Digitisation of the Collection
Armando Leça:
A contribution to the history of magnetic recording in the field between 1939-40

Nadja Wallaszkovits
with contributions by Friedrich Engel, Gerhard Kuper

135th AES Convention New York, 2013
History of Field Recording Technology:
A (very) short summary
Jesse Walter Fewkes: Passamaquoddy Cylinder Collection, March 1890

Frances Densmore recording Mountain Chief, 1916
Cylinder Recordings

- Disadvantages: every replay – loss of signal quality
- In the very early days: no possibility of copying without dramatic loss of quality of the original as well as of the copy (mechanical coupling of the replay and recording styli by use of a pantograph)
Acoustical Recordings on Discs

• Disadvantages: heavy weight

• Recording pickups for Berliner grammophone were not available at the market

• Both systems: had to be positioned absolutely even, otherwise cutting errors, speed errors, etc.
Wiener Archivphonograph type V, original, metal negative and copy

Rudolf Pöch, Baifa men, Kalahari 1906
Archivphonograph type III
Electrical Recordings on Discs

- Neumann disc cutting machine
- Portable version for instantaneous discs
Alternative Systems...

Philips-Miller recording system, mix of mechanical recording and optical reading

Expensive, not usable in the field
Disadvantages:

• Short recording time (up to ~ 4min)

• Both systems: had to be positioned absolutely even and vibration-free, otherwise cutting errors, speed errors, etc…

• Wax media could only be replayed very few times, otherwise loss of signal quality
• Mechanical recording was the dominating recording technology in the field between 1890 and the middle of the 1930’s

• Alternative system of **magnetic recording** needed nearly 50 years to be established…
• 10 years later published in a well known journal

...without reflection...

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THE ELECTRICAL WORLD.

Some Possible Forms of Phonograph.

BY OBERLIN SMITH.

There being nowadays throughout the scientific world great activity of thought regarding listening and talking machines, the reader of THE ELECTRICAL WORLD may be interested in a description of two of the possible methods of making a phonograph, which the writer contrived some years ago, but which were laid aside and never brought to completion for want of press of other work.

One of these methods is rudely shown in Figs. 1, 2 and 3, the construction and operation being as follows: A is a brass mouth piece and diaphragm, with spring and indenting...
…needed another 10 years (1898/1902) to be realized by Valdemar Poulsen and his employees:

• Magnetic recording was described on media as wire, steel tape, and even....
… for discs!

Magnetic hard disc, preferred storage medium until now, is an invention of the year 1903!
Disadvantage of the early magnetic recording systems:

- Very low playback level due to lack of (affordable) amplifiers
- This situation changed substantially with the extension of radio broadcasting
• 1929 Curt Stille: steel tape recorder

• Financed by his partner Ludwig Blattner, who handed over the property rights to British Marconi Wireless Telegraph Co.Ltd
• 1932 steel tape recording was first introduced by BBC, later by radio stations in Europe, Canada and Australia
• In use until 1950’s

Marconi MSR 3
weight: 450 kg
DEUTSCHES REICH

AUSGEgeben AM
26. JUNI 1930

REICHSPATENTAMT

PATENTSCHRIFT

№ 500 900

KLASSE 42g GRUPIE 17

P 57028 IX/42g

Tag der Bekanntmachung über die Erteilung des Patents: 5. Juni 1930

Fritz Pfleumer in Dresden

Lautschriftträger

Patentiert im Deutschen Reiche vom 31. Januar 1928 ab

Phot. Ströhla
1933
1935
Microphone -> Magnetophon K 2, 1936
The Collection Armando Leça, recorded Nov. 1939- April 1940, AEG Magnetophon K4 Serial nr. 1260
Armando Leça
1893-1977
Overview: magnetic tape recording in the field

<table>
<thead>
<tr>
<th>Year</th>
<th>Person/Location</th>
<th>Device</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1936</td>
<td>Wolfgang Sichardt, Switzerland</td>
<td>Magnetophon K2</td>
<td></td>
</tr>
<tr>
<td>1939</td>
<td>Leandro Mazzoni, Albania</td>
<td>Magnetophon K6</td>
<td></td>
</tr>
<tr>
<td>1939/40</td>
<td>Armando Leça, Portugal</td>
<td>Magnetophon K4</td>
<td>(ser. Nr. 1260)</td>
</tr>
<tr>
<td>1940/43</td>
<td>Alfred Quellmalz, Southern Tyrolia</td>
<td>Magnetophon K4</td>
<td>(ser. Nr. 1297)</td>
</tr>
</tbody>
</table>
1939

