8 are added on to obtain the product **4,128** as in:

4	0	4	
	0	8	8
4	1	2	8

Transfer of a ten resulting from the addition **of** the individual products is taken care of by the register mechanism during the idle return movement of the racks. For each rotation of a dial of the main register mechanism beyond 0 or 10 respectively. whether in a positive or a negative sense, + 1 is to be added *to* the next digit to the left. Such rotation pushes a so-called tens transporter out of its normal position (preparation) and engages it, by corresponding motive mechanisms, with the next dial to the left at the proper moment so as to carry over the ten in question.

The following synopsis shows the sequence of the various functions of the calculating machine during one rotation of the hand crank:

Rotation of Crank K from 0" to 360"

0"–90": Coupling of the bevel gears **of** the transmission mechanism with the register mechanism. Transfer of the tens values and preparation for carrying tens resulting from the addition of the new item to the previously registered amount.

90°–100°: Uncoupling of the bevel gears from the register mechanism. Idle return **of** the **racks,** displacement of the register mechanism to the left. Transfer of the tens carried from the previous addition.

180°–270°: Coupling of the bevel gears with the register mechanism. Transverse displacement of the multiplication body. Transmission of the unit values and preparation for carrying tens resulting from the addition.

270"–360": Uncoupling of the bevel gears from the register mechanism. Idle return of the racks and transfer of the tens carried from the previous addition. Transverse displacement of the multiplication body into its initial position.

Models

6 x 6 x 12 places with slide setting and hand operation

6 x 6 x 12 places with keyboard and hand operation

8 x 8 x 16 places with slide setting and hand operation

8 x 8 x 16 places with keyboard and hand operation

8 x 8 x 16 places with slide setting and electrical drive

8 x 8 × 16 places with keyboard and electrical drive

8 x 8 x 16 places with double counting mechanism, keyboard, hand operation, and, stand

X x 8 × 16 places with double counting mechanism, keyboard, electrical drive, and stand

10 x 10 × 20 places with slide setting and hand operation

10 × 10 × 20 places with keyboard and hand operation

10 × 10 × 20 places with slide setting and electrical drive

10 x 10 × **20** places with keyboard and electrical drive

12 × 8 × **20** places with keyboard and electrical drive

Designer: Otto Steiger (deceased) of St. Gallen, manufacturer: H. W. Egli, A. G., Zurich 2.

Monopol-Duplex (1894)

This machine developed from a construction by W. Kuttner in Burgk. Later the production passed into the hands of Woldemar Heinitz of Dresden and still later to the Dresden Control Cash and Calculating Machine Factory, **A.** G. in Dresden. In 1904 the production passed to the Bicycle Works Salzer and Company, G.m.b.H., the present name of this firm being Schubert and Salzer **A.** G. of Chemnitz.

The Monopol-Duplex machine was the first pinwheel machine that possessed tens-carry in the revolution counter, thus for the first time ensuring appearance of the correct value in the revolution counter not only in ordinary but also in shortcut multiplications and divisions.

In this machine the carriage is located above the setting mechanism, and the crank is positioned on the left side. Originally it was manufactured with 8 x 16 x 8 places and later with 6 × 12 × 7 places. The price **of** the machine was 460 marks. Production has been discontinued since 1914.

At some time Woldemar Heinitz produced an adding machine that printed the items and the totals. Depression **of** the keys sets the amount, but transmission into the counting mechanism and printing occurred by movement of the crank or by pressure upon the motor key. The machine appeared in different models, but production has long been discontinued.

Saxonia (1895)

This machine emerged indirectly from the Burkhardt Arithmometer; the owners of the Saxonia firm, Schumann and Company (Zeibig and Strassberger), had fonnerly been employed by Burkhardt for many years. It is therefore understandable that their product was rather similar to Burkhardt's. Figure 1 shows the machine in its original form having six setting slides, twelve places in the result machanism, and seven places in the revolution counter; it also has the customary setting screws below the windows. ***R*** designates a somewhat complicated and time-consuming wheel clearance that was customary at the time and had previously been employed in other stepped drum machines. Since 1901 it has been replaced by the instantaneous clearance that is now generally in use.

Figure 97 shows a later model of the machine with venetian-blind locks and collapsible side walls. This model generally agrees with the other stepped drum machines. but instead of the customary setting slides we find small levers, movable in circular arcs with easily read checking digits arranged in a straight line positioned above the levers. The setting mechanism is dust proof. Two instantaneous clearing devices are provided on the right end of the carriage, and the setting levers may also be returned to zero by an instantaneous clearance device.

Figure 98 shows another model that appeared somewhat later. This model was available in the following four sizes:

Setting mechanism	Result mechanism	Revolution counter	Weight
8 places	13 places	7 places	7.1 kg
8 places	16 places	9 places	7.5 kg
10 places	16 places	9 places	**8.4** kg
10 places	20 places	**11** places	9.0 kg

Production of this model has been discontinued.

Today's product is illustrated in figure 99. The early slide or rotatable lever-setting mechanism has been replaced by a keyboard. The machine comes in a black enameled aluminum casing with handles, and protective sheet metal box is supplied. Carriage and clearance devices remain the same as in the earlier model. The machine has eight columns of keys. **A** large, easily readable checking digit may be found above each column of keys, All keys may

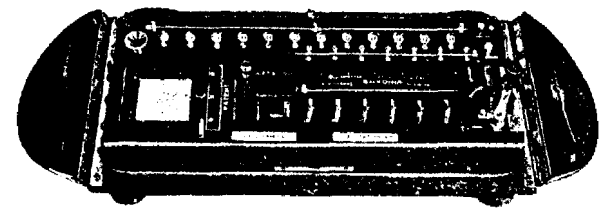

Figure 97
Saxonia.

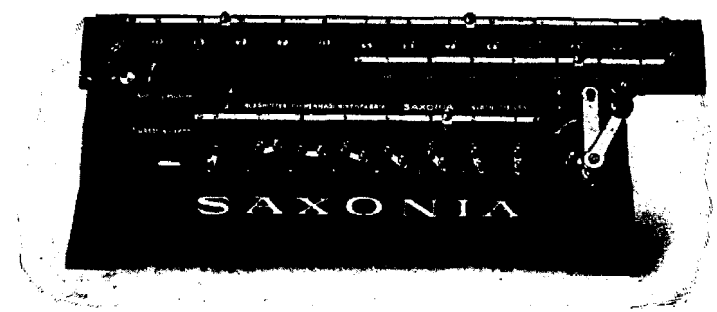

Figure 98

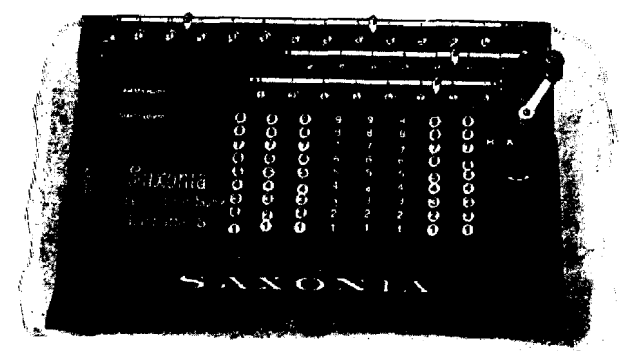

Figure 99

be set to zero by a single key on the right side of the keyboard. Every column of keys may be individually set to zero by a key located at the bottom of the keyboard. Columns of keys are colored in groups, which matenally facilitates operation. Key reversing is secured by a positive locking mechanism and the same is true for the tens-carry mechanism. This keyboard machine excels all stepped drum machines having setting slides, particularly in cases in which relatively large additions are to be carried out, because the keys may be automatically cleared by means of a lever positioned at the right side of the keyboard. At the present time this model is furnished in the following four sizes:

