Meissner's Generator of Electrical Waves: On the History of an Artifact

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***Abstract*—Alexander Meissner, an engineer at the laboratory of the Telefunken Company, prepared a patent application with regard to a 'set for generating electric oscillations' early in 1913. The history of this set, which was realized with a Lieben valve in the same year, will be investigated from its invention process over its role in the production of transmitters and receivers up to its display in the exhibits of the Deutsches Museum.**

Stories about the invention and development of feedback effects or regeneration circuits with valves have been told in different ways, mostly referring to the question of priority. Contributions of Armstrong, Meissner, Langmuir, de Forest, and others have been analyzed in this context, as well as the infringement processes, which were eventually decided – at least in the U.S.A. – in favor of Edwin H. Armstrong. However, the inclusion of national diversities in the research style, different technological and economic preconditions, various visions of the development of wireless technologies, and so on makes the stories a bit more complex and leads to new historical questions.

Tracing the history of a specific object, the Meissner generator, helps to reveal various connections and contexts and, consequently, to find similarities and differences in the development of the early wireless technologies. For instance, Meissner's background in both engineering and physics refers to the problem of research cultures which also influenced visions of the importance of continuous-wave technologies. Although there had been obvious constraints as regards the possible output of valve transmitters, engineers and scientists dealt with them differently. The competition on both economic and political levels reinforced the differences in the evaluation of the utilization of valve circuits, especially on the transmitter side. This is also applicable to the dealing with the artifacts by historians and curators. The various historical interpretations and forms of displaying a feedback amplifier will provide us with new criteria in order to reflect on our approaches and, eventually, re-evaluate the meaning of high-frequency generators.

***Index Terms*—History of artifacts, History of communications engineering, History of wireless technology.**

I. Introduction

In the receipt book of objects of the Deutsches Museum one can find the entry "1 Lieben-Röhrensender EN. 75 No 3550 mit Kondensator CV. 202 u. m. 1 Röhre 15º"'.[i] It is also noted there that the valve transmitter, together with the capacitor and the valve, was a gift of Telefunken, which arrived at the Deutsches Museum on the 28th of February 1925. 'One Lieben-valve transmitter' soon was converted by the museum staff into 'first Lieben-valve transmitter', which had been invented and produced by Alexander Meissner at the *Gesellschaft für drahtlose Telegraphie m.b.H., System 'Telefunken'* in 1913.[ii] The *Deutsches Museum for Masterpieces of Sciences and Technology* of course wanted to have the very first valve transmitter that was based on the feedback principle and had revolutionized the wireless technologies by enabling transmission and reception of wireless waves of an unanticipated quality, including the creation of radio broadcasting. That this device was of German origin was a highly welcomed side-effect.

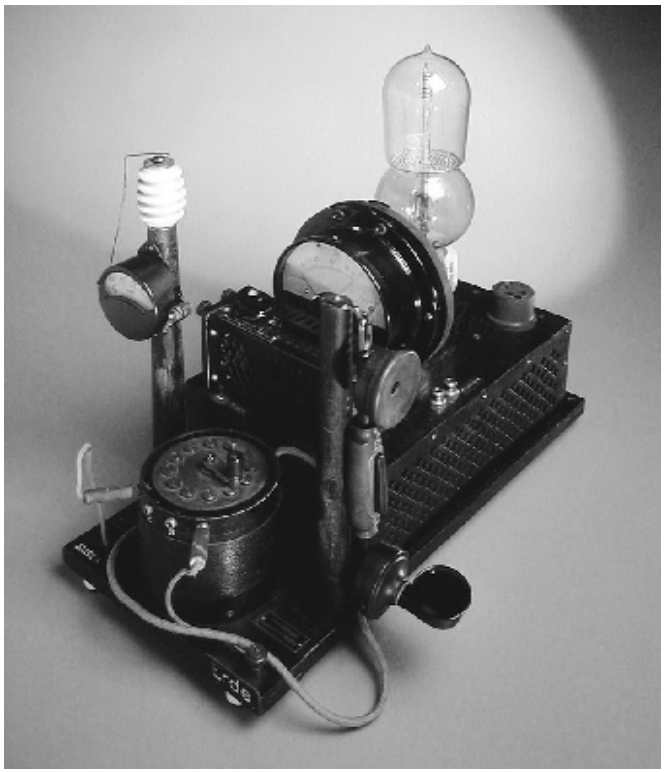

Fig. 1. Lieben-Valve transmitter, ca. 1913, at the Deutsches Museum. Photo Deutsches Museum.

