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AUTOMOTIVE BATTERY, A HISTORIOGRAPHY FROM PATENTS

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1.INTRODUCTION

To think of history is to reflect on structuring models of a multidimensional analysis, sometimes opening a comprehensive outcome and enabling the emergence of a pattern or even patterns, with which we can illuminate a cohesive narrative,

> The new economic and social history places cyclical oscillation at the forefront of its research, and rests on its duration: it has linked itself to the mirage, and also to the reality of cyclical rises and falls in prices. There is, now, alongside the narrative (or the traditional "recitative"), a recitation of the conjuncture that focuses on the past over long periods: ten, twenty or fifty years. (BRAUDEL, 1965, p.263)

A long duration, conceptualized by Fernand Braudel, french historian, can be applied in the present work in an effort to draw, from a specific object, the electric vehicle, showing a path of technological correlations, oscillations and a material arrangement routed, nourishing itself in social arrangements, economic and with an unpredictable hint of the observed history.

The 20th century is the temporal clipping that glimpses unique transformations, or even expressions that were already taking body previous centuries. The century that produces great names, movements of western proportions and an absurd development in small spaces of time. The vehicle powered by the charging of electric batteries, is not an ambition protected to the present 21th century, with this study we can show that at least since the beginning of the last century was thought of vehicles powered by electricity. Historian Edward Hallett Carr draws attention to a less empirical side of the historicity of events, "Facts speak only when the historian addresses them: it is he who decides what facts come to the scene and in what order or context." (E.H. CARR), in this sense, mass data, such as battery patents and electric vehicles, recorded over the years, are documentary facts that only begin to speak from some approach. So, using Johann Gustav Droysen words, one of the most important German historians of the nineteenth century,

> However, in awakening the perspective that the arts, the formation of the law, in addition to each human creation and all the configurations of the moral world, can be historically researched so that one understands what it is from the process of transformation [...]. (DROYSEN, 1868, p.44)

This thought legitimate our use from patentes as history documents, therefore, our use to sugest history contexts and explanation answers. To make such reference to alternative history sources, we would like to introduce a brief look into the beginning of the century XX, with a classical Portuguese literature. Eça de Queirós (1845-1900), started writting “City and the Sierras” before 1900, bud than he died and just in 1901, when his friend Ramalho Ortigão took the manuscripts to organize, it was published.

> But inside the peristyle, I was soon struck by an elevator installed by Jacinto-though it was only two stories high, and connected by a staircase so sweet that it had never offended D. Angelina's asthma! Spacious, taped, he offered, for that seven-day journey, numerous

