Gustav Tauschek's Punchcard Accounting Machines

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Abstract. *As of 1926 the Austrian inventor and pioneer of informatics Gustav Tauschek constructed the prototypes of his system of punchcard accounting machines, featuring an accounting and calculating machine, appropriate punchcards, punching machines, sorting and mixing machines and printing units. The accounting machine could be extended with additional components like a multiplication unit, a division unit, post puncher, and a device to cross-sum amounts punched on a punchcard [2].*
Despite the undoubted value and usefulness of Tauschek's inventions - many of them where adapted to be used in machines of the IBM - the name of Gustav Tauschek is barely mentioned in history books.

1.   Introduction

Abbildung 1. Gustav Tauschek (Archive of Technischen Museum Wien, Vienna)

The Austrian inventor Gustav Tauschek was born on September 10th 1899 in Vienna. As of the year 1921, when he was employed in the Austrian National Bank, he began to improve existing accounting and statistical machines. He applied for patents for these early improvements.
As of 1926 the Rheinische Metall- und Maschinenfabrik in Sömmerda (Germany), an engineering works where manually operated calculating machines were produced since 1922, decided to construct an accounting system. When they did patent search, they took notice of Gustav Tauschek and thereafter he and the Austrian engineer Engelbert Reingruber were hired. They constructed a complete system of punchcard controlled accounting machines, the SSystem Tauschek". In 1928 this branch

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of the company was spun off under the name of Rheinmetall Lochkarten GmbHänd soon bought by IBM. Since IBM was more interested in selling their own machines, the SSystem Tauschek"was never produced in series. 169 of Tauschek's patents were taken over IBM. Tauschek himself signed a five year contract and he remained in possession of his prototypes, which were brought to Vienna. Nowadays the system is in the depot of the Technisches Museum Wienïn Vienna.

In November 1930 Tauschek published the book „Die Lochkartenbuchhaltungmaschinen meines Systems" („The punchcard accounting machines of my system") as a self-publisher. In this book he described the functionality and interaction of the single machines, and he gave examples of use to show typical settings of his systems and to allow an estimation of the operating speed.

Until his death on February 14th 1945 in Zurich, Switzerland, Tauschek worked on further inventions for IBM, including the first magnetic memory in 1932, a reading machine, which can be considered as an early scanner, in 1930, an audio recording and reproducing device in 1933 and many more machines, components and solutions of detail [1].

2. „System Tauschek" in Detail

For his system, Tauschek used punchcards of his own format, which had 60 columns. Each column represented a decimal digit, where the number of punched holes was equal to the value of the digit. Additionally there was a row used as for signs or to differ between credit accounts and debet accounts. To gain a better readability for human operators a raster and column names were printed on the punchcards. Just the upper half of a punchcard was designated to be punched, the lower half provided space for a caption. The cards size was 110 x 268 mm, so a card could be labeled with a conventional typewriter or by hand. In a duplicate recording system, the punchcard was kept as original document of an entry.
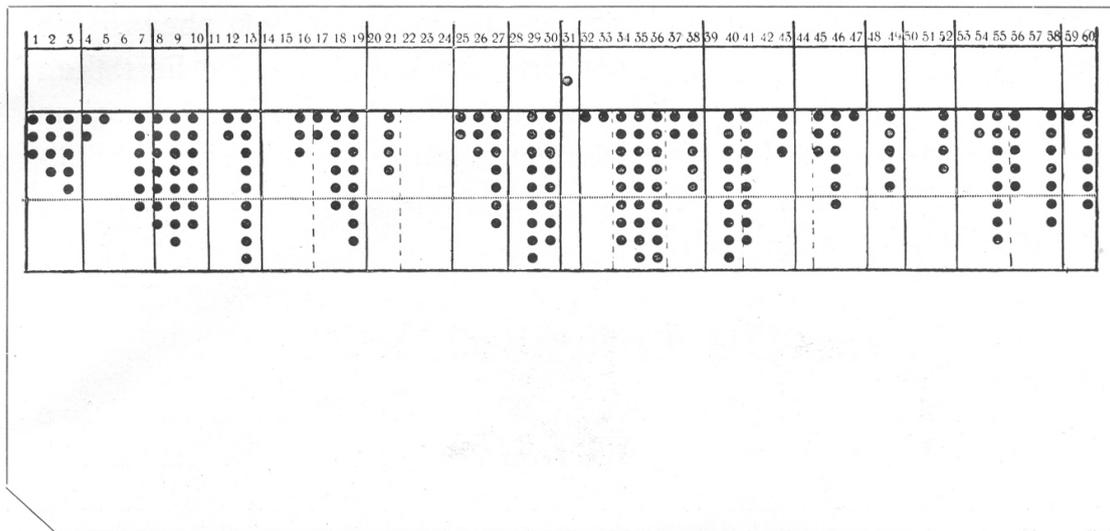

