

Voices for toys – First commercial spin-offs in speech synthesis

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Abstract: When the collection of phonetic instruments of the Phonetic Institute of the Hamburg University came to the HAPS Dresden in 2005, it included also some small mechanic voices, which can produce single sounds as well as few simple words. These voices are well-known in the phonetic literature as an early attempt to provide hard-hearing people with automatic training tools, following a proposal of the otologist Johannes Kessel in 1899. On the other hand, the phonetic literature never took any notice from the real origin of these interesting pieces. Therefore the author started an investigation some years ago [1], which guided him not only to the interesting field of mechanical voices in the manufacturing of toys and dolls, but moreover back to the roots of mechanical speech synthesis at the end of the 18th century. This paper gives a rough overview about the recent state of this investigation.

1 From Kempelen to Mälzel

Apart from other reasons, the speaking machine of Wolfgang von Kempelen received its fame by a good marketing, which was mainly effected by demonstrations of Kempelen's automata throughout Europe at his journey in the years 1783/84 [2]. The Saxon major-domo Joseph Freiherr zu Racknitz reports about the presentation of the automata in Dresden 1784, that "the speaking machine aroused admiration, while the chess player also produced curiosity" [3]. In 1791, von Kempelen published his summarizing book about the speaking machine [4]. The chess player, however, was stored in the Schönbrunn castle for two decades.

After von Kempelen's death in 1804, the chess player (called "the Turk") came into the ownership of Johann Nepomuk Mälzel (1772–1838). He was a famous German musician, engineer, automata constructor, and entertainer, who is known today mainly as the eponym of the metronome. He restored Kempelen's chess player and demonstrated it together with his own constructions throughout Europe and, from 1825, in America [5].

It is not completely clear whether Mälzel also acquired a copy of the speaking machine from the estate of Kempelen. Anyhow, he came to Vienna already in 1792, where he certainly got in touch with Kempelen and his work. He was educated very well in constructing mechanical musical instruments like the famous "Panharmonicon" (1805) and instrument-playing automata like a spectacular trumpeter (1808). Therefore it appears logically, that he started to equip his automata with voices. As an instance, he presented an automatic tightrope walker, which spoke words like "Oh là là". Best known, the chess player obtained in the winter season 1819/20 the ability to pronounce the word "échec" (check) [6].

Edgar Allan Poe mentions in his famous essay on "Maelzel's Chess-Player" from 1836 [7]: "During the progress of the game, the figure now and then rolls its eyes, as if surveying the board, moves its head, and pronounces the word 'echec' (check) when necessary. [...] The making the Turk pronounce the word 'echec', is an improvement by M. Maelzel. When in possession of Baron Kempelen, the figure indicated a 'check' by rapping on the box with his right hand."

(13)

1600.

31. janvier 1824.

BREVET D'INVENTION DE CINQ ANS,

Pour une mécanique ou automate dite *poupée parlante*, qui prononce, par le jeu de ses bras, les deux mots *papa* et *maman*,

Au sieur MAELZEL (Jean), mécanicien à Paris.

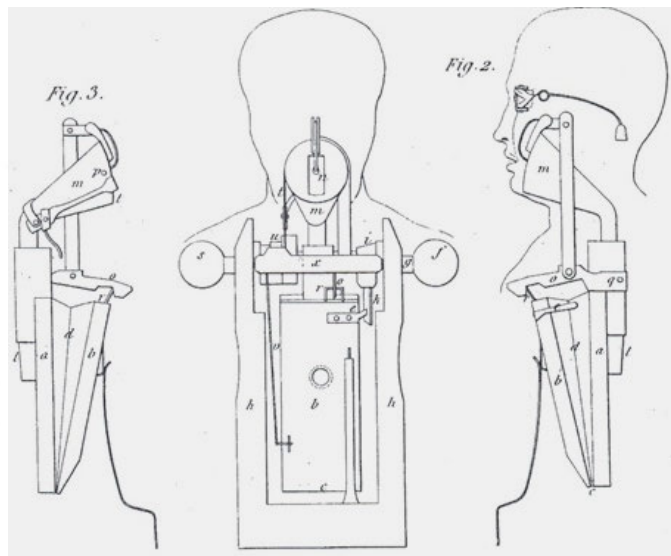


Figure 1 - Schematic presentation of the Papa/Mama voice from the patent of J. N. Mälzel [8].