Setting mechanism	Result mechanism	Revolution counter	Weight
9 places	13 places	7 places	10.4 kg
9 places	16 places	9 places	10.7 kg
10 places	16 places	9 places	10.5kg
10 places	20 places	11 places	11.5 kg

It has an improved tens-carry warning device through to the last position of the carriage. In 1920 the Saxonia factory was merged with that of the Burkhardt Arithniometer. The firm that produces the machine at the present time is Vereinigte Glashutter Rechenmaschinen-Fabriken, Tachometer and Fenmechanische Werke, Glashutte Saxony.

Runge (1896)

This is an adding machine with only two rows of keys. The numbers to be entered could be classified according to their value by means of an indicator device, that is, as units, tens, hundreds, and so on up to nine decimal places. The designer was Ed. Runge of Berlin; the machine did not advance beyond the experimental stage although it permitted the entering of totals.

A. T. Ashwell (1897)

This keyed printing adding machine is based on German patents 102935 and 103099. It has (after Mehmke) obviously made use of a design from typewriters that allows one piece **of** paper to be printed with parallel rows of

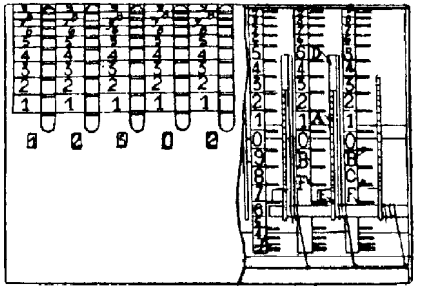

Figure 100

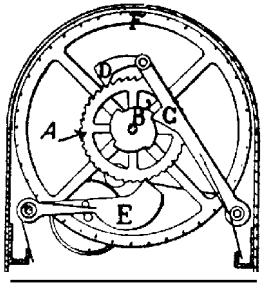

Figure 101

numerical columns without being removed from the machine. When a preset number of rows have been printed, a bell sounds.

Fossa-Mancini (1900)

This is an eight-place adding machine with stylus setting. The individual numeral wheels are printed with four groups of the digits 0 to 9. Entering of the individual values occurs in the usual way by pulling down the respective numeral wheels **of** the number to be added until encountering **a** positive **stop.** The respective sums of the entered values appear in windows in front of the machine. The last numeral wheel to the left causes a bell to sound with every quarter revolution as **a** sign that the capacity of the machine has been exceeded.

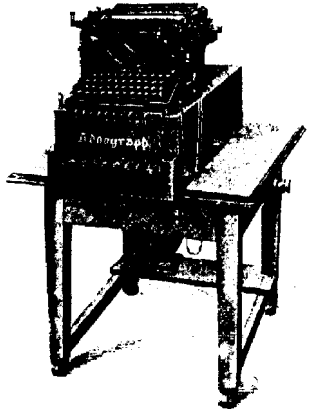

Figure 102

Addograph (1900)

A machine was brought out under this name that can transform every typewriter into a writing adding machine or an adding typewriter. It is only necessary to place the machine under the typewriter and, as soon as the numerical keys of the typewriter are used, place the adding mechanism in action. At any time the Addograph is capable of showing the result of the addition of the series of numbers entered on the typewriter. The device can also be used independently of the typewriter and, for this purpose, is easily separated from it. Of course, once separated, the entered numbers will no longer print. The apparatus cost $100 and was produced by the Addograph Co., 71 Broadway, New York. The inventor is B. M. des Jardins of Hartford, Connecticut. The Addograph was also sold out of Berlin in 1908. It never attained great significance either with us or in America, and production has long been discontinued.

Mechanical Accountant (1900)

This is an adding and subtracting machine that resembles, in appearance, the Mercantile machine but has a result mechanism and checking windows located above it. Both counting mechanisms may successively be set to zero by means of a crank. A bar. located below the lowest row of keys, and extending transversely over the whole width of the machine. serves for clearing the

lower counting mechanism, which is used as the result mechanism. The machine calculates directly, thus it is not necessary to transmit the entered amount into the result mechanism by rotation of a crank. The original model (Simplex Model) was arranged only for operation with columns, that is, several keys could be depressed simultaneously only if none of the key depressions had to accomplish a tens-carry, otherwise the tens-carry would have been lost. The Simplex model was made in two forms: one with only five keys per column, and one with nine keys per column. Machines having only five keys were based on the theory, which was tested in Germany, that it is easier to depress two keys having a small descent than one key having a large descent. Later the so-called Duplex machines appeared on the market; on these it was possible to depress several keys at the same time because the tens-carry took place sequentially. This Duplex model is made with five and nine keys per column, but it has no setting checking windows. Clearance of the result takes place by a small crank. Today the five-key design is supplied in the following models: 6 × 6 places, $125.00; 8 × 9 places, $150.00; 10 × 11 places, $175.00; and 12 × 13 places, $200.00. The nine-key design is supplied in the following models: 9 × 10 places, $175.00; 11 × 12 places, $200.00; and 13 × 14 places. $250.00.

The designer is J. A. V. Turck; manufacturers are the Mechanical Accounting Company in Providence, Rhode Island. A few machines reached Europe.

Berolina (1901)

The Berolina is one of the oldest pinwheel machines, and its main parts have been described in the introduction. Originally it was manufactured by Ernst Schuster of Berlin, SW. 68, 87 Charlotte Street. In 1923 the manufacture transferred to the German-American Metalware Manufacturing and Trading Company in Berlin, S. 42,51 Oranien Street, which marketed the machine, under Schuster's management, under the name of Damhag. After dissolution of this company, in 1924 Ernst Schuster again took over production and sales, and today his office is in Berlin, W. 57.3 Bülow Street.