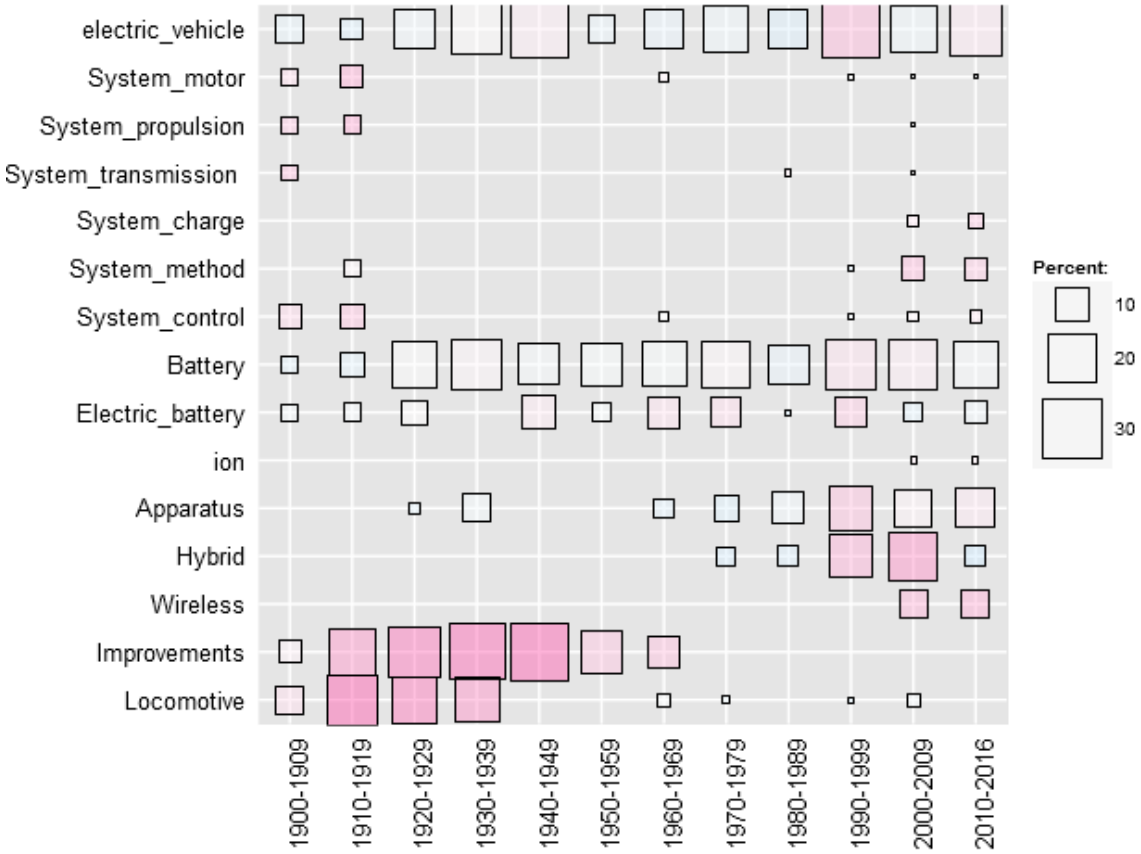
> comforts, a couch, a bear's skin, a Paris street script, barred shelves with cigars and books. [...] A servant, more attentive to the thermometer than a pilot with the needle, regulated the golden mouth of the calourífero loosely. [...].
>
> I murmured in the depths of my haunted being:
>
> - This is Civilization!
>
> City and the Sierras, by Eça de Queirós

2.METHOD

When questioning the historical route of the electric vehicle, recalling the informational, bibliographic and quantitative capacity of the patents (Golembiewski, Stein, Sick, & Wiemhofer, 2015). With a search cataloged patents under the Patents Google database, we started the analysis categories, supporting all data capture in two CPCs (Cooperative Patent Classification): B60L and Y02T10.7005. The first refers to the "Electrical equipment or propulsion of electric propulsion vehicles, magnetic suspension or vehicle levitation; Electrodynamic brake systems for vehicles in general "(CPC B60L); Already the second one is protected to all idea of "Batteries". From the beginning of the collection of information, the most relevant patents were prioritized in order of citation, so we obtained a list of most relevant patents in chronological order separated in decades, beginning the count in the year 1900. The chronology was used to organize All this information in the temporal dimension, and also the categorization (already included in the data collection) of patents by family order, that is, patents identified to a given region by priority publication date, enabling us to have a spatial dimension along years.

Once, with all patent titles organized in spreadsheets from decade to decade from 1900 to 2016, we realized the potency that a semantic analysis could give to thinking rational and imaginary prevailing in certain time frames. With the help of a free software of network analysis, the KHCoder[i], we try to codify and treat this mass of data, remembering the quotation of E. H. Carr from the introduction, the facts only talk with the historians when they are approached by them, and this analysis had been chosen so that we could understand what the facts (patents) as documentary sources were able to tell us. The aim of this project is to think through a longitudinal perspective of the object, through this perspective, the Kh coder software helped us to build a matrix with the titles of patents, relating frequency of words per decade. With excel set-counting tools and word markers that appeared in the immediate first twenty placements, we were able to gradually build an efficient word-coding that would evidence paths, and in a cross-view, be endowed with narratives. To illustrate the process discussed here, note the longitudinal tabulation at the bottom (figure 1).