Magnetophon Koffergerät
Modell K4
Recording equalization circuit
Playback equalization circuit
Two men are shown carrying suitcases. One man carries a suitcase weighing 20 kg and a briefcase weighing 15 kg, totaling 35 kg. The other man carries a suitcase weighing 57 kg. The diagram illustrates the weight distribution.
AEG K4 “special”, Ser.Nr. 3020
1946 designed for German national postal authority “Deutsche Reichspost”, later brought to San Francisco in 1947/48 by Jack Mullin
Why does it sound as it sounds?
Armando Leças machine – a prototype
Schüller-Müller-Ernesti erase head
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Digitisation:
The tapes
Preexamination of the Collection

Preservation status - physical condition

• 62 tapes
• 30 cm diameter pancakes on flangeless 70 mm hubs
Preexamination of the Collection

Preservation status - physical condition

Several types of splices:

• historical splices using liquid glue, overlapping layers, originating from manufacturing process or from editing process at time of recording
• historical splices using splicing tape
• modern splices using splicing tape, originating from repairing broken tape parts
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Splices using liquid glue before and after carrier restoration
Carrier restoration

- Physical carrier restoration
  - Repair bad/ bleeding splices – remove old adhesives, clean tape from splice residues with highly purified light fuel
  - Add leader tape - only if necessary for complete signal retrieval
  - Restore tape pack to flat wind – often very difficult with brittle acetate tape
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Preexamination of the Collection

Preservation status - chemical condition

Basically good!

- Deformation (form of eaves gutter)
- Spoking
- Brittleness
- Corrosion due to water influence
Preexamination of the Collection

Preservation status - chemical condition

• Instability of cellulose acetate

Historic tapes with a substrate or binder of acetate (produced until sixties):

• Different elongation and stretching properties of the components
• Hygroscopic
• Vinegar syndrome \(\Rightarrow\) brittleness, deformation, cracks, disruption, crimps and ripples
Chemical carrier restoration

Recently developed by the Phonogrammarchiv::

permanent refreshment of highly deteriorated acetate tapes
Before....  

...and after treatment
Removal of storage related artefacts, e.g. print through...
Preexamination of the Collection

Replay parameters

Basically pre-standardisation
• Recording format: mono full track
• Tape width: 6.5 mm
• Recording speed: 77 cm/s
• Tapes B wind (Schicht aussen)
• Equalisation: can be assumed to correspond with IEC I (35 µs)
• Digitisation resolution: 192 kHz/24 Bit
Preexamination of the Collection

Choice of replay track format

Mono full track or studio stereo „butterfly“ head?
Preexamination of the Collection

Choice of replay track format

Mono full track head:
- Advantage: 100% congruent trackwidth, slightly better S/N ratio

Butterfly head:
- Accurate basis adjustment of azimuth can be reached by using analysis tools (not only the ears…)
- Possible advantages for future digital restoration of dynamic azimuth deviations, that cannot be corrected manually
- Acetate tapes: vertical parts break off the tape, sometimes over a longer part
- Manufacturing tolerances concerning the properties of the magnetic layer can change within the width of the tape – level differences between upper and lower edge of the tape

Advantages for further restoration
Playback parameters

- tape speed is very often not easy to determine a priori (e.g. unknown machine, irregularities, etc…)

- helpful analyses:
  - listening to the audio contents, identify signals
  - analysis of the hum of the power supply – sometimes problematic
  - analysis of the high frequency bias signal – not possible (DC biasing)
• Erasing artefacts
• Distortions
• Wet glues
Original photographs, documenting various recording situations
MANY THANKS TO:

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Dr. Gerhard Kuper, Wedel, Germany,  
formerly head of basic engineering for AEG,  
for providing several pictures of the machines and the magnetic heads

Their comprehensive and absolutely fabulous encyclopedia of magnetic  
tape development is also available as e-book from  
www.beam-ebooks.de/ebook/40085/1
and

**Eduardo Leite**, Portuguese Radio *Emissora Nacional Portuguesa*,

for providing photos of Armando Leças tape recorder

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**THANK YOU FOR YOUR ATTENTION!**

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http://www.phonogrammarchiv.at/

http://www.jazzpoparkisto.net/audio

http://www.iasaweb.org