The machine has nine setting levers, thirteen places in the result mechanism, and eight places in the revolution counter. The many confusing digits on the cover plate have been omitted. Carriage shift from place to place occurs by rotation of the crank. Distinctiveness and comprehensive view of the digits are the distinguishing features of the machine. The digits of the two counting mechanisms are positioned directly on the surface. A double zero-

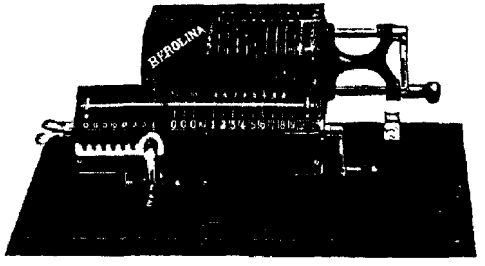

Figure 103

setting device enables the two counting mechanisms to be returned to zero by a single rotation of the crank. A locking device for the setting levers makes it impossible for the entered values to be accidentally changed, however fast a calculation is performed. A double-acting locking device prevents overthrow of the digits even during fast revolution. The tens-carry is effective to the thirteenth place. Dimensions: 7 × 23 × 40 cm, weight 11.5 kg, price approximately 400 gold marks. This firm also produces the Duplikator machine. This is the Rcrolina machine with two result mcchanisms and two revolution counters. In this machine two opposite calculations may be simultaneously carried out in the two counting mechanisms; one may add or subtract in both mechanisms or may operate one while disconnecting the other. Thus the machine is especially suited for integral calculus computations. The dimensions of the Duplikator are: 23 x 23 × 40 cm, weight is 14 kg, and the price is approximately 950 gold marks.

Calcumeter (1901)

This machine is very similar to the adding and subtracting machine known as Patent Michel Baum, however it has several disadvantages as compared with Michel Baum's machine. When entering digits larger than five, it is necessary to move the stylus in an arc of over 180 degrees; there are no means for checking whether the item to be added has been correctly entered; the machine does not have automatic clearance of all the windows, thus every dial must be individually set to zero; and the windows of the machine are positioned at the left of the digit circles between the digits 7 and 8. The machine was available with six, seven, eight, and nine places. It was manufactured in America and was imported into Germany via Hamburg in 1912 where it sold for about 100 marks. The number of sales was very small.

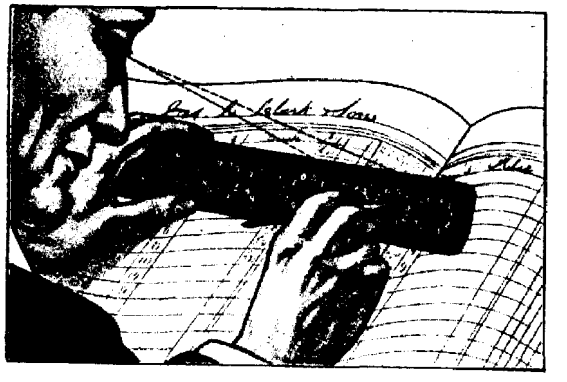

Figure 104

Dalton (1902)

Designer: Hubert Hopkins. Manufacturer: Dalton Adding Machine Company (located at first in Poplar Bluff, Missouri, now in Cincinnati, Ohio).

This is the most important of the printing, ten-key adding machines. By the end of 1906 only six machines had been manufactured, but from January 1907 they were manufactured on a large scale and, since then, have been retailed with ever growing success. From the beginning, the machine has been supplied with a double-row keyboard with 2, 4, 5, 7, and 9 in the upper row and 1, 3, 0, 6, and 8 in the bottom row. The machine is designed so that it is possible to operate it without having to look at the keyboard. Originally. the ribbon had to be moved by means of a lever on the keyboard, but later an automatic ribbon system was installed. On the first machines the side walls were made of glass and only later of metal casing. The older models were equipped with a 10-, 25-, 33-, or 46-cm-wide carriage or sliding carriage with a two-color ribbon, combined total and subtotal key, nonaddition, correction, and nonprinting keys, and dividing devices (so that this machine could print two columns and add simultaneously or else one column could be printed, added, and combined with dates, etc.)

The present so-called super model has been manufactured since the beginning of 1921 in more than 150 designs. This number is even larger if you consider that all models can be equipped with either manual or electric drive and can be completely fitted out according to the wishes of the customer. Generally, they are supplied with nine, eleven, or thirteen places; in the Little

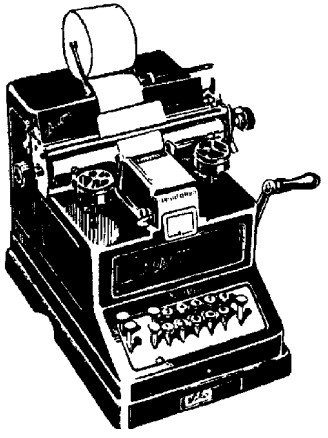

Figure 105

Giant series they are also available with six or seven places. Base, side sections, and casing weigh approximately **4** kg in this model. a considerable reduction from the 13.5kg in the older model. On the other hand, the interior mechanism is more durable since it is made of steel and is protected against rust. To specify all the models here is pointless, for they are mostly tailored for American standards. Nonetheless, the following points should be noted: the nonaddition, return, subtraction, multiplication, and repeat keys are all on the keyboard; the correction key is on the upper left; the nonprinting key is next to the right ribbon spool; the total and subtotal keys are in the front section on the right. Electrically driven machines have an activation key that looks like the spacing key of a typewriter and is also found below the keyboard. The machines are equipped with a sliding carriage for 15-, 25-, 33-, 46-, 61-, or 76-cm-wide paper and can also accommodate rolls of paper of between **5** and 25 cm. Printing is fully visible, in two colors, with automatic ribbon movement. Totals are clearly indicated by an asterisk, nonadded quantities by a ◇, subtotals by *S*, and subtraction items by –. In order to set up subtractions, it is only necessary to use the red complementary digits when entering a number and then press the subtraction key. Subtraction values are not printed. Printing such a value can only be done with the aid of the nonaddition key. All Dalton machines, except for the Little Giant, can be used for addition in two columns; that is, the printing of dates, etc. in the first column and addition in the second.

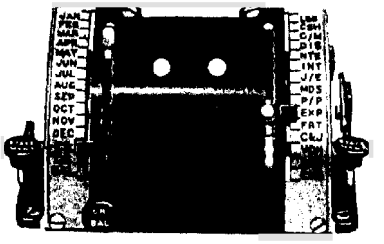

Figure 106
Double printing device

In many work situations, the printing of statements is important. **A** special printing device attached to the regular printing mechanism is used in this operation. There are single and double printing devices. The single device specifies the months, as well as the credit, debit, and balance of accounts. The double has the same symbols but, according to the wishes of the customer, can be fitted with an additional fifteen symbols—for example, symbols for interest, rebate, weight, currencies, etc. Printing these symbols is done by shifting the setting slide to the appropriate symbol, just like slide setting in the calculating machines, and pressing the printing key. Entering the value to be added is carried out in the usual way.

The basic model, although lacking a word-printing device, has in addition to the devices already mentioned adjustable column tabulators, an injector and ejector, a paper release lever, an item counter with a bell instead of a left hand platen button (so that the bottom of the paper is signaled at the right time), an adjustable paper guide, a carriage release key, a lever for spacing between the lines, and a device that makes it possible to print OR previously drawn lines.

Some of these mechanisms are superfluous for certain purposes and can be omitted. On other occasions, wider carriages are required. Thus a large number of different models are manufactured. The average machine costs **$350,** has nine-piace capacity, and has a 25-cm carriage.