The renowned Korean historian of technology Sungook Hong, who is hardly purported to be a nationalist as regards any western state, tells the story of the development of the

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feedback circuit quite differently.[iii] He speaks of the 'audion revolution' as an example of simultaneous innovation in which about six engineers from the USA, Germany, and Great Britain, respectively, were involved in the time period between 1912 and 1914: Edward Howard Armstrong, Lee de Forest, Alexander Meissner, Irving Langmuir, Fritz Lowenstein, and Henry Joseph Round. Although Hong reveals some interesting stories – such as the leading idea of a negative resistance and the contradictions in patent conflicts in which some of the above named contributors were involved – he tells stories from a US-American perspective. He hardly touches the Telefunken story, which might be due to the fact that not much of the archival material of Telefunken survived. But we still have some material sources, such as the Lieben-valve transmitter.

The aim in this short paper is to investigate what can be added to the international story, which Hong and others have researched on over the last decades. Whereby, Meissner's transmitter will be regarded as both an epistemic and a technical thing. This approach will lead us to historical questions by looking at the way in which individuals dealt with devices like this one. Additionally, we have to look at the implicit assumptions which engineers made and historians make. For instance, how can we interpret the implicit message that the Lieben-valve should have been part of the 'audion revolution'? The story of the valve as well as of the valve transmitter can contribute to answer such questions.

II. The Lieben-Valve Transmitter in the Deutsches Museum

The Deutsches Museum was founded in 1903, and provisional exhibitions were opened in different places in Munich from 1906 on. In May 1925, its own museum building could be presented to the public. This prompted some conceptual activities as to how to build up the new exhibitions. These activities were liable to the general idea of the Deutsches Museum as a place where so-called historical artifacts had to be displayed, that is artifacts which were essential parts of important 'discoveries' or 'improvements'. So the museum was especially interested in devices, which had been used in academic or industrial laboratories. This also fitted the ideology that technology has to be regarded as applied science. The curator Franz Fuchs, a physicist and specialized in electrodynamics, was responsible for the entire field of physics – including its 'applications'. In wireless technology he could build on a solid collection which had been acquired by experts in the middle of the first decade of the 20th century.[iv]

Fuchs reactivated the contact to the then leading German company in wireless technology, i.e. Telefunken, in order to get more recent devices. While starting his activities another event supported his acquisition: the first radio fair in Berlin in December 1924.[v] This fair was supposed to show the history of wireless technologies, too. The German Post Office was responsible for this part and asked the Deutsches Museum as well as Telefunken to lend some of its items. The close cooperation of these three institutions helped to both intensify and simplify the process of completing the collection of the museum at the end of 1924 and the beginning of 1925. Fuchs had the opportunity to get a guided tour through the fair and learned about the most recent aspects of wireless technology as well as about material relicts of its development. In that way he learned about the presumable existence of the first valve transmitter from Telefunken.

Fuchs asked Meissner whether he could have the original apparatus of his first feedback-circuit experiment with the Lieben valve and received the answer that it had been lost during World War I. But Meissner offered him another transmitter set of similar construction, i.e. a transmitter which could have been used for both the telephone transmission in 1913 and the heterodyne reception carried out by Telefunken in the United States in 1917. In the case that the museum would like to get some other items Meissner would also be happy to 'assemble' them. Additionally, he offered the museum the first Telefunken vacuum-valve transmitter from 1913 which, however, had to be completed because of meanwhile missing parts. The museum accepted the (nearly first) Lieben-valve and the (first) vacuum-valve transmitter with delight but decided later to ask for a demonstration model of the vacuum-valve transmitter instead of the original but incomplete transmitter. It had already prepared a display panel of the principle of the "telephony valve-transmitter with speaking on [i.e. modulating of] the grid and feedback circuit of A. Meissner" (Inv.-Nr. 52432). All these items fitted the idea of the museum to demonstrate the functioning and the possibilities of wireless telephony without going too much into details. But, at the same time, these items should make discernible the enormous amount of technological efforts in developing and producing them whereby only authentic sources were used – in contrast, for instance, to the propaganda of the media.

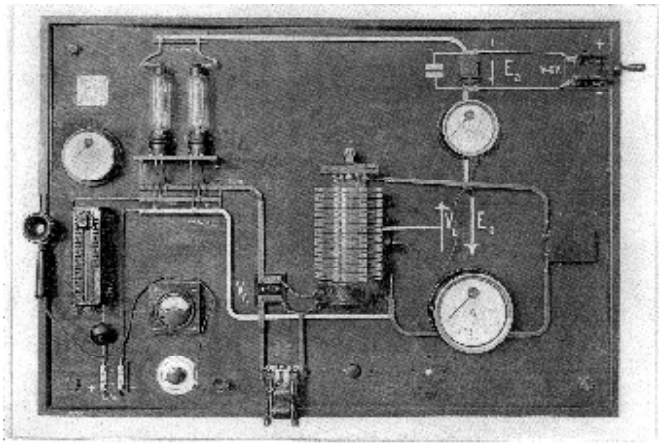

Fig. 2. Demonstration model of a valve transmitter at the Deutsches Museum, 1925. Photo Deutsches Museum.