Abbildung 2. Lochkarte im System Tauschek (Quelle: [2])

For data entry Tauschek constructed a punching machine in which he paid attention to usability issues. Almost the whole punchcard in the carriage was visible to the operator, only a small part was hidden

by a matrize carrier, which contained nine punching dies. These punching dies were operated by an electro-magnetic drive, which was activated by the operator's keyboard entries. Beside the keys for the digits, the keyboard had a further key to punch the sign and two keys to move the carriage to the left or right. The carriage was moved by springs, which had to be clamped by a crank-handle.

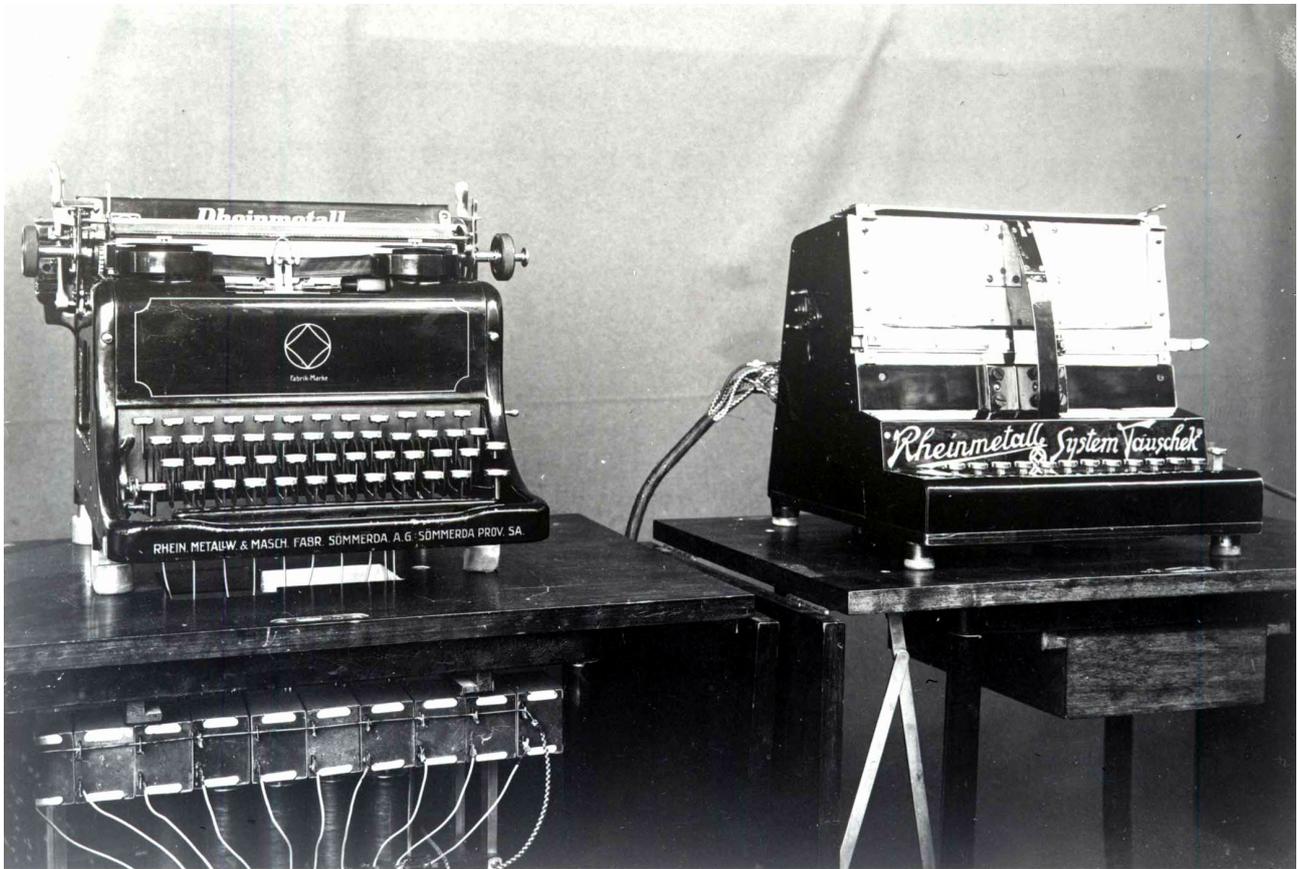External devices could be connected to the punching machine, like electro-mechanical printers to