The motor drive creates a certain uniformity among all the machines. Every Dalton can be driven electrically. All that is required is to switch to the electric motor, connect the electrical circuit, and set the machine up. If electric drive is no longer required, then it is always possible to use the machine manually. This is true of all models. Power on and off takes place automatically. This

prevents the possibility of having the motor running all night if the operator has forgotten to switch it off in the evening.

The eleven- and thirteen-place machines are equipped with two special additions: general release of all auxiliary keys, which may sometimes be pressed incorrectly (keys on the left of the subtotal key), and a motor release lever on the right side of the keyboard. With the aid of this lever, the motor can be disengaged so that the machine can be used with the crank and vice versa. The price of this model (thirteen place, 25-cm carriage) is **$450.** For an extra charge the following can be added: a device for continual multiplication, which prevents changes being made to the set multiplicand, and a duplex device. which allows the machine to register and add two columns next to one another.

The next model is a bookkeeping machine. It has, in addition to the devices just mentioned. the word-printing device described earlier, an adjustable paper facility (which means that if the same form is used a second time, in order to record further postings, the new digits can be brought directly under the previous ones). The machine also has an automatically advancing carriage. Tne price for a nine-place. 25-cm carriage machine is **$600**.

Another design is also for use in bookkeeping, primarily in the calculation of the daily balance of all customer accounts. The price for a nine-place, 25-cm carriage machine is **$650.**

There is a special model for monthly statements, which lists and adds up credit items with dates. subtracts debit totals from credit totals, and prints the balance. This machine is fitted with a printing device so that the items can be marked for debit, credit, and balance. Such a machine with nine places and a 25-cm carriage costs **$475.**

The Little Giant is the same Dalton but has no dividing device, no word-printing device, no automatic carriage, and is equipped on request with a two-colored ribbon, a nonprinting key, subtraction key, and nonaddition key. This model is also made with eight and seven places. The price is **$125** and up, depending on the model, i.e., according to carriage width and any specially requested features.

Finally, there is the Dalton combined with a cash register. This model obviously requires the word-printing device to specify the individual items in more detail.

All special machines can also be used as normal adding, subtracting. multiplying. and dividing machines so that they can be in daily use for every sort of activity.

In **1924** the Dalton Multiplex came onto the market. This was different from the rest of the Dalton models in that it subtracted directly and therefore did not need complementary digits. The direct subtracting machine **is,** for the present, supplied in four different designs: the normal manual model, a machine with automatic carriage return, a ledger entry model, and a bank ledger entry model. The machine not only adds and subtracts simultaneously but also adds and multiplies simultaneously.

Adix (1903)

The Adix, manufactured by the Adix Company (Pallweber and Bordt, later Adolf Bordt of Mannheim), is an adding machine with only nine keys. It was always supplied in a case. It is constructed of steel, aluminum, and brass and is composed of only **122** parts. **Its** weight, including the case, is **250** grams. Its length is 15 cm, its width is **8** cm, and its height is **2** cm, thus it may conveniently be carried in the pocket. The whole mechanism lies exposed so that the operator may clearly see the manner in which the key depression is transmitted to the counting mechanism. Addition occurs by key depression, but the machine does not permit addition of whole amounts, it merely permits additions of columns of individual digits to the extent to which they do not exceed a total sum of **999.** If calculation in one column has been completed, the operator makes a note of the last digit and registers the carryover by means of the keys. The machine sold originally for eighteen marks and the later model, which was somewhat improved, for thirty marks (figure 107).

In **1906** the Diera emerged from the Adix. **The** seven shiftable levers, positioned at the right side of the keyboard, serve merely for recording the final digits of every added column so that paper and pencil are not required in operating the Diera. Zero setting occurs automatically by depression of a lever. Dimensions: 13 × **26** cm. Weight: **1250** grams. Price: **40** marks.

The Kuli **is** a later improvement (1909). It is sturdier than its predecessors and has large keys such as may be found on typewriters. It too serves for adding columns, but after addition of a column it is only necessary to depress a special key to start with the next column of digits. The total remains in the machine up to a twelve decimal place result. Depression of a particular key shifts the module with the counting mechanism into the desired higher decimal place. The Kuli may even be used for multiplication, in fact five-digit numbers may be multiplied by six-digit numbers. Multiplication, too, occurs merely by depression of keys. Size: 23-cm wide, 10-cm deep, and 8-cm high.

Figure 107

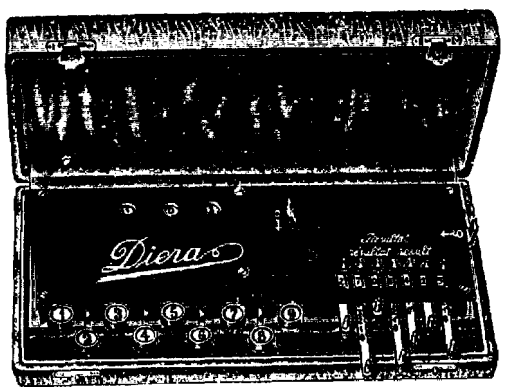

Figure 108

Weight: without case 1300 grams. Price: originally 60 marks, later 75 marks.

The production of the Adix, Diera. and Kuli has long been discontinued. The Bordt adding machine of later date emerged from these machines, and the **Bordt** machine in turn may be termed the predecessor of the Adma machine,

Wales (1903)

From the beginning the Wales was a strong rival of the Burroughs. From the outside it resembles the earlier Universal but has the advantage of visible

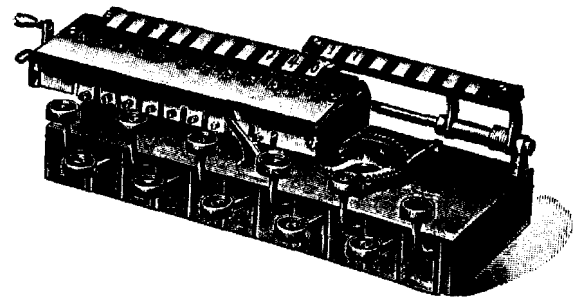

Figure 109
Kuli.

print, something not thought about much with respect to adding machines until lately. In the Wales the results are visible above the keyboard, the value entered is printed by means of the crank, and the keys then spring back to their normal position. Formerly, the Wales was produced in more than forty different models that varied according to carriage width, number of places, and auxiliary keys. Since the end of 1923 only two main types are still being made—large machines and small portable ones. Both types are made with one or two calculating mechanisms. The large machines are supplied with a fixed carriage for paper reels or with a wide, movable carriage for use in bookkeeping (the portable machines only have reels). Generally, both types are supplied with seven and nine places, but large machines are also available with more digits.