Figure 1 - Crosstab frequency-term



With this *Crosstab* constructs identified that permeate the decades and show rational economy and market, and highlight moves that reflect the historical imagination of each period. Let us take as a reference the construct "Battery", which by the theme of this work would be expected to be a constant presence, nevertheless, it is an electric battery concept emerging from filters B60L and Y02T10.7005, which remains active throughout the 20th century and still make presence in the 21st century. As we begin the historical view, we see this concept more closely.

For now, we may consider us to the constructs of the *Crosstab*. Each term carries a code condition, such as "System_motor" is counted each time the words "system" and "motor" appear close to each other, so that all compound terms under analysis are coded by proximity because the count is made by paragraphs and each paragraph is a patent title, so it is possible to say that the study is also done at the level of semantic analysis by syntactic relations, and these in turn mean something.

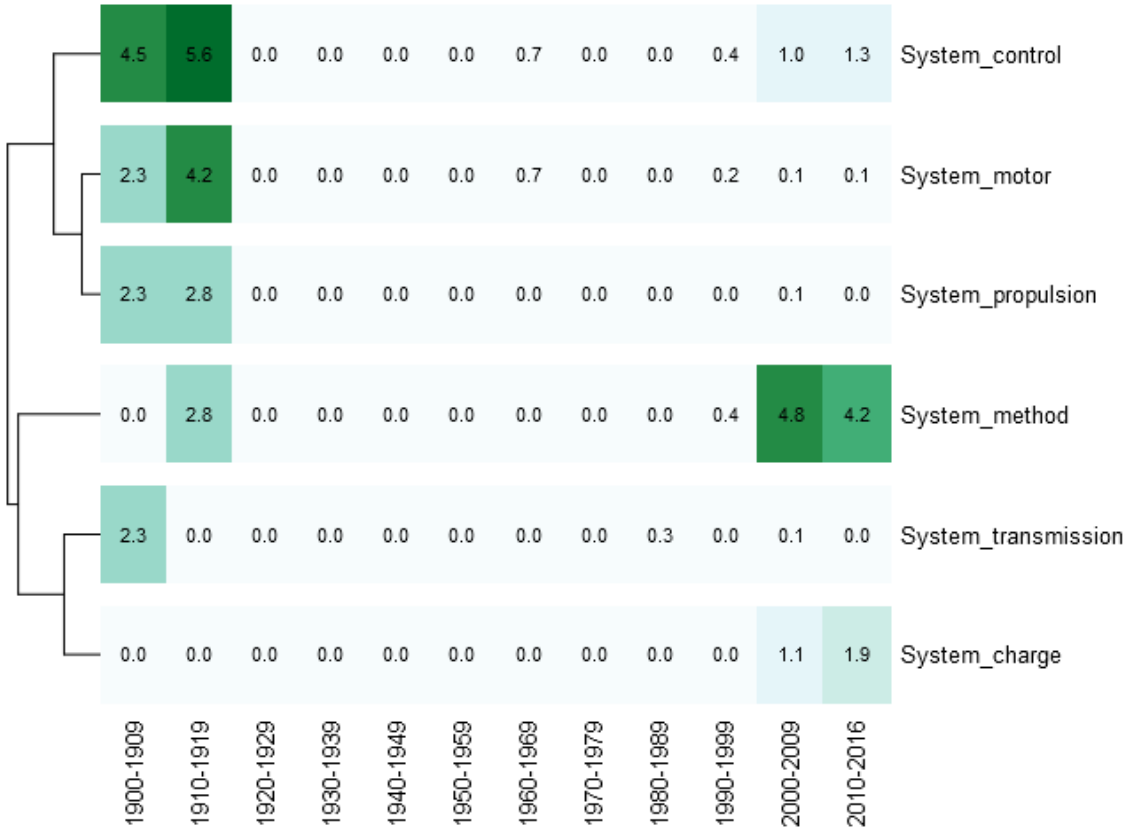
If we look at the movement of these codes over time, we observe movements, transformations and oscillations,