Abbildung 3. Punching machine (right) connected to a typewriter: [2]

log the entries to the punching machine. Such logs provided benefits for checking the entries and for archival storage. Electro-mechanical typewriters were not very common those days, but Tauschek owned a patent concerning the retrofitting of mechanical typewriters. Such an upgraded typewriter could be controlled by the punching machine.

Tauschek denounced a low power consumption of approximatly 200 W. A conversant user could punch 8 digits a second, which Tauschek considered as a comparativly high operating speed.

Nearly every punchcard system had its own sorting machines, and they all worked very similar. Card by card was taken from the card batch. A sensing device read the content of a certain column by closing an electric circuit. According to the detected holes the course to a stacking tray was set.

Tauschek's sorting machine featured connector sockets for several counters, which allowed to count the number of cards in each stacking tray. The position of the sensor, and thereby the column being read could be adjusted by a crank-handle. Sorting a batch of cards by multiple columns required multiple sorting passes. Furthermore the machine was able to sort by the sign punch.

The sorting machine processed approximatly 20.000 punchcards per hour.

The complement of a sorting machine is a mixing machine, which is used to mix several batches of punchcards by given rules. With Tauschek's machine this could be done for a fixed ratio from 1:1 to 1:10 or depending on the punching of the cards. For this purpose the mixing machine featured a sensing device similar to the one in the sorting machine.

In the latter case, a card was taken from the second batch whenever the value of the sensed column changed. This was a useful feature to add empty punchcards to store results from calculations.

For a fixed mixing ratio of 1:1 Tauschek denounced an operating speed of 20.000 cards per hour.

The core of Tauschek's system was the accounting and calculation machine, which featured addition and subtraction, and was programmable via a patchbay. This machine was designed in a way, that optional components could be added to extend functionality. These optional components are described further below.

As storage elements Tauschek used electro-mechanical latches of his own patent. This latches were incremented by electrical pulses. The pulses were delivered by the sensing device, which read all columns of a punchcards in parallel. The machine was equipped with a counter of 75 latches. Considering the 60 columns of the punchcards, there were 15 digits reserved for carries. Tauschek considered the 75 decimal digits „naturally sufficient in any case." The counter could be splitted in several regions by disconnecting the carry link between to latches. Thus each punchcard could hold serveral entries.

 The sensing device, which was also patented by Tauschek, featured a contact brush which ranged over the whole width of the punchcard and a base plate, which consisted of conductive fins, which were isolated from each other. Each fin was assigned to a column of the punchcards. Commonly used sensing devices had a solid base plate and a contact brush for each column. Tauschek's device was mechanically more trustworthy, and more insensible against lateral displacement of a punchcard, which resulted in poor signal quality with common devices.

The basic functionality of the accounting and calculating machine was to increase or to decrease the the internal counter according to the values read from the punchcard. After a card was read, the result could be printed on paper with a number printer included in the back of the machine.

The card batch container and the transport unit could be removed from the machine to allow punchcards being feed manually. This was useful when the machine was used to invoice active transactions or to make original documents of transactions.