The Large Machines

These have a full keyboard with self-correcting keys grouped by color. There are also complementary digits for subtraction. The repeat, subtotal, and total keys are on the left of the keyboard; the correction, nonaddition, and nonprinting keys are above the keyboard. The machine is provided with a two-colored ribbon. The entire ribbon mechanism can be removed. Zero setting of the calculating mechanism is done by pulling the lever; at the same time the symbol *T* is printed, which is a sign that the machine is reset to zero. The first new item following this one is identified by means of a circle with a dot in the middle, a sign that can only be printed if the machine was initially set at zero. If requested, the machine can be supplied with a carriage for 33-cm or 46-cm-wide paper. The carriage moves sideways by pressing on the lever attached to the right side of the platen. The paper reel can be turned up to

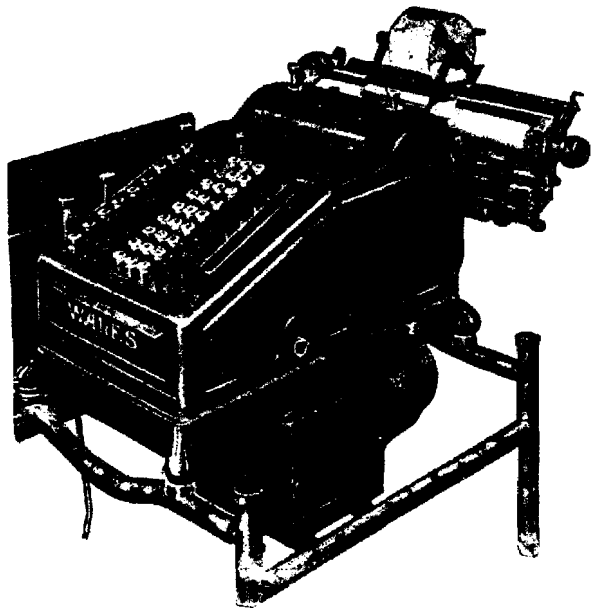

Figure 110

print on wide paper. An automatic item counter is connected to the left platen knob.

Model 20:	9 places	33-cm-wide paper	$300.00
Model 208:	9 places	paper rolls	$250.00
Model 25:	7 places	33-cm-wide paper	$225.00
Model 25B:	7 places	paper rolls	$175.00
Model 401:	11 places	33-cm-wide paper (with dividing device)	$360.00

For an extra charge. special requirement:, can be met.

The bookkeeping machine largely conforms to the model so far described except that it has two calculating mechanisms that work independently of one another and two corresponding rows of windows. One can be used for debit, the other for credit items; the items of one appear in black, the other in red. To the right of both rows of windows is a lever for turning the lower or upper calculating mechanism on or off. Debit and credit items can be combined and entered into the machine. then both kinds of values are added up respectively.

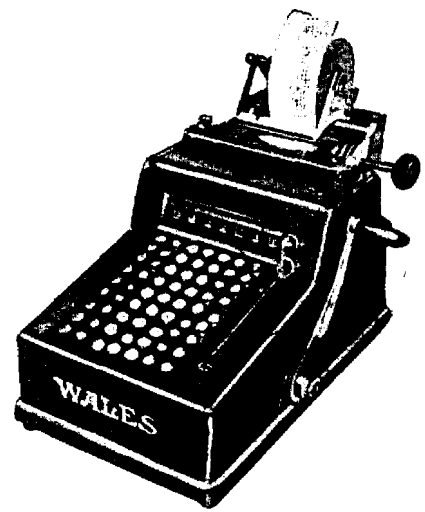

Figure 111

If the balance is to be made, then the lever on the left of the windows is pressed, and at the same time the crank is moved twice; this action prints the balance. If the left lever is pulled down, then the debit item is reduced by the credit item. If it is moved up, then the debit value is subtracted from the credit value. Keyboard and calculating mechanisms can be optionally divided between the fifth and the eleventh decimal place *so* that two columns can be simultaneously printed side by side. In addition, up to twelve symbol keys can be attached. irrespective of the number of places. These symbols are all composed of three letters and are used *to* provide annotation to the particular bookkeeping items. The bookkeeping machine has either nine or eleven places and is equipped only with electric drive. For example, an eleven-place machine with dividing device and carriage for 33-cm-wide paper costs $700. Also the bookkeeping machines can be adapted according to any individual requirements. Machines are also available for monthly statements, with six or seven places. injector and ejector, dividing device, date and repeat key, letter-printing device, etc. The price for such machines with a hand crank varies from $375 to $510.

Portable Machines

These have been available since 1921. They largely resemble the big machines but weigh less than 14 kg. They are only supplied with a paper roll

and a hand crank. Auxiliary keys are on the right side so that the left hand is always free. All portable machines are equipped with two calculating mechanisms, but they do not function the same way as in the big bookkeeping machines. When both calculating mechanisms work simultaneously, items transferred into the first calculating mechanism also appear in the second. If the total of the first calculating mechanism is printed, then the total in the second calculating mechanism is not disturbed.

Model 103:	seven places, one calculating mechanism	$185
Model 105:	seven places, two calculating mechanisms	$235

(There are also six-place machines)

Those machines with two calculating mechanisms have only one row of windows. The portable machines are also supplied with a connecting cash till and are available in both models, i.e., with one or two calculating mechanisms. In these machines, the recording rolls of paper are wound up in the interior of the machine. Nine keys can be attached to the left side of the machine to signify who registered each individual item. The total can only be made by an authorized person. Machines with two calculating devices print on two paper strips, one with particulars on purchases, the other with the total of purchases. The first paper strip, to be given to the customer, can be supplied with whatever specifications one chooses. Items that have been paid for are, with the aid of the nonaddition key, prevented from being carried over into the calculating mechanism. Such machines cost $235 with one calculating mechanism and $285 with two.

Finally, machines are also available with devices for pay envelopes. These print on the pay envelopes while they automatically fill them; at the same time they give out duplicate copies, on a counterfoil, of all work carried out.

Manufacturer: Wales Adding Machine Company, Wilkes-Barre, PA.

Graeber's Arithmometer (1903)

Designer and manufacturer: Joseph Graeber of Vienna, XVIII, Martin Street. Production was discontinued in 1905. It was a stepped drum machine in a wooden case according to the general description given in the introduction. It was available with six, eight, twelve, sixteen, and twenty places in the result mechanism. It had no unusual features.

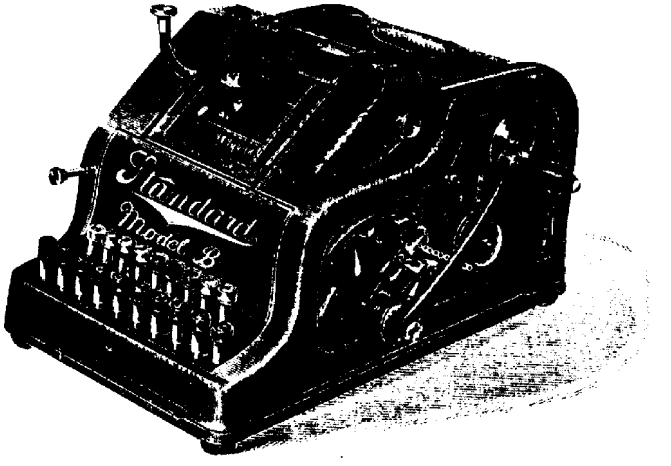

Figure 112

Standard (1903)

This is the first ten-key, visible printing adding machine to achieve wide distribution. The ten keys are in one row, underneath which are the nine tabulator keys. In order to enter a number, the corresponding tabulator key must first be pressed. If the amount to be added has five places, then first the tabulator key marked 5 is pressed; the amount is entered from left to right—for example. if the amount is 125.30, then the digits 1, 2, 5, 3, 0 are typed one after another exactly as they would be typed on a typewriter.