Despite the lack of the Deutsches Museum to reflect on its being part of the media landscape this kind of ex-post historical identification of technological development refers to

an idealistic view which also neglects the propaganda work inherent in every innovation process. In other words, economic, political, and individual competition are excluded and the interpretation of the innovation process is open for either seemingly objective decisions of patent offices or for more or less conscious partisanship and chauvinism. From the dealing of the Deutsches Museum with the Meissner device it has become obvious that the usage of terms such as 'Lieben-valve transmitter', 'telephone transmitter', 'device with feedback circuit', or 'device for heterodyne reception' – leaving the indication 'first' and its contexts aside – refers to different motivations and intensions. It is interesting to see that Alexander Meissner also switches from one term to another – even in the same sentence. Although we are used to observing that engineers often change their vocabulary when they describe the same facts, especially in the dawn of new technologies, this circumstance also refers to displacements of historical meanings, which are based on a different dealing with the artifact at different times and in different contexts.

III. Meissner and the Lieben-valve wave generator

Shortly after the end of World War I, Meissner summarizes the development of valve transmitters at Telefunken and its impact on wireless technologies worldwide.[vi] He emphasizes that these transmitters not only have revolutionized the technology but also have fundamentally changed the direction of research and development in this field. Especially, these transmitters stopped the struggle between the propagandists for damped and un-damped waves, respectively. At Telefunken, this struggle had started with experiments as regards the high-frequency arc-lamp transmitter of Valdemar Poulsen in 1906 where un-damped waves had been produced for the first time. Technical, economical, and cultural reasons were brought into the discussion of how a reliable wireless system has to look in the future. When Alexander Meissner entered the Telefunken laboratory in 1907 he had to cope with the measurement of attenuation and learned from Graf von Arco, the Technical Director of Telefunken, about the advantage of continuous but still damped waves of spark transmitters. This fitted the conservative style of Graf von Arco although some of the engineers of the Telefunken laboratory were eager to test and develop alternative systems based on the generation of un-damped waves. Some of them eventually left the company.[vii]

The scene changed when the valves of Lee de Forest and Robert von Lieben had to be tested in 1910 and 1911.[viii] The laboratory staff, mostly mechanical and electrical engineers, looked at the fragile valves as unwelcome physical instruments. But with the Lieben valve – not burdened with high license fees at that time – the Telefunken management saw an economical way to invest in a modern connotated technology. It had been encouraged by the demonstration of Otto von Bronk, head of the patent department of Telefunken, early in 1911 that the de Forest valve could be used as a high-frequency amplifier. The type of valve seemed to be exchangeable, and the laboratory engineers eventually got engaged in the design of valve circuits.

Fig. 3. Alexander Meißner (* 09-14-1883 in Vienna, † 01-3-1958 in Berlin). Photo Deutsches Museum.

Meissner, an engineer with additional background in physics,[ix] soon found out that the amplifier valve could be embedded in a feedback circuit and therefore generate waves of a certain power. We do hot have much evidence of how Meissner came to his feedback circuit in detail.[x] But from his patent specification, his ex-post writings, and the general culture in research and development at the Telefunken laboratory we can draw some plausible conclusions. The first patent (DRP 291604) is entitled "Set for generating electric oscillations". It is noted there that such sets with either thermionic or vacuum valves have the advantage over any other set of generating waves that it produces un-damped oscillations of absolutely constant frequency and amplitude. Although this statement brings the patent in connection with transmitters it avoids expressing this explicitly because of the great variety of possible applications. In the second and third patent specification (DRP 290256 and DRP 290257) the circuit of the set is described as part of a receiving device which can reach a higher amplification than the HF-amplifier circuit of Otto von Bronk. The specification of the patents as

an additional patent to that of von Bronk[xi] may mainly be due to political reasons. According to von Bronk's patent the new ones refer to vacuum valves instead of Lieben valves. It is mentioned in all of these three patents from 1913 that the amplification process is not yet known in detail. This fits into the research style at Telefunken where research and development were primarily oriented towards quick results and technical experience dominated physical investigation. Meissner's additional interest in physical explanation could only be met ex post. And he very soon was aware of the fact that the Lieben valve could only be of some use on the receiver side. So already in April 1913, the construction of vacuum valves was initiated and a vacuum-valve transmitter built, and, in 1914, a special vacuum-valve laboratory erected.[xii]