2 The invention of the speaking doll in France

Before his relocation into the New World, Mälzel was mainly located in Vienna, where he was appointed to the k. k. Court Chamber Machinist in 1808. But the second center of his life was Paris, where he, for instance, established a factory for the production of metronomes in 1815 [5, p. 140].

At the French Industry Exhibition in Paris 1823, dolls had been shown which pronounced ‘Mama’, if the right hand was lifted toward the shoulder, and ‘Papa’, if this was done with the left one [5, p. 184]. The were produced by J. N. Mälzel, who received a patent for this in 1824 (Figure 1) [8].

The patent explains, that the movement of the left arm opens a bellows by means of an eccentric disk. The air from the closing bellows excites a vibrating tongue, the sound of which is modulated by a funnel-like “articulation tract” to produce the vowel *a*. The CVCV structure of the words *mama* and *papa* is simply achieved by closing the funnel twice.

Slightly different to the aforementioned description, the right arm serves mainly for switching between *mama* and *papa*. There is a small hole provided at the funnel. If it is closed, the plosive is produced, otherwise the nasal. We will find the same principle in the construction of Hugo Hölbe below. Some more details have been described and illustrated in [9, p. 325].

We do not know whether real objects from that time have survived. Later, the speaking dolls were equipped with spring drives, which enabled them to kick or to move. Two still existing examples of this type, manufactured by Jules Nicolas Steiner, Paris, in the 1860s, are shown in a catalogue from 1991 [10, no. 167/169].

We want to stress that the Mälzel patent describes the category of “pulling voices”, which means that there is a bellows, which must be opened by pulling or a comparable action. The sounds are produced when the bellows is emptied due to the pressure of a spring. There is another, simpler category, which is called “pressure voices”, where the user is pressing onto a bellows, which immediately produces a sound. This principle was applied for simple animal voices. The products, which are called “bellows animals” (Balgtiere), are also found from French producers (cf. the example in [11, ch. XIII], Figure 3 a).



Figure 2 - Exhibits from the Deutsches Spielzeugmuseum Sonneberg: (a) Speaking doll from Carl Bergner; (b) voice of a doll from Hugo Hölbe. Photographs by courtesy of Deutsches Spielzeugmuseum.

3 Voices in the manufacturing of dolls and toys in Germany

3.1 Sonneberg – the world capital of toys

Sonneberg was part of the Thuringian dukedom Sachsen-Meiningen since 1825. The town including the surrounding region formed a traditional location for manufacturing toys, mainly from wood and, following its introduction around 1805, from papier-maché. The production, which was nearly completely performed in outwork and small family-based workshops, developed rapidly over the 19th century, and Sonneberg was called the “world capital of toys” until World War I.

Of course, the invention of the speaking doll influenced the product spectrum [12, p. 232]: “The message of the speaking doll in Paris excited the toy manufacturers in Thuringia. When the first ‘täuflinge’¹ were produced in Sonneberg in 1852, the pressed hollow bodies from papier-maché were equipped with the first voices.”

Early examples of speaking dolls are generally rare. The Deutsches Spielzeugmuseum Sonneberg preserves an example of the ‘täuflinge’, shown at [13]. A second speaking doll came to the museum in 1908 (Figure 2 a). Another exhibit (Figure 2 b) demonstrates the speaking mechanism of a doll separately.

Max von Boehn (1860–1932), who was a productive writer of popular works on cultural history, reproduced a photograph of an early “jointed speaking doll” [14, p. 158]. He designates the origin as Bayerisches National-Museum, Munich, but unfortunately this statement proves to be wrong.

¹Täufling (literally: a child to be baptized) is the name of a certain type of dolls.