Originally, the machine was available in four designs:

Model B: the most frequently used adding machine.

Model B 1: with an automatic position key for adding columns of numbers with an equal number of decimal places.

Model B 2: for adding items of figures with fractions.

Model B 3: for adding figures with fractions and with automatic position key.

These models were built until 1913. There was also a model E, the details of which are lacking, and finally a model K, which was available from 1914 until only recently. The manufacturer was originally the Standard Adding Machine Company, Spring Avenue, St. Louis. This later became the New Stan-

dard Adding Machine Company, 1827 Pine St., St. Louis. The machine is no longer being built, although it can still be obtained through the Adding Machine Inspection and Sales Company, 61 Fulton Street, New York.

Originally, the machine was only supplied with narrow paper rolls. These were inside the machine and were pressed from behind against the digits as they were set up. From 1904 on, the machine was also supplied with a carriage for 30-cm-wide paper. To attach the carriage, the typewriter ribbon guide (which is automatically changed over) has to be fixed on the outside of the casing. The machine has an item counter, to prevent one from typing too far down the bottom of the page, which makes it impossible to enter more items after the counter has reached its limit (the limit being set by a pin on a small indicator). A bell rings to indicate the total should be entered. Then the indicator automatically springs back to zero so that one can start again from the beginning. This model can also be equipped with narrow paper rolls that are fixed on a holder behind the carriage and fed through the typing cylinder platen exactly as a whole sheet of paper would be. The machine always had nine places in the **setup** mechanism and ten places in the result mechanism. The price is $150 for machines with paper roll.

Triumphator (1904)

The Triumphator plant in Leipzig-Molkau provided the pinwheel machine from the very beginning with two pioneering improvements, namely:

1. A row of windows showing the amount registered by the setting levers in a straight line so that it may be conveniently checked **for** accuracy.

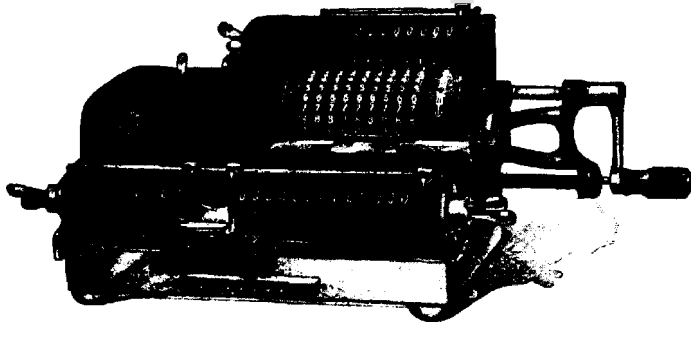

Figure 113
Triumphator, model C

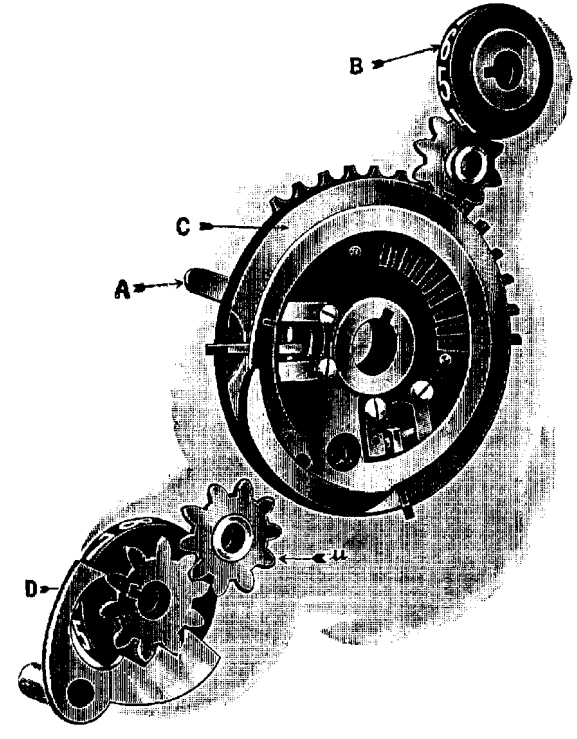

Figure 114
Cross **section of the Triumphator**

2. The tens-carry in the revolution counter, superseding the red digits that were previously employed in competitive machines, which substantially facilitates shortcut multiplication. The machines were provided with much larger and very distinct white digits. The entered digits were locked before rotation of the crank, and movement **of** the carriage occurred by depression of a tabulator key. The Triumphator machines of more recent date possess a device by means of which all setting levers may simultaneously be returned to zero position. In these machines, the carriage **is** located perpendicularly to the setting levers; thus, the lifting of the carriage will effect a zero setting.

The most important Triumphator models produced today are:

Model ***C:*** nine places in the setting mechanism, eight places in the revolution counter, thirteen places in the result mechanism, weight **8** kg, dimensions **36** × 16 × 11 cm.

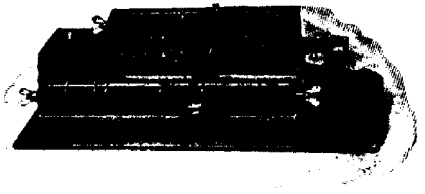

Figure 115
Duplex model

Model D: twelve places in the setting mechanism and in the revolution counter, twenty places in the result mechanism, weight 11.5 kg, dimensions 36 × 16 × 14.5 cm.

Model P: ten places in the setting mechanism and revolution counter, eighteen places in the result mechanism, but tens-carry only to the thirteenth place from the right, weight 8.5 kg, dimensions 38 × 12.5 × 12.5 cm.

Duplex Model: This model has two setting mechanisms, each for nine places; two result mechanisms, each for thirteen places; and one revolution counter with eight places. Its weight is 23 kg, dimensions 60 × 19 × 15 cm. The two counting mechanisms may operate in the same or in the opposite sense. A reversing lever controls the two setting mechanisms. Thus, this machine is capable of calculating problems such as (12,875 × 7,849)/486 = 207,933.89 with eighteen crank revolutions in one single operation.

Machines with red complement digits in the left counting mechanism, instead of tens-carry, can be made cheaper and are frequently in demand because of price considerations. For this reason the Triumphator plant furnishes a model H with an upper straight setting and a model K without such a setting. Before the war the products of the Triumphator plant were supplied in a much larger and heavier finish, which may be still obtained if especially required. In general, however, only the previously mentioned models are in demand. The prices of the Triumphator calculating machines range from 400 to 1,000 gold marks (figures 113, 114, 115).

Golden Gem (1904)

This machine is also known under the name Gancher Adding Machine but so far has not been imported into Europe. Designer: Abraham J. Gancher; manufacturer: The Automatic Adding Machine Company, 148/152 Duane Street, New York. The factory mainly sells directly to the consumer.