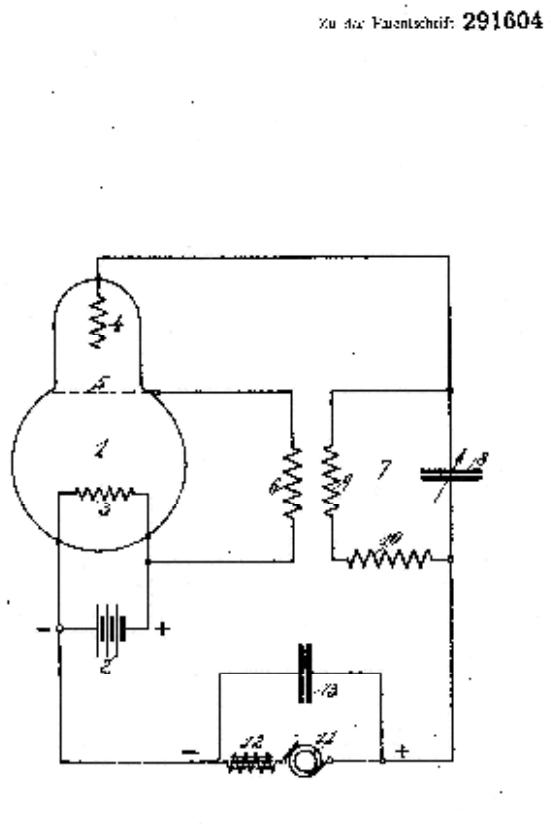

Fig. 4. Scheme in the first patent of A. Meissner, filed on the 10th of April, 1913. Photo Deutsches Museum.

Whereas the Lieben-valve transmitter was successfully tested for short-range telephony the construction of both reliable and powerful transmitter valves turned out to be a more difficult task which could be solved only in 1915. But on the receiver side the deficiencies of the Lieben valve did not seem to be too serious. Therefore Meissner as well as Charles Samuel Franklin and Henry Joseph Round from the British Marconi Company developed at the same time and based on the first Meissner patent such receivers with feedback circuits by using more efficient circuits already in the middle of 1913. The first technically and economically successful application of his wave generator, however, was the beat reception, a principle that was already known from Reginald Fessenden's patent No. 1,050,728 in 1902. Its impressive demonstration by Telefunken in the USA was to encourage an intensification of vacuum-tube research in various countries.


Bild 28. Erster Überlagerer mit Kathodenröhre (alter Liebenröhre) als Schwingungserzeuger nach Alexander Meißner, Mai 1913. Anodenspannung 220 Volt.

Fig. 5. The device without telephone set was called heterodyne device. Photo Deutsches Museum.

IV. Construction and Deconstruction of Myths

Sungook Hong tells us that the "audion redefined theory and practice in radio engineering"[xiii] although he admits to the necessity of a broader consideration of factors such as social and cultural ones. The investigation of the history of Meissner's Lieben-valve transmitter has brought us to some aspects, which could broaden Hong's interpretation by simultaneously shifting the perspective a bit. The audion as well as the Lieben-valve can in fact be considered as central artifact of the development of radio telephony and radio broadcasting. But the valves differed as technical things in some aspects. The Lieben valve was foremost and from its very beginning a telephone relay, i.e. an amplifier, which became an epistemic thing especially for material scientists in order to improve its components and therefore its reliability. This proved not to be very successful before World War I. The audion, on the other side, was first of all a detector. It became an epistemic thing foremost for electrical engineers and physicists who tried to explore the anticipated amplification effects. The similarities in the development of both valve types pertained to the question, whether an ionized gas was crucial for the desired effects, and the problem of how to integrate the valve in circuits of wireless devices.

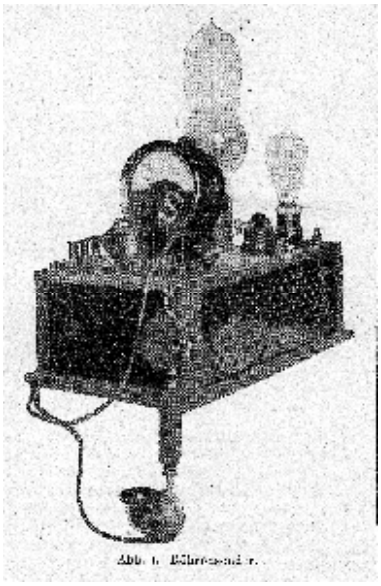

Fig. 6 Photo of the presumably first Lieben-valve transmitter in the Elektrotechnische Zeitschrift, vol. 40, 1919, p. 65.