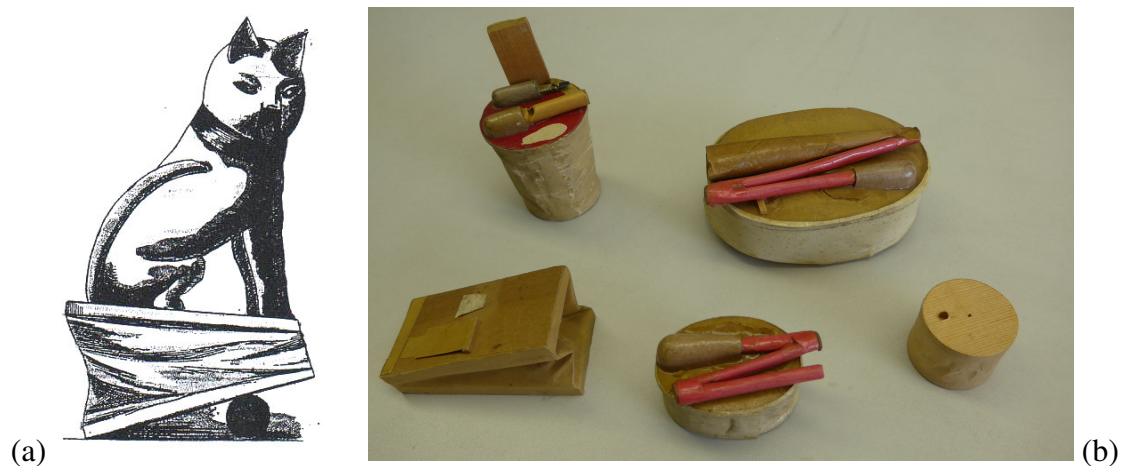


Figure 3 - Examples for pressure voices. (a) Typical construction of a “bellows animal”. Copy of an illustration in [11]. (b) Examples of pressure voices. HAPS Dresden, gift of J. and M. Cieslik.

3.2 The voices and their manufacturers

The production of the mechanical voices required special skills. There was a clear differentiation between several jobs in the manufacturing process of dolls and toys [15], and one of the professions was that of the *voice maker*.

Voice maker (Stimmenmacher) was another profession than *bellows maker* (Balgmacher). The latter produced solely pressure voices, which were mainly used in bellows animals, similar to Figure 3 a. A bellows animal was firstly mentioned in a catalogue from 1753/54, and many examples of these nice toys are shown in [16]. Pressure voices were produced in most different versions until the 20th century (Figure 3 b).

In contrast, voice makers produced also the pulling voices for dolls and animals, which were more complicated and showed high variability. Among them were also monstrous constructions for big animals in store windows and similar displays (Figure 4 a). The life of the voice makers was described in the ethnographic literature at different places, for instance [17].

It is reported in [12, p. 232], that the mechanic Hensold in Neustadt was the first manufacturer of voices for dolls in that area. However, the first voices were not articulated, and it lasted until 1857/58, when the first voices in Sonneberg were able to pronounce *Mama* and *Papa*. The modeler Christoph Motschmann from Sonneberg received a patent for a *Mama / Papa* voice from the Ministry in Meiningen on April 30, 1857, which was published in the relevant law gazette at May 6 (cited in [12, p. 201]).

The workshops of the voice makers were distributed among different places in the Sonneberg area. The most detailed examination of the structure of the working world was done for the village Judenbach [16]. Regarding the town of Sonneberg, we know eight voice makers according to the address book from 1911. The most important among them was Hugo Hölbe.

3.3 The voice maker Hugo Hölbe

Hugo Hölbe (March 25, 1844–May 24, 1931) is mentioned as a voice maker in the address books of Sonneberg from 1887 to 1911 [18]. His work forms the most extensive stock of historic voices in the Deutsches Spielzeugmuseum Sonneberg. He was since 1897 a member of the Board and the Committee of the Industrieschule, the collection of which formed the basis of the recent museum. The main part of the voices gave Hölbe to the museum as a gift [19]. Interestingly, he also donated a representative selection of five pulling and three pressure voices



Figure 4 - Pulling voices from the estate of Hugo Hölbe in the collections of the Deutsches Spielzeugmuseum Sonneberg. (a) Dieter Mehnert demonstrates two of the monstrous animal voices. (b) Voices for the vowels *a*, *e*, *i*, *o*, *u*. Photographs from a visit in February 2007.

to the Deutsches Museum Munich in 1909 [20].