> At first glance, the past is this mass of small facts, very clear, very visible, others obscure and indefinitely repeated, the very ones of which microsociology or sociometry, today, make their daily collection (there is also a microhistory). But this mass constitutes all reality, all the thickness of history, on which scientific reflection can work at will. Social science has almost horror of the event. Not without reason: short

> time is the most capricious, the most misleading of durations. (BRAUDEL, 1965, p.265)

In addition to the codes that are always present over time (Electric_vehicle, Battery and Electric_battery), we have some with which we can begin the narrative. If we look at all the codes that carry the term "System" identified a polarized way they behave in history *(figure 2)*

Figure 2 - "high-low" frequency "System"



3.A HISTORY POINT OF VIEW

There is an evident predominance in the first two decades as regards "control", "engine" and "propulsion" systems. It is also concerned with methods of automotive and transmission system, however, at this point we should remember the great Ford Motor Company, which revolutionized the American market with a new logic of production, which until now conceptualize as *Fordism.* Henry Ford was concerned with mass production and with that standardization of the system, he thought of the first line of mobile assembly, in this logistics the integration of the Ford factory was vertical and all parts were produced in the factory itself, causing prices to plummet and the middle class could have access to euphoric technological modernity. We assume that with this Fordist standardization, the incentive to think or even rethink "systems and methods" has been affected.

> It is seen, therefore, that Ford was innovative in several planes. He was the introducer of mass production, by means of the standardization of machinery and equipment, labor and raw materials and, consequently, of products. He was also one of the first corporate men to use non-wage

> incentives for his employees. In the marketing area, it implemented technical assistance, the dealer system and an intelligent pricing policy. (SZEZERBICKI, PILATTI and KOVALESKI, 2004, p.108)

An important dimension that emphasizes the attention to look at figure 1, and we can select how rational a priori structuring of this analysis are the two well - defined phases between *Improvements* (1900-1969) *Apparatus* and (1969-2016). In a quick conceptual classification, using the Cambridge Dictionary, we can understand improvements such as "the process or result of something getting better", that is, putting development anxiety at the helm, looking at contexts in which improvements appear in patent titles, recurrent ideas of this term improvements in the structure and technological base, for example, some securities quote here patents: *improvements* in motor vehicles mechanism is (1900-1909); *Improvements* to the control of automobiles (1910-1919); *Improvements* to the traction batteries (1920-1929); *Improvements* in or relating to electrical systems Employing secondary batteries (1930-1939); *Improvements* in or relating to power transmission systems for vehicles (1930-1939); *Improvements* to electric car control devices (1940-1949); *Improvements* in or relating to the control of battery-operated electric vehicles (1950-1959); *Improvements* relating to and battery electric vehicles (1960-1969). It was understood, or even we can glimpse this movement from the viewpoint of the "need" to structure a technological base, evidently it is not a linear process, much more with amorphous characteristics, whereas it is an asset influencing the intellectual and technological production, it is also likely to historical events such as advent of *Ford Motor Company*, world wars, economic depression and political systems. We checked the transfer of an atmosphere to another, even in the 60s, "improvements" and "apparatus" appear together, as the case of this patent: *"Improvements* in or relating to *apparatus* for Indicating the State of Charge of an Electric Battery". From the 1960s onwards, the idea of "improvements" disappears, and the new rational format is "apparatus", which according to Cambridge Dictionary, the concept is explained as "a set of equipment or tools used for a particular purpose" Thus starting the face of a period bathed in the sense of sound systems and applications. To view, we quote some titles patent: Method and *apparatus* for monitoring currents storage batteries (1960-1969); Flywheel electric transmission *apparatus* (1970-1979); Brushless motor control *apparatus* for an electric vehicle (1970-1979); Control *apparatus* and method for engine electric hybrid vehicle (1980-1989); Method and *Apparatus* for Supplying cooling liquid to the storage battery (1980-1989); *Apparatus* for interactively accelerating an electric vehicle drive (1980-1989); Motor speed control *apparatus* (1980-1989); Control Method and *Apparatus* for the internal combustion engine electric hybrid vehicles (1990-1999); Methods and *apparatus* for updating navigation information in a motorized vehicle (1990-1999); Methods and *apparatus* for inputting messages, including advertisements, to the vehicle (1990-1999); Hybrid vehicle propulsion *apparatus* (1990-1999); System for Managing Energy Vehicle, and Method and *Apparatus* for Same (2010-2016).