As mentioned before the machine was programmable via a patchbay, which provided a number of jacks, that had to be connected depending on the specific application. The most important elements of the patchbay were the output jacks of the sensing device, the input jacks for the machine's counter and the "group control switches". To load the value of given columns to a given region of the counter, the according output jacks of the sensing device had to be connected to the according input jacks of the counter. The 75 group control switches were used to connect or disconnect the carry link between two latches of the counter. Additionally the patchbay had jacks to program the use of storage cards and the use of the optional post puncher, and jacks and switches for other optional components.

Besides simple operability and appropriate functionality Tauschek and Reingruber's goal was to construct a compact and fast calculating machine. The prototype of the machine reached an operating speed of 4.000 punchcards per hour. The use of optional components, like the multiplication unit, which required a card to be read multiple times, reduced the speed of the machine accordingly.

Tauschek felt, that the bulk of work could be done with a simpler machine, so he built an adder, which was a pared-down version of the calculating machine. It featured a more compact sensing and transportation unit and had no built-in counter, and this required the use of an external counter. With 4.000 punchcards per hour the operating speed of the adder was as high as the speed of the calculating
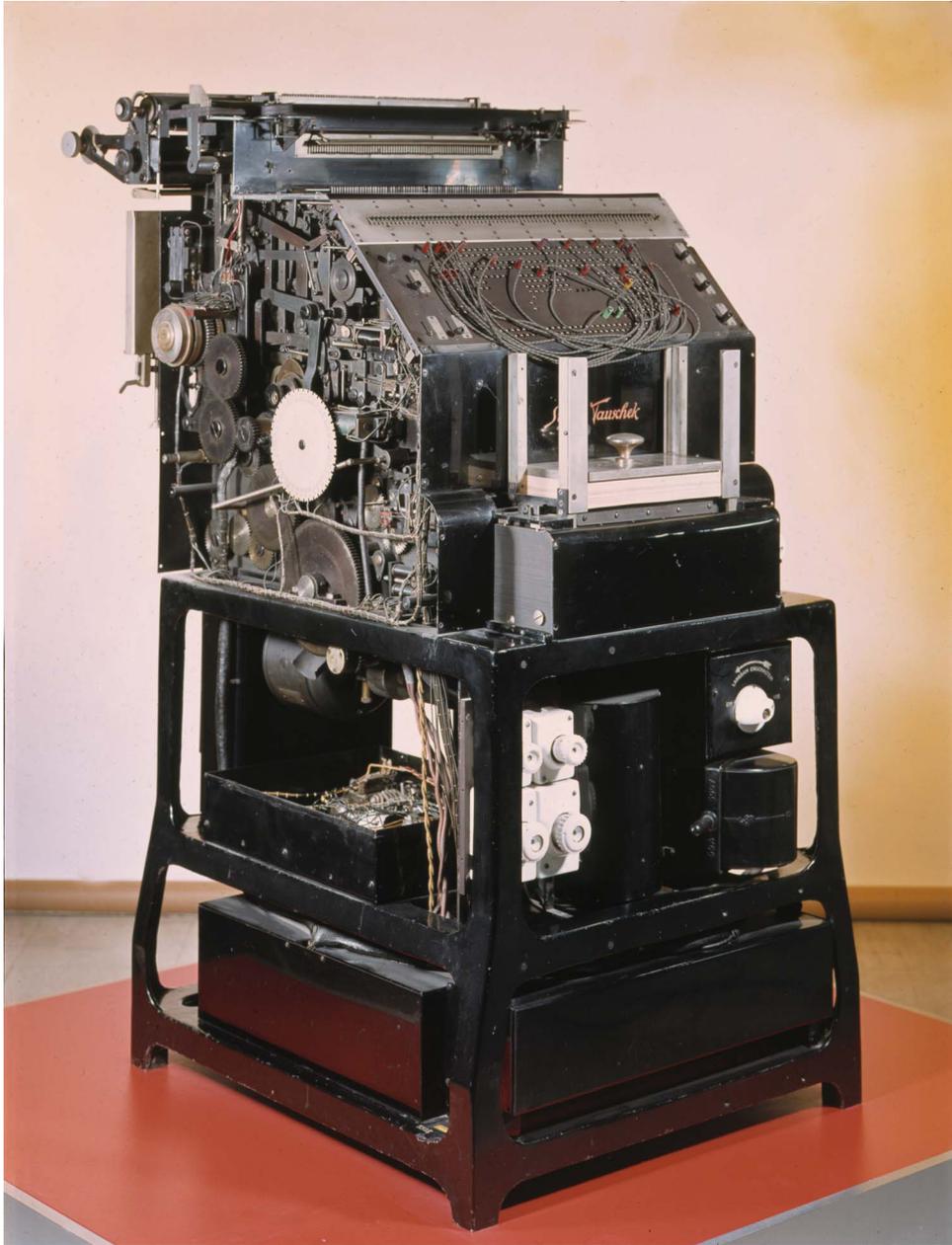
Abbildung 4. Buchhaltungs- und Rechenmaschine (Gustav Tauschek, Quelle: Archiv des Technischen Museum Wien)