Basing on the estate in the Sonneberg museum, we have a good overview on the spectrum of Hölbe's products. The predominant part of about 33 objects includes animal voices from the frog to the elephant and, of course, nearly all domestic animals. More interesting in the focus of this paper (which is still synthetic speech) is a set of voices, which can produce the vowels *a*, *e*, *i*, *o*, and *u* (Figure 4 b), the diphthong *au*, and the consonant *r*. According to the files of the museum, the pieces are manufactured around the year 1870.

Moreover, the collection includes also voices, which are able to produce small words. We know the principle from Mältzel's voice for *Papa / Mama*: When the bellows is closing, its movement does not only press the air in the "articulation tract", but controls also some mechanic parts, which, for instance, close the "mouth" of the device temporarily. From the mechanical point of view, a kind of link motion control (known in German as *Kulissensteuerung*) is implemented. Apart from the classics *Papa / Mama*, the Sonneberg collection includes voices for *Maria*, *Emma*, *Mimi*, *Anni*, and finally, as Hölbe's masterpiece, for *Hurra* (or *Hurrah*, in older German writing).

The *Hurra* voice (Figure 5 b) forms the attraction of any collection of pulling voices. The production of a clearly recognizable *r*-sound was the most essential prerequisite. This problem was solved by mounting a small flap over the end of a simple voice (Figure 5 a), which really produces a sound like the purring of a cat. Hölbe was obviously proud of his invention and registered it as protected design in 1880.

Hugo Hölbe was also holding a patent from 1883 (DRP 26 082) for a singing mechanism for dolls, where a bellows drives a kind of musical roller. In 1923, he registered a "voice for dolls and the like" as protected design (DRGM 847 182) [12, p. 121].

It is worth to mention that there was another voice maker Hölbe with the Christian name Richard. He worked in Oberlind, which is today a district of Sonneberg. He was holding several patents [12]. One of them (DRP 62 868 from 1890) comes back to the switching act between *Papa* and *Mama* in Mältzel's invention, which was performed by closing and opening a hole, respectively. Hölbe invented a self-acting mechanism, which alternately closed and opened the hole, causing the doll to switch between *Papa* and *Mama* automatically.



Figure 5 - The *Hurra* voice from Hugo Hölbe. (a) Voice for producing the consonant *r* separately. HAPS Dresden. (b) Voice for producing the word *Hurra*. HAPS Dresden, photograph by Rolf Dietzel. (c) Signature of Hölbe at the underside of the *Hurra* voice in the collection of the Deutsches Spielzeugmuseum Sonneberg. Photograph from a visit in February 2007.

4 The proposal by Johannes Kessel

The voices from Hölbe found an exceptionally application in the field of pronunciation training. Johannes Kessel (1839–1907) was an extraordinary professor of otology at the Jena university since 1886². It was an element of his tasks since 1888, to supervise the pupils of the institute for blind and deaf-and-dumb children in the neighbored residence town Weimar. Therefore, Kessel was engaged in the treatment of deaf-and-dumb people in growing extent.

In that time, deaf-and-dumb people were frequently considered as mentally deficient. Methods for improving their education were developed step by step. A big common meeting of the otologists and the deaf teachers, which took place in Munich in September 1899, can be considered as a milestone. The treatment of probands who have a certain residual of hearing capacity formed a controversial point at the meeting. It sounds very modern when Kessel pointed out in his contribution [21], that these patients need very much time for pronunciation training, which are not enough teachers are available (and payable) for. Therefore he proposed, that the patients should be equipped with automatic training tools.

Kessel demonstrated in Munich a set of mechanical voices, which included at least the vowels and the words *Mama*, *Papa*, and *Marie*. He mentioned in his contribution explicitly, that they were manufactured by Hugo Hölbe in Sonneberg. Unfortunately, we know nothing about the way, in which Kessel came in touch with Hölbe. Maybe, he bought a copy of the “speaking picture books”, which we will describe in Section 6, for one of his four children and learned about the mechanic voices in this way.

There seemed to be some understandable criticism at the conference regarding the poor quality of the synthesized speech [22]. Kessel was even ridiculed in a journal for his “shrieking dolls” [23]. More than one century later, we know that the development of synthetic speech required a long way to achieve a more or less satisfactory quality level. Nowadays, the computer-aided pronunciation training (CAPT) is one of the most emerging application fields in speech technol-

²Cf. the remark on Kessel and his detailed biography in Section 4.2 of the contribution of Hoffmann & Mehnert in this volume.

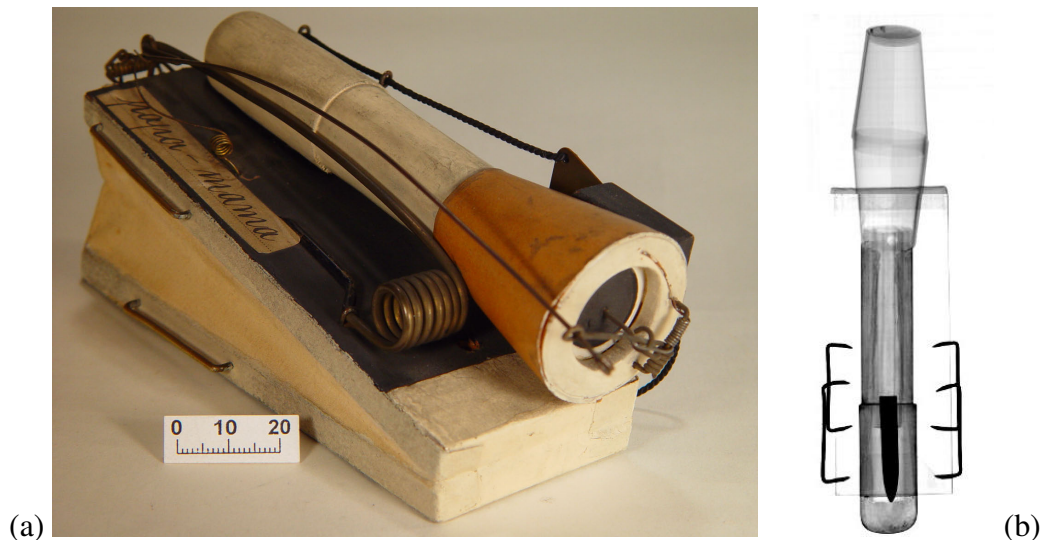


Figure 6 - Examples for the voices in the HAPS collection. (a) The voice for *Mama/Papa* with opened bellows. Photograph by Rolf Dietzel. (b) X-ray photograph (top view) of the voice for the vowel *o*.

ogy not only for second language learners, but also in rehabilitation engineering. We appreciate Kessel as a pioneer in this field, who recognized the potential of synthetic speech³.

Hermann Gutzmann sen. (1865–1922) was probably the first who recognized the importance of Kessel’s proposal. His father Albert Gutzmann (1837–1910) had joined the Munich meeting as Director of the Berlin institute for the deaf-and-dumb. Hermann Gutzmann, who was the founder of the Phonetic Laboratory of the Berlin University, inserted a reference to the voices from Kessel in the second edition of his *Speech therapy* [24].

5 The mechanical voices in the HAPS Dresden

Giulio Panconcelli-Calzia (1878–1966), the Director of the Phonetic Laboratory (later Institute) of the Hamburg University, was not only an important representative of experimental phonetics, but also author of numerous historic publications. Basing on the remark of Gutzmann, he mentioned Kessel’s voices in his historic work and expressed [25] [26, p. 48]: “The original equipment is situated in the Phonetic Laboratory in Hamburg.” When the purchase book of the laboratory was laid out in 1913, this set of “artificial voices” was already among the inventory, labeled with a value of totally 66 Reichsmark.

The hint from Gutzmann and Panconcelli-Calzia to Kessel’s voices was cited in the phonetic literature from time to time, but neither Panconcelli-Calzia nor other authors discussed the real origin of the mechanic synthesizers.

The voices came with all other exhibits from Hamburg to the historic acoustic-phonetic collection (HAPS) of the TU Dresden in 2005. The set includes ten pieces: 5 vowels, *au*, *r*, *Papa/Mama*, *Emma*, *Hurra*. Examples are shown in Figures 5 a, 5 b, 6 a and in the catalogue of the HAPS [27, p. 186]. Due to kind support of the laboratories of the department, X-ray photographs of the objects were produced (Figure 6 b).