In the 1960s, motor and control systems return, whereas jointly *Locomotives* are recollected in the 60s and 70s, and again in the 90s and the first decade of 2000. It is interesting to note that the steam locomotives operate with great success Since the first half of the 19th century. With the wave of electrification of the technological environment, the questioning could not be left: Is it possible? several attempts of electric locomotives permeated not only the imagination of the nineteenth century, but also of that first railway phase (1900-1939) analyzed here. However this period is still the *Improvements*, which is thought structure and restructuring, improving base. In a second phase (1960-1979) observed in figure 1, the locomotive immediately emerges in the transition period and *Apparatus Improvements* in parallel with the return of motor and control systems in the 1960s.

Anyway, system is forgotten in the 1970s (Figure 2), emerging an important new actor, the *hybrid* (Figure 1). We can see that the 1970s have this characteristic, it houses the developmental cradle that had been brewed decades before, but that actually appears only around 1970. At that time, it is thought of hybrid locomotives and hybrid vehicles, it is a New logic that comes to delineate the following decades with the empowerment of phrases like "Low or zero pollution [...]", which is the beginning of the title of a patent of the 1970s: "Low or zero pollution hybrid energy converter Transmission unit ".

> The antecedents of ideas and ideas go back to the 19th century (or even before), but environmentalism, with the cause and effect of a profound change of mentality, only recently began to appear in the significant context of post-World War II, basically The 1950s and 1960s (McCormick, 1992). The expansion of the ecological ethos has manifested itself steadily since those years. (CAVALCANTI (org.), LEIS & D'AMATO, p.44)

The Stockholm Conference is organized by the ONU, runs from June 5 to 16, and places heads of state in a room to think about the environment. It is very relevant to look at this perspective, because if we outline, the 1950s emerge the environmentalism of scientists, in the 1960s NGOs and in the 1970s it is the turn of political actors. In addition to the Stockholm Conference, there is the expansion of state environmental agencies, such as the United Nations Environment Program (UNEP), and green parties in the 1970s have an expressive territory. (CAVALCANTI (ed.), LEIS & D'AMATO, p.45). A curious fact is that we can question the premises of a patent, because if environmentalism emerges in the scientific sphere in the 1950s, it is only in the decade in which political action comes to dominate the landscape that patents appear.

Another important event is the market price fluctuations and oil crisis due to very specific political, social and cultural contours. Therefore, in the exploration here, we are not going to go too deeply, we only consider it important The United States and the Middle East, which in 1964 created the Organization of Petroleum Exporting Countries (OPEC) in a protectionist policy of the oil market, creating an economic embargo on all countries that assisted Israel in the War of Yom Kippur (PEREIRA, 2008), being a fuse, destabilizing an entire economic and market wing that depended on the access and price stability of a barrel of oil.

> The "black gold" has its main utility as an energy generator, especially when it is transformed into gasoline, car fuel. Other fuels such as diesel, benzene, kerosene and various solvents are petroleum derivatives. In addition, it serves as raw material for asphaltic products, plastic polymers and even some medicines. (PEREIRA, 2008, p.56)

For the next two decades, we see contributions in the sense of systems. We suggest thinking in the following way: 1970 offers us with patents for hybrid vehicles, a proposal that had already presented a serious and exploratory gestation, whereas the 80s implements to revisit transmission systems, and the 90's enters the systems of method, Motor and control (figure 2).