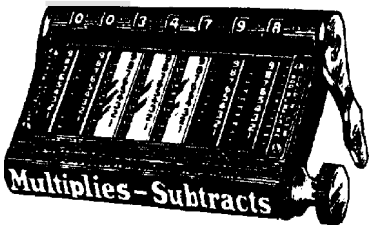

Figure 116

The links of an endless chain may be seen in each of the setting slots. Adding occurs in the customary manner by inserting a calculating stylus into the chain link of the digit to be added and pulling it down until the chain stops. This transfers the digit into the window of the respective decimal place or adds it to the digit already there. Tens-carry occurs automatically. The machine may be used for subtraction as well, but there are no complementary digits in the cheaper models. Zero setting occurs by turning the knob on the right side.

Models:

seven places, $15.00

nine places, $20.00

eight places (Model 16), $20.00, with red subtraction digits

eight places (Model 15), $20.00, without subtraction digits

seven places, $20.00, with ⅛ to ⅞

nine places, $25.00, as above

seven places, $25.00, adds feet and inches.

Model for English currency, $30.00.

The weight of the machine is about 750 grams. It is provided with a stand and its dimensions are approximately 17 × 80 × 100 mm. It is supplied with a leather case and may easily be carried around in the pocket. Previously the seven-place model was sold for $10.00.

Figure 117

Universal (1904)

This was a full-keyboard adding machine manufactured by Universal Adding Machine Company, 3823 Laclede Avenue, St. Louis. It was available as both seven and nine-place versions with the result windows above the keyboard. The printing, on the other hand, could only be seen after the carriage had been raised, just as with a covered typewriter. A pointer indicated the exact point of printing. From the beginning, the Universal had steel-type slugs so that it was strong enough to make carbon copies. The machine was the first to be supplied with a two-colored ribbon. The addition items were printed either in black or violet, and the total values in red, without any special assistance by the operator. If a wrong key was pressed in any column, it could be cancelled by pressing the red cancellation key under the respective column of keys. The electric drive could be replaced by a hand crank. In Germany, models 4 and 5 were, until recently, available for $300, and an extra $75 was charged for an electric drive.

In 1908 the production rights were transferred to the Burroughs Adding Machine Company in Detroit, but they did not continue production. It appears they wanted only to get rid of a disagreeable competitor. The Universal was the first printing-adding machine with an electric drive.

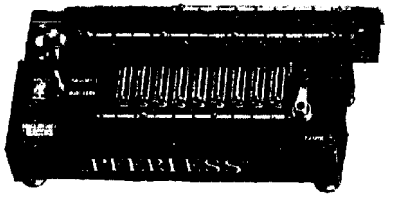

Figure 118

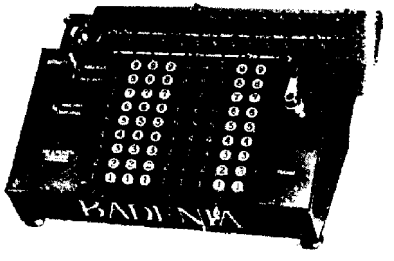

Figure 119

Peerless (1904)

The manufacturer of this stepped drum machine is Math. Bäuerle in St. Georgen in the Black Forest. Originally it was supplied in the customary wooden case, later mounted on a solid cast iron base, and more recently in a metal sheet casing. The construction has remained substantially the same since the beginning.

The amount registered by the setting slides may be read in a straight line from the setting checking mechanism located below the slots. All setting levers may be shifted to their zero position by a lever provided on the left side of the cover plate. The Badenia is a Peerless machine with a keyboard in which a mechanism provides automatic key release after every revolution during addition and subtraction. In spite of their small size, both machines have clearly readable digits. The Badenia also shows the entered amount in straight line.

Recently the factory placed the Rapid on the market. This machine is also a keyboard calculating machine with all the advantages of the Badenia, in addition, it has a new transmission device that makes it possible to accomplish multiple multiplications in every place of a quotient by a single revolution.

For small numbers a quarter revolution is sufficient, for medium ones a full revolution will suffice, and for the highest capacities one and a half revolutions are sufficient. In the case of addition and subtraction, a short depression of the crank produces the result of the operation and automatically releases the keys.

Until about 1912 the factory provided the Peerless machine (which had either motor drive or manual drive) with a special setting mechanism, located below the setting slots, for a multiplier. At that time the value corresponding to the multiplicand had to be entered by a setting crank; today a similar device is located in a straight line to the right of, and adjacent to, the key body. A special design of the exterior frame positions the three rows of windows, in every machine, at a very convenient angle of vision for the operator.

Details of the various models:

Model	Number of places	Weight	External dimensions
Badenia			
I	9 × 8 × 13	9 kg	34 x 25 x 16 cm
II	9 × 9 × 16	9½ kg	39½ x 25 x 16 cm
IIa	12 x 9 x 16	10% kg	40 x 25 x 16 cm
III	12 x 11 x 20	11½ kg	47% x 25 × 16 cm
IV	12 × 12 × 24	12½ kg	55½ × 25 × 16cm
Badenia-Rapid			
I	9 × 8 × 13	10 kg	38½ x 25 x 19cm
II	9 × 9 × 16	10½ kg	39½ × 25 × 19 cm
Peerless			
I	9 × 8 × 13	6 kg	34 x 18 × 12 cm
II	9 × 9 × 16	6% kg	39½ x 18 x 12 cm
IIa	12 x 9 x 16	7½ kg	40 x 18 x 12 cm
III	12 x 11 x 20	7½ kg	47% x 18 x 12 cm
IV	12 x 12 x 24	8 kg	55% x 18 x 12cm
Baby Peerless			
	9 × 8 × 12	5 kg	30½ × 15 × 12 cm

The Baby Peerless is a machine, fitted into a wooden frame, with setting slides; it is so small that it may justly be called the smallest stepped drum machine. Like all Bauerle's calculating machines, this machine possesses three rows of windows and is otherwise designed in the same way as the other Peerless calculating machines. The crank may be folded to permit convenient closing of the wooden lid. This may easily be carried around in a briefcase.

Previously the machine was supplied with 6 x 7 x 12 places, 8 x 9 x 16 places, and 10 × 11 × 20 places. In France it was sold under the name Calculographe.

National (1904)

The National is an adding machine that can either be connected to a typewriter or used alone. The connecting of the two machines is carried out by means of a simple lever system. At any time the machines can be separated from one another by means of a knee lever; each machine can then be used independently. The capacity of the machine is ten billion. It prints totals and subtotals in red ink. and each value is immediately visible to the eye. The machine adds not only horizontally but also vertically. It is founded upon the most essential patents of the earlier Bankers' Adding Machine, but both the National and the Bankers' did not seem to make it out of the trial period. They have never been shipped to Europe and even in America they remained relatively unknown. Production was, however, soon to be resumed.