machine.

To extend the functionality of the accounting and calculating machine, Tauschek developed four different optional components. These were a cross-sum device, a multiplication unit, a division unit and a post puncher.

The cross-sum device was used to add up different amounts of a single punchcard, while the calculating machine and the adder could be used to add amounts from consecutive punchcards. The patchbay had a number of jacks reserved for the cross-sum device, which had to be connected to the input jacks of the calculating machine's counter. Each summand had to be read from the punchcard separatly. If one wanted to add three amounts, the card hat to be read three times.

The operating mode of the multiplication unit was based on the principle of the multiple addition with arithmetic shift, very similar to the way multiplication is done manually. E. g. to multiply the numbers 521 and 643, the multiplication unit computed $5 * 64.300 + 2 * 6.430 + 1 * 643$. The operations of the multiplications were mapped to a corresponding number of additions. The part of the counter containing the multiplier was counted down to 0, so the multiplication required the card to be read multiple times. The number of reading operations was equal to the checksum of the multiplier.

The division unit worked analogous to the multiplication unit. The dividend was read into the counter and the (arithmetically shifted) divisor was subtracted from the dividend as often as possible. The number of subtractions was equal to the number of the currently processed digit.

The post puncher was an automatic puncher, which was used to punch values after a calculation. The main purpose was to punch calculation results onto storage cards. Further applications were a consecutive numbering of the cards or punching the same value on a batch of cards. The post puncher was restricted to 20 columns, but since it was mounted on a movable carriage, the columns to be punched were arbitrary.

Besides the number printer Tauschek constructed a printer for individual printing plates, supporting text up to 30 characters to be printed. For each processed punchcard a new printing plate was taken from a plate container and moved in front of a electro-magnetically driven hammer. After the printing process, the plate was moved to an other container. As an appliance of this printer, Tauschek suggested the making of payrolls, where the employee's name was printed next to the disbursement. An other application could be the labelling of storage cards e.g. with the words „total" or „subtotal".

For the use of the plate printer it was important to ensure that the printing plates, which had to be put into the plate container manually, were sorted in the correct order according to the order of the punchcards in the batch.

To keep certain amounts in memory, the system featured additional 8-digit counters. These counters could be connected in parallel to the calculating machine's main counter, and the amount stored in an additional counter could be read through a vision panel. In usual applications the additional counters received the same pulses as the main counter, but they could be reset independently. Since these counters were coupled electrically, they could be located in another room to monitor the system. Tauschek suggested to use them to monitor cash balances during an accounting process.

The „System Tauschek" was a compact and highly productive calculating system, which stands out because of its progammability to adapt the system for different business processes, like the duplicate recording system for accounting, and its expandability with additional components, reminding of a modern computer system with its expansion cards. Considering the form of the user interface, the system's design follows already an idea of usability. The labeling of the punchcards and the plate printer show such attempts. Gustav Tauschek not only wanted to potentiate a quick automatic accounting, but

also simplify the accountant's job.

Literatur

[1] M. Helfert, P. Mazuran, C. M. Wintersteiger *Gustav Tauschek und seine Maschinen*, Trauner Verlag Linz, 2007.

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[3] Dr. Josef Nagler *Blätter für Technik-Geschichte*, 28. Heft, Springer-Verlag Wien, 1966.