The differences in the development after 1910 were mostly due to an alternation in the attitude towards a transmission by continuous and un-damped waves. At that time, arc-lamp, quenched-spark, and high-frequency machine transmitters were used and their technical and epistemic aspects successively elaborated, whereupon the valve – until then a more underestimated artifact – became an interesting device to deal with more intensively. Its investigation in an atmosphere of international and intranational competition tried in an eclectic manner to include all known effects, regardless whether they had been revealed in theory or practice. As Hong has shown, the feedback circuit became a vision at the Hammond laboratory, where Lowenstein worked, and an output of the in amateur radio interested student Armstrong. I may add, that it became an experimental playground for engineers at Telefunken. The propaganda of Telefunken was oriented towards different effects in the competition mentioned above. The 'generator for electric oscillations', as it was correctly noted in the patent specification, was re-interpreted after the publication ban during World War I into 'valve transmitter', intending to occupy the anticipated market for broadcasting devices. When the supremacy in the development of wireless telephony and telegraphy was in question, the demonstration of the beat reception in the USA and its consequences were emphasized. Although the variety of coupling the output of the valve to its input ranked first place during its development, the partial emphasis of a general feedback circuit was due to the wish to maintain the international reputation in engineering sciences. The leading idea of a negative resistance seems to me to be pushed a bit into the background, the patent conflicts to be a self-evident reaction to the interests of such a incoherent variety of agents.

The Lieben valve as telephone relay made it easier than the vacuum valve to concentrate on the principal engineering task of designing circuits. But only after these circuits came into being and the different dealings of the agents with the circuits became known, the circuits and their components were seen once more as an epistemic task – now on a more challenging level. This task was eventually solved by extraordinary scholars such as Irving Langmuir and their research conditions, respectively.

ENDNOTES

[i] Eingangsbuch, Deutsches Museum, 1925.

[ii] "Erster Röhrensender mit Lieben-Röhre", Inv.-Nr. 53292. This has been written on its label from the very beginning.

[iii] S. Hong, *Wireless – From Marconi's Black-Box to the Audion*. Cambridge, MA and London, 2001.

[iv] The content of this and the following chapter is documented in Deutsches Museum, Archives, VA 1845 and VA 1847.

[v] See also Habrich, "Führer durch die geschichtliche Ausstellung der Deutschen Reichspost in der großen Deutschen Funk-Ausstellung Berlin 1924", in F. M. Feldhaus and W. H. Fitze, *Geschichtszahlen der drahtlosen Telegraphie und Telephonie*, Berlin, 1925, pp. 125-154. and *Funkalmanach: offizieller Ausstellungskatalog zur Großen Deutschen Funkausstellung*. Berlin, 1924.

[vi] A. Meißner, "Über Röhrensender", in *Elektrotechnische Zeitschrift*, vol. 40, 1919, pp. 65-68 and 78-79. The same article and similar versions of it, respectively, were published in many other journals and commemorative publications, too.

[vii] For details see M. Fuchs, *Georg von Arco (1869-1940) – Ingenieur, Pazifist, Technischer Direktor von Telefunken. Eine Erfinderbiographie*. Berlin and Diepholz, 2004.

[viii] See also O. Blumtritt, *The Lieben Valve – A German "universal amplifier"*. [Online]. Available: http://www.ieee.org/portal/cms_docs_iportals/iportals/aboutus/history_center/conferences/che2004/Blumtritt.pdf

[ix] I. Ahrens, "Meißner, Alexander, Funkingenieur", in *Neue Deutsche Biographie*, vol. 16, Berlin 1990, pp. 695-697. See also A. Meißner, Curriculum vitae. undated [1908]. Technische Universität Wien, Archives, Rig.-ZL. 2/239-1901-11.

[x] See, for instance, Archives of the Deutsches Technikmuseum, AEG Archives, I No. 2386.

[xi] DRP 271059. (1911).

[xii] A. Meißner, "Der Röhrensender", in *25 Jahre Telefunken – Festschrift der Telefunken-Gesellschaft 1903-1928*. Berlin, 1928, pp. 63-72. O. v. Bronk, "Telefunkens Patentbesitz", in *Ibid.*, pp. 103-113. H. Rukop, "Die Telefunkenröhren und ihre Geschichte", in *Ibid.*, pp. 114-145.

[xiii] S. Hong, *Wireless – From Marconi's Black-Box to the Audion*. Cambridge, MA and London, 2001, pp. 191-192.

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