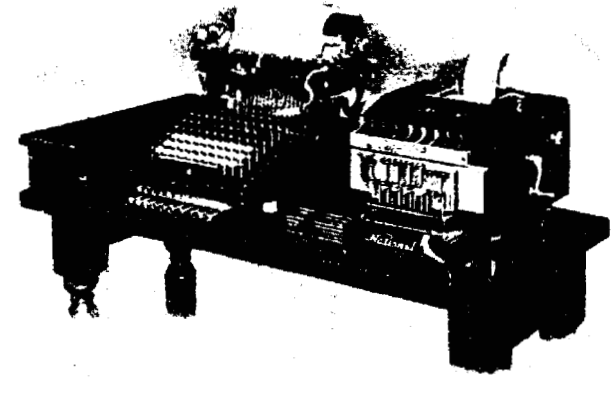

Figure 120

Figure 121

Pike (1904)

The original manufacturers were Pike Adding Machine Co., Orange, N.J. In 1909, production was transferred to the Burroughs Company. which still builds the mode1 today. In Europe the Pike attracted much attention, especially in England, Germany, and France.

The visible printing, full-keyboard adding machine is supplied with a carriage for paper 30-cm wide but can also accommodate a narrow paper roll. On the left side, above the keyboard, can be found: the repeat, nonaddition, total. and subtotal keys. The result windows are visible, and the machine has a keyboard release in columns. It is manufactured with seven, eight, nine, and ten places (see also the entry on Burroughs).

Arithmograph (1904)

An invention of John T. Howieson in New York, this is an adding and subtracting device for typewriters. The Fay-Sholes Typewriter Co. in Chicago

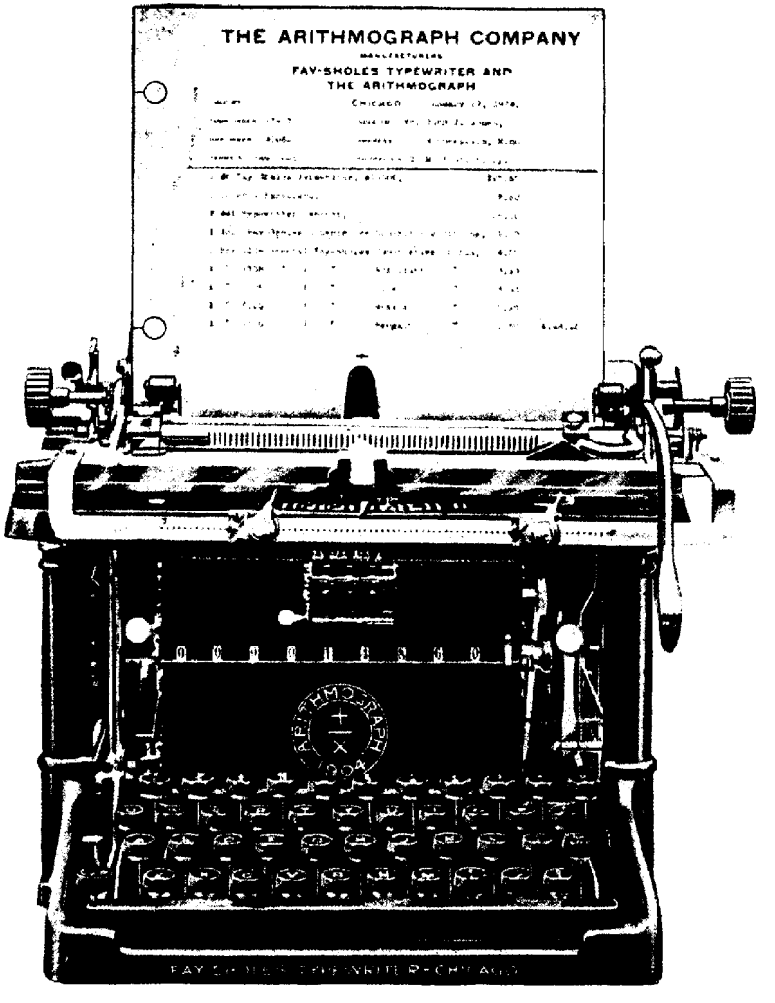

Figure 122

amalgamated with the Arithmograph Co. and introduced to the market, both in America and in **Europe,** their typewriters combined with the arithmetic device belonging to the Arithmograph Co. In Germany, for example, the calculating Fay-Sholes was sold for a price of 800 marks. But the machine was not engineered thoroughly, and there also arose a number of difficulties in the administration **of** both companies, with the result that the production of the Arithmograph, in conjunction with the Fay-Sholes typewriters, was given up in **1907.** The adding device was situated above the typing keys, and the digit keys **of** the typewriter were connected to the adding device. The typewriter could, of course, also be used without the adding device.

Mallmann (1904)

Manufacture was carried out by the Mallmann Addograph Mfg. Co., Chicago. The machine is no longer manufactured and has not been for a number of years. In fact, it has never reached Europe at all. It is a full-keyboard adding machine in the same style as the Wales except that the printing **is not** visible. It is a nine-place machine and has **a** 25-cm-wide carriage. The price is $250.

Adder (1904)

This machine was built by the Adder Machine Company in Detroit. It could be employed in combination with a typewriter. It never appeared in Europe and it remained almost unknown in America. After a few years production was discontinued.

Figurator (1905)

This machine was also known under the name Ray and was manufactured and sold by the Ray Adding Machine Company, **465** Washington Street, New York. The present address of this firm is unknown, This machine was similar to the Lightning Calculator and its price was $25.00 for a seven-place device.

Twentieth-Century Computator (1905)

The Campbell Manufacturing Company of Hackensack. New Jersey, has been

mentioned as the manufacturer of this machine. It has not been possible to determine any details of the device.

Matador (1905)

This is a single-column adding machine with setting levers from the well-known calculating machine factory Grimme, Natalis and Company, A. G. in Braunschweig. **As** compared with their other products, this machine has the following advantages: the result of individual columns of digits need not be written on paper, nor the counting mechanism set to zero, nor is it necessary to reenter the carryover because the calculating mechanism may be shifted laterally place for place (which occurs every time after a column has been added up). whereas the carryover remains in its place with the additional digits being added thereto. The weight of the machine was 9 kg and its price 150 marks, but it has not been manufactured for many years because the time **of** the single-column machines has long passed and many improved machines are available at reasonable cost.

Gauss (1905)

Designer: Christian Hamann of Berlin-Friedenau. The first model of the machine was exhibited at the Paris Exhibition in 1900, but its construction was not entirely the same as the model to be briefly described here. Plant production commenced in 1905, and the sales were handled by the mail-order house R. Raiss in Liebenwerda in Saxony.

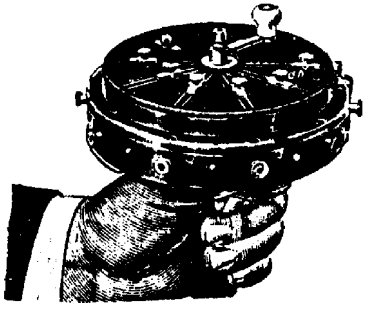

Figure 123