If these voices are compared to other work from Hölbe (like that in Figure 4), there is some doubt whether they are really the originals from Kessel and Hölbe. Later on, the precision engineer Julius Ganske from Zehlendorf (today part of Berlin) offered replicas of the voices,

³Kempelen also explained in his book about the speaking machine, that the main usage might be in teaching deaf people and healing patients with wrong pronunciation [4, p. XI].



Figure 7 - The speaking picture book. (a) Cover of the German edition. (b) View of the (opened) hollow space, which contains the voices. Photographs of the copy from the 16th edition in the HAPS, Dresden.

the appearance of which is very close to that of the voices in the HAPS [28]. We simply suffer from a lack of information, whether Panconcelli-Calzia got the collection from Kessel or from Hölbe or from Ganske.

Ganske included the voices in his catalogue of devices for the experimental phonetics as “artificial vowels and words for the explanation of the effect of the vowel tract”. The set corresponds to the aforementioned, except from the *au*.

The former Hamburg, now HAPS, collection includes another set of 12 voices in a display box, which undoubtedly goes back to Hölbe [27, p. 185]. Dated on August 22, 1917, the purchase book of the Phonetic Laboratory Hamburg registers the purchase of 12 “voice mechanisms” (5 vowels, *au*, *r*, *Hurra*, *Papa*, *Marie*, *Emma*, cat voice) for 23 Reichsmark from Hugo Hölbe, Sonneberg. The inventory number is still readable and allows a unique identification.

6 The speaking picture book

The mechanical voices were applied in the first book with multimodal properties. The bookseller and publisher Theodor Brand (* 1847) from Sonneberg developed the idea for a “speaking picture book” in 1874 and received a patent for this in 1878 [29, 30].

At a first glance, the speaking book looks like a regular book in quarto size (Figure 7 a). The book block, however, turns out to be a box containing a set of pulling voices (Figure 7 b). Some book pages are mounted between the book cover and the box, showing different animals or people along with corresponding texts or poems. A knob at the long side of the box is assigned to each picture by a printed arrow. Pulling the knob activates the voice of the animal. The effect is really amusing, and the book is now a desired object for collectors.

Theodor Brand published the book in different versions over a long time. It achieved worldwide distribution, because the text pages were printed in several languages (German, English, French, Spanish). Therefore it was a big commercial success, especially at the US market [31].

The success of Brand’s book inspired more manufacturers at the begin of 20th century, therefore other designs than that from Figure 7 are also found. However, the production of speaking picture books with the complicated pulling voices remained restricted to Sonneberg and Judentbach. At the latter location, Albin Matthäi (1892–1974) should be mentioned, because he

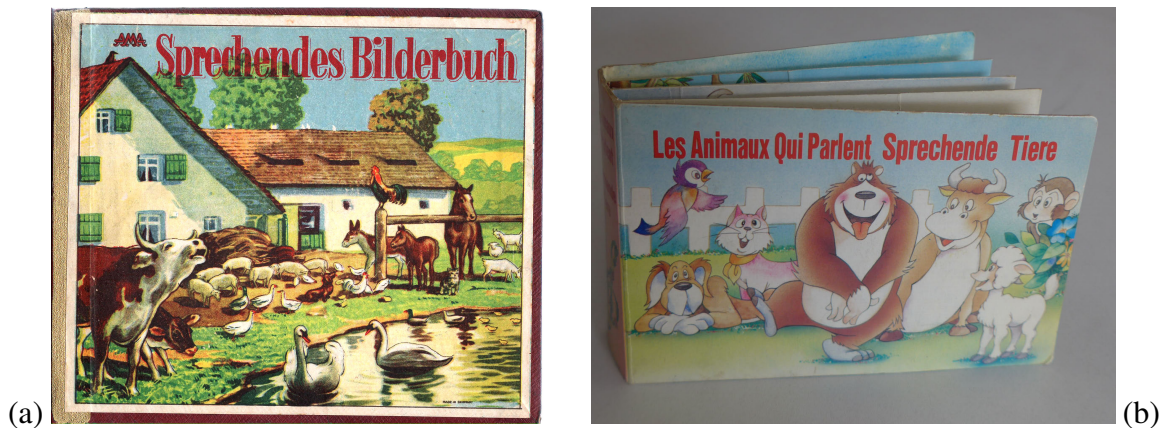


Figure 8 - Examples for the later, simplified “speaking picture books” with pressure voices. (a) Book with seven double-sided cardboards from the manufacturer AMA, Judenbach, probably 1930/40s. (b) Book with German and French text, unspecified, probably around 1960. Private collection.

introduced books with pressure voices in his company “AMA” around the year 1930. These cheaper books (Figure 8 a) were still produced after World War II in the GDR. More details can be found in [16, pp. 251–254].

Speaking picture books with pressure voices consist of several cardboards with pictures of animals. Flat special versions of pressure voices are inserted into the cardboards. The sound is produced, when the user is pressing a picture. Although the term “speaking book” was furthermore used for the product, the simple sounds have nothing to do with speech; actually it is a “screeching book”. Interestingly, the book type survived somewhere, as we learn from antiquarian offers like that in Figure 8 b. Unfortunately, these books have no imprints, but the design points to the 1960s.

7 Conclusion

We followed the development of the mechanic voices from the late Baroque until the 1960s, spanning nearly two centuries. It is interesting that the success story lasted as long, despite of the invention of the phonograph by Edison in 1877/78. Even Panconcelli-Calzia wondered about the fact, that Kessel made his proposal using the mechanic voices in 1899, when the phonograph was more than ten years old [25]! It should be also remembered, that the invention of Edison enabled the production of a new generation of speaking dolls in the US (Figure 9), which surprisingly did not win the competition to the dolls with mechanic voices. “Phonograph dolls” have also been produced in Germany [12, p. 277] and France [10, p. 161]. Later on, the application of gramophone discs for speaking dolls was more successful. They were also produced in Sonneberg [16, p. 152]. But all these inventions disappeared in the history after the introduction of electronic systems.

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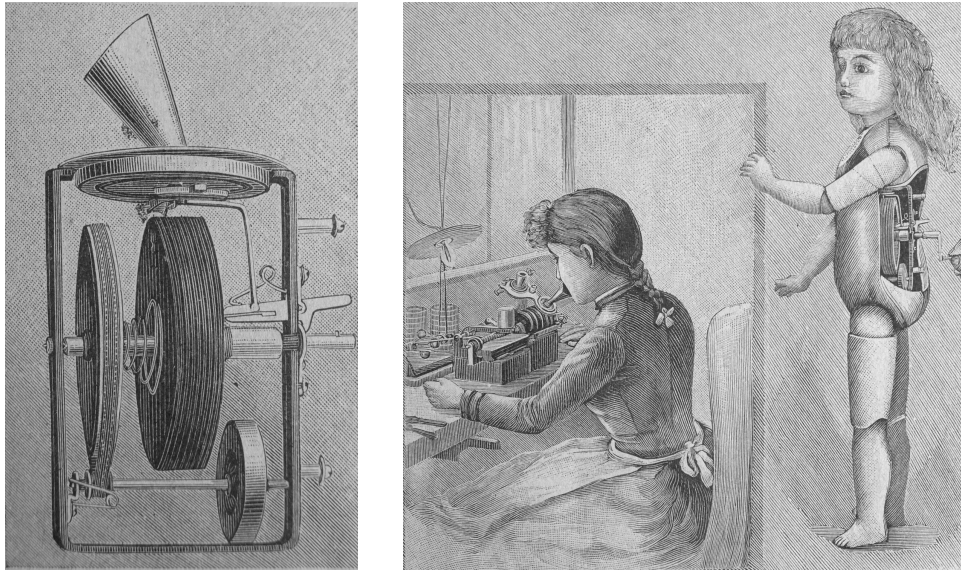


Figure 9 - Speaking doll (right) and small phonograph (left) from Edison. The central picture shows how the recording on the wax cylinders was performed. Details of a contemporary newspaper illustration.

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