> The twentieth century witnessed the development of the mass media, [...]. While there have been fundamental advances in transmission, telecommunications, and computer technology before World War II, many critics argue that the growth of these areas since the 1950s defined economic infrastructure in the late twentieth century and paved the way

> for the twenty-first century. (BESANKO, DRANOVE, SHANLEY, SCHAEFER, 2006, p.82-83)

The sophistication for information in networks, transmissions without physical connectors is what the transversal analysis of patents poses at the beginning of the 21st century. The term "Wireless" for the first time appears in the first decade 2000-2009 (figure 1), along with the return of all systems logics (figure 2).

If we look at the color intensity trajectory in *figure 2*, we find a polarization of the early twentieth century, engine, control and propulsion to the early twenty-first century, in which method and loading are thinking of hybrid and electric alternatives. Let us explain that this reversal of perspectives is also closely linked to the change of rational pre-1960s "Improvements" and post-1960s with "Apparatus", by a change of needs, technical development and historical development itself. Some patent titles of the period: Method and system for charging electric vehicles; Vehicle charging, monitoring and control systems for electric and hybrid electric vehicles; Electric vehicle charging station in a residence; Hybrid energy management system and method.

In parallel, there is the development of Lithium ion batteries, which also appear as an aparratus and alternative energy, as we can see in the contexts of patent titles: Lithium secondary batteries and nonaqueous electrolyte for use in the same; Battery module having lithium battery, and vehicle control system employing battery module having lithium battery; Lithium secondary battery, electrolytic solution for lithium secondary battery, electric power tool, electrical vehicle, and electric power storage system; Lithium Ion Battery Control System and Assembled Battery Control System.

4.THEORIC MODEL

To Marc Bloch, one of the most importante historian from 20th century, historians are something like past judges, is the one who strives to grasp truth and justice in time, and history "is an effort to know it better: therefore, a thing in motion" (BLOCH, 1997, p.46)

> Abundant concordances or disagreements are made of a multitude of particular cases. In total, accidental influences are destroyed. Do we, on the contrary, consider each element independently of the others? The action of these variables can no longer be eliminated. Even if the data were hooked, the isolated throw would always be more difficult to predict than the outcome of the match; Therefore, once launched, subject to a much greater diversity of explanations. That is why, as one has penetrated more in detail, the likelihood of criticism is degrading. (BLOCH, 1997, p.122)

In this excerpt from the text, we can see the debate of the importance of looking at history in a global and interdisciplinary perspective, as Bloch said, "Our civilization will have made great progress on the day when dissimulation, erected into a method of action and almost into bourgeois virtue, gives way to a taste for information, that is, necessarily through exchanges of information. (BLOCH, 1997, p.86). Globalizing view Presenting us with the inspiration taken from a historical consciousness, beyond a long duration, a clarification revealed to the detriment of a fragmented consciousness that focuses microanalyses. (BRAUDEL, 1965)

Karl Weick, an American organizational theorist, says that "Action" has a logic, and he explains in three instances: a) Every action happens by the premise of a dyad, a direct or indirect relationship between two individuals. In this instance, I can have two or more individuals, all interconnected by an intersubjectivity, even with divergences something connects them, the idea of interdisciplinarity makes sense for these individuals, it is empowered by them, thus being an intersubjective factor that connects several researchers to the same niche. The effort about think in a perspective os longitudinal way, makes this action kind; b) from the moment that intersubjectivity becomes regulated, that is, there is a document such as a book or an article, accepted by its peers and researchers, which puts into words and concepts, is passed to a generic subjective instance; c) in the last degree, what was previously regulated took such great proportions that it has become something extra subjective, for it is now a cultural guideline or even a legal force, as patents, result of an institutionalization action. Sociologist W. Richard Scott in his book Institutions and Organizations, Ideas and interests develops: Institutions focus on three fundamental pillars: cultural cognitive, normative and regulatory.

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[ii] http://khc.sourceforge